The **Self-healing** Control Technique Development and Research in **Smart Distribution Network**

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Guangdong province finance high-tech service area is selected to be the plot project.

The most important function of advanced distribution automation (ADA) in smart distribution network.

The target of self-healing control in smart distribution.
Key points in distribution self-healing control

1. The modeling and simulation technique in smart distribution network containing DG, micro-grid and energy store devices

2. The analysis and test technique in smart distribution network containing DG, micro-grid and energy store devices.

3. **On-line intellective analysis and decision-making technique**

4. The fault character analysis technique in smart distribution network containing DG, micro-grid and energy store devices

5. The control protection technique in smart distribution network protection devices

6. The important load ensure technique and the large area outage restore technique under extreme conditions

7. **The fault isolation and network restructure technique**
System structure

Communication system

Distribution control center

Energy Management System (EMS)

Geographic Information System (GIS)

Client Information System (CIS)

Other Systems

CSGC-3000/SCADA/DA/DPAS
Master station

CSGC-3000/PIB
Information exchanging bus

CSGC-3000/OMS
Outage management

Industrial users

Residential users

User

10kV line breakers

MV switching station

Distribution room

Ring main unit

Substation

Transformers

10kV BUS Bar

MV switching station

Distribution room

Distribution

MG

WT

PV

MT

BES

SIFANG
The **level structure** in the master system

**Application level**
- The user interface of the smart distribution self-healing control system
  - Faulty network restructure
  - Preventive network restructure
  - Economic network restructure

**Assessment level**
- The operation statuses classify
- Risk evaluation and early-warning

**Analysis level**
- Power flow calculation
- Load transferred analysis
- Network topology
- States evaluation
- Load forecast

**Basic level**
- Distribution network operation supervisory control
- DG supervisory control
- Distribution network operation simulation
- The unified support platform of the smart distribution self-healing control system
Self-healing control proposal

01  Function > Online risk assessment

02  Function > Security early warning

03  Function > self-healing control under abnormal condition

04  Function > optimization control for normal state
The classify of distribution operation statuses

1. Load forecast data
2. Rules in the guide warehouse
3. On-line data
4. Network analysis

- On-line alarm/early warning/weakness assessment

- System fault information

- Any risk?
  - yes: Warning status
    - put in remove the reactive power compensation capacitor
    - regulate DG active power
    - Network restructure
      - The records
  - no: Normal status
    - Faulty network restructure
      - Faulty restructure proposal
      - Load shedding proposal
      - Load shedding records
      - Status records
## Network restructure

<table>
<thead>
<tr>
<th>Economic Network Restructure</th>
<th>Preventive Network Restructure</th>
<th>Faulty Network Restructure</th>
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<tbody>
<tr>
<td>Based on node short term load forecast values, to minimize distribution network losses by changing the status of section breakers and connect breakers.</td>
<td>Using the over-limit information of the future important lines and devices and defect devices provided by on-line alarm module, to remove over-limit through changing the status of section breakers and connect breakers.</td>
<td>In the precondition of fault isolation, to restore no fault area as soon as possible, to give control steps and load shedding proposals by way of changing the status of section breakers and connect breakers.</td>
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The fault process flow

1. Distribution terminals proceed with information.
2. Master station receives fault and breaker status information sent by distribution terminals.
3. Fault location, tagging to the fault section and color the fault feeder line.
4. Estimate if terminal isolation is same to fault location.
   - No: Show the difference to the dispatchers and give them isolate advices. They will judge how to do.
   - Yes: Continue to isolate the fault?
     - Yes: Remote control to isolate the fault.
     - No: Load transfer is finished completely?
       - Yes: Finish: record the fault event.
       - No: No fault area has not been restore, start the faulty network restructure.
5. Execute the network restructure program and record the fault event.
6. The end.
**DG supervisory control**

- Smart distribution network statuses analysis and assessment provide necessary data.

- Supervisory control the status of DG and micro-grid incorporate in/off power network, when it is essential, incorporate DG or micro-grid off power network.

- IEC 608705-104 protocol is used.

- Peak value of total power 500kW PV
- MW level gas turbine distribution power supply
- Distribution PV/energy storage integration system
<table>
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<td>- Smart distribution network self-healing control system connect with other automation systems using information exchange bus based on standardization interface adapter.</td>
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<td>- Information exchanging with smart distribution terminals.</td>
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<td>- Information exchanging with DG supervisory control system.</td>
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<td>- Information exchanging with energy management system.</td>
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<tr>
<td>- Information exchanging with distribution network AM/FM/GIS.</td>
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<tr>
<td>- Information exchanging with outage management system.</td>
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To build smart distribution network model containing DG and micro-grid.

To achieve smart distribution network full view model and data integration through information exchanging with EMS, GIS, CIS, etc.

To realize fault fast deal-with by coordinate with smart distribution terminals.

To assess operation status using smart distribution network on-line analysis.

To restructure distribution network according to the status evaluation results in order to improve operation security and economy.
Thanks a lot!