D5000 : A New Generation of EMS in China

Yaozhong Xin, State Grid Corp. of China
Boming Zhang, Tsinghua University
• Why to do?
• How to do?
• The result.
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• How to do?
• The result.
Electric Power Increase in China

Installed Capacity 2016

Wind Power
- 2013: 75GW
- 2014: 96GW
- 2016: 148GW

PV Power
- 2013: 15GW
- 2014: 27GW
- 2016: 77GW
Operation Requirement for Very Large Scale Power Grid

Temporal and Spacial Coordination Between SCADA in multi EPCC and Local DCS is key
10 separated and Isolated application systems

<table>
<thead>
<tr>
<th>EMS</th>
<th>WAMS</th>
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<tbody>
<tr>
<td>DSA</td>
<td>TMR</td>
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<tr>
<td>OSCH</td>
<td>HYA</td>
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<td>PIM</td>
<td>OMS</td>
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<td>WF</td>
<td>LM</td>
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</tbody>
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- Temporal and Spacial Coordination
- Global Optimization
- Real Time Tracing N-1
• Why to do?
• How to do?
• The result.
Smart Grid Control Center

Horizontal integration of applications
Vertical unification of operation business

Unified Platform

D5000

1 National D5000

6 Regional D5000

28 Provincial D5000

Real-Time Monitoring & Alert Issuing
Operation Scheduling
Security & Stability Analysis
Operation Management
Horizontal Integration of Applications

• Start from 2004, Complete in 2009.
• Integrate 10+ application systems into one
• One Platform: Unified Supporting Platform: D5000
• 3 class of Applications:
  • Real-Time Monitoring and Alarming (SCADA, AGC, AVC, WAMS, PAS, DSA,....)
  • Operation Scheduling (day-ahead scheduling, Hydro Thermal schedule, security checking,.....)
  • Operation Management (....)
Vertical Unification of Operation Business

Production and Control Zone

Management and Information Zone

1 National

- Real-Time Monitoring & Alarming
- Operation Scheduling
- Operation Management

6 Regional

28 Provincial

- Real-Time Monitoring & Alarming
- Operation Scheduling
- Operation Management
• 4 class of buses
  – Security service bus
  – Dynamic message bus
  – Real time data bus
  – Message and email bus

• 4 class of data bases
  – Steady state real-time data base
  – Dynamic time sequence data base
  – Dynamic time sequence history data base
  – Steady state history relation data base

• 4 class of MMI
  – G Graphic
  – GIS Graphic
  – Web Graphic
  – Graph plug-in unit

• Unified system management & security management

• Unified platform access interface API

Server Cluster, Secure & Reliable Operation system
• Based on CIM/E and CIM/G
• Unified network modelling for Real-time data
• Model data maintained at the source terminals and shared by all EPCCs
• Remote security skim to all the data for all level of EPCCs
• State Grid EPCC collects 8.6 M real-time information, covering 8,000 power plants and substations.
（1）Multi level Coordination Control

- Close loop AGC (All controled) and Close loop AVC (Almost All controlled)
- Security Coordination btw multi level EPCCs
(2) Tracing On-line Dynamic Security Analysis

- Running in the period of 15 minutes (10K buses)
- Running with Event driven
- power angle stability, voltage stability, small signal stability

Normal state, each 15 min

Event driven

9:00 9:15 9:30

Time: minute

9:19 event

2017/6/27
(3) Wide Area Measurement System (WAMS)

28 Provincial Dispatching Centers

6 Regional Dispatching Centers

Multiple Data Connections from PMU

Thermal Plant T1

Substation S2

Substation S2

Hydro-Plant H1

Substation S1
PMU Coverage in SGCC

Total of PMU: 2958

1500 Pwr Plants and Substations

For 500kV Grid: PMU Coverage >96%
(4) Operation Scheduling

Scheduling based on Year, Month, Week, Day Ahead, in the Day, and real time.
Generation Scheduling and Security Checking are iterated btw 3 levels EPCC
• Why to do?
• How to do?
• The result.
• In 2009, First D-5000 system was completed
• In 2010, 10 D-5000 systems were put into on-line operation
• To the end of 2016, 249 D-5000 systems were put into operation in State, Regional, provincial, and most area EPCCs.
• 7.6 M CBs or Switches in 31,804 substations are controlled. AVC is implemented in 28,709 substations.
• 1300 wind farms, 800 PV plants, 600 hydro stations
Thanks