Achieving Smarter Grid and Greener Future in Macau: CEM’s Perspective

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Agenda

- CEM Overview
- CEM Smart Grid Domains & Targets
- CEM Initiatives for smarter grid
- Opportunities & Challenges for smart grid
- Summary
CEM Overview

- CEM is the only private, vertical integrated utility serving Macau SAR.
  - Local generation capacity: 472 MW
  - HV Network: 220kV, 110kV, 66kV
  - Power Importation: > 90% (2013)
  - No. of Customers: > 239,000
  - Historical peak load: 845 MW (Aug 2014)

- CEM provides power supply service to the customers with high reliability
  - SAIDI in 2013: 2.36 min
  - Best performance achieved in 2012 with SAIDI = 0.578 min
## CEM Smart Grid Domains & Targets

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From Computerized Maintenance Management to Full Enterprise Asset Management

- Grid Asset Maintenance (CBM)
- Project & Risk mangt.
- HR/Skills/Time&Payroll mangt.
- Financial Optimization
- etc.

Unified Comm. Infra & IT Integration
- IEC 61850 Digital Substation
- MV Closed-Ring
- MV Fiber Communication
- Integrated utility (ESB & SOA)

Integrated Network Management & Optimal Operation
- Integrated SCADA/EMS/DMS with advanced EMS/DA applications
- Integration of OT systems using SOA/ESB

Achieving Smarter Grid

Customer Engagement & Energy efficiency
- Smart Metering with two-way communication
- MDMS
- Home Area networks
- Demand side Management programs

Enabling a sustainable and green City
- EV charging infrastructure for high penetration of EVs in the future
- Central management system for EV charging infra
- Accommodating high levels of PVs

Automati on & Comm.

Smart Control Center

Advanced Asset Managmt

Renewables & EVs

AMI
CEM Initiatives for Smarter Grid (2/6)

IEC61850 Digital S/S & MV Closed-Ring

IEC 61850 based Digital Substation

- First IEC 61850 substation put into service in 2008.
- All the new primary substations in CEM are IEC 61850 based.

MV Closed-Ring Network

- More than 10 Closed-Rings in CEM
- Rapid fault isolation time (<100ms)
  - Differential relay triggered (<30ms)
  - CB tripped (<70ms)
CEM Initiatives for Smarter Grid (3/6)

Dispatch Center Upgrade

Pre-System Dispatch
- No SCADA
- Radio & Telephone for communications

1st Generation System Dispatch
- Modern Dispatch Center with Centralized SCADA function
- Efacec PDP-11 SCADA platform

System Dispatch with SCADA/EMS
- Siemens Spectrum 4.3.2 SCADA platform
- EMS function and basic feeder automation

New Dispatch Center (Advanced SCADA/EMS/DMS)
- Intelligent monitoring with adequate situational awareness
- Comprehensive network security analysis
- Advanced DA applications (FLISR, VVC)
- SOA-based integration with other systems using web services technology and ESB
- CIM-compliant applications integration
- Compliant with cyber security standards

Dispatch Center Upgrade Project (from 2012)

Before 1992
1992 - 2002
2002 - Now
CEM Initiatives for Smarter Grid (4/6)

Advanced Asset Management

From **Computerized Maintenance Management to Enterprise Asset Management**

- Enterprise Asset Management (EAM) roadmap study completed in 2013
- Condition-based Maintenance (CBM) is an important integrated part of EAM
- CBM implementation: Partial Discharge Online Monitoring System is installed to online monitor and pre-identify the potential cable faults to facilitate cable maintenance and replacement before it happens.

**Partial Discharge Online Monitoring (PDOL)**

- Started in 2008 to monitor 11kV MV cables
- 43 sets of PDOL equipment installed in CEM
CEM Initiatives for Smarter Grid (5/6)

Advanced Metering Infrastructure

Prelim Feasibility Study (2011) ➔ AMI Phase 1 Project (2012~) ➔ AMI Full Development

Site Test
- To check the last mile communication technologies (PLC & RF)
- To test the AMI proposals and system functions from different vendors

Site Test (Jul 2013 – Feb 2014)
- 8 PLC meters & 8 RF meters
- Data concentrator
- Head End
- MDMS

Pilot Project Implementation
- Around 2000 smart meters will be installed

Complete Feasibility Study
- Analyze the feasibility of AMI full development

AMI Pilot System Diagram
CEM Initiatives for Smarter Grid (6/6)

EV Charging Infrastructure

- CEM launched the first public EV charging station in Macau in 2010.
- There is also private charging infrastructure in Macau.

- EV charging stations are available at 9 public car parks
- 3 infra for E-cars
- 2 infra for E-bikes
- E-car & E-bike Charging

CEM launched the first public EV charging station in Macau in 2010. There is also private charging infrastructure in Macau.
Opportunities for a Smarter Grid

- Quality of Services Improvement
- Optimal asset utilization
- Data-driven decision making

- More reliable and economic power supply
- Proactive energy management
- DERs and renewables integration

- Green city with low carbon footprint
- Increased energy efficiency
- Sustainable development

Utility
Customer
Society
Challenges for a Smarter Grid

- Choosing the technologies that suit Macau’s environment
- Skilled Workforce for new technologies
- Accommodating high levels of EVs & PVs

Technical

- Project management
- Asset management
- Data management

Management

- How to make the customers understand the potential benefits of smart grid applications
- Effective incentive to customers

Customer Engagement

New IT & OT technologies
- IEC 61850, CIM, SOA
- Data mining & Analytics
- Cyber security, etc.

AMI
- Smart meters & DSM

EVs
- EV charging infrastructure

PVs
- The by-law for integration requirements of PVs will take effect in Jan 2015

Smart grid training program
Learning from others
Close corporation with industry
Positive communication with regulator & customers
Strong Project Management Structure
Summary

- CEM has been making efforts to develop a smarter grid to contribute to the green Macau. The CEM smart grid roadmap was developed in 2012 and 6 smart grid domains were identified.
- CEM is implementing several programs/projects that enabling a smarter grid and greener Macau, such as digital substation, AMI, CBM, advanced dispatch center, EV charging infrastructure, etc.
- There are both opportunities and challenges on the way to a smarter grid and greener city but the challenges could be coped with through continuous efforts by utility, the public and the government.
Muito obrigado!
Thank you!

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