Introduction of Kansai’s “New Metering System” (AMI)

THE KANSAI ELECTRIC POWER CO., INC.

August 24, 2011
1. Overview of KEPCO
There are 10 utility companies.

All companies:
- Founded in 1951
- Generation ~ Distribution

Generating capacity as of 31/3/2010

Total: 207GW

Frequency conversion stations
(3 sites, total 1000MW)

Interconnection

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<Company profile>

Corporate data *FY 2009

<p>| | |</p>
<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Capital</td>
<td>5,259 mil USD</td>
</tr>
<tr>
<td>Revenue</td>
<td>28,016 mil USD</td>
</tr>
<tr>
<td>Sales volume</td>
<td>145,867 GWh</td>
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</table>

Having over 13 million customers in Kansai Area, including big cities such as Osaka, Kyoto and Kobe.
Outline of distribution network

Distribution substation

<KEPCO’s facilities>

Distribution (# of feeders) : 13.5 thousand
Lines (total length) : 127 thousand [km]
Utility poles : 2.6 million
Remote-controlled SWs : 101 thousand
Meters : 13 million
2. KEPCO’s Integrated DAS Strategy
General concept of integrated DAS (1985)

- Automating customer-related works
  - Improving efficiency of administrative work for customer move/change
  - Saving manpower of notification of power outage to customers
  - Improving meter-reading efficiency
  - Improving customer-related works
  - Responsive and prompt load adjustment
- Expanding the metering system for season-of-use and time-of-use
  - Minimizing the frequency of accidental power outage (time, area)
  - Minimizing the frequency of power outage for distribution works (time, area)
- Automating load control
  - Expanding the metering system for season-of-use and time-of-use
- Automating distribution line operation
  - Upgrading system monitoring
  - Upgrading system control

New Metering System

Responsive and prompt load adjustment

Distribution Automation System

[Reference] 21 ~ 26
3. New Metering System (AMI)
Current operation of metering business

【Manufacturers】
- Production
- Inspection

【Certification center】
- Official inspection and certification
- Re-certification

【KEPCO】
- Selecting meters according to contract type
- Every 10 years*
  *According to the term of the certification
- Replacement (1.2 million / year)

【Field】
- Installation (300,000 / year)
- Monthly meter-reading (12 million / month)

*: Data as of FY2009
Conventional LV meters (KEPCO)

- For the contract with single rate
- For the time-of-use (TOU) contract (with two-time bands)
- For the contract with different rate according to the time, day of week and seasons of use (TOU with 4-time bands)
- Calendar is installed

➢ In order to improve the level of customer services, we have introduced TOU menus, which require dedicated meters.
➢ The calendar installed in meters needs to be updated, when national holidays are changed.
Issues around metering operations

**[Manufacturers]**
- Production
- Inspection

**[Certification center]**
- Official inspection and certification

**[KEPCO]**
- Selection of meters according to contract type
  - Production
  - Inspection

**[Field]**
- Old meters
- Replacement (1.2 million/year)
- Monthly meter-reading (12 million/month)
- Installation (300,000/year)

**[Meters]**
- Necessity of replacement according to contract change

**[Contract & Accounting]**
- Termination of electric power supply to a bad-payment customer
- Update of internal calendar-setting corresponding to the change of national holidays, etc.

**[Meter-Reading]**
- Bad location of meter makes reading difficult
- Injury risk in reading meters on-site

Issues around metering operations:

- Necessity of replacement according to contract change
- Replacement work on live-line induces injury risks for line-man
- Termination of electric power supply to a bad-payment customer
- Update of internal calendar-setting corresponding to the change of national holidays, etc.
- Bad location of meter makes reading difficult
- Injury risk in reading meters on-site

Data as of FY2009
### Basic idea for the solution of issues

<table>
<thead>
<tr>
<th>Issues</th>
<th>Description</th>
</tr>
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</table>
| Meters | Replacement according to contract change  
Live-line work for replacement |
| Meter-reading | Bad location makes reading difficult  
Injury risk in meter-reading on-site |
| Contract & Accounting | Power termination work  
Calendar updating |

**Tele-metering and batch-processing of metering data** will be able to eliminate these works and issues.

**Plug-in structure of metering unit** will be able to eliminate live-line work from meter-related work.

**SW-unit and remote control system** will be able to improve this work.

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Our AMI, “New Metering System”, which equips these features will solve all issues.
Basic Concept of our “New Metering System”

Improvement of utility operation
- Efficiency and safety of on-site operation
- Optimization of distribution facilities

Improvement of customer service
- Enrichment of customer consultation
- Quick restoration of outage
KEPCO’s New Meter (Plug-in module type)

Conventional

- Same size

New!

- Communication unit
  - Proper communication media can be selected.

- Metering unit
  - Certification is only for this unit
  - Plug-in structure realize no live-line work

- Switching unit (option)
  - Switching function is achieved by SW-unit
  - On/Off work is done remotely

- Plug-in module structure frees us from live-line work !!
- SW unit or other value-added function unit can be installed if necessary
Communication Network for “New Metering System”

- Remote meter reading
  - reducing injury accident risk on meter reading
  - solving hard-to-access meter problem

- Select appropriate communication system based on the WHM installation environment
  - Specified low power radio
  - Charge-free communication network
  - Automatically configured ad-hoc network

- Eliminating the need for
  - replacing meter according to contract change
  - calendar function

- Fiber optics ↔ KEPCO’s own network
### Trial schedule

<table>
<thead>
<tr>
<th></th>
<th>FY2007</th>
<th>FY2008</th>
<th>FY2009</th>
<th>……</th>
<th>FY2020～</th>
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<tr>
<td>New Meter</td>
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<tr>
<td>(plug-in module</td>
<td>production</td>
<td>Spec. defined</td>
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<tr>
<td>type)</td>
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<tr>
<td>- Communication</td>
<td></td>
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<tr>
<td>unit</td>
<td>production</td>
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<tr>
<td>- Concentrator</td>
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<tr>
<td>Related systems</td>
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<tr>
<td></td>
<td>production</td>
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※R&D has been continuing since 1999

- Evaluating;
  - Long-term reliability of equipment and materials
  - Security and reliability of communication
  - Smooth operation during the system transition period etc.

**870 thousands of New Meters (as of July 2011)**

We are soon going to make a decision to move forward to a full scale deployment in entire service area.
Technical Challenges for “New Metering System”

Business Process System
- Charge Calculation
- Process Management
- Logistics
- Asset Management

- Maximizing the effects by coordinating with buz. sys.
- Dealing with operations in transition period
- Ensuring security

Control System
- Collecting, checking & transferring measurement data to business system.
- Command connect/disconnect toward subsystem

- Bulky data processing
- Collecting data gaps
- Priority management of individual data process
- Ensuring security

Com. device system (WHM)
- Transferring measurement data to host system
- Connect/disconnect is implemented by host system command.

Establishing;
- the plug-in module configuration
- low-cost and reliable last-one-mile com. network

Not only meters and communication network, we have established sophisticated whole system covering all of meter-related work.
Summary of KEPCO’s approach

- As a result of the achievement of integrated DAS implementation, which was established in 1985, we are now confident that we can solve many problems regarding meter-related work including “Safety issues”.
- Even based on 25-year old concept, our system can cope with many issues we are now facing. This is because we have been considering its flexibility and applicability.
- “New Metering System” concept was also established for resolving problems on meter-related work before the word of “smart meter” was highlighted.
- We are now working toward the accomplishment of our goal to meet the needs of “today’s Smart Meter” with our “New Metering System”.

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Challenges for the future

Issues to be discussed as “Smart-Meter” related matters

- Demand Response (DR)
- Diversification of electricity tariff
- Home appliance control (direct/via HEMS)
- Visualizing electricity usage and displaying a variety of information
- Effective utilization of tele-metered electricity usage data

In Japan, we are still discussing what should be achieved by “Smart Meter”. Whatever our goal will be, we are going to cope with it relying on the flexibility of our “new metering system”.

(e.g.)
- easy to adapt to various tariff structure by collected metering data at data center
- possibility to access to in-home devices by selecting proper communication media
- possibility to utilize collected metering data for "Smart-Grid" purpose
Web-based notification service

- Trial of notification without posting the statement bill into the mailbox
- Providing the visualization service of electricity consumption

Trial started in July 2009

- Consumption
- Charge

CO2 emission is calculated corresponding to monthly electricity consumption

- Hourly graph (update daily): Customers with remote metering
- Monthly graph: Others

2008年5月 フーリーさんのご家庭のCO2排出量

今月のCO2排出量 340.6kgです。

家計1人あたり1.79tです。

日本の平均年にあたっての平均的な排出量は、18.3t-CO2となっています。

今月の料金合計 28,768 円です。

CO2排出量

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4. [Reference] Distribution Automation System (DAS)
- Remotely control switchgears from service office via communication line
- Automatically minimize outage section

<<Supervision>>
- status of switchgear (ON/OFF)
- voltage, current

<<Control>>
- Remote control

Fiber optics  
Communication line
Control unit
- Control switchgear
- Monitors status of switchgear (On/Off), voltage and current of distribution line

Remote-controlled switchgear
- Isolate outage section
- Connect normal section to adjacent D/L

Communication line
- Transmit & receive data for switchgear control and monitoring distribution line

[Ref.] DAS components
Conventional time sequential auto re-closing system

|---------|----------------------------|-------------------------------------|-------------------------------------|

New distribution automation system

<table>
<thead>
<tr>
<th>Symbol:</th>
<th>Remote-controlled switchgear with time-sequential transmission</th>
<th>Remote-controlled switchgear</th>
</tr>
</thead>
</table>

The amount of outage (minute × customers) (total area of bar graph) are reduced by 76%
Through electric power system with “high efficiency”, “high quality” and “high reliability” by using ICT, realizing a low-carbon society and a better energy supply to customers.

Grid technologies related to renewable energy (mainly PV power system) are required.
Our target is to enhance the function of supervising and controlling voltage in order to improve electric quality in spite of mass PV introduction.

1. Switchgear with voltage sensor supervise the system voltage
2. Voltage regulation are remotely controlled
3. Watt hour data transmitted by New Meters can be used to estimate system voltage more accurately
4. Furthermore, weather forecast information can be used to estimate PV power system more accurately.
Thank you!
<table>
<thead>
<tr>
<th><strong>Name</strong></th>
<th>Koji Maegawa</th>
<th><strong>Photo</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Title</strong></td>
<td>Manager, Distribution Group (R&amp;D), Power System Division</td>
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<td><a href="mailto:maegawa.koji@c3.kepco.co.jp">maegawa.koji@c3.kepco.co.jp</a></td>
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<tr>
<td><strong>Website</strong></td>
<td><a href="http://www1.kepco.co.jp/english/index.html">http://www1.kepco.co.jp/english/index.html</a></td>
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<tr>
<td><strong>Educational Background</strong></td>
<td>Koji Maegawa was graduated from Osaka University in March 1994 with a Master’s Degree in Communication Engineering.</td>
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<tr>
<td><strong>Work Experience</strong></td>
<td>Koji Maegawa joined Kansai Electric Power Co., Inc in 1994. He has been mainly engaged in R&amp;D work of distribution division. From 2006, he has been responsible for the communication between WHMs, and the data collection system from WHMs (a part of MDM).</td>
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<tr>
<td><strong>Autobiography</strong></td>
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