Loss Management at Customer Network Centre level with the focus on non-technical losses per feeder

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Points for discussion

- Energy losses management
- Energy flow
- Energy losses breakdown (Network Level)
- Simple network diagram
- Typical network scenario
- Feeder balancing overview
- Feeder Balancing Application data architecture
- Feeder balancing process
- Mapping of substations/switching stations, stats meters and feeders
- Typical Energy Balancing Calculation
- Conclusion
# Energy Losses Management

## Analyse Energy Losses
- Dx/OU Losses
- Energy Balancing
- LPU/SPU Demand/Consumption
- CC&B Anomaly Reports
- Tip Off's
- Technical Losses Simulation

## Plan & Execute Audits
- Plan & Prioritise Audits
- Source & Manage resources to perform audits
- Perform Audits & Capture required info
- Consolidate & Report on Audit Findings

## Resolve Audit Findings
- Remove Illegal Connections
- Disconnect Tamper Tamps
- Issue/Manage Tamper Fines
- Revise Supply Group Codes
- Repair Faulty Meter Installations
- Correct Data Issues
- Recover Revenue

## Evaluate Performance
- Losses performance reporting
- Evaluate ROI of losses management interventions
- Implement continuous improvement initiatives

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### Social Marketing (Operation Khanyisa)
- Distribution
- Customer Services
- Corporate Affairs
- GroupSecurity
- Group IT

### Investigations, Arrests, Prosecution

### Systems – Risk Analysis, Energy Balancing, Audits, Data
Energy Flow

- Power Plant: Generates Electricity
- Transmission Lines: Carry Electricity Long Distances
- Distribution Lines: Carry Electricity To Houses
- Neighborhood Transformer: Steps Down Voltage
- Transformers On Poles: Step Down Electricity Before It Enters Houses

Sent-Out:

Purchases:

Tx Losses:

Dx Losses:

Sales:

Tx

Dx
Energy Losses Breakdown (Network Level)

Tx Losses Measured as difference between energy metered at Gx/Tx interface and Tx/Dx interface

Dx Losses Measured as difference between total MTS purchases (from Tx) & total Dx Sales

Gx Power Stations
- Efficiency Losses

Transmission Lines (132kV to 765kV)
- Technical Losses
  - Line Losses

MTS Tx/Dx interface
- Technical Losses
  - Line Losses
  - Transformer Losses
  - Non-Technical Losses for bulk fed customers
  - Metering Errors
  - Data Errors

Subtransmission Lines (44kV to 132kV)
- Technical Losses
  - Line Losses
  - Transformer Losses
  - Non-Technical Losses
  - Illegal Connections
  - Meter Tampers
  - Ghost Vending
  - Data errors
  - Metering Errors

Dx Substations

MV Feeders (11kV to 33kV)
- Technical Losses
- Line Losses
- Transformer Losses
- Non-technical Losses
- Illegal Connections
- Meter Tampers
- Ghost Vending
- Data errors
- Metering Errors

MV feeder level losses measured as difference between statistical meter energy inflow & total sales for customers linked to the feeder

*current coverage of MV feeders with stats meters is 90%
Simple network diagram

Energy Delivered

Sub Station

Stats Meter

Energy Used

Feeder (Overhead Line)

Transformer 1

Customer 1

Customer n

Transformer n

Customer n1

Customer nn
NTL = (Energy Delivered – Tech Loss) – Energy Used

Feeder NTL = (ED – TL) – EU

Feeder C
(Calculated at meter)

Energy Delivered = \(\sum ED\) (c)
Energy Used = \(\sum EU\) (c)
Tech Loss = \(\sum TL\) (c)
Typical scenario ii/ii)

**Feeder NTL** = (ED – TL) – EU

Energy Delivered = ED (d) - \( \sum \) ED (a+b)

Energy Used = \( \sum \) EU (c)

Tech Loss = \( \sum \) TL (c)
Feeder Balancing Overview

- The Feeder Balancing Application (FBA) purpose is to enable calculation and analysis of Technical Losses (TL) and Non-Technical Losses (NTL) by comparing energy delivered to energy used at MV feeder level.

- FBA enables the **mapping** of stats meters to feeders, mapping of **unallocated CDU sales** to feeders, **adjustment** on energy delivered and used, setting and changing various **statuses** and TL %.

- **Energy Delivered** readings are recorded and calculated on a **Stats Meter** from **meter management system**.

- **Energy Used** is customer consumption billed on **customer billing system**. This is linked to and summed up at a **Feeder (Overhead Line)**.

- Substation, Feeder and Transformer/Bulk details and mappings.

- **TL** is calculated on a Feeder (Overhead Line).

- **NTL** = (Energy Delivered – TL) – Energy Used. This should be calculated on a Stats meter.
FBA Data Architecture

- Statistical Metering
- Network
- Customer Billing

Data Repository

Feeder Balancing Application
Feeder balancing process

- Source Data Analysis
- Import Source Data
- Network Configuration Analysis
- Configure Network
- Balance
- Balancing Analysis
- Publish Results

Check imported data of network configurations and do necessary remedial actions
Mapping of substations/switching stations, stats meters and feeders

Statistical Meter

Maps to

Substation/ Switching Station

Overhead line/ Feeder

Maps to

Statistical Meter

Feeder Meter

Substation

Substation Meter

Feeder
Typical Energy Balancing Calculation (i/ii)
## Typical Energy Balancing Calculation (ii/ii)

### Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Can not Balance</td>
<td>36</td>
<td>8.26%</td>
</tr>
<tr>
<td>Sub / Fdr Meter Combination</td>
<td>13</td>
<td>2.98%</td>
</tr>
<tr>
<td>Sub Metered -&gt; 1 Fdr not Metered</td>
<td>2</td>
<td>0.46%</td>
</tr>
<tr>
<td>Sub Metered -&gt; 2 or more Fdrs not Metered</td>
<td>4</td>
<td>0.92%</td>
</tr>
<tr>
<td>Sub not Metered -&gt; All Fdrs Metered</td>
<td>189</td>
<td>43.35%</td>
</tr>
<tr>
<td>Substation not Mapped</td>
<td>192</td>
<td>44.04%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>436</td>
<td></td>
</tr>
</tbody>
</table>

### Feeder breakdown

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fdrs Metered</td>
<td>832</td>
<td>76.97%</td>
</tr>
<tr>
<td>Metered via Sub meter</td>
<td>45</td>
<td>4.16%</td>
</tr>
<tr>
<td>Metered via Fdr meter</td>
<td>787</td>
<td>72.8%</td>
</tr>
<tr>
<td>Fdrs Not Metered</td>
<td>3</td>
<td>0.28%</td>
</tr>
<tr>
<td>Fdrs Not Mapped</td>
<td>246</td>
<td>22.76%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1081</td>
<td></td>
</tr>
</tbody>
</table>

### Balancing Non Tech Loss

<table>
<thead>
<tr>
<th>Region</th>
<th>Fdrs</th>
<th>Meters</th>
<th>ED kWh</th>
<th>NTL kWh</th>
<th>NTL %</th>
<th>NTL % 12mma</th>
<th>Fdrs &lt; 30%</th>
</tr>
</thead>
<tbody>
<tr>
<td>KwaZulu-Natal Operating Unit</td>
<td>832</td>
<td>730</td>
<td>533787039</td>
<td>71014186</td>
<td>13.3%</td>
<td>17.44%</td>
<td>470</td>
</tr>
<tr>
<td>Empangeni Zone</td>
<td>196</td>
<td>163</td>
<td>188804732</td>
<td>24083369</td>
<td>12.76%</td>
<td>16.43%</td>
<td>94</td>
</tr>
<tr>
<td>Newcastle Zone</td>
<td>238</td>
<td>220</td>
<td>117964641</td>
<td>13138307</td>
<td>11.14%</td>
<td>16.11%</td>
<td>146</td>
</tr>
<tr>
<td>Pietermaritzburg Zone</td>
<td>398</td>
<td>347</td>
<td>227017666</td>
<td>33792510</td>
<td>14.89%</td>
<td>18.89%</td>
<td>230</td>
</tr>
</tbody>
</table>
Conclusion

• The case shows how the systemization of losses reduction in all business levels with the focus on the lowest level of the network at MV is done.

• For the systemisation and automisation of accurate loss calculations there are data requirements for energy delivery, energy consumption and network/configuration as well as predefined business rules adjustable to business needs.

• Network in a form of stats metering equipment and operating technology infrastructure needs to be integrated to enable the flow of the data required.

• FBA software is fed with business knowledge and experience to ensure automation of this energy balancing process in all business areas.

• Automating the calculation process gives allowance for more time to be invested in investigations and analysis.