Distribution Network Planning Philosophy
Hursthill Area
Agenda

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• Empire – Perth Corridor Requirements
• Existing Distribution Network
• Existing Substation Philosophy - Feederboards
• Case study area
• Distribution Network Selection
• Energy Losses
• Substation Extension
• Conclusion
Introduction

- The legacy spatial planning left the City with sprawling low density areas with a very limited public transport system.
- This resulted in the fact that the majority of poor and working class citizens settled and live on the fringes of the City.
- This place a heavy burden on these citizens as it is both time consuming and costly to travel to the central and business hubs allocated within the City boundaries.
- To alleviate the problem and to create an environment where people can be close to work and shopping without having to own a vehicle, the City has embarked on the creation of Corridors of Freedom.
- In total there will be eight individual corridors throughout the City.
Empire – Perth Corridor Requirements

Hursthill/Mayfair

Mayfair/Braamfontein

Pennyville/Industria

Empire-Perth COF

<table>
<thead>
<tr>
<th></th>
<th>Hursthill Area</th>
<th>COF</th>
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</thead>
<tbody>
<tr>
<td>Area</td>
<td>99km²</td>
<td>13,45km²</td>
</tr>
<tr>
<td>Existing LPU</td>
<td>941</td>
<td>-</td>
</tr>
<tr>
<td>Existing Residential units</td>
<td>42604</td>
<td>16029</td>
</tr>
<tr>
<td>Population @ 3,5ppl/unit</td>
<td>127812</td>
<td>54019</td>
</tr>
<tr>
<td>MVA Existing</td>
<td>81MVA</td>
<td>58MVA</td>
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Existing Distribution Network

- Hursthill area is a low density residential area.
- This results in long MV distributors from the substation
- Allocation 15 to 25 load centres per distributor.
- Cable Sizes 185mm x 3c Cu XLPE Main distributors with the average length being approximately 4.3km. Sub Rings – 95mm x 3c.
- Main feeders maximum diversified designed capacity at 6MVA.
- 40+ Year cables
Existing Substation Philosophy - Feederboards

- City Power use a standard 2500A, 17 panel 11kV Feeder board design.
- Maximum of 3 feeder boards per substation (135MVA Firm capacity) using 4 transformers

**Option 1**
- Ring Distributor
- 6MVA capacity
- 50% Efficiency

**Option 2**
- 3 Leg Ring
- 12 MVA
- 66% Efficiency

300mm² XLPE Cu
SWS – 1250A
23MVA @11kV
Case Study Area

- Proposed spatial development plan – Town Planning
- Following factors were considered:
  - Number of Distributors and Distributor Lengths
  - Initial Capital Cost
  - Road Reserve capability (Electricity, Gas, Water, Sewerage, Telkom, Fibre) 1 m wide along BRT road
  - Energy Losses
  - System Operational requirements
Case Study Area

#97 – 670kVA

#27 – 930kVA

TSS 5
400kVA

MSS 6
315kVA

#97 – 670kVA

90m

200m

230m
Distribution Network Selection

- Pure Ring System
- Three leg System
- Switching Station System

### Distributors

<table>
<thead>
<tr>
<th>Design Option</th>
<th>Number of Distributors @ S/S</th>
<th>Total length of 300mm Cu</th>
<th>Total length of MV cable 185mm Cu/300mm Alu</th>
<th>Usage Factor Dist</th>
<th>% Cable Risk in Road Reserve - definite outage result</th>
<th>Number of Dist's for COF in HH S/S area</th>
<th>Additional Feeder boards Req</th>
<th>% Cost (Capital)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>0</td>
<td>13535</td>
<td>50%</td>
<td>178%</td>
<td>24</td>
<td>2</td>
<td>127%</td>
</tr>
<tr>
<td>2</td>
<td>6</td>
<td>0</td>
<td>10697</td>
<td>67%</td>
<td>140%</td>
<td>18</td>
<td>1.5</td>
<td>100%</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>2892</td>
<td>7614</td>
<td>67%</td>
<td>100%</td>
<td>9 - 12</td>
<td>1</td>
<td>121%</td>
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</table>
Energy Losses

- Eskom Charge City Power on a Time of Use Tarrif
- At Peak demand periods R/kVA is 615% compared to off peak periods
- Modelled each option’s individual current flow per section in every distributor.
- Existing SCADA data – Residential distributors
- The PU Load Profile was incorporated in all distributors to get the I²R Profile
- Comparing the 3 networks over a 24hr period a cost comparison can be summated considering the technical losses City Power will absorb to provide the maximum required capacity.

### TOU Tariff (High Demand Season) vs Domestic Load Profile

<table>
<thead>
<tr>
<th>Network losses experience during peak loading</th>
<th>Option</th>
<th>% Increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option 1</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Option 2</td>
<td>186%</td>
<td></td>
</tr>
<tr>
<td>Option 3</td>
<td>120%</td>
<td></td>
</tr>
<tr>
<td>Option 2 with two open point design</td>
<td>123%</td>
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Substation Extension

- The existing substation were designed for 135MVA
- Currently a 90MVA substation
- Can create an additional transformer bay
- Expected Load +/- 129MVA (96%)
- Limited capacity natural growth
- Give direct input into 20yr Transmission Masterplan
- Claremont Substation – Relieve Hursthill/Mayfair and Industria S/S in long term future
Conclusion

- The area divided into 3 switching station zones
- Zone saturation demand between 18 and 21MVA
- Mixture of ring feeders and three leg ring networks from switching stations depending on geographical load
Thank You