NTPC Conference

Outage Execution Control – new lever in meeting power demand in South Africa

February 13, 2012
Agenda

Introduction to Eskom

Development of OPIC

Performance Matrices

Conclusion
About Eskom

- Strategic 100% state-owned electricity utility, strongly supported by the government
- Supplies approximately 95% of South Africa’s electricity needs and than 40% of total the continent’s production
- For the six months ended 30 September 2012:
  - Electricity sales of 111 TWh (2011: 114 TWh) and electricity revenues of R71.9bn (2011: R63.1bn)
- As at 30 September 2012:
  - 44,913 group employees (September 2011: 41,756)
  - 4.9 million customers (September 2011: 4.7 million)
  - Net maximum generating capacity of 41.7GW (September 2011: 41.3GW)
  - 17.1GW of new generation capacity by 30 September 2018, of which 5.8GW already commissioned

Eskom electricity sales by customer for the six months ended 30 September 2012 (2011)

<table>
<thead>
<tr>
<th>Customer Type</th>
<th>Share 2012</th>
<th>Change 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercial and agricultural</td>
<td>6.5%</td>
<td>(6.0%)</td>
</tr>
<tr>
<td>Mining</td>
<td>14.7%</td>
<td>(14.5%)</td>
</tr>
<tr>
<td>Rail</td>
<td>1.4%</td>
<td>(1.3%)</td>
</tr>
<tr>
<td>Residential</td>
<td>4.9%</td>
<td>(4.8%)</td>
</tr>
<tr>
<td>Foreign</td>
<td>6.5%</td>
<td>(5.6%)</td>
</tr>
<tr>
<td>Industry</td>
<td>23.0%</td>
<td>(25.7%)</td>
</tr>
<tr>
<td>Municiplities</td>
<td>43.0%</td>
<td>(42.1%)</td>
</tr>
</tbody>
</table>

Generation capacity – 30 September 2012

<table>
<thead>
<tr>
<th>Power Source</th>
<th>Share 2012</th>
<th>Change 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydro</td>
<td>41.7%</td>
<td>85.0%</td>
</tr>
<tr>
<td>Coal</td>
<td>3.4%</td>
<td></td>
</tr>
<tr>
<td>Gas</td>
<td>4.4%</td>
<td></td>
</tr>
<tr>
<td>Nuclear</td>
<td>5.8%</td>
<td></td>
</tr>
<tr>
<td>Coal</td>
<td>85.0%</td>
<td></td>
</tr>
</tbody>
</table>
Power station map
### New generation capacity and transmission networks 2005–2018

#### Commissions of new stations

<table>
<thead>
<tr>
<th>Location</th>
<th>First unit</th>
<th>Last unit</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Medupi</strong></td>
<td>2013</td>
<td>2017</td>
</tr>
<tr>
<td><strong>Kusile</strong></td>
<td>2014</td>
<td>2018</td>
</tr>
<tr>
<td><strong>Ingula</strong></td>
<td>2014</td>
<td>2014</td>
</tr>
</tbody>
</table>

- ~ 17 082MW of new capacity (5 756MW installed and commissioned)
- ~ 4 700km of required transmission network (3 899.3km installed)
- 20 600MVA planned (20 195MVA installed)

#### Medupi is the first coal-generating plant in Africa to use supercritical power generation technology

(1) Includes 1.62 MW for Solar PV (MWP, Lethabo & Kendal) Source: Eskom Group Capital Division (Construction Management)
Lack of historical investment and maintenance has caused deterioration across the fleet

- Historical underinvestment in new plants came to a head in 2008 with **rolling load-shedding**

- **A significant number of outages are forced (UCLF)**

- The state of the boilers and turbines is critical and exasperated by a **spares shortage and long delivery lead times**.

- The previously moth-balled stations are not as efficient and require **substantial ongoing maintenance**.

- Due to the age of some units, spares need to be custom made adding to further delivery times for replacement parts

Source: OPIC
Agenda

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In the journey to improved outage performance, Eskom is currently at phase 4 of the journey.

Current status

Develop capabilities and roll-out ‘best practices’

- Codify outage management best practices and train all outage teams in best practice outage management

Create outage strategy

1. Determine capacity requirement of 3 GW for comprehensive outage programme (2 GW approved)
2. Freeze schedule for 26 outages under conservative system

Improve outage preparation

3. Conduct independent party reviews of outage readiness according to agreed checklist
4. Establish OPIC to enable daily visibility on outages
5. Provide on-station support to 23 outages in 2012 to improve outage due date and UCLF performance
6. Fill outage organisation with skilled personnel

Create transparency

Improve outage execution and staff organisation

Improve outage procurement

5. Turnaround Rotek performance through co-ordination and capacity increases
6. Optimise contractor management and procurement effectiveness

Source: OPIC
Our new strategy enabled us to address multiple structural challenges

1. **Centralisation**
   - **Description**
     - **Centralised planning and execution of outages** under Outage Management thereby creating a single point of accountability with a clear mandate
     - Tasked Outage Management with clear performance expectations including **improving overall energy availability by 3 percentage points** over 5 years, post outage unit capability loss factors, due date performance and quality
     - Created OPIC that is a **central control centre** providing planning and execution visibility enabling faster issue resolution and stakeholder executive support
     - OPIC serves as a **centre of excellence and a nerve centre** for outage management from where expertise is disbursed where needed.
     - **Supported overall process compliance and support ensuring** outage programme run to a drumbeat with clear roles and responsibilities
     - Provided full **transparency** on unit outage status and a single version of the truth
     - Enabled **knowledge sharing** and developed expertise

2. **Outage Performance Improvement Centre (OPIC)**
   - **Description**
     - Invested in Rotek to handle the complete service engineering on the turbine island in line with international benchmarks
     - **Re-set relationships with contractors** and enhanced their involvement during planning of outages and established technical working forums
     - Leveraged Government to **encourage localization of parts manufacturing** and capacitation of service engineering

3. **Contractor capacitation**
   - **Description**
     - **Partnered with international service providers** to implement standard project management tools that allow easy benchmarking and progress monitoring
     - Worked with global technical consultants to provide international experts to account for **unavailable local skills and developed critical skills** in areas including turbine blading, welding engineering and gen rotor winders

SOURCE: McKinsey & Company
Our new strategy enabled us to address multiple structural challenges

### Description

<table>
<thead>
<tr>
<th>5</th>
<th>Description</th>
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| **Spares** | - Started **acquisition of critical interchangeable spares and modules** that will enable life extensions of the centre-line equipment as well as creating ability for Eskom to recover from unforeseen breakdowns effectively.  
- Enabled planned **outages to be executed in compressed times** with greater certainty whilst allowing refurbishment of equipment to take place off-line. |

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<th>6</th>
<th>Description</th>
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| **Performance reviews** | - Evaluated pre-outage data and performance calculation results to quantify the available capacity improvement opportunity and balance the available gain against the cost of repair.  
- **Validated outage planning** against the measured results provided by historical performance data.  
- **Quantified the return on investment** from each improvement and benchmark that improvement against historical data  
- Established **performance benchmarks for post outage** to monitor off-design performance that can lead to incremental capacity loss, unplanned outages and forced de-ratings. |
OPIC is responsible for the central, day to day management of outages

1. **8:00-8:30**
   - Review of daily outage issue logs received from Outage Senior managers.

2. **8:30-9:30**
   - Daily leadership conference call with Partners to discuss key outage issues, early warnings and mitigation actions.

3. **9:30 – 10:30**
   - Update daily issue log & Issue to Plant Managers

4. **9:30 – 11:30**
   - Development discussions on a number of initiatives e.g., knowledge centre, Intranet site, planning reporting, Partner integration

5. **11:30 – 12:00 Mondays & Tuesdays**
   - Update Genprod & Ops Excellence Presentations
   - Update performance matrices

6. **12:00 – 13:30 Thursdays Only**
   - Pre-OPIC briefing with leadership to review weekly data and determine key focus areas

7. **13:30 – 16:00**
   - Deep Dive on a pre-selected outage to review risks
   - Undertake Partner Reviews (per invitation)

8. **15:00 – 17:00 Thursdays Only**
   - Weekly OPIC Meeting to review key outage planning and execution data. Agree required outage deep-dives and support to be provided

9. **17:00 – 17:30 Thursdays Only**
   - Conduct OPIC meeting review and draft meeting actions

Source: OPIC
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3. Performance Matrices
4. Conclusion
There has been a steady improvement in ORI and progression towards the 80% threshold.
DDP in January has improved this year (83%) compared to January last year (29%).

Due Date Performance (DDP) Trend

Percent of outages returned on time or earlier – monthly average

- Due Date Performance (DDP) Trend
  - Target 90
  - Average June’11 – Jan’12 = 50.0%
  - Average June’12 – Jan’13 = 53.3%

DDP comparison

<table>
<thead>
<tr>
<th>Quarter</th>
<th>FY12</th>
<th>FY13</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td>50.0%</td>
<td>61.1%</td>
</tr>
<tr>
<td>Q2</td>
<td>83.3%</td>
<td>80.0%</td>
</tr>
<tr>
<td>Q3</td>
<td>53.3%</td>
<td>71.4%</td>
</tr>
</tbody>
</table>

- DDP for Q1 was 61.1%, Q2 was 80% and Q3 was 71.4%
- Despite a DDP of 71.4% in Q3 FY13 for 14 outages, it is stronger than Q3 of FY12 which saw DDP at 53.3% for 15 outages
- A significant number of planned and forced outages started in Q3 which stretched existing resources

Number of outages returned by month

- Total Jun’11 – Jan’12 = 32
- Total Jun’12 – Jan’13 = 36

Average duration of outages return by month

- Average June’11 – Jan’12 = 54
- Average June’12 – Jan’13 = 53

1 All official outages longer than 14 days. Defined and reflected as “the number of outages returning to service on or before the planned end date expressed as a percentage of the total number of outages in the preceding 12 month window”
2 No outages were returned in August 2012

SOURCE: OPIC, GPSS
Outage Weld Repair Rate has steadily improved to 5.6% for the 51,230 completed welds

Weld repair rate for returned outages in FY12

Data reflects all welding reported to OPIC on weekly basis for outages

Key findings

- WRR has continued to show signs of improvement though it is still above the aspirational target of 3.5%
- OPIC, partners and Outage Managers continue to focus on reducing WRR and improving productivity
- There will be additional welding Technical Forums and Partner Performance reviews to contain the WRR

1 WRR as reported by Outage Managers on a weekly basis to OPIC and validated with Outage Managers
Source: OPIC
Outages returned since April of 2012 have an average UCLF of 14% (1 month) and 8% (2 month)

Post outage UCLF station

% UCLF

1 Month UCLF
2 Month UCLF
Month 2 Target
Month 1 Target

21st May

Key findings

- Target UCLF for most stations in the 3-6% range
- Only 20 of 38 units had UCLF of less than 6% in their 1st month on load since April of this year
- 23 units had UCLF of less than 3% in their 2nd month on load

1 Average UCLF excludes interim UCLF data
2 No outages retuned in August ’12

Source: GPSS, Weekly Outage Team submitted data
Pre & Post Outage Reviews are conducted to quantify outage ROI

Key findings

- Quantifiable improvements in unit heat rate performance and capacity, and a 2% reduction in emissions
- Post-outage evaluation confirmed that a total annual fuel savings in excess of R11.4 million can be attributed to the work performed during the outage
- Boiler efficiency improved 2.2% over pre-outage conditions
- Secondary air heater efficiency improved in excess of 25% over the pre-outage conditions due to new baskets being installed
- The main condenser cleaning and re-tubing contributes R2.3M to annual fuel savings. Condenser cleanliness data shows a step change improvement of 30% over the pre-outage conditions.
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Centralisation of outages has enabled better execution control and enables value adding in addressing maintenance backlog and ensuring continuity of supply

- Pre-outage evaluations ensure that Eskom is spending resources in the appropriate areas and successfully validates the outage plan with measurable data.
- A consistent, repeatable process has been established to benchmark post-outage equipment, unit performance and operation.
- Performance matrix including post-outage UCLF are effective measurements for short-term availability improvements as a result of the outage work.
- Post-outage evaluations provide ROI in terms of capacity increase, heat rate improvement and emissions reductions.
- Established capacity and equipment performance benchmarks allow Eskom to more quickly realize and pinpoint off-design operation and performance prior to load losses or equipment degradation.

Source: GPSS
‘In these days, a person who says a thing cannot be done is quite apt to be interrupted by some idiot doing it’

- Elbert Hubbard