Racecourse Cogeneration Project

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Project Overview

- 150 t/h HP bagasse boiler and 38 MW cogen plant at Racecourse Mill.
- 25 MW export ➔ supplies 30% of Mackay electricity needs year-round.
- Operates 49 weeks each year
- Supplies steam and electricity to mill and refinery.
- Extended bagasse storage facilities: ~130,000 tonnes bagasse is stored for 13 weeks operation in the non-crush
- Coal burned in remaining 14 weeks of the non-crush.
- 200,000 tpa GHG abatement.
- A$120m project was approved in January 2010.
- Completed on-time and within budget with commissioning and performance tests completed in March 2013.
Major plant items

Power Plant:
- 150 t/hr, 80 bar, 525°C steam boiler & de-aerator
- 38 MW condensing extraction steam turbine generator
- 80 t/h condenser, cooling tower and pumps
- Coal plant and moving grate
- 11kV / 66kV transformer

Auxiliary Plant:
- New condensate system
- Improved evaporator steam efficiency measures
- New control and switchrooms
- Switchyard and 66kV interconnection (5.5km)
- Extra bagasse storage facility (45,000 t. → 160,000 t. total)

Project Management:
- Mackay Sugar (AE&E insolvent 11m into 3 year $90m+ contract)
- MSL took over contract and employed 26 ex-AE&E people
Crushing season steam flowsheet

COGENERATION

VHP Steam
80 bar(g)

Condensor

38MW STG

VHP/IP

IP Steam
5 bar(g)

LP Reheater

LP Steam
1.5 bar(g)

2 bar(g)

Deaerator

Steam Transformer

HP/LP

ID Fans

T/As

Shredder

Mills Misc.

No.2 Boiler

No.3 Boiler

LP Steam
1.5 bar(g)

To 3E & 3W

LP/V1

Vapour System
0.7 bar(g)

PE1 A

PE1 B (Old)

1E & 1W

2E & 2W

Vapour System
0.7 bar(g)

Refinery

Sugar Mill

Melters

Pans

#1 Mill Pan

Mill Pans
Non-crushing season steam flowsheet

Cogen Boiler

VHP Steam
80 bar(g)
Condensor

38MW STG

IP Steam
5 bar(g)
LP Reheater

LP Steam
1.5 bar(g)

Vapour System
0.7 bar(g)

Deaerator
Steam Transformer

COGENERATION

No.2 Boiler
No.3 Boiler

PE1

A

Pans #1
Mill
Pan

Melters
No.3 Boiler
No.2 Boiler

Refinery
Sugar Mill

Vapour System
0.7 bar(g)
Innovative project features

- High steam pressure / temp → maximise generation.
- Operates 49 weeks/yr → high plant capacity factor & PPA certainty.
- Coal firing → ensures reliable steam and electricity outputs.
- Supplies refinery energy in non-crush → full year cogeneration maximises site energy efficiency.
- Re-use existing chimney, bagasse plough points and milling building for STG hall to reduce capital costs.
- No flue gas airheater; uses large economiser with water pass-out for SA and UGA airheaters, reducing dewpoint corrosion at low load.
- Pre-evaporator boils ESJ during the crush, and re-boils refinery condensate during non-crush, segregating quality steam from process.
- Two pre-primary juice heaters use final effet vapour to improve efficiency.
Cogeneration Operations

**Crush**
- Marian
  - 4.0 MW
  - 80,000 t

- Farleigh
  - 50,000 t

25 MW

**Non-Crush**
- Racecourse
  - 25.0 MW – Bagasse (13.0W)
  - 20.0 MW – Coal (peak price)
  - 10.0 MW – Coal (off-peak price)

- Bagasse
  - 130,000 t

- Coal
  - 30,000 t

Racecourse @ 500TCH

0 t
Outputs of the Cogeneration Project

Power plant operates at MCR:
• 150 t/h steam at 80 bar to STG
• 15 t/h passout at 5 bar
• 70 t/h passout at 1.5 bar
• 65 t/h to condensor.

Power plant operates at near MCR:
• 140 t/h steam at 80 bar to STG
• 15 t/h passout at 5 bar
• 45 t/h passout at 1.5 bar
• 80 t/h to condensor.

Peak elec. price:
• 125 t/h steam to STG
• 15 t/h passout at 5 bar
• 45 t/h passout at 1.5 bar
• 65 t/h to condensor.

Off-peak elec. Price
• 75 t/h steam to STG
• 15 t/h passout at 5 bar
• 45 t/h passout at 1.5 bar
• 10 t/h to condensor
Contractors

- 143 contracts in total:
  - 123 Power Plant contracts (novated from AE&E)
  - 20 Balance-of-plant contracts
  - 413,000 contractor man-hours worked @ Racecourse
  - Max site workforce was 180 personnel
  - 5.5 km Ergon powerline
  - Site planning crucial for cut-ins: Rac boilers down for 2 weeks pa.

- Injuries:
  - 1 lost time
  - 8 medical treatments
  - 31 first aid

- Project spend:
  - 50.2% Mackay based businesses
  - 4.3% Other QLD based businesses
  - 27.1% Other Australian based businesses
  - 18.4% Overseas businesses
Boiler design - 3D model
<table>
<thead>
<tr>
<th>Component</th>
<th>Sub-contractor</th>
</tr>
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<tbody>
<tr>
<td>Grate Combustion System</td>
<td>Detroit Stoker, USA</td>
</tr>
<tr>
<td>Steam Turbine Generator</td>
<td>Shin Nippon, Japan</td>
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<td>Brush, Netherlands</td>
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<tr>
<td>Boiler Fabrication: Industry</td>
<td>Suzhou Hailu Heavy</td>
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<tr>
<td>Economizer</td>
<td>Greens Power, UK</td>
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<tr>
<td>Hot Water Air Heater</td>
<td>Jord, Australia</td>
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<tr>
<td>Heat Exchangers</td>
<td>GEA, Germany / Daewoo, Korea</td>
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<tr>
<td>Wet Scrubber</td>
<td>Mikropul, Australia</td>
</tr>
<tr>
<td>Fan Package</td>
<td>Ebara Hamada, Japan</td>
</tr>
<tr>
<td>Pump Package</td>
<td>KSB, Australia</td>
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<tr>
<td>Electrical and I&amp;C Package</td>
<td>ABB, Australia</td>
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<tr>
<td>Control Valves</td>
<td>KSB, Australia</td>
</tr>
<tr>
<td>Transformer</td>
<td>ABB, Vietnam</td>
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Components manufactured worldwide
STG rotor – Shin Nippon works
Boiler pressure parts – China supply
Project site - Before and after
Conclusions for a successful project

Cost control:
- Detailed estimates based on accurate work scopes
- Re-use existing mill infrastructure where possible
- Compile detailed specifications (technical and commercial)
- Source competitive tenders from competent contractors, incl o/sea
- Weekly reviews of cost and progress reports

Program:
- Initiate connection agreement enquiry well before project start
- Detailed program compiled before awarding contracts
- Include as much float as possible for large supply items (eg STG)
- Effective control of multiple site contractors

Best returns:
- Operate beyond crush (preferably year-round)
- Fuel: source quality fuel (eg bagasse from nearby mills) for non-crush
Acknowledgements

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- The dedicated MSL in-house Cogen Project Team.