BENCHMARKING CONTINUOUS MINER OPERATIONS IN CHINA.

Coaltech Delegation
Visit China
--
January 2003
Benchmarking continuous miner operations.
- National completed
- International survey to USA

Exceptional performance claimed from flagship Chinese Coal mining company; Shenhau Shendong Coal Company.

A delegation of industry representatives was formed.
A two week fact finding tour arranged through Joy China and the Chinese Coal Mining Institute.
SA CM PERFORMANCES

SA best: 164000
SA Aver: 58000
Intern: 234700
CHINA

- Population – 1.3 Billion
- Single child families
- 3rd World with 1st world cities and technology
- Beijing – 13 Million
- 5% Unemployment
- 85% In agriculture
- < 5% Have own motorised transport
CHINA - Economy

- Economic growth rate 2002–
  - 8% economic Growth
  - 14 % industrial Growth
- Yuan undervalued by 50%
- Taken over Japan in GDP
- Foreign investment 52.7bn pounds 2002
- New member of WTO.
- Manufacture “anything” including mining equipment
- Relative cheap labour
- SARS scare?
China - Culture

- Politically, Communism still alive and well, in business capitalist principles being adopted.
- In industrialized areas every man and every women works
- “Culture of keeping busy” – Strong work ethics
- Young people “run the show”
- High level of tertiary education – graduates
- Long working hours, little time for vacation
- Fear of failure, only speak of successes.
- Little dissension
- Disciplined
Chinese coal fields
- Proven reserve base (200 years)
- Expanding exploration program
- Consolidation of major coal groups expected in 2003-4
## CHINESE COAL INDUSTRY – CONFIGURATION

<table>
<thead>
<tr>
<th>Type of Coal Mines</th>
<th>Number</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>State owned key mines</td>
<td>119</td>
<td>54%</td>
</tr>
<tr>
<td>State owned local mines</td>
<td>2000</td>
<td>20%</td>
</tr>
<tr>
<td>Township coal mines (TVE’s)</td>
<td>31000</td>
<td>26%</td>
</tr>
</tbody>
</table>

Major drive to reduce the number of TVE’s and smaller mines, modernize and amalgamate into mining groups.
Individually managed at mine level – Group head appointed by the state.
All large mining groups state assisted and capitalized – expected to return on investment to government.
Amalgamation of major mining groups envisaged in 2004.
CHINESE COAL PRODUCTION
(Million tons mined)

CHINESE COAL PRODUCTION
(Million tons mined)
CHINA – Power Supply

Energy growth rate 2002–2005

- Deregulation drive by the State Electricity Regulatory Commission
- Introduce a market-based pricing mechanism that will encourage power producers to increase capacity to meet rising demand.
- Power consumption is expected to top 2.09 trillion kW/yr by the end of 2005, up 28% from the 1.63 trillion kW in 2002.
- China's electric power output for the first five months of 2003 is expected to have risen 15% from a year earlier to almost 700bn kWh.
10% - 15% Opencast only
65% Consumed for power generation
89 Mt export 2002 (up from 38Mt in 1998)
China exports of energy coal increase market share particularly in South East Asia 2002
- 70.5 Mt from China
- Verses 98.5Mt from Australia
Only four mining groups have export license – volumes and prices determined centrally
Predicted that this policy may change under WTO pressure
Railage very expensive
Largest Coal company in China - One of the big four (New model mining Groups)

Project Infrastructure. 10 Shafts and associated services; Town for 20,000 people (Shenhau); 815 km double track rail coalink through desert and mountain range; 12,000 MW power station; 30 million ton export terminal.

Initial Capital Cost RMB 44 bn (1996 Terms)
Listed on LSE
6 Longwall Mines
- Daliuta, Huojitu,
- Bulianta, Yu Jia Liang,
- Sunjiaguo
- Wulan Mulun (Chinese Equipment)

4 Continuous Miner Mines
- Shangwan,
- Dahaize, Halaguo,
- Kanjiatan.
Reserves: 223.6bn tonnes
Potential Capacity: 100mtpa
## Continuous Improvement/Growth

<table>
<thead>
<tr>
<th></th>
<th>2002</th>
<th>2003</th>
<th>2005</th>
<th>2030</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHINA COAL PRODUCTION</td>
<td>1.321 Bt</td>
<td>1.45 Bt</td>
<td></td>
<td>3.5 Bt</td>
</tr>
<tr>
<td>SHENDONG'S PRODUCTION</td>
<td>51.4 Mt</td>
<td>64 Mt</td>
<td>100 Mt</td>
<td></td>
</tr>
<tr>
<td>IN-SEAM GASSIFICATION</td>
<td>3 EXP MINES</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PRODUCTION FOR 2002

Shendong Mining Corporation – 51.37 Mil tonnes
- Capacity:
  - 8 x Long wall
  - 22 x Continuous miners

Daliuta Mine – 10.4 Mil tonnes
- 1 x Long wall – 8.7 Mil tonnes
- 2 x Continuous miners

ShangWan - 2.2 Mil tonnes
- 12CM15 with Long Airdox chain conveyor
In 2001, 18 face moves have been completed in the coalfield, and the average time is 8 days. In September 2001, Yujialiang mine took only 6 days and 23 hours to complete the face move. A specialized crew of 100 work around the clock until the move is complete.
# Shendong Longwall mine production

<table>
<thead>
<tr>
<th>Mine</th>
<th>2001</th>
<th>2002</th>
<th>2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Daliuta Complex</td>
<td>15.12</td>
<td>16.25</td>
<td>20.20</td>
</tr>
<tr>
<td>(2 longwalls and 4 miners)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Daliuta Longwall</td>
<td>7.73</td>
<td>8.74</td>
<td>7.60</td>
</tr>
<tr>
<td>Huojitu Longwall</td>
<td>5.28</td>
<td>5.04</td>
<td>8.40</td>
</tr>
<tr>
<td>Yujieliang Mine</td>
<td>6.62</td>
<td>10.59</td>
<td>11.00</td>
</tr>
<tr>
<td>(1 longwall and 2 miners)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yujieliang Longwall</td>
<td>5.62</td>
<td>8.65</td>
<td>8.40</td>
</tr>
<tr>
<td>Bulianta Mine</td>
<td>5.12</td>
<td>7.60</td>
<td>9.00</td>
</tr>
<tr>
<td>(1 longwall and 2 miners)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bulianta Longwall</td>
<td>4.80</td>
<td>6.96</td>
<td>8.30</td>
</tr>
<tr>
<td>Kangjiatan (Sunjiagou)</td>
<td>1.08</td>
<td>2.80</td>
<td>8.00</td>
</tr>
<tr>
<td>Kangjiatan Longwall</td>
<td>-</td>
<td>1.30</td>
<td>6.80</td>
</tr>
</tbody>
</table>
SHENDONG GEOLOGY

- Workable coal seams 1, 2, 4, 5 (2 seam mined currently)
- Seam inclination 1 to 3 deg
- Simple geology, little to no dolerites
- Simple geohydrology
- Shendong proven reserve base:
  - Number 2 seam < 100 metres deep
  - Seam thickness from 2 – 7 metres
  - 27 MJ/Kg ROM
  - > 14% Moisture
  - < 0.5% Sulphur
  - 6% Ash
  - 95% yield
  - 30% ROM beneficiated (jigs)
GEOTECHNICAL

- Number 2 seam < 100 metres deep
- Seam thickness from 2 – 7 metres
- 75% In panel volumetric extraction rate
- 7.7 – 22 Mpa coal hardness (Ave 14.2Mpa)
- Cutting factor 3 (Soft, little abrasives)
- Quoted tons per pick ‘1,000’
- Pillars stand up well, do not scale/spawl ‘little cleating and jointing’
- Immediate roof interlaminated mud/sand stone 1.8m overlain by 20m of competent medium sandstone.
- Roadway support systematic: Full column resin - 1.6m rebar 16mm diam. 1.1m apart four in a row. (American Standard)
- Surface Protection not of concern.
WONGAWILLI PANEL DESIGN

- Chain Road pre developed up to 1 km
- Advance mining up dip
- No Ventilation in mined-out branches
- All Roadways supported except side webs
- Full caving encouraged
- Every 7th pair of branches a 15m pillar is left.
- Bottom coal taken
- State that main pillars extracted on retreat?
- Panels sealed at main entry with 5m clay and steel door stoppings
JOY 12CM15 / LONG AIRDOX HAULAGE
WANGAWILLI/ SHENHAU METHOD

140 deg 13
12
11
10
9
8
7
6
5
4
3
2
1
15 m
3.3 m
78 m
25.5 m
5.5 m
5 m
6 m
15 m
0.5 m
11 m
15 m
140 deg 13
transport heading 5.0m
Belt road
WANGAWILLI APPLICATION IN SA

- Ventilation concerns
- Major collapse and inrushes
- Accuracy of cutting essential
- Spawling properties of pillars
- Goafing properties of strata
- Full extraction methods – EMPR implications
- Further investigation required
## Shangwan Cost Summary Report

<table>
<thead>
<tr>
<th>Item</th>
<th>Planned cost this year</th>
<th>Operation cost this month</th>
<th>Actual cost this month</th>
<th>Accumulated cost this year</th>
<th>Cost compared with last year</th>
<th>Operational ratio this month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total cost</td>
<td>30.67</td>
<td>30.67</td>
<td>30.19</td>
<td>27.59</td>
<td>31.18</td>
<td>-0.48</td>
</tr>
<tr>
<td>Material cost</td>
<td>7.1</td>
<td>7.1</td>
<td>6.75</td>
<td>6.15</td>
<td>8.25</td>
<td>-0.35</td>
</tr>
<tr>
<td>including spare parts</td>
<td>3.41</td>
<td>3.41</td>
<td>2.06</td>
<td>3.17</td>
<td>3.21</td>
<td>-1.35</td>
</tr>
<tr>
<td>Wages</td>
<td>3.25</td>
<td>3.25</td>
<td>-2.2</td>
<td>2.93</td>
<td>2.92</td>
<td>-5.45</td>
</tr>
<tr>
<td>Workforce</td>
<td>0.46</td>
<td>0.46</td>
<td>-0.31</td>
<td>0.41</td>
<td>0.41</td>
<td>-0.77</td>
</tr>
<tr>
<td>Electricity</td>
<td>1.9</td>
<td>1.9</td>
<td>1.6</td>
<td>1.53</td>
<td>1.95</td>
<td>-0.3</td>
</tr>
<tr>
<td>Other costs</td>
<td>5.07</td>
<td>5.07</td>
<td>10.08</td>
<td>6.96</td>
<td>8.14</td>
<td>5.01</td>
</tr>
<tr>
<td>Cost beyond operation</td>
<td>0.04</td>
<td>0.04</td>
<td>0</td>
<td>0.01</td>
<td>0.08</td>
<td>-0.04</td>
</tr>
<tr>
<td>Operational cost from equipment</td>
<td>9.71</td>
<td>9.71</td>
<td>12.68</td>
<td>6.98</td>
<td>6.73</td>
<td>2.97</td>
</tr>
<tr>
<td>Engineering cost</td>
<td>0.83</td>
<td>0.83</td>
<td>0.58</td>
<td>0.7</td>
<td>0.89</td>
<td>-0.25</td>
</tr>
<tr>
<td>Preparation plant cost</td>
<td>2.31</td>
<td>2.31</td>
<td>1.03</td>
<td>1.92</td>
<td>1.91</td>
<td>-1.28</td>
</tr>
<tr>
<td>Sales coal</td>
<td>3,000,000</td>
<td>3,000,000</td>
<td>262,310</td>
<td>3,179,257</td>
<td>2,224,048</td>
<td>(2,737,690)</td>
</tr>
<tr>
<td>including monthly accumulation plan</td>
<td>250,000</td>
<td>250,000</td>
<td>262,310</td>
<td>264,938</td>
<td>185,337</td>
<td>123,10</td>
</tr>
</tbody>
</table>
Miner - 12CM15 D
Short body length – 56 tons – 140kw cutter motors – height range 2.4 – 4.6m
ARO – 4 Drill on sliding boom Roofbolter.
488 Scoop
2 X mobile supports (removed)
LONGWALL PANEL DESIGN

- Chain Road pre developed up to 6 km; 250 apart
- Retreat mining down dip– Ave 500m per month
- Target 9 x 0.865m per shift
- Pre-developed salvage Roadways
- All outbye Roadways bolted and arch shotcreted
LONGWALL SECTION
EQUIPMENT

- Miner – Joy 6LS 5 – 610kw per cutter drum – 0.865m web – cutting height 2.2 to 5.0m
- AFC – 2,200 tph – 250m long by 1m wide – 700kw drive main and tail.
- 143 Shields – 2 leg - 5m high x 1.75 centres, 777 ton rated.
- Stage loader and impact crusher
Safety Status

- Poor safety record, especially on TVE's
- 554 Explosion fatalities in 19 months
- 7000 fatalities 2002. 3000 so far 2003; 28 weeks
- Very conscious of record and reputation.
- Mine Closed down (American Asian mine) fatality
- Strategy Controls at Shendong.
- Relatively good safety record – one fatality in last two years.
- Contravention penalty scheme
  - Spot fines R1000 per contravention
  - Individual and superior fined
  - Repetition leads to dismissal
  - Peer pressure will intervene prior to this
- Fatality penalty – Mine manager losses 50% of annual salary.
- Inspector per mine permanently at each site.
- 1 046 Regulations influencing mines
- Low environmental standards
SHE Cont’

- Observations
  - Gas, dust and ventilation controls poor
  - Only one methanometer seen
  - No stonedust or passive barriers
  - Risk area limited to in-face – No flame proof fans and LDV’s
  - Occupational Health controls poor
  - Limited PPE
  - No scrubbers and limited sprays
  - No mention of occupational diseases.
  - Support good (US standard)
  - House keeping excellent
  - Environmental impacts low priority
Section Manning

Continuous miner per 8 hour shift:
1 x Continuous miner operator
4 x Chain haulage operator
2 x Roof bolter operator
1 x Foreman
1 x Belt operator/electrician

20 Maintenance operators for LW and 2 continuous miners

LW per 8 hour shift:
2 x Shearer
3 x Shields/pan line
1 x Stage loader
1 x Pump station
1 x Foreman
MANNING CONTINUED

- 36 in Surface work shops (Rotate/boundaryless)
- Daliuta – 274 (Excluding contractors)
- 34 in Supervisors/management team
- 38,000t/man year
- Shendong – 2 441 (Excluding contractors)
- High level of discipline (Military)
- High level of ownership/work pride
CONDITIONS OF EMPLOYMENT

- Pay and benefits.
  - Operators R 6000 per month
  - Bonus around +25% possible  Drivers – Q C D A
  - Mine Manager (Shangwan) brags about new package of R 300, 000 plus VW jetta bonus for 2002. Triple that of five years ago. Best in industry.

- Hours of work
  - Typical three shift rotation
  - Six days per week, 8 hours on the face (hot seat change).
  - Overtime for production common. (day off worked).

- Leave
  - Two public holidays Chinese New Year and May day.
  - Holidays not generally taken – very little leisure infrastructure – return home to family village.
MAINTENANCE

- Big emphasis on maintenance (Maturity level high)
- Big emphasis on training and skills
- Mine specific training 15 to 20 days per year
- Urgency
  - recording of response/repair times
  - Deployment of equipment immediate
  - Boundaryless approach
  - Spare equipment – speedy rotation
- Supplier provides follow-up training yearly on mine updating and refresher
- Plan high availability versus plan high production
- Plan for 95% total availability
- 2 Hours daily per section -
- Dedicated Maintenance team also does infrastructure extensions.
MAINTENANCE

- Belt driver is expert artisan
- Big maintenance when section is on stop
- Longest breakdown – Broken cattrack – 3 Hours
- Central Work shop main supplier on mine open 24/7
- Complete machine overhaul on 2 million tonnes Wash and brush up 1 million tons.
- Underground artisans involved in Machine build up toward latter stages of major overhaul.
EMPLOYEE TRAINING

- **Scholars**
  - Schools run six days a week from 8 to 5 – extremely competitive – focus on maths and science.

- **University and higher education**
  - Large proportion of employees selected from state universities – many mining engineering students / bursaries offered – quality of degrees very high.
  - 70 institutions in Beijing alone.

- **Mine level**
  - 22 days training/year/employee
  - Most managers and potential managers multiple degrees.
  - Employees will have multiple formal skills (typical operator, artisan, condition monitor).
  - Workshop experience with ex-pats (OEM’s), cascade of skills.
CONTINUOUS IMPROVEMENT/GROWTH

- Equipment for delivery 2003 (Joy only)
  - 7LS Shearer
  - 3 AFCs (2 of 48mm Chain)
  - 5 12CM27 Miners (4.6m 235kW Cutter Motors)
  - 5 off 12CM15 Miners
  - 12CM15 WH Bolter Miner
  - 2 off 20 tonne capacity Shuttle Cars

- Projects
  - 30 million ton per annum ‘Sasol type plant’ by 2005
  - Upgrade of Rail line and port for undisclosed export tonnage
  - Increase from 30Mt/annum
SUCCESS FACTORS – ACCORDING TO SHENDONG’S

- One of the best Coal reserves in the World
- Quality equipment selection and leading edge technology
- Maintenance excellence
- The best people for the job
KEY LEARNING AND OPPORTUNITIES

- Are truly World leaders in Coal Industry (UG)
- Technically similar to global modern mining operations
- Perfection of cloned systems admirable
- Prepared to make mistakes and learn from it.
- Maintenance culture and maturity world class
- Common goal, focus and determination
- Thirst for knowledge
- Recruitment and employee development top priority
- High level of ownership although boundaryless
- Passion to be the best “Everyone”
Closing Remark

The sleeping giant has awoken

Thank you for the opportunity