Modern Technology in mining

Hindustan Zinc Limited
Integrated mining and Metal Company

15 Feb 2017
Safety & Sustainability

Zero harm to people, host communities and environment

- Safety cultural transformation journey from reactive to interdependent;
- Promoting behaviour based safety

Sustainability Initiatives

- Zero water discharge
- Sewage treatment plant as sustainable water source
- Green energy of 309MW

LTIFR (per million man-hours worked)

*As per new ICMM Guidelines
Portfolio of Tier - 1 Assets

**Rampura Agucha Mine**
- Reserve: 51.1mt
- Resource: 52.7mt
- Reserve Grade: Zn 14.0%, Pb 1.8%
- Current Ore Capacity: 6.15 mtpa

**Zawar Mining Complex**
- Reserve: 9.5mt
- Resource: 82.3mt
- Reserve Grade: Zn 3.4%, Pb 1.7%
- Current Ore Capacity: 1.80 mtpa
- CPP: 80MW

**Kayad Mine**
- Reserve: 3.9mt
- Resource: 2.0mt
- Reserve Grade: Zn 13.4%, Pb 1.8%
- Current Ore Capacity: 1.00 mtpa

**Sindesar Khurd Mine**
- Reserve: 33.2mt
- Resource: 76.3mt
- Reserve Grade: Zn 4.7%, Pb 3.2%
- Current Ore Capacity: 4.00 mtpa

**Rajpura Dariba Mine**
- Reserve: 9.3mt
- Resource: 49.4mt
- Reserve Grade: Zn 6.3%, Pb 1.6%
- Current Ore Capacity: 0.90 mtpa

**Chanderiya Smelting Complex**
- Pyrometallurgical Lead Zinc Smelter: 105,000 tpa Zinc and 85,000 tpa Lead
- Hydrometallurgical Zinc Smelter: 420,000 tpa Zinc
- Captive Power Plant: 234MW

**Dariba Smelting Complex**
- Hydrometallurgical Zinc Smelter: 210,000 tpa Zinc
- Lead Smelter: 100,000 tpa Lead
- Captive Power Plant: 160MW

**Zinc Smelter Debari**
- Hydrometallurgical Zinc Smelter: 88,000 tpa Zinc

**Pantnagar & Haridwar**
- Processing & Refining of Zinc, Lead & Silver

▲ **Wind Power** Generation Capacity of 274 MW
Pioneers in Mineral Exploration in India

VTEN HELIBORNE SURVEY
High Sensitivity Magnetic & Time Domain EM survey over 1500 sqkm area (~8700 line km) in Sawar-Jobner RP

VTEN Survey 2010
(First to fly in Indian Private Sector)

Titan Deep Earth Imaging Survey
Strong Track Record of Growth

Reserve & Resource (mt) - 2.5X Growth

<table>
<thead>
<tr>
<th>FY03</th>
<th>FY04</th>
<th>FY05</th>
<th>FY06</th>
<th>FY07</th>
<th>FY08</th>
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Ore Production (mt) - 3X Growth

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**Way Forward**

- Resource driven growth
- Five major projects to increase mined metal capacity by 20% to 1.2 mtpa.

**Transition to underground mining (% share in MIC)**

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<tr>
<th>Year</th>
<th>FY 15</th>
<th>FY 16</th>
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<th>FY 18</th>
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<tr>
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<tr>
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<tr>
<td>FY 18</td>
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<tr>
<td>FY 19</td>
<td>80%</td>
<td>20%</td>
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<td>FY 20</td>
<td>100%</td>
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**Journey Ahead - Projects**

- RAM UG: FY 16: 0.2, FY 20: 3.75
- SKM: FY 16: 4.5, FY 20: 3
- ZWM: FY 16: 1.3, FY 20: 4
- Kayad: FY 16: 0.8, FY 20: 1
- RDM: FY 16: 0.7, FY 20: 1.2
Operational Excellence : RA Mine

Background:
• Ore production 0.9 Mtpa to 6.15 Mtpa

Mine planning and designing:
• Pit designing and optimization with best in class software
• Ramp gradient changed from 1:16 to 1:12 & finally to 1:10, resulting into 10% reduction of waste & improvement in OEE of HEMM

Drilling & Blasting:
• ANFO to SME (Site mix emulsion) and from D Chord to electronic detonator.
• Established (in consultation with CIMFR) and carrying out pre splitting at the perimeter of every cut back – enabled mining upto a depth of 400m.

Loading & Hauling –
• Bigger fleet from 50 T to 100 T and to 221 T class trucks and excavators from 4.3 Cub M to 34 Cub M
• Real time management through Truck Dispatch System (TDS) improved truck utilization from 70% to 82%
• Simulator based operators’ skill mapping and up gradation
Operational Excellence : RA Mine

Slope Stability Management

• Established three layers slope monitoring system i.e. SSR, Prisms, & Inclinometers; First mine in India to use SSR
• Depressurization of pit walls through vertical and sub horizontal holes

Waste Management

• Design of Stand Off distance from toe of WD to crest of pit.
• Monitoring of OB dump slopes by SSR and Prisms
• The overall slope angle is $26^0$, with FOS of 1.2
Adoption of technologies in UG operations

Mine Access:
- Track less mining with decline: 5.5 m X 5.0 m to accommodate bigger fleet
- Large dia high speed shaft: From 3 meter to 7.5 meter dia

Equipment:
- **Face Drilling**: From jack hammer to long feed jumbos
- **Production Drilling**: From pneumatic to high speed long hole electro-hydraulic solo
- **Loading**: From track loader to LHDs (from 1 T to 17 T). Manual to remote operation and moving to fully automated system.
- **Hauling**: From track to trackless mining (5 T GB car to 63 T LPDTs)
- **Back Filling**: From sand fill to paste fill
- **Hoisting**: Large dia high speed shaft: From 3 meter to 7.5 meter dia
- **Blasting**: From ANFO with safety fuse to emulsion with electronic detonators
- **Vertical Development**: From drill blast to mechanical raise boring
Best Practices : Safety

- Use of hand held Gas Detector (CO/SOx/NOx)
- Use of self Rescuer and Refuge Chamber
- Use of Leaky Feeder based voice communication
- Automatic Fire extinguisher system on vehicles
- Well equipped mine rescue stations

Use of Self Rescuer

Multi-gas Detectors
NO Detectors
Self Rescuer
Refuge Chamber
Underground Ambulance
Shaft Sinking and Final Configuration
Underground Mine Production Cycle

1. **Stope Drilling**
2. **Stope Filling & Curing**
3. **Stope Blasting**
4. **Loading & Transportation**
Single Shot Blasting: Current Practice

**D & B Parameters**
- Drilling Factor: 10 te/mtr
- Toe Spacing: 3.3 mtr
- Ring burden: 3 mtr
- Slot raise (WxH): 2m x 3m
- Hole size: 89mm (shot hole), 127mm (reamer)
- Powder Factor: 3.3 te/kg
- Total firing time: 8 sec (approx)

**Upgradation**
- Increasing the void by stripping the extraction level i.e. sides and roof
- Drilling the entire stope by SOLO (Drill rig: DL 421-15C)
- Firing sequence of stope blasting in single shot (using Electronic Detonators)

Slot raise → Widening of slot up to full width

FW Rings ↔ HW Rings

13
Paste Fill Technology

Tailings from plant

Existing DCT

250 m$^3$

Buffer Tank

228.6 m$^3$/h at 58% w/w

Filter Feed Tank

1028 m$^3$

E-Disc Filter (4 Nos)

228.6 m$^3$/h

Cake at 83% w/w

Dilution Slurry

Dilution water

Mixer

Cake at 83% w/w

Paste

161 m$^3$/h at 74.1% w/w

Positive Displacement pump

Paste Pump Discharge to U/G Boreholes

Cement Silo

800 tons (2 Nos)

Dosing at 13%
Skill mapping of operators
skill enhancement
Refresher training
Only skilled and certified operators are authorised to operate HEMM
Adoption of Latest Technologies in Mining

Digital Mining

Establishing wi-fi network underground to improve the safety & Productivity

- Asset (Men/Machine/Material) tracking using wi-fi tags & real time visibility of operations
- Tele-remote operations of Loaders
- Automation of auxiliaries – Pumping station, ventilation, Sub-stations etc
- VoIP based communication

Way Forward

- Refrigerated ventilation may be required in deep mining
- New mining methods for geo technically challenging ground conditions
- Top down mining method at RA UG for better ground management and stability
- Centralized control & command center for integrated mining operations
- Use of slag & fly ash as binder in paste design
THANK YOU!