

Mining In Action



Truckless Mining – Optimising Loading & Crushing Cycles at the Face

Day Two

Thursday 11 November 2010

Session 3: IPCC Solutions

3:25 – 3:50pm

Doug Turnbull – Principal Mining Engineer

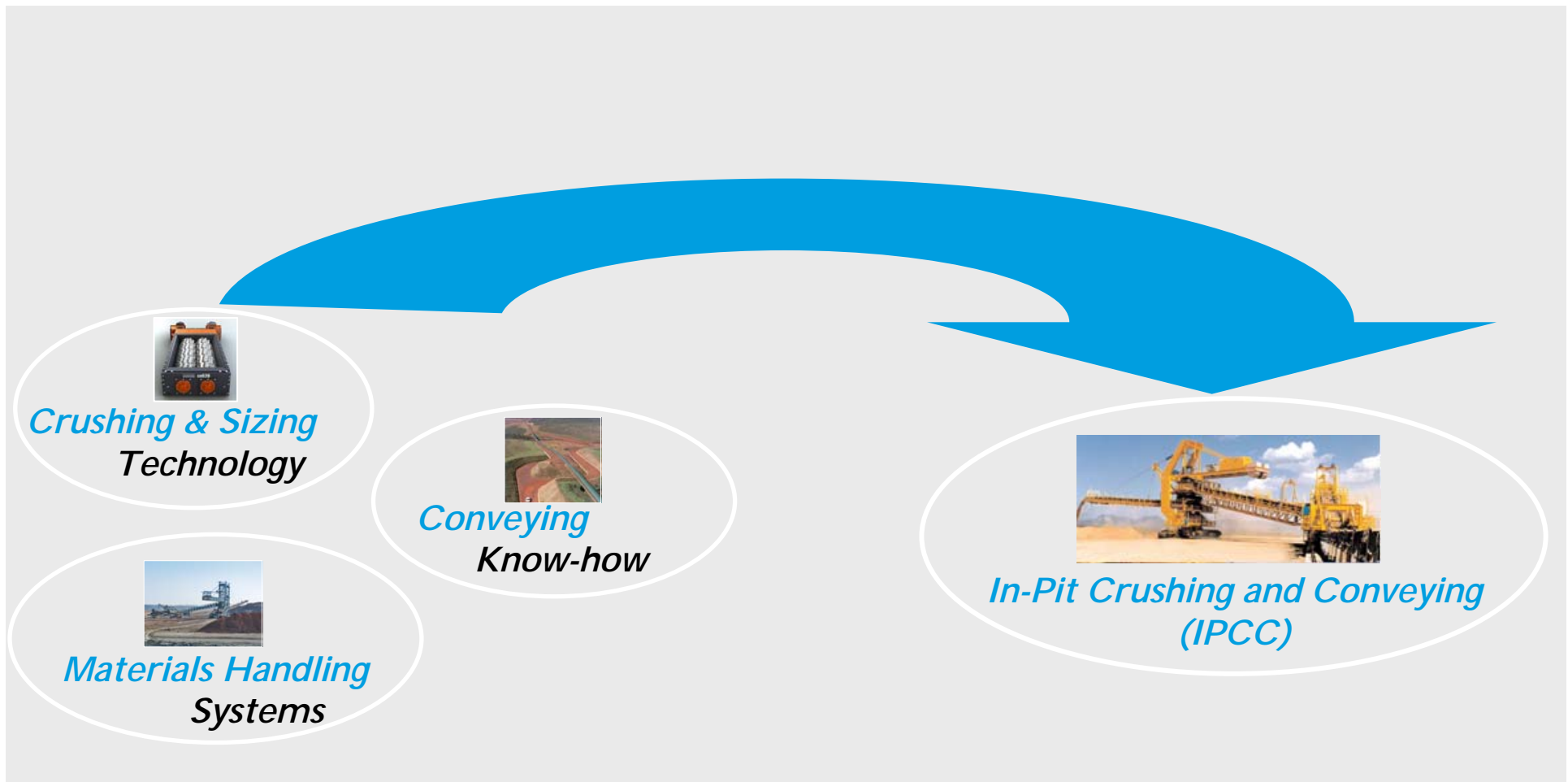
Why talk about IPCC



- 1. Increased waste stripping, ageing workforce, ability to attract, logistics on bulk commodities (eg fuel/tyres), desire for automation, and need for opex reduction - demands a new approach**
- 2. Things need to change in a revolutionary rather than evolutionary way to reduce opex costs, as more and more inventive cost burdens are thrown at the mining industry (MRRT, Carbon Tax etc)**
- 3. IPCC is one way to achieve energy efficiency and in-turn opex reduction**
- 4. IPCC is already automated from single control room and therefore could be considered much safer (70/70).**

PROCESSING IN THE PIT

IPCC – not rocket science & not new a viable alternative to traditional trucks



Introduction

In Pit Crushing & Conveying (IPCC)



1. Continuous mining is common in lignite & soft coal mines for decades – loading using bucket wheel excavators, continuous haulage by conveyors, waste dump spreaders
2. In hard rock applications – truck and shovel is prevalent
3. Development of crushing technology has enabled IPCC in all rock applications
4. IPCC has many economic & environmental advantages over truck and is increasingly competing
5. 3 types of IPCC embraced – fixed IPCC (crusher at or near pit rim versus plant), semi mobile IPCC (much smaller fleet of trucks runs short distance to relocatable crusher) and fully mobile IPCC (truly truckless main production mining)
6. Equipment & mine scheduling/planning completely different to traditional truck/shovel – so therefore – modest acceptance to date.

Over 200 IPCC Sites Worldwide

2 non lignite IPCC operations in Australia



German Rhineland Lignite Mines (example soft rock)



- RWE Power Rhineland lignite mines (Hambach, Garzweiler & Inden)
- largest open pit mines in Europe
- multi bench continuous mining down 500m
- Bucket wheel excavators, conveyors, spreaders
- 266 km conveyors 2,000-2,800mm beltwidth
- >100mtpa coal produced on >35billion tonne reserve
- 19 waste dump spreaders >240,000m³ per day





FULLY MOBILE IPCC

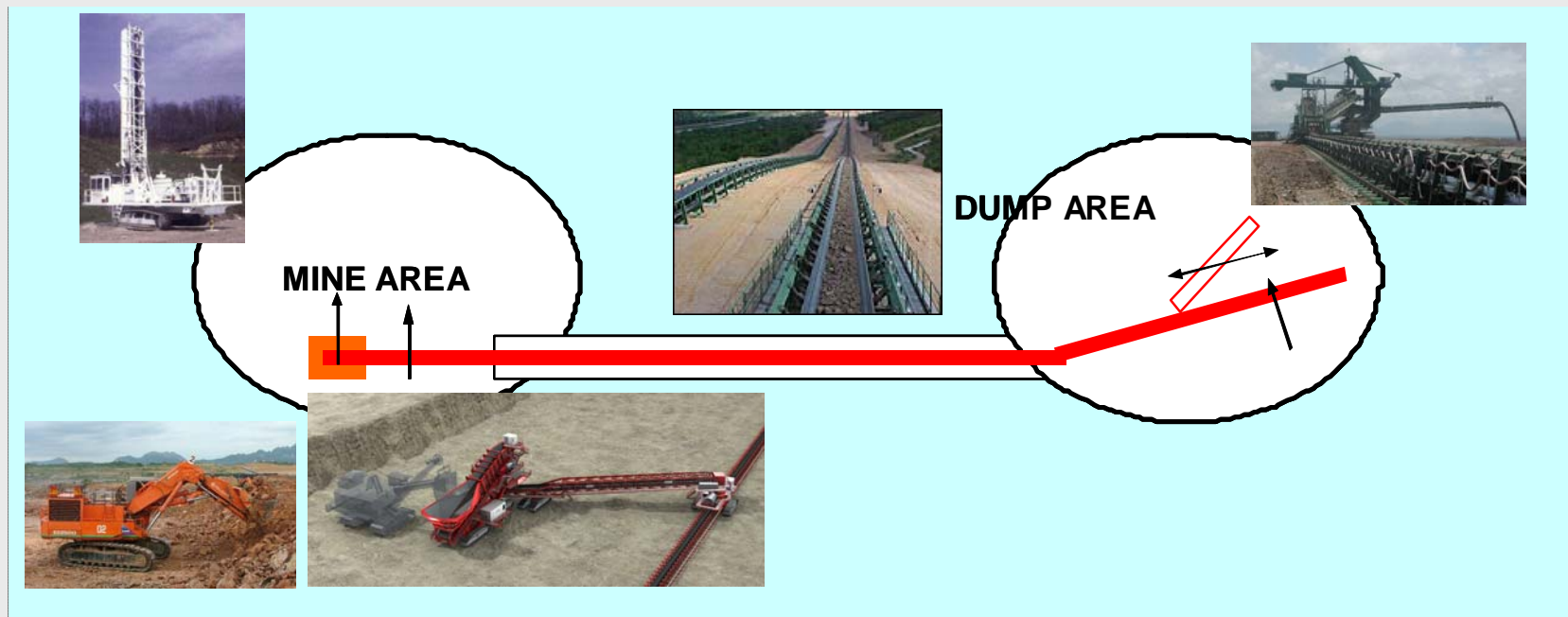
is today's presentation focus

Mining & haulage in hard rock open pit mines

IPCC with fully mobile crushing system - overview



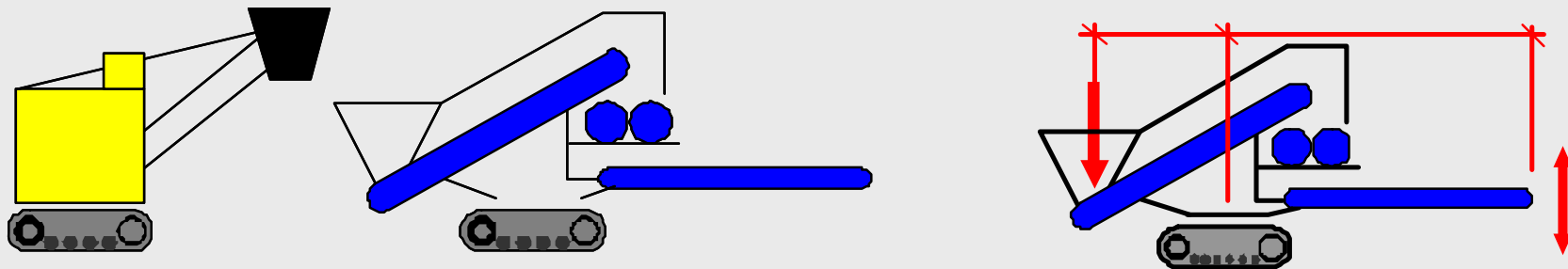
- IPCC with fully mobile crushing system
- Process includes drilling, blasting, loading by shovel or excavator, crushing in FMC, conveying and dumping
- No truck haulage



Fully mobile crusher – yesteryear common design



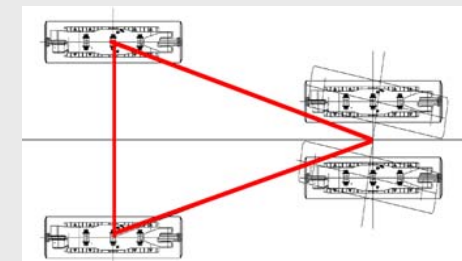
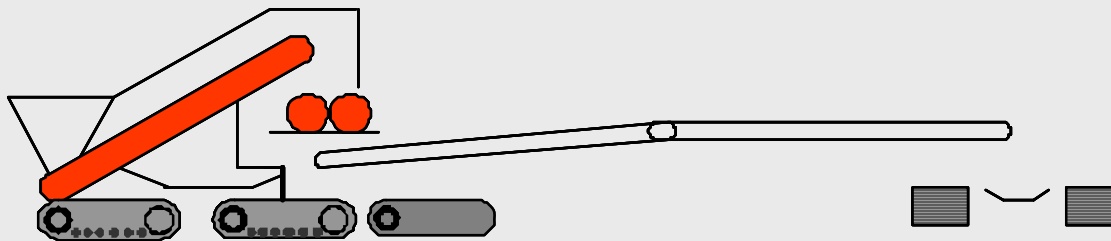
- Shovel is loading into hopper of mobile crusher
- Common designs have typically two crawler arrangement
- Little support for eccentric impact load
- Impact of unloading shovel bucket causes vibrations to crusher ext
- Temporary support reduces flexibility
- “Dancing issues” between shovel & hopper and stinger & conveyor
- => improvement required



Fully mobile crusher – new concept



- Scheme of patent pending Sandvik fully mobile crusher PF 300
- 2 crawlers at hopper and 2 crawler underneath the crusher/sizer
- No discharge conveyor but conveyor bridge on separate crawlers (or belt wagon)
- Stable without temporary support requirement
- High mobility and flexibility
- Suitable for capacities to largest shovel types
- Speed 8m/min, GBP 232kpa empty or 305kpa loaded
- Crusher overload protection (eg to cater for bucket teeth)



Matching loading device to crusher – fully mobile system



- Hopper capacity 2.5 times bucket capacity of loading device
- Hybrid long term average hardness capacity 225MPa
- System long term average throughput only limited by loading device, input fragmentation, density and output crushed sizing



Fully mobile mine layout



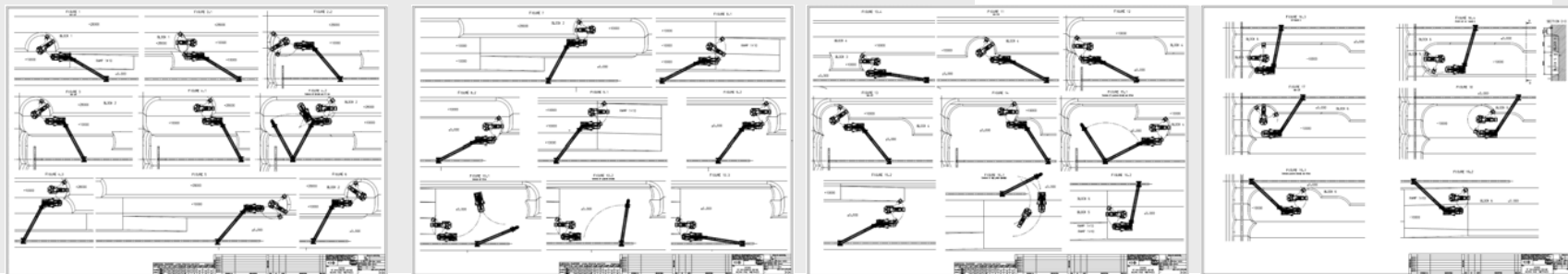
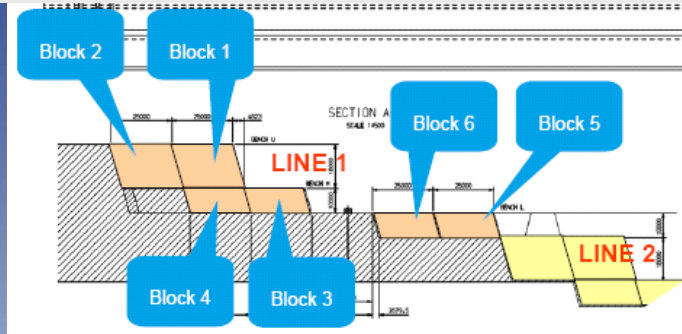
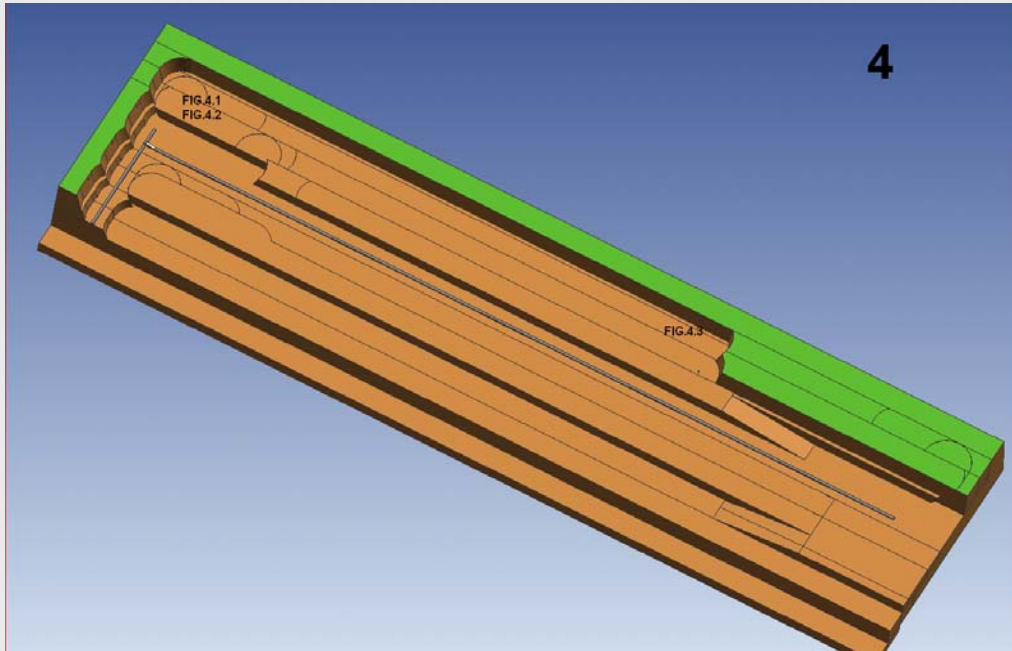
- IPCC requires “different” mine planning to traditional truck – get it right, understand that truck scheduling packages will not work well
- Example shows mine plan for IPCC with fully mobile crusher
 - Sandvik PF 300 with conveyor bridge
 - Mining cycle of 6 blocks in 3 benches
- Sandvik provide studies for all relevant process steps



Mine layout – Fully mobile crusher (example)



4



PF300 with Slewable Bridge



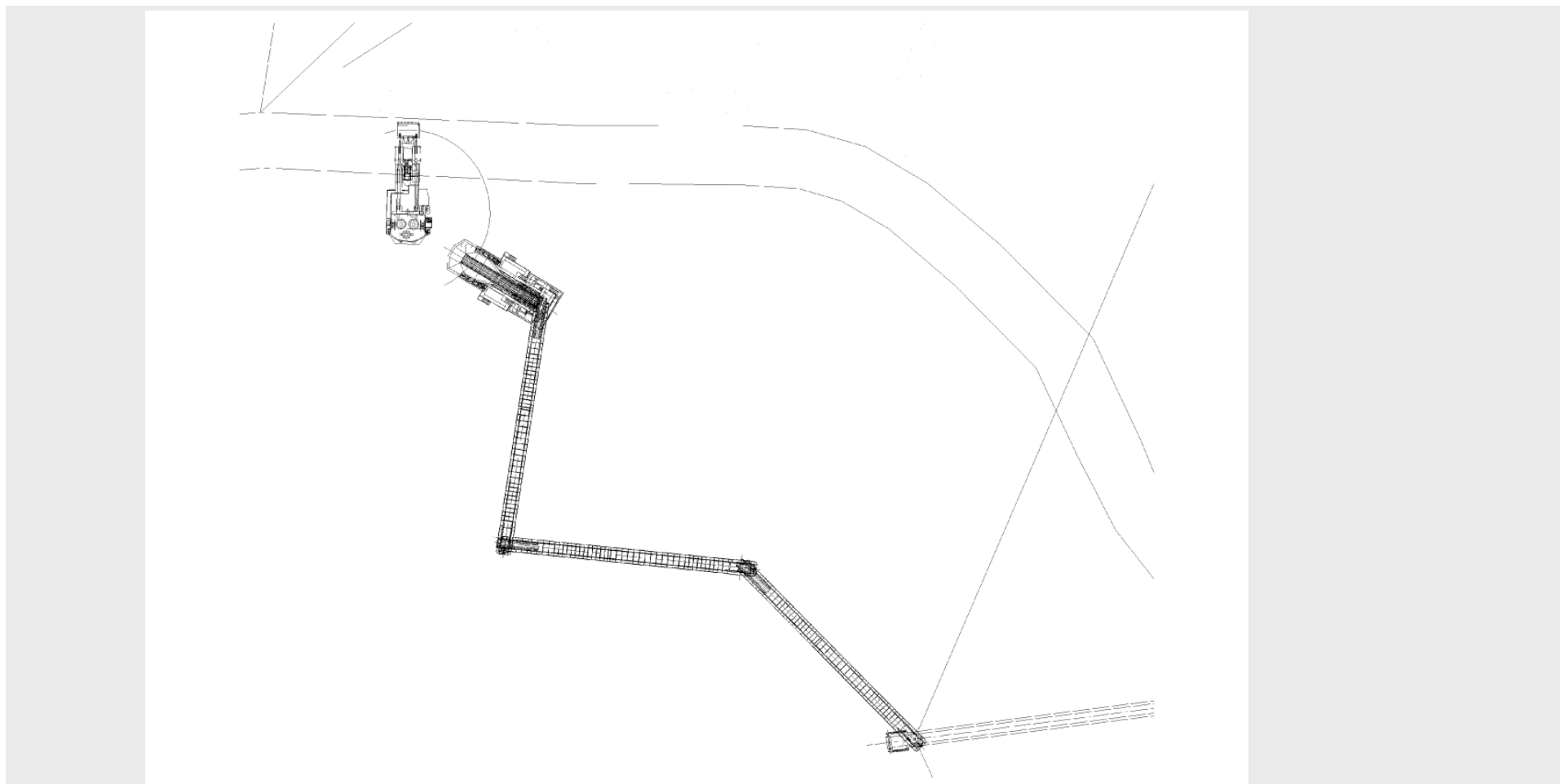
PF300 with bridge 2nd pass



PF300 with bridge lower pass



Alternative to beltwagon or bridge multiple link conveyors



Iron Ore Mine – Brazil (2 x PF300 x 3000tph) commission Dec 2011



IPCC LESSONS FROM THE PAST – WHAT TO CONSIDER FOR THE FUTURE

So will IPCC work for me? (1)



1. Mine Life

- Need at least 15 years to get any economic pay back

2. Material movements

- Need at least 25mtpa

3. Electricity cost versus diesel cost

- Electricity price (\$/kwh) less than 40% of diesel price (\$/l)

4. Rock strength, abrasiveness & clay content

- Who knows the waste properties for crushing? Everybody knows the ore! There is a crusher for every type of hardness but what about one for high clay content.

5. Space for operation

- At least 100m cutback width needed for an IPCC installation

So will IPCC work for me? (2)



6. Manning reductions

- An average reduction of 6.5 persons per truck saved using IPCC

7. New tax – called a carbon tax or MRRT or?

- IPCC generally produces far less carbon emissions (typical 240t truck generates 3500t Co2 per year)

8. Automation & safety

- IPCC lends itself to easy automation & removes large dump truck vehicular interaction (sheer volume reduction of trucks on haul roads)

9. Dust & noise generation lower and water usage is less

- IPCC generates less dust/noise (30-40%) and uses less water (50%) than an equivalent material movement truck operation

10. Timing

- IPCC is ideally suited to expansion plans or new operations, rather than steady state operation

So will IPCC work for me? (3)



11. Managing the paradigm shift on how material is moved

- Without operational acceptance it may never get off the ground as mine planning is different under IPCC versus traditional truck/shovel.

12. Truck cycle times

- In a mining operation IPCC may not payback well if cycles are less than 20 minutes.

13. Capex

- IPCC is generally capex neutral compared to truck when taking into account replacement schedule and opex is less

14. Transfer points

- Conveyor transfer points should cater for clay as well as rock

15. Shifting conveyors

- Track shifting versus dozer and chain or demantling

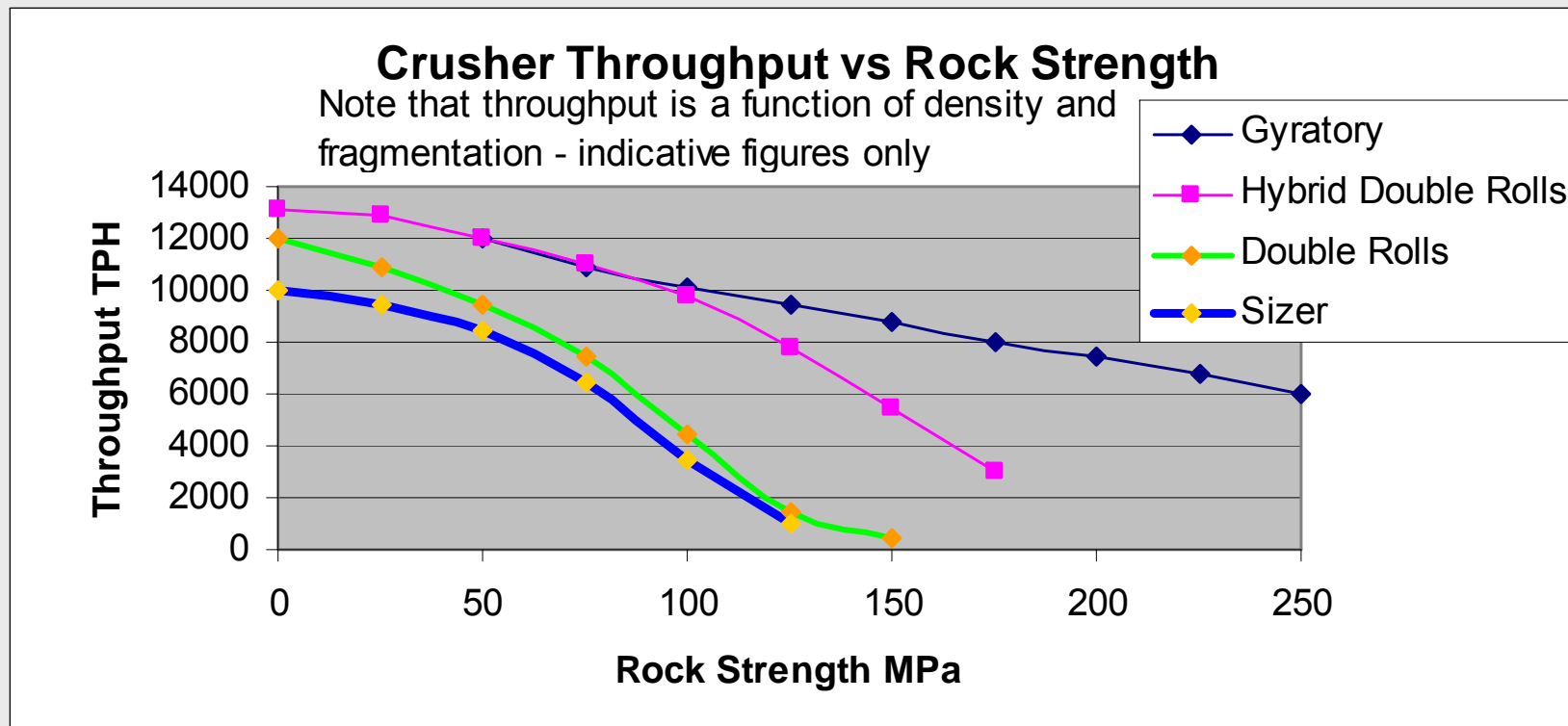
Key IPCC risks for fully mobile systems



- Failure to achieve operating hours
 - [frequency of relocation of dump & face conveyors critical]
- Failure to achieve throughput
 - [rock harder or more frequently more clay]
- Potential for blast damage to IPCC components
 - [min 70m or structure must be relocatable]
- Risk of impact on conveyors by haul trucks
 - [risk reduced because of lower truck numbers]
- Power supply risk
 - [will another transmission line/s be needed?]
- Lack of understanding of key IPCC mine planning criteria.
 - [no commercial software available for IPCC scheduling (all truck based)]

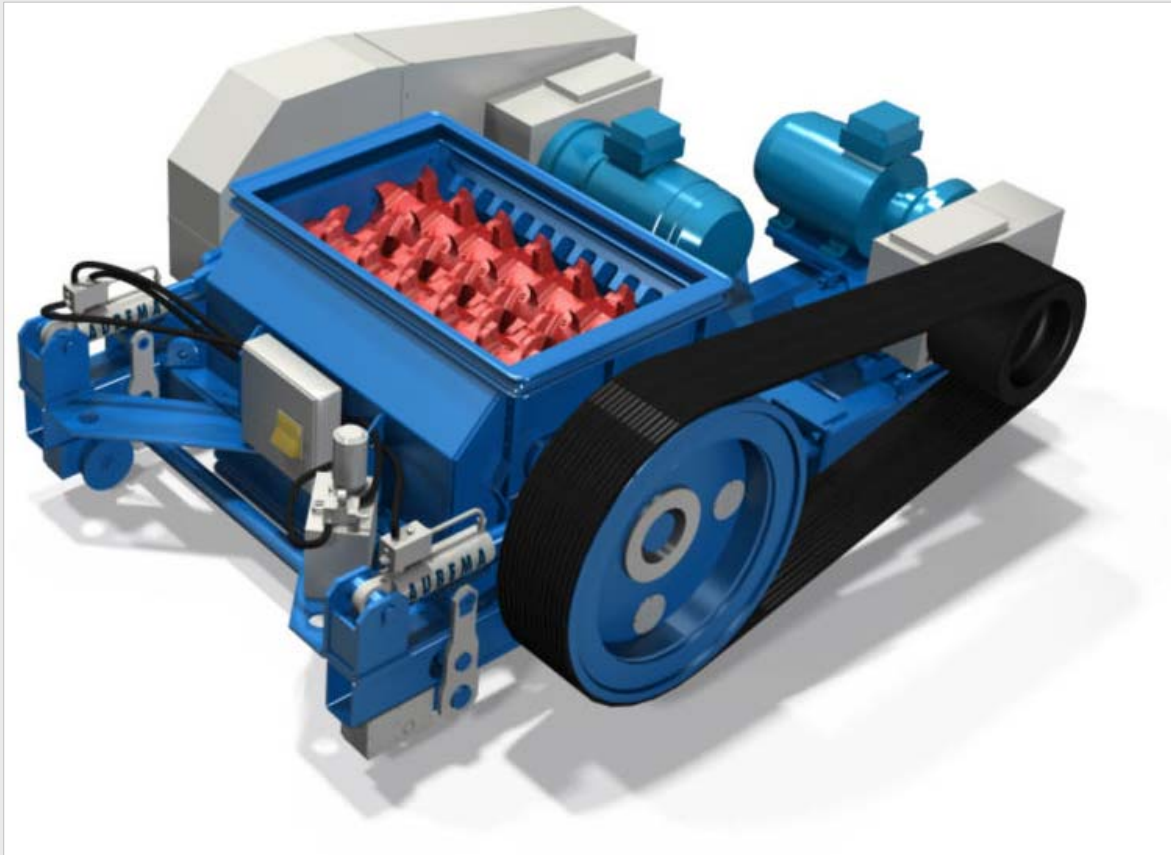
CRUSHING & SCREENING

Crusher type and the impact of rock strength



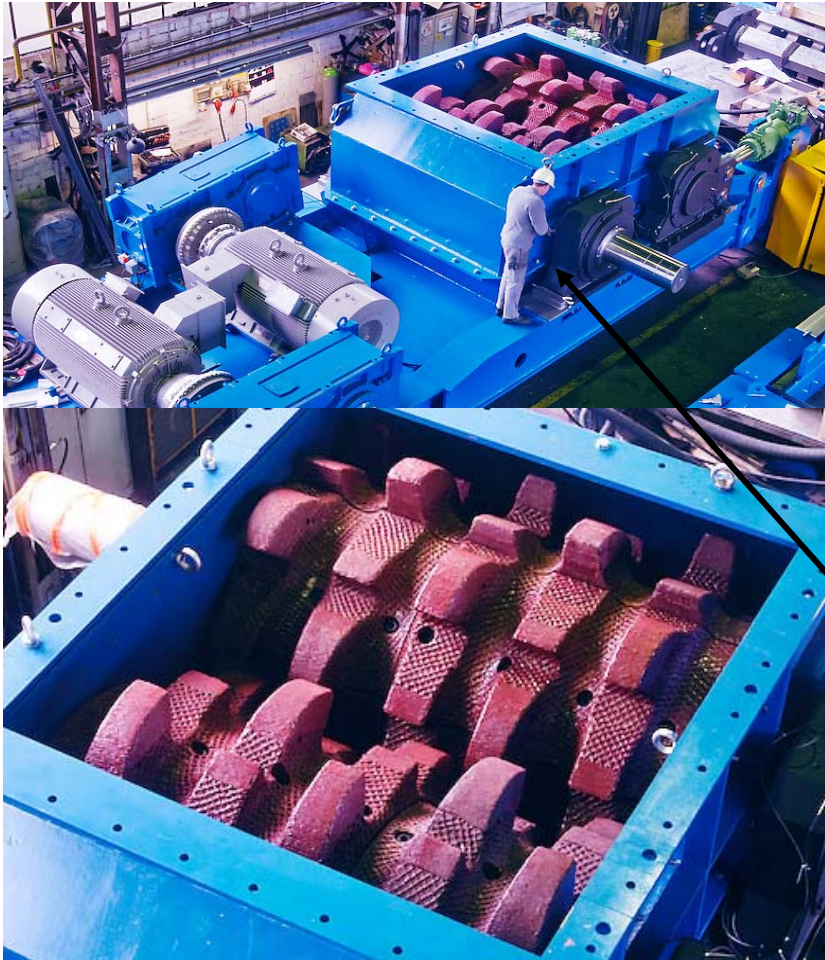
Note that throughput is also affected by **DENSITY** and **FRAGMENTATION**

Hybrid double-roll crusher



- **CR810 Series**
- **Capacity: max 12000 t/h**
- **Lump size: max. 3000 mm**
- **Product size: 15-400mm**
- **Reduction ratio: 1:4 to 1:8**
- **Required power: to 2 x1200 kW**
- **Hardness: designed to take varying hardness with instant release up to 225MPa**

CR810 hybrid



- Wostochny [Kazakhstan]
feed material: coal mine overburden
feed size: 0 - 1500 mm
product size: 0 - 300 mm
capacity: 4250 tph

Sandvik solution
2x CR810/20-25 Hybrid

Size scale against technician

CONVEYORS

Conveyor haulage



- Conveyor system consists of drive and tail station and conveyor modules
- Shiftable conveyor modules with steel sleepers and rails
- Stationary conveyor modules on concrete sleepers



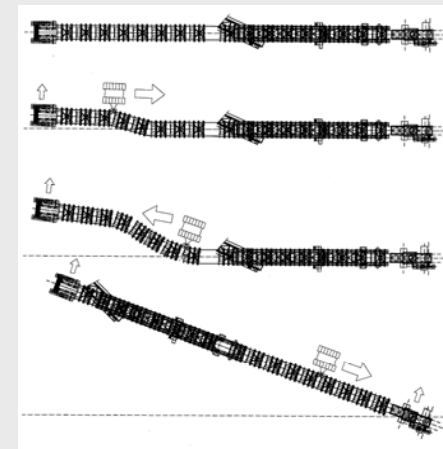
Track Shiftable Conveyor (TSC)



Conveyor haulage – Track shifting

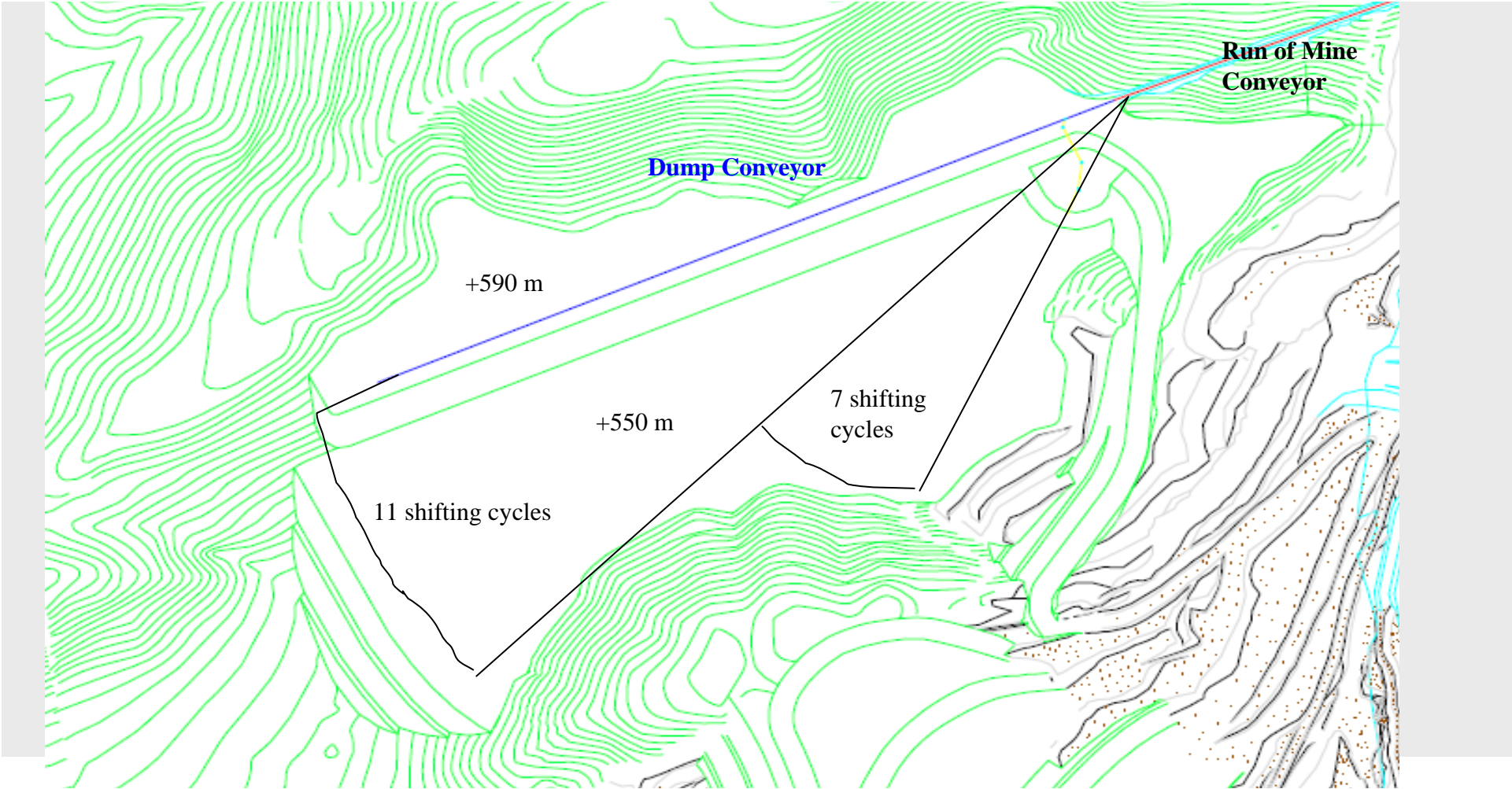


- Reloaction of shiftable conveyors by „track shifting“
- Pipe layer equippped with track shifting head
- TSH is connected to rail
- Lifting of module and lateral movement while travelling along conveyor
- Several passes of about one metre to achieve final position
- Very fast – typically 3km moved 80m in 1 x 12hour shift



Waste Dump Methodology

Waste dump design -radial shifting



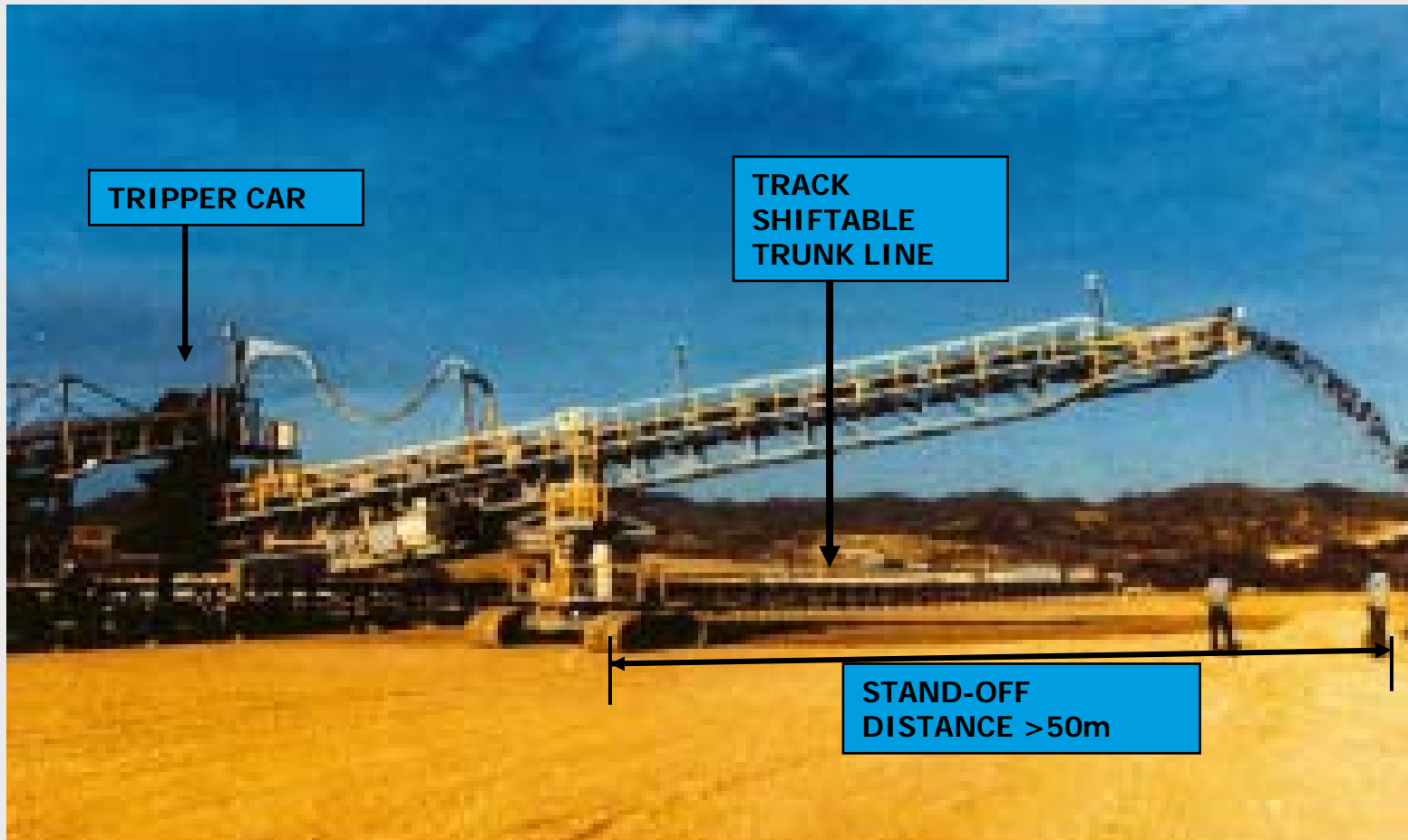
Waste dump – downcasting Travels around head end to high cast





SPREADERS

Non-slewable spreader



Sandvik PA200 (C-frame type) slewable spreader

50m boom and 50m bridge and tripper car



Sandvik 260m boom 13000tph spreader



IPCC in 2009, 2010 and beyond



- Many consultants pretend to know all about IPCC (IPCC used to be dismissed at start of thinking)
- Companies - no trust in IPCC – believe it maybe a viable solution BUT (1st to be 2nd syndrome)
- To date some systems sold each year – approx 200 operating in world today
- OEM's continuing to provide education, background and confidence in MH Equipment IN THE MINE v plant or stockyard
- OEM's made improvements to technology
- Now the industry is calling for an assessment of IPCC as part of mainstream thinking
- IPCC becomes part of university mining curriculum
- No IPCC scheduling software available



THANK YOU!