SunHills Mining

SunHills Technologies

Pushing the lowest cost of service

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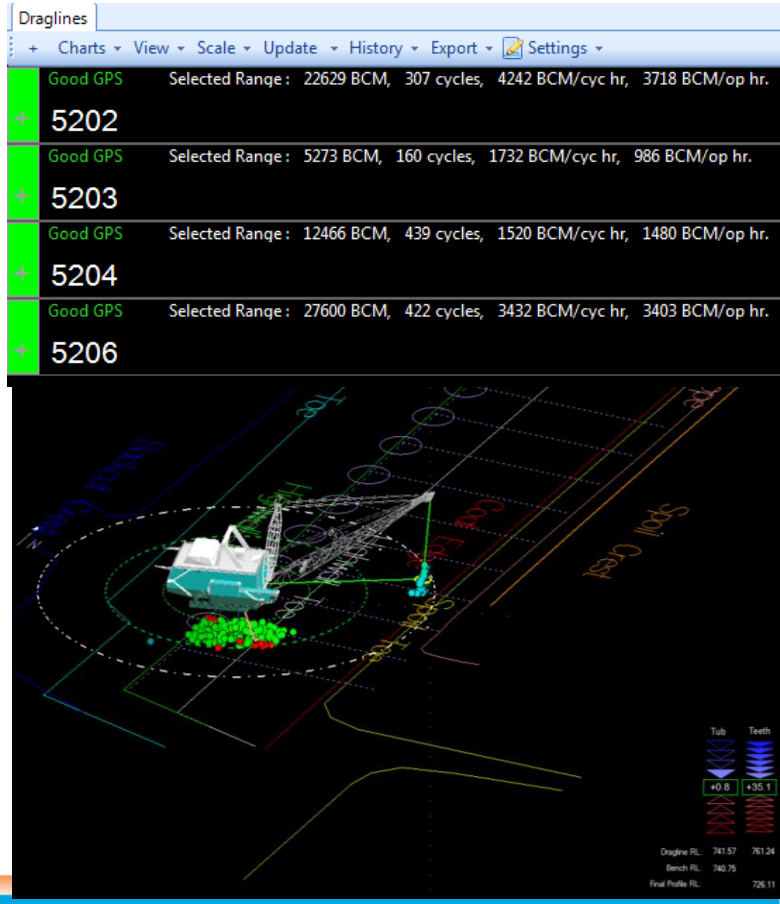
Highvale Mine

- Providing low cost coal to TransAlta's Sundance and Keephills Power Plants since 1970
  - 13M tonnes mined annually to produce up to 3360 MW
  - 110M TCMs moved
  - ~ 100 production units
    - 4 Draglines (BE1360, M8050, M8750 & B8750AC)
    - 2 Shovels (BE495 & P&H4100 XPB)
    - 4 Hydraulic Shovel (2 - RH170s, EX3500 & RH200)
    - > 40 Trucks (6 - T282, 9 – 930, 6 – MT4400,
      5- 789s , 17 – 776/777s…)

Pegasys

Initiative

- Increase dragline productivity
- Overview
  - Full swing cycle breakdown – Timelines, Payload, Production rates
  - PLC integration – OEM Alarms, rope lengths, machine idling
  - Position guidance and grade control
  - Strain gauge payload and basic stress load monitoring
  - Unified office management interface
- Strengths
  - Production focused – Machine achievable targets, detailed swing cycle breakdown accessible from cab and office.
  - SSRS Report developers are highly skilled
  - PLC interface. User Customizable alarms provide environment context. Good electrical health monitoring.
  - Desktop management software is well designed and unified – Mine Topography, SQL reports, Data retrieval from a single UI
  - Fully managed support – software and hardware replacement



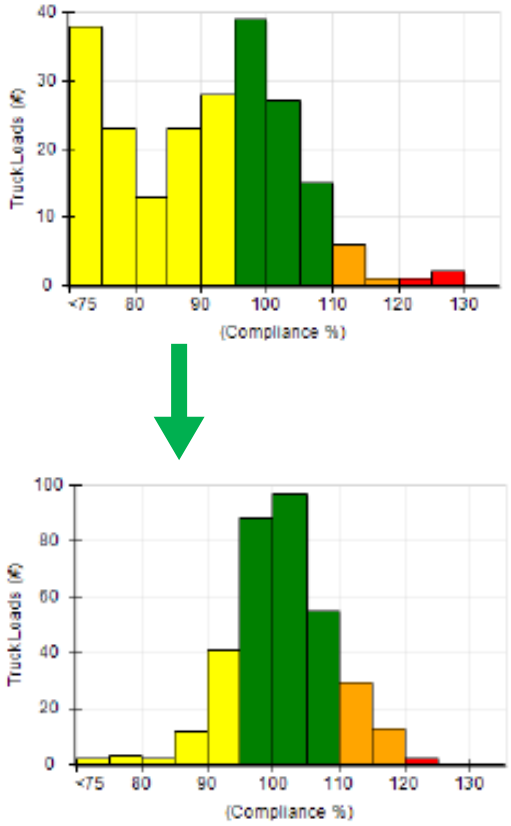
Pegasys

- Benefits
  - 5% increased productivity, annual savings of ~ $3M, payback < 1 year
  - Report benchmarks are based on peer and machine performance. Highlight strengths and areas of improvement for each operator.
  - Boom RSL compliance and payload distribution
  - Real-time Bucket and Tub positioning eliminates survey support
  - Optional PTZ cameras, Lidar, DTM enhancements are available
- Drawbacks
  - Not a structural health monitoring system. Payload is reported only after material is dumped. Single material density.
  - Camera system does not support events – conditions to notify supervisors
  - Digital Terrain Model feature should be included in base product.
  - Desktop software does not provide access to all features and configuration settings.
- Learnings
  - Not a structural health monitoring system. Payload is reported only after material is dumped. Single material density.
  - Camera system does not support events – conditions to notify supervisors
  - Digital Terrain Model feature should be included in base product.
  - Desktop software does not provide access to all features and configuration settings.

Argus

Initiative

- Increase shovel productivity
- Overview
  - Shovel side payload system – single calibration point
  - Minimal RFID management on trucks
  - Leverages existing Pegasys IT systems and desktop software
- Strengths
  - Production focused on payload distribution
  - PLC integration – OEM and user defined alarms, notification
  - Unified desktop UI for remote monitoring, report viewing, data retrieval
  - Fully managed support – software and hardware replacement
- Benefits
  - Primary benefit is truck fill – Identify over and under loaded trucks.
  - 3% productivity improvement guarantee, annual savings of ~$1.5 Million
  - Grade control for bench and push back compliance
  - Feedback for stress accumulation and RSL
  - Acceptance by SunHills maintenance truck / shovel group



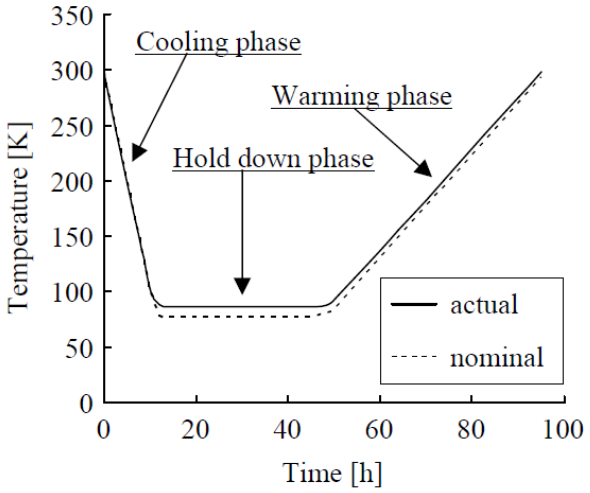
Argus

- Drawbacks
  - Not a replacement for a truck dispatching system. Will not assign trucks to shovels for blend or production requirements.
  - Limited to a single density material. Cannot assign different truck payload targets for materials – coal, rock
  - Cannot determine truck carryback. Payload is displayed only after dipper is tripped.
  - Other systems provide better structural health feedback
  - Argus requires post-install optimization – will differ site to site
- Learnings
  - Commissioning suffered significant setbacks. Thoroughly review requirements and inspect the conditions of OEM systems and compatibility
  - Depending on shovel model and service vendor, in-house control systems expertise may be advised.
  - Dragline system is the premier flagship product from Mineware.
  - Argus borrows the Pegasys hardware platform, the software is not as refined.

Extend Life of Wear Components

Initiative

- Increase component wear life - Deep Cryogenic Treatment
  - Process has been around since the 1930's. Lower the temperature of the component slowly, holding it there for a period of time and then warming it slowly
  - Increased transformation of austenite to martensite
  - Precipitation of carbides which reduces internal stress on the martensite, which further reduces micro cracking and residual stress
  - Drives point defects out of the structure grain boundaries
  - Creating a more exact distance of the atoms in the crystals



Extend Life of Wear Components

Trials Completed

- Carbide tip drill bit inserts
  - Increase life more than 2X
  - Yearly savings $30K
  - Redesigning inserts to get further increased life

Trials in Progress

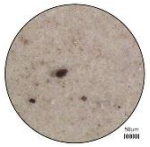
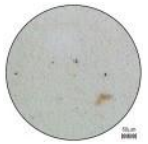
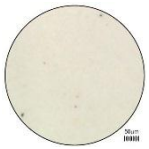
- 495 shovel teeth
  - Minor changes to wear life – too many varied conditions
  - Currently extending overlay down the tooth as there was a significant difference in wear on previous DCT teeth
- 495 dutchmen and latch bar insert
  - Installed April 28, 2016

Future Trials

- Carbide serrated grader blades
- Coal crusher segments
- Dragline lip shrouds
- Dozer corner bit
- Drill bit and steel
- Track pads with ice lugs
- Rigging

Deep Cryogenic Treatment

Diesel and Lubricant Filtration

	10W	15W40 (5W40)[1]	30W	Univis N32	Diesel
August 2014 (pre-upgrade) Water content, temperature	21%, 16 ˚ *C*	25%, 15 ˚ *C*	27%, 18 ˚ *C*	45%, 17 ˚ *C*	36%, 14 ˚ *C*
ISO code (PFC400W)	22/19/10	23/22/16	22/19/11	20/17/10	17/15/13
					
February 2016 (post-upgrade) Water content, temperature	31%, 20 ˚ *C*	34%, 22 ˚ *C*	41%, 22 ˚ *C*	40%, 22 ˚ *C*	69%, -14 ˚ C
ISO code (PCM400W)[2]	13/12/7	16/14/9	11/9/7	12/11/7	13/10/7
					
Improvement	**> 100X**	**64X**	**> 100X**	**64X**	**32X**

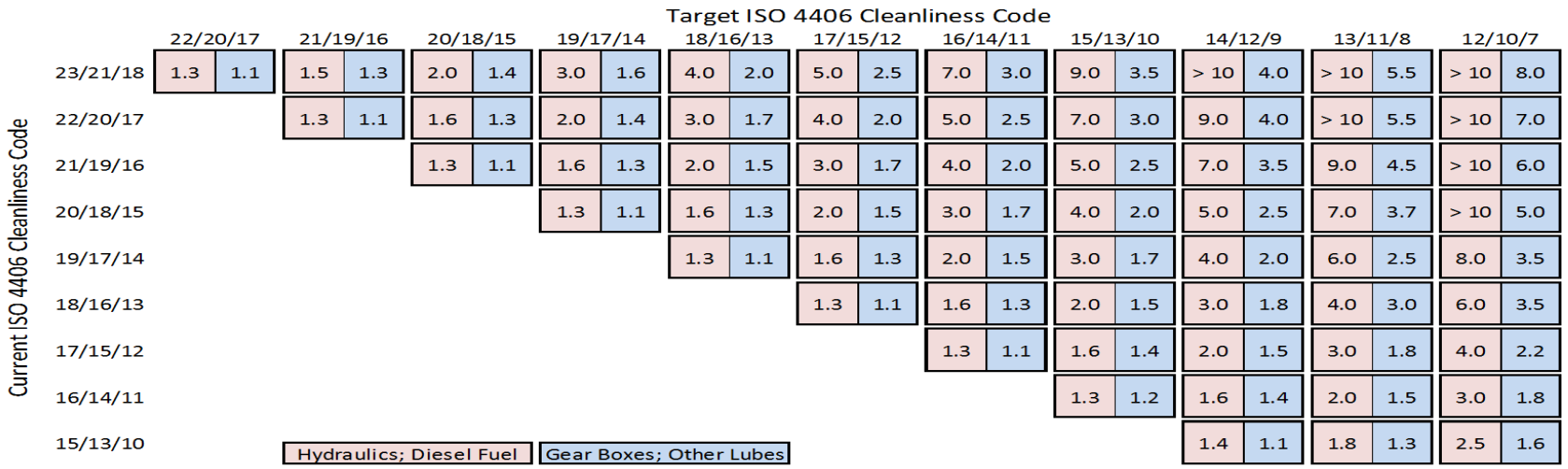
Diesel and Lubricant Filtration

- Collaborated with SMS and PALL filtration for a system analysis and improvement plan.
  - Installed new breathers, bulk and point of usage filters at the lube islands and shop bays
  - Installed return filtration on the RH170, RH200 and EX3500
  - In progress
    - Filtration for two 740 lube trucks
    - Fluid fill and high pressure filtration on RH170, RH200, and EX3500
    - Filter carts for draglines and truck wheel motors
    - Carts to recondition oils

Diesel and Lubricant Filtration

Benefits

- Reduction of diesel consumption by 5%
- Filtering and reusing wheel motor oils $360K per year
- Extending component life



Engine Oil Drain Extensions

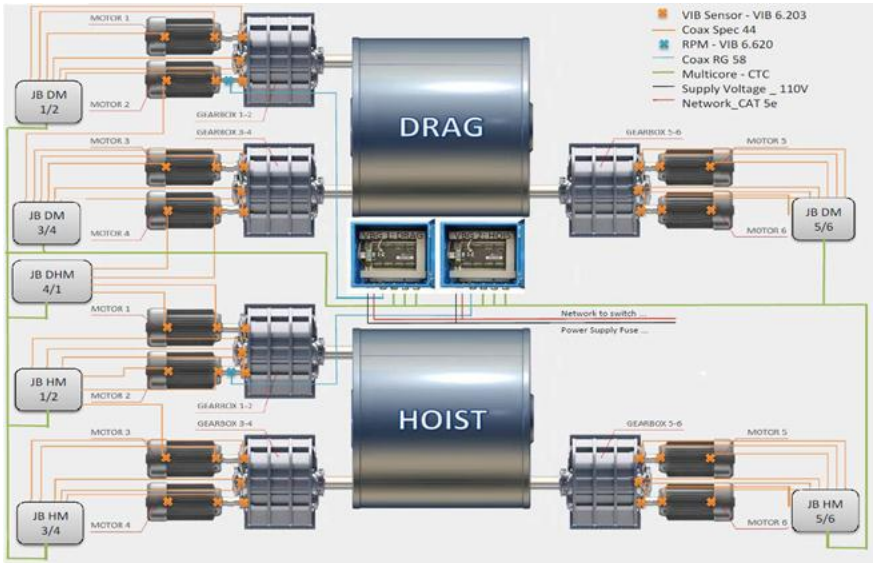
- **Initiative**
  - Extend all mining equipment engine oil drains from 350/500hrs to 1000hrs
- **Milestones**
  - Internal site oil optimization: system cleanup, sample locations review, single sampler and pre-PM sampling implementation – February 2015 – 4 months
  - Switch from Mobil Delvac 1300 Super 15W-40 to full synthetic Mobil Delvac 1 ESP 5W-40 engine oil – May 2015 – 3 months
  - Update PM cycles to 1000hrs oil changes – July 2015
  - Sample (every 100hrs from 500 to 1000hrs) and analyze results (PPM/hr, PPM max, viscosity, sulfation, nitration, oxidation) – August 2015 – 5 months
  - MOC study and program validation on oil drain extensions – Sept 2015 – 6 months
  - Fluid Life CARE program on engines – March 2016

Engine Oil Drain Extensions

- **Direct Yearly Program Benefits**
  - 110,639 L – saved oil consumption
  - 3,788 hrs – increased equipment hours
  - 3,788 hrs – re-allocated manhours
  - $903,760 – combined savings
- **Other Program Benefits**
  - Increased focus on engine CBM
  - Potential increase on engine life hours
  - Utilizing full life out of oil

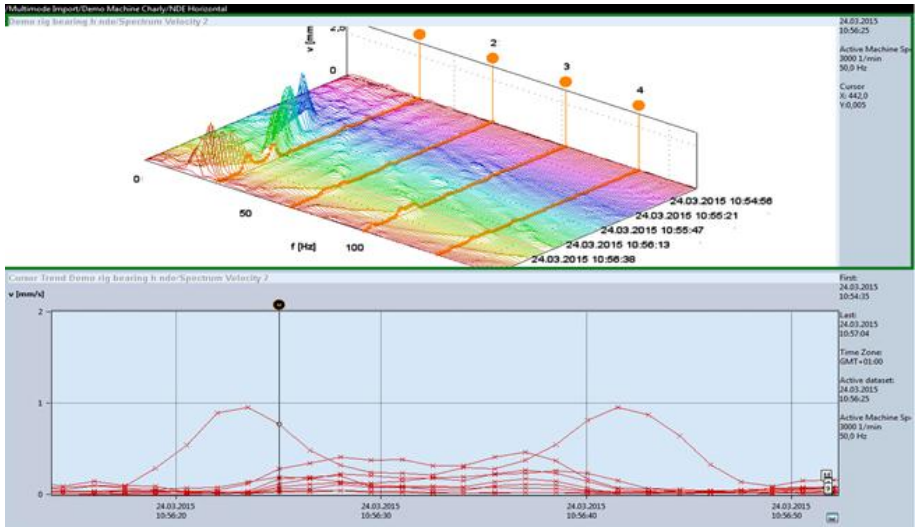
Dragline Wireless Vibration Monitoring

- **Challenges**
  - Vibration CBM critical for component health
  - Continuous varying RPM, direction and load
  - High number of data points (21 data points minimum per system)
  - Production loss to perform traditional vibration route data collection
  - Manhours required to perform vibration route
  - Traditional 6 week interval data collection introduces high risk to CBM components replacement program
  - Traditional vibration personnel and program sustainability



Dragline Wireless Vibration Monitoring

- **Solution**
  - VIBGUARD Viewer and Online Viewer software by Pruftechnik
  - System install, monitoring and data analysis by Vibetec
- **System Specifications**
  - 42 data points (radial and axial)
  - Continuous time waveform and RPM simultaneous recording
  - Analysis - readings triggered over 1000 rpm and a spectrum is produced every 30 minutes from an average of readings
  - Continuous monitoring - online system health viewer and email notification



- **Benefits**
  - Reliable, repeatable and accessible vibration results
  - 0 production loss and manhours to collect vibration readings

Thank you.