

Wirth Pump On Line Condition Monitoring

National Instruments Technical Symposium
Sydney
March 9, 2006



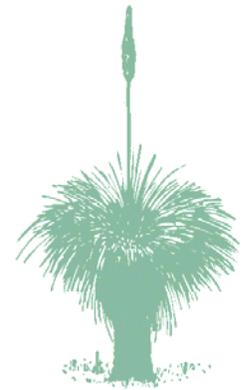
"If it's not safe, don't do it that way"



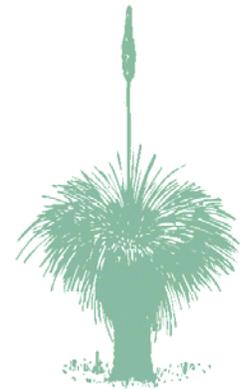
Outline

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- Introduction to Application
- Hardware Features
- Software Features
- Results to Date
- Future Developments



- The Comalco Alumina Refinery was constructed at Yarwun, 15km NW of Gladstone over the period 2002-2004
- The Process refines the oxide of aluminium (alumina) from bauxite – a naturally occurring mineral
- The nature of the process requires the bauxite be dissolved or “digested” in caustic liquor under temperature and pressure.
- CAR is a 1.4 Mtpa refinery. Currently the alumina is worth approximately US\$630/t, business conditions are very favourable.



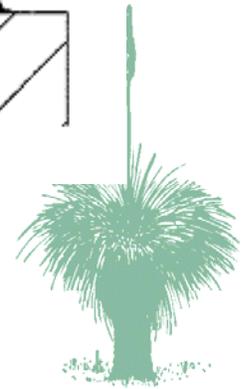
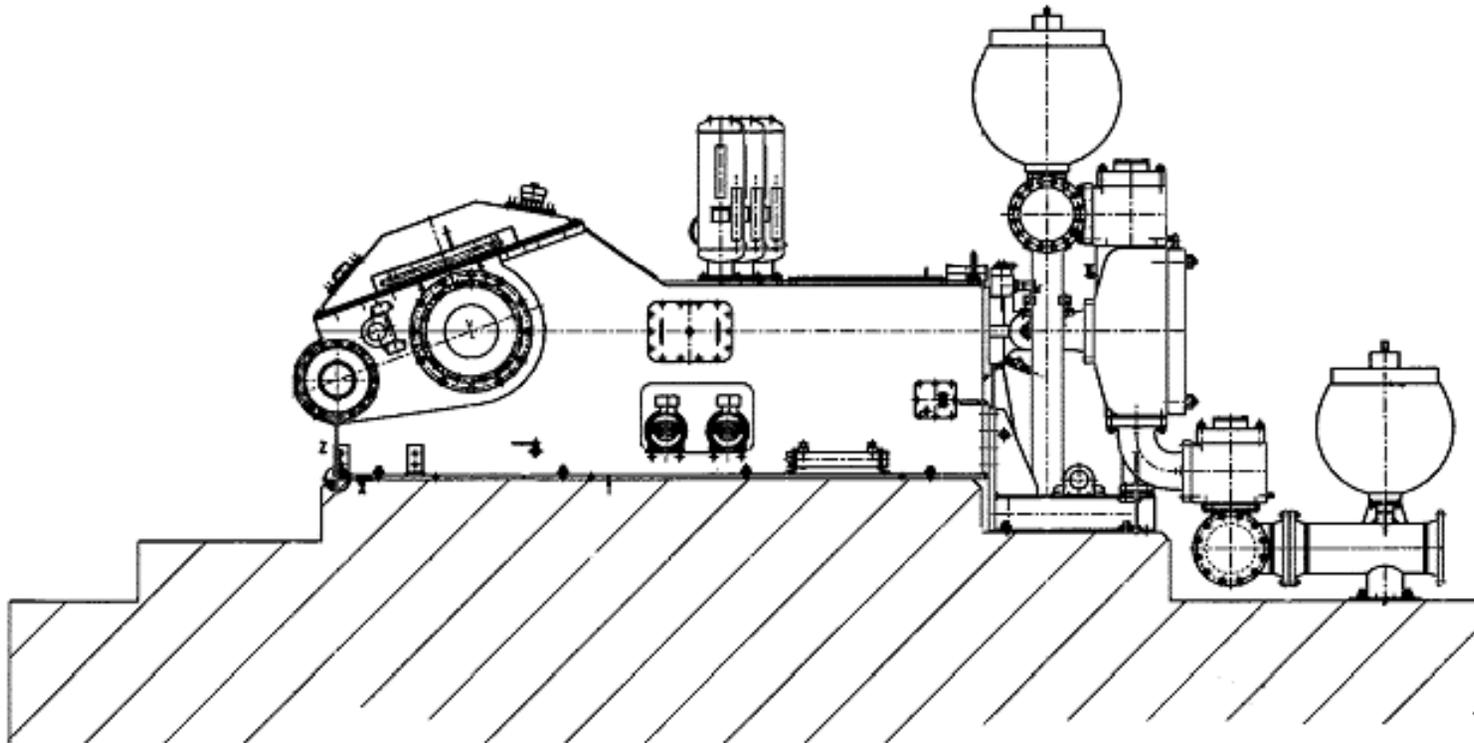
- The Wirth Pumps drive the bauxite slurry through the Digester Train.
 - There are 6 pumps, grouped into two units of three pumps per unit. 2 further pumps are on order for installation in 2006
 - The Pumps are a three piston positive displacement pump
 - Slurry properties: 80°C, 15% solids, 260 gpl NaOH
- Suction Pressure – 270kPa
 - Discharge Pressure – 6,000 to 9,000 kPa
 - Driven by 1.275 MW Variable Speed Drive



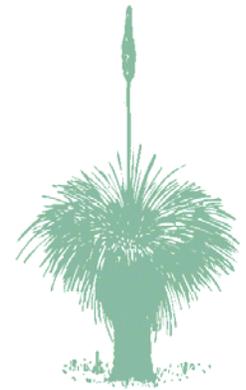


COMALCO
ALUMINA REFINERY

Introduction to Application

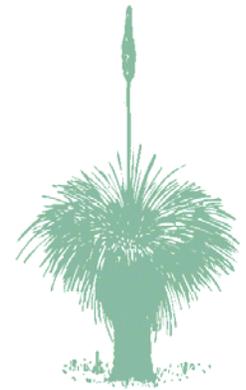


- Design requirement of the Wirth Pumps is 96% availability – 2005 achieved 87% availability. Represents 120,000 t lost production.
- Factors affecting availability:
 - Valve Failures
 - 2 to 6 hours downtime
 - Actual life < 4 weeks vs design life 8 weeks
 - Diaphragm Failures
 - 6 to 24 hours downtime
 - up to 10 failures per month
 - Crankshaft Failures
 - 5 Failures, 3 catastrophic
 - Up to 1 month downtime
 - Piping redesign required whilst 2 pumps failed on Unit 1

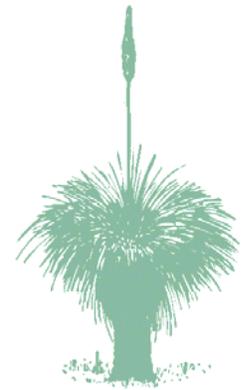
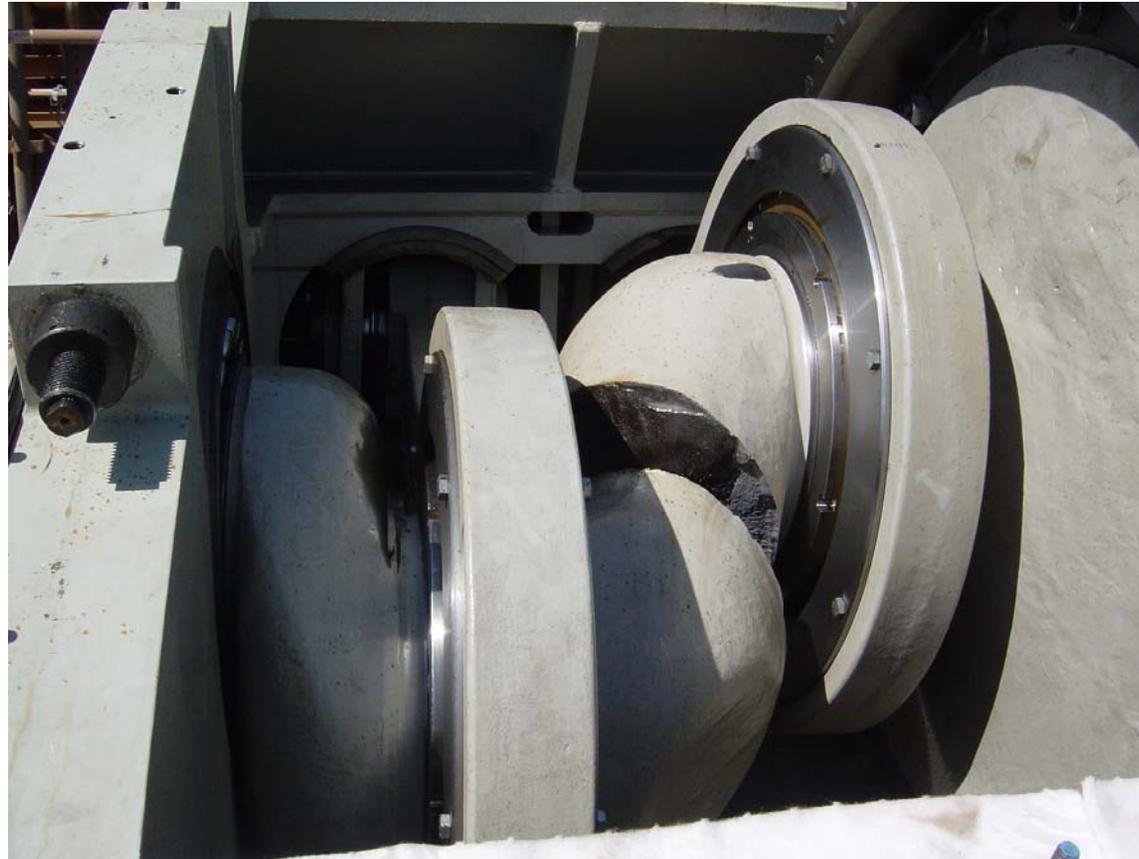




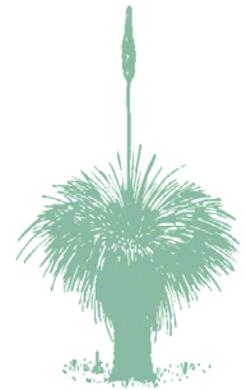
Failure Modes - Diaphragm



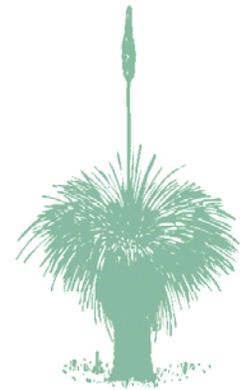
Failure Modes - Crankshaft



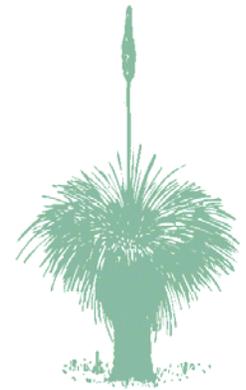
- Management decided to assemble a Team of Specialists in various fields to tackle the pump related issues.
- One of the first objectives was to collect process data which would hopefully uncover some of the reasons why the failures have been occurring.
- Throughout the procedure Comalco have been in close liaison with the OEM, Wirth. However without a large installed base on similar applications we do not have a repository of information and experience to draw upon.
- Comalco have invested \$900K in the Wirth Pump Condition Monitoring System



- White Rock Engineering
 - Positive Displacement Pump design and application specialists
 - Initial Site Survey was carried out using a tablet PC using a PCMCIA DAQ-Card attached to an SCC box.
 - System designed for data collection, off line review and reporting.



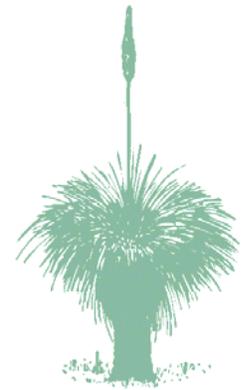
- Comalco Application
 - Permanently installed On-Line and Real Time presentation of data
 - See the data in real time
 - High Performance – processing speed an issue with large files
 - Equipment standards – permanent installation
 - Options for future expansion



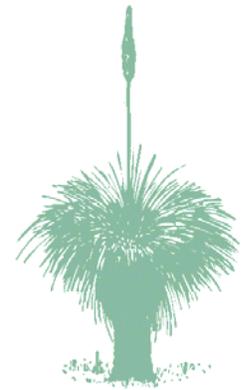
- Selection of PXI Hardware
 - PXI-1052 Chassis
 - PXI-8196 Processor
 - PXI-6259 DAQ Card
 - SCXI-1225/1338
 - SCXI-1530
- LabVIEW 8.0
- Remote Interface
- OPC Server
- Environmental Factors



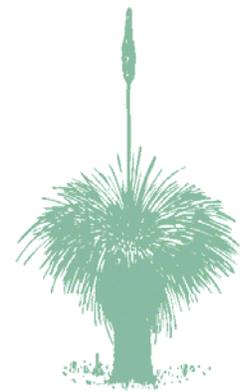
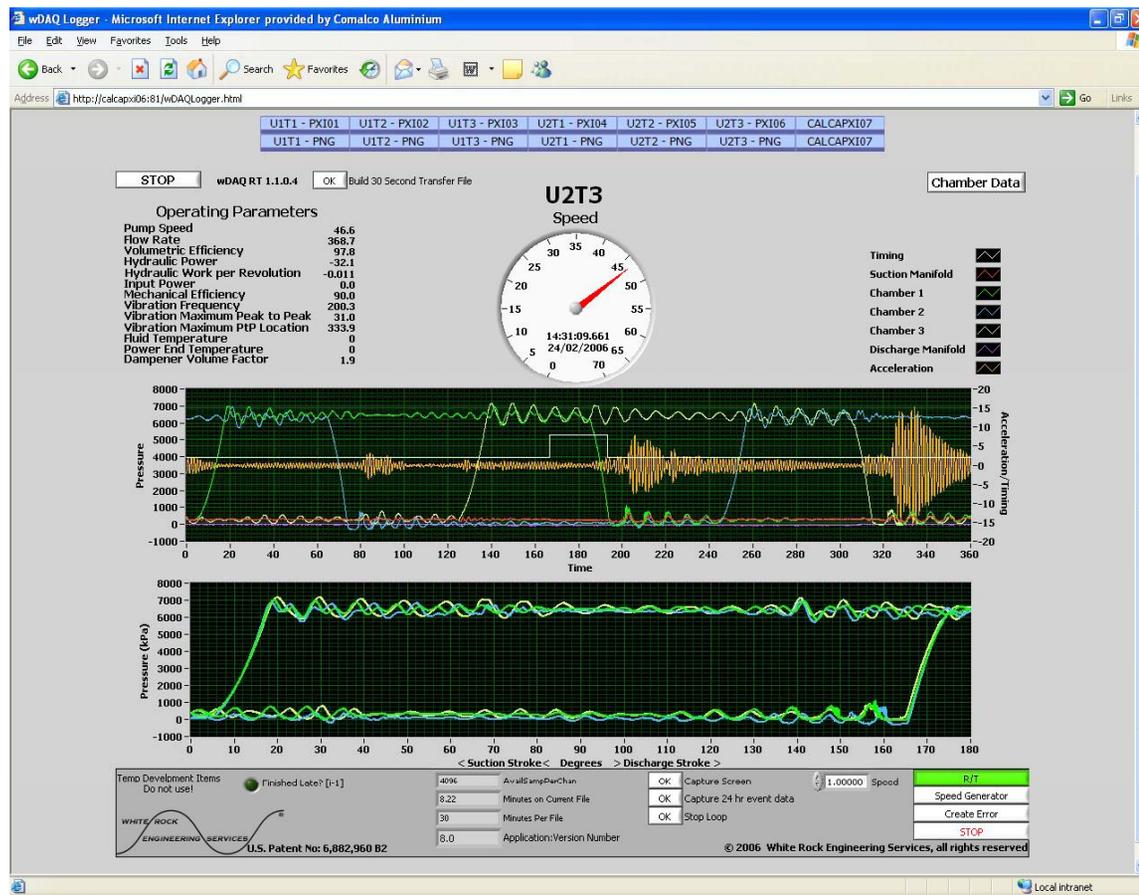
- Instrumentation
 - Suction Manifold Pressure (4-20mA)
 - Discharge Manifold Pressure (4-20mA)
 - 3 x Oil Chamber Pressure (4-20mA)
 - Vibration of Crankshaft (Piezo-Electric Accelerometer)
 - Crank position (Inductive Proximity Sensor)
 - Sample rate 4096 Hz



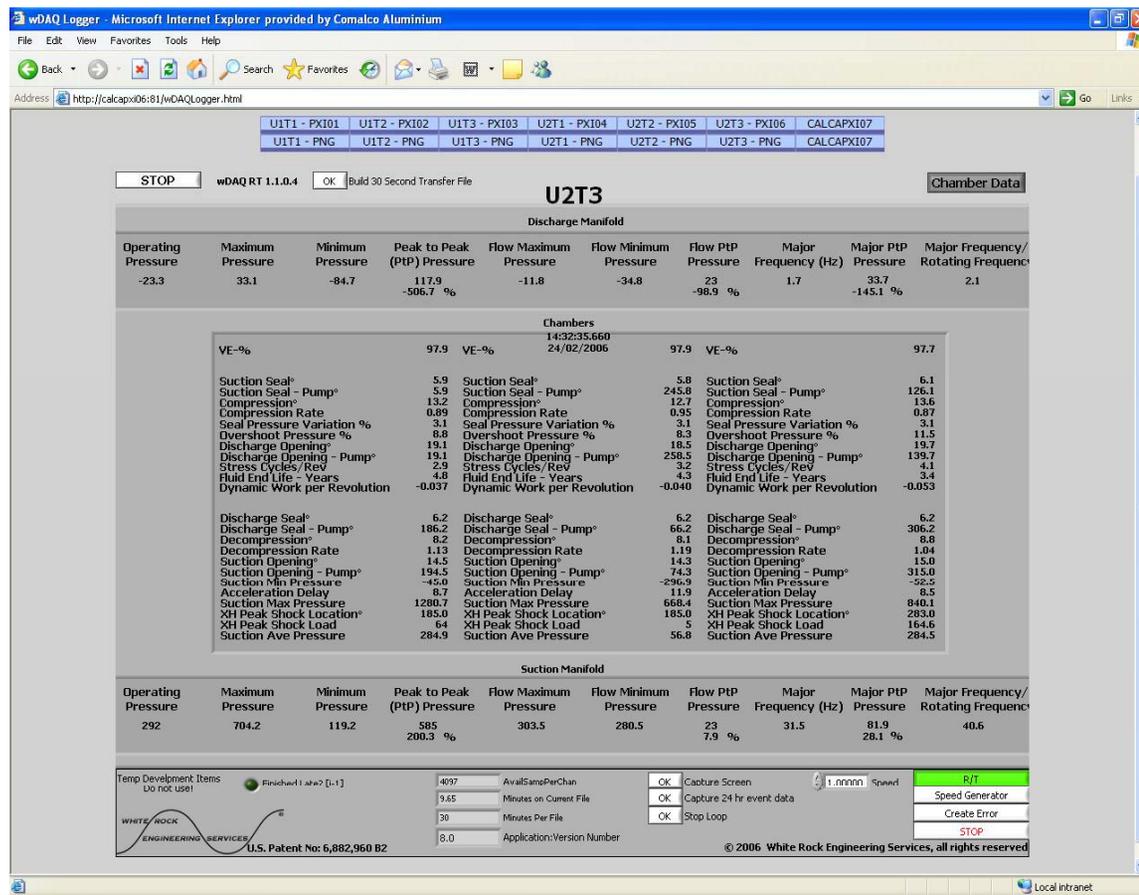
Selection of Hardware - Sensors



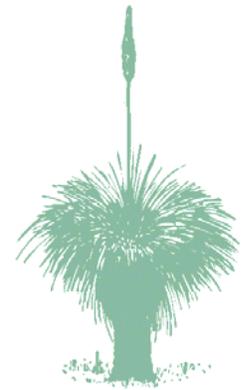
- Presentation of Data



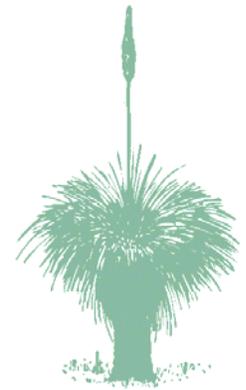
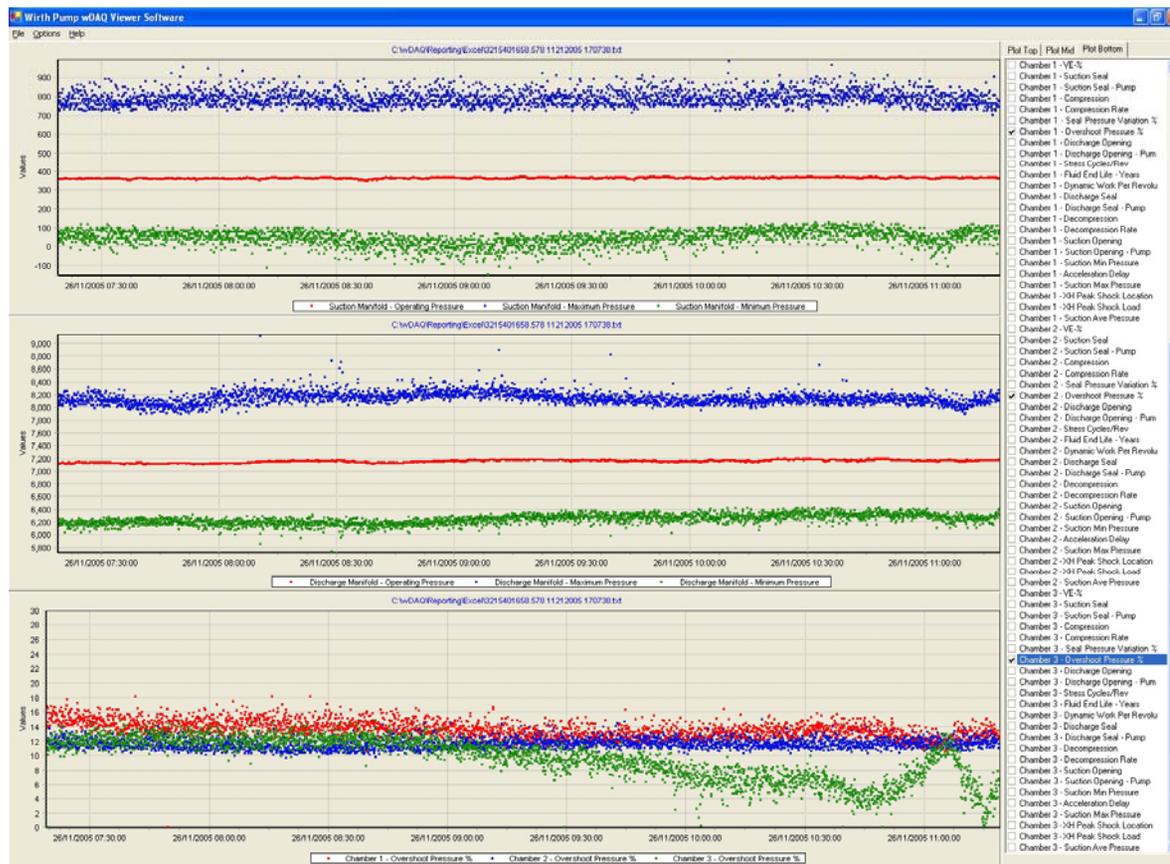
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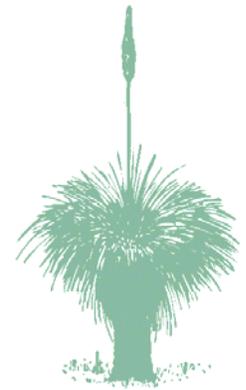
The screenshot displays the wDAQ Logger software interface within a Microsoft Internet Explorer browser window. The browser address bar shows the URL: `http://calcap06:81/wDAQLogger.html`. The software interface includes a menu bar (File, Edit, View, Favorites, Tools, Help) and a toolbar with navigation icons. Below the browser window, the software displays a control panel with a 'STOP' button, version information 'wDAQ RT 1.1.0.4', and a 'Build 30 Second Transfer File' button. The main data area is titled 'U2T3' and 'Chamber Data'. It features two summary tables for 'Discharge Manifold' and 'Suction Manifold', each with columns for Operating Pressure, Maximum Pressure, Minimum Pressure, Peak to Peak (PTP) Pressure, Flow Maximum Pressure, Flow Minimum Pressure, Flow PTP Pressure, Major Frequency (Hz), Major PTP Pressure, and Major Frequency/Rotating Frequency. The Discharge Manifold table shows values such as Operating Pressure: -23.3, Maximum Pressure: 33.1, Minimum Pressure: -84.7, Peak to Peak (PTP) Pressure: 117.9 (-506.7 %), Flow Maximum Pressure: -11.8, Flow Minimum Pressure: -34.8, Flow PTP Pressure: 23 (-98.9 %), Major Frequency: 1.7, Major PTP Pressure: 33.7 (-145.1 %), and Major Frequency/Rotating Frequency: 2.1. The Suction Manifold table shows values such as Operating Pressure: 292, Maximum Pressure: 704.2, Minimum Pressure: 119.2, Peak to Peak (PTP) Pressure: 585 (208.3 %), Flow Maximum Pressure: 303.5, Flow Minimum Pressure: 280.5, Flow PTP Pressure: 23 (7.9 %), Major Frequency: 31.5, Major PTP Pressure: 81.9 (28.1 %), and Major Frequency/Rotating Frequency: 40.6. Below these tables is a detailed list of parameters for 'Chambers' (143235.660, 24/02/2006) with columns for VE-%, Suction Seal, Compression Rate, Seal Pressure Variation %, Overshoot Pressure %, Discharge Opening, Discharge Opening - Pump, Stress Cycles/Rev, Fluid End Life - Years, Dynamic Work per Revolution, Discharge Seal, Decompression Rate, Suction Opening, Suction Min Pressure, Acceleration Delay, Suction Max Pressure, XH Peak Shock Location, XH Peak Shock Load, and Suction Ave Pressure. At the bottom, there is a 'Temp Development Items' section with a 'Finished 1 item? [1-1]' indicator, a 'WHITE ROCK ENGINEERING SERVICES' logo, and a 'U.S. Patent No. 6,882,960 B2'. A control panel at the bottom right includes buttons for 'Capture Screen', 'Capture 24 hr event data', 'Stop Loop', 'R/T', 'Speed Generator', 'Create Error', and 'STOP'. The footer of the software interface reads '© 2006 White Rock Engineering Services, all rights reserved' and 'Local Intranet'.



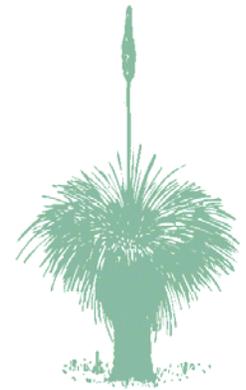
- Report Function for long term trends



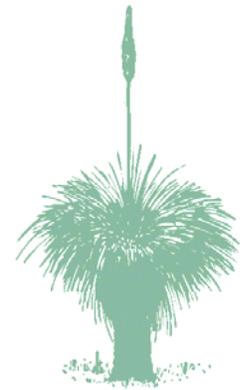
- **OPC Interface**
 - The Pump Data is collected by the Plant Historian which allows the data generated by the Condition Monitoring System to be correlated to Process Data – ie Tank Levels, Flow Rates, Pressures etc.
 - Usually we need to know what is happening in the process when we identify issues in the pump data



- Examples of where the Condition Monitoring System has brought improvements to Pump Operations
 - CSSM – Redesign of Suction Manifold
 - Mill Screen Failure
 - Valve Failure



- Fully Integrate Fault Detection DCS interface
 - Pump Alarm – Immediate Response
 - Pump Warning – Requires investigation but not immediately
 - System fault – Card fault/low disk space etc
 - Develop a catalogue of scenarios which will allow CROs to identify pump failures/issues in real time
- Evaluate new components
 - New valve types, fluid types, PSVs etc
- Implement Work History of Pump Components
 - Accumulated total of work done by pump components



- Questions???

