

TRUenergy Yallourn Power Station



In Pursuit of Excellence

(Ref-131338)



Our Maintenance Journey



- ◆ Organisation & People
- ◆ Systems & Processes
- ◆ Condition Monitoring Program
- ◆ Root Cause Analysis
- ◆ Continuous Improvement
- ◆ Results so far.....

- ◆ Why apply for the AMEA awards?
- ◆ What we have learned from the assessment process...





About us..

Power Station – 4 Units
Total 1480 MW capacity

Stage 1 commissioned 1974/75,
Stage 2 1981/82

Average age 24 – 32 years old
Initial Design life 25 years!!
Current Business Plan to operate to 2032!!!



First Victorian Power Station/Mine privatised 1996

Purchased by China Light & Power Group (CLP) in 2001



CLP purchased TXU in 2005 – name
changed to "TRUenergy"

Why change?

Current Business Plan – 90% Capacity Factor out to year 2032

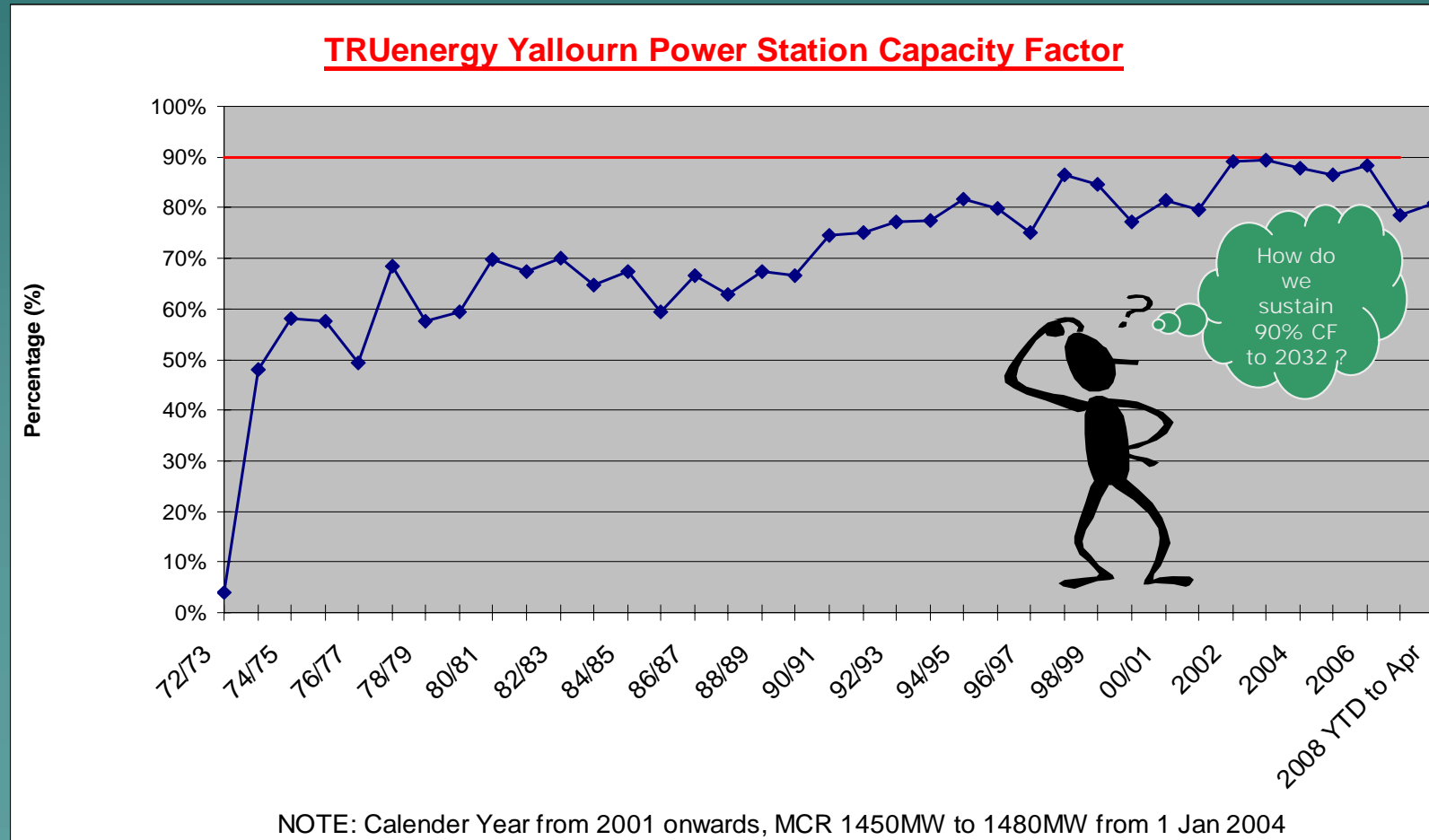
Competitive Electricity Market – increase production at reduced cost, meet contracts, minimise risk to fluctuating pool prices

We need

High
Availability

and

High
Reliability



The Maintenance Journey - Organisation & People



- ◆ Maintenance Organisation – Alliance with Silcar in 2001
Current contract recently extended to end 2008
- ◆ Flat organisational structure introduced in 2002
 - Process based fully accountable Teams – Engineering, Technical, Planning & Trades
 - Maintenance Improvement Team – Condition Monitoring & Reliability
 - Asset Team - longer term business focus
- ◆ Strong focus on people
 - Business Plans – Alliance & each Team
 - PDP's for everyone – Contract & trades
 - required skills for Teams/flexibility
 - accountability at shop floor
 - = Cultural Change!!

Logistics Team Contracted out to Alliance in 2003
-strong integration with Maintenance



The Maintenance Journey

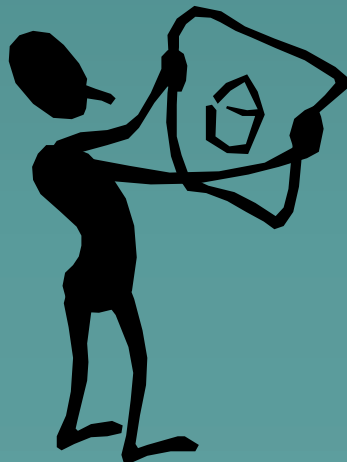
- Systems & Processes

Increased use of CMMS System – improved reporting for accurate analysis – costs, failure reporting, recurring faults

Emphasis on reporting and trending KPI's to meet Business Objectives and for Continuous Improvement – Alliance & Team levels – some down to Plant System level!



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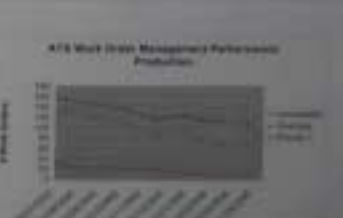
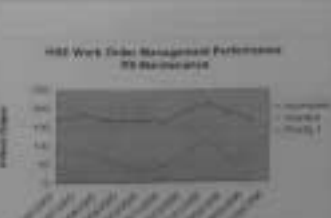
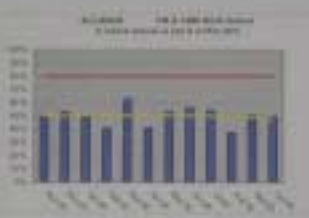
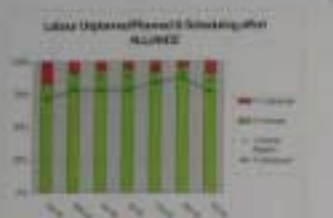
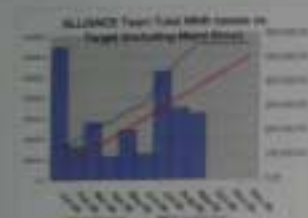
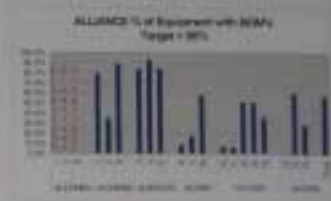
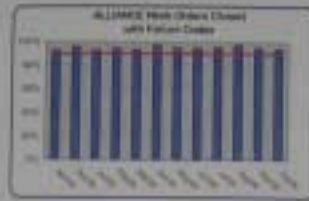
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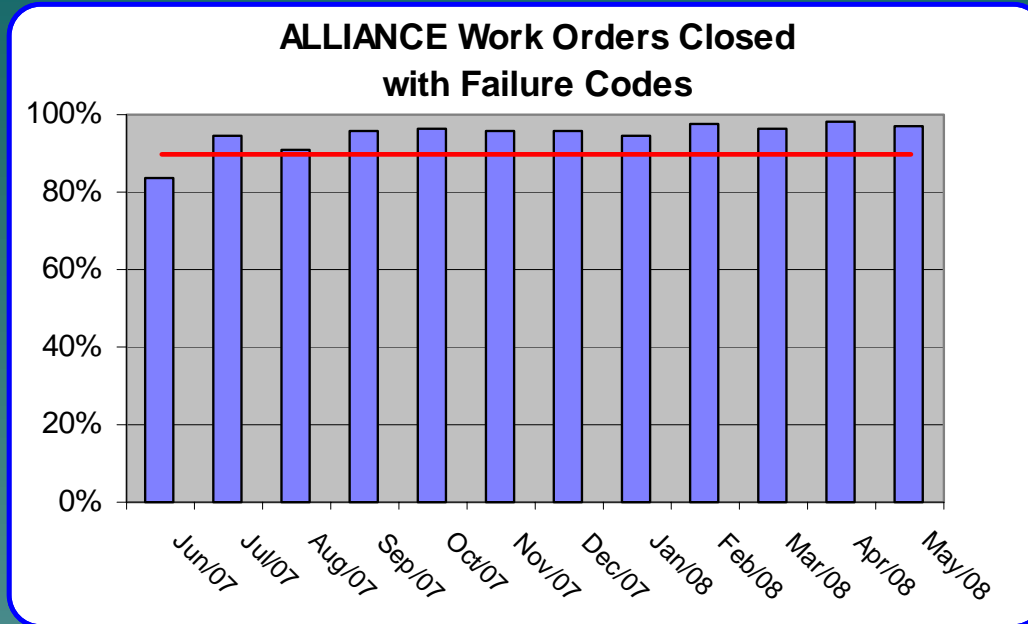
The Maintenance Journey - Systems & Processes



Alliance Key Performance Indicators



Interpretation - why do we have KPI's? - what behaviours are they driving?



High level of compliance to complete failure code history
Provides accurate info allowing analysis of plant faults
Prevents recurring plant faults when acted upon
Data can be used for Reliability Engineering/
RCA processes etc

Work Orders Closed with Failure Codes Target >90%

Incomplete/unreliable failure code history
Unable to analyse plant faults
Minimises continuous improvement of maintenance
strategy & processes

Interpretation

The Maintenance Journey

- Systems & Processes

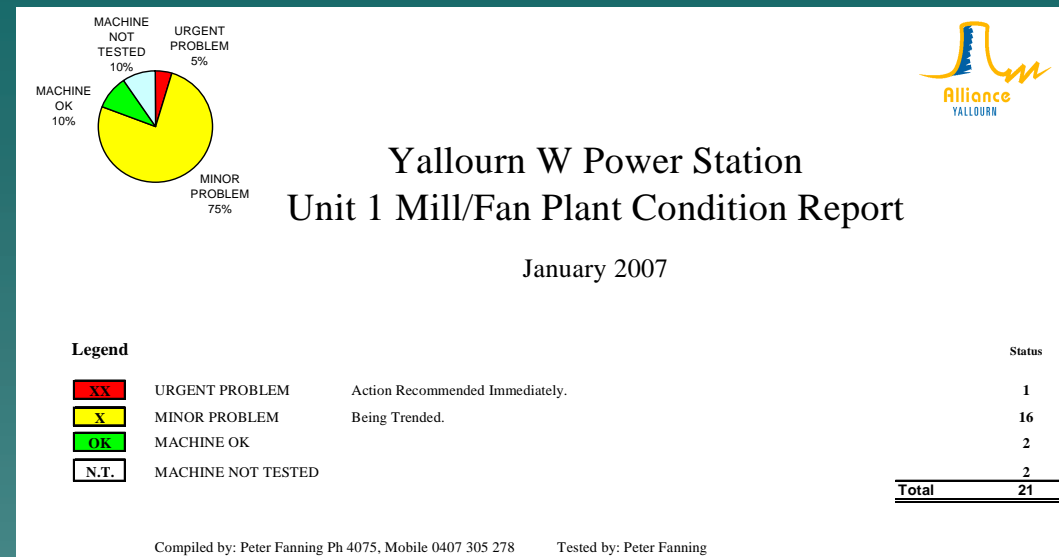


- ◆ Strong emphasis on Proactive Maintenance
 - development of Asset Management Plan
 - updating of existing Life Maintenance Plans
 - review & recommitment to routine (PM) program
- ◆ Already a strong Condition Monitoring program
 - most technologies covered “in house”
 - equipment, systems & processes in place



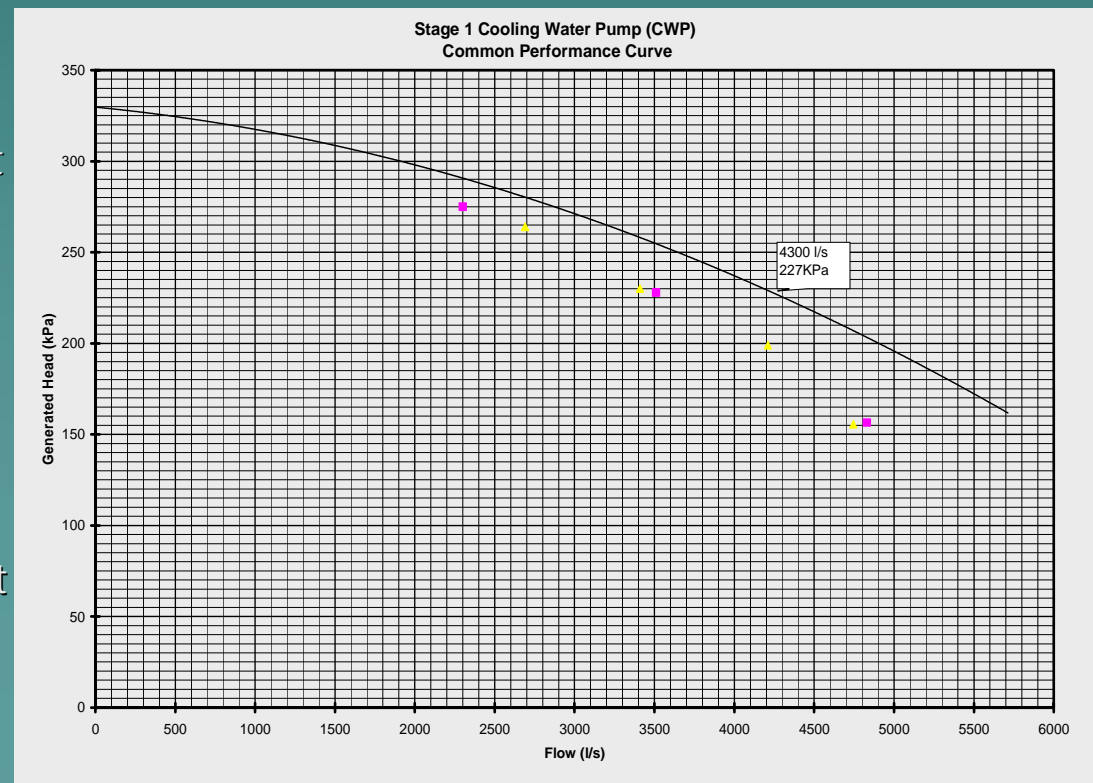
Vibration testing, analysis & reporting...

- ◆ Covers 437 machines & 3257 measurement points at optimal frequency – 1,2,4,6 or 12 monthly based on reliability/criticality of plant.
- ◆ Utilise CSI Data Collectors & utilise CSI's Machinery Health Manager program for data storage, trending & analysis
- ◆ After recent in house training program – Tradespeople within Teams conduct data collection, CM Analysts conduct analysis, reporting and follow up work.
- ◆ Analysts are trained to undertake more advanced testing – balancing, phase analysis, resonance testing, rundown/runup testing etc.
- ◆ Bentley Nevada DM2000 on line Supervisory System installed on Turbine Plant, and the CSI 4500 rack has been installed to monitor the Stage 2 IDF's



Pump Performance testing...

- ◆ Covers 142 Pumps at optimal frequency – 2,4,6,12 monthly or 6 yearly based on reliability/criticality of plant.
- ◆ Utilise portable ultrasonic & transit time flowmeters & pressure equipment for majority of plant testing.
- ◆ For critical plant utilise installed orifice plate/dp cell or annubar equipment.
- ◆ DCS is now being used to conduct “live” performance testing of critical plant through use of PI
- ◆ Use Machinery Health Manager program for data storage & trending
- ◆ Conducted by CM Analysts with support from Process Teams – requires close liaison with Operations to provide varied plant conditions for full testing capabilities.



Heat Exchanger Performance testing...



- ◆ Covers 95 Heat Exchangers on 3 monthly basis.
- ◆ Utilise portable Infrared non contact or Digital contact Thermometers
- ◆ Conducted by Process Team tradespeople with analysis & reporting by CM Analysts.

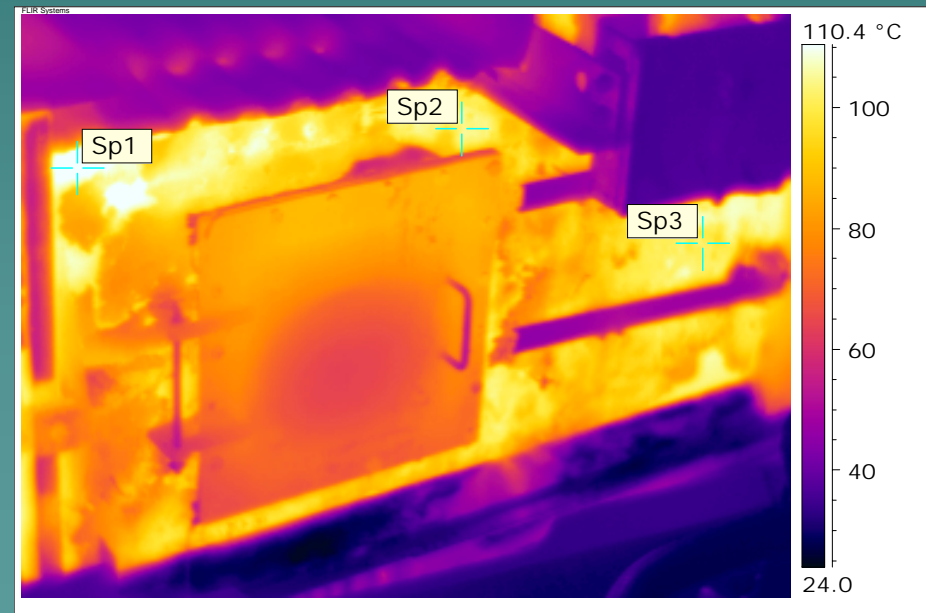
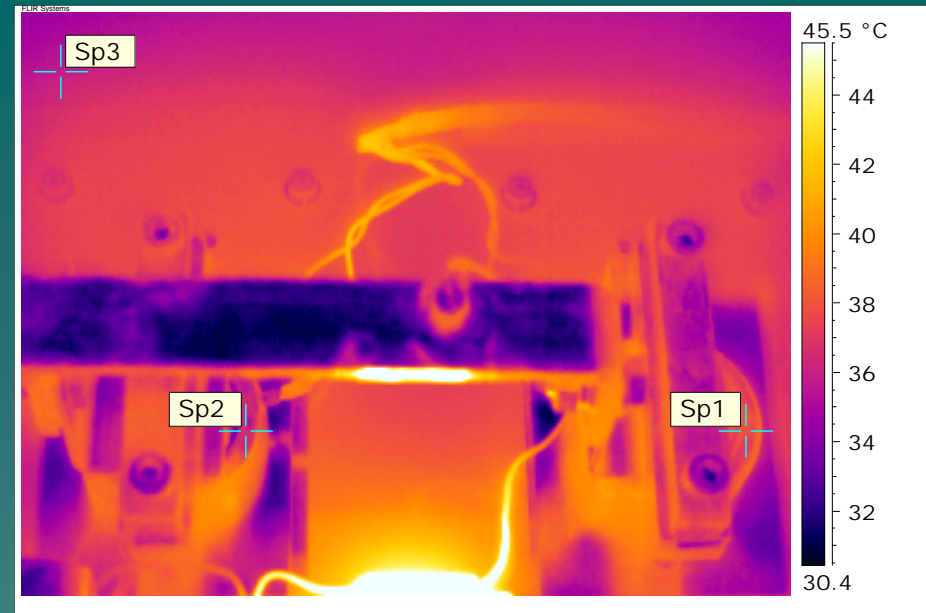
Non Destructive testing...

- ◆ Predominantly Ultrasonic Thickness Testing & Surveys across Pressure Parts plant (ie Boiler pipes & tubing) during planned Unit Outages (Up to 500 points measured during boiler cleans & up to 5000 measurements during major outages).
- ◆ Provide Secondary damage tube assessments during tube leak forced outages.
- ◆ Routine testing conducted by combination of in house and contractors depending on workload and outage opportunities.
- ◆ Other specialist NDT techniques (ie time of flight crack detection, advanced ultrasonics & radiography techniques) conducted by external contractors



Thermography ...

- ◆ Purchased a high level Thermography camera Jan 04, followed by the purchase in 2006 of 3 more basic Thermography cameras which are now residing within Operations and the Coal Delivery Team.
- ◆ Currently covers a range of Mechanical and Electrical Plant at 4,6 or 12 monthly plus pre-outage intervals as follows;
 - Mechanical: valves, drain lines, boiler leak detection, chimney surveys and conveyor idlers.
 - Electrical routines cover 240V/50V DC Batteries, 240/415V Cubicles, Transformers, Switchboards, Local panels CB cubicles, Distribution boards etc.
- ◆ In house program is still developing – training and trial/implementation of routine testing across the full range of plant is continuing.



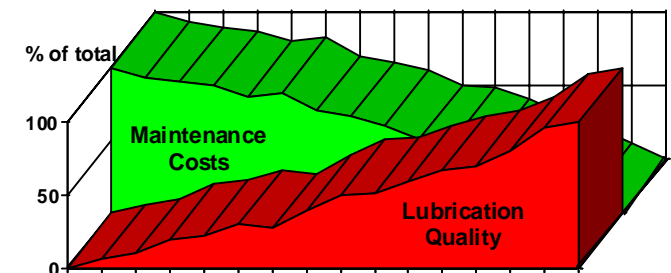
Oil Testing & Analysis (Tribology)...

- ◆ On site oil testing program in place utilising CSI's sampling & analysing 74 machines and 186 sample points.
- ◆ Oilview on site equipment range;
 - Oil Analyser for basic screening/assessment
 - Particle Counter, Viscometer, Ferrous Wear monitor, Patch testing etc for analysis
- ◆ Critical Systems - Samples sent external for more advanced analysis (ie RBOT, Mobil Monitor, Dissolved Gas Analysis for Transformers and Tap Changers etc)
- ◆ Routine Sampling conducted by Lubrication Team personnel with analysis/support by Chem Team/CM Analysts. Recommendations back to Process Teams for action.
- ◆ Where possible on line filtering is conducted by the Lubrication Team to clean up the oil (remove water, ferrous & non ferrous particles) on line & return to acceptable cleanliness levels for long term reliability of systems.
- ◆ Number of on line filtering systems available on site – Pall Oil Purifiers & Portable Filter carts. This on line clean up process eliminates unnecessary dumping of oil – minimises environmental impact, reduces machine downtime and maintenance costs.
- ◆ This is one of the most proactive Condition Based activities as lubrication quality is a basic essential for ongoing plant component operation and reliability.



Lubrication Costs

... lubrication quality has a major impact on life of equipment & subsequent overall cost of maintenance

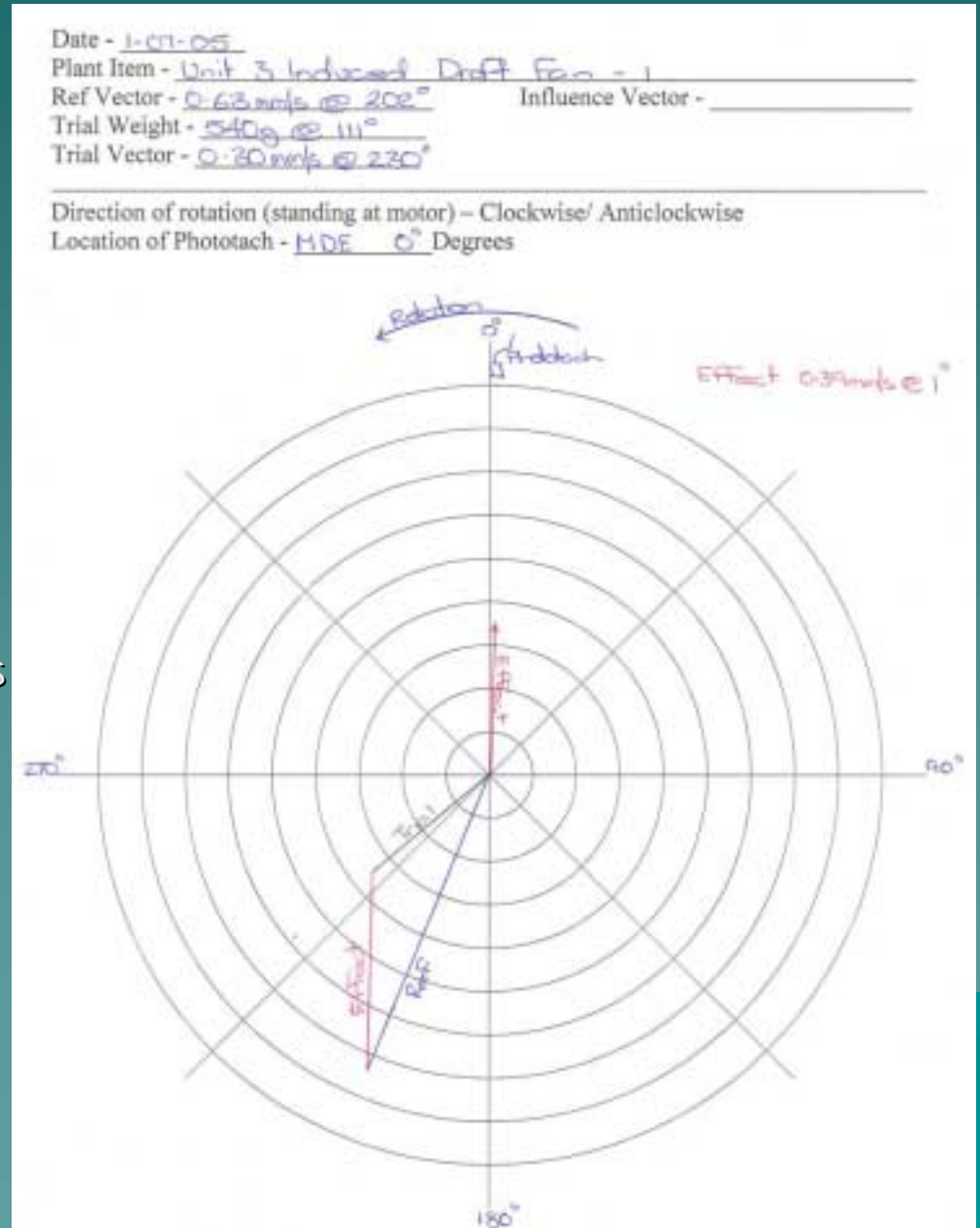


Electrical Monitoring...

- ◆ Specialist Electrical Testing - DLA testing, Partial Discharge (on line and off line) for electrical equipment, Frequency Response analysis for Transformers) at optimised frequency based on maintenance strategy conducted by external contractor.
- ◆ Purchase of Motor Circuit Tester (All Test Pro) in July 2004 to develop on site testing program for detection of motor/circuit faults including broken rotor bars, loose winding connections, insulation degradation etc. Will also provide QA checks/acceptance testing of newly overhauled electrical equipment prior to acceptance as fit for service.
- ◆ Program for implementation of All Test Pro across the Process Teams to be developed including training requirements (electrical tradespeople) and program/software setup.

Precision Balancing

- ◆ Precision Balancing is conducted by Senior CM Technicians.
- ◆ Balancing is a complex activity with many variables affecting the results. Things to consider are: Machine speed, machine design, operating mode, measurement units, sensitivity etc.
- ◆ A good understanding of these parameters and the calculations are critical, if the balance weight is installed into the wrong position dire consequences could result.
- ◆ Machines balanced onsite are: Mill Beaterwheels, FD and ID Fans, Turbines & Generators. (ie large mass rotating equipment)



Precision Alignment

Alignment is conducted by trained maintenance fitters across the Teams.

Laser alignment is used to ensure alignment at the coupling between the drive and driven equipment is conducted quickly and within strict tolerances (based on speed) to minimise rotating forces.

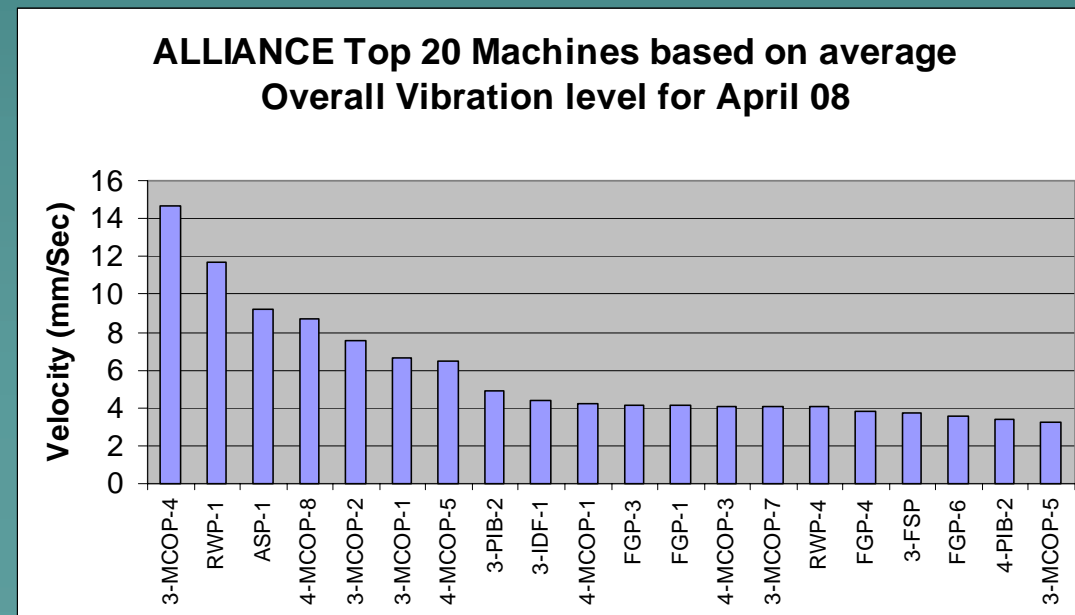
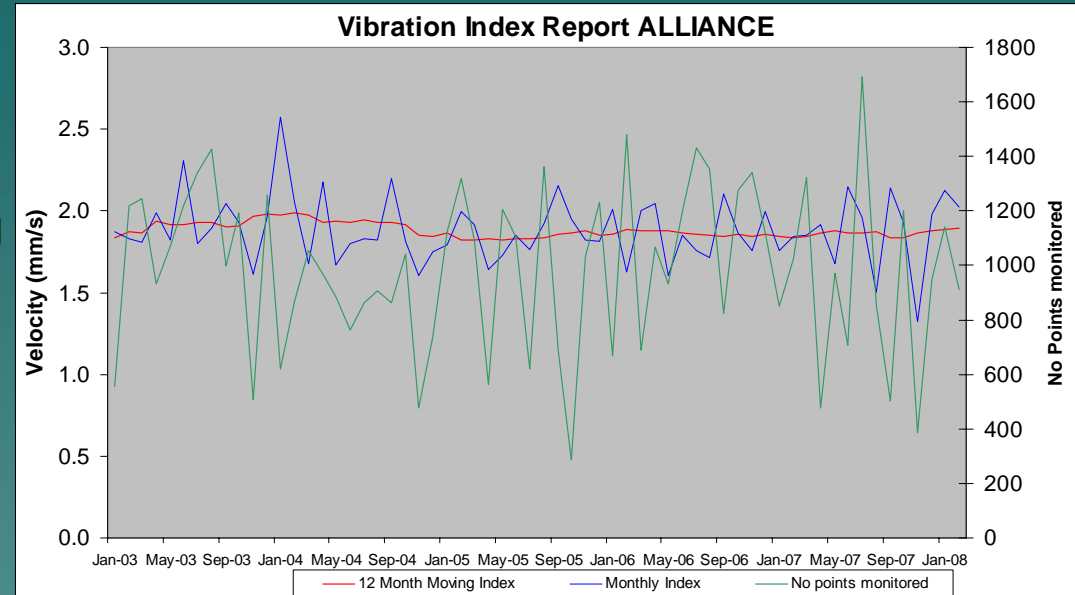
This allows plant to run at minimum vibration levels, ensuring longer term reliability of plant & reduced wear of components.



Condition Monitoring KPI's and Targets...aligned with Power Station Alliance Business Plan

PROACTIVE MEASURES

- ◆ Vibration Index – reducing long term trend is a broad indicator of longer term plant reliability/operation
- ◆ Pareto analysis of Plant with highest Vibration – assists in focussing on areas for continuous improvement/RCA



Setup & commitment to a Root Cause Analysis Program

- ◆ Formal Program introduced late 2004
- ◆ Support from key stakeholders
- ◆ Develop Strategy & Implementation plan
- ◆ Develop Guidelines for use – procedures & triggers
- ◆ Review RCA techniques available
- ◆ Involvement & input from key “users” early on

RCA -Training and gaining momentum ...

- ◆ Who to train?
 - Facilitators (2 day) – Maintenance & Operations
 - Shop Floor (1 day) – Maintenance & Operations
- ◆ How to train?
 - Use of external trainer – course meets business needs
 - In house (reduce costs)
- ◆ Expected outputs
 - Put up 5 “real” plant problems
 - On the job training
- ◆ Promotion & reporting on progress



Breaking down the barriers between Maintenance & Operations using RCA...the benefits

Co-operation

Buy In

Results

Education

Working together

Structured

Opportunity for input

Shared workload
**Shared ownership of problem
& solution**

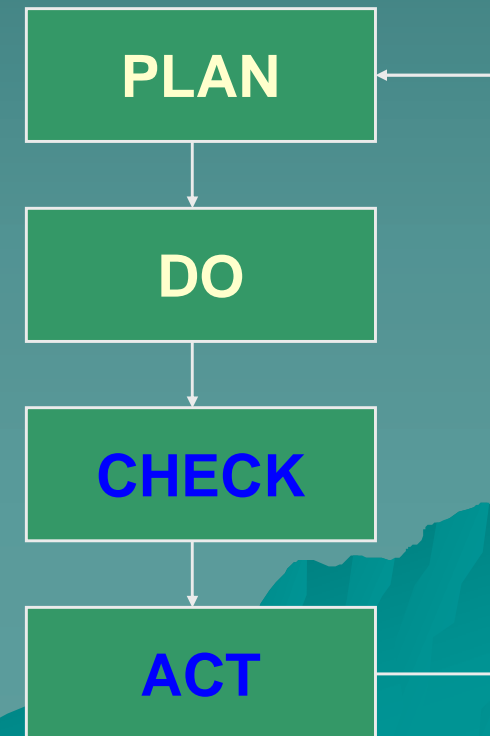
Best Solution

Team Momentum

Continuous Improvement

ie: Focus on the “Check” and
“Act” of the Maintenance
Continuous Improvement Cycle

Maintenance
Improvement Cycle

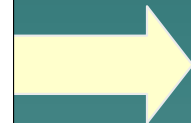
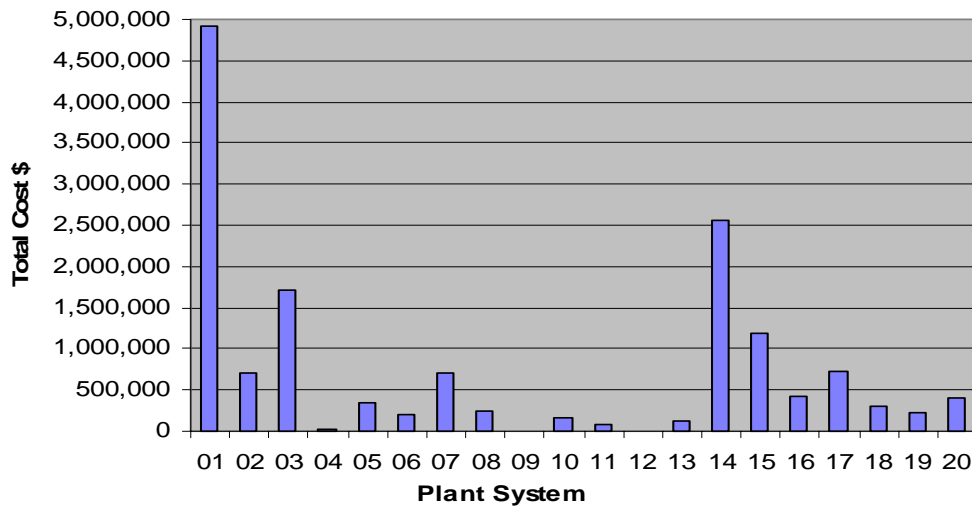


Continuous Improvement

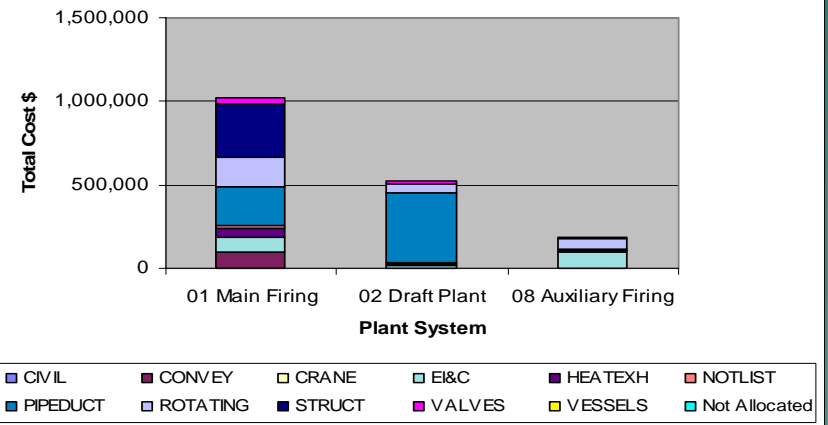


Use CMMS & LOA data to focus on areas which will give the biggest impact - \$\$\$ Repair Costs

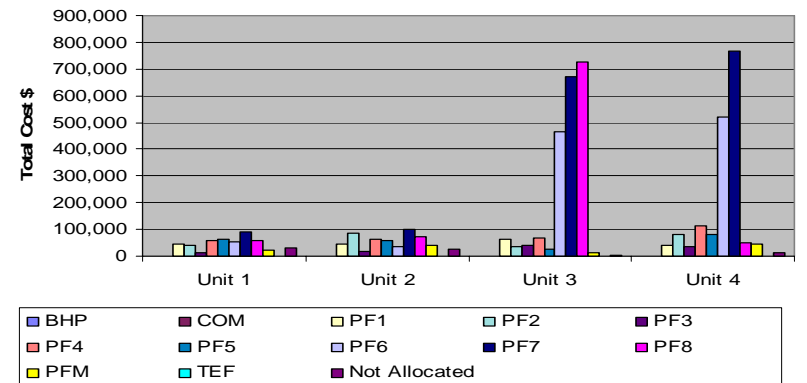
Alliance \$ Costs by Plant System for 2007



Alliance \$ Costs by Plant System for Stage 1 by Work Type for 2007



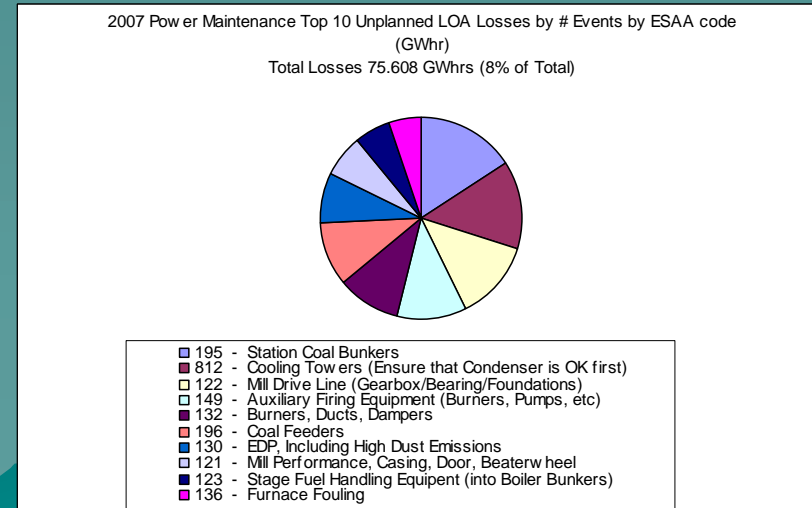
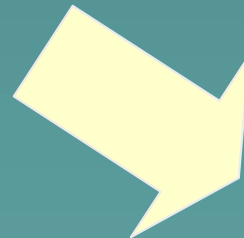
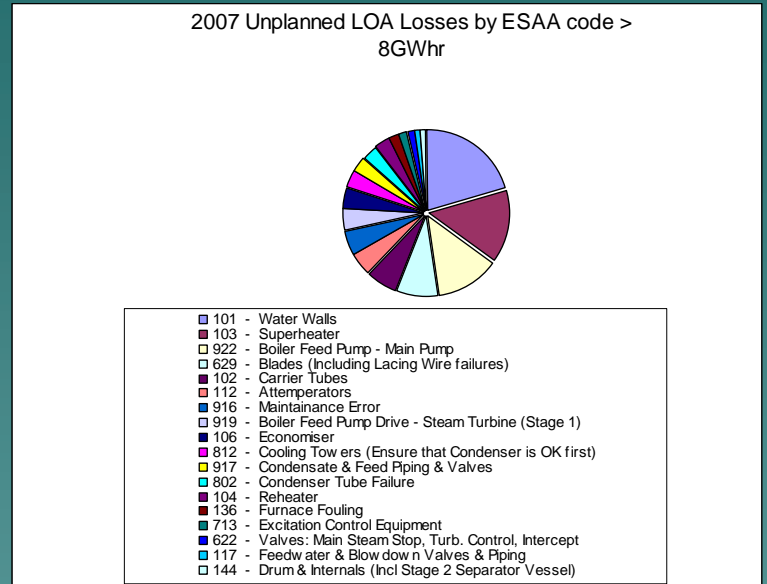
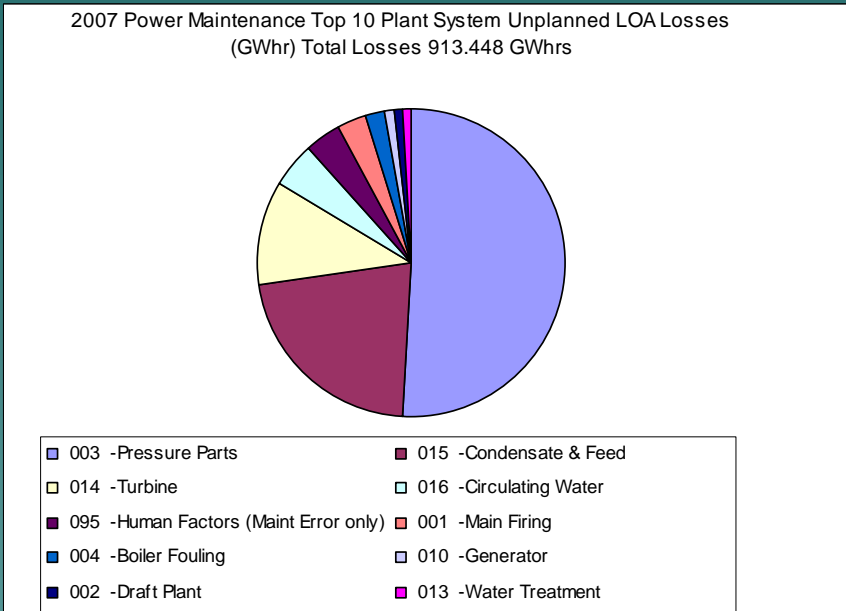
Alliance \$ Costs for Plant System #1 (Main Firing) by Sub System for 2007



Continuous Improvement



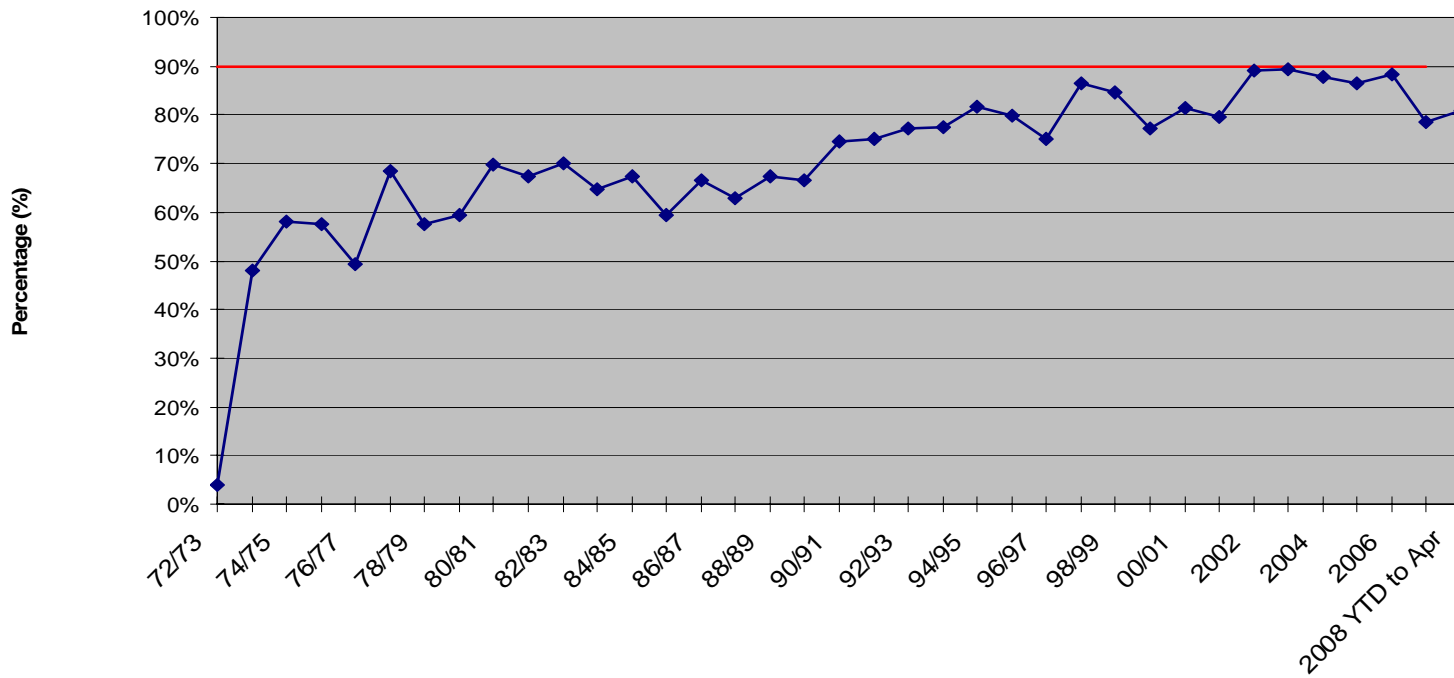
Use CMMS & LOA data to focus on areas which will give the biggest impact – Generation (Income) Losses



The results so far..

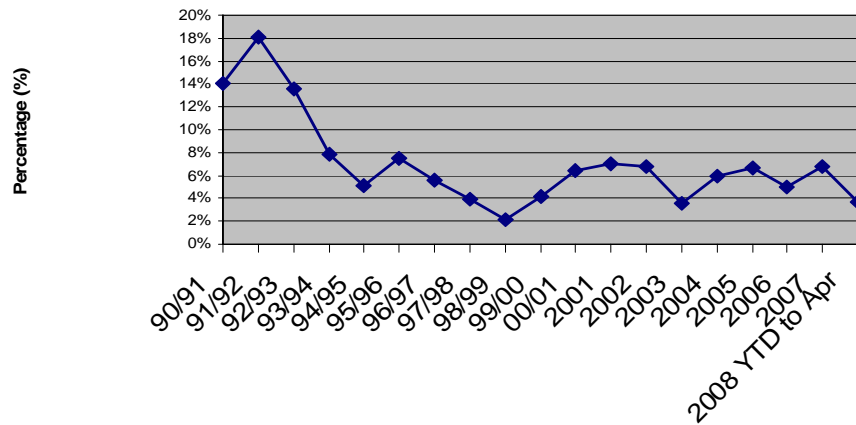


TRUenergy Yalourn Power Station Capacity Factor



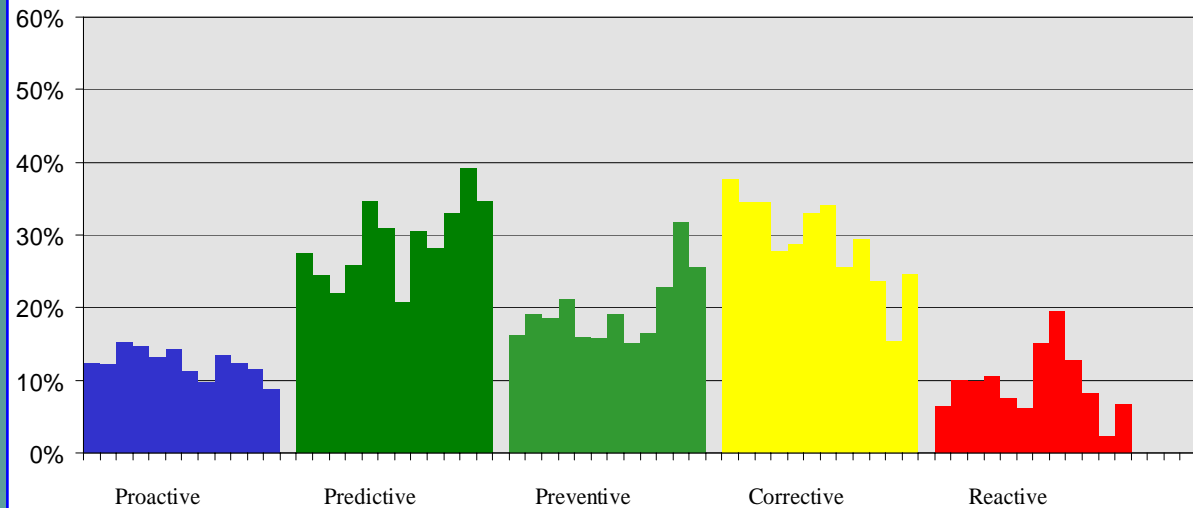
NOTE: Calender Year from 2001 onwards, MCR 1450MW to 1480MW from 1 Jan 2004

TRUenergy Yalourn Power Station Equivalent Forced Outage Factor*



*NOTE: Equivalent Forced Outage Rate (EFOR) used pre 99/00. Calendar year from 2001 onwards MCR 1450MW to 1480MW from 1 Jan 2004

Alliance 12 Month Moving Maintenance Effort Trend



Why apply for the AMEA awards?



- ◆ Maintenance Alliance has placed significant emphasis on improving processes and practices in past 6 years to optimise the maintenance performance in order to meet TRUenergy's business objectives both now and well into the future.
- ◆ Lot of work done, lot of change!
- ◆ Evaluate where are we now in regards to "best practice" for maintenance?
- ◆ Develop improvement opportunities to continue to work towards maintenance excellence
- ◆ Integrate these improvement opportunities with future business planning strategies for Alliance & Teams – 2008 and beyond



Confirmation - doing right things
- recognised outside business
- acknowledge people involved

What we have learned through AMEA self audit/assessment process



- ◆ We are on the right track!!!
- ◆ Continue to develop & regularly review LMP's for all plant areas
- ◆ Finalise Bills of Materials (BOMs) project
- ◆ Setup systems for review/optimisation of current PM program
- ◆ Rejuvenate Continuous Improvement Team to drive reliability improvement through data analysis
- ◆ Root Cause Analysis - continue to promote/support until it is the tool of choice for solving plant problems at the shop floor
- ◆ Review & optimise current KPI's

Continue to Benchmark

Continue to Network and learn from others
- power and other industries



TRUenergy Yallourn



We're excited by our Maintenance Journey and Improvement program

- even if you're not!!!

