



Data-Driven Inspections, Life Extension and Remaining Useful Life Forecasting Reduce O&M Costs at Kruger Energy

Client

Kruger Energy, a business unit of Kruger Inc., specializes in the development and management of green and renewable energy power plants. Kruger manage and operate 35 production sites, ranging from hydroelectric and wind power plants to biomass cogeneration and biogas plants, with a total installed capacity of 523 MW.

Challenge

Romax provide best in class service for early detection and forecasts of remaining useful life of components, providing transparency on the health of the main bearing, gearbox and generator components. Combined with main bearing life extension by grease flushing and drivetrain engineering advisory, Kruger have the support required.

Solution

With the Port Alma and Chatham Wind Farm moving to a hybrid self-perform/OEM service model, Kruger needed shadow monitoring and life extension services in order to reduce the cost of failures.

Benefits

Kruger reduces unplanned maintenance costs by optimizing repairs, reducing downtime, and focusing inspections with data driven punch lists.

Unplanned labour, unscheduled downtime and additional crane mobilization fees are all factors that can easily deplete a wind farm's annual operations and maintenance (O&M) budget. Efficient analysis of SCADA and CMS data, resulting in data driven inspections, can be an invaluable way to improve maintenance cost forecasting. When data driven inspections are combined with life extension strategies and remaining useful life forecasts, the wind farm owner is equipped with a powerful toolset for minimizing downtime and saving on O&M expenditures.

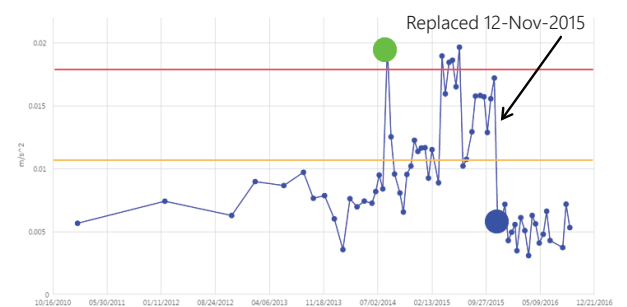
Data-Driven Inspections

Romax InSight has been shadow monitoring the 88 Siemens 2.3MW wind turbines at Port Alma and Chatham wind farms since 2014. Romax's engineering team utilizes Fleet Monitor software and data from Kruger's existing CMS system, together with lubrication reports and operations and maintenance records, to provide six-week health assessment reports. In addition to a prioritized punch list of recommended actions, these reports include a detailed explanation of alarms which enable Kruger to gain an increased understanding of the condition of their turbines.

Figure 1 illustrates an example where Romax detected an Intermediate Stage Bearing Roller Fault in April of 2015. The site inspected the turbine in June of 2015, confirming damage to the bearing roller on the generator side. Romax statistically forecasted the damaged component's remaining useful life using RomaxRepair, which utilizes mathematical models and statistical failure data along with engineering experience to forecast the time to failure.

With this information, the site was able to avoid a gearbox replacement and repair the bearing up tower providing a savings of over 100K to the site.

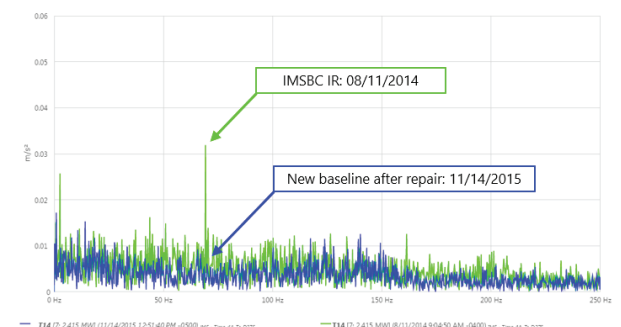
Turbine Number	TXX
Component	Intermediate stage
Condition	Now repaired
Diagnosis	IMS B/C bearing fault (before replacement)
First Detected	11-Aug-2014
Inspected Date	03-Jun-2015
Inspection Comments	Pitting found on generator side IMS bearing
Recommendation	Monitor vibrations
Notes	Replaced 12-Nov-2015



Fleet Monitor showing the vibration trend rise over 15 months and returning to normal after repair



Inspection found pitting on generator side IMS bearing



IMS B/C IR peaks were present before placement

"Romax provides clear and concise reporting that delivers early warning and damage trending for drivetrain component failures, enabling us to gain an increased understanding of the condition of our fleet. It's typical of Romax to provide us 6-12 months warning on a developing failure in the main bearing and gearbox, with rarely a false call."

J.J. Davis
Regional Manager
Kruger Energy

Life Extension – Main Bearing Flushing

Another example where Fleet Monitor provided advanced warning on a developing main bearing failure is shown below. Utilizing Romax's proprietary main bearing flushing technology, the damaged main bearing was flushed twice and continued to operate successfully for over 2 years.

Flushing, combined with RomaxRepair remaining useful life estimates, allowed the site to delay the cost of the replacement and plan the repair during the low wind season with other planned repairs.

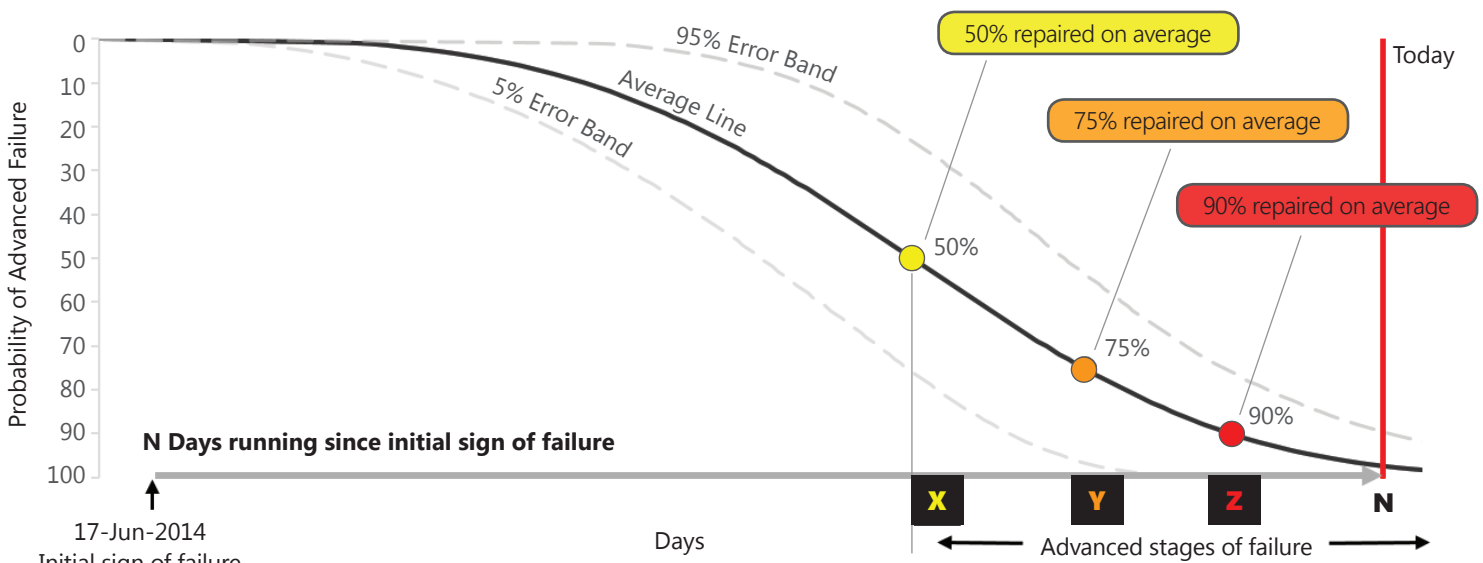
"Romax InSight has performed their flushing process on several of our main bearings which helped extend their life and maintain productivity. We are now implementing flushing as part of our main bearing maintenance practices and this will contribute to reducing our overall maintenance costs. Transparent tracking of main bearings condition helps my planning tremendously."

J.J. Davis

Turbine Number	TXX
Component	Main bearing
Condition	Critical
Diagnosis	Outer race fault
First Detected	01-Aug-2014
Inspected Date	20-May-2015
Inspection Comments	Progressed damage
Recommendation	Replace main bearing
Notes	1 st flush 19-Nov-2014 2 nd flush 17-Sep-2015

RomaxREPAIR			
This bearing has run statistically much longer than the average failing main bearing			
RomaxREPAIR	5% Error	Average	95% Error
Days running since initial sign of failure		N	
Days left until 50% repaired	-X	-X	-X
Days left until 75% repaired	-Y	-Y	-Y
Days left until 90% repaired	-Z	-Z	-Z

Probability That Damage Has Progressed to Advance Stage of Failure



Frequency based analysis in Fleet Monitor showed the fault indication 15 months before repair allowing for good planning

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