PREDICTIVE MAINTENANCE SYSTEM FOR MORGOIL® BEARINGS

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Abstract

Morgan Construction Company is developing a system to monitor MORGOIL® backup bearing operation in an effort to help mills reduce unscheduled down time and increase productivity. This system will provide mill operators with a warning if bearing operating parameters exceed safe limits and will also indicate the level of severity. Unsafe operating parameters can be caused by mill components other than the bearings themselves and diagnostics are reported that can help identify the contributing component. Additionally, the system ensures that there is adequate oil flow to the bearings before rolling is started. Parameter history can be stored along with coil information so if an issue with a coil is found at a later time, the backup bearings can be checked for contributing factors. The system has extensions to fully monitor the lubrication system and interface with the roll shop to track the history of components and help troubleshoot problems. The system can be interfaced with other mill information systems. This paper describes the initial phases of the system in development, as well as future phases which are planned.

Key words: Oil film bearing; Predictive maintenance.

42nd Rolling Seminar: Processes, Rolled and Coated Products, Santos, SP, Brazil, October 25-28, 2005

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INTRODUCTION

Optimizing the efficiency and availability of MORGOIL® bearings, directly impacts rolling mill productivity and quality. Management is aware of the significant benefits associated with a well-run roll and bearing shop, however few companies have the resources or expertise to implement “predictive technologies”. These systems are the basis for preventing problems and properly planning maintenance, thus achieving long-term mill success. Using condition-monitoring technologies, Morgan Construction Company is developing a predictive maintenance system to monitor and assess MORGOIL® backup bearing operations in an effort to reduce unscheduled down time and to increase productivity. This system utilizes a full complement of sensor technologies, industrial computers, and analytical and data management software to capture and interpret vital information from operating bearings. The computer interface will provide mill operators a ‘real time’ warning if bearing operating parameters exceed safe limits, and will also indicate the severity of the condition. These out of range parameters can be caused by mill components other than the bearings, and diagnostics are reported that will help identify the contributing component. Additionally, the system ensures that there is adequate oil flow to the bearings before rolling is started. Parameter history can be stored along with coil information so that management can properly diagnose and implement adequate corrective actions. The system will have extensions to fully monitor the lubrication system and interface with the roll shop to track the history of bearing components. Component histories will allow the roll shop to be warned if there are repeat problems with specific parts. The system is designed so it can be interfaced with other mill information systems.

BACKGROUND AND SYSTEM TESTING

Rolling mill operators are being pushed to do more with less personnel and fewer spare parts. Unfortunately this means the loss of valuable knowledge from experienced workers, a lack of time to evaluate patterns, and a lack of spare parts in the case of a major problem. The result of this is the inability to recognize important operational signs during mill operations. This includes interpreting wear of components during bearing rebuilds.

Detecting fault conditions before they threaten MORGOIL® bearing operation, and diagnosing the underlying cause, allows problems to be corrected on a convenient schedule resulting in maintenance cost savings and reducing production losses. Often times, a single problem found and corrected will more than pay for the cost of implementing the monitoring system. A successful monitoring system reduces emergency repairs and the costs associated with them. As program reliability is further proven, additional savings result from a decreased need for a large spare parts inventory and redundant off line units.

In order to support continuous bearing research, Morgan Construction Company commissioned the worlds first and only full size Bearing Test Stand for the development of flat mill oil film bearing technology. The Bearing Test Stand, shown in Figure 1, is built around a full size 28”-76 KLX or 30”-75 KL bearing, with a journal diameter of approximately 600 mm. This bearing and chock assembly are designed exactly as they would appear in an operating mill.

The Bearing Test Stand was designed with an AGC cylinder that applies up to 800 tonnes of force, and a variable speed drive system that can run from 3 to 1000 RPM. A 120-channel data acquisition system was installed so that pressure, temperature,

strain, force, and cylinder position could be continuously monitored. Proximity probes were installed in each test bushing to measure oil film thickness in real time. Other bearing parameters such as oil drain flow and temperature, oil inlet flow and temperature have also been tested in the Bearing Test Stand. Components of the monitoring system were developed using this unique testing facility.

SYSTEM OVERVIEW

The MORGOIL® Bearing Monitoring System has been designed as a modular system. The system can be economically implemented in phases. Each mill stand has an independent system of transducers along with necessary data acquisition computers and reporting displays. Each of these stand based systems can operate independently or can be networked into the full MORGOIL® Bearing Monitoring System.

Figure 2 is an overview of the system. The heart of the complete system is the central monitoring software, the MORGOIL® Data Manager. Continuous data from each stand is recorded in a database. Other computers on the mill network can then access this data. Potentially, Morgan could also remotely monitor this data and provide advice to operators. The MORGOIL® Data Manager will be able to continuously review the data looking for potential failure points so that mill operations can be warned before there is a problem.

The Stand Monitoring System, module 1, is the starting point for data collection. This provides the data necessary for the full system to monitor and report on bearing status. Module 2 is equipment to monitor the lubrication system. This information will also be fed to the MORGOIL® Data Manager to provide more background information for predicting failure points. Module 3 is equipment to provide roll shop data to the system. This will allow the MORGOIL® Data Manager to track and troubleshoot usage of sleeves, bushings, and chocks. Module 4 is finally an interface to the main mill computer system. This will allow the logging of any information to the mill database and provide coil information to the MORGOIL® Data Manager.

SYSTEM DETAIL

The following sections detail the functions of individual system modules.

MORGOIL® Data Manager

The MORGOIL® Data Manager is a central computer with software that integrates and stores all data from the sub-systems. This central computer will track and display all alarms and will perform historical trending of data from any system transducer.

Most importantly, the system will have the troubleshooting experience of MORGOIL® field service personnel built into it. The system will continuously monitor the data trends looking for patterns that would indicate a problem with a mill component. Many times bearing failures are caused by other mill components such as rocker plates. Indications from different bearing parameters can point to this type of problem if interpreted properly.

When combined with the Roll Shop Tracking System, operational information can be linked to the various bearing components so “trouble” parts can be identified.

When connected to the central mill computer with the Connectivity Module, coil information can also be linked as well as operational parameters passed back to the central mill system.

Data, including alarms and trends, can be displayed on any properly configured mill computer. These can be located in places such as the roll shop and engineering offices. Additionally, Morgan Construction, if authorized, can also review the data to assist mill personnel.

Module 1 - Stand Monitoring System

The Stand Monitoring System, Figure 3, is designed to operate totally independently of the full MORGOIL® Bearing Monitoring System. It includes facilities for monitoring oil flow into and out of the chocks as well as oil pressure, temperature, and flow. Optionally, transducers can be mounted in the bushing to monitor the oil film condition and chock alignment. Each stand has an optional display that warns of problems with oil flow, temperature, and bearing oil film breakdown. Alarm outputs for individual stands are also managed at this level.

The bearing drains contain flow sensors, which continuously monitor oil flowing through the bearing, as well as drain temperature. Oil pressure, flow, and temperature into the bearing is tracked. As an option, temperature sensors can be located in the bushing to monitor surface temperature. These transducers, when properly interpreted by the MORGOIL® Data Manager, can warn of impending oil film breakdown and bearing misalignment.

The individual Stand Systems are designed to be integrated into the MORGOIL® Bearing Monitoring System, but they can also be left as stand-alone. When used in stand-alone mode, there is no logging of data, but all operational alarms can be displayed for the operator.

Note that Figure 3 only shows half of a stand for clarity, the actual Stand System monitors all four bearings.

Module 2 - Lubrication Monitoring System

The Lubrication Monitoring System is depicted in Figure 4. Pressures, temperatures, and flows are monitored throughout the lubrication system. There is a local data acquisition system with optional display. The data is sent to the MORGOIL® Data Manager where it is integrated into the troubleshooting diagnostics. All lube system information can be displayed by the MORGOIL® Data Manager. This system helps to ensure that the proper quantity of oil at the correct temperature and pressure are supplied to the bearings. It can also provide alerts on such things as when to clean filters.

Proper lubrication is essential for reliable MORGOIL® bearing operation. MORGOIL® field service experience shows that incorrect lubrication accounts for a significant percentage of bearing failures. Lubrication is the 'blood of the bearing' and the proper maintenance of its parameters can make or break bearing service and life. The integration of lubrication system parameters with mill stand parameters provides the best possible predictive maintenance for the MORGOIL® bearing.

Module 3 - Roll Shop Tracking System

The Roll Shop Tracking System, currently under development, will allow the tracking of components in the mill. It is shown in Figure 5. This is valuable information that can lead to the prevention of failures. Parts and their operation will be linked together, so information such as "whether there is a specific chock is running hotter than the others" can help to remove a suspect component from service so maintenance can be performed before it contributes to a failure. Additionally, the life of components can be tracked, such as the average bushing and sleeve life.

This module will act as a MORGOIL® Field Service Expert Manager, providing maintenance advise based on visual inspection of wear patterns in the different MORGOIL® bearing components.
Roll shop personnel will also be able to look at all the other operational bearing information provided by the MORGOIL® Data Manager, so they can stay informed about the status of in-use components. The MORGOIL® Data Manager also will have a knowledge base of troubleshooting information for bearing components. This can help a roll shop find the root cause of bearing problems they encounter.

Module 4 - Mill Operations & Database Connectivity

The Mill Connectivity module, Figure 6, will allow the MORGOIL® Data Manager to communicate with the main mill computers and receive coil information so component tonnage can be tracked. Also, if there is a problem, affected coils can be identified. Additionally, any bearing related parameters can be passed to the central mill database to be stored at that level.

OPERATION

Currently several components of the MORGOIL® Bearing Monitoring System are under evaluation using the MORGOIL® Test Stand located in Worcester. This setup allows bearing operational parameters to be varied under controlled circumstances and the effects to be reviewed.

CONCLUSION

The MORGOIL® Bearing Monitoring System is being introduced to the marketplace due to mill operator requests to respond to the continuous pressure to improve equipment reliability while keeping maintenance cost to a minimum. A well implemented and managed MORGOIL® predictive maintenance system, combined with proper roll shop analysis, is the most effective method of managing risk, increasing reliability, and ensuring the best possible return on mill operation.
Condition-based monitoring of critical equipment will continue to grow and it will become more sophisticated. Remote monitoring will become prevalent in the future. MORGOIL® is ready to support customers in these critical technologies.

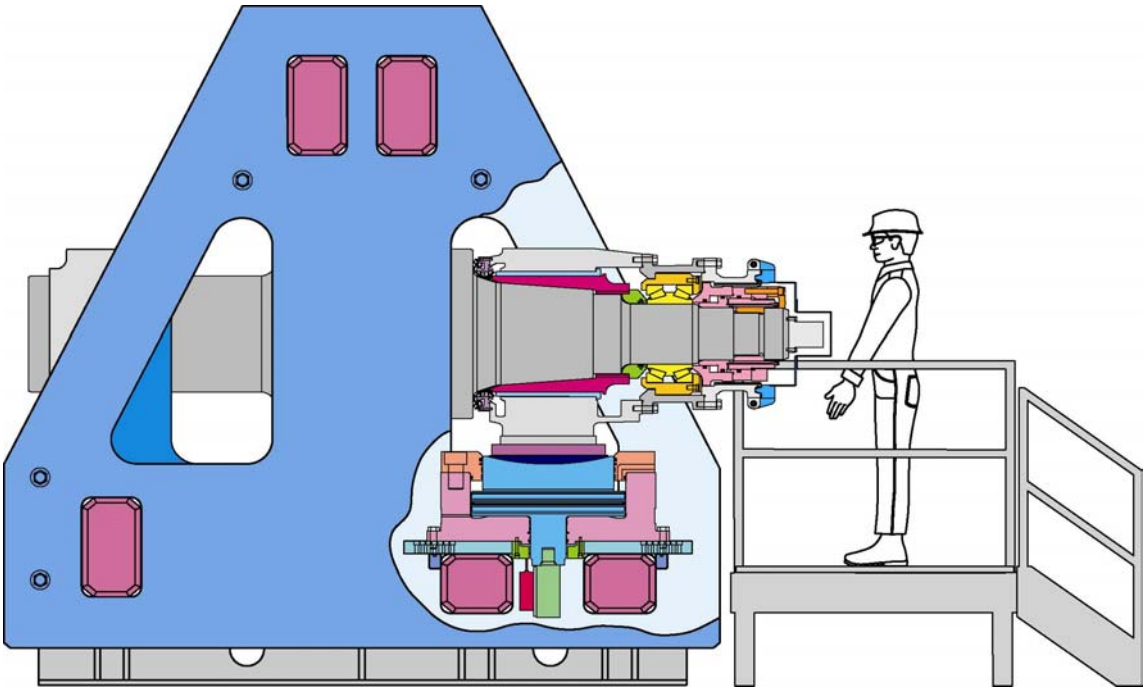

Figure 1.Schematic of MORGOIL® Bearing Test Stand built by Morgan Construction Company

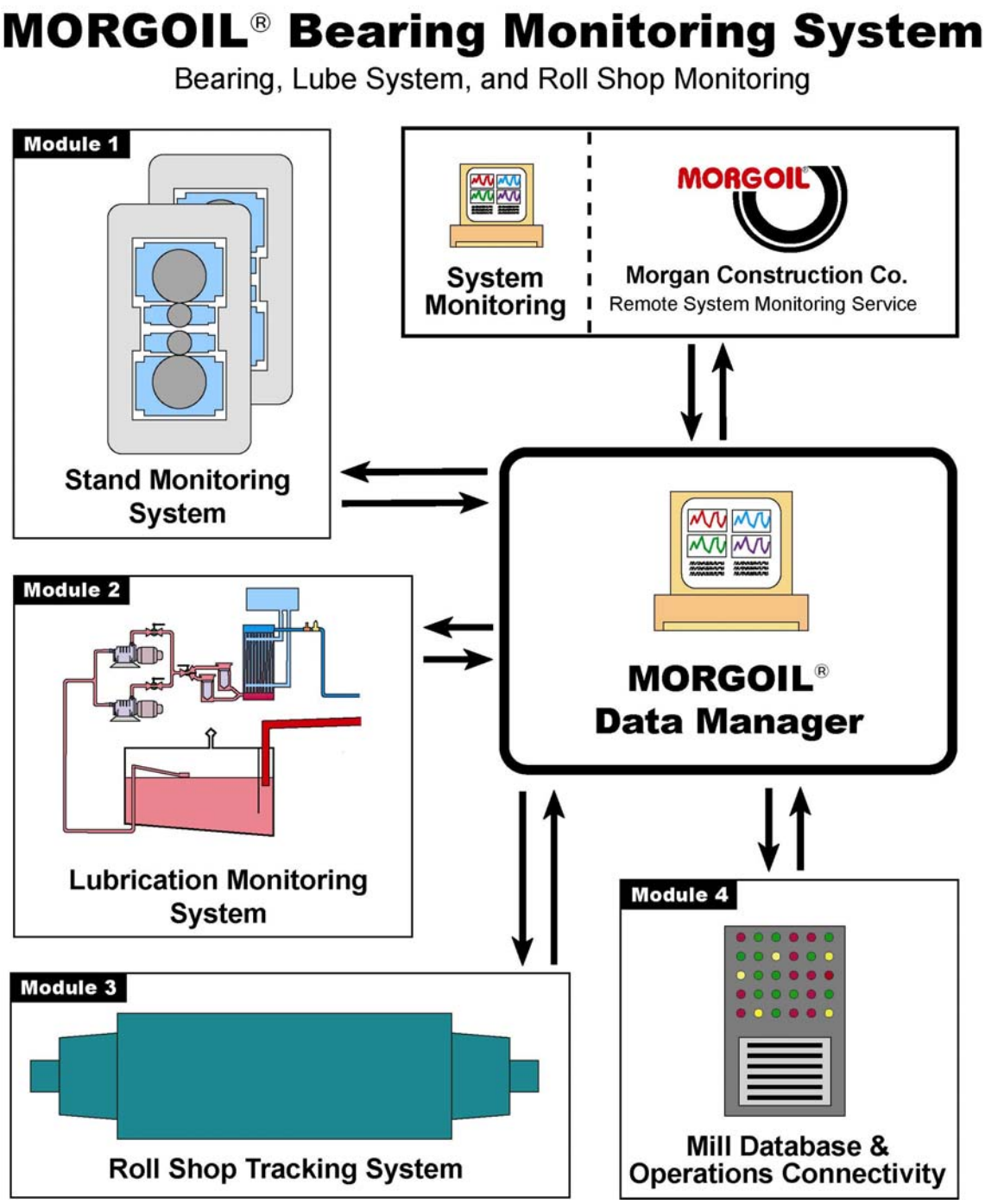

Figure 2. MORGOIL® Bearing Monitoring System overview

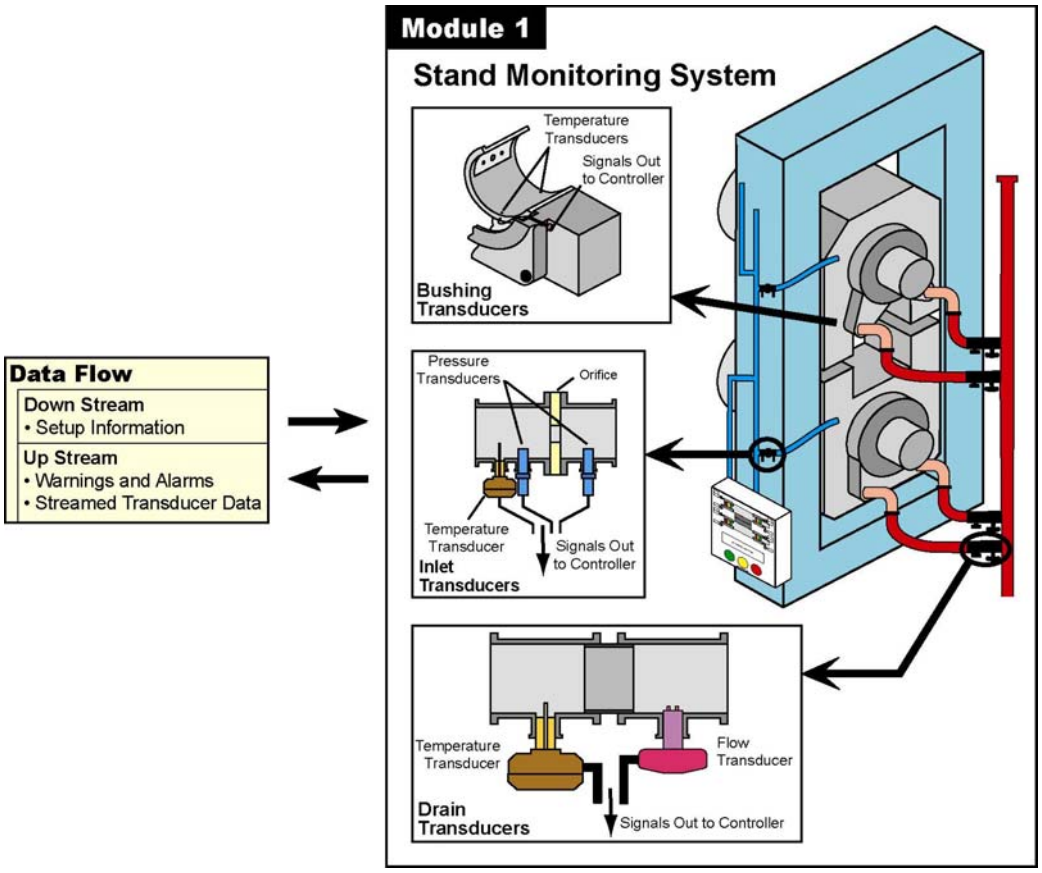

Figure 3. Module 1 - Stand Monitoring System

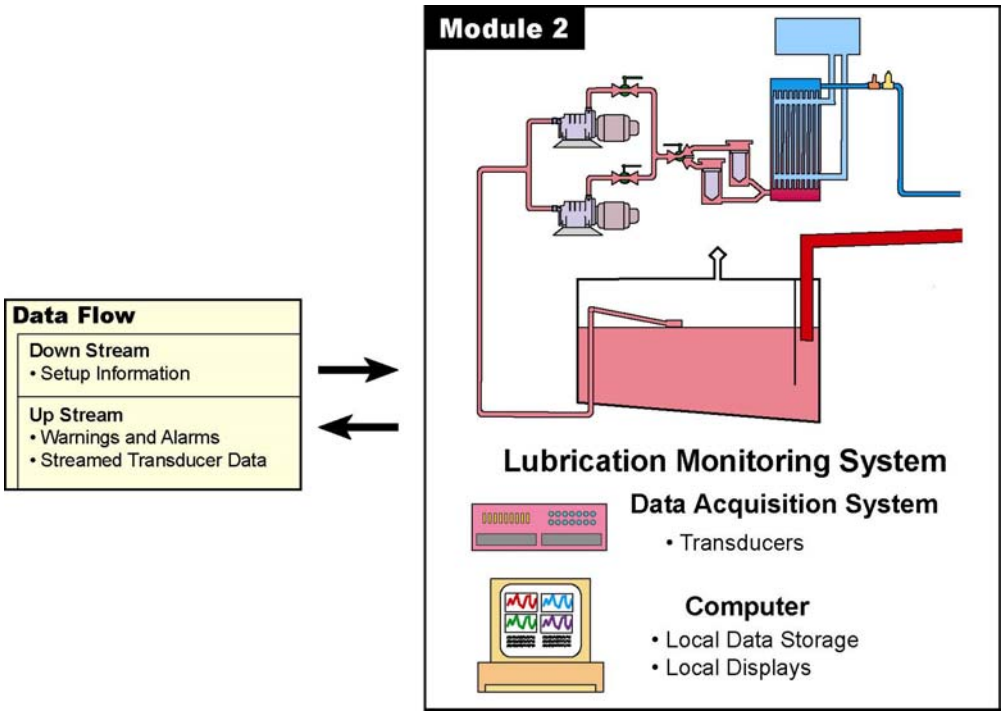

Figure 4. Module 2 - Lubrication Monitoring System

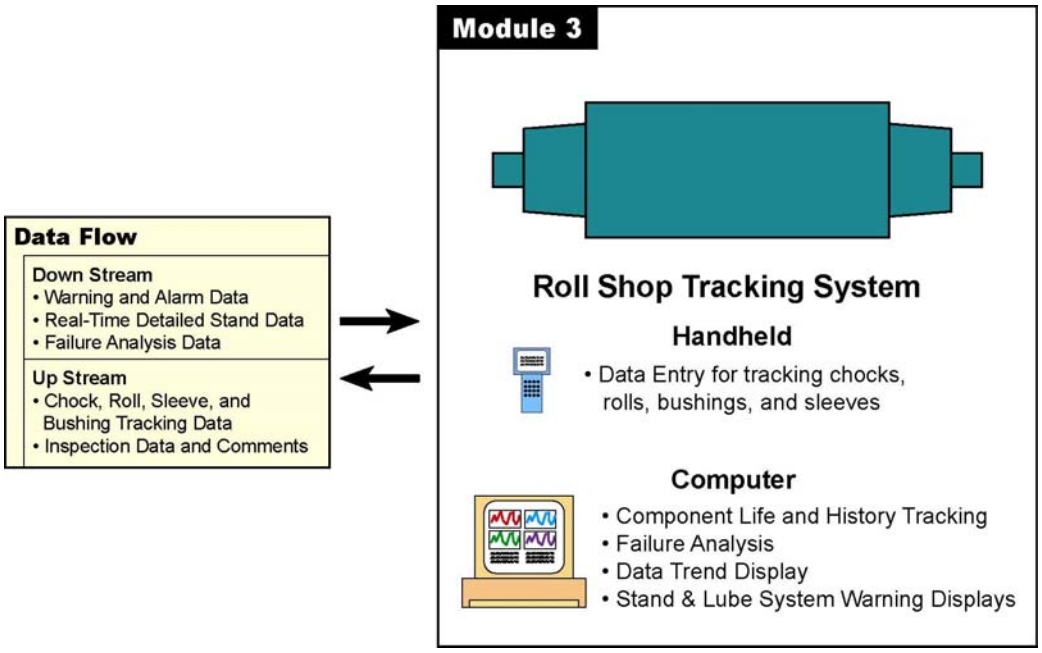

Figure 5. Module 3 - Roll Shop Tracking System

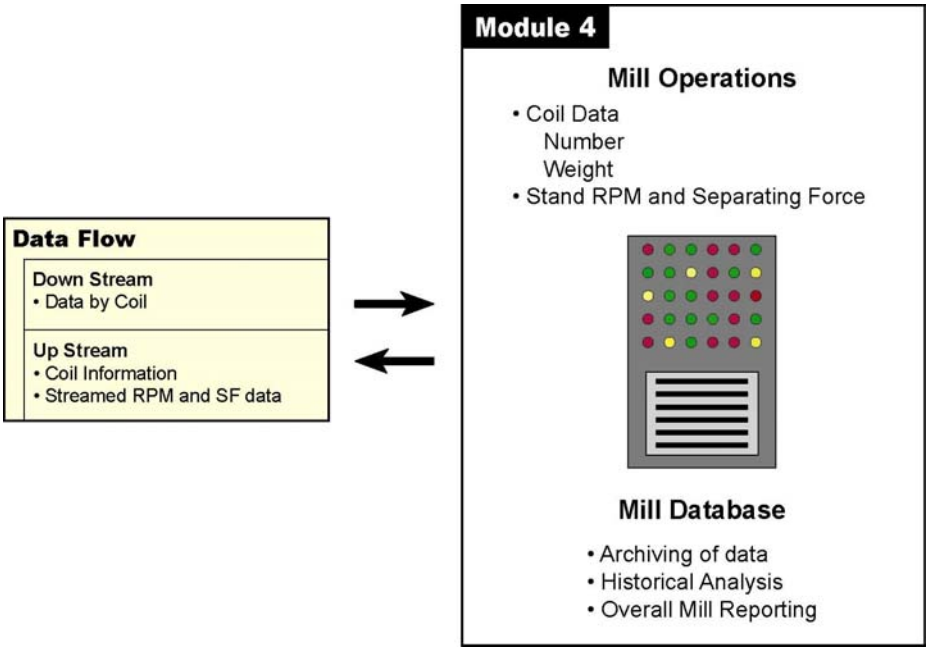

Figure 6. Module 4 - Mill Operations & Database Connectivity

SISTEMA DE MANUTENÇÃO PREVENTIVA PARA MANCAIS MORGOIL® [1]

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Resumo

Baseado no fato que a eficiência e disponibilidade dos mancais MORGOIL® impactam diretamente na produtividade e qualidade dos laminadores onde são aplicados e que sua perfeita disponibilidade e gerenciamento impactam positivamente nesta produtividade e na oficina de cilindros, porém como poucas companhias dispõe de recursos e expertise para desenvolvimento de sistemas de manutenção preventiva. Estes sistemas são a base para prevenção de problemas e programação da manutenção conseguindo assim o requerido sucesso na operação a longo prazo. Baseado na tecnologia de monitoramento de condições operacionais a Morgan Construction Company vem desenvolvendo um "Sistema de Manutenção Preventiva" para monitorar e assegurar a operação dos mancais MORGOIL® num esforço de minimizar paradas não programadas e aumentar a produtividade. Este sistema utiliza uma tecnologia completa de sensoriamento, computadores industriais e um software de análise e gerenciamento de dados para capturar e interpretar as informações vitais na operação dos mancais MORGOIL®. A interface do programa irá oferecer aos operadores do laminador uma análise em tempo real dos avisos em casos onde os parâmetros de operação dos mancais excederem seus limites de segurança. Estes parâmetros fora de limite podem ser causados pelas partes componentes do laminador ou mesmo pelos mancais e os diagnósticos são reportados para ajudar a identificar este componente. Adicionalmente, o sistema assegura que há fluxo de óleo suficiente e adequado para os mancais antes do início da laminação. Os históricos destes parâmetros são armazenados junto ao histórico de processo da bobina, desta forma ações gerenciais podem ser tomadas a fim de implementar ações corretivas. O sistema tem a possibilidade de expandir suas funções realizando um completo monitoramento da sala de óleo bem como realizar rastreabilidade na oficina de cilindros guardando um histórico dos componentes envolvidos. O histórico dos componentes assegura à oficina de cilindros a percepção de que falhas repetitivas se devem à componentes específicos. O sistema interage com os sistemas de controle e operação do laminador. Uma boa implementação e gerenciamento do "Sistema Preventivo MORGOIL®" aliado com uma apropriada análise da oficina de cilindros é o mais efetivo método de gerenciamento de riscos, aumentando a confiabilidade e assegurando o melhor retorno operacional do laminador.

Palavras-chave: Sistemas preventivos; MORGOIL®; Sistemas de monitoramento; Análise de desempenho; Automação.

[1] *Contribuição Técnica ao 42º Seminário de Laminação Processos e Produtos Laminados e Revestidos; 25 a28 de Outubro de 2005, Santos, SP, Brasil.*

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