STEAM SLURRY PUMP STRATEGIC MAINTENANCE APPROACH

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Abstract

Pump performance in the Alumina Refining industry has a significant impact on overall production and cost. This is due to large networks of pumps and pumping systems used to transport the required process media in an alumina refinery. The aim of this paper is to discuss, how a strategic and holistic approach to asset management can be adopted in order to address pump performance criteria such as reliability, availability and maintainability.

In particular the pump that is the focus of this paper is the Worthington 20 x 14 x 24 Duplex Steam Slurry Pump, used as part of the Digestion process at Queensland Alumina Limited. This pump is a reciprocating positive displacement pump using a piston and cylinder arrangement to pump liquor (caustic soda) across a slurry to liquor interface. The purpose of the pump is to transport bauxite slurry to Digestion Unit 3.

During the period of July 2005 to December 2006 there was a general increase in the production downtime attributed to these pumps and subsequently a maintenance project was initiated. The focus of this project was to review and address areas of concern such as existing maintenance & operation strategies, drawings & documentation, warehouse management, bill of materials, condition monitoring, downtime monitoring, rotating spares and work instructions & manuals.

By engaging all the necessary stakeholders the above areas of concern were addressed successfully. Subsequently a decrease in production downtime was recorded. The use of a strategic and holistic approach to asset management in conjunction with involvement from all stakeholders provided QAL with a positive outcome. This paper will discuss the journey and the outcomes

Notation and units

QAL	Queensland Alumina Limited
SAP	Systems Applications Products in-data processing
RCMO	Reliability Centred Maintenance and Optimisation
NDT	Non – Destructive Testing
KPI	Key Performance Indicator

1. Introduction

This paper aims to describe how a strategic maintenance approach to asset management can be applied in order to improve reliability, availability and maintainability of existing plant within QAL. The plant that will be the focus of this paper is the Worthington 20 x 14 x 24 Duplex steam slurry pump. QAL utilizes six of these pumps as part of the Digestion process to transport the bauxite-caustic slurry media to Unit 3 digester at a pressure of up to 4000KPa. Typically only four of the six pumps are used at any one point in time with two remaining on stand-by. This paper will illustrate the methodology and tools used to improve the performance of the steam slurry pumps whilst engaging individual stakeholder participation throughout the process.

2. Background

Historically the steam slurry pumps have been used as part of the Bayer process at QAL and like most reciprocating positive displacement pumps are seen to be high cost pumps used within the plant. In addition to this the manufactured design of steam slurry pumps date back as far as the 1960's. Therefore reliability and maintainability are crucial elements for their use as compared to other modern pumps used in industry today. During the period of July 2005 to December 2006 the steam slurry pumps were recognized as critical plant causing flow capability loss to Digestion Unit 3. This criticality assessment was initiated using capability loss data relying on control room operator feedback. The data showed how the steam slurry pumps performance affected flow capability production loss, measured in tonnes. During the period of July 2005 to December 2006 the steam slurry pumps contributed to significant production loss capability as compared to previous year records. Hence the Maintenance Services Department of QAL engaged the site pumping systems engineer to initiate a strategic maintenance project. The aim of this project was to address short falls in reliability, availability and current maintenance activities adopted for these pumps.

3. Methodology - Strategic Maintenance Project Framework

Prior to initiating the maintenance project for the steam slurry pumps a formal framework was needed to provide direction for the team participating in the project. The frame work utilized was the Equipment Care Strategy Flowchart shown below in Figure 1.

In essence this frame-work provides a methodical process which utilizes the PDCA (Plan, Do, Check, Act) cycle in order to deliver the stated objective being reliability, maintainability and availability for the steam slurry pumps. Incorporated into the Equipment Care strategy are also strategy analysis tools such as RCM (reliability centred maintenance) analysis and FMEA (failure mode equipment analysis) review. Using this frame-work a project team was developed consisting of a day area supervisor, maintenance supervisors, maintenance planners, maintenance technicians, reliability engineers and leading the team was the pumping systems engineer.

4. Project Approach

Once a team was developed the initial task was to initiate an RCM analysis on the steam slurry pumps. Reliability Centred Maintenance and Optimisation software was utilized at QAL to facilitate this analysis. This process consisted of identifying functional failures, failure modes and failure effects. This then resulted in a proposed recommendation for each failure effect throughout the analysis. Figure 2 below shows and example of this.

EQUIPMENT CARE STRATEGY FLOWCHART

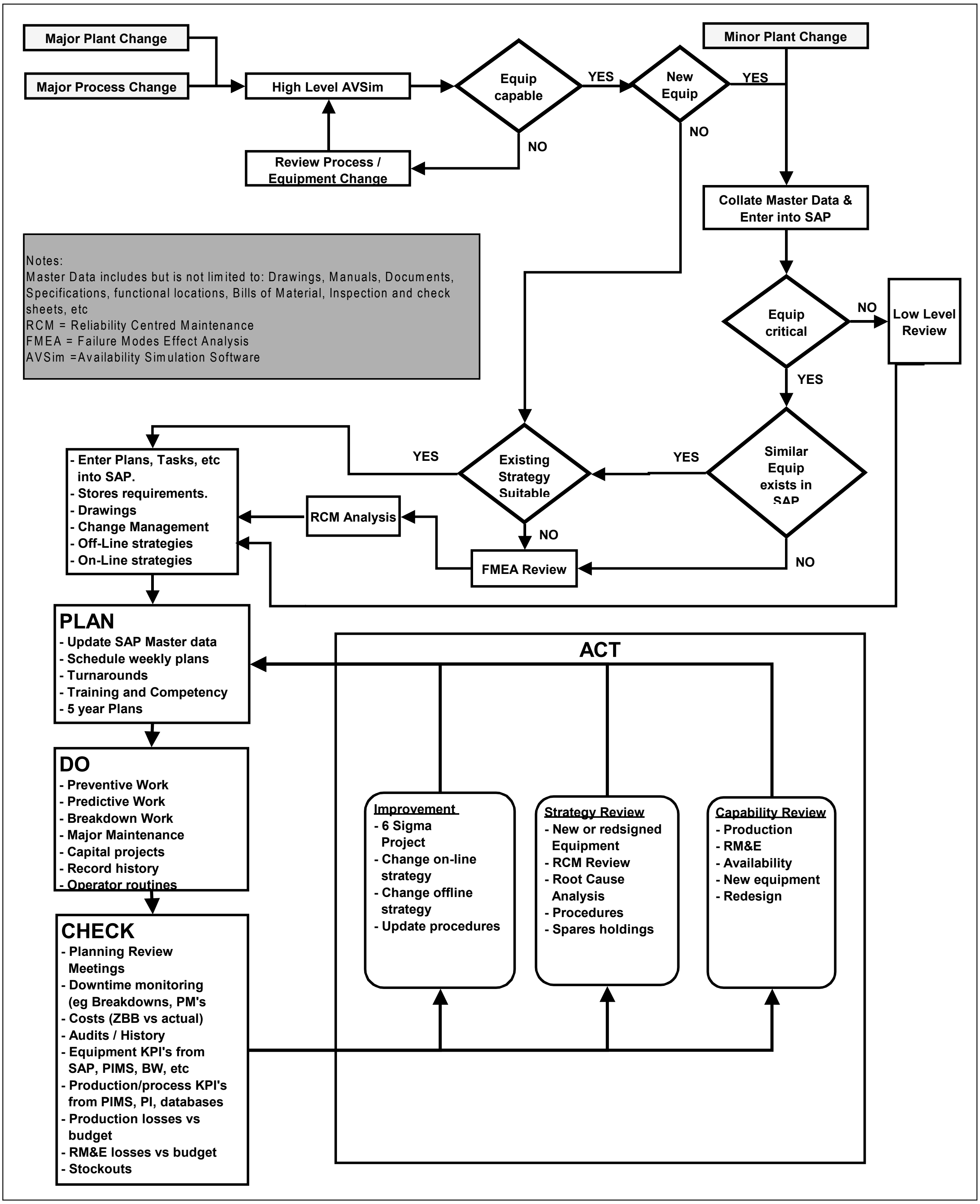

Figure 1. Equipment Care Maintenance Strategy (McDonald 2004, p.1)

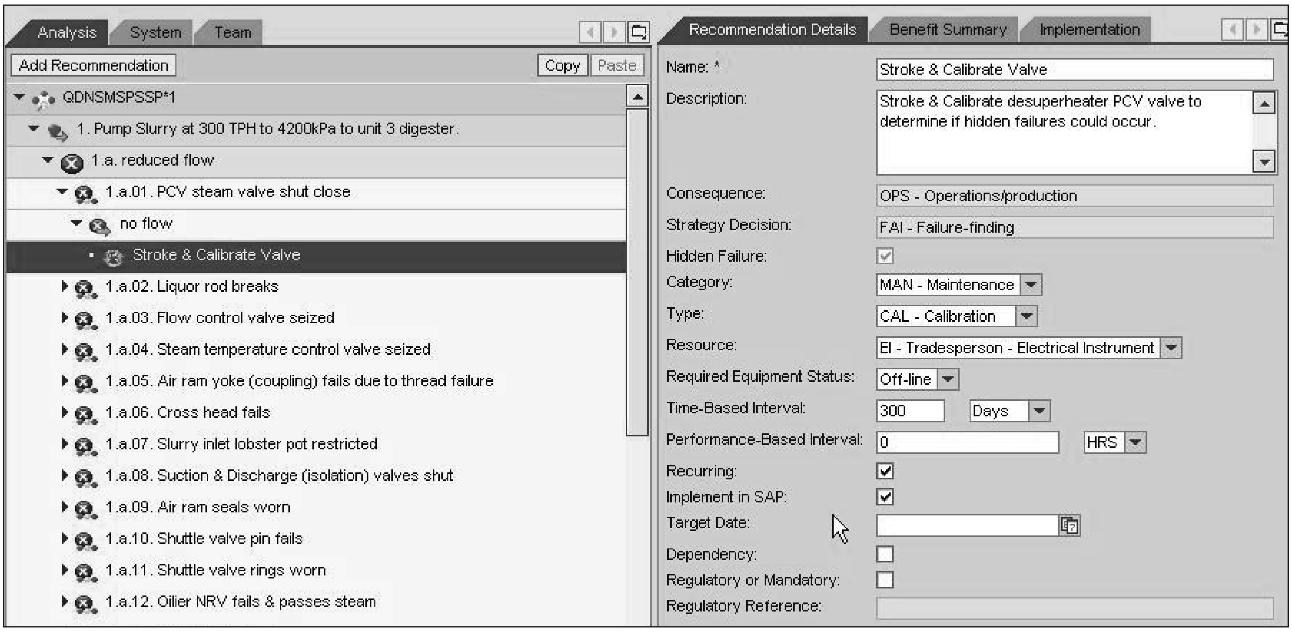

Figure 2. Example of RCMO Analysis Recommendation (RCMO 2007)

The RCMO analysis required facilitation of fived staged workshop sessions. The first two sessions required identification of all the respective functional failures and their respective failure modes for the steam slurry pumps. This required brainstorming all of the applicable functional failures and identifying appropriate failure modes relating to the steam slurry pump and associated equipment. With now the functional failures and failure modes identified the remaining three workshop sessions were run to outline the appropriate recommendations. A key part of building the analysis was providing the necessary information to ultimately develop quality recommendations. This included detailed descriptions of the recommendation, accompanied by the decision strategy, the consequence, type of working being conducted, work group conducting the task and finally the duration of the recommendation task.

On completion of the RCMO analysis a list of recommendations were developed and deployed. Some of these recommendations affected work groups such as engineering maintenance, mechanical maintenance teams, electrical and instrument teams, operational teams and the process control group.

Subsequent to this RCMO analysis a number of key influences affecting the overall success of the maintenance strategy for the steam slurry pumps were also addressed and reviewed most of which were recommendations of the RCMO analysis. This review included the following items all of which were critical to the overall success of the maintenance strategy, these included:

1. Functional Location Hierarchy
2. Bill of Material
3. SAP Maintenance Plans
4. SAP Maintenance Task list (mechanical & electrical/ instrument)
5. Engineering Standard
6. Operating Procedure
7. Warehouse Stock Holdings
8. Rotating Spares
9. Control Strategy
10. Maintenance & Operating Procedures
11. Rotating Spares Rebuild Procedures
12. Condition Monitoring & NDT
13. Specification (Lubrication)
14. Down Time Monitoring (metrics & KPI's)

These key maintenance influences played a significant role in achieving the desired outcomes for the steam slurry pumps. When addressed and rectified, noticeable changes in production capability and reliability for the steam slurry pumps were noticed.

This process however would not have proven successful if the key stakeholders were not included as part of the initial project team. More specifically key plant personnel such as lead tradesmen from the maintenance team were directly involved in addressing some of the key influences mention earlier. This included direct involvement with maintenance personnel who helped develop in-service inspection and rebuild procedures, identified flaws in the steam slurry pump control strategy, reviewed existing bill of materials, updated and improved SAP maintenance task lists for their teams and also provided input into changes required for the existing maintenance strategy.

A key learning that was evident after completion of the strategic maintenance project was the early participation of select maintenance personnel. This not only provided the desired outcome which was to improve production loss capability and reliability but also provided a sense of ownership within the maintenance team who are tasked to conduct maintenance on the steam slurry pumps.

5. Conclusions

The purpose of this paper was to define a methodical strategic maintenance approach towards asset management and in particular the focus of this paper being the steam slurry pumps. This paper has identified the methodology and processes used to identify and examine existing maintenance strategies as well as utilizing tools such as RCMO which help document such strategies. This maintenance project however would not have proven successful had QAL not engaged the correct stakeholders as part the project team. Utilizing such plant knowledge and expertise along with a strategic maintenance approach has provided QAL with a reduction in capability production loss as well as improved reliability and maintainability of the steam slurry pumps.

References

McDonald, C. 2004, Equipment Care Management-Policy 101.001, *Queensland Alumina Limited*, Gladstone, Iss. 2, Rev. 0, p.1

Reliability Centered Maintenance and Optimization 2007, QAL – Portal, *Queensland Alumina Limited*, Retrieved: February 11, 2008, from http://16qal.qal.com.au:89/irj/portal.