RCM Process Reduces Maintenance Spending and Increases Production Output

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Abstract: *RCM analysis is a powerful tool to change attitudes and practices for both maintenance and operations personnel. This case study examines how Purac America successfully used RCM to improve high cost, underperforming equipment. Maintenance spend fell from 7% of RAV to 4% of RAV and production increased from 50% to 133% of rated nameplate capacity.*

Introduction

Purac's RCM process fundamentally changed a plant that was struggling to survive into a profitable, highly competitive enterprise. They achieved this result through a carefully planned, measured approach that heightened awareness of the need to "manage the consequences of failure" and developed the capability to do so. This paper documents the process that Purac followed and provides some insight into their success.

Initial Conditions

This facility was designed and built to produce lactic acid, something that it failed to do after commissioning in the early 1990s. Indeed, the facility underwent two false starts before Purac joined as a joint venture partner and product began to flow in 1996. Lactic acid production is delicate and its production can create harsh conditions. Prior to the RCM work, it was not uncommon to find deep potholes in the concrete flooring where leaks accumulated. Outward signs of production struggles, such as the flooring potholes, were confirmed by the failure of output to exceed 50% of nameplate and the facility's maintenance expense running at 7% of RAV. The facility was modified further by a redesign project in 1999, which failed to significantly improve production or maintenance performance.

Road to Success

New plant leadership went in search of a process that would identify both production and maintenance issues. Rather than immediately launching into the RCM process, Purac partnered with MRG to identify foundational issues. By developing a master equipment list and ranking all assets according to criticality, they were able to design an efficient PM program. In addition, Purac undertook several root cause failure analyses. By clearly defining what was required to maintain the equipment and beginning the practice of informing operations of how their practices impacted equipment, these activities laid the groundwork for successful RCM.

Purac and MRG, working together, then designed a series of interlinked steps to turn around the operational and maintenance performance of the facility. The steps consisted of System Definition, Logistics, Tool Development, Implementation Planning and Sustainability.

The RCM process began with the definition of key systems. In all, 33 systems were identified and their boundaries were defined. Systems ranged from a simple Plant Compressed Air System to a Highly Advanced Distillation Process. Subsequently, the group prioritized the relative importance of each system to establish the order in which they would be addressed. A number of criteria were used to prioritize these systems, including criticality ranking, work history, and process complexity.

After establishing the order in which the equipment would be addressed, the group then identified who would participate in the analysis of each system. Purac and MRG emphasized that representation from all areas in the facility was essential to the success of the program. The group assembled teams, including:

- Craftsmen
- Operators
- EHS
- Automation
- Management
- Engineering

The group placed a very high priority on involving operators of each system in the analysis.

Because most team members had not participated in an RCM analysis and to better reinforce the mission of the team, all team members participated in a two-day training prior to beginning the analysis. The training stressed the fundamentals of RCM, such as defining all functions of the system, failure modes, effects, and causes and introduced the terminology and tools of the process. The trainings established a baseline understanding of RCM techniques that enabled the teams to be productive from the beginning of each system analysis.

Purac viewed experience with RCM and an ability to drive the process forward as the criteria for selecting an RCM facilitator. The RCM process was also designed to include a Recorder capable of acting as a second facilitator. The Recorder is a key role to maintain energy and balance during the analysis sessions. On the basis of the design of the desired process and the selection criteria, Purac chose MRG to facilitate the RCM sessions.

Purac and MRG made a concerted effort during the early phase of the project to publicize the goals of the process and the activities associated with attaining the goals. The group published a detailed schedule for the analysis of all 33 systems, including:

- Date
- Time
- Personnel
- System

The schedule allowed a clear understanding of what systems were being addressed and showed progress towards an intermediate goal of completing the analysis of all systems.

Each RCM analysis began with the development of a functional block diagram that detailed each system. Each diagram included the equipment, instrumentation, major valves, piping and associated numbering systems. During the development of the diagrams, each team revisited the system boundaries to assure that all key functions were

included. The functional block diagram was constantly displayed during the RCM sessions to help guide the analysis.

The RCM analysis followed Failure Modes and Effect Analysis (FMEA) forms that were distributed to all team members during the analysis. In addition, the FMEA forms were also "filled out" by the group on a large white board. The facilitator and recorder used the white board to guide the process and to display progress.

The results of the RCM sessions led to the development of detailed action item lists, which affected a wide range of existing processes, including:

- Standard Operating Procedure development and revision
- Preventive maintenance procedure development and revision
- Predictive technology deployment
- Plant design recommendations
- MRO process development or revision
- DCS programming changes
- Operator directed maintenance actions
- Contractor re-evaluation

The team prioritized, assigned and then managed the implementation of the action item lists. Attention to detail at this step was essential to the ultimate success of the RCM project. As with any organizational change, the RCM process requires changes to the people, process and system dimensions of the organization. The system dimensions of the organizational change were supported by Purac's CMMS. The RCM teams modified workflows as required.

Sustainability

The people dimension of the RCM changes was a primary focus area during the development of the RCM program. The Purac/MRG group strove from the outset to involve as many people as possible. This enabled the people who would ultimately be affected by the changes to take ownership of them. Most participants enjoyed the analysis process and even the most experienced personnel learned something new about their system. Indeed, the process instilled a focus for the entire operation on "how can we correctly identify the failure mode and put the controls in place to mitigate the consequences of that failure." The group maintained the early momentum by providing ongoing training for operators and maintainers that directed them to review the applicable RCM for their system continuously. As a result, a system was started to recognize the efforts in problem resolution using the RCM thought process. Finally, Purac made every possible effort to publicize successes.

Results

Purac's RCM process has yielded long-lasting results that can be tied directly to top and bottom line results. Maintenance costs have been cut by more than 50% since the inception of the program, while production has been boosted from less than 50% of

nameplate capacity to significantly that level. In balance, the RCM program has generated a double digit ROI amounting, cumulatively to more than $10 million.