

## **The Journey from Reactive to Proactive - How Portland General Electric is Using RCM to Change Their Maintenance Culture**

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### **Abstract**

Portland General Electric has recently completed a number of Reliability Centered Maintenance studies at their Boardman generating facility. Although the predicted results are impressive Portland General Electric is simply using Reliability Centered Maintenance as the tool to initiate a change in their maintenance culture. Each Reliability Centered Maintenance study is viewed as a model for change, an opportunity to engage their workforce and promote the benefits of proactive maintenance. Indications that a shift in maintenance culture is occurring are beginning to appear. Maintenance engineers are suggesting assets for further Reliability Centered Maintenance studies; maintenance planners are willingly gathering data and maintenance trades are openly providing information during facilitated sessions. News of the positive results obtained from these initial studies is starting to now filter throughout the rest of the company and is changing the mindset of those who had previously steered away from Reliability Centered Maintenance. The changing mindset is also partially due to the simulation software that has been used which can rapidly collect knowledge and show benefits for each maintenance task either from a cost point of view or lower safety/environmental and operational risk. These optimal tasks are loaded electronically to Maximo providing a rapid solution to what has been a major obstacle to implementing the results of Reliability Centered Maintenance Studies. Portland General Electric is not successful just yet in achieving an institutionalized and self sustaining culture of proactive maintenance but they are heading in the right direction and the reliability journey continues.

## **Introduction**

Setting out to shift an organizations culture towards proactive maintenance is certainly quite a goal. It is one that most organizations strive for but many fail to achieve. At Portland General Electric (PGE) this same goal is the desire and the same challenges exist.

What separates PGE is not commitment to the program at all levels of the organization although with constant communication this is changing. It is not the quality of failure data; it is not even the IT infrastructure that is in place. What separates PGE is that the reliability improvement program has been developed to empower people. The program promotes the benefits of proactive maintenance and enables people to realize that there are tools and methods available to get out of the reactive maintenance environment and become part of a proactive maintenance culture. This self realization is being achieved through on-site presentations, training, coaching and facilitated RCM studies. This self realization is used as a very powerful tool which is supported when necessary by the reliability improvement team. The support provided includes leading, mentoring, coaching and assisting people to achieve results. This kind of support is proving essential to ensure that those people who are motivated to become proactive are engaged which in turn encourages others to also become proactive. This snow ball effect is allowing PGE to shift the critical culture mass towards a sustaining proactive maintenance environment.

## **Promoting**

Through the reliability improvement program a number of RCM studies have been completed at various generating sites. These studies have purposely been small in nature often being less than 2 weeks duration. The results are obtained quickly and presented in summary to the plant managers upon completion of the study. The results alone are impressive however they primarily enable promotion of the benefits of a applying a proactive maintenance culture at each generating site. The argument that “RCM will not work here” or “proactive maintenance is not for us” can no longer be sustained. The results are so impressive that they cannot be ignored.

Prior to the first RCM study being completed a small group of employees from the Boardman generating facility and from the reliability improvement team undertook a 3 day intensive training workshop. The workshop was focused on providing an understanding of the RCM method of maintenance task optimization. The participants gained an understanding of the use of failure data analysis and failure forecasting and how to choose optimum maintenance tasks that reduce the costs to the business. This workshop was the first step at promoting the benefits of a proactive maintenance culture. By carrying out this training prior to the RCM study it encouraged site employees to get involved in the study as they were able to understand how valuable the RCM results would be.

## **RCM Study #1**

The soot blowers at the Boardman generating facility were the focus of the first RCM study. These were chosen based on the very high percentage of reactive maintenance that was being

done. In fact almost no preventative maintenance routines existed. The problem was that only the costs associated with completed plant shutdown were being considered when making decisions to justify planned maintenance activities. Although the loss of one or two soot blowers will not cause a plant shutdown it is essential that they be in working order to maintain optimum fuel efficiency. The higher operating costs due to efficiency losses resulting from soot blower failures were not being recognized as an avoidable cost. The RCM study promoted the benefits of reducing unplanned failures and reducing efficiency losses through the development of an optimized maintenance plan.

To develop the optimized maintenance plan the computer simulation software (RCMCost) was used. This allowed rapid development of the RCM models, provided rapid feedback on the effectiveness of the maintenance task decisions and provided facilities for objective decision making and updating. The results generated include budget predictions, labor usage, spares usage, failure mode criticality and asset strategy reports. It is the asset strategy reports that contain the maintenance plans and maintenance tasks that were to be implemented electronically into Maximo.

To ensure management buy-in to the resulting optimized strategy a justification based on total cost was developed. Using the simulator the total cost over the lifetime for the optimized strategy is calculated and compared to the “run to fail” cost. This comparison is shown in figure 1.

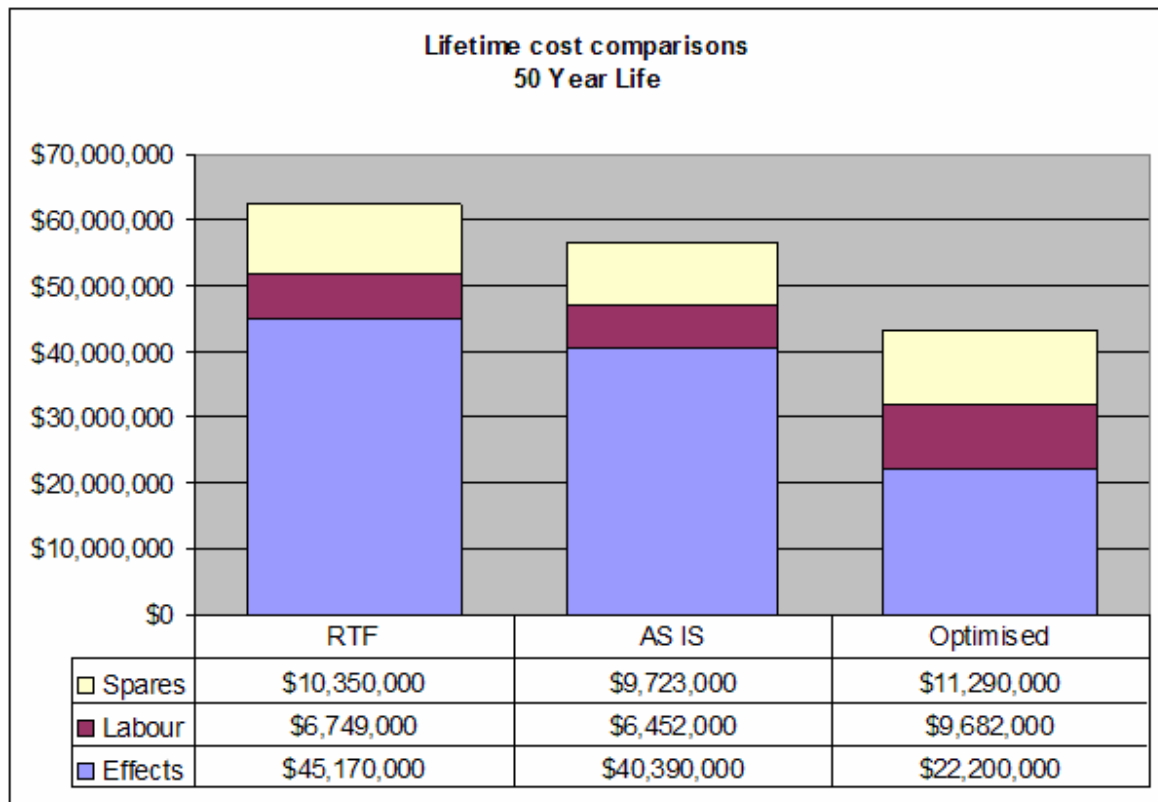


Figure 1: Total cost comparison over 50 year lifetime of the maintenance strategy options

Although there is an increase in the maintenance and spares cost for the optimized strategy the net benefit is \$267,000 annually. This is due completely to the reduction in efficiency losses caused by unplanned soot blower outages. This comparison was used to justify the adoption of the optimized strategy. The predicted maintenance budget is the second essential item to ensure management buy-in was received. This was also developed as part of the RCM study and is shown in figure 2.

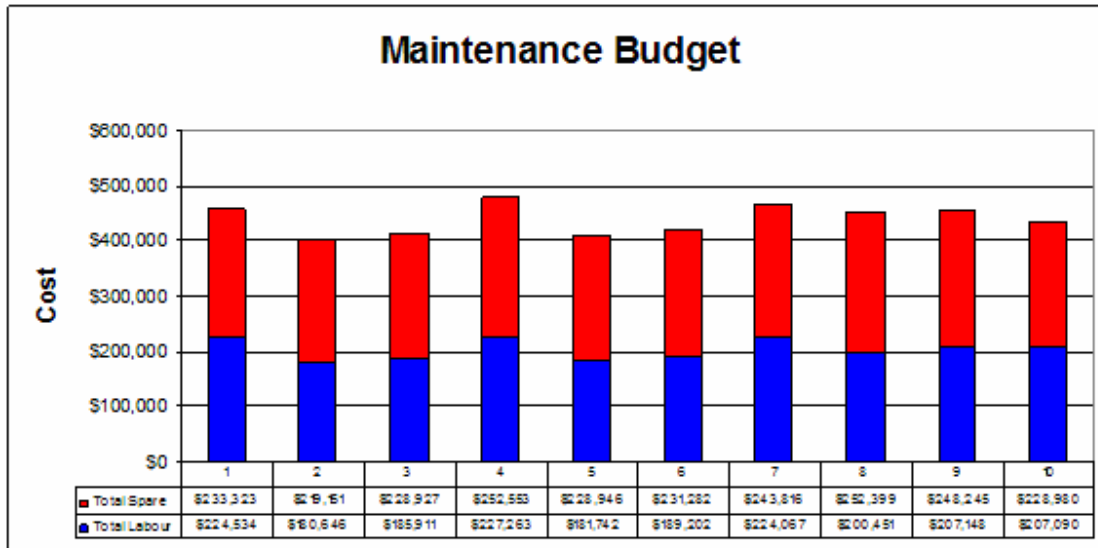


Figure 2 – Maintenance budget profile

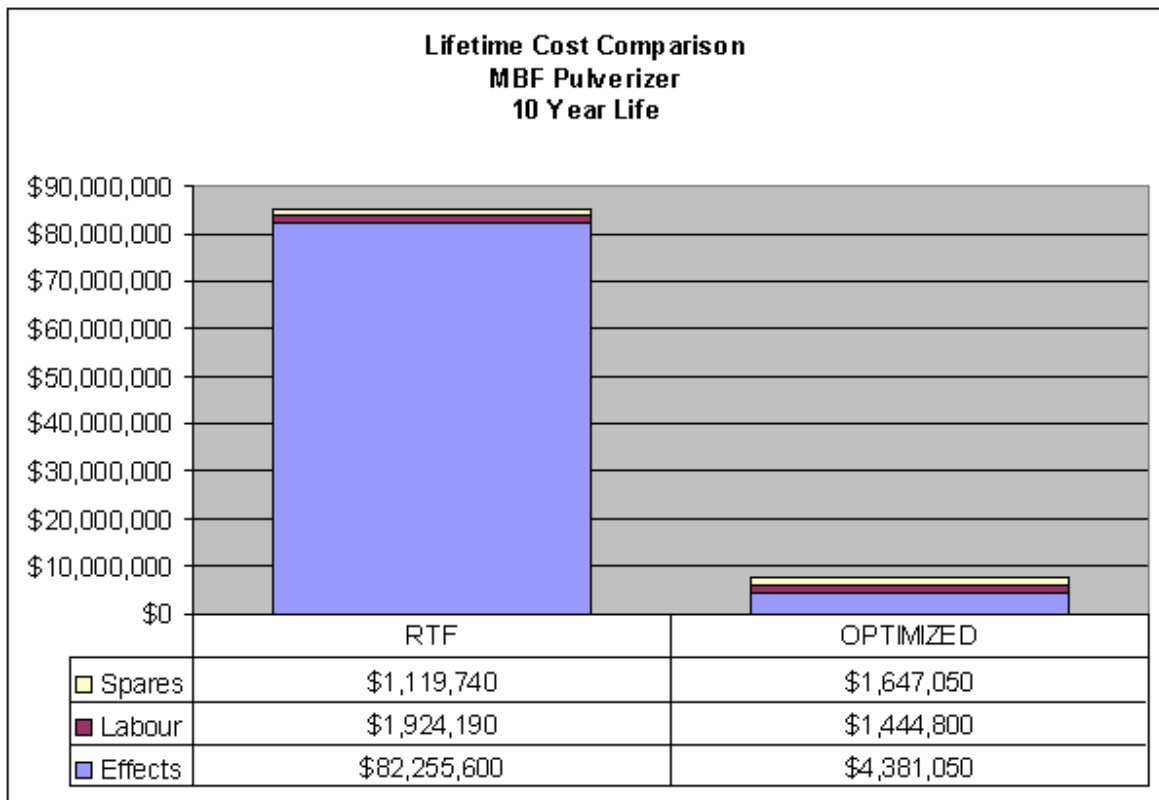
The maintenance budget will vary over time as equipment ages and requires replacement/refurbishment. This profile reflects a true zero based budget as it includes predicted breakdown maintenance costs, scheduled maintenance costs and secondary action costs as a result of inspections. This budget is easily challenged and justifiable against efficiency losses. The development of this maintenance budget was the first time that expenditure on the soot blowers was able to be separated from the total plant maintenance costs.

These results were presented to plant managers who after only a few minutes into the presentation were already discussing which assets to work on next and are starting to believe that proactive maintenance can provide the results that they have been working so hard to reach and never achieving. Promotion of the results is one of the keys to self realization.

### RCM Study #2

On the back of the successful result of the soot blower RCM study the next RCM study was initiated through a request from the Boardman generating station plant engineer. Previously this proactive thinking was unheard of. The reliability improvement team saw this as an opportunity to promote RCM as a method for the plant engineer to reduce his reactive day to day work load and enable him to focus on longer term proactive improvements.

The items studied this time were the coal pulverizers. There were eight (8) of these units. Six (6) of which were identical. By carrying out the RCM study on one of the six identical pulverizers the benefit obtained would be multiplied by six. The RCM study began by modeling the current maintenance practice. The goal in this case was not to optimize the maintenance strategy during the first phase of the study but rather to develop inspection documentation and a spares criticality listing. Phase 2 of the study which involved the optimization of the maintenance strategy was initially planned to be carried out by those people trained in the RCM approach and used as a coaching exercise. Instead of doing this it was decided that immediate results were required and a facilitated exercise to complete the optimization would be better supported. Through the facilitation process site employee involvement was critical to the success of the study and the overall reliability improvement program. The same business cost justification for the optimized strategy was developed and is shown in figure 3 below.



**Figure 3 – Total cost comparison over 10 year lifetime of the maintenance strategy options**

The presentation of the results to the plant manager and the completion of this project were viewed as a critical point in the desire of the Boardman generating station to adopt a proactive maintenance culture. The reliability improvement team did not see continuing to facilitate RCM studies as the successful path forward. Instead it was time to set-up a project team on-site and coach them through the RCM process.

### RCM Study #3

Before the on-site team was in place at Boardman a RCM study was about to be undertaken at the Beaver generating station. This would be the third study for PGE and the first at the Beaver generating station. As with the first study at Boardman it was important to promote the benefits of a proactive maintenance approach before commencing the study. Instead of the 3 day RCM workshop that was carried out at Boardman a 4 hour introduction of reliability tools and the benefits of proactive maintenance was carried out. This was attended by the plant and engineering managers, maintenance engineers, maintenance planners and schedulers. After this simple 4 hour presentation all of the key stake holders were willing to provide resources to the RCM study.

The asset chosen for this study was the clarifier. This asset was identified for the study due to a recent change in the operating requirements and the criticality of operation. At the commencement of the study the work order history was extracted from Maximo however the quality of this information was found to be poor. To overcome this the failure and repair information was collected from the experienced craftsperson in the area to develop the model. At Beaver the crafts and trades people were embraced as valuable sources of reliability information and the RCM study provided a platform for them to provide this information. The model was able to predict the benefit of the current maintenance philosophy by comparing this to the run to failure philosophy. It turned out that the current maintenance is quite effective although further improvement was possible by ensuring the critical spares were available on-site. The comparison based on total business cost between the each of these scenarios is shown in figure 4.

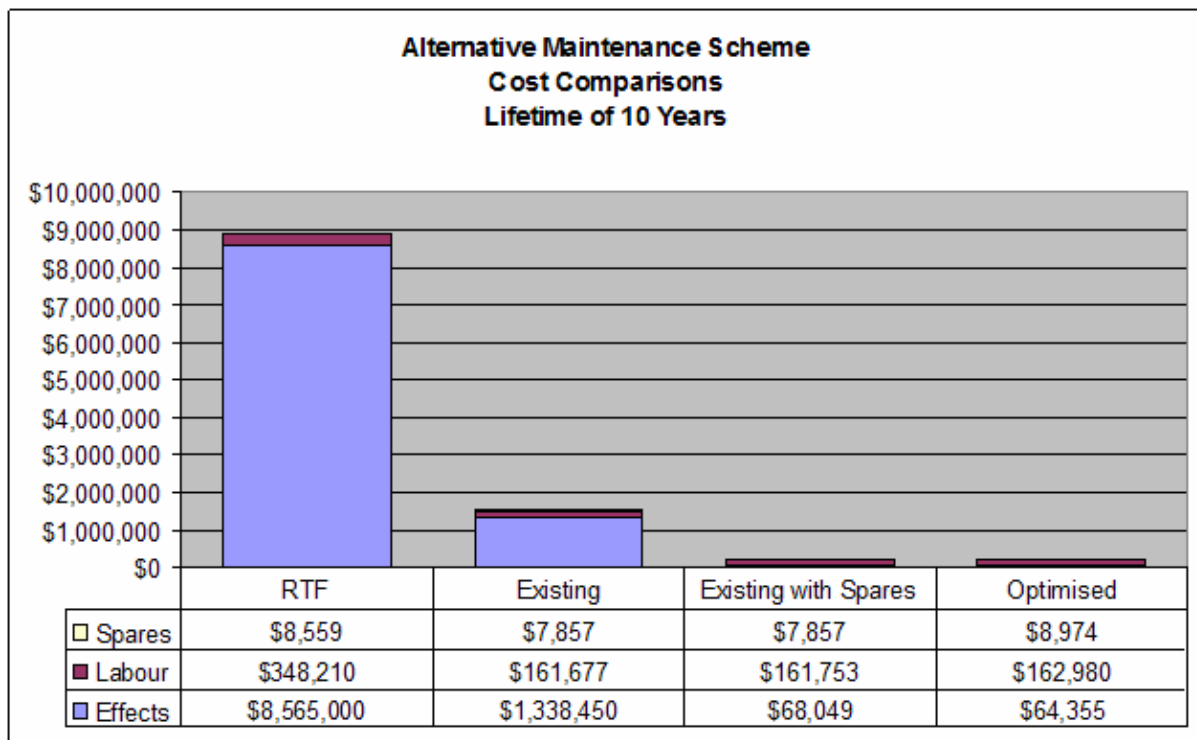


Figure 4 – Total cost comparison over a 10 year lifetime of the maintenance strategy options.

Although the RCM study did produce results such as the above cost comparison, budget predictions and a documented maintenance strategy it also highlighted chronic plant issues that could be targeted for improvement using a Root Cause Analysis (RCA) approach. At the Beaver generating facility the concept of a focused reliability improvement team quickly became reality which engaged a cross functional team and empowered them to solve these issues. This focused reliability improvement team is still in its infancy however a project plan is in place and successes will be published and presented to the highest levels of the organization. PGE has also placed in emphasis on the collection of quality information in Maximo to assist in further reliability studies.

### **The Journey Continues**

The journey for PGE which commenced in 2006 continues to gain support in 2008. This support has now reached the highest levels in the organization and signs are now evident that RCM is embedded as part of the maintenance culture. These signs include the fact that each generating site manager has a goal to complete and implement a minimum of two RCM studies. At one site in particular they are striving to complete four such studies. This is in part due to the RCM simulation tool being embraced by this site and in part due to the realization that the time to implement the resulting optimized maintenance strategy into Maximo is minimal. Other positive signs include the fact that the RCM program and methodology continues to be supported even with changes to the personnel make-up of the reliability improvement team.

This paper has presented only three of the studies undertaken in the journey from reactive to proactive maintenance PGE has taken over the last two years. The total number of studies undertaken by PGE at the time of writing has now reached fourteen. The type of assets and systems chosen for some of these studies have included a boiler feedwater system, a circulating cooling water system, a hydro generating power train, a heat recovery steam generator and an ammonia system. Each of these studies was selected to assist the plant engineers and managers to develop an optimized asset strategy and to promote the benefits of RCM in achieving proactive maintenance.

The journey for PGE will not end in 2008. Instead the plan will be to further empower and engage their workforce and continue to promote the benefits of proactive maintenance. The first stage of this plan has recently been completed with each of the sites sending representatives to workshops entitled “Reliability Tools for Maintenance Managers” and “Managing Reliability Centered Maintenance”. These were designed to teach participants how to make asset management decisions to move from a reactive to proactive behavior using reliability methods and how to develop optimized asset strategies using RCM simulation. The future training plan involves the coaching of the participants to ensure all future reliability studies undertaken are used as both learning experiences and as an opportunity to further empower plant personnel. Through this plan and commitment to the reliability improvement PGE will be successful in becoming a proactive organization.