WALKING AND TALKING ON AND UNDER WATER

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Abstract

A collaborative project involving Central Queensland University, the electricity support organization AUSTA Energy, and four Queensland power stations is described. The process that was used in setting up and coordinating the project is analyzed and discussed.
This paper describes the development of *Guidelines for the Total Management of Treated Water Systems in Queensland Power Stations* by the team. The objective of the project was to minimize corrosion in the stations' Treated Water (TW) circuits by assessing the corrosion inhibitor technologies being used. The challenge faced by the group was not only to choose an inhibitor that was "chemically effective" but, above all, to ensure that it was Workplace Health and Safety, and also environmentally acceptable.
The strategy used to obtain and collate the materials needed to write the guidelines is discussed and the outcomes of the project are presented.

Introduction

Johnson and Donaghue (1996) have commented on the very low percentage of Australian university academics who chose to take a study leave program at a large chemical industry. This influenced one of the authors to spend an Outside Study Program (OSPRO) in the Queensland electricity generation industry during 1997. This was an interesting experience, not only because of the challenges arising from the project, but also in part to the major restructuring changes that the industry was undergoing at the time.
The objective of the OSPRO was to review the chemical inhibitors used to minimise metallic corrosion in the TW circuits in Queensland fossil fuel-fired power stations and to make a recommendation on the ideal inhibitor. It needed to be not only chemically effective but also Workplace, Health and Safety compliant, and environmentally friendly.
Prior to the restructure that commenced on July 1, 1997, AUSTA Electric was a single body running the States power generation facilities. Cooperation between the stations was commonplace where a Chemists Group routinely addressed major chemical problems facing the industry and devised strategies for their successful solution. Most of the research and development work was done by the Engineering and Technology support group and all their intellectual property was distributed within the industry.
When the OSPRO commenced in July 1997, the industry structure changed dramatically. Four independent organizations were established by the State Government, three generating bodies and an electricity support organization, AUSTA Energy. The objectives of the OSPRO had to be fine-tuned to fit in with the new structure. The problem being investigated was still common to all the power

generation facilities. However, the situation was now one where the facilities were all "independent" and were competing with one another.

Results and Discussion

The structure of the team that was set up to investigate the problem is shown in Figure 1.

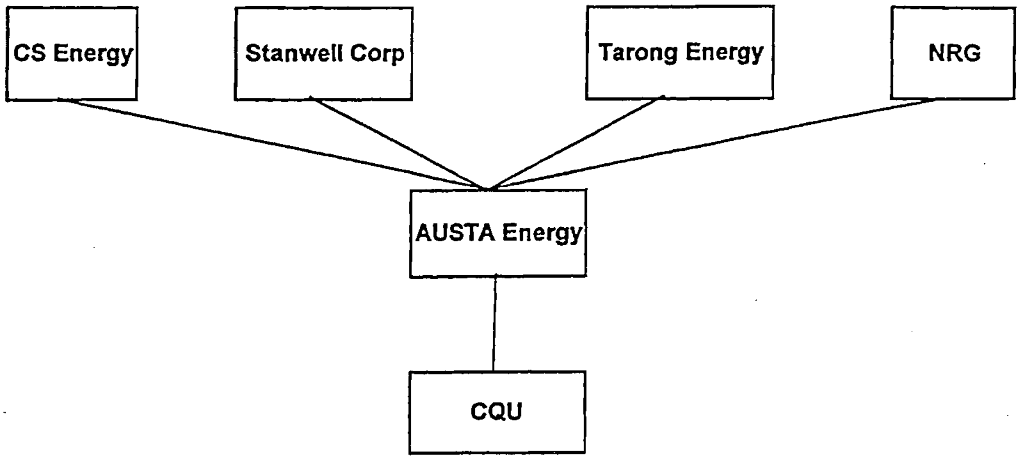


Figure 1 **The structure of the team investigating the Treated Water review for Queensland power stations**

AUSTA Energy coordinated the project. since they had both an excellent overview and had fully documented TW practices used by all stations since commissioning (Chalmers, 1993; Flitt, 1994; Kelly, 1990; Knights, 1993; and Robinson, 1995). The objective was to critically evaluate the existing literature and to design a *best practice* to be adopted by all stations.

TW is a cooling system for a range of boiler and plant turbine equipment including primary coolers for Unit Cycle sampling. Heat is rejected from the TW system via the circulating water system (Queensland Electricity Commission, 1993).

The choice of materials for TW Systems is governed by the need to

- maximise heat transfer in the cooling system
- reduce scale formation and microbiological growth
- minimise corrosion

With power station owners demanding that plant equipment should have better than a 25 to 40 year lifetime, it is imperative for scientists and engineers to ensure that stations have a *best practice* procedure to achieve this goal. Unfortunately, metals and alloys most suitable for maximising heat transfer in the system are not always the best materials choice from a corrosion management point of view, and vice versa. Therein lay the challenge!

The task was to decide on the most suitable corrosion inhibitor for the aqueous phase in the TW circuits. Even though it was known that corrosion inhibition should begin at the design and materials selection stage, current materials at the stations had to be used. In addition, the choice of inhibitor had to be Workplace, Health and Safety compliant, and environmentally friendly.

The initial step was to review the extensive literature held by AUSTA Energy. TW Chemistry had been documented since the 1970s. Each station had developed its own inhibitor treatment strategy for TW circuits, and they all used a different approach! The reasons for this were mainly historical. The choice of inhibitor treatments often reflected attempts to overcome costly TW shutdowns caused by tube corrosion failures.

The next phase was to interview station chemists and technical staff involved with TW operation and maintenance. This was done by visits to the power stations, interviews and an extensive questionnaire designed to evaluate their strategy to TW management.

Prior to writing the *Guidelines for the Total Management of Treated Water Systems in Queensland Power Stations,* the authors spent a reasonable amount of time on instructional design. It was realized that feedback from Station personnel on all aspects was critical, as the document being developed was one that the station people would be working with, and relying on, to solve problems that might occur in the system.

A major hurdle was to convince station chemists of the need to reassess the use of very effective TW inhibitors such as hydrazine and zinc chromate. The argument employed was that it was essential to use chemicals having a minimal impact on personnel and on the environment.

The next obstacle, was to convince stations personnel that they could change inhibitors without significant damage to the TW systems. The very significant research and development by the industry over the last 30 years, showed that the change could be successfully implemented (Flitt, 1994).

The *best practice* advocated was:

- a low-level phosphate inhibitor
- the use of demineralised water
- pH maintained at 9.0 to 9.5

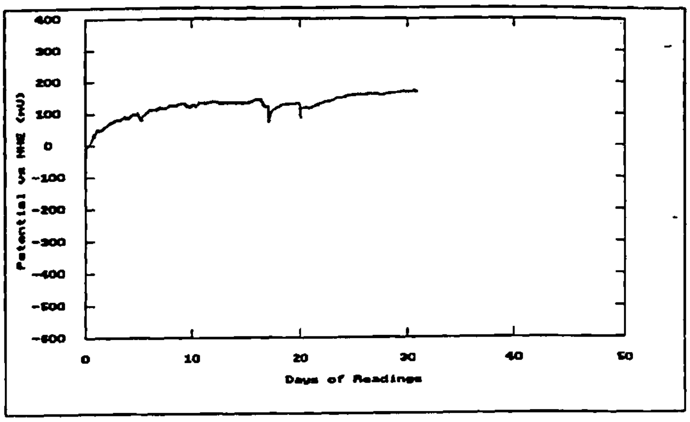
A recommended procedure for TW management with the above corrosion inhibitor was written for technical personnel maintaining the circuits (Druskovich, 1998). Issues such as TW pre-treatment, system control ranges, monitoring, and system blowdown and chemical dosing were addressed.

The final aspect considered in the *Guidelines* was the issue of a corrosion management strategy for TW Systems. This is a topic which, although important, has in the past been neglected because of more pressing priorities, and because it is often seen as a highly technical task best left to experts. This view has changed in the last few years since reliable, user-friendly instrumentation, available at a reasonable cost, can be used to monitor this important parameter.

Corrosion tests recommended as essential were:

- potential monitoring
- coupon analysis
- linear polarisation resistance (LPR)

The usefulness of the potential monitoring technique is illustrated in Figure 2 which shows potential/time data actually obtained at a Queensland power station. When the potential data is superimposed on an E/pH, or Pourbaix diagram, it may be seen that the system is in a "safe" operating region. Such a monitoring system could easily be automated and the result displayed on a computer screen. If the TW system failed for any reason, and the potential moved to an "unsafe" region, an alarm could be triggered to alert the operator to attend to the system.



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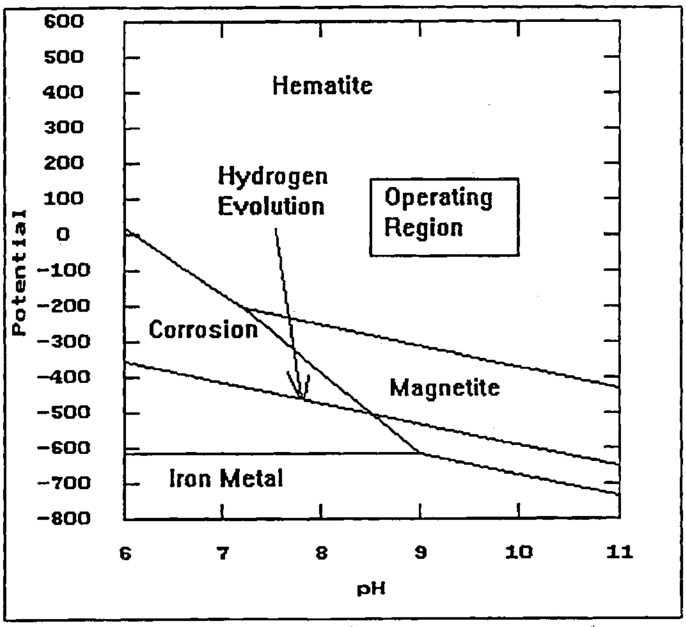

(b)

Figure 2 **(a) Corrosion potential-time data for a Queensland power station (b) The data displayed on a Pourbaix diagram; illustrating that the system is in a "safe" operating mode.**

Conclusion

This paper has presented the strategy that was developed to review the TW practices in Queensland power stations. Guidelines have been written which advocate the use of a workplace and environmentally compliant corrosion inhibitor, designed to extend the life of TW metal components and reduce costly maintenance.

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