



# Case Studies

## **Failure Prevention through Designed-in RCM.**

### *Proactive Maintenance by Design*

#### **SUMMARY:**

Proactive Maintenance should start at the design stage. But failure prevention and maintenance cost control by Maintenance Managers is so often frustrated right in the equipment design phase. This project took direct aim at these objectives by using RCM analysis to set design parameters for the engineering of a Bio-Filter for a Municipal Waste Water operation

#### **BACKGROUND AND OBJECTIVES:**

In this project, an Ontario engineering company approached OMDEC to help to build the principles of cost-effective maintenance into the equipment design and procurement specifications. The target equipment was a bio-filter designed for use in a waste-water filtration plant owned and operated by a large municipal utility. The objective was to ensure that the equipment procurement process took account of the resources, time and cost required to perform best practices maintenance during the equipment life-cycle.

The project required three specific outputs:

1. A FMECA analysis (Failure modes, effects and criticality analysis) of the bio-filter
2. A series of criteria to embed RCM thinking into the design of the bio-filter leading to cost-effective maintenance.
3. Recommendations as the tasks required for the preparation of the EAM Work Orders.

#### **METHODOLOGY:**

1. Step 1: Start with a typical RCM analysis:
  - Establish the functions, functional failures & failure modes for the bio-filter in its planned operational environment
  - Understand failure behaviour – especially the relationship between potential failures and functional failures
  - Complete the FMECA
  - Develop the maintenance task types using the RCM decision algorithm
  - Prepare a brief for use in preparing the EAM-ready work orders for the bio-filter

2. Step 2: Detail the design elements inherent in applying the RCM techniques:
  - Explore with the design engineers some core reliability philosophies to provide a framework for their design work:
    - i. Reliability is constrained by the design of the equipment and the manufacturing processes that produce it.
    - ii. Scheduled maintenance can help to ensure that the inherent reliability characteristics are achieved.
    - iii. Maintenance cannot provide reliability characteristics beyond those inherent in the design.
    - iv. Life-time maintenance costs can be greatly reduced by smart design
  - Define the RCM elements and the maintenance activities as they are apply to the design criteria of the bio-filter
    - i. Design in features that allow easy identification of potential failures. Clogged filters, as an example, must be readily apparent – not just as an OK-NOK status, but an actual measurement of a trend.
    - ii. Provide for easy and safe access when inspection is required. Hidden failures are well recognised as RCM's public enemy Number 1 and must be eliminated early in the design stage.
    - iii. Make sure the Inspections and PM tasks can be performed without interrupting operations.
    - iv. Plan for the easy removal and replacement of vulnerable parts with no downtime. Expensive shutdowns can often be avoided by smart design.
    - v. Make sure that monitoring of system operations, performance and condition can be performed by readily available instruments and other techniques. Requiring specialist maintenance operations and tools will often act counter to good maintenance cost control.
    - vi. Ensure protection of essential functions by redundancy or by backup devices that reduce the consequences of failure.
3. Step 3: Define the Maintenance tasks that can be readily built into the EAM using the following criteria:
  - i. Use the inspections to identify potential failures
  - ii. Use the potential failures as a means of predicting functional failures and triggering PM tasks that impact directly on functional failures
  - iii. Define PM's that act directly on preventing or delaying the functional failures
  - iv. Where functional failures occurs, automatically perform a root cause analysis to rectify the RCM record and update the maintenance plan

#### **NEXT STEPS:**

This analysis was accepted by the design engineers and the municipal client. Design and construction of the bio-filter is now under way. While it is too soon to measure the long run results of this project, the client management is convinced this is the right way to go. Therefore the maintenance and operations management at the client site is setting in place the measurement tools and the KPI's required to track the frequency, type and cost of both the maintenance and the operations activities compared to other similar units in their fleet. OMDEC will revisit this case study at a later date to monitor the results.

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