Available online at www.sciencedirect.com

ScienceDirect

Procedia Manufacturing 19 (2018) 119–126

Procedia MANUFACTURING

www.elsevier.com/locate/procedia

6th International Conference on Through-life Engineering Services, TESConf 2017, 7-8 November 2017, Bremen, Germany

Cost benefit evaluation of maintenance options for aging equipment using monetised risk values: a practical application

M.C. Leva[a], G. Baldissone[b], R. Caso[b], M. Demichela[b], L. Lawlor[c], B. Mcaleer[c]*

[a]*Dublin Institute of Technology Health And Safety Department, Dublin, Ireland*
[b]*Politecnico di Torino, DISAT Dipartimento Scienza Applicata E Tecnologia, Torino, Italy,* [c]*ESB Electricity Supply Board, Dublin, Ireland*

Abstract

With constant pressure to reduce maintenance costs as well as short-term budget constraints in a changing market environment, asset managers are compelled to continue operating aging assets while deferring maintenance and investment. The scope of the paper is to get an overview of the methods used to evaluate risks and opportunities for deferred maintenance interventions on aging equipment, and underline the importance to include monetised risk considerations and timeline considerations, to evaluate different scenarios connected with the possible options. Monetised risk values offer the opportunity to support risk-based decision-making using the data collected from the field. The paper presents examples of two different methods and their practical applicability in two case studies in the energy sector for a company managing power stations. The use of the existing and the new proposed solutions are discussed on the basis of their applicability to the concrete examples

Peer-review under responsibility of the scientific committee of the 6th International Conference on Through-life Engineering Services.

Keywords: Cost benefit evaluation, monetised risk values,

* Corresponding author. Tel.: +353 86-1613570;.
E-mail address: chiara.leva@dit.ie

2351-9789
Peer-review under responsibility of the scientific committee of the 6th International Conference on Through-life Engineering Services.
10.1016/j.promfg.2018.01.017

1. Introduction: Aging Equipment in the energy sector, risks and opportunities

Asset managers in the Energy sector are more and more required to maintain operational continuity with aging assets while deferring maintenance and investment. The consequences of such decisions are rarely immediate, deferring maintenance and investment can result in cost reduction in the short term, however it also required on the other end to set up an "intelligent prognostics" system, which can measure, control, and alert the operating personnel, detecting unavoidable risk degradation. [1]

Overall the situation calls for better monitoring and control on ageing equipment, to quantify the impact of operating modes on system reliability, to accurately estimate their residual life and to adapt the maintenance strategy, while respecting safety, regulation and operational performance.

Any power plant is required to supply the amount of energy demanded by the market and to comply with the regulatory requirements defined by government laws. To attain the objective, one of the most important aspects is to guarantee technical availability. This feature is not always easily achieved: during operation, the equipment that are used the most are gradually deteriorating, until they reach a deterioration failure, or other types of failures, such as fatigue or corrosion, induced by the specific operating conditions of the equipment itself.

New opportunities are given by monitored systems in modern process plants, whose data have to be integrated in DCS (distributed control systems) and PLC (programmable logic controller) to prevent potential dangerous outcomes. Data gained through the automated monitoring and control systems, but also through inspections, are fundamental and can bee used to support risk- based decision making, and ultimately the risk management of ageing equipment. To understand, identify, and manage critical states in aging or deterioration, it is necessary to develop mathematical models that represent the aging process to show the deterioration of power equipment, and determine the cause of aging. A review of the most recurrent causes of trips in a power generation company in The republic of Ireland showed that 43% of all the trips are attributed to equipment aging as root cause and in those 43% more than 65% explicitly mention equipment aging as the primary causes. Although aging and deterioration effects are unavoidable, it is desirable to find a way to slow down the deterioration rate, and to extend equipment's service life and this could be obtained by reducing exposure to the operating, environmental or transient conditions that cause or exacerbate deterioration.

The aim of this paper is to present a risk-based assessment for decision related to different maintenance intervention options as applied to the context of power generation [2] [3].

2. Asset management and Risk Analysis

The standard ISO 5500 for Asset management [4] [5] states that a proper evaluation of risks and opportunities are essential to the effective control and the governance of assets to achieve the desired balance of cost, risk and performance. Asset health indices provide a qualitative indication of probability of failure while asset criticality provides a qualitative indication of the consequences of an asset's failure, not only for the asset itself but also for the power system and the environment where the asset is located.

The aim of the asset management is to have a view of the asset operation and maintenance as a unity, to reach a perfect understanding of the whole life cycle costs. The asset management processes focus on Life Cycle Management of the power system equipment. Understanding the ageing processes of the equipment that can be affected by some common mechanism such as corrosion or fatigue, and the consequent impact on equipment performance is a critical factor for asset management to be able to address key questions on safe performance of the equipment. In terms of asset maintenance management within a modem power utility there are some important questions that need to be answered, particularly regarding the fatigue or corrosion issues: if there is an equipment in a safe condition sometimes companies don't know how to asses its performance, or what maintenance and testing regime to set, or whether to refurbish or replace it, or allow it to run to failure.

Appropriate asset management strategies allows companies to achieve risk reduction, opportunity identification or process improvement, which can be identified early in the implementation, and can be exploited to demonstrate returns and gain stronger stakeholder support. An asset management system can help in gaining an understanding of assets, their performance, the risks associated with managing assets, it supports a long-term and sustainable