Extension of Life of Cranes in Aluminium Smelters

Denis Chapdelaine[1] and Frédéric Moreira Pereira[2]
1. Sales Manager
Fives Services Inc., Montréal, Québec, Canada
2. Service Development Manager
Fives ECL, Ronchin, France
Corresponding authors: denis.chapdelaine@fivesgroup.com
or frederic.pereira@fivesgroup.com

Abstract

The life cycle of aluminium smelters is comparable to the life of human beings. All over the world aluminium smelters need to work longer to sustain an ever competitive economy. As smelters age, their health must be checked. Often, corrective actions must be taken in order to ensure safe and efficient duty for the remaining lifetime. Based on Fives' 70 years of experience and a comprehensive installed base of more than 1300 ECL Tending Machines operating in the world, Fives is able to provide accurate and valuable assessment of the health of aging equipment. The assessment is a theoretical and field study performed in six steps. Such assessment is especially important for equipment that are more than 20 years old.

Keywords: Smelter life time, pot tending machine, assessment of equipment health.

1. Introduction

Some 85 % of aluminium smelters which are currently producing metal are over 20 years old. And with the aluminium prices regaining their strength, many of these old smelters are under pressure to produce metal safely and efficiently for longer than they were originally commissioned for. Their industrial equipment has aged. Although it may still be operating, it has reached a stage where an overall assessment of its remaining life is required, and the necessary actions taken.

2. Maximizing the Efficiency and Safety of Mature Smelters

In particular, many of the world's potroom cranes were built during or before the 1980s and are close to 40 years old. They were designed according Fédération Européenne de la Manutention (FEM), (the European Materials Handling Confederation), rules with a limited life span, equivalent to 10 years for mechanical assemblies (gearboxes, wheels, hoisting, etc.) and 20 years for structures. Computerized calculations were not available at the time, and conservative safety factors were applied during the design and manufacturing phases. Many cranes are still in use, providing a high level of safety, operating performance and serviceability. Nevertheless, a thorough asset management program is needed for this equipment to ensure that it complies with the latest safety standards and that they will continue to do so for the remaining operational life of the smelter. To maximize the customer's safety and efficiency, FIVES has devised an Extension Of Life (EOL) program based on the company's 70 years of experience on a fleet of over 1 300 operating cranes. Around 50 % of ECL cranes have exceeded their theoretical design life span for structures and the EOL program has been designed to help clients build an appropriate asset management plan for their machines. It will also help them face, or anticipate, insurance companies' requirements.

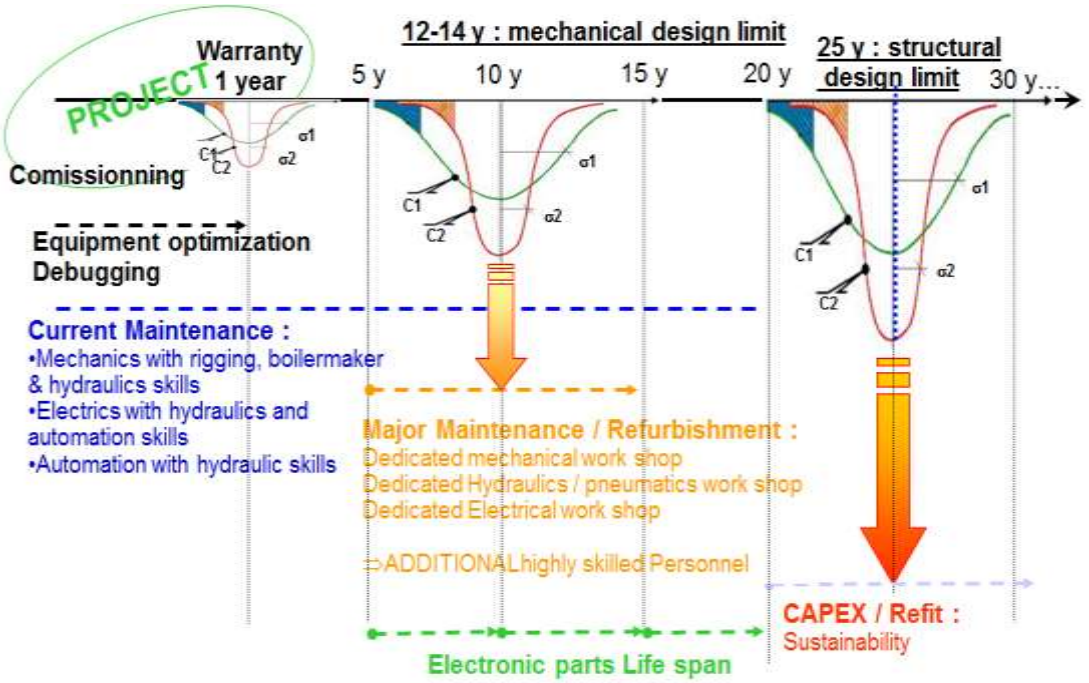

Figure 1. Smelter crane life cycle.

Curves in Figure 1, show different design limits, around 5 to 10 years for mechanical parts and 25 years for structure. The likelihood of failures increases closer to the end of design life. Proper maintenance and use will assure service exceeding any projected "life expectancy". Conversely, the lack of maintenance and operational abuse will reduce greatly the estimated "life expectancy". C1 and C2 are curves that represent distribution of reliability characteristics versus constraints distribution. Operation costs increase over time as the crane needs more frequent maintenance and spare parts.

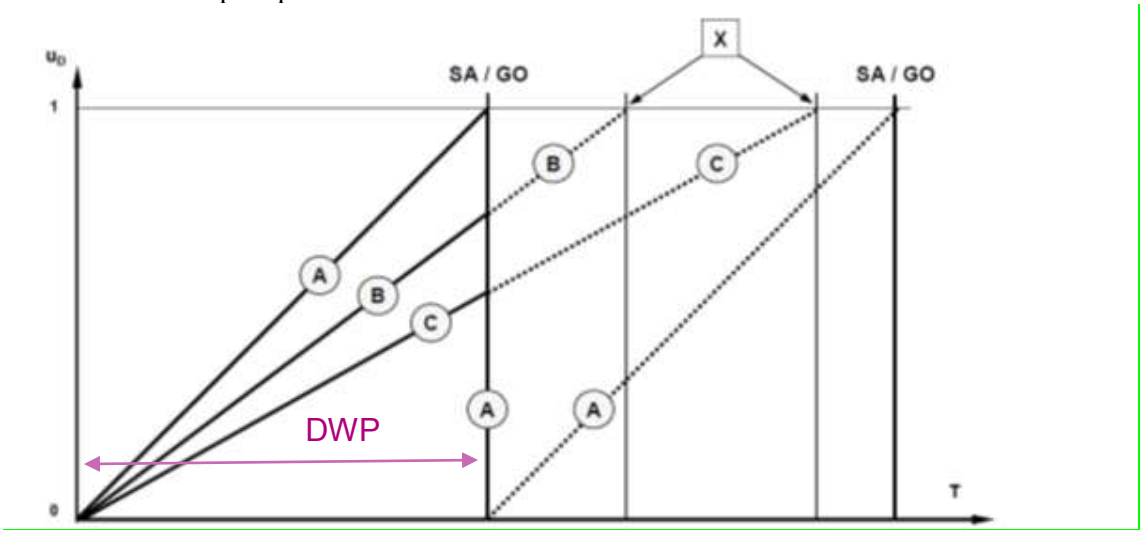

Figure 2. ISO/DIS 16716 Cranes with suspended load - Crane life cycle design. SA: Special assessment (Specific inspection), DWP: Design working period, GO: General overhaul, UD: % use compared to original design, T: Time of use, A: Component replaced at 1st GO, B, C: Component inspected at 1st GO, X: Design working period of components B and C (actions to plan).

Typically the operational period for industrial cranes is from 10 to 20 years. Fives ECL make calculation of its equipment for a life cycle of 20 to 25 years for structures, and 10 years for mechanisms. In figure 2, X axis is the Time and Y axis is the number of cycles. Each equipment is designed for certain number of cycles. Once the number of cycles is reached, if it is requested

and FIVES' 70 years long experience, the EOL program concludes with the production of a report with fact-based tool-set designed to assist the aluminium smelter in adopting the right technical directions and actions to reach their safety and economic objectives.

Figure 6. A team of FIVES experts carries out a thorough inspection of a crane in a customer's smelter.

4. A proven approach

Fives' EOL program has been constructed not only according to the expertise on crane audits but also in application of international standards such as the Australian AS1418 / AS2550 standards [3 - 4]. Fives' expertise in tailor-made cranes is used for interpretation of the results and for building the conclusions and the solutions in order to extend lifetime of the cranes. As part of the development phases, the EOL approach was used for audits on Rio Tinto sites in Australia (BSL, Tomago) and the Alcoa Portland site. The EOL program in its mature form has been implemented at the request of Alcoa (Deschambault, Baie Comeau and San Cyprian) for its complete crane fleet, comprising ECL stud-pulling cranes, Pot Tending Machine (PTM) and Furnance Tending Assembly FTA. It has also been engaged at Aluminérie de Becancour (ABI), Albras, Alouette, Alucam, Rio Tinto Grande Baie, Intalco, TRIMET St Jean de Maurienne, Lochaber, Laterriere, and Aluminium of Greece smelters.

5. Reference

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   - AS 1418.1 – 2002, Cranes, hoists and winches - General requirements
   - AS 1418.2-1997, Cranes (including hoists and winches) - Serial hoists and winches
   - AS 1418.3-1997, Cranes, hoists and winches - Bridge, gantry, portal (including container cranes) and jib cranes
   - AS 1418.14-1996, Cranes (including hoists and winches) - Requirements for cranes subject to arduous working conditions
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