**ABSTRACT**

The mission and objectives of maintenance management in Hydroelectric Power Station of Belver-Portugal of EDP-Production Company is to reduce to a minimum the unavailability of equipment. For such there is a strong implementation of the Preventive (Predetermined and Conditioned-based) Maintenance (EN 13306) and whenever possible, improvements are implemented to increase the reliability of equipment and reduce intervention times in the course of Corrective Maintenance (EN 13306), maintenance that is intended to be "0" fortuitous events. The maintenance sector of this company aims to ensure the optimal operation of Hydroelectric Power Station in the best technical and economic conditions of operation (reliability, availability) and security, maximizing the supply of electricity at the lowest cost. Belver Hydroelectric Power Station have 4 generator groups of 8.8MW (group I to IV), 1 generator group of 15.5MW (group V) and 1 generator group of 30 MW (group VI). In this work is described the study methodology based on LEAN philosophy applied in two problems that were identified during the preventive maintenance works: one on aeration system of 4 turbines (group I to IV) and the other on the refrigeration system of another turbine of group VI. Excellent results of these two studies are presented improving the turbines of Group I and IV aeration system and increasing the reliability and efficiency of the cooling system of group VI.

**Keywords:** reliability, lean, maintenance, refrigeration system, aeration system, turbines.

**INTRODUCTION**

The efficiency of the maintenance of the industrial systems is a major economic stake for their business concern. The main difficulties and the sources of ineffectiveness live in the choice of the actions of maintenance especially when the machine plays a vital role in the process of production (Womack, 1996). The theoretical basis of this work is the LEAN philosophy. This philosophy aims at the systematic elimination of waste and the creation of value. Since its initial development (it was first used by Womack and Daniel Jones Jomas in 1996), until today, has evolved thanks to its precursors and businesses that served as reference as Toyota Motors Corporation; and also due to the contribution and entities of experience all over the world, which will contribute to the growth of philosophy, developing it and implementing it in various business sectors. In this article, is implemented in the Portuguese Hydroelectric industry.

There was a problem caused by the aeration system of 4 turbines (groups I to IV) that were flooding the near equipment causing random failures. As the turbine fails there was the need of a fast intervention for reducing the Mean Time to Repair (MTTR). One intervention for a
situation like this would need at least four workers during four hours to solve the problem. This aeration system needs to work in excellent conditions because the turbine needs air to compensate the lack of water in the circuit to reduce the cavitation; or in a large scale if the system doesn’t work it can cause an implosion of the turbine! So was need to use the Lean thinking to optimize a solution; a test pipe connected was made to the opening left by a removed aeration valve and after running some tests this pipe was replicated removing all the valves creating a maintenance free system.

To reduce power consumption, equipment wear, Mean Time Between Failures (MTBF) and MTTR in the refrigeration system of another turbine (Group VI), Lean think was also used. This system had some random failures caused by filth from the water intake that obstruct the main pumps and caused low pressure in the circuit and damage to the pumps. Was found a cheap and reliable solution, apply “Y” type filters in line with the intake pipes, making a fast maintenance solution eliminating the damage of the primary pumps. Still in this refrigeration system there was one secondary pump working 24 hours, 7 days for week causing wear, and when the primary pumps start working the intake of the secondary pump increase the pressure from 1 bar to 5 bar, originating water hammer inside of them, causing damage to the seals and to the inside structure. The solution found was create a bypass to them. So, when the primary pumps start working the secondary stops and the water goes through the bypass feeding the system in the same way, reducing significantly the power consumption, equipment wear and increasing MTBF.

RESULTS AND CONCLUSIONS

The results from the solution of the aeration system (groups I to IV) shows to be excellent; it become a maintenance free system, with no failures compromising the generator reliability and increasing its MTBF.

Group VI refrigeration system results demonstrate that the pumps no longer got obstructed by filth, the damage on the seals disappeared and they started to work softer. In the case of the secondary pumps they don’t present more damage caused by water hammer and the MTBF increased.

With these work there were an increase of installation reliability and a quality improve of the energy production service of Belver Hydroelectric Central of EDP Group.

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