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ANALYTICAL EVALUATION OF CRACK PROPAGATION FOR BULB HYDRAULIC TURBINES SHAFTS

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Rezumat. *Centralele hidroelectrice utilizează energia regenerabilă a cursurilor de apă. Turbinele hidraulice Bulb funcţionând la căderi reduse reprezintă surse excelente de energii alternative. Arborii turbinelor Bulb sunt piese masive, de formă cilindrică realizate din oţel slab aliat. Lucrarea analizează fisurile de oboseală ce au apărut în zona de racordare dintre arbore şi flanşa turbinei. Starea de tensiune din această zonă a fost analizată cu programele ANSIS şi AFGROW. Ca rezultat final, a fost stabilit numărul orelor de funcţionare până la străpungerea completă a peretelui arborelui.*

Abstract. *The Hydroelectric Power Plants uses the regenerating energy of rivers. The hydraulic Bulb turbines running with low heads are excellent alternative energy sources. The shafts of these units present themselves as massive pieces, with cylindrical shape, manufactured from low-alloyed steels. The paper analyses the fatigue cracks occurring at some turbines in the neighbourhood of the connection zone between the shaft and the turbine runner flange. To obtain the tension state in this zone ANSIS and AFGROW computing programs were used. The number of running hours until the piercing of the shaft wall is established as a useful result.*

Keywords: bulb turbines, horizontal shafts, fatigue cracks, crack propagation

1. Introduction

The horizontal shafts are more exposed to fatigue cracks than the vertical ones as a result of the variable stresses occurring at each turn. From constructive reasons, the great majority of the Power Stations have the hydro aggregates vertically oriented and the fatigue fracture is an unusual event. The exception are the station endowed with Bulb turbines, Pelton turbines with a reduced number of injection nozzles as well as the aggregates with small and very small output. For the Pelton turbine case, the shaft is permanently wetted because of jets in the turbine chamber. In this situation, at variable stresses, the Wöhler curve does not present an asymptotic tendency limit, so after a certain number of running hours, the fatigue fracture occurs. This phenomenon is known as corrosive fatigue. Many years ago, through oral reports, I have heard about an extremely interesting breakdown of the horizontal

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