

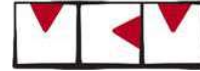
UNIVERSITY OF
Kragujevac



FACULTY OF ENGINEERING



DEPARTMENT OF
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CONSTRUCTIONS AND
MECHANIZATION



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SYSTEMS

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INTEGRITY EVALUATION FOR THE AIR TANK OF THE REGULATION SYSTEM OF TURBINE AT HYDROPOWER PLANT

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Key words: non-destructive tests, damage repair, strength calculation, integrity evaluation.

Vertical Kaplan turbines with nominal power of 200 MW, made in Russia, have been installed at 6 hydroelectric generating sets of "Djerdap 1". Most of the components were made of steel in accordance with GOST and ASTM standards. During the rehabilitation of the hydroelectric generating set A6 non-destructive testing methods were performed on parent material and welded joints of the main oil/air tank and air tank with the auxiliary oil/air tank, which acts as pressure accumulator in the regulation system, in order to carry out the analysis of the current state and integrity evaluation for the regulation system of the turbine. Regulation system supplies the turbine regulator with oil and regulates the movement of guide vane apparatus vanes. It also regulates the position of runner blades and number of revolutions of the turbine shaft (Figure 1). Shells of all 3 tanks were made of steel Č 1205, while bottoms were made of Russian steel St 20K. Tests were also performed on pipeline elements (pipes and elbows). In order to carry out the analysis of the current state and evaluate the integrity of the air tank, which is a component of the regulation system of A6 turbine at hydro power plant "Djerdap 1", non-destructive tests were performed. These tests were supposed to confirm the adopted value of quality factor of the welded joint $v = 1$, because for this value no damages on parent material and welded joints of pressure equipment are allowed.

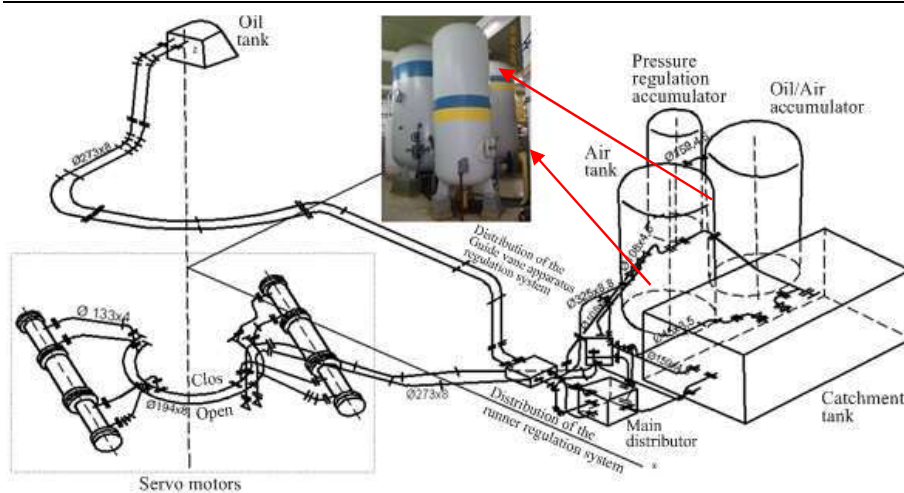


Figure 1. Appearance of tanks which are integral parts of the regulation system of A6 turbine

The results of non-destructive tests performed on air tank are presented in this paper. Mechanical damages were detected by visual inspection at parent material of the shell and at the upper bottom, as well as discontinuous and incompletely welded joints on the inside and outside of the tank. Surface linear crack type indications were detected through magnetic particle testing at intersections of welded joints on the inside of the tank. Internal crack type defects were detected through ultrasonic testing of welded joints. On the basis of test results the technology of reparatory welding / surface welding of parent material and welded joints was created, while on the basis of the analytical calculation of tank strength the evaluation of its integrity for the following 40 years of operation was obtained. Integrity of structures is a relatively new scientific and engineering discipline which, generally, comprises the state analysis, behavioral diagnostics, service life evaluation and rehabilitation of structures. It means that, aside from the usual situation in which the integrity of the structure needs to be evaluated when the defect is detected, this discipline also comprises the stress state analysis of the crackless structure. This approach is especially relevant for welded structures subjected to operating conditions suitable for crack initiation, such as fatigue and corrosion.

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