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CONTENTS

GROWTH OF CORROSION CRACKS IN STRUCTURAL STEEL 10GN2MFA

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Relationship between corrosion crack growth rate and stress intensity factor, based on the static corrosion crack resistance diagram, is described. The main working hypothesis on the discrete nature of crack growth in structural steel is confirmed.

Keywords: *welded structures, NPP steam generator, static corrosion crack resistance diagram, structural steel, corrosion cracks, electron microscopy, stress intensity factor, hydrogen embrittlement*

Corrosion cracks are among the most dangerous defects formed in modern durable steel structures. In a number of cases the process of initiation and formation of such defects is hard to determine. Therefore, duration of this process of formation of corrosion cracks may substantially change with time, depending on rather small changes in specific factors.

Under these conditions, of high importance is to timely detect the formed corrosion crack and determine the kinetics of its growth with time during operation of a corresponding structure.

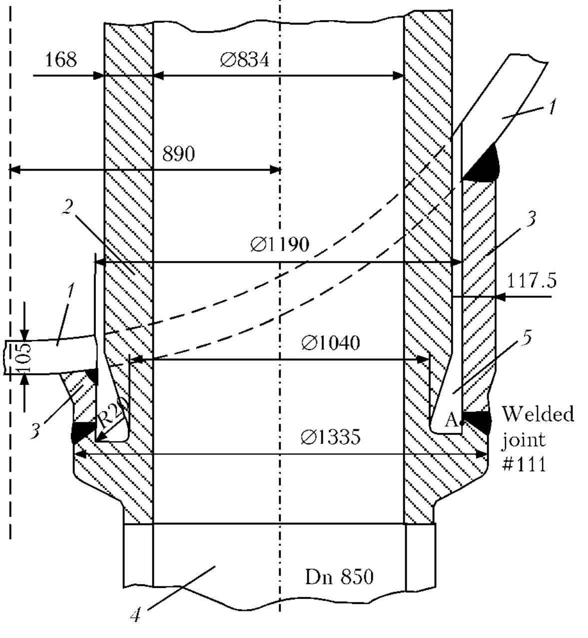

Figure 1. Schematic of the assembly of joining collector to steam generator casing by using branch pipe: *1* — steam generator casing; *2* — collector; *3* — branch pipe; *4* — main circulation piping; *5* — pocket

Very often the latter is crucial and requires accumulation and generalisation of the corresponding experimental data. So, the present study is dedicated particularly to this issue.

Welded joint 111 (Figure 1) in steam generators PG-1000 of modern power units of water-moderated water cooled reactor WWER-1000 considered in this study involves a problem in this respect, as each of units of this NPP comprises four steam generators. 13 such units at 4 NPPs with a service life of 8 to 28 years are in operation now in Ukraine.

The first defects in welded joints 111 were detected in Ukraine in 2003 at the South-Ukrainian NPP. Before that, such cracks in joints 111 were detected at the Novovoronezhskaya and Kalininskaya NPPs in Russia, whish had been in operation for about 20 years. The first detected cracks were mainly longitudinal, i.e. located along the weld, and of rather big sizes both on the circumference and in depth [1], which caused difficulties in detecting them by the non-destructive test methods. The special ultrasonic testing procedure was developed for these purposes [2], which allowed revealing such defects at the early stages of their formation. As the procedure for repair of these defects detected at the early stage of their formation is time-consuming and requires shutdown of the entire unit, the necessity arose for predictive estimates of safe service life of a steam generator with detected crack-like defects in welded joints 111 between both hot (joint 111-1) and cold (joint 111-2) collector and branch pipes of the steam generator casing (see Figure 1).

These predictions are based on the knowledge of the static corrosion crack resistance diagram (SCCRD) (Figure 2). Such diagrams are developed for specific materials (steels) and aggressive