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OF THE PRIMARY CIRCUIT OF THE NUCLEAR POWER PLANTS**

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THE USE OF THE ACOUSTIC EMISSION FOR THE COMPONENTS
OF THE PRIMARY CIRCUIT OF THE NUCLEAR POWER PLANTS

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A B S T R A C T

The Modřany Engineering Works (Modřanské strojířny) is a producer and a final supplier of the main connecting piping circuit systems and valves for the nuclear power plants (type VVER 440 and VVER 1000) built in Czechoslovakia.

Besides the delivery and assembly of valves and components methods there were developed for a monitoring of the stated equipment ability of a service in the Material and Diagnostic Laboratory, which is a part of the company. An important object of this work is to obtain a sufficient set of data and to work out suitable methods, on the basis of which it would be possible to perform a serious estimation of residual service life of the main piping components after certain service operation of the nuclear power plant.

During the operation of a nuclear power station a failure of the main piping circuit could happen in either of two possible modes:

1.) A sudden break - by an unstable defect prepagation leading to a final fracture of the piping
- 2)- A fatigue failure - which is characterized by a gradual subcritical growth of defects in relation to the loading parameters. This process is frequently accelerated by further processes, e.g. corrosion.

It is therefore suitable to use such physical and mechanical quantities, which characterize the material damage.

Acoustic emission signals belongs to these quantities. A knowledge of the response of these signals in relation to the damage of the material gives us the possibility to evaluate the residual life of the piping containing defects. The importance of this is increasing mainly after a long period of service.

The paper deals in details with experience gained in application of acoustic emission during pressure tests of primary circuit components (elbow, welds, T- junction e.t.c.) in laboratory conditions which imitate those in service. There are shown some results of cyclic fatigue tests by internal pressure on prototypes models and specimen.

Acoustic emission method represents the diagnostic tool which is suitable for volume inspection of structures and integrity control of pressure vessels and piping systems. By means of acoustic emission it is possible to detect crack initiation- localisation of the defects on object and also crack growth rate in structures. In addition to this the method enables evaluation of existing defects in structures to be made from the viewpoint of the risk involved.

Prior to the actual application of the acoustic emission method at a nuclear power station a large- scale experimental program was realized on specimen, pipe models and prototype of the primary circuit. On these components an initiation and propagation of defects, regardless whether natural or artificial, was investigated. A very good correlation between the crack growth rate and acoustic emission signals was determined.

The second stage of these experiments was application of AE method at nuclear power station during start-up and periodic control inspections.

The present development of the measuring technology in connection with computer technique in the area of acoustic emission makes it possible to determine in real time the character of acoustic emission sources, which correspond to defects in structures under test loading conditions or under real exploitation.