SUMMARY

The strain criteria of fracture are used for structural analysis of pressure vessels in the strain concentration zones. The application of these criteria is based upon the numerical and experimental analysis of strain field kinetics taking into account the suitable isocyclic stress-strain curves. These curves are used for strain concentration calculation by means of FEM analysis, by means of improved Neuber's formula and also from direct displacement field measuring.

The corresponding data were obtained in the zone of vessel nozzles and for the weld toe compensator. The numerical calculation was realised to estimate the mechanical and thermal stressing under internal pressure and temperature gradient loading taking into account the effect of protection weld facing (with another mechanical properties and thermal expansion coefficient) on strain distribution. The calculation shows a significant strain arising and large plasticity fields in above mentioned zones under real loading condition of pressure vessels that were designed according to safety codes.

The calculations for repeated low cycle loading were made on base of cyclic stress-strain diagrams and the determined strain amplitudes were used to estimate the fatigue life by crack initiation criteria. The strain fields data also confirm the good fitness of improved Neuber's formula for calculation of cyclic strain concentration factors. The used strain criteria of fracture initiation reflect the cyclic plasticity properties kinetic in connection with strain ageing and embrittlement effect at elevated temperature and with the interaction of creep and fatigue damage at high temperature. The prediction of service crack initiation life on base of these criteria is realised by introduction in suitable expression of the two terms equation of low cycle fatigue curve as the function of strain amplitude from fracturing number of cycles. The parameters of this equation include the effect of total loading time and also the time-temperature dependence of critical plasticity value. The calculation of service life by this way reflects the real cyclic loading and heating conditions of vessels, the strain field and mechanical kinetic properties of materials. This kinetic influence is important particularly at high temperature. For instance the cyclic life analysis for 18-8 type steel under 650 °C ($\gamma_r=3$) shows that if the dwell times of cycle increase on four order the fatigue life is reduced by twenty times and more.

The low cycle crack propagation rate is determined also in light of the strain criteria. The strain field and crack rate are described in terms of strain intensity factors and critical strain amplitude at the crack tip. This mechanical property value is a function of temperature, time and type of stress state.