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THE APPLICATION OF THE FINITE ELEMENT METHOD FOR THE LOW-CYCLE FATIGUE CALCULATION OF THE ELEMENTS OF THE PIPELINES' FIXED SUPPORT CONSTRUCTION FOR THE AREAS OF ABOVE-GROUND ROUTING OF THE OIL PIPELINE «ZAPOLYARYE — NPS „PUR-PE"»

The present article studies the order of performing low-cycle fatigue strength calculation of the elements of the full-scale specimen construction of the fixed support DN 1000 of the above-ground oil pipeline "Zapolyarye — Purpe" during rig-testing. The calculation is performed with the aim of optimizing the quantity of testing and, accordingly, cost cutting for expensive experiments. The order of performing the calculation consists of two stages. At the first stage the calculation is performed by the finite element method of the full-scale specimen construction's stressed-deformed state in the calculation complex ANSYS. The article describes the main creation stages of the finite element calculation model for the full-scale specimen in ANSYS. The calculation model is developed in accordance with a three-dimensional model of the full-scale specimen, adapted for rig-testing by cyclic loads. The article provides the description of the full-scale specimen construction of the support and loading modes in rig-testing. Cyclic loads are accepted as calculation ones, which influence the support for the 50 years of the oil pipeline operation and simulate the composite impact in the process of the loads' operation connected to the changes in the pumping pressure, operational bending moment. They also simulate preloading in the case of sagging of the neighboring free support. For the determination of the unobservable for the diagnostic devices defects impact on the reliability of the fixed support and welding joints of the fixed support with the oil pipeline by analogy with the full-scale specimen, artificial defects were embedded in the calculation model. The defects were performed in the form of cuts of the definite form, located in a special way in the spool and welding joints. At the second stage of calculation for low-cycle fatigue strength, the evaluation of the cyclic strength of the full-scale specimen construction's elements of the fixed support was performed in accordance with the requirements of Russian State Standard GOST R 52857.6—2007 on the basis of the overall and local stress condition, received according to the results of the calculation in ANSYS. In accordance with the results of the conducted work the conclusion was drawn about fulfilling the standard requirements for the low-cycle fatigue strength of the developed full-scale specimen of the support. Therefore, the application of the modern approaches to the numerical modeling of the fixed support construction operation allowed minimizing the quantity of full-scale tests of the specimen with the cyclic load, escaping the excessive conservatism in evaluation of the cyclic strength and developing of the optimal for the metal intensity construction.

Key words: oil pipelines, fixed support, aboveground oil pipeline, pipeline system "Zapolyar'e — NPS "Pur-pe"", finite element method, low-cycle fatigue strength.

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