

The Use of Geographic Information System Technologies for Geotechnical Monitoring of Pipeline Systems

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Abstract : Issues of obtaining unbiased data on the status of pipeline systems of oil- and oil product transportation become especially important when laying and operating pipelines under severe nature and climatic conditions. The essential attention is paid here to researching exogenous processes and their impact on linear facilities of the pipeline system. Reliable operation of pipelines under severe nature and climatic conditions, timely planning and implementation of compensating measures are only possible if operation conditions of pipeline systems are regularly monitored, and changes of permafrost soil and hydrological operation conditions are accounted for. One of the main reasons for emergency situations to appear is the geodynamic factor. Emergency situations are proved by the experience to occur within areas characterized by certain conditions of the environment and to develop according to similar scenarios depending on active processes. The analysis of natural and technical systems of main pipelines at different stages of monitoring gives a possibility of making a forecast of the change dynamics. The integration of GIS technologies, traditional means of geotechnical monitoring (in-line inspection, geodetic methods, field observations), and remote methods (aero-visual inspection, aero photo shooting, air and ground laser scanning) provides the most efficient solution of the problem. The united environment of geo information system (GIS) is a comfortable way to implement the monitoring system on the main pipelines since it provides means to describe a complex natural and technical system and every element thereof with any set of parameters. Such GIS enables a comfortable simulation of main pipelines (both in 2D and 3D), the analysis of situations and selection of recommendations to prevent negative natural or man-made processes and to mitigate their consequences. The specifics of such systems include: a multi-dimensions simulation of facilities in the pipeline system, math modelling of the processes to be observed, and the use of efficient numeric algorithms and software packets for forecasting and analyzing. We see one of the most interesting possibilities of using the monitoring results as generating of up-to-date 3D models of a facility and the surrounding area on the basis of aero laser scanning, data of aerophotoshooting, and data of in-line inspection and instrument measurements. The resulting 3D model shall be the basis of the information system providing means to store and process data of geotechnical observations with references to the facilities of the main pipeline; to plan compensating measures, and to control their implementation. The use of GISs for geotechnical monitoring of pipeline systems is aimed at improving the reliability of their operation, reducing the probability of negative events (accidents and disasters), and at mitigation of consequences thereof if they still are to occur.

Keywords : databases, 3D GIS, geotechnical monitoring, pipelines, laser scanning

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