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Active faults crossing trunk pipeline routes: some important steps to avoid the disaster

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Trunk pipelines that pass through tectonically active areas connecting oil and gas reservoirs with terminals and refineries cross active faults that can produce large earthquakes. Besides strong motion affecting vast areas, these earthquakes are often associated with surface faulting that provides additional hazard to pipelines. To avoid significant economic losses and environmental pollution, pipelines should be designed to sustain both effects (shaking and direct rupturing) without pipe damage and spill. Special studies aimed to provide necessary input data for the designers should be performed in the course of engineering survey. However, our experience on conducting and review of such studies for several oil and gas trunk pipelines in Russia show urgent need of more strict definition of basic conceptions and approaches used for identification and localization of these potentially hazardous tectonic features.

Identification of active faults (fault zones) considered as causative faults – sources of strong motion caused by seismic waves that affect dozens kilometers of pipeline route can be done by use of both direct and indirect evidence of Late Pleistocene – Holocene activity of faults and fault zones. Since strong motion parameters can be considered as constant within the near-field zone, which width in case of large earthquake is up to dozens kilometers, accuracy of active fault location is not so critical and $\pm$1-2 km precision provided by use of indirect evidence is acceptable.

In contrast, if one have to identify and characterize zones of potential surface rupturing that require special design of the endangered pipeline section, only direct evidence of such activity can provide reliable input data for crossing design with relevant accuracy of fault location, amount and direction of displacement. Only traces of surface faults displacing Late Pleistocene – Holocene sediments and/or geomorphic features are considered as direct evidence of fault activity. Just these data allow selection of really hazardous features that require special measures to ensure pipeline safety among numerous faults that cross pipeline routes hundreds to thousands kilometers long.