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RISK ASSESSMENT AND COST-BENEFIT ANALYSIS FOR PIPELINES BURIED IN SLOW-MOVING LANDSLIDES

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ABSTRACT

The annual risk of failure of a pipeline buried in a slow-moving landslide can be thought of as the product of the probability that landslide displacements within the next 12 months will exceed the capacity of the pipeline, and the associated consequence of pipeline failure. The current landslide displacement capacity of the pipeline will be subject to uncertainty, but can be estimated through interpretation of landslide morphology, inertial measurement unit (IMU) bending strain analysis, consideration of axial strain loading, and finite element analysis (FEA). A Markov Chain and Monte Carlo Simulation analysis can provide probability distributions of annual landslide displacements and estimates of the probability that displacements will exceed the pipeline capacity. Without intervention, the probability (and risk) of failure will increase with time as pipeline displacement capacity is used up and as uncertainties about future landslide movements grow. But with estimates of annualized time-dependent risk, the cost-benefit of different management options such as monitoring and warning, landslide stabilization, and pipeline re-route, can be calculated to support risk-informed decision making. This paper outlines a procedure for estimating failure probability and risk over the pipeline design life under a range of possible risk management options, and the analysis of the expected cost and benefit of each option.