

Development of a probabilistic methodology for slope stability and seismic assessments of embankment dams in the UK

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SYNOPSIS. The introduction of the “An engineering guide to seismic risk to dams in the UK” in 1991 has led Inspecting Engineers to pay greater attention to the seismic risk of the dams they inspect. For owners of large stocks of dams, such as United Utilities (UU), this has resulted in the need to investigate a large proportion of their dams. In order to proceed in a structured way, UU commissioned a Panel of Experts to advise on a methodology to investigate and analyse their embankment dams and to establish the need for detailed investigation and/or remedial works.

Since the publication of the methodology, which was based on a pilot study of five dams, over 30 further embankment dams have been investigated using the approach. This has not only verified the appropriateness of the initial methodology but has also provided a database of geotechnical information. This information has allowed the methodology to be refined to incorporate probabilistic, in parallel with deterministic analyses. Deterministic analysis suffer from limitations such as the inability to consider variability in the input parameters. Also, there is no direct relationship between factor of safety and probability of failure. Probabilistic slope stability analysis allows for the consideration of variability in the input parameters and it quantifies the probability of failure of a slope. It can be performed using the Monte Carlo method, where a re-running of the analysis is performed using new input parameters estimated from the mean and standard deviation values of the chosen parameters. A distribution of factors of safety is then obtained which can be related to risk of failure. A methodology has been developed to incorporate the results of deterministic and probabilistic analyses, which aligns with current thinking regarding risk assessments.