Estimating In-situ Void Ratio for Tailings Deposits using a Novel Advanced Sampling Device

W R Wood1, P N Looijen2 and V Suárez Méndez3

1.Consultant, Fugro, Houston, Texas, 77079. Email: rwood@fugro.com

2.Director Mobile Autonomous Robots & Sensors, Fugro, Nootdorp, Netherlands, 2631 RT. Email: p.looijen@fugro.com

3.Mechanical Design Engineer, Fugro, Nootdorp, Netherlands, 2631 RT. Email: v.suarez@fugro.com

Keywords: Tailings, Sampler, Void Ratio, Liquefaction, Undisturbed

# ABSTRACT

Recent failures of retention dams for Tailings Facilities (TFs) over the past decade have highlighted the need for high fidelity geotechnical data associated with these structures to allow reliable assessments to be made of their stability and safety. Static liquefaction of loose, saturated tailings has been shown to both cause failure of tailings impoundment structures or where these structures have failed for some other reason, subsequent static liquefaction within the impounded materials has exacerbated the consequences of the failure with large volumes of mud flow causing considerable environmental damage and, in some cases, significant fatalities in facilities downstream.

It is known that contractive behaviour on shearing of loose tailings materials is necessary for static liquefaction to occur. To assess whether contractive behaviour is likely it is necessary to determine the in-situ void ratio of the tailings material and compare this value with the void ratio at the critical state for the same mean effective stress conditions. Until recently there has been no practical and cost-effective method for determining in-situ void ratio directly. The industry largely relies on empirical correlations with piezocone penetration tests which are often based on materials dissimilar to the actual tailings materials under investigation. This paper describes the development of a device designed specifically to obtain as undisturbed as possible a sample of loose tailings material and positively retain all sample constituents in a sealed chamber for subsequent laboratory determination of voids ratio. The sampling device is easily deployed using conventional geotechnical drilling rigs or can be pushed from the surface using CPT equipment. Results of laboratory tests and field trials in natural deposits are also presented demonstrating the efficacy of the device.