Executive Summary

Ove Arup & Partners Hong Kong Limited (ARUP) have been appointed by GEO to carry out the Quantitative Risk Assessment (QRA) of collapses and excessive displacements due to deep excavations associated with private developments in August 1998. ARUP are supported in this study by ERM Hong Kong Ltd. The risk assessment is to quantify the risk to life from deep excavations. The study was carried out based on the past records of collapses and excessive displacements as catalogued in GEO Report No. AR 2/92 “Review of collapses and excessive deformation of excavations”.

The approach to the study includes a review of previous incidents in Hong Kong and abroad. Subsequently hazard identification studies, frequency assessment, consequence assessment and risk estimation were carried out based only on data from private developments in Hong Kong. As stated above only the risk to life was estimated.

The QRA study presented in this report leads to the following conclusions:

a) The risk to life is calculated to have a PLL of about between 0.015 and 0.03 per year. These values include workers who account for about a third of the risk.

b) The higher of the above range of results comes from the average rate of failures observed since 1980. Government control has improved since 1990 and if trends since then are used for predicting the effects of future excavations the lower figure is more realistic.

c) The contribution to the risk is significantly higher for sheet pile walls than for other types of walls. The case histories show this is mainly due to inadequate penetration due to obstructions or inadequate strutting.

d) Poor site control is a dominant cause of the observed problems. Occasionally poor planning leads to reports of excessive displacement.

e) The public are most at risk from buildings on pad foundations adjacent to excavations collapsing. Risk to pedestrians is the next main contribution.

The following measures are recommended to reduce the risk:

a) improved site control, principally by more thorough
supervision and random site visits.

b) improved planning to prepare better for cases where significant displacements are expected at the design stage.

c) routine monitoring to maximise the chance of warning of a collapse.

The estimated risk has been compared to that estimated previously from pre GCO man made slopes and retaining walls. The overall risk from deep excavations in the Hong Kong Special Administrative Region is many times less than that from slopes. The risk from an individual excavation however is the same order as the annual risk from a slope feature. For example the worst combination for an individual excavation, namely a deep sheet pile supported excavation adjacent to a building on pad foundations, is comparable to the annual risk calculated for some sites with a history of failure. It must be noted however that the risk from an excavation is transient whereas for a slope it is effectively permanent over many years.