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Groundwater Management During Intermediate-to-Deep Underground Coal Gasification

Shaun Lavis (1), Edward Stanley (2), Marc Mostade (3), and Matthew Turner (4)

(1) Clean Coal Ltd, UK (Shaun.Lavis@Cleancoalucg.com), (2) Clean Coal Ltd, UK (ed.stanley@cleancoalucg.com), (3) Clean Coal Ltd, UK (marc.mostade@cleancoalucg.com), (4) Clean Coal Ltd, UK (matthew.turner@cleancoalucg.com)

Underground coal gasification (UCG) is a safe, economic way to extract energy from coal with significant environmental benefits compared with other coal-based energy production methods. However, in the wrong hands, UCG can adversely impact groundwater systems in two ways: 1) by contamination with inorganic and organic compounds; and 2) groundwater depletion. The hydrogeological conditions of UCG are highly site-specific and so the risks to groundwater have to be evaluated on a case-by-case basis. Site selection plays a fundamental role in managing these risks and it is possible to identify the general characteristics that will minimise risks of environmental impacts. However, large volumes of water, much of which will come from groundwater, are consumed during UCG projects, leading to possible significant groundwater depletion at such settings. Insufficient water supplies will impact the quality of the syngas produced by UCG because coal conversion efficiencies will decrease. Furthermore, depletion of groundwater levels may extend beyond the UCG site boundary, with consequent implications for regulatory regimes and any off-site groundwater users.

Additional artificial water supplies may therefore be required, although the manner in which the water is delivered to the UCG system will also likely have an impact on syngas quality. Large volumes of water delivered via the injection well will likely impact gasification efficiency because 1) large amounts of heat will be used to vaporise the water leading to suppression of the reactor temperature and inhibition of (endothermic) gasification reactions; and 2) the "steam jacket" originally present around the UCG reactor will be absent, which will lead to further heat loss from the system. Additional water may therefore have to be supplied via the surrounding strata and/or coal seam, thus mimicking the natural conditions prior to groundwater depletion.

Much of the hydrogeological modelling to date has focussed on a single UCG reactor and so the groundwater impacts of full commercial scale UCG (where perhaps greater than ten modules could be operated simultaneously) are not fully understood. Careful hydrogeological (coupled with geomechanical and chemical) modelling will be required on a site-by-site basis to ensure that groundwater supplies are adequate, that environmental risks are minimised and that any additional water supplies are delivered efficiently.