

**Summary of considerations and recommendations on the  
Environmental Evaluations of Cougar Energy**

**24 January 2011**

**Report of the Independent Scientific Panel on Underground Coal Gasification to  
the Department of Employment, Economic Development and Innovation (DEEDI) in  
response to a request from the Department of Environment and Resource  
Management (DERM)**

This report is supported by a range of individual reports previously delivered to DERM and DEEDI by members of the Independent Scientific Panel on numerous occasions following various stages of the Environmental Evaluation Process. All reports have been provided in confidence. This report has been extracted so as to provide a document from the ISP that can be communicated into the public domain should DEEDI choose to do so.

Independent Scientific Panel:

Professor C.J. Moran Director, Sustainable Minerals Institute, The University of Queensland.

Emeritus Professor C. Cuff, Principal, C&R Consulting.

Professor J. da Costa, School of Chemical Engineering, The University of Queensland.

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## **1. OVERVIEW**

The report summarises a number of pieces of advice previously delivered to the Department of Environment and Resource Management (DERM) and the Department of Employment, Economic Development and Innovation (DEEDI).

This report summarises the ISP's advice on environmental issues, the quantity and quality of information provided to the ISP by Cougar Energy, infrastructure failures and operating compromises to the trial and the scale, scope and nature of the pilot. These topics were considered on the basis of a specific request by DERM.

The ISP proposes to continue to follow its established roadmap for the trial. The ISP will send in the next weeks the proposed reporting risk assessment approach to the company for feedback. This will be followed by finalisation of the reporting risk assessment format and the minimum data set required to support reporting. The ISP expects Cougar Energy to participate because the decommissioning process for that site once completed, should form part of their complete report to the ISP. The ISP's report to government is to provide government with the considerations of the ISP of the success or otherwise of each of the technology based on the pilot trial. Assessment of the Cougar Energy technology should be on the same basis as the other companies.

## 2. CONSIDERATIONS

### ***2.1. Environmental issues***

*Commentary on environmental aspects (including air, water, land and waste) of the three pilots with respect to the underground gasification process and any gas treatment*

The ISP has found some difficulty in assessing the implications of the Environmental Evaluations in some aspects of environment because of a lack of sufficient base line information. More systematic monitoring should have been required and undertaken at the outset. All trials should have had the same initial baseline and monitoring requirements and minimum conditions for Environmental Authorities (EAs) should have been in place and been as consistent as possible across the trials.

Environmental Evaluations implications have been observed for water and land in relation to the Cougar Energy trial where benzene and toluene were each detected. Detection occurred in adjacent bores, ie, benzene in one bore and toluene in another in a different stratum/horizon. Each bore recorded one reading less than stock water limits but greater than drinking water limits. Both were detected in bores at some distance (approx. 250m) from the chamber, which is a concern as it indicates high likelihood of transport from the chamber. It is not possible to be certain of this because no isotopic signatures of the benzene or toluene were reported. However, gas composition that was measured at the same locations is consistent with the gas source being the chamber. Therefore, water quality was compromised. It is unknown whether pollution of the soil/regolith on the path between the chamber inlet and the bores occurred. No benzene or toluene was detected in surrounding bores and water systems following extensive survey conducted by DERM. However, in a sample submitted by Cougar on the 28 October, a benzene concentration of 45 micrograms per litre was found in borehole T5058. This is above the trigger level of 1 microgram per litre.

In all three pilots more attention should have been given to obtaining appropriate base line data (see section 3.3 – monitoring). The information disclosed by Cougar Energy is inadequate. Acquisition of better data beforehand would have revealed the complexities of the hydrological situation at Kingaroy before the burn. The complexity at this site may have indicated a precautionary approach.

For valid environmental comparisons, all three trials should have had similar compliance conditions within their EAs.

## ***2.2. Quality and quantity of information provided to the ISP***

All companies provided the ISP initially with background information that described their technologies and also general information on the benefits to society and the Queensland economy of underground coal gasification. The latter material, in particular, was clearly articulated. The case made was obviously aimed at advocacy for the UCG industry but that was explicit and not otherwise represented.

Cougar Energy have a stated position that they are not engaged in running a pilot trial of a new technology but a small-scale facility of a well-tested technology. Consequently, they assert, they do not need a lot of in-house technical capability and can rely on consultants as required. Consistent with this view, when the ISP interviewed Cougar Energy at their offices a consultant explained, via use of a whiteboard alone, their underground design and operational approach. The ISP prefers the approach adopted by another company of building strong internal technical capacity.

The documentation for the Environmental Evaluations and monitoring information provided by Cougar Energy has generally lacked detail and been less-than-clear in explanation with some self-contradictory comments and other comments that were difficult to interpret. In some cases, specific requests were made and either overlooked or misinterpreted.

### ***2.3. Infrastructure failures or operating compromises in the trials***

*This section considers any malfunctions that may have occurred at any of the sites, the risk to the environment from these and corrective measures put in place, or proposed, to prevent a recurrence during the remainder of the trial*

The current situation is that Cougar Energy has had a failure of infrastructure. Understanding the causes of this failure is important, and obtaining this understanding should be an essential part of the pilot study.

At Cougar Energy, backpressure soon after ignition appears to be the best explanation for the pushing of water and ash up the inflow bore/pipe. Pressure and temperature have been proposed as explanation for the compromise to the bore casing at a point where, during construction, a join was made. Water and gas then escaped through the compromised infrastructure and were detected in bore down the gradient of groundwater flows. It is possible that the flow was along a preferential pathway at the interface between two horizons/strata. Gas continued to appear in one of the bores for some time after the event indicating the compromise did not self anneal. The Cougar Energy situation is concerning, with at least a casing breach of the bores, and the additional potential of an underground explosion, having released contaminated waters into the groundwater. The fact that the possible existence of an explosion has yet to be confirmed or ruled out, means that corrective measures have not been put in place to prevent the reoccurrence of this type of malfunction. Finally, the compromised infrastructure remains in the condition it was when the incident occurred (assuming no further deterioration, which may have occurred). Whilst infrastructure compromise is the most convincing explanation, detection of benzene and toluene in separate bores in different aquifers remains unexplained. Even though various hypotheses have been put forward none are very convincing. Other transport mechanisms and pathways, therefore, cannot be entirely ruled out.

#### ***2.4. Scale, scope and nature of each pilot***

The scale, nature and scope of these pilot programmes are in line with their purpose as technological trials, and are appropriate for this function.

#### ***2.5. Site specific considerations***

*This section considers any matters relevant to the location of each of the sites and environmental values at each location.*

The ISP's view is that the location of the Cougar Energy trial in the Kingaroy region was not optimal. The local hydrogeology indicates considerable underground complexity and potential for preferential flow of groundwater. This information was contained in the consultant's report that was available to Cougar Energy (and therefore potentially to government) at the time of approval. It is unclear why the trial was not located in a more simple hydrogeological setting, which was available not too distant from the existing site. The complexity of the aquifers and strata surrounding the test chamber are not competent to contain potential, and as it turns out actual, fluid flows potentially containing contaminants. Regardless of the hydrogeological setting, the ISP does not accept that the surrounding land use provides an optimal site setting for UCG. In particular, agricultural reliance on the groundwater of the region is not a circumstance prudent for trialling UCG production, given the environmental, anthropogenic and political consequences of a malfunction such as happened. The location for testing of this type of technology should be carried out in as close to controlled circumstances as possible.

An important site consideration is the maintenance of sufficient groundwater pressure surrounding the chamber to contain and control the burn. One potential change to the current operating environment is the regional development of the coal seam gas (CSG) industry. To extract coal seam gas, groundwater pressure must be reduced to allow the gas to desorb from the coal. Origin Energy presented their estimates of pressure reduction across the CSG production region to the ISP and the State government interdepartmental working group. Their proposition was that a significant pressure decrease would occur and they contend that this is likely to

impact UCG. The details of the Origin groundwater modelling (calibration, validation and simulation results) have not yet been received by the ISP. It is unknown from the presentation whether modelling was only undertaken in the Walloon coal measures (from where CSG is extracted in the Surat Basin) or whether pressure changes in other connected aquifers was also modelled. If the former, then the Origin information is only relevant for assessment of pressure effects where UCG is being undertaken in the same measures as the CSG extraction. If modelling was extended to other connected aquifer systems then the information may be of assistance in assessing pressure impacts on UCG in those connected systems.

Without the Origin modelled data it is difficult for the ISP to assess the impact of pressure decrease from CSG on UCG. It is important that DERM access the modelling outputs and assess the details. The ISP is prepared to assist in this activity. Given uncertainty over the time course of development of CSG and that the assumptions regarding this in the Origin Energy modelling are unknown, the ISP does not feel it appropriate to make recommendations regarding responses by government. If however, pressure is expected to be reduced to below the chamber operating pressure in the UCG pilot trial within the next 6-12 months then a discussion between government, the CSG and UCG companies should occur to determine the best course of action with respect to spatial development of CSG. If however, the drawdown is to occur after the pilot trials are concluded then the issue would be more appropriately dealt with in the ISP considerations of impacts of UCG industry scale up. The Cougar Energy Kingaroy trial has the least exposure to this potential impact.

### **3. RECOMMENDATIONS**

#### ***3.1. Alteration in scope, scale or nature of each trial***

The scale, nature and scope of the pilot programmes are appropriate for a trial programme. There is no need to alter these factors. However, alteration of regulatory controls may include measures to dictate factors including the scope, scale and nature of future trials, especially with regards to monitoring requirements.



*Recommendation 1.* Given the incident at the Cougar Energy site, it is recommended that the nature of the Cougar Energy trial be changed to short circuit the operational phase and move under a planned regime to decommissioning of the chamber.

### **3.2. Alterations in any regulatory controls**

*Recommendation 2.* It is recommended that the Government moves to place all three trials under the same minimum Environmental Authority conditions without delay.

### **3.3. Monitoring**

*Recommendation 3.* It is recommended that improved groundwater monitoring be initiated at all pilot sites and that pressure and gas monitoring be examined for adequacy.

A critical factor concerning environmental monitoring, to assist in regulatory and operational control, is the implementation of a comprehensive monitoring scheme to establish background levels of the water chemistry and soil properties. This factor relates to the issue faced by the three companies that have run UCG trials, which is the lack of initial regulatory oversight and structure within which to operate.

In all three pilots more attention should have been given to obtaining better base line data. This could have been facilitated by implementing more systematic monitoring. It is not too late to improve the water monitoring and it is recommended that this be done forthwith at all three sites.

It is recommended that concentric arrays of boreholes into all aquifers above the coal aquifer, the coal aquifer itself, and the aquifer below the burn chamber should be installed. Distances for these arrays should be logarithmic away from the burn chamber. Some bores close to the chamber may have to be sacrificed as the chamber expands. This should be seen as a reasonable and necessary cost of the trials because it is critical to have early warning of any changes to the groundwater as this is a signal that unexpected changes may be occurring in the chamber. Risk management protocols should be in place to ensure such signals trigger appropriate

actions. These actions should have been agreed with the approving government agencies before the trials commenced. Triggers should be put in place for all known possible risks at all trial sites. Triggers for temperature, gas, pressure and water quality and flow should be included.

For Western Queensland base line monitoring must include seasonal variations in groundwater compositions.

*Recommendation 4.* Monitoring at entry and exit points from the chamber should be standard for all trials to ensure that any leaks are immediately detected.

*Recommendation 5.* Soil testing in all pilots should be undertaken as close to the chamber as practical (safe) as the chamber expands. This will provide information on the possible release of contaminants from the chamber. It is considered unlikely that this will occur during normal operations of the chamber as groundwater flow is always into the chamber. However, deviations from normal operating conditions can occur and monitoring should be in place to detect any contamination as a result.

*Recommendation 6.* Given that the incident at the Cougar Energy site has resulted in a halt to gasification activities, the ISP recommends that additional monitoring be put in place immediately. This should consist of regular monitoring of water levels in the chamber (at least weekly). Further, the chamber should be surrounded by a ring of bores into the coal seam and into the aquifers above and below it. These bores should be sampled at least fortnightly for all the analytes specified in the Environmental Authority for the site. If no exceedance occurs after 6 weeks monitoring could be reduced to monthly. Further, should rainfall exceed 100mm in any 24 hour period, sampling should be conducted as soon as the site can be safely accessed.

### **3.4. Information**

*Recommendation 7.* It is recommended that the Government put together a succinct summary of cause of each of the UCG incidents, the environmental

compromises that occurred (including site and DERM monitoring information) and consequent actions and put this into the public domain as soon as possible.

### ***3.5. Continuance of the trials***

*Recommendation 8.* The ISP recommends that the Cougar Energy trial *not* be reignited. The basis for this recommendation is that it is very likely that the incident resulted in a compromise to infrastructure allowing gas and water to escape from the chamber into the surrounding environment. Further, the Environmental Evaluation report indicated that Cougar Energy did not act sufficiently rapidly to shut down the facility when the changes to infrastructure were first observed. This indicates insufficient risk management protocols for the site and/or insufficient sensitivity of controls. It is unknown but possible that the escape of water and gas may have been avoided if the facility had have been shutdown more rapidly. Further, operating in such a hydrogeologically complex site should only proceed after it is shown to be acceptable on the basis of significantly better base line information. It should be noted that this will *not* change the edaphic and socio-political suitability of the site.

It is recommended that Cougar Energy move to decommission the cavity. First, a plan should be submitted for government approval and action taken immediately thereafter. It is an important (critical) part of all of the pilot trials that effective decommissioning can be undertaken and demonstrated not to leave unacceptable legacies in the environment. It is *not* recommended that a “clean up” approach be adopted. That is, the site should be treated as a pilot trial moving into orderly and planned decommissioning following an unscheduled permanent shutdown.