Statement of Environmental Objectives

Paralana 2

Hydraulic Fracturing Stimulation and Induced Seismicity

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BEACH ENERGY

petratherm

TRU energy

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1 Introduction

1.1 Purpose

This Statement of Environmental Objectives (SEO) has been prepared to meet the requirements of Sections 99 and 100 of the South Australian *Petroleum and Geothermal Energy Act 2000* (SA) (the Act) and Regulations 12 and 13 of the *Petroleum and Geothermal Energy Regulations 2000* (SA) (the Regulations).

The intent of the SEO is to outline the environmental objective that are required to be achieved during hydraulic fracturing stimulation operations of geothermal wells, and the criteria upon which these objectives are to be assessed. Environmental objectives have been developed on the basis of information provided in the Environmental Impact Report (EIR) for Hydraulic Fracturing Stimulation (*EIR, Paralana 2 Hydraulic Fracturing Stimulation, Petratherm 2010*).

1.2 Scope

This SEO applies to reservoir stimulation activities conducted by parties of the Paralana Joint Venture (Petratherm Limited, Beach Energy Limited and TRUEnergy) on the project site in the Arrowie Basin, South Australia (Figure 1). The operations that are covered by this SEO are:

- Construction of lined ponds/ dams up to 4 ML capacity for the storage of water and smaller lined collection pits
- Use of low pressure HDPE pipelines to transfer water between ponds/ dams/ collection pits to supply water from approved sources
- Installation and use of pressure vessel/chokes
- Use of high pressure pumps
- Fuel, oil and chemical storage
- Accommodation and amenities

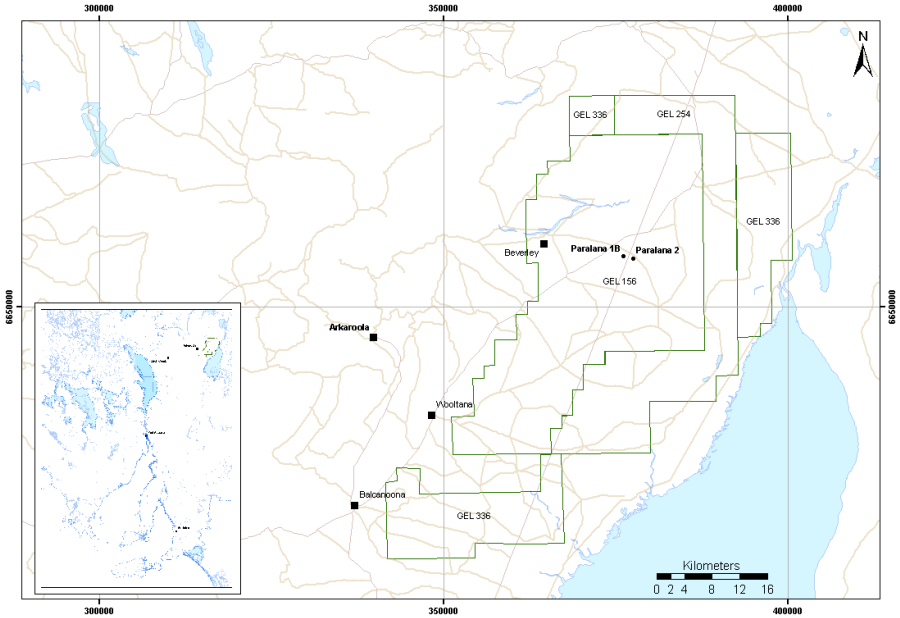

Figure 1 Location map of Paralana Geothermal Project in northern South Australia.

2 Environmental Objectives

2.1 Objectives

The environmental risks posed by the key operations associated with the hydraulic fracturing stimulation of geothermal wells were identified in the EIR (Petratherm, 2011). Measures proposed to manage and mitigate the risks of these activities are also set out in the EIR.

Table 1 of this report sets out the environmental objectives and assessment criteria for the stimulation of geothermal wells in the Arrowie Basin based on the information and analysis provided in the EIR (2011) and the requirements of the Act and Regulations in relation to the content of an SEO.

The environmental objectives for the activity are:

1. Minimise impact on native flora and fauna and endangered ecological communities.
2. Avoid the introduction or spread of pest plants and animals.
3. Avoid or minimise disturbance to stakeholders and/or associated infrastructure.
4. Avoid disturbance to sites of cultural and heritage significance.
5. Avoid contamination of environment by geofluid.
6. Avoid contamination of soil, shallow groundwater[1] and surface waters with chemicals, fuels, oils etc used in stimulation.
7. Avoid impact on existing groundwater infrastructure.
8. Prevent the occurrence of seismic activity that could cause concern to local populations or damage to local infrastructure.
9. Optimise waste avoidance, reduction, reuse, recycling treatment and disposal.

2.2 Assessment Criteria

The criteria for measuring achievement of the environmental objectives are set out in Table 1 and take one of the following forms:

2.2.1 Defined Conditions

In some cases, the achievement of an objective can be assessed through ensuring defined conditions are met or carried out. Such conditions include:

- Prohibitions to undertake a specific action (for example, to achieve the objective 'Minimise impacts on native flora' during site preparation, the assessment criteria may be to prevent the removal of native trees and shrubs).
- Requirements to carry out certain actions in accordance with approved procedures or industry accepted standards or Australian Standards.

2.2.2 Goal Attainment Scaling (GAS) criteria

Environmental objectives requiring visual assessment are likely to be prone to uncertainties of subjective judgement. To minimise this, GAS is used to measure such objectives against a series of

[1] Shallow groundwater: Aquifer zones in close proximity to the surface that may be accessed by local stakeholders for agricultural and or industrial purposes.

criteria described by a written description and/or photographically. GAS is applicable to measuring objectives related to minimisation of disturbances to natural vegetation, soil and rehabilitation of sites.

2.2.3 Scientific studies/monitoring

In some cases the assessment of the environmental objectives may not be possible in the shorter term and may require longer term monitoring and scientific evaluation. In such cases, the assessment criteria may be in the form of longer term data and information gathering.

Table 1 Environmental Objectives and Assessment Criteria

Environmental Objectives	Assessment Criteria	Guide of how objective can be achieved	Comments
1. Minimise impact on native flora and fauna and endangered ecological communities.	• Any sites with rare, vulnerable and endangered flora and fauna have been identified and avoided. • 0, +1, +2 GAS criteria are attained for 'Minimise impact on native vegetation' • No deaths or injury to fauna as a result of project activities	• Proposed operation sites have been assessed for rare, vulnerable and endangered flora, fauna and ecological communities before commencement of operation. • Site facilities designed and constructed to minimise fauna entrapment. • Ponds fenced to minimise animal access. • No domestic pets allowed on site.	Primary risk to native fauna include clearing of habitat and obstruction of movement through cleared areas, the presence of fuel, chemicals.
2. Avoid the introduction or spread of pest plants and animals.	• No weeds or feral animals are introduced to, or spread in operational areas as a consequence of activities.	• Where appropritate a weed and feral animal management strategy is in place (avoidance and control strategies)	Activity associated with site preparation, such as the movement of vehicle and equipment is a potential source of weed or disease introduction and spread. The most effective technique to prevent the introduction and spreading of weed species is to ensure that vehicles and equipment are appropriately cleaned prior to entry to/departure from site on a risk-based approach.
3. Avoid or minimise disturbance to stakeholders and/or associated infrastructure.	• No reasonable stakeholder complaints left unresolved.	• Induction for all employees and contractor which covers pastoral, conservation, tourism, legislation and infrastructure issues. • Relevant stakeholders are notified prior to site works and operations. • All gates left in the condition in which they are found. • Potential sources of contamination are fenced to prevent stock access. • System is in place for logging landholder complaints to ensure that issues are addressed.	Communication and the establishment of good relations with stakeholders and community is fundamental to minimising disturbance to as low as possible.

4. Avoid disturbance to sites of cultural and heritage significance.	• Sites of operations have been surveyed and any sites of cultural and heritage significance identified. • Any identified cultural and heritage sites avoided	• Consultation with stakeholders in relation to the possible existence of heritage sites. • Heritage clearance survey completed and reported • A procedure in place to respond to any sites discovered during activities.	The aim of the objective is to ensure that any sites of cultural or heritage significance are identified and protected.
5. Avoid contamination of environment by stimulation or geo-fluid.	• No contamination of soil, shallow groundwater or surface waters by stimulation or geo-fluid.	• Stimulation activities not conducted above well and equipment design pressure • Stimulation equipment and wellhead piped to allow quick flowback to lined pits • Future well operations to consider potential material limitations and mitigation requirements (chemical, physical and operational)	The SEO relates to the specific task of fracture stimulation at Paralana-2. Subsequent operations will require understanding of material design limitations
6. Avoid contamination of soil, shallow groundwater and surface waters with chemicals, fuels, oils etc used in stimulation.	• No contamination of soil, shallow groundwater or surface water.	• All fuel and oil to be stored in accordance with the appropriate standards (AS1940 storage and handling of flammable and combustible liquids). • Hazardous materials transported in accordance with Australian Dangerous Goods Code • Chemical specific handling and storage provided by stimulation service provider according to MSDS requirements • Record any spill events and corrective actions maintained in accordance with company procedure. • Spills or leaks are immediately reported and clean-up using spill kits.	There is the potential for the contamination of chemical and fuel storage areas and during transportation. Localised contamination may result from spills or leaks during storage and handling.
7. Avoid impact on existing groundwater infrastructure	• No unresolved stakeholder complaints about groundwater impact	• Community consultation informed local residents and stakeholders about the stimulation project • Stakeholders complaints about groundwater impacts to be registered, evaluated and resolved promptly (well deliverability and changes) • With project expansion baseline groundwater data, well register and monitoring may be required to assess impact	No comments received while using water during drilling phase. One off volume required for Paralana-2 fracture stimulation not on-going water withdrawal

8. Prevent the occurrence of seismic activity that could cause concern to local populations or damage to local infrastructure.	• Local seismic indicators (ground velocity, acceleration or moment magnitudes) not to exceed level where damage to infrastructure is possible as determined by the site specific risk assessment (Petratherm, 2010).	• A site specific seismic risk assessment has been undertaken to identify the infrastructure at risk and determine the maximum moment magnitude to be triggered by stimulation activities alone. • Seismic monitoring of the geothermal site, prior during and post stimulation to detect the development of the geothermal reservoir. • Seismic data to be analysed in real-time to determine event magnitudes and to guide activities accordingly. • Community consultation to inform local community of activities. • Activity specific response plan to be developed as part of notification of activity and adhered to as outlined in seismic risk assessment (Petratherm, 2010).	
9. Optimise waste avoidance, reduction, reuse, recycling treatment and disposal.	• All wastes to be disposed at an EPA facility. • Wastewater disposal of in accordance with the Public and Environmental Health (Waste Control) Regulations 1995 or to the Department of Health's satisfaction. • Attainment of GAS criteria for "Site to be left clean, tidy and safe".	• Covered bins are provided for the collection and storage of waste. All loads of rubbish are covered during transportation to waste facility. • Waste is segregated to maximise the opportunity for recycling. • Production of waste is minimised by purchasing specifying reusable, biodegradable or recyclable material where practical. • Wastewater disposal of in accordance with the Public and Environmental Health (Waste Control) Regulations 1995	Waste reduction required continual improvements in purchasing, efficiency of use and reuse. The geographical isolation reduces the available opportunities to recycle.

3 Reporting

Regulation 12(2) requires an SEO to identify events that could cause a serious incident or a reportable incident within the meaning of Section 85 of the Act.

3.1 Definitions

The following descriptions have been provided to help clarify and elaborate on the definitions given in Section 85(1) of the Act and regulation 32(1).

3.1.1 Serious incidents

Section 85(1) of the Act defines a 'serious incident' as an incident in which:

a) a person is seriously injured or killed
b) an imminent risk to public health or safety arises
c) serious environmental damage occurs or an imminent risk of serious environmental damage arises
d) security of natural gas supply is prejudiced or an imminent risk of prejuices to security of natural gas supply arises or
e) some other event or circumstance occurs or arises that result in the incident falling within a classification of serious incidents under the regulations or a relevant statement of environmental objectives, for example, damage to local infrastructure as a result of induced seismicity.

Table 2 identifies the potential serious and reportable incidents relevant to stimulation activities. Serious incidents must be reported to the minister as soon as practicable after the occurrence, as per Section 85 of the Act and Regulation 32.

Under section 83 of the Environmental Protection Act 1993, the following incidents also require reporting to the EPA as soon as reasonably practicable after becoming aware of the harm or threat:

- serious or material environmental harm from pollution, either caused or threatened in the course of activity
- activities that affect or threaten water occurring naturally under the ground through contamination at the site or in the vicinity of the site

3.1.2 Reportable incidents

Section 85(1) of the Act defines reportable incidents (other than a serious incident) arising from activities conducted under a licence that are classified under the Regulations as a reportable incident.

In accordance with Regulation 32(1), the following are classified as reportable incidents:

a) an escape of petroleum, a processed substance, a chemical or a fuel that affects an area that has not been specifically designed to contain such an escape; and
b) an incident indentified as a reportable incident under the relevant Statement of Environmental Objectives.

All events categorised as ‘Tolerable ‘ or ‘Intolerable’ as described in Table 16, Section 4.1.3, of the Paralana-2 Hydraulic Fracture Stimulation Induced Seismicity Risk Assessment (Petratherm 2010) and Table 5, Section 4.9 of the Environmental Impact Report (Petratherm 2011) to be reported as reportable incidents.

Reportable incidents must be reported to PIRSA on a quarterly basis within 1 month after the end of each quarter.

Table 2 Potential Serious and Reportable Incidents

Serious Incidents	Reportable Incidents
1. A person is seriously injured or killed. 2. An imminent risk to public health or safety arises. 3. Serious environmental damage occurs or an imminent risk of serious environmental damage arises, for example: • Disturbance to sites of cultural and/or heritage significance without appropriate permits and approvals. • A spill or release of fuel, oil, chemicals or geofluid during stimulation that could contaminate soils, shallow ground water or surface waters*. • Any removal of rare, vulnerable or endangered flora or fauna without appropriate approval. • Detection of a declared weed, animal/plant pathogen or plant pest species that has been introduced or spread as a direct result of activities. 4. Security of natural gas supply is prejudiced or an imminent risk of prejudice to security of natural gas supply arises. 5. An event that compromises the physical integrity of an asset or facility, for example: • Pipeline rupture or facility failure. • Unauthorised activity on a pipeline easement where the pipeline is contacted and repair action is required. • Damage to local infrastructure as a result of induced seismicity. 6. An uncontrolled release resulting in the activation of emergency response and/or evacuation procedures of an area in or adjacent to the release*.	1. An escape of geofluid, chemical or a fuel that affects an area that has not been specifically designed to contain such an escape. 2. An event that has the potential to compromise the physical integrity of an asset or facility such as: • An unapproved excursion outside of critical design or operating conditions/parameters • Failure of a critical procedural control in place to reduce a credible threat to low or as low as reasonably practicable • Unauthorised activity on a pipeline easement with equipment or vehicles that have been identified as exceeding allowable stress limits determined in accordance with AS2885 • Unauthorised activity on a pipeline easement where the pipeline is contacted but repair action is not required 3. Malfunction or failure of critical plant or equipment that had (or has) potential to cause a cause a serious incident 4. Unresolved complaints from public and stakeholders regarding stimulation activities, for example ground velocities, or other pre-agreed seismic magnitude indicator, exceeding predetermined limits as defined in the response plan for the specific activity

* items likely to require EPA notification under section 83 of the Environmental Protection Act 1993

4 REFERENCES

Petratherm Ltd. (2011) *Environmental Impact Report, Paralana 2 Hydraulic FracturingStimulation.* Petratherm Ltd, Adelaide.

Petratherm Ltd. (2010) *Paralana-2 Hydraulic Fracturing, Stimulation: Induced Seismicity Risk Assessment for GEL156.* Petratherm Ltd, Adelaide.