

REGULATORY NIRVANA FOR GEOTHERMAL RESOURCE DEVELOPMENT

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ABSTRACT

The enormous worldwide prospectivity to develop all forms of geothermal resources underpins realistic expectations for the security of competitive base-load energy supplies for centuries to come. Proof-of-concept and pre-competitive enhanced (engineered) geothermal system (EGS) projects near to communities unfamiliar with fracture stimulation operations has put pressure on governments to nimbly and simultaneously attain sustainable social, natural and economic outcomes. Nirvana regulatory frameworks for profitable and environmentally sustainable development operations for all forms of geothermal energy resource development entail:

- Attractive licence¹ tenure;
- Regulatory certainty and efficiency without taint of capture by special interests;
- Regulators and licensees have trustworthy capabilities (competence and capacity);
- Effective (informative) stakeholder consultation well-ahead of land access;
- Public access to details of risks and reliable research to back-up risk management strategies so the basis for regulation is contestable anytime, everywhere;
- Timely notice of entry with sufficient operational details to effectively inform stakeholders;
- Potentially affected people and organizations can object to land access - without support for vexatious objections;
- Fair and expeditious dispute resolution processes;
- Fair compensation to affected land-users for costs, losses, and deprivation due to operations;

- Risks are reduced to low or as low as reasonably practicable while also meeting community expectations for net outcomes;
- Licensees monitor and report on the efficacy of their risk management processes, while the regulator probes same;
- Regulator can prevent and stop operations, require restitution, levy fines and cancel licenses; and
- Industry compliance records are made public, so the efficacy of regulation is transparent.

Regulation for compatible, multiple-use of land in Australia is undertaken with community ownership of subsurface resources² in mind. Indeed, net benefits to communities are the foundation of good government policy. This is the end-in-mind for South Australia's *Petroleum and Geothermal Energy Act 2000* (the P&GE Act, as amended in 2009). This paper will describe how the above-stated principles are deployed in South Australia (Figure 1) where:

- Since implementing South Australia's Petroleum and Geothermal Energy Act 2000 (the P&GE Act) in September 2000, more than 11,000 notices of entry for petroleum and geothermal operations have been issued with only one triggering a Court hearing, and that was a matter taken to the District Court of South Australia to establish legal precedent (certainty) that reflection seismic surveys could extend outside a license area to attain full-fold control within a license;
- 86% (\$581 million) of \$679 million estimated to have been spent nationally for all geothermal work program investment in Australia has been invested in SA-based projects in the term January 2002 – December 2010³;

¹ Australian state and territory governments issue licences (leases) and regulates all activities undertaken for exploration, development and production of mineral and energy resources (including geothermal energy) over lands and submerged lands (rivers, lakes, bays, gulfs, etc) inland of the 3 nautical miles of the mapped coastline of states and territories. The Australian Federal Government issues and regulates activities for offshore areas beyond 3 nautical miles of the mapped coastline of states and territories.

² Australian subsurface resources are owned by the crown and licenses are provided by elected governments to entitle enterprises to explore for, develop and produce resources for profit, subject to the requirements of legislation and regulation, including the payment of prescribed royalties to government(s).

³ Statistics to YE 2011 will be determined in 1Q2012

- SA-based projects attracting 97% of the \$198.8m⁴ for Australian Government grants to foster the commercialization of geothermal energy;
- Australia's flagship deep drilling projects are located: Geodynamics/Origin in the Cooper Basin, Petrathem/Beach in the Flinders Range, and Panax Geothermal in the Otway Basin (Figure 1); and
- The number of South Australian geothermal licenses grew from 3 in 2004 to 209 at year-end 2011, despite the decline in overall investment in geothermal in Australia since the global financial crisis since 2008.

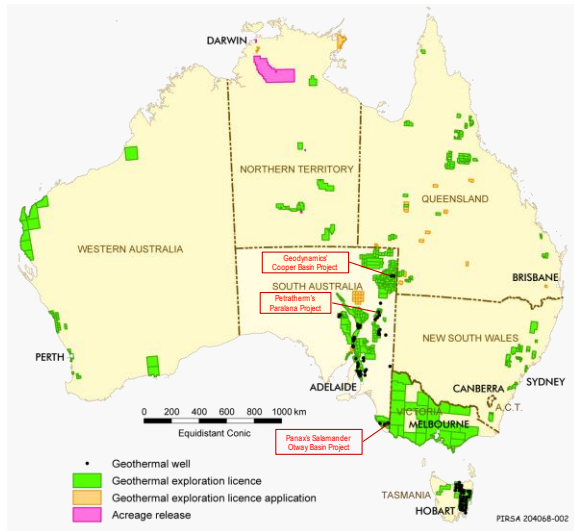


Figure 1. Geothermal energy licences in State and Territories of Australia as of year-end 2011. South Australia has attracted more geothermal energy project investment than any other Australian jurisdiction.

The introduction of new energy development technologies (such as Engineered Geothermal Systems) is inevitable, so regulatory Nirvana will remain a vision for which success is never done, anywhere. South Australia aspires to attain as good as it gets regulation for the geothermal energy sector.

Expeditious, welcomed access to land for compatible, multiple uses is the metric for performance of regulations covering energy resource development. Leading practice is based on the principle that trust is the most valuable lead factor and lag outcome in sustaining welcomed land access for energy resource exploration, development and production.

RECIPE FOR REGULATORY NIRVANA

Nirvana regulatory frameworks for profitable and environmentally sustainable development of operations for geothermal energy resources entail the ingredients described in brief below, with several discussed in further detail under separate headers.

- Attractive license tenure;
- Regulatory certainty and efficiency for environmentally sustainable development;
- Trustworthy capabilities (competence and capacity) in regulatory agencies without taint of capture by special interests;
- Restricting the grant of licenses to companies with capacity to invest in and undertake trustworthy operations;
- Effective (informative) stakeholder consultation well ahead of any particular application for land access so stakeholders reach informed views as to: (1) potential risks, (2) trustworthiness of risk management strategies, and (3) standards for life-cycle outcomes e.g. terms for land access negotiated well before any location and timing-specific activity approvals. This drives upstream petroleum licensees to negotiate terms for land access to stakeholders' satisfaction well before activity approvals are applied-for.
- Easy 24/7 public access to:
 - Details of operational risks and research to back-up risk management strategies so the basis for regulation is contestable anytime, everywhere;
 - Records of engagement with stakeholders e.g. details of stakeholders' concerns as answers to frequently asked questions (FAQs) and, with necessary consents - the publication of submissions from stakeholders and licensees' replies. This level of transparency enables both (1) experience-based, continuous improvement and (2) busting myths and mis-information along the way;
 - Standards for outcomes that reflect community expectations;
 - Requirements for, and results of both licensees' environmental monitoring programs and probing by the regulator; and
 - Timely, telling reports on industry compliance so the efficacy of the regulatory regime is always open to public scrutiny.
- Good faith negotiations that lead to expeditious, conjunctive (life-cycle) land access agreements that are fair to land users and sustainable in relation to development. In Australia, good faith negotiations with relevant Aboriginal landowners, Native Title holders and Native Title claimants are a very important sub-set. In this regard, best practice outcomes are expeditious, conjunctive land access agreements reached through the Right to Negotiate (RTN) and Indigenous Land Use Agreement (ILUA) processes that are fair to Aboriginal people, sustainable in relation to development, and compliant with State and Commonwealth legislation for the protection of both Native Title and heritage. Trust in land access agreements is bolstered with public access to relevant deeds. This latter step fosters best efficient, experienced-based evolution towards best practice agreements; the evolutionary status of RTN and ILUA agreements in South Australia are discussed in further detail in the proceeding text.

⁴ This statistic reflects the cancellation of 5 of 7 Australian Federal Geothermal Drilling Program grants in 2011.

- If operator-run consultation (on the behalf of licensees) is judged to be insufficiently robust, then the regulator consults directly with stakeholders to attain regulatory standards that meet community expectations for net outcomes;
- Timely notice of entry is required with sufficient operational details to effectively inform potentially affected (and hence informed) stakeholders for on-ground operations;
- People and organizations with relevant interests are entitled (given leverage) to object to land access for any particular operation - without support for vexatious claims;
- Trustworthy, expeditious and effective dispute resolution processes prevail. In South Australia, the regulator decisions and licensees' notices of entry are open to legal challenge.
- Fair compensation from licensees to relevant land-users for (1) reasonable costs sustained during the process of negotiating land access in good faith and (2) losses and deprivation due to operations through to decommissioning;
- Licensees -deploy effective risk management to minimize the chance of mishaps to low or as low as reasonably practicable while also meeting community expectations for net outcomes;
- Requirements for licensees to report on the efficacy of their risk management processes at least annually, and by exception if and when environmental incidents occur;
- Industry compliance records are made public, so the efficacy of regulation is transparent. The publication of licensees' environmental compliance reports is a feature of the PGE Act, as one feature of South Australia's policy for regulatory transparency and to demonstrate the risk of regulator capture is controlled;
- The regulator probes operations for the integrity and implementation of management systems, and prepares an annual compliance report to the government's legislative body;
- Licensees driven to meet community expectations for net outcome with regulator having powers to 'say no' (prevent operations); 'say stop' (require operations to cease); require restitution, levy fines for non-compliance; and cancel licenses; and
- Review of regulations by exception or no less frequent than once every 5-years to stay modern and sustain trust with the public and investors.

SOUTH AUSTRALIAN APPROACH (TO BE SIMPLY IRRESISTIBLE FOR TRUSTED GEOTHERMAL ENERGY INVESTMENT)

All regulation for compatible, multiple-use of land in Australia is undertaken with community ownership of subsurface resources in mind. Indeed, net benefits to communities are the foundation of good government policy. This is the end-in-mind for South Australia's *Petroleum and Geothermal Energy Act*

2000 (the P&GE Act), as amended in 2009. The preceding text describes how the above-stated principles are deployed in South Australia where:

- Since implementing South Australia's Petroleum and Geothermal Energy Act 2000 (the P&GE Act) in September 2000, more than 11,000 notices of entry for petroleum and geothermal operations have been issued with only one triggering a Court hearing, and that was a matter taken to the District Court of South Australia to establish legal precedent (certainty) that reflection seismic surveys could extend outside a license area to attain full-fold control within a license;
- 86% (\$581 million) of \$679 million estimated to have been spent nationally for all geothermal work program investment in Australia has been invested in SA-based projects in the term January 2002 – December 2010;
- SA-based projects attracting 97% of the \$198.8m for Australian Government grants to foster the commercialization of geothermal energy;
- Australia's flagship deep drilling projects are based (Geodynamics/Origin in the Cooper Basin, Petrathern/Beach in the Flinders Range, and Panax Geothermal in the Otway Basin); and
- The number of South Australian geothermal licenses grew from 3 in 2004 to 209 at year-end 2011, despite the decline in overall investment in geothermal in Australia since the global financial crisis since 2008.

The introduction of new energy development technologies is inevitable so regulatory Nirvana will remain a vision for which success is never done, anywhere. South Australia aspires to attain as good as it gets regulation for the upstream petroleum sector. Expeditious, welcomed access to land for compatible, multiple uses is the metric for performance, and best practice is based on the principle that that trust is the most valuable lead factor and lag outcome in stakeholder consultation.

ATTRACTIVE LICENCE TENURE

Exploration, discovery and appraisal to book sufficient reserves in a new geothermal energy play-trend to make decisions to contract produce geothermal energy for electricity generation and/or direct use usually takes more than five years. Hence, standard Australian exploration licenses of just five year terms with requirements to surrender one-third to one-half of license areas at 5 year junctures is an imperfect fit for the realistic life-cycle of commercializing hot sedimentary aquifer (HSA) or Engineered Geothermal Systems (EGS) plays in Australia.

South Australian geothermal exploration licenses (GELs) have five-year terms, with annual work programs. Requirements to surrender a part of GELs at the end of each five-year term can be offset where exploration has discovered reserves or resources with

realistic scope for future commercialization. This provides GEL holders entitlement to be granted life-of-project (1) geothermal energy production licenses (GPLs) over lands up to twice the probable area of petroleum reserves (equivalent to at least a 50% level of certitude for the areal extent of reserves), or (2) geothermal energy retention licenses (GRLs) over lands up to twice the possible area of petroleum resources (equivalent to at least a 10% level of certitude for the areal extent of resource). Also, any areas excised from GELs to become GPLs or GRLs count towards any residual requirements for the relinquishment of GEL areas not established within GPLs or GRLs.

To date, 15 GRLs covering 1,482 km² in South Australia have been granted to Geodynamics and its joint venture partners. No GPLs have been granted to date. GPLs will be held by production and will be subject to the '24 month rule'. In practice, where production never started or ceased within a GPL for more than 24 months, the regulator will generally ask the GPL holder(s) to specify why the GPL should be retained rather than be surrendered. This enables the State to mitigate the risk of anti-competitive warehousing of land areas in GPLs without production (which is the purpose of a GPL) that could otherwise be offered for over-the-counter or competitive work program bids for new GEL(s). Where a GPL holder credibly demonstrates a schedule to, for example, to produce geothermal energy into long term contracts, then the regulator has flexibility to allow GPLs to continue without production.

GPLs can also be converted in part or in total into GRLs to cover up to twice the possible area of geothermal resources.

GRLs have five-year terms with annual work programs designed to commercialize the resource within the GRLs. There is no prescribed limit to the number of contiguous five-year PRL renewal terms with appropriate (and possibly shared) work programs. Work programs for PRLs are negotiated between the applicant and the regulator as a delegate of the Minister.

Hence, PGE Act GELs, GRLs and GPLs provide attractive tenure for companies exploring, appraising, developing and producing geothermal energy plays.

THE PUBLIC'S SKIN IN THE GAME

The State considers the attraction of exploration investment by multiple competitors on multiple independent energy plays as the most efficient and effective way to beget supply-side security and competition in energy markets. It is arguable that secure, supply-side competition that delivers

competitively priced energy to markets is at least if not more valuable than the associated royalties paid to governments. In particular, the intrinsic renewable, low emission and reliably continuous supply characteristics of geothermal energy are well recognized in Australia, and this has justified considerable government support for proof-of-concept and demonstration geothermal energy projects. Recognizing excellent prospects for the development of hot rock geothermal energy in the state, South Australia's government:

- provides nation-leading investment frameworks and a one-stop-shop for the regulation of the geothermal energy sector;
- provided seed funding to run the South Australian Centre for Geothermal Energy Research at the University of Adelaide (SACGER);
- provides targeted grants to co-fund (with industry) geothermal energy exploration projects; and
- underpins non-parochial national leadership (through its Department of Manufacturing, Innovation, Trade, Resources and Energy - DMITRE) by:
 - Serves as Australia's contracting party to the International Energy Agency's Geothermal Implementing Agreement⁵, (IEA GIA) and provides a Vice Chairman for the Executive Committee of the IEA GIA;
 - Provides of the Secretariat, Technical Interest Group Leaders and the website for the Australian Geothermal Energy Group (the AGE⁶);
 - Provides of the Australian convener for the Induced seismicity working group of the International Partnership for Geothermal Technologies; and
 - Pro-actively supports the sharing of geothermal energy information and concepts through participation in Australian and international conferences and workshops.

REGULATORY CERTAINTY FOR ENVIRONMENTALLY SUSTAINABLE

⁵ For details, visit: <http://www.iea-gia.org/>

⁶ The AGE⁶ is the whole-of-sector representative body for Australia's geothermal sector, and has 109 organisational members (86 companies, 14 universities, and 9 government agencies from all States, the NT and the Federal governments). For details visit: <http://www.pir.sa.gov.au/geothermal/ageg>

DEVELOPMENT

Legislated Objectives

Amongst the highest level objectives of the PGE Act are objectives to:

- Sustain trusted practical, efficient, and effective regulation for upstream petroleum and geothermal enterprises in the State;
- Encourage competition in the upstream energy resource sectors;
- Protect the public's interest in the sustainability of natural, social and economic environments from risks inherent in energy resource operations;
- Sustain effective consultation processes with people affected by regulated activities, and the public in general; and
- Ensure as reasonably practical the security of supply of energy supplies.

It is important to recognize that the definition of environment under the PGE Act is broad and includes:

- Land, air, water (including both surface and underground water), organisms and ecosystems;
- Buildings, structures and cultural artifacts;

- Productive capacity or potential;
- The external manifestations of social and economic life; and
- The amenity values of an area.

Licence Holder Criteria

Only parties with the demonstrated capacity to invest in and safely conduct on-ground activities including work programs are eligible to become PGE Act licence holders.

Leading Practice for Transparent Approvals

Clear, efficient and effective activity approval processes are rudimentary for trustworthy regulation. Mapping approval processes also elucidate scope to reduce red tape. Figure 2 illustrates the approvals process within a one-stop-shop approach in South Australia for exploration and production operations. This map of approvals for energy resource operations has enabled DMITRE to coordinate policies and processes with its co-regulators for human health, safety, and environmental protection

LICENSING AND APPROVALS PROCESS FOR EXPLORATION, RETENTION, PRODUCTION AND ASSOCIATED ACTIVITIES PETROLEUM AND GEOTHERMAL ENERGY ACT (PGE) ACT 2000

The PGE Act process consists of three stages. Firstly, access to land is obtained through the grant of a licence specific to the proposed activity. Environmental assessments are then required to develop environmental objectives and assessment criteria for approval. Finally, a location-specific activity notification is submitted for approval (as required). Each stage is shown independently in this flowchart and all stages are required to be completed before regulated activities can commence. In reality, it will be possible for some aspects of the separate stages to occur in parallel - this is best discussed with DMITRE early in project planning. References to appropriate sections of the PGE Act and/or Regulation are provided where these will assist the proponent.

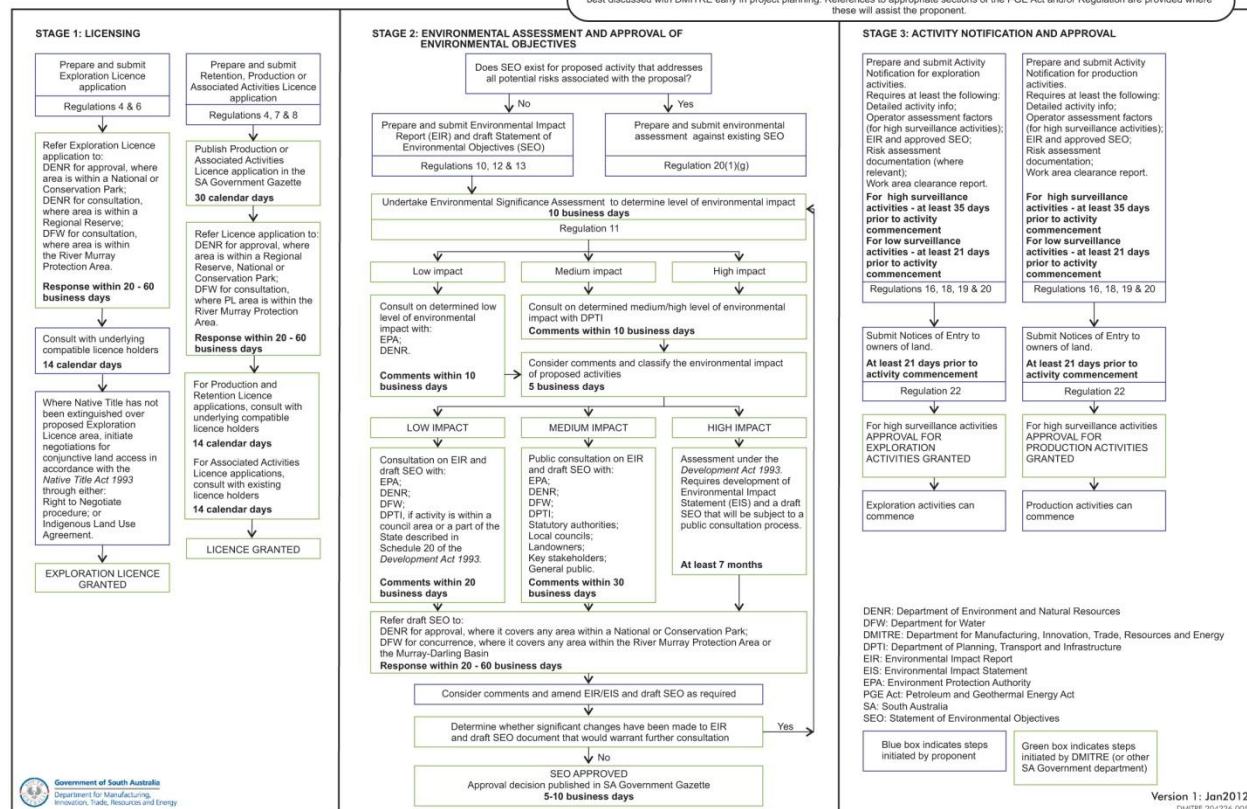


Figure 2. South Australian activity approvals process within a one-stop-shop approach led by DMITRE for exploration and production operations. This map was developed by Hayter (2011) in response to an assessment undertaken by South Australia's Office of Economic Development Board (2011).

Statements of Environmental Objectives Are Leading Practice

The grant of PGE Act licenses for geothermal exploration, geothermal retention, and geothermal production do not provide an automatic entitlement to land access for regulated upstream petroleum operations. Rather, regulated activities under the P&GE Act cannot be carried out unless there is an approved Statement of Environmental Objectives (SEO) in place, prepared on the basis of an Environmental Impact Report (EIR).

The EIR identifies all potential risks relating to the activity and the appropriate risk mitigation strategies. The SEO identifies the environmental objectives to be achieved to address the risks identified in the EIR and the criteria to be used to assess achievement of the objectives. This drives the implementation of a modern, goal-seeking, risk-management approach by requiring PGE Act licensees to:

- Undertake and document risk assessments;
- Design operations and facilities to minimize risks to low or as low as is reasonably practicable;
- Formalize change management processes to keep risk management evergreen;
- Implement risk management systems to sustain safe operations and fit-for-purpose integrity of facilities;
- Meet all relevant standards for operations and;
- Both report on, and be probed (by the regulator) for compliance with all relevant regulations.

For example, activities must avoid potentially harmful cross-flow of fluids and gases between aquifers, either potable or saline. This can be ensured through proper design and installation of casing and cementing in all wells. DMITRE also require companies to have effective risk management systems to assure the life cycle fitness-for-purpose (integrity) of facilities from construction through decommissioning.

In addition to these environmental safeguards, activities regulated pursuant to the PGE Act must be carried out with due care for the health and safety of people who potentially may be affected by those activities.

Leading Practice Stakeholder Consultation and Transparency (Mitigate Angst)

Through the consultation requirements of the P&GE Act, stakeholders including landholders are required to be informed of the potential risks associated with proposed activities, and management strategies to be

deployed to minimize such risks to an acceptable level.

Stakeholders are also provided with opportunities to raise any issues of concern they may have prior to the commencement of regulated activities. Indeed, the State's regulations require operations to effectively manage risks and meet community expectations for net outcomes, or the activities will not be approved.

All SEOs and associated EIRs are also public documents to be found on the Department's website.

In addition, licensees are required to submit annual reports detailing activities undertaken within each license area during the respective license year, as well as the activities proposed for the ensuing license year. An important part of this reporting is to ensure that each licensee regularly reviews, assesses and reports on their performance and compliance with the P&GE Act and the relevant environmental objectives.

Utilizing the information provided in the EIR, DMITRE completes an environment significance assessment (DMITRE, 2009) in accordance with publicly documented criteria that address the level of certainty in predicting consequences (including stakeholder concerns) and the level to which these consequences will be managed. The level of environmental impact that is assigned to a particular activity determines the consultation that DMITRE undertakes on the EIR and draft SEO documents. Where activities are assessed as low environmental impact, DMITRE consults with relevant government agencies, including the Environment Protection Authority, the Department for Water, the Department of Environment and Natural Resources and, if relevant, other agencies, such as the Department of Planning and Local Government and SafeWork SA. Where activities are assessed as medium environmental impact, DMITRE initiates a public consultation process. Proposed activities assessed as high environmental impact are referred to the Department for Planning and Local Government for assessment under the *Development Act 1993*.

During the public consultation process, the EIR and draft SEO are made available to the public through the DMITRE website and at local council offices for at least 30 business days. Members of the public are notified of the consultation process through advertisements in local newspapers as well as on the DMITRE website, and in addition directly affected stakeholders are provided with targeted correspondence from DMITRE.

The environmental significance criteria enable identification of deficiencies in stakeholder consultation during the development of the EIR and draft SEO. Where DMITRE's assessment identifies

such a deficiency, the determined level of environmental significance will be greater and is likely to trigger more extensive stakeholder consultation by DMITRE. This ensures relevant stakeholders are provided with appropriate time for opinions to be considered and represented equitably in advance of SEO and subsequent activity approvals.

Concerns raised during consultation are incorporated into the EIR documents as appropriate, and the SEO will become the subject of further consultation, enabling significant changes prior to approval by the Minister.

All of this happens well before any company can apply to undertake any on-ground activities regulated pursuant to the P&GE Act.

The Minister's approval of an SEO is open to challenge through the consultation process, and after approval, through the Minister's Department, the Minister and as a last resort, by application to the District Court of South Australia. In short, SEOs are the result of robust consultation with stakeholders, enable goal-seeking innovation, are required to remain modern, and are contestable.

Leading Practice Land Access Agreements Are Fair and Sustainable

Mutual trust for compatible, sustainable land access for upstream petroleum operations are traditionally indemnified with formal land access agreements struck between licensees potentially affected people and enterprises. To provide impetus for fair and sustainable land access for petroleum, geothermal energy and gas storage operation in the State, SA's PGE Act was amended in 2009 to expand the 'owner of land' definition to cover all persons who may be directly affected by regulated activities, entitling them to notices of entry and compensation. This amendment has proved to be a driver for mutual respect. With this incremental legislated requirement, owners of land are provided with opportunities to raise concerns prior to the commencement of regulated activities, and the State's regulations require operations to effectively manage risks and meet community expectations for net outcomes, or the activities will not be approved. The outcome is demonstrable leverage to all persons who may be directly affected by regulated activities, not just those holding land titles, but also people such as Native Title claimants, and anyone leasing potentially affected land for enterprises.

Transparency in Land Access Agreements Will Foster Progress to Best Practice

South Australia publishes native title land access agreements (signed by the State Government) on DMITRE's website, providing the benefits of

experience for subsequent negotiations. With that as an exception, there are currently no other requirements in any Australia jurisdiction for public access to land access agreements between geothermal licensees and (for example) people and enterprises affected by geothermal energy operations. It is worth considering the risk and reward implications of industry opting to provide public access to at least template terms for leading practice, to enable experience-based learnings, and adding certainty for outcomes in future land access negotiations

Notice of Entry - The Only Good Surprise Is No Surprise

The grant of P&GE Act geothermal exploration, geothermal retention, and geothermal production licenses does not provide an automatic entitlement to land access for regulated geothermal energy operations. Only after an approved SEO is in place can a geothermal energy license holder apply to undertake an on-ground activity. With an approved SEO in place, timely notice of entry is required with sufficient operational details to effectively inform potentially affected (and hence informed) stakeholders for on-ground operations.

Each on-ground activity requires submission of a separate location-specific activity notification to DMITRE (DMITRE, 2011).

Requirements of the P&GE Act for stakeholder consultation includes requirements to consult widely, so that landholders are informed of the potential risks associated with proposed activities, and informed of the management strategies to be deployed to minimise such risks to an acceptable level.

Stakeholders are provided with opportunities to raise any issues of concern they may have during the development of EIRs and SEOs, before any activities are approved by the Minister, and again, prior to the commencement of regulated activities, subsequent to every notice of entry.

Geothermal licensees are also obliged to give notice of entry to landowners at least 21 days before their land is to be entered, including information on anticipated events and consequences and actions to be taken to manage these events and consequences.

Trustworthy Dispute Resolution Processes Are Fair

Under the provisions of SA's P&GE Act, the landowner has 14 days within which they can object to the entry. If an objection is lodged, the activity cannot be undertaken until the dispute is resolved.

The South Australian regulator always encourages local negotiations between the license holder and the landowner to meet local expectations, while

preserving dispute resolution options including mediation stewarded by the Minister, and the opportunity to apply to the Warden's Court for a resolution of the dispute. Negotiated terms for land access are the only outcome to date from disputed Notices of Entry. This is a metric for regulatory Nirvana.

Also, under the P&GE Act - landowners are entitled to appropriate compensation from geothermal licensees for any losses, deprivation or reasonable costs sustained during both the process of negotiating land access and for the full cycle (of time) for land access, right through to decommissioning.

Bottom line for the SEO Approach

In detail, SA's P&GE Act gives all stakeholders (people and enterprises) entitlements to be consulted well ahead of land access through the process of considering EIRs and SEOs, and again ahead of land access with the required Notice of Entry process, and provides ample opportunity to all relevant stakeholders to negotiate proper commercial terms for land access, and the opportunity to have the Minister act as a mediator (by policy, through the appointment of a knowledgeable, independent and highly regarded person), and to apply to have the matter resolved in Court. The obligations for SA's P&GE Act licensees to compensate stakeholders underpin the position of power given to stakeholders under SA's P&GE Act.

Since implementing South Australia's Petroleum and Geothermal Energy Act 2000 (the P&GE Act) in September 2000, more than 11,000 notices of entry for petroleum and geothermal operations have been issued with only one triggering a Court hearing, and that was a matter taken to the District Court of South Australia to establish legal precedent (certainty) that reflection seismic surveys could extend outside a license area to attain full-fold control within a license;

Wanted: Capable Regulators Without Taint of Capture

A key lesson learnt in the post-event audit of both the Gulf of Mexico (Macondo) and Northwest Shelf (Montara) uncontrolled well flow incidents is that regulators must have relevant and up-to-date capabilities (competence and capacity) to be trusted to act in the interests of the public in protecting natural, social and economic environments from resource industry mishaps. Additionally the risks of regulatory capture must be effectively managed. In this regard, Australia's Productivity Commission (2009) concluded:

- One-Stop-Shops (lead agencies) are the most efficient regulatory approach when well managed without capture;
- Under a lead agency, approval of most, if not all, aspects rests with one designated agency that maintains control of the process, and in most cases, would consult with other relevant agencies rather than formally refer the application to a number of separate agencies for assessment. Where impacts are considered to be significant, a formal referral may take place. By maintaining control of the approval process the lead agency approach is able to minimize time delays. South Australia's one-stop-shop (through DMITRE) 'is widely seen as a model for other jurisdictions to emulate'; and
- With appropriate governance, experience in South Australia suggests that lead agencies can achieve an appropriate balance between enforcing legislative provisions and expediting approvals.

Properly resourced one-stop-shops (lead agencies) that transparently act pursuant to all co-regulatory objectives, and hence are trusted, are an integral part of regulatory Nirvana.

Wanted: Compliant Operations

Licensees are required to submit annual reports detailing activities undertaken within each license area during the respective license year, as well as the activities proposed for the ensuing license year. An important part of this reporting is to ensure that each licensee regularly reviews, assesses and reports on their performance and compliance with the P&GE Act and the relevant environmental objectives. Company Annual Compliance Reports are available on DMITRE's website (DMITRE, 2012a). DMITRE also prepares a P&GE Act Annual Compliance Report for the purpose of (1) outlining the compliance monitoring and surveillance activities carried out by DMITRE during each year for activities regulated under the P&GE Act; and (2) providing an overview of the regulatory performance of the energy resource industries in accordance with the requirements of the P&GE Act. These reports are also available on DMITRE's website (DMITRE, 2012b)

Requirement to Demonstrate the Efficacy of Risk Management Systems (Don't lose the kingdom for want of a nail, Wikipedia, 2011)

In South Australia, geothermal licensees must be able to:

- demonstrate the integrity of risk management controls in advance of activity approvals;
- demonstrate the fitness-for-purpose of processes, plant, and equipment in advance of approval to

commission and thereafter at least once every 5 years; and

- monitor and report incidents of non-compliance with regulatory standards, including the standards specified in SEOs.

The regulator (DMITRE) simultaneously probes for compliance.

Wanted: Predictable Enforcement

Regulators' actions should be predictable and reliable. While accounting for natural justice and providing for efficiency regulators should be held accountable with requirements to provide public access to descriptions of incidents that had potential consequences for natural, social and economic environments. South Australia's approach to provide fair, trustworthy regulation has been described by Malavazos (2001) and entails a publicly available compliance policy. For efficiency and effect, South Australia's compliance policies emphasize the prevention of harmful incidents with potential to arise in geothermal energy operations – but culminate in prosecution and loss of licenses. The relevant compliance enforcement pyramid is provided as figure 3, and articulates the nature and time of a detected non-compliance under the P&GE Act and the appropriate level of government intervention it will attract.

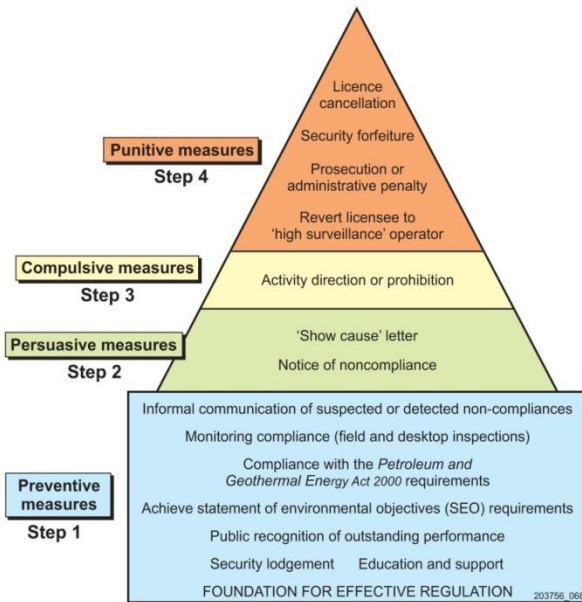


Figure 3. Illustration of South Australia's compliance enforcement policies for activities regulated pursuant to the *Petroleum and Geothermal Energy Act 2000*.

Wanted: Risk Management to Protect Environments

As described earlier in this paper, only after SEOs have been approved; only after people and enterprises potentially affected by operations have been satisfied with risk

mitigation (through a consultation process that entails a highly leveraged right to object); only then are geothermal project operators able to seek activity approval and the privilege to give Notice of Entry to potentially affected *landowners* in South Australia. Trust in this process is augmented with publicly available evidence-based risk assessments – as described in EIRs and answers to frequently asked questions (FAQs).

Just the Facts (for FAQs)

The enhancement of geothermal reservoirs with fracture stimulation will induce seismicity. The potential risks need be ascertained on a project-by-project basis, and will benefit from growing experience in the development of EGS plays. The associated benefits have the prospects of providing enormous benefits to people. In regulatory Nirvana:

- the public is well informed of the benefits and risks of naturally occurring and made-made geothermal reservoirs;
- regulators are trusted to keep people and the natural environment out of harm's way, and
- industry behaves in ways that underpin prosperity with the supply of safe, secure, competitively-priced geothermal energy.

Vital Concerns

Two vital public concerns associated with the development of geothermal energy are summed-up in the following questions:

- Are well construction and operations fit-for-purpose and trustworthy to: assure well integrity to mitigate risks of contamination of water supplies, avoid surface subsidence; avoid soil contamination, avoid consequential induced seismicity; and mitigate to loss of amenities, including the multiple uses of land (for industries in addition to geothermal energy production and communities in general) to continue?; and
- Are the cumulative potential effects of geothermal energy development consequential?

Prevention is the best cure. Demonstrably safe operations will tend to be welcomed.

Table 1. – Key environmental impact reports (EIRs) and statements of environmental objectives (SEOs) prepared to inform stakeholders and to set standards for EGS operations ahead of activity approvals in South Australia. All are publicly available from DMITRE’s webpages.

Cooper-Eromanga Basins

[Reservoir Stimulation and Evaluation, Cooper Basin – EIR](#), (Geodynamics, 2010a)

[Reservoir Stimulation and Evaluation, Cooper Basin – SEO](#), (Geodynamics, 2010b)

Arrowie Basin

[EIR: Paralana 2 Hydraulic Fracturing Stimulation](#) (Petratherm, 2011a).

[SEO: Paralana 2 Hydraulic Fracturing Stimulation and Induced Seismicity](#)
Petratherm, 2011b.

[Risk Assessment: Paralana 2 Hydraulic Fracturing Stimulation: Induced Seismicity, GEL 156](#).
Petratherm, 2010.

EGS Operations in the South Australian

Two EGS projects in South Australia were undertaken without consequential induced seismicity incidents. These include five fracture stimulated EGS wells in South Australia: Geodynamics’ Habanero 1, 2, 3, and Jolokia 1 in the Cooper Basin; and Petratherm’s Paralana 2 in the Arrowie Basin.

Goldstein, et al (2010) described South Australia’s strategies for the risk management of geothermal well operations, and the scope of environmental impact research required to establish local standards for the risk management of EGS operation with a focus on the potential risk posed by ground movement (induced seismicity) during fracture stimulation operations.

Bendall, et al (2012) describes guidelines and protocols developed in South Australia for risk assessment strategies and for publicly available repositories of data to enable ongoing research into understanding induced seismicity. These guidelines and protocols are consistent with international protocols and data archiving standards.

All EGS projects to date in South Australia have met community expectations for pre-activity approval risk assessment and the subsequent risk management of induced seismicity.

Both Geodynamics and Petratherm demonstrated the existing Cooper Basin SEO for drilling and well operations was relevant, and adopted that SEO (Santos, 2009) for operations in deep drilling operations.

Table 1 provides a list of publicly available research commissioned by DMITRE along with EIRs and SEOs developed by geothermal licensees

One recent additional technology to show promise to delineate the extent of effective fracture stimulation are

measurements of changes in magneto-telluric character during the placement of fracture stimulation fluids a proxy for changes rock conductivity (Thiel, S. 2011)

CONCLUSIONS

- (1) Trusted land access is the most valuable lead factor and outcome of regulatory Nirvana.
- (2) Regulation for compatible, multiple-use of land in Australia is undertaken with community ownership of subsurface resources in mind.
- (3) Industry must act to effectively inform stakeholders if myths and misinformation are to be busted.
- (4) Trustworthy, efficient and effective regulation is rudimentary to attracting investment with community support.
- (5) Informed policies for land access consider net benefits from environmentally sustainable development as the benchmarks for desirable outcomes.
- (6) The key ingredients of regulatory nirvana are frameworks that: elicit community trust and investor confidence; provide certainty; entail robust public consultation processes; are transparent; enable flexibility; are open to amendment; are efficient; are practical; and focus on outcomes. This amounts to an overall check-list for best practice co-regulation.
- (7) Scope for evolutionary improvement to regulatory frameworks is inevitable.
- (8) A one-stop-shop approach to regulation enables co-regulators to do their jobs in parallel, rather than in series. This fosters efficiency without reducing stringent standards for ecologic, social, heritage and economic outcomes.

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