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Submission on Regulating Major Hazards Facilities

To Ministry of Business, Innovation and Employment

On behalf of the New Zealand Geothermal Association

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Introduction

The New Zealand Geothermal Association (NZGA) would like to thank the Ministry of Business, Innovation and Employment (MBIE) for the opportunity for discussion around "Developing regulations to support the new Health and Safety at Work Act", with our submission focussed on "Chapter 6: Regulating Major Hazard Facilities". The New Zealand geothermal industry has welcomed a review of health and safety at work. Our industry is safety-conscious, and visitors to our sites are immediately aware of the health and safety culture. Discussions to date coupled with the material within this particular discussion document have been valuable in assessing the "risk landscape" associated with the geothermal industry.

The New Zealand Geothermal Association (NZGA) is an independent, non-profit association that provides information on geothermal phenomena and utilisation for industry, government and educational organisations. In addition, the NZGA, as a member of the International Geothermal Association, contributes to the international exchange of information within the geothermal development industry. NZGA membership comprises participants, regulators, and interested parties within the geothermal community. It totals 318 members currently.

This submission will be published on the NZGA website, and we have no objection to it being published in any other setting.

The **Question headings** to the comments below relate to specific questions raised in the discussion document (see http://www.mbie.govt.nz/about-us/consultation/development-of-regulations-to-support-the-new-health-and-safety-at-work-act).

Question 1. Pg 15. Do you have any comment to offer on the proposed approach to phasing the development of regulations?

NZGA supports the phased approach to the review of Regulations.

We note the *Geothermal Energy Regulations 1961,* the *Health and Safety in Employment Pressure Equipment, Cranes and Passenger Ropeways) Regulations 1999* and the *Health and Safety in Employment (Pipelines) Regulations 1999* will be subject to minor changes coming in to force on 1 April 2015 to bring these under the new Health and Safety at Work Act. Officials have previously advised us of this, so we would like to thank them for their timely advice.

NZGA has been working with industry on the updating of *NZS 2403 Code of Practice for Deep Geothermal Wells*, which is referred to specifically in the *Geothermal Energy Regulations 1961*. This revised 'code of practice' has been with a Standards New Zealand committee and is now out for public consultation. The end result will be a document that

reflects current best practice, especially around well design, drilling and testing. Thus the minor changes to the *Geothermal Energy Regulations 1961* will also capture these current best practice elements.

We also note that these regulations will come under more detailed revision to be in place by 1 April 2017 including "geothermal operations (based on a review of existing regulations and looking to other international jurisdictions for current best practice)". Again, we thank MBIE staff for prior warning of this. The geothermal industry will engage in the development of these new regulations.

Question 145. Pg 137. Do you have any comment to make on the proposed definitions?

Facility – We are supportive of the current definition of "Facility" in so far as it relates to areas "under the control of the same person". In locations such as Kawerau, there are several binary cycle plants located on the field, but under different ownership or operation. The binary cycle plants present (in addition to back pressure turbine in the Norske Skog facility, 100MW Kawerau station owned by Mighty River Power, and various direct heat applications of globally significant size) include Nova Energy's 2.4MW TG1 and 3.5MW TG2 plants, Eastland Energy's 8.3MW TGL (KA24) plant (operated by Mighty River Power) and Norske Skog Tasman's 25MW TOPP1 plant. While an assessment of the combined risk over the whole area would be higher than individual components, the requirement for control when it comes to planning and emergency management is paramount.

The definition then goes on to include multiple areas under the same control where these are separated by "a road, railway, inland waterway, or pipeline". This definition is still a little loose. As an example, at Kawerau the TG1 and TG2 plants are about 300m apart and separated by a road, the Tarawera River and land under other ownership and use (related to the Kawerau mills or geothermal operations by an external party). There may be a case for combining these two plants, because of the common control and relative proximity. The case for combining the two Ngawha stations owned by Top Energy is more difficult to justify as these are separated along a road by a distance of 1.5km. In contrast, the case for combining the assessments of Contact Energy's Wairakei Binary cycle plant and their Te Huka plant which are separated by 4.5km and the Waikato River/farmland/industrial estates and roads appears very weak. It should be made clear that combination of areas should only be undertaken when these are separated "**only** by a road, railway…" or by a fixed maximum distance of 100 or 200 m (to be assessed by MBIE based on risk management).

Operator – The proposed definition is clear.

Question 146. Pg 138. Do you have any comments on the types of facilities that are proposed in scope or are proposed to be out of scope?

In a general sense we are satisfied with the inclusion of major hazard facilities based on ratio of quantities of hazardous substances on site to that of upper and lower threshold quantities as currently outlined (but also see response to question 167). We do have specific issue for geothermal binary cycle plants with the quantity 'being present or likely to be present' that currently includes both all of the working quantity **and** "the maximum capacity of the storage tanks and vessels used for hazardous substances".

In practice, for a geothermal binary cycle plant, the storage tanks should be largely empty for safe and effective operation. If maintenance is required on any part of the working cycle, working fluid is evacuated to the storage tank. In the event of plant-wide maintenance then all fluid in a unit may be evacuated to the storage tank (or some temporary additional storage vessels). If the storage tanks were fully loaded then it would not be possible to undertake necessary maintenance work. As a rule these tanks are largely empty during normal operation and it is an error to assess a maximum stored capacity assuming that these and the system could all be filled at some stage.

We have no objections to the currently planned exclusions from scope of the Major Hazard regulations, as Petroleum Exploration/Extraction and Mining currently come under the

purview of the High Hazards Unit and have just been subject to rigorous regulation development.

Questions remain about the appropriate classification of geothermal developments.

In wider planning, geothermal works have been lumped in with upstream petroleum and mining as high-hazard industries. Geothermal's high-hazard categorisation is partly because WorkSafe NZ's drilling expertise is focussed on oil and gas drilling which is resident in the high hazards unit. However, consider a continuum of drilling operations from offshore deep-water drilling for petroleum (with 100 people trapped on the rig and a risk of fire or explosion), to a small water-well driller in the Hauraki Plains drilling a 50m geothermal well to intercept 40^{o}C fluid for a hot pool. Clearly the hazards are not comparable, but both operations currently fall under the High Hazards Unit (HHU), so are labelled "high hazard". This discussion of the apparently overstated hazard level associate with geothermal development is expanded on in: White, B.R. (2013) *A brief review of geothermal health and safety regulations following the "Pike River Inquiry"* presented at the New Zealand Geothermal Workshop November 2013[1].

Beyond this, much of the discussion of geothermal energy in this consultation document comes through categorising geothermal binary cycle plants as an example of a major hazard facility specifically targeted for regulation by 1 April 2015. However, NZGA now believes, based on thresholds presented in the discussion document, that binary cycle plants do not constitute a class of major hazard facilities.

For several years, MBIE staff have been concerned that geothermal binary cycle plant have significant quantities of hydrocarbons stored and used on site as a working fluid, which could represent a major hazard. Iso-pentane is used as the working fluid in the oldest geothermal binary cycle power stations in New Zealand (TG1 and TG2 constructed in 1989 and 1993 respectively and owned by Nova Energy) and the Wairakei Binary plant, while more recent plant built after 1997 use n-pentane as the working fluid. Iso-pentane is slightly more volatile than n-pentane due to a lower boiling point. Iso-pentane boils at around 28^{o}C, while n-pentane boils at around 36^{o}C. The dividing point for HSNO Class 3.1 flammable liquids is a boiling point of 35^{o}C, making iso-pentane Class 3.1A (flammable liquids: very high hazard) and n-pentane Class 3.1B (flammable liquid: high hazard). Table 2 Page 147 of the discussion document (which is based on the Australian model regulations and United Kingdom *Control of Major Accident Hazards Regulations 1999)* then gives the following threshold values:

Column 1	Column 2	Column 3	Column 4 (lower threshold)	Column 5 (upper threshold)
Item	Material	HSNO Hazard classification	Quantity (tonnes)	
2	Flammable substances	Class 3.1A (flammable liquids: very high hazard)	50	200
		Class 3.1B (flammable liquids: high hazard)	5,000	50,000

The industry does take risks associated with binary cycle plant seriously. Two examples of this are Top Energy's response to an alarm at their Ngawha plant in February 2014 when the plant was temporarily shut down and fire service called in as part of standard operating procedure, and Nova Energy's planned decommissioning of the aging TG1 plant.

However the extent of the risk can be gauged by comparing the quantities of working fluid that can be stored on sites with the threshold quantities as set out in the table above.

[1] http://www.geothermal-energy.org/pdf/IGAstandard/NZGW/2013/White_Final.pdf

Table 1: New Zealand Binary Cycle Plants – Comparison of potential on-site working fluid quantities with threshold quantities

Plant Name	Field	Capacity (MW)	Year Commissioned	Working Fluid	Working Quantity (tonnes)	Storage Capacity (tonnes)	Combined Quantity (tonnes)	Threshold Quantity (tonnes)	Percentage of Lower Threshold	Owner
TG1	Kawerau	2.4	1989	iso-pentane	7.4	0	7.4	50-200	14.8%	Nova Energy
TG2	Kawerau	3.5	1993	iso-pentane	11.4	18.5	29.9	50-200	59.8%	Nova Energy
GDL (KA 24)	Kawerau	8.3	2008	n-pentane	85	32	117	5,000-50,000	2.3%	Geothermal Developments Ltd (Eastland Energy)
TOPP1	Kawerau	25	2013	n-pentane	NA	NA	108	5,000-50,000	2.2%	Norske Skog Tasman
Total Kawerau quantities									79.1%	
Mokai 1, 2 and 1A (hybrid plant)	Mokai	113	1999, 2005, 2007	n-pentane	252	30	282	5,000-50,000	5.6%	Tuaropaki Power Company
Ngatamariki	Ngatamariki	82	2014	n-pentane	315	63	378	5,000-50,000	7.6%	Mighty River Power
Ngawha 1	Ngawha	10	1998	n-pentane	NA	NA	38	5,000-50,000	0.8%	Ngawha Generation Ltd (Top Energy Group)
Ngawha 2	Ngawha	15	2008	n-pentane	NA	NA	63 (expanding to 82)	5,000-50,000	1.2%	Ngawha Generation Ltd (Top Energy Group)
Rotokawa and extension (hybrid plant)	Rotokawa	35	1997, 2003	n-pentane	69	6	76	5,000-50,000	1.5%	Rotokawa Generation (Mighty River Power)
Te Huka	Tauhara	23	2010	n-pentane	105	32	137	5,000-50,000	2.7%	Contact Energy
Wairakei Binary	Wairakei	14.4	2005	iso-pentane	78	31	110	50-200	220%	Contact Energy

Note: the combined quantity will be an overestimate because spare volume is required in storage tanks for normal operation. TG1 uses an approved trailer to transport fluid to the TG2 tank when required.

It would appear that geothermal binary cycle plants do not warrant being targeted as a class of major hazard facility, as only one of the plants (and the combinations of these where located in close proximity at Kawerau) approach the threshold limits set out in the discussion documents. When it is further considered that some of these plants are large by global standards, with Ngatamariki being the largest pure[2] binary cycle plant in the world, then likelihood of significantly larger plant is remote. If all New Zealand geothermal fields are considered then the greatest available capacity (after Tauhara for which condensing plant is envisaged) is 240MW for Tikitere-Taheke i.e. potentially 4 times the size of Ngatamariki. Even a quadrupling of Ngatamariki working fluid quantities would lead to a combined quantity only 30% of the lower threshold.

There is interest in the development of binary cycle plant in New Zealand through HERA's Above Ground Geothermal and Applied Technologies (AGGAT) research programme and these new plants may use alternative working fluids, which could have lower threshold quantities. They will need to be reviewed on a case-by-case basis when specific designs are proposed. However, globally geothermal binary cycle plant is dominated by the supplier, Ormat which has supplied all plant used in New Zealand to date, and their preference for working fluids is clearly seen in the table above.

NZGA suggests that future documentation should avoid all reference to geothermal binary cycle plant as a category of major hazard facility, as this is not justified. If exceptions occur through new technology developments then these can be picked up through general rules around thresholds.

Question 151. Pg 148. Do you agree with the proposed threshold calculation? Why/why not?

The threshold calculation is simple and workable, but effort should be directed to avoiding capture and assessment of insignificant quantities.

Question 167. Pg 162. Do you have any comments in relation to the proposal to require operators to notify WorkSafe NZ of dangerous incidents?

NZGA is supportive of the reporting of dangerous incidents including 'near miss' events to WorkSafe NZ. However we note that there is a long list of dot points covering incidents that exposes a worker or any person to a serious risk to that person's health or safety. Of these, most are unrelated to the threshold criteria developed earlier, suggesting that the threshold criteria are too limited in defining major hazard facilities. These other areas of risk include:

- "An escape of gas or steam; or
- An escape of pressurised substance; or
- Electric shock; or
- The fall or release from height of any plant, substance or thing; or
- The collapse, overturning, failure or malfunction of, or damage to, any plant that is required to be authorised for use in accordance with the regulations; or
- The collapse or partial collapse of a structure; or
- The collapse or failure of an excavation or any shoring supporting an excavation; or
- The inrush of water, mud, or gas in workings in an underground excavation or tunnel; or the interruption of the main system of ventilation in an underground excavation or tunnel…".

One example is the "escape of gas or steam". On geothermal developments, there are periods of well testing with deliberate discharge of steam, water and gas to atmosphere.

[2] There are geothermal power stations such as Mokai in New Zealand that have a greater capacity, but this is achieved through combinations of steam turbines and binary cycle plant – essentially a hybrid design.

Normally these are controlled events which should not be included as incidents, but there have been recent occasions overseas and one occasion in New Zealand when gas was not adequately dispersed and workers were temporarily overcome. I note that such incidents can happen outside what might be considered the boundaries of a 'major hazard facility'.

For geothermal fields there is also the possibility of hydrothermal eruptions (as a special form of "escape of gas or steam" or "escape of a pressurised substance") which could be located several kilometres from a development site and may or may not be related to the project's operation – they are also a feature of undisturbed geothermal fields. To date, these have been without personal injury. Consider for instance an eruption that occurred in Kuirau Park in January 2001, across the road from Rotorua hospital and spewing mud and ash up the side of Pukeroa/Hospital Hill. Blocks and ejecta were thrown 100 m high and 1 m diameter blocks were thrown 50 m away. With hundreds of well owner/operators across the field, and similar events predating any development, who would have had responsibility for reporting such an event, or managing an ongoing incident? This should be explored further but we would initially suggest this responsibility lies with the Regional Council which has responsibility for sustainable management of resources.

Photo 1: Geologist inspects Kuirau Park eruption crater immediately after the 2001 eruption

We trust these comments are helpful, and would be happy to be involved in further discussion.

Yours faithfully

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