GOOD PRACTICE GUIDELINES

Self-managing shallow geothermal well systems

FOR PCBUs WITH GEOTHERMALLY HEATED POOLS OR PLANT

March 2018

New Zealand Government

WORKSAFE NEW ZEALAND | MAHI HAUMARU AOTEAROA

These guidelines are for PCBUs (including local authorities) who have geothermally heated swimming pools, mineral pools, or plant such as steam boxes.

Self-managing shallow geothermal well systems

KEY POINTS

- Make sure all wells and pipework are designed and constructed using suitable materials.
- Make sure a suitably qualified and experienced person carries out inspections and maintenance on your geothermal well system.

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1.0 Introduction

IN THIS SECTION:

The purpose of these guidelines is to assist a well owner or manager as a person conducting a business or undertaking (PCBU) to self-manage the shallow geothermal well system.

These guidelines apply to shallow geothermal wells, which are defined as wells not exceeding 150 metres (m) in depth, and covers the entire system from production to re-injection.

Because a hotel or motel is a workplace under the Health and Safety at Work Act 2015 (HSWA), you have responsibilities as the PCBU (well owner or manager) of a geothermal well for the health and safety of workers and other people.

Your geothermal system must also meet the requirements of the Geothermal Energy Regulations 1961 (the Regulations).

These guidelines contain the essential technical information that you need to self-manage your geothermal well and include two templates that you can use to check your compliance with the legal and technical requirements relating to shallow geothermal well systems.

1.1 Your legal responsibilities

Health and Safety at Work Act 2015

HSWA defines the roles and responsibilities of different duty holders. These include PCBUs, officers, workers and other persons at workplaces.

For more information see WorkSafe's special guide *Introduction to the Health and Safety at Work Act 2015*, available at: worksafe.govt.nz

Geothermal Energy Regulations 1961

As well as HSWA the Geothermal Energy Regulations 1961 (the Regulations) set out duties and responsibilities for PCBUs. In particular, regulation 26 of the Regulations states that:

- all wells and pipework must be constructed of suitable and sound materials.
- all wells and pipework must be designed, constructed, operated, and maintained in accordance with safe, proper, and proficient geothermal engineering practice.

- the well, and the equipment used in the geothermal work, must be maintained to prevent damage or risk of damage to the well and the equipment, and to prevent danger to persons on the site, or in the vicinity, of the geothermal work.
- all geothermal work in circumstances where the heat discharged by any well is likely to exceed 20 terrajoules measured above 0°C over any period of 12 consecutive months shall be carried out in accordance with *NZS 2402P Code of Practice for Geothermal Heating Equipment in Rotorua* (except Parts 2, 6, 7, and 10).
- the manager must ensure that the site of the geothermal work is maintained in a safe condition.

Fencing swimming pools

The Building (Pools) Amendment Act 2016 promotes the safety of young children by requiring fencing of certain swimming pools. As the owner, or the person in control of a pool, you must ensure that the pool and immediate pool area is fenced with a fence that complies with the requirements of the Building Act 2004 building code. Make sure to register any existing pool with your local authority.

There are also standards that might apply to your swimming pool, for more information refer to:

- NZS 4441 Swimming Pool Design Standard
- NZS 5826 Pool Water Quality

Territorial authority requirements

You must comply with any territorial authorities' bylaws as applicable. Check if your local council has bylaws related to mineral pools.

Your council might have additional rules that you need to meet. Check with your local council for specific rules that apply in your region (eg bylaws related to mineral pools or geothermal safety).

2.0 Shallow geothermal wells

IN THIS SECTION:

This section applies to any surface casings, annulus cement, outer cement circle, and shallow cellars. It covers the wellhead valves, flanges, fittings, and spools.

Maintain and abandon each well according to NZS 2403 Code of practice for deep geothermal wells or WorkSafe's good practice guidelines *Shallow Geothermal Well Safety* available at: worksafe.govt.nz

2.1 Surface well maintenance

Keep the site area clear of any plant growth which could enhance corrosion or inhibit access to the well or the erection of workover equipment.

Site drainage should prevent surface run-off entering the cellar or accumulating around the well at ground level.

Make sure a suitably qualified and experienced person carries out any maintenance.

Wellhead maintenance

Inspect and make sure the wellhead and it's steel surfaces are substantially free of corrosion. Remove and assess the depth of corrosion if it has formed and carry out maintenance. Monitor outer casings, outer cement, annulus cement, and outer casings for corrosion and deterioration and any defects. Repair them as soon as practicable.

If protective paint systems require renewal, remove all defective areas by wire brushing or, if necessary, by sandblasting, before applying fresh coatings.

If severe casing corrosion is apparent or you suspect it's on the near outer casings, remove the outer casings until you can expose sound casing. Sandblast and paint the exposed casing and reinstate the outer casings, outer cement, and annular seal.

Inspect all valves, fittings, glands, and flanged fittings for leaks of geothermal fluid. Repair them as soon as practicable.

If possible, regularly monitor the wellhead pressure. Carry out wellhead pressure monitoring on a six-monthly basis, or more frequently if reservoir conditions are not static.

For more information about wellhead maintenance, refer to NZS 2403.

Equipment maintenance

Make sure your equipment is free of leaks and in sound operating condition. The failure of this equipment will affect the well's integrity.

Check for any deposits of dissolved solids as they may prevent the correct functioning of some equipment, particularly pressure-relief valves.

Stop leaks past gate seats, valve stems and flange seals by operating the valve, injecting, replacing the sealant, or evenly tightening the flange's studs. If this does not stop the leak, further controls are in WorkSafe's good practice guidelines *Shallow Geothermal Wells* available at: worksafe.govt.nz

3.0 Geothermal heating equipment

IN THIS SECTION:

This section provides guidance on different plant, equipment, and geothermal heating systems.

For more information about geothermal heating equipment, refer to NZS 2402P which applies to commercial and residential heating equipment that draws from Rotorua's geothermal field.

3.1 Supply pipework

Supply valve

Do not use a master valve to regulate well flow. If you don't have a flow control device, use a suitably rated supply valve to control the flow of geothermal fluid. Inspect and test the supply valve once every six months.

Acceptable flow control devices in place at a supply valve include:

- orifice plates
- flow restrictors (typically a short section of small-diameter pipe)
- control valves.

Use suitable materials

Use appropriately rated piping with welded, flanged, or threaded joints. Use carbon steel or galvanised piping. The design should be simple, with straight lengths of pipe, adequately supported and that allow for thermal expansion. Fit all take-offs from the supply line with isolation valves located as close as possible to the main supply line.

Workmanship

Construct all plant in accordance with sound geothermal engineering practice and workmanship.

Conditions of pipework

Assess piping for corrosion. Pay particular attention to pipework encased in pumice insulation and underground pipework. As part of maintaining the pipework, check the joints for any leaks.

Protection from burn injury

Provide lagging for exposed pipework with surface temperatures above 70 degrees Celsius (°C).

Maintenance

Check for visible leaks and corrosion, and if any pipework needs servicing.

Make sure a suitably qualified and experienced person carries out any maintenance.

3.2 Plant equipment

Suitable location

Make sure there is adequate access and egress to the plant equipment.

Do not locate the:

- heat exchanger in a habitable building
- plant equipment below ground level, unless you make suitable provisions to prevent and clear the area of any gas that could accumulate.

Adequate ventilation

Ventilation in the plant room should be cross-flow and of adequate design to clear any accumulation of gas. Permanently fix vents and make sure they are not able to be closed. Any vents and extraction should be at ground level. Consider installing shaker systems to disrupt the water surface and prevent H_2S from accumulating.

Check the pipework's design

Check that the system is designed to a minimum pressure of 1.5 times the maximum discharge pressure of the well. Make sure there is adequate room for thermal expansion in the system, and that connections between primary and secondary systems are designed according to sound geothermal engineering practice.

Workmanship/engineering practice

Make sure all connections are welded, flanged or threaded and all components, valves and pipework are pressure rated and certified. Use thread tape on joints.

Use suitable materials

Use stainless steel seats in temperature pockets. Assess the materials used on plate exchanger plates – in low-pressure systems, rubber is adequate; in high-pressure systems, use heat-resistant gaskets.

Maintenance

Check the overall condition of the system, and specifically check the system for fluid or gas leaks.

Make sure a suitably qualified and experienced person carries out any maintenance.

Isolation valves

Check valves for appropriate pressure ratings. Make sure there is an isolation valve on the inlet and outlet side of the heat exchanger. Make sure the valves are accessible and operable.

Control the temperature

Install a suitable temperature control device on the effluent line from the heat exchanger. This device should control the temperature of fluid in the secondary system. The temperature control device may be any of the following:

- automatic control valve
- remote-sensing thermostatic valve
- self-acting valve.

Make sure there is a temperature gauge to show the temperature of the fluid in the system.

Safety shut-off device

Install an approved safety shut-off device on the inlet line to shut off the geothermal supply if the temperature in the system rises above a safe pre-set level.

Fit a strainer

To prevent the valve blocking up, install a strainer on the effluent line upstream of the control valve. The strainer will require regular servicing to function properly.

Pipe colour coding and identification

Pipe colour coding is only applicable to commercial systems. Make sure that you can easily identify the geothermal pipes from the town supply water.

3.3 Hot water system

Use suitable materials

Use appropriately rated piping for the hot water system, with welded, flanged or threaded joints that allow for thermal expansion.

Check the design

Check to make sure the system is designed in accordance with sound engineering practice.

Control the discharge temperature

Fit a temperature control device to regulate the discharge temperature to 80°C or less.

The tap water temperature of the hot water system should not exceed 55°C for public buildings or for visitor accommodation.

Maintenance

Check for visible leaks and corrosion, and if any equipment needs servicing.

Make sure a suitably qualified and experienced person carries out any maintenance.

3.4 Mineral pools

Do you need a gas separator?

Assess if you need a gas separator and where it could be located. Make sure the gas separator's design is adequate to remove gas, and that the vent is functional and adequately designed. If gas is present in the geothermal fluid, make sure all geothermal water supplied to the mineral pool passes through a gas separator.

Check the pipework's design

Make sure the system is designed using suitable materials. Pipework from a gas separator needs to maintain a water seal to prevent gas entrainment in the water. Geothermal supply is only to be cascaded after the primary exchanger if an approved low-temperature gas separator is installed.

Minimise the risk from burns

Assess the position and location of the pipeline to determine if there is a risk from burn injury. First try eliminating any burn injury risk. If elimination is not possible, apply shielding or insulation to minimise the risk.

Maintenance

Check for visible leaks and corrosion, and if any equipment needs servicing. Make sure a suitably qualified and experienced person carries out any maintenance.

Is there adequate ventilation?

Check the bathhouse's design to determine if cross-flow ventilation is adequate at floor and roof level. Ventilation should be permanent. Check the H_2S level above pools and particularly above the pool overflow pipe to waste; the H_2S level should be less than 5 ppm. A shaker system to continually break up the water surface can help in dispersing H_2S.

Check that the sides of pool are not too high to allow gas accumulation (the height of the sides above the water line should not exceed 100 mm). Provide adequate non-slip areas (steps, wet areas, etc).

Check the cold water supply

Check and make sure there is a cold water supply to pools for cleaning purposes and emergency use. Make sure the cold water supply is not permanently running to maintain the pool's temperature.

Control the pool's temperature

The pool's temperature should not exceed 40°C. Fit a tempering or mixing valve to control the temperature and make sure there is a temperature gauge to show the temperature of the mineral pool.

Make sure there is no direct water supply from the geothermal well to a pool.

Put up warning signs

At public pools, put up suitable signs to indicate the risks of scalding from hot water and the risk of primary amoebic meningo-encephalitis (PAME).

Measuring H_2S gas

To get a correct measurement of H_2S gas levels, use fit-for-purpose equipment following manufacturer's instructions. Take the reading near the geothermal supply's inlet, above the water line, and agitate the water.

3.5 Effluent pipework

Check the design

Make sure the pipework is designed in accordance with sound geothermal engineering practice and workmanship, allowing for thermal expansion.

If a territorial authority's consent is applicable, there should not be any discharging to stormwater drains or sewerage drains without that consent.

Use suitable materials

Use appropriately rated piping with welded, flanged, or threaded joints.

Maintenance

Check for visible leaks and corrosion, and if any pipework needs servicing.

Make sure a suitably qualified and experienced person carries out any maintenance.

Minimise the risk from burns

Assess the position and location of the pipeline to determine if there is a risk from burn injury. First try eliminating any burn injury risk. If elimination is not possible, apply shielding or insulation to minimise the risk.

Is there adequate ventilation?

Adequately ventilate all geothermal heating equipment supplied with geothermal fluid from a self-flowing well.

Check the gas vent's design

To minimise the risk of downwash into adjoining buildings, make sure the location and height of a gas vent pipe conforms to the following conditions:

- diameter and size enable a minimum efflux velocity of 15 metres per second (m/s)
- 3 m above the ridgeline of the nearest building
- at least 1.5 m from any boundary.

3.6 Steam boxes, drying, and other uses

Check the design

Check that the design of the equipment is fit-for-purpose and clean. The equipment should use a heating coil rather than raw steam.

A steam box should not to be located in an enclosed building.

Check the materials

Check the materials used. Make sure the system uses appropriately rated piping with welded, flanged, or threaded joints.

Maintenance

Check the overall condition of the system, and specifically check the system for fluid or gas leaks.

Make sure a suitably qualified and experienced person carries out any maintenance.

Isolation valve

Check to make sure an isolation valve is fitted, functional, and serviced.

Appendices

IN THIS SECTION:

Appendix A: Shallow geothermal well systems template

Make sure a suitably qualified and experienced person completes and signs this.

Name:		
Address:		
Production well number:		
Reinjection well number:		
Heating engineer:		
Address:		
Work phone:	Mobile phone:	
1. Is geothermal system included in the health and safety management plan hazard register?		○ Yes ○ No
2. Does the geothermal system comply with *NZS 2402P Code of Practice for Geothermal Heating Equipment in Rotorua* and WorkSafe's guidelines *Shallow Geothermal Wells*?		○ Yes ○ No
3. Are mineral pools included in the system?		○ Yes ○ No

I,

certify that this geothermal system complies with the Geothermal Energy Regulations 1961 and relevant guidelines.

Signature:	Date: DD / MM / YEAR

Appendix B: Monthly/weekly/daily registers

Complete this register in the timeframes indicated.

Daily checklist

1. Are H_2S levels less than 10 ppm or less than the territorial authority's requirement (if less than 10 ppm)?

DAY																												
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31

Indicate Yes (Y) or No (N)

Weekly checklist

	WEEK												
	1	2	3	4	5	6	7	8	9	10	11	12	13
1. Is the system free of visible leaks (fluid/steam/gas)?													
2. Are all valves operable and efficient?													
3. Is the hot water from the tap 55°C maximum (accommodation and public buildings only)?													
4. Is well-head pressure monitored?													

Indicate Yes (Y) or No (N)

Monthly checklist

	MONTH							
	1		2		3		4	
1. Is the heat exchanger's room adequately ventilated?	Yes	No	Yes	No	Yes	No	Yes	No
2. Is the installed strainer regularly cleaned out?	Yes	No	Yes	No	Yes	No	Yes	No
3. Are the wellhead and components corrosion-free?	Yes	No	Yes	No	Yes	No	Yes	No

Appendix C: More information

Local Council

Your council might have additional rules that you need to meet. Check with your local council for specific rules that apply in your region.

For example, check if you need to comply with any geothermal bylaws from Rotorua Lakes Council or Bay of Plenty Regional Council.

New Zealand legislation

To access all legislation including Acts and regulations visit the New Zealand Legislation website: www.legislation.govt.nz

The Institution of Professional Engineers New Zealand (IPENZ)

A list of competent engineers can be found on the IPENZ website, under the Chartered Professional Engineers (CPEng) Register available at: www.ipenz.nz

WorkSafe New Zealand

For information and guidance about health and safety visit WorkSafe's website: worksafe.govt.nz or call 0800 030 040.

For information and guidance specifically about electrical or gas safety visit WorkSafe's website: www.energysafety.govt.nz or call 0800 030 040.

Standards

NZS 2402P Code of practice for geothermal heating equipment in Rotorua

NZS 2403 Code of practice for deep geothermal wells

NZS 4441 Swimming Pool Design Standard

NZS 5826 Pool Water Quality

Guidance

Introduction to the Health and Safety at Work Act 2015
WorkSafe New Zealand: worksafe.govt.nz

Consents and Reports Required by the Geothermal Energy Regulations 1961
WorkSafe New Zealand: worksafe.govt.nz

Shallow Geothermal Well Safety
WorkSafe New Zealand: worksafe.govt.nz

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