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Legal Framework and National Policy for Geothermal Development in Iceland

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ABSTRACT

In this paper, a brief description is given of the national policy, legal framework and official monitoring of geothermal resources in Iceland. It is the policy of the Government of Iceland to increase the utilisation of the energy resources, e.g. to fuel the transport sector, in harmony with the environment. The Master Plan for hydro and geothermal energy resources in Iceland will categorise and evaluate the impact possible power projects can have on the economy and environment. Three major amendments have recently been made to the energy legal framework in Iceland: (1) Ownership of resources cannot longer be sold by the state or municipalities although utilisation rights can be leased to a developer for up to 65 years with a possibility of extension. Royalties for the utilisation are determined by the Prime Minister. (2) Producers of electricity compete on an open market in Iceland. Therefore CHP power plants are obliged to keep separated accounts for heat and power production to prevent cross subsidisation of electricity. (3) Orkustofnun can grant licenses on behalf of the Minister of Industry. Geothermal energy plays an important role in providing the nation with clean and reliable energy and is fundamental to the Icelandic economy as well as Icelandic welfare and independence. Effective policy making and official monitoring of geothermal development for sustaining a renewable energy society in Iceland is crucial for sustaining a long-term lifespan of the resource.

1. INTRODUCTION

During the 20th century Iceland has emerged from being a nation dependent upon imported oil and coal, to a country where practically all stationary energy, and 82% of primary energy, is derived from indigenous renewable sources with near carbon-free electricity production in year 2008. This is the result of an effective policy in making renewable energy a long-term priority in Iceland. Nowhere else does geothermal energy play a greater role in providing a nation's energy supply.

When the oil crisis struck in the early 1970s, fuelled by the Arab-Israeli War, the world market price for crude oil rose by 70%. At about the same time, close to 90,000 people enjoyed geothermal heating in Iceland, about 43% of the nation. Heat from oil served over 50% of the population, the remainder using electricity. In order to reduce the effect of rising oil prices, Iceland began subsidising those who used oil for space heating. The oil crises in 1973 and 1979 (Iranian Revolution) caused Iceland to change its policy, reducing oil use and turning to domestic energy resources, hydropower and geothermal heat. This policy meant exploring for new geothermal resources, and building new heating utilities across the country. It also meant constructing transmission pipelines (commonly 10-20 km) from geothermal fields to towns, villages and individual farms. This involved converting household heating systems from electricity or oil to geothermal heat. But despite the reduction in the use of oil for space heating from 53% to 7% from 1970 to 1982, the share of oil still remained about 50% to 60% of the total heating cost due to rising oil prices. Today about nine out of ten households are heated with geothermal. From an economical perspective, the present value of the estimated savings of house heating with geothermal instead of oil between 1970 and 2008, using 2% real interest rate over the cost price index, is estimated at 880.000 million ISK (127 ISK/US$) (see figure 2). In 2008 the estimated savings of that year amounted to about 12% of the value of imported goods or almost equivalent to the total imports of refined oil products. Total use of geothermal energy amounted to 39 PJ in year 2008 as can be seen in figure 1. (Björnsson, 2009).

The use of oil to produce the heat provided by geothermal energy to the heating of houses in 2008 would have caused the emission of 2.2 Mt of CO_2 and increased the total anthropogenic release of CO_2 equivalents from an estimated 4.9 Mt in 2008 to 7.1 Mt. The generation of the 4,037 GWh of electricity produced in 2008 from geothermal energy caused the release of an estimated 188 kt of CO2 equivalents. It is estimated that the generation of this electricity by advanced combined cycle natural gas power plants would have caused the emissions of 1.5 Mt of CO_2 equivalents (Björnsson, 2009).

That being said, the focus of this paper is not to give a detailed account of statistics in Iceland. The point is to examine Icelandic policy in respect of geothermal energy, both research and utilisation, and at the same time observe how official monitoring of both geothermal research and utilisation manifests itself in Icelandic legislation. Geothermal energy plays an important role in providing the nation with clean and reliable energy and is fundamental to the Icelandic economy as well as Icelandic welfare and independence.

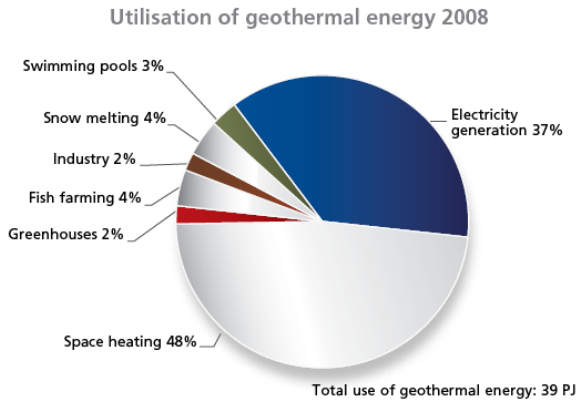

Figure 1: Geothermal utilisation in year 2008. (Orkustofnun, 2009)

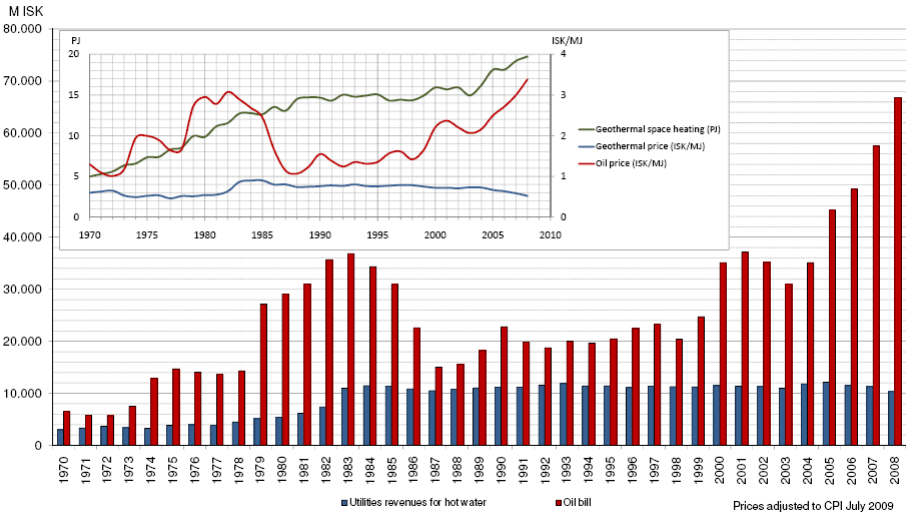

Figure 2: Heating cost of all houses connected at each time to geothermal supply (blue) compared to equivalent oil bill (red). Total use of geothermal energy for space heating (green) can be seen along with the price of oil (red) and geothermal energy (blue) in the figure within.

2. NATIONAL POLICY

It is the policy of the Government of Iceland to increase the utilisation of the renewable energy resources further, e.g. for fuelling the transport sector. A broad consensus on conservation of valuable natural areas has been influenced by social opposition, increasing over the last decade, against large hydropower and some geothermal projects.

According to the 2009 Government Coalition Platform one of the cornerstones of the Government‘s environmental policy is to utilise the natural resources of Iceland in a sustainable manner. The Government‘s goals in respect of geothermal energy are twofold. First there is a plan in motion to enforce a new Planning and Building Act. It will provide a national planning strategy, formulated in co-operation between the state and local authorities, and viewing the country as a single entity. Second, a comprehensive energy strategy will be formulated e.g. for the use of renewable energy to fuel the transport sector. A precautionary and protective approach will be followed in hydroelectric and geothermal energy production. The energy strategy will support diversified industry, emphasising the development of ecologically beneficial high-tech industry. The energy strategy will aim at sustainable utilisation, avoiding for instance aggressive utilisation of geothermal areas (Prime Minister’s Office, 2009).

2.1 Master Plan

The Icelandic Government decided in 1997 to develop a Master Plan for hydro and geothermal energy resources in Iceland. All proposed projects are being evaluated and categorised on the energy efficiency and economics but also on the basis of the impact that the power developments would have on the environment (Master Plan, 2009).

Results of the first-phase study were presented in November 2003. During the first-phase evaluation 19 hydro projects, mostly glacial rivers located in Iceland’s Highlands, and 24 geothermal projects centered in the high-temperature fields near the inhabited regions in the south, southwest and northeast Iceland, were compared. The hydro projects had a combined potential of 10.5 TWh/a. A number of these projects, with a combined potential of 4.7 TWh/a, were, however, estimated to cause so severe an environmental impact that their development might not be acceptable. The geothermal projects considered had a combined potential of 13.2 TWh/a. Projects with a total potential of 4.2 TWh/a were also considered liable to cause severe environmental impact (Þórhallsdóttir, 2006).

A second phase evaluation of projects, comparing all projects in major high temperature geothermal fields, and new or revised hydro projects is now being prepared and will be presented to the Icelandic Parliament, in 2010. It is hoped that this comparison will aid in the selection of the most feasible projects to develop, considering both the economic and environmental impact of such decisions, such as which rivers or geothermal fields should not be harnessed due to their value as natural heritage and for recreation.

2.2 Market Development and Stimulation

As Bjornsson noted (1995) geothermal was not competitive with hydro on a major scale. This has changed in the recent years. Geothermal energy is today competitive with hydro in Iceland and is not subsidised; providing reliable base load, small surface footprint, green energy and favourable prices; 8 ISK/kWh + VAT for 3.5 MWh/a public consumption (127 ISK/US$) but can get considerably lower for the power intensive industry due to very high load factor. For cost of residential heating see figure 3.

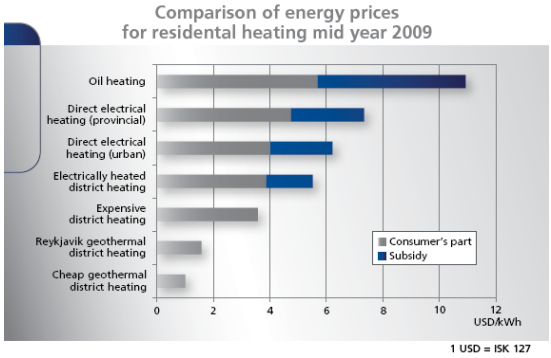

Figure 3: Comparison of energy prices for residential heating mid year 2009 (Orkustofnun, 2009).

The Icelandic Government gives grants to small projects in the field of energy. However, for the last few years emphasis has been on finding usable geothermal water for space heating in areas where resources were previously unknown. The high demand for electricity for intensive industry resulting from the favourable prices of electricity has resulted in large-scale geothermal energy development in a competitive basis with large scale hydropower projects.

The power intensive industry consumed 77% of the total consumption in 2008. Due to the success in Iceland, the geothermal industry has been increasingly exporting the know-how to other countries.

The Government supports the Iceland Deep Drilling Project (IDDP) with 342 million ISK which could start a new era in geothermal development. The main purpose is to find out if it is economically feasible to extract energy and chemicals out of hydrothermal systems at supercritical conditions.

2.3 Iceland's Energy Challenges

The Icelandic Government has expressed a strong will and supported various research and demonstration programs for the transition from hydrocarbon fuels, e.g. methane collected from waste-yard and hydrogen generation. Currently oil is still needed for 17% of the primary energy demand in the country, about half to operate the fishing fleet and the other half mainly for motor vehicles. Almost all electricity in Iceland is produced from renewable energy sources (99.9%) and 16.5 TWh/a are generated of the estimated potential of 50 TWh/a. One of the possibilities of transition from hydrocarbon fuels is thus electricity as fuel. It is estimated that 0,6 TWh are required to drive private motor vehicles in Iceland (200.000 in total) with 200 Wh/km consumption. The capacity needed is thus about 170 MW assuming 15.000 km/a per vehicle. This means that all use of electricity in transport, in Iceland, can be fossil free from well to wheel. Carbon dioxide capturing from geothermal power plants can as well be a source for alternative fuel by converting it to methanol, e.g. Carbon Recycling Ltd. is planning to construct a pilot plant at Svartsengi power plant for this purpose.

Up to this time, Iceland has been an island not only geographically but also economically to a greater extent than many of its neighbours in Europe. In recent years another possibility, besides energy intensive industry in Iceland, of increased utilisation, of the country's energy resources has been considered with growing seriousness, viz. export of electricity via HVDC submarine cables. (Björnsson, 1995).

3. LEGAL FRAMEWORK

The ownership of resources in the ground is attached to a private land, while on public land resources in the ground are the property of the State of Iceland, unless others can prove their right of ownership. Even though the ownership of resources is based on the ownership of land, research and utilisation is subject to licensing according to the Act on Survey and Utilisation of Ground Resources, No. 57/1998 and the Electricity Act, No. 65/2003. Survey, utilisation and other development pursuant to these Acts are also subject to the Nature Conservation Act, Planning and Building Act, Environmental Impact Assessment Act and other acts relating to the survey and utilisation of land and land benefits.

3.1 Act on Survey and Utilisation of Ground Resources

The Act on Survey and Utilisation of Ground Resources covers resources in the ground, at the bottom of rivers and lakes and at the bottom of the sea within netting limits. The Act also covers surveys of hydropower for the generation of electricity. The term resource applies to any element, compound and energy that can be extracted from the earth, whether in solid, liquid or gaseous form, regardless of the temperature at which they may be found.

According to the Act the Minister of Industry is permitted to take the initiative in and/or give instructions on surveying and prospecting for resources in the ground anywhere in the country, regardless of whether the owner of the land has himself or herself begun such surveying or prospecting or permitted others such surveying or prospecting, unless the party in question holds a valid prospecting licence pursuant to the Act. In the same way, the Minister of Industry may permit others to survey or prospect, in which case a prospecting licence shall be issued to them. A prospecting licence confers the right to search for the resource in question within a specific area during the term of the licence, survey extent, quantity and potential yield and to observe in other respects the terms which are laid down in the Act and which the Minister considers necessary.

The utilisation of resources in the ground is subject to a licence from the Minister of Industry, whether it involves utilisation on private land or public land, with the exceptions provided for in the Act. A landowner does not have priority to an utilisation licence for resources on his or her land, unless such an owner has previously been issued a prospecting licence. An utilisation licence permits the licence holder to extract and use the resource in question during the term of the licence to the extent and on the terms laid down in the Act and regarded necessary by the Minister. Before the holder of an utilisation licence begins extraction on private land the holder needs to reach an agreement with the landowner on compensation for the resource or obtain permission for expropriation and request assessment. In the event of neither an agreement made on compensation nor expropriation requested within 60 days immediately following the date of issue of an utilisation licence, the licence shall be cancelled. The same applies if utilisation on the basis of the licence has not started within three years of the issuance of the licence. This also applies to the utilisation of resources on public land.

The Minister of Industry may revoke the above licences if their conditions are not fulfilled. If a licence holder does not comply with the conditions established in the licence or contracts relating to the licence, the Minister shall issue a written warning and provide time limits for rectification. Should the licence holder not comply with such a warning, the licence shall be revoked.

3.2 Electricity Act

According to the Electricity Act a licence issued by the Minister of Industry is required to construct and operate a power plant. However, such a licence is not required for power plants with a rated capacity of less than 1 MW, unless the energy produced is delivered into the distribution system of a distribution system operator or into the national transmission grid. The owners of power plants with a rated capacity of 30 – 1,000 kW shall submit technical details of the plant to Orkustofnun. Also, Orkustofnun shall be informed annually of the total generation of power plants with a rated capacity of over 100 kW.

Orkustofnun is responsible for monitoring mineral prospecting or extraction areas and geothermal areas, as well as to regulate the compliance of companies operating

under issued licences. Orkustofnun will report to the Minister of Industry on the conduct of exploration, prospecting, and extraction in accordance with further instructions issued by the Minister. The protection and monitoring of prospecting and extraction areas is also subject to the Nature Conservation Act. The above mentioned procedures have recently been modified and in the following chapter the changes will be described in more details.

3.3 Amendments to the law

Three major amendments have recently been made to the legal energy framework in Iceland. The first two amendments where made with Act, No. 58/2008 on changing several Acts in the Field of Resources and Energy. Comments attached to the bill from the drafter i.e. the Minister of Industry, state that the purpose of these changes is to set forth rules regarding ownership of state-owned resources and to make the boundaries between production based on an exclusive license or on an open market. These comments go on to say that the point of the changes is to ensure that the all the most valuable water and geothermal entitlements that are in state and municipalities ownership stay that way. This amendment to the law entails that the ownership of resources can no longer be sold by the state or municipalities although utilisation rights can be leased to a developer for up to 65 years with a possibility of extension. Royalties for the utilisation are determined by the Prime Minister. The second amendment in the aforementioned Act 58/2008 dictates that CHP power plants are obliged to keep separate accounts for heat and power production to prevent cross subsidisation of electricity. Producers of electricity compete in an open market in Iceland, Hence, the conflicts with a plant receiving state subsidisation for space-heating but at the same time producing electricity and keeping one set of financial records is obvious in relation to e.g. the Administrative Act, No. 37/1993 as well as Art. 65 of the Icelandic Constitution. It is to be noted that this provision on separate accounts took effect as of July 1, 2009 (Parliamentary Record, 2008).

Orkustofnun can grant licenses on behalf of the Minister of Industry. The provision that enables the Minister of Industry to do this can be found in Art. 32 of the Electricity Act, No. 65/2003 and Art. 33 of the Act on the Survey and Utilisation of Ground Resources, No. 57/2998. Orkustofnun was granted this power to grant licenses officially with an authorisation issued by the Minister of Industry effective as of August 1, 2008 (Parliamentary Record, 2008).

4. OFFICIAL MONITORING

In June 1999 the Icelandic Parliament passed Act No. 27/1999 on Official Monitoring in order to promote efficient yet beneficial monitoring praxis. The objective of this act is to ensure that official monitoring is conducted in the most economic way possible, both for the State and for those the monitoring is aimed at. The official monitoring rules have to be effective in order for it to serve its aims. According to Art. 2, the objective of the Act is also to ensure that official monitoring rules promote the welfare of the Nation, safety and public health, safety of property, environmental protection, normal business practices and consumer protection. The Official Monitoring Act requires authorities to conduct an economic evaluation before new monitoring rules are passed as law, to ensure that the extent of the monitoring is reasonable in proportion to the objectives aimed for. The monitoring should not be more extensive or more complex in execution than is required to achieve the distinctive objectives.

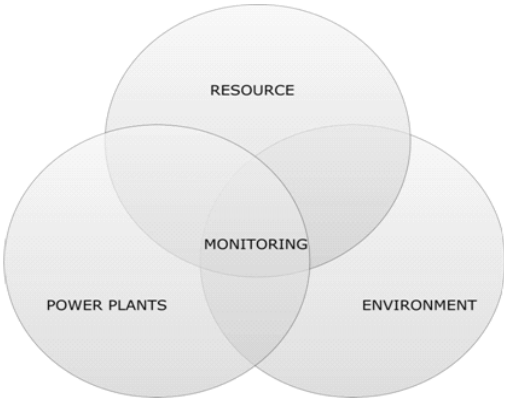

Figure 4: The monitoring of geothermal utilisation can be divided into three main sectors

The official monitoring of utilisation of geothermal resources in Iceland is rather extensive and is the responsibility of different public authorities, as will later be addressed. The monitoring of geothermal utilisation can be divided into three main sectors as shown in figure 4.

The objective of the monitoring for each sector is different, respectively: to protect the environment, to prevent over-exploitation of the resource, and to secure occupational safety and safety of delivery at the power plants as outlined in the following sections.

4.1 Environmental monitoring

The objective of official monitoring of the environment surrounding geothermal projects in Iceland is reflected in the stated aims of Art. 1 of the Nature Protection Act No. 44/1999. The objective is to regulate the interaction of man with his environment so that it harms neither the biosphere nor the geosphere, nor pollutes the air, sea or water. The ultimate aim is to ensure that the Icelandic ecosystem can develop according to its own laws and to ensure the conservation of its exceptional or historical aspects.

An important pillar in environmental protection according to Icelandic legislation is Act No. 106/2000 on Environmental Impact Assessment (EIA Act). Projects which are of a certain magnitude are or can be subject to environmental impact assessment. The objective of this assessment is to gauge the effects the project may have on the environment and to minimise as far as possible the negative environmental impact of projects. Furthermore, when resource utilisation and power plant licences are issued, environmental factors should be taken into consideration. Surveying, utilisation and power plant licences may be bound by specific conditions in order to safeguard environmental requirements, according to the Resources Act, Art. 17 and the Electricity Act, Art. 5. The areas of environmental law discussed here are shown in figure 5.

With the Strategic Environmental Assessment Act No. 105/2006 (SEA Act), Iceland adopted Directive 2001/42/EC from the European Parliament and the Council. The object of the Directive is to protect the environment and to encourage sustainable development by conducting an environmental assessment of plans which are likely to have an impact on the environment. In the Directive it is assumed that the impact of plans and programmes on the environment is assessed before they are passed and executed (Steinsdóttir, 2009).

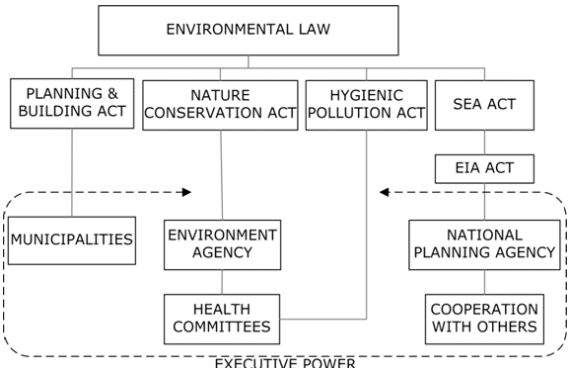

Figure 5: A section of the acts and institutions classified under Environmental Law that are chiefly responsible for monitoring according to each act.

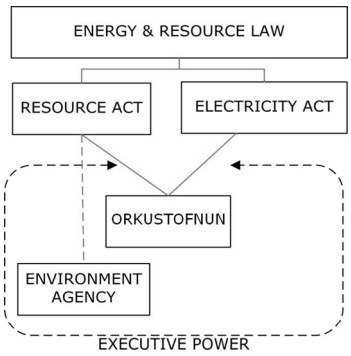

Figure 6: Orkustofnun has responsibility according to the Act on Survey and Utilisation of Ground Resources and the Electricity Act

As can be seen in figure 5 the executive power is put in the hands of various agencies, one being the health committees. These committees derive their power from the Hygienic & Pollution Act No. 7/1998. The Act divides Iceland into ten regulatory zones and each zone has one committee. The operation licenses for power plants are issued by these health committees. The objective of these licenses is to prevent pollution from e.g. run-off water and to promote a clean environment. The operation license is equipped with conditions and the health committees oversee that these conditions are met. Failure to do so can result in official warnings, daily penalties and termination of the license.

4.2 Resource monitoring

Another objective of official monitoring of utilisation of geothermal resources is to ensure that the most efficient exploitation of the resource is withheld in the long run and that extraction of geothermal fluid does not exceed levels deemed necessary, according to Art. 25 of the Act on Survey and Utilisation of Ground Resources. One way to ensure this is to have an effective official monitoring of the utilisation taking place at every geothermal project. Besides efficient monitoring it is also important that relevant institutions, municipalities and developers are aware of the fact that utilisation of geothermal energy in Iceland is to be conducted as stipulated in Art. 25 of the Act on Survey and Utilisation of Ground Resources.

The Act on Survey and Utilisation of Ground Resources covers legislation regarding control, utilisation and treatment of natural resources. The legislation is connected to other fields of law such as property law, environmental law and administration law. Some natural resources are exhaustible, therefore it has been considered necessary to apply rules to manage their utilisation, in order to ensure natural resources are protected and maintained for coming generations.

The Act on Survey and Utilisation of Ground Resources and the Electricity Act provide the main legislation when it comes to utilising geothermal energy and generating electricity. Orkustofnun has the responsibility to monitor geothermal areas being researched or utilised, according to the Act on Survey and Utilisation of Ground Resources. Orkustofnun is also responsible for the official monitoring stipulated in the Electricity Act. This is illustrated in figure 6. Orkustofnun is a public institution which the Minister of Industry, administrates. According to Art. 2 of Orkustofnun Act No. 87/2003 its role is to advise the Government on energy issues and related topics, carry out research, collect data and information on energy resources and to supervise the operation of licences issued for research and utilisation of natural resources, operation of power plants and other major energy constructions.

In an appendix with utilization licenses and power plant licenses it is stipulated what detailed information the developer is supposed to present once a year to Orkustofnun. The information required is as follows:

- The amount of fluid extracted or reinjected into each well in the geothermal field, each month.
- The temperature of the water reinjected into the geothermal reservoir each month.
- Results of water level measurements in wells in which the water level can be measured and are within the geothermal field.
- The pressure changes or drawdown determined in the geothermal reservoir.
- The results of measurements of the enthalpy of the fluid from every production well in the geothermal field.
- Chemical analysis of the geothermal water (and steam, if appropriate).
- Results from simulations of the geothermal reservoir.
- Results of measurements made to monitor changes in the geothermal reservoir.
- Information on drilling in the industrial area.
- A resume of improved understanding of the physical characteristics of the geothermal reservoir based on the results of the latest drilling.

The above mentioned items should provide all the necessary information for the monitoring authority to monitor the utilisation of the resource.

4.3 Safety and management

The objective of monitoring of utilisation of geothermal energy does not only entail monitoring of the surrounding environment and the resource. This third objective of monitoring of geothermal projects is to ensure the safety and responsible management of the power plants which generate electricity from geothermal energy.

Monitoring of a power plant starts before construction of the plant begins. First, the municipal authority in the area where the power plant is to be built issues a development licence or a building license, according to the Planning and Building Act No. 73/1997. According to Paragr. 2 in Art. 38 it is the local authority's responsibility to monitor power plant development and its surroundings, according to the terms of the development or building licence that it has issued for the power plant. The council is to make sure that

all buildings are built according to the development plan, rules and regulations.

Second, a power plant licence is required in order to build and operate a power plant, according to Art. 4 of the Electricity Act. Orkustofnun is responsible for official monitoring of the conditions stipulated in the relevant licence. The objective of monitoring after generation of electricity at the power plant has begun is to ensure that operations are conducted according to the requirements of the act. On-site monitoring at the power plant, quality of electricity, security of supply of electricity and the accounting should be as stipulated in the Electricity Act.

4.4 Reaching the objectives

According to Act No. 27/1999 on Official Monitoring the objective is to ensure that official monitoring rules promote the welfare of the Nation, safety and public health, safety of property, environmental protection, normal business practices and consumer protection. In Paragr. 4 in Art. 9 of the derivative Regulation of the Official Monitoring Act it is stipulated that the requirements of individual official monitoring authorities is to be harmonised and the monitoring implemented by one and the same party to the greatest possible extent. This is a requirement which might not have been implemented completely for the official monitoring arrangement of geothermal utilisation. This is an issue which is worth looking into, with a view to harmonising and unifying the monitoring obligation to one authority. This would also support the objective of making official monitoring more economic (Steinsdóttir, 2009).

The objectives formulated in the legislation concerning the arrangements for official monitoring of utilisation are in general being reached, especially regarding the preparation phase for utilisation, environmental protection and the construction phase. What might be in contrast, and not arranged in a manner suitable for the achievement of its objectives, as stipulated previously, is the limited authority Orkustofnun is given in the Act on Survey and Utilisation of Ground Resources to conduct its monitoring obligations and the relative lack of consideration of generation of electricity from geothermal resources in the Electricity Act (Steinsdóttir, 2009).

5. CONCLUSION

This paper gives a short overview of the national policy, legal framework and official monitoring of geothermal resources in Iceland. Utilisation of geothermal resources has expanded rapidly during the last decade and those companies which are involved intend to intensify the utilisation even further. Iceland's long term objective is to ensure long term utilisation of the resources and the legal amendments mentioned earlier, as well as the future implementation of the Master Plan for hydro and geothermal energy resources in Iceland are steps in maintaining and sustaining this objective. Iceland has developed a great deal of know-how and experience in harnessing of geothermal resources, both for space heating and electricity generation.

Three major amendments have recently been made to the legal framework in Iceland that concerns geothermal development. These amendments were made with the goal of clarifying the rules regarding ownership of natural resources as well as making the division between production based on exclusive licenses and production on the open market more conclusive. On top of that the shift of power to grant licenses was made with a comparative goal in mind, which is efficiency. Orkustofnun is now purely an administrative agency when it comes to granting licenses and its decisions can be appealed to the Ministry of Industry.

Geothermal energy plays an important role in providing the nation with clean and reliable energy and is fundamental to the Icelandic economy as well as Icelandic welfare and independence. The rules and procedures of official monitoring in Iceland have been explained in this article in a concise manner. The legal framework itself is extensive and counting derivative regulations the law on the matter is vast. Some of the legislation is recent while other branches are long-standing. Effective policy making and official monitoring of geothermal development for sustaining a renewable energy society in Iceland is crucial for sustaining a long-term lifespan of the resource.

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