



## Public Monitoring of Geothermal Utilisation:

Lessons Learned in Iceland considered for  
Geothermal Development in Nicaragua

**Guðlín Steinsdóttir  
Sindri Kristjánsson  
Jónas Ketilsson**

*Prepared for ÍSOR*

**OS-2009/006**



**ORKUSTOFNUN**

National Energy Authority

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**Abstract:**

In this report suggestions are made for the framework of public monitoring of geothermal utilisation in Nicaragua. The legal and institutional arrangements in Iceland, with a case study of the Hellisheidi power plant, give an example of the objective and execution of public monitoring in a country with geothermal contributing 2/3 of the primary energy consumption. However, technical aspects of geothermal utilisation are not detailed in Icelandic legislation. Therefore a comparison of the framework in United States of America and New Zealand is made where codes of practice are detailed. The objective and structure of a Nicaraguan Mandatory Technical Standard for geothermal exploration and utilisation is suggested. The aim of this report is thus to give an overview of public monitoring in countries with a long history of geothermal utilisation in order to suggest to Nicaraguan authorities how efficient utilisation of the resource in the long run can be ensured, how to protect the environment and how to secure occupational safety and safety of delivery.

**Keywords:**

Legal, regulatory, public monitoring, environmental monitoring, resource monitoring, energy, Nicaragua, Iceland

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# 1 INTRODUCTION

The project titled "Iceland - Nicaragua: Geothermal Capacity Building Project" has its origin in a proposal put forth by the Government of Nicaragua to the Government of Iceland, through the Ministry of Energy and Mines (MEM), as the main counterpart, and the Ministry of the Environment and Natural Resources (MARENA). The project is financed by the Icelandic Agency for International Development (ICEIDA). The project consists of three components: short and medium-term technical assistance; instruction and training; and endowment with equipment. These three components are closely linked to the overall objective which is to enhance geothermal utilisation.

A part of the assistance, required by Nicaragua involved their legislation primarily that dealing with public monitoring of the geothermal utilisation. In Nicaragua the Geothermal Resources Act No. 443 and the Regulation of the Geothermal Resources Act No. 003-2003 are currently valid, neither of which provides detailed rules on public monitoring. There is a need for further rules that provide clear instructions for the developer and ensure that the objectives of public monitoring are reached.

The National Energy Authority (NEA) in Iceland undertook a task that is part of the project for the ICEIDA. NEA will, in cooperation with MEM and Iceland GeoSurvey (ISOR), make suggestions for the purpose and structure of National Technical Obligatory Standards and recommendations to amend the existing regulatory environment of exploration and utilisation of geothermal resources (see Annex 2, part 4: Regulations and Tendering on pg. 109 in Final Project Document).

Jonas Ketilsson (JK), a geothermal specialist, and Gudlin Steinsdottir (GS), a legal adviser, from NEA visited Nicaragua from June 28th to July 2nd (JK) and July 11th 2008 (GS). During the visit the consultants, Magdalena Perez at the Geothermal Department of MEM and Gioconda Guevara at ICEIDA met with representatives from the Nicaraguan Institute of Energy (INE), Ministry of the Environment and Natural Resources (MARENA), Ministry of Development, Industry and Commerce (MIFIC) and MEM to discuss the scope of work and jurisdiction of each institution.

In a report from July 2008, Visit to Nicaragua July 2008, Geothermal Legal Environment in Nicaragua (OS 2008/006), preliminary recommendations are made to change the current legal environment in Nicaragua.

This report is structured by six main chapters. The second chapter focuses on the general objectives of public monitoring of geothermal utilisation in Iceland. The third chapter entails how Icelandic law and governmental institutions are arranged to fulfil their monitoring obligations. The fourth chapter gives a brief overview of the Nicaraguan law and governmental institutions already in place. The fifth chapter compares regulatory framework and monitoring in New Zealand and U.S.A. Chapter six contains the suggestions this report makes for the next steps in Nicaragua regarding public monitoring of geothermal utilisation. The sixth and final chapter contains the conclusion of the report with recommendations.

## 2 PUBLIC MONITORING IN ICELAND

This chapter aims to explain in general terms the objectives of public monitoring. Furthermore, the public monitoring of geothermal projects will be specified. In Iceland public monitoring has expanded gradually in recent years in terms of its impact on society and individuals.

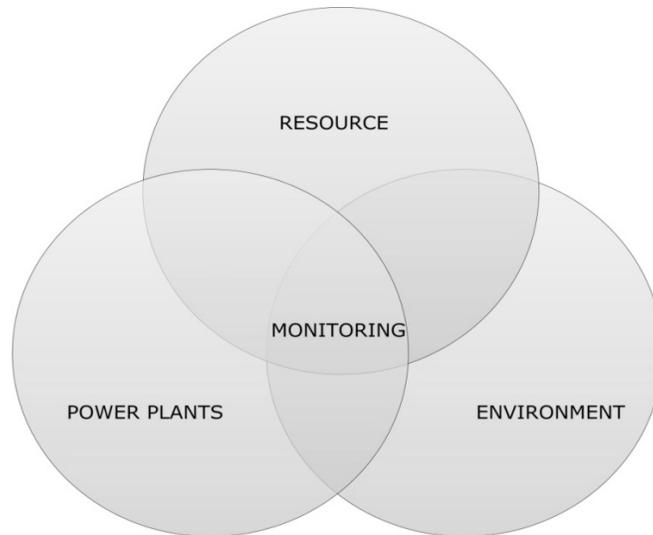
In June 1999 the Icelandic Parliament (Althingi) passed Act No. 27/1999 on Public Monitoring Rules (Monitoring Act) in order to promote efficient yet beneficial monitoring in practice. The objective of this act is to ensure that public monitoring is conducted in the most economic way possible, both for the State and for those the monitoring is aimed at. The public 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 public monitoring rules promote the welfare of the Nation, safety and public health, safety of property, environmental protection, normal business practices and consumer protection. The 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.

The Monitoring Act and the derivative Regulation No. 812/1999 provide guidance for public authorities on deciding how they are going to manage their monitoring activities. When creating a monitoring system, Art. 9, Par. 4 of the Regulation stipulates that the selection of a method of monitoring shall aim to allow a choice of options for complying with the legislation and a choice of monitoring parties to undertake the monitoring where possible.

Efforts shall be made to maximise flexibility of the monitoring system, integrate various elements of monitoring and enable the monitoring party to employ comprehensive methods for fulfilling the stipulated requirements. A particular effort shall be made to integrate monitoring which is directed at identical or similar factors, in order to enable the requirements of individual official monitoring authorities to be harmonised and the monitoring to be implemented by one and the same party to the greatest possible extent, according to Art. 9, Par. 4 of the Regulation.

Before any monitoring is determined, there must be a recognised need for the monitoring, according to Art. 3 of the Monitoring Act and Art. 4 of the derivative Regulation No. 812/1999. The objective of the monitoring has to be clear. It is the authority responsible for the monitoring that evaluates the need for the monitoring. The evaluation can consist of e.g. risk assessment, assessment of international commitments on monitoring, assessment of the cost for the public authority, and assessment of whether the same results can be achieved by more economical methods or by making an assessment of the economic value of the monitoring.

The public 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: Environment, resource and power plant (see Figure 1). 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.



*Figure 1.* Monitoring of geothermal utilisation can be divided into three sectors.

## **2.1 Environmental monitoring**

The objective of public 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 (Nature Conservation Act). 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. In Art. 21 of the Resource law it is stipulated that the Nature Conservation Act should be considered for research and monitoring purposes.

An important pillar of environmental protection in Icelandic legislation is Act No. 106/2000 on Environmental Impact Assessment. 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 No. 57/1998 (Resources Act), Art. 17 and the Electricity Act No. 65/2003 (Electricity Act), Art. 5.

To achieve the objectives of the monitoring of the environment the Environment Agency and the local health authority play the biggest role, as will be addressed further in chapter 3.2.

## **2.2 Resource monitoring**

Another objective of public 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 Resources Act as well as Art. 5 of Regulation No. 1040/2005.<sup>1</sup> One way to ensure this is to have an effective public 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 Resource Act.

## **2.3 Safety and management**

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

Monitoring of the power plant starts before construction of the plant begins. Firstly, 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 (Planning Act). Art. 38, Par. 2, of the act provides that during the construction of a power plant it is the local authority's responsibility to continue to monitor all development of the power plant 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.

Secondly, a power plant licence is required in order to build and operate a power plant, according to Art. 4 of the Electricity Act. As soon as this licence has been issued the National Energy Authority starts to have a monitoring obligation, according to the Electricity Act. 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 and derivatives regulations.

In addition there is the Act on the Safety of Electrical Installations, Consumer Apparatus and Electrical Materials No. 146/1996 (Electrical Installation Act), which is managed by the Iceland Fire Authority (Brunamálastofnun). The objective of the Act is to reduce as much as possible the potential for danger and damage resulting from electrical installations, consumer apparatus and electrical materials as well as disturbances caused by their operations.

Finally may be mentioned the Act on Working Conditions, Health and Safety in the Workplace No. 46/1980, and a number of regulations ratified by the Minister for Social Affairs, which cover workplaces on land with a staff of one or more persons. It is the Administration of Occupational Safety and Health which has the role of carrying out this legislation and preventing accidents and damage to persons' health. It conducts inspection and supervision at workplaces, and in this respect geothermal power plants are no exception.

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<sup>1</sup> See chapter 3.3.2.1 for further details on Regulation No. 1040/2005.

### 3 LEGAL AND INSTITUTIONAL ARRANGEMENTS IN ICELAND

The different objectives of the three aforementioned sectors are stipulated in Icelandic legislation and different authorities are responsible for monitoring that these objectives are achieved. Bear in mind that the Monitoring Act also sets out objectives for the content and purpose of monitoring rules. In this chapter an overview is given of the legal framework, obligations and jurisdiction of institutions and municipalities which supervise the monitoring of geothermal projects. Each institution has a certain responsibility and role when it comes to monitoring geothermal operations, relating to the environment, the geothermal resource or the power plant. This chapter ends with a case-study on Heillisheidi power plant.

#### 3.1 Administration and licences

Usually the monitoring of geothermal projects starts when licences are issued. When activities are subject to licences in compliance with the law and the law stipulates certain requirements for monitoring, those requirements are being promoted by issuing a licence. The monitoring requirements begin as soon as the licence is issued, e.g. if the conditions set specify that only qualified individuals can be issued licences. Further monitoring requirements can be set as a condition in each licence, and licences can be revoked if these conditions are not complied with.

As mentioned in Art. 17 of the Resources Act, when granting utilisation licences care should be taken that the utilisation of ground resources is carried out in a manner which takes account of environmental perspectives and that the utilisation of the resources is efficient from a macro-economic point of view. If it is the authority's opinion that the intended operations of the applicant for utilisation licence do not meet these requirements, the authority may refuse to grant the licence or insert special conditions in the licence. When an administration authority issues a licence, it makes an authority decision, a decision by a public authority on the rights or duties of individuals, according to Art. 1 of the Administration Act No. 37/1993 (Administration Act). The subject of an authority decision is often divided into main subjects, e.g. licence and additional subject, e.g. conditions. In Icelandic administration law, it is the general rule that it is not authorised to set conditions for an authority decision without it being expressly authorised in the legislation, as is the case in the aforementioned Art. 17.<sup>2</sup>

When authorities issue licences, thereby making a decision of authority, the decision has to be in accordance with the Administration Act. Certain principles are stipulated in the Administration Act which authorities should consider when making an authority decision, such as promoting fairness and certain methods of decision making, e.g. the principle of equality in Art. 11 and the principle of proportionality in Art. 12. When licences are issued according to the law, certain conditions are usually set and the developer is hence made aware of the boundaries and obligations he must conduct according to the licence and the authority that issues the licence commits to monitor that those conditions are followed.

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<sup>2</sup> Hreinsson, Páll, "Framkvaemdaleyfi". *Tímarit lögfræðinga* 2004 (2), p. 260.

### 3.2 Environmental Law

Geothermal areas are often located in untouched or sensitive ecosystems. According to Art. 21 of the Resources Act it is stipulated that for the purposes of protection and monitoring, the Nature Conservation Act is also valid within the spheres of research and utilisation. Other relevant acts are discussed below. The areas of environmental law discussed here are shown in Figure 2.

#### 3.2.1 Environmental Impact Assessment

Due to the nature and often the location of the intended geothermal utilisation, an environmental impact assessment usually has to be made before the utilisation commences. One of the objectives of environmental impact assessments is to minimise as far as possible the negative environmental impact of projects, as stated in Art. 1 of the Environmental Impact Assessment Act No. 106/2000 (EIA Act). The environmental impact assessment is a preventive measure to ensure that before consent is granted for a project, an assessment of the environmental impact which the execution of the project might have has been carried out. The environmental impact assessment is based on amongst other things the location of the project and the activities it will involve.

One of the strategies to prevent as far as possible the negative impact is to make the developer, who is planning a project or activity which is subject to environmental impact assessment, responsible for compiling a report on the environmental impact assessment of the proposed project. In the report the developer is to specify the cumulative and synergic, direct and indirect, effects which the proposed project and associated activities may have on the environment and the interaction of individual

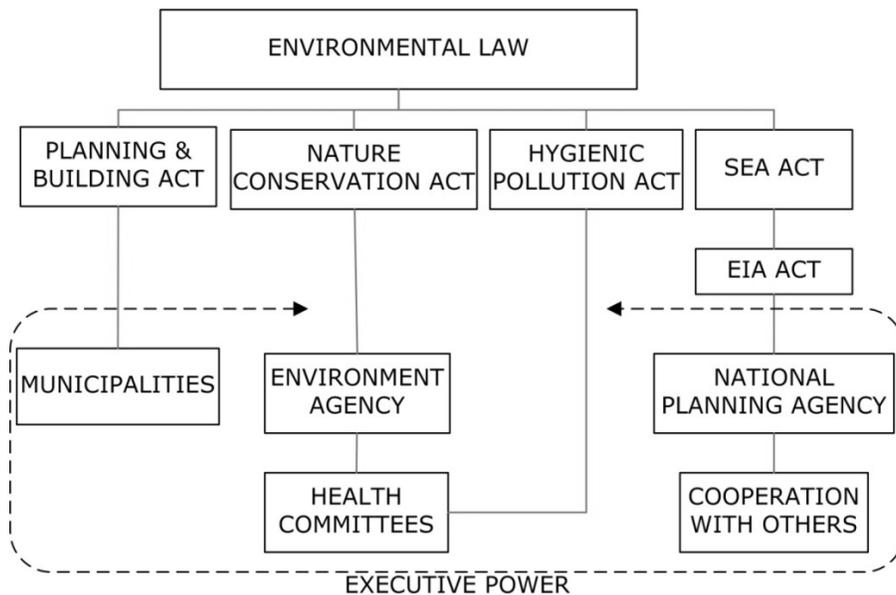


Figure 2. A section of the acts and institutions classified under Environmental Law that are chiefly responsible for monitoring according to each act.

environmental factors, as stated in Art. 9 of the EIA Act. Having the developer realise what effect the proposed project might have on the environment, is considered a rational first step towards minimising as far as possible the negative environmental impact of projects. Geothermal power stations and other thermal power installations with a heat output of 50 megawatts or more are always subject to environmental impact assessment, according to Item 2 in Annex I of the EIA Act. If power stations or other thermal power installations are planned with a lower heat output than 50 megawatts or if the intention is only to survey an area or to drill research holes in high-temperature geothermal regions, these operations may be subject to environmental impact assessment, according to Annex II of the EIA Act. Those projects which may have a substantial impact on the environment are assessed on a case-by-case basis, to determine whether they should be subject to environmental impact assessment pursuant to this Act, according to further paradigms in Annex III of the Act.

According to Art. 4 of the EIA Act the National Planning Agency (Skipulagsstofnun) oversees the implementation of the EIA Act and provides guidelines in accordance with it. The Agency is also the official institution responsible for the administration, monitoring and implementation of the Planning Act, according to Art. 4 of the Planning Act; the EIA Act, according to Art. 4, Par. 2 of the EIA Act; and the Strategic Environmental Assessment Act No. 105/2006 (SEA Act), according to Art. 4, Par. 2 of the SEA Act.

When it comes to research or utilisation of geothermal energy the National Planning Agency is only responsible for administrating environmental impact assessment, where necessary. The agency has no responsibility as a monitoring authority; as soon as the environmental assessment has been conducted the monitoring becomes the responsibility of the authority that issues a licence for a project. For example, when the municipal council has issued a development or a building licence for a construction subject to environmental impact assessment, that council is hence responsible for the monitoring of that construction.

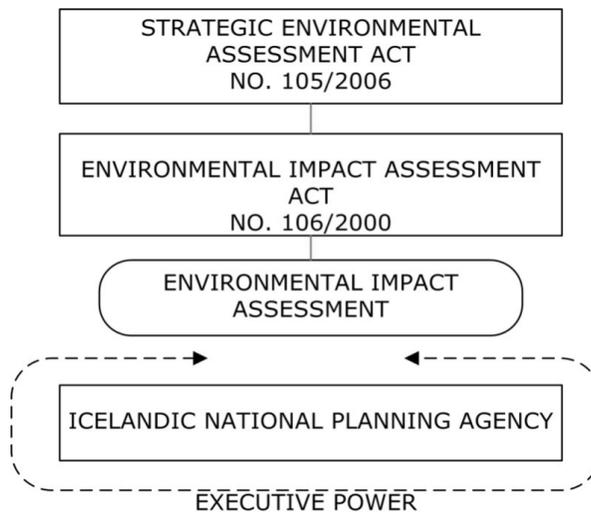


Figure 3. The connection of the National Planning Agency, the SEA Act and EIA Act.

In Art. 3 of the SEA Act, it is stipulated that the Act is valid for environmental assessment of the plans and programmes and changes to them, and states a policy regarding issuing licences for types of development mentioned in the EIA Act.

As an example, in a development plan where a geothermal power plant is scheduled to be built, according to Item 2 in Annex I of the EIA Act, the Strategic Environmental Assessment Act would then be valid for that development plan (see Figure 3).

With the SEA Act, Iceland adopted Directive 2001/42/EC from the European Parliament and the Council.<sup>3</sup> The objective 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.

In the preparatory documents for the SEA Act it is stated that there is a difference between the EIA Act and the SEA Act in terms of accuracy, procedure and approval of the assessment. On one hand the SEA Act concerns general decisions regarding a given project's broad direction and the synergistic effects of many projects on specific environmental features or areas. The EIA Act on the other hand concerns decisions relating to individual projects and the narrow, more specific and focused evaluation of environmental assessment.<sup>4</sup> The content of the SEA Act and the EIA does not involve public monitoring, the acts provide for necessary measures to prevent negative impact on the environment.

### **3.2.2 The Planning and Building Act**

Iceland, as a whole, is to be organised according to a development plan, according to the Planning Act, Art. 9. The building of houses and other structures above or below ground, along with all other operations that affect or alter the appearance of the environment must be done according to the plan. Art. 4.7.1 of Planning Regulation No. 400/1998 states that power plants are to be built in an "industrial zone". In the general development plan, account must be made for previously built area as well as sites of intended industrial developments in urban and in rural areas.

The Minister for the Environment oversees all development and planning, but the municipalities in Iceland govern their own affairs and are responsible for their local development plans. Each municipality has an elected council that governs the community and is responsible for the execution of legally determined projects. One of those projects is to prepare a development plan for their region and the councils are to issue development licences and building licences as stated in the Planning Act (see Figure 4).

A development licence from the council is required before carrying out any major operation that can have an impact on the environment or alter its appearance. Thus a development licence is required for wells drilled for research. If an operation requires a building licence, a development licence is not required.

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<sup>3</sup> Official Journal L 197/, 21/07/2001, pp. 30-37. Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain plans and programmes on the environment.

<sup>4</sup> Bill on the Act of Strategic Environmental Assessment, Parliament document 376, Case 342, Chapters 2 and 3.

Internet edition of the Parliamentary Record, address: <http://www.althingi.is/altext/132/s/0376.html>  
Retrieved: 08.11.2008.

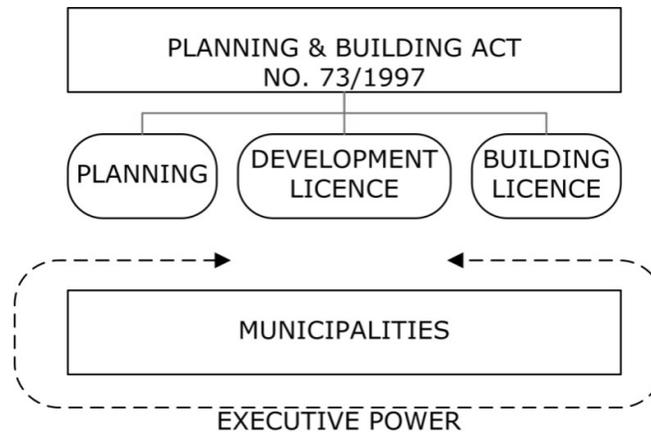


Figure 4. The main subjects of the Planning Act

A building licence, from the regional council, is required before a foundation is dug, before a house is raised, demolished, or modified, before a house's structural frame is altered, and before modifying a house's form, appearance or usage, as stipulated in Art. 36, Par. 1 of the Planning Act. A building licence is required for any construction above or below ground with certain exceptions such as power plants, whether they are being built by public institutions or carried out according to specific legislation. A building licence is required for the building of permanent structures associated with the aforementioned types of construction, as stated in Art. 36, Par. 2 of the Planning Act.

This is why a building licence is required when privately owned power plants are being built but not required when public institutions build power plants. Any permanent structures associated with a power plant do however require a building licence, regardless of whether they are under public or private ownership.

The municipal councils or other local authorities within the municipality issue development licences and building licences in accordance with the development plan. The councils can only issue development licences if an environmental impact assessment has been carried out or if the National Planning Agency has decided that the project is not subject to such assessment. The council then reaches a decision based upon the verdict of the National Planning Agency, and in the development licence the council can apply the recommendations set forth in the Agency's decision on the need for environmental impact assessment.

As illustrated in Figure 6 the municipalities have executive power, according to the Planning Act. It is the municipal council's responsibility to continue to monitor projects, both those subject to a development licence and those subject to a building licence; the council is to make sure that the project is carried out according to the description in the licence and relevant legislation. The procedure is more detailed for the building licence than for the development licence, as set out in the Planning Act and in Building Regulation No. 441/1998 supporting the Act.

### 3.2.3 The Nature Conservation Act

The objective of the Nature Conservation Act, according to Art. 1, 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. In Art. 21, of the Resources Act it is stipulated that the Nature Conservation Act is also valid with respect to the protection and monitoring of geothermal areas being researched and utilised.

Hot springs of multifarious type have, for decades, been considered one of Iceland's natural wonders. Relatively extensive utilisation of geothermal energy in low temperature areas has taken its toll on the environment, but with increased environmental awareness, efficient legislation and better monitoring the prospects are good. According to the comments on the bill that followed the Nature Conservation Act it is considered necessary that all pollution of hot springs in low temperature areas must be stopped and further utilisation should be carried out with caution. In high temperature areas where geothermal energy is utilised to generate electricity, special consideration must be given to the conservation of hot springs, so that these natural wonders can be seen by generations to come.<sup>5</sup>

In the preparatory documents for the Resources Act there is no clarification of why it was considered essential to make special mention of the fact that the Nature Conservation Act is also valid with respect to protection and monitoring of natural resources and geothermal areas being researched and utilised, given that the Act is already valid with respect to those areas.<sup>6</sup> This is most likely done in order to emphasise the importance of environmental conservation in general. No specific licences are issued for geothermal projects, according to the Nature Conservation Act, as displayed in Figure 5; the Act is for general protection and monitoring.

The Environment Agency (Umhverfisstofnun), which operates under the direction of the Ministry for the Environment, is the regulatory authority of the Nature Conservation Act. Its role is to promote the conservation and sustainable use of Iceland's natural resources, as well as public welfare, by helping to ensure a healthy environment and safe consumer goods, according to Art. 6 of the Nature Conservation Act. Should the Environment Agency consider it necessary to supervise a certain project specifically it shall conclude an agreement thereto with the developer. The

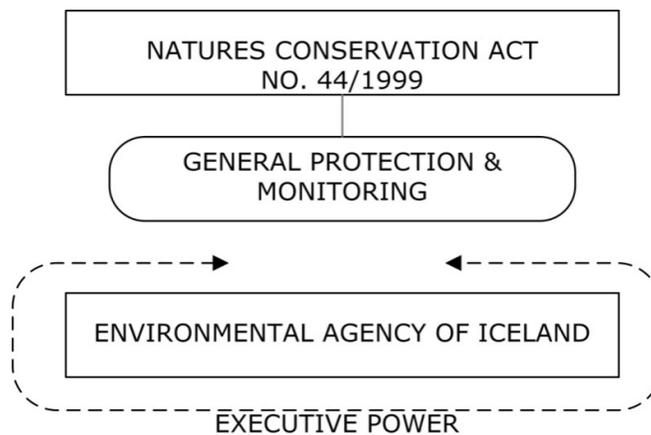


Figure 5. The Nature Conservation Act in relation to geothermal projects.

<sup>5</sup> Bill on the Act of Nature Conservation Protection, Parliament document 848, Case 528, Chapter IX. Internet edition of the Parliamentary Record, address: <http://www.althingi.is/altext/123/s/0848.html> Retrieved: 02.11.2008.

<sup>6</sup> Bill on the Act of Ownership and Utilisation of Natural Resources in the Ground, Parliament document 574, Case 359. Internet edition of the Parliamentary Record, address: <http://www.althingi.is/altext/122/s/0574.html> Retrieved: 10.10.2008.

agreement shall concern internal checks and monitoring by the developer and supervision by other public parties.

It is also the Environment Agency's and nature conservation committees' responsibility to present their verdict before a development or building licence is issued, according to Art. 27 and Art. 43 of the Planning Act, for projects which involve disturbance of types of landscape referred to in the first Par. of Art. 37 of the Nature Conservation Act, unless a development plan exists in which a verdict on this matter has already been obtained from the Nature Conservation Agency and nature conservation committees.

The Environment Agency supervises the proper enforcement of Act. No. 7/1998 on Hygiene and Pollution Control (Pollution Control Act) by supervising and coordinating health inspection and monitoring. The Environment Agency also ensures that health inspection and monitoring is carried out in an efficient manner and does not overlap.

### 3.2.4 The Hygiene and Pollution Control Act

According to Art. 1, of the Pollution Control Act, the objective of the Act is to guarantee the people of Iceland a healthy environment and to protect the values of a clean and unpolluted environment. In Art. 9 of the Pollution Control Act, it is provided that the Minister for the Environment has ultimate responsibility for matters stipulated in the Pollution Control Act.

According to the Pollution Control Act, geothermal power plants are categorised as an operation that has to have a valid operating licence before any operation starts at the power plant, according to Art. 4, Par. 1a. The operating licence is issued by a local health committee, according to Regulation 786/1999, Annex 2, Art. 9 (see Figure 6).

Iceland is divided into ten regulatory zones. Each zone has one health committee which is responsible for health inspection and monitoring in its designated area. Among the conditions stipulated in the operating licence are that the health committee monitors and makes sure that the licence holder enforces the conditions as described in the licence. The objective of operating licences is to prevent pollution and promote a wholesome and clean environment.

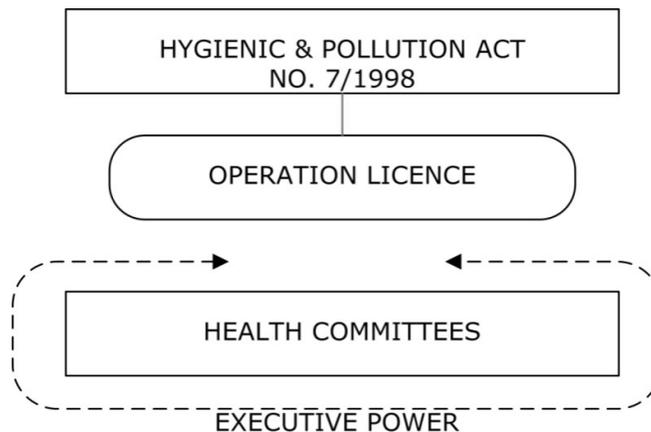


Figure 6. An operation licence is issued by the Health committees.

When an operating licence is issued for a geothermal power plant, certain conditions are stipulated for the construction project and the health committee is responsible for maintaining extensive monitoring of the project, making sure that these conditions are met in development and in operation. Health committees can intervene to enforce the developer to manage his/her operations as instructed in the operating licence. The health committees are authorised to issue reminders and to stop or limit operations if conditions are not met, according to Art. 27 of the Pollution Control Act.

### 3.3 Energy and Resource Law

Resource Law 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 generations to come.<sup>7</sup>

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

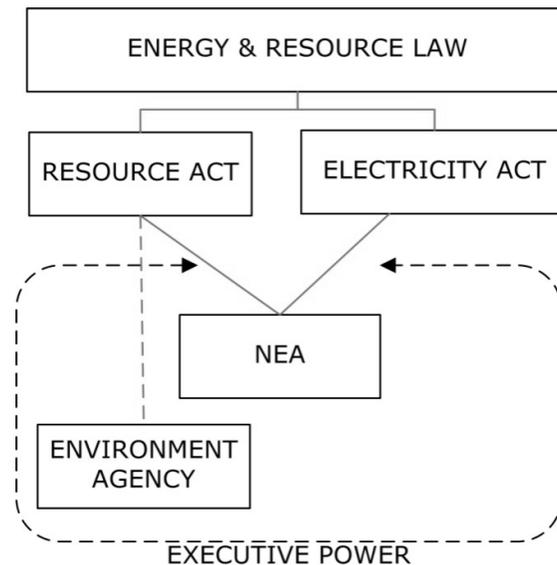


Figure 7. NEA has responsibility according to the Resource and Electricity Act.

<sup>7</sup> Gauksdóttir, Guðrún and Kristjánsdóttir, Margrét V., "Audlindaréttur". *Lagakrókar* 2006 (1), p. 38.

### 3.3.1 The Resource and Utilisation Act

Before the enactment of the Resources Act in June 1998, various laws covered the field of legislature that focused on natural resources in the ground. These were the now discarded provisions of the Energy Act No. 58/1967 as well as the Act on Ownership and Rights of Usage of Geothermal Resources No. 98/1940 and the Power Plant Act No. 60/1981. These Acts were, as their nomenclature suggests, all meant to deal with energy production, heat as well as electricity. In October 1995 the Icelandic government nominated a workgroup to draft bills regarding property rights on land and the right to operate hydroelectric power stations.<sup>8</sup> The objective was to encompass in one Act all the relative rules on ownership of resources in the ground as well as to establish the government's role in research and utilisation of these resources. The workgroup was to consider earlier recommendations made on this subject submitted to Parliament in the past. The workgroup was also to consider whether the legislation violated Art. 72 of the Constitution of the Republic of Iceland No. 33/1944 (the Constitution) which declares private ownership an inalienable right.

The Resources Act applies to research and utilisation of natural resources found in the ground, those resources being defined as any type of elements, compounds or energy that can be processed from the ground, found in solid, liquid or gaseous form at any temperature, according to Art. 1, Par. 2. This is a vast definition which includes multifarious types of resources found in the ground, including geothermal energy. The Act applies e.g. to all utilisation of geothermal fluid from the low temperature systems and where the run-off fluid from high temperature systems is used to heat up cold ground water for direct use.<sup>9</sup>

In Iceland all geothermal resources are the property of the owner of the land where the resource is located. A landowner is authorised to carry out research of geothermal energy in his land without a licence from the Minister or the National Energy Authority. If the landowner intends to utilise this energy he is not required to apply for an utilisation license if he only intends to utilise the resource to a limited extent for his "household and agricultural use, including for greenhouse cultivation, industry and cottage industry, up to 3.5 MW based on the heat extracted from the ground within private land."<sup>10</sup> The landowner must however apply for such a license if the intended production is more than 1 MW or intends to connect to the national transmission grid.<sup>11</sup> Where geothermal energy is only utilised for a landowner's home and husbandry, it is not subject to public monitoring. However, the landowner has to notify the NEA of this utilisation and the authority can set certain conditions for that utilisation. Despite the fact that the right to private ownership is declared to be inalienable in the Constitution, restrictions on utilisation for landowners with property rights over geothermal energy resources are set in the Resource Act. Further restrictions on utilisation of natural resources are also to be found in other acts, e.g. the Nature Conservation Act, the Planning Act and the EIA Act.

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<sup>8</sup> Bill on the Act of Ownership and Utilisation of Natural Resources in the Ground, Parliament document 574, Case 359.

Internet edition of the Parliamentary Record, address: <http://www.althingi.is/altext/122/s/0574.html>

<sup>9</sup> In some power plants cold water is heated up with run-off fluid and used directly, e.g. at Svartsengi, according to the Hitaveita Sudurnesja, accessible at: <http://www.hs.is/HSDistribution/HSDistributionHeating.aspx?tabnumber=5>  
Retrieved: 10/12/2008.

<sup>10</sup> Unofficial translation by the Ministry of Industry.

<sup>11</sup> This is in accordance with Art. 1 Par. 4 of the Electricity Act.

According to Art. 2 of Act No. 58/1998 on Common Land and Boundaries of Private Land, Common Land and Highland Pasture (Common Land Act), the Icelandic State is the owner of land and its benefits in commons, except benefits that have been declared private property. Except where mentioned in special legislation, it is forbidden to utilise geothermal resources in Common Land except with permission from the Prime Minister, as stated in Art. 3, Par. 2, of the Common Land Act.

According to a recent amendment of the Resource Act, with Act No. 58/2008, the Icelandic state, municipalities and companies owned by them are not allowed to permanently assign the property rights to geothermal resources. Those parties are however still allowed to assign usufruct of the resource for up to 65 years, or longer, according to Art. 1. When assigning the usufruct, equality must be taken into consideration and the decision should also promote efficient use of the resource and investments of constructions. The Prime Minister decides the royalties for the usufruct on State-owned land, according to Art. 3a of the Resources Act, as mentioned in Act No. 58/2008, Art. 6.

It makes a difference whether it is the owner of the resource or a leaseholder who utilises the resource, since they make different assumptions. The difference is that before the leaseholder can start to utilise the geothermal resource and before any income starts rolling in, the leaseholder has to invest quite extensively in structures and equipment which it is not foreseen that s/he will be able to use once the renting period ends. This is related to the idea of sunk cost in economics, meaning costs which cannot be recovered once they have been incurred.<sup>12</sup>

The owner of the resource most likely wants to utilise it in the most efficient manner long-term, while the leaseholder most likely wants to get as much profit from utilising the resource for the duration of the leasing period. When it comes to the end of the leasing period the leaseholder will most likely not invest any capital or effort into the maintenance of constructions which would ensure safety and profit, nor does the leaseholder have any economic motivation to utilise the resource in a way which

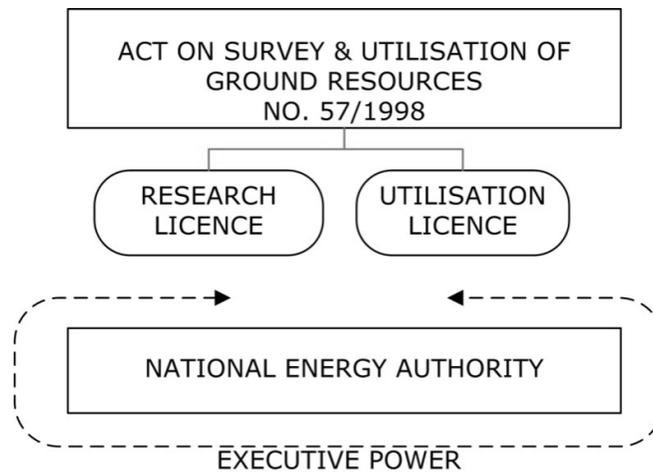


Figure 8. The NEA issues research and utilisation licences.

<sup>12</sup> Baldursson, Fridrik and Fehr, Nils-Hendrik, Report for the Ministry of Industry, Energy and Tourism. Accessible at: <http://www.althingi.is/pdf/umsogn.php4?lthing=135&malnr=432&dbnr=1963&nefnd=i> Retrieved: 06.10.2008.

ensures the long-term efficiency of the resource, as is set forth in Art. 25 of the Resources Act. Since the leaseholder does not have the economic motivation to comply with Art. 25, effective public monitoring of the resource is necessary.

As previously mentioned the monitoring of utilisation of geothermal energy to generate electricity is just one of the responsibilities of the NEA. The monitoring role can roughly be divided into three main parts, these being the monitoring of the geothermal resource, generation of electricity and the accounting.

Before going on further it is important to note one thing. Since the enactment of the Electricity Act No. 65/2003 (further discussed in chapter 3.3.2.) the Resources Act and its paragraphs on utilisation only applies to geothermal resources when utilised for the purpose of heat production for space heating. The Electricity Act deals with geothermal utilisation for electricity production.

### **3.3.1.1 Geothermal resources**

According to the Resources Act and the Electricity Act the NEA has an extensive role as an arbiter and as regulatory authority for geothermal resources in Iceland. In August 2008 the Minister of Industry, Energy and Tourism assigned the NEA the authority to issue research and utilisation licences, to revoke licences and to initiate research into natural resources, according to Art. 1, of Act No. 68/2008 on the changes of the Resources Act (see Figure 8). The NEA also submits its opinion for environmental impact assessments if required before a research or utilisation licence is issued.

The NEA is also responsible for all monitoring of the geothermal resource and can revoke a licence if the conditions of the licence are not met by the licence holder or if the licence holder or his company is put into liquidation.

Assigning the NEA the authority to issue research and utilisation licences was done in order to make the process for acquiring a licence more approachable. Other arguments for these amendments were that it was considered more appropriate for an institution which specialises in matters of natural resources and energy to handle these matters than for a Minister to do so. Secondly, all decisions made by the institution can be appealed to the Minister of Industry, Energy and Tourism, which promotes fair processing of all decisions if objections arise.<sup>13</sup>

Applications for research and utilisation licences must disclose in a clear manner the purpose of the application and include detailed information concerning the proposed operations of the applicant. According to Art. 17 of the Resources Act, before the NEA issues an utilisation licence, it should evaluate whether it is the applicant's intention to utilise the resource in an economically advantageous way, whether he will consider environmental impact and will make note of other potential utilisation in the vicinity. If the NEA has any doubt that the licence holder will carry out his responsibilities, the NEA can deny issuing the licence or put special conditions in the licence, according to Art. 17 of the Resources Act.

The monitoring activity of the NEA, according to Art. 22 of the Resources Act, consists of receiving a report from the licence holder at least once a year and when the licence expires. The annual report should contain information on results of research and utilisation, information on the nature and extent of the resource, total quantity and

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<sup>13</sup> Bill on the Act to change the research and utilisation of Natural Resources in the Ground No. 57/1998, and the Act of ownership of the Icelandic State of the Natural Resources on the Seabed No. 73/1990, later amended, Parliament Document 854, Case 553.  
Internet edition of the Parliamentary Record, address: <http://www.althingi.is/altext/135/s/0854.html>  
Retrieved: 12.10.2008.

assessment of the value of a resource that has been exploited, along with other matters as further stipulated in the licence in question.

Furthermore, the licence holder must submit geological samples if requested by the NEA. The licence holder must keep a logbook for all drilling activity according to the Resources Act. In the logbook the following information must be entered: Location, sedimentary strata, type and depth, when water or steam enters the well, temperature and other facts that the NEA might request.<sup>14</sup>

Based on the annual report from the licence holder, the NEA continues to monitor a resource and evaluates whether the conditions listed in Art. 25 are being honoured. The Act stipulates that those who utilise geothermal energy must do so in such manner that the long-term efficiency of a resource is maximised. This includes not extracting more geothermal energy than necessary and that drilling must be conducted in such a way that it causes the minimum possible inhibition of future exploitation of a resource.

According to Art. 24, Par. 3, of the Resources Act the licence holder is obliged to seal boreholes and mark them when they are no longer in use. No further requirements are stipulated in the Resources Act for how the licence holder is to abandon a geothermal area when he is no longer utilising it. Obligations on how to abandon a geothermal area must however be stipulated in the issued licence, according to Art. 18, item 11, of the Resources Act. This raises the possibility that this fails to be mentioned in the licence, either by human or technical error. For safety and environmental purposes it is important that abandonment of a geothermal area is done properly. In my opinion, it would be preferable if such an important issue as this is mentioned in the legislation.

In order to execute its powers as a regulatory authority the NEA has access to just two sources of data according to the Resources Act. The institution receives reports once a year, and receives logbooks for all drilling which is carried out. The NEA can ask for any information to be given in the yearly report, but only has the opportunity to submit a request for this information when issuing the licence.

This is before any utilisation has begun and it is thus impossible for the NEA to anticipate what, if any, further information will be needed from each licence holder in order to be able to monitor the geothermal resource in an adequate way. It is debatable whether the powers that the institution has are far-reaching enough to maintain a suitable level of monitoring of geothermal resources.

### **3.3.1.2 Extended authority in 2007**

According to the preparatory documents that followed the amendment of the NEA Act, the restricted authority given to the NEA by the Resource Act to monitor geothermal resources was considered to inhibit the institution's ability to obtain the information needed and licence holders were becoming more and more reluctant to provide appropriate information.<sup>15</sup> This was not only obstructing the NEA from fulfilling its role according to the NEA Act, but was also obstructing the institution from conducting energy forecasts and gathering information required in order to account for greenhouse

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<sup>14</sup> In an appendix to each utilisation licence is given a list of what information should be provided to the NEA. This list was compiled by two Icelandic specialists and is considered to cover all the information necessary to monitor the resource in an adequate manner.

<sup>15</sup> Bill on changing the Act of NEA No. 87/2003, Parliament Document 399, Case 367, Chapter 3. Internet edition of the Parliamentary Record, address: <http://www.althingi.is/alttext/133/s/0399.html> Retrieved: 02.11.2008.

gas emissions, according to the Act No. 65/2007 on the Emission of Greenhouse Gases.<sup>16</sup>

When the NEA Act was amended in March 2007 the authority of the institution to gather information was extended. Par. 5 was added to Art. 2 of the Act, which gives the institution greater authority to request additional information regarding utilisation of resources in the ground, energy generation and energy usage. The institution was also given the authority to demand compensation through the imposition of daily fines. The daily fines may be in the range of 10,000 to 100,000 ISK, according to Art. 2, Par. 6. This provision for increased authority for the NEA promotes its powers to approach relevant and necessary information.

### 3.3.2 The Electricity Act

The Icelandic Electricity Act No. 65/2003 is based on the framework provided by Directive 96/92/EC and Directive 2003/54/EC on inner electricity markets which became a part of the EEA Agreement in November 1999. The Directives do not state how monitoring is to be carried out. The only responsibility that the member states have regarding monitoring is to ensure that the content of the Directive is enforced.<sup>17</sup>

According to the comments in the preparatory documents for the Electricity Act, there is a continued awareness of the fact that the most economic means of generating electricity is to make the position of domestic companies more competitive in relation to foreign companies. It is recommended that a sufficient yet economical monitoring program for transportation and distribution be maintained. Consideration should be given to the environmental perspective. It was also considered important to safeguard the interests of consumers with rules on quality and security of delivery, efficient monitoring and simple ways for the user to lodge complaints.<sup>18</sup>

A licence from the NEA is required to construct and operate electric power plants with a capacity rated at 1 MWe or more, (see Figure 9). Power plants with a capacity rated at less than 1 MWe must however also have a license if the energy

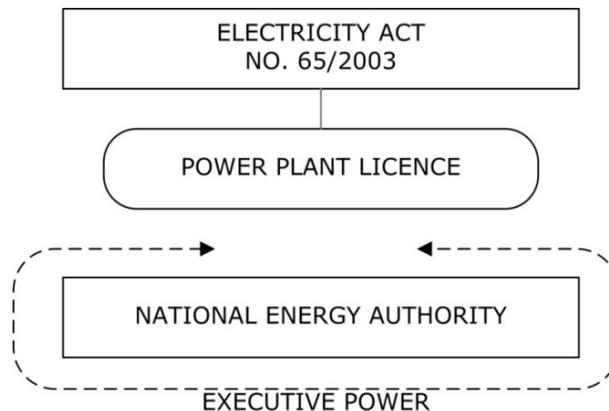


Figure 9. The NEA issues power plant licences.

<sup>16</sup> *Ibid.*

<sup>17</sup> Bill on the Electricity Act, Parliament document 700, Case 462, Chapter 6.4.6. Internet edition of the Parliamentary Record, address: <http://www.althingi.is/altext/128/s/0700.html> Retrieved: 21.09.2008.

<sup>18</sup> *Ibid.*, Chapter 1.1.

produced is sold on to the national transmission grid.<sup>19</sup> Power plant licences will only be granted to an independent legal and taxable entity. After the power plant starts generating electricity, Act No. 146/1996 on Safety of Electrical Installations, Consumer Apparatus and Electrical Materials is also valid.

### **3.3.2.1 Generating electricity**

Generation of electricity in Iceland should be done in accordance with the Electricity Act. Some geothermal power plants, e.g. that at Svartsengi, are both generating electricity and utilising the run-off fluid to heat up cold ground water which is then used to e.g. heat up houses. Svartsengi Power Plant consequently needs to have both an utilisation licence according to the Resources Act, and a power plant licence for their operations according to the Electricity Act.<sup>20</sup> As permissible in Art. 32 of the Electricity Act, the Minister of Industry, Energy and Tourism assigned his power to issue licences to the NEA on August 1<sup>st</sup> 2008. As well as issuing licences the NEA also has the power to establish conditions for issuing a power development licence which are designed to promote an adequate supply of electricity, security, reliability and efficiency of the electricity supply system and the utilisation of renewable energy sources. Furthermore, conditions may be stipulated in relation to environmental protection, land use and the technological and financial capacity of the power development licence holder.

The NEA administrates monitoring of all companies that operate according to the Electricity Act. It consults with the Competition Authority, where applicable, when administrating monitoring of operation and tariffs for transmission system operators and distribution system operators, according to Art. 24, Par. 1, of the Electricity Act.

The NEA consults with parties subject to regulatory monitoring concerning the implementation and development of said monitoring. For this purpose, a special consultation committee was nominated, consisting of representatives of parties subject to regulatory monitoring. The NEA holds regular meetings with the consultation committee, but the committee has no power of decision in matters concerning the NEA, according to Art. 24. The NEA may appoint an accredited inspection body to perform the monitoring on its behalf, pursuant to Art. 24, Par. 1 of the Electricity Act. The accredited body must satisfy the conditions stipulated in Act No. 100/1992 on Measures, Weights and Accreditation and the Accreditation Act No. 24/2006.

The NEA has quite extensive authority to conduct its monitoring activities, according to the Electricity Act. According to Art. 25, the institution is allowed to require that parties subject to monitoring submit all information and data needed for such monitoring. Such data and information is to be delivered within a reasonable deadline. The NEA may also stipulate that these parties regularly inform the institution of matters which are important for the purposes of monitoring, and it is also authorized to request parties subject to regulatory monitoring to establish internal controls pursuant to requirements established by the institution.

The NEA may demand compensation subject to the imposition of daily fines if operation subject to regulatory monitoring does not conform to the conditions of the licence and the law. The nature of negligence or violation may be taken into

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<sup>19</sup> See 13.

<sup>20</sup> In some power plants cold water is heated up with run-off fluid and used directly, e.g. at Svartsengi, according to the Hitaveita Sudurnesja, accessible at:  
<http://www.hs.is/HSDistribution/HSDistributionHeating.aspx?tabnumber=5>  
Retrieved: 10/12/2008.

consideration in the determination of daily fines that may range from 10,000 to 500,000 ISK, according to Art. 26, Par. 1. It is a principle under Icelandic law that authorities are not allowed to use forcible measures when their decisions are not respected without it being expressly and clearly mentioned in relevant legislation.<sup>21</sup> In the Electricity Act it is clearly stated that one of the resources that the NEA has is to require compensation subject to the imposition of daily fines. Decisions to impose daily fines are enforceable by law. Daily fines are a disbursement of money, which citizens subject to fines are obliged to disburse, according to the decision of an authority, when they have not fulfilled a certain obligation to which they are subject. The objective of daily fines is to compel the citizen to honour a given obligation. If it is utterly impossible for the citizen to take the appropriate actions, daily fines should not be applied.<sup>22</sup>

The NEA may, for the purposes of its regulatory activities, request information and data from other public authorities, notwithstanding their obligation to maintain confidentiality. The NEA is also authorised, in the course of its investigations, to perform necessary inspections of the places of business of parties subject to monitoring and to seize documents when there is strong reason to believe that the provisions of the Electricity Act, government regulations established there under, the conditions of a licence, the provisions of an agreement pursuant to Art. 8 of the Act or other authorization have been violated. The provision of the Code of Criminal Procedure regarding search and seizure of property applies to such actions, according to Art. 25, Par. 3, of the Electricity Act.

The Competition Act No. 44/2005 applies to business activities covered by e.g. the Electricity Act. According to the Competition Act the Competition Authority is to enforce the provisions and prohibitions of the Act. According to Art. 27 in the Electricity Act, if a geothermal power plant that generates electricity utilises the steam or hot water for something else as well, that company is not allowed to use the income generated by the utilisation of the steam or hot water to offset the cost of generating electricity, for that would create uneven competition for other companies that only generate electricity. The Competitive Authority can order companies to separate, in their accounts, the different types of utilisation.

Finally may be mentioned the Administration of Occupational Safety and Health which is an independent institution under the Ministry of Social Affairs and Social Security. Its role is to prevent accidents and damage to persons' health in the workplace. The current legislation, Act on Working Conditions, Health and Safety in the Workplace No. 46/1980, and a number of regulations ratified by the Minister for Social Affairs, cover workplaces on land with a staff of one or more persons. The Administration is responsible for enforcing the legislation. It also conducts inspection and supervision to ensure that the law and regulations of health and safety in the workplace are followed.

The Electricity Act provides the NEA with extensive authority to conduct its monitoring of the generation of electricity, and is thorough with regard to permissible accounting procedures and requires that safety of delivery is ensured. It is however noticeable that the Act does not include any specific measures concerning the generation of electricity from geothermal resources. In Art. 18 of the Resources Act it is i.a. required that in a research or utilisation licence it should be stipulated how much and at what rate the resource may be utilised. This is not explicitly stipulated in the Electricity Act, but in its derivative regulation No. 1040/2005 it is clearly stated in Art.

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<sup>21</sup> Hreinsson, P., "Þvingunarúrræði stjórnvalda". In Bragadóttir, R. (President of Editorial Board), *Afmaelisrit Jónatan Thórmundsson sjötugur 19. desember 2007*. Reykjavík 2007, p. 374.

<sup>22</sup> *Ibid.*

5 that the Minister shall enact measures to promote sustainable utilisation of renewable energy resources. It is worth mentioning that since the Electricity Act came into effect later than the Resource Act, one must always look at both of the acts when studying these aspects of Icelandic resource and energy legislation. The two have a synergistic relationship when it comes to utilising geothermal power in Iceland as one deals with research and utilisation while the other deals specifically with energy production from the resource. The Resources Act however acts alone when dealing with production solely intended for hot-water and space heating.

### **3.4 Amendments to the law**

Three major amendments have recently been made to the legal energy framework in Iceland. The first two amendments were 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 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 subsidization 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.<sup>23</sup>

NEA 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. NEA was granted this power to grant licenses officially with an authorization issued by the Minister of Industry effective as of August 1, 2008.<sup>24</sup>

### **3.5 Case study: Hellisheidi Power Plant**

The Hellisheidi power plant is owned by Orkuveita Reykjavíkur (OR) and is situated in the Hengilsvaedi, which is a high temperature area approximately 20 kilometres southeast of Reykjavik. The plant's purpose is to meet the increasing demand for electricity and hot water for space heating in the industrial and domestic sectors.<sup>25</sup> In

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<sup>23</sup> Bill on changing several Acts in the Field of Resources and Energy, Parliament document 1232, Case 432. Parliamentary Records.

<sup>24</sup> *Ibid.*

<sup>25</sup> Orkuveita Reykjavíkur, information from website, accessible at: <http://www.or.is/English/Projects/HellisheidiGeothermalPlant/>

Table 1 and in the discussion which follows a description is given of what monitoring activity each of the relevant authorities has carried out.

OR has coordinated the health and safety issues in the construction area of Hellisheidi and has been certified according to the OHSAS 18001 - Occupational Health and Safety Standard.<sup>26</sup> A security council operates in the area during the construction period; amongst other activities this council holds environmental and safety meetings once a month with the relevant public monitoring authorities, these being: the building and planning administrator, an agent from the Health Committee, the Chief of the Fire Department and an agent from the Administration of Occupational Safety and Health. These meetings are held in order to coordinate the work of the monitoring authorities and to make sure that everyone is aware of the status of the project.

Before construction began at Hellisheidi, the municipality of Ölfus issued several development licences, e.g. for the drilling of wells. A building licence was also issued according to Art. 36, Par. 1 of the Planning Act for the building of permanent structures associated with the power plant, according to Art. 36, Par. 2 of the Planning Act. Ölfus took on its responsibility to monitor the projects its capacity extended to, both those subject to a development licence and those subject to a building licence. The council of Ölfus' responsibility is to make sure that projects are carried out according to the description in the licence and relevant legislation.

Where Ölfus did not have sufficient capacity to fully execute its duty as a responsible monitoring authority for such a large project as the Hellisheidi Power Plant represents, the OR entered into a contract with a consultant agency which executed the monitoring on the construction site; at the same time the planning- and building-administrator of Ölfus works closely with that agency and makes comments and suggestions, as he makes inspections on his own.

The chief of the fire department in Ölfus visits the construction site regularly, making sure that all buildings are situated and completed in such a way that there is

*Table 1.* Overview of the actual public monitoring that has been conducted at Hellisheidi power plant and by which authority.

	<b>Preparation phase</b>	<b>Construction phase</b>	<b>In operation</b>
Municipality			
Fire Department			
Environment Agency			
Health Committee			
NEA			
Competitive Authority			
Iceland Fire Authority			
OSH			

Monitoring after a licence has been issued	General monitoring	No monitoring
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Retrieved: 09.01.2009.

<sup>26</sup> The Occupational Health and Safety Standard is an international occupational health and safety management system specification. For more information see '<http://www.ohsas-18001-occupational-health-and-safety.com/>'.

easy access for the purpose of fire-fighting and rescue work is and that access to water is good, as stipulated in Art. 8.8 in the Building Regulation No. 441/1998.

In the beginning of the period of construction an agent from the Environment Agency was also summoned to the regular environmental and safety meetings but when these were discontinued, the agent from the Environment Agency visited the construction area approximately five times, mostly on the initiative of the Environment Agency. This agent focused on monitoring the removal of gravel and the completion of old gravel mines.<sup>27</sup>

An agent from the Health Committee visits the construction site 15-20 times a year; after the construction period has been completed and the power plant is producing the agent will visit once a year and whenever special circumstances arise. The agent also monitors all drilling activity. In November 2006, the Health Committee issued an operation licence for Hellisheidi Power Plant and that licence is subject to changes.<sup>28</sup> Changes were made to the licence on the 17<sup>th</sup> of March 2009 where OR was required to measure and react to sulphur release.<sup>29</sup> The licences describe the activity at the power plant, what materials are used and how much energy will be generated, as well as stipulating what rules apply to the activity of the plant.

In May 2001 the Minister of Industry, Energy and Tourism issued a prospecting licence, valid from 1<sup>st</sup> of June 2001 until the 1<sup>st</sup> of June 2016.<sup>30</sup>

In October 2004 the Minister of Industry, Energy and Tourism issued a Power Plant licence for Hellisheidi power plant; the licence authorises an 80 MW<sub>e</sub> power plant to be build and operated. In that power plant licence there is no limitation set on how much or at what rate the resource may be utilised,<sup>31</sup> leaving the licence holder not restricted or motivated in any way, according to the terms of the licence, to utilise the resource in a way which maximises its long-term efficiency. That being said, the obligation of protecting the resource lies with NEA and in turn the Ministry of Industry as the aforementioned Art. 5 of regulation 1040/2005 stipulates.

In February 2006 OR was granted a licence to enlarge the power plant to 160 MW<sub>e</sub>.<sup>32</sup> In September 2008 the Minister of Industry, Energy and Tourism issued a utilisation licence to OR. The licence authorises the withdrawal of 40 PJ/a net primary energy consumption.<sup>33</sup> In October 2008 the Minister of Industry, Energy and Tourism issued another Power Plant licence to OR; this licence authorises a 213 MW<sub>e</sub> power plant to be built and operated.<sup>34</sup> After the first licence was issued, the National Energy Authority started to have a legal obligation to monitor the power plant. The monitoring activity of the NEA, according to Art. 22 of the Resources Act, consists of receiving a report from the licence holder at least once a year and when the licence expires. The annual report contains information on the results of research and utilisation, information on the nature and extent of resources, total quantity and assessment of the value of a

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<sup>27</sup> Author's interview with Stefánsson, Björn, Senior Advisor at the Environmental Agency 17.02.2009.

<sup>28</sup> Operation Licence, dated 19.10.2006. From the archive of the Health Committee of South Iceland.

<sup>29</sup> Operation Licence (amended) with appendix, dated 17.03.2009. From the archive of the Health Committee of South Iceland.

<sup>30</sup> Research Licence, dated 07.05.2001. From the archive of National Energy Authority.

<sup>31</sup> Power Plant Licence for Hellisheidarvirkjun, dated 07.10.2004. From the archive of the National Energy Authority.

<sup>32</sup> Power Plant Licence for Hellisheidarvirkjun, dated 08.02.2006. From the archive of the National Energy Authority.

<sup>33</sup> Utilisation Licence, dated 22.10.2008. From the archive of the National Energy Authority.

<sup>34</sup> Power Plant Licence for Hellisheidarvirkjun, dated 22.10.2008. From the archive of the National Energy Authority.

resource that has been exploited, along with other matters as further stipulated in the licence in question. OR submitted its annual report for the year 2006 in 2007 but OR did not submit its report for the year 2007 until the end of 2008.

OR, as the party responsible for electrical installations and consumer apparatus, is responsible for ensuring that its condition complies with law. With the aim of ensuring the safety of electrical installations and their operations as fully as possible, OR is responsible for electrical installations of electrical utilities and heavy industrial plants and shall, in accordance with a decision by the Minister, establish internal safety control systems for installations.

An agent from the Administration of Occupational Safety and Health has visited the construction site regularly to monitor the working environment. The agent has examined e.g. the construction equipment and the heavy machinery and certified pressure tests. The Administration of Occupational Safety and Health and others have provided for several safety workshops in the area.<sup>35</sup>

After getting information from each relevant monitoring authority, one incident was discovered which proves how important public monitoring is. It was an agent from the Health Committee who noticed a lagoon starting to develop near the power plant at Hellisheidi. The run-off water was not being re-injected into the ground as described in the operation licence, but was forming a lagoon which had not been anticipated. In May 2008 the Health Committee sent OR a reprimand because the run-off water was not being handled as described in the operation licence.<sup>36</sup> The Health Committee instructed OR to amend this problem and ensure that the run-off water is dealt with as described in the operation licence, to prevent further development of a lagoon, and furthermore to protect the environment and the ground water. OR did respond to the reprimand after repeated enquiries from the agent of the Health Committee. As a result new injection wells have been drilled to reinject the run-off water. The agent goes at least once a month to the power plant to attend the environmental and safety meetings, as well as to examine the run-off water issues.<sup>37</sup>

This case verifies the importance of public monitoring of the utilisation of geothermal projects, considering the environmental and safety issues at stake. This also proves that the public monitoring system did work effectively in this case. One interesting fact regarding this case is that the NEA was not notified and nor was it aware of this incident at the power plant despite being a monitoring authority for research and utilisation areas after licences have been issued, according to Art. 21 of the Resource Act. If the relevant authorities were legally bound to communicate with one another it would promote a greater awareness of incidents like this among all of the authorities.

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<sup>35</sup> Author's interview with Sveinsson, Gísli R., specialist at the Administration of Occupational Safety and Health, 06.02.2009

<sup>36</sup> Letter from the Health Committee sent to OR, dated 16.05.2008. From the archive of the Health Committee of South Iceland.

<sup>37</sup> Author's interview with Thórdarson, Birgir, specialist at the Health Committee, dated 24.03.2009.

## **4 LEGAL AND INSTITUTIONAL ARRANGEMENTS IN NICARAGUA**

Geothermal resources in Nicaragua are a common property in accordance with the Constitution and other national laws. Within their respective spheres of work and jurisdiction, the Ministry of Energy and Mines (MEM) and the Ministry of the Environment and Natural Resources (MARENA) are jointly responsible for regulating, supervising and controlling geothermal resource exploration and production activity. MEM was created in January 2007 and is responsible for planning, proposing, coordinating and implementing the Strategic Plan and Public Policy of the energy and geological resources sector. The Minister of MEM is chosen by the President. MARENA is the ministry that administrates the use and management of environmental resources by means of actions, economic measures, investments, institutional and legal procedures to maintain or recover and enhance quality of the environment, decrease vulnerability, and ensure productivity of resources and sustainable development. The Minister of MARENA is chosen by the President. MEM and MARENA establish coordination with municipal governments in the areas for which the geothermal resource license areas are granted.

Any person or entity may conduct, perform, carry out or undertake preliminary geothermal resource exploration and utilisation investigations, upon receipt of a license issued by MEM, according to Geothermal Resources Act No. 443 and Regulation No. 003/2003. MEM authorizes and grants geothermal resource research and utilisation licenses. A geothermal resource research license may be acquired through public tender arranged by MEM in accordance with applicable laws. The terms and conditions of the license must be agreed by MEM and then between MEM and the prospective license holder, aiming at the best use of geothermal resources.

A geothermal resource utilisation license gives the holder of the license the exclusive right to extract geothermal fluids that may be transformed into electricity within a delimited area and period of time. The geothermal resource utilisation license may be awarded to any exploration license holder that exercised his/her/its pre-emptive rights or the successful bidder for a public tender, either a person or an entity, pursuant to Art. 15 of the Geothermal Resources Act.

In order to conduct monitoring of geothermal projects the license holder is to provide MEM with technical reports at the end of each three-month period relevant to the work and purposes covered by the license. This report is to detail work accomplished, approximate costs incurred and any modification planned by the license holder to change the annual work program and budget as a result of contract operations. The relevant progress report must also contain an annual account summarizing the four quarterly reports. MEM can then specify in the license any further information which is to be provided in the reports. MEM may where appropriate carry out inspections and supervisory actions. MEM can monitor and supervise license-related operations and activities, and the license holder must provide MEM with facilities to ensure the fulfilment of obligations and liabilities defined in laws, regulations and the license.

INE is in charge of the general direction of electricity and is the national electricity regulator. INE applies the policies defined by the government (e.g. by MEM) and is in charge of regulation and taxation. INE is an autonomous state agency to which the National Assembly nominates an executive board to govern and therefore INE is not directly under a ministry. INE supervises the price purchase agreement (PPA) between

the distributor and the developer. When the developer receives the exploration concession and has ascertained the base load, the developer applies to INE for a tariff. The developer can sell excess generation on the public market. However, INE can fine the developer for not producing according to the PPA. The developer has to keep technical matters in order, according to a special operations manual. If the developer fails to do so, the distributor can withhold payments to the developer. This happened during the start of generation at the San Jacinto Tizate geothermal power plant.

MIFIC is another government agency in Nicaragua this is responsible for the Direction of Technology, Normalisation, and Metrology. The National Technical Obligatory Standards and Technical Standards as Guidelines with a Special Objective originate from MIFIC. The process for making National Technical Obligatory Standards (es. *Norma Tecnica Obligatoria Nicaraguense - NTON*) and Technical Standards as Guidelines with a Special Objective (es. *Normas Tecnica Nicaraguense - NTN*) starts when a committee is formed by a shared decision of the minister and a commission. In this committee are representatives from the public, consumers and other parties. The committee makes a suggestion of standards. These standards are sent to various relevant parties that get 60 days to comment on the standards, the standards are also published and the public can comment on it. After the 60 days the committee reviews the comments and decides whether revision of the standards is needed. When the document is finalized it has to go through a commission of 7 relevant ministers of the government. The commission reviews the standards and can make comments on it. If no comments are made the standards are published and take effect.

## 5 PUBLIC MONITORING IN OTHER COUNTRIES

Geothermal energy is utilised to generate electricity in 25 countries all over the world.<sup>38</sup> To broaden the perspective and better apprehend whether the system in Iceland can be improved, it is helpful to study how geothermal energy resources are managed in other countries.

The management of such operations in the United States of America, New Zealand and briefly other nations will be used for the purpose of comparison. Where these countries chosen for comparison because the United States and New Zealand have extensive experience of utilising geothermal energy. The following comparison is neither definitive nor exhaustive, but is intended to give an idea of how the management and monitoring of geothermal projects is carried out in these three countries. Before describing how monitoring is conducted in these countries, a short overview will be given of the general geothermal legal environment in these countries.

### 5.1 United States of America

In the United States, the process of licensing primarily depends on whether the land utilised is a private property, is owned by the State or by the federal government, or is Native American land. As in Iceland the geothermal resources on private land are the property of the private landowner, unless the resources have been previously conveyed or reserved. The process of obtaining licences is different in every state, different agencies are involved and different rules apply. However, the basic structure of the procedure is similar.

First, access to the land has to be gained. Therefore local and state agencies need to be contacted to determine the requirements for local land use, including development plan laws and building permits. In some states, water and mineral rights need to be secured. Environmental impact studies have to be conducted, as required by the National Environmental Policy Act or state environmental laws. Construction permits have to be obtained. Environmental regulation is important both before and during project development. The composition of the resource has to be identified as soon as possible so as to prevent harmful impacts on the environment, and a fluid disposal plan has to be determined. Permits for underground injection or surface disposal have to be obtained.

On federal land, where approximately 90% of geothermal resources in the US are located, the Bureau of Land Management (BLM), an agency of the US Department of the Interior, has the authority to issue leases and to grant access to the resource through a competitive leasing process established by the Geothermal Steam Act of 1970, as amended and as modified by the Energy Policy Act of 2005. BLM permits are required at each step of the geothermal leasing process: research, drilling, utilisation (facility construction) and commercial use.<sup>39</sup>

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<sup>38</sup> 25 countries in the year 2005, according to the IGA, International Geothermal Association, accessible at: <http://iga.igg.cnr.it/geo/geoenergy.php>  
Retrieved: 08.11.2008.

<sup>39</sup> "Kempthorne Launches Initiative to Spurn Geothermal Energy and Power Generation on Federal Lands" News Release of the U.S. Department of the Interior". Accessible at: [http://www.doi.gov/news/08\\_News\\_Releases/102208b.html](http://www.doi.gov/news/08_News_Releases/102208b.html)

When it comes to monitoring of geothermal operations on federal land the BLM has field offices working in a number of states and they are responsible for the monitoring. Special forms are available for the licence holder to fill in and submit to the field office once a month. The monthly reports on geothermal operations consist of information from each well regarding monthly production or injection, production or injection rate and the average pressure and temperature. As well as all operations conducted during the month the following activities must be documented and described: Drilling, remedial drilling, re-drilling, stimulation, testing and other well work carried out.

Most of the states where geothermal energy can be found have a special leasing agency and regulations regarding geothermal leasing and operations. To take one example, in Hawaii the Department of Land and Natural Resources (DLNR) administrates all geothermal activities of the State land in Hawaii. A board composed of seven members is the head of the DLNR. The DLNR convenes twice monthly to review and take action on submittals to the Department, including land leases and Conservation District Use Applications (CDUAs). Testimony from the public on programme actions, development plans, permit applications, and all other DLNR actions are accepted and heard at this time.

According to Chapter 184 of the Administrative Rules for the State of Hawaii Department of Land and Natural Resources, Land Division; *Designation and Regulation of Geothermal Resource Subzones*: "The operator of any geothermal well shall keep, or cause to be kept, a careful and accurate log, core record, and history of the drilling of the well, including: Lithology and depths of formations encountered; cores; water-bearing and geothermal heat-bearing strata and their depths, pressures and temperatures; and other well surveys and logs of temperature, chemical, radioactive, and electrical characteristics of the well."<sup>40</sup>

The records are kept within the State in the local office of the operator or his designated agent and, together with all other reports of the operator, are subject to the inspection of the Chairperson. The board may also require additional data or reports relating to production or utilisation of geothermal resources and such by-products as may appear to be necessary or desirable, either generally or specifically, for the prevention of waste and the optimum use of geothermal, water and other natural resources of the state.

The Chairperson of the board also receives monthly reports from the developer which give information on the amount of geothermal resources produced, sold, and used, and the amount of fluid injected over the past month. The Chairperson also has quite extensive authority to conduct monitoring of any well and appurtenances.

The legislation and monitoring of geothermal resources is quite extensive in the United States. Despite this fact, there was a major drawdown of pressure in the Geysers steam field in Northern California in the 1990s due to overly excessive utilisation. During the years 1981-1988 generation of electricity was doubled and instead of one company utilising the geothermal resources in the area, six companies were utilising them. The California Energy Commission was not critical enough in issuing licences. In addition, the companies in the area were not critical of the situation and competed to utilise as much of the resources as possible, without considering how much utilisation

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Retrieved: 05.11.2008.

<sup>40</sup> *Administrative Rules for the State of Hawaii Department of Land and Natural Resources, Land Division, Chpt.184. Accessible at: <http://www.state.hi.us/dlnr/land/rules/Chap184.pdf>*

Retrieved: 22.05.2009

the area could support. Pressure dropped and the geothermal power plants were not able to generate at full rate.<sup>41</sup>

The experience from the Geyser area shows that despite extensive legislation and monitoring, mistakes can be made and this highlights the importance of evaluating all regulatory systems frequently, improving them and keeping them in line with the development of the industry. In Iceland there is a requirement that all monitoring rules should only be valid for a limited time, and should be revised at least every five years, according to Art. 4 of the Monitoring Act. This is a positive arrangement and should ensure that regulatory rules are up-to-date with the most recent developments. However, when one surveys the legislation valid for monitoring activities of utilisation in Iceland it is clear that this Art. is not exactly being honoured, at least not when the age of the relevant legislation is considered.

American documents of interest in relation to monitoring are numerous. NEA recommends e.g. Lava Law 4<sup>th</sup> ed. (see Appendix 1), the Energy Policy Act 2005 (specifically Title II, Subtitle B on geothermal energy) (see Appendix 2), PEIS (Programmatic Environmental Impact Statement) for geothermal leasing in the Western United States) (see Appendix 3) and finally the California Code of Regulations from the California Department of Conservation, Division of Oil, Gas and Geothermal Resources (see Appendix 4).

## 5.2 New Zealand

Geothermal resources are considered a national asset in New Zealand and are managed by the Regional Councils on behalf of the community. The Resource Management Act 1991 (RMA) (see Appendix 5) is the principal regulatory instrument controlling the utilisation of geothermal fluid and energy in New Zealand. The Geothermal Energy Regulations 1961 (see Appendix 6) deal with the technical and safety requirements for drilling and maintaining geothermal wells which are overseen by the Department of Occupational Safety and Health (OSH).

There have been various amendments to the RMA, one of these being implemented through the passing of the Resource Management (Energy and Climate Change) Amendment Act 2004 (see Appendix 7). This defined geothermal energy as renewable for the purposes of the Act, and required councils to consider the benefits to be derived from the use and development of renewable energy.

There are three regions in New Zealand that have the most significant geothermal resources and following councils manage the resource for each region: Waikato Regional Council (Environment Waikato), Bay of Plenty Regional Council and Northland Regional Council. Regional councils have the function of issuing licences, known as *resource consents* for geothermal energy projects along with consents for discharges to land, air and water. Land use permits (planning), which are issued by the City or District Council, regulate landscape, noise, and other planning issues. Applications for consents must be submitted and assessment of environmental impacts provided together with the application and this information is assessed against the RMA legislation that has as its central tenet the concept of sustainable management. Each region also has specific policies for managing geothermal resources that are set out by the municipal councils. The Waikato Regional Council (see Appendix 8) has adopted a Geothermal Variation to their regional plan. The plan “identifies and discusses resource

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<sup>41</sup> Pálmason, Gudmundur, *Jardhitabók. Edli og nýting audlindar*, pp. 84-85.

management issues that specifically concern geothermal water and sets out objectives and policies applying to geothermal water and the effects of the take, use and discharge of the geothermal energy and water on other resources, including fresh water.”<sup>42</sup>

When permits are issued they usually have a number of monitoring and surveillance conditions to ensure that the projects are managed as predicted. This usually means that information and reports need to be submitted to the Regional Council to ensure compliance with the consent.

A panel of independent experts, Peer Review Panel, meets annually to make recommendations on amendments to monitoring requirements etc. The Panel has no liability. Decisions to change monitoring requirements can only be made by the Regional Council. See Appendix 9 for the New Zealand Health and Safety Guidelines for Geothermal Wells. Another document of importance is the Code of Practice for Deep Geothermal Wells<sup>43</sup>.

### 5.3 Australia, Kenya and Canada

In Australia six states (South Australia, New South Wales, Queensland, Tasmania, Victoria and Western Australia) have legislation in place to regulate geothermal exploration and development. Geothermal energy exploration falls under the *Petroleum Act 2000* in South Australia; in New South Wales geothermal exploration and development are governed by the *Mining Act 1992*; The *Mineral Resources Development Act 1995* governs geothermal energy exploration in Tasmania and the *Geothermal Energy Resources Act 2005* governs the geothermal projects in Victoria.

The different independent laws in each of the states mentioned above have many common elements. The legislation is quite extensive, offering descriptive rules on how things should be managed. Usually there is a basic Act stipulating the procedure of leasing and tending, general rules on technical issues and reporting. Following the Act a Regulation offers more detailed rules on technical issues and reporting. The Geothermal Energy Resources Act 2005 in Victoria, (see Appendix 10), describes the administration, exploration permits and leasing. The Victorian Geothermal Energy Resource Regulation 2006, (see Appendix 11), describes in detail what information the developer is to present annually to the authorities. The legislation does not provide for detailed technical instructions. In 2007 the Australian Geothermal Code Committee, sponsored by the Australian Geothermal Energy Group and the Australian Geothermal Energy Association, was established. Its purpose was to “produce and maintain a methodology for public reporting of the estimation, assessment and quantification of geothermal resources and reserves that would promote transparency, consistency and confidence.”<sup>44</sup> The committee published the Australian Geothermal Reporting Code in 2008. The Code covers “a minimum, mandatory set of requirements for the Public reporting of Geothermal Resources and Reserves”<sup>45</sup> (see Appendix 12).

Kenya is the only country in Africa utilising geothermal energy in a significant manner. The Geothermal Resource Act No. 12 of 1982 and the Geothermal Resources Regulation 1990 transferred ownership of geothermal resources to the Government and gives power to the Minister to issue licenses for its development. Other licenses

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<sup>42</sup> Geothermal Variation to the Waikato Regional Plan, 2008.

<sup>43</sup> NZS 2403:1991 Code of Practice for Deep Geothermal Wells. The ICEIDA office in Nicaragua possesses a copy of the document.

<sup>44</sup> The Geothermal Reporting Code. 2008.

<sup>45</sup> *Ibid.*

required by a contractor include exploration and development licenses, environmental permit, land permit, etc. Most of the fiscal issues are negotiable in order to encourage investment. The Minister of Energy is responsible for all geothermal exploration and development. The legislation is not detailed but the Minister has extensive authority to evaluate circumstances and set conditions for each licensee to fulfil.

The Canadian province of British Columbia has the Geothermal Resources Act 1996, (see Appendix 13), and the Geothermal Drilling and Production Regulation, (see Appendix 14). The Act stipulates the ownership of Geothermal Resources in general, describes how permits and leases are issued, covers the operation and conservation measures, as well as issues regarding royalties and utilization. The regulation offers quite detailed rules regarding technical aspects of geothermal utilisation e.g. instructions for collecting samples and cores; tests, analysis, surveys and logs; tools, casing, equipment and materials and casing requirements.

What is common to most of the legislation in the above countries is that it does not stipulate in detail the technical procedures of utilising geothermal energy, most likely because the developer is trusted and technical procedures vary between areas and in time. Code of practices and standards can be found in some countries. The developer is though not obliged to follow them. In Iceland there are no specific technical rules for geothermal utilisation. Certain ground rules are provided for in the legislation and then the developer is trusted to carry out the technical procedure to utilise the resource in an appropriate manner. In an appendix attached to utilisation licenses and power plant licenses certain criteria regarding information that the developer is supposed to submit to the National Energy Authority once a year are listed.

## 6 CONCLUSION AND RECOMENDATIONS

The aim of this report has been to give an overview of public monitoring in countries where the history of geothermal utilisation is extensive with special emphasis on Iceland. This has been done to suggest how Nicaraguan authorities can utilise the geothermal resource in an efficient manner. In the case of Iceland, geothermal power has been harnessed since 1908 for heating houses and since then the Icelandic legislature, Althingi, has structured a framework of law and founded government agencies which are entrusted, amongst other obligations, with the task of monitoring the utilisation of Iceland's geothermal resources. As permits for research, utilisation and productions are awarded by the government it is the state's role to make sure that the utilisation of geothermal is conducted in a manner which aims at sustainable use of the resource. The case study that is included in this report, of the Hellisheidi power plant, gives a clear example of how public monitoring in Iceland is arranged.

Despite the elaborate monitoring framework, technical aspects of geothermal utilisation are not detailed in Icelandic legislation. Therefore a comparison to the framework in both United States of America and New Zealand is made where codes of practice are detailed. This compilation of the monitoring framework in New Zealand and the United States should give a somewhat distinct picture of how technical aspects of geothermal utilisation are incorporated in to law in the two countries. Further discussion on other states utilising geothermal power should provide even further options for Nicaraguan authorities on how to utilise Nicaragua's geothermal resources sustainably with the set goals of long-term utilisation and environmental protection as well as securing occupational safety and ensuring delivery of power to consumers. Overly extensive monitoring can result in significant expense for the economy and can restrict companies' competitive position. Nevertheless it is clear that well-conducted public monitoring, which consists of clear and accessible rules and is executed in an efficient way, is beneficial both for the economy and for society as a whole.<sup>46</sup>

The recommendations NEA makes to MEM to enhance the legal framework for public monitoring of geothermal utilisation are as follows:

### *Amendments to the Legal Framework*

It is recommended that certain articles of the Geothermal Resources Act No. 443 and in the Commercialization Act No. 585 should be changed in order to develop further knowledge of the Nicaraguan geothermal resources and make the exploration and utilisation process more effective and competent than at present. These articles are specifically as follows:

1. General supervision in Geothermal Resources Act No. 443:

*“Article 3. The Nicaraguan Energy Institute, hereinafter called INE, is the government agency that authorizes and*

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<sup>46</sup> *Skýrsla rádgjafarnefndar um opinberar eftirlitsreglur um áhrif laga um opinberar eftirlitsreglur og störf nefndarinnar 1999–2002.* Report for the Prime Minister's office, 2002. Accessible at: [http://www.forsaetisraduneyti.is/raduneyti/verkefni/Opinb\\_eftirlitsreglur/nr/54](http://www.forsaetisraduneyti.is/raduneyti/verkefni/Opinb_eftirlitsreglur/nr/54)  
Retrieved: 25.11.2008.

*grants geothermal resource exploration and production licenses.*

*Within their respective scope of work and jurisdiction, INE and the Ministry of the Environment and Natural Resources (MARENA) are jointly responsible for regulating, supervising and controlling geothermal resource exploration and production actions. They shall establish coordination with municipal governments where geothermal resource license areas are located."*

In the reform Act No. 290 for the creation of MEM, all of INE's geothermal issues have been transferred to MEM. However, according to INE<sup>47</sup>, further supervision role has been granted to INE. The amendment act has not yet been sent to NEA. In Art. 3 it is stressed that responsibility, regulating, supervising and controlling geothermal resource exploration and production action should be within the respective scope of work and jurisdiction of relevant institutions. However, during the visit in year 2008 it was notable that the jurisdiction of each institution, according to the opinion of the employees, overlaps and is unclear. A possible result of an ambiguous administration can lead to an ineffective development of the geothermal resources. Therefore it is of great importance to clarify the role and responsibility of each institution and increase collaboration.

2. Size of the production license area in Geothermal Resources Act No. 443:

*"Article 26. The geothermal resource production license area shall not exceed twenty square kilometres (20 km<sup>2</sup>). The production license area shall be defined in the production license agreement thereof, taking into account feasibility study findings, geothermal reservoir capacity and dimensions."*

In order to maintain sustainable production of the reservoir and build up more profound knowledge of the geothermal reservoir it would be preferable if the law would not decide upon a size limit for geothermal resource production license areas. The size of the area should be decided in the geothermal resource production agreement between MEM and the developer with the possibility for the developer to enlarge the production license area if the exploration suggests that the size of the geothermal reservoir exceeds those 20 km<sup>2</sup>. If, e.g., another developer would get exploitation rights close to an existing concession it might result in over-exploitation of the geothermal system and lack of trust between the developers and the government. This is addressed in Article 30 of the Geothermal Resources Act No. 443:

*"Article 30. In the event of two or more geothermal resource production licenses share the same geothermal reservoir,*

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<sup>47</sup> See report: Visit to Nicaragua, OS-2008/006.

*license holders shall agree themselves common technical production procedures...*"

Even so, this might cause problems and therefore it is preferable that a single developer is exploiting any one geothermal reservoir. Just for comparison in the State of Victoria in Australia a maximum permit area is stipulated to be ten thousand square kilometres.

3. Timeframe of licenses in Geothermal Resources Act No. 443:

*"Article 27. The geothermal resource production license granted under this Act shall be valid for twenty-five (25) years following the production license agreement signing."*

*"Article 28. Two consecutive 5-year extensions may be granted following the geothermal resource production license expiration, provided that the production license holder applies for an extension six months prior to the production license or extension expiry date, as the case may be and such license holder has fulfilled all contract obligations and liabilities. Procedures shall be defined by this Act and its regulations there under."*

If the geothermal resource production license holder has fulfilled all contract obligations and liabilities and is interested in continuing his work it is unjust that he has to stop after 35 years, if there is potential of generating more electricity in harmony with the environment. It is understandable that some timeframe is set in the laws but there also has to be a possibility for licence holders to continue exploiting the geothermal resource if the exploitation is sustainable. Especially if the objective of the authorities is to utilise the resources in a sustainable manner.

4. In the Commercialization Act No. 585 restraints are given for activities within protected areas. Due to the nature of geothermal developments buildings have to be allowed to be higher than 13.75 m for e.g. the cooling towers and aeroplanes have to be allowed to fly lower than 1500 m over protected areas for reconnaissance.
5. Possible objectives of the Nicaraguan geothermal legislation in general could be any or all of the following:
- a. to manage access to the State's geothermal resources for the benefit of all citizens;
  - b. to encourage and facilitate efficient and responsible exploration for the State's geothermal resources;
  - c. to provide an effective and efficient regulatory system for geothermal exploration;
  - d. to enhance knowledge of the State's geothermal resources;
  - e. to ensure that geothermal exploration is carried out in a way that minimizes conflict related to land use;

- f. to facilitate constructive consultation with, and appropriate compensation for, persons adversely affected by geothermal exploration;
- g. to encourage an appropriate level of competition in geothermal exploration;
- h. to encourage responsible management of land during geothermal exploration;
- i. to promote the safety of persons involved in geothermal exploration.

### ***National Technical Obligatory Standards (NTON) for Geothermal***

6. It is recommended that a steering committee consisting of representatives from MEM, MARENA and INE is nominated, to work on National Technical Obligatory Standards (NTON) and possibly Technical Standards as Guidelines with a Special Objective (NTN) for geothermal development. The committee can then define and clarify the role and jurisdiction of each mentioned institution, e.g. to what institution the developer should report to in case of unforeseen events, i.e. MEM, MARENA or INE. The NEA can advise the committee if needed. The following are recommendations the committee can evaluate:
7. Before any monitoring is determined in the NTON, there must be a recognised need for the monitoring. The objective of the monitoring has to be clear. It is the authority responsible for the monitoring, i.e. MARENA, MEM and INE, that evaluates the need for the monitoring. The evaluation can consist of e.g. risk assessment, assessment of international commitments on monitoring, assessment of the cost for the public authority, and assessment of whether the same results can be achieved by more economical methods or by making an assessment of the economic value of the monitoring.
8. Overly extensive monitoring can result in significant expense for the economy and can restrict companies' competitive position. Nevertheless it is clear that well-conducted public monitoring, which consists of clear and accessible rules and is executed in an efficient way, is beneficial both for the economy and for society as a whole.<sup>48</sup>
9. The objectives of the NTON can be narrowed down to the provision of clear and direct instructions for a developer and ensure i.e. the objectives of public monitoring is reached. The Standards should close gaps in the legislation regarding utilisation of geothermal resources, providing clear instructions i.e. on how information should be presented to the public authority conducting the monitoring of geothermal projects and instructions on how to abandon wells.
10. Regarding the NTON the following should be taken into account: In the Environment and Natural Resources Act No. 217 it is stipulated in Art. 1 that the purpose of the Act is to establish standards and regulations for protecting, improving and reclaiming the environment and natural resources, ensuring their

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<sup>48</sup> *Skýrsla rádgjafarnefndar um opinberar eftirlitsreglur um áhrif laga um opinberar eftirlitsreglur og störf nefndarinnar 1999–2002*. Report for the Prime Minister's office, 2002. Accessible at: [http://www.forsaetisraduneyti.is/raduneyti/verkefni/Opinb\\_eftirlitsreglur/nr/54](http://www.forsaetisraduneyti.is/raduneyti/verkefni/Opinb_eftirlitsreglur/nr/54)  
Retrieved: 25.11.2008.

rational and sustainable use. In Art. 19 of the Geothermal Resources Act it is stipulated that when geothermal resource exploration license agreement terms and conditions are being agreed on by MEM and between MEM and the prospective license holder, the optimum use of the geothermal resources should be envisaged.

11. The MEM has suggested that the Nicaraguan Hydrocarbon Standards could be used as a template for drafting NTON. The NEA reviewed the Hydrocarbon Standard and has concluded that it can be used to some extent as a template with major restructuring and reorganisation:

- a. The NEA would recommend that the Hydrocarbon Standard should be carefully assessed since the objective of various rules stipulated are sometimes unclear.
- b. In the Hydrocarbon Standards some repetition of the same or similar kind can be found, e.g. 11.4 Measures to prevent pollution, 12.6 Spillage control measures, 12.10 Disaster prevention and control. This should be avoided in the standards for geothermal exploration and production.
- c. The NEA recommends that the structure of the Standard could be clearer if it would be organized according to the three main pillars of geothermal monitoring; environment, resource and power plant (see Figure 1).
- d. The Standard stipulates in great detail the environmental and technical principles, requirements and procedures that must be complied by all persons and companies that carry out surface reconnaissance, exploration, development and exploitation of hydrocarbons in the country, as well as their transport and storage. There is a lack of certain issues which it would probably be advantageous to stipulate in a standard for geothermal utilization.

12. In regards to the resource the NTON should provide clear instructions for the developer as to the keeping of a logbook for all his activities, drilling and utilisation and what information is to be presented to the authorities. In Iceland it is stipulated what detailed information the developer is obliged to present once a year in an appendix with utilisation licenses and power plant licenses. This information is as follows:

- i. The amount of geothermal fluid extracted from the geothermal reservoir each month.
- ii. The amount of geothermal fluid extracted from each well in the geothermal area each month.
- iii. The amount of fluid re-injected into the geothermal reservoir each month.
- iv. The temperature of the water re-injected into the geothermal reservoir each month.
- v. Results of water level measurements in wells in which the water level can be measured and are within the geothermal area.
- vi. The pressure changes or drawdown determined in the geothermal reservoir
- vii. The results of measurements of the enthalpy of the fluid from every production well in the geothermal area.

- viii. Chemical analyses of the geothermal water (and steam, if appropriate).
- ix. Results from simulations of the geothermal reservoir.
- x. Results of measurements made to monitor changes in the geothermal reservoir.
- xi. Information on drilling in the industrial area.
- xii. A resume of improved understanding of the physical characteristics of the geothermal reservoir based on the results of the latest drilling.

The data that should be turned in are on the one hand information regarding wells as a construction and on the other hand information regarding wells and the geothermal heat as a resource.

Constructional information e.g.:

- i. Location of the well (coordinate, place, area).
- ii. Depth of well and casing.
- iii. Drilling year.

Resource information e.g.:

- i. Flow from the hole.
- ii. Temperature of the well fluid.
- iii. Locations of water veins in the well.
- iv. Chemical combination of the well fluid.
- v. Temperature and pressure in the geothermal reservoir.

The official monitoring institution can ask for the soil and rock examples to be kept and can ask for copy of the logbook, after the drilling has been completed for one month. The above mentioned items should provide all the necessary information for the monitoring authority to monitor the utilisation of the resource. NEA recommends that this list be integrated in the NTON set by MIFIC and the committee in charge (see chapter 4).

### ***Technical Standards as Guidelines with a Special Objective (NTN) for Geothermal***

- 13. The mandatory geothermal standards (NTON) should only provide such rules for procedure that are considered necessary. Too many detailed rules on how the developer should act can be repressive and confusing. It is hard to anticipate in the legislation all the circumstances that may arise and the appropriate reaction. If the standards are over extensive the important aspects of public monitoring might be overlooked (see item 12). However, detailed technical standards can be useful and have been applied in e.g. New Zealand and in the United States (see chapter 5). This is equivalent to the NTN, a set of guidelines for the developer which he can choose to follow. If the authorities have the need to create such guidelines see chapter five for references.
- 14. The lessons learned from public monitoring of geothermal development in Iceland is that well conducted public monitoring, which consists of clear and accessible rules with an efficient execution, is beneficial both for the economy and for society as a whole as to meet initial environmental statements of the developer.