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Development of GSAP - Geothermal Sustainability Assessment Protocol

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ABSTRACT

In 2016 the three largest Icelandic Power Companies and two Governmental Agencies formed a Working Group for the development of an assessment tool to measure geothermal sustainability performance; Geothermal Sustainability Assessment Protocol, GSAP.

Background: At the initiative of the International Hydropower Association, IHA, a multi stakeholder Sustainability Assessment Protocol, HSAP, was prepared in the period 2008 to 2010. Representatives from IHA, Governments, Finance Institutions and NGOs prepared the Protocol. HSAP is now applied worldwide, to assess key sustainability factors of projects; social, environmental and economic. The aim is to measure, guide and improve performance for sustainability topics. Iceland actively participated in the preparation of HSAP.

The GSAP Working Group took on to transform this widely accepted HSAP tool to geothermal application. As the stakeholders are in principle more or less the same, modifications are kept to a minimum to maintain as possible the existing consensus on HSAP. A Draft GSAP is now prepared and successfully tested for the Preparation Stage of *Theistareykir 90 MWe* and the Operation Stage of *Hellisheidi 300 MWe/130 MWth*.

1. INTRODUCTION

The Hydropower Sustainability Assessment Protocol, HSAP, was prepared at the initiative of the International Hydropower Association, IHA, and first published in November 2010. The Protocol is a product of a considerable effort by multi-stakeholder parties, representing the hydropower industry, several developing and developed countries, the finance sector and international environmental and social NGOs. The aim is to provide a tool to measure, guide and improve the performance in the industry for the key sustainability factors; social, environmental and economic. It enables the production of a sustainability profile for a project through the assessment of performance within important sustainability topics.

Separate protocol documents were provided for the four project stages; Early Stage, Preparation, Implementation and Operation. The HSAP is governed by the multi-stakeholder Hydropower Sustainability Assessment Council and assessments are performed by accredited assessors. Comprehensive information is found on the Council webpage and the general approach is described and explained in the first part of the Assessment Protocol: Background Document. *(Hydropower Sustainability, 2019).*

Representatives from Iceland were active participants in the preparation of HSAP, including the multi-stakeholder Forum established for the Protocol. Also, Landsvirkjun, the National Power Company, has applied the HSAP for official assessments of one preparation stage project and two operating facilities. These assessments were considered highly valuable and they initiated positive improvements of procedures and work methods.

In addition to hydro, geothermal development has a long history and is highly advanced in Iceland, for electrical production, space heating, swimming pools, greenhouses and various other industrial purposes. In this context, members of the Icelandic power sector proposed to adapt the internationally recognized and fully tested HSAP to geothermal plants.

Three Icelandic Power Companies and two Governmental Agencies formed a Working Group for the GSAP initiative:

- Orkustofnun, National Energy Authority; Dr. Gudni A Johannesson, Director General, leads the working group, Mr. Jonas Ketilsson, Deputy Director General, Mr. Kristinn Einarsson, Senior Advisor.
- Landsvirkjun, National Power Company; Mr. Jon Ingimarsson, Manager Environmental Dept, Mrs. Ragnheidur Olafsdottir, Environmental Manager, Mr. Bjarni Palsson, Manager Geothermal Dept.
- Orkuveita Reykjavikur, Reykjavik Energy; Mr. Bjarni Bjarnason, CEO, Mrs. Hildigunnur H Thorsteinsson, Managing Director Research and Development, Mrs. Hólmfríður Sigurðardottir, Head of Environmental Affairs.
- HS Orka; Mr. Asgeir Margeirsson, CEO, Mrs. Kristin Vala Matthiasdottir, VP Resources.
- Umhverfisstofnun, Environmental Agency of Iceland; Mrs. Kristin Linda Arnadottir, Director General, Mrs. Adalbjorg Guttormsdottir, Team Leader Integration Dept.

Moderator and Project Manager is Mr. Sigurdur St. Arnalds, of engineering firm Mannvit hf in Iceland.

As a first step, a Draft GSAP Preparation Stage was prepared in 2016 and a subsequent test assessment performed for the Theistareykir 90 MWe geothermal project in Northeast Iceland. *(Landsvirkjun, 2017).* As a next step a Draft GSAP Operation Stage was prepared in 2017 and a subsequent test assessment performed for the Hellisheidi 300 MWe/130 MWth geothermal plant in Southwest Iceland, owned and operated by ON Power, a subsidiary of Orkuveita Reykjavikur (OR), Reykjavik Energy. *(ON Power, 2018).*

A highly experienced assessor and former member of the multi-stakeholder Hydropower Sustainability Assessment Forum, Dr Joerg Hartmann, was the lead assessor in both test cases, followed by valuable comments and suggestions on the basis of the assessments.

The required adaption changes from HSAP to GSAP have been kept to a minimum with the aim to maintain as much as possible the international recognition and multi-stakeholder consensus obtained for the HSAP. Further testing and modifications remain to be addressed, preferably in co-operation with a prospective wider participation. In short, the test assessments illustrate the applicability of such an adapted GSAP, obstacles were not found in the process related to the fact that the plants were geothermal and not hydro. The products provide a good illustration of this method for sustainability assessment of a geothermal project.

2. HISTORICAL

In the second half of the twentieth century a huge development in the construction of dams took place around the world, for multiple purposes; water supply, irrigation, flood control, hydroelectric production, etc. Tens of thousands of large dams (higher than 15 metres) were constructed in this period around the world. This development had multiple environmental impacts but also social. Even if the dams were built to provide positive social and economic benefits to nations, the negative social impacts were in several cases considerable, in particular relocation of people and their livelihoods. The issues concerned all three pillars of sustainability: social, environmental and economic.

Motivated by debate and increased criticism, the World Bank and the International Union for the Conservation of Nature (IUCN) initiated a multi-stakeholder body in 1997; the World Commission on Dams (WCD), to review the development and provide recommended guidelines for the future. *(World Commission on Dams, 2000)*. The final report was presented by Nelson Mandela of South Africa in London, November 2000. *(Mandela, N, 2000)*. It was concluded that while dams have made important and significant contribution to human development and benefits have been considerable, too often the water infrastructure projects had been developed at an unacceptable environmental and social cost. The recommendations address e.g. the need for proper evaluation of options, public acceptance and other key sustainability issues.

The International Hydropower Association (IHA), formed in 1997, was inspired by the WCD report to improve the performance of the hydropower industry, with increased focus on the participation of affected communities in project planning. Sustainability guidelines were issued in 2004 and an initial Sustainability Assessment Protocol in 2006. This had the purpose and aim to motivate the industry to improve work procedures in respect to the key sustainability factors of projects; social, environmental and economic.

Recognizing the value of this first version, WWF and The Nature Conservancy (environmental NGO's) approached IHA with a view to further refining the tool. IHA agreed that the Protocol would benefit from a more inclusive process that would encompass sustainability perspectives from all hydropower stakeholders, and it was decided to bring together a group to achieve this, the Hydropower Sustainability Assessment Forum.

The Forum consisted of representatives of governments of developing and developed countries (China, Zambia, Norway, Iceland and Germany), commercial and development banks (Equator Principles Financial Institutions, World Bank), social and environmental NGOs (TNC, WWF, Oxfam, Transparency International) and the hydropower sector, all in all 14 Forum members plus a Forum Chair from the finance sector and a coordinator from IHA. The representatives were supported by reference groups.

The members of the Forum spent two and a half years deeply involved in research, analysis, meetings, outreach, trials, review, exchanging views, negotiating content and finding solutions to divergent views. Review includes the WDC recommendations, the Equator Principles, the World Bank Safeguard Policies, IFC performance Standards and IHA´s previous sustainability tools. The result of this considerable effort was a tool to measure and guide sustainability performance in the hydropower sector; the Hydropower Sustainability Assessment Protocol (HSAP), first published in November 2010 and formally launched at the IHA world congress in May 2011. The HSAP was updated in 2018 with a new assessment topic on Climate Change Mitigation and Resilience. *(Hydropower Sustainability, 2019).*

The HSAP tool is governed by a multi-stakeholder body, the Hydropower Sustainability Assessment Council, which includes representatives of social and community organisations, environmental organisations, governments, commercial and development banks and the hydropower sector, meeting four times a year. IHA acts as management entity and oversees training and accreditation.

Assessments by the HSAP tool have been conducted for projects worldwide and the resulting reports can either be official or kept internal. The official assessments can be found on the Council website. (Hydropower Sustainability, 2019).

Iceland participated actively in the preparation of HSAP. The Director General of Orkustofnun, the National Energy Authority in Iceland, was one of the 14 Forum members, and Landsvirkjun, the National Power Company of Iceland, provided participation in a backup reference group to the Forum. The Icelandic Government, together with the governments of Norway and Germany provided substantial funding for the initiative together with IHA, TNC, WWF and the World Bank.

In Iceland, 90% of space heating and 27% of electrical production is from geothermal sources. The remaining 10% space heating is based on direct use of electricity, hydropower and geothermal power, hence all electricity and heating are by renewable energy sources. Harnessing of geothermal has a century long history and the current research, development and operation is highly advanced.

In 2007, the Minister of Industry in Iceland requested that the Steering Committee for the Master Plan for Energy Protection and Energy Utilization (hydro and geothermal) in Iceland would consider the sustainability of the utilization of geothermal resources, when assessing potential projects. A working group was established in 2008 to review how sustainability could be evaluated for geothermal projects. In 2010 the working group concluded it´s work with a report (Ketilsson et al., 2010a). The main emphasis was

on the sustainability of the geothermal resource, but ten goals were also introduced for sustainable geothermal utilization based on the Brundtland definition. A paper on the subject was presented at the World Geothermal Congress (Ketilsson et al., 2010b). With this work, first steps were taken on the development of a sustainability protocol for geothermal utilization.

In recent years, HSAP assessments have been conducted in Iceland for Landsvirkjun, which has applied the HSAP for official assessments of a preparation stage project and two operating facilities. These assessments led to improved procedures and work methods and stronger stakeholder relations.

In the light of the above, it is only natural that the Icelandic energy sector would look to the thoroughly developed, tested and internationally recognized multi-stakeholder assessment tool HSAP, when the sector wished to be able to conduct sustainability assessments for geothermal projects as well as hydro. This is indeed a very practical and reasonable approach.

In the year 2016, a GSAP Working Group as listed in the Introduction above was established in Iceland by three Icelandic Power Companies and two Governmental Agencies. The task at hand was to adapt the existing HSAP to GSAP, keeping the adaption changes to the minimum with the aim to maintain as much as possible the existing international recognition and consensus on the relevant topics and issues. Preparation Stage and Operation Stage were targeted for this adaption. A project is a project, be it hydro or geothermal, and the projects are prepared and operated in a comparable way with respect to the key sustainability factors; social, environmental and economic.

3. STRUCTURE OF THE ASSESSMENT TOOL

The Forum for HSAP agreed on a set of main Topics that were considered important to forming a view on the overall sustainability of a project at that point in its life cycle. The Topics cover the environmental, social, technical and economic/financial perspectives, that were considered most important to reflect the relevant sustainability issues of a project. The Preparation Stage includes 24 Topics and the Operation Stage includes 20 Topics.

To give a view of the subjects covered by the Topics, the Preparation Stage covers the following:

Communication & Consultation; Governance; Demonstrated Need and Strategic Fit; Siting and Design; Environmental & Social Impact Assessment & Management; Integrated Project Management; Hydrological Resource, Infrastructure Safety; Financial Viability; Project Benefits; Economical Viability; Procurement; Project Affected Communities and Livelihoods; Resettlement; Indigenous Peoples; Labour & Working Conditions; Cultural Heritage; Public Health; Biodiversity & Invasive Species; Erosion & Sedimentation; Water Quality; Reservoir Planning; Downstream Flow Regimes; Climate Change Mitigation and Resilience.

The last one was added in 2018. As can be seen from this list, most of these topics are highly relevant for geothermal projects as well as hydro projects. The exception are hydro Topics that are directly related to river flow and storage reservoirs.

All the relevant Topics are assessed on the basis of up to 6 criteria. These criteria are:

Assessment; Management; Stakeholder Engagement; Stakeholder Support; Outcomes and Conformance/Compliance.

This reflects in principle that the evaluation is focused on how well the different topics and issues have been assessed by the developer, how well they are managed, the level of stakeholder engagement and support, etc., etc.

Scoring levels are from Level 1 to 5, where Level 3 describes basic good practice and Level 5 describes proven best practice. Level 2 represents one significant gap to basic good practice and Level 4 represents one significant gap to proven best practice. The results are illustrated in a spider diagram for easy visual reference.

The Protocol document contains description and intent statements for each Topic and scoring statements and short assessment guidance for each Topic.

The assessments are conducted by independent accredited assessors through the HSA Council, normally one to three assessors participate, depending on the size and complexity of a project. The most relevant documentation available is reviewed and interviews arranged with representatives of the Developer, various relevant authorities and a range of different stakeholders. A draft report from the assessors is reviewed by the Developer in order to confirm facts and relevance and the final report is presented to the participants of the interviews and in most cases made public by the Developer.

A 60 days period for public comments commences when the report has been published, after which the assessors respond to the comments and make changes if they find relevant. The final report includes an annex outlining the changes made/not made in response to comments received.

4. ADAPTION OF HSAP TO GSAP

The general approach is to make minimum changes; to eliminate Topics and text that only refers to hydropower issues and replace with the relevant information and Topics for geothermal. Many Topics need very little modification as the same working procedures, management and requirements generally apply for different types of significant power projects. Examples are procurement, requirements for formal EIA, communication and consultations with stakeholders, financial and economic viability, labour and working conditions etc., etc.

Issues related to storage reservoirs and flow of rivers and the associated environmental and social impacts are hydro specific, while on the other hand the GHG emissions from geothermal fields and utilization, the underground resource assessment and management, unique volcanic geological features, deep drilling and the multiple use of the heat opportunities are geothermal

specifics. Infrastructure safety issues for the public related to dams are hydro specific while in the case of geothermal the hazardous gas can be a safety and health issue to the public.

The concluding adaption for the Preparatory Stage after the relevant restructuring is 21 Topics for the GSAP compared with 24 Topics for the HSAP. As compared with the list of Topics for the Preparation Stage shown in the section above:

Hydrological Resource becomes Geothermal Resource; Infrastructure Safety and Public Health are combined; Erosion & Sedimentation is replaced with Induced Seismicity and Subsidence; Water Quality becomes Air and Water Quality; Reservoir Planning is eliminated; Downstream Flow Regimes is eliminated.

Similarly, the GSAP for Operation Stage contains 17 Topics as compared with 20 Topics of the HSAP.

All text in the assessment protocol is thoroughly reviewed and adapted to geothermal conditions and the description and intent statements for Topics, scoring statements and the assessment guidance modified accordingly.

5. TEST ASSESSMENTS IN ICELAND

Experience shows that choices made in the preparation stage of projects have the largest influence on sustainability and therefore the GSAP Working Group initially focused on the development of a GSAP assessment tool for the Preparation Stage. Based on the current Draft GSAP, it was decided to conduct a test assessment for this stage.

An assessment was initiated by Landsvirkjun, the National Power Company, on the preparation of their Theistareykir Geothermal Power Project in Northeast Iceland. The project is 90 MWe with a potential for future expansion and it enables the build-up of a power intensive industry near the neighbouring town of Husavik on the north-eastern coast. Preparations were in fact mostly concluded and the project had reached the construction stage. A very experienced accredited Lead Assessor from the HSA Council, Dr Joerg Hartmann, was contracted, a planning and general geothermal exploring visit was conducted in October 2016 and an on-site assessment in January 2017, encompassing two weeks of stakeholder interviews and collection of the most relevant project information.

As the assessment was the first test of the Draft GSAP, the primary objective was to confirm the applicability of the adapted assessment tool from hydro to geothermal. At the same time, the objective was the same as for regular HSAP assessments; to gain insights into the performance related to this project, and to identify opportunities for improvements of this and other geothermal projects in Iceland.

The resulting comprehensive assessment report was published on the Landsvirkjun website. *(Landsvirkjun, 2017)*. The main results show low adverse environmental and social impacts and positive socio-economic effects for the sparsely populated project region. All Topics receive the Level 3 definition of basic good practice or higher, but there are some gaps from the Level 5 definition of proven best practice. The gaps then again provide opportunities for improvements on the preparation of future geothermal projects. The results are shown in the following Figure 1 spider diagram illustration:

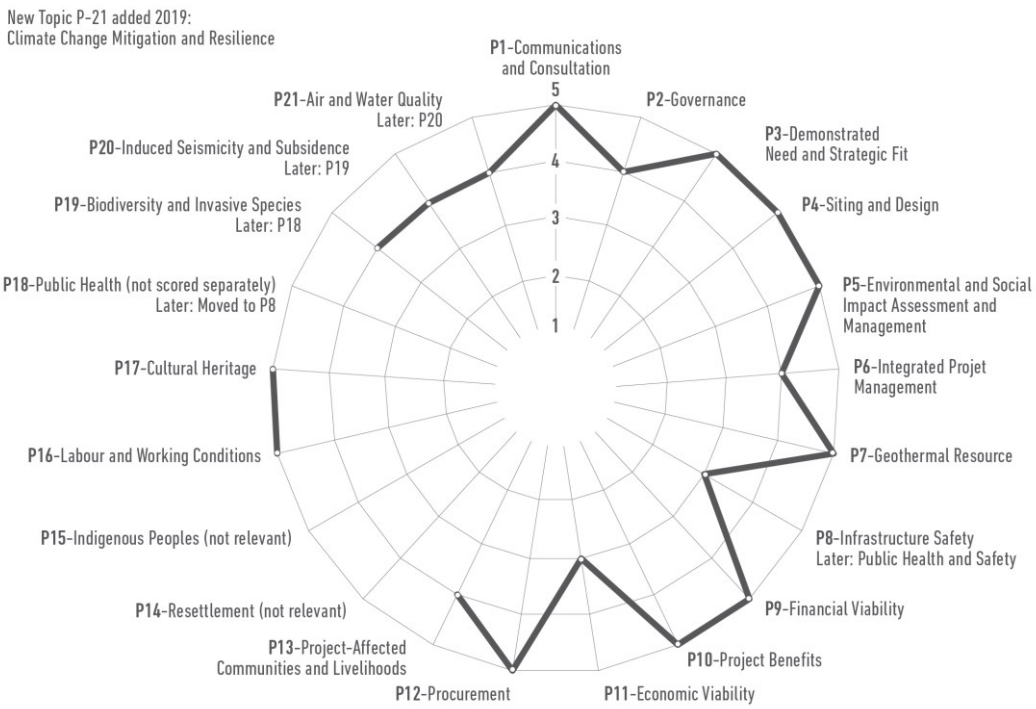

Figure 1: Sustainability Profile for Theistareykir 90 MWe – Preparation Stage – year 2017. *(Landsvirkjun, 2017).*

Following the successful test assessment of the Draft GSAP Preparation Stage, the draft version was updated on the basis of the test and recommendations from the assessor, e.g. combining P8 and P18, as shown on Figure 1. A comparable Draft GSAP Operation Stage was subsequently prepared and the Working Group decided to test this Operation Stage version in Iceland as well.

An assessment was initiated by ON Power, a subsidiary of Orkuveita Reykjavikur (OR), Reykjavik Energy, on the operation of their Hellisheidi 300 MWe/130 MWth geothermal plant in Southwest Iceland. The electrical power is connected to the main national grid and the hot water production, with a potential for further expansion, goes to the capital city area. This is the largest geothermal plant in Iceland and one of the largest in the world. Operation of the plant started in 2006.

Two accredited and highly experienced assessors from the HSA Council were contracted; Dr Joerg Hartmann again as Lead Assessor and Dr Bernt Rydgren as Co-Assessor. The assessment was carried out from the fall of 2017 to springtime of 2018 including a planning visit, on-site assessment visit, an internal workshop and a special stakeholder meeting on the results.

The resulting assessment report was published on the ON Power website. (ON Power, 2018). As for the Theistareykir assessment, the test was successful, and the results showed a range of high scores. Also, as for Theistareykir, the results have initiated opportunities for a follow up to address the identified gaps in the assessment. Reference is made to a separate paper on the GSAP test assessment for Hellisheidi Geothermal Heat and Power Plant, prepared by authors from ON/OR for this same WGC 2020 conference.

CONCLUSION

Criticism by the World Commission of Dams (WCD) around the turn of the century inspired the hydropower sector to introduce a sustainability assessment tool, HSAP, to improve performance on sustainability issues when preparing, building and operating hydropower facilities. Assessments have taken place around the world on this basis for a decade. The value for the sector is e.g. independent review of sustainability issues and guidance on improvement opportunities, comparison with international best practice, communication and improved engagement with stakeholders and the facilitating of access to finance.

The Icelandic power sector has a very positive experience with this kind of assessment for their hydropower projects and wished to extend this procedure to include also geothermal power projects. Adapting a thoroughly developed, proven and internationally widely recognised multi-stakeholder methodology seemed the most reasonable and practical way forward. A draft of adaption of the assessment tool to geothermal projects, Draft GSAP at Preparation Stage and Operation Stage, has been prepared and tested for two projects in Iceland, Theistareykir 90MWe and Hellisheidi 300 MWe/130 MWth.

The Icelandic GSAP initiative shows that this adaption approach from another power sector is successful and the two test assessments have proven the actual applicability and practicality of the initiative. As for similar hydro assessments, the geothermal test assessments have motivated improvements in practices and working procedures at the respective power companies.

At the time of writing this paper (mid 2019), further development and testing of Draft GSAP for international geothermal development is being considered and discussed as well as the future governance, with the aim on best possible international consensus as for the HSAP tool.

The importance of further development of geothermal energy and hydropower has grown with increased concern on climate change, the alarming need to reduce the emission of greenhouse gases and replacement of fossil fuels. Further green renewable energy projects are required, but they need to be approached in the best possible manner with respect to sustainability issues and performance. The most appropriate alternatives need to be selected after thorough evaluation and adequate consultations. Assessments as discussed above provide important guidance in this respect. They can be defined as evidence-based objective assessment of a project´s sustainability performance and are prepared by accredited assessors. This approach can be summarized by simple quotation to one of the experienced Assessors:

"*Do the right projects – and do them well*".

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