



FINAL REPORT

EIGMIA

Evaluation and Improvements of Geothermal Models using Inverse Analysis

Project ID: 09-01-028

Coordinator: Magnus Thor Jonsson, University of Iceland

Start date: 01/2010

Duration: 3 years

Partners: Stefan Finsterle, Staff Scientist, Lawrence Berkeley National Laboratory, Earth Sciences Division (LBNL)

1 Project summary

In this project, emphasis has been placed on establishing an inverse modeling methodology to use it on three different aspects of geothermal power development, i.e. for (1) a coupled wellbore reservoir system for analyzing geothermal system's workloads, (2) a thermal and structural analysis of wells and wellheads, and to (3) optimize the steam gathering systems and examine the functionality of separator stations.

Figure 1 shows an overview of the systems that have been developed and used in this project. The iTough2 pre- and postprocessor designed using Matlab was used to model different geothermal areas such as Reykjanes area. A wellbore model FloWell was developed and connected to iTough2-pest in such a way that the FloWell wellbore analysis was coupled to the iTough2 reservoir model. Results were presented in an MSc thesis and a paper at both the SIMS conference and at the Stanford Geothermal Workshop. The system was used to analyse the Reykjanes area. A thermal and structural well model of the well and the wellhead was also developed in ANSYS and used to analyse the discharge of a well and to compare the wellhead displacements using an inverse analysis. Results were presented in a paper at SIMS and the Stanford Geothermal Workshop. Topography distance transform was established for the optimum route selection based on the shortest distance, the unidirectional slope and minimum visual effects. For analysing the flow and functionality of separators, an Ansys model was developed for both vertical and horizontal types of separators.

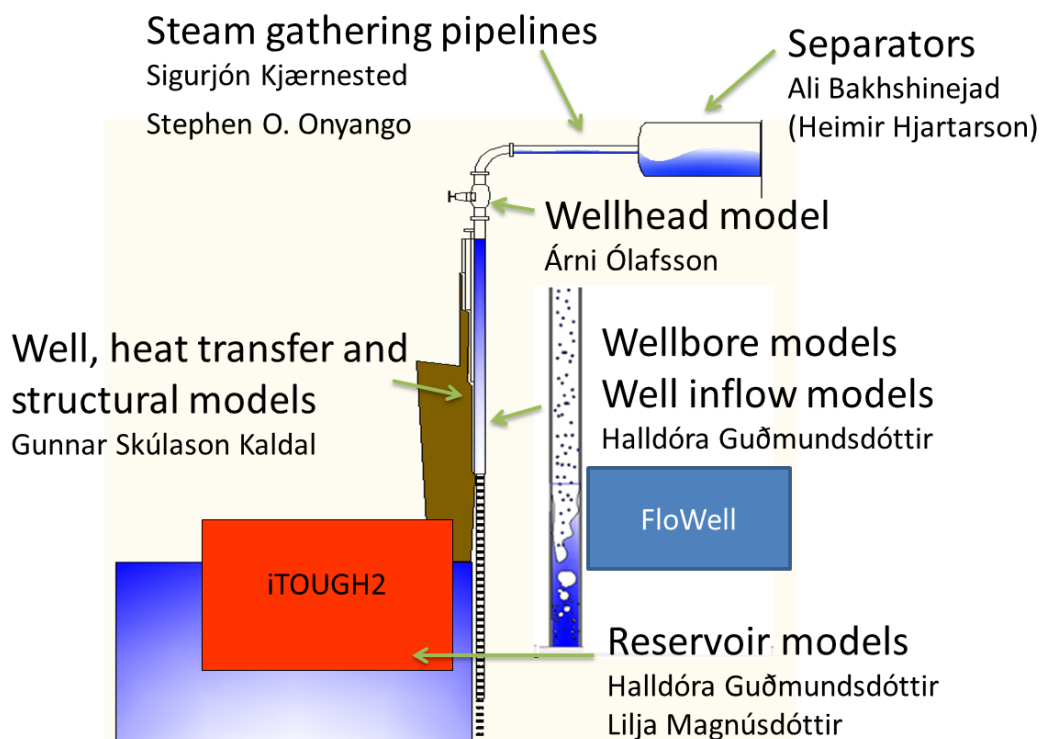


Figure 1. Overview of EIGMIA models.

Models:

(1) Coupled wellbore reservoir system for analyzing geothermal system’s workloads.

Pre- and postprocessor for iTough2 (LM)
(User Manual)

FlowWell/iTough2 pest analysis and iTough2 coupling (HG)
(Paper: Stanford Workshop 2012, 2013, SIMS 2012)

(2) Thermal and structural analysis of wells and wellheads.

Well head Ansys model (ÁÓ) (MSc. thesis)

Well structural and thermal model (GSK)

(Papers: Stanford Workshop 2011, Stanford Workshop 2012 and Stanford Workshop 2013
and SIMS 2013)

(3) Steam gathering pipelines and the functionality of separator stations.

Optimization model for steam gathering systems (SNK)

(Papers: Stanford Workshop 2011 and IDETC/CIE 2011) (MSc. thesis)

SHP – two phase flow model (HH) (Paper: Stanford Workshop 2011)

Numerical model for mist separators (AB) (Paper: Stanford Workshop 2014)

For inverse analysis, the iTough2-Pest was developed by Stefan Finsterle and Figure 2 shows the connections between iTough2-Pest and general models.

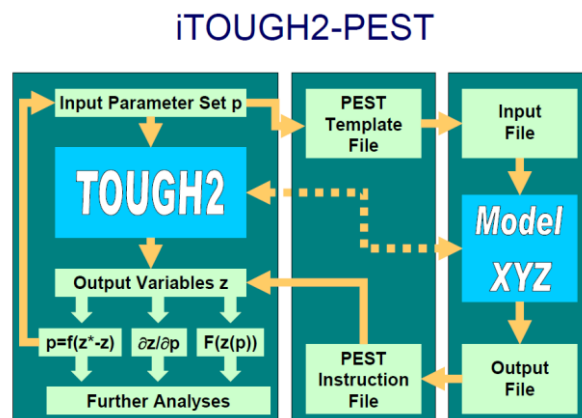


Figure 2. Flow chart of the major steps of inverse analysis using iTough2 - Pest.

Milestones:	Planned date:	Confirmed date:
Project stated:	01.01.2010	01.01.2010
Progress Report #1	15.05.2010	20.03.2011
Annual Report #1	07.11.2010	10.03.2011
Second year (Signature of contract):	30.04.2011	30.04.2011
Progress Statement (Report #2):	20.10.2011	20.10.2011
Annual Report #2:	20.06.2012	20.06.2012
Third year (Signature of contract):	15.06.2012	15.06.2012
Progress Statement (Report #3):	22.11.2012	22.11.2012
Final Report #3	31.12.2013	01.04.2014

MSc Thesis:	
Árni Ólafsson	30.09.2011
Sigurjón Norberg Kjærnested	18.10.2011
Halldóra Guðmundsdóttir	03.10.2012

Conference papers:	
Stanford Workshop 2011 (3 papers)	05.02.2011
ASME Conference 2011(1 paper)	29.08.2011
Stanford Workshop 2012 (4 papers)	01.02.2012
SIMS Conference 2012(1 paper)	06.11.2012
Stanford Workshop 2013 (4 papers)	13.02.2013
SIMS Conference 2013(1 paper)	18.11.2013
Stanford Workshop 2014 (1 paper)	21.02.2014

The final project schedule is shown in Figure 3. The first part, coupled wellbore reservoir system for analyzing geothermal system's workloads (activity 4. in the figure) was in accordance with the first time plan. But the second part of the project, structural and heat analysis of wells and the third part, modeling the functionality of separators (activities 5. and 6.) were delayed. The reasons for the delay was a maternity leave (Gunnar Skúlason Kaldal was taking care of his children's for six months) and Heimir Hjartarson postpone his PhD study.

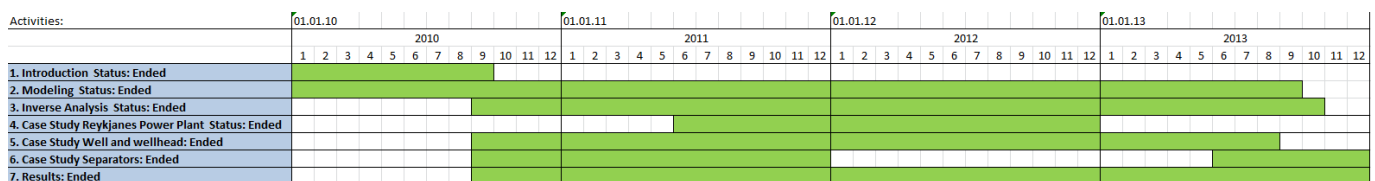


Figure 3. Project schedule.

2 Project Management

The steering group of the project is composed of Professor Magnús Þór Jónsson at the Department of Mechanical Engineering at the University of Iceland and Stefan Finsterle, Staff Scientist at the Lawrence Berkeley National Laboratory (LBNL).

The project is supervised by Professor Magnús Þór Jónsson, who is the main coordinator and project manager. Stefan Finsterle is the coordinator of the research in Berkeley.

3 Student involvement

Group of EIGMIA students:

- PhD student at UI, Gunnar Skúlason
- PhD student at UI, Heimir Hjartarson (was supported by University of Iceland)
- PhD student at Stanford (internship), Lilja Magnúsdóttir
- MSc student at UI, Árni Ólafsson
- MSc student at UI, Daniel J. Drader
- MSc student at UI, Sigurjón Norberg Kjærnested
- MSc student at UI, Halldóra Guðmundsdóttir
- MSc student at UI, Ali Bakhshinejad (after his MSc. degree)

4 Publications and disseminations

MSc. Thesis:

Sigurjón Norberg Kjærnested, *A Comparative Study of Geothermal Pipeline Route Selection Methods with Visual Effects Optimization*, Faculty of Industrial Engineering, Mechanical Engineering and Computer Science, University of Iceland, October 2011. <http://skemman.is/item/view/1946/10231>

Árni Ólafsson, *Structural and Stress Analysis of a High Temperature Geothermal Wellhead*, Faculty of Industrial Engineering, Mechanical Engineering and Computer Science, University of Iceland, September 2011. <http://skemman.is/handle/1946/10164>

Halldóra Guðmundsdóttir, *A Coupled Wellbore-Reservoir Simulator utilizing Measured Wellhead Conditions*, Faculty of Industrial Engineering, Mechanical Engineering and Computer Science, University of Iceland, October 2012. <http://skemman.is/handle/1946/13219>

Conference papers:

Sigurjon N. Kjaernested, Magnus Th. Jonsson and Halldor Palsson, *METHODOLOGY FOR PIPELINE ROUTE SELECTION USING THE NSGA II AND DISTANCE TRANSFORM ALGORITHMS*, Proceedings of the ASME 2011 International Design Engineering Technical Conferences & Computers and Information in Engineering Conference IDETC/CIE 2011 August 29-31, 2011, Washington, DC, USA.

Gunnar Skúlason Kaldal, Magnús Þ. Jónsson, Halldór Pálsson, Sigrún N. Karlsdóttir and Ingólfur Ö. Þorbjörnsson, *LOAD HISTORY AND BUCKLING OF THE PRODUCTION CASING IN A HIGH TEMPERATURE GEOTHERMAL WELL*, Proceedings, Thirty-Sixth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 31 - February 2, 2011. <http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2011/2011program.html>

Heimir Hjartarson, Magnús Þ. Jónsson and Halldór Pálsson, *SIMULATION OF TWO-PHASE FLOW IN GEOTHERMAL PIPES USING SMOOTHED PARTICLE HYDRODYNAMICS*, Proceedings, Thirty-Sixth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 31 - February 2, 2011. <http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2011/2011program.html>

Kjaernested, S.N. Jonsson, M.T. Palsson, H, *A METHODOLOGY FOR OPTIMAL GEOTHERMAL PIPELINE ROUTE SELECTION WITH REGARDS TO VISUAL EFFECTS USING DISTANCE TRANSFORM ALGORITHMS*, Proceedings, Thirty-Sixth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 31 - February 2, 2011. <http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2011/2011program.html>

Gunnar Skúlason KALDAL, Magnús Þ. JONSON, Halldór PALSSON, Sigrún N. KARLSDOTTIR, *Thermal and Structural Analysis of the Casing in a High Temperature Geothermal Well During Discharge*, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 30 - February 1, 2012. <http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2012/2012program.html>

Halldora GUDMUNDSDOTTIR, Magnus Thor JONSSON, Halldor PALSSON, *Coupling Wellbore Simulator with Reservoir Simulator*, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 30 - February 1, 2012.

<http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2012/2012program.html>

Daniel DRADER, Halldór PÁLSSON and Magnús Þór JÓNSSON, *Improved Power Production Efficiency of Hydrothermal Reservoirs Using Downhole Pumps*, Thirty-Seventh Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 30 - February 1, 2012.

<http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2012/2012program.html>

Larus THORVALDSSON, Halldor PALSSON *Modeling Liquid Dominated Two Phase Flow in Geothermal Reservoirs in Vicinity to, and Inside Wells*, Proceedings, Thirty-Seventh Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, January 30 - February 1, 2012.

<http://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2012/2012program.html>

Halldóra Gudmundsdottir; Magnus Thor Jonsson; Halldor Palsson; Development of a Coupled Geothermal Reservoir-Wellbore Simulator Using Measured Wellhead Parameters and Inverse Analysis; SIMS 2012 The 53rd International Conference of the Scandinavian Simulation Society, Reykjavik, Iceland, October 4-6, 2012.

Gunnar Skúlason Kaldal, Magnús Þór Jónsson, Halldór Pálsson, and Sigrún Nanna Karlsdóttir; Using Probabilistic Analysis with Finite Element Modeling of High Temperature Geothermal Well Casings; SIMS 54th conference Bergen University College, Norway October 16-18, 2013.

<http://www.scansims.org/sims2013/SIMS2013.pdf>

Halldora GUDMUNDSDOTTIR, Magnus Thor JONSSON, Halldor PALSSON; The Wellbore Simulator FloWell; Stanford Geothermal Workshop 2013.

<https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2013/Gudmundsdottir.pdf>

Halldora GUDMUNDSDOTTIR, Magnus Thor JONSSON, Halldor PALSSON; A Coupled Wellbore-Reservoir Simulator Utilizing Measured Wellhead Conditions; Stanford Geothermal Workshop 2013.

<https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2013/Gudmundsdottir1.pdf>

Gunnar Skulason KALDAL, Magnus Thor JONSSON, Halldor PALSSON, Sigrun N. KARLSDOTTIR; Collapse Analysis of the Casing in a High Temperature Geothermal Well; Stanford Geothermal Workshop 2013. <https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2013/Kaldal.pdf>

Larus THORVALDSSON, Halldor PALSSON *A Numerical Analysis on Flow in Hydrothermal Systems*, Proceedings, Thirty-Eighth Workshop on Geothermal Reservoir Engineering Stanford University, Stanford, California, 2013.

<http://www.geothermal-energy.org/pdf/IGAstandard/SGW/2013/Thorvaldsson.pdf>

Ali BAKHSHINEJAD, Magnus Thor JONSSON, Halldor PALSSON; Numerical Model for Mist Separators; Stanford Geothermal Workshop 2014.

<https://pangea.stanford.edu/ERE/pdf/IGAstandard/SGW/2014/Bakhshinejad2.pdf>

Courses:

Course VÉL 031 F Inverse Modeling 3rd-5th August 2010

Instructors: Stefan Finsterle, Lawrence Berkeley National Laboratory (LBNL)
Yingqi Zhang, Lawrence Berkeley National Laboratory (LBNL)
Magnús Þór Jónsson, University of Iceland (UI)

Participants:

Björn Margeirsson [bjorn.margeirsson@matis.is]
Daher Elmi Houssein [deh1@hi.is]
Edda Sif Aradóttir [esa@hi.is]
Gunnar Skúlason [gunnarsk@gmail.com]
Javier González-García [ja_jagg@hotmail.com]
Jónas Ketilsson [jonas.ketilsson@os.is]
Ketill Heiðar Guðmundsson [khg@hi.is]
Lilja Magnúsdóttir [liljam@stanford.edu]
Manuel Plasencia [mpg2@hi.is]
María Sigríður Guðjónsdóttir [msg11@hi.is]
Marta Rós Karlsdóttir [mrk1@hi.is]
Oddgeir Guðmundsson [oddgeir@hi.is]
Sigurjón Norberg Kjærnested [snk1@hi.is]

5 Cost statement

The cost items and financing contribution are basic salaries, overhead cost, work facilities and traveling expenses.

Contribution

Salaries including overhead and work facilities cost:

Participants		Basic Salaries		Salary exp.		Work facilities		Total
Magnús Þór Jónsson	MPJ	716	UI 100%	144	UI 100%	140	UI	1000
Stefan Finsterle	SF	1000	BLL 100%	200	BLL 100%	800	BLL	2000
Heimir Hjartarson	HH	256	UI 100%	52	UI 100%	90	UI	398
Gunnar Skúlason	GS	256	GEORG/UI	52	GEORG/UI	90	UI	398
Lilja Magnúsdóttir	LM	256	GEORG	52	GEORG	90	UI	398
Sigurjón N. K.	SNK	210	GEORG	42	GEORG	60	UI	312
Daniel J. Drader	DJD	210	GEORG	42	GEORG	60	UI	312
Árni Ólafsson	ÁÓ	210	GEORG	42	GEORG	60	UI	312
Halldóra Guðmundsdóttir	HG	210	GEORG	42	GEORG	60	UI	312
Ali Bakhshinejad	AB	210	GEORG/UI	42	GEORG/UI	60	UI	312

Traveling expenses:

MTJ	: 1700 K-IKR	100% Sáttmálasjóður and Engineering Research Institute
SF	: 520 K-IKR	100% GEORG
HH	: 250 K-IKR	100% GEORG
GS	: 750 K-IKR	100% GEORG
LM	: 475 K-IKR	100% GEORG
SNK	: 500 K-IKR	100% GEORG
HG	: 500K-IKR	100% GEORG

Total cost statements:

Total								
Duration	01.01.10-31.12.13			48				
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	Total
Initials	MPJ	SF	HH	GS	LM	NK/DJD/A	ÁÓ/HG	
Man months	10,0	1,8	21,0	42,0	3,3	18,0	14,0	110,1
Salaries	8600	2160	6468	12936	1030	4536	3528	39258
Travel	1700	520	250	750	230	500	500	4450
Facilities	2840	1800	2982	5964	475	1836	1428	17325
Total cost	13140	4480	9700	19650	1735	6872	5456	61033
GEORG funding	0,0	1154,0	1106,0	5702,0	1030,0	4050,0	3868,0	16910
Other financing	11700	2966	7502	11764	531	2066	1000	44123

Consortium: UIERI and LBNL

Name of Project: Evaluation and Improvements of Geothermal Models using Inverse Analysis

ISK '000	Year	Year 1 2010/2011		Year 2 2011/2012		Year 3 2012/2013		Grand Total	
		Unit cost	Man-months	Total	Man-months	Total	Man-months		Total
Salaries including overhead									
Research coordinator MTJ		1.000	3	3.000	3	3.000	1	1.250	7.250
Research coordinator SF		2.000	1	1.600	1	1.000	0	500	3.100
PhD student	HH	398	12	4.776	9	3.582	0	0	8.358
PhD student	GS	398	12	4.776	12	4.776	14	5.572	15.124
PhD student	LM	398	3	1.194	0	137	0	0	1.331
MS students	DJD/SNK	312	8	2.496	5	1.560	5	1.560	5.616
MS students	HG/ÁÓ	312	5	1.560	4	1.248	5	1.560	4.368
Total			44	19.402	34	15.303	26	10.442	45.147
Operational exp.									
Fieldwork and data collection			0	0	0	0	0	0	0
Total			0	0	0	0	0	0	0
Travel expenses									
Visit SF to Iceland (2 weeks per year)			520	0	0	0	0	520	520
Visit to Berkeley (Stanford Workshop)			380	1.900	1.400	1.400	1.400	3.680	3.680
ASME conference			250	0	0	0	0	250	250
Total			1.150	1.900	1.400	1.400	1.400	4.450	4.450
Total cost			20.552	17.203	11.842	11.842	11.842	49.597	49.597
Financing									
Contribution UI Salaries /Tra MTJ, HH, GS			13.666	9.133	7.422	7.422	7.422	30.221	30.221
Own contribution Salaries SF			966	1.000	500	500	500	2.466	2.466
Total other financing			14.632	10.133	7.922	7.922	7.922	32.687	32.687
Requested funding from GEORG			5.920	7.070	3.920	3.920	3.920	16.910	16.910
Total financing			20.552	17.203	11.842	11.842	11.842	49.597	49.597 100%

Cost item		Funding		Other financing		Total
2010/2011	Salaries					19.402
	Operational expenses					0
	Travel expenses					1.150
	Total 2010/2011:	5.920	29%	14.632	71%	20.552
2011/2012	Salaries					15.303
	Operational expenses					0
	Travel expenses					1.900
	Total 2011/2012:	7.070	41%	10.133	59%	17.203
2012/2013	Salaries					10.442
	Operational expenses					0
	Travel expenses					1.400
	Total 2012/2013:	3.920	33%	7.922	67%	11.842
Grand Total		16.910	34%	32.687	66%	49.597

Yearly cost statements:

Year #1									
Duration	01.01.10-31.12.10		12		Man months:			43,8	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	Total	
Initials	MPJ	SF	HH	GS	LM	SNK/DJD	ÁÓ		
Man months	3,0	0,8	12,0	12,0	3,0	8,0	5,0	43,8	
Salaries	2580	960	3696	3696	924	2016	1260	15132	
Travel	400	520	0	0	230	0	0	1150	
Facilities	420	640	1080	1080	270	480	300	4270	
Total cost	3400	2120	4776	4776	1424	2496	1560	20552	
GEORG funding	0	1154	856	256	924	1680	1050	5920	
Other financing	3400	966	3920	4520	500	816	510	14632	

Year #2									
Duration	01.01.11-31.12.11		12		Man months:			33,8	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	Total	
Initials	MPJ	SF	HH	GS	LM	SNK	HG		
Man months	3,0	0,5	9,0	12,0	0,3	5,0	4,0	33,8	
Salaries	2580	600	2772	3696	106	1260	1008	12022	
Travel	900	0	250	250	0	500	0	1900	
Facilities	420	400	810	1080	31	300	240	3281	
Total cost	3900	1000	3832	5026	137	2060	1248	17203	
GEORG funding	0	0	250	3946	106	1760	1008	7070	
Other financing	3900	1000	3582	1080	31	300	240	10133	

Year #3									
Duration	01.01.12-31.12.12		12		Man months:			16,5	
Institution	UIERI	LBNL		UIERI			UIERI	Total	
Initials	MPJ	SF		GS			HG		
Man months	2,0	0,5		9,0			5,0	16,5	
Salaries	1720	600		2772			1260	6352	
Travel	200	0		250			500	950	
Facilities	280	400		810			300	1790	
Total cost	2200	1000		3832			2060	9092	
GEORG funding	0	0		1500			1810	3310	
Other financing	2200	1000		2332			250	5782	

Year #4									
Duration	01.01.13-31.12.13		12		Man months:			16,0	
Institution	UIERI	LBNL		UIERI		UIERI		Total	
Initials	MPJ	SF		GS		AB			
Man months	2,0	0,0		9,0		5,0		16,0	
Salaries	1720	0		2772		1260		5752	
Travel	200	0		250		0		450	
Facilities	280	0		810		300		1390	
Total cost	2200	0		3832		1560		7592	
GEORG funding	0	0		0		610		610	
Other financing	2200	0		3832		950		6982	

Project Status: 31.12.2013 Ended
1. Introduction Status: Ended

Duration	01.01.10-01.10.10		8,5		Man months:			8,5	Total: 8,5	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total	
Initials	MbJ	SF	HH	GS	LM	SNK/DJD	ÁÓ			
Man months	0,5	0,0	4,0	2,0	0,0	1,0	1,0		8,5	
Salaries	430	0	1232	616	0	252	252		2782	
Travel	200	0	0	0	0	0	0		200	
Facilities	70	0	360	180	0	60	60		730	
Total cost	700	0	1592	796	0	312	312		3712	
GEORG funding	0	0	256	256	0	210	210		932	
Other financing	700	0	1336	540	0	102	102		2780	

2. Modeling Status: Ended

Duration	01.01.10-31.12.11		/End: 31.09.13		Man months:			54,5	Total: 52,0	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total	
Initials	MbJ	SF	HH	GS	LM	SNK/DJD	HG/ÁÓ			
Man months	2,0	0,5	16,0	21,0	2,0	8,0	5,0		54,5	
Salaries	1720	600	4928	6468	616	2016	1260		17608	
Travel	900	520	250	250	230	500	0		2650	
Facilities	280	400	1440	1890	180	480	300		4970	
Total cost	2900	1520	6618	8608	1026	2996	1560		25228	
GEORG funding	0	654	730	3022	668	2348	1260		8682	
Other financing	2900	866	5888	5586	358	648	300		16546	

3. Inverse Analysis Status: Ended

Duration	01.09.10-31.10.12		/End: 31.10.13		Man months:			14,6	Total: 30,5	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total	
Initials	MbJ	SF	HH	GS	LM	SNK	HG/ÁÓ			
Man months	2,5	0,8	1,0	2,0	1,3	4,0	3,0		14,6	
Salaries	2150	960	308	616	414	1008	756		6212	
Travel	200	0	0	0	0	0	0		200	
Facilities	350	640	90	180	121	240	180		1801	
Total cost	2700	1600	398	796	535	1248	936		8213	
GEORG funding	0	500	120	308	362	988	756		3034	
Other financing	2700	1100	278	488	173	260	180		5179	

4. Case Study Reykjanes Power Plant Status: Ended

Duration	01.06.11-01.06.12		/End: 31.12.12		Man months:			6,5	Total: 24,0	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total	
Initials	MbJ	SF	HH	GS	LM	DJD	HG			
Man months	1,3	0,3	0,0	0,0	0,0	3,0	2,0		6,5	
Salaries	1075	300	0	0	0	756	504		2635	
Travel	0	0	0	0	0	0	0		0	
Facilities	175	200	0	0	0	180	120		675	
Total cost	1250	500	0	0	0	936	624		3310	
GEORG funding	0	0	0	0	0	0	504		504	
Other financing	1250	500	0	0	0	936	120		2806	

5. Case Study Well and wellhaed Status: Ended

Duration	01.06.11-01.06.12 /End: 31.08.13			Man months:			12,3	Total: 24,0	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total
Initials	MbJ	SF	HH	GS	LM	JD/SNK/Al	ÁÓ		
Man months	0,3	0,0	0,0	11,0	0,0	0,0	1,0		12,3
Salaries	215	0	0	3388	0	0	252		3855
Travel	0	0	0	0	0	0	0		0
Facilities	35	0	0	990	0	0	60		1085
Total cost	250	0	0	4378	0	0	312		4940
GEORG funding	0	0	0	2116	0	0	252		2368
Other financing	250	0	0	2262	0	0	60		2572

6. Case Study Steam gatering and separators Status: Ended

Duration	01.06.11-01.06.12 /End: 31.12.13			Man months:			1,3	Total: 24,0	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total
Initials	MbJ	SF	HH	GS	LM	SNK/AB	HG/ÁÓ		
Man months	0,3	0,0	0,0	0,0	0,0	1,0	0,0		1,3
Salaries	215	0	0	0	0	252	0		467
Travel	0	0	0	0	0	0	0		0
Facilities	35	0	0	0	0	60	0		95
Total cost	250	0	0	0	0	312	0		562
GEORG funding	0	0	0	0	0	252	0		252
Other financing	250	0	0	0	0	60	0		310

7. Results Status: Ended

Duration	01.06.11-01.06.12 /End: 31.12.13			Man months:			5,5	Total: 24,0	
Institution	UIERI	LBNL	UIERI	UIERI	UIERI	UIERI	UIERI	UIERI	Total
Initials	MbJ	SF	HH	GS	LM	JD/SNK/Al	HG/ÁÓ		
Man months	0,5	0,0	0,0	2,0	0,0	1,0	2,0		5,5
Salaries	430	0	0	616	0	252	504		1802
Travel	400	0	0	500	0	0	500		1400
Facilities	70	0	0	180	0	60	120		430
Total cost	900	0	0	1296	0	312	1124		3632
GEORG funding	0	0	0	0	0	252	886		1138
Other financing	900	0	0	1296	0	60	238		2494