Demonstration of Improved Energy Extraction from a Fractured Geothermal Reservoir

A progress report for the period 1.3.1996 - 30.9.1997 for the Thermie project GE-0060/96

Hita- og Vatnsveita Akureyrar, HVA
Orkustofnun - National Energy Authority
Uppsala University
Hoechest Danmark A/S
RARIK - Iceland State Electricity

November 1997

Content

1. SUMMARY

The design phase of the demonstration project at Laugaland lasted from September 1996 through July 1997. It involved design of the return water pipeline, injection pumps, automatic monitoring- and control system and the seismic monitoring network, as well as logging of the injection wells.

The manufacturing phase started in November 1996 by production and construction of the return water pipeline, followed by modification of existing seismic software and manufacture of monitoring equipment, injection pumps and seismic equipment. This phase lasted until the end of September 1997.

The assembly and installation phase lasted from June through September 1997. It involved assembly and installation of the monitoring- and control system, the injection pumps and the seismic network.

The commissioning phase of the project took place in August and September 1997, by start-up of the seismic network and reservoir monitoring. This was followed by the start-up of the re-injection on the 8th of September.

The progress of the project has been mostly in line with the time- and cost schedule of the corresponding contract and no major deviations have occurred yet.

2. PROGRESS REPORT

2.1 Introduction

The structure of this progress report is based on the items described in the detailed breakdown of the project in table 21 of Annex I of the project contract, with some minor deviations. Work on the project started in September 1996 and the progress until end of September 1997 is described. A progress diagram for the project is shown on the following page.

2.2 Design

2.2.1 Overall design of the project

This part of the project was mostly finished during the preproposal phase. The overall design was reviewed in connection with the more detailed design of individual parts of the project, resulting in only minor changes from the original design. The overall design of the project is under constant re-evaluation during the progress of the project, however.

2.2.2 Logging

The first logging phase was completed during the autumn of 1996 under the supervision of Orkustofnun. This included sonic-, resistivity- and borehole televiewer logging of the two re-injection wells as well as several other conventional logs.

2.2.3 *Pipeline design*

The general specifications for the return-water pipeline were available in October 1996 and its detailed design in November 1996. The design work was carried out by the technical department at HVA, with the assistance of consulting engineers.

2.2.4 *Design of pumps*

The design of pumps for the re-injection system was completed at the end of February 1997. This was carried out by the technical department of HVA in co-operation with Orkustofnun, RARIK and consulting engineers.

2.2.5 *Design of seismic monitoring system*

The design of the seismic monitoring system started in December 1996 and was finished by the end of June 1997. The design was the responsibility of the University of Uppsala in co-operation with Orkustofnun and HVA.

Field investigation of the Laugarland area, regarding selection of sites for the six seismic stations, was performed on January 17th. Good bedrock was found on hill-sides west and east of the river Eyjarfjardara, but the flat valley floor is covered by thick sediments, which cause unfavourable conditions for precise detection of high frequency seismic signals. The valley bottom was therefore avoided in site selections.

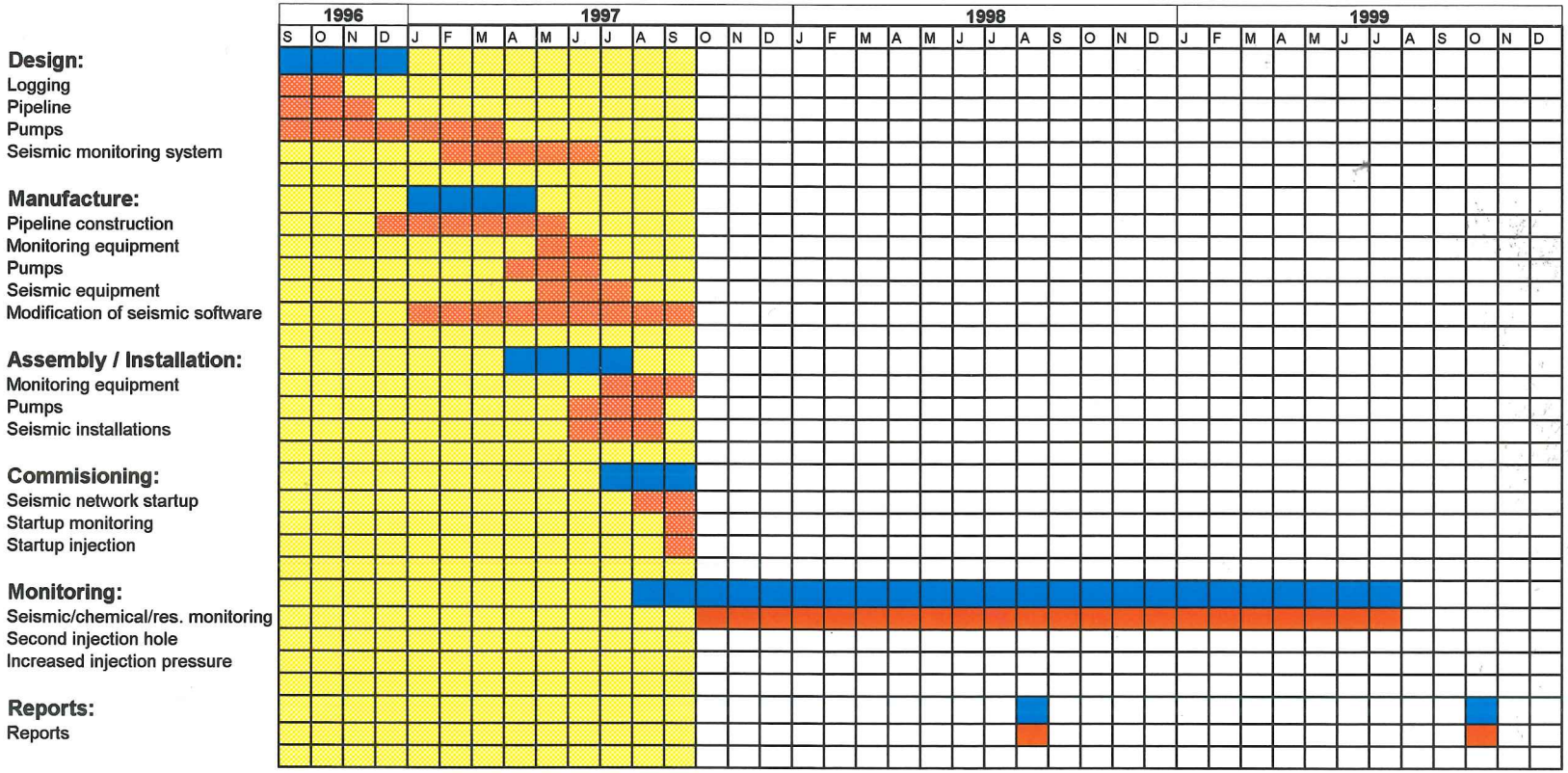
Genetic Algorithms were used to invert for the best location of the stations. The criteria used in the inversion was maximising the variance of the: a) distances up to 3500 m, b) angles from the source to the stations, and c) the angles within quadrant modules. The results showed a very strong dependency on the exact location of the closest station. To find a suitable site for the closest station, noise tests were carried out April 1997 to record the ground motion from pumps in the hot water production wells, which can produce large signals especially close to the resonance frequency of the pumps.

Contacts was established with the National Telephone Company P&S to get information about the availability of telephone lines in the area. The type of connection we were seeking ranged from: a) simple modem connection, b) X.25 connection, c) Internet subscription or d) ISDN connection. We selected the simple modem connection which was the alternative with the best price-performance ratio for our purpose.

Several alternatives were considered regarding the three component seismometers. Two main types of seismometers are available; active elements with feedback electronics and passive elements which do not include any electronic circuitry (pure mechanical). Considering the frequency range, the background ground motion and the size of the expected seismic signals we excluded the active seismometers due to the noise characteristics of these devices. The final decision made was to purchase separate passive 4.5 Hz elements for each component (vertical, North-South and East-West) and assemble them in a robust housing. The assemble work was carried out by Orkustofnun.

Progress diagram for project GE-0060/96.

The diagram shows the inital time schedule, the actual progress until 30.9.1997 and expected time scedule from that date



Legend:

- Time schedule according to the contract
- Actual/expected time schedule 30.9. 1997
- Time period for the progress report

There are not many digitizers on the market meeting the requirements of up to 1000 samples per second, high dynamic range and very low electronic noise. The units with the best price-performance ratio were found in the HRD-24 24 bit digitizer from Nanometrics in Canada.

2.3 Manufacture

2.3.1 Pipeline construction

Manufacture of plastic pipes for the 12 km long return-water pipeline from Akureyri to Laugaland was completed in early December 1996. Hochest Danmark was responsible for this part of the project with aid of a subcontractor, Set hf. The pipeline has an inner diameter of 150 mm.

An open tender for the construction of 8 km of the pipeline was launched in December 1996. The remaining 4 km were constructed by the staff of HVA as well as all welding and transport of the pipeline. A total of 5 contractors made bids. The lowest bid was accepted and a subcontract signed in December 1996. The lowest bid amounted to 38%, while the highest one was 83%, of the expected cost. These unusually low prices result from limited activities among contractors during the main winter season. The pipeline construction started in late December 1996 and 8 of the 12 km had been finished by the end of February 1997, in spite of difficult weather conditions. The remainder of the pipeline had been completed by the end of May 1997. The pipeline is buried at a depth of 1.2 m to avoid freezing in winter-time.

2.3.2 Monitoring equipment

Automatic, computer-controlled equipment for monitoring various parameters describing the injection, and the response of the Laugaland reservoir to the injection, were manufactured in May and June 1997. These parameters include the flow-rate and temperature of the return-water leaving the pumping station in Akureyri, rate of injection, water temperature and well-head pressure for both injection wells, as well as flow-rate and water temperature for the three production wells at Laugaland. In addition the system monitors the frequency of the pump-motors involved.

2.3.3 Pumps

Pumps for injecting the return-water into the two injection wells were manufactured during April through June 1997. These have capacities of 20 l/s at 30 bar pressure and 10 l/s at 10 bar pressure, respectively. A pump intended for pumping the return water from the pumping station in Akureyri towards Laugaland was manufactured during the same period.

2.3.4 Seismic equipment

Digitizers of the type HRD-24 were ordered from a Canadian company, Nanometrics. Six vertical and twelve horizontal 4.5 Hz geophones were ordered from the company SENSOR in the Netherlands. An individual calibration test was ordered for each geophone element. Seven Pentium PC's with internal modems and one Sun SPARC

Station was ordered from a local dealer. Optic cables for the data communication between digitizer in the seismic station vaults and the on-site computers were ordered from the National Telephone Company P & S. Power backup units are installed for all digitizers and all computers, both at the seismic stations and at HVA headquarters.

2.3.5 Modification of seismic software

During December 1996 and January 1997 work focused on software development related to the interfacing of the Nanometrics HRD digitizer to the SIL Utility Software. Tests were performed for 500 samples per second on three channels using Pentium computer. The results showed a good performance. Configurable logging facilities was implemented for logging various "State Of Health" parameters available from the digitizer.

During the period Mars through May work concentrated on adaptation of the phase-detection procedure to the 500 cps configuration and the higher frequency content of the data. Adaptation of the rest of the seismological software was carried out during May through July. This involved among other things the change from using single float representation of coordinate and time information into double precision. This was necessary due to the small size of the network area. To make the interactive view of the seismic activity more sensible, information regarding source location is displayed relative to the injection borehole, both in distance and angle.

Work during May and June involved software development and configuration of the standard Unix-to-Unix communication package (UUCP). Some modifications of the acquisition software related to the communication between the stations and the center was done. This mainly involved modifications or rewriting of Unix shell scripts.

2.4 Assembly/Installation

2.4.1 Monitoring equipment

The automatic injection- and reservoir monitoring system was installed and tested during the period from July through September 1997. This work was carried out by the technical department of HVA, Raftákn Consulting Engineers and Raftó Electrical Contractors. Data collected by this system, as well as instantaneous information on the status of the injection and production wells, can be accessed through computers in the pumping station of HVA in Akureyri, as well as in its headquarters. Consequently these data are transmitted by e-mail to Orkustofnun for evaluation and analysis.

2.4.2 Pumps

The pumps for pumping the return water from Akureyri to Laugaland, and hence into the injection wells, were assembled and installed during the period from June through August 1997. This was done by the staff of HVA and RARIK with the aid of Raftó Electrical Contractors.

2.4.3 Seismic installations

The vaults housing the seismic stations, and the associated infrastructure, were constructed during the period from late May through the middle of July 1997. Some less sophisticated vaults were constructed for additional mobile seismic stations to be operated in case of observed seismic activity located in the reservoir. The mobile stations are made available by Uppsala University. If seismic activity on faults within the reservoir is detected by the permanent network four additional mobile stations will be activated within 52 hours to secure the best possible recordings of micro-earthquakes on these faults. This is done to ensure the best available data on active faults due to the injection allowing for very accurate relative location of the micro-earthquakes leading to precise fault orientation.

The seismic network was installed during the period of July 15th through July 30th. Technically the network was in operation on July 30th and remotely available for parameter tuning and adjustments from Uppsala through Internet. During August and September the main work concentrated on tuning the network parameters for the highest possible micro-earthquake detection ability, within the reservoir. The large amount of earthquakes north and north-east of the area (50 to 100 km distance) are avoided by using different detection parameters for different regions. The day by day control of the network operation is done in Uppsala through the Internet. All saved earthquake data is also transfered to Uppsala through the Internet at night.

2.5 Commissioning

2.5.1 Seismic network startup

The start-up of the seismic network took place in late August.

2.5.2 Startup monitoring

The start-up of the monitoring took place during September 1997. This involved water-level measurements in a number of observation wells inside, as well as outside, the Laugaland area. It also involved the collection of water samples from hot water production wells, and a return water sample, for chemical analyses, which will be used as references during later phases of the project. Furthermore, the start-up of monitoring involved additional logging of the two injection wells, as well as start-up of the automatic monitoring system. Some fine-tuning of the automatic monitoring system was also performed in September. In addition, the start-up included a step-rate injection test of the main injection well.

2.5.3 Startup injection

The start-up of the actual injection took place on the 8th of September 1997. A nearly constant injection rate of 8 l/s was maintaned through the remainder of September. The temperature of the return-water, as it was injected, was around 21°C. The well-head pressure increased slowly to about 6 bar-g during this period. At the end of the start-up period a chemical tracer was injected into the injection well. The recovery of this tracer in the production wells in the Laugaland area will be monitored carefully.

2.6 Monitoring

The monitoring phase of the re-injection project at Laugaland started on October 1st 1997. At that time the rate of injection was about 8 l/s, while a production of about 41 l/s was maintained from one of three hot water production wells in the area. This will be maintained during the first few months of the monitoring phase.

3.1 Financial report from Hita- og Vatnsveita Akureyrar

PART D - FINANCIAL REPORT Nr. 1
(to be submitted in 4 copies)

Nature of costs (1) :...Total cost
Name and address of the contractor: **Hita- og Vatnsveita Akureyrar**

Contract Nr: **GE- 0060-96**
Name of Financial Officer: **Franz Árnason**
Telephone: 354-461-2110
Telefax: 354-461-2591
Place designated for financial audit:
Hita- og Vatnsveita Akureyrar, Rangárvöllum, 600 Akureyri

Exchange rate applies for national conversion / ECU currency (4): 78,8593

A) Expenditure incurred during the period from ...1.3.1997...to...28.09.1997

Category of expenditure (5)	Expenditure per period	
	Nat. currency	ECU
Direct costs:		
1. Personnel	10.283.600	130.404
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	12.440.396	157.754
4. Subcontracting	11.937.675	151.379
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	7.210.130	91.430
Indirect costs (10):		0
8. Personnel overheads (Annex I)	7.566.600	95.951
9. Equipment overheads (Annex 3)		0
VAT (12)	0	0
TOTAL A (to be carried over)	49.438.401	626.919

40% contribution of the commission	19.775.360	250.768

(*) See page "Contractors Declaration" and Part D of Annex II to the contract for declaration and explanatory notes on the expenditure submitted.

Carry Over of Total A	49.438.401	626.919

B) Total expenditure previously submitted	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	9.146.000	115.979
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	2.425.831	30.762
4. Subcontracting	3.765.281	47.747
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	72.960	925
7. Other expenditure (9)	1.119.405	14.195
Indirect costs (10):		
8. Personnel overheads (Annex I)	7.496.400	95.060
9. Equipment overheads (Annex 3)	0	0
Adjustment of previous expenditure (11)	0	0
VAT (12)		
TOTAL B	24.025.877	304.668

C) Cumulative expenditure since the work commencement date	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	19.429.600	246.383
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	14.866.227	188.516
4. Subcontracting	15.702.956	199.126
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	72.960	925
7. Other expenditure (9)	8.329.535	105.625
Indirect costs (10):		
8. Personnel overheads (Annex I)	15.063.000	191.011
9. Equipment overheads (Annex 3)	0	0
VAT (12)	0	0
TOTAL C	73.464.278	931.587

CONTRACTORS CERTIFICATE (13)

We certify that

- the above expenditure was incurred for the work specified in the contract and that it was necessary to the proper performance of this work;

- this involves actual expenditure which falls within the definition of allowable costs specified in the contract;

- all the necessary authorizations were obtained from the Commission;

- all the documents justifying the costs are available for the purpose of audit;

- any necessary adjustments to expenditure reported in previous expenditure statements have been incorporated in this statement.

Date: 20.11.97

Name of Project Manager
Magnús Finnsson
Signature of Project manager

Date: 20.11.97

Name of Financial Officer
Franz Árnason
Signature of Financial Officer

NOTES

1 Insert the applicable indication: TC (total cost); AC (additional cost).
2 Cross out the useless indication - for the associated contractor, see Article 3 of Annex II. Each associated contractor has to give a separate statement of expenditure via the contractor with hom he is associated - his costs should not appear in the statement of expenditure of the contractor concerned.
3 The associated contractor must specify the contractor's name with which he is associated.

4 The exchange rates must correspond to the rate indicated in Article 21, paragraph 1 of Annex II.
5 Separate details need not be provided for each specific category in the annexes that follow.
6 Equipment must be depreciated - see Article 19, paragraph 2 of Annex II.
7 See Article 19, paragraph 4 of Annex II.
8 See Article 19, paragraph 5 of Annex II.
9 See Article 19, paragraph 6 of Annex II. They must be approved by the Commission.
10 See Article 20 of Annex II. The contractors who apply the method of additional cost can attribute up to 20% of the direct costs to personnel, material, travel, consumables, computer costs and other high costs specific to the project.
11 Does not apply to the first cost statement. Any correction has to be detailed and justified.
12 For any invoice or note specific to the project, drawn up by a supplier where the amount exceeds ECU 2.500, se Article 3, paragraph 2 of the contract.
13 The technical and the financial officer responsible must sign the certificate.
14 This concerns the person appointed as being directly responsible for the completion of the work - see Article 2, paragraph 3 of Annex II.

1. PERSONNEL AND OVERHEADS

ANNEX 1

Staff categories (1)	Names A	Number of hours or of days B	Wage rate (2) C	Time scale for overheads (3) D	Amount for personnel (B) * (C)	Assembling overheads (B) * (D)
Project leader	Franz Árnason	367	2200	1800	807.400	660.600
Engineers:	Ármi Árnason	690	2200	1800	1.518.000	1.242.000
	Magnús Finnsson	484	2200	1800	1.064.800	871.200
	Árni Kristjánsson	394	2200	1800	866.800	709.200
	Vignir Hjaltason	578	2200	1800	1.271.600	1.040.400
					0	0
Technicians and equivalents	Diverse technicians	0	2000	1640	0	0
					0	0
Other categories (to be specified)	laborers	3804	1250	800	4.755.000	3.043.200
				Sub-totals	10.283.600	7.566.600
				TOTAL (Personnel + overheads)		17.850.200

1 Use the categories corresponding to the contractor's valid salary structure.

2 This wage rate contains the items indicated in Article 19, paragraph 1 of Annex II.

3 The principles applicable to overheads are indicated in Article II of the contract. This column should remain empty when contractors apply the method of additional cost.

2. DEPRECIATION ON EQUIPMENT [1)]

ANNEX 2

(national currency)

Description	Purchase date (invoice)	Cost	Period of depreciation 36/60 month	% of assignment to the project [2)]	Amount
				TOTAL	0

1) For the calculation of refundable costs, see Article 19, paragraph 2 of Annex II
2) Percentage of use of the equipment to be depreciated under the project

2. CONSUMABLE EQUIPMENT EXPENDITURE

ANNEX 3

(national currency)

Date of purchase	Accounting reference	Suppliers	Type of equipment	Amount
1. Consumables/ materials				
1.1.- Direct purchases				
	680865-0199	Ísleifur Jónsson	Pumps	440.228
	471194-3019	Héðinn	Controlling equipment	1.131.450
	710269-3869	Þór hf	Controlling equipment	276.729
	430184-0409	EJS	Data loggers	676.006
		Diverse	Div.	33.571
	560187-2039	Tölvutæki	Data loggers	1.008.555
	550978-0169	Floway	Pumps	2.300.000
	550978-0169	Siemens	PLC computers	1.170.000
	550978-0169	IWK	Control valves	280.000
	550978-0169	Högfors	Control valves	260.000
	550978-0169	Siebert	Digital meters	400.000
	550978-0169	Nanometrics	A/D converters	3.100.000
1.3- Internal supplies				
	550978-0169	HVA		1.363.857
			Total consumables	12.440.396
			Overheads of equipment	

(1) Where necessary , indicate the overheads specifically applicable to the equipment (quality control, handling and storage expenses)

4. SUBCONTRACTING
(Services, Studies, Consultancy)

ANNEX 4

(national currency)

Invoices		Suppliers (1)	Brief description of type of assistance	Amount
Dates	ACC. Refer.			
	6661076-0119	Raftákn	Electronic & computer serv	2.629.342
	560175-0869	VN	Engineering consultance	783.646
	440297-2429	Ratfó	Electrical construction	2.627.422
	560197-2769	Halldór Baldursson	Pipeline construction	1.707.427
	500269-5379	OS	Scientific consultancy	688.630
		Diverse	div.	1.551.129
	510269-1879	Póstur og símí	Telecomunication	413.905
	530696-2949	Nett	Telecomunication	18.850
	590279-0219	Ösp	Pipeline construction	930.000
	560187-2039	Tölvutæki	Software consulting	29.600
	530696-2949	Nett	Software consulting	229.195
	530696-2949	Nett	Software consulting	328.529
			TOTAL 4	11.937.675

1) Any relationship , ownership or control between the supplier and contractor must be declared

5. COMPUTER COSTS

ANNEX 5

(national currency)

- Processing centre:
-Computer type:
-Invoicing units:

Month	Code	Utilisation types (1)			Rate (2)	Amount
					TTA 5	0

1) -Connection time
   - CPU time
   - printing (line)
   - Storage
   - Specific equipment and material

2) Method of calculation must be included

6. TRAVEL AND SUBSISTENCE FOR CONTRACTOR'S STAFF

ANNEX 6

(national currency)

Date	Place	Purpose	Name	Expenditure		
				Travel	Hotel & expenses	TOTAL
6.1. Trips inside the EU						
						0
6.2. Trips outside the EU[1]						
					TOTAL 6	0

1) See Article 19, paragraph 4 of Annex II

7. OTHER EXPENDITURE

ANNEX 7

(national currency)

Invoices		Suppliers	Type of expenditure	Amount
Dates	ACC. Refer.			
	560187-2039	Tölvutæki	Construction material	4.522
	460289-1309	Sandbl. og málmh	Construction material	562.688
	600269-0469	Slippstöðin	Construction material	231.945
	530292-2079	Nýherji	Construction material	180.000
	690384-0789	Sæplast	Construction material	310.338
	550978-0169	HVA	Construction machines	1.193.954
	670169-5459	J. Rönning	Construction material	554.154
	530276-0239	Tæknival	Construction material	273.544
	550978-0169	HVA	cars	847.099
	550978-0169	HVA	lorries	770.618
		Diverse	Travel and meeting costs	731.073
	410169-6229	City of Akureyri	Geodetic measurements et	147.404
		Diverse	construction material etc.	1.402.791
			TOTAL 7	7.210.130

8. SUMMARY OF THE PARTICIPANTS' CONTRACTUAL COSTS (IN ECU)

ANNEX 8

For the period from: 1-mar-97 to: 30-sep-97

Title of the project: **Demonstartion of improved energy extraction from a fractured geothermal reservoir**

Contract nr: **GE-0060-96**

The participant's name[1]	Position[2]	Total costs (ECU)	community contribution (ECU)	Nature of the costs[3]	Comments[4]
HVA	COO	626.919	250.768	TC	
OS	CR	68.415	27.366	TC	
UU	CR	74.767	29.907	TC	
Rarik	CR	18.622	7.449	TC	
Hoechest	CR	0	0	TC	
	TOTAL	788.723	315.489		

The original copy of the statement of expenditure signed by each participant is attached.

Certified by the person(s) appointed by the contractors (5) as being essential to work carried out under the contract.

Name: Franz Árnason Name:

Position: director Position:

Signature: Franz Árnason Signature:

Date: 20 november 1997 Date:

1) Coordinator, contractors, associated contractors and, if the contract requires it, principal subcontractors.

2) Insert the corresponding indication: COO (coordinator), CR (contractor), AC (Associated contractor).

3) Insert the corresponding indication: TC (total costs), AC (additional costs).

4) When a participant does not give a statement of expenditure, indicate "no statement" in the column "Remarks". If the statement of expenditure of a participant covers more than one period, indicate the number of periods in the column "Remarks". Separate cost statements must be given for each period.

5) Or persons designated for the purpose of Article 2 (b), paragraph 2 of Annex II

3.1 Financial report from Orkustofnun

PART D - FINANCIAL REPORT Nr 1
(to be submitted in 4 copies)

Nature of costs (1) :...Total cost.....
Name and address of the contractor: **Orkustofnun**

Contract Nr :**GE-0060-96**
Name of Financial Officer: **Jón Haukur Guðlaugsson**
Telephone: 569-6000
Telefax: 568-8896
Place designated for financial audit:
Orkustofnun, Grensásvegur 9, 108 Reykjavík, Iceland

Exchange rate applies for national conversion / ECU currency (4): 78,8593

A) Expenditure incurred during the period from ...1.03.96...to...30.09.1997.

Category of expenditure (5)	Expenditure per period	
	Nat. currency	ECU
Direct costs:		
1. Personnel	2.234.901	28.340
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	1.423.900	18.056
Indirect costs (10):		0
8. Personnel overheads (Annex I)	1.736.349	22.018
9. Equipment overheads (Annex 3)		0
VAT (12)	0	0
TOTAL A (to be carried over)	5.395.150	68.415

40 % contribution of the commission	2.158.060	27.366

(*) See page "Contractors Declaration" and Part D of Annex II to the contract for declaration and explanatory notes on the expenditure submitted.

Carry Over of Total A	5.395.150	68.415

B) Total expenditure previously submitted	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	832.000	10.159
2. Depreciation of Equipment (6)		
3. Consumable equipment (8)		
4. Subcontracting		
5. Data-processing costs (8)		
6. Travel and related costs (7)		
7. Other expenditure (9)		
Indirect costs (10):		
8. Personnel overheads (Annex I)	646.400	7.893
9. Equipment overheads (Annex 3)		
Adjustment of previous expenditure (11)		
VAT (12)		
TOTAL B	1.478.400	18.052

C) Cumulative expenditure since the work commencement date	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	3.066.901	38.499
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	1.423.900	18.056
Indirect costs (10):		
8. Personnel overheads (Annex I)	2.382.749	29.911
9. Equipment overheads (Annex 3)	0	0
VAT (12)	0	0
TOTAL C	6.873.550	86.467

CONTRACTORS CERTIFICATE (13)

We certify that

- the above expenditure was incurred for the work specified in the contract and that it was necessary to the proper performance of this work;

- this involves actual expenditure which falls within the definition of allowable costs specified in the contract;

- all the necessary authorizations were obtained from the Commission;

- all the documents justifying the costs are available for the purpose of audit;

- any necessary adjustments to expenditure reported in previous expenditure statements have been incorporated in this statement.

Date: 1997-11-19 Date: 1997-11-19

Name of Project Manager
Guðni Axelsson

Name of Financial Officer
Jón Haukur Guðlaugsson

Signature of Project manager

Signature of Financial Officer

NOTES

1 Insert the applicable indication: TC (total cost); AC (additional cost).
2 Cross out the useless indication - for the associated contractor, see Article 3 of Annex II. Each associated contractor has to give a separate statement of expenditure via the contractor with hom he is associated - his costs should not appear in the statement of expenditure of the contractor concerned.
3 The associated contractor must specify the contractor's name with which he is associated.

4 The exchange rates must correspond to the rate indicated in Article 21, paragraph 1 of Annex II.
5 Separate details need not be provided for each specific category in the annexes that follow.
6 Equipment must be depreciated - see Article 19, paragraph 2 of Annex II.
7 See Article 19, paragraph 4 of Annex II.
8 See Article 19, paragraph 5 of Annex II.
9 See Article 19, paragraph 6 of Annex II. They must be approved by the Commission.
10 See Article 20 of Annex II. The contractors who apply the method of additional cost can attribute up to 20% of the direct costs to personnel, material, travel, consumables, computer costs and other high costs specific to the project.
11 Does not apply to the first cost statement. Any correction has to be detailed and justified.
12 For any invoice or note specific to the project, drawn up by a supplier where the amount exceeds ECU 2.500, se Article 3, paragraph 2 of the contract.
13 The technical and the financial officer responsible must sign the certificate.
14 This concerns the person appointed as being directly responsible for the completion of the work - see Article 2, paragraph 3 of Annex II.

1. PERSONNEL AND OVERHEADS

ANNEX 1

Staff categories (1)	Names A	Number of hours or of days B	Wage rate (2) C	Time scale for overheads (3) D	Amount for personnel (B) * (C)	Assembling overheads (B) * (D)
Project leader	Guðni Axelsson	254	2600	2020	660.400	513.080
Experts	Grímur Björnsson	20	2600	2020	52.000	40.400
	Sigvaldi Thordason	49	2600	2020	127.400	98.980
	Kjartan Birgissson	27	2600	2020	70.200	54.540
	Guðrún Sverrisdóttir	48	2600	2020	124.800	96.960
	Ómar Sigurðsson	40	2600	2020	104.000	80.800
	Helga B. Sveinbjörnsdóttir	84	2600	2020	218.400	169.680
	Ólafur G. Flóvenz	134	2600	2020	348.400	270.680
	Halldór Ármannsson	2	2600	2020	5.200	4.040
	Einar H. Haraldsson	176	2600	2020	457.600	355.520
	Karl Gunnarsson	24	2600	2020	62.400	48.480
Technicians and equivalents					0	0
					0	0
Other categories (to be specified)	Sylvia Jóhannsdóttir (assistant)	3	1367	1063	4.101	3.189
				Sub-totals	2.234.901	1.736.349
				TOTAL (Personnel + overheads)		3.971.250

1 Use the categories corresponding to the contractor's valid salary structure.

2 This wage rate contains the items indicated in Article 19, paragraph 1 of Annex II.

3 The principles applicable to overheads are indicated in Article II of the contract. This column should remain empty when contractors apply the method of additional cost.

7. OTHER EXPENDITURE

ANNEX 7

(national currency)

Invoices		Suppliers	Type of expenditure	Amount
Dates	ACC. Refer.			
		internal	Well logging	1.137.460
		internal	Chemical analyses	286.440
			TOTAL 7	1.423.900

3.1 Financial report from Uppsala University

PART D - FINANCIAL REPORT Nr. 2
(to be submitted in 4 copies)

Nature of costs (1) :Total cost
Name and address of the contractor /
Uppsala University

Contract Nr: **GE-0060-96**
Name of Financial Officer: Inga-Stina Hansson
Telephone: 46-18-183312
Telefax: 46-18-181-640
Place designated for financial audit:
Uppsala Univeersity, Villavaegen 16, S-75236 Uppsala

Exchange rate applies for national conversion / ECU currency (4): 8,64594

A) Expenditure incurred during the period from .....1.3.1997.....to...30.09.1997.....

Category of expenditure (5)	Expenditure per period	
	Nat. currency	ECU
Direct costs:		
1. Personnel	346 794	40 111
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	971	112
Indirect costs (10):		0
8. Personnel overheads (Annex I)	298 663	34 544
9. Equipment overheads (Annex 3)	0	0
VAT (12)	0	0
TOTAL A (to be carried over)	646 428	74 767

40% contribution of the commission	258 571	29 907

(*) See page "Contractors Declaration" and Part D of Annex II to the contract for declaration and explanatory notes on the expenditure submitted.

Carry Over of Total A	648 428	74 767

B) Total expenditure previously submitted	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	139 433	16 127
2. Depreciation of Equipment (6)		
3. Consumable equipment (8)		
4. Subcontracting		
5. Data-processing costs (8)		
6. Travel and related costs (7)	4 760	551
7. Other expenditure (9)	345	40
Indirect costs (10):		
8. Personnel overheads (Annex I)	120 081	13 889
9. Equipment overheads (Annex 3)		
Adjustment of previous expenditure (11)		
VAT (12)		
TOTAL B	264 619	30 606

C) Cumulative expenditure since the work commencement date	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	486 227	56 238
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	4 760	551
7. Other expenditure (9)	1 316	152
Indirect costs (10):	0	0
8. Personnel overheads (Annex I)	418 744	48 433
9. Equipment overheads (Annex 3)	0	0
VAT (12)	0	0
TOTAL C	911 047	105 374

CONTRACTORS CERTIFICATE (13)

We certify that

- the above expenditure was incurred for the work specified in the contract and that it was necessary to the proper performance of this work;

- this involves actual expenditure which falls within the definition of allowable costs specified in the contract;

- all the necessary authorizations were obtained from the Commission;

- all the documents justifying the costs are available for the purpose of audit;

- any necessary adjustments to expenditure reported in previous expenditure statements have been incorporated in this statement.

Date: 971106

Name of Project Manager
Reynir Böðvarsson

Signature of Project manager

Date: 971106

Name of Financial Officer
Inga-Stina Hansson

Signature of Financial Officer

NOTES

1 Insert the applicable indication: TC (total cost); AC (additional cost).
2 Cross out the useless indication - for the associated contractor, see Article 3 of Annex II. Each associated contractor has to give a separate statement of expenditure via the contractor with hom he is associated - his costs should not appear in the statement of expenditure of the contractor concerned.
3 The associated contractor must specify the contractor's name with which he is associated.

4 The exchange rates must correspond to the rate indicated in Article 21, paragraph 1 of Annex II.
5 Separate details need not be provided for each specific category in the annexes that follow.
6 Equipment must be depreciated - see Article 19, paragraph 2 of Annex II.
7 See Article 19, paragraph 4 of Annex II.
8 See Article 19, paragraph 5 of Annex II.
9 See Article 19, paragraph 6 of Annex II. They must be approved by the Commission.
10 See Article 20 of Annex II. The contractors who apply the method of additional cost can attribute up to 20% of the direct costs to personnel, material, travel, consumables, computer costs and other high costs specific to the project.
11 Does not apply to the first cost statement. Any correction has to be detailed and justified

3.1 Financial report from RARIK

PART D - FINANCIAL REPORT Nr 1

(to be submitted in 4 copies)

Nature of costs (1) :...Total cost.....
Name and address of the contractor: **Rarik**

Contract Nr :**GE-0060-96**
Name of Financial Officer: **Tryggvi Aðalsteinsson**
Telephone: 569-6000
Telefax: 568-8896
Place designated for financial audit:
Rarik, Óseyri 9, 600 Akureyri, Iceland

Exchange rate applies for national conversion / ECU currency (4): 78,8593

A) Expenditure incurred during the period from ...1.03.97...to...30.09.1997.

Category of expenditure (5)	Expenditure per period	
	Nat. currency	ECU
Direct costs:		
1. Personnel	684.600	8.681
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	233.861	2.966
Indirect costs (10):		0
8. Personnel overheads (Annex I)	550.060	6.975
9. Equipment overheads (Annex 3)		0
VAT (12)	0	0
TOTAL A (to be carried over)	1.468.521	18.622

40 % contribution of the commission	587.408	7.449

(*) See page "Contractors Declaration" and Part D of Annex II to the contract for declaration and explanatory notes on the expenditure submitted.

Carry Over of Total A	1.468.521	18.622

B) Total expenditure previously submitted	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	106.600	1.302
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	0	0
Indirect costs (10):		
8. Personnel overheads (Annex I)	82.820	1.011
9. Equipment overheads (Annex 3)	0	0
Adjustment of previous expenditure (11)	0	0
VAT (12)		
TOTAL B	189.420	2.313

C) Cumulative expenditure since the work commencement date	Expenditure per period Nat. currency	ECU
Direct costs:		
1. Personnel	791.200	9.983
2. Depreciation of Equipment (6)	0	0
3. Consumable equipment (8)	0	0
4. Subcontracting	0	0
5. Data-processing costs (8)	0	0
6. Travel and related costs (7)	0	0
7. Other expenditure (9)	233.861	2.966
Indirect costs (10):		
8. Personnel overheads (Annex I)	632.880	7.986
9. Equipment overheads (Annex 3)	0	0
VAT (12)	0	0
TOTAL C	1.657.941	20.935

CONTRACTORS CERTIFICATE (13)

We certify that

- the above expenditure was incurred for the work specified in the contract and that it was necessary to the proper performance of this work;

- this involves actual expenditure which falls within the definition of allowable costs specified in the contract;

- all the necessary authorizations were obtained from the Commission;

- all the documents justifying the costs are available for the purpose of audit;

- any necessary adjustments to expenditure reported in previous expenditure statements have been incorporated in this statement.

Date: 20.11.'97 Date: 20.11.97.

Name of Project Manager
Tryggvi Þór Haraldsson

Name of Financial Officer
Tryggvi Aðalsteinsson

Signature of Project manager

Signature of Financial Officer

NOTES

1 Insert the applicable indication: TC (total cost); AC (additional cost).
2 Cross out the useless indication - for the associated contractor, see Article 3 of Annex II. Each associated contractor has to give a separate statement of expenditure via the contractor with hom he is associated - his costs should not appear in the statement of expenditure of the contractor concerned.
3 The associated contractor must specify the contractor's name with which he is associated.

4 The exchange rates must correspond to the rate indicated in Article 21, paragraph 1 of Annex II.
5 Separate details need not be provided for each specific category in the annexes that follow.
6 Equipment must be depreciated - see Article 19, paragraph 2 of Annex II.
7 See Article 19, paragraph 4 of Annex II.
8 See Article 19, paragraph 5 of Annex II.
9 See Article 19, paragraph 6 of Annex II. They must be approved by the Commission.
10 See Article 20 of Annex II. The contractors who apply the method of additional cost can attribute up to 20% of the direct costs to personnel, material, travel, consumables, computer costs and other high costs specific to the project.
11 Does not apply to the first cost statement. Any correction has to be detailed and justified.
12 For any invoice or note specific to the project, drawn up by a supplier where the amount exceeds ECU 2.500, se Article 3, paragraph 2 of the contract.
13 The technical and the financial officer responsible must sign the certificate.
14 This concerns the person appointed as being directly responsible for the completion of the work - see Article 2, paragraph 3 of Annex II.

1. PERSONNEL AND OVERHEADS

ANNEX 1

Staff categories (1)	Names	Number of hours	Wage rate (2)	Time scale for overheads (3)	Amount for personnel	Assembling overheads
	A	B	C	D	(B) * (C)	(B) * (D)
Project leader	Tryggvi Þór Haraldsson	32	2600	2020	83.200	64.640
					0	0
					0	0
Engineers	Arnar Sigtýsson	43	2600	2020	111.800	86.860
	Þórhallur Hjartarson	26	2600	2020	67.600	52.520
					0	0
					0	0
					0	0
					0	0
					0	0
					0	0
Technicians and equivalents	Diverse technicians	211	2000	1640	422.000	346.040
					0	0
Other categories (to be specified)					0	0
				Sub-totals	684.600	550.060
				TOTAL (Personnel + overheads)		1.234.660

1 Use the categories corresponding to the contractor's valid salary structure.

2 This wage rate contains the items indicated in Article 19, paragraph 1 of Annex II.

3 The principles applicable to overheads are indicated in Article II of the contract. This column should remain empty when contractors apply the method of additional cost.

2. DEPRECIATION ON EQUIPMENT [1)]

ANNEX 2

(national currency)

Description	Purchase date (invoice)	Cost	Period of depreciation 36/60 month	% of assignment to the project [2)]	Amount
				TOTAL	0

1) For the calculation of refundable costs, see Article 19, paragraph 2 of Annex II
2) Percentage of use of the equipment to be depreciated under the project

2. CONSUMABLE EQUIPMENT EXPENDITURE

ANNEX 3

(national currency)

Date of purchase	Accounting reference	Suppliers	Type of equipment	Amount
1. Consumables/ materials				
1.1.- Direct purchases				
1.3- Internal supplies				(1)
xxxxxxxxxxxxxxxxx		xxxxxxxxxxxx		
xxxxxxxxxxxxxxxxx		xxxxxxxxxxxx		
xxxxxxxxxxxxxxxxx		xxxxxxxxxxxx		(1)
			Total consumables	0
			Overheads of equipment	Formúla

(1) Where necessary , indicate the overheads specifically applicable to the equipment (quality control, handling and storage expenses)

4. SUBCONTRACTING
(Services, Studies, Consultancy)

ANNEX 4

(national currency)

Invoices		Suppliers (1)	Brief description of type of assistance	Amount
Dates	ACC. Refer.			
			TOTAL 4	0

1) Any relationship , ownership or control between the supplier and contractor must be declared

5. COMPUTER COSTS

ANNEX 5

(national currency)

- Processing centre:
-Computer type:
-Invoicing units:

Month	Code	Utilisation types (1)			Rate (2)	Amount
					TTA 5	0

1) -Connection time
   - CPU time
   - printing (line)
   - Storage
   - Specific equipment and material

2) Method of calculation must be included

6. TRAVEL AND SUBSISTENCE FOR CONTRACTOR'S STAFF

ANNEX 6

(national currency)

Date	Place	Purpose	Name	Expenditure		
				Travel	Hotel & expenses	TOTAL
6.1. Trips inside the EU						
6.2. Trips outside the EU[1]						
					TOTAL 6	0

1) See Article 19, paragraph 4 of Annex II

7. OTHER EXPENDITURE

ANNEX 7

(national currency)

Invoices		Suppliers	Type of expenditure	Amount
Dates	ACC. Refer.			
31/5 - 31/8		Diverse	Electrical cables etc	175.017
		Rarik	Electrical power	58.844
			TOTAL 7	233.861

3.1 Hochest Danmark as

No financial report for this period from Hoechest Danmark since the paricipation of Hochest was finished before the starting time of this report.