

PREEMINARY DESIGN

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FOR

KRAFLA GEOTHERWAL POWER PLANT

FOR

KRAFLA PROJECT EXECUTIVE COMMITTEE AKUREYRI, ICELAND

VOLUME 2 COST ESTIMATE

Prepared as a Joint Venture by

ROGERS ENGINEERING CO. INC. AND.

THORODDSEN AND PARTNERS

ENGINEERS & ARCHITECTS 111 PINE STREET

CONSULTINGENGINEERS ARMULA 4 REYKJAVIK, ICELAND

SAN FRANCISCO, CALIFORNIA 94111 USA

APRIL 15, 1975

PRELIMINARY DESIGN

REPORT

FOR

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AKUREYRI, ICELAND

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111 Pine Street
San Francisco, California USA

THORODDSEN AND PARTNERS Consulting Engineers Armúla 4

Reykjavík, Iceland

April 15, 1975

S-74028

VOLUME 2 COST ESTIMATE

The account numbers used in the cost estimate are those established by the United States Federal. Power Commission for the electric utility industry in the U.S. The purpose of this system is to assure a uniform accounting procedure for the electric utility industry.

The cost estimate includes the cost of the contractors move into the site, temporary facilities, lodging for the construction labor force and the necessary access road to the site.

Permanent housing is included for five families at Myvatn as well as one building to house operators at the power plant site; in addition, a dommitory-type building with cooking, eating and washing facilities is provided for housing 20 maintenance personnel during overhaul periods.

Also included in the estimate are all the structures and improvements, consisting of the powerhouse, cooling tower basin, grading and paving, and exterior equipment foundations. Detail costs for the turbine generating units, all auxiliaries, electrical equipment, fire protection system and control systems are shown in the following cost breakdowns. Engineering, construction management, a contingency, and interest during the construction, are shown as separate items in the cost breakdown.

The cost estimate assumes that equipment, materials and construction costs will be paid for in the normal manner which does not involve long term supplier or contractor financing. The turbine generator unit is included at contract price including spare parts. Other equipment costs shown reflect manufactures expected firm bid prices.

Labor costs are included at current labor rates and include escalation expected during the construction of the power plant. Contractor overhead, taxes, insurance and fee are included for each element of the project.

The cost of the necessary geothermal wells, the steam and hot water collection piping, steam water separators and the geothermal waste water disposal systems is not included since they are outside of the

scope of work assigned to the consulting engineers.

The total budget estimate for the project is 3,826.500 million Icelandic Kronur (\$25,510.000 U.S. Dollars). The cost per kW on the basis of the 60 MW plant rating is 63,775 Icelandic Kronur (\$425 U.S. Dollars).

KRAFLA GEOTHERMAL POWERPLANT CIVIL AND STRUCTURAL WORK

| | | Icelandic Kronur | U.S. Dollars |
|------|-----------------------------------|---------------------|-----------------|
| 1. | POWERHOUSE BUILDING | by 1000 | , |
| 1.1 | Excavation | 10.500 | 70.000 |
| 1.2 | Concrete | 116.900 | 779.000 |
| 1.3 | Prestressed concrete | 19.900 | 132.400 |
| 1.4 | External Insulation | 13.100 | 87.300 |
| 1.5 | Masonry | 22.600 | 150.000 |
| 1.6 | Steelwork | 8.800 | 58.600 |
| 1.7 | Architectural Finishing | 2.800 | 18.600 |
| 1.8 | Painting | 19.400 | 130.000 |
| 1.9 | Sanitary Installation | 8.400 | 56.000 |
| 1.10 | Heating and ventilation | 15.600 | 104.000 |
| 1.11 | Lighting | 5.200 | 34.600 |
| | | | н. |
| 2. | COQLING TOWER FOUNDATION | 15.000 | 100.000 |
| 3. | STRUCTURAL WORK ON SITE | 8.500 | 56.000 |
| 4. | EXCAVATION AND FILL | 22.700 | 151.300 |
| 5. | CONTRACTORS MOVE-IN | 84.000 | 560.000 |
| 6. | ACCESS ROAD | 63.000 | 420.000 |
| 7. | PERSONNEL LODGINGS | 73.600 | 490.500 |
| | TOTAL INSTALLED COST | 510.000 | 3.398.300 |
| 5 | Contingency on Equipment 5% | 8.600 | 57.400 |
| | Contingency on Labor at 15% | 50.900 | 339.500 |
| | Escalation on Labor at 8% | 31.200 | 208.000 |
| | Sub Total | 600.700 | 4.003.400 |
| | Engineering and supervision at 10 | % 60.100 | 400.400 |
| | Sub Total | 660.800 | 4.403.800 |
| | Construction Financing at 7 1/2% | 49.600 | 330.400 |
| | Total Structural Cost | 710.400 | 4.734.200 |

CONSTRUCTION COST ESTIMATE

KRAFLA GEOTHERMAL POWER PLANT

| Account No. | Description | Icelandic Kronur by 1,000 | U.S. <u>Dollars</u> |
|-------------|--|--|---|
| 310 | Land & Land Rights | .Not Included | Not Included |
| 311 | Structures & Improvments | . 510.000 | 3.398.300 |
| 312 | Geothermal Wells Steam-Water Separators Steam & Water Gathering Piping Geothermal Water Disposal System. | .Not Included | Not Included |
| 314 | Turbine Generator Units: Bridge Crane Condenser, Ejectors & Intercondens Cooling Tower Hot Well Pumps Aux. Cooling Water Pumps Miscellaneous Equipment Piping and Insulation Instrumentation Lighting, Power & Control Cable | | 13.162.300 |
| 315 | Accessory Electric Equipment: Startup Generator 11 kV Switchgear & Bus Duct Unit Substation w/400 V Switchgea: Motor Control Centers Generator Switchboards System Ground & Batteries | | 836.700 |
| 316 | Miscellaneous Power Plant Equipme Fire & Jockey Pumps Instrument & Plant Air Compressor Maintenance Equipment Waiting Room, Office, & Change Ro Furnishings Piping Instrumentation | s | 527.700 |
| 353 | Station Equipment: Generator Step-Up Transformer 132 kV OCB & Disconnect Switch Phase Bus Duct Switchboard for Substation Grounding & 132 kV Substation Equ LTC for Step-Up Transformer | | 1.568.800 |
| | Total Installed Cost | . 103.100 . 129.400 . 79.300 . 3.236.000 . 323.600 . 3.559.600 . 266.900 | 19.493.800 687.200 862.500 529.000 21.572.500 2.157.300 23.729.800 1.780.200 25.510.000 |

CONSTRUCTION COST ESTIMATE KRAFLA GEOTHERMAL POWER PLANT

| | | 4 | | THE TOTAL | | | | |
|---------|--|--|--------------------------------------|--|---|--|--|--|
| Account | $\underline{\mathtt{Description}}$ | Equipment Cost Delivered To <u>Húsavík</u> | Materials Delivered To Húsavík | Transportation From Húsavík to Site and Handling at Site | Installation or Construction Labor | Installation Equipment | Contractor's Overhead Taxes, Insuranse And Fee | TOTAL |
| 310 | Land & Land Rights | Not Incl. | Not Incl. | Not Incl. | Not Incl. | Not Incl. | Not Incl. | Not incl. |
| 311 | Structures & Improvements | | 833,000 | | 1,357,400 | 303,000 | 904,900 | |
| 312 | Geothermal Wells Steam-Water Separators Steam & Water Gathering Piping Geothermal Water Disposal System | Not Incl. | Not Incl. | Not Incl. | Not Incl. | Not Incl. | , | 3,398,300 |
| 314 | Turbine Generator Units | 5,872,000 | , | 58,000 | | | Not Incl. | Not Incl. |
| | Bridge Crane Condenser,Ejectors & Intercondenser Cooling Tower Hot Well Pumps Aux. Cooling Pumps Miscellaneous Equipment Piping and Insulation Instrumentation Lighting, Power & Control Cable | 215,000 1,230,000 990,000 730,000 61,000 34,000 | 718,000 171,000 151,000 | 21,500 12,300 Ine. 7,300 600 5,300 7,200 1,700 1,500 | 148,000 61,400 185,000 Inc. 47,600 8,200 32,500 472,300 190,200 | 89,000 14,000 43,000 Inc. 11,000 4,400 18,000 109,000 43,000 | 318,000 51,000 153,000 Inc. 39,000 15,000 70,800 390,000 158,000 | 6,485,000 362,900 1,623,300 990.000 834,900 89,200 160,600 1,696,500 563,900 |
| 315 | Accessory Electric Equipment Start-Up Generator 11 kV Switchgear & Bus Duct Unit Substation w/400 V Switchgear Motor Control Centers Generator Switchboards System Ground & Batteries | 80,000 148,000 166,000 23,000 118,000 | 81,000 | 800 1,500 1,700 200 1,200 800 | 48,600 11,500 16,400 2,500 34,000 13,300 | 24,000 11,000 2,700 3,800 600 8,000 | 70,000 25,000 6,000 8,600 1,100 13,000 | 356,000 165,400 169,700 196,500 27,400 174,200 |
| 316 | Miscellaneous Power Plant Equipment Fire & Jockey Pumps Instrument & Plant Air Compressors Maintenance Equipment Waiting Room, Office, & Change Room Furnishing Piping Instrumentation | 24,000 66,000 47,000 5,000 | 12,000 5,000 100,000 17,000 | 200 700 600 100 1,000 200 | 5,900 12,000 19,700 2,300 123,400 11,300 | 3,000 1,400 2,800 4,600 500 24,000 2,600 | 5,400 1,300 2,700 4,500 400 27,000 2,500 | 32,800 84,200 88,400 13,300 275,400 |
| 353 | Station Equipment Generator Step-Up Transformer 132 kV 0CB & Disconnect Sw. Phase Bus Duct Switchboard for Substation Grounding & 132 kV Substation Equipment LTC for Step-Up Transformer | 344,000 330,000 20,000 145,000 | 145,000 | 3,500 3,300 200 1,500 1,400 700 | 17,500 40,700 1,800 29,000 233,000 2,000 | 2,700 9,400 400 6,700 53,000 400 | 3,900 16,500 500 10,000 79,000 700 | 33,600 371,600 399,900 22,900 192,200 511,400 70,800 |
| | | | | | | Total Installed Cost Contingency on Equipment at 5% Contingency on Labor at 15% Escalation on Labor at 8% Sub.Total Engineering & Supervision at 10% Sub Total Construction Financing at 7½% | | 19,493,800 687,200 862,500 529,000 21,572,500 2,157,300 23,729,800 1,780,200 |
| | | | | | | | Total Project | 25,510.000 |

KRAFLA GEOTHERMAL POWER PROJECT SCHEDULE OF PAYMENTS IN Thousand of DOLLARS

| | <u>II</u> | TOTAL NVESTMENT | COMMITMENT | COMMITMENT | PAYMENT 1975 | |
|----|--|--------------------|-----------------|----------------|--------------|--|
| 1. | Mechanical Equipment | 16.750 | 12.190 | 4.560 | 1.219 | |
| 2. | Electrical Equipment | 1.130 | 800 | 330 | 80 | |
| 3. | Miscellaneous Power Plant Equipment | 740 | 180 | 560 | 18 | |
| 4. | Substation Equipment | 2.100 | 1.360 | 740 | 136 | |
| 5. | Civil and Structural work | 2.700 | 1.600 | 1.100 | 1.600 | |
| 6. | Personnel lodging | 690 | 250 | 440 | 250 | |
| 7. | Contractors Move-In. | 800 | 800 | | 800 | |
| 8. | Access Road. | 590 | 590 | | 590 | |
| | Thousand US \$ Million Icel. kr. | 25.500 | 17.770 2.665 | 7.730 1.160 | 4.693 705 | |

The above estimate is based on the same financing conditions for item 1-2-3-4 as were negotiated for the turbine/generator units i.e. 10% on order, 10% on delivery, 80% as a 7 year loan with 7,5% interest starting on the date of delivery. Items 5-6-7-8 are entered as direct payments when due.