

Febr. 1955

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Specification for
The "Vestfirðir" Project

SPECIFICATION FOR
THE "VESTFIRDIR" PROJECT

General

a) The project

Drawing no. 4245E6 shows the general layout of the project and drwg. no. 3191E6 the main one line diagram. The project is located in the western part of Iceland called "Vestfirðir" and consists of:

- I. 3000 kVA power station on river "Mjólka"
- II. 500 kVA power station on river "Fossa"
- III. 33/11 kV switching station at farm "Rafnseyri"
- IV. 33/11 kV transformerstation at village "Bildudalur"
- V. Ditto at village "Sveinseyri"
- VI. Ditto at village "Vatneyri"
- VII. Ditto at village "Thingeyri"
- VIII. Ditto at village "Flateyri"
- IX. Ditto at existing power station "Fossavatn"
- X. Ditto for future extension (and as extra equipment)
- XI. Telephone communication system
- XII. Several 11/0,23 kV transformer stations for distribution inside villages
- XIII. Several km of 11 kV and low tension underground cables for ditto, insulated wires etc.
- XIV. Submarine cables for crossing of fjord "Arnarfjord" and fjord "Dyrafjord"

The system consists further of 33 kV and 11 kV overhead

transmission lines, low tension overhead distribution lines etc. This equipment is however not included in these specifications.

The system will after few years be connected to a 5000 kVA station on river "Dynjandi" see drawing no. 4245E6 and later perhaps to a bigger system over a long transmission line.

This should be kept in mind with regard to stability when the power station on river "Mjolka" is designed.

b) The specifications

Attached are specifications for the project as described above. The specifications are not obligatory as they may be altered to the extent it may be desirable and/or necessary for better adaptability to the offered equipment, or where, from other reasons, alterations will be proposed.

The State Electric Power Works, hereafter called "the purchaser", reserves its rights, neither to have to accept the lowest tender, nor to have to accept any tender.

The following general conditions apply to all the specification:

1. Weather conditions

The lowest and highest temperatures during winter and summer are normally -15°C and $+20^{\circ}\text{C}$. All outdoor equipment must however be able to stand -30°C and $+30^{\circ}\text{C}$ as the temperature occasionally can reach these values.

The climate is very salty and heavy and wet snowstorms occur frequently during winter time. All outdoor equipment insulation must be able to stand these conditions. Bushings for instance must either be of higher voltage class than the

operating voltage specified or be specially designed with regard to salty climate.

Lightning occurs very seldom, almost never, but it is however felt that lightning arresters should be used to some extent.

2. Transport facilities, weights etc.

Purchaser will arrange shipment from foreign harbour to Icelandic harbours and take care of all transport from Icelandic harbours to site. It is believed that transport problems will not be too difficult (except for the submarine cables which will have to be discussed separately) but tenders should state the maximum shipping and transport weights and main dimensions of the heaviest and bulkiest equipment, separately for each piece. Especially the transport weights for equipment to power station "Mjolka" should not be heavier than necessary.

3. Descriptions, drawings

Tenders should include descriptions, dimensions sketches and drawings, necessary for estimate of the offered equipment.

4. Materials, standards, guarantees, tests, inspection

All materials offered shall be of the best available quality for the purpose for which they are intended and all materials and equipment offered shall conform to applicably standard specifications officially recognized in the country of its manufacture.

In case of purchase, the manufacturer will be requested to give all usual guarantees and to make all usual shop tests and further to give such extra guarantees and to make such

extra tests as might be mutually agreed upon. The purchaser will reserve himself the right to have his representative inspect the material and equipment during manufacture and assembly and to witness tests. The purchaser will further reserve himself the right to repeat, as mutually agreed upon, any such tests after the complete installation of the equipment on site.

5. Prices, delivery

All material and equipment is to be offered fob an export harbour having shipping facilities to Iceland.

Tenders should preferably give specific prices on the offered equipment. For main equipment such as penstocks, turbines, cranes, generators, transformers, metalclad switchgear units, power circuit breakers etc. price for each piece should be given.

All prices shall include first class export packing.

Time of delivery (from date of order to the date of delivery from workshop) should be specified to the same extent as the prices.

6. Erection

The purchaser himself will take care of the erection of all equipment, but manufacturers will be asked to inspect the erection of turbines and generators before the initial start up. The outlay of the submarine cables will have to be discussed separately.

7. Spare Parts

Where manufacturer is asked for his opinion as regards spare parts the great distance from manufacturer to the site of erection should be born in mind.

8. Contracts

In case of purchase, an agreement, regarding the manufacture and delivery of the equipment mentioned above and specified below, between the manufacturer and the purchaser shall be established in a contract in which prices, delivery time, terms of payment, all requirements etc. shall be fixed with such amendments as might be mutually agreed upon by the manufacturer and the purchaser.

Reykjavík, Febr. 1955

THE STATE ELECTRIC POWER WORKS

Eiríkur Briem
(sign)

I. POWER STATION "MJOLKA"

Two alternatives with different head are to be considered.

Alternative I

Drwg. no. 29105 shows the proposed main arrangement of the station and drwg. no. 3190E2 the one line diagram. The head and tail water elevations are 214 m and 4 m respectively.

a) Turbine with accessories

- Item 1. One horizontal shaft Pelton turbine for direct coupling to a three phase electric generator, 50 cycles. Speed of turbine to be as recommended by turbine manufacturer. Full load output to be 3500 HP (1 HP = 75 kgm/sec.) at 210 m brutto head. Turbine to be complete with bearings, flywheel, suitable valve between penstock and turbine, all control and safety devices, cooling and lubricating system, drainage, gauges etc.
- Item 2. One hydraulic governor, complete with all accessories and with remote controlled speed adjustment and stroke limiter. See "note" below. Governor to be controlled from a permanent magnet generator on the shaft of the unit. This P.M.G. to be included in tender. The governor to be suitable for both single and parallel operation.
- Item 3. One set of spare parts as recommended by manufacturer.

Manufacturer is requested to state in tender:

Efficiency of turbine at 1/4, 1/2, 3/4 and 1/1 load.

Runaway speed of turbine.

Prescribed flywheel effect.

Speed rise (drop) and pressure rise (drop) when 1/4, 1/2, 3/4 and 1/1 load thrown off (on).

Net and gross weight of the machinery including shipping and mounting weights and main dimensions of heaviest and bulkiest pieces.

Manufacturer is further requested to submit main arrangement drawings and to inform as to the time required for preparing complete drawings necessary for designing the power house.

Note: High efficiency of turbine at lower loads is important and Pelton therefore more suitable than Francis even if Francis could be used. This should also be kept in mind when the governing system is designed.

b) Penstock and dam gates

Item 1. An approx. tender on a suitable pressure penstock, as indicated on drawing no. 29105. Penstock to be buried where possible and insulated elsewhere. Penstock to be placed on concrete foundations as mutually agreed upon between manufacturer and purchaser.

Item 2. A suitable automatic selfclosing valve at the upper end of the penstock, complete with air intake valve etc.

c) Generator with accessories (see drwg. no. 3190E2)

- Item 1. One horizontally mounted 3-phase, 50 cycles, class B insulated generator rated 3000 kVA at power factor 0,8 star connected, 6/6,6 kV, for direct coupling to a horizontal Pelton turbine. Speed to be as recommended by turbine manufacturer. Generator to be complete with automatic brake system and all conventional accessories.
- Item 2. Main exciter and pilot exciter directly coupled on the main shaft with provision made for a permanent magnet generator, furnished by turbine manufacturer.
- Item 3. One complete high speed automatic voltage regulator system, suitable for single and parallel operation and line drop compensation.
- Item 4. Discharge resistance with discharge switch for main exciter field.
- Item 5. Breaker and discharge resistance for suppression of the main field of the generator.
- Item 6. One set of spare parts comprising:
- 1/6th set of stator windings.
 - 1 set of linings for the bearings
 - 3 sets of brushes for generator, main exciter

and pilot exciter.

3 brush holders of each type.

Other spare parts if and as recommended by manufacturer.

All 6 terminals of the generator shall be brought out. Temperature detectors shall be provided for in the stator windings, which shall be of the vacuumpressure impregnated type, class B. Temperature detectors are also required for the bearings of the machine and the bearings are also to have mercury type temperature devices and oil level gauges.

The generator shall be effectively insulated against stray currents.

Manufacturer is requested to state in tender:

Efficiency at 1/4, 1/2, 3/4 and 1/1 load at unity power factor and 0,8 power factor.

Maximum full load regulation at rated voltage and speed, in per cent of rated voltage.

Temperature guarantees.

Speed and flywheel effect as mutually agreed upon between turbine and generator manufacturers.

Also the runaway speed.

Short circuit ratio (as mentioned in the general chapter the station will perhaps later be connected to a rather large and a rather weak system. The short circuit ratio should therefore preferably not be lower than 120%).

Net and gross weights of the machinery including shipping and mounting weights and main dimensions

of heaviest and bulkiest pieces.

Necessary capacity of powerhouse crane and necessary lifting height.

Manufacturer is further requested to submit main arrangement drawings and to inform as to the time required for preparing complete drawings necessary for the design of the powerhouse.

d) Powerhouse crane

Item 1. One suitable powerhouse crane.

e) Transformer and switchgear (see drwg. no. 3190E2)

It is proposed to have the station attended by only two operators. Operator is supposed to visit the station only few times a day. All control and supervising devices should be selected accordingly.

Item 1. One 3000 kVA outdoor transformer, oil immersed, self cooled, three phase, 50 cycles. Voltage ratio at no load 6300 volts delta to 30.000 volts wye (Yd 11) with the neutral point brought out through a fully insulated bushing for solid grounding. Transformer to have full capacity taps for 31500, 33000, 34500 and 36000 volts brought out from the H.V. winding to off load tap changing switches arranged for external operation. H.V. and L.V. connections brought out through bushings and provision made for mounting of three cable boxes for receiving of three single

core cables from the generator on the 6,3 kV side. Transformer to be complete with oil and all conventional accessories including Buchholz relay.

Item 2. One complete set of primary and secondary coils for one leg of the above specified transformer and one H.V. and one L.V. bushing (spare parts).

Item 3. One 200 kVA transformer, oil immersed, self cooled, three phase, 50 cycles. Voltage ratio at no load 6000 volts delta to 400 volts wye (Dy11) with the neutral point brought out through bushing for solid grounding.

Transformer to have full capacity taps for 6300 and 6600 volts brought out from the H.V. winding to off load tap changing switches arranged for external operation. H.V. and L.V. connections brought out through suitable cable boxes. Transformer to be complete with oil and all conventional accessories.

Manufacturer is requested to state in tender all the usual information about the transformers such as losses, temperature guarantees, per cent impedance, net and gross weight etc. The shipping weight of the 3000 kVA transformer should not be more than absolutely necessary.

Item 4. One 33 kV, 3-pole, outdoor power circuit breaker, remote controlled from a 110 volts D.C. battery complete with necessary C.T:s for differential

protection, measuring and relaying.

Also bushings for one phase (spare).

- Item 5. One 3-pole, 33 kV, outdoor mounted and manually operated disconnecting switch complete with operating mechanism and grounding devices. Also insulators for one phase (spare).
- Item 6. Four (one as spare) 33 kV outdoor lightning arresters (solidly grounded neutral), one suitable outdoor C.T. for the main transformer neutral and two suitable outdoor P.T:s 33000/110 volts for measuring and synchronizing.
- Item 7. Suitable galvanized steel structure for the outdoor 33 kV switchgear including necessary support insulators, busbars etc.
- Item 8. A metal clad cubicle for the generator neutral comprising suitable C.T:s for differential protection, measuring, relaying etc. (C.T:s for measuring, relaying etc. can also be placed on the H.T. side of the generator if considered better), suitable grounding device for the generator, cable boxes, wiring etc.
- Item 9. A metal clad cubicle for the generator H.T. side comprising suitable C.T:s, cable boxes for receiving incoming cables from the generator, the main transformer and the station supply transformer, H.T. fuses for the station supply trans-

former, suitable P.T:s, busbars, wiring etc.

Item 10. A suitable 110 volts Alkaline D.C. battery metal clad cubicle complete with an automatic rectifier, a suitable battery control panel, wiring etc.

Item 11. A suitable low tension metal clad cubicle for station supply, complete as indicated on drwg.

Item 12. One set of necessary relays, meters, signal, alarm, synchronizing and control equipment for the station in accordance with best modern practice. Relays meters etc. to be mounted on suitable panels and flush mounted on front side.

It is felt that this equipment should not be specified in detail but drwg. no. 3190E2 indicates what purchaser has in mind.

It should be mentioned here that the 33 kV breakers in the switching station at "Rafnseyri" are to be remote controlled from this power station. Necessary equipment should be included.

Item 13. One set of spare parts for the switchgear in general, as recommended by manufacturer.

Item 14. It is felt that power and control cables etc. should not be specified until later but manufacturer is requested to estimate roughly the cost of these cables with accessories.

f) Reserve Power

Item 1. One complete diesel electric set 25 kVA, 3-phase, 50 cycles, 400 volts, wye connected.

Alternative II

Drwg. no. 29205 shows the proposed main arrangement of the station. The station is exactly similar to the station specified under alternative I except that the head and tail water elevations are 316 m and 4 m respectively and thus the brutto head 312 m.

II. POWER STATION "FOSSA"

Drwg. no. A1179 shows the proposed main arrangement of the station and drwg. no. 3189E2 the one line diagram. The head and tail water elevations are 330 m and 20 m respectively.

a) Turbine with accessories

Item 1. One horizontal shaft Pelton turbine for direct coupling to a three phase electric generator, 50 cycles. Speed of turbine to be as recommended by turbine manufacturer. Full load output to be 600 HP (1 HP = 75 kgm/sec.) at 310 m brutto head. Turbine to be complete with bearings, flywheel, suitable valve between penstock and turbine, all control and safety devices, cooling and lubricating system, drainage, gauges etc.

Item 2. One hydraulic governor, complete with all accessories and with remote controlled speed adjustment and stroke limiter. See "note" below. Governor to be belt driven from the main shaft. The governor to be suitable for both single and parallel operation.

Item 3. One set of spare parts as recommended by manufacturer.

Manufacturer is requested to state in tender:

Efficiency of turbine at 1/4, 1/2, 3/4 and 1/1 load.

Runaway speed of turbine.

Prescribed flywheel effect.

Speed rise (drop) and pressure rise (drop) when 1/4, 1/2, 3/4 and 1/1 load thrown off (on).

Net and gross weight of the machinery including shipping and mounting weights and main dimensions of heaviest and bulkiest pieces.

Manufacturer is further requested to submit main arrangement drawings and to inform as to the time required for preparing complete drawings necessary for designing the power house.

Note: High efficiency of turbine at lower loads is important and Pelton therefore more suitable than Francis even if Francis could be used. This should also be kept in mind when the governing system is designed.

b) Penstock and dam gates

Item 1. An approx. tender on a suitable pressure penstock as indicated on drawing no. All79. Penstock to be buried where possible and insulated elsewhere. Penstock to be placed on concrete foundations as mutually agreed upon between manufacturer and purchaser.

Item 2. A suitable automatic selfclosing valve at upper end of penstock, complete with air intake valve etc.

c) Generator with accessories (see drwg. no. 3189E2)

Item 1. One horizontally mounted 3-phase, 50 cycles, class B insulated generator, rated 500 kVA at power factor 0,8, star connected, 3/3,3 kV, for direct coupling to a horizontal Pelton turbine. Speed to be as recommended by turbine manufacturer. Generator to be complete with automatic brake system and all conventional accessories.

Item 2. Exciter directly coupled on the main shaft.

Item 3. One complete high speed automatic voltage regulator system, suitable for single and parallel operation and line drop compensation. Also suitable discharge systems for suppression of the exciter and generator fields.

Item 4. One set of spare parts comprising:

1/6th set of stator windings.

1 set of linings for the bearings.

3 set of brushes for generator and exciter.

3 brush holders of each type.

Other spare parts if and as recommended by manufacturer.

All 6 terminals of the generator shall be brought out and the stator windings shall be of the vacuumpressure impregnated type, class B. Thermostats are required for the bearings of the machine and the bearings are also to have mercury type temperature devices and oil level gauges.

The generator shall be effectively insulated against stray currents.

Manufacturer is requested to state in tender:

Efficiency at 1/4, 1/2, 3/4 and 1/1 load at unity power factor and 0,8 power factor.

Maximum full load regulation at rated voltage and speed, in per cent of rated voltage.

Temperature guarantees.

Speed and flywheel effect as mutually agreed upon between turbine and generator manufacturers.

Also the runaway speed.

Short circuit ratio.

(The station is connected to a rather large and a rather weak system. The short circuit ratio should therefore preferably not be lower than 120%).

Net and gross weights of the machinery including shipping and mounting weights and main dimensions

of heaviest and bulkiest pieces.

Necessary capacity of powerhouse crane and necessary lifting height.

Manufacturer is further requested to submit main arrangement drawings and to inform as to the time required for preparing complete drawings necessary for the design of the powerhouse.

d) Powerhouse crane

Item 1. One suitable powerhouse crane, handoperated.

e) Transformer and switchgear (see drwg. no. 3189E2)

It is proposed to have the station attended by only one operator. Operator is supposed to visit the station only once a day. All control and supervising devices should be selected accordingly.

Item 1. One 500 kVA outdoor transformer, oil immersed, self cooled, three phase, 50 cycles. Voltage ratio at no load 3150 volts delta to 10.000 volts wye (Yd11) with the neutral point brought out through a fully insulated bushing for impedance grounding. Transformer to have full capacity taps for 10.500, 11.000 and 11.500 volts brought out from the H.V. winding to off load tap changing switches arranged for external operation. H.V. and L.V. connections brought out through suitable cable boxes. Transformer to be complete with oil and all conventional accessories including Buchholz relay.

- Item 2. One complete set of primary and secondary coils for one leg of the above specified transformer and one H.V. and one L.V. bushing (spare parts).

Manufacturer is requested to state in tender all the usual information about the transformer such as losses, temperature guarantees, per cent impedance, net and gross weight etc.

- Item 3. Suitable grounding device for the generator.

- Item 4. A suitable 110 volts Alkaline D.C. battery metal clad cubicle complete with an automatic rectifier, a suitable battery control panel, wiring etc.

- Item 5. One suitable grounding impedance for the 11 kV neutral. For different reasons probable neither Peterson coil grounding nor solid grounding is suitable and this question has actually not been settled in general for the 11 kV systems in Iceland. The 11 kV networks (3 phase - 3 wire) are as a rule rather unbalanced, as often considerable parts of the networks consist of single phase lines and further they are often sectionalized with powerbreakers. This matter will have to be discussed in detail with the manufacturer but manufacturer is requested to suggest a solution.

- Item 6. An 11 kV, 3-phase indoor metal clad switchgear complete with three power circuit breakers each with tripping and closing device for 110 volts D.C., station supply cubicle, current and potential

transformers, cable boxes, busbars, wiring, etc.
all as indicated on drwg. no. 3189E2.

Item 7. Six 11 kV outdoor lightning arresters (see item 5).

Item 8. One set of necessary relays, meters, signal, alarm, synchronizing and control equipment for the station in accordance with best modern practice. Relays meters etc. to be mounted on the 11 kV metal clad (item 6) or suitable panels and flush mounted on front side. It is felt that this equipment should not be specified in detail but drwg. 3189E2 indicates what purchaser has in mind.

Item 9. One set of spare parts for the switchgear in general as recommended by manufacturer.

Item 10. It is felt that power and control cables etc. should not be specified until later but manufacturer is requested to estimate roughly the cost of these cables with accessories.

III. SWITCHING STATION "RAFNSEYRI"

Drwg. no. 4239E3 shows the one line diagram.

Item 1. Three 33 kV, 3-phase, outdoor, remote controlled power circuit breakers each complete with tripping device for 32 volts D.C., closing device for 220 volts A.C. and necessary C.T:s for relaying.

- Item 2. Four, 3-pole, 33 kV, outdoor, manually operated disconnecting switches each complete with operating mechanism.
- Item 3. Three ditto with grounding devices.
- Item 4. Three, 33 kV, outdoor, lightning arresters for the submarine cable over "Arnarfjord" (the system is solidly grounded only at "Mjolka", "Fossavatn" and "Vatneyri" and one has therefore probably to reckon with full phase voltage to ground in certain cases).
- Item 5. Three suitable H.R.C. outdoor fuse units for 100 kVA transformer.
- Item 6. Suitable relays and meters for the 33 kV switchgear as indicated on drwg. This equipment to be mounted on a suitable indoor panel.
- Item 7. Suitable galvanized steel structure for the outdoor 33 kV switchgear and transformer (land space for the outdoor switchyard is more than sufficient) including necessary 33 kV supporting insulators, busbars etc.
- Item 8. One 100 kVA outdoor pole mounting transformer, oil immersed, self cooled, three phase, 50 cycles. Voltage ratio at no load 30000 volts delta to 230 volts wye (Dyll) with the neutral point brought out through bushing for solid grounding. The

transformer to have full capacity taps for 31500, 33000 and 34500 volts brought out from the H.V. winding to off load tap changing switches arranged for external operation. High voltage connections brought out through bushings and L.V. through a suitable cable box. Transformer to be complete with oil and all conventional accessories. Manufacturer is requested to state all usual information about the transformer such as losses, per cent impedance, gross weight etc.

Item 9. Suitable L.T. indoor station supply metal clad cubicle complete as indicated on drwg.

Item 10. One suitable indoor 32 volts alkaline D.C. battery metal clad cubicle complete with rectifier, suitable battery control panel, wiring etc.

Item 11. Spare parts as recommended by manufacturer.

Note: The 33 kV breakers in this switching station are to be remote controlled from power station "Mjolka". Necessary equipment should be included in tender.

IV. TRANSFORMERSTATION "BILDUDALUR"

Drwg. no. 4240E3 shows the one line diagram. The drwg. shows the difference between this station and transformer-station "Flateyri" but otherwise the specifications are identical for both stations.

V. TRANSFORMERSTATION "SVEINSEYRI"

Drwg. no. 4241E3 shows the one line diagram. The drwg. shows the difference between this station and transformerstation "Flateyri" but otherwise the specifications are identical for both stations. The 250 kVA transformer should preferably be "pole mounted" in the steel structure.

VI. TRANSFORMERSTATION "VATNEYRI"

Drwg. no. 4242E3 shows the one line diagram. The 11 kV side will be connected to the 11 kV busbars in the existing diesel electric power station. The 11 kV neutral in this station is solidly grounded. The capacity of this station is now 600 kVA and will be increased later.

- Item 1. One transformer similar to the 3000 kVA transformer for power station "Mjolka" except 1000 kVA instead of 3000 kVA, 11 kV on the L.T. side instead of 6,3 kV and with a suitable cable box on the 11 kV side.
- Item 2. One 33 kV breaker similar to the 33 kV breakers for switching station "Rafnseyri".
- Item 3. One 33 kV disconnecting switch similar to the 33 kV switch for power station "Mjolka".
- Item 4. Three 33 kV outdoor lightning arresters (solidly grounded neutral).

- Item 5. Suitable outdoor C.T. for transformer neutral.
- Item 6. Relays and meters for the 33 kV switchgear as indicated on drwg., for mounting on an indoor panel.
- Item 7. Suitable galvanized steel structure for the 33 kV switchgear with 33 kV supporting insulators, busbars etc.
- Item 8. An 11 kV, 3-phase indoor metal clad switchgear complete with three power circuit breakers each with tripping device for 32 volts D.C. and closing device for 220 volts A.C., current and potential transformers, relays and meters, cable boxes, busbars, wiring, etc. all as indicated on drwg.
- Item 9. One suitable 32 volts alkaline D.C. battery metal clad cubicle complete with rectifier, suitable battery control panel, wiring etc.
- Item 10. Spare parts as recommended by manufacturer.

VII. TRANSFORMERSTATION "THINGEYRI"

Drwg. no. 4238E3 shows the one line diagram. The drwg. shows the difference between this station and transformer-station "Flateyri" but otherwise the specifications are identical for both stations. Three extra lightning arresters 11 kV and three 33 kV should be offered here, for use at the end of

the submarine cables at "Hofdaoddi".

VIII. TRANSFORMERSTATION "FLATEYRI"

Drwg. no. 4237E3 shows the one line diagram.

- Item 1. Two 33 kV, 3-phase, outdoor, remote controlled power circuit breakers each complete with tripping device for 32 volts D.C., closing device for 220 volts A.C., reclosing features and necessary C.T:s for relaying. The reclosing equipment will only be used under certain conditions.
- Item 2. Three, 3-pole, 33 kV, outdoor, manually operated disconnecting switches each complete with operating mechanism.
- Item 3. Two ditto with grounding devices.
- Item 4. Three, 33 kV, outdoor, lightning arresters (the system is solidly grounded only at "Mjolka", "Vatneyri" and "Fossavatn", and one has therefore probably to reckon with full phase voltage to ground in certain cases).
- Item 5. Three suitable H.R.C. outdoor fuse units for 1000 kVA transformer.
- Item 6. Suitable relays and meters for the 33 kV switchgear as indicated on drwg. This equipment to be mounted on the 11 kV metal clad switchgear specified under item 10 or on a separate panel.

Item 7. Suitable galvanized steel structure for the outdoor 33 kV switchgear (land space for the outdoor switchyard is more than sufficient) including necessary 33 kV supporting insulators, busbars etc.

Item 8. One 1000 kVA outdoor transformer, oil immersed, self cooled, three phase, 50 cycles. Voltage ratio at no load 30000 volts delta to 11000 volts wye (Dyll) with the neutral point brought out through a fully insulated bushing for impedance grounding. The transformer to have full capacity taps for 31500, 33000 and 34500 volts brought out from the H.V. winding to off load tap changing switches arranged for external operation. High voltage connections brought out through bushings and L.V. through a suitable cable box. Transformer to be complete with oil and all conventional accessories including Buchholz relay. Manufacturer is requested to state all usual information about the transformer such as losses, per cent impedance, gross weight etc.

Item 9. One suitable grounding impedance for the 11 kV neutral. For different reasons probable neither Peterson coil grounding nor solid grounding is suitable and this question has actually not been settled in general for the 11 kV systems in Iceland. The 11 kV networks (3 phase - 3 wire) are

as a rule rather unbalanced, as often considerable parts of the networks consists of single phase lines and further they are often sectionalized with powerbreakers. This matter will have to be discussed in detail with the manufacturer but manufacturer is requested to suggest a solution.

- Item 10. An 11 kV, 3-phase indoor metal clad switchgear complete with one power circuit breaker with tripping device for 32 volts D.C. and closing device for 220 volts A.C. and two ditto with reclosing features, station supply cubicle, current and potential transformers, relays and meters, cable boxes, busbars, wiring, etc. all as indicated on drwg. (see item 9).
- Item 11. One suitable 32 volts alkaline D.C. battery metal clad cubicle complete with rectifier, suitable battery control panel, wiring etc.
- Item 12. Six 11 kV outdoor lightning arresters (see item 9).
- Item 13. Spare parts as recommended by manufacturer.

IX. TRANSFORMERSTATION "FOSSAVATN"

Drwg. no. 4236E3 shows the one line diagram. The 6 kV side will be connected to the 6 kV busbars in the existing hydroelectric power station. The capacity of this station is now 1500 kVA and will probably be increased later (with diesel-

electric set).

- Item 1. One transformer similar to the 3000 kVA transformer for power station "Mjolka" except 1500 kVA instead of 3000 kVA and with suitable cable box on the 6 kV side.
- Item 2. One 33 kV breaker similar to the 33 kV breaker in switching station "Rafnseyri".
- Item 3. One 33 kV disconnecting switch similar to the 33 kV switch for power station "Mjolka".
- Item 4. Three 33 kV outdoor lightning arresters (solidly grounded neutral).
- Item 5. Suitable outdoor C.T. for transformer neutral.
- Item 6. Relays and meters as indicated on drwg. for mounting on panel in existing power station.
- Item 7. Suitable galvanized steel structure for the 33 kV switchgear with 33 kV supporting insulators, busbars etc.
- Item 8. Spare parts as recommended by manufacturer.

X. TRANSFORMERSTATION FOR FUTURE EXTENSION

Manufacturer is here requested to offer one transformer-station exactly similar to transformerstation "Bíldudalur".

XI. TELEPHONE COMMUNICATION SYSTEM

It is intended to install a telephone communication system (push to talk) on the 33 kV network for communication between the 33/11 kV transformerstations and the power stations "Mjolka", "Fossavatn" and "Vatneyri" and manufacturer is requested to offer the necessary equipment. This problem will probably have to be discussed separately because of the submarine cables.

XII. 11/0,23 KV TRANSFORMERSTATIONS

It is intended to use three standard sizes or 300, 150 and 75 kVA stations. The equipment for the 300 and 150 kVA stations will be housed indoors in small concrete buildings whereas the 75 kVA stations will be pole mounted stations (H-pole) with the low tension equipment housed in a suitable shed placed between the two poles. In spite of this all the transformers should be designed for both indoor and outdoor operation.

Item 1. Eight 300 kVA stations according to drwg 4228E4 and each comprising:

One H.T. metal clad cubicle complete with suitable switches, fuses, cable boxes, busbars, wiring etc.

One 300 kVA transformer, oil immersed, self cooled, three phase, 50 cycles. Voltage ratio at no load 10000 volts delta to 230 volts wye (Dy 11) with

the neutral point brought out through a fully insulated bushing for solid grounding. Transformer to have full capacity taps for 9500 and 10500 volts brought out from the H.V. winding to off load tap changing switches arranged for external operation. High voltage and L.V. connections brought out in a suitable manner for busbar connection to the H.T. and L.T. cubicles. Transformer to be complete with oil and all conventional accessories. Manufacturer is requested to state in tender all usual information about the transformer.

One L.T. metal clad cubicle complete with suitable C.T:s, fuse switches, street lighting equipment, meters, station supply outlets, cable boxes, busbars, wiring etc.

Two suitable busbar connections between H.T. and L.T. cubicles and transformer as indicated on drwg.

Item 2. Three 300 kVA transformers similar to the transformers specified under item 1. except H.V. and L.V. connections brought out through bushings on cover.

Item 3. Five 150 kVA stations according to drwg. 4227E4 but otherwise as item 1.

Item 4. Six 75 kVA stations according to drwg. 4226E4 with drop-out fuses instead of H.T. cubicle but

otherwise as item 1.

Item 5. Spare parts as recommended by manufacturer.

In certain cases it may become desirable to arrange the 75 kVA stations as indoor stations in similar manner to the 150 kVA stations and vice versa to arrange the 150 kVA stations as pole mounting stations in similar manner to the 75 kVA stations. The H.V. and L.V. windings of the 75 kVA transformers should therefore be brought out in the same manner as the windings of the 150 kVA transformers and be fitted with suitable cable boxes so that either cable boxes can be used for pole mounting arrangement according to drwg. 4226E4 or busbar mounting arrangement according to drwg. 4227E4. It should then also be possible to fit such cable boxes to the 150 kVA transformers.

The specifications call for fuse switches on the L.T. side. Manufacturer is however requested to inform what the price difference would be for each station if automatic air break switches were used instead.

XIII. UNDERGROUND CABLES, INSULATED WIRES ETC.

Item 1. 6 km, 3 core, stranded, 16 sq. mm copper, 11 kV paper insulated, lead covered, double steel taped underground cable (according to VDE 1937) on suitable drums.

Item 2. 1 km, 3 core, stranded, 150 sq. mm. copper, 1 kV,

paper insulated, lead covered, double steel
taped underground cable (according to VDE 1937)
on suitable drums.

Item 3. 1 km ditto except 3 x 120 sq. mm.

Item 4. 2 - - - 3 x 95 - -

Item 5. 6 - - - 3 x 70 - -

Item 6. 5 - - - 3 x 50 - -

Item 7. 2 - - - 3 x 35 - -

Item 8. 5 - - - 3 x 25 - -

Item 9. 6 - - - 3 x 16 - -

Item 10. 2 - - - 3 x 10 - -

Item 11. 8 - - - 2 x 10 - -

Item 12. 2 - hard drawn, stranded, 70 sq. mm., double
braided and weather resisting compounded aerial
copperwire on suitable drums.

Item 13. 2 km ditto except 50 sq. mm

Item 14. 7 - - - 25 - -

Item 15. 13 - - - 16 - -

Item 16. 2 - soft drawn, stranded, 25 sq. mm plastic
insulated copperwire (for low tension outdoor
use) on suitable drums.

- Item 17. 4 km ditto except 16 sq. mm.
- Item 18. 12 outdoor pole mounting cable boxes for item 1,
complete with all accessories.
- Item 19. 10 ditto except for item 3
- Item 20. 40 - - - - 4
- Item 21. 40 - - - - 5.
- Item 22. 60 - - - - 8.
- Item 23. 40 - - - - 10.
- Item 24. 7 underground "straight through" cable boxes
for item 1, complete with all accessories.
- Item 25. 3 ditto except "T" instead of "straight through".

XIV. SUBMARINE CABLES

Drwg. no. 4247E5 shows the profile of the fjord "Arnar-fjord" which is to be crossed with a 33 kV cable and drwg. no. 4248E5 the profile of the fjord "Dyrafjord" which is to be crossed with a 33 kV cable and an 11 kV cable. The design, transport and layout of these cables will have to be discussed in detail with manufacturer but in order to form a basis for the discussion manufacturer is requested to offer the following:

- Item 1. 10 km, 3 core, stranded, 25 sq. mm copper, 33 kV
paper insulated, lead covered, steel armoured

submarine cable for crossing of fjord "Arnarfjord". The cable should be designed according to strictest specifications and be armoured with one layer of galvanized round steel wires, 6 mm diameter. Suitable wires for measuring faults should be imbedded in cable. The cable should be offered in one length if possible.

- Item 2. 0,5 km ditto on suitable drum (spare)
- Item 3. 10 km same as item 1 except 3 single core cables (3 x 10 km total) instead of a 3-core cable (alternative).
- Item 4. 0,5 km ditto on suitable drum (spare).
- Item 5. 2 km same as item 1 for crossing of fjord "Dyrafjord".
- Item 6. 2 km same as item 1 for crossing of fjord "Dyrafjord" except 3 x 16 sq. mm copper and 11 kV instead of 3 x 25 sq. mm copper and 33 kV.
- Item 7. 0,25 km ditto on suitable drum (spare).
- Item 8. Necessary and suitable end boxes (pole mounting) for the above specified cables including all accessories and suitable spares.

Note: In case 35 sq. mm, 33 kV cables are technically safer than 25 sq. mm ditto, 35 sq. mm should be offered instead of 25 sq. mm under item 1, 2, 3, 4 and 5.