

APPENDICE

- IMPEADANCE MAP IN STEG POWER SYSTEM IN 1989
- LOAD DISTRIBUTION
- POWER FLOW AND VOLTAGE REGULATION AT PEAK TIME IN 1985
- POWER FLOW AND VOLTAGE REGULATION AT MIDNIGHT TIME IN 1985
- POWER FLOW AND VOLTAGE REGULATION AT PEAK TIME IN 1989
- POWER FLOW AND VOLTAGE REGULATION AT MIDNIGHT TIME IN 1989

SUPPLEMENTARY STUDIES (SENSIBILITY ANALYSIS, ETC.)

Approximate prospect for economic feasibility of Kasseb Project can be obtained from the descriptions in Chapter 10.

In this supplementary studies, verification of economic feasibility is performed by modifying some elements of the Project.

The elements taken into consideration are as follows;

- Integrated efficiency of Kasseb power station
- Fuel consumption rate of gas-turbine power station
- Serviceable years of Kasseb and gas-turbine power station
- Fuel price

I. PREPOSITION OF THE VERIFICATION

I-1 Criteria for comparison

For simplicity purpose, the total costs converted to present worth of Kasseb Project and its alternative gas-turbine plan calculated on the following assumptions are adopted as criteria for comparison.

Operation pattern of power station	Case "X"
Price rise rate	7% per annum
Discount rate	8% per annum

Based on the said assumptions, the total costs converted to present worth of Kasseb Project and its alternative gas-turbine plan will be as follows based on Table 10-8.

Table A-1 Total cost converted to present worth (standard value)

	(1,000 DT)		
Item	Upper-stream alternative	Down-stream alternative	Gas-turbine
Construction cost	73,667.7	84,598.6	45,601.3
Operation & maintenance cost	29,499.5	33,433.7	37,173.7
Replacement cost	14,298.7	14,284.7	75,923.9
Fuel cost	99,637.8	99,637.8	89,873.3
Total	217,089.7	231,954.8	248,572.2

Therefore, the ratio of benefit and cost will be as follows:

Kasseb up-stream alternative	248,572.2/217,089.7 = 114.5%
Kasseb down-stream alternative	248,572.2/231,954.8 = 107.2%

I-2 Modification of parameters

- (1) The effect with 5% fall of integrated efficiency of Kasseb power station, e.i, $64.3\% \times 0.95 = 61\%$ is studied.**
- (2) The effect with 5% fall of fuel consumption rate, e.i, $3,340 \text{ kcal}/0.95$ $3,516 \text{ kcal/kWh}$ is studied.**
- (3) The effect to modify the serviceable years of gas-turbine into 20 years against those of Kasseb power station into 60 years is studied.**
- (4) The effect with the fuel cost of 35 DT/TEP, which is the international price of heavy oil and natural gas, for both gas-turbine and Kasseb power stations, is studied.**

II. RESULTS OF ANALYSIS

The fuel cost in Table A-1 above will be modified for the cases of I-2-(4), I-2-(1) and I-2-(2).

For case I-2-(3), replacement cost, operation and maintenance cost and fuel cost will be changed.

According to the analysis based on the parameters in I-2, the total cost converted to present worth will be tabulated as follows;

Table A-2 Variation of total cost converted to present worth (1,000 DT)

Item	Up-stream alternative	Down-stream alternative	Gas-turbine
Case "I-2-(4)"			
Construction cost	73,667.7	84,398.6	45,601.3
Operation & maintenance cost	29,499.5	33,433.7	37,173.7
Replacement cost	14,284.7	14,284.7	75,923.9
Fuel cost	139,492.9	139,492.9	125,822.6
Total	256,944.8	271,799.9	284,521.5
Case "I-2-(1)"			
Construction cost	73,667.7	84,598.6	45,601.3
Operation & maintenance cost	29,499.5	33,433.7	37,173.7
Replacement cost	14,284.7	14,284.7	75,923.9
Fuel cost	104,888.7	104,888.7	89,873.3
Total	222,340.6	237,205.7	248,572.2
Case "I-2-(2)"			
Construction cost	73,667.7	84,598.6	45,601.3
Operation & maintenance cost	29,499.5	33,433.7	37,173.7
Replacement cost	14,284.7	14,284.7	75,923.9
Fuel cost	99,637.8	99,637.8	94,609.6
Total	217,089.7	231,954.8	253,308.5
Case "I-2-(3)"			
Construction cost	73,667.7	84,598.6	45,601.3
Operation & maintenance cost	37,299.6	42,252.4	47,438.3
Replacement cost	19,370.5	19,370.5	61,699.2
Fuel cost	117,649.7	117,649.7	106,120.0
Total	247,987.5	263,871.2	260,858.8

There are various possibilities for combination of some cases mentioned above.

The ratio of benefit and cost for each case are tabulated as follows;

Table A-3 Variation of ratio of benefit and cost

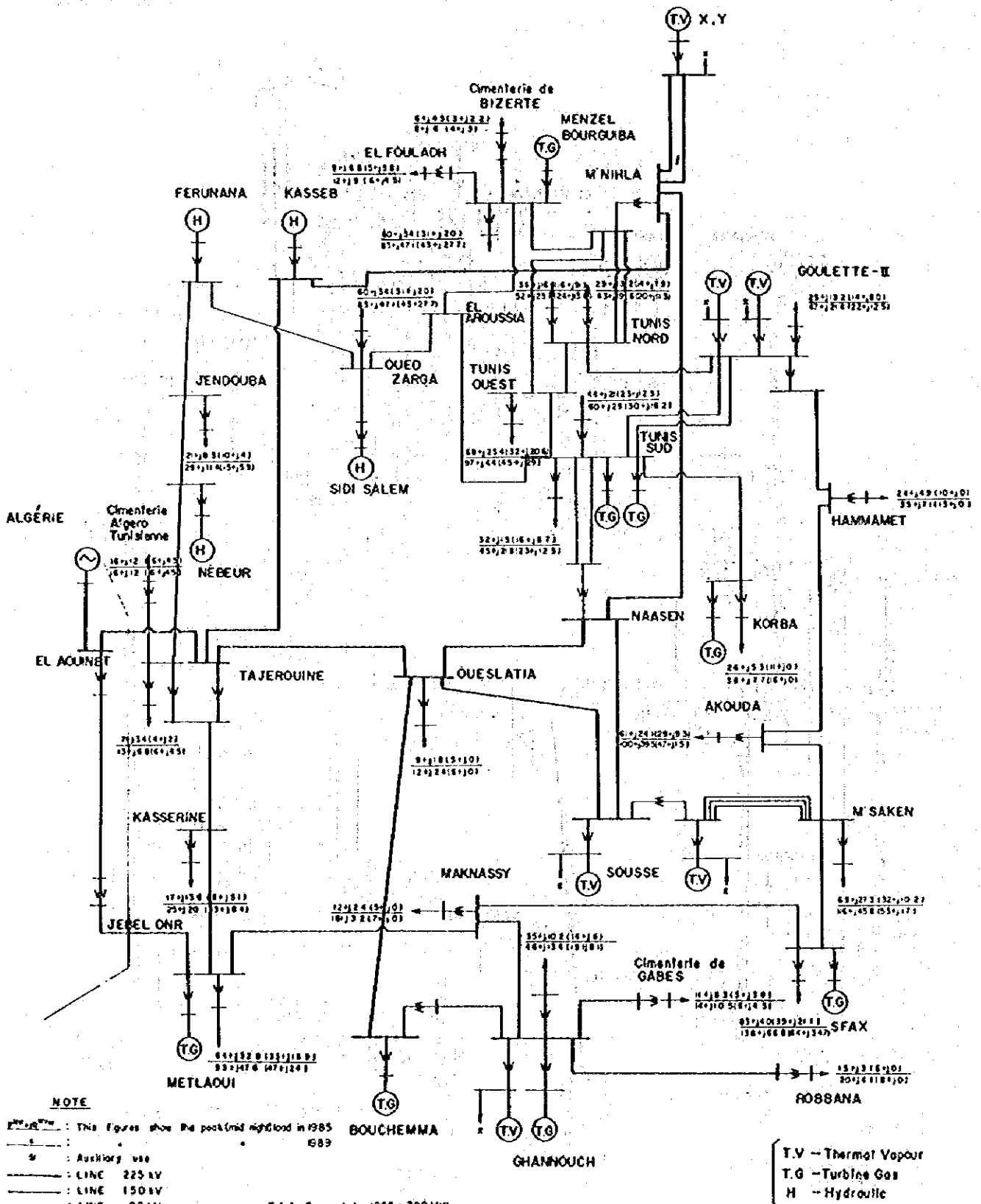
Item	Up-stream alternative	Down-stream alternative
Standard value	114.5%	107.2%
Case "I-2-(4)"	110.7%	104.7%
Case "I-2-(1)"	111.8%	104.8%
Case "I-2-(2)"	116.7%	109.2%
Case "I-2-(3)"	105.2%	98.8%

If the serviceable years of gas-turbine power station is modified from 15 years to 20 years, benefit-cost ratio of Kasseb Project will be decreased about 7 to 8% and the economic feasibility of down-stream alternative will be inferior to that of gas-turbine power station.

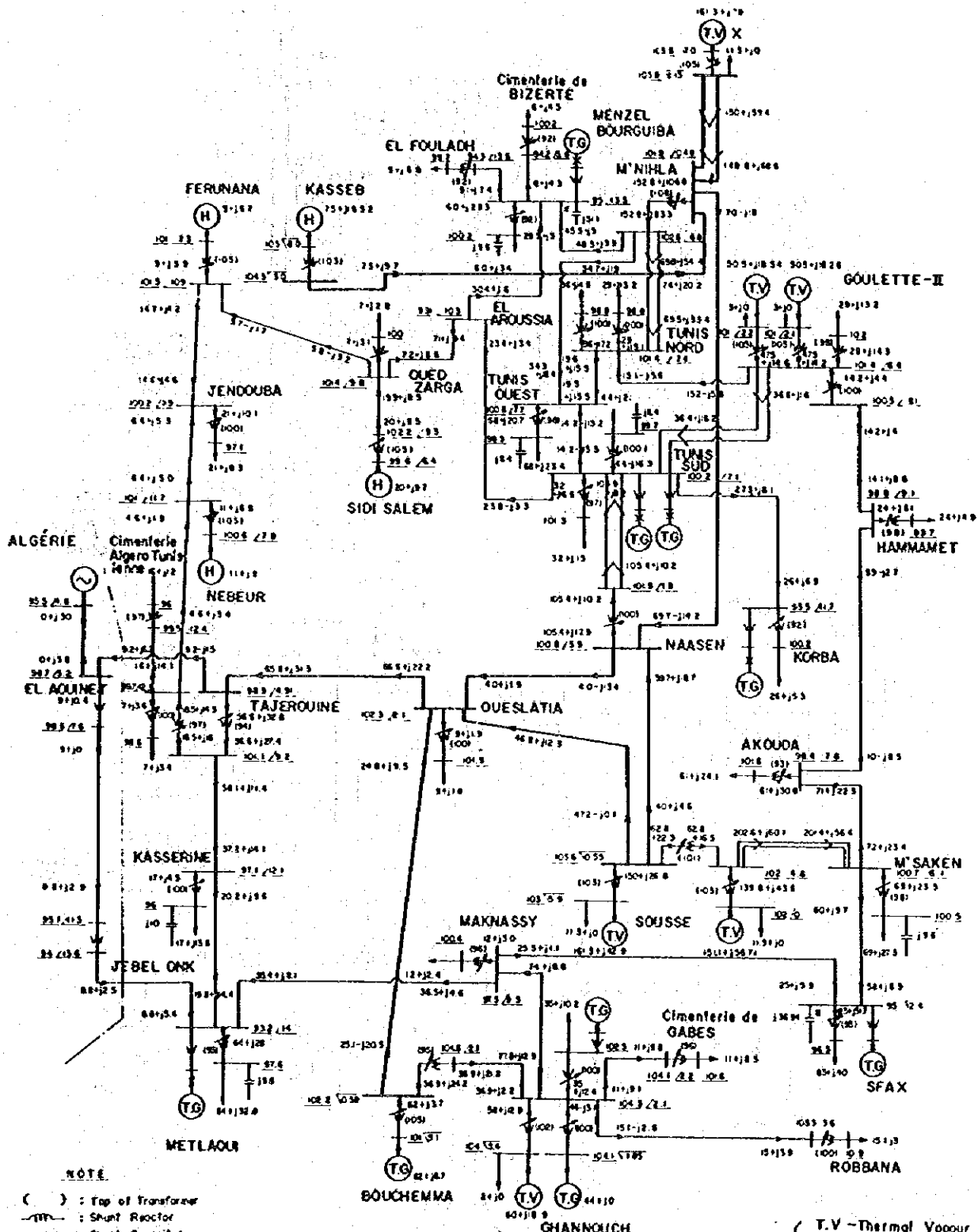
Even if the integrated efficiency for pumping up will be decreased 5%, benefit-cost ratio will decrease only about 3%.

As assumptions for sensibility analysis, the conditions for cases I-2-(1) and I-2-(3) will be the limiting ones, so that it can be said that the economic feasibility of both up-stream and down-stream alternatives of Kasseb Project is much superior to that of gas-turbine power station, except for the case of longer serviceable years of gas-turbine power station.

Load Distribution



Power Flow and Voltage Regulation at Peak Time in 1985



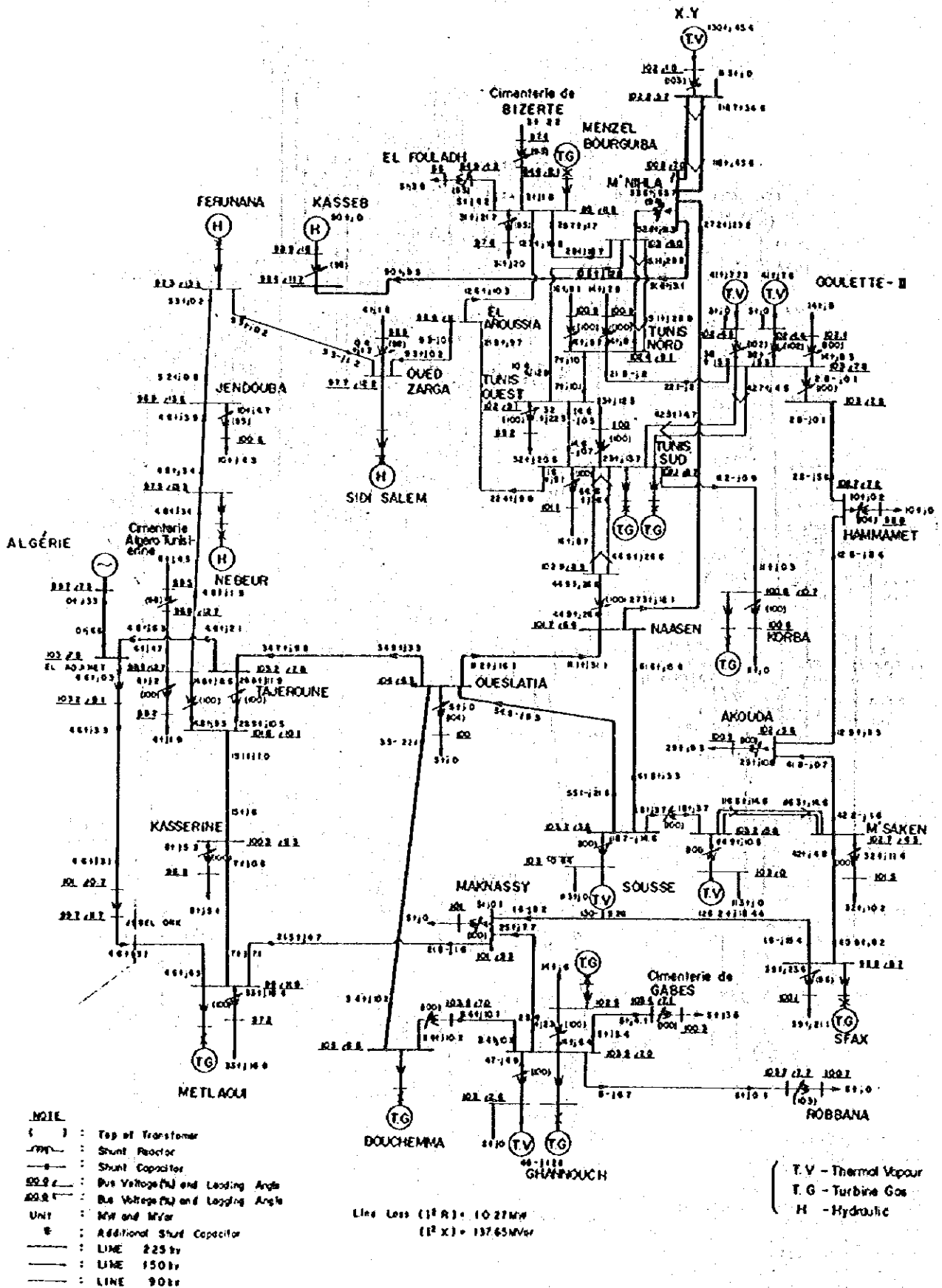
NOTE

- () : Top of Transformer
- TV— : Shunt Reactor
- C— : Shunt Capacitor
- 50. / : Bus Voltage (kV) and Leading Angle
- 50. / : Bus Voltage (kV) and Lagging Angle
- Unit : MW and MVar
- ⊗ : Additional Shunt Capacitor
- : LINE 225 kv
- : LINE 150 kv
- : LINE 90 kv

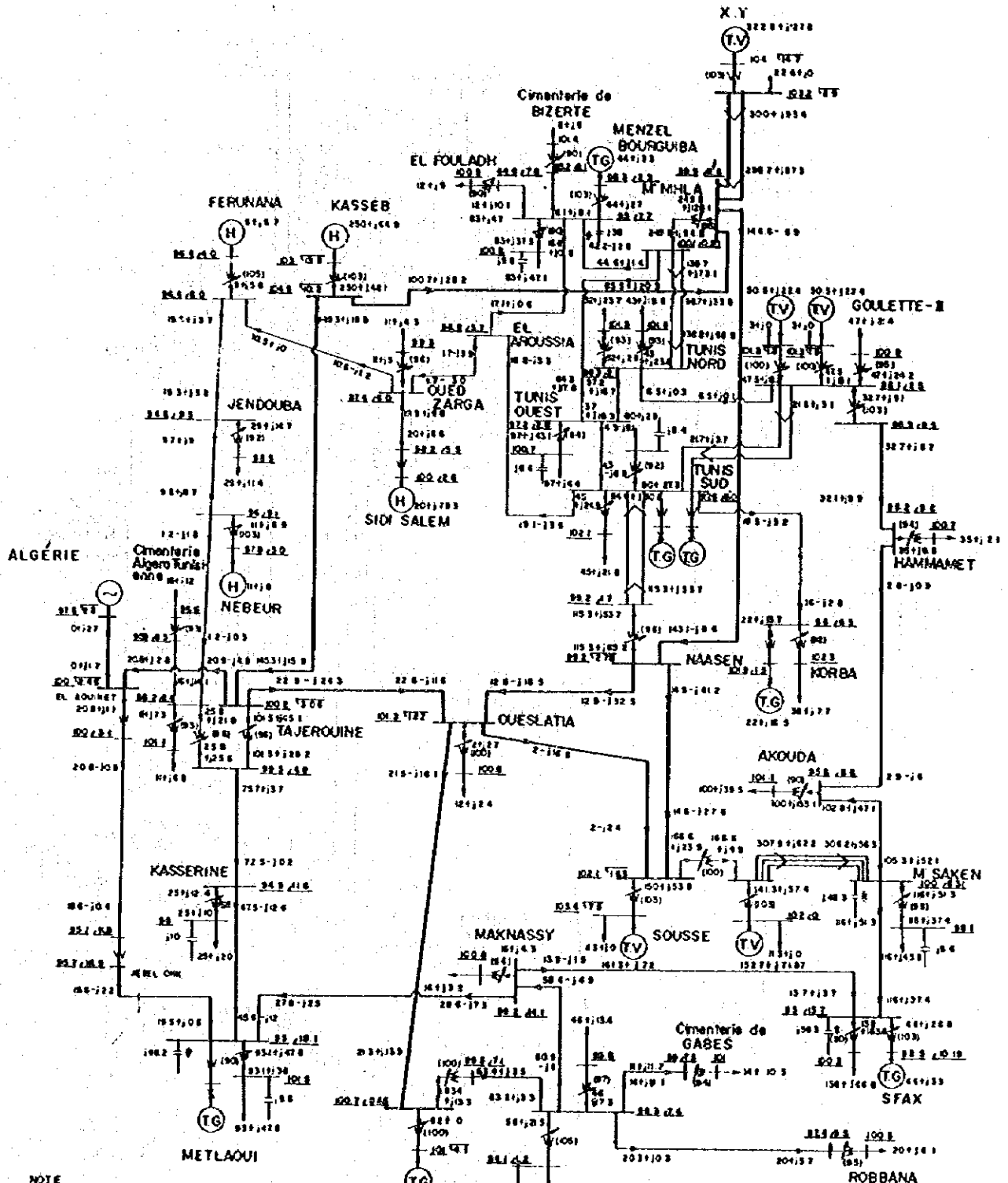
Line Loss ($I^2 R$) = 2363 MW
 $V_{11} = 31.52$ MVar

- T.V - Thermal Vapor
- T.G - Turbine Gas
- H - Hydraulic

Power Flow and Voltage Regulation of Midnight Time in 1985



Power Flow and Voltage Regulation at Peak Time in 1989

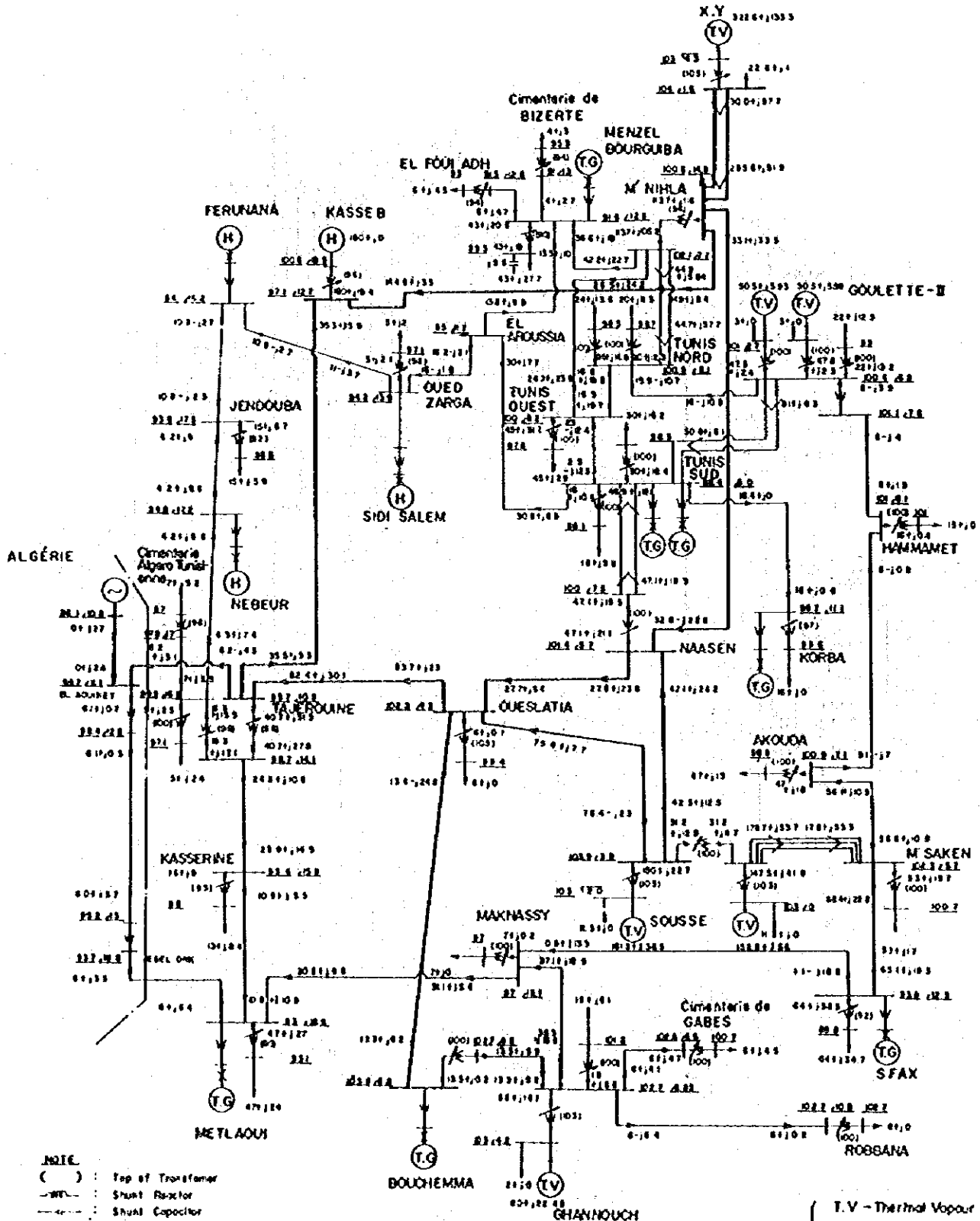


- NOTE**
- () : Top of Transformer
 - - - : Shunt Reactor
 - - - : Shunt Capacitor
 - EL.L : Bus Voltage (kV) and Leading Angle
 - EL.L.L : Bus Voltage (kV) and Lagging Angle
 - Un2 : MW and MVar
 - ⊕ : Additional Shunt Capacitor
 - : LINE 225 kv
 - : LINE 150 kv
 - : LINE 90 kv

Line Loss ($I^2 R$) = 39.40 MW
 $(I^2 X) = 23.08 \text{ MVar}$

- T.V - Thermof Vapour
- T.G - Turbine Gas
- H - Hydraulic

Power Flow and Voltage Regulation at Midnight Time in 1989



- NOTE.**
- () : Top of Transformer
 - WR- : Shunt Reactor
 - C- : Shunt Capacitor
 - 2050 : Bus Voltage (kV) and Leading Angle
 - 202.5 : Bus Voltage (kV) and Leading Angle
 - Unit : MW and MVar
 - ⊕ : Additional Shunt Capacitor
 - : LINE 225 kV
 - - - : LINE 150 kV
 - · · : LINE 90 kV

- T.V - Thermal Vapor
- T.G - Turbine Gas
- H - Hydraulic

Line Loss (1° R) = 25.57 MW
 (1° X) = 9.37 MVar

FIGURES

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(LISTE DES FIGURES)**

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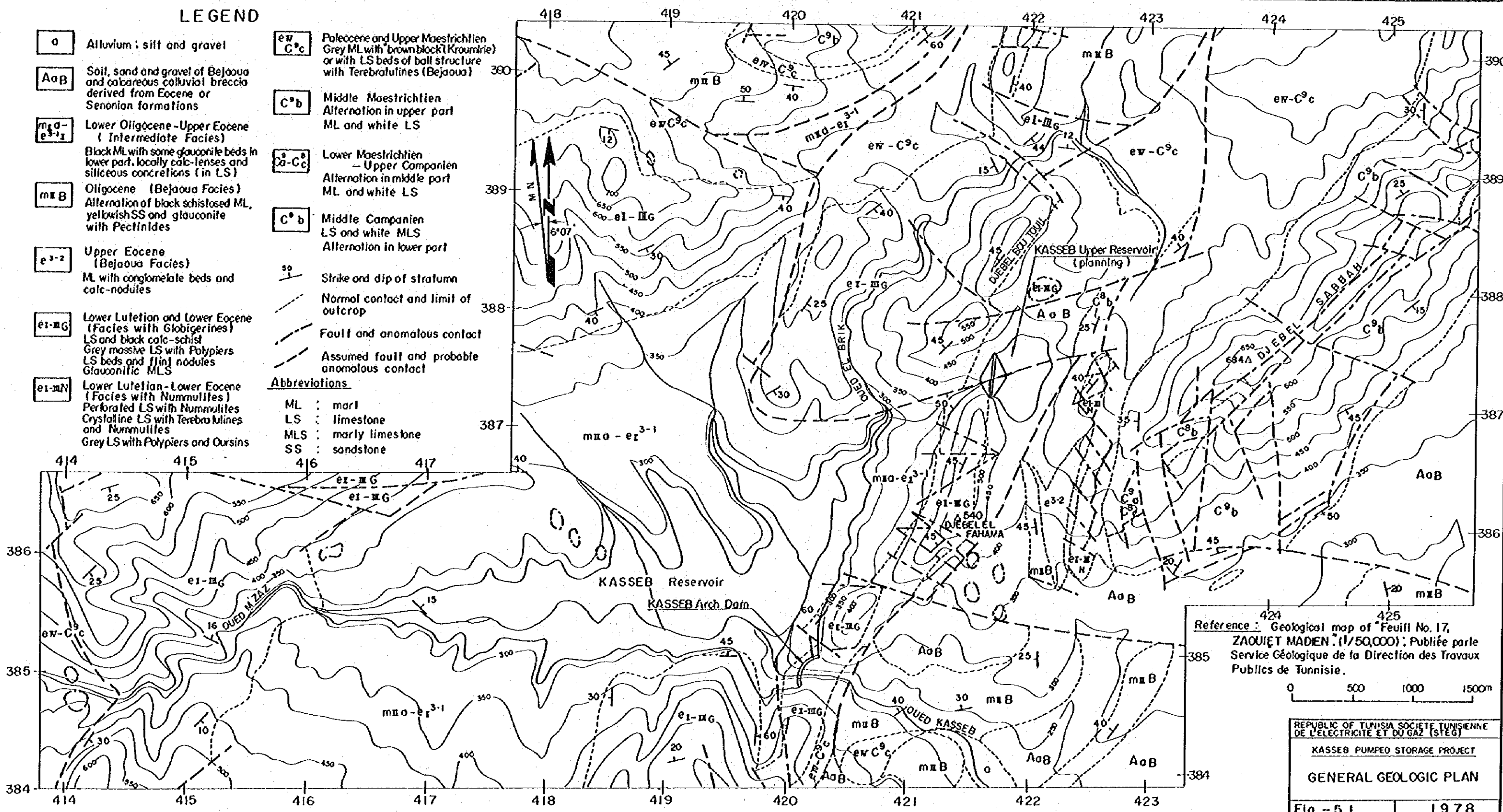
17.	Power House (3-3) Fig. - 8.15 (Centrale (3-3)) – Downstream Alternative (B) – (Drawdown : 20 m) (– Variante Aval (B) –) (Marnage : 20 m)	
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LEGEND

- | | | | |
|---------------------------------------|--|--------------------------------------|---|
| o | Alluvium : silt and gravel | e³⁻¹ | Paleocene and Upper Maestrichtien
Grey ML with brown block (Kroumirie)
or with LS beds of ball structure
with Terebratulines (Bejaoua) |
| A₀B | Soil, sand and gravel of Bejaoua
and calcareous colluvial breccia
derived from Eocene or
Senonian formations | C⁹b | Middle Maestrichtien
Alternation in upper part
ML and white LS |
| m₁a-e³⁻¹ | Lower Oligocene - Upper Eocene
(Intermediate Facies)
Black ML with some glauconite beds in
lower part, locally calc-lenses and
siliceous concretions (in LS) | C⁸a-C⁸c | Lower Maestrichtien
- Upper Campanien
Alternation in middle part
ML and white LS |
| m₁B | Oligocene (Bejaoua Facies)
Alternation of black schistose ML,
yellowish SS and glauconite
with Pectinides | C⁹b | Middle Campanien
LS and white MLS
Alternation in lower part |
| e³⁻² | Upper Eocene
(Bejaoua Facies)
ML with conglomerate beds and
calc-nodules | 50 | Strike and dip of stratum |
| e₁-m₁G | Lower Lutetian and Lower Eocene
(Facies with Globigerines)
LS and black calc-schist
Grey massive LS with Polypiers
LS beds and [(in)] nodules
Glauconitic MLS | --- | Normal contact and limit of
outcrop |
| e₁-m₁N | Lower Lutetian - Lower Eocene
(Facies with Nummulites)
Perforated LS with Nummulites
Crystalline LS with Terebratulines
and Nummulites
Grey LS with Polypiers and Oursins | - - - | Fault and anomalous contact |
| | | - - - - | Assumed fault and probable
anomalous contact |

Abbreviations

- | | |
|-----|-------------------|
| ML | : marl |
| LS | : limestone |
| MLS | : marly limestone |
| SS | : sandstone |



Reference : Geological map of "Feuill No. 17,
ZAOUËT MADIEN" (1/50,000); Publiée par le
Service Géologique de la Direction des Travaux
Publics de Tunisie.

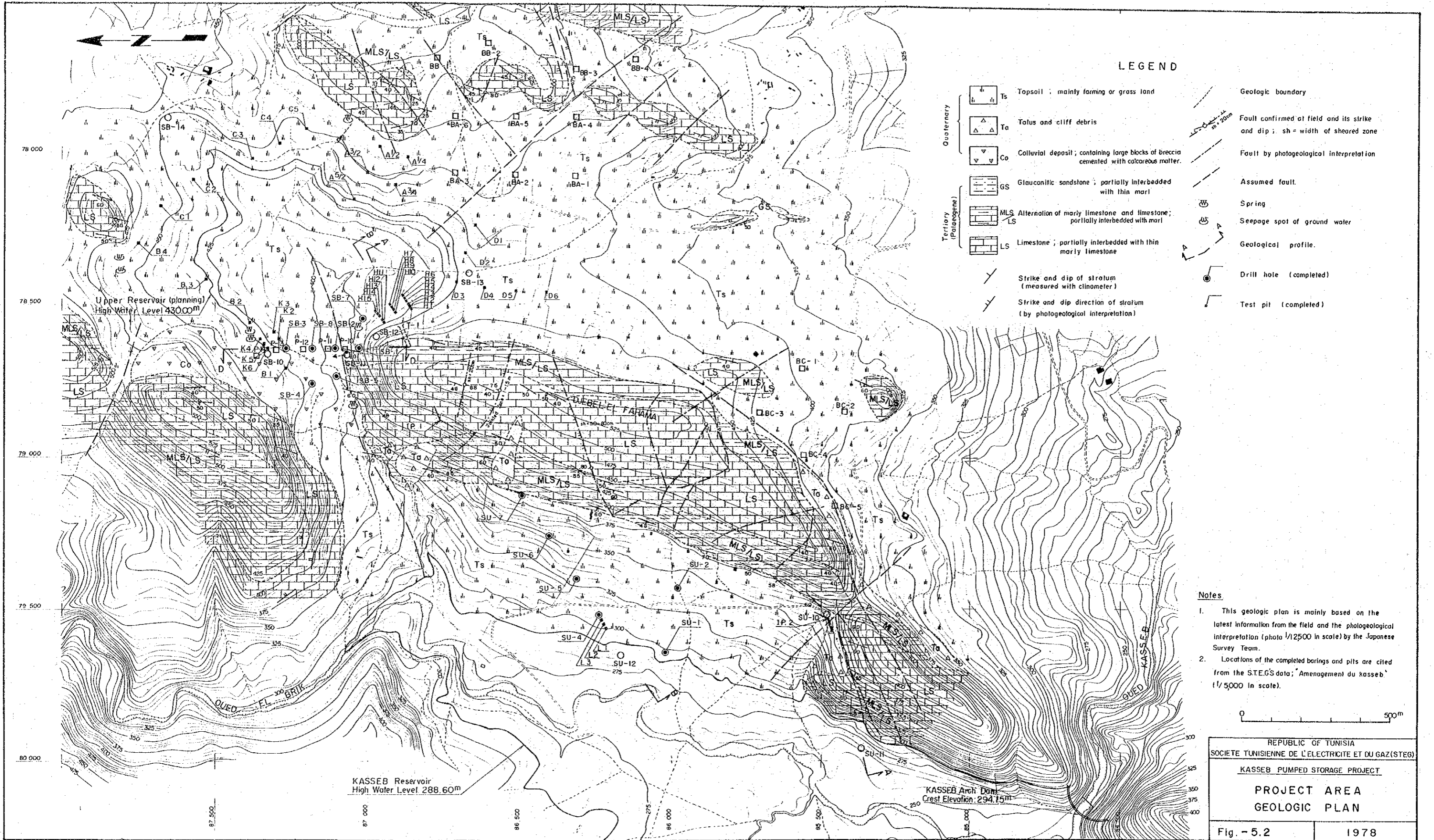


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KASSEB PUMPED STORAGE PROJECT

GENERAL GEOLOGIC PLAN

Fig.-5.1 1978



LEGEND

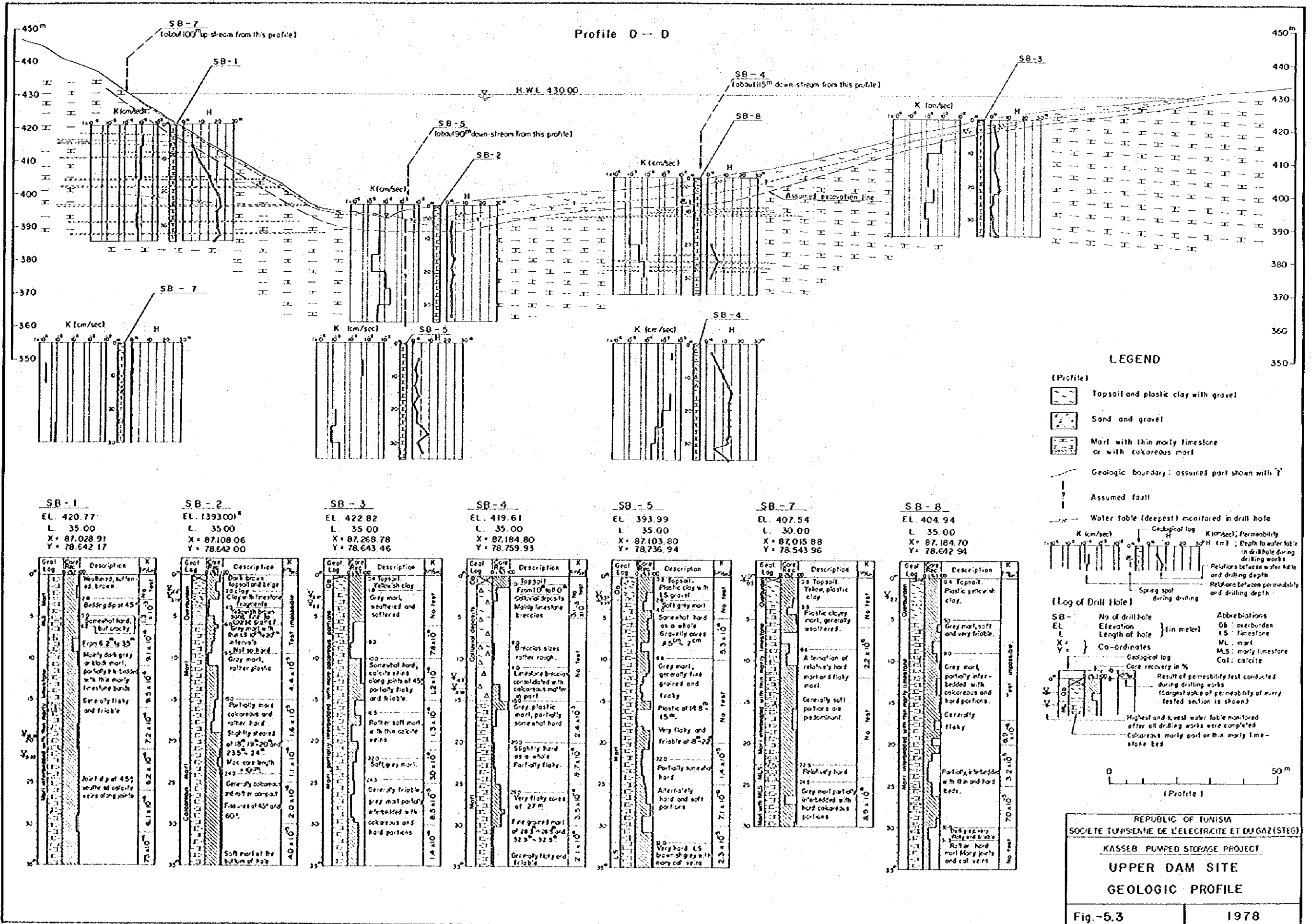
- | | | | | | |
|----------------------|--|--|--|------------------------------|--|
| Quaternary | | Ts Topsoil ; mainly farming or grass land | | Geologic boundary | |
| | | Ta Talus and cliff debris | | | Fault confirmed at field and its strike and dip ; sh = width of sheared zone |
| | | Co Colluvial deposit ; containing large blocks of breccia cemented with calcareous matter. | | | Fault by photogeological interpretation |
| | | GS Glauconitic sandstone ; partially interbedded with thin marl | | | Assumed fault. |
| Tertiary (Paleogene) | | MLS Alternation of marly limestone and limestone ; partially interbedded with marl | | Spring | |
| | | LS Limestone ; partially interbedded with thin marly limestone | | Seepage spot of ground water | |
| | | Strike and dip of stratum (measured with clinometer) | | Geological profile. | |
| | | Strike and dip direction of stratum (by photogeological interpretation) | | Drill hole (completed) | |
| | | | | Test pit (completed) | |

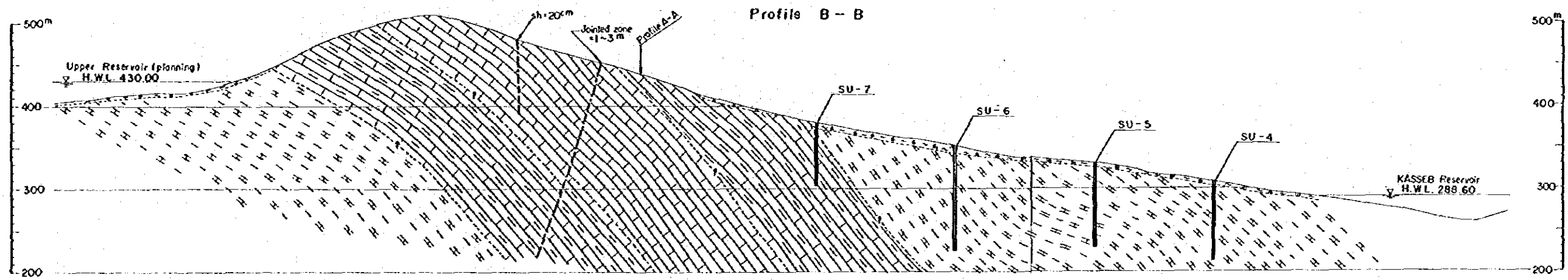
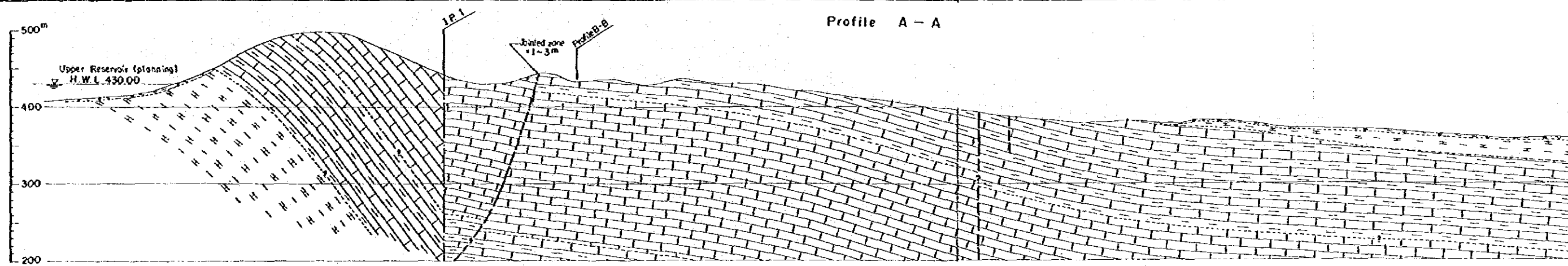
Notes

1. This geologic plan is mainly based on the latest information from the field and the photogeological interpretation (photo 1/12500 in scale) by the Japanese Survey Team.
2. Locations of the completed borings and pits are cited from the S.T.E.G.'s data; "Aménagement du Kasseb" (1/5000 in scale).



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 KASSEB PUMPED STORAGE PROJECT
**PROJECT AREA
 GEOLOGIC PLAN**





SU - 1
 EL. 298.57
 L. 70.0
 X = 86,022.03
 Y = 79,644.05

Geol. Log	Description	K (cm/sec)
0-10	Yellow clay, plastic	No test
10-15	Yellow sandy clay with marl	62 x 10 ⁻⁵
15-20	Weathered marl, partially grey and hard. Generally softened.	51 x 10 ⁻⁵
20-25	Mainly flaky and friable marl, partially interbedded with thin hard marl.	64 x 10 ⁻⁵
25-30		14 x 10 ⁻⁵
30-35		29 x 10 ⁻⁵
35-40	Grey marl with thin glauconitic-sandy part, somewhat friable in part.	76 x 10 ⁻⁵
40-45	Glauconitic-sandy marl rather hard and crackly.	94 x 10 ⁻⁵
45-50	Mainly grey marl partially interbedded with glauconitic-sandy marl.	32 x 10 ⁻⁵
50-55	Rather hard in glauconitic-sandy part.	24 x 10 ⁻⁵
55-60		38 x 10 ⁻⁵
60-70	Joints at 45° calcite veins along joints, exfoliative.	10 x 10 ⁻⁶

End of hole at 70m

SU - 2
 EL. 339.79
 L. 38.5
 X = 85,985.16
 Y = 79,429.74

Geol. Log	Description	K (cm/sec)
0-5	Topsoil and yellow clay.	No test
5-10	Weathered marl schistosity at 45°	No test
10-20	Mainly grey marl, partially interbedded with thin limestone and/or glauconitic-sandy marl.	20 x 10 ⁻⁶
20-30	Generally rather flaky and friable.	13 x 10 ⁻⁶
30-35	Somewhat hard in calcareous or glauconitic-sandy part.	No test
35-40	Disturbed and fractured, brittle, cracks at 45°.	No test
40-45	Hard limestone, pack of 60°	No test

End of hole at 38.5m

SU - 4
 EL. 310.22
 L. 100.0
 X = 86,242.47
 Y = 79,516.81

Geol. Log	Description	K (cm/sec)
0-5	Yellowish grey clay with small calcite veins.	No test
5-10	Mainly grey marl, softened. Many thin calcite veins.	No test
10-20	Grey, slightly schistose marl. Generally flaky and friable.	No test
20-30	Grey marl, slightly weathered, generally flaky and friable.	12 x 10 ⁻⁶
30-40	Bedding of 60°-70°	14 x 10 ⁻⁶
40-45	Partly greenish grey and somewhat hard cores.	11 x 10 ⁻⁶
45-50	Generally flaky and friable, partially interbedded with thin glauconitic-sandy marl.	27 x 10 ⁻⁶
50-55		35 x 10 ⁻⁶
55-60	Grey, slightly sandy marl, somewhat hard and compact. Core length 5 to 10m in part. Bedding at 45°.	22 x 10 ⁻⁶
60-70		76 x 10 ⁻⁶
70-80	Mainly grey or dark grey marl, flaky and friable as a whole.	44 x 10 ⁻⁶
80-90	Bedding approximately horizontal.	26 x 10 ⁻⁶
90-100	Partly glauconitic marl, friable in part.	No test

End of hole at 100m

SU - 5
 EL. 330.00
 L. 100.0
 X = 86,319.87
 Y = 79,400.52

Geol. Log	Description	K (cm/sec)
0-5	Topsoil and yellowish clay.	No test
5-10	Grey marl, very soft, plastic.	No test
10-20	Grey-dark grey marl, slightly schistose.	43 x 10 ⁻⁶
20-30	Generally flaky and friable. Core length max 5-6m, mainly small fragments. Weak shearing recognizable as a whole. Bedding of 20° to 30°.	26 x 10 ⁻⁶
30-40		64 x 10 ⁻⁶
40-45		21 x 10 ⁻⁶
45-50	Dark grey marl, mainly flaky cores with somewhat cores like coin.	23 x 10 ⁻⁶
50-55	Bedding approximately horizontal.	40 x 10 ⁻⁶
55-60	Very flaky or clayey at 430-445° and 480-55°.	No test
60-65	Dark grey marl, with thin glauconitic marl in part. Core length 5 to 20m, somewhat exfoliative and friable as a whole.	31 x 10 ⁻⁶
65-70		14 x 10 ⁻⁶
70-75	Dark grey marl with glauconitic and sandy marl in part. Core length 5-10m and the rest gravelish cores.	12 x 10 ⁻⁶
75-80	Generally exfoliative, partially very flaky and friable.	No water-logs under Part 2
80-85		56 x 10 ⁻⁶
85-90	Bedding of 0°-20° at 675-78m and at 20°-30° at 78-100m.	61 x 10 ⁻⁶

End of hole at 100m

SU - 6
 EL. 350.14
 L. 125.0
 X = 86,413.12
 Y = 79,260.43

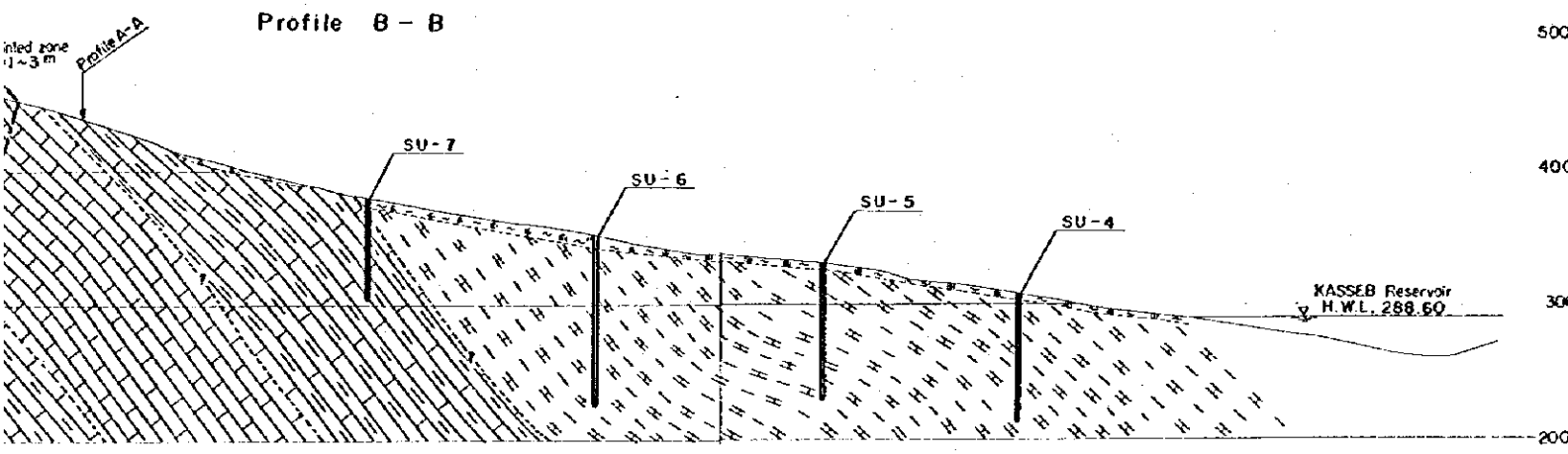
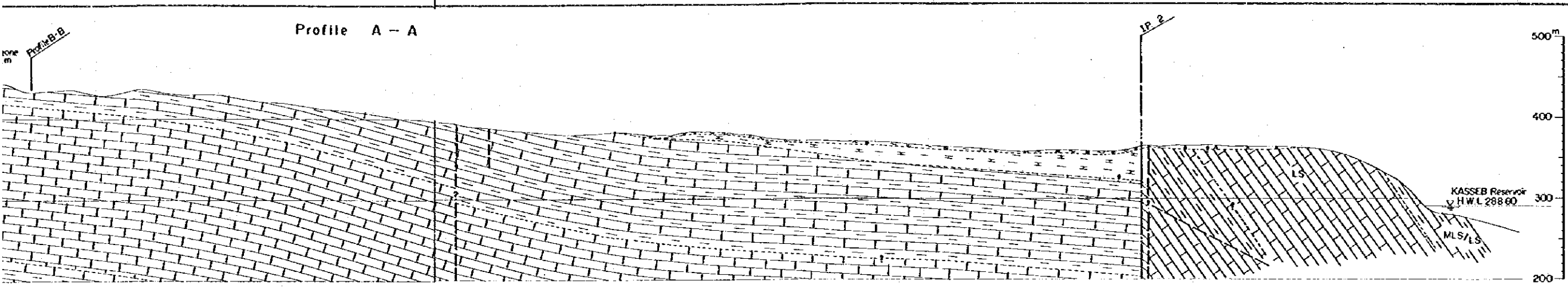
Geol. Log	Description	K (cm/sec)
0-5	Topsoil and yellowish sandy clay with a few gravel.	No test
5-10	Weathered marl softened and brittle, partially clayey.	No test
10-20	Dark grey marl, mostly gravelish cores, partially very flaky.	No test
20-30	Some long cores (max 30cm) in part. Generally rather weathered and brittle.	(Test impossible)
30-40	Many thin calcite veins as a whole.	28 x 10 ⁻⁶
40-45	5-22 Sheared and brittle.	30 x 10 ⁻⁶
45-50	Partially flaky and brittle. Horizontal bedding at 50.5m. Dip 47° bedding at 52.5m.	31 x 10 ⁻⁶
50-55		11 x 10 ⁻⁶
55-60	Dark grey marl, somewhat hard as a whole. Core length 20m to 30cm, partially gravelish cores.	12 x 10 ⁻⁶
60-65	Core broken into small pieces, rather brittle.	54 x 10 ⁻⁶
65-70	Mainly marl, partially with thin glauconitic and sandy marl. Core length 20m to 30m, somewhat hard but exfoliative in general.	41 x 10 ⁻⁶
70-75	Partially sheared and clayey. At 85° bedding about 60°.	76 x 10 ⁻⁶
75-80		28 x 10 ⁻⁶

End of hole at 125m

Geol. Log	Description	K (cm/sec)
0-5	Topsoil	No test
5-10	Dark grey marl and dark greenish grey glauconitic and sandy marl.	28 x 10 ⁻⁶
10-20	Glauconitic-sandy part rather compact and somewhat hard. Partially somewhat exfoliative.	30 x 10 ⁻⁶
20-30		31 x 10 ⁻⁶

SU - 7
 EL. 380.24
 L. 75.0
 X = 86,502.77
 Y = 79,125.87

Geol. Log	Description	K (cm/sec)
0-5	Topsoil	No test
5-10	Brown silt w/ gravels #2	No test
10-20	Dark grey marl, flaky, glauconitic. Core length 5-10m.	No test
20-30	Dark grey marl, slightly brittle.	No test
30-40	Generally brittle.	No test
40-50	Bedding at 45°	No test
50-60	Core length 5-10m.	No test
60-70	Mainly grey marl, only a few gravel.	No test
70-80	Generally very friable.	No test
80-90	Partially friable.	No test
90-100	Core length 5-10m.	No test
100-110	Bedding at 45°	No test



- ### LEGEND
- (Profile)
- Topsoil and mainly clay with gravel
 - Talus or cliff debris
 - Marl; partially interbedded with thin marly limestone
 - Alternation of marly limestone and limestone; partially interbedded with marl
 - Limestone; partially interbedded with thin marly limestone
 - Geologic boundary: assumed part shown with "?"
 - Fault and width of sheared zone
sh = width of sheared zone (in cm)
 - Assumed fault or assumed part of fault
 - Intersection point of profile
 - Drill hole

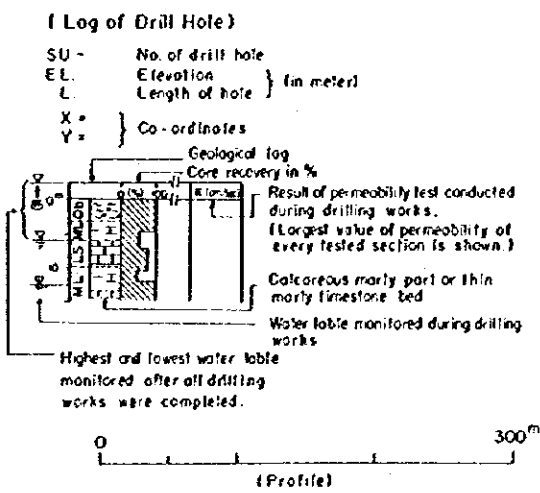
Description	K (cm/sec)
Yellowish grey clay with small calcite veins	No test
Mainly grey marl, softened. Many thin calcite veins. Cores broken into fragments in general.	No test
Grey, slightly schistose marl. Generally flaky and friable.	No test
Grey marl, slightly weathered, generally flaky and friable. Bedding at 60°-70°	12 x 10 ⁻⁴
Partially greenish grey and somewhat hard cores	14 x 10 ⁻⁴
Generally flaky and friable. Partially interbedded with thin glauconitic-sandy marl.	11 x 10 ⁻⁴
Grey, slightly sandy marl, somewhat hard and compact. Core length 5 to 10 cm in part. Bedding at 45°	2.7 x 10 ⁻⁴
Mainly grey or dark grey marl, flaky and friable as a whole. Bedding approximately horizontal.	3.5 x 10 ⁻⁴
Partially glauconitic marl, friable in part.	7.6 x 10 ⁻⁵
	4.4 x 10 ⁻⁴
	2.6 x 10 ⁻⁴

SU - 5	
EL. 330.00 L. 100.0 X = 86,319.87 Y = 79,400.52	
Geol. Log	Description
0-5	Topsoil and yellowish clay
5-10	Grey marl, very soft, plastic.
10-20	Grey-dark grey marl, slightly schistose. Generally flaky and friable. Core length max 5-6 cm, mainly small fragments. Weak shearing recognizable as a whole. Bedding at 20° to 30°.
20-30	Dark grey marl, mainly flaky cores with some thin calcite veins. Bedding approximately horizontal.
30-40	Very flaky or clayey at 430-440 cm and 480-55 cm.
40-50	Dark grey marl, with thin glauconitic marl in part. Core length 5 to 20 cm, somewhat exfoliative and friable as a whole.
50-60	Dark grey marl, with glauconitic and sandy marl in part. Core length 5 to 10 cm and the rest gravelish cores. Generally exfoliative, partially very flaky and friable. Bedding at 0°-20° in 675-78 cm and at 20°-30° in 78-100 cm.

SU - 6	
EL. 350.14 L. 125.0 X = 86,413.12 Y = 79,260.43	
Geol. Log	Description
0-5	Topsoil and yellowish sandy clay with a few gravels.
5-10	Weathered marl softened and brittle, partially clayey.
10-20	Dark grey marl, mostly gravelish cores, partially very flaky.
20-30	Some long cores (max 30 cm) in part. Generally rather weathered and brittle.
30-40	Many thin calcite veins as a whole.
40-50	512-522 Sheared and brittle. Partially flaky and brittle. Horizontal bedding at 50.5 m. Dip 45° bedding at 52.5 m.
50-60	Dark grey marl, somewhat hard as a whole. Core length 20 cm to 30 cm, partially gravelish cores.
60-70	Core broken into small pieces, from 75.5 to 102.0 m.
70-80	Mainly marl, partially with thin glauconitic and sandy marl. Core length 20 cm to 30 cm, somewhat hard but exfoliative in general. Partially sheared and clayey. At 85 m bedding about 60°.

SU - 7	
EL. 380.24 L. 75.0 X = 86,502.77 Y = 79,125.87	
Geol. Log	Description
0-5	Topsoil (30 cm thick) and yellowish brown silt with limestone gravels (1.5 to 10 cm)
5-10	Dark grey marl, generally weathered, flaky. Partially sandy or glauconitic. Bedding at 45°. Core length: average 10 cm to 20 cm.
10-20	Dark grey-grey, marly limestone. Dark colored part more marly, and slightly brittle. Generally hard and compact. Bedding at 45°. Core length: average 10 cm to 20 cm, max. 40 cm.
20-30	Mainly grey limestone with only a few thin marly limestone. Generally very hard and compact. Partially thin calcite veins. Core length: average 20-30 cm, max. 70 cm.
30-40	Bedding at 45°

SU - 7	
EL. 380.24 L. 75.0 X = 86,502.77 Y = 79,125.87	
Geol. Log	Description
0-5	Topsoil (30 cm thick) and yellowish brown silt with limestone gravels (1.5 to 10 cm)
5-10	Dark grey marl, generally weathered, flaky. Partially sandy or glauconitic. Bedding at 45°. Core length: average 10 cm to 20 cm.
10-20	Dark grey-grey, marly limestone. Dark colored part more marly, and slightly brittle. Generally hard and compact. Bedding at 45°. Core length: average 10 cm to 20 cm, max. 40 cm.
20-30	Mainly grey limestone with only a few thin marly limestone. Generally very hard and compact. Partially thin calcite veins. Core length: average 20-30 cm, max. 70 cm.
30-40	Bedding at 45°

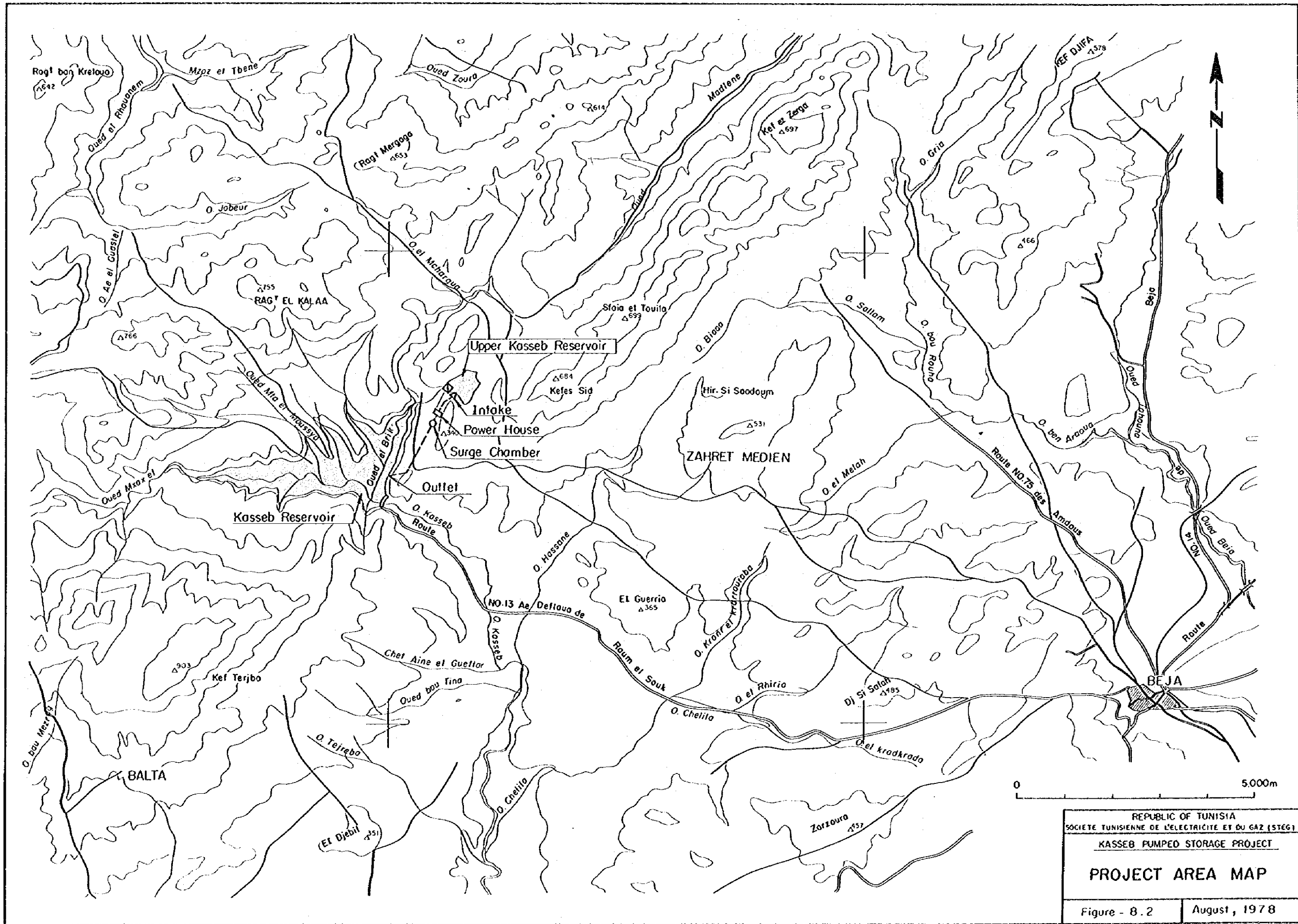


REPUBLIC OF TUNISIA
SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)

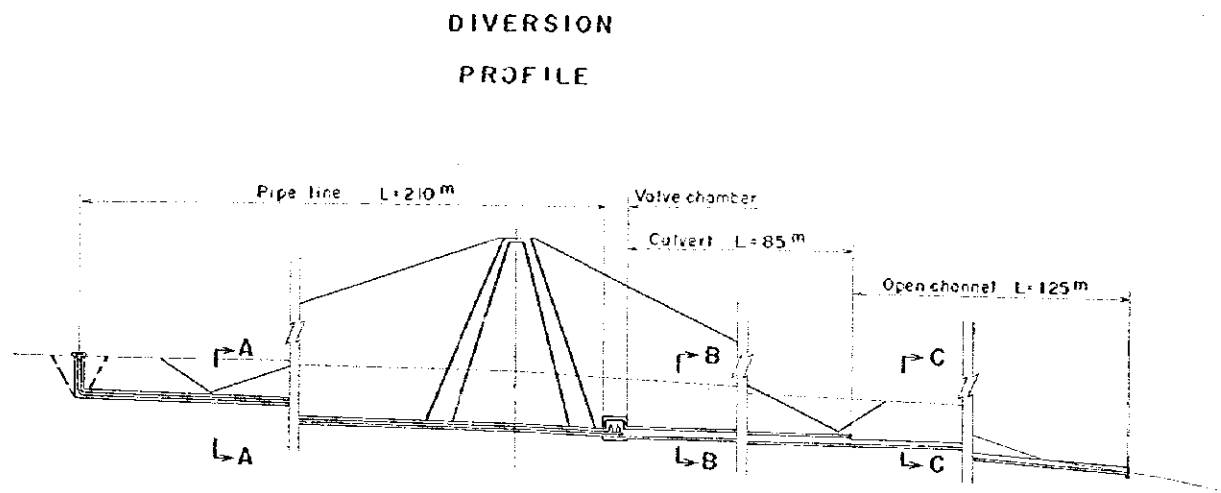
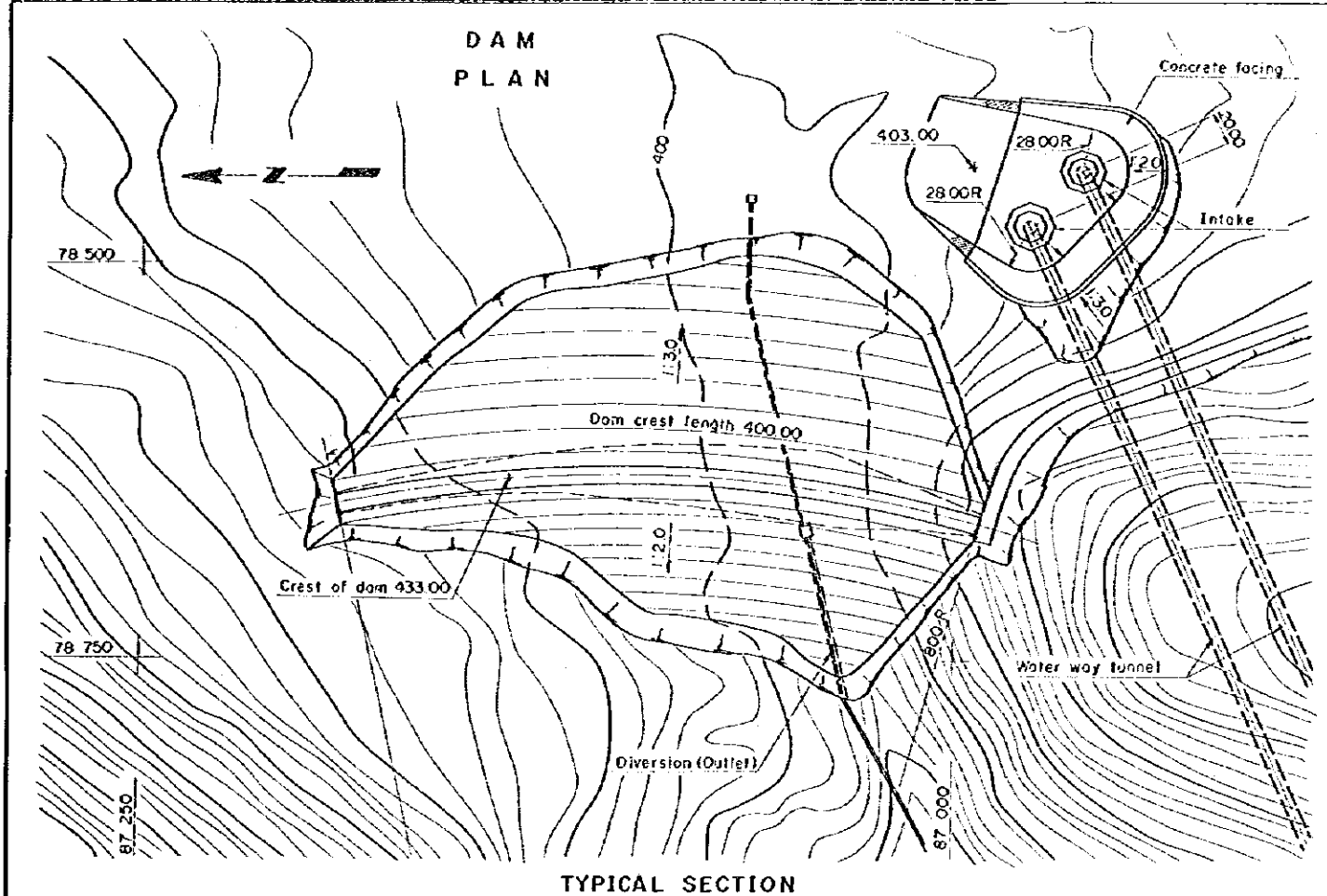
KASSEB PUMPED STORAGE PROJECT

WATER WAY ALIGNMENT
GEOLOGIC PROFILE

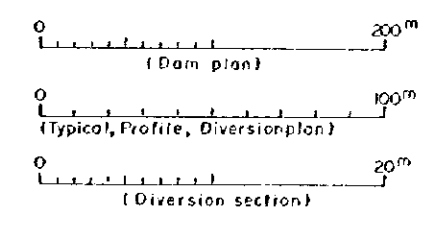
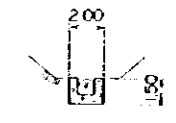
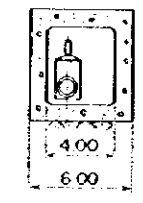
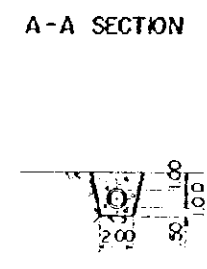
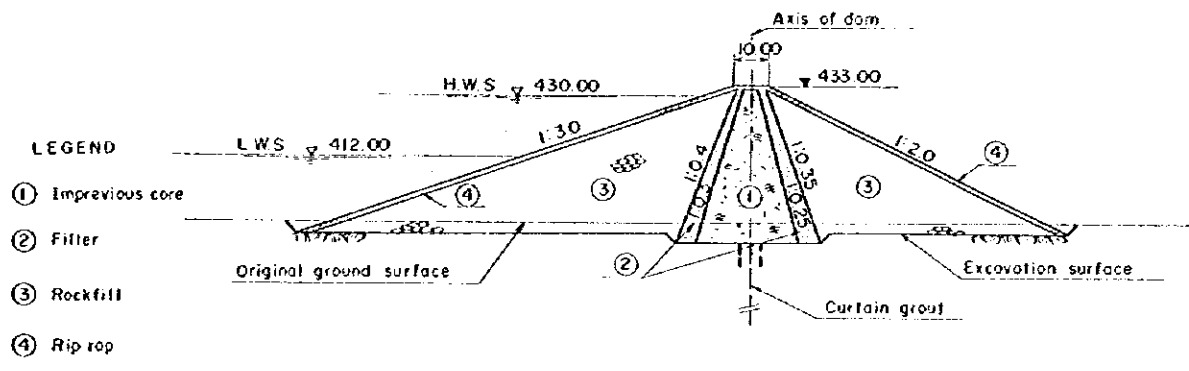
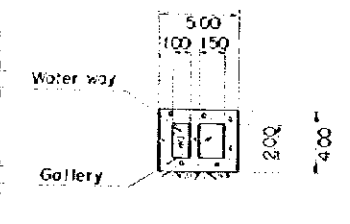
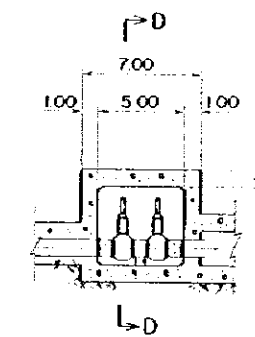
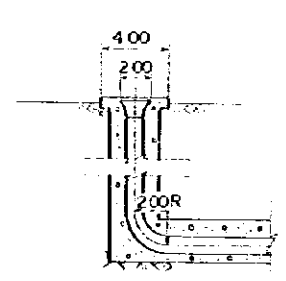
Fig - 5.4 1978



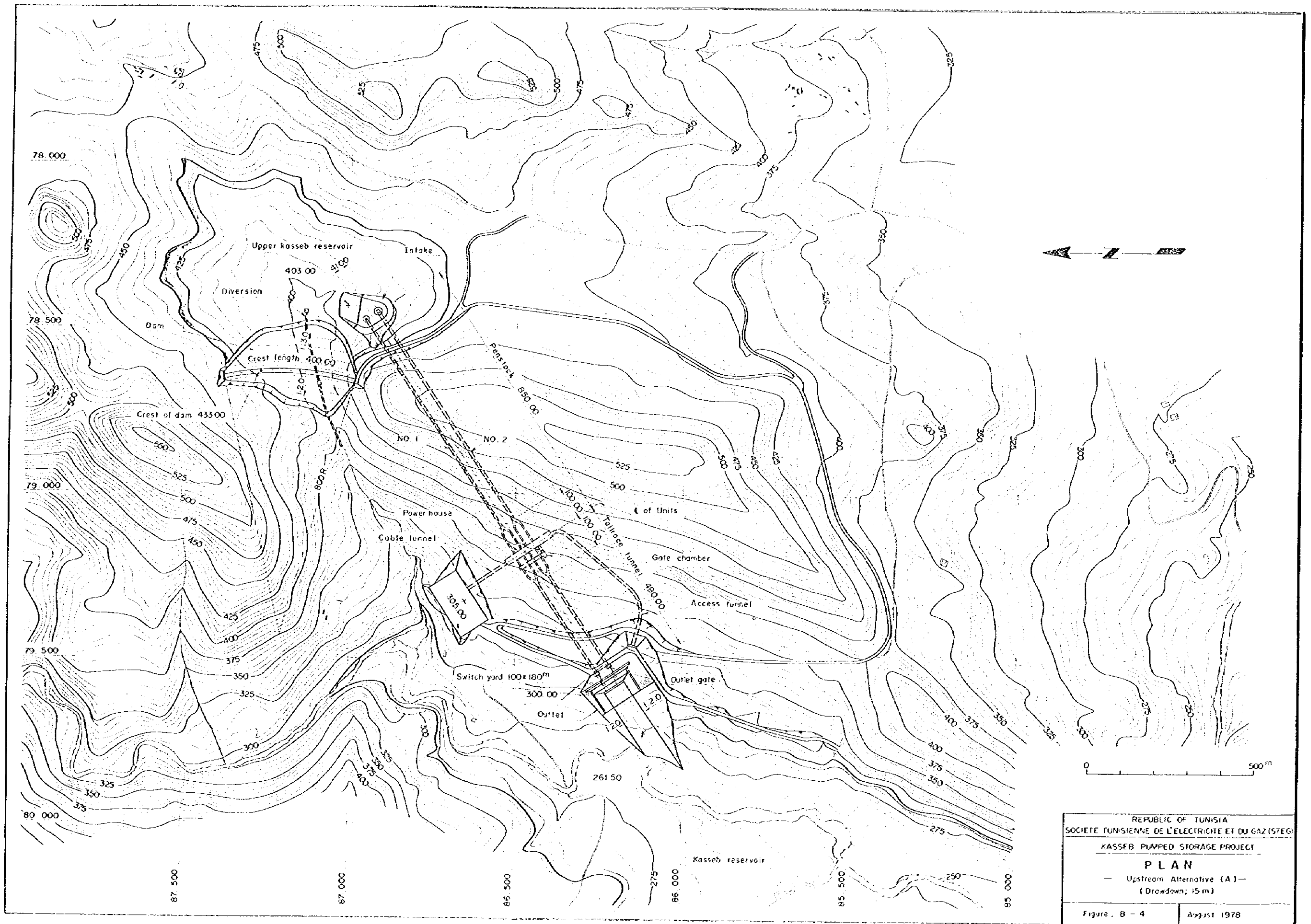
REPUBLIC OF TUNISIA	
SOCIÉTÉ TUNISIENNE DE L'ÉLECTRICITÉ ET DU GAZ (STEG)	
KASSEB PUMPED STORAGE PROJECT	
PROJECT AREA MAP	
Figure - 8.2	August, 1978



INTAKE LONGITUDINAL SECTION VALVE CHAMBER LONGITUDINAL SECTION B-B SECTION



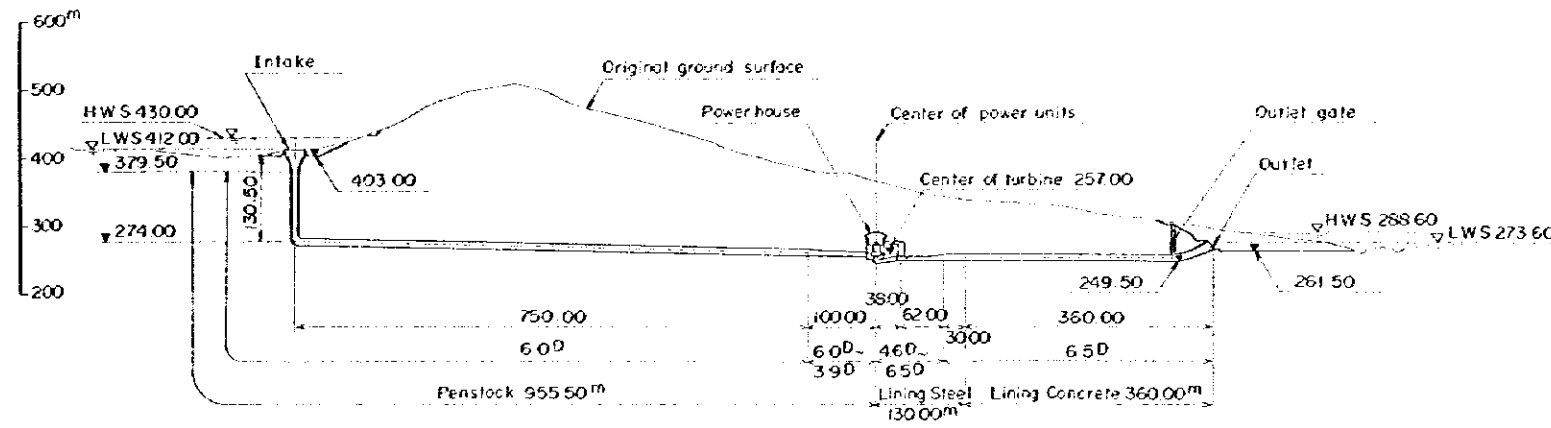
REPUBLIC OF TUNISIA
 SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)
 KASSEB PUMPED STORAGE PROJECT
DAM AND DIVERSION (OUTLET)
 -- Upstream Alternative (A) --
 (Drawdown: 15 m)



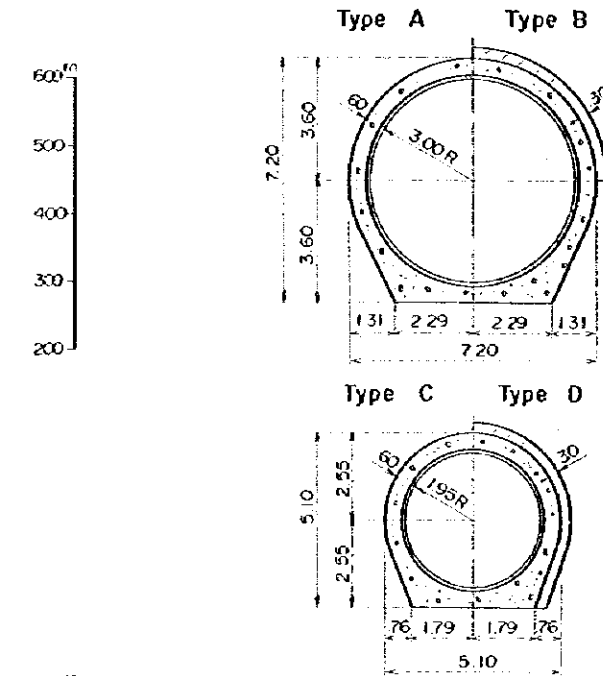
REPUBLIC OF TUNISIA
 SOCIÉTÉ TUNISIENNE DE L'ÉLECTRICITÉ ET DU GAZ (STEG)
 KASSEB PUMPED STORAGE PROJECT
PLAN
 — Upstream Alternative (A) —
 (Drawdown: 15m)

Figure B - 4 August 1978

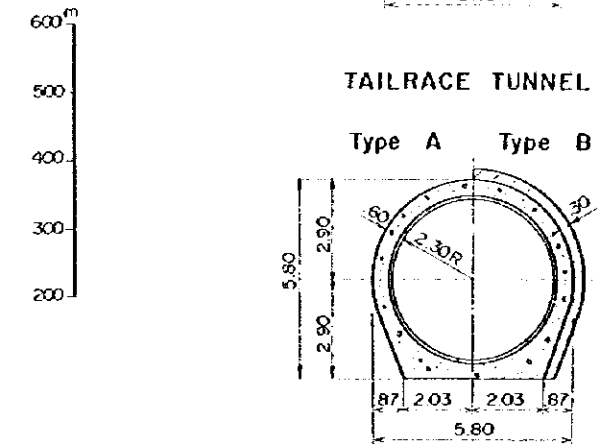
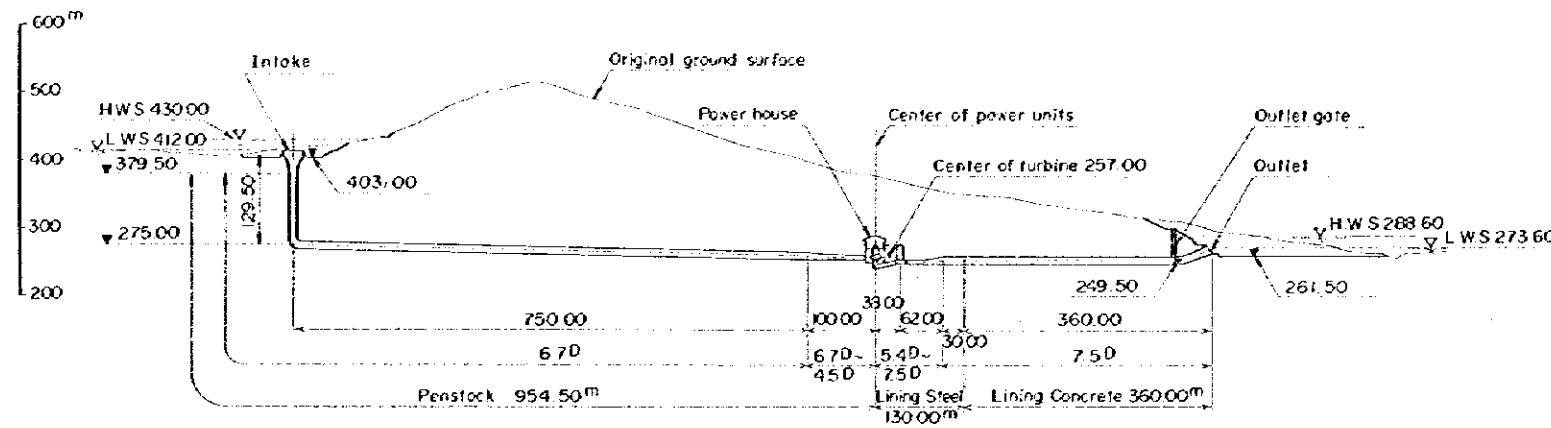
NO.1 WATERWAY TUNNEL LONGITUDINAL SECTION



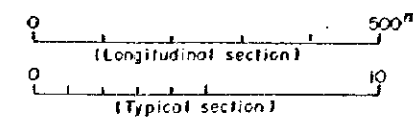
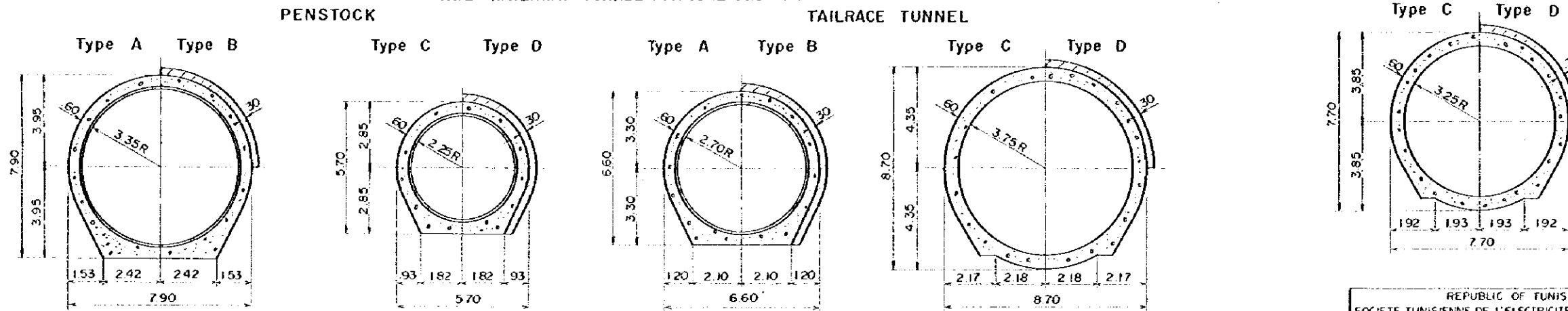
NO.1 WATERWAY TUNNEL TYPICAL SECTION PENSTOCK



NO.2 WATERWAY TUNNEL LONGITUDINAL SECTION



NO.2 WATERWAY TUNNEL TYPICAL SECTION



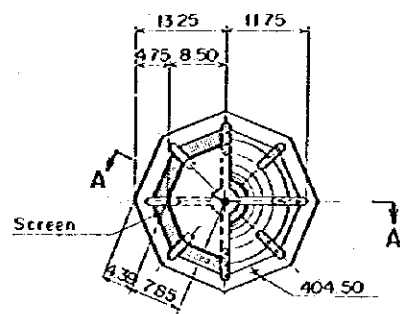
REPUBLIC OF TUNISIA
SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)

KASSEB PUMPED STORAGE PROJECT

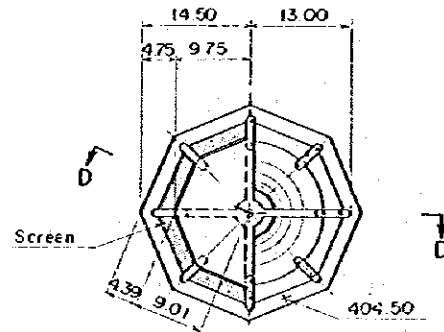
WATERWAY TUNNELS

— Upstream Alternative (A1) —
(Drawdown; 15m)

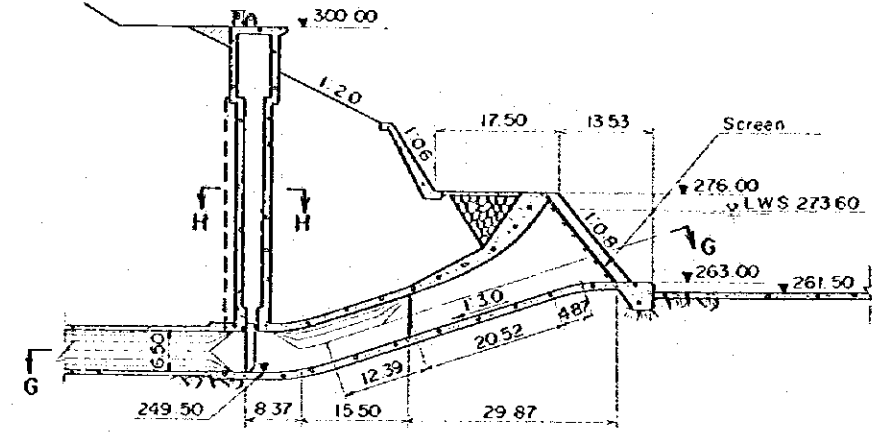
NO.1 INTAKE
PLAN



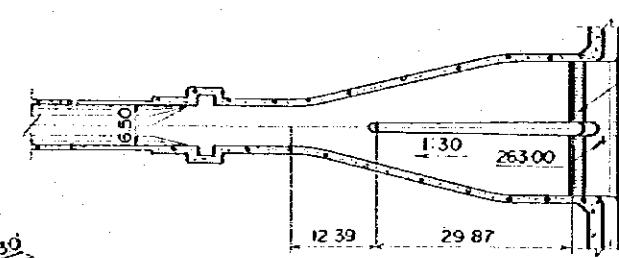
NO.2 INTAKE
PLAN



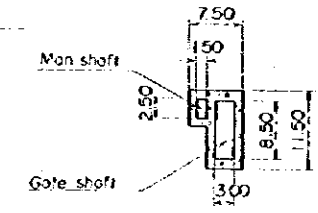
NO.1 OUTLET LONGITUDINAL SECTION



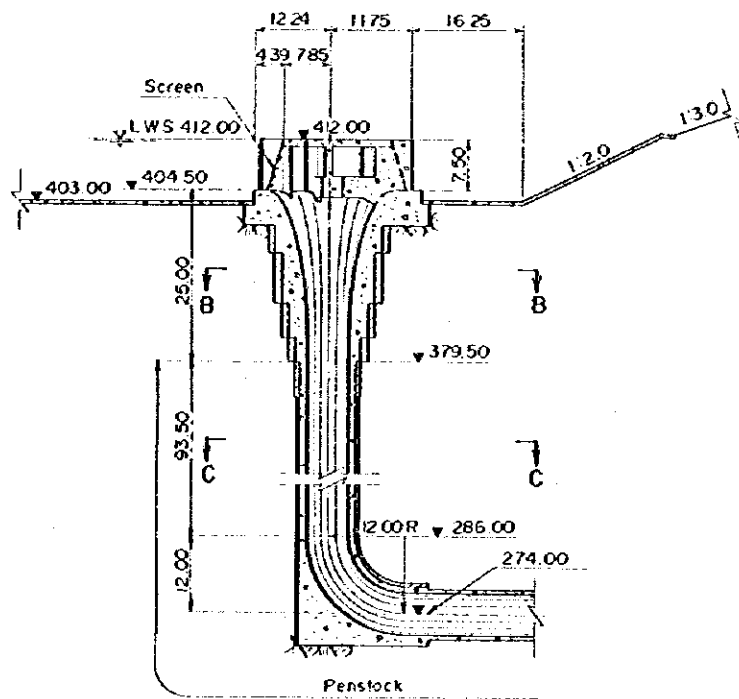
G-G SECTION



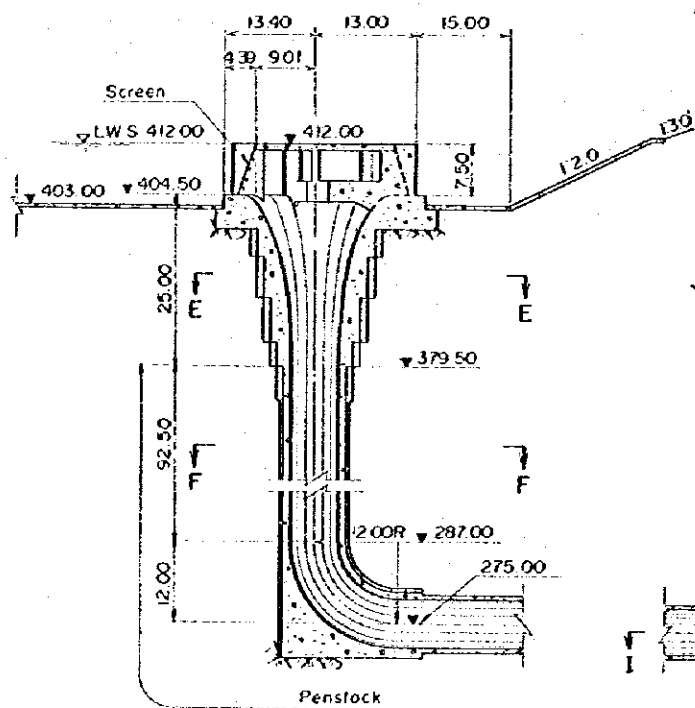
H-H SECTION



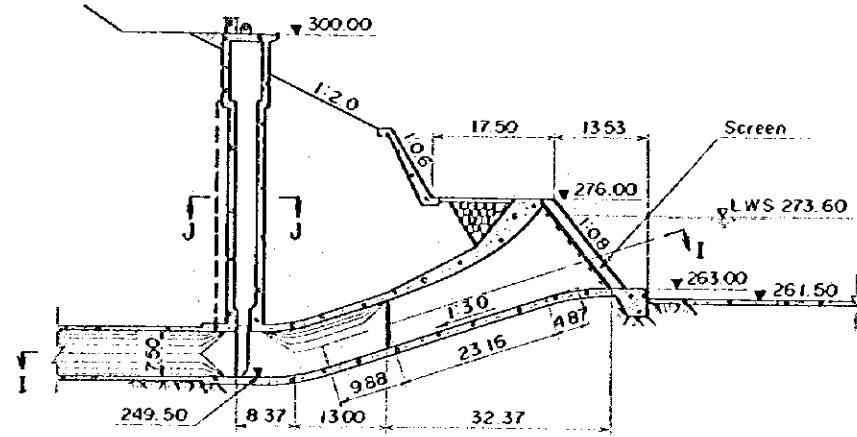
A-A SECTION



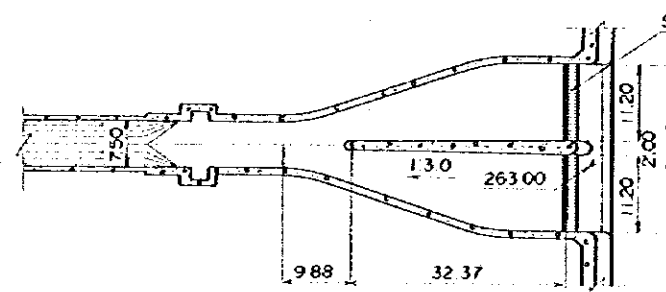
D-D SECTION



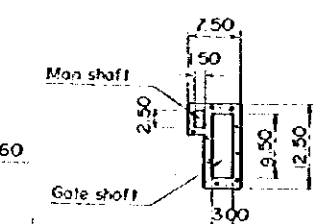
NO.2 OUTLET LONGITUDINAL SECTION



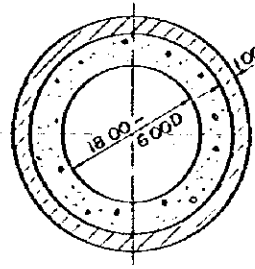
I-I SECTION



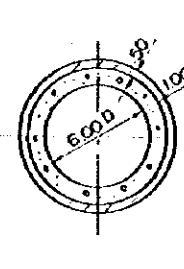
J-J SECTION



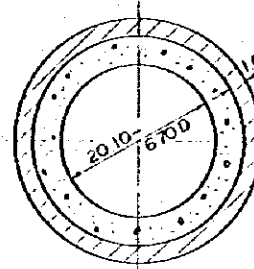
B-B SECTION



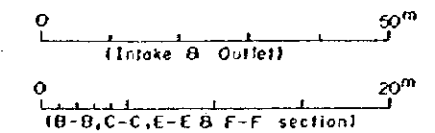
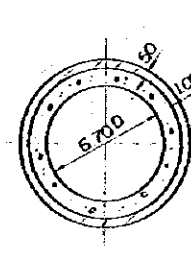
C-C SECTION



E-E SECTION



F-F SECTION



REPUBLIC OF TUNISIA
SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)

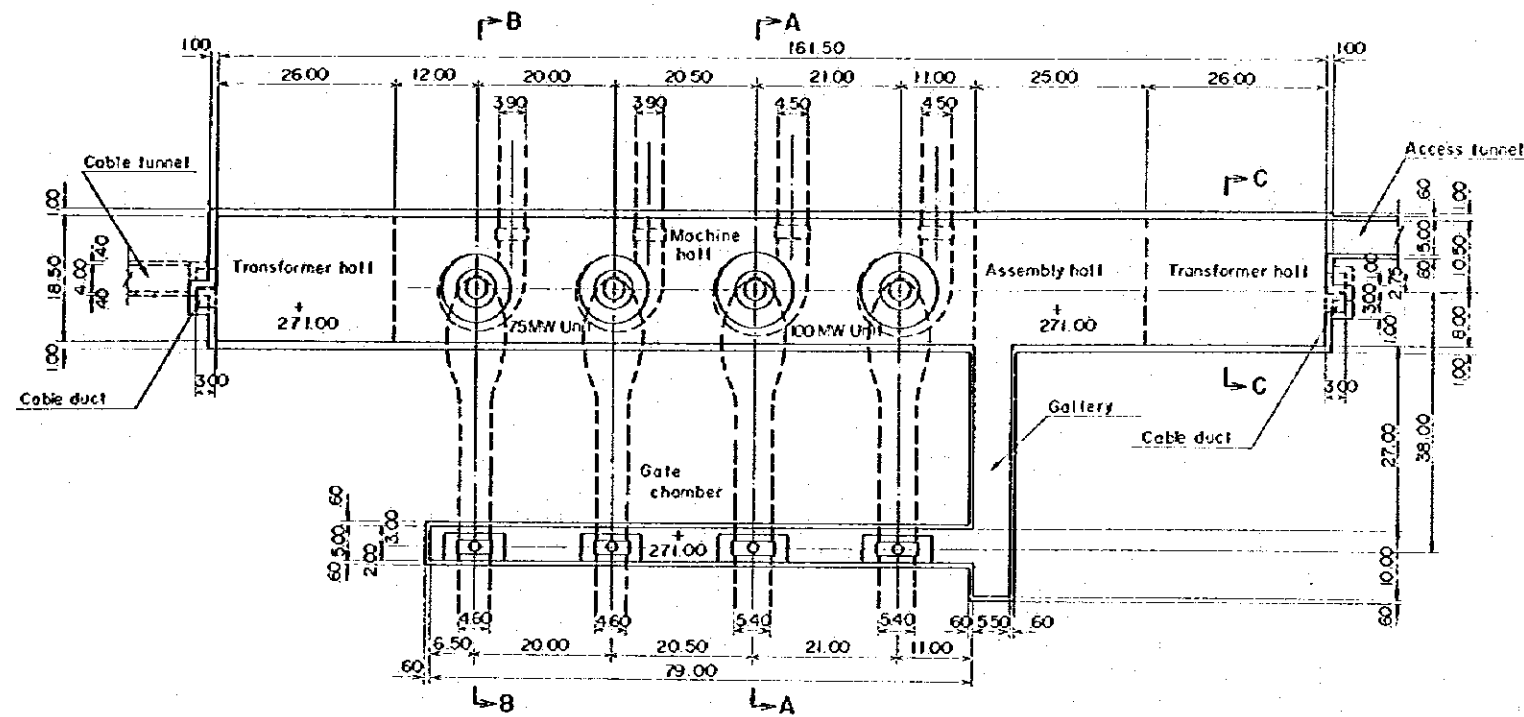
KASSEB PUMPED STORAGE PROJECT

INTAKE AND OUTLET

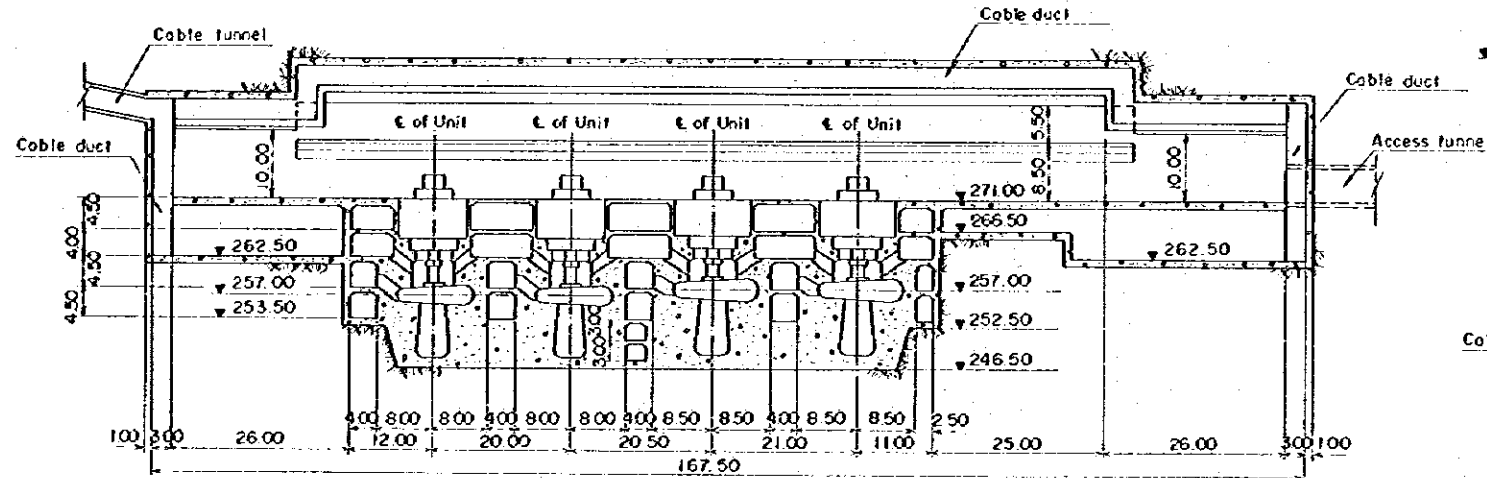
— Upstream Alternative (A) —

(Drawdown: 15 m)

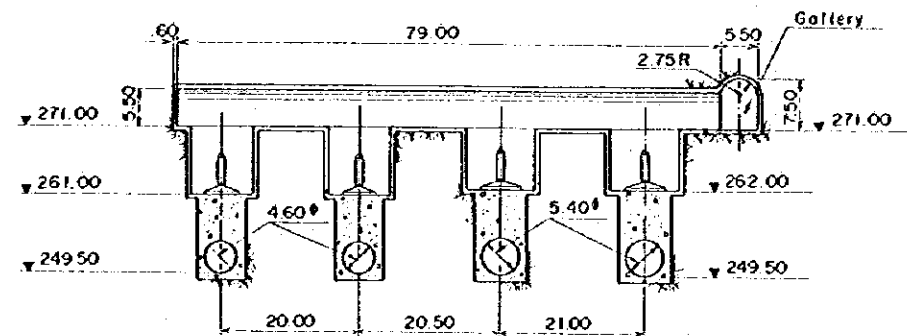
POWERPLANT PLAN



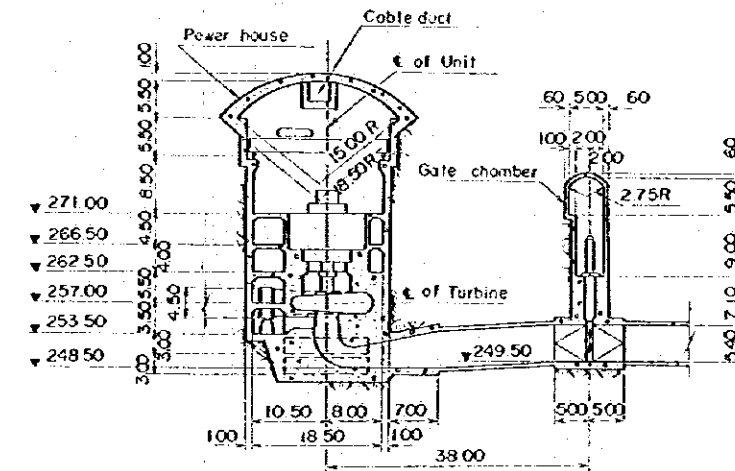
POWER HOUSE LONGITUDINAL SECTION



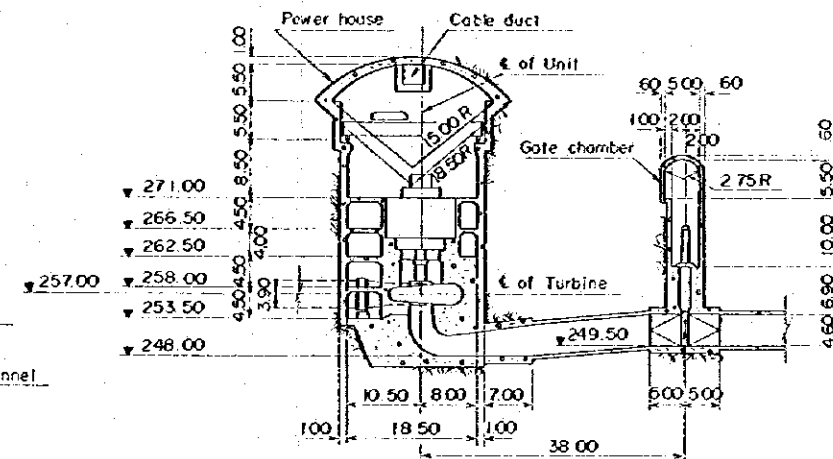
GATE CHAMBER LONGITUDINAL SECTION



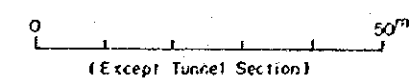
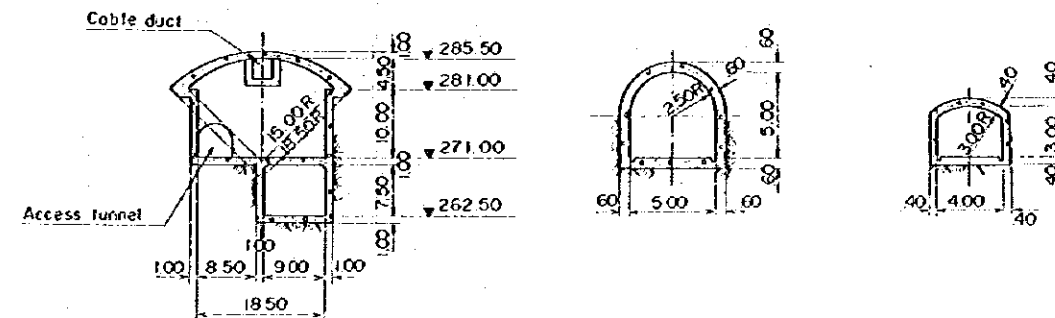
A-A SECTION (100.MW SIDE)



B-B SECTION (75.MW SIDE)

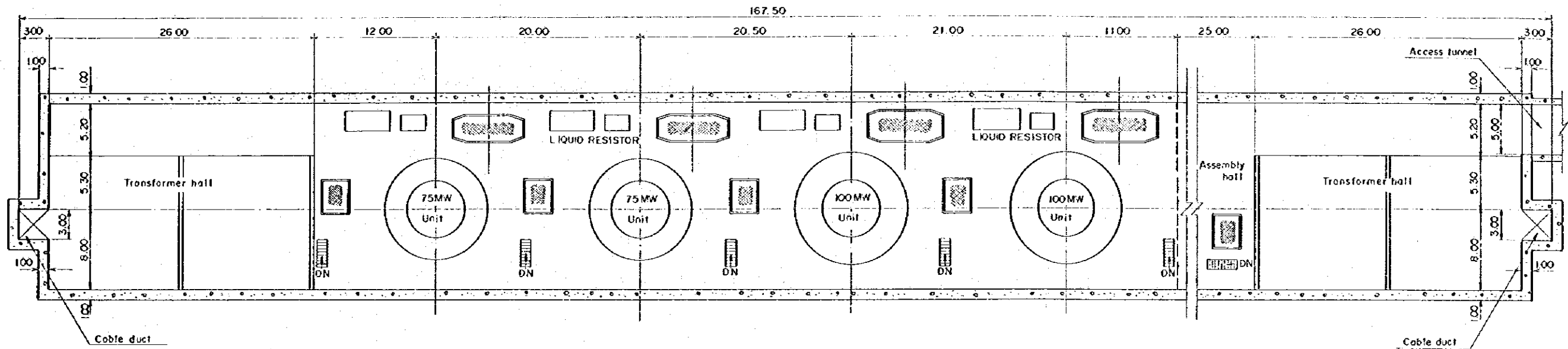


TRANSFORMER HALL (C-C) SECTION ACCESS TUNNEL SECTION CABLE TUNNEL SECTION

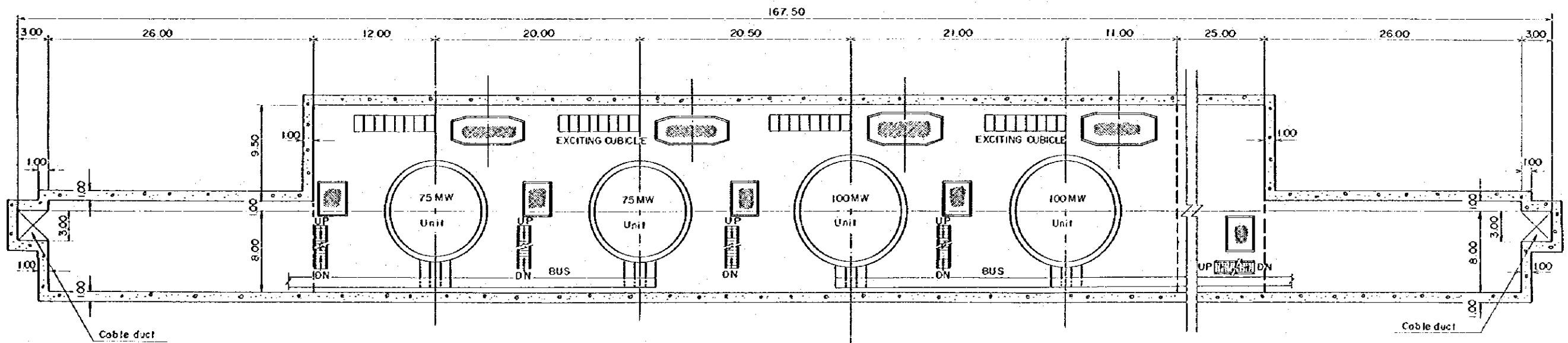


REPUBLIC OF TUNISIA
SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)
KASSEB PUMPED STORAGE PROJECT
POWER HOUSE (1-3)
Upstream Alternative (A)
(Drawdown: 15 m)

EL. 271.00

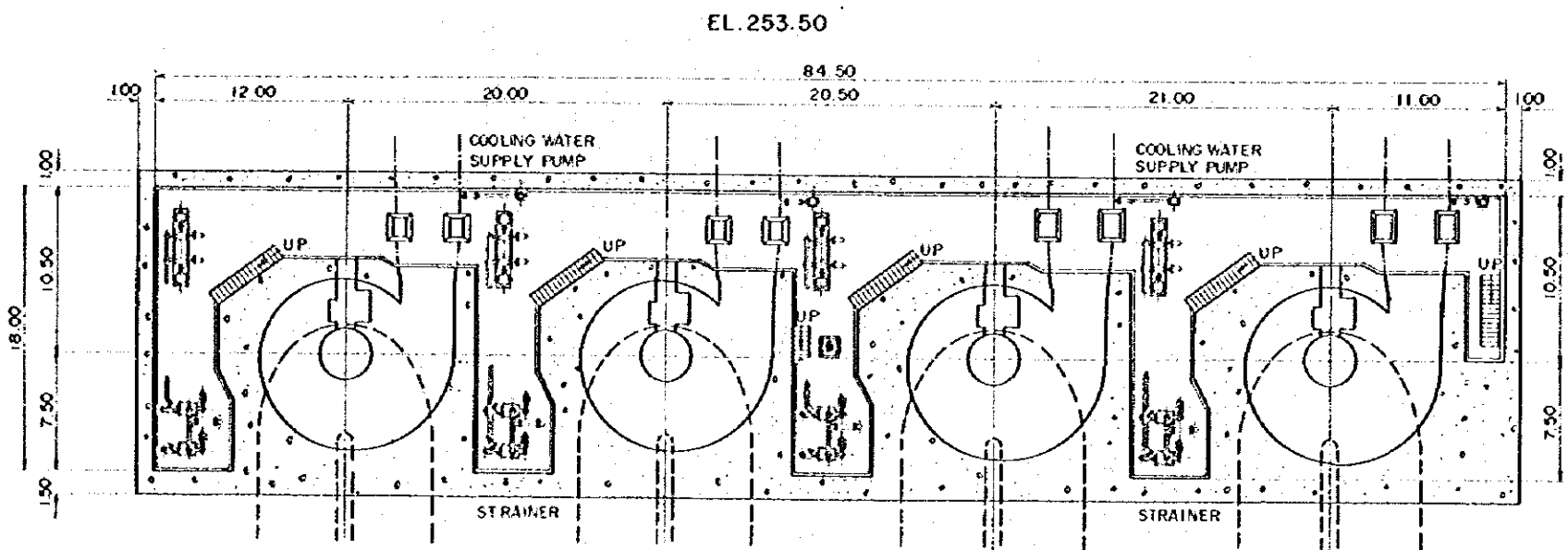
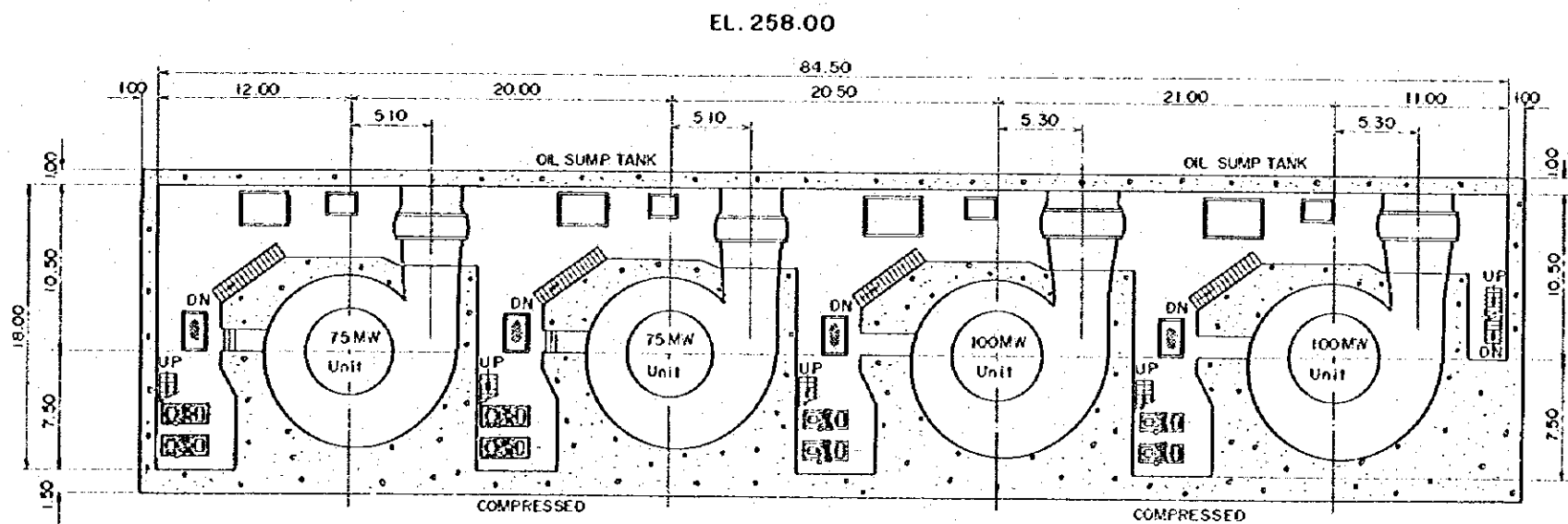
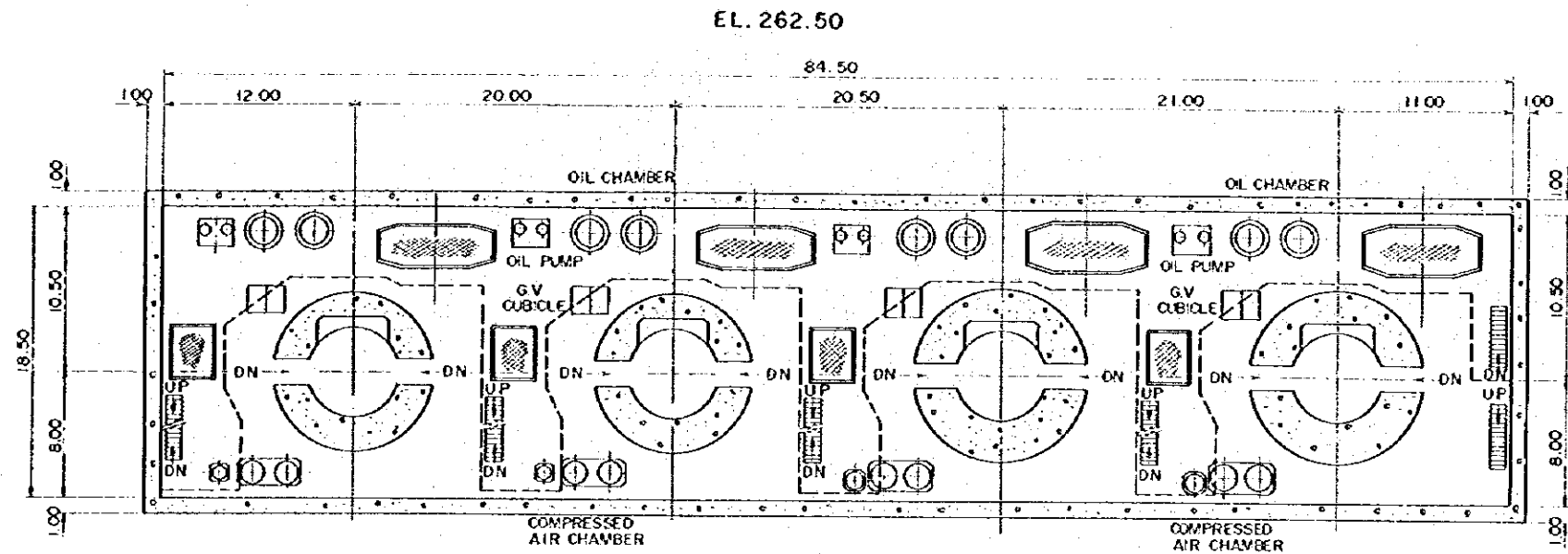


EL. 266.50

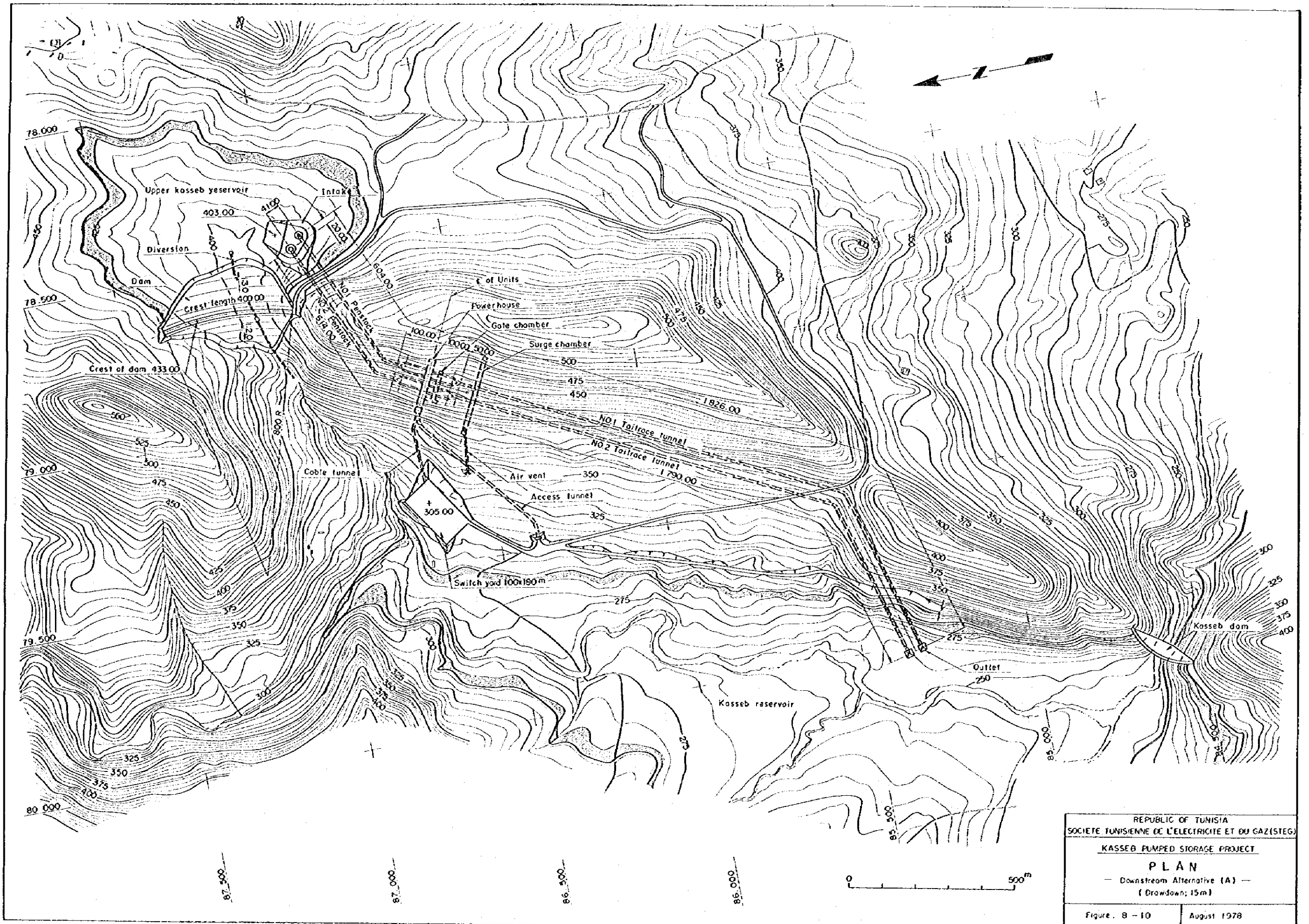


REPUBLIC OF TUNISIA
 SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)
 KASSEP PUMPED STORAGE PROJECT
 POWER HOUSE (2-3)
 - Up stream Alternative (A) -
 (Drawdown, 15m)

Figure - 8 - 8 August 1978

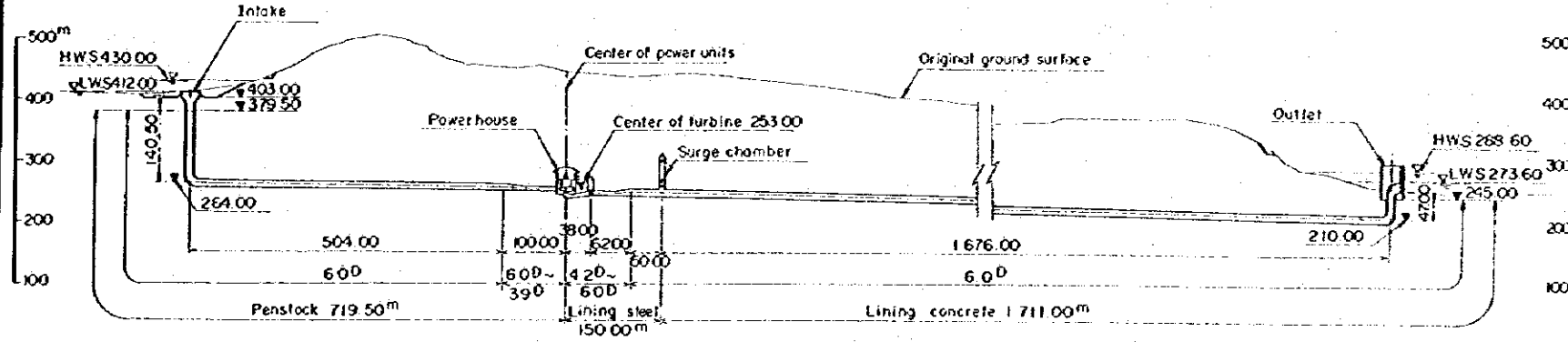


REPUBLIC OF TUNISIA SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)	
KASSEB PUMPED STORAGE PROJECT	
POWER HOUSE (3-31)	
- Up stream Alternative (A) - (Drawdown, 15m)	
Figure 8 - 9	August 1978

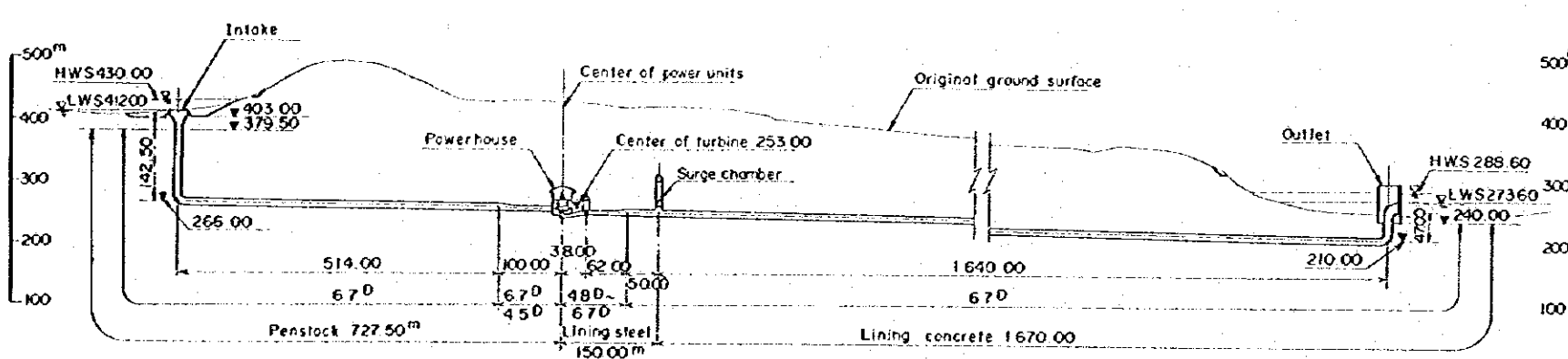


REPUBLIC OF TUNISIA
 SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)
 KASSEB PUMPED STORAGE PROJECT
PLAN
 - Downstream Alternative (A) -
 (Drawdown: 15m)
 Figure. 8-10 August 1978

NO.1 WATERWAY TUNNEL LONGITUDINAL SECTION

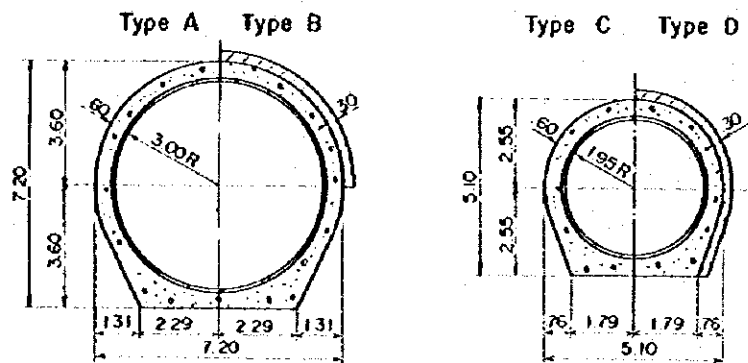


NO.2 WATERWAY TUNNEL LONGITUDINAL SECTION

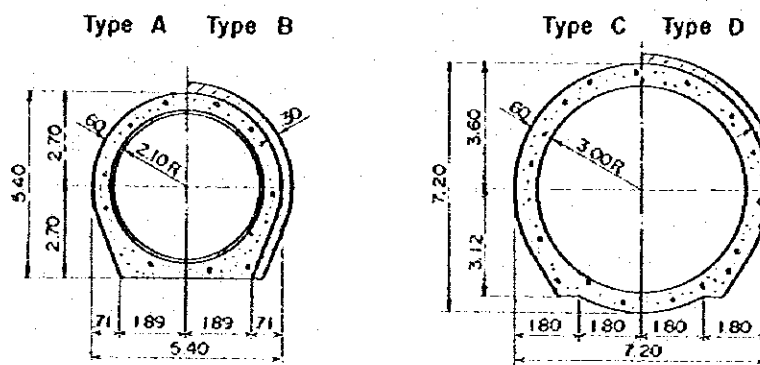


WATERWAY TUNNEL TYPICAL SECTION

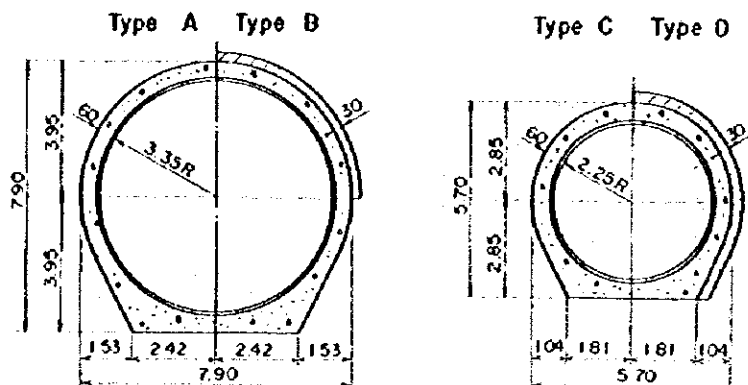
NO.1 PENSTOCK



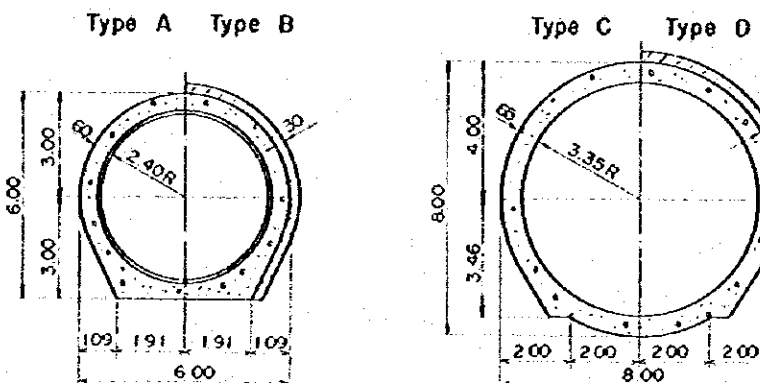
NO.1 TAILRACE TUNNEL



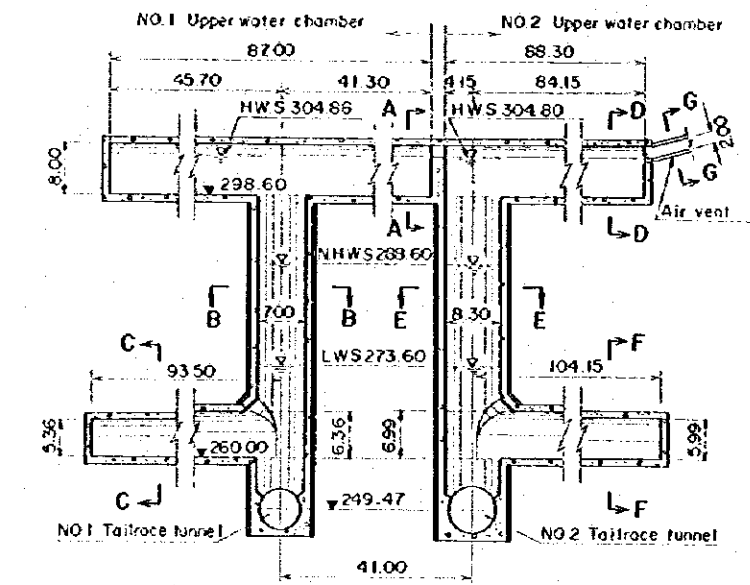
NO.2 PENSTOCK



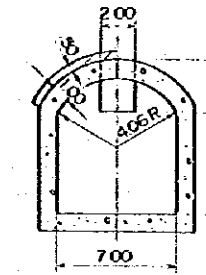
NO.2 TAILRACE TUNNEL



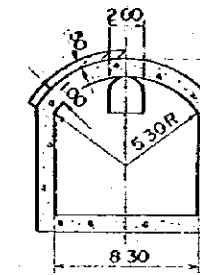
SURGE CHAMBER



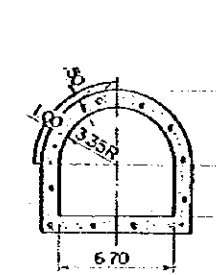
A-A SECTION



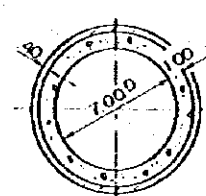
D-D SECTION



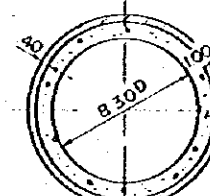
F-F SECTION



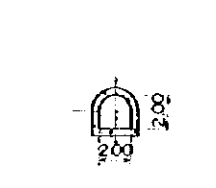
B-B SECTION



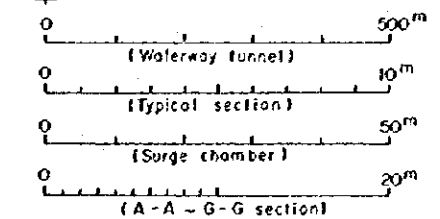
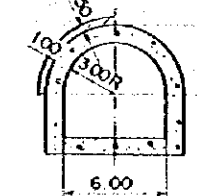
E-E SECTION



G-G SECTION

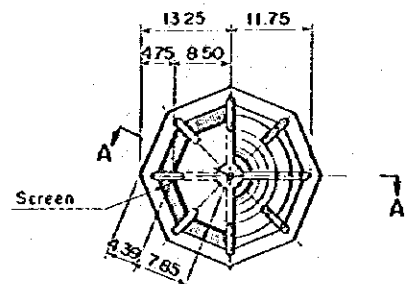


C-C SECTION

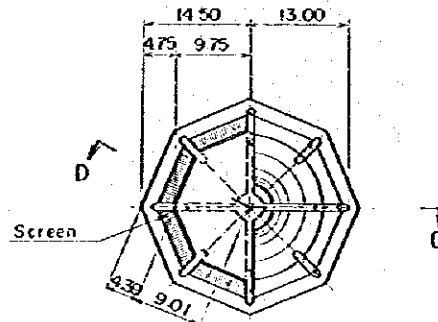


REPUBLIC OF TUNISIA
 SOCIÉTÉ TUNISIENNE DE L'ÉLECTRICITÉ ET DU GAZ (STEG)
 KASSEB PUMPED STORAGE PROJECT
 WATERWAY TUNNEL AND SURGE CHAMBER
 — Downstream Alternative (A) —
 (Drawdown: 15 m)

NO.1 INTAKE
PLAN

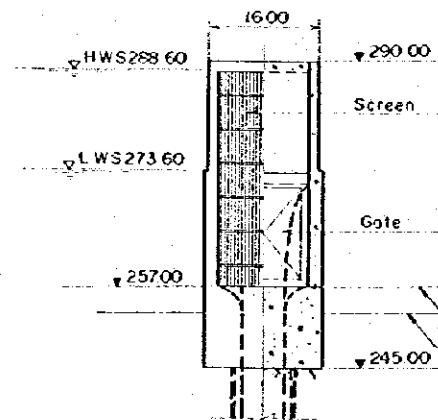


NO.2 INTAKE
PLAN



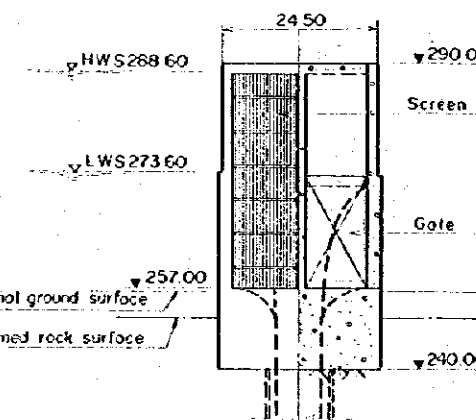
NO.1 OUTLET

G-G SECTION H-H SECTION

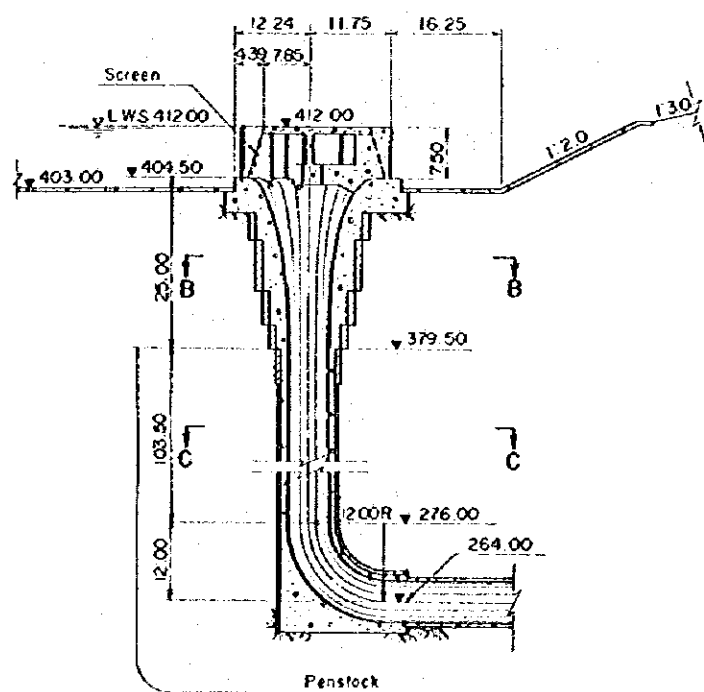


NO.2 OUTLET

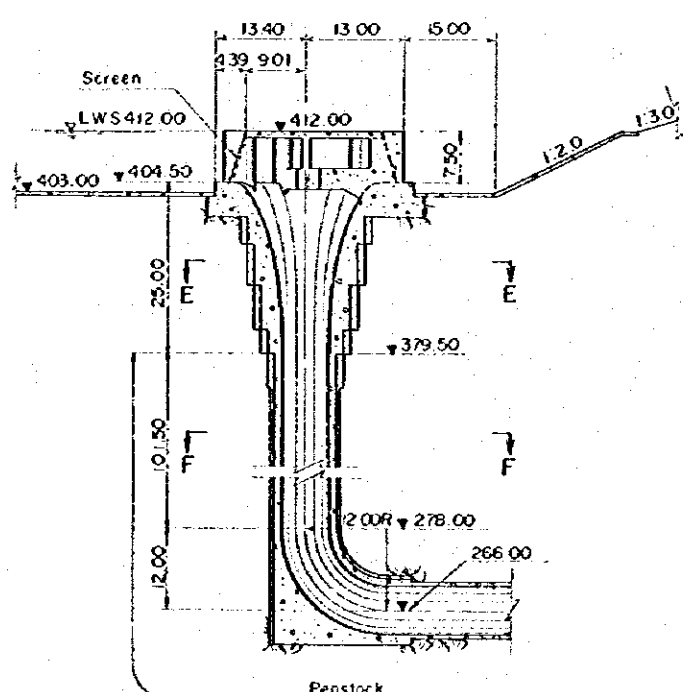
K-K SECTION L-L SECTION



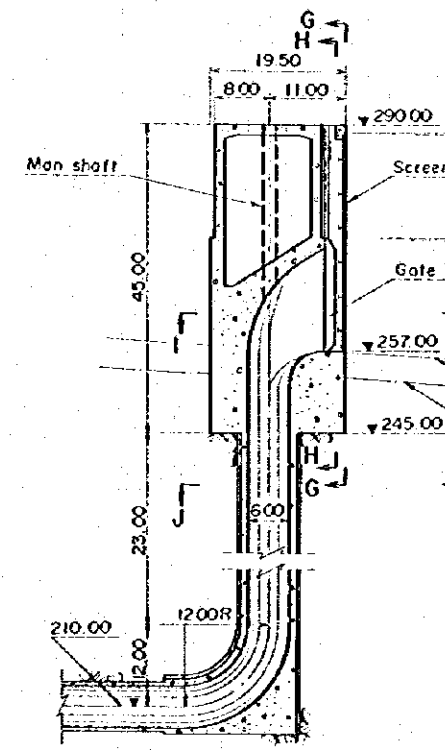
A-A SECTION



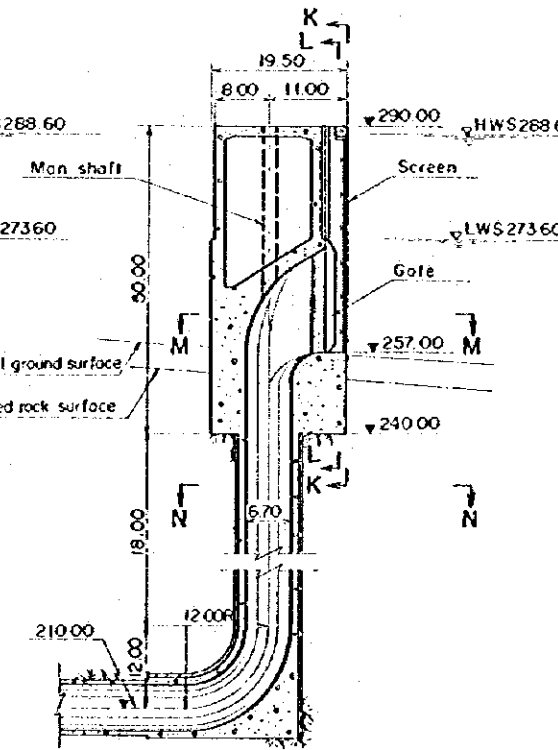
D-D SECTION



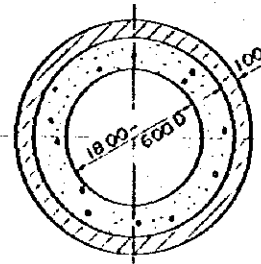
LONGITUDINAL SECTION



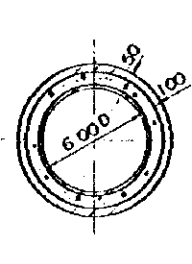
LONGITUDINAL SECTION



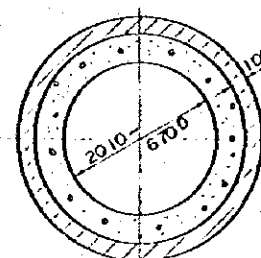
B-B SECTION



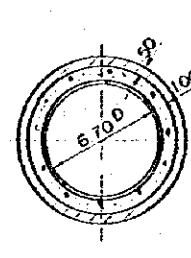
C-C SECTION



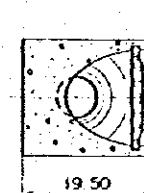
E-E SECTION



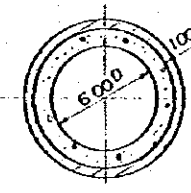
F-F SECTION



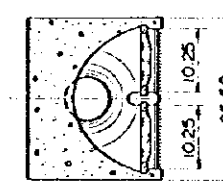
I-I SECTION



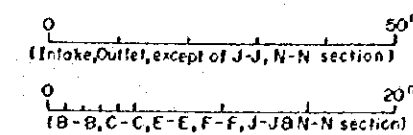
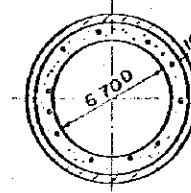
J-J SECTION



M-M SECTION

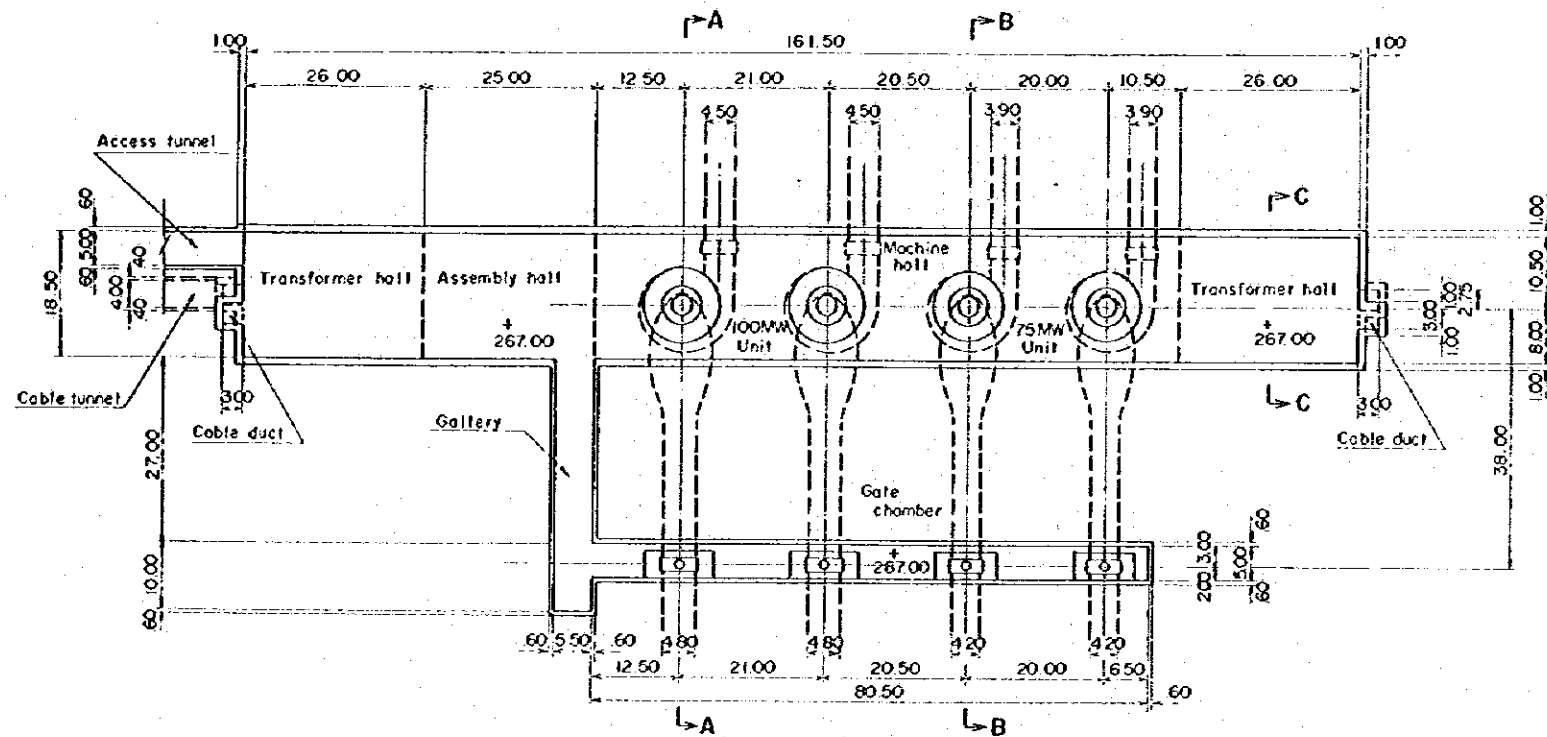


N-N SECTION

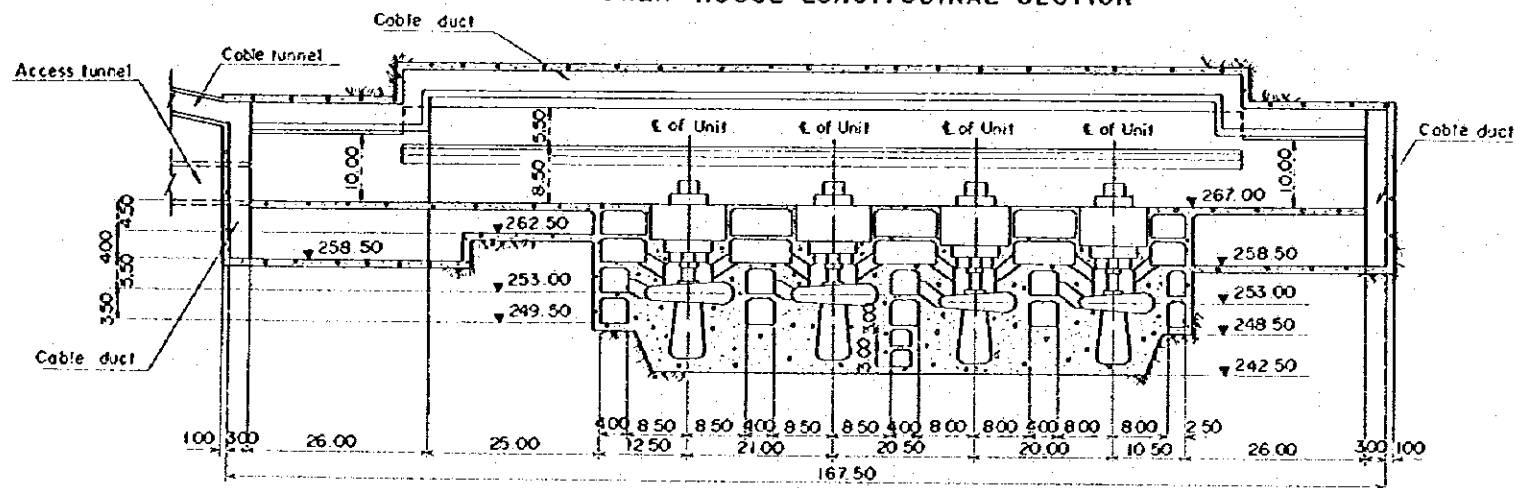


REPUBLIC OF TUNISIA
SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)
KASSEB PUMPED STORAGE PROJECT
INTAKE AND OUTLET
— Downstream Alternative (A) —
(Drawdown; 15 m)
Figure. B-12 August 1978

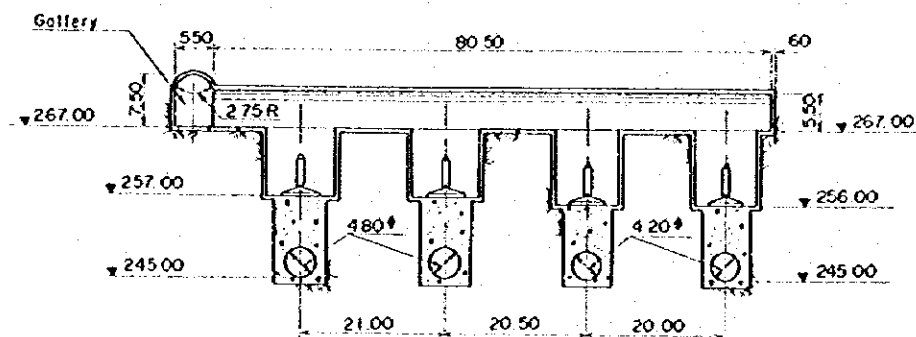
POWERPLANT PLAN



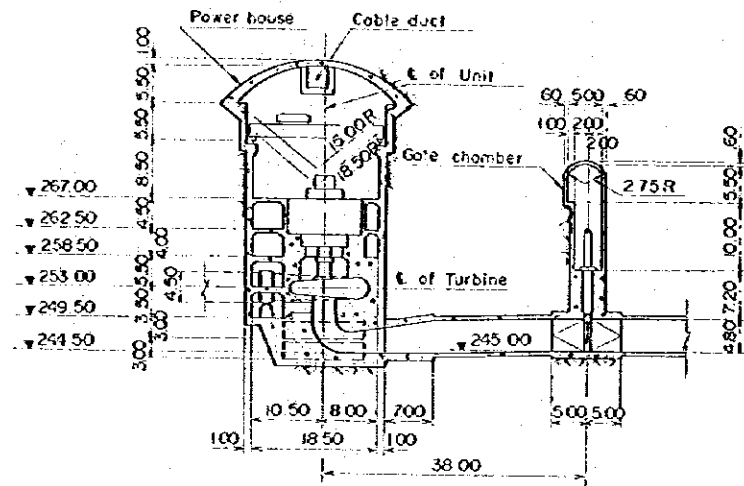
POWER HOUSE LONGITUDINAL SECTION



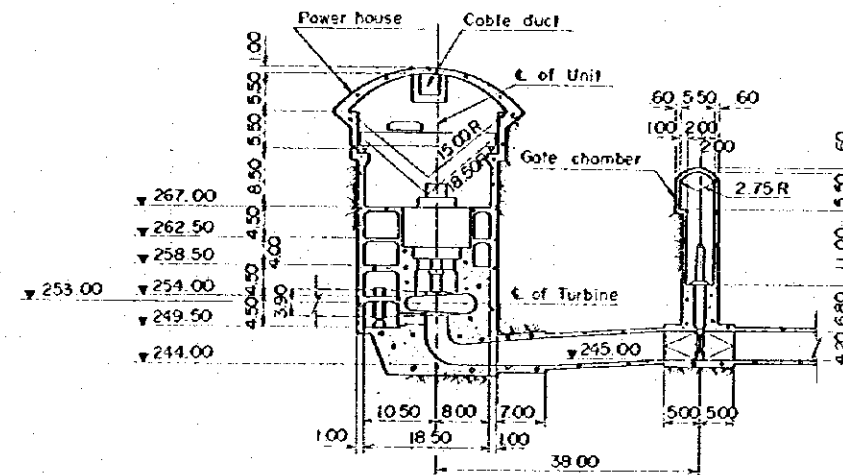
GATE CHAMBER LONGITUDINAL SECTION



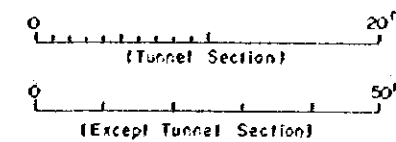
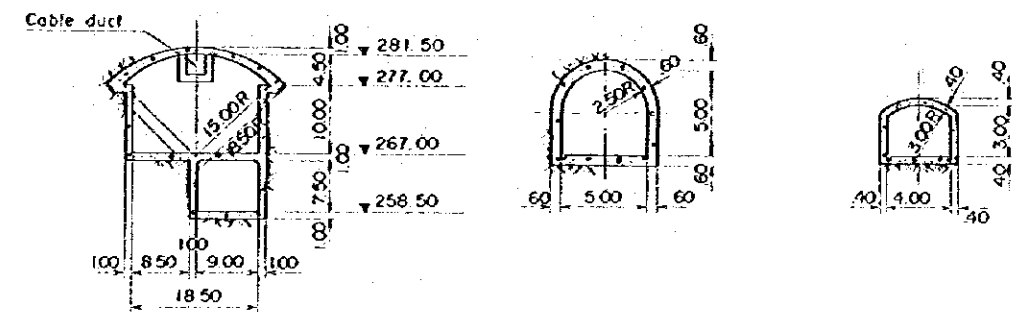
A-A SECTION (100MW SIDE)



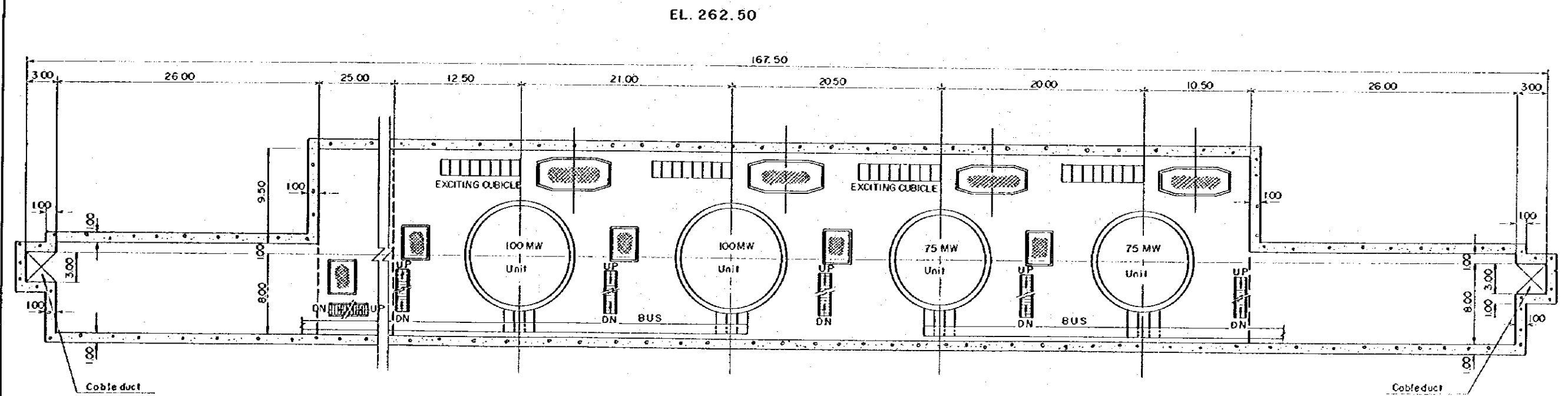
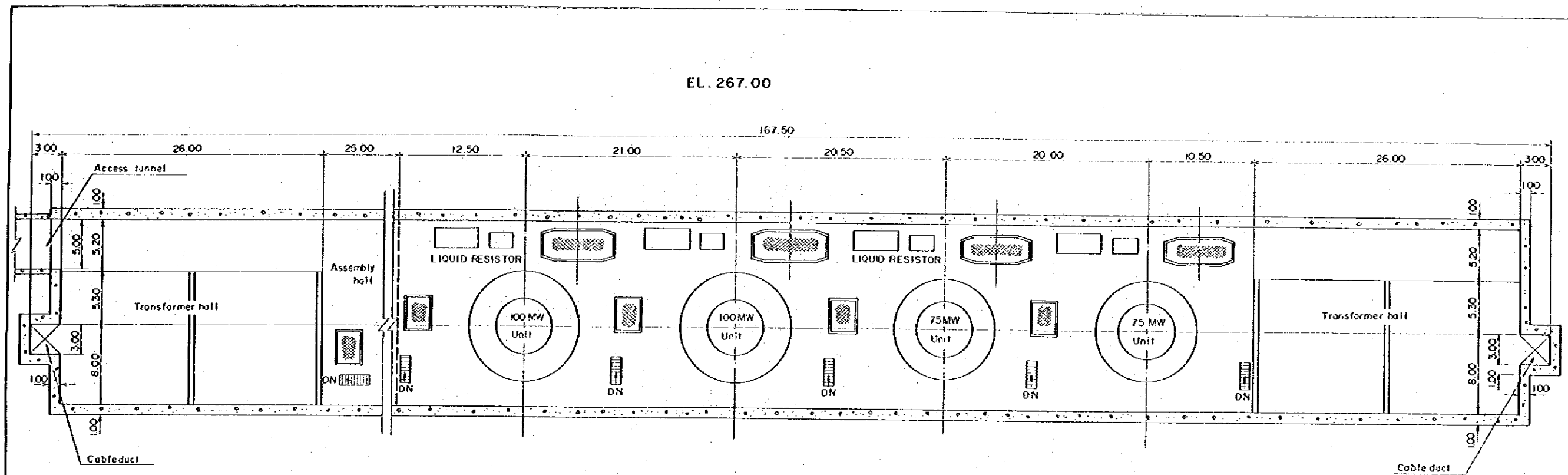
B-B SECTION (75MW SIDE)



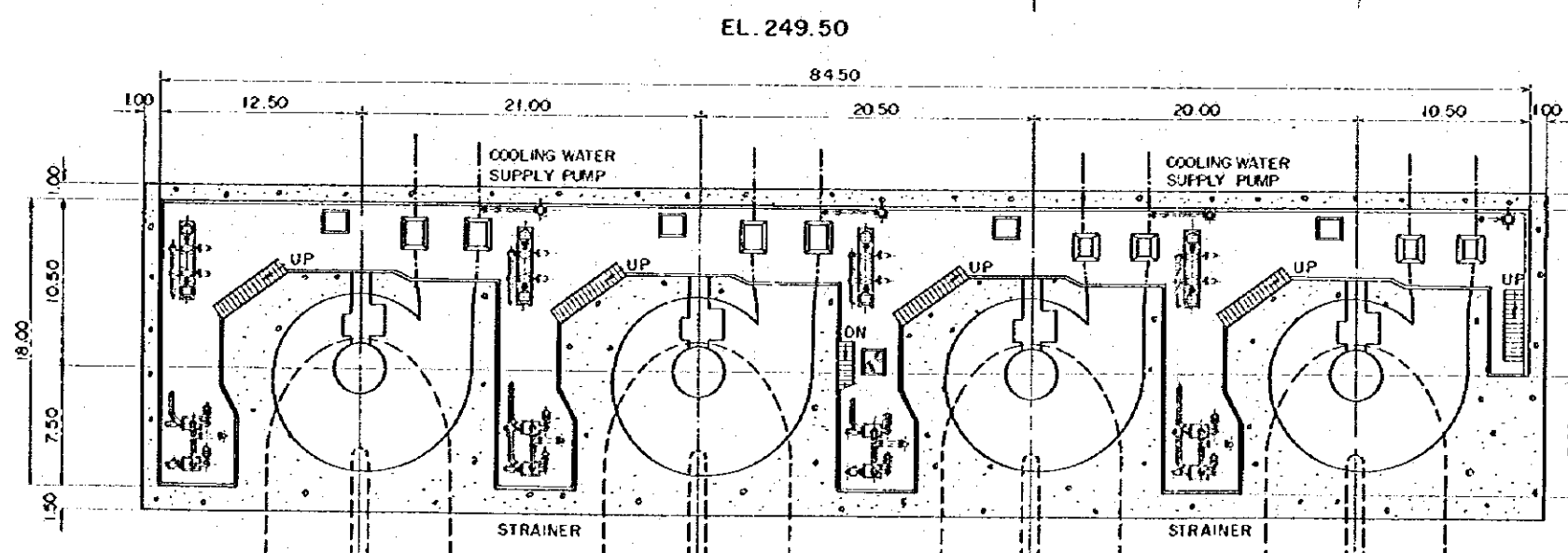
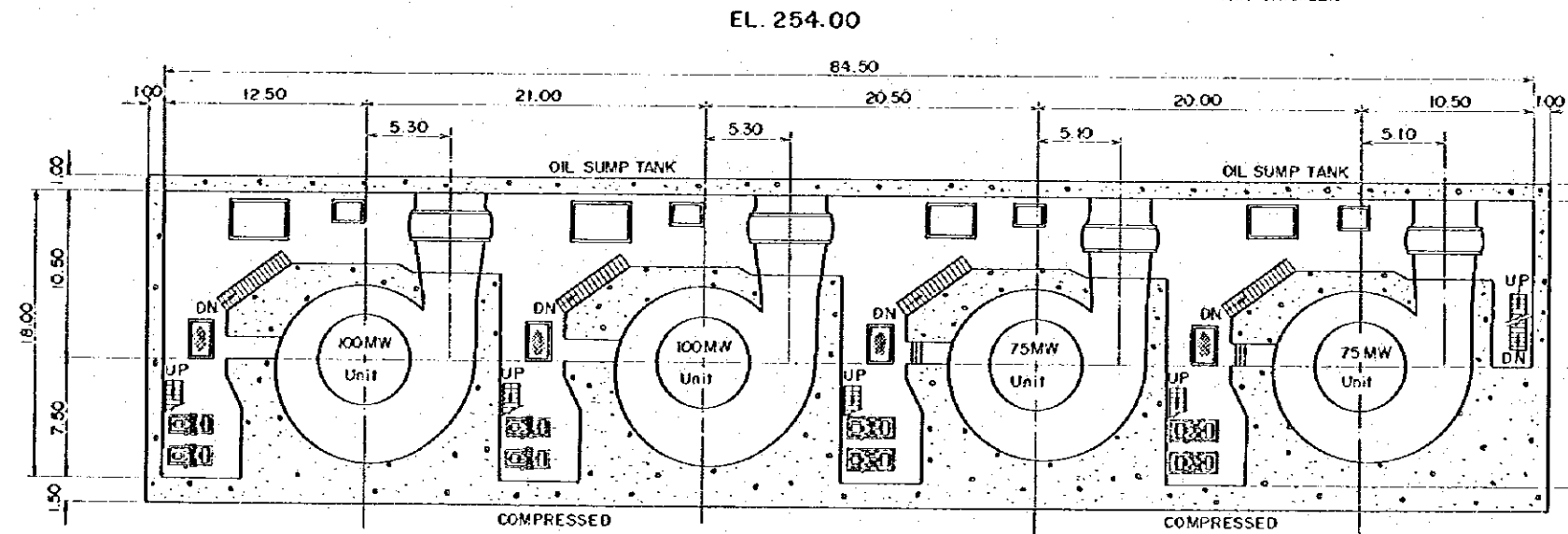
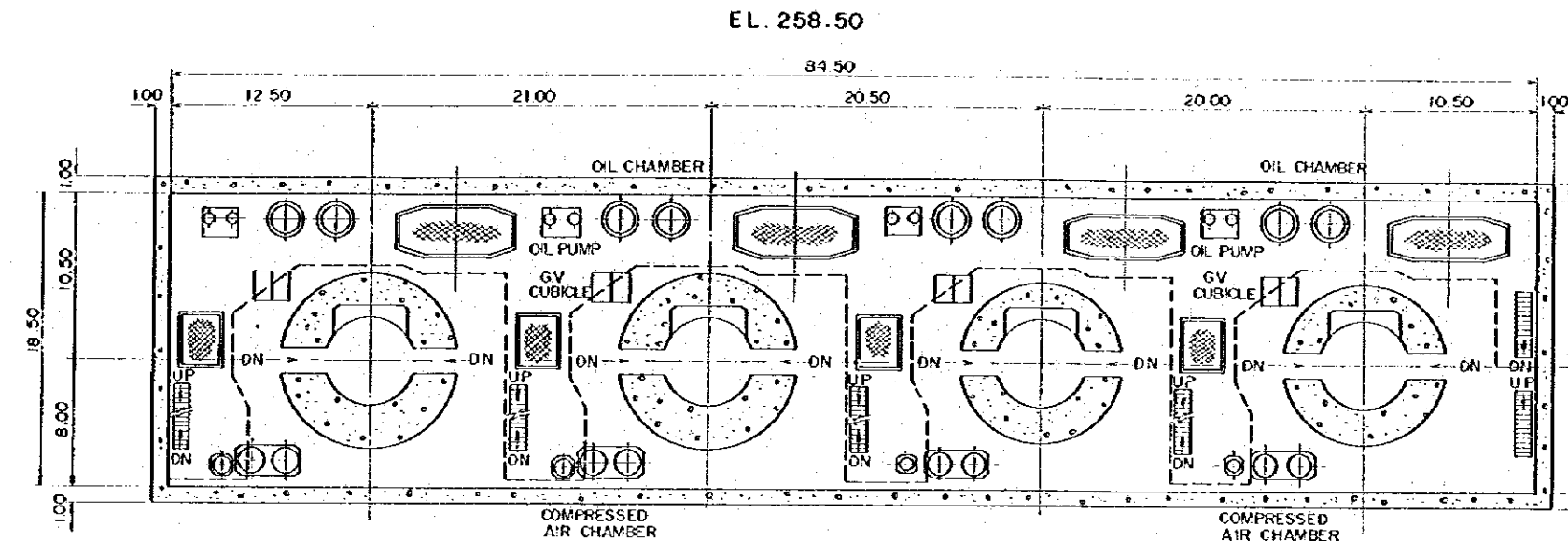
TRANSFORMER HALL (C-C) SECTION ACCESS TUNNEL SECTION CABLE TUNNEL SECTION



REPUBLIC OF TUNISIA
SOCIÉTÉ TUNISIENNE DE L'ÉLECTRICITÉ ET DU GAZ (STEG)
KASSEB PUMPED STORAGE PROJECT
POWER HOUSE (1-3)
— Downstream Alternative (A) —
[Drawdown: 15 m]

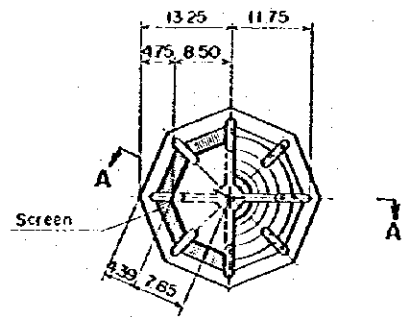


REPUBLIC OF TUNISIA SOCIÉTÉ TUNISIENNE DE L'ÉLECTRICITÉ ET DU GAZ (STEG)	
KASSEB PUMPED STORAGE PROJECT	
POWER HOUSE (2-3) - Down stream Alternative (A) - (Drawdown, 15m)	
Figure 8 - 14	August 1978

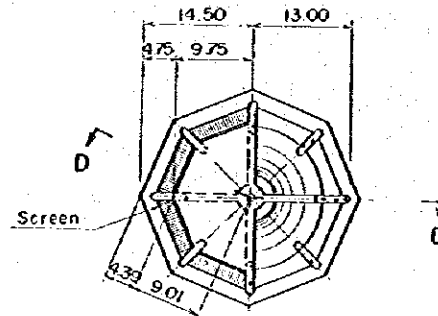


REPUBLIC OF TUNISIA SOCIÉTÉ TUNISIENNE DE L'ÉLECTRICITÉ ET DU GAZ (STEG)	
KASSEB PUMPED STORAGE PROJECT	
POWER HOUSE (3-3)	
— Down stream Alternative (A) — (Drawdown, 15m)	
Figure - 6 - 15	August 1978

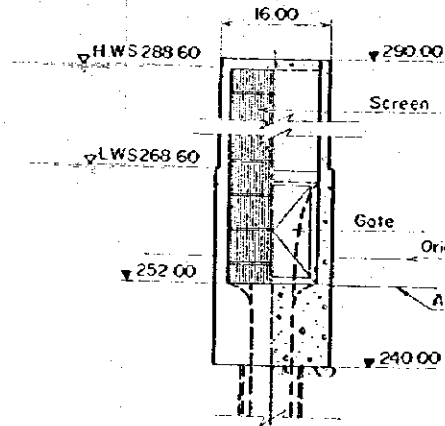
NO.1 INTAKE
PLAN



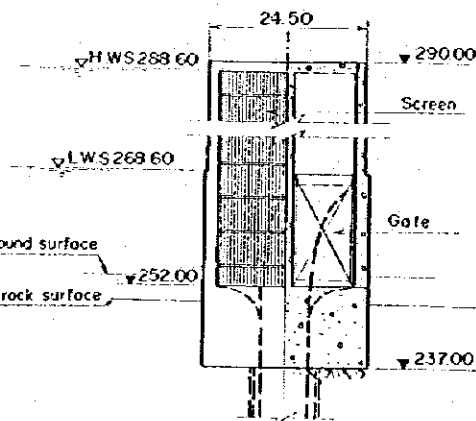
NO.2 INTAKE
PLAN



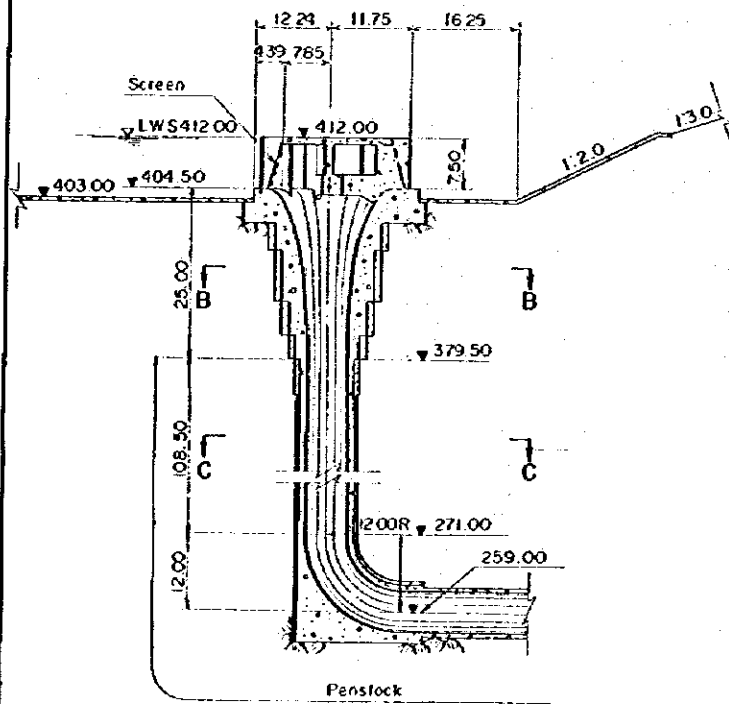
NO.1 OUTLET
G-G SECTION H-H SECTION



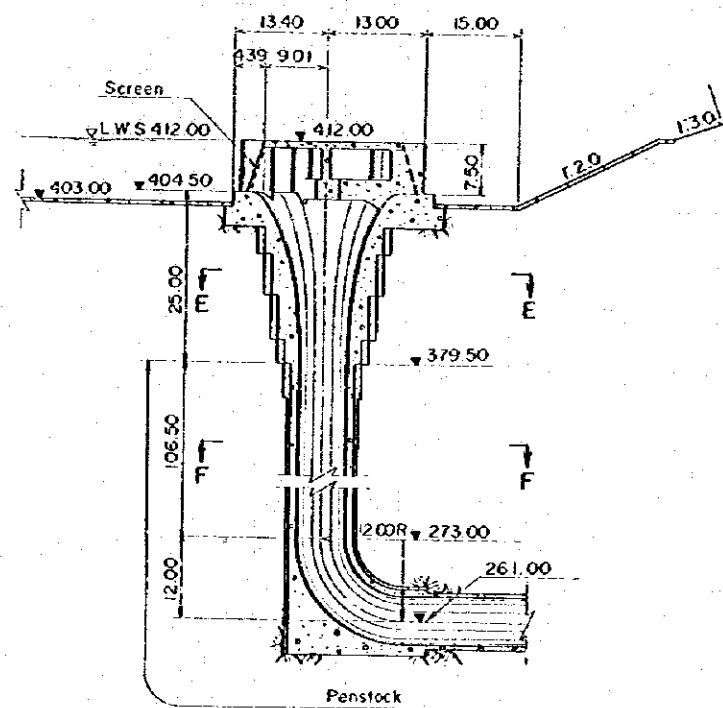
NO.2 OUTLET
K-K SECTION L-L SECTION



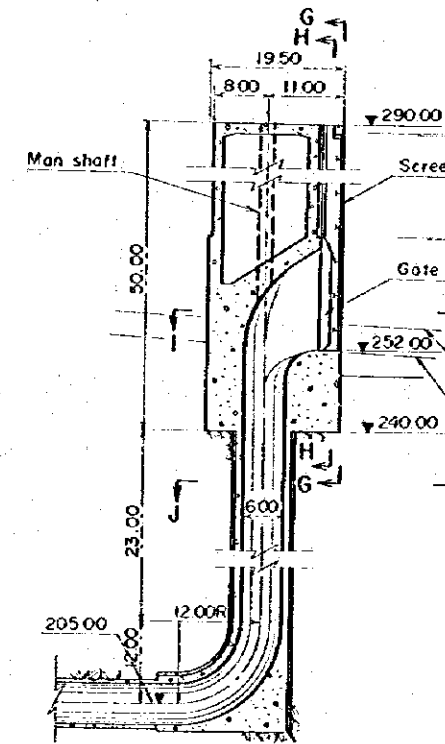
A-A SECTION



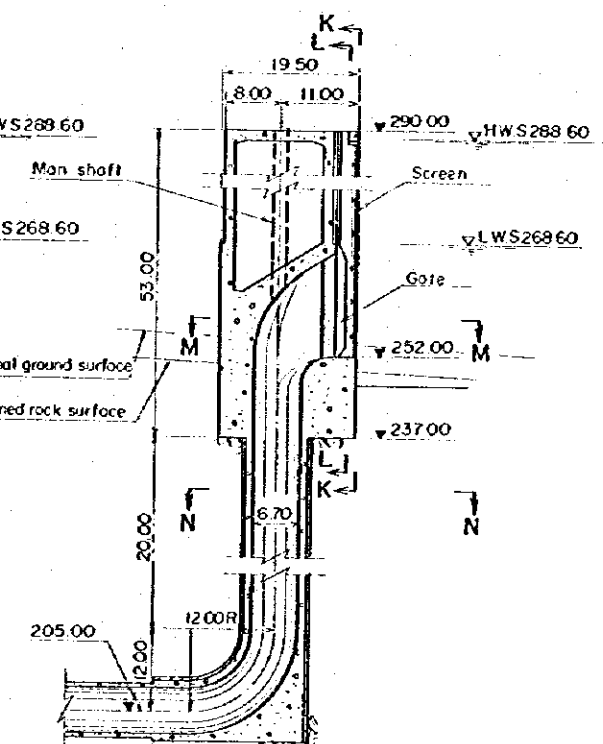
D-D SECTION



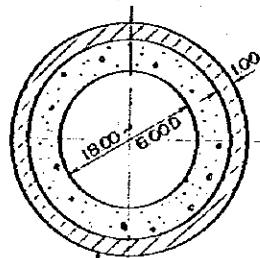
LONGITUDINAL SECTION



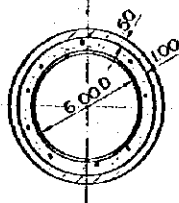
LONGITUDINAL SECTION



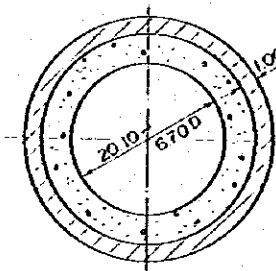
B-B SECTION



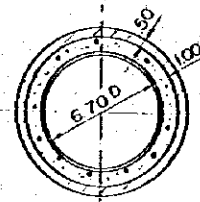
C-C SECTION



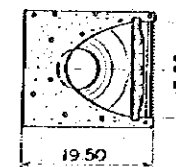
E-E SECTION



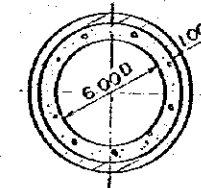
F-F SECTION



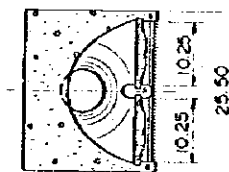
I-I SECTION



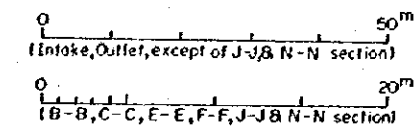
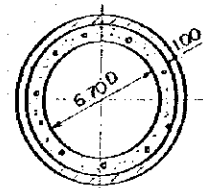
J-J SECTION



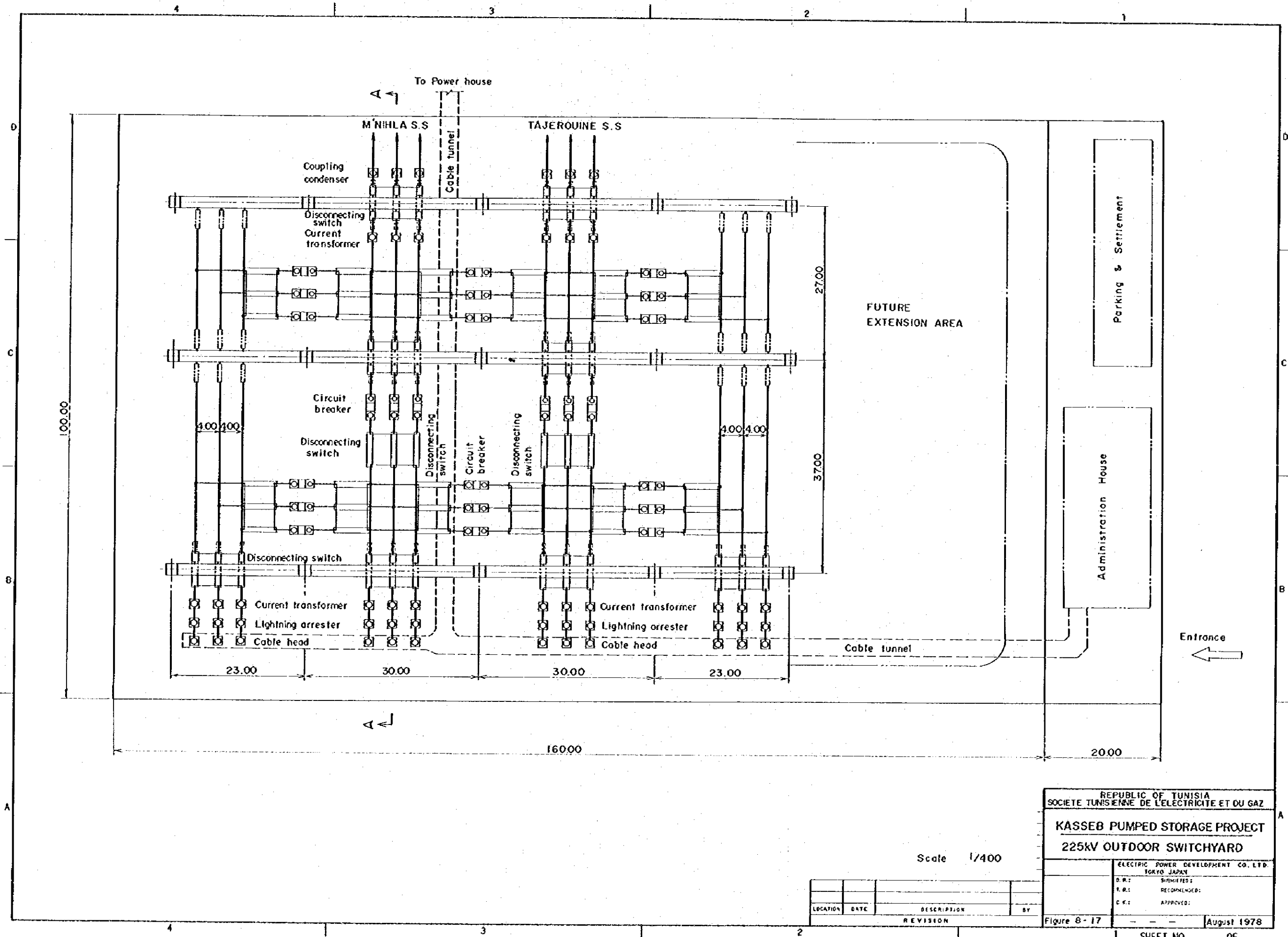
M-M SECTION



N-N SECTION



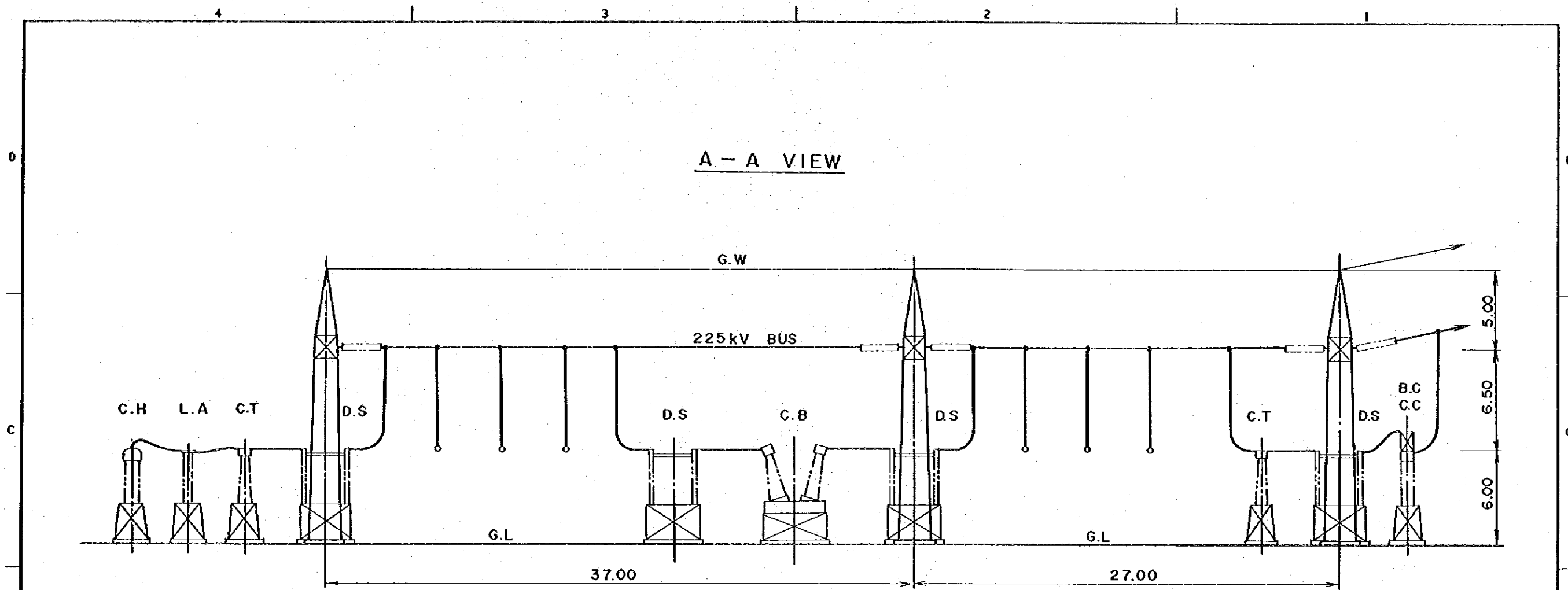
REPUBLIC OF TUNISIA
SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ (STEG)
KASSEB PUMPED STORAGE PROJECT
INTAKE AND OUTLET
— Downstream Alternative (B) —
(Drawdown: 20m)
Figure. 8-16 August 1978



Scale 1/400

LOCATION	DATE	DESCRIPTION	BY
REVISION			

REPUBLIC OF TUNISIA SOCIETE TUNISIENNE DE L'ELECTRICITE ET DU GAZ	
KASSEB PUMPED STORAGE PROJECT 225KV OUTDOOR SWITCHYARD	
ELECTRIC POWER DEVELOPMENT CO. LTD. TOKYO JAPAN	
D.R.:	SUBMITTED:
R.R.:	RECOMMENDED:
C.K.:	APPROVED:
Figure 8-17	August 1978



- LEGEND :
- C.H Cable Head
 - L.A Lightning Arrester
 - C.T Current Transformer
 - D.S Disconnecting Switch
 - C.B Circuit Breaker
 - B.C Blocking Coil
 - C.C Coupling Condenser
 - G.W Ground Wire
 - G.L Ground Level

LOCATION	DATE	DESCRIPTION	BY
REVISION			

REPUBLIC OF TUNISIA SOCIETE TUNISIENNE DE L'ELECTRICITE ET OUGAZ	
KASSEB PUMPED STORAGE PROJECT	
225KV OUTDOOR SWITCHYARD (2-2)	
ELECTRIC POWER DEVELOPMENT CO., LTD. TOKYO JAPAN	
D.R.:	SUBMITTED:
T.R.:	RECOMMENDED:
C.A.:	APPROVED:
Figure 8-18	August 1978

