B-5. COST EVALUATION

Table B-5 summarizes the construction cost for the developed lay-out of São Lourenço Reversible Power Station.

The construction cost is estimated on US$.1514 x 10^6 or US$ 394 /kW, as follows:

TABLE B-5 Construction Cost of São Lourenço Reversible Power Station

Description	10^6US$	US$/kW
Civil works	344.29	89.7
Hydraulic works	219.86	33.8
Electric-mechanic works	435.00	113.3
Transmission line	39.90	10.4
Contingency	112.12	29.2
Indirect costs	198.44	51.7
Interest during construction	254.68	66.3
Grand total	1,514.29	394.4

Note: Cost estimation, Sept. 1981

Similarly to the "Consorcio" criteria, costs of access road to the power house and to the access tunnels are not included. These costs, however, may be estimated, in the case of the shown lay-out, as 12 x 10^6US$, or 3.1 US$/kW, considering only the access roads to the power house, intake, outlet and access tunnel sites.

B-6. CONCLUSIONS AND COMMENTS

According to the developed lay-out for the alternative 2, the construction cost is estimated on US$... 394/kW, for the total installed capacity of 3840 MW. The following observations have to be considered.

. For the transmission line costs, the values chosen on CEEP's report to DAEE are adopted;

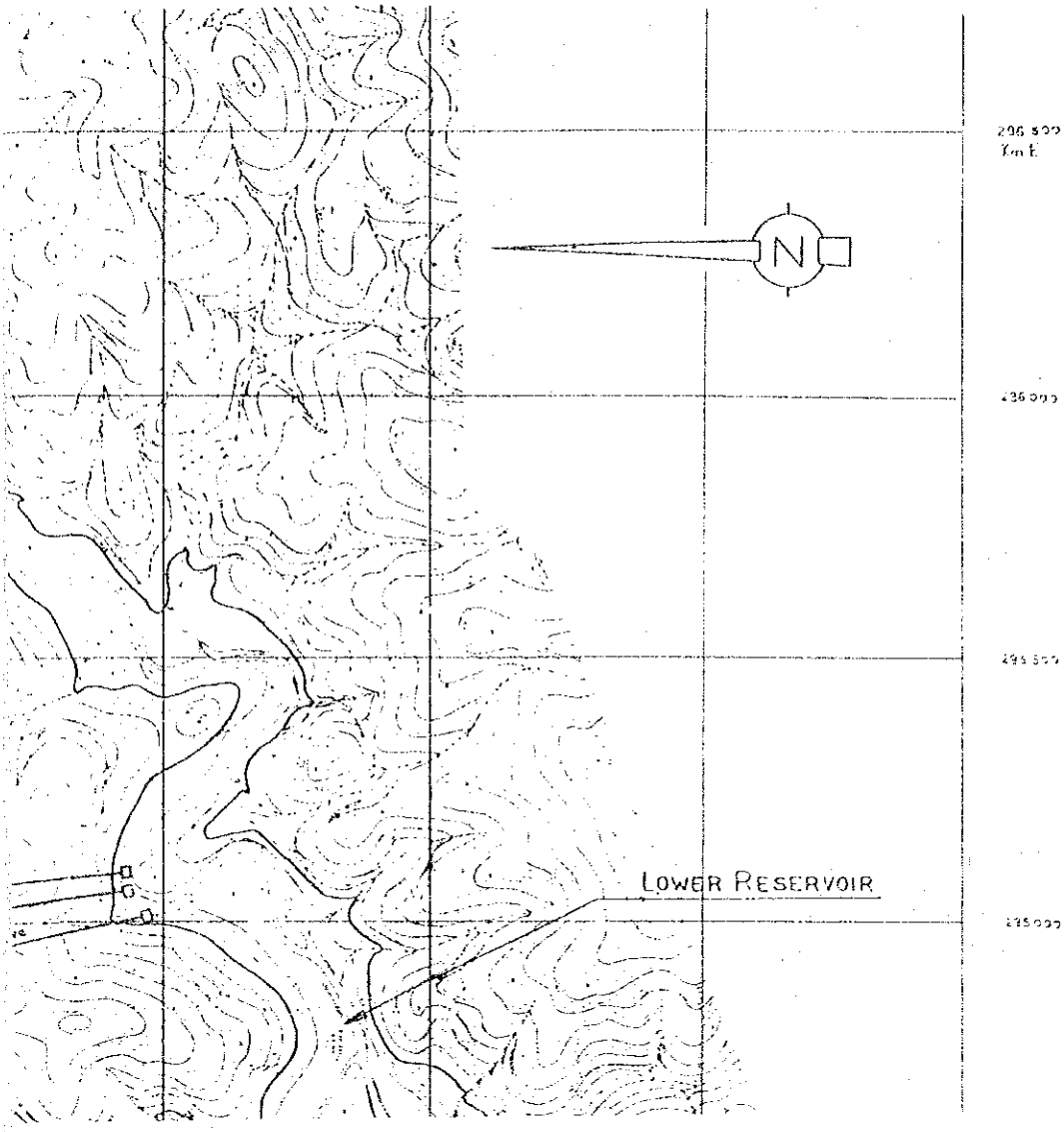
. Contingency and Indirect costs are adopted according to the procedures

considered in other projects developed in Brazil;

. Hydraulic works and electric-mechanic works costs are difficult to estimate so that international average prices for similar projects are adopted in this case, considering an increasing factor because of importation, transportation, insurance and taxes.

. Also, it is important to mention that the costs of the upper and lower and reservoirs are not included.

. In conclusion, for more detailed studies, it is recommendable to establish investigation programs, after completing the geological map in the scale of 1:5,000 along the selected alternative 2, and to perform, as fast as possible, the geological and rock mechanical investigations. Inspections along the power structures have been already provided as explained in the Appendix-C and it confirms that these data are required for the next step studies.


N
LOWER RESERVOIR

UPPER RESERVOIR

DAM LA'S

Alternative 1

Alternative 2

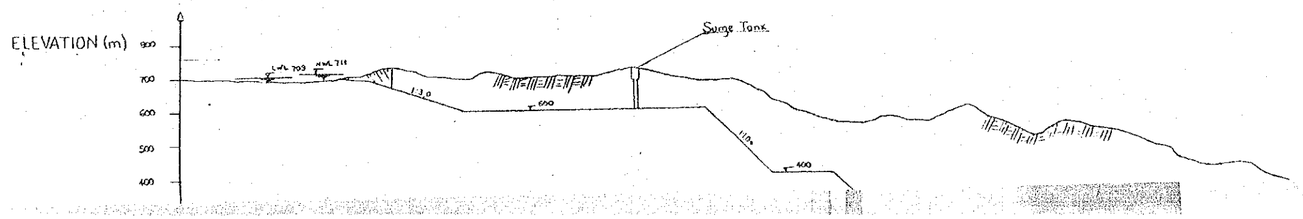
Final Alternative

Preliminary Plan Alternative

LOWER RESERVOIR

Consortium's Alternative

Alternative 4



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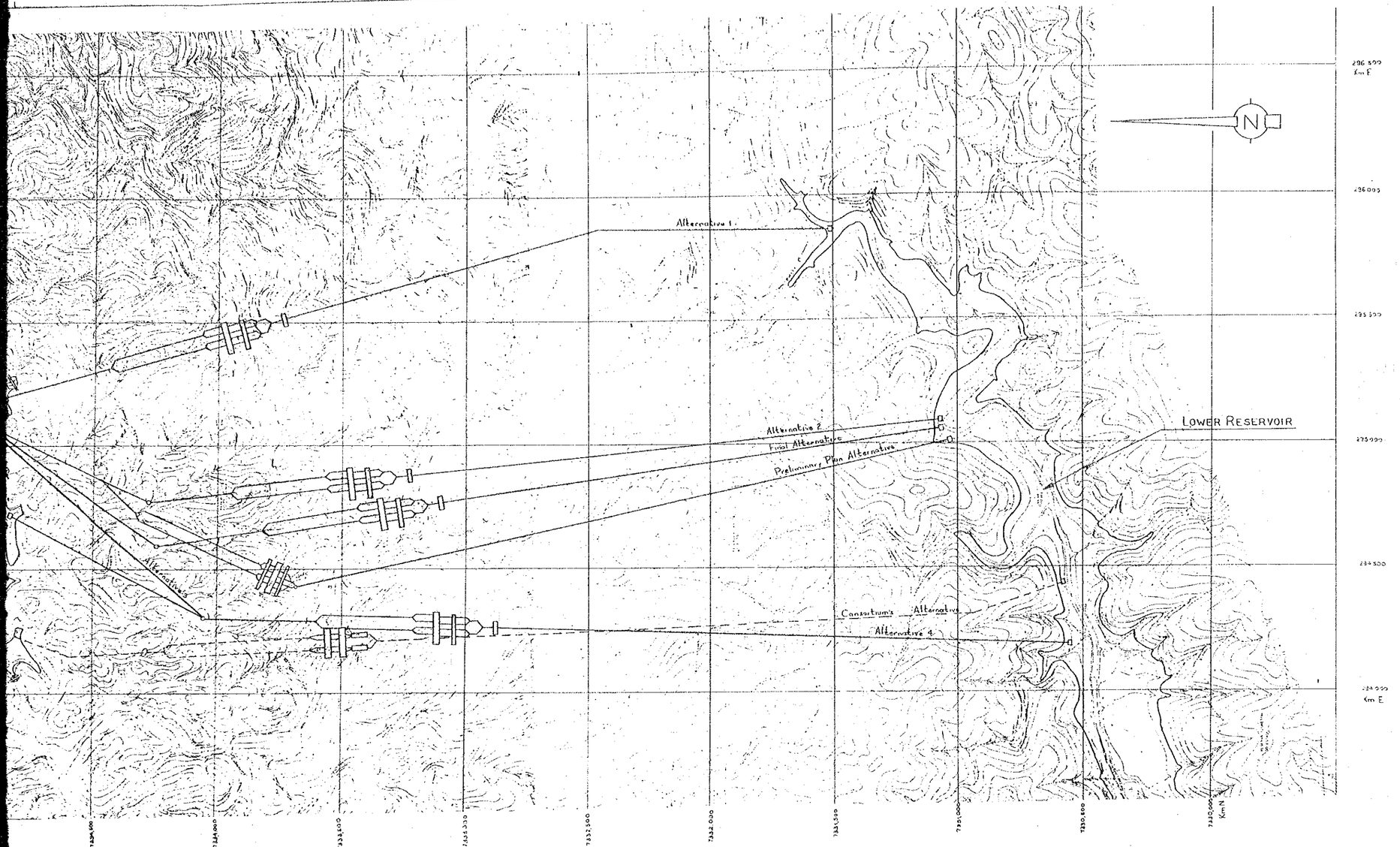

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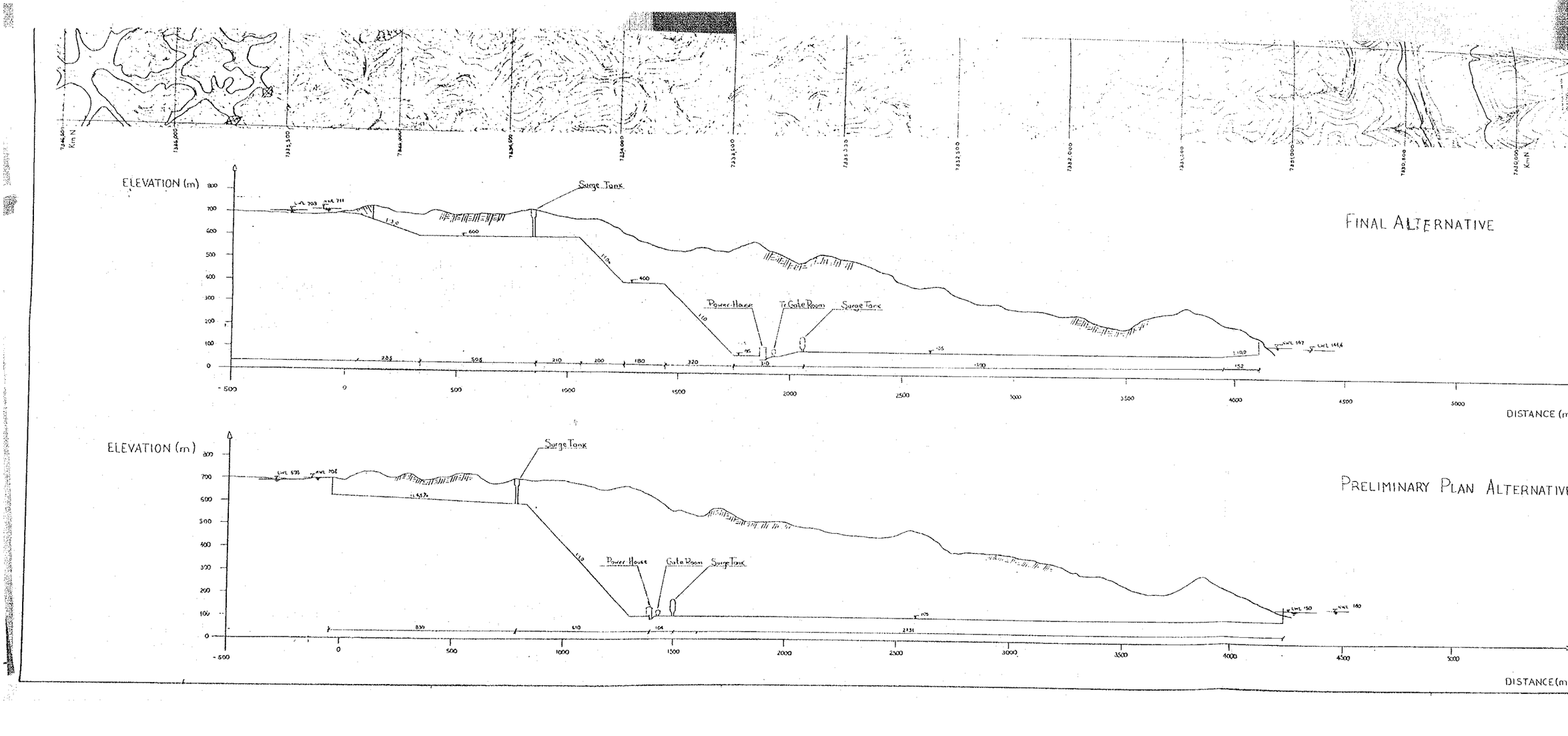
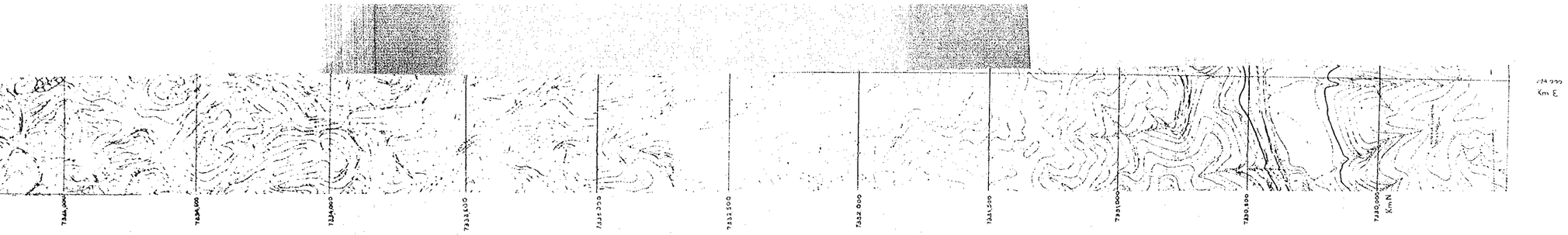

ELEVATION (m)
Surge Tank
Power House
Tr Gate Room
Surge Tank
DISTANCE (m
FINAL ALTERNATIVE
ELEVATION (m)
Surge Tank
Power House
Gate Room
Surge Tank
DISTANCE (m)
PRELIMINARY PLAN ALTERNATIVE



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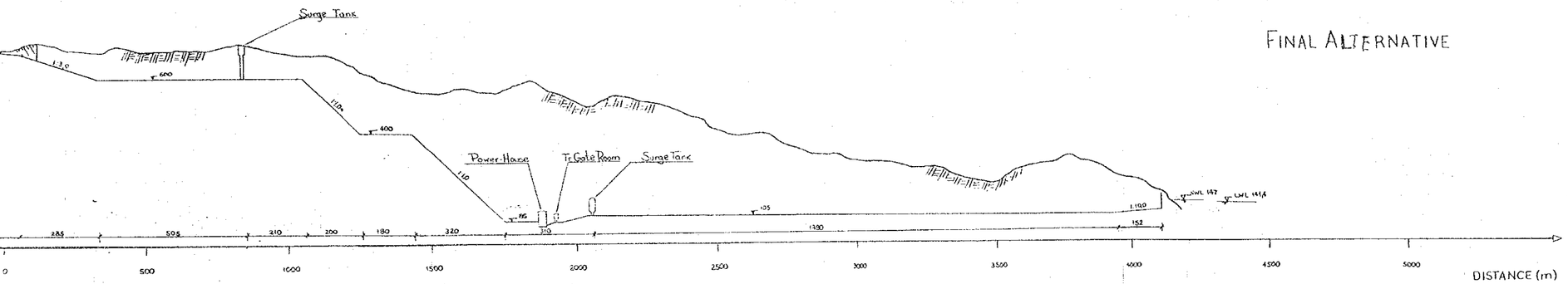

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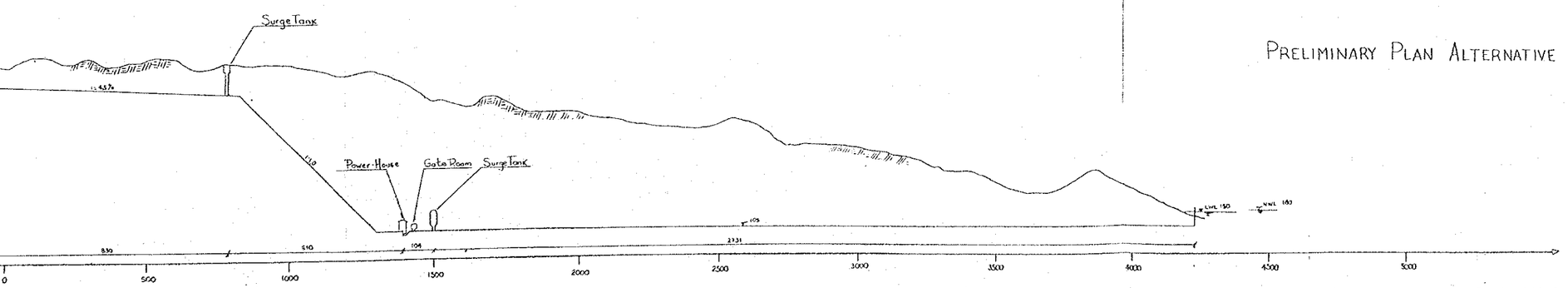

PROJETADO	
DESENHADO	
VERIFICADO	
DATA	Abril de 82
APROVADO	
APROVADO	

SECRETARIA DE OBRAS E DO MEIO AMBIENTE
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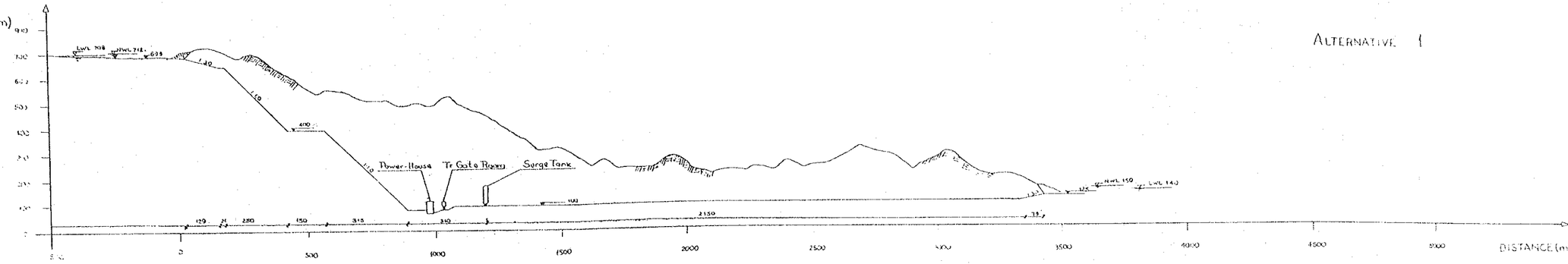
São Lourenço Power Station
Alternatives-Plant And
Longitudinal Section

ESCALA 1 : 10.000

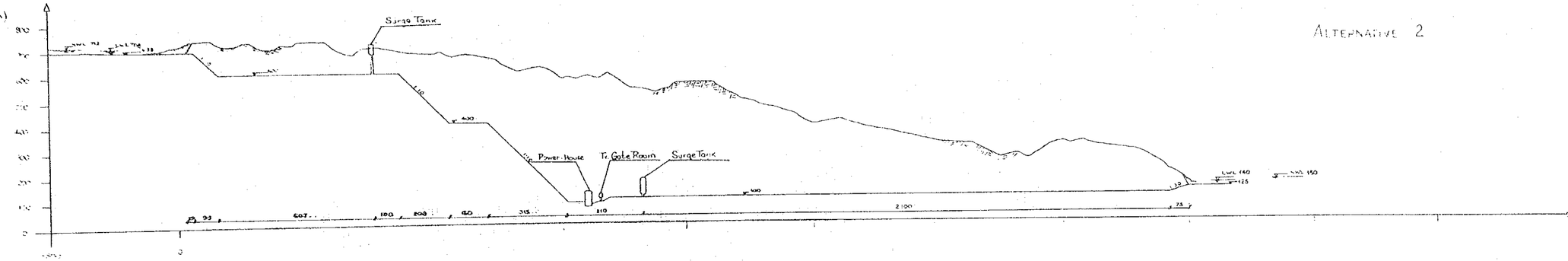
NÚMERO DO DESENHO FIGURE 01
AT 81 - A 008

ELEVATION(m)

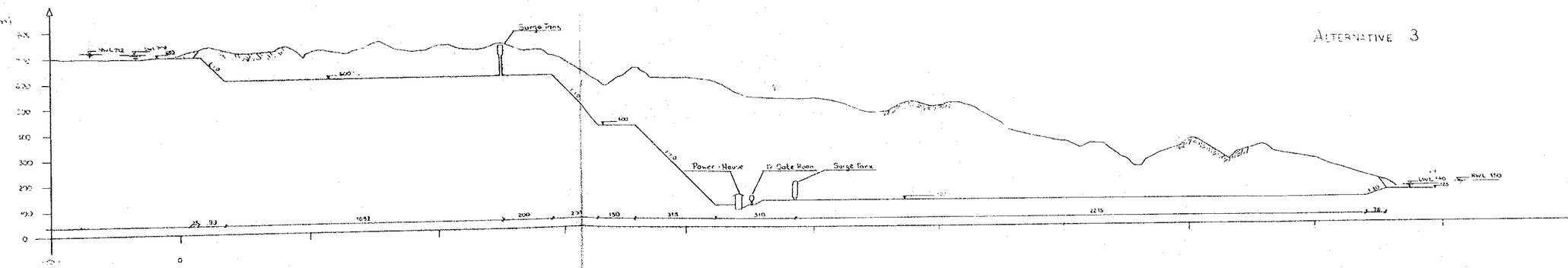


ALTERNATIVE 1

ELEVATION(m)

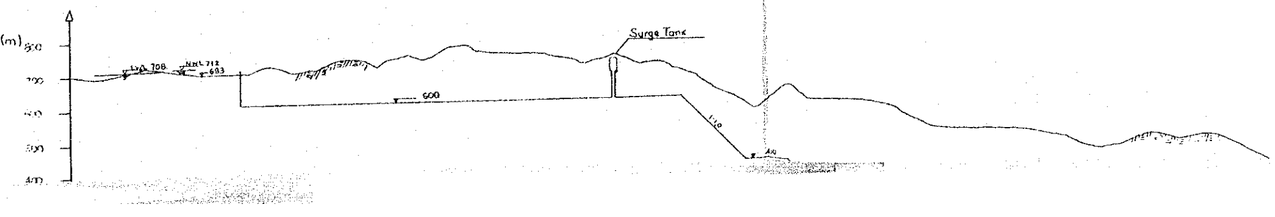


ALTERNATIVE 2



ALTERNATIVE 3

ELEVATION(m)

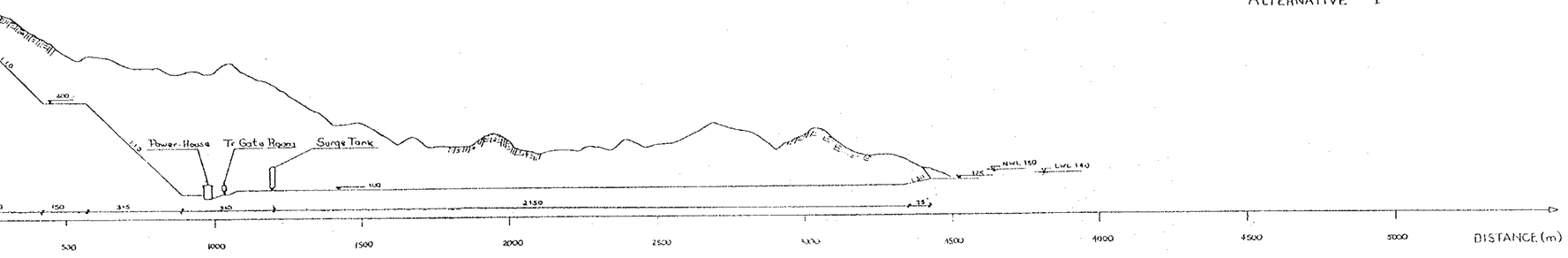


ALTERNATIVE 4

REVISÕES	REV.	APR.	DATA

OBSERVAÇÕES:

ALTERNATIVE 1



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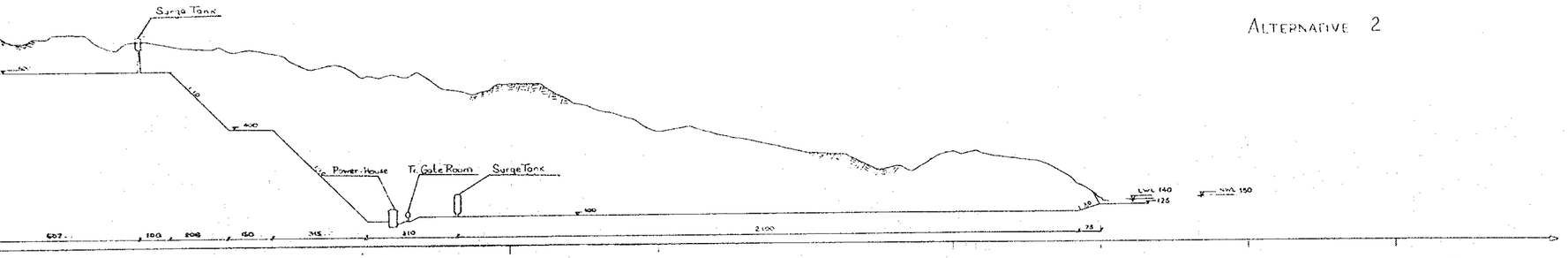

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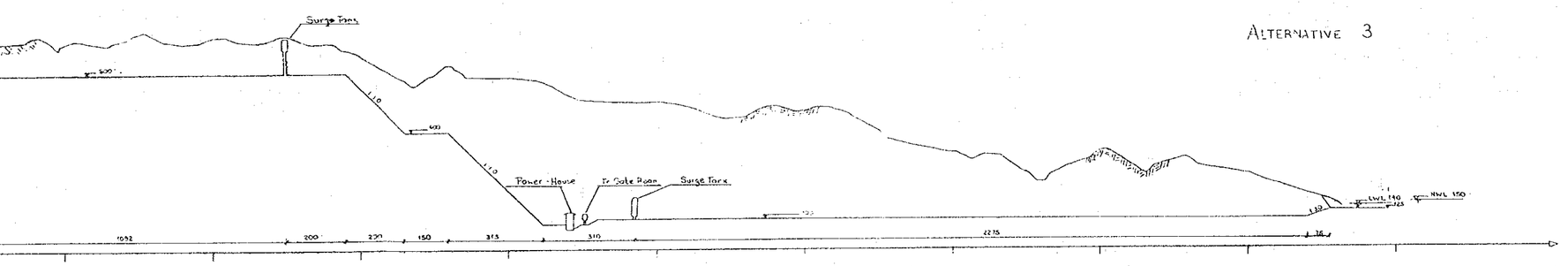

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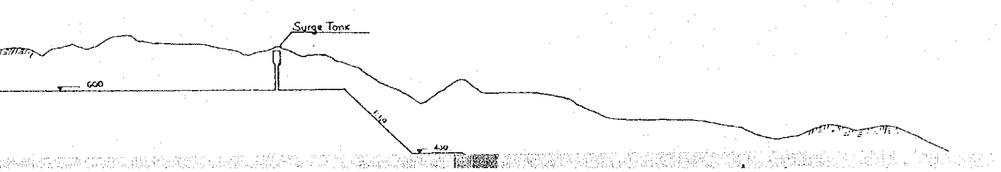

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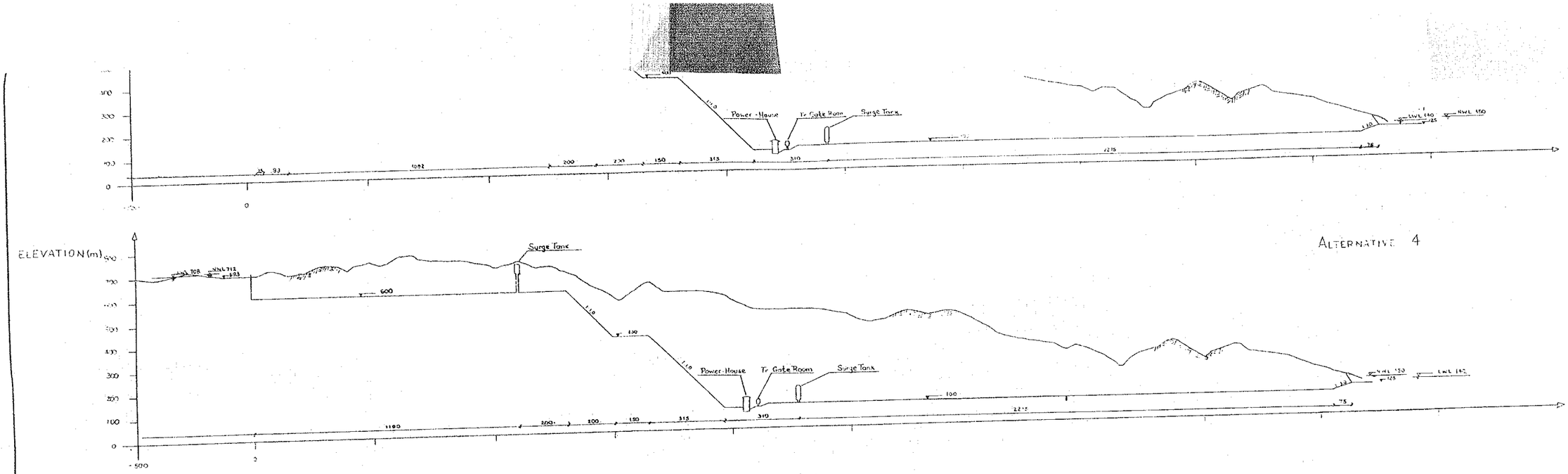
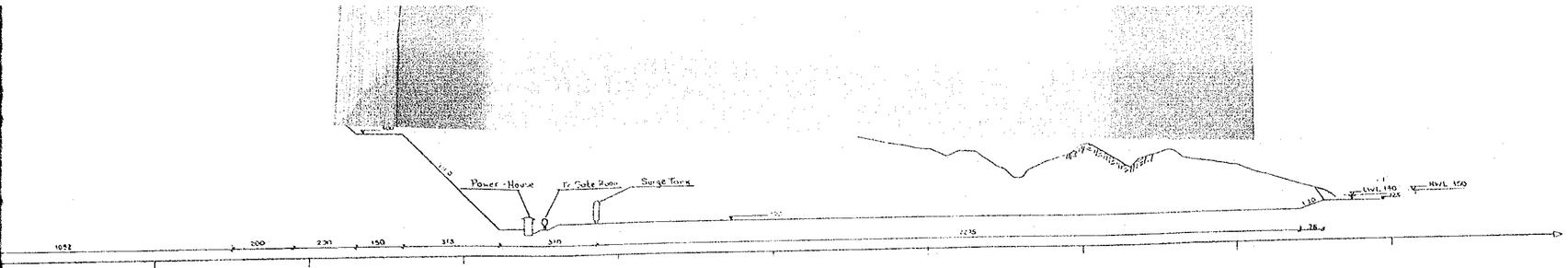

Power-House
Tr. Gate Room
Surge Tank
0
93
1092
200
230
150
313
310
2275
78
NWL 150
LWL 140
ELEVATION (m)
Surge Tank
NWL 712
600
110
130
Power-House
Tr. Gate Room
Surge Tank
1100
200
100
150
315
310
2275
100
75
NWL 150
LWL 142
-500
0
ALTERNATIVE 4
ELEVATION (m)
Surge Tank
NWL 304
Option Scheme
Power-House
Vertical Shaft System
NWL 147.00
LWL 137.40
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
DISTANCE (m)
CONSORTIUM'S ALTERNATIVE
Graphic Sca



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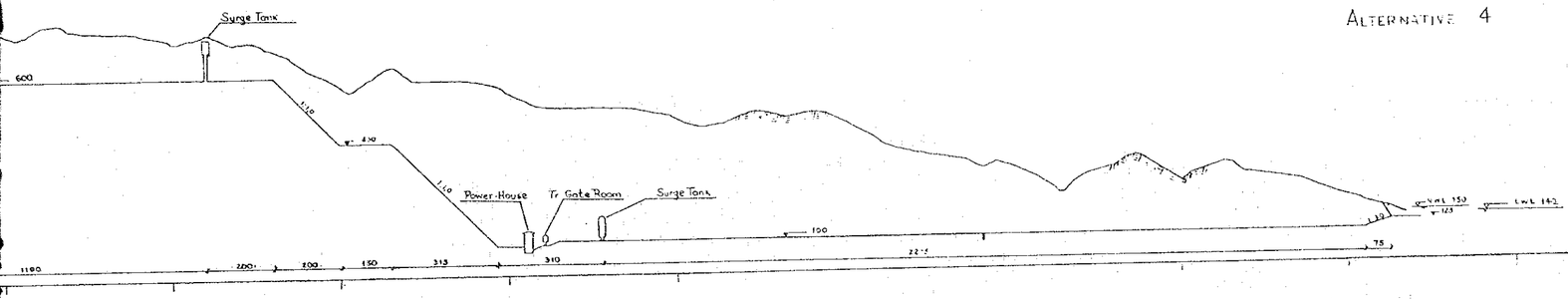

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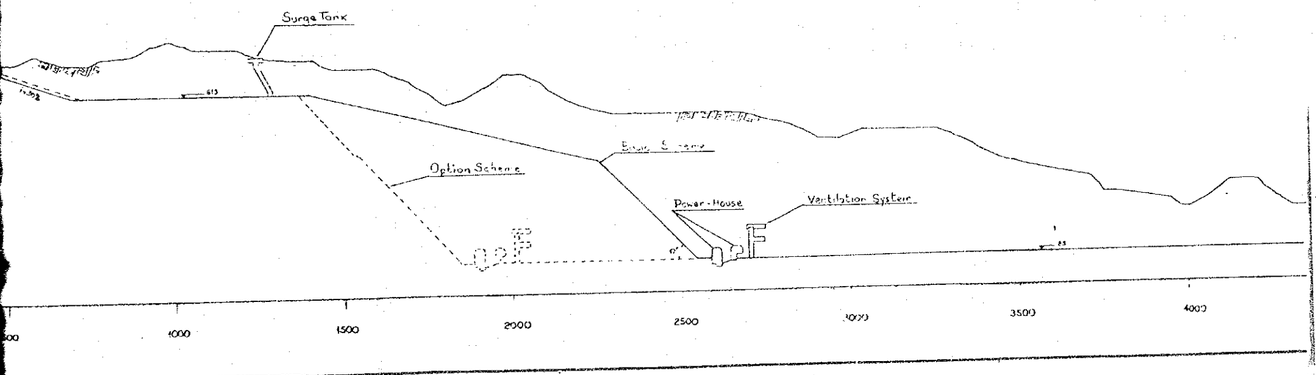
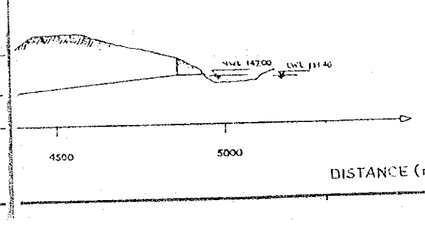




Graphic Scale

0 100 200 300 400 500 (m)

REFERENCIAS

PROJETADO
DESENHADO
VERIFICADO
DATA Abr. 96
APROVADO
APROVADO

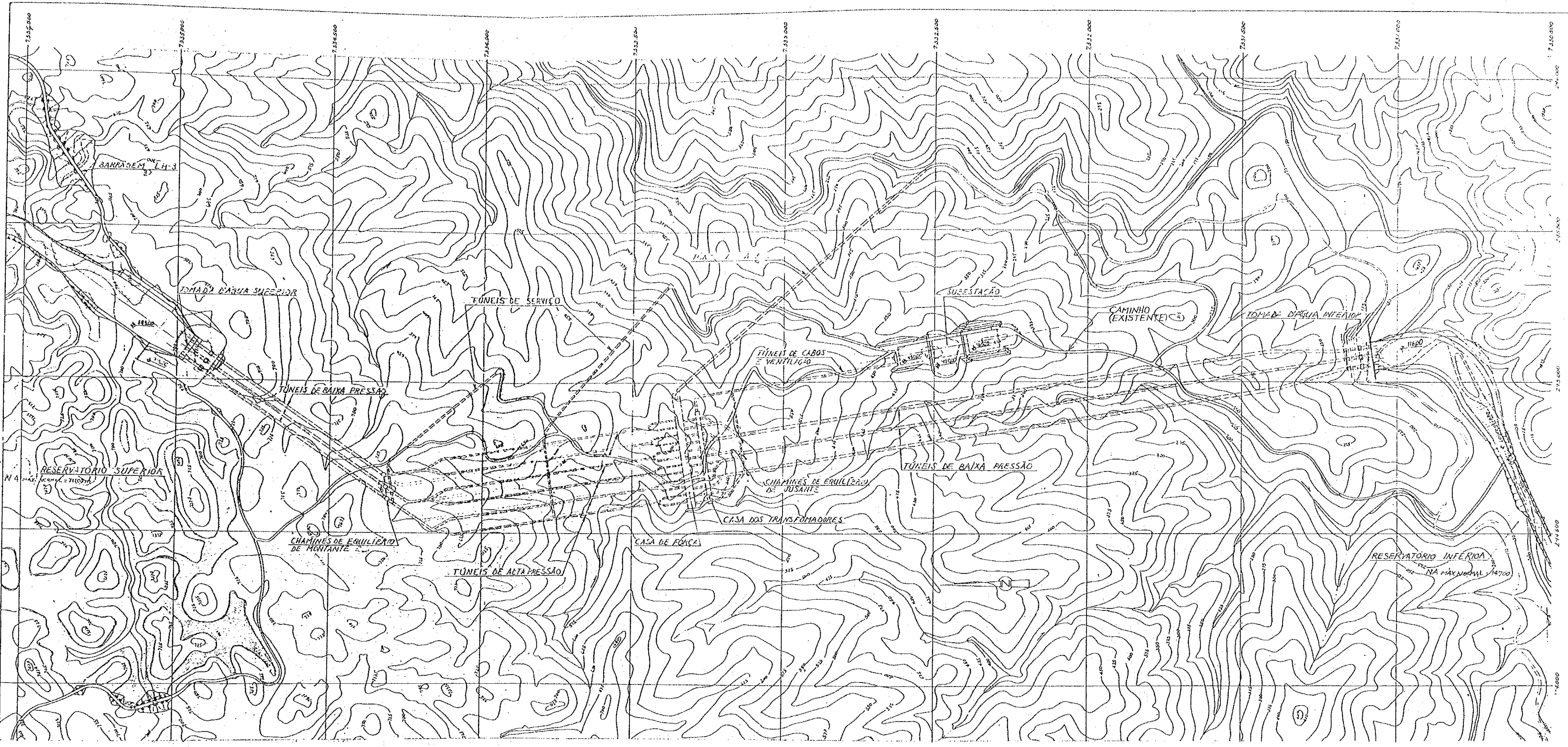
DAEE SECRETARIA DE OBRAS E DO MEIO AMBIENTE
DEPARTAMENTO DE ÁGUAS E ENERGIA ELÉTRICA

TÍTULO

São Lourenço Power Station
Alternatives-Longitudinal
Section

ESCALA 1:10.000

NÚMERO DO DESENHO FIGURE 02



PLANTA GERAL

0 100 200 300 400 500 m

REFERÊNCIA CARTOGRÁFICA:

Levantamento Aerofotogramétrico na escala 1:5000 executado para o DAEE em 1981 pelo TERRAFOTO Atividades de Aerolevantamentos S.A.

Abril de 82

1:5000

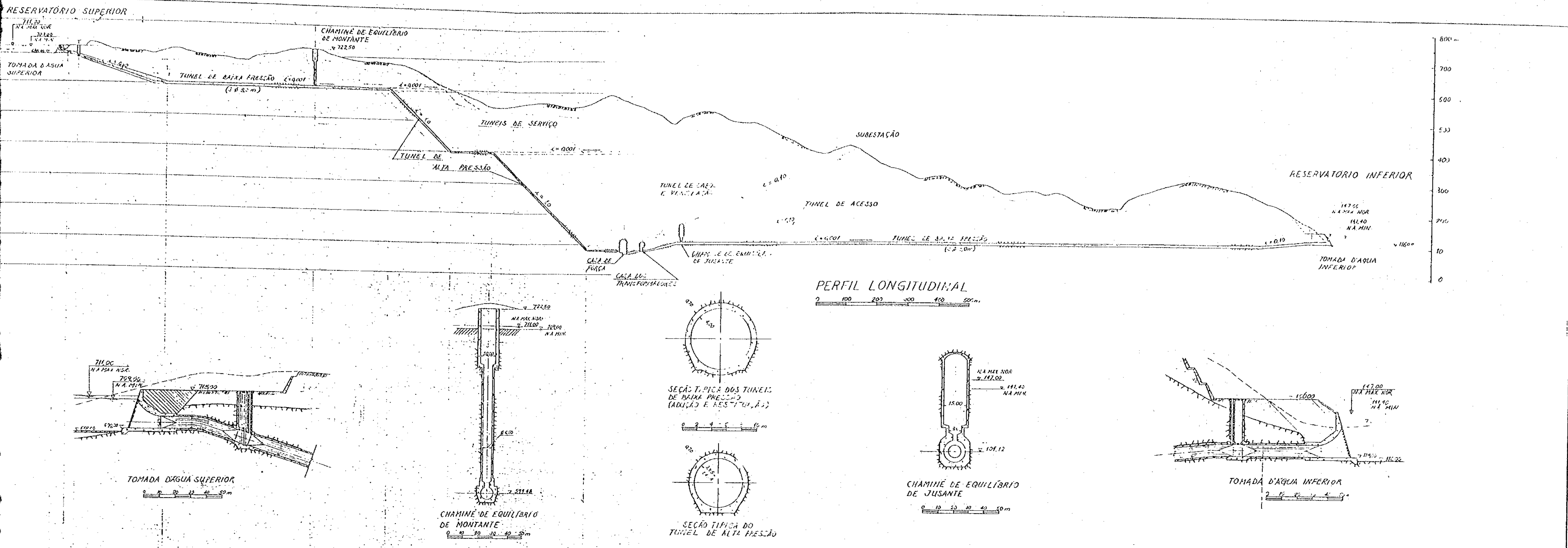
DAEE

SECRETARIA DE OBRAS E DO MEIO AMBIENTE

USINA REVERSÍVEL

PLANTA GERAL

— 327 —



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0	694,00	0,0	00
1	694,00	45,00	45,00
2	685,00	75,00	30,00
3	600,00	358,00	283,00
4	599,54	821,00	463,00
5	599,29	1066,00	245,00
6	377,29	1266,00	200,00
7	599,29	1406,00	140,00
8	80,00	1726,00	320,00
9	80,00	1846,00	120,00
10	79,50	1906,00	60,00
11	101,12	2036,00	130,00
12	106,00	3599,00	1863,00
13	122,00	4076,00	177,00
14	122,00	4150,00	74,00

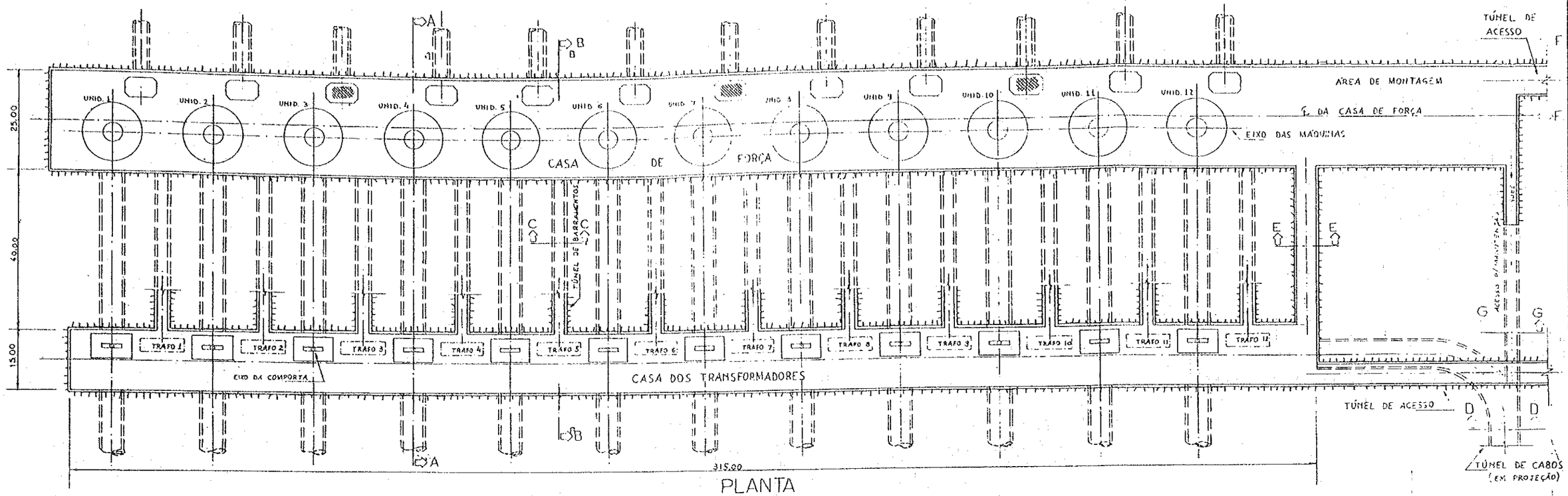
PROJETO | DESENHO | VERIFICAÇÃO | DATA Abril de 82 | APROVAÇÃO | ESCALA

DAEE
SECRETARIA DE OBRAS E DO MEIO AMBIENTE
DEPARTAMENTO DE ÁGUAS E ENERGIA ELÉTRICA
DIRETORIA DE PLANEJAMENTO E CONTROLE

SISTEMA JUQUIÁ - SÃO LOURENÇO

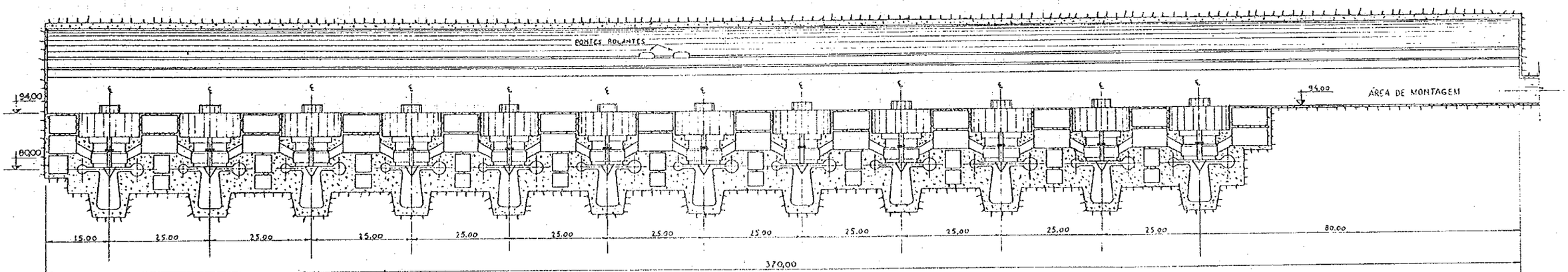
USINA REVERSÍVEL DE SÃO LOURENÇO - UR-4
PERFIL LONGITUDINAL E CORTES

DESENHO J-04



PLANTA

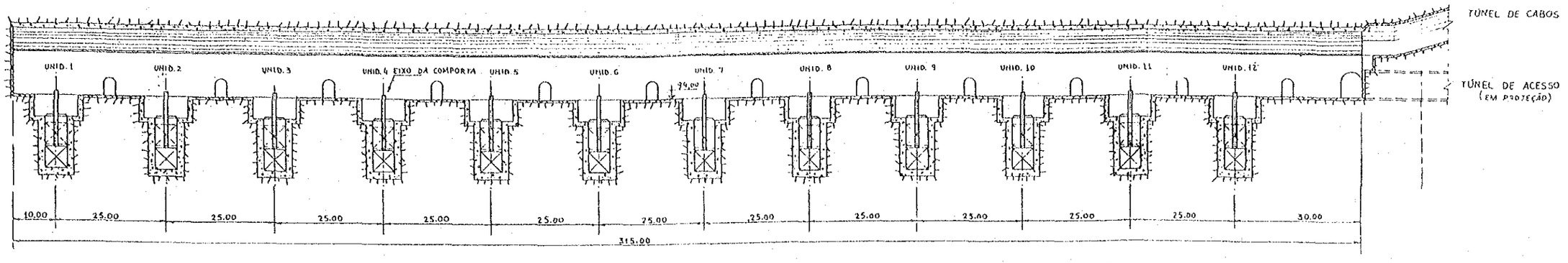
0 10 20 30 m



CORTE LONGITUDINAL DA CASA DE FORÇA

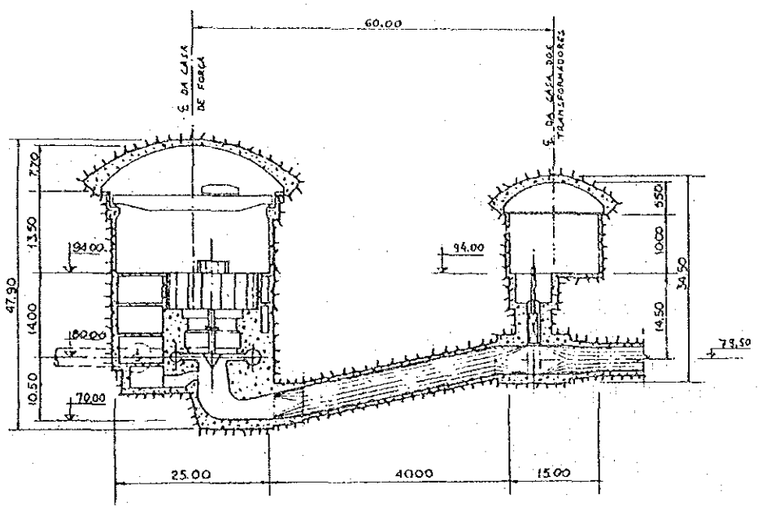
0 10 20 30 m

		1:500 ESCALA	DAEE — SECRETARIA DE OBRAS E DO MEIO AMBIENTE — DEPARTAMENTO DE ÁGUAS E ENERGIA ELÉTRICA — DIRETORIA DE PLANEJAMENTO E CONTROLE
			SISTEMA JUQUIÁ - SÃO LOURENÇO — DESENHO 05
			USINA REVERSÍVEL DE SÃO LOURENÇO — 1
			— 329 — PLANTA E CORTE



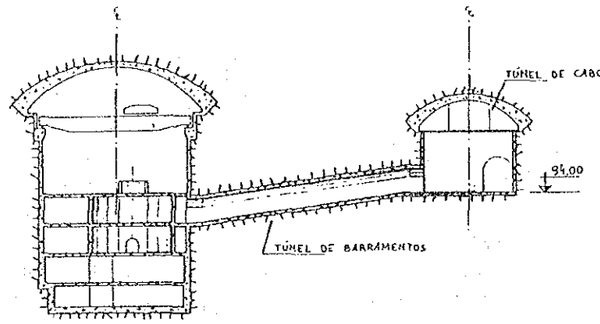
CORTE LONGITUDINAL DA CASA DOS TRANSFORMADORES

0 25 m



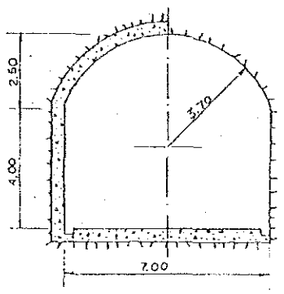
CORTE A-A

0 25 m



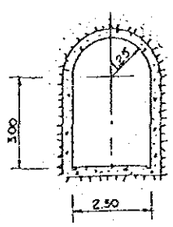
CORTE B-B

0 25m



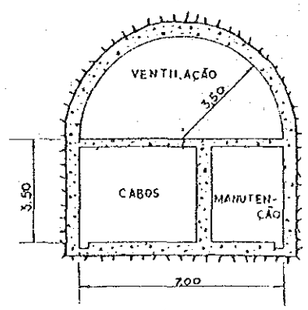
CORTE DO TÚNEL DE ACESSO (F-F)

0 5m



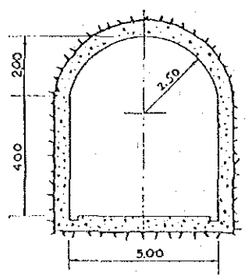
CORTE DO TÚNEL DE BARRAMENTOS (C-C)

0 5m



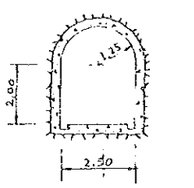
CORTE DO TÚNEL DE CABOS (D-D)

0 5m



CORTE E-E

0 5m



CORTE G-G

0 5m

DAEE
SECRETARIA DE [illegible] DO MEIO AMBIENTE
DEPARTAMENTO DE ÁGUA E ENERGIA ELÉTRICA
DIRETORIA DE PLANEJAMENTO E CONTROLE

SISTEMA JURUMIRIM - SÃO LOURENÇO
USINA REVERSÍVEL DE SÃO LOURENÇO
DE 1-06

ESCALA

Appendix - C

Field Investigations

C-1 Field Investigations of Cubatão Compounded Reversible Power Station

C-2 Field Investigations of São Lourenço Reversible Power Station (1)

C-3 Field Investigations of São Lourenço Reversible Power Station (2)

C-4 Field Investigations Along São Lourenzo River

C-5 Field Investigations of Road Conditions for São Lourenço and Cubatão Reversible Power Stations

C-1. FIELD INVESTIGATIONS OF CUBATAO COMPOUNDED REVERSIBLE POWER STATION

Date: 1981 Dec. 22

1. Summit Control of Billings Reservoir

Gate opening is restricted to only 1.20 m in spite of 5.00 m height because of vibration, which happens by means of gate structure itself and no-enough stilling fuction. Perhaps, the latter will be the main cause considering the jet flow conditions. When the compounded reversible power station is layouted to use this summit control, this gate has to be repaired, but repairing procedures will be quite difficult because other gates have to be operated for the existing power stations. Therefore, it is, at first, recommendable to study the main cause of vibration by means of hydraulic analysis and to execute model test for confirmation of hydraulic analysis, if there is some doubt.

2. Intake

Considering the topographical condition around the intake, the intake structure is judged to be easily constructed, but the fore-bay (canal) excavation will be a little difficult because of necessiation of deep canal (at least 15 m below the low water level) and anticipation of shallow rock exposure (lower part of canal route is anticipated to reach rock foundation at nearly 10 m depth, but slope and hill part is 2 - 3 m depth) Excavation will have to be executed after providing cofferdam at the upstream and this procedure will be the most easy one. For this purpose, at least drillings along the canal, and 2 2 drillings around the intake structure are recommendable to confirm permeability and stability of overburden and rock condition.

3. Cubatão Lower Reservoir

1) Dam-site

The dam site of this reservoir is better than Moje-site (other alternative site) considering geological and topographical conditions. River bed material is supposed to be consisted of mainly GP - GM classification which is considered from the point of topographical and river condition views of which materials are usually permeable but have high

bearing strength, so that counter-measures to cope with the permeability has to be taken. The blanket type rock-fil dam will be the best countermeasures for this purpose.

Fortunately, the right hill is consisted of schist and the weathered rock is deposited of which material is usually impermeable and has high shear strength though natural water content is seemed to be a little high.

Rock material can be transported easily from the both banks, therefore, it will be the best way to transport the embankment materials (Rock and impervious core) from the same borrow area which will be found out at the right hill. (Dam-high is not high so that schist is able to be satisfactorily used for rock embankment).

Filter material will be gathered from the river-bed material and quality is quite sufficient.

This dam-site is most suitable comparing with other two dam-sites so that the following investigations are recommendable.

(1) Dam-axis; 4 drillings as far as rock foundations to confirm qualities of river bed material.

2 drillings at both banks each to confirm the depth of sail and the rock condition. 3 pits near dam-axis to investigate river bed material.

(2) Impervious Core Material.

In the first place, the field investigation to select the borrow-area sites is necessary and some pits and adits are to be executed to confirm the quality and quantity of impervious core material and rock material.

2) Reservoir Area

There is no important problem around the reservoir area. Speaking forcedly, the piers of high-way and small landsliding are pointed out; The former, of which bridge is consisted of gerber-type so that irregular deformation is allowable and up-lift by submergence is also easy

to make measures.

The latter is scattered around the reservoir area but scale is usually very small and these landslidings have been occurred by means of rain-fall invasion between shallow overburden and sound rock surface.

3) Water Supply System

There is water supply system owned by SABESP ($Q = 3m^3/sec$) which is located at 500 m downstream from the dam-site. Intake facility is free-flow system and available capacity is not large so that relocation of intake facility at the back-water position of the reservoir and construction of channel to the existing site through the left bank are considered to be the best compensation procedures.

4) Spillway Tunnel for Flood Controlling

This facility, which is planned by DAEE, is unuseful and expensive, and makes pollute the other river, therefore, it is recommendable to regulate the flood-flow in the reservoir within the restricted downstream release.

C-2. FIELD INVESTIGATION OF SAO LOURENCO REVERSIBLE POWER STATION (1)

Date: 1982 Feb. 10

1. Intake

Selected location of intake is more or less reasonable because of no other suitable place considering topographical and hydraulic conditions. But the lay-out has to be carefully designed taking into consideration of geological conditions.

2. LH-3 Damsite

The semi-rockfill dam will be the most suitable type considering geo-topographical conditions, but the proposable borrow area for dam embankment materials has to be selected, and made field and laboratory investigations. The borrow area has to be selected at more than 710 m of elevation considering transportation condition of materials because high natural water content is antecipated according to the field investigation.

Further more, the trace of landslide is to be carefully investigated near-by the damsite.

3. GD-6 Damsite

The damsite is geologically consisted of granite and extremely weathered untill deep portion and the rock contains high-mica content so that careful rock foundation treatments are necessary for every structures.

The semi-roch fill dam with surface protection will be most recommendable and it is quite important to select the semi-weathered or the much coarser borrow area for this purpose through the field investigations and the borrow area with low mica content has to be also selected.

4. Upper Reservoir

The most of reservoir area is covered with jungle, and consisted of marshy place though it is wet season.

At first, cleaning of reservoir area is the most important subject, but the depth of organic soil is antecipated to be more than 5 m around the marshy place, so that careful field investigations are quite important to determine the depth of excavation. If excavation untill the necessary depth would not be done, the reservoir water will be surely pollute year by year by means of decomposition of organic material.

Secondary, though many canals have to be excavated and many dikes to be embanked to secure the necessary reservoir capacity, the both constructions will certainly need some special treatments and much expenses.

Thirdly, even if it is wet season, river water of the both São Lourenço and Juquiá seems to contain much organic material by means of smelling and tasting at the field so that periodical bio-chemical investigations are quite recommendable because these investigations will be useful to determine the excavation depth of reservoir area.

As the results of the above mentioned view points, the pondage type reservoir and other measures will have to be considered because quality of water is the most important subject.

5. Surge Tank

Location and structure of surge tank are to be considered through the study of water way designing because the space restricted.

6. Water-Way

According to geological map, some faults passing through the water-way are anticipated so that careful field investigations are quite important to determine the water-way layout, the locations of underground power-house and other structures.

C-3. FIELD INVESTIGATIONS OF SÃO LOURENCO PUMPED STORAGE POWER STATION (2)

Date: 1982 Mar. 9.

1. Tributary of São Lourencinho River near the intake

- River bed condition - Constituted with weathered migmatite.
  - excavation of about 2 m is enough to obtain the foundation of open structures.
  - surface of sound rock is assumed to be 25 m deep considering seismic sounding velocity.
  - the water is very clean, but dissolved organic material will be probably contained in the reservoir water if the cleaning of reservoir is not executed.

2. Surge Tank Area

- organic material depth is 2,0 m
- soil is constituted basically with weathered migmatite (1-2m)
- the surface of the road is covered with weathered migmatite which has enough strength for the foundation of upper chamber.

3. Point *1 (about 200 m Surge Tank downstream)

- weathered migmatite constituted by high percentage of quartz (lens of quartzit).
- sound rock is about 30 meters.

4. Point *2 (500 m downstream from the Surge Tank)

- weathered migmatite rock is found along the road surface,
- it is possible to construct tunnel of 7 m class diameter, utilizing steel form and loosen zone is necessary to make grouting.

5. Power House

- The power house is located between two valleys so that water leakage may be concentrated to the power-house.
- According to the field investigation along the road, highly concentrated cracks, of which directions are more less parallel, are found and these cracks are probably occured by means of faulting actions. And there are probabilities of 2 or 3 faults.
- Rock bolt and concrete wall are necessary to be provided for construction of power house and other big cave type structures.
- Determination of fault zone lines, and highly concentrated crack directions and degrees around the power-house elevation is very important subject to determine the location and layout of underground structures. According to this geo-technical determination, location and layout are very changeable.

6. Near the Main Fault

- High concentraction of seams near the main fault is found.
- Pegmatite (quartz, feldspat, turmaline) is intruded in migmatite. In this case, pegmatite is usually consisted of very rapid alternation.

7. View of São Lourenço River

- São Lourenço river is toporgaphically consisted of deep valley so that there is possibility of fault zone along the river and near LH-3 dam site.

8. Switchyard Area

- Switchyard area is located between deep valleys.
- To make more economic structure, it is necessary to select carefully

the best site and to get the best solution.

- Concrete walls is the best solution to protect the embankment and to avoid too much excavation.
- Rock excavation volume will be high.

9. Half-way of Tailrace Tunnel

- Geologic structure is consisted of migmatite and biotitegnaiss is intruded.
- Sometimes this kind of formation is overlaped.

10. River Bed of Tributary of São Lourencinho River

- River bed is constituted with rolled gravels and block of pegmatite, migmatite and biotite-gnaiss rocks.
- Sound rock surface is about 2 m depth.
- River water is very clean but it contains a little dissolved organic material.

11. River Bed of São Lourencinho River

- River bed is constituted of rolled gravels and blocks of pigmatite and biotite-gnaiss rocks.
- Sound rock surface is about 5 m depth.
- Very clean water, a little dissolved organic material.

12. Outlet of São Lourenço Power Station

It is better to change a little the direction of the tailrace tunnel to downstream near the outlet considering river condition.

- It is necessary to excavate a little at the opposite side of the outlet to make waterflow smooth.
- The excavation procedure of canal along the river has to be carefully considered because deep excavation is necessary.

13. Acess Road

- This existing acess road can be utilized during the construction of power station and after then for maintenance of switchyard, surge tank, the upper reservoir and so on but for this purpose, it is necessary to make repairing at several reaches but utilization of this road is surely economic.

14. Summary

- Along all way of the existing road, rock is exposed so that geological surface investigations must be executed carefully as soon as possible to check the aero-geological map. And there are many valleys around the project area and there are surely supposed to have exposed rock along these valleys so that careful geological surface investigations are inevitable to complete geological map.
  If this correct geological map is not completed, layouting and designing of this project is, difficult and further more geological investigation programs can not be established, because some fault zones are surely existing, concentrated seam directions are also observed and rock structure is supposed to be very complicated.

- According to field investigation, existing geological data especially seismic sounding data must be re-examined and classified in accordance with your geological classification because geological classifications are too much rough considering geo-technical view points.

C-4. FIELD INVESTIGATIONS ALONG SÃO LOURENCINHO RIVER

Date: 1982 Apr. 15, 16

A) General Topographical and Geological Views of Reservoir Areas.

Reservoir area of LH-1 is mainly consisted of marshy place and rock formation is supposed to be too deep, but topographical condition changes suddenly at LH-5 and river bed is consisted of exposed rock, as going up to the upstream and the both banks of the river are getting steep but traces of small land-sliding are found at everyplaces.

The rock formation is geologically consisted of schist and migmatite and they are supposed to have eminent direction, but rock quality is,

generally speaking, supposed to be enough for the foundations of dam and the underground pump station.

B) Vegetation Around Reservoirs of LH-1 and LH-2

Reservoir area below EL170 m of LH-1 is covered with banana plantation and dense tall grasses, and water at low land gives out offensive smell. Area above that elevation is covered with dense primeval forest.

Upstream area from LH-5 does not have low land and is consisted of dense primeval forest.

River water gets dirt as going to downstream, though it is after rain, but the water of upstream from LH-5 is really clean, that means that cleaning of reservoir is shown to be important.

Considering bad smell water at the low land, depth of organic material is assumed to be comparatively deep especially at the low elevation as seen in the 1:50,000 scale topographical map, but cutting the trees and pulling out those root are supposed to be enough to keep clean the reservoir water at the other forest.

C) Investigations at LH-2 and LH-2A Damsites

C.1. LH-2 Damsite

- As for topographical characteristics, mainly the left bank of LH-2 dam site isn't enough, considering the normal water level of this reservoir at 153^{m}. The right bank has a good topographical characteristics for the dam and the spillway, but for the dissipator structures, big excavation will be necessary considering the area of landslide deposit.
- Considering that this axis is located between two tributaries

(Ribeirão Arcoverde at upstream and Ribeirão Pedreira at downstream) perhaps some difficulties in the construction of cofferdams will be happen.

- According to the existing geological investigations, the soil depth in this area is about 20 - 25 m and soil classification is CH and CL. At the level of 140 m, the soil is CH and will be somehow difficult to be used as a core material without pre-treatments such as exposing and mixing with coarse material.
- The river bed is consisted of exposed rock of quartz-schist which is supposed to be very good for the dam foundation. The treatment of foundation will be necessary (grouting depth - 10 m). Rock classification is A-1 and A-2, and EG ≅70.000 kg/cm^2 and RQD ≅ 70 - 80%.
- The average value of sediment transportation in this region is assumed to be 300 - 400 m^3/km^2. year, considering the topographical and geological conditions and the traces of small landsliding.

C.2. LH-2A Dam site

- Topographical condition of this site, at the first view, is better than LH-2 dam site.
- For the spillway location, the right bank offers a good place, but for the location of dissipator structures it will be necessary to make big excavation considering area of landslide deposits.
- Also for the diversion, considering the topographical condition, the right bank is the best side, but the upstream cofferdam has to be carefully designed especially at the left bank.
- River bed is consisted of exposed quartz-schist rock of good quality for the foundation (EG ≅75.000 kg/cm^2 and RQD ≅ 70 - 80%).
- Looking along small tributaries, it is possible to find very hard gravels blocks and sand which are little wethered rocks, that means that sound rock formation will not be so deep and that the construction of underground pump station will not have difficulty even if the over-burden is not deep.
- Considering the both banks of just downstream portion, some small landsliding traces are found so that the protection walls for landsliding at the both banks and the inflow protection facility of bed-

load are quite necessary.

- Some geological investigations are important to determine the layout of main structures.

C-5. FIELD INVESTIGATION OF ROAD CONDITIONS FOR SÃO LOURENÇO AND CUBATÃO REVERSIBLE POWER STATIONS

Date: 1982 Jun, 28, 29

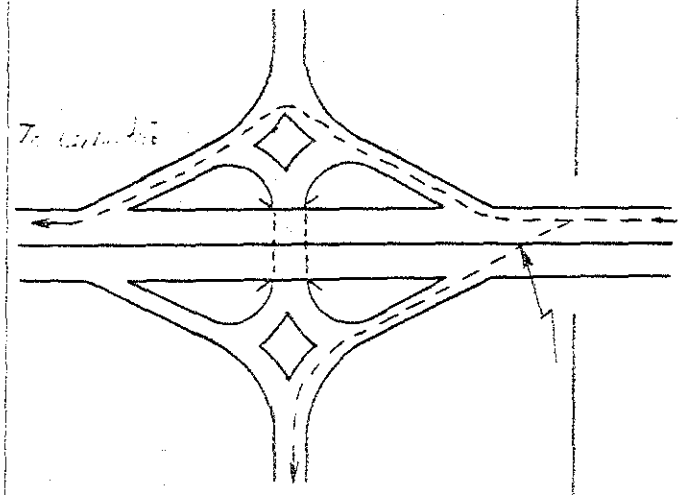
Field investigation of road conditions to transport the heavy equipment for construction of big power station is essential to determine maximum transportable weight and size at the planning stage, because transportable weight and size is not only one of important factor to determine the optimum unit, especially electric-mechanic equipment, but also it is necessary to minimize the traffic disturbance before and during their transportations, the former means the reconstruction and or reinforcement of unreasonable road and the latter means not to give traffic disturbance as little as possible.

Investigated items are divided into mainly three namely, bridge, road curve and or road condition and tunnel dimension. Fortunately, the road conditions excepting some bridges are found to be no problem so that preliminary bridge investigations along the two transporting routes are performed and and the investigated results and the locations of bridges are shown in the attached Table and Map.

According to these bridges, designing and or design criteria are recommendable to be collected from the related organization and to be confirmed that that each of them is bearable or not for the heavy equipment transformer about 65 ton, maximum size of turbine runner about 5.5 m diameter, no included trailer weight) because these weights are especially exceeding the normal design loads described in the Standard. These researchings are essential not to give traffic disturbances and to make transportations safely at the feasibility stage.

Finally, the class II and III bridges are recommendable to be carefully studied how to reinforce them, or no necessary to do so and how to adopt other measures.

Number	Name	Type	Span(m)	Width (m)	Class	Note
Route to Cubatão P/S.						
1.	Rio Cubatão Bridge in Via Anchieta	Concrete langer with simple Beams at Both Sides	15+40+15=70	7.5	III	1. Old bridge 2. Reinforcement exposed everywhere. 3. Measure (1) Supporting to reinforce beam. (2) Spreading steel plate to distribute load.
2.	Overpass, Via Anchieta Road on Rodovia Pedro Taques (BR-101)	Simple Concrete Slab	7	2x10	III	1. Viaduto 2. Reinforcement exposed amd folded. 3. Clearance limit=4.0m 4. Measure (1) No-bearable (2) Using detour as following

Number	Name	Type	Span(m)	Width (m)	Class	Note
						
3.	Fepasa Railway Overpass in Via Anchieta	Pre-stressed Simple	11x40 =440	10	I	1. New bridge with big camber 2. Pier; limit design 3. Railway crossing under bridge 4. Measure No - necessary
4.	Rio Casqueiro Bridge in Via Anchieta	R.C. Gerber	10x50 =500	10	I-II	1. A little old bridge with small camber 2. Other line P.C. 3. Measure Necessary stress checking

Number	Name	Type	Span(m)	Width (m)	Class	Note
4.	Santos Harbor	-	-	-	-	1. Berth depth; 36 ft = 11 m: Maximum tonnage 25,000 ton. 2. Travelling unloader; 6-16^{t}. 3. Crane ship unloader;150^{t} 4. Measure No-necessary
Route to São Lourenço P/S.						
1.	Rio Itariri Bridge in BR-116 Road	R.C. Continuous with Cantilever at both sides	5+7x20+5= 150	6.0	II	1. A little old bridge with two beams of variable sections 2. Pier; limit design 3. Shoe; wood 4. Measure (1) Stress checking (2) Reinforcing pier and beam
2.	Fepasa Railway Overpass in BR-116 Road	R.C. Continous with Cantilever at both sides	5+2x15+5= 40	6.0	II	1. A little old bridge with two beams of uniforme section 2. Railroad passing under bridge 3. Pier; limit design 4. Measure (1) Stress checking (2) Reinforcing pier and beam

Number	Name	Type	Span (m)	Width (m)	Class	Note
3.	Rio do Peixe Bridge in SP-165	P.C. Continuous with Cantilever at both sided	5+2x20+5= 50	7.5	I	1. New bridge with four beams of uniform section. 2. Measure No-necessary
4.	Rio do Azeite Bridge in SP-165 Road	P.C. Continuous with Cantilever at both sides	5+2x20+5= 50	7.5	I	1. New bridge with four beams of uniform section 2. Measure Foundation at right bank pier must be checked
5.	Rio Areado Bridge in SP-165 Road	Simple R.C.	10	7.5	I	1. Measure No-necessary
6.	Rio Preto Bridge in BR-101 Road	Slab Typer Cantilever at both sides	5+20+5= 30	10	I	1. New bridge 2. Measure Foundation at both bank piers must be checked
7.	Rio Itanhaen Bridge in BR-101 Road	P.C. simple	6 x 40 = 240	10	I	1. New bridge with 6 beams 2. Measure No-necessary

Number	Name	Type	Span(m)	Width (m)	Class	Note
8.	Rio Mongaguá Bridge in BR-101 Road	Simple T-Beam	4 x 15 = 60	10	III	1. Old bridge with small T-Type beams. H = 50, B = 35 2. Reinforcement exposed everywhere 3. Numbers of pier 5. Diameter 40 cm 4. Measure (1) Fundamentally reinforcing or search other route.
9.	Rio Itinga Bridge in BR-101 Road	Simple T-Beam	2 x 15 = 30	10	III	1. As same as Mongaguá 2. Both abutments no stable, especially concrete pile 3. Measure As same as Mongaguá
10.	Fepasa Railway Overpass in BR-101 Road	Slab Type Gerber	1.5+2x12.5+1.5= 28	7.5	I	1. Pier; 2. D= 0.80m 2. Crashed by shearing at pin-hinge around center portion of road 3. Measure Gerber portion must be supported

Number	Name	Type		Width (m)	Class	Note
11.	Rio Boturoca Bridge in BR-101 Road	P.C.Simple	5+5x40+5= 210	7.5	I	1. Pier; 2 D = 1.5m 2. 4-Beam H = 1.5m 3. Measure No necessary
12.	Fepasa Railway Overpass in BR-101 Road	Box Type R.C. Curved Continuous	10+20+10 = 40	10.0	I	1. Beam H = 1.5m 2. Pier: 3 D = 1.5m 3. Railway passing under bridge 4. Measure No necessary