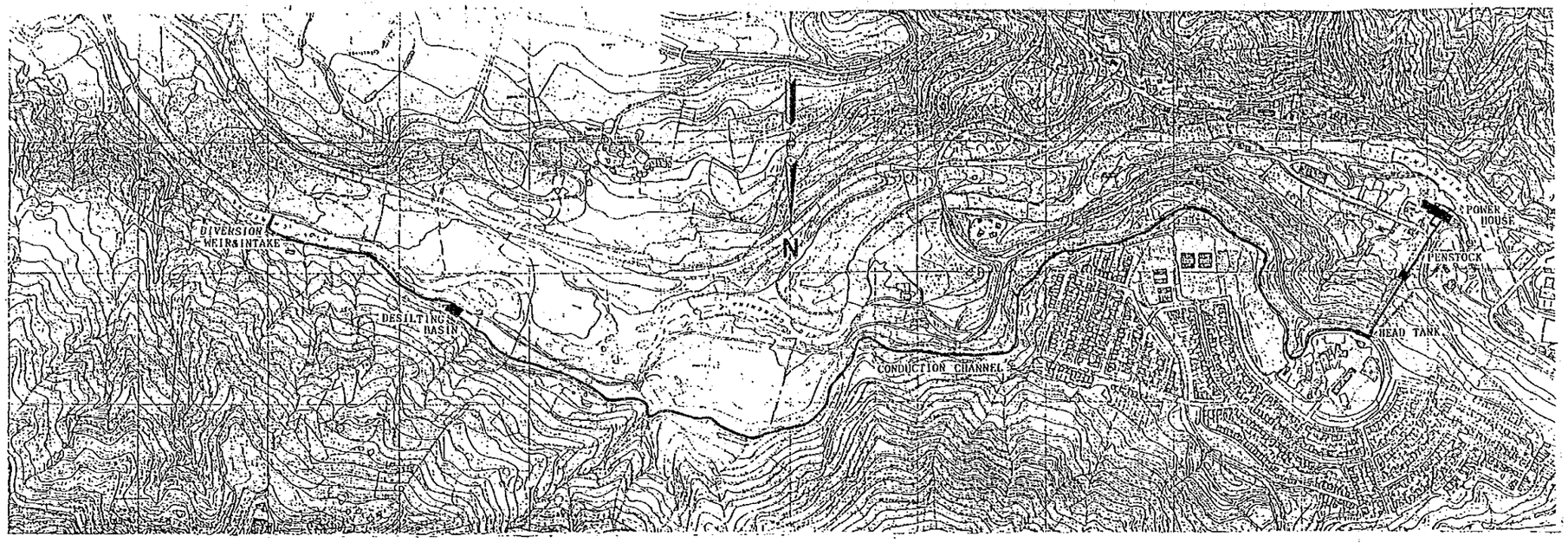
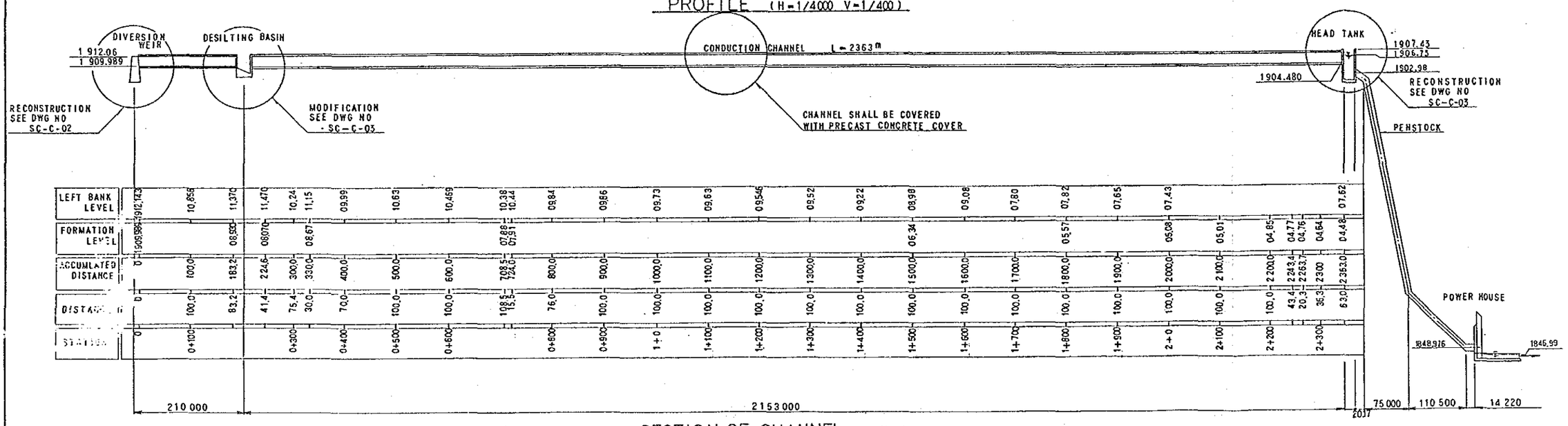
Drawings

Title	Drawing No.
San Cancio	
General Plan and Profile	SC-C-01
Diversion Weir and Intake	SC-C-02
Desilting Basin and Head Tank	SC-C-03
Powerhouse and Tailrace	SC-C-04
Duration Curves	SC-H-01
Geological Plan	SC-G-01
One Line Diagram	SC-E-01
Intermedia	
General Plan and Profile	IN-C-01
Powerhouse and Tailrace	IN-C-02
Duration Curves	IN-H-01
Geological Plan	IN-G-01
One Line Diagram	IN-E-01
Municipal	
General Plan and Profile	MU-C-01
Diversion Weir and Intake	MU-C-02
Desilting Basin	MU-C-03
Head Tank	MU-C-04
Powerhouse and Tailrace	MU-C-05
Duration Curves	MU-H-01
Geological Plan	MU-G-01
One Line Diagram	MU-E-01

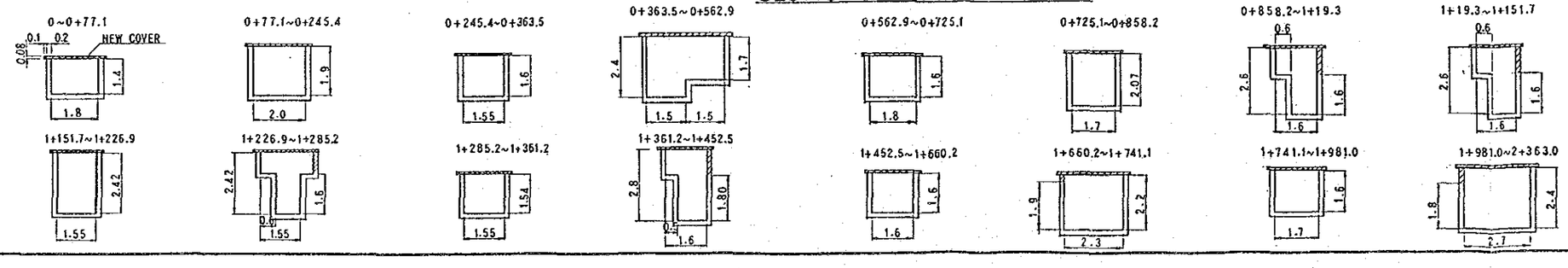
GENERAL PLAN (S = 1/4000)



PROFILE (H = 1/4000 V = 1/400)



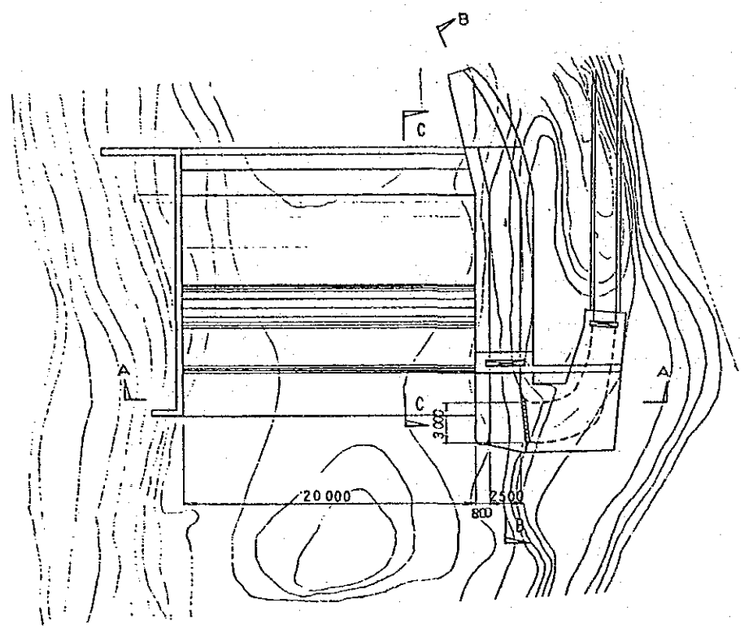
SECTION OF CHANNEL (S = 1/100)

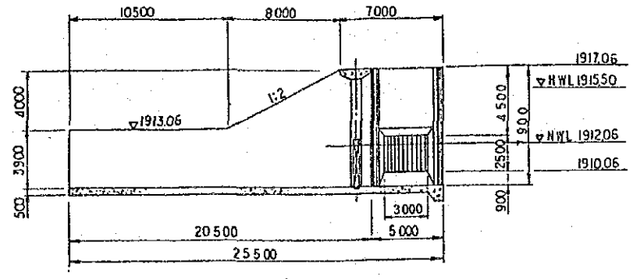


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
GENERAL PLAN AND PROFILE	
DRAWING NO.	SC - C - 01
SCALE 1/4000	DATE

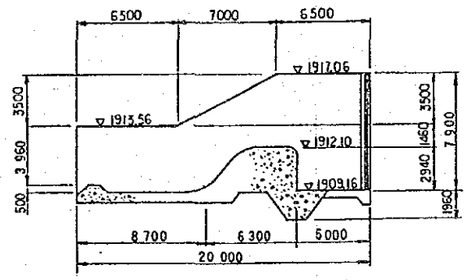
DIVERSION WEIR & INTAKE

P L A N (S=1/200)

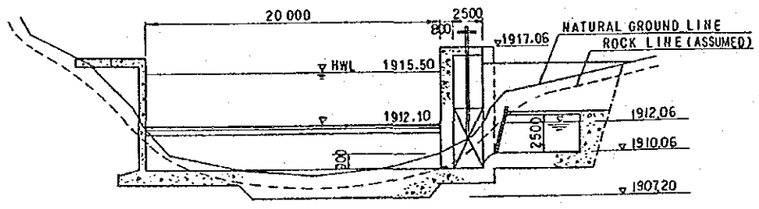




B — B



C — C

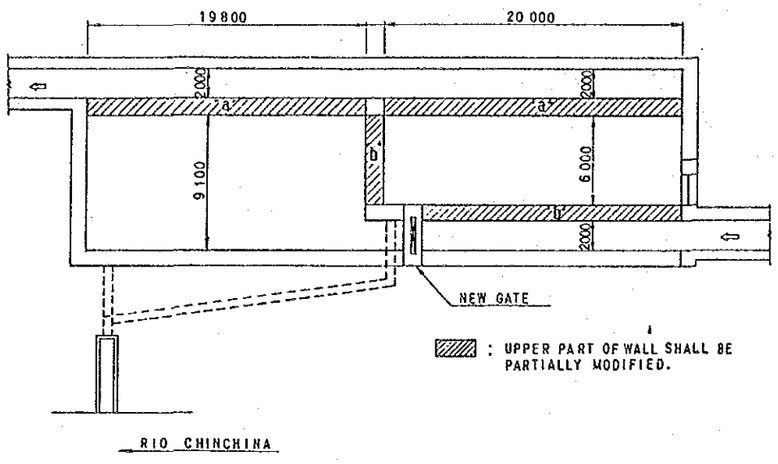


A — A

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
DIVERSION WEIR AND INTAKE	
DRAWING NO.	SC-C-02
SCALE 1/200	DATE

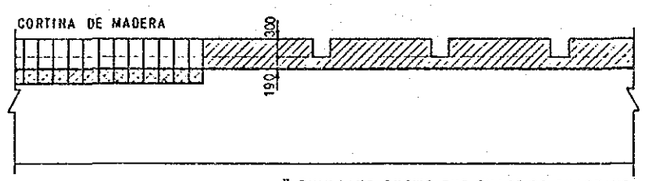
MODIFICATION OF DESILTING BASIN

PLAN (S=1/200)



: UPPER PART OF WALL SHALL BE PARTIALLY MODIFIED.

DETAIL "a" (S=1/50)

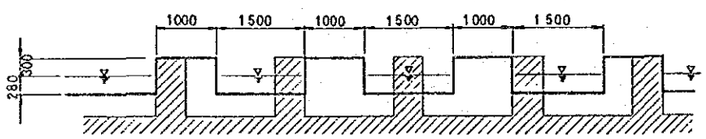


※ THIN LINE SHOWS THE SHAPE OF EXISTING STRUCTURE AND THICK LINE DENOTES MODIFIED SHAPE.

: CHIPPING OF CONCRETE.

: WITH CONCRETE RAISED

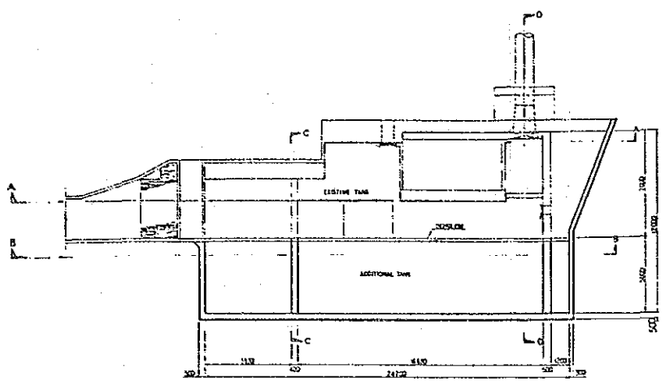
DETAIL "b" (S=1/50)

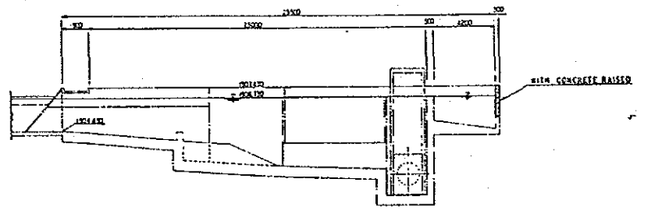


※ THIN LINE SHOWS THE SHAPE OF EXISTING STRUCTURE AND THICK LINE DENOTES MODIFIED SHAPE.

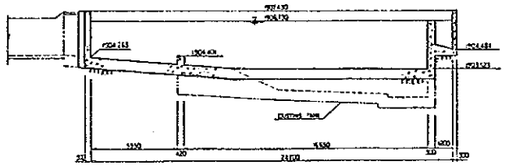
RECONSTRUCTION OF HEAD TANK

PLAN (S=1/200)

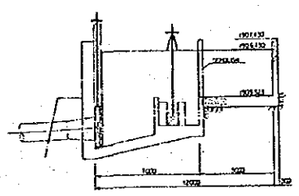




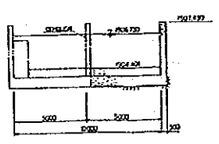
A — A



B — B



D — D

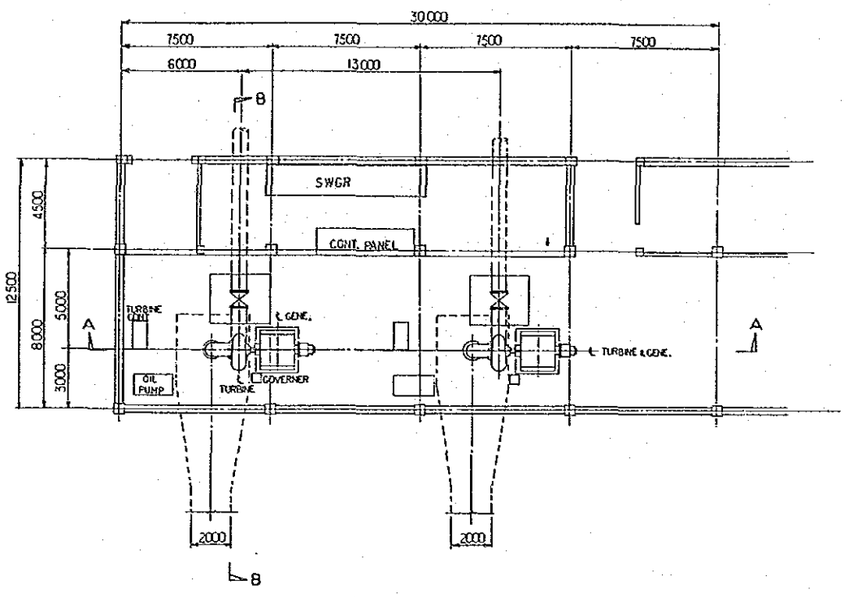


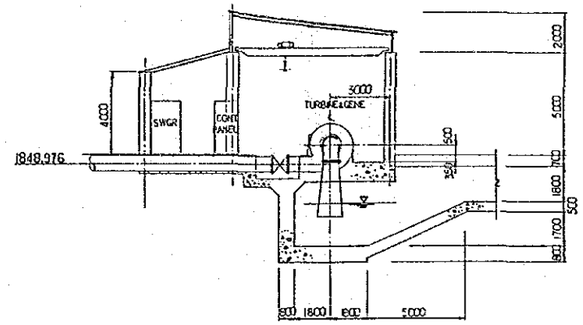
C — C

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
DESILTING BASIN AND HEAD TANK			
DRAWING NO.		SC - C - 03	
SCALE	1/200	DATE	

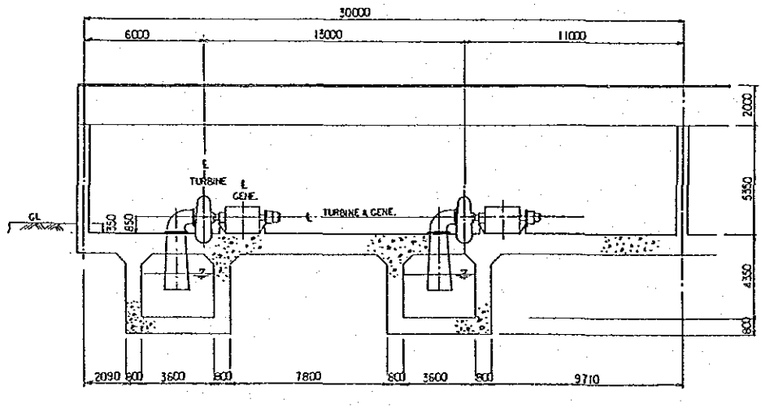
POWERHOUSE & TAILRACE

PLAN (S=1/150)





B – B

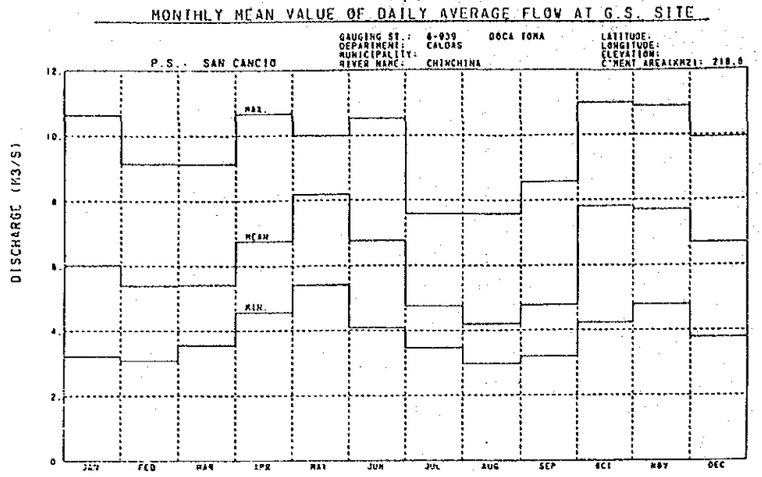


A – A

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
POWERHOUSE AND TAILRACE	
DRAWING NO.	SC-C-04
SCALE 1/150	DATE

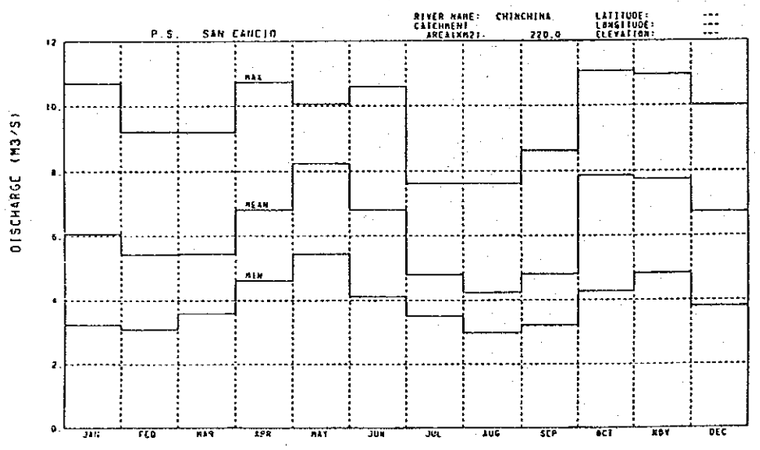
(1)

MONTHLY MEAN VALUE OF DAILY AVERAGE FLOW AT G.S. SITE



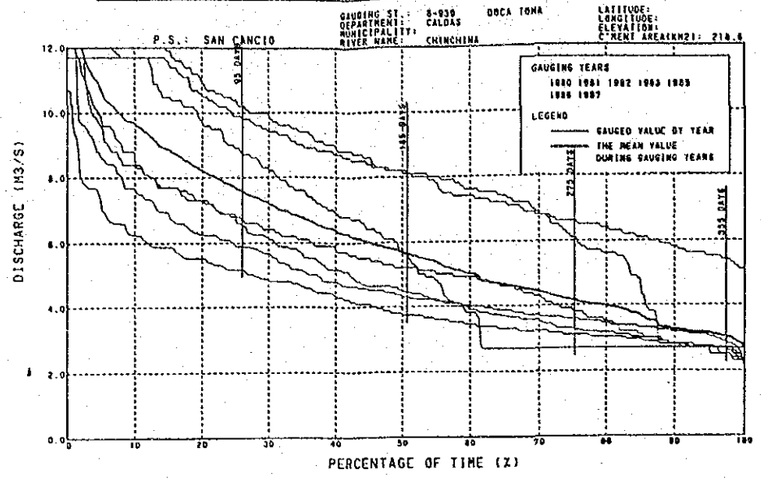
(2)

MONTHLY MEAN VALUE OF DAILY AVERAGE FLOW AT INTAKE SITE



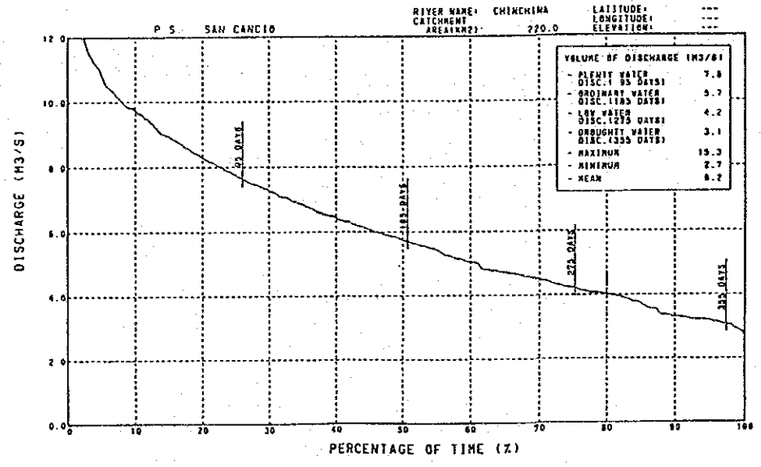
(3)

FLOW DURATION CURVE AT GAUGING STATION SITE



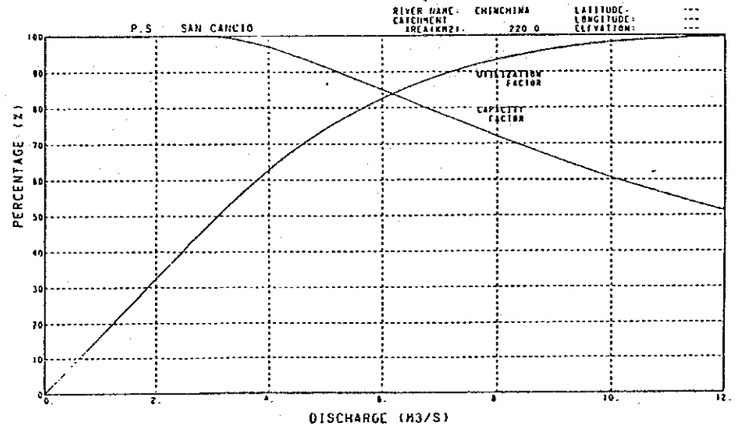
(4)

TYPICAL FLOW DURATION CURVE AT INTAKE SITE



(5)

UTILIZATION & CAPACITY FACTOR



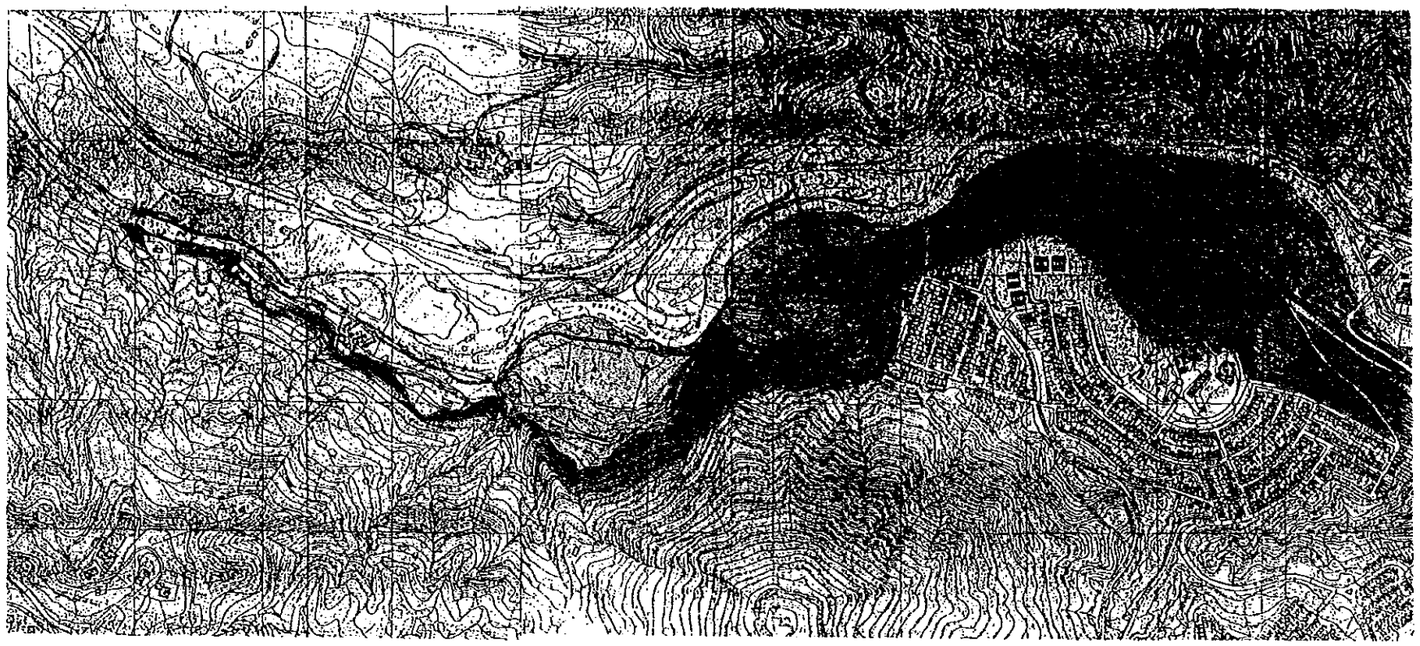
Data of Hydrological Gauging Station

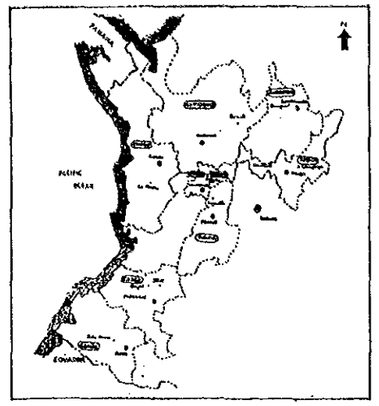
No. of Station	6 — 939
Name of Station	Bocatoma
River	Chinchina
Management	CHEC
Installation Year — Month	— —
Coordinates (Deg. — Min.)	
Latitude	— —
Longitude	— —
Above Sea Level s.n.m. (m)	— —
Long River (km)	— —
Catchment Area (km²)	— —
Water Shed (m)	— —
Observation Period	1979 — 1987

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA

DURATION CURVES

DRAWING NO.	SC — H — C 1
SCALE	DATE





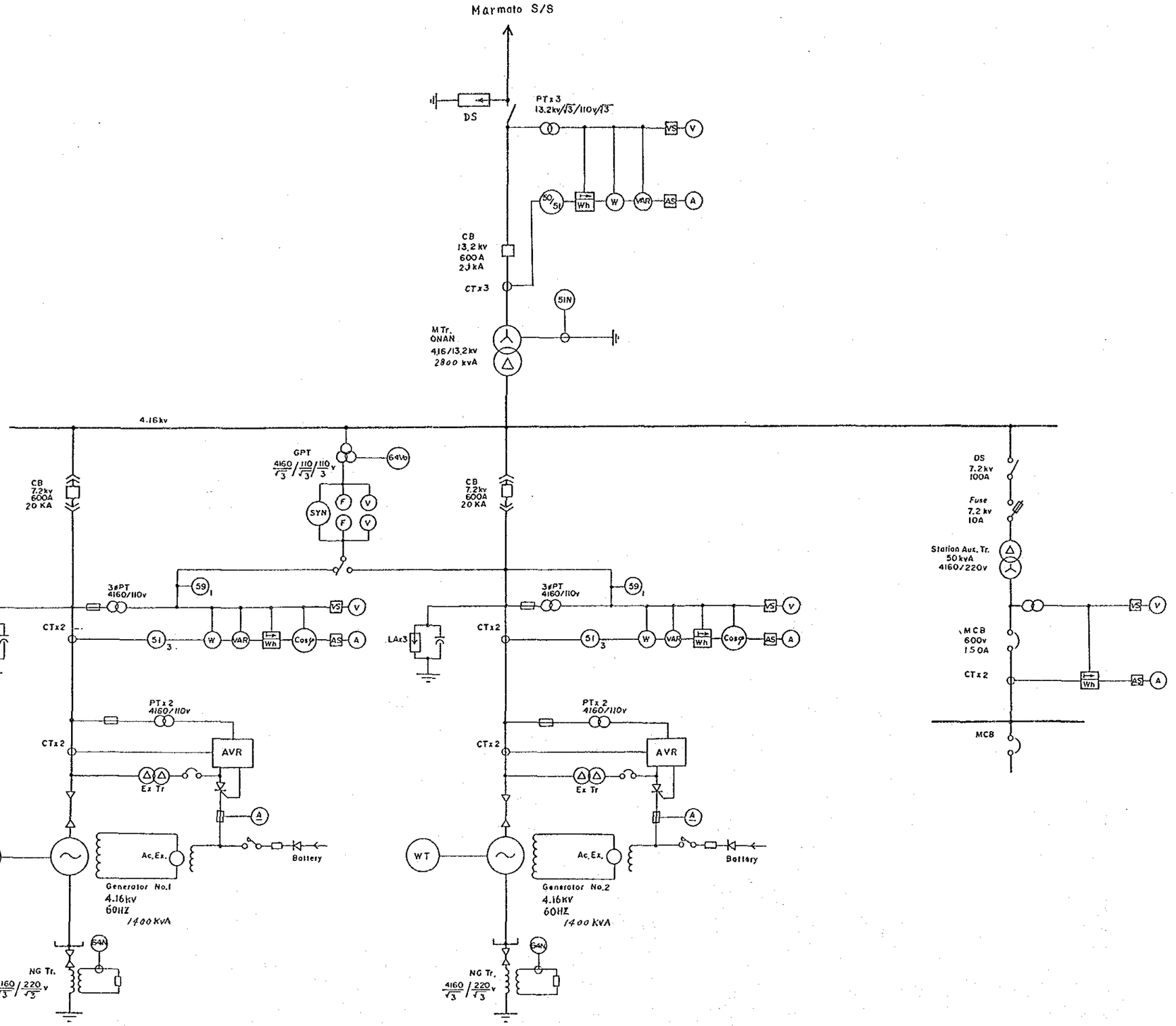
LEGEND

- River bed deposits
- Talus deposits
- Terrace deposits
- *Old debris flow deposits*
- Andesite lava
- Crystalline schist
- Geological boundary
- Collapse

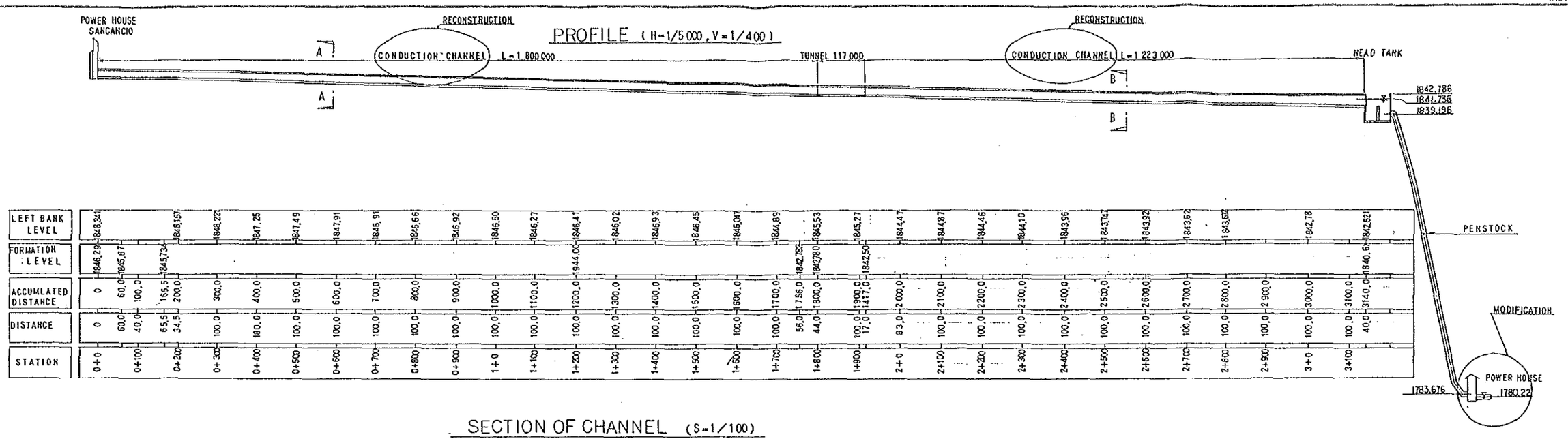
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA

Geological Plan
San Cancio

DRAWING NO.	SC-G-01		
SCALE	1/9,300	DATE	



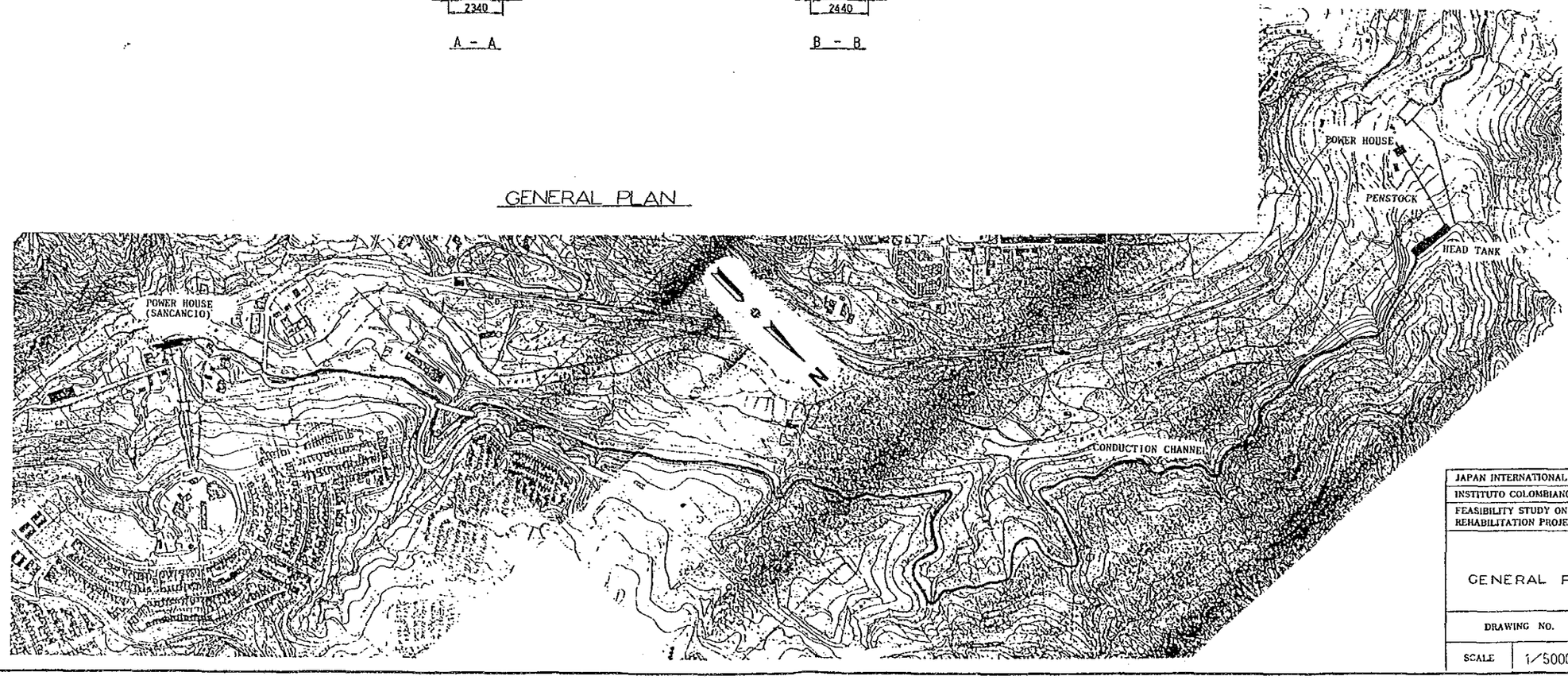
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
ONE LINE DIAGRAM *San Cancio*	
DRAWING NO.	SC-E-01
SCALE —	DATE



SECTION OF CHANNEL (S=1/100)

(NEW CONDUCTION CHANNEL)

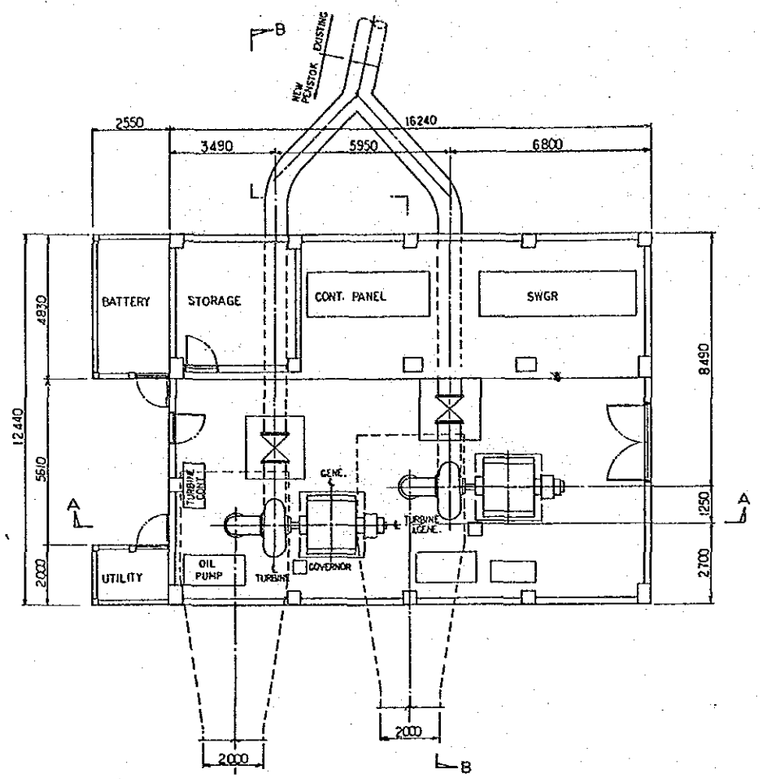
GENERAL PLAN

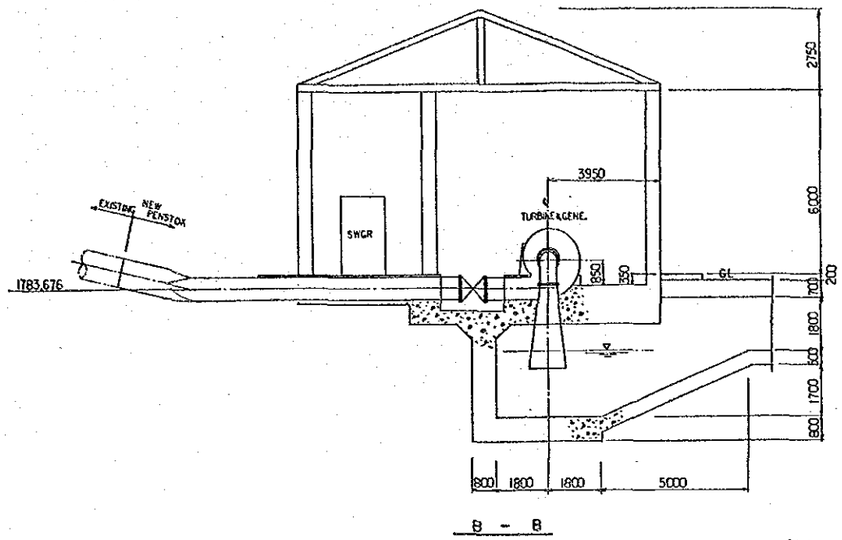


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
GENERAL PLAN AND PROFILE			
DRAWING NO.		IN-C-01	
SCALE	1/5000	DATE	

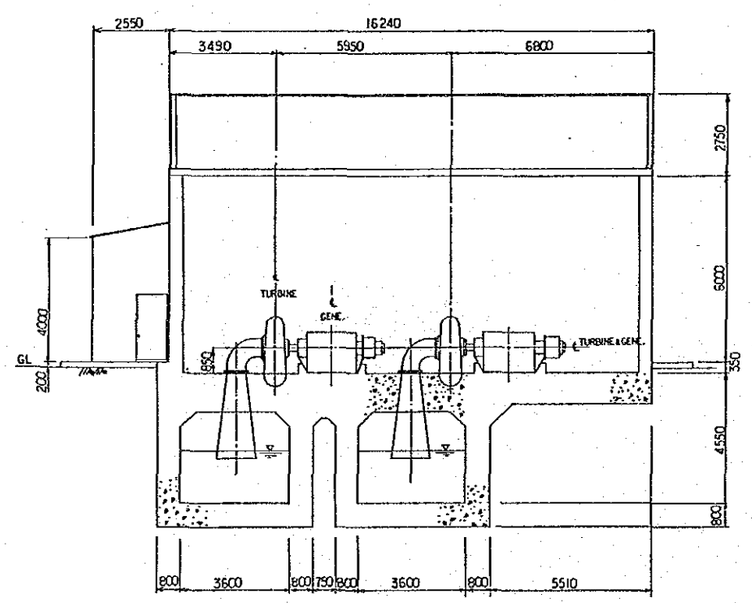
POWERHOUSE & TAILRACE

PLAN (S=1/100)





B – B

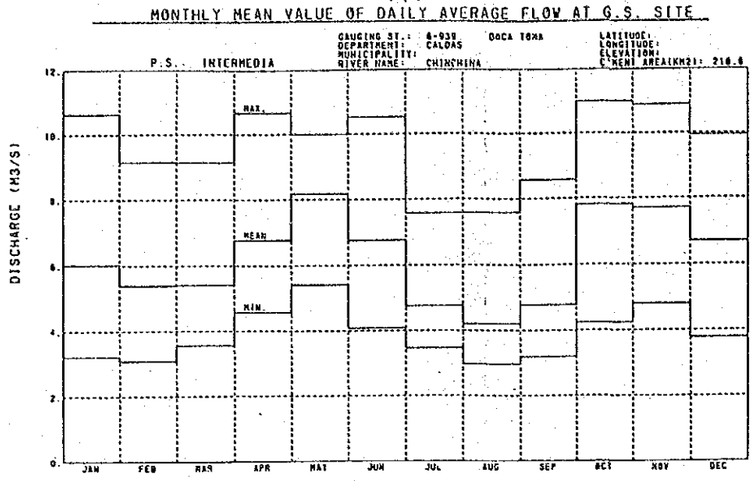


A – A

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS *REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA*			
POWERHOUSE AND TAILRACE			
DRAWING NO.	IN-C-02		
SCALE	1/100	DATE	

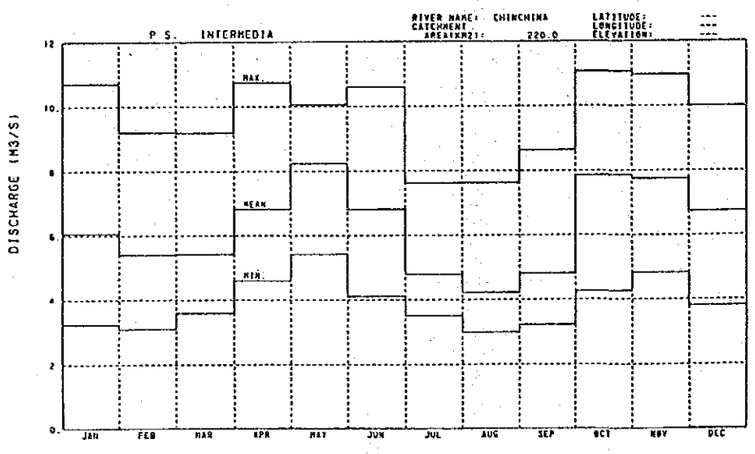
(1)

MONTHLY MEAN VALUE OF DAILY AVERAGE FLOW AT G.S. SITE



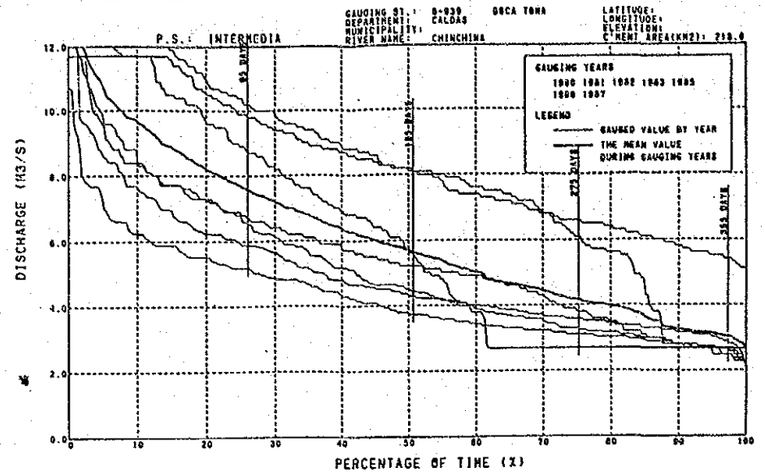
(2)

MONTHLY MEAN VALUE OF DAILY AVERAGE FLOW AT INTAKE SITE



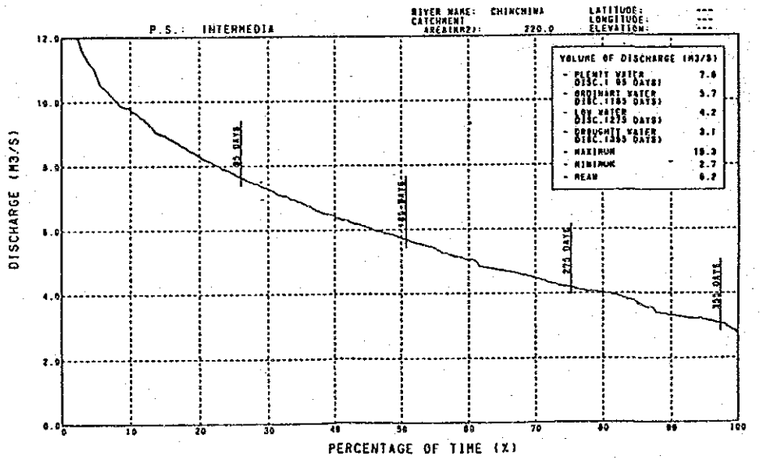
(3)

FLOW DURATION CURVE AT GAUGING STATION SITE



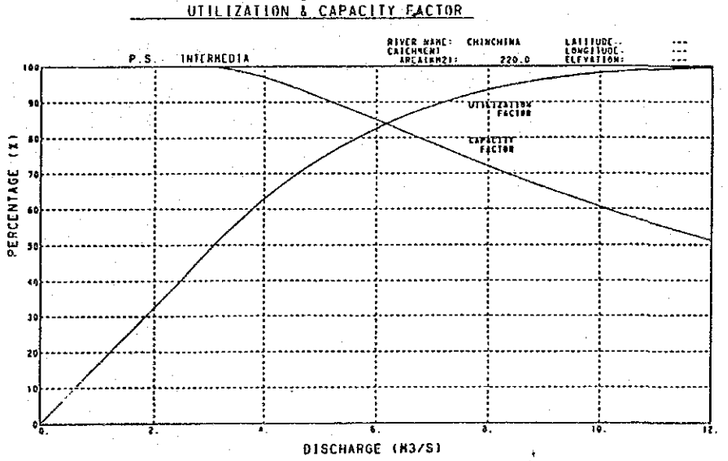
(4)

TYPICAL FLOW DURATION CURVE AT INTAKE SITE



(5)

UTILIZATION & CAPACITY FACTOR



Data of Hydrological Gauging Station

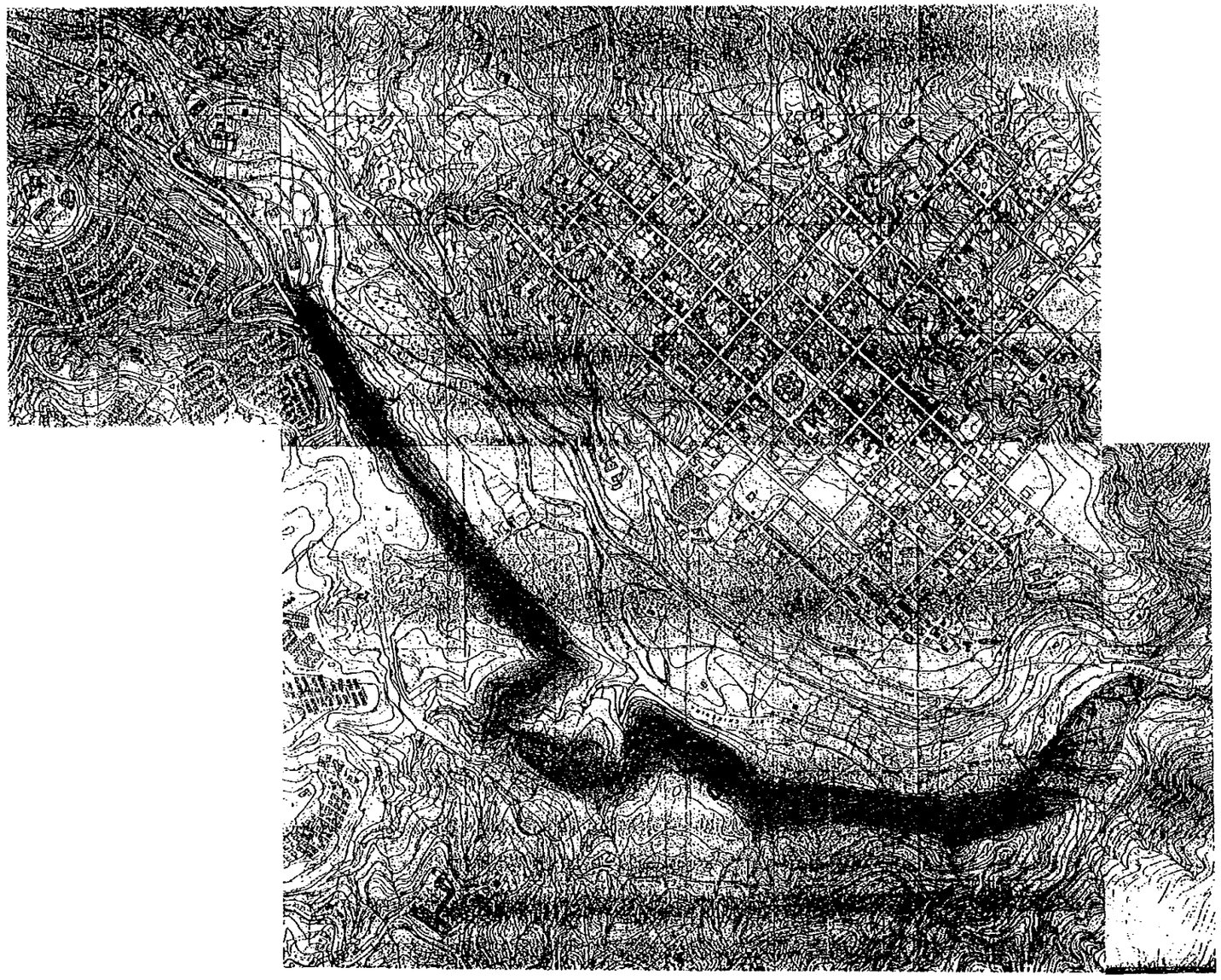
No. of Station	6 – 939
Name of Station	Bocatoma
River	Chinchina
Management	CHEC
Installation Year – Month	— —
Coordinates (Deg. – Min.)	
Latitude	— —
Longitude	— —
Above Sea Level s.n.m. (m)	— —
Long River (km)	— —
Catchment Area (km²)	— —
Water Shed (m)	— —
Observation Period	1979 – 1987

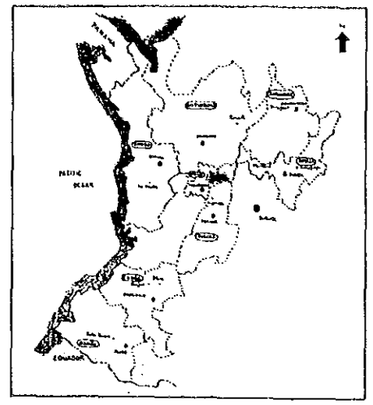
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA

DURATION CURVES

DRAWING NO.	IN – H – 01
SCALE ——	DATE

12-10

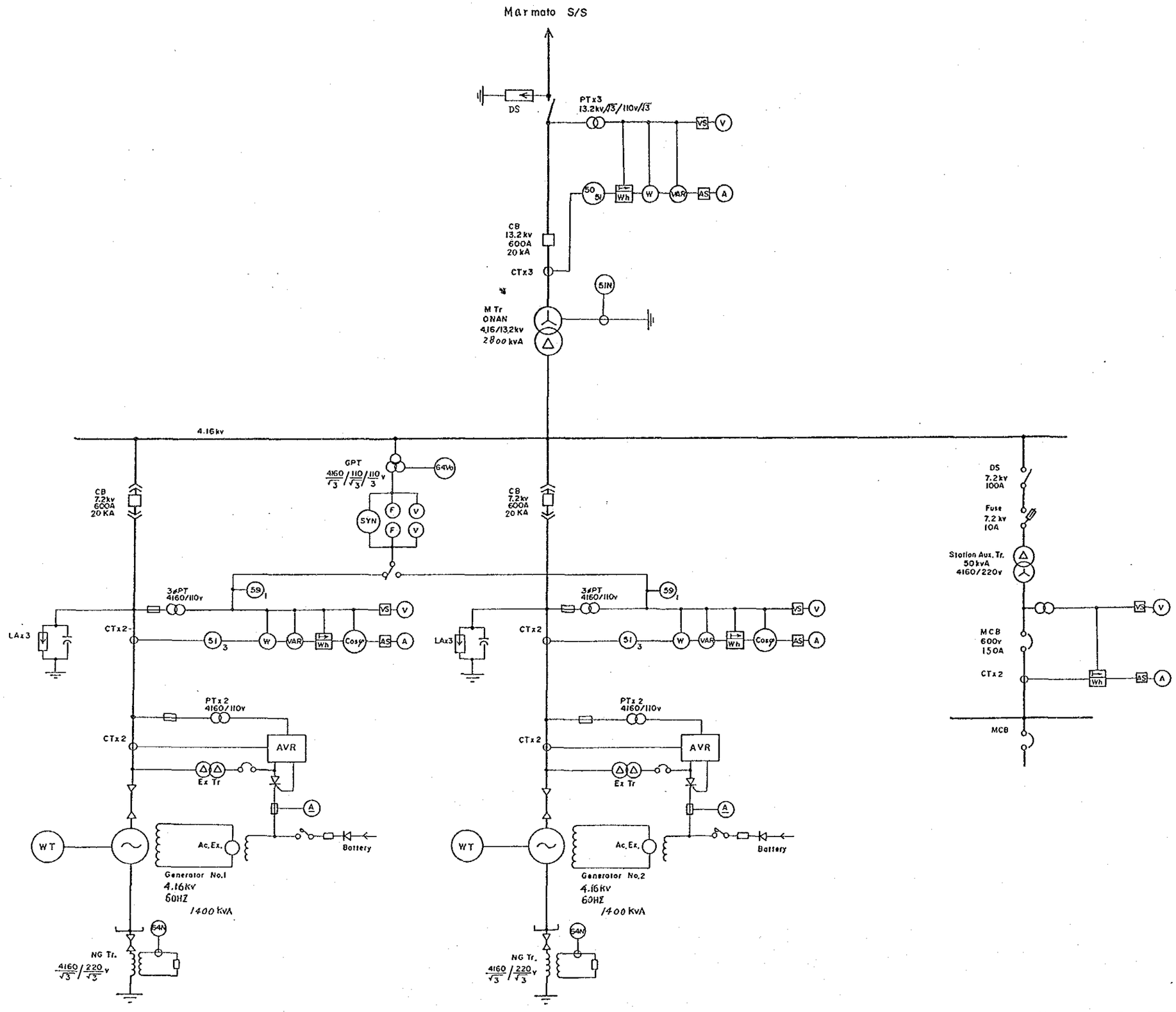




LEGEND

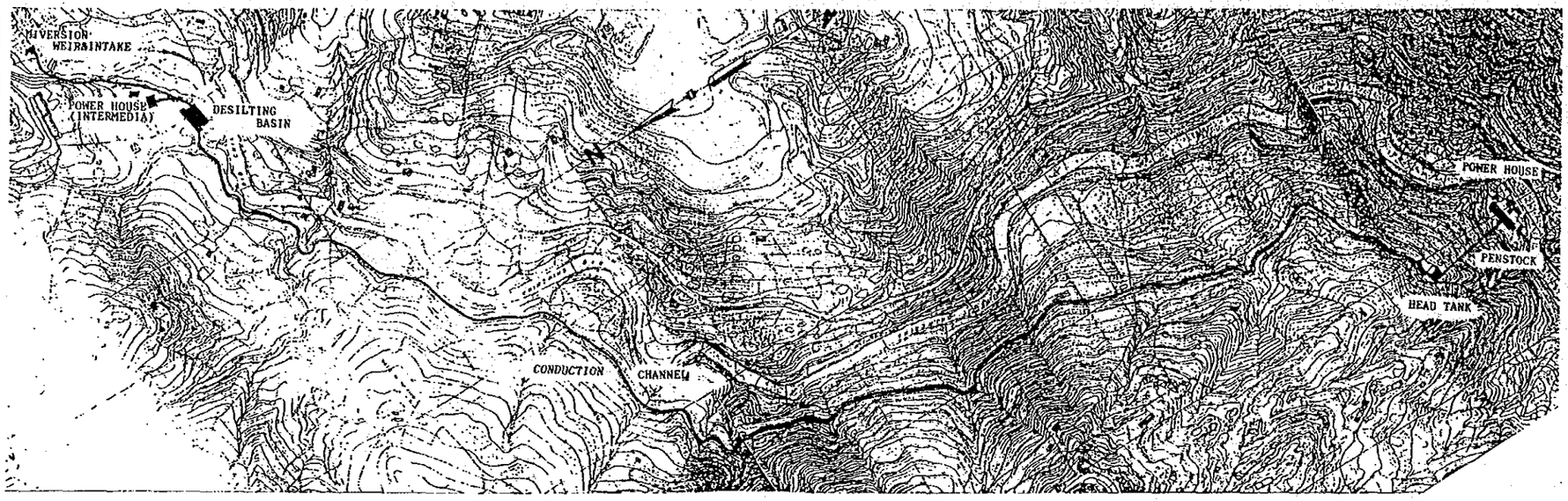
- River bed deposits
- Detritus
- Talus deposits
- Terrace deposits
- Old debris flow deposits
- Geological boundary
- Collapse

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
Geological Plan Intermedia	
DRAWING NO.	IN-G-01
SCALE 1/9,300	DATE

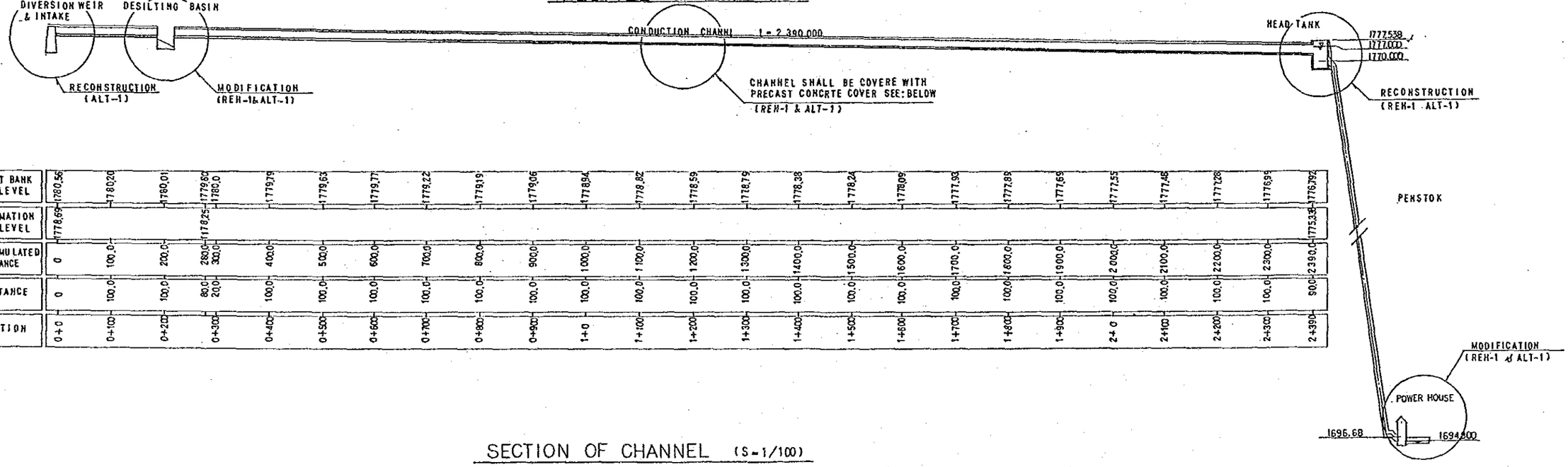


JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
ONE LINE DIAGRAM *Intermedia*			
DRAWING NO.	IN-E-01		
SCALE	—	DATE	

GENERAL PLAN (S=1/4000)

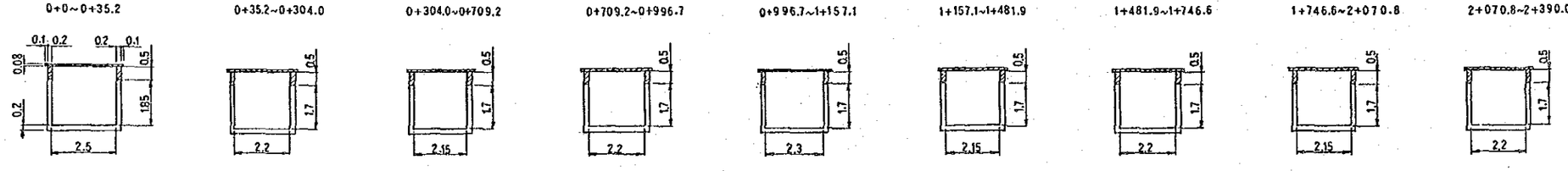


PLOFILE (H=1/4000,V=1/400)



LEFT BANK LEVEL	1780.56	1780.20	1780.01	1779.80	1780.0	1779.79	1779.63	1779.77	1779.22	1779.19	1779.06	1778.94	1778.82	1778.59	1778.79	1778.38	1778.24	1778.09	1777.93	1777.89	1777.69	1777.55	1777.46	1777.28	1776.99	1776.792
FORMATION LEVEL	1778.69			1778.25																		1775.38				
ACCUMULATED DISTANCE	0	100.0	200.0	280.0	300.0	400.0	500.0	600.0	700.0	800.0	900.0	1000.0	1100.0	1200.0	1300.0	1400.0	1500.0	1600.0	1700.0	1800.0	1900.0	2000.0	2100.0	2200.0	2300.0	2390.0
DISTANCE	0	100.0	100.0	80.0	20.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	90.0
STATION	0+0	0+100	0+200	0+300		0+400	0+500	0+600	0+700	0+800	0+900	1+0	1+100	1+200	1+300	1+400	1+500	1+600	1+700	1+800	1+900	2+0	2+100	2+200	2+300	2+390

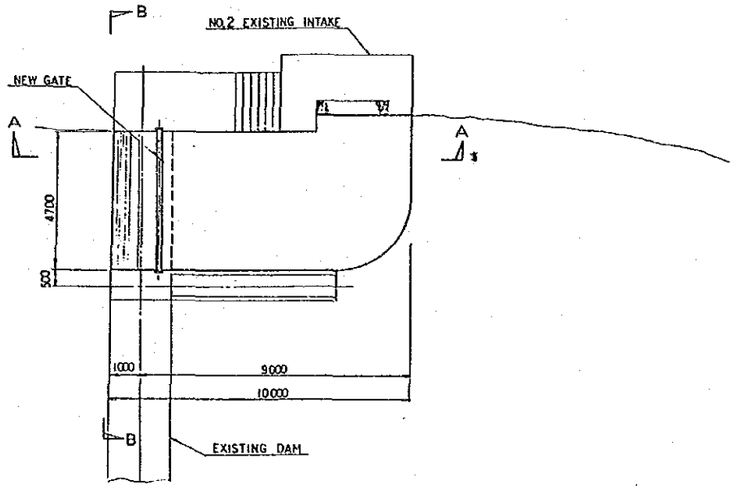
SECTION OF CHANNEL (S=1/100)



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
GENERAL PLAN AND PROFILE(ALT-2)	
DRAWING NO.	MU-C-01
SCALE 1/4000	DATE

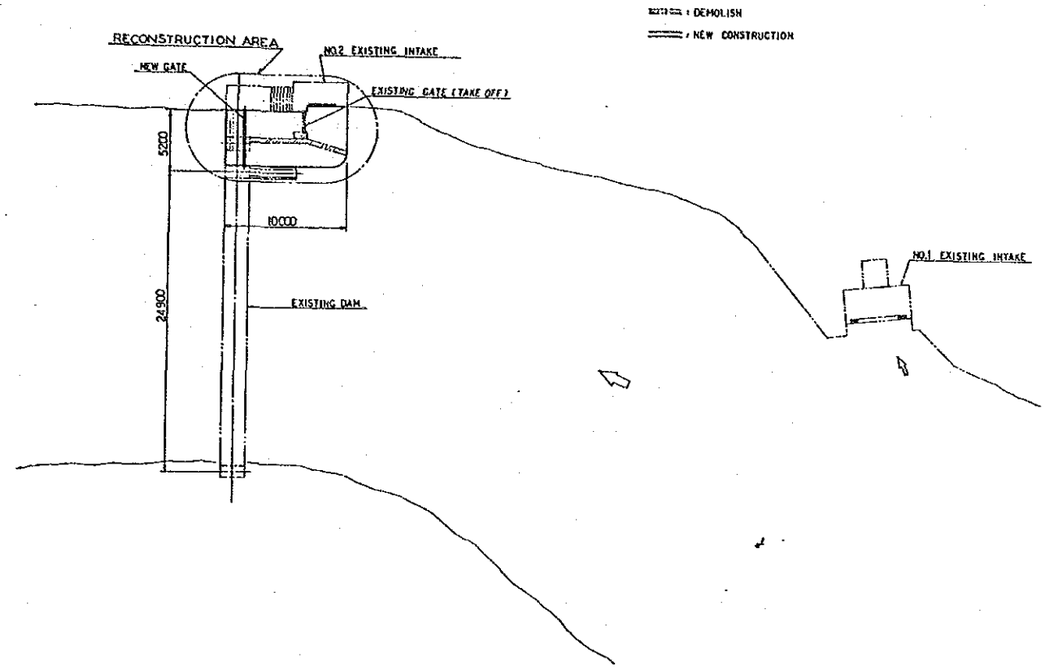
DIVERSION WEIR & INTAKE

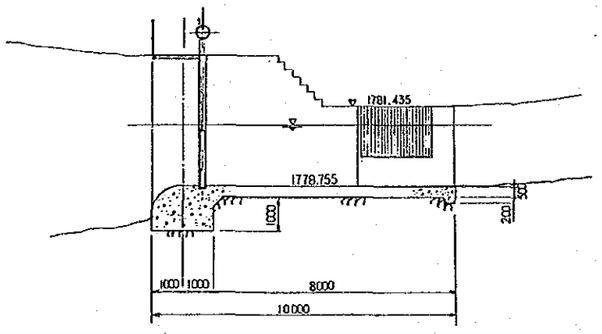
PLAN (S=1/100)



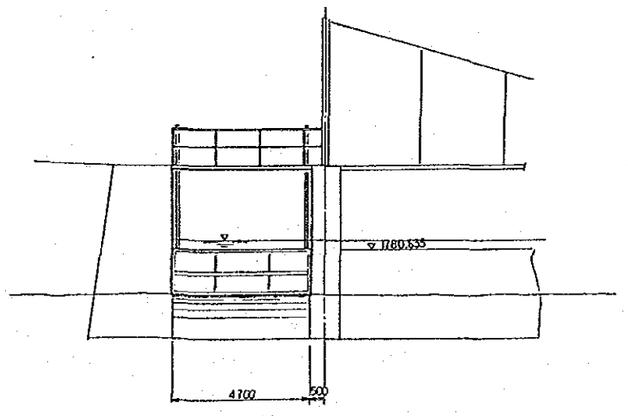
LOCATION OF RECONSTRUCTION AREA

(S = 1/250)





A – A

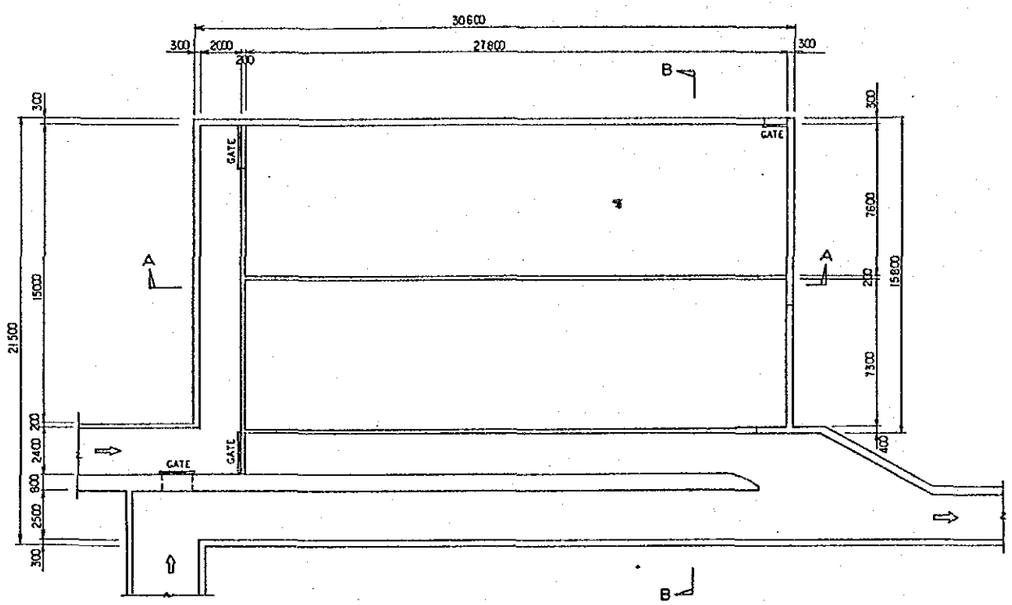


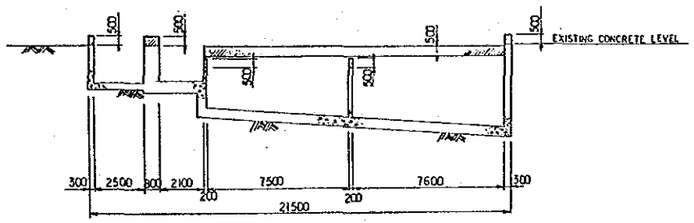
B – B

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
DIVERSION WEIR AND INTAKE (ALT-2)			
DRAWING NO.	MU-C-02		
SCALE	1/100	DATE	

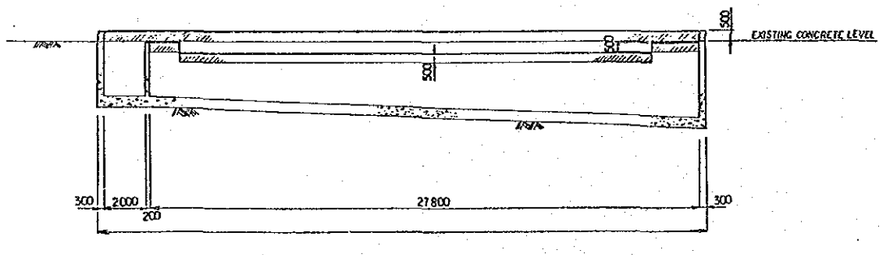
DESILTING BASIN

PLAN (S=1/150)





B — B



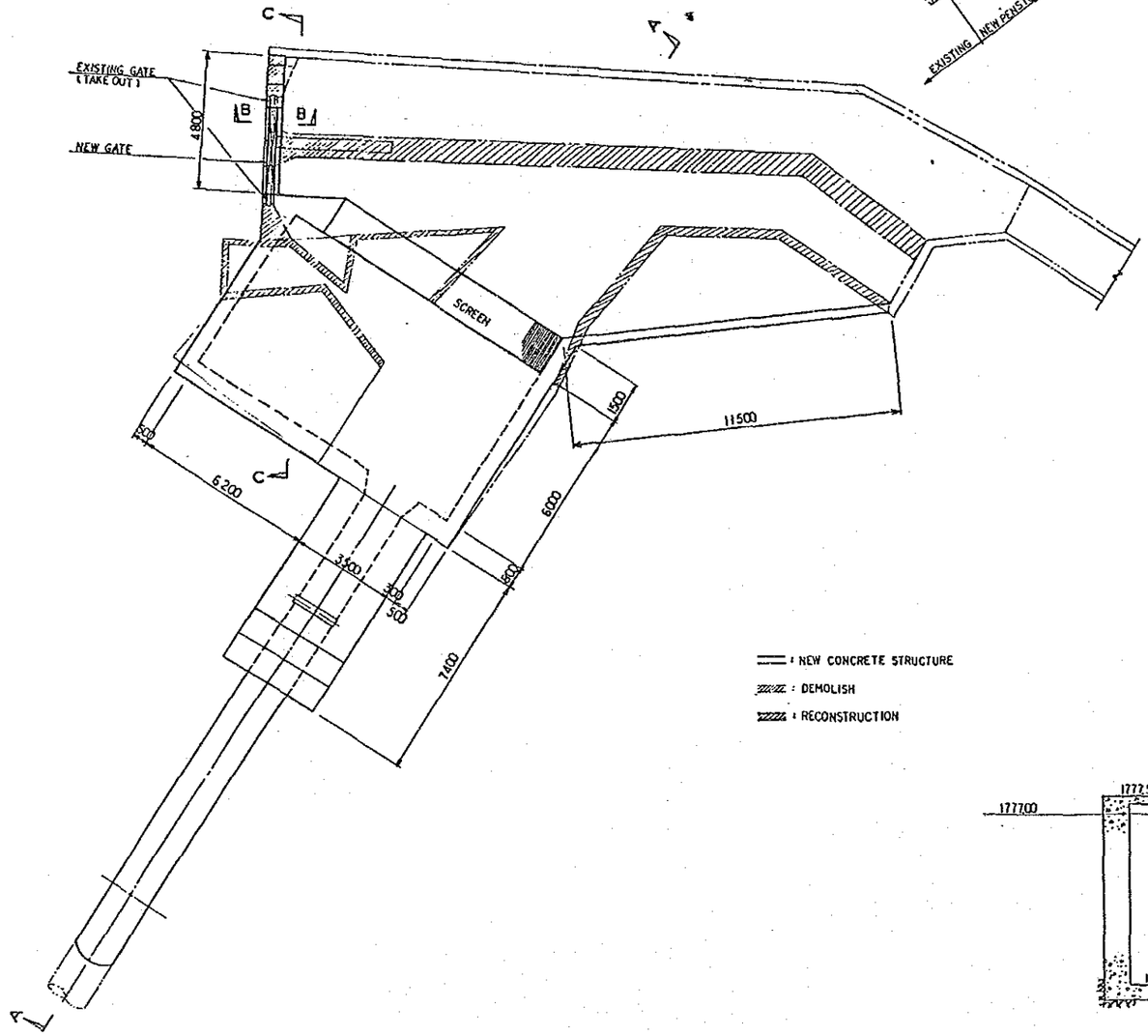
A — A

▨ : WITH CONCRETE RAISED

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
DESILTING BASIN (ALT-2)			
DRAWING NO.	MU-C-03		
SCALE	1/150	DATE	

HEAD TANK

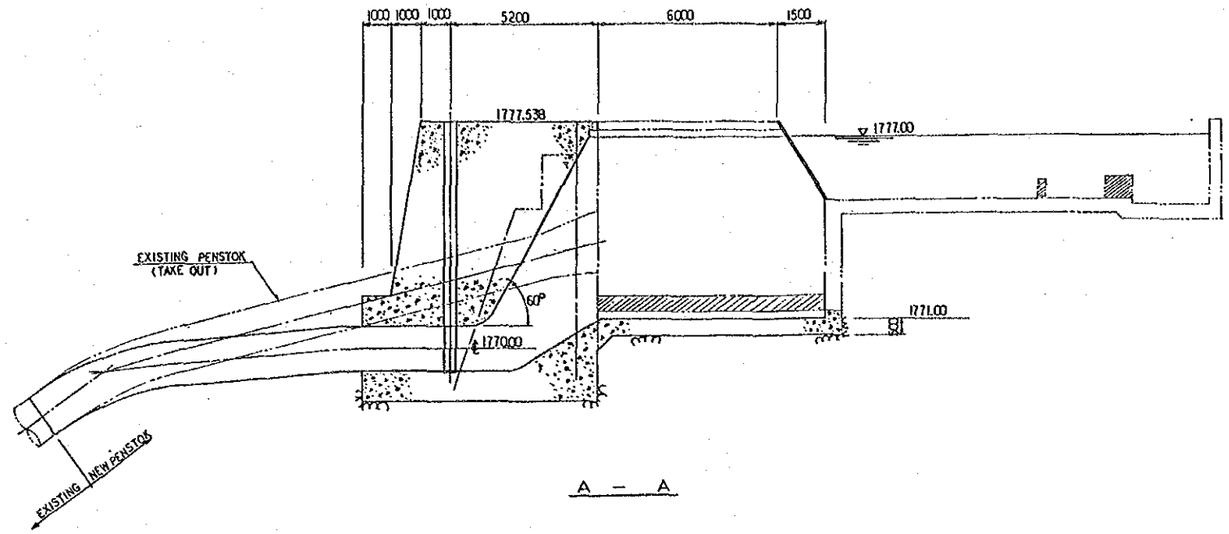
PLAN (S = 1/100)



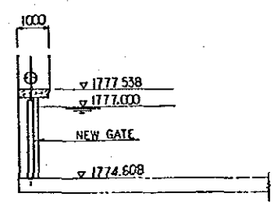
: NEW CONCRETE STRUCTURE

: DEMOLISH

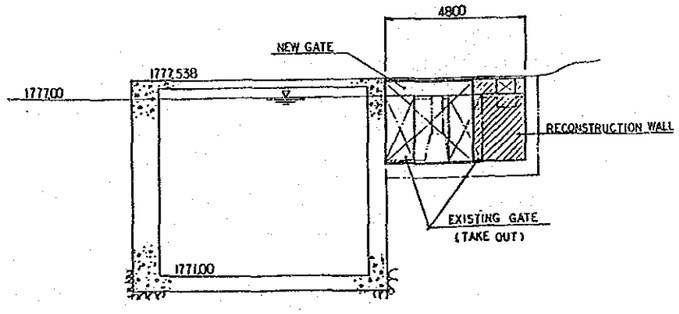
: RECONSTRUCTION



A — A



B — B

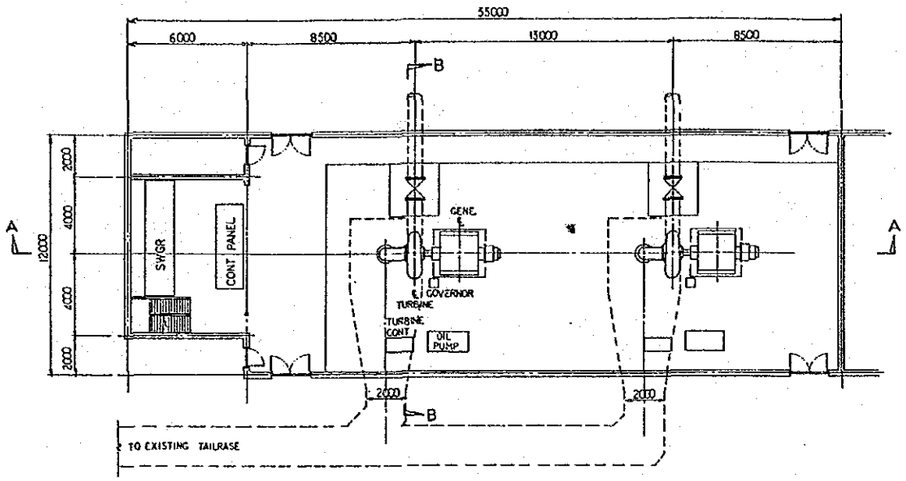


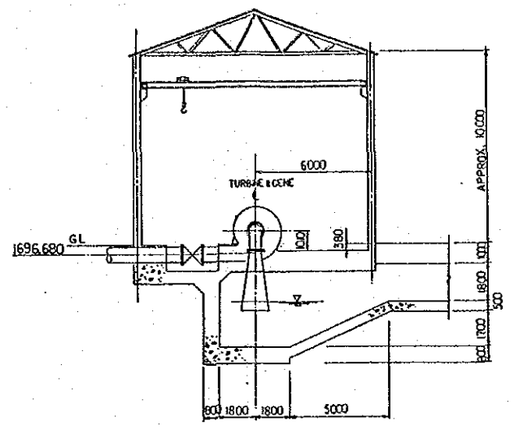
C — C

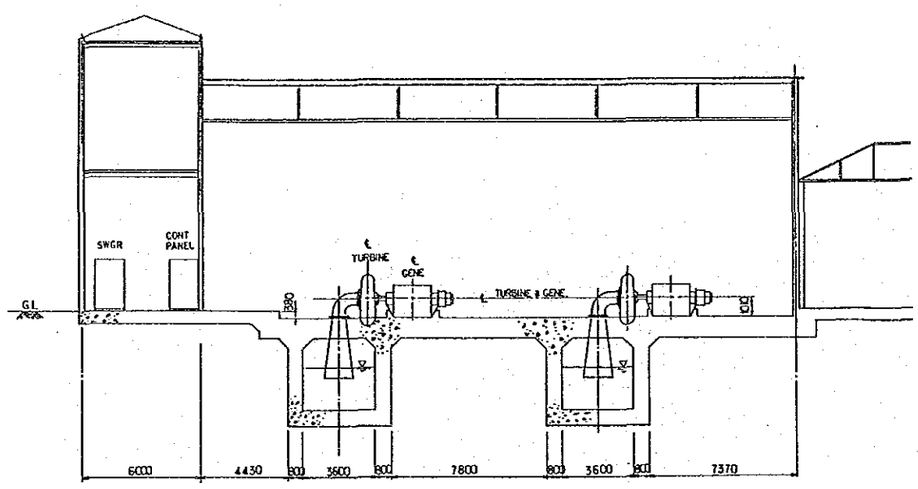
JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
HEAD TANK (ALT-2)			
DRAWING NO.		MU-C-04	
SCALE	1/100	DATE	

POWERHOUSE & TAILRACE

PLAN (S=1/150)





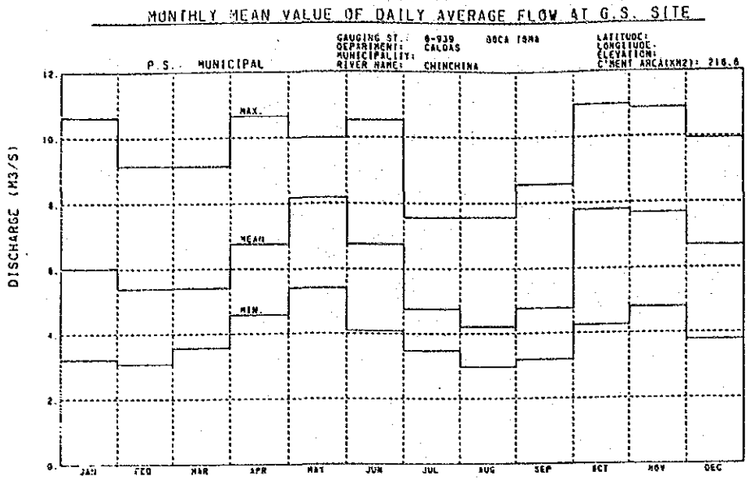


A — A

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)	
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)	
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA	
POWERHOUSE AND TAILRACE (ALT-2)	
DRAWING NO.	MU-C-05
SCALE 1/150	DATE

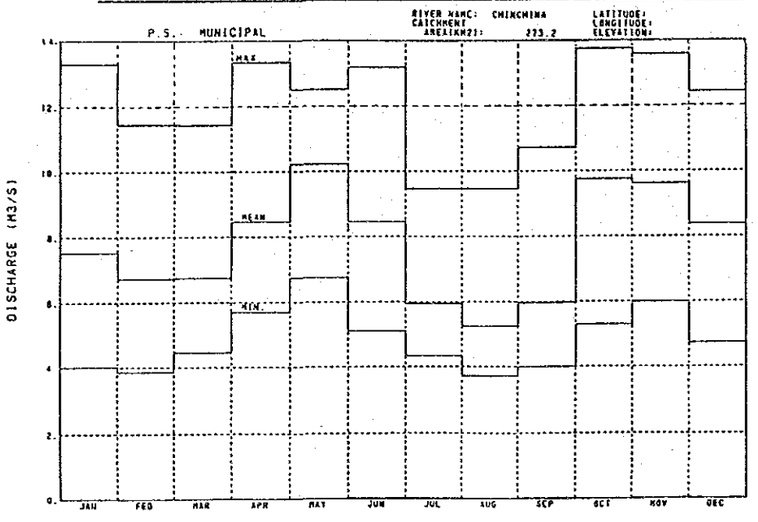
(1)

MONTHLY MEAN VALUE OF DAILY AVERAGE FLOW AT G.S. SITE



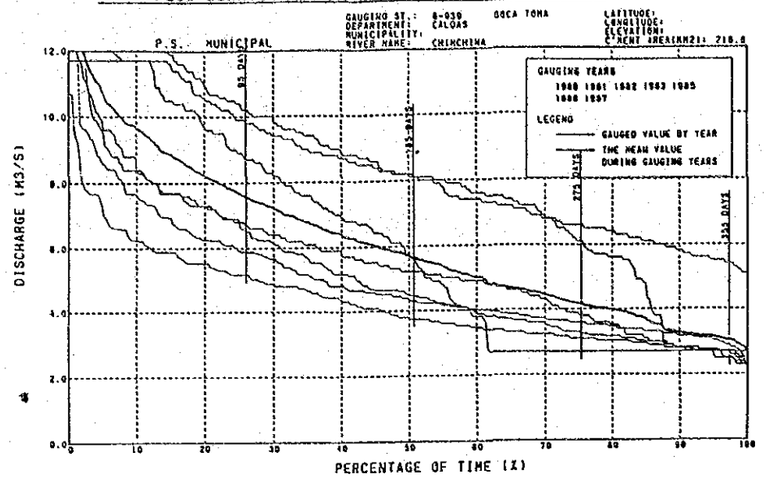
(2)

MONTHLY MEAN VALUE OF DAILY AVERAGE FLOW AT INTAKE SITE



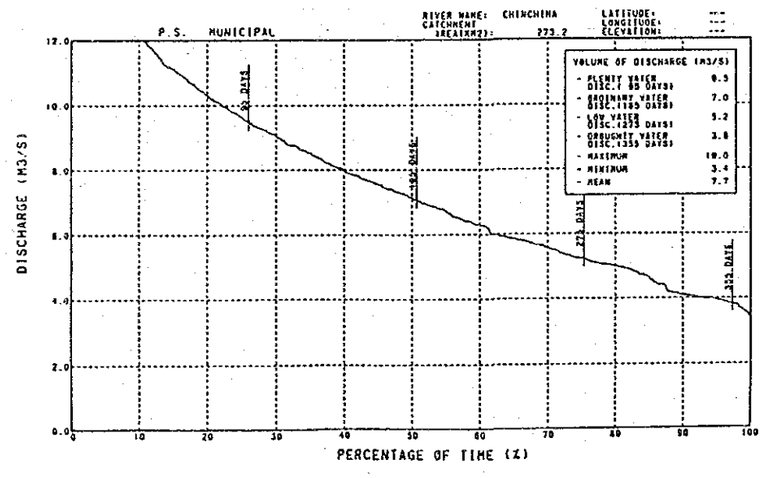
(3)

FLOW DURATION CURVE AT GAUGING STATION SITE



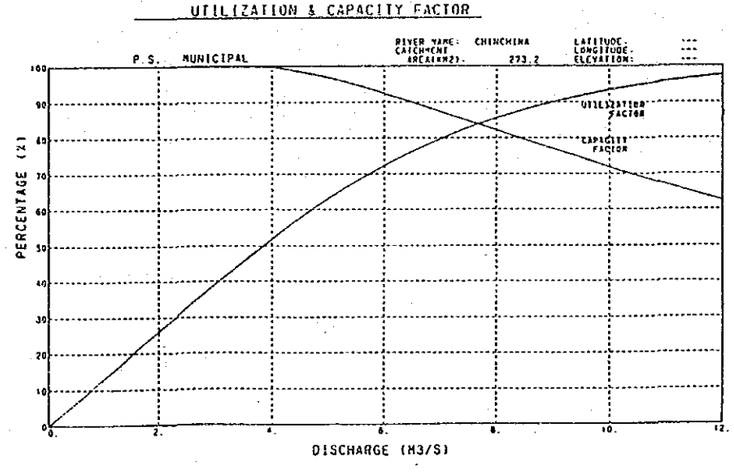
(4)

TYPICAL FLOW DURATION CURVE AT INTAKE SITE



(5)

UTILIZATION & CAPACITY FACTOR



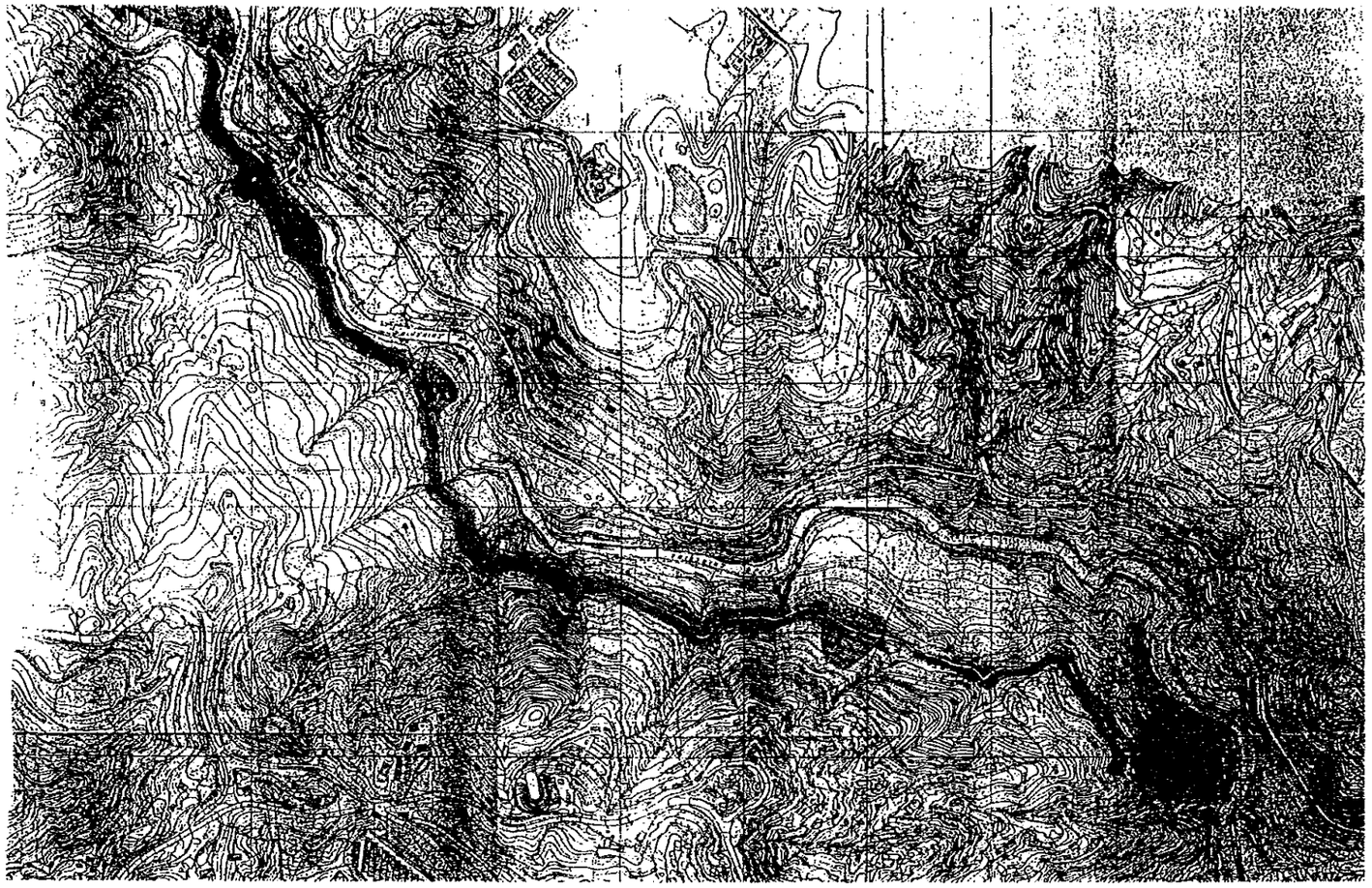
Data of Hydrological Gauging Station

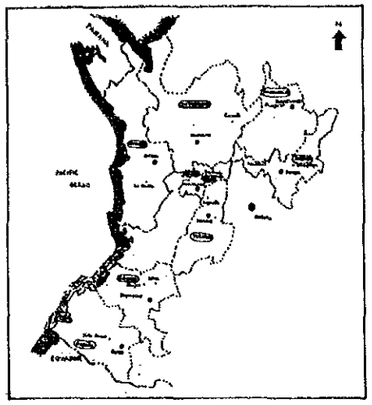
No. of Station	6 — 939
Name of Station	Bocatoma
River	Chinchina
Management	CHEC
Installation Year — Month	— —
Coordinates (Deg. — Min.)	
Latitude	— —
Longitude	
Above Sea Level s.n.m. (m)	— —
Long River (km)	— —
Catchment Area (km²)	— —
Water Shed (m)	— —
Observation Period	1979 — 1987

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA

DURATION CURVES

DRAWING NO.	MU — H — 01
SCALE ——	DATE





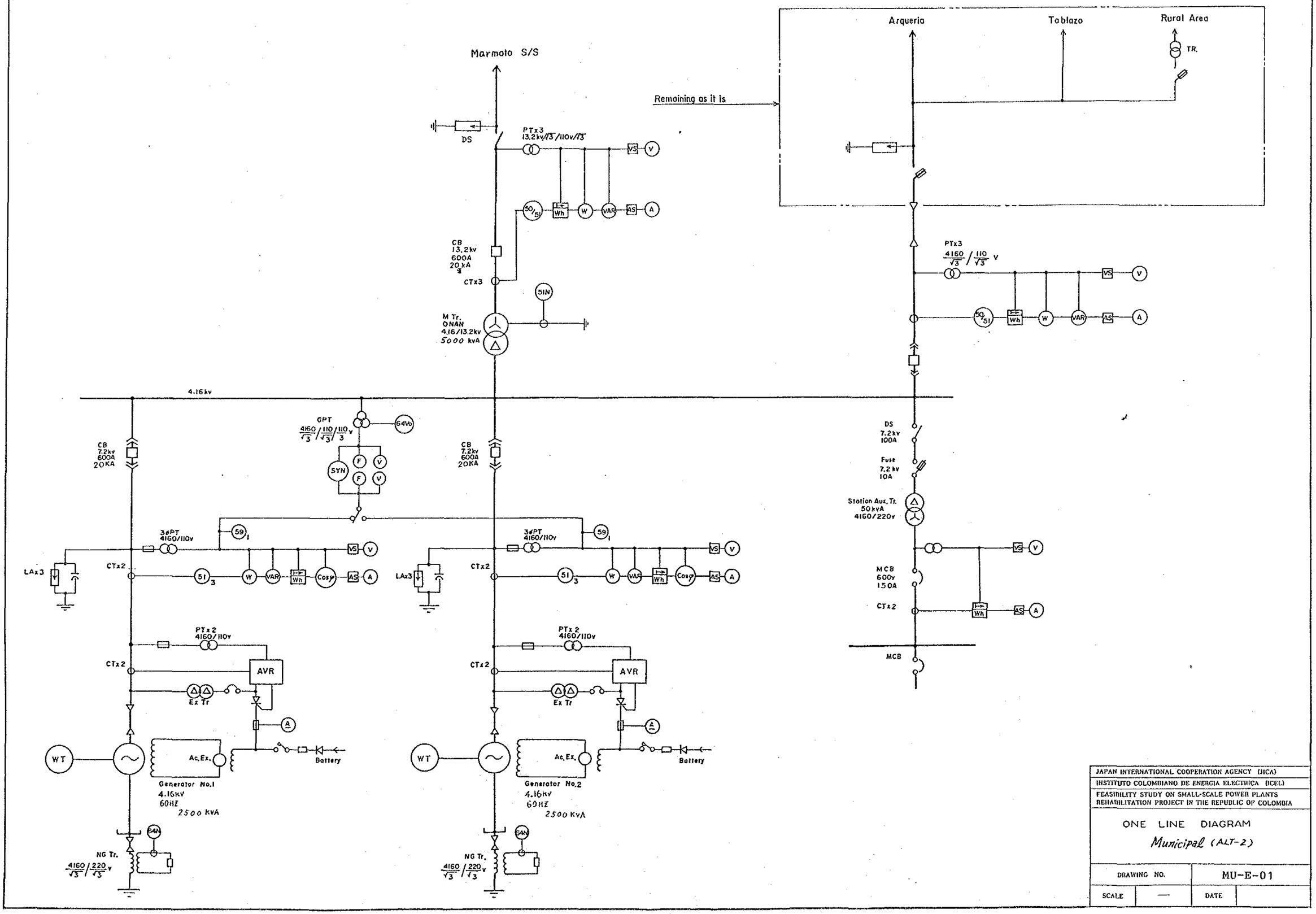
LEGEND

- River bed deposits
- Detritus
- Talus deposits
- Terrace deposits
- Old debris flow deposits
- Sandstone
- Crystalline schist
- Geological boundary
- Collapse

JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA

Geological Plan
Municipal

DRAWING NO.		MU-G-01	
SCALE	1/9,300	DATE	



JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)			
INSTITUTO COLOMBIANO DE ENERGIA ELECTRICA (ICEL)			
FEASIBILITY STUDY ON SMALL-SCALE POWER PLANTS REHABILITATION PROJECT IN THE REPUBLIC OF COLOMBIA			
ONE LINE DIAGRAM *Municipal (ALT-2)*			
DRAWING NO.		MU-E-01	
SCALE	—	DATE	

Attached Data

1. Facility Register for the Existing Power Plant

2. Survey Record

Facility Register for the Existing Power Plant

Power Plant	San Cancio
Electric Power Company	CHEC
Location	Manizales/Caldas
River	Chinchina
Generating Method	Run-of-River
Year Installed	1929/1947
Years in Service	
Installed Capacity	2,320 kW
Available Capacity	1,750 kW

Civil

Item	Data		
1. Dam			
1) Type	concrete, gravity		
2) Height (m)	1912.06 ~ 1908.51 3.55		
3) Crest length (m)	17.7		
4) Height of overflowing crest (m)	1912.06		
5) Width of overflowing crest (m)	9.8		
6) Depth of overflowing crest (m)	no data available		
2. Intake Gate			
1) Type	sluice		
2) Number of gates	2		
3) Dimensions (W x H)(m)	no data available		
3. Intake			
1) Intake sill height (m)	1,910.02		
2) Number of intake	2		
3) Dimensions (W x H)(m)	1.9 x 1.3 3.4 x 2.4		
4. Desilting Basin		No.1	No.2
1) Dimensions (W x L x H)(m)		9.9 x 43.1 x 2.7	14.2 x 21.8 x 5.1
5. Sand Trap Gate			
1) Type		sluice	sluice
2) Number of gates		1	1
3) Dimensions (W x H)(m)		1.2 x 1.2	1.6 x 1.2
6. Headrace			
1) Type	open channel		
2) Dimensions (W x H)(m)	average 1.6 x 1.7		
3) Length (m)	2,363		

Civil	
Item	Data
7. Reservoir Tank	
1) Dimensions (W x L x H)(m)	4.8 x 29.8 x 5.8
8. Forebay	
1) Dimensions (W x H)(m)	no data available
9. Penstock	
1) Number of lines	1
2) Penstock diameter (d)(m)	12.4
3) Penstock length (L)(m)	231.209
10. Tailrace	
1) Dimensions (W x H)(m)	no data available

Equipment		
Item	Data	
	# 2	# 1
1. Water Turbine		
1) Manufacturer's name	Leffel	Voith
2) Year manufactured	1947	1929
3) Type	Francis	Pelton
4) Output (KW)	1,800FHP	1,609 HP
5) Revolution (rpm)	600	257
6) Ancillary equipment		
a) Type of governor	Mechanical Hydraulic	Mechanical Hydraulic
b) Inlet valve		
- Type	Gate	Gate
- Diameter (mm)	1,240	1,240
2. Generator and Exciter		
1) Manufacturer's name	GE	Siemens
2) Year manufactured	1947	1929
3) Type	Synchro.	Synchro.
4) Capacity (kVA)	1,500	1,400
5) Power factor (%)	80	80
6) Voltage (V)	4,160	4,000
7) Frequency (Hz)	60	60
8) Revolution (rpm)	600	257
9) Method of neutral earthing	direct	direct
10) Type of exciter	no data available	

Equipment	
Item	Data
3. Transformer	
1) Manufacturer's name	N/A
2) Year manufactured	
3) Type	
4) Capacity (kVA)	
5) Primary voltage (kV)	
6) Secondary voltage (kV)	
7) Number of unit	
8) Vector-group symbol	
9) Impedance (%)	
10) Purpose for use	
4. Circuit Breaker	
1) Manufacturer's name	no data available
2) Year manufactured	
3) Type	
4) Voltage (kV)	
5) Rated current (A)	
6) Rupturing capacity (kA)	
7) Purpose for use	
5. Transmission Line	
1) Destination	Marmato S/S
2) Length (m)	no data available
3) Voltage (kV)	4.16
4) Number of circuit	1
5) Number of pylons	no data available
6) Size of conductors	〃
7) Materials of conductors	〃

Equipment	
Item	Data
6. Battery	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Capacity (AH/HR)	
4) DC voltage (V)	
5) Type	
7. Battery Charger	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Capacity	
4) Incoming voltage (V)	
8. Overhead Crane	
1) Weight (ton)	15
2) Method of operation	Manual
3) Span (m)	*no data available*

Facility Register for the Existing Power Plant

Power Plant	Intermedia
Electric Power Company	CHEC
Location	Manizales/Caldas
River	Chinchina
Generating Method	Run-of-River
Year Installed	1947
Years in Service	1947
Installed Capacity	1,120 kW
Available Capacity	900 kW

Civil

Item	Data
1. Dam	N/A
1) Type	
2) Height (m)	
3) Crest length (m)	
4) Height of overflowing crest (m)	
5) Width of overflowing crest (m)	
6) Depth of overflowing crest (m)	
2. Intake Gate	N/A
1) Type	
2) Number of gates	
3) Dimensions (W x H)(m)	
3. Intake	N/A
1) Intake sill height (m)	
2) Number of intake	
3) Dimensions (W x H)(m)	
4. Desilting Basin	N/A
1) Dimensions (W x L x H)(m)	
5. Sand Trap Gate	N/A
1) Type	
2) Number of gates	
3) Dimensions (W x H)(m)	
6. Headrace	
1) Type	*open ditch (no linning)*
2) Dimensions (W x H)(m)	*average 2.80 x 1.60*
3) Length (m)	*3,140*

Civil	
Item	Data
7. Reservoir Tank	
1) Dimensions (W x L x H)(m)	7.9 x 72.1 x 4.5
8. Forebay	
1) Dimensions (W x H)(m)	N/A
9. Penstock	
1) Number of lines	1
2) Penstock diameter (d)(m)	1.24
3) Penstock length (L)(m)	153.533
10. Tailrace	
1) Dimensions (W x H)(m)	N/A

Equipment	
Item	Data
1. Water Turbine	
1) Manufacturer's name	Voith
2) Year manufactured	1935
3) Type	Pelton
4) Output (kW)	1,120
5) Revolution (rpm)	257
6) Ancillary equipment	
a) Type of governor	Mechanical Hydraulic
b) Inlet valve	
- Type	Gate
- Diameter (mm)	1,240
2. Generator and Exciter	
1) Manufacturer's name	Siemens
2) Year manufactured	1935
3) Type	Synchro.
4) Capacity (kVA)	1,400
5) Power factor (%)	80
6) Voltage (V)	4,000
7) Frequency (Hz)	60
8) Revolution (rpm)	257
9) Method of neutral earthing	direct
10) Type of exciter	no data available

Equipment	
Item	Data
3. Transformer	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Type	
4) Capacity (kVA)	
5) Primary voltage (kV)	
6) Secondary voltage (kV)	
7) Number of unit	
8) Vector-group symbol	
9) Impedance (%)	
10) Purpose for use	
4. Circuit Breaker	no data available
1) Manufacturer's name	
2) Year manufactured	
3) Type	
4) Voltage (kV)	
5) Rated current (A)	
6) Rupturing capacity (kA)	
7) Purpose for use	
5. Transmission Line	
1) Destination	Marmato S/S
2) Length (m)	no data available
3) Voltage (kV)	4.16
4) Number of circuit	1
5) Number of pylons	no data available
6) Size of conductors	〃
7) Materials of conductors	〃

Equipment	
Item	Data
6. Battery	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Capacity (AH/HR)	
4) DC voltage (V)	
5) Type	
7. Battery Charger	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Capacity	
4) Incoming voltage (V)	
8. Overhead Crane	
1) Weight (ton)	15
2) Method of operation	Manual
3) Span (m)	no data available

Facility Register for the Existing Power Plant

Power Plant	Municipal
Electric Power Company	CHEC
Location	Manizales/Caldas
River	Chinchina
Generating Method	Run-of-River
Year Installed	1945
Years in Service	1945
Installed Capacity	2,112 kW
Available Capacity	1,400 kW

Civil

Item	Data
1. Dam	
1) Type	concrete, gravity
2) Height (m)	2.5
3) Crest length (m)	34.0
4) Height of overflowing crest (m)	1,781.798
5) Width of overflowing crest (m)	21.25
6) Depth of overflowing crest (m)	no data available
2. Intake Gate	N/A
1) Type	
2) Number of gates	
3) Dimensions (W x H)(m)	
3. Intake	
1) Intake sill height (m)	1,779.548
2) Number of intake	2
3) Dimensions (W x H)(m)	5.4 x 2.8 2.3 x 1.7
4. Desilting Basin	
1) Dimensions (W x L x H)(m)	17.6 x 30.6 x 4.6
5. Sand Trap Gate	
1) Type	Sluice
2) Number of gates	1
3) Dimensions (W x H)(m)	1.2 x 1.2
6. Headrace	
1) Type	open channel
2) Dimensions (W x H)(m)	2.20 x 1.70
3) Length (m)	2,390

Civil	
Item	Data
7. Reservoir Tank	
1) Dimensions (W x L x H)(m)	10 x 23 x 2.6
8. Forebay	N/A
1) Dimensions (W x H)(m)	
9. Penstock	
1) Number of lines	1
2) Penstock diameter (d)(m)	1.52
3) Penstock length (L)(m)	157.83
10. Tailrace	
1) Dimensions (W x H)(m)	no data available

Equipment		
Item	Data	
	#1	#2
1. Water Turbine		
1) Manufacturer's name	no data available	
2) Year manufactured	1935	1935
3) Type	Pelton	Pelton
4) Output (kW)	1,769 HP	1,769 HP
5) Revolution (rpm)	360	360
6) Ancillary equipment		
a) Type of governor	Mechanical Hydraulic	Mechanical Hydraulic
b) Inlet valve		
- Type	Gate	Gate
- Diameter (mm)	1,520	1,520
2. Generator and Exciter		
1) Manufacturer's name	ASEA	ASEA
2) Year manufactured	1935	1935
3) Type	Synchro.	Synchro.
4) Capacity (kVA)	1,320	1,320
5) Power factor (%)	80	80
6) Voltage (V)	4,300	4,300
7) Frequency (Hz)	60	60
8) Revolution (rpm)	360	360
9) Method of neutral earthing	direct	direct
10) Type of exciter	no data available	

Equipment	
Item	Data
3. Transformer	
1) Manufacturer's name	ASEA
2) Year manufactured	1945
3) Type	Outdoor, ONAN
4) Capacity (kVA)	900 x 3
5) Primary voltage (kV)	4.3
6) Secondary voltage (kV)	13.2
7) Number of unit	1
8) Vector-group symbol	D/Y
9) Impedance (%)	no data available
10) Purpose for use	Step-up
4. Circuit Breaker	
1) Manufacturer's name	ASEA
2) Year manufactured	
3) Type	OCB
4) Voltage (kV)	13.2
5) Rated current (A)	no data available
6) Rupturing capacity (kA)	〃
7) Purpose for use	transmission line
5. Transmission Line	
1) Destination	Marmato S/S
2) Length (m)	no data available
3) Voltage (kV)	13.2
4) Number of circuit	2
5) Number of pylons	no data available
6) Size of conductors	〃
7) Materials of conductors	〃

Equipment	
Item	Data
6. Battery	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Capacity (AH/HR)	
4) DC voltage (V)	
5) Type	
7. Battery Charger	N/A
1) Manufacturer's name	
2) Year manufactured	
3) Capacity	
4) Incoming voltage (V)	
8. Overhead Crane	
1) Weight (ton)	10
2) Method of operation	Manual
3) Span (m)	*no data available*

Survey Records

San Cancio Hydroelectric Power Plant

Date of Survey : 13～14 Feb. 1989

I. RECORDS BY VISUAL INSPECTION AND HEARING SURVEY

Unit No.: 1

Type of Turbine: Pelton

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Cover	1) Presence of vibration	1) Normal
	Bucket	1) Existence of corrosion	1) Corrosion : not existing Abrasion : existing
	Shaft	1) Shaking of shaft axis	1) No objection
	Bearing	1) Oil shortage on bearing surface	1) 〃
		2) Lack of oil viscosity	2) 〃
	Governor control	1) Control by belt-driven type 2) Speed detection device 3) Speed regulation system	1) Belt driven 2) Speeder 3) Manual
		4) Installation of load limiter	4) N/A
		5) Accuracy of governor speed regulation	5) Poor accuracy (low response)

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Oil pressure equipment	1) Existence of oil leakage	1) A little, but no objection to operation
		2) Application of oil pressure pumping system	2) Shaft driven
	Inlet valve	1) Operation method	1) Manual and motor (AC. 220v, 2.4HP) control by push button from control panel
		2) Locking condition	2) No objection
		3) Smoothness of pressurized oil operation	3) N/A
	Nozzle and Needle	1) Existence of corrosion	1) Corrosion : not existing Abrasion : existing
		2) Presence of water leakage from nozzle pipe when needle is closed	2) No objection
	Deflector	1) Smoothness of control	1) Operation is very hard due to manual operation.
	Jet Brake	1) Smoothness of control	1) N/A

Unit No. 1

Generating Facilities		Check item by visual inspection and hearing	Results
Generator for Pelton	Rotor	1) Discoloration of winding surface due to heat	1) No objection
		2) Existence of erosion for core	2) 〃
		3) Fitness of between rotor and shaft	3) 〃
	Stator winding	1) Frequency of burning trouble or repair	1) 〃
		2) Reduction of insulation resistance	2) Reducing due to being advanced in year:
		3) Rust and erosion of core	3) No objection
	Bearing	1) Occurrence of deformation on metal surface	1) Repair work has been done every 2 years
		2) Lack of oil lubrication	2) No objection
		3) Occurrence of temperature rise	3) 〃
	Exciter	1) Exchange frequency of brushes worn out	1) Every 2 months
		2) Sufficient stock of spare brush	2) Sufficient
	Voltage regulator	1) Operation method of voltage regulator	1) Manual (control panel)
		2) Response of voltage detection for load variation	2) Voltage is always regulated by operate

Unit No.: 2

Type of Turbine: Francis

	Generating Facilities	Check item by visual inspection and hearing	Results
Francis Turbine	Casing	1) Existence of corrosion	1) No objection (interior was painted)
		2) Wear in thickness	2) 〃 (measured by ultra-sonic)
		3) Presence of vibration	3) 〃
	Runner	1) Existence of corrosion	1) a little (due to cavitation)
		2) Occurrence of porosity by sand pitting	2) 〃 (〃)
	Shaft	1) Shaking of shaft axis	1) No objection
	Bearing	1) Oil shortage on bearing surface	1) 〃
		2) Lack of oil viscosity	2) 〃
	Governor control	1) Control by belt-driven type	1) motor
		2) Speed detection device	2) speeder
		3) Speed regulation system	3) automatic
		4) Installation of load limiter	4) N/A
		5) Accuracy of governor speed regulation	5) not so good (low response)

Generating Facilities		Check item by visual inspection and hearing	Results
Francis Turbine	Oil pressure equipment	1) Existence of oil leakage 2) Application of oil pressure pumping system	1) A little, but no objection to operation 2) Shaft driven for lubrication and cooling Motor driven for governor (A.C. 220V, 2HP)
	Inlet valve	1) Operation method 2) Locking condition 3) Smoothness of pressurized oil operation	1) Manual and motor 2) No objection 3) N/A
	Guide vanes	1) Smoothness of control 2) Presence of water leakage from casing when guide vanes are closed 3) Break frequency of shear pins	1) No objection 2) A little, but no objection to operation 3) 3 or 4 per year
	Sealing device	1) Sufficiency of water sealing for shaft 2) Sufficiency of packing for shaft seal	1) N/A 2) Sufficient (material : Teffron)

Unit No. 2

Generating Facilities		Check item by visual inspection and hearing	Results
Generator for Francis	Rotor	1) Discoloration of winding surface due to heat	1) No objection
		2) Existence of erosion for core	2) 〃
		3) Fitness of between rotor and shaft	3) 〃
	Stator winding	1) Frequency of burning trouble or repair	1) 〃
		2) Reduction of insulation resistance	2) Reducing due to being advanced in years.
		3) Rust and erosion of core	3) No objection
	Bearing	1) Occurrence of deformation on metal surface	1) Repaire work has been done every 2 years
		2) Lack of oil lubrication	2) No objection
		3) Occurrence of temperature rise	3) 〃
	Exciter	1) Exchange frequency of brushes worn out	1) Every 2 months
		2) Sufficient stock of spare brush	2) Sufficient
	Voltage regulator	1) Operation method of voltage regulator	1) Manual (control panel)
		2) Response of voltage detection for load variation	2) Voltage is always regulated by operator

Generating Facilities		Check item by visual inspection and hearing	Results
Control Board	Metering equipment	1) Sufficiency of accuracy for instruments	1) It is necessary to calibrate due to being advanced in years.
		2) Lack of necessary instruments	2) Sufficient
		3) Items constantly recorded	3) Gen.. : A, V, W, Wh, Hz, cosφ, Ex. : A, V Turbine Pressure , rpm
	Protection equipment	1) Lack of relays to be installed	1) Sufficient
		2) Operation method in case of accident in transmission lines	2) 52G is tripped by 50/51
	Remote control equipment	1) Control method for turbine and generator operation	1) Remote control panel is not provided.
		2) Control method for voltage and speed control	2) Voltage : manual (local control panel Speed : Francis – motor or manual Pelton – manual
		3) Operation method of synchronized switching	3) Manual
	Power system	1) Power supply voltage (kV) after rehabilitation work	1) 4.16 kV

Generating Facilities		Check item by visual inspection and hearing	Results
Indoor Switchgear	Insulation level	1) Sufficiency of insulation level 2) Unification of insulation level 3) Reduction of insulation registances	1) Sufficient (4.16Kv) 2) Unified (4.16Kv) 3) No objection
	Accessibility and Safety	1) Accessibility to high voltage devices	1) Safety
		2) Sufficiency of protection for high voltage cable terminals	2) Sufficient
		3) Method and reliability of operation for synchronizing circuit breaker	3) Manual It is reliable.

Generating Facilities		Check item by visual inspection and hearing	Results
Outdoor Equipment	Transformer	1) Presence of over load operation	1) N/A
	Circuit breaker	1) Situation of tripfor outgoing feeder breaker in case of accident on transmission line	1) 〃
		2) Fitness of maintenance in case of oil circuit breaker	2) 〃
	Line switch	1) Operation method	1) Manual
		2) Reliability of operation	2) It is not reliable.
	Insulator	1) Presence of damage and dusts	1) No objection
	Structural steel	1) Occurence of erosion due to rust	1) 〃
		2) Presence of injury	2) 〃
	Line protection	1) Existence of adequate protection relays to connect to RED	1) 50/51

II. ACTUAL GENERATED ENERGY AND OPERATION TIME

Unit No.: 1 and 2

Installed Capacity of Generator: _____ KVA

Type of Turbine: _____

MWH : Gross

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL	REMARKS
1983	MWH	911	569	543	898	1,102	964	548	448	503	489	775	1,031	8,781	
	OPE. TIME														
1984	MWH	1,050	566	539	643	712	702	753	731	913	1,112	434	1,047	9,202	
	OPE. TIME														
1985	MWH	837	623	789	936	998	973	647	864	925	898	371	586	9,447	
	OPE. TIME														
1986	MWH	598	705	985	921	975	971	871	565	581	927	1,033	780	9,912	
	OPE. TIME														
1987	MWH	618	541	376	563	838	701	632	647	570	747	820	428	7,481	
	OPE. TIME														
1988	MWH	274	332	477	551	614	746	1,040	696	387	456	415	207	6,175	
	OPE. TIME														

III. REPAIR RECORDS

No.	Study Item	Results
	The past records concerning the following items shall be obtained to evaluate reliability of generating facilities.	
	1) Repaired locations and method for repairing	Without available informations
	2) Causes for damage/defect	
	3) Duration of repairing and power supply stoppage	
	4) Repaired by;	
	a) staff in Power Plant	
	b) manufacturer	
	c) other	
	5) Repair cost	
	6) Operation life after the completion of repairing work	

IV . SITUATION OF STOCK SPARE PARTS

No.	Study Item	Results
	Data on the situation of stock spare parts shall be obtained to evaluate maintainability of generating facilities.	1) Following spare parts have been made in CHEC's repair shop. a. Backet for Pelton b. Needle " " c. Nozzle " " d. Sealing for valves e. Guide vane for Francis f. Bolts and nuts

V. CHEC's INTENTION FOR REHABILITATION

No.	Study Item	Results
	Make with √ in pertinent columns.	Leaving as it is / Repair work / Replacement / Notes
-	Inlet valve	Repair work: √ — Notes: ※-1 Change to ...
-	Turbine, governor, auxiliary equipment	Leaving as it is: Francis : √ — Replacement: Pelton = √ (change to Francis) — Notes: efficiency machi
-	Generator, exciter	※-2
-	Control panel	Repair work: √ — Notes: Only Calibration
-	Switchgear	Leaving as it is: √ — Notes: Good conditio
-	Transformer	N/A
-	Substation equipment (Circuit breaker, Isolator, etc.)	N/A
-	Transmission tower, conductor and insulator	Leaving as it is: √ — Notes: Good conditio
-	Power House	Repair work: √ — Notes: Depend on F/S
-	Penstock	Leaving as it is: √ — Notes: Already cha... 5 years ago.

※-1 : Change to full automatic (52G trip and Inlet valve is closed automatically.)

※-2 :

	Generator	Exciter
Francis	Stator winding should be change	Leaving as it is
Pelton	Replace	Replace

Survey Records

Intermedia Hydroelectric Power Plant

Date of Survey : 13 ~ 14 Feb. 1989

I. RECORDS BY VISUAL INSPECTION AND HEARING SURVEY

Unit No.: 1

Type of Turbine: Pelton

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Cover	1) Presence of vibration	1) Normal
	Bucket	1) Existence of corrosion	1) Corrosion : not existing Abrasion : a little existing
	Shaft	1) Shaking of shaft axis	1) No objection
	Bearing	1) Oil shortage on bearing surface	1) 〃
		2) Lack of oil viscosity	2) 〃
	Governor control	1) Control by belt-driven type	1) Belt driven
		2) Speed detection device	2) Speeder
		3) Speed regulation system	3) Manual
		4) Installation of load limiter	4) N/A
		5) Accuracy of governor speed regulation	5) poor accuracy (low response)

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Oil pressure equipment	1) Existence of oil leakage	1) A little, but no objection to operation.
		2) Application of oil pressure pumping system	2) Shaft driven
	Inlet valve	1) Operation method	1) Motor (A.C. 220V, 2.3KW), control from local control panel
		2) Locking condition	2) No objection
		3) Smoothness of pressurized oil operation	3) N/A
	Nozzle and Needle	1) Existence of corrosion	Corrosion : not existing 1) Abrasion : a little
		2) Presence of water leakage from nozzle pipe when needle is closed	2) No objection
	Deflector	1) Smoothness of control	1) No objection
	Jet Brake	1) Smoothness of control	1) N/A

Unit No. /

Generating Facilities		Check item by visual inspection and hearing	Results
Generator	Rotor	1) Discoloration of winding surface due to heat	1) No objection
		2) Existence of erosion for core	2) 〃
		3) Fitness of between rotor and shaft	3) 〃
	Stator winding	1) Frequency of burning trouble or repair	1) 〃
		2) Reduction of insulation resistance	2) Reducing due to being advanced in year.
		3) Rust and erosion of core	3) No objection
	Bearing	1) Occurrence of deformation on metal surface	1) Deformation is existing.
		2) Lack of oil lubrication	2) No objection
		3) Occurrence of temperature rise	3) 〃
	Exciter	1) Exchange frequency of brushes worn out	1) Every 2 months
		2) Sufficient stock of spare brush	2) Sufficient
	Voltage regulator	1) Operation method of voltage regulator	1) Manual
		2) Response of voltage detection for load variation	2) Voltage is always regulated by operator.

Generating Facilities		Check item by visual inspection and hearing	Results
Control Board	Metering equipment	1) Sufficiency of accuracy for instruments	1) Not so good
		2) Lack of necessary instruments	2) Sufficient
		3) Items constantly recorded	3) Gen.: A, V, W, Wh, Hz, cosφ Ex. : A, V Turbine speed, rpm
	Protection equipment	1) Lack of relays to be installed	1) Sufficient
		2) Operation method in case of accident in transmission lines	2) 52 G is tripped by 50/51
	Remote control equipment	1) Control method for turbine and generator operation	1) Remote control panel is not provided.
		2) Control method for voltage and speed control	2) Voltage : manual (local control panel) Speed : manual
		3) Operation method of synchronized switching	3) Manual
	Power system	1) Power supply voltage (kV) after rehabilitation work	1) 4.16 kV

Generating Facilities		Check item by visual inspection and hearing	Results
Indoor Switchgear	Insulation level	1) Sufficiency of insulation level 2) Unification of insulation level 3) Reduction of insulation registance	1) *Sufficient* 2) *Unified* 3) *No objection*
	Accessibility and Safety	1) Accessibility to high voltage devices	1) *Safety*
		2) Sufficiency of protection for high voltage cable terminals	2) *Sufficient*
		3) Method and reliability of operation for synchronizing circuit breaker	3) *Manual* *It is reliable.*

Generating Facilities		Check item by visual inspection and hearing	Results
Outdoor Equipment	Transformer	1) Presence of over load operation	1) N/A
	Circuit breaker	1) Situation of tripfor outgoing feeder breaker in case of accident on transmission line 2) Fitness of maintenance in case of oil circuit breaker	1) 〃 2) 〃
	Line switch	1) Operation method 2) Reliability of operation	1) Manual 2) It is not reliable
	Insulator	1) Presence of damage and dusts	1) No objection
	Structural steel	1) Occurence of erosion due to rust 2) Presence of injury	1) 〃 2) 〃
	Line protection	1) Existence of adequate protection relays to connect to RED	1) 50/51

II. ACTUAL GENERATED ENERGY AND OPERATION TIME

Unit No.: 1

Installed Capacity of Generator: _____ KVA

Type of Turbine: _____

MWH = Gross

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL	REMARKS
1983	MWH	0	0	0	0	0	0	382	462	580	462	583	641	3,110	
	OPE. TIME														
1984	MWH	189	599	539	594	607	566	629	537	555	524	0	322	5,661	
	OPE. TIME														
1985	MWH	478	541	475	399	385	442	443	487	280	110	326	0	4,366	
	OPE. TIME														
1986	MWH	0	0	0	0	0	0	0	0	0	0	0	0	0	
	OPE. TIME														
1987	MWH	0	0	0	285	448	428	326	429	327	271	439	381	3,334	
	OPE. TIME														
1988	MWH	398	90	2	373	411	267	240	551	492	442	14	0	3,279	
	OPE. TIME														

III. REPAIR RECORDS

No.	Study Item	Results
	The past records concerning the following items shall be obtained to evaluate reliability of generating facilities. 1) Repaired locations and method for repairing 2) Causes for damage/defect 3) Duration of repairing and power supply stoppage 4) Repaired by; a) staff in Power Plant b) manufacturer c) other 5) Repair cost 6) Operation life after the completion of repairing work	without available informations

IV . SITUATION OF STOCK SPARE PARTS

No.	Study Item	Results
	Data on the situation of stock spare parts shall be obtained to evaluate maintainability of generating facilities.	1) Following spare parts have been made in CHEC's repair shop. a. Backet for Pelton b. Needle " " C. Nozzle " " d. Sealing for valve e. Bolts and nuts

V. CHEC's INTENTION FOR REHABILITATION

No.	Study Item	Results			
	Mark with ✓ in pertinent columns.	Leaving as it is	Repair work	Replacement	Notes
	- Inlet valve		✓		※-1
	- Turbine, governor, auxiliary equipment			✓ (change to Francis)	Change to high efficiency machine
	- Generator, exciter		✓		change to Stator winding only
	- Control panel		✓		Calibratim
	- Switchgear	✓			Good conditi
	- Transformer	N/A			
	- Substation equipment (Circuit breaker, Isolator, etc.)	N/A			
	- Transmission tower, conductor and insulator	✓			Good conditi
	- Power House		✓		Depend on F/S
	- Penstock	✓			Already change 5 years ago.

※-1 : Change to full automatic (52G trip and Inlet valve is closed automatically.)

Survey Records

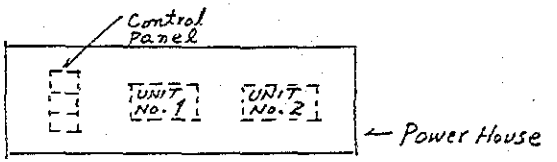
Municipal Hydroelectric Power Plant

Date of Survey : 13～14 Feb. 1989

I. RECORDS BY VISUAL INSPECTION AND HEARING SURVEY

Unit No.: 1

Type of Turbine: Pelton



Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Cover	1) Presence of vibration	1) A little, but no objection to operation
	Bucket	1) Existence of corrosion	1) Corrosion : not existing Abrasion : a little existing
	Shaft	1) Shaking of shaft axis	1) No objection
	Bearing	1) Oil shortage on bearing surface	1) 〃
		2) Lack of oil viscosity	2) 〃
	Governor control	1) Control by belt-driven type 2) Speed detection device 3) Speed regulation system	1) 2) 3) } Not existing due to broken
		4) Installation of load limiter	4) N/A
		5) Accuracy of governor speed regulation	5) can't regulate due to not existing

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Oil pressure equipment	1) Existence of oil leakage	1) N/A
		2) Application of oil pressure pumping system	2) N/A
	Inlet valve	1) Operation method	1) Manual
		2) Locking condition	2) No objection
		3) Smoothness of pressurized oil operation	3) N/A
	Nozzle and Needle	1) Existence of corrosion	1) Corrosion : not existing Abrasion : a little existing
		2) Presence of water leakage from nozzle pipe when needle is closed	2) Runner is rotating when needle is closed.
	Deflector	1) Smoothness of control	1) not provided
	Jet Brake	1) Smoothness of control	1) N/A

Unit No. 1

Generating Facilities		Check item by visual inspection and hearing	Results
Generator	Rotor	1) Discoloration of winding surface due to heat	1) No objection
		2) Existence of erosion for core	2) 〃
		3) Fitness of between rotor and shaft	3) 〃
	Stator winding	1) Frequency of burning trouble or repair	1) 〃
		2) Reduction of insulation resistance	2) It is about the time to change to the new one due to reduction.
		3) Rust and erosion of core	3) No objection
	Bearing	1) Occurrence of deformation on metal surface	1) Repair work has been done every 2 years
		2) Lack of oil lubrication	2) No objection
		3) Occurrence of temperature rise	3) Occurred several times
	Exciter	1) Exchange frequency of brushes worn out	1) Every 2 months
		2) Sufficient stock of spare brush	2) Sufficient
	Voltage regulator	1) Operation method of voltage regulator	1) Manual
		2) Response of voltage detection for load variation	2) Voltage is always regulated by operator.

Unit No.: 2

Type of Turbine: Pelton

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Cover	1) Presence of vibration	1) A little existing
	Bucket	1) Existence of corrosion	1) Corrosion : not existing Abrasion : a little existing
	Shaft	1) Shaking of shaft axis	1) No objection
	Bearing	1) Oil shortage on bearing surface	1) 〃
		2) Lack of oil viscosity	2) 〃
	Governor control	1) Control by belt-driven type	1) } Not existing due to broken
		2) Speed detection device	2) }
		3) Speed regulation system	3) }
		4) Installation of load limiter	4) N/A
		5) Accuracy of governor speed regulation	5) cannot regulate due to not existing

Generating Facilities		Check item by visual inspection and hearing	Results
Pelton Turbine	Oil pressure equipment	1) Existence of oil leakage 2) Application of oil pressure pumping system	1) N/A 2) N/A
	Inlet valve	1) Operation method 2) Locking condition 3) Smoothness of pressurized oil operation	1) Manual 2) No objection 3) N/A
	Nozzle and Needle	1) Existence of corrosion 2) Presence of water leakage from nozzle pipe when needle is closed	1) Corrosion : not existing Abrasion : a little existing 2) Runner is rotating when needle is closed.
	Deflector	1) Smoothness of control	1) not provided
	Jet Brake	1) Smoothness of control	1) N/A

Generating Facilities		Check item by visual inspection and hearing	Results
Indoor Switchgear	Insulation level	1) Sufficiency of insulation level 2) Unification of insulation level 3) Reduction of insulation registance	1) *Sufficient* 2) *Unified* 3) *Reducing*
	Accessibility and Safety	1) Accessibility to high voltage devices	1) *Safety*
		2) Sufficiency of protection for high voltage cable terminals	2) *Sufficient*
		3) Method and reliability of operation for synchronizing circuit breaker	3) *Manual. It is reliable*

Generating Facilities		Check item by visual inspection and hearing	Results
Outdoor Equipment	Transformer	1) Presence of over load operation	1) *No objection*
	Circuit breaker	1) Situation of trip for outgoing feeder breaker in case of accident on transmission line	1) *Automatically tripped*
		2) Fitness of maintenance in case of oil circuit breaker	2) *Oil has been changed every 1 year.*
	Line switch	1) Operation method	1) *Manual*
		2) Reliability of operation	2) *It is not reliable and dangerous to operation.*
	Insulator	1) Presence of damage and dusts	1) *No objection*
	Structural steel	1) Occurence of erosion due to rust	1) *existing*
		2) Presence of injury	2) *No objection*
	Line protection	1) Existence of adequate protection relays to connect to RED	1) *50/51*

Unit No. 2

Generating Facilities		Check item by visual inspection and hearing	Results
Generator	Rotor	1) Discoloration of winding surface due to heat	1) No objection
		2) Existence of erosion for core	2) 〃
		3) Fitness of between rotor and shaft	3) 〃
	Stator winding	1) Frequency of burning trouble or repair	1) Winding had been changed 3 years ago
		2) Reduction of insulation resistance	It is about the time to change to the 2) new one due to reduction.
		3) Rust and erosion of core	3) No objection
	Bearing	1) Occurrence of deformation on metal surface	1) Repair work has been done every 2 years.
		2) Lack of oil lubrication	2) No objection
		3) Occurrence of temperature rise	3) Occurred several times
	Exciter	1) Exchange frequency of brushes worn out	1) Every 2 months
		2) Sufficient stock of spare brush	2) Sufficient
	Voltage regulator	1) Operation method of voltage regulator	1) Manual
		2) Response of voltage detection for load variation	2) Voltage is always regulated by operator.

Generating Facilities		Check item by visual inspection and hearing	Results
Control Board	Metering equipment	1) Sufficiency of accuracy for instruments	1) Bad condition due to old.
		2) Lack of necessary instruments	2) Sufficient, but there are no functional instruments.
		3) Items constantly recorded	3) Gen. : A, V, W, wh, Hz, cosφ Ex. : A, V Turbine pressure, rpm
	Protection equipment	1) Lack of relays to be installed	1) 87G
		2) Operation method in case of accident in transmission lines	2) 52G is tripped by 50/51
	Remote control equipment	1) Control method for turbine and generator operation	1) Remote control panel is not provided.
		2) Control method for voltage and speed control	2) Voltage : manual (local control panel) Speed : manual
		3) Operation method of synchronized switching	3) Manual
	Power system	1) Power supply voltage (kV) after rehabilitation work	1) Gen. Voltage : 4.16 or 13.2kV Transmission : 13.2kV

II. ACTUAL GENERATED ENERGY AND OPERATION TIME

Unit No.: 1 and 2

Installed Capacity of Generator: _____ KVA

Type of Turbine: _____

YEAR		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL TOTAL	REMARKS
1983	MWH	590	511	736	713	676	599	599	404	388	403	595	707	6.921	
	OPE. TIME														
1984	MWH	645	598	524	535	581	600	646	644	439	662	342	577	6.793	
	OPE. TIME														
1985	MWH	712	624	624	574	377	387	440	499	508	337	356	635	6.073	
	OPE. TIME														
1986	MWH	608	518	540	562	630	622	590	427	523	553	512	457	6.542	
	OPE. TIME														
1987	MWH	444	321	485	492	495	454	345	509	460	381	264	175	4,825	
	OPE. TIME														
1988	MWH	754	606	482	451	485	439	464	514	473	465	287	27	5,448	
	OPE. TIME														

III. REPAIR RECORDS

No.	Study Item	Results
	The past records concerning the following items shall be obtained to evaluate reliability of generating facilities. 1) Repaired locations and method for repairing 2) Causes for damage/defect 3) Duration of repairing and power supply stoppage 4) Repaired by; a) staff in Power Plant b) manufacturer c) other 5) Repair cost 6) Operation life after the completion of repairing work	Without available informations

IV . SITUATION OF STOCK SPARE PARTS

No.	Study Item	Results
	Data on the situation of stock spare parts shall be obtained to evaluate maintainability of generating facilities.	1) Following spare parts have been made in CHEC's repair shop. a. Backet for Pelton b. Needle " " c. Nozzle " " d. Sealing for valves e. Bolts and nuts

V. CHEC's INTENTION FOR REHABILITATION

No.	Study Item	Results			
	Mark with ✓ in pertinent columns.	Leaving as it is	Repair work	Replacement	Notes
	- Inlet valve		✓		※-1
	- Turbine, governor, auxiliary equipment			✓ (Change to Francis)	Change to high efficiency machine
	- Generator, exciter		✓		Change to Stator winding
	- Control panel			✓	many trouble
	- Switchgear			✓	
	- Transformer	✓			
	- Substation equipment (Circuit breaker, Isolator, etc.)			✓	
	- Transmission tower, conductor and insulator	✓			
	- Power House		✓		depend on F/s Already changed
	- Penstock	✓			5 years ago.

※-1 : change to full automatic (52G trip and Inlet valve is closed automatically.)