

GENERAL

Power Plant	NO. 236 CHOACHI	Investigated Date	16 Dec. 1987
Electric Company	MUNICIPIO DE CHOACHI	Available Capacity (kW)	19
Location	CUNDINAMARCA		
River	PALMAR		
Generating Method	RUN-OF-RIVER		
Installed Year	1954	Service-in	1954

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )		1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)	3.0	- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)		- Type	FRANCIS
- Ordinary Water Discharge		- Crest Length (m)	30.0	- Output (kW)	307
- Low Water Discharge		- Elevation of overflowing Crest (m)		- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge		- Width of Overflowing Crest (m)	30.0	- Type of Governor	NO NAME PLATE
- Minimum		- Depth of Overflowing (m)		- Regulating Valve	
- Mean		2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)		- Type	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	1.0	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)	1,830	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	
- Tailwater Level (EL)	1,785	- Elevation of Intake Sill (m)		- Number of Generator	1
- Gross Head	45.0	- Dimensions (m) (WxH)		- Capacity (kVA)	384
- Head Loss		- Number of Intake	1	- Power Factor (%)	80
- Net Head		4. Dimensions of Forebay (m)		- Voltage (V)	380/220
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.0x10.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	300	6. Intake Gate		- Revolution (rpm)	NO NAME PLATE
8. Output (MWh)		- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)		- Dimensions (m) (W x H)	W H 1.5 x 1.5	- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)		- Number of Gates		- Type	NO NAME PLATE
pesos/kWh		7. Headrace		- Capacity (kVA)	NO NAME PLATE
11. Others		- Type	OPEN	- Primary Voltage (V)	220
		- Dimensions (m) (W x H)	W H 0.6 x 0.75	- Secondary Voltage (kV)	6.6
		- Length (m)	60	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L H x2.0x	- Connection	NO NAME PLATE
		9. Penstock		- Number	1
		- Dimensions (m) (φ x L)	φ = 0.55 L = 180	Continuous Stand-by	
		- Number of Lines		4. Others	
		10. Dimensions of Tailrace (W x H) (m)		TO: - LA UNION S/S - ALTO DELA VIGA S/S	

1. Present Condition and Problems

- ① This is a small power plant established in the Qd Palmar of the Rio Negro river system. The Qd Palmer is abundant in quantity whose water is also clean. In just upper reaches from the intake gate, an intake weir for service water has been provided.
- ② Although the rated output is 300 kW, the current output is only 19 kW (6 %). That is because there are some 10 subscribers. It is said that if the demand is secured this power plant may be generated up to a rated level.

2. Key Points for the Rehabilitation Plan

- ① To be excluded from the proposed site list.

GENERAL

Power Plant	NO. 237 APULO	Investigated Date	15 Dec. 1987
Electric Company	CEMENTOS DIAMANTES S.A.	Available Capacity (kW)	0
Location	CUNDINAMARCA		
River	RIO BOGOTA		
Generating Method	RUN-OF-RIVER		
Installed Year	1928/1947	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	5,544	1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)	150	- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)		- Type	TUBULAR x 5
- Ordinary Water Discharge		- Crest Length (m)	85	- Output (kW)	600
- Low Water Discharge		- Elevation of overflowing Crest (m)		- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge		- Width of Overflowing Crest (m)	65	- Type of Governor	NO NAME PLATE
- Minimum		- Depth of Overflowing (m)		- Regulating Valve	
- Mean		2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)		- Type		Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	23.0	- Dimensions (WxH) (m)	W x H 3.0 x	2. Generator	
5. Head (m)		- Number of Gates	3	- Manufacturing Year	
- Headwater Level (EL)	415	3. Intake		- Type	NO NAME PLATE
- Tailwater Level (EL)	400	- Elevation of Intake Sill (m)		- Number of Generator	5
- Gross Head	15	- Dimensions (m) (WxH)		- Capacity (kVA)	700
- Head Loss		- Number of Intake	1	- Power Factor (%)	80
- Net Head		4. Dimensions of Forebay (m)		- Voltage (V)	6,600
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 7.0x15.0x2.9	- Frequency (Hz)	50
7. Plant Capacity (kW)	3,000	6. Intake Gate		- Revolution (rpm)	NO NAME PLATE
8. Output (MWh)		- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)		- Dimensions (m) [W x H]	W x H 3.0 x	- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)		- Number of Gates	2	- Type	
pesos/kWh		7. Headrace		- Capacity (kVA)	1,000
11. Others		- Type	OEPN	- Primary Voltage (V)	13,800
		- Dimensions (m) [W x H]	W x H 5.0 x 3.0	- Secondary Voltage (V)	34,500
		- Length (m)	1,775	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L H 7.0x10.0x2.9	- Connection	NO NAME PLATE
		9. Penstock CONCRETE		- Number	
		- Dimensions (m) (φ x L)	φ = 2.4 L = 40	Continuous Stand-by	UNKNOWN UNKNOWN
		- Number of Lines	2	4. Others	TO S/S
		10. Dimensions of Tailrace [W x H] (m)		- ANAPOIMA	
				- TOCAIMA	
				- VDAS. LA VEGA Y GUACA	

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

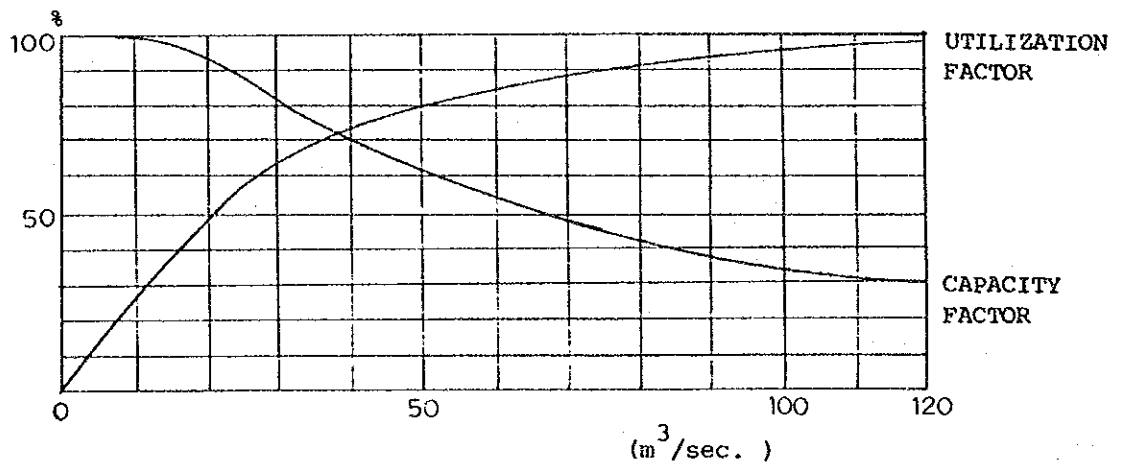
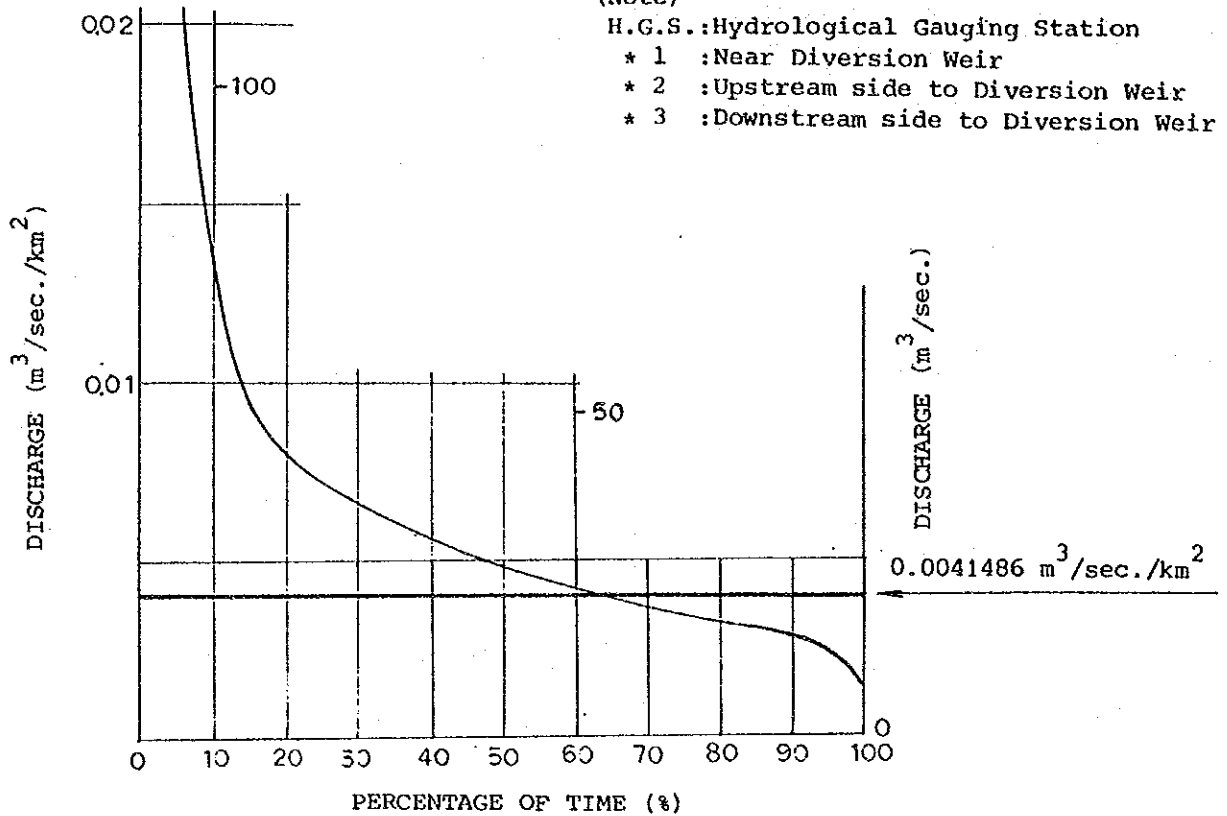
NO. 237 APULO

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1973 - 1982
Used Data	1977 - 1979

(Note)

H.G.S.: Hydrological Gauging Station

- \* 1 : Near Diversion Weir
- \* 2 : Upstream side to Diversion Weir
- \* 3 : Downstream side to Diversion Weir



1. Present Condition and Problems

- ① This power plant is owned by a private company Cementos Del Diamantes and has been suspended since 1984 when the cement plant was stopped.
- ② The conduit structures except for gates, valves and screens, are kept in a good condition.
- ③ As the two concrete-wound steel made penstocks and the generators have grown old-fashioned, a sufficient inspection is necessary before the restart of the operation. The auxilliary equipments such as control monitor, protection units, etc. shall be replaced.
- ④ The river water has been contaminated by waste water flown from Bogota City.
- ⑤ The as-built drawings have been stored, but no copies of which has not been obtained.

2. Key Points for the Rehabilitation Plan

- ① It is said that during the operations the generation up to a rated output could not be achieved because of the shortage of water. For this reason, calculate the flow / facility utilization rate curve by use of flow data from the EEEB hydrological gauging station (No. 2120 824, Tocaima) and review it.
- ② Inspection works for the penstock and replacement if necessary.
- ③ Inspection works of the generator through overhaul and replacement if necessary.
- ④ Inspection of river water quality.

GENERAL

Power Plant	NO. 238 LA VICIOSA	Investigated Date	2 Mar. 1988
Electric Company	ELECTRO HUILA S.A.	Available Capacity (kW)	0
Location	HUILA		
River	Q. LA VICIOSA		
Generating Method	RUN-OF-RIVER		
Installed Year	1950	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	969	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	UNKNOWN	- Height (m)	± 2.0	- Type	FRANCIS x 2 LE FFEL SP TYPE
- Ordinary Water Discharge	UNKNOWN	- Crest Length (m)	7.0	- Output (kW)	100 KW, 125 KW, 210 FHP
- Low Water Discharge	UNKNOWN	- Elevation of over-flowing Crest (m)	NO DATA	- Revolution (rpm)	1,200
- Droughty Water Discharge	UNKNOWN	- Width of Over-flowing Crest (m)	7.0	- Type of Governor	WOODWARD LH TYPE
- Minimum	UNKNOWN	- Depth of Over-flowing (m)	NO DATA	- Regulating Valve	
- Mean	UNKNOWN	2. Sand Trap Gate	SLUICE	Type	LUDELOW 175W
3. Utilizable Flow (m <sup>3</sup> /s)	UNKNOWN	- Type		Dimension (mm)	NOT CONFIRM
4. Firm Discharge (m <sup>3</sup> /s)	0.5	- Dimensions (ØxH) (m)	W H 1.36 x	2. Generator	
5. Head (m)	NO DATA	- Number of Gates	1	- Manufacturing Year	
- Headwater Level (EL)	NO DATA	3. Intake		- Type	GEAT1
- Tailwater Level (EL)	NO DATA	- Elevation of Intake Sill (m)	NO DATA	- Number of Generator	2
- Gross Head	NO DATA	- Dimensions (m) (WxH)	W H 0.75 x 2.45	- Capacity (kVA)	125 @ 1 156 @ 1
- Head Loss	NO DATA	- Number of Intake	1	- Power Factor (%)	80
- Net Head	45.5	4. Dimensions of Forebay (m)	NOT CONFIRM	- Voltage (V)	240
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.0x15.0x	- Frequency (Hz)	3
7. Plant Capacity (kW)	225	6. Intake Gate		- Revolution (rpm)	1,200
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price	511 K\$	- Dimensions (m) (W x H)	W H 0.75 x	- Manufacturing Year	N/A
10. Unit Price pesos/kw	2,271	- Number of Gates	1	- Type	N/A
pesos/kWh	UNKNOWN	7. Headrace		- Capacity (kVA)	N/A
11. Others		- Type	TUNNEL OPEN	- Primary Voltage (kV)	N/A
		- Dimensions (m) (W x H)	W H 1.2-1.3 x 1.8	- Secondary Voltage (kV)	N/A
		- Length (m)	± 2,500	- Number of Phase	N/A
		8. Dimensions of Water Reservoir (m)	W L H 4.0x13.0x	- Connection	N/A
		9. Penstock		- Number Continuous Stand-by	N/A
		- Dimensions (m) (Ø x L)	Ø = 0.62 L =	4. Others	
		- Number of Lines	1 (2-BRANCH)		
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRM		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 238 LA VICIOSA

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1963 - 1985
Used Data	1983 - 1985

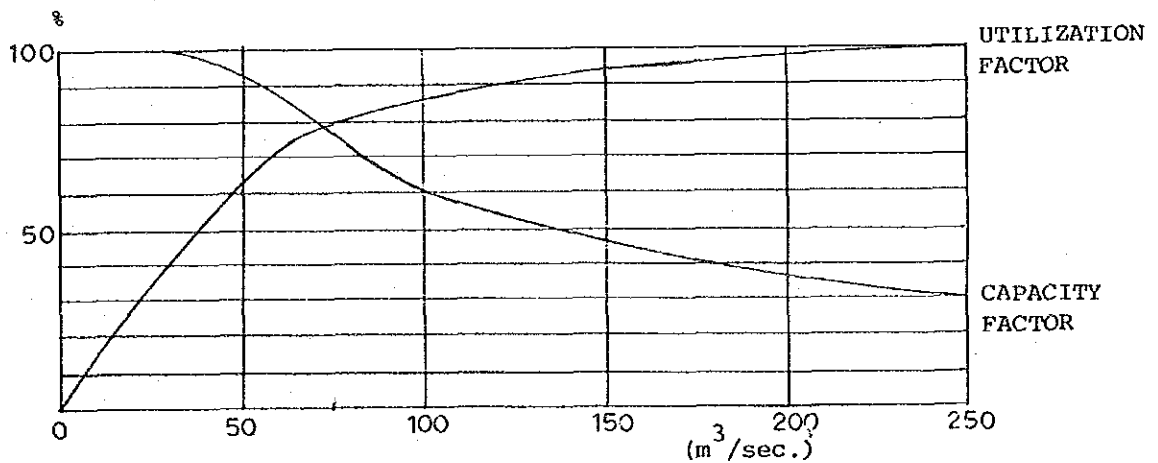
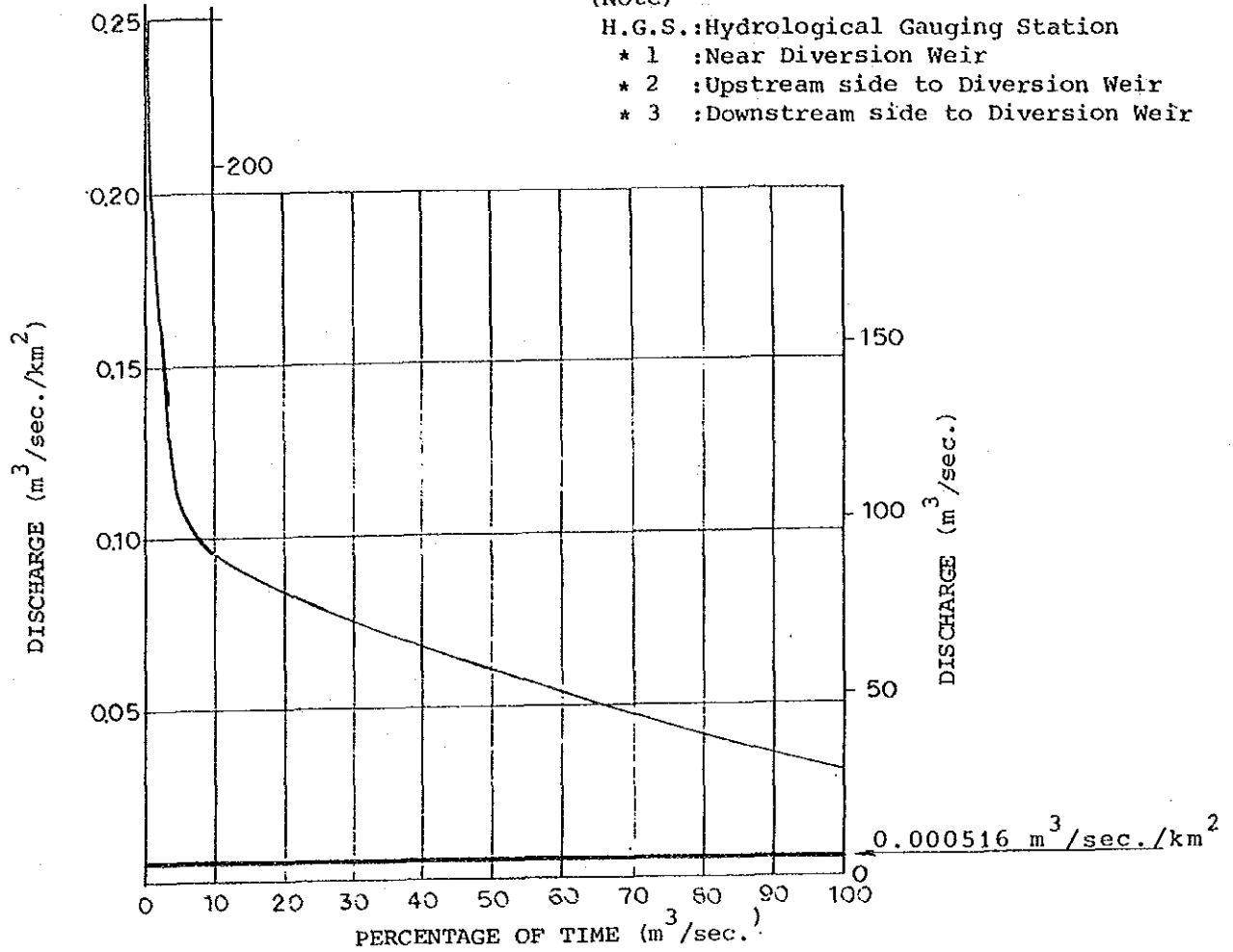
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



No. 238      La Viciosa

1. Present Condition and Problems

- ① This power plant has been suspended since 1985. The intaken water has ineffectively been discharged from the spillway of the head tank.
- ② As no flow data and design drawings have been provided, the flow condition and head cannot be checked.
- ③ Although not a good design, the conduit structures are kept in a relatively well condition. The intake weir has been heaped to the crest with gravel, earth and soil.
- ④ In the Qd. Viciosa river basin, a large quantity of gravel, earth and soil flow out down. However, this river seems to have an abundant flow.

2. Key Points for the Rehabilitation Plan

- ① Although the Electrohuila S.A. does not desire any rehabilitation, it seems that there is room for review of the possibility of an extension after a survey of the flow condition in the intake site.



GENERAL

Power Plant	NO. 239 LA PITA	Investigated Date	2 Mar. 1988
Electric Company	ELECTRO HUILA S.A.	Available Capacity (kW)	1,060
Location	HUILA		
River	Q. MAYO		
Generating Method	RUN-OF-RIVER		
Installed Year	1964/1973	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	UNKNOWN	- Height (m)	3.0	- Type	T.M. VOITH HORIZONTAL FRANCIS X 2
- Ordinary Water Discharge	UNKNOWN	- Crest Length (m)	8.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	UNKNOWN	- Elevation of overflowing Crest (m)	998.56	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	UNKNOWN	- Width of Over-flowing Crest (m)	8.0	- Type of Governor	WOOD WARD L-R
- Minimum	UNKNOWN	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve Type	ERHARD PLANTURN 350
- Mean	UNKNOWN	2. Sand Trap Gate	SLUICE	- Dimension (mm)	NOT CONFIRM
3. Utilizable Flow (m <sup>3</sup> /s)	0.75	- Type			
4. Firm Discharge (m <sup>3</sup> /s)	UNKNOWN	- Dimensions (WxH) (m)	1.3 x 1		
5. Head (m)	993.5	- Number of Gates	1	2. Generator	#1 #2
- Headwater Level (EL) P. STOCK	( $\pm$ OF P. STOCK)	3. Intake		- Manufacturing Year	
- Tailwater Level (EL)	873.0	- Elevation of Intake Sill (m)	UNKNOWN	- Type	GE ATB BB WTK
- Gross Head	120.5	- Dimensions (m) (WxH)	W H	- Number of Generator	1 1
- Head Loss	NO DATA	- Number of Intake	1	- Capacity (kVA)	875 900
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80 80
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.0x30.0x2.7	- Voltage (V)	2,400 2,400
7. Plant Capacity (kW)	1,420	6. Intake Gate		- Frequency (Hz)	60 60
8. Output (MWh)	UNKNOWN	- Type	SLUICE	- Revolution (rpm)	1,200 1,200
9. Construction Price	18,295K\$	- Dimensions (m) [W x H]	W H 1.05 x 0.87	3. Transformer	
10. Unit Price pesos/kw	12,884	- Number of Gates	1	- Manufacturing Year	
pesos/kwh	UNKNOWN	7. Headrace	OPEN CALVERT	- Type	TFL BB TEK
11. Others		- Type		- Capacity (kVA)	1,000 880
		- Dimensions (m) [W x H]	W x H 2.2 x 1.4	- Primary Voltage (V)	2,400 2,400
		- Length (m)	2,498	- Secondary Voltage (V)	13,200 14,400
		8. Dimensions of Water Reservoir (m)	2,498	- Number of Phase	3 3
		9. Penstock	$\phi = 0.56, 0.66$ L = 298.18	- Connection	$\Delta/\lambda \Delta/\lambda$
		- Dimensions (m) ( $\phi \times L$ )		- Number	1 1
		- Number of Lines	2	Continuous Stand-by	0 0
		10. Dimensions of Tailrace [W x H] (m)	W H 2.0 x 2.55	4. Others	

No. 239

1. Present Condition and Problems

- ① As no flow data has been provided, the details are unknown. However this power plant is considered to be low in the river-water utilization rate.
- ② The Rio Mayo river has an abundant flow, but on the other hand bounding stones flow down away much.
- ③ Among the two generator units, the #1 unit was replaced in 1973, However because of the slanted horizontal shaft, this unit has been vibrated and the output has also been reduced.  
#1 unit; Output of 460 kW (66 %)  
for a rated output of 700 kW  
#2 unit; Output of 600 kW (66 %)  
for a rated output of 720 kW
- ④ The structures from intake weir to head tank are not of a good design but kept in a fairly good condition.


2. Key Points for the Rehabilitation Plan

- ① Investigate the flow condition at the intake gate and calculate the quantity of water intaken to achieve a proper river water utilization rate and flow / facility utilization rate.
- ② In executing the extention, it is necessary to remodel the overall facilities.

GENERAL

Power Plant	NO. 240 FORTALECILLAS	Investigated Date	29 Feb. 1988
Electric Company	ELECTRO HUILA S.A.	Available Capacity (kW)	0
Location	HUILA		
River	FORTALECILLAS		
Generating Method	RUN-OF-RIVER		
Installed Year	1968	Service-in	

SUMMARY OF GENERATING FACILITIES

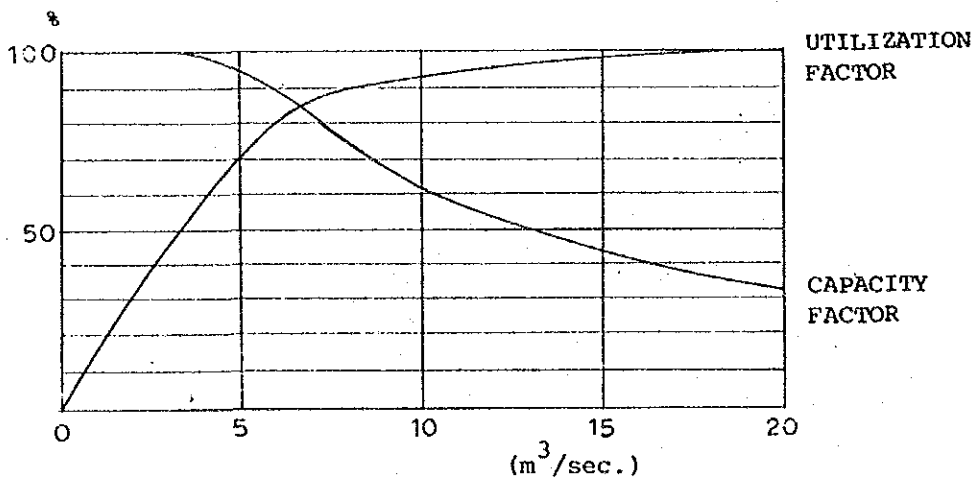
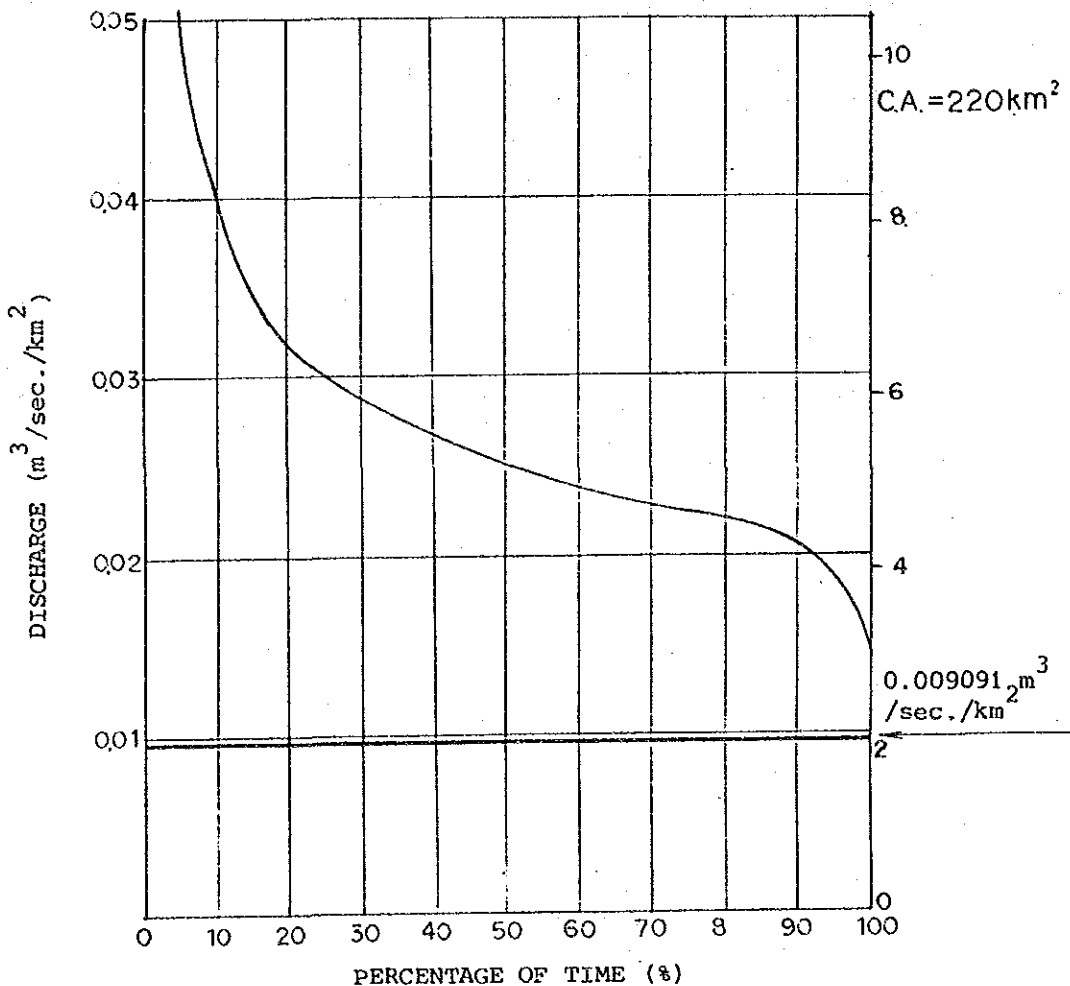
General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	220	1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	NON	- Manufacturing Year	
- Plenty Water Discharge	UNKNOWN	- Height (m)	NON	- Type	J.M. VOITH HORIZONTAL FRANCIS
- Ordinary Water Discharge	UNKNOWN	- Crest Length (m)	NON	- Output (kW)	NO NAME PLATE
- Low Water Discharge	UNKNOWN	- Elevation of Over-flowing Crest (m)	NON	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	UNKNOWN	- Width of Over-flowing Crest (m)	NON	- Type of Governor	NO NAME PLATE
- Minimum	UNKNOWN	- Depth of Over-flowing (m)	NON	- Regulating Valve	
- Mean	UNKNOWN	2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	2.0	- Type	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	UNKNOWN	- Dimensions (R x H) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	NO DATA	3. Intake		- Type	B. BOVERI
- Tailwater Level (EL)	NO DATA	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	28.0	- Dimensions (m) (W x H)	W H 4.1 x 3.1	- Capacity (kVA)	510
- Head Loss	NO DATA	- Number of Intake	1	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2,300
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 8.0x18.5x	- Frequency (Hz)	60
7. Plant Capacity (kW)	408	6. Intake Gate		- Revolution (rpm)	900
8. Output (MWh)	UNKNOWN	- Type	WOODEN SLUICE	3. Transformer	
9. Construction Price	5,693K\$	- Dimensions (m) [W x H]	W H 4.1 x 0.5	- Manufacturing Year	
10. Unit Price pesos/kw	14,233	- Number of Gates	1	- Type	TFKO
pesos/kWh	UNKNOWN	7. Headrace		- Capacity (kVA)	3,300
11. Others		- Type	OPEN	- Primary Voltage (V)	2,400
		- Dimensions (m) [W x H]	W H 2.5 x 2.0	- Secondary Voltage (kV)	NO NAME PLATE
		- Length (m)	3,287	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L H 8.0x15.0x	- Connection	
		9. Penstock		- Number	1
		- Dimensions (m) (φ x L)	φ = 1.20 L = 69.49	Continuous Stand-by	0
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace [W x H] (m)	W H 2 x 4.5 x		

# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 240 FORTALECILLAS

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1980 - 1985
Used Data	1983 - 1985

(Note)  
 H.G.S.: Hydrological Gauging Station  
 \* 1 : Near Diversion Weir  
 \* 2 : Upstream side to Diversion Weir  
 \* 3 : Downstream side to Diversion Weir



No. 240 Fortalecillas

1. Present Condition and Problems

- ① The 200 kW generator installed in 1947 was extended up to 408 kW in 1968. However, it has been suspended since 1984 and the turbine has remained dismantled.
- ② The conduit has been utilized as the channel both for city water and irrigation water. The water channel for generation has been shut down.

2. Key Points for the Rehabilitation Plan

- ① Electrohuila S.A. has no intention of rehabilitation.

GENERAL

Power Plant	NO. 241 RIO IQUIRA - I	Investigated Date	1 Mar. 1988
Electric Company	ELECTRO HUILA S.A.	Available Capacity (kW)	2,230
Location	HUILA		
River	IQUIRA		
Generating Method	RUN-OF-RIVER		
Installed Year	1951/1961	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	465	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	5.5	- Type	J.M. VOITH PELTON x 3
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	13.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	936.0	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	13.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		- Type	PHOTO
3. Utilizable Flow (m <sup>3</sup> /s)	2.5	- Type	SLUICE	- Dimension (mm)	PHOTO
4. Firm Discharge (m <sup>3</sup> /s)	UNKNOWN	- Dimensions (WxH) (m)	1.83 x 1	2. Generator	
5. Head (m)	929.0	- Number of Gates	1	- Manufacturing Year	
- Headwater Level (EL)	(2 OF P. STOCK) 736.6	3. Intake		- Type	B. BOVERI
- Tailwater Level (EL)	(6 OF TURBINE) 192.4	- Elevation of Intake Sill (m)	934.7	- Number of Generator	3
- Gross Head	NO DATA	- Dimensions (m) (WxH)	W H 2.8 x 2.65	- Capacity (kVA)	1,800
- Head Loss	NO DATA	- Number of Intake		- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	W L 1.83 x 4.50	- Voltage (V)	2,400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 12.2x50.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	@1,440x3 = 4,320	6. Intake Gate		- Revolution (rpm)	720/1,320
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price	22,043K\$	- Dimensions (m) (W x H)	W H 1.25 x 1	- Manufacturing Year	
10. Unit Price pesos/kw	4,898	- Number of Gates	1	- Type	TFKO
pesos/kWh	UNKNOWN	7. Headrace	VARIATION OF BOX. TUN. OPEN	- Capacity (kVA)	1,875
11. Others		- Type		- Primary Voltage (V)	2,400
		- Dimensions (m) (W x H)	W H 1.6 x 1.2	- Secondary Voltage (kV)	NO NAME PLATE
		- Length (m)	3,615	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	UNUSED ('' LANDSLIDE)	- Connection	$\Delta / \lambda$
		9. Penstock		- Number	3
		- Dimensions (m) ( $\phi$ x L)	$\phi = 1.07$ L = 830	Continuous Stand-by	0
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace (W x H) (m)	W H 2.9 x		

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

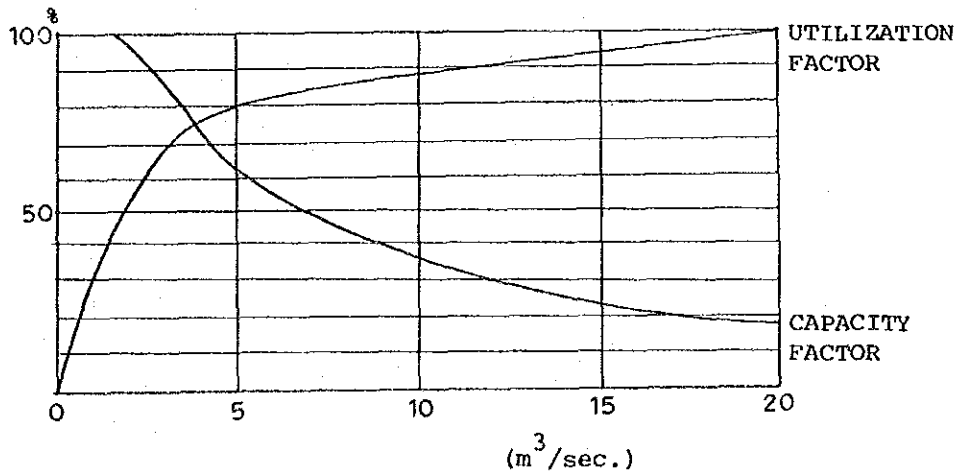
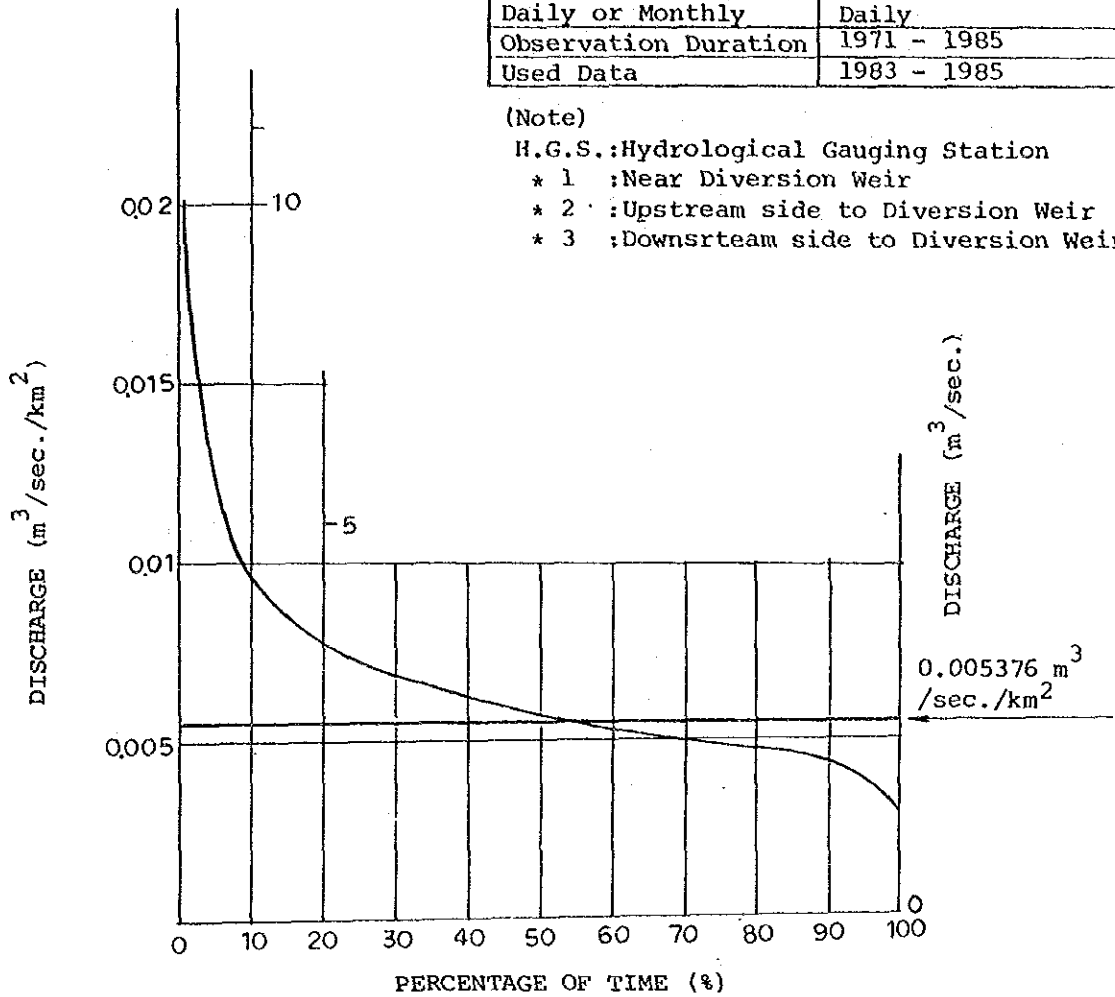
NO. 241 RIO IQUIRA-I

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1971 - 1985
Used Data	1983 - 1985

(Note)

H.G.S.: Hydrological Gauging Station

- \* 1 : Near Diversion Weir
- \* 2 : Upstream side to Diversion Weir
- \* 3 : Downsrteam side to Diversion Weir



1. Present Condition and Problems

① The main rehabilitation desired by E. Huila S. A. is to replace the ancillary equipment such as control, supervisory and protection panels, etc.

② The generating facilities have been operated at a range of 76% to 78% of the rated output as shown below:

#1 unit: Output of 1130 kW (78%) to the rated output of 1440 kW

#2 unit: Output of 1100 kW (76%) to the rated output of 1440 kW

#3 unit: Under repair

③ Discharge in the Rio Iquirá-I is insufficient, because flow-controlling pondage constructed on the side of penstock in 1959 was collapsed by landslide and was not used.

④ The headrace structures are generally kept in a good condition. The diversion weir has been accumulated with sand to its crest.

⑤ The hydrological data and design drawings have been kept in readiness.

2. Key Points for the Rehabilitation Plan

① The water utilization rate every season shall be confirmed using the observation record from the HIMAT's hydrological gauging station (No. 2108-705 Bocatoma).



- ② A geological investigation survey shall be conducted in or around the flow-controlling pondage to devise the plan for protection of landslide. (e.g., reduction of moment by cutting)
- ③ The specifications for the existing control, supervisory and protection panels and their defective parts shall be confirmed.

GENERAL

Power Plant	NO. 242 RIO IQUIRA - II	Investigated Date	1 Mar. 1988
Electric Company	ELECTRO HUILA S.A.	Available Capacity (kW)	700
Location	HUILA		
River	RIO IQUIRA - I → PEPELNAL		
Generating Method	RUN-OF-RIVER		
Installed Year	1954	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	465	1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	NON	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	NON	- Type	HORIZONTAL FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	NON	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	NON	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	NON	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	NON	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		- Type	BUTTERFLY
3. Utilizable Flow (m <sup>3</sup> /s)	2.5	- Dimensions (WxH) (m)	NON	- Dimension (mm)	≅ ∅ 0.80
4. Firm Discharge (m <sup>3</sup> /s)	UNKNOWN	- Number of Gates	NON	2. Generator	
5. Head (m)	728.75 (EL. OF P. STOCK)	3. Intake	TAILRACE OF IQUIRA-I	- Manufacturing Year	
- Headwater Level (EL.)	920.35	- Elevation of Intake Sill (m)	W H	- Type	B. BOVERI
- Tailwater Level (EL.)	191.6	- Dimensions (m) (WxH)	2.9 x	- Number of Generator	1
- Gross Head	728.75	- Number of Intake	—	- Capacity (kVA)	3,000
- Head Loss	NO DATA	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin. (m) (W x L x H)	W L H 18.5x30.0x	- Voltage (V)	2,400
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60
7. Plant Capacity (kW)	2,400	- Type	SLUICE	- Revolution (rpm)	720/1,270
8. Output (Mwh)	UNKNOWN	- Dimensions (m) (W x H)	W H 1.75x	3. Transformer	
9. Construction Price	17,487K\$	- Number of Gates	1	- Manufacturing Year	
10. Unit Price pesos/kw	7,286	7. Headrace	VARIATION OF PIPE, BOX, OPEN	- Type	TFKO
pesos/kWh	UNKNOWN	- Type		- Capacity (kVA)	3,300
11. Others		- Dimensions (m) (W x H)	B <sub>1</sub> = 2.6 B <sub>2</sub> = 1.4 H=1.2	- Primary Voltage (V)	2,400
		- Length (m)	4,258	- Secondary Voltage (V)	13,200
		8. Dimensions of Water Reservoir (m)	NON	- Number of Phase	3
		9. Penstock		- Connection	Δ/Δ
		- Dimensions (m) (∅ x L)	∅ = 1.20 L = 634	- Number Continuous Stand-by	1 0
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace (W x H) (m)	W H 2.0 x 1.05		

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 242 RIO IQUIRA-II

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1971 - 1985
Used Data	1983 - 1985

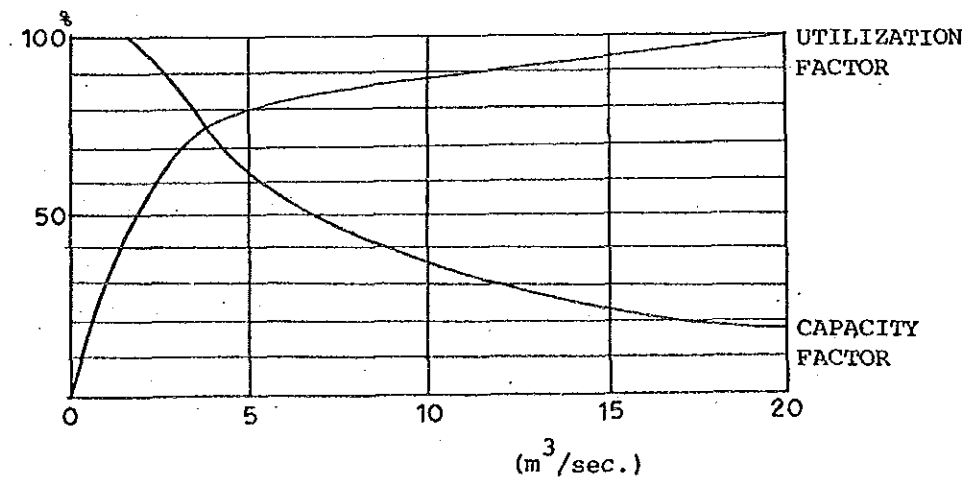
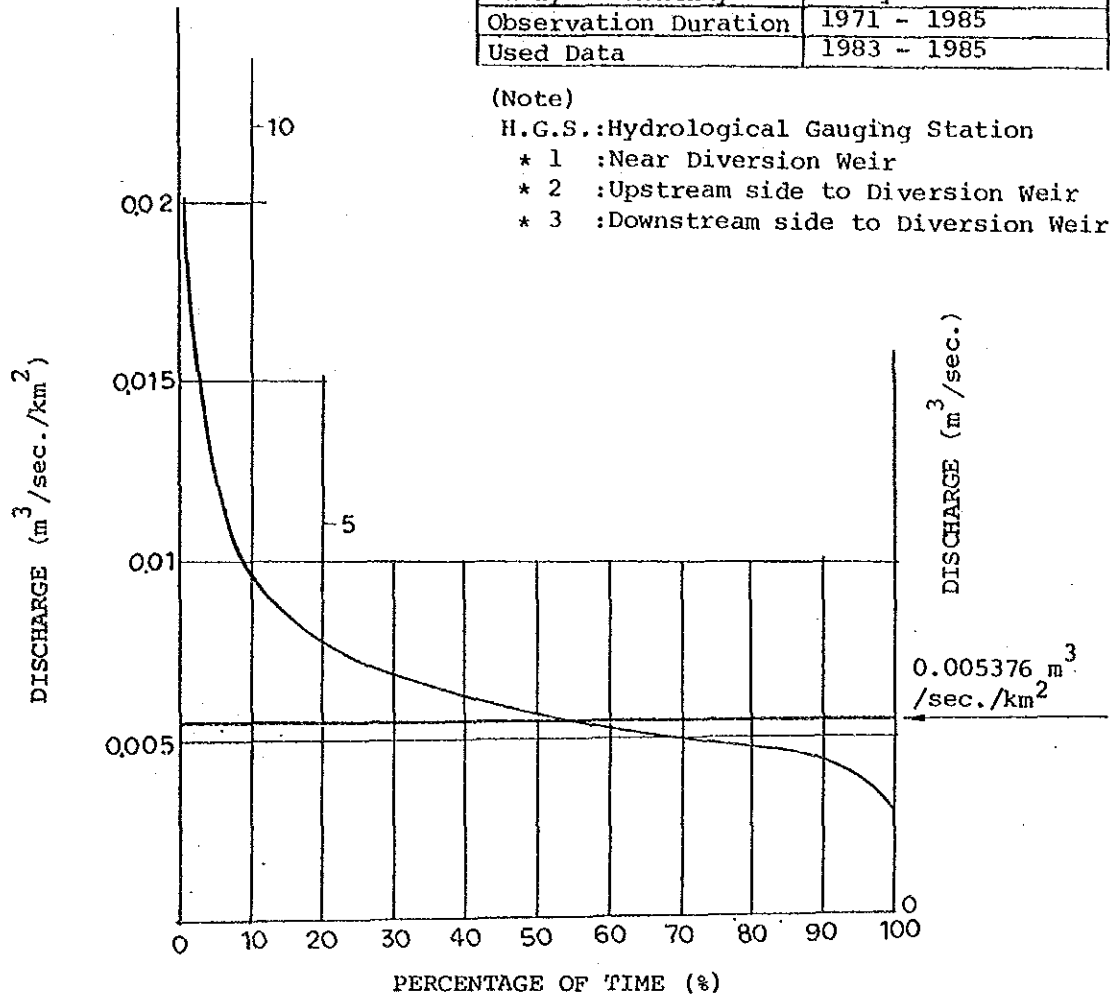
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



1. Present Condition and Problems

- ① The rehabilitation object desired by E. Huila S. A. is to replace the ancillary equipment such as control, supervisory and protection panels, etc. in the same way as Rio Iquira-I.
- ② The intake for the Iquira-II is directly connected to the tailrace for the Rio Iquira-I. Therefore, the output depends on the operation condition of Iquira-I.
- ③ The generating facilities were changed from two units (1500 kVA x 2) to one unit (3000 kVA) in 1954.

2. Key Points for the Rehabilitation Plan

- ① The specifications for the existing control, supervisory and protection panels and their defective parts shall be confirmed.

GENERAL

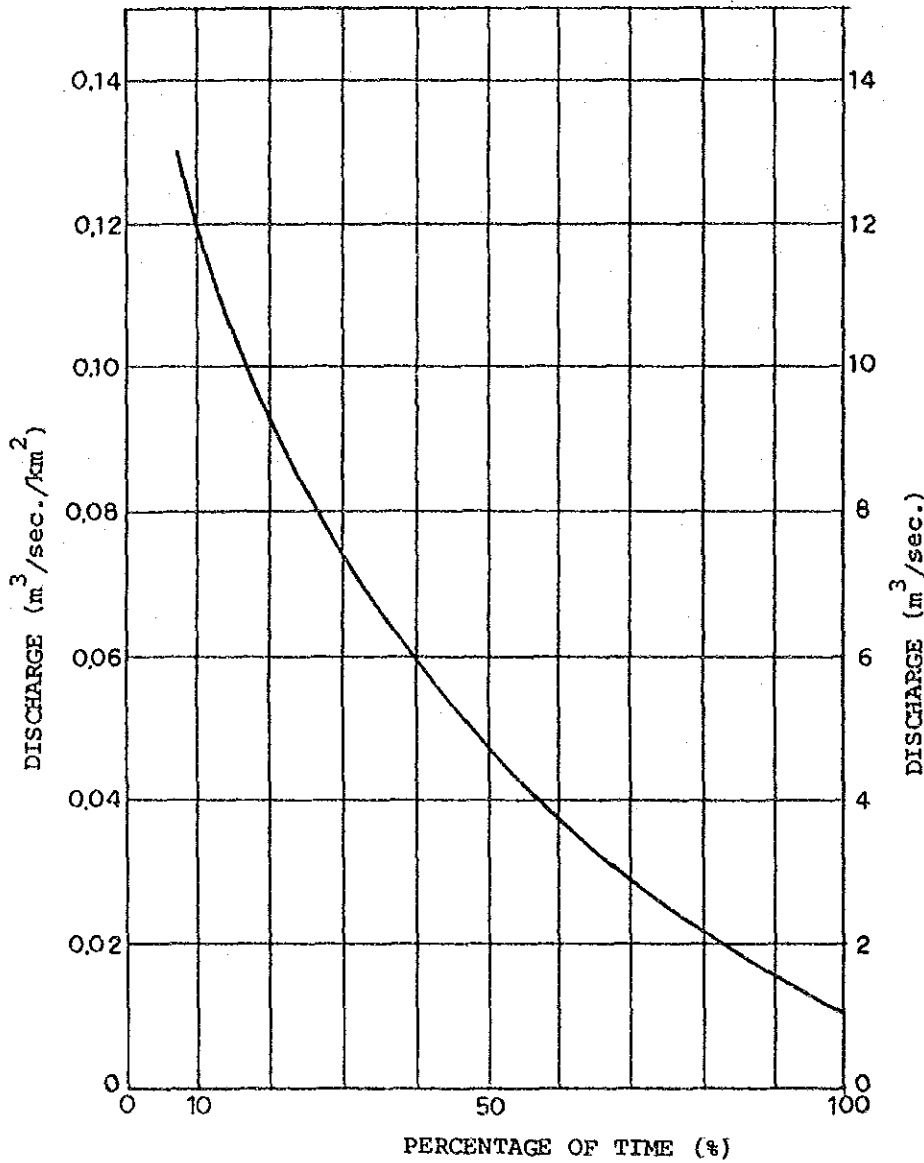
Power Plant	NO. 243 EL CALVARIO	Investigated Date	20 Feb. 1988
Electric Company	ELECTRO META S.A. (EMSA)	Available Capacity (kW)	16
Location	MESA		
River	Q. LA PANELA		
Generating Method	RUN-OF-RIVER		
Installed Year	1984	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	99	1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	CONCRETE	- Manufacturing Year	
- Plenty Water Discharge		- Height (m)	1.0	- Type	PELTON
- Ordinary Water Discharge		- Crest Length (m)	10.0	- Output (kW)	
- Low Water Discharge		- Elevation of overflowing Crest (m)		- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge		- Width of Overflowing Crest (m)	10.0	- Type of Governor	NO NAME PLATE
- Minimum		- Depth of Overflowing (m)		- Regulating Valve	
- Mean		2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	0.04	- Type		Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)		- Dimensions (R x H) (m)		2. Generator	
5. Head (m)		- Number of Gates		- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYNCHRO
- Tailwater Level (EL)		- Elevation of Intake Sill (m)		- Number of Generator	1 1
- Gross Head	60	- Dimensions (m) (W x H)		- Capacity (kVA)	25 100
- Head Loss		- Number of Intake	1	- Power Factor (%)	0.8 0.8
- Net Head		4. Dimensions of Forebay (m)		- Voltage (V)	208/ NO NAME PLATE
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)		- Frequency (Hz)	60
7. Plant Capacity (kW)	20	6. Intake Gate		- Revolution (rpm)	1,800 NO NAME PLATE
8. Output (MWh)	UNKNOWN	- Type	MANUAL	3. Transformer	
9. Construction Price (1,000,000 pesos)	UNKNOWN	- Dimensions (m) [W x H]		- Manufacturing Year	N/A
10. Unit Price 1,000 pesos/kW	UNKNOWN	- Number of Gates		- Type	N/A
pesos/kWh	UNKNOWN	7. Headrace		- Capacity (kVA)	N/A
11. Others		- Type	CONCRETE & COVER	- Primary Voltage (kV)	N/A
		- Dimensions (m) [W x H]	0.45 x 0.3	- Secondary Voltage (kV)	N/A
		- Length (m)	450	- Number of Phase	N/A
		8. Dimensions of Water Reservoir (m)	4 x 4 H = 2.5	- Connection	N/A
		9. Penstock		- Number	N/A
		- Dimensions (m) (φ x L)	0.25	Continuous Stand-by	N/A
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace [W x H] (m)			

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 243 EL CALVARIO



Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1969 - 1985
Used Data	1980 - 1982

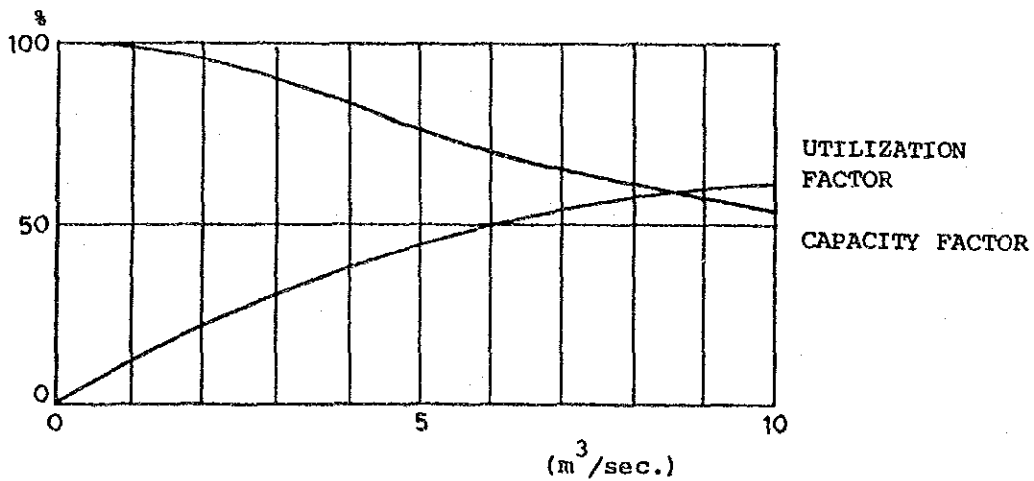
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



1. Present Condition and Problems

- ① A considerably old-fashioned (without nameplate) generator was installed in 1984, and still now operates for 5 hours in the evening. The output reduction rate is as low as 20 %.
- ② Because of self-supporting system, the generated power are utilized only by the El Calvario village.
- ③ The conduit is of a bad construction and the sand-discharge function has been lost.
- ④ A part of water from the head tank is utilized for drinking water.
- ⑤ The leaked water is found in various positions of the penstock. In particular the water is furiously leaked from the valve part.
- ⑥ A trace of rehabilitated landslide is found on a part of the conduit. The landslide will probably recurs before long.
- ⑦ The monitor panel for the generator works insufficiently because of the shortage of measuring instruments.

2. Key Points for the Rehabilitation Plan

- ① Take some reinforcing measures for the conduit.
- ② Rehabilitate the penstock.
- ③ Rehabilitate the monitor panel.

GENERAL

Power Plant	NO. 244 SAN JUANITO	Investigated Date	18 Feb. 1988
Electric Company	ELECTRO META S. A. (EMSA)	Available Capacity (kW)	20
Location	META		
River	GUAJARO		
Generating Method	RUN-OF-RIVER		
Installed Year	1986	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	781	1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	WOODEN	- Manufacturing Year	
- Plenty Water Discharge		- Height (m)	3	- Type	FRANCIS
- Ordinary Water Discharge		- Crest Length (m)	10	- Output (kW)	50
- Low Water Discharge		- Elevation of over-flowing Crest (m)		- Revolution (rpm)	(727)
- Droughty Water Discharge		- Width of Over-flowing Crest (m)		- Type of Governor	NO NAME PLATE
- Minimum		- Depth of Over-flowing (m)		- Regulating Valve	NO NAME PLATE
- Mean		2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)		- Type	N/A	Dimension (mm)	NO NAME PLATE
- Dimensions (W x H) (m)		- Dimensions (W x H) (m)	N/A		
- Number of Gates		- Number of Gates	N/A	2. Generator	
4. Firm Discharge (m <sup>3</sup> /s)	0.1	3. Intake		- Manufacturing Year	
5. Head (m)		- Elevation of Intake Sill (m)		- Type	SYNCR0
- Headwater Level (EL)		- Dimensions (m) (W x H)		- Number of Generator	1
- Tailwater Level (EL)		- Number of Intake	1	- Capacity (kVA)	25
- Gross Head	53	4. Dimensions of Forebay (m)	N/A	- Power Factor (%)	80
- Head Loss		5. Dimensions of Settling Basin (m) (W x L x H)	N/A	- Voltage (V)	220/127
- Net Head		6. Intake Gate		- Frequency (Hz)	60
6. Efficiency (%)	UNKNOWN	- Type	MANUAL	- Revolution (rpm)	1,800
7. Plant Capacity (kW)	20	- Dimensions (m) [W x H]	0.41 x 0.32	3. Transformer	
8. Output (MWh)	UNKNOWN	- Number of Gates	1	- Manufacturing Year	
9. Construction Price (1,000,000 pesos)	UNKNOWN	7. Headrace		- Type	ONAN
10. Unit Price (1,000 pesos/kWh)	UNKNOWN	- Type	CONCRETE CANNAL	- Capacity (kVA)	30
pesos/kWh	UNKNOWN	- Dimensions (m) [W x H]	0.47 x 0.43	- Primary Voltage (V)	228
		- Length (m)	H = 0.53 850	- Secondary Voltage (kV)	13.2
11. Others		8. Dimensions of Water Reservoir (m)	2.6 x 4.1 H = 1.9	- Number of Phase	3
		9. Penstock	0.25	- Connection	(YND)
		- Dimensions (m) (φ x L)		- Number	
		- Number of Lines	1	Continuous Stand-by	1 0
		10. Dimensions of Tailrace [W x H] (m)	0.44 x 0.98 H = 0.78	4. Others	



# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 244 SAN JUANITO

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1969 - 1984
Used Data	1977 - 1979

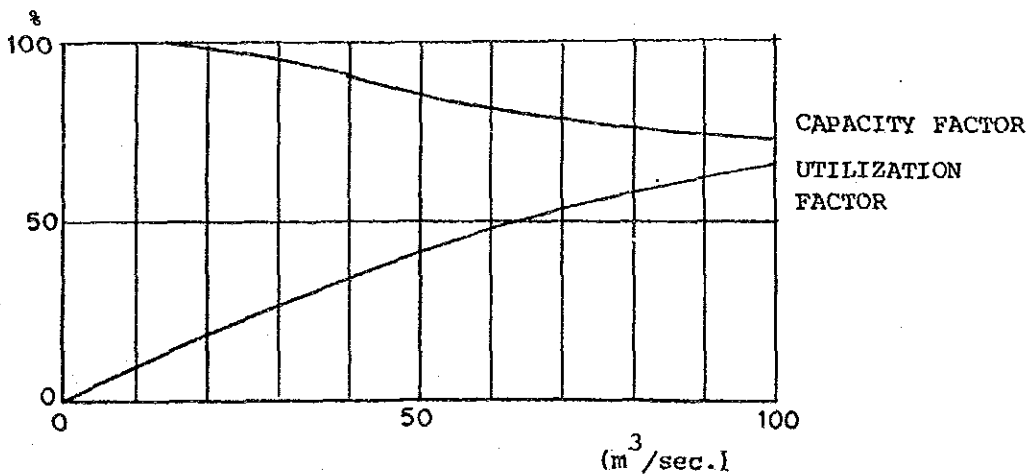
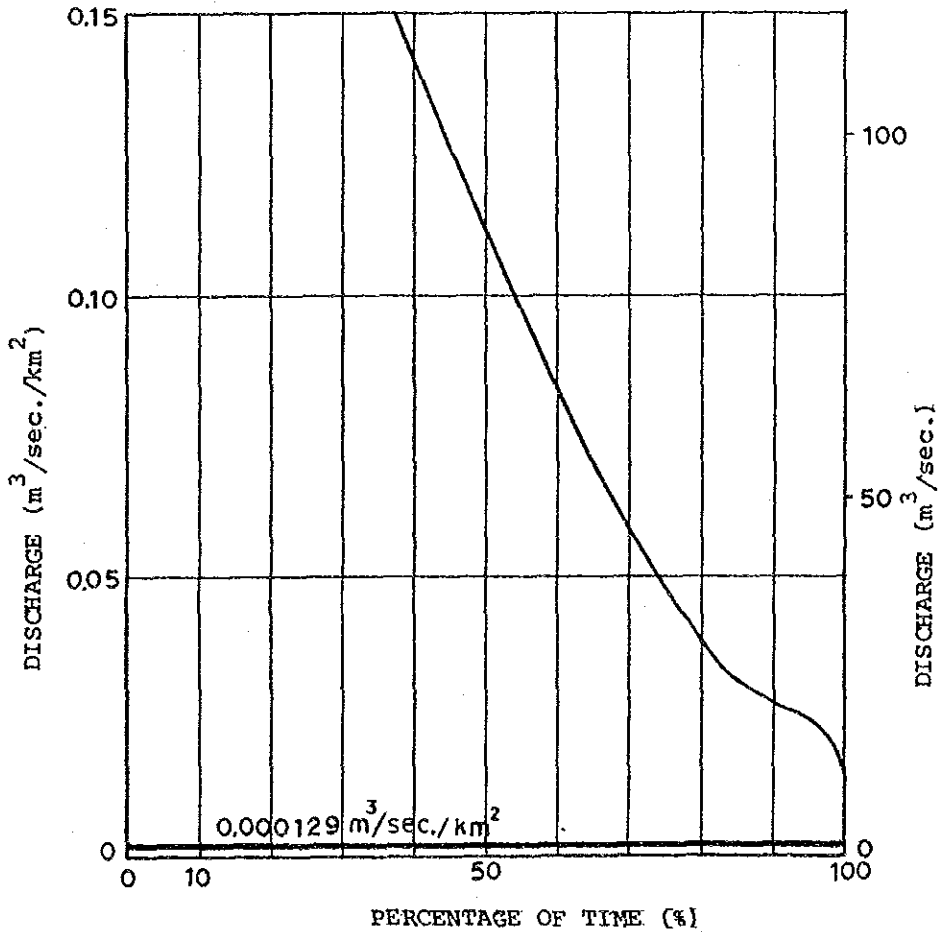
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



No. 244 San Juanito

1. Present Condition and Problems

- ① A 1964-year-model generator was installed in 1986. This generator operates for 24 years everyday in a good condition at a rated output level.
- ② The intake weir is made of wood and has been heaped to the crest with sands. This causes a strength problem.
- ③ The conduit and head tank are strong and kept in a good condition.
- ④ The penstock is of steel on the upstream side while of PVC on the rest.

2. Key Points for the Rehabilitation Plan

- ① Analyze the stability of the intake weir and rehabilitate it if necessary.

GENERAL

Power Plant	NO. 245 RIO MAYO - II	Investigated Date	3 Dec. 1987
Electric Company	CEDENAR	Available Capacity (kW)	20,000
Location	MARINO		
River	MAYO		
Generating Method	PONDAGE TYPE		
Installed Year	1969	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment			
Item	Data	Item	Data	Item	Data		
1. Catchment Area (Km <sup>2</sup> )	450	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1	#2	#3
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	1963/65	1963/65	1965/66
- Plenty Water Discharge	NO DATA	- Height (m)		- Type	FRANCIS FRANCIS FRANCIS		
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30	- Output (kW)	NO NAME PLATE		
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)		- Revolution (rpm)	720	720	720
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)		- Type of Governor	NO NAME PLATE		
- Minimum	NO DATA	- Depth of Over-flowing (m)		- Regulating Valve			
- Mean	14.7	2. Sand Trap Gate		Type	NO NAME PLATE		
3. Utilizable Flow (m <sup>3</sup> /s)	12.5	- Type	RADIAL	Dimension (mm)	NO NAME PLATE		
4. Firm Discharge (m <sup>3</sup> /s)	5.8	- Dimensions (ØxH) (m)	W H 6.0 x 2.5	2. Generator			
5. Head (m)	1,603	- Number of Gates	3	- Manufacturing Year			
- Headwater Level (EL)		3. Intake		- Type	SYN.	SYN.	SYN.
- Tailwater Level (EL)	1,385	- Elevation of Intake Sill (m)		- Number of Generator	1	1	1
- Gross Head	218	- Dimensions (m) (WxH)		- Capacity (kVA)	8,750	8,750	8,750
- Head Loss	9	- Number of Intake	1	- Power Factor (%)	80		
- Net Head	209	4. Dimensions of Forebay (m)	NON	- Voltage (kV)	6.6		
6. Efficiency (%)	209	5. Dimensions of Settling Basin (m) (W x L x H)		- Frequency (Hz)	60		
7. Plant Capacity (kW)	21,000	6. Intake Gate		- Revolution (rpm)	720		
8. Output (MWh)	141.3	- Type		3. Transformer			
9. Construction Price \$	130x10 <sup>6</sup>	- Dimensions (m) [W x H]		- Manufacturing Year			
10. Unit Price pesos/kW	6,190	- Number of Gates		- Type	ONAN, OUTDOOR		
pesos/kWh	0.92	7. Headrace		- Capacity (kVA)	8,750	1,500	4,000
11. Others		- Type	TUNNEL	- Primary Voltage (kV)	6.6	6.6	6.6
		- Dimensions (m) (W x H)	W H 2.0 x 2.3	- Secondary Voltage (kV)	115	13.2	34.5
		- Length (m)	1,624	- Number of Phase	1	3	3
		8. Dimensions of Water Reservoir (m)		- Connection	Δ/Δ Δ/Δ Δ/Δ		
		9. Penstock		- Number			
		- Dimensions (m) (φ x L)	φ = 2.0 - 1.8 L =	Continuous Stand-by	3	1	1
		- Number of Lines	1		0	0	0
		10. Dimensions of Tailrace [W x H] (m)		4. Others	#1, 2, 3 Unit: Operating		

# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

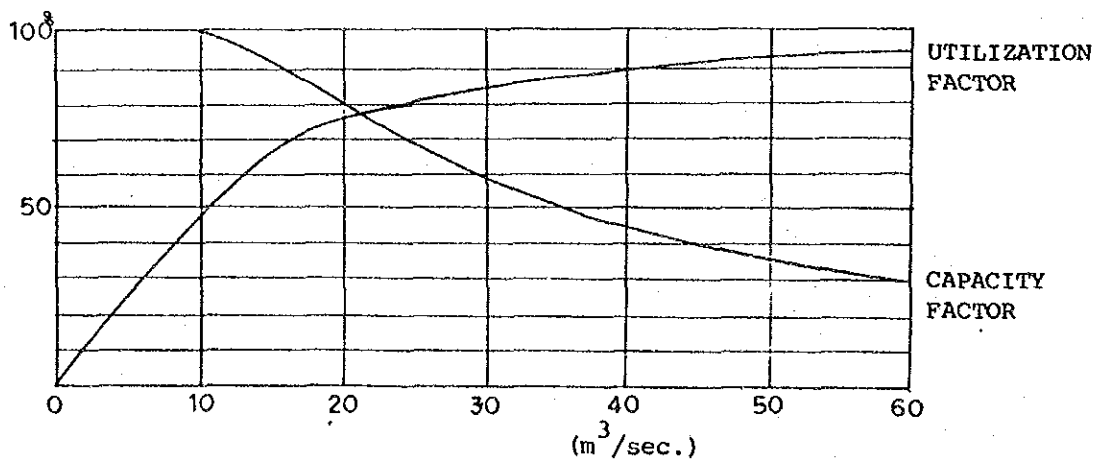
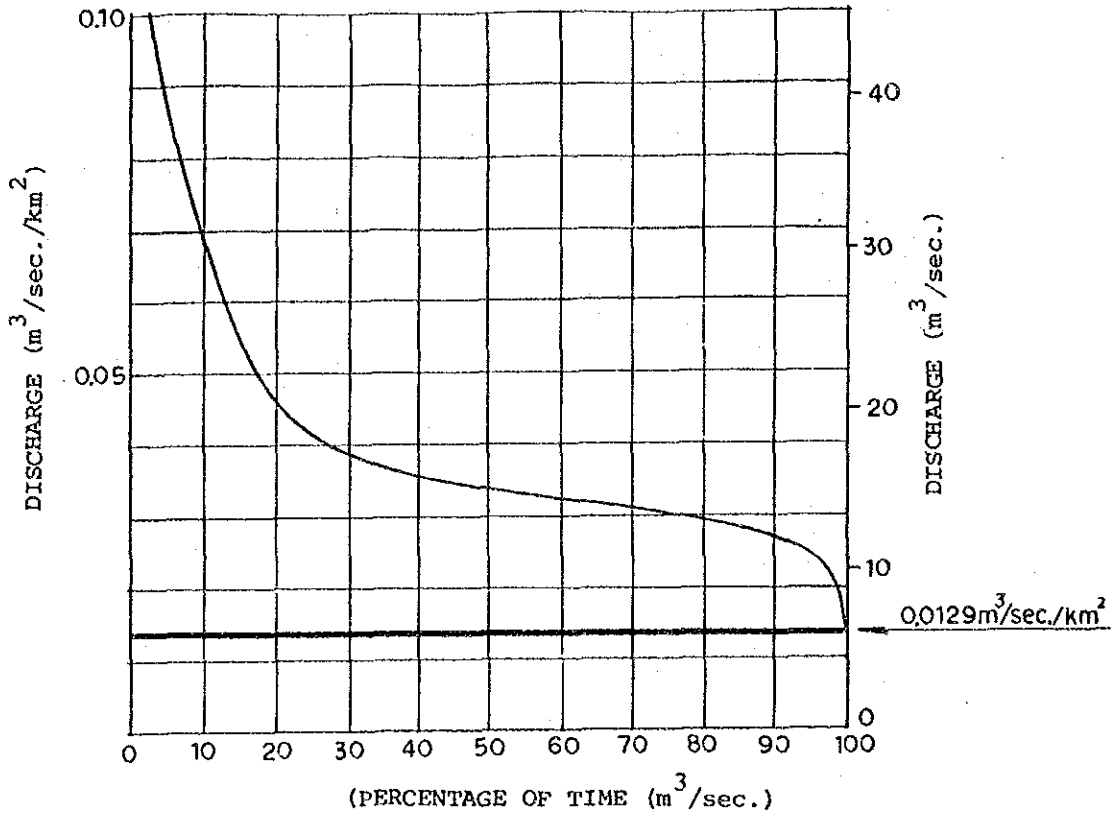
NO. 245 RIO MAYO-II

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1961 - 1985
Used Data	1983 - 1985

(Note)

H.G.S.:Hydrological Gauging Station

- \* 1 :Near Diversion Weir
- \* 2 :Upstream side to Diversion Weir
- \* 3 :Downsrteam side to Diversion Weir



No. 245 Rio Mayo-II

1. Present Condition and Problems

- ① Except for the problem of sands sedimented in the reservoir, there are no fatal operational obstacles. To solve the heaped sand problem, the following measures should be reviewed.
  - a. Have a grasp of the quantity of flown-into sand through a regular cross-sectional survey within the reservoir.
  - b. Take the sand-control measures for the mountain stream in the river basin.
  - c. Execute an emergency dredging work at the end of reservoir back-water.

2. Key Points for the Rehabilitation Plan

- ① Nothing in particular.

GENERAL

Power Plant	NO. 246 RIO BOBO	Investigated Date	2 Dec. 1987
Electric Company	CEDENAR	Available Capacity (kW)	0
Location	NARIÑO		
River	BOBO → OPONGOI		
Generating Method	RUN-OF-RIVER		
Installed Year	1956	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment			
Item	Data	Item	Data	Item	Data		
1. Catchment Area (Km <sup>2</sup> )	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1	#2	#3
2. Volume of Discharge (m <sup>3</sup> /s)	2.0	- Type		- Manufacturing Year			
- Plenty Water Discharge		- Height (m)	5.7	- Type	PELTON	PELTON	PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	25.8	- Output (kW)	NO NAME PLATE	450 HP	2,110 HP
- Low Water Discharge	NO DATA	- Elevation of Overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE	720	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Overflowing Crest (m)	25.8	- Type of Governor	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
- Minimum	NO DATA	- Depth of Overflowing (m)	UNKNOWN	- Regulating Valve Type	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Dimension (mm)	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	NOT CONFIRMED	2. Generator			
4. Firm Discharge (m <sup>3</sup> /s)	1.8	- Dimensions (WxH) (m)	NOT CONFIRMED	- Manufacturing Year			
5. Head (m)		- Number of Gates	NOT CONFIRMED	- Type	SYN.	SYN.	SYN.
- Headwater Level (EL)	2,830	3. Intake		- Number of Generator	1	1	1
- Tailwater Level (EL)	2,510	- Elevation of Intake Sill (m)	UNKNOWN	- Capacity (kVA)	1,800	1,800	1,750
- Gross Head	320	- Dimensions (m) (WxH)	W x H	- Power Factor (%)	80	80	85
- Head Loss	UNKNOWN	- Number of Intake	1	- Voltage (V)		3,300	
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Frequency (Hz)		60	
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Revolution (rpm)		720	
7. Plant Capacity (kW)	4,368	6. Intake Gate		3. Transformer			
8. Output (MWh)	UNKNOWN	- Type	SLUICE	- Manufacturing Year			
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NOT CONFIRMED	- Type	ONAN	ONAN	ONAN
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	- Capacity (kVA)	OUTDOOR	OUTDOOR	OUTDOOR
pesos/kWh	NO DATA	7. Headrace		- Primary Voltage (kV)	1,800x3	500	
11. Others		- Type	CHANNEL	- Secondary Voltage (kV)	3.3	3.3	
		- Dimensions (m) [W x H]	W x H	- Number of Phase	34.5	13.2	
		- Length (m)	1,000	- Connection	1	3	
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Number	Y/Δ	NO NAME PLATE	
		9. Penstock		- Continuous Stand-by	3	1	
		- Dimensions (m) (φ x L)	φ = 0.76 L = 485	4. Others	0	0	
		- Number of Lines	1	#1, 2, 3 Unit:			Stpped
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED				

No. 246 Rio Bobo

1. Present Condition and Problems

- ① Because of its damaged part of conduit (under the rehabilitation design), this power station had no water supply and has been suspended.
- ② As no flow data and design drawings have been provided, the flow condition and head cannot be checked.  
The conduit structures are not well designed. However, if repair for the conduit is over, the operation will be restarted.
- ③ There is a vast irrigation reservoir in the upstream of the intake weir. This power plant intakes the water discharged from the reservoir. Because of the shortage of the water to be intaken in the draught water season, the increase of the reservoir water level has been reviewed.

2. Key Points for the Rehabilitation Plan

- ① By use of a vast reservoir located in the upstream of the intake weir, review the conversion of this site into a reservoir-type power plant.
- ② Prepare the water level records and flow data for the reservoir.
- ③ Execute the aerial-photo survey and geological survey and select an optimum waterway route and power plant site. (Refer to the annexed figure.)

GENERAL

Power Plant	NO. 247 RIO SAPUYES	Investigated Date	2 Dec. 1987
Electric Company	CEDENAR	Available Capacity (kW)	780
Location	NARINO		
River	SAPUYES		
Generating Method	RUN-OF-RIVER		
Installed Year	1956	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment			
Item	Data	Item	Data	Item	Data		
1. Catchment Area (Km <sup>2</sup> )	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine			
2. Volume of Discharge (m <sup>3</sup> /s)		- Type			#1	#2	#3
- Plenty Water Discharge	NO DATA	- Height (m)	6.0	- Manufacturing Year	1954	1956	1957
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	22.2	- Type	FRANCIS	FRANCIS	FRANCIS
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Output (kW)	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	22.2	- Revolution (rpm)	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Type of Governor	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Regulating Valve	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	SLUICE	Type	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	2.0	- Dimensions (R x H) (m)	NOT CONFIRMED	Dimension (mm)	NO NAME PLATE	NO NAME PLATE	NO NAME PLATE
5. Head (m)	UNKNOWN	- Number of Gates		2. Generator			
- Headwater Level (EL)	UNKNOWN	3. Intake		- Manufacturing Year			
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	SLIDE	- Type	SYN.	SYN.	SYN.
- Gross Head	107	- Dimensions (m) (W x H)	NOT CONFIRMED	- Number of Generator	1	1	1
- Head Loss	UNKNOWN	- Number of Intake	1	- Capacity (kVA)	410	410	1,500
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Power Factor (%)	80	80	80
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W x H x L	- Voltage (V)	500-289	500-289	500
7. Plant Capacity (kW)	1,856		12.3x3.0x	- Frequency (Hz)		60	
8. Output (Mwh)	UNKNOWN	6. Intake Gate		- Revolution (rpm)	720-1,310	720-1,310	900-1,610
9. Construction Price (1,000,000 pesos)	NO DATA	- Type	SLUICE	3. Transformer			
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Dimensions (m) (W x H)	W H	- Manufacturing Year	ONAN	ONAN	ONAN
11. Others	NO DATA	- Number of Gates	2.5 x	- Type	OUTDOOR	OUTDOOR	OUTDOOR
		7. Headrace	1	- Capacity (kVA)	410	470	2,500
		- Type	CHANNEL	- Primary Voltage (V)	500	500	13.2
		- Dimensions (m) (W x H)	W H	- Secondary Voltage (kV)	13.2	13.2	34.5
		- Length (m)	3.0 x 1.8	- Number of Phase	3	1	1
		8. Dimensions of Water Reservoir (m)	3,100	- Connection	Δ/Δ	L/L	λ/Δ
			NOT CONFIRMED	- Number Continuous Stand-by	2	3	3
		9. Fenstock	φ = 0.6, 0.9		0	0	0
		- Dimensions (m) (φ x L)	L = 200	4. Others			
		- Number of Lines	2		#1, 2, 3 Unit:		
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRMED		Operating		



No. 247      Rio Sapuyes

1. Present Condition and Problems

- ① The operation is kept in a good condition. The rehabilitation priority order decided by the electric power company is also low.
- ② As no flow data and design drawing have been supplied, the flow condition and head cannot be checked.
- ③ Except for the incidental gates and valves, the conduit structures are kept in a good condition.
- ④ In the upstream of the intake weir, a weir for the flood control and sand-control is under construction.


2. Key Points for the Rehabilitation Plan

- ① Replacement of the gates, valves and screens incidental to the conduit structures.

GENERAL

Power Plant	NÓ. 248 JULIO BRAVO	Investigated Date	1 Dec. 1987
Electric Company	CEDENAR	Available Capacity (kW)	0
Location	NARINO		
River	PASTO		
Generating Method	RUN-OF-RIVER		
Installed Year	1942	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment				
Item	Data	Item	Data	Item	Data			
1. Catchment Area (Km <sup>2</sup> )	177	1. Dam	OVERFLOW CONCRETE	1. Turbine				
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	NOT CONFIRMED	- Manufacturing Year				
- Plenty Water Discharge	NO DATA	- Height (m)	NOT CONFIRMED	- Type	PELTON	PELTON	PELTON	
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	NOT CONFIRMED	- Output (kW)	725HP	725HP	725HP	
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	NOT CONFIRMED	- Revolution (rpm)	720		720	
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	NOT CONFIRMED	- Type of Governor				
- Minimum	NO DATA	- Depth of Over-flowing (m)	NOT CONFIRMED	- Regulating Valve				
- Mean	NO DATA	2. Sand Trap Gate		Type				
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	NOT CONFIRMED	Dimension (mm)				
4. Firm Discharge (m <sup>3</sup> /s)	2.0	- Dimensions (WxH) (m)	NOT CONFIRMED	2. Generator				
5. Head (m)		- Number of Gates	NOT CONFIRMED	- Manufacturing Year				
- Headwater Level (EL)	2,170	3. Intake		- Type	SYN.	SYN.	SYN.	
- Tailwater Level (EL)	2,040	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1	1	1	
- Gross Head	120	- Dimensions (m)	W H	- Capacity (kVA)	625			
- Head Loss	UNKNOWN	(WxH)	2.0 x 2.2	- Power Factor (%)	80			
- Net Head	UNKNOWN	- Number of Intake	1	- Voltage (KV)	6.9			
6. Efficiency (%)	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Frequency (Hz)	60			
7. Plant Capacity (kW)	(ASSUMED) 1,500	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Revolution (rpm)	720			
8. Output (MWh)	UNKNOWN	6. Intake Gate		3. Transformer				
9. Construction Price (1,000,000 pesos)	NO DATA	- Type	SLUICE	- Manufacturing Year				
10. Unit Price 1,000 pesos/kWh	NO DATA	- Dimensions (m) [W x H]	W H	- Type		OWAN, OUTDOOR		
11. Others		- Number of Gates	2.0 x 1.6	- Capacity (kVA)		2,500		
		7. Headrace	1	- Primary Voltage (V)		6,600		
		- Type	OPEN	- Secondary Voltage (kV)		13.2		
		- Dimensions (m) [W x H]	W H	- Number of Phase		3		
		- Length (m)	1.9 x 1.6	- Connection				
		8. Dimensions of Water Reservoir (m)	4,000	- Number		1		
		9. Penstock	NOT CONFIRMED	Continuous Stand-by		0		
		- Dimensions (m) (φ x L)	φ = 0.6 L = 200	4. Others		Stopped		
		- Number of Lines	2					
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED					

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 248 JULIO BRAVO

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1972 - 1985
Used Data	1983 - 1985

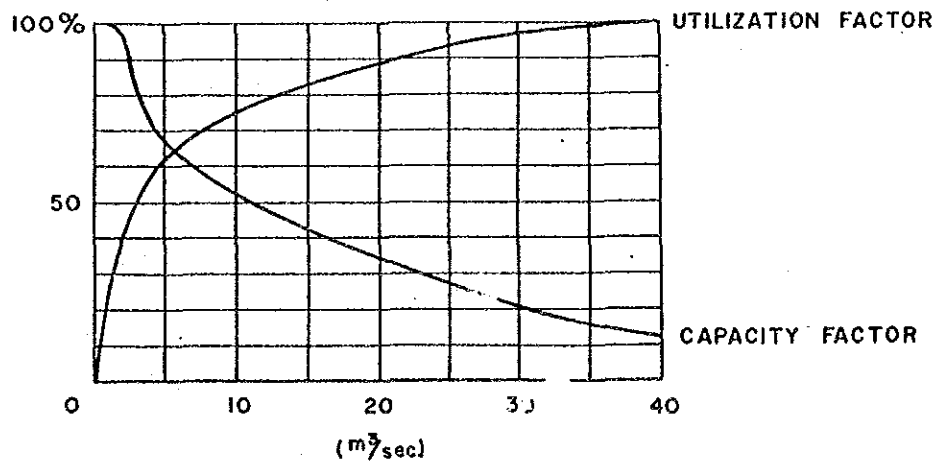
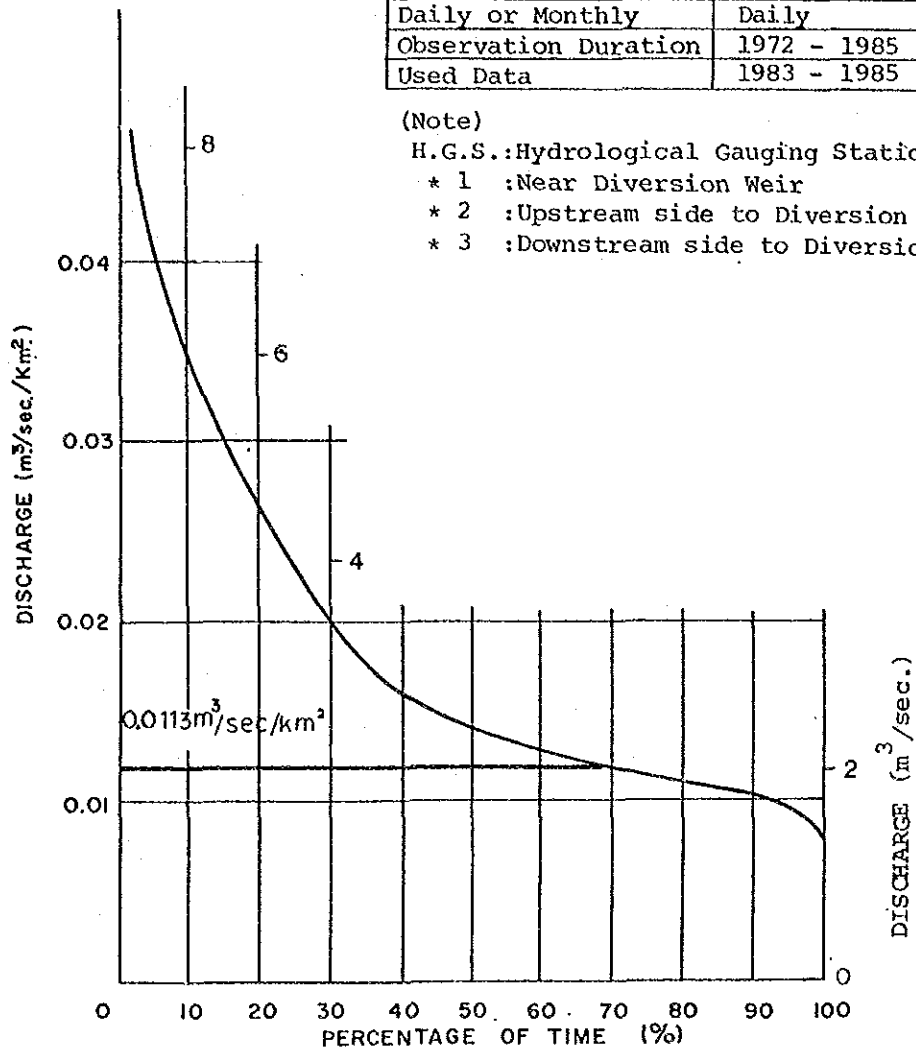
(Note)

H.G.S.:Hydrological Gauging Station.

\* 1 :Near Diversion Weir

\* 2 :Upstream side to Diversion Weir

\* 3 :Downstream side to Diversion Weir



1. Present Condition and Problems

- ① Penstocks in two rows are installed. The first installed one (diameter: ø22 inch) was damaged. Generating facilities have been suspended since 1984, because the newly constructed penstock, was worn out.
- ② The diversion weir, intake and settling basin have partially been damaged and have also some structural defects, so that they should be rehabilitated. The headrace shall be modified to an open channel to prevent the earth and sand from flowing into.
- ③ The generating facilities are obsolete and worn out. They have not maintained in a favorable condition while they are suspended. #2 unit has been changed to #4 unit and #3 unit has already been removed.
- ④ The water quality test of the Pasto River shall be conducted, because the wastewater from Pasto City flows into this river and this river is contaminated.

2. Consultation of the Rehabilitation Plan

- ① To recognize the hydrological regime at the intake according to hydrological data from the HIMAT's hydrological gauging station (No. 5204-701, Universidad) in the upstream, find the quantity of water intake in proportion to a proper plant capacity factor and then set up an optimum installed capacity.

- ② To check the possible flow capacity in the existing waterway, determine desired sectional forms for the rehabilitation.
- ③ To study the materials of the penstocks and turbine to be used, based on the result of water quality test.

GENERAL

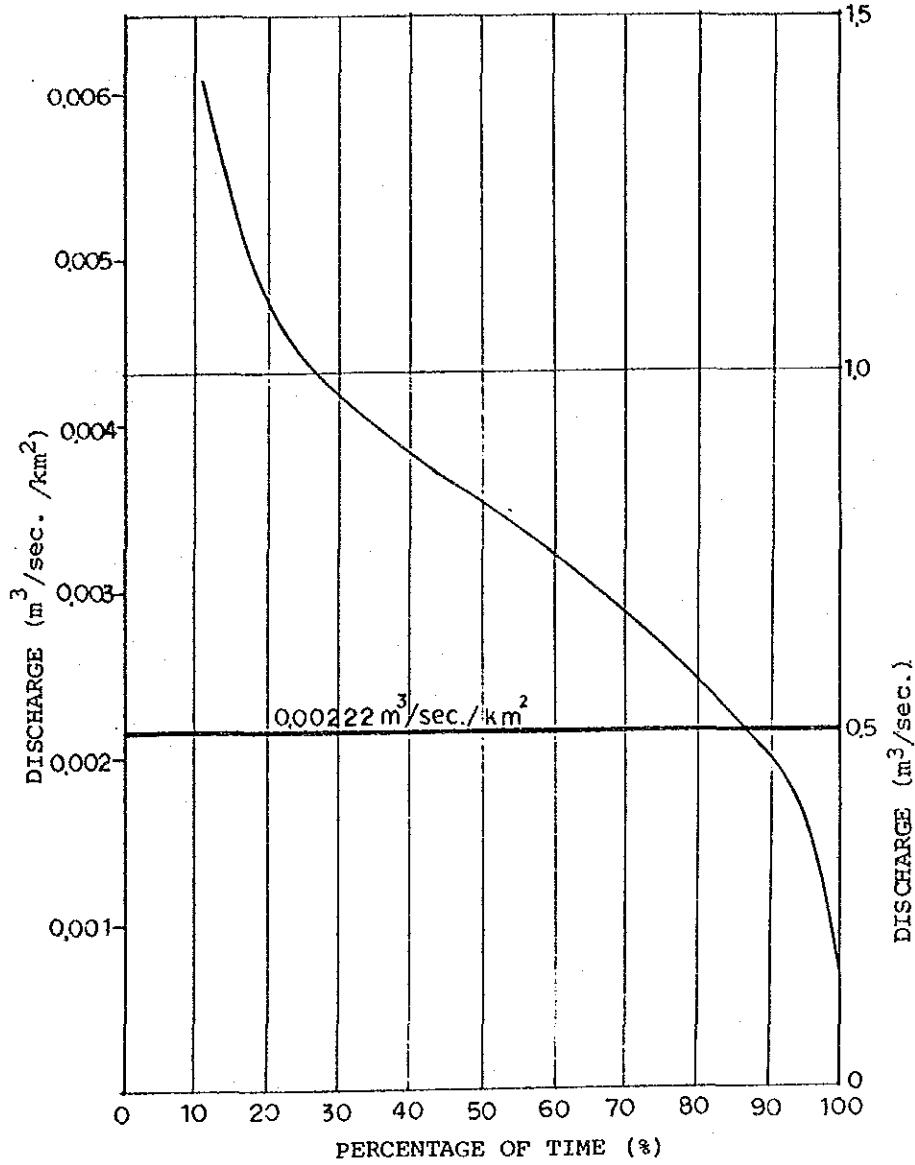
Power Plant	NO. 249 MULATO	Investigated Date	
Electric Company	HCOCA	Available Capacity (kW)	0
Location	PUTUMAYO		
River	MULATO		
Generating Method	RUN-OF-RIVER		
Installed Year	1964	Service-in	

SUMMARY OF GENERATING FACILITIES (DID NOT FIELD RECONNAISSANCE)

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	226	1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)		- Type	FRANCIS X 1
- Ordinary Water Discharge		- Crest Length (m)		- Output (kW)	
- Low Water Discharge		- Elevation of Over-flowing Crest (m)		- Revolution (rpm)	
- Droughty Water Discharge	0.7	- Width of Over-flowing Crest (m)		- Type of Governor	
- Minimum		- Depth of Over-flowing (m)		- Regulating Valve	
- Mean	1.8	2. Sand Trap Gate		Type	
3. Utilizable Flow (m <sup>3</sup> /s)		- Type		Dimension (mm)	
4. Firm Discharge (m <sup>3</sup> /s)	0.5	- Dimensions (ØxH) (m)		2. Generator	
5. Head (m)		- Number of Gates		- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	
- Tailwater Level (EL)		- Elevation of Intake Sill (m)		- Number of Generator	1
- Gross Head	50	- Dimensions (m) (WxH)	W L 10.2 x 0.7	- Capacity (kVA)	210
- Head Loss		- Number of Intake		- Power Factor (%)	80
- Net Head		4. Dimensions of Forebay (m)		- Voltage (kV)	
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 2.5x14.0x2.9	- Frequency (Hz)	
7. Plant Capacity (kW)	168	6. Intake Gate		- Revolution (rpm)	1,200
8. Output (MWh)		- Type		3. Transfozmer	
9. Construction Price (1,000,000 pesos)		- Dimensions (m) (W x H)		- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)		- Number of Gates		- Type	
pesos/kWh		7. Headrace		- Capacity (kVA)	250
11. Others		- Type	CHANNEL	- Primary Voltage (kV)	
		- Dimensions (m) (W x H)	A = 0.33 M <sup>2</sup>	- Secondary Voltage (kV)	2.4
		- Length (m)	1,100	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L H 4.0x4.0x5.0	- Connection	
		9. Penstock		- Number	
		- Dimensions (m) (Ø x L)	Ø = 0.6 L = 95	Continuous Stand-by	1
		- Number of Lines		4. Others	
		10. Dimensions of Tailrace (W x H) (m)	W H 1.5 x 2.0		Isolated

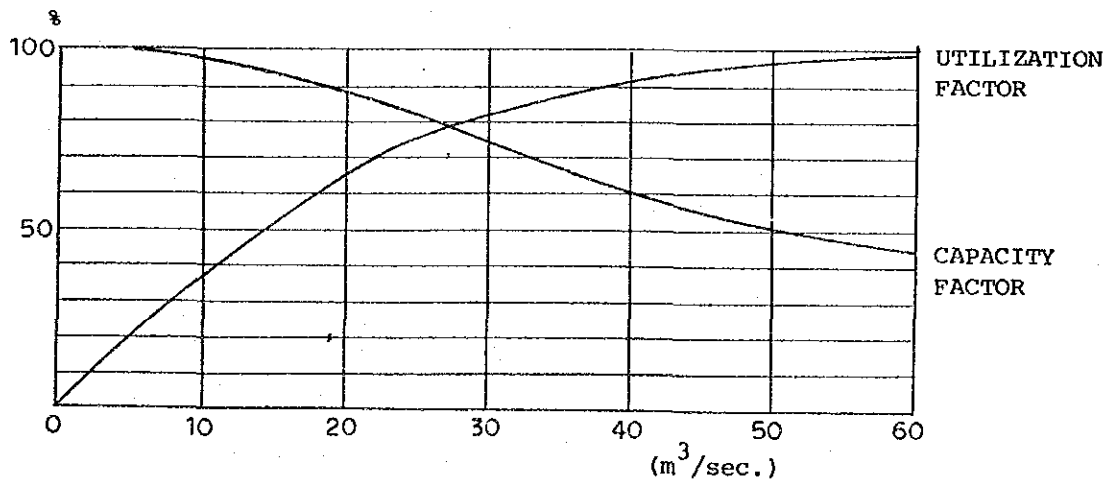
FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 249 MULATO



Location of H.G.S.	*
Daily or Monthly	Monthly
Observation Duration	1977 - 1984
Used Data	1977 - 1984

(Note)  
 H.G.S.:Hydrological Gauging Station  
 \* 1 :Near Diversion Weir  
 \* 2 :Upstream side to Diversion Weir  
 \* 3 :Downstream side to Diversion Weir



No. 249 Mulato

1. Present Condition and Problems

- ① This power plant has been suspended.
- ② No policy has been decided as to if this power plant should be specialized only for the power generating or shared with the city water.
- ③ This site was omitted from the field investigation.

2. Key Points for the Rehabilitation Plan



GENERAL

Power Plant	NO. 250 PALMAS	Investigated Date	9 Dec. 1987
Electric Company	ESSA	Available Capacity (kW)	13,000
Location	SANTANDER		
River	LEBRIJA		
Generating Method	PONDAGE TYPE		
Installed Year	1950/1960	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (km <sup>2</sup> )	1,865	1. Dam	CONC. GRAV. + FRAP GATE	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)	± 2.9	- Type	FRANCIS X 4
- Ordinary Water Discharge		- Crest Length (m)	30.0	- Output (kW)	4,500 X 4
- Low Water Discharge		- Elevation of overflowing Crest (m)		- Revolution (rpm)	720
- Droughty Water Discharge		- Width of Over-flowing Crest (m)	30.0	- Type of Governor	
- Minimum		- Depth of Over-flowing (m)		- Regulating Valve	
- Mean		2. Sand Trap Gate		- Type	
3. Utilizable Flow (m <sup>3</sup> /s)		- Type		- Dimension (mm)	
4. Firm Discharge (m <sup>3</sup> /s)	17.0	- Dimensions (WxH) (m)	W H 3.0 x 2.0	2. Generator	
5. Head (m)		- Number of Gates	4	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	
- Tailwater Level (EL)		- Elevation of Intake Sill (m)		- Number of Generator	4
- Gross Head	150	- Dimensions (m)	W H 7.0 x	- Capacity (kVA)	5,600
- Head Loss		- Number of Intake	2	- Power Factor (%)	80
- Net Head		4. Dimensions of Forebay (m)		- Voltage (V)	4,160
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 2x15.0x50.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	18,000	6. Intake Gate		- Revolution (rpm)	720
8. Output (MWh)		- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)		- Dimensions (m) [W x H]		- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)		- Number of Gates		- Type	
pesos/kWh		7. Headrace		- Capacity (kVA)	6,500
11. Others		- Type	TUNNEL	- Primary Voltage (v)	4,160
		- Dimensions (m) [W x H]	φ = 2.4	- Secondary Voltage (kV)	34.5
		- Length (m)	7,650	- Number of Phase	
		8. Dimensions of Water Reservoir (m)		- Connection	
		9. Penstock		- Number	
		- Dimensions (m) (φ x L)	φ = 1.5 L = 300 φ = 1.3 L = 140	Continuous Stand-by	4
		- Number of Lines	2	4. Others	
		10. Dimensions of Tailrace [W x H] (m)			

# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 250 PALMAS

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1972 - 1985
Used Data	1977, 1983, 1985

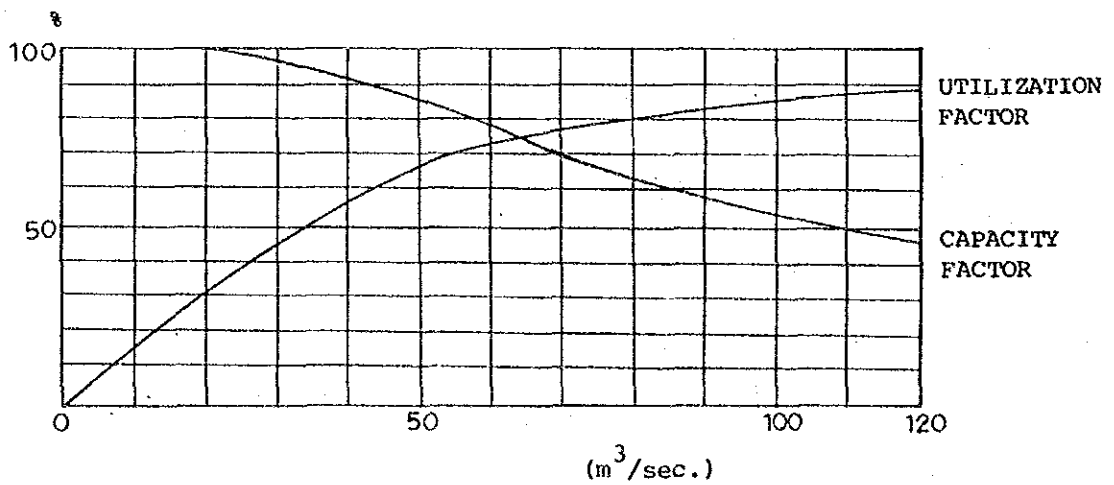
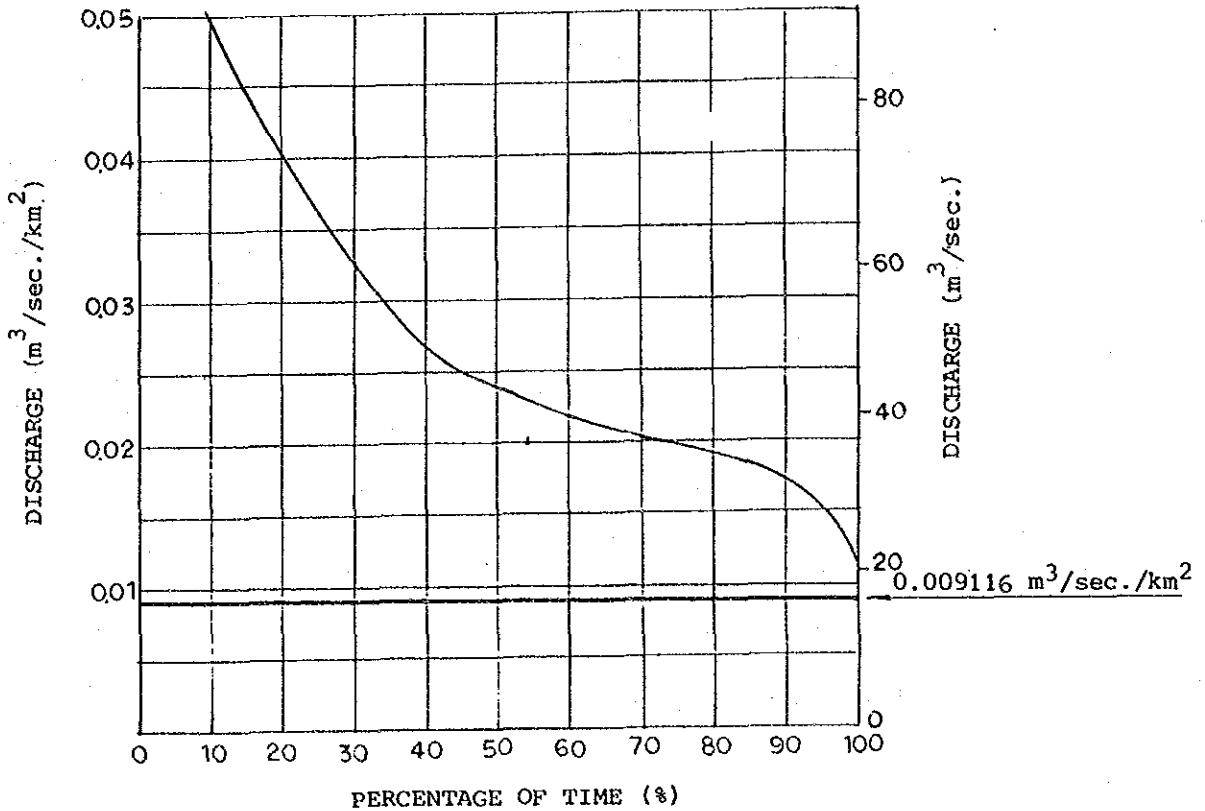
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



1. Present Condition and Problems

- ① Except for the sedimentation problem for the reservoir, this power plant is kept in a good condition.
  - Output in operation with #1 and #2 units.  
8 mW (90 % of the rated output)
  - Output in operation with #1, #2 and #3 units.  
11.8 mW (88 % of the rated output)
  - Output in operation with #1, #2, #3 and #4 units.  
13.0 mW (72 % of the rated output)
- ② In April 1987, because of a poor air valve operation, the penstocks for the #3 and #4 units have been crushed, but they are under rehabilitation works.
- ③ A F/S on an extension plan up to 28 mW was executed. (1981).

2. Key Points for the Rehabilitation Plan

- ① This power plant shall aim at a future extension program rather than a rehabilitation plan.

GENERAL

Power Plant	NO. 251 ZARAGOZA	Investigated Date	9 Dec. 1987
Electric Company	ESSA	Available Capacity (kW)	800
Location	SANTANDER		
River	SURATA		
Generating Method	RUN-OF-RIVER		
Installed Year	1931/1935/1948	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	1,284	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)	30	- Type	NO DATA	- Manufacturing Year	FRANCIS X 3
- Plenty Water Discharge	UNKNOWN	- Height (m)	NO DATA	- Type	
- Ordinary Water Discharge	UNKNOWN	- Crest Length (m)	NO DATA	- Output (kW)	520
- Low Water Discharge	UNKNOWN	- Elevation of over-flowing Crest (m)	NO DATA	- Revolution (rpm)	720
- Droughty Water Discharge	UNKNOWN	- Width of Over-flowing Crest (m)	NO DATA	- Type of Governor	
- Minimum	UNKNOWN	- Depth of Over-flowing (m)	NO DATA	- Regulating Valve	
- Mean	UNKNOWN	2. Sand Trap Gate	SLUICE	Type	
3. Utilizable Flow (m <sup>3</sup> /s)	UNKNOWN	- Dimensions (WxH) (m)	NOT CONFIRMED	Dimension (mm)	
4. Firm Discharge (m <sup>3</sup> /s)	6.5	- Number of Gates	3	2. Generator	
5. Head (m)	740	3. Intake		- Manufacturing Year	
- Headwater Level (EL)	710	- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYNCHRONOUS
- Tailwater Level (EL)	30	- Dimensions (m) (WxH)	W H	- Number of Generator	3
- Gross Head	UNKNOWN	- Number of Intake	3.5 x	- Capacity (kVA)	650
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)		- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H	- Voltage (V)	2,300
6. Efficiency (%)			20.0x40.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,560	6. Intake Gate		- Revolution (rpm)	720
8. Output (MWh)		- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H	- Manufacturing Year	
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1.8 x 1.5	- Type	
11. Others	NO DATA	7. Headrace	2	- Capacity (kVA)	650
		- Type	CHANNEL	- Primary Voltage (V)	2,300
		- Dimensions (m) (W x H)	W = 2.3-3.2	- Secondary Voltage (kV)	11.4
		- Length (m)	H = 1.3-1.6	- Number of Phase	
		8. Dimensions of Water Reservoir (m)	1,800	- Connection	
			W L H	- Number	4
		9. Penstock	10.0x15.0x	Continuous Stand-by	
		- Dimensions (m) (φ x L)	φ = 1.5	4. Others	
		- Number of Lines	L = 100		
		10. Dimensions of Tailrace (W x H) (m)	1		
			NOT CONFIRMED		

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 251 ZARAGOZA

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1968 - 1985
Used Data	1983 - 1985

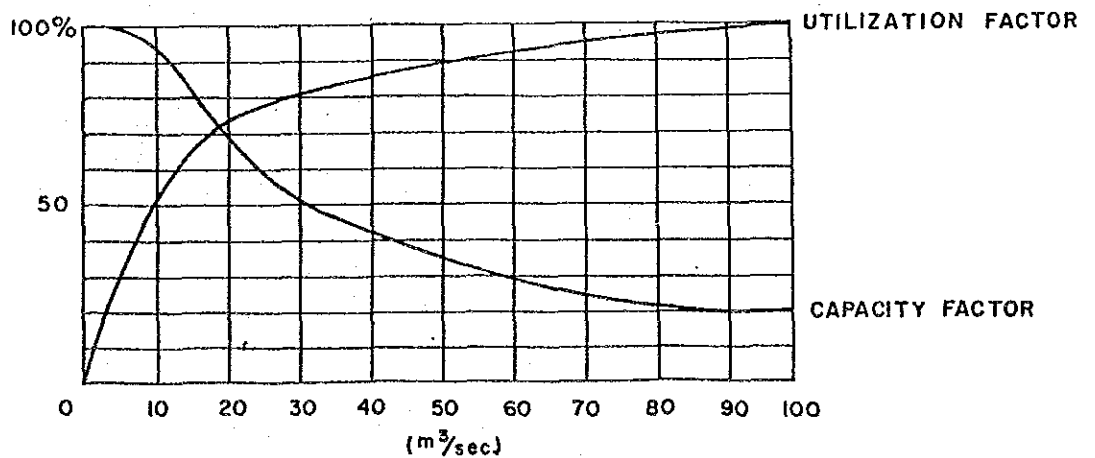
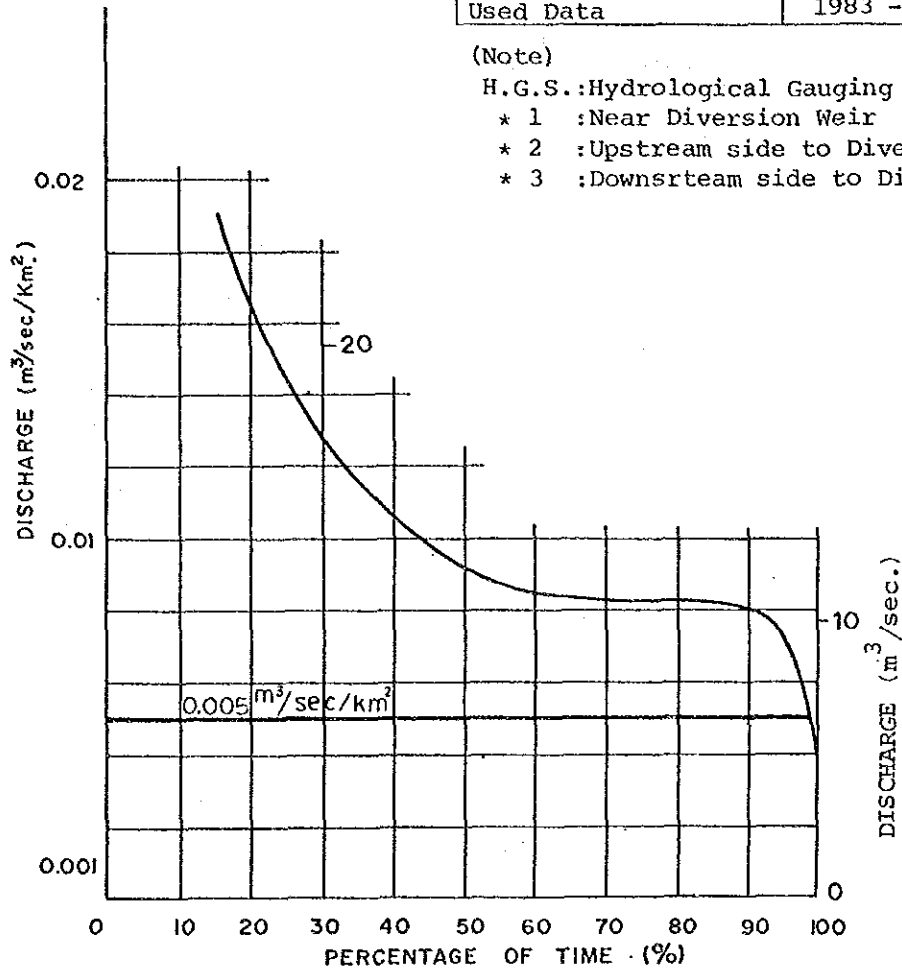
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downsrteam side to Diversion Weir



No. 251      Zaragoza

1. Present Condition and Problems

- ① River-water utilization factor in this power plant is low.
- ② The intake facilities have partially been damaged and have structural defects. Therefore they should be modified. The capacity of reservoir tank is small.
- ③ The generating facilities are obsolete. #3 unit is under repair.
- ④ The diversion weir for water supply to Bucaramanga city is provided in the downstream to the tailrace.
- ⑤ Erosion control works shall be executed in the upper reach of the Rio Surata.

2. Consultation of the Rehabilitation Plan

- ① To the hydrological regime at the intake, calculate the quantity of water intake in proportion to proper river-water utilization factor and plant capacity factor, and then set up an optimum installed capacity.
- ② To check the possible flow capacity at the headrace and then rehabilitate the headrace with desired sectional forms.
- ③ To estimate the quantity of sediment inflow from the river basin, and formulate erosion control plan.

GENERAL

Power Plant	NO. -252 CASCADA	Investigated Date	7 Mar. 1988
Electric Company	ESSA	Available Capacity (kW)	1,300
Location	SANTANDER		
River	FONCE		
Generating Method	RUN-OF-RIVER		
Installed Year	1939/1952/1956/1963	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	1,849	1. Dam	OVERFLOW CONCRETE	1. Turbine	#4 #5
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	J.M.VOITH '56 J.M.VOITH '63
- Plenty Water Discharge	80	- Height (m)	5.0	- Type	
- Ordinary Water Discharge	UNKNOWN	- Crest Length (m)	40.0	- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge	UNKNOWN	- Elevation of overflowing Crest (m)	NO DATA	- Revolution (rpm)	NO NAME PLATE NO NAME PLATE
- Droughty Water Discharge	UNKNOWN	- Width of Over-flowing Crest (m)	40.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	UNKNOWN	- Depth of Over-flowing (m)	NO DATA	- Regulating Valve	
- Mean	UNKNOWN	2. Sand Trap Gate		Type	BUTTERFLY BUTTERFLY
3. Utilizable Flow (m <sup>3</sup> /s)	21.8	- Type	NON	Dimension (mm)	ø1.5 ø1.5
4. Firm Discharge (m <sup>3</sup> /s)	18.8	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	NO DATA	3. Intake		- Type	BBC WA616
- Tailwater Level (EL)	NO DATA	- Elevation of Intake Sill (m)	NO DATA	- Number of Generator	1 1
- Gross Head	24.5	- Dimensions (m) (WxH)	W = 12.0x5.0	- Capacity (kVA)	1,500 1,500
- Head Loss	0.5	- Number of Intake	2	- Power Factor (%)	80 80
- Net Head	24.5	4. Dimensions of Forebay (m)	W L 15x(45x50)	- Voltage (V)	3,150 6,300
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) { W x L x H }	W L H 15.0x60.0x	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	3,350	6. Intake Gate		- Revolution (rpm)	450/870 450/870
8. Output (MWh)	UNKNOWN	- Type	WOODEN SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 1.95x2.30x2.55	- Manufacturing Year	
10. Unit Price 1,000 pesos/kWh	UNKNOWN	- Number of Gates	2	- Type	SOLVA BAIC-F NO NAME PLATE NO NAME PLATE
pesos/kWh	UNKNOWN	7. Headrace		- Capacity (kVA)	1,500 NO NAME PLATE NO NAME PLATE
11. Others		- Type	OPEN	- Primary Voltage (V)	13,200 NO NAME PLATE NO NAME PLATE
		- Dimensions (m) [W x H]	W = 4.45x6.10 H = 2.1	- Secondary Voltage (kV)	6.3 NO NAME PLATE NO NAME PLATE
		- Length (m)	740	- Number of Phase	3 NO NAME PLATE NO NAME PLATE
		8. Dimensions of Water Reservoir (m)	W L H 15.0x50.0x	- Connection	Y NO NAME PLATE
		9. Penstock		- Number	1 1
		2 x ø = 1.5		Continuous	0 0
		2 x ø = 1.2		Stand-by	
		- Dimensions (m) (ø x L)	L = 30	4. Others	
		- Number of Lines	4		
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

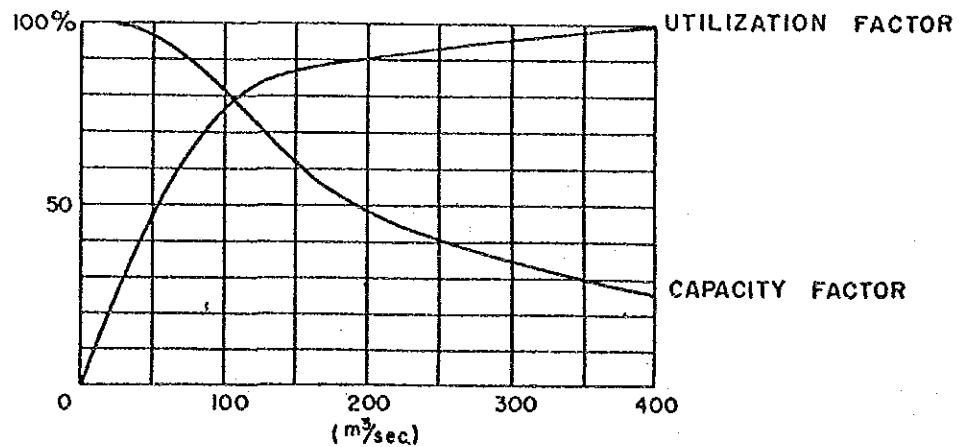
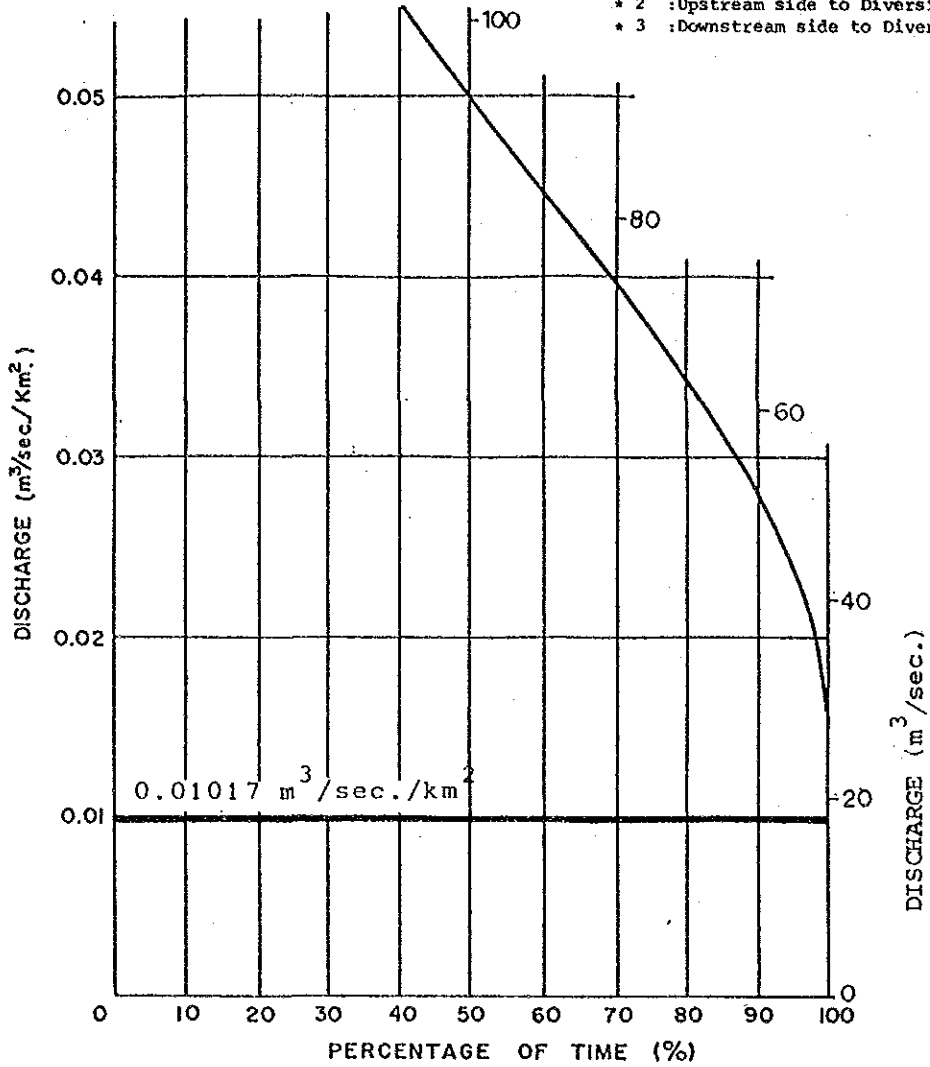
NO. 252 CASCADA

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1957 - 1985
Used Data	1981, 1984, 1985

(Note)

H.G.S.:Hydrological Gauging Station

- \* 1 :Near Diversion Weir
- \* 2 :Upstream side to Diversion Weir
- \* 3 :Downstream side to Diversion Weir





No. 252 Cascada

1. Present Condition and Problems

- ① A F/S on an extension plan up to 10 mW has already been executed (February, 1980).
- ② The intake weir has been collapsed due to leaked water. The intake facility has been repeatedly extended and is of a complicated construction. The construction of the head tank is in the same way.
- ③ Among the five generators, the three units of #1, #2, and #3 have been suspended. For this reason, the two units of #4 and #5 are now mainly utilized.

2. Key Points for the Rehabilitation Plan

- ① This proposed site should be planned for a substantial extension (Increase of 3600 to 7600 output) rather than for the rehabilitation of the #1, #2 and #3 generators (Rated output in total of 950 kW).

GENERAL

Power Plant	NO. 253 COMODA	Investigated Date	8 Mar. 1988
Electric Company	ESSA	Available Capacity (kW)	0
Location	SANTANDER		
River	LENGUARUCO		
Generating Method	RUN-OF-RIVER		
Installed Year	1912/1954	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment					
Item	Data	Item	Data	Item	Data				
1. Catchment Area (km <sup>2</sup> )	NO DATA	1. Dam		1. Turbine		#1	#2	#3	#4
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	NON	- Manufacturing Year					
- Plenty Water Discharge	UNKNOWN	- Height (m)	NON	- Type		R. BELL	WH		
- Ordinary Water Discharge	UNKNOWN	- Crest Length (m)	NON	- Output (kW)		FRANCIS	PELTON		
- Low Water Discharge	UNKNOWN	- Elevation of overflowing Crest (m)	NON	- Revolution (rpm)					
- Droughty Water Discharge	UNKNOWN	- Width of overflowing Crest (m)	NON	- Type of Governor		K. BELL	WH		
- Minimum	UNKNOWN	- Depth of overflowing (m)	NON	- Regulating Valve		FRANCIS	PELTON		
- Mean	UNKNOWN	2. Sand Trap Gate		- Type					
3. Utilizable Flow (m <sup>3</sup> /s)	UNKNOWN	- Type	NON	- Dimension (mm)		294	294	160	160
4. Firm Discharge (m <sup>3</sup> /s)	1.3	- Dimensions (WxH) (m)	NON			1,200	1,200	600	600
5. Head (m)		- Number of Gates	NON	2. Generator					
- Headwater Level (EL)	UNKNOWN	3. Intake		- Manufacturing Year					
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Type		BBC	BBC	WH	WH
- Gross Head	UNKNOWN	- Dimensions (m) (WxH)	W H	- Number of Generator		1	1	1	1
- Head Loss	UNKNOWN	- Number of Intake	2.40 x 1	- Capacity (kVA)		345	345	200	200
- Net Head	89.0	4. Dimensions of Forebay (m)	L = 70.0	- Power Factor (%)		UN- KNOWN	UN- KNOWN	UN- KNOWN	UN- KNOWN
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 4.15x65.9x2.5	- Voltage (V)			2,400		
7. Plant Capacity (kW)	(ASSUMED) 880	6. Intake Gate		- Frequency (Hz)			60		
8. Output (MWh)	UNKNOWN	- Type	SLUICE	- Revolution (rpm)		UN- KNOWN	UN- KNOWN	UN- KNOWN	UN- KNOWN
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 1.1 x 2.0	3. Transformer			N/A		
10. Unit Price (1,000 pesos/kWh)	UNKNOWN	- Number of Gates	3	- Manufacturing Year					
11. Others	UNKNOWN	7. Headrace		- Type					
		- Type	OPEN	- Capacity (kVA)					
		- Dimensions (m) (W x H)	W H 2.40 x 1.10	- Primary Voltage (kV)					
		- Length (m)	1,140	- Secondary Voltage (kV)					
		8. Dimensions of Water Reservoir (m)	W= 8.5 ~ 2.9 L= 15.0	- Number of Phase					
		9. Penstock CONCRETE		- Connection					
		- Dimensions (m) (φ x L)	φ 0.6 L=264 φ 0.46	- Number					
		- Number of Lines	3	Continuous Stand-by					
		10. Dimensions of Tailrace (W x H) (m)	W H 1.3x1.6 x 1.0	4. Others					

1. Present Condition and Problems

- ① A F/S on an extension plan up to 2600 kW has already been executed (February, 1980). The established power plant (880 kW) has been suspended because the conduit was collapsed due to the sinking of ground.
- ② The collapsed open channel has been replaced into a concrete-wound steel pipe (2 line of  $\phi$  90 cm and  $\phi$  62 cm). However those pipes have been suspended.
- ③ The soil is alternately composed of sandstone and clay slate. The conduit passes through the cliff part.
- ④ Into the intake yard of the front intake gate, bounding stones have been flowing and heaped on it.

2. Key Points for the Rehabilitation Plan

- ① This site shall be planned for a remodelling on the assumption of extension rather than the rehabilitation plan for the established facilities. However, the flow data, topographical geological data are in short supply. It is recommendable to start with the precise preparation / collection of basic data.

GENERAL

Power Plant	NO. 254 SERVITA	Investigated Date	
Electric Company	ESSA	Available Capacity (kW)	720
Location	SANTANDER		
River	SERVITA		
Generating Method	RUN-OF-RIVER		
Installed Year	1962	Service-in	

SUMMARY OF GENERATING FACILITIES (DID NOT FIELD RECONNAISSANCE)

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )		1. Dam		1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)		- Type	FRANCIS X 2
- Ordinary Water Discharge		- Crest Length (m)	9.8	- Output (kW)	
- Low Water Discharge		- Elevation of over-flowing Crest (m)		- Revolution (rpm)	900
- Droughty Water Discharge		- Width of Over-flowing Crest (m)	6.3	- Type of Governor	
- Minimum		- Depth of Over-flowing (m)		- Regulating Valve	
- Mean		2. Sand Trap Gate		Type	
3. Utilizable Flow (m <sup>3</sup> /s)		- Type		Dimension (mm)	
4. Firm Discharge (m <sup>3</sup> /s)	0.60	- Dimensions (ØxH) (m)		2. Generator	
5. Head (m)		- Number of Gates		- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	
- Tailwater Level (EL)		- Elevation of Intake Sill (m)		- Number of Generator	2
- Gross Head	169.5	- Dimensions (m) (W x H)	W L x 3.5	- Capacity (kVA)	475
- Head Loss		- Number of Intake		- Power Factor (%)	80
- Net Head		4. Dimensions of Forebay (m)		- Voltage (V)	440
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 6.0x19.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	800	6. Intake Gate		- Revolution (rpm)	900
8. Output (MWh)		- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)		- Dimensions (m) (W x H)		- Manufacturing Year	
10. Unit Price 1,000 pesos/kW		- Number of Gates		- Type	
pesos/kWh		7. Headrace		- Capacity (kVA)	950
11. Others		- Type	OPEN CONC. PIPE	- Primary Voltage (v)	440
		- Dimensions (m) (W x H)	W x H = 0.8x0.8	- Secondary Voltage (kV)	13.2
		- Length (m)	φ = 0.85 2,300	- Number of phase	
		8. Dimensions of Water Reservoir (m)		- Connection	
		9. Penstock		- Number	1
		- Dimensions (m) (φ x L)	φ = 0.46 L = 285	Continuous Stand-by	
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace (W x H) (m)			

No. 254      Servita

1. Present Condition and Problems

- ① The generators were installed 21 years ago. The output reduction rate is as low as 10 %.
- ② The river flow speed is so fast that the back area of the intake weir has been scoured.
- ③ The sedimentation basin does not work well.
- ④ The turbine blade has been damaged because of invaded sands and has been repaired while operating. Therefore, the generating electric power has been reduced.
- ⑤ Partly because of the low priority order by ESSA and partly because of time restriction, the field investigation was omitted.

2. Key Points for the Rehabilitation Plan

GENERAL

Power Plant	NO. 255 CALICHAL	Investigated Date	
Electric Company	ESSA	Available Capacity (kW)	220
Location	SANTANDER		
River	SERVITA		
Generating Method	RUN-OF-RIVER		
Installed Year	1950	Service-in	

SUMMARY OF GENERATING FACILITIES (DID NOT FIELD RECONNAISSANCE)

General		Civil		Equipment		
Item	Data	Item	Data	Item	Data	
1. Catchment Area (Km <sup>2</sup> )		1. Dam		1. Turbine	#1	#2
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year		
- Plenty Water Discharge		- Height (m)		- Type	FRANCIS	FRANCIS
- Ordinary Water Discharge		- Crest Length (m)	2.0	- Output (kW)	180 HP	230 HP
- Low Water Discharge		- Elevation of over-flowing Crest (m)		- Revolution (rpm)	1,200	900
- Droughty Water Discharge		- Width of Over-flowing Crest (m)		- Type of Governor		
- Minimum		- Depth of Over-flowing (m)		- Regulating Valve		
- Mean		2. Sand Trap Gate		Type		
3. Utilizable Flow (m <sup>3</sup> /s)		- Type		Dimension (mva)		
4. Firm Discharge (m <sup>3</sup> /s)	1.2	- Dimensions (R x H) (m)		2. Generator		
5. Head (m)		- Number of Gates		- Manufacturing Year		
- Headwater Level (EL)		3. Intake		- Type		
- Tailwater Level (EL)		- Elevation of Intake Sill (m)		- Number of Generator	1	1
- Gross Head	26	- Dimensions (m) (W x L)	W L x 2.0	- Capacity (kVA)	156	194
- Head Loss		- Number of Intake	1	- Power Factor (%)	80	80
- Net Head		4. Dimensions of Forebay (m)		- Voltage (V)	2,400	500/289
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)		- Frequency (Hz)	60	60
7. Plant Capacity (kW)	280	6. Intake Gate		- Revolution (rpm)	1,200	
8. Output (MWh)		- Type		3. Transformer		
9. Construction Price (1,000,000 pesos)		- Dimensions (m) [W x H]		- Manufacturing Year		
10. Unit Price (1,000 pesos/kWh)		- Number of Gates		- Type		
11. Others		7. Headrace		- Capacity (kVA)	50x3	200 750
		- Type	OPEN	- Primary Voltage (v)	1,400	400 7,530
		- Dimensions (m) (W x H)	W = 0.6 x 0.9 H = 1.3 x 1.7	- Secondary Voltage (kv)	7.2	7.2 13.86
		- Length (m)	1,000	- Number of Phase	1	3 3
		8. Dimensions of Water Reservoir (m)		- Connection		
		9. Penstock		- Number		
		- Dimensions (m) (φ x L)	φ = 0.81 L = 40	Continuous Stand-by		
		- Number of Lines	1	4. Others		
		10. Dimensions of Tailrace (W x H) (m)				

No. 255 Calichal

1. Present Condition and Problems

- ① This power plant was installed 32 years ago. the output reduction rate is as well as 21 %.
- ② The intake gate with bad design cannot suffiociently intake water.
- ③ Partly because of the low priority order by ESSA and partly because of time restriction, the field investigation was omitted.

2. Key Points for the Rehabilitation Plan

GENERAL

Power Plant	NO. 256 GUALI (HONDA)	Investigated Date	2 Mar. 1988
Electric Company	ELECTROLIMA S.A.	Available Capacity (kW)	0
Location	TOLIMA		
River	GUALI		
Generating Method	RUN-OF-RIVER		
Installed Year	1926/1955	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment		
Item	Data	Item	Data	Item	Data	
1. Catchment Area (Km <sup>2</sup> )	1,082	1. Dam	CONC. GRAVITY	1. Turbine	#1	#2
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year		
- Plenty Water Discharge	30	- Height (m)	5.0	- Type	FRANCIS	FRANCIS
- Ordinary Water Discharge	25	- Crest Length (m)	45.0	- Output (kW)	250 HPx2	NO NAME PLATE
- Low Water Discharge	19	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	257	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	45.0	- Type of Governor	NO NAME PLATE	NO NAME PLATE
- Minimum	NO DATA	- Depth of overflowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Type		
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	NON	- Dimension (mm)	NO NAME PLATE	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	12.0	- Dimensions (WxH) (m)	NON	2. Generator		
5. Head (m)		- Number of Gates	NON	- Manufacturing Year		
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYNC.	SYNC.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	2	1
- Gross Head	13.9	- Dimensions (m) (WxH)	W H 2.5 x 5.0	- Capacity (kVA)	150 x 2	935
- Head Loss	UNKNOWN	- Number of Intake	2	- Power Factor (%)	80	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2,300	4,160
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 15.5x37.3x5.0	- Frequency (Hz)	60	60
7. Plant Capacity (kW)	1,048	6. Intake Gate	WOODEN SLUICE	- Revolution (rpm)	257	NO NAME PLATE
8. Output (MWh)	UNKNOWN	- Type		3. Transformer		
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 3.5 x 2.0	- Manufacturing year	1976	
10. Unit Price 1,000 pesos/kWh	NO DATA	- Number of Gates	1	- Type	ONAN	ONAN
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	6,250	1,000
11. Others		- Type	OPEN	- Primary Voltage (kV)	13.8	4.16
		- Dimensions (m) [W x H]	W H 2.9x3.6x2.8x4.0	- Secondary Voltage (kV)	34.5	13.2
		- Length (m)	1,875	- Number of Phase	3	3
		8. Dimensions of Water Reservoir (m)	W L H 6.85x4.5x3.5	- Connection	Y/B	NO NAME PLATE
		9. Penstock	φ = 1.20 L = 15.0	- Number	1	1
		- Dimensions (m) (φ x L)		- Continuous Stand-by	0	0
		- Number of Lines	2	4. Others	THERE WERE TWO (2) D/G SETS AND ONE (1) KAPRAN, BUT THEY WERE NOT USED DUE TO OLD MACHINES.	
		10. Dimensions of Tailrace [W x H] (m)	W H 2 x 2.75 x			



# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

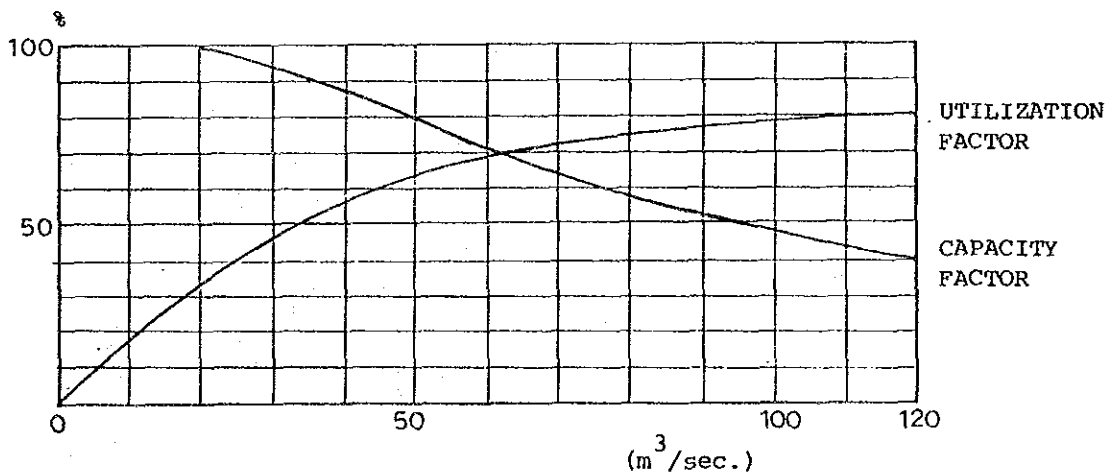
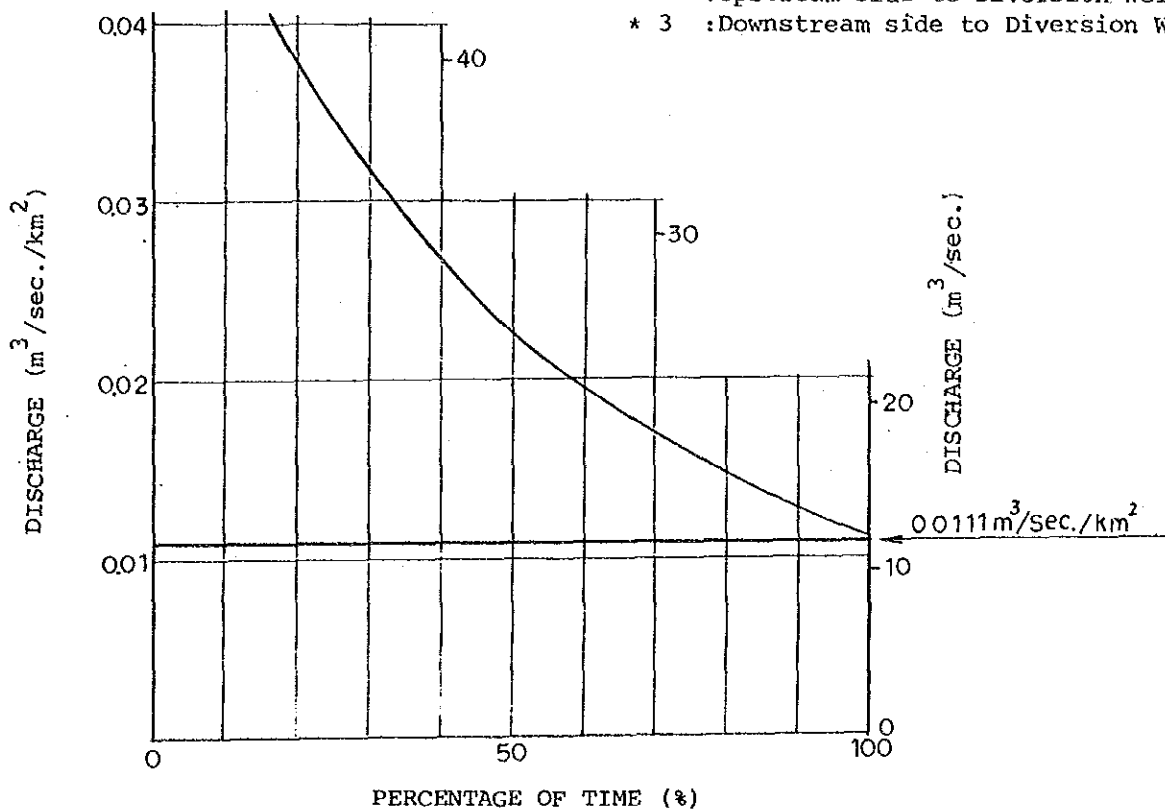
NO. 256 GUALI (HONDA)

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1972 - 1985
Used Data	1983 - 1985

(Note)

H.G.S.:Hydrological Gauging Station

- \* 1 :Near Diversion Weir
- \* 2 :Upstream side to Diversion Weir
- \* 3 :Downstream side to Diversion Weir



1. Present Condition and Problems

- ① This hydraulic power plant has a very small river water utilization rate. The service flow for an established facility is equivalent to approx. a half drought water quantity.
- ② Because of their past repeated extension / remodelling, the structures, in particular the power plant building take complicated shapes.
- ③ Through the avalanche of sand and stone resulting from the explosion of the Nevado Del Ruiz occurred in the 1980s, a part of the intake weir, intake gate and power generating building have been destroyed and suspended.
- ④ In reply to the power demand for Honda City, this site is given higher rehabilitation priority order by the Electrolima S.A.

2. Key Points for the Rehabilitation Plan

- ① Formulate the rehabilitation plan to recover the existing level.
- ② By use of the flow condition curve at the intake gate, select the capacity of water intaken to achieve a proper river water utilization rate and flow / facility utilization rate and calculate an optimum installed capacity.

GENERAL

Power Plant	NO. 257 RIO RECIO	Investigated Date	2 Mar. 1988
Electric Company	ELECTROLIMA S.A.	Available Capacity (kW)	1,200
Location	TOLIMA		
River	RECIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1960	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	610	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	28	- Height (m)	5.0	- Type	FRANCIS x 2
- Ordinary Water Discharge	20	- Crest Length (m)	40.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	13	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	8	- Width of Over-flowing Crest (m)	40.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	16	2. Sand Trap Gate	SLUICE	Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Dimensions (WxH) (m)	W H 1.45 x 1.6	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	5.0	- Number of Gates	2	2. Generator	
5. Head (m)	480.77	3. Intake	UNKNOWN	- Manufacturing Year	
- Headwater Level (EL)		- Elevation of Intake Sill (m)		- Type	SYNC.
- Tailwater Level (EL)	380.15	- Dimensions (m) (WxH)	W H 1.4 x 4.0	- Number of Generator	2
- Gross Head	100	- Number of Intake	4	- Capacity (kVA)	2,500 x 2
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin. (m) (W x L x H)	NON	- Voltage (V)	4,160
6. Efficiency (%)	UNKNOWN	6. Intake Gate	SLUICE	- Frequency (Hz)	60
7. Plant Capacity (kW)	4,000	- Type		- Revolution (rpm)	720 Max. 1,320
8. Output (Mwh)	UNKNOWN	- Dimensions (m) (W x H)	W H 1.4 x 4.0	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	4	- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)	NO DATA	7. Headrace	CANAL/TUNNEL BRIDGE	- Type	ONAN, INDOOR
pesos/kwh	NO DATA	- Type		- Capacity (kVA)	2,500 x 2
11. Others		- Dimensions (m) (W x H)	W H 4.1 x 2.1	- Primary Voltage (V)	4,160
		- Length (m)	7,000	- Secondary Voltage (KV)	33
		8. Dimensions of Water Reservoir (m)	W L H 5.15x5.05x4.5	- Number of Phase	3
		9. Penstock	∅ = 1.52 → 1.35 L = 259	- Connection	4/1
		- Dimensions (m) (∅ x L)		- Number	2
		- Number of Lines	1	Continuous Stand-by	0
		10. Dimensions of Tailrace (W x H) (m)	W H 3.5 x 4.8	4. Others	#1 Unit: Operating #2 Unit: Stopped

# FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 257 RIO RECIO

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1980 - 1985
Used Data	1983 - 1985

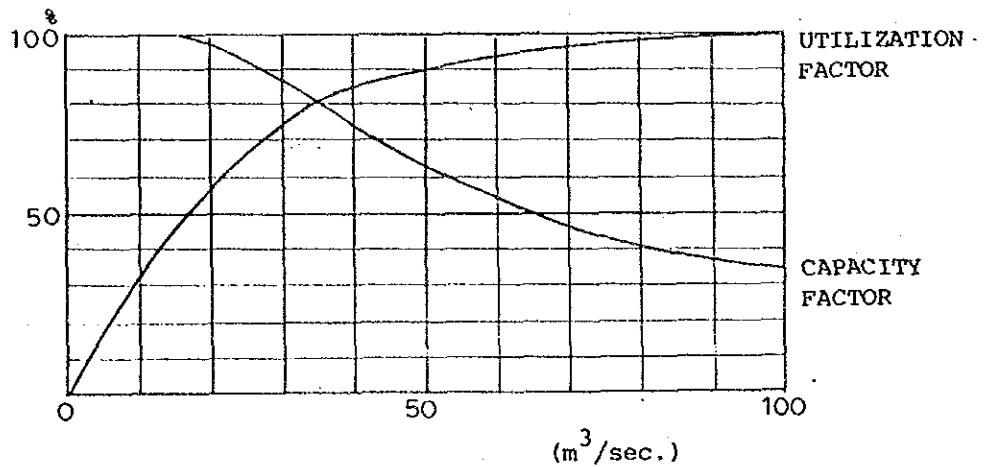
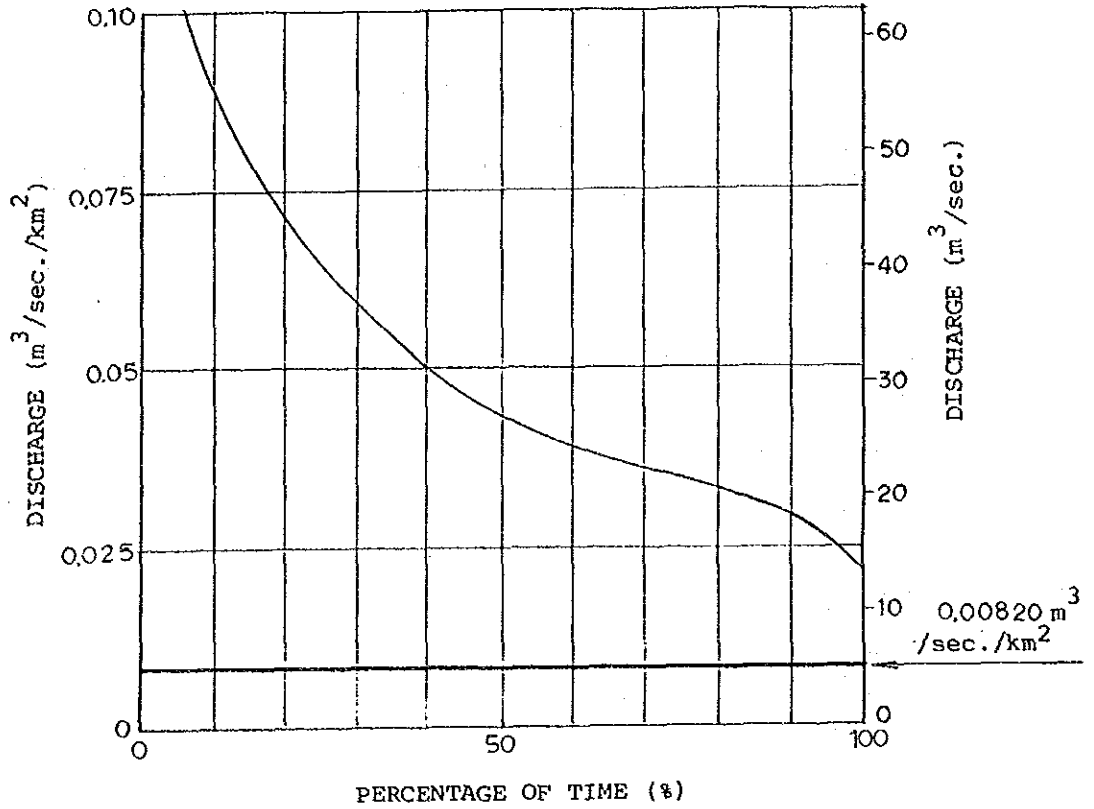
(Note)

H.G.S.:Hydrological Gauging Station

\* 1 :Near Diversion Weir

\* 2 :Upstream side to Diversion Weir

\* 3 :Downstream side to Diversion Weir



No. 257 Rio Recio

1. Present Condition and Problems

- ① This power plant is operated by receiving the water diverted from the agricultural water channel (12 m<sup>3</sup>/sec) of Rio Recio constructed by HIMAT.
- ② The design flow of this power plant is set at 5 m<sup>3</sup>/sec. However, owing to recent HIMAT circumstance, only 2 m<sup>3</sup>/sec can be diverted and the output has been reduced.
- ③ For the power plant facilities, the diversion facility from the HIMAT and head tank are somewhat poor. However, the penstock and other facilities are well maintained and kept in a good condition.
- ④ The HIMAT intends to permit the diversion of 5 m<sup>3</sup>/sec on the assumption that the discharged water after power generation can be returned to the downstream of the HIMAT agricultural water channel.

2. Key Points for the Rehabilitation Plan

The point of the rehabilitation is to construct a channel for the return of discharged water to the HIMAT agricultural water channel.

This power plant was excluded from the proposed F/S sites because there are rehabilitation obstacles in connection with the right of water.

- ① It is unreasonable as a realistic problem that the serviced water once discharged into the Rio Recio should be circulated into the HIMAT agricultural channel.

GENERAL

Power Plant	NO. 258 MIROLINDO	Investigated Date	1 Mar. 1988
Electric Company	ELECTROLIMA S.A.	Available Capacity (kW)	1,000
Location	TOLIMA		
River	COMBEIMA		
Generating Method	RUN-OF-RIVER		
Installed Year	1946	Service-in	

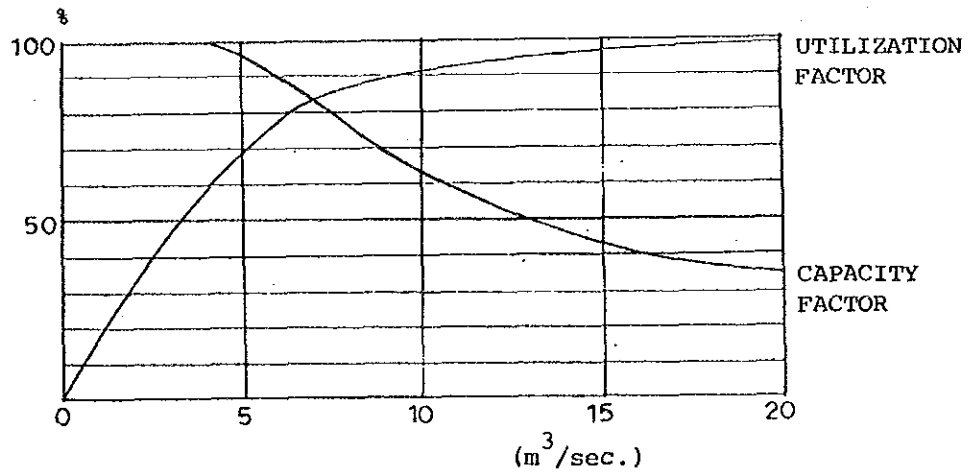
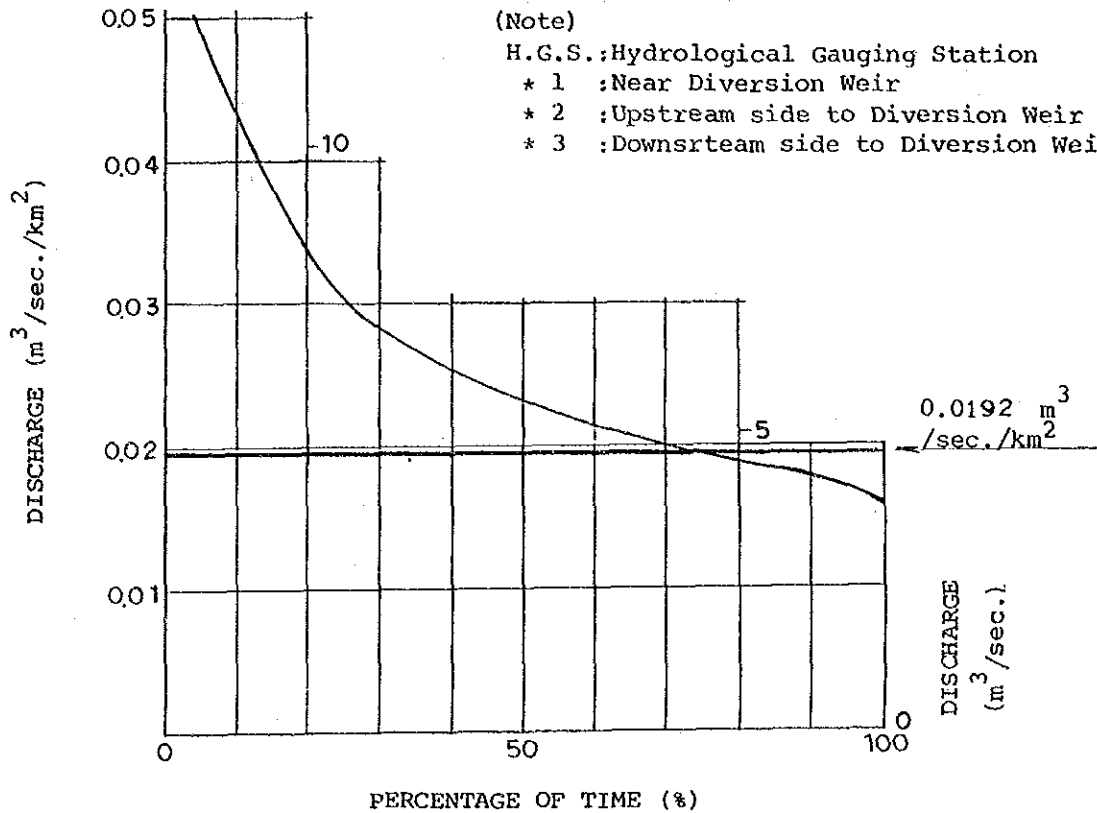
SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	245	1. Dam	OVERFLOW	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	CONCRETE	- Manufacturing Year	1953
- Plenty Water Discharge	37	- Height (m)	7.0	- Type	FRANCIS x 3
- Ordinary Water Discharge	27	- Crest Length (m)	35.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	14	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	900
- Droughty Water Discharge		- Width of Over-flowing Crest (m)	35.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	12	2. Sand Trap Gate		- Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Dimensions (WxH) (m)	SLUICE W H 1.4 x 2.0	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	4.7	- Number of Gates	1	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	1,369	- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYNC.
- Tailwater Level (EL)	1,272	- Dimensions (m) (WxH)	W H 1.9 x	- Number of Generator	3
- Gross Head	97	- Number of Intake	1	- Capacity (kVA)	1,500 x 3
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 12.0x31.0x4.5	- Voltage (V)	2,400
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60
7. Plant Capacity (kW)	3,600	- Type	SLUICE	- Revolution (rpm)	900
8. Output (MWh)	UNKNOWN	- Dimensions (m) [W x H]	W H 1.30 x	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	2	- Manufacturing Year	#1 1951 #2 #3
10. Unit price 1,000 pesos/kW	NO DATA	7. Headrace		- Type	ONAN ONAN ONAN
pesos/kWh	NO DATA	- Type	CANAL BRIDGE	- Capacity (kVA)	1,500 1,600 1,600
11. Others		- Dimensions (m) [W x H]	W L H 3.7x6.9 x 5.0	- Primary Voltage (V)	2,300 2,400 2,400
		- Length (m)	2.5 x 1.65	- Secondary Voltage (kV)	13.86 13.86 13.86
			5.139	- Number of Phase	3 3 3
		8. Dimensions of Water Reservoir (m)	W L H 7.0x8.7x2.6	- Connection	Δ/Δ Δ/Δ Δ/Δ
		9. Penstock		- Number Continuous Stand-by	1 1 1
		- Dimensions (m) (φ x L)	φ = 0.8 L = 500	0 0 0	
		- Number of Lines	3	4. Others	#1 Unit: Operating #2, 3 Unit: Stopped
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 258 MIROLINDO

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1984 - 1985
Used Data	1985



No. 258      Mirolindo

1. Present Condition and Problems

- ① The intake weir has partially been damaged.
- ② As the water channel passes through Ibaguè City, the capital city of Tolima department, there are a lot of flown waster water and discharged garbage, which causes the water quality to grow worse.
- ③ There are two sedimentation basins. The No.1 sedimentation basin is strong. No.2 basin has been damaged on both the main body and gate and does not work.
- ④ The head tank is small in capacity. The screen mesh has been choked with dust.
- ⑤ The output reduction rate is as high as 72 %. The cause is explained as because of the shortage of water. However, the conduit utilizes nearly all the profile. For this reason, the unbalance between the conduit flow-down capacity and installed capacity is also regarded as one of the main causes.

2. Key Points for the Rehabilitation Plan


- ① Check for the passage-through capacity of the conduit.
- ② The conduit shall be covered to prevent both the dust discharge and the flown-into waster water.  
(Regarding the waster water, a water disposal F/S on the whole Ibaguè City has already been performed.)
- ③ Rehabilitate the No.2 sedimentation basin.
- ④ Enlarge the head tank capacity.



GENERAL

Power Plant	NO. 259 PASTALES	Investigated Date	1 MAR. 1988
Electric Company	ELECTROLINA S.A.	Available Capacity (kW)	0
Location	TOLIMA		
River	COMBEIMA/Q. LA PLATA		
Generating Method	RUN-OF-RIVER		
Installed Year	1947	Service-in	

SUMMARY OF GENERATING FACILITIES

General		CIVIL		LA PLATA		Equipment	
Item	Data	Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	12	1. Dam	OVERFLOW CONCRETE	BROKEN	1. Turbine		
2. Volume of Discharge (m <sup>3</sup> /s)		- Type			- Manufacturing Year		
- Plenty Water Discharge	14.0	- Height (m)	1.5	BROKEN	- Type	FRANCIS	
- Ordinary Water Discharge	8.8	- Crest Length (m)	10.0	BROKEN	- Output (kW)	1,200 PS	
- Low Water Discharge	6.3	- Elevation of over-flowing Crest (m)	UN-	BROKEN	- Revolution (rpm)	720	
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	KNOWN	BROKEN	- Type of Governor	NO NAME PLATE	
- Minimum	NO DATA	- Depth of Over-flowing (m)	UN-	BROKEN	- Regulating Valve	NO NAME PLATE	
- Mean	NO DATA	2. Sand Trap Gate	WOOD	METAL	Type	NO NAME PLATE	
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	SLUICE	SLUICE	Dimension (mm)	NO NAME PLATE	
4. Firm Discharge (m <sup>3</sup> /s)	3.87	- Dimensions (WxH) (m)	W 1.6	1.3	2. Generator		
5. Head (m)	1,550	- Number of Gates	H 1.5	1.25	- Manufacturing Year		
- Headwater Level (EL)		3. Intake			- Type	SYNC.	
- Tailwater Level (EL)	1,520	- Elevation of Intake Sill (m)	UN-	UN-	- Number of Generator	1	
- Gross Head	30	- Dimensions (m) (W x H)	W 4.6	1.3	- Capacity (kVA)	1,050	
- Head Loss	UNKNOWN	- Number of Intake	H 1.4	1.5	- Power Factor (%)	80	
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	NON	- Voltage (V)	500	
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W 4.0		- Frequency (Hz)	60	
7. Plant Capacity (kW)	840	- Number of Gates	L 30.0	NON	- Revolution (rpm)	720	
8. Output (MWh)	UNKNOWN	6. Intake Gate	H		MAX. 1,350		
9. Construction Price (1,000,000 pesos)	NO DATA	- Type	WOOD	METAL	3. Transformer		
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Dimensions (m) [W x H]	SLUICE	SLUICE	- Manufacturing Year		
11. Others	NO DATA	- Number of Gates	1.7	1.3	- Type	ONAN, INDOOR	
		7. Headrace	1.3	1.25	- Capacity (kVA)	1,000	
		- Type	2	1	- Primary Voltage (V)	500	
		- Dimensions (m) [W x H]	OPEN (METAL)	OPEN	- Secondary Voltage (kV)	13.9	
		- Length (m)	W 2.5	0.6	- Number of Phase	3	
			H 1.3	0.6	- Connection		
			600	NOT CONFIRMED	- Number	1	
		8. Dimensions of Water Reservoir (m)	W L H		Continuous Stand-by	0	
		- Dimensions (m) (φ x L)	3.4x10.0x2.5		4. Others	Stopped	
		- Number of Lines	1				
		9. Penstock	φ = 1.20				
		- Dimensions (m) (φ x L)	L = 30				
		10. Dimensions of Tailrace (W x H) (m)	W = 4.3 H = 1.5				
			L = 150				

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 259 PASTALES

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1984 - 1985
Used Data	1985

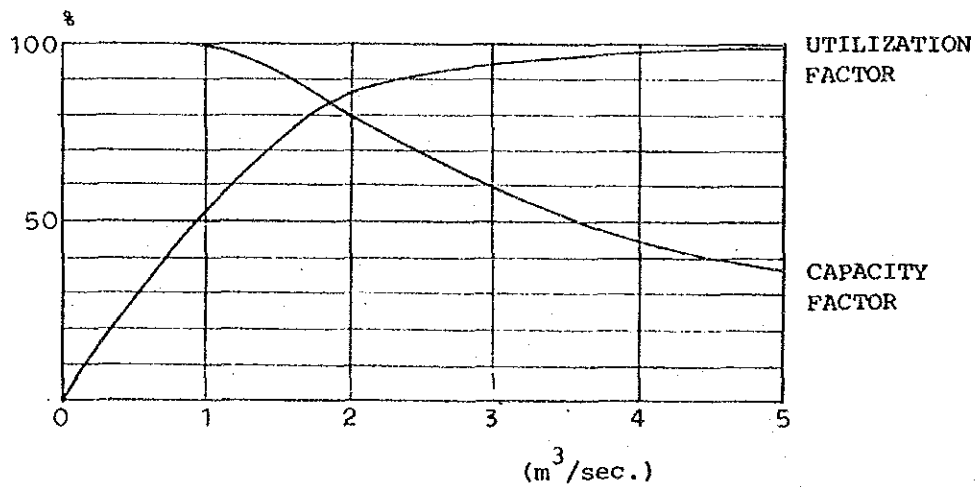
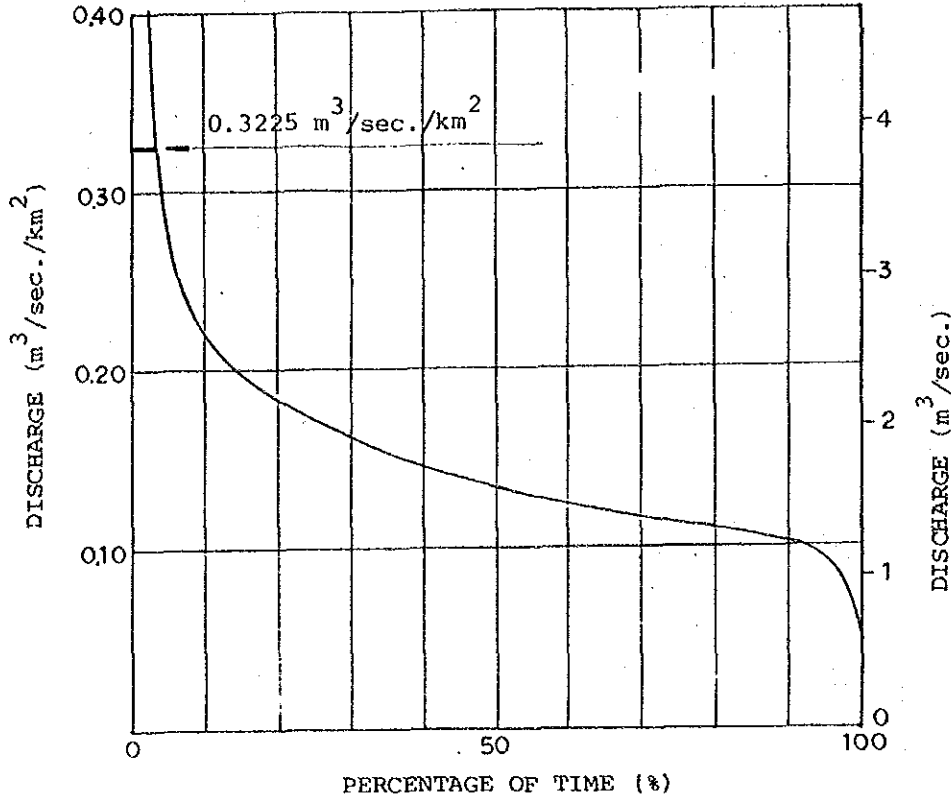
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



No. 259      Pastales

1. Present Condition and Problems

- ① This power plant is located in approx. 50 meters upstream from the junction of the Rio Combeima and Qd La Pita. A part of water from the Qd La Pita river basin is intaken and joined with immediately before the head tank.
- ② In 1987, due to avalanche of sand and stone occurring in the upstream of the Q. La Pita, the power plant was covered with sand and stone to the ceiling of the plant building and then was suspended. At the same time, the former river bed of the Qd La Pita was substantially raised through the heaped avalanche of sand and stone. The intake gate which had guided the water due to natural flow down has been of no use.
- ③ The sand and stone flown into the power plant building has already been discharged and almost all the equipment repairs have finished and the operation will be restarted before long.
- ④ A selection if the water diversion from the Qd La Pita can be continued is left as a future problem.

2. Key Points for the Rehabilitation Plan

- ① Depending on the results of the rehabilitation work being executed by E/ Tolima.

GENERAL

Power Plant	NO: 260 PRADO	Investigated Date	4 Mar. 1988
Electric Company	ELECTROLIMA S.A.	Available Capacity (kW)	51,000
Location	TOLIMA		
River	PRADO		
Generating Method	RESERVOIR TYPE		
Installed Year	1974	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )		1. Dam	ROCK	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	FILL	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	90	- Type	FRANCIS x 1 (HORI. AXIS) FRANCIS x 3 (VERT. AXIS)
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	240	- Output (kW)	(3) 15,300 (1) 5,100
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	367	- Revolution (rpm)	300/400
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	NON	- Type of Governor	OLE OR MECHANICAL
- Minimum	NO DATA	- Depth of Over-flowing (m)	NON	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		- Type	MARIPOSA
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	RADIAL	- Dimension (mm)	2.8 1.6
4. Firm Discharge (m <sup>3</sup> /s)	112	- Dimensions (R x H) (m)	W 7.0 x H 8.46	2. Generator	
5. Head (m)		- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)	NO DATA	3. Intake		- Type	SYNCHRO.
- Tailwater Level (EL)	NO DATA	- Elevation of Intake Sill (m)	330.2	- Number of Generator	4
- Gross Head	36.0	- Dimensions (m) (W x H)	W 14.1 x H 8.7	- Capacity (KVA)	3 x 18,000 1 x 6,000
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Voltage (V)	6,600 4,160
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Frequency (Hz)	60
7. Plant Capacity (kW)	51,000	6. Intake Gate		- Revolution (rpm)	300/400
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price	1,000 x 10 <sup>6</sup> s	- Dimensions (m) [W x H]	W 5.5 x H 4.0	- Manufacturing Year	
10. Unit Price pesos/kw	19,608	- Number of Gates	2	- Type	DY11
pesos/kWh	2.28	7. Headrace	NON	- Capacity (kVA)	3 x 18,000 1 x 6,000
11. Others		- Type	NON	- Primary Voltage (V)	6,600
		- Dimensions (m) [W x H]	NON	- Secondary Voltage (kV)	4,160 115 33
		- Length (m)	NON	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	NON	- Connection	DY11
		9. Penstock		- Number	4
		- Dimensions (m) (φ x L)	φ6.0 → 5.0	Continuous Stand-by	-
		- Number of Lines	1 (3-BRANCHES)	4. Others	OPERATING
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

1. Present Condition and Problems

The power plant and reservoir are owned by the ICEL and lent to the E. Tolima.

- ① The rated output is 51,000 kW while the current output is as well as 100 %.
- ② As the urgent problem, the following two are given:
  - a. In summer, a lot of water weeds grow in the reservoir, which causes the intake gate screen to be choked.
  - b. The gases occurring in the reservoir melt into water to deteriorate the water quality and have a bad effect on the steel structures such as screen, gate, penstock, etc.

2. Key Points for the Rehabilitation Plan

GENERAL

Power Plant	NO. 261 LAGUNILLA	Investigated Date	3 Mar. 1988
Electric Company	ELECTROLIMA S.A.	Available Capacity (kW)	0
Location	TOLIMA		
River	LAGUNILLA → CHINCHINA		
Generating Method	RUN-OF-RIVER		
Installed Year	1940	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	460	1. Dam		1. Turbine	#1 #2
2. Volume of Discharge (m <sup>3</sup> /s)		- Type	BROKEN	- Manufacturing Year	
- Plenty Water Discharge	10	- Height (m)	BROKEN	- Type	PELTON PELTON
- Ordinary Water Discharge	8	- Crest Length (m)	BROKEN	- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge	5.5	- Elevation of over-flowing Crest (m)	BROKEN	- Revolution (rpm)	NO NAME PLATE NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of over-flowing Crest (m)	BROKEN	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of over-flowing (m)	BROKEN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	BROKEN	Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	0.5	- Dimensions (WxH) (m)	BROKEN	2. Generator	
5. Head (m)		- Number of Gates	BROKEN	- Manufacturing Year	
- Headwater Level (EL)	319	3. Intake		- Type	NO NAME PLATE NO NAME PLATE
- Tailwater Level (EL)	199	- Elevation of Intake Sill (m)	BROKEN	- Number of Generator	1 2
- Gross Head	120	- Dimensions (m) (WxH)	BROKEN	- Capacity (kVA)	(ICEL 300 kW) NO NAME PLATE 95 x 2
- Head Loss	UNKNOWN	- Number of Intake	BROKEN	- Power Factor (%)	NO NAME PLATE 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	BROKEN	- Voltage (V)	NO NAME PLATE 4,400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Frequency (Hz)	NO NAME PLATE 60
7. Plant Capacity (kW)	452 (ASSUMED)	6. Intake Gate		- Revolution (rpm)	NO NAME PLATE 900
8. Output (MWh)	UNKNOWN	- Type	BROKEN	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	BROKEN	- Manufacturing Year	N/A N/A
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	BROKEN	- Type	N/A N/A
	NO DATA	7. Headrace		- Capacity (kVA)	N/A N/A
11. Others		- Type	OPEN TUNNEL	- Primary Voltage (kV)	N/A N/A
		- Dimensions (m) (W x H)	W L H 1.5 x 1.0 0.65 x 0.85	- Secondary Voltage (kV)	N/A N/A
		- Length (m)	55.5	- Number of Phase	N/A N/A
		8. Dimensions of Water Reservoir (m)	W L H 1.75x2.3x1.9	- Connection	N/A N/A
		9. Penstock		- Number	N/A N/A
		- Dimensions (m) (φ x L)	φ = 0.55, 0.4 L = 175	Continuous Stand-by	N/A N/A
		- Number of Lines	2	4. Others	Stopped
		10. Dimensions of Tailrace (m)	W H 2 x 1.0 x 1.6		

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

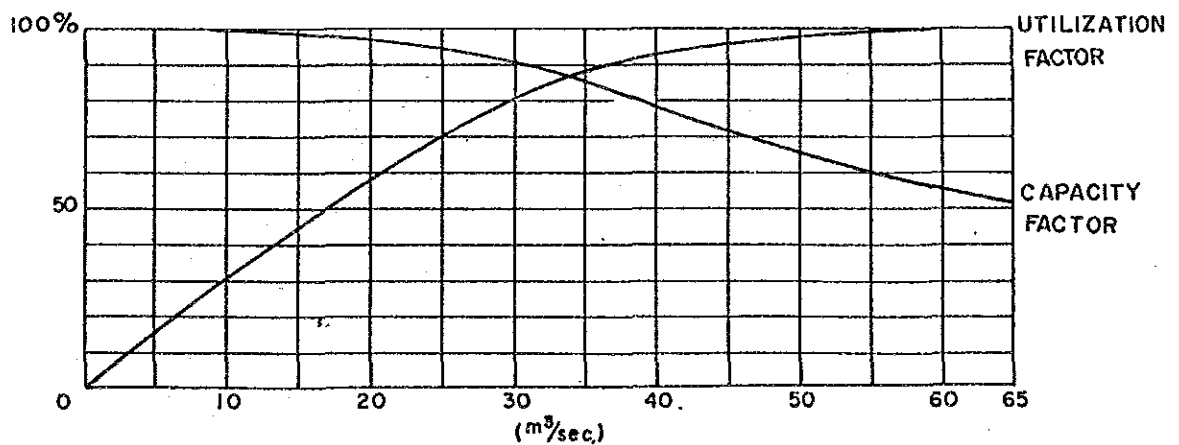
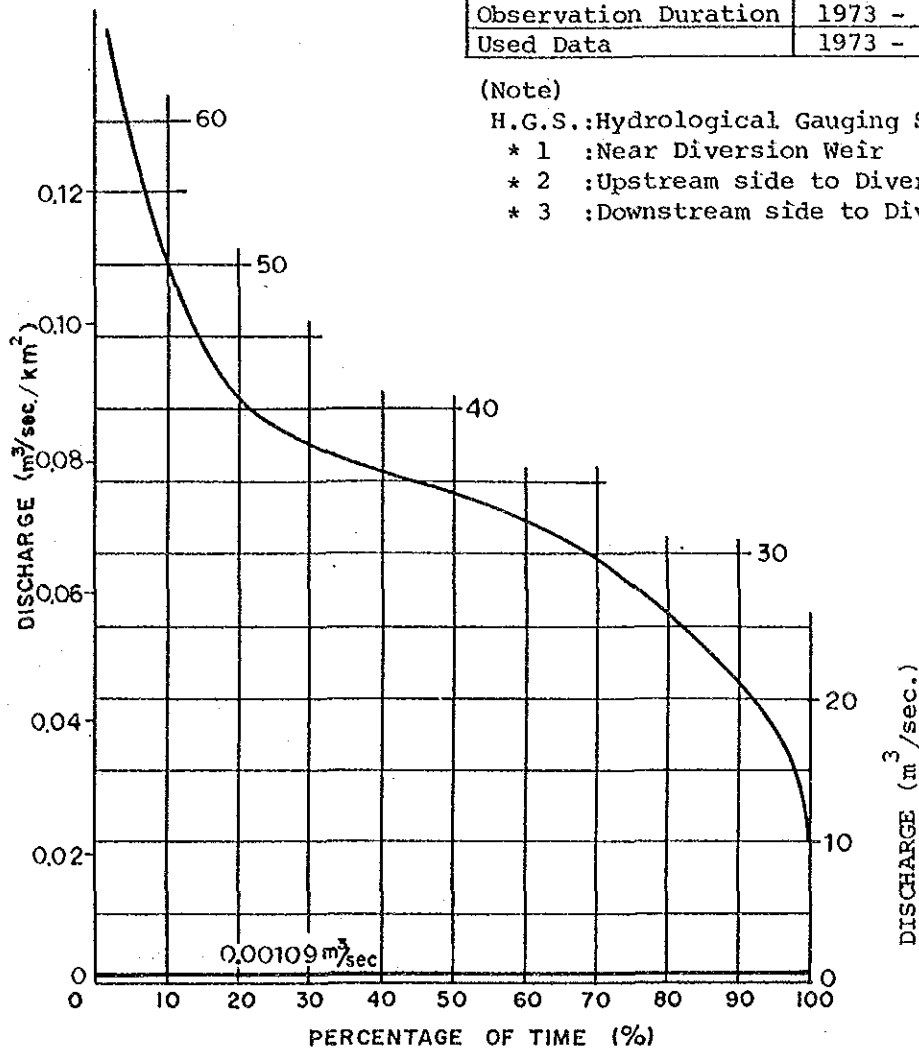
NO. 261 LAGUNILLA

Location of H.G.S.	*
Daily or Monthly	Monthly
Observation Duration	1973 - 1976
Used Data	1973 - 1976

(Note)

H.G.S.:Hydrological Gauging Station

- \* 1 :Near Diversion Weir
- \* 2 :Upstream side to Diversion Weir
- \* 3 :Downstream side to Diversion Weir



No. 261 Lagunilla

1. Present Condition and Problems

- ① The intake is provided on top of the waterfall having a 300 m head. The existing powerhouse building is constructed halfway up the waterfall, and a part of head remains utilized.
- ② Generating facilities have been left alone since they were damaged and stopped 15 years ago. The penstock as well as generating facilities has been corroded considerably. Therefore, the rehabilitation is impossible.
- ③ The intake has been destroyed by debris flow resulting from the volcanic eruption of the Nevado Del Ruizu three years ago.
- ④ The available hydrological station (No. 2125-708, Quinta Cobra) is situated approx. 2 km from the intake (to the downstream side). It is necessary to appropriately convert discharge according to the ratio of the catchment area, etc., because the observed hydrological flow data include the records for the Qd. Primarera.

2. Consultation of the Rehabilitation Plan

- ① To lower the location of the powerhouse building for effective use of the head to secure about 280 m head.



- ② To calculate the quantity of water intake in proportion to appropriate river-water utilization factor and plant capacity factor using the conversion flow-duration curve at the intake and determine an optimum installed capacity.
- ③ To newly construct the headrace structures according to design discharge.

GENERAL

Power Plant	NO. 262 VENTANAS	Investigated Date	1 Mar. 1988
Electric Company	TOLIMA S.A.	Available Capacity (kW)	2,500
Location	TOLIMA		
River	COELLO		
Generating Method	RUN-OF-RIVER		
Installed Year	1958	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km <sup>2</sup> )	1,580	1. Dam	OVERFLOW FILL	1. Turbine	
2. Volume of Discharge (m <sup>3</sup> /s)		- Type		- Manufacturing Year	
- Plant Water Discharge	NO DATA	- Height (m)	3.0	- Type	FRANCIS x 2
- Ordinary Water Discharge	18	- Crest Length (m)	≅ 500.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	13	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge		- Width of Over-flowing Crest (m)	≅ 500.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		- Type	NO NAME PLATE
3. Utilizable Flow (m <sup>3</sup> /s)	NO DATA	- Type	TENTER	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m <sup>3</sup> /s)	25.3	- Dimensions (WxH) (m)	W H 2.45 x 3.0	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	NO NAME PLATE
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	2
- Gross Head	28.6	- Dimensions (m) (WxH)	W H 2.7 x 4.0	- Capacity (kVA)	3,750
- Head Loss	UNKNOWN	- Number of Intake	3	- Power Factor (%)	90
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Voltage (V)	4,160
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 30.0x32.0x5.5	- Frequency (Hz)	60
7. Plant Capacity (kW)	6,000	6. Intake Gate		- Revolution (rpm)	300
8. Output (MWh)	UNKNOWN	- Type	TENTER	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W x H 2.7	- Manufacturing Year	1961 1957
10. Unit Price (1,000 pesos/kW)	NO DATA	- Number of Gates	3	- Type	ONAN ONAN
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	6,500 3,750
11. Others		- Type	TUNNEL OPEN	- Primary Voltage (V)	13,800 4,160
		- Dimensions (m) (W x H)	TUN. OPEN 3.60 15.0	- Secondary Voltage (kV)	33 14.4
		- Length (m)	6,000	- Number of Phase	3 3
		8. Dimensions of Water Reservoir (m)	W L H 30.0x32.5x4.0	- Connection	Y/Δ YD11
		9. Penstock		- Number	1 2
		- Dimensions (m) (φ x L)	φ = 2.13 L = 47	- Continuous Stand-by	0 0
		- Number of Lines	2	4. Others	#1 Unit: Operating #2 Unit: Stopped
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRMED		

# FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 262 VENTANAS

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1983 - 1985
Used Data	1985

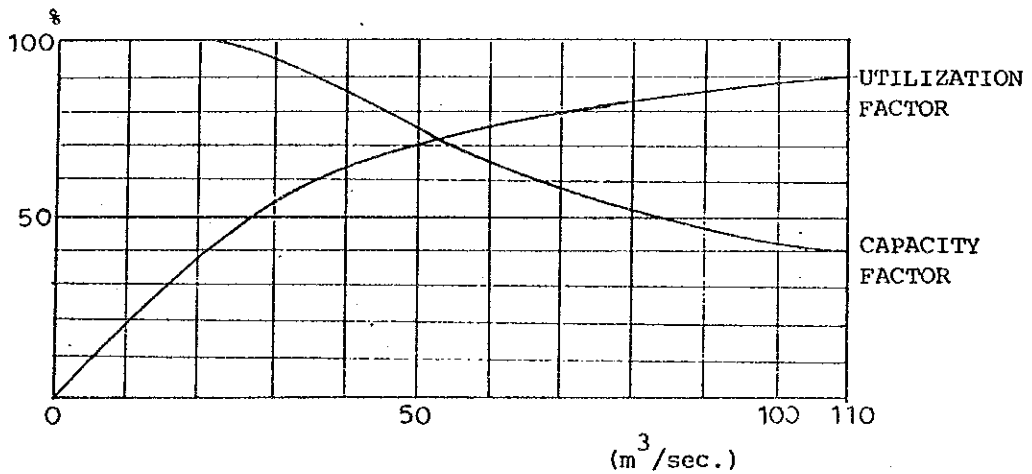
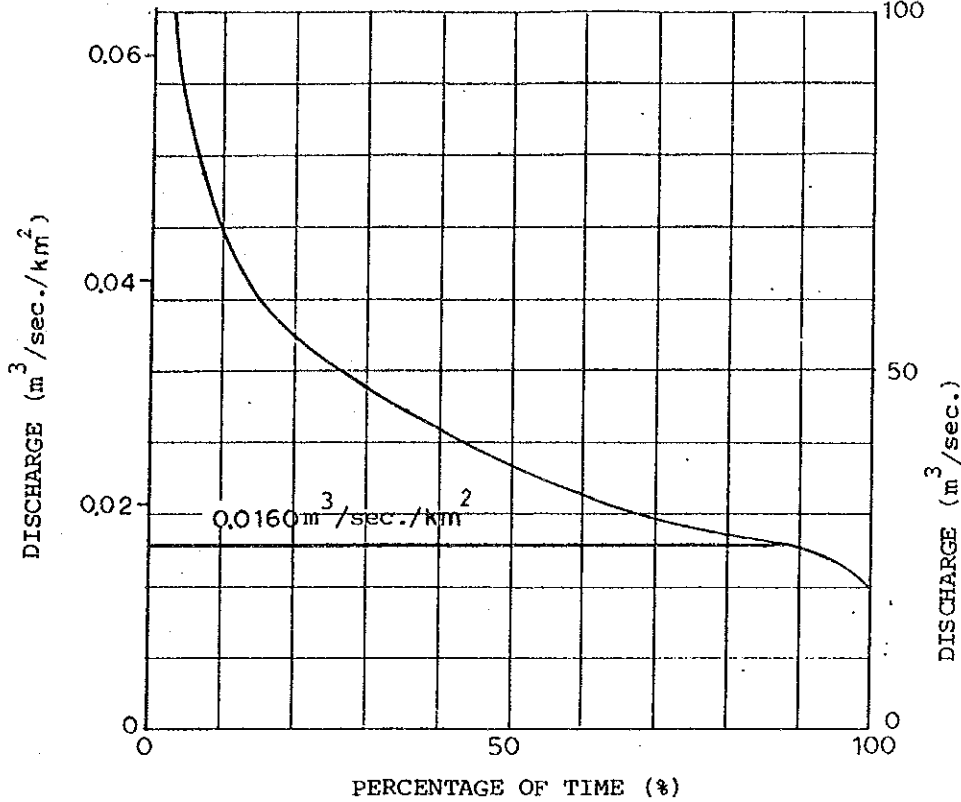
(Note)

H.G.S.: Hydrological Gauging Station

\* 1 : Near Diversion Weir

\* 2 : Upstream side to Diversion Weir

\* 3 : Downstream side to Diversion Weir



1. Present Condition and Problems

- ① All the water intaken from the Rio Coelld flow into the head tank, where the water is diverted into the two routes of both generating and HIMAT agricultural.
- ② The right of water is under the jurisdiction of HIMAT. The power generating facities are kept in a good condition. However, to give the agricultutral water priority, the generating water cannot be sufficiently obtained, which causes reduced output.
- ③ In spite of a large quantity of sand and soil mixed into the flown water, the conduit of approx. 7 km contains no sedimentation basin. In addition, the head tank is also utilized as the sedimentation basin. However, to discharge the sand, it is necessary to frequently flush. This facilitates the shortage of water.

2. Key Points for the Rehabilitation Plan

- ① The establishment of a new sedimentation basin enables a part of water shortage to be dissolved. Moreover, near the conduit there is another room, where a new sedimentation basin can be established.
- ② However, the fundamental water shortage can not be dissolved before any coordination with HIMAT having the right of water has been achieved.

### **(3) DIESEL POWER PLANTS**

Facility Register of Diesel Power Plant (1/3)  
(a) General (1/2)

(at JAN. 1988)

Code Electric No. Power Company	Power Plant	1. Present Data										Number of User	Peak House Demand (kW)	Energy (kWh)
		Level Q'ty	Installed Capacity (kW)	Operating Hour (h/day)	Fuel Tank	Fuel Price (\$/gal)	Manual	Tariff	Popula- tion	House	of			
301 E.Choco	Acandi	1	1	275	5 Day	290	No	Fixed	5,000	700	3)	126		
302 E.Choco	Pizarro 1)	1	1	120	3)	3)	3)	3)	2,000	400	3)	82	4)	
303 E.Choco	Unguila	1	1	150	6 No	250	No	Fixed	4,000	600	3)	103		
304 E.Choco	Capurgana	2	1	150	6 No	300	No	Fixed	540	32	125	50		
312 E.Choco	Villa Claret 1)	2	1	25	3)	3)	3)	3)	240	72	3)	18	4)	
314 E.Choco	Sipi 1)	1	1	80	3)	3)	3)	3)	2,800	67	3)	56	4)	
315 E.Choco	Bahia Solano	1	2	240	5 Day/STG	250	No	Fixed	3,700	500	3)	110		
321 E.Choco	Nuqui	1	1	150	3 No	273	No	Fixed	2,500	200	3)	83		
326 E.Choco	Zapzurro	2	1	17.5	4 No	350	No	Fixed	200	60	70	15		
337 EMSA	Puerto Lopez	1	7	2,220	24 Storage	170	No	Meter	11,100	2,220	3)	970	4,394	
339 EMSA	S.J. de Arama	1	3	525	5 Day	200	No	Fixed	1,800	300	900	145		
340 EMSA	Vista Hermosa 1)	1	2	455	5 3)	165	3)	Fixed	4,300	350	600	380		
341 CEDENAR	Terrotumaco	1	4	10,000	24 Storage	150	Yes	Meter	46,600	6,540	3)	7,480	30,112	
344 CEDENAR	Llorente	2	1	120	5 Day	200	No	Fixed	700	140	3)	38		
345 CEDENAR	Sala Honda	1	2	210	4 Day	210	No	Fixed	2,400	350	450	91		
350 CEDENAR	La Playa	2	1	75	4 Day	118	No	Fixed	400	55	75	53		
357 CEDENAR	Baquerias	2	1	35	4 No	200	No	Fixed	200	80	92	28		

1) This data is based on the information by ICEL

2) 1 : Municipality 2 : Other

3) This data is not available

4) This data is estimated value

Facility Register of Diesel Power Plant (2/3)  
(a) General (2/2)

Code No.	Electric Power Company	Power Plant	2. Forecasting Data (1991)			Energy A.I.R. (%)	Population A.I.R. (%)	Capacity Factor (%)
			a) Peak Demand A.I.R. (%)	b) Demand (kW)	c) (MWh)			
301	E.Choco	Acandi	3	142	3	1.6	5,330	
302	E.Choco	Pizarro	3	92	3	1.6	2,130	
303	E.Choco	Unguia	3	116	3	1.6	4,260	
304	E.Choco	Capurgana	3	56	3	1.6	580	
312	E.Choco	Villa Claret	3	20	3	1.6	260	
314	E.Choco	Sipi	3	63	3	1.6	2,980	
315	E.Choco	Bahia Solano	3	124	3	1.6	3,940	
321	E.Choco	Nuqui	3	93	3	1.5	2,560	
326	E.Choco	Zapzurro	3	17	3	1.6	210	
337	EMSA	Puerto Lopez	20	2,011	31	4.6	13,290	
339	EMSA	S.J. de Arama	13	236	13	4.6	2,150	
340	EMSA	Vista Hermosa	3	428	3	4.6	5,150	
341	CEDENAR	Termotumaco	9	10,559	7	2.0	50,440	
344	CEDENAR	Llorente	2	41	2	2.0	760	
345	CEDENAR	Sala Honda	2	99	2	2.0	2,600	
350	CEDENAR	La Playa	3	60	3	2.0	430	
357	CEDENAR	Baquerias	3	31	3	2.0	220	

A.I.R. : Average Increase Rate

- Notes : 1) Increasing rate of peak demand is calculated based on the information by ICEL  
2) Existing #3 & #4 Units are not considered in this value







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