

コロンビア共和国 小規模発電設備修復計画 プレ・フィージビリティ調査 発電設備台帳

昭和63年7月

国際協力事業団

JICA

コロンビア共和国

小規模発電設備修復計画
プレ・フィージビリティ調査

発電設備台帳

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FACILITY REGISTER

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- (1) THERMAL POWER PLANTS
- (2) HYDRAULIC POWER PLANTS
- (3) DIESEL POWER PLANTS

(1) THERMAL POWER PLANTS

Facility Register of Thermal Power Plant

No.	Description	Power Plant			
		1	2	3	4
		Termopaipa		Termopalenque	
		2		3	
		1		3	
		1		3	
1	Turbine				
1)	Type				
2)	Output	33,000	66,000	74,000	Condensing steam 66,000 GAS (W-191G) 15,000
3)	Steam pressure	KW 65	88	88	89
4)	Steam temp. (at inlet M.S.V.)	KG/cm2 500	510	510	510
5)	Vacuum	mmHG-Abs 64	70	70	
6)	Speed	RPM 3,600	3,600	3,600	4,912
7)	Condition of inlet	•P/psi-abs -	-	-	77/1361
8)	Air flow	l/sec -	-	-	24.216
9)	Manufacturer	ALSTHOM	MITSUBISHI	MITSUBISHI	ALSTHOM WESTING HOUSE
2	Condenser				
1)	Volume of cooling water	t/h 6.500	11,600	116,000	11,300
2)	Volume of water	t/h 182.27	210.09	40-43 (River water)	-
3)	Rated temp. of cooling water	°C -	-	-	-
3	Boiler				
1)	Type				
2)	Steam pressure (Max. allowable working)	KG/cm2 69	92	92	92
3)	Steam temp. at outlet of superheater	°C 505	515	515	515
4)	Volume of evaporator Max. Cont. Rating	t/h 140	250	290	245
5)	Fuel	Coal	Coal	Coal	Fuel Oil/Natural Gas
6)	Manufacturer	ROUBAIX & ALSTHOM	DISTRAL	DISTRAL	-
4	Generator				
1)	Output	KVA 41,250	87,360	87,360	78,000
2)	Power factor	% 80	85	85	85
3)	Voltage	V 13,800	13,800	13,800	13,800
4)	Frequency	Hz 60	60	60	60
5)	Speed	rpm 3,600	3,600	3,600	900
6)	Manufacturer	ALSTHOM	MITSUBISHI	MITSUBISHI	WESTING HOUSE
5	Main transformer				
1)	Rated capacity	MVA 13,200	88	88	78
2)	Primary voltage	V 115,000	13,200	13,200	13,800
3)	Secondary voltage	V -	115,000	115,000	230,000
4)	Tertiary voltage	V -	-	-	33,000
5)	Manufacturer	ALSTHOM	MITSUBISHI	MITSUBISHI	13,800

(2) HYDRAULIC POWER PLANTS

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GENERAL

Power Plant	No. 201 CARACOLI	Investigated Date	29 Jan. 1988
Electric Company	EADE	Available Capacity (kW)	2,300
Location	CARACOLI ANTIOQUIA		
River	NUS		
Generating Method	RUN-OF-RIVER		
Installed Year	1935/1963	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	320	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	2.0	- Type	PELTON FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	45.0	- Output (kW)	HP 2500 PS 2500
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	327 1200
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	45.0	- Type of Governor	NO NAME NO NAME PLATE PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	0.08	- Regulating Valve	NO NAME NO NAME PLATE PLATE
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	Type	NO NAME NO NAME PLATE PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type		Dimension (mm)	NO NAME NO NAME PLATE PLATE
4. Firm Discharge (m ³ /s)	5.0	- Dimensions (WxH) (m)	W H 1.0 x 3.0	2. Generator	
5. Head (m)		- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)	713.5	3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	624.8	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	86.0	- Dimensions (m) (WxH)	W H 4.0 x 6.0	- Capacity (kVA)	2000 2000
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2300 2300
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 25.0x30.0x9.0	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	3,200	6. Intake Gate		- Revolution (rpm)	327 1200
8. Output (Mwh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H 2.0 x 6.0	- Manufacturing Year	1961
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	2	- Type	ONAN ONAN ONAN
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	OUTDOOR-OUTDOOR-OUTDOOR- 667x3 2000 2000
11. Others		- Type	NON	- Primary Voltage (kV)	2.3 2.3 13.2
		- Dimensions (m) (W x H)	NON	- Secondary Voltage (kV)	40.83 44 44
		- Length (m)	NON	- Number of Phase	1 3 3
		8. Dimensions of Water Reservoir (m)	NON	- Connection	NO NAME PLATE Δ/Δ Δ/Δ
		9. Penstock		- Number	3 1 1
		- Dimensions (m) (φ x L)	φ = 1.4 L = 1200	Continuous Stand-by	0 0 0
		- Number of Lines	1	4. Others	#1, 2 Unit: Operating.
		10. Dimensions of Tailrace (W x H) (m)	W H 2.3 x 0.8 2.4 x 1.1		

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

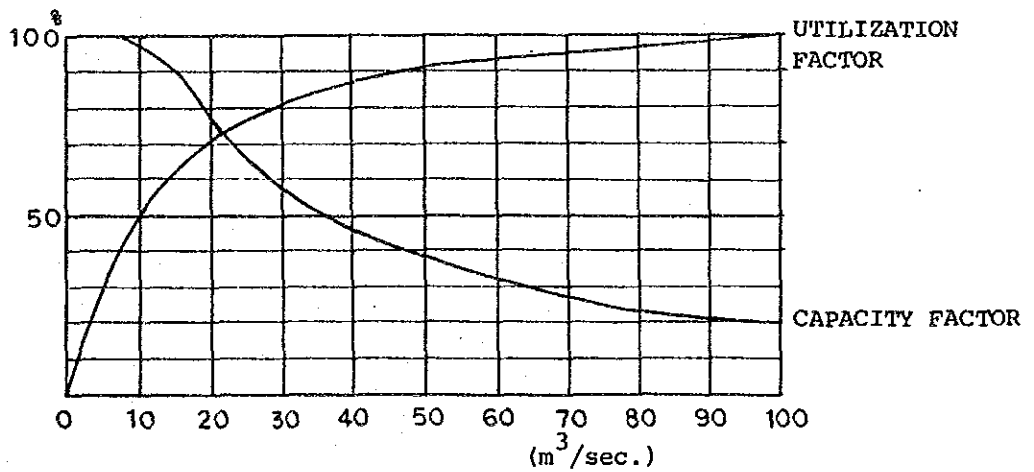
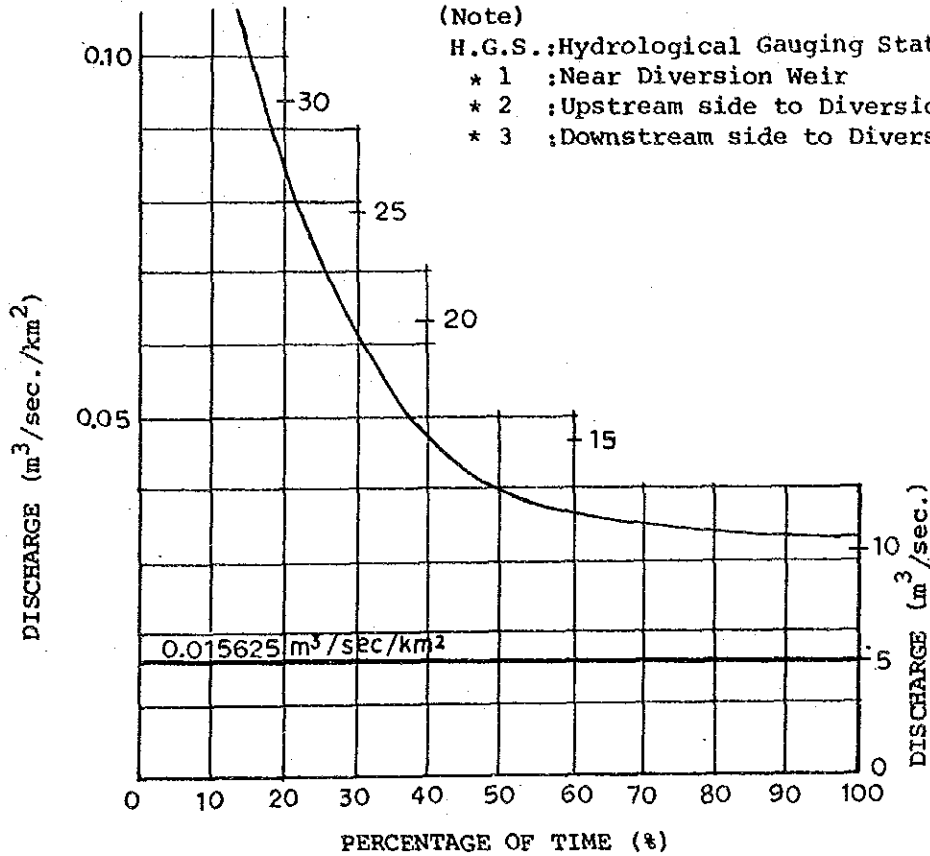
NO. 201 CARACOLI

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1975 - 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 River-water utilization factor in this power plant is low for the Nus River with an abundant flow.
- ② The diversion weir, intake and settling basin/head tank have been built in a poor layout and clumsy design, so that the settling basin does not sufficiently work because of its internally occurred vortex. In addition, the above structures themselves were damaged or deteriorated.

The gates and valves installed on headrace structures have been worn, or damaged, and their functions have remarkably been reduced.

- ③ The penstock consists of approx. 80 m long tunnel covered by stone-masonry and steel pipe line $\phi 1.4$ m, approx. 1100 m long. The steel pipe line has been replaced with a new one and is kept in a good condition.
- ④ The generating equipment are old-fashioned and two types of Pelton and Francis turbines are installed.

2. Key Points for the Rehabilitation Plan

- ① The diversion weir, intake and settling basin/head tank shall be modified and rehabilitated with consideration given to the future extension. According to a rough estimation from the flow duration curve, this plant capacity factor ranges from approx. 75 to 80%, even if a maximum discharge will be given as $20 \text{ m}^3/\text{s}$ (4 times as the present discharge).

- ② The generating equipment shall be designed to be in the same output and select the same type turbine. It is recommended to the Cross Flow type turbine shall be selected considering the operation efficiency, and maintenance and control.

GENERAL

Power Plant	NO. 202 LA REBUSCA	Investigated Date	30 Jan. 1988
Electric Company	EADE	Available Capacity (kW)	470
Location	ANTIOQUIA		
River	SANROQUE		
Generating Method	RUN-OF-RIVER		
Installed Year	1932/1934	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)	6.0	- Type		- Manufacturing Year	1934 1932
- Plenty Water Discharge		- Height (m)	1.50	- Type	PELTON PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	21.0	- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	600 600
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	21.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	0.10	- Regulating Valve Type	NO NAME PLATE NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Dimension (mm)	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	2. Generator	
4. Firm Discharge (m ³ /s)	1.0	- Dimensions (WxH) (m)	0.8 x 1.8	- Manufacturing Year	
5. Head (m)		- Number of Gates	1	- Type	SYN. SYN.
- Headwater Level (EL)	1,230	3. Intake		- Number of Generator	1 1
- Tailwater Level (EL)	1,140	- Elevation of Intake Sill (m)	UNKNOWN	- Capacity (kVA)	438 350 KW
- Gross Head	90	- Dimensions (m)	W 1.7 x H 3.3	- Power Factor (%)	NO NAME PLATE NO NAME PLATE
- Head Loss	UNKNOWN	- Number of Intake	1	- Voltage (V)	2300 2300
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Frequency (Hz)	60 60
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Revolution (rpm)	600 600
7. Plant Capacity (kW)	700	6. Intake Gate		3. Transformer	
8. Output (MWh)	UNKNOWN	- Type	SLUICE	- Manufacturing Year	1962 1971
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W 1.5 x H 1.8	- Type	ONAN ONAN
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	- Capacity (kVA)	900 2000
pesos/kWh	NO DATA	7. Headrace		- Primary Voltage (kV)	2.3 13.2
11. Others		- Type	OPEN NATURAL	- Secondary Voltage (kV)	13.2 44
		- Dimensions (m) [W x H]	W (1.5-1.8) x H 1.5	- Number of Phase	3 3
		- Length (m)	65	- Connection	Δ/Δ Δ/Δ
		8. Dimensions of Water Reservoir (m)	W L H 2.87x4.3x2.3	- Number	
		9. Penstock		- Continuous Stand-by	1 1
		- Dimensions (m) (φ x L)	φ = 0.75 L = 200		0 0
		- Number of Lines	1	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace (W x H) (m)	W H 1.9 x 2.0		

No. 202 La Rebusca

1. Present Condition and Problems

- ① In this power plant, the head is obtained by establishing intake facilities at the gate of a waterfall.
- ② The current output is low, which is equivalent to 45 % of the rated output. That is because the equipments and devices have become old-fashioned.
- ③ As the flow data and design drawings are not found, neither flow condition nor head can be confirmed.
- ④ This site has been given lower rehabilitation priority by the electric power company. However, if sufficient flow data is prepared, this power plant is prospected for an extention because of its short conduit length and compact-type intake facilities.

2. Key Points for the Rehabilitation Plan

- ① Remodel the intake weir and intake gate.
- ② The conduit is short, namely approx. 65 meter in length, but its bottom is irregular here and there due to excavation witout timbering. The flow-down capacity has been more reduced compared with the original profile. For this reason, this conduit shall be shaped up and remodeled into a covered channel. In addition, the head tank shall be increased in capacity.
- ③ Inspect the tear and wear condition of the penstock and replace it if necessary.
- ④ Have a grasp of the flow condition at the intake gate to set a proper installed capacity.

GENERAL

Power Plant	NO. 203 CALERA	Investigated Date	29 Jan. 1988
Electric Company	EADE	Available Capacity (kW)	64
Location	ANTIOQUIA		
River	Q. MALENA		
Generating Method	RUN-OF-RIVER		
Installed Year	1938	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam	OVERFLOW	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	CONCRETE	- Manufacturing Year	#1 #2
- Plenty Water Discharge	20.0	- Height (m)	1.5	- Type	1935
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30.0	- Output (kW)	PELTON PELTON
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Overflowing Crest (m)	30.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of Overflowing (m)	0.05	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		- Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	- Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.0	- Dimensions (R x H) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	190	3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	170	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	20	- Dimensions (m) (W x H)	W L H 1.4 x 2.7	- Capacity (kVA)	100 100
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2400 2400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.0 x 2.0 x	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	160	6. Intake Gate		- Revolution (rpm)	900 900
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W L H 1.2 x 1.6	- Manufacturing Year	1987
10. Unit Price		- Number of Gates	1	- Type	ONAN, OUTDOOR
1,000 pesos/kW	NO DATA	7. Headrace		- Capacity (kVA)	75 x 3
pesos/kWh	NO DATA	- Type	OPEN CONC./NATURAL	- Primary Voltage (V)	2300
11. Others		- Dimensions (m) (W x H)	W H 1.7 x 0.8	- Secondary Voltage (kV)	7.62
		- Length (m)	800	- Number of Phase	1
		8. Dimensions of Water Reservoir (m)	W L H 9.2 x 4.4 x 2.9	- Connection	Iio
		9. Penstock		- Number	3
		- Dimensions (m) (φ x L)	φ = 0.6 L = 32.0	Continuous Stand-by	0
		- Number of Lines	2	4. Others	
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRMED	#1 Unit: Stopped (Under repair)	
				#2 Unit: Operating	

1. Present Condition and Problems

- ① The power generating facility utilization rate is as low as 40%. This is because one of the two generators has been suspended. The facility utilization of the generator in operation is 80 %.
- ② The sedimentation basin has poorly been maintained and has been heaped with sand. In addition, a large quantity of plants has grown there.
- ③ The intake weir, intake gate and conduit structures are kept in a good state. The head tank is small in capacity, so a lot of water is uneffectively discharged.
- ④ As no flow data and design drawings have been provided, the flow condition and head cannot be confirmed.

2. Key Points for the Rehabilitation Plan

- ① The generating facility suspended was constructed 50 years ago. Its repair is impossible and it should be replaced with a new one.
- ② Before executing the rehabilitation, it is necessary to grasp the flow condition at the intake gate and then compare the existing configuration of 80 kW × 2 units with a 160 kW × 1 unit plan.

GENERAL

Power Plant	NO. 204 RIO ABAJO	Investigated Date	1 Feb. 1988
Electric Company	EADE	Available Capacity (kW)	600
Location	ANTIOQUIA		
River	RIO NEGRO		
Generating Method	RUN-OF-RIVER		
Installed Year	1947	Service-in	

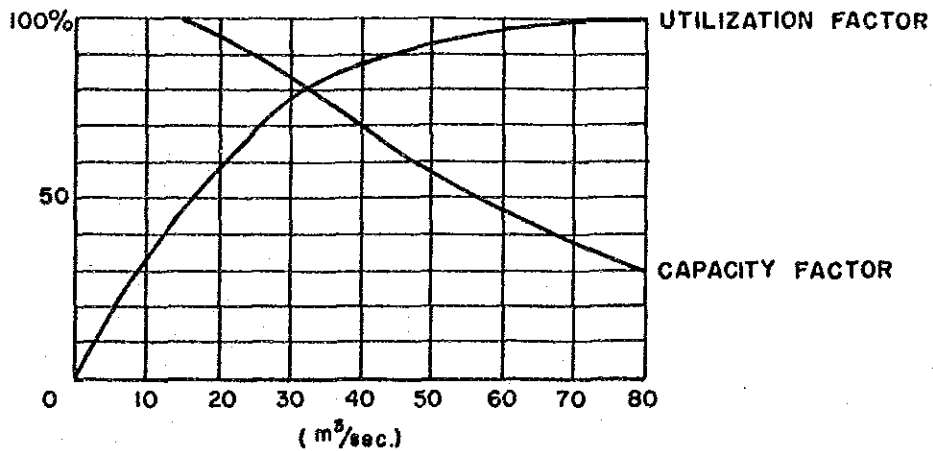
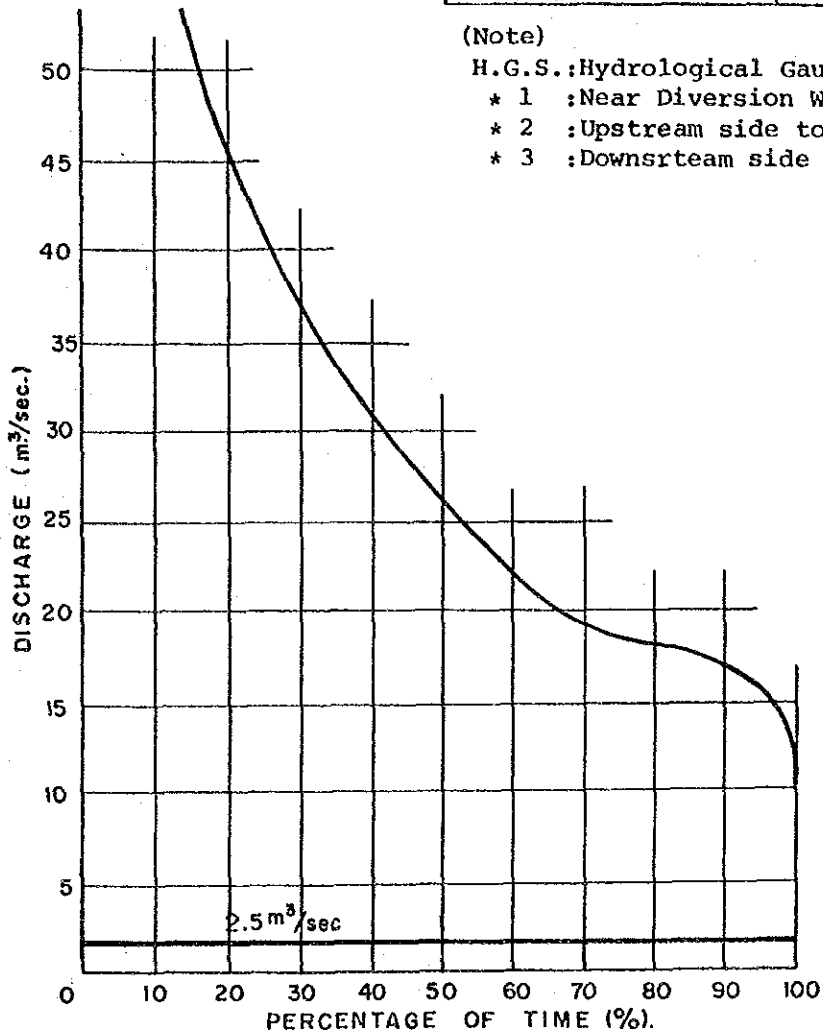
SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	842	1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	OVERFLOW ROCK	- Manufacturing Year	1947
- Plenty Water Discharge	NO DATA	- Height (m)	UNKNOWN	- Type	PELTON x 2
- Ordinary Water Discharge	30	- Crest Length (m)	55	- Output (kW)	825 BHP x 2
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	600
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	55	- 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 ³ /s)	NO DATA	- Type	NON	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	2.5	- Dimensions (ØxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	1,998	3. Intake		- Type	SYN.
- Tailwater Level (EL)	1,947	- Elevation of Intake Sill (m)	NOT CONFIRMED	- Number of Generator	2
- Gross Head	51	- Dimensions (m) (W x H)	NOT CONFIRMED	- Capacity (kVA)	625 x 2
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)		- Voltage (v)	2,400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 4.0x19.0x4.5	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,000	6. Intake Gate		- Revolution (rpm)	600
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NOT CONFIRMED	- Manufacturing Year	
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	2	- Type	ONAN, OUTDOOR
11. Others		7. Headrace		- Capacity (kVA)	430 x 3
		- Type	TUNNEL CONC.	- Primary Voltage (kV)	2,3
		- Dimensions (m) [W x H]	"U"	- Secondary Voltage (kV)	13.2
		- Length (m)	TUNNEL 400 CHANNEL 2,500	- Number of Phase	1
		8. Dimensions of Water Reservoir (m)	W L H 5.0x4.0x3.7	- Connection	Δ/Δ
		9. Penstock		- Number	Continuous Stand-by
		- Dimensions (m) (Ø x L)	Ø = 1.0 L = 353.4	3	
		- Number of Lines	1	0	
		10. Dimensions of Tailrace (W x H) (m)	W H 2 x 1.85 x 1.4	4. Others	#1, 2 Units: Operating

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 204 RIO ABAJO

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1964 - 1980
Used Data	1978 - 1980



1. Present Condition and Problems

- ① The power generating facility utilization rate (current output/rated output) at the time of field investigation is approx. 60 %. The output has been reduced because of the shortage of flow. When in the test the 2-unit operation was inverted into 1-unit operation, the power generating facility utilization rate per unit was increased up to approx. 80 %.
- ② To secure the quantity of water intaken, the weir bulk-increase work is now in progress by laying wire-cylinders including rubble aggregate.
- ③ The conduit structures except for the weir is kept in a good state.
- ④ The Rio Abajo is abundant in flow. The flow data from the EPM hydrological gauging station (No. 2308-709 Rio Abajo PN-4A) is available. For this reason, an increased output is also prospective.

2. Key Points for the Rehabilitation Plan

- ① The capacity of water intaken shall be secured by a full-scale rehabilitation of the intake weir.

GENERAL

Power Plant	NO.205 PIEDRAS	Investigated Date	3 Feb. 1988
Electric Company	EADE	Available Capacity (kW)	250
Location	ANTIOQUIA		
River	PIEDRAS		
Generating Method	RUN-OF-RIVER		
Installed Year	1935/1958	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	133	1. Dam - Type	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)	15	- Height (m)	2.2	- Manufacturing Year	1947 1938
- Plenty Water Discharge		- Crest Length (m)	18.0	- Type	FRANCIS FRANCIS
- Ordinary Water Discharge		- Elevation of overflowing Crest (m)	UNKNOWN	- Output (kW)	450 EHR NO NAME PLATE
- Low Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	18.0	- Revolution (rpm)	900 NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Depth of Over-flowing (m)	0.10	- Type of Governor	NO NAME NO NAME PLATE PLATE
- Minimum	NO DATA	2. Sand Trap Gate		- Regulating Valve	NO NAME NO NAME PLATE PLATE
- Mean	NO DATA	- Type	NON	- Type	NO NAME NO NAME PLATE PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NON	- Dimension (mm)	NO NAME NO NAME PLATE PLATE
4. Firm Discharge (m ³ /s)	1.5	- Number of Gates	NON	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	2,004	- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN. SYN.
- Tailwater Level (EL)	1,955	- Dimensions (m) (W x H)	W H 2.1 x 2.5	- Number of Generator	1 1
- Gross Head	49	- Number of Intake	1	- Capacity (kVA)	312 260
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80 80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.0x1.50x3.8	- Voltage (V)	400 400
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60 60
7. Plant Capacity (kW)	458	- Type	SLUICE	- Revolution (rpm)	900 900-1,500
8. Output (MWh)	UNKNOWN	- Dimensions (m) (W x H)	W H 0.9 x 2.0	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	2	- Manufacturing Year	1975
10. Unit Price (1,000 pesos/kWh)	NO DATA	7. Headrace		- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	- Type	OPEN	- Capacity (kVA)	500
11. Others		- Dimensions (m) (W x H)	W 1.8 ~ 2.2 H 1.5 ~ 1.8	- Primary Voltage (V)	480
		- Length (m)	1,500	- Secondary Voltage (kV)	13.8
		8. Dimensions of Water Reservoir (m)	W L H 1.8x6.0x3.0	- Number of Phase	3
		9. Penstock	$\phi = 0.6,$ $\phi + 0.75$ L = 108	- Connection	NO NAME PLATE
		- Dimensions (m) ($\phi \times L$)		- Number	1
		- Number of Lines	2	Continuous Stand-by	0
		10. Dimensions of Tailrace (W x H) (m)	W H 2 x 1.5 x 3.5	4. Others	#1 Unit: Operating #2 Unit: Stopped (Under repair)

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

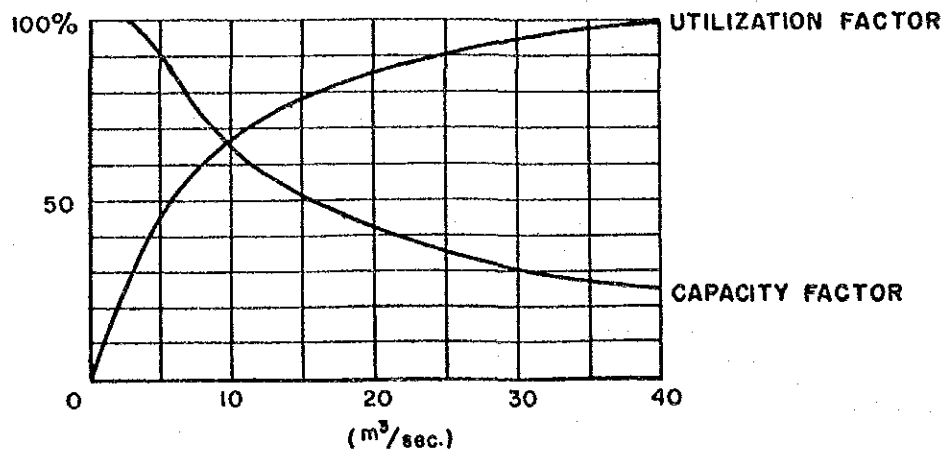
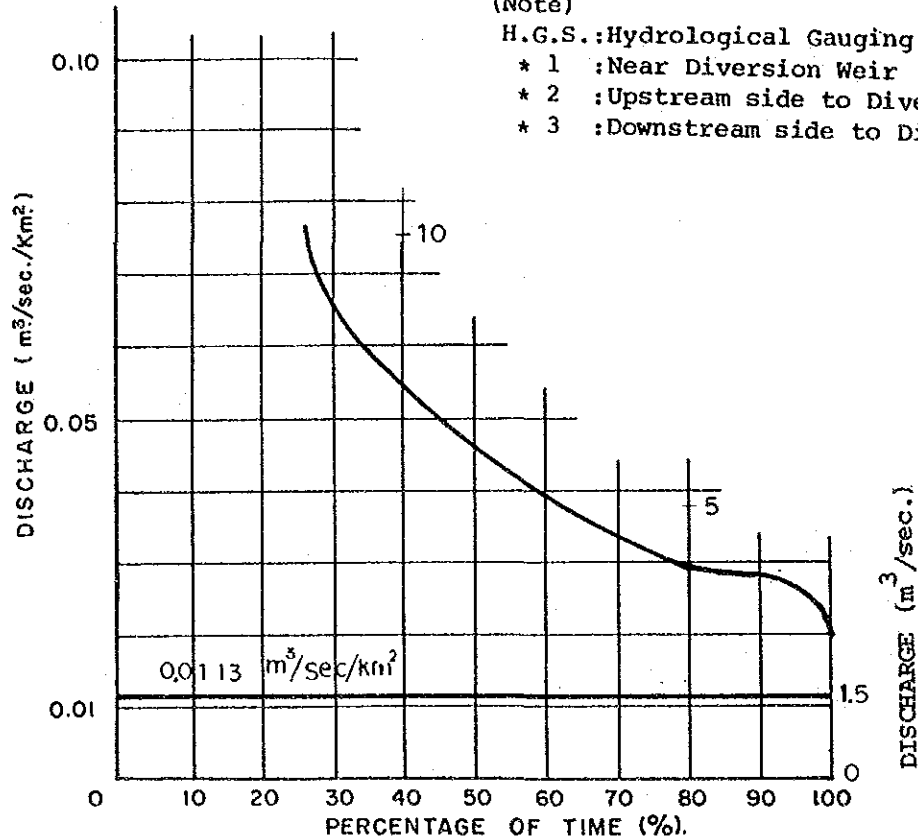
NO. 205 PIEDRAS

Location of H.G.S.	* 1
Daily or Monthly	Daily
Observation Duration	1940 - 1979
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. 205 Piedras

1. Present Condition and Problems

- ① A EPM's hydrological gauging station (No. 2618-707, Bocatoma PLTA) is situated in an immediately upper reaches from the intake gate. Judging from a flow curve received from this station, this power plant has a very low river-water utilization rate. The current service water flow ($Q = 1.5 \text{ m}^3/\text{s}$) is much below the droughty-water discharge ($Q \approx 3.5 \text{ m}^3/\text{s}$).
- ② As a generating facility constructed in 1938 (#2 of 208 kW) has been suspended, the power generating facility utilization rate has also been reduced to approx. 53 %.
- ③ One of the two penstocks has become too old for work. It is said that there are 100 or more points to be repaired.
- ④ The conduit has been considerably old-fashioned, but kept in a good state. However, the sedimentation basin and head tank are small in capacity.

2. Key Points for the Rehabilitation Plan

- ① Replace the generator (#2 208 kW). Otherwise, make the #1 of 250 kW standby to convert the facility into one unit of 450 kW (alternative plan).
- ② Replacement of the penstock.
- ③ An overall facility remodelling is required to increase both the river-water utilization rate and flow control equipment utilization rate.

GENERAL

Power Plant	NO. 206 SONSON	Investigated Date	2 Feb. 1988
Electric Company	EADE	Available Capacity (kW)	3,600
Location	ANTIOQUIA		
River	SONSON		
Generating Method	REGULATION TYPE		
Installed Year	1967	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (km ²)	13	1. Dam	OVER FLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	8	- Height (m)	10.0	- Type	PELTON
- Ordinary Water Discharge		- Crest Length (m)	29.5	- Output (kW)	5,750 C.V.
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	900
- Droughty Water Discharge	NO DATA	- Width of Overflowing Crest (m)	29.5	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Overflowing (m)	NOT CONFIRMED	- Regulating Valve Type	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Dimension (mm)	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	2. Generator	
4. Firm Discharge (m ³ /s)	1.0	- Dimensions (RxH) (m)	2.2 x 2	- Manufacturing Year	
5. Head (m)		- Number of Gates	2	- Type	SYN.
- Headwater Level (EL)	2,316	3. Intake		- Number of Generator	1
- Tailwater Level (EL)	1,790	- Elevation of Intake Sill (m)	2,310.5	- Capacity (kVA)	4,500
- Gross Head	536	- Dimensions (m) (WxH)	NOT CONFIRMED	- Power Factor (%)	80
- Head Loss	UNKNOWN	- Number of Intake	NOT CONFIRMED	- Voltage (V)	6,600
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Frequency (Hz)	60
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Revolution (rpm)	900
7. Plant Capacity (kW)	3,600	6. Intake Gate		3. Transformer	
8. Output (Mwh)	UNKNOWN	- Type	SLUICE	- Manufacturing Year	1961
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NOT CONFIRMED	- Type	ONAN, OUTDOOR
10. Unit Price 1,000 pesos/kw	NO DATA	- Number of Gates	2	- Capacity (kVA)	4,500
pesos/kWh	NO DATA	7. Headrace		- Primary Voltage (V)	6,600
11. Others		- Type	BOX CALVERT	- Secondary Voltage (kV)	44
		- Dimensions (m) [W x H]	2.0 x 2.0	- Number of Phase	3
		- Length (m)	710	- Connection	Δ/Δ
		8. Dimensions of Water Reservoir (m)	NON	- Number	1
		9. Penstock		Continuous Stand-by	0
		- Dimensions (m) (φ x L)	φ = 0.8 L = 925	4. Others	Operating
		- Number of Lines	1		
		10. Dimensions of Tailrace [W x H] (m)	W H 1.8 x 2.2		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

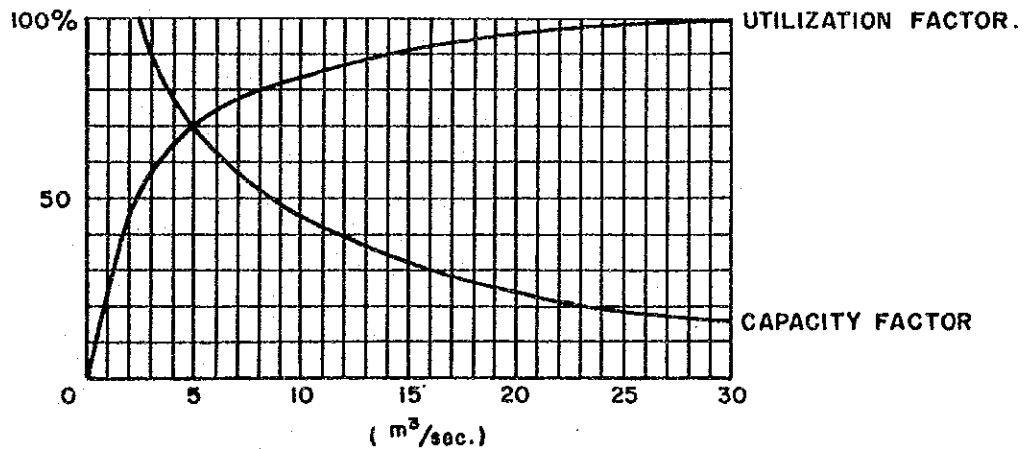
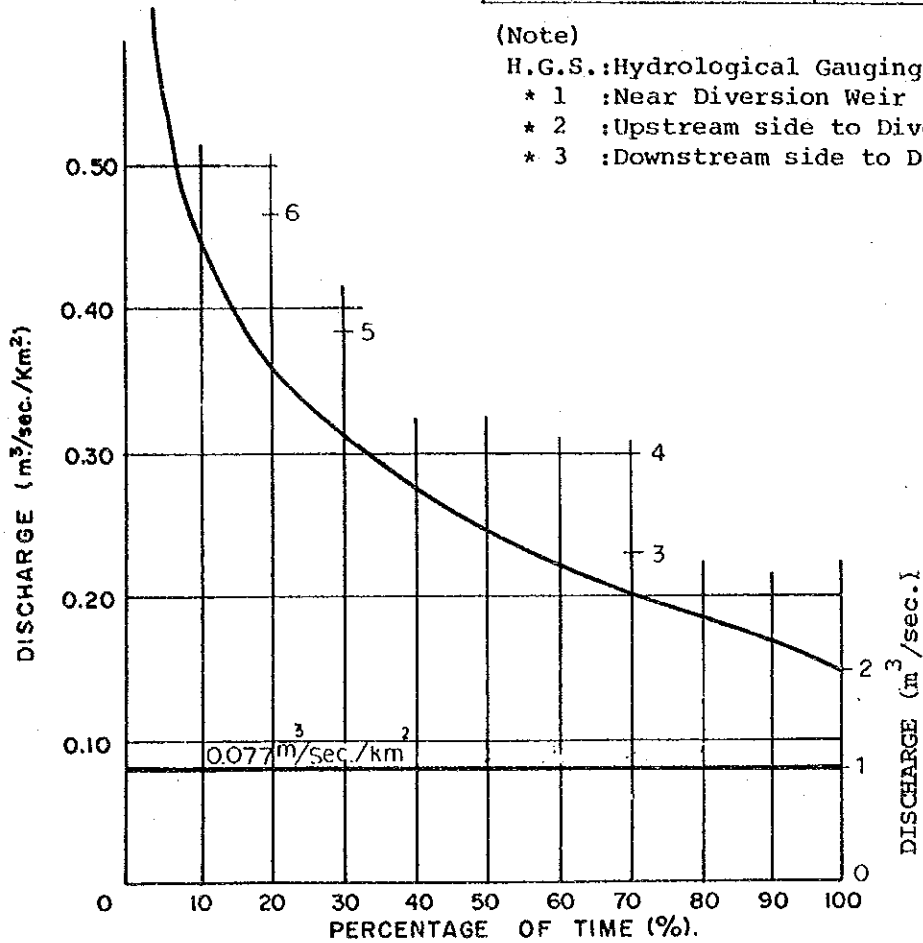
NO. 206 SONSON

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1973 - 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. 206 Sonson

1. Present Condition and Problems

- ① The conduit structures have been designed and constructed with the service water flow as $Q = 4.0 \text{ m}^3/\text{s}$, in consideration of a future possible extension. The current service water flow is $Q = 1.0 \text{ m}^3/\text{s}$. The rehabilitation work has only to increase the penstock and generator. The existing facility is kept in a good operation state and maintained in a rated output.
- ② Although a F/S report has been prepared, no extension plan has been actualized. That is partly because water flow is in short supply in the dry seasons.

2. Key Points for the Rehabilitation Plan

- ① Review on the weir adjustable capacity.
- ② Discussion on the possibility of a mountain stream intake or water conveyance from the neighbouring rivers.
- ③ Utilization of an unutilized head (approx. 150 m) located below the outlet.

GENERAL

Power Plant	NO. 207 TAMESIS	Investigated Date	4 Feb, 1988
Electric Company	EADE	Available Capacity (kW)	1,160
Location	ANTIOQUIA		
River	RIO FRIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1940/1951/1961	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment			
Item	Data	Item	Data	Item	Data		
1. Catchment Area (Km ²)	88	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1	#2	#3
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1928	1951	1961
- Plenty Water Discharge	NO DATA	- Height (m)	6.0	- Type	PELTON	PELTON	PELTON
- Ordinary Water Discharge	30.0	- Crest Length (m)	25.0	- Output (kW)	BHP		
- Low Water Discharge	NO DATA	- Elevation of Over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	750		
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	25.0	- Types of Governor	900	NO NAME	NO NAME
- Minimum	NO DATA	- Depth of Over-flowing (m)	0.10	- Regulating Valve	PLATE	PLATE	PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Type	NO NAME	NO NAME	NO NAME
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	- Dimension (mm)	PLATE	PLATE	PLATE
4. Firm Discharge (m ³ /s)	1.2	- Dimensions (WxH) (m)	NOT CONFIRMED	2. Generator	NO NAME	NO NAME	NO NAME
5. Head (m)		- Number of Gates	1	- Manufacturing Year			
- Headwater Level (EL)	1,762	3. Intake		- Type	SYN.	SYN.	SYN.
- Tailwater Level (EL)	1,595	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1	1	1
- Gross Head	167	- Dimensions (m) (WxH)	W H	- Capacity (kVA)	625	630	630
- Head Loss	UNKNOWN	- Number of Intake	4.0 x	- Power Factor (%)	80	80	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	6.6 KV	500-289	500-289
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H	- Frequency (Hz)	60	60	60
7. Plant Capacity (kW)	1,508	6. Intake Gate		- Revolution (rpm)	900	720-1,420	720-1,420
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer			
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H	- Manufacturing Year	1958	1952	1962
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	- Type	ONAN	ONAF	ONAF
11. Others		7. Headrace		- Capacity (kVA)	625	625	625
		- Type	OPEN	- Primary Voltage (kV)	6	.48	.48
		- Dimensions (m) (W x H)	W H	- Secondary Voltage (kV)	13.7	14.38	13.7
		- Length (m)	1,000	- Number of Phase	3	3	3
		8. Dimensions of Water Reservoir (m)	W L H	- Connection	Δ	Δ	Δ
		- Dimensions (m) (φ x L)	φ = 0.4, 0.75	- Number	1	1	1
		- Number of Lines	L = 287	Continuous	0	0	0
		10. Dimensions of Tailrace (W x H) (m)	W H	Stand-by	0	0	0
			2 x 1.0 x 1.3	4. Others	#1, 2, 3 Unit: Operating		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

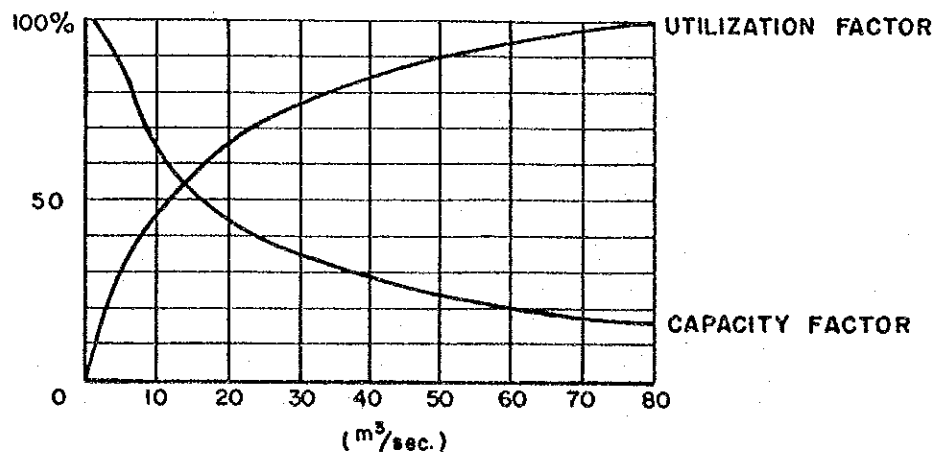
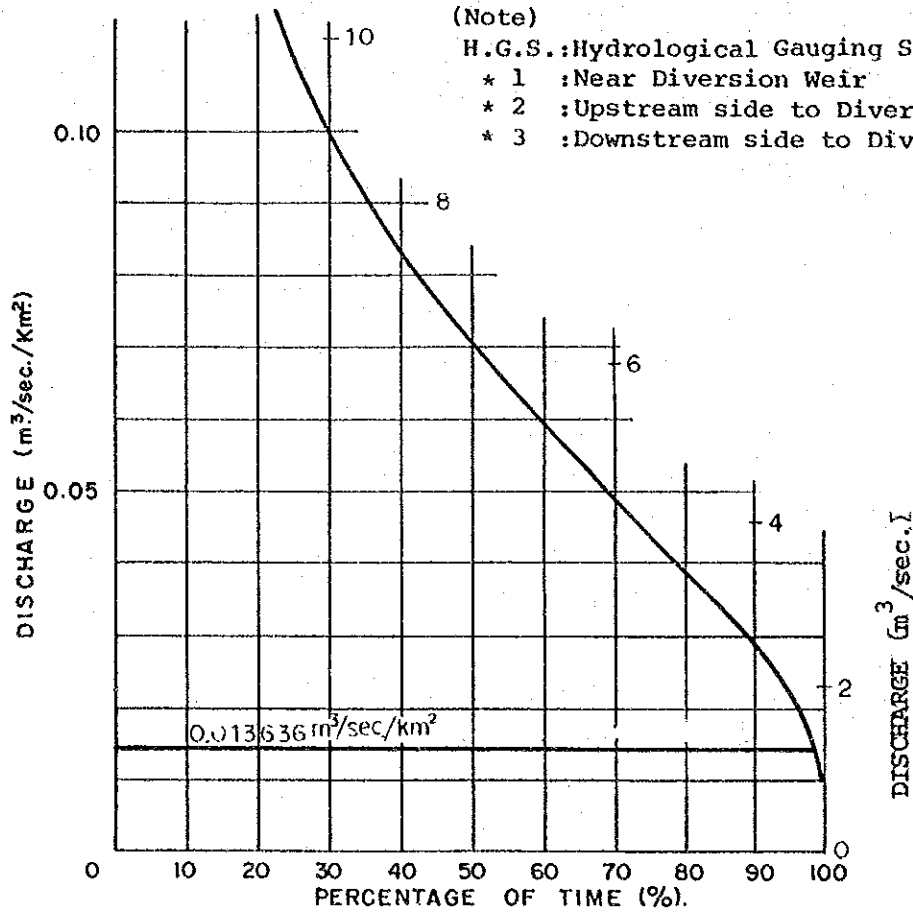
NO. 207 TAMESIS

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1969 - 1985
Used Data	1981, 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 According to the listening survey by ICEL, one of the three generators had been destroyed, another had been suspended and only the rest one was in operation. However, all the three generators are now in operation and the facility utilization rate reaches 76 %.
- ② As no flow data, topographical map, and design drawing have been provided, the flow condition and head cannot be confirmed. A number of head sites remain unutilized on the upstream side of the intake gate and on the downstream side of the outlet.
- ③ The intake gate and sedimentation basin are of old-fashioned but strongly-built structures. For the conduit, an approx. 15 meter work-increase and a cover plate installation work are in progress.

2. Key Points for the Rehabilitation Plan

- ① For a rehabilitation in the present condition, it is necessary to replace the screen and gate with a new ones and enlarge the head tank to some extent.
- ② For a future possible extension, it is desirable to prepare both the structure status drawing and hydrological gauging record.

GENERAL

Power Plant	NO. 208 URRAO	Investigated Date	5 Feb. 1988
Electric Company	EADE	Available Capacity (kW)	430
Location	ANTIOQUIA		
River	URRAO → PENDERISCO		
Generating Method	RUN-OF-RIVER		
Installed Year	1964	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	3.0	- Type	FRANCIS FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	15.0	- Output (kW)	NO NAME PLATE FS 1,020
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE 900
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	15.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.5	- Dimensions (ØxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYN SYN
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	70	- Dimensions (m) (WxH)	W H 1.3 x 2.0	- Capacity (kVA)	250 780
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2,400 500
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 10.0x18.0x3.0	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	824	6. Intake Gate		- Revolution (rpm)	1,200 900
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H 1.1 x 0.9	- Manufacturing Year	1976
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	- Type	ONAN ONAN
	NO DATA	7. Headrace		OUTDOOR OUTDOOR	
11. Others		- Type	TUNNEL OPEN	- Capacity (kVA)	275 800
		- Dimensions (m) [W x H]	W 1.4 ~ 2.0 H 1.3 ~ 1.2	- Primary Voltage (V)	2,300 440
		- Length (m)	1,500	- Secondary Voltage (kV)	13.2 13.2
		8. Dimensions of Water Reservoir (m)	W L H 6.0x15.0x3.0	- Number of Phase	3 3
		9. Penstock		- Connection	Y/Y Δ/Y
		- Dimensions (m) (φ x L)	φ = 0.55, 0.75 L = 80	- Number Continuous Stand-by	1 1 0 0
		- Number of Lines	2	4. Others	#1, 2 Unit: Stopped
		10. Dimensions of Tailrace (W x H) (m)	W H 2 x 1.4 x 1.6		

1. Present Condition and Problems

- ① One of the two penstocks has been suspended because of its burst by wear and tear. As this power plant does not have a construction in which only the burst pipe can be shut down, the whole power plant has been suspended. The rehabilitation work will be started before long.
- ② As no flow data and design drawing are provided, the flow condition and head cannot be checked.
- ③ Some damages are found on a part of the intake weir and conduit, but the conduit structures are kept in a good state. Regretfully, the design is complicated.
- ④ Because the generators are of old-fashioned and their spare parts are hard to be procured, the maintenance operation is insufficient.

2. Key Points for the Rehabilitation Plan

- ① A partial rehabilitation of the conduit structures and replacement of the incidental gates and valves.
- ② Inspection for the penstocks. Their replacement, if necessary.
- ③ Overhaul / inspection works for the generators and their replacement if needed.

GENERAL

Power Plant	NO. 209 ABEJORRAL	Investigated Date	2 Feb. 1988
Electric Company	EADE	Available Capacity (kW)	490
Location	ANTIOQUIA		
River	Q. LAS YEGUAS		
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 ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1960 1951
- Plenty Water Discharge	NO DATA	- Height (m)	3.0	- Type	PELTON PELTON
- Ordinary Water Discharge	5.0	- Crest Length (m)	15.0	- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)		- Revolution (rpm)	NO NAME PLATE NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	15.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	0.3	- Regulating Valve	NO NAME PLATE NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.0	- Dimensions (ØxH) (m)	NON	2. Generator	
5. Head (m)	1,575	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	1,440	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	135	- Dimensions (m) (WxH)	W L 0.9 x 1.0	- Capacity (kVA)	660 245
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	400 400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.5x15.0x1.8	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	724	6. Intake Gate		- Revolution (rpm)	600 900
8. Output (MWh)	UNKNOWN	- Type	NON	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NON	- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)	NO DATA	- Number of Gates	NON	- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	NAME PLATE WAS MISSING
11. Others		- Type	OPEN	- Primary Voltage (kV)	NAME PLATE WAS MISSING
		- Dimensions (m) [W x H]	W 0.85 ~ 2.0	- Secondary Voltage (kV)	NAME PLATE WAS MISSING
		- Length (m)	H 1.0	- Number of Phase	NAME PLATE WAS MISSING
		8. Dimensions of Water Reservoir (m)	W L H 1.8x6.75x3.0	- Connection	NAME PLATE WAS MISSING
		9. Penstock		- Number	2
		- Dimensions (m) (Ø x L)	Ø = 0.6 L = 320.0	Continuous Stand-by	0
		- Number of Lines	1	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace (m) [W x H]	W H 2 x 0.64 x 0.66		

1. Present Condition and Problems

- ① This power plant makes use of a waterfall head. As no flow data, topographical drawings, and design drawings have been provided, the flow condition and head cannot be checked.
- ② There is a (fine) intake facility of a private power plant of Cement El Cairo immediately downstream from the outlet. This private power plant intakes both the water flowing from outlet and the river flow. The design service flow can be increased to the same level as this power plant.
- ③ The conduit was poorly designed, so that the profile and slope are remarkably changeable from place to place. For this reason, the water flow is insufficient.
- ④ Erosions have proceeded against the gates and valves incidental to the conduit structures. Therefore, the gates and valves are not in operation.

2. Key Points for the Rehabilitation Plan

- ① Rehabilitate the conduit and replace the gates and valves.
- ② Inspect the penstock and replacement if necessary.
- ③ Overhaul the generators and replacement if necessary.
- ④ In this site, the length of the conduit is relatively short. If almost all the river flow is intaken like the above Cement El Cairo, the output will be increased to about twice or three times a current rated output.

GENERAL

Power Plant	NO. 210 P. GUILLERMO	Investigated Date	25 Feb. 1988
Electric Company	BOYACA S.A.	Available Capacity (kW)	0
Location	BOYACA		
River	SUAREZ		
Generating Method	RUN-OF-RIVER		
Installed Year	1963	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (km ²)	NO DATA	1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)		- Type	FRANCIS x 2
- Ordinary Water Discharge	NO DATA	- Crest Length (m)		- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)		- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)		- Type of Governor	MECHANICAL
- Minimum	NO DATA	- Depth of Over-flowing (m)		- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		Type	GEARED MANUAL
3. Utilizable Flow (m ³ /s)	NO DATA	- Type		Dimension (mm)	0.5
4. Firm Discharge (m ³ /s)	2.6	- Dimensions (WxH) (m)		2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYNCHRO
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)		- Number of Generator	2
- Gross Head	58.0	- Dimensions (m) (WxH)		- Capacity (kVA)	800 x 2
- Head Loss	UNKNOWN	- Number of Intake	2	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)		- Voltage (V)	240
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 4.0x x4.0	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,280	6. Intake Gate		- Revolution (rpm)	900
8. Output (MWh)	UNKNOWN	- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]		- Manufacturing Year	
10. Unit Price		- Number of Gates	2	- Type	ONAN
1,000 pesos/kW	NO DATA	7. Headrace		- Capacity (kVA)	800 x 2
pesos/kWh	NO DATA	- Type	CHANNEL	- Primary Voltage (V)	240/139
11. Others		- Dimensions (m) [W x H]	W H 3.0 x 2.0	- Secondary Voltage (KV)	22
		- Length (m)	380	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)		- Connection	Δ (PRIM.) Δ (SECOND)
		9. Penstock		- Number	2
		- Dimensions (m) (φ x L)	φ = 1.0 L =	Continuous Stand-by	1
		- Number of Lines	2	4. Others	
		10. Dimensions of Tailrace [W x H] (m)			

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

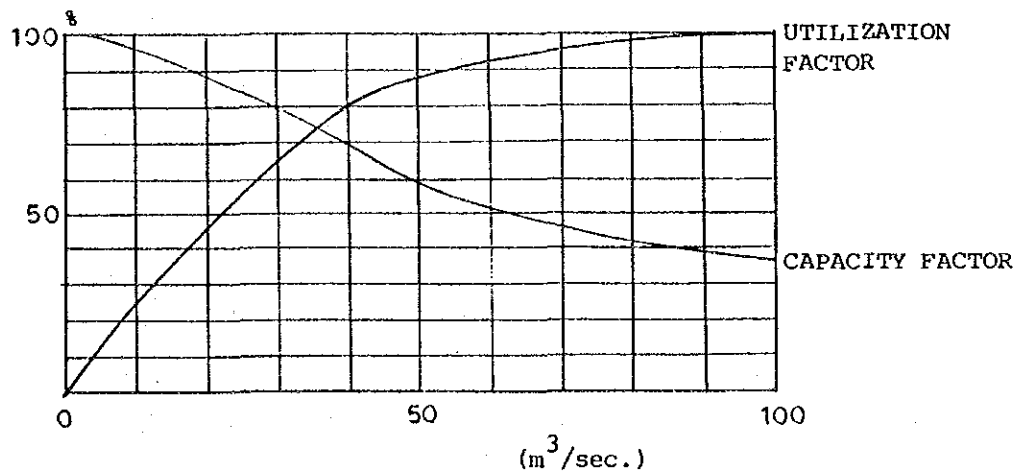
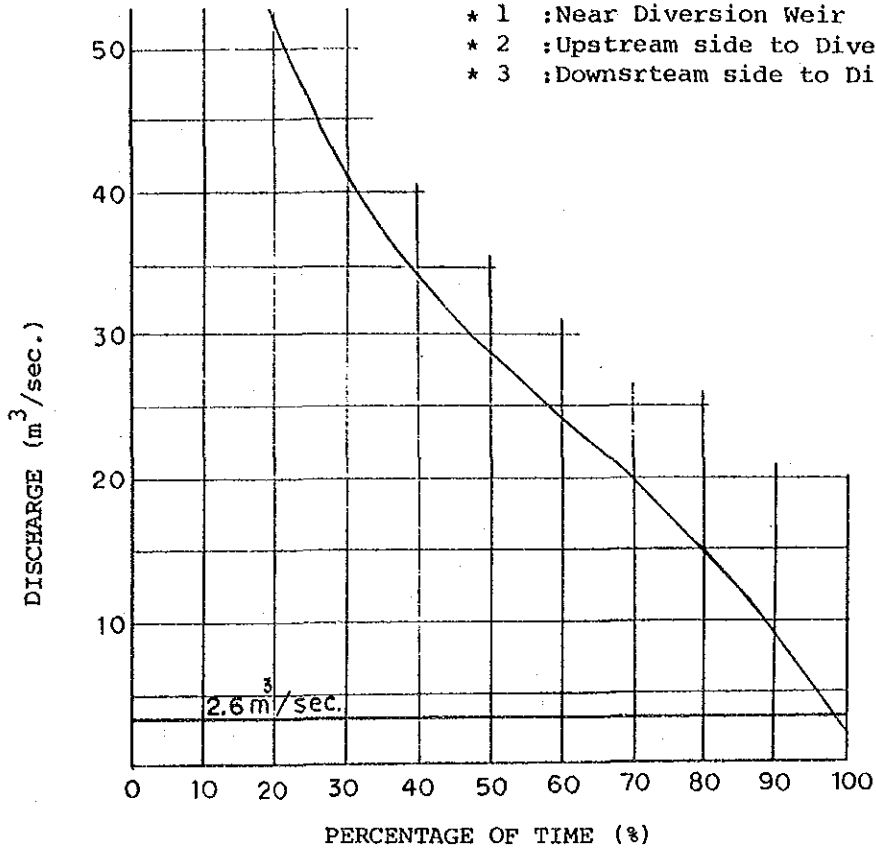
NO. 210 P. GUILLERMO

Location of H.G.S.	* 1
Daily or Monthly	Monthly
Observation Duration	1960 - 1983
Used Data	1960 - 1983

(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 penstock was destroyed by the subsidence of anchor blocks and the generating facilities have been suspended three years ago.
- ② The strata are alternately composed of sandstone and clay slate. The head is provided in this power plant by making use of a steep cliff of the sandstone portion. The penstock is installed on the talus of the steep cliff.
- ③ The diversion weir, intake settling basin and headrace are kept in a good condition. However, gates, valves and screens, etc. should be replaced.
- ④ The hydrological records from CAR's Chiquinquirá office are available but have not yet been obtained.
- ⑤ The duration service of #1 unit and #2 unit is 28 and 38 years, respectively. If the repair work of the penstock has been completed, it is said that the rated output will be recovered up to approx. 90.
- ⑥ A check dam shall be built in the upstream side to prevent boulders from flowing down.

2. Consultation of the Rehabilitation Plan

- ① Geological survey shall be conducted around the reservoir tank and penstock for their improvement.
- ② The generating facilities shall be overhauled and then inspected. If necessary, #2 unit shall be replaced, or #1 unit shall be used as standby to change to one unit (1200 kW).

GENERAL

Power Plant	NQ. 211 SAN CANCIO	Investigated Date	9 Feb. 1988
Electric Company	CHEC	Available Capacity (kW)	1,750
Location	CALDAS		
River	CHINCHINA		
Generating Method	RUN-OF-RIVER		
Installed Year	1929/1947	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (km ²)	NO DATA	1. Dam - Type	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Height (m)	2.0	- Manufacturing Year	1947 1929
- Plenty Water Discharge	NO DATA	- Crest Length (m)	19.0	- Type	FRANCIS PELTON
- Ordinary Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Output (kW)	FHP 1,800 NO NAME PLATE
- Low Water Discharge	NO DATA	- Width of overflowing Crest (m)	19.0	- Revolution (rpm)	600 NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Depth of overflowing (m)	UNKNOWN	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	2. Sand Trap Gate	SLUICE	- Regulating Valve	NO NAME PLATE NO NAME PLATE
- Mean	NO DATA	- Type		Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	W H 1.9 x 3.0	Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	5.6	- Number of Gates	2	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	1,001.25	- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN. SYN.
- Tailwater Level (EL)	943.74	- Dimensions (m) (WxH)	W H 2.0 x 2.0	- Number of Generator	1 1
- Gross Head	59.75	- Number of Intake	1	- Capacity (kVA)	1,500 1,400
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80 80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 8.2x20.2x1.5	- Voltage (V)	4,160 4,000
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60 60
7. Plant Capacity (kW)	2,320	- Type	SLUICE	- Revolution (rpm)	600
8. Output (MWh)	UNKNOWN	- Dimensions (m) (W x H)	W H 1.8 x 1.8	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Manufacturing Year	N/A N/A
10. Unit Price (1,000 pesos/kw)	NO DATA	7. Headrace		- Type	N/A N/A
pesos/kwh	NO DATA	- Type	TUNNEL OPEN	- Capacity (kVA)	N/A N/A
11. Others		- Dimensions (m) (W x H)	W 2.0 - 3.0 H 2.0	- Primary Voltage (kV)	N/A N/A
		- Length (m)	4,000	- Secondary Voltage (kV)	N/A N/A
		8. Dimensions of Water Reservoir (m)	W L H 5.4x23.0x3.0	- Number of phase	N/A N/A
		9. Penstock		- Connection	N/A N/A
		- Dimensions (m) (φ x L)	φ = 1.24 L = 125.0	- Number	N/A N/A
		- Number of Lines	1	Continuous Stand-by	N/A N/A
		10. Dimensions of Tailrace (W x H) (m)	W H 2 x 4.0 x 1.0	4. Others	#1 Unit: Stopped (Under repair) #2 Unit: Operating

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

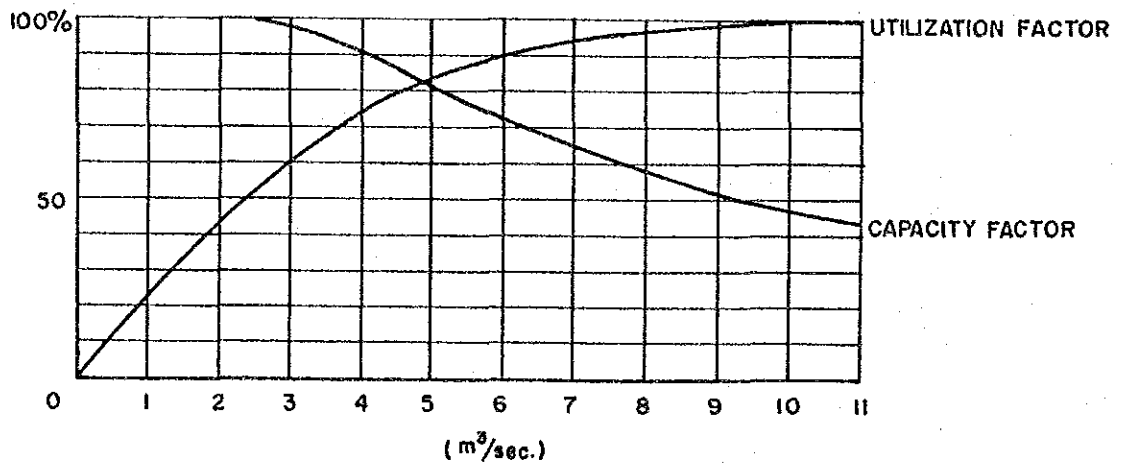
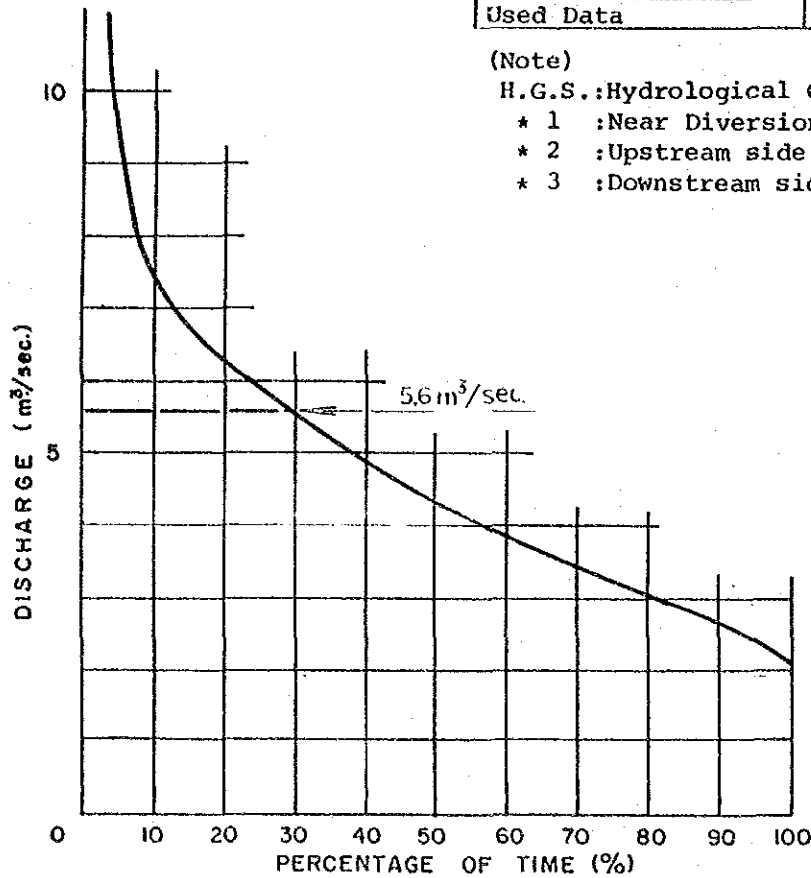
NO. 211 SAN CANCIO

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1979 - 1984
Used Data	1979 - 1984

(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 located as one of three power plants in the Chinchina River. In its downstream, Intermedia and Municipal power plants have been located.
- ② In comparison with the generating output, the installed capacity is restricted to as low as about 10%.
- ③ The both Pelton and Francis types turbines are installed as generating facilities. Their service life of 41 to 59 years, the output drop rate is 35%, because the duration of their service ranges from 41 to 59 years.
- ④ Like the other power plants, the diversion weir has been accumulated with sand upto its crest. A lot of sand have been mixed into the headrace. The flow capacity has been reduced, because of different sectional form of the headrace.
- ⑤ The setting basin and penstock are kept in a good condition. However, the capacity of head tank is considered to be insufficient.

2. Key Points for the Rehabilitation Plan

- ① The same type of generating facilities shall be selected for two power plants in the downstream side, considering simple maintenance and compactibility of spare parts.
- ② The diversion weir, headrace and reservoir tank shall be improved.

GENERAL

Power Plant	NO. 212 INTERMEDIA	Investigated Date	9 Feb. 1988
Electric Company	CNEC	Available Capacity (kW)	900
Location	CALDAS		
River	CHINCHINA		
Generating Method	RUN-OF-RIVER		
Installed Year	1947	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)	NO DATA	- Type	NON	- Manufacturing Year	1935
- Plenty Water Discharge	NO DATA	- Height (m)	NON	- Type	PELTON
- 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	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	5.6	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	NON	- Number of Generator	1
- Gross Head	59.01	- Dimensions (m) (WxH)	NON	- Capacity (kVA)	1,400
- Head Loss	UNKNOWN	- Number of Intake	NON	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	4,000
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,120	6. Intake Gate		- Revolution (rpm)	257
8. Output (MWh)	UNKNOWN	- Type	NON	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NON	- Manufacturing Year	N/A
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	NON	- Type	N/A
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	N/A
11. Others		- Type	BOX CAL. OPEN	- Primary Voltage (kV)	N/A
		- Dimensions (m) [W x H]	W L H 2.0 x 2.5	- Secondary Voltage (kV)	N/A
		- Length (m)	4.000	- Number of Phase	N/A
		8. Dimensions of Water Reservoir (m)	W L H 14 x 68 x 4.0	- Connection	N/A
		9. Penstock		- Number Continuous Stand-by	N/A
		- Dimensions (m) (φ x L)	φ = 1.24 L = 153.0	4. Others	Stopped
		- Number of Lines	1		
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

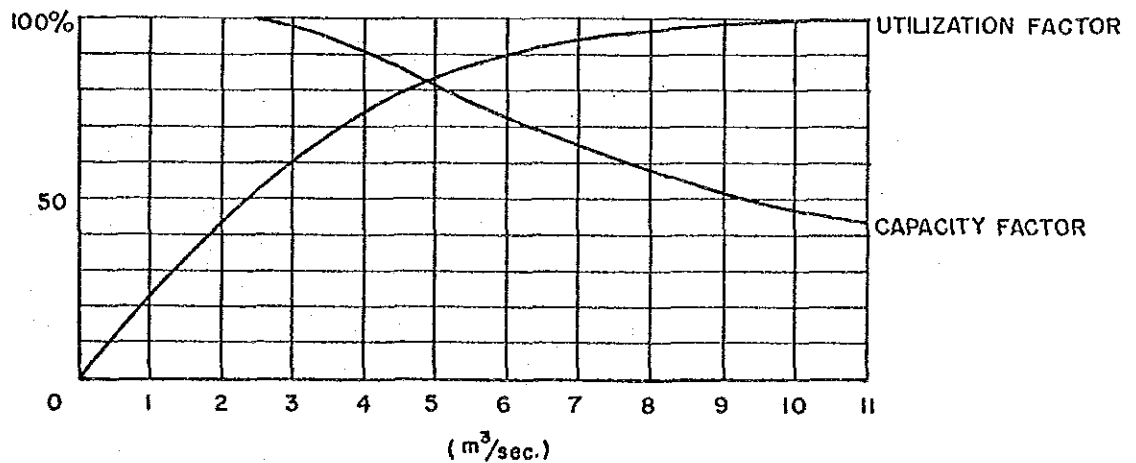
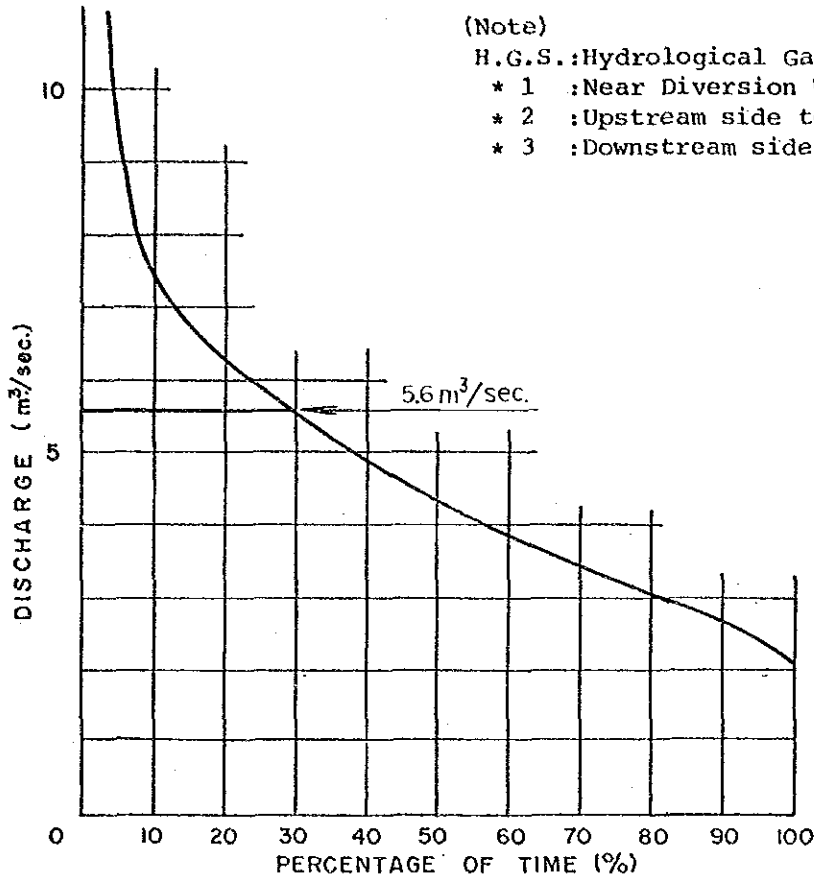
NO. 212 INTERMEDIA

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1979 - 1984
Used Data	1979 - 1984

(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 tailrace for the San Cancio is connected to the headrace for this power plant.
- ② The generating output is twice or more as the installed capacity. The replacement of the generating facilities would lead to drastic increase of output.
- ③ Although the reservoir tank is very rigid, the design of the headrace and settling basin shall be reviewed.
- ④ The penstock has considerably been corroded.

2. The Rehabilitation Plan

- ① A proper installed capacity shall be determined.
- ② Types of generating facilities used in this power plant, San Cancio and Municipal power plants shall be standardized.
- ③ The headrace and settling basin shall be improved.
- ④ The penstock shall be replaced.

GENERAL

Power Plant	NO. 213 MUNICIPAL	Investigated Date	9 Feb. 1988
Electric Company	CHEC	Available Capacity (kW)	1,400
Location	CALDAS		
River	CHINCHINA		
Generating Method	RUN-OF-RIVER		
Installed Year	1945	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (km ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)	NO DATA	- Type		- Manufacturing Year	1935
- Plenty Water Discharge	NO DATA	- Height (m)	3.0	- Type	PELTON x 2
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	25.7	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Broughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	25.7	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NOT CONFIRMED	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	5.6	- Number of Gates	2	2. Generator	
5. Head (m)	799.47	3. Intake		- Manufacturing Year	
- Headwater Level (EL)		- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN.
- Tailwater Level (EL)	719.15	- Dimensions (m) (WxH)	NOT CONFIRMED	- Number of Generator	2
- Gross Head	80.52	- Number of Intake	2	- Capacity (kVA)	1,320 x 2
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Voltage (v)	4,300
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60
7. Plant Capacity (kW)	2,112	- Type	SLUICE	- Revolution (rpm)	360
8. Output (MWh)	UNKNOWN	- Dimensions (m) [W x H]	NOT CONFIRMED	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Manufacturing Year	ONAN ONAN
10. Unit Price (1,000 pesos/kWh)	NO DATA	7. Headrace		- Type	OUTDOOR OUTDOOR
pesos/kWh	NO DATA	- Type	OPEN	- Capacity (kVA)	900 NO NAME PLATE
11. Others		- Dimensions (m) (W x H)	W H	- Primary Voltage (V)	4,300 4,160
		- Length (m)	2.2 x 1.8	- Secondary Voltage (kV)	13.2 NO NAME PLATE
			4,500	- Number of Phase	1 NO NAME PLATE
		8. Dimensions of Water Reservoir (m)	W L x H	- Connection	NO NAME PLATE NO NAME PLATE
			13.0x26.0x3.0	- Number	3 1
		9. Penstock	φ = 1.52	Continuous	0 0
		- Dimensions (m) (φ x L)	L = 16B	Stand-by	
		- Number of Lines	1	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace (W x H) (m)	W H		
			2.2 x 1.8		

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

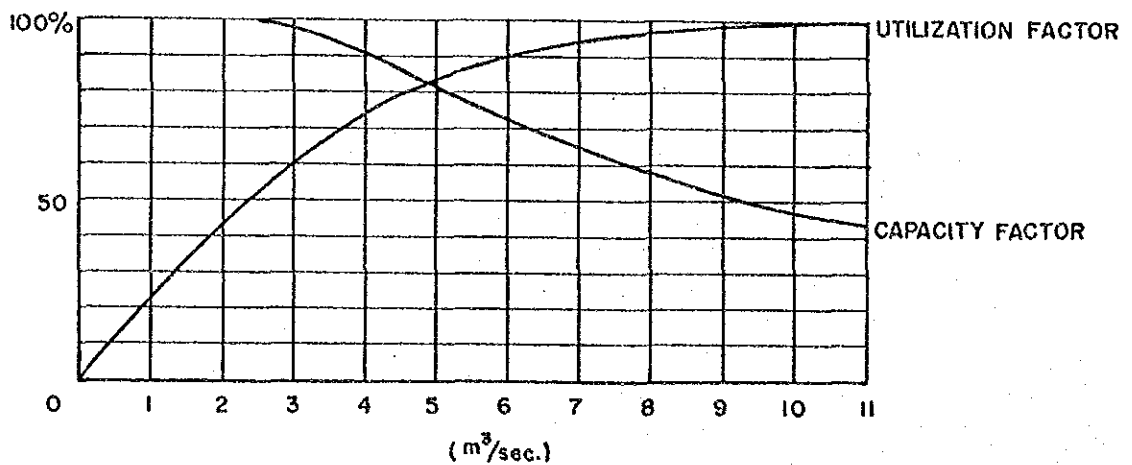
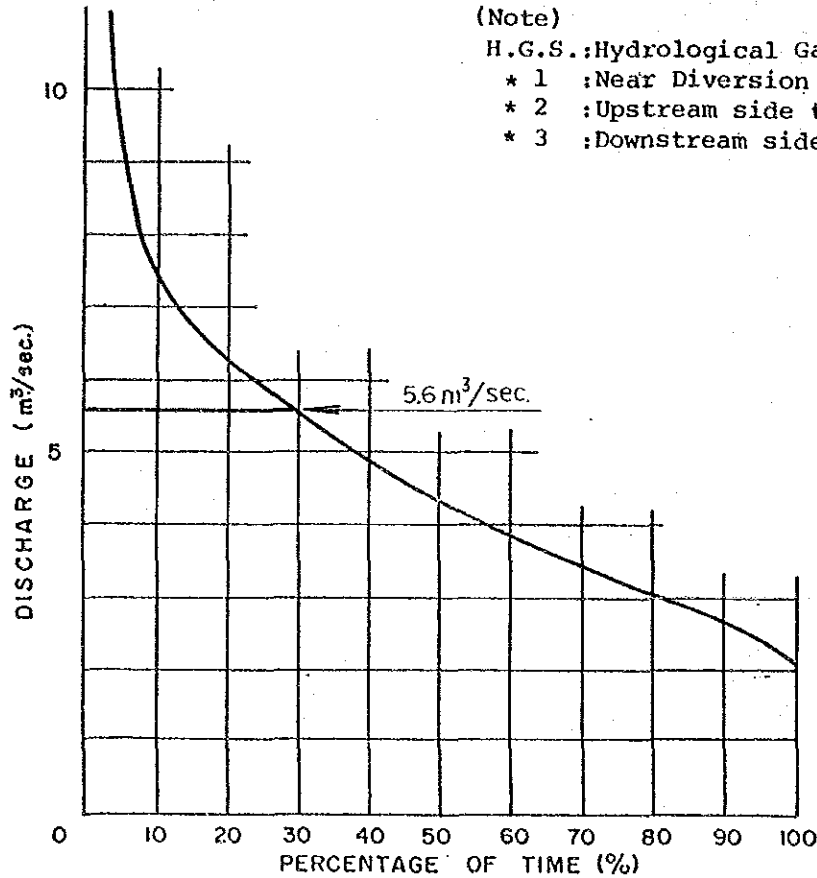
NO. 213 MUNICIPAL

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1979 - 1984
Used Data	1979 - 1984

(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 Like the Intermedia, there is some imbalance between the generating output and installed capacity. The replacement of the generating facilities enables the installed capacity to be increased up to approx. 1.5 times.
- ② The diversion weir has been accumulated with sand up to its crest.
- ③ The flow capacity has been reduced, because of different sectional form of the headrace.

2. Consultation of the Rehabilitation Plan

- ① An appropriate installed capacity shall be set up.
- ② Types of generating facilities used in this power plant, San Cancio and Intermedia power plants shall be standardized.
- ③ The diversion weir and headrace shall be improved.
- ④ The rehabilitation plan shall be made as one package of this power plant, the San Cancio and Intermedia power plants.

GENERAL

Power Plant	NO. 214 GUACAICA	Investigated Date	10 Feb. 1988
Electric Company	CHEC	Available Capacity (kW)	0
Location	CALDAS		
River	GUACAICA		
Generating Method	RUN-OF-RIVER		
Installed Year	1929	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	150	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	4.0	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	28.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Broughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	28.0	- 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 ³ /s)	NO DATA	- Type	SLUICE	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	4.0	- Dimensions (WxH) (m)	2.1 x	2. Generator	
5. Head (m)		- Number of Gates	1	- Manufacturing Year	
- Headwater Level (EL)	1,503.22	3. Intake		- Type	ABANDON
- Tailwater Level (EL)	1,435.92	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	ABANDON
- Gross Head	67.8	- Dimensions (m) (WxH)	2.1 x 3.0	- Capacity (kVA)	ABANDON (ICEL 1,120 kW)
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	ABANDON
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (kV)	ABANDON (4.16)
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 16.9x 26.1x3.2	- Frequency (Hz)	ABANDON
7. Plant Capacity (kW)	0	6. Intake Gate		- Revolution (rpm)	ABANDON
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	2.1 x 1.95	- Manufacturing Year	
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	- Type	ONAN, OUTDOOR
11. Others		7. Headrace		- Capacity (kVA)	150 x 2
		- Type	TUNNEL OPEN	- Primary Voltage (V)	4,160
		- Dimensions (m) [W x H]	W H 1.4 x 1.5	- Secondary Voltage (kV)	33
		- Length (m)	3,500	- Number of Phase	1
		8. Dimensions of Water Reservoir (m)	W H L 12.0x28.0x3.0	- Connection	NO NAME PLATE
		9. Penstock		- Number	2
		- Dimensions (m) (φ x L)	φ = 1.24 L = 125	- Continuous Stand-by	0
		- Number of Lines	1	4. Others	Stopped (Gen. was burned)
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 214 GUACAICA

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1969 - 1978
Used Data	1969 - 1978

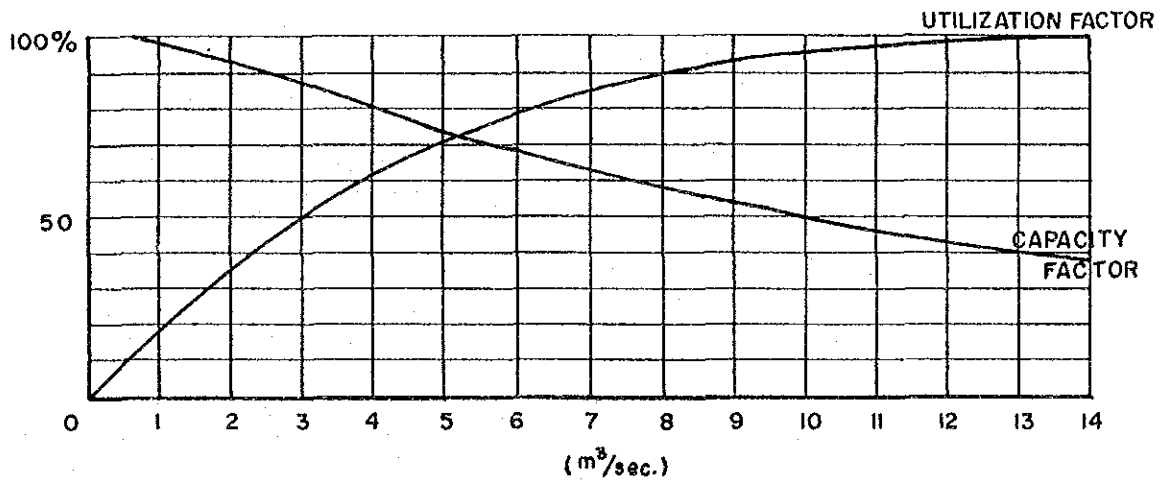
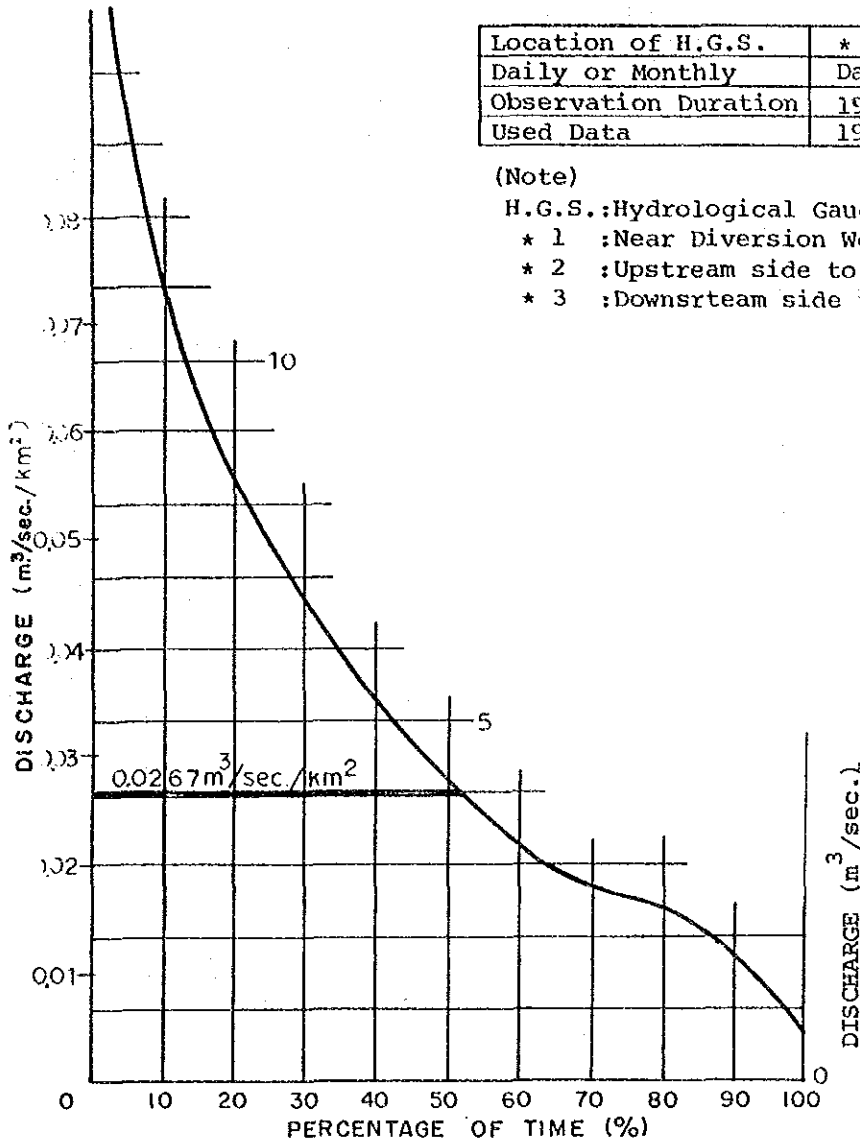
(Note)

H.G.S.:Hydrological Gauging Station

* 1 :Near Diversion Weir

* 2 :Upstream side to Diversion Weir

* 3 :Downsrteam side to Diversion Weir



No. 214 Guacaica

1. Present Condition and Problems

- ① This power plant has been suspended since the generator was burned off ten years ago. However, the procedure for its parts procurement has been in progress.
- ② The current installed capacity is as low as approx. 50 % of the generating output.
- ③ The intake weir has been heaped to the crest with sands, which unables the mixed earth and sands into the conduit to be prevented.
- ④ The screens and gates, etc. have been erroded and do not work.

2. Key Points for the Rehabilitation Plan

- ① By use of a flow curve at the intake gate, calculate a proper utilization rate both for the river water and flow / facility to formulate an optimum installed capacity.
- ② Remodelling of the intake weir and improvement of the conduit.
- ③ Replacement of the gates and screens.

GENERAL

Power Plant	NO. 215 SALAMINA	Investigated Date	10 Feb. 1988
Electric Company	E.P. DE SALAMINA	Available Capacity (kW)	140 (Assumed)
Location	CALDAS		
River	Q. LA FRISOLERA/Q. LA PALO.		
Generating Method	RUN-OF-RIVER		
Installed Year	1943	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	5.0 } 3.0	- Type	PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	NOT CONFIRMED	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	UNKNOWN	- 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 ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	0.4	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	85.0	- Dimensions (m) W L H	5.0 } 20.0 } NOT CONFIRMED	- Capacity (kVA)	350
- Head Loss	UNKNOWN	- Number of Intake	0.6 } 1 } 1	- Power Factor (%)	NO NAME PLATE
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	4,000
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Frequency (Hz)	60
7. Plant Capacity (kW)	280 (Assumed)	6. Intake Gate		- Revolution (rpm)	450
8. Output (MWh)	UNKNOWN	- Type	NON	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	NON	- Manufacturing Year	N/A
10. Unit Price 1,000 pesos/kWh	NO DATA	- Number of Gates	"	- Type	N/A
10. Unit Price pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	N/A
11. Others		- Type	BOX OPEN	- Primary Voltage (kV)	N/A
		- Dimensions (m) (W x H)	NOT CONF.	- Secondary Voltage (kV)	N/A
		- Length (m)	NOT CONF.	- Number of Phase	N/A
		8. Dimensions of Water Reservoir (m) W L H	2.5 x 10.0 x	- Connection	N/A
		9. Penstock		- Number Continuous Stand-by	N/A
		- Dimensions (m) (φ x L)	φ = 0.35		
		- Number of Lines	L = 150		
		10. Dimensions of Tailrace (W x H) (m)	1	4. Others	Operating
			NOT CONFIRMED		

1. Present Condition and Problems

- ① This power plant was constructed approx. 45 years ago. The current output has been reduced to 50 % of the rated output.
- ② Since no control panel and protection unit panel are provided, the operators monitor the equipments and devices only with the voltage meter.
- ③ This power plant is independent of the other power sources and supplies Salamina City with power via distribution lines of 4.16 kV.
- ④ The conduit from the Od. Frisolera has a lot of structural defects. If the intake site is moved to a place with a lower altitude, the capacity of water intaken will be increased.
- ⑤ The earthquake occurred in 1981 caused numerous numbers of cracks in the walls and floors of the buildings. For this reason, the buildings should be newly built.

2. Key Points for the Rehabilitation Plan

- ① Replacement of all the generating facilities including the power plant buildings.
- ② The existing facility is of Perton type turbine. The head is of middle-class, which is 85 meters, so the Cross-Flow type turbine should be adopted.
- ③ The existing 4.16 kV distribution facility (pole, distribution line, etc.) has also become old-fashioned.

GENERAL

Power Plant	NO. 216 ANSERMA	Investigated Date	
Electric Company	E.P. DE ANSERMA	Available Capacity (kW)	
Location	CALDAS		
River	Q. CAUYA		
Generating Method	RUN-OF-RIVER		
Installed Year		Service-in	

SUMMARY OF GENERATING FACILITIES (DELETED)

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)		1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)		- Type	
- Ordinary Water Discharge		- Crest Length (m)		- Output (kW)	
- Low Water Discharge		- Elevation of over-flowing Crest (m)		- Revolution (rpm)	
- 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 ³ /s)		- Type		Dimension (mm)	
4. Firm Discharge (m ³ /s)		- 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	
- Gross Head		- Dimensions (m) (W x H)		- Capacity (kVA)	
- Head Loss		- Number of Intake		- Power Factor (%)	
- Net Head		4. Dimensions of Forebay (m)		- Voltage (kV)	
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)		- Frequency (Hz)	
7. Plant Capacity (kW)		6. Intake Gate		- Revolution (rpm)	
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	
pesos/kWh		7. Headrace		- Capacity (kVA)	
11. Others		- Type		- Primary Voltage (kV)	
		- Dimensions (m) [W x H]		- Secondary Voltage (kV)	
		- Length (m)		- Number of Phase	
		8. Dimensions of Water Reservoir (m)		- Connection	
		9. Penstock		- Number	
		- Dimensions (m) (φ x L)		Continuous Stand-by	
		- Number of Lines		4. Others	
		10. Dimensions of Tailrace [W x H] (m)			

No. 216 Anserma

1. Present Condition and Problems

- ① This power plant was excluded from the proposed rehabilitation sites by the CHEC.

2. Key Points for the Rehabilitation Plan

Nothing in particular.

GENERAL

Power Plant	NO. 217 BELMONTE	Investigated Date	12 Feb. 1988
Electric Company	E.P. DE PEREIRA (E.P.P.)	Available Capacity (kW)	3,300
Location	RISALARDA		
River	OTUN		
Generating Method	RUN-OF-RIVER		
Installed Year	1941	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	198	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	3.5	- Type	PELTON x 2
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	21.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	18.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	Ø H 3.0 x	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	6.0	- Number of Gates	1	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Dimensions (m) (W x H)	W H 4.0 x	- Number of Generator	2
- Gross Head	115	- Number of Intake	1	- Capacity (kVA)	2,350 x 2
- Head Loss	UNKNOWN	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 6.0x47.0x	- Voltage (V)	2,400
6. Efficiency (%)	UNKNOWN	6. Intake Gate	SLUICE WOODEN	- Frequency (Hz)	60
7. Plant Capacity (kW)	3,760	- Type		- Revolution (rpm)	450
8. Output (MWh)	UNKNOWN	- Dimensions (m) (W x H)	W H 1.6 x	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	2	- Manufacturing Year	ONAN 1952 ONAN
10. Unit Price (1,000 pesos/kWh)	NO DATA	7. Headrace	TUNNEL OPEN	- Type	OUTDOOR OUTDOOR
pesos/kWh	NO DATA	- Type		- Capacity (kVA)	1,600 x 3 700 x 3
11. Others		- Dimensions (m) (W x H)	W H 2.7 x 2.65	- Primary Voltage (V)	2,400 2,400
		- Length (m)	4,500	- Secondary Voltage (kV)	17.325 13.1
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Number of Phase	1 1
		9. Penstock	Ø = 1.38 L = 288.0	- Connection	NO NAME PLATE
		- Dimensions (m) (Ø x L)		- Number	3 3
		- Number of Lines	2	Continuous	0 0
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRMED	Stand-by	
				4. Others	#1, 2 Unit: Operating

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

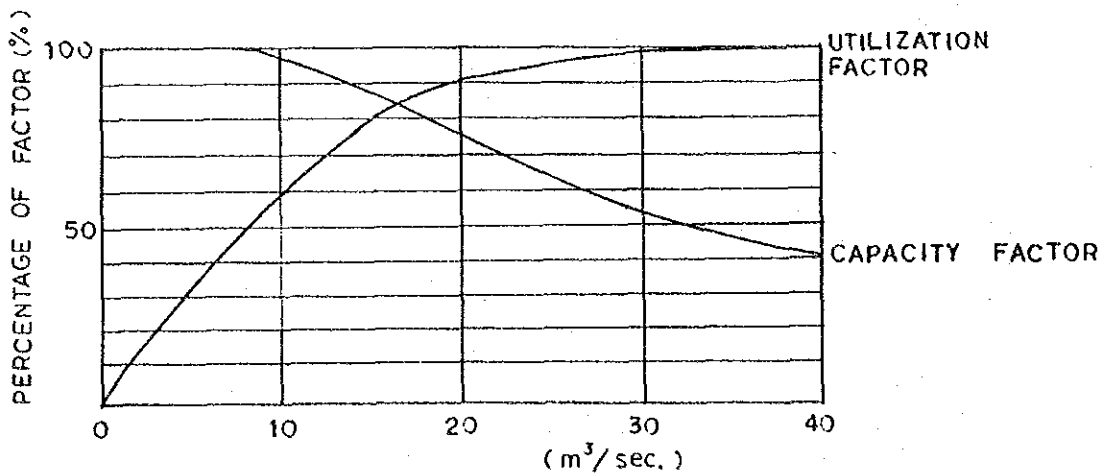
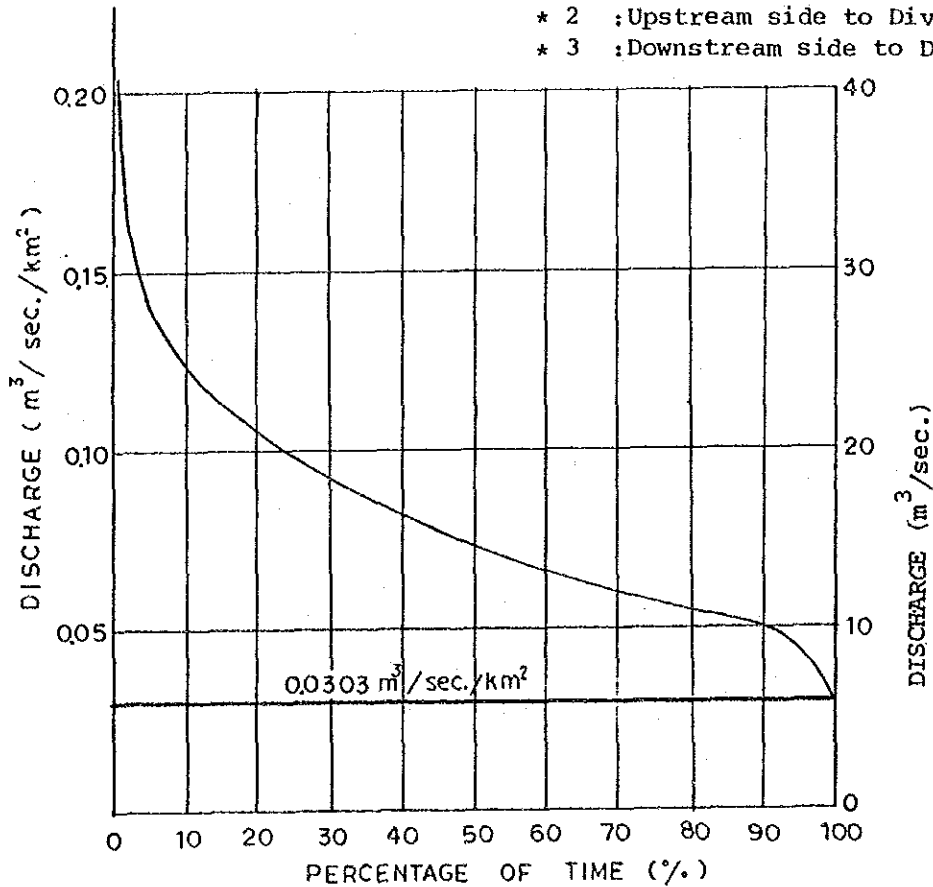
NO. 217 BELMONTE

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1971 - 1985
Used Data	1976 - 1978

(Note)

H.G.S.:Hydrological Gauging Station

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



No. 217 Belmonte

1. Present Condition and Problems

- ① Although the generator was installed 47 years ago, the operation condition remains still well. The output is kept in 88 % of the rated one.
- ② The conduit is also kept in a good state.
- ③ It is hoped to convert the control devices into an automatic system.

2. Key Points for the Rehabilitation Plan

Nothing in particular.

GENERAL

Power Plant	NO. 218 DOS QUEBRADAS	Investigated Date	12 Feb. 1988
Electric Company	E.P. DE PERSIRA (E.P.P.)	Available Capacity (kW)	8,200
Location	RISALARDA		
River	OTUN		
Generating Method	RUN-OF-RIVER		
Installed Year	1955	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	198	1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	TENTER GATE	- Manufacturing Year	1953, 1959
- Plenty Water Discharge	NO DATA	- Height (m)	3.0	- Type	FRANCIS x 2
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	33.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Overflowing Crest (m)	30.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Overflowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	10.0	- Dimensions (WxH) (m)	W H 3.0 x 2.5	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	1	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	2
- Gross Head	113	- Dimensions (m) (WxH)	W H 1.8 x 3.0	- Capacity (kVA)	5,000 x 2
- Head Loss	UNKNOWN	- Number of Intake	3	- Power Factor (%)	85
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	4,160
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 13.6x20.5x2.5	- Frequency (Hz)	60
7. Plant Capacity (kW)	8,500	6. Intake Gate		- Revolution (rpm)	720
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H 1.8 x 1.5	- Manufacturing Year	
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	3	- Type	ONAN, OUTDOOR
11. Others		7. Headrace		- Capacity (kVA)	5,000
		- Type	OPEN & CALVERT	- Primary Voltage (V)	4,160
		- Dimensions (m) (W x H)	W H 2.1 x 2.1	- Secondary Voltage (kV)	13.74
		- Length (m)	5,520	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Connection	Δ/Λ
		9. Penstock		- Number	2
		- Dimensions (m) (φ x L)	φ = 1.2 L = 528	Continuous Stand-by	0
		- Number of Lines	2	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace (W x H) (m)	W H 4.3 x 2.0		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 218 DOS QUEBRADAS

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1971 - 1985
Used Data	1976 - 1978

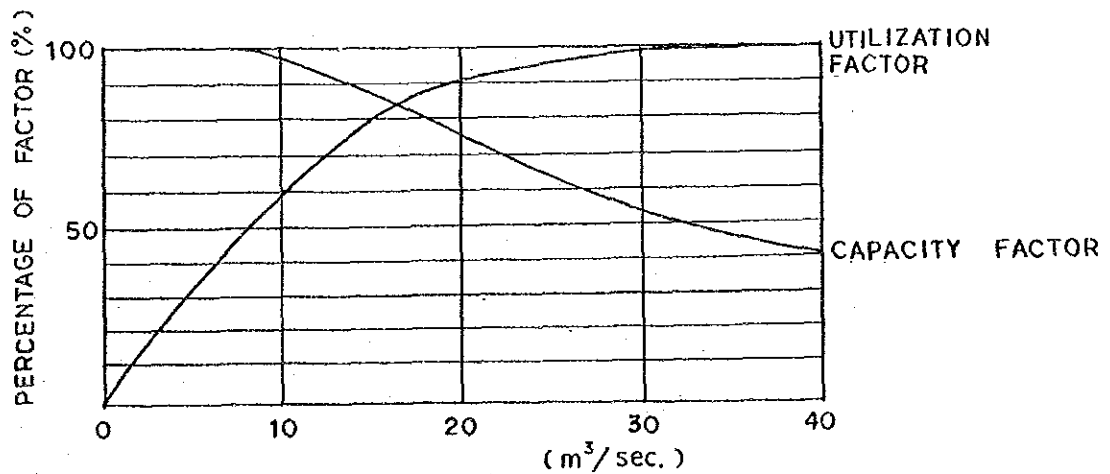
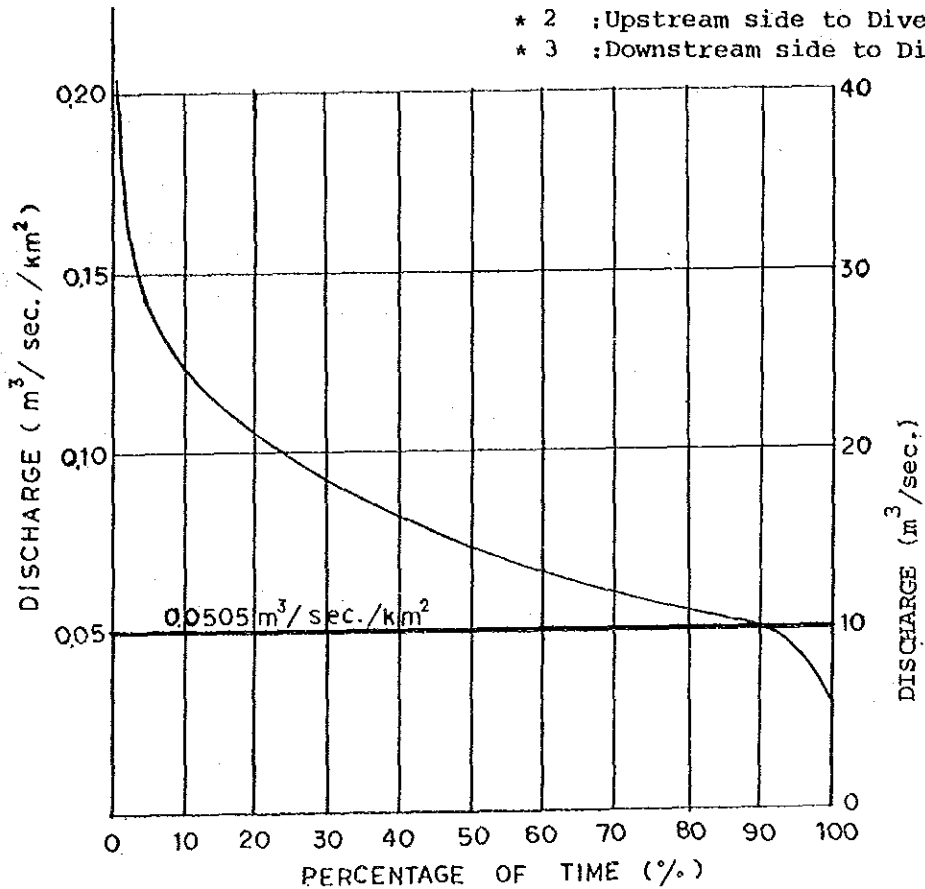
(Note)

H.G.S.: Hydrological Gauging Station

* 1 : Near Diversion Weir

* 2 : Upstream side to Diversion Weir

* 3 : Downstream side to Diversion Weir



No. 218 Dos Quebradas

1. Present Condition and Problems

- ① The generators have been operated for 35 years (#1 unit) to 29 years (#2 unit) since they were erected. However, the operation is still kept in a good state. The output remains 96 % of the rated level.
- ② The conduit is also of strong construction and kept in a good condition.
- ③ It is hoped to convert the control devices into an automatic system.

2. Key Points for the Rehabilitation Plan

Nothing in particular.

GENERAL

Power Plant	NO. 219 SANTA ROSA	Investigated Date	11 Feb. 1988
Electric Company	E.P. DE SANTAROSA	Available Capacity (kW)	139
Location	RISALARDA		
River	SAN EUGENIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1927	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	156	1. Dam	OVERFLOW	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Type	CONCRETE	- Manufacturing Year	1927
- Plenty Water Discharge	NO DATA	- Height (m)	2.0	- Type	PELTON FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	NOT CONFIRMED	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type		Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.2	- Dimensions (WxH) (m)	W H 1.2 x 1.6	2. Generator	
5. Head (m)		- Number of Gates	1	- Manufacturing Year	
- Headwater Level (EL)	1,760.6	3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	1,705.6	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	55.0	- Dimensions (m) (WxH)	W H 1.8 x 2.0	- Capacity (kVA)	312 150
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2,400 2,400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 10.0x10.0x4.0	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	450	6. Intake Gate		- Revolution (rpm)	360 1,200
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 1.7 x 1.6	- Manufacturing Year	1956
10. Unit Price 1,000 pesos/kw	NO DATA	- Number of Gates	1	- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	7. Headrace	OPEN TUNNEL & BRIDGE	- Capacity (kVA)	450
11. Others		- Type		- Primary Voltage (kV)	2,400
		- Dimensions (m) (MIN) [W x H]	W H 0.8 x 0.85	- Secondary Voltage (kV)	4,315
		- Length (m)	4,000	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L H 2.5x2.9x4.0	- Connection	Δ/Λ
		9. Penstock		- Number	1
		- Dimensions (m) (φ x L)	φ = 0.61 L = 230	Continuous Stand-by	0
		- Number of Lines	2	4. Others	#1, 2 Unit: Stopped
		10. Dimensions of Tailrace [W x H] (m)	W H 1.1 x 1.5		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 219 SANTA ROSA

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1971 - 1985
Used Data	1983, 1984

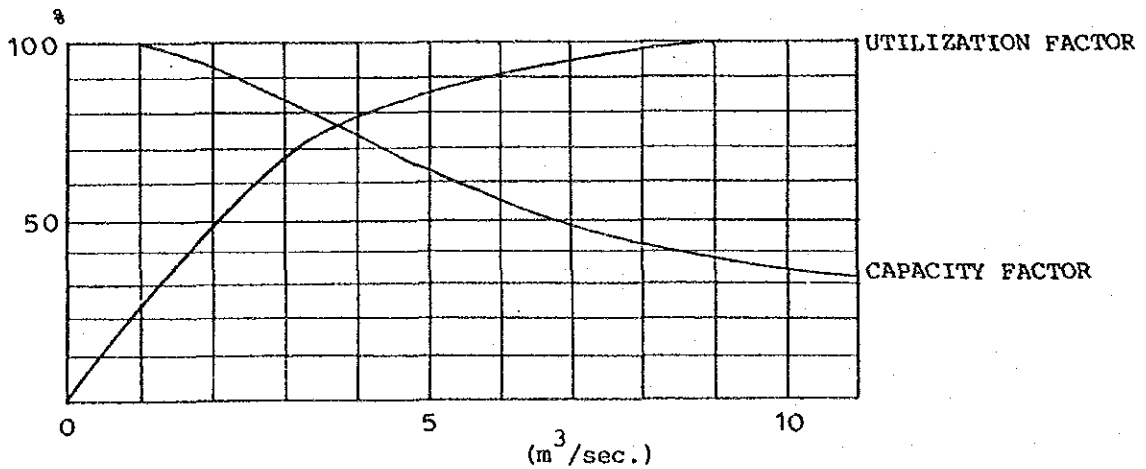
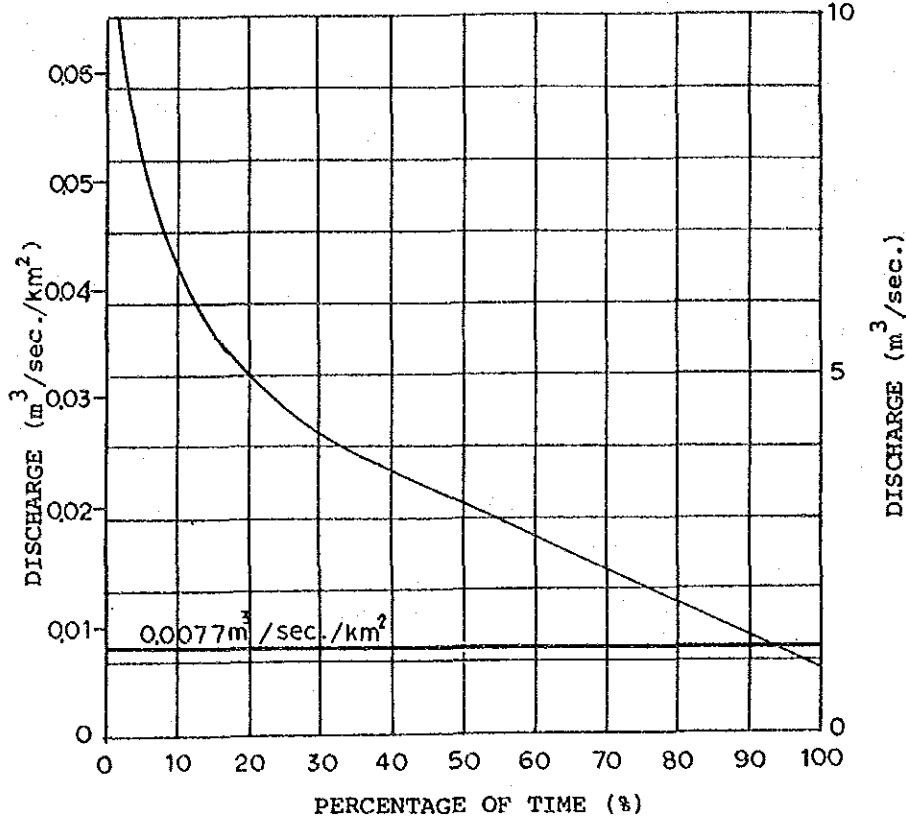
(Note)

H.G.S.:Hydrological Gauging Station

* 1 :Near Diversion Weir

* 2 :Upstream side to Diversion Weir

* 3 :Downstream side to Diversion Weir



No. 219 Santa Rosa

1. Present Condition and Problems

- ① The generators were constructed 61 years ago. The #1 unit with a 350-kW rated output has, however, a current output of 139 kW. The #2 unit (100 kW) is unable to be in operation.
- ② The penstock has unsufficiently been maintained, so that a lot of rust has already occurred.
- ③ The head tank, though located in a flat place, is very small in capacity.
- ④ The conduit has a long extention of approx. 4.0 km. Almost of it was dug without timbering and have been scoured. Consequently, the shape and size are all different. A part of the tunnels and aqueduct bridge were excavated without timbering.
- ⑤ The intake weir and intake gate is kept in a good state, but heaped to the crest with sands.
- ⑥ This site has been given lower rehabilitation priority by the electric power companyw.

2. Key Points for the Rehabilitation Plan

- ① Replace the generators because their service lives have substancially exceeded the duration period.
- ② The penstock shall be inspected for any wear and tear and replaced if necessary.
- ③ The head tank shall be enlarged in both capacity and sedimentartion faculty.
- ④ Because of its long extention, the conduit shall be partially and selectively rehabilitated.

GENERAL

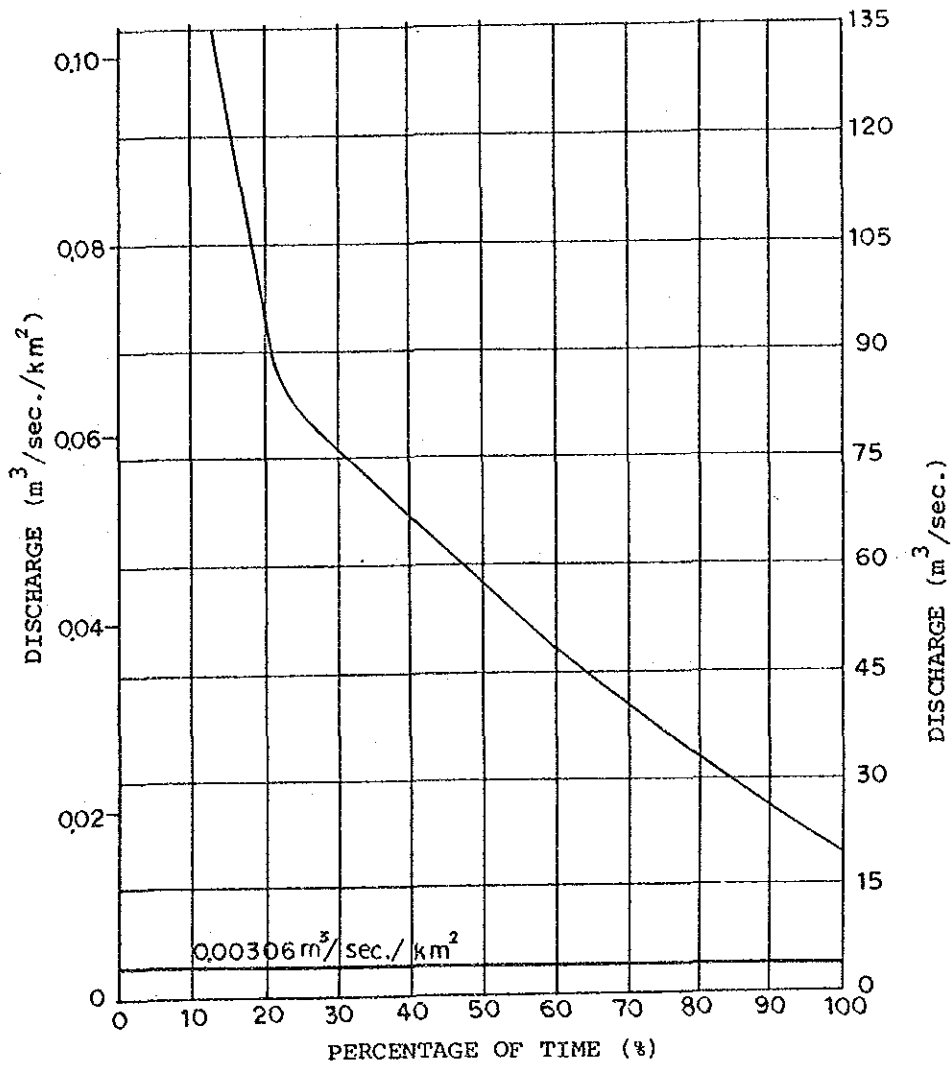
Power Plant	NO. 220 EL BOSQUE	Investigated Date	16 Feb. 1988
Electric Company	E. P. DE ARMENIA	Available Capacity (kW)	0
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1929	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	1,309	1. Dam	OVERFLOW	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	CONCRETE	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	2.0	- Type	PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	27.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of Over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	27.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	4.0	- Dimensions (WxH) (m)	W H 3.1 x 2.5	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	90.0	- Dimensions (m) (WxH)	W H 2.0 x 2.5	- Capacity (kVA)	2,850
- Head Loss	UNKNOWN	- Number of Intake	2	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (v)	3,300
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 7.0x9.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	2,280	6. Intake Gate		- Revolution (rpm)	240
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 2.0 x 1.5	- Manufacturing Year	
10. Unit Price (1,000 pesos/kw)	NO DATA	- Number of Gates	2	- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	7. Headrace	OPEN	- Capacity (kVA)	950 x 3
11. Others		- Type		- Primary Voltage (V)	3,150
		- Dimensions (m) (W x H)	W H 5.6 x 2.0	- Secondary Voltage (kV)	20
		- Length (m)	7,000	- Number of Phase	1
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Connection	NO NAME PLATE
		9. Penstock		- Number	3
		- Dimensions (m) (φ x L)	φ = 0.86 L = 229	Continuous Stand-by	1
		- Number of Lines	1	4. Others	Stopped (Gen. was burned)
		10. Dimensions of Tailrace (W x H) (m)	W H 3.2 x 2.5		

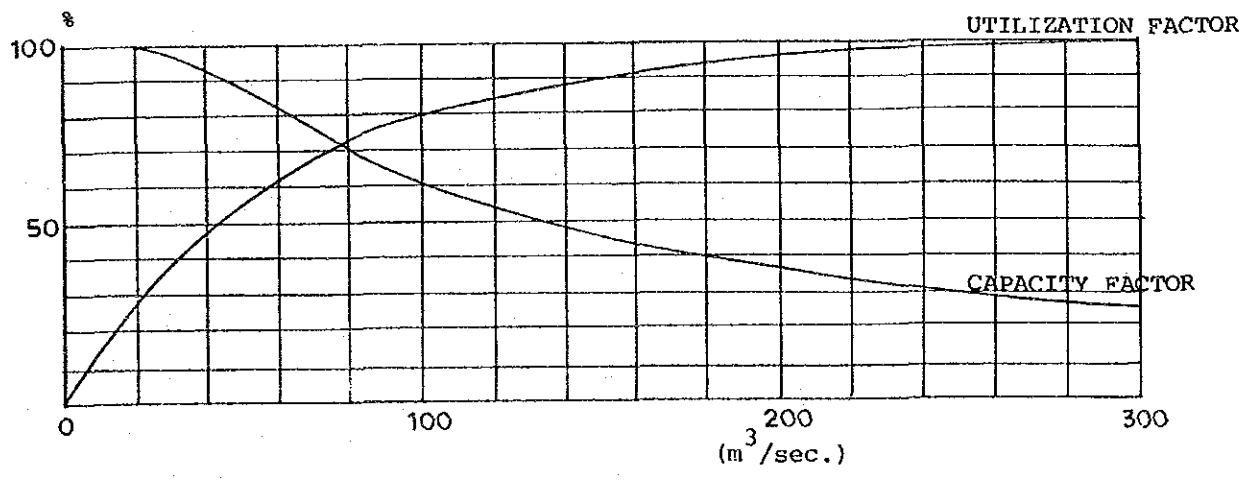
FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 220 EL BOSQUE



Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1953 - 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. 220 El Bosque

1. Present Condition and Problems

- ① 2 Francis types and 1 Pertion type generators have been provided. Among them, the two Francis types had been withdrawn a long time ago. The rest Pertion type generator was also burnt off in 1984 and has been suspended since then.
- ② A rehabilitation F/S for this power plant has already been made by Colombia University, Manisales Branch. The report was issued in February 1988.

2. Key Points for the Rehabilitation Plan

GENERAL

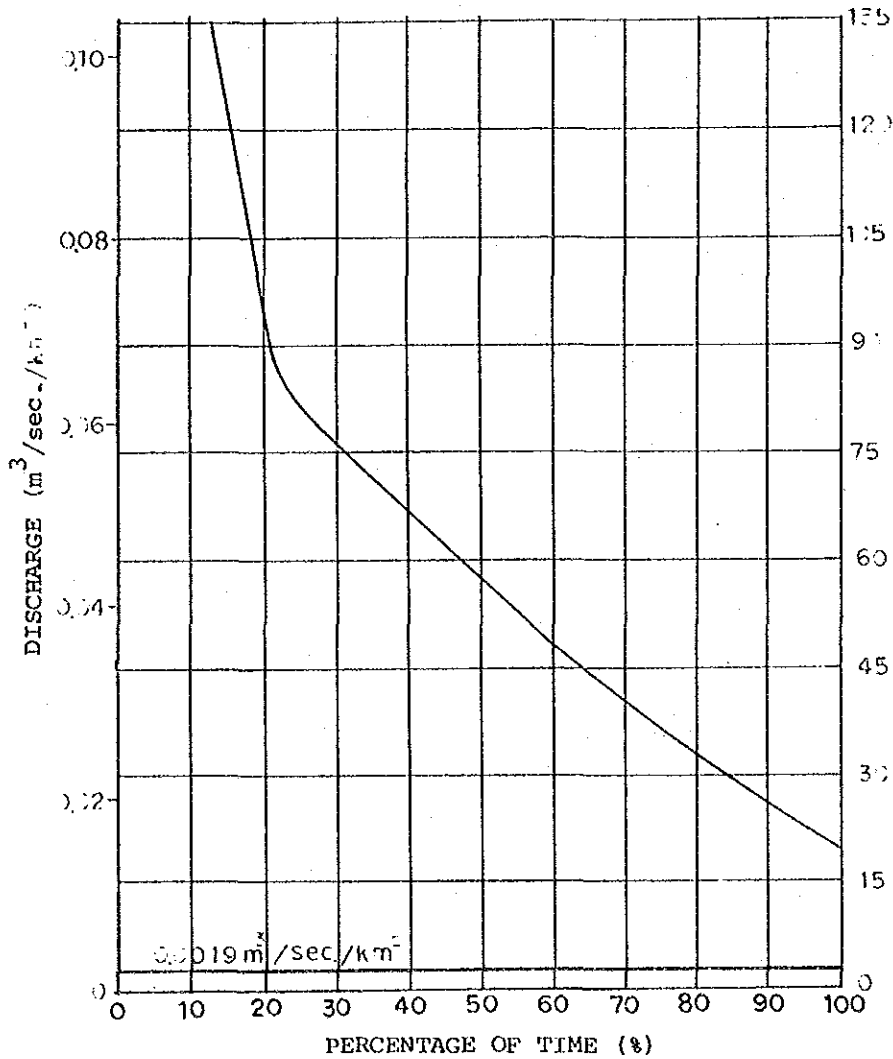
Power Plant	NO. 221 BAYONA	Investigated Date	15 Feb. 1988
Electric Company	E.P. DE CALARCA	Available Capacity (kW)	159
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1952	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	1,309	1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	NON	- Manufacturing Year	#1 1946 #2 1932
- Plenty Water Discharge	NO DATA	- Height (m)	NON	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	NON	- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of Over-flowing Crest (m)	NON	- Revolution (rpm)	NO NAME PLATE NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	NON	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	NON	- Regulating Valve	NO NAME PLATE NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	2.5	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	30.0	- Dimensions (m) (WxH)	W H 1.5 x 1.0	- Capacity (kVA)	1,260 440
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	6,600 6,600
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 13.6x36.5x2.6	- Frequency (Hz)	60 50
7. Plant Capacity (kW)	1,008	6. Intake Gate		- Revolution (rpm)	720 750
8. Output (MWh)	UNKNOWN	- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NON	- Manufacturing Year	N/A N/A
10. Unit Price 1,000 pesos/kW	NO DATA	- Number of Gates	NON	- Type	N/A N/A
pesos/kWh	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)	VARIABLE	- Secondary Voltage (kV)	N/A N/A
		- Length (m)	1,500	- Number of Phase	N/A N/A
		8. Dimensions of Water Reservoir (m)	W L H 3.0x4.3x3.5	- Connection	N/A N/A
		9. Penstock		- Number	N/A N/A
		- Dimensions (m) (ϕ x L)	ϕ = 1.20 L = 100	Continuous Stand-by	N/A N/A
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace (W x H) (m)	W H 3.0 x 1.0	#1 Unit: Operating	
				#2 Unit: Stopped still 20 years	

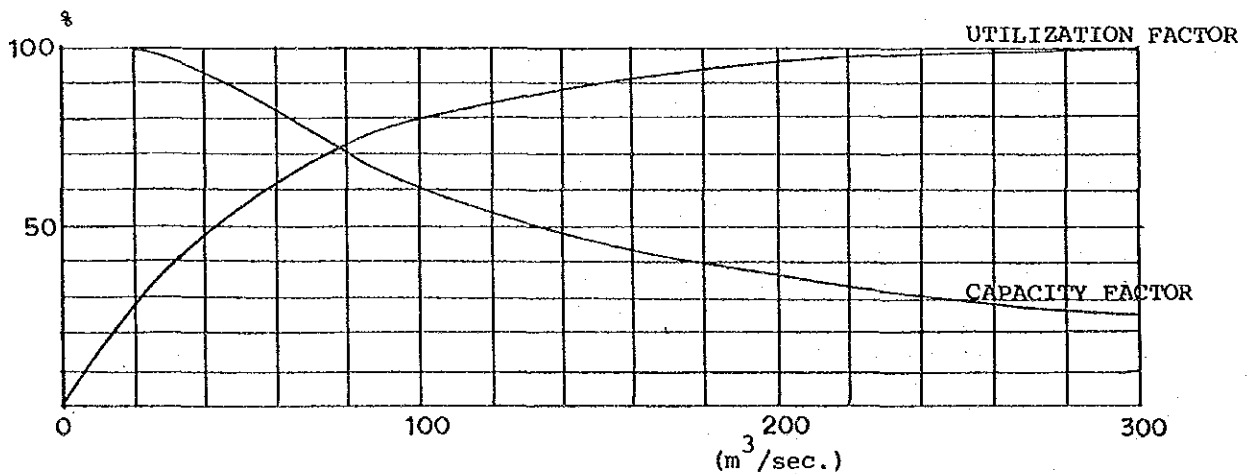
FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 221. BAYONA



Location of H.G.S.	* 1
Daily or Monthly	Daily
Observation Duration	1953 - 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. 221 Bayona

1. Present Condition and Problems

- ① Since the installed capacity is larger than the logical output, the power generating plan comes into question.
- ② The output reduction rate is as high as 84 % partly because of its unreasonable installed capacity.
- ③ Although no intake weir is provided, some stone-masonry bank has been established along the flow direction in the center of the river, thereby guiding the water.
- ④ No intake gate is provided. Only an opening of the non-wound tunnel is installed on the right bank.
- ⑤ The conduit is all different in shape and size and has a lot of sections excavated without timbering. Therefore, the passage-through capacity is reduced.
- ⑥ The sedimentation basin and head tank are in a body. However, the gate does not work. The sand-discharging capacity is lost.

2. Key Points for the Rehabilitation Plan

- ① Formulate a consistent power generating program including the Campestore La Union. And convert the installed capacity into one adjustable for the generating output.
- ② Rehabilitate / remodel the overall conduit structures.
- ③ Replace the gates.

GENERAL

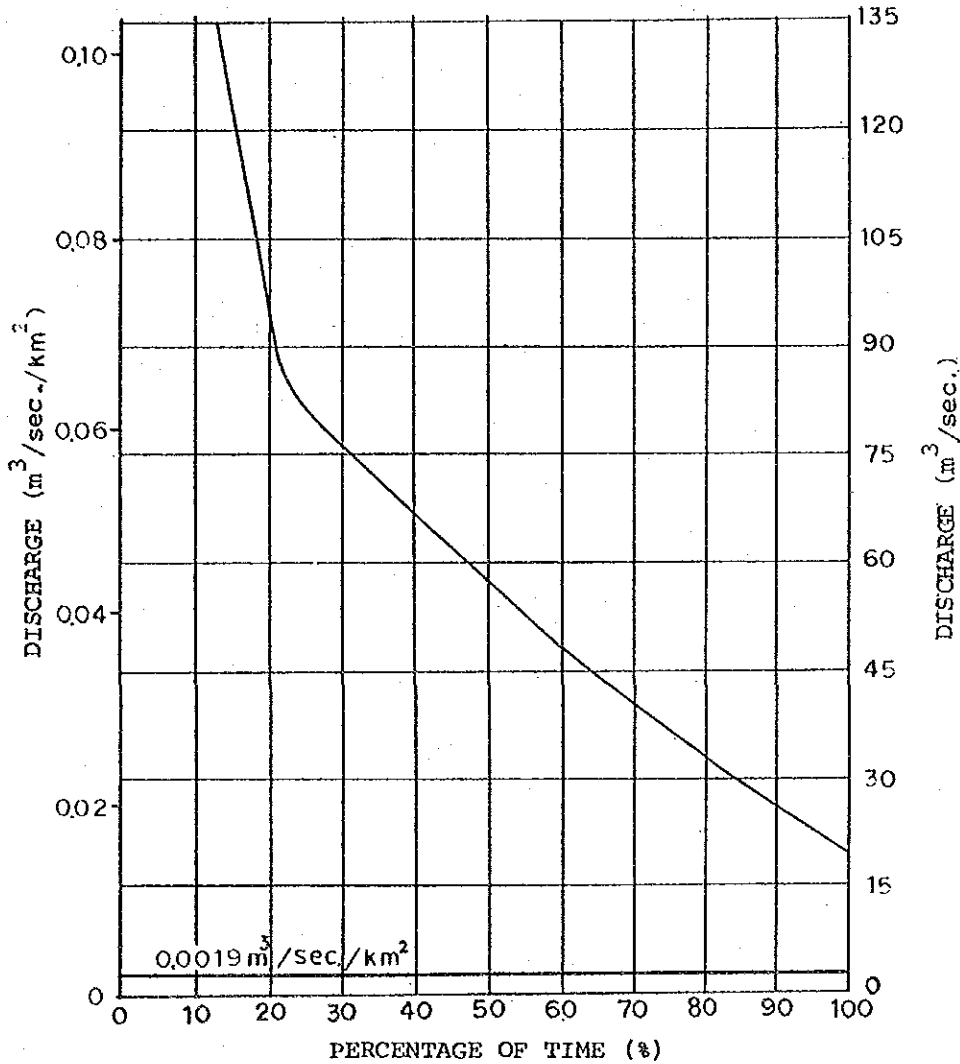
Power Plant	NO. 222 CAMPESTRE	Investigated Date	15 Feb. 1988
Electric Company	E.P. DE CALARCA	Available Capacity (kW)	62
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1956	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	1,309	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1952
- Plenty Water Discharge	NO DATA	- Height (m)	3.5	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	26.0	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	26.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of overflowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	- Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type		- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	2.5	- Dimensions (R x H) (m)	W H	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	1.2 X 2	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	54.0	- Dimensions (m) (W x H)	W x 35.0	- Capacity (kVA)	1,400
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	500/290
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,120	6. Intake Gate		- Revolution (rpm)	1,200
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	NOT CONFIRMED	- Manufacturing Year	
10. Unit Price 1,000 pesos/kW	NO DATA	- Number of Gates	2	- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	7. Headrace	OPEN PIPE	- Capacity (kVA)	1,375
11. Others		- Type		- Primary Voltage (V)	500
		- Dimensions (m) (W x H)	W=1.3 H=2.0	- Secondary Voltage (kV)	13,010
		- Length (m)	φ=1.7 5,000	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Connection	Δ/Δ
		9. Penstock		- Number	1
		- Dimensions (m) (φ x L)	φ = 0.9 L = 80	Continuous Stand-by	0
		- Number of Lines	1	4. Others	Operating
		10. Dimensions of Tailrace (W x H) (m)	W H 1.7 x 1.1		

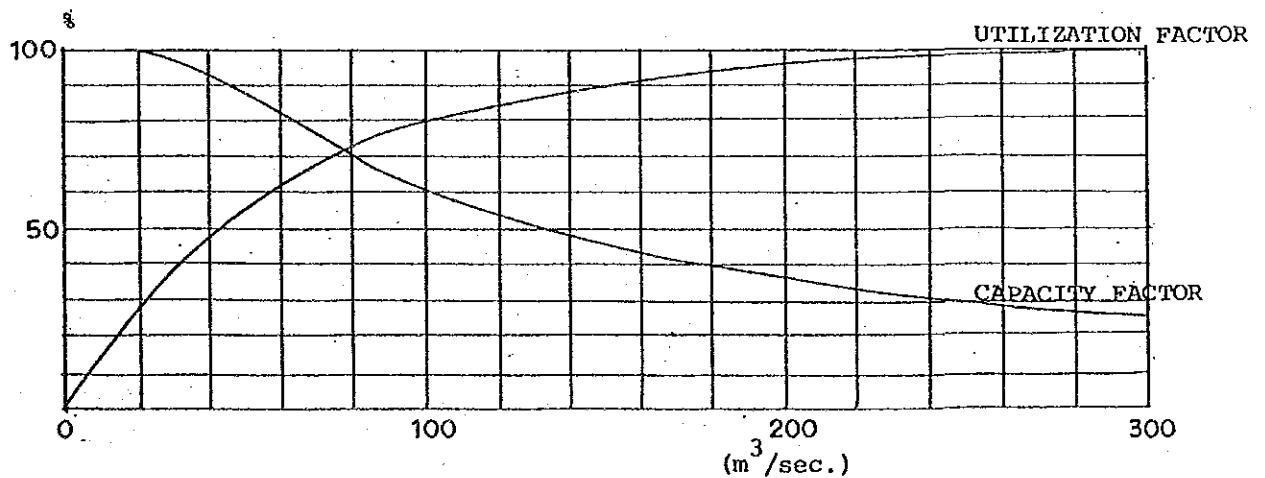
FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 222 CAMPESTRE



Location of H.G.S.	* 1
Daily or Monthly	Daily
Observation Duration	1953 - 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. 222 Campestre

1. Present Condition and Problems

- ① A line of 3 power plants, namely Bayona, La Union and Campestre are located in the Rio Quindio river system.
- ② The intake weir is of Tylolean type and has been heaped to the crest with sands.
- ③ Almost the conduit is of RC-open-channel type with a few tunnels and an aqueduct bridge. Therefore, it is kept in a relatively good condition.
- ④ The gates have become too old for work.
- ⑤ The output has been reduced to 94 %, which means this power plant is nearly suspended.

2. Key Points for the Rehabilitation Plan

- ① Under the jurisdiction of a publick electric power company in Quindio department, which is to be established in January 1989, formulate a consistent power generating plan including the Bayona and La Union. And then determine an optimum installed capacity.
- ② Rehabilitate and remodel the whole facilities except for the conduit.

GENERAL

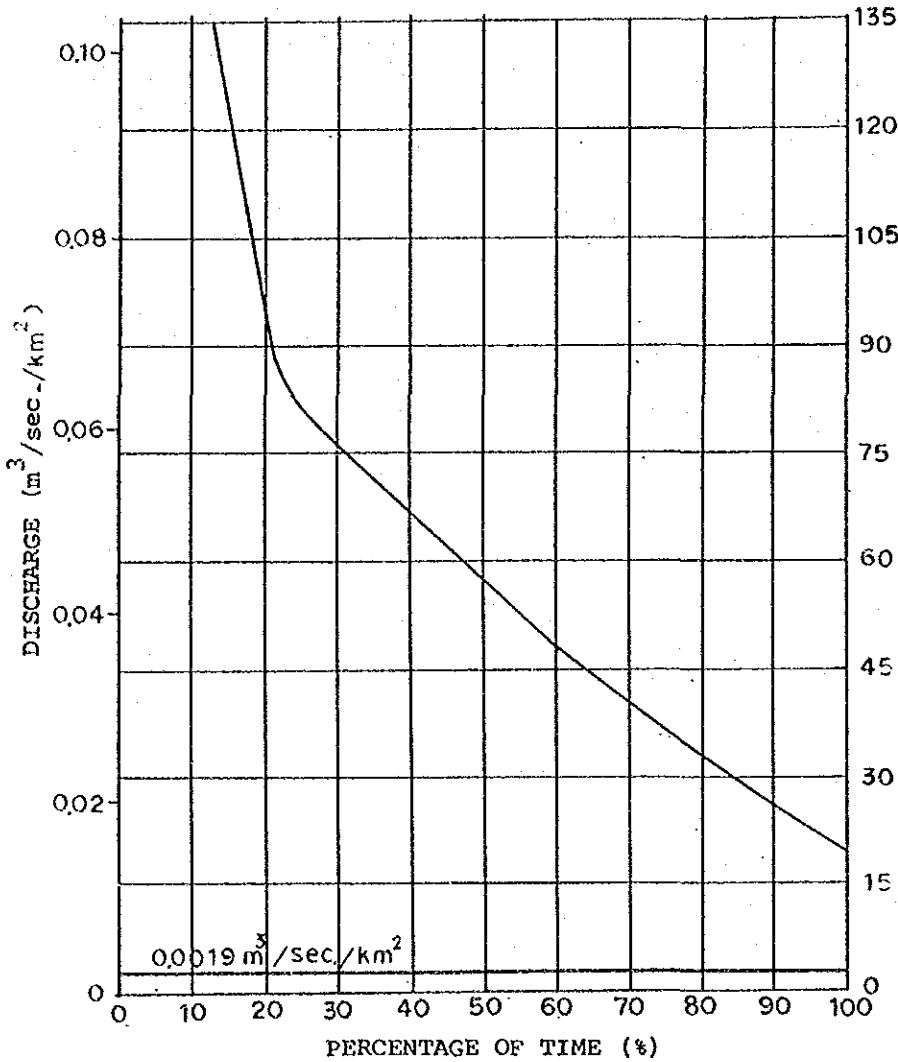
Power Plant	NO. 223 LA UNION	Investigated Date	15 Feb. 1988
Electric Company	E.P. DE CALARCA	Available Capacity (kW)	0
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1938	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	1,309	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1935
- Plenty Water Discharge	NO DATA	- Height (m)	NOT CONFIRMED	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	NOT CONFIRMED	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	NOT CONFIRMED	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	NOT CONFIRMED	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of overflowing (m)	NOT CONFIRMED	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	2.5	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	43.0	- Dimensions (m) (WxH)	NOT CONFIRMED	- Capacity (kVA)	1,250
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	6,500
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 9.0x17.0x4.0	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,000	6. Intake Gate	SLUICE	- Revolution (rpm)	900
8. Output (MWh)	UNKNOWN	- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	NOT CONFIRMED	- Manufacturing Year	N/A
10. Unit Price 1,000 pesos/kw	NO DATA	- Number of Gates	1	- Type	N/A
pesos/kwh	NO DATA	7. Headrace	OPEN NATURAL CONCRETE	- Capacity (kVA)	N/A
11. Others		- Type		- Primary Voltage (kV)	N/A
		- Dimensions (m) [W x H]	W H 2.0 x 1.0	- Secondary Voltage (kV)	N/A
		- Length (m)	5,000	- Number of Phase	N/A
		8. Dimensions of Water Reservoir (m)	W L H 4.1 x 2.0 x	- Connection	N/A
		9. Penstock (R.C.)	φ = 1.2 L = 79	- Number	N/A
		- Dimensions (m) (φ x L)		Continuous Stand-by	N/A
		- Number of Lines	1	4. Others	Stopped (Gen. was burned)
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

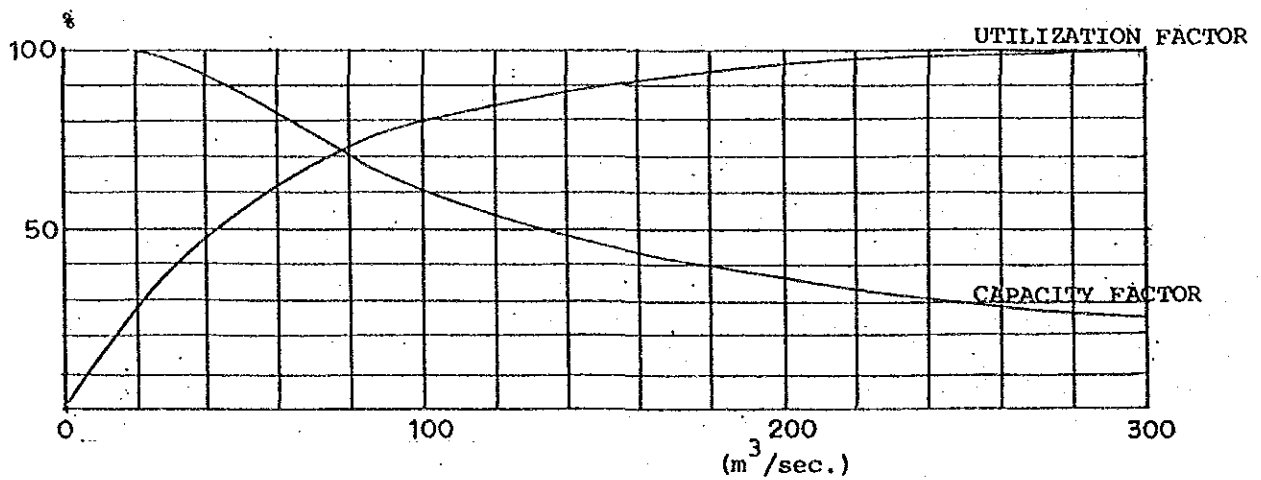
FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 223 LA UNION



Location of H.G.S.	* 1
Daily or Monthly	Daily
Observation Duration	1953 - 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. 223 La Union

1. Present Condition and Problems

- ① Although the generator became old-fashioned and the current output had already been reduced substantially, the generator was burnt off in January 1988 and then has been suspended.
- ② The intake weir has been heaped to the crest with sands.
- ③ The intake gate level is higher than those of the intake weir and river water level. This means that this power plant has a structure hard to intake water.
- ④ As no sedimentation basin is provided, the head tank has also been utilized as the sedimentation basin. However, its function is naturally insufficient.
- ⑤ The penstock is made by R.C.

2. Key Points for the Rehabilitation Plan

- ① Formulate a consistent power generating plan including the Campestre and Bayona, thereby determining an optimum installed capacity.
- ② Rehabilitate and remodel the whole conduit structures.

GENERAL

Power Plant	NO. 224 SAJANDI	Investigated Date	5 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	1,640
Location	CAUCA		
River	SAJANDI		
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 ²)	1,846	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1	#2	#3
2. Volume of Discharge (m ³ /s)	NO DATA	- Type		- Manufacturing Year	1957		
- Plenty Water Discharge		- Height (m)	3.0	- Type	FRANCIS	FRANCIS	PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	20.0	- Output (kW)	NO NAME	NO NAME	NO NAME
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	PLATE	PLATE	PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	20.0	- Type of Governor	NO NAME	NO NAME	NO NAME
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	PLATE	PLATE	PLATE
- Mean	NO DATA	2. Sand Trap Gate		- Type	NO NAME	NO NAME	NO NAME
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	- Dimension (mm)	PLATE	PLATE	PLATE
4. Firm Discharge (m ³ /s)	3.0	- Dimensions (WxH) (m)	NON	2. Generator			
5. Head (m)		- Number of Gates	NON	- Manufacturing Year			
- Headwater Level (EL)	1,205	3. Intake		- Type	SYN.	SYN.	SYN.
- Tailwater Level (EL)	1,100	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1	1	1
- Gross Head	104	- Dimensions (m) (WxH)	W H	- Capacity (kVA)	1,050	1,050	800 kW
- Head Loss	UNKNOWN	- Number of Intake	x 3.0	- Power Factor (%)	80	80	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (kV)	4.4	4.4	4.4
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H	- Frequency (Hz)	60	60	60
7. Plant Capacity (kW)	2,480	6. Intake Gate		- Revolution (rpm)	900	NO NAME	450
8. Output (MWh)	3,134	- Type	SLUICE	3. Transformer			
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H	- Manufacturing Year	NOT CONFIRMED		
10. Unit Price (1,000 pesos/kW)	NO DATA	- Number of Gates	2.0 x 2.0	- Type	NOT CONFIRMED		
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	NOT CONFIRMED		
11. Others		- Type	OPEN BRIDGE	- Primary Voltage (kV)	NOT CONFIRMED		
		- Dimensions (m) [W x H]	W H	- Secondary Voltage (kV)	NOT CONFIRMED		
		- Length (m)	1.6 x 1.6	- Number of Phase	NOT CONFIRMED		
		8. Dimensions of Water Reservoir (m)	3,700	- Connection	NOT CONFIRMED		
		9. Penstock	NOT CONFIRMED	- Number	NOT CONFIRMED		
		- Dimensions (m) (φ x L)	φ = L = 248	Continuous Stand-by	NOT CONFIRMED		
		- Number of Lines	1	4. Others	#1, 2, 3 Unit: Operating		
		10. Dimensions of Tailrace (W x H) (m)	W H				
			2.0 x 1.8				

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 224 SAJANDI

Location of H.G.S.	* 3
Daily or Monthly	Daily
Observation Duration	1975 - 1985
Used Data	1979, 1980, 1983

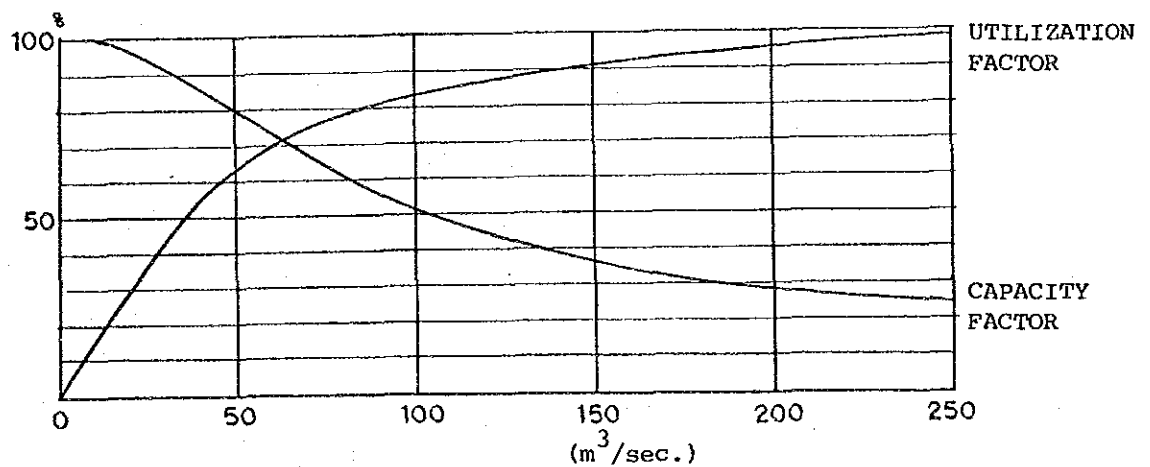
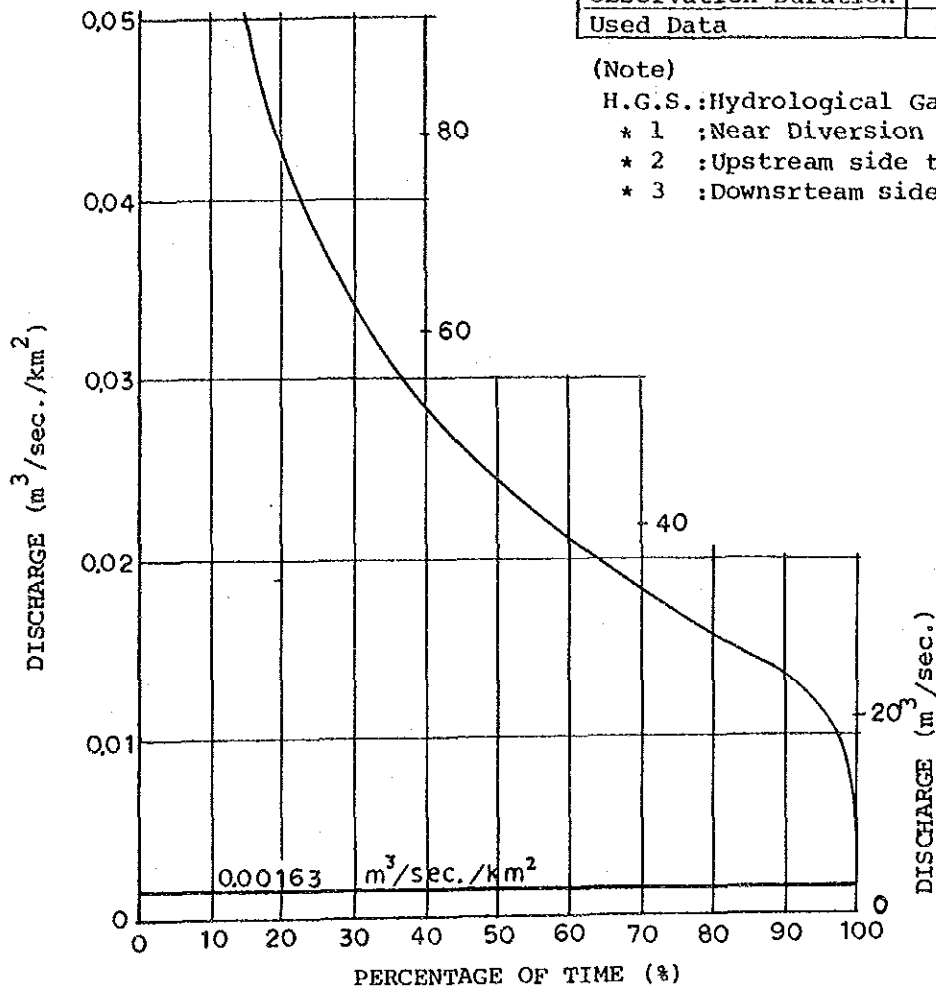
(Note)

H.G.S.: Hydrological Gauging Station

* 1 : Near Diversion Weir

* 2 : Upstream side to Diversion Weir

* 3 : Downsrteam side to Diversion Weir



No. 224 Sajandi

1. Present Condition and Problems

- ① The facility output reduction rate is approx. 22 %. Therefore the operation is kept in a good condition. The penstock has been made thinner in its pipe thickness because of earth and sand flown into.
- ② In the Rio Sajandi basin, the earth and sand flow down away hard. The intake weir has been heaped to the crest with sands. The intake weir is not provided with a sand-preventive gate. In addition, the three earth spill gates established in the sedimentation basin and conduit hardly any work.
- ③ It is feared that the penstock should be torn and worn due to earth and sand flown into. In addition, the earth and sand are flown into partly because the penstock is too small in capacity.

2. Key Points for the Rehabilitation Plan

- ① Remodelling of the intake weir, removal of the sedimented sands and establishment of a sand-preventive weir in the upstream if necessary.
- ② Inspection works of the penstock. If necessary, replacement of the penstock as well as remodelling of the head tank.
- ③ Replacement of the gates and valves incidental to the conduit structures.

GENERAL

Power Plant	NO. 225 EL PALO	Investigated Date	11 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	1,280
Location	CAUCA		
River	PALO		
Generating Method	RUN-OF-RIVER		
Installed Year	1964	Service-in	

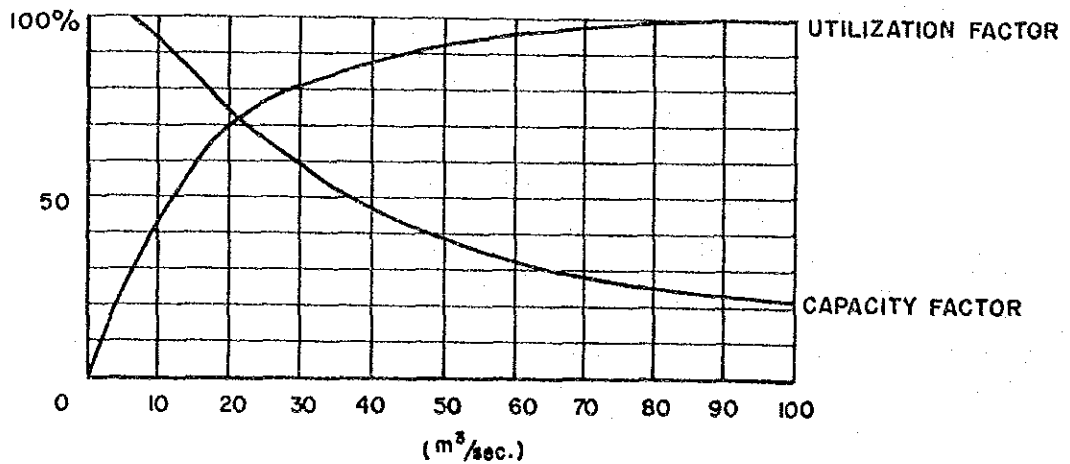
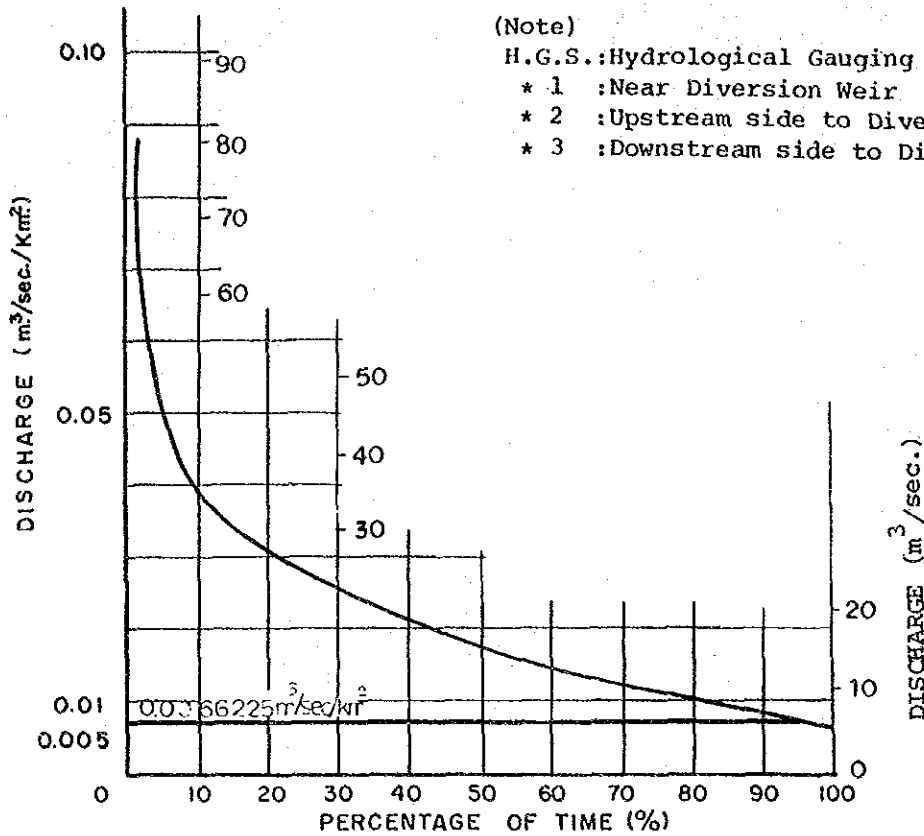
SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	906	1. Dam	OVERFLOW	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	CONCRETE	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	5.0	- Type	FRANCIS x 2
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30.0	- Output (kW)	1,020 HP x 2
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	514
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	30.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		Type	
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	6.0	- Dimensions (WxH) (m)	1.55 x 1.50	2. Generator	
5. Head (m)	1,194	- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN.
- Tailwater Level (EL)	1,169	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	2
- Gross Head	24.5	- Dimensions (m) (WxH)	1.45 x 4.8	- Capacity (kVA)	900 x 2
- Head Loss	1	- Number of Intake	3	- Power Factor (%)	80
- Net Head	24	4. Dimensions of Forebay (m)	NON	- Voltage (v)	440
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Frequency (Hz)	60
7. Plant Capacity (kW)	1,440	6. Intake Gate		- Revolution (rpm)	514
8. Output (Mwh)	4,821	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	1.45 x 4.8	- Manufacturing Year	
10. Unit Price 1,000 pesos/kw	NO DATA	- Number of Gates	3	- Type	ONAN, OUTDOOR
pesos/kwh	NO DATA	7. Headrace	OPEN	- Capacity (kVA)	900 x 2
11. Others		- Type		- Primary Voltage (v)	440
		- Dimensions (m) (W x H)	3.6 x 1.95	- Secondary Voltage (kV)	33
		- Length (m)	3,944	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L x H	- Connection	NO NAME PLATE
			8.0x20.0x3.0	- Number	
		9. Penstock	φ = 1.5	Continuous	2
		- Dimensions (m) (φ x L)	L = 83.4	Stand-by	0
		- Number of Lines	1	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace [W x H] (m)	5.5 M ²		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 225 EL PALO

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1945 - 1985
Used Data	1980 - 1982



1. Present Condition and Problems

- ① This power plant has a very small river-water utilization rate.
- ② The generator has a maintenance rate of as high as 89 %. The maintenance is perfect and kept in a good condition.
- ③ All the conduit works are kept in a good condition.
- ④ In the Rio Palo river basin, earth and sand flow out much. The intake weir has been heaped to the crest with sands. In addition, because of collapse of the revetment wall on the left bank in the upstream from the intake weir, the scouring has proceeded, which facilitates the sand-sedimentation phenomenon.

2. Key Points for the Rehabilitation Plan

- ① Inspection works for the penstock. (Check up of the wear and tear condition.)
- ② Check the established conduit for its possible passage water flow. If there is sufficient passage flow, remodel the head tank and penstock to review the possibility of increased output.

GENERAL

Power Plant	NO. 226 MONDOMO	Investigated Date	9 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	470
Location	CAUCA		
River	MONDOMO		
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 ²)	913	1. Dam	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	2.0	- Type	FRANCIS FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30.0	- Output (kW)	435 BHP 435 BHP
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	720 720
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	30.0	- 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 ³ /s)	NO DATA	- Type	NON	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	2.0	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	1,308	3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	1,277	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	29	- Dimensions (m) (WxH)	NOT CONFIRMED	- Capacity (kVA)	375 375
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80 80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	2,400 2,400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 4.0x18.0x	- Frequency (Hz)	60
7. Plant Capacity (kW)	600	6. Intake Gate		- Revolution (rpm)	720
8. Output (MWh)	3,780	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [H x H]	2.0 x 2.0	- Manufacturing Year	
10. Unit Price (1,000 pesos/kw)	NO DATA	- Number of Gates	3	- Type	ONAN, INDOOR
pesos/kwh	NO DATA	7. Headrace	TUNNEL OPEN	- Capacity (kVA)	250 x 3
11. Others		- Type		- Primary Voltage (V)	2,400
		- Dimensions (m) [W x H]	W H 2.5 x 1.7	- Secondary Voltage (kV)	14.4
		- Length (m)	600	- Number of Phase	1
		8. Dimensions of Water Reservoir (m)	W L H 8.0x10.0x	- Connection	NO NAME PLATE
		9. Penstock		- Number	3
		- Dimensions (m) (φ x L)	φ = 0.76 L = 78	Continuous Stand-by	0
		- Number of Lines	2	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

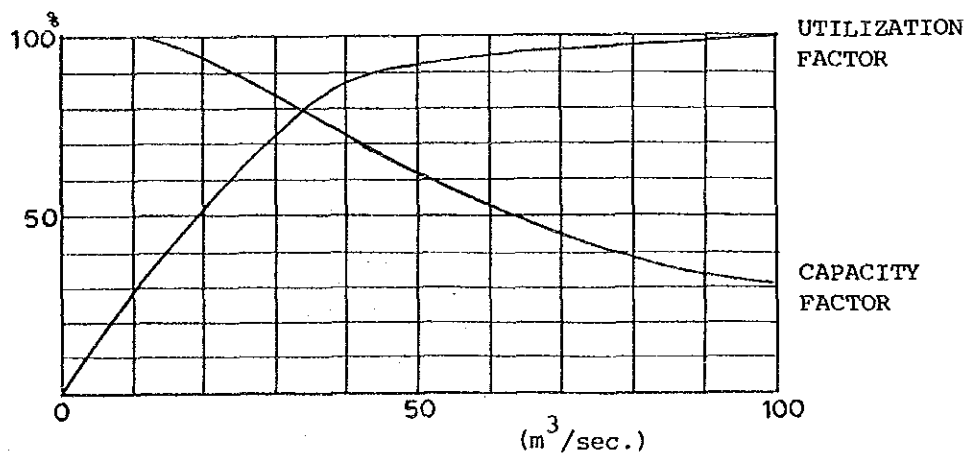
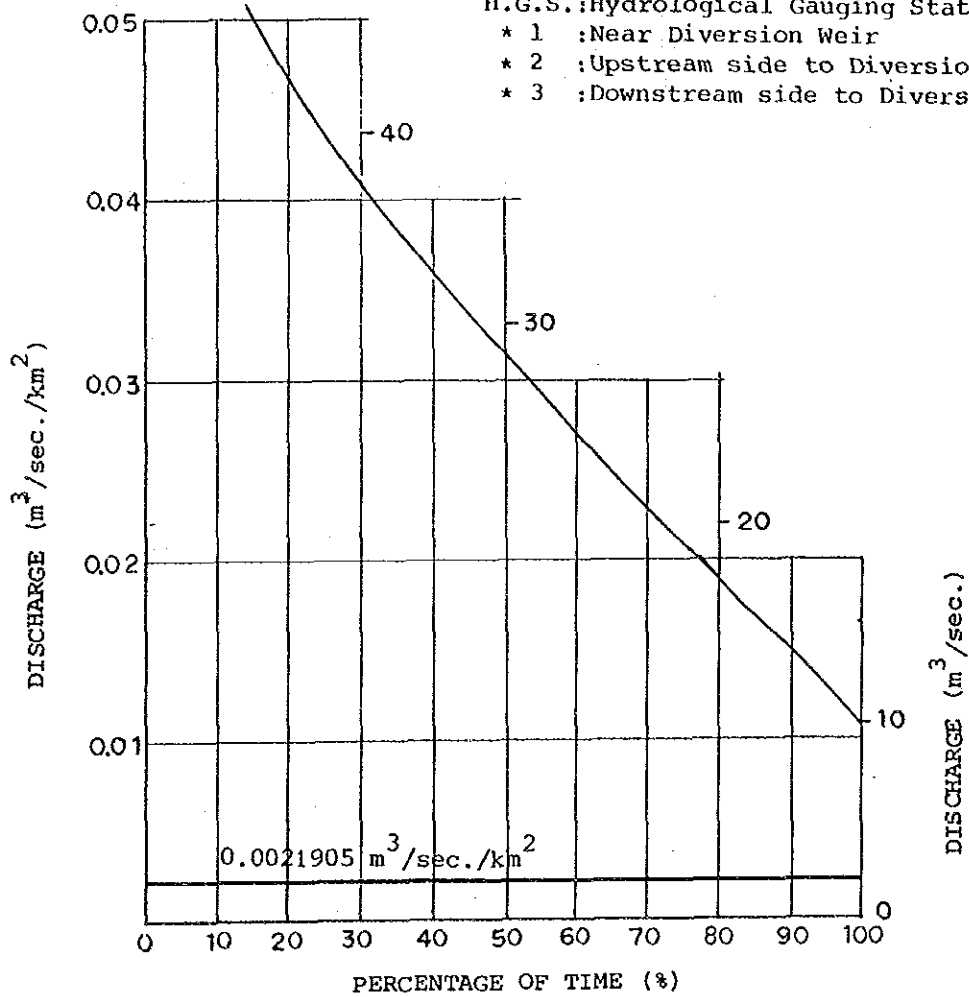
NO. 226 MONDOMO

Location of H.G.S.	* 1
Daily or Monthly	Daily
Observation Duration	1965 - 1985
Used Data	1982, 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. 226 Mondomo

1. Present Condition and Problems

- ① The power generating facility maintenance rate is as well as 78 %.
- ② The conduit structures are strong, except for the gate. But allmost all the gates have been damaged, so the sedimentation basin hardly works.
- ③ It is feared that the penstock has become thinner in its pipe thickness caused by abrasion through flown earth dnd soil.
- ④ The oil leaks from the #2 generator have been found.

2. Key Points for the Rehabilitation Plan

- ① Replace the packing of the No2 unit generator.
- ② Replace the gates and valves.
- ③ Inspection works for the penstock. Replace it if the wear and tear are serious.

GENERAL

Power Plant	NO. 227 SILVIA	Investigated Date	9 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	100
Location	CAUCA		
River	PIENDAMO		
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 ²)	392	1. Dam - Type	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Height (m)	2.0	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Crest Length (m)	12.0	- Type	FRANCIS FRANCIS
- Ordinary Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Output (kW)	150 BHP
- Low Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	12.0	- Revolution (rpm)	900
- Droughty Water Discharge	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	2. Sand Trap Gate		- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	- Type	NON	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.5	- Number of Gates	NON	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	1,197	- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN. SYN.
- Tailwater Level (EL)	1,165	- Dimensions (m) (WxH)	NOT CONFIRMED	- Number of Generator	1 1
- Gross Head	31	- Number of Intake	1	- Capacity (kVA)	130 625
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80 80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Voltage (V)	480 276 6,900
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60 60
7. Plant Capacity (kW)	604	- Type	SLUICE	- Revolution (rpm)	900 1,750 720
8. Output (MWh)	746	- Dimensions (m) (W x H)	NOT CONFIRMED	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Manufacturing Year	1959
10. Unit Price 1,000 pesos/kW	NO DATA	7. Headrace		- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	- Type	OPEN	- Capacity (kVA)	142.5
11. Others		- Dimensions (m) [W x H]	W H 0.9 x 1.2	- Primary Voltage (V)	480
		- Length (m)	600	- Secondary Voltage (kV)	13
		8. Dimensions of Water Reservoir (m)		- Number of Phase	3
		9. Penstock		- Connection	NO NAME PLATE
		- Dimensions (m) (φ x L)	φ = 0.92 L = 50	- Number	1
		- Number of Lines	1	Continuous Stand-by	
		10. Dimensions of Tailrace [W x H] (m)	2.2 M ²	4. Others	#1 Unit: Operating #2 Unit: Stopped

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

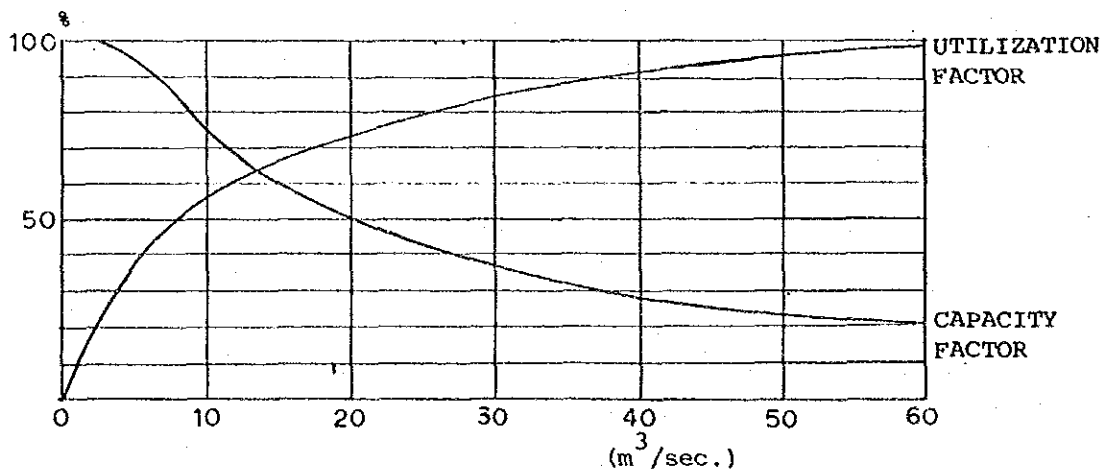
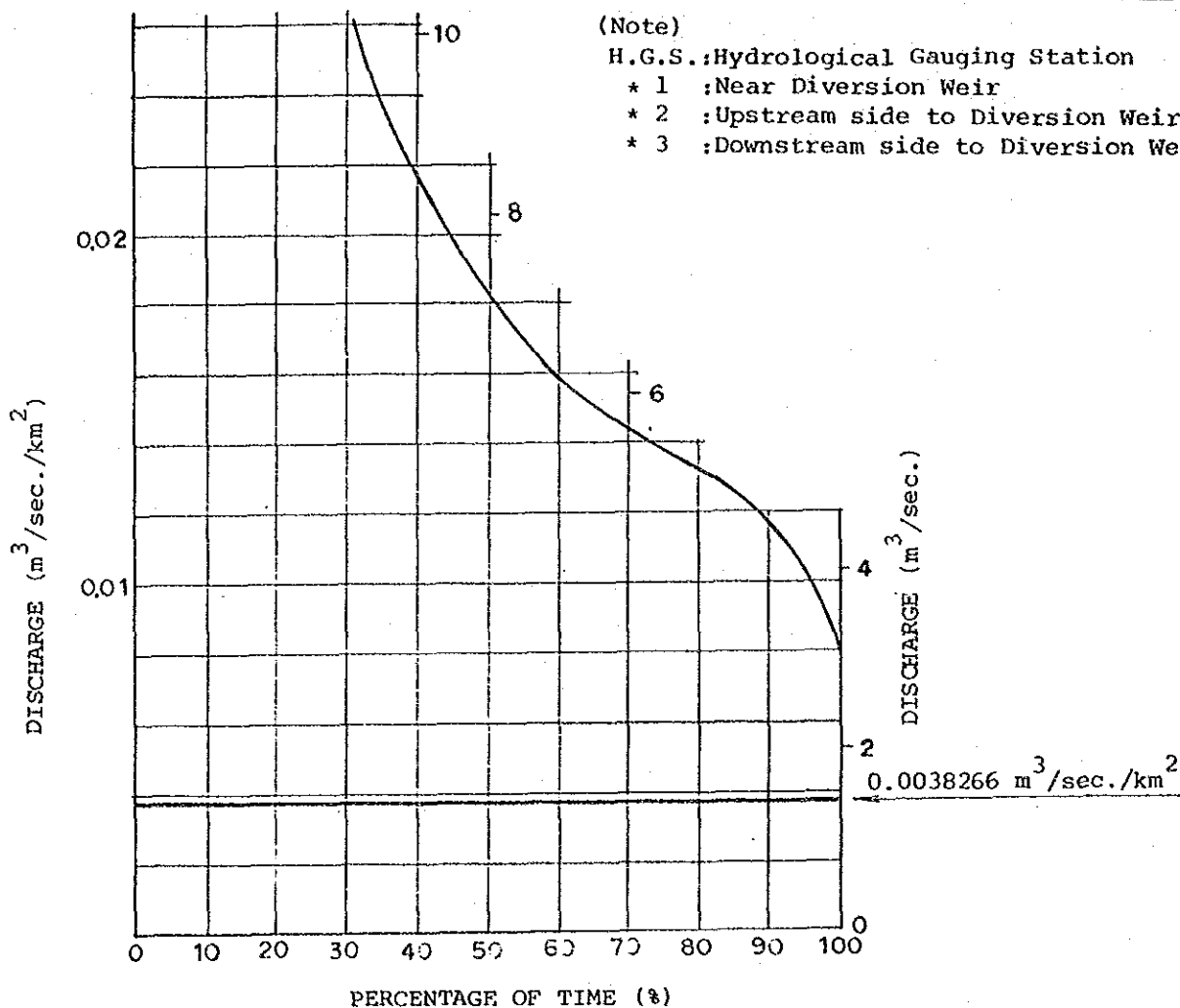
NO. 227 SILVIA

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1970 - 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. 227 Silvia

1. Present Condition and Problems

- ① This power plant has a very small river-water utilization rate.
- ② A 100 kW and a 504-kW generators were installed. However, the 504-kW generator has been suspended since 15 years ago. The 100-kW generator is still in operation according to the rated output.
- ③ All the penstock and conduit structures are strong and kept in a good condition.

2. Key Points for the Rehabilitation Plan

- ① Replace the 500 kW generator and restore the output to a rated level.
- ② By use of a flow curve at the intake gate, select the quantity of water intaken to meet a proper river water utilization rate and flow / facility utilization rate. And then determine an optimum installed capacity.

GENERAL

Power Plant	NO. 228 OVEJAS	Investigated Date	10 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	650
Location	CAUCA		
River	OVEJAS		
Generating Method	RUN-OF-RIVER		
Installed Year	1939	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1940
- Plenty Water Discharge	NO DATA	- Height (m)	1.35	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30	- Output (kW)	1,250 HP
- Low Water Discharge	NO DATA	- Elevation of Over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	400
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	30	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	NON	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	7.0	- Number of Gates	NON	2. Generator	
5. Head (m)	1,197	3. Intake		- Manufacturing Year	
- Headwater Level (EL)		- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN.
- Tailwater Level (EL)	1,173	- Dimensions (m) (WxH)	W H 4.9 x 4.0	- Number of Generator	1
- Gross Head	24.5	- Number of Intake	1	- Capacity (kVA)	1,125
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Voltage (kV)	12.5
6. Efficiency (%)	UNKNOWN	6. Intake Gate	(WOOD)	- Frequency (Hz)	60
7. Plant Capacity (kW)	900	- Type		- Revolution (rpm)	400
8. Output (MWh)	UNKNOWN	- Dimensions (m) (W x H)	SLUICE W H 4.9 x 2.0	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Manufacturing Year	N/A
10. Unit Price		7. Headrace	STEEL PIPE	- Type	N/A
1,000 pesos/kWh	NO DATA	- Type		- Capacity (kVA)	N/A
pesos/kWh	NO DATA	- Dimensions (m) (W x H)	φ = 1.85	- Primary Voltage (kV)	N/A
11. Others		- Length (m)	1,309	- Secondary Voltage (kV)	N/A
		8. Dimensions of Water Reservoir (m)	W L H 5.2x22.5x3.2	- Number of Phase	N/A
		9. Penstock	φ = 1.8 L = 71	- Connection	N/A
		- Dimensions (m) (φ x L)		- Number	N/A
		- Number of Lines	1	Continuous Stand-by	N/A
		10. Dimensions of Tailrace (W x H) (m)	0.95 M ²	4. Others	Operating

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 228 OVEJAS

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

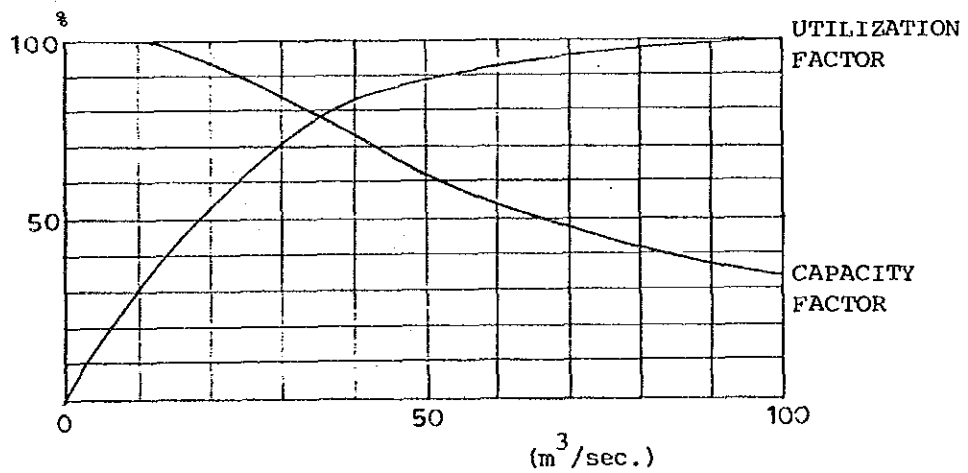
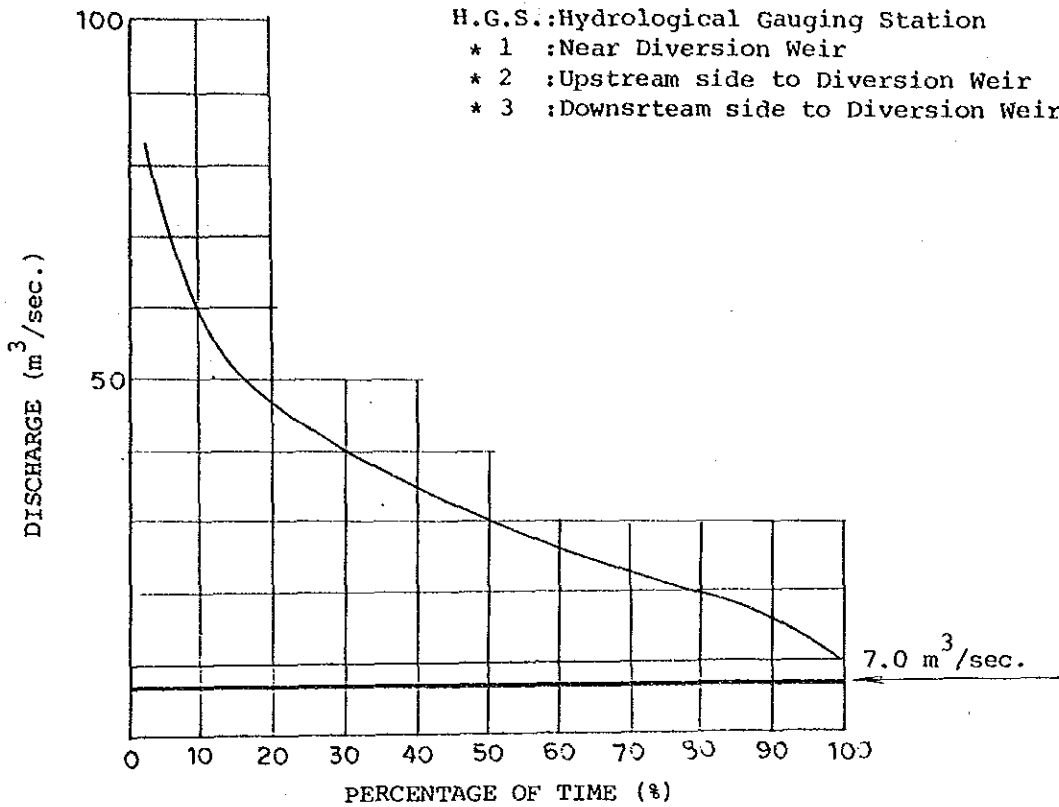
(Note)

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 Almost all the length of the conduit is penstock. Because of the repeated occurrence of small scale negative pressure and long service life, numerous number of deformed part and rehabilitation traces are found.
- ② An approx. 30-meter section in the upstream from the surge tank has been crushed due to negative pressure and earth pressure. However, a rehabilitation has recently been completed and the operation has been started.
- ③ A part of the crest of the intake weir has been damaged.

2. Key Points for the Rehabilitation Plan

- ① Remodelling of the intake weir and intake gate.
- ② Replacement of the conduit into an open channel type as preventive measures against the negative pressure occurring in the conduit.
- ③ Replacement of the penstock.
- ④ Replacement of the generator.

GENERAL

Power Plant	NO. 229 ASNAZU	Investigated Date	10 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	300
Location	CAUCA		
River	ASNAZU		
Generating Method	RUN-OF-RIVER		
Installed Year	1932	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type	2.5	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	15.0	- Type	PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	UNKNOWN	- Output (kW)	300
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	15.0	- Revolution (rpm)	514
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	UNKNOWN	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	NON	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NON	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.0	- Dimensions (WxH) (m)	NON	2. Generator	
5. Head (m)	1,200	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN.
- Tailwater Level (EL)	1,065	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	135	- Dimensions (m) (WxH)	W H 1.65 x 2.65	- Capacity (kVA)	500
- Head Loss	1	- Number of Intake	2	- Power Factor (%)	80
- Net Head	134	4. Dimensions of Forebay (m)	NON	- Voltage (V)	4,200
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Frequency (Hz)	60
7. Plant Capacity (kW)	450	6. Intake Gate		- Revolution (rpm)	514
8. Output (MWh)	1,345	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H 1.65 x 2.0	- Manufacturing Year	
10. Unit Price		- Number of Gates	2	- Type	ONAN, OUTDOOR
1,000 pesos/kWh	NO DATA	7. Headrace	NON	- Capacity (kVA)	150 x 3
pesos/kWh	NO DATA	- Type		- Primary Voltage (V)	4,200
11. Others		- Dimensions (m) (W x H)	NON	- Secondary Voltage (kV)	12.5
		- Length (m)	NON	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	W L H 3.7x12.0	- Connection	
		9. Penstock		- Number	3
		- Dimensions (m) (φ x L)	φ = 0.92 L = 1,192	Continuous Stand-by	0
		- Number of Lines	1	4. Others	Operating
		10. Dimensions of Tailrace (W x H) (m)	W H L 1.8x0.6x300		

No. 229 Asnazu:

1. Present Condition and Problems

- ① The generators were installed 56 years ago. However, the output reduction rate is as well as 33 %.
- ② The generating output is twice as much as the installed output. This means that there exists unbalance between the two.
- ③ There are indeed no flow data for the Rio Asnzu, but the river flow at the field investigation time was more abundant than intake flow. This power plant has a low river-water utilization rate.
- ④ To prevent the intake weir from being damaged by increased river water, a bypass with a gate has been provided 50 meters upper than the intake weir.
- ⑤ The intake gate and head tank are in a body but small in capacity.
- ⑥ The conduit is of a ground pipe line, a part of which has a syphon construction. A lot of leaked parts are also found, so the life is close on the limit.

2. Key Points for the Rehabilitation Plan

- ① The generator has been too old for use. so it is unable to be rehabilitated up to a rated output level. For this reason, replace the generator with a new one. In this case, select a proper installed capacity to meet the power plant output.
- ② Enlargement of the intake gate and head tank.
- ③ Inspect the penstock. If the wear and tear has proceeded, replace it.

GENERAL

Power Plant	NO. 230 INZA	Investigated Date	8 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	0
Location	CAUCA		
River	ULLUCOS		
Generating Method	RUN-OF-RIVER		
Installed Year	1971	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	512	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	3.0	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	15	- Output (kW)	525 PS
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	1,200
- Droughty Water Discharge	NO DATA	- Width of Overflowing Crest (m)	15	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Overflowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NOT CONFIRMED	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	0.6	- Number of Gates	1	2. Generator	
5. Head (m)		3. Intake	UNKNOWN	- Manufacturing Year	
- Headwater Level (EL)	1,418	- Elevation of Intake Sill (m)		- Type	NO NAME PLATE
- Tailwater Level (EL)	1,339	- Dimensions (m) (WxH)	NOT CONFIRMED	- Number of Generator	1 (ICEL 360
- Gross Head	72	- Number of Intake	1	- Capacity (kVA)	NO NAME PLATE (KW)
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)		- Power Factor (%)	NO NAME PLATE
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 3.0x10.3x2.15	- Voltage (kV)	NO NAME PLATE
6. Efficiency (%)	UNKNOWN	6. Intake Gate	SLUICE	- Frequency (Hz)	NO NAME PLATE
7. Plant Capacity (kW)	360	- Type		- Revolution (rpm)	NO NAME PLATE
8. Output (MWh)	992	- Dimensions (m) (W x H)	NOT CONFIRMED	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Manufacturing Year	1970
10. Unit Price		7. Headrace	OPEN	- Type	ONAN, OUTDOOR
1,000 pesos/kW	NO DATA	- Type		- Capacity (kVA)	250
pesos/kWh	NO DATA	- Dimensions (m) (W x H)	W H 1.30 x 0.75	- Primary Voltage (V)	231
11. Others		- Length (m)	2,524	- Secondary Voltage (kV)	13.2
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Number of Phase	3
		9. Penstock	∅ = 0.65	- Connection	NO NAME PLATE
		- Dimensions (m) (∅ x L)	L = 135	- Number	2
		- Number of Lines	1	Continuous Stand-by	0
		10. Dimensions of Tailrace (W x H) (m)	A = 1.52 M ²	4. Others	Stopped (Under repair)

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

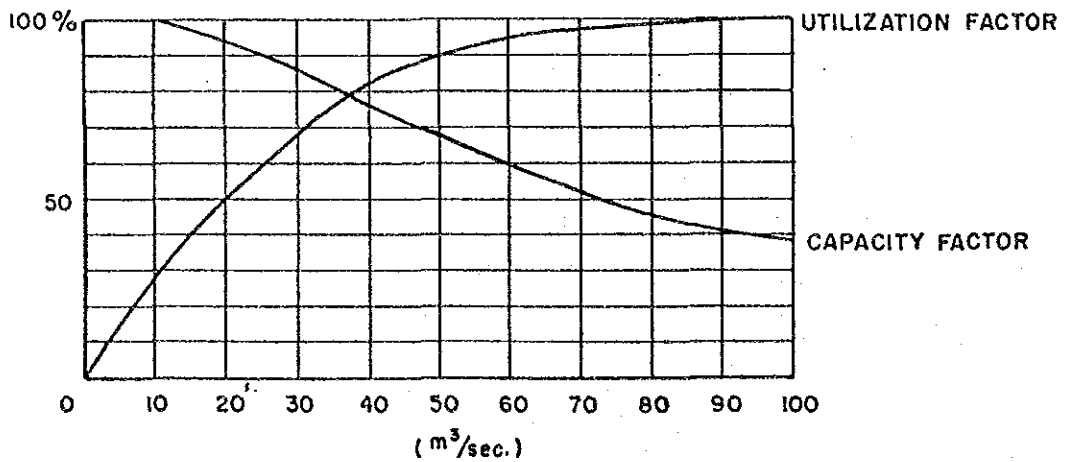
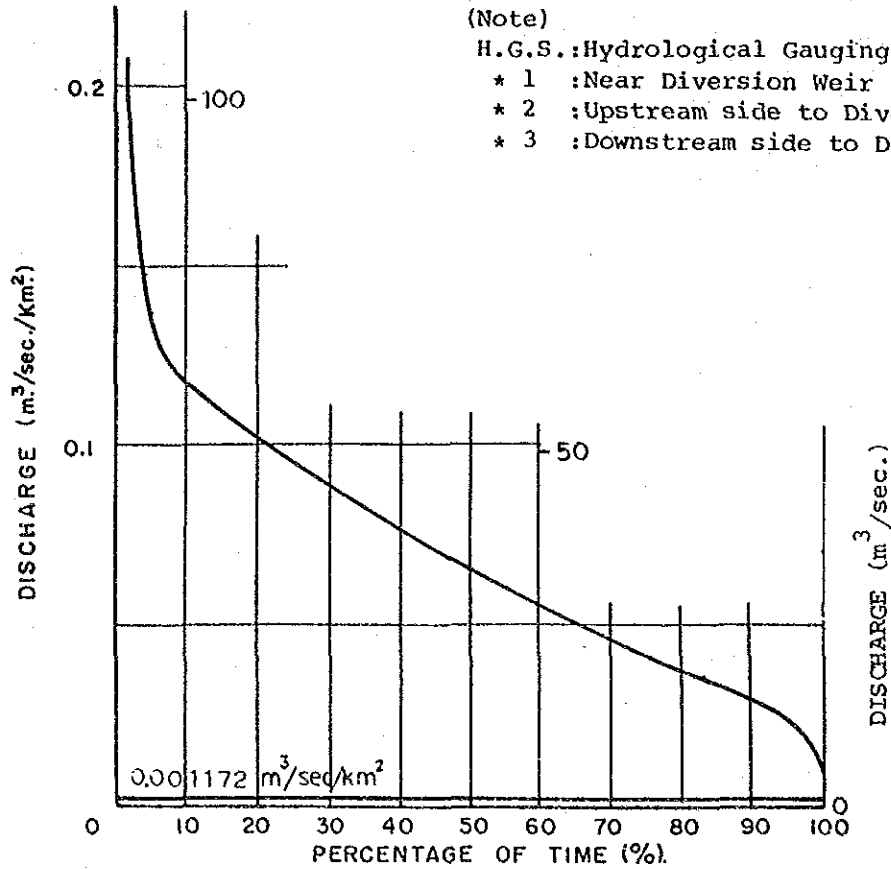
NO. 230 INZA

Location of H.G.S.	* 3
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



No. 230 Inza

1. Present Condition and Problems

- ① The generator and conduit structures of this power plant are in a good condition, which were constructed in consideration of a future possible extension (360 kW).
- ② The generating building also has space to additionally construct generators. With the construction of a penstock and a generator, the rated output will be doubled.
- ③ The river flow is abundant and the current flow utilizes no more than one tenth the droughty water discharge.

2. Key Points for the Rehabilitation Plan

- ① The CEDERCA has hoped the installed capacity to be increased, so it is easy to increase the output by 360 kW.
- ② The conduit is rather as long as 2.5 km. In addition, since the droughty water discharge is $10 \text{ m}^3/\text{sec}$, this power plant can be expected to be substantially increased in the installed capacity.

GENERAL

Power Plant	NO. 231 TORIBIO	Investigated Date	11 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	35
Location	CAUCA		
River	ISABELILLA		
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 ²)	NO DATA	1. Dam	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1963
- Plenty Water Discharge	NO DATA	- Height (m)	1.92	- Type	UNKNOWN
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	8.0	- Output (kW)	80 HP
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	365
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	8.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of overflowing (m)	UNKNOWN	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate		Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	0.5	- Dimensions (WxH) (m)	2.1 x 2.0	2. Generator	
5. Head (m)	315	- Number of Gates	1	- Manufacturing Year	1963
- Headwater Level (EL)		3. Intake		- Type	SYN.
- Tailwater Level (EL)	300	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	13	- Dimensions (m) (WxH)	W H 2.1 x 2.0	- Capacity (kVA)	63 KW
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	230
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Frequency (Hz)	60
7. Plant Capacity (kW)	63	6. Intake Gate	SLUICE	- Revolution (rpm)	1,200
8. Output (MWh)	198	- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 1.1 x 0.8	- Manufacturing Year	
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	- Type	ONAN, OUTDOOR
	NO DATA	7. Headrace		- Capacity (kVA)	50
11. Others		- Type	OPEN	- Primary Voltage (V)	220
		- Dimensions (m) [W x H]	W H 1.0 x 0.6	- Secondary Voltage (kV)	13.2
		- Length (m)	355	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Connection	NO NAME PLATE
		9. Penstock		- Number Continuous Stand-by	1 0
		- Dimensions (m) (φ x L)	φ = 0.68 L = 36	4. Others	Operating, Isolated
		- Number of Lines	1		
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

No. 231 Toribio

1. Present Condition and Problems

- ① As there are no flow data and design drawings, the flow condition and head cannot be confirmed. The installed capacity is 63 kW. If the power plant output is calculated from the flow and head data listening survey, the value is set at 48 kW. The current output is 33 kW.
- ② The conduit structures including the penstock are kept in a good condition. However, the intake gate does not work, while it is open. For this reason, in the wet seasons, a part of the river flow overflows from the conduit.

2. Key Points for the Rehabilitation Plan

- ① This power plant is now a self-supporting power source and separate from the other power systems. However in 1990, it is planned to connect this power plant with the El Palo power plant via 13.2 kV transmission line. The priority order decided by the CEDELCA is also low.

GENERAL

Power Plant	NO. 232 FLORIDA - I	Investigated Date	7 Dec. 1987
Electric Company	CEDELCA	Available Capacity (kW)	0
Location	CAUCA		
River	CAUCA		
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 ²)	948	1. Dam - Type	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Height (m)	2.0	- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Crest Length (m)	56.0	- Type	FRANCIS x 2
- Ordinary Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)		- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	56.0	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Depth of Over-flowing (m)		- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	2. Sand Trap Gate		- Regulating Valve	
- Mean	NO DATA	- Type		Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)		Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	6.5	- Number of Gates		2. Generator	
5. Head (m)	1,812.17	3. Intake		- Manufacturing Year	
- Headwater Level (EL)		- Elevation of Intake Sill (m)	1,820	- Type	SYN.
- Tailwater Level (EL)	1,766.35	- Dimensions (m) (W x H)	W H 2.12 x 1.55	- Number of Generator	2
- Gross Head	48	- Number of Intake		- Capacity (kVA)	1,300 x 2
- 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)		- Voltage (V)	500/289
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Frequency (Hz)	60
7. Plant Capacity (kW)	2,300	- Type		- Revolution (rpm)	900/1,800
8. Output (MWh)	UNKNOWN	- Dimensions (m) [W x H]		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates		- Manufacturing Year	1954
10. Unit Price 1,000 pesos/kWh	NO DATA	7. Headrace		- Type	INDIAN INDOOR
pesos/kWh	NO DATA	- Type	OPEN	- Capacity (kVA)	1,300 1,250
11. Others		- Dimensions (m) (W x H)		- Primary Voltage (V)	500 11 KV
		- Length (m)	4,960	- Secondary Voltage (kV)	11.43 66
		8. Dimensions of Water Reservoir (m) W L H	x55.0x	- Number of Phase	3 3
		9. Penstock		- Connection	NO NAME PLATE
		- Dimensions (m) (φ x L)	φ = 1.0 L = 53.0	- Number	
		- Number of Lines	2	Continuous	2 1
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED	Stand-by	0 0
				4. Others	#1, 2 Unit: Stopped

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

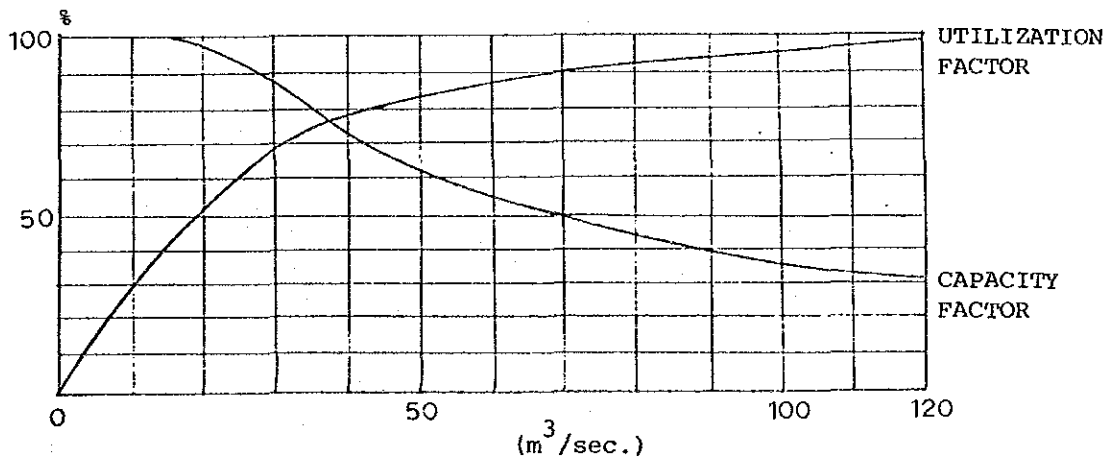
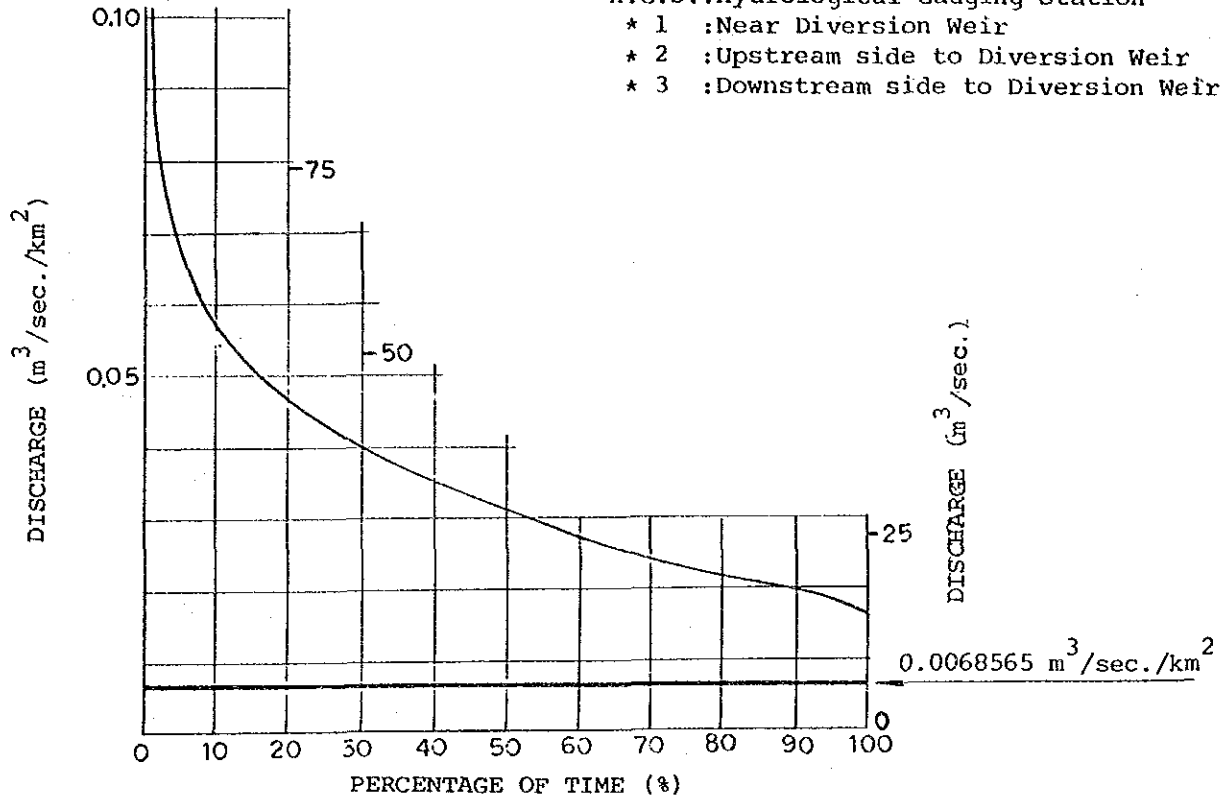
NO. 232 FLORIDA-1

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1965 - 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 Since the headrace of the reservoir tank was damaged by landslide six years ago, generating facilities have been suspended.
- ② The generating facilities installed 32 years ago have been stopped for six years, it is impossible to operate them under the rated output.
- ③ An access road was blocked by landslide during the conduct of the field reconnaissance, so that the reconnaissance for the diversion weir and headrace structures was not carried out. According to the information from the ICEL and CEDERCA, the headrace and settling basin have partially been damaged.

2. Consultation of the Rehabilitation Plan

- ① To replace the generating facilities with new ones.
- ② To improve the diversion weir, headrace and settling basin.
- ③ To carefully conduct the geological survey, because landslide phenomena have been observed around this power plant.

GENERAL

Power Plant	NO. 233 LA VUELTA	Investigated Date	26 Jan. 1988
Electric Company	ELECTRO CHOCO (MINEROS DEL CHOCO S.A.)	Available Capacity (kW)	500
Location	CHOCO		
River	ANDAGUEDA		
Generating Method	RUN-OF-RIVER		
Installed Year	1916	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	1,030	1. Dam	OVERFLOR WOODEN	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	
- Plenty Water Discharge	100.0	- Height (m)	4.8	- Type	VERTICAL AXIS FRANCIS x 2
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	120	- Output (kW)	NO NAME PLATE
- Low Water Discharge	NO DATA	- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Overflowing Crest (m)	120	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Overflowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	NON	Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type		Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	54.0	- Dimensions (ØxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN.
- Tailwater Level (EL)		- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	2
- Gross Head	4.8	- Dimensions (m) (WxH)	W H 12.0 x 6.0	- Capacity (kVA)	1,250 x 2
- Head Loss	UNKNOWN	- Number of Intake	2	- Power Factor (%)	80
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (V)	4,400
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Frequency (Hz)	60
7. Plant Capacity (kW)	2,000	6. Intake Gate		- Revolution (rpm)	72
8. Output (MWh)	UNKNOWN	- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	UNKNOWN	- Dimensions (m) [W x H]	SLUIGE W H 3.0 x 6.0	- Manufacturing Year	
10. Unit Price (1,000 pesos/kW)	UNKNOWN	- Number of Gates	6	- Type	ONAN, OUTDOOR
pesos/kWh	UNKNOWN	7. Headrace		- Capacity (kVA)	833 x 3
11. Others		- Type		- Primary Voltage (V)	4,400
		- Dimensions (m) [W x H]	W H 13.0 x 12.0	- Secondary Voltage (kV)	34.5
		- Length (m)	37	- Number of Phase	1
		8. Dimensions of Water Reservoir (m)	NON	- Connection	NO NAME PLATE
		9. Penstock	NOT CONFIRMED	- Number	3
		- Dimensions (m) (Ø x L)		Continuous Stand-by	0
		- Number of Lines	2	4. Others	#1, 2 Unit: Operating Isolated
		10. Dimensions of Tailrace [W x H] (m)			

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 233 LA VUELTA

Location of H.G.S.	* 2
Daily or Monthly	Daily
Observation Duration	1977 - 1985
Used Data	1983 - 1985

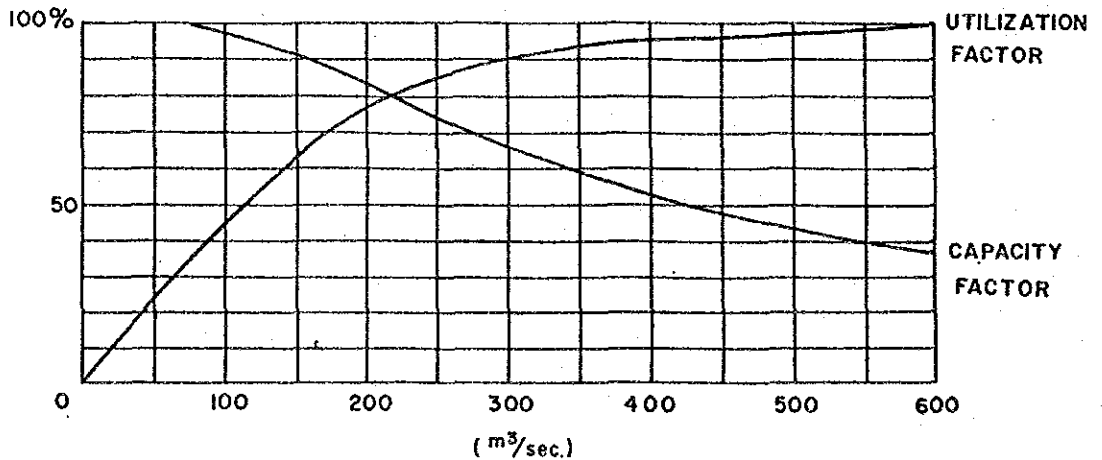
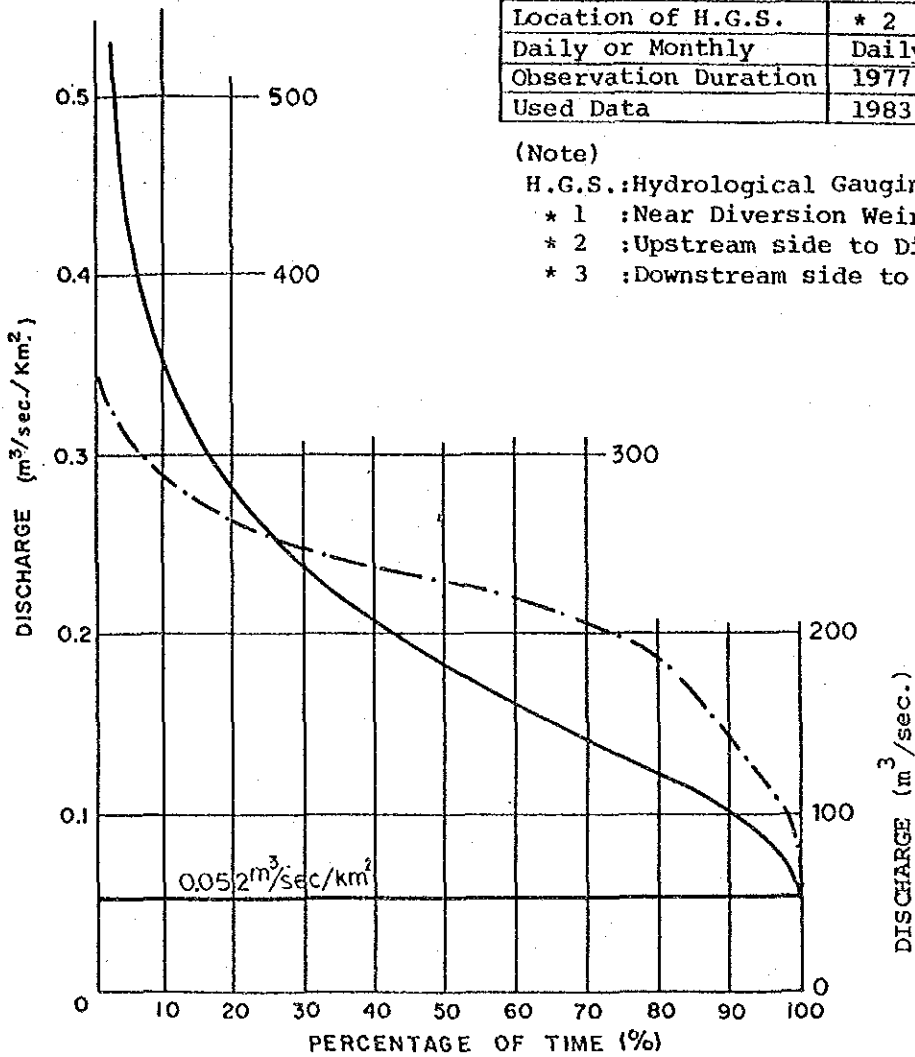
(Note)

H.G.S.: Hydrological Gauging Station

* 1 : Near Diversion Weir

* 2 : Upstream side to Diversion Weir

* 3 : Downstream side to Diversion Weir



No. 233 La Vuelta

1. Present Condition and Problems

- ① The generator was constructed 67 years ago. Although the rated output is 2,000 kW, the current output has been reduced to 500 kW (25 %).
- ② Adjacent from the power plant building, there is a navigation lock to allow a canoe to pass through, which is still now available. The water level difference for this lock shows the head.
- ③ Judging from the flow data received from the HIMAT hydrological gauging station (No. 1101-701, Aguasal) on the approx. 1-km downstream side, this power plant has a low river water utilization rate.
- ④ The concrete-made structures of the intake gate and intake gate yard have been damaged. The intake weir has been rehabilitated by lifting wooden beams with wires.
- ⑤ The transport from Quibdo to this site is mainly made by ship. However, the river is very shallow. In particular between Lloro and La Vuelta the maximum depth the depth is as shallow as approx. 1.0 meter.
- ⑥ The as-built drawing has been stored in the site office, but most data have been scattered. almost all the drawings concerning the civil engineering structures have been lost.

2. Key Points for the Rehabilitation Plan

- ① Collect data for the flow condition of the intake gate, define an intake quantity to enable a proper flow / facility utilization rate and finally calculate an optimum installed capacity.
- ② Review an access plan by the route of ground transport.
- ③ Because of self-supporting power source, an alternative power source shall be considered during the construction works.
- ④ Review the transmission route between Qubdo - Yuto Lloro - La Volta - Andagoya.

GENERAL

Power Plant	NO. 234 LA SALADA	Investigated Date	15 Dec. 1987
Electric Company	ELECTROCUNDI S.A.	Available Capacity (kW)	0
Location	CUNDINAMARCA		
River	RIO BOGOTA		
Generating Method	RUN-OF-RIVER		
Installed Year	1935	Service-in	1936

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)		1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)	150	- Type		- Manufacturing Year	
- Plenty Water Discharge		- Height (m)		- Type	FRANCIS
- Ordinary Water Discharge		- Crest Length (m)	100	- Output (kW)	280
- Low Water Discharge		- Elevation of over-flowing Crest (m)		- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge		- Width of Over-flowing Crest (m)	100	- Type of Governor	NO NAME PLATE
- Minimum		- Depth of Over-flowing (m)		- Regulating Valve	
- Mean		2. Sand Trap Gate		- Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)		- Dimensions (WxH) (m)		- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	2.3	- Number of Gates		2. Generator	
5. Head (m)	345	3. Intake		- Manufacturing Year	
- Headwater Level (EL)		- Elevation of Intake Sill (m)		- Type	
- Tailwater Level (EL)	330	- Dimensions (m) (WxH)	W H 6.3 x	- Number of Generator	1
- Gross Head	15	- Number of Intake		- Capacity (kVA)	350
- Head Loss		4. Dimensions of Forebay (m)		- Power Factor (%)	NO NAME PLATE
- Net Head		5. Dimensions of Settling Basin (m) (W x L x H)		- Voltage (V)	4,160/2,400
6. Efficiency (%)		6. Intake Gate		- Frequency (Hz)	NO NAME PLATE
7. Plant Capacity (kW)	280	- Type		- Revolution (rpm)	NO NAME PLATE
8. Output (MWh)		- Dimensions (m) [W x H]	W H 1.5 x	3. Transformer	
9. Construction Price (1,000,000 pesos)		- Number of Gates		- Manufacturing year	N/A
10. Unit Price 1,000 pesos/kWh		7. Headrace		- Type	N/A
pesos/kWh		- Type	CHANNEL (NATURAL)	- Capacity (kVA)	N/A
11. Others		- Dimensions (m) [W x H]	W = 4 ~ 6.0 H =	- Primary Voltage (kV)	N/A
		- Length (m)	5,000	- Secondary Voltage (kV)	N/A
		8. Dimensions of Water Reservoir (m)	W L H 3.0 x x	- Number of Phase	N/A
		9. Penstock		- Connection	N/A
		CONC. COATING		- Number	N/A
		- Dimensions (m) (φ x L)	φ = 1.2 L = 90	Continuous Stand-by	N/A
		- Number of Lines	1	4. Others	
		10. Dimensions of Tailrace (W x H) (m)			

No. 234 La Salada

1. Present Condition and Problems

- ① This is a small scale hydraulic power plant, which was established near the end of an irrigation water channel (approx. 5 km) in 1913. The plant was started 53 years ago. However, as the penstock inlet has been covered with the flown-into earth and soil, the power generation is unable to be in operation.
- ② To restart the operation, an overall rehabilitation equivalent to a new construction is required. And also judging from the site condition, this area is hard to be approved for a suitable site for the hydraulic power plant.

2. Key Points for the Rehabilitation Plan

- ① Exclude this power plant from the proposed sites to be rehabilitated.

GENERAL

Power Plant	NO. 235 RIO NEGRO	Investigated Date	15 Jun. 1988
Electric Company	ELECTROCUNDI S.A.	Available Capacity (kW)	9,500
Location	CUNDINAMARCA		
River	RIO NEGRO - Q. LA PITA		
Generating Method	RUN-OF-RIVER		
Installed Year	1974	Service-in	

SUMMARY OF GENERATING FACILITIES

General		Civil		Equipment	
Item	Data	Item	Data	Item	Data
1. Catchment Area (Km ²)	3,045	1. Dam		1. Turbine	
2. Volume of Discharge (m ³ /s)		- Type		- Manufacturing Year	1962
- Plenty Water Discharge	100	- Height (m)	9	- Type	FRANCIS x 2
- Ordinary Water Discharge		- Crest Length (m)	50		NEYRPIC-ALSTHOM
- Low Water Discharge		- Elevation of over-flowing Crest (m)	294	- Output (kW)	6,960 C.V.
- Droughty Water Discharge		- Width of Over-flowing Crest (m)	50	- Revolution (rpm)	514
- Minimum		- Depth of Over-flowing (m)		- Type of Governor	
- Mean		2. Sand Trap Gate		- Regulating Valve	
3. Utilizable Flow (m ³ /s)		- Type	ROLLER	Type	
4. Firm Discharge (m ³ /s)	17	- Dimensions (ØxH) (m)	12.0 x 2.5	Dimension (mm)	
5. Head (m)		- Number of Gates	2	2. Generator	
- Headwater Level (EL)		3. Intake		- Manufacturing Year	
- Tailwater Level (EL)		- Elevation of Intake Sill (m)		- Type	SGT420-140,14
- Gross Head	78.2	- Dimensions (m) (ØxH)	W H 2.3 x 2.0	- Number of Generator	2
- Head Loss		- Number of Intake	1	- Capacity (kVA)	6,000
- Net Head		4. Dimensions of Forebay (m)		- Power Factor (%)	80
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	W L H 15.5x63.0x4.3	- Voltage (kV)	4.16 ± 10%
7. Plant Capacity (kW)	9,600	6. Intake Gate		- Frequency (Hz)	60
8. Output (MWh)		- Type		- Revolution (rpm)	2,514
9. Construction Price (1,000,000 pesos)		- Dimensions (m) [W x H]		3. Transformer	
10. Unit Price (1,000 pesos/kWh)		- Number of Gates		- Manufacturing Year	1962
11. Others		7. Headrace		- Type	DOPA 3352
		- Type	TUNNEL	- Capacity (kVA)	6,000
		- Dimensions (m) (W x H)	Ø = 2.5 M	- Primary Voltage (kV)	4.16
		- Length (m)	1,415	- Secondary Voltage (kV)	34.9
		8. Dimensions of Water Reservoir (m)	W L H 15.5x11.0x4.7	- Number of Phase	3
		9. Penstock		- Connection	Xd5
		- Dimensions (m) (Ø x L)	Ø = 2.2 L = 379	- Number	2
		- Number of Lines		Continuous Stand-by	-
		10. Dimensions of Tailrace (W x H) (m)		4. Others	

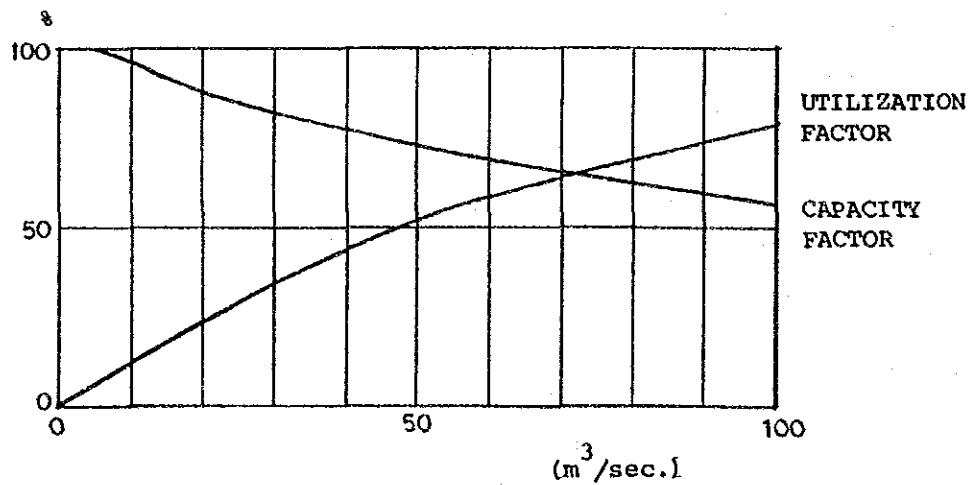
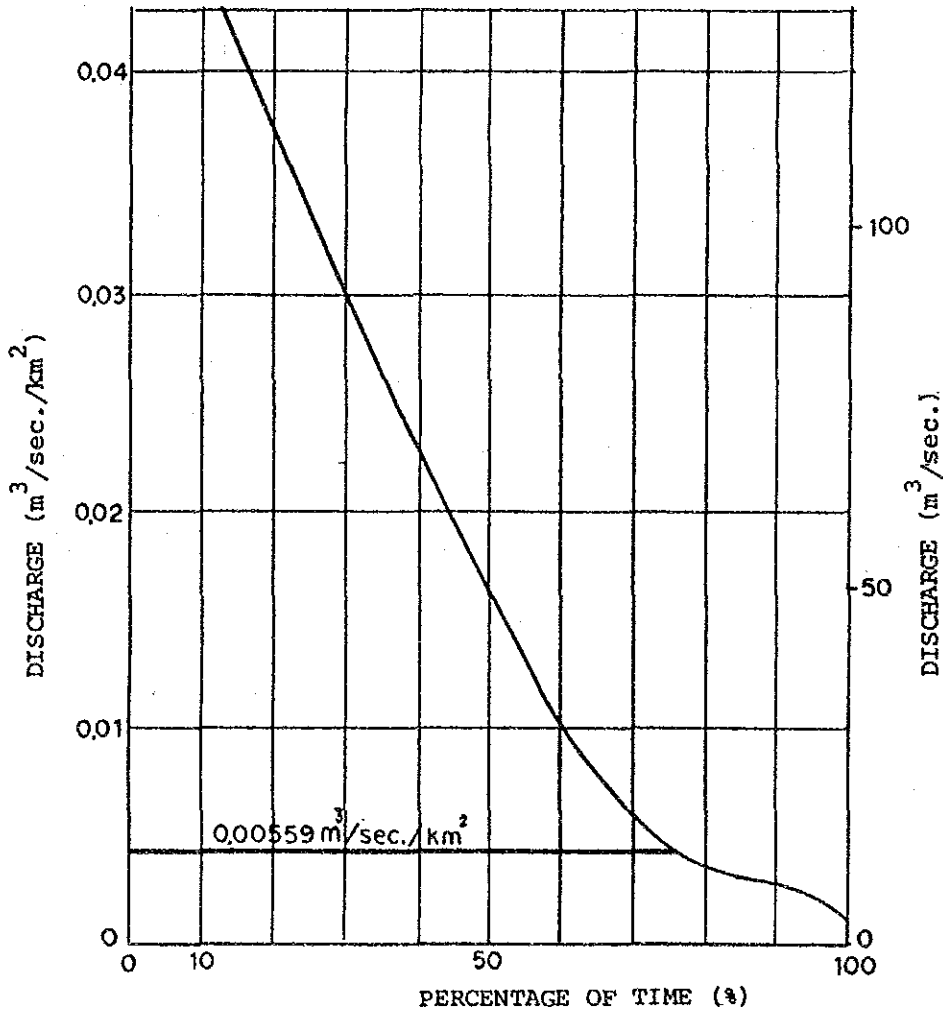
FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

NO. 235 RIO NEGRO

Location of H.G.S.	*
Daily or Monthly	Daily
Observation Duration	1951 - 1985
Used Data	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 This power plant, where a pondage dam was provided in the Rio Negro was discharged via headrace tunnel (max. discharge: $Q = 17 \text{ m}^3/\text{s}$) to the Qd. La Pita River. Such dam and outlet facilities were not completely constructed according to the design drawings, although the duration of service of this power plant was 14 years.
- ② The water of the Rio Negro become turbid, because of mixture from a mine located on the upperstream side of the river, and total sedimentation load is high.
- ③ Although four tainter gates were designed as dam, only two gates were constructed on the left bank of the river. On its right bank, there was an ungated overflow dam. A part of cofferdam was left over in the river. Thus, the right bank on the upperstream side to the dam was accumulated with the earth and sand, and the intake on the left bank was accumulated with dust, driftwood, etc. during the rainfall. To remove such dust, etc. generating facilities were stopped.
- ④ A re-regulating pondage on the downstream side to the outlet which was designed was not constructed, so that the both banks of the Qd. La Pita River was eroded.

- ⑤ A tainter gate for controlling discharge was provided at the entrance of the settling basin, and the water jumped up because of the improper location of the dam, so that the settling basin did not function properly.
- ⑥ It is said that the penstock was worn out because of sedimentation load and its pipe thickness was reduced. The water partially leaked out through the expansion joints.
- ⑦ Generating facilities have been operated under the rated output.

2. Key Points for the Rehabilitation Plan

- ① The intake facilities shall be modified as follows:
 - Installation of floating nets in front of the intake
 - Installation of automatic rake at the intake
 - Expansion of the entrance of headrace tunnel and new construction of settling basin
 - Removal of sand accumulated on the right bank of the upstream side to the dam
- ② The condition of penstock worn out shall be checked and penstock worn out shall be replaced.
- ③ The following two cases shall be studied from the economical point of view and then selected optimally.
 - Installation of the re-regulating pondage for protection of erosion in the Qd. La Pita River
 - River improvement work