

**PRE-FEASIBILITY STUDY
ON
SMALL-SCALE POWER PLANTS
REHABILITATION PROJECT
IN
THE REPUBLIC OF COLOMBIA**

FACILITY REGISTER

JULY 1988

JAPAN INTERNATIONAL COOPERATION AGENCY



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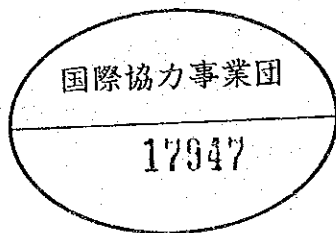
JAPAN INTERNATIONAL COOPERATION AGENCY

国際協力事業団

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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 Unit No.	1	2	3	Termopalaipa	3	Termobarranca	4	Termozalenque
1	Turbine									
1)	Type									
2)	Output		33,000	66,000	74,000	Condensing steam	66,000	66,000	GAS (W-191G)	15,000
3)	Steam pressure	KW	65	88	88		88	89		-
4)	Steam temp. (at inlet M.S.V.)	Kg/cm2	500	510	510		510	510		-
5)	Vacuum	mmHg·Abs		64	70					-
6)	Speed	rpm	3,600	3,600	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)	Manufacture		ALSTHOM	MITSUBISHI	MITSUBISHI		ALSTHOM	ALSTHOM		WESTING HOUSE
2	Condenser									
1)	Volume of cooling water	t/h	6,500	11,600	116,000		11,300	11,300		-
2)	Volume of water	t/h		182.27	210.09					-
3)	Rated temp. of cooling water	°C					40-43 (River water)			-
3	Boiler									
1)	Type									
2)	Steam pressure (Max. allowable working)	Kg/cm2	69	92	92	Natural circulation			Natural circulation	-
3)	Steam temp. at outlet of superheater	°C	505	515	515		515	515		-
4)	Volume of evaporator Max.Cont.Rating	t/h	140	250	290	Coal	290	245	Fuel Oil/Natural Gas	-
5)	Fuel		Coal	Coal	Coal					-
6)	Manufacture		ROUBAIX & ALSTHOM	DISTRAL	DISTRAL					-
4	Generator									
1)	Output	KVA	41,250	87,360	87,360		78,000	78,000		19,200
2)	Power factor	%	80	85	85		85	85		85
3)	Voltage	V	13,800	13,800	13,800		13,800	13,800		13,800
4)	Frequency	HZ	60	60	60		60	60		60
5)	Speed	rpm	3,600	3,600	3,600		3,600	3,600		900
6)	Manufacture		ALSTHOM	MITSUBISHI	MITSUBISHI					WESTING HOUSE
5	Main transformer									
1)	Rated capacity	MVA		88	88		78	78		30/40
2)	Primary voltage	V	13,200	13,200	13,200		13,800	13,800		115,000
3)	Secondary voltage	V	115,000	115,000	115,000		230,000	230,000		33,000
4)	Tertiary voltage	V								13,800
5)	Manufacture		ALSTHOM	MITSUBISHI	MITSUBISHI					

(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		- Type	NO NAME NO NAME PLATE PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	- 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
11. Others		7. Headrace		- Capacity (kVA)	OUTDOOR-OUTDOOR-OUTDOOR- 667x3 2000 2000
		- 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

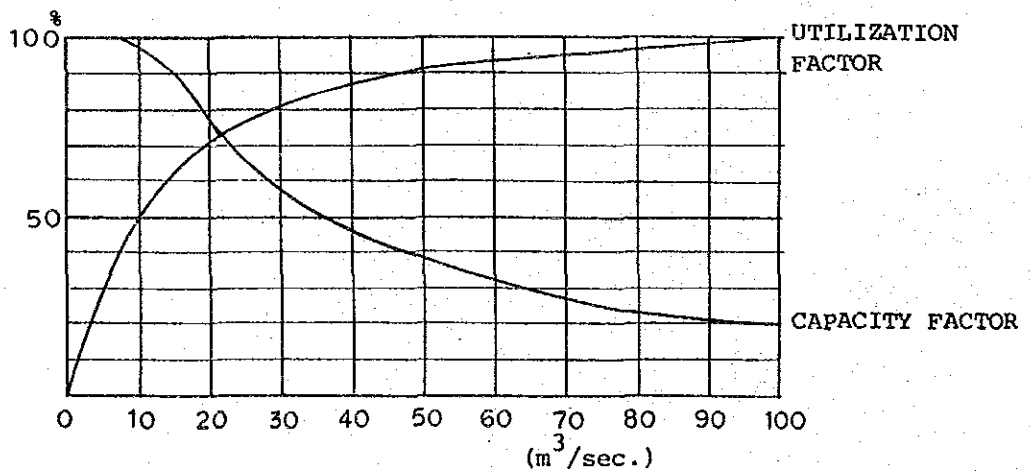
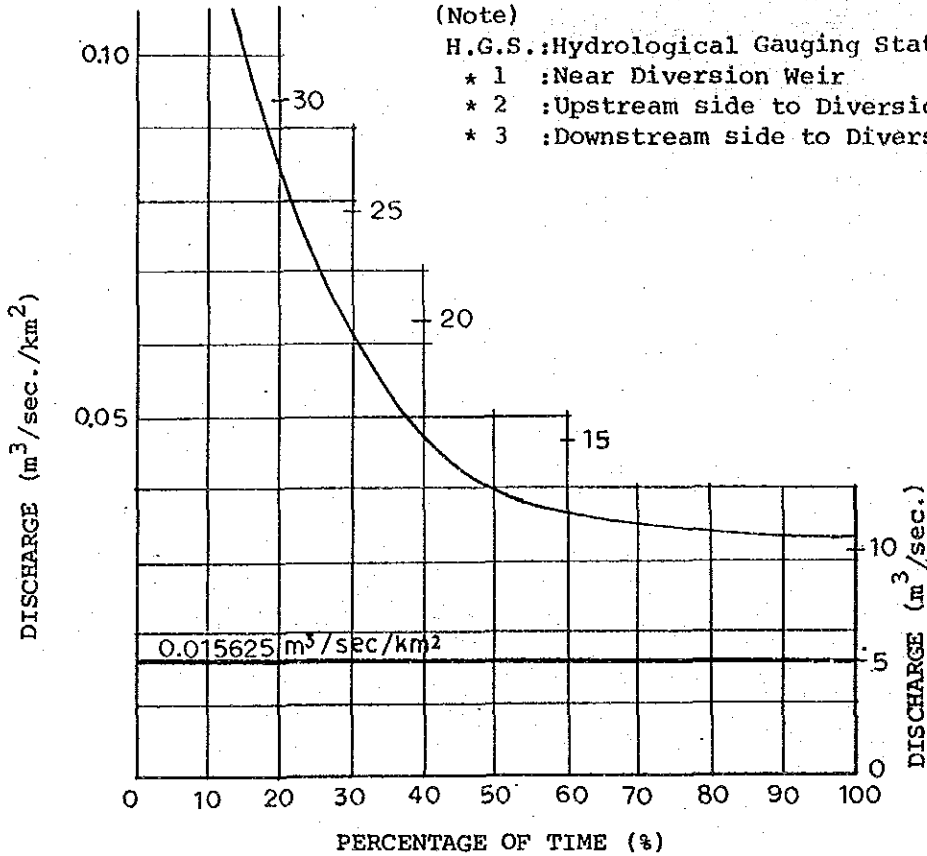
(Note)

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 $\varnothing 1.4$ 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. 1968
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		- Crest Length (m)	21.0	- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge		- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	600 500
- Droughty Water Discharge		- Width of overflowing Crest (m)	21.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum		- Depth of Overflowing (m)	0.10	- 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	SLUICE	- Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.0	- Dimensions (WxH) (m)	0.8 x 1.8	2. Generator	
5. Head (m)		- Number of Gates	1	- Manufacturing Year	
- Headwater Level (EL)	1,230	3. Intake		- Type	SYN. SYN.
- Tailwater Level (EL)	1,140	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1 1
- Gross Head	90	- Dimensions (m) (WxH)	1.7 x 3.3	- Capacity (kVA)	438 350 KW
- Head Loss	UNKNOWN	- Number of Intake	1	- Power Factor (%)	NO NAME PLATE NO NAME PLATE
- 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)	NON	- Frequency (Hz)	60 60
7. Plant Capacity (kW)	700	6. Intake Gate		- Revolution (rpm)	600 600
8. Output (MWh)	UNKNOWN	- Type	SLUICE	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	1.5 x 1.8	- Manufacturing Year	1962 1971
10. Unit Price 1,000 pesos/kW	NO DATA	- Number of Gates	1	- Type	ONAN ONAN
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	900 2000
11. Others		- Type	OPEN NATURAL	- Primary Voltage (kV)	2.3 13.2
		- Dimensions (m) (W x H)	(1.5x1.8)x1.5	- Secondary Voltage (kV)	13.2 44
		- Length (m)	65	- Number of Phase	3 3
		8. Dimensions of Water Reservoir (m)	W L H 2.87x4.3x2.3	- Connection	Δ/Δ Δ/Δ
		9. Penstock		- Number	
		- Dimensions (m) (φ x L)	φ = 0.75 L = 200	Continuous Stand-by	1 1 0 0
		- Number of Lines	1	4. Others	#1, 2 Unit: Operating
		10. Dimensions of Tailrace (m) (W x H)	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 extension 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 without 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	#1 #2
2. Volume of Discharge (m ³ /s)		- Type	CONCRETE	- Manufacturing Year	1935
- Plenty Water Discharge	20.0	- Height (m)	1.5	- Type	PELTON PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	30.0	- Output (kW)	NO NAME PLATE NO NAME PLATE
- 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	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 (WxH) (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) (WxH)	W 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 3.0x2.0x	- 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 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	OPEN CONC./NATURAL	- Capacity (kVA)	75 x 3
pesos/kWh	NO DATA	- Type		- 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 9.2x4.4x2.9	- Connection	110
		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 (WxH) (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) (WxH)	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		- Number of Gates	2	- Type	ONAN, OUTDOOR
1,000 pesos/kw	NO DATA	7. Headrace		- Capacity (kVA)	430 x 3
pesos/kwh	NO DATA	- Type	TUNNEL CONC. "U"	- Primary Voltage (kV)	2,3
11. Others		- Dimensions (m) [W x H]	W L H 2.2 x 1.1	- 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) (φ x L)	φ = 1.0 L = 353.4	4. Others	
		- Number of Lines	1	#1, 2 Units: Operating	
		10. Dimensions of Tailrace (W x H) (m)	W H 2 x 1.85 x 1.4		

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

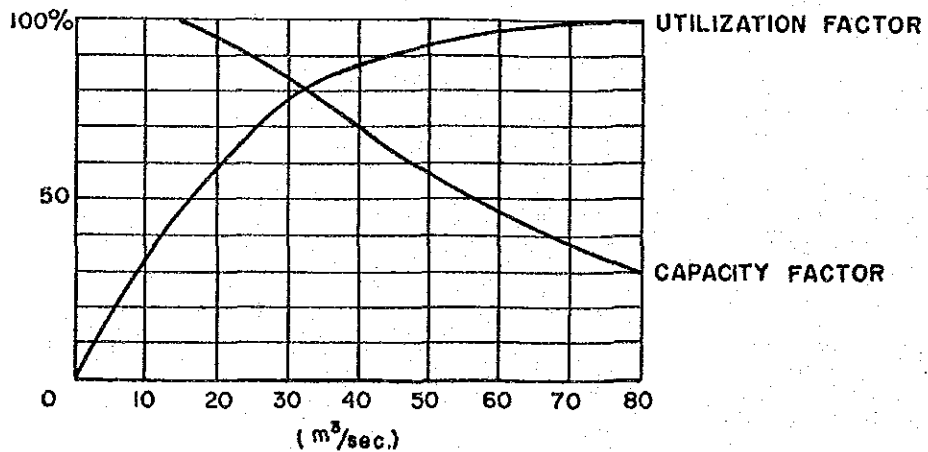
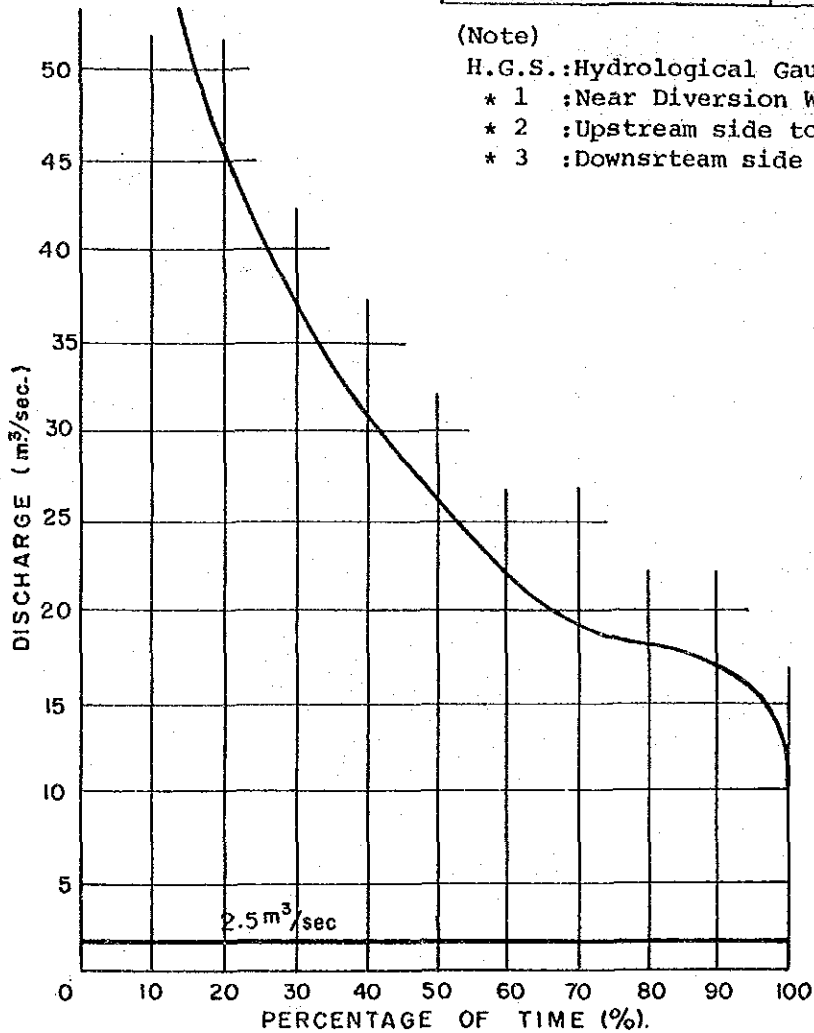
(Note)

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 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	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)	15	- Type		- Manufacturing Year	1947 1938
- Plenty Water Discharge		- Height (m)	2.9	- Type	FRANCIS FRANCIS
- Ordinary Water Discharge		- Crest Length (m)	18.0	- Output (kW)	450 EHP NO NAME PLATE
- Low Water Discharge		- Elevation of overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	900 NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	18.0	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	- Depth of overflowing (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	NON	2. Generator	
4. Firm Discharge (m ³ /s)	1.5	- Dimensions (WxH) (m)	NON	- Manufacturing Year	
5. Head (m)		- Number of Gates	NON	- Type	SYN. SYN.
- Headwater Level (EL)	2,004	3. Intake		- Number of Generator	1 1
- Tailwater Level (EL)	1,955	- Elevation of Intake Sill (m)	UNKNOWN	- Capacity (kVA)	312 260
- Gross Head	49	- Dimensions (m) (WxH)	2.1 x 2.5	- Power Factor (%)	80 80
- Head Loss	UNKNOWN	- Number of Intake	1	- Voltage (V)	400 400
- 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)	3.0x1.50x3.8	- Revolution (rpm)	900 900-1,500
7. Plant Capacity (kW)	458	6. Intake Gate		3. Transformer	
8. Output (MWh)	UNKNOWN	- Type	SLUICE	- Manufacturing Year	1975
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	0.9 x 2.0	- Type	ONAN, OUTDOOR
10. Unit Price 1,000 pesos/kw	NO DATA	- Number of Gates	2	- Capacity (kVA)	500
pesos/kwh	NO DATA	7. Headrace		- Primary Voltage (V)	480
11. Others		- Type	OPEN	- Secondary Voltage (kV)	13.8
		- Dimensions (m) [W x H]	W 1.8 ~ 2.2 H 1.5 ~ 1.8	- Number of Phase	3
		- Length (m)	1,500	- Connection	NO NAME PLATE
		8. Dimensions of Water Reservoir (m)	W L H 1.8x8.0x3.0	- Number	1
		9. Penstock		Continuous Stand-by	0
		- Dimensions (m) (φ x L)	φ = 0.6, φ+0.75 L = 108	4. Others	#1 Unit: Operating
		- Number of Lines	2		#2 Unit: Stopped (Under repair)
		10. Dimensions of Tailrace [W x H] (m)	W H 2 x 1.5 x 3.5		

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

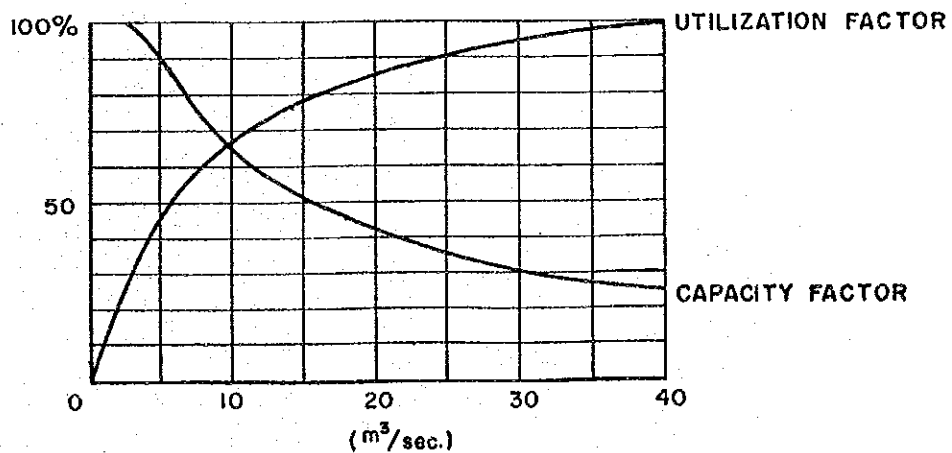
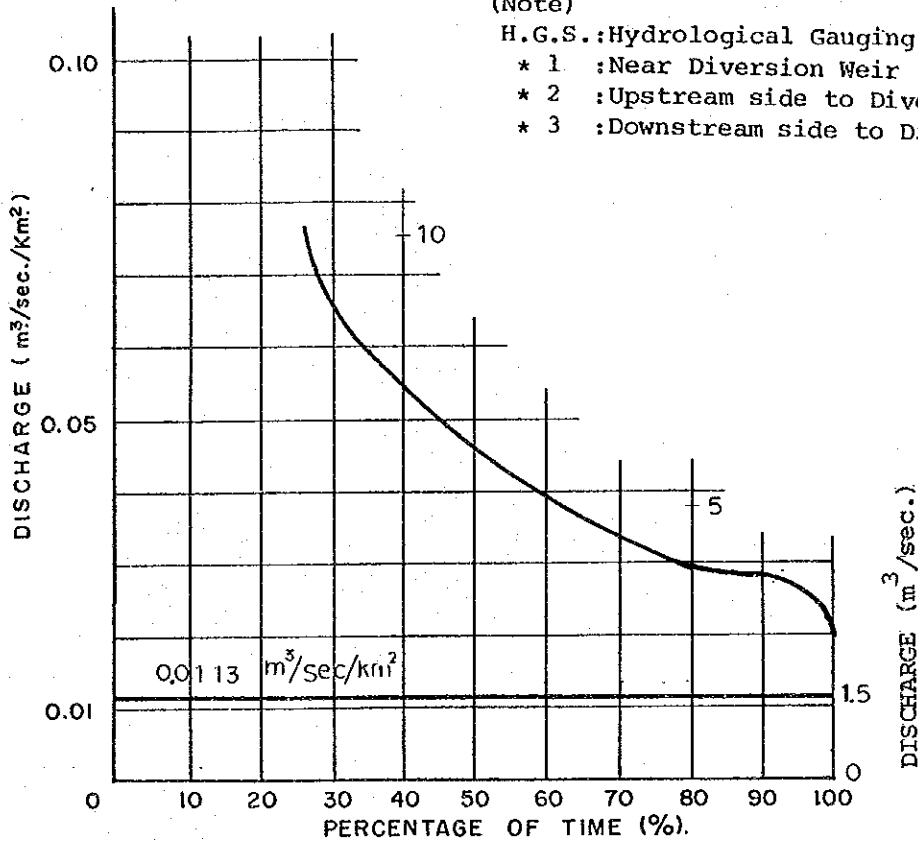
(Note)

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 ($Q \doteq 3.5 \text{ m}^3/\text{s}$).
- 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	NO DATA	- Crest Length (m)	29.5	- Output (kW)	5,750 C.V.
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	900
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	29.5	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	NOT CONFIRMED	- Regulating Valve	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	- Regulating Valve Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	W x H	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.0	- Number of Gates	2	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	2,316	- Elevation of Intake Sill (m)	2,310.5	- Type	SYN.
- Tailwater Level (EL)	1,780	- Dimensions (m) (WxH)	NOT CONFIRMED	- Number of Generator	1
- Gross Head	536	- Number of Intake	NOT CONFIRMED	- Capacity (kVA)	4,500
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NOT CONFIRMED	- Power Factor (%)	80
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Voltage (V)	6,600
6. Efficiency (%)	UNKNOWN	6. Intake Gate	SLUICE	- Frequency (Hz)	60
7. Plant Capacity (kW)	3,600	- Type		- Revolution (rpm)	900
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	2	- Manufacturing Year	1961
10. Unit Price 1,000 pesos/kW	NO DATA	7. Headrace		- Type	ONAN, OUTDOOR
pesos/kwh	NO DATA	- Type	BOX CALVERT	- Capacity (kVA)	4,500
11. Others		- Dimensions (m) (W x H)	W H 2.0 x 2.0	- Primary Voltage (V)	6,600
		- Length (m)	710	- Secondary Voltage (kV)	44
		8. Dimensions of Water Reservoir (m)	NON	- Number of Phase	3
		9. Penstock		- Connection	Δ/Δ
		- Dimensions (m) (φ x L)	φ = 0.8 L = 925	- Number	1
		- Number of Lines	1	Continuous Stand-by	0
		10. Dimensions of Tailrace (W x H) (m)	W H 1.8 x 2.2	4. Others	Operating

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

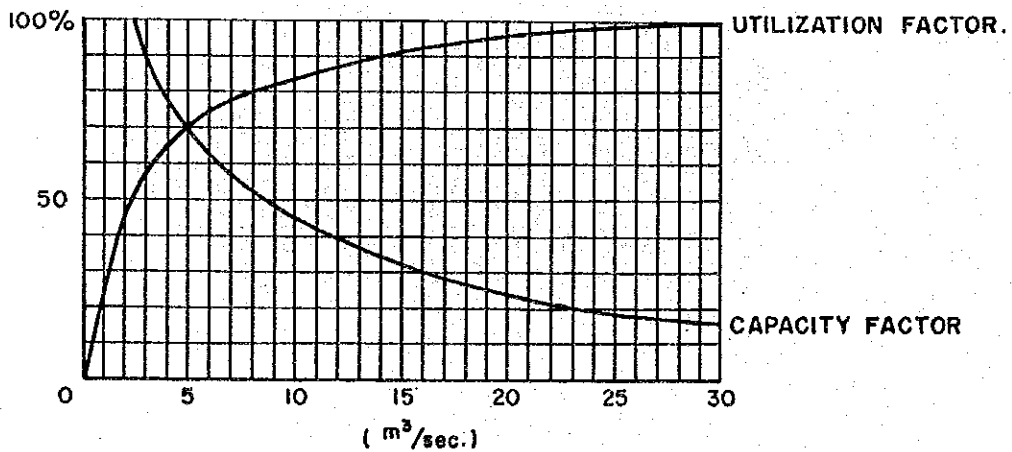
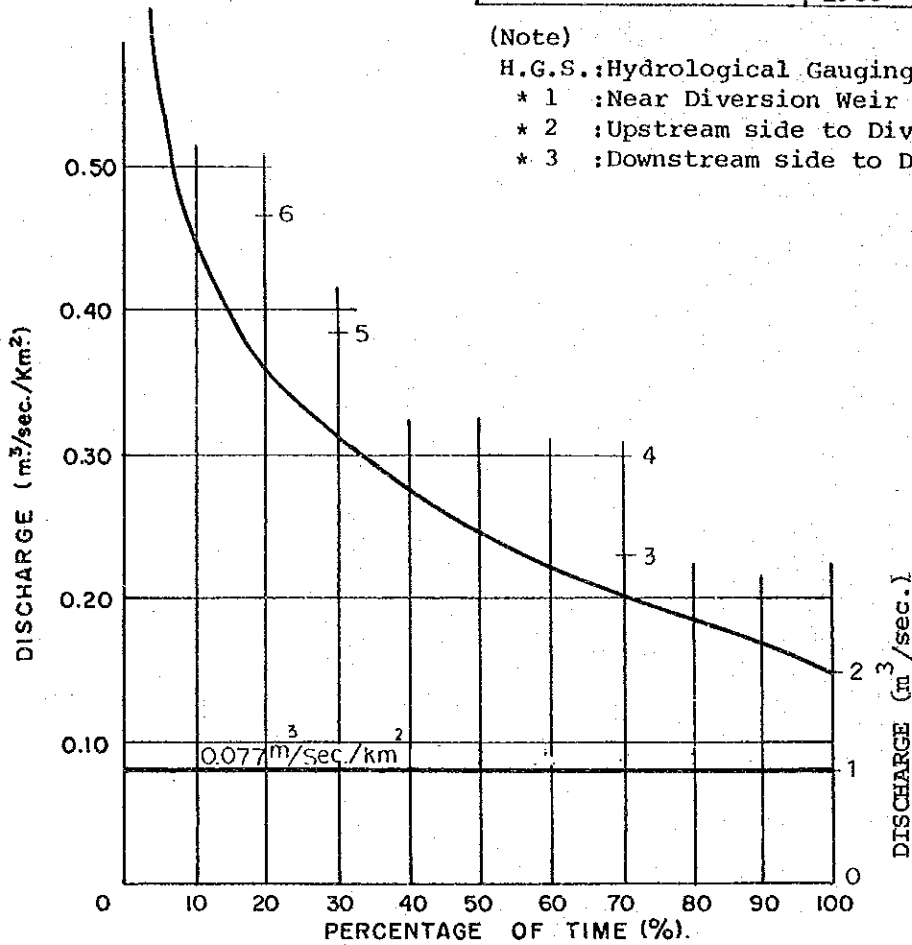
NO. 206 SONSON

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



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	6.0	- Manufacturing Year	1928	1951	1961
- Plenty Water Discharge	NO DATA	- Height (m)	25.0	- Type	PELTON	PELTON	PELTON
- Ordinary Water Discharge	30.0	- Crest Length (m)	UNKNOWN	- Output (kW)	BHP		
- Low Water Discharge	NO DATA	- Elevation of over-flowing Crest (m)	25.0	- Revolution (rpm)	750		
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	0.10	- Type of Governor	NO NAME	NO NAME	NO NAME
- Minimum	NO DATA	2. Sand Trap Gate		- Regulating Valve	PLATE	PLATE	PLATE
- Mean	NO DATA	- Type	SLUICE	- Type	NO NAME	NO NAME	NO NAME
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NOT CONFIRMED	- Dimension (mm)	PLATE	PLATE	PLATE
4. Firm Discharge (m ³ /s)	1.2	- Number of Gates	1	2. Generator	NO NAME	NO NAME	NO NAME
5. Head (m)		3. Intake		- Manufacturing Year	PLATE	PLATE	PLATE
- Headwater Level (EL)	1,762	- Elevation of Intake Sill (m)	UNKNOWN	- Type	NO NAME	NO NAME	NO NAME
- Tailwater Level (EL)	1,595	- Dimensions (m) (WxH)	W H	- Number of Generator	PLATE	PLATE	PLATE
- Gross Head	167	- Number of Intake	4.0 x 1	- Capacity (kVA)	NO NAME	NO NAME	NO NAME
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	PLATE	PLATE	PLATE
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H	- Voltage (V)	NO NAME	NO NAME	NO NAME
6. Efficiency (%)	UNKNOWN		4.0x19.0x3.1	- Frequency (Hz)	PLATE	PLATE	PLATE
7. Plant Capacity (kW)	1,508	6. Intake Gate		- Revolution (rpm)	NO NAME	NO NAME	NO NAME
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/kW	NO DATA	- Number of Gates	1.5 x 2.5	- Type	ONAN	ONAF	ONAF
pesos/kWh	NO DATA	7. Headrace	1	- Capacity (kVA)	INDOOR	INDOOR	OUTDOOR
11. Others		- Type	OPEN	- Primary Voltage (kV)	625	625	13,300
		- Dimensions (m) [W x H]	W H	- Secondary Voltage (kV)	6	.48	.48
		- Length (m)	1.30 x 0.8	- Number of Phase	13.7	14.38	13.7
		8. Dimensions of Water Reservoir (m)	W L H	- Connection	44		
			2x2.5x4.0x3.0	- Number	3	3	3
		9. Penstock		- Continuous Stand-by	1	1	1
		- Dimensions (m) (φ x L)	φ = 0.4, 0.75	4. Others	0	0	0
		- Number of Lines	L = 287				
		10. Dimensions of Tailrace [W x H] (m)	W H				
			2 x 1.0 x 1.3				

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

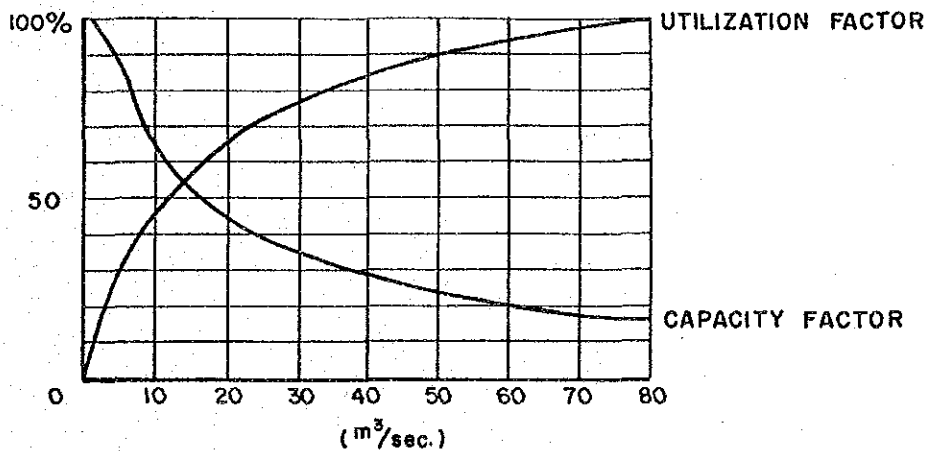
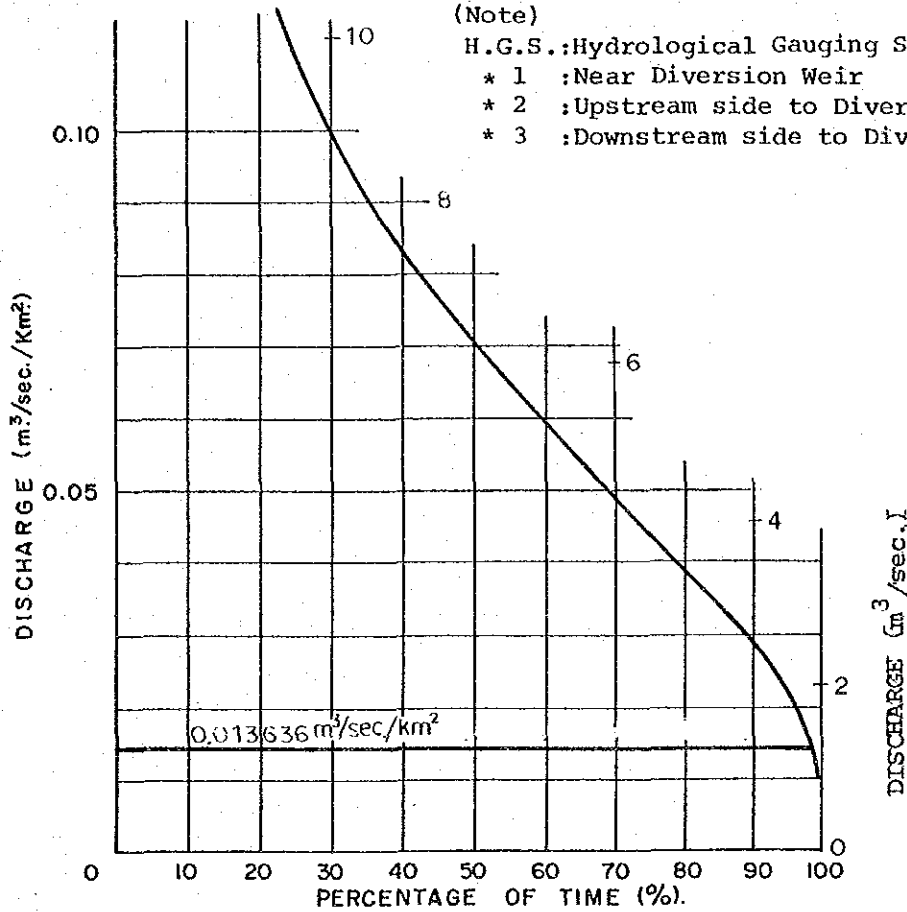
(Note)

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 vult-increase work 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	ANTIOQUITA		
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	
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 (WxH) (m)	NON	2. Generator	
5. Head (m)		- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	SYN 1 SYN 1
- Gross Head	70	- Dimensions (m) (WxH)	W 1.3 x H 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 10.0 x L 18.0 x H 3.0	- 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 1.1 x H 0.9	- Manufacturing Year	1976
10. Unit Price		- Number of Gates	1	- Type	ONAN ONAN
1,000 pesos/kW	NO DATA	7. Headrace		- Capacity (kVA)	275 800
pesos/kWh	NO DATA	- Type	TUNNEL OPEN	- Primary Voltage (V)	2,300 440
11. Others		- Dimensions (m) (W x H)	W 1.4 ~ 2.0 H 1.3 ~ 1.2	- Secondary Voltage (kV)	13.2 13.2
		- Length (m)	1,500	- Number of Phase	3 3
		8. Dimensions of Water Reservoir (m)	W 6.0 x L 15.0 x H 3.0	- Connection	Y/Y Δ/Y
		9. Penstock		- Number	1 1
		- Dimensions (m) (φ x L)	φ = 0.55, 0.75 L = 80	Continuous Stand-by	0 0
		- Number of Lines	2	4. Others	#1, 2 Unit: Stopped
		10. Dimensions of Tailrace (W x H) (m)	W 2 x H 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 - Type	OVERFLOW CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Height (m)	3.0	- Manufacturing Year	1960 1951
- Plenty Water Discharge	NO DATA	- Crest Length (m)	15.0	- Type	PELTON PELTON
- Ordinary Water Discharge	5.0	- Elevation of overflowing Crest (m)		- Output (kW)	NO NAME PLATE NO NAME PLATE
- Low Water Discharge	NO DATA	- Width of overflowing Crest (m)	15.0	- Revolution (rpm)	NO NAME PLATE NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Depth of overflowing (m)	0.3	- Type of Governor	NO NAME PLATE NO NAME PLATE
- Minimum	NO DATA	2. Sand Trap Gate		- Regulating Valve	NO NAME PLATE NO NAME PLATE
- Mean	NO DATA	- Type	NON	Type	NO NAME PLATE NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	NON	Dimension (mm)	NO NAME PLATE NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.0	- Number of Gates	NON	2. Generator	
5. Head (m)	1,575	3. Intake		- Manufacturing Year	
- Headwater Level (EL)		- Elevation of Intake Sill (m)	UNKNOWN	- Type	SYN. SYN.
- Tailwater Level (EL)	1,440	- Dimensions (m) (WxH)	W L 0.9 x 1.0	- Number of Generator	1 1
- Gross Head	135	- Number of Intake	1	- Capacity (kVA)	660 245
- 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 3.5x15.0x1.8	- Voltage (V)	400. 400.
6. Efficiency (%)	UNKNOWN	6. Intake Gate	NON	- Frequency (Hz)	60. 60
7. Plant Capacity (kW)	724	- Type		- Revolution (rpm)	600 900
8. Output (MWh)	UNKNOWN	- Dimensions (m) (W x H)	NON	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	NON	- Manufacturing Year	
10. Unit Price 1,000 pesos/kw	NO DATA	7. Headrace		- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	- Type	OPEN	- Capacity (kVA)	NAME PLATE WAS MISSING
11. Others		- Dimensions (m) (W x H)	W 0.85 ~ 2.0 H 1.0	- Primary Voltage (kV)	NAME PLATE WAS MISSING
		- Length (m)	300	- Secondary Voltage (kV)	NAME PLATE WAS MISSING
		8. Dimensions of Water Reservoir (m)	W L H 1.8x6.75x3.0	- Number of Phase	NAME PLATE WAS MISSING
		9. Penstock		- Connection	NAME PLATE WAS MISSING
		- Dimensions (m) (φ x L)	φ = 0.6 L = 320.0	- Number	2
		- Number of Lines	1	Continuous Stand-by	0
		10. Dimensions of Tailrace (W x H) (m)	W H 2 x 0.64 x 0.66	4. Others	#1, 2 Unit: Operating

No. 209 Abejorral

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 Discharge	NO DATA	- Depth of Over-flowing (m)		- Regulating Valve	
- Mean Discharge	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 (1,000 pesos/kWh)	NO DATA	- Number of Gates	2	- Type	ONAN
11. Others	NO DATA	7. Headrace		- Capacity (kVA)	800 x 2
		- Type	CHANNEL	- Primary Voltage (V)	240/139
		- 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)			

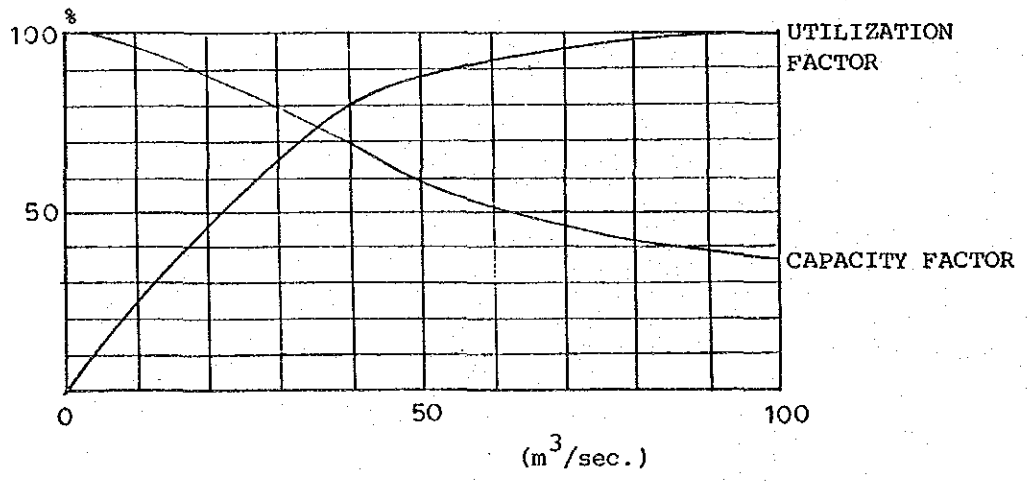
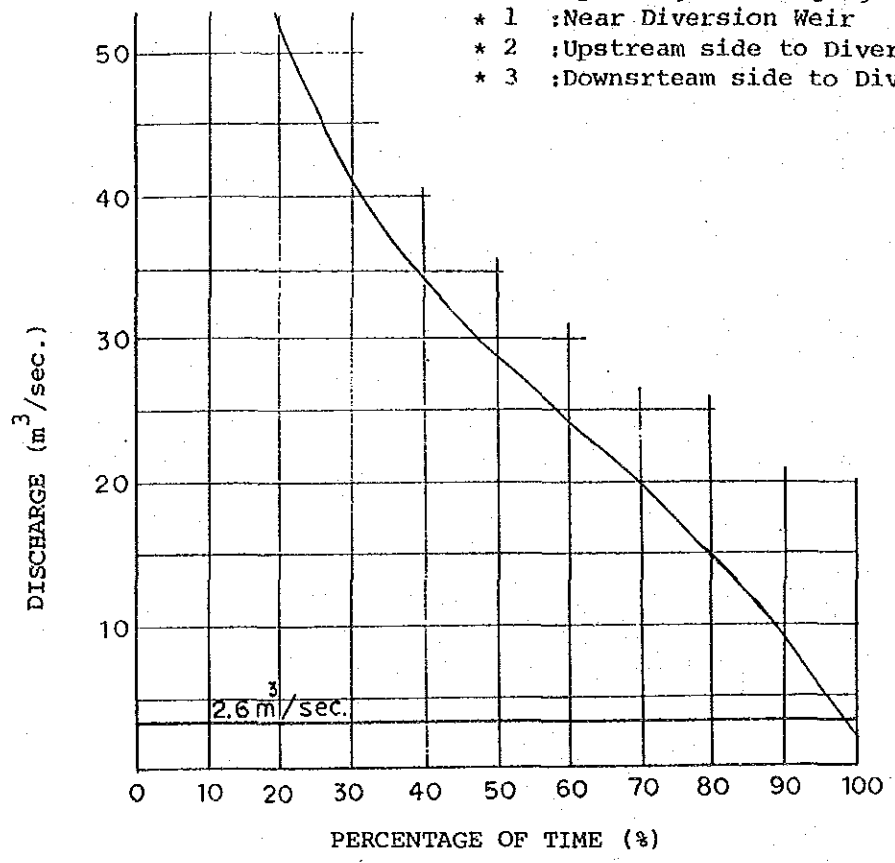
FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

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

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

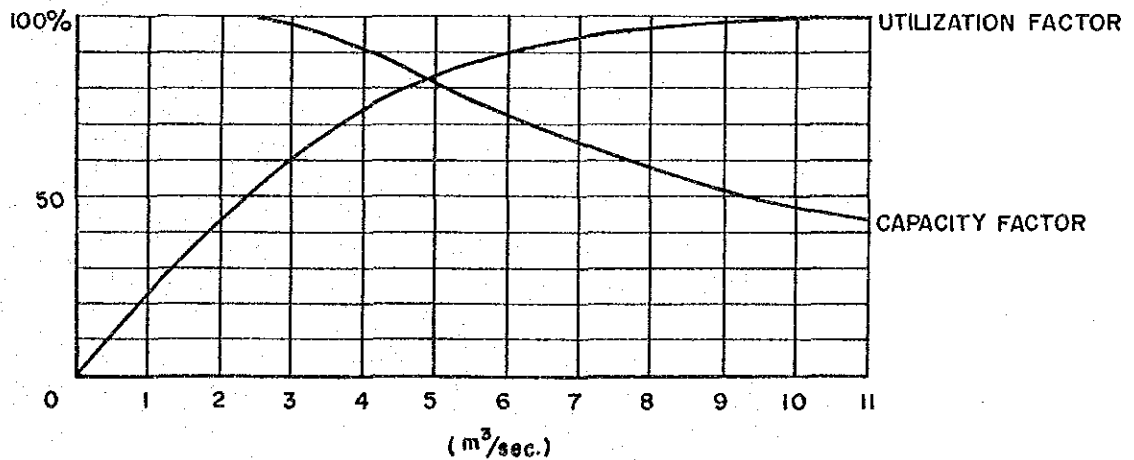
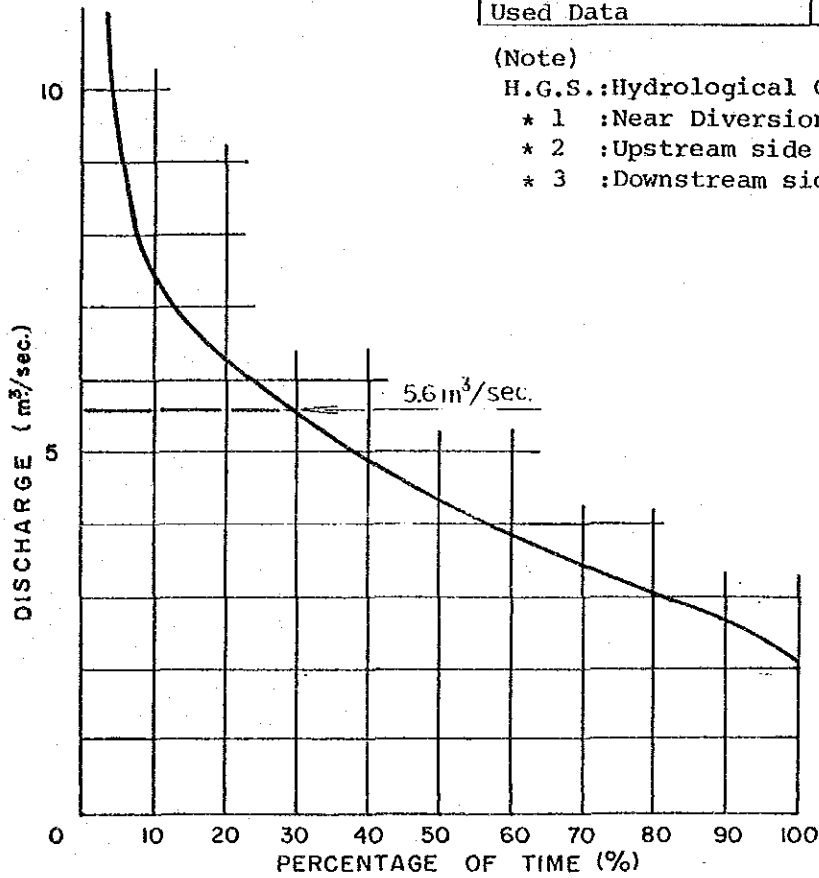
(Note)

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	CHEC	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/kw	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 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	N/A
		- Dimensions (m) (φ x L)	φ = 1.24 L = 153.0	Continuous Stand-by	N/A
		- Number of Lines	1	4. Others	Stopped
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

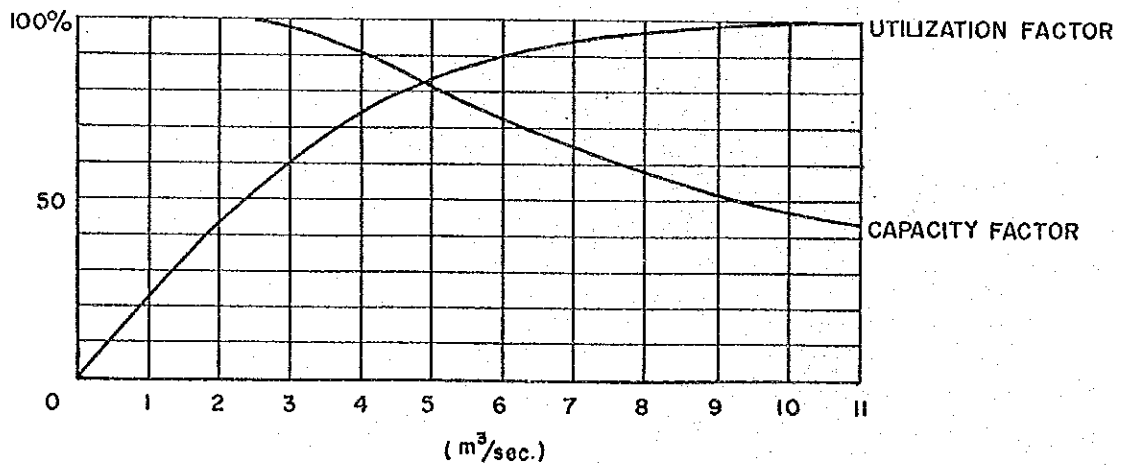
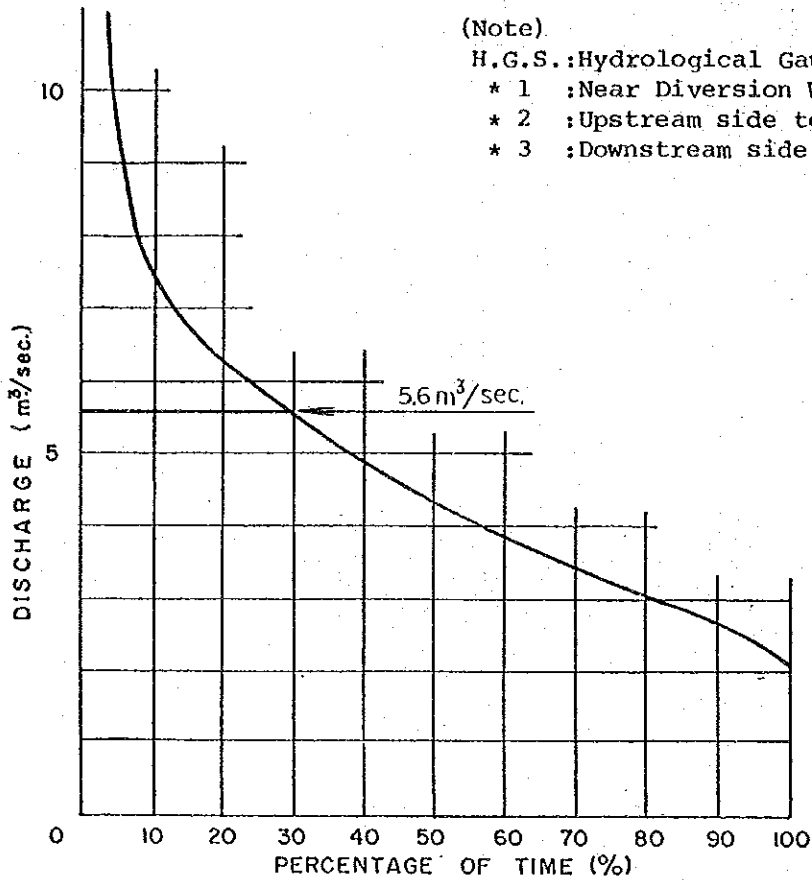
NO. 212 INTERMEDIA

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 setting 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
- Droughty 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 Type	NO NAME PLATE
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	Dimension (mm)	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	NOT CONFIRMED	2. Generator	
4. Firm Discharge (m ³ /s)	5.6	- Dimensions (WxH) (m)	2	- Manufacturing Year	
5. Head (m)	799.47	3. Intake	UNKNOWN	- Type	SYN.
- Headwater Level (EL)		- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	2
- Tailwater Level (EL)	719.15	- Dimensions (m) (WxH)	NOT CONFIRMED	- Capacity (kVA)	1,320 x 2
- Gross Head	80.57	- Number of Intake	2	- Power Factor (%)	80
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Voltage (v)	4,300
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Frequency (Hz)	60
6. Efficiency (%)	UNKNOWN	6. Intake Gate		- Revolution (rpm)	360
7. Plant Capacity (kW)	2,112	- Type	SLUICE	3. Transformer	
8. Output (Mwh)	UNKNOWN	- Dimensions (m) [W x H]	NOT CONFIRMED	- Manufacturing Year	ONAN ONAN
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Type	OUTDOOR OUTDOOR
10. Unit Price 1,000 pesos/kW	NO DATA	7. Headrace		- Capacity (kVA)	900 NO NAME PLATE
pesos/kWh	NO DATA	- Type	OPEN	- Primary Voltage (V)	4,300 4,160
11. Others		- Dimensions (m) [W x H]	W H 2.2 x 1.8	- Secondary Voltage (kV)	13.2 NO NAME PLATE
		- Length (m)	4,500	- Number of Phase	1 NO NAME PLATE
		8. Dimensions of Water Reservoir (m)	W L x H 13.0x26.0x3.0	- Connection	NO NAME PLATE NO NAME PLATE
		9. Penstock	φ = 1.52 L = 168	- Number	3 1
		- Dimensions (m) (φ x L)		Continuous Stand-by	0 0
		- 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

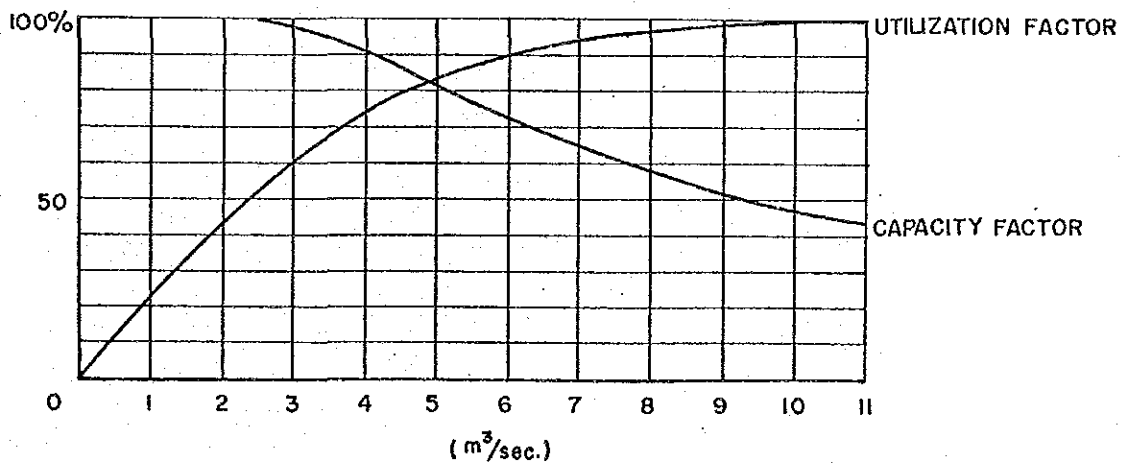
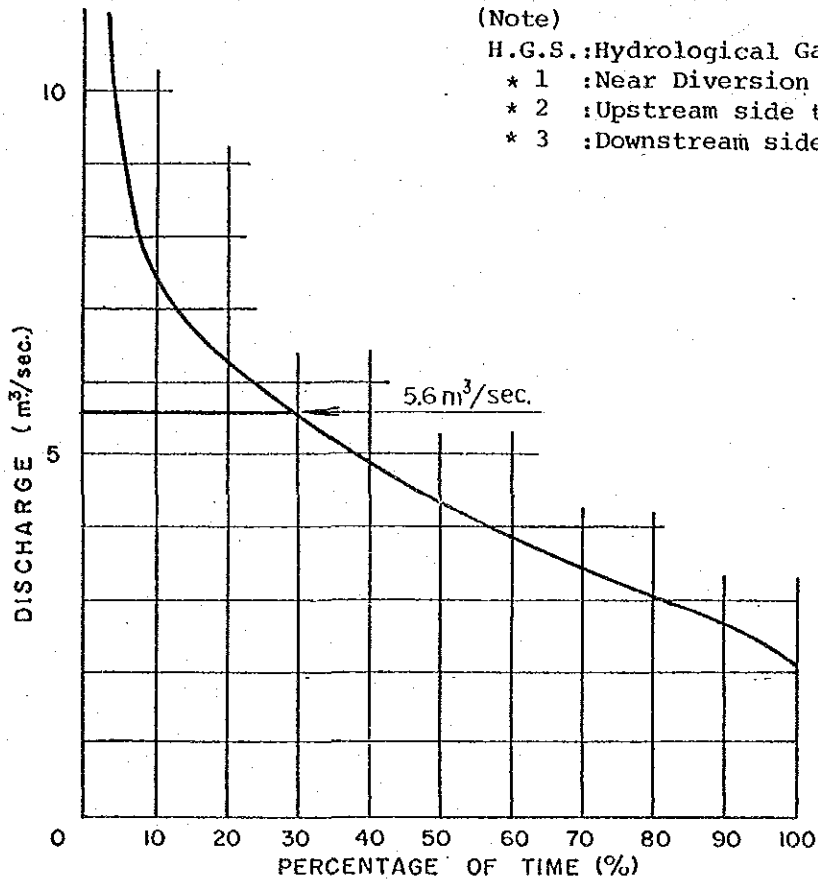
NO. 213 MUNICIPAL

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



No. 213 Municipal

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
- Droughty 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	SLUICE	- Type	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Dimensions (WxH) (m)	W H 2.1 x	- Dimension (mm)	NO NAME PLATE
4. Firm Discharge (m ³ /s)	4.0	- Number of Gates	1	2. Generator	
5. Head (m)		3. Intake		- Manufacturing Year	
- Headwater Level (EL)	1,503.22	- Elevation of Intake Sill (m)	UNKNOWN	- Type	ABANDON
- Tailwater Level (EL)	1,435.42	- Dimensions (m) (WxH)	W H 2.1 x 3.0	- Number of Generator	ABANDON
- Gross Head	67.8	- Number of Intake	1	- Capacity (kVA)	ABANDON (ICEL 1,120 kW)
- Head Loss	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Power Factor (%)	ABANDON
- Net Head	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 16.9 x 26.1 x 3.2	- Voltage (kV)	ABANDON (4.16)
6. Efficiency (%)	UNKNOWN	6. Intake Gate	SLUICE	- Frequency (Hz)	ABANDON
7. Plant Capacity (kW)	0	- Type		- Revolution (rpm)	ABANDON
8. Output (MWh)	UNKNOWN	- Dimensions (m) [W x H]	W H 2.1 x 1.95	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Number of Gates	1	- Manufacturing Year	
10. Unit Price 1,000 pesos/kWh	NO DATA	7. Headrace		- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	- Type	TUNNEL OPEN	- Capacity (kVA)	150 x 2
11. Others		- Dimensions (m) [W x H]	W H 1.4 x 1.5	- Primary Voltage (V)	4,160
		- Length (m)	3,500	- Secondary Voltage (kV)	33
		8. Dimensions of Water Reservoir (m)	W H L 12.0x28.0x3.0	- Number of Phase	1
		9. Penstock	φ = 1.24 L = 125	- Connection	NO NAME PLATE
		- Dimensions (m) (φ x L)		- Number	2
		- Number of Lines	1	Continuous Stand-by	0
		10. Dimensions of Tailrace [W x H] (m)	NOT CONFIRMED	4. Others	Stopped (Gen. was burned)

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

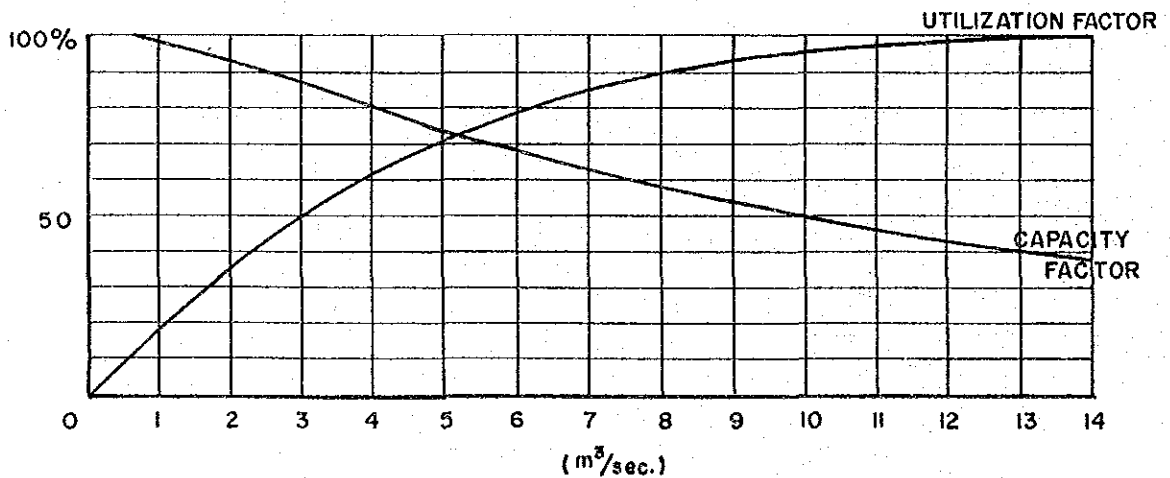
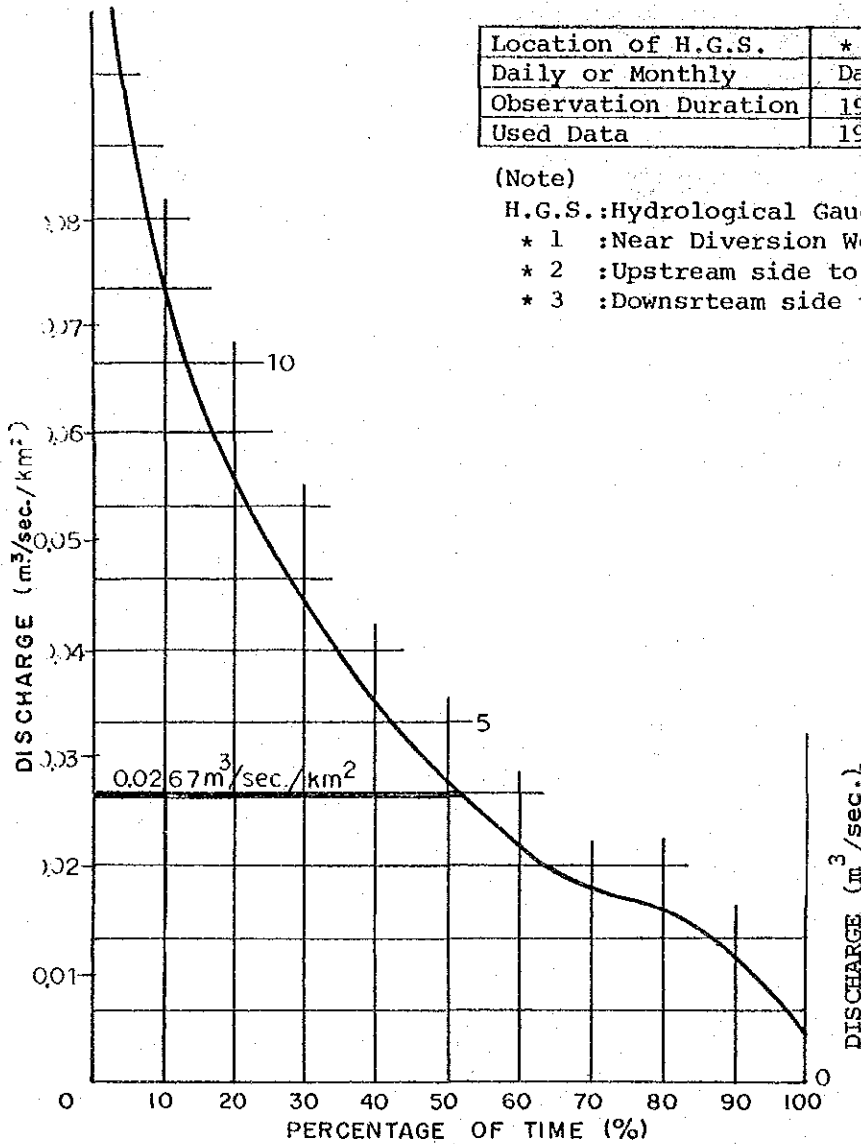
NO. 214 GUACAICA

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

No. 215 Salamina

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 (WxH) (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) (WxH)		- 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/kW		- 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 overflowing 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		Type	
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	Dimension (mm)	NO NAME PLATE
		- Dimensions (WxH) (m)	W H 3.0 x		
		- Number of Gates	1		
4. Firm Discharge (m ³ /s)	6.0	3. Intake		2. Generator	
5. Head (m)		- Elevation of Intake Sill (m)	UNKNOWN	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	- Dimensions (m) (WxH)	W H 4.0 x	- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Number of Intake	1	- Number of Generator	2
- Gross Head	115	4. Dimensions of Forebay (m)	NON	- Capacity (kVA)	2,350 x 2
- Head Loss	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 6.0x47.0x	- Power Factor (%)	80.
- Net Head	UNKNOWN	6. Intake Gate		- Voltage (V)	2,400
6. Efficiency (%)	UNKNOWN	- Type	SLUICE	- Frequency (Hz)	60
7. Plant Capacity (kW)	3,760	- Dimensions (m) (W x H)	W H 1.6 x	- Revolution (rpm)	450
8. Output (MWh)	UNKNOWN	- Number of Gates	2	3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	7. Headrace		- Manufacturing Year	ONAN 1952 ONAN
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Type	TUNNEL OPEN	- Type	ONAN OUTDOOR ONAN OUTDOOR
pesos/kWh	NO DATA	- Dimensions (m) (W x H)	W H 2.7 x 2.65	- Capacity (kVA)	1,600 x 3 700 x 3
		- Length (m)	4,500	- Primary Voltage (V)	2,400 2,400
11. Others		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Secondary Voltage (kV)	17.325 13.1
		9. Penstock		- Number of Phase	1 1
		- Dimensions (m) (φ x L)	φ = 1.38 L = 288.0	- Connection	NO NAME PLATE
		- Number of Lines	2	- Number	3 3
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRMED	Continuous Stand-by	0 0
				4. Others	#1, 2 Unit: Operating

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

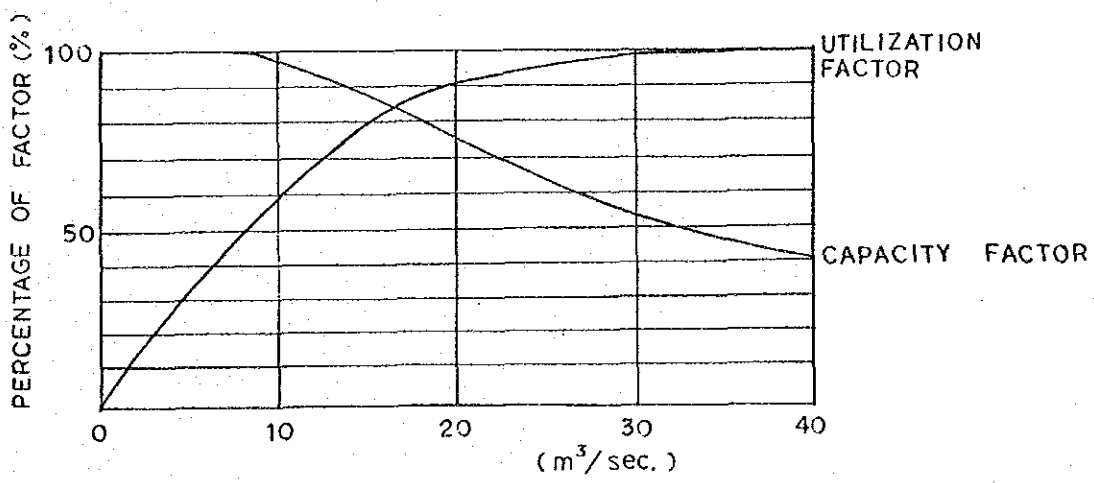
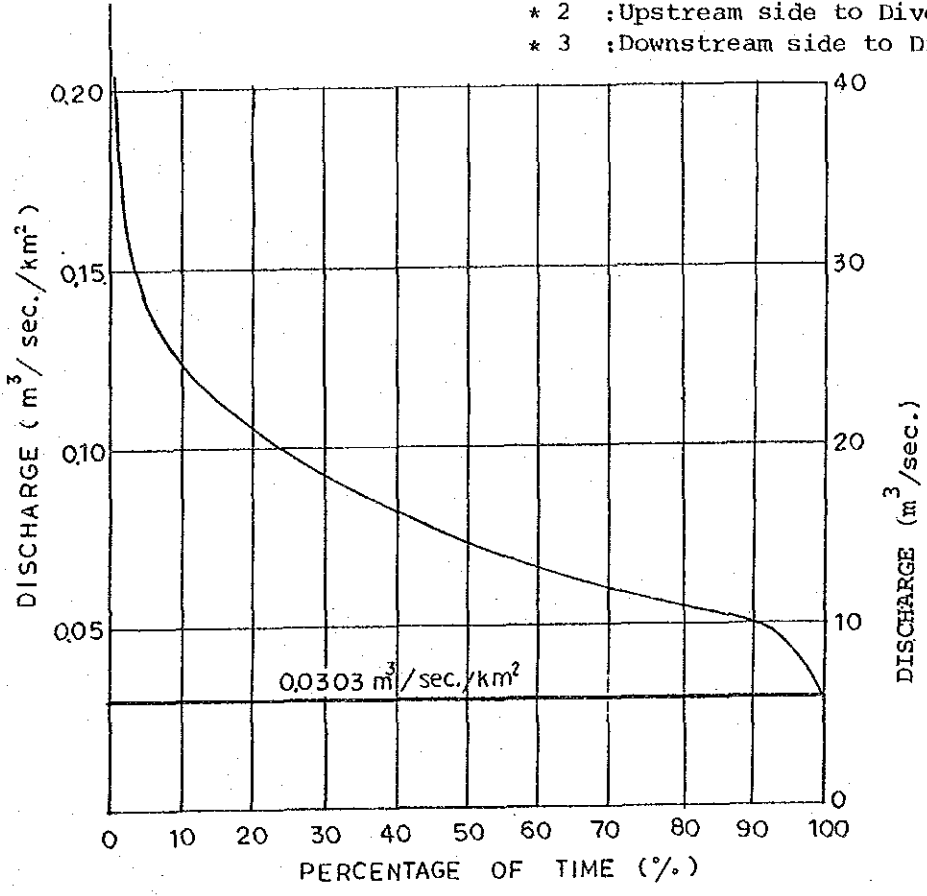
NO. 217 BELMONTE

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 PEREIRA (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 over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- 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	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/kW	NO DATA	- Number of Gates	3	- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	7. Headrace		- Capacity (kVA)	5,000
11. Others		- 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

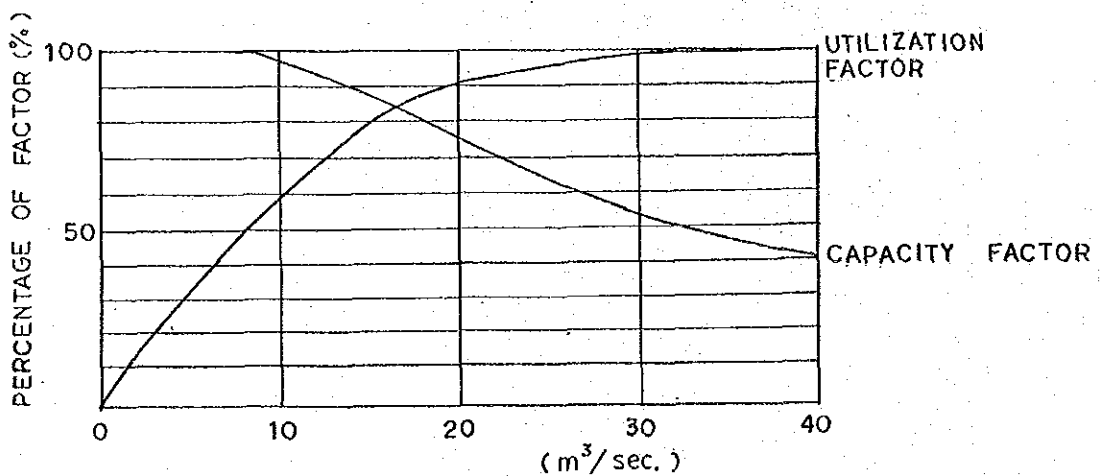
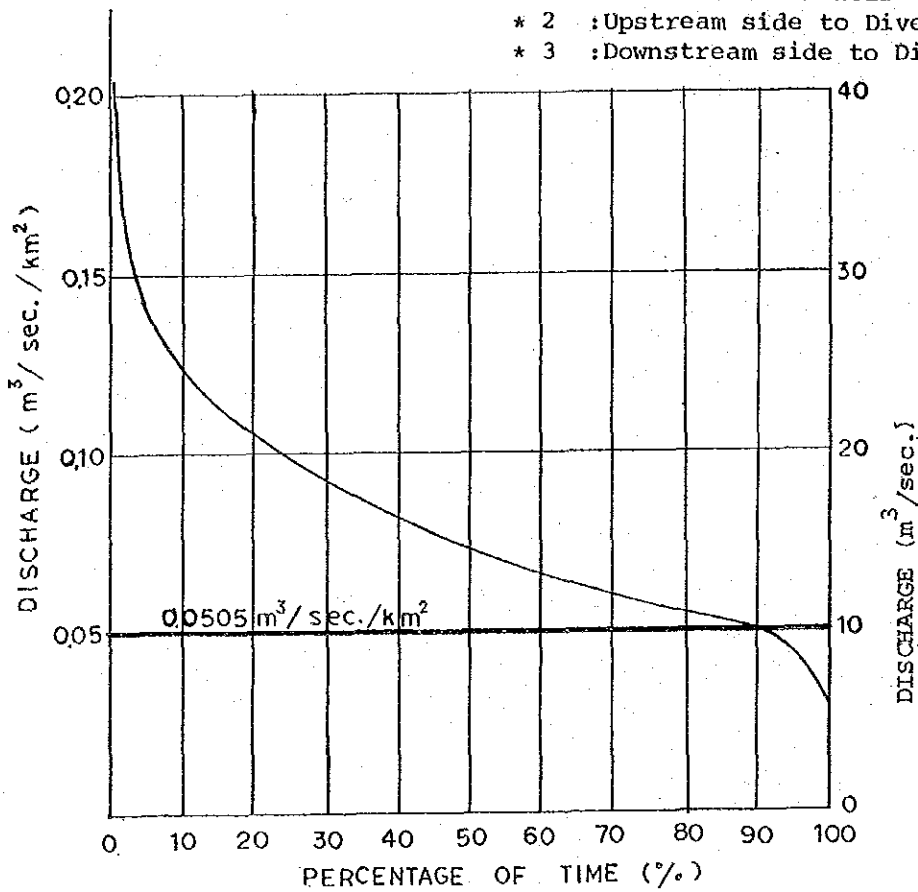
NO. 218 DOS QUEBRADAS

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 CONCRETE	1. Turbine	#1 #2
2. Volume of Discharge (m ³ /s)		- Type		- 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 over-flowing 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 Discharge	NO DATA	- Depth of Over-flowing (m)	UNKNOWN		
- Mean	NO DATA	2. Sand Trap Gate	SLUICE	- Regulating Valve	
3. Utilizable Flow (m ³ /s)	NO DATA	- Type		Type	NO NAME PLATE
4. Firm Discharge (m ³ /s)	1.2	- Dimensions (WxH) (m)	W H 1.2 x 1.6	Dimension (mm)	NO NAME PLATE
5. Head (m)		- Number of Gates	1		
- Headwater Level (EL)	1,760.6	3. Intake		2. Generator	
- Tailwater Level (EL)	1,705.6	- Elevation of Intake Sill (m)	UNKNOWN	- Manufacturing Year	
- Gross Head	55.0	- Dimensions (m) (WxH)	W H 1.8 x 2.0	- Type	SYN. SYN.
- Head Loss	UNKNOWN	- Number of Intake	1	- Number of Generator	1 1
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Capacity (kVA)	312 150
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	W L H 10.0x10.0x4.0	- Power Factor (%)	80 80
7. Plant Capacity (kW)	450	6. Intake Gate		- Voltage (V)	2,400 2,400
8. Output (MWh)	UNKNOWN	- Type	SLUICE	- Frequency (Hz)	60 60
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H 1.7 x 1.6	- Revolution (rpm)	360 1,200
10. Unit Price (1,000 pesos/kWh)	NO DATA	- Number of Gates	1	3. Transformer	
11. Others		7. Headrace	OPEN TUNNEL & BRIDGE	- Manufacturing Year	1956
		- Type		- Type	ONAN, OUTDOOR
		- Dimensions (m) (MIN) (W x H)	W H 0.8 x 0.85	- Capacity (kVA)	450
		- Length (m)	4,000	- Primary Voltage (kV)	2,400
		8. Dimensions of Water Reservoir (m)	W L H 2.5x2.9x4.0	- Secondary Voltage (kV)	4,315
		9. Penstock		- Number of Phase	3
		- Dimensions (m) (φ x L)	φ = 0.61 L = 230	- Connection	Δ/Δ
		- Number of Lines	2	- Number	1
		10. Dimensions of Tailrace (W x H) (m)	W H 1.1 x 1.5	Continuous Stand-by	0
				4. Others	#1, 2 Unit: Stopped

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

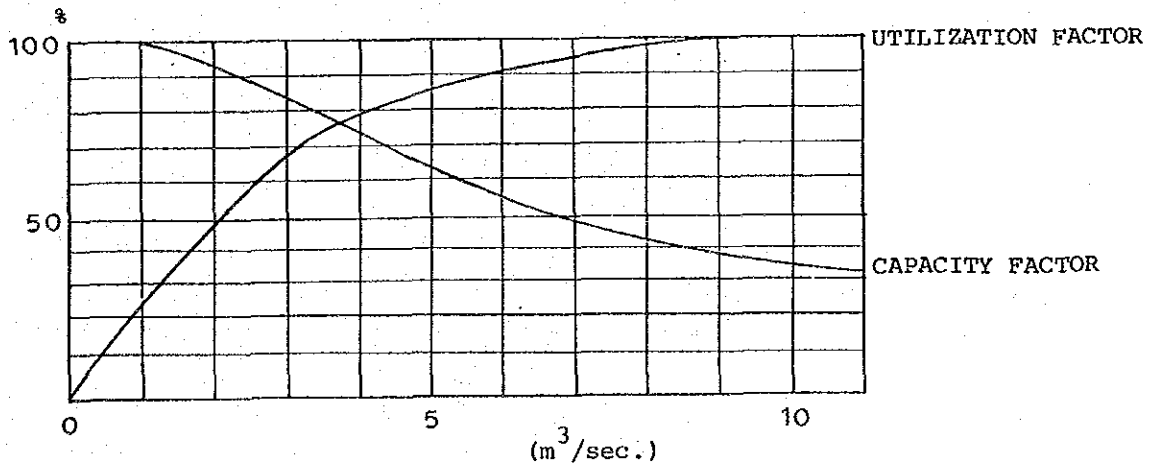
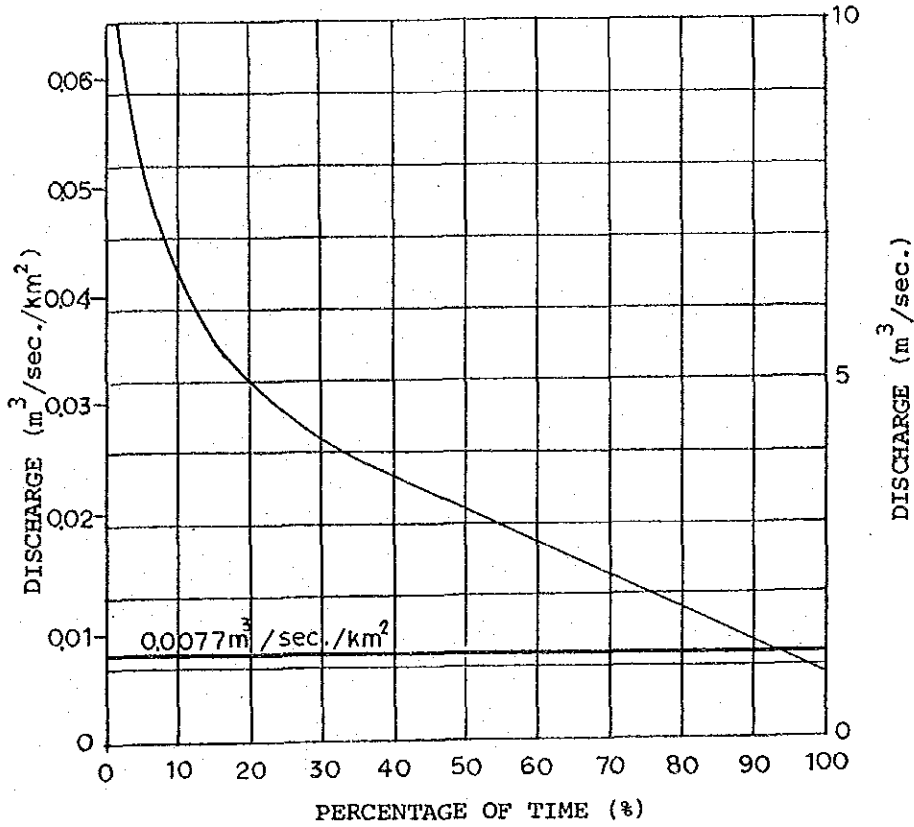
(Note)

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

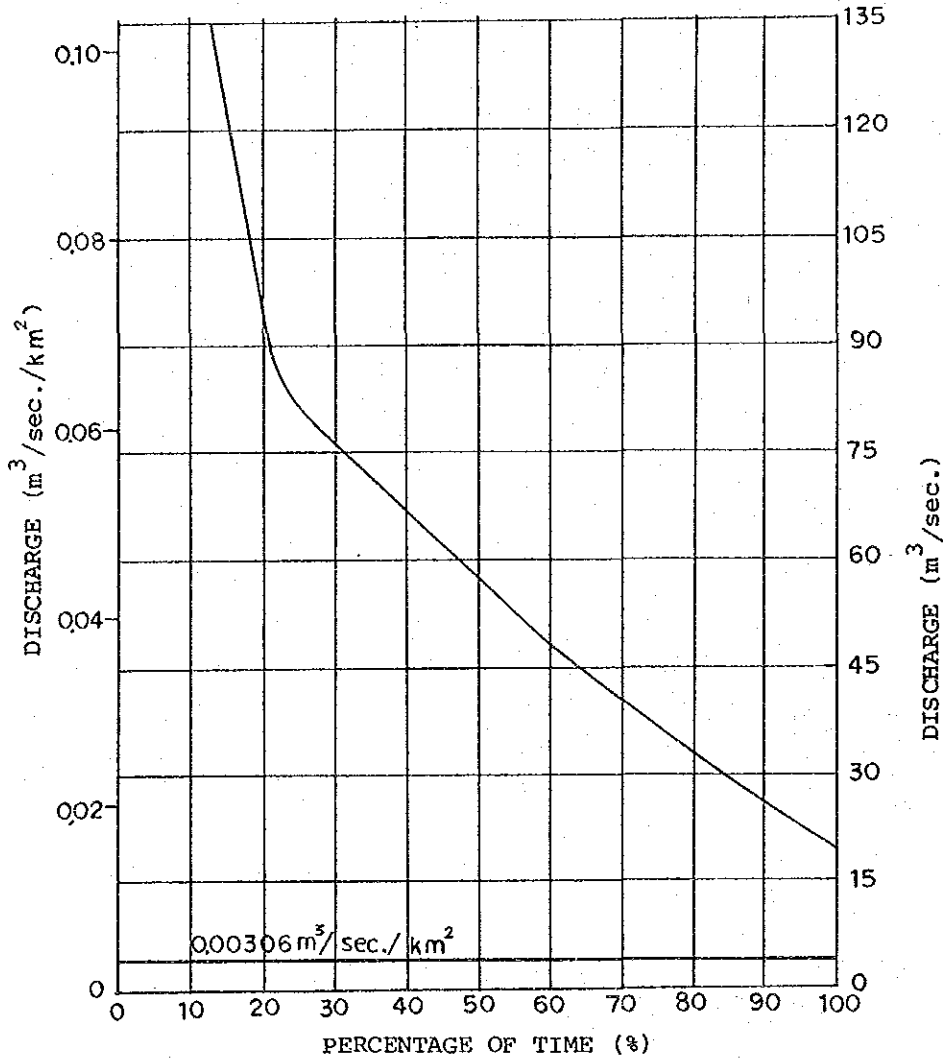
Power Plant	NO. 220 EL BOSQUE	Investigated Date	16 Feb. 1988
Electric Company	E. P. DE ARMENIA	Available Capacity (kW)	0
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1929	Service-in	

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 overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	27.0	- Type of Governor	NO NAME PLATE
- Minimum Discharge	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)	4.0	- Dimensions (WxH) (m)	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
11. Others	NO DATA	7. Headrace	OPEN	- Capacity (kVA)	950 x 3
		- 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	$\phi = 0.86$	- Number	3
		- Dimensions (m) ($\phi \times L$)	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		

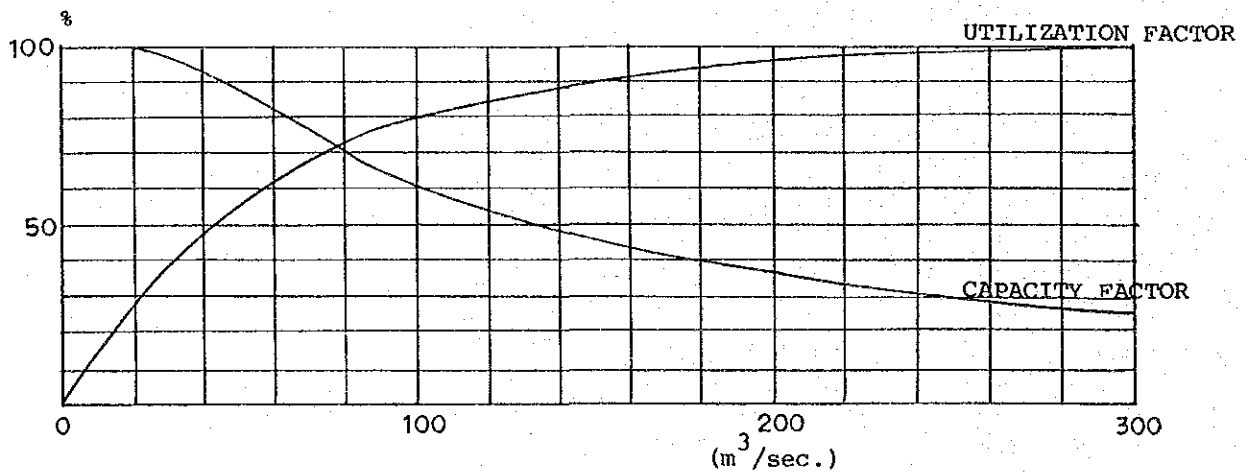
FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

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

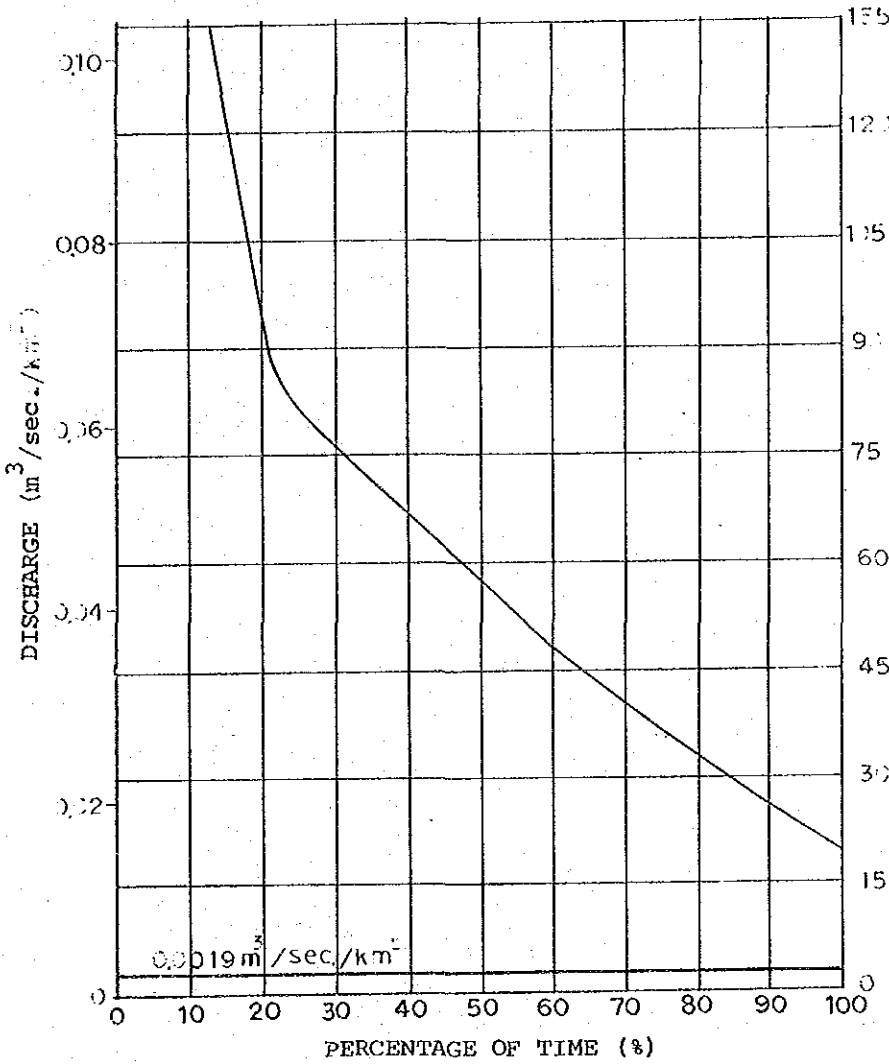
Power Plant	NO. 221 BAYONA	Investigated Date	15 Feb. 1988
Electric Company	E.P. DE CALARCA	Available Capacity (kW)	159
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1952	Service-in	

SUMMARY OF GENERATING FACILITIES

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

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

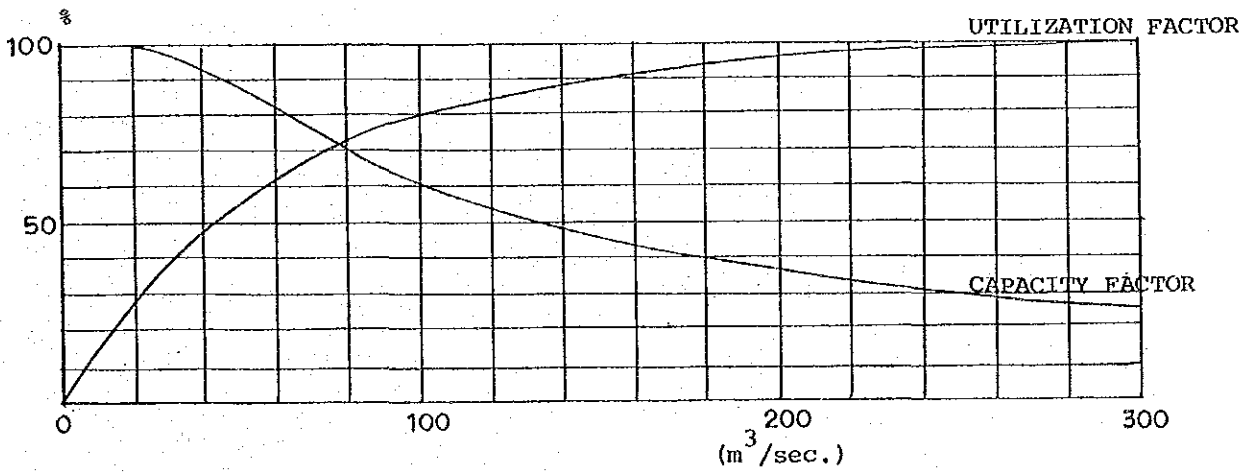
NO. 221 BAYONA



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

DISCHARGE ($m^3/sec.$)



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 Campestre 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

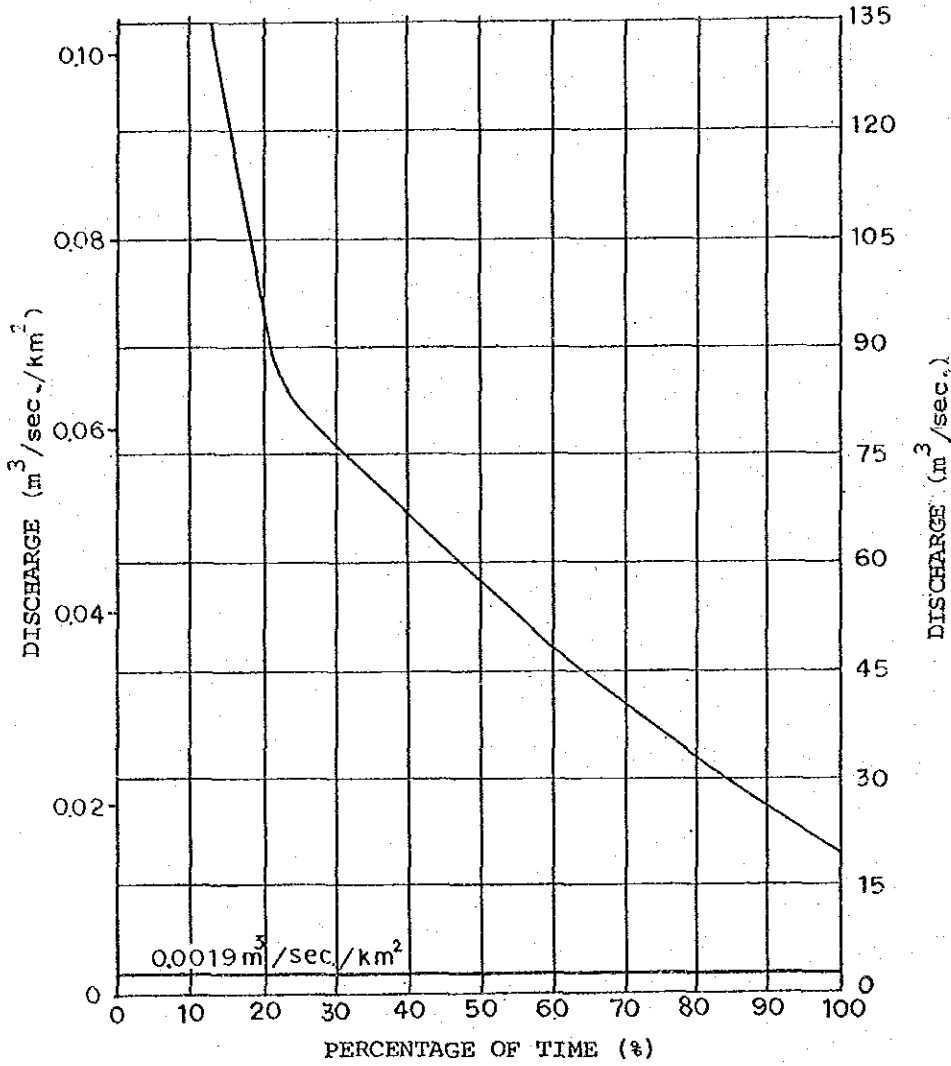
Power Plant	NO. 222 CAMPESTRE	Investigated Date	15 Feb. 1988
Electric Company	E.P. DE CALARCA	Available Capacity (kW)	62
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1956	Service-in	

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 over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	NO NAME PLATE
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	26.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	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 (WxH) (m)	W H 1.2 x	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	2	- Manufacturing Year	
- Headwater Level (EL)		3. Intake		- Type	SYN.
- Tailwater Level (EL)	UNKNOWN	- Elevation of Intake Sill (m)	UNKNOWN	- Number of Generator	1
- Gross Head	54.0	- Dimensions (m) (WxH)	W L 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/kWh)	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 φ=1.7	- Secondary Voltage (kV)	13,010
		- Length (m)	5,000	- Number of Phase	3
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Connection	Δ/λ
		9. Penstock		- Number Continuous Stand-by	1 0
		- Dimensions (m) (φ x L)	φ = 0.9 L = 80	4. Others	Operating
		- Number of Lines	1		
		10. Dimensions of Tailrace (W x H) (m)	W H 1.7 x 1.1		

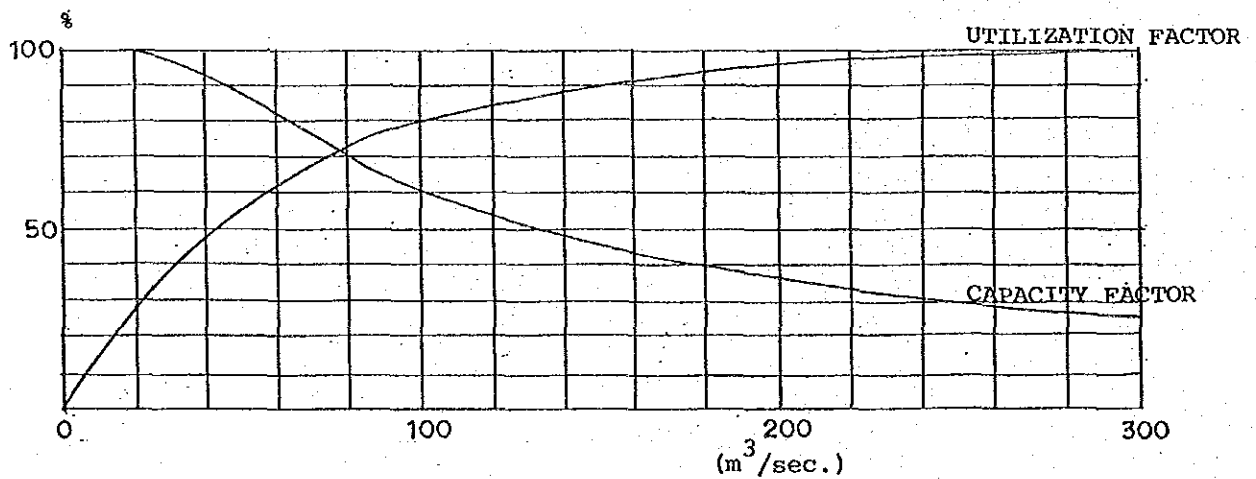
FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

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

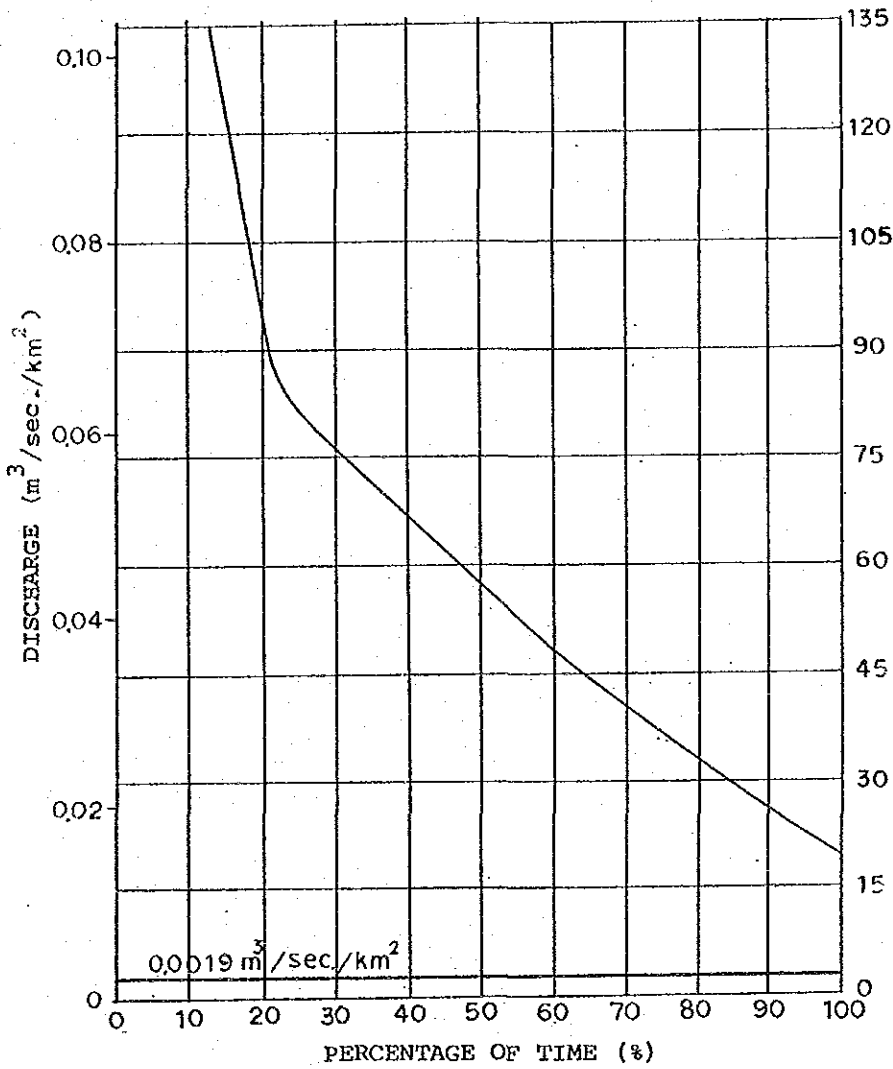
Power Plant	NO. 223 LA UNION	Investigated Date	15 Feb. 1988
Electric Company	E.P. DE CALARCA	Available Capacity (kW)	0
Location	QUINDIO		
River	QUINDIO		
Generating Method	RUN-OF-RIVER		
Installed Year	1938	Service-in	

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 Discharge	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 (RxH) (m)	NON	2. Generator	
5. Head (m)	UNKNOWN	- Number of Gates	NON	- Manufacturing Year	
- Headwater Level (EL)	UNKNOWN	3. Intake		- Type	
- 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)	6,600
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/kWh)	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

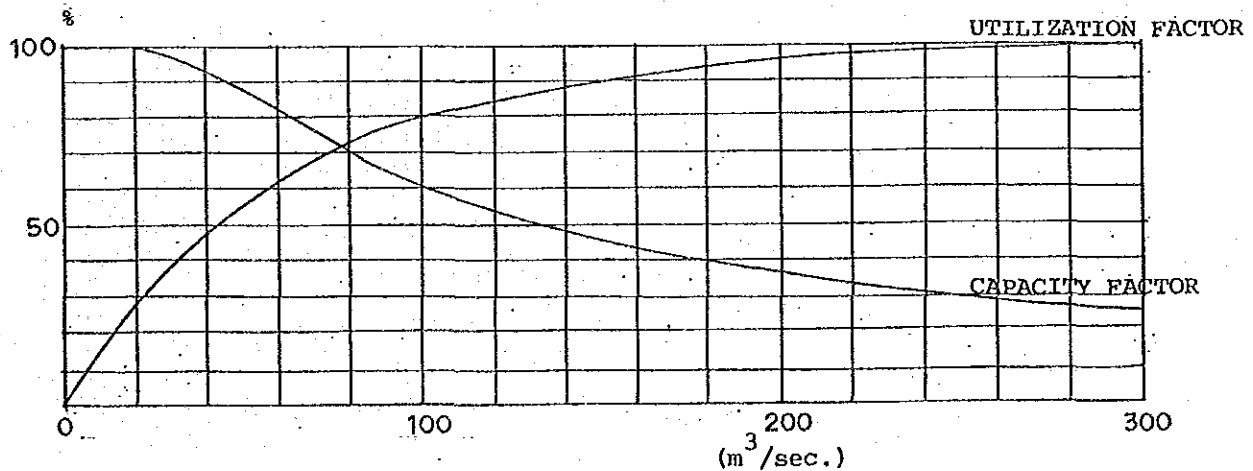


Location of H.G.S.	* 1
Daily or Monthly	Daily
Observation Duration	1953 - 1985
Used Data	1983 - 1985

(Note)

H.G.S.: Hydrological Gauging Station

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



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 overflowing Crest (m)	UNKNOWN	- Revolution (rpm)	PLATE	PLATE	PLATE
- Droughty Water Discharge	NO DATA	- Width of overflowing Crest (m)	20.0	- Type of Governor	NO NAME	NO NAME	NO NAME
- Minimum	NO DATA	- Depth of overflowing (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 x 3.0	- Capacity (kVA)	1,050	1,050	800 kW
- Head Loss	UNKNOWN	- Number of Intake	1	- 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 8.0x35.0x	- Frequency (Hz)	60	60	60
7. Plant Capacity (kW)	2,480	6. Intake Gate		- Revolution (rpm)	900	NO NAME	450
8. Output (MWh)	8,134	- Type	SLUICE	3. Transformer			
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) (W x H)	W H 2.0 x 2.0	- Manufacturing Year	NOT CONFIRMED		
10. Unit Price (1,000 pesos/kW)	NO DATA	- Number of Gates	2	- 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 1.6 x 1.6	- Secondary Voltage (kV)	NOT CONFIRMED		
		- Length (m)	3.700	- Number of Phase	NOT CONFIRMED		
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Connection	NOT CONFIRMED		
		9. Penstock		- 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

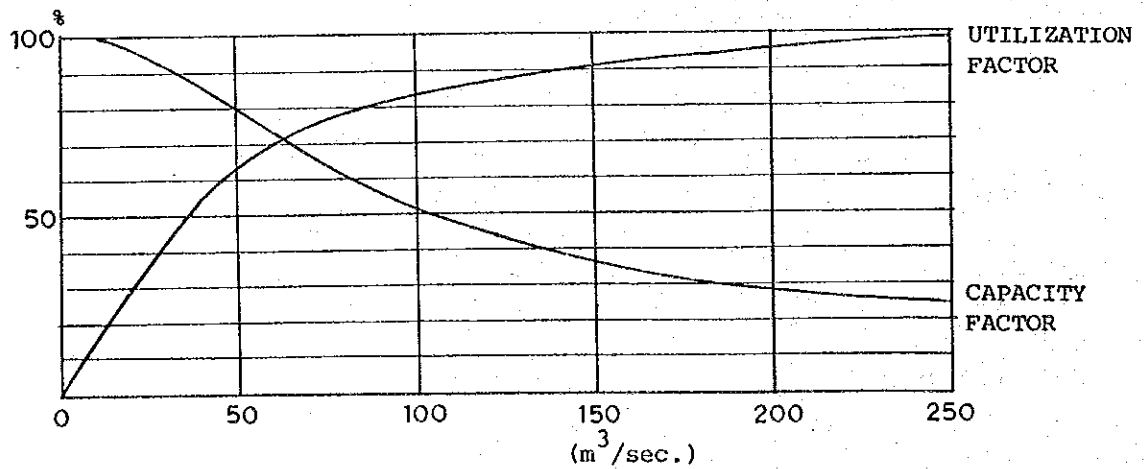
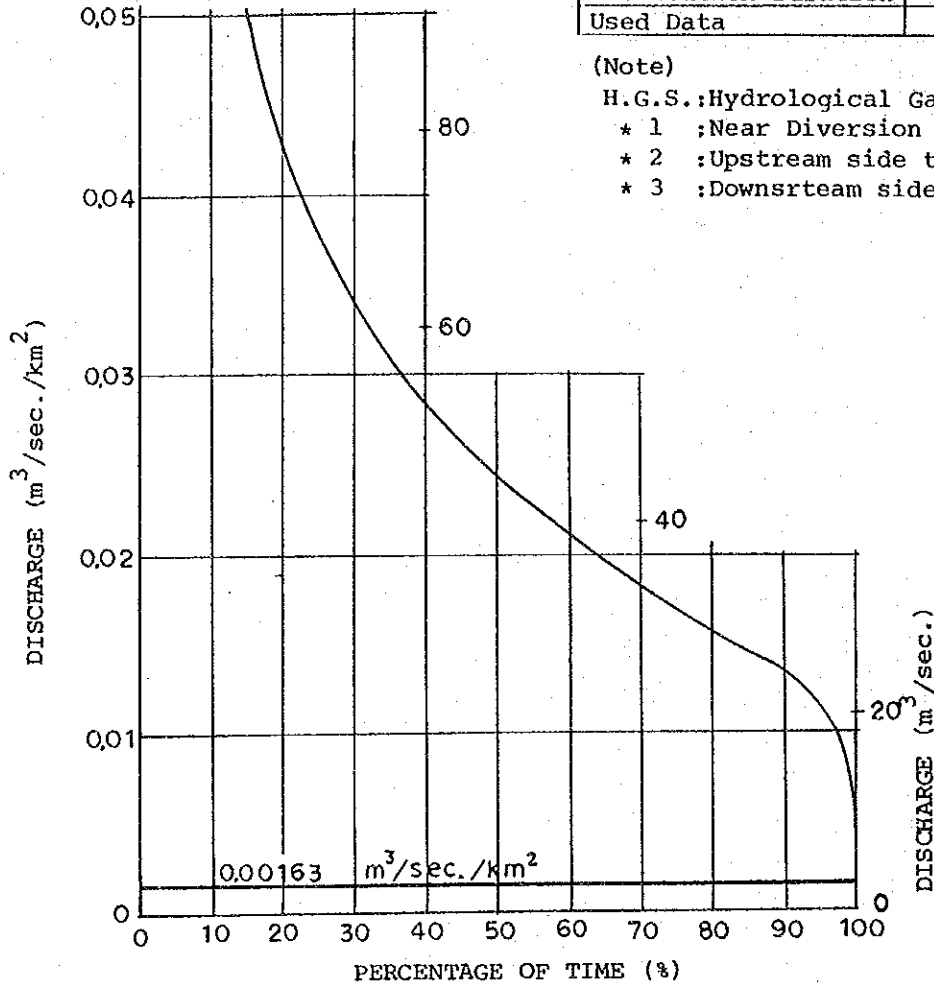
(Note)

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 flow 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 flow 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 overflowing 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 Discharge	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve Type	NO NAME PLATE
- Mean Discharge	NO DATA	2. Sand Trap Gate	SLUICE	- Dimension (mm)	NO NAME PLATE
3. Utilizable Flow (m ³ /s)	NO DATA	- Type	SLUICE	2. Generator	
4. Firm Discharge (m ³ /s)	6.0	- Dimensions (WxH) (m)	W H 1.55 x 1.50	- Manufacturing Year	
5. Head (m)	1,194	- Number of Gates	2	- Type	SYN.
- Headwater Level (EL)		3. Intake		- Number of Generator	2
- Tailwater Level (EL)	1,169	- Elevation of Intake Sill (m)	UNKNOWN	- Capacity (kVA)	900 x 2
- Gross Head	24.5	- Dimensions (m) (WxH)	W H 1.45 x 4.8	- Power Factor (%)	80
- Head Loss	1	- Number of Intake	3	- Voltage (V)	440
- Net Head	24	4. Dimensions of Forebay (m)	NON	- Frequency (Hz)	60
6. Efficiency (%)		5. Dimensions of Settling Basin (m) (W x L x H)	NON	- Revolution (rpm)	514
7. Plant Capacity (kW)	1,440	6. Intake Gate		3. Transformer	
8. Output (Mwh)	4,821	- Type	SLUICE	- Manufacturing Year	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 1.45 x 4.8	- Type	ONAN, OUTDOOR
10. Unit Price 1,000 pesos/kWh	NO DATA	- Number of Gates	3	- Capacity (kVA)	900 x 2
pesos/kWh	NO DATA	7. Headrace	OPEN	- Primary Voltage (V)	440
11. Others		- Type		- Secondary Voltage (kV)	33
		- Dimensions (m) [W x H]	W H 3.6 x 1.95	- Number of Phase	3
		- Length (m)	3,944	- Connection	NO NAME PLATE
		8. Dimensions of Water Reservoir (m)	W L x H 8.0x20.0x3.0	- Number	2
		9. Penstock	φ = 1.5	Continuous Stand-by	0
		- Dimensions (m) (φ x L)	L = 83.4	4. Others	#1, 2 Unit: Operating
		- Number of Lines	1		
		10. Dimensions of Tailrace (W x H) (m)	5.5 M ²		

FLOW - DURATION CURVE and UTILIZATION & CAPACITY FACTOR

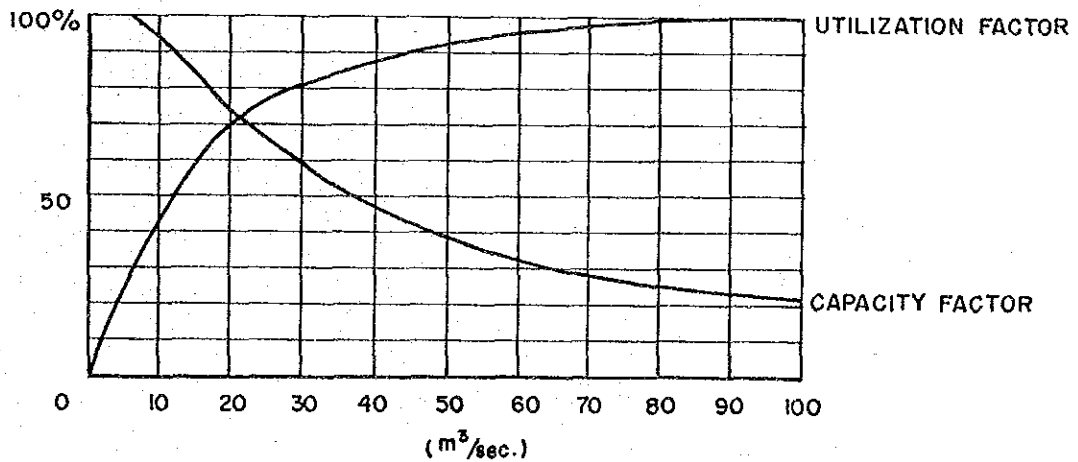
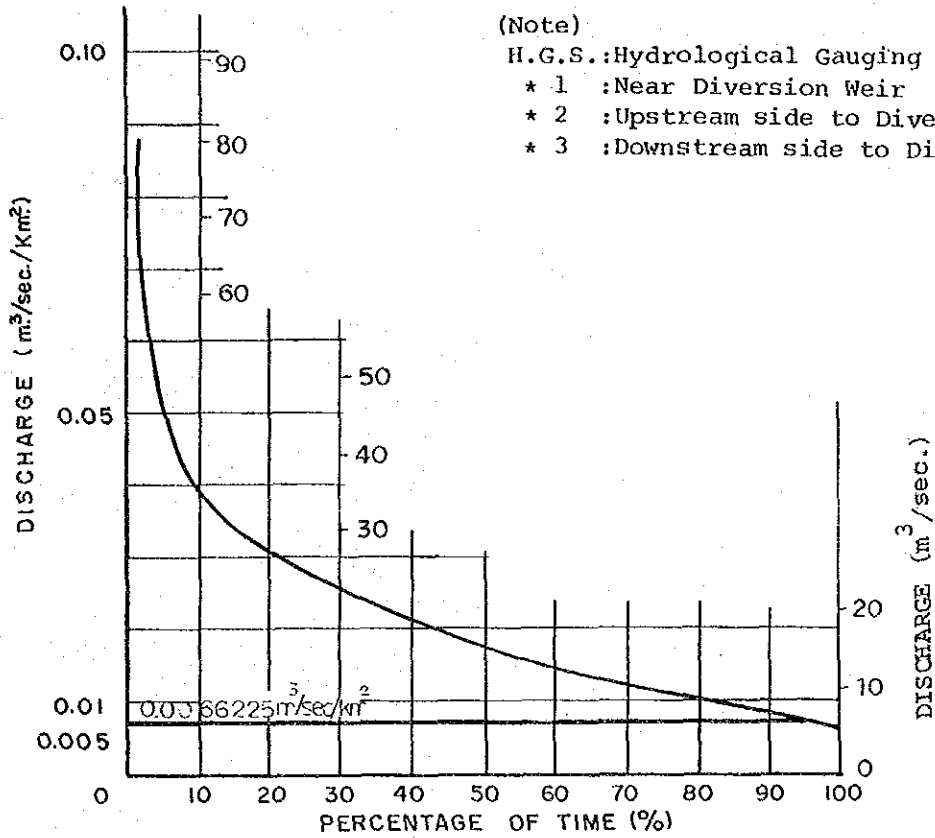
NO. 225 EL PALO

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

(Note)

H.G.S.: Hydrological Gauging Station

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



No. 225 El Palo

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 overflowing Crest (m)	30.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of overflowing (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	SLUICE	- Revolution (rpm)	720
8. Output (MWh)	3,780	- Type		3. Transformer	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W 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 Continuous Stand-by	3 0
		- Dimensions (m) (φ x L)	φ = 0.76 L = 78	4. Others	#1, 2 Unit: Operating
		- Number of Lines	2		
		10. Dimensions of Tailrace (W x H) (m)	NOT CONFIRMED		

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

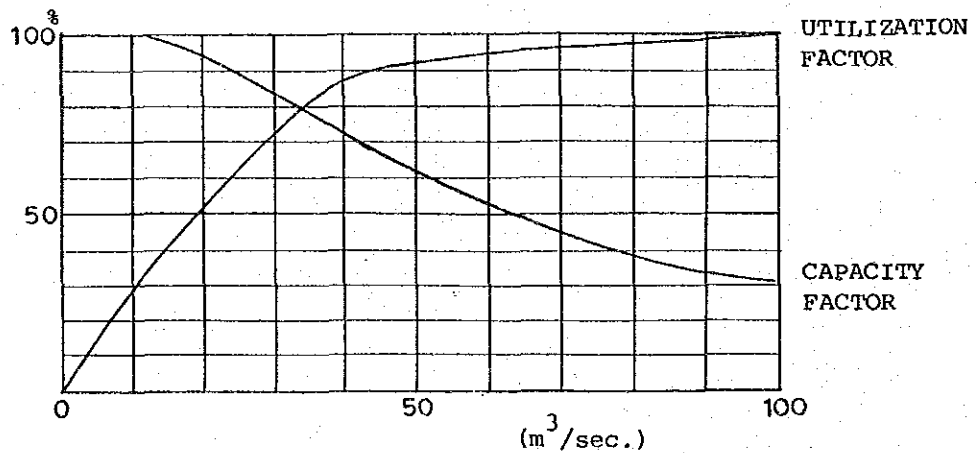
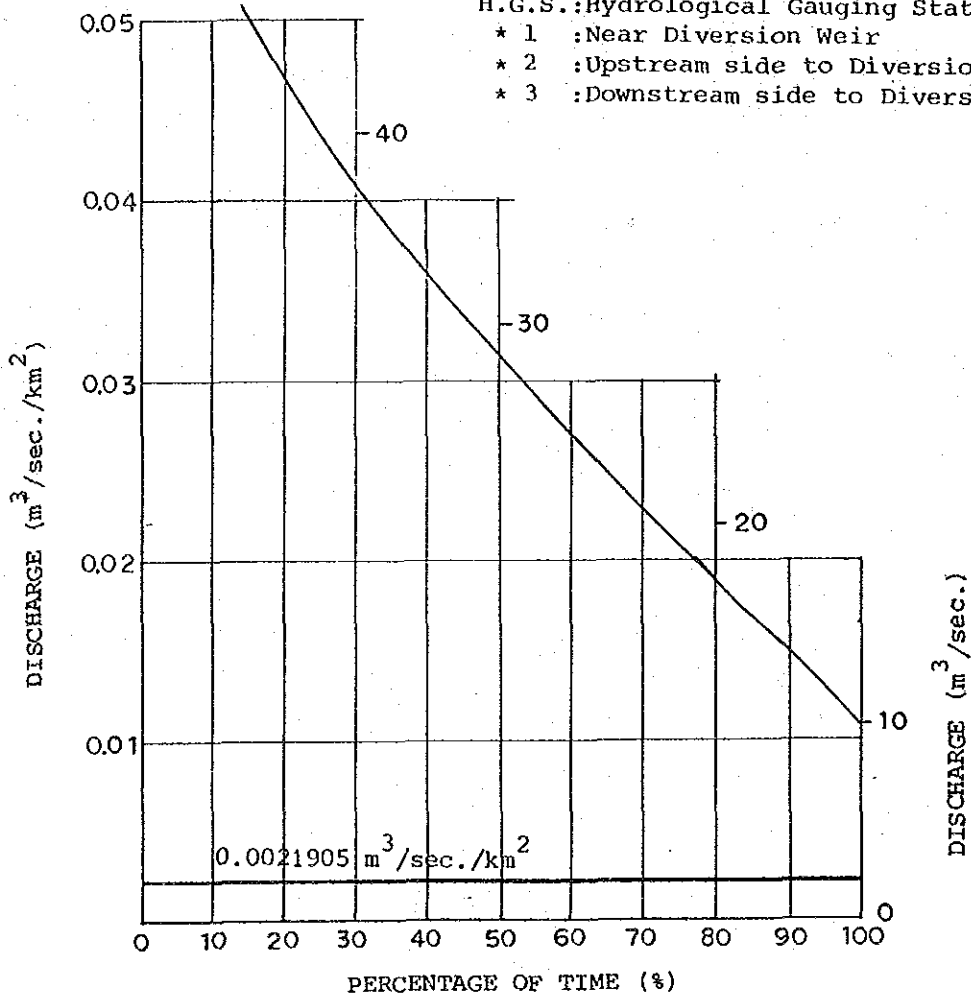
NO. 226 MONDOMO

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

FLOW-DURATION CURVE and UTILIZATION & CAPACITY FACTOR

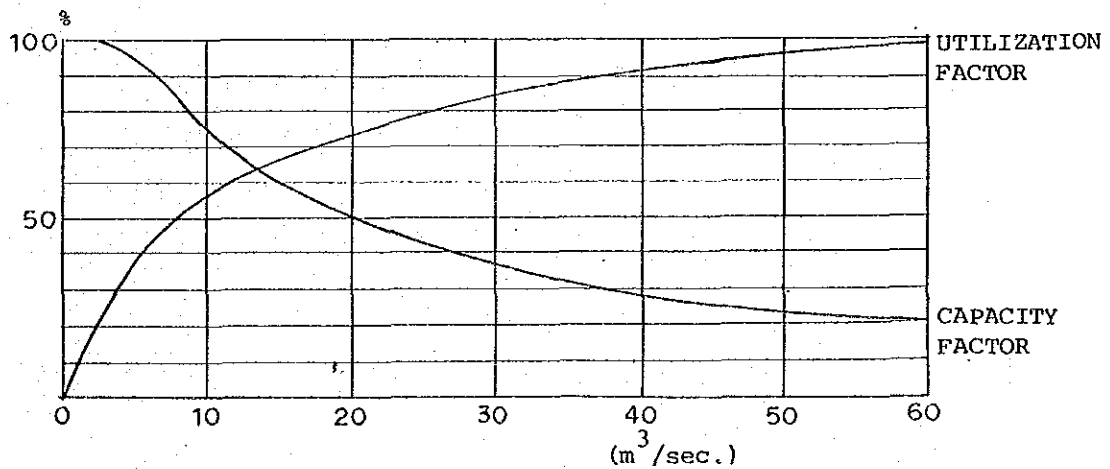
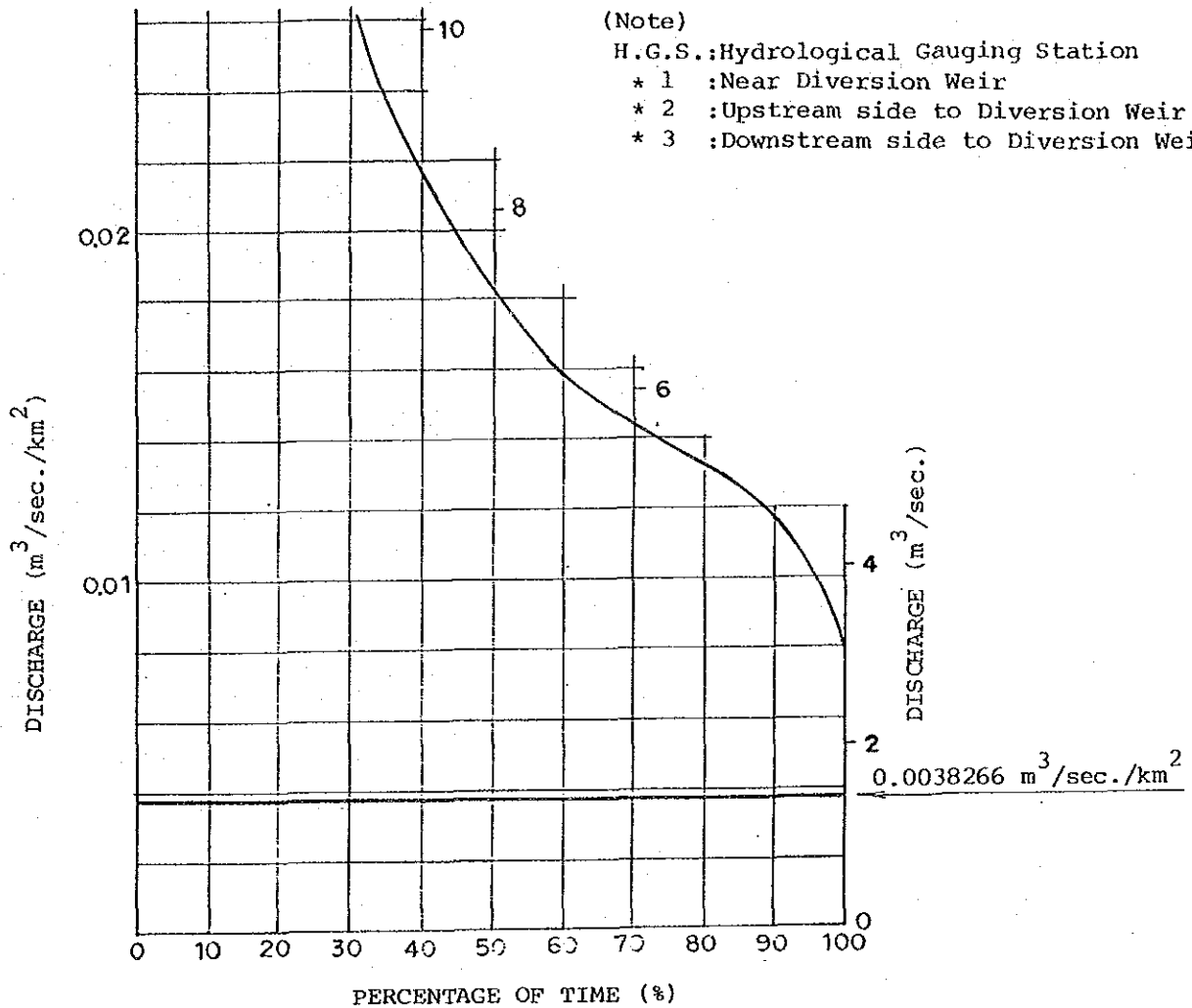
NO. 227 SILVIA

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 - Type	OVERFLOW CONCRETE	1. Turbine	
2. Volume of Discharge (m ³ /s)		- Height (m)	1.35	- Manufacturing Year	1940
- Plenty Water Discharge	NO DATA	- Crest Length (m)	30	- Type	FRANCIS
- Ordinary Water Discharge	NO DATA	- Elevation of Over-flowing Crest (m)	UNKNOWN	- Output (kW)	1,250 HP
- Low Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	30	- Revolution (rpm)	400
- 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	
- 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)	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 (t)	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	SLUICE	- Revolution (rpm)	400
8. Output (MWh)	UNKNOWN	- Dimensions (m) (W x H)	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 (1,000 pesos/kWh)	NO DATA	7. Headrace	STEEL PIPE	- Type	N/A
pesos/kWh	NO DATA	- Type		- Capacity (kVA)	N/A
11. Others		- Dimensions (m) (W x H)	φ = 1.85	- Primary Voltage (kV)	N/A
		- 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		- Connection	N/A
		- Dimensions (m) (φ x L)	φ = 1.8 L = 71	- 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

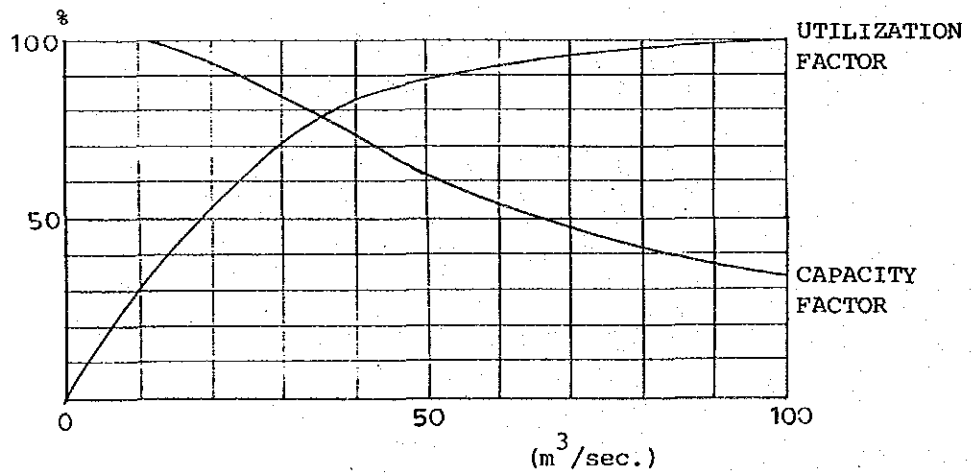
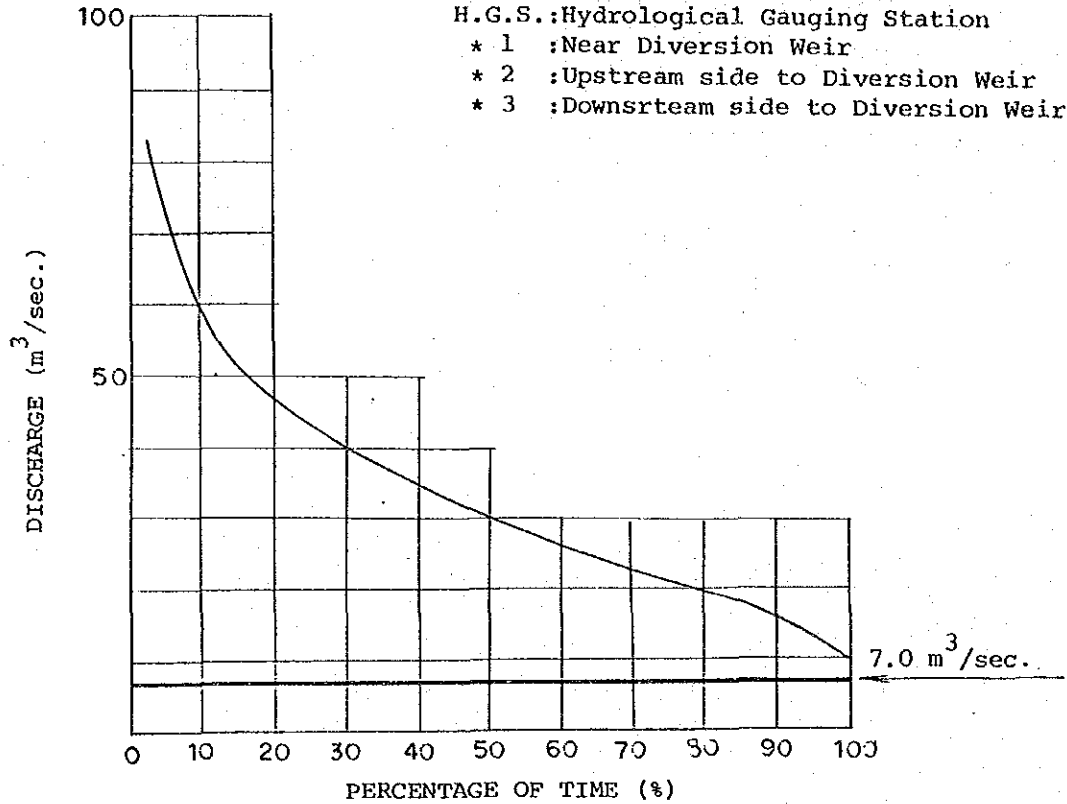
NO. 228 OVEJAS

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 presure. 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 Remodlling of the intake weir and intake gate.
- ② Replacemeent 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		- Manufacturing Year	
- Plenty Water Discharge	NO DATA	- Height (m)	2.5	- Type	PELTON
- Ordinary Water Discharge	NO DATA	- Crest Length (m)	15.0	- Output (kW)	300
- 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)	15.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- Regulating Valve	
- Mean	NO DATA	2. Sand Trap Gate	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	1
		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 Asnazus

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 over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	1,200
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	15	- 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	- 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		- Manufacturing Year	
- Headwater Level (EL)	1,418	- Elevation of Intake Sill (m)	UNKNOWN	- Type	NO NAME PLATE
- Tailwater Level (EL)	1,339	- Dimensions (m) (WxH)	NOT CONFIRMED	- Number of Generator	1 (ICEL 360 kW)
- Gross Head	72	- Number of Intake	1	- Capacity (kVA)	NO NAME PLATE
- 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		- Frequency (Hz)	NO NAME PLATE
7. Plant Capacity (kW)	360	- Type	SLUICE	- 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 (1,000 pesos/kWh)	NO DATA	7. Headrace		- Type	ONAN, OUTDOOR
pesos/kWh	NO DATA	- Type	OPEN	- Capacity (kVA)	250
11. Others		- Dimensions (m) (W x H)	W H 1.30 x 0.75	- Primary Voltage (V)	231
		- Length (m)	2,524	- Secondary Voltage (kV)	13.2
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Number of Phase	3
		9. Penstock	φ = 0.65	- Connection	NO NAME PLATE
		- Dimensions (m) (φ 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

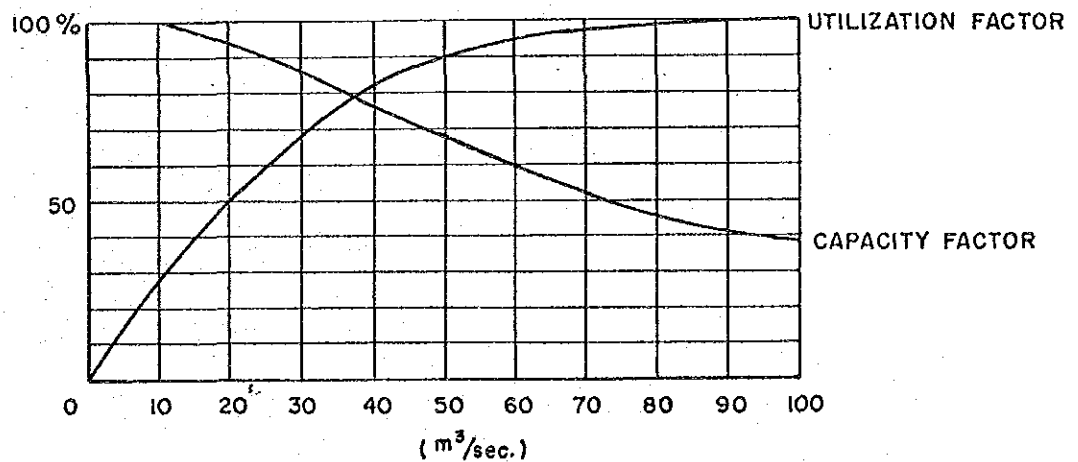
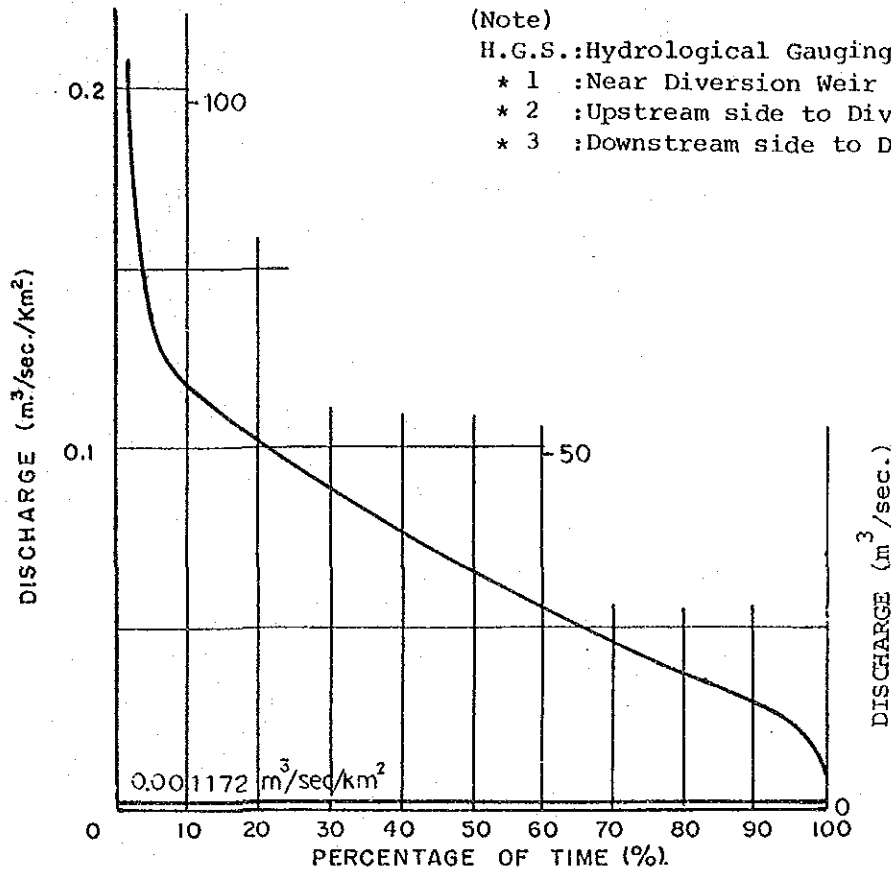
NO. 230 INZA

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 over-flowing Crest (m)	UNKNOWN	- Revolution (rpm)	365
- Droughty Water Discharge	NO DATA	- Width of Over-flowing Crest (m)	8.0	- Type of Governor	NO NAME PLATE
- Minimum	NO DATA	- Depth of Over-flowing (m)	UNKNOWN	- 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)	0.5	- Dimensions (WxH) (m)	W H 2.1 x	- Manufacturing Year	1963
5. Head (m)	315	- Number of Gates	1	- Type	SYN.
- Headwater Level (EL)		3. Intake		- Number of Generator	1
- Tailwater Level (EL)	300	- Elevation of Intake Sill (m)	UNKNOWN	- Capacity (kVA)	63 KW
- Gross Head	13	- Dimensions (m) (WxH)	W H 2.1 x 2.0	- Power Factor (%)	80
- Head Loss	UNKNOWN	- Number of Intake	1	- Voltage (V)	230
- Net Head	UNKNOWN	4. Dimensions of Forebay (m)	NON	- Frequency (Hz)	60
6. Efficiency (%)	UNKNOWN	5. Dimensions of Settling Basin (m) (W x L x H)	NOT CONFIRMED	- Revolution (rpm)	1,200
7. Plant Capacity (kW)	63	6. Intake Gate	SLUICE	3. Transformer	
8. Output (MWh)	198	- Type		- Manufacturing Year	
9. Construction Price (1,000,000 pesos)	NO DATA	- Dimensions (m) [W x H]	W H 1.1 x 0.8	- Type	ONAN, OUTDOOR
10. Unit Price		- Number of Gates	1	- Capacity (kVA)	50
1,000 pesos/kW	NO DATA	7. Headrace		- Primary Voltage (V)	220
pesos/kWh	NO DATA	- Type	OPEN	- Secondary Voltage (kV)	13.2
11. Others		- Dimensions (m) [W x H]	W H 1.0 x 0.6	- Number of Phase	3
		- Length (m)	355	- Connection	NO NAME PLATE
		8. Dimensions of Water Reservoir (m)	NOT CONFIRMED	- Number Continuous Stand-by	1 0
		9. Penstock		4. Others	Operating, Isolated
		- Dimensions (m) (φ x L)	φ = 0.68 L = 36		
		- 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.