

All other current problems with the power generating equipment can be resolved by repairs and rehabilitation.

By effecting all the proposed repairs, the turbine should be restored to its conditions just after original installation, and stable operation can be expected for at least the next 10 years. As for other equipment, defective parts will be removed. With the recovery of original turbine conditions the Nam Ngum Power Station will continue to play a significant role.

(2) Improvement in Turbine's Efficiency

Since a 2 percent increase in turbine efficiency can be expected after repair of cavitation erosion, the potential power energy per annum will increase by about 9,000,000 kWh after repair of No.3 and No.4 turbines.

Once the potential increase in energy production is realized it is proposed that additional supplies be provided to the village in the vicinity of Nam Ngum Power Station. Power is supplied to this village at present by 22 kV distribution lines as part of the rural electrification scheme. These supplies service about 20,000 people (about 4,000 houses) and the energy supplied in 1988 was 6,400,000 kWh. If the plan is implemented, and if the power consumption per connection remains substantially the same, supplies could be extended to an additional 28,000 potential customers (5,600 houses) in the vicinity of Nam Ngum Power Station without affecting electric power exports to EGAT.

7-2 Indirect Benefits of Project Implementation

Though experience and observation of disassembly and repair work on No.3 and No.4 generating equipment, the power station staff will have the chance for learn about planning and implementation for disassembly and repairs which they themselves can do in the future.

CHAPTER 8

**CONCLUSIONS
AND
RECOMMENDATIONS**

CHAPTER 8 CONCLUSIONS AND RECOMMENDATIONS

8-1 Conclusions

The Nam Ngum Power Station has been providing electric power to the areas in and around Vientiane and to inhabitants near the power station since its inauguration more than ten years ago.

Its capacity should be sufficient to cover the energy demands expected after completion of the Vangvieng-Luang Prabang transmission line project as well as the rural electrification project under development by EDL in the Vientiane plain.

The energy demands in Lao PDR are forecast to increase at a steady rate because power networks are being extended on a countrywide scale not only around Vientiane but also over the rural areas.

Nam Ngum Power Station has an important role in foreign currency earnings arising from electric power sales to EGAT.

As a result of the site investigations and subsequent analysis, it was found that No.3 and No.4 units require overhauling and repair at the earliest stage possible because these are already long overdue and even more serious conditions will develop if this opportunity is missed. The Lao PDR government understands the situation well, but cannot commission the work for themselves due to present financial limitations in Lao PDR.

Implementation of the Project will not only contribute to the provision of stable electric power, but will also provide training for the power station staff in the disassembly and overhaul of hydroelectric equipment.

In view of the above situation, the request is considered reasonable. It is concluded that implementation of the Project is

extremely desirable and that the scale of the Project is suitable for grant aid from Japan.

8 - 2 Recommendation

It was judged that there will be no essential problems in operation and maintenance organization of the Nam Ngum Power Station after completion of the Project. It seems, however, that sometimes effective results cannot be obtained, especially regarding technical matters, despite routine instruction and training by EDL and extensive study of instruction manuals by the staff concerned.

In order to strengthen the operation and maintenance organization, and to maintain the facilities in good condition, the following are recommended to the Government of Lao PDR:

- Promote training for operation and maintenance staff
- Establish procedures and rules to ensure periodic procurement of imported materials such as spare parts, consumables, etc. required for proper care and maintenance of the equipment.

ATTACHMENT

Fig.- 1

EDL NAM NGUM	#3, #4 SITE SURVEY	
	WICKET GATE & RUNNER GAP	14 / 1 / 89

UNIT : NO.3

UNIT : mm

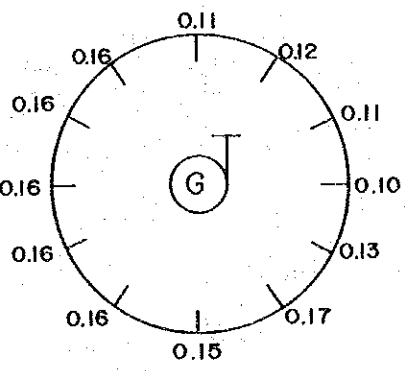
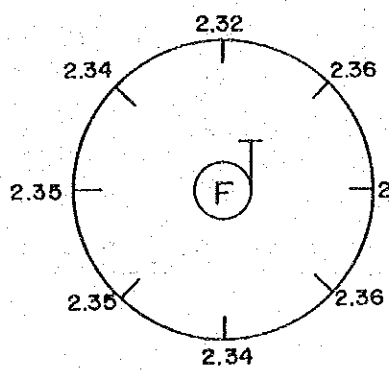
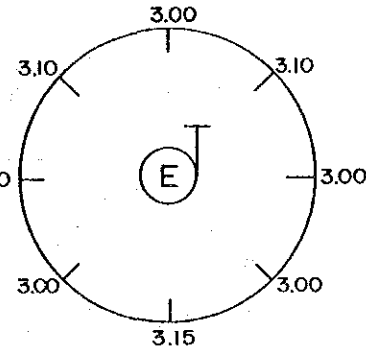
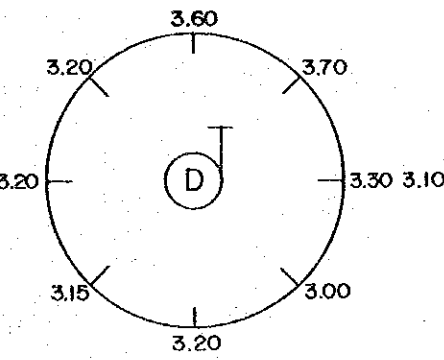
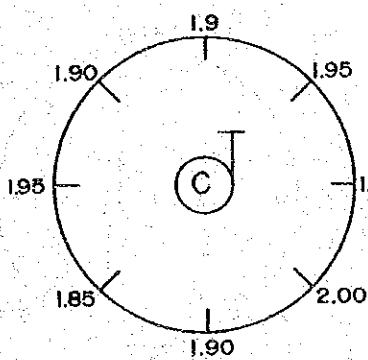
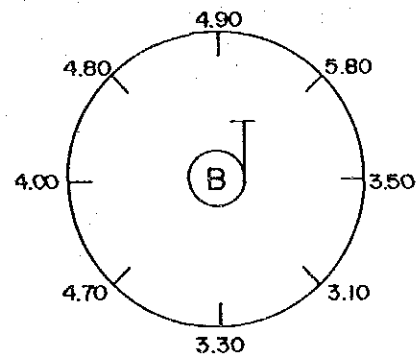
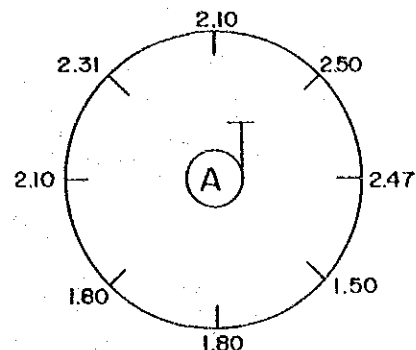
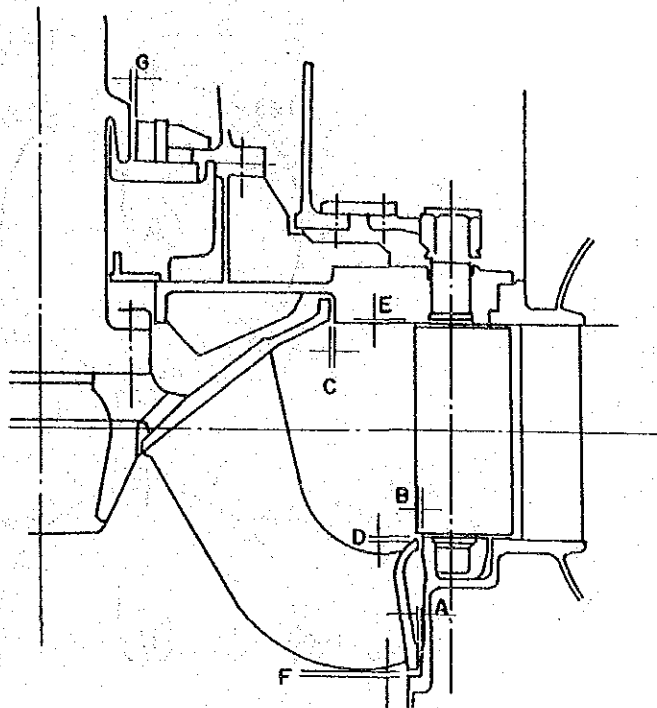


Fig.- 2

EDL NAM NGUM	# 3, # 4 SITE SURVEY WICKET GATE & RUNNER GAP	19/1/1989
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UNIT : NO.4

UNIT : mm

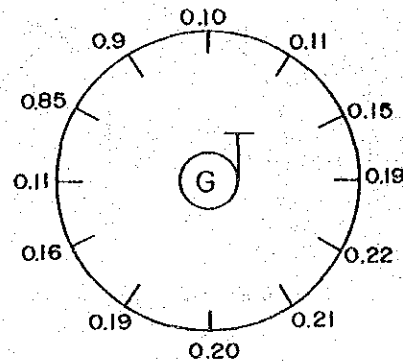
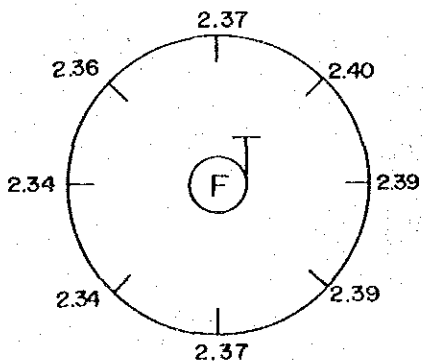
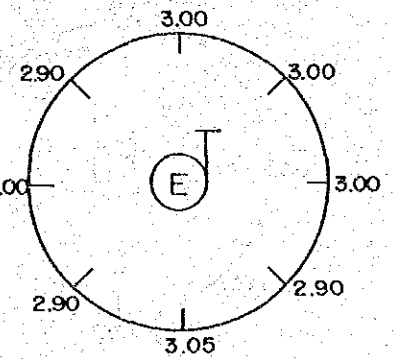
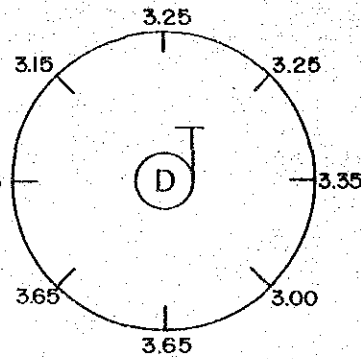
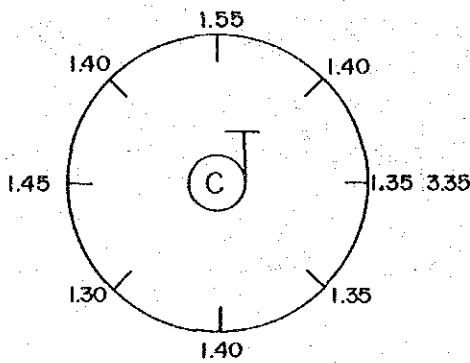
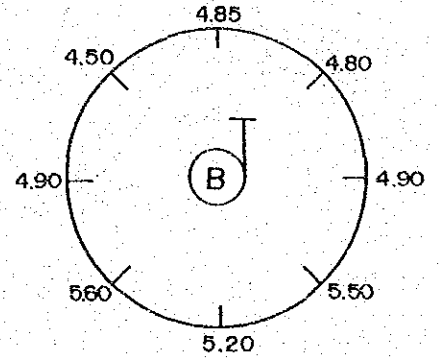
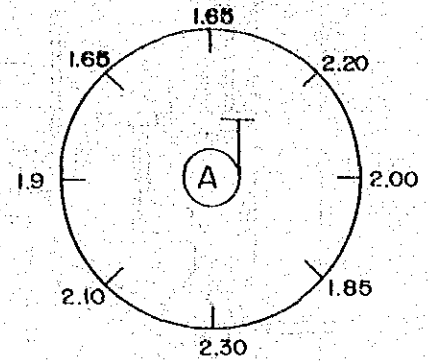
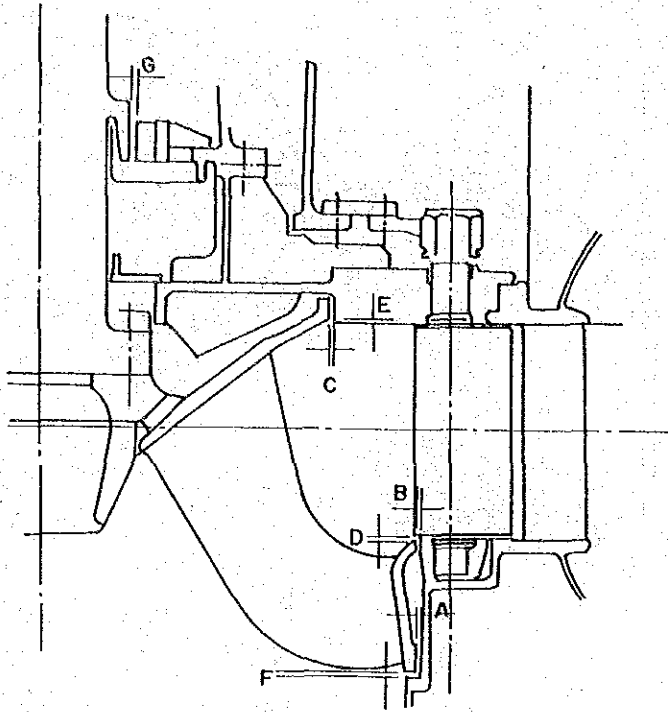


Fig.-3

EDL NAM NGUM	CAVITATION DAMAGE ON DRAFT TUBE FIN	15 / 1 / 1989
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UNIT : NO.3

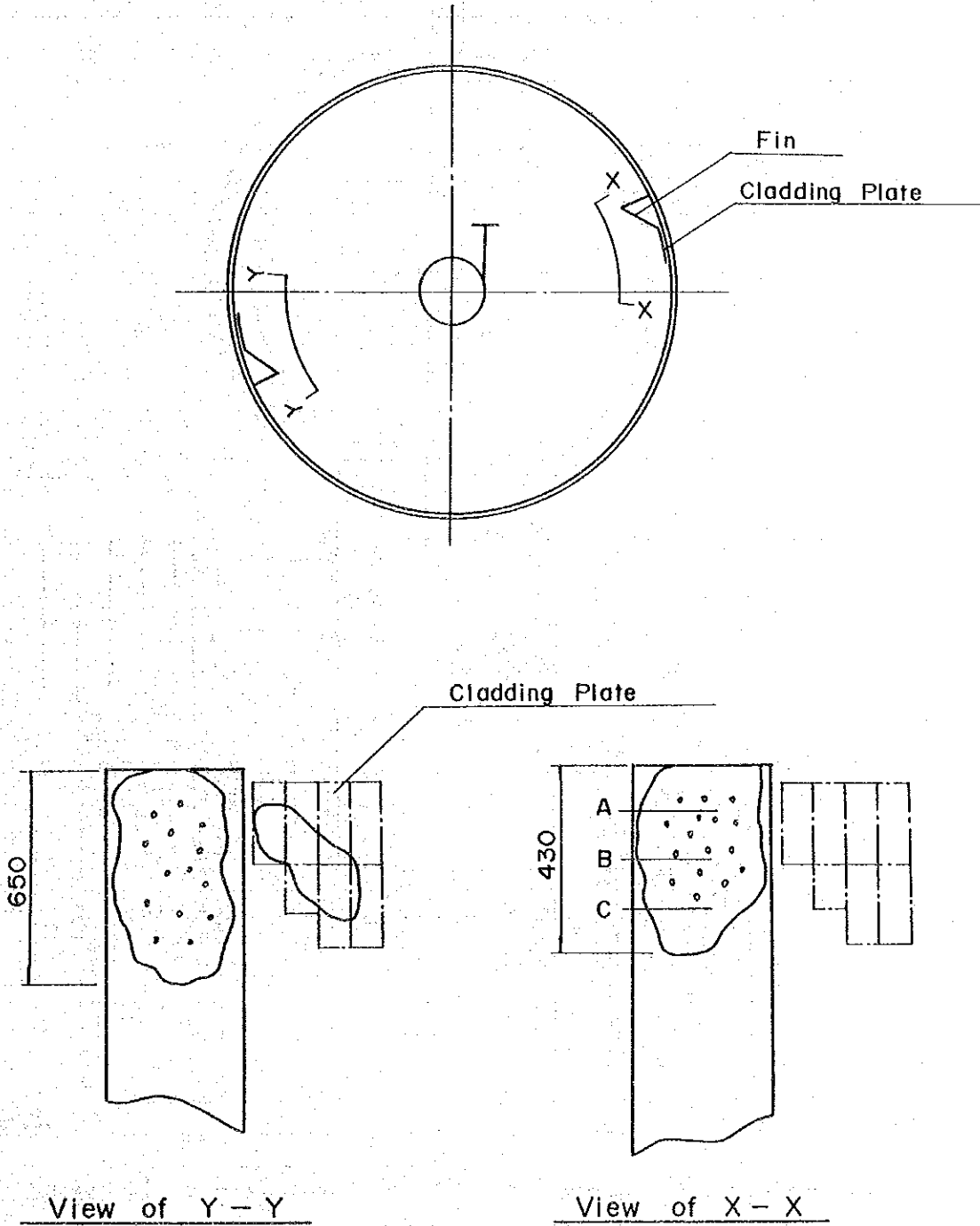


Fig.-4

Shape of Cavitation and Corrosion on Draft Tube Fins

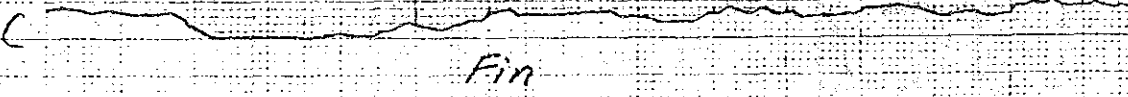
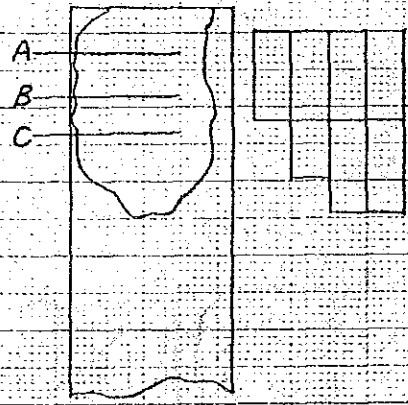
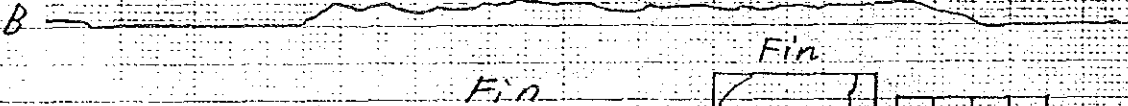
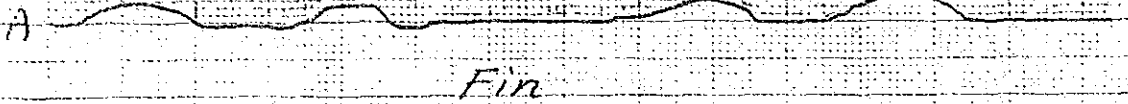
15-1-1989

Unit No.3

(Unit: mm)

LEFT

RIGHT



LEFT

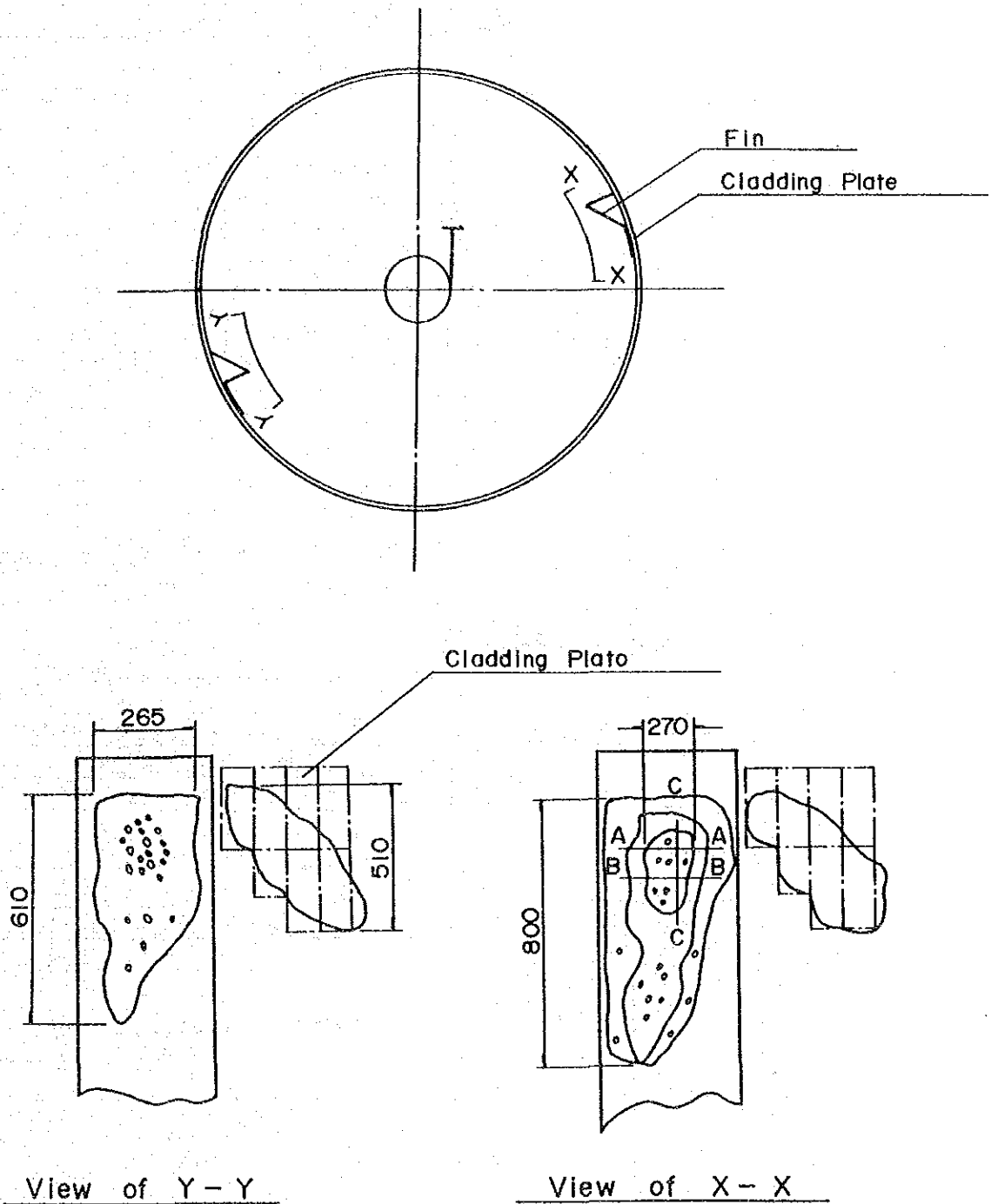
RIGHT

Cladding plate

Fig.-5

EDL NAM NGUM	CAVITATION DAMAGE ON DRAFT TUBE FIN	
		.24 / 1 / 1989

UNIT NO.4



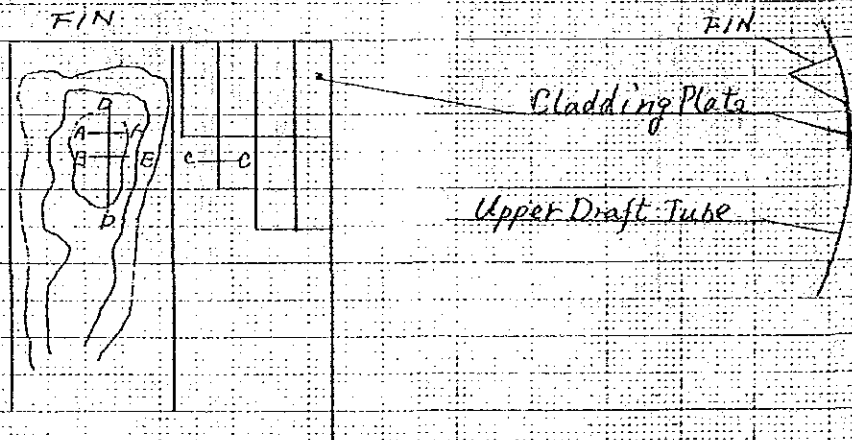
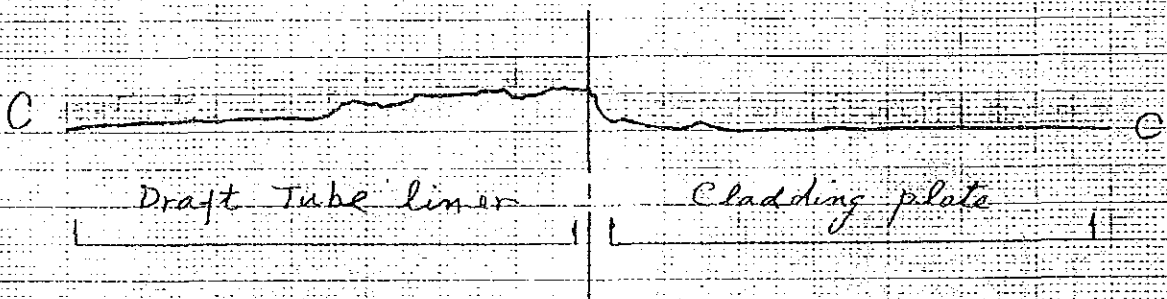
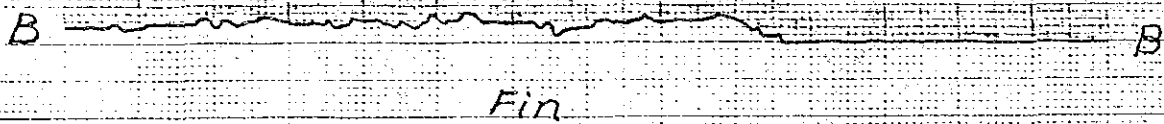
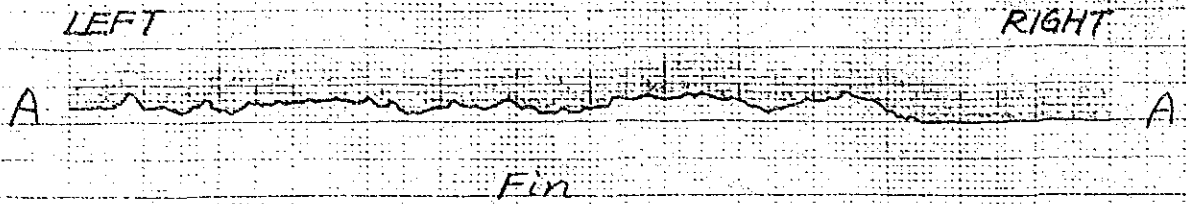
Shape of Cavitation and
Corrosion on Draft Tube Fins
and its Down Stream Areas

Fig.-6

22-1-1989

Unit No. 4

(unit - mm)



Shape of Cavitation and
Corrosion on Draft Tube Fins
and its Down Stream Areas

Fig.-7

22-1-1989

Unit No.4

(Unit: mm)

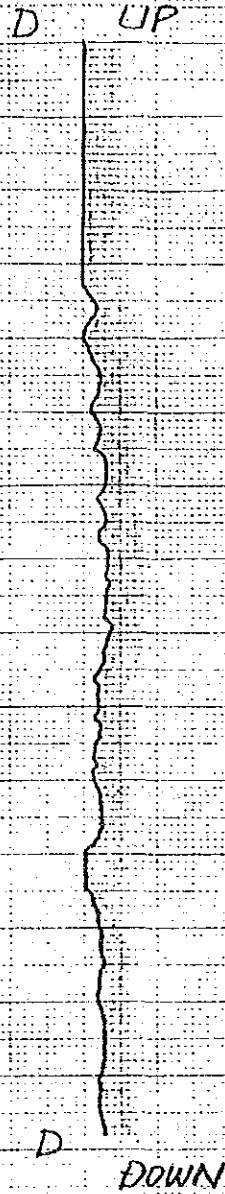
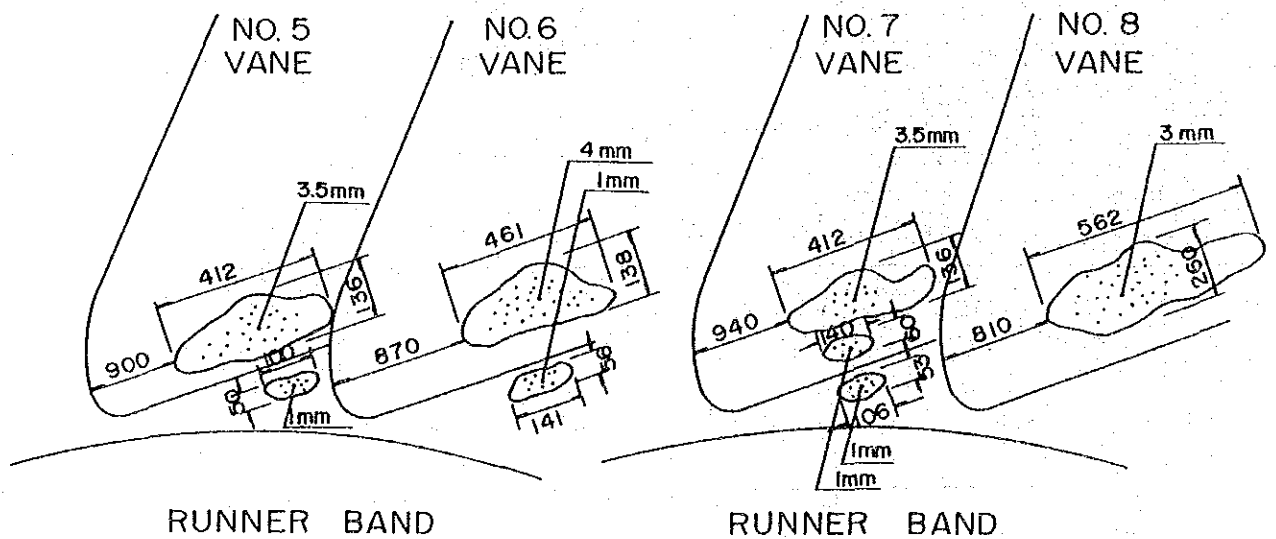
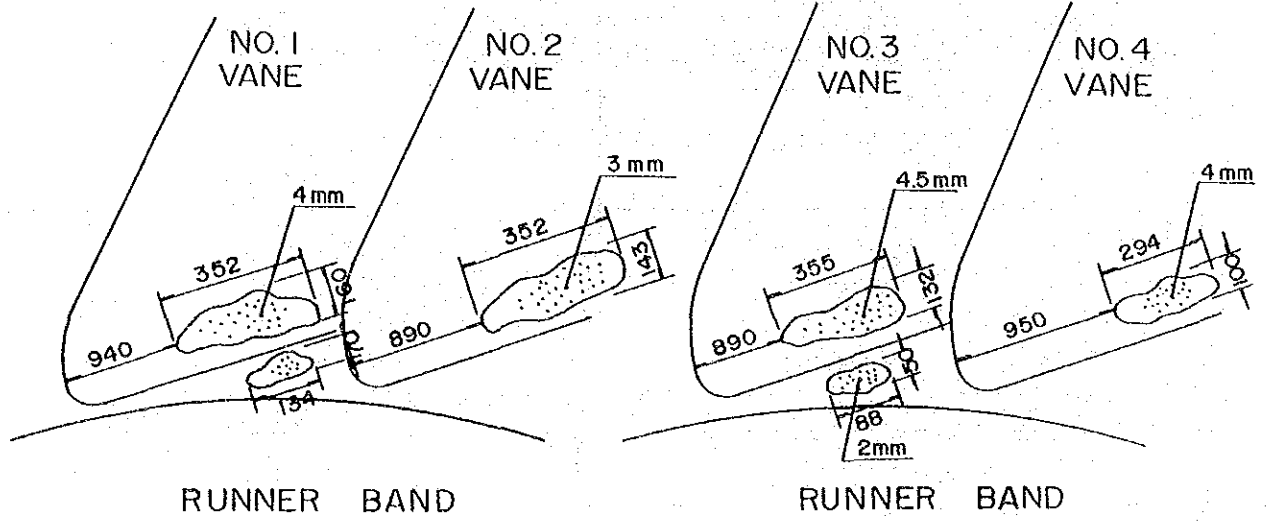


Fig.- 8

EDL NAM NGUM	#3, #4 SITE SURVEY CAVITATION PITTING	16 / 1 / 1989
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UNIT : NO.3

UNIT : mm



Shape of Cavitation
Pitting on Runner Vane

Fig.-9

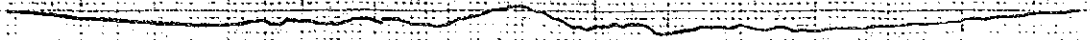
15-1-1989

Unit No. 3

(Unit: mm)

DOWN

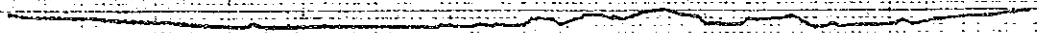
UP



VANE No. 4

DOWN

UP



VANE No. 5

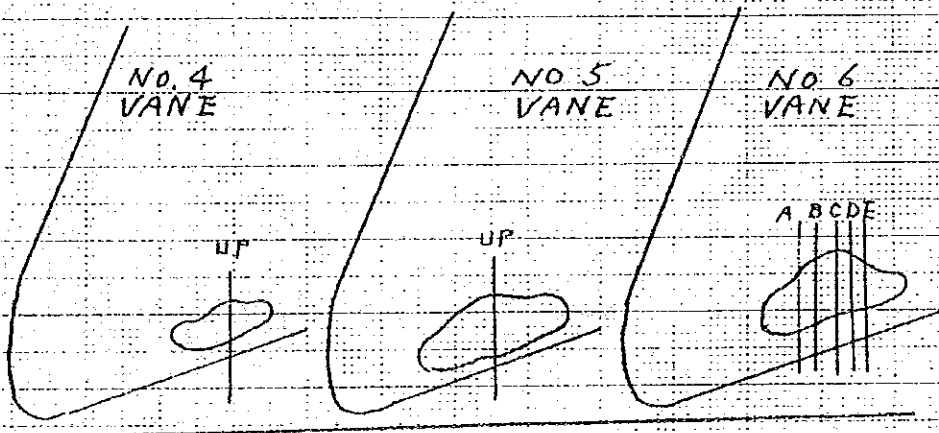


Fig.-10

Shape of Cavitation
Pitting on Runner Vane

Unit NO.3

15 1 19.89

VANE NO.6

(Unit: mm)

DOWN

UP

A

B

C

D

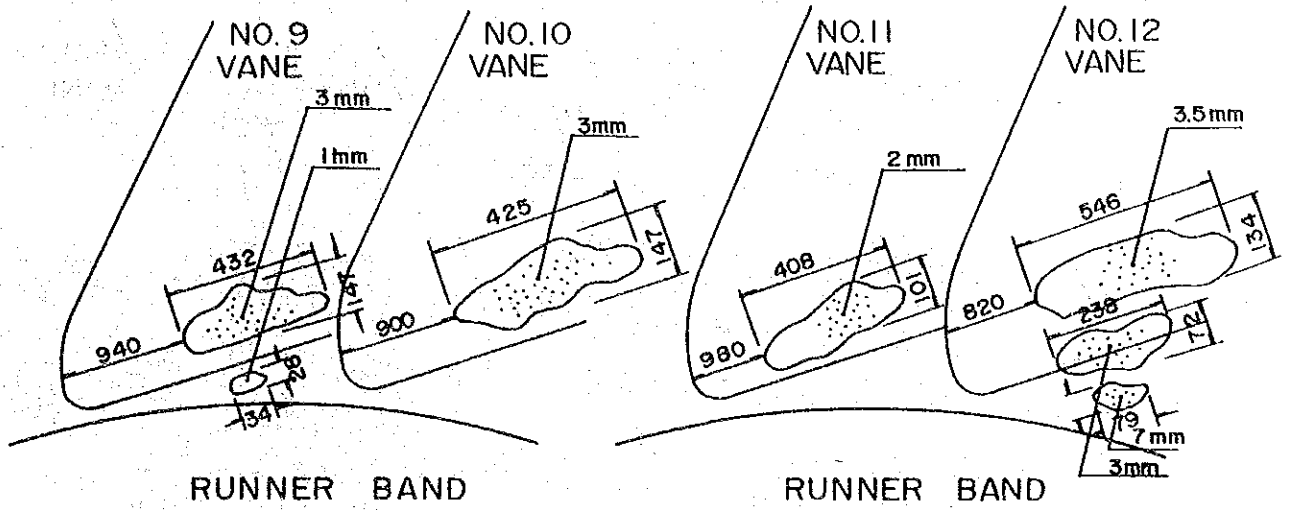
E

Fig.- 11

EDL NAM NGUM	# 3, # 4 SITE SURVEY CAVITATION PITTING	
		16 / 1 / 1989

UNIT : NO.3

UNIT : mm



Total Area \doteq 6400cm²
 Max. depth \doteq 4.5mm

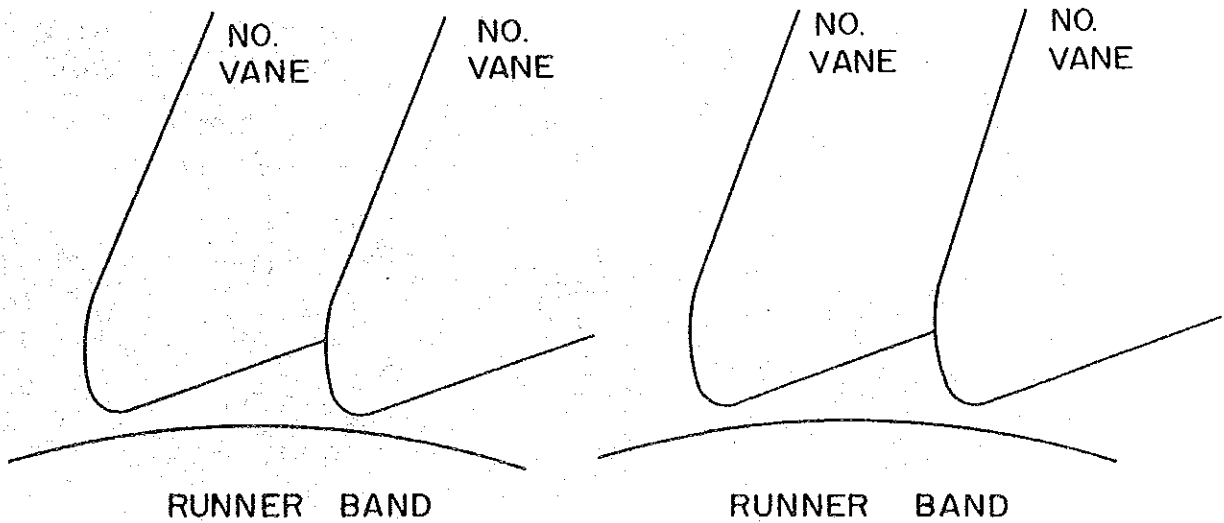


Fig.-12

EDL NAM NGUM	# 3, #4 SITE SURVEY CAVITATION PITTING	24 / . 1 / 1989
-----------------	---	-----------------

UNIT : NO.4

UNIT : mm

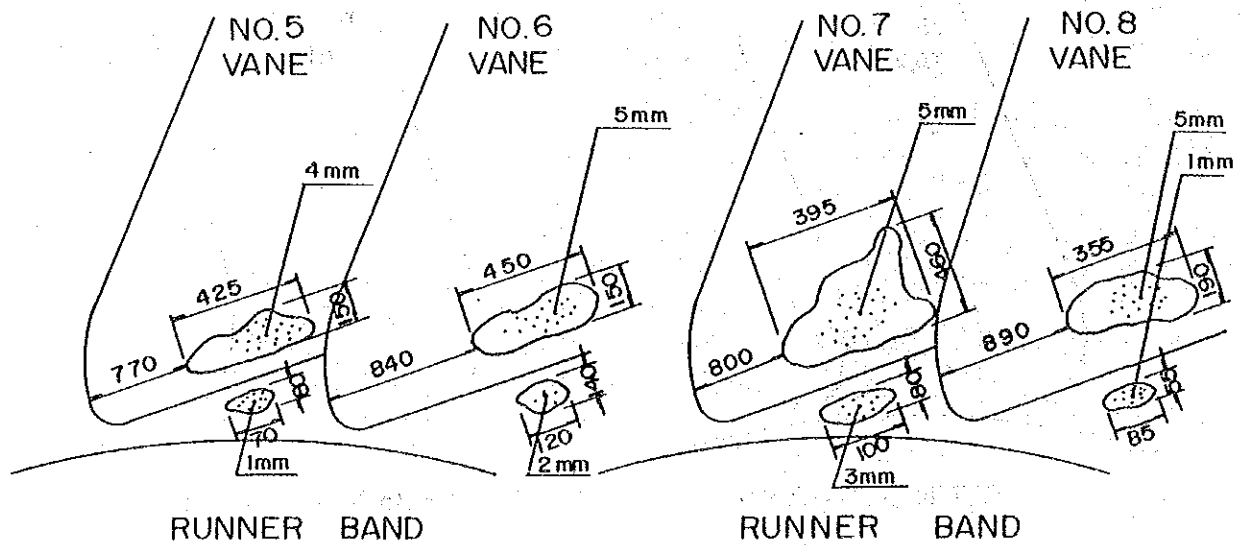
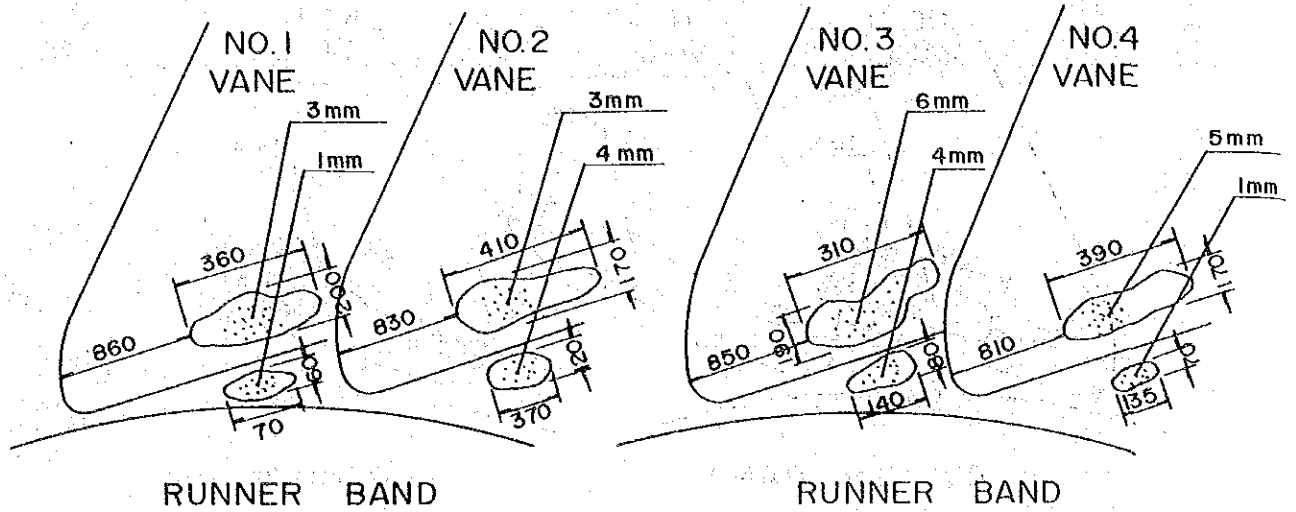


Fig.-13

Shape of Cavitation
Pitting on Runner Vane

Unit No. 4

24-1-1989

VANE NO. 2

(Unit: mm)

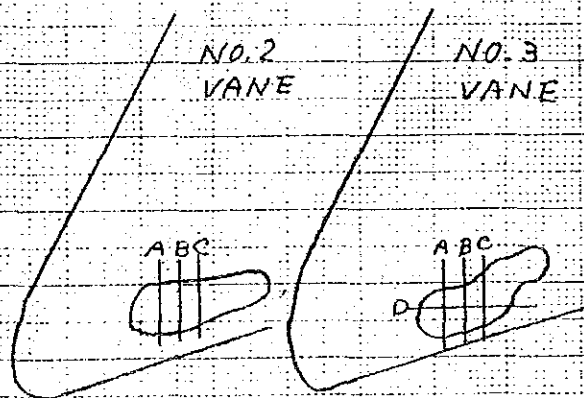
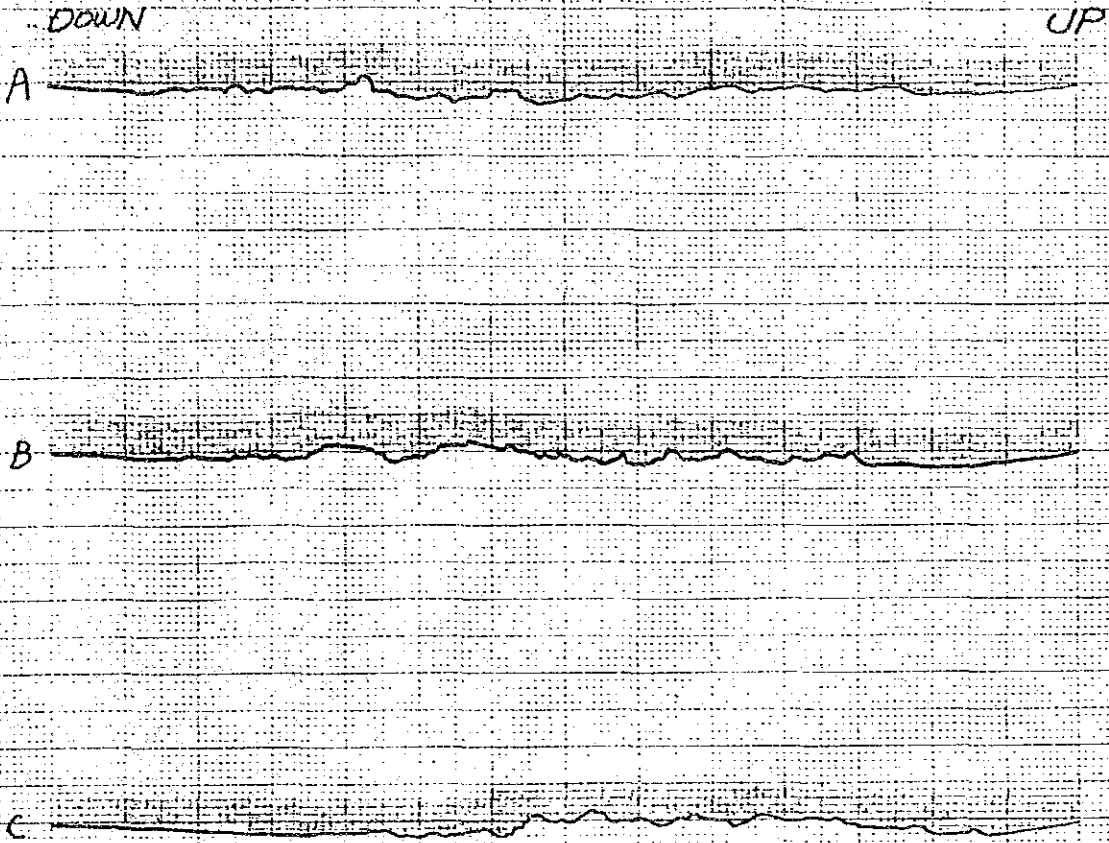


Fig.-14

Shape of Cavitation
Pitting on Runner Vane

Unit No.4

29-1-1989

(Unit:mm)

VANE NO.3

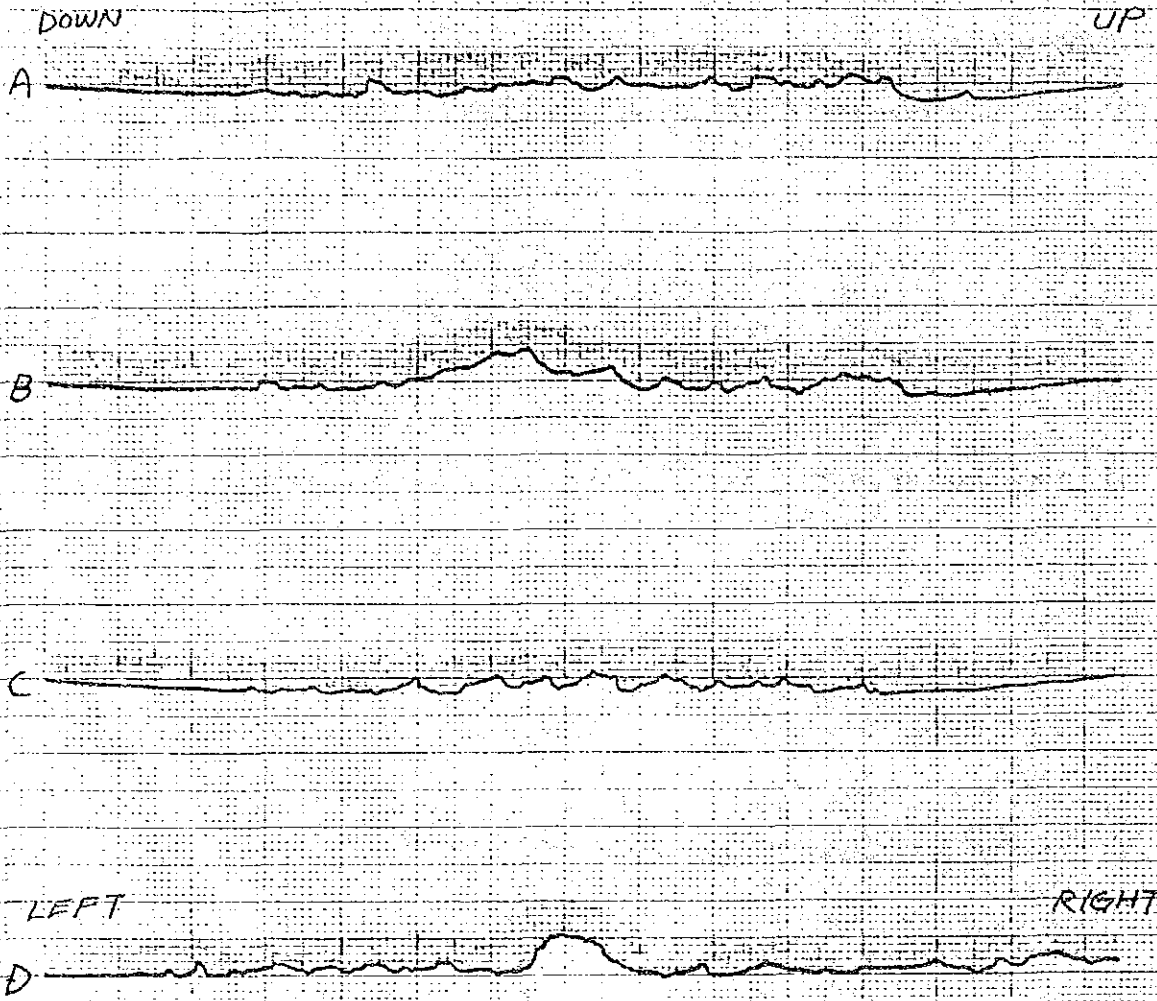
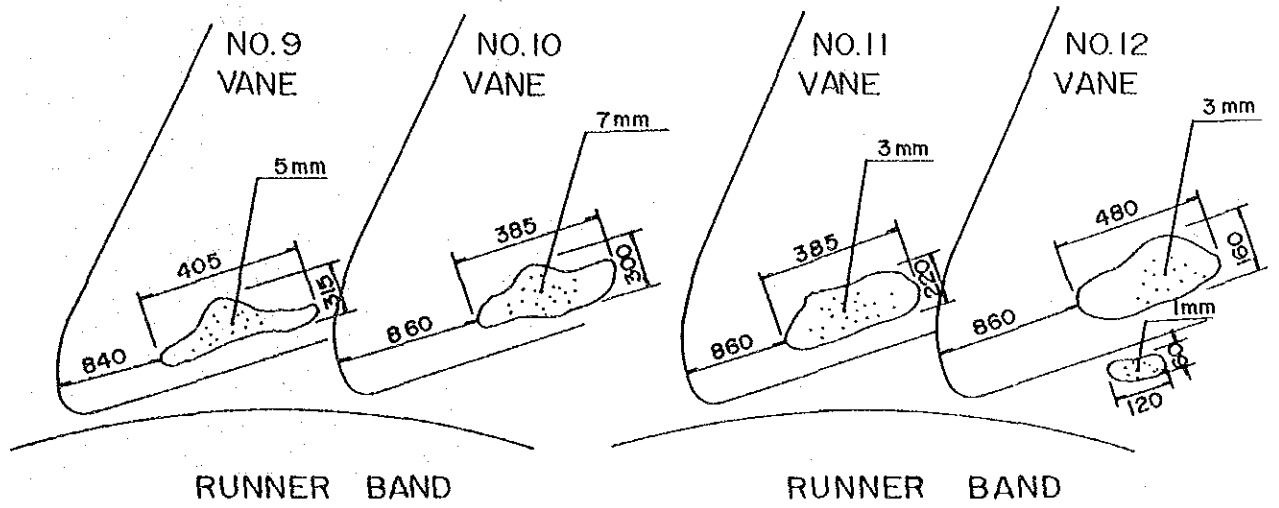


Fig.- 15

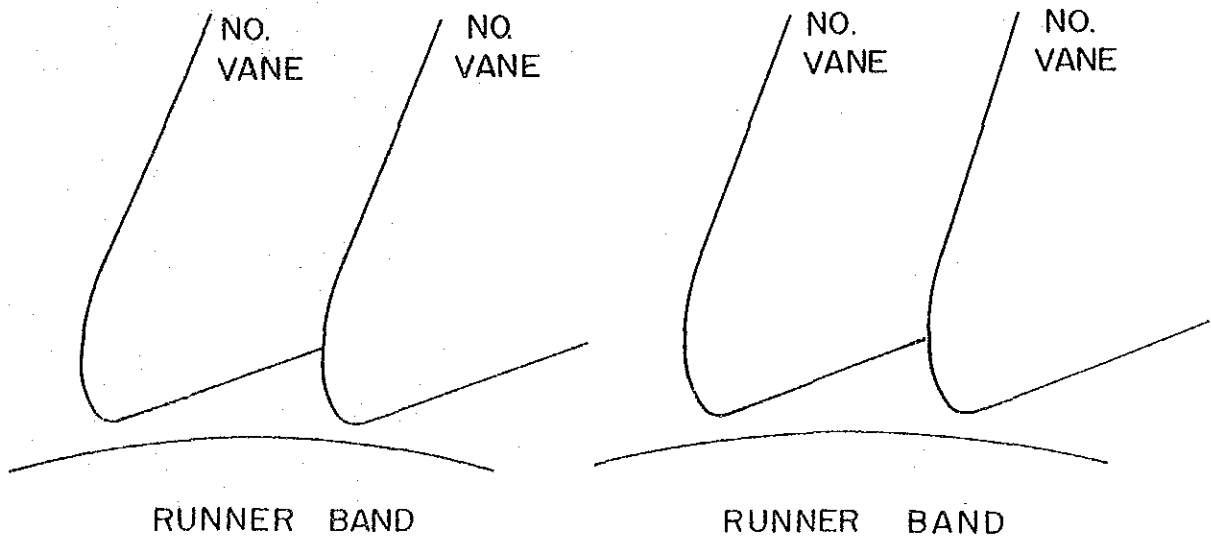
EDL NAM NGUM	# 3, #4 SITE SURVEY CAVITATION PITTING	
		24 / 1 / 1989

UNIT : NO4

UNIT : mm

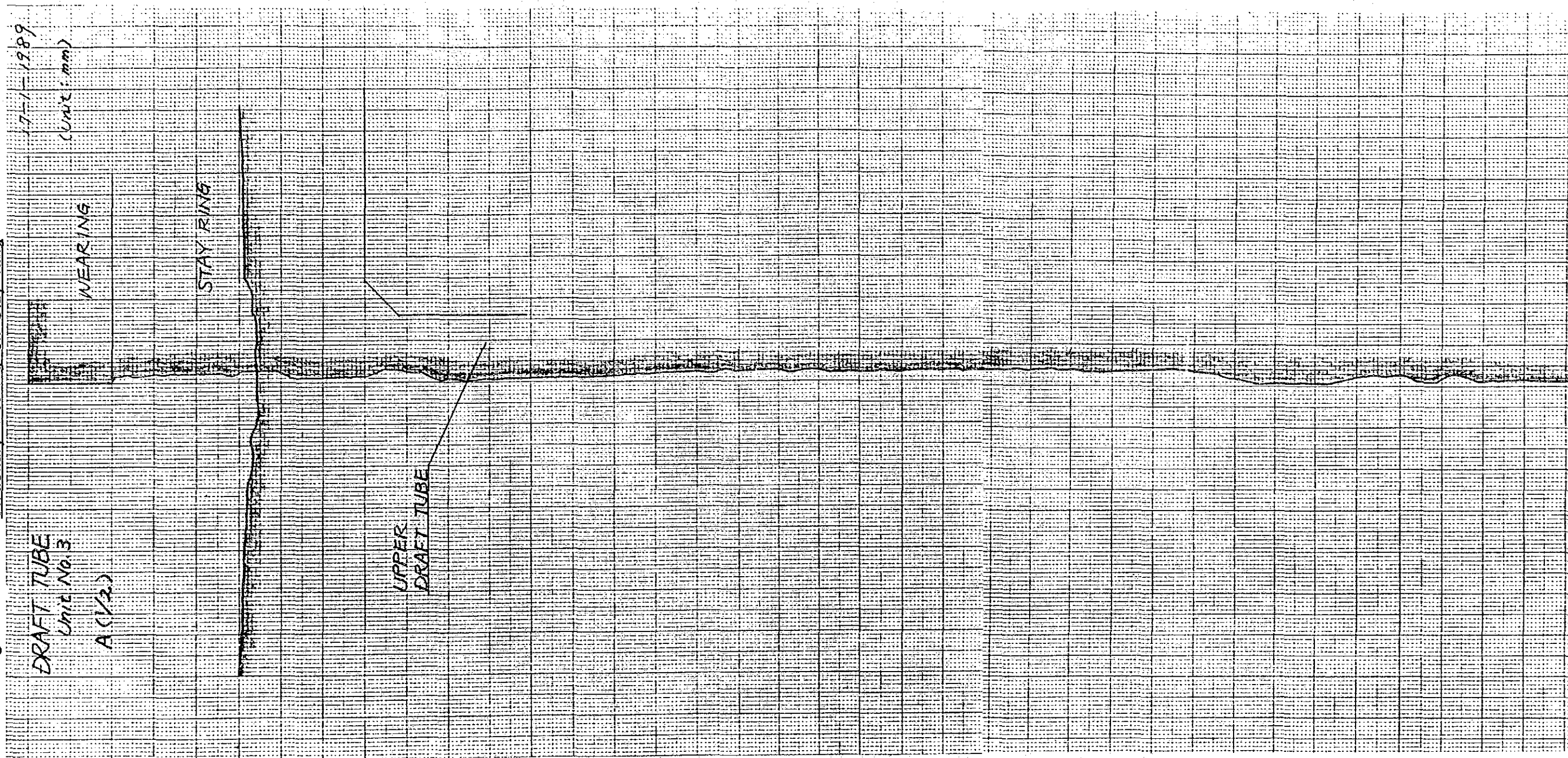


Total Area \approx 9200 cm²
 Max. depth \approx 7mm



Shape of Cavitation
and Corrosion just under
Stationary Wearing on Stay Ring

Fig.-16



Shape of Cavitation
and Corrosion just under
Stationary Wearing on Stay Ring

Fig.-17

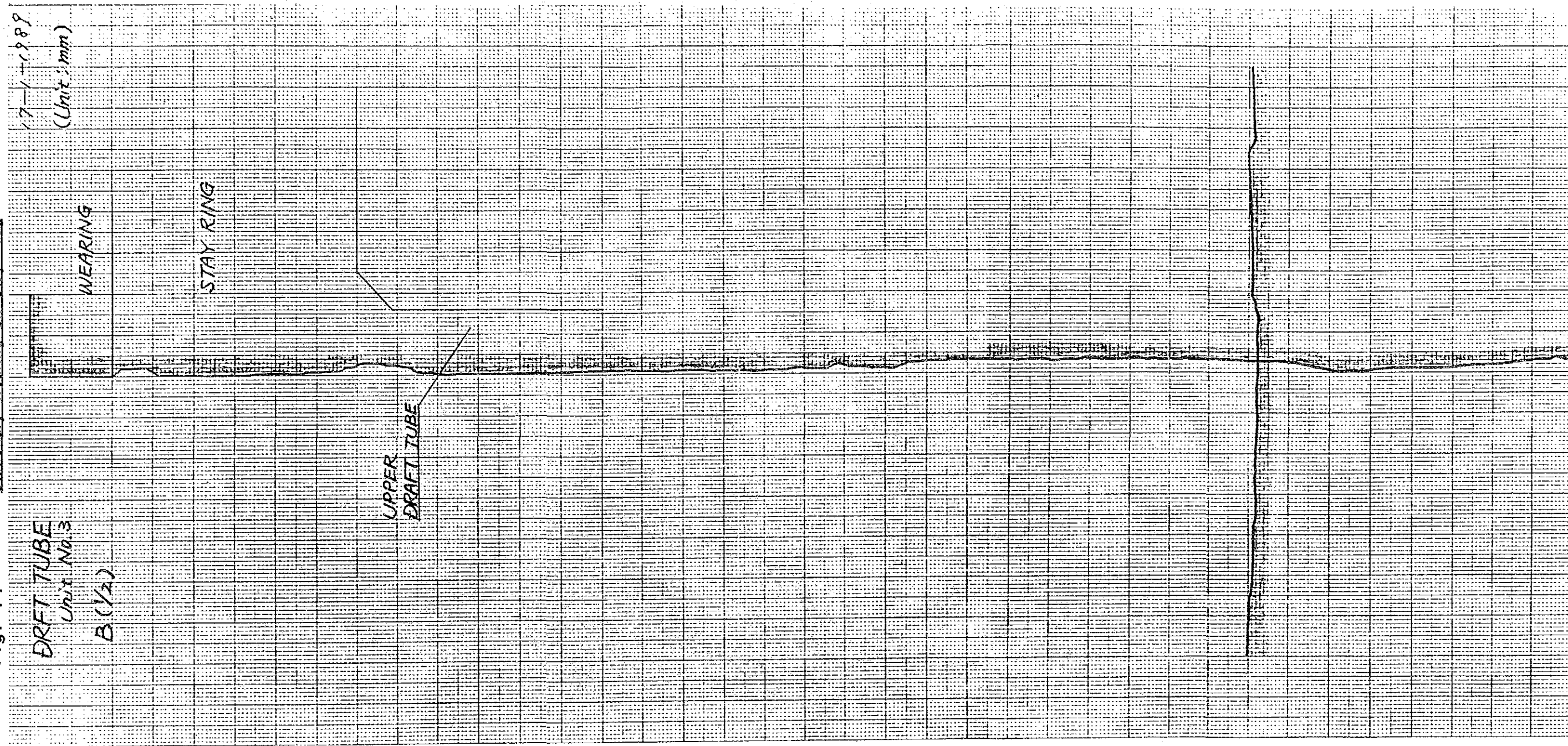


Fig.-18

Shape of Cavitation
and Corrosion just under
Stationary Wearing on Stay Ring

15-1-1989

Unit No.3

(Unit: mm)

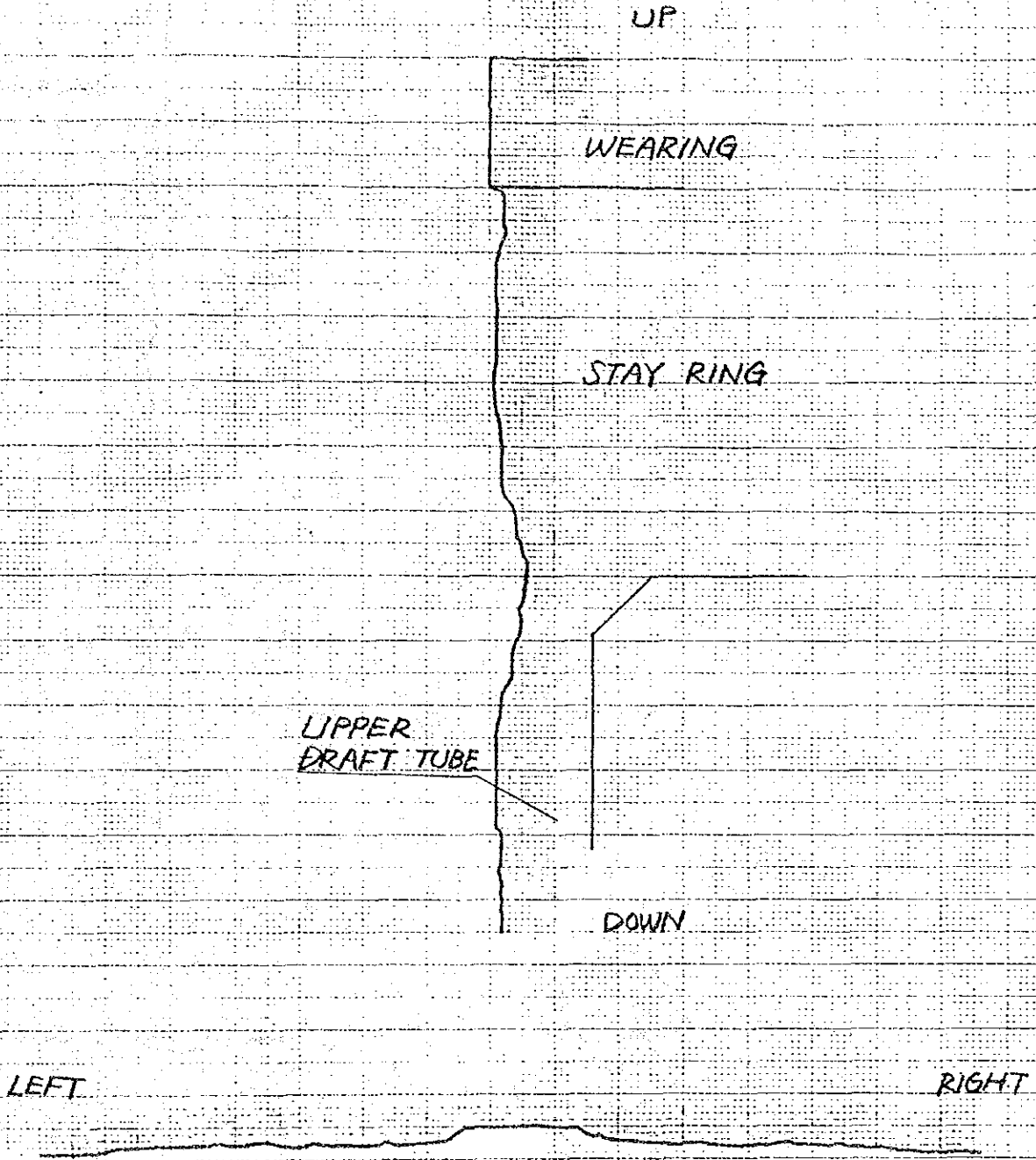


Fig.-19

Shape of Cavitation
and Corrosion just under
Stationary Wearing on Stay Ring

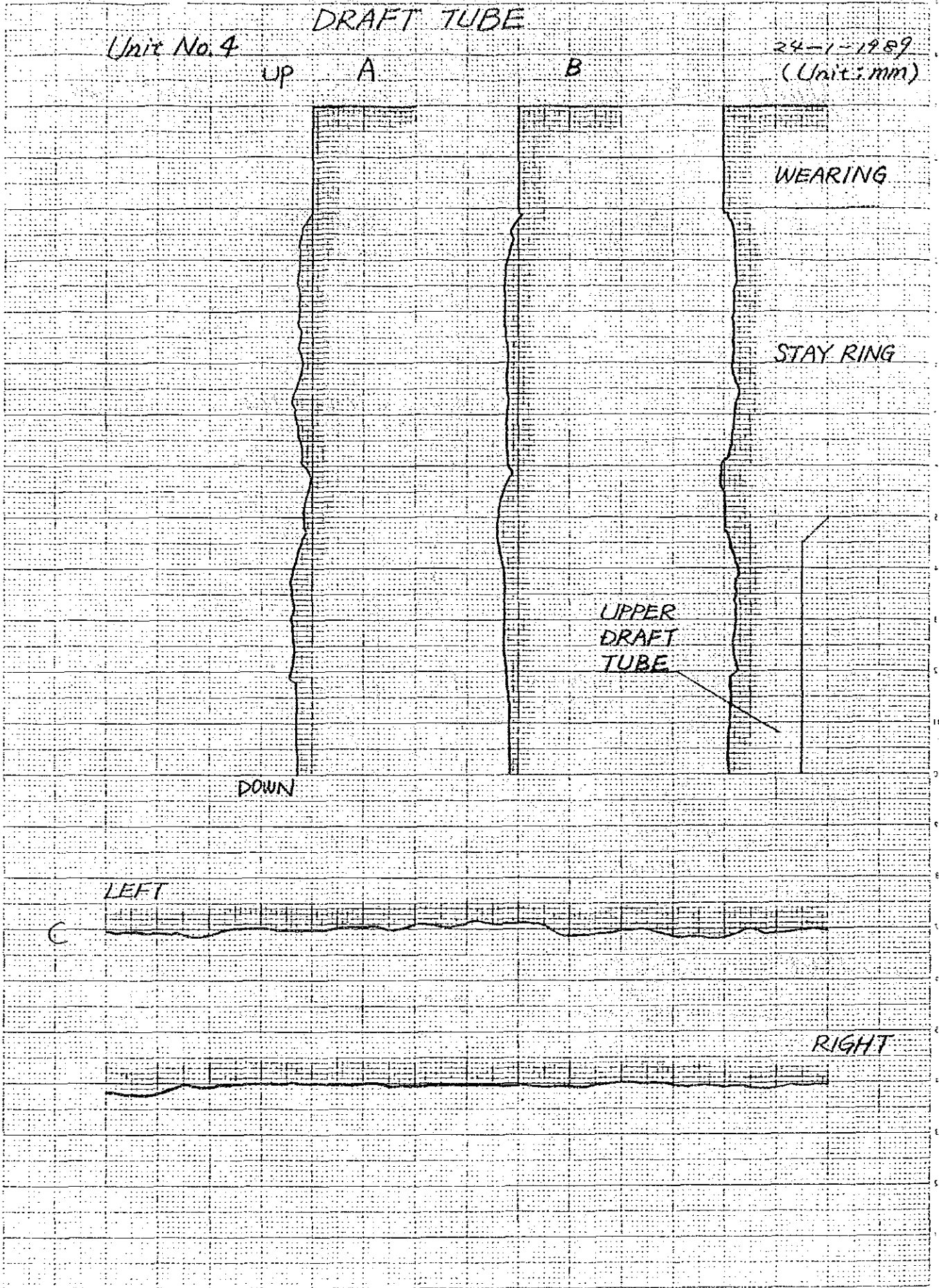


Fig.-20

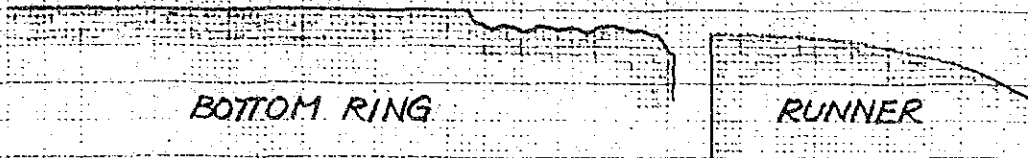
Shape of Corrosion on Bottom Ring

BOTTOM RING AND RUNNER
(Guide Vane No. 11-12)
Unit No. 3

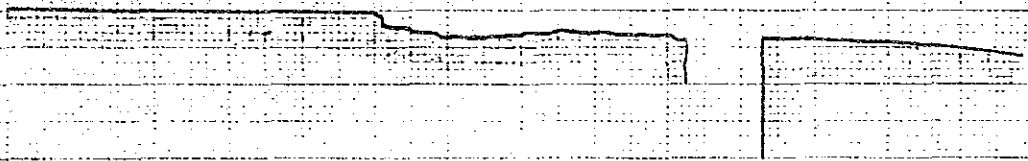
12-1-1989

(Unit: mm)

A-A SECTION



B-B SECTION



STAY RING

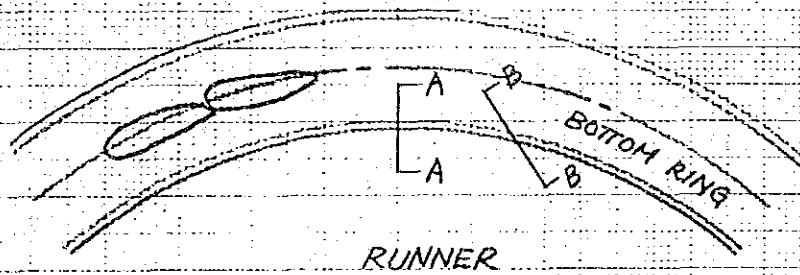


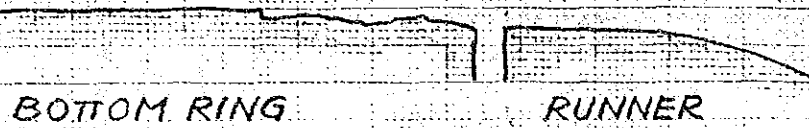
Fig.-21

Shape of Corrosion on Bottom Ring

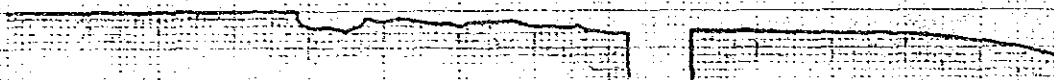
BOTTOM RING AND RUNNER
(Guide Vane No. 15-16)
Unit No. 4

22-1-1989
(Unit: mm)

A-A SECTION



B-B SECTION



STAY RING

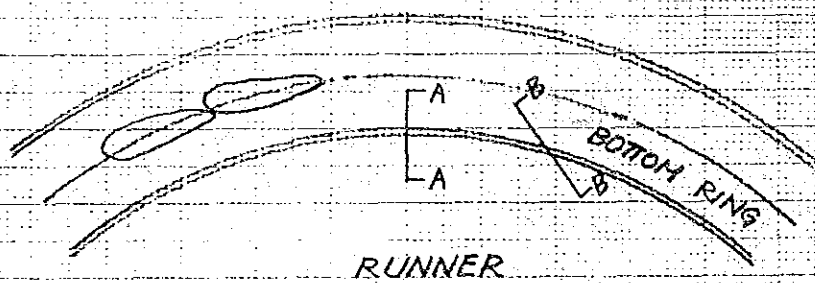


Fig. - 2 2

Shape of Corrosion on Stay Ring

BOTTOM RING AND STAY VANE
(Guide Vane No. 15-16)
Unit No. 4

24-1-1989

(Unit: mm)

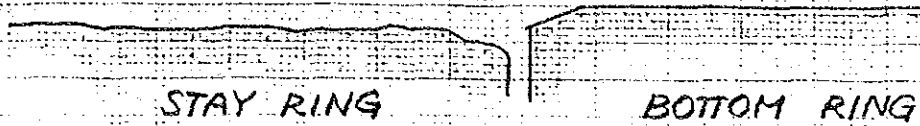


Fig.-23

Defect on Protective
Plate of Bottom Ring

17-1-1989

BOTTOM RING (Guide Vane No. 11-12.)
Unit NO.3

(Unit: mm)

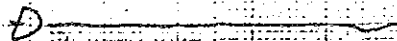
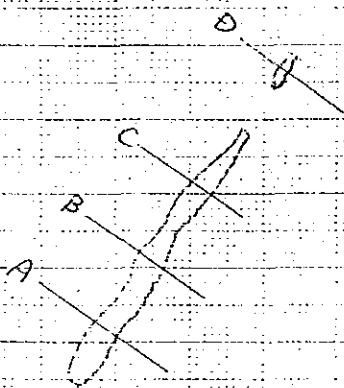
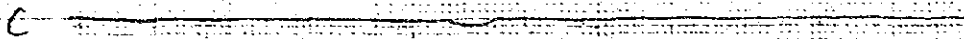
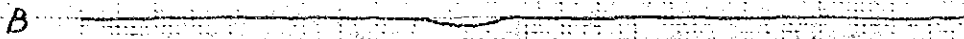
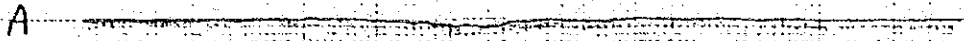
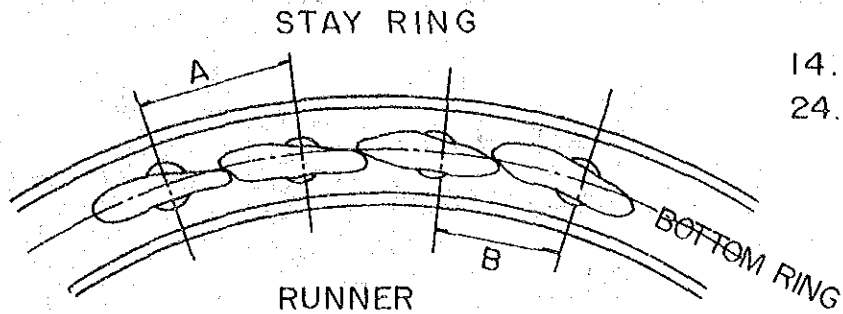


Table-1

EDL NAM NGUM	MAX. GAP BETWEEN BOTTOM RING AND STAYRING,	
	BOTTOM RING AND RUNNER	



14. 1. 1989

24. 1. 1989

Data Shows Maximum
Value ^{ON} Span A and B

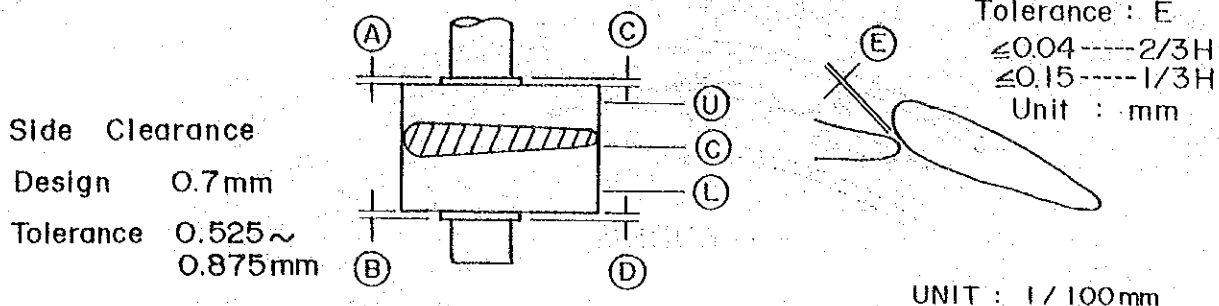
註 数値は区間 A, B 間の
最大値を示す

UNIT GV NO.	MAX. GAP BETWEEN BOTTOM RING AND STAY RING (A)		MAX. GAP BETWEEN BOTTOM RING AND RUNNER (B)	
	NO. 3	NO. 4	NO. 3	NO. 4
1-2	5.2	4	5.8	5.7
2-3	4.7	3.8	5.4	6.1
3-4	4.9	3.8	5.0	6.1
4-5	5	3.9	6.0	6.5
5-6	5.4	4.1	6.0	6.5
6-7	5.5	4	8.2	7.1
7-8	5.6	4	6.4	7.0
8-9	6.8	4.3	6.4	7.0
9-10	5.6	4.3	6.2	7.7
10-11	5.5	4.1	6.4	6.5
11-12	5.7	4.2	6.2	6.5
12-13	5.7	4.1	7.3	6
13-14	5.8	4.3	6.2	6
14-15	5.6	4.2	6.1	5.9
15-16	5.5	4.1	6.1	5.7
16-17	5.3	4.2	5.7	5.8
17-18	6.1	4.4	5.5	5.0
18-19	6.6	4.5	5.2	5.0
19-20	5.9	4.6	5.2	4.2
20-1	5.2	4.3	5.2	4.4

Table-2

EDL NAM NGUM	# 3, # 4 SITE SURVEY	
	WICKET GATE CLEARANCE	19/11/1984

UNIT : NO.3



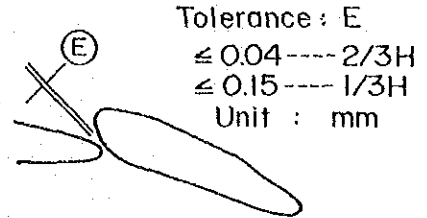
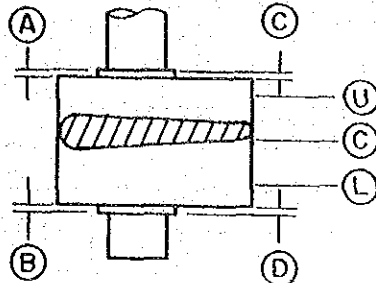
G.V NO.	WICKE GATE SIDE CLEARANCE						SHUTTER SUR- FACE CLEARANCD (E)		
	(A)	(B)	(C)	(D)	(A)+(B)	(C)+(D)	(U)	(C)	(L)
	1	41	36	65	111	77	176	0	0
2	50	50	55	165	100	220	0	0	0
3	45	75	50	265	120	315	0	0	0
4	40	76	46	223	116	269	0	0	0
5	50	40	55	75	90	130	0	0	0
6	40	80	50	130	120	180	0	0	0
7	59	155	65	200	214	265	0	0	0
8	50	100	55	165	150	220	0	0	0
9	45	130	60	400	175	460	0	0	0
10	52	70	50	145	122	195	0	0	0
11	40	55	65	115	95	180	0	0	0
12	40	153	50	350	193	400	0	0	0
13	45	125	60	300	170	360	0	0	0
14	40	90	55	132	130	187	0	0	0
15	55	80	50	110	135	160	0	0	0
16	52	72	54	119	124	173	0	0	0
17	50	50	50	55	100	105	0	0	0
18	40	48	50	40	88	90	0	0	0
19	35	40	60	55	75	115	0	0	0
20	50	45	70	75	95	145	0	0	0
mean	46	78.5	55.8	161.5	125	217			

Table-3

EDL NAM NGUM	#3, #4 SITE SURVEY WICKET GATE CLEARANCE	
-----------------	---	--

UNIT : NO.4

Side Clearance
Design 0.7mm
Tolerance 0.525~
0.875mm



UNIT : 1/100mm

G.V NO.	WICKE GATE SIDE CLEARANCE						SHUTTER SUR- FACE CLEARANCD		
	(A)	(B)	(C)	(D)	(A) + (B)	(C) + (D)	(E)		
							(U)	(C)	(L)
1	55	80	100	260	135	360	3	3	3
2	56	61	86	243	117	329	0	0	0
3	80	100	70	320	180	390	0	3	0
4	67	73	50	149	140	199	3	3	3
5	65	220	80	280	285	360	0	0	3
6	40	100	50	184	140	234	0	0	0
7	70	155	85	280	225	365	0	0	0
8	70	120	60	320	190	380	0	0	0
9	60	120	80	135	180	215	0	0	0
10	54	110	57	310	164	367	0	0	0
11	100	120	97	245	220	342	0	0	0
12	75	120	80	165	195	245	0	0	0
13	65	110	105	270	175	375	0	0	0
14	65	100	80	260	165	340	0	0	0
15	55	85	70	145	140	215	0	0	0
16	55	60	65	275	115	340	0	0	0
17	70	65	95	160	135	255	0	0	0
18	100	50	100	120	150	220	0	0	3
19	80	70	100	150	150	250	0	0	0
20	45	65	100	120	110	220	0	0	0
mean	66.4	99.2	80.5	219.5	166	300			

Table-4

OPERATION RECORD

EDL NAM NGUM	LOAD TEST Unit No. 3		23.1.1989		
Load	(MW)			32	
Generator	Voltage	(kV)		11.3	
	Current	(A)		1650	
	Frequency(Hz)	(Hz)		50	
	Power Factor	(%)		0.99 lag.	
Exciter	Voltage	(V)		200	
	Current	(A)		560	
Speed	(r.p.m)			136.4	
Servomotor	Stroke	(mm)		-	
Temperature (oC)	Stator Coil			-	
	Stator Coil			-	
	Stator Coil			-	
Temperature (oC) Bearing Oil (R.T.D)	W.T Guide Bearing			41	
	A.C.G Thrust Bearing			45	
Temperature (oC) (R.T.D)	W.T Guide Bearing			51	
	A.C.G Thrust Bearing			56	
	A.C.G Guide Bearing			48	
Temperature Cooling Water (oC)	Inlet			32	
	W.T Bearing Outlet			36	
	A.C.G Thrust Bearing Outlet			-	
Pressure	Spiral Case	(kgf/cm ²)		3.7	
	Draft Tube	(mAq)		7	
Shaft Runout	Turbine Shaft (1/100 mm)		5.0	8.0	3.0
Vibration (1/100 mm)	Generator	V	2.0	2.8	1.7
		H	5.0	7.0	4.5
	W.T Head Cover	V	4.0	5.0	1.5
		H	-	-	-
Upper Reservoir	EL (m)			203.692	
Tailrace	EL (m)			166.6	
Ambient Temperature of Generator Room (oC)					33

Table-5

OPERATION RECORD

EDL NAM NGUM	LOAD TEST Unit No. 4		13.1.1989		
Load	(MW)		10	22	34
Generator	Voltage	(kV)			11.1
	Current	(A)			1780
	Frequency	(Hz)			50
	Power Factor	(%)			0.99 lag.
Exciter	Voltage	(V)			200
	Current	(A)			540
Speed	(r.p.m)				136.4
Servomotor	Stroke	(mm)			-
Temperature (oC)	Stator Coil				-
	Stator Coil				-
	Stator Coil				-
Temperature (oC) Bearing Oil (R.T.D)	W.T Guide Bearing				40
	A.C.G Thrust Bearing				44
Temperature (oC) (R.T.D)	W.T Guide Bearing				49.5
	A.C.G Thrust Bearing				56
	A.C.G Guide Bearing				46
Temperature Cooling Water (oC)	Inlet				30
	W.T Bearing Outlet				40
	A.C.G Thrust Bearing Outlet				44
Pressure	Spiral Case	(kgf/cm ²)			3.6
	Draft Tube	(mAq)			6.5
Shaft Runout	Turbine Shaft (1/100 mm)		5.0	7.5	2.5
Vibration (1/100 mm)	Generator	V	-	-	-
		H	-	-	-
	W.T Head Cover	V	3.5	5.2	1.5
		H	-	-	-
Upper Reservoir	EL (m)				203.689
Tailrace	EL (m)				167
Ambient Temperature of Generator Room (oC)					33

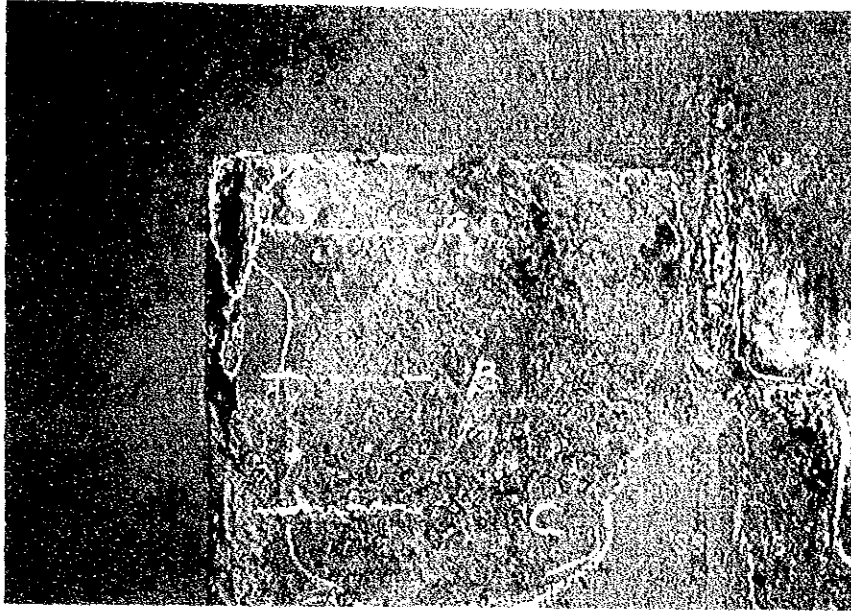


Photo-1 Damage on The Surface of Whirl Suppressing Fin
inside Draft Tube, Unit No.3

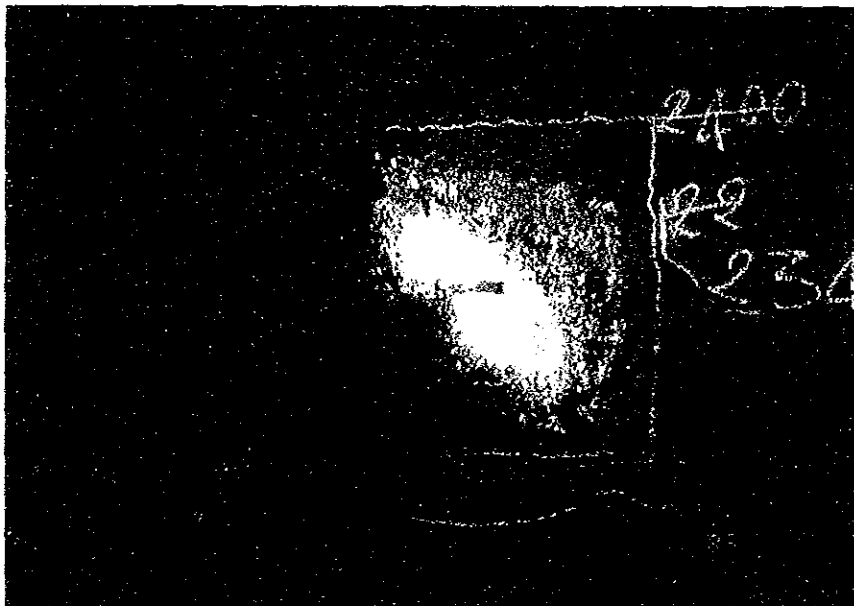


Photo-2 Cavitation Pitting of The Downstream of Whirl
Suppressing Fin, Unit No.3

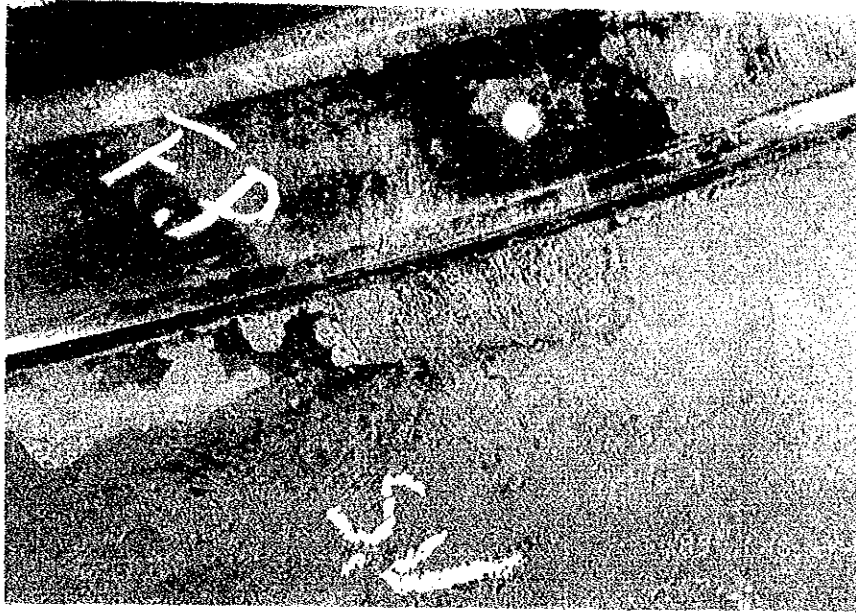


Photo-3 Erosion of The Staying facing to The Bottom Ring, Unit No.3

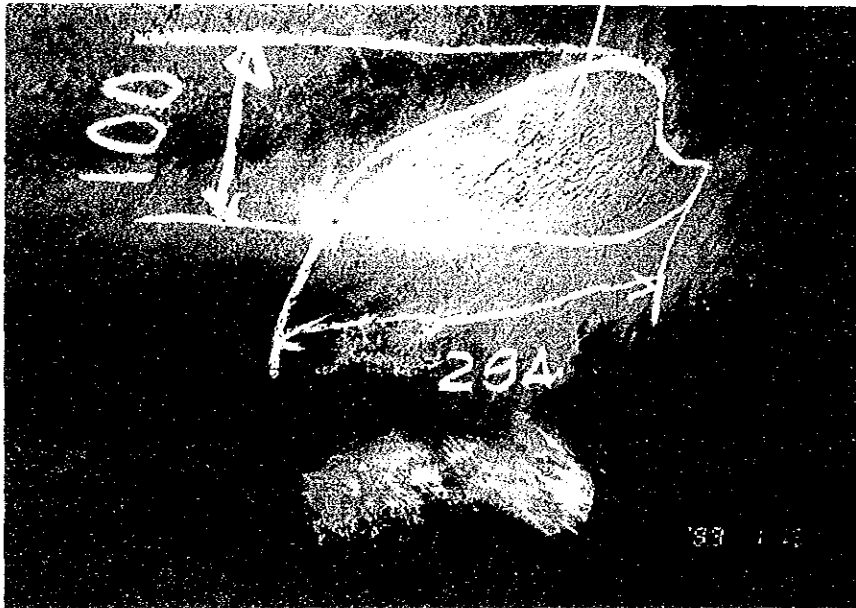


Photo-4 Cavitation Pitting of No.6 Runner Vane, Unit No.3

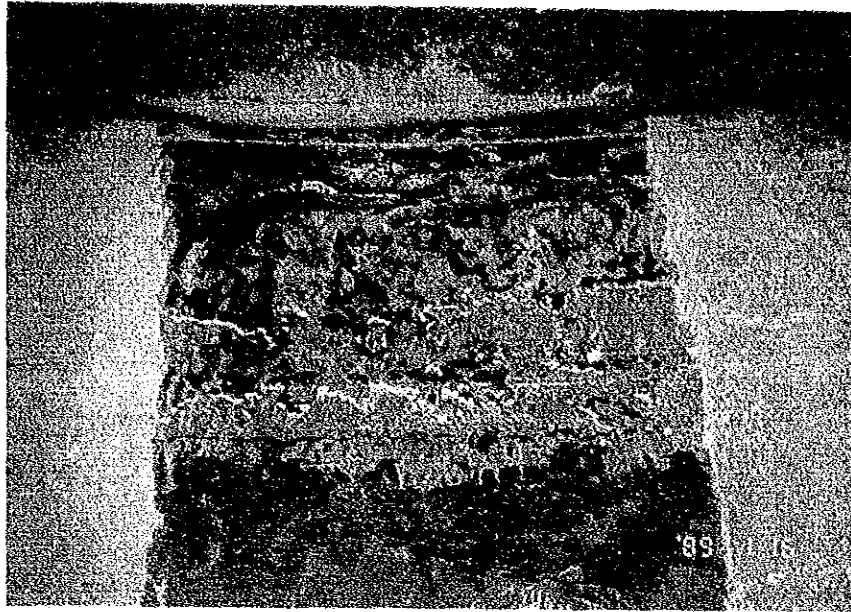


Photo-5 Cavitation Pitting on The Upper Draft Tube Liner just below Runner Outlet, Unit No.3

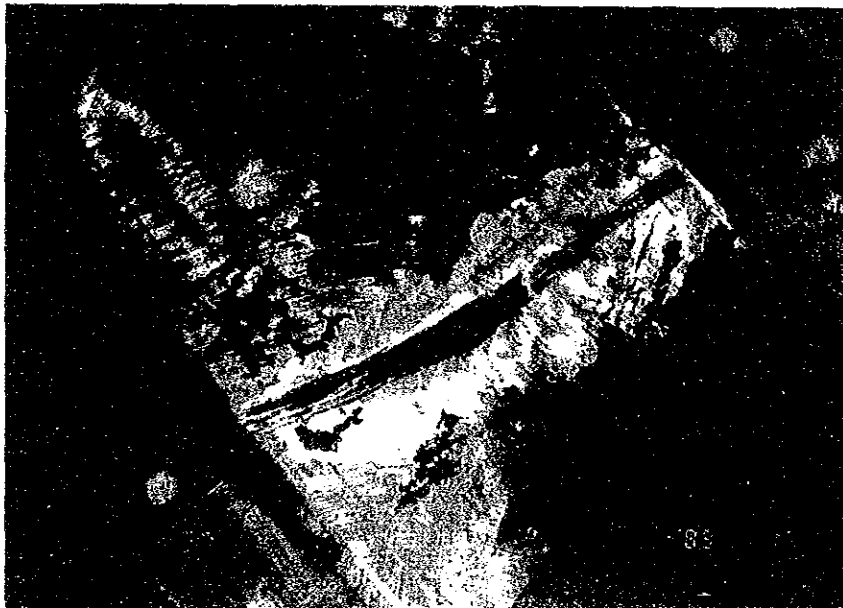


Photo-6 Damage of Protection Plate, Unit No.3



Photo-7 Erosion of Bottom Ring, Unit No.3

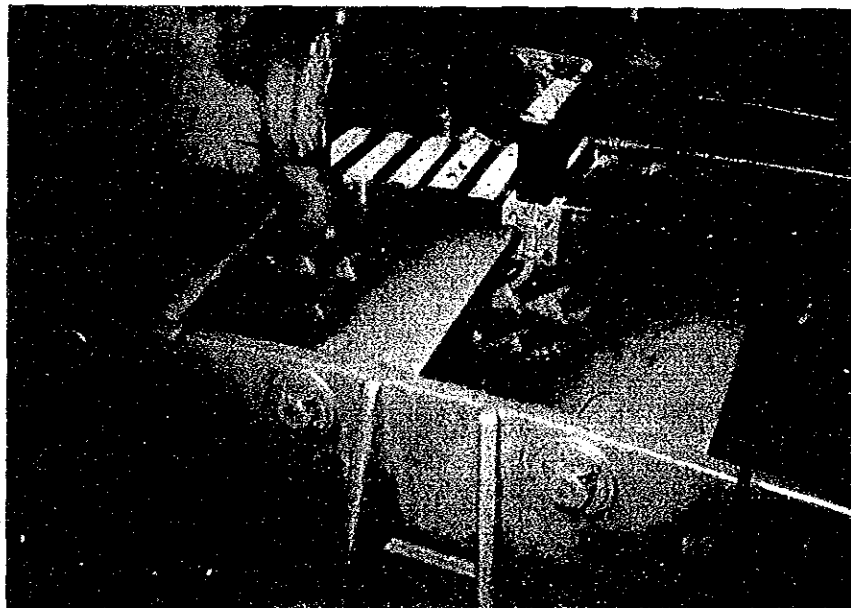


Photo-8 Joint Parts of The Stator Windings
(This photo was taken under temporary removal of the end bell. The red colored insulation varnish oozes out. The varnish drop stays beneath the red points.)



Photo-9
Ooze of Red Colored Insulation
Varnish, Unit No.4



Photo-10 Oil Leakage from Thrust Bearing Oil Tank, Unit No.3

APPENDIX

MEMBER OF STUDY TEAM

Team Leader	Bunzo SATO	Ministry of International Trading and Industry, Japan
Engineer for Power Generating Planning	Sumao ICHIKAWA	Nippon Koei Co., Ltd.
Engineer for Hydraulic Turbine	Shigeo IKEDA	Nippon Koei Co., Ltd.
Expert for A.C. Generator and Electrical Equipment	Masami KAWAHARA	Nippon Koei Co., Ltd.
Engineer for Intake Gate and Mechanical Engineering	Kenji SETO	Nippon Koei Co., Ltd.

SCHEDULE OF BASIC DESIGN STUDY TEAM

Date	Mr. B. Saio	Mr. S. Ichikawa	Mr. S. Ikeda	Mr. M. Kawahara	Mr. K. Seto
Jan. 9 (Mon.)	NRT - BKK (TG 641)				
Jan. 10 (Tue.)	BKK - VTE (QV 422)				
Jan. 11 (Wed.)	Courtesy call and explanation on the Project to Japanese Embassy				
Jan. 12 (Thu.)	Courtesy call on Director of Department No.2 of Ministry of Foreign Affairs, Lao PDR and Minister of Industry and Handycraft, Lao PDR and Ambassador of Japan				
Jan. 13 (Fri.)	General explanation of the Project at EDL Head office in Vientiane				
Jan. 14 (Sat.)	Explanation and discussion on Questionnaire at EDL Head office in Vientiane				
Jan. 15 (Sun.)	VTE-NNG				
Jan. 16 (Mon.)	General inspection of the Nam Ngum Power Station				
Jan. 17 (Tue.)	General inspection, data collection and preparation of schedule				
Jan. 18 (Wed.)	Discussion with key Personnel of the Nam Ngum Power Station				
Jan. 19 (Thu.)	Inspection and data collection				
Jan. 20 (Fri.)	Interior inspection of No.3 turbine				
Jan. 21 (Sat.)	Interior inspection of No.3 generator				
Jan. 22 (Sun.)	Interior inspection of No.3 turbine				
Jan. 23 (Mon.)	Interior inspection of No.3 generator				
Jan. 24 (Tue.)	Measurement of No.4 unit operation				
Jan. 25 (Wed.)	Inspection of auxiliary equipment and facilities				
Jan. 26 (Thu.)	NNG-VTE				
Jan. 27 (Fri.)	Interim reporting on inspection of No.3 unit at meeting held at EDL office in Vientiane				
Jan. 28 (Sat.)	Technical discussion between EDL and the Team at EDL office in Vientiane				
Jan. 29 (Sun.)	Signing on the Minutes of Discussion and reporting to Japanese Embassy				
Jan. 30 (Mon.)	VTE-BKK(QV 416)				
Jan. 31 (Tue.)	General inspecting of No.4 unit				
Feb. 1 (Wed.)	Site inspection				
Feb. 2 (Thu.)	Interior inspection of No.4 turbine				
Feb. 3 (Fri.)	Interior inspection of No.4 generator				
Feb. 4 (Sat.)	Interior inspection of No.4 turbine				
Feb. 5 (Sun.)	Interior inspection of No.4 turbine				
Feb. 6 (Mon.)	Interior inspection of No.4 generator				
Feb. 7 (Tue.)	Measurement of No.3 unit operation				
Feb. 8 (Wed.)	Inspection of air conditioning and ventilation systems				
Feb. 9 (Thu.)	Compilation of inspection results				
Feb. 10 (Fri.)	Inspection of auxiliary equipment of No.3 and No.4 units				
Feb. 11 (Sat.)	Discussion on inspection results with key personnel at the Nam Ngum Power Station				
Feb. 12 (Sun.)	NNG-VTE				
Feb. 13 (Mon.)	Technical meeting on field inspection with key personnel at EDL office and reporting to Japanese Embassy				
Feb. 14 (Tue.)	VTE-BKK(QV 416)				
Feb. 15 (Wed.)	BKK-NRT(TG 640)				

NRT: Naria, Japan
 BKK: Bangkok, Thailand
 VTE: Vientiane, Laos
 NNG: Nam Ngum Site, Laos

LIST OF COLLECTED DATA

1. Drawings and Design Data	
(1) Drawings of Generator	21 sheets
(2) Technical Data (AEG)	18 pages
(3) Drawings of Turbine	8 sheets
(4) Drawings of Intake Gate	19 sheets
(5) Parts List of Intake Gate Hoist	31 pages
2. Operation Records	
(1) Nam Ngum Dam Reservoir Operation Curve and Monthly Maximum Energy Production Plan	1 page
(2) Nam Ngum Monthly Energy Production and Discharge Record	3 pages
(3) Turbine Efficiency Curve	1 page
(4) Operation Manual of Intake Gate	16 pages
3. Statistics Data	
(1) Country Data	20 pages
(2) Nam Ngum Statistics Data of Export and Import of Electricity	15 pages
(3) Statement of Accounts of EDL	13 pages
(4) Table of EDL Tariff	1 page
(5) EDL Budget and Results for 5 years	1 page
(6) Xeset Hydro Project Feasibility Study Report	1 copy

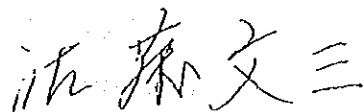
MINUTES OF DISCUSSIONS
ON
THE BASIC DESIGN STUDY
ON
THE PROJECT FOR REPAIR OF NAM NGUM DAM POWER STATION
UNITS NO.3 AND NO.4
IN
THE LAO PEOPLE'S DEMOCRATIC REPUBLIC

In response to the request made by the Government of the Lao People's Democratic Republic for a grant aid of the Project for Repair of Nam Ngum Dam Power Station, Units No. 3 and No. 4 (hereinafter referred to as "the Project") the Government of Japan has dispatched, through the Japan International Cooperation Agency (JICA), a survey team headed by Mr. Bunzo SATO, official of the Ministry of International Trading and Industry, Japan (hereinafter referred to as "the Team") to conduct the basic design study on the Project for 19 days from January 10 to January 28, 1989.

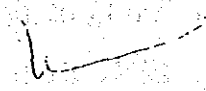
The Team has carried out a field survey, had a series of discussions and exchanged views with the Laotian authorities concerned of the Project.

As a result of the survey and discussions, the Team and Laotian authorities have agreed to recommend to their respective Governments that the results of the discussions attached herewith should be examined toward the realization of the Project.

Vientiane, January 20, 1989



Bunzo SATO
Team Leader
JICA Survey Team



Khammone PHONEKEO
General Manager
ELECTRICITE DU LAOS

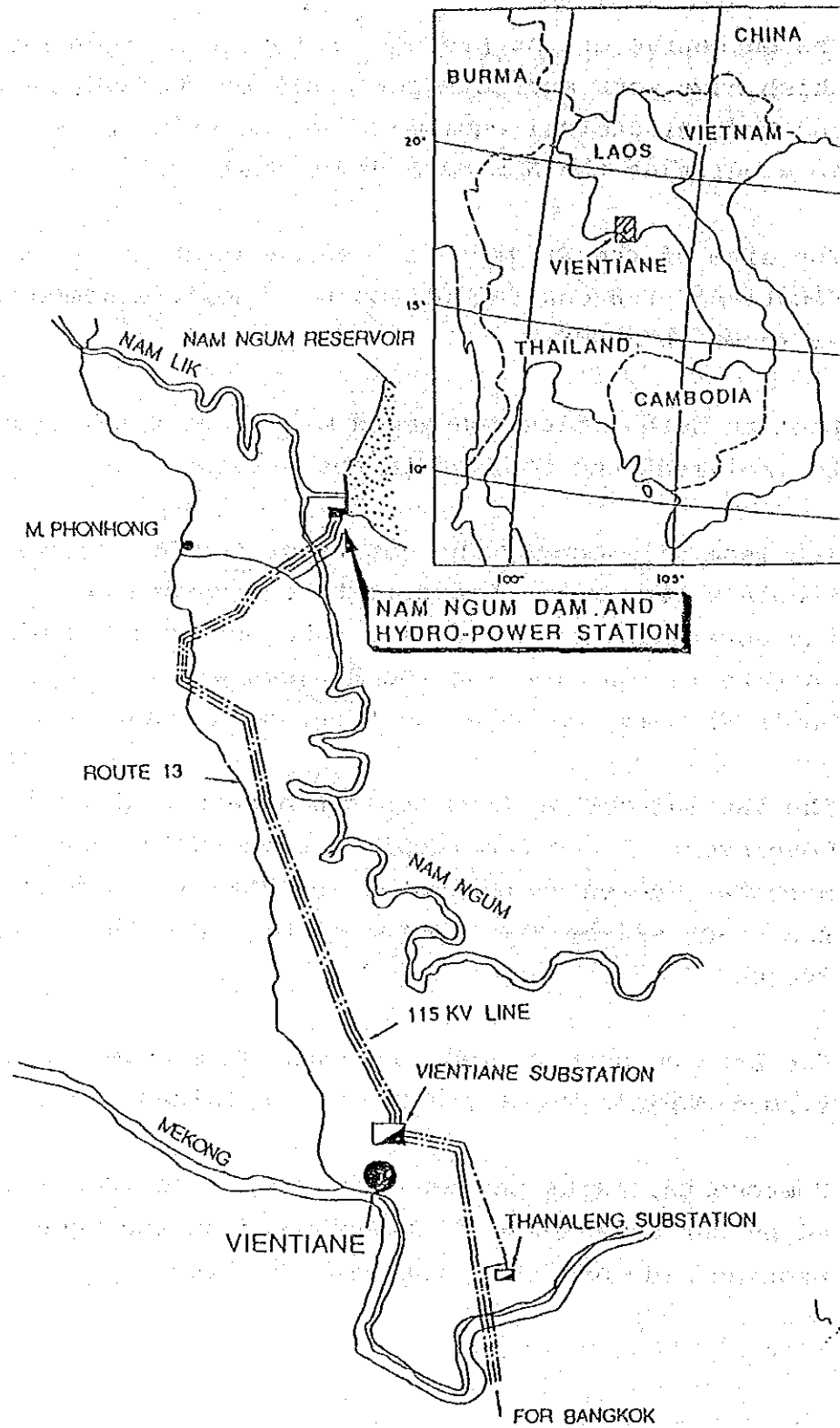
ATTACHMENT

1. The objective of the Project is to repair components and parts which have worn and torn seriously of the hydromechanical and hydroelectrical equipment on the existing No.3 and/or No.4 units at the Nam Ngum Power Station.
2. The site of the Project is located at about 90 km north from Vientiane, the capital of the Lao People's Democratic Republic as shown in ANNEX I.
3. Laotian authorities concerned will have total responsibility to implement the Project in the Laotian side.
4. The Team will convey the desire of the Government of the Lao People's Democratic Republic to the Government of Japan that the Government of Japan will take necessary measures to cooperate in implementing the Project within the scope of Japan's Economic Cooperation Program in grant form.
5. The Laotian authorities concerned have confirmed that the Government of the Lao People's Democratic Republic will take necessary measures as listed in ANNEX II on condition that the grant aid by the Government of Japan is extended to the Project.
6. The Laotian authorities concerned have understood and confirmed Japan's Grant Aid System explained by the Team.
7. Components, parts and services to be provided will be finalized by the Government of Japan based on the request of the Laotian side and the result of the study.

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ANNEX I



LOCATION MAP

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ANNEX II

Components, parts and services requested by the Government of the Lao People's Democratic Republic whose cost will be borne by the Government of Japan are:

1. Hydraulic turbines No.3 and No.4
2. Generators No.3 and No.4 except excitation systems
3. Auxiliary mechanical equipment
4. Intake gates No.3 and No.4
5. 115 kV switchyard equipment
6. Unit control systems of units No.3 and No.4
7. AC/DC auxiliary power supplies

Above seven (7) items are subject to change by the results of the basic design work.

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ANNEX III

Following measures are to be undertaken by the Government of the Lao People's Democratic Republic.

1. To provide data and information necessary for basic design.
2. To secure the spaces for execution of the repair work and storage of equipment and materials required.
3. To obtain official permission of EGAT to stop the unit(s) for execution of the repair work at predetermined times and for an agreed period.
4. To provide electric power necessary for execution of the repair work.
5. To bear commissions to a Japanese foreign exchange bank for the banking services based upon the Banking Arrangement.
6. To ensure prompt unloading, tax exemption, and customs clearance at the port of disembarkation in the Lao People's Democratic Republic and prompt internal transportation of the imported equipment and materials for the Project.
7. To exempt Japanese nationals concerned from customs duties, internal taxes and other fiscal levies which may be imposed in the Lao People's Democratic Republic with respect to the supply of the products and services under the verified contracts.
8. To provide and accord necessary permission, licences and other authorization required for the Project.
9. To bear all the expenses other than those to be borne by the grant, necessary for the execution of the Project.
10. To maintain and use properly and effectively the equipment for the Project.

January 27, 1989

MEMORANDUM

To : Mr. Khammone Phonekeo, General Manager of EDL

From : B. Sato, Leader of JICA Team

Subject : Field Investigation of Generating Equipment, Units No.3 and No.4 at Nam Ngum Power Station

Reference : - EDL's Preliminary Study Report (March 1988) on Repair of Nam Ngum Dam Power Station (Units No.3 and No.4)
 - JICA's Inception Report (January 1989)
 - Minutes of Discussion signed on January 20, 1989

A. Results of Field Investigation

Upon completion of the comprehensive field investigation of the generating equipment units No.3 and No.4 and other relating facilities, the following matters have become clear:

1. The statement of Clause 3.2 in Chapter III of the EDL's Report on observation results obtained from investigation at the site during June 1986 are generally correct. However, Sub-clause (5) on the main transformers is to be deleted.
2. Proposed considerations mentioned in Clause 3.3 of the EDL's Report on countermeasures to be taken are technically justifiable with the exception of Sub-clause 2-8) on excitation system of the generator and Sub-clause (5) on the main transformers.
3. Present conditions of the turbine and generator units No.3 and No.4 are almost identical with each other.
4. Progress of fatigue including of corrosion/erosion in the units No.3 and No.4 since execution of the investigation during June 1986 is slow.

B. Findings during Investigation

The following are findings observed and information confirmed which are not mentioned clearly in the EDL's Report:

1. Insulation varnish applied on connecting bars for stator windings of both the No.3 and No.4 generators oozes out.
2. Mechanical speed switches for the No.4 unit are out of service at present.
3. The check valves in the cooling water system which are now out of services are in the primary circuits instead of the secondary circuit (re: Sub-clause 3-5-2).

4. Strands of wire rope used for 5-ton hoist of the 100-ton overhead crane have deformed passably, while the EDL's Report mentions replacement of wire rope of the 5-ton hoist of 80-ton crane in Sub-clause 3-1-3).
5. Indication of water levels for reservoir and tailrace is incorrect.
6. Position indicator of the No.3 intake gate does not function.

C. Additional Items

Mr. Houmphone, Manager of Nam Ngum Power Station, has requested the Team to deal the items mentioned in Annex-1 as "Additional Items for the Project".

The Team will take these items into the Basic Design Work within the limit of budgetary arrangement by the Japanese Government with reference to EDL's understanding on the priority which is given in the next Article D.

D. Priority of Project Items

Alphabetical order represents higher priority of the Project Items as "A" means the top priority. The following are so-called ranking of these priority understood by EDL:

"A" : All items mentioned in the Minutes of Discussion.

Although the definite conclusion will be formulated in the Basic Design Work, tentative judgement of the Team on countermeasures to be taken for major items is as given below:

a) Turbines

- Overhaul (including auxiliary equipment)
- Welding repair on cavitation pitting of the runners
- Repair of limited erosion on top and bottom surfaces of specific guide vanes
- Repair of unevenness in the top portion of upper draft tube liners
- Partial application of anti-corrosive paint inside of the turbines
- Replacement of jointers for mechanical speed switches
- Supply of spare parts which are needed urgently

b) Generators

- Overhaul
- Change of insulation on connecting bars of the stator windings by use of good quality materials
- Supply of spare parts which are needed urgently

c) Auxiliary Mechanical Equipment

- Replacement of water level indicating equipment
- Supply of spare parts for the cooling water system

d) Intake Gates

- Replacement of electrical components which are in faulty condition
- Replacement of distribution box on dam crest
- Replacement of faulty limit switches of gantry cranes

e) 110kV Switchgear

- Overhaul of the circuit breakers and disconnecting switches
- Replacement of the potential devices

f) Control, Instrumentation and Protection

- Calibration/repair/replacement of instruments for indication, integration and recording
- Operation test of principal protective relays

g) AC/DC Auxiliary Power Supplies

- Replacement of storage batteries installed in Phase II
- Replacement of defective MCCB's

- "B" :
- Replacement of rubber sealing strips for bearing housings
 - Renewal of brake shoes
 - Change of location of oil mist separators from turbine pit
 - Supply of V-belts for the ventilation and A.C. system
 - Operation test of automatic synchronizer

- "C" :
- Replacement of defective switchgear equipment mounted inside 22kV outdoor cubicle
 - Overhaul of 11kV circuit breakers in main circuit of No.1 and No.2 generators
 - Overhaul of ACB's in low tension circuits installed in Phase I
 - Supply of spare parts requested by EDL

E. Classification of Work Items

The Team has proposed to classify the work items in accordance with the following categories in case of execution of the Repair Project:

- Work I : Execution of the works by the Contractor
Work II : Execution of the works by EDL personnel with technical guidance services by the Contractor's supervisors
Work III: Execution of the works by EDL personnel only

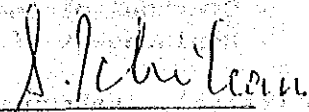
Annex-2 shows the EDL's ideas on the said classification for execution.

F. Operating Condition of the Units No.3 and No.4

The Team has judged that the present condition of the units No.3 and No.4 is in a good level because the temperature and vibration of the respective portions are all moderate. Then, the continuous operation of both the units can be done, without any apprehension, until the overhaul of them will be executed expectantly in coming 1990.

Acknowledgement

The Team heartily appreciates kind arrangement and positive cooperation of you and your personnel concerned given during the investigation.


for B. Sato
Leader of JICA Survey Team

Encl: Annex-1 and Annex-2

Copies to:

- Mr. Houmphone, Manager of Nam Ngum P.S.
- Embassy of Japan, Vientiane

Received by



Khammone Phonekeo
General Manager
EDI,

ANNEX-1

Additional Items requested by EDL for the Project

A. Drainage Sump Tank and Pressurized Tank

1. Control circuit/electrode command check
2. Pumping condition and water piping check and remedy

B. Intake Gate

1. Overhaul of control cabinet, gate position indicator and brake system
2. Level indicator
3. Transmitter

C. Control, Instrumentation and Protection

1. Signal lamps
2. DC motors for speed changer and load limiter as spare

D. 110kV Switchgear

1. Overhaul of all air blast circuit breakers
2. Overhaul of instrumentation transformers and lightning arresters
3. Supply of spare parts
4. Supply of one circuit breaker for primary side of local transformer

E. 11kV Switchgear

1. Overhaul
2. Overhaul/change of transformers of AVR for units No.3 and No.4
3. Electro-pneumatic valve for ABB
4. Closing coil and tripping coil for ABB as spare
5. Station post insulator for bus support to main transformer
6. Surge absorbers (3 sets)

F. 22kV Switchgear

(Overhaul or replacement of the following equipment:)

1. Oil circuit breaker
2. Disconnecting switch
3. Current transformer
4. Watthour meter
5. Fault annunciator
6. Meters and relays

G. AC/DC Auxiliary Power Supplies

1. Lead acid storage batteries
2. Overhaul of low tension cubicle and of air circuit breaker
3. Diluted sulfuric acid
4. DC voltmeter

5. Hydrometer

II. Field Breaker

1. Air circuit breaker with spare parts for units No.1 and No.2

I. Main Control Board

1. Change of 3-phase watt-hour meter for No.1 transmission line
2. Fault analyzer

ANNEX-2

Classification of Work Items

Work I

- Works for turbines and auxiliary equipment
- Works for generators
- Works for 11kV switchgear
- Replacement of rubber seals for bearing housing
- Replacement of generator air brake shoe
- Change of location of oil mist separator
- Operation test of automatic synchronizer
- Works for 11kV switchgear
- Works for low tension switchgear

Work II

- Calibration/repair/replacement of instruments
- Operation test of protective relays
- Replacement of storage batteries
- Replacement of defective MCCB's

Work III

- Works for auxiliary mechanical equipment
- Works for intake gate and gantry crane
- Replacement/repair of distribution box on dam crest
- Replacement of defective switchgear equipment inside 22kV cubicle

LIST OF OFFICIALS CONCERNED
AND
COUNTERPART PERSONNEL

1. Officials Concerned

(1) Ministry of Foreign Affairs

Mr. Sombath Chounlamany	Director of Department No.2
Mrs. Somsanouk Vongsack	Department No.2, Japanese Desk

(2) Ministry of Industry and Handicraft

Mr. Soulivong Daravong	Minister
------------------------	----------

(3) Electricite du Laos

Mr. Khammone Phonekeo	General Manager
Mr. Sisomphet Simuong	Deputy General Manager

(4) Embassy of Japan

Mr. Teruo Hayakawa	Ambassador Extraordinary and Plenipotentiary
Dr. Teruo Kamihigashi	Minister Counsellor
Mr. Hiroshi Manabe	First Secretary

2. Counterpart Personnel

Electricite du Laos

Mr. Houmphone Bulyaphol	Manager of Nam Ngum Power Station
Mr. Khamphone Saignasane	Manager of System Operation Department
Mr. Watthana Prathoumvanh	Manager of Technical Department
Mr. Monckham Keonakhone	Deputy Manager of Finance Department
Mr. Te	Chief of Electrical Section, Nam Ngum Power Station
Mr. Khamvene	Chief of Mechanical Section, Nam Ngum Power Station
Mr. Phoumy	Chief of Operation Section, Nam Ngum Power Station

COUNTRY DATA

I. Basic Index

1. Name of country : The Lao People's Democratic Republic
 Capital of country : Vientiane
 Independence of country : December 2, 1975

2. Land and Population (in 1986)

- Area : 236,800 km²
 population : 3.7 million
 Density of population : 16 person / km²
 Growth rate of population : 2.9 %

3. Form of Government

Democratic republican government under the Lao People's Revolution Party

4. Religion

Buddhism

5. Language

Laotian

6. Race

Thai lineage (60%), Protenesia lineage, Chinese lineage

7. Education

Enrollment ratio of primary school : 81 % (1987)

8. Currency

Currency : Kip
 Exchange rate : US\$ 1 = Kip 450 (in 1988)

9. Climate and Topography

The Lao PDR is a land locked country with an area of 236,800 km². The country is bordered by Vietnam in the east, Kampuchea in the south, Thailand in the west and Burma and China to the north. About 80 % of the country is mountainous ranging in height between 200 to 3,000 m. The climate is tropical monsoon and is characterized by two pronounced seasons, the wet season from May to October and the dry season from November to April. The cultivation of Paddy is mainly made in the lowland areas along the Mekong river and its tributaries.

II. Socio-economic Index

1. Gross Domestic Product (GDP) in 1987

GDP : US\$ 676 million
Per capital GNP : US\$ 156
Annual growth ratio : 6.4 % (1982 ~ 1986)

2. Structure of GDP

Agriculture : 75 %
Industry : 14 %
Service : 11 %

3. Composition of Official Export

(Unit: US\$ million)

	1983	1984	1985	1986	1987
(1) Exports to the Convertible Area	27.8	31.8	38.4	39.5	35.1
Coffee	1.6	0.6	0.3	2.1	0.9
Electric power	24.0	26.9	29.4	29.9	13.7
Logs	1.7	3.3	3.8	4.9	17.9
Wood products	-	0.4	1.8	0.6	0.6
Other exports	0.5	0.6	3.1	2.0	1.0
(2) Exports to the Nonconvertible Area	13.0	13.8	19.0	15.6	29.1
Coffee	6.9	8.1	8.2	7.1	8.5
Logs and wood products	1.3	1.3	5.6	2.3	13.3
Tin and gypsum	3.7	2.3	2.5	5.0	4.2
Other exports	1.1	2.1	2.7	1.2	3.1
Total	40.8	45.6	57.4	55.0	64.2

Composition of Official Import

(Unit: US\$ million)

	1983	1984	1985	1986	1987
(1) Nonaid Import from the Convertible Area	<u>52.1</u>	<u>35.4</u>	<u>38.3</u>	<u>41.1</u>	<u>55.6</u>
Rice and other food	6.3	4.0	1.7	3.0	7.7
Petroleum products	14.0	10.8	10.6	7.8	6.4
Machinery and raw material	16.0	10.3	11.1	12.3	14.8
Other official imports	11.0	5.3	7.7	9.4	17.2
Private imports	4.8	4.9	2.2	3.6	4.5
Provincial imports	-	-	5.0	5.0	5.0
(2) Nonaid Import from the Nonconvertible Area	<u>40.0</u>	<u>62.0</u>	<u>66.6</u>	<u>71.5</u>	<u>82.4</u>
(3) Imports Under Aid Programs	<u>57.3</u>	<u>64.5</u>	<u>88.3</u>	<u>71.2</u>	<u>78.2</u>
Convertible area	24.2	23.9	39.3	37.3	26.1
Nonconvertible area	33.1	40.6	49.0	35.8	52.1
Total Imports	<u>149.4</u>	<u>161.9</u>	<u>193.2</u>	<u>185.7</u>	<u>216.2</u>
Convertible area	76.3	59.3	77.6	78.4	81.7
Nonconvertible area	73.1	102.6	115.6	107.3	134.5

4. Balance of Payment

(Unit: US\$ million)

	1983	1984	1985	1986	1987
Trade balance	-108.6	-118.1	-139.5	-130.7	-152.0
Exports	40.8	43.8	53.6	55.0	64.2
Imports	149.4	161.9	193.2	185.7	216.2
Services	-12.5	-9.8	-7.2	6.6	7.2
Balance of transfers	25.4	44.9	53.1	34.2	30.5
Current account	-95.7	-82.4	-93.7	-89.9	-114.3
Capital account	76.5	86.0	101.9	106.7	115.0
Errors and omissions	31.1	-9.1	10.4	-7.7	-11.8
Overall balance	11.9	-6.0	18.7	9.1	-11.1

5. External Public Debt Disbursed and Outstanding

(Unit: US\$ million)

	1984	1985	1986	1987
Convertible area	126.2	145.3	175.4	200.8
Nonconvertible area	318.8	341.8	432.2	534.8
Total debt	445.0	487.1	607.6	735.6

6. Trade to Japan

(Unit: US\$ million)

	1986	1987
Exports (wood)	1.44	1.52
Imports (Machinery, iron goods)	12.92	15.43

7. Consolidated Government Budget

(Unit: Kip million)

	1982	1983	1984	1985	1986	1987
Revenue	2,755	3,496	4,948	10,299	18,503	20,108
Expenditure	2,259	2,945	4,126	10,624	15,883	16,833
Current surplus	496	551	822	-325	2,620	3,275
Capital expenditure	3,216	3,750	4,250	10,182	11,732	11,841
Overall Deficit	-2,720	-3,199	-3,437	-10,507	-9,112	-8,566
Financing (External resources)	2,720	3,199	3,437	10,507	9,112	8,566

III. Development Index

(1) Past national development plan

Three-Year Plan 1978 - 1980
 First Five-Year Plan 1981 - 1985

Through the above development plans, the country has been involved in a policy of developing its agriculture and timber resources. The goal is i) to become self-sufficient in basic food commodities and to have a surplus of certain agricultural products for exports, ii) to develop commerce with the aim of exchange between city and countryside, in order gradually to bring the farmers into the cash nexus, and iii) to go beyond the backward

state of the existing traditional economy through the growth of commerce and communications.

The principal objectives of the first Five-Year Plan were the followings:

- to increase agricultural and forestry production so as to provide enough food for consumption and to increase exports of timber,
- to increase industrial production,
- to improve the economic basic infrastructure by expanding internal transport and constructing route 9 to reach the port of Da Nang in Vietnam, developing the distribution network for electricity, and improving the capacity to maintain equipment and capital,
- to improve the internal distribution of goods,
- to increase the number of state enterprises and state controlled cooperatives so as to consolidate the leading role of the socialist sector in the economy,
- to increase, through taxation, exports and foreign aid, the mobilization of resources for investment,
- to expand the education and training system and improve the health system, and
- to improve economic management and organization.

(2) Current national development plan

Second Five-Year Plan 1986 - 1990

The development priorities are oriented as follows:

- (i) acceleration of development and exports to achieve food self-sufficiency, reduces non-food imports and improvement of balance of payments (export of agricultural, timber, mining, energy and industrial products, particularly to convertible countries),
- (ii) improvement of transportation and communication sectors, and

(iii) strengthening of management and development of human resources.

The measures required to reach the above priority objectives are shown below:

(i) Economic measures

- better use of the existing equipment and infrastructures, upgrading them if necessary,
- selection of small scale and high-return projects,
- increased and systematic use of measures to stimulate production (price and service supports to benefit state, cooperative and private producers),
- diversified and increased production, particularly in agriculture, and
- better utilization of local raw materials for the development of agro-industries and the wood industry.

(ii) Financial measures

- stabilization and reduction of the budget deficit by limiting the least essential expenses and by increasing certain fiscal and semi-fiscal revenues, and
- improvement of the balance of trade and the balance of payments by promoting exports.

(iii) Measures to control inflation

- reduction of expansion in the money supply,
- control of the debt levels of the public sector,
- increase of the domestic share in the national revenue assigned to savings, and
- change of the price and subvention policy.

(iv) Measures to planning capabilities and management of the economy

- establishment of a viable statistical apparatus,
- development of the coordination of economic policy and external aid,
- improvement of capacities for selection, execution and evaluation of projects,
- rationalization of administrative structures and state enterprises, and
- rationalization of the functional framework of the private sector.

Investment costs of projects identified for the 1986 - 1990 period is shown as follows.

	Investment cost in 1988 prices (US\$ million)	Percentage
Agriculture	148	18.5
Industry, mining and energy	164	20.5
Commerce	22	2.7
Transport	212	26.5
Construction	65	8.1
Other productive investment	13	1.6
Education	35	4.4
Health	27	3.4
Culture	20	2.5
Housing	21	2.6
Other	74	9.2
Total	801	100.0

Appendix-8

INCOME STATEMENT

Kips Million

<u>Financial year ended Dec. 31</u>	<u>1987</u>	<u>1986</u>
Total generation (GWH)	566.6	867.3
EDL generation (GWH)	566.6	867.3
Gross imported power (GWH)	-	-
Losses (%)	6.6	7.2
Power sold (GWH)	528.9	804.8
Average revenue (Kips/kwh)	3.51	4.27
=====	=====	=====
Income from electricite sale	1,858.0	3,437.6
Other Income - Excl. of sale	163.5	92.5
<u>OPERATING REVENUE</u>	<u>2,021.5</u>	<u>3,530.1</u>
=====	=====	=====
<u>OPERATING EXPENSES</u>		
Salaries and allowances	92.5	69.2
Balk purchase	-	-
Consumption of materials	253.9	218.1
Other cash operating expenses	111	205.7
Depreciation	524.0	500.8
<u>Total Operating Expenses</u>	<u>981.4</u>	<u>993.8</u>
=====	=====	=====
<u>OPERATING SURPLUS</u>	<u>1,040.1</u>	<u>2,536.3</u>
=====	=====	=====
Interest on loans	225.3	226.1
<u>Income before tax and dividend</u>	<u>814.8</u>	<u>2,310.2</u>
Tax and dividend payable to Government	427.3	2,185.5
Adjustment for previous year	204.6	
<hr/>		
Net income	182.9	124.7
Less Provision for staff welfare	98.4	
Net income retained by EDL.	84.5	

Foreign Exchange
Department,
Ministry of Finance

Minister of
Industry & Handicraft

Vientiane, 17 AUG 1988
The General Manager,



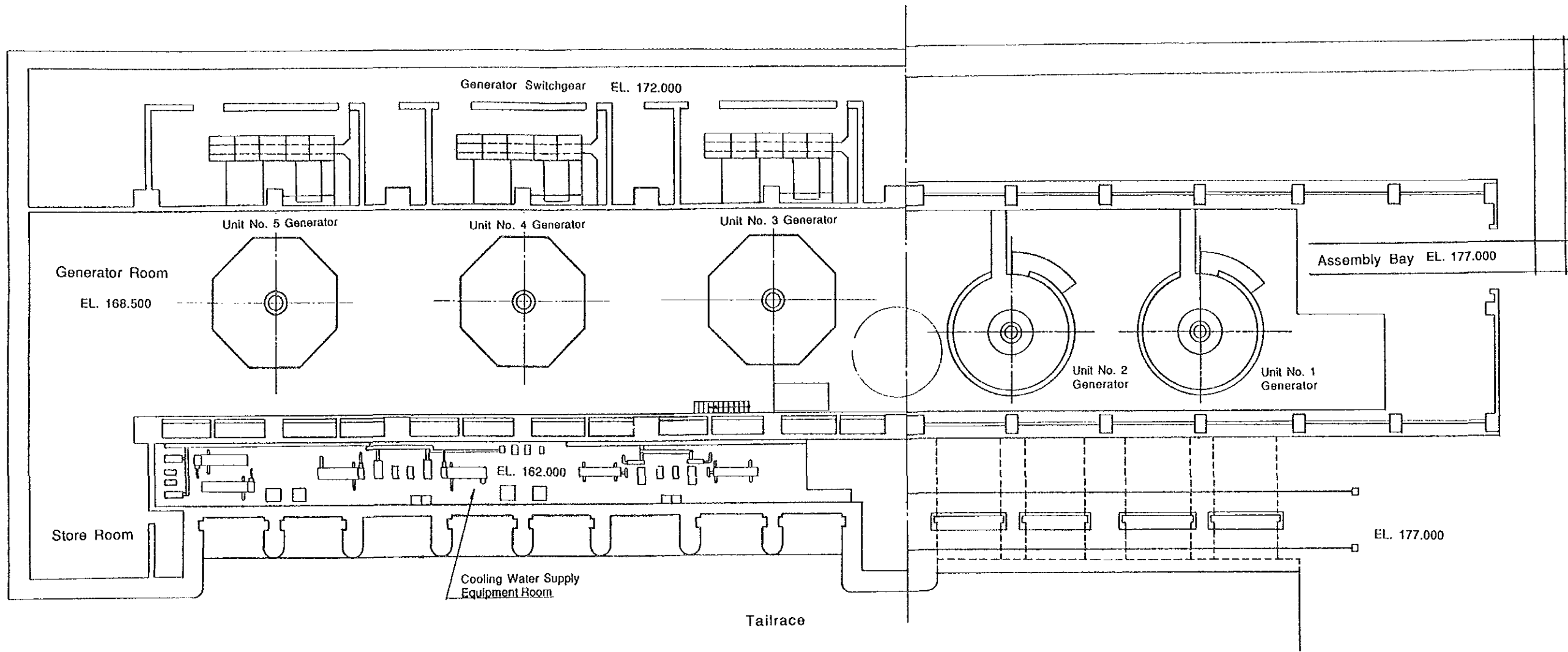
Khammone PHONKHO

CHANGE OF THE TARIFF FOR EGAT

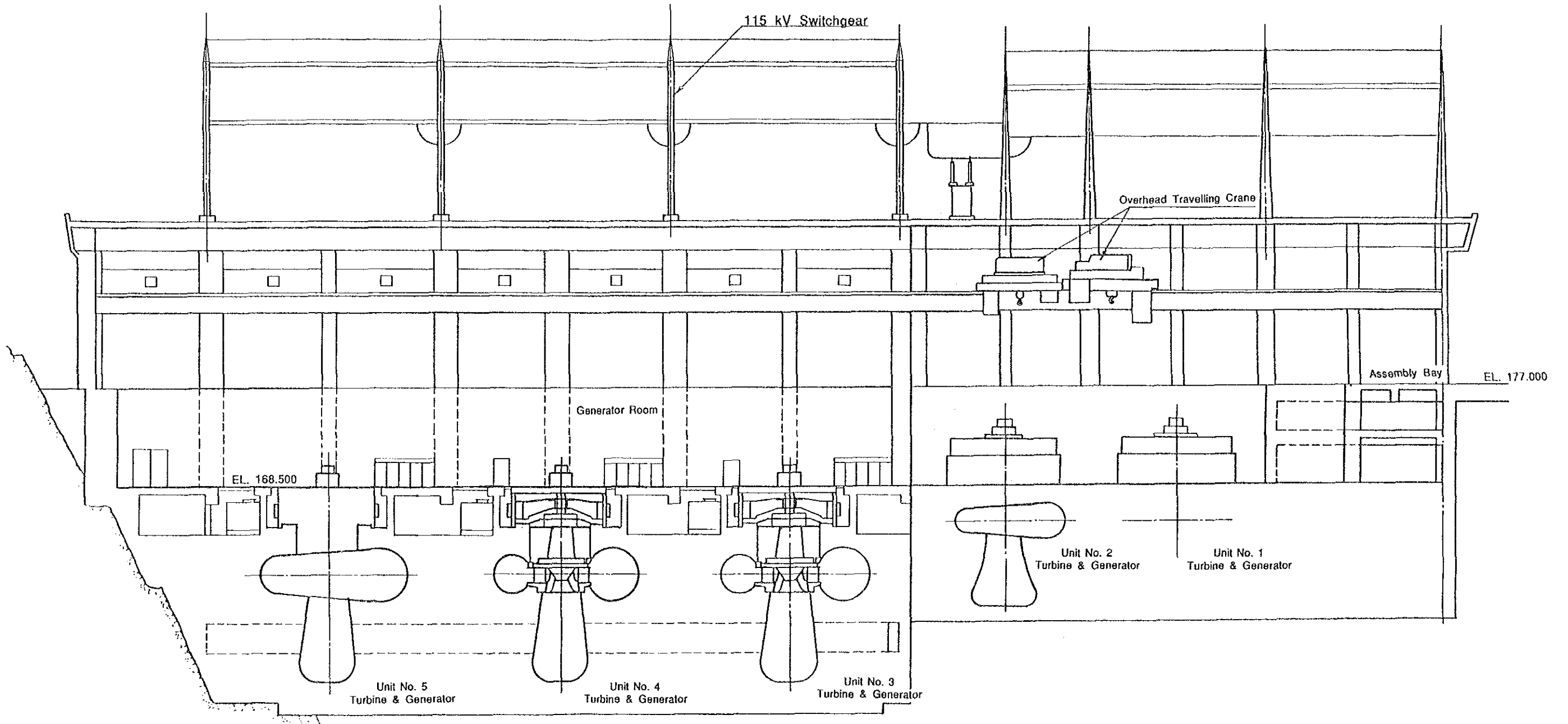
No.	Priond	Export Tariff	Import Tariff
1	1971 ~ 1974	0.19 Bahts	0.29 Bahts
2	1975 ~ Sep. 1981	0.0105 US\$	0.01539 US\$
3	Oct. 1981 ~ Sep. 1982	0.031 US\$	0.036 US\$
4	Oct. 1982 ~ Sep. 1983	0.03379 US\$	0.03879 US\$
5	Oct. 1983 ~ Sep. 1984	0.03683 US\$	0.04183 US\$
6	Oct. 1984 ~ Sep. 1985	0.04014 US\$	0.04514 US\$
7	Oct. 1985 ~ Sep. 1986	0.04376 US\$	0.04876 US\$
8	Oct. 1986 ~ Sep. 1987	0.0300 US\$	0.0350 US\$
9	Oct. 1987 ~ Sep. 1990	0.0305 US\$	0.0355 US\$

(Source: EDL)

DRAWINGS



LAO PEOPLE'S DEMOCRATIC REPUBLIC			
THE PROJECT FOR REPAIR OF NAM NGUM DAM POWER STATION UNIT NO. 3 AND NO. 4			
TITLE OF DRAWING			
PLAN OF NAM NGUM POWER STATION			
Date		Drawing No	0001
JAPAN INTERNATIONAL COOPERATION AGENCY			



LAO PEOPLE'S DEMOCRATIC REPUBLIC

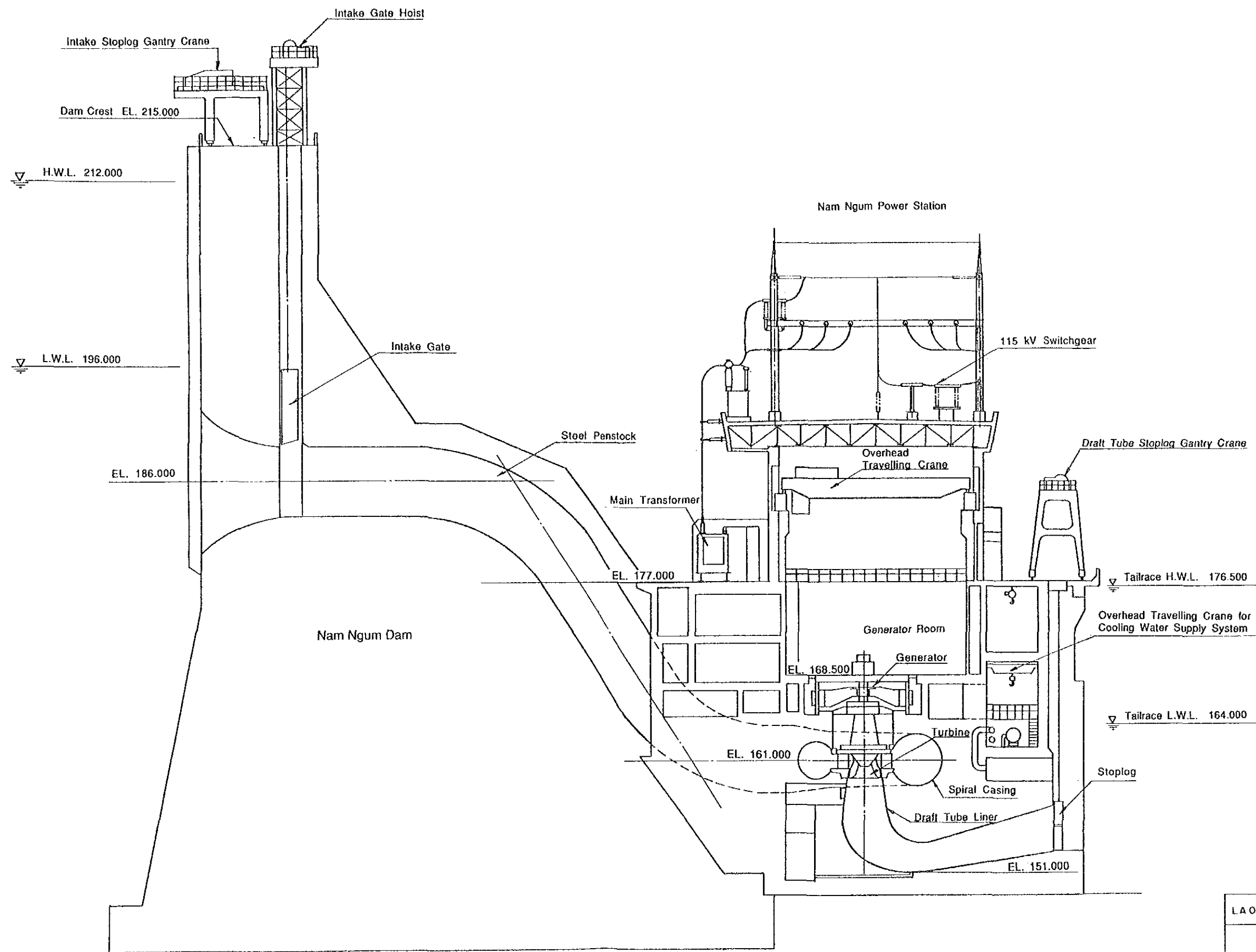
THE PROJECT FOR REPAIR OF NAM NGUM DAM
POWER STATION UNIT NO. 3 AND NO. 4

TITLE OF DRAWING

ELEVATION OF NAM NGUM POWER STATION

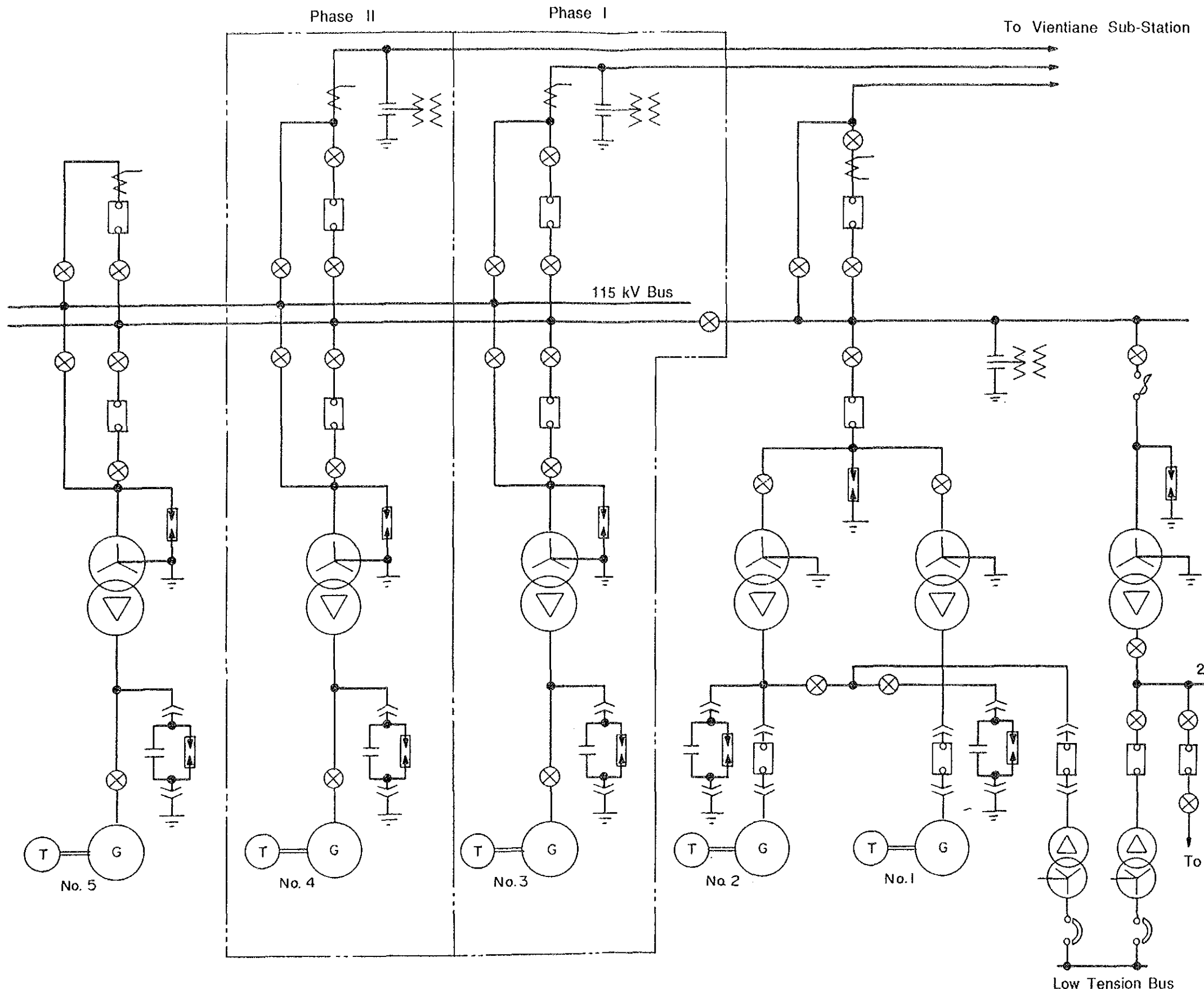
Date		Drawing No	0002
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JAPAN INTERNATIONAL COOPERATION AGENCY



LAO PEOPLE'S DEMOCRATIC REPUBLIC			
THE PROJECT FOR REPAIR OF NAM NGUM DAM POWER STATION UNIT NO. 3 AND NO. 4			
TITLE OF DRAWING			
SECTION OF NAM NGUM POWER STATION			
Date		Drawing No.	0003
JAPAN INTERNATIONAL COOPERATION AGENCY			

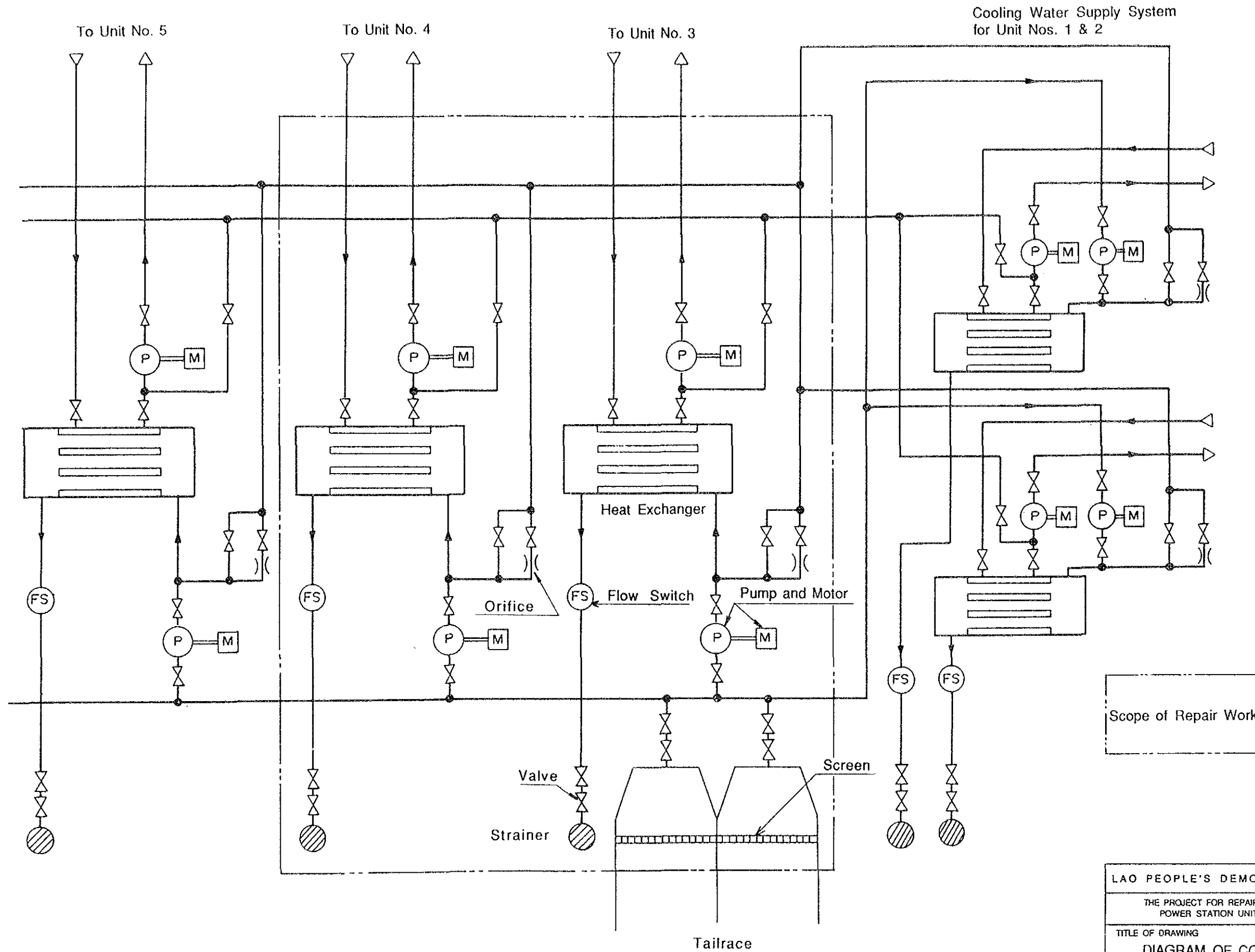




Symbol	Description
(G)	Generator
(T)	Turbine
(C)	Transformer
(CB)	Circuit Breaker
(DS)	Disconnecting Switch
(LA)	Lightning Arrester
(SA)	Surge Absorber
(CT)	Current Transformer
(PT)	Potential Transformer
(ACB)	Air Circuit Breaker
(PF)	Power Fuse

Scope of Repair Work

LAO PEOPLE'S DEMOCRATIC REPUBLIC		
THE PROJECT FOR REPAIR OF NAM NGUM DAM POWER STATION UNIT NO. 3 AND NO. 4		
TITLE OF DRAWING SINGLE LINE DIAGRAM		
Date	Drawing No.	0005
JAPAN INTERNATIONAL COOPERATION AGENCY		



LAO PEOPLE'S DEMOCRATIC REPUBLIC			
THE PROJECT FOR REPAIR OF NAM NGUM DAM POWER STATION UNIT NO. 3 AND NO. 4			
TITLE OF DRAWING DIAGRAM OF COOLING WATER SUPPLY SYSTEM			
Date		Drawing No.	0006
JAPAN INTERNATIONAL COOPERATION AGENCY			

JICA