REPUBLIC OF THE UNION OF MYANMAR
Hydropower Generation Enterprise (HPGE)

THE PREPARATORY SURVEY (2)
ON
THE PROJECT
FOR
REHABILITATION OF BALUCHAUNG NO.2 HYDROPOWER PLANT
IN
REPUBLIC OF THE UNION OF MYANMAR

Final Report
(Annex)

March 2013

JAPAN INTERNATIONAL COOPERATION AGENCY
(JICA)

NIPPON KOEI CO., LTD.
TOKYO ELECTRIC POWER COMPANY

IL
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ANNEX

CHECK LIST OF SITE INSPECTION

ANNEX 1 Generating equipment (Water Turbine)

ANNEX 2 Generating equipment (Generator)

ANNEX 3 Transformer and Control System

ANNEX 4 Civil & Metal Facility

ANNEX 1

GENERATING EQUIPMENT (WATER TURBINE)

Check List of Site Inspection for Generating Equipment (Water Turbine)

(Unit 1)

REMARKS ○: Good condition

△: Caution

×: Countermeasure to be considered

ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI

Turbine Type HP-2R4ND

Manufactured in 1958,

Inspection 9 through 10-Jul-2012

Items		Result	Photo No.
1	Cavitation Pitting	△[1)]	---
2	Runner Bucket Crack by PT	×[2)]	---
3	Needle, Nozzle, Needle Shaft	×[3)]	T-001 to -003
4	Deflector	×[4)]	T-004
5	Jet Brake	×[5)]	---

1) Please refer to separate Photos for Unit No. 1.On Bucket No. 13 of No. 1A runner and Bucket No. 20 of No. 1B runner, quite heavy cavitation pitting is observed. Also, on action side of Bucket No. 20 of No. 1B runner, hitting mark is noticed. From the back side cavitation, it is recognized thatt the high pressure flow direction from the nozzle is deformed by cavitation pitting of needle and nozzle tip.

2) Please refer to separate Inspection Data Sheets for Unit No.1.
On Unit No. 1B runner, the cracks are detected at the left side rib of bucket No. 9, 14 and 17 and at the right side rib of bucket No. 19.

3) Due to heavy leakage water from the needle nozzle, details of needle and nozzle cannot be inspected.

4) Typical photo shows the cavitation damage around the middle of the deflector leading edge on Unit No. 1A (Upper), which will cause further rapid pitting of the deflector and shall be replaced with new one.

5) Due to the sticking problem of the jet brake valve rod and it's oil servomotor rod, the jet brake valve cannot be opened fully. The jet brake shall be replaced with new one.

1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI

Type Rotary Valve with Oil Operated Servomotors having Upstream/downstream Seals

Manufactured in 1958 (Rubber Seal Type),

Inspection 9 through 10-Jul-2012

Items		Result	Photo No.
1	Downstream and Upstream Seal of Inlet Valve and Others	× 1)	T-005
2	Inlet Valve Servomotor	△ 2)	---
3	Inlet Valve Control Panel	× 3)	---
4	Penstock Drain Valve	× 4)	T-006

1) From the large water leakage from the nozzle, both downstream and upstream seals are not properly functioned to seal the penstock high pressure. From this serious condition, it is essential to replace one complete inlet valve with newly designed one.

2) The oil operated servomotors for inlet valve is still operational. There is no locking device for servomotor closing position on Unit No. 1 Servomotors, which provision is required for safety aspect.

3) Due to malfunction of both downstream and upstream seals, the inlet valve control panel shall be replaced with new one.

4) Penstock drain valve is no longer used due to no movement of valve disc handle, and the downstream flange is closed with blind cover.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI

Type Mechanical Type Governor

Manufactured in 1992 (Unit No. 1 overhauled)

Inspection 9 through 10-Jul-2012

Items		Result	Photo No.
1	Governor Cabinet	△ 1)	T-007 & -008
2			

1) It is observed that many instruments mounted on Instrument and Governor Cabinets are broken or malfunctioned. These instruments shall be replaced with new ones to have more reliability. Leaked oil inside of all governor cabinet is observed. Dirty governor oil shall be purified.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI

Manufactured in 1992

Inspection 9 through 10-Jul-2012

Items		Result	Photo No.
1	Oil Tank	△ 1)	---
2	Oil Pressure System	△ 2)	---
3			

1) Overall deterioration of oil pressure system is observed. The pressure gauge on oil tank indicates the different value of the gauge on instrument panel. These gauges shall be replaced with new ones. Also, the oil level indicator glass mounted on Governor oil tank becomes dirty, and it shall be replaced with new one.

2) One oil pump and control panel shall be replaced with new one.

1-5. Operational Condition

Inspection in 10 through 11-Jul-2012

Items		Result	Photo No.
1	Pressure Oil System Test	△ 1)	---
2	Generator Output vs. Needle Stroke	△ 2)	---
3	Inlet Valve	× 3)	---

1) Please refer to the separate data documents for Unit No. 1.

2) Please refer to the separate data documents for Unit No. 1.
It is evaluated that over 40 years old generating unit is relatively in good operating condition, which proves frequent and well maintenance by powerhouse staff.

3) Penstock water cannot be stopped by either upstream or downstream seals. This sealing condition is really unsafe and unreliable for unit outage, so that urgent and complete countermeasure to the inlet valve is essential.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Unit 2)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI
Turbine Type HP-2R4ND
Manufactured in Runner: 1993 (for Unit No. 2),
Inspection 18 through 19-Jul-2012

Items		Result	Photo No.
1	Cavitation Pitting	△ 1)	---
2	Runner Bucket Crack by PT	× 2)	---
3	Needle, Nozzle, Needle Shaft	× 3)	T-001 to -003
4	Deflector	× 4)	T-002
5	Jet Brake	× 5)	---

1) Please refer to separate Photos for Unit No. 2.
2) Please refer to separate Inspection Data Sheets for Unit No. 2.
On Unit No. 2A runner, a crack is detected at right side rib of bucket No. 9 (new crack having 70mm length is detected) and No. 10. Also, on Unit No. 2B runner, a crack is detected at left side of bucket No. 8 and at right side of bucket No. 7 and No. 10. On bucket No. 7, the crack is propagated from 65mm (based on previous record) to 77 mm.
3) Due to heavy leakage water from the needle nozzle, details of needle and nozzle cannot be inspected. Since needle tip and nozzle tip damage will induce deflector cavitation, runner bucket cavitation and turbine efficiency drop, these shall be replaced with new ones at the earliest days. The needle shaft drain line is closed with blind cover, and this line is no longer used.
4) Heavy leakage water hits the deflector edge, which is causing cavitation pitting and erosion on the deflector.
5) Water leakage from the valve stem of jet brake on Unit No. 2 is observed. The jet brake shall be replaced with new one.

1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI

Type Rotary Valve with Oil Operated Servomotor(s) having Upstream/downstream Seals

Manufactured in 1958 (for Unit No. 2, Rubber Seal Type)

Inspection 18 through 19-Jul-2012

Items		Result	Photo No.
1	Downstream and Upstream Seal of Inlet Valve and Others	×1)	---
2	Inlet Valve Servomotor	△2)	---
3	Inlet Valve Control Panel	×3)	---
4	Penstock Drain Valve	×4)	T-004

1) Both downstream and upstream seals with rubber seals are not properly functioned, so that complete inlet valve with servomotor and control panel shall be replaced with new one.

2) The oil operated servomotors for inlet valve is still operational. However, there is no locking device for servomotor closing position. This locking provision shall be required for safety aspect.

3) Together with inlet valve, the control panel shall be replaced with new one.

4) The penstock drain valve is closed with blind cover, and this line is no longer used.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI

Type Mechanical Type Governor

Manufactured in 1992 overhauled

Inspection 18 through 19-Jul-2012

Items		Result	Photo No.
1	Governor Cabinet	△1)	T-005
2			

1) It is observed that many instruments mounted on Instrument and Governor Cabinets are broken or malfunctioned. These instruments shall be replaced with new ones to have more reliability. Leaked oil inside of all governor cabinet is observed. Dirty governor oil, which needs to be purified, is used.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI

Manufactured in 1992

Inspection 9 through 30-Jul-2012

Items	Result	Photo No.

1	Oil Tank	△ 1)	---
2	Oil Pressure System	△ 2)	---
3			

1) Overall deterioration of oil pressure system is observed. The pressure gauge on oil tank indicates the different value of the gauge on instrument panel. These gauges shall be replaced with new ones. Also, the oil level indicator glass mounted on Governor oil tank becomes dirty, and it shall be replaced with new one.

2) One oil pump having oil leakage and control panel shall be replaced with new one.

1-5. Operational Condition

Inspection in 21-Jul-2012

Items		Result	Photo No.
1	Pressure Oil System Test	△ 1)	---
2	Generator Output vs. Needle Stroke	△ 2)	---
3	Inlet Valve	× 3)	---
4			

1) Please refer to the separate test record for Unit No. 2.

2) Please refer to the separate data documents for Unit No. 2.

3) Penstock water cannot be stopped by both upstream or downstream seals. This leaking condition is really unsafe and unreliable for unit outage, so that urgent and complete countermeasure to the inlet valve is essential.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Unit 3)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI
Turbine Type HP-2R4ND
Manufactured in Runner: 1993 (for Unit No. 3)
Inspection 26-Jul-2012

Items		Result	Photo No.
1	Cavitation Pitting	△[1)]	---
2	Runner Bucket Crack by PT	△[2)]	---
3	Needle, Nozzle, Needle Shaft	△[3)]	T-001 & -002
4	Deflector	△[3)]	T-001
5	Jet Brake	×[4)]	T-003

1) Please refer to separate Photos for Unit No. 3. Very light cavitation pitting is observed on both 3A and 3B runners.
2) Please refer to separate Inspection Data Sheets for Unit No. 3. No cracks are detected on No. 3A and 3B runners.
3) As compared with other units (Unit No. 4 through 6), the pitting damage of Unit No. 3 needle, nozzle and deflector seems to be lighter. There is no valve handle of the needle shaft drain line.
4) Due to the sticking problem of the jet brake valve rod and it's oil servomotor rod of Unit No. 3, the jet brake valve cannot be opened fully. As a result, it takes longer time (approx. 30 minutes) to stop the Generating unit. This jet brake shall be replaced with new one.

1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI
Type Rotary Valve with Oil Operated Servomotors having Upstream/downstream Seals
Manufactured in 1958 (Rubber Seal Type)
Inspection 26-Jul-2012

	Items	Result	Photo No.
1	Downstream and Upstream Seal of Inlet Valve and Others	× 1)	T-004
2	Inlet Valve Servomotor	× 2)	---
3	Inlet Valve Control Panel	× 3)	---
4	Others (Needle & Deflector Servomotor)	△	T-005
5	Penstock Drain Valve	× 4)	T-006

1) Both downstream and upstream seals are not operated properly due to malfunction of rubber seal system. Accordingly, quite large water leakage is observed from the inlet valve. From the present condition, it is essential to replace one complete inlet valve with newly designed one.
2) The oil operated servomotors for inlet valve is still operational. However, there is no locking device for servomotor closing position. The servomotors shall be replaced with new ones.
3) This control valve panel together with inlet valve shall be replaced with new one.
4) The penstock drain line is not used.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI
Type Mechanical Type Governor
Manufactured in 1992 (for Unit No. 3)
Inspection 26-Jul-2012

	Items	Result	Photo No.
1	Governor Cabinet	△ 1)	---
2			

1) It is observed that many instruments mounted on Governor Cabinet are broken or malfunctioned. These instruments shall be replaced with new ones to have more reliability. Leaked oil inside of governor cabinet is observed.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI
Manufactured in 1992 (for Unit No. 3)
Inspection 26-Jul-2012

	Items	Result	Photo No.
1	Oil Tank	△ 1)	---
2	Oil Pressure System	△ 2)	---
3			

1) The pressure gauge on oil tank indicates the different value of the gauge on instrument panel. These gauges shall be replaced with new ones. Also, the oil level indicator glass mounted on Governor oil tank becomes filthy, and it shall be replaced with new one.
2) One oil pump and control panel shall be replaced with new ones.

1-5. Operational Condition

Inspection in 27-Jul-2012

Items		Result	Photo No.
1	Pressure Oil System Test	△ 1)	---
1	Generator Output vs. Needle Stroke	△ 2)	---
2	Inlet Valve	× 3)	---
3			

1) Please refer to the separate test record for Unit No. 3.

2) Please refer to the separate data sheet for Unit No. 3.
It is evaluated that operation for the unit over 40 years old is in good condition, which proves frequent and well maintenance by powerhouse staff.

3) Penstock water cannot be stopped by either upstream or downstream seal due to malfunction of the rubber seals. And also, the penstock water cannot be stopped at needle and nozzle. Basically, the needle and nozzle is designed and used to control the water flow volume and not to seal the penstock water. Only both A and B water deflectors provided downstream of needles are used to stop the unit. This sealing operation is really unsafe and unreliable for unit stop, so that the whole inlet valve shall be replaced with new one.

Check List of Site Inspection for Generating Equipment (Water Turbine)

(Unit 4)

REMARKS ○: Good condition

△: Caution

×: Countermeasure to be considered

ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI

Turbine Type HP-2R4ND

Manufactured in 1972

Inspection 23-Jul-2012

Items		Result	Photo No.
1	Cavitation Pitting	△ 1)	---
2	Runner Bucket Crack by PT	△ 2)	---
3	Needle, Nozzle, Needle Shaft	× 3)	T-001, -002
4	Deflector	× 4)	T-003
5	Jet Brake	○	---

1) Please refer to separate Photos for Unit No. 4. On, both 4A and 4B runners, cavitation pitting is considered small.

2) Please refer to separate Inspection Data Sheets for Unit No. 4. No cracks are observed on both 4A and 4B runners.

3) Due to heavy leakage water from the needle nozzle, details of needle and nozzle cannot be inspected. Since needle tip and nozzle tip damage will induce further deflector cavitation during unit stop condition, these shall be replaced with new ones at the earliest days.

4) Deflector tip is being damaged with cavitation pitting.

1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI

Type Rotary Valve with Oil Operated Servomotor having Upstream/downstream Seals

Manufactured in 1972 (Metal Seal Type)

Inspection 23-Jul-2012

Items		Result	Photo No.
1	Downstream and Upstream Seal of Inlet Valve and	× 1)	T-004 to -007

	Others		
2	Inlet Valve Servomotor	△ 2)	---
3	Inlet Valve Control Panel	× 3)	T-008 to -010
4			

1) Both downstream and upstream seals are no longer used at all due to malfunction of distributing valves (No. 530, 550, 580 and 590) mounted in the Inlet Valve Control Panel. Water supply line to the downstream and upstream seals are completely closed at before and after strainers..

   Also, on Unit No. 4A inlet valve, water leakage from anti-servomotor stem side is observed. From these serious conditions, it is essential to replace one complete inlet valve with newly designed one.

2) The oil operated servomotor for inlet valve is still operational.

3) Due to malfunction of the distributing valves (No. 530, 550, 580 and 590), both downstream and upstream seals are no longer used. The water supply line to the above control valves are fully closed at the manual valves around water strainers by MEPE. The water line strainers for operating the downstream and upstream seals are clogged by muddy silt water. These strainers shall be periodically (at least every two weeks) washed out and cleaned for reliable operation of these seals.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI
Type Mechanical Type Governor
Manufactured in 1972
Inspection 23-Jul-2012

Items		Result	Photo No.
1	Governor Cabinet	△ 1)	T-011 to -013
2			

1) It is observed that many instruments mounted on Instrument and Governor Cabinets are broken or malfunctioned. These instruments shall be replaced with new ones to have more reliability. Leaked oil inside of all governor cabinet is observed. Dirty governor oil, which needs to be purified, is used.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI
Manufactured in 1972 (for Unit No. 4-6)
Inspection 23-Jul-2012

Items		Result	Photo No.
1	Oil Tank	△ 1)	T-014, -015
2	Oil Pressure System	△ 2)	---

3			

1) Overall deterioration of oil pressure system is observed. The pressure gauge on oil tank indicates the different value of the gauge on instrument panel. These gauges shall be replaced with new ones. Also, the oil level sight glass mounted on oil tank becomes filthy, and it shall be replaced with new one.

2) Since oil pressure pump is in service over 40 years, overall deterioration of oil system is observed. The oil pumps/motors with control panel shall be replaced with new ones.

1-5. Operational Condition

Inspection in 24-Jul-2012

Items		Result	Photo No.
1	Pressure Oil System Test	△ 1)	---
2	Generator Output vs. Needle Stroke	△ 2)	---
3	Inlet Valve	× 3)	---
4			

1) Please refer to the separate test record for Unit No. 4.

2) Please refer to the separate data for Unit No. 4.
It is evaluated that the operation for the unit over 40 years old is in good condition, which proves frequent and well maintenance by powerhouse staff.

3) During Unit shutdown, penstock water cannot be stopped by either upstream or downstream seal due to malfunction of the distributing valves mounted in the inlet valve control panel. This sealing condition is really unsafe and unreliable to stop the unit, so that urgent and complete countermeasure to the inlet valve is essential.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Unit 5)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI
Turbine Type HP-2R4ND
Manufactured in 1972
Inspection 30-Jul-2012

Items		Result	Photo No.
1	Cavitation Pitting	△[1)]	---
2	Runner Bucket Crack by PT	△[2)]	---
3	Needle, Nozzle, Needle Shaft	×[3)]	T-001 to-003
4	Deflector	×[4)]	T-002
5	Jet Brake	○	---
6	Water Shelter	×[5)]	T-004

1) Please refer to separate Photos for Unit No. 5. On both 5A and 5B runners, cavitation pitting is relatively light. Also, on No. 5B runner bucket, typical fish scale surface condition by erosion is noticed at the stream surface of the bucket No. 12..
2) Please refer to separate Inspection Data Sheets for Unit No. 5. No cracks at runner bucket rib's roots are detected.
3) On Unit No. 5 A (upper) with visible water leakage from the nozzle, typical photo is taken, which indicates the cavitation pitting and erosion at the stream surface of the needle tip. Since needle tip and nozzle tip damage will induce deflector cavitation, runner bucket cavitation and turbine efficiency drop, these needles and nozzles shall be replaced with new ones at the earliest days. On the other hand, due to heavy leakage water from the needle nozzle on Unit No. 5B, details of needle and nozzle cannot be inspected. Water leakage from the needle shaft seal is also observed on Unit No. 5B (Upper). The needle shaft seal packing shall be replaced with new one.
4) Typical photo shows the cavitation pitting and erosion around the middle of the deflector leading edge on Unit No. 5A (Upper), which will cause further rapid pitting of the deflector and

shall be replaced with new one.

5) The water shelter for Unit No. 5B shaft is not assembled. New water shelter shall be installed.

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1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI

Type Rotary Valve with Oil Operated Servomotor having Upstream/downstream Seals

Manufactured in 1972 (Metal Seal Type)

Inspection 30-Jul-2012

Items		Result	Photo No.
1	Downstream and Upstream Seal of Inlet Valve and Others	× 1)	---
2	Inlet Valve Servomotor	× 2)	T-005 to -007
3	Inlet Valve Control Panel	× 3)	---
4			

1) Both downstream and upstream seals are no longer used at all due to malfunction of distributing valves (No. 530, 550, 580 and 590) mounted in the Inlet Valve Control Panel. Water supply line to the downstream and upstream seals are completely closed at the inlet and outlet of the strainers..

2) The oil operated servomotor for inlet valve is still operational. However, quite deep scratched surface is observed on Unit No. 5B servomotor rod, which will cause oil leak by seal packing damage in future.

Also, the followings are typical condition of present servomotor openings.

No. of Servomotor	Fully Closed Position	Fully Opened Position
5A Servomotor	**3 Degrees**	**84 Degrees**
5B Servomotor	**26 Degrees**	90 Degrees

Even though opening or closing problem of the servomotor cannot be investigated at this inspection, the present servomotor condition is abnormal, so that the servomotor together with inlet valve shall be replaced with new one.

3) Due to malfunction of the distributing valves (No. 530, 550, 580 and 590), both downstream and upstream seals are no longer used. The water supply line to the above control valves are fully closed at the manual valves around water strainers by MEPE. The water line strainers for operating the downstream and upstream seals are clogged by muddy silt water. These strainers shall be periodically (at least every two weeks) washed out and cleaned for reliable operation of these seals.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI

Type Mechanical Type Governor

Manufactured in 1972

Inspection 30-Jul-2012

	Items	Result	Photo No.
1	Governor Cabinet	△ 1)	T-008 to -010
2			

1) Different wattmeter is temporary mounted on Unit No. 5 Governor cabinet. It is observed that many instruments mounted on Instrument and Governor Cabinets are broken or malfunctioned. These instruments shall be replaced with new ones to have more reliability. Leaked oil inside of all governor cabinet is observed.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI

Manufactured in 1972

Inspection 30-Jul-2012

	Items	Result	Photo No.
1	Oil Tank	△ 1)	---
2	Oil Pressure System	△ 2)	---
3			

1) Overall deterioration of oil pressure system is observed. The pressure gauge on oil tank indicates the different value of the gauge on instrument panel. These gauges shall be replaced with new ones. Also, the oil level sight glass mounted on Governor oil tank becomes dirty, and it shall be replaced with new one.

2) Overall deterioration of oil system is observed. The oil pumps/motors and control panel shall be replaced with new ones.

1-5. Operational Condition

Inspection in 9 through 30-Jul-2012

	Items	Result	Photo No.
1	Pressure Oil System Test	△ 1)	---
2	Generator Output vs. Needle Stroke	△ 2)	---
3	Inlet Valve	× 3)	---
3			

1) Please refer to the separate test record for Unit No. 5.

2) Please refer to the separate data documents for Unit No. 5.
It is evaluated that the operation for over 40 years old unit is in good condition, which proves frequent and well maintenance by powerhouse staff.

3) Penstock water cannot be stopped by either upstream or downstream seal due to malfunction of the distributing valves mounted in the inlet valve control panel. Also, the needle and nozzle

cannot stop the penstock water. This sealing condition is really unsafe and unreliable for unit outage, so that urgent and complete countermeasure to the inlet valve is essential.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Unit 6)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI
Turbine Type HP-2R4ND
Manufactured in 1972
Inspection 28-Jul-2012

Items		Result	Photo No.
1	Cavitation Pitting	△ 1)	---
2	Runner Bucket Crack by PT	△ 2)	---
3	Needle, Nozzle, Needle Shaft	× 3)	T-001 to -003
4	Deflector	× 3)	---
5	Jet Brake	× 4)	T-004

1) Please refer to separate Photos for Unit No. 6. On both No. 6A and No. 6B runners, relatively light cavitation pitting is observed. However, at the backside inlet of No. 5 bucket of No. 6B runner, heavy cavitation pitting is recognized.
2) Please refer to separate Inspection Data Sheets for Unit No. 6. No crack on backside rib roots is detected on both 6A and 6B runners..
3) From relatively small water leakage from the No. 6A needle nozzle, needle tip cavitation and deflector pitting is observed. However, due to heavy leakage water, details of needle and nozzle of No. 6B cannot be inspected. Since needle tip and nozzle tip damage will induce further deflector cavitation, runner bucket cavitation and turbine efficiency drop, these needles and nozzles shall be replaced with new ones at the earliest days. Water leakage from the needle shaft seal is also observed on Unit No. 6A (Upper). The needle shaft seal packing shall be replaced with new one.
4) Water leakage from the jet brake valve body on Unit No. 6 is observed. This jet brake shall be replaced with new one.

1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI

Type Rotary Valve with Oil Operated Servomotor having Upstream/Downstream Seals

Manufactured in 1972 (Metal Seal Type)

Inspection 28-Jul-2012

Items		Result	Photo No.
1	Downstream and Upstream Seal of Inlet Valve and Others	× 1)	---
2	Inlet Valve Servomotor	× 2)	T-006 to -007
3	Inlet Valve Control Panel	× 3)	---
4			

1) Both downstream and upstream seals are no longer used at all due to malfunction of distributing valves (No. 530, 550, 580 and 590) mounted in the Inlet Valve Control Panel. Water supply line to the downstream and upstream seals are completely closed at before and after water strainers..

On Unit No. 6B inlet valve, the grease supply line to valve disc stem (servomotor side) is broken and plugged, so that there is no grease supply to the stem bushing and seal packing area, which is causing quick bush wear and seal packing damage and water leakage. These bushes and seal packing shall be replaced with newly designed ones.

2) The oil operated servomotor for inlet valve is still operational. However, quite deep scratched surface is observed on Unit No. 6B servomotor rod, which will cause oil leak by seal packing damage in future.

The followings are typical condition of present servomotor openings.

No. of Servomotor	Fully Closed Position	Fully Opened Position
6A Servomotor	0 Degrees	**92 Degrees**
6B Servomotor	**4 Degrees**	**92 Degrees**

Even though opening or closing problem of the servomotor cannot be investigated at this inspection, the present servomotor condition is abnormal. The servomotor together with inlet valve shall be replaced with new one.

3) Due to malfunction of the distributing valves (No. 530, 550, 580 and 590), both downstream and upstream seals are no longer used. The water supply line to the above control valves are fully closed at the manual valves around water strainers by MEPE. The water line strainers for operating the downstream and upstream seals are clogged by muddy silt water. These strainers shall be periodically (at least every two weeks) washed out and cleaned for reliable operation of these seals.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI

Type Mechanical Type Governor

Manufactured in 1972

Inspection 28-Jul-2012

	Items	Result	Photo No.
1	Governor Cabinet	△ 1)	---
2			

1) It is observed that many instruments mounted on Instrument and Governor Cabinets are broken or malfunctioned. These instruments shall be replaced with new ones to have more reliability. Leaked oil inside of all governor cabinet is observed. Dirty governor oil, which needs to be purified, is used. Since there is no sufficient oil purification equipment, it is recommended to have one set of oil purifier unit.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI

Manufactured in 1972

Inspection 1-August-2012

	Items	Result	Photo No.
1	Oil Tank	△ 1)	---
2	Oil Pressure System	△ 2)	---
3			

1) Overall deterioration of oil pressure system is observed. The pressure gauge on oil tank indicates the different value of the gauge on instrument panel. These gauges shall be replaced with new ones. Also, the oil level indicator glass mounted on oil tank becomes dirty, and it shall be replaced with new one.

2) Since oil pressure pump for Unit No.6 is in service over 40 years, deterioration and aging of oil pressure system is observed. The oil pumps/motors with control cabinet shall be replaced with new ones.

1-5. Operational Condition

Inspection in 31-July through 1-August-2012

	Items	Result	Photo No.
1	Pressure Oil System Test	△ 1)	---
2	Generator Output vs. Needle Stroke	△ 2)	---
3	Inlet Valve	× 3)	---
4			

1) Please refer to the separate test record for Unit No. 6.

2) Please refer to the separate data documents for Unit No. 6.

It is evaluated that the operation for the unit over 40 years old is in good condition, which proves frequent and well maintenance by powerhouse staff.

3) Penstock water cannot be stopped by either upstream or downstream seal of the inlet valves due to malfunction of the distributing valves mounted in the inlet valve control panel. This sealing condition is really unsafe and unreliable for unit outage, so that urgent and complete countermeasure to the inlet valve is essential.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(House Turbine)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. House Turbine, Inlet Valve, Governor, Pressure Oil System

1-1. Runner Bucket, Needle Nozzle, Deflector, Jet Brake (Visual Inspection)

Manufacturer HITACHI
Turbine Type P1N1-H
Manufactured in 1958
Inspection 3-August-2012

Items		Result	Photo No.
1	Cavitation Pitting	ND[1)]	---
2	Runner Bucket Crack by PT	ND[1)]	---
3	Needle, Nozzle, Needle Shaft	ND[1)]	---
4			

1) Due to heavy leakage water from the inlet valve, needle and nozzle tip, the runner cover cannot be disassembled for inspection of runner bucket, needle tip and nozzle tip. Leakage from this inlet valve is causing cavitation pitting and erosion of downstream needle and nozzle portion, inlet valve seal portion shall be repaired at the earliest convenience.

.

1-2. Inlet Valve, Servomotor, Valve Control Panel (Visual Inspection)

Manufacturer HITACHI
Type ϕ 160 sluice type shutoff valve
Manufactured in 1958
Inspection 3-August-2012

Items		Result	Photo No.
1	Seal of Inlet Valve and Others	×[1)]	TH-001
2	Inlet Valve Servomotor	△	TH-001
3			

1) From the inlet valve leakage, inlet valve seal is not acting properly.

1-3. Governor System (Visual Inspection)

Manufacturer HITACHI

Type Mechanical Type Governor

Manufactured in 1958

Inspection 3 through 6-August-2012

Items		Result	Photo No.
1	Governor Cabinet	△ 1)	HT-002, -003
2			

1) Governor is operational. On governor cabinet, meter glass is frosted and not clearly visible.

1-4. Pressure Oil System for Governor (Visual Inspection)

Manufacturer HITACHI

Manufactured in 1958

Inspection 3 through 6-August-2012

Items		Result	Photo No.
1	Oil Tank	△ 1)	HT-004
2	Oil Pressure System	△ 1)	HT-004
3			

1) Overall deterioration of oil pressure system is observed. The gauges shall be replaced with new ones. Also, the oil level indicator glass mounted on Governor oil tank becomes filthy, and it shall be replaced with new one.

1-5. Operational Condition

Inspection in 3 through 6-August-2012

Items		Result	Photo No.
1	Generator Output vs. Needle Stroke	ND	---
2	Inlet Valve	ND 1)	---
3			

1) WARNING: Due to heavy leakage from inlet valve, inlet valve seal shall be urgently replaced with new one. Since no deflector is provided to the house turbine, turbine could not be stopped, if leakage from the inlet valve and further downstream needle and nozzle is becoming large.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Auxiliary Equipment)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. House Drainage Pumps, Cooling Water Supply System, Grease Supply System, Governor Actuator Motor

Supplier HITACHI
Manufactured in 1958
Inspection 20-July through 3-August-2012

Items		Result	Photo No.
1	House Drainage Pumps	×[1)]	AU-001
2	Cooling Water Supply System for Unit No. 2	×[2)]	AU-002
3	Grease Supply System	×[3)]	AU-003
4	Governor Actuator Motor	×[4)]	AU-004

1) The originally supplied two pumping units are no longer used, and temporary pumping unit is installed. This temporary pump unit does not have sufficient capacity, so that these old pumps shall be replaced with new ones.

2) The existing two pumps for cooling water supply system are deteriorated, so that these two pumps and motors shall be replaced with new ones.

3) Grease supply system for every unit (No. 1 through 6) shall be checked and repaired during the overhaul period.

4) The existing governor actuator motor has deteriorated, and replaced with spares. Since there is no spare, spare actuator motors shall be obtained.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Spare Parts)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, heavy water leakage, etc)

1. Spare Parts in Warehouse

Inspection 20-Jul-2012

Items		Result	Photo No.
1	Metal Seal Parts for Inlet Valve are as follows;	○[1)]	T-001, -002
	5 sets of upstream seal ring	○	
	5 sets of upstream seat ring	○	
	2 sets of upstream seal guide	○	
	5 sets of downstream seal ring	○	
	5 sets of downstream seat ring	○	
	2 sets of downstream seal guide	○	

1) There is neither spare D-type rubber packing nor round rubber packing for upstream and downstream seal replacement.

Check List of Site Inspection for Generating Equipment (Water Turbine)
(Overhead Traveling Crane)

REMARKS ○: Good condition
△: Caution
×: Countermeasure to be considered
ND: No data available (due to damaged meter, etc)

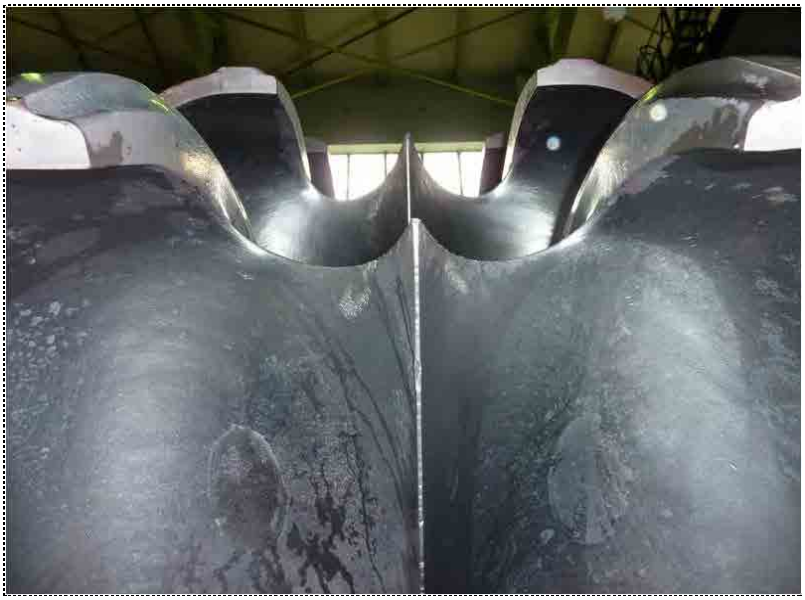
1. 60 / 10 Tons × 47'-0'' EOT Crane No. 2 (Unit No. 6 side) Operation Condition

Manufacturer HITACHI (Kameari Works)
Type EOT-KF-L (DWG No. C961667)
Manufactured in 1958
Inspection 1 through 5-August-2012

Items of Problem on Crane No. 2		Result	Photo No.
1	Travelling Speed of Crane	△ 1)	C-001 to -003
2	Lowest Limit of 10 Tons Auxiliary Hoisting	△ 2)	
3			

1) When traveling to right side direction on the rails, one speed (the lowest speed) only is available even though 5 speed settings were originally provided. From the site survey, there is a malfunction at the CF brake, which horizontal arm does not move even changing the speed lever. Related DWG is No. KS719231 (Connection Diagram of Master Controller), and No. KS525480-1 (CF Brake).

2) 10 Tons hoist hook cannot lower over approx. 6 feet height from the ground floor. This is a malfunction of the limit switch setting.



No 1

Date 10-Jul-12

Unit No. 1 A Runner Bucket Cavitation

Near the inlet edge of the action surface of Bucket No.13, light cavitation is observed.

No 2

Date 10-Jul-12

Unit No. 1 A Runner Bucket Cavitation

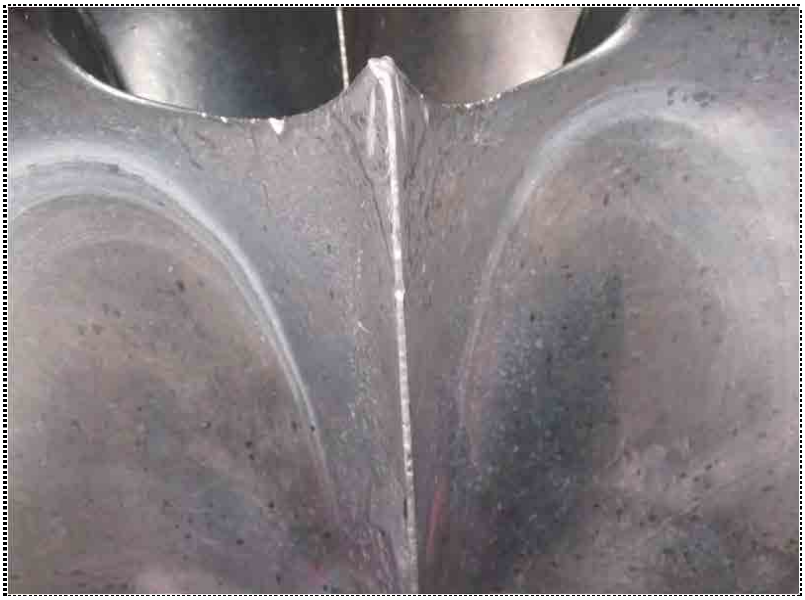
Typical photo of inlet edge cavitation on action surface on Bucket No. 13

No 3

Date 10-Jul-12

Unit No. 1 A Runner Bucket Cavitation

Cavitation pitting on back side of No. 13 Bucket Inlet, which is the most severe cavitation damage in Unit 1 runner bucket



No 4

Date 10-Jul-12

Unit No. 1 B Runner Bucket Cavitation

At the inlet edge top of the action surface of Bucket No.20, hitting mark and cavitation is observed.

No 5

Date 10-Jul-12

Unit No. 1 B Runner Bucket Cavitation

Typical photo of inlet edge cavitation and hitting mark at knife edge on action surface on Bucket No. 20

No 6

Date 10-Jul-12

Unit No. 1 B Runner Bucket Cavitation

Cavitation pitting on back side of No. 20 Bucket Inlet, which is the most severe cavitation in Unit 1 B runner bucket

No 7

Date 19-Jul-12

Unit No. 2 A Runner Bucket Cavitation

Near the inlet edge top of the action surface of Bucket No.9, light cavitation is observed.

No 8

Date 19-Jul-12

Unit No. 2 A Runner Bucket Cavitation

Typical photo of light inlet edge cavitation and hitting mark of action surface on Bucket No. 9

No 9

Date 19-Jul-12

Unit No. 2 A Runner Bucket Cavitation

Cavitation pitting on back side of No. 9 Bucket Inlet, which is the most severe cavitation damage in Unit 2 A runner bucket

No 10

Date 19-Jul-12

Unit No. 2 B Runner Bucket Cavitation

Quite heavy cavitation pitting is observed at the leading edge of the action side of Bucket No. 5

No 11

Date 19-Jul-12

Unit No. 2 B Runner Bucket Cavitation

Typical photo of heavy inlet edge cavitation of action surface on Bucket No. 5

No 12

Date 19-Jul-12

Unit No. 2 B Runner Bucket Cavitation

Cavitation pitting on back side of No. 5 Bucket Inlet, which is the most severe cavitation damage in Unit 2 B runner bucket

No 13

Date 26-Jul-12

Unit No. 3 A Runner Bucket Cavitation

Relatively light Cavitation pitting at the leading edge of the action side of Bucket No. 5

No 14

Date 26-Jul-12

Unit No. 3 A Runner Bucket Cavitation

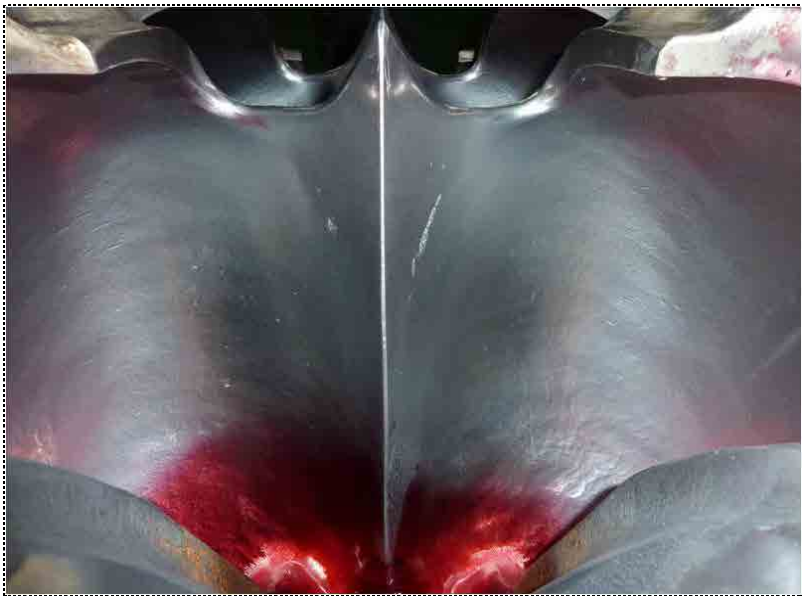
Typical photo of light inlet edge cavitation of action surface on Bucket No. 5

No 15

Date 26-Jul-12

Unit No. 3 A Runner Bucket Cavitation

Light cavitation pitting on back side of No. 5 Bucket Inlet



No 16

Date 26-Jul-12

Unit No. 3 B Runner Bucket Cavitation

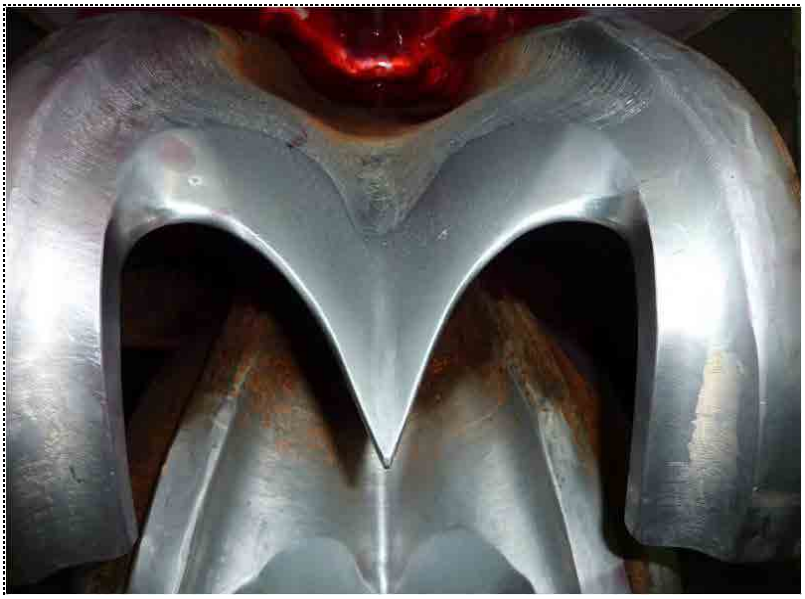
Light cavitation pitting is observed near the leading edge of the action side of Bucket No. 6

No 17

Date 26-Jul-12

Unit No. 3 B Runner Bucket Cavitation

Typical photo of inlet edge and stream surface cavitation of action surface on Bucket No. 6



No 18

Date 26-Jul-12

Unit No. 3 B Runner Bucket Cavitation

No cavitation pitting on back side of No. Bucket Inlet

No 19

Date 23-Jul-12

Unit No. 4 A Runner Bucket Cavitation

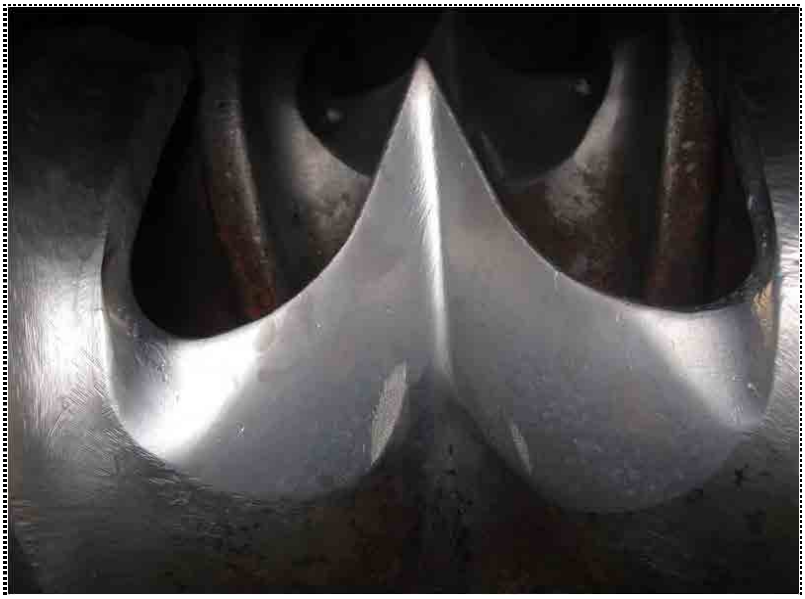
Small cavitation pitting is observed near the leading edge of the action side c Bucket No. 1

No 20

Date 23-Jul-12

Unit No. 4 A Runner Bucket Cavitation

Typical photo of light inlet edge cavitation of action surface on Bucket No. 1 Also, at the stream surface of the bucket erosion is observed.

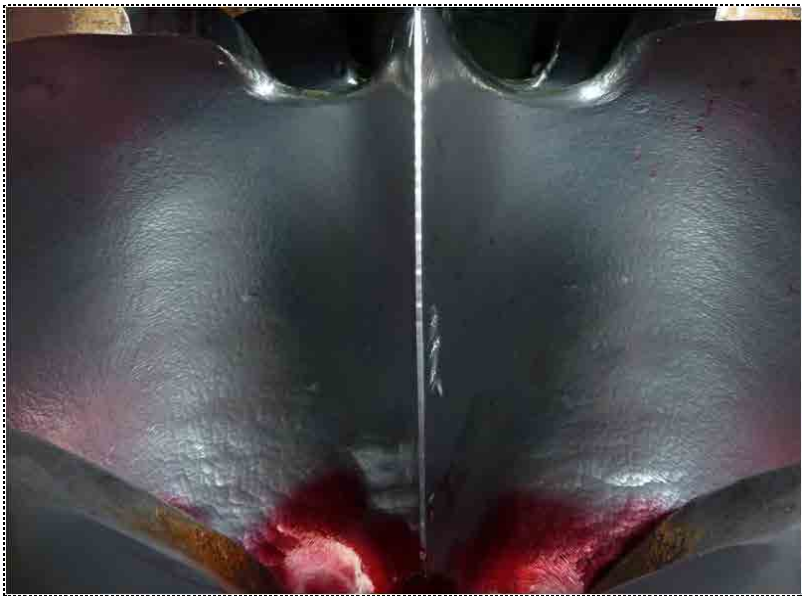


No 21

Date 23-Jul-12

Unit No. 4 A Runner Bucket Cavitation

Minor cavitation pitting on back side of No. 1 Bucket inlet is observed.

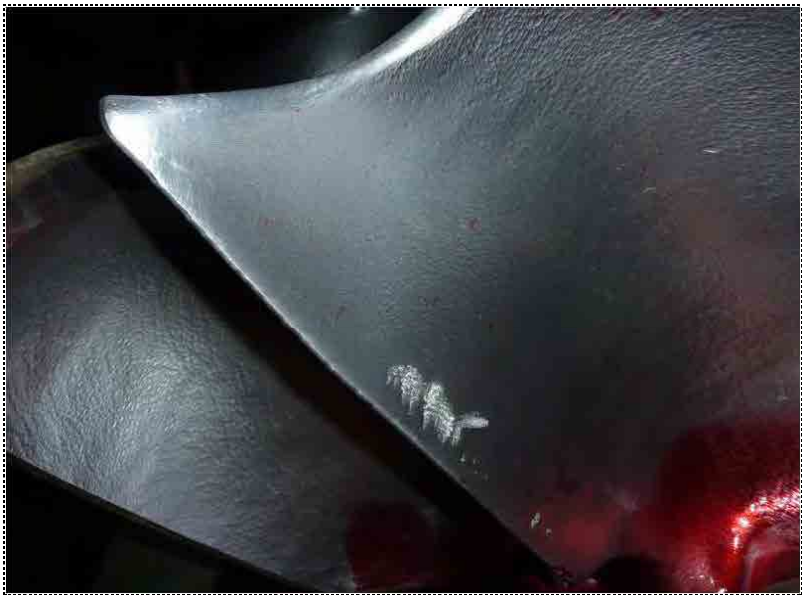


No 22

Date 23-Jul-12

Unit No. 4 B Runner Bucket Cavitation

Rather light cavitation pitting is observed at the leading edge and center line of the action side of Bucket No. 3

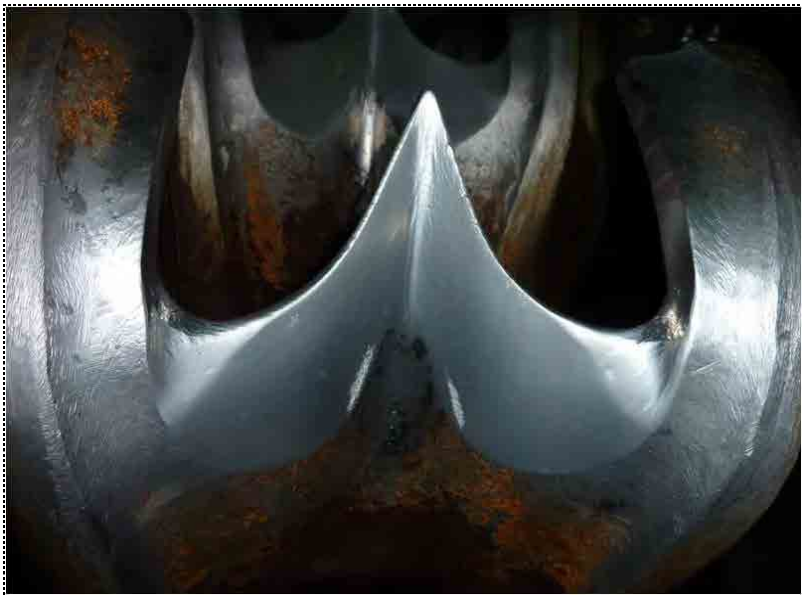


No 23

Date 23-Jul-12

Unit No. 4 B Runner Bucket Cavitation

Typical photo of light inlet edge cavitation of action surface on Bucket No. 3



No 24

Date 23-Jul-12

Unit No. 4 B Runner Bucket Cavitation

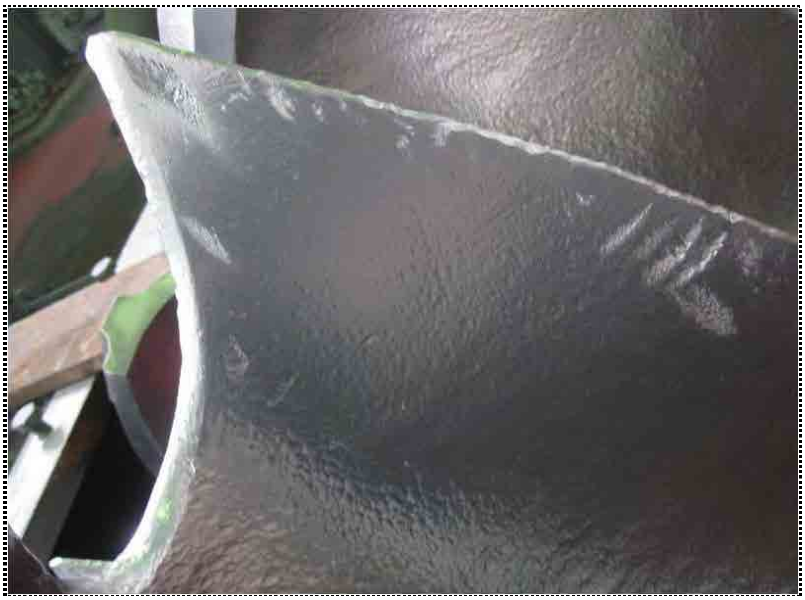
Cavitation pitting on back side of No. 3 Bucket Inlet

No 25

Date 30-Jul-12

Unit No. 5 A Runner Bucket Cavitation

Light cavitation pitting at the leading edg of the action side of Bucket No. 19 and erosion at the stream surface of the bucket is observed.



No 26

Date 30-Jul-12

Unit No. 5 A Runner Bucket Cavitation

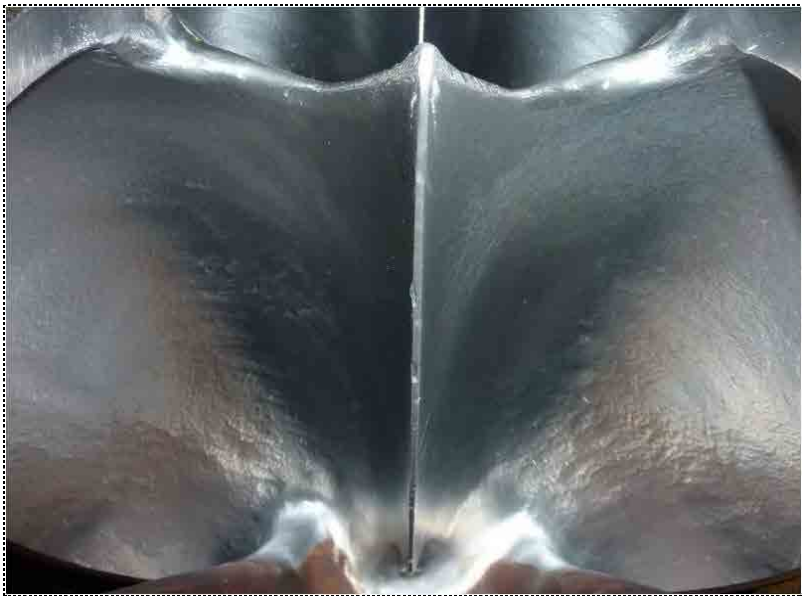
Typical photo of light inlet edge and knife edge cavitation of action surface on Bucket No. 19

No 27

Date 30-Jul-12

Unit No. 5 A Runner Bucket Cavitation

Cavitation pitting on back side of No. 19 Bucket Inlet, which is the most severe cavitation damage in Unit 5 A runner bucket



No 28

Date 30-Jul-12

Unit No. 5 B Runner Bucket Cavitation

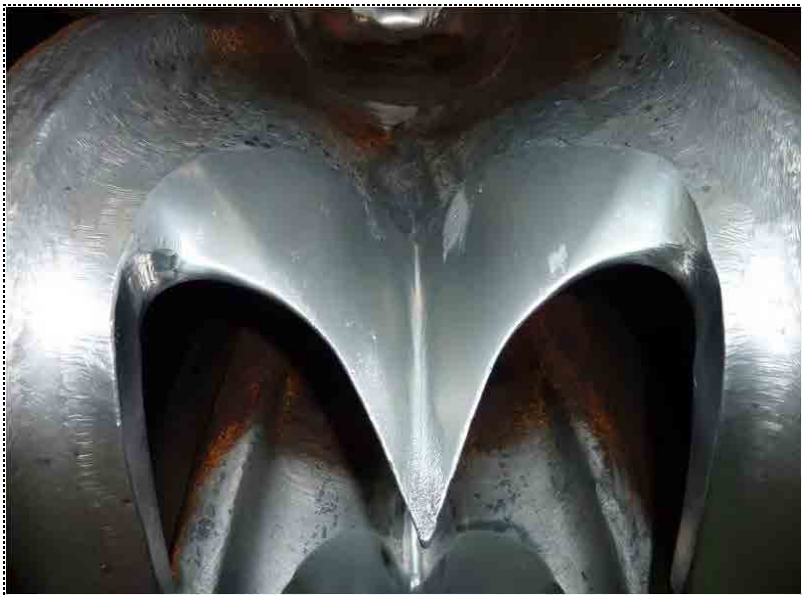
Light cavitation pitting is observed at the leading edge of the action side of Bucket No. 12

No 29

Date 30-Jul-12

Unit No. 5 B Runner Bucket Cavitation

Typical photo of light cavitation at the center edge of action surface on Bucket No. 12



No 30

Date 30-Jul-12

Unit No. 5 B Runner Bucket Cavitation

Cavitation pitting on back side of No. 12 Bucket Inlet

No 31

Date 28-Jul-12

Unit No. 6 A Runner Bucket Cavitation

Light cavitation pitting is observed at the leading edge of the action side of Bucket No. 10

No 32

Date 28-Jul-12

Unit No. 6 A Runner Bucket Cavitation

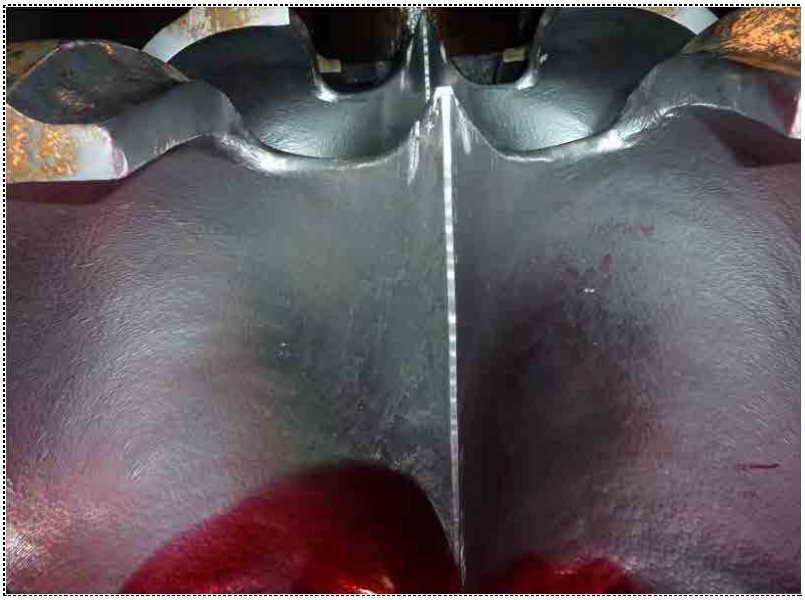
Typical photo of light inlet edge cavitation of action surface on Bucket No. 10

No 33

Date 28-Jul-12

Unit No. 6 A Runner Bucket Cavitation

Cavitation pitting on back side of No. 10 Bucket

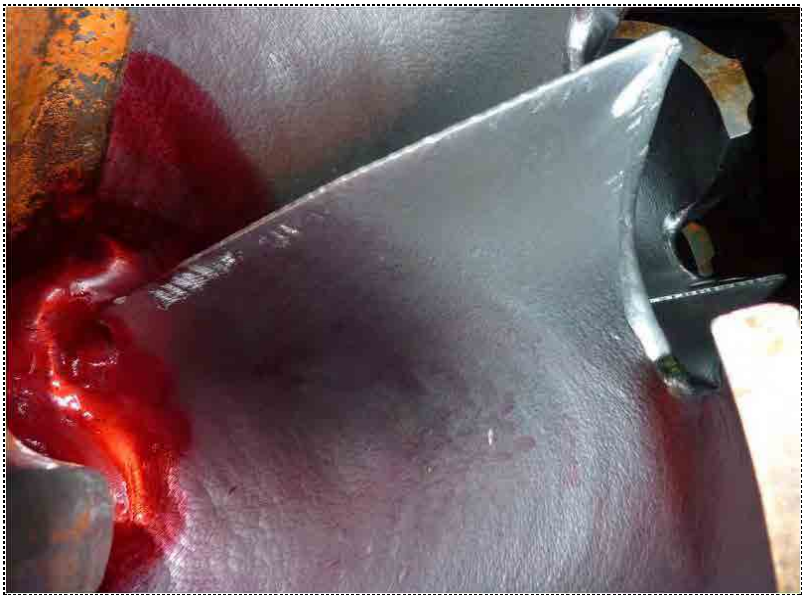


No 34

Date 28-Jul-12

Unit No. 6 B Runner Bucket Cavitation

Rather light cavitation pitting is observed at the leading edge of the action side of Bucket No. 5



No 35

Date 28-Jul-12

Unit No. 6 B Runner Bucket Cavitation

Typical photo of inlet edge cavitation of action surface on Bucket No. 5

No 36

Date 28-Jul-12

Unit No. 6 B Runner Bucket Cavitation

Cavitation pitting on back side of No. 5 Bucket Inlet, which is the most severe cavitation pitting in Unit 6 B runner bucket

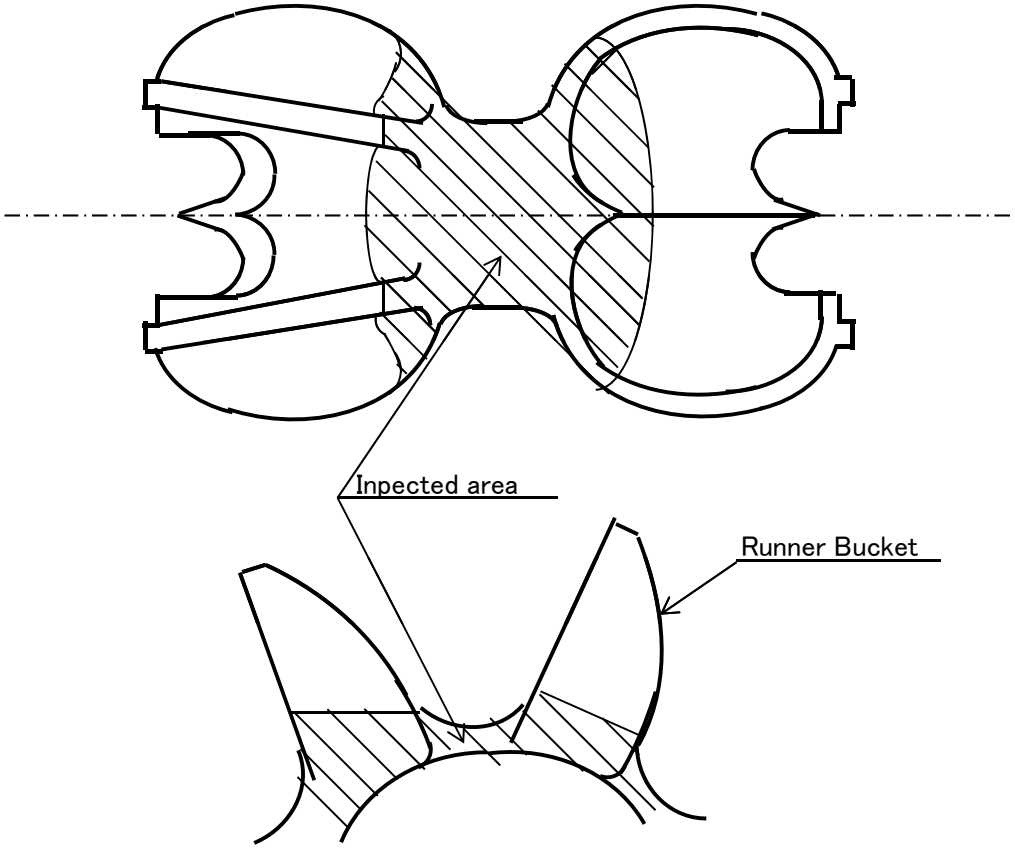
Position of Runner Bucket for Penetrant Testing(PT)

1. Material : Remover
Penetrant
Developer

2. Penetration time

3. Ambient temprature

4. Inspection area



No.1 Runner Bucket PT Result

Inspection Date	9 and 10 Jul. 2012												9 and 10 Jul. 2012											
Unit No.	A												B											
ID No.	U606												U605											
Bucket	L				D				R				L				D				R			
No.	Pre1	Pre2	Pre3	**This**	Pre1	Pre2	Pre3	**This**	Pre1	Pre2	Pre3	**This**	Pre1	Pre2	Pre3	**This**	Pre1	Pre2	Pre3	**This**	Pre1	Pre2	Pre3	**This**
1	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
3	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
4	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
5	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
6	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
7	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
8	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
9	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	80	80	80	**80**	0	0	0	**0**	0	0	0	**0**
10	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
11	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
12	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
13	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
14	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	85	85	85	**85**	0	0	0	**0**	0	0	0	**0**
15	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
16	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
17	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	100	100	100	**100**	0	0	0	**0**	0	0	0	**0**
18	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
19	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	91	91	91	**91**
20	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
Number of Crack	0	0	0	0	0	0	0	0	0	0	0	0	3	3	3	3	0	0	0	0	1	1	1	1

Location : L=Left rib D=Dalta R=Right rib in the view from the the back of Runner

Pre1 : Previous time(Nov.1998) Pre2 : Previous time (Aug.1999) Pre3 : Previous time (Jan.2000) This : This time

0 : Examined and no crack

Number : Length of crack

Date 10-Jul-12

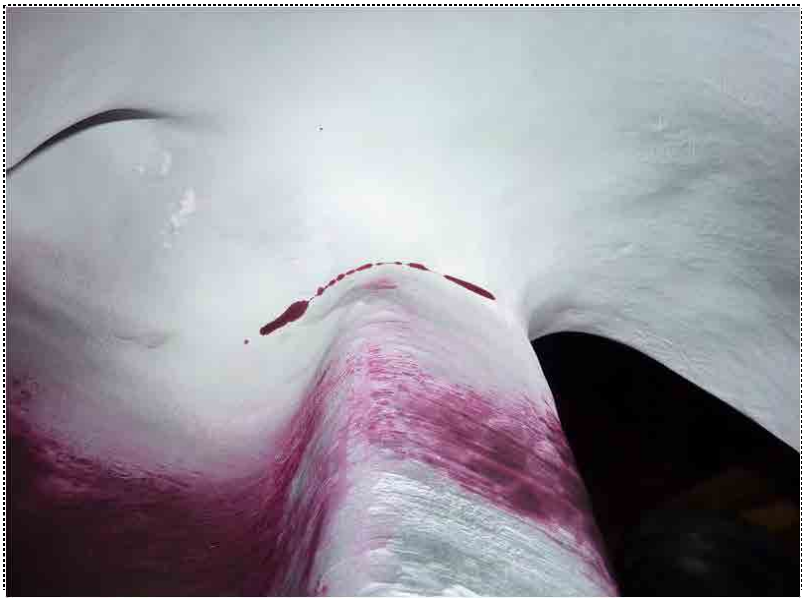
Unit No.1

SideB No.9 bucket crack

Date 10-Jul-12

Unit No.1

SideB No.14 bucket crack



Date 10-Jul-12

Unit No.1

SideB No.17 bucket crack

Date 10-Jul-12

Unit No.1

SideB No.19 bucket crack

写真

写真

No.2 Runner Bucket PT Result

Inspection Date	18, 19 Jul. 2012												18, 19 Jul. 2012											
Unit No.	A												B											
ID No.	U798												U799											
Bucket	L				D				R				L				D				R			
No.	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This
1	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
3	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
4	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
5	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
6	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
7	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	65	65	65	**77**
8	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	22	22	22	**25**	0	0	0	**0**	0	0	0	**0**
9	0	0	0	**0**	0	0	0	**0**	0	0	0	**70**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
10	0	0	0	**0**	0	0	0	**0**	65	65	65	**65**	0	0	0	**0**	0	0	0	**0**	23	23	23	**23**
11	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
12	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
13	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
14	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
15	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
16	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
17	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
18	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
19	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
20	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
Number of Crack	0	0	0	**0**	0	0	0	**0**	1	1	1	**2**	1	1	1	**1**	0	0	0	**0**	2	2	2	**2**

Location : L=Left rib D=Dalta R=Right rib in the view from the the back of Runner

Pre1 : Previous time(Nov.1998) Pre2 : Previous time (July.1999) Pre3 : Previous time (Feb.2000) This : This time

0 : Examined and no crack

Number Length of crack

Date 19-Jul-12

Unit No.2

SideA No.9 bucket crack

Date 18-Jul-12

Unit No.2

SideA No.10 bucket crack

Date 19-Jul-12

Unit No.2

SideB No.7 bucket crack

Date 19-Jul-12

Unit No.2

SideB No.8 bucket crack

Date 18-Jul-12

Unit No.2

SideB No.10 bucket crack

写真

No.3 Runner Bucket PT Result

Inspection Date	26 Jul. 2012												26 Jul. 2012											
Unit No.	A												B											
ID No.	F924												F643											
Bucket	L				D				R				L				D				R			
No.	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This	Pre1	Pre2	Pre3	This
1	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
2	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
3	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
4	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
5	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
6	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
7	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
8	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
9	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
10	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
11	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
12	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
13	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
14	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
15	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
16	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
17	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
18	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
19	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
20	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**
Number of Crack	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**	0	0	0	**0**

Location : L=Left rib D=Dalta R=Right rib in the view from the the back of Runner

Pre1 : Previous time(Nov.1998) Pre.2 : Previous time (July.1999) Pre3 : Previous time (Feb.2000) This : This time

0 : Examined and no crack

Number Length of crack

No.4 Runner Bucket PT Result

Inspection Date	23 Jul. 2012									23 Jul. 2012								
Unit No.	A									B								
ID No.	F533									F156								
Bucket	L			D			R			L			D			R		
No.	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This
1	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
2	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
3	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
4	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
5	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
6	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
7	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
8	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
9	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
10	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
11	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
12	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
13	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
14	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
15	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
16	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
17	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
18	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
19	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
20	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Number of Crack	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**

Location : L=Left rib D=Dalta R=Right rib in the view from the the back of Runner

Pre1 : Previous time(6.July.1997) Pre2 : Previous time (3Mar.2000) This : This time

0 : Examined and no crack

Number Length of crack

No.5 Runner Bucket PT Result

Inspection Date	30 Jul. 2012									30 Jul. 2012								
Unit No.	A									B								
ID No.	F749									F956								
Bucket	L			D			R			L			D			R		
No.	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This
1	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
2	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
3	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
4	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
5	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
6	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
7	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
8	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
9	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
10	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
11	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
12	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
13	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
14	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
15	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
16	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
17	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
18	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
19	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
20	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**
Number of Crack	0	0	**0**	0	0	**0**	0	0	**0**	—	0	**0**	—	0	**0**	—	0	**0**

Location : L=Left rib D=Dalta R=Right rib in the view from the the back of Runner

Pre1 : Previous time(8.July.1997) Pre2 : Previous time (24Feb.2000) This : This time

0 : Examined and no crack

Number Length of crack

No.6 Runner Bucket PT Result

Inspection Date	28 Jul. 2012									28 Jul. 2012								
Unit No.	A									B								
ID No.	F982									F853								
Bucket	L			D			R			L			D			R		
No.	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This	Pre1	Pre2	This
1	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
2	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
3	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
4	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
5	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
6	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
7	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
8	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
9	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
10	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
11	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
12	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
13	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
14	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
15	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
16	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
17	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
18	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
19	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
20	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**
Number of Crack	—	0	**0**	—	0	**0**	—	0	**0**	0	0	**0**	0	0	**0**	0	0	**0**

Location : L=Left rib D=Dalta R=Right rib in the view from the the back of Runner

Pre1 : Previous time(7.July.1997) Pre2 : Previous time (10Mar.2000)…A Side (1Apr.2000)…B Side This : This time

0 : Examined and no crack

Number Length of crack

Baluchaung No.2		Unit No.	1
Pressure Oil System (Unloader Test)		**Date**	**10 Jul. 2012**
1. Test Result of No.1 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	27.2	27.2	27.2
(3) Oil Pressure at On-loading (lb/in2)	295	294	295
(4) Oil Pressure at Unloading (lb/in^2)	310	310	310
(5) Oil Level at On-loading (mm)	-10	-8	-9
(6) Oil Level at Unloading (mm)	75	80	78
2. Test Result of No.2 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	37.5	37.5	37.5
(3) Oil Pressure at On-loading (lb/in2)	295	294	295
(4) Oil Pressure at Unloading (lb/in^2)	310	310	310
(5) Oil Level at On-loading (mm)	-5	-5	-5
(6) Oil Level at Unloading (mm)	80	80	80

Baluchaung No.2	Unit No.	2
Pressure Oil System (Unloader Test)	**Date**	**21 Jul. 2012**

1. Test Result of No.1 Pump

(1) Test No.	1	2	Average
(2) On-load Time	21	21	21
(3) Oil Pressure at On-loading (lb/in^2)	297	297	297
(4) Oil Pressure at Unloading (lb/in^2)	310	310	310
(5) Oil Level at On-loading (mm)	27	30	29
(6) Oil Level at Unloading (mm)	110	112	111

2. Test Result of No.2 Pump

(1) Test No.	1	2	Average
(2) On-load Time	32	33	33
(3) Oil Pressure at On-loading (lb/in^2)	297	297	297
(4) Oil Pressure at Unloading (lb/in^2)	310	310	310
(5) Oil Level at On-loading (mm)	30	35	33
(6) Oil Level at Unloading (mm)	110	115	113

Ambient temperature is 30℃. Oil temperature was not obtained due to no indicator.

Baluchaung No.2		Unit No.	3
Pressure Oil System (Unloader Test)		**Date**	**27 Jul. 2012**
1. Test Result of No.1 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	29	27	28
(3) Oil Pressure at On-loading (lb/in^2)	287	288	288
(4) Oil Pressure at Unloading (lb/in^2)	-70	-70	-70
(5) Oil Level at On-loading (mm)	308	308	308
(6) Oil Level at Unloading (mm)	31	30	31
2. Test Result of No.2 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	43	45	44
(3) Oil Pressure at On-loading (lb/in^2)	288	287	288
(4) Oil Pressure at Unloading (lb/in^2)	-83	-88	-86
(5) Oil Level at On-loading (mm)	305	305	305
(6) Oil Level at Unloading (mm)	10	8	9

Ambient temperature is 27℃. Oil temperature was not obtained due to no indicator.

Baluchaung No.2		Unit No.	4
Pressure Oil System (Unloader Test)		**Date**	**24 Jul. 2012**
1. Test Result of No.1 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	60	59	60
(3) Oil Pressure at On-loading (lb/in^2)	395	395	395
(4) Oil Pressure at Unloading (lb/in^2)	-10	-9	-10
(5) Oil Level at On-loading (mm)	435	435	435
(6) Oil Level at Unloading (mm)	96	95	96
2. Test Result of No.2 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	49	47	48
(3) Oil Pressure at On-loading (lb/in^2)	405	405	405
(4) Oil Pressure at Unloading (lb/in^2)	20	20	20
(5) Oil Level at On-loading (mm)	440	440	440
(6) Oil Level at Unloading (mm)	105	106	106

Ambient temperature is 28℃. Oil temperature was not obtained due to no indicator.

Baluchaung No.2		Unit No.	5
Pressure Oil System (Unloader Test)		**Date**	**31 Jul. 2012**
1. Test Result of No.1 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	61	61	61
(3) Oil Pressure at On-loading (lb/in^2)	385	385	385
(4) Oil Pressure at Unloading (lb/in^2)	-29	-30	-30
(5) Oil Level at On-loading (mm)	425	425	425
(6) Oil Level at Unloading (mm)	89	97	93
2. Test Result of No.2 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	50	51	51
(3) Oil Pressure at On-loading (lb/in^2)	387	387	387
(4) Oil Pressure at Unloading (lb/in^2)	-28	-25	-27
(5) Oil Level at On-loading (mm)	420	420	420
(6) Oil Level at Unloading (mm)	75	75	75

Ambient temperature is 27℃. Oil temperature was not obtained due to no indicator.

Baluchaung No.2		Unit No.	6
Pressure Oil System (Unloader Test)		**Date**	**31 Jul. 2012**
1. Test Result of No.1 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	53	53	53
(3) Oil Pressure at On-loading (lb/in^2)	402	402	402
(4) Oil Pressure at Unloading (lb/in^2)	-41	-42	-42
(5) Oil Level at On-loading (mm)	440	439	440
(6) Oil Level at Unloading (mm)	55	53	54
2. Test Result of No.2 Pump			
(1) Test No.	1	2	Average
(2) On-load Time	34	35	35
(3) Oil Pressure at On-loading (lb/in^2)	400	400	400
(4) Oil Pressure at Unloading (lb/in^2)	-65	-68	-67
(5) Oil Level at On-loading (mm)	421	421	421
(6) Oil Level at Unloading (mm)	-7	-6	-7

Ambient temperature is 28℃. Oil temperature was not obtained due to no indicator.

Baluchaung No.2				Unit No.		1	
Generator Output vs Servomotor Stroke				Date		11 Jul. 2012	
1. General							
(1) Test No.	under stoppage	1	2	3	4	5	
(2) TIME		10:09	10:29	10:43	10:53	11:02	
(3) Generator Output (MW)	-	5.0	9.9	15.0	20.0	23.0	
2. Needle Servomotor Stroke (mm)							
(1) Servomotor for Runner A	2	52	86	121	162	192	
(2) Upper Needle Rod for Runner A	3	14	27	41	60	76	
(3) Lower Needle Rod for Runner A	-3	13	24	38	57	73	
(4) Servomotor for Runner B	0	51	84	117	159	191	
(5) Upper Needle Rod for Runner B	-3	11	24	38	56	70	
(6) Lower Needle Rod for Runner B	-3	13	24	38	57	71	
3. Deflector Servomotor Stroke (%)							
(1) for Runner A	2	96	98	98	99	99	
(2) for Runner B	0	92	97	99	99	99	
4. Position meter for Governor							
(1) for Runner A		18	26	48	52	60	
(2) for Runner B		18	26	48	52	62	
5. Vibration (μm p-p)							
(1) Horizontal at A side Pedestal	2	135	165	160	130	100	
(2) Vertical at A side Pedestal	2	32	28	20	22	22	
(3) Axial at A side Pedestal	2	32	40	46	46	42	
(4) Horizontal at B side Pedestal	2	34	36	38	38	38	
(5) Vertical at B side Pedestal	2	16	16	18	22	22	
(6) Axial at B side Pedestal	2	8	10	14	24	16	

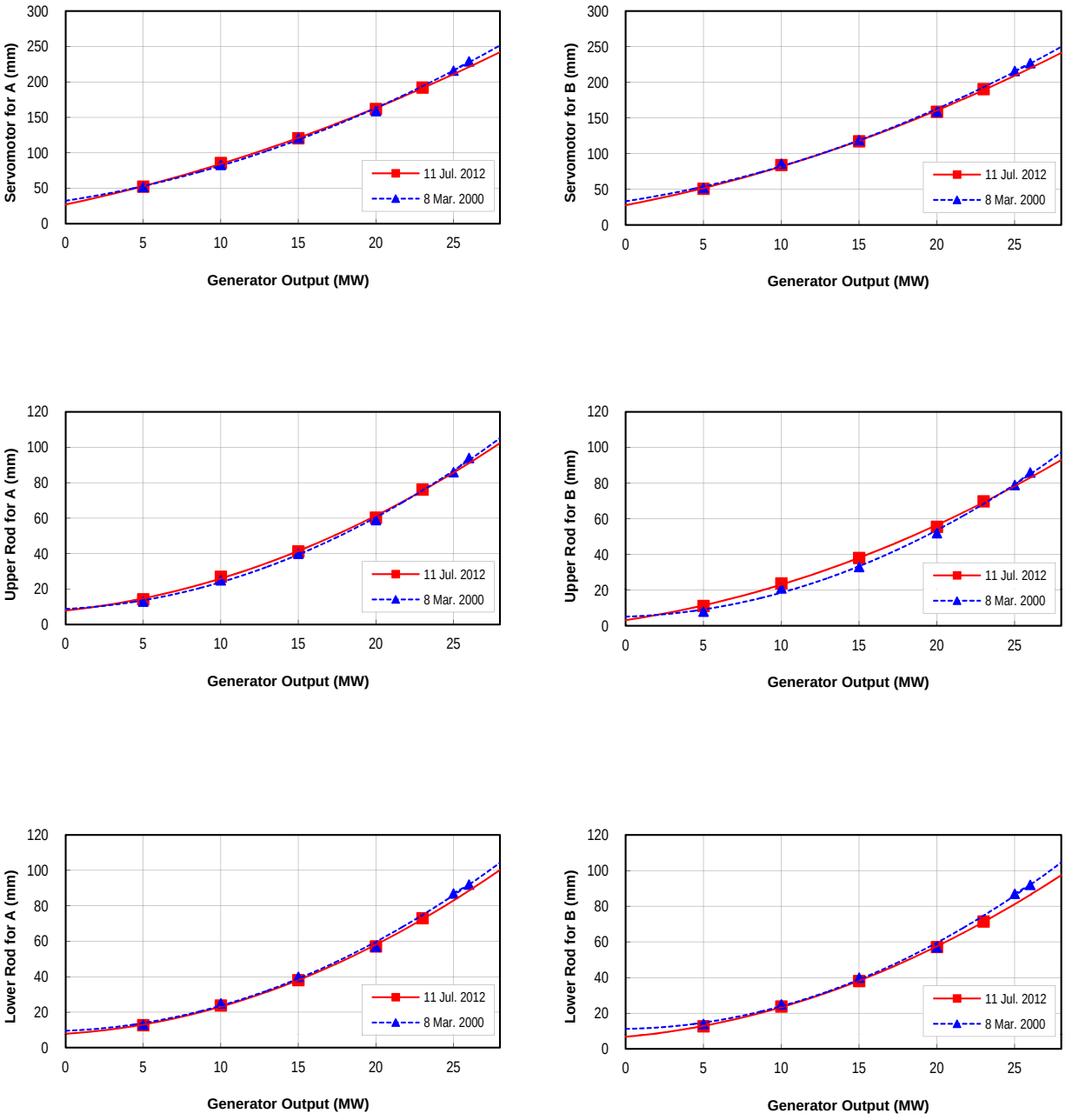
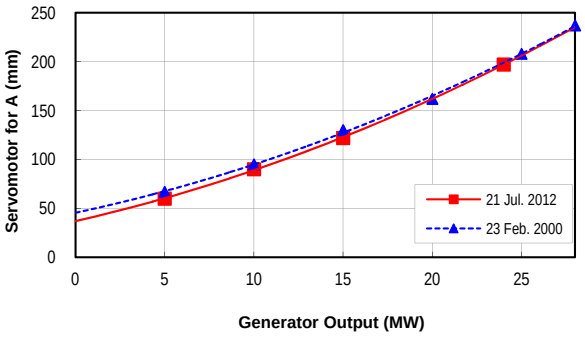
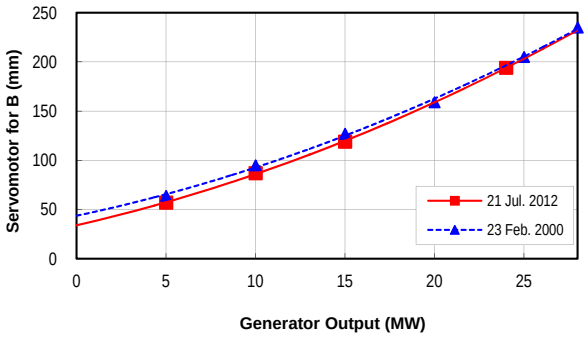


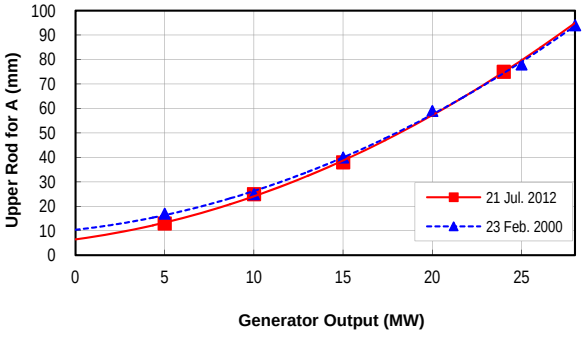
Fig. Generator Output vs Needle Servomotor Stroke

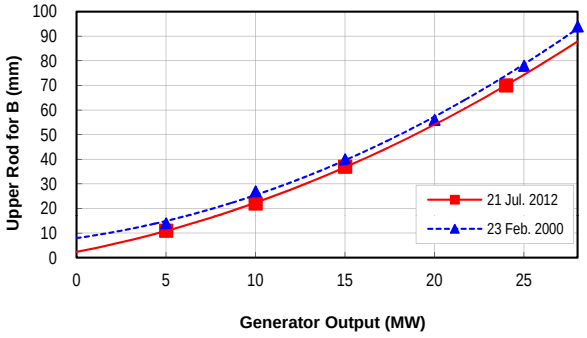
Generator Output	Runner A						Runner B					
	Servomotor		Upper Rod		Lower Rod		Servomotor		Upper Rod		Lower Rod	
	11 Jul. 2012	8 Mar. 2000	11 Jul. 2012	8 Mar. 2000	11 Jul. 2012	8 Mar. 2000	11 Jul. 2012	8 Mar. 2000	11 Jul. 2012	8 Mar. 2000	11 Jul. 2012	8 Mar. 2000
0												
1												
2												
3												
4												
5	52	52	14	13	13	13	51	52	11	8	13	14
6												
7												
8												
9												
10	86	83	27	25	24	25	84	86	24	21	24	25
11												
12												
13												
14												
15	121	121	41	40	38	40	117	119	38	33	38	40
16												
17												
18												
19												
20	162	159	60	59	57	57	159	159	56	52	57	57
21												
22												
23	192		76		73		191		70		71	
24												
25		216		86		87		216		79		87
26		229		94		92		227		86		92
27												
28												

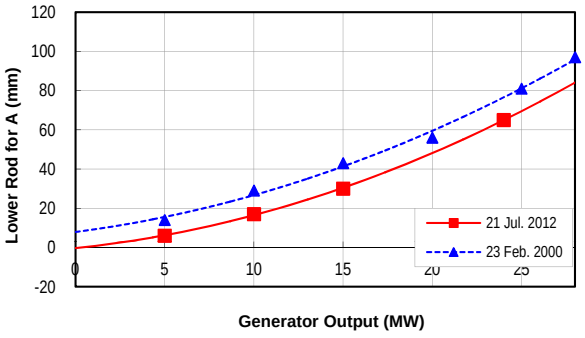
Baluchaung No.2				Unit No.		2	
Generator Output vs Servomotor Stroke				**Date**		**21 Jul. 2012**	
1. General							
(1) Test No.	under stoppage	1	2	3	4		
(2) TIME	9:54	10:24	10:37	10:52	11:07		
(3) Generator Output (MW)	-	5.0	10.0	15.0	24.4		
(4) Penstock Pressure (ft)	1,440	1,440	1,430	1,400	1,400		
2. Needle Servomotor Stroke (mm)							
(1) Servomotor for Runner A	0	60	90	122	197		
(2) Upper Needle Rod for Runner A	-2	13	25	38	75		
(3) Lower Needle Rod for Runner A	-3	6	17	30	65		
(4) Servomotor for Runner B	0	57	87	119	194		
(5) Upper Needle Rod for Runner B	-3	11	22	37	70		
(6) Lower Needle Rod for Runner B	0	8	19	33	67		
3. Deflector Servomotor Stroke (%)							
(1) for Runner A	0	82	87	90	94		
(2) for Runner B	0	80	85	87	94		
4. Position meter for Governor							
(1) for Runner A		21	25	40	67		
(2) for Runner B		18	29	41	69		
5. Vibration (μm p-p)							
(1) Horizontal at A side Pedestal	3	25	24	26	27		
(2) Vertical at A side Pedestal	7	10	10	13	30-90		
(3) Axial at A side Pedestal	3	13	13	14	15		
(4) Horizontal at B side Pedestal	2	26	27	27	30		
(5) Vertical at B side Pedestal	8	12	16	15	16		
(6) Axial at B side Pedestal	5	10	14	16	17		
6. Output of Other Units (MW)							
(1) Unit 1		21.0	21.0	20.1	19.8		
(2) Unit 3		21.0	21.0	20.0	19.5		
(3) Unit 4		24.5	24.5	23.0	24.7		
(4) Unit 5		17.0	17.3	17.3	19.8		
(5) Unit 6		25.0	26.0	26.0	27.0		











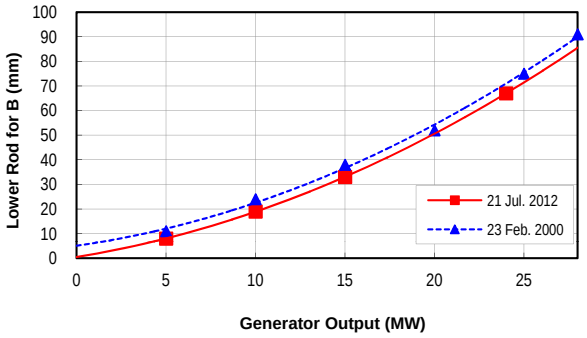


Fig. Generator Output vs Needle Servomotor Stroke

Generator Output	Runner A						Runner B					
	Servomotor		Upper Rod		Lower Rod		Servomotor		Upper Rod		Lower Rod	
	21 Jul. 2012	23 Feb. 2000	21 Jul. 2012	23 Feb. 2000	21 Jul. 2012	23 Feb. 2000	21 Jul. 2012	23 Feb. 2000	21 Jul. 2012	23 Feb. 2000	21 Jul. 2012	23 Feb. 2000
0												
1												
2												
3												
4												
5	60	67	13	17	6	14	57	64	11	14	8	11
6												
7												
8												
9												
10	90	95	25	25	17	29	87	95	22	27	19	24
11												
12												
13												
14												
15	122	130	38	40	30	43	119	127	37	40	33	38
16												
17												
18												
19												
20		162		59		56		159		56		52
21												
22												
23												
24	197		75		65		194		70		67	
25		208		78		81		205		78		75
26												
27												
28		237		94		97		235		94		91

Baluchaung No.2				Unit No.		3	
Generator Output vs Servomotor Stroke				**Date**		**27 Jul. 2012**	
1. General							
(1) Test No.	under stoppage	1	2	3	4	5	
(2) TIME	-	14:51	15:06	15:13	15:25	15:36	
(3) Generator Output (MW)	-	5.0	10.0	15.0	20.0	25.0	
(4) Penstock Pressure (ft)	1,450	1,450	1,450	1,430	1,420	1,420	
2. Needle Servomotor Stroke (mm)							
(1) Servomotor for Runner A	0	54	79	110	143	181	
(2) Upper Needle Rod for Runner A	0	15	25	37	52	70	
(3) Lower Needle Rod for Runner A	-	-	-	-	-	-	
(4) Servomotor for Runner B	-3	51	79	110	141	181	
(5) Upper Needle Rod for Runner B	0	15	25	37	51	67	
(6) Lower Needle Rod for Runner B	0	15	25	37	52	70	
3. Deflector Servomotor Stroke (%)							
(1) for Runner A	0	95	96	98	99	99	
(2) for Runner B	0	95	96	98	99	99	
4. Position meter for Governor							
(1) for Runner A	0	18	23	40	52	68	
(2) for Runner B	0	20	24	42	53	69	
5. Vibration (μm p-p)							
(1) Horizontal at A side Pedestal	2	14	14	16	16	16	
(2) Vertical at A side Pedestal	4	7	8	10	8	8	
(3) Axial at A side Pedestal	10	10	14	10	11	14	
(4) Horizontal at B side Pedestal	2	24	24	22	25	26	
(5) Vertical at B side Pedestal	4	14	12	10	11	14	
(6) Axial at B side Pedestal	3	8	11	11	12	12	
6. Output of Other Units (MW)							
(1) Unit 1	-	19.2	19.0	19.1	18.3	18.2	
(2) Unit 2	-	15.5	15.5	15.3	14.9	13.7	
(3) Unit 4	-	14.8	15.8	16.2	16.2	14.8	
(4) Unit 5	-	-	-	-	-	-	
(5) Unit 6	-	-	-	-	-	-	

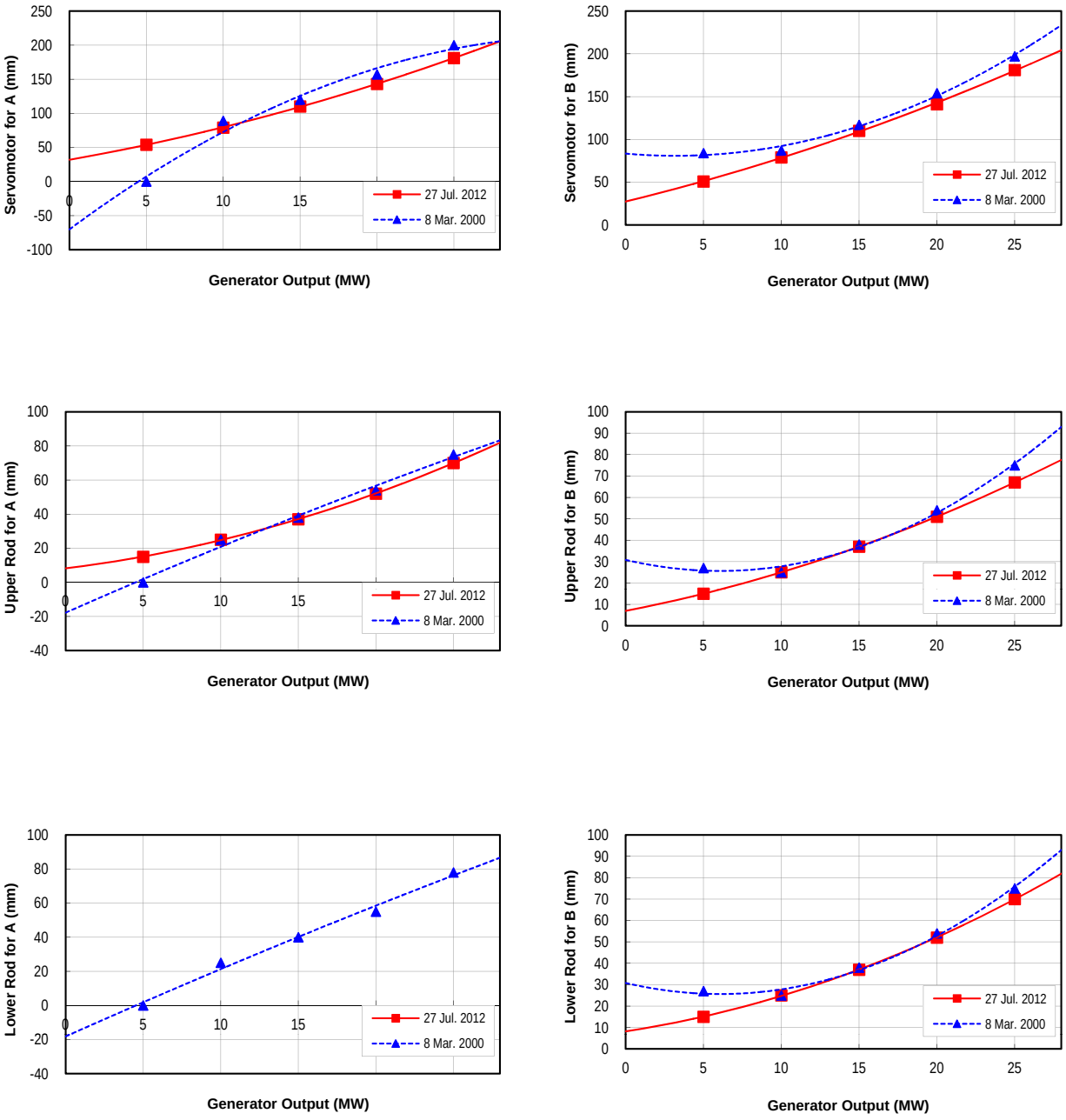
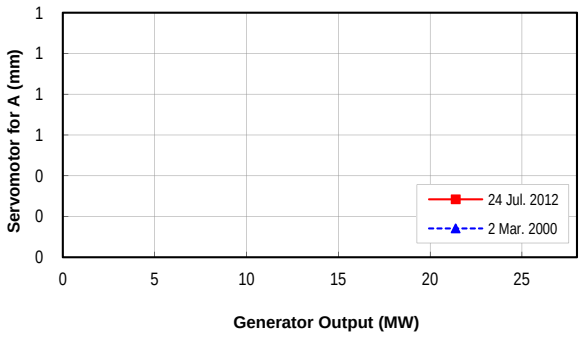
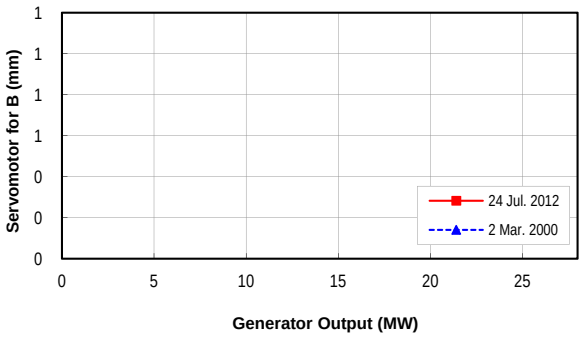


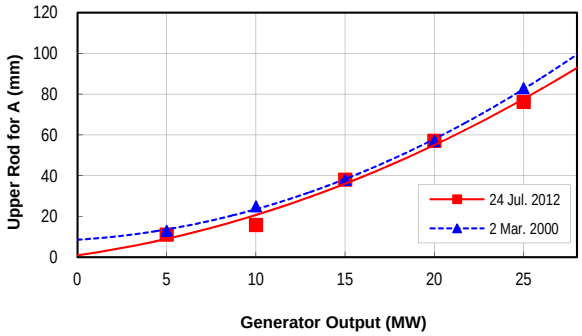
Fig. Generator Output vs Needle Servomotor Stroke

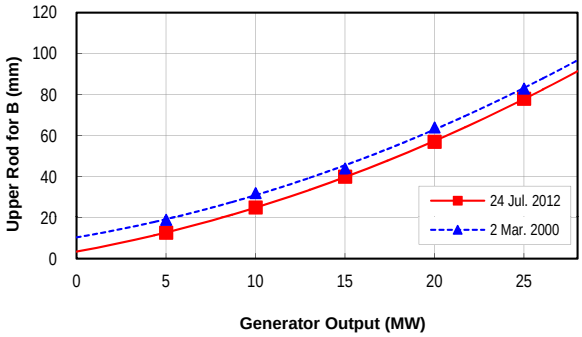
Generator Output	Runner A						Runner B					
	Servomotor		Upper Rod		Lower Rod		Servomotor		Upper Rod		Lower Rod	
	27 Jul. 2012	8 Mar. 2000	27 Jul. 2012	8 Mar. 2000	27 Jul. 2012	8 Mar. 2000	27 Jul. 2012	8 Mar. 2000	27 Jul. 2012	8 Mar. 2000	27 Jul. 2012	8 Mar. 2000
0												
1												
2												
3												
4												
5	54	0	15	0	0		51	84	15	27	15	27
6												
7												
8												
9												
10	79	89	25	25	25		79	87	25	25	25	25
11												
12												
13												
14												
15	110	120	37	38	40		110	117	37	38	37	38
16												
17												
18												
19												
20	143	157	52	54	55		141	154	51	54	52	54
21												
22												
23												
24												
25	181	200	70	75	78		181	197	67	75	70	75
26												
27												
28												

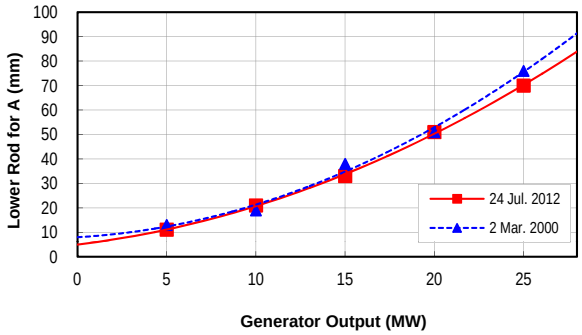
Baluchaung No.2				Unit No.		4	
Generator Output vs Servomotor Stroke				Date		24 Jul. 2012	
1. General							
(1) Test No.	under stoppage	1	2	3	4	5	
(2) TIME	-	16:31	16:49	17:00	17:10	17:20	
(3) Generator Output (MW)	-	5.0	10.0	15.0	20.0	25.0	
(4) Penstock Pressure (lb/in^2)	610	610	610	610	605	600	
2. Needle Servomotor Stroke (mm)							
(1) Servomotor for Runner A	-	-	-	-	-	-	
(2) Upper Needle Rod for Runner A	0	11	16	38	57	76	
(3) Lower Needle Rod for Runner A	0	11	21	33	51	70	
(4) Servomotor for Runner B	-	-	-	-	-	-	
(5) Upper Needle Rod for Runner B	0	13	25	40	57	78	
(6) Lower Needle Rod for Runner B	6	6	16	29	48	67	
3. Deflector Servomotor Stroke (mm)							
(1) for Runner A	0	180	195	205	216	224	
(2) for Runner B	1	184	195	205	216	224	
4. Position meter for Governor							
(1) for Runner A	2	9	18	28	40	56	
(2) for Runner B	0	10	18	28	40	57	
5. Vibration (μ m p-p)							
(1) Horizontal at A side Pedestal	4	10	10	10	10	11	
(2) Vertical at A side Pedestal	4	8	9	8	6	10	
(3) Axial at A side Pedestal	4	6	6	6	8	6	
(4) Horizontal at B side Pedestal	2	9	10	10	10	12	
(5) Vertical at B side Pedestal	4	5	7	6	8	10	
(6) Axial at B side Pedestal	2	7	8	8	8	10	
6. Output of Other Units (MW)							
(1) Unit 1		19.8	19.7	19.7	19.7	19.7	
(2) Unit 2		21.7	21.8	21.8	21.7	21.8	
(3) Unit 3		9.0	9.0	9.1	9.1	9.1	
(4) Unit 5		25.3	25.0	25.0	24.7	16.7	
(5) Unit 6		26.8	26.5	26.3	25.9	26.0	











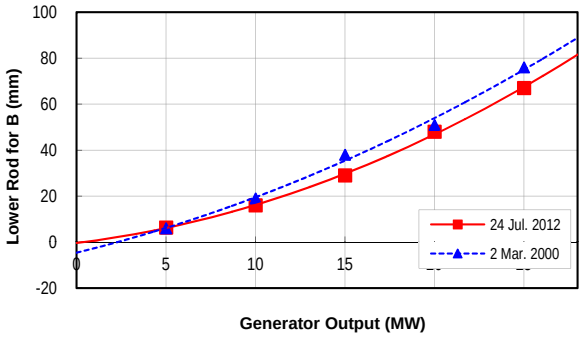
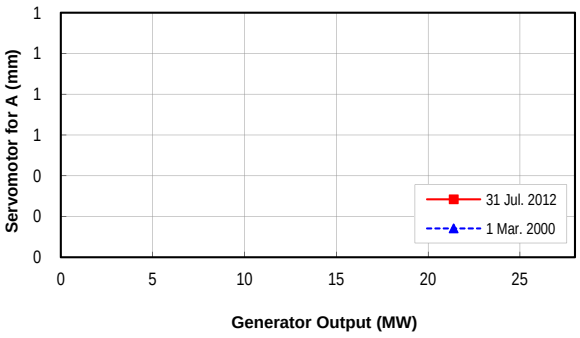
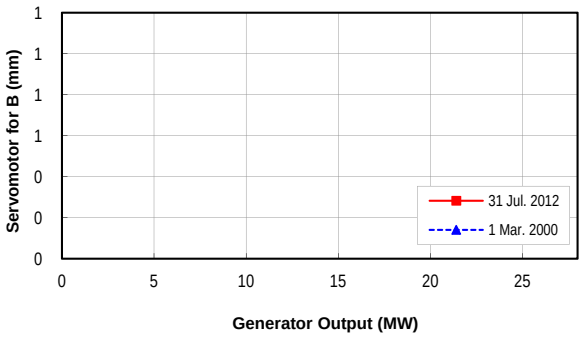


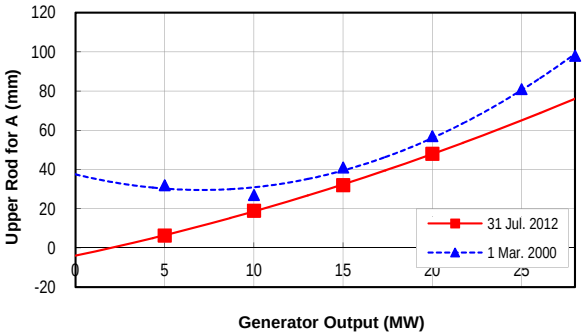
Fig. Generator Output vs Needle Servomotor Stroke

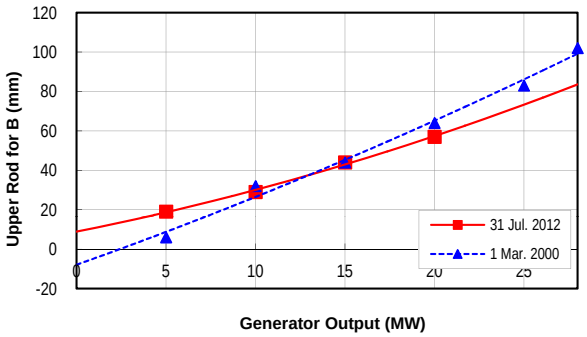
Generator Output	Runner A						Runner B					
	Servomotor		Upper Rod		Lower Rod		Servomotor		Upper Rod		Lower Rod	
	24 Jul. 2012	2 Mar. 2000	24 Jul. 2012	2 Mar. 2000	24 Jul. 2012	2 Mar. 2000	24 Jul. 2012	2 Mar. 2000	24 Jul. 2012	2 Mar. 2000	24 Jul. 2012	2 Mar. 2000
0												
1												
2												
3												
4												
5			11	13	11	13			13	19	6	6
6												
7												
8												
9												
10			16	25	21	19			25	32	16	19
11												
12												
13												
14												
15			38	38	33	38			40	44	29	38
16												
17												
18												
19												
20			57	57	51	51			57	64	48	51
21												
22												
23												
24												
25			76	83	70	76			78	83	67	76
26												
27												
28												

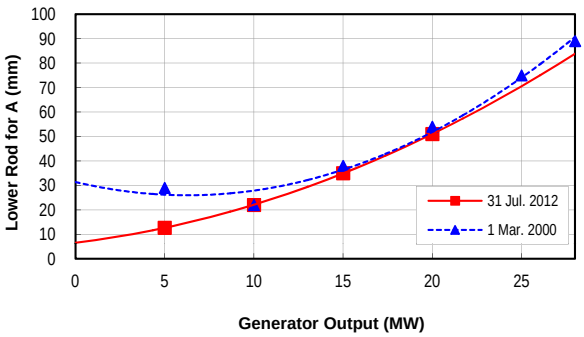
Baluchaung No.2				Unit No.		5	
Generator Output vs Servomotor Stroke				Date		31 Jul. 2012	
1. General							
(1) Test No.	under stoppage	1	2	3	4		
(2) TIME	-	14:21	14:28	14:37	14:44		
(3) Generator Output (MW)	-	5.0	10.0	15.0	20.0		
(4) Penstock Pressure (ft)	-	1,550	1,550	1,550	1,540		
2. Needle Servomotor Stroke (mm)							
(1) Servomotor for Runner A	-	-	-	-	-		
(2) Upper Needle Rod for Runner A	0	6	19	32	48		
(3) Lower Needle Rod for Runner A	10	13	22	35	51		
(4) Servomotor for Runner B	-	-	-	-	-		
(5) Upper Needle Rod for Runner B	3	19	29	44	57		
(6) Lower Needle Rod for Runner B	6	19	29	41	57		
3. Deflector Servomotor Stroke (mm)							
(1) for Runner A	3	181	193	202	212		
(2) for Runner B	0	181	192	201	211		
4. Position meter for Governor							
(1) for Runner A	1	5	15	24	35		
(2) for Runner B	2	13	21	31	42		
5. Vibration (μm p-p)							
(1) Horizontal at A side Pedestal	2	4	8	8	8		
(2) Vertical at A side Pedestal	8	4	4	4	5		
(3) Axial at A side Pedestal	4	7	4	4	4		
(4) Horizontal at B side Pedestal	2	12	11	12	10		
(5) Vertical at B side Pedestal	6	8	8	7	5		
(6) Axial at B side Pedestal	3	7	10	9	9		
6. Output of Other Units (MW)							
(1) Unit 1		14.8	14.9	13.8	11.8		
(2) Unit 2		15.7	15.7	14.1	13.0		
(3) Unit 3		-	-	-	-		
(4) Unit 4		18.5	18.7	15.1	13.6		
(5) Unit 6		-	-	-	-		











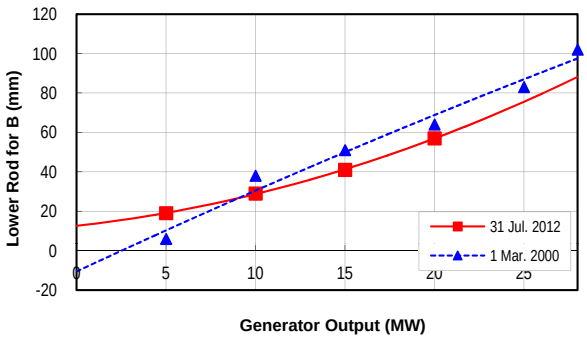
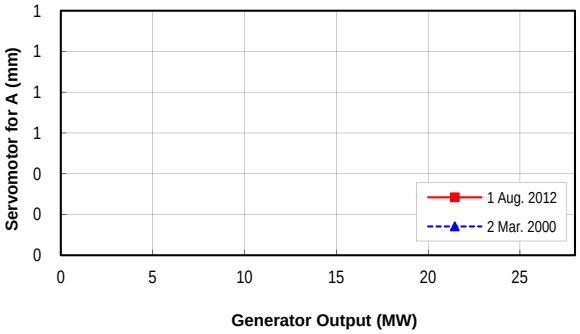
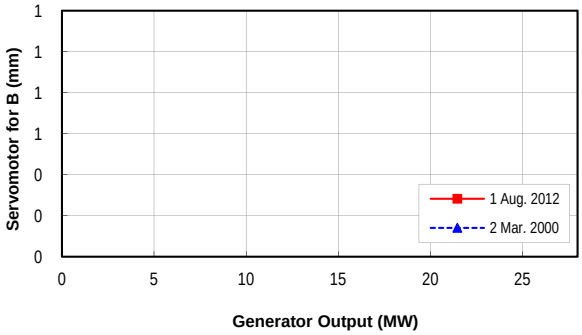


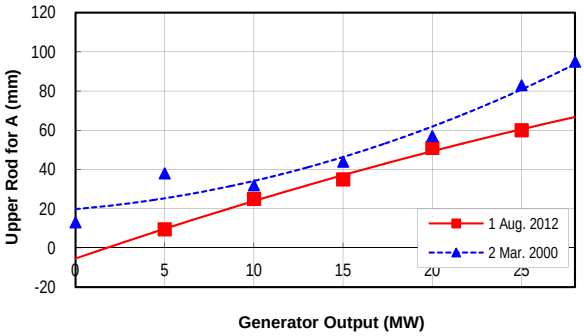
Fig. Generator Output vs Needle Servomotor Stroke

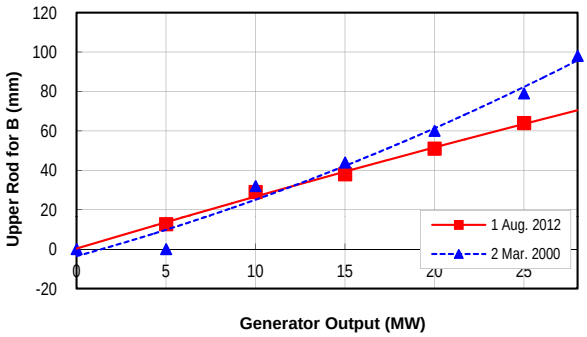
Generator Output	Runner A						Runner B					
	Servomotor		Upper Rod		Lower Rod		Servomotor		Upper Rod		Lower Rod	
	31 Jul. 2012	1 Mar. 2000	31 Jul. 2012	1 Mar. 2000	31 Jul. 2012	1 Mar. 2000	31 Jul. 2012	1 Mar. 2000	31 Jul. 2012	1 Mar. 2000	31 Jul. 2012	1 Mar. 2000
0												
1												
2												
3												
4												
5			6	32	13	29			19	6	19	6
6												
7												
8												
9												
10			19	27	22	22			29	32	29	38
11												
12												
13												
14												
15			32	41	35	38			44	44	41	51
16												
17												
18												
19												
20			48	57	51	54			57	64	57	64
21												
22												
23												
24												
25				81		75				83		83
26												
27												
28				98		89				102		102

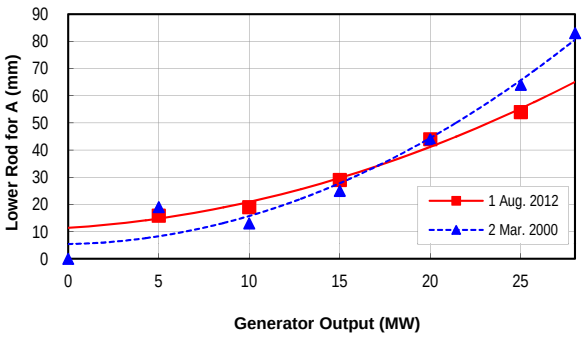
Baluchaung No.2				Unit No.		6	
Generator Output vs Servomotor Stroke				Date		01 Aug. 2012	
1. General							
(1) Test No.	under stoppage	1	2	3	4	5	
(2) TIME	-	14:16	14:25	14:32	14:40	14:47	
(3) Generator Output (MW)	-	5.0	10.0	15.0	20.0	25.0	
(4) Penstock Pressure (lb/in^2)	940	930	925	925	920	920	
2. Needle Servomotor Stroke (mm)							
(1) Servomotor for Runner A	-	-	-	-	-	-	
(2) Upper Needle Rod for Runner A	0	10	25	35	51	60	
(3) Lower Needle Rod for Runner A	6	16	19	29	44	54	
(4) Servomotor for Runner B	-	-	-	-	-	-	
(5) Upper Needle Rod for Runner B	0	13	29	38	51	64	
(6) Lower Needle Rod for Runner B	0	6	25	32	44	60	
3. Deflector Servomotor Stroke (mm)							
(1) for Runner A	0	183	200	206	215	222	
(2) for Runner B	0	181	199	205	213	220	
4. Position meter for Governor							
(1) for Runner A	3	9	17	24	35	45	
(2) for Runner B	1	10	20	26	38	46	
5. Vibration (μ m p-p)							
(1) Horizontal at A side Pedestal	4	14	14	14	14	14	
(2) Vertical at A side Pedestal	8	4	12	7	7	7	
(3) Axial at A side Pedestal	4	4	6	9	10	9	
(4) Horizontal at B side Pedestal	4	8	7	7	8	8	
(5) Vertical at B side Pedestal	8	6	8	6	8	10	
(6) Axial at B side Pedestal	4	4	5	7	7	6	
6. Output of Other Units (MW)							
(1) Unit 1	19.9	14.3	10.9	10.9	10.8	10.8	
(2) Unit 2	19.4	15.3	15.4	15.3	15.3	15.3	
(3) Unit 3	-	-	-	-	-	-	
(4) Unit 4	20.2	17.5	17.5	17.5	17.5	17.5	
(5) Unit 5	-	-	-	-	-	-	











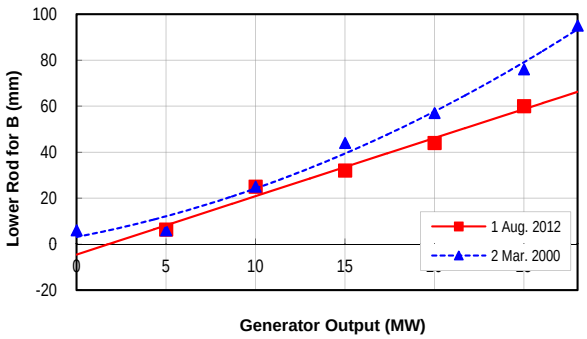


Fig. Generator Output vs Needle Servomotor Stroke

Generator Output	Runner A						Runner B					
	Servomotor		Upper Rod		Lower Rod		Servomotor		Upper Rod		Lower Rod	
	1 Aug. 2012	2 Mar. 2000	1 Aug. 2012	2 Mar. 2000	1 Aug. 2012	2 Mar. 2000	1 Aug. 2012	2 Mar. 2000	1 Aug. 2012	2 Mar. 2000	1 Aug. 2012	2 Mar. 2000
0				13		0				0		6
1												
2												
3												
4												
5			10	38	16	19			13	0	6	6
6												
7												
8												
9												
10			25	32	19	13			29	32	25	25
11												
12												
13												
14												
15			35	44	29	25			38	44	32	44
16												
17												
18												
19												
20			51	57	44	44			51	60	44	57
21												
22												
23												
24												
25			60	83	54	64			64	79	60	76
26												
27												
28				95		83				98		95

No T-001

Date 9-Jul-12

Unit No. 1 A Upper Needle, Leakage

No T-002

Date 9-Jul-12

Unit No. 1 B Upper Needle, Leakage

No T-003

Date 9-Jul-12

Unit No. 1 A Lower Needle Shaft Water Drain

Drain line is closed with blind cover.

No T-004

Date 9-Jul-12

Unit No. 1 A Upper Deflector

Damaged by cavitation pitting and erosion

No T-005

Date 4-Aug-12

Unit No. 1 A Companion Flange and Bypass Valve Line

No T-006

Date 31-Jul-12

Unit No. 1A Penstock Drain Valve

This valve is permanently closed with blind cover.

No T-007

Date 31-Jul-12

Unit No. 1 Governor Cabinet and Damaged Dial Indicators

No T-008

Date 31-Jul-12

Unit No. 1 Governor Indicators

No T-001

Date 28-Jul-12

Unit No. 2 A Upper Needle Cavitation

Around the needle tip,
cavitation pitting and erosion is observed.

No T-002

Date 28-Jul-12

Unit No. 2 B Upper Needle Shaft Leakage

Due to damage of needle and nozzle,
leakage water is observed.

No T-003

Date 10-Jul-12

Unit No. 2 B Needle Shaft Drain Line

This drain line is closed with blind cover.

No T-004

Date 10-Jul-12

Unit No. 2 A Penstock Drain Line

Downstream flange of penstock drain valve is closed with blind cover.

No T-005

Date 10-Jul-12

Unit No. 2 Governor Cabinet

No T-001

Date 26-Jul-12

Unit No. 3 A Upper Needle Cavitation

From relatively smaller water leakage from the needle tip, cavitation pitting around needle, nozzle and deflector seems to be lighter comparing with Unit No. 4 through 6,

This condition is the same with No. 3 B needl nozzle and deflector.

No T-002

Date 31-Jul-12

Unit No. 3 A Needle Shaft Drain

The drain valve handle is removed.

No T-003

Date 31-Jul-12

Unit No. 3 Jet Brake Valve

Due to sticking problem of the valve rod, jet brake is disassembled and repaired.

No T-004

Date 10-Jul-12

Unit No. 3 A Inlet Valve and Companion Flange

No T-005

Date 28-Jul-12

Unit No. 3 B Oil Leakage from Needle & Deflector Servomotor

No T-006

Date 28-Jul-12

Unit No. 3 B Penstock Drain Valve Line

The penstock drain line is removed from downstream of valve.

No T-001

Date 23-Jul-12

Unit No. 4 A Upper Needle Water Leakage

Large water leakage from 4A needle nozzle is observed.
Only deflector works to stop water not to hit the runner bucket.

No T-002

Date 23-Jul-12

Unit No. 4 B Upper Needle Water Leakage

Leaked water hits the deflector heavily.

No T-003

Date 10-Jul-12

Unit No. 4 A Upper Deflector

Deflector machined surface is being damaged cavitation pitting and erosion.

No T-004

Date 28-Jul-12

Unit No. 4 A Water Drain Piping of Downstream Seal is Removed

Downstream seal supply and drain line is no longer used.

No T-005

Date 28-Jul-12

Unit No. 4 A Water Drain Piping of Upstream Seal is Removed

No T-006

Date 28-Jul-12

Unit No. 4 A Water Leakage from Inlet Valve Stem (Anti-Servomotor Side)

No T-007

Date 28-Jul-12

Typical Photo of Disassembled Strainer on Seal Water Supply Line

Strainer mesh is heavily clogged with muddy silt.

No T-008

Date 28-Jul-12

Unit No. 4 B Inlet Valve Control Panel

No T-009

Date 25-Jul-12

Typical Photo of Disassembled Distributing Valve No. 550

Due to galling and sticking problem of distributing valve rod, this valve is removed from the panel for repair

No T-0010

Date 25-Jul-12

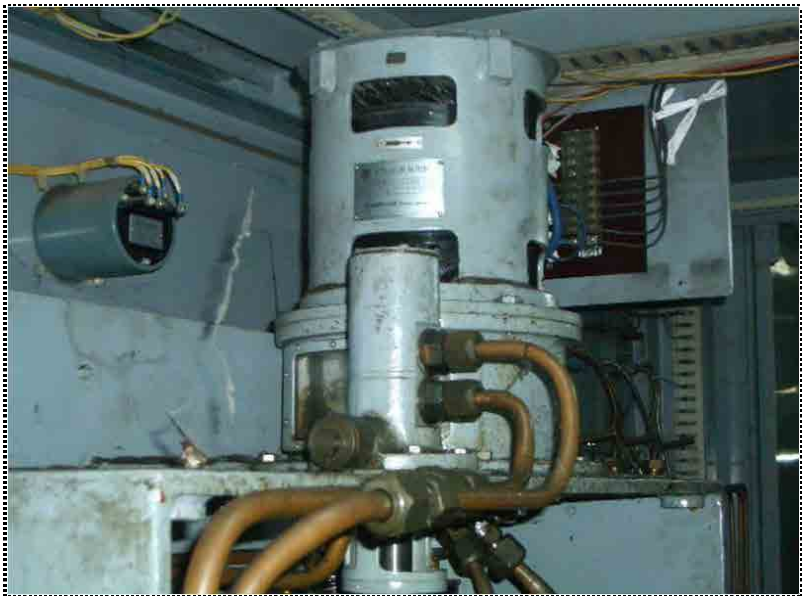
Typical Photo of Disassembled Distributing Valve

Due to sticking problem, this distributing valve No. 590 is removed from inlet valve control panel

No T-011

Date 31-Jul-12

Unit No. 4 Governor Cabinet General View



No T-012

Date 31-Jul-12

Typical Photo of Actuator Motor on Unit No. 4

No T-013

Date 31-Jul-12

Unit No. 4 Governor Inside

Leaked oil is observed at the inside of governor cabinet

No T-014

Date 4-Aug-12

Unit No. 4 Governor Tank Level Gauge

Sight level gauge is discolored.

No T-015

Date 4-Aug-12

Pressure Gauge mounted on Governor Tank

No T-016

Date 4-Aug-12

Unit No. 4 Grease Pump Unit

No T-001

Date 28-Jul-12

Unit No. 5 A Upper Needle Nozzle Leakage

Due to heavy water leakage, details of needle tip surface cannot be inspected.

No T-002

Date 28-Jul-12

Unit No. 5 A Upper Deflector

Deflector machined surface edge is damaged by cavitation pitting and erosion.

No T-003

Date 28-Jul-12

Water Leakage from 5B Needle Shaft Seal

Back side: 5B (Front Side 6A) water leakage from needle shaft seal

No T-004

Date 28-Jul-12

Unit No. 5 B Water Shelter is not mounted

No T-005

Date 28-Jul-12

Unit No. 5 B Inlet Valve Servomotor

Unclosed Servomotor Indicator (26 Degrees)

No T-006

Date 28-Jul-12

Unit No. 5 B Inlet Valve Servomotor Rod

Servomotor rod has many scratches caused by dirty oil.

No T-007

Date 28-Jul-12

Unit No. 5 B Inlet Valve Servomotor

Too much grease is supplied to inlet valve stem.

No T-008

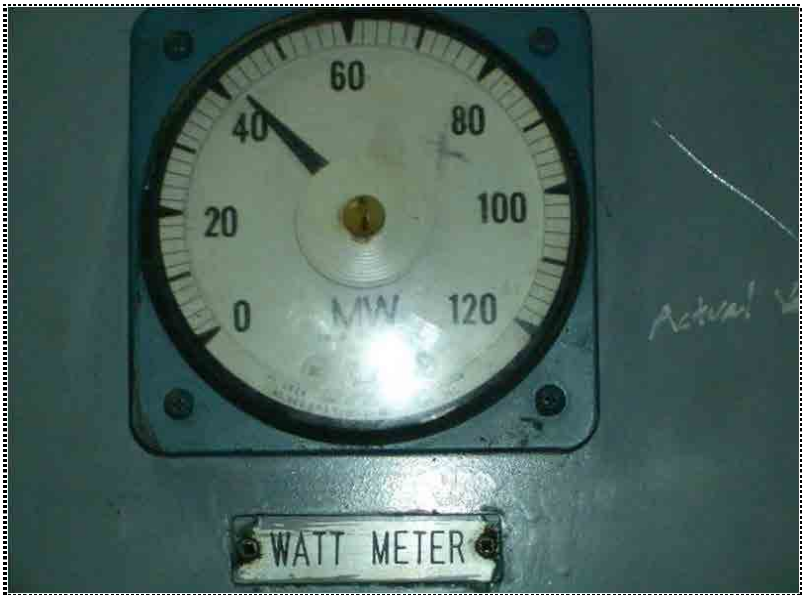
Date 30-Jul-12

Unit No. 5 Governor Cabinet General View

No T-009

Date 30-Jul-12

Typical Photo of Glass Damaged Indicator



No T-010

Date 30-Jul-12

Wattmeter on Unit No. 5 Governor Cabinet

Different Wattmeter is mounted on Unit No. 5 Governor cabinet

No T-001

Date 28-Jul-12

Unit No. 6 A Upper Needle Cavitation

Around the needle tip, heavy cavitation pitting and erosion is observed. Due to this damage, penstock water can not be sealed at the needle fully closed position.

No T-002

Date 28-Jul-12

Unit No. 6 B Upper Needle Cavitation

Due to heavy water leakage from the needle nozzle, details of cavitation pitting and erosion cannot be inspected.

No T-003

Date 28-Jul-12

Water Leakage from Needle Shaft on No. 6 A

Water leakage is observed on No. 6 A needle shaft area.

No T-004

Date 28-Jul-12

Leakage from Jet Brake Body

Leaking portion is temporary sealed with steel plate and rubber sheet.

No T-005

Date 28-Jul-12

6B Inlet Valve Servomotor Rod

Rod surface is heavily scratched by muddy silt water.

No T-006

Date 28-Jul-12

Plugged Grease Line for Inlet Valve Stem

Grease supply line to inlet valve stem is plugged.

No T-007

Date 28-Jul-12

Unit No. 6 B Inlet Valve Water Leakage from Stem Seal

From the servomotor side stem, water leakage is observed.
This water leak is by the damage of the seal elements provided at the stem.
Also, servomotor body is exposed to muddy silt water.

No HT-001

Date 3-Aug-12

Inlet Valve for House Turbine

Due to heavy leakage from inlet valve, runner cover cannot be disassembled.

No HT-002

Date 3-Aug-12

Governor Cabinet for House Turbine

No HT-003

Date 3-Aug-12

Frosted Gauge Glass on Governor Board

No HT-004

Date 3-Aug-12

Oil Pressure Tank System for Governor

No AU-001

Date 3-Aug-12

Temporary House Drainage Pump Unit

The existing drainage pumping units are no longer used, and temporary pump unit is installed. This pump unit does not have enough capacity to drain water.

No AU-002

Date 3-Aug-12

Existing Cooling Water Supply Pump and Motor for Unit No. 2

The existing pump has leakage problem and the motor is damaged.

No AU-003

Date 3-Aug-12

Existing Grease Supply Pumping Unit

No AU-004

Date 3-Aug-12

Disassembled Governor Actuator Motors

No T-001

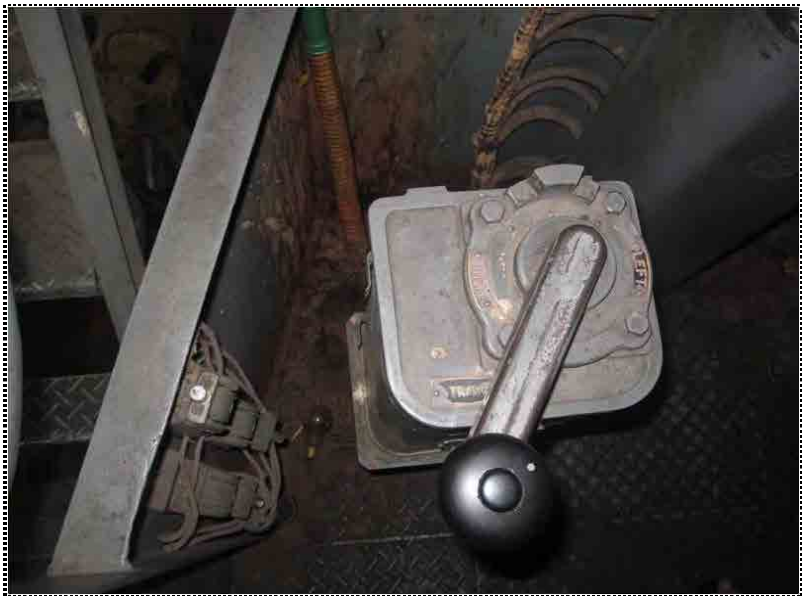
Date 20-Jul-12

Spare Inlet Valve Metal Seals (2 sets) with Seal Guides

No T-002

Date 20-Jul-12

Spare Inlet Valve Metal Seals (3 sets) without Upstream and Downstream Seal Guides

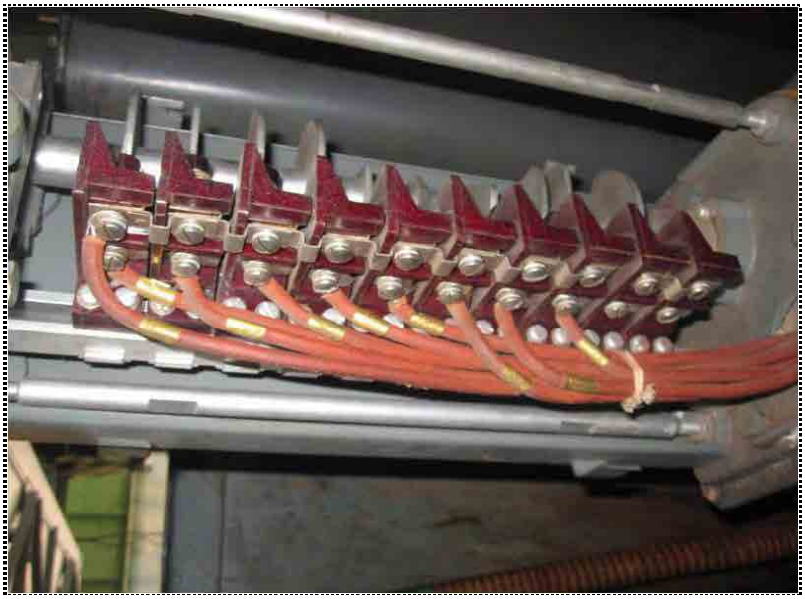


No C-001

Date 1-Aug-12

Unit No. 2 (Unit No. 6 side) Crane Controller

Overall View of Master Controller for Travelling
Only one speed (the lowest speed) is available to move right side direction



No C-002

Date 1-Aug-12

Unit No. 2 (Unit No. 6 side) Crane Controller for Travelling

Inside View of Master Controller, Switches

No C-003

Date 1-Aug-12

Unit No. 2 (Unit No. 6 side) Crane CF Brake

When crane moves to right side direction only one speed (the lowest speed) is available. From the operational inspection, it is found that brake lever does not lift up.

ANNEX 2

GENERATING EQUIPMENT (GENERATOR)

Check list of site inspection for Generating Equipment (Generator)

(Unit 1)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type EFBW

Manufactured in 1958 (Rewinding：1993)

Inspection in 8, 9 and 10-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	○	
2	Damage of Coil End	△(1	1
3	Insulation Deterioration (aging) of Coil End	○(2	
4	Pollution of Coils	△(3	2
5	Coil Binding	○	
6	Loosening (Slackness) of Wedge	○	
7	Undulation of Core	○	3
8	Rust on Core Surface	○	
9	Red rust on Split of Core	△	4
10	Defect on Air Duct of Core	△(4	5, 6
11	Insulation Resistance and Polarity Index	△(5	
12	Water Leakage from Air Cooler	-	
13	Corrosion of Air Cooler and Piping	-	
14	Damage of Cooler Cover	-	

1) Coil cover was damaged by repair work.
2) No Discoloration, no powder occurrence
3) Contamination by oil and carbon particles
4) A part of core duct at the upper side of stator came down by 5mm.
5) See the attached. The value of the polarity index was decreased due to high humidity.

1-2. Rotor (Visual Inspection)

Manufacturer HITACHI

Type EFBW

Manufactured in 1958 (Rewinding：1993)

Inspection in 8, 9 and 10-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	○	
4	Pollution on Rotor Coils and Collector Ring	△(1	7, 8
5	Abrasion Damage of Commutator, Collector Ring	○	
6	Insulation resistance	○(2	

1) Contamination by oil and carbon particles

2) See the attached.

1-3. Exciter (Visual Inspection)

Manufacturer HITACHI

Type FB

Manufactured in 1958

Inspection in 8, 9 and 10-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	○	9
2	Condition of HTD	△(1	10, 11
3	Condition of Excitation control cubicle	△(2	12

1) Discoloration of the commutator was observed.

2) Overall deterioration was observed.

1-3. Operational Condition

Inspection in 17-Jul-2012

Items		Result	Photo No.
1	Power Swing	○	
2	Unsteadiness of Voltage	○	
3	Abnormal Sound	○	
4	Abnormal Odor	○	
5	Temperature of Stator Coil	ND(1	13
6	Temperature of Cooler Inlet [℃] measured/demand	54 / 65	
7	Temperature of Cooler Outlet [℃] measured/demand	35 / 50	
8	Temperature of Power House [℃] measured/demand	33	

1) Unmeasurable due to malfunction of meter panel in the control room

Check list of site inspection for Generating Equipment (Generator)

(Unit 2)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type EFBW

Manufactured in 1958 (Rewinding：1993)

Inspection in 17-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	○	
2	Damage of Coil End	○	
3	Insulation Deterioration (aging) of Coil End	○(1	1
4	Pollution of Coils	△(2	1
5	Coil Binding	○	2
6	Loosening (Slackness) of Wedge	○	
7	Undulation of Core	○	3
8	Rust on Core Surface	○	
9	Red rust on Split of Core	○	4
10	Defect on Air Duct of Core	○	
11	Insulation Resistance and Polarity Index	○(3	
12	Water Leakage from Air Cooler and Piping	○	5
13	Corrosion of Air Cooler and Piping	○	6
14	Damage of Cooler Cover	○	7
15	Search Coil Resistance	△(4	8

1) No Discoloration, no powder occurrence
2) Contamination by oil and carbon particles
3) See the attached.
4) See the attached. Some search coils might be broken.

1-2. Rotor (Visual Inspection)

Manufacturer HITACHI

Type EFBW

Manufactured in 1958 (Rewinding：1993)

Inspection in 17-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	9
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	○	
4	Pollution on Rotor Coils and Collector Ring	△(1	9
5	Abrasion Damage of Commutator, Collector Ring	○	10
6	Insulation resistance	○(2	

1) Contamination by oil and carbon particles

2) See the attached.

1-3. Exciter (Visual Inspection)

Manufacturer HITACHI

Type FB

Manufactured in 1958

Inspection in 18-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	△(1	11, 12
2	Condition of HTD	△(2	13
3	Condition of Excitation control cubicle	△(3	14, 15

1) Deformation and discoloration of the commutator was observed.

2) Discoloration of the commutator was observed.

3) Slide surface of the field regulator is worn.

1-3. Operational Condition

Inspection in 23-Jul-2012

Items		Result	Photo No.
1	Power Swing	○	
2	Unsteadiness of Voltage	○	
3	Abnormal Sound	○	
4	Abnormal Odor	○	
5	Temperature of Stator Coil	ND(1	
6	Temperature of Cooler Inlet [℃] measured/demand	49 / 65	
7	Temperature of Cooler Outlet [℃] measured/demand	24 / 50	
8	Temperature of Power House [℃] measured/demand	29	

1) Unmeasurable due to malfunction of meter panel in the control room

Check list of site inspection for Generating Equipment (Generator)

(Unit 3)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type EFBW

Manufactured in 1958 (Rewinding：1994)

Inspection in 25-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	○	
2	Damage of Coil End	○	
3	Insulation Deterioration (aging) of Coil End	○(1	1
4	Pollution of Coils	△(2	1
5	Coil Binding	○	
6	Loosening (Slackness) of Wedge	○	
7	Undulation of Core	○	2
8	Rust on Core Surface	○	
9	Red rust on Split of Core	○	3
10	Defect on Air Duct of Core	○	
11	Insulation Resistance and Polarity Index	○(3	
12	Water Leakage from Air Cooler and Piping	○	
13	Corrosion of Air Cooler and Piping	○	
14	Damage of Cooler Cover	○	
15	Search Coil Resistance	△(4	4

1) No Discoloration, no powder occurrence

2) Contamination by oil and carbon particles

3) See the attached.

4) See the attached. Some search coils might be broken.

1-2. Rotor (Visual Inspection)

Manufacturer HITACHI

Type EFBW

Manufactured in 1958 (Rewinding：1994)

Inspection in 25-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	○	
4	Pollution on Rotor Coils and Collector Ring	△(1	5
5	Abrasion Damage of Commutator, Collector Ring	○	6
6	Insulation resistance	○(2	

1) Contamination by oil and carbon particles

2) See the attached.

1-3. Exciter (Visual Inspection)

Manufacturer HITACHI

Type FB

Manufactured in 1958

Inspection in 25-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	△(1	7
2	Condition of HTD	△(2	8
3	Condition of Excitation control cubicle	△(3	9

1) Deformation and discoloration of the commutator was observed.

2) Discoloration of the commutator was observed.

3) Slide surface of the field regulator is worn.

1-3. Operational Condition

Inspection in 18-Jul-2012

Items		Result	Photo No.
1	Power Swing	○	
2	Unsteadiness of Voltage	○	
3	Abnormal Sound	○	
4	Abnormal Odor	○	
5	Temperature of Stator Coil	ND(1	
6	Temperature of Cooler Inlet [℃] measured/demand	54 / 65	
7	Temperature of Cooler Outlet [℃] measured/demand	37 / 50	
8	Temperature of Power House [℃] measured/demand	30	

1) Unmeasurable due to malfunction of meter panel in the control room

Check list of site inspection for Generating Equipment (Generator)

(Unit 4)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type TFBLW

Manufactured in 1972

Inspection in 22-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	△(1	1
2	Damage of Coil End	○	
3	Insulation Deterioration (aging) of Coil End	○(2	
4	Pollution of Coils	△(3	
5	Coil Binding	△(4	2
6	Loosening (Slackness) of Wedge	×(5	3
7	Undulation of Core	○	
8	Rust on Core Surface	△	4
9	Red rust on Split of Core	△	5
10	Defect on Air Duct of Core	○	
11	Insulation Resistance and Polarity Index	△(6	
12	Water Leakage from Air Cooler and Piping	×(7	6
13	Corrosion of Air Cooler and Piping	○	
14	Damage of Cooler Cover	○	
15	Search Coil Resistance	—(8	

1) Deterioration of vanish was observed.
2) No Discoloration, no powder occurrence
3) Contamination by oil and carbon particles
4) Coating of the coil bindings has come off.
5) At least fifteen (15) drops of the wedge was observed.
6) See the attached. It is supposed that the value of the insulation resistance was decreased due to heavy contamination and the value of the polarity index was decreased due to high humidity.

7) Water leakage from the air cooler was observed.

8) It was impossible to measure the resistance due to the location of the terminal board for the search coil.

1-2. Rotor (Visual Inspection)

Manufacturer HITACHI

Type TFBLW

Manufactured in 1972

Inspection in 22-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	○	
4	Pollution on Rotor Coils and Collector Ring	△(1	7
5	Abrasion Damage of Commutator, Collector Ring	○	
6	Insulation resistance	△(2	

1) Contamination by oil and carbon particles

2) See the attached. It is supposed that the value of the insulation resistance was decreased due to heavy contamination.

1-3. Exciter (Visual Inspection)

Manufacturer HITACHI

Type EFO

Manufactured in 1972

Inspection in 21, 22-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	○	
2	Condition of HTD	○	
3	Condition of Excitation control cubicle	△(1	8, 9

1) Some parts of excitation control system were damaged.

1-3. Operational Condition

Inspection in 18-Jul-2012

Items		Result	Photo No.
1	Power Swing	○	
2	Unsteadiness of Voltage	○	
3	Abnormal Sound	○	

4	Abnormal Odor	○	
5	Temperature of Stator Coil	ND(1	
6	Temperature of Cooler Inlet [℃] measured/demand	50 / 65	
7	Temperature of Cooler Outlet [℃] measured/demand	39 / 45	
8	Temperature of Power House [℃]	30	

1) Unmeasurable due to malfunction of meter panel in the control room

Check list of site inspection for Generating Equipment (Generator)

(Unit 5)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type TFBLW

Manufactured in 1972

Inspection in 28-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	△(1	1
2	Damage of Coil End	○	
3	Insulation Deterioration (aging) of Coil End	○(2	
4	Pollution of Coils	△(3	1
5	Coil Binding	△(4	2
6	Loosening (Slackness) of Wedge	×(5	3
7	Undulation of Core	○	
8	Rust on Core Surface	○	
9	Red rust on Split of Core	○	
10	Defect on Air Duct of Core	○	
11	Insulation Resistance and Polarity Index	△(6	
12	Water Leakage from Air Cooler and Piping	△(7	4
13	Corrosion of Air Cooler and Piping	○	
14	Damage of Cooler Cover	○	
15	Search Coil Resistance	—(8	

1) Deterioration of vanish was observed.
2) No Discoloration, no powder occurrence
3) Contamination by oil and carbon particles
4) Coating of the coil bindings has come off.
5) Looseness of the wedge was observed.
6) See the attached. It is supposed that the value of the polarity index was decreased due to high humidity.

7) The track of water leakage from the air cooler was observed on the floor.

8) It was impossible to measure the resistance due to the location of the terminal board for the search coil.

1-2. Rotor (Visual Inspection)

Manufacturer HITACHI

Type TFBLW

Manufactured in 1972

Inspection in 28-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	○	
4	Pollution on Rotor Coils and Collector Ring	△(1	5
5	Abrasion Damage of Commutator, Collector Ring	○	
6	Insulation resistance	○(2	

1) Contamination by oil and carbon particles

2) See the attached.

1-3. Exciter (Visual Inspection)

Manufacturer HITACHI

Type EFO

Manufactured in 1972

Inspection in 27, 28-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	×(1	6
2	Condition of HTD	△(2	7
3	Condition of Excitation control cubicle	△(3	8

1) Deformation and discoloration of the commutator was observed.

2) Discoloration of the commutator was observed.

3) Slide surface of the field regulator is worn.

1-3. Operational Condition

Inspection in 18-Jul-2012

Items		Result	Photo No.
1	Power Swing	○	
2	Unsteadiness of Voltage	○	

3	Abnormal Sound	○	
4	Abnormal Odor	○	
5	Temperature of Stator Coil	ND(1	
6	Temperature of Cooler Inlet [℃] measured/demand	51 / 65	
7	Temperature of Cooler Outlet [℃] measured/demand	35 / 45	
8	Temperature of Power House [℃]	30	

1) Unmeasurable due to malfunction of meter panel in the control room

Check list of site inspection for Generating Equipment (Generator)

(Unit 6)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type TFBLW

Manufactured in 1972

Inspection in 30, 31-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	△(1	1
2	Damage of Coil End	×(2	1, 2
3	Insulation Deterioration (aging) of Coil End	○(3	
4	Pollution of Coils	△(4	3
5	Coil Binding	○	
6	Loosening (Slackness) of Wedge	×(5	4
7	Undulation of Core	○	
8	Rust on Core Surface	△	5
9	Red rust on Split of Core	○	
10	Defect on Air Duct of Core	○	
11	Insulation Resistance and Polarity Index	△(6	
12	Water Leakage from Air Cooler and Piping	○	
13	Corrosion of Air Cooler and Piping	○	
14	Damage of Cooler Cover	○	
15	Search Coil Resistance	—(7	

1) Deterioration of vanish was observed.
2) Discoloration was observed. Some spacers for stator coils are coming off.
3) No Discoloration, no powder occurrence
4) Contamination by oil and carbon particles
5) Looseness of the wedge was observed.
6) See the attached. It is supposed that the value of the insulation resistance was decreased due to heavy contamination and the value of the polarity index was decreased due to high humidity.

7) It was impossible to measure the resistance due to the location of the terminal board for the search coil.

1-2. Rotor (Visual Inspection)

Manufacturer HITACHI
Type TFBLW
Manufactured in 1972
Inspection in 30-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	○	
4	Pollution on Rotor Coils and Collector Ring	△(1	6
5	Abrasion Damage of Commutator, Collector Ring	○	
6	Insulation resistance	○(2	

1) Contamination by oil and carbon particles
2) See the attached. It is supposed that the value of the insulation resistance was decreased due to heavy contamination.

1-3. Exciter (Visual Inspection)

Manufacturer HITACHI
Type EFO
Manufactured in 1972
Inspection in 30-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	×(1	7
2	Condition of HTD	△(2	8
3	Condition of Excitation control cubicle	○	

1) Deformation and discoloration of the commutator was observed.
2) Discoloration of the commutator was observed.

1-3. Operational Condition

Inspection in 18-Jul-2012

Items		Result	Photo No.
1	Power Swing	○	
2	Unsteadiness of Voltage	○	
3	Abnormal Sound	○	

4	Abnormal Odor	○	
5	Temperature of Stator Coil	ND(1	
6	Temperature of Cooler Inlet [℃] measured/demand	52 / 65	
7	Temperature of Cooler Outlet [℃] measured/demand	35 / 45	
8	Temperature of Power House [℃]	30	

1) Unmeasurable due to malfunction of meter panel in the control room

Check list of site inspection for Generating Equipment (Generator)

(House Turbine-Generator)

REMARKS ○: Good condition

△: Caution

×: Consider to countermeasure

ND: No data (with damaged meter and things like that)

1. Generator

1-1. Stator (Visual Inspection)

Manufacturer HITACHI

Type SB1

Manufactured in 1958

Inspection in 31-Jul-2012

Items		Result	Photo No.
1	Damage of Coil Surface	○	
2	Damage of Coil End	○	
3	Insulation Deterioration (aging) of Coil End	○(1	1, 2
4	Pollution of Coils	○	
5	Coil Binding	○	
6	Loosening (Slackness) of Wedge	○	
7	Undulation of Core	○	3
8	Rust on Core Surface	○	
9	Red rust on Split of Core	－	
10	Defect on Air Duct of Core	○	
11	Insulation Resistance and Polarity Index	×(2	
12	Water Leakage from Air Cooler and Piping	－	
13	Corrosion of Air Cooler and Piping	－	
14	Damage of Cooler Cover	－	
15	Search Coil Resistance	－	

1) No Discoloration, no powder occurrence

2) The insulation resistance value of stator windings for U, V, W and N measured by 500V Meggar was 0.05 MΩ. It is supposed that the value of the insulation resistance was decreased since the terminals absorbed moisture in the pit.

1-2. Rotor (Visual Inspection)

Inspection in 31-Jul-2012

Items		Result	Photo No.
1	Condition of Connecting Conductor	○	
2	Condition of Fan	○	
3	Condition of Coil Insulation Material	△(1	4
4	Pollution on Rotor Coils and Collector Ring	○	
5	Abrasion Damage of Commutator, Collector Ring	○	5
6	Insulation resistance	―	

1) Damage of coil insulation material was observed.

1-3. Exciter (Visual Inspection)

Inspection in 31-Jul-2012

Items		Result	Photo No.
1	Condition of Exciter	○	6
2	Condition of HTD	―	
3	Condition of Excitation control cubicle	△(1	7, 8

1) Overall deterioration was observed.

1-3. Operational Condition

Inspection in ―

Items		Result	Photo No.
1	Power Swing	―	
2	Unsteadiness of Voltage	―	
3	Abnormal Sound	―	
4	Abnormal Odor	―	
5	Temperature of Stator Coil	―	
6	Temperature of Cooler Inlet [℃] measured/demand	―	
7	Temperature of Cooler Outlet [℃] measured/demand	―	
8	Temperature of Power House [℃]	―	

Check list of site inspection for Generating Equipment (Generator)
(Auxiliary Equipment)

REMARKS ○: Good condition
△: Caution
×: Consider to countermeasure
ND: No data (with damaged meter and things like that)

1. Auxiliary Equipment for Generator

Manufacturer HITACHI

Inspection in 14, 20, 24, 28 & 31-Jul and 6-Aug-2012

Items		Result	Photo No.
1	Lubricating oil system	×(1	1, 2
2	Guide Bearing	△(2	3, 4
3	Oil lifter	×(3	5
4	Generator air cooler	×(4	6, 7
5	Speed detector for generator	×(5	8, 9

1) Pumps / motors and control panels have been used since commissioning. Heavy oil leakage and aged deterioration was observed for Unit 1 to 3. Relevant relays for Unit 1 to 6 were also deteriorated.

2) Bearing metals for Unit 4 to 6 were damaged at the accident in 2011 and replaced with spare ones. There are not any necessary spare ones.

3) The oil lifter cannot be operated automatically due to the malfunction of the timer relays on the control panel for Unit 4 to 6.

4) All spare parts for the air cooler were damage and it was observed that 20% of piping for spare one was closed due to water leakage.

5) A part of the gear for the speed detector of Unit 4 was damaged.

Baluchaung No.2	Unit No.	1
Insulation Resistance Test for Generator	**Date**	**8 Jul. 2012**

Ambient Temperature	30℃
Humidity	75%

1. Insulation Resistance of Stator Winding [MΩ]

Time	A	B	C
1 min.	380	830	870
2 min.	460	1,100	1,300
3 min.	470	1,300	1,500
4 min.	470	1,400	1,700
5 min.	560	1,500	1,800
6 min.	580	1,600	2,000
7 min.	590	1,600	> 2,000
8 min.	600	1,700	
9 min.	540	1,600	
10 min.	510	1,500	

- Insulation resistance should be more than 10.0 MΩ Tested by 1,000V Meggar

	A	B	C
PI Value (10 min. / 1 min.)	1.3	1.8	more than 2.3

- PI Value should be more than 2.5

2. Insulation Resistance of Rotor (all 14 poles are connected) [MΩ]

(1) Resistance of 1min.	5.8
(2) Resistance of 1min. (after cleaning)	7.5

- Insulation resistance should be more than 1.0 MΩ Tested by 500V Meggar

Baluchaung No.2	Unit No.	2
Insulation Resistance Test for Generator	**Date**	**17 Jul. 2012**

Ambient Temperature	33 ℃
Humidity	49%

1. Insulation Resistance of Stator Winding [MΩ]

Time	T	S	R
1 min.	490	490	490
2 min.	840	790	780
3 min.	1,000	1,000	1,000
4 min.	1,200	1,200	1,200
5 min.	1,400	1,400	1,400
6 min.	1,600	1,600	1,500
7 min.	1,700	1,700	1,700
8 min.	1,900	1,800	1,600
9 min.	> 2000	> 2000	1,800
10 min.			> 2000

- Insulation resistance should be more than 10.0 MΩ Tested by 1,000V Meggar

	T	S	R
PI Value (10 min. / 1 min.)	more than 4.0	more than 4.0	more than 4.0

- PI Value should be more than 2.5

2. Insulation Resistance of Rotor (all 14 poles are connected) [MΩ]

(1) Resistance of 1min.	0.98
(2) Resistance of 1min. (after cleaning)	3.6

- Insulation resistance should be more than 1.0 MΩ Tested by 500V Meggar

Baluchaung No.2	Unit No.	3
Insulation Resistance Test for Generator	**Date**	**25 Jul. 2012**

Ambient Temperature	30 ℃
Humidity	63%

1. Insulation Resistance of Stator Winding [MΩ]

Time	T	S	R
1 min.	500	680	700
2 min.	760	970	1,000
3 min.	900	1,200	1,300
4 min.	1,000	1,500	1,500
5 min.	1,000	1,400	1,600
6 min.	1,000	1,500	1,800
7 min.	1,100	1,400	1,900
8 min.	1,100	1,500	>2000
9 min.	1,100	1,800	
10 min.	1,400	1,600	

- Insulation resistance should be more than 10.0 MΩ Tested by 1,000V Meggar

	T	S	R
PI Value (10 min. / 1 min.)	2.8	2.3	more than 2.8

- PI Value should be more than 2.5

2. Insulation Resistance of Rotor (all 14 poles are connected) [MΩ]

(1) Resistance of 1min.	120

- Insulation resistance should be more than 1.0 MΩ Tested by 500V Meggar

Baluchaung No.2	Unit No.	4
Insulation Resistance Test for Generator	**Date**	**22 Jul. 2012**

Ambient Temperature	30 ℃
Humidity	67%

1. Insulation Resistance of Stator Winding [MΩ]

Time	R	S	T
1 min.	18	18	38
2 min.	18	19	38
3 min.	18	18	42
4 min.	19	20	43
5 min.	19	20	41
6 min.	18	20	40
7 min.	18	22	38
8 min.	17	22	38
9 min.	17	22	40
10 min.	17	23	42

- Insulation resistance should be more than 10.0 MΩ Tested by 1,000V Meggar

	R	S	T
PI Value (10 min. / 1 min.)	0.9	1.3	1.1

- PI Value should be more than 2.5

2. Insulation Resistance of Rotor (all 14 poles are connected) [MΩ]

(1) Resistance of 1min.	0.74
(2) Resistance of 1min. (after cleaning)	0.74

- Insulation resistance should be more than 1.0 MΩ Tested by 500V Meggar

Baluchaung No.2	Unit No.	5
Insulation Resistance Test for Generator	**Date**	**28 Jul. 2012**

Ambient Temperature	27 ℃
Humidity	76%

1. Insulation Resistance of Stator Winding [MΩ]

Time	R	S	T
1 min.	500	490	650
2 min.	530	540	760
3 min.	520	560	810
4 min.	500	590	830
5 min.	530	620	840
6 min.	520	610	840
7 min.	520	650	830
8 min.	530	660	800
9 min.	550	640	780
10 min.	580	640	780

- Insulation resistance should be more than 10.0 MΩ Tested by 1,000V Meggar

	R	S	T
PI Value (10 min. / 1 min.)	1.2	1.3	1.2

- PI Value should be more than 2.5

2. Insulation Resistance of Rotor (all 14 poles are connected) [MΩ]

(1) Resistance of 1min.	155

- Insulation resistance should be more than 1.0 MΩ Tested by 500V Meggar

Baluchaung No.2	Unit No.	6
Insulation Resistance Test for Generator	**Date**	**30 Jul. 2012**

Ambient Temperature	28 ℃
Humidity	76%

1. Insulation Resistance of Stator Winding [MΩ]

Time	R	S	T
1 min.	96	55	68
2 min.	99	61	109
3 min.	96	61	110
4 min.	98	59	95
5 min.	102	63	80
6 min.	102	58	88
7 min.	102	54	83
8 min.	104	55	111
9 min.	101	64	112
10 min.	100	60	155

- Insulation resistance should be more than 10.0 MΩ Tested by 1,000V Meggar

	R	S	T
PI Value (10 min. / 1 min.)	1.0	1.1	2.3

- PI Value should be more than 2.5

2. Insulation Resistance of Rotor (all 14 poles are connected) [MΩ]

(1) Resistance of 1min.	3.2

- Insulation resistance should be more than 1.0 MΩ Tested by 500V Meggar

Baluchaung No.2	Unit No.	2
Resistance of Search Coil for Stator Windings	Date	20 Jul. 2012

1. Search Coil Resistance

[Ω]

Terminal No.	R - W	R - B	W - B
1	28.4	28.4	0.1
2	28.9	28.9	0.2
3	29.0	28.9	0.1
4	28.9	28.9	0.3
5	infinity	25,000	41,000
6	infinity	infinity	0.2
7	infinity	infinity	0.2
8	infinity	infinity	0.3
9	infinity	infinity	0.2
10	infinity	infinity	0.2
11	29.0	29.0	0.3
12	29.1	29.1	0.3

Terminal No.	Result	Usage	Slot No. [1)]
1	normal	spare	18 (U)
2	normal	in use	82 (U)
3	normal	spare	109 (U)
4	normal	in use	172 (U)
5	abnormal	spare	1 (V)
6	abnormal	in use	26 (V)
7	abnormal	spare	92 (V)
8	abnormal	in use	116 (V)
9	abnormal	spare	35 (W)
10	abnormal	spare	10 (W)
11	normal	in use	126 (W)
12	normal	in use	100 (W)

1) referred to the Drawing No. HB-163-803

Baluchaung No.2	Unit No.	3
Resistance of Search Coil for Stator Windings	Date	25 Jul. 2012

1. Search Coil Resistance (Ambient Temperature: 30℃) [Ω]

Terminal No.	R - W	R - B	W - B
1	29.0	29.0	0.2
2	infinity	infinity	0.2
3	infinity	infinity	0.2
4	29.1	29.0	0.4
5	28.9	29.0	0.2
6	infinity	infinity	0.2
7	29.4	29.5	0.2
8	infinity	infinity	0.2
9	infinity	infinity	0.2
10	28.9	28.9	0.2
11	29.3	29.4	0.3
12	infinity	infinity	0.3

Terminal No.	Result	Usage	Slot No. [1)]
1	normal	in use	18 (U)
2	abnormal	spare	82 (U)
3	abnormal	in use	109 (U)
4	normal	spare	172 (U)
5	normal	in use	1 (V)
6	abnormal	spare	26 (V)
7	normal	in use	92 (V)
8	abnormal	spare	116 (V)
9	abnormal	spare	35 (W)
10	normal	in use	10 (W)
11	normal	in use	126 (W)
12	abnormal	spare	100 (W)

1) referred to the Drawing No. HB-163-803

Baluchaung No.2 Operation Condtion	Date (No.1, 3-6)		18-Jul-12		30℃, 71%	
	Date (No.2)		23-Jul-12		29℃, 76%	
1. Unit No.	1	2	3	4	5	6
2. Output [MW]	22.0	19.0	25.0	26.8	26.3	26.3
3. Reactive Power [Mvar] [1]	4.0	3.5	5.0	1.0	-0.5	-1.0
4. Stator Coil Temperature [℃] [2]	-	-	-	-	-	-
5. Bearing Temperature [℃]						
(1) Collector Ring Side	48	46	38	41	44	30
Collector Ring Side (demand)	(60)	(60)	(65)	(65)	(65)	(65)
(2) Counter-Collector Ring Side	51	47	48	54	49	52
Counter-Collector Ring Side (demand)	(60)	(60)	(65)	(65)	(65)	(65)
6. Air Cooler Tempereture [℃]						
(1) Air Cooler Inlet	53	49	54	50	51	52
(1) Air Cooler Inlet (demand)	(65)	(65)	(65)	(65)	(65)	(65)
(2) Air Cooler Outlet	34	24	37	39	35	35
(2) Air Cooler Outlet (demand)	(50)	(50)	(50)	(45)	(45)	(45)
(3) Cooling Water Inlet	26.5	26.0	26.0	25.5	26.0	25.5

1) Measured value is supposed to be inaccurate due to a malfunction in a meter.
2) It is unmeasurable due to malfunciton in a meter.

No 1

Date 9-Jul-12

Stator Coil

No 2

Date 8-Jul-12

Stator Coil

No 3

Date 9-Jul-12

Stator Core

No 4

Date 9-Jul-12

Stator Core

Red rust on Split of Core

No 5

Date 10-Jul-12

Stator Core

Defect on Air Duct of Core

No 6

Date 10-Jul-12

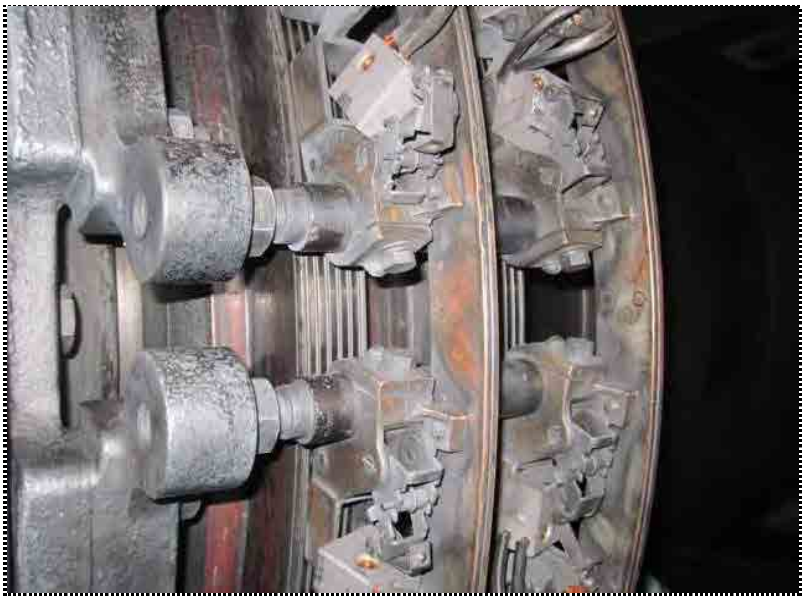
Stator Core

Defect on Air Duct of Core

No 7

Date 9-Jul-12

Rotor Winding



No 8

Date 9-Jul-12

Collector Ring

No 9

Date 9-Jul-12

DC Exciter

No 10

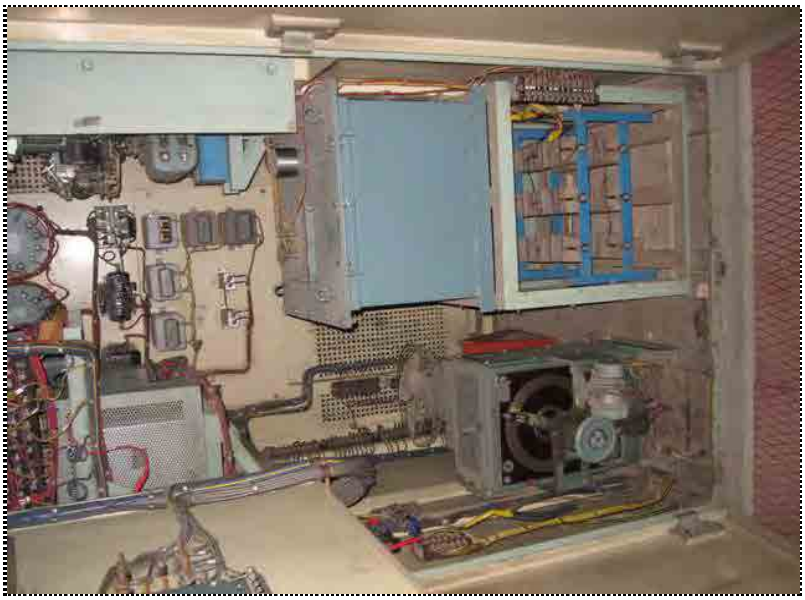
Date 9-Jul-12

HTD

No 11

Date 9-Jul-12

HTD



No 12

Date 8-Jul-12

Excitation System

No 13

Date 10-Jul-12

Temperature Panel

写真

No

Date

写真

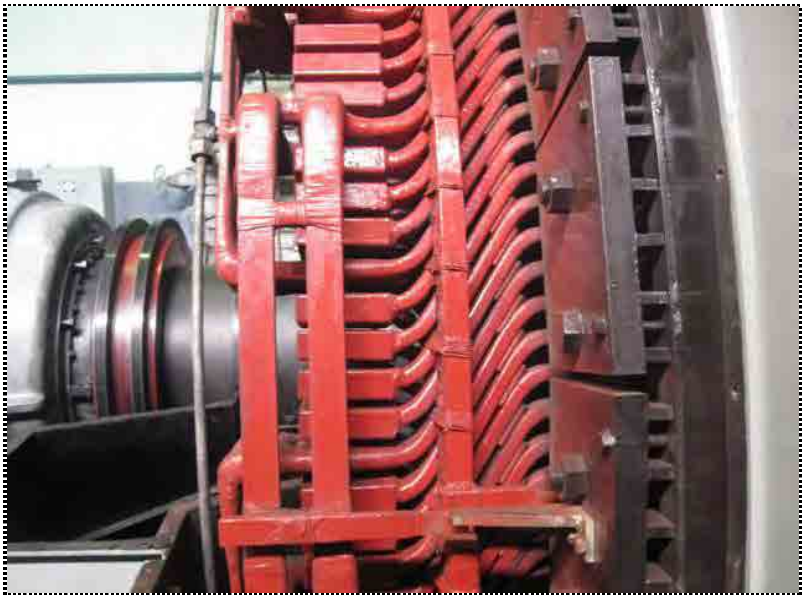
No

Date

No 1

Date 17-Jul-12

Stator Coil



No 2

Date 17-Jul-12

Stator Coil

No 3

Date 17-Jul-12

Stator Core

No 4

Date 17-Jul-12

Stator Core

Split of Core

No 5

Date 17-Jul-12

Air Cooler

No 6

Date 17-Jul-12

Air Cooler

No 7

Date 17-Jul-12

Air Cooler

No 8

Date 20-Jul-12

Search Coil

No 9

Date 17-Jul-12

Rotor Winding

No 10

Date 17-Jul-12

Collector Ring

No 11

Date 17-Jul-12

DC Exciter (sub)

Commutator

No 12

Date 17-Jul-12

DC Exciter (main)

Commutator

No 13

Date 18-Jul-12

HTD

No 14

Date 18-Jul-12

Excitation System

No 15

Date 18-Jul-12

Excitation System

No 1

Date 25-Jul-12

Stator Coil

No 2

Date 25-Jul-12

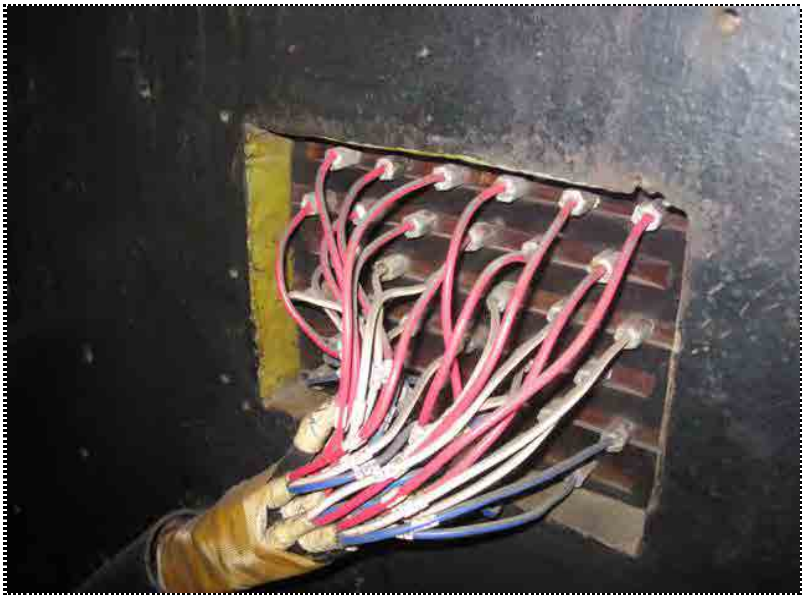
Stator Core

No 3

Date 25-Jul-12

Stator Core

Split of Core



No 4

Date 25-Jul-12

Search Coil

No 5

Date 25-Jul-12

Rotor Winding

No 6

Date 25-Jul-12

Collector Ring

No 7

Date 25-Jul-12

DC Exciter (main)

Commutator

No 8

Date 25-Jul-12

HTD

No 9

Date 25-Jul-12

Excitation System

No 1

Date 22-Jul-12

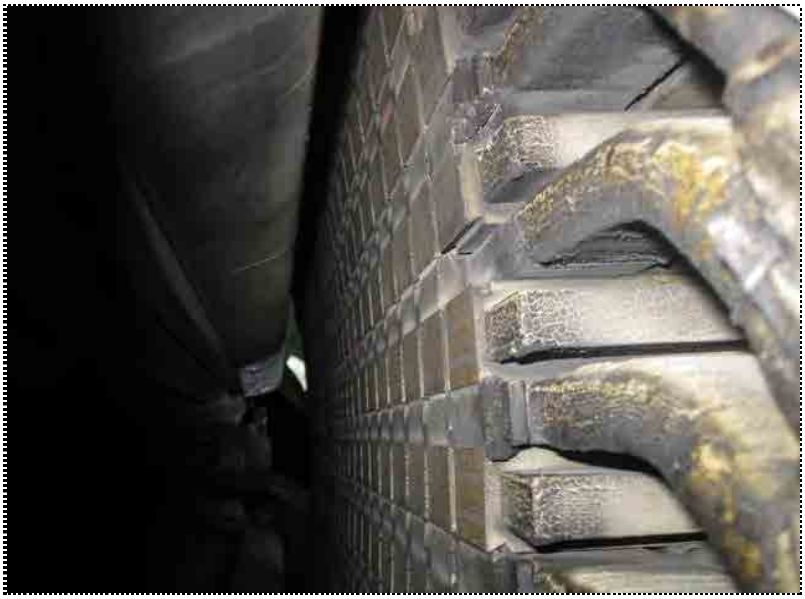
Stator Coil

No 2

Date 22-Jul-12

Stator Coil

Coil Binding



No 3

Date 22-Jul-12

Stator Coil

the Drop of Wedge

No 4

Date 22-Jul-12

Stator Core

Red rust

No 5

Date 22-Jul-12

Stator Core

Split of Core

No 6

Date 22-Jul-12

Air Cooler

Water Leakage

No 7

Date 22-Jul-12

Rotor Winding

No 8

Date 21-Jul-12

Excitation System

Damaged part (Thyristor)

No 9

Date 21-Jul-12

Excitation System

Damaged Part (motor)

No 1

Date 28-Jul-12

Stator Coil

No 2

Date 28-Jul-12

Stator Coil

Coil Binding

No 3

Date 27-Jul-12

Stator Coil

Loosening (Slackness) of Wedge

No 4

Date 28-Jul-12

Air Cooler

The track of water leakage

No 5

Date 28-Jul-12

Rotor Winding

No 6

Date 28-Jul-12

DC Exciter

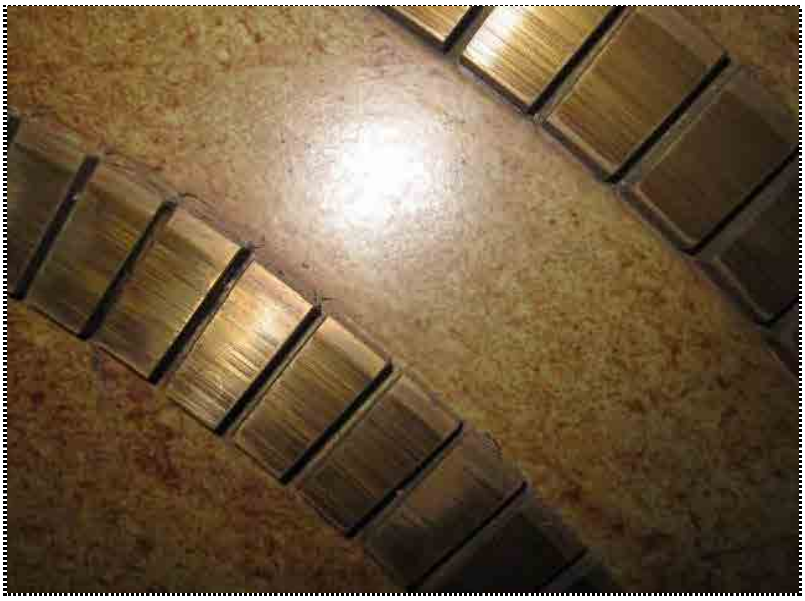
Commutator

No 7

Date 27-Jul-12

HTD

Commutator



No 8

Date 27-Jul-12

Excitation System

Slide surface of the field regulator

写真

No

Date

No 1

Date 30-Jul-12

Stator Coil

Discoloration and Deformation of Coil Cover

No 2

Date 30-Jul-12

Stator Coil

A spacer for stator coil is coming off

No 3

Date 30-Jul-12

Stator and Rotor

No 4

Date 30-Jul-12

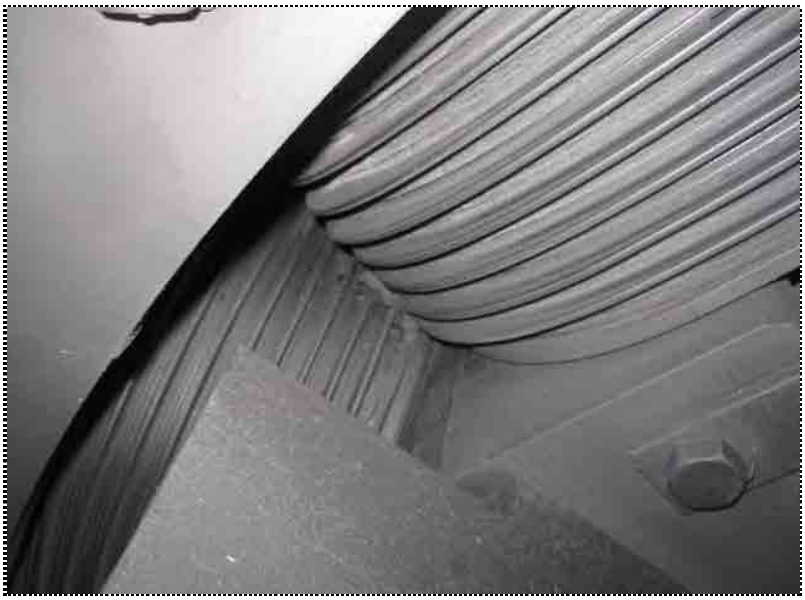
Stator Coil

a drop of the wedge

No 5

Date 30-Jul-12

Stator Core



No 6

Date 30-Jul-12

Rotor Winding

No 7

Date 30-Jul-12

DC Exciter

Commutator and Brush

No 8

Date 30-Jul-12

HTD

Commutator

写真

No

Date

No 1

Date 31-Jul-12

Stator Coil

No 2

Date 31-Jul-12

Stator Coil

No 3

Date 31-Jul-12

Stator Core

No 4

Date 31-Jul-12

Rotor Winding

No 5

Date 31-Jul-12

Collector Ring

No 6

Date 31-Jul-12

DC Exciter

Commutator

No 7

Date 31-Jul-12

Excitation System

No 8

Date 31-Jul-12

Excitation System

写真

No

Date

No 1

Date 31-Jul-12

Lubricating oil system

Pump / motor for Unit 1

No 2

Date 31-Jul-12

Lubricating oil system

Control Panel

No 3

Date 20-Jul-12

Guide Bearing

Damaged Bearing (1)

No 4

Date 20-Jul-12

Guide Bearing

Damaged Bearing (2)

No 5

Date 14-Jul-12

Oil Lifter

Timer Relays on the Control Panel

No 6

Date 28-Jul-12

Generator Air Cooler

Damaged air cooler (1)

No 7

Date 28-Jul-12

Generator Air Cooler

Damaged air cooler (1)

No 8

Date 24-Jul-12

Speed detector for generator

Damaged gear (1)

No 9

Date 24-Jul-12

Speed detector for generator

Damaged gear (2)