

MAHIPAR UNIT 3

Commissioning Report Turbine Governor Model 48

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**REHABILITATION OF MAHIPAR & SAROBI HPPs,
AFGHANISTAN**

MAHIPAR POWER PLANT - Unit 3

Voith Siemens Hydro Power Generation

Commissioning Report

Turbine Governor, Model 48

Customer: Ministry of Water and Power
Kabul, Afghanistan

Consultant: Lahmeyer International

Contractor: Voith Siemens Hydro Kraftwerkstechnik

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(VSHK)

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(Client)

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1. General Remarks

1.1 Technical Data of Turbine

Brand: VOITH
Turbine Nr.: 16922

| | |
|--------------|-----------------------|
| Net head: | 335 m |
| Discharge: | 7,5 m ³ /s |
| Rated speed: | 750 rpm |
| Rated power: | 22,350 MW |

1.2 Technical Data of Generator

Brand: Siemens Schluckertwerke AG
Type: SPFL540/40-8
Serial Nr.: D650109

| | |
|-----------------|-----------|
| Rated load: | 22350 kVA |
| Rated voltage: | 10000 V |
| Rated current: | 1500 A |
| cos φ : | 0,8 |

1.3 Technical Data of Excitation

| | |
|----------------|-------|
| Rated voltage: | 67 V |
| Rated current: | 870 A |

1.4 Technical Data of Governor

| | |
|----------------|------------------|
| Brand: | VOITH Heidenheim |
| Serial Number: | 10490 (1967) |
| Model: | 48 |

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2. Commissioning of the Turbine Governor System

It has to be mentioned that the whole governor system was in a very bad condition and was repaired as good as possible by VSHK commissioning stuff.

2.1 Time schedule

The commissioning was during Period:

17.03.2007 - 29.03.2006

The 10 days Trial run started on the **08.03.2007** and was successfully finished.

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2.2 Commissioning of the hydraulic unit

2.2.1 Unloaded valve

| | |
|---|---------------------|
| Normal operating pressure of pressure tank: | 25 bar |
| Operating Pressure range (unloaded valve): | 22- 24,6 bar |
| Oil level of pressure tank indicated at the sight glass: (Measured from the middle of lower flange of sight glass) | 220- 275 mm |
| Oil level of the sump tank at 24,4 bar pressure: | 310 mm |

2.2.2 Quick shut down valve

The function of the quick shut down valve was checked for following conditions:

=> Manual control switch at the machine control board

=> Automatic switching to ON due to trip simulation: "Temperature of turbine bearing is too high" (see Message Matrix Mahipar unit 3)

2.2.3 Pressure switches at the pressure tank

| Pressure switches of pressure tank | | | |
|---|------------------------------|-----------------------------|---|
| Pressure switch Nr. | Function | Adjusted limit [bar] | Remarks |
| 1 | Pump ON | < 23 => ON | Function tested |
| 2 | Pump OFF | > 25 => OFF | Function tested |
| 3 | Pressure low => Alarm | < 17,5 | Function tested (Message matrix Mahipar unit 3) |
| 4 | Pressure very low => Trip | < 16,5 | Function tested (Message matrix Mahipar unit 3) |

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2.2.4 Safety valves

Safety valve of pump switching pressure: **26 bar**

Safety valve of pressure tank switching pressure: **27 bar**

2.2.5 Commissioning of the wicket gate

2.2.5.1 Adjustment the pressing of the wicket gate vans

The servo motor was adjusted as followed:

1. Wicket gate closed at approximately 0 bar oil pressure
2. Increasing the pressure up to approximately 11,5 bar
3. Adjusting the mechanical blocking (closed position) at the servomotor for that condition

2.2.5.2 Adjustment of the fully open and closed position

The opening limitation and the feedback curve were adjusted to save following conditions:

Closed position: => "0" indication at the mounted meter of the wicket gate
 => Opening limitation fully closed

Open position: => "63" indication at the mounted meter of the wicket gate
 => Opening limitation fully opened

The mounted meter shows the values used before rehabilitating the unit.

Adjusted Op. Hysteries: => half turn of the manual opening screw at 0% before the servomotor starts moving to open position.

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2.2.6 Opening and Closing Time of the Wicket Gate

Diagram 1 show the opening and closing time measurements. The test was done at dry conditions. The opening limitation was set to 100% and the quick shut down valve was switched.

Oil pressure: 23 bar
Oil temperature 23 °C

Maximum opening time: 8,0s

Maximum closing time: 7,6s

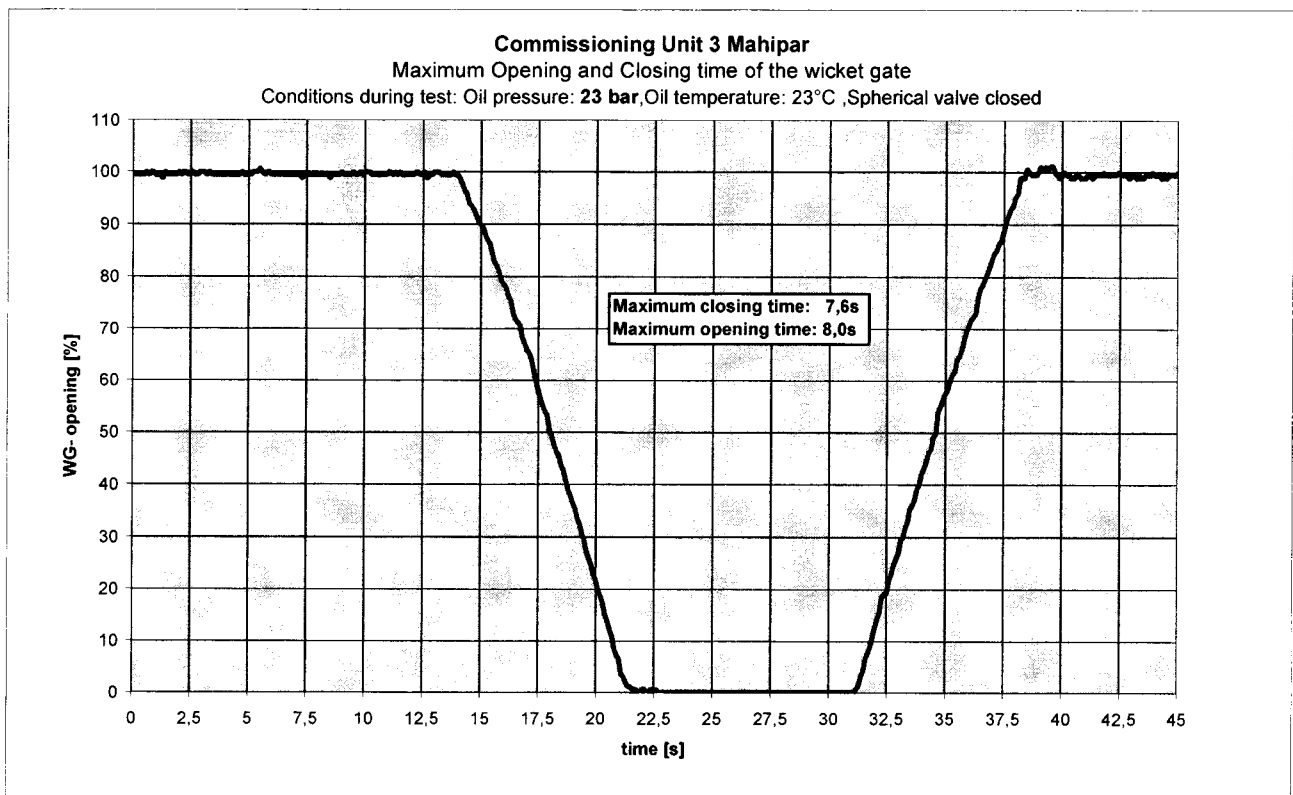


Diagram 1: Maximum opening and closing time of the wicket gate, Mahipar unit 3

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2.3 Commissioning of the governor control unit

2.3.1 Adjustment of the feedback transducer

2.3.1.1 Opening limitation

Position switches

...have been adjusted as found in the old drawings (unit 2) as follows:

| Terminal 2KR (Governor oil tank) | Name | Switch type |
|---|-------------|--------------------|
| 7 | b30 | Normally open |
| 8 | | |
| 9 | b29 | Normally closed |
| 10 | | |
| 11 | - | Not connected |
| 12 | | |
| 13 | - | Not connected |
| 14 | | |

Indication devices

The potentiometers were adjusted as good as possible. Some of the changeable resistances are damaged and there are no new spare parts available at site.

| Set point | Indication (Control room) | Indication (machine control board) |
|------------------|--------------------------------------|---|
| 0 % | 0% | -4% |
| 100 % | 100% | 100% |

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2.3.1.2 Speed set point

Position switches

...have been adjusted as found in the old drawings (unit 2) as follows:

| Terminal 2KR (Governor oil tank) | Name | Switch type |
|-------------------------------------|------|-----------------|
| 21 | b33 | Normally open |
| 22 | | |
| 23 | b32 | Normally closed |
| 24 | | |
| 25 | - | Not connected |
| 26 | | |
| 27 | - | Not connected |
| 28 | | |

Indication devices

The potentiometers were adjusted as good as possible. Some of the changeable resistances are damaged and there are no new spare parts available at site.

| Set point | Indication (Control room) | Indication (machine control board) |
|-------------|---|---|
| 100 % speed | Middle position of meter (100%speed) | Middle position of meter (100%speed) |

2.3.1.3 Wicket gate position

Position switches

...have been adjusted as found in the old drawings (unit 2) as follows:

| Terminal 2KR (Governor oil tank) | Name | Switch type |
|-------------------------------------|------|-----------------|
| 35 | b31 | Normally closed |
| 36 | | |
| 37 | b32 | Normally closed |
| 38 | | |
| 39 | b33 | Normally closed |
| 40 | | |
| 41 | b34 | Normally closed |
| 42 | | |
| 43 | - | Not connected |
| 44 | | |
| 45 | - | Not connected |
| 46 | | |

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Indication devices

The potentiometers were adjusted as good as possible. Some of the changeable resistances are damaged and there are no new spare parts available at site.

| Set point | Indication (Control room) | Indication (machine control board) |
|-----------|------------------------------|---------------------------------------|
| 0 % | 0% | 0% |
| 100 % | 102% | 98% |

2.3.2 Automatic control

2.3.2.1 Speed set point control

Motor Type: KM 80- 40 220V

Time for fully moving way (**24 turns** at the manual screw): **83 s**

2.3.2.2 Opening limitation set point control

Motor Type: UG 80- 40 220V

Time for fully moving way (0- 100%, **21 turns** at the manual screw): **75s**

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2.4 Adjustment of the speed governor

2.4.1 Speed set point at no load

The speed governor was adjusted to **101% speed** at no load for:

1. 12 turns at the manual speed set point control screw
2. Arrow of the indication devices in middle position
3. Opening limitation at 50%

2.4.2 Step responses

Diagram 2 shows step responses of the speed governor at no load. Because of the good result of the step responses (no alternating and fast reaching of the set point), the parameters have not been changed.

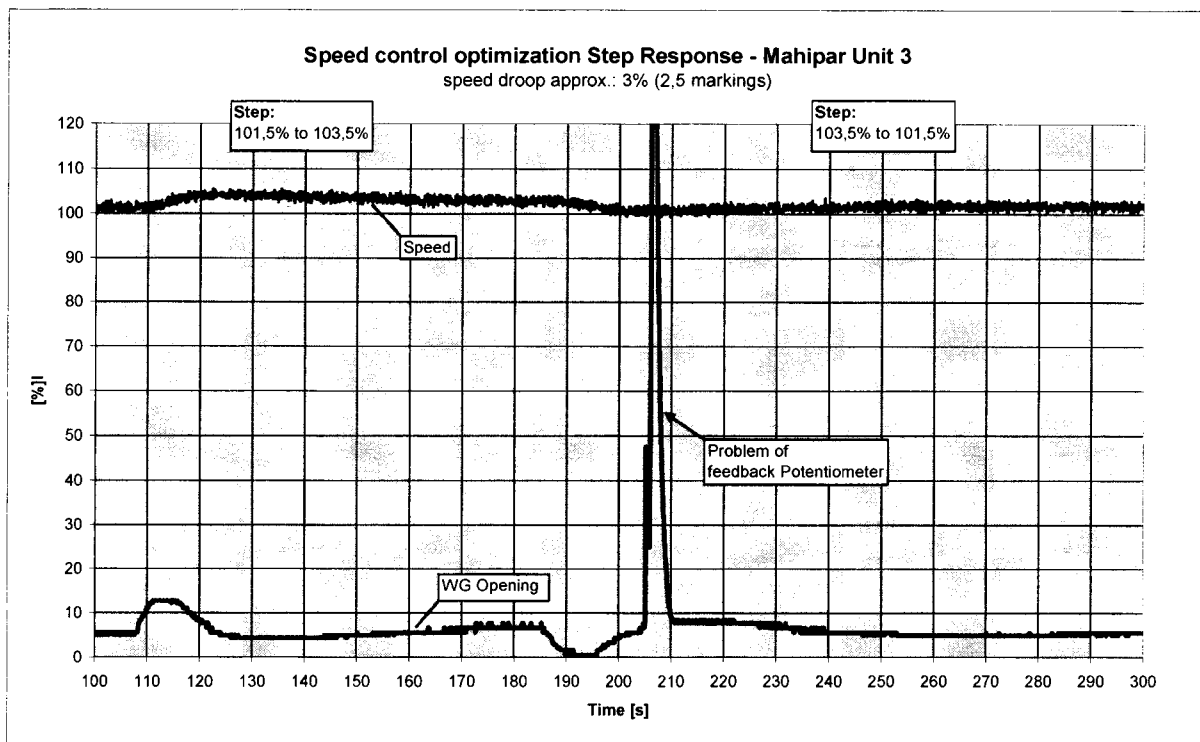


Diagram 2: Step response of speed governor, Mahipar unit 3

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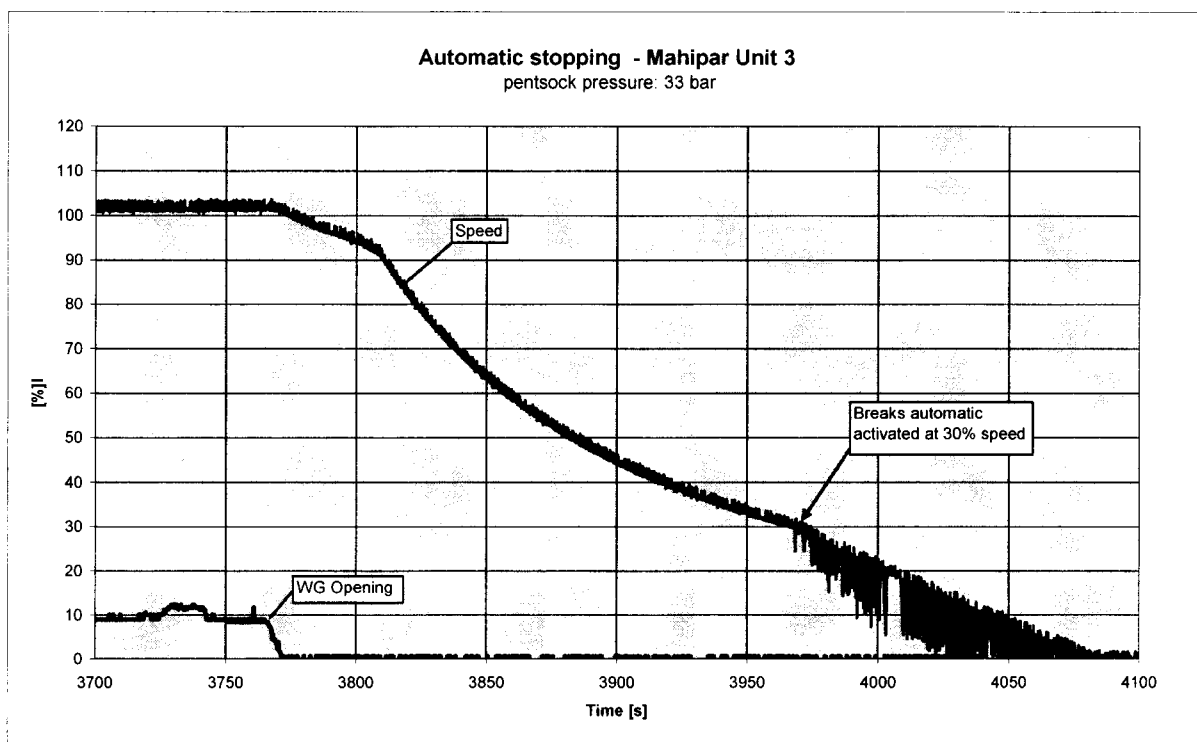
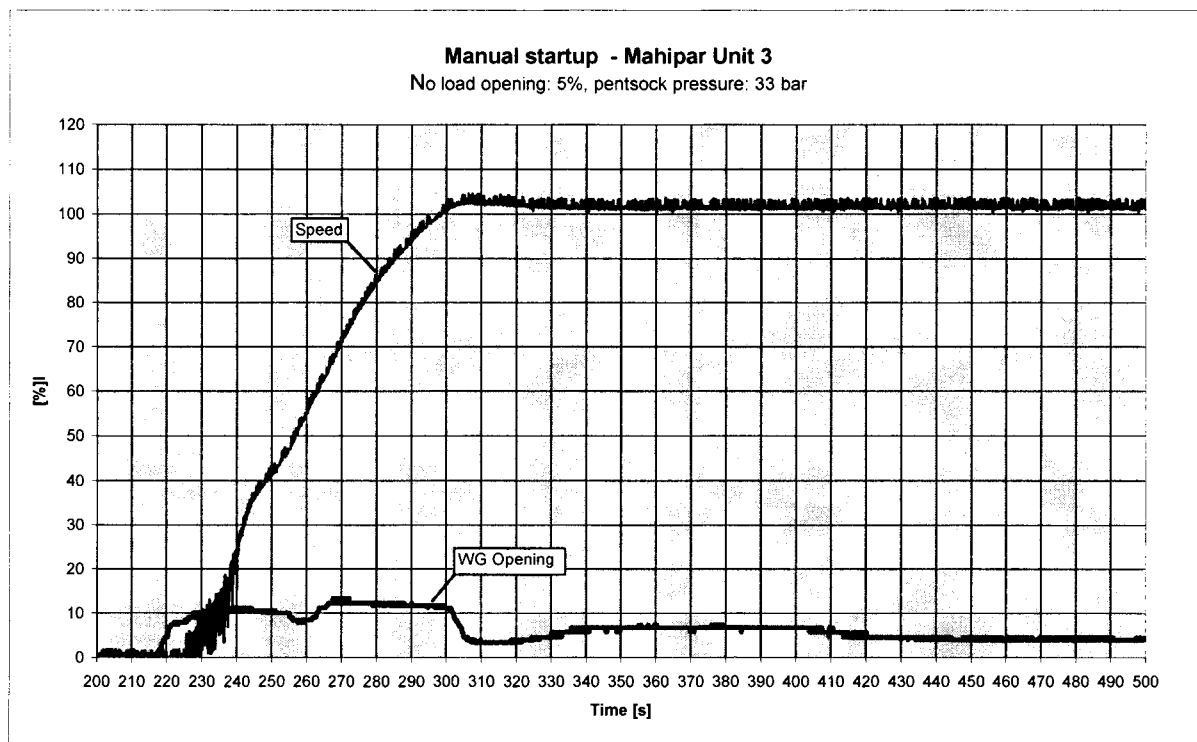
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2.4.3 Readings of Start and Stopping



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2.5 Load rejection tests

Conditions during the Load rejection tests

Pressure transmitter for penstock pressure installed at level (PTL): 1825,79m

The result of the Load rejection tests shows the Table below. The measured curves are in the appendix.

| Load [MW] | Static Pressure [bar] (PTL) | Max. Pressure [bar] (PTL) | Pressure Rise [%] | Speed Before Rejection [%] | Max. Speed [%] | Speed Rise [%] |
|--------------|--------------------------------------|------------------------------------|-------------------------|-------------------------------------|----------------------|----------------------|
| 12 | 33,0 | 35,7 | 8,2 | 100 | 120 | 20 |
| 16 | 32,7 | 36,0 | 10,1 | 100 | 129 | 29 |
| 22 | 32,1 | 36,0 | 12,1 | 100 | 136 | 36 |
| | | | | | | |

2.6 Speed droop

The speed droop was not changed and is approximately 4% (3 marking rings visible).

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3. List of enclosures

- 1 Load Rejection P = 12 MW
- 2 Load Rejection P = 16 MW
- 3 Load Rejection P = 22 MW

Jad Rejection 12MW

Wicket gate position: 0- 100% => 5% / div
 Speed: 0- 200% => 10% / div
 Penstock pressure: 30- 90 bar => 3bar / div
 Chart speed: 100mm/min => 0.1min/div
 Δ Speed: 20% (120% / 100%)
 Δ Penstock pressure: 8.2% (35.7bar / 33bar)

WICKET GATE POS.

SPEED

GENERATOR VOLTAGE U_G

PENSTOCK PRESSURE

GEN. VOLTAGE U_G
 PENSTOCK PRESSURE
 PENSTOCK PRESSURE

$U_G = 100\%$

$U_G = 0\%$

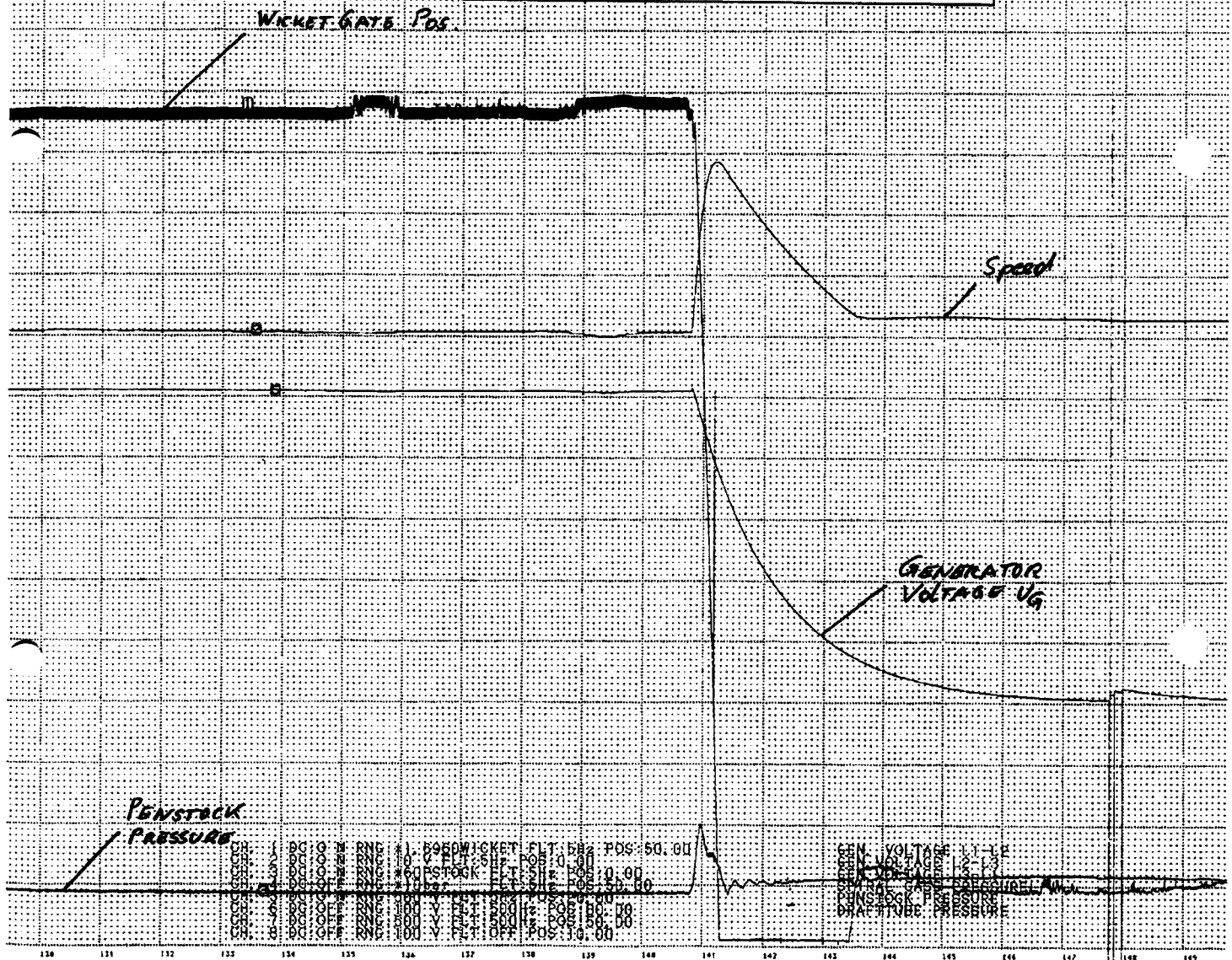
CH 1 2010 4 10 11 00 00
 CH 2 2010 4 10 11 00 00
 CH 3 2010 4 10 11 00 00
 CH 4 2010 4 10 11 00 00
 CH 5 2010 4 10 11 00 00
 CH 6 2010 4 10 11 00 00
 CH 7 2010 4 10 11 00 00
 CH 8 2010 4 10 11 00 00
 CH 9 2010 4 10 11 00 00
 CH 10 2010 4 10 11 00 00
 CH 11 2010 4 10 11 00 00
 CH 12 2010 4 10 11 00 00
 CH 13 2010 4 10 11 00 00
 CH 14 2010 4 10 11 00 00
 CH 15 2010 4 10 11 00 00
 CH 16 2010 4 10 11 00 00
 CH 17 2010 4 10 11 00 00
 CH 18 2010 4 10 11 00 00
 CH 19 2010 4 10 11 00 00
 CH 20 2010 4 10 11 00 00
 CH 21 2010 4 10 11 00 00
 CH 22 2010 4 10 11 00 00
 CH 23 2010 4 10 11 00 00
 CH 24 2010 4 10 11 00 00
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 CH 26 2010 4 10 11 00 00
 CH 27 2010 4 10 11 00 00
 CH 28 2010 4 10 11 00 00
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 CH 31 2010 4 10 11 00 00
 CH 32 2010 4 10 11 00 00
 CH 33 2010 4 10 11 00 00
 CH 34 2010 4 10 11 00 00
 CH 35 2010 4 10 11 00 00
 CH 36 2010 4 10 11 00 00
 CH 37 2010 4 10 11 00 00
 CH 38 2010 4 10 11 00 00
 CH 39 2010 4 10 11 00 00
 CH 40 2010 4 10 11 00 00
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 CH 88 2010 4 10 11 00 00
 CH 89 2010 4 10 11 00 00
 CH 90 2010 4 10 11 00 00
 CH 91 2010 4 10 11 00 00
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 CH 93 2010 4 10 11 00 00
 CH 94 2010 4 10 11 00 00
 CH 95 2010 4 10 11 00 00
 CH 96 2010 4 10 11 00 00
 CH 97 2010 4 10 11 00 00
 CH 98 2010 4 10 11 00 00
 CH 99 2010 4 10 11 00 00
 CH 100 2010 4 10 11 00 00

COMMISSIONING - SAROBI - UNIT 1
 MODE: TRANSIENT (R-T) Apr 10, '07 11:21:52 DATA No. 0469 CHART SPEED = 50mm/min (0,2min/div)

STARTUP OPENING

Load Rejection 16MW

Wicket gate position: 0- 100% => 5%/ div
 Speed: 0- 200% => 10%/ div
 Penstock pressure: 30- 90 bar => 3bar/ div
 Chart speed: 50mm/min => 0,2min/div
Δ Speed: 29% (129%/ 100%)
Δ Penstock pressure: 10,1% (36bar/ 32.7bar)



COMMISSIONING - SAPOBICOMMISSIONING - SAPOBI - UNIT 1
 (0, MODE:R-T Apr 10, '07 MODE:R-T Apr 10, '07 11:37:52 DATA No. 0469 CHART SPEED = 50mm/min (0,2min/div)

STARTUP: OPENING STARTUP: OPENING

Load Rejection 22MW

Wicket gate position: 0- 100% => 5%/ div
 Speed: 0- 200% => 10%/ div
 Penstock pressure: 30- 90 bar => 3bar/ div
 Chart speed: 100mm/min => 0,1min/div
 Δ Speed: 36% (136%/ 100%)
 Δ Penstock pressure: 12,1% (36bar/ 32,1bar)

