National Transmission & Despatch Company Ltd.

General Manager (System Operation) NPCC

No. 611730 /GM (SO)/NPCC/HVDC Dated: 27 /04/2021

Chief Engineer (HVDC),
618-WAPDA House Lahore.

Subject: **Dispatch Procedure (A-5) for Monopole High Power Commissioning Test**

Ref: 1-This office letter No. 5363-73/GM(SO)/NPCC/HVDC dated:16-04-2021.
2- OE email addressed to your office with copy to others dated : 22-04-2021.

It is apprised that this office has prepared the dispatch procedure in compliance reviewed commissioning Test program (A-5).The same is forwarded to your office alongwith commissioning committee proforma attached as Annexure 'A' for seeking necessary signature/consent of the other committee members as mentioned in the proforma at the earliest but not later than 28 April 2021.

Furthermore, following are the comments of this office regarding general and pre-requisites prior to the starts of the high power monopole commissioning/test.

i. All the pre-requisites and general condition as mentioned in the dispatch procedure (A-5) required to be fulfilled.
ii. Concurrence of the NTDC working group regarding system stability during commissioning test.
iii. The tripping of monopole at 2200MW/2000MW etc under emergency switch-off, fault and reduced voltage operation can impact the stability. Therefore, the planning, protection and control, and asset management (North & South) must be on board by signing above concurrence.
iv. Necessary approval of the competent authority to authorize the NPCC to impact instruction regarding commencement of testing.
v. Concurrence on stability study conducted by PMLTC(As per MOU, OE, PSP, IE , PMLTC and NPCC should develop prior on the study so that system could be adjusted accordingly during the testing).
vi. Voice Communication links between Matiari and NPCC highlighted earlier has yet not been established. Ensure its functionality prior to commissioning test for smooth communication.

Therefore, it is requested to arrange above mentioned pre-requisite well in time prior to start of commissioning test and ensure implementation of the general and pre-condition as mentioned in the attached dispatch procedure to avoid any inconvenience during the test or at later stage.

(Engr. Ghulam Abbas Memon)
General Manager (S.O),
NPCC, NTDC, Islamabad

Copy to:
i. Managing Director, NTDC, 614-WAPDA House, Lahore.
ii. Dy. Managing Director (P&E), WAPDA House, Lahore.
iii. Dy. Managing Director (AD&M), WAPDA House, Lahore.
iv. General Manager (PSP), NTDC, PIA Tower, Lahore.
v. General Manager (Design), NTDC, WAPDA House, Lahore
vi. General Manager (Project Delivery-North), NTDC, Room No. 219, WAPDA House Lahore.
vii. General Manager (Project Delivery-South), NTDC Hyderabad.
viii. General Manager (Asset Management-North), NTDC, WAPDA House, Lahore.
ix. General Manager (Asset Management-South), NTDC, Jamshoro.
x. Chief Engineer (Telecom), NTDC, WAPDA House, Lahore.
xi. Chief Engineer (Protection and Control), WAPDA House, Lahore.
xii. Dy. CEO, Chief Engineer CET/PMLTC, H# 581-Z, St# 17, Phase-III, DHA, Lahore.
xiii. Mr. Iftikhar Representative of OE(Hatch).

Anex "A"

National Transmission & Despatch Company Limited

(National Power Control Center)

REVIEWED RBJ RBJ Engineering Corporation
Bruno Bisewski 29-April-2021
☐ No comments
☒ Comments as Indicated
This review does not convey Acceptance or Approval and does not relieve Contractor of full responsibility for system performance.

In general we agree with the comments of CET/PMLTC. Only minor changes to the text were made to ensure meaning is clear.

DC MONOPOLE HIGH POWER COMMISSIONING

DESPATCH PROCEDURE OF

MATIARI & LAHORE CONVERTER STATION

27042021-NPCC-DCDP V 1.72

April, 2021

Commissioning Committee Approval Proforma

DC MONOPOLE HIGH POWER COMMISSIONING DESPATCH PROCEDURE OF

MATIARI & LAHORE CONVERTER STATION

±660kV HVDC MATIARI-LAHORE, PROJECT, PAKISTAN

Document Number	:	**27042021-NPCC-DCDP V 1.72**
Reference Document Submitted by PMLTC/CET and reviewed/approved by NTDC/OE dated 21-04-2021	:	Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests, (5) Monopole High Power System Tests Program HXT2020-109 dated 21-04-2021.
Issue Date	:	27-04-2021
Prepared by:		**NPCC**
Whether dispatching procedure reviewed by M/S PMLTC		**Yes**

Approved by Commissioning Committee

Engr. Ghulam Abbas Memon General Manager (System Operation) NPCC	Dr. Chang Yong Chief Engineer (PMLTC)	Mr. Aldo Danielli Independent Engineer M/S CESI
Sign:	Sign:	Sign:

Note:

1. Disseminated for information and implementation to all concerned.

2. Errors/Omissions are accepted.

Commissioning Working Group Consent Proforma **DC MONOPOLE HIGH POWER COMMISSIONING DESPATCH PROCEDURE OF MATIARI & LAHORE CONVERTER STATION ±660kV HVDC MATIARI-LAHORE, PROJECT, PAKISTAN**	
Reference Document Number : PMLTC/CET	Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests, (5) Monopole High Power System Tests Program HXT2020-109 dated 21-04-2021.
Reference Document Number : NPCC	Despatch Procedure Of DC Monopole High Power Commissioning Tests (**27042021-NPCC-DCDP V 1.72**).
Issue Date :	Issued for review on 16-April-2021
Commissioning Working Group Consent	
Mr. Anwar Ahmed CE (HVDC) , Focal Person	Sign:
Mr. Sajjad Akhter CE (Net. Operation)	Sign:
Mr. Waseem Younas CE (Planning)	Sign:
Mr. Atif Mujeeb Usmani CE (P&C)	Sign:
Mr. M. Rauf Khan CE(Telecom)	Sign:
Mr. M. Kamran Siddique CE (TSG)	Sign:
Mr. Sajid Hussain Focal Person from Owner Engineer (M/S HATCH)	Sign:
Member of O&M of Transmission line under DMD (AD&M) which will be carried out after COD.	Sign:

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References

[1] A5-Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests-Monopole High Power System Tests Program HXT2020-109 dated 21-04-2021.

[2] Lahore Converter station SLD document number DCL00, dated: 17-08-2020, Rev-00.

[3] Matiari Converter station SLD document number DCM01, dated: 13-10-2020, Rev-01.

1 General Conditions

1.1. This dispatch procedure is issued for operational co-ordination during "Commissioning Tests Plan" of the HVDC System/switchyard at both Matiari/Lahore Converter stations of ±660kV HVDC Matiari –Lahore project as per reference information provided by Pakistan Matiari Lahore Transmission Company (PMLTC) through CE HVDC [1].

1.2. The authorized representatives from PMLTC and NPCC (list of despatcher on duty and key personnel to be provided later) shall confirm in writing the revision number of the Commissioning Test Plans [1] to be followed throughout the testing prior to start of testing. Any changes made to the test plan once testing has started shall be noted and approved in writing by both the authorized representatives from PMLTC and NPCC.

1.3. The authorized personnel (2 personnel) as identified by PMLTC shall remain at NPCC during whole DC commissioning period.

1.4. PMLTC shall provide the 24/7 duty roster along with names/designation of authorized operational staff of Matiari and Lahore converter station to NPCC.

1.5. It shall be the responsibility of PMLTC and Test Director to establish desired safe communications during entire commissioning period with the authorized control room operators at Matiari-Lahore Converter station regarding requirement of switching etc. for the scheduled test item.

1.6. The operator at Matiari and Lahore Converter Station shall be well conversant with the prudent practices and SOPs regarding compliance to the instructions of system operator (NPCC authorized dispatcher on duty).

1.7. CET/PMLTC shall attach this dispatch procedure (27042021-NPCC-DCDP V 1.72), including its all annexures with commissioning test program.

1.8. The commissioning director appointed by CET shall be responsible for coordination and compliance of NPCC Instructions.

1.9. The test director(s) shall re-submit final adjusted test plan three days in advance at 10:00 Hrs to NPCC and re-confirm the next day test plan one day in advance at 10:00 Hrs every day.

1.10. Prior to each test, the test director (XIE GUOPING) of China Electric Power Research Institute shall notify the relevant departments, participating in test, through the tele-conference call system dial-in number (to be determined), in the converter station.

1.11. The test director shall be identified by PMLTC prior to the start of testing daily.

1.12. The NPCC authorized dispatcher on duty shall be identified by NPCC prior to the start of testing daily.

1.13. NPCC shall manage the AC system parameters according to the requirements of the commissioning (as mentioned in commissioning program).

1.14. Operators of Matiari and Lahore converter stations are responsible for equipment status report and the execution of the operation orders issued by NPCC.

1.15. The test director(s) shall seek permission from **NPCC** regarding switching of any HVAC and HVDC switchgear(s) to meet the test requirement as per agreed test activity of the commissioning program.

1.16. NPCC upon request of Test Director shall impart instructions to the authorized operational personnel on duty in control room of Matiari and Lahore Converter stations. The communication procedure shall be as follows:

i. NPCC authorized dispatcher shall identify themselves.
ii. NPCC authorized dispatcher shall state the instruction to be followed
iii. Operation personnel on duty in the control room of Matiari and Lahore Converter station shall identify themselves.
iv. Operation personnel on duty in the control room of Matiari and Lahore Converter stations shall acknowledge the instruction by repeating the instruction back to the authorized NPCC dispatcher, to re-confirm the instruction.
v. NPCC authorized dispatcher shall confirm the instruction to be followed and approve execution.
vi. Operation personnel on duty in the control room of Matiari and Lahore Converter stations shall acknowledge confirmation to execute the operation.
vii. Operation personnel on duty in the control room of Matiari and Lahore Converter stations shall then execute the operation and shall inform NPCC after execution.
viii. NPCC authorized dispatcher shall acknowledge, that operation has been executed, by verifying the status from OWS/ SCADA.
ix. Any delay in execution of instructions/operations by PMLTC shall be communicated by stating the cause/reason of delay.
x. All the communications between NPCC and PMLTC operation personnel shall be recorded on both sides.

2 Pre-requisites to the commissioning:

2.1 **PMLTC** shall ensure that the final SLDs [2] have been approved and issued by **NPCC** and equipment's code in the switchyards, control room panels and relay rooms has been marked as per approved SLDs. The switching sequences during and after the commissioning shall be performed as per Dispatch Code/ nomenclature of the approved SLDs [2].

2.2 Round the clock healthy voice-communication (Hotline, direct dialing etc.) between the control room of Matiari/Lahore Converter stations and **NPCC** shall be ensured by PMLTC.

2.3 CET/PMLTC shall submit commissioning plan along with sequence of operation to NPCC during the

commissioning/energization process. CET/PMLTC shall also inform NPCC its possible effects on AC system under operation.

2.4 PMLTC shall provide the "Power Curves", which are to be used during commissioning, 3 days prior to the start of commissioning to NPCC.

2.5 Prior to commissioning, **PMLTC** and CE HVDC NTDC shall ensure the provision of real time data through OWS and SCADA in NPCC control centers for supervisory control and monitoring.

2.6 The commissioning test program [1] shall be confirmed by **PMLTC** and **Chief Engineer HVDC, NTDC** as the final version.

2.7 **PMLTC** shall submit the final version of the commissioning test program document to all related participants, before start of the commissioning test.

2.8 Chief Engineer HVDC, NTDC will record and issue the list of representatives nominated by all stakeholders and re-issue the changings in list of representatives during commission / testing activities.

2.9 Chief Engineer HVDC, NTDC shall prepare the methodology to ensure clear coordination and decision making during the commissioning / testing.

2.10 PMLTC shall provide fully functional Stability Control System (SCS) & Oscillation Splitting Devices, to ensure power system stability and reliability.

2.11 DC commissioning tests A1 and A2 for Matriari and Lahore converter stations respectively, have been successfully completed, including Open Line Test with DC line, and DC lines of both poles Pole-I and Pole-II have been successfully energized.

2.12 The results of DC commissioning tests A1, A2, A3, and A4 for Matriari and Lahore converter stations respectively, including all graphs/charts related to pole power, current, voltages, firing angles and extinction angles, tap positions etc... have been approved by NTDC / Owner Engineer (M/S HATCH).

2.13 Approval of NTDC authority is required before conducting AC line fault tests.

2.14 Relevant personnel from Asset Management, protection and control, TSG, CE (HVDC) must be at the site to witness the AC line fault test.

2.15 Optional tests may or may not be carried out by NPCC as per the then system prevailing conditions

2.16 Studies have been performed and reviewed to quantify the risk to the ac system during the tests including single and double contingencies for power transfer up to the maximum power that will be transferred in the tests.

2.17 Transformer oil samples to be taken before and after the P1 and P2 High power tests and the results of the gas in oil analysis to be presented in a report after the tests.

3 Safety Precautions during Commissioning Tests:

Prior to energization of DC switch yard, Bipole DC Transmission Line or any of its component and pre-energization commissioning test(s); PMLTC shall make sure following:

3.1 During the test, CET/PMLTC is responsible for on-site safety measures at both converter stations to ensure that they do not affect the operation of equipment.

3.2 During the commissioning of DC system, PMLTC will be responsible for taking on-site safety measures, as per requirement of the commissioning and NEPRA Codes (Power Safety Codes, Grid Codes etc.) and international standards, to ensure equipment and personnel safety at both Matiari and Lahore Converter stations.

3.3 At Matiari and Lahore converter stations, the test equipment or external equipment should be properly tagged /locked out, or use the black, red and white tape belt and other warning signs/ equipment.

4 Commissioning Procedure:

The procedure for the commissioning of DC system is as follows:

4.1 Commissioning director shall seek formal permission from NPCC before initiating any commissioning test.

4.2 NPCC will manage the operation of AC system to meet the requirements of commissioning tests as planned for a particular day.

4.3 If in any case, the commissioning work cannot be carried out in accordance with the commissioning plan due to undesired AC system / Power grid conditions, test plan of that day shall be rescheduled by NPCC, with co-ordination of CE-HVDC and PMLTC.

4.4 NPCC instructions to be followed by all concerned during the commissioning of HVDC system in view of prevailing system conditions.

5 Disturbance Handling:

During the test, CET/PMLTC is responsible for on-site safety measures at both converter stations to ensure human safety and stable operation of equipment. The scope of responsibilities in the event of disturbance handling during the commissioning of DC system is as follows:

5.1 NPCC is responsible for the switching operation and disturbance management of AC system of the associated grid stations/plants connected with the converter stations, and PMLTC is responsible for the switching operation and disturbance management of Matiari and Lahore Converter stations and Bipole DC Transmission Line.

5.2 In case there is any problem or equipment fault occurred with the AC system during the commissioning test, NPCC will coordinate with relevant NTDC Asset Management to fix it. In case there is any problem or equipment fault occurred at Matiari and Lahore Converter stations and Bipole DC Transmission Line, PMLTC will fix it.

5.3 During the commissioning, if any equipment under test depicts abnormal behavior, the commissioning director is responsible for managing the disturbance.

5.4 During the commissioning, if an emergent situation arises that endangers personal safety and poses serious threat to the main equipment, the operators may not wait for the commissioning director order and is permitted to immediately stop the DC system, and inform NPCC.

5.5 If the DC system is out of service due to an abnormal AC system or fault, the converter station operator shall immediately report the disturbance to NPCC.

6 Equipment Status Report (ESR) before start of commissioning tests:

Commissioning Directors at both Matiari and Lahore converter stations shall submit following ESR to NPCC prior to commissioning test each day as follows:

6.1 AC breakers controlling converter transformer of pole I and II at both Matiari/Lahore C/S are in cold standby state or otherwise.

6.2 Complete DC switchgear at Matiari/Lahore C/S is in *cold standby state.

6.3 DC line of pole I and II at both Matiari/Lahore C/S is in *cold standby state.

6.4 All AC filters at both Matiari/Lahore C/S are in "Ready for Operation" condition.

6.5 AC lines and the remaining 500 kV equipment at both Matiari/Lahore C/S is in normal operation.

7 Commissioning Test Startup Procedure:

Commissioning Directors at both Matiari and Lahore converter stations shall seek a telephonic permission from NPCC, to formally start the tests as mentioned in the approved plan of that particular day after receiving the acknowledgement of "Commissioning Application" (as mentioned in 4.3) from NPCC. The prerequisites and Test steps related to each individual tests are described below:

7.1 Pole I High Power Tests, Normal Power Direction

Follow the sequence described in "Annexure-E-I" and "Test Plan (A5).

7.2 Pole-II High Power Test, Normal Power Direction

Follow the sequence described in "Annexure-E-II" and "Test Plan (A5).

7.3 Pole I & II High Power Test Reversed Power Direction

Follow the sequence described in "Annexure-E-III" and "Test Plan (A5).

	Monopolar High Power Tests Dispatch Matrices
A	All these tests will be performed in Monopolar/Bipolar Mode.
B	Sequence as mentioned in sequence table shall be followed
C	Test Block HP1 & HP2 must be carried out first before carrying out HP3, HP4
D	General conditions and System configurations must be selected as indicated before performing each test.
E	There are at least 2 LV reactors available at Matiari and two LV reactors available at Lahore converter station.
F	AC system short circuit level has been measured prior to commissioning test each day, at both Matiari and Lahore converter stations and it is confirmed to be suitable for the tested power.
G	Monopole and Bipole Low Power Test at normal and ~~reverse direction~~ has been successfully finished

Matiari—Lahore ±660kV HVDC Project
High Power Monopolar Pole 1, Pole 2 System Commissioning Tests

Sr. No.	Test Block	Commissioning Items	Mode	Item Designations	Sub-item Designation	Power imported from AC Network (MW)
High Power System Tests-Monopolar (Will be updated once the draft gets approved)						
All tests above must be successful before executing the High Power tests						
The tests in HP-1, HP-2, HP-3, HP-4 should be performed in sequence. In the case of any failure or delay in Block HP-1, next test in the block should not proceed until the reason for failure or delay is resolved.						
Pole1 High Power Tests, Normal Power Direction						
1	HP-1	2.3.1	GR	Pole 1 High Power Test,	Pole-I Start	200
2		2.3.2	GR	Pole 1 High Power Test	Pole-I Ramp Up & Control System Switchover	200-2200
3		3.3.1	GR	Pole 1 Heat Run Test and Special Measurements	Pole-I Run at 1.00 p.u. in Monopole without Redundant Cooling	2200
4			GR	Pole 1 High Power Test	Pole Control,DC Side Protections, AC Side Protections [Analogue Input Checks]	
5		3.3.2	GR	Pole 1 Heat Run Test and Special Measurements	Pole-I Run at 1.1 p.u. in Monopole with Redundant Cooling	2400
6		2.3.3	GR	Pole 1 High Power Test	Tap Changer Control, Manual Tap Changer Step	2000
7		2.3.4	GR /MR	Pole 1 High Power Test	Ground/Metallic Return Transfer	2000
8		3.3.3	GR	Pole 1 Heat Run Test and Special Measurements	Radio Interference Measurements	2200/2400
9		3.3.4	GR	Pole 1 Heat Run Test and Special Measurements	Audible Noise Check	2200/2400
10		3.3.5	GR	Pole 1 Heat Run Test and Special Measurements	Station Auxiliary Power Losses	2200/2400
11		3.3.6	GR	Pole 1 Heat Run Test and Special Measurements	Temperature Measurement With IR-Camera Equipment	2200/2400
12		3.3.7	GR	Pole 1 Heat Run Test and Special Measurements	Pole-I Ground Electrode Test	2200/2400
13		AS-2.3.2 steps 19-25	GR	Pole 1 High Power Test	Pole-I Pole Ramp Down & Control System Switchover	2000-200

Pole2 High Power Tests, Normal Power Direction						
14	HP-2	4.3.1	GR	Pole 2 High Power Test,	Pole-II Start	200
15		4.3.2	GR	Pole 2 High Power Test	Pole-II Ramp Up & Control System Switchover	200-2200
16			GR	Pole 2 High Power Test	Pole Control,DC Side Protections, AC Side Protections [Analogue Input Checks]	
17		5.3.1	BPGR	Pole 2 Heat Run Test and Special Measurements	Pole-II Run at 1.00 p.u. in Monopole without Redundant Cooling	2200
18		5.3.2	BPGR	Pole 2 Heat Run Test and Special Measurements	Pole-II Run at 1.1 p.u. in Monopole with Redundant Cooling	2400
19		4.3.3	BPGR	Pole 2 High Power Test	Tap Changer Control, Manual Tap Changer Step	2400
20			BPGR	Pole 2 High Power Test	Pole-II Control System Switchover	2400
21		-	BPGR	Manual Reduced Voltages	Order Manual Reduced Voltages in Pole-I	2400
22		-	BPGR	RPC action	Filter Replacement Test	2200
23		BPGR →	MPGR	Control System	Pole-II Pole Ramp Down & Control System Switchover during ramping	2200-200
24		-	BPGR	Disturbance Test	ESOF in Pole-II with transfer of Power to Pole-I	2200
25		-	BPGR		Current & Power Step Test at Nominal Rated Power in Pole-I	2200-2000
26		-	BPGR		Order Reduced voltage in Pole-II from dc line protection on first Restart	2200
27		5.3.7	BPGR		Loss of Pole at Y MW with no transfer to other pole Test	Y=(2000-1400 MW)
28		5.3.3	BPGR	Pole 2 Heat Run Test and Special Measurements	Radio Interference Measurements	2200/2400
29		5.3.4	BPGR	Pole 2 Heat Run Test and Special Measurements	Audible Noise Check	2200/2400
30		5.3.5	BPGR	Pole 2 Heat Run Test and Special Measurements	Station Auxiliary Power Losses	2200/2400
31		5.3.6	BPGR	Pole 2Heat Run Test and Special Measurements	Temperature Measurement With IR-Camera Equipment	2200/2400
Pole-I High Power Test, Reversed Power Direction						
32	HP-3	6.3.1	GR	Pole1 High Power Test	Pole Start	200
33		6.3.2	GR	Pole1 High Power Test	Pole-I Ramp up	1000
34		6.3.3	GR	Pole1 High Power Test	Pole-I Ramp down	1000
Pole-II High Power Test, Reversed Power Direction						
35	HP-4	6.3.1	GR	Pole2 High Power Test	Pole Start	200
36		6.3.2	GR	Pole2 High Power Test	Pole-2 Ramp up	1000
37		6.3.3	GR	Pole2 High Power Test	Pole-2 Ramp down	1000

Monopole High Power System Tests

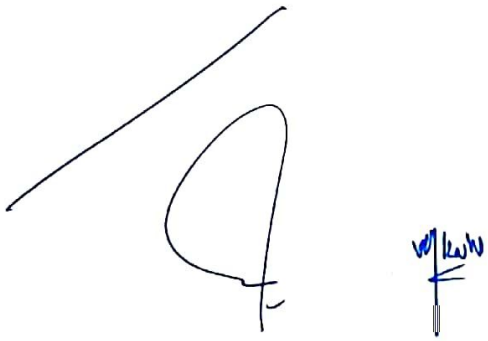
Pole I High Power Tests

Normal Power Direction

Test Objective	The test objective is to check DC equipment performance during high power test.					
Condition	**Sr. No.**	**Station**	**Action**	**Equipment/ Configuration**	**State of Equipment/configuration**	**Description**
Pre-Test Conditions & Configurations (AC/DC)	1	AC side at Matiari & Lahore C/S	Voltage Limits	Utmost efforts will be made to maintain the voltages within ±5% range. However, reactive compensation devices installed at both converter stations can be used, if needed, to control the voltages keeping in view the then prevailing system conditions.		
	2		AC Yard of Lahore & Matiari Converter Station is in normal Position		CLOSED State	All bays including Filter Banks are complete and energized with no component in maintenance state.
	3	DC side at Matiari & Lahore C/S	See Status Table "P1-GR"			Ground Return Mode
	4		See Status Table "P2-GR"			Ground Return Mode
	5	General PreConditions	Monopole and Bipole Low Power Test at normal direction has been successfully finished.			
	6		Before start of Heat Run Test, samples for DGA (Dissolved Gas Analysis) shall be taken from all converter transformers of the Pole at both stations.			
	7		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (2400 MW) for the test. Availability of N-1 contingency on parallel AC corridor. AC system short circuit level has been measured at both Matiari and Lahore converter stations and it is confirmed to be suitable for the tested power.			
	8	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	9		Return	Ground		Ground Return Mode
	10		Udc Mode	Normal		±660kV
	11		Telecom Mode	Operational		
	12		Master Station	Matiari		Can be changed to Lahore Station
	13	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	14			B	Standby	
	15		Pole Control Protection (PCP)	A	ACTIVE	
	16			B	Standby	
	17		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	18		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	19		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	20		Reactive Power Control Variable	Q-Control	ACTIVE	Reactive Power exchange between AC Yard of Converter Station and NTDC system will be automatically controlled.

Testing Start Up Sequence

Pole-I Start (A5-2.3.1)	21	Matiari/Lahore C/S DC	Verify Pole 1 in Pole Power Control, Ready for Operation Conditions.			
	22	Matiari & Lahore	Start the Pole-I	Power	200 MW	Refer To Pole De-Blocking and starting sequence
	23			Ramp Rate:	100 MW/Min	
	24		Wait to achieve Target Value	Max Time	2 min	
	25	Matiari	Verify Performance Indicators	Firing angle (α)	15°±2.5°	
	26			DC Voltages	660kV	
	27			RPC Operation	BP-11/13 , HP24/36	
	28	Lahore		Extinction Angle (g)	17°	
	29			DC Voltages	Range to be mentioned	
	30	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	31	Lahore		HP12/24		
	32	Matiari/ Lahore	Verify	Continuous Steady Operation		
	33			Verify stable operation & Normal start at minimum		
	34			Perform normal inspections (visual and acoustical)		
Pole-I Ramp Up & Control System Switchover(A5-2.3.2)	35	Matiari/Lahore C/S DC	Verify Pole 1 in Pole Power Control, Ready for Operation Conditions.			
	36	Matiari	Ramp Up	200MW	400MW	50MW/Min
	37	Matiari	Ramp Up	400MW	600MW	999 MW/Min
	38	Matiari & Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole 1 power ramping.		
	39	Matiari/Lahore	Verify	Continuous Steady Operation of the transmission		
	40			power reaches the reference value after ramping is completed		
	41			RPC in both stations connects the appropriate number of filters and shunt banks during ramping.		
	42			No Transients		
	43	Matiari	Ramp Up	600MW	800MW	50 MW/Min
	44	Matiari & Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole 1 power ramping.		
	45	Matiari/Lahore	Verify	Continuous Steady Operation		
	46			Ramping Done and Holding the target Value		
	47			No Transients, no unexpected Time Delay		
	48	Matiari/Lahore	Ramp Up	800MW	1000MW	50MW/Min
	49		Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole 2 power ramping.		
	50		Switch Control System both poles (during Ramping)	PCP-A to PCP-B to PCP-A		
	51			SC-A to SC-B to SC-A		
	52	Matiari/Lahore	Verify	Continuous Steady Operation		
	53			PCP-A	Active	
	54			SC A	Active	
	55			Ramping Done and Holding the target Value		
	56			No Transients, no unexpected Time Delay		
	57	Matiari	Continue the ramp up with the rate 50MW/Min in steps of 200MW, till the DC Power to reaches 2000MW			
	58	Matiari /Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole 2 power ramping.		

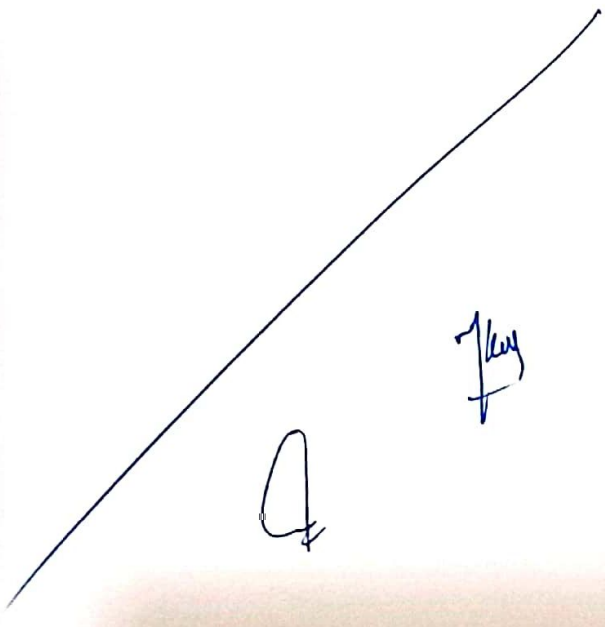


Pole-I Ramp Up & Control System Switchover(A5-2.3.2)

59	Matiari/Lahore	Verify	Continuous Steady Operation		
60			Ramping Done and Holding the target Value		
61			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping	
62			No Transients, no unexpected Time Delay		
63	Matiari/Lahore	Inspect AC/DC analogue input signal of following systems while operating the pole at maximum power 2000 MW.	Trigger TFR manually to Pole 1 DC side Analogue signal check In controls and Protection, and check the overlap		
64	Matiari	Start the Pole-2 In Pole Power Control	Power	200 MW	
65			Ramp Rate:	100 MW/Min	
66		Wait to achieve Target Value	Max Time	2 min	
67	Matiari/Lahore	Verify pole2 stable operation & Normal start at minimum power			
68		Perform normal inspections (visual and acoustical) while pole is deblocked.			
69	Matiari	Change pole 2 from pole power control to bipole power control and set the bipole power reference 2200MW			
70		Verify stable operation & bipole power transmission at 2200MW			
71	Matiari/Lahore	Verify	Continuous Steady Operation		
72			PCP-A	Active	
73			SC A	Active	
74			No False Action by Control Systems		
75			No Transients, no unexpected Time Delay		
76	Matiari/Lahore	Verify	Pole 1 steady state operation at 2000MW		
77			Pole 2 steady state operation at 200MW		
78	Matiari/Lahore	Switch Control System (at Pole Power 2000 MW)	PCP-A to	PCP-B	
79			SC-A to	SC-B	
80	Matiari/Lahore	Verify	PCP-B	Active	
81			SC-B to	Active	
82			Continuous Steady Operation		
83			No False Action by Control Systems		
84			No Transients, no unexpected time delay		
85	Matiari/Lahore	Switch Control System (at Pole Power 2000 MW)	PCP-B to	PCP-A	
86			SC-B to	SC-A	
87	Matiari/Lahore	Verify	Continuous Steady Operation		
88			PCP-A	Active	
89			SC A	Active	
90			No False Action by Control Systems		
91			No Transients, no unexpected Time Delay		

Pole-I Run at 1.00 p.u. in Monopole without Redundant Cooling (AS-3.3.1)	92	Matiari/Lahore	Verify	DC Power	Pole1 power:2000MW	
	93			The reference is fulfilled after the ramping is completed		
	94			The measured currents and voltages at DC and AC side are correct.		
	95		Keep the pole in operation for 4 hours at 1.0 p.u. If any of the transformers has not reached steady state temperature, then continue for another 1/2 hour.			
	96		Verify	the measured currents and voltages at DC and AC side are correct.		
	97		Measure & Record	valve cooling water temperature inlet and outlet continuously until a stable temperature is reached (temperatures should be stable within approximately 15 minutes).		
	98			temperature of coil winding and hot spot in converter transformer every 30 minutes. until reasonable stable temperature is reached (temperatures should be stable within approximately 3 hours).		
	99			AC-side individual harmonics, Dn, THD, THFF, both stations external TFR 10000Hz sample rate		
	100			DC-side harmonics and leq in Matiari andLAHORE C/S from the power quality analyser.		
	101					
	103		Perform following measurements: 3.3.3 Radio Interference, 3.3.4 Audible Noise, 3.3.5 Station Service Power Loss, 3.3.6 Temperature Measurements with IR Camera, 3.3.7 Ground Electrode Test			
Pole-I Run at 1.10 p.u. in Monopole without Redundant Cooling (AS-3.3.2)	104	Matiari	Ramp Up Pole-I	2000MW	2200MW	50MW/Min
	105		set the bipole power reference 2400MW			
	106		Verify	DC Power	Pole1 power:2200MW	
	107			The reference is fulfilled after the ramping is completed		
	108			The measured currents and voltages at DC and AC side are correct.		
	109		Keep the pole in operation for 2 hours at 1.1 p.u. The following verifications should be carried during this period			
	110		Verify	the reference is fulfilled after the ramping is completed		
	111			the measured currents and voltages at DC and AC side are correct.		
	112		Measure & Record	valve cooling water temperature inlet and outlet continuously until a stable temperature is reached (temperatures should be stable within approximately 15 minutes).		
	113			Record andd plot the coil winding and hot spot in converter transformer every 30 minutes.		
	114			AC-side individual harmonics, Dn, THD, THFF, both stations external TFR 10000Hz sample rate		
	115			DC-side harmonics and leq in Matiari andLAHORE C/S from the power quality analyser.		
	116	Matiari/Lahore	Perform following measurements: 3.3.3 Radio Interference, 3.3.4 Audible Noise, 3.3.5 Station Service Power Loss, 3.3.6 Temperature Measurements with IR Camera, 3.3.7 Ground Electrode Test			
	117	Matiari	Pole-I will automatically Ramp-down to 2000MW by overload timer after completion of 2 hours. Pole-II will automatically Ramp up to 400 MW			
	118		Switch Pole 2 to Pole Power control and Manually Stop Pole2			
	119		Pole 2 goes to 200MW and stops.			
Pole-I Tap Changer Control, Manual Tap Changer Step (2.3.3)	120	Matiari	Set tap changer control in MANUAL CONTROL mode			
	121		Lower one steps for decreasing Udi0.			
	122		Verify	Firing Angle decreased		
	123			Transmitted Power is maintained		
	124			No Transients, no unexpected Time Delay		
	125		Set tap changer control in AUTO CONTROL mode			
	126		Verify	Tap increased automatically		
	127			Firing Angle increased back to control limits		
	128			Transmitted Power is maintained		
	129			No Transients, no unexpected Time Delay		
	130	Lahore	Set tap changer control in MANUAL CONTROL mode			
	131		Lower one steps for decreasing Udi0.			
	132		Verify	Decreased DC Voltages		
	133			Maintained Gamma in Lahore		
	134			Transmitted Power is maintained with DC current increased		
	135			No Transients, no unexpected Time Delay		
	136	Matiari	Verify	Tap position decreased to maintain firing angle in control limits		
	137	Lahore	Set tap changer control in AUTO CONTROL mode			
	138		Verify	Tap increased automatically		
	139			Firing Angle back in control limits		
	140			DC Voltage back to normal		
	141			Transmitted Power is maintained		
	142			No Transients, no unexpected Time Delay		
	143	Matiari	Verify	Tap position increased to maintain firing angle in control limits		

Pole-I Ground/Metallic Return Transfer (AS-2.3.4)	144	Matiari/Lahore	Order Pole-I Transfer GR to MR			
	145		Matiari Verify	NE11	OPEN	
	146			WNQ1, WNQ11,WP2Q10	CLOSED	
	147			WN3Q1,WN3Q11,WN3Q12	OPEN	
	148			Transmitted Power is maintained		
	149			No Transients, no unexpected Time Delay		
	150		Lahore Verify	NE11	OPEN	
	151			WNQ11,WP2Q10	CLOSED	
	152			Transmitted Power is maintained		
	153			No Transients, no unexpected Time Delay		
	154	Matiari/Lahore	Order Pole-I Transfer MR to GR			
	155		Matiari Verify	NE11	CLOSED	
	156			WNQ1, WNQ11,WP2Q10	OPEN	
	157			WN3Q1,WN3Q11,WN3Q12	CLOSED	
	158			Transmitted Power is maintained		
	159			No Transients, no unexpected Time Delay		
	160		Lahore Verify	NE11	CLOSED	
	161			WNQ11,WP2Q10	OPEN	
	162			Transmitted Power is maintained		
	163			No Transients, no unexpected Time Delay		
Pole-I Radio Interference Measurements (AS-3.3.3)	164	Matiari \Lahore	Measure / Record /Save	Choose 1 or 2 test places inside the converter stations and about 450m away outside the converter station and carry out the measurement of the interference frequency spectrum.		
	165			the frequency spectrum characteristics of radio interference under the outlet line of the ±660 kV valve hall and at 20 m from the outlet line inside the converter station		
	166			places inside the converter stations and about 450m away outside the converter station and carry out the measurement of the interference frequency spectrum		
Pole-I Audible Noise Check (AS 3.3.4)	167	Matiari \ Lahore	Measure / Record /Save	Audible noise near the convertor transformer in the converter station		
	168			Audible noise along the boundary line outside the converter station		
	169			Measurement of Audible noise in front of the houses near the converter station, If there are houses.		
Pole-I Station Auxiliary Power Losses (AS-3.3.5)	170	Matiari / Lahore	Record	In status R eady for Operation , the loads on the 400V power level are measur ed wit h in on e scheduled time pe rio d (for example 5 times measurements in one hour with recording sheets . The measurement results are averaged to get values, which are equivalent losses to the no--load or fixed Auxiliary Power losses.		
	171		Verify	Measured loss values should be within limited value specified by technical specification		
	172		Record	When Operating at 1.0pu or 1.1pu - Measure loads on 400V power level 5 times in one hour, calculate average of measured values		
	173		Verify	Measured loss values should be within limited value specified by technical specification		
Pole-I Temperature Measurement With IR-Camera Equipment (AS-3.3.6)	174	Matiari / Lahore	Record/Verify	The temperature of busbars, clamps conductors, equipment, etc. are acceptable in DC-yard, AC-yard, and valve hall		
Pole-I Ground Electrode Test (AS-3.3.7)	175	Matiari & Lahore	Measure and Record	Measure the electrode resistance by measuring the neutral bus voltage and the electrode current.		
	176			Measure step and touch potentials at the electrode sites		
	177			Measure the various cable current of the electrode		
	178			Measure the temperature rise in the electrode conductor and the soil in the electrode site.		
	179		Verify	The current distribution within the various parts cables of the electrode shall be within the design limits.		
	180			Step and touch potentials must be within safe limits		
	181			The electrode conductor temperature shall be within the design limits.		



Pole-I Pole Ramp Down & Control System Switchover (AS-2.3.2 steps 19-25)	182	Matiari/Lahore	Ramp Down	2000 MW	1800 MW	50MW/Min
	183		Verify	Continuous Steady Operation		
	184			Ramping Done and Holding the target Value		
	185			No Transients, no unexpected Time Delay		
	186	Matiari	Ramp Down	1800MW	1600MW	50MW/Min
	187	Matiari/Lahore	Verify	Continuous Steady Operation		
	188			Ramping Done and Holding the target Value		
	189			No Transients, no unexpected Time Delay		
	190	Matiari	Ramp Down	1600MW	1400MW	50MW/Min
	191	Matiari/Lahore	Switch Control System (during Ramping)	PCP-A to PCP-B to PCP-A		
	192			SC-A to SC-B to SC-A		
	193	Matiari/Lahore	Verify	Continuous Steady Operation		
	194			PCP-A	Active	
	195			SC A	Active	
	196			Ramping Done and Holding the target Value		
	197			No Transients, no unexpected Time Delay		
	198	Matiari	Continue the ramp down with the rate 50MW/Min in steps of 200MW, till the DC Power reaches 600MW			
	199	Matiari/Lahore	Verify	Continuous Steady Operation		
	200			Ramping Done and Holding the target Value		
	201			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping	
	202			No Transients, no unexpected Time Delay		
	203	Matiari	Ramp Down	600MW	400MW	999MW/Min
	204	Matiari/Lahore	Verify	Continuous Steady Operation		
	205			Ramping Done and Holding the target Value		
	206			Correct RPC Operation		
	207			No Transients, no unexpected Time Delay		
	208	Matiari	Stop the Pole-I	Power	0 MW	Refer To Pole Blocking and stop sequence
	209			Ramp Rate:	100MW/Min	
Test Acceptance Criteria	210	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	211		All Operations executed successfully			
	212		Stability Control System and Oscillation splitting devices did not operate during the testing and the system remain stable.			
	213		The synchronizing voltage and the phasing of the firing control signals are correct.			
	214		All thyristor check-back signals are available.			
	215		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	216		Measuring quantities are available and the values are within the specified range and phase.			
	217		No abnormal corona discharges and no operation of surge arresters shall occur at energized			
	218		No Stuck Condition			
	219		All the sequence as recorded in OWS should be documented, All the Charts related to pole power, current, voltages, firing angles and extinction angles, tap positions. Should be recorded and documented. TFR data in Comtrade format to be captured and recorded.			
	220		No False Tripping by DC Protection System			
	221		No Tripping in AC side of converter Station			
	222		No issues with PLC interference for AC side protection PLC			

Monopole High Power System Tests

Pole II High Power Tests
Normal Power Direction

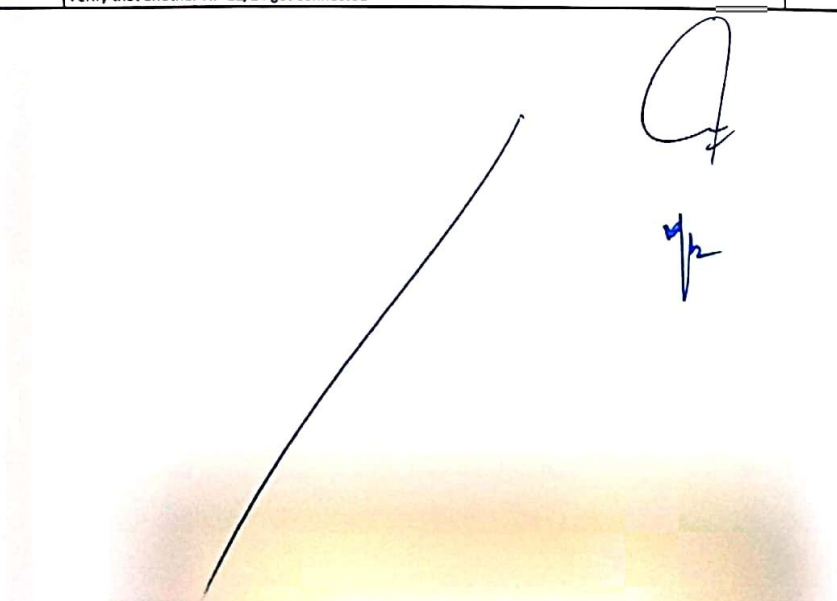
Test Objective	The test objective is to check DC equipment performance during high power test.					
Condition	**Sr. No.**	**Station**	**Action**	**Equipment/ Configuration**	**State of Equipment/configuration**	**Description**
Pre-Test Conditions & Configurations (AC/DC)	1	AC side at Matiari & Lahore C/S	Voltage Limits	Utmost efforts will be made to maintain the voltages within ±5% range. However, reactive compensation devices installed at both converter stations can be used, if needed, to control the voltages keeping in view the then prevailing system conditions.		
	2		AC Yard of Lahore & Matiari Converter Station is in normal Position		CLOSED State	All bays including Filter Banks are complete and energized with no component in maintenance state.
	3	DC Side at at Matiari & Lahore C/S	See Status Table "P1-GR"			Ground Return Mode
	4		See Status Table "P2-GR"			Ground Return Mode
	5	General PreConditions	Monopole and Bipole Low Power Test at normal direction has been successfully finished.			
	6		Before start of and after Heat Run Test, samples for DGA (Dissolved Gas Analysis) shall be taken from all converter transformers of the Pole at both stations.			
	7		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (2400 MW) for the test. Availability of N-1 contingency on parallel AC corridor. AC system short circuit level has been measured at both Matiari and Lahore converter stations and it is confirmed to be suitable for the tested power.			
	8	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	9		Return	Ground		Ground Return Mode
	10		Udc Mode	Normal		±660kV
	11		Telecom Mode	Operational		
	12		Master Station	Matiari		Can be changed to Lahore Station
	13	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	14			B	Standby	
	15		Pole Control Protection (PCP)	A	ACTIVE	
	16			B	Standby	
	17		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	18		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	19		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	20		Reactive Power Control Variable	Q-Control	ACTIVE	Reactive Power exchange between AC Yard of Converter Station and NTDC system will be automatically controlled.

Testing Start Up Sequence

Pole-II Start (AS-4.3.1)	21	Matiari/Lahore C/S DC	Verify Pole-II in Pole Power Control, Ready for Operation Conditions.			
	22	Matiari & Lahore	Start the Pole-II	Power	200 MW	Refer To Pole De-Blocking and starting sequence
	23			Ramp Rate:	100 MW/Min	
	24		Wait to achieve Target Value	Max Time	2 min	
	25	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	26			DC Voltages	660kV	
	27					
	28	Lahore		Extinction Angle (g)	17°	
	29			DC Voltages	Nominal	
	30	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	31	Lahore		HP12/24		
	32	Matiari/ Lahore	Verify	Continuous Steady Operation		
	33			Verify stable operation & Normal start at minimum		
	34			Perform normal inspections (visual and acoustical) while		
Pole-I Ramp Up & Control System Switchover (AS-4.3.2 step1-16)	35	Matiari/Lahore C/S DC side	Verify Pole2 in Pole Power Control, Ready for Operation Conditions.			
	36		Ramp the pole2 power up to 2000MW at 50MW/min rate in steps of200MW with a stop interval of 2 minutes at the end of each step. Theinterval is to make sure the system is stable.			
	37	Matiari	Ramp Up	200MW	400MW	50MW/Min
	38	Matiari	Ramp Up	400MW	600MW	999 MW/Min
	39	Matiari & Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.		
	40	Matiari/Lahore	Verify	Continuous Steady Operation of the transmission		
	41			power reaches the reference value after ramping is completed		
	42			RPC in both stations connects the appropriate number of filters and shunt banks during ramping.		
	43			No Transients		
	44	Matiari	Ramp Up	600MW	800MW	50 MW/Min
	45	Matiari & Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.		
	46	Matiari/Lahore	Verify	Continuous Steady Operation		
	47			Ramping Done and Holding the target Value		
	48			No Transients, no unexpected Time Delay		
	49	Matiari/Lahore	Ramp Up	800MW	1000MW	50MW/Min
	50		Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.		
	51		Switch Control System both poles (during Ramping)	PCP-A to PCP-B to PCP-A		
	52			SC-A to SC-B to SC-A		
	53	Matiari/Lahore	Verify	Continuous Steady Operation		
	54			PCP-A	Active	
	55			SC A	Active	
	56			Ramping Done and Holding the target Value		
	57			No Transients, no unexpected Time Delay		
	58	Matiari	Continue the ramp up with the rate 50MW/Min in steps of 200MW, till the DC Power to reaches 2000MW			
	59	Matiari /Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.		

Pole-I Ramp Up & Control System Switchover (AS-4.3.2 step 1-16)	60	Matiari/Lahore	Verify	Continuous Steady Operation		
	61			Ramping Done and Holding the target Value		
	62			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping	
	63			No Transients, no unexpected Time Delay		
	64	Matiari/Lahore	Inspect AC/DC analogue input signal of following systems while operating the pole at maximum power 2000 MW.	Trigger TFR manually to Pole-I DC side Analogue signal check in controls and Protection, and check the overlap		
	65	Matiari	Start the Pole-1 in Pole Power Control	Power	200 MW	
	66			Ramp Rate:	100 MW/Min	
	67		Wait to achieve Target Value	Max Time	2 min	
	68	Matiari/Lahore	Verify pole-1 stable operation & Normal start at minimum power			
	69		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	70	Matiari	Change Pole-I from pole power control to bipole power control and set the bipole power reference 2200MW			
	71		Verify stable operation & bipole power transmission at 2200MW			
	72	Matiari/Lahore	Verify	Continuous Steady Operation		
	73			PCP-A	Active	
	74			SC A	Active	
	75			No False Action by Control Systems		
	76			No Transients, no unexpected Time Delay		
	77		Verify	Pole-II steady state operation at 2000MW		
	78			Pole-I steady state operation at 200MW		
	79		Switch Control System (at Pole Power 2000 MW)	PCP-A to	PCP-B	
	80			SC-A to	SC-B	
	81		Verify	PCP-B	Active	
	82			SC-B to	Active	
	83			Continuous Steady Operation		
	84			No False Action by Control Systems		
	85			No Transients, no unexpected time delay		
	86		Switch Control System (at Pole Power 2000 MW)	PCP-B to	PCP-A	
	87			SC-B to	SC-A	
	88		Verify	Continuous Steady Operation		
	89			PCP-A	Active	
	90			SC A	Active	
	91			No False Action by Control Systems		
	92			No Transients, no unexpected Time Delay		
Pole-II Run at 1.00 p.u. in Monopole without Redundant Cooling (AS-5.3.1)	93	Matiari/Lahore	Verify	DC Power	Pole2 power:2000MW	
	94			The reference is fulfilled after the ramping is completed		
	95			The measured currents and voltages at DC and AC side are correct.		
	96		Keep the pole in operation for 4 hours at 1.0 p.u. If any of the transformers has not reached steady state temperature, then continue for another 1/2 hour.			
	97		Verify	The measured currents and voltages at DC and AC side are correct.		
	98		Measure & Record	valve cooling water temperature inlet and outlet continuously until a stable temperature is reached (temperatures should be stable within approximately 15 minutes).		
	99			temperature of coil winding and hot spot in converter transformer every 30 minutes. until reasonable stable temperature is reached (temperatures should be stable within approximately 3 hours).		
	100			AC-side individual harmonics, Dn, THD, THFF, both stations external TFR 10000Hz sample rate		
	101					
	102			DC-side harmonics and Ieq in Matiari andLAHORE C/S from the power quality analyser.		
	103					
	104		Perform following measurements: 5.3.3 Radio Interference, 5.3.4 Audible Noise, 5.3.5 Station Service Power Loss, 5.3.6 Temperature Measurements with IR Camera,			
Pole-II Run at 1.10 p.u. in Monopole with Redundant Cooling (AS-5.3.2)	105	Matiari	Ramp Up Pole-II	2000MW	2200MW	50MW/Min
	106		set the bipole power reference 2400MW			
	107		Verify	DC Pole- II (Power)	2200MW	
	108			The reference is fulfilled after the ramping is completed		
	109			The measured currents and voltages at DC and AC side are correct.		
	110		Keep the pole in operation for 2 hours at 1.1 p.u. The following verifications should be carried during this period			
	111		Verify	the reference is fulfilled after the ramping is completed		
	112			the measured currents and voltages at DC and AC side are correct.		
	113		Measure & Record	valve cooling water temperature inlet and outlet continuously until a stable temperature is reached (temperatures should be stable within approximately 15 minutes).		
	114			temperature of coil winding and hot spot in converter transformer every 30 minutes. until reasonable stable temperature is reached (temperatures should be stable within approximately 3 hours).		
	115			AC-side individual harmonics, Dn, THD, THFF, both stations external TFR 10000Hz sample rate		
	116					
	117			DC-side harmonics and Ieq in Matiari andLAHORE C/S from the power quality analyser.		
	118					
	119	Matiari/Lahore	Perform following measurements: 5.3.3 Radio Interference, 5.3.4 Audible Noise, 5.3.5 Station Service Power Loss, 5.3.6 Temperature Measurements with IR Camera,			
	120	Matiari	Pole-II will automatically Ramp-down to 2000MW by overload timer after completion of 2 hours. Pole-I will automatically Ramp up to 400 MW			@ 200MW/Min

Pole-II Tap Changer Control, Manual Tap Changer Step (4.3.3)	121	Matiari/Lahore	Make sure that above tests are completed, Test to be perfomed after the Heat run tests.			
	122	Matiari	Set tap changer control In MANUAL CONTROL mode			
	123		Lower one steps for decreasing Udi0.			
	124		Verify	Firing Angle decreased		
	125			Transmitted Power is maintained		
	126			No Transients, no unexpected Time Delay		
	127		Set tap changer control in AUTO CONTROL mode			
	128		Verify	Tap increased automatically		
	129			Firing Angle Increased back to control limits		
	130			Transmitted Power is maintained		
	131			No Transients, no unexpected Time Delay		
	132	Lahore	Set tap changer control In MANUAL CONTROL mode			
	133		Lower one steps for decreasing Udi0.			
	134		Verify	Decreased DC Voltages		
	135			Maintained Gamma In Lahore		
	136			Transmitted Power is maintained with DC current increased		
	137			No Transients, no unexpected Time Delay		
	138	Matiari	Verify	Tap position decreased to maintain firing angle in control limits		
	139	Lahore	Set tap changer control In AUTO CONTROL mode			
	140		Verify	Tap increased automatically		
	141			Firing Angle back in control limits		
	142			DC Voltage back to normal		
	143			Transmitted Power is maintained		
	144			No Transients, no unexpected Time Delay		
	145	Matiari	Verify	Tap position increased to maintain firing angle in control limits		End of test 4.3.3
Pole-II Control System Switchover	146	Matiari /Lahore	Switch Control System in Pole-II (at Pole Power 2000 MW)	PCP-B to	PCP-A	
	147			SC-B to	SC-A	
	148		Verify	Continuous Steady Operation		
	149			PCP-A	Active	
	150			SC A	Active	
	151			No False Action by Control Systems		
	152			No Transients, no unexpected Time Delay		
Order manual Reduced voltage in Pole-II	153	Lahore	Initiate Sequence of Master Station			
	154		In Pole-II Set manually reduced Voltage mode 70%			
	155		Verify	DC voltage ramps down to 70% (462kV)		
	156					
	157			DC current stays 3030A		
	158			Pole-II Power is reduced to 1400 MW and the [illegible] power is being shared by the Pole-1.		After reaching 660kV Order order Pole-II power to ramp up to 2000MW.(because the DC system Power order is reset and cannot go back to 2000MW automatically after reduced action)
	159			No transients		
	160		Operate in Reduced voltage mode for 15 min			
	161		Order Normal Voltages (660kV)			
	162		Verify	DC Voltage is ramping up to Normal Voltage (660kV)		
	163			DC current reduces to 2121A during the ramp. Pole-II power remains constant at 1400MW		
	164		~~Verify~~ Verify	Pole-II DC power ramps back up to 2000 MW and Pole-I power back to 400 MW		
	165			No transients		
Filter Replacement Test	166	Matiari	Initiate Sequence of Master Station			
	167		Rampdown Pole-I	400 MW	200 MW	50MW/Min
	168		Order RPC from Automatic to Manual			and order Pole-I bipole power control value from 2400MW to 2200MW, Step 167 will happen automatically.
	169		Switch off connected sub-bank BP-11/13			
	170		Verify that another BP-11/13 did not got connected within 1 second			
	171		Order RPC from Automatic to Auto			
	172		Verify that another BP-11/13 got connected			
	173	Lahore	Order RPC from Automatic to Manual			
	174		Switch off connected sub-bank HP-24/36			
	175		Verify that another HP-24/36 did not get connected within 1 second			
	176		Order RPC from Manual to Automatic			
	177		Verify that another HP-12/24 got connected			



no need

Pole-II Pole Ramp Down & Control System Switchover during ramping	178	Matiari	~~Set bipole order to 2000MW~~			
	179		Stop Pole-I ~~Pole-II goes to 2000MW~~			Pole-II stays at 2000MW
	180		Ramp Down Pole-II	2000MW	1600 MW	50MW/Min
	181		Ramp Down Pole-II	1600MW	1400 MW	50MW/Min
	182	Matiari and Lahore	Switch Control System (during ramping) Note: Pole- Is not in operation anymore	PCP-A to	PCP-B	
	183			SC-A to	SC-B	
	184		Verify	PCP-B	Active	
	185			SC-B to	Active	
	186			Continuous Steady Operation		
	187			No False Action by Control Systems		
	188			No Transients, no unexpected time delay		
	189	Matiari	Ramp Down POLE-II	1400MW	800 MW	50MW/Min
	190	Matiari/Lahore	Verify	Continuous Steady Operation		
	191			Ramping Done and Holding the target Value		
	192			No Transients, no unexpected Time Delay		
	193	Matiari	Ramp Down	800MW	600MW	999MW/Min
	194	Matiari/Lahore	Verify	Continuous Steady Operation		
	195			Ramping Done and Holding the target Value		
	196			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping	
	197			No Transients, no unexpected Time Delay		Finish Pole-II Ramp_down
	198	Matiari	Ramp Down	600MW	200MW	50 MW/Min
	199	Matiari/Lahore	Verify	Continuous Steady Operation		
	200			Ramping Done and Holding the target Value		
	201			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping	
	202			No Transients, no unexpected Time Delay		
ESOF in Pole-II with transfer of Power to Pole-I	203	Matiari	Select both poles to Bipole Power control			
	204		Set Bipole Power Order to 400MW Start Pole-1			
	205		After Pole 1 starts Both Poles at 200MW			
	206		Ramp Ramp Up Bipole to 2200MW	400MW	2200 MW	200MW/Min
	207	Matiari/ Lahore	Verify	Continuous Steady Operation		
	208			Verify stable operation & Normal start at minimum		
	209			Perform normal inspections (visual and acoustical) while		
	210	Matiari	Make margin of 1100 MW on parallel AC corridor			
	211	Matiari	Push ESOF button in Pole-II to trip Pole-II.			
	212	Matiari/Lahore	Verify	DC power of Pole-II transferred to Pole-I		
	213			Pole-I steady state operation at 2200MW		
Current & Power Step Test at Nominal Rated Power in Pole-I	221	Matiari	Change Pole-I from Bipole power control to pole power control			
	222		Ramp Down Pole-I	2200MW	2000 MW	200MW/Min
	223		Instruct Test Commander to apply a +0.08 P.U Step in Power Order with duration of 1000 msec in active PCP system.			High Power Step response tests must be done in Pole-I since Pole-II does not yet have overload available. Should be done with other pole off.
	224		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value			XX value to be determined verified later with DPS studies
	225		Instruct Test Commander to apply a -0.08 P.U Step in Power Order with duration of 1000 msec in active PCP system.			
	226		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value			XX value to be determined verified later with DPS studies
	227		Change all the modified settings back to original value			
	228		Change pole1 control mode from pole power control to pole current control			
	229		Instruct Test Commander to apply a +0.08 P.U Step in Current Order with duration of 1000 msec in active PCP system.			
	230		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value			XX value to be determined verified later with DPS studies
	231		Instruct Test Commander to apply a -0.08 P.U Step in Current Order with duration of 1000 msec in active PCP system.			
	232		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value			XX value to be determined verified later with DPS studies
	233		Change all the modified settings back to original value			
	234		Record and save all test dat			

Order Reduced voltage In Pole-II from dc line protection on first Restart	246	Matiari	Change pole I to pole power control mode			
	247		Restart pole II with pole power control mode at 200MW			
	248	Matiari/ Lahore	verify	Pole-I (Pole Power)	2000 MW	
	249			Pole-II (Pole Power)	200 MW	
	250			Continuous Steady Operation		
	251			Verify stable operation & Normal start at minimum		
	252			Perform normal inspections (visual and acoustical) while		
	253	Matiari/Lahore	The test would lead to low AC voltage for around 10s, before action NPCC has to adjust AC voltage higher than normal according to system analysis result and confirm that AC system can withstand such a low voltage.			
	254		Make safe margion of 700 MW in parallel AC Corridor			
	255		Perform a simulated DC line fault in Pole-I with restart to 70% voltage on first restart attempt			
	256		Verify	Sharp reduction in DC voltage to 70% (462kV) with current increase to about 3030A at Pole I. Allow tap changers to move until maximum tap.		
	257			DC power sharp change from 2000MW to 1400MW at pole I,and firing angle reduces as the tap increases. No power change at Pole II. The AC Corridor power will increase by 700 MW		
	258		Instruct Test Commander to change the modified settings back to default.			Then order pole-I power from 1400MW ramp up to 2000MW.(because DC system can not automatically go back to 2000MW after the reduced voltage resets)
	264		Order Normal Voltage			
	265		Verify	Smooth slow voltage ramp to 660kV No change in dc power during the ramp(pole I keep 2000MW,pole II keep 200MW) . Current drops as the voltage increases.		
Loss of Pole at Y MW with no transfer to other pole Test AS- 5.3.7	266	Matiari	Keep Pole-II to minumum power (200MW) in Pole Power control. Verify that RPC is in automatic at both stations in Q control.			
	267		verify	Pole-I (Pole Power)	Y MW	Y could be 2000 MW or 1400 MW depending on the studies and clearance by protection and control.
	268			Pole-II (Pole Power)	200 MW	
	269			Continuous Steady Operation		
	270			Verify stable operation & Normal start at minimum		
	271			Perform normal inspections (visual and acoustical) while		
	272		Adjust North and South generation to get AC corridor power to Z MW from south to north.NTDC should be sure of AC system protection no malfunction. Final DC POWER Should be decided according to the study result.			Z could be 500 MW or 700 MW depending on the studies and clearance by protection and control.
	273		Push ESOF button in Pole-I to trip Pole-I.			
	274		Verify	DC power of Pole-I is not transferred to Pole-II. AC corridor flow increases to about P MW.		where P= Y+Z
	275			Pole-II steady state operation at 200MW. Filters are not tripped automtically but rather by RPC in response to Q control.		
	276		Record the overvoltages and filter tripping times at both stations. Record and save all data.			
	277		Stop the Pole-II	Power	0 MW	Refer To Pole Blocking and stop sequence
	278			Ramp Rate:	100MW/Min	
			Perform Following Tests In parallel with AS-5.3.1 & 5.3.2			
Pole-I Radio Interference Measurements (AS-5.3.3)	279	Matiari \Lahore	Measure / Record /Save	Choose 1 or 2 test places inside the converter stations and about 450m away outside the converter station and carry out the measurement of the interference frequency spectrum.		
	280			the frequency spectrum characteristics of radio interference under the outlet line of the ±660 kV valve hall and at 20 m from the outlet line inside the converter station		
	281			places inside the converter stations and about 450m away outside the converter station and carry out the measurement of the interference frequency spectrum		
Pole-I Audible Noise Check (AS 5.3.4)	282	Matiari \Lahore	Measure / Record /Save	Audible noise near the convertor transformer in the converter station		
	283			Audible noise along the boundary line outside the converter station		
	284			Measurement of Audible noise in front of the houses near the converter station, if there are houses.		

Pole-I Station Auxiliary Power Losses (AS-5.3.5)	285	Matiari / Lahore	Record	In status R eady for Operation , the loads on the 400V power level are measur ed wit h in on e scheduled time pe rio d (for example 5 times measurements in one hour with recording sheets . The measurement results are averaged to get values, which are equivalent losses to the no–load or fixed Auxiliary Power losses.
	286		Verify	Measured loss values should be within limited value specified by technical specification
	287		Record	When Operating at 1.0pu or 1.1pu - Measure loads on 400V power level 5 times in one hour, calculate average of measured values
	288		Verify	Measured loss values should be within limited value specified by technical specification
Pole-I Temperature Measurement With IR-Camera	289	Matiari / Lahore	Record/Verify	The temperature of busbars, clamps conductors, equipment, etc. are acceptable in DC-yard, AC-yard, and valve hall
Test Acceptance Criteria	290	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	291		All Operations executed successfully	
	292		Stability Control System and Oscillation splitting devices did not operate during the testing and the system remain stable.	
	293		The synchronizing voltage and the phasing of the firing control signals are correct.	
	294		All thyristor check-back signals are available.	
	295		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	296		Measuring quantities are available and the values are within the specified range and phase.	
	297		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	298		No Stuck Condition	
	299		All the sequence as recorded in OWS should be documented, All the Charts related to pole power, current, voltages, firing angles and extinction angles, tap positions. Should be recorded and documented. TFR data in Comtrade format to be captured and recorded.	
	300		No False Tripping by DC Protection System	
	301		No Tripping In AC side of converter Station	
	302		No issues with PLC Interference for AC side protection PLC	

Monopole High Power System Tests

Pole I High Power Tests Reverse Power Direction (Optional)

Test Objective	The test objective is to check DC equipment performance during high power test in reverse direction.

Condition	Sr. No.	Station	Action	Equipment/ Configuration	State of Equipment/configuration	Description
Pre-Test Conditions & Configurations (AC/DC)	1	AC side at Matiari & Lahore C/S	Voltage Limits	Utmost efforts will be made to maintain the voltages within ±5% range. However, reactive compensation devices installed at both converter stations can be used, if needed, to control the voltages keeping in view the then prevailing system conditions.		
	2		AC Yard of Lahore & Matiari Converter Station is in normal Position		CLOSED State	All bays including Filter Banks are complete and energized with no component in maintenance state.
	3	DC Side at Lahore C/S	See Status Table "P1-GR"			Ground Return Mode
	4		See Status Table "Mat-P2-Maint" for Matiari and "Lah-P2-Maint" for Lahore.			Maintenance Mode
	5	General PreConditions	Low Power Reverse Tests has been finished successfully			
	6		Before start of Heat Run Test, samples for DGA (Dissolved Gas Analysis) shall be taken from all converter transformers of the Pole at both stations.			
	7		Both sides AC system of Matiari & Lahore C/S are capable to accept and supply the power (1000 MW) for the test. Availability of N-1 contingency on parallel AC corridor. AC system short circuit level has been measured at both Matiari and Lahore converter stations and it is confirmed to be suitable for the tested power.			
	8	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Reverse		Lahore to Matiari
	9		Return	Ground		Ground Return Mode
	10		Udc Mode	Normal		±660kV
	11		Telecom Mode	Operational		
	12		Master Station	Lahore		Can be changed to Matiari Station
	13	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	14			B	Standby	
	15		Pole Control Protection (PCP)	A	ACTIVE	
	16			B	Standby	
	17		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	18		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	19		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	20		Reactive Power Control Variable	Q-Control	ACTIVE	Reactive Power exchange between AC Yard of Converter Station and NTDC system will be automatically controlled.

Testing Start Up Sequence

	21	Matiari/Lahore C/S DC	Verify Ready for Operation Conditions.			
Pole-I Pole Start (AS-6.3.1)	22	Matiari & Lahore	Start the Pole-I in Reversed Power Direction	Power	200 MW	Refer To Pole De-Blocking and starting sequence
	23			Ramp Rate:	100 MW/Min	
	24		Wait to achieve Target Value	Max Time	2 min	
	25	Lahore	Verify Performance Indicators	Firing angle (α)	15°±2.5°	
	26			DC Voltages	660kV	
	27			RPC Operation	1xHP12/24	
	28	Matiari		Extinction Angle (g)	17°	
	29			DC Voltages	Range to be mentioned	
	30			RPC Operation	BP-11/13, HP-24/36	
	31	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	32		Perform normal inspections (visual and acoustical) while pole is			
	33	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	34	Lahore		HP12/24		
	35	Matiari/ Lahore	Verify	Continuous Steady Operation		
	36			Ramping Done and Holding the target Value		
	37			No Transients, no unexpected Time Delay		
	38	Matiari	Start the Pole-2	Power	200 MW	
	39			Ramp Rate:	100 MW/Min	
	40		Wait to achieve Target Value	Max Time	2 min	
	41	Matiari/Lahore	Verify pole2 stable operation & Normal start at minimum power			
	42		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	43	Matiari/Lahore	Change pole 2 from pole power control to bipole power control and set the bipole power reference 2200MW			
	44	Lahore	Ramp Up Pole-I	200MW	400MW	50 MW/Min
Pole-I Pole Ramp Up (AS-6.3.2)	45	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	46		Verify	Continuous Steady Operation, Correct RPC action		
	47			Continuous Steady Operation		
	48			power reaches the reference value after ramping is completed		
	49			No Transients		
	50	Matiari	Ramp Up Pole-I	400MW	600MW	50 MW/Min
	51	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	52	Matiari/Lahore	Verify	Continuous Steady Operation, Correct RPC action		
	53			Ramping Done and Holding the target Value		
	54			No Transients, no unexpected Time Delay		
	55	Matiari	Ramp Up Pole-I	600MW	800MW	999 MW/Min
	56	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	57	Matiari/Lahore	Verify	Continuous Steady Operation, Correct RPC action		
	58			Ramping Done and Holding the target Value		
	59			No Transients, no unexpected Time Delay		
	60	Matiari	Ramp Up Pole-I	800MW	1000MW	50MW/Min
	61	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	62	Matiari/Lahore	Verify	Continuous Steady Operation, Correct RPC action		
	63			Ramping Done and Holding the target Value		
	64			No Transients, no unexpected Time Delay		

Pole-I Pole Ramp Down (AS-6.3.2)	65	Lahore	Ramp Down Pole-II	1000MW	800MW	50MW/Min
	66	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	67		Verify	Continuous Steady Operation, Correct RPC action		
	68			Ramping Done and Holding the target Value		
	69			No Transients, no unexpected Time Delay		
	70	Lahore	Ramp Down Pole-II	800MW	600MW	50MW/Min
	71	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	72		Verify	Continuous Steady Operation, Correct RPC action		
	73			Ramping Done and Holding the target Value		
	74			No Transients, no unexpected Time Delay		
	75	Lahore	Ramp Down Pole-II	600MW	400MW	50MW/Min
	76	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	77		Verify	Continuous Steady Operation, Correct RPC action		
	78			Ramping Done and Holding the target Value		
	79			No Transients, no unexpected Time Delay		
	80	Lahore	Ramp Down Pole-II	400MW	200MW	999MW/Min
	81	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	82	Matiari/Lahore	Verify	Continuous Steady Operation		
	83			Ramping Done and Holding the target Value		
	84			Correct RPC Operation		
	85			No Transients, no unexpected Time Delay		
	86	Lahore	Stop the Pole-I, II	Power	0 MW	Refer To Pole Blocking and stop sequence
	87			Ramp Rate:	100MW/Min	
Test Acceptance Criteria	88	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	89		All Operations executed successfully			
	90		Stability Control System and Oscillation splitting devices did not operate during the testing and the system remain stable.			
	91		The synchronizing voltage and the phasing of the firing control signals are correct.			
	92		All thyristor check-back signals are available.			
	93		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	94		Measuring quantities are available and the values are within the specified range and phase.			
	95		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	96		No Stuck Condition			
	97		All the sequence as recorded in OWS should be documented, All the Charts related to pole power, current, voltages, firing angles and extinction angles, tap positions. Should be recorded and documented. TFR data in Comtrade format to be captured and recorded.			
	98		No False Tripping by DC Protection System			
	99		No Tripping in AC side of converter Station			

Monopole High Power System Tests

Pole II High Power Tests Reverse Power Direction

Test Objective	The test objective is to check DC equipment performance during high power test in reverse direction.					
Condition	**Sr. No.**	**Station**	**Action**	**Equipment/ Configuration**	**State of Equipment/configuration**	**Description**
Pre-Test Conditions & Configurations (AC/DC)	1	AC side at Matiari & Lahore C/S	Voltage Limits	Utmost efforts will be made to maintain the voltages within ±5% range. However, reactive compensation devices installed at both converter stations can be used, if needed, to control the voltages keeping in view the then prevailing system conditions.		
	2		AC Yard of Lahore & Matiari Converter Station is in normal Position		CLOSED State	All bays including Filter Banks are complete and energized with no component in maintenance state.
	3	DC Side at Lahore C/S	See Status Table "P2-GR"			Ground Return Mode
	4		See Status Table "Mat-P1-Maint" for Matiari and "Lah-P1-Maint" for Lahore.			Maintenance Mode
	5	General PreConditions	Low Power Reverse Tests has been finished.			
	6		Before start of Heat Run Test, samples for DGA (Dissolved Gas Analysis) shall be taken from all converter transformers of the Pole at both stations.			
	7		Both sides AC system of Matiari & Lahore C/S are capable to accept and supply the power (1000 MW) for the test. Availability of N-1 contingency on parallel AC corridor. AC system short circuit level has been measured at both Matiari and Lahore converter stations and it is confirmed to be suitable for the tested power.			
	8	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Reverse		Lahore to Matiari
	9		Return	Ground		Ground Return Mode
	10		Udc Mode	Normal		±660kV
	11		Telecom Mode	Operational		
	12		Master Station	Lahore		Can be changed to Matiari Station
	13	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	14			B	Standby	
	15		Pole Control Protection (PCP)	A	ACTIVE	
	16			B	Standby	
	17		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	18		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	19		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	20		Reactive Power Control Variable	Q-Control	ACTIVE	Reactive Power exchange between AC Yard of Converter Station and NTDC system will be automatically controlled.

Testing Start Up Sequence

Pole-II Pole Start (AS-6.3.1)	21	Matiari/Lahore C/S DC	Verify Ready for Operation Conditions.			
	22	Matiari & Lahore	Start the Pole-II	Power	200 MW	Refer To Pole De-Blocking and starting sequence
	23			Ramp Rate:	100 MW/Min	
	24		Wait to achieve Target Value	Max Time	2 min	
	25	Lahore	Verify Performance Indicators	Firing angle (α)	15°±2.5°	
	26			DC Voltages	660kV	
	27			RPC Operation	1xHP12/24	
	28	Matiari		Extinction Angle (γ)	17°	
	29			DC Voltages	Range to be mentioned	
	30			RPC Operation	BP-11/13, HP-24/36	
	31	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	32		Perform normal inspections (visual and acoustical) while pole is			
	33	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	34	Lahore		HP12/24		
	35	Matiari/ Lahore	Verify	Continuous Steady Operation		
	36			Ramping Done and Holding the target Value		
	37			No Transients, no unexpected Time Delay		
Pole-II Pole Ramp Up & Control System Switchover (AS-6.3.2 steps 1 to 3)	38	Lahore	Ramp Up	200MW	400MW	50 MW/Min
	39	Matiari/Lahore	Verify	Continuous Steady Operation of the transmission		
	40			PCP-A is active		
	41			PCP-A to	PCP-B	
	42			Continuous Steady Operation		
	43			power reaches the reference value after ramping is completed		
	44			No Transients		
	45	Matiari	Ramp Up	400MW	600MW	50 MW/Min
	46	Matiari	Verify (during Ramping)	SC-A	ACTIVE	
	47		Switch Control System (during Ramping)	SC-A to	SC-B	
	48	Matiari/Lahore	Verify	Continuous Steady Operation		
	49			SC B	Active	
	50			Ramping Done and Holding the target Value		
	51			No Transients, no unexpected Time Delay		
	52	Matiari	Ramp Up	600MW	800MW	999 MW/Min
	53	Matiari/Lahore	Verify	Continuous Steady Operation		
	54			Ramping Done and Holding the target Value		
	55			No Transients, no unexpected Time Delay		
	56	Matiari	Ramp Up	800MW	1000MW	50MW/Min
	57		Switch Control System (during Ramping)	PCP-B to	PCP-A	
	58			SC-B to	SC-A	
	59	Matiari/Lahore	Verify	Continuous Steady Operation		
	60			PCP-A	Active	
	61			SC A	Active	
	62			Ramping Done and Holding the target Value		
	63			No Transients, no unexpected Time Delay		
	64		Verify	Continuous Steady Operation		
	65			Ramping Done and Holding the target Value		
	66			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping	
	67			No Transients, no unexpected Time Delay		
	68	Matiari	Switch Control System (at Pole Power 1000 MW)	PCP-A to	PCP-B	
	69			SC-A to	SC-B	
	70	Matiari/Lahore	Verify	Continuous Steady Operation		
	71			Holding the target Value		
	72			No False Action by Control Systems		
	73			No Transients		
	74	Matiari	Switch Control System (during Ramping)	PCP-B to	PCP-A	
	75			SC-B to	SC-A	
	76	Matiari/Lahore	Verify	Continuous Steady Operation		
	77			PCP-A	Active	
	78			SC A	Active	
	79			Ramping Done and Holding the target Value		
	80			No Transients, no unexpected Time Delay		

Pole-II Pole Ramp Down & Control System Switchover (AS-6.3.2 steps 3 to 6)	S1	Lahore	Ramp Down	1000MW	800MW	50MW/Min
	S2	Matiari/Lahore	Verify (during Ramping)	PCP-A	ACTIVE	
	S3		Switch Control System (during Ramping)	PCP-A to	PCP-B	
	S4		Verify	Continuous Steady Operation		
	S5			PCP-B	Active	
	S6			Ramping Done and Holding the target Value		
	S7			No Transients, no unexpected Time Delay		
	S8	Lahore	Ramp Down	800MW	600MW	50MW/Min
	S9	Matiari/Lahore	Verify (during Ramping)	SC-A	ACTIVE	
	90		Switch Control System (during Ramping)	SC-A to	SC-B	
	91		Verify	Continuous Steady Operation		
	92			SC B	Active	
	93			Ramping Done and Holding the target Value		
	94			No Transients, no unexpected Time Delay		
	95	Lahore	Ramp Down	600MW	400MW	50MW/Min
	96	Matiari/Lahore	Switch Control System (during Ramping)	PCP-B to	PCP-A	
	97			SC-B to	SC-A	
	98		Verify	Continuous Steady Operation		
	99			PCP-A	Active	
	100			SC A	Active	
	101			Ramping Done and Holding the target Value		
	102			No Transients, no unexpected Time Delay		
	103	Lahore	Ramp Down	400MW	200MW	999MW/Min
	104	Matiari/Lahore	Verify	Continuous Steady Operation		
	105			Ramping Done and Holding the target Value		
	106			Correct RPC Operation		
	107			No Transients, no unexpected Time Delay		
	108	Lahore	Stop the Pole-II	Power	0 MW	Refer To Pole Blocking and stop sequence
	109			Ramp Rate:	100MW/Min	
Test Acceptance Criteria	110	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	111		All Operations executed successfully			
	112		Stability Control System and Oscillation splitting devices did not operate during the testing and the system remain stable.			
	113		The synchronizing voltage and the phasing of the firing control signals are correct.			
	114		All thyristor check-back signals are available.			
	115		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	116		Measuring quantities are available and the values are within the specified range and phase.			
	117		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	118		No Stuck Condition			
	119		All the sequence as recorded in OWS should be documented, All the Charts related to pole power, current, voltages, firing angles and extinction angles, tap positions. Should be recorded and documented. TFR data in Comtrade format to be captured and recorded.			
	120		No False Tripping by DC Protection System			
	121		No Tripping in AC side of converter Station			