National Transmission & Despatch Company Limited

(National Power Control Center)

DC MONOPOLE LOW POWER COMMISSIONING DESPATCH PROCEDURE OF MATIARI & LAHORE CONVERTER STATION

15022021-NPCC-DCDP V 1.7

February, 2021

DC MONOPOLE LOW POWER COMISSIOINING DESPATCH PROCEDURE OF MATIARI & LAHORE CONVERTER STATIONS

±660kV HVDC MATIARI-LAHORE, PROJECT, PAKISTAN (V 1.7)

Document Number :	15022021-NPCC-DCDP V 1.7	
Reference Document Number : PMLTC/CET	Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests-Monopole Low Power System Tests Program V4.0-updated 29-01-2020	
Issue Date :	15-12-2020	
Prepared by:		**NPCC**
Review by NTDC Working Group:		
Review by M/S HATCH:		
Review by PMLTC:		
Review by M/S CESI:		
Approved by Commissioning Committee:		
Engr. Muhammad Ayub General Manager System Operation NPCC	Dr. Chang Yong Chief Engineer (PMLTC)	Mr. Aldo Danielli Independent Engineer M/S CESI
Sign:	Sign:	Sign:
Disseminated for information and implementation to all concerned.		

Table of Contents

References

[1] Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests-Monopole Low Power System Tests Program V4.0-updated 29-01-2020

[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. Scope of this dispatch procedure includes first-time energization/testing/the commissioning of DC system in the HVDC switchyard at ±660kV Matiari and Lahore Converter station.

1.3. 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.

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

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

1.6. 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.

1.7. 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).

1.8. CET/PMLTC shall attach this dispatch procedure (15022020-NPCC-DCDP V 1.7), including its all annexures with commissioning test program.

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

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

1.11. The test schedule (time and date) of each test item of the DC station system/switchyard of the Lahore

and Matiari Converter stations shall be approved by General Manager (System Operations, NPCC) with mutual understanding of PMLTC/CE HVDC NTDC one day before commencement of the test.

1.12. It shall be the discretion of NPCC to carry out all operations/switching through remote control whether through passing telephonic instructions to control room operators at concerned substations or by NPCC system operator himself through SCADA/OWS in presence of Chinese expert at NPCC.

1.13. 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.

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

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

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

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

1.18. 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.

1.19. 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 N**PCC** 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 to ensure power system stability and reliability during DC commissioning.

2.11 DC commissioning tests A1 and A2 for Matiari 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 and A2 for Matiari 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 all concerned NTDC formations (Asset management, Protection & Control, Project Delivery, TSG, Design department) and Owner Engineer (M/S HATCH).

3 Energization and Clearance Certificate for Equipment Status

3.1 Provision of Clearance Certificate by PMLTC/CE HVDC NTDC to NPCC

Prior to energization of DC switch yard or any of its component and pre- energization commissioning test(s); PMLTC through CE HVDC, NTDC, shall submit an energization message/clearance certificate (Bipole DC Transmission Line and the relevant component of DC system at Lahore and Matiari Converter stations) along with certificate of Readiness / Synchronization, by the consultant to Director Power Control, NPCC by verifying the following:

i. The construction of primary, secondary and auxiliary infrastructure of all equipment involved in the start-up and commissioning of DC Yard at both Matiari and Lahore converter stations have been completed.

ii. The construction personnel have been evacuated from the site, and the infrastructure construction grounding wires have been removed.

iii. All required main protection and backup protection have been put into operation, automation, communication, defense lines and remedial actions system etc has been implemented and functioning properly.

iv. The pre-energization tests including sub system on site tests of the circuit/equipment to be energized have been performed by the concerned formations and results found satisfactory.

v. The measuring and debugging equipment required for the system commissioning of DC System substation is ready. The relevant equipment on the measuring point has been connected, and the safety measures have been taken.

vi. Therefore, NPCC is requested to initiate switching/ operations for energization of ±660kV HVDC Matiari - Lahore system as per approved commissioning program.

vii. NPCC shall ensure that the AC system is normal and shall allow CET to commence the commissioning test.

viii. Director Power Control, NPCC shall acknowledge the clearance certificate of the energization.

4 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:

4.1 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.

4.2 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.

4.3 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.

5 Commissioning Procedure:

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

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

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

5.3 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.

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

6 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:

6.1 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.

6.2 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.

6.3 During the commissioning, if any equipment under test depicts abnormal behavior, the commissioning director is responsible for managing the disturbance. Furthermore, written fault analysis report shall be submitted officially after the test.

6.4 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.

6.5 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.

7 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:

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

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

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

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

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

*Cold Standby: All switch gears (Breakers, isolators, earth switches) are in open/off state

8 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:

8.1 Initial Operation Tests, Joint Current Control, Normal Power Direction, Ground Return

Follow the sequence described in "Annexure-C-I" and "Test Plan (A3).

8.2 Initial Operation Tests, Joint Current Control, Normal Power Direction, Metallic return

Follow the sequence described in "Annexure-C-II" and "Test Plan (A3).

8.3 Protective Trip X, Y, and Z, Joint Current Control, Normal Power Direction, Ground return

Follow the sequence described in "Annexure-C-III" and "Test Plan (A3).

8.4 System Supervision & Switchover, Joint Current Control, Normal Power Direction, Ground Return

Follow the sequence described in "Annexure-C-IV" and "Test Plan (A3).

8.5 Steady State Operation, Joint Current Control, Normal Power Direction, Ground return

Follow the sequence described in "Annexure-C-V" and "Test Plan (A3).

8.6 Steady State Operation, Joint Power Control, Normal Power Direction, Ground return

Follow the sequence described in "Annexure-C-VI" and "Test Plan (A3).

8.7 Normal Operation, Separate Current Control without Telecom, Ground return

Follow the sequence described in "Annexure-C-VII" and "Test Plan (A3).

8.8 Normal/Reduced Voltage Operation, Joint Power Control, Ground return

Follow the sequence described in "Annexure-C-VIII" and "Test Plan (A3).

8.9 Reactive Power Control, Joint Power Control, Ground return

Follow the sequence described in "Annexure-C-IX" and "Test Plan (A3).

8.10 Ground/Metallic Return Transfer, Joint Power Control, Ground return

Follow the sequence described in “Annexure-C-X” and “Test Plan (A3).

8.11 Backup Control, Joint Power Control, Ground return

Follow the sequence described in “Annexure-C-XI” and “Test Plan (A3).

8.12 Initial Operation Tests, Ground Return Operation, Reversed Power Direction, Joint Power Control

Follow the sequence described in “Annexure-C-XII” and “Test Plan (A3).

8.13 Initial Operation Tests, Ground Return Operation, Reversed Power Direction, Joint Power Control, Ground return

Follow the sequence described in “Annexure-C-XIII” and “Test Plan (A3).

8.14 Disturbances, Joint Power Control, Ground return

Follow the sequence described in “Annexure-C-XIV” and “Test Plan (A3).

8.15 Control Pulse Loss Failure, Reversed Power Direction, Joint Power Control

Follow the sequence described in “Annexure-C-XV” and “Test Plan (A3).

Monopolar Low Power Tests Dispatch Matrices	
A	All these tests will be performed in Monopolar Mode.
B	Sequence as mentioned in sequence table shall be followed
C	Test Block LP1 & LP2 must be carried out first to verify that control systems of both poles are fully functional. No any other test should be conducted if LP1 & LP2 were unsuccessfull.
D	General conditions and System configurations must be selected as indicated before performing each test.
E	There are four voltage 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	Furthermore, prior to the commissioning test each day, the following tests shall be performed without energization at both stations:
	（1） Inter-station telecommunication check of control and protection signals
	（2） Dry run connect/isolate pole
	（3） Repeat as above with system change over during sequence
	（4） Dry run metallic/ground return transfer
	（5） Repeat as above with system change over during sequence
	（6） Emergency stop, dry run.

Matiari—Lahore ±660kV HVDC Project
Execution Sequence for Monopolar (Pole 1, Pole 2) Low Power Commissioning Tests

The test execution sequence will be as mentioned below.

Sr. No.	Test Block	Commissioning Items	Mode	Item Designations	Sub-item Designation	Power imported from AC Network (MW)
DC Monopolar Point to Point Tests-Low Power						
DC Station Tests must be successful before starting these tests						
All tests in Test Block-LP1, LP2 should be executed in sequence as mentioned below. If any test fails in one block, next test item in the same block should not be executed however, next test block (Test Block-LP1,LP2) can be executed in the listed sequence.						
Pole1 Low Power System Test, Normal Power Direction						
		Ground return mode				
1	Test Block-LP1	2.3.1	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Start /Stop Pole, Manual Block	200
2		2.3.2	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Test of Emergency Stop	200
3		2.3.3	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Control System Switchover	200
4		2.3.4	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Pole Control, Analogue Input Check	200
5		2.3.5	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	DC Side Protections, Analogue Input Check	200
6		2.3.6	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	AC Side Protections, Analogue Input Check	200
		Metallic return mode				
7		2.4.1	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Start /Stop Pole, Manual Block	200
8		2.4.2	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Test of Emergency Stop	200
9		2.4.3	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Control System Switchover	200
10		2.4.4	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Pole Control, Analogue Input Check	200
11		2.4.5	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	DC Side Protections, Analogue Input Check	200

Pole2 Low Power System Test, Normal Power Direction						
		Ground return mode				
12	Test Block-LP2	2.3.1	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Start /Stop Pole, Manual Block	200
13		2.3.2	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Test of Emergency Stop	200
14		2.3.3	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Control System Switchover	200
15		2.3.4	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Pole Control, Analogue Input Check	200
16		2.3.5	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	DC Side Protections, Analogue Input Check	200
17		2.3.6	GR	Initial Operation Tests, Joint Current Control, Normal Power Direction	AC Side Protections, Analogue Input Check	200
		Metallic return mode				
18		2.4.1	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Start /Stop Pole, Manual Block	200
19		2.4.2	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Test of Emergency Stop	200
20		2.4.3	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Control System Switchover	200
21		2.4.4	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	Pole Control, Analogue Input Check	200
22		2.4.5	MR	Initial Operation Tests, Joint Current Control, Normal Power Direction	DC Side Protections, Analogue Input Check	200

DC Monopolar Low Power Protective Trip Testing						
DC Tests from Sr. No. 01-22 must be successful before starting these tests						
All tests in Test Block-LP3, LP4 may/may not be executed in sequence as mentioned below. If any test fails in one block, next test item in the same block can be executed however next test block (Test Block-LP4) cannot be executed until sucessful execution of Test Block 3.						
Pole1 Low Power System Test						
23	Test Block-LP3	3.3.1	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip X in Rectifier with Telecommunication	200
24		3.3.2	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip Y in Rectifier with Telecommunication	200
25		3.3.3	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip Z in Rectifier with Telecommunication	200
26		3.3.4	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip X in Inverter with Telecommunication	200
27		3.3.5	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip Y in Inverter with Telecommunication	200
28		3.3.6	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip Z in Inverter with Telecommunication	200
29		3.3.7	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip Y in Rectifier without Telecommunication	200
30		3.3.8	GR	Protective Trip X, Y, and Z, Normal Power Direction	Protective Trip Y in Inverter without Telecommunication	200
31		3.3.9	GR	Protective Trip X, Y, and Z, Normal Power Direction	VBE Fault Protection Trip – Rectifier	200
32		3.3.10	GR	Protective Trip X, Y, and Z, Normal Power Direction	VBE Fault Protection Trip – Inverter	200
33		4.3.1	GR	System Supervision and Switchover	Active System Power Failure	200
34		4.3.2	GR	System Supervision and Switchover	Profibus bus Failure	200
35		4.3.3	GR	System Supervision and Switchover	LAN Bus Failure	200
36	Test Block-LP4	5.3.1	GR	Steady State Operation, Joint Current Control, Normal Power Direction	Current Ramping and Hold on	530
37		5.3.2	GR	Steady State Operation, Joint Current Control, Normal Power Direction	System Switchover and Telecommunication Failure During Current Ramping	330
38		5.3.3	GR	Steady State Operation, Joint Current Control, Normal Power Direction	Tap Changer Control, Manual Tap Changer Stepping	200
39		5.3.4	GR	Steady State Operation, Joint Current Control, Normal Power Direction	Current Step Test	330
40		5.3.5	GR	Steady State Operation, Joint Current Control, Normal Power Direction	Voltage Step Test	330
41		5.3.6	GR	Steady State Operation, Joint Current Control, Normal Power Direction	Angle γ Step Test	330
42		5.3.7	GR	Steady State Operation, Joint Current Control, Normal Power Direction	Control Mode Shift, Current Margin Compensation	330
43		6.3.1	GR	Steady State Operation, Joint Power Control, Normal Power Direction	Start/Stop Pole	200
44		6.3.2	GR	Steady State Operation, Joint Power Control, Normal Power Direction	System Switchover and Telecommunication Failure During Power Ramping	500
45		6.3.3	GR	Steady State Operation, Joint Power Control, Normal Power Direction	Power Step Test	400
46		6.3.4	GR	Steady State Operation, Joint Power Control, Normal Power Direction	Control Mode Shift, Current Margin Compensation	400

Monopolar Low Power Operational Tests						
DC Tests from Sr. No. 23-46 must be successful before starting these tests						
All tests in Test Block-LP5, LP6, LP7, LP8 should be executed in sequence as listed below. If any test fails in one block, next test item in the same block should not be executed however, next test block (Test Block-LP5,LP6,L LP7,LP8) can be executed in the listed sequence.						
47	**Test Block-LP5**	7.3.1	GR	Normal Operation, Separate Current Control without Telecommunication	Start/Stop Pole	200
48		7.3.2	GR	Normal Operation, Separate Current Control without Telecommunication	System Switchover During Current Ramp	330
49		8.3.1	GR	Normal/Reduced Voltage, Normal Power Direction	Manual/Protection Triggering Reduced Voltage	200
50		8.3.2	GR	Normal/Reduced Voltage, Normal Power Direction	Power/Current Ramp	400
51	**Test Block-LP6**	9.3.1	GR	Reactive Power Control, Normal Power Direction	Filter Requirement	750
52		9.3.2	GR	Reactive Power Control, Normal Power Direction	Filter Replacement	200
53		9.3.3	GR	Reactive Power Control, Normal Power Direction	Reactive Power Control	400
54		9.3.4	GR	Reactive Power Control, Normal Power Direction	Voltage Control	400
55		9.3.5	GR	Reactive Power Control, Normal Power Direction	Umax Control	400
56	**Test Block-LP7**	10.3.1	GR/MR	Ground/Metallic Return Transfer	Ground/Metallic Return Transfer	200
57		10.3.2	GR/MR	Ground/Metallic Return Transfer	Metallic Return Operation With Station Ground at LAHORE Converter Station	200
58	**Test Block-LP8**	15.3.1	GR	Backup Control	Monopole Start/Stop in Backup Panel	200
59		15.3.2	GR	Backup Control	Monopole Ramp up/down in Backup Panel	400

DC Monopolar Low Power Tests -Reverse Power						
All DC Low Power Tests in Normal Direction must be successful before starting these tests						
All tests in Test Block-LP9, LP10, LP11 should be executed in sequence as listed below. If any test fails in one block, next test item in the same block should not be executed however, next test block (Test Block- LP10,LP11) can be executed in the prescribed sequence.						
60	Test Block-LP9	11.3.1	GR	Initial Operation Tests, Ground Return Operation, Reversed Power Direction	Start/Stop Pole	200
61		11.3.2	GR	Initial Operation Tests, Ground Return Operation, Reversed Power Direction	Control System Switchover	200
62		11.3.3	GR/MR	Initial Operation Tests, Ground Return Operation, Reversed Power Direction	Ground/Metallic Return Transfer	200
63		12.3.1	MR	Joint Power Control, Metallic Return Operation, Reversed Power Direction	Start/Stop Pole, Joint Power Control	200
64		12.3.2	MR	Joint Power Control, Metallic Return Operation, Reversed Power Direction	Control System Switchover	200

DC Monopolar Low Power Disturbance Tests						
All tests above must be sucessful before executing these tests						
65	Test Block-LP10	14.3.1	GR	Disturbances	DC Filter Switching	200
66		14.3.2	GR	Disturbances	Loss of 125V DC System C of Pole	200
67		14.3.3	GR	Disturbances	Loss of 125V DC System A of Pole	300
68		14.3.4	GR	Disturbances	Loss of 125V DC System B of Pole	300
69		14.3.5	GR	Disturbances	Simulated DC Line Fault (only Matiari)	200
70		14.3.6	GR	Disturbances	Simulate Fault of Converter Transformer PT Breaking at Matiari station	200
71		14.3.7	GR	Disturbances	Simulate Fault of Converter Transformer PT Breaking at LAHORE station	200
72		14.3.8	GR	Disturbances	Simulate Fault of DC Line PT Breaking at Matiari station	200
73		14.3.9	GR	Disturbances	Simulate Fault of DC Line PT Breaking at LAHORE station	200
74		14.3.10	GR	Disturbances	Simulate ACTIVE signal loss of pole control changeover device	200
75	Test Block-LP-11	13.3.1	GR	Control Pulse Loss Failure, Normal Power Direction	Multiple (>5) Pulses Loss Fault at Inverter in Ground Return	200
76		13.3.3	GR	Control Pulse Loss Failure, Normal Power Direction	Multiple (>5) Pulses Loss Fault at Rectifier in Ground Return	200
77		13.3.2	MR	Control Pulse Loss Failure, Normal Power Direction	Multiple (>5) Pulses Loss Fault at Inverter in Metallic Return	200
78			MR	Control Pulse Loss Failure, Normal Power Direction	Multiple (>5) Pulses Loss Fault at Rectifier in Metallic Return	200

Pole2 Low Power System Test (Protective Trip/Operational/Reverse Power/Disturbance)		
Repeat Tests from Test No 23 to 78 for Pole-2		
P2-79-164	LP3-LP-11	

Monopole Low Power Tests

1-Initial Operation Tests, Joint Current Control, Normal Power Direction, Ground Return.

Test Objective	To verify the basic function of deblock/block, manually switchover and ESOF, and check the correctness and accuracy of analog signal of control and protection system.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	All the Prerequisites as mentioned in DC Dispatch Plan should be met.			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Converter transformer protection and the charging protection of corresponding converter AC bus breaker are put into operation.			
	19		Air humidity and temperature in valve hall are within expected limits.			
	20		Station Tests have been successful			
	21		OLT with DC Line must be successful			
	22		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 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.			
	23	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	24		Return	Ground		Ground Return Mode
	25		Udc Mode	Normal		±660kV
	26		Telecom Mode	Operational		
	27		Master Station	Matiari		
	28	Configuration Setting at Lahore & Matiari C/S DC	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	29			B	Standby	
	30		Pole Control (PCP)	A	ACTIVE	
	31			B	Standby	
	32		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	33		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.

	34	Lahore & Matiari C/S DC side	Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	35		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 Start/Stop Pole Manual Block (Sr. No. 1)	36	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	37	Matiari	Start the Pole	DC Current	303 A [200 MW]	
	38			Ramp Rate:	100A/Min	
	39		Wait to achieve Target Value	Max Time	5 min	
	40		Verify Performance indicators	Firing angle (α)	15°±2.5°	
	41			DC Voltages	660kV	
	42			RPC Operation	BP-11/13 , HP24/36	
	43	Lahore		Extinction Angle (γ)	17°	
	44			DC Voltages	Range to be mentioned	
	45			RPC Operation	1xHP12/24	
	46	Matiari/Lahore	Verify stable operation at minimum current.			
	47		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	48	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	49	Lahore		1xHP12/24		
	50	Matiari	Stop the Pole			
	51		Verify Performance parameters	Retard, Reduced Current		
	52	Lahore		Firing angle (α)	90°	
Test of Emergency stop (Sr. No. 2)	53	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	54	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	55			Ramp Rate:	100A/Min	
	56		Emergency Stop the Pole			
	57		Verify Protection Functions	Y-block		
	58			Trip Action	Converter T/F AC Breakers	
	59				AC Filter Breakers by RPC	
	60			Pole IsolationSequence		
	61			Start Breaker Failure Protection		
	62			Set lockout relay for the tripped AC circuit breaker(s)		
	63	Lahore		Normal Y-block sequence		
	64			Trip of the AC Filters breakers by RPC		
	65		Make sure, Master Station is selected			If pole is being operated at 200 MW ignore this step
	66		Verify Ready for Operation Conditions.			
	67		Start the Pole	Current	303 A [200 MW]	
	68			Ramp Rate:	100A/Min	
	69		Emergency Stop the Pole			
	70		Verify Protection Functions	Y-block		
	71			Block Converter with By-Pass pair		
	72			Trip	Converter T/F AC Breakers	
	73				AC Filter Breakers by RPC	
	74			Pole IsolationSequence		
	75			Set lockout relay for the tripped AC circuit breaker(s)		
	76			Start Breaker Failure Protection		
	77	Matiari		Normal Y-block sequence		
	78			Trip of the AC Filters breakers by RPC		
Control System Switchover (Sr. No. 3)	79	Matiari	Make sure, Master Station is selected			If pole is being operated at 200 MW ignore this step
	80		Verify Ready for Operation Conditions.			
	81		Start the Pole-1	Current	303 A [200 MW]	
	82			Ramp Rate:	100A/Min	
	83		Verify	PCP-A	ACTIVE	
	84		Switch Control System	PCP-A to	PCP-B	
	85		Verify	Continuous Steady Operation of the transmission		
	86			PCP-B is active		
	87			No Transients on switchover, no unexpectd Time Delay		
	88		Switch Control System	PCP-B to	PCP-A	
	89		Verify	Continuous Steady Operation of the transmission		
	90			PCP-A is active		
	91			No Transients on switchover, no unexpectd Time Delay		
	92		Verify	SC-A	ACTIVE	
	93		Switch Control System	SC-A	SC-B	
	94		Verify	Continuous Steady Operation of the transmission		
	95			SC-B is active		
	96			No Transients on switchover, no unexpectd Time Delay		
	97		Switch Control System	SC-B	SC-A	
	98		Verify	Continuous Steady Operation of the transmission		
	99			SC-A is active		
	100			No Transients on switchover, no unexpectd Time Delay		

Control System Switchover (Sr. No. 3)	101	Lahore	Verify	PCP-A	ACTIVE	
	102		Switch Control System	PCP-A to	PCP-B	
	103		Verify	Continuous Steady Operation of the transmission		
	104			PCP-B is active		
	105			No Transients on switchover, no unexpectd Time Delay		
	106		Switch Control System	PCP-B to	PCP-A	
	107		Verify	Continuous Steady Operation of the transmission		
	108			PCP-A is active		
	109			No Transients on switchover, no unexpectd Time Delay		
	110		Verify	SC-A	ACTIVE	
	111		Switch Control System	SC-A	SC-B	
	112		Verify	Continuous Steady Operation of the transmission		
	113			SC-B is active		
	114			No Transients on switchover, no unexpectd Time Delay		
	115		Switch Control System	SC-B	SC-A	
	116		Verify	Continuous Steady Operation of the transmission		
	117			SC-A is active		
	118			No Transients on switchover, no unexpectd Time Delay		
Pole Control. DC Side Protections AC Side Protections [Analogue Input Checks] (Sr. No. 4)	119		Make sure, Master Station is selected			If pole is being operated at 200 MW ignore this step
	120		Verify Ready for Operation Conditions.			
	121	Matiari	Start the Pole	Current	303 A [200 MW]	
	122			Ramp Rate:	100A/Min	
	123		Inspect AC/DC analogue input signal of following systems while operating the pole at minimum power 303 Amps	Pole Control		
	124			DC Side Protections		
	125			AC Side Protections		
	126	Lahore	Inspect AC/DC analogue input signal of following systems while operating the pole at minimum power 303 Amps	Pole Control		
	127			DC Side Protections		
	128			AC Side Protections		
Test Acceptance Criteria	129	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	130		All Operations executed successfully			
	131		The synchronizing voltage and the phasing of the firing control signals are correct.			
	132		All thyristor check-back signals are available.			
	133		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	134		Measuring quantities are available and the values are within the specified range and phase.			
	135		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	136		No Stuck Condition			
	137		No False Tripping by DC Protection System			
	138		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.			
	139		No Tripping in AC side of converter Station			

Monopole Low Power Tests

2-Initial Operation Tests, Joint Current Control, Normal Power Direction, Metallic return

Test Objective	To verify the basic function of deblock/block, manually switchover and ESOF, and check the correctness and accuracy of analog signal of control and protection system.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-MR"			Metallic Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-MR"			Metallic Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Converter transformer protection and the charging protection of corresponding converter AC bus breaker are put into operation.			
	19		Air humidity and temperature in valve hall are within expected limits.			
	20		Initial Operation Tests in Ground Return Mode were successful.			
	21		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 MW)			
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	23		Return	Metallic		Metallic Return Mode
	24		Udc Mode	Normal		±660kV
	25		Telecom Mode	Operational		
	26		Master Station	Matiari		
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	28			B	Standby	
	29		Pole Control (PCP)	A	ACTIVE	
	30			B	Standby	
	31		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	32		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	33		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	34		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

	35	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
Pole Start/Stop Pole Manual Block (Sr. No. 5)	36	Matiari	Start the Pole	Current	303 A [200 MW]	
	37			Ramp Rate:	100A/Min	
	38		Wait to achieve Target Value	Max Time	5 min	
	39		Verify Performance indicators	Firing angle (α)	15°±2.5°	
	40			DC Voltages	660kV	
	41			Valve Voltages	660kV	
	42			RPC Operation	BP-11/13 , HP24/36	
	43	Lahore		Extinction Angle (γ)	17°	
	44			DC Voltages	Range to be mentioned	
	45			RPC Operation	1xHP12/24	
	46			Valve Currents	Range to be mentioned	
	47			Valve Voltages	Range to be mentioned	
	48	Matiari/Lahore	Verify stable operation at minimum current.			
	49		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	50	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	51	Lahore		1xHP-12/24		
	52	Matiari	Stop the Pole			
	53		Verify Performance parameters	Retard, Reduced Current		
	54	Lahore		Firing angle	90°	
Test of Emergency stop	55	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	56	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	57			Ramp Rate:	100A/Min	
	58		Emergency Stop the Pole			
	59		Verify Protection Functions	Y-block		
	60			Trip Action	Converter T/F AC Breakers	
	61				AC Filter Breakers by RPC	
	62			Pole IsolationSequence		
	63			Start Breaker Failure Protection		
	64			Set lockout relay for the tripped AC circuit breaker(s)		
	65	Lahore		Normal Y-block sequence		
	66			Trip of the AC Filters breakers by RPC		
	67		Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	68			Ramp Rate:	100A/Min	
	69		Emergency Stop the Pole			
	70		Verify Protection Functions	Y-block		
	71			Block Converter with By-Pass pair		
	72			Trip	Converter T/F AC Breakers	
	73				AC Filter Breakers by RPC	
	74			Pole IsolationSequence		
	75			Set lockout relay for the tripped AC circuit breaker(s)		
	76	Matiari		Normal Y-block sequence		
	77			Trip of the AC Filters breakers by RPC		
Control System Switchover	78	Matiari	Make sure, Master Station is selected			
	79		Verify Ready for Operation Conditions.			
	80		Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	81			Ramp Rate:	100A/Min	
	82		Verify	PCP-A	ACTIVE	
	83		Switch Control System	PCP-A to	PCP-B	
	84		Verify	Continuous Steady Operation of the transmission		
	85			PCP-B is active		
	86			No Transients on switchover, no unexpectd Time Delay		
	87		Switch Control System	PCP-B to	PCP-A	
	88		Verify	Continuous Steady Operation of the transmission		
	89			PCP-A is active		
	90			No Transients on switchover, no unexpectd Time Delay		
	91		Verify	SC-A	ACTIVE	
	92		Switch Control System	SC-A	SC-B	
	93		Verify	Continuous Steady Operation of the transmission		
	94			SC-B is active		
	95			No Transients on switchover, no unexpectd Time Delay		
	96		Switch Control System	SC-B	SC-A	
	97		Verify	Continuous Steady Operation of the transmission		
	98			SC-A is active		
	99			No Transients on switchover, no unexpectd Time Delay		

Control System Switchover	100	Lahore	Verify	PCP-A	ACTIVE	
	101		Switch Control System	PCP-A to	PCP-B	
	102		Verify	Continuous Steady Operation of the transmission		
	103			PCP-B is active		
	104			No Transients on switchover, no unexpectd Time Delay		
	105		Switch Control System	PCP-B to	PCP-A	
	106		Verify	Continuous Steady Operation of the transmission		
	107			PCP-A is active		
	108			No Transients on switchover, no unexpectd Time Delay		
	109		Verify	SC-A	ACTIVE	
	110		Switch Control System	SC-A to	SC-B	
	111		Verify	Continuous Steady Operation of the transmission		
	112			SC-B is active		
	113			No Transients on switchover, no unexpectd Time Delay		
	114		Switch Control System	SC-B to	SC-A	
	115		Verify	Continuous Steady Operation of the transmission		
	116			SC-A is active		
	117			No Transients on switchover, no unexpectd Time Delay		
Pole Control. DC Side Protections AC Side Protections [Analogue Input Checks]	118	Matiari	Make sure, Master Station is selected			If pole is being operated at 200 MW ignore this step
	119		Verify Ready for Operation Conditions.			
	120		Start the Pole	Current	303 A [200 MW]	
	121			Ramp Rate:	100A/Min	
	122		Inspect AC/DC analogue input signal of following systems while operating the pole at minimum power 303 Amps	Pole Control		
	123			DC Side Protections		
	124			AC Side Protections		
	125	Lahore	Inspect AC/DC analogue input signal of following systems while operating the pole at minimum power 303 Amps	Pole Control		
	126			DC Side Protections		
	127			AC Side Protections		
Test Acceptance Criteria	128	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	129		All Operations executed successfully			
	130		The synchronizing voltage and the phasing of the firing control signals are correct.			
	131		All thyristor check-back signals are available.			
	132		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	133		Measuring quantities are available and the values are within the specified range and phase.			
	134		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	135		No Stuck Condition			
	136		No False Tripping by DC Protection System			
	137		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.			
	138		No Tripping in AC side of converter Station			

Monopole Low Power Tests

3-Protective Trip X, Y, and Z, Joint Current Control, Normal Power Direction, Ground return

Test Objective: The test is carried on both sides and to check trip and block sequence.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Converter transformer protection and the charging protection of corresponding converter AC bus breaker are put into operation.			
	19		Air humidity and temperature in valve hall are within expected limits.			
	20		Initial Operation Tests in Ground Return Mode of Pole-I and Pole-II must be successful.			
	21		Initial Operation Tests in Metallic Return Mode of both Pole-I and Pole-II must be successful.			
	22		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 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.			
	23	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	24		Return	Ground		Ground Return Mode
	25		Udc Mode	Normal		±660kV
	26		Telecom Mode	Operational		
	27		Master Station	Matiari		
	28	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	29			B	Standby	
	30		Pole Control Protection (PCP)	A	ACTIVE	
	31			B	Standby	
	32		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	33		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	34		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	35		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

Protective Trip X in rectifier with TELECOM	36	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	37	Matiari	Start the Pole	Current	303 A [200 MW]	
	38			Ramp Rate:	100A/Min	
	39		Instruct Test commander to Simulate Valve short Circuit Protection Stage 2 TRIP as mentioned in commissioning program.			
	40		Verify Protection Functions	X-block		
	41			Trip Action	Converter T/F AC Breakers	
	42				AC Filter Breakers by RPC	
	43			Set lockout relay for the tripped AC circuit breaker(s)		
	44			Start Breaker Failure Protection		
	45			Pole IsolationSequence		
	46	Lahore		Normal Y-STOP sequence		
	47			Trip of the AC Filters breakers by RPC		
Protective Trip Y in rectifier with TELECOM	48	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	49	Matiari	Start the Pole	Current	303 A [200 MW]	
	50			Ramp Rate:	100A/Min	
	51		Verify	PUMP-A	ACTIVE	
	52		Turn OFF	PUMP-A		
	53		Verify	Continuous Steady Operation of the transmission		
	54			PUMP-B is active		
	55			No Transients		
	56		Restore Supply of PUMP-A			
	57		Turn OFF	PUMP-B		
	58		Verify	Continuous Steady Operation of the transmission		
	59			PUMP-A is active		
	60			No Transients		
	61		Turn OFF	PUMP-A		
	62		Verify Protection Functions	Y-block		
	63			Block Converter with By-Pass pair		
	64			Trip	Converter T/F AC Breakers	
	65				AC Filter Breakers by RPC	
	66			Pole IsolationSequence		
	67			Start Breaker Failure Protection		
	68			Set lockout relay for the tripped AC circuit breaker(s)		
	69	Lahore		Normal Y-STOP sequence		
	70			Trip of the AC Filters breakers by RPC		
Protective Trip Z in rectifier with TELECOM	71	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	72	Matiari	Start the Pole	Current	303 A [200 MW]	
	73			Ramp Rate:	100A/Min	
	74		Instruct Test Commander to Simulate Pole Bus Differential Protection Stage-2 Trip as mentioned in commissioning program.			
	75		Verify Protection Functions	Z-block		
	76			Trip Action	Converter T/F AC Breakers	
	77				AC Filter Breakers by RPC	
	78			Pole IsolationSequence		
	79			Start Breaker Failure Protection		
	80			Set lockout relay for the tripped AC circuit breaker(s)		
	81	Lahore		Normal Y-STOP sequence		
	82			Trip of the AC Filters breakers by RPC		
Protective Trip X in inverter with TELECOM	83	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	84	Lahore	Start the Pole	Current	303 A [200 MW]	
	85			Ramp Rate:	100A/Min	
	86		Instruct Test commander to Simulate Valve short Circuit Protection Stage 2 TRIP as mentioned in commissioning program.			
	87		Verify Protection Functions	X-block		
	88			Block Converter with by pass pair		
	89			Trip Action	AC circuit breaker(s) feeding the converter transformer	
	90				AC Filter Breakers by RPC	
	91			Pole IsolationSequence		
	92			Start Breaker Failure Protection		
	93			Set lockout relay for the tripped AC circuit breaker(s)		
	94	Matiari		Normal Y-stop sequence		
	95			Trip of the AC Filters breakers by RPC		

Protective Trip Y in inverter with TELECOM	96	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	97	Lahore	Start the Pole	Current	303 A [200 MW]	
	98			Ramp Rate:	100A/Min	
	99		Verify	PUMP-A	ACTIVE	
	100		Turn OFF	PUMP-A		
	101		Verify	Continuous Steady Operation of the transmission		
	102			PUMP-B is active		
	103			No Transients		
	104		Restore Supply of PUMP-A			
	105		Turn OFF	PUMP-B		
	106		Verify	Continuous Steady Operation of the transmission		
	107			PUMP-A is active		
	108			No Transients		
	109		Turn OFF	PUMP-A		
	110		Verify Protection Functions	Y-block		
	111			Retard & Block Converter with By-Pass pair		
	112			Trip Action	AC circuit breaker(s) feeding the converter transformer	
	113				AC Filter Breakers by RPC	
	114			Pole IsolationSequence		
	115			Start Breaker Failure Protection		
	116			Set lockout relay for the tripped AC circuit breaker(s)		
	117	Matiari		Normal Y-stop sequence		
	118			Trip of the AC Filters breakers by RPC		
Protective Trip Z in inverter with TELECOM	119	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	120	Lahore	Start the Pole-1	Current	303 A [200 MW]	
	121			Ramp Rate:	100A/Min	
	122		Instruct test director to Simulate Pole Bus Differential Protection Stage 2TRIP as mentioned in commissioning program.			
	123		Verify Protection Functions	Z-block		
	124			Block Converter with by pass pair		
	125			Trip Action	AC circuit breaker(s) feeding the converter transformer	
	126			Pole IsolationSequence		
	127			Trip Action	AC Filter Breakers by RPC	
	128			Set lockout relay for the tripped AC circuit breaker(s)		
	129			Start Breaker Failure Protection		
	130	Matiari		Normal Y-stop sequence		
	131			Trip of the AC Filters breakers by RPC		

Protective Trip Y in rectifier without TELECOM	132	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	133			Ramp Rate:	100A/Min	
	134		Disable the telecommunication (both channels).			
	135		Instruct test commander to Simulate Neutral Bus Capacitor Overcurrent Protection Action			
	136		Verify Protection Functions	Y-block		
	137			Trip Action	Converter T/F AC Breakers	
	138				AC Filter Breakers	
	139			Set lockout relay for the tripped AC circuit breaker(s)		
	140			Start Breaker Failure Protection		
	141			Pole IsolationSequence		
	142			Start Breaker Failure Protection		
	143	Lahore		Trip from DC control monitoring function.		
	144			Z-Block Order		
	145			Pole Isolation		
	146			Trip of the AC Filters breakers		
	147	Matiari	Restore All Telecommunications			
Protective Trip Y in inverter without TELECOM	148	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	149	Lahore	Start the Pole	Current	303 A [200 MW]	
	150			Ramp Rate:	100A/Min	
	151		Disable the telecommunication (both channels).			
	152		Instruct Test director to Simulate Neutral Bus Capacitor Overcurrent Protection Action as mentioned in commissioning program			
	153		Verify Protection Functions	Y-block		
	154			Retard and blocking of the converter with by-pass pair		
	155			Trip Action	Converter T/F AC Breakers	
	156				AC Filter Breakers by RPC	
	157			Pole IsolationSequence		
	158			Set lockout relay for the tripped AC circuit breaker(s)		
	159			Start Breaker Failure Protection		
	160	Matiari		Trip Pole Undervoltage Protection .		
	161			Y-Block Order		
	162			Pole Isolation		
	163			Trip of the AC Filters breakers by RPC		
	164	Lahore	Restore All Telecommunications			

VBE Fault Protection Trip in rectifier	165	Matiari	Verify	Both Sets of VBE	ACTIVE	
	166			HVDC	BLOCKED	
	167			Converter T/F	Energized	
	168			VBE-A	ACTIVE	
	169		Turn OFF	VBE-A		
	170		Verify	Continuous Steady Operation of the transmission		
	171			VBE-B is active		
	172			No Transients on switchover, no unexpectd Time Delay		
	173		Restore Supply of VBE-A			
	174		Turn OFF	VBE-B		
	175		Verify	Continuous Steady Operation of the transmission		
	176			VBE-A is active		
	177			No Transients on switchover, no unexpectd Time Delay		
	178		Restore Supply of VBE-B			
	179		Instruct test director to simulate the VBE Fault Trip in Pole as per commissioning program			
	180		Verify Protection Functions	Y-block		
	181			Trip	Converter T/F AC Breakers	
	182			Start Breaker Failure Protection		
	183			Set lockout relay for the tripped AC circuit breaker(s)		
	184			Pole IsolationSequence		
	185	Lahore		Normal Y-STOP sequence		Order Firing angle 90°, then block with BPPO
VBE Fault Protection Trip in inverter	186	Lahore	Verify	Both Sets of VBE	ACTIVE	
	187			HVDC	BLOCKED	
	188			Converter T/F	Energized	
	189			VBE-A	ACTIVE	
	190		Turn OFF	VBE-A		
	191		Verify	Continuous Steady Operation of the transmission		
	192			VBE-B is active		
	193			No Transients on switchover, no unexpectd Time Delay		
	194		Restore Supply of VBE-A			
	195		Turn OFF	VBE-B		
	196		Verify	Continuous Steady Operation of the transmission		
	197			VBE-A is active		
	198			No Transients on switchover, no unexpectd Time Delay		
	199		Restore Supply of VBE-B			
	200		Instruct test director to simulate the VBE Fault Trip in Pole as per commissioning program			
	201		Verify Protection Functions	Y-block		
	202			Trip	Converter T/F AC Breakers	
	203			Start Breaker Failure Protection		
	204			Set lockout relay for the tripped AC circuit breaker(s)		
	205			Pole IsolationSequence		
	206	Matiari		Normal Y-STOP sequence		Order Firing angle 90°, then block with BPPO
Test Acceptance Criteria	207	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	208		All Operations executed successfully			
	209		The synchronizing voltage and the phasing of the firing control signals are correct.			
	210		All thyristor check-back signals are available.			
	211		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	212		Measuring quantities are available and the values are within the specified range and phase.			
	213		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	214		No Stuck Condition			
	215		No False Tripping by DC Protection System			
	216		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.			
	217		No Tripping in AC side of converter Station			

Monopole Low Power Tests

4-System Supervision & Switchover
Joint Current Control, Normal Power Direction, Ground Return

Test Objective: The test objective is to check system supervision and control and protection system function when active system power failure ,main computer and profibus bus fault happen.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Initial Operation Tests in Ground Return Mode of Pole-I and Pole-II must be successful.			
	20		Initial Operation Tests in Metallic Return Mode of both Pole-I and Pole-II must be successful.			
	21		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200			
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	23		Return	Ground		Ground Return Mode
	24		Udc Mode	Normal		±660kV
	25		Telecom Mode	Operational		
	26		Master Station	Matiari		
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	28			B	Standby	
	29		Pole Control Protection (PCP)	A	ACTIVE	
	30			B	Standby	
	31		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	32		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	33		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	34		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

Active System Power Failure Test	35	Matiari/Lahore C/S DC	Verify Ready for Operation Conditions.			
	36	Matiari	Make sure Matiari is Master Station			
	37		Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	38			Ramp Rate:	100A/Min	
	39		Verify	PCP-A	ACTIVE	
	40		Switch Off	PCP-A		
	41		Verify	Continuous Steady Operation of the transmission		
	42			PCP-B is active		
	43			No Transients on switchover, no unexpectd Time Delay		
	44		Switch On	PCP-A		
	45		Restore PCP-A to StandBy Mode			
	46		Switch Off	PCP-B		
	47		Verify	Continuous Steady Operation of the transmission		
	48			PCP-A is active		
	49			No Transients on switchover, no unexpectd Time Delay		
	50		Switch On	PCP-B		
	51		Restore PCP-B to StandBy Mode			
	52	Lahore	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	53			Ramp Rate:	100A/Min	
	54		Verify	PCP-A	ACTIVE	
	55		Switch Off	PCP-A		
	56		Verify	Continuous Steady Operation of the transmission		
	57			PCP-B is active		
	58			No Transients on switchover, no unexpectd Time Delay		
	59		Switch On	PCP-A		
	60		Restore PCP-A to StandBy Mode			
	61		Switch Off	PCP-B		
	62		Verify	Continuous Steady Operation of the transmission		
	63			PCP-A is active		
	64			No Transients on switchover, no unexpectd Time Delay		
	65		Switch On	PCP-B		
	66		Restore PCP-B to StandBy Mode			
Pole Profi Bus Failure	67	Matiari	Make sure Matiari is Master Station			
	68		Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	69			Ramp Rate:	100A/Min	
	70		Provoke a Profibus failure	PCP-A		
	71		Verify	Continuous Steady Operation of the transmission		
	72			PCP-B is active		
	73			No Transients on switchover, no unexpectd Time Delay		
	74		Re-establish normal operation of main computer in PCPA			
	75		Restore PCP-A to StandBy Mode			
	76		Provoke a Profibus bus failure	PCP-B		
	77		Verify	Continuous Steady Operation of the transmission		
	78			PCP-A is active		
	79			No Transients on switchover, no unexpectd Time Delay		
	80		Re-establish normal operation of main computer in PCP-B			
	81		Restore PCP-B to StandBy Mode			
	82	Lahore	Make sure Lahore is Master Station			
	83		Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	84			Ramp Rate:	100A/Min	
	85		Provoke a Profibus failure	PCP-A		
	86		Verify	Continuous Steady Operation of the transmission		
	87			PCP-B is active		
	88			No Transients on switchover, no unexpectd Time Delay		
	89		Re-establish normal operation of main computer in PCPA			
	90		Restore PCP-A to StandBy Mode			
	91		Provoke a Profibus bus failure	PCP-B		
	92		Verify	Continuous Steady Operation of the transmission		
	93			PCP-A is active		
	94			No Transients on switchover, no unexpectd Time Delay		
	95		Re-establish normal operation of main computer in PCP-B			
	96		Restore PCP-B to StandBy Mode			

Pole LAN Bus Failure	97	Matiari	Make sure Matiari is Master Station			If pole is being operated at 200 MW ignore this step
	98		Start the Pole	Current	303 A [200 MW]	
	99			Ramp Rate:	100A/Min	
	100		Provoke a Control LAN bus failure	PCP-A		
	101		Verify	Continuous Steady Operation		
	102			PCP-A is active		
	103			ALARM		
	104		Remove the second Control LAN bus			
	105		Verify	Continuous Steady Operation of transmission		
	106			PCP-B is active		
	107			]No transients on switchover, no unexpectd Time Delay		
	108		Re-establish normal operation of main computer in PCPB			
	109		Provoke a Control LAN bus failure	PCP-B		
	110		Verify	Continuous Steady Operation		
	111			PCP-B is active		
	112			ALARM		
	113		Remove the second Control LAN bus			
	114		Verify	Continuous Steady Operation of the transmission		
	115			PCP-A is active		
	116			No Transients on switchover, no unexpectd Time Delay		
	117		Re-establish normal operation of main computer in PCP-B			
	118	Lahore	Make sure Lahore is Master Station			If pole is being operated at 200 MW ignore this step
	119		Start the Pole	Current	303 A [200 MW]	
	120			Ramp Rate:	100A/Min	
	121		Provoke a Control LAN bus failure	PCP-A		
	122		Verify	Continuous Steady Operation		
	123			PCP-A is active		
	124			ALARM		
	125		Remove the second Control LAN bus			
	126		Verify	Continuous Steady Operation of transmission		
	127			PCP-B is active		
	128			No transients on switchover, no unexpectd Time Delay		
	129		Re-establish normal operation of main computer in PCPB			
	130		Provoke a Control LAN bus failure	PCP-B		
	131		Verify	Continuous Steady Operation		
	132			PCP-B is active		
	133			ALARM		
	134		Remove the second Control LAN bus			
	135		Verify	Continuous Steady Operation of the transmission		
	136			PCP-A is active		
	137			No Transients on switchover, no unexpectd Time Delay		
	138		Re-establish normal operation of main computer in PCP-B			

Test Acceptance Criteria	139	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	140		All Operations executed successfully	
	141		The synchronizing voltage and the phasing of the firing control signals are correct.	
	142		All thyristor check-back signals are available.	
	143		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	144		Measuring quantities are available and the values are within the specified range and phase.	
	145		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	146		No Stuck Condition	
	147		No False Tripping by DC Protection System	
	148		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.	
	149		No Tripping in AC side of converter Station	

Monopole Low Power Tests

5-Steady State Operation
Joint Current Control, Normal Power Direction, Ground return

Test Objective	The test is carried on both sides and to check trip and block sequence.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Protective Trip X, Y, Z test in Normal Power Direction with Grount Return Mode (Annex-C-3 have			
	20		System Supervision and Switchover in Normal Power Direction with Ground Return Mode (Annex-C-			
	21		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (530 MW)			
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	23		Return	Ground		Ground Return Mode
	24		Udc Mode	Normal		±660kV
	25		Telecom Mode	Operational		
	26		Master Station	Matiari		
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	28			B	Standby	
	29		Pole Control Protection (PCP)	A	ACTIVE	
	30			B	Standby	
	31		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	32		Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	33		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	34		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 Current Ramping and Holding On	35	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	36	Matiari	Start the Pole	Current	303 A [200 MW]	
	37			Ramp Rate:	100A/Min	
	38		Ramp Up	303A	500A	100A/Min
	39		Verify	Ramping at correct ramp rate		
	40			No Transients, no unexpectd Time Delay		
	41		Order STOP Ramp			
	42		Verify	Ramp stopped, holding stopped value		
	43			No Transients, no unexpected Time Delay		
	44		Transfer the MASTER station	TO LAHORE		
	45		Ramp Up	Stopped Ramp Value	500A	100A/Min
	46		Verify	Ramping at correct ramp rate		
	47			Continuous Steady Operation		
	48			Ramping Done and Holding the target Value		
	49			No Transients, no unexpected Time Delay		
	50		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	51		Ramp Up	500A	800A	999A/Min
	52		Verify	Ramping at correct ramp rate		
	53			Continuous Steady Operation		
	54			Ramping Done and Holding the target Value		
	55	Lahore		No Transients, no unexpected Time Delay		
	56		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	57		Ramp Down	800A	500A	999A/Min
	58		Verify	Ramping at correct ramp rate		
	59			Continuous Steady Operation		
	60			Ramping Done and Holding the target Value		
	61			No Transients, no unexpectd Time Delay		
	62		Confirm Lahore is MASTER station.			
	63		Ramp Down	500A	303A	100A/Min
	64		Verify	Ramping at correct ramp rate		
	65			No Transients, no unexpected Time Delay		
	66		Order STOP Ramp			
	67		Verify	Ramp stopped, holding stopped value		
	68			No Transients, no unexpected Time Delay		
	69		Transfer the MASTER station	TO Matiari		
	70		Ramp Down	Stopped Ramp Value	303A	100A/Min
	71		Verify	Continuous Steady Operation		
	72			Ramping Done and Holding the target Value		
	73			No Transients, no unexpectd Time Delay		
	74		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	75	Matiari	Ramp Up	303A	500A	999A/Min
	76		Verify	Continuous Steady Operation		
	77			Ramping Done and Holding the target Value		
	78			No Transients, no unexpectd Time Delay		
	79		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	80		Ramp Down	500A	303A	999A/Min
	81		Verify	Continuous Steady Operation		
	82			Ramping Done and Holding the target Value		
	83			No Transients, no unexpectd Time Delay		

Pole System Switch over and Telecommunication Failure During Current Ramping	84	Lahore	Confirm Lahore is Master Station			
	85		Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	86			Ramp Rate:	100A/Min	
	87		Ramp Up	303A	500A	50A/Min
	88		Manual Switch Over during Ramp up	PCP-A	PCP-B	
	89			PCP-B	PCP-A	
	90		Verify during ramping	Continuous Steady Operation		
	91			No Transients, no unexpectd Time Delay		
	92		Order TRANSFER TO POWER CONTROL while ramping			
	93		Verify	No transfer to power control		
	94			Ramping Done and Holding the target Value		
	95			No transient change in current		
	96	Matiari	Initiate the sequence of MASTER station.			
	97		Ramp Down	500A	303A	50A/Min
	98		Manual Switch Over during Ramp down	PCP-A	PCP-B	
	99			PCP-B	PCP-A	
	100		Disabled the telecommunication in both channels during the ramping process.			
	101		Verify	Continuous Steady Operation		
	102			Ramping Done and Holding the target Value		
	103			Emergency Current Control mode would be automatically activated.		The ramping rate would be reduced but the ramp would continuing and the current reference value would be reached when the telecommunication is disabled,
	104		Restore the telecommunication.			
Pole Tap Changer Control, Manual Tap Changer Stepping	105	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	106			Ramp Rate:	100A/Min	
	107		Set tap changer control in MANUAL CONTROL mode			
	108		Raise two steps for increasing Udi0.			
	109		Verify	Firing Angle Increased		
	110			Transmitted Current is maintained		
	111			No Transients, no unexpectd Time Delay		
	112		Set tap changer control in AUTO CONTROL mode			
	113		Verify	Tap decreased automatically		
	114			Firing Angle Increased		
	115			Transmitted Current is maintained		
	116			No Transients, no unexpectd Time Delay		
	117	Lahore	Set tap changer control in MANUAL CONTROL mode			
	118		Lower two steps for increasing Udi0.			
	119		Verify	Decreased DC Voltages		
	120			Maintained Gamma in Lahore		
	121			Transmitted Current is maintained		
	122			No Transients, no unexpectd Time Delay		
	123		Set tap changer control in AUTO CONTROL mode			
	124		Verify	Tap increased automatically		
	125			Firing Angleback in control limits		
	126			DC Voltage back to normal		
	127			Transmitted Current is maintained		
	128			No Transients, no unexpectd Time Delay		
Current Step Test	129	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	130	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	131			Ramp Rate:	100A/Min	
	132		Ramp Up	303A	500A	100A/Min
	133		Instruct Test Commander to apply a +0.08 P.U Step in current Order with duration of 1000 msec in active PCP system.			
	134		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
	135		Change all the modified settings back to original value			
	136		Record and save all test dat			

Voltage Step Test	137	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	138			Ramp Rate:	100A/Min	
	139		Ramp Up	303A	500A	100A/Min
	140	Lahore	Instruct Test Commander to apply a -10% P.U Step in Voltage Order with duration of 1000 msec in active PCP system.			
	141		Record the voltage response and the overshoot, make sure the overshoot doesnot exceeds XX Value			XX value to be determined verified later with DPS studies
	142		Change all the modified settings back to original value			
	143		Record and save all test dat			
Angle γ Step Test Step Test	144	Matiari	Start the Pole	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	145			Ramp Rate:	100A/Min	
	146		Ramp Up	303A	500A	100A/Min
	147	Lahore	Instruct Test Commander to apply a +10% deg. Step in Extinction Angle with duration of 1000 msec in active PCP system.			
	148		Record the extinction angle response and the overshoot, make sure the overshoot doesnot exceeds XX Value			XX value to be determined verified later with DPS studies
	149		Change all the modified settings back to original value			
	150		Record and save all test dat			
Control Mode Shift, Current Margin Compensation	151	Matiari	Start the Pole-1	Current	303 A [200 MW]	If pole is being operated at 200 MW ignore this step
	152			Ramp Rate:	100A/Min	
	153		Ramp Up	303A	500A	100A/Min
	154	Matiari/Lahore	Set tap changer control in MANUAL CONTROL mode			
	155	Matiari	Force a control mode shift by decreasing the tap changer until the inverter starts to control current			
	156		Verify	Alarm(CMC active warning)		
	157			Transmitted Current is maintained		
	158			Firing angle in Matiari at the minimum value		
	159			No Transients, no unexpectd Time Delay		
	160	Lahore	Verify	The symbol 'DCON200/YCS'in PCP/CPU5/E05_CC_C1/Page 16 software page in LAHORE is turned to be 2.		
	161			The symbol 'CMC200/Y' in PCP/CPU3/C03_COC_PC/Page 5 software page in LAHORE turn to be '0.1p.u.'.		
	162			Transmitted Current is maintained		
	163			Current order is increased to compensate the current		
	164			No Transients, no unexpectd Time Delay		
	165	Matiari/Lahore	Set tap changer control in AUTO CONTROL mode			
	166		Verify	Tap increased automatically		
	167			Firing Angleback in control limits		
	168			DC Voltage back to normal		
	169			Transmitted Current is maintained		
	170			No Transients, no unexpectd Time Delay		
	171	Matiari	Ramp Down	500A	303A	100A/Min
	172	Matiari/Lahore	Record and save all test dat			
Test Acceptance Criteria	173	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	174		All Operations executed successfully			
	175		The synchronizing voltage and the phasing of the firing control signals are correct.			
	176		All thyristor check-back signals are available.			
	177		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	178		Measuring quantities are available and the values are within the specified range and phase.			
	179		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	180		No Stuck Condition			
	181		No False Tripping by DC Protection System			
	182		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.			
	183		No Tripping in AC side of converter Station			

Monopole Low Power Tests

6-Steady State Operation
Joint Power Control, Normal Power Direction, Ground return

Test Objective	The test is carried on both sides and to check trip and block sequence.

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 side at Matiari & Lahore C/S	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 switchyard status	During Pole-I testing			
	4	DC Side switchyard status	See Status Table "P1-GR"			Ground Return Mode
	5	DC Side switchyard status	See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6	DC Side switchyard status	During Pole-II testing			
	7	DC Side switchyard status	See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8	DC Side switchyard status	See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10	General Preconditions	Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11	General Preconditions	All electrical connections are available.			
	12	General Preconditions	Correct grounding of all equipment is available.			
	13	General Preconditions	Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14	General Preconditions	Thyristor valves and valve hall is cleaned.			
	15	General Preconditions	Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
		General Preconditions	Inter-station telecommunication check of control and protection signals			
	17	General Preconditions	Converter valve low voltage tests must be completed.			
	18	General Preconditions	Air humidity and temperature in valve hall are within expected limits.			
	19	General Preconditions	Steady State Operation Tests (current Control Mode) in Normal Power Direction with Ground			
	20	General Preconditions	Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (500 MW)			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Return	Ground		Ground Return Mode
	23	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Udc Mode	Normal		±660kV
	24	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Telecom Mode	Operational		
	25	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Master Station	Matiari		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	B	Standby	
	28	Configuration Setting at Lahore & Matiari C/S DC side	Pole Control Protection (PCP)	A	ACTIVE	
	29	Configuration Setting at Lahore & Matiari C/S DC side	Pole Control Protection (PCP)	B	Standby	
	30	Configuration Setting at Lahore & Matiari C/S DC side	Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	31	Configuration Setting at Lahore & Matiari C/S DC side	Station Control Mode	Joint	Active	Matiari & Lahore will operate jointly.
	32	Configuration Setting at Lahore & Matiari C/S DC side	Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33	Configuration Setting at Lahore & Matiari C/S DC side	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 Start/Stop Pole	34	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	35	Matiari	Start the Pole	Power	200 MW	
	36			Ramp Rate:	50MW/Min	
	37		Wait to achieve Target Value	Max Time	5 min	
	38		Verify Performance indicators	Firing angle (α)	15°±2.5°	
	39			DC Voltages	660kV	
	40			RPC Operation	BP-11/13 , HP24/36	
	41	Lahore		Extinction Angle (γ)	17°	
	42			DC Voltages	Range to be mentioned	
	43			RPC Operation	1xHP12/24	
	44	Matiari/Lahore	Verify stable operation at minimum power			
	45		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	46	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	47	Lahore		1xHP12/24		
	48	Matiari	Stop the Pole			
	49		Verify Performance parameters	Retard, Reduced Current		
	50	Lahore		Firing angle	90°	
Pole System Switch over and Telecommunication Failure During Power Ramping	51	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	52	Matiari	Start the Pole	Power	200 MW	
	53			Ramp Rate:	50 MW/Min	
	54		Ramp Up	200 MW	400 MW	50 MW/Min
	55		Manual Switch Over during Ramp up	PCP-A to	PCP-B	
	56		Manual Switch Over during Ramp up	PCP-B to	PCP-A	
	57		Verify	Ramping at correct ramp rate		
	58			No Transients, no unexpectd Time Delay		
	59		Order STOP Ramping while ramping			
	60		Verify	Ramping Stopped smoothly		
	61			No Transients, no unexpectd Time Delay		
	62	Lahore	Initiate the sequence of MASTER station at Lahore.			
	63		Ramp Up	From stopped value	400 MW	50 MW/Min
	64		Order TRANSFER TO Current CONTROL while ramping			
	65		Verify	no transfer during the power ramping		
	66			no transient change in power		
	67		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	68		Ramp Up	400 MW	500 MW	999 MW/Min
	69		Verify	Continuous Steady Operation		
	70			Ramping Done and Holding the target Value		
	71			No Transients, no unexpected Time Delay		
	72		NPCC makes sure, parallel AC corridor has margin for sharing 100 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	73		Ramp Down	500 MW	400 MW	999 MW/Min
	74		Verify	Continuous Steady Operation		
	75			Ramping Done and Holding the target Value		
	76			No Transients, no unexpectd Time Delay		
	77		Confirm Lahore is Master Station			
	78		Ramp ~~Up~~ Down	400 MW	200 MW	50 MW/Min
	79		Manual Switch Over during Ramp down	PCP-A to	PCP-B	
	80			PCP-B to	PCP-A	
	81		Verify	Ramping at correct ramp rate		
	82			No Transients, no unexpectd Time Delay		
	83		Order STOP Ramping while ramping			
	84		Verify	Ramping Stopped smoothly		
	85			No Transients, no unexpectd Time Delay		
	86		Ramp Down	From stopped value	200 MW	50 MW/Min
	87		Verify	Continuous Steady Operation		
	88			Ramping Done and Holding the target Value		
	89		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	90		Ramp Up	200 MW	400 MW	999 MW/Min
	91		Verify	Continuous Steady Operation		
	92			Ramping Done and Holding the target Value		
	93			No Transients, no unexpectd Time Delay		
	94		NPCC makes sure, parallel AC corridor has margin for sharing 200 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	95		Ramp Down	400 MW	200 MW	999 MW/Min
	96		Verify	Continuous Steady Operation		
	97			Ramping Done and Holding the target Value		
	98			No Transients, no unexpectd Time Delay		

Pole System Switch over and Telecommunication Failure During Power Ramping	99	Matiari	Make sure Matiari is MASTER station.			
	100		Ramp Up	200 MW	400 MW	50 MW/Min
	101		Disabled the telecommunication in both channels during the ramping process.			
	102		Verify	BSC mode is automatically activated & ramping continues		
	103			Ramping Done and Holding the target Value		
	104			No Transients, no unexpectd Time Delay		
	105		Ramp Down	400 MW	200 MW	50 MW/Min
	106		Restore the telecommunication while ramping down			
	107		Verify	Ramping continues when telecommunication restored		
	108			Ramping Done and Holding the target Value		
	109			No Transients, no unexpectd Time Delay		
Power Step Test	110	Matiari	Start the Pole	Power	200 MW	
	111			Ramp Rate:	50MW/Min	
	112		Ramp Up	200 MW	400 MW	50 MW /min
	113		Instruct Test Commander to apply a +0.08 P.U Step in Power Order with duration of 1000 msec in active PCP system.			
	114		Record the power response and the overshoot, make sure the overshoot doesnot exceeds XX Value			
	115		Change all the modified settings back to original value			
	116		Record and save all test dat			
Control Mode Shift, Current Margin Compensation	117	Matiari	Start the Pole	Power	200 MW	
	118			Ramp Rate:	50MW/Min	
	119		Ramp Up	200 MW	400 MW	50 MW /min
	120	Matiari/Lahore	Set tap changer control in MANUAL CONTROL mode			
	121	Matiari	Force a control mode shift by decreasing the tap changer until the inverter starts to control current			
	122		Verify	Alarm(CMC active warning)		
	123			Transmitted Current is maintained		
	124			Firing angle in Matiari at the minimum value		
	125			No Transients, no unexpectd Time Delay		
	126	Lahore	Verify	The symbol 'DCON200/YCS'in PCP/CPU5/E05_CC_C1/Page 16 software page in LAHORE is turned to be 2.		
	127			The symbol 'CMC200/Y' in PCP/CPU3/C03_COC_PC/Page 5 software page in LAHORE turn to be '0.1p.u.'.		
	128			Transmitted Current is maintained		
	129			Current order is increased to compensate the current margin.		
	130			No Transients, no unexpectd Time Delay		
	131	Matiari/Lahore	Set tap changer control in AUTO CONTROL mode			
	132		Verify	Tap increased automatically		
	133			Firing Angle back in control limits		
	134			DC Voltage back to normal		
	135			Transmitted Current is maintained		
	136			No Transients, no unexpectd Time Delay		
	137	Matiari	Ramp Down	400 MW	200 MW	50 MW/Min
	138	Matiari/Lahore	Record and save all test dat			

Test Acceptance Criteria	139	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	140		All Operations executed successfully	
	141		The synchronizing voltage and the phasing of the firing control signals are correct.	
	142		All thyristor check-back signals are available.	
	143		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	144		Measuring quantities are available and the values are within the specified range and phase.	
	145		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	146		No Stuck Condition	
	147		No False Tripping by DC Protection System	
	148		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.	
	149		No Tripping in AC side of converter Station	

Monopole Low Power Tests

7-Normal Operation
Separate Current Control without Telecom, Ground return

Test Objective	The test objective is to check control system performance under BSC control mode.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Steady State Operation Tests (Power Control Mode) in Normal Power Direction with Ground Return			
	20		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (330 MW)			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	22		Return	Ground		Ground Return Mode
	23		Udc Mode	Normal		±660kV
	24		Telecom Mode	Operational		
	25		Master Station	Matiari		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27			B	Standby	
	28		Pole Control Protection (PCP)	A	ACTIVE	
	29			B	Standby	
	30		Transmission Control Mode	Current	ACTIVE	HVDC will operate in power control mode.
	31		Station Control Mode	Seperate	Active	Matiari & Lahore will operate jointly.
	32		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33		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 Start/Stop Pole	34	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	35	Matiari & Lahore	Disabled the telecommunication in both channels .			
	36	Matiari & Lahore	Start the Pole, (By phone) [De-Block Inverter First Then De-Block Rectifier]	Current	303 Amps	
	37			Ramp Rate:	100 A/Min	
	38		Wait to achieve Target Value	Max Time	5 min	
	39	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	40			DC Voltages	660kV	
	41			RPC Operation	BP-11/13 , HP24/36	
	42	Lahore		Extinction Angle (γ)	17°	
	43			DC Voltages	Range to be mentioned	
	44			RPC Operation	1xHP12/24	
	45	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	46		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	47	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	48	Lahore		1xHP12/24		
	49	Matiari/Lahore	Stop the Pole (By phone) [Block Rectifier First Then Block Inverter]			
	50		Verify Performance parameters	Retard, Reduced Current		
	51	Lahore		Firing angle (α)	90°	
Pole System Switch over During Current Ramping w/o Telecom	52	Matiari/Lahore C/S DC side	Make sure communication is disabled.			
	53	Matiari / Lahore	Start the Pole-1, (By phone) [De-Block Inverter First Then De-Block Rectifier]	Current	303 Amps	
	54			Ramp Rate:	100 A/Min	
	55	Matiari	Ramp Up	303 Amps	500 Amps	100 A/Min
	56		Manual Switch Over during Ramp up	PCP-A	PCP-B	
	57		Manual Switch Over during Ramp up	PCP-B	PCP-A	
	58		Verify	Continuous Steady Operation		
	59			Ramping Done and Holding the target Value		
	60			No Transients, no unexpectd Time Delay		
	61		Order STOP Ramping while ramping			
	62		Verify	Ramping Stopped smoothly		
	63			No Transients, no unexpected Time Delay		
	64		Ramp Up	from stopped value	500 Amps	100 A/Min
	65		Order transfer to Power Control while ramping			
	66		Verify	No transfer to power control		
	67			No transient change in DC current		
	68			Continuous Steady Operation		
	69			Ramping Done and Holding the target Value		
	70			No Transients, no unexpectd Time Delay		
	71		Ramp Down	500 Amps	303 Amps	100 A/Min
	72		Verify	Continuous Steady Operation		
	73			Ramping Done and Holding the target Value		
	74			No Transients, no unexpected Time Delay		

Test Acceptance Criteria	75	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	76		All Operations executed successfully	
	77		The synchronizing voltage and the phasing of the firing control signals are correct.	
	78		All thyristor check-back signals are available.	
	79		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	80		Measuring quantities are available and the values are within the specified range and phase.	
	81		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	82		No Stuck Condition	
	83		No False Tripping by DC Protection System	
	84		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.	
	85		No Tripping in AC side of converter Station	

Monopole Low Power Tests

8-Normal/Reduced Voltage Operation
Joint Power Control, Ground return

Test Objective	The test objective is to check control system perfo rmance under reduced voltage operation mode.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Normal Operation, Separate Current Control without Telecom with Ground Return Mode (Annex-C-7			
	20		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (400 MW)			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	22		Return	Ground		Ground Return Mode
	23		Udc Mode	Reduced		±462kV
	24		Telecom Mode	Operational		
	25		Master Station	Matiari		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27			B	Standby	
	28		Pole Control Protection (PCP)	A	ACTIVE	
	29			B	Standby	
	30		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	31		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	32		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33		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

Manual/Protection Triggering Reduced Voltage	34	Matiari	Make sure Voltages are set in reduced Voltage mode, 80% (528kV)			
	35	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	36	Matiari & Lahore	Start the Pole,	Power	200MW	
	37			Ramp Rate:	50 MW/Min	
	38		Wait to achieve Target Value	Max Time	5 min	
	39	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	40			DC Voltages	528 kV	
	41			RPC Operation	BP-11/13 , HP24/36	
	42	Lahore		Extinction Angle (γ)	17°	
	43			DC Voltages	Range to be mentioned	
	44			RPC Operation	1xHP12/24	
	45	Matiari/Lahore	Verify	Normal start at 80% reduced voltage with minimum power (DC current of 379A)		
	46			Stable Operation		
	47		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	48	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	49	Lahore		1xHP12/24		
	50	Matiari	Set manually reduced Voltage mode 70%			
	51	Matiari/ Lahore	Verify	DC voltage ramps down to 70% (462kV)		
	52			DC power remains constant		
	53			DC current ramps up to 433A		
	54			No transients		
	55	Matiari	Order Normal Voltages (660kV)			
	56		Verify	DC Voltage is ramping up to Normal Voltage (660kV)		
	57			DC power remains constant		
	58			DC current ramps down to 303A		
	59			No transients		
	60		Stop the Pole			
	61	Matiari/Lahore	Verify Performance parameters	Retard, Reduced Current		
	62			Firing angle (α)	90°	
	63	Lahore	Initiate the sequence of MASTER station.			
	64		**Order Reduced Voltages (70%/470kV)**			
	65		Start the Pole,	Power	200MW	
	66			Ramp Rate:	100 MW/Min	
	67		Wait to achieve Target Value	Max Time	5 min	
	68	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	69			DC Voltages	470 kV	
	70			RPC Operation	BP-11/13 , HP24/36	
	71	Lahore		Extinction Angle (γ)	17°	
	72			DC Voltages	Range to be mentioned	
	73			RPC Operation	1xHP12/24	
	74	Matiari/Lahore	Verify	Normal start at 70% reduced voltage with minimum power (DC current of 433A)		
	75			Stable Operation		
	76		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	77	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	78	Lahore		1xHP12/24		
	79	Lahore	Order Normal Voltages (660kV)			
	80		Verify	DC Voltage is ramping up to Normal Voltage (660kV)		
	81			DC power remains constant		
	82			DC current ramps down to 303A		
	83			No transients		

Manual/Protection Triggering Reduced Voltage	84	Matiari	Initiate Sequence of Master Station		
	85		Set manually reduced Voltage mode 70%		
	86		Verify	DC voltage ramps down to 70% (462kV)	
	87			DC power remains constant	
	88			DC current ramps up to 433A	
	89			No transients	
	90		Order Normal Voltages (660kV)		
	91		Verify	DC Voltage is ramping up to Normal Voltage (660kV)	
	92			DC power remains constant	
	93			DC current ramps down to 303A	
	94			No transients	
	95	Lahore	Initiate Sequence of Master Station		
	96		Set manually reduced Voltage mode 70%		
	97		Verify	DC voltage ramps down to 70% (462kV)	
	98			DC power remains constant	
	99			DC current ramps up to 433A	
	100			No transients	
	101		Order Normal Voltages (660kV)		
	102		Verify	DC Voltage is ramping up to Normal Voltage (660kV)	
	103			DC power remains constant	
	104			DC current ramps down to 303A	
	105			No transients	
	106	Matiari	Initiate Sequence of Master Station		
	107	Matiari/ Lahore	Instruct Test Commander to Set REDUCED VOLTAGE from the DC-line Protection (70% of nominal voltage)		
	108		Verify	Sharp reduction in DC votlage to 70% (462kV)	
	109			DC power remains unchanged	
	110		Instruct Test Commander to change the modified settings back to default.		
	111		Disabled the telecommunication in both channels .		
	112		Verify	No disturbances in the power transmission.	
	113			Voltage remained steady at REDUCED VOLTAGE level.	
	114		Enabled the telecommunication in both channels . Again		
	115	Lahore	Initiate the sequence of MASTER station.		
	116		Order Normal Voltage		
	117		Verify	Smooth voltage ramp to 660kV	
	118			No change in dc power	
	119		Stop the Pole		

Power / Current Ramp	120	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is being operated at 200 MW ignore this step
	121	Matiari	Start the Pole,	Power	200MW	
	122			Ramp Rate:	50 MW/Min	
	123		Wait to achieve Target Value	Max Time	5 min	
	124		Set manually REDUCED VOLTAGE mode (70% of nominal voltage).			
	125		Ramp Up	200 MW	400 MW	50 MW/Min
	126		Order TRANSFER TO Current CONTROL while ramping			
	127	Matiari / Lahore	Verify	no transfer during the power ramping		
	128			no transient change in power		
	129			No disturbances in the power transmission.		
	130			Voltage remained steady at REDUCED VOLTAGE level.		
	131	Matiari	Order Normal Voltages (660kV)			
	132		Manual Switch Over during voltage ramp	PCP-A to	PCP-B	
	133		Manual Switch Over during voltage ramp	PCP-B to	PCP-A	
	134	Lahore	Initiate the sequence of MASTER station.			
	135		Set manually REDUCED VOLTAGE mode (70% of nominal voltage).			
	136		Ramp Down	400 MW	200 MW	50 MW/Min
	137	Matiari / Lahore	Verify	No disturbances in the power transmission.		
	138			Voltage remained steady at REDUCED VOLTAGE level.		
	139	Lahore	Order Normal Voltages (660kV)			
	140		Manual Switch Over during voltage ramp	PCP-A to	PCP-B	
	141		Manual Switch Over during voltage ramp	PCP-B to	PCP-A	
Test Acceptance Criteria	142	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	143		All Operations executed successfully			
	144		The synchronizing voltage and the phasing of the firing control signals are correct.			
	145		All thyristor check-back signals are available.			
	146		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	147		Measuring quantities are available and the values are within the specified range and phase.			
	148		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	149		No Stuck Condition			
	150		No False Tripping by DC Protection System			
	151		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.			
	152		No Tripping in AC side of converter Station			

Monopole Low Power Tests

9-Reactive Power Control
Joint Power Control, Ground return

Test Objective	The test objective is to check reactive power and AC voltage control performance of DC system.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Steady State Operation Tests (Power Control Mode) in Normal Power Direction with Ground Return			
	20		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (750 MW)			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	22		Return	Ground		Ground Return Mode
	23		Udc Mode	Normal		±660kV
	24		Telecom Mode	Operational		
	25		Master Station	Matiari		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27			B	Standby	
	28		Pole Control Protection (PCP)	A	ACTIVE	
	29			B	Standby	
	30		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	31		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	32		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33		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

Filter Requirement Test	34	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	35	Matiari & Lahore	Start the Pole	Power	200 MW	
	36			Ramp Rate:	50 MW/Min	
	37		Wait to achieve Target Value	Max Time	5 min	
	38	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	39			DC Voltages	660kV	
	40			RPC Operation	BP-11/13 , HP24/36	
	41	Lahore		Extinction Angle (γ)	17°	
	42			DC Voltages	Range to be mentioned	
	43			RPC Operation	1xHP12/24	
	44	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	45	Lahore		1xHP12/24		
	46	AC Network	NPCC makes sure, parallel AC corridor has margin for sharing 550 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	47	Matiari	Ramp Up	200 MW	750 MW	50 MW/Min
	48	Matiari	Verify RPC action	No additional filters		
	49	Lahore		No additional filters		
	50	AC Network	NPCC makes sure, parallel AC corridor has margin for sharing 550 MW with DC System. (Sudden load sharing from AC corridor to DC corridor will happen in next step)			
	51	Matiari	Ramp Down	750 MW	200 MW	50 MW/Min
Filter Replacement Test	52	Matiari	Start the Pole	Power	200 MW	If pole is already been operated at 200 MW ignore this step
	53			Ramp Rate:	50MW/min	
	54		Wait to achieve Target Value	Max Time	5 min	
	55	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	56			DC Voltages	660kV	
	57			RPC Operation	BP-11/13 , HP24/36	
	58	Lahore		Extinction Angle (γ)	17°	
	59			DC Voltages	Range to be mentioned	
	60			RPC Operation	1xHP12/24	
	61	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	62	Lahore		1xHP12/24		
	63	Matiari	Order RPC from Automatic to Manual			
	64		Switch off connected sub-bank BP-11/13			
	65		Verify that another BP-11/13 got connected within 1 second			
	66		Switch off connected sub-bank HP-24/36			
	67		Verify that another HP-24/36 got connected within 1 second			
	68	Lahore	Switch off connected sub-bank HP-12/24			
	69		Verify that another HP-12/24 got connected within 1 second			
	70	Matiari	Order RPC from Manual to Automatic			
Reactive Power Control	71	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	72	Matiari & Lahore	Start the Pole	Power	200 MW	
	73			Ramp Rate:	50 MW/Min	
	74		Wait to achieve Target Value	Max Time	5 min	
	75	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	76			DC Voltages	660kV	
	77			RPC Operation	BP-11/13 , HP24/36	
	78	Lahore		Extinction Angle (γ)	17°	
	79			DC Voltages	Range to be mentioned	
	80			RPC Operation	1xHP12/24	
	81	Matiari	Verify Q-Control action	BP-11/13, HP-24/36		
	82	Lahore		1xHP-12/24		
	83	Matiari	Ramp Up	200 MW	400 MW	50 MW/Min
	84	Matiari	Verify Q-Control action	No additional filter		
	85	Lahore		1 additional HP12/24		
	86	Lahore	Instruct Test Commander to change the Q-reference (Q-reference should subject to the prevailing situation) in order to provoke a filter switching ON by the RPC.			
	87		Verify that an AC filter is switched ON accordingly.			
	88		Restore the Q-reference,			

Voltage Control	89	Matiari/Lahore C/S DC side	Verify U-Control instead of Q-Control.			
	90	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	91	Matiari & Lahore	Start the Pole	Current	200 MW	
	92			Ramp Rate:	50 MW/Min	
	93		Wait to achieve Target Value	Max Time	5 min	
	94	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	95			DC Voltages	660kV	
	96			RPC Operation	BP-11/13 , HP24/36	
	97	Lahore		Extinction Angle (γ)	17°	
	98			DC Voltages	Range to be mentioned	
	99			RPC Operation	1xHP12/24	
	100	Matiari	Verify U-Control action	BP-11/13, HP-24/36		
	101	Lahore		1xHP-12/24		
	102	Matiari	Ramp Up	200 MW	400 MW	50 MW/Min
	103	Matiari	Instruct Test Commander to change the U-reference (U-reference should subject to the prevailing situation) in order to provoke a filter switching ON by the RPC.			
	104		Verify that an AC filter is switched ON accordingly.			
	105		Restore the U-reference,			
Umax Control	106	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	107	Matiari & Lahore	Start the Pole	Current	200 MW	
	108			Ramp Rate:	50 MW/Min	
	109		Wait to achieve Target Value	Max Time	5 min	
	110	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	111			DC Voltages	660kV	
	112			RPC Operation	BP-11/13 , HP24/36	
	113	Lahore		Extinction Angle (γ)	17°	
	114			DC Voltages	Range to be mentioned	
	115			RPC Operation	1xHP12/24	
	116	Matiari	Verify U-Control action	BP-11/13, HP-24/36		
	117	Lahore		1xHP-12/24		
	118	Matiari	Ramp Up	200 MW	400 MW	50 MW/Min
	119	Matiari	Decrease the Umax upper limit value to a value which is lower than AC voltage.			
	120		Instruct Test commander to change the U-reference in order to provoke a filter switching ON by the			
	121		Verify that there is no more input filter in Matiari station because of Umax limit.			
	122		Increase the Umax upper limit value to a value which is higher than AC voltage.			
	123		Verify that one sub bank BP11/13 in Matiari station switching on.			
	124		Restore the Umax upper limit value and U-reference to the initial setting value.			
	125	Lahore	Decrease the Umax upper limit value to a value which is lower than AC voltage.			
	126		Instruct Test commander to change the U-reference in order to provoke a filter switching ON by the			
	127		Verify that there is no more input filter in Lahore station because of Umax limit.			
	128		Increase the Umax upper limit value to a value which is higher than AC voltage.			
	129		Verify that one sub bank HP12/24 in Lahore station switching on.			
	130		Restore the Umax upper limit value and U-reference to the initial setting value.			
Test Acceptance Criteria	131	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	132		All Operations executed successfully			
	133		The synchronizing voltage and the phasing of the firing control signals are correct.			
	134		All thyristor check-back signals are available.			
	135		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	136		Measuring quantities are available and the values are within the specified range and phase.			
	137		No abnormal corona discharges and no operation of surge arresters shall occur at energized			
	138		No Stuck Condition			
	139		No False Tripping by DC Protection System			
	140		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.			
	141		No Tripping in AC side of converter Station			

Monopole Low Power Tests

10-Ground/Metallic Return Transfer
Joint Current Control, Ground return

Test Objective	The test objective is to check transfer sequence of Ground/Metallic Return configuration.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus breaker are			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Steady State Operation Tests (Power Control Mode) in Normal Power Direction with Ground Return Mode			
	20		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 MW) for the			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	22		Return	Ground		Ground Return Mode
	23		Udc Mode	Normal		±660kV
	24		Telecom Mode	Operational		
	25		Master Station	Matiari		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27			B	Standby	
	28		Pole Control Protection (PCP)	A	ACTIVE	
	29			B	Standby	
	30		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	31		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	32		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33		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

Ground/Metallic Return Transfer	34	Matiari/Lahore C/S DC side	Verify that the other pole is isolated and both stations are ready for metallic return operation.			
	35		Verify Ready for Operation Conditions.			
	36	Matiari & Lahore	Start the Pole,	Current	303 Amps	
	37			Ramp Rate:	100 A/Min	
	38		Wait to achieve Target Value	Max Time	5 min	
	39	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	40			DC Voltages	660kV	
	41			RPC Operation	BP-11/13 , HP24/36	
	42	Lahore		Extinction Angle (γ)	17°	
	43			DC Voltages	Range to be mentioned	
	44			RPC Operation	1xHP12/24	
	45	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	46		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	47	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	48	Lahore		1xHP12/24		
	49	Matiari/Lahore	Order TRANSFER TO METALLIC RETURN.			
	50	Matiari/Lahore	Verify	Correct sequential operation of switches and breakers.		
	51			Correct operation of MRTB in Matiari (The operation of the breaker should be visually observed carefully in case that the sequence is interrupted by maloperation)		
	52			No disturbance in power transfer.		
	53			Check whether all related switches and breakers in Matiari and LAHORE are correctly operated in line with the technical specification.		
	54	Matiari/Lahore	Order TRANSFER TO GROUND RETURN.			
	55	Matiari/Lahore	Verify	Correct sequential operation of switches and breakers.		
	56			Correct operation of GRTS in Matiari (The operation of the breaker should be visually observed carefully in case that the sequence is interrupted by maloperation)		
	57			No disturbance in power transfer.		
	58			Check whether all related switches and breakers in Matiari and LAHORE are correctly operated in line with the technical specification.		
	59	Matiari/Lahore	Order TRANSFER TO METALLIC RETURN. During GR→MR, Initiate a manual switchover from PCPA to PCPB, and then from PCPB to PCPA in Matiari station.			
	60	Matiari	Verify	Correct sequential operation of switches and breakers.		
	61			Correct operation of MRTB in Matiari (The operation of the breaker should be visually observed carefully in case that the sequence is interrupted by maloperation)		
	62			System GR/MR transfer Normally and no transient changes in DC current in Matiari.		
	63			No disturbance in power transfer.		
	64			Check whether all related switches and breakers in Matiari and LAHORE are correctly operated in line with the technical specification.		
	65	Matiari/Lahore	Order TRANSFER TO GROUND RETURN.			
	66	Lahore	Verify	Correct sequential operation of switches and breakers.		
	67			Correct operation of MRTB in Matiari (The operation of the breaker should be visually observed carefully in case that the sequence is interrupted by maloperation)		
	68			System GR/MR transfer Normally and no transient changes in DC current in Matiari.		
	69			No disturbance in power transfer.		
	70			Check whether all related switches and breakers in Matiari and LAHORE are correctly operated in line with the technical specification.		

Metallic Return Operation with Station Ground at Lahore C/s	71	Matiari/Lahore	Order TRANSFER TO METALLIC RETURN.			
	72	Matiari & Lahore	Start the Pole,	Current	303 Amps	
	73			Ramp Rate:	100 A/Min	
	74		Wait to achieve Target Value	Max Time	5 min	
	75	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	76			DC Voltages	660kV	
	77			RPC Operation	BP-11/13 , HP24/36	
	78	Lahore		Extinction Angle (γ)	17°	
	79			DC Voltages	Range to be mentioned	
	80			RPC Operation	1xHP12/24	
	81	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	82		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	83	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	84	Lahore		1xHP12/24		
	85	Matiari/Lahore	Instruct Test Commander to Simulate Electrode Line Open Circuit Protection Zone I Action by executing the following action, and then the NBGS would be automatically closed in LAHORE			
	86	Lahore	Then the NBGS would be automatically closed in LAHORE			
	87	Matiari/Lahore	Order OPEN (WN3Q11) manually			
	88	Matiari	Stop the Pole			
	89		Verify Performance parameters	Retard, Reduced Current		
	90	Lahore		Firing angle	90	
	91		Verify DC system is in metallic return mode and LAHORE station operates with station ground			
	92	Matiari	Start the Pole	Current	303 Amps	
	93			Ramp Rate:	100 A/Min	
	94		Wait to achieve Target Value	Max Time	5 min	
	95		Verify Performance indicators	Firing angle (α)	15°±2.5°	
	96			DC Voltages	660kV	
	97			RPC Operation	BP-11/13 , HP24/36	
	98	Lahore		Extinction Angle (γ)	17°	
	99			DC Voltages	Range to be mentioned	
	100			RPC Operation	1xHP12/24	
	101	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	102		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	103	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	104	Lahore		1xHP12/24		
	105	Matiari	Stop the Pole			
	106		Verify Performance parameters	Retard, Reduced Current		
	107	Lahore		Firing angle	90	
	108	Matiari/Lahore	Restore Settings			
	109		Order Close WN3Q11 and then Open NBGS.			

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		The synchronizing voltage and the phasing of the firing control signals are correct.	
	113		All thyristor check-back signals are available.	
	114		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	115		Measuring quantities are available and the values are within the specified range and phase.	
	116		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	117		No Stuck Condition	
	118		No False Tripping by DC Protection System	
	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 Tripping in AC side of converter Station	

Monopole Low Power Tests

11-Backup Control
Joint Power Control, Ground return

Test Objective: The test objective is to check control system perfo rmance under reduced voltage operation mode.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Set tap changer to position giving lowest valve voltage			
	20		Steady State Operation Tests (Power Control Mode) in Normal Power Direction with Ground Return			
	21		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (400 MW)			
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	23		Return	Ground		Ground Return Mode
	24		Udc Mode	Normal		±660 kV
	25		Telecom Mode	Operational		
	26		Master Station	Matiari		
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	28			B	Standby	
	29		Pole Control Protection (PCP)	A	ACTIVE	
	30			B	Standby	
	31		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	32		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	33		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	34		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

Monopole Start/Stop in Backup Panel	35	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	36		Switch DC Local Control Interface from 'REMOTE' to 'LOCAL'.			
	37	Matiari & Lahore	Start the Pole,	Current	200 MW	
	38			Ramp Rate:	50 MW/Min	
	39		Wait to achieve Target Value	Max Time	5 min	
	40	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	41			DC Voltages	660kV	
	42			RPC Operation	BP-11/13 , HP24/36	
	43	Lahore		Extinction Angle (γ)	17°	
	44			DC Voltages	Range to be mentioned	
	45			RPC Operation	1xHP12/24	
	46	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	47		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	48	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	49	Lahore		1xHP12/24		
	50	Matiari/Lahore	Stop the Pole			
	51		Verify Performance parameters	Retard, Reduced Current		
	52	Lahore		Firing angle (α)	90°	
Monopole Ramp up/down in Backup Panel	53	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	54		Switch DC Local Control Interface from 'REMOTE' to 'LOCAL'.			
	55	Matiari & Lahore	Start the Pole,	Power	200 MW	
	56			Ramp Rate:	50 MW/Min	
	57		Wait to achieve Target Value	Max Time	5 min	
	58	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	59			DC Voltages	660kV	
	60			RPC Operation	BP-11/13 , HP24/36	
	61	Lahore		Extinction Angle (γ)	17°	
	62			DC Voltages	Range to be mentioned	
	63			RPC Operation	1xHP12/24	
	64	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	65		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	66	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	67	Lahore		1xHP12/24		
	68	Matiari	Ramp Up	200 MW	400 MW	50 MW/Min
	69		Order STOP RAMPING.			
	70		Verify also that the ramp could stop while ramping			
	71		Ramp Up	from stopped value	400MW	50 MW/Min
	72		Verify that the current reaches the reference value after each ramping is completed in both stations and that the ramping process is smooth and without disturbances.			
	73	Lahore	Initiate the sequence of MASTER station.			
	74		Ramp Down	400 MW	200 MW	50 MW/Min
	75		Order STOP RAMPING.			
	76		Verify also that the ramp could stop while ramping			
	77		Ramp Down	from stopped value	200MW	50 MW/Min
	78		Verify that the current reaches the reference value after each ramping is completed in both stations and that the ramping process is smooth and without disturbances.			
	79		Switch DC Local Control Interface from 'LOCAL' to 'REMOTE'.			
	80	Matiari/Lahore	Stop the Pole			
	81		Verify Performance parameters	Retard, Reduced Current		
	82	Lahore		Firing angle (α)	90°	

Test Acceptance Criteria	83	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	84		All Operations executed successfully	
	85		The synchronizing voltage and the phasing of the firing control signals are correct.	
	86		All thyristor check-back signals are available.	
	87		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	88		Measuring quantities are available and the values are within the specified range and phase.	
	89		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	90		No Stuck Condition	
	91		No False Tripping by DC Protection System	
	92		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.	
	93		No Tripping in AC side of converter Station	

Monopole Low Power Tests

12-Initial Operation Tests, Ground Return Operation, Reversed Power Direction Joint Current Control

Test Objective	Verify the basic function of deblock/block, manually switchover of control and protection system.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		All DC Low Power Tests as in Annex-C-1 to 11 must be successful			
	20		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 MW)			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Reverse		Lahore to Matiari
	22		Return	Ground		Ground Return Mode
	23		Udc Mode	Normal		±660kV
	24		Telecom Mode	Operational		
	25		Master Station	Lahore		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27			B	Standby	
	28		Pole Control Protection (PCP)	A	ACTIVE	
	29			B	Standby	
	30		Transmission Control Mode	Current	ACTIVE	HVDC will operate in current control mode.
	31		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	32		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33		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 Start/Stop Pole	34	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	35	Lahore	Start the Pole	Current	303 A [200 MW]	
	36			Ramp Rate:	100A/Min	
	37		Wait to achieve Target Value	Max Time	5 min	
	38		Verify Performance indicators	Firing angle (α)	15°±2.5°	
	39			DC Voltages	660kV	
	40			RPC Operation	BP-11/13 , HP24/36	
	41	Matiari		Extinction Angle (γ)	17°	
	42			DC Voltages	Range to be mentioned	
	43			RPC Operation	1xHP12/24	
	44	Matiari/Lahore	Verify stable operation at minimum current.			
	45		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	46	Matiari	Verify RPC action	BP-11/13 , HP24/36		
	47	Lahore		1xHP12/24		
	48	Lahore	Stop the Pole			
	49		Verify Performance parameters	Retard, Reduced Current		
	50	Matiari		Firing angle (α)	90°	
Control System Switchover	51	Lahore	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	52		Start the Pole	Current	303 A [200 MW]	
	53			Ramp Rate:	100A/Min	
	54		Verify	PCP-A	ACTIVE	
	55		Switch Control System	PCP-A to	PCP-B	
	56		Verify	Continuous Steady Operation of the transmission		
	57			PCP-B is active		
	58			No Transients		
	59		Verify	SC-A	ACTIVE	
	60		Switch Control System	SC-A to	SC-B	
	61		Verify	Continuous Steady Operation of the transmission		
	62			SC-B is active		
	63			No Transients		
	64		Switch Control System	PCP-B to	PCP-A	
	65		Verify	Continuous Steady Operation of the transmission		
	66			PCP-A is active		
	67			No Transients		
	68		Switch Control System	SC-B to	SC-A	
	69		Verify	Continuous Steady Operation of the transmission		
	70			SC-A is active		
	71			No Transients		
	72	Matiari	Verify	PCP-A	ACTIVE	
	73		Switch Control System	PCP-A to	PCP-B	
	74		Verify	Continuous Steady Operation of the transmission		
	75			PCP-B is active		
	76			No Transients		
	77		Verify	SC-A	ACTIVE	
	78		Switch Control System	SC-A to	SC-B	
	79		Verify	Continuous Steady Operation of the transmission		
	80			SC-B is active		
	81			No Transients		
	82		Switch Control System	PCP-B to	PCP-A	
	83		Verify	Continuous Steady Operation of the transmission		
	84			PCP-A is active		
	85			No Transients		
	86		Switch Control System	SC-B to	SC-A	
	87		Verify	Continuous Steady Operation of the transmission		
	88			SC-A is active		
	89			No Transients		

Ground/Metallic Return Transfer	90	Matiari/Lahore C/S DC side	Verify that the other pole is isolated and both stations are ready for metallic return operation.			
	91		Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	92	Matiari & Lahore	Start the Pole,	Current	303 Amps	
	93			Ramp Rate:	100 A/Min	
	94		Wait to achieve Target Value	Max Time	5 min	
	95	Lahore	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	96			DC Voltages	660kV	
	97			RPC Operation	BP-11/13 , HP24/36	
	98	Matiari		Extinction Angle (γ)	17°	
	99			DC Voltages	Range to be mentioned	
	100			RPC Operation	1xHP12/24	
	101	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	102		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	103	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	104	Lahore		1xHP12/24		
	105	Matiari/Lahore	Order TRANSFER TO METALLIC RETURN.			
	106	Matiari/Lahore	Verify	Correct sequential operation of switches and breakers.		
	107			Correct operation of MRTB in Matiari (The operation of the breaker should be visually observed carefully in case that the sequence is interrupted by maloperation)		
	108			No disturbance in power transfer.		
	109			Check whether all related switches and breakers in Matiari and LAHORE are correctly operated in line with the technical specification.		
	110	Matiari/Lahore	Order TRANSFER TO GROUND RETURN.			
	111	Matiari/Lahore	Verify	Correct sequential operation of switches and breakers.		
	112			Correct operation of GRTS in Matiari (The operation of the breaker should be visually observed carefully in case that the sequence is interrupted by maloperation)		
	113			No disturbance in power transfer.		
	114			Check whether all related switches and breakers in Matiari and LAHORE are correctly operated in line with the technical specification.		
Test Acceptance Criteria	115	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	116		All Operations executed successfully			
	117		The synchronizing voltage and the phasing of the firing control signals are correct.			
	118		All thyristor check-back signals are available.			
	119		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	120		Measuring quantities are available and the values are within the specified range and phase.			
	121		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	122		No Stuck Condition			
	123		No False Tripping by DC Protection System			
	124		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.			
	125		No Tripping in AC side of converter Station			

Monopole Low Power Tests

13-Initial Operation Tests, Ground Return Operation, Reversed Power Direction Joint Power Control, Ground return

Test Objective	Verify the basic function of deblock/block, manually switchover of control and protection system.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Metalic Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Metallic Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		Initial Operation Tests (Reverse Power) in Ground Return Mode (Annex-C-12) were successful.			
	20		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 MW)			
	21	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Reverse		Lahore to Matiari
	22		Return	Metallic		Ground Return Mode
	23		Udc Mode	Normal		±660kV
	24		Telecom Mode	Operational		
	25		Master Station	Matiari		
	26	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	27			B	Standby	
	28		Pole Control Protection (PCP)	A	ACTIVE	
	29			B	Standby	
	30		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	31		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	32		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	33		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

Start/Stop Pole	34	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	35		Make Sure that configuration is set in Metallic Return Mode			
	36	Lahore	Start the Pole	Power	200 MW	
	37			Ramp Rate:	50 MW/min	
	38		Wait to achieve Target Value	Max Time	5 min	
	39		Verify Performance indicators	Firing angle (α)	15°±2.5°	
	40			DC Voltages	660kV	
	41			RPC Operation	BP-11/13 , HP24/36	
	42	Matiari		Extinction Angle (γ)	17°	
	43			DC Voltages	Range to be mentioned	
	44			RPC Operation	1xHP12/24	
	45	Matiari/Lahore	Verify stable operation at minimum current.			
	46		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	47	Matiari	Verify RPC action	BP-11/13 , HP24/36		
	48	Lahore		1xHP12/24		
	49	Lahore	Stop the Pole			
	50		Verify Performance parameters	Retard, Reduced Current		
	51	Matiari		Firing angle (α)	90°	
Control System Switchover	52	Lahore	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	53		Start the Pole	Power	200 MW	
	54			Ramp Rate:	50 MW/min	
	55		Verify	PCP-A	ACTIVE	
	56		Switch Control System	PCP-A to	PCP-B	
	57		Verify	Continuous Steady Operation of the transmission		
	58			PCP-B is active		
	59			No Transients		
	60		Verify	SC-A	ACTIVE	
	61		Switch Control System	SC-A to	SC-B	
	62		Verify	Continuous Steady Operation of the transmission		
	63			SC-B is active		
	64			No Transients		
	65		Switch Control System	PCP-B to	PCP-A	
	66		Verify	Continuous Steady Operation of the transmission		
	67			PCP-A is active		
	68			No Transients		
	69		Switch Control System	SC-B to	SC-A	
	70		Verify	Continuous Steady Operation of the transmission		
	71			SC-A is active		
	72			No Transients		
	73	Matiari	Verify	PCP-A	ACTIVE	
	74		Switch Control System	PCP-A to	PCP-B	
	75		Verify	Continuous Steady Operation of the transmission		
	76			PCP-B is active		
	77			No Transients		
	78		Verify	SC-A	ACTIVE	
	79		Switch Control System	SC-A to	SC-B	
	80		Verify	Continuous Steady Operation of the transmission		
	81			SC-B is active		
	82			No Transients		
	83		Switch Control System	PCP-B to	PCP-A	
	84		Verify	Continuous Steady Operation of the transmission		
	85			PCP-A is active		
	86			No Transients		
	87		Switch Control System	SC-B to	SC-A	
	88		Verify	Continuous Steady Operation of the transmission		
	89			SC-A is active		
	90			No Transients		
	91	Lahore	Stop the Pole			
	92		Verify Performance parameters	Retard, Reduced Current		
	93	Matiari		Firing angle (α)	90°	

Test Acceptance Criteria	94	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	95		All Operations executed successfully	
	96		The synchronizing voltage and the phasing of the firing control signals are correct.	
	97		All thyristor check-back signals are available.	
	98		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	99		Measuring quantities are available and the values are within the specified range and phase.	
	100		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	101		No Stuck Condition	
	102		No False Tripping by DC Protection System	
	103		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.	
	104		No Tripping in AC side of converter Station	

Monopole Low Power Tests

14-Disturbances
Joint Power Control, Ground return

Test Objective: The test objective is to check control system perfo rmance under reduced voltage operation mode.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		All Normal Power Direction Monopole Low Power Tests as in Annex-C-1 to 10 are successful			
	20		All Reverse Power Direction Monopole Low Power Tests as in Annex-C-11 to 13 are successful			
	21		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (300 MW)			
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	23		Return	Ground		Ground Return Mode
	24		Udc Mode	Reduced		±462kV
	25		Telecom Mode	Operational		
	26		Master Station	Matiari		
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	28			B	Standby	
	29		Pole Control Protection (PCP)	A	ACTIVE	
	30			B	Standby	
	31		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	32		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	33		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	34		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

DC Filter Switching	35	Matiari	Make Sure that Voltages are set in reduced Voltage mode			
	36	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	37	Matiari & Lahore	Start the Pole,	Power	200 MW	
	38			Ramp Rate:	50 MW/Min	
	39		Wait to achieve Target Value	Max Time	5 min	
	40	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	41			DC Voltages	462 kV	
	42			RPC Operation	BP-11/13 , HP24/36	
	43	Lahore		Extinction Angle (γ)	17°	
	44			DC Voltages	Range to be mentioned	
	45			RPC Operation	1xHP12/24	
	46	Matiari/Lahore	Verify stable operation & Normal start at reduced voltage with minimum power			
	47		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	48	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	49	Lahore		1xHP12/24		
	50	Matiari	Verify	Verify the switches of DC filter are closed.		
	51			Initiate the sequence of DC Filter Isolation;		
	52		Verify	Successful isolation of DC filter		
	53			No disturbances to the power transmission.		
	54			Initiate the sequence of DC Filter Connection		
	55		Verify	Successful connection of DC filter		
	56			No disturbances to the power transmission.		
	57	Lahore	Verify	Verify the switches of DC filter are closed.		
	58			Initiate the sequence of DC Filter Isolation;		
	59		Verify	Successful isolation of DC filter		
	60			No disturbances to the power transmission.		
	61			Initiate the sequence of DC Filter Connection		
	62		Verify	Successful connection of DC filter		
	63			No disturbances to the power transmission.		
	64	Matiari/Lahore	Order Normal Voltages (660kV)			
	65		Verify DC Voltages is ramping up to Normal Voltages without change in power and reach the specified volatges smoothly and without any interruption.			
	66	Matiari/Lahore	Stop the Pole			
	67		Verify Performance parameters	Retard, Reduced Current		
	68	Lahore		Firing angle (α)	90°	

Loss of 125V DC System C of Pole	69	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	70	Matiari & Lahore	Start the Pole,	Power	200 MW	
	71			Ramp Rate:	50 MW/Min	
	72		Wait to achieve Target Value	Max Time	5 min	
	73	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	74			DC Voltages	660kV	
	75			RPC Operation	BP-11/13 , HP24/36	
	76	Lahore		Extinction Angle (γ)	17°	
	77			DC Voltages	Range to be mentioned	
	78			RPC Operation	1xHP12/24	
	79	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum			
	80		Perform normal inspections (visual and acoustical) while pole is			
	81	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	82	Lahore		1xHP12/24		
	83	Matiari	Switch the incoming to 125 V DC distribution board C (EC1), from system A (U1) to system B (U2), alternative from system B to system A depending on present pre-conditions.			
	84		Verify Continuing Normal operation of power transmission.			
	85		Switch the incoming to 125 V DC distribution board C (EC1), from system B (U2) to system A (U1), alternative from system A to system B depending on present pre-conditions.			
	86		Verify Continuing Normal operation of power transmission.			
	87	Lahore	Switch the incoming to 125 V DC distribution board C (EC1), from system A (U1) to system B (U2), alternative from system B to system A depending on present pre-conditions.			
	88		Verify Continuing Normal operation of power transmission.			
	89		Switch the incoming to 125 V DC distribution board C (EC1), from system B (U2) to system A (U1), alternative from system A to system B depending on present pre-conditions.			
	90		Verify Continuing Normal operation of power transmission.			
Loss of 125V DC System A of Pole	91	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	92	Matiari & Lahore	Start the Pole,	Power	200 MW	
	93			Ramp Rate:	50 MW/Min	
	94		Wait to achieve Target Value	Max Time	5 min	
	95	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	96			DC Voltages	660kV	
	97			RPC Operation	BP-11/13 , HP24/36	
	98	Lahore		Extinction Angle (γ)	17°	
	99			DC Voltages	Range to be mentioned	
	100			RPC Operation	1xHP12/24	
	101	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum			
	102		Perform normal inspections (visual and acoustical) while pole is			
	103	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	104	Lahore		1xHP12/24		
	105	Matiari	Ramp Up	200 MW	300 MW	50 MW/Min
	106	Matiari	Open the 125 V DC system A main switch.			
	107		Verify Continuing Normal operation of power transmission.			
	108		Re-close the 125 V DC system A main switch.			
	109		Verify Continuing Normal operation of power transmission.			
	110	Lahore	Open the 125 V DC system A main switch.			
	111		Verify Continuing Normal operation of power transmission.			
	112		Re-close the 125 V DC system A main switch.			
	113		Verify Continuing Normal operation of power transmission.			
Loss of 125V DC System B of Pole	114	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			If pole is already been operated at 200 MW ignore this step
	115	Matiari & Lahore	Start the Pole	Power	200 MW	
	116			Ramp Rate:	50 MW/Min	
	117		Wait to achieve Target Value	Max Time	5 min	
	118	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	119			DC Voltages	660kV	
	120			RPC Operation	BP-11/13 , HP24/36	
	121	Lahore		Extinction Angle (γ)	17°	
	122			DC Voltages	Range to be mentioned	
	123			RPC Operation	1xHP12/24	
	124	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum power			
	125		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	126	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	127	Lahore		1xHP12/24		
	128	Matiari	Ramp Up	200 MW	300 MW	50 MW/Min
	129	Matiari~~/Lahore~~	Open the 125 V DC system B main switch.			
	130		Verify Continuing Normal operation of power transmission.			
	131		Re-close the 125 V DC system B main switch.			
	132		Verify Continuing Normal operation of power transmission.			
	133	Lahore	Open the 125 V DC system B main switch.			
	134		Verify Continuing Normal operation of power transmission.			
	135		Re-close the 125 V DC system B main switch.			
	136		Verify Continuing Normal operation of power transmission.			

Simulated DC Line Fault o nly Matiari	137	Matiari/Lahore C/S DC side	Select Joint Current Control, Verify Ready for Operation Conditions.			
	138	Matiari & Lahore	Start the Pole,	Current	303 Amps	
	139			Ramp Rate:	100 A/Min	
	140		Wait to achieve Target Value	Max Time	5 min	
	141	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	142			DC Voltages	660kV	
	143			RPC Operation	BP-11/13 , HP24/36	
	144	Lahore		Extinction Angle (γ)	17°	
	145			DC Voltages	Range to be mentioned	
	146			RPC Operation	1xHP12/24	
	147	Matiari/Lahore	Verify stable operation & Normal start at reduced with minimum			
	148		Perform normal inspections (visual and acoustical) while pole is			
	149	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	150	Lahore		1xHP12/24		
	151	Matiari	Instruct Test inspector to Simulate a DC Line Fault by activating the DC line protection in PCPA in Matiari.			
	152	Matiari	Verify	Verify the firing angle has been retarded in Matiari station.		
	153	Matiari/Lahore		Verify that the system quickly recovers within the expected time delays.		
	154		Change all the modified settings back to original value.			
	155		Stop the Pole			
	156		Verify Performance parameters	Retard, Reduced Current		
	157			Firing angle (α)	90°	
Simulate Fault of Converter Transformer PT Breaking at Matiari station	158	Matiari	Verify pole is in Power Control Mode respectively.			
	159	Matiari/Lahore	Start the Pole,	Power	200 MW	
	160			Ramp Rate:	50 MW/Min	
	161		Wait to achieve Target Value	Max Time	5 min	
	162	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	163			DC Voltages	660kV	
	164			RPC Operation	BP-11/13 , HP24/36	
	165	Lahore		Extinction Angle (γ)	17°	
	166			DC Voltages	Range to be mentioned	
	167			RPC Operation	1xHP12/24	
	168	Matiari	Switchover active system to check PCPA and PCPB are healthy.			
	169		Verify PCP-A of system is active in pole.			
	170		Instruct test commander to Simulate Fault of Converter Transformer PT Breaking in active system at Matiari station by pulling out the cable which connected the secondary circuit of converter phase A PT and CTPA.			
	171		Verify	Low AC Voltage Detected		
	172			Pole System Switchover by Low AC Voltage On		
	173		Restore the cable, and then verify the PCPA would automatically restore to standby status and PCPB is the active system.			
	174		Instruct test commander to Simulate Fault of Converter Transformer PT Breaking in active system at Matiari station by pulling out the cable which connected the secondary circuit of converter phase A PT and CTPB.			
	175		Verify	Low AC Voltage Detected		
	176			Pole System Switchover by Low AC Voltage On		
	177		Restore the cable, and then verify the PCPB would automatically restore to standby status and PCPA is the active system.			
	178	Matiari	Stop the Pole			
	179		Verify Performance parameters	Retard, Reduced Current		
	180	Lahore		Firing angle (α)	90°	
Simulate Fault of Converter Transformer PT Breaking at Lahore station	181	Matiari	Verify pole is in Power Control Mode respectively.			
	182	Matiari/Lahore	Start the Pole	Power	200 MW	
	183			Ramp Rate:	50 MW/Min	
	184		Wait to achieve Target Value	Max Time	5 min	
	185	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	186			DC Voltages	660kV	
	187			RPC Operation	BP-11/13 , HP24/36	
	188	Lahore		Extinction Angle (γ)	17°	
	189			DC Voltages	Range to be mentioned	
	190			RPC Operation	1xHP12/24	
	191	Lahore	Switchover active system to check PCPA and PCPB are healthy.			
	192		Verify PCP-A of system is active in pole.			
	193		Instruct test commander to Simulate Fault of Converter Transformer PT Breaking in active system at Matiari station by pulling out the cable which connected the secondary circuit of converter phase A PT and CTPA			
	194		Verify	Low AC Voltage Detected		
	195			Pole System Switchover by Low AC Voltage On		
	196		Restore the cable, and then verify the PCPA would automatically restore to standby status and PCPB is the active system.			
	197		Instruct test commander to Simulate Fault of Converter Transformer PT Breaking in active system at Matiari station by pulling out the cable which connected the secondary circuit of converter phase A PT and CTPB.			
	198		Verify	Low AC Voltage Detected		
	199			Pole System Switchover by Low AC Voltage On		
	200		Restore the cable, and then verify the PCPB would automatically restore to standby status and PCPA is the active system.			
	201	Matiari	Stop the Pole			
	202		Verify Performance parameters	Retard, Reduced Current		
	203	Lahore		Firing angle (α)	90°	

Simulate Fault of DC Line PT Breaking at Matiari station	204	Matiari	Verify pole is in Power Control Mode respectively.			
	205	Matiari/Lahore	Start the Pole	Current	200 MW	
	206			Ramp Rate:	50 MW/Min	
	207		Wait to achieve Target Value	Max Time	5 min	
	208	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	209			DC Voltages	660kV	
	210			RPC Operation	BP-11/13 , HP24/36	
	211	Lahore		Extinction Angle (γ)	17°	
	212			DC Voltages	Range to be mentioned	
	213			RPC Operation	1xHP12/24	
	214	Matiari	Switchover active system to check PCPA and PCPB are healthy.			
	215		Verify PCP-A of system is active in pole.			
	216		Instruct test commander to Simulate Fault of DC Line PT Breaking in active system at Matiari station by pulling out the signal which connected the secondary circuit of DC line PT and PCPA.			
	217		Verify	Pole DC Line Voltage Measurement Value Error		
	218			Pole Active System Switchover.		
	219		Restore the cable, and then verify the PCPA would automatically restore to standby status and PCPB			
	220		Instruct test commander to Simulate Fault of DC Line PT Breaking in active system at Matiari station by pulling out the signal which connected the secondary circuit of DC line PT and PCPB.			
	221		Verify	Pole DC Line Voltage Measurement Value Error		
	222			Pole Active System Switchover.		
	223		Restore the cable, and then verify the PCPB would automatically restore to standby status and PCPA			
	224	Matiari	Stop the Pole			
	225		Verify Performance parameters	Retard, Reduced Current		
	226	Lahore		Firing angle (α)	90°	
Simulate Fault of DC Line PT Breaking at Lahore station	227	Lahore	Verify pole is in Power Control Mode respectively.			
	228	Matiari/Lahore	Start the Pole	Current	200 MW	
	229			Ramp Rate:	50 MW/Min	
	230		Wait to achieve Target Value	Max Time	5 min	
	231	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	232			DC Voltages	660kV	
	233			RPC Operation	BP-11/13 , HP24/36	
	234	Lahore		Extinction Angle (γ)	17°	
	235			DC Voltages	Range to be mentioned	
	236			RPC Operation	1xHP12/24	
	237	Lahore	Switchover active system to check PCPA and PCPB are healthy.			
	238		Verify PCP-A of system is active in pole.			
	239		Instruct test commander to Simulate Fault of DC Line PT Breaking in active system at Matiari station by pulling out the signal which connected the secondary circuit of DC line PT and PCPA			
	240		Verify	Pole DC Line Voltage Measurement Value Error		
	241			Pole Active System Switchover.		
	242		Restore the cable, and then verify the PCPA would automatically restore to standby status and PCPB is the active system.			
	243		Instruct test commander to Simulate Fault of DC Line PT Breaking in active system at Matiari station by pulling out the signal which connected the secondary circuit of DC line PT and PCPB.			
	244		Verify	Pole DC Line Voltage Measurement Value Error		
	245			Pole Active System Switchover.		
	246		Restore the cable, and then verify the PCPB would automatically restore to standby status and PCPA is the active system.			
	247	Matiari	Stop the Pole			
	248		Verify Performance parameters	Retard, Reduced Current		
	249	Lahore		Firing angle (α)	90°	
Simulate NO ACTIVE signal loss of pole control changeover devi ce	250	Lahore	Verify pole is in Power Control Mode respectively.			
	251	Matiari/Lahore	Start the Pole-2	Current	200 MW	
	252			Ramp Rate:	50 MW/Min	
	253		Wait to achieve Target Value	Max Time	5 min	
	254	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	255			DC Voltages	660kV	
	256			RPC Operation	BP-11/13 , HP24/36	
	257	Lahore		Extinction Angle (γ)	17°	
	258			DC Voltages	Range to be mentioned	
	259			RPC Operation	1xHP12/24	
	260	Matiari	Switchover active system to check PCPA and PCPB are healthy.			
	261		Verify PCP-A of system is active in pole.			
	262		Instruct test commander to Simulate NO ACTIVE signal loss of pole control changeover device at Matiari station by pulling out the signal which send the NO ACTIVE signal cable.			
	263		Verify	Pole keep stable operation.		
	264		Restore the cable, and then verify the PCPA would automatically restore to standby status and PCPB			
	265	Lahore	Switchover active system to check PCPA and PCPB are healthy.			
	266		Verify PCP-A of system is active in pole.			
	267		Instruct test commander to Simulate NO ACTIVE signal loss of pole control changeover device at Lahore station by pulling out the signal which send the NO ACTIVE signal cable.			
	268		Verify	Pole 2 keep stable operation.		
	269		Restore the cable, and then verify the PCPB would automatically restore to standby status and PCPA			
	270	Matiari	Stop the Pole			
	271		Verify Performance parameters	Retard, Reduced Current		
	272	Lahore		Firing angle (α)	90°	

Test Acceptance Criteria	273	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)	
	274		All Operations executed successfully	
	275		The synchronizing voltage and the phasing of the firing control signals are correct.	
	276		All thyristor check-back signals are available.	
	277		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.	
	278		Measuring quantities are available and the values are within the specified range and phase.	
	279		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.	
	280		No Stuck Condition	
	281		No False Tripping by DC Protection System	
	282		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.	
	283		No Tripping in AC side of converter Station	

Monopole Low Power Tests

15-Control Pulse Loss Failure, Normal Power Direction, Joint Power Control

Test Objective	The test objective is to check the DC system operation and system switchover during control pulse loss failure.

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 switchyard status	During Pole-I testing			
	4		See Status Table "P1-GR"			Ground Return Mode
	5		See Status Table "Mat-P2-ISOLAT" for Matiari and "Lah-P2-ISOLAT" for Lahore.			Isolation Mode
	6		During Pole-II testing			
	7		See Status Table "Mat-P1-ISOLAT" for Matiari and "Lah-P1-ISOLAT" for Lahore.			Isolation Mode
	8		See Status Table "P2-GR"			Ground Return Mode
	9	General Preconditions	Converter transformer protection and the charging protection of corresponding converter AC bus breaker are			
	10		Visual inspections of AC switchyard, AC filter yard, DC yard and DC valve hall prior first energization or switching.			
	11		All electrical connections are available.			
	12		Correct grounding of all equipment is available.			
	13		Thyristor valve cooling in operation for 24 hours, no water leakage observed.			
	14		Thyristor valves and valve hall is cleaned.			
	15		Verify Sequence of Events Recorder (SER) and make sure that no relevant alarms are present, and all systems are operational.			
			Inter-station telecommunication check of control and protection signals			
	17		Converter valve low voltage tests must be completed.			
	18		Air humidity and temperature in valve hall are within expected limits.			
	19		All Normal Power Direction Monopole Low Power Tests as in Annex-C-1 to 10 are successful			
	20		All Reverse Power Direction Monopole Low Power Tests as in Annex-C-11 to 14 are successful			
	21		Both sides AC system of Matiari & Lahore C/S are capable to supply and accept the power (200 MW) for the			
	22	DC Configuration Selection (Automatically apply to both Lahore and Matiari)	Direction	Normal		Matiari to Lahore
	23		Return	Ground		Ground Return Mode
	24		Udc Mode	Normal		±660kV
	25		Telecom Mode	Operational		
	26		Master Station	Matiari		
	27	Configuration Setting at Lahore & Matiari C/S DC side	Station Control (SC)	A	ACTIVE	Can be changed to B during test
	28			B	Standby	
	29		Pole Control Protection (PCP)	A	ACTIVE	
	30			B	Standby	
	31		Transmission Control Mode	Power	ACTIVE	HVDC will operate in power control mode.
	32		Station Control Mode	Joint	ACTIVE	Matiari & Lahore will operate jointly.
	33		Reactive Power Control Mode	Automatic	ACTIVE	Automatically Switch in/out the AC Filters/Reactors
	34		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

Multiple (>5) Pulses Loss Fault at Inverter in Ground Return	35	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	36	Matiari & Lahore	Start the Pole,	Power	200 MW	
	37			Ramp Rate:	50 MW/Min	
	38		Wait to achieve Target Value	Max Time	5 min	
	39	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	40			DC Voltages	660kV	
	41			RPC Operation	BP-11/13 , HP24/36	
	42	Lahore		Extinction Angle (γ)	17°	
	43			DC Voltages	Range to be mentioned	
	44			RPC Operation	1xHP12/24	
	45	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	46		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	47	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	48	Lahore		1xHP12/24		
	49	Lahore	Instruct Test Commander to Simulate more than five consecutive firing pulses loss in LAHORE by pulling out a CP signal optical fiber from PCP A system to VBE A system. PCP B system is out of service.			
	50	Lahore	Verify	Advancing of Gamma		
	51			Switch to the standby pole control system		
	52			Y-block of the converter		
	53			Trip of the AC circuit breaker(s) feeding the converter transformer.		
	54			Pole isolation.		
	55			Trip of the AC Filters breakers by RPC.		
	56			Start breaker failure protection.		
	57			Set lockout relay for the tripped AC circuit breaker(s).		
	58	Matiari		Lock the DC-line protection. (?)		
	59			Y-block of the converter.		
	60			Trip of the AC Filters breakers by RPC.		
	61			Set lockout relay for the tripped AC circuit breaker(s).		
Multiple (>5) Pulses Loss Fault at Rectifier in Ground Return	62		Initiate the sequence for transfer from Metallic to Ground Return.			
	63	Matiari/Lahore C/S DC side	Verify Ready for Operation Conditions.			
	64	Matiari & Lahore	Start the Pole	Power	200 MW	
	65			Ramp Rate:	50 MW/Min	
	66		Wait to achieve Target Value	Max Time	5 min	
	67	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	68			DC Voltages	660kV	
	69			RPC Operation	BP-11/13 , HP24/36	
	70	Lahore		Extinction Angle (γ)	17°	
	71			DC Voltages	Range to be mentioned	
	72			RPC Operation	1xHP12/24	
	73	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	74		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	75	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	76	Lahore		1xHP12/24		
	77	Matiari	Instruct Test Commander to Simulate more than five consecutive firing pulses loss in Matiari by pulling out a CP signal optical fiber from PCP B system to VBE B system. PCP A system is out of service.			
	78	Matiari	Verify	Switch to the standby pole control system		
	79			Y-block of the converter		
	80			Trip of the AC circuit breaker(s) feeding the converter transformer.		
	81			Pole isolation.		
	82			Trip of the AC Filters breakers by RPC.		
	83			Start breaker failure protection.		
	84			Set lockout relay for the tripped AC circuit breaker(s).		
	85	Lahore		Normal Y-stop sequence.		
	86			Trip of the AC Filters breakers by RPC.		

Multiple (>5) Pulses Loss Fault at Inverter in Metallic Return	87	Matiari/Lahore	Initiate the sequence for transfer from Ground to Metallic Return.			
	88		Verify Ready for Operation Conditions.			
	89	Matiari/Lahore	Start the Pole-1,	Power	200 MW	
	90			Ramp Rate:	50 MW/Min	
	91		Wait to achieve Target Value	Max Time	5 min	
	92	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	93			DC Voltages	660kV	
	94			RPC Operation	BP-11/13 , HP24/36	
	95	Lahore		Extinction Angle (γ)	17°	
	96			DC Voltages	Range to be mentioned	
	97			RPC Operation	1xHP12/24	
	98	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	99		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	100	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	101	Lahore		1xHP12/24		
	102	Lahore	Instruct Test Commander to Simulate more than five consecutive firing pulses loss in LAHORE by pulling out a CP signal optical fiber from PCP A system to VBE A system. PCP B system is out of service.			
	103	Lahore	Verify	Advancing of Gamma		
	104			Switch to the standby pole control system		
	105			Y-block of the converter		
	106			Trip of the AC circuit breaker(s) feeding the converter transformer.		
	107			Pole isolation.		
	108			Trip of the AC Filters breakers by RPC.		
	109			Start breaker failure protection.		
	110			Set lockout relay for the tripped AC circuit breaker(s).		
	111	Matiari		Lock the DC-line protection. (?)		
	112			Y-block of the converter.		
	113			Trip of the AC Filters breakers by RPC.		
	114			Set lockout relay for the tripped AC circuit breaker(s).		
Multiple (>5) Pulses Loss Fault at Rectifier in Metallic Return	115	Matiari/Lahore	Verify Ready for Operation Conditions.			
	116	Matiari/Lahore	Start the Pole,	Power	200 MW	
	117			Ramp Rate:	50 MW/Min	
	118		Wait to achieve Target Value	Max Time	5 min	
	119	Matiari	Verify Performance indicators	Firing angle (α)	15°±2.5°	
	120			DC Voltages	660kV	
	121			RPC Operation	BP-11/13 , HP24/36	
	122	Lahore		Extinction Angle (γ)	17°	
	123			DC Voltages	Range to be mentioned	
	124			RPC Operation	1xHP12/24	
	125	Matiari/Lahore	Verify stable operation & Normal start at minimum power			
	126		Perform normal inspections (visual and acoustical) while pole is deblocked.			
	127	Matiari	Verify RPC action	BP-11/13, HP-24/36		
	128	Lahore		1xHP12/24		
	129	Lahore	Instruct Test Commander to Simulate more than five consecutive firing pulses loss in LAHORE by pulling out a CP signal optical fiber from PCP A system to VBE A system. PCP B system is out of service.			
	130	Lahore	Verify	Advancing of Gamma		
	131			Switch to the standby pole control system		
	132			Y-block of the converter		
	133			Trip of the AC circuit breaker(s) feeding the converter transformer.		
	134			Pole isolation.		
	135			Trip of the AC Filters breakers.		
	136			Start breaker failure protection.		
	137			Set lockout relay for the tripped AC circuit breaker(s).		
	138	Matiari		Lock the DC-line protection. (?)		
	139			Y-block of the converter.		
	140			Trip of the AC Filters breakers.		
	141			Set lockout relay for the tripped AC circuit breaker(s).		