



National Transmission & Despatch Company Limited (National Power Control Center)

REVIEWED

RBJ RBJ Engineering Corporation

Bruno Bisewski

29-April-2021

- No comments
 Comments as Indicated
- This review does not convey Acceptance or Approval and does not relieve Contractor of full responsibility for system performance.

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

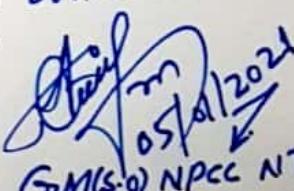
DC MONOPOLE HIGH POWER COMMISSIONING DESPATCH PROCEDURE OF MATIARI & LAHORE CONVERTER STATION

27042021-NPCC-DCDP V 1.72

April, 2021

Commissioning Committee Approval Proforma DC MONOPOLE HIGH POWER COMMISSIONING DESPATCH PROCEDURE OF MATIARI & LAHORE CONVERTER STATION ±660kV HVDC MATIARI-LAHORE, PROJECT, PAKISTAN		
Document Number :		27042021-NPCC-DCDP V 1.72
Reference Document : Submitted by PMLTC/CET and reviewed/approved by NTDC/OE dated 21-04-2021		Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests, (5) Monopole High Power System Tests Program HXT2020-109 dated 21-04-2021.
Issue Date :		27-04-2021
Prepared by:		NPCC
Whether dispatching procedure reviewed by M/S PMLTC		Yes
Approved by Commissioning Committee		
Engr. Ghulam Abbas Memon General Manager (System Operation) NPCC	Dr. Chang Yong Chief Engineer (PMLTC)	Mr. Aldo Danielli Independent Engineer M/S CESI
Sign:  05/04/2021	Sign: Chang Yong 2021. 4. 29.	Sign: Aldo Danielli 05. 05. 01 Ref. Letter 6117-30/Gen(50)/NPCC-HVDC
Note: 1. Disseminated for information and implementation to all concerned. 2. Errors/Omissions are accepted.		

Note:- It's already intimated vide GM(S.O) NPCC, NTDC Letter No. 6117-30 dt: 27-04-2021 addressed to C-E (HVDC) NTDC that- "the Pre-requisites prior to starts the "High Power Monopole tests/Commissioning tests" must be fulfilled in order to ensure the system security, stability and reliability in all respect whereas our NPCC NTDC team is available round the clock for any co-ordination, if desired.



GM(S.O) NPCC NTDC.



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References

- [1] A5-Matiari-Lahore ±660kV HVDC Transmission Project Commissioning Tests-Monopole High Power System Tests Program HXT2020-109 dated 21-04-2021.
- [2] Lahore Converter station SLD document number DCL00, dated: 17-08-2020, Rev-00.
- [3] Matiari Converter station SLD document number DCM01, dated: 13-10-2020, Rev-01.

1 General Conditions

- 1.1. This dispatch procedure is issued for operational co-ordination during “Commissioning Tests Plan” of the HVDC System/switchyard at both Matiari/Lahore Converter stations of ±660kV HVDC Matiari –Lahore project as per reference information provided by Pakistan Matiari Lahore Transmission Company (PMLTC) through CE HVDC [1].
- 1.2. The authorized representatives from PMLTC and NPCC (list of despatcher on duty and key personnel to be provided later) shall confirm in writing the revision number of the Commissioning Test Plans [1] to be followed throughout the testing prior to start of testing. Any changes made to the test plan once testing has started shall be noted and approved in writing by both the authorized representatives from PMLTC and NPCC.
- 1.3. The authorized personnel (2 personnel) as identified by PMLTC shall remain at NPCC during whole DC commissioning period.
- 1.4. PMLTC shall provide the 24/7 duty roster along with names/designation of authorized operational staff of Matiari and Lahore converter station to NPCC.
- 1.5. It shall be the responsibility of PMLTC and Test Director to establish desired safe communications during entire commissioning period with the authorized control room operators at Matiari-Lahore Converter station regarding requirement of switching etc. for the scheduled test item.
- 1.6. The operator at Matiari and Lahore Converter Station shall be well conversant with the prudent practices and SOPs regarding compliance to the instructions of system operator (NPCC authorized despatcher on duty).
- 1.7. CET/PMLTC shall attach this dispatch procedure (27042021-NPCC-DCDP V 1.72), including its all annexures with commissioning test program.
- 1.8. The commissioning director appointed by CET shall be responsible for coordination and compliance of NPCC Instructions.
- 1.9. The test director(s) shall re-submit final adjusted test plan three days in advance at 10:00 Hrs to NPCC and re-confirm the next day test plan one day in advance at 10:00 Hrs every day.
- 1.10. Prior to each test, the test director (XIE GUOPING) of China Electric Power Research Institute shall notify the relevant departments, participating in test, through the tele-conference call system dial-in number (to be determined), in the converter station.
- 1.11. The test director shall be identified by PMLTC prior to the start of testing daily.

- 1.12. The NPCC authorized dispatcher on duty shall be identified by NPCC prior to the start of testing daily.
- 1.13. NPCC shall manage the AC system parameters according to the requirements of the commissioning (as mentioned in commissioning program).
- 1.14. Operators of Matiari and Lahore converter stations are responsible for equipment status report and the execution of the operation orders issued by NPCC.
- 1.15. The test director(s) shall seek permission from NPCC regarding switching of any HVAC and HVDC switchgear(s) to meet the test requirement as per agreed test activity of the commissioning program.
- 1.16. NPCC upon request of Test Director shall impart instructions to the authorized operational personnel on duty in control room of Matiari and Lahore Converter stations. The communication procedure shall be as follows:
 - i. NPCC authorized dispatcher shall identify themselves.
 - ii. NPCC authorized dispatcher shall state the instruction to be followed
 - iii. Operation personnel on duty in the control room of Matiari and Lahore Converter station shall identify themselves.
 - iv. Operation personnel on duty in the control room of Matiari and Lahore Converter stations shall acknowledge the instruction by repeating the instruction back to the authorized NPCC dispatcher, to re-confirm the instruction.
 - v. NPCC authorized dispatcher shall confirm the instruction to be followed and approve execution.
 - vi. Operation personnel on duty in the control room of Matiari and Lahore Converter stations shall acknowledge confirmation to execute the operation.
 - vii. Operation personnel on duty in the control room of Matiari and Lahore Converter stations shall then execute the operation and shall inform NPCC after execution.
 - viii. NPCC authorized dispatcher shall acknowledge, that operation has been executed, by verifying the status from OWS/ SCADA.
 - ix. Any delay in execution of instructions/operations by PMLTC shall be communicated by stating the cause/reason of delay.
 - x. All the communications between NPCC and PMLTC operation personnel shall be recorded on both sides.

2 Pre-requisites to the commissioning:

- 2.1 PMLTC shall ensure that the final SLDs [2] have been approved and issued by NPCC and equipment's code in the switchyards, control room panels and relay rooms has been marked as per approved SLDs. The switching sequences during and after the commissioning shall be performed as per Dispatch Code/ nomenclature of the approved SLDs [2].
- 2.2 Round the clock healthy voice-communication (Hotline, direct dialing etc.) between the control room of Matiari/Lahore Converter stations and NPCC shall be ensured by PMLTC.
- 2.3 CET/PMLTC shall submit commissioning plan along with sequence of operation to NPCC during the

DC Monopole High Power Commissioning Despatch Procedure

- 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 changes in list of representatives during commission / testing activities.
- 2.9 Chief Engineer HVDC, NTDC shall prepare the methodology to ensure clear coordination and decision making during the commissioning / testing.
- 2.10 PMLTC shall provide fully functional Stability Control System (SCS) & Oscillation Splitting Devices, to ensure power system stability and reliability.
- 2.11 DC commissioning tests A1 and A2 for Matriari and Lahore converter stations respectively, have been successfully completed, including Open Line Test with DC line, and DC lines of both poles Pole-I and Pole-II have been successfully energized.
- 2.12 The results of DC commissioning tests A1, A2, A3, and A4 for Matriari and Lahore converter stations respectively, including all graphs/charts related to pole power, current, voltages, firing angles and extinction angles, tap positions etc... have been approved by NTDC / Owner Engineer (M/S HATCH).
- 2.13 Approval of NTDC authority is required before conducting AC line fault tests.
- 2.14 Relevant personnel from Asset Management, protection and control, TSG, CE (HVDC) must be at the site to witness the AC line fault test.
- 2.15 Optional tests may or may not be carried out by NPCC as per the then system prevailing conditions
- 2.16 Studies have been performed and reviewed to quantify the risk to the ac system during the tests including single and double contingencies for power transfer up to the maximum power that will be transferred in the tests.
- 2.17 Transformer oil samples to be taken before and after the P1 and P2 High power tests and the results of the gas in oil analysis to be presented in a report after the tests.

3 Safety Precautions during Commissioning Tests:

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

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

- 3.2 During the commissioning of DC system, PMLTC will be responsible for taking on-site safety measures, as per requirement of the commissioning and NEPRA Codes (Power Safety Codes, Grid Codes etc.) and international standards, to ensure equipment and personnel safety at both Matiari and Lahore Converter stations.
- 3.3 At Matiari and Lahore converter stations, the test equipment or external equipment should be properly tagged /locked out, or use the black, red and white tape belt and other warning signs/ equipment.

4 Commissioning Procedure:

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

- 4.1 Commissioning director shall seek formal permission from NPCC before initiating any commissioning test.
- 4.2 NPCC will manage the operation of AC system to meet the requirements of commissioning tests as planned for a particular day.
- 4.3 If in any case, the commissioning work cannot be carried out in accordance with the commissioning plan due to undesired AC system / Power grid conditions, test plan of that day shall be rescheduled by NPCC, with co-ordination of CE-HVDC and PMLTC.
- 4.4 NPCC instructions to be followed by all concerned during the commissioning of HVDC system in view of prevailing system conditions.

5 Disturbance Handling:

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

- 5.1 NPCC is responsible for the switching operation and disturbance management of AC system of the associated grid stations/plants connected with the converter stations, and PMLTC is responsible for the switching operation and disturbance management of Matiari and Lahore Converter stations and Bipole DC Transmission Line.
- 5.2 In case there is any problem or equipment fault occurred with the AC system during the commissioning test, NPCC will coordinate with relevant NTDC Asset Management to fix it. In case there is any problem or equipment fault occurred at Matiari and Lahore Converter stations and Bipole DC Transmission Line, PMLTC will fix it.
- 5.3 During the commissioning, if any equipment under test depicts abnormal behavior, the commissioning director is responsible for managing the disturbance.
- 5.4 During the commissioning, if an emergent situation arises that endangers personal safety and poses serious threat to the main equipment, the operators may not wait for the commissioning director order and is permitted to immediately stop the DC system, and inform NPCC.
- 5.5 If the DC system is out of service due to an abnormal AC system or fault, the converter station operator shall immediately report the disturbance to NPCC.

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

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

- 6.1 AC breakers controlling converter transformer of pole I and II at both Matiari/Lahore C/S are in cold standby state or otherwise.
- 6.2 Complete DC switchgear at Matiari/Lahore C/S is in *cold standby state.
- 6.3 DC line of pole I and II at both Matiari/Lahore C/S is in *cold standby state.
- 6.4 All AC filters at both Matiari/Lahore C/S are in “Ready for Operation” condition.
- 6.5 AC lines and the remaining 500 kV equipment at both Matiari/Lahore C/S is in normal operation.

7 Commissioning Test Startup Procedure:

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

7.1 Pole I High Power Tests, Normal Power Direction

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

7.2 Pole-II High Power Test, Normal Power Direction

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

7.3 Pole I & II High Power Test Reversed Power Direction

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

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



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

Sr. No.	Test Block	Commissioning Items	Mode	Item Designations	Sub-item Designation	Power imported from AC Network (MW)
<i>High Power System Tests-Monopolar (Will be updated once the draft gets approved)</i>						
<i>All tests above must be successful before executing the High Power tests</i>						
<i>The tests in HP-1, HP-2, HP-3, HP-4 should be performed in sequence. In the case of any failure or delay in Block HP-1, next test in the block should not proceed until the reason for failure or delay is resolved.</i>						
Pole1 High Power Tests, Normal Power Direction						
1	HP-1	2.3.1	GR	Pole 1 High Power Test,	Pole-I Start	200
2		2.3.2	GR	Pole 1 High Power Test	Pole-I Ramp Up & Control System Switchover	200-2200
3		3.3.1	GR	Pole 1 Heat Run Test and Special Measurements	Pole-I Run at 1.00 p.u. in Monopole without Redundant Cooling	2200
4			GR	Pole 1 High Power Test	Pole Control, DC Side Protections, AC Side Protections [Analogue Input Checks]	
5		3.3.2	GR	Pole 1 Heat Run Test and Special Measurements	Pole-I Run at 1.1 p.u. in Monopole with Redundant Cooling	2400
6		2.3.3	GR	Pole 1 High Power Test	Tap Changer Control, Manual Tap Changer Step	2000
7		2.3.4	GR /MR	Pole 1 High Power Test	Ground/Metallic Return Transfer	2000
8		3.3.3	GR	Pole 1 Heat Run Test and Special Measurements	Radio Interference Measurements	2200/2400
9		3.3.4	GR	Pole 1 Heat Run Test and Special Measurements	Audible Noise Check	2200/2400
10		3.3.5	GR	Pole 1 Heat Run Test and Special Measurements	Station Auxiliary Power Losses	2200/2400
11		3.3.6	GR	Pole 1 Heat Run Test and Special Measurements	Temperature Measurement With IR-Camera Equipment	2200/2400
12		3.3.7	GR	Pole 1 Heat Run Test and Special Measurements	Pole-I Ground Electrode Test	2200/2400
13		A5-2.3.2 steps 19-25	GR	Pole 1 High Power Test	Pole-I Pole Ramp Down & Control System Switchover	2000-200




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

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Monopole High Power System Tests

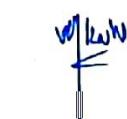
Pole I High Power Tests

Normal Power Direction

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

Testing Start Up Sequence

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



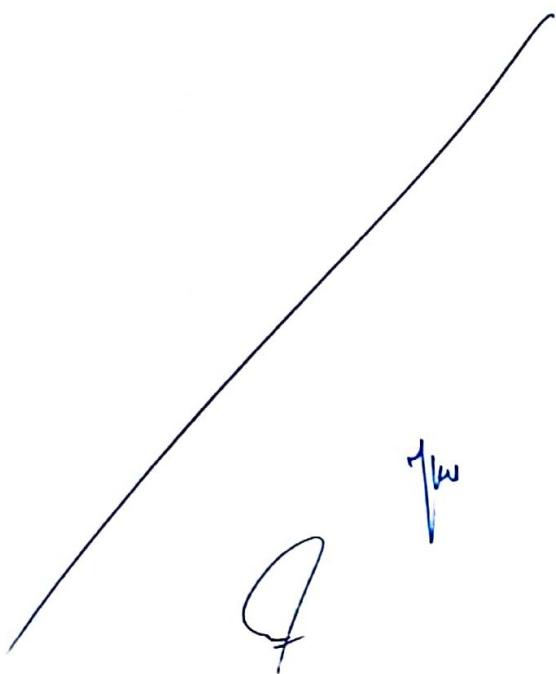
Pole-I Ramp Up & Control System Switchover(A5-2.3.2)

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

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

			Order Pole-I Transfer GR to MR		
144	Matiari/Lahore	Matiari Verify	NE11	OPEN	
145			WNQ1,	CLOSED	
146			WNQ11,WP2Q10		
147			WN3Q1,WN3Q11,WN	OPEN	
148			3Q12		
149		Lahore Verify	Transmitted Power is maintained		
150			No Transients, no unexpected Time Delay		
151			NE11	OPEN	
152			WNQ11,WP2Q10	CLOSED	
153		Order Pole-I Transfer MR to GR	Transmitted Power is maintained		
154	Matiari/Lahore		No Transients, no unexpected Time Delay		
155			NE11	CLOSED	
156			WNQ1,	OPEN	
157			WNQ11,WP2Q10		
158			WN3Q1,WN3Q11,WN	CLOSED	
159			3Q12		
160			Transmitted Power is maintained		
161			No Transients, no unexpected Time Delay		
162			NE11	CLOSED	
163			WNQ11,WP2Q10	OPEN	
Pole-I Radio Interference Measurements (AS-2.3.4)		Measure / Record /Save	Transmitted Power is maintained		
164	Matiari \Lahore		No Transients, no unexpected Time Delay		
165			NE11	CLOSED	
166			WNQ11,WP2Q10	OPEN	
Pole-I Audible Noise Check (AS 3.3.4)		Measure / Record /Save	Places inside the converter stations and about 450m away outside the converter station and carry out the measurement of the interference frequency spectrum.		
167	Matiari \ Lahore		the frequency spectrum characteristics of radio interference under the outlet line of the ±660 kV valve hall and at 20 m from the outlet line inside the converter station		
168			Places inside the converter stations and about 450m away outside the converter station and carry out the measurement of the interference frequency spectrum		
169			Audible noise near the convertor transformer in the converter station		
Pole-I Station Auxiliary Power Losses (AS-3.3.5)		Record	Audible noise along the boundary line outside the converter station		
170	Matiari / Lahore		Measurement of Audible noise in front of the houses near the converter station, if there are houses.		
171			In status R eady for Operation , the loads on the 400V power level are measured with in one scheduled time period (for example 5 times measurements in one hour with recording sheets . The measurement results are averaged to get values, which are equivalent losses to the no-load or fixed Auxiliary Power losses.		
172			Measured loss values should be within limited value specified by technical specification		
173	Verify	When Operating at 1.0pu or 1.1pu - Measure loads on 400V power level 5 times in one hour, calculate average of measured values			
Pole-I Temperature With IR-Camera Equipment (AS-3.3.6)			Measured loss values should be within limited value specified by technical specification		
174		Matiari / Lahore	The temperature of busbars, clamps conductors, equipment, etc. are acceptable in DC-yard, AC-yard, and valve hall		
Pole-I Ground Electrode Test (AS-3.3.7)		Record/Verify	The temperature of busbars, clamps conductors, equipment, etc. are acceptable in DC-yard, AC-yard, and valve hall		
175	Matiari & Lahore		Measure the electrode resistance by measuring the neutral bus voltage and the electrode current.		
176			Measure step and touch potentials at the electrode sites		
177			Measure the various cable current of the electrode		
178			Measure the temperature rise in the electrode conductor and the soil in the electrode site.		
179			The current distribution within the various parts cables of the electrode shall be within the design limits.		
180			Step and touch potentials must be within safe limits		
181			The electrode conductor temperature shall be within the design limits.		

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



Monopole High Power System Tests

Pole II High Power Tests

Normal Power Direction

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

Testing Start Up Sequence

Pole-II Start (AS-4.3.1.1)	21	Matiari/Lahore C/S DC	Verify Pole-II in Pole Power Control, Ready for Operation Conditions.						
	22	Matiari & Lahore	Start the Pole-II	Power	200 MW	Refer To Pole De-Blocking and starting sequence			
	23			Ramp Rate:	100 MW/Min				
	24	Matiari	Wait to achieve Target Value	Max Time	2 min				
	25			Firing angle (α)	15°±2.5°				
	26			DC Voltages	660kV				
	27	Lahore	Verify Performance indicators	Extinction Angle (δ)	17°				
	28			DC Voltages	Nominal				
	29	Matiari	Verify RPC action	BP-11/13, HP-24/36					
	30			HP12/24					
	31	Lahore		Continuous Steady Operation					
	32	Matiari/ Lahore	Verify	Verify stable operation & Normal start at minimum					
	33			Perform normal inspections (visual and acoustical) while					
	34			Verify Pole2 in Pole Power Control, Ready for Operation Conditions.					
Pole-I Ramp Up & Control System Switchover (AS-4.3.2 Step1-16)	35	Matiari/Lahore C/S DC side	Ramp the pole2 power up to 2000MW at 50MW/min rate in steps of 200MW with a stop interval of 2 minutes at the end of each step. The interval is to make sure the system is stable.						
	36								
	37	Matiari	Ramp Up	200MW	400MW	50MW/Min			
	38	Matiari	Ramp Up	400MW	600MW	999 MW/Min			
	39	Matiari & Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.					
	40	Matiari/Lahore	Verify	Continuous Steady Operation of the transmission power reaches the reference value after ramping is completed					
	41								
	42			RPC in both stations connects the appropriate number of filters and shunt banks during ramping.					
	43	Matiari	Ramp Up	No Transients					
	44	Matiari & Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.					
	45								
	46	Matiari/Lahore	Verify	Continuous Steady Operation					
	47			Ramping Done and Holding the target Value					
	48			No Transients, no unexpected Time Delay					
	49	Matiari/Lahore	Ramp Up	800MW	1000MW	50 MW/Min			
	50		Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.					
	51		Switch Control System both poles (during Ramping)						
	52	Matiari/Lahore	Verify	PCP-A to PCP-B to PCP-A					
	53			SC-A to SC-B to SC-A					
	54			Continuous Steady Operation					
	55			PCP-A	Active				
	56			SC A	Active				
	57			Ramping Done and Holding the target Value					
	58	Matiari	No Transients, no unexpected Time Delay Continue the ramp up with the rate 50MW/Min in steps of 200MW, till the DC Power reaches 2000MW						
	59	Matiari /Lahore	Verify (during Ramping)	At Each stop record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during Pole-II power ramping.					

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Pole-I Ramp Up & Control System Switchover (AS-4-32 step 1-16)	60	Matiari/Lahore	Verify	Continuous Steady Operation			
	61			Ramping Done and Holding the target Value			
	62			RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping			
	63			No Transients, no unexpected Time Delay			
	64	Matiari/Lahore	Inspect AC/DC analogue input signal of following systems while operating the pole at maximum power 2000 MW.	Trigger TFR manually to Pole-I DC side Analogue signal check in controls and Protection, and check the overlap			
	65	Matiari	Start the Pole-1 in Pole Power Control	Power 200 MW			
	66		Wait to achieve Target Value	Ramp Rate: 100 MW/Min			
	67			Max Time 2 min			
	68	Matiari/Lahore	Verify pole-1 stable operation & Normal start at minimum power				
	69		Perform normal inspections (visual and acoustical) while pole is deblocked.				
	70	Matiari	Change Pole-I from pole power control to bipole power control and set the bipole power reference 2200MW				
	71		Verify stable operation & bipole power transmission at 2200MW				
	72	Matiari/Lahore	Verify	Continuous Steady Operation			
	73			PCP-A Active			
	74			SC A Active			
	75			No False Action by Control Systems			
	76			No Transients, no unexpected Time Delay			
	77		Verify	Pole-II steady state operation at 2000MW			
	78			Pole-I steady state operation at 200MW			
	79			Switch Control System (at Pole Power 2000 MW) PCP-A to PCP-B			
	80			SC-A to SC-B			
	81		Verify	PCP-B Active			
	82			SC-B to Active			
	83			Continuous Steady Operation			
	84			No False Action by Control Systems			
	85			No Transients, no unexpected time delay			
	86		Switch Control System (at Pole Power 2000 MW)	PCP-B to PCP-A			
	87			SC-B to SC-A			
	88		Verify	Continuous Steady Operation			
	89			PCP-A Active			
	90			SC A Active			
	91			No False Action by Control Systems			
	92			No Transients, no unexpected Time Delay			
Pole-II Run at 1.00 p.u. in Monopole without Redundant Cooling (AS-5-3.1)	93	Matiari/Lahore	Verify	DC Power Pole2 power:2000MW			
	94			The reference is fulfilled after the ramping is completed			
	95			The measured currents and voltages at DC and AC side are correct.			
	96		Keep the pole in operation for 4 hours at 1.0 p.u. If any of the transformers has not reached steady state temperature, then continue for another 1/2 hour.				
	97		Measure & Record	Verify The measured currents and voltages at DC and AC side are correct.			
	98			valve cooling water temperature inlet and outlet continuously until a stable temperature is reached (temperatures should be stable within approximately 15 minutes).			
	99			temperature of coil winding and hot spot in converter transformer every 30 minutes. until reasonable stable temperature is reached (temperatures should be stable within approximately 3 hours).			
	100			AC-side Individual harmonics, Dn, THD, THFF, both stations external TFR 10000Hz sample rate			
	101			DC-side harmonics and leq in Matiari and LAHORE C/S from the power quality analyser.			
	102		Perform following measurements: 5.3.3 Radio Interference, 5.3.4 Audible Noise, 5.3.5 Station Service Power Loss, 5.3.6 Temperature Measurements with IR Camera,				
	103		Matiari	Ramp Up Pole-II 2000MW 2200MW 50MW/Min			
	104			set the bipole power reference 2400MW			
	105			DC Pole- II (Power) 2200MW			
	106			Verify The reference is fulfilled after the ramping is completed			
	107			The measured currents and voltages at DC and AC side are correct.			
	108			Keep the pole in operation for 2 hours at 1.1 p.u. The following verifications should be carried during this period			
	109		Verify	the reference is fulfilled after the ramping is completed			
	110			the measured currents and voltages at DC and AC side are correct.			
	111		Measure & Record	valve cooling water temperature inlet and outlet continuously until a stable temperature is reached (temperatures should be stable within approximately 15 minutes).			
	112			temperature of coil winding and hot spot in converter transformer every 30 minutes. until reasonable stable temperature is reached (temperatures should be stable within approximately 3 hours).			
	113			AC-side individual harmonics, Dn, THD, THFF, both stations external TFR 10000Hz sample rate			
	114			DC-side harmonics and leq in Matiari and LAHORE C/S from the power quality analyser.			
	115			Perform following measurements: 5.3.3 Radio Interference, 5.3.4 Audible Noise, 5.3.5 Station Service Power Loss, 5.3.6 Temperature Measurements with IR Camera,			
	116			Pole-II will automatically Ramp-down to 2000MW by overload timer after completion of 2 hours. Pole-I will automatically Ramp up to 400 MW			
	117			@ 200MW/Min			
	118						
Pole-II Run at 1.10 p.u. in Monopole with Redundant Cooling (AS-5-3.2)	119	Matiari/Lahore	Perform following measurements: 5.3.3 Radio Interference, 5.3.4 Audible Noise, 5.3.5 Station Service Power Loss, 5.3.6 Temperature Measurements with IR Camera,				
	120	Matiari	Pole-II will automatically Ramp-down to 2000MW by overload timer after completion of 2 hours. Pole-I will automatically Ramp up to 400 MW				



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

After reaching 660kV Order Pole-II power to ramp up to 2000MW.(because the DC system Power order is reset and cannot go back to 2000MW automatically after reduced action)

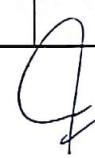
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			Set bipole order to 3000MW	no need
178	Matiari		Stop Pole-I Pole-II goes to 2000MW	Pole-II stays at 2000MW
179		Ramp Down Pole-II	2000MW	1600 MW
180		Ramp Down Pole-II	1600MW	1400 MW
181				50MW/Min
182	Matiari and Lahore	Switch Control System (during ramping) Note: Pole-I is not in operation anymore	PCP-A to	PCP-B
183			SC-A to	SC-B
184			PCP-B	Active
185			SC-B to	Active
186			Continuous Steady Operation	
187			No False Action by Control Systems	
188			No Transients, no unexpected time delay	
189		Ramp Down POLE-II	1400MW	800 MW
190	Matiari/Lahore	Verify	Continuous Steady Operation	
191			Ramping Done and Holding the target Value	
192			No Transients, no unexpected Time Delay	
193	Matiari	Ramp Down	800MW	600MW
194	Matiari/Lahore	Verify	Continuous Steady Operation	
195			Ramping Done and Holding the target Value	
196			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping
197			No Transients, no unexpected Time Delay	
198	Matiari	Ramp Down	600MW	200MW
199	Continuous Steady Operation			
200	Ramping Done and Holding the target Value			
201	RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping		
202			No Transients, no unexpected Time Delay	
203	Matiari	Select both poles to Bipole Power control		
204		Set Bipole Power Order to 400MW Start Pole-1		
205		After Pole 1 starts Both Poles at 200MW		
206		Ramp Ramp Up Bipole to 2200MW	400MW	2200 MW
207	Matiari/ Lahore	Verify	Continuous Steady Operation	
208			Verify stable operation & Normal start at minimum	
209			Perform normal inspections (visual and acoustical) while	
210	Matiari	Make margin of 1100 MW on parallel AC corridor		
211	Matiari	Push ESOF button in Pole-II to trip Pole-II.		
212	Matiari/Lahore	Verify	DC power of Pole-II transferred to Pole-I	
213			Pole-I steady state operation at 2200MW	
221	Matiari	Change Pole-I from Bipole power control to pole power control		
222		Ramp Down Pole-I	2200MW	2000 MW
223		Instruct Test Commander to apply a +0.08 P.U Step in Power Order with duration of 1000 msec in active PCP system.		
224		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value		
225		Instruct Test Commander to apply a -0.08 P.U Step in Power Order with duration of 1000 msec in active PCP system.		
226		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value		
227		Change all the modified settings back to original value		
228		Change pole1 control mode from pole power control to pole current control		
229		Instruct Test Commander to apply a +0.08 P.U Step in Current Order with duration of 1000 msec in active PCP system.		
230		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value		
231		Instruct Test Commander to apply a -0.08 P.U Step in Current Order with duration of 1000 msec in active PCP system.		
232		Record the current response and the overshoot, make sure the overshoot doesnot exceeds XX Value		
233		Change all the modified settings back to original value		
234		Record and save all test dat		




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

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




Monopole High Power System Tests

Pole I High Power Tests Reverse Power Direction (Optional)

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

Testing Start Up Sequence

Pole-I Pole Start (A5-6.3.1)					
21	Matiari/Lahore C/S DC			Verify Ready for Operation Conditions.	
22	Matiari & Lahore	Start the Pole-I in Reversed Power Direction		Power	200 MW
23				Ramp Rate:	100 MW/Min
24	Lahore	Wait to achieve Target Value		Max Time	2 min
25		Verify Performance Indicators		Firing angle (α)	15°±2.5°
26	Matiari			DC Voltages	660kV
27				RPC Operation	1xHP12/24
28	Matiari/Lahore			Extinction Angle (g)	17°
29				DC Voltages	Range to be mentioned
30	Lahore			RPC Operation	BP-11/13, HP-24/36
31		Verify stable operation & Normal start at minimum power			
32	Matiari	Perform normal inspections (visual and acoustical) while pole is			
33		Verify RPC action		BP-11/13, HP-24/36	
34	Lahore			HP12/24	
35		Verify		Continuous Steady Operation	
36	Matiari/Lahore			Ramping Done and Holding the target Value	
37				No Transients, no unexpected Time Delay	
38	Matiari	Start the Pole-2		Power	200 MW
39				Ramp Rate:	100 MW/Min
40	Matiari/Lahore	Wait to achieve Target Value		Max Time	2 min
41		Verify pole2 stable operation & Normal start at minimum power			
42	Matiari/Lahore	Perform normal inspections (visual and acoustical) while pole is deblocked.			
43	Matiari/Lahore	Change pole 2 from pole power control to bipole power control and set the bipole power reference 2200MW			
44	Lahore	Ramp Up Pole-I		200MW	400MW
45	Matiari & Lahore	Verify (during Ramping)		record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, In Matiari and LAHORE C/S during pole1 power ramping.	
46		Verify		Continuous Steady Operation, Correct RPC action	
47	Matiari			Continuous Steady Operation	
48				power reaches the reference value after ramping is completed	
49	Matiari & Lahore			No Transients	
50		Ramp Up Pole-I		400MW	600MW
51	Matiari & Lahore	Verify (during Ramping)		record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, In Matiari and LAHORE C/S during pole1 power ramping.	
52		Verify		Continuous Steady Operation, Correct RPC action	
53	Matiari/Lahore			Ramping Done and Holding the target Value	
54				No Transients, no unexpected Time Delay	
55	Matiari	Ramp Up Pole-I		600MW	800MW
56	Matiari & Lahore	Verify (during Ramping)		record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, In Matiari and LAHORE C/S during pole1 power ramping.	
57		Verify		Continuous Steady Operation, Correct RPC action	
58	Matiari/Lahore			Ramping Done and Holding the target Value	
59				No Transients, no unexpected Time Delay	
60	Matiari	Ramp Up Pole-I		800MW	1000MW
61	Matiari & Lahore	Verify (during Ramping)		record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, In Matiari and LAHORE C/S during pole1 power ramping.	
62		Verify		Continuous Steady Operation, Correct RPC action	
63	Matiari/Lahore			Ramping Done and Holding the target Value	
64				No Transients, no unexpected Time Delay	

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	65	Lahore	Ramp Down Pole-II	1000MW	800MW	50MW/Min
Pole-I Pole Ramp Down (A5-6.3.2)	66	Matiari & Lahore	Verify (during Ramping)	record AC-side Individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, In Matiari and LAHORE C/S during pole1 power ramping.		
	67		Verify	Continuous Steady Operation, Correct RPC action		
	68			Ramping Done and Holding the target Value		
	69			No Transients, no unexpected Time Delay		
	70	Lahore	Ramp Down Pole-II	800MW	600MW	50MW/Min
	71	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	72		Verify	Continuous Steady Operation, Correct RPC action		
	73			Ramping Done and Holding the target Value		
	74			No Transients, no unexpected Time Delay		
	75	Lahore	Ramp Down Pole-II	600MW	400MW	50MW/Min
	76	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
	77		Verify	Continuous Steady Operation, Correct RPC action		
	78			Ramping Done and Holding the target Value		
	79			No Transients, no unexpected Time Delay		
	80	Lahore	Ramp Down Pole-II	400MW	200MW	999MW/Min
	81	Matiari & Lahore	Verify (during Ramping)	record AC-side individual harmonics, Dn, total harmonic distortion, THD, Telephone Harmonic Form Factor, THFF, in Matiari and LAHORE C/S during pole1 power ramping.		
Test Acceptance Criteria	82	Matiari/Lahore	Verify	Continuous Steady Operation		
	83			Ramping Done and Holding the target Value		
	84			Correct RPC Operation		
	85			No Transients, no unexpected Time Delay		
	86	Lahore	Stop the Pole-I, II	Power	0 MW	Refer To Pole Blocking and stop sequence
	87			Ramp Rate:	100MW/Min	
	88	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	89		All Operations executed successfully			
	90		Stability Control System and Oscillation splitting devices did not operate during the testing and the system remain stable.			
	91		The synchronizing voltage and the phasing of the firing control signals are correct.			
	92		All thyristor check-back signals are available.			
	93		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	94		Measuring quantities are available and the values are within the specified range and phase.			
	95		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	96		No Stuck Condition			
	97		All the sequence as recorded in OWS should be documented, All the Charts related to pole power, current, voltages, firing angles and extinction angles, tap positions. Should be recorded and documented. TFR data in Comtrade format to be captured and recorded.			
	98		No False Tripping by DC Protection System			
	99		No Tripping in AC side of converter Station			

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Monopole High Power System Tests

Pole II High Power Tests Reverse Power Direction

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

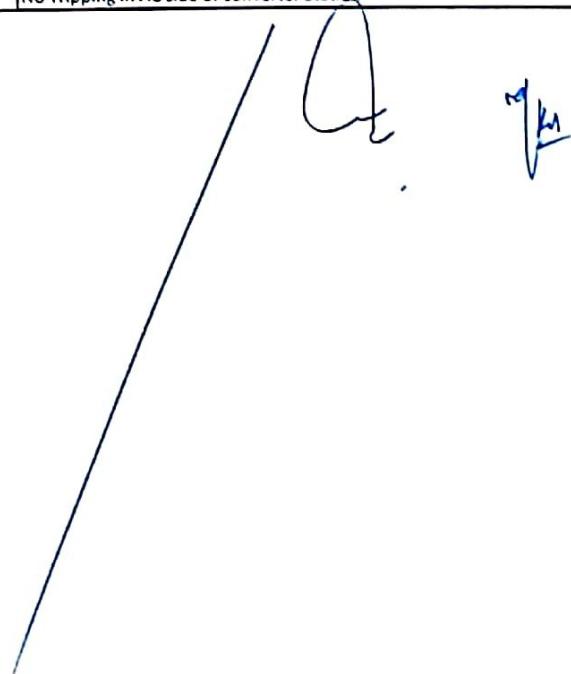



Testing Start Up Sequence

Testing Start Up Sequence					
Pole-II Pole Start (A5-6.3.1)	21	Matlari/Lahore C/S DC	Verify Ready for Operation Conditions.		
	22	Matlari & Lahore	Start the Pole-II	Power	200 MW
	23			Ramp Rate:	100 MW/Min
	24	Lahore	Wait to achieve Target Value	Max Time	2 min
	25			Firing angle (α)	15°±2.5°
	26	Matlari	Verify Performance Indicators	DC Voltages	660kV
	27			RPC Operation	1xHP12/24
	28	Matlari/Lahore	Verify Performance Indicators	Extinction Angle (γ)	17°
	29			DC Voltages	Range to be mentioned
	30	Matlari/Lahore	Verify Performance Indicators	RPC Operation	BP-11/13, HP-24/36
	31			Verify stable operation & Normal start at minimum power	
	32			Perform normal Inspections (visual and acoustical) while pole is	
	33	Matlari	Verify RPC action	BP-11/13, HP-24/36	
	34	Lahore		HP12/24	
	35	Matlari/Lahore	Verify	Continuous Steady Operation	
	36			Ramping Done and Holding the target Value	
	37			No Transients, no unexpected Time Delay	
Pole-II Pole Ramp Up & Control System Switchover (A5-6.3.2 steps 1 to 3)	38	Lahore	Ramp Up	200MW	400MW
	39	Matlari/Lahore	Verify	Continuous Steady Operation of the transmission	
	40			PCP-A Is active	
	41	Matlari/Lahore	Verify	PCP-A to	PCP-B
	42			Continuous Steady Operation	
	43	Matlari/Lahore	Verify	power reaches the reference value after ramping is completed	
	44			No Transients	
	45	Matlari	Ramp Up	400MW	600MW
	46	Matlari	Verify (during Ramping)	SC-A	ACTIVE
	47			Switch Control System (during Ramping)	SC-A to SC-B
	48	Matlari/Lahore	Verify	Continuous Steady Operation	
	49			SC B	Active
	50	Matlari/Lahore	Verify	Ramping Done and Holding the target Value	
	51			No Transients, no unexpected Time Delay	
	52	Matlari	Ramp Up	600MW	800MW
	53	Matlari/Lahore	Verify	Continuous Steady Operation	
	54			Ramping Done and Holding the target Value	
	55			No Transients, no unexpected Time Delay	
	56	Matlari	Ramp Up	800MW	1000MW
	57			PCP-B to	PCP-A
	58			SC-B to	SC-A
	59	Matlari/Lahore	Verify	Continuous Steady Operation	
	60			PCP-A	Active
	61			SC A	Active
	62			Ramping Done and Holding the target Value	
	63			No Transients, no unexpected Time Delay	
	64	Matlari/Lahore	Verify	Continuous Steady Operation	
	65			Ramping Done and Holding the target Value	
	66			RPC Operation	RPC should connect Appropriate no. of Filters and Shunt Banks during Ramping
	67			No Transients, no unexpected Time Delay	
	68	Matlari	Switch Control System (at Pole Power 1000 MW)	PCP-A to	PCP-B
	69			SC-A to	SC-B
	70	Matlari/Lahore	Verify	Continuous Steady Operation	
	71			Holding the target Value	
	72			No False Action by Control Systems	
	73			No Transients	
	74	Matlari	Switch Control System (during Ramping)	PCP-B to	PCP-A
	75			SC-B to	SC-A
	76	Matlari/Lahore	Verify	Continuous Steady Operation	
	77			PCP-A	Active
	78			SC A	Active
	79			Ramping Done and Holding the target Value	
	80			No Transients, no unexpected Time Delay	

Pole-II Pole Ramp Down & Control System Switchover (A5-6.3.2 steps 3 to 6)	S1	Lahore	Ramp Down	1000MW	800MW	50MW/Min
	S2	Matiari/Lahore	Verify (during Ramping)	PCP-A	ACTIVE	
	S3		Switch Control System (during Ramping)	PCP-A to	PCP-B	
	S4		Verify	Continuous Steady Operation		
	S5			PCP-B	Active	
	S6			Ramping Done and Holding the target Value		
	S7			No Transients, no unexpected Time Delay		
	S8	Lahore	Ramp Down	800MW	600MW	50MW/Min
	S9	Matiari/Lahore	Verify (during Ramping)	SC-A	ACTIVE	
	S10		Switch Control System (during Ramping)	SC-A to	SC-B	
	S11		Verify	Continuous Steady Operation		
	S12			SC B	Active	
	S13			Ramping Done and Holding the target Value		
	S14			No Transients, no unexpected Time Delay		
	S15	Lahore	Ramp Down	600MW	400MW	50MW/Min
	S16	Matiari/Lahore	Switch Control System (during Ramping)	PCP-B to	PCP-A	
	S17			SC-B to	SC-A	
	S18		Verify	Continuous Steady Operation		
	S19			PCP-A	Active	
	S20			SC A	Active	
	S21			Ramping Done and Holding the target Value		
	S22			No Transients, no unexpected Time Delay		
	S23	Lahore	Ramp Down	400MW	200MW	999MW/Min
	S24	Matiari/Lahore	Verify	Continuous Steady Operation		
	S25			Ramping Done and Holding the target Value		
	S26			Correct RPC Operation		
	S27			No Transients, no unexpected Time Delay		
	S28	Lahore	Stop the Pole-II	Power	0 MW	Refer To Pole Blocking and stop sequence
	S29			Ramp Rate:	100MW/Min	
Test Acceptance Criteria	110	Matiari/Lahore C/S	The voltage of the AC system should be within the specified limits (450-550kV)			
	111		All Operations executed successfully			
	112		Stability Control System and Oscillation splitting devices did not operate during the testing and the system remain stable.			
	113		The synchronizing voltage and the phasing of the firing control signals are correct.			
	114		All thyristor check-back signals are available.			
	115		Measuring system and controls remain operational. No transients on switchover of PCP or SC systems.			
	116		Measuring quantities are available and the values are within the specified range and phase.			
	117		No abnormal corona discharges and no operation of surge arresters shall occur at energized equipment.			
	118		No Stuck Condition			
	119		All the sequence as recorded in OWS should be documented, All the Charts related to pole power, current, voltages, firing angles and extinction angles, tap positions. Should be recorded and documented. TFR data in Comtrade format to be captured and recorded.			
	120		No False Tripping by DC Protection System			
	121		No Tripping in AC side of converter Station			



 [Signature]