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Pakistan Matiari-Lahore ±660HVDC power transmission project

System debugging plan

Debugging plan for dual maximum power system

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ABSTRACT

Bipole High Power System Tests Program for Pakistan Matiari-Lahore ±660kV HVDC Transmission Project includes pole start, Bipole power ramp, tap changer control, ground/metallic return transfer, heat run test and special measurements.

KEYWORDS: Pakistan Matiari-Lahore HVDC Project, Bipole High Power System Test Program, System Commissioning

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**1 Test conditions**

Important: During the test, the pole power should reach 2000MW, which is equivalent to 3030A. Before all tests and during the commissioning period, the AC voltage of the converter stations in Matiari and Lahore should be maintained at 505-525kV. The frequency of the two converter stations should be 49.5-50.5 Hz

Before starting the high-power bipolar transmission test, the following tests must be completed:

-Low power unipolar test

-Verify that the converter transformer, smoothing reactor and valve cooling equipment are operating normally, and that the fan and pump are switched normally. In addition, the availability of backup pumps, fans and cooler converters must be checked.

-The valve cooling system has been running for more than 24 hours and all valves have been checked.

In addition, the following conditions apply to all debugging defined in this procedure. If any specific test conditions are required for a specific test, that condition will be added to the test description.

-CEPRI and the owner’s test leader must be appointed.

-All equipment commissioning and equipment subsystem commissioning involved in this test must be completed.

-Low voltage test completed

-AC switch and related protection, including circuit breaker failure protection debugging completed

-Perform a final trip test for each area before energizing.

-Verify the remaining test items and ensure that the test can continue.

-Verify the temporary connection items to ensure that the power can be continued.

-Verify the sequence of event records (SER) and ensure that there are no related alarms and all systems are running.

-The switch sequence prepared by the owner is ready, and the station system (or all equipment involved in the commissioning) has been handed over to the operating unit.

**2 Bipolar rated load operation, normal power direction**

2.1 Test purpose

The purpose of the test is to conduct a hot running test and parameter measurement during high-power debugging.

2.2 Test conditions

(1) All low-power debugging has been completed.

(2) AC system test conditions:

1) The 500kV bus voltage of the two AC systems is 505~525kV.

2) Both sides of the AC system can supply power for debugging.

(3) Test conditions of DC system:

Matiari:

[X] Master Control Station

[X] Station control A on duty [] Station control B on duty

[X] Extreme control A on duty [] Extreme control B on duty

[X]Normal power transmission direction [] Reverse power transmission direction

[X] There is communication [] No communication

[X] Power control [] Current control

[X] Joint control [] Independent control

[X] Reactive power automatic control [] Reactive power manual control

[] Q control [X] U control

[X] Full pressure operation [] Reduced pressure operation

[X]Earth loop [ ] Metal loop

Lahore:

[] Master Station

[X] Station control A on duty [] Station control B on duty

[X] Extreme control A on duty [] Extreme control B on duty

[X]Normal power transmission direction [] Reverse power transmission direction

[X] There is communication [] No communication

[X] Power control [] Current control

[X] Joint control [] Independent control

[X] Reactive power automatic control [] Reactive power manual control

[X] Q control [] U control

[X] Full pressure operation [] Reduced pressure operation

[X]Earth loop [ ] Metal loop

2.3 Test content and procedures

2.3.1 Bipolar power rate

(1) Operate the circuit breaker and switch to make the converter enter the "ready to run" state.

(2) Verify that the two stations are in the "ready to run" state.

(3) Start the bipolar with the minimum power in the positive direction, the power is 400MW (303A), and the rate is 100MW/min.

(4) Verify that the system operates stably under the minimum power.

(5) Increase the power from 400MW to 4000MW at a speed of 100MW/min, with an interval of 2 minutes for each increase of 400MW:

(6) Verification:

1) At each power level, the power of both stations can reach the reference value.

2) Stable operation of each power bipolar.

3) In the process of increasing the power, the reactive power control systems of the two stations are put into the appropriate number of filter banks.

(7) Reduce the power to 400MW at a speed of 100MW/min, and for every reduction of 400MW, at an interval of 2 minutes:

(8) In the process of power change, the manual switching of the pole control A and B systems is performed.

(9) Verification:

1) The power change process is smooth and continuous, and the transmitted power does not change instantaneously.

2) At each power level, the power of both stations can reach the reference value.

(10) Stop pole

(11) Record and save test data

2.3.2 Thermal running test at rated power

Notes:

(1) Keep the bipolar running at rated power for 2 hours. During this period, the following verifications should be carried out:

(2) Perform the following tests or measurements:

1) After the power rise and fall are completed, verify whether the two stations reach the reference value.

2) Verify that the measured current and voltage on the DC and AC sides are correct.

3) Continuously record the temperature of the inlet and outlet valves of the cold water (local and remote indication) until the normal stable temperature is reached (the temperature should be stable within about 15 minutes).

4) Record the temperature of the coil windings and hot spots in the converter transformer and smoothing reactor every 30 minutes (local or remote indication) until the normal stable temperature is reached (the temperature should be stable within about 3 hours).

5) Record single harmonic coefficient, total harmonic distortion coefficient, telephone harmonic wave form coefficient in Matiari and Lahore.

6) Record the harmonics and Ieq on the DC side of Matiari and Lahore.

(3) Carry out the following tests or measurements:

1) Verify the main parameters: ignition angle, extinguishing angle, AC and DC current and voltage.

2) Record the temperature of the valve cold water, transformer and reactor, and check whether the operation is stable.

3) Carry out special measurements as described in Section 2.3.3-2.3.6 below.

4) The power loss in the station should be measured by subtracting the DC power from the power flowing into the converter transformer.

(4) Record and save all data.

2.3.3 Radio interference measurement

Check whether the radio and television interference generated by the high-voltage direct current transmission equipment is within the specified range of the specified location.

(1) Choose 1 or 2 test locations within the converter station and about 450 meters outside the converter station to measure the interference frequency spectrum.

(2) Measure the radio interference spectrum characteristics under the outlet of 800kV valve hall and 20 m from the outlet of the converter station.

(3) Record and save all data.

2.3.4 Noise inspection

Check whether the audible noise level generated by the high-voltage direct current transmission equipment is within the specified range of the specified location.

(1) Measure the audible noise near the converter transformer of the converter station.

(2) Measure the audible noise on the outer boundary line of the converter station.

(3) Measure the audible noise in front of houses near the converter station (if there are houses).

(4) Record and save all data.

2.3.5 Power loss of station auxiliary equipment

The purpose of this test is to determine the loss of the auxiliary power supply under load and no-load conditions. According to the research report, only the critical and basic loads of the equipment provided are included.

(1) In the ready-to-run state, measure the load at a power level of 400V within a period of time (for example, measure 5 times within an hour). Take the average of the measurement results to get a loss value equivalent to the no-load or fixed loss.

(2) Verify that these measured loss values ​​should be within the limits specified in the technical specifications.

(3) When the bipolar is operating at rated power, measure the load at the 400V power level within a period of time (for example, 5 measurements within an hour). Take the average of the measurement results to get a loss value equivalent to the no-load or fixed loss.

(4) Record and save all data.

2.3.6 Temperature measurement with infrared camera equipment

1. Use infrared temperature measurement to measure the normal temperature of DC field, AC field and bus bars, fixture conductors, equipment, etc. in the valve hall.

(2) Record and save all data.

**3 Safety measures and precautions for commissioning in the station**

3.1 For HVDC transmission system

(1) All personnel participating in the test shall strictly abide by all safety regulations of electrical engineering.

(2) In the power station, the owner shall appoint a qualified engineer as the person in charge of the test, and the person in charge shall be the coordinator of the CEPRI commissioning engineer.

(3) In the station, when the test is going on, qualified technicians from the owner, Assembly Company or manufacturing company must be appointed to observe the equipment in the AC field, the DC field and the valve hall respectively. When they find any abnormalities or malfunctions in the equipment, they should immediately report to the person in charge of the test.

(4) Without permission, no one is allowed to enter the test area.

(5) All high-voltage areas should be isolated with enclosed fences and notice boards with "high-voltage danger"!

(6) In the station, an emergency maintenance team should be equipped to carry out maintenance or inspection work when needed.

(7) Only personnel with test identity are allowed to enter the test area.

(8) Only qualified operators can operate.

(9) All operations should be carried out in strict accordance with the operating instructions.

(10) Temporary test wiring and maintenance of on-site main equipment and control protection cabinet should be carried out by qualified personnel under the supervision of qualified experts, and corresponding safety measures should be taken.

(11) The test wiring of the control or protection cabinet should be demonstrated and supervised by qualified experts.

3.2 For the AC system

All regulations and safety measures for the operation of the communication system must be strictly observed.

**4 accessories**

HVDC-High Voltage Direct Current

HVDC

DC-Direct Current

DC-direct current

AC-Alternative Current

Communicate with

CEPRI-China Electric Power Research Institute

China Electric Power Research Institute

TFR-Transient Fault Recorder

Transient fault recorder

PCP-Pole Control & Protection

Extreme control

SCM-SCADA and Monitoring

SCADA monitoring system

SC-Station Control

Station control

RPC-Reactive Power Control

Reactive power control

DGA-Dissolved Gas Analysis

Dissolved gas analysis

IR Camera-Infrared Camera

Infrared Thermometer

Dn-Individual Harmonics

Single harmonic

THD-Total Harmonic Distortion

Total harmonic distortion

THFF-Telephone Harmonic Form Factor

Telephone harmonic form factor

IEQ-Equivalent Interference Current

Equivalent interference current