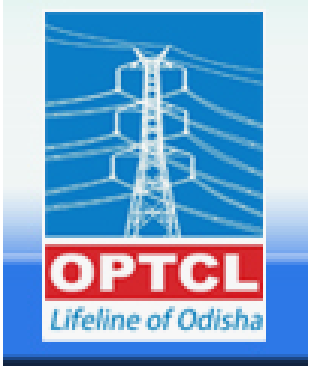
BLACK START FACILITY
START-UP POWER
AND
RESTORATION PROCEDURE
FOR ODISHA GRID
(SEPTEMBER - 2022)



STATE LOAD DESPATCH CENTRE
ODISHA POWER TRANSMISSION CORPORATION LTD
MANCHESWAR RLY COLONY
BHUBANESWAR-751017

1.0 Introduction

Odisha grid comprises of four numbers of Distribution Utilities operating in the State namely TPCODL, TPSODL, TPWODL and TPNODL and State Generating Stations, IPPs, CGPs, RE generators. OPTCL network has interconnections with States like West Bengal, Jharkhand, Chhattisgarh as well as with neighbouring regions like SR and WR. The state caters to core sector loads, including steel, coal, aluminium and traction. 15870 ckt kms lines (132kV and above) and 184 no of sub-stations serve the State, the bulk power being transmitted through the backbone network of OPTCL.

2.0 Genesis

The state restoration procedure, since its earlier publication by SLDC, Bhubaneswar underwent revisions, in consideration of the expansion and changes taking place over the years in the state grid.

In compliance with clause 5.8 (a) and (b) of IEGC Regulations, 2010 and 5.9 (1) and (2) of the OGC Regulations, 2015, the restoration procedure has to be annually updated and finalized by SLDC in consultation with all the users of the state grid. In order to accomplish this objective, SLDC has interacted with the State entities. The present revision has been done based on the changes in the transmission network.

3.0 Scope & Objective

This document describes the procedures to be followed by SLDC in coordination with ERLDC, for restoration of the State grid following a complete or partial collapse.

The objective of this procedure is to achieve restoration of the total state EHV power system in the shortest possible time viz.

- Secure generation
- Secure transmission
- Restore interconnection with neighbours
- Avoid utility / consumer plant damage
- Restore demand

4.0 GENERAL CRITERIA - METHODOLOGY TO BE FOLLOWED IN CASE OF GRID COLLAPSE

1. SLDC shall inform the power stations who have black start facilities to take immediate action.

2. While choosing the path for start-up power, 220 kV and above lines are to be avoided as far as possible to avoid over voltage.

3. Minimum number of sections in 132 kV are to be chosen to avoid coordination and switching problem.

4. If required, load is to be released in a coordinated manner as far as possible at intermediate sub-stations to arrest over-voltage, if any.

5. To avoid unbalancing, phase balancing should be kept in view if traction load is released.

6. Generator loading which is supplying start-up power should be checked and total loading should not cross 80% of its capacity. Efforts should be made to keep the generator operating to lagging side, if not possible at least to near unity power factor.

7. Thermal stations should be provided survival power as early as possible to avoid damage to the equipment in case of D.C. failure. (e.g. Barring gear, lube oil, seal oil, compressor for circuit breakers etc.).Operator should be able to distinguish between start-up and survival power.

8. Auxiliary power should be released in steps so that all the running units could be started gradually.

10. Check the sub-stations which have synchronising facilities in proper working order/capabilities (it is apprehended that due to continuous integrated operation, Operating personnel have lost the experience of synchronising the lines in most of the sub-stations). Rough synchronisation should be avoided as small system may not be able to take the jerk.

11. In order to increase spinning reserve in healthy system, if required shedding should be done in islands which have survived.

12. The start-up procedure should be known to everyone and working level personnel should do it without referring or waiting for management's consent during the crisis.

13. Priorities of load which is to be connected in steps should be documented and while releasing loads for example Traction loads, underground coalmines/deep gassy mines/AIR/TV/Telephone exchange, hospital, pumping station etc. should be given priority depending on available generation.

14. Tap position of station transformers, bus voltage, frequency etc. in the power station should be carefully monitored to see that over fluxing do not occur when efforts are on to bring the unit back.

15. To control over-voltage, following may be considered as per requirement of situation.
    _ start synchronous condenser wherever available.
    _ keep GTs running
    _ Back charging from 132 kV side of transformer without loading the same.
        i) 132/33 kV transformer
        ii) 132/220 kV auto transformer
        iii) 220/400 kV auto transformer
        iv) 400 kV bus reactor; if required by tap changing

16. The 132 kV lines which are normally kept off may be required to be used during start-up procedure. The lines, therefore, should be tested once in a month for its healthiness. The communication between the concerned stations should be kept healthy.

17. A list of telephone nos. of all the sub-stations should be available at plant and at SLDC as communication is the essential requirement during the restoration process.

18. Before asking power station to draw start-up power, the capacity of island to sustain the starting current of biggest Induction Motor (generally BFP) should be checked.

19. Priority should be given to provide support power to captive units in case they so request and vice-versa.

20. It is felt that there is a need for strategy of restoration to be available rather than details. Details with 1st, 2nd & 3rd alternative may be drawn up by SLDC under intimation to ERLDC.

5.0 General principle followed while formulating the restoration plans for individual power stations:

Case (A): Total collapse of the State system– Priority wise sources identified in neighbouring systems, from which power can be extended to the power station(s) of the State.

Case (B): Total black out of the individual power station only – The first priority of availing assistance should be from the other part of the State. In case this is not possible, assistance should be availed from neighbouring system.
However, the above priority may change, depending upon station specific factors / advantages.

SOME DON'TS

a) Do not load lines beyond 80% capacity.
b) Do not hastily connect loads and do not allow frequency to come below 50 Hz in any case. The case of any surviving island or even unit with house-load should be informed to SLDC.
c) Once power is extended to a power station, it should not be disconnected except emergency as all actions taken by the power station have to be redone.
d) Till the restoration process is over, SLDC should not be disturbed in any way for working as Management Information System.
e) No commercial problem should be brought up for extending power during restoration process.
f) Communication links should not be made unnecessarily busy during Start-up process.

6.0 Power Stations with Black Start facility

Sl. No	Name of Power Station	Unit Capacity (MW)	Type	Source	Capacity
1	Rengali	5x50	Hydro	Diesel	1 X 750 kVA
2	Upper Indravati	4x150	Hydro	Diesel	2 X 625 kVA
3	Balimela	6x60+2x75	Hydro	Diesel	1 X 750 kVA
4	Upper Kolab	4x80	Hydro	Diesel	1 X 750 kVA
5	Burla	2x49.5+2x32+2X43.65+1X37.5	Hydro	Diesel	1 X 750 kVA
6	Chipilima	3x24	Hydro	Diesel	1 X 500 kVA

6.1 List of Power stations and S/S having synchronizing facility.

Sl No	Name of Power Station / S/S	Voltage level
1	Rengali	220 kV
2	Upper Indravati	220 kV

3	Balimela	220 kV
4	Upper Kolab	220 kV
5	Burla	132 kV
6	Chipilima	132 kV
7	IBTPS	220 kV
8	TTPS	220 kV
9	Vedanta Ltd IPP	400 kV
10	GMR, Kamalanga	400 kV
11	Bhanjanagar	220 kV
12	Theruvali	220 kV
13	Jayanagar	220 kV
14	Joda	220 kV
15	Meramundali	400 / 220 kV
16	Mendhasal	400 / 220 kV
17	Balasore	220 kV
18	Barkote	220 kV
19	Bidanasi	220 kV
20	Budhipadar	220 kV
21	Chandaka	220 kV
22	Duburi	220 kV
23	Duburi (New)	400 / 220 kV
24	Narendrapur	220 kV
25	Tarkera	220 kV

6.2 Restoration plan for State Hydro Stations

POWER STN.	**PRIORITY:I**	**PRIORITY:II**	**PRIORITY:III**	**PRIORITY:IV**
RENGALI	BLACK START	TSTPP (NTPC)	RENGALI(PG)	TTPS
BALIMELA	BLACK START	JAYNAGAR	UPPER KOLAB	JEYPORE (MACHKUND)
UPPER KOLAB	BLACK START	JAYNAGAR	THERUBALI	JEYPORE (MACHKUND)
HIRAKUD-I (BURLA)	BLACK START	LAPANGA	KATAPALI	SAMBALPUR
HIRAKUD-II (CHIPLIMA)	BURLA	KATAPALI		
INDRAVATI	BLACK START	JEYPORE	THERUVALI	
IBTPS (OPGC)	BUDHIPADAR	KORBA (MPEB)		
IBTPS 3 & 4 (OPGC)	LAPANGA	JHARSUGUDA		

6.3 Restoration Path

CASE	PRIORITY WISE RESTORATION PATH	
1. RENGALI HPS		
A. Total collapse of GRIDCO system but power available from neighbouring system	I.	Black start of own house set
	II.	220 KV Rengali HPS –TTPS-Meramandali- NALCO (if the CPP survived after islanding from GRIDCO).
	III.	220 KV Rengali HPS- TSTPP.
	IV.	220 KV Rengali HPS-Rengali S/yard-Rengali (PG).
	V.	220 KV Rengali HPS-Rengali S/yard-Tarkera (Via Barkot-Bonai/ Chandiposh) -Rourkela (PG).
B. Outage of all running units	I.	220 KV Rengali HPS – TTPS
	II.	220 KV Rengali HPS-TSTPP.
	III.	220 KV Rengali HPS-Rengali S/yard-Rengali (PG).
	IV.	220 KV Rengali HPS – TTPS-Meramandali- NALCO
	V.	220 KV Rengali HPS-Rengali S/s (GRIDCO)- Tarkera(Via Barkote/ Chandiposh)
	VI.	Black start of own house set
2. BALIMELA HPS		
A. Total collapse of GRIDCO system but power available from neighbouring system.	I.	Black start of own house set
	II.	220 KV Balimela-Jaynagar-Jeypore (PG). (Power from other Region can also be arranged with bypass arranegemnt)
	III.	220 KV Balimela-Jaynagar-Upper Kolab (Black Start).
	IV.	220 KV Balimela-Jaynagar (GRIDCO)-132 kV Jaynagar- Machkund-Vizag(APTRANSCO).
	V.	220 KV Balimela-Upper Sileru(AP).
B. Outage of all running units only.	I.	220 KV Balimela-Jaynagar-Jeypore (POWERGRID)
	II.	220 KV Balimela-Jaynagar
3. UPPER KOLAB HPS		
A. Total collapse of GRIDCO system but power available from neighbouring system	I.	Black start of own house set
	II.	220 KV Upper Kolab-Jaynagar and 132 KV Jaynagar- Machkund-Vizag.(AP)
	III.	220 KV Upper Kolab-Jaynagar-Jeypore (PG).
	IV.	220 KV U. Kolab-Jaynagar-Balimela (Black Start).
	V.	220 KV Upper Kolab- Jaynagar-Balimela-Upper Sileru(AP).
	VI.	220 KV Upper Kolab-Therubali-Indravati (Blackstart) or 400/220 kV Indravati (PG)
B. Outage of all running units only.	I.	220 KV Upper Kolab-Jaynagar.
	II.	220 KV Upper Kolab-Theruvalli
	III.	220 KV Upper Kolab-Jaynagar-Jeypore (PG).
	IV.	220 KV Upper Kolab-Jaynagar and 132 KV Jaynagar-Machkund.
	V.	220 KV Upper Kolab-Therubali-Indravati
4. HIRAKUD-I (BURLA) HPS		
A. Total collapse of GRIDCO system but power available from	I.	Black start of own house set
	II.	132 KV Burla-Lapanga- Budhipadar-220 kV Budhipadar-Korba(WR)
	III.	132 KV Burla-Sambalpur- Maneswar-Rairakhol-Boinda -Angul-Talcher 220 KV TTPS - TSTPP

CASE	PRIORITY WISE RESTORATION PATH	
neighbouring system	IV.	132 kV Burla-Chiplima-Katapali-220kV Katapali-Budhipadar-Korba(WR)
	V.	132 kV Burla-Lapanga-Katapali 220 KV Katapali-Bolangir(PG)
	VI.	132 kV Burla- Hindalco (if the CPP survived after islanding from GRIDCO)
	VII.	132 kV Burla-Lapanga-Budhipadar-Tarkera-RSP(if the CPP survived after islanding from GRIDCO)
	VIII.	132 kV Burla-Sambalpur-Shyam DRI- Aryan Ispat (if the CPP survived after islanding from GRIDCO)
	IX.	132 kV Burla-Lapanga-Budhipadar-220 kV Budhipadar-VAL (if the CPP survived after islanding from GRIDCO)
B. Outage of all running units only.	I.	132 KV Burla- Lapanga-Budhipadar
	II.	132 KV Burla- Sambalpur- Maneswar-Rairakhol-Boinda-Angul-Talcher TPS -220 KV TSTPP
	III.	132 kV Burla- Hindalco
	IV.	132 kV Burla-Lapanga-Budhipadar-Rajgangpur
	V.	132 kV Burla- Katapali
	VI.	132 kV Burla- Chiplima-Katapali
5.HIRAKUD-II (CHIPLIMA) HPS		
A. Total collapse of GRIDCO system but power available from neighbouring system	I.	132KV Chiplima- Burla- Lapanga- Budhipadar- 220 kV Budhipadar-Korba (WR)
	II.	132 KV Chiplima-Burla-Sambalpur-Manewar-Rairkhol-Angul-Talcher TPS -220 KV TSTPP.
	III.	132 kV Chiplima-Katapali-220kV Katapali-Lapanga-Budhipadar-Korba(WR)
	IV.	132 kV Chiplima-Katapali 220 KV Katapali-Bolangir(PG)
	V.	132 kV Chiplima-Burla-Lapanga-Budhipadar-Tarkera-RSP(if the CPP survived after islanding from)
	VI.	132 kV Chiplima-Burla-Sambalpur-Shyam DRI- Aryan Ispat (if the CPP survived after islanding from)
B. Outage of all running units only.	I.	132 KV Chiplima-Burla.
	II.	132 kV Chiplima-Katapali
6. INDRAVATI HPS		
A. Total collapse of GRIDCO system but power available from neighbouring system	I.	Black Start
	II.	400 KV Indravati HPS-Indravati (PG)
B. Outage of all running units only.	I.	220 kV Indravati - Theruvali
	II.	400 KV Indravati HPS-Indravati (PG)-Jeypore (PG).
7. IBTPS		
A. Total collapse of GRIDCO system but power available from neighbouring	I.	220 KV IBTPS-Budhipadar-Tarkera-Rourkela (PG).
	II.	220 KV IBTPS-Budhipadar-Lapanga-Katapali (Direct or via Bargarh)--Bolangir (PG).
	III.	220 KV IBTPS-Budhipadar-Korba East/Raigarh (WR).
	IV.	220 kV IBTPS-Budhipadar-VAL (if the CPP survived after islanding from

CASE	PRIORITY WISE RESTORATION PATH	
system		GRIDCO)
B. Outage of all running units only.	I.	220 kV IBTPS-Budhipadar-Tarkera-Rourkela (PG).
	II.	220 KV IBTPS-Budhipadar-Lapanga-Katapali (Direct or via Bargarh)-Bolangir (PG)
	III.	220 kV IBTPS-Budhipadar & 132 KV B'padar-Lapanga- Burla.
8. OPGC (IBTPS 3 & 4)		
A. Total collapse of GRIDCO system but power available from neighbouring system	I.	400 kV OPGC-400 kVJhasurguda (PG)
	II.	400 kV OPGC-Lapanga-Budhipadar-220 kV (CPP/WR)
	III.	400 kV OPGC-Lapanga-Sterlite (CPP)/ 400 kV OPGC-Jhasurguda-Sterlite (CPP) if CPP Survived
	IV.	400 kV OPGC-Lapanga-220 kV Katapali-Burla/Chiplima (Black start)
B. Outage of all running units only.	I.	400 kV OPGC-400 kVJhasurguda (PG)
	II.	400 kV 400 kV OPGC-Lapanga
Extension of supply to GRIDCO power stations in case of total collapse of Eastern Grid.	I.	220 KV IBTPS-Budhipadar-Korba (WR).
	II.	220 KV Balimela-Upper Sileru (AP).
	III.	400 kV Gazuwaka-Jeypore-Indravati (POWERGRID)-Indravati
	IV.	400 kV Raigarh (WR)-400 kV Jhasurguda
	V.	765 kV Raipur PS (WR)/Dharamjaigad (WR)-765/400 kV Jhasurguda
	VI.	HVDC Talcher-Kolar (Reverse Power flow)

7.0 Procedure for periodic exercise of blackstart

Background

In compliance with the provisions of IEGC / OGC, periodic testing of black-start facilities is required to be undertaken in the State as part of preparedness to combat emergency conditions in the State grid. Accordingly, mock black start exercises are required to be carried out in a phased manner.

As per the program decided in the ERPC meeting, ERLDC drafted a plan indicating details of load segregation in the State and switching actions to be carried out in the process of implementation of the mock exercise.

The same is being circulated to the power station and the grid S/S involved for formation of the island.

7.1 Procedure for periodic exercise of black starting Upper Kolab HEP

Network configuration required:

Bus segregation required at UKHEP

At UKHEP, Bariniput both the Bus (Bus - A & B) cannot be used simultaneously due to non provision of independent PT supply to both Bus. One of the unit, identified to be black-started and the 220kV Upper Kolab-Jayanagar circuit are to be connected to any one of the 220kV Buses while rest of the units and lines shall be kept 'OFF'.

Bus segregation required at Jayanagar Sub-station (220 kV)

The 220 kV switchyard of the sub-station is having one-and-half breaker configuration. The 220 kV Upper Kolab-Jayanagar ckt-I line (charged from the isolated UKHEP unit) and 220kV Jayanagar-Balimela ckt-II are to be connected to 220 kV Bus-I, while all other lines and auto Transformers are to be connected to the other 220 kV Bus-II.

Switching operation at Jayanagar

The 220kV Jayanagar-Balimela ckt-II is to be connected only to 220 kV Bus-1 by switching off the respective main CB with Bus 2. The main CBs of 220 kV Upper Kolab 2, Laxmipur 1 & 2 feeders, & 220/132kV Auto-1, connected to Bus 1 are to be switched off. The tie-breakers of these feeders shall be in closed position to enable their connectivity with Bus-2. 220kV Jayanagar-Jeypore PG ckt-III will remain in OFF condition from Jayanagar end. 220 kV Upper Kolab-Jayanagar circuit-I shall be kept on Bus-1 only by opening the tie-breaker.

Switching operation at UKHEP

The selected unit and 220 kV Jayanagar circuit-I are to be switched off and connected to the selected 220kV Bus. Other feeders and units are to be kept 'OFF'.

Switching operation at Balimela(OPTCL)

At Balimela (OPTCL) 220kV breakers of 220kV Balimela (OHPC)-Jayanagar-Balimela T ckt and 220kV shall be kept open.

Switching operation at Balimela PH 220kV switchyard

220kV Balimela (OHPC) –Jayanagar Ckt.-II and 220kV Balimela (OHPC)-Balimela OPTCL shall be kept open.

The Procedure

The selected unit of UKHEP is to be self-started with the help of DG and 220 kV UKHEP-Jayanagar ckt-I to be charged. At Balimela OPTCL 220 kV CB for Auto Transformer-1 is to be closed. This will also charge the 132 kV load feeder. Load is then to be released gradually taking care to maintain the island frequency and voltages at UKHEP within acceptable limits. Load is to be released gradually as per the direction of SLDC. The islanded operation of the unit may be continued for around 15 minutes. After successful completion, the island is to be synchronized with the system at Jayanagar as per the instruction of SLDC and normal configuration is to be restored.

SEQUENCE OF OPERATION:

1. 220 kV Upper Kolab-Jayanagar ckt-I. shall be made OFF from both the ends.

2. At Upper Kolab PH switchyard, all outgoing 220 kV feeders i.e. Jaynagar-I & II, all running units shall be made 'OFF'.

3. At Upper Kolab PH switchyard, 220 kV Jayanagar Ckt.-I and the identified unit for black start shall be kept on the selected 220 kV Bus.

4. At Jayanagar grid sub-station, 220 kV Upper Kolab ckt-I and 220kV Balimela-II shall be transferred to 220kV Bus-I.

5. At Jayanagar grid sub-station, 220 kV Upper Kolab-II, Laxmipur-I & II, & Auto-I shall be transferred to 220kV Bus-II. 220kV Jayanagar-Jeypore PG ckt-III will remain in OFF condition from Jayanagar end.

6. At Balimela (OPTCL) sub-station, 220kV breakers of 220KV Balimela (OHPC)-Balimela (OPTCL) Ckt. and 220KV Balimela (OPTCL) –Jayanagar Ckt.-II shall be opened as per instruction of SLDC.

7. At Balimela HPS, 220KV Balimela (OHPC) –Jayanagar Ckt.-II shall be kept open.

6. At Upper Kolab PH, the identified unit shall be started by availing auxiliary power supply from DG set and charged the selected Bus. The DG set starting time and the output parameters shall be recorded.

7. At Upper Kolab PH switchyard, 220 kV Jayanagar ckt-I shall be charged from the black started unit through selected 220kV Bus.

8. At Jayanagar grid sub-station, the 220 kV Bus-I shall be charged by availing power supply through Upper Kolab ckt-I and subsequently Balimela-II shall be charged.
9. At Balimela OPTCL grid sub-station, 220kV Balimela OPTCL-Jayanagar ckt-II feeder shall be charged and gradually loaded.

10. Assuming the minimum stable generation level of Upper Kolab unit to be 20 MW, load of the same order is to be released by connecting 33kV feeders at Balimela (OPTCL) & Malkangiri sub-station.

11. The island created should operate stably for around ten minutes and to be synchronized at Jayanagar Grid substation as per the instruction of SLDC through 220kV Balimela (OPTCL)-Jayanagar Ckt. - II.

12. At each step, Jayanagar grid sub-station and Upper Kolab PH shall record all the parameter readings such as Power Flow (both MW & MVAr), Frequency, voltage etc.

13. All operations shall be carried out in co-ordination with SLDC.

The electrical parameters at different time period of operation and the activity time should be recorded at Upper Kolab HPS in the format given below.

Sl. No.	Parameters	Time	Time	Time	Time	Time
1.	Frequency (Hz)					
2.	Load (MW)					
3.	Generator Voltage (kV)					
4.	220kV isolated Bus Voltage (kV)					
5.	Reactive Power (MVAr)					
6.	Generator Current (kA)					
7.	Power Factor (lead / lag)					

Activity	Time (Minutes)
Time taken to start DG set after black out of Island	
Time taken to charge dead bus at Black start station	
Time taken to charge dead bus at Remote end by line charging	
Time taken to connect first load post a black out in the island	
Duration of stable island operation after successful black start and building up the of the island till synchronization with grid	
Time taken to synchronize the island with Grid	

7.2 Procedure for periodic exercise of black starting Balimela HEP

Switching operations required:

At Balimela Power House (OHPC) 220kV switchyard

- At Balimela HPS, the unit to be black-started and the 220kV Balimela (OHPC)-Balimela (OPTCL) circuit to be charged by this unit to remain connected at one 220kV bus while rest of the units and lines to be shifted to the other 220kV bus, by opening the 220kV main bus coupler CB. 220kV Balimela (OHPC)-Balimela (OPTCL) Ckt-I and 220kV Balimela(OHPC)- Balimela(OPTCL)-Jayanagar T ckt hall be kept open.

At Balimela sub-station (OPTCL) 220kV switchyard

- At Balimela (OPTCL), 220kV breakers of 220KV Balimela (OHPC)-Balimela (OPTCL) Ckt-I & II and 220kV Balimela(OHPC)- Balimela(OPTCL)-Jayanagar T ckt shall be kept open.

At Jayanagar sub-station (OPTCL) 220kV switchyard

- 220KV Balimela (OHPC) –Jayanagar Ckt.-II shall be kept open.

Sequence

1. At Balimela (OPTCL) sub-station, 220kV breakers of 220KV Balimela (OHPC)-Balimela (OPTCL) Ckt-I and 220kV Balimela(OHPC)- Balimela(OPTCL)-Jayanagar T ckt shall be opened as per instruction of SLDC.
2. At Balimela HPS, the unit to be black-started and the 220kV Balimela (OHPC)-Balimela (OPTCL) T ckt to be charged from Balimela HPS shall be kept on one bus and all other available units and lines shall be transferred to other 220kV bus. 220KV Balimela (OHPC) –Jayanagar Ckt.-II shall be kept open at Jayanagar end. 220kV Balimela(OHPC)-Balimela(OPTCL) ckt shall remain in OFF condition.
3. On receipt of clearance from SLDC, Balimela HPS should start up the identified unit using the DG set as the source of auxiliary supply and charge the dead 220kV station bus.
4. The selected unit should have its AVR and governor action activated.
5. On receipt of clearance from SLDC as well as Balimela (OPTCL) sub-station, the 220kV Balimela (OHPC)-Balimela (OPTCL) T ckt is to be idle charged from Balimela HPS.
6. Assuming the minimum stable generation level of Balimela unit to be 20 MW, load of the same order is to be released by connecting 33kV feeders at Balimela (OPTCL) & Malkangiri sub-station.
7. The island created should operate stably for around ten minutes and to be synchronized at Jayanagar Grid substation as per the instruction of SLDC through 220kV Balimela (OPTCL) - Jayanagar Ckt. - II.

8. During the exercise, SLDC, OPTCL may keep record of the time of issuance of every instruction and time of actual execution of the switching operation.
9. Additional data such as frequency and voltage of the isolated Balimela (OPTCL) 220kV bus, terminal voltage, MW and MVAR of the unit should also be recorded by Balimela(OHPC)/ Balimela (OPTCL)/SLDC.
10. The electrical parameters at different time period of operation and the activity time should be recorded at Balimela PH in the format given below

Sl. No.	Parameters	Time	Time	Time	Time	Time
1.	Frequency (Hz)					
2.	Load (MW)					
3.	Generator Voltage (kV)					
4.	220kV isolated Bus Voltage (kV)					
5.	Reactive Power (MVAr)					
6.	Generator Current (kA)					
7.	Power Factor (lead / lag)					

Activity	Time (Minutes)
Time taken to start DG set after black out of Island	
Time taken to charge dead bus at Black start station	
Time taken to charge dead bus at Remote end by line charging	
Time taken to connect first load post a black out in the island	
Duration of stable island operation after successful black start and building up the of the island till synchronization with grid	
Time taken to synchronize the island with Grid	

7.3 Procedure for periodic exercise of black starting Indravati HEP

1. **Bus segregation required at UIHEP**
   The 220 kV switchyard of this station is of 2-main + 1 transfer Bus configuration. On one of the 220 kV main bus, one hydro unit to be black started and the 220 kV Indravati-Jayapatna line are to be connected while all other units, lines and transformers to be connected to the other main bus.
2. **Switching operation at Jayapatna**
   The 220 kV Jayapatna-Kasipur Feeder is to be made off at Jayapatna Grid SS end.
   Switching operation at Dabugaon
   The 132kV Dabugaon-Tentulikhunti Feeder is to be made off and isolated after getting instruction from SLDC and in coordination with Jayapatna, Tentulikhunti and Jayanagar GSS, so that power can be availed from the unit of UIHEP under black start operation.
3. **Switching operation at UIHEP 220 kV**
   The selected unit and 220 kV Jayapatna feeder to be switched off and connected to Main Bus-2. Other feeders, ICTs and units are to be connected to Main Bus-1. By opening the bus coupler CB, the selected unit and 220 kV UIHEP-Jayapatna feeder will get isolated.

4. **The procedure**
   Before carrying out the trial operation, it is to be ensured that both the 400/220 kV ICTs at Jeypore and Indravati and 220 kV Jeypore-Jayanagar D/C line are in service. Availability of data and voice communication of Jeypore and Indravati with ERLDC and between UIHEP, Jayapatna, Dabugaon and Umerkote is also to be checked.

5. **The entire operation is to be co-ordinated by SLDC.**
   The selected unit of UIHEP is to be self-started with the help of DG and 220 kV UIHEP-Jayapatna feeder to be charged. At Jayapatna GSS, power supply to be extended to the 132kV Bus by charging the Auto Transformer. Then 132kV Dabugaon feeder is to be charged to extend the power supply to Dabugaon and Umerkote GSS. Load is then to be released gradually taking care to maintain the island frequency and voltages at UIHEP and Dabugaon within acceptable limits. Around 50 MW load is to be released. The islanded operation of the unit may be continued for around 15 minutes. After successful completion, the island is to be synchronized with the system at Indravati PH as per the instruction of SLDC and normal configuration is to be restored.

SEQUENCE OF OPERATION:

1. 220 kV Indravati-Jayapatna feeder shall be made OFF from both the ends.

2. 132kV Jayapatna-Dabugaon feeder shall be made OFF from both the ends.

3. At Indravati PH switchyard, all outgoing 220 kV feeders i.e. Theruvali-1, 2 & 3, ICT 1 & 2, all running units shall be kept on Bus-1.

4. At Indravati PH switchyard, 220 kV Jayapatna feeder and the identified unit for black start shall be kept on 220 kV Bus-2. Bus coupler breaker shall be kept OFF.

5. At Jayapatna grid sub-station, 220kV Kasipur feeder shall be made OPEN.

6. At Indravati PH, the identified unit shall be started by availing auxiliary power supply from DG set and charged the Bus-2. The DG set starting time and the output parameters shall be recorded.
7. At Indravati PH switchyard, 220 kV Jayapatna feeder shall be charged.

8. At Jayapatna grid sub-station, 220 kV Indravati feeder shall be CLOSED to avail the power supply from the Black Start unit at Indravati P.H.

9. At Dabugaon grid sub-station, 132kV Tentulikhunti feeder shall be made open.

10. At Jaypatna grid sub-station, Auto Transformer and then 132kV Dabugaon feeder shall be charged.
11. At Dabugaon grid sub-station, 132kV Jaypatna feeder shall be charged to extend power supply to Umerkote grid sub-station.

12. Now load to be released gradually at Umerkote, Dabugaon and Jaypatna grid sub-stations in coordination with SLDC and Indravati P.H.

13. At each step, Umerkote, Dabugaon grid sub-station and Indravati PH shall record all the parameter readings such as Power Flow (both MW & MVAr), Frequency and Voltage etc.

14. The island so formed shall be synchronized with the system at Indravati P.H as per the direction of SLDC.

15. All operations shall be carried out in co-ordination with SLDC.

16. The electrical parameters at different time period of operation and activity time should be recorded at Upper Indravati HPS in the format given below.

Sl. No.	**Parameters**	**Time( )**	**Time( )**	**Time( )**	**Time( )**	**Time( )**
1.	Frequency (Hz)					
2.	Load (MW)					
3.	Generator Voltage (kV)					
4.	220kV isolated Bus Voltage (kV)					

5.	Reactive Power (MVAr)					
6.	Generator Current (kA)					
7.	Power Factor (lead / lag)					

Activity	Time (Minutes)
Time taken to start DG set after black out of Island	
Time taken to charge dead bus at Black start station	
Time taken to charge dead bus at Remote end by line charging	
Time taken to connect first load post a black out in the island	
Duration of stable island operation after successful black start and building up the of the island till synchronization with grid	
Time taken to synchronize the island with Grid	

7.4 Procedure for periodic exercise of black starting Rengali HEP

1. The 220kV line flows around Rengali P.H. and OPTCL network as a whole, to be closely monitored by SLDC.

AT RENGALI PH (OHPC)

1. 220 kV Rengali(HPS)-Rengali Switchyard Ckt.-II to be switched off from both ends.

2. All outgoing / incoming feeders i.e. TTPS, Kaniha, Rengali Switchyard Ckt-I & Station Transformer to be transferred to 220kV Bus-B except 220kV Rengali Switchyard Ckt-II, which is to be connected to Bus-A. Both the buses are to be isolated by opening the bus-coupler breaker.

3. The selected generating unit at Rengali HPS to be started up using the diesel generating set available at the power station.

4. The above unit is to be connected to the isolated Bus -A at Rengali HPS.

5. 220kV Rengali PH- Rengali Switchyard Ckt.-II to be idle charged from Rengali PH end from Bus -A.

AT RENGALI SWITCHYARD SUB-STATION (OPTCL)

1. All outgoing / incoming feeders i.e. Rengali PH Ckt-I, PGCIL- I & II, Tarkera (Chandiposh), Barkote(Deogarh) to be kept on 220kV Bus-A except 220kV Rengali PH Ckt-II. Both the buses are to be isolated by opening the bus-coupler breaker.

2. 220kV Bus-B is to be made free at Rengali Switchyard S/s (OPTCL). 220kV Rengali PH-Rengali Switchyard Ckt.-II, idle charged from Rengali PH is to be connected to Bus-B.

3. Both 220/33kV, 20MVA transformer load at Rengali switchyard to be transferred to Bus-B by isolating from Bus-A after getting clearance from SLDC.

SEQUENCE OF OPERATION:

1. 220 kV Rengali PH-Rengali Switchyard Ckt.-2 shall be made OFF from both the ends.

2. At Rengali PH switchyard, all outgoing 220 kV feeders i.e. TTPS, Kaniha, Rengali Switchyard Ckt-I & Station Transformer shall be transferred to 220kV Bus-B.

3. At Rengali PH switchyard, 220 kV Rengali PH-Rengali Switchyard Ckt.-2 and the identified unit for black start shall be kept on 220 kV Bus-A. Both the buses are to be isolated by opening the bus-coupler breaker.

4. At Rengali Switchyard grid sub-station, all outgoing / incoming feeders i.e. Rengali PH Ckt-I, PGCIL- I & II, Tarkera (Chandiposh) & Barkote (Deogarh) to be kept on 220kV Bus-A.

5. At Rengali Switchyard grid sub-station, 220kV Rengali PH- Rengali Switchyard Ckt.-II & both 220/33kV, 20MVA transformers shall be transferred to Bus-B.

6. At Rengali PH, the identified unit shall be started by availing auxiliary power supply from DG set and charge the Bus-A. The DG set starting time and the output parameters shall be recorded.

7. At Rengali PH switchyard, 220 kV Rengali PH-Rengali Switchyard Ckt.-2 shall be charged.

8. At Rengali Switchyard grid sub-station, the 220 kV Bus-B shall be charged by availing power supply from Rengali PH Ckt.-II.

9. At Rengali Switchyard grid sub-station, 220/33kV, 20MVA transformers shall be charged and gradually loaded.

10. At each step, Rengali Switchyard grid sub-station and Rengali PH shall record all the parameter readings such as Power Flow (both MW & MVAr), Frequency and Voltage etc.

11. The island so formed shall be synchronized with the system at Rengali PH as per the direction of SLDC.

12. All operations shall be carried out in co-ordination with SLDC.

Important Points:

- Voltage of the isolated bus and reactive power generation by the unit (on primary side of GT) before and after idle-charging the 220 kV circuit as well as after connecting load are to be recorded.
- The unit is to be synchronized with the system at Rengali PH as per the direction of SLDC.
- During the exercise, SLDC shall keep record of the time of issuance of every instruction and time of actual execution of the switching operation.
- Additional data such as frequency & voltage of the MW / MVAr of the unit shall also be recorded by Rengali PH / SLDC.
- The electrical parameter at different time period of operation and activity time should be recorded at Rengali HPS in the format given below.

Time--→			
Frequency (Hz)			
Load (MW)			
Generator Terminal Voltage (kV)			
220 kV Isolated Bus Voltage			
Reactive Power (Mvar)			
Generator Current (kA)			
Pf (Lead / Lag)			

Activity	Time (Minutes)
Time taken to start DG set after black out of Island	
Time taken to charge dead bus at Black start station	
Time taken to charge dead bus at Remote end by line charging	
Time taken to connect first load post a black out in the island	
Duration of stable island operation after successful black start and building up of the island till synchronization with grid	
Time taken to synchronize the island with Grid	

7.5 Procedure for periodic exercise of black starting Burla HEP

The 132kV line flows around Burla and OPTCL network as a whole, to be closely monitored by SLDC.

AT BURLA PH (OHPC)

1. 132 kV Burla (HPS)-Sambalpur Ckt. to be switched off from both ends.

2. All outgoing / incoming feeders i.e. Chiplima, Lapanga I(Hirakud) & Lapanga- II, 132kV Burla (HPS)-Katapalli ckt.-I & II & Station Transformers to be transferred to 132kV Main Bus except 132kV Burla (HPS)-Sambalpur ckt., which is to be connected to 132kV Reserve Bus. Both the buses are to be isolated by opening the bus-coupler breaker.

3. The selected generating unit at Burla HPS to be started up using the Diesel Generator set available at the power station.

4. The above unit is to be connected to the isolated Reserve Bus at Burla HPS.

5. 132 kV Burla (HPS)-Sambalpur ckt. to be idle charged from Burla PH end through Reserve Bus.

AT SAMBALPUR SUB-STATION (OPTCL)

1. All outgoing / incoming 132kV feeders i.e. Katapali, SDRI & 132 / 33kV Transformer to be kept on 132kV Main Bus except one 132kV Burla PH Ckt and 132kV Maneswar Ckt. 132kV Burla PH Ckt and 132kV Maneswar Ckt. are to be connected through Reserve Bus of Sambalpur. Both the buses are to be isolated by opening the bus-coupler breaker.

2. 132kV Burla PH - Sambalpur Ckt, idle charged from Burla PH will be extended up to Maneswar Grid Sub-station.

AT MANESWAR SUB-STATION (OPTCL)

1. 132kV Sambalpur-Maneswar ckt and 132kV Maneswar-Rairakhol will be connected to Main Bus of Maneswar.

2. Maneswar & Rairakhol area load will be put on 132kV Burla-Sambalpur, 132kV Sambalpur- Maneswar-Rairakhol ckt after getting clearance from SLDC.

AT RAIRAKHOL SUB-STATION (OPTCL)

1. 132kV Rairakhol-Boinda Ckt. is to be kept open at Rairakhol end after getting clearance from SLDC.
2. 132kV Rairakhol-Maneswar-Sambalpur-Burla P.H. Ckt. To be charged after getting clearance from SLDC.

SEQUENCE OF OPERATION:

1. 132 kV Burla PH-Sambalpur Ckt. shall be made OFF from both the ends.

2. At Burla PH switchyard, all outgoing / incoming feeders i.e. Chiplima, Lapanga I & II, 132kV Burla (HPS)-Katapalli ckt.-I & II & Station Transformers to be transferred to 132kV Main Bus except 132kV Burla (HPS)-Sambalpur ckt., which is to be connected to 132kV Reserve Bus. Both the buses are to be isolated by opening the bus-coupler breaker.

3. At Burla PH the identified unit for black start shall be kept on Reserve Bus.

4. At Sambalpur grid sub-station Switchyard, 132kV Katapali - Sambalpur Ckt. & 132kV SDRI- Sambalpur Ckt. to be kept on 132kV Main Bus and 132kV Burla P.H. - Sambalpur Ckt. & 132kV Sambalpur-Maneswar Ckt. to be kept on Reserve Bus.

5. At Maneswar grid sub-station, 132kV Sambalpur-Maneswar and 132kV Maneswar-Rairakhol to be kept on Main Bus.

6. At Rairakhol grid sub-station Switchyard 132kV Rairakhol-Boinda Ckt. is to be kept open.

7. At Burla PH, the identified unit shall be started by availing auxiliary power supply from DG set and charge the Reserve Bus. The DG set starting time and the output parameters shall be recorded.

8. At Burla PH switchyard, 132 kV Burla PH-Sambalpur Ckt. shall be charged.

9. At Sambalpur grid sub-station Switchyard, the Reserve Bus shall be charged by availing power supply from Burla PH Ckt. and power supply shall be extended to Maneswar grid substation through 132kV Sambalpur-Maneswar Ckt.

10. At Maneswar grid sub-station, 132kV Sambalpur-Maneswar and 132/33kV 40MVA transformers shall be charged and gradually loaded in consultation with Burla P.H/SLDC.

11. At Rairakhol grid sub-station, 132kV Maneswar-Rairakhol and 132/33kV, 12.5MVA transformers shall be charged and gradually loaded in consultation with Burla P.H/SLDC.

12. At each step, Rairakhol grid sub-station and Burla PH shall record all the parameter readings such as Power Flow (both MW & MVAr), Frequency and Voltage etc.

13. The island so formed shall be synchronized with the system at Burla PH as per the direction of SLDC.

All operations shall be carried out in co-ordination with SLDC.

Important Points:

- Voltage of the isolated bus and reactive power generation by the unit (on primary side of GT) before and after idle-charging the 132 kV circuit as well as after connecting load are to be recorded.
- The unit is to be synchronized with the system at Burla PH as per the direction of SLDC.
- During the exercise, SLDC shall keep record of the time of issuance of every instruction and time of actual execution of the switching operation.
- Additional data such as frequency & voltage of the MW / MVAr of the unit shall also be recorded by Burla PH / SLDC.
- The electrical parameter at different time period of operation and activity time should be recorded at Burla HPS in the format given below.

Sl. No.	Parameters	Time	Time	Time	Time	Time
1.	Frequency (Hz)					
2.	Load (MW)					
3.	Generator Voltage (kV)					
4.	220kV isolated Bus Voltage (kV)					
5.	Reactive Power (MVAr)					
6.	Generator Current (kA)					
7.	Power Factor (lead / lag)					

Activity	Time (Minutes)
Time taken to start DG set after black out of Island	
Time taken to charge dead bus at Black start station	
Time taken to charge dead bus at Remote end by line charging	
Time taken to connect first load post a black out in the island	
Duration of stable island operation after successful black start and building up the of the island till synchronization with grid	
Time taken to synchronize the island with Grid	