

Standard Operating Procedure for Islanding Schemes

1. Design Protocol

- i. As per Clause 10 of the Central Electricity Authority (Grid Standards), Regulations, 2010:

*“Islanding Schemes.- (1) The **Regional Power Committees** shall prepare Islanding schemes for separation of systems with a view to save healthy system from total collapse in case of grid disturbance. (2) The Entities shall ensure proper implementation of the Schemes referred to in sub regulation (1).”*

- ii. As per Indian Electricity Grid code amended from time to time, all regional constituents shall ensure that the islanding schemes are always functional.
- iii. Islanding Schemes may be designed:
 - for survival of some predefined generations and loads at the time of grid disturbance to avoid total blackout and quicker restoration of failed grid.
 - for major cities having loads of VIP areas, Defence, Space, Airport, Metro, ports and important industries etc.
- iv. Ministry of Defence(MoD) may be consulted to include their defense loads in such Islanding schemes. In case MoD requests any of their locations for which Islanding schemes is to be designed, the same would be considered. Only those defence establishments may be included in the Islanding Schemes for which MoD is agreed. The Ministry of Defence/Dept. of Military Affairs shall furnish information regarding their requirements as per format given at **Annexure I**. All the existing islanding scheme may be reviewed to include the Defence load in the scheme. Defence load of small capacity (upto 2 MW) not falling under any major cities may be continued with their arrangement of backup supply.
- v. The Essential loads falling under an Islanding schemes may be taken under consideration while designing Islanding schemes. Generally the essential loads are classified into two categories (i) Super critical Load and (ii) Critical loads. The super Critical load may cover the loads of Defence area, Raj Bhawan, Parliament house, residence of VIPs, Metro rails etc. The Critical loads may consist of loads of hospitals, Airport, Railways, Important Industries etc falling under the area covered in Islanding schemes. The critical and super critical load of the major city may be considered in consultation with the DISCOMs/SLDC and MoD.
- vi. If there is need to establish a power plant in/around such a city for the purpose, the proposal may be submitted for consideration of the concerned State /Utility under intimation to MoP. Possibility of installation of storage system at such location may also be explored. This provision may be suitably qualified for extremely sensitive loads only.

- vii. Islanding Schemes are to be formed with anticipated load-generation balance and with tripping of predetermined feeders/ ICTs/ generators. In every islanding scheme, adequate automated mechanism should be implemented for achieving load generation balance in the islanded sub-system.
- viii. Islanding schemes should not be taken as a system for continued supply to important loads. Necessary arrangement for emergency supply to important critical loads must be made separately.
- ix. Studies are to be carried out for verifying the operation of the Islanded system.
- x. The cyber security in the power system for Islanding schemes must be in accordance with the guidelines issued by Government of India.

2. Monitoring of Vital Parameters

- i. Since formation of Island can take place at any time, monitoring of the following vital parameters, which have a significant role in on successful Island formation, is of paramount interest:
 - a. Anticipated/ actual Generation within the electrical boundary of the Island.
 - b. Anticipated/ actual Load within the electrical boundary of the Island.
 - c. Voltage, Frequency & Power Flows along the peripheral lines which are required to be tripped to form the Island.
- ii. Above parameters are to be monitored in real-time basis in the Control Room/ Despatch Centre (i.e Sub SLDCs/SLDC/RLDC/NLDC) of the area by creating a dedicated page specific to the Islanding Scheme in the SCADA display. To accomplish this, provision should also be made, if required, for installing adequate measuring instruments (like PMU) at suitable locations within the Island.
- iii. The data in the formats at Annexures –II (Format I) may be submitted by RLDC/SLDCs to RPCs on monthly basis to certify the healthiness of communication system for monitoring the vital parameters of Islanding Schemes.

3. Certification of Healthiness of Islanding Scheme:

- i. Since healthiness of an integrated system depends on the healthiness of its constituting components, healthiness of Islanding Scheme has to be ascertained/ ensured by seeking monthly certificate for healthiness of batteries, installed at all Substations located within the electrical boundary of the Islanding Scheme. The idea is since these battery banks provide power supply to Relays, RTUs and PLCC equipment, healthiness of the former is critical to operation of the latter when called for.
- ii. It is to confirm the healthiness of islanding schemes by participating Generators as well as concerned transmission utilities for their respective portion in the monthly OCC meeting.
- iii. The data in the formats at **Annexures –II** (Format II to IV) may be submitted by Generators/Transmission utilities/Discoms etc to RPCs on monthly basis to certify the healthiness of Islanding Schemes.

4. Role and Responsibility and Coordination Activities:

- i. The Role and Responsibility of the Organizations / Officers/Officials in designing and operating the Islanding Schemes is defined at Annexure-III.
- ii. This is proposed to be achieved by having a Nodal Officer for each participating Utility in the Island [i.e., those who own assets (Generating stations, substations, transmission lines, distribution lines, etc.) within the Island], and a Chief Nodal Officer from the concerned Despatch/ Control Centre. The Chief Nodal Officer from LDC and Utility-specific Nodal Officers ensure free flow of information among them w.r.t. Islanding Scheme Operational status, and ensure correct & prompt communication between the SCADA Control Centre and various stations (Generating Stations/ Substations). There will be a coordination officer in each region from each RLDCs.
- iii. An updated list of contact details of all Nodal Officers as mentioned above shall be maintained with LDC & all Utilities involved. The Details of officials as mentioned above may be obtained in the in the Format V of Annexures –II:

5. Sensitization and Training of Officers involved:

- i. Even though chances of Island formation in a strongly integrated grid are remote, since the Islanding schemes are designed to protect major critical loads/ sensitive generation in the unfortunate event of failing of all other defence mechanisms, The Nodal Officers & concerned field staff associated with O& M of various stations (generating stations as well as substations) within the electrical boundary of the Island should be sufficiently sensitized about the colossal loss of those critical assets on account of Island failure, and consequent disruption to various sectors & businesses.
- ii. To ensure this, apart from conducting periodic orientation training programmes, the concerned Officers/ staff should also be involved in the activities concerning management of grid under stressed conditions, SCADA control, communication upkeep, and in the activities relating to audit/ inspection of critical loads & sensitive stations within the Island.
- iii. The Officials and Officers in the Generating Station/Substation/Utilities / LDC/ RLDC / RPCs would be sensitized about the (concerned) Islanding Scheme. They also to be trained to handle the Critical and Emergency Load Management in the system.
- iv. Training shall be focused on individual Islanding Schemes and integration of Islanding schemes with rest of the grid until restoration of normalcy to the regional grid.
- v. All the concerned utilities shall organise periodic training program for the nodal officers and concerned field officers. The training programs shall be in consultation and coordination with the RPCs. The training and sensitization program may be conducted once in six months.

6. Periodic Inspection/ Audit of Essential Components:

Inspection/ audit of all essential components as given below shall be carried out regularly (by third party) and inspection/Audit report may be submitted to respective RPCs:

- i. Under Frequency Relays (UFR) on Island forming elements (Lines & ICTs) – Quarterly.
- ii. Associated communication equipment at all stations within Island - Bi-monthly.
- iii. Associated DC supply for Control panel & communication system-Bi- monthly.

7. Review Plan of Islanding Schemes:

- i. Considering the fact that Network Changes (additions/ deletions/ reconfigurations of transmission elements & generators) in an evolving grid such as Indian electrical grid are unavoidable/ inevitable, it is but necessary to review the Islanding scheme operation w.r.t. prevailing grid conditions at regular intervals, and incorporate requisite changes so as to make them reliable & dependable.
- ii. In such review, all details as used in the existing scheme have to be re-collected including the new changes for studying the modifications to be carried out in the In-service Island. These details, among others, include participating generators, anticipated generation, participating loads, anticipated load, elements (lines and/ or ICT's) to be tripped to form the modified Island, geographical map & SLD of the modified Island, AUFR load relief, df/dt load relief, pumped loads details, etc. Using these details, system studies also need to be carried out to verify stability (including voltage profile & line loadings profile) of the modified Island.
- iii. It is recommended to carry out above review of the In-Service Islanding scheme once in six months by all concerned utilities. However, the review may also be carried out as soon as any network change, which may affect the operation of the Islanding Scheme, comes to notice.

8. Identification of Short-comings & Remedial action:

Based on the shortcomings noticed as a result of the activities performed in monitoring of vital parameters of the Island, ascertaining healthiness of Island, carrying out periodic inspection/ audit of essential components of the Island, prompt remedial action shall be taken to redress the observed deficiencies. The period of redressal from the instant of noticing shortcomings shall be at most one week/ fortnight. The compliance report may be submitted to RPCs in this regard.

9. Post Islanding survival:

In every islanding scheme, adequate automated mechanism should be implemented for achieving load generation balance in the islanded sub-system. Also, for frequency control of islanded subsystem there should be generating units in the island on restricted/ free governor mode of operation. Also, load connection/ disconnection should be possible remotely from the dispatch centre of the islanded sub-system. Health of all facilities in the islanding scheme should be closely monitored so as keep necessary electrical, mechanical, electronics and communication systems in good health all the time.

10. SOP Template for Islanding Schemes is at Annexure-IV

MINISTRY OF POWER
CENTRAL ELECTRICITY AUTHORITY

Details of information to be furnished by Defence installations for the purpose of designing the Electrical Islanding schemes:

Item No.	Description	Details
1	Basic Details:	
1.1	Service: Army/Navy/Airforce/MES etc.	
1.2	Name of the Establishment	
1.3	Location (State, District, Taluk & Village)	
1.4	Name of the nearest City & Distance from it	
2.	Power Supply Details:	
2.1	Name of the DISCOM (Power Supply Distribution Company) from which supply is being availed:	
2.2	Name of the DISCOM Substation from which supply is being availed:	
2.3	Number of incoming lines/feeders of supply and Voltage level	
3	Load Details:	
3.1	Contracted Capacity in kVA/MVA	
3.2	Maximum Demand in kVA/ MVA	
3.3	Connected Load in kW/MW	
3.4	Critical Load(kW/MW)/ Non Critical Load(kw/MW)	
3.5	Any other information on Load details	
4	Backup Power Supply:	

4.1	Details of DG sets: (Number of DG sets & their Rating in kVA/MVA & No. of hours they can run/sustain)	
4.2	Battery Banks/ UPS Rating:	
4.3	In-house Solar Generation in kW/MW	
4.4	Captive Generation, if any, in kW/ MW	
5	Specific Requirement from Ministry of Power, CEA/RPCs, NLDC, RLDC, ST, SLDC and Discoms wrt uninterrupted power supply to Defence installation	
6	Other Relevant Information, if any	

Formats for collection of information regarding Islanding Schemes:**a. Format - I** for RLDC/SLDCs

S.NO	Name of Islanding Scheme	Healthiness of Communication channel

b. Format - II for Generating Station

S.NO	Name of Islanding Scheme	Healthiness of Islanding Relay	Healthiness of Communication channel

c. Format - III for Transmission Utility/ DISCOMs

S.NO	Name of Islanding Scheme	Elements considered for tripping to from Island	For communication based tripping logic of feeders	For UFR based tripping logic of feeders	
			Healthiness of Communication channel	Healthiness of PT Fuse and status of DC supply to UFR relay*	Healthiness of Relay#

* Where dedicated UFR relay have been installed for tripping of the feeders under islanding scheme

Where UFR function have been enabled within backup protection relay of the line

d. Format - IV for collecting Relay details of the Islanding scheme.

The following format may be used to get Relay details of the Islanding scheme:

S.NO	Description	UFRs-for load relief (A)	df/dt -for load relief (B)	Relay for Island creation(C)
1	Relay location (S/s name)			
2	Relay make & model			

3	Frequency setting of the relay (at which load shedding is envisaged)			
4	Feeder name (voltage level and source-destination name) signalled by the Islanding Relay for separation /load shedding/separation from outside grid			
5	Quantum of load relief due to tripping of feeder (as per state's peak of previous year)			
6	Quantum of load (Min, Avg, Max in MW) on the feeder (as per state's peak of previous year)			

e. Format - V for Contact details of all Nodal Officers

Utility Name & Location	Name	Designation	Organization	Email ID	Mobile No.

Roles and Responsibilities of Officers involved in Islanding Schemes:

1.	RPCs	<ul style="list-style-type: none">i. In comply with CEA(Grid Standards) 2010 and its amendments, MS, RPCs shall be responsible for preparation of Islanding Schemes. The designing/ implementation and Review of Islanding Scheme may be discussed in appropriate Committee/Sub-Committee of RPCs or a separate Sub-group may be formed.ii. MS, RPC may Nominate Officer at the level of Superintending Engineer for Coordinating the Islanding Schemes in the Region.iii. MS, RPCs shall be responsible for periodic review of the Islanding Schemes to accommodate the network changes, load generation balance or constraints, if any.iv. MS, RPC shall be responsible for third party audit of the components of an Islanding Scheme.
2.	RLDCs	<ul style="list-style-type: none">i. There shall be a nodal officer at the level of General Manager & above appointed by the appropriate Authority of the RLDC. Nodal officer of RLDCs may act as Coordinating Nodal officer.ii. The Nodal officer of RLDCs shall coordinate the Chief Nodal officers of SLDCs in their respective regions.iii. Coordinating Nodal Officer shall ensure monitoring of the vital parameters of operational/implemented Islanding Schemes in their region, which have a significant role in successful Island formation at their SCADA system.iv. To ensure proper monitoring, measuring instruments (like PMUs etc.) and communication systems may be recommended by Co coordinating nodal officer to the concerned utility.v. Coordinating Nodal officers shall monitor and ensure the healthiness of the components involved in the Islanding Scheme like SCADA system, communication channel etc. at their end.vi. Coordinating Nodal officer shall conduct monthly self-certification of healthiness of the communication systems at their end and communicate it to the concerned RPCs in the format prescribed in the SOP.vii. Coordinating Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPCs in a time bound manner.
3.	Nodal officer of LDCs	<ul style="list-style-type: none">i. There shall be a nodal officer at the level of Chief Engineer & above for all Islanding Schemes in the respective state appointed by the appropriate Authority of the LDCs.ii. Nodal officer of LDCs shall act as Chief Nodal officers for nodal officers of DISCOMs, TRANSCOS & GENCOs of the

		<p>state and shall ensure proper communication among all the nodal officers.</p> <p>iii. The Chief Nodal officer shall coordinate and responsible for implementation of newly designed Islanding Schemes in coordinated manner with all utilities involved.</p> <p>iv. Chief Nodal officer is responsible for collection of data from the concerned utilities and submission the same to committee for study purpose in respect of existing/new IS for review/design purpose.</p> <p>v. Chief Nodal Officer shall ensure monitoring of the vital parameters of operational/implemented Islanding Schemes in the state, which have a significant role in successful Island formation.</p> <p>vi. To ensure proper monitoring, measuring instruments (like PMUs etc.) and communication system etc. may be recommended by nodal officer to the concerned utility</p> <p>vii. Chief Nodal officers shall ensure the healthiness of the components involved in the Islanding Scheme like SCADA system, communication channel etc. at their end.</p> <p>viii. Chief Nodal officer shall conduct monthly self-certification of healthiness of the components at their end involved in the Islanding scheme and communicate it to the concerned RPC in the format prescribed in the SOP.</p> <p>ix. Chief Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPC in a time bound manner.</p>
4.	Nodal officer of Participating GENCOs	<p>i. There shall be a nodal officer at the level of General Manager / Chief Engineer & above for Islanding Schemes appointed by the appropriate Authority of the Generation Company.</p> <p>ii. Nodal officers shall be responsible for the implementation of newly designed Islanding Schemes for Genco's part and submission of data to Study committee wrt Islanding scheme.</p> <p>iii. Nodal officer is responsible for submission of data for Genco part to committee for study in respect of existing/new IS for review/design purpose.</p> <p>iv. Nodal officers shall ensure the healthiness of the components involved in the operational Islanding Scheme like Generating Units, Substations /Switch yards, Relays, communication channel etc. at their end.</p> <p>v. Nodal officer shall conduct monthly self-certification of healthiness the components at their end involved in the Islanding scheme and communicate it to the concerned RPCs in the format prescribed in the SOP.</p> <p>vi. Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPCs in a time bound manner.</p>

5.	Nodal officer of STUs/PGCIL	<ul style="list-style-type: none"> i. There shall be a nodal officer at the level of General Manager / Chief Engineer & above for all the Islanding Schemes appointed by the appropriate Authority of the Transmission Company. ii. Nodal officers shall be responsible for the implementation of newly designed Islanding Schemes at transmission part. iii. Nodal officer is responsible for submission of data to committee for study in respect of existing/new IS for review/design purpose for Transmission part . iv. Nodal officers shall ensure the healthiness of their components involved in the operational Islanding Scheme like Substations, Transmission Lines, Relays, communication channel etc. at their end. v. Nodal officer shall conduct monthly self-certification of healthiness of the components at their end involved in the Islanding scheme and communicate it to the concerned RPC in the format prescribed in the SOP. vi. Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPC in a time bound manner.
6.	Nodal officer of DISCOMs	<ul style="list-style-type: none"> i. There shall be a nodal officer at the level of General Manager /Chief Engineer & above for each Islanding Schemes appointed by the appropriate Authority of the Distribution Company. ii. Nodal officer shall be responsible for identification of essential loads and defence load for the Islanding Scheme. iii. Nodal officers shall be responsible for the implementation of newly designed Islanding Schemes at their end. iv. Nodal officer is responsible for submission of data for their part to committee for study in respect of existing/new IS for review/design purpose. v. Nodal officers shall ensure the healthiness of the components involved in the Islanding Scheme like Feeders, Relays, communication channel etc. at their end. vi. Nodal officer shall conduct monthly self-certification of healthiness of the components involved in the Islanding scheme at their end and communicate it to the concerned RPC in the format prescribed in the SOP. vii. Nodal officer shall ensure follow-up of the recommendation of the third party Audit conducted by RPC in a time bound manner.

SOP Template for Islanding Schemes:

1. Purpose
2. Design
 - i. Generation
 - a. Coal
 - b. Gas
 - c. Nuclear
 - d. Hydro
 - e. Solar
 - f. Wind
 - g. Total generation
 - h. PLF or availability /scheduling
 - i. Generation considered
 - j. Generators on prolonged outage
 - k. Probability of the anticipated generation
 - l. Pumped storage?
 - m. ISGS
 - n. SGS
 - o. IPP/MPP
 - ii. Load
 - a. Drinking water
 - b. Irrigation
 - c. Agriculture
 - d. Industrial
 - e. Commercial
 - f. Domestic
 - g. Hospital
 - h. Railways/Metro
 - i. Defence
 - j. Lift Irrigation System/Scheme
 - i. Load relief
 - a. df/dt-I
 - b. df/dt-II
 - c. AUFR-I
 - d. AUFR-II
 - e. AUFR-III
 - f. AUFR-IV
 - ii. Transmission lines in the islanded area
 - a. 765 kV
 - b. 400 kV
 - c. 220/230 kV
 - d. 132/110 kV
 - e. 66 kV

- f. 11/22/33 kV
 - g. Inter regional lines
 - h. Inter-state lines
 - i. Intra-state lines o Substations in the area
 - j. CTU
 - k. STU
 - l. ISTS
- iii. Transmission lines that get disconnected on operation of df/dt and AUF relays
 - 220/230 kV
 - 132/110 kV
 - 66 kV
 - 11/22/33 kV
- iv. Transmission lines to be tripped for forming Island
 - a. 765 kV
 - b. 400 kV
 - c. 220/230 kV
 - d. 132/110 kV
 - e. 66 kV
 - f. 11/22/33 kV
- v. Name of the cities covered
 - a. 10 million
 - b. 1 million
 - c. Defence locations
- vi. Diagrams
 - a. SLD map of the island
 - b. Geographical map of the island with boundary
 - c. Major cities/critical loads/defence loads marked
 - d. Substations marked
- 3. SCADA mapping
 - Island generation and island loads on the SCADA display
- 4. Constraints
 - a. Generation limits
 - b. Line loading limits
 - c. ICT loading limits o Frequency set points
 - d. df/dt-I
 - e. df/dt-II
 - f. AUFR-I
 - g. AUFR-II
 - h. AUFR-III
 - i. AUFR-IV
 - j. LIS relief frequency
 - k. RE generation disconnection frequency
 - l. Islanding frequency
- 5. Controlling generation in islanded area

- a. AGC
 - b. RGMO/FGMO
- i. Controlling load in islanded area
 - a. Automatic
 - b. Flow based
 - c. Voltage based
 - d. Frequency based
 - e. Manual
- ii. Validation check list
 - Generation > Load?
 - Non-Hydro only islanding?
 - Less number of disconnecting lines?
 - All disconnecting lines with AUFR?
 - RE-solar/wind excluded?
 - LIS loads excluded?
 - LF studies for islanded area, converging?
 - In the converged LF studies, line loadings profile & voltage profile are within permissible limits?
 - All critical load/defence loads included?
 - Critical/defence loads are not part of SPS, df/dt or AUFR schemes?
 - Islanding frequency - (47.9 Hz)?
 - Adequate margin between lower frequency of IEGC band and first stage AUFR?
 - Adequate margin between islanding frequency and AUFR last stage?
 - Scheme was discussed & approved in OCC/ PCC?
 - Scheme approved in RPC?

50.20		
50.10		
50.05		
50.00	IEGC band	
49.90		
49.80		
49.70	Urgent load Mgt.	
49.60		
49.50		

49.40		Emergency Load Mgt.
49.30		
49.20		
49.10		
49.00		UFR load shedding
48.90		
48.80		
48.70		
48.60		
48.50		
48.40		
48.30		
48.20		
48.10		
48.00		
47.90		Islanding Frequency
47.80		

*** Above values are subject to change as per newly adopted frequency settings in NPC

6. Operation

i. Successful

- Generation in the islanded area
- Load in the islanded area
- Date & time island formation
- Date & time of island closed/shutdown
- Frequency of the islanded area
- Voltage profile of the buses
- Flows/ Loadings on critical lines
- Duration of island survival
- Whether anticipated generation was there?
- Whether anticipated load was there?

- All the lines were disconnected as per the plan?
 - Reason for islanding success
 - Any measures to further improve
- ii. Failure
 - a. Generation in the islanded area
 - b. Load in the islanded area
 - c. Date & time island formation
 - d. Date & time of island closed/shutdown
 - e. Duration of island survival
 - f. Whether anticipated generation was there?
 - g. Whether anticipated load was there?
 - h. All the lines were disconnected as per the plan?
 - i. Reason for islanding failure
 - j. Remedial measures

7. Review plan

- i. Island formed and approved date
- ii. Change in generation
 - Addition
 - Deletion
 - Alteration
- iii. Change in load
 - a. Addition
 - b. Deletion
 - c. Alteration
- iv. Change of the lines to be disconnected
- v. Any new lines to be included for disconnecting
- vi. Requirement of additional df/dt & AUFR relays

8. Nodal officers of Islanding Scheme

- i. RLDC
- ii. SLDC
- iii. STU
- iv. SGS
- v. ISGS
- vi. ISTS (SR-I, SR-II)

9. Sensitization Training of nodal officers

- i. Training by RLDC
- ii. Training by NPTI/PSTI
- iii. Training by SLDC
- iv. SRPC special meetings

10. Periodic Inspection of Essential components of Islanding Scheme

- i. Inspection of UF relays of disconnecting lines
- ii. Ensuring adequate relief under df/dt and AUFR stages

- iii. Ensuring relays for disconnecting RE sources
- iv. Ensuring relays for disconnecting LIS
- v. Ensuring critical/defence loads are not under df/dt & AUFR stages
- vi. Monitoring the anticipated generation and load in the islanded area

11. Mock drill

- i. Mock drill to follow any major or near miss incidents
- ii. Frequent heavy over drawl by states
- iii. Frequent Very low frequency of operation
- iv. Before peak period of the region
- v. Before peak period of the state
- vi. Loss of many lines due to cyclone/weather
- vii. Loss of generating plants due to cyclone/weather
- viii. RE is highest and entirely absorbed by states

12. Certifications of healthiness of IS

- i. Batteries
- ii. Relays
- iii. Lines within the islanded area

13. Identifications of short comings

14. Further updations.
