EASTERN REGIONAL POWER COMMITTEE

ADDITIONAL AGENDA FOR 180th OCC MEETING TO BE HELD ON 22.06.2021(WED) AT 10:30 HRS

ITEM NO.1: Standard Operating Procedure for Islanding Schemes.

A meeting was held on 16.04.2021 through video conference (VC) under the chairmanship of Secretary (Power) to review Islanding schemes of India Grid. As per decision taken in the meeting, CEA has to prepare Standard Operating Procedure (SOP) for the Islanding Schemes.

The SOP for the Islanding Schemes has been prepared by CEA. The draft SOP is placed at **Annexure-1.1**.

MOP vide letter dated 16.06.2021 forwarded the comments/observations of on the draft SOP. The same is placed at **Annexure-1.2.**

In the observations of the MoP on Standard Operating Procedure (SOP) SL. No. (f) it has been submitted that:

"*A model islanding scheme, one of the better available islanding schemes, may be enclosed for ease of reference*".

In line with the above observation all the concerned utilities are advised to provide requisite data as per **Annexure-1.3** to ERPC secretariat latest by 25.06.2021 for onward submission to MoP.

Further all the concerned utilities are advised to send their comments/observations, if any, on the SOP to ERPC secretariat latest by 25.06.2021.

Members may discuss.

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 subregulation (1)."*

ii. As per Indian Electricity Grid code amended from to time ,all regional constituents shall ensure that the islanding schemes are always functional.

iii. Islanding Schemes for survival of some predefined generations and loads at the time of grid disturbance may be designed to avoid total blackout and quicker restoration of failed grid.

iv. Islanding schemes may also be designed for major cities having loads of VIP areas, Defence, Space, Airport, Metro, ports and important industries etc.

v. Ministry of Defence may be consulted to include their defense loads in such Islanding schemes.

vi. In case MoD requests any of their locations for which Islanding schemes is to be designed, the same would be considered. Only thosedefence establishments may be included in the Islanding Schemes for which MoD is agreed.

vii. The Ministry of Defence/Dept. of Military Affairs shall furnish information regarding their requirements as per format given at **Annexure I**.

viii. 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 load, Raj Bhawan, Parliament house, residence of VIPs, Metro rails. The Critical loads may consist of loads of hospitals, Airport, Railways, Important Industries etc falling under the area covered in Islanding schemes.

ix. All the Islanding scheme may coverthe critical and super critical load of the major city in consultation with the DISCOMs/SLDC and MoD.

x. All the existing islanding scheme may be reviewed to include the Defence load in the scheme.

xi. Defence load of small capacity (2 MW) not falling under any major cities may be continued with their arrangement of backup supply.

xii. The existing Islanding Scheme shall be reviewed periodically/seasonally to identify the constraints in them. Load-generation balance in Islanding Scheme may change based on season, there would be need to review the scheme on seasonal basis. Such review should also capture network changes taking place in the interim period. The constraints/change, if any, identified shall be rectified in a time bound manner.

xiii. If there is a need to establish a power plant in / around such a city for the purpose, the proposal for the same may be submitted for consideration of the MoP. Possibility of installation of storage system at such location may also be explored.

xiv. Generating Stations, which are spatially near to strategic and essential loads, shall be given priority in designing the Islanding schemes.

xv. The cyber security in the power system for Islanding schemes must be ensured and in accordance with the guidelines issued by Government of India.

xvi. Sufficient gaps should be maintained between frequency band of normal operation, frequency band for pre-islanding defense mechanism and trigger frequencies of islanding schemes.

xvii. 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 sufficient number/capacity of generating units in the island on free/restricted governor mode of operation.

xviii. Also, load connection/ disconnection should be remotely from the dispatch centre of the islanded sub-system. Health of all facilities required in the islanding scheme should be closely monitored so as keep at the necessary electrical, mechanical, electronics and communication systems in good health all the time.

xix. Islanding schemes should generally be implemented for only those sub-parts of network which connect to rest of grid in an electrically radial manner or with only a few interconnecting lines and having their own load generation balance to a large extent, requiring comparatively smaller exchanges with rest of the grid.

xx. 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.

xxi. Frequency of Island formation may be 47.9 Hz. Islanding scheme could be a **two-tier scheme**. At frequency level of say 47.9 Hz, signal for formation of islands comprising of more than one generating stations along with pre-identified load could be initiated. However, if after the formation of island, frequency continues to fall further to say 47.7 Hz, these islands could be further broken into smaller islands comprising of single generating station with pre-identified loads.

xxii. Islanding Schemes are to be formed with anticipated load-generation balance and with tripping of predetermined feeders/ ICTs/ generators.

xxiii. Islanded system should preferably have 20% excess generation than load.

xxiv. Islanding scheme should preferably have a good mix of Thermal–Hydro–Gas based generation.

xxv. Islanding schemes involving only hydro generation is generally not recommended due to wide variation in hydro generation from season to season and during peak/off-peak hours of day.

xxvi. AUFR &df/dt Loads are not be considered in the Island since they would have given their load relief as per their frequency setting much before formation of Islanding commences at 47.9 Hz.

xxvii. Lift Irrigation & Pumped Loads are not to be considered in the Island due to their uncertain nature, and should be tripped at a suitable frequency, say, 48.5 Hz, much before the formation of Islanding commences at 47.9 Hz.

xxviii. Wind/ solar generating stations, because of their uncertain nature, shall not form part of Islanding Scheme; hence incoming wind/ solar feeders to the substation are to be tripped at Islanding Frequency of 47.9 Hz..

xxix. Load flow studies are to be carried out for verifying the operation of the Islanded system.

xxx. All generation shall go to House-Load in the unavoidable eventuality of unsuccessful formation of Island.

xxxi. If the frequency rises above 52 Hz even after FGMO/RGMO operation (due to non-availability of anticipated loads at the time of separation), high-frequency time-graded tripping of generators is to be carried out.

2. Monitoring of Vital Parameters:

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:

- Anticipated/ actual Generation within the electrical boundary of the Island
- Anticipated/ actual Load within the electrical boundary of the Island
- Voltage, Frequency & Power Flows along the peripheral lines which are required to be tripped to form the Island

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's) at suitable locations within the Island.

3. Certification of Healthiness of Islanding Scheme:

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 (esp. those at the boundary).

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.

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.

The data in the following formats may be submitted by STU/Discomsetc to RPCson monthly basis to certify the healthiness of Islanding Schemes.

Format for Generating Station		
Name of Islanding Scheme	**Healthiness of Islanding Relay**	**Healthiness of Communication channel**

Format for Transmission Utility/Discoms				
Name of Islanding Scheme	**Name of Feeders 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

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

Description	A) UFRs (for load relief)	B) df/dt (for load relief)	C) Relay for Island creation

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

4. Coordination Activities:

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 (esp. those at Island boundary).

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 following format:

S/s Name	Name	Designation	Organization	Email ID	Mobile No.

5. Sensitization Training of Officers involved:

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 (gen. 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.

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.

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:

- Under Frequency Relays (UFR's) on Island forming elements (Lines & ICTs) - Quarterly
- Associated communication equipment at all stations within Island - Bi-monthly

7. Review Plan of Islanding Schemes:

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.

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.

It is recommended to carry out above review of the In-Service Islanding scheme once in six months by all concerned utilities.

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 sufficient number/capacity of 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-II

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Annexure –I

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/feedersof 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 Discomswrt uninterrupted power supply to Defence installation**	
6	**Other Relevant Information, if any**	

Annexure -II

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
    iii. Load relief
        a. df/dt-I
        b. df/dt-II
        c. AUFR-I
        d. AUFR-II
        e. AUFR-III
        f. AUFR-IV
    iv. 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 oSubstations in the area
        j. CTU
        k. STU
        l. ISTS

v. 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

vi. 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

vii. Name of the cities covered
   a. 10 million
   b. 1 million
   c. Defence locations

viii. 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 oFrequency 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 lmits?
- 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?

50.2		
50.1		
50.05		
50		IEGC band
49.9		
49.8		
49.7		Urgent load mgmt
49.6		
49.5		
49.4		emergency Load mgmt
49.3		
49.2		
49.1		
49		UFR load shedding
48.9		
48.8		
48.7		
48.6		
48.5		
48.4		
48.3		
48.2		

48.1		
48		
47.9		Islanding frequencies
47.8		

**** 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
    - Inspection of UF relays of disconnecting lines
    - Ensuring adequate relief under df/dt and AUFR stages
    - Ensuring relays for disconnecting RE sources
    - Ensuring relays for disconnecting LIS
    - Ensuring critical/defence loads are not under df/dt& AUFR stages
    - 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

Annexure-1.2

सं. 22-1306/37/2020-ओएम
भारत सरकार
Government of India
विद्युत् मंत्रालय
Ministry of Power
श्रम शक्ति भवन, रफ़ी मार्ग, नयी दिल्ली-110 001
Shram Shakti Bhawan, Rafi Marg, New Delhi-110 001

Dated 16th June, 2021

To
The Chairperson
Central Electricity Authority,
Sewa Bhawan, R.K. Puram,
New Delhi-110066

Subject: Standard Operating Procedure (SOP) for the Islanding Schemes - reg.

Sir/Madam,

I am directed to refer to CEA's e-mail dated 16.05.2021 on the subject mentioned above, whereunder the draft SOP for Islanding Schemes was forwarded to Ministry of Power for approval.

2. The comments/observations of the Ministry on the draft SOP are annexed. It is requested that the comments/observations be suitably incorporated in the draft SOP and the revised SOP be sent to the Ministry urgently.

Encl: as above

Yours faithfully,

(Rita Singh)
Under Secretary to the Govt. of India
Telefax: 23717737
Email:opmonitor-power@nic.in

Copy to:

1. Ms. Rishika Sharan, Chief Engineer (National Power Committee), Central Electricity Authority, Sewa Bhawan, R.K. Puram, New Delhi-110066

Observations of the Ministry on Standard Operating Procedure (SOP)

(a) **Point xiii** under the heading "Design Protocol" says, "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 MoP. Possibility of installation of storage system at such location may also be explored." As many important cities may not have adequate capacity of generating stations required for load balancing in the islanding area, this provision may lead to flurry of requests to MoP to establish power plants. I believe the primary responsibility of successful run of islanding scheme lies with the concerned state. Therefore, the request for establishing new power plant should be placed with the state concerned under intimation to MoP. Further, this provision may be suitably qualified for extremely sensitive loads only.

(b) **Point xxviii** under the heading "Design Protocol" says, "Wind/solar generating stations, because of their uncertain nature, shall not form part of islanding scheme; hence incoming wind/solar feeders to the substation are to be tripped at Islanding frequency of 47.9 Hz". In this regard it is all right to not take into account wind/solar stations as far as load balancing is concerned in the islanding area. However, at the time of islanding, if solar/wind generators are available, it may help in balancing the load and therefore, tripping of solar/wind feeders necessarily at islanding doesn't seem appropriate. If at the time to islanding, there is need to cut down generation, the solar/wind generation may be the first ones to be disconnected.

(c) Under the heading "Design Protocol" there are 31 sub points. Some issues are repeated across several points. This "Design Protocol" part can be made more concise.

(d) Formats for collection of various information can all be numbered and kept as annexures.

(e) Roles and responsibilities of identified officers, may be by designation, and training protocols may be included in the SoP.

(f) A model islanding scheme, one of the better available islanding schemes, may be enclosed for ease of reference.

Annexure-1.3

Information needed for Islanding Scheme

1) Name of the Islanding Scheme (better available):
2) Brief Working/design of the above Islanding Scheme (with SLD and other details .
3) Other Data Required in respect of the above IS

i. Format (I)

Format (I) for Generating Station			
S.NO	Name of Islanding Scheme	Healthiness of Islanding Relay	Healthiness of Communication channel

ii. Format (II)

Format (II) for Transmission Utility/Discoms					
S.NO	Name of Islanding Scheme	Name of Feeders 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#

iii. **Format (III)** :

Format (III) : Relay details of the Islanding scheme				
S.NO	Description	(A) UFRs (for load relief)	(B) df/dt (for load	(C) Relay for Island creation

			relief)	
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)			

iv. Format IV

Format **IV**:Contact details of all Nodal Officers					
S/s Name	Name	Designation	Organization	Email ID	Mobile No.