

Grid Controller of India Limited (Grid-India)
Formerly Power System Operation Corporation Ltd.

Detailed Procedures
for
Security Constrained Unit Commitment (SCUC),
Unit Shut Down (USD), and
Security Constrained Economic Despatch (SCED)
at Regional Level

*Prepared in Compliance to Central Electricity Regulatory Commission
(Indian Electricity Grid code) Regulations, 2023*

Version History

Document Name:	Detailed Procedures for Security Constrained Unit Commitment (SCUC), Unit Shut Down (USD), and Security Constrained Economic Despatch (SCED) at Regional Level		
Document Creation Date:	07 Sep 2023		
Version History			
Sr.No	Description of Change	Date of Change	Revision No.
1	Initial Document	07 Sep 2023	0.0

Contents

1.0	Background	1
2.0	Objective	1
3.0	Scope.....	1
4.0	Definitions.....	2
5.0	Roles and Responsibilities	3
6.0	Procedure for Security Constrained Unit Commitment (SCUC)	6
7.0	Unit Shut Down (USD).....	11
8.0	Security Constrained Economic Despatch (SCED).....	12
9.0	Accounting and Settlement under SCUC	14
10.0	Accounting and Settlement under SCED.....	16
11.0	Removal of Difficulties	19
	Format-1: Tentative list of generating stations, scheduled below the minimum turndown level	20
	Format-2: List of generating stations with incremental power scheduled to achieve minimum turndown level	21
	Annexure-1: Objective Function, Constraints and Inputs for SCUC.....	22
	Format-3(a): List of units that are required to come on bar on the next day	25
	Format-3(b): Advance intimation of the list of units that are required to come on bar on the next two days	26
	Annexure-2: Objective Function and Constraints for SCED	27
	Annexure-3: Sharing mechanism of SCED benefits	28
	Format SCUC_AA: RPC "Regional SCUC Weekly Statement"	30
	Format SCUC_BB: RPC "Net Regional Shortfall/emergency and SCUC weekly Statement"	31
	Format SCUC_CC: RPC "Statement of Compensation due to Part Load Operation due to SCUC"	32
	Format SCED_AA: RPC "Regional SCED Monthly Statement"	33
	Format SCED_CC: RPC "Statement of Compensation due to Part Load Operation due to SCED"	35
	Format SCED_DD: NLDC "National Statement of Compensation due to Part Load Operation due to SCED"	36
	Format SCED_EE: RPC "Details of Beneficiary schedule energy from SCED generator"	37
	Format SCED_FF: NLDC " National net SCED Benefits Distribution Statement"- SCED Generator.....	38
	Format SCED_GG: NLDC " National net SCED Benefits Distribution Statement"" - Beneficiary	39

1.0 Background

- 1.1 CERC (Indian Electricity Grid Code) Regulations, 2023 hereinafter referred to as the IEGC, includes chapters on SCUC, Unit Shut Down (USD), and SCED.
- 1.2 The current procedure is prepared in accordance with Regulations 46(4)(i), 47(2), 46(4)(j), 46(5)(a), 46(5)(b), 49(2)(a)(iv), 49(2)(a)(xi) of the IEGC. This procedure supersedes the earlier procedures prepared for SCED, and Reserve Shut Down (RSD).
- 1.3 All the words and expressions used in the Procedure shall have the same meaning as assigned to them in various CERC Regulations.

2.0 Objective

- 2.1 The objective of this procedure is to lay down the roles of various entities and methodology for the operation of SCUC, USD, and SCED mechanisms.
- 2.2 The objective of Security Constrained Unit Commitment (SCUC) is to commit a generating station or unit thereof, for the maximisation of reserves in the interest of grid security.
- 2.3 The objective of Security Constrained Economic Despatch (SCED) is to optimise generation despatch and achieve National Merit Order after gate closure in the real time market and after finalisation of schedules under RTM, by incrementing generation from the generating stations with cheaper charge and decrementing commensurate generation from the generating station with higher charge, after considering the operational and technical constraints of generation and transmission facilities.

3.0 Scope

- 3.1 This procedure shall be applicable to regional entity thermal generating stations or units thereof, for which tariffs are determined under section 62 of the Act, and other regional entity thermal generating stations which may opt to participate under SCUC/SCED. A thermal generating station which opts to participate in SCUC is mandated to participate in SCED.

4.0 Definitions

- 4.1 All the words and expressions used in the Procedure shall have the same definition as assigned to them in the Electricity Act, 2003 and various CERC Regulations.
- 4.2 SCUC-Up means the incremental generation scheduled under the head "SCUC" in the scheduling system, in order to bring the schedule up to minimum turndown level.
- 4.3 SCUC-Down means the decremental generation scheduled under the head "SCUC" in the scheduling system, in order to balance the SCUC-Up scheduled in other generating stations.
- 4.4 "Cold Start" in relation to steam turbine means start up after a shutdown period exceeding 72 hours (turbine metal temperatures below approximately 40% of their full load values).
- 4.5 "Hot Start" in relation to steam turbine, means the start up after a shutdown period of less than 10 hours (turbine metal temperatures below approximately 80% of their full load values)
- 4.6 "Warm Start" means the start up after a shutdown period between 10 hours and 72 hours (turbine metal temperatures between approximately 40% to 80% of their full load values) in relation to steam turbine.
- 4.7 "Minimum Up Time" means the minimum time for which a unit shall be kept on bar, once committed under SCUC.
- 4.8 "Minimum Down Time" means the minimum shutdown duration that would be provided between de-synchronization and synchronization of a generator under SCUC.

5.0 Roles and Responsibilities

5.1 Role of NLDC

- 5.1.1 NLDC shall be the nodal agency for coordinating and overseeing SCUC, and SCED processes.
- 5.1.2 NLDC, in coordination with RLDC's, shall prepare a tentative list of generating stations or units that are likely to be scheduled below their minimum turndown levels for the day ahead and publish the tentative list on its website by 1400 hrs of D-1 day.
- 5.1.3 NLDC shall communicate with beneficiaries and generating stations to finalize the list of units that will participate in SCUC.
- 5.1.4 NLDC shall schedule incremental energy from generating units to bring them to their minimum turndown levels to maximize availability of on-bar units.
- 5.1.5 NLDC shall indicate the quantum of reserves to be kept in the generating station or unit brought under SCUC.
- 5.1.6 NLDC shall conduct SCUC three days in advance under certain conditions, notifying generating stations about commitments.
- 5.1.7 NLDC shall ensure proper coordination with RLDCs, generating stations, and beneficiaries for the entire SCUC process.
- 5.1.8 NLDC shall perform Security Constrained Economic Despatch (SCED) to manage and optimize the generation schedule based on real-time conditions.

5.2 Role of RLDCs

- 5.2.1 RLDC shall be the nodal agency for overseeing USD process in consultation with NLDC.
- 5.2.2 RLDC shall prepare entitlements and declare the share of each beneficiary for the day ahead.
- 5.2.3 RLDC shall prepare injection and drawl schedules based on the availability of generating units and beneficiary schedules.

5.2.4 RLDC shall provide necessary data and information to NLDC for the SCUC and SCED processes.

5.2.5 RLDC shall facilitate the coordination between NLDC and regional generating stations for the entire SCUC and SCED processes.

5.3 Role of Generating stations

5.3.1 Generating stations shall provide necessary data and information to Regional Load Despatch Centres (RLDCs) and National Load Despatch Centre (NLDC) for scheduling and despatch.

5.3.2 The generating stations which are willing to participate in SCED/SCUC shall declare the Variable charge, or Compensation Charge, and other data, as applicable as per IEGC. NOAR shall be the single point entry and the master repository for submitting variable charge/compensation charge applicable for SRAS, TRAS, SCUC, and SCED. Same variable charge/compensation charge shall be used for dispatch under all the mechanisms and/applications.

5.3.3 Generating stations which have declared DC and choose to go under Unit Shut Down (USD) due to schedule below minimum turndown level shall fulfil their obligations to supply electricity to beneficiaries by arranging alternate supply through contracts, other generating stations, or SCED, for the periods they declare Declared Capacity (for Section 62 generating stations) or as per the contracts (other than Section 62).

5.3.4 Generating stations shall facilitate with NLDC, RLDCs, and beneficiaries to ensure proper implementation of SCUC and SCED processes.

5.3.5 Generating stations shall follow the directives of NLDC to come on bar under hot, warm, and cold conditions as necessary for maintaining grid security.

5.3.6 Generating stations shall adjust their injection based on schedules under SCED, either increasing or decreasing generation, as required.

- 5.3.7 Generating stations shall ensure that the quantum of power identified as reserves by NLDC in the SCUC process is not made available for scheduling by beneficiaries or for sale.
- 5.3.8 The participating SCED generators other than section 62 shall also communicate the details of constituent-wise share in generating station, requisition (day-ahead and last revision) from the generating station to respective RLDC and RPCs.
- 5.3.9 The participating SCED generator with no tied capacity (merchant generator) shall inform about contracts for power sale, if any, entered at least 7 working days in advance before the commencement of scheduling of the same to the concerned RLDC and RPCs.
- 5.3.10 The participating SCED generator other than section 62 with part tied capacity shall inform about any change in status of the tied-up capacity at least 7 working days in advance before the commencement/ termination of scheduling due to such change in status to the concerned RLDC and RPCs.
- 5.3.11 SCED generators shall reconcile the amount paid and received due to participation in SCED and benefits accrued in National Pool Account (SCED) with NLDC on quarterly basis based on the RPCs and NLDC statement.

5.4 Role of Beneficiaries

- 5.4.1 Beneficiaries shall submit their requisitions to the RLDC based on their demand forecasts and requirements.
- 5.4.2 Beneficiaries may revise their requisitions based on the tentative list of generating stations or units likely to be scheduled below their minimum turndown levels, as communicated by NLDC.
- 5.4.3 Revised requisitions of the beneficiaries shall become final and binding at 1430 hrs of D-1 day, and further reduction in drawal schedule shall not

be allowed from such stations identified at para 5.4.2, below minimum turn-down level.

5.4.4 Beneficiaries shall facilitate with NLDC, RLDCs and Generating stations to ensure proper implementation of Security Constrained Unit Commitment (SCUC) and Security Constrained Economic Despatch (SCED) processes.

5.5 Role of RPCs

5.5.1 RPCs shall prepare Energy and Deviation Accounts of the SCUC and SCED participants based on variable charge or compensation charge, as the case may be, as per IEGC.

5.5.2 The RPCs shall prepare monthly SCUC/SCED account as per schedule data provided to them by the RLDCs. Any post-facto revision in rates/charges by participating SCUC/SCED generator shall not be permitted.

5.5.3 The RPCs would issue monthly "Statement of Compensation due to Part Load Operation due to SCUC/SCED" separately in its accounts for participating SCUC/SCED Section 62 generators along with monthly REA.

6.0 Procedure for Security Constrained Unit Commitment (SCUC)

6.1 The generating stations shall submit their declared capability/Pmax along with ramp rate and minimum turndown level/Pmin for the next day on D-1 [by 0600 hrs].

6.2 Regional Load Despatch Centres (RLDCs) would prepare the entitlements and declare the share of each beneficiary on D-1 [by 0700 hrs]. Beneficiaries shall submit their requisitions/schedules from ISGS on D-1 [by 0800 hrs].

6.3 Based on the station availability and the schedules submitted by beneficiaries/procurers, RLDCs shall prepare and publish the injection and drawl schedules [by 0945 hrs]. The power station then can participate in Day-ahead Energy Market (DAM-Energy) and/or Day-ahead TRAS Market (DAM-TRAS). The

- DAM-Energy shall be cleared [by 1300 hrs], and Power Exchanges would convey DAM results to NLDC after clearing of market.
- 6.4 NLDC shall assess the requirement of tertiary reserves to be procured from AS-DAM, factoring units committed under SCUC 3 days in advance, and status of reserves with State as per approved procedure by CERC.
- 6.5 The bids for Tertiary Reserve Ancillary Services TRAS-DAM-Up and TRAS-DAM-Down collected by the power exchanges shall be consolidated and cleared by NLDC [by 1430 hrs], and the TRAS-DAM-Up-Cleared quantum shall be say "X" MW.
- 6.6 The injection and drawal schedules by the regional entities and the results of the Day-ahead market would be available with NLDC [by 1430 hrs].
- 6.7 The block wise TRAS-RTM-Up and TRAS-RTM-Down reserves expected to be available (say "Y" MW) shall be considered as the minimum of the last 7 days data.
- 6.8 If the Total TRAS Reserve Requirement say "Z" MW is more than the total cleared MW in TRAS-DAM and TRAS-RTM (i.e., X+Y MW), for some time blocks, then system would need additional reserves for such duration. The following shall be factored while calculating the TRAS Reserve Requirement "Z", for the purpose of SCUC for the next day.
- 6.8.1 The reserves created due to action of SCUC in the previous 7 days
- 6.8.2 The reserves anticipated to be available in Section 62 plants
- 6.8.3 Advance reserves procured, and reserve position intimated by the states
- 6.9 Additional Up reserve required ($R=Z-X-Y$) MW would be committed from two categories of generators (including section 62 generators, and other opting generators):
- 6.9.1 Cat#1: Units that are likely to go below their minimum turndown level
- 6.9.2 Cat#2: Units under Unit Shut Down
- 6.10 By 1400 hrs of D-1, NLDC in coordination with RLDCs shall publish a tentative list of generating stations or units thereof, which are likely to be scheduled

below the minimum turndown level of the respective stations for some or all the time blocks of the D day. Refer **Format-1**.

- 6.11 Beneficiaries of such stations, whose units are likely to be scheduled below minimum turndown level for some or all-time blocks of the D day, shall be permitted to revise their requisitions from such stations by 1430 Hrs of D-1 day, in order to enable such units to be on bar. After 1430 hrs of D-1 day, the schedules of the beneficiaries shall be final and binding, and further reduction in drawal schedule shall not be allowed from such stations below minimum turn-down level. After 1430 Hrs, NLDC in coordination with RLDCs shall prepare the final list of such generating units that are likely to go below their minimum turndown level.
- 6.12 NLDC may schedule incremental power from the generating units which are likely to go below their technical minimum level, so as to bring such units to their minimum turndown level, in order to maximize availability of on bar units, by 1500 hrs of D-1 day and update the list on the respective RLDC website. Refer **Format-2**. Bringing these units to technical minimum would preserve the Up reserves by avoiding the units going under USD, in different time blocks.
- 6.12.1 Such generation shall be scheduled as per merit order, in the order of the lowest energy charge to the highest energy charge.
- 6.12.2 Changes in drawal schedule shall not be considered between 1430 hrs to 1500 hrs.
- 6.13 The allowable time for revival of units under hot, warm and cold start up shall be 4 hours, 8 hours, and 12 hours respectively. The total time available for the revival of the unit would be the duration between the time of instruction by NLDC/RLDCs and the target time for synchronization of the unit.
- 6.13.1 In case the unit is under wet preservation, then an additional 6 hours start up time shall be allowed for units under cold start up.

- 6.13.2 In case all the units in a generating station are under shutdown, an additional 6 hours shall be allowed for deaeration of feedwater. This activity shall be carried out in parallel with revival from wet preservation.
- 6.13.3 A generator can submit a lower time limit than the above to NLDC/RLDCs, and the same would be considered.
- 6.14 For SCUC, the following Minimum Up time and Minimum Down Time shall be considered
- 6.14.1 A minimum dispatch duration of forty eight (48) time blocks i.e., twelve hours (12) hours shall be given to the thermal (coal/lignite based) generators by default.
- 6.14.2 A minimum dispatch duration of twelve (12) time blocks i.e., three (3) hours shall be given to the gas/RLNG/liquid-based thermal generators by default.
- 6.14.3 A minimum shutdown duration of 4 hours would be provided before synchronizing an off bar generator to the grid.
- 6.14.4 A generator can submit a lower time limit than the above to NLDC/RLDCs, and the same would be considered.
- 6.15 If the entire incremental reserve ($R=Z-X-Y$) requirement is not fulfilled by Cat#1 units, then new units have to be committed from Cat#2 units, for future resource and reserve adequacy management. While bringing units on bar from the Cat#2 stack, the three-day ahead block-wise inter-state generation requirement forecasted shall be considered, including Up and Down reserves. Information of units committed for the periods under Cat#1 would be factored while bringing units on bar under Cat#2.
- 6.15.1 The system security constraints and power plant constraints that would be considered by NLDC for SCUC, is provided in **Annexure-1**.
- 6.15.2 Subsequently, units under USD may be selected by the NLDC algorithm to come on bar under hot, warm and cold conditions as per the time period specified.

- 6.15.3 The selected units would be scrutinized by the NLDC for plausibility checks, and the list would be finalized based on up-to-date information, practical considerations due to exigencies, extreme weather conditions, and other situations impacting grid security.
- 6.15.4 The list of units that are required to come on bar on the next day, under hot, warm, and cold conditions shall be published in the NLDC website every day at 1500 hrs, with date and time. Refer **Format-3(a)**.
- 6.15.5 Additionally, units with longer startup time that are required on bar on the dates of D-1, and D, shall be published on a D-2 basis at 1000 hrs, considering the startup time, and anticipation/forecast. Refer **Format-3(b)**.
- 6.15.6 Note that units that have been intimated to be brought on bar by advance intimation through Format 3(b) [at 1000 hrs] would be factored while preparing the additional list of units to be brought on bar on the next day through Format 3(a) [at 1500 hrs].
- 6.16 As a part of SCUC, a 96 time block multi-period day-ahead optimization would be run at NLDC starting 1500 hrs of D-1 [with a 15 minute periodic cycle] for day "D". Where SCUC stations have to be scheduled SCUC-Up, commensurate reduction shall be done in generation from some of the other generating station(s) as SCUC-Down, subject to technical constraints, following merit order. This would ensure maintaining the load generation balance.
- 6.16.1 The updated schedule [at 1500 hrs] would then be compared with the initial schedule at [1430 hrs].
- 6.16.2 For generating stations or units committed through SCUC, corresponding initial drawal schedule shall be adjusted against the requisition from the beneficiaries, under a separate head in the scheduling system, "SCUC".
- 6.16.3 Once SCUC support has been extended by NLDC (intimated to the scheduling system by SCUC software), then downward revision of

requisition by the beneficiaries of that power plant would be blocked in those power plants from 1500 hrs of D-1.

- 6.16.4 The total MW reserves in the regional entity thermal generators in the real-time, for each time block, after the SCUC and multiperiod SCED exercise thus shall be expected to be greater than the Total TRAS Reserve Requirement (DAM+RTM requirement).
- 6.17 Typically, the net sum of generation schedules under SCUC head would be zero, as only reserves are being created through SCUC and extra energy is not being scheduled.
- 6.17.1 However, during emergency conditions, extra unit commitment may be needed for serving energy under SCUC head.
- 6.18 NLDC shall indicate the reserve quantum earmarked in each unit brought on bar under SCUC by 1500 hrs to the scheduling system. Such quantum of power identified as reserves shall not be available for scheduling by the beneficiaries or for sale by the generating station through the energy market. The quantum of power over and above the identified quantum of reserves can be rescheduled by the beneficiaries or scheduled by way of selling in the market.
- 6.19 The 96 time block multi-period day-ahead optimization would be run at NLDC starting 1500 hrs of D-1 [with a 15 minute periodic cycle] for day "D" until 2315 hrs.

7.0 Unit Shut Down (USD)

- 7.1 The generating stations or units not brought on bar under SCUC, shall have the option to operate at a level below the minimum turn down level or to go under Unit Shut Down (USD).
- 7.2 In case a generating station opts to go under unit shut down (USD), the generating company owning such generating station shall fulfil its obligation to supply electricity to its beneficiaries who had made requisition from the said

- generating station prior to it going under USD [i.e., before 1530 hrs], by arranging supply either
- 7.2.1 by entering into a contract(s); or
 - 7.2.2 by arranging supply from any other generating station or unit thereof owned by such generating company; or
 - 7.2.3 rely on SCED for arranging the schedule 30 minutes before dispatch
- 7.3 The power scheduled from alternate supplier shall be reduced from the schedule of the generating station.
- 7.4 In case of emergency conditions, for reasons of grid security, a generating station or unit thereof, which is under USD may be directed by NLDC to come on bar, and in such event the generating station or unit thereof shall come on bar under hot, warm and cold conditions as per **Format-3(a) or Format-3(b)**.
- 7.4.1 Once a generating station is brought on bar as per Format-3(a) or Format-3(b) of this Procedure, it shall be treated as a unit under SCUC.
- 7.5 The reserve quantum earmarked in each unit brought on bar under SCUC shall remain blocked for use by NLDC and shall not be available for requisition by beneficiaries or sale by generating station.
- 8.0 Security Constrained Economic Despatch (SCED)**
- 8.1 SCED shall run after the Real Time Market (RTM) dispatch, and would be conducted on the schedules of the thermal power plants (section 62 and other opting generators) in the real time, at least 30 minutes before the actual dispatch period.
 - 8.2 All the generating stations (including the other than section 62 thermal plants willing to participate in SCED) shall declare the energy charge, or the SCED Compensation Charge (after factoring in the likely changes in fuel cost and part load compensation, if any), and other data, as applicable, to NLDC on a weekly basis.

- 8.3 The objective function and the constraints for SCED are provided in **Annexure-2**.
- 8.4 The net demand for performing SCED would be the total schedule of all the generators plus the total quantum in the “SCUC” head in the latest revision of the scheduling system.
- 8.4.1 SCUC-Up and SCUC-Down shall be evaluated/re-adjusted for every generator, for each time block under consideration factoring the up-revision by the beneficiaries, and any market sale transactions by the generator.
- 8.5 In case a regional entity generating station gets scheduled below minimum turndown level and wishes to go under USD after arranging power scheduled by its buyers through SCED, it shall submit consent to NLDC before gate closure [at least 75 minutes before the delivery time block] for arranging the scheduled power for such generating station through SCED. NLDC shall consider the drawal schedules in respect of such generating station, under SCED subject to
- 8.5.1 Availability of reserves such that entire drawal schedule against such generating station can be accommodated under SCED
- 8.5.2 If the energy charge or SCED Compensation Charge, is higher than that of the marginal generating station of SCED.
- 8.5.2.1 Higher SCED Compensation Charge would automatically ensure that the generating station under USD would receive SCED-Down regulation. This would also automatically ensure that the generating stations below the marginal cost of SCED stack receive commensurate SCED-Up.
- 8.5.2.2 The minimum value i.e., P_{min} of the generating station willing to arrange power through SCED would be considered as 0. The maximum value i.e., P_{max} of that station would be considered equal to the schedule.

8.5.3 Note that there is no guarantee that SCED can provide the incremental schedule to meet the minimum turn down level, and hence this feature may be used as last resort to accommodate small (say, 5 MW, 10 MW, etc.) difference with respect to the zero MW level.

9.0 Accounting and Settlement under SCUC

9.1 Payments for the stations where incremental power is scheduled and beneficiaries of those stations to ensure Resource and Reserve Adequacy under the head "SCUC" in the scheduling system, shall be made to/from the Deviation and Ancillary Services Pool Account.

9.1.1 The generating station from which incremental energy has been scheduled shall be paid their equivalent energy charge from the Deviation and Ancillary Services Pool Account.

9.1.2 The generating station where decremental energy has been scheduled to balance the additional energy above, shall pay back the equivalent energy charge to the Deviation and Ancillary Services Pool Account.

9.1.3 Compensation for part load operation of a generating station or unit thereof brought on bar under SCUC shall be paid from the Deviation and Ancillary Services Pool Account.

9.2 Any deployment of Ancillary services from the additionally committed generating station under SRAS or TRAS shall be settled in accordance with the CERC Ancillary Services Regulations-2022.

9.3 Energy Accounting for SCUC schedule shall be done on weekly basis along with Accounting of SRAS & TRAS on net basis and for SCED schedules, Energy Accounting shall be done on monthly basis by the respective RPCs for respective regional/ intra-state generators with day wise resolution figure made available in the SCUC/SCED account based on the data provided to them by RLDCs.

9.4 No startup cost shall be paid to the generator brought under SCUC/SCED.

9.5 The RPCs shall publish Energy Accounting for SCUC schedule "Regional SCUC Weekly Statement" (**Format SCUC AA**). RPCs shall issue a

consolidated Energy Accounting covering SRAS, TRAS & SCUC (**Format SCUC BB**).

- 9.6 All payment to SCUC generator shall be paid on net basis. The concerned SCUC Generators who are required to pay back the indicated charges (**Format SCUC BB**), shall pay back within seven (07) working days of the issue of statement of SCUC by the RPCs. If payments are delayed beyond seven (7) working days the defaulting Generator shall pay simple interest @ 0.04% for each day of delay on the payable amount.
- 9.7 The concerned SCUC Generator who are required to be paid, the indicated charges (**Format SCUC BB**) shall be paid within ten (10) working days of the issue of statement of SCUC by the RPCs.
- 9.8 The RPCs would issue monthly "Statement of Compensation due to Part Load Operation due to SCUC" (**Format SCUC CC**), subject to yearly computation as the heat rate computation is being done on annual cumulative basis.
- 9.9 Compensation due to Part Load Operation due to SCUC to SCUC generator shall be paid from their respective regional 'Deviation and Ancillary Service Pool Account'.
- 9.10 In case of deficit in the Deviation and Ancillary Service Pool Account for payment (as per Format SCUC BB and Format SCUC CC) surplus amount available in other regional Deviation and Ancillary Service Pool Account shall be used for such payment.
- 9.11 For Section 62 Inter State Generating Stations (ISGS) that are regional entities, the heat rate compensation for part load operation shall be provided as per CERC (Indian Electricity Grid Code) Regulations, 2023 as amended from time to time.
- 9.12 Other than Section 62 Inter State Generating Stations (ISGS) that are regional entities, the heat rate compensation for part load operation shall not be provided. It shall be part of their compensation charge.
- 9.13 Any bank interest accumulated due to delay in payment by SCUC generator or bank interest, shall be considered as surplus for Deviation and Ancillary Service Pool Account. This surplus shall be utilized for payable for deviation and ancillary services charges.

10.0 Accounting and Settlement under SCED

- 10.1 The incremental/decremental day-ahead SCED schedules shall be maintained under a separate head in the scheduling system.
- 10.2 The schedule of beneficiaries shall not be changed on account of SCED. Buyers or beneficiaries shall continue to pay the charges for the scheduled energy directly to the generating station(s) participating in the SCED.
- 10.3 Gains out of the SCED process would be accumulated into the "SCED Account", and those benefits are shared with generating stations and their beneficiary states.
 - 10.3.1 For any increment in the generation schedule on account of SCED, the participating generator shall be paid from the 'SCED Account' at the rate of its energy charge or SCED Compensation Charge declared upfront by the generator.
 - 10.3.2 For any decrement in the generation schedule on account of SCED, the participating generator shall pay to the 'SCED Account' at the rate of energy charge or SCED Compensation Charge, as applicable.
 - 10.3.3 The net savings shall be shared between the beneficiaries or buyers and the generating stations as per the mechanism proposed in **Annexure-3**:
- 10.4 Part load compensation for reduction in schedule on account of SCED, in respect of a generating station or unit thereof whose tariff is determined under Section 62 of the Act shall be paid from the savings in the SCED Account.
- 10.5 Part load compensation for reduction in schedule of a generating station or unit thereof other than those whose tariffs are determined under Section 62 of the Act shall be factored in by such generating station while declaring the SCED Compensation Charge and shall not be paid separately.
- 10.6 SCED schedules are also required to be incorporated in the inter-regional schedules for each region and accordingly, NLDC shall compute the impact of SCED schedules on the inter-regional schedules for all regions. The incremental change in the inter-regional schedules shall be communicated by NLDC to the respective RLDCs for incorporation in the

net inter-regional schedules being given to the RPCs for the purpose of accounting.

- 10.7 NLDC would maintain and operate a separate bank account in the name of "National Pool Account (SCED)" for payments to/receipts from the SCED Generators. The details of the bank account would be displayed on the NLDC website.
- 10.8 Based on the NLDC would prepare a consolidated all India statement, monthly indicating the SCED schedules.
- 10.9 For any decrement in schedule of SCED Generator due to SCED, the SCED Generator shall pay to the 'National Pool Account (SCED)' for the decrement in generation at the rate of its variable charges/compensation charge.
- 10.10 For any increment in schedule of SCED Generator due to SCED, the SCED generator would be paid from the 'National Pool Account (SCED)' for the incremental generation at the rate of its variable charges/compensation charge.
- 10.11 The payments/receipts by/to the SCED Generators would be based on the "Regional SCED Monthly Statement" (**Format SCED AA**) issued by respective RPCs, and consolidated "National SCED Monthly Statement" (**Format SCED BB**) issued by NLDC.
- 10.12 Day wise details for SCED Generators shall also be made available in the SCED account by RPCs/ SLDCs.
- 10.13 NLDC would issue a consolidated "National SCED Monthly Statement" comprising of payment and receipts to/from all SCED Generators based on the "Regional SCED Monthly Statements" issued by all the RPCs.
- 10.14 The concerned SCED Generator would pay the indicated charges for SCED decrement within seven (07) working days of the issue of statement of SCED by the RPCs to the 'National Pool Account (SCED)'. Payments against SCED shall not be adjusted against any other payments by the SCED Generator.
- 10.15 The concerned SCED Generator shall be paid the indicated charges for SCED increment within ten (10) working days of the issue of consolidated "National SCED Monthly Statement" by the NLDC from the 'National Pool Account (SCED)'.

- 10.16 If payments by the SCED Generator, due under the SCED, are delayed beyond seven (7) working days from the date of issue of the "Regional SCED Monthly Statement" by the RPCs, the defaulting SCED Generator shall pay simple interest @ 0.04% for each day of delay on the payable amount.
- 10.17 If payments to the SCED generator, due under the SCED are delayed beyond ten (10) working days from the date of issue of the consolidated "National SCED Monthly Statement" by NLDC, the SCED Generator shall be paid simple interest @ 0.04% for each day of delay on the receivable amount.
- 10.18 The RPCs would issue monthly "Statement of Compensation due to Part Load Operation due to SCED" (**Format SCED CC**), subject to yearly computation as the heat rate computation is being done on annual cumulative basis.
- 10.19 For Section 62 Inter State Generating Stations (ISGS) that are regional entities, the heat rate compensation for part load operation shall be provided as per CERC (Indian Electricity Grid Code) Regulations, 2023 as amended from time to time.
- 10.20 Other than Section 62 Inter State Generating Stations (ISGS) that are regional entities, the heat rate compensation for part load operation shall not be provided. It shall be part of their compensation charge.
- 10.21 NLDC would issue monthly "National Statement of Compensation due to Part Load Operation due to SCED" (**Format SCED DD**) on the compensation to be paid to the SCED Generator for heat rate degradation, from National Pool Account (SCED) based on Format SCED_CC statement issued by respective RPCs.
- 10.22 The concerned SCED Generator shall be paid the indicated charges of compensation for heat rate degradation as per the statement issued by "National Statement of Compensation due to Part Load Operation due to SCED" by the NLDC from the National Pool Account (SCED) within seven (07) working days of the issue of the monthly statement subject to yearly computation, as the heat rate computation is being done on annual cumulative basis.
- 10.23 If payments are delayed beyond seven (7) working days from the date of issue of the "National Statement of Compensation due to Part Load

Operation due to SCED” by the NLDC, the SCED Generator shall be paid simple interest @ 0.04% for each day of delay.

- 10.24 In case of any recovery on account of Heat rate compensation due to part load operation from SCED generator, the concerned SCED Generator would pay back to the ‘National Pool Account (SCED)’ the indicated charges within seven (07) working days of the issue of “National Statement of Compensation due to Part Load Operation due to SCED” by the NLDC.
- 10.25 If payments are delayed beyond seven (7) working days from the date of issue of the “National Statement of Compensation due to Part Load Operation due to SCED” by the NLDC, the defaulting SCED Generator shall pay simple interest @ 0.04% for each day of delay.
- 10.26 NLDC shall maintain a record of all savings on accrual basis in the ‘National Pool Account (SCED)’.
- 10.27 NLDC shall issue the statement of interest due to delay in payment on quarterly basis. The concerned SCED Generator would pay back to the ‘National Pool Account (SCED)’ the indicated charges within seven (07) working days from the issue of “National Statement of Interest due to delay in payments”. NLDC shall disburse the interest amount from the ‘National Pool Account (SCED)’ to the eligible SCED Generators due to delay in receipt of Monthly SCED payment for net SCED down.
- 10.28 If the concerned SCED generator fails to pay the interest amount within the stipulated period as mentioned, NLDC shall adjust that amount from the amount receivable by the particular generator either in “Monthly SCED statement” and /or “Monthly SCED statement due to part load operation due to SCED” and / or “Monthly benefit sharing statement”.

11.0 Removal of Difficulties

- 12.1 Notwithstanding anything contained in this Procedure, NLDC/RLDCs may take appropriate decisions in the interest of System Operation. Such decisions shall be taken under intimation to CERC and the procedure shall be modified/amended, as necessary.
- 12.2 In case of any difficulty in implementation of this procedure, this procedure shall be reviewed or revised by Grid-India and submitted to the CERC.

Format-1: Tentative list of generating stations, scheduled below the minimum turndown level

Time: 1400 hrs

Date <published on D-1 basis>: DD/MMM/YYYY

For Date "D": DD/MMM/YYYY

Sno	Name of generator (Multiple entries allowed)	From time block	To time block	Schedule (MW)	Turndown level (MW)	ECR (Paise/kWh)
1	Gen-A	10	20	225	275	330
2	Gen-A	25	35	180	275	330
3	Gen-B	5	96	200	275	375

Note: The expected station schedule is indicated. Stations are advised to maintain as many units as possible on bar.

Format-2: List of generating stations with incremental power scheduled to achieve minimum turndown level

Time: 1500 hrs

Date <published on D-1 basis>: DD/MMM/YYYY

For Date "D": DD/MMM/YYYY

Sno	Name of generator (Multiple entries allowed)	Time block	Schedule (MW) @1430 hrs	Revised Schedule (MW) @ 1500 hrs	Pmax (MW)	ECR (Paise/kWh)
1	Gen-A	10-20	225	275	500	330
2	Gen-A	25-35	180	275	500	330
3	Gen-B	5-96	200	275	500	375

Time Block	Total Up Reserves from Cat#1 units (MW)
1	0
2	0
....	
10	450
....
25	450

Note: The expected station schedule is indicated. Stations are advised to maintain as many units as possible on bar.

Annexure-1: Objective Function, Constraints and Inputs for SCUC

Objective function

The objective of SCUC is to minimize the 3 day-ahead power plant variable operation cost. The operation costs comprise of energy cost and startup cost.

Heat rate degradation has been neglected to keep the formulation in the linear domain.

Constraints

1. Meeting the 3 day ahead forecasted demand

The 3 day ahead total thermal generation requirement will be forecasted by NLDC (including section 62 generators, and other opting generators) based on the block wise historical data of the previous 7 days.

2. Maintaining the required spinning reserve

Methodology has been dovetailed with TRAS reserve procurement. TRAS reserves procurement process considers the historical surplus reserves available in Section 62 generators, and other opting generators, as deemed available reserves.

X MW = TRAS-DAM Cleared MW

Y MW = Historical data minimum of the previous 7 days TRAS-RTM Cleared MW

Z MW = Total Reserve Requirement

Z MW factors anticipated Section 62 reserves, advance procured reserves, reserve position intimated by the States, and past SCUC created reserves

Additional Up reserve requirement ($R=Z-X-Y$) would be committed from two categories of generators (including section 62 generators, and other opting generators):

Cat#1: Units that are likely to go below their minimum turndown level (Refer Format-2.

Cat#2: Units under Unit Shut Down

If the entire incremental reserve requirement ($R=Z-X-Y$) is not fulfilled by Cat#1 units, then new units have to be committed from Cat#2 units, for serving the remaining requirement.

3. Honouring transmission constraints

SCUC will ensure that the unit commitment honours the ATC constraints.

4. Must RUN/ Must OFF units

This provision allows the operator to factor uncertainties related to weather, outages, and live information, etc. Intervention in D day can be due to (i) extreme variation in weather conditions; (ii) high load forecast; (iii) the requirement of maintaining reserves on regional or all India basis for grid security; (iv) network congestion.

5. Capacity and Ramp constraints

The DC, technical minimum and ramp rates declared by the plants will be honoured while deciding the unit commitment. For DC and technical minimum, the previous 7 days data would be used as a proxy. Unit wise availability information also would be collected from the power plant on a look-ahead basis. Technical minimum would be considered as $55\% \times \text{Normative IC}$, by default.

6. Minimum Up Time and Minimum Down Time

When a unit is committed, it has to remain ON for certain minimum time called Minimum Up Time. Similarly, when a unit is decommitted it has to remain OFF for certain minimum time called Minimum Down Time before it can be brought back on bar. Same would be honoured, and the status of each unit for Hot/Warm/Cold would be maintained in NLDC database on a continuous basis.

7. Crew constraint

Typically, the number of crew in a power plant will be just sufficient to start one unit at a time. This constraint ensures a minimum time gap between startup of two units in the plant. Since all the units in a stage will have the same variable cost, SCUC would commit them at the same time if crew constraint is not modeled. Hence, the same would be considered.

Inputs

For the purpose of unit commitment, following inputs would be suitably considered.

Suitable assumptions shall be made by NLDC, in case of non-availability of the data.

1. Blockwise unit availability considering planned/forced outages
2. Technical Minimum and Ramp Rate
3. Unit Minimum Up Time and Minimum Down Time
4. Crew constraint time
5. Variable charge / Compensation charge, as applicable
6. Startup costs (Hot/Warm/Cold)
7. Startup time (Hot/Warm/Cold) and unit boiler status ISGS
8. Time required for combined cycle operation under cold/warm conditions
9. Cat#1 unit commitment details

Outputs of SCUC [by 1500 hrs]:

1. List of units to be brought on bar (SCUC-Up flag)
2. Units scheduled to at least 55%
3. Earmarked reserves in each unit brought on bar under SCUC to the scheduling system
4. SCUC Up/Down MW for load-generation balance

Format-3(a): List of units that are required to come on bar on the next day

Time: 1500 hrs

Date <published on D-1 basis>: DD/MMM/YYYY

For Date "D": DD/MMM/YYYY

Sno	<Station Name>#<unit number>	Unit synchronization time	Unit synchronization date
1	Gen-A#1	0000 hrs	D
2	Gen-A#2	0800 hrs	D
3	Gen-A#3	1300 hrs	D
4	Gen-B#1	1600 hrs	D

Format-3(b): Advance intimation of the list of units that are required to come on bar on the next two days

Time: 1000 hrs

Date <published on D-2 basis>: DD/MMM/YYYY

For Date "D": DD/MMM/YYYY

Sno	<Station Name>#<unit number>	Unit synchronization time	Unit synchronization date
1	Gen-A#1	1500 hrs	D-1
2	Gen-A#2	1600 hrs	D-1
3	Gen-A#3	0100 hrs	D
4	Gen-B#1	0200 hrs	D

Annexure-2: Objective Function and Constraints for SCED

SCED Objective Function

Minimize Variable Cost of Generation

SCED Constraint Equations

Import ATC limit constraint

Export ATC limit constraint

SCED equality Constraint for demand supply balance

Maximum generation limit constraint

Minimum generation limit constraint

Ramp up limit on movement of generators

Ramp down limit on movement of generators

Plant level Maximum check (for Gas)

Plant level Minimum check (for Gas)

Inputs:

1. SCUC-Up Flag for each station from the SCUC engine, U_g
2. Earmarked MW reserves in each station, E_g
3. Net Schedule of the station after RTM clearing
4. Variable charge / Compensation charge, as applicable

Outputs:

1. Adjusted/re-evaluated SCUC-Up/SCUC-Down quantum for each station
2. SCED-Up/SCED-Down quantum for each station

Annexure-3: Sharing mechanism of SCED benefits

1. Beneficiary(ies) of SCED Generators shall provide the Bank account details to NLDC as per format published in the Grid-India website to facilitate payments to/from the beneficiary of participating SCED generator due to net benefits accrued in National Pool Account (SCED).
2. The net benefits as a result of SCED optimization after adjusting heat rate compensation for part load operation of the generators shall be shared in the following manner as given below.
3. The benefits shall be shared in the ratio of 50:50 between the generators and the concerned beneficiaries, aggregated on a monthly basis as per Regional Energy Account (REA)/ State Energy Account (SEA) and NLDC monthly SCED accounts.
4. The total net SCED benefits corresponding to the Beneficiary shall be distributed in proportion to their final schedule from the SCED generator as per the Regional Energy Account (REA)/ State Energy Account (SEA).
5. In case of merchant generators, they shall be beneficiaries of their schedule generation as per REA/SEA(other than SCED/SCUC) and this schedule energy shall be considered for deriving their share in other 50% saving marked for beneficiaries.
6. In case of part tied up generators, they shall be beneficiaries of their schedule generation under T_GNA and for rest capacity scheduled shall be shared with beneficiaries as per REA/SEA for deriving their share in other 50% saving marked for beneficiaries.
7. RPCs/SLDCs shall issue the "Detail of Beneficiary schedule energy from SCED generator" (**Format SCED EE**) and RPCs/SLDCs shall transfer such details through suitable electronic interface such as API (Application Programming Interface) to NLDC.
8. The benefits corresponding to the SCED generator out of the total Net SCED benefits shall be distributed in the ratio of their total schedule under SCED Up and SCED Down respectively. This shall be based on the block wise SCED Up and SCED Down energy aggregated on monthly basis. Benefits as computed above for the SCED generators would then be summed up for the month.
9. NLDC would issue Monthly "National net SCED Benefits Distribution Statement" (after adjusting the heat rate compensation) indicating the payment to SCED

10. generators (**Format SCED FF**) and Beneficiary of SCED generator (**Format SCED GG**) based on statements issued by respective RPCs/SLDC. This would be made available to the stakeholders through the NLDC website.
11. The payment to the SCED Generator and Beneficiary shall be paid within ten (10) working days of the issue of monthly "National net SCED Benefits Distribution Statement" by the NLDC from the 'National Pool Account (SCED)'.
12. The payment of Net SCED benefits to the SCED Generator will be made by NLDC after deducting any pending interest on delay payment of variable / refund of Compensation charges from the respective SCED generator.

(To be issued by concerned RPC)

SCED Account For Week <<from date>> <<to date>>

*(+) means payable from the Deviation and Ancillary Service Pool Account to SCUC Generator

/ (-) means receivable by 'Regional Deviation and Ancillary Service Pool Account' from SCUC Generator

S.N.	SCUC Generator	Increment due to SCUC schedule (MWHr) (A)	Decrement due to SCUC scheduled (MWHr) (B)	Charges To be Paid to SCUC Generator (in ₹) (C) = (A) x V.C.	Charges To be Refunded by SCUC (in ₹) (D) = (B) x V.C.	Net Charges Payable for SCUC (+) / Receivable (-) (in ₹) (E)* = (C) - (D)
1	SCUC Generator 1					
2	SCUC Generator 2					
....					
	Total	Total of (A)	Total of (B)	Total of (C)	Total of (D)	Total of (E)

Format SCUC_BB: RPC “Net Regional Shortfall/emergency and SCUC weekly Statement”

(To be issued by concerned RPC)

***(+)** means payable from the Deviation and Ancillary Service Pool Account

/ (-) means receivable by ‘Regional Deviation and Ancillary Service Pool Account’

SCUC/shortfall/ emergency/SCUC Generator	SRAS total charges Rs (A)	Shortfall/Emergency Condition charges Rs (B)	Net Charges Payable for SCUC Rs (C)
Generator 1			
Generator 2			
.....			
Total			

Format SCUC_CC: RPC “Statement of Compensation due to Part Load Operation due to SCUC”

(To be issued by concerned RPC)

***(+)** means payable from the Deviation and Ancillary Service Pool Account to SCUC Generator

/ (-) means receivable by ‘Regional Deviation and Ancillary Service Pool Account’ from SCUC Generator

For Month:

SCUC Generator	Decrement due to SCED (MWHr)	Compensation Amount Payable due to SCUC for the month(in ₹)*	Compensation Amount Payable due to SCUC up to the month(in ₹)*
SCUC Generator 1			
SCUC Generator 2			
.....			
Total			

Format SCED_AA: RPC “Regional SCED Monthly Statement”

(To be issued by concerned RPC)

SCED Account For Month <<from date>> <<to date>>

***(+)** means payable from the ‘National Pool Account (SCED)’ to SCED Generator

/ (-) means receivable by ‘National Pool Account (SCED)’ from SCED Generator

S.N.	SCED Generator	Increment due to SCED scheduled to VSCED [Region] (MWHr) (A)	Decrement due to SCED scheduled to VSCED [Region] (MWHr) (B)	Charges To be Paid to SCED Generator from National Pool (SCED) (in ₹) (C) = (A) x V.C.	Charges To be Refunded by SCED Generator to National Pool (SCED) (in ₹) (D) = (B) x V.C.	Net Charges Payable (+) / Receivable (-) (in ₹) (E)* = (C) – (D)
1	SCED Generator 1					
2	SCED Generator 2					
....					
	Total	Total of (A)	Total of (B)	Total of (C)	Total of (D)	Total of (E)

Format SCED_BB: NLDC "National SCED Monthly Statement"

For Month <<from date>> <<to date>>

*** (+) means payable from the National Pool Account (SCED) to SCED Generator**

/ (-) means receivable by National Pool Account (SCED) from SCED Generator

S.N.	SCED Generator	Region	Increment due to SCED scheduled to VSCED (MWHr) (A)	Decrement due to SCED scheduled to VSCED (MWHr) (B)	Charges To be Paid to SCED Generator from National Pool (SCED) (in ₹) (C) = (A) x V.C.	Charges To be Refunded by SCED Generator to National Pool (SCED) (in ₹) (D) = (B) x V.C.	Net Charges Payable (+) / Receivable (-) (in ₹) (E)* = (C) - (D)	Average Untied capacity of Generator during the month (%) (F)
1	SCED Generator 1	NR						
2	SCED Generator 2	WR						
....						
	Total		Total of (A)	Total of (B)	Total of (C)	Total of (D)	Total of (E)	

(To be issued by concerned RPC)

*(+) means payable from the National Pool Account (SCED) to SCED Generator

/ (-) means receivable by National Pool Account (SCED) from SCED Generator

For Month:

SCED Generator	Decrement due to SCED (MWHr)	Compensation Amount Payable due to SCED from National Pool Account (SCED) to SCED Generator (in ₹)*
SCED Generator 1		
SCED Generator 2		
.....		
Total		

Format SCED_DD: NLDC "National Statement of Compensation due to Part Load Operation due to SCED"

***(+)** means payable from the National Pool Account (SCED) to SCED Generator

/ (-) means receivable by National Pool Account (SCED) from SCED GeneratorFor

Month:

SCED Generator	Region	Decrement due to SCED (MWHr)	Compensation Amount Payable due to SCED from National Pool Account (SCED) to SCED Generator (in ₹)
SCED Generator 1	NR		
SCED Generator 2	WR		
.....		
Total			

Format SCED_EE: RPC "Details of Beneficiary schedule energy from SCED generator"

Details from REA* <<Month>>

Entity	Beneficiary 1	Beneficiary 2	Beneficiary 3	Beneficiary ...	Total
Plant	Schedule energy(MWh)	Schedule energy(MWh)	Schedule energy(MWh)	Schedule energy(MWh)	Schedule energy(MWh)
SCED Gen1					
SCED Gen2					
SCED Gen3					
SCED Gen...					

**** Each RPC will furnish beneficiary data for the SCED generators under the respective RLDC Control Area.***

Format SCED_FF: NLDC " National net SCED Benefits Distribution Statement" - SCED Generator

For the Month <<Month>>

Table 1: System Savings

Total Saving for the month (Rs.) (A)	Heat Rate Compensation (Rs.) (B)	Net Saving for the month (Rs.) (C)	SCED UP + DOWN in MW (D)

Table 2:Share of System Savings for SCED Generator

Sl. N o.	SCED UP Generators	SCED Schedule (E) (Up+Do wn)	Generator's Contribution (%) (F)=(E)/ (D)	Final Benefit to Generator for tied Capacity(G) (Rs.) =(F)*(C)	benefit to Generator for merchant Capacity(H) (Rs.) *As per format SCED_GG	Total Benefit (I)= (G)+(H) (Rs)
1	SCED Gen1					
2	SCED Gen2					
3	SCED Gen3					
n	SCED Gen.....					
All India Total						

Format SCED_GG: NLDC " National net SCED Benefits Distribution Statement"" - Beneficiary

Sl no	Beneficiary	REGIO N	Total schedule Energy(Mwh) as per REA	Share in 50% ofSystem Savingsin (Rs)
1	Beneficiary 1			
2	Beneficiary 2			
3	Beneficiary 3			
n	Beneficiary ...n			
n+1	Generator1			
	All India			