



पावर सिस्टम ऑपरेशन कॉर्पोरेशन लिमिटेड  
(भारत सरकार उद्यम)  
**POWER SYSTEM OPERATION CORPORATION LIMITED**  
(A Government of India Enterprise)



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संदर्भ संख्या: पोसोको/एनएलडीसी/2019/ 164

दिनांक: 10<sup>th</sup> October, 2019

सेवा मे,

*As per distribution list*

**विषय:** Revised Procedure for Pilot on Security Constrained Economic Despatch (SCED) for Inter State Generating Stations pan India

- संदर्भ:**
1. CERC order Petition No. 02/SM/2019 (Suo-Motu) dated 31st Jan' 2019
  2. Procedure for Pilot on SCED for Inter State Generating Stations pan India dated 18<sup>th</sup> Apr'2019
  3. CERC order Petition No. 08/SM/2019 (Suo-Motu) dated 11th Sep'2019

**महोदय,**

Hon'ble Commission, vide suo-motu order in petition no 08/SM/2019 dated 11<sup>th</sup> Sep'2019 has extended the SCED pilot for the period upto 31st March, 2020. The Commission has also given the methodology of sharing of benefits between Beneficiaries and SCED generator and directed POSOCO to modify the procedure to suitably incorporate the direction of Commission.

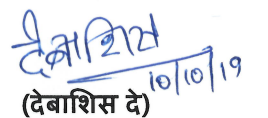
In compliance to above, the Revised Procedure for Pilot on Security Constrained Economic Despatch (SCED) for Inter State Generating Stations pan India is enclosed as **Annex-1** for kind information.

Block wise SCED despatch details is considered for accounting and settlement of SCED generator. Heat rate compensation is calculated by RPCs on monthly basis and further worked out on annual basis. Accordingly this aspect has been considered while framing the procedure.

सादर धन्यवाद,

संलग्न: As above

भवदीय,

  
(देबाशिस दे)

कार्यपालक निदेशक

Copy: 1. Secretary, CERC, 3rd & 4th Floor, Chandralok Building, Janpath, New Delhi.

2. Executive Director NRLDC/WRLDC/ERLDC/NERLDC/SRLDC

पंजीकृत कार्यालय : प्रथम तल, बी-9, कुतुब इंस्टीट्यूशनल एरिया, कटवारिया सराय, नई दिल्ली - 110016  
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## (A) RPCs

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3. Member Secretary, SRPC, 29,Race Course Cross Road,Bangalore-560009
4. Member Secretary, ERPC, 14,Golf Club Road , Kolkata-700033
5. Member Secretary, NERPC, NERPC Complex, Dong Parmaw ,Lapalang, Shillong – 793006

## (B)Beneficiary

EASTERN REGION	
1	Chief Engineer (Commercial) Damodar Valley Corporation DVC Towers, VIP Road Kolkata – 700 054
2	Sr. Genl. Manager (PP) GRIDCO. 4 <sup>th</sup> Floor, Vidyut Bhavan, Janpath Bhubaneswar – 751 022
3	Chief Engineer, SLDC, West Bengal State Electricity Transmission Company Limited, Andul Road., P.O : Danesh Seikh Lane, Howrah – 711109.
4	Chief Engineer (Commercial & Revenue) Jharkhand Bijli Vitran Nigam Limited , Engineering Building , HEC,Dhurwa, Ranchi – 834 004.
5	Chief Engineer (HQ) Energy & Power Deptt., Govt. of Sikkim, Kazi Road, Gangtok, Pin - 737 101

6	Chief Engineer (Transmission-O&M), Bihar State Electricity Board, Vidyut Bhavan, Bailey Road, Patna – 800 021
7	General Manager (Commercial) ERTS-II, POWERGRID CF- 17, Action Area – 1C, New Town, Kolkata -700 156
8	GM(Commercial), Power Grid Corporation of India Ltd. BSEB Colony,Regional Head Quarter, ERTS-I, Shashtri Nagar, Near TRW Patna-800023
9	AGM(BD), NVVN Ltd, 7 <sup>th</sup> Floor, Core-3, SCOPE Complex, 7 Institutional Area, Lodhi Road, New Delhi-110003

#### SOUTHERN REGION

10	The Chief Engineer (Commercial), Andhra Pradesh Power Co-ordination Committee Vidyuth Soudha, Gunadala, Vijayawada 520004, Andra Pradesh
11	The Chief Engineer ( Commercial & Tariff ), Kerala State Electricity Board Vydyuthi Bhavanam, Pattom Thiruvananthapuram 695004, Kerala.
12	The Chief Financial Controller (Revenue) 7th Floor, Eastern Wing, NPKRR Maaligai TANGEDCO, TNEB Ltd, 144 Anna Salai Chennai 600002, Tamil Nadu.
13	The Chief Engineer (Commercial) Telangana State Power Coordination Committee 4th Floor, Vidyuth Soudha, Khairatabad, Hyderabad 500082, Telangana.
14	The Superintending Engineer - I I Floor, Main Building, Electricity Department, Govt of Puducherry 605001 Puducherry.
15	The Executive Engineer Electricity Department Division No: III, Curti, Ponda 403401, GOA.

16	The Executive Director Power Grid Corporation of India Ltd., SRTS - II, Near RTO Driving Track, Singanayakanahalli, Yelahanka-Doddaballapur Road, Bangalore 560064, Karnataka.
17	The Additional Director (Projects) Power Company of Karnataka Ltd KPTCL Building, Kaveri Bhavan Bangalore 560009, Karnataka.
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18	Chief Engineer(P) Western Elect. Zone Dept. of Power, Govt. of Ar. Pradesh, Bidyut Bhavan, Itanagar- 791111
19	Chairman, APDCL, Bijuli Bhavan, Paltan Bazar, Guwahati- 781001
20	Managing Director, MSPDCL, 3rd Floor New Directorate Building Near second M.R. Gate Imphal- Dimapur Road Imphal-795001
21	Director (Distribution), MeECL, Lumjingshai Short Round Road, Integrated Office Complex, Shillong- 793001
22	Engineer-in-Chief, P & E Dept., Govt. of Mizoram, Tuikhuahtlang, Aizawl- 796001.
23	Executive Engineer (Transmission), Electrical Circle, Dept. of Power Govt. of Nagaland, Dimapur- 797112.
24	Chairman & Managing Director, TSECL, Bidyut Bhavan, North Banamalipur, Agartala- 799001

**WESTERN REGION**

25	The Chief Engineer (Commercial), C.S. Power Distribution Company Ltd., Danganiya,Raipur- 492013.
26	CE(SLDC) , MP Power Transmission Co. Ltd., Nayagaon, Rampur, Jabalpur, 482008, MP
27	Chief Engineer(LD), Maharashtra State Electricity Transmission Co.Ltd., State Load Despatch Centre, Kalwa, Thane-Belapur Road, Airoli, Navi Mumbai 400 708
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33	Superintendent Engineer,  Electricity Import - Export and Payment Circle, UP Power Corporation Limited,11 <sup>th</sup> Floor, Shakti Bhavan Extension, 14, Ashok Marg, Lucknow, UP, India

34	Chief General Manager (Commercial) Uttarakhand Power Corporation Ltd. Kanwali Road, Urja Bhawan , Dehradun-248001, Uttarakhand
35	Chief Engineer HARYANA POWER PURCHASE CENTRE, Room 308, Shakti Bhawan, Sector-6, Panchkula Haryana 134109
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37	Divisional Senior Electrical Engineer (Traction Distribution), DRM Office North Central Railway Nawab Yusuf Rd, Civil Lines, Prayagraj, Uttar Pradesh 211001
38	Chief Engineer (State Load Despatch Center) ALDC Complex , Near State Bank Of India, Totu, Shimla, Himachal Pradesh 171011
39	Chief Engineer (Commercial and Survey Wing),  Power development department,  Narwal Bala , Gladini,Jammu,180004
40	Superintendent Engineer Punjab State Power Corporation Ltd,  Shed No. E1, A, Thermal Design,  Patiala-147 001, Punjab
41	Director (Operation), Vidyut Bhavan RAJASTHAN RAJYA VIDYUT PRASARAN NIGAM LIMITED VIDYUT BHAWAN, JYOTI NAGAR, JAIPUR-302015 RAJASTHAN
42	A.G.M (Commercial), NR-I, B-9, Qutab Institutional Area, Katwaria Sarai, New Delhi -110016

## (C)SCED Generator

### Northern Region

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2. General Manager, Rihand Super Thermal Power Station-I, NTPC, Rihand Nagar, Dist-Sonbhadra, UP-231223
3. General Manager, Rihand Super Thermal Power Station-II, NTPC, Rihand Nagar, Dist-Sonbhadra, UP-231223
4. General Manager, Rihand Super Thermal Power Station-III, NTPC, Rihand Nagar, Dist-Sonbhadra, UP - 231223
5. General Manager, Dadri, National Capital Power Project, Dadri Dhaulana Road, Distt. Gautam Buddh Nagar, UP-201008
6. General Manager, Dadri – Stage - II, National Capital Power Project, Dadri Dhaulana Road, Distt. Gautam Buddh Nagar, UP-201008
7. General Manager, Firoz Gandhi Unchahar Thermal Power Project-I, Unchahar, Distt. Raibareilly, UP 229406
8. General Manager, Firoz Gandhi Unchahar Thermal Power Project-II, Unchahar,,Distt. Raibareilly, UP 229406
9. General Manager, Firoz Gandhi Unchahar Thermal Power Project-III, Unchahar, Distt. Raibareilly, UP 229406
10. General Manager, Firoz Gandhi Unchahar Thermal Power Project-IV, Unchahar, Distt. Raibareilly, UP 229406
11. General Manager, Indira Gandhi Super Thermal Power Project PO -Jharli, Tahsil Matanhail, DistJhajjar (Haryana)-124125

### Western Region

12. General Manager, Korba STPS STG ( I & II), NTPC Ltd., P.O.: Vikas Bhavan, Jamnipali, Korba(District), Chhattisgarh- 495 450.
13. General Manager, Korba STPS STG (III), NTPC Ltd, P.O.Vikas Bhavan, Jamnipali, Korba(Dist), Chhattisgarh- 495 450.
14. General Manager, VSTPS-STAGE-I, Vindhayachal STPS, NTPC Ltd, P.O.: Vindhyanagar, Sidhi(District), Madhya Pradesh – 486 885

15. General Manager, VSTPS-STAGE-II, Vindhayachal STPS, NTPC Ltd., P.O.: Vindhyanagar, Sidhi(Dist), Madhya Pradesh – 486 885
16. General Manager, VSTPS-STAGE-III, Vindhayachal STPS, NTPC Ltd, P.O.: Vindhyanagar, Sidhi(Dist), Madhya Pradesh – 486 885
17. General Manager, VSTPS-STAGE-IV, Vindhayachal STPS, National Thermal Power Corporation of India Ltd, P.O Vindhyanagar, Sidhi(Dist), Madhya Pradesh – 486 885
18. General Manager, VSTPS-STAGE-V, Vindhayachal STPS, National Thermal Power Corporation of India Ltd, P.O Vindhyanagar, Sidhi(Dist), Madhya Pradesh – 486 885
19. General Manager, SIPAT TPS Stg-I, NTPC Ltd, SIPAT, Chhattisgarh - 495558.
20. General Manager, SIPAT TPS Stg-II, NTPC Ltd., SIPAT, Chhattisgarh-495558..
21. General Manager, Mouda STPP Stage-I, NTPC Ltd, Mouda Ramtek Road, P.O.Mouda, Nagpur (Dist), Maharashtra
22. General Manager, Mouda STPP Stage-II, NTPC Ltd, Mouda Ramtek Road, P.O.Mouda, Nagpur (Dist), Maharashtra
23. Executive Director, Costal Gujarat Power Ltd (CGPL-UMPP), Tunda Vandh Road, Tunda Village, Mundra, Gujarat Kutch 370435
24. General Manager, NTPC-SAIL Power Company Privte Ltd, Puranena Village, Chhattisgarh Dist - Durg, Bhilai 490021
25. Managing Director, Sasan Power Ltd, DAKC, I Block, 2nd Floor, North Wing, Thane Belapur Road, Koparkhairana Maharashtra New Mumbai 400710
26. General Manager, Solapur STPP, Village Fatetewadi, Post Hotgi Station, Taluka – South Solapur Maharashtra 413003
27. General Manager, NTPC Lara, PO- Pussoree, Dist-Raigarh, Chhattisgarh 496440

#### **Eastern Region**

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29. The General Manager, FSTPS - III, NTPC Limited, P.O. Nabarun, Dist: Murshidabad, West Bengal-742 236
30. The General Manager, KhSTPS - I, NTPC Limited, P.O. Kahalgaon STP, District: Bhagalpur, Bihar- 813 214



31. The General Manager, KhSTPS - II, NTPC Limited, P.O. Kahalgaon STP, District: Bhagalpur, Bihar-813 214
32. The General Manager, TSTPS-I, NTPC Limited, P.O. Deepshikha, District: Angul, Orissa-759 147
33. GM, NTPC,BARH, P.O.NTPC Campus, District:Patna, Bihar-803215
34. General Manager, NTPC ER-I HQ , 2nd floor ,Lok Nayak Jai Prakash Bhavan, Dak Bungalow chowk , Patna-800001
35. General Manager, NTPC ER-II HQ , OLIC Building, Plot no N17/2, Nayapalli, Bhubaneswar, Orissa-751012
36. General Manager, Bharatiya Rail Bijlee Company Ltd. Nabinagar, Khera Police Station Bihar Dist.- Aurangabad, 824303
37. General Manager, Kanti Bijlee Utpadan Nigam Limited Muzaffarpur Thermal Power Station, MTPS – II, Bihar Muzaffarpur 843130
38. Group Head (Commercial), Maithon Power Limited,Village Dambhui, P.O. Barbindia, P.S. Nirsa, District Dhanbad,828 205, Jharkhand
39. General Manager, Nabinagar Power Generation Corporation Ltd NPGC Nabinagar, Bihar Aurangabad 831014

#### **Southern Region**

40. The Executive Director, Ramagundam Super Thermal Power Station, Stage I and II, National Thermal Power Corporation Ltd, Jyothi Nagar, Karim Nagar District, PIN: 505 215, Telangana
41. The Executive Director, Ramagundam Super Thermal Power Station, Stage III, National Thermal Power Corporation Ltd, Jyothi Nagar, Karim Nagar District, PIN: 505 215, Telangana
42. The Group General Manager, Simhadri Super Thermal Power Station, Stage I, National Thermal Power Corporation Ltd, POST – NTPC, Vishakhapatnam, Simhadri, PIN: 531 020, Andhra Pradesh
43. The Group General Manager, Simhadri Super Thermal Power Station, Stage II, National Thermal Power Corporation Ltd, POST – NTPC, Vishakhapatnam, Simhadri, PIN: 531 020, Andhra Pradesh
44. The Executive Director, Talcher Super Thermal Power Station, Stage II, National Thermal Power Corporation Ltd., Kaniha, Deepshikha Post, Angul District, PIN: 759147, Orissa
45. The General Manager , Thermal Power Station II, Stage – I, Neyveli Lignite Corporation Ltd., Neyveli, Cuddalore Dist., PIN: 607 807, Tamil Nadu

46. The General Manager , Thermal Power Station II, Stage – II, Neyveli Lignite Corporation Ltd., Neyveli, Cuddalore Dist., PIN: 607 807, Tamil Nadu
47. The General Manager, Thermal Power Station I Expansion, Neyveli Lignite Corporation Ltd., Neyveli, Cuddalore Dist., PIN: 607 807, Tamil Nadu
48. The General Manager, Thermal Power Station II Expansion, Neyveli Lignite Corporation Ltd., Neyveli, Cuddalore Dist., PIN: 607 807, Tamil Nadu
49. The Chief Executive Officer, NTPC Tamilnadu Energy Company Ltd., Vallur Thermal Power Project, Vellivoyal chavadi POST, Ponneri Taluk, Tiruvallur Dist., Chennai – 600 103, Tamil Nadu
50. The Chief Executive Officer, NLC Tamilnadu Power Limited, 2\*500, MW JV Thermal Power Project, Harbour Estate, Tuticorin, PIN: 628 004, Tamil Nadu
51. The General Manager, Kudgi Super Thermal Power Project, T.K.Basavana Bagewadi, Bijapur Dist., PIN: 586121 , Karnataka.

**North Eastern Region**

52. Group General Manager, NTPC Bongaigaon, Salakati, Kokrajhar - 783370, Assam

**Power System Operation Corporation Ltd.**  
**National Load Despatch Centre (NLDC)**



**Procedure for Pilot**  
**on**  
**Security Constrained Economic Despatch for**  
**Inter State Generating Stations pan India**

*Prepared in Compliance*

*to CERC Orders:*

*Petition No. 02 /SM/2019 (Suo-Motu) dated 31<sup>st</sup> January 2019*

*and*

*Petition No. 08/SM/2019 (Suo-Motu) 11th September, 2019*

**Revision – 2: October 2019 (w.e.f 01<sup>st</sup> October, 2019)**

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## 1. Preamble

- 1.1. This Procedure is issued in compliance to CERC order dated 31<sup>st</sup> January 2019 in Petition No. 02/SM/2019 (Suo-Motu) in the matter of Pilot on Security Constrained Economic Dispatch (SCED) of Inter-State Generating Stations (ISGS) Pan India, hereinafter referred to as "**SCED Pilot**".
- 1.2. SCED optimises the despatch of the generation resources at inter-state level which are participating in the SCED Pilot and reduce the total variable charges for production of electricity. The implementation of SCED is a step towards introduction of optimization techniques in the despatch processes at inter-state level in the Indian Power System.
- 1.3. All the words and expressions used in the Procedure shall have the same meaning as assigned to them in various CERC Regulations.
- 1.4. This procedure would be applicable during the period of implementation of SCED Pilot w.e.f **01st October 2019**.
- 1.5. The total net SCED benefits during the pilot project from 01<sup>st</sup> April, 2019 will be shared among beneficiaries/generators as stipulated in this procedure.

## 2. Objective

- 2.1. The objective of the procedure is to lay down the roles, responsibilities, scheduling, despatch, accounting and settlement methodologies to be followed by the National Load Despatch Centre (NLDC), Regional Load Despatch Centres (RLDCs), State Load Despatch Centres (SLDCs), Regional Power Committees (RPCs), ISGS in the implementation of the SCED.

## 3. Scope

- 3.1. The Procedure shall be applicable to all the thermal ISGS that are regional entities participating in the Reserve Regulation Ancillary Services (RRAS)

mechanism and whose tariff is determined or adopted by the CERC for their full capacity, hereinafter, referred to as **"SCED Generators"**. To begin with, the multi-fuel ISGS stations are being excluded in the pilot project as one physical station is using multiple fuel types (domestic gas, RLNG, liquid fuels) and therefore, there is an added complexity due to unit commitment/open or closed cycle operation to be factored in real time.

- 3.2. The Procedure shall also apply to CTU, SLDCs, RLDCs, NLDC and RPCs.
- 3.3. CERC vide Suo-moto order in petition no Petition No. 08/SM/2019 dated 11th September, 2019 has extended the SCED Pilot with participation by willing generators. Any **"SCED Generators"** unwilling to participate in SCED shall inform NLDC one week before starting of the month on one time basis clearly indicating the reasons for non-participating. NLDC may seek further clarifications from the generator keeping in view the Regulations issued by CERC from time to time. 'SCED generators' except as above shall be considered as 'participating' by NLDC for optimization under SCED mechanism.
- 3.4. Any "Generator" willing to participate in SCED and comply to the section 3.1 above,, such generator shall provide the details mentioned under 8.2.1 to the concern RLDC/NLDC.
- 3.5. The SCED Pilot envisages optimization for a despatch period of one time block of 15 minutes at a time repeated every 15-minutes over the day for 96 time blocks.
- 3.6. CERC vide para 19 in suo-motu order in petition no 08/SM/2019 mentions the need for detailed analysis of various parameters during the SCED pilot and the need for consultations with various stakeholders before framing the

appropriate regulatory framework. Accordingly, during the course of the SCED pilot, NLDC in consultation with the stakeholders would explore the following. :

- 3.6.1. Factoring reserves in the SCED model and attempt to find out the unit commitment for overall benefit of the system. This exercise would also try to factor the requisition given by States for the units under Reserve Shut Down (RSD).
- 3.6.2. Multi period optimization runs in this pilot project to assess its impact on ramp constraints.
- 3.6.3. Co-optimization of ancillary and energy module.
- 3.6.4. Factoring net incremental/ decremental loss due to perturbation in SCED schedule and including the same in the total optimization formulation(Annexure-I)

#### **4. Role of National Load Despatch Centre (NLDC)**

- 4.1. NLDC would develop and implement requisite software applications for the SCED Pilot and update it from time to time for all the SCED Generators honouring the existing scheduling practices prescribed in the Indian Electricity Grid Code (IEGC).
- 4.2. NLDC would run the SCED software application to generate the SCED schedules (up/down) for the SCED Generators and communicate the same to the RLDCs for incorporation in the schedules.
- 4.3. NLDC would maintain and operate a separate bank account in the name of "National Pool Account (SCED)" for settlement of payments to/from the SCED Generators.
- 4.4. NLDC would prepare a consolidated all India Monthly statement indicating the SCED schedules

- 4.5. NLDC would issue a consolidated "National SCED Monthly Statement" indicating the payment and receipts to/from all SCED generators which would be made available to the stakeholders through the NLDC website.
- 4.6. NLDC shall issue a Monthly statement "National net SCED Benefits Distribution statement" detailing disbursement for different utilities in the net accrued amount due to reduction in total variable charge through SCED mechanism in "National Pool Account SCED". This statement would be made available to the stakeholders through the NLDC website.

## **5. Role of Regional Load Despatch Centres (RLDCs)**

- 5.1. The respective RLDCs would incorporate the SCED schedules as received from NLDC and maintain the relevant scheduling data during the operation of the SCED pilot (including but not limited to generating station-wise installed capacity, declared capacity, schedule, Un-Requisitioned Surplus (URS), generator wise Variable cost, RRAS, SCED schedules for up/down and requisitions from the generating stations).
- 5.2. The reconciliation of SCED schedules would be done by RLDCs with the data provided by NLDC before forwarding implemented schedule to RPCs.

## **6. Role of Regional Power Committees (RPCs)**

- 6.1. The RPCs would issue Monthly SCED account based on the data provided to them by the RLDCs.
- 6.2. The RPCs would issue monthly "Statement of Compensation due to Part Load Operation due to SCED" separately in its accounts for all SCED generators along with monthly REA.



## 7. Role of Beneficiary of SCED Generators

- 7.1. Beneficiary/SLDC of SCED Generators shall provide the Bank account details to NLDC to facilitate payments to/from the beneficiary of SCED generator due to net benefits accrued in National Pool Account (SCED).
- 7.2. Beneficiary shall reconcile the amount received due to benefits accrued in National Pool Account (SCED) with NLDC on monthly basis based on the RPCs statement.
- 7.3. Beneficiary shall reconcile the SCED payment details with NLDC within 15 days of receipt of reconciliation statement; else it shall be treated as deemed reconciled.

## 8. Scheduling & Despatch of ISGS under SCED

- 8.1. The existing schedule & despatch procedure in accordance with IEGC (*Part 6 - Scheduling and Despatch Code*) would continue for all entities.
- 8.2. NLDC would prepare the SCED schedules based on the following data:
  - 8.2.1. Generator Parameter
    - 8.2.1.1. Normative On bar declared capability
    - 8.2.1.2. Injection schedule (latest revision)
    - 8.2.1.3. Ramp Rates (as declared in RRAS)
    - 8.2.1.4. Variable Charges (as declared in RRAS)
    - 8.2.1.5. Technical Minimum (as per IEGC provisions)
  - 8.2.2. Transmission Capability Constraint
    - 8.2.2.1. Inter-Regional Transfer Margins as assessed by RLDCs/NLDC

The Mathematical Formulation of the Economic Despatch Model used for SCED procedure is enclosed at **Annexure - I**.
- 8.3. A schematic of scheduling under SCED Procedure is placed at **Annexure - II** for better clarity and understanding.

- 8.4. The SCED software program would consider only the units on bar.. Further, SCED would run after all schedule revisions as per the allowable time lines have been incorporated by the RLDCs and RRAS despatched by NLDC.
- 8.5. The SCED schedules, with the increment (up)/decrement values (down), for each SCED Generator in a particular time block would be intimated by NLDC to respective RLDCs, normally about one-time block in advance.
- 8.6. Triggering in of the SCED optimization (smooth take-off) and reverting to normal schedules (smooth landing) in case of any interruption of SCED algorithm due to any reason are issues that need to be taken care of. The triggering in of the SCED optimization algorithm shall have least impact on the total schedules if at the time of triggering in, the schedules of the generators are close to optimized schedules. This would generally be the situation during peak hours. Likewise, in the case of an interruption, the impact of safe landing would be minimized with the generators reverting gradually to the base schedules as per the ramp rates. NLDC would attempt multi period optimization runs in this pilot project to assess its impact on ramp constraints.

In case of failure or interruption of the SCED software program or a communication failure for any reason, the schedules without SCED shall become applicable. NLDC/RLDCs shall notify the same. In such a case, the SCED Generators shall come back to their schedules without SCED schedule as per their respective ramp rate. The mismatch in schedules after accounting for the generating station's ramp rate shall be taken care in the SCED implemented schedules by RLDCs in consultation with NLDC for the affected generators. After resolving the issues leading to interruption, SCED optimization algorithm shall be triggered in again.

- 8.7. Diversity in the regional load-generation patterns has given rise to the present scope of generation optimization through SCED. However, opposing ramping requirements of different regions also impose constraints in terms of overall ramping that is required for the optimization process. This may sometimes lead to an infeasible/non-converged solution while solving the SCED optimization problem.

In the event of an infeasible/non-converged solution by the SCED optimization algorithm within the given set of constraints, the classical method of relaxation of the constraints, incrementally in steps, and/or penalizing the objective function shall be attempted in order to find an optimal solution. The lessons learnt during the pilot phase would help in improving the optimization process nuances. Such small incremental relaxation of constraint(s), required to obtain an optimal solution, shall automatically be accounted for in the SCED implemented schedules and through the National Pool Account. Higher ramping capability of the participating generators will help in improving the optimization and the above mentioned issues.

- 8.8. RLDCs would incorporate the SCED schedule in the respective SCED Generator's schedule and provide a net injection schedule.
- 8.9. SCED schedules would be treated as deemed delivered. There would be no retrospective changes in the SCED schedules except in situations as mentioned in Para 8.6 and 8.7 above.
- 8.10. The schedules of the states/beneficiaries would not be changed under SCED and the beneficiaries would continue to be scheduled based on their requisitions from different power plants as per the existing practices.
- 8.11. A virtual SCED entity, VSCED-[Region] would be created in the scheduling process of the RLDCs which shall act as a counter-party to the SCED schedules for the SCED generators. For example, in the Northern Region,

VSCED-NR shall be created. The virtual SCED entity, by its very nature, is not a physical entity bounded by meters and hence, shall not form a part of the Regional DSM Pool.

- 8.12. Applicable injection and withdrawal loss will be applied to SCED schedules as per the existing scheduling practice.
- 8.13. The URS available due to Regulation of Power Supply provisions as per the CERC Regulations would also be used for SCED procedure similar to RRAS.
- 8.14. The SCED Generator whose scheduling has been restricted due to transmission constraints shall be excluded from the SCED optimization process to begin with. However, later these stations can also be considered in the SCED optimization algorithm with revised constraints (maximum/minimum generation limits) for despatch. The concerned RLDC shall inform NLDC about such generators.

## 9. Data and Voice Communication

- 9.1. All SCED Generators would ensure the availability of real time updated data to the RLDCs. CTU would ensure reliable communication between the respective SCED Generators and RLDCs and between RLDCs and NLDC.
- 9.2. RLDCs would provide information related to SCED schedules of SCED Generators on their websites. The data display on RLDCs Website (for each SCED Generator) would be as per **Format SCED1**.

## 10. Energy Accounting & Settlement

- 10.1. Energy Accounting for SCED optimized schedules shall be done by the respective RPC on monthly basis with day wise resolution figure made available in the SCED account based on the data provided to them by RLDCs

- 10.2. 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.
- 10.3. NLDC would prepare a consolidated all India statement, monthly indicating the SCED schedules
- 10.4. The variable charges (paise/kWh) declared by the generators for the purpose of Reserve Regulation Ancillary Services (RRAS) shall be considered in the SCED procedure.
- 10.5. 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.
- 10.6. 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.
- 10.7. For any increment in schedule of SCED Generator due to SCED procedure, the SCED generator would be paid from the 'National Pool Account (SCED)' for the incremental generation at the rate of its variable charges.
- 10.8. The payments/receipts by/to the SCED Generators would be based on the **"Regional SCED Monthly Statement" (Format SCED2)** issued by the RPCs . consolidated **"National SCED Monthly Statement" (Format SCED3)** issued by NLDC
- 10.9. Day wise details for SCED Generators shall also be made available in the SCED account by RPCs as per Format SCED7.

- 10.10. 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.
- 10.11. 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 RPC to the 'National Pool Account (SCED)'. Payments against SCED shall not be adjusted against any other payments by the SCED Generator.
- 10.12. 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)'.
- 10.13. 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.
- 10.14. 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.
- 10.15. The RPCs would issue monthly "Statement of Compensation due to Part Load Operation due to SCED" (**Format SCED4**). The compensation for heat rate degradation to the SCED generators as per the statement issued by the RPCs would be payable from the National Pool Account (SCED) within seven (07) working days of the issue of the monthly statement by the respective RPCs subject to yearly computation, as the heat rate computation is being done on annual cumulative basis.

10.16. NLDC would issue monthly “National Statement of Compensation due to Part Load Operation due to SCED” (**Format SCED5**) on the compensation to be paid to the SCED Generator for heat rate degradation, from National Pool Account (SCED) based on Format SCED4 statement issued by respective RPCs.

NLDC shall maintain a record of all savings on accrual basis in the ‘National Pool Account (SCED)’ on a Monthly basis.

## **11. Distribution of Benefits due to SCED.**

11.1. The benefits accrued in the “National Pool Account (SCED)” after adjusting compensation for part load operation of the generators herein after referred to as “total net SCED Benefit” shall be distributed in the ratio of 50:50 between the generators participating in SCED and their respective Beneficiary on a monthly basis.

11.2. 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).

11.3. RPCs shall issue the “Detail of Beneficiary schedule energy from SCED generator” (Format SCED6) and provided soft copy to NLDC on monthly basis.

11.4. The benefits corresponding to the SCED generator out of the total Net SCED benefits shall be distributed in the ratio 60:40 between the SCED generators receiving SCED Up and SCED Down respectively. This shall be based on the block wise SCED Up and SCED Down energy accumulated on monthly basis.

11.5. 60% of the SCED generator’s benefit shall be distributed among all the participating generators receiving total SCED up signals in proportion to their block wise SCED schedule accumulated on monthly basis.

- 11.6. 40% of the SCED generator's benefit shall be distributed among all the participating generators receiving SCED down signals in proportion to their block wise SCED schedule accumulated on monthly basis.
- 11.7. Benefits as computed above for the SCED generators would then be summed up for the month
- 11.8. NLDC would issue Monthly "National net SCED Benefits Distribution Statement"(SCED8 and SCED9) (after adjusting the heat rate compensation) indicating the payment to SCED generators and Beneficiary of SCED generator based on Format SCED2,SCED6 and SCED7 statement issued by respective RPCs. This would be made available to the stakeholders through the NLDC website.
- 11.9. 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. 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 POSOCO and submitted to the CERC for information.



## Mathematical Formulation of Security Constrained Economic Despatch

### Objective Function

- Minimize Pan India ISGS Variable Cost

### Subject to Constraints

- Meeting Total Requisition by States from ISGS
- Transmission Constraints (ATC)
- Technical Minimum of Plants
- Maximum Generation (DC-on-bar)
- Ramp up/down rates
- 

$$\text{Minimise } \sum_{i=1}^k C_i P_i + \sum(\text{Violation Penalties}) + \sum_{i=1}^k \Delta P_i L_i \dots\dots\dots(1)$$

- $k$  = total number of Plants
- Where  $C_i$  is the variable per unit cost of the  $i^{\text{th}}$  Plant
- $P_i$  is the optimised scheduled power of the  $i^{\text{th}}$  Plant
- *Violation Penalties* are computed based on constraint violations
- $L_i$  is the incremental POC loss percentage
- $\Delta P_i$  is the change in schedule to SCED.

### Subject to

$$\text{➤ } \sum_{i=1}^k P_i = \sum_{i=1}^k S_i - \text{Schedule violation} \dots\dots\dots(2)$$

$$\text{➤ } P_i \leq (\text{DC on bar}) \dots\dots\dots(3)$$

$$\text{➤ } P_i \geq P_{i,\text{min}} \dots\dots\dots(4)$$

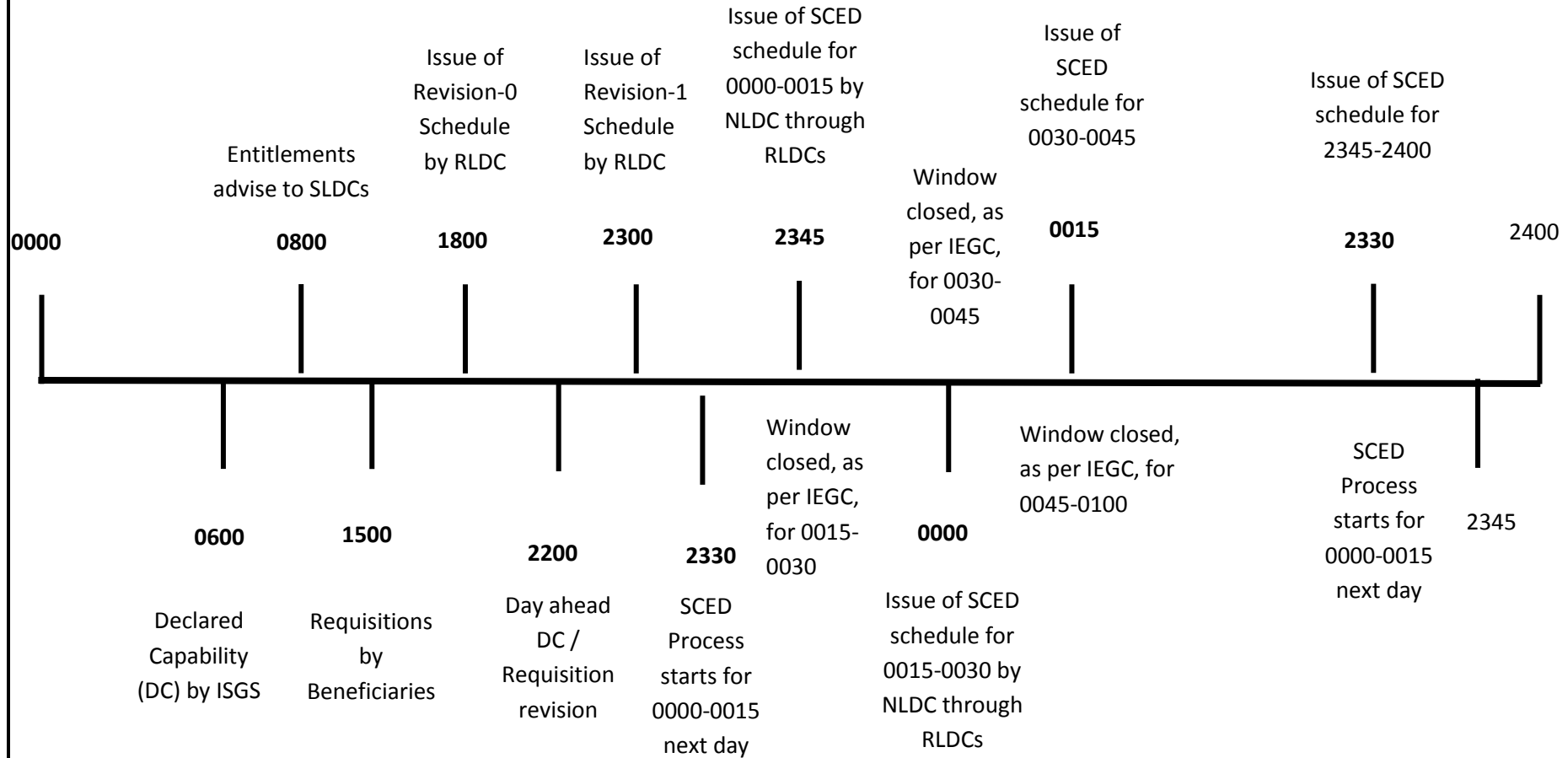
$$\text{➤ } P_{i,t} \leq P_{i,t-1} + \text{Ramp up rate} + \text{Ramp up violation} \dots\dots\dots(5)$$

$$\text{➤ } P_{i,t} \geq P_{i,t-1} - \text{Ramp down rate} - \text{Ramp down violation} \dots\dots\dots(6)$$

$$\text{➤ } \forall r \in R, \sum_r (P_{i,r} - S_{i,r}) \geq \min((SCHIR_r - ATC_r), 0) - \text{ATC violation} \dots\dots(7)$$

- $S$  -is the scheduled power
- $t$  -represents current time of execution
- $R$  -represents each of the regions viz., North, East, West, South and North East
- $ATC$  -is the Available Transmission Capability of each region  $R$
- $SCHIR$  -is the Scheduled Net Interchange of the region  $R$
- $P_{i,\text{min}}$  is the *technical minimum* for thermal power plants considered at 55% of normative DC on bar or schedule whichever is less
- Penalty factors
  - Schedule violation: Highest Variable cost rounded upto the nearest rupee.
  - Ramp Violation:  $1/3^{\text{rd}}$  of Schedule violation.
    - $ATC$  violation: 2X Schedule violation.

## Annexure II: Schematic of Scheduling Process under SCED Procedure







## Format SCED2: ...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					
....	.....					
	<b>Total</b>	Total of (A)	Total of (B)	Total of (C)	Total of (D)	Total of (E)



## Format SCED3: 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)
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)



## Format SCED4: ...RPC "Statement of Compensation due to Part Load Operation due to SCED"

*(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 <b>(MWhr)</b>	Compensation Amount Payable due to SCED from National Pool Account (SCED) to SCED Generator <b>(in ₹)*</b>
SCED Generator 1		
SCED Generator 2		
.....		
<b>Total</b>		



## Format SCED5: 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 Generator

**For Month:**

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



## Format SCED6: ...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 SCED7: ...RPC "SCED Generator Monthly Statement"

SCED Account For Month <<.....> Name of SCED

Generator: SCED Generator1

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

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

Date	Increment due to SCED scheduled to VSCED [Region] <b>(MWHr)</b> <b>(A)</b>	Decrement due to SCED scheduled to VSCED [Region] <b>(MWHr)</b> <b>(B)</b>	<b>V.C.</b> (Variable cost) Paisa/Unit	Charges To be Paid to SCED Generator from National Pool (SCED) <b>(in ₹)</b> <b>(C) =</b> <b>(A) x V.C.</b>	Charges To be Refunded by SCED Generator to National Pool (SCED) <b>(in ₹)</b> <b>(D) =</b> <b>(B) x V.C.</b>	Net Charges Payable (+) / Receivable (-) <b>(in ₹)</b> <b>(E)* =</b> <b>(C) - (D)</b>
01/mm/yy						
02/mm/yy						
03/mm/yy						
dd/mm/yy						
<b>Total</b>	Total of (A)	Total of (B)		Total of (C)	Total of (D)	Total of (E)



## Format SCED8:NLDC " National net SCED Benefits Distribution

### Statement"" - SCED Generator

For the Month <<Month>>

Total Saving for the month (Rs.) (A)	Heat Rate Compensation (Rs.) (B)	Net Saving for the month (Rs.) (C)	Net Benefit sharing for generators (Rs.) (D=50% of C)	For SCED UP (Rs.) (E=60% of D)	For SCED Down (Rs.) (F=40% of D)

Sl.No.	SCED Generator	Region	SCED UP Energy (MWH) (A)	For SCED UP (Rs.) (B)	SCED DOWN Energy (MWH) (C)	For SCED Down (Rs.) (D)	Total(Rs.)
1	SCED Gen1						
2	SCED Gen2						
3	SCED Gen3						
n	SCED Gen.....						
<b>All India Total</b>							



## Format SCED9:NLDC " National net SCED Benefits Distribution

### Statement"" - Beneficiary

Sl no	Beneficiary	REGION	Total schedule Energy(Mwh) as per REA	Total receivable in (Rs)
1	Beneficiary 1			
2	Beneficiary 2			
3	Beneficiary 3			
n	Beneficiary ...n			
	All India			