**MINUTES OF TWENTY FIRST MEETING OF "TECHNICAL COMMITTEE FOR IMPLEMENTATION OF FRAMEWORK ON RENEWABLES AT THE STATE LEVEL"**

| | | |
|---|---|---|
| Venue | : | Upper Ground Floor<br>CERC, New Delhi |
| Date | : | 08-10-2018 |
| List of Participants | : | At Annexure –1**(Enclosed)** |

1. The Twenty First meeting of Technical Committee on Implementation of Framework for Renewables at the State level was held on 8thOctober 2018 Dr. M.K Iyer, Member, CERC welcomed all the participants of the meeting and special invitees. Former Chairperson of the Committee, Shri A.S Bakshi also attended the meeting as special invitee.

2. Dr. Sushanta.K.Chatterjee, Joint Chief (RA), CERC welcomed all the members, special invitees and other participants of the Standing Technical Committee and highlighted the agenda items scheduled for the meeting. The meeting started with Agenda Item No.2.

**3. <u>Discussions on the Agenda items</u>**

**(A) Agenda Item No. 2: Electricity Contracts in US- Insights for India Sharing of US experience on Capacity Market, Financial Contracts and take away for India's Market Reform**

- **Presentation by USAID and NARUC**

a) Dr Chatterjee briefly provided the background of the study being conducted under the Greening the Grid (GtG) programme of US-India partnership. He highlighted the need for market design changes to achieve ambitious target of adding 175 GW of Renewable Energy by 2022. The basic objective of the study was to gain insight into international experience around market design, with special focus on treatment of existing and future contracts.

b) Ms. Monali Hazra, Program Management Specialist – USAID briefed the Committee about USAID's Greening the Grid (GTG) program, being implemented in partnership with the Ministry of Power (MoP), which focuses on supporting peer-to-peer exchanges between U.S and India regulators by providing relevant international experiences and regulatory expertise. NARUC the USAID's implementing partner for this component of GTG, has a Memorandum of Understanding (MOU) with the Forum of Regulators (FOR) for this purpose. Ms. Monali informed that NARUC with assistance from E3 (US based Energy Consulting Firm), developed the report based on the inputs from representatives from POSOCO and CERC, highlighting international

experiences on structures of contracts in different market models and requested Ms. Lakshmi Alagappan, Director of E3 (US based Energy consulting firm) to present the report before Technical Committee.

c) Ms Lakshmi Alagappan from E-3 made a presentation (Annexure-II) on "Regulatory Guidelines: Insights from the U.S. on Electricity Contracting and Markets". She highlighted that India's power sector is currently in a transition, dealing with how power plants are contracted and operated from a heavy reliance on long-term contracting with limited operational flexibility to a greater reliance on short-term markets and more operational flexibility. She stated that in the United States, policymakers and regulators faced similar situation during their transition to electricity markets which can provide valuable insights for India.

d) She emphasized that the report examined the evolution of electricity contracting in U.S. electricity markets siting two case studies of Market Reforms in New York and California. In California, regulated utilities provide most of the retail electricity service. While the regulatory authorities have a large influence on contract terms and conditions, forward contracts have been a large source of inflexibility in the California ISO (CAISO) market. In New York, while competitive retailers play a larger role, regulators only intervene in contracting by utilities that provide default service to customers who do not choose a retail provider. She also informed the Committee that the New York ISO (NYISO) rules require generators with bilateral contracts to submit economic bids.

e) The presentation concluded by reiterating that higher penetrations of solar and wind generation have increased the importance of a well-functioning spot market in which real-time balancing and ancillary services markets are interactive.

***Action points/ Decisions***

*The Committee noted the presentation and desired that the report (**enclosed**) be circulated with the request to provide comments/suggestions within 3 weeks days.*

## (B) Agenda Item No. 3: Draft Report on Gap Assessment for Comprehensive Metering and Accounting Framework for Grid Connected Solar Rooftop PV in India

a. It was informed that the draft report was discussed in the 64th meeting of the Forum of Regulators in Ranchi and the report has been accordingly modified to take into account observations made by some members in the FOR meeting. The representative from E & Y broadly explained the contours of the report which include technical, commercial and operation challenges in Solar Rooftop penetration on larger scale (Annexure- III). It was underscored that the present

provisions of model regulation, 2013 and that of State Regulations has put certain restrictions in terms of system capacity that an individual can install, how much capacity can be allowed on single DT and maximum capacity that can installed by individual consumer.

b. The study was broadly divided into four (4) categories i.e. Integration arrangement, Energy Accounting and commercial arrangement, metering and other regulatory provision. In the presentation, representative of E&Y highlighted the issues around the existing regulatory framework of net metering and explained the suggested upcoming business models,

c. The consultant highlighted business models which have to be considered in the ambit of this new framework and briefed the Technical Committee on the simulation with six business models for two States i.e Delhi and Chhattisgarh to estimate the impact on the distribution utilities. It was concluded that impact of such transition can be minimized by adopting the suitable business models based on the State specific needs and goals.

d. Chairperson, TNERC raised the issue of financial health of DISCOMs due to net metering regulation.

***Action points/ Decisions***

*After discussion, it was decided that the issues raised be addressed and the report be presented in the next meeting of the Technical Committee/FOR.*

**(C) Agenda Item No. 5: Report of Sub-Group on Load Despatch Centers (LDCs) Institutional Building and Strengthening:**

- **Discussion and consideration for Approval**

a. Shri S.K. Soonee , Advisor, POSOCO gave a brief background of the sub group and informed that the sub-group carried out extensive research and surveys on best practices of Indian and international ISOs/TSOs and held eleven (11) meetings and interacted with sixteen (16) SLDCs before finalization of report and Model Regulation on Fees and Charges for Load Depsatch Centers.

b. Ms Shilpa Aggarwal, Joint Chief (Engg), CERC made a presentation on "**Institutional Capacity Building and Strengthening of LDCs" (Annexure IV).** She highlighted that the objective of the survey is to analyze existing and future requirement of Human Resource, Civil Infrastructure, Amenities, IT Infrastructure at Load Despatch Centres (LDCs) in India.

c. It was highlighted that LDCs need to be equipped with adequate human resource, civil infrastructure, Information Technology infrastructure and adequate financial resources. Further, it was stated that there is a need to evolve suitable

framework for LDCs to attract and retain talent. During the survey it was also highlighted that all LDCs required a separate regulatory cell.

d. It was also emphasized that currently around 2200 person are working in LDCs, which include 1700 executive and 500 are workmen through all the LDCs in the country. She presented that total HR requirement would be in the range of 3000 – 4000 in LDCs. HR expenses should be carved out from main budget and must factor training, business travel, official nominations, sanctioned/contingency leaves etc. The LDCs should be provided with night shift pick-up and drop, night shift reimbursement, residential facilities and other basic amenities such as restrooms, canteen, ergonomic seating/workplace etc.

e. Further, it was stressed that Incentivization is necessary in LDCs and it may be linked with certification. This will help in retaining talent. Monthly incentives model has been suggested in the report.

f. She stated currently the ARR of SLDC is a part of the ARR of the STU. Hence, the SLDC may carve itself out from STU or there should be separate fund for LDCs in STU to meet contingency requirement.

***Action points/ Decisions***

*After detailed deliberation, Committee endorsed the report and Model Regulation.*

**General Discussion**

Due to paucity of time, Committee decided to take up Agenda item No 1 & 4 in the next meeting.

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**Annexure-1**

**LIST OF PARTICIPANTS AT THE TWENTY FIRST MEETING OF TECHNICAL COMMITTEE FOR IMPLEMENTATION OF FRAMEWORK ON RENEWABLES AT THE STATE LEVEL HELD ON 8TH OCTOBER 2018 AT CERC, NEW DELHI**

| | | |
|---|---|---|
| 1 | Dr. M.K Iyer, Member | CERC |
| 2 | Shri Akshayakumar, Chairperson | TNERC |
| 3 | Shri I.A. Khan, Chairperson | TSERC |
| 4 | Shri Dev Raj Birdi, Chairperson | MPERC |
| 5 | Shri R N Sen, Chairperson | WBERC |
| 6 | Shri R.P. Singh, Chairperson | APSERC |
| 7 | Shri A.S. Bakshi, Ex-Member | CERC |
| 8 | Shri Pendyala Rama Mohan, Member | APERC |
| 9 | Shri Mukesh Khullar, Member | MERC |
| 10 | Shri Sanoj Kumar Jha, Secretary | CERC |
| 11 | Shri Abhijit Deshpande, Secretary | MERC |
| 12 | Shri S.C. Srivastava, Chief (Engg.) | CERC |
| 13 | Dr. S.K. Chatterjee, JC(RA) | CERC |
| 14 | Smt. Shilpa Agarwal, Joint Chief (Engg.) | CERC |
| 15 | Shri K.V.S. Baba, CMD | POSOCO |
| 16 | Shri S.K. Soonee, Advisor | POSOCO |
| 17 | Shri S.R. Narasimhan,ED | POSOCO |

| | | |
|---|---|---|
| 18 | Shri Vivek Pandey | POSOCO |
| 19 | Shri B.B. Mehta, CE | SLDC Gujarat |
| 20 | Shri A.V. Kolap, CE | SLDC Maharashtra |
| 21 | Shri V.D. Pande, SE | SLDC Maharashtra |
| 22 | Shri N Bhasker, CE | SLDC Telangana |
| 23 | Shri M.K. Verma, EE | SLDC Rajasthan |
| 24 | Shri N.K. Agrawal, AE | SLDC Rajasthan |
| 25 | Ms. Rashmi S. Nair, DC(RA) | CERC |
| 26 | Ms. Monali Hazra | USAID |
| 27 | Ms. Priya Sreedharan | USAID |
| 28 | Ms. Lakshmi Alayappan | E3 |
| 29 | Shri Ajit Pandit | Consultant |
| 30 | Shri Anant Sant | Consultant |
| 31 | Shri Ravindra Kadam, Advisor (RE) | CERC |
| 32 | Representatives of E&Y | E&Y |
| 33 | Representatives of Deloitte | Deloitte |
| 34 | Shri Neeraj Singh Gautam, RO | CERC |

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# Regulatory Guidelines:

## *Insights from the U.S. on Electricity Contracting and Markets*

**FOR Technical Committee Meeting**
**October 8th, 2018**

Lakshmi Alagappan
Director
Energy and Environmental Economics (E3)

# Project Background

- Significant changes are underway in India's electricity industry
  - Rapid declines in solar PV and wind costs
  - Aggressive national RE policy
  - Growing discom interest in shorter-term contracts
  - Concerns over coal plant utilization
  - Open access and customer choice
  - Ongoing efforts to improve financial health of discoms


USAID/NARUC/E3 Engagement with CERC and FOR

- Year 1: Regulatory Primer
  - Identified potential regulatory solutions to help inform more efficient power system operations in India
    - Focus on market design and imbalance mechanisms
    - Focus on integration of renewables
    - Draw from U.S. experience and Indian field research
- Year 2: Regulatory Guidelines
  - Examines transitional aspects of moving existing long-term contracts into a market-based structure with a focus on lessons learned from the U.S.

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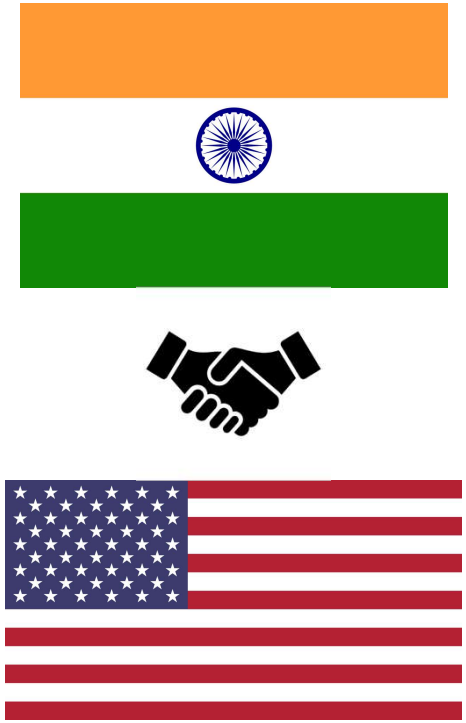
# Key Questions

- How to transition long-term physical contracts to financial contracts, allowing buyers and sellers more flexibility to participate in short-term markets?
- How to regulate contracts in a more market-oriented environment, including contract duration and other terms and conditions?
- How to create meaningful spot market pricing that reflects system marginal costs and facilitates lower cost dispatch and more flexible operation?
- How to reduce the amount of uneconomic self-scheduling by long-term contract holders?
- When and how to introduce financial products to allow sellers and buyers to hedge electricity market risk?
- How much fuel price, electricity market price, and investment risk to pass on to generators?
- How to ensure that, even with greater reliance on shorter-term markets, load serving entities still have incentives to invest in adequate resources to meet electricity demand?
- How to ensure that markets are competitive and that greater reliance on electricity markets does not create unacceptable risks for discoms and customers?

# Why focus on the US?

- Many parts of the US had electricity sectors that looked much like India's today – long-term contracts/owned generation with coal plants, rapidly declining technology/fuel costs, aggressive energy policy
- As policymakers and regulators considered transitioning to markets, they asked similar questions during the transition that Indian regulators are asking now
- Overall contract and dispatch framework as proposed by CERC (CFDs and bid into DAM) is similar to the US
- E3 has a long history of work in jurisdictions that have undergone similar transitions and chose two case studies for the Guidelines from which to distill best practices and lessons learned: California and New York



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# Case Studies: California & New York

- Case study regions were chosen based on their different points along spectrums of industry structures, regulatory oversight of contracting, and integration of long-term contracts into ISO markets
  - California – primarily regulated utilities that provide retail service, regulatory authorities have large influence on contract terms and conditions, forward contracts are a large source of inflexibility in the market
  - New York – competitive retailers play a large role, regulators only intervene in regulated utilities that provide default service, and market requires all bilateral contracts to be economically bid


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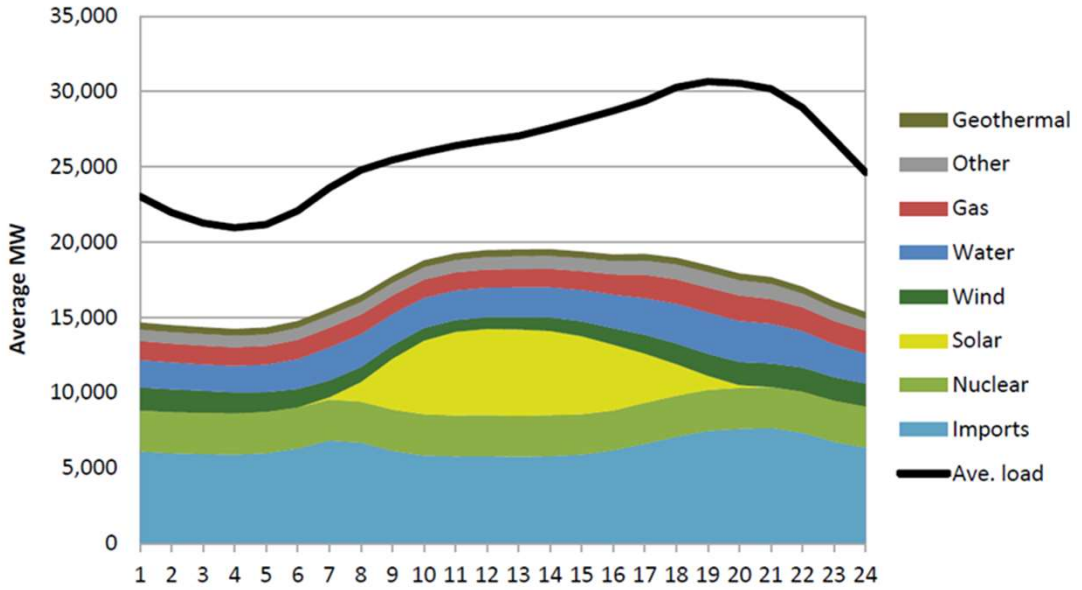
# Key Takeaway #1

- Long-term bilateral contracting can be compatible with merit order dispatch, but enabling compatibility between them may require changes in markets and regulation to reduce self-scheduling

- CA: Still large amounts of self-scheduling in market (see right); have tried changes to market design to help encourage more economic bidding
- NY: No generation self-scheduling; all generation is economically cleared through the market, including generators that have bilateral contracts with offtakers




Average Hourly Self-Scheduled Resources (Shaded Area) Relative to Average Hourly Demand (Black Line) for the CAISO, 2016

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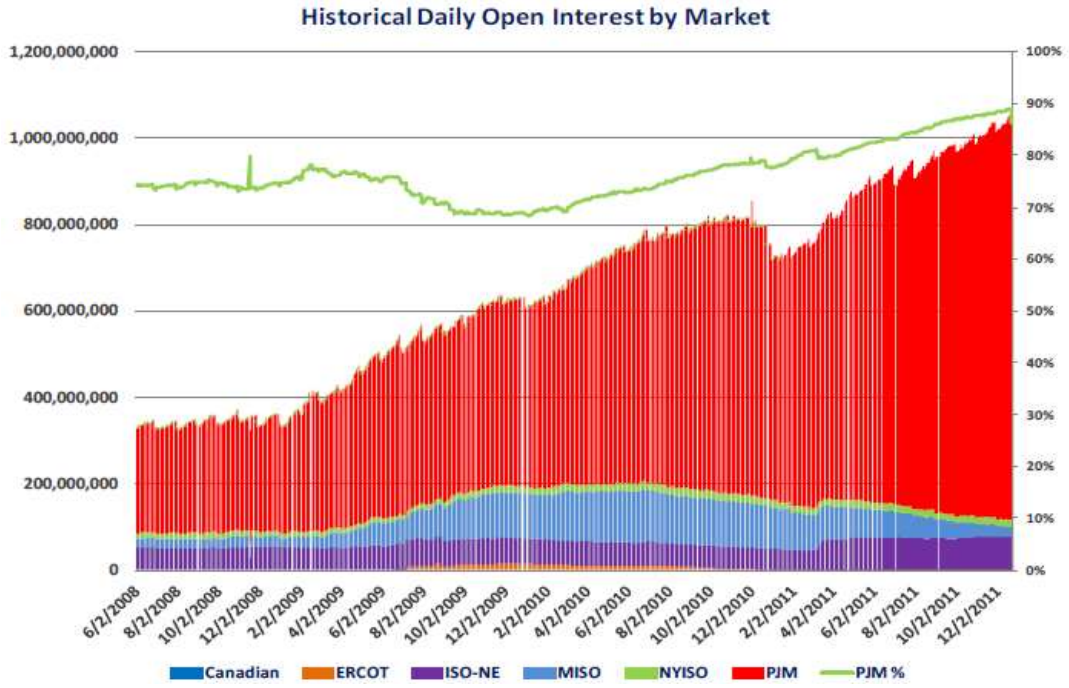
# Key Takeaway #2

- Hedging tools are critical for managing electricity spot market risks, but the development of exchange-traded financial products for electricity will likely be demand-driven and iterative

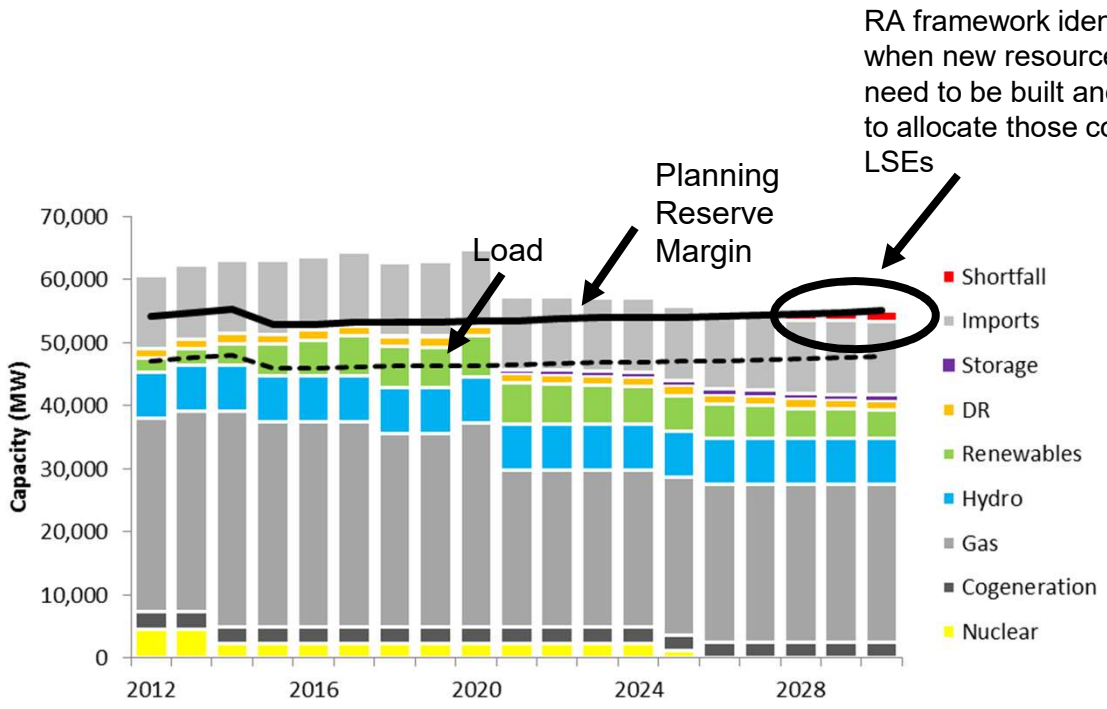
- CA: Use utility owned generation, long- and short-term bilateral contracts, and natural gas futures to hedge against market price risk
- NY: use short-term bilateral contracts and electricity financial products like futures, options, swaps
- Exchange based products were slow to develop and responded to demand and were iterative




Interest by ISO market in CME exchange products from 2008-2011

## Key Takeaway #3

- As reliance on spot markets increases, resource adequacy and fairly allocating fixed generation costs become more important




California Planning Reserve Margin for Resource Adequacy

- CA and NY both have resource adequacy programs to ensure enough generation is online for next 6-12 months
- Also have long-term procurement mechanisms for new generation investment (see left for CA)

## Key Takeaway #4

- Developing or expanding electricity markets does not reduce the cost of expensive legacy contracts, but markets can improve future decision-making
  - High average electricity prices were a key driver to market development in CA and NY, but legacy contracts were a sunk cost
  - Continue to pay the fixed costs, regardless of dispatch (They are reconciled to this reality); variable costs are paid only when dispatched
  - If economic, some legacy contracts were bought out and terminated or assets were made to be more dispatchable so that they could be meet flexibility requirements

## Key Takeaway #5

- In expanding retail competition and choice, it is important that lawmakers and regulators have a vision for who will sign long-term contracts to finance new generation
  - Competitive retail providers will generally try to avoid long-term contracts, because of uncertainty in long-term demand; generators typically need a longer-term contracts to obtain financing
  - CA and NY are still grappling with this tension – regulated utilities are signing some contracts on behalf of competitive retailers in CA; state agencies are signing long-term contracts in NY

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# Key Takeaways #6-9

- There are multiple contractual arrangements through which electricity sellers and buyers with long-term bilateral contracts can participate in spot markets.
- There are no simple regulatory formulas for setting long-term contracting requirements for regulated utilities
- Higher penetrations of solar and wind generation have increased the importance of a well-functioning spot market
- Forward, real-time balancing, and ancillary services markets are interactive; lack of consistent incentives across markets can create opportunities for gaming and reliability challenges

***Please read the Guidelines for more detail on each of these takeaways***


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# Thank You!

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Lakshmi Alagappan, Director (lakshmi@ethree.com)

# Developing Comprehensive Metering Regulations & Accounting Framework for Grid Connected Rooftop Solar Deployment in India

**Presentation to Technical Committee Forum of Regulators**

**October, 2018**

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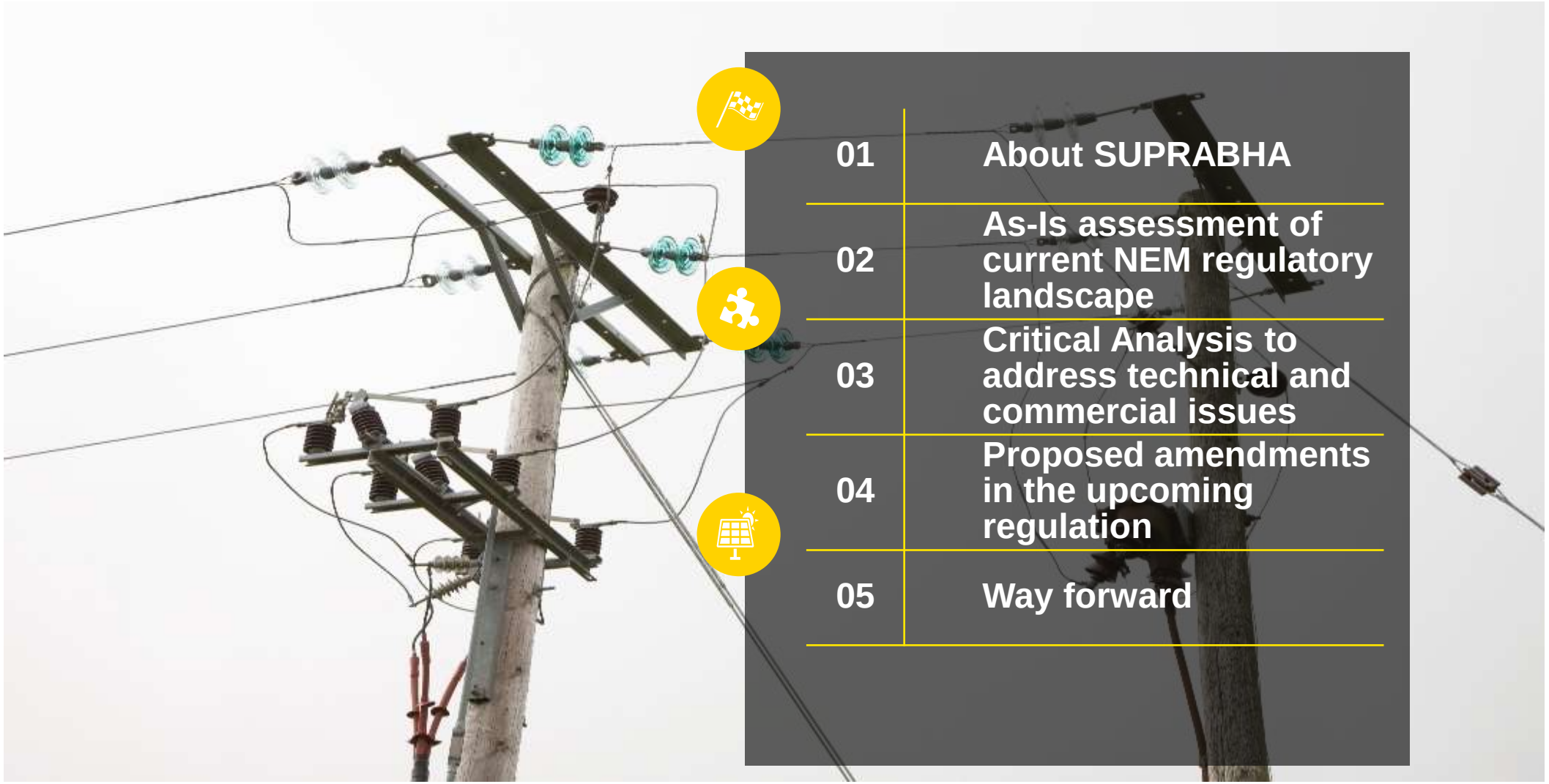

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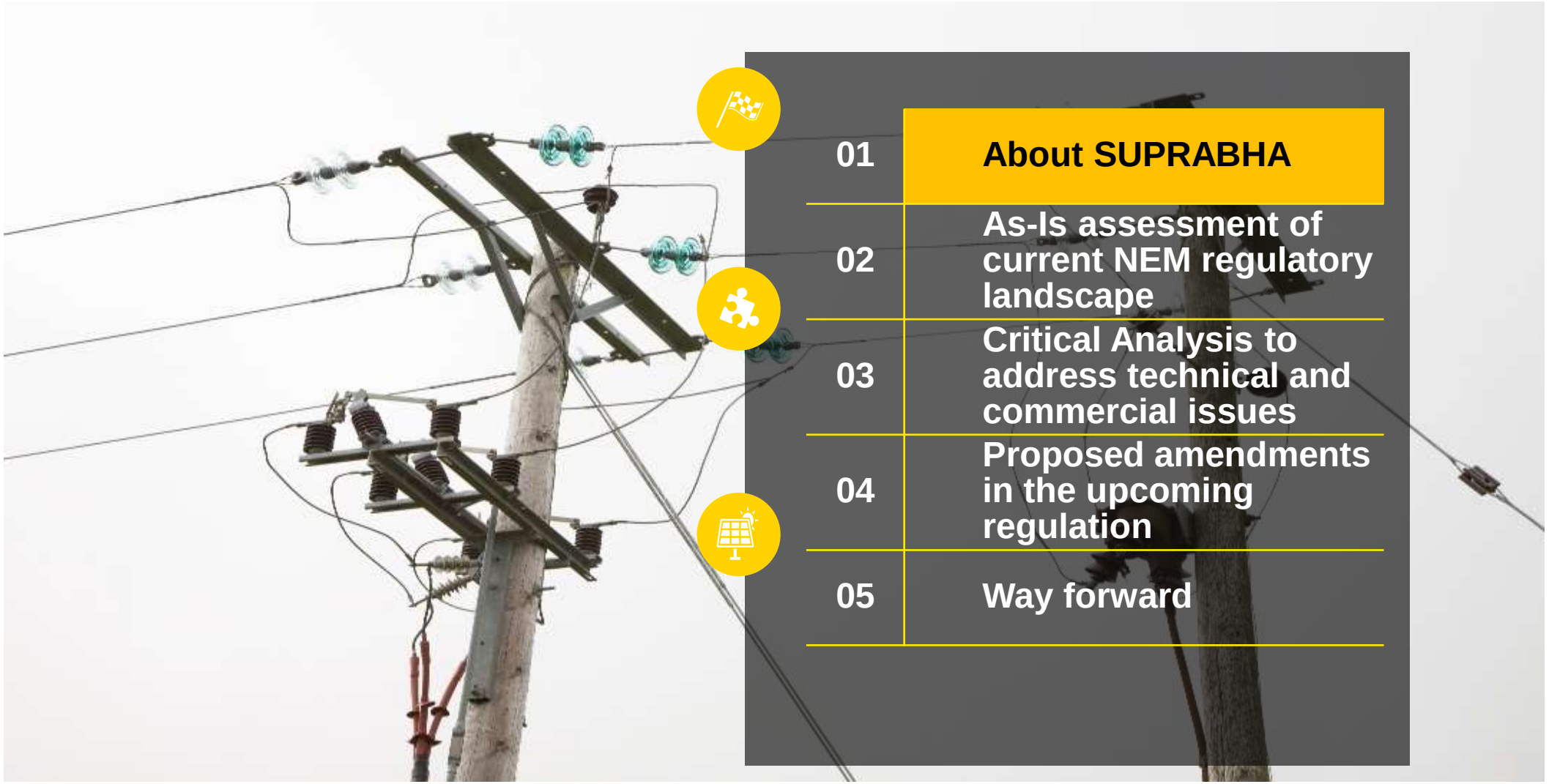


# The World Bank – SBI Grid Connected Rooftop Solar Photo Voltaic Technical Assistance Program

SUPRABHA

SUSTAINABLE PARTNERSHIP FOR
ROOFTOP SOLAR ACCELERATION IN BHARAT

# SUPRABHA Rooftop Solar TA Program

| Funding Body | Implementing Agency | Installation target |
|---|---|---|
| WORLD BANK GROUP | SBI | 600 MW GRPV |

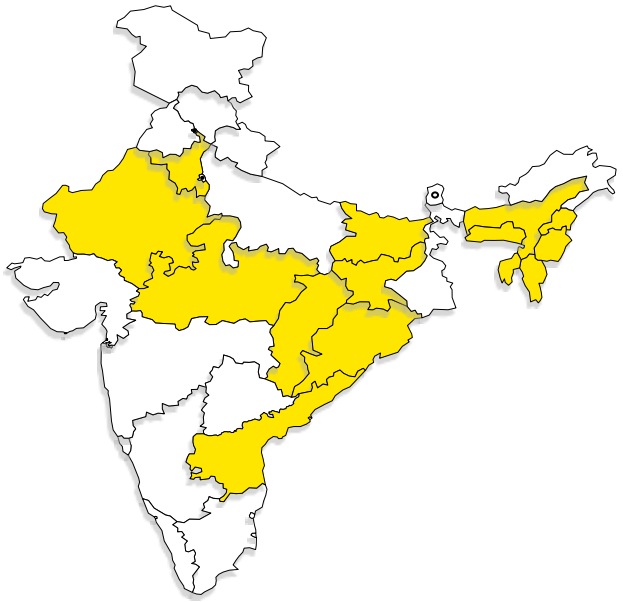
**Long Term Concessional Loan: USD 625 Million**
https://www.sbi.co.in/webfiles/uploads/files/SBI_WORLD_BANK.pdf

**Technical Assistance : USD 13 Million**
**www.suprabha.org**

## Stakeholders

- Residential Consumers
- Regulators & Distribution Companies
- Urban Local Bodies
- C&I Consumers
- Financial Institutions
- Entrepreneurs

## Coverage : 17 Indian states



- Jharkhand
- Bihar
- Orissa
- Chhattisgarh
- Rajasthan
- Haryana
- Madhya Pradesh
- Delhi
- Chandigarh
- Assam
- Nagaland
- Manipur
- Mizoram
- Tripura
- Meghalaya
- Sikkim
- Andhra Pradesh

### Interventions:

1. Policy & Regulatory
2. Capacity Building
3. SSN Knowledge Exchange
4. Media & Outreach
5. Process Streamlining
6. Demand Aggregation

# Structure of the SUPRABHA TA program

**Adoption of Synergetic design principles to gain impactful outcomes**

**Capturing Sectoral issues** → **Deliverables outlined in TA program** → **Development of activities / scope**

**Work Packages for Execution**

**PART 1**

1 Mobilization

2 Visioning Workshop and development of Project monitoring framework – Dashboard

**PART 2**

3 Policy & Regulatory

4 Capacity Building

5 SSN Knowledge Exchange

6 Media & Outreach

7 Process Streamlining

8 Demand Aggregation

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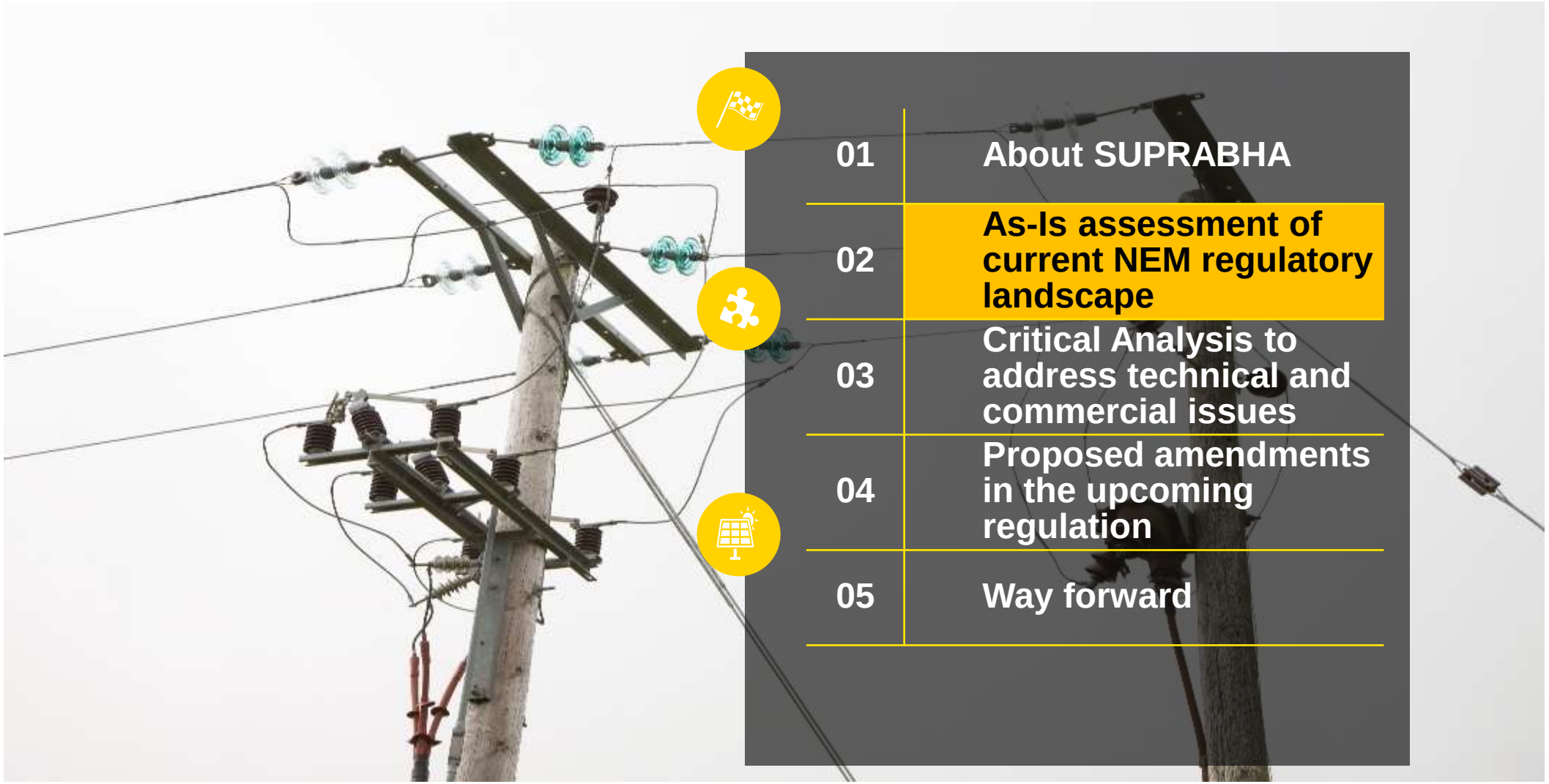


# Net Metering Regulation, 2013 - Highlights

| | |
|---|---|
| **Interconnection arrangements** | ▶Respective Commissions to decide the target capacity<br>▶No limit on individual capacity installed based on sanctioned load<br>▶Interconnection limit : up to **15% of the peak capacity** of the distribution transformer (DT)<br>▶Maximum installed capacity possible**: 1 MW** |
| **Energy accounting & commercial arrangements** | ▶Promotes self consumption<br>▶**No payment/credit Carry forward to consumer** for the excess electricity generated<br>▶Settlement period : Financial Year<br>▶ToD consumers: Excess generation treated as if occurred during off-peak hours |

# Net Metering Regulation, 2013 - Highlights

| | |
|---|---|
| **Metering** | ▶ MRI type meters<br>▶ Accuracy class – Net meter (1.0 or better), Solar meter (0.2)<br>▶ Check meter mandatory for above 20 KW GRPV systems |
| **Other regulatory provisions** | ▶ RPO: Benefit to DISCOM in case of non-obligated consumer<br>▶ Promotes CAPEX/ RESCO Model only; No scope for Utility Centric model<br>▶ Provision for setting higher capacity through alternative mechanisms |

Need for review:

- ▶ **Changing landscape** as higher capacities coming-up in India, available advanced metering and communication capabilities
- ▶ **Enabling regulatory framework** to support ambitious government targets and support relevant policies
- ▶ **Introducing new business models** to Improve GRPV penetration; based on international experience
- ▶ **Need of remunerative commercial arrangement** to increase consumer participation

# Adoption of NEM 2013 by States: Differences in state adoption in few key features

### Capacity Cap

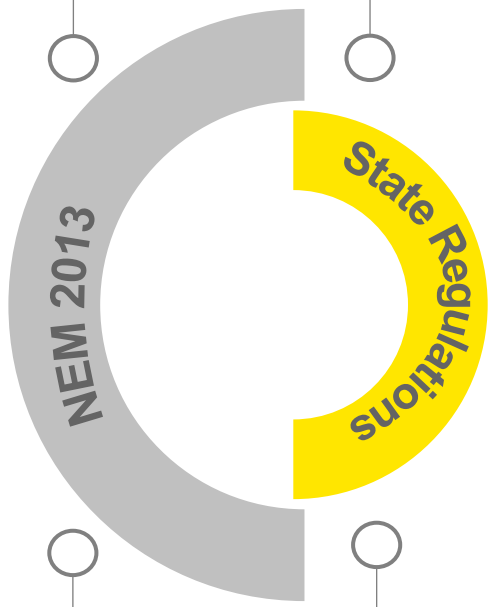
No cap in terms of sanctioned load

15% of  in terms of peak DT capacity

### Capacity Cap

40% to 100% in terms of sanctioned load

15% to 80%  in terms of peak DT capacity




### Maximum Capacity

1 MW  under net metering

### Maximum Capacity

1 MW and 500 KW under net metering

### Commercial Settlement

No payment or  carry forward in case excess generation

### Commercial Settlement

Some states followed NEM 2013, other wise @APPC or FiT

# As Is Assessment: Identification of key issues

| Sr. No. | Issues identified | Type |
|---|---|---|
| T-1 | Need for relaxing the maximum individual capacity that can be deployed based on sanctioned load | Technical |
| T-2 | Need for clarifying the interconnection limits on GRPV capacities connected to DT | Technical |
| T-3 | Need for provisioning for real time monitoring of solar generation and participation in system operations; required in case of large penetration of GRPV systems | Technical, grid stability & safety |
| C-1 | Need for accommodating newer business models available to consumer and developers, limited scope to DISCOMs in present scenario | Commercial |
| C-2 | Present PPA or connection agreement need additional aspects related to change in ownership and flexibility in existing PPA/connection agreement | Commercial |
| C-3 | Need for compensating for excess generation in present energy accounting and commercial settlement principles | Commercial |
| O-1 | Definition of premises and Solar roof-top PV systems needs review owning to future possibility of different scenarios | General definition & others |
| O-2 | Metering and communication requirements needs review to provide greater visibility on solar generation to DISCOMs and system operations | Communication, metering & safety |

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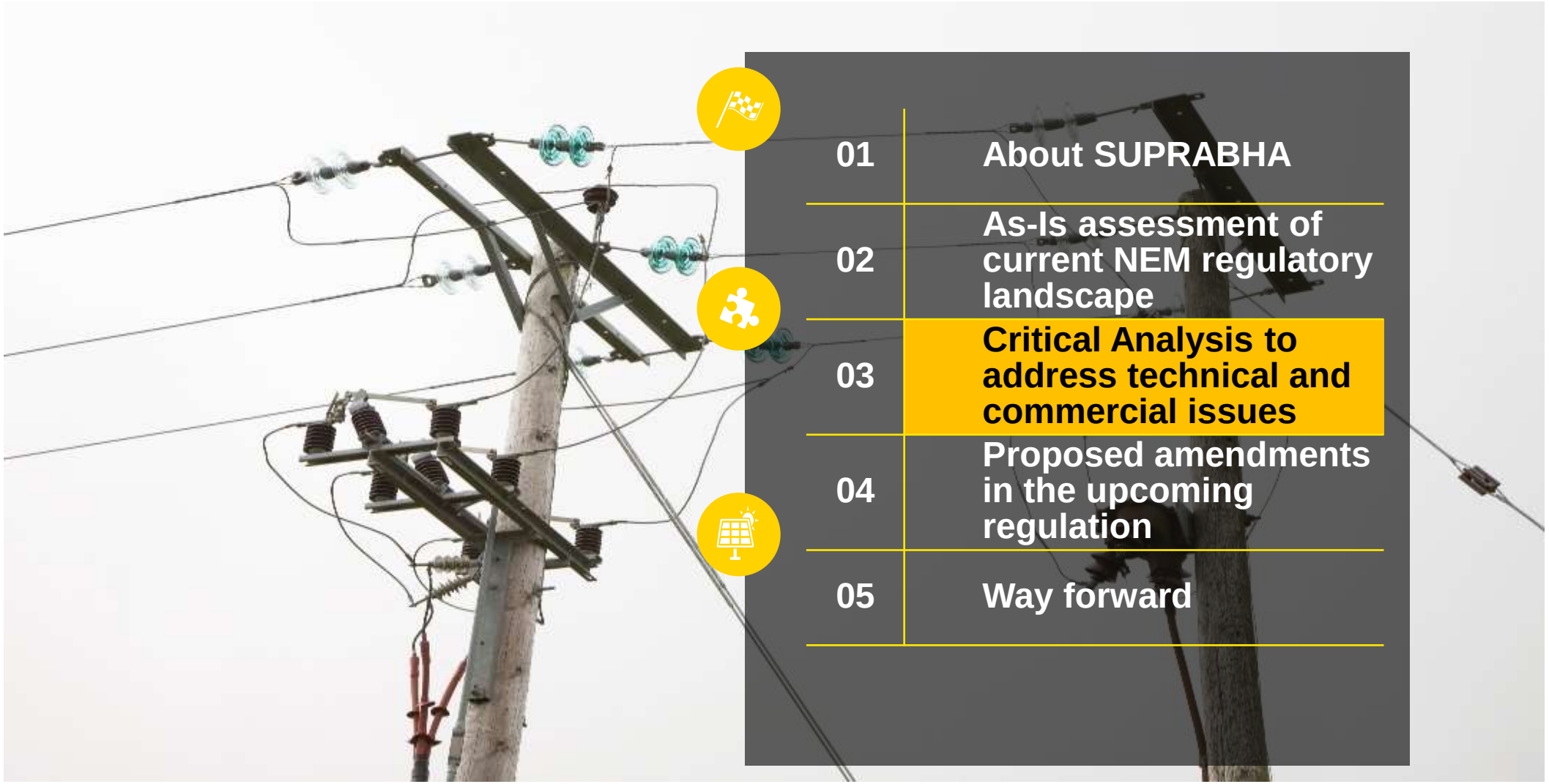
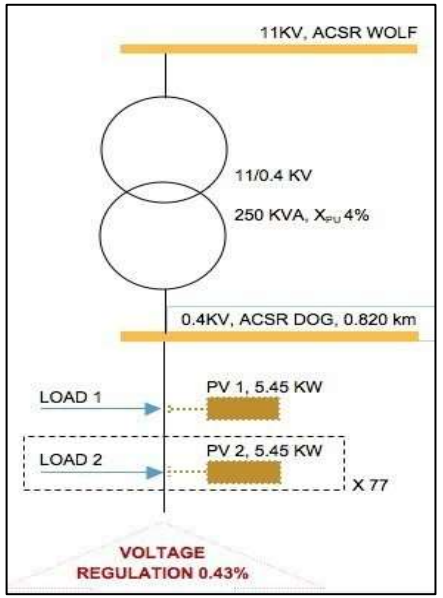


# Critical Analysis to address technical issues

- Technical study conducted to assess maximum aggregated capacity of solar PV rooftop plants that can be connected to grid without impacting system operation within existing control and infrastructure configuration
- Impact assessment considering two key limiting parameters
  - Feeder/Grid asset thermal capacity
  - Over-voltage at point of interconnection
- Simulation model to conduct maximum capacity under different scenarios:
  - Different voltage level (0.4KV, 11 KV and 33KV)
  - Different DT capacity
  - Different  loading conditions (rural, urban)




- If the installed PV capacity is limited to 100% of the sanctioned load, no limiting factors apply to the distribution element for 0 – 100 % DT loading.
- If the installed PV capacity exceeds the sanctioned load, the following will act as limiting factors
  - Thermal capacity of the feeder (in case the loads are equally distributed across the feeder)
  - Voltage rise (in case the PV are concentrated at farther end of the of the feeder)
  - Technically feasible to set up GRPV systems beyond 1 MW

# Critical Analysis to address Commercial issues

- Study of business models adopted in leading developed countries in solar rooftop deployment like Germany, USA, Canada and the settlement mechanism adopted
- Selection of business models based on following primary consideration
  - Responsibility of CAPEX
  - Responsibility of OPEX
  - Commercial Settlement
- Additional conditions considered for selection of business models
  - High Demand, Small roof
  - Multiple Beneficiaries
- Total 72 combinations developed and their operational feasibility evaluated

- Proposed Consumer centric and Utility centric business models and their respective accounting and settlement mechanisms be in the regulation
- Suggested 6 business models
  - Detailed cash flow analysis done for each model suggested
  - Benefit Analysis done for different stakeholders for each model suggested; Utility, Consumer and developer

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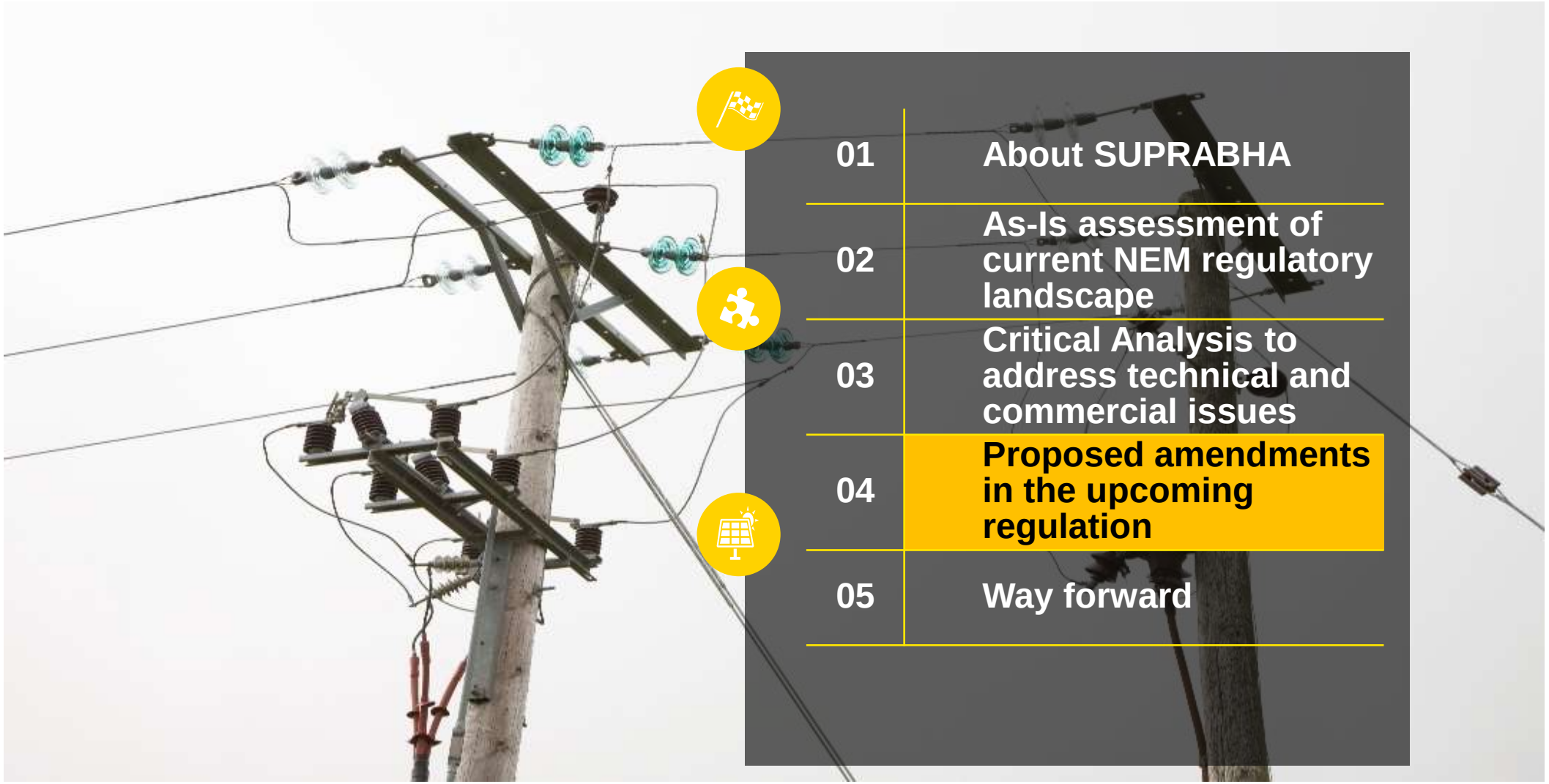


# New sections/Concepts proposed in the upcoming regulation

1

## New business models

Utilities might act as various type of facilitators such as RESCO, EPC contractor, demand aggregator, resulting in promotion of innovative business models

2

## Operational improvements

Consumer application to final system commissioning – the entire consumer interface with DISCOMs will be online through interactive portals

3

## Metering Arrangements

Net Metering , Net billing for Prosumer based system and Independent DRE system

4

## Government structure and institutional framework

DRE cell at DISCOMs, formation of DRE advisory committee , clarity in their role and responsibilities

5

## Promotion of distributed generation

Provisions related to RPO targets, incentive to DISCOMs to procure power from distributed generation

# Amendments proposed for T-1: Need for relaxing the maximum individual capacity that can be deployed based on sanctioned load

**Proposed changes in the model regulation:**

- For Prosumer owned DRE System (PDRES) - Individual project capacity not to exceed the sanctioned load/contract demand of the prosumer
- For Independent DRE System (IDRES) - Individual project capacity will be evaluated based on technical constraints
- Minimum system sizes for PDRES net metering & PDRES net billing will be 1 kW & 10 kW respectively where as minimum size for IDRES will be 50 kW

# Amendments proposed for T2: Need for clarifying the interconnection limits on GRPV capacities connected to DT

**Proposed change in the model regulation:**

- The cumulative capacity of distribution renewable energy systems allowed to be interconnected with the distribution network (feeder/ distribution transformer, owned by distribution licensee) shall not exceed 100% of the feeder and / or distribution transformer capacity, as applicable.

# Amendments proposed for T-3: Need for provisioning for real time monitoring of solar generation and participation in system operations; required in case of large penetration of GRPV systems

- For stable grid operation, visibility on solar generation (at least beyond certain capacity) required in case of large penetration of GRPV systems
- In future, the GRPV systems must also respond to system operation requirements

**Proposed change in the model regulation:**

- All meters shall have Advanced Metering Infrastructure (AMI) facility with RS 485 (or higher) communication port to connect future grid digitalization

# Amendments proposed for C-1: Need for provisions to accommodate business models available to consumer and developers, limited scope to DISCOMs in present scenario

**Proposed changes in the model regulation:**

- The distribution licensee may explore appropriate utility driven business models such as demand aggregation, distribution licensee as a RESCO or EPC, etc. to promote installations of distributed renewable energy in its area of supply.
- “Independent Distributed Renewable Energy System” or “IDRES” means a distributed renewable energy system set up by any person and is connected to the distribution licensee network and sells electricity to distribution licensee under Power Purchase Agreement;
- Additional definitions added like “ Prosumer” and “RESCO” to adopt different ownership options

# Suggested business models

| S. No. | Business model |
|---|---|
| **A. Consumer-centric** | |
| 1. | Consumer Owned (Cap-Ex model) |
| 2. | Third Party Owned (RESCO Model) |
| **A. Utility-centric** | |
| 3. | Consumer Owned (Utility only aggregates) |
| 4. | Consumer Owned (Utility aggregates and acts as EPC) |
| 5. | Third Party Owned (Utility aggregates and acts as trader between the RESCO and Consumer) |
| 6. | Third party Owned (Utility aggregates and acts as RESCO) |

# Benefit analysis in case of different business models (1/4)

| S. No | Model | Utility | Consumer | Developer |
|---|---|---|---|---|
| 1 | Consumer-owned model (Cap-Ex) | Reduced energy sale | EPC fees | Profit on EPC fee received |
| | | Benefits due to RPO, reduced procurement and lower AT&C losses | n*T | |
| | **Overall** | Utility revenue decreases. Benefits due to abovementioned factors. | Saves on electricity bill. Gains the asset | Gains revenue as EPC fee |
| 2 | Third-party owned (RESCO) model | Reduced energy sale | n(T-T') | EPC fees |
| | | Benefits due to RPO, reduced procurement and lower AT&C losses | | n*T' |
| | | | | |
| | **Overall** | Utility revenue decreases. Benefits due to abovementioned factors. | Saves on electricity bill. | Gains asset and revenue due to sale of service |

| Legend | |
|---|---|
| T | Grid tariff |
| T' | Discovered tariff |
| m | Total consumption (number of units) |
| n | Number of units of electricity consumed from the Rooftop Solar System |

# Benefit analysis in case of different business models (2/4)

| S. No | Model | Utility | Consumer | Developer |
|---|---|---|---|---|
| 3 | Consumer owned model (utility only aggregates) | Facilitation fees (assuming 2-3% of the total investment) | EPC fees | Profit on EPC fee received |
| | | Benefits due to RPO, reduced procurement and lower AT&C losses | n*T | Facilitation fees (assuming 2-3% of the total investment) |
| | | Reduced energy sale | | |
| | **Overall** | Utility loses revenue due to reduced sale, but makes revenue on facilitation fees. Other benefits due to abovementioned factors. | Lower cost of procurement due to economies of scale. CapEx model overall beneficial under the current regulations. | Gains revenue as EPC fee and saves on transaction cost. |

# Benefit analysis in case of different business models (3/4)

| S. No | Model | Utility | Consumer | Developer |
|---|---|---|---|---|
| 4 | Consumer Owned (Utility aggregates and acts as EPC) | Facilitation fees (assuming 2-3% of the total investment) | EPC fees | Profit on EPC Fee (after a margin cut) |
| | | % on back to back EPC agreements | n*T | p% on back to back EPC agreements |
| | | Loss of energy sale due to influx of rooftop solar | | Facilitation fees (assuming 2-3% of the total investment) |
| | | Benefits due to RPO, reduced procurement and lower AT&C losses | | |
| | **Overall** | Utility loses revenue due to reduced sale, but makes revenue on facilitation fee for aggregation and margin on back to back EPC contract. Other benefits due to abovementioned factors. | Lower cost of procurement due to economies of scale. CapEx model overall beneficial under the current regulations. | Gains revenue on EPC. Saves on transaction cost and gains payment security. |

# Benefit analysis in case of different business models (4/4)

| S. No | Model | Utility | Consumer | Developer |
|---|---|---|---|---|
| 5 | Third Party owned (Utility aggregates and acts as trader) | Loss of energy sale due to influx of rooftop solar | n(T-T') | EPC Fee |
| | | Facilitation fees (assuming 2-3% of the total investment) | | Facilitation fees (assuming 2-3% of the total investment) |
| | | % on all units of energy traded | | % on all units of energy traded |
| | | Benefits due to RPO, reduced procurement and lower AT&C losses | | Revenues from energy sale |
| | **Overall** | Utility makes revenues due to energy trading and facilitation fees for aggregation. Other benefits due to abovementioned factors | RESCO model beneficial due to no capital investment. Energy costs reduced. | Revenues due to energy sale. Low transaction costs and lower capital cost due to aggregated demand. Also, gains the asset. |
| 6 | Utility aggregates and acts as RESCO | EPC Fee | n(T-T') | |
| | | Revenue from energy sale (y*n) | | |
| | | Benefits due to RPO, reduced procurement and lower AT&C losses | | |
| | **Overall** | Utility makes revenue on energy sale to the consumers. Lower cost of procurement due to economies of scale. | RESCO beneficial due to no capital investment. Energy costs reduced. | Developer plays no role |

# Commercial impact of rooftop solar penetration on a DISCOM

For assessing the commercial impact of rooftop solar penetration on a DISCOM, an analytical tool capturing the actual revenue loss due to rooftop solar and the benefits due to RPO, reduced procurement and reduced losses has been developed.

**The tool captures**

- Consumer categories
- Existing and expected rooftop solar penetration
- Assumptions such as
  - Tariff escalation
  - Energy sales annual escalation
  - Average cost of supply and annual escalation
  - Distribution loss escalation
  - APPC escalation
  - RPO targets and RPO deficit
  - Solar EPC costs and other financials
  - Grid injection percentage (% energy injected by the rooftop solar system back into the grid)

**Outputs**

- Estimation of total revenues lost by the DISCOM due to rooftop solar penetration
- Estimation of benefits due to rooftop solar to the DISCOM
  - RPO benefits
  - Reduced AT&C losses
  - Overall reduced procurement
- Estimation of benefits due to rooftop solar to the DISCOM
- Overall loss / benefit for the utility considering the proposed business models

Snapshots of the model

# Case studies

Commercial impact of rooftop solar on two DISCOMs has been assessed – JBVNL (Jharkhand Bijli Vitran Nigam Limited) and BYPL (BSES Yamuna Power Limited, New Delhi) using the model. The two case studies are as follows

## Case Study 1 – Jharkhand - Jharkhand Bijli Vitran Nigam Limited

- In case of JBVNL, an **overall benefit of INR 1.3 Cr.** (**0.017% of the approved ARR**) for 2019 is observed. The overall benefit in case of JBVNL is due to the small difference between the APPC and the tariff charged. The overall benefit / loss has been computed by considering the revenue loss, RPO benefits, benefits due to reduced procurement and benefits due to reduced AT&C losses.

- Business Model 6 i.e. utility aggregates and acts as a RESCO; is the most commercially feasible model for the utility. Under Business Model 6, the PPA cost which leads to no commercial impact on the utility assessed. For JBVNL, it lies between **3.5-3.6 INR/kWh**

## Case Study 2 – New Delhi - BSES Yamuna Power Limited

- For BYPL, the overall loss due to rooftop solar is limited to INR 9.93 Cr. (**0.25% of the approved ARR**) for 2019. The overall benefit / loss has been computed by considering the revenue loss, RPO benefits, benefits due to reduced procurement and benefits due to reduced AT&C losses.

- The commercial impact of the abovementioned business models was also assessed. Business Model 6 i.e. utility aggregates and acts as a RESCO; is the most commercially feasible model for the utility. Under Business Model 6, the PPA cost which leads to no commercial impact on the utility assessed. For BYPL, the PPA cost lies between **5.8-5.9 INR/kWh**.

# Amendments proposed for C-2: Present PPAs/connection agreements need additional aspects related to change in ownership (1/2)

- In the wake of newer arrangements, associations (such as RWAs, etc.) may also set up GRPV systems definition of agreement needs to be widened within present legal framework
- As per EA 2003, a “person” shall refer to the eligible consumer, group of eligible consumers or any company or body, corporate or association or body of individuals, whether incorporated or not, or artificial juridical person;

**Proposed Change in the model regulation:**

- “Agreement” means an agreement entered into by the distribution licensee with the person;

# Amendments proposed for C-2: Present PPAs/connection agreements need additional aspects related to change in ownership (1/2)

**New definitions proposed in the model regulation:**

- "**Independent Distributed Renewable Energy System**" or "IDRES" means a distributed renewable energy system set up by any person and is connected to the distribution licensee network and sells electricity to distribution licensee under Power Purchase Agreement;
- "**Prosumer**" is a person who consumes electricity from the grid and can also inject electricity into the grid using same network from renewable energy system set up on consumer side of the meter.
- "**Renewable Energy Service Company (RESCO)**" means an energy service company which owns a renewable energy system and provides renewable energy to the consumer.

  Provided that the distribution licensee may act as a RESCO. However, this business shall be treated as other business of the distribution licensee.

# Amendments proposed for C-3: Need for compensating for excess generation in present energy accounting and commercial settlement principles

- Few states allowed compensation, though, at different rates

| State | Andhra Pradesh | Assam, Gujarat, Karnataka, Kerala, Madhya Pradesh, New Delhi, Telangana | Bihar, Tamil Nadu | Jharkhand, Uttar Pradesh |
|---|---|---|---|---|
| Treatment of excess energy in Net Metering | @ACoS | @APPC | @Tariff in force for that particular consumer | @INR 0.50/kWh |

**Proposed changes in the regulation:**

- Excess energy generated by PRDES to be settled at Average Power Purchase Cost for the year in which such excess energy is procured by the distribution license.
- The distribution licensee may undertake procurement of power from IDRES plants under Section 63 of the Act according to the prevailing bidding guidelines

# Amendments proposed for O-1: Definition of premises and Solar roof-top PV systems needs review owning to future possibility of different scenarios

**Proposed changes in the regulation:**

- Definition of premises is retained as per the EA 2003
- New definitions of Prosumer Distributed Renewable Energy System (PDRES) and Independent Distributed Renewable Energy System (IDRES)
- Individual capacity restricted based on sanctioned load for PDRES system
- Individual project capacity to be evaluated based on technical constraints for IDRES system

# Amendments proposed for O-2: Metering & communication requirements need review to provide greater visibility on solar generation to DISCOMs and system operations

| Aspects | Proposed Dispensation | Remarks |
|---|---|---|
| Metering | • Meters to have AMI facility (RS 485 or higher communication port | • Required to monitor generation<br>• Monitoring and reporting framework to be part of the model Regulations |
| Solar Generation meter | • Mandatory for all the systems | • RPO accounting for DISCOMs |
| Cost of Meters | • To be borne by consumer | • N.A. |
| New Consumer applying both electricity connection and DRE system | • Allowed | • N.A. |

# Proposed Structure of the new regulation(1/2)

| | |
|---|---|
| **Part — A**<br>**Preliminary** | • Short title, and commencement<br>• Definition and interpretations<br>• Scope and applicability<br>• Control Period<br>• Web based application processing system<br>• Monitoring and reporting framework |
| **Part — B**<br>**Renewable Purchase Obligation** | • General Principles |
| **Part — C**<br>**Technical Standards and Safety, Metering Infrastructure** | • Interconnection with the grid: Technical standards and safety<br>• Metering Infrastructure |
| **Part — D**<br>**Net Metering and Net Billing Arrangement** | • Prosumer and project capacity<br>• Net Metering Arrangement<br>• Net Billing Arrangement<br>• Role of the Distribution Licensee<br>• Hosting Capacity:<br>• Interconnection Point<br>• Application Process and Procedure<br>• Energy Accounting – Net Metering/ Net Billing |

# Proposed Structure of the new regulation(2/2)

| | |
|---|---|
| **Part — E**<br>**Independent Distributed Renewable Energy Systems** | • Eligibility and project capacity<br>• Role of the Distribution Licensee<br>• Interconnection Point |
| **Part — F**<br>**Governance Structure, institutional framework, roles and responsibilities** | • Roles of Stakeholders<br>• DRE Advisory Committee<br>• Distributed Renewable Energy Cell |
| **Part — G**<br>**Miscellaneous** | • Penalty or Compensation<br>• Power to give directions<br>• Power to relax<br>• Power to amend<br>• Power to Remove Difficulties<br>• Repeal and Savings |

# Salient Features of Net Metering ….. (1/2)

- The prosumer may **set up distributed renewable energy system** to **offset the prosumer's electricity consumption from the distribution licensee**.
- The **distribution licensee shall** procure **any excess energy generated by PDRES at Average Power Purchase Cost for the year** in which such excess energy is procured by the distribution licensee.
- In case, the **electricity injected by the renewable energy system exceeds the electricity consumed** during the billing period, such **excess injected electricity shall be carried forward to the next billing period** as excess electricity and may be utilized in the following billing periods but within the same settlement period;
- In case, the **electricity supplied by the distribution licensee** during any billing period **exceeds the electricity injected in the grid by the PDRES,** the **distribution licensee shall raise bill for the net electricity** consumption after taking into account any excess electricity carried forward from the previous billing period;



PDRES: Prosumer Distributed Renewable Energy System

# Salient Features of Net Metering ….. (2/2)

- In case the prosumer is under the **ambit of Time of Day Tariff**, following process shall be followed:
  - **Electricity consumption in any time block** (e.g., peak hours, off-peak hours, etc.) shall be **first compensated with the electricity generation** in the **same time block**.
  - Any **excess generation over consumption** in any time block in a billing cycle shall be accounted as if the excess generation occurred during immediately lower tariff time block. This process will continue till all consumption in lower tariff blocks is set off against PDRES generation.
  - Any excess generation after setting off consumption in lower tariff time blocks would be carried forward to the next billing cycle.
- Regardless of availability of excess electricity with the prosumer during any billing period, the consumer will continue to pay all other charges such as fixed/demand charges, Government levy, etc.
- The PDRES shall be exempted from all wheeling, cross subsidy, transmission and distribution, and banking charges and surcharges.



PDRES: Prosumer Distributed Renewable Energy System

# Salient Features of Net Billing Arrangement ….. (1/2)

- The prosumer may **set up distributed renewable energy system to offset the prosumer's electricity purchase** bill from the distribution licensee.
- Net billing is the arrangement where DRE Plant is:
  - Installed to serve a specific consumer,
  - Connected on utility side on the consumer meter,
  - Selling power to distribution licensee under Power Purchase Agreement,
  - Entire power is consumed by the consumer
- The distribution licensee **shall enter into Power Purchase Agreement** at **tariff to be determined by the Commission.**
- **Entire quantum of electricity** generated by the DRE plant shall be procured by the distribution licensee.
- The distribution licensee shall enter into **Power Sale Agreement with the consumer** for sale of entire quantum of power generated by the relevant DRE plant.



PDRES: Prosumer Distributed Renewable Energy System

# Salient Features of Net Billing Arrangement ….. (2/2)

- Rate of **sell of power to the consumer** shall be the same rate as **determined by the Commission for procurement of power from DRE Plant**.
- The **distribution licensee** shall **give credit to the consumer by billing the consumer at the tariff** determined by the Commission.

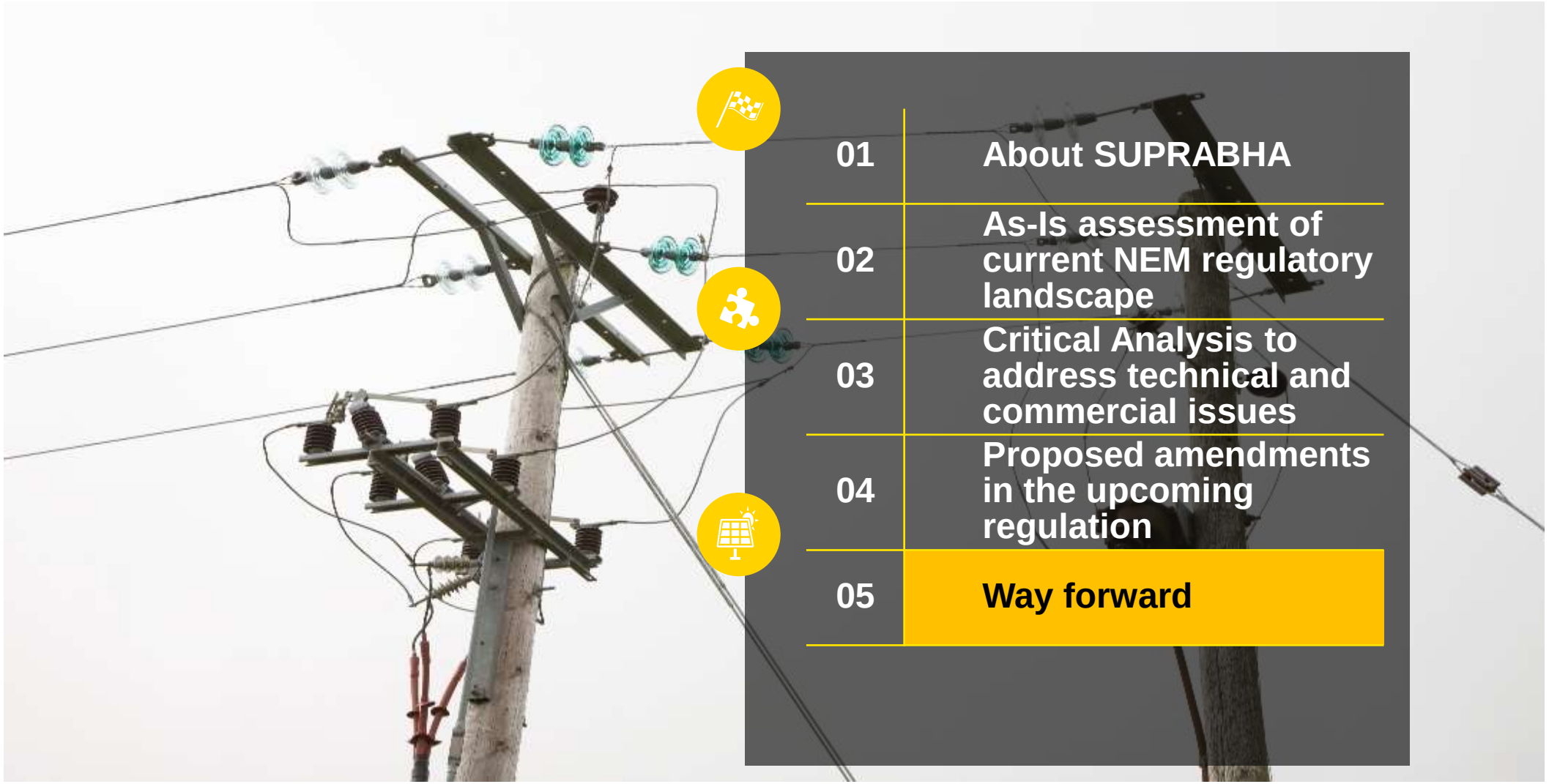
$$\textit{Energy Bill of Consumer} = \textit{Fixed charges + other applicable charges and levies} + (E_{DL} * T_{RST}) - (E_{RE} * T_{PSA}) - \textit{Billing}_{Credit}$$

Where:

- $E_{RE}$ means the energy units recorded for the billing period by the DRE Plant's generation meter;
- $T_{PSA}$ means the energy charges as per the energy sale agreement signed between the consumer and distribution licensee;
- $E_{DL}$ means the energy units supplied by the distribution licensee over and above the $E_{RE}$ for the billing period;
- $T_{RST}$ means the applicable retail supply tariff of the concerned consumer category as per the retail supply Tariff Order of the Commission;
- Billing credit is the amount by which value of DRE generation in a particular month is more than value of all other components of consumer bill

- In case, ( $E_{RE} * T_{PSA}$) is more than (Fixed charges + other applicable charges and levies + ($E_{DL} * T_{RST}$)), utility shall give credit of amount equal to difference (Billing Credit) and the same shall be carried forward to next billing cycle.

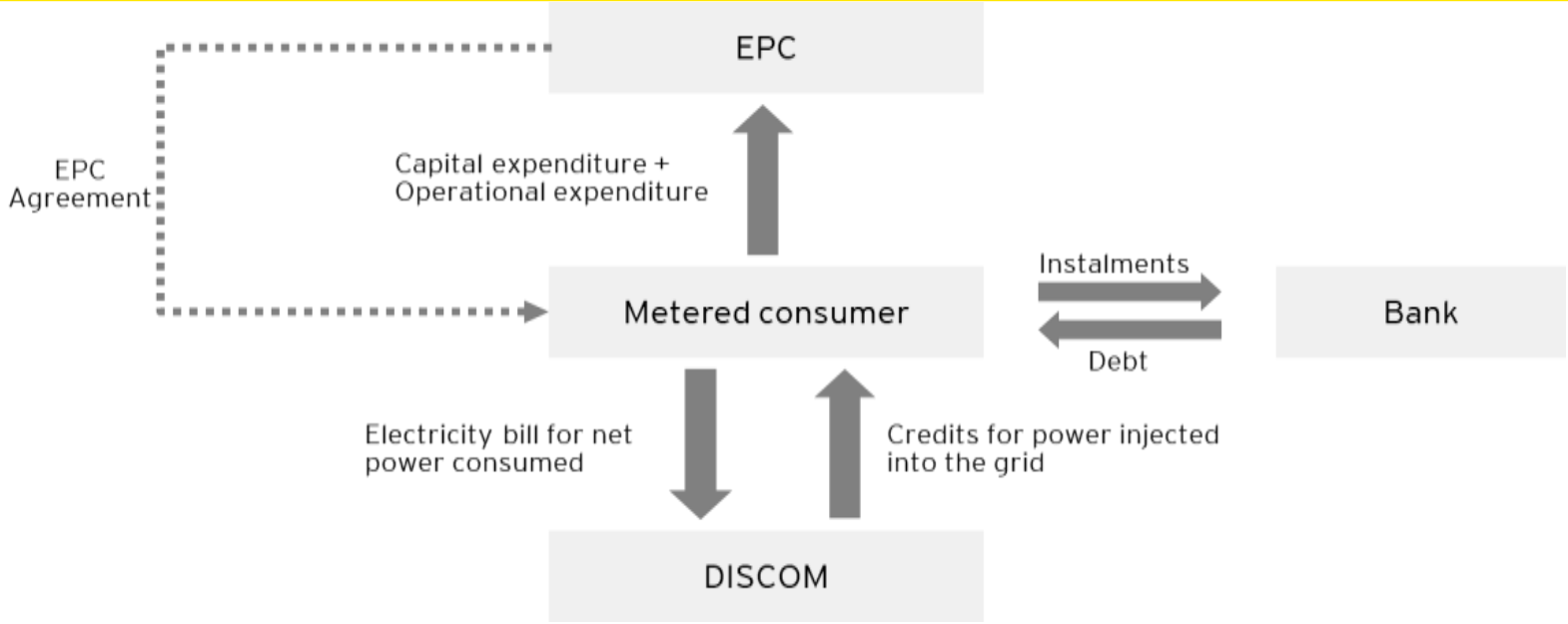
# Contents



# Way-forward

- Solicit comments from Technical Committee on the gaps identified and the suggested business models
- Solicit comments from Technical Committee on draft regulation
- Incorporation of Technical Committee comments in the draft regulation
- Present before the next FOR meeting
- Release final model regulation by FoR after incorporating the changes proposed in the FOR meeting

# 1. Consumer – owned model (Cap – Ex)



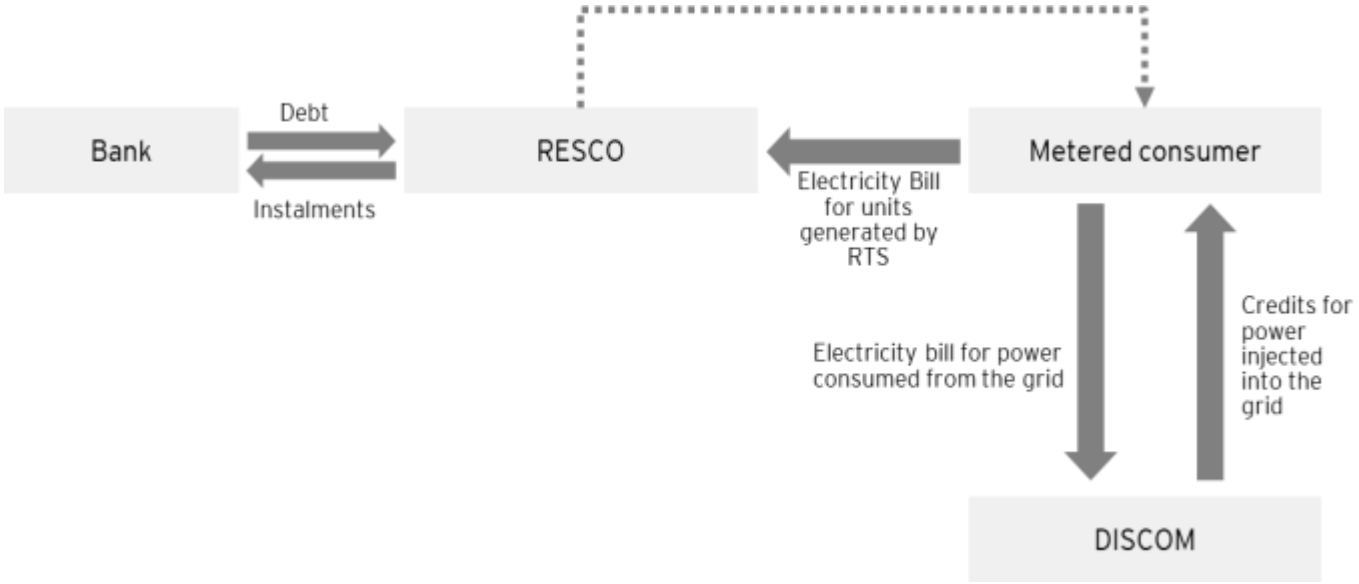

## Benefits

- Consumer completely owns the asset (rooftop solar system)

## Drawbacks

- Consumer faces an upfront capital expenditure
- Operation and maintenance expenditure

# 2. Third-party owned (RESCO) model




## Benefits

- No upfront capital expenditure for the consumer
- Operation and maintenance is performed by the RESCO

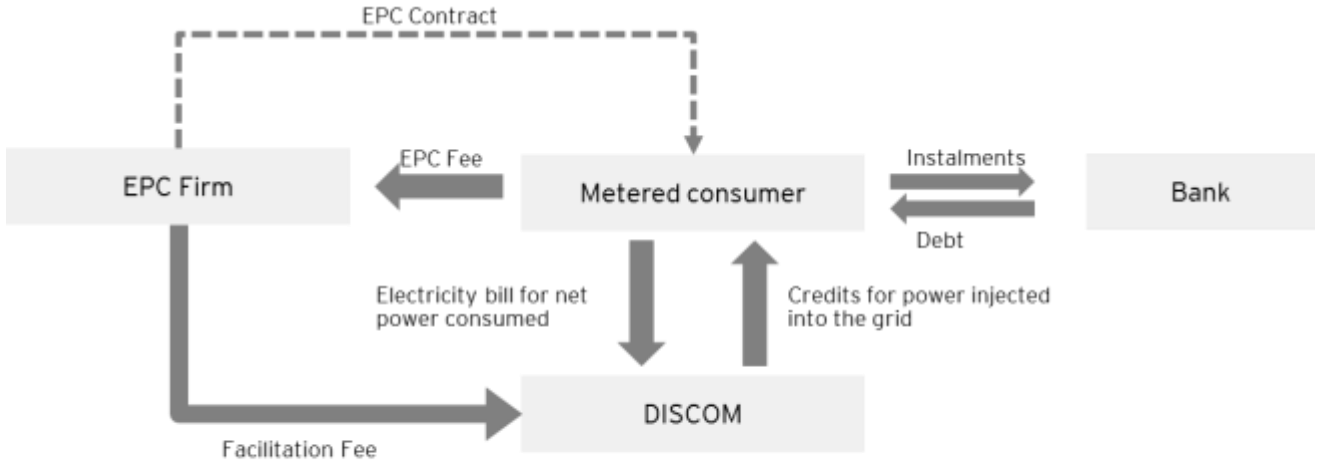
## Drawbacks

- Payment default risk exists for the RESCO



Business models - main

# 3. Consumer Owned (utility only aggregates)



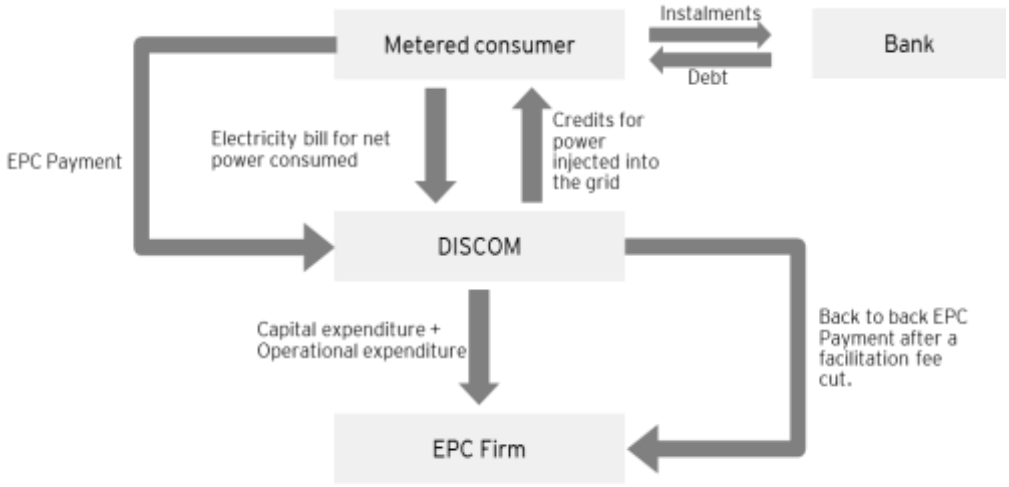

## Benefits

- Single-window portal for the consumer for installation of rooftop solar
- Reduced EPC costs due to economies of scale and competition amongst EPC providers
- Streamlined interconnection process due to continued involvement of the utility through the installation stage
- Verified quality of the installed systems due to setting up of procurement standards
- Reduced financing costs due to lower risks

## Drawbacks

- Upfront capital expenditure is required from the consumer
- Payment default risk for the lender

# 4. Consumer Owned (Utility aggregates and acts as EPC)



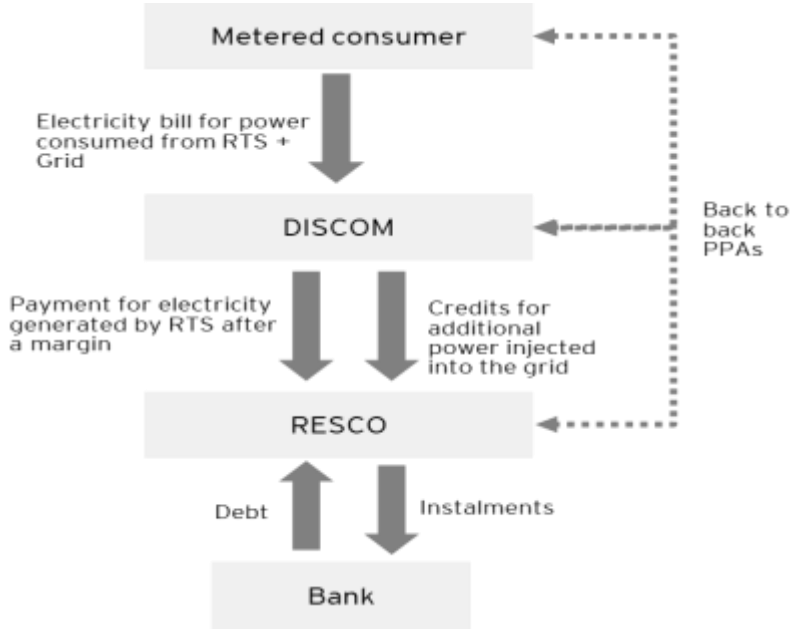

## Benefits

- Single-window portal for the consumer for installation of rooftop solar
- Improved service experience for the consumer due to project management by the utility
- Reduced EPC costs due to economies of scale and competition amongst EPC providers
- Streamlined interconnection process due to continued involvement of the utility through the installation stage
- Verified quality of the installed systems due to setting up of procurement standards
- Securitised payments to the EPC providers
- Reduced financing costs due to lower risks

## Drawbacks

- Upfront capital expenditure is required from the consumer
- Payment default risk for the lender

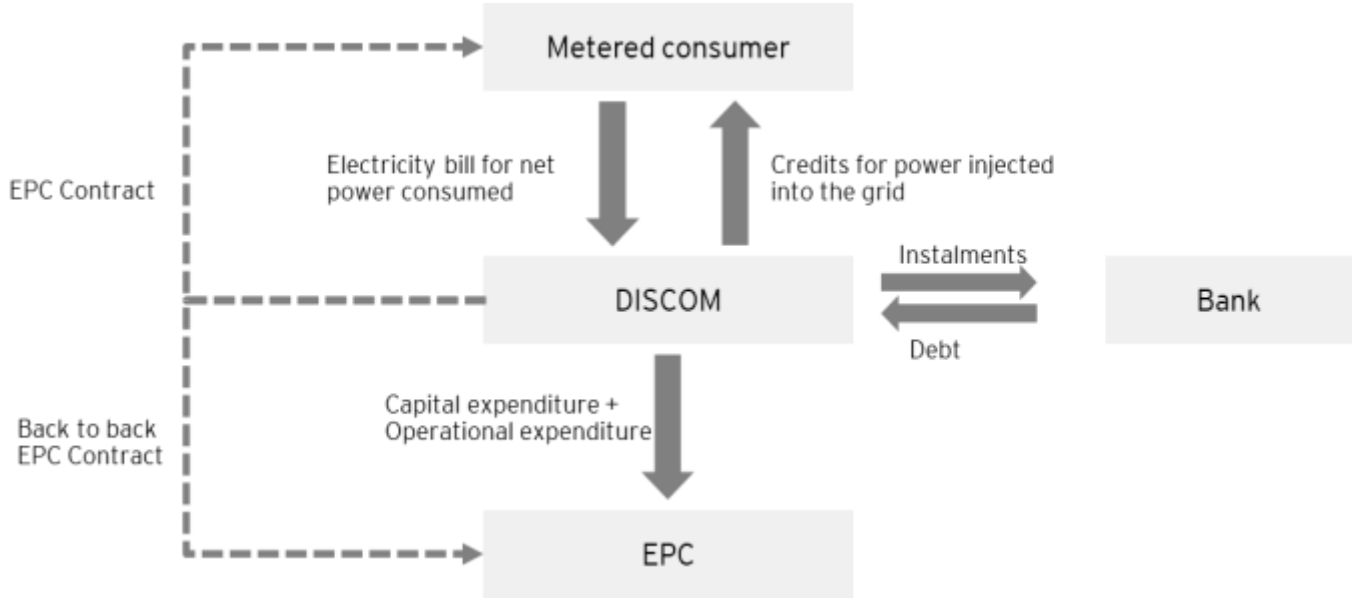
# 5. Utility aggregates and acts as trader between RESCO and consumer




## Benefits

- Single-window portal for the consumer for installation of rooftop solar (including finance).
- Reduced finance costs due to economies of scale, lower risk profile due to utility involvement and lower transaction costs.
- Securitised payments to the financiers and the RESCO.
- Reduced financing costs due to lower risks.

# 6. Utility aggregates and acts as RESCO




## Benefits

- Single-window portal for the consumer for installation of rooftop solar (including finance).
- Reduced finance costs due to economies of scale, lower risk profile due to utility involvement and lower transaction costs.
- Securitised payments to the financiers and the RESCO.
- Reduced financing costs due to lower risks.

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MINISTRY OF NEW AND RENEWABLE ENERGY

SUPRABHA
SUSTAINABLE PARTNERSHIP FOR ROOFTOP SOLAR ACCELERATION IN BHARAT

# Thank you


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EY

GSES

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EVI

Idam

Edelman

# A few business model options for uptake of rooftop solar have been developed

**Primary considerations based on three parameters**

- Ownership – the Party which incurs capital expenditure –
  - 3 options: Utility/Consumer/RESCO
- Operational Expenditure Responsibility – the Party with incurs operation expenditure
  - – 3 options: Utility/Consumer/RESCO
- Settlement – the Party with which settlement is done –
  - 2 options: Utility/RESCO

**Two more conditions**

- ‘High Demand, Small Roof’ – One or more facility with higher load and non-availability of rooftop space or, one or more facility with lower load and availability of ample rooftop space
- ‘Multiple Beneficiaries’ – multiple beneficiaries of the same rooftop solar plant

A total of 3x3x2x2x2 = 72 combinations

# Of the 72 combinations, the following six were shortlisted based on operational feasibility

- **Business models shortlisted**
  1. Consumer Owned (Cap-Ex model).
  2. Third Party Owned (RESCO Model).
  3. Third Party Owned (Utility aggregates acts as trader)
  4. Utility aggregates and acts as RESCO

- **Additional identified business models**
  1. Consumer Owned model (utility only aggregates)
  2. Consumer Owned (Utility aggregates and acts as EPC)

# Assumptions for cash flow analysis

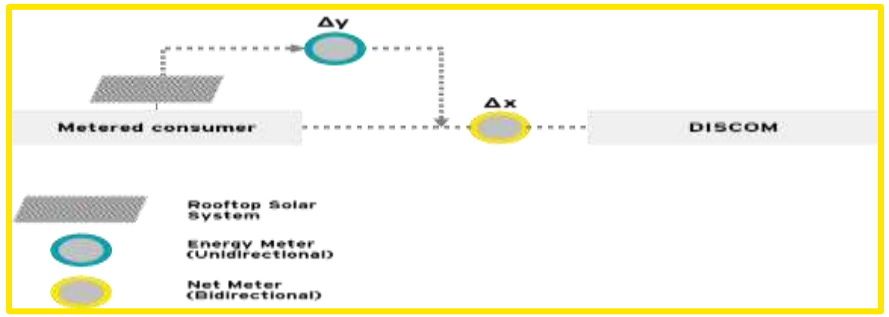
- **Business as usual (hereinafter referred to as BAU)**
  - Assumptions
  - No rooftop solar installation
  - Total consumption in the billing period – 200  kWh
  - Monthly consumer electricity bill – 200 kWh x 10 INR / kWh = INR 2000
- **Rooftop solar system installed**
  - System Capacity – 1 kW
  - Number of units generated per day – 5 kWh
  - Settlement period – 30 days
  - Total consumption in the settlement period – 200 kWh
  - Total generation by the rooftop solar plant in the settlement period – 150 kWh (5X30)
  - Grid tariff – 10 INR / kWh
  - PSA tariff – 8 INR / kWh
  - PPA tariff – 7 INR / kWh
  - Utility trading margin – 1 INR / kWh

- **Therefore**

| | Net Metering | Net Billing |
|---|---|---|
| $\Delta x$ | 50 | 200 |
| $\Delta y$ | 150 | 150 |

# 1. Consumer owned model (Cap – Ex)

## Net Metering Arrangement




Assuming that

- xn – Net meter reading for month “n”
- yn – Energy meter reading for month “n”
- Δx – Number of units (kWh) consumed from the grid i.e. xn – xn-1
- Δy – Number of units (kWh) generated by the rooftop solar plant
- T – Grid tariff

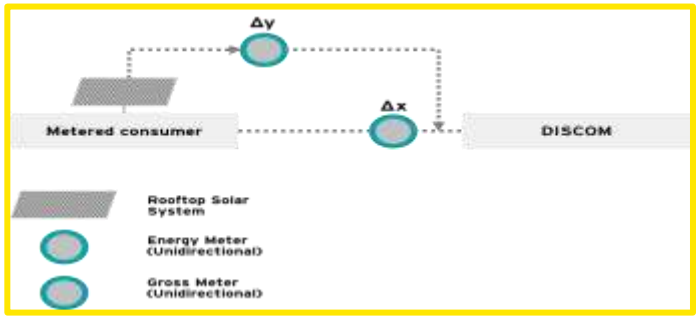
**Electricity bill = Fixed charges + Δx*T**

| | Case 1 (BAU) | | Case 2 | | |
|---|---|---|---|---|---|
| | Cash inflow | Cash outflow | Cash inflow | Cash outflow | Profit / loss as compared to base case |
| **Utility** | 200 kWh X 10 INR / kWh = 2000 INR | | 50 kWh x 10 INR / kWh = 500 INR | | Loss of INR 500 - 2000 = - INR 1500 |
| **Consumer** | | 200 kWh X 10 INR / kWh = 2000 INR | - | 1.50 kWh x 10 INR / kWh = 500 INR<br><br>2.Operation & maintenance expenditure (hereinafter referred to as OME) | Savings of INR 2000 – (500 + OME) |

| | Revenue | Expenditure |
|---|---|---|
| **Consumer** | | EPC fees |
| **EPC** | EPC fees | |

# 1. Consumer owned model (Cap – Ex)

## Net Billing Arrangement




Assuming that

- xn – Gross meter reading for month “n”
- yn – Energy meter reading for month “n”
- Δx – Total number of units (kWh) consumed i.e. xn – xn-1
- Δy – Number of units (kWh) generated by the rooftop solar plant
- T – Grid tariff
- T’ – Net Billing tariff

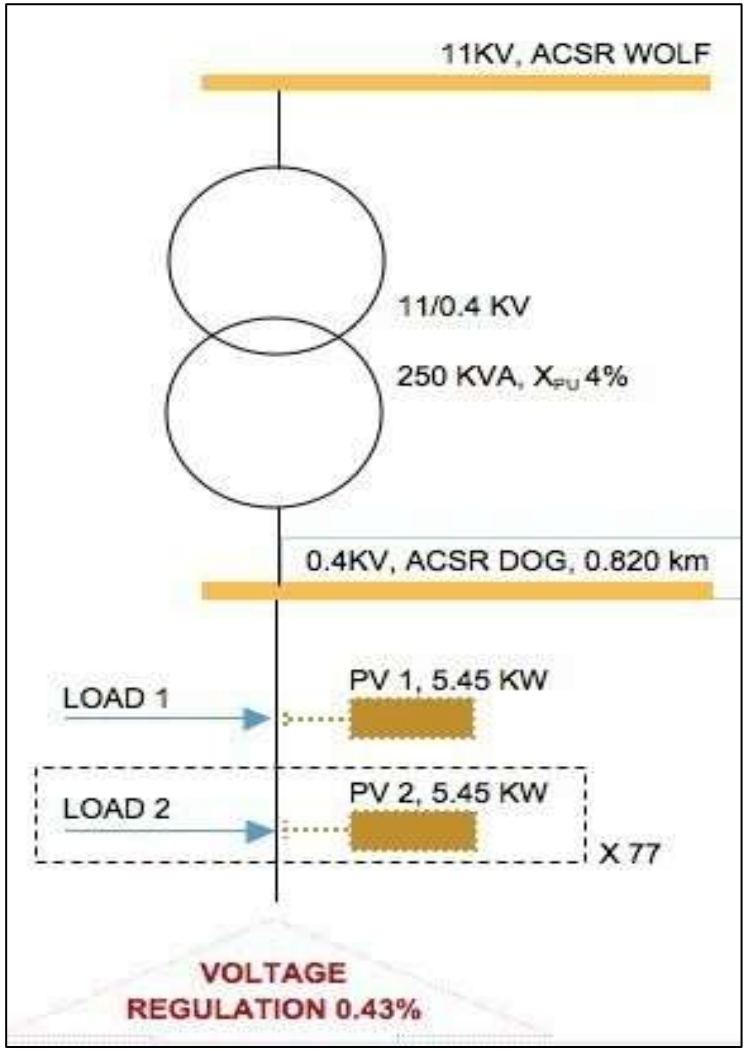
**Electricity bill = Fixed charges + Δx*T - Δy*T’**

| | Case 1 (BAU) | | Case 2 | | |
|---|---|---|---|---|---|
| | Cash inflow | Cash outflow | Cash inflow | Cash outflow | Profit / loss as compared to BAU |
| **Utility** | 200 kWh x 10 INR / kWh = 2000 INR | | 200 kWh x 10 INR / kWh = 2000 INR | 150 kWh x 8 INR / kWh = 1200 INR | Loss of INR (2000 – 1200) – 2000 = -1200 INR |
| **Consumer** | | 200 kWh x 10 INR / kWh = 2000 INR | 150 kWh x 8 INR / kWh = 1200 INR | 1.200 kWh x 10 INR / kWh = 2000 INR<br><br>2.OME | Savings of INR (1200 – 2000 – OME) + 2000 = INR 1200 – OME |

| | Revenue | Expenditure |
|---|---|---|
| **Consumer** | | EPC fees |
| **EPC** | EPC fees | |

# System Study to assess maximum hosting capacity

- System study to assess maximum aggregated capacity of solar PV rooftop plants that can be connected to grid without impacting system operation within existing control and infrastructure configuration
- Impact assessment considering two key limiting parameters
  - Feeder/Grid asset thermal capacity
  - Over-voltage at point of interconnection
- Simulation model to conduct power flow analysis under different scenarios:
  - Different voltage level (0.4KV, 11 KV and 33KV)
  - Different DT capacity
  - Different  loading conditions (rural, urban)



# To provide recommendations to the regulations the impact of excess rooftop solar generation on the grid has been assessed

## Load flow study

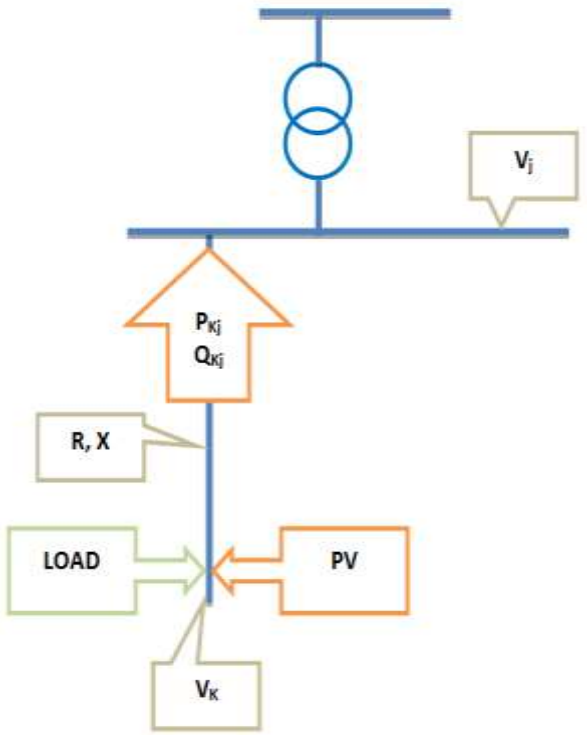
1. Reverse Power Flow will occur when Solar PV Generation goes beyond minimum running load (at consumer's place).

2. When such scenario occurs, Reverse Active Power 'Pkj' and Reverse Reactive Power 'Qkj', will enter into the Grid, and start feeding the neighbouring consumers.

3. If all loads are fed, the 'Pkj' and 'Qkj' will enter the 11 KV, through 'Distribution Transformer' itself, to feed the neighboring DTs, through 11 KV.

The basic equation to define Reverse Power Flow is -

**Reverse Power Flow ($P_{reverse}$) = $P_{PV\ max}$ - $P_{LOAD\ min}$**




**11/0.4 KV FEEDER BLOCK DIAGRAM**

# Reverse Power Flow: Grid Asset(s) Loading How and Consequences

## Load flow study

- When Photovoltaic generation exceeds ‘Minimum Running Load’, the excess generated KVA enters into the grid, to feed the neighboring consumers.

PV GENERATION > ‘MINIMUM RUNNING LOAD’, INVERTER INJECTS BACK INTO GRID

**CONSEQUENCES**

**1. Excess heating of Grid Asset(s).**

**2. Reduced life of Transformers.**

**3. Permanent failure of Power Cables.**

**4. Worst - Grid Asset(s) Burnout**

- During Injection, if Inverter's reverse current exceeds the Asset(s) rated amperage, the above mentioned points could be the outcome.

# Reverse Power Flow: Feeder Voltage Rise How and Consequences

## Load flow study

- When Photovoltaic generation exceeds ‘Minimum Running Load’, the excess generated KVA enters into the grid, to feed the neighboring consumers.

PV GENERATION > ‘MINIMUM RUNNING LOAD’, INVERTER INJECTS BACK INTO GRID

**CONSEQUENCES**

**1. Stress on Grid Asset(s) Insulation, such as that of Transformers and Power Cables.**

**2. Damage to Electronics, and other Voltage Sensitive equipments, at consumer’s places.**

**3. Again, heating of Grid Asset(s).**

- With Injection, goes up the Voltage.
- Even with 5% Injection, Voltage rises notably.
- Voltage Regulation (VR) must be less than 8.43%, always.

# Case Study 1: 0.4KV Feeder and 63KVA DT at Ranchi

**INPUTS**

**LV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 63.00 | KVA |
| Station Primary Voltage: | 11000.00 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 0.17% | |
| Enter Station Overloading: | 0.00% | |
| Enter Safety Factor (on Station running capacity): | 0.00% | |
| Enter Margin Factor (on Voltage regulation): | 100.00% | |
| Enter PV Penetration: | 100.00% | |
| PV Installed Capacity: | 63.00 | KW |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Fac | 0.98 | |
| Enter Load Quantity: | 1 | |
| Enter Running Load: | 0.11 | KVA |
| Enter Feeder Resistance R | 0.250 | Ω/km |
| Enter Feeder Reactance X | 0.050 | Ω/km |
| Enter Feeder Length: | 0.100 | km |

**PV Inverter Data**

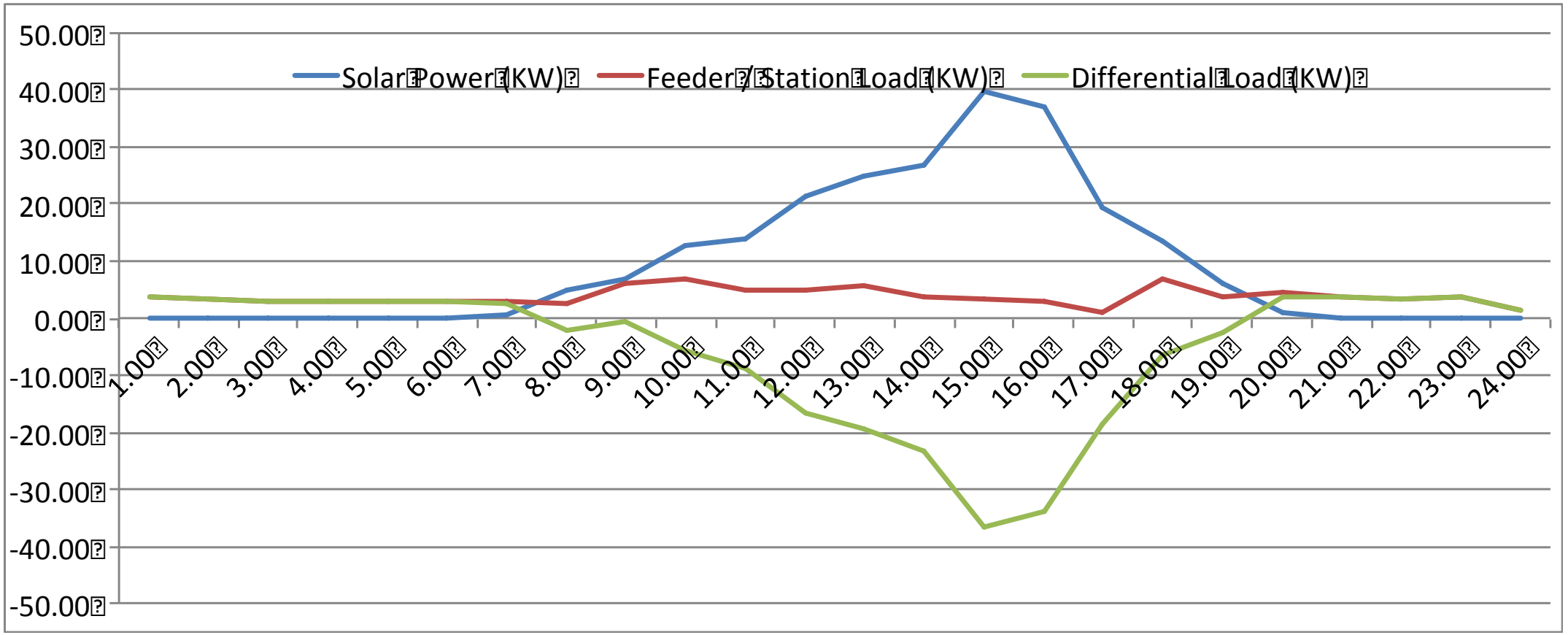
| | |
|---|---|
| Operating Power Fact | 1.00 |
| Select Operating Mod | Overexcited (lead) |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 63.00 | KVA |
| Peak PV Generation (KW): | 63.00 | KW |
| Peak PV Generation (KVAr): | 0.00 | KVAr |
| Running Load Consumption (W): | 107.80 | W |
| Running Load Consumption (VAr): | 21.89 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 62892.20 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| **Feeder End Voltage:** | 418.79 | V |
| Feeder End Voltage Rise: | 0.91% | |
| Acceptable: | Yes | |
| **Feeder Running Load:** | 86.71 | A |
| **Feeder Ampacity:** | 87.65 | A |
| Loading on Grid Assets: | 98.93% | |
| Acceptable: | Yes | |

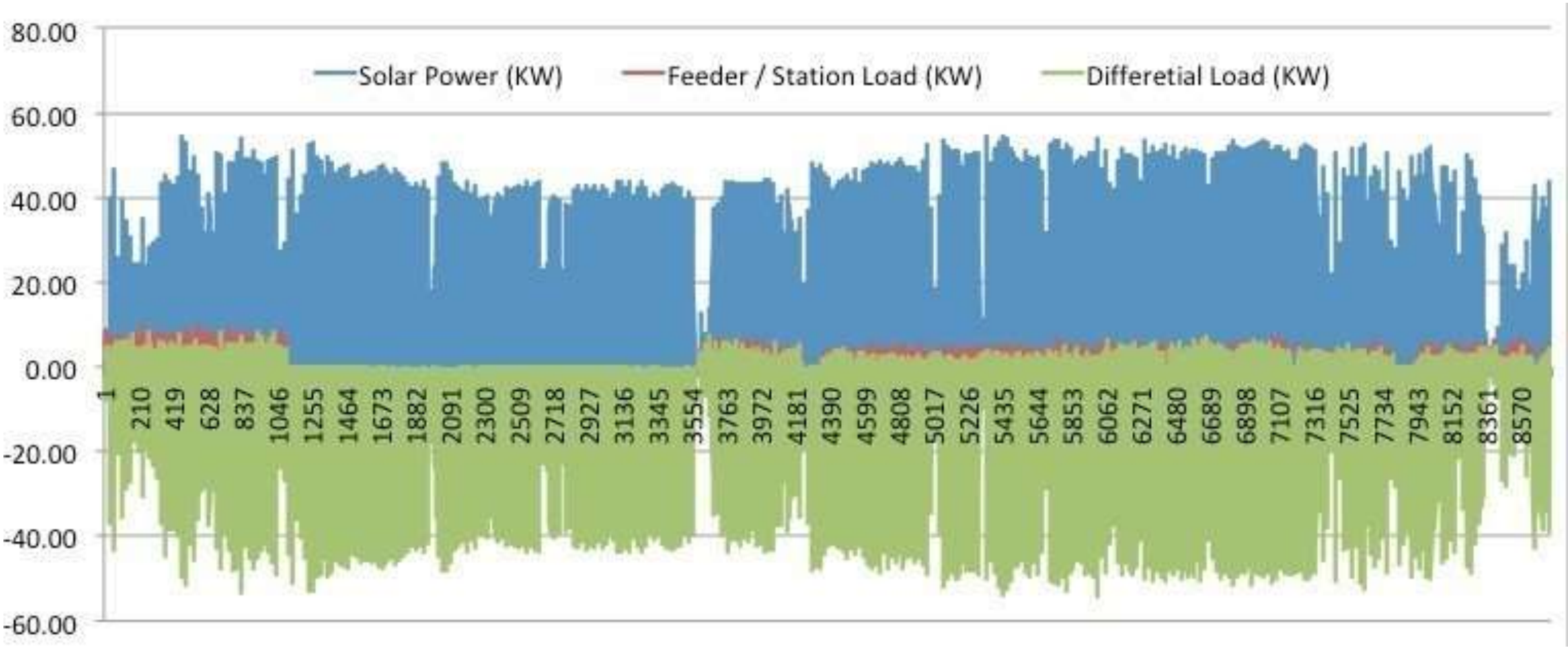
# Case Study 1: 0.4KV Feeder and 63KVA DT at Ranchi

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case Study 1: 0.4KV Feeder and 63KVA DT at Ranchi

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case Study 2: 0.4KV feeder and 100KVA DT at Ranchi

**INPUTS**

**LV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 100.00 | KVA |
| Station Primary Voltage: | 11000.00 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 0.02% | |
| Enter Station Overloading: | 0.00% | |
| Enter Safety Factor (on Station running capacity): | 0.00% | |
| Enter Margin Factor (on Voltage regulation): | 100.00% | |
| Enter PV Penetration: | 100.00% | |
| PV Installed Capacity: | 100.00 | KW |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor | 0.98 | |
| Enter Load Quantity: | 1 | |
| Enter Running Load: | 0.02 | KVA |
| Enter Feeder Resistance R: | 0.150 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.075 | Ω/km |
| Enter Feeder Length: | 0.350 | km |

**PV Inverter Data**

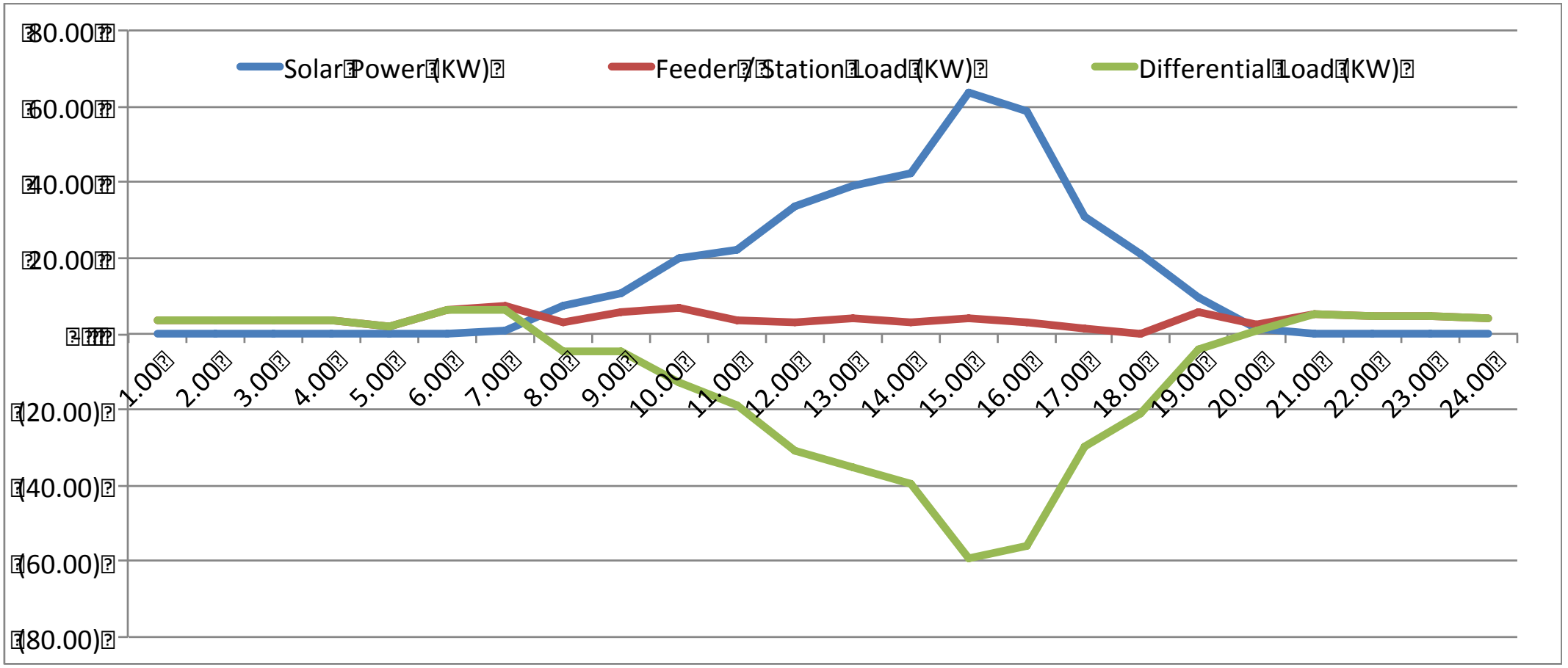
| | |
|---|---|
| Operating Power Factor: | 1.00 |
| Select Operating Mode: | Overexcited (lead) |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 100.00 | KVA |
| Peak PV Generation (KW): | 100.00 | KW |
| Peak PV Generation (KVAr): | 0.00 | KVAr |
| Running Load Consumption (W): | 23.52 | W |
| Running Load Consumption (VAr): | 4.78 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 99976.48 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| **Feeder End Voltage:** | 427.65 | V |
| Feeder End Voltage Rise: | 3.05% | |
| Acceptable: | Yes | |
| **Feeder Running Load:** | 134.98 | A |
| **Feeder Ampacity:** | 139.12 | A |
| Loading on Grid Assets: | 97.02% | |
| Acceptable: | Yes | |

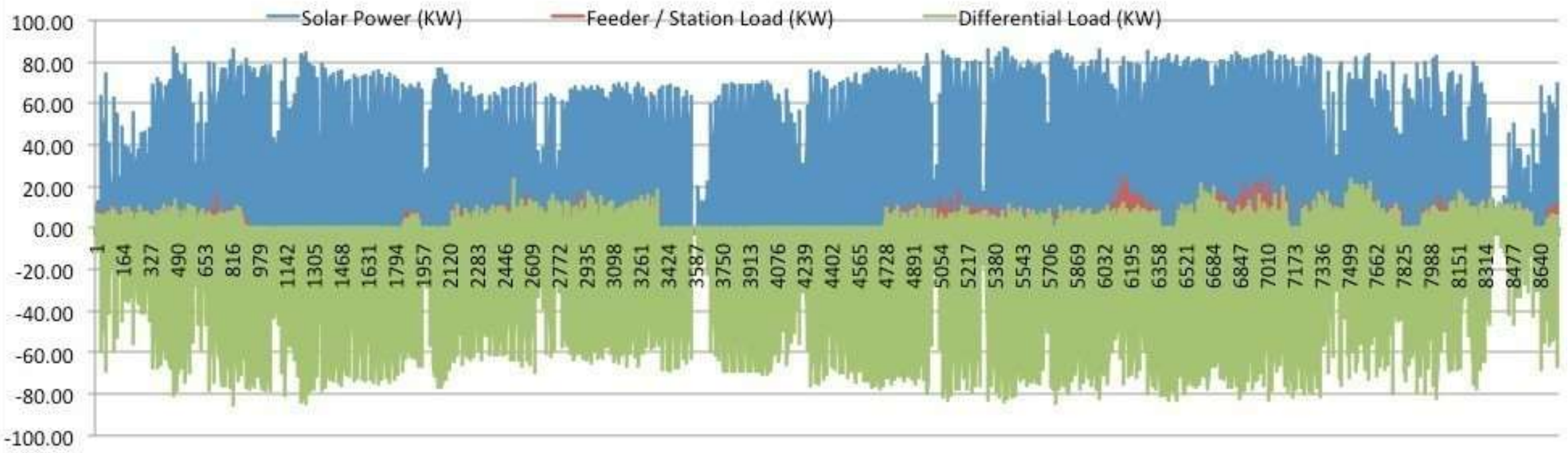
# Case Study 2: 0.4KV feeder and 100KVA DT at Ranchi

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case Study 2: 0.4KV feeder and 100KVA DT at Ranchi

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case Study 3: 0.4KV feeder and 100KVA DT at Ranchi

**INPUTS**

**LV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 100.00 | KVA |
| Station Primary Voltage: | 11000.00 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 1.56% | |
| Enter Station Overloading: | 0.00% | |
| Enter Safety Factor (on station running capacity): | 0.00% | |
| Enter Margin Factor (on voltage regulation): | 100.00% | |
| Enter PV Penetration: | 101.00% | |
| PV Installed Capacity: | 101.00 | KW |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor | 0.98 | |
| Enter Load Quantity: | 26 | |
| Enter Running Load: | 0.06 | KVA |
| Enter Feeder Resistance R: | 0.279 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.000 | Ω/km |
| Enter Feeder Length: | 0.450 | km |

**PV Inverter Data**

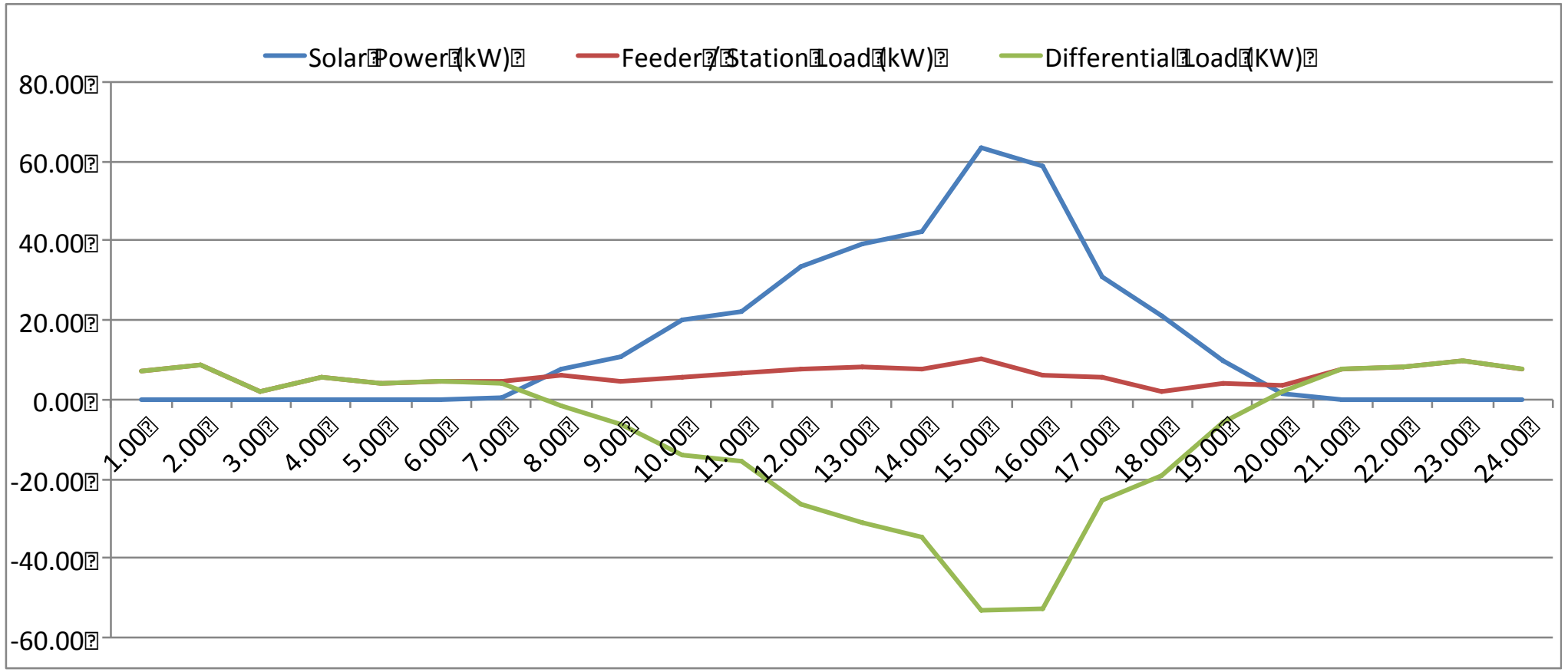
| | |
|---|---|
| Operating Power Factor: | 1.00 |
| Select Operating Mode: | Overexcited (lead) |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 3.88 | KVA |
| Peak PV Generation (KW): | 3.88 | KW |
| Peak PV Generation (KVAr): | 0.00 | KVAr |
| Running Load Consumption (W): | 58.80 | W |
| Running Load Consumption (VAr): | 11.94 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 3825.82 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| Feeder End Voltage: | 416.16 | V |
| Feeder End Voltage Rise: | 0.28% | |
| Acceptable: | Yes | |
| Feeder Running Load: | 138.00 | A |
| Feeder Ampacity: | 139.12 | A |
| Loading on Grid Assets: | 99.20% | |
| Acceptable: | Yes | |

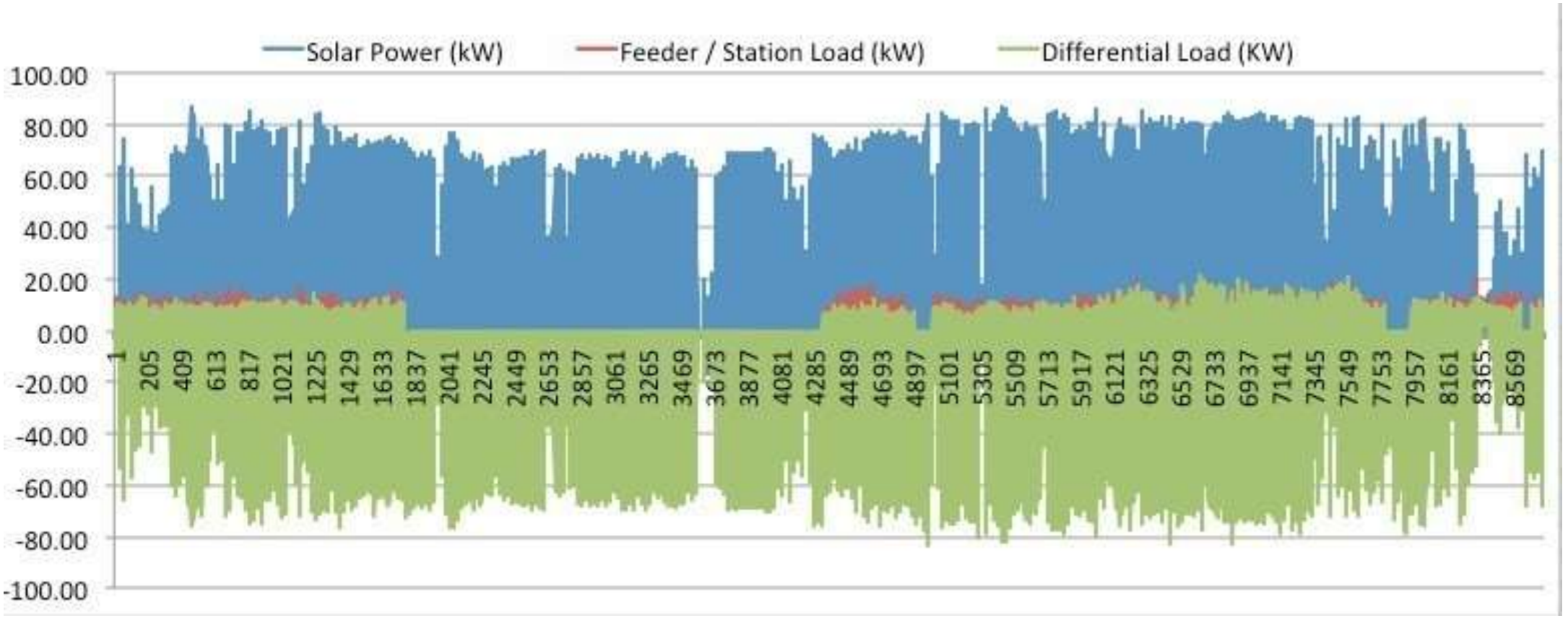
# Case Study 3: 0.4KV feeder and 100KVA DT at Ranchi

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case Study 3: 0.4KV feeder and 100KVA DT at Ranchi

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case study 4: 11KV feeder and 115KVA station at Ranchi

INPUTS

**MV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 115.00 | KVA |
| Station Primary Voltage: | 33000.00 | V |
| Station Secondary Voltage: | 11000.00 | V |
| Station Running Capacity: | 0.00% | |
| Enter Station Overloading: | 0.00% | |
| Safety Factor (on station running capacity): | 0.00% | |
| Margin Factor (on voltage regulation): | 100.00% | |
| Enter PV Penetration: | 100.00% | |
| PV Installed Capacity: | 115.00 | KW |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 115.00 | KVA |
| Peak PV Generation (KW): | 115.00 | KW |
| Peak PV Generation (KVAr): | 0.00 | KVAr |
| Running Load Consumption (W): | 1.31 | W |
| Running Load Consumption (VAr): | 0.92 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 114998.69 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| Feeder End Voltage: | 11000.88 | V |
| Feeder End Voltage Rise: | 0.01% | |
| Acceptable: | Yes | |
| Feeder Running Load: | 6.04 | A |
| Feeder Ampacity: | 6.04 | A |
| Loading of Grid Assets: | 99.99% | |
| Acceptable: | Yes | |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor: | 0.86 | |
| Enter Load Quantity: | 16 | |
| Enter Running Load: | 0.00 | KVA |
| Enter Feeder Resistance R: | 0.350 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.015 | Ω/km |
| Enter Feeder Length: | 0.650 | km |

**LV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Quantity: | 1 | |
| Station Installed Capacity: | 115.00 | KVA |
| Station Primary Voltage: | 11000.00 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 0.00% | |
| Station Running Capacity: | 0.00 | KVA |
| Station Per Unit Reactance $X_{PU}$: | 7.00% | |
| Station Base Reactance $X_{BASE}$: | 75625000 | Ω |
| Station Actual Reactance $X_\Omega$: | 5293750 | Ω |

**MV Feeder Data**

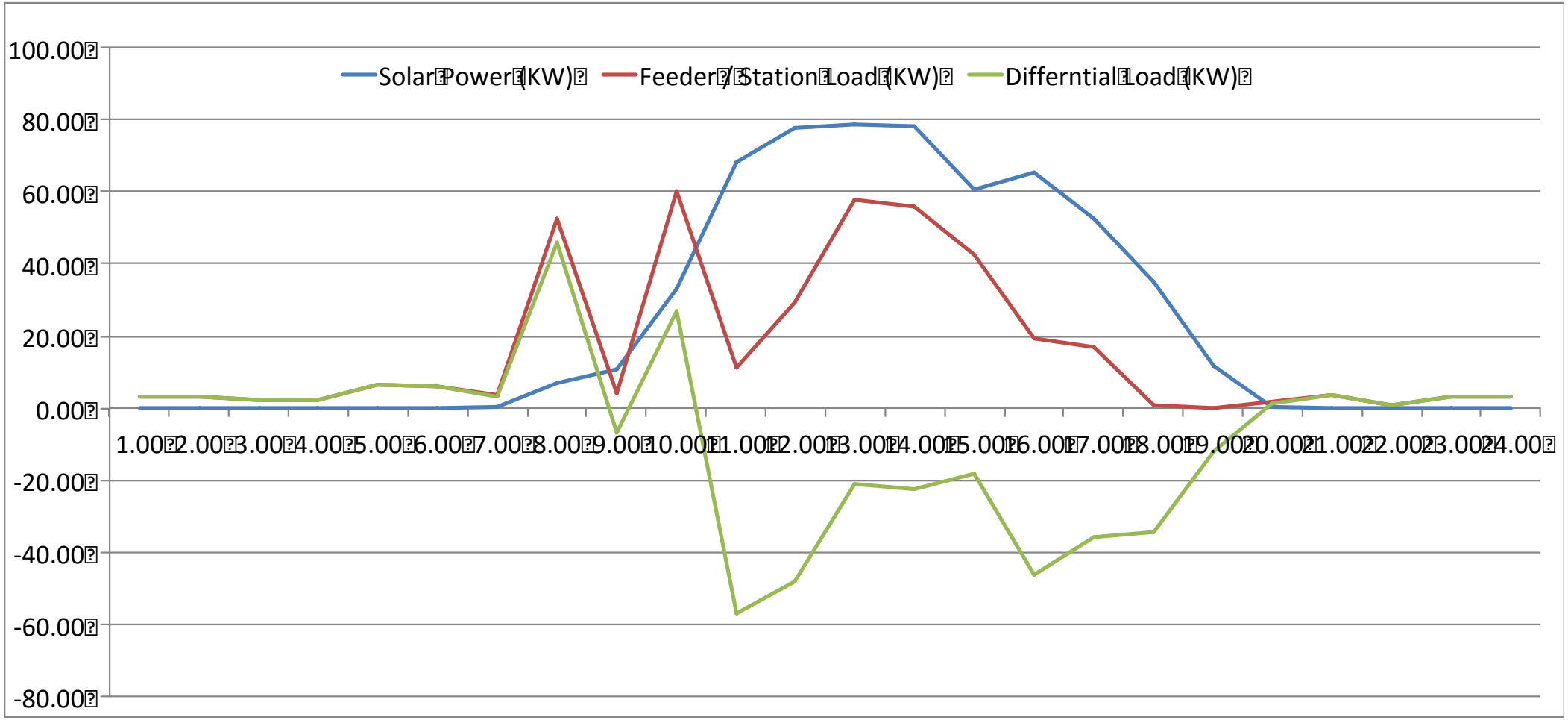
| | | |
|---|---|---|
| Operating Power Factor: | 0.82 | |
| Enter Adjusted Power Factor: | 0.82 | |
| Enter Feeder Resistance R: | 0.187 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.000 | Ω/km |
| Enter Feeder Length: | 0.450 | km |

**PV Inverter Data**

| | | |
|---|---|---|
| Operating Power Factor: | 1.00 | |
| Select Operating Mode: | verexcited (lea | |

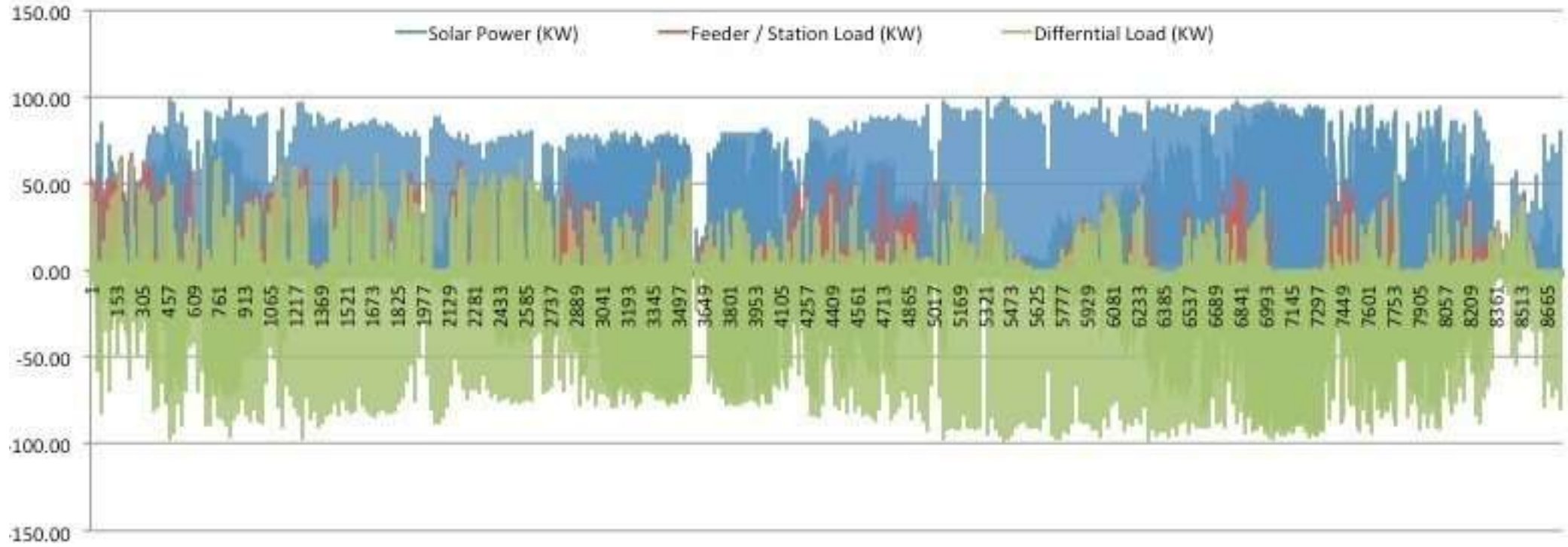
# Case study 4: 11KV feeder and 115KVA station at Ranchi

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case study 4: 11KV feeder and 115KVA station at Ranchi

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case study 5: 11KV feeder and 140KVA station at Ranchi

INPUTS

**MV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 140.00 | KVA |
| Station Primary Voltage: | 33000.00 | V |
| Station Secondary Voltage: | 11000.00 | V |
| Station Running Capacity: | 0.00% | |
| Enter Station Overloading: | 0.00% | |
| Safety Factor (on Station running capacity): | 0.00% | |
| Margin Factor (on Voltage regulation): | 100.00% | |
| Enter PV Penetration: | 100.00% | |
| PV Installed Capacity: | 140.00 | KW |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 140.00 | KVA |
| Peak PV Generation (KW): | 140.00 | KW |
| Peak PV Generation (KVAr): | 0.00 | KVAr |
| Running Load Consumption (W): | 1.76 | W |
| Running Load Consumption (VAr): | 0.36 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 139998 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| Feeder End Voltage: | 11001.07 | V |
| Feeder End Voltage Rise: | 0.01% | |
| Acceptable: | Yes | |
| Feeder Running Load: | 7.35 | A |
| Feeder Ampacity: | 7.35 | A |
| Loading of Grid Assets: | 99.99% | |
| Acceptable: | Yes | |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor: | 0.86 | |
| Enter Load Quantity: | 18 | |
| Enter Running Load: | 0.00 | KVA |
| Enter Feeder Resistance R: | 0.350 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.015 | Ω/km |
| Enter Feeder Length: | 0.750 | km |

LV Upstream Station Data

| | | |
|---|---|---|
| Enter Station Quantity: | 1 | |
| Enter Station Installed Capacity: | 140.00 | KVA |
| Station Primary Voltage: | 11000.00 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 0.00% | |
| Station Running Capacity: | 0.00 | KVA |
| Enter Station Per Unit Reactance $X_{PU}$: | 7.00% | |
| Station Base Reactance $X_{BASE}$: | 67222222 | Ω |
| Station Actual Reactance $X_\Omega$: | 4705556 | Ω |

**MV Feeder Data**

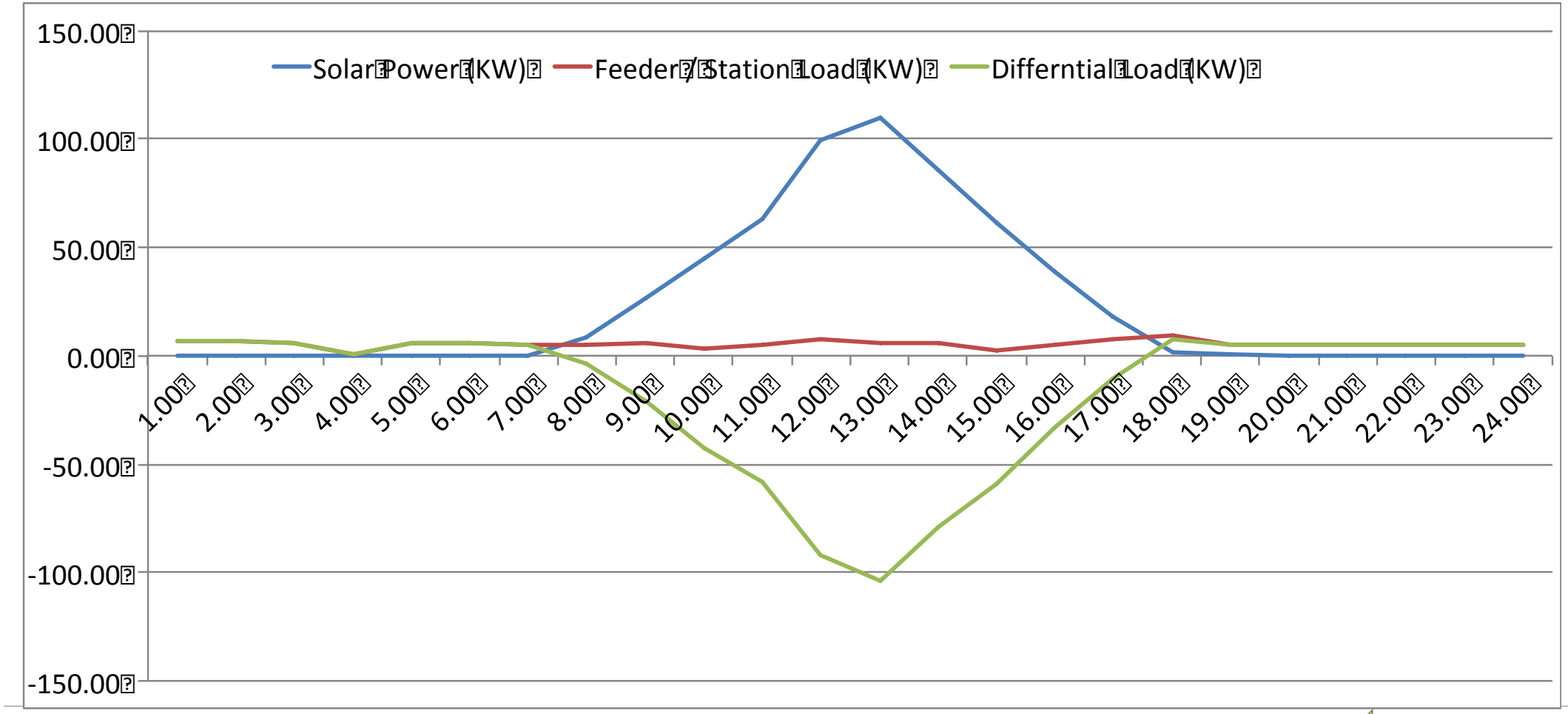
| | | |
|---|---|---|
| Operating Power Factor: | 0.82 | |
| Enter Adjusted Power Factor: | 0.98 | |
| Enter Feeder Resistance R: | 0.187 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.000 | Ω/km |
| Enter Feeder Length: | 0.450 | km |

**PV Inverter Data**

| | | |
|---|---|---|
| Operating Power Factor: | 1.00 | |
| Select Operating Mode: | Overexcited (lead) | |

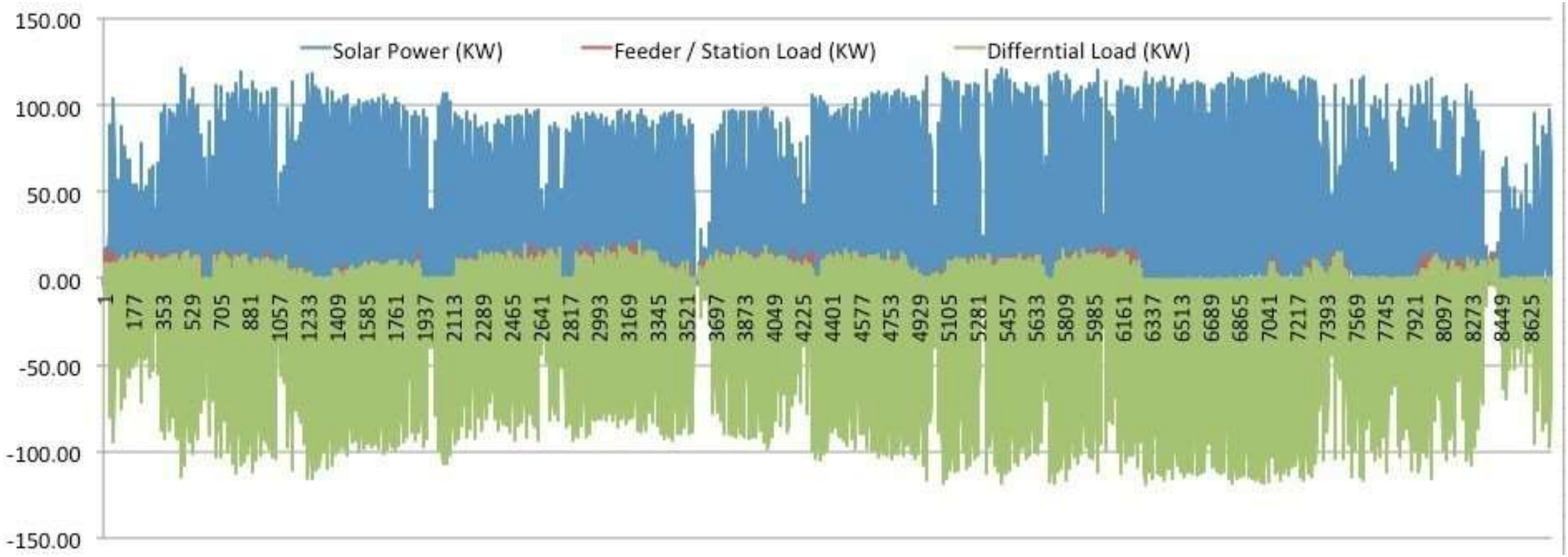
# Case study 5: 11KV feeder and 140KVA station at Ranchi

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case study 5: 11KV feeder and 140KVA station at Ranchi

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case study 6: 11KV feeder and 630KVA station at Delhi

INPUTS

**MV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 630.00 | KVA |
| Station Primary Voltage: | 33000 | V |
| Station Secondary Voltage: | 11000 | V |
| Station Running Capacity: | 12.41% | |
| Enter Station Overloading: | 0.00% | |
| Safety Factor (on Station running capacity): | 0.00% | |
| Margin Factor (on Voltage regulation): | 100% | |
| Enter PV Penetration: | 112% | |
| PV Installed Capacity: | 705.60 | KW |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 706 | KVA |
| Peak PV Generation (KW): | 706 | KW |
| Peak PV Generation (KVAr): | 0.00 | KVAr |
| Running Load Consumption (W): | 76618 | W |
| Running Load Consumption (VAr): | 15558 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 628982 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| Feeder End Voltage: | 11008 | V |
| Feeder End Voltage Rise: | 0.08% | |
| Acceptable: | Yes | |
| Feeder Running Load: | 33.00 | A |
| Feeder Ampacity: | 33.07 | A |
| Loading of Grid Assets: | 99.79% | |
| Acceptable: | Yes | |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor: | 0.96 | |
| Enter Load Quantity: | 62 | |
| Enter Running Load: | 1.26 | KVA |
| Enter Feeder Resistance R: | 0.350 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.015 | Ω/km |
| Enter Feeder Length: | 0.750 | km |

LV Upstream Station Data

| | | |
|---|---|---|
| Enter Station Quantity: | 1 | |
| Station Installed Capacity: | 630 | KVA |
| Station Primary Voltage: | 11000 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 12.41% | |
| Station Running Capacity: | 78.18 | KVA |
| Station Per Unit Reactance $X_{PU}$: | 6.00% | |
| Station Base Reactance $X_{BASE}$: | 1548 | Ω |
| Station Actual Reactance $X_\Omega$: | 92.86 | Ω |

**MV Feeder Data**

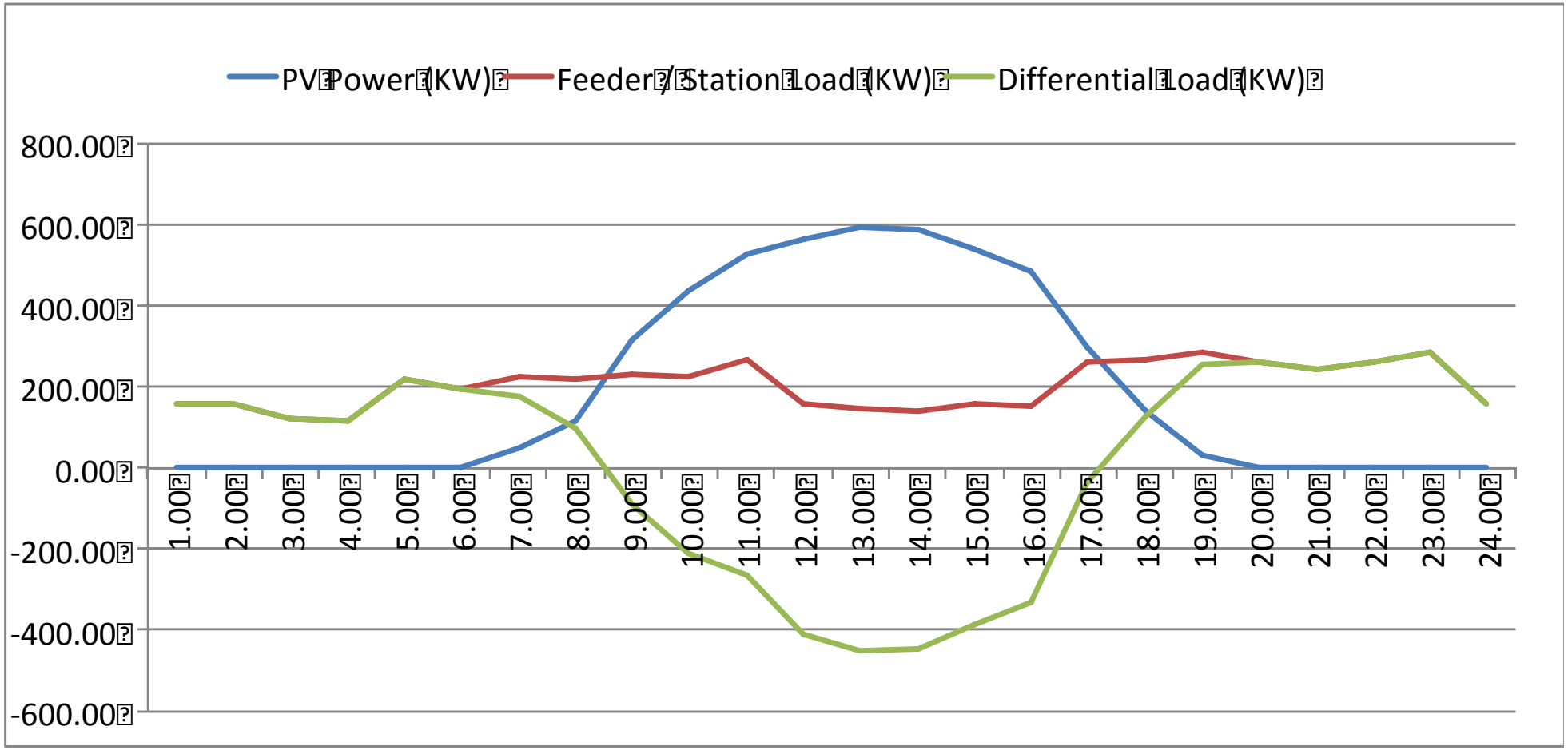
| | | |
|---|---|---|
| Operating Power Factor: | 0.94 | |
| Enter Adjusted Power Factor | 0.98 | |
| Enter Feeder Resistance R: | 0.150 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.100 | Ω/km |
| Enter Feeder Length: | 0.750 | km |

**PV Inverter Data**

| | | |
|---|---|---|
| Operating Power Factor: | 1.00 | |
| Select Operating Mode: | Overexcited (lead | |

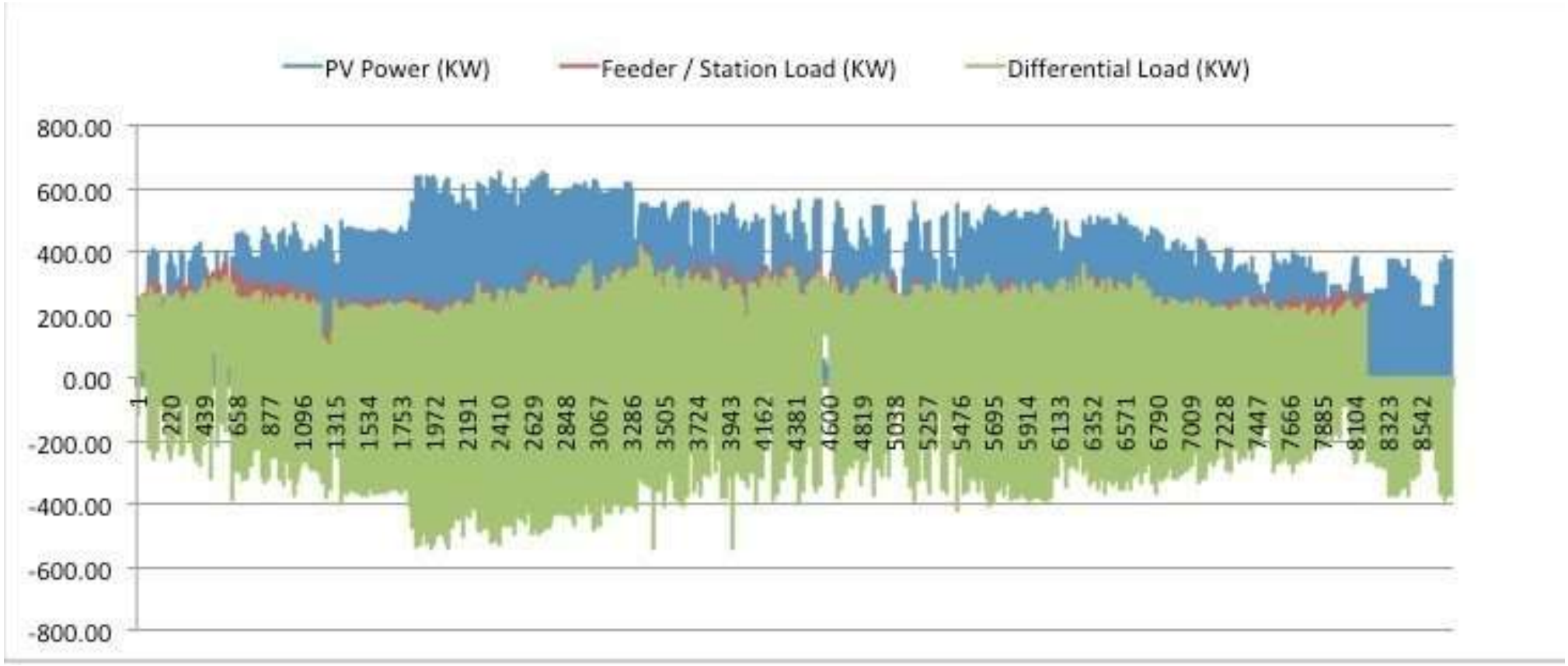
# Case study 6: 11KV feeder and 630KVA station at Delhi

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case study 6: 11KV feeder and 630KVA station at Delhi

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case study 7: 33KV feeder and 1.1MVA station at Jamshedpur

INPUTS

**HV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 11000 | KVA |
| Station Primary Voltage: | 132000 | V |
| Station Secondary Voltage: | 33000 | V |
| Station Running Capacity: | 11.78% | |
| Enter Station Overloading: | 0.00% | |
| Safety Factor (on Station running Capacity): | 0.00% | |
| Margin Factor (on Voltage regulation): | 100.00% | |
| Enter PV Penetration: | 111.00% | |
| PV Installed Capacity: | 12210 | KW |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation (KVA): | 12210 | KVA |
| Peak PV Generation (KW): | 12210 | KW |
| Peak PV Generation (KVAr): | 0 | KVAr |
| Running Load Consumption (W): | 1231200 | W |
| Running Load Consumption (VAr): | 404676 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow (Pkj): | 10978800 | W |
| Reverse Reactive Power Flow (Qkj): | 0.00 | VAr |
| Feeder End Voltage: | 33458 | V |
| Feeder End Voltage Rise: | 1.39% | |
| Acceptable: | Yes | |
| Feeder Running Load: | 189.58 | A |
| Feeder Ampacity: | 192.46 | A |
| Loading of Grid Assets: | 98.51% | |
| Acceptable: | Yes | |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor: | 0.87 | |
| Enter Load Quantity: | 30 | |
| Enter Running Load: | 10.80 | KVA |
| Enter Feeder Resistance R: | 0.450 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.025 | Ω/km |
| Enter Feeder Length: | 0.750 | km |

LV Upstream Station Data

| | | |
|---|---|---|
| Enter Station Quantity: | 4 | |
| Enter Station Installed Capacity: | 2750.00 | KVA |
| Station Primary Voltage: | 11000.00 | V |
| Station Secondary Voltage: | 415.00 | V |
| Station Running Capacity: | 11.78% | |
| Station Running Capacity: | 324.00 | KVA |
| Station Per Unit Reactance $X_{PU}$: | 6.00% | |
| Station Base Reactance $X_{BASE}$: | 373.46 | Ω |
| Station Actual Reactance $X_\Omega$: | 22.41 | Ω |

**MV Feeder Data**

| | | |
|---|---|---|
| Operating Power Factor: | 0.84 | |
| Enter Feeder Resistance R: | 0.350 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.015 | Ω/km |
| Enter Feeder Length: | 4.850 | km |

MV Upstream Station Data

| | | |
|---|---|---|
| Enter Station Quantity: | 1 | |
| Enter Station Installed Capacity: | 11000.00 | KVA |
| Station Primary Voltage: | 33000.00 | V |
| Station Secondary Voltage: | 11000.00 | V |
| Station Running Capacity: | 11.78% | |
| Station Running Capacity: | 1296.00 | KVA |
| Station Per Unit Reactance $X_{PU}$: | 7.00% | |
| Station Base Reactance $X_{BASE}$: | 840.28 | Ω |
| Station Actual Reactance $X_\Omega$: | 58.82 | Ω |

**HV Feeder Data**

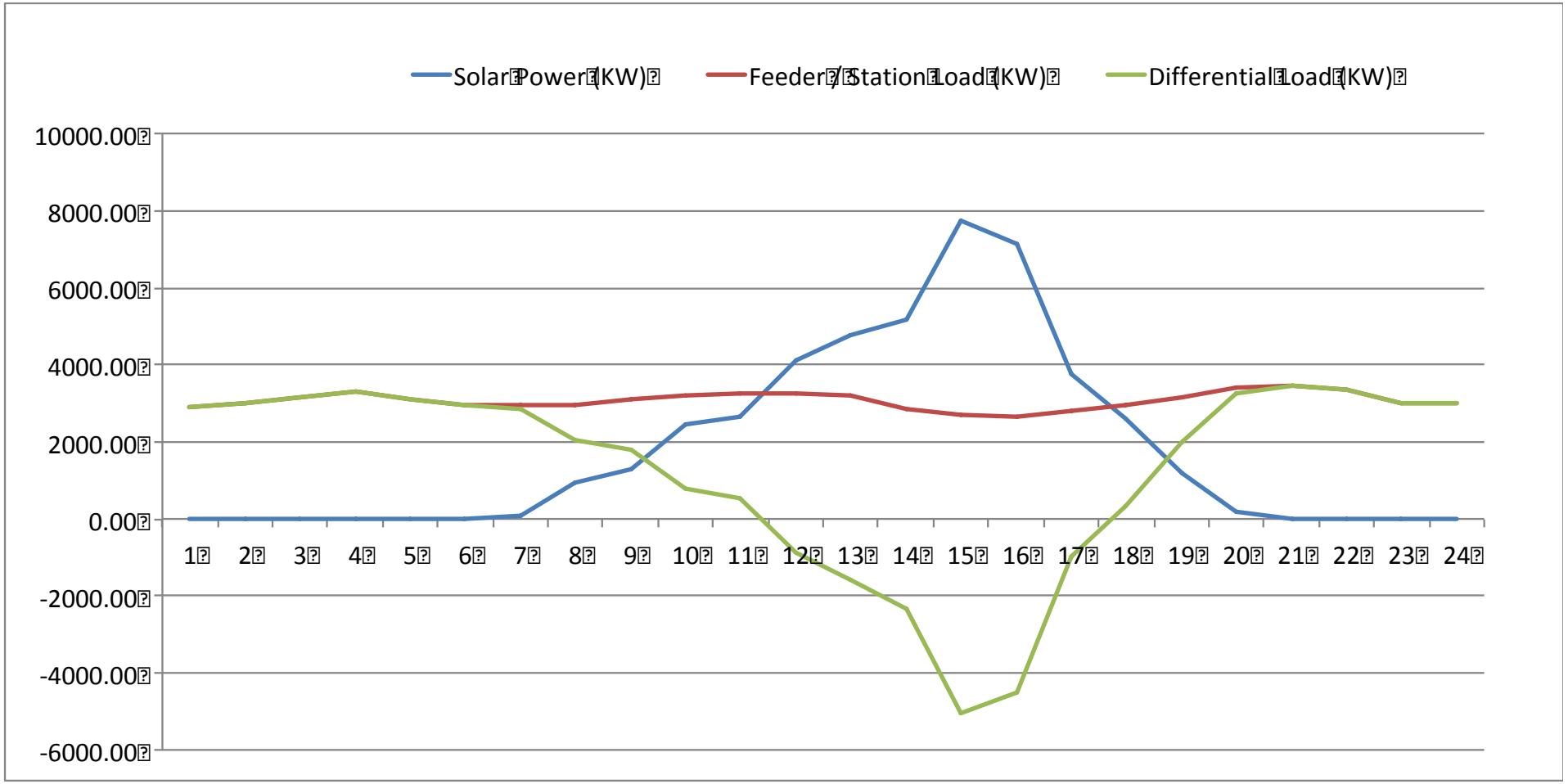
| | | |
|---|---|---|
| Operating Power Factor: | 0.80 | |
| Enter Adjusted Power Factor: | 0.95 | |
| Enter Feeder Resistance R: | 0.139 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.000 | Ω/km |
| Enter Feeder Length: | 9.500 | km |

**PV Inverter Data**

| | |
|---|---|
| Operating Power Factor: | 1.00 |
| Select Operating Mode: | Overexcited (lead) |

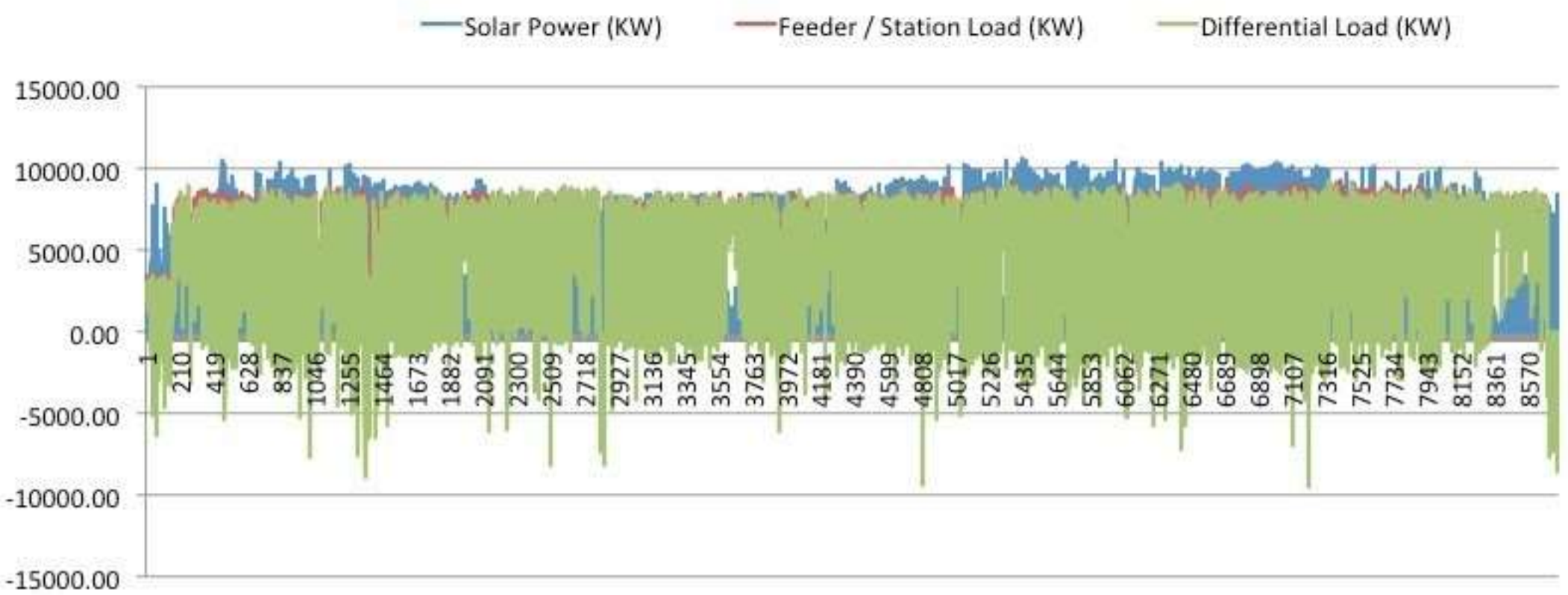
# Case study 7: 33KV feeder and 1.1MVA station at Jamshedpur

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case study 7: 33KV feeder and 1.1MVA station at Jamshedpur

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Case study 8: 33KV feeder and 1.75MVA station at Jamshedpur

INPUTS

**HV Upstream Station Data**

| | | |
|---|---|---|
| Enter Station Installed Capacity: | 1750 | KVA |
| Station Primary Voltage: | 132000 | V |
| Station Secondary Voltage: | 33000 | V |
| Station Running Capacity: | 0.41% | |
| Enter Station Overloading: | 0.00% | |
| Safety Factor 1 (on Station running capacity): | 0.00% | |
| Margin Factor 1 (on voltage regulation): | 100.00% | |
| Enter PV Penetration: | 100.00% | |
| PV Installed Capacity: | 1750 | KW |

OUTPUTS

| | | |
|---|---|---|
| Peak PV Generation 1 (KVA): | 1750 | KVA |
| Peak PV Generation 1 (KW): | 1750 | KW |
| Peak PV Generation 1 (KVAr): | 0.00 | KVAr |
| Running Load Consumption 1 (W): | 6624 | W |
| Running Load Consumption 1 (VAr): | 2822 | VAr |
| Reverse Power Flow: | Yes | |
| Reverse Active Power Flow 1 (Pkj): | 1743376 | W |
| Reverse Reactive Power Flow 1 (Qkj): | 0.00 | VAr |
| Feeder End Voltage: | 33070 | V |
| Feeder End Voltage Rise: | 0.21% | |
| Acceptable: | Yes | |
| Feeder Running Load: | 30.44 | A |
| Feeder Ampacity: | 30.62 | A |
| Loading of Grid Assets: | 99.41% | |
| Acceptable: | Yes | |

**LV Feeder Data**

| | | |
|---|---|---|
| Enter Operating Power Factor: | 0.87 | |
| Enter Load Quantity: | 16 | |
| Enter Running Load: | 0.23 | KVA |
| Enter Feeder Resistance R: | 0.450 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.025 | Ω/km |
| Enter Feeder Length: | 0.750 | km |

LV Upstream Station Data

| | | |
|---|---|---|
| Enter Station Quantity: | 2 | |
| Enter Station Installed Capacity: | 875.00 | KVA |
| Station Primary Voltage: | 11000 | V |
| Station Secondary Voltage: | 415 | V |
| Station Running Capacity: | 0.41% | |
| Station Running Capacity: | 3.60 | KVA |
| Station Per Unit Reactance $X_{PU}$: | 6.00% | |
| Station Base Reactance $X_{BASE}$: | 33611 | Ω |
| Station Actual Reactance $X_\Omega$: | 2017 | Ω |

**MV Feeder Data**

| | | |
|---|---|---|
| Operating Power Factor: | 0.84 | |
| Enter Feeder Resistance R: | 0.350 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.015 | Ω/km |
| Enter Feeder Length: | 4.850 | km |

MV Upstream Station Data

| | | |
|---|---|---|
| Enter Station Quantity: | 1 | |
| Enter Station Installed Capacity: | 1750.00 | KVA |
| Station Primary Voltage: | 33000.00 | V |
| Station Secondary Voltage: | 11000.00 | V |
| Station Running Capacity: | 0.41% | |
| Station Running Capacity: | 7.20 | KVA |
| Station Per Unit Reactance $X_{PU}$: | 7.00% | |
| Station Base Reactance $X_{BASE}$: | 151250 | Ω |
| Station Actual Reactance $X_\Omega$: | 10588 | Ω |

**HV Feeder Data**

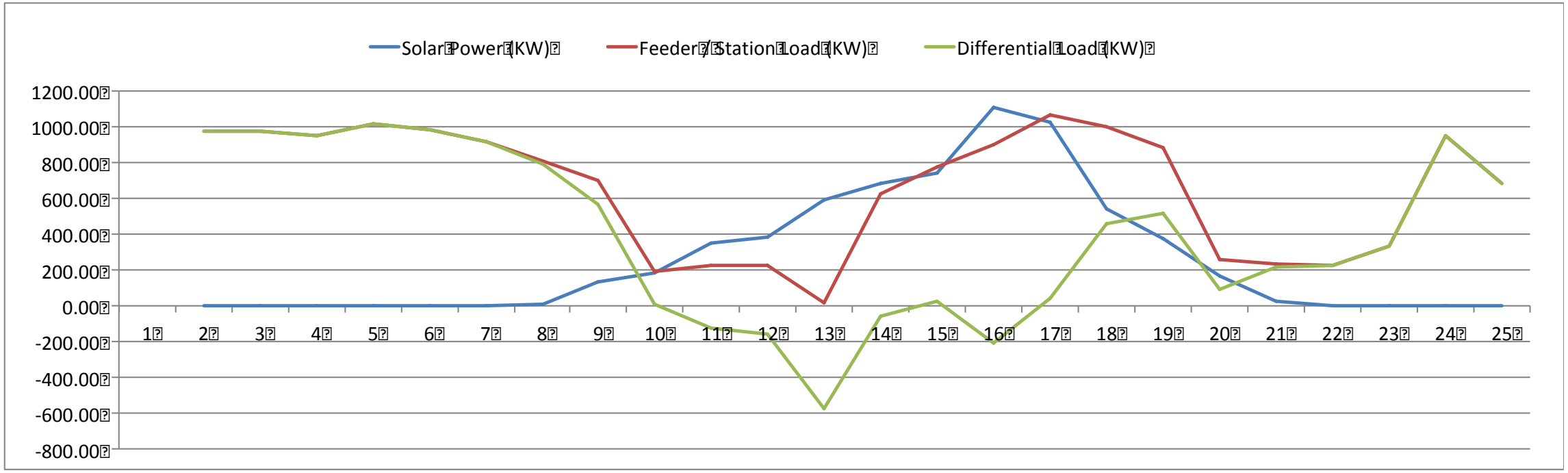
| | | |
|---|---|---|
| Operating Power Factor: | 0.80 | |
| Enter Adjusted Power Factor: | 0.92 | |
| Enter Feeder Resistance R: | 0.139 | Ω/km |
| Enter Feeder Reactance $X_L$: | 0.000 | Ω/km |
| Enter Feeder Length: | 9.500 | km |

**PV Inverter Data**

| | | |
|---|---|---|
| Operating Power Factor: | 1.00 | |
| Select Operating Mode: | Overexcited (lead | |

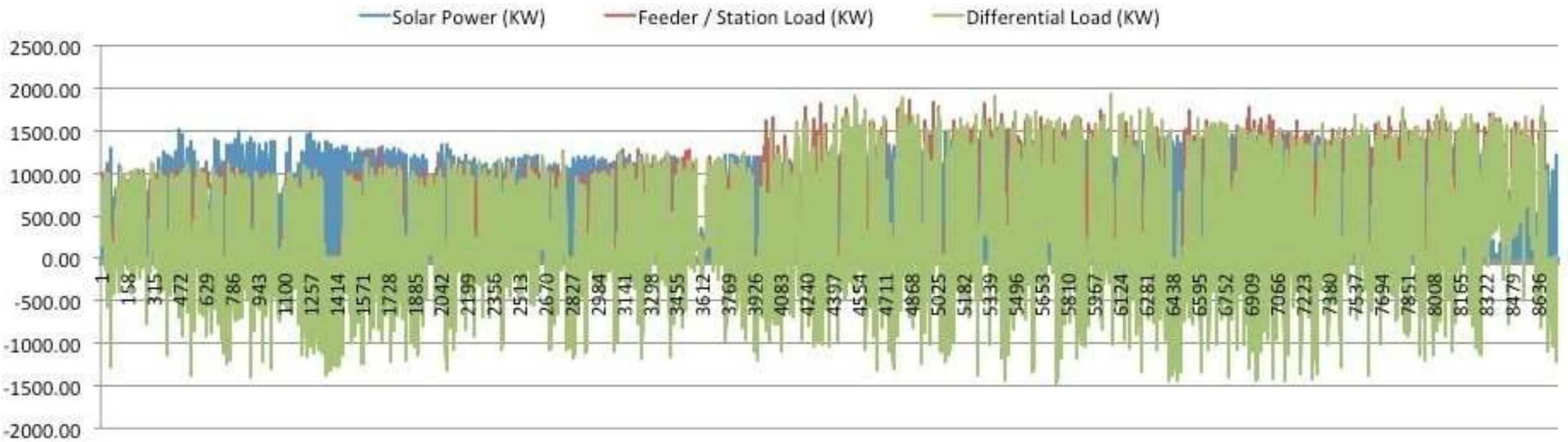
# Case study 8: 33KV feeder and 1.75MVA station at Jamshedpur

## Daily load profile showing  Solar Power, Consumer Load and Differential load



# Case study 8: 33KV feeder and 1.75MVA station at Jamshedpur

## Annual load profile showing  Solar Power, Consumer Load and Differential load



# Benefit analysis for a utility: Jharkhand & Delhi case study (1/3)

**An analytical model was developed to assess the financial impact of rooftop solar penetration on the distribution utility in the geography.**

The model was utilised to assess the financial impact of rooftop solar penetration on **JBVNL, Jharkhand and BYPL, Delhi**.

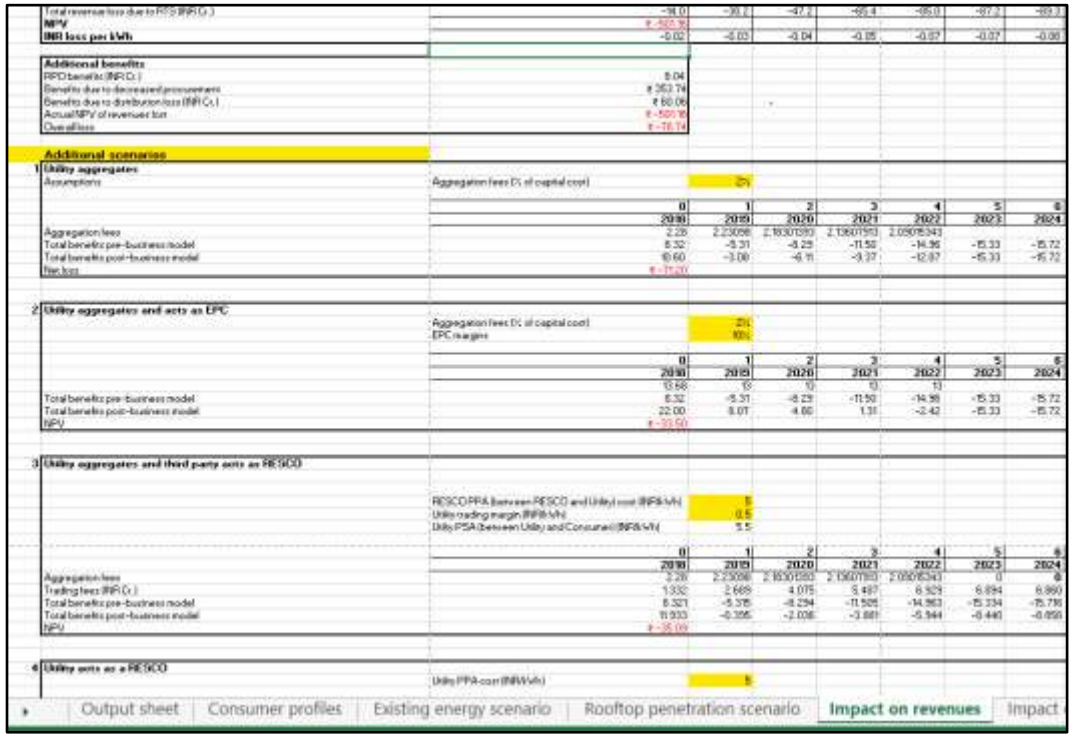
Key considerations for developing the impact model were as follows

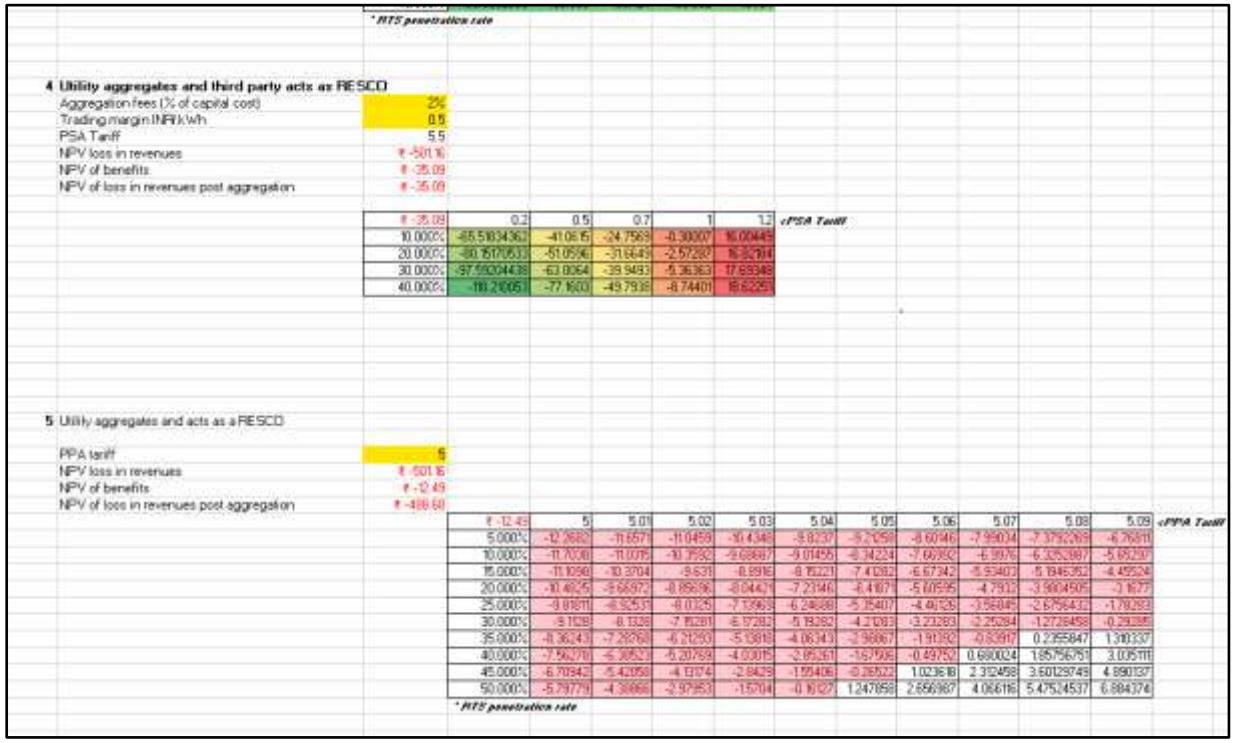
- **The abovementioned 6 business models were considered for the assessment**
- **Following rooftop solar penetration scenarios were considered**
  - **MNRE Targets**
  - **10% growth**
  - **20% growth**
  - **30% growth**
  - **40% growth**
- **Existing tariff structures, APPC, ACoS, distribution losses and RPOs for DISCOMs were considered as mentioned in the ARR for developing the impact model**

# Benefit analysis for a utility: Jharkhand & Delhi case study (2/3)

**Key output of the analytical model is the financial impact on the utility due to uptake of rooftop solar in its distribution circle. Impact on utility due to utility-centric business models is also assessed.**

Snapshots from the model:



Hyperlinks to the models are as follows - Model for JBVNL Model for BYPL

Microsoft Excel Worksheet

Microsoft Excel Worksheet

# Benefit analysis for a utility: Jharkhand & Delhi case study (3/3)

| Key observations |
| --- |
| • Rooftop solar installations provides various commercial benefits to the utilities such as RPO benefits, reduced AT&C losses and benefits due to reduced power procurement.<br><br>**Recommendation** - To restructure the tariffs with higher fixed charges and lower energy charges to optimize DISCOMs revenues. |
| • Only “Utility as a RESCO” business model returns a profit or a no-profit-no-loss scenario. Sensitivity analysis was utilised to determine the PPA tariff for the utility for a no-profit-no-loss scenario under the “Utility as a RESCO” business model.<br><br>• For JBVNL, the PPA tariff was determined to be in the range of 5.74 – 5.75 INR/kWh.<br><br>• For BYPL, the PPA tariff was determined to be in the range of 7.4 – 7.5 INR/kWh.<br><br>• The PPA tariff is higher in Delhi as compared with Jharkhand due to higher retail tariffs and lower AT&C losses in Delhi. The “Utility as a RESCO” model will be financially feasible on in the case of commercial consumer segment.<br><br>**Recommendation** – To provide a facilitative regulatory environment to encourage DISCOM participation as RESCOs (Utility as a RESCO business model) |

# Benefit analysis for a utility: Key observations from Jharkhand & Delhi case study (1/4)

| Business model | Key observations |
|---|---|
| CAPEX and RESCO, Utility aggregation | • Any penetration of rooftop solar will result in loss of revenues for the utility.<br>• Actual loss to the utility is ~15 – 25% of the revenue loss to the utility due to compensation by reduced procurement, reduced losses and RPO benefits.<br><br>**Recommendation** - To restructure the tariffs with higher fixed charges and lower energy charges to optimize DISCOMs revenues. |
| Utility as EPC | • The actual loss to the utility is reduced by ~10-25% compared to the previous business models.<br><br>**Recommendation** - To restructure the tariffs with higher fixed charges and lower energy charges to optimize DISCOMs revenues. |

# Benefit analysis for a utility: Key observations from Jharkhand case study (2/4)

| Business model | Key observations |
|---|---|
| Utility aggregates and third party acts as RESCO | • The actual loss/benefits are dependant on the penetration growth rate and trading margin for the DISCOMs.<br>• For Jharkhand, for a no-benefit & no-loss scenario, trading margin for the DISCOM lies between 1-1.04 INR/kWh for penetration growth rates 5-20%.<br>• For Delhi, the trading margin lies between 2.4-2.5 INR/kWh for a no-benefit & no-loss scenario due to higher retail tariffs and lower AT&C losses. To make up the lost revenue, due to rooftop solar, the utility will have to charge a higher trading margin.<br><br>**Recommendation** – To identify the trading margin based on the above-mentioned factors and the current grid tariffs. Consumers will not uptake rooftop if landed PPA tariff > grid tariff. |

# Benefit analysis for a utility: Key observations from Jharkhand case study (3/4)

| Business model | Key observations |
|---|---|
| Utility aggregates and acts as RESCO | • The utility will be able to **retain or increase** their revenues based on the penetration growth rates and PPA tariff.<br>• For Jharkhand, for a no-benefit and no-loss scenario, PPA tariffs can be selected between 5.0 – 5.2 INR/kWh based on the penetration growth rates (Range: 10%-100%)<br>• For Delhi, PPA tariff was determined to be in the range of 7.4 – 7.5 INR/kWh. The PPA tariff is higher in Delhi as compared with Jharkhand due to higher retail tariffs and lower AT&C losses in Delhi. The “Utility as a RESCO” model will be financially feasible on in the case of commercial consumer segment.<br><br>**Recommendation** – To select the PPA tariff, the abovementioned factors and the grid tariffs should be taken into consideration. |

# Benefit analysis for a utility: Key observations from Jharkhand case study (4/4)

## Other observations

- The following measures can also be selected for optimising revenues for the utilities –
  - Restructuring the tariffs with higher fixed charges and lower energy charges
  - Implementing ToD tariffs
  - Implementing separate tariff slabs for rooftop solar consumers (higher fixed charges for rooftop solar consumers)

- Actual losses are only a (~15%) of the revenue losses due to rooftop solar penetration

- Penetration scenarios within consumer segments are key to assess revenue loss for DISCOM

- The trading margin and the PPA tariff for the DISCOM should be selected based on the existing tariff structure & rooftop solar penetration growth and other factors assumed in the detailed model such as RPO benefits, tariff escalation, AT&C losses etc.

- Benefits due to decrease in distribution losses and benefits due to RPO benefits as high as 25% of the total expected revenue loss

# Important definitions and key concepts introduced

## PDRES Prosumer Distributed Renewable Energy System

- A distributed renewable energy system set up by prosumer under net metering or net billing, connected on the prosumer side of the meter or on service line to the prosumer.

## IDRES Independent Distributed Renewable Energy System

- A distributed renewable energy system set up by any person and is connected to the distribution licensee network and sells electricity to distribution licensee under Power Purchase Agreement;

### Prosumer

- A person who consumes electricity from the grid and can also inject electricity into the grid using same network from renewable energy system set up on consumer side of the meter.

### Renewable Energy Service Company (RESCO)

- RESCO means an energy service company **which owns a renewable energy system** and **provides renewable energy to the consumer**.
- Provided that the **distribution licensee** may act **as a RESCO**. However, this **business shall be treated as other business of the distribution licensee**

### Distributed Renewable Energy Sources (DRES)

- DRES means the renewable sources or combination of such sources, such as Mini, Micro and Small Hydro, Wind, Solar, Biomass including bagasse, bio-fuel, urban or Municipal Solid Waste as recognized by the Ministry of New and Renewable Energy, Government of India;

# Salient Features of Net Metering ….. (1/2)

- The prosumer may **set up distributed renewable energy system** to **offset the prosumer's electricity consumption from the distribution licensee**.
- The **distribution licensee shall** procure **any excess energy generated by PDRES at Average Power Purchase Cost for the year** in which such excess energy is procured by the distribution licensee.
- In case, the **electricity injected by the renewable energy system exceeds the electricity consumed** during the billing period, such **excess injected electricity shall be carried forward to the next billing period** as excess electricity and may be utilized in the following billing periods but within the same settlement period;
- In case, the **electricity supplied by the distribution licensee** during any billing period **exceeds the electricity injected in the grid by the PDRES,** the **distribution licensee shall raise bill for the net electricity** consumption after taking into account any excess electricity carried forward from the previous billing period;

# Salient Features of Net Metering ….. (2/2)

- In case the prosumer is under the **ambit of Time of Day Tariff**, following process shall be followed:
  - **Electricity consumption in any time block** (e.g., peak hours, off-peak hours, etc.) shall be **first compensated with the electricity generation** in the **same time block**.
  - Any **excess generation over consumption** in any time block in a billing cycle shall be accounted as if the excess generation occurred during immediately lower tariff time block. This process will continue till all consumption in lower tariff blocks is set off against PDRES generation.
  - Any excess generation after setting off consumption in lower tariff time blocks would be carried forward to the next billing cycle.
- Regardless of availability of excess electricity with the prosumer during any billing period, the consumer will continue to pay all other charges such as fixed/demand charges, Government levy, etc.
- The PDRES shall be exempted from all wheeling, cross subsidy, transmission and distribution, and banking charges and surcharges.

# Salient Features of Net Billing Arrangement ….. (1/2)

- The prosumer may **set up distributed renewable energy system to offset the prosumer's electricity purchase** bill from the distribution licensee.
- The **distribution licensee** shall **procure excess energy generated by PDRES** at **Average Power Purchase Cost for the year** in which such excess energy is procured by the distribution licensee.
- Net billing is the arrangement where DRE Plant is:
  - Installed to serve a specific consumer,
  - Connected on utility side on the consumer meter,
  - Selling power to distribution licensee under Power Purchase Agreement,
  - Entire power is consumed by the consumer
- The distribution licensee **shall enter into Power Purchase Agreement** at **tariff to be determined by the Commission.**
- **Entire quantum of electricity** generated by the DRE plant shall be procured by the distribution licensee.
- The distribution licensee shall enter into **Power Sale Agreement with the consumer** for sale of entire quantum of power generated by the relevant DRE plant.

# Salient Features of Net Billing Arrangement ….. (2/2)

- Rate of **sell of power to the consumer** shall be the same rate as **determined by the Commission for procurement of power from DRE Plant**.
- The **distribution licensee** shall **give credit to the consumer by billing the consumer at the tariff** determined by the Commission.

$$\textit{Energy Bill of Consumer} = \textit{Fixed charges + other applicable charges and levies} + (E_{DL} * T_{RST}) - (E_{RE} * T_{PSA}) - \textit{Billing}_{Credit}$$

Where:

- $E_{RE}$ means the energy units recorded for the billing period by the DRE Plant's generation meter;
- $T_{PSA}$ means the energy charges as per the energy sale agreement signed between the consumer and distribution licensee;
- $E_{DL}$ means the energy units supplied by the distribution licensee over and above the $E_{RE}$ for the billing period;
- $T_{RST}$ means the applicable retail supply tariff of the concerned consumer category as per the retail supply Tariff Order of the Commission;
- Billing credit is the amount by which value of DRE generation in a particular month is more than value of all other components of consumer bill

- In case, ( $E_{RE} * T_{PSA}$) is more than (Fixed charges + other applicable charges and levies + ($E_{DL} * T_{RST}$)), utility shall give credit of amount equal to difference (Billing Credit) and the same shall be carried forward to next billing cycle.

# [Central / __State] Electricity Regulatory Commission

[Location]

**No. ERC /** **Dated:** ….. /……/20….

**NOTIFICATION**

In exercise of powers conferred under Section [178/181] of the Electricity Act, 2003 (36 of 2003) read with sub section [4 of section 28/sub section 3 of section 32] thereof and all other powers enabling it in this behalf, and after previous publication, the [Central/Name of the State] Electricity Regulatory Commission hereby makes the following regulations, namely:

## CHAPTER-1
## PRELIMINARY

**1. Short title and commencement**

(1) These regulations may be called the [Central/Name of the State] Electricity Regulatory Commission (Fees and Charges of [Regional/State/National] Load Despatch Centre and other related matters) Regulations, 2019.

(2) These regulations shall come into effect from the date of their publication in the Official Gazette, and unless reviewed earlier or extended by the Commission, shall be applicable during the control period from 1.4.2019 to 31.3.2024.

**2. Scope and extent of application**

These regulations shall be applicable for determination of fees and charges to be collected by the [Regional/State] Load Despatch Centres from the generating companies, distribution licensees, [inter/intra]-State transmission licensees, buyers, sellers and [inter/intra]-State trading licensees and any other users of the respective load despatch centre defined from time time.

**3. Definitions**: In these regulations, unless the context otherwise requires:

(1) **'Act'** means the Electricity Act, 2003 ;

(2) **'Additional Capitalization'** means the capital expenditure incurred or projected to be incurred, after the date of commercial operation of the project and admitted by the Commission after prudence check;

(3) **'Annual LDC Charges (ALC)':** The Annual LDC charges (ALC) shall comprise the aggregate revenue requirement (ARR) for meeting the annual expenditure to be incurred by the Regional/National/State Load Despatch Centre as approved by the Appropriate Commission.

(4) **'Auditor'** means an auditor appointed by the Load Despatch Centre, qualified for appointment as an auditor in accordance with the provisions of sections 224, 233B and 619 of the Companies Act, 1956 (1 of 1956), as amended from time to time or Chapter X of the Companies Act, 2013 (18 of 2013), or any other law for the time being in force;

(5) **'Bank Rate'** means the base rate of interest as specified by the State Bank of India from time to time or any replacement thereof plus 350 basis points;

(6) **'Buyer'** means a person buying power through medium term open access or long term access and whose scheduling, metering and energy accounting is coordinated by the [Regional/National/State]

Load Despatch Centre;

(7) **'Capital Cost'** means the capital cost as defined in Regulation 9 of these regulations;

(8) **'Capital Expenditure' or** '**CAPEX'** means the expenditure of capital nature planned to be incurred during the control period for creation of assets of the [Regional/State] Load Despatch Centres or National Load Despatch Centre, as the case may be;

(9) **'Charges'** means recurring payments on monthly basis to be collected by the [Regional/State] Load Despatch Centres for the services rendered by Load Despatch Centre;

(10) **'Commission'** means Central Electricity Regulatory Commission referred to in sub-section (1) of section 76 or the State Electricity Regulatory Commission referred to in section 82 or the Joint Commission referred to in section 83 of the Act as the case may be;

(11) **'Contracted Capacity'** means the capacity arranged through long **t**erm access or medium term open access;

(12) **'Control Period'** means a period of five years starting from 1.4.2019;

(13) **'Day'** means the 24 hour period starting at 0000 hour;

(14) **'Expenditure Incurred'** means the fund, whether equity or debt or both, actually deployed and paid in cash or cash equivalent, for creation or acquisition of a useful asset and does not include commitments and the liabilities for which no payment has been made;

(15) **'Ergonomics'** means the science of refining the design of products/Office equipments to optimize them for human use. Human characteristics, such as height, weight, as well as information about human hearing, sight, temperature preferences and so on are considered while choosing the workplace equipment/furniture. Ergonomics is sometimes known as human factors engineering.

(16) **'Fees'** means the non-refundable one-time or annual fixed payments collected by the [National/Regional/State] Load Despatch Centres for the services rendered for commencement of grid access and scheduling ,and on account of registration, membership or any other purpose as specified by the Commission from time to time;

(17) Forum **of Load Despatchers (FOLD)** means the forum of load despatchers having NLDC, RLDCs, SLDCs as its members and constituted by the Forum of Regulators (FOR) in its 9$^{th}$ meeting held on 14$^{th}$ & 15$^{th}$ November 2008, with secretariat office at NLDC and having following Vision and Mission:

Vision

"*Forum of Load Despatchers envisions being a catalyst in reliable, efficient and economic operation of the Indian bulk electric power supply system*."

Mission

"*Forum of Load Despatchers of India shall strive to achieve its vision through technical cooperation, knowledge sharing, regular interaction, active collaboration, mutual respect, cooperation, consensus building, international benchmarking and promoting ethical, non-discriminatory and fair practices*."

(18) **'Grid Access'** means the permission granted by the [RLDC/SLDC] concerned for integration of the generating station including a stage or unit of the generating station, or licensees, buyers and sellers

with the grid on meeting the technical requirements;

(19) **'Licensee'** means a person granted a license under Section 14 of the Act;

(20) **'Logistics Function**' means support functions for System Operation including but not limited to the following:

(a) Engineering of new SCADA/EMS upgrades
(b) Synchro-phasor technologies
(c) Real time Applications
(d) Off-line applications
(e) Big Data Analytics tools
(f) Decision Support
(g) IT and Communication
(h) Website development, upgrading and maintaining
(i) Cyber security
(j) Access control
(k) Conference call facilities (multiple)
(l) Conference Rooms
(m) Work Area for statutory auditors
(n) Workstations for guests/interns
(o) Guest Wi-fi
(p) Power supply system
(q) Fire fighting
(r) Ergonomics
(s) Public Address System
(t) Operational philosophy (In house development/technology partner/outsourcing)

(21) **'Market Operation Function'** includes but not limited to the following functions:

(a) Facilitating Grid Access to new entities including but not limited to first time charging of new grid elements
(b) Market Design,
(c) Open Access Administration,
(d) Finalization of Inter-change schedules for energy accounting
(e) Day Ahead Market,
(f) Real Time Market,
(g) Ancillary Services Market,
(h) Interface Energy Metering,
(i) Accounting & Settlement and Pool Accounts,
(j) Taxation and TDS Reconciliation,
(k) Billing & Collection of LDC Fees and charges,
(l) Registry Function under REC / PAT and similar other mechanisms
(m) Legal & Regulatory Affairs, Policy Advocacy
(n) Information dissemination, RTI etc.

(o) Any other functions assigned to the NLDC/RLDCs/SLDC under the Act and/or National Load Despatch Centre Rules, 2005 ('NLDC Rules') or the regulations and orders issued by the Commission from time to time;

(22) **'National Load Despatch Centre' or 'NLDC'** means the Centre at the national level established by the Central Government under sub-section (1) of section 26 of the Act;

(23) **'Power System Operation Corporation Limited' or 'POSOCO'** means a company entrusted with the operation of the National Load Despatch Centre in accordance with Section 26 of the Act and Regional Load Despatch Centres in accordance with Section 27 of the Act or any other related function assigned by the Govt./ Commission from time to time [In case of States, a company/corporation/authority entrusted with the operation of State Load Despatch Centre, (if any) in line with Section 31 of the Act];

(24) **'Region'** means any one of the regions demarcated by the Central Government under Section 25 of the Act;

(25) **'Regional entity'** means an entity whose scheduling, metering and energy accounting is done at the regional level by the concerned Regional Load Despatch Centre;

(26) **'Regional Load Despatch Centre' or 'RLDC'** means the Centre for each region established by the Central Government under sub-section (1) of section 27 of the Act;

(27) **'Replacement Expenditure' or** '**REPEX'** means the expenditure incurred or projected to be incurred for replacement of capital assets on completion of their useful life but are not covered under the Repairs and Maintenance expenses;

(28) **'Regulatory Pool Account'** means the account operated by RLDCs or NLDC or SLDC under the relevant regulations or orders by the Commission for handling Deviation Settlement Charges, Reactive Energy Charges, Ancillary Services, Congestion Charges and Congestion amount due to market splitting or any other account / market product which may be operated by RLDCs or NLDC or SLDC from time to time as per the Regulations or directions of the Commission. SLDC/RLDCs/NLDC will operate these pool accounts as custodians and do not have any lien on the money deposited on these accounts.

(29) **'Scheme'** means the facilities and equipments associated with and installed at the NLDC, RLDCs, SLDC and Corporate office of Load Despatch Centre (if applicable), as the case may be, and shall include but shall not be limited to the following, namely:-

i) Supervisory control and data acquisition (SCADA) System, Wide Area Measurement System (WAMS), Renewable Energy Management Centre (REMC), Weather Portal and other such related information systems

ii) Computer systems, hardware and software, Cyber Security Systems, Multiple Video conferencing facilities, Voice Recording Systems

iii) Auxiliary power supply system comprising Uninterrupted Power Supply, Diesel Generating Set and DC power system,

iv) Communication system including redundant communication infrastructure – Satellite communication in addition to conventional systems,

v) Other infrastructure facilities, such as air-conditioning, fire-fighting and construction and

renovation of buildings,

vi) Any innovative schemes R & D projects and pilot projects for better system operation, such as Synchrophasors, System Protection Scheme,

vii) Back-up control centres for NLDC & RLDCs/ SLDCs,

viii) Surveillance System,

ix) Dual redundant internet connectivity for Web Servers of LDCs

x) NMS (Network Management Tool) & Asset management tool for Network & IT Asset Monitoring

xi) Cyber Security System infrastructure facilities such as Anti-APT (advanced Persistent Threat) monitoring & control Device, Local Area Network (LAN) Zone & Layer, Secure Sockets Layer (SSL) Certificate , SSL Virtual Private Network (VPN) and Security Information & Event Management (SIEM)

xii) Infrastructure to ensure high availability of the Information Technology (IT) and Operational Technology (OT) applications:

a) Redundant communication links / distribution path for IT / OT equipment

b) Redundant site infrastructure – DR

c) Multiple independent distribution path serving the equipment

d) Dual powered and fully compatible with the site topology

e) Concurrently maintainable site infrastructure

f) Cooling equipment dual powered including air-conditioning system

g) Fault tolerant site infrastructure with electrical power storage, standby power supply, distribution facility

h) Physical access security needs to be ensured for IT – OT infrastructure with biometric access, CCTV surveillance, fire alarm and fighting system, Very Early Smoke Detection and Alarm (VESDA).

xiii) Additional infrastructure facilities like 'Digital Signature', 'Instant Messaging for Business', 'Centralized Patch Management and Antivirus server', 'Syslog Server' and 'Enterprise class Backup and replication software' etc.

xiv) Future Technologies like Cloud Computing (e.g. PaaS (Platform as a Service), SaaS (Software as a Service), DaaS (Desktop as a Service) and are available on Public Cloud, Private Cloud and Hybrid Cloud), Big Data Analytics tools and Advanced data visualization tool (with GIS interfacing) etc.

xv) Ergonomically designed office equipments

(30) **'Seller'** means a person other than a generating company supplying power through medium term open access or long term access and whose scheduling, metering and energy accounting is coordinated by [Regional/State] Load Despatch Centre;

(31) **'State Entity' means** an entity whose scheduling, metering and energy accounting is done at the intra-state level by the concerned State Load Despatch Centre

(32) **'State Load Despatch Centre (SLDC)' means the center established under subsection (1) of section 31 of the Electricity Act, 2003;**

(33) **'System Operation Function'** includes but not limited to the following;:

**a) Operational Planning**

i) Load Forecasting
ii) RE forecasting
iii) Fuel security assessment
iv) Production cost optimization studies
v) Generating outage planning
vi) Transmission outage planning
vii) Assessment of Transfer Capability
viii) Reactive Power studies
ix) Short circuit and transient stability studies
x) small signal stability studies
xi) Electromagnetic transient studies
xii) Mock black start drills
xiii) Activation of back up control centre
xiv) Preparations for special events like festivals, natural calamities like cyclone, floods etc.
xv) Documentation of procedures (operating, restoration)

**b) Scheduling**

i) Day ahead security studies factoring all outages
ii) Day ahead unit commitment
iii) Day ahead optimization and scheduling
iv) Crew Resource Management
v) Anticipating and mitigating congestion
vi) Preparation for special events
vii) Handling requests for emergency/urgent outages unforeseen in operational planning horizon

**c) Real Time Operation**

i) Frequency Control
ii) Voltage control
iii) Tie line loading or congestion management
iv) Ensuring N-1 security at all times
v) Real Time Contingency Analysis
vi) Dynamic Security Assessment
vii) Monitoring weather updates
viii) Handling emergency outage requests
ix) Restoration of network after tripping
x) Rescheduling of generation
xi) Reporting of a grid disturbance (GD)/grid incident (GI)
xii) Periodic communication with stakeholders and sensitizing in case of emergency
xiii) De-briefing after an extreme event

**d) After the Fact or Post Despatch Analysis:**

i) Analysis of frequency and voltage

ii) Analysis of Grid Code violations and follow up with agencies

iii) Analysis of Grid Events (GD/GI)

iv) Evaluating primary response viz.computation of Frequency Response Characteristics (FRC) of individual control areas

v) Low Frequency Oscillations (LFO) monitoring and analysis

vi) Detailed reports of Grid Disturbances/Grid Events

vii) Simulation of events and learnings thereof

viii) Event replay, lessons learnt and dissemination of same

ix) Taking up shortcomings with stakeholders

**e)** Submission of Operational feedback to CEA/CTU/STU/CERC/SERC

**f)** Information dissemination and any other function(s) assigned to the NLDC/RLDCs/SLDC, as the case may be, under the Act or NLDC Rules or regulations and/or orders issued by the Appropriate Commission from time to time;

(34) **'User'** means the generating companies, distribution licensees, buyers, Bulk consumers (SEZ), sellers and [inter/intra]-State transmission licensees, Demand Response Consumers, EV Charging Stations, Grid Reliability Service Users like NHPTL or any other such entity(ies) who use the [inter/intra]-state transmission network or the associated facilities and services of National/Regional/State Load Despatch Centre:

**Note:**

(1) A generating station or unit whose scheduling, metering and energy accounting is carried out separately for each stage or unit, such generating station or stage or unit shall be considered as a user for the purpose of sharing of Annual LDC Charges (ALC) in accordance with Regulation 25 of these Regulations and for payment of registration fees in accordance with Regulation 24 of these Regulations;

(2) In case of [inter/intra]-State transmission licensees, each [Region/State] where the licensee has the operation shall be considered as a user for the purpose of these Regulations;

(3) Where the inter-State Transmission System is having cross-border international connections, the agency designated by Government of India for coordinating the scheduling, metering and energy accounting for the transaction carried out for import and export of power through the said transmission system shall be considered as a user for the purpose of these Regulations;

(4) Where any international/cross border generating station is connected to the inter-state transmission system of the Indian National Grid and injecting power through short/medium or long term PPA, the agency designated by Government of India for coordinating the scheduling, metering and energy accounting for the transaction carried out for import and export of power through the said transmission system shall be considered as a user for the purpose of these Regulations;

(5) The Sardar Sarovar Project (SSP) and Bhakra Beas Management Board (BBMB), whose scheduling, metering and energy accounting is carried out by the concerned RLDCs, shall be

considered as users for the purpose of this Regulation;

(6) Distribution licensee selling power through LTA/MTOA and using transmission system shall be considered as a user under the category "Seller" for the purpose of these Regulations;

(7) Any other entity which may use services of the SLDC/RLDC/NLDC from time to time;

(35) **'Year'** means a financial year;

(36) The words and expressions used in these regulations and not defined herein but defined in the Act shall have the meaning assigned to them under the Act or the CERC (Indian Electricity Grid Code) Regulations 2010 as amended from time to time.

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## CHAPTER-2

## GENERAL

**4. Registration**

(1) The users shall register with the respective [National/Regional/State] load Despatch Centre for commencement of Grid Access for availing system operation services of [(RLDCs or NLDC)/SLDC] as under:

(a) All generating stations, distribution licensees and [inter/intra]-State transmission licensees or any other user defined under clause 3(33) of these regulations intending to avail the Grid Access shall register themselves with concerned [National/Regional/State] Load Despatch Centre responsible for scheduling, metering, energy accounting and switching operations, not less than 30 days prior to intended date of commencement of Grid access, by filing an application in the format prescribed as **Appendix-IV** to these regulations:

Provided that when a unit is added to a generating station, the generating company, as the case may be, shall send an intimation to the concerned [RLDC(s)/SLDCs] for updating its records;

Provided that when an element is added to a transmission system, transmission licensee shall send intimation to the concerned [RLDC (s)/SLDCs] for updating its records by 20th of every month.

(b) The buyers and sellers who intend to avail grid access shall register themselves with the concerned [National/Regional/State] Load Despatch Centre not less than 30 days prior to intended date of commencement of grid access by filing an application in the format prescribed as **Appendix-IV** to these regulations;

(c) The Power exchanges and traders who intend to avail the services of [(RLDCs and NLDC)/SLDC] shall register themselves with the National Load Despatch Centre and State Load Despatch Centre by filing an application in the format prescribed as Appendix-IV to these regulations.

(2) The [(Regional Load Despatch Centres and National Load Despatch Centre)/State Load Despatch Centre], as the case may be, after scrutinizing applications for registration and on being satisfied with correctness of the information furnished in the application shall register the applicant and send a written intimation to an applicant:

Provided that the generating companies, licensees, power exchanges, buyers and sellers who have been registered as per [Central/State] Electricity Regulatory Commission ([RLDC/SLDC] Fees and Charges and other related matters) Regulations, 2009 & 2014 shall be deemed to have been registered with the [(RLDCs or NLDC)/SLDCs], as the case may be, under these Regulations and they shall not to pay the registration fee as required under Regulation 24 of these Regulations.

(3) The generating companies, distribution licensees, [inter/intra]-State transmission licensees, power exchanges, traders, sellers and buyers and any other user as specified in Regulation 3(33) shall pay the registration fees as specified in these Regulations.

(4) [(Regional Load Despatch Centres and National Load Despatch Centre)/State Load Despatch Centre] shall maintain a list of registered users on their website along with their date of registration.

**5. Capital Expenditure (CAPEX) and Replacement Expenditure (REPEX) Plan:**

(1) The [(Regional Load Despatch Centres and National Load Despatch Centre)/State Load Despatch Centre] shall formulate the scheme for Capital Expenditure (CAPEX) and Replacement Expenditure (REPEX) for the control period duly approved by the Board of Load Despatch Centre. The CAPEX and REPEX plan shall also include future costs to be incurred for the up-gradation, modernization, automation and expansion of infrastructure in addition to existing capital assets.

(2) The concerned [(Regional Load Despatch Centre and National Load Despatch Centre)/ State Load Despatch Centre] shall submit the following along with the petition for determination of fees and charges:

(a) the CAPEX for the control period of 2019-24 along with details of estimated expenses, financing plan and estimated completion period of each scheme ;

(b) the REPEX plan for capital expenditure of existing asset, completion of life of existing asset, cumulative depreciation recovered, date of replacement, cumulative repayment of loan upto date of replacement, writing off of the gross value of the original assets from the original fixed assets along with estimated expenses and estimated completion period of each scheme.

(3) In relation to any consolidated schemes of CAPEX and REPEX involving one or more RLDCs and/or NLDC, the capital expenditure chargeable to each RLDC and NLDC shall be segregated and considered as a part of capital expenditure of RLDC concerned and NLDC, as the case may be (Applicable only to RLDCs and NLDC).

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## CHAPTER-3

## APPLICATION FOR FEES AND CHARGES, COMPUTATION OF CAPITAL COST AND CAPITAL STRUCTURE

**6. Application for determination of fees and charges**

(1) The [(RLDC and NLDC)/SLDC] shall make application in the formats annexed as **Appendix-I** to these regulations within 180 days from the date of notification of these Regulations, for determination of fees and charges for the control period, based on capital expenditure incurred and duly certified by the auditor as on 1.4.2019 and projected to be incurred during the control period based on the CAPEX and the REPEX.

(2) The application shall contain particulars such as source of funds, equipments proposed to be replaced, details of assets written off, and details of assets to be capitalized etc.

(3) Before making the application, the concerned [(RLDC or NLDC)/SLDC], as the case may be, shall serve a copy of the application on the users and submit proof of service along with the application. The concerned [(RLDC or NLDC)/SLDC] shall also keep the complete application posted on its website till the disposal of its petition.

(4) The concerned [(RLDC or NLDC)/SLDC], as the case may be, shall within 7 days after making the application, publish a notice of the application in at least two daily newspapers, one in English language and one in Indian modern language, having circulation in each of the States or Union Territories where the users are situated, in the same language as of the daily newspaper in which the notice of the application is published, in the formats given in **Appendix-II** to these regulations. NLDC/RLDCs/SLDCs will recover such expenditure on publication of notice of the application from the Users as one-time expenditure.

(5) The concerned [(RLDC or NLDC)/SLDC], as the case may be, shall be allowed the fees and charges by the Commission based on the capital expenditure incurred as on 1.4.2019 and projected to be incurred during control period on the basis of CAPEX and REPEX duly certified by the auditor in accordance with these Regulations:

Provided that the application shall contain details of underlying assumptions and justification for the capital expenditure incurred and the expenditure proposed to be incurred in accordance with the CAPEX and REPEX.

(6) If the application is inadequate in any respect as required under **Appendix-I** of these regulations, the application shall be returned to the concerned RLDC or NLDC or SLDC for resubmission of the petition within one month after rectifying the deficiencies as may be pointed out by the staff of the Commission.

(7) If the information furnished in the petition is in accordance with the regulations and is adequate for carrying out prudence check of the claims made, the Commission shall consider the suggestions and objections, if any, received from

the respondents and any other person including the consumers or consumer associations. The Commission shall issue order determining the fees and charges order after hearing the petitioner, the respondents and any other person permitted by the Commission.

(8) During pendency of the application, the applicant shall continue to bill the users on the basis of fees and charges approved by the Commission during previous control period and applicable as on 31.3.2019, for the period starting from 1.4.2019 till approval of the Fees and Charges by the Commission, in accordance with these Regulations.

(9) After expiry of the control period, the applicant shall continue to bill the users on the basis of fees and charges approved by the Commission and applicable as on 31.3.2024 for the period starting from 1.4.2024 till approval of fees and charges under the applicable regulations.

**7. Determination of Fees and Charges**

(1) The Fees and Charges shall be determined separately for each of the [(Regional Load Despatch Centres and National Load Despatch Centre)/State Load Despatch Centre];

Provided that the annual charges of NLDC including corporate office expenses for the control period shall be apportioned among Regional Load Despatch Centre on the basis of the peak demand served (in MW) in the respective region as indicated on CEA's website for the preceding year (applicable only to NLDC & RLDCs).

**8. Truing up of Annual Charges**

(1) The [(RLDCs and NLDC)/SLDCs] shall make an application, in the formats annexed as Appendix-I to these regulations by 31.10.2024, for carrying out truing up exercise after end of the control period.

(2) The [(RLDCs and NLDC)/SLDCs] shall submit, along with the application for truing up, details of capital expenditure including additional capital expenditure, sources of financing, human resource expenditure, operation and maintenance expenditure etc. incurred for the period from 1.4.2019 to 31.3.2024, duly audited and certified by the auditor.

(3) The Commission shall carry out truing up exercise along with the application for determination of fees and charges for the next control period based on the capital expenditure including additional capital expenditure incurred up to 31.3.2024 and as admitted by the Commission after prudence check at the time of truing up:

Provided that each of the Regional Load Despatch Centre or National Load Despatch Centre or the State Load Despatch Centre, as the case may be, shall carry out truing up of expenditure based on the capital expenditure including additional capital expenditure up to 31st March of each financial year of the control period and refund the additional recovery of fees and charges to the users by 30$^{th}$ September of the following year.

Provided that each of the Regional/State/National Load dispatch centre, as the case may be shall carry out mid-term review of its expenses if the same is felt necessary in view of the emergent situation such as pay revision, significat deviation w.r.t. approved CAPEX/REPEX etc., and may suitably file the Mid Term Review Petition before the appropriate commission.

(4) The amount under-recovered or over-recovered by each of the Regional Load Despatch Centres or

National Load Despatch Centre or State Load Despatch Centre, as the case may be, along with simple interest at the rate equal to the bank rate as on 1st April of the respective year, shall be recovered or refunded by the respective RLDCs or NLDC or SLDCs or users, as the case may be, in six equal monthly instalments starting within three months from the date of the order issued by the Commission after the truing up exercise.

**9. Computation of Capital Cost**

(1) The capital cost as admitted by the Commission after prudence check, for each of the Regional Load Despatch Centre or NLDC or SLDC, as the case may be, shall form the basis for determination of annual charges.

(2) The capital cost shall be computed by considering the following:

i) The Capital cost as admitted by the Commission as on 01.04.2019 duly trued up by excluding liability, if any;

ii) Expenditure on account of additional capitalization and de-capitalization determined in accordance with the Regulation 10;

iii) The original capital cost of the fixed assets which has been replaced during control period shall be de-capitalized from the admitted capital cost from the respective date duly adjusting cumulative depreciation and cumulative repayment, if any;

iv) Interest during construction and incidental expenditure during construction;

v) Any grant received from the Central or State Government or any statutory body or authority for execution of the project which does not carry any liability of repayment shall be excluded from the Capital Cost for the purpose of computation of interest on loan, return on equity and depreciation;

(3) The Capital cost shall be admitted after prudence check which may include scrutiny of the reasonableness of the capital expenditure, financing plan, Interest During Construction (IDC), Incidental Expenditure During Construction (IEDC), financing charges, any gain or loss on account of Foreign Exchange Rate Variation (FERV), and such other matters as may be considered appropriate by the Commission:

Provided further that interest during construction shall be computed corresponding to the loan from the date of infusion of debt fund, and after taking into account the prudent phasing of funds duly adjusting IDC on account of time over run if any;

Provided further that incidental expenditure during construction shall be computed after prudence check duly adjusting the IEDC on account of time over run if any, interest on deposits or advances, or any other receipts and liquidated damages recovered or recoverable corresponding to the delay.

**10. Additional Capitalization and De-Capitalization**

(1) The capital expenditure incurred or projected to be incurred for the assets already in service and the additional assets projected to be procured during tariff period may be admitted, in its discretion, by the Commission, subject to prudence check.

(2) To ensure that good occupational health practices in Load Despatch Centres, ergonomically designed furniture/Office equipments may be admitted, in its discretion, by the Commission.

(3) In case of de-capitalization of assets under the REPEX or otherwise, the original cost of such asset as on the date of de-capitalization shall be deducted from the value of gross fixed asset along with corresponding adjustment in equity, outstanding loan, cumulative repayment of loan and depreciation in the year such de-capitalization takes place.

**11. Debt-Equity Ratio**

(1) The actual debt - equity ratio as admitted by the Commission for the period ending 31.3.2019 shall be considered for the opening capital cost of each of the [(Regional Load Despatch Centres and National Load Despatch Centre)/State Load Despatch Centre], as the case may be.

(2) The capital expenditure incurred prior to 1.4.20..[…], where debt - equity ratio has not been determined by the Commission for determination of annual charges of RLDC/SLDC for the period ending 31.3.20[..], the Commission shall determine the debt: equity ratio in accordance with Regulation […] of the [Central/State] Electricity Regulatory Commission (Fees and Charges for [Regional/National/State] Load Despatch Centres and other related matters) Regulations, 20[..].

(3) For the capital expenditure incurred or projected to be incurred on or after 1.4.2019, the debt-equity ratio shall be considered as 70:30. If the equity actually deployed is more than 30% of the capital cost, equity in excess of 30% shall be treated as normative loan:

Provided that:

i. where equity actually deployed is less than 30% of the capital cost, actual equity shall be considered for determination of Return on Equity;

ii. the equity invested in foreign currency shall be designated in Indian rupees the date of each investment;

iii. any grant obtained for the execution of the project shall not be considered as a part of capital structure for the purpose of debt - equity ratio.

**Explanation:** The premium, if any, raised by the [Power System Operation Corporation Limited. (POSOCO) / Load Despatch Centre] while issuing share capital and investment of internal resources created out of its free reserve, for the funding of the project, shall be reckoned as paid up capital for the purpose of computing return on equity, only if such premium amount and internal resources are actually utilised for meeting the capital expenditure of the RLDC/SLDC.

**12. LDC [Strengthening/Empowerment/Evolution] [Reserve/Pool/Kitty]**

(1) The Load Despatch Centre shall create and maintain a separate fund called 'Load Despatch Centre [Strengthening (S)/Empowerment (E)/Evolution(E)] [Reserve/Pool/Kitty]' ('LDC[S/E/E] [Reserve/Pool/Kitty]') for administering capital expenditure.

(2) The charges on account of return on equity, interest on loan, depreciation of the [(Regional Load Despatch Centres and National Load Despatch Centre)/State Load Despatch Centre] including the registration fee, shall be deposited into the LDC[S/E/E] [Reserve/Pool/Kitty] after meeting the statutory tax requirements:

Provided that short term open access charges and other income of RLDCs or NLDC or SLDCs, if

any, shall not form part of the LDC[S/E/E] [Reserve/Pool/Kitty].

(3) The [Power System Operation Corporation /LDC] shall be entitled to utilise the money deposited in the LDC[S/E/E] [Reserve/Pool/Kitty] for creation of new assets, loan repayment, servicing the capital raised in the form of interest and dividend payment (Restricted to percentage (allowed in proviso 16(2) of these Regulations) of Paid up Capital, meeting stipulated equity portion in asset creation, margin money for raising loan from the financial institutions, Corporate Social Responsibility and Sustainability Activities in compliance of the applicable provisions of the Companies Act and DPE Guidelines issued and amended from time to time, Capacity Building of [(State Load Despatch Centres and other users / stake holders by RLDCs/NLDC/POSOCO directly)/(Sub-LDCs & other stake holders within State by SLDC directly)] and using the platform of Forum of Load Despatchers (FOLD) through In-house facilities/ through Institutes of repute like NPTI/PSTI/IITs/IIM etc. and funding of R & D projects.

(4) To ensure betterment of Power System, it is imperative that LDC promotes interaction among stakeholders, shares and learns the best practices, quickly adopts technologies through using the platforms such as FOLD. LDC will ensure payment of any fees like membership fees or any other recurring or non-recurring expenditure related to the participation in the activities of the FOLD from its LDC[S/E/E] [Reserve/Pool/Kitty]. NLDC, as the secretariat of FOLD, to deposit such fees to its LDC[S/E/E] [Reserve/Pool/Kitty] after meeting the expenses on FOLD activities, if any.

(5) The LDC[S/E/E] [Reserve/Pool/Kitty] shall not be utilized for any other revenue expenditure. However, in case of shortfall in meeting the revenue expenditure including human resource expenses, Load Despatch Centre shall be entitled to take interest free advance from LDC[S/E/E] [Reserve/Pool/Kitty] which shall be recouped from the expenditure allowed by the Commission under the respective heads at the time of truing up to be carried out after the expiry of the control period 2019-24.

(6) Any asset created by the Power System Operation Corporation Ltd. out of the money deposited into the LDC[S/E/E] [Reserve/Pool/Kitty] shall be considered for computation of return on equity at a nominal rate of 10% , and depreciation as per the rates specified in these Regulations. There will be no Interest on Loan on same principles as in case of grant. Load Despatch Centre shall submit details of such assets in the CAPEX plan.

(7) Load Despatch Centre shall submit the amount accumulated in LDC [Strengthening (S)/Empowerment (E)/Evolution(E)] [Reserve/Pool/Kitty]along with the break-up of sources from where the fund is received.The Commission shall review the Load Despatch Centre [Strengthening (S)/Empowerment (E)/Evolution(E)] [Reserve/Pool/Kitty] every year and issue directions to Load Despatch Centre for effective utilization of the funds, if required.

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## CHAPTER-4

## [RLDC/NLDC/SLDC] FEES AND CHARES STRUCTURE

**13. Components of [RLDC/SLDC] Fees and Charges:** The [NLDC/RLDC/SLDC] Fees and Charges shall comprise [National/Regional/State] Load Despatch Centre Fees to be recoverable by [Power System Operation Corporation /Load Despatch Centre] towards registration for commencement of grid access and scheduling and annual charges to be collected in the form of Annual LDC Charges from users.

**14. Annual LDC Charges (ALC)**: The annual LDC charges shall correspond to the expenditure proposed to be incurred by the RLDC/SLDC/NLDC and as approved by the appropriate Commission. - . The annual LDC charges as approved by the Appropriate Commission shall be recovered on monthly basis . The annual charges shall consist of the following components, namely:

(a) Return on equity;

(b) Interest on loan capital;

(c) Depreciation;

(d) Operation and maintenance (excluding human resource) expenses;

(e) Human resource expenses including Human Resource Development expenses;

(f) NLDC & Corporate office expenses /RLDC [as applicable] charges; and

(g) Interest on working capital;

**15. Monthly LDC Charges:** The monthly LDC charges shall be calculated for the [inter/intra]-State transmission licensees, generating stations, sellers and distribution licensees and buyers as under:

(a) The LDC Charges for [inter/intra]-state transmission licensees shall be determined on the basis of 33.33% of approved annual charges and shall be worked out on the basis of the circuit kilometers (ckt-km) of the lines owned by [inter/intra]-state transmission licensees;

(b) The LDC Charges for the [inter/intra]-state Generating station and sellers shall be determined on the basis of 33.34% of annual LDC charges and shall be worked out on the basis of installed capacity in case of the generating station and long term and/or medium term contracted capacity in case of sellers;

(c) The LDC Charges for the distribution licensees and buyers shall be determined on the basis of 33.34% of annual charges and shall be worked out on the basis of sum of aggregate allocated capacity and/or contracted capacities in case of distribution licensee including deemed distribution licensees and sum of long term and/or medium term contracted capacity in case of buyer.

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## CHAPTER-5

## COMPUTATION OF ANNUAL LDC CHARGES (ALC)

**16. Return on Equity**

(1) Return on equity shall be computed in Rupee terms on the equity base determined in accordance with Regulation 11 of these regulations.

(2) Return on equity shall be computed on pre-tax base rate of [….%] to be grossed up as per the sub-clause (3) of this regulation.

(3) The rate of return on equity shall be computed by grossing up the base rate with the effective tax rate of the financial year 2019-20 applicable to the [Power System Operation Company/Load Despatch Centre]:

Provided that the return on equity with respect to the actual tax rate applicable to the [Power System Operation Company/Load Despatch Centre] in line with the provisions of the relevant Finance Acts of the respective year during control period shall be trued up at the end of the control period.

(4) Rate of return on equity shall be rounded off to three decimal points and be computed as per the following formula:

Rate of pre-tax return on equity = Base rate/ (1-t)

Where 't' is the effective tax rate in accordance with sub-clause (3).

**17. Interest on Loan Capital**

(1) The loan determined in accordance with Regulation 11 shall be considered as gross normative loan for calculation of interest on loan.

(2) The normative loan outstanding as on 01.04.2019 shall be worked out by deducting the cumulative repayment as admitted by the Commission up to 31.03. 2019 from the gross normative loan.

(3) The repayment for respective year of the control period shall be deemed to be equal to the depreciation allowed for that year. In case of de-capitalization of assets, the repayment shall be adjusted by taking into account cumulative repayment on a pro-rata basis and the adjustment should not exceed cumulative depreciation recovered up to the date of de-capitalization of such asset.

(4) The rate of interest shall be the weighted average rate of interest calculated on the basis of the actual loan portfolio at the beginning of each year applicable to the respective [National/Regional/State] Load Despatch Centre:

Provided that if there is no actual loan for a particular year but normative loan is still outstanding, the last available weighted average rate of interest shall be considered;

Provided further that if any of the [National/Regional/State] Load Despatch Centre does not have actual loan, then the weighted average rate of interest on the loan of [Power System Operation Company/Load Despatch Centre] as a whole shall be considered.

(5) The interest on loan shall be calculated on the normative average loan of the year by applying the

weighted average rate of interest.

(6) The [Power System Operation Corporation /Load Despatch Centre] shall make every effort to re-finance the loan as long as it results in net savings on interest and in that event the costs associated with such re-financing shall be borne by the users and the net savings shall be shared between the users and the [Power System Operation Corporation /Load Despatch Centre] in the ratio of 2:1. The changes to the terms and conditions of the loans shall be reflected from the date of such re-financing.

(7) In case of dispute, any of the parties may make an application in accordance with the [Central/State] Electricity Regulatory Commission (Conduct of Business) Regulations, [Year], as amended from time to time, including statutory re- enactment thereof, for settlement of the dispute:

Provided that the users shall not withhold any payment on account of the interest claimed by the users and the [Power System Operation Company/Load Despacth Centre] during the pendency of any dispute arising out of re-financing of loan.

**18. Depreciation**

(1) The value base for the purpose of depreciation shall be the capital cost of the assets admitted by the Commission.

(2) The salvage value of the asset (excluding IT equipment and Software) shall be considered as 10% and depreciation shall be allowed up to maximum of 90% of the capital cost of the asset. The salvage value for IT equipments and software shall be considered as NIL and 100% value of the assets shall be considered as depreciable.

(3) Land shall not be a depreciable asset and its cost shall be excluded from the capital cost while computing depreciable value of the capital cost of the asset.

(4) Depreciation shall be calculated annually based on Straight Line Method and at rates specified in Appendix-III to these regulations for the assets of the State Load Despatch Centre/Regional Load Despatch Centre/National Load Despatch Centre/ [Power System Operation Company/Load Despatch Centre].

(5) Assets fully depreciated shall be shown separately.

(6) Value of the assets not in use or declared obsolete shall be taken out from the capital cost for the purpose of calculation of depreciation.

(7) The balance depreciable value as on 1.4.2019 shall be worked out by deducting the cumulative depreciation from the gross depreciable value of the assets appearing in the books of accounts of the [Load Despatch Centre/ Power System Operation Company] for the respective State Load Despatch Centre/ Regional Load Despatch Centre/National Load Despatch Centre & Corporate Office of the Company .

(8) In case of de-capitalization of assets in respect of concerned SLDC/RLDC/NLDC/Corporate Office of the Company, the cumulative depreciation shall be adjusted by taking into account the depreciation recovered in tariff by the de-capitalized asset during its useful services.

**19. Operation and Maintenance Expenses**

(1) Operation and maintenance (O&M) expenses (excluding human resource expenses) shall be derived on the basis of actual operation and maintenance expenses for the years 2014-15 to 2018-19, based on the audited balance sheets. The O&M expenses shall be normalized by excluding abnormal operation

and maintenance expenses, donation, loss-in-inventory, prior-period adjustments, claims and advances written-off, provisions, etc, if any, after prudence check by the Commission

(2) The normalized operation and maintenance expenses, after prudence check, for the years 2014-15 to 20183-19, shall be escalated at the rate of […..%] to arrive at the normalized operation and maintenance expenses at the 2018-19 price level respectively and then averaged to arrive at normalized average operation and maintenance expenses for the 2014-15 to 2018-19 at 2018-19 price level. The average normalized operation and maintenance expenses of 2018-19 price level shall be escalated at the escalation rate as worked out in accordance with clause(4) of this Regulation to arrive the operation and maintenance expenses for the year 2019-20.

(3) The operation and maintenance expenses for the year 2019-20 shall be escalated further at the annual escalation rate as worked out in accordance with clause (4) this Regulation to arrive at permissible operation and maintenance expenses for the subsequent years of the control period.

(4) The escalation rate shall be worked out by considering the compounded annual growth rate, inflation rate, rationalization of O&M expenses and other factors, if any.

(5) The actual expenditure towards Annual Maintenance Contract (AMC) of SCADA system, after prudence check, shall be considered for arriving at the Operation and Maintenance Expenses during 2019-20 to 2023-24.

**20. Human Resource Expenses**

(1) Human resource expenses shall be derived on the basis of actual human resource expenses for the years 2014-15 to 2018-19 based on the audited balance sheets. The human resource expenses shall be normalized by excluding abnormal Human resource expenses, ex-gratia, VRS expenses, prior-period adjustments, claims and advances written-off, provisions, etc, if any, after prudence check by the Commission:

Provided that performance related pay computed in accordance with DPE guidelines shall be met from the incentive allowed in accordance with sub- clause (5) of Regulation 29 of these Regulations.

(2) The normalized human resource expenses, after prudence check, for the year 2014-15 to 2018-19, shall be escalated at the rate of […..% ]to arrive at the normalized human resource expenses at the 2018-19 price level respectively and then averaged to arrive at normalized average human resource expenses for the 2014-15 to 2018-19 at 2018-19 price level.

(3) The manpower approved during the year 2018-19 shall be the basis for computation of the HR expenses for 2019-20. Thereafter, for the subsequent years, the HR expenses shall be escalated at the annual escalation rate.

(4) The average normalized human resource expenses of 2018-19 price level shall be escalated at the escalation rate as worked out in accordance with clause (6) this Regulation to arrive the operation and maintenance expenses for the year 2019-20.

(5) The human resource expenses for the year 2019-20 shall be escalated further at the annual escalation rate as worked out in accordance with clause (6) this Regulation to arrive at permissible human resource expenses for the subsequent years of the control period:

(6) The escalation rate shall be worked out by considering the compound annual growth rate, inflation rate, rationalization of human resource and other factors, if any.

(7) The cost of anticipated increase in the manpower of each year of the control period shall also be considered after prudence check. The strength of manpower required for effective functioning of RLDCs/NLDC/SLDC will be as approved by the CERC / Appropriate Commission while specifying the fees and charges.

(8) Human Resource Development (HRD) expenses, incurred by the NLDC/RLDC/SLDC will be a part of HR Expenses from FY 2019-20 onwards. In addition to the capacity building of the employees of LDC, capacity building workshops / training programs organized for other stakeholders will also form part of the HRD expenses Projected annual HRD expenses will be at least 5% of the HR expenses arrived based on the methodology defined above. However, if the actual utilization towards HRD expenditure exceeds the 5% of HR expenses of any year, it shall be allowed at the time of truing up by the Commission after prudence check. In case of less than 5% utilization, it shall be refunded at the time of annual truing up to be done by NLDC/RLDCs by 30$^{th}$ September every year. All efforts will be made to ensure minimum seven days training per employee per annum is imparted as per the National Training Policy.

**21. Interest on Working Capital**

(1) The working capital shall cover:

(i) Operation and maintenance expenses (excluding human resource expenses) for one month;

(ii) Human resource expenses including Human Resource Development Expenses for one month;

(iii) NLDC charges for one month (applicable to RLDCs only); and

(iv) Receivables equivalent to two months of annual charges as approved by the Commission.

(2) Rate of interest on working capital shall be on normative basis and shall be considered as the bank rate as on 1.4.2019.

(3) Interest on working capital shall be payable on normative basis notwithstanding that the [Power System Operation Company/Load Despatch Centre] has not taken any loan for working capital from any outside agency.

**22. [(NLDC Charges and Corporate Office)/RLDC Charges] Expenses**

(1) To the extent applicable, NLDC charges shall be computed by following the methodology specified for computing annual charges of Regional Load Despatch Centres except interest on working capital.

(2) The Corporate Office Expenses, computed in accordance with the actual expenses incurred, shall be allowed by the Commission, after prudence check.

(3) The expenditure towards running the FOLD Secretariat computed in accordance with the actual expenses incurred, shall be allowed by the Commission, after prudence check.

(4) All expenses of NLDC and Corporate Office expenses approved by the Commission shall be apportioned to the Regional Load Despatch Centre on the basis of the peak demand served (in MW) in the respective region as indicated in CEA's website for the preceding year.

(5) RLDC Charges being paid by the SLDC shall be approved by the Commission while allowing the Annual Fees & Charges of Load Despatch Centre.

**23. Contingency Expenses**

(1) The [Power System Operation Company/ Load Despatch Centre] shall maintain a separate account for the other income like short term open access charges and REC charges, PAT Charges, other charges (if

any) etc.

(2) The [Power System Operation Corporation/Load Despatch Centre] shall use such income to meet the short fall, if any, in the annual charges allowed by the Commission or to meet the contingency expenses which were not foreseen at the time of making the application for fees and charges and are considered necessary for the efficient power system operation. Recovery of Contingency expenses incurred for works assigned by the Commission will be allowed after prudence check.

(3) The balance amount shall be deposited into the LDC Strengthening Reserve after meeting the statutory tax requirements.

(4) There may be some requirements for which funds available under the contingency expenses are not enough to meet the unforeseen requirements. Such short fall may be met from the LDC strengthening reserve.

***

## CHAPTER-6

## COMPUTATION AND PAYMENT OF FEES AND LDC CHARGES

**24. Registration Fees:** The fees shall be payable by the users including power exchanges and electricity traders before commencement of grid access and scheduling for system and market operation. The fees payable are as under:

(1) The distribution licensees and [inter/intra]-State transmission licensees shall pay non-refundable one-time registration fee of Rs. 10 Lakh along with application for commencement of grid access:

Provided that the [RLDCs/SLDCs] concerned shall be intimated by 20th of every month by the [inter/intra]-State transmission licensees about the existing as well as additions of transmission elements synchronized with the grid and by the distribution licensees about the additional capacity tied up for the purpose of updating the record by concerned RLDC/SLDC;

Provided that all other users having NIL contracted capacity shall be charged on the basis of a minimum capacity of 100 MW which is the least MW load for which an entity is eligible for grant of connectivity to ISTS as per the Connectivity Regulations of the Central Commission.

(2) The generating companies shall pay registration fee as under:

a) For generating station up to 10 MW installed capacity: Rs. 0.50 Lakh;

b) Generating stations having installed capacity of not less than 10 MW and up to 100 MW: Rs. 1.0 Lakh;

c) Generating stations having installed capacity of not less than 100 MW and up to 2000 MW : Rs. 5.0 Lakh;

d) Generating stations having capacity of 2000 MW and above : Rs.10.0 Lakh, and;

e) Provided that the entire capacity of the generating station or stage thereof whose scheduling, metering and energy accounting is done separately shall be considered for the purpose of registration fee at the time of the initial registration;

f) Provided further that the generating companies shall intimate RLDCs/SLDCs concerned about the additional capacity commissioned by the generating station or a stage thereof in the previous month by 20th day of each month.

(3) The [inter/intra]-State trading licensees, sellers and buyers shall pay one time registration fee of Rs. 10,000.00 (Rupees Ten Thousands only) along with application for commencement of scheduling for market operation.

(4) The Power exchanges shall pay Rs. 20.0 Lakh (Rupees Twenty Lakh only)as one time registration fees to NLDC and shall pay […….] as one time registration fee to SLDC.

**25. Computation and Payment of LDC Charges**:

(1) The rates of LDC charges for [inter/intra]-state transmission licensee shall be computed on annual basis and recovered on monthly basis in accordance with following formula;

Monthly LDC Charge rate (for Transmission Licensee) =

(33.30%) [ALC/(Ckt_Km)]/12 in Rs./kilometer

Where,

ALC = Approved Annual LDC Charges in accordance with Regulation 14;

Ckt_Km = Length of aggregate [inter/intra]-state transmission lines as on last day of the month prior to the month of billing (rounded off to the nearest two decimals);

Provided that the monthly LDC charges for individual transmission licensee shall be computed on the basis of rates determined above and the length (in Ckt_ Km) of transmission lines owned and operated by the respective transmission licensee(s).

(2) The rates of LDC charges for generating companies and sellers shall be computed on annual basis and recovered on monthly basis in accordance with following formula:

Monthly LDC Charge rate (for Generation or seller) =

(33.34%) (ALC/(Capacity))/12 in Rs./ MW

Where,

ALC = Approved Annual LDC Charges in accordance with Regulation 14;

Capacity = Aggregate Installed capacity (in MW) of generating stations and contracted capacity (in MW) of the sellers (rounded off to the nearest two decimals) whose scheduling and energy accounting is covered under concerned RLDC/SLDC as on last day of the month prior to the month of billing;

Provided that the monthly LDC charges for generating companies or sellers shall be computed on the basis of rates determined above and respective capacity of the generating station or seller.

(3) The rates of LDC charges for distribution licensee and buyers shall be computed on annual basis and recovered monthly after taking into account aggregate contracted capacity in accordance with following formula:

Monthly LDC Charge rate (for Distribution Licensee or buyer) =

(33.34%) (ALC/ (Capacity))/12 in Rs./ MW

Where,

ALC = Approved Annual LDC Charges in accordance with Regulation 14;

Capacity = Aggregate long term or medium term contracted capacity by distribution licensees and buyers (rounded off to the nearest two decimal) whose scheduling and accounting is covered under concern RLDC/SLDC as on last day of the month prior to the month of billing;

Provided that the monthly LDC charges from distribution licensees and buyers shall be collected in proportion to the sum of their allocations and contracted capacities, as the case may be, as on the last day of the month prior to billing of the month.

(4) The respective State Load Despatch Centre (SLDC) shall be the nodal agency for collection of monthly LDC charges payable to the concerned Regional Load Despatch Centre (RLDC), from the distribution licensees in the State. After collecting the monthly LDC charge the concerned SLDC shall deposit the same into the account of the concerned RLDC.

**26. National Load Despatch Centre charges and corporate office expenses:** All the expenses of National Load Despatch Centre and Corporate Office, as approved by the Commission, shall be apportioned to the Regional Load Despatch Centres on the basis of the demand served in the respective regions. The expenditure incurred for activities envisaged for the Forum of Load Despatchers(FOLD) shall be booked

under NLDC charges & corporate office expenses.

***

## CHAPTER-7

## PERFORMANCE LINKED INCENTICE

**27. Performance linked incentive to [(RLDCs and NLDC)/SLDC]**

(1) Recovery of incentive by the [National/Regional/Name of the State] Load Despatch Centre shall be based on the achievement of the Key Performance Indicators as specified in **Appendix-V** or such other parameters as may be prescribed by the Commission.

(2) Each [National/Regional/Name of the State] Load Despatch Centre shall submit its actual performance against each of the key performance indicators to the Commission on annual basis as per the format specified in **Appendix-V**.

(3) [NLDC/RLDC/SLDC] shall submit the details in regards to each Key Performance Indicator in the format specified in **Appendix-V** along with the methodology for approval of the Commission.

(4) The Commission shall evaluate the overall performance of the SLDC/RLDCs and/or NLDC, as the case may be, on the basis of weightage specified in **Appendix-V**. The Commission, if required, may seek advice of the Central Electricity Authority for evaluation of the performance of system operator.

(5) The SLDC/RLDCs or NLDC, as the case may be, shall be allowed to recover incentive of 10 % of Annual Gross Turnover/Sales for aggregate performance level of 85% for three years commencing from 1.4.2019. The incentive shall increase by 1% of annual charges for every 5% increase of performance level above 85%:

Provided that incentive shall be reduced by 1% of annual charges on pro-rata basis for the every 3% decrease in performance level below 85%.

(6) The RLDCs or NLDC, as the case may be, shall compute the Key Performance Indicators on annual basis for the previous year ending on 31st March and submit to the Commission along with petitions for approval of the Commission as per **Appendix-V and Appendix-VI** of these Regulations**:**

Provided that the key performance indicators of previous year ending on 31st March shall be considered to recover incentive on each year and shall be trued up at the end of the control period.

**28. Certification Retainer-ship Amount to the employees of SLDC/RLDCs/NLDC**

(1) The employees of Regional Load Despatch Centres and National Load Despatch Centre who acquire the certificate of basic level and specialist level in their respective areas of specialization shall be allowed a fixed retainer-ship amount during the currency of such certificate period as per the following parameters:

| SI. No. | Certification Level | Retainer-ship amount (in Rs. Per Month) |
|---|---|---|
| 1 | Basic | 7500 |
| 2 | Specialist | 10000 |
| 3 | Management | 12000 |

Provided that a person acquiring one basic level and more than one Specialist /Management level

certificate shall be entitled for maximum retainer ship amount of Rs.12000/- only

(2) Certificate Retainer-ship Amount shall be in addition to the performance related incentive as specified in Regulation 29.

***

## CHAPTER-8

## BILLING AND OTHER MISCELLANEOUS PROVISIONS

**29. Billing and Payment of charges**

(1) Bills shall be raised for the LDC charge on monthly basis by the Load Despatch Centre (RLDC/SLDC) in accordance with these regulations, and payments shall be made by the users directly to the concerned Load Despatch Centre.

(2) Persistent default in payment of SLDC/RLDCs/NLDC fee and charges shall be brought to the notice of the Commission.

**30. Late payment surcharge**: In case the payment of any bill for charges payable under these regulations is delayed by a user beyond a period of 30 days from the date of billing, a late payment surcharge at the rate of **1.5%** per month shall be levied from the users.

**31. Recovery of cost of hedging or Foreign Exchange Rate Variation**: Recovery of cost of hedging or foreign exchange rate variation shall be made directly by the SLDC/ RLDCs from the users without making any application before the Commission:

Provided that in case of any objections by users regarding the cost of hedging or foreign exchange rate variation, the RLDCs may make an appropriate application before the Commission for decision.

**32. Rebate**

(1) A rebate of 2% shall be allowed by the SLDC/RLDCs or NLDC on gross bill amount settled through RTGS, NEFT, Letter of Credit or cheque up to seventh day (i.e. T+6 day) from the date of issuance of the bills, where T is the date of issuance of the bill.

(2) The rebate of 1% shall be allowed when payment is made from T+7 to T+15 days from issuance of the bill.

(3) No rebate shall be allowed for payment made from T+15 days till T+30 days from the date of issuance of the bill.

**33. Power to Relax:** The Commission, for reasons to be recorded in writing, may relax any of the provisions of these regulations on its own motion or on an application made before it by SLDC/NLDC/RLDCs/Users after giving reasonable opportunity to those likely to be affected by such relaxation.

**34. Removal of Difficulty:** The Commission, for reasons to be recorded in writing, may relax any of the provisions of these regulations on its own motion or on an application made before it by SLDC/NLDC/RLDCs/Users after giving reasonable opportunity to those likely to be affected by such relaxation.

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# APPENDIX

# TARIFF FILING FORMS FOR NLDC/RLDCs/SLDCs

**Appendix-I**

**INDEX**

**Checklist of Forms and other information/ documents for tariff filing for SLDC/NLDC/RLDCs**

| Form No. | Tariff Filing Formats (SLDC/RLDCs/NLDC) | Tick |
|---|---|---|
| **FORM-1** | Summary Sheet | |
| **FORM-2** | Normative Parameters considered for calculations | |
| **FORM-3A** | Financial Package upto COD | |
| **FORM-3B** | Statement of Capital cost | |
| **FORM-3C** | Financing of Additional Capitalisation | |
| **FORM-4A** | Calculation of Interest on Normative Loan | |
| **FORM-4B** | Calculation of Weighted Average Rate of Interest on Actual Loans | |
| **FORM-5A** | Statement of Depreciation | |
| **FORM-5B** | Calculation of Depreciation Rate | |
| **FORM-6A** | Details of Operation and Maintenance Expense excluding human resource<br>Expenses | |
| **FORM-6B** | Details of Human Resource Expenses | |
| **FORM-6C** | Details of Repairs and Maintenance Expenses | |
| **FORM-6D** | Details of Administrative and General expenses | |
| **FORM-7** | Calculation of Interest on Working Capital | |
| **FORM-8** | Year wise statement of LDC development fund (projected) | |
| **FORM-9** | Other Income | |

| **Other Information/ Documents** | | |
|---|---|---|
| **Sl. No.** | **Information/Document** | **Tick** |
| **1** | Audited Balance Sheet and Profit & Loss Accounts with all the Schedules &<br>Annexure for RLDC and NLDC/Corporate office. | |
| **2** | Copies of relevant loan Agreements | |
| **3** | a) Copies of the approval of Competent Authority for the Capital Cost and Financial package.<br>b) CAPEX and REPEX plan along with Board approval, estimated capital cost and justification | |
| **4** | a) Copies of the Equity participation agreements and necessary approval for the foreign equity, if any.<br>b) Equity contribution from LDC development fund along with Board Approval | |
| **5** | Any other relevant information, (Please specify) | |

**Note 1.** Electronic copy of the petition (in words format) and detailed calculation as per these formats (in excel format) and any other information submitted shall also be furnished in the electronic form.

**FORM-1**

**Summary Sheet**

**Name of the LDCs**: _____

(Rs. in lacs)

| S.No. | Particulars | Form No. | Existing 2018-19 | 2019 -20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
|---|---|---|---|---|---|---|---|---|
| 1 | 2 | | 3 | 4 | 5 | 6 | 7 | 8 |
| | | | | | | | | |
| 1 | Return on Equity[1] | | | | | | | |
| 2 | Interest on Loan Capital | | | | | | | |
| 3 | Depreciation | | | | | | | |
| 4 | O&M Expenses excluding human resource expenses | | | | | | | |
| 5 | Human resource expenses | | | | | | | |
| 6 | NLDC Charges and Corporate office expenses | | | | | | | |
| 7 | Interest on Working Capital | | | | | | | |
| | **Total** | | | | | | | |

[1] Details of calculations, considering equity as per regulation, to be furnished.

**Petitioner**

**FORM-2**

**Normative Parameters considered for calculations of annual charges**

**Name of the LDC:**

| Particulars | Unit | As Existing | Control Period | | | | |
|---|---|---|---|---|---|---|---|
| | | Existing 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| Base Rate of Return on Equity | % | | | | | | |
| Tax Rate | % | | | | | | |
| Receivables in Months for WC | months | | | | | | |
| O&M excluding human resource expenses in Months for WC | months | | | | | | |
| Human resource expenses in Months for WC | months | | | | | | |
| NLDC charges in Months for WC | months | | | | | | |
| Base Rate of SBI as on (date) | % | | | | | | |

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**FORM-3A**

## Financial Package up to COD

**Name of the LDC:** _____
**Project Cost as on 1.4.2019:** _____
**Date of Commercial Operation:** _____

(Amount in lacs)

| | **Financial Package as Approved** | | **Financial Package as on 1.4.2019** | | **As Admitted on 1.4.2019** | |
|---|---|---|---|---|---|---|
| | **Currency and Amount[3]** | | **Currency and Amount[3]** | | **Currency and Amount[3]** | |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Loan-I | | | | | | |
| Loan-II | | | | | | |
| Loan-III | | | | | | |
| and so on | | | | | | |
| | | | | | | |
| Equity- | | | | | | |
| Foreign | | | | | | |
| Domestic | | | | | | |
| Total Equity | | | | | | |
| Debt : Equity Ratio | | | | | | |

**Petitioner**

**FORM-3B**

## Statement of Capital cost

**Name of the LDC :**

| | | **As on relevant date.[1]** |
|---|---|---|
| **A** | **a)** Opening Gross Block Amount as per books | |
| | **b)** Amount of capital liabilities in A(a) above | |
| | **c)** Amount of IDC, FC, FERV & Hedging cost included in A(a) above | |
| | **d)** Amount of IEDC (excluding IDC, FC, FERV & Hedging cost) included in A(a) above | |
| | | |
| **B** | **a)** Addition in Gross Block Amount during the period | |
| | **b)** Amount of capital liabilities in B(a) above | |
| | **c)** Amount of IDC, FC, FERV & Hedging cost included in B(a) above | |
| | **d)** Amount of IEDC (excluding IDC, FC, FERV & Hedging cost) included in B(a) above | |
| | | |
| **C** | **a)** Closing Gross Block Amount as per books | |
| | **b)** Amount of capital liabilities in C(a) above | |
| | **c)** Amount of IDC, FC, FERV & Hedging cost included in C(a) above | |
| | **d)** Amount of IEDC (excluding IDC, FC, FERV & Hedging cost) included in C(a) above | |

[1] Relevant date/s means date of COD and financial year start date and end date

**Petitioner**

**FORM-3C**

**Financing of Additional Capitalization Name of the LDC:**

(Amount in Rs. lakh)

| | Projected/Actual | | | | | Admitted | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Financial Year (Starting from 1.4.2019)** | **Year 1[1]** | **Year 2** | **Year 3** | **Year 4** | **Year 5 & So on** | **Year 1** | **Year 2** | **Year 3** | **Year 4** | **Year 5 & So on** |
| **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** |
| | | | | | | | | | | |
| **Amount capitalised in Work/ Equipment** | | | | | | | | | | |
| | | | | | | | | | | |
| **Financing Details** | | | | | | | | | | |
| **Loan-1** | | | | | | | | | | |
| **Loan-2** | | | | | | | | | | |
| **Loan-3 and so on** | | | | | | | | | | |
| **Total Loan[2]** | | | | | | | | | | |
| | | | | | | | | | | |
| **Equity** | | | | | | | | | | |
| **Internal Resources** | | | | | | | | | | |
| **Others** | | | | | | | | | | |
| | | | | | | | | | | |
| **Total** | | | | | | | | | | |

[1] Year 1 refers to Financial Year of COD and Year 2, Year 3 etc. are the subsequent financial years respectively.

**Petitioner**

**FORM-4A**

| **Particulars** | **Existing 2018-19** | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| | | | | | | |
| Gross Normative loan – Opening | | | | | | |
| Cumulative repayment of Normative Loan upto previous year | | | | | | |
| Net Normative loan-Opening | | | | | | |
| Increase/Decrease due to ACE during the Year | | | | | | |
| Repayments of Normative Loan during the year | | | | | | |
| Net Normative loan-Closing | | | | | | |
| Average Normative Loan | | | | | | |
| Weighted average Rate of Interest on actual Loans | | | | | | |
| Interest on Normative loan | | | | | | |

**Calculation of Interest on Normative Loan**

Name of LDC: .....

(Amount in Rs. lakh)

**Petitioner**

**FORM-4B**

**Calculation of Weighted Average Rate of Interest on Actual Loans[1]**
**Name of LDC :_____**

(Amount in Rs. lakh)

| Sl. no. | Particulars | Existing 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | **Loan-1** | | | | | | |
| | Gross loan – Opening | | | | | | |
| | Cumulative repayments of Loans upto previous year | | | | | | |
| | Net loan – Opening | | | | | | |
| | Add: Drawal(s) during the Year | | | | | | |
| | Less: Repayment (s) of Loans during the year | | | | | | |
| | Net loan – Closing | | | | | | |
| | Average Net Loan | | | | | | |
| | Rate of Interest on Loan on annual basis | | | | | | |
| | Interest on loan | | | | | | |
| | Loan repayment effective from (date to be indicated) | | | | | | |
| | **Loan-2 …** | | | | | | |
| | **Loan-3…** | | | | | | |
| | **Total Loan** | | | | | | |
| | Gross loan – Opening | | | | | | |
| | Cumulative repayments of Loans upto previous year | | | | | | |
| | Net loan – Opening | | | | | | |
| | Add: Drawal(s) during the Year | | | | | | |
| | Less: Repayment (s) of Loans during the year | | | | | | |
| | Net loan – Closing | | | | | | |
| | Average Net Loan | | | | | | |
| | Interest on loan | | | | | | |
| | **Weighted average Rate of Interest on Loans** | | | | | | |

[1]In case of Foreign Loans, the calculations in Indian Rupees is to be furnished. However, the calculations in Original currency is also to be furnished separately in the same form.

**Petitioner**

**FORM-5A**

## Statement of Depreciation

**Name of LDC:**

(Amount in Rs. lakh)

| **Financial Year** | **Existing 2018-19** | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
|---|---|---|---|---|---|---|
| **1** | **2** | **11** | **12** | **13** | **14** | **15** |
| | | | | | | |
| **Depreciation on Capital Cost** | | | | | | |
| Depreciation recovered during the Year | | | | | | |
| Cumulative depreciation deducted due to de-capitalization or write off of the assets etc. | | | | | | |
| **Cumulative Depreciation & Advance against Depreciation recovered upto the year** | | | | | | |

**Petitioner**

**FORM-5B**

**Calculation of Depreciation Rate**

**Name of LDC:**

(Amount in Rs lakh)

| **Sl. no.** | **Name of the Assets[1]** | **gross Block as on 31.03.2019, whichever is later and subsequently for each year therafter upto 31.3.2024** | **Depreciation Rates as per CERC's Depreciation Rate Schedule** | **Depreciation Amount for each year up to 31.03.2024** |
|---|---|---|---|---|
| | 1 | 2 | 3 | 4= Col.2 X Col.3 |
| **1** | Land | | | |
| **2** | Building | | | |
| **3** | and so on | | | |
| **4** | | | | |
| **5** | | | | |
| | **TOTAL** | | | |
| | **Weighted Average Rate of Depreciation (%)** | | | |

**1** Name of the Assets should conform to the description of the assets mentioned in Depreciation Schedule appended to the Notification.

**Petitioner**

**FORM-6A**

**Details of Operation and Maintenance Expenses excluding human resource expenses**

**Name of LDC :**

(Rs. in lacs)

| | ITEMS | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| 1 | **Repairs and maintenance expenses** | | | | | |
| 2 | **Administrative and general expenses etc.** | | | | | |
| 3 | **Total** | | | | | |

**NOTE:**

1. Detail of these expenditure as per formats enclosed
2. To be furnished for all the SLDC, RLDCs, NLDC and Corporate office.

**Petitioner**

**FORM-6B**

**Name of LDC:**

**Details of Human Resource Expenses**

| | | |
|---|---|---|
| **Period-** | 1 | ACTUALS FOR PREVIOUS FIVE YEARS |
| | 2 | ACTUALS FOR IST SIX MONTHS OF THE CURRENT YEAR |
| | 3 | EXPECTED FOR LAST SIX MONTHS OF THE CURRENT YEAR |
| | 4 | EXPECTED FOR ENSUING YEAR |

| **Sr. No.** | **Account Code** | **Particulars** | **Executive** | | **Non-Executive** | | **Total** |
|---|---|---|---|---|---|---|---|
| | | | **Technical** | **Non-Tech.** | **Technical** | **Non-Tech.** | |
| 1 | Number of Employees | | | | | | |
| 2 | Salaries | | | | | | |
| 3 | Over-time | | | | | | |
| 4 | Dearness Allowance | | | | | | |
| 5 | Other Allowance | | | | | | |
| 6 | Bonus | | | | | | |
| **7** | Productivity Linked Incentive | | | | | | |
| **8** | **Sub Total (1 to 6)** | | | | | | |
| | **OTHER STAFF COST** | | | | | | |
| 8 | Reimbursement of Medical Expenses | | | | | | |
| 9 | Leave Travel Concession | | | | | | |
| 10 | Reimbursement of House Rent | | | | | | |
| 11 | Interim Relief to Staff | | | | | | |
| 12 | Encashment of Earned Leave | | | | | | |
| 13 | Honorarium | | | | | | |
| 14 | Payment under Workmen compensation Act | | | | | | |
| 15 | Ex-gratia | | | | | | |
| 16 | Expenditure on VRS | | | | | | |
| **17** | **Sub Total (8 to 16)** | | | | | | |
| 18 | Staff Welfare Expenses | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 19 | Terminal Benefits | | | | | | |
| 20 | Provisions | | | | | | |
| 21 | Others (Specify) | | | | | | |
| 22 | Human Resource Development | | | | | | |
| **23** | **Total (7+17+18+19+20+21+22)** | | | | | | |
| 24 | Revenue recovered, if any | | | | | | |
| **25** | **Net Total (23-24)** | | | | | | |
| **Additional Information** | | | | | | | |
| 1 | No. of Employees as on : | | | | | | |
| | i) Executives | | | | | | |
| | ii) Non-Executives | | | | | | |
| | iii) Skilled | | | | | | |
| | iv) Non-Skilled | | | | | | |
| | **Total** | | | | | | |
| 2 | No. of Employees per | | | | | | |
| | i) MW handled | | | | | | |
| | ii) MKwh handled | | | | | | |

| | |
|---|---|
| I) | An annual increase in HR expenses under a given head in excess of 20 percent should be explained with proper justification. |
| II) | The data should be based on audited balance sheets. |
| III) | Details of arrears, if any pertaining to prior period should be mentioned separately. |
| IV) | No. of employees opting for VRS during each year should be indicated. |
| V) | Details of abnormal expenses, if any shall be furnished separately. |

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**FORM-6C**

**Details of Repairs and Maintenance Expenses**

**Name of LDC:**

**A. Repairs and Maintenance Expenses (Actuals)**

| Sr.No. | Description | Actuals for previous Financial Year | Current Financial Year | | | Estimates for ensuing year |
|---|---|---|---|---|---|---|
| | | | Actual For First Six Months | Projection For Balance Six Months | Total | |
| 1 | Consumption of stores and spares | | | | | |
| 2 | Loss of stores and spares | | | | | |
| 3 | Plant & Machinery repairs and maintenance | | | | | |
| 4 | Civil works repairs and maintenance | | | | | |
| 5 | Annual Maintenance Contract (4a+4b+4c) | | | | | |
| 5a | -Plant & machineries | | | | | |
| 5b | -Civil repairs and maintenance | | | | | |
| 5c | -Others | | | | | |
| 6 | Others (Specify) | | | | | |
| **7** | **Total (1+2+3+4+5+6)** | | | | | |
| 8 | Revenue recoveries, if any | | | | | |
| **9** | **Net Total (7-8)** | | | | | |

**B. Repairs And Maintenance Expenses (As per Regulation)**

| Particulars | 2014-15 | 2015-16 | 2016-17 | 2017-18 | 2018-19 |
|---|---|---|---|---|---|
| **Admitted Capital cost as on 1st April of the year** | | | | | |
| **Repairs and Maintenance expenses** | | | | | |
| **Repairs and Maintenance expenses as a percentage of Capital cost** | | | | | |

**Petitioner**

**FORM-6D**

## Details of Administrative and General Expenses Name of LDC/:

| SI. No. | Description | Actuals for previous five Financial Year | (Current Financial Year) | | | Estimates for ensuing year |
|---|---|---|---|---|---|---|
| | | | Actual For First Six Months (Rs. in Crs.) | Projection For Balance Six Months | Total | |
| **Property Related Expenses** | | | | | | |
| 1 | License Fees | | | | | |
| 2 | Rent | | | | | |
| 3 | Rates & Taxes | | | | | |
| 4 | Insurance | | | | | |
| 5 | Contribution to accident reserve fund | | | | | |
| **6** | **Sub total :** | | | | | |
| | **Communication** | | | | | |
| 7 | Telephone & Trunk Call | | | | | |
| 8 | Postage & Telegram | | | | | |
| 9 | Telex, Teleprinter Charges, Telefax | | | | | |
| 10 | Courier Charges | | | | | |
| 11 | Other | | | | | |
| **12** | **Sub total :** | | | | | |
| | **Professional Charges** | | | | | |
| 13 | Legal expenses | | | | | |
| 14 | Consultancy charges | | | | | |
| 15 | Technical fees | | | | | |
| 16 | Audit fees | | | | | |
| 17 | Other charges | | | | | |
| **18** | **Sub total :** | | | | | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | **Conveyance & Travelling** | | | | | |
| 19 | Conveyance expenses | | | | | |
| 20 | Travelling expenses | | | | | |
| 21 | Hire charges of vehicle | | | | | |
| 22 | Others | | | | | |
| **23** | **Sub total :** | | | | | |
| | **Other Expenses** | | | | | |
| 24 | Electricity charges | | | | | |
| 25 | Fees & Subscription | | | | | |
| 26 | Books & Periodicals | | | | | |
| 27 | Printing & Stationery | | | | | |
| 28 | Advertisement | | | | | |
| 29 | Entertainment | | | | | |
| 30 | Watch & Ward | | | | | |
| 31 | Miscellaneous | | | | | |
| 32 | Organisational Development Expenses | | | | | |
| 33 | Donation | | | | | |
| 34 | **Sub total :** | | | | | |
| | **Material Related Expenses** | | | | | |
| 35 | Demmurage and Wharfage on materials | | | | | |
| 36 | Clearing & forwarding charges | | | | | |
| 37 | Transit insurance | | | | | |
| **38** | **Sub total :** | | | | | |
| 39 | Others (Specify) | | | | | |
| 40 | **Total (6+12+18+23+34+38+39)** | | | | | |
| 41 | Revenue recoveries, if any | | | | | |
| 42 | **Net Total (40-41)** | | | | | |



**Petitioner**

**FORM-7**

## Calculation of Interest on Working Capital

**Name of LDC/**

(Amount in lacs)

| Sl. No. | Particulars | Existing 2018-19 | 2019-20 | 2020-21 | 2021-22 | 2022-23 | 2023-24 |
|---|---|---|---|---|---|---|---|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| 1 | O & M expenses excl. HR | | | | | | |
| 2 | Human resource expenses | | | | | | |
| 3 | NLDC charges (Applicable for RLDC only) | | | | | | |
| 4 | Receivables | | | | | | |
| 5 | Total Working Capital | | | | | | |
| 6 | Rate of Interest | | | | | | |
| 7 | Interest on Working Capital | | | | | | |

**Petitioner**

**FORM 8**

## LDC Development Fund

**Name of LDC : _____**

(Amount in lacs)

| **Particulars** | **Existing 2018-19** | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Opening LDC development fund – Opening | | | | | | |
| Additions in LDC development fund during the year | | | | | | |
| Total LDC development fund | | | | | | |
| Less : Utilization for capital expenses | | | | | | |
| Less : Utilization for revenue expenses | | | | | | |
| Net LDC development fund as on 31st March of the year | | | | | | |
| Average fund accumulated during the year | | | | | | |

Note : Break of additions and utilization shall be provided in separate sheet for each year

**Petitioner**

**FORM 9**

## Other Income

**Name of LDC:**_____

(Amount in lacs)

| **Particulars** | **As on 31.3.2019** | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
|---|---|---|---|---|---|---|
| **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| | | | | | | |
| Other Income – Opening | | | | | | |
| Add : Short term open access charges | | | | | | |
| Add : Allocation from REC income | | | | | | |
| Add: …. | | | | | | |
| Add: …. | | | | | | |
| Add:…. | | | | | | |
| Gross Income during the year | | | | | | |
| Less : Utilization to meet shortfall | | | | | | |
| Less : Use for… | | | | | | |
| So on | | | | | | |
| … | | | | | | |
| Net Income as on 31st March | | | | | | |

**Petitioner**

**Appendix-II**

[To be published in pursuance of Regulation 6]

**Name of the Applicant (in Bold Letters)**

**(Registered Office Address)**

1. The applicant above-named has made an application before the (Central/Name of State] Electricity Regulatory Commission, [Location] for determination of fees and charges for [Give name of the applicant].

2. The users of the NLDC/RLDC/SLDC are:

   a. ……

   b. ....……

3. Details of tariff (Publish only applicable portion):

(Rs. in lakh)

| | **Tariff for the previous year** | **Year-wise tariff sought to be determined** | | | | | |
|---|---|---|---|---|---|---|---|
| | | Previous year | **2019-20** | **2020-21** | **2021-22** | **2022-23** | **2023-24** |
| RLDC | | | | | | | |
| NLDC | | | | | | | |
| SLDC | | | | | | | |

4. A copy of the application made for determination of tariff is posted on the website (indicate here the address of the website).

5. The suggestions and objections, if any, on the proposals for determination of tariff contained in the application be filed by any person, including the beneficiary before **the Secretary, [ Central/Name of State] Electricity Regulatory Commission, [Address]** with a copy to the applicant within 30 days of publication of this notice.

Place_____ Name and Designation of the Authorised Signatory

Date _____

**Appendix-III**

## Depreciation Schedule

| Sr. No. | Asset Particulars | Depreciation Rate |
|---|---|---|
| A | Land under full ownership | 0.00% |
| B | Land under lease | |
| (a) | for investment in the land | 3.34% |
| (b) | For cost of clearing the site | 3.34% |
| | | |
| C | Other Assets | |
| | | |
| A | Building & Civil Engineering works | |
| (i) | Offices and residential | [3.34%] |
| (ii) | Containing plant and equipments | 3.34% |
| (iii) | Temporary erections such as wooden structures | [100.00%] |
| (iv) | Roads other than Kutcha roads | [3.34%] |
| (v) | Others | [3.34]% |
| B | Transformers, Kiosk, sub-station equipment & other fixed apparatus (including plant foundation) | |
| (i) | Transformers including foundations having rating of 100 KVA and over | 5.28% |
| (ii) | Others | 5.28% |
| | | |
| C | Solar Panel/Wind Mill | 5.28% |
| | | |
| D | Lightning arrestor | |
| (i) | Station type | 5.28% |
| (ii) | Pole type | 5.28% |
| (iii) | Synchronous condenser | 5.28% |
| | | |
| E | Batteries | 15.00% |
| (i) | Underground cable including joint boxes and disconnected boxes | 5.28% |
| (ii) | Cable duct system | 3.34% |
| | | |

| | | |
|---|---|---|
| **F** | **Overhead lines including cable support systems** | |
| **(i)** | **Lines on fabricated steel operating at terminal voltages higher than 66 KV** | **3.34%** |
| **(ii)** | **Lines on steel supports operating at terminal voltages higher than 13.2 KV but not exceeding 66 KV** | **5.28%** |
| **(iii)** | **Lines on steel on reinforced concrete support** | **5.28%** |
| **(iv)** | **Lines on treated wood support** | **5.28%** |
| | | |
| **G** | **Meters** | **5.28%** |
| | | |
| **H** | **Self propelled vehicles** | **9.50%** |
| | | |
| **I** | **Air Conditioning Plants** | |
| **(i)** | **Static** | **5.28%** |
| **(ii)** | **Portable** | **9.50%** |
| | | |
| **j (i)** | **Office furniture and furnishing** | **6.33%** |
| **(ii)** | **Office equipment** | **6.33%** |
| **(iii)** | **Internal wiring including fittings and apparatus** | **6.33%** |
| **(iv)** | **Street Light fittings** | **5.28%** |
| **K** | **Apparatus let on hire** | |
| **(i)** | **Other than motors** | **9.50%** |
| **(ii)** | **Motors** | **6.33%** |
| **L** | **Communication equipment** | |
| **(i)** | **Radio and high frequency carrier system** | **6.33%** |
| **(ii)** | **Telephone lines and telephones** | **6.33%** |
| **M** | **I. T equipments** | **15.00%** |
| **N** | **Softwares** | **30.00%** |
| **O** | **Any other assets not covered above** | **5.28%** |



**Petitioner**

**Appendix-IV**

**(In Compliance of Regulation 4)**

1. **Name of the entity** (in bold letters):

2. **Registered office address**:

3. **Region in which registration is sought**:
   i. North-eastern
   ii. North
   iii. East
   iv. West
   v. South

4. **User category**:
   i. Generating Station
   ii. Seller
   iii. Buyer
   iv. Transmission Licensee
   v. Distribution Licensee
   vi. Trading Licensee
   vii. Power Exchange
   viii. Battery Energy Storage system
   ix. Electric Vehicle Charging Stations
   x. QCA / Aggregators
   xi. Others

5. **User details** (as on 31st March of last financial year):

   **i. Category – generating Station**

   i. Total Installed Capacity
   ii. Maximum Contracted Capacity (MW) using ISTS
   iii. Points of connection to the ISTS:

| **Sl. No.** | **Point of connection** | **Voltage level (kV)** | **Number of Special Energy Meters (Main) installed at this location** |
|---|---|---|---|
| | | | |

   **ii. Category - Seller/Buyer/Distribution Licensee**

   i. Maximum Contracted Capacity (MW) using ISTS
   ii. Points of connection to the ISTS:

| **Sl. No.** | **Point of connection** | **Voltage level (kV)** | **Number of Special Energy Meters (Main) installed at this location** |
|---|---|---|---|
| | | | |

   **iii. Category – Transmission Licensee (inter-State)**

   i. Sub-stations:

| **Sl. No.** | **Sub-station Name** | **Number of transformer** | **Total Transformation Capacity or Design MVA handling capacity if switching Station** |
|---|---|---|---|
| | | | |

ii. Transmission lines: (line wise details to be given)

| **Sl. No.** | **Voltage level (kV)** | **Number of transmission lines** | **Total Circuit-Kilometers** |
|---|---|---|---|
| | | | |

**iv. Category (Others):** Please specify details.

**6. Contact person(s) details for meters related to SLDC/RLDC/NLDC**:

i. Name:
ii. Designation:
iii. Telephone No.:
iv. E-mail address:
v. Postal address:

**7. Other Details:**

i. PAN No.:
ii. GST No.:
iii. Bank Account No.:
iv. Bank Name and Address:
v. MICR No:

The above information is true to the best of my knowledge and belief.

Signature of Authorised Representative

Place:
Date:

Name:
Designation:
Contact number:

**Appendix-V**

## Assessment of Key Performance Indicators

**Name of LDC:** _____

**Performance Year:** _____

| Category | No. | Key Performance Indicators | Weightage | Previous Year | Current Year |
|---|---|---|---|---|---|
| **(A) Stake holder satisfaction** | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | . | | | | |
| **(B) Financial Prudence** | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | . | | | | |
| **(C)Learning & Growth** | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | . | | | | |
| **(D) Internal Process** | 1 | | | | |
| | 2 | | | | |
| | 3 | | | | |
| | . | | | | |

(Calculations of specific key performance indicators above are given in Appendix-VI)

**Appendix-VI**

## CALCULATION OF KEY PERFORMANCE INDICATORS