Model Terms of Reference for Network Planning Tool

Noida Smart Distribution Project

Contents

1. Introduction and General information

1.1 Introduction

Power system studies are a prerequisite for any electrical system development, renovation, modernization, and expansion plan. It is also an imperative step towards meeting the objectives of system planning, design, protection, and control, developing a system operation strategy, commercial evaluation and technical feasibility studies.

Noida City has been experiencing an increase in peak demand which requires network upgradation and identification of incremental supply sources. On the other hand, penetration of behind-the-meter Distributed Energy Resources (DERs) are increasing which is causing 2-way flow of energy and is changing the power flow pattern on the electricity grid. Noida also plans to install solar rooftops on 25000 households, which will add to the DER penetration.

Meeting the future demand and managing the dynamic loading conditions of the grid (on account of intermittent and variable DER/ RE sources) requires robust scientific assessment of the network conditions / constraints. Thus, PVVNL requires a robust and efficient network planning & analysis tool to conduct scientific, thorough, and continual study of its sub-transmission and distribution network of Noida city. This will enable efficient planning of network augmentation in a cost-effective manner and install necessary balancing mechanisms (such as reactive compensation, capacitor bank planning etc.) for effective load management in the city.

1.2 Objective

The overall objective is to select and procure a suitable Network Planning & Analysis Tool for graphical visualization, contingency analysis and detailed study of network topology, load management, FLISR, switching, load growth, scheduling, load distribution and transfer etc.

The network planning tool shall assist PVVNL in:

- Building network topology, equipment technical parameters for performing power flow, short circuit, voltage stability, detailed technical loss assessment etc.
- Evaluating what - if studies in case of outages / failures, identification of revised switching plan for loss reduction, identification of new RMU locations, identification of weak links in the system during load transfers
- Model all the components of distribution substations so as to take into account the effects of these installations on the overall distribution system to produce results
- As a Utility all received application of RFT solar application or any new DER and load requirement can be immediately evaluated for its integration feasibility with respective feeders so that PVVNL can quickly evaluate the feasibility check.

1.3 Key outcomes for PVVNL

PVVNL shall be benefited by use of the network planning tool by:

- Analysis of the existing infrastructure and network capacity for continuous network planning w.r.t. additional infrastructure required for strengthening and continual upgrading of the power distribution network of the city.
- Detailed techno-economic analysis of various proposed investments.

3

2. System requirements

The following sections outline the key requirements of the Network Planning Tool. As this will be an off-the-shelf solution, it is understood that some terminologies / modules might differ between different OEMs. The key functionalities required from the software shall be as follows:

2.1 Network modelling

The software shall provide the ability to create and maintain accurate models of PVVNL's distribution network, including feeders, transformers, switches, and loads. Integration with existing GIS (Geographic Information System) data is preferred. The network modeling capabilities must encompass all possible voltage levels in sub-transmission and distribution system. It shall also be able to model different equipment and conductor sizes in form of a pre-existing library. For non-standard equipment specifications, the software shall have the ability to add new items to the library with ease.

The network modelling system shall enable accurate representation of all the components of a distribution substation, a group of substations, overhead or underground lines in form of Single line diagram (SLD). In addition to SLD, geographical representation in form of topography map layer shall also be provided.

2.2 Load flow analysis

The software shall perform steady-state performance analysis of the power system under various operating conditions. This shall determine voltage profiles, power flows, and losses throughout the network. The software shall use iterative techniques for voltage drop calculation as well as load flow analysis highlighting power factor issues, high losses, abnormal conditions and unbalanced factors.

2.3 Short-circuit analysis

The short circuit or fault analysis shall help in analyzing fault current under balanced / unbalanced, polyphase systems and in radial or meshed networks. The fault analysis module shall comprise of

- Evaluation of open circuit or asymmetrical line impedance conditions on the distribution system.
- Impact of simultaneous faults at different locations in the network.
- Finding possible locations of a fault on the network.
- Impact of a sudden sag or swell of voltage
- Any other fault condition as specified by Nodal officer of PVVNL

2.4 Load balancing analysis

The software shall provide a load balancing analysis function to determine which loads can be connected to which phase of the system so as to minimize kW losses or balance the current, the load, or the voltage. It shall provide a comprehensive report stating which changes must be made to the network and the corresponding improvements that shall be brought about by the change.

2.5 Reactive compensation analysis

The network planning tool shall provide reports on optimal capacitor placement and sizing. This analysis shall help in determining the ideal location and size of shunt capacitors banks to reduce kW losses or to improve the system voltage while maintaining a desired power factor. The provided reports through this module shall list out all possible capacitor placement locations and resulting impact on the network parameters.

2.6 Network planning

The software shall provide the ability to create, view and manage augmentation and re-organization scenarios for any selected part of the network and for a selected period of time. The system shall facilitate optimization strategies for feeder reconfiguration, capacitor placement, and voltage regulation. The system shall also help in optimizing the relay coordination (or coordination of other protective devices like fuses and circuit breakers) between upstream and downstream network elements to ensure fast and selective fault isolation.

2.7 Distributed Energy Resources (DER) analysis

The software shall conduct the DER impact evaluation studies which can integrate multiple criteria-based verifications and scenarios in order to flag abnormal conditions. It shall be capable of evaluating the power quality disturbances produced by the equipment on a power source's signal by determining if the equipment passes different power quality tests.

2.8 Power quality analysis

The software shall have the capability of conducting reliability assessment by power outage analysis. It shall also be capable of conducting harmonic analysis to evaluate the impact of non-linear loads on the network.

2.9 System optimization

The network planning tool shall provide the feature of system optimization by prompting appropriate placing of network elements such as circuit breakers, isolators and reclosures. It shall also help PVVNL engineers to optimize the tap settings of power transformers wherever applicable. The optimization criteria shall be reliable and quality power supply.

2.10 Data analytics (AI / ML)

The software shall take help of appropriate AI / ML algorithms to improve the working of PVVNL and with the objective of overall loss reduction, efficiency improvements and consumer service improvement. In this context, the selected bidder / implementing agency shall research and implement novel cases for use of AI / ML algorithms. Special emphasis shall be given to latest technological advancements such as Large Language Models (LLMs) and generative AI to improve process efficiency and consumer services.

To make the analytics align with the objective of overall loss reduction, efficiency improvements, and consumer service improvement, network planning tool must have following capabilities:

1. Expandable Solution- The network planning tool must have capabilities of scaling up to transition the electrical offline model to a real-time, integrating with the existing or future RTU/IED and SCADA/DMS system to get the data.

2. Network planning tool must have capability of a centralized enterprise protection asset management solution that communicates with field protection relays and protection & Coordination modules to manage location, information and settings throughout the life cycle of protective relays and electrical assets to get maximum data.

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2.11   Handling of data

All the data and related reports shall be shared with the nodal officer of PVVNL on a monthly basis.

Sensitive data shall be encrypted and kept in a cloud storage service. Relevant formats shall be shared with the nodal officer for handover of data each month together with signoff.

2.12   Monitoring and evaluation

In order to monitor, evaluate and improve the Network Planning tool, the implementing agency shall deploy a suitable team stationed at PVVNL, Noida. This team shall coordinate with nodal officer of PVVNL on a regular basis. Review methodology and frequency of review shall be defined in consultation with nodal officer of PVVNL.

3.   Scope of work

The selected bidder shall empanel a qualified and experienced agency with requisite skillsets, teams and technology stack complementing the requirements underlined in this Scope of Work. The bidder is required to provide an unpriced Bill of Quantity (BoQ) for the Network planning tool. This unpriced BoQ must state all the line items influencing the development / customization of the solution as defined in this scope of work and the section on system requirements given above.

The scope of work shall include but will not be limited to the following:

3.1   Design / requirement gathering Phase

1. The selected bidder / implementing agency shall collaborate with project stakeholders i.e., PVVNL or its identified entities / partners / consultant / agency etc., for the objectives before customizing the design of Network Planning tool.

2. Based on the discussions with PVVNL, the selected bidder / implementing agency shall prepare an Information Architecture document that will describe the post-customization flow of the interactions and data in the Network Planning tool. It will also outline the multiple entry and exit touchpoints and how different users will be interacting with the product.

3.2 Customization Phase

1. The selected bidder / implementing agency shall start the customization work once the design / structure of Network Planning tool is fully conceptualized and necessary approvals have been obtained from PVVNL.

2. The project deliverables include but are not limited to Source Code, Operational / Technical manual, library files, setup programs, Unit/ Integration/ User Acceptance Test Cases and Results etc.

3. Proper sign-off from nodal officer of PVVNL shall be obtained at each stage before proceeding to the next.

3.3 Hosting Infrastructure

1. PVVNL intends to host the Network Planning tool on cloud, using the latest "cloud computing" technologies. This will provide secured on-demand access to the resources with minimal management requirements.

2. The Hosting infrastructure shall have separate Development / UAT and Production Environment. The selected bidder / implementing agency shall be responsible for keeping these environments in sync.

3. Cloud Service Providers such as Azure, AWS, Google Cloud which have high uptime and SLAs shall be used. Required services shall be purchased in the name of the PVVNL. Cloud infra should be dynamic and scalable i.e., at initial phase, lesser cloud infra may be required and later it shall be upgradeable as per the requirements of the project. (In terms of the VM, CPU, memory, Space, bandwidth, load balancers etc.)

4. Alternatively, the selected bidder / implementing agency may use its own cloud hosting / on premise facilities and provide user licenses for use of PVVNL officers. These modalities shall be discussed with the nodal officer of PVVNL.

5. In both cases mentioned above, Cloud Service provider should be empaneled with MeitY and the data should reside within India only.

3.4 Security Policy

1. The selected bidder/implementing agency shall ensure that all the modules/screens being developed/customized are error free and hack proof. The system shall be secured from all types of unauthorized/malicious access such as hackers, malware, spyware, Trojans, backdoors etc.

2. Adequate measures shall be taken to prevent cross-site scripting, SQL injection, fishing, session hijacking, email bomb etc.

3. The system shall undergo mandatory Quality Control and QA testing.

4. The selected bidder / implementing agency shall ensure proper UAT environment for all the modules to be tested by program stakeholders. The selected bidder / implementing agency must create enabling environment on the existing infrastructure where the website has been hosted for UAT.

5. The entire system shall be free from OWASP Top 10 Vulnerabilities.

3.5 System Control and Audit

1. The system shall have proper security and maintenance facility with controlled access to its various functions to the users delegated with appropriate authority. The system shall restrict users from unauthorized access by allowing only the authorized users with valid profile / password to access only the allowed set of transactions mapped to the users.

2. The system shall have a capability to assign activities to roles, and map roles to users and provide role-based access to users. The date and time of critical transactions with details of creation, reading, updating, deletion or printing shall be logged by user and terminal.

3. The system shall place control on scope of activity of each user (data file, program, module, screen, data table, record, field, etc.)

4. The system shall have a capability to track changes to fields or settings and shall be able to record audit trails, audit logs and transaction logging requirements (what, when, who has changed)

3.6 Third party Certification

1. The selected bidder/implementing agency shall appoint a CERT-IN empaneled independent auditor/IT Security agency to evaluate the security IT System and shall provide certificate at its own cost.

2. All cost for Security audit shall be borne by the selected bidder / implementing agency. Security Audit shall be required minimum once a year.

3.7 Data Digitization and Migration

1. The selected bidder / implementing agency shall perform data digitization and migration of existing data/ database to the new IT solution of as required. This shall include all network related information and development of models within the Network planning tool.

2. The selected bidder / implementing agency shall migrate the data from old database(s) / excel to new common database including digitization of data from hard copy files to new database if required.

3.8 Installation, testing & go-live

1. All levels of testing shall be conducted at Noida.

2. Testing must demonstrate that the system satisfies the operational and technical performance criteria.

3. Procurement and supply of the relevant software licenses, e-mail / SMS services, their installation, API integration and commissioning at all Sites and the required VPS infrastructure, space at cloud servers will have to provide by the selected bidder / implementing agency.

4. All defects found during review and acceptance testing shall be fixed by the selected bidder / implementing agency to the satisfaction of the nodal officer of PVVNL.

5. In case the whole IT System or any part thereof is found to be of inferior quality or not performing satisfactorily, the same shall be developed or modified free of charge immediately by the selected bidder / implementing agency.

6. All the expenses for UAT shall be borne by selected bidder / implementing agency.

7. It is selected bidder's/implementing agency's responsibility to evaluate test results and recommend any further changes to the infrastructure and / or system.

8. The selected bidder/implementing agency must describe how the testing methodologies will conform to requirements.

3.9 System Architecture and Platform Technological Details

1. The application shall be able to fetch data through APIs from different platforms / external sources etc. if required. Hence, data migration, integration and development effort may be required in order to integrate with other systems of PVVNL.

2. The application shall be built in such manner that it can share its own application data through API end points with other systems such as existing / future systems of PVVNL.

3.10 Import/ Export Facility

The system shall support upload and download of the following type of documents into from the system:

a) Microsoft Excel files for export
b) pdf files / documents

c) Data files (including ASCII formats like *.csv. *.txt)
d) Image files
e) Any other file-formats required by PVVNL during the implementation / maintenance period.

3.11   Data Backup / Data Archival / Restore

1. The system shall be able to archive data based on user specified parameters (for instance date range) and restore archival data for on-line use when required.

2. The system shall provide data backup and recovery facility (online and offline mode).

3. The system shall provide features to schedule backup/restore operations. The selected bidder/ implementing agency shall ensure that activities such as proper data backup, data restoration, and data synchronization with DR site etc. are tested and implemented.

4. The system shall have the ability to run multiple backup tasks in parallel.

5. The system shall have the ability to manually override scheduled backup operations.

6. The system shall produce a report for each backup / restore task.

7. The system shall support direct backup of data from one machine to another / from server to storage media such as SSDs etc.

8. The system shall have provision to keep data on storage media with high tolerance of failure.

9. The system shall allow recovery of data in case of hardware / software failure, data corruption, etc. It shall be able to perform recovery to a recent historical restore point when required.

10. The selected bidder / implementing agency shall maintain a periodic duplicate database backup to minimize the chances of data loss.

3.12   On-Going Development & Iterations

1. This shall be an on-going engagement and require the selected bidder / implementing agency to have dedicated resources towards iterative development as the complexity and scale of the system grows with time.

2. Monthly meetings with PVVNL nodal officer and committee would take place for review of ongoing works and planning for the subsequent month. Each sprint would consist of one month wherein the scope would be clearly defined and agreed between all parties.

3. The selected bidder / implementing agency shall continue to provide upgrades, new features, rectify any issues, maintain and ensure 99.9% uptime at application and server layer.

4. The selected bidder / implementing agency shall be responsible for quality assurance, testing, and ongoing fixes in issues with response times mutually agreed with the nodal officer of PVVNL.

5. The selected bidder / implementing agency shall be responsible for maintaining uptime of cloud servers and shall work with PVVNL IT team to ensure security of the system remains intact throughout the operational tenure of this pilot demonstration.

3.13   Installation / Upgrade / Enhancement / New Development

1. The system shall have the facility of seamless upgradation of patches / new versions without having any adverse impact on its components.

2. Upgrades shall have minimal impact on the system and its components. Upgrades shall be implemented during non-working hours after seeking approval from PVVNL.

3. The system shall have the facility to maintain versions with documentation of changes/ modifications made in each release. If required, the System shall be able to restore to the previous stable version.

4. The selected bidder / implementing agency shall be responsible for doing any kind of new development including:

    a. Addition of new services
    b. Third-party application integration
    c. Modification / up-gradation / enhancement in the process or functionality to fix some complex problem requests or defect fixing to upgrade the application performance.
    d. Update web-portal & application: design & content, layout, color schema, input forms, etc.
    e. MIS report format

3.14   Conducting system studies

The selected bidder / implementing agency shall not only undertake network modelling on the planning tool. They shall also conduct relevant system studies from time to time as directed by nodal officer of PVVNL. The outcome of these studies shall be presented to PVVNL in monthly reports as part of the deliverables (refer section 6).

4.   Training and O&M support

4.1 Training

The selected bidder shall provide comprehensive and detailed training plan describing the proposed approach & methodology, calendar / timelines, course contents, course duration, training materials, training tools, training logistics, etc.

1. Overview Training shall be provided to PVVNL Project Committee (including Nodal officer) and Project Management Unit (PMU) members at the beginning of implementation of each phase/ module.

2. Technical Training shall be provided to PVVNL IT team

3. End User training shall be provided to PVVNL end users before each go-live/change. The selected bidder/implementing agency shall conduct training sessions for the users of Head Office and all regional offices and/or any other office/users suggested by PVVNL.

4. The selected bidder/implementing agency shall be responsible for preparation of the training materials, videos, handouts and update end user manuals covering "how to use" concepts for all functions/modules to be implemented. Training content and mode of delivery shall be approved by PVVNL. Training material shall be provided in both hard and soft copies. PVVNL shall be the owner of all such training materials.

5. PVVNL shall provide training halls and conference rooms (venues) at the locations where the trainings are to be imparted by the selected bidder / implementing agency.

6. All incidental expenses (travel, lodging & boarding, local conveyance etc. for the selected bidder's /implementing agency's team) pertaining to training programs and workshops shall be borne by the selected bidder.

4.2 Operational Support and Maintenance (O & M)

The selected bidder / implementing agency shall provide onsite / offsite / hybrid support for smooth functioning of solution supplied. The Operational and Maintenance support shall remain valid for 1-year (total contract duration is 2 years - at the discretion of PVVNL) from the date of the "Final Signoff of all modules / warranty phase" of the Network planning tool.

O&M support shall have the following purpose:

1. For overall system stabilization, solution maintenance
2. System administration, security administration, database administration, network administration and end- user problem resolution (support for VPS Server, traffic, space etc.)
3. Necessary updates of software
4. Removal of the bugs from the application, modification / correction of and updates in the indicators on the dashboard / application, etc. The operational support shall ensure that the solution is functioning as intended.
5. The support shall also include supply of new versions / releases (including next generation release) upgrades, bug fixes, functionality enhancements and patches to cater to changes (including tax, legal, statutory and policy requirements) along with related documentation

5. Key Professionals (Onsite / Offsite / Hybrid Mode)

Development / customization team should have diversified experience in their specific field of expertise in Design, Development of Web, MIS Applications, AI / ML including experience in customization, development, hosting of portal / system creation, system documentation and fully conversant with the principles and working methods of project management life cycle.

The bidder should have Back Office Support & Services, IT Technical expertise team on its own roll viz., Project Leader, Technical Lead, Subject Matter Specialist, Dev OPS, Full Stack Developer/ Programmer (specialize in financial projects/ MIS Development), Database Designer /Database Administrator, etc. of sufficiently experienced and qualified.

System Administrators / Cloud Engineer / Network/ Security DevOps/ Product manager may also be needed for this project. Domain Expert on the above-mentioned modules, financial software's developments i.e. may also be included or software developers on these domains (Electric Vehicle/ Telematics/ MIS/ Dashboard/ Financial Loan Management/ Financial Risk Management /Guarantee product) may be preferred.

6. Deliverables

The following deliverables shall be expected from the successful bidder

No.	Deliverables

No.	Deliverables
	Phase I – Selection Phase
A B	• Selection of Network planning tool • Customization of Network planning tool
	Phase II – Network modelling Phase
C D	• Data gathering from various sources • Modelling the network in tool
	Phase III – Analysis Phase
E	• Conduct network analysis and generate monthly reports

Note:

The above specified scope of work is indicative and not exhaustive, and the bidder / agency is deemed and obliged to provide all necessary / incidental services and related works within their quoted cost for successful implementation / commission of the assigned work / project as per requirements of PVVNL.

7. Exit Management as per the project status

1. Agency may kindly note that contract will be continued subject to satisfactory performance of the program and availability of the funds/finance for this activity.

2. PVVNL has rights to discontinue and terminate the contract due to any unforeseen situation as mentioned above at Sr. No 1. However, all payments till that date shall be honored by PVVNL subject to acceptance of deliverables.