

# HARYANA VIDYUT PRASARAN NIGAM LIMITED

## Project Management Consultancy Services For Expansion of SCADA/EMS Project

### **Terms of Reference (TOR)**

#### **1 General**

Haryana Vidyut Prasaran Nigam Limited (HVPNL), a fully owned company of the Government of Haryana, acting in its capacity as the State Transmission Utility in the State of Haryana (the 'Employer') is responsible for ensuring development of an efficient coordinated and economical system for intra-state transmission and distribution of electricity with a view to increasing and improving the supply of electricity. In order to carry out the expansion of the existing Load Dispatch and Communication system in Haryana, required due to the expansion of the Power system over the years in the State and keeping in view the future expansion, the Employer has decided to employ Project Management Consultant (the 'Consultant') for the expansion of the Supervisory Control & Data Acquisition/ Energy Management System (SCADA/EMS) Project in the State of Haryana (the '**Project**'). The project management consultancy shall include but not limited to:

- (a) Working out the plan for data acquisition in accordance with guidelines of Central Electricity Authority of India (CEA), statutory requirement of the Indian Electricity Act-2003, Indian Electricity Grid Code, National Grid Code/ the State Grid Code and the provisions / recommendations of the report of the Northern Regional Power Committee (NRPC) on minimum standard requirements for the Unified Load Dispatch and Communication (ULDC) Scheme (Phase-II) December-2009, and integration with the existing SCADA/EMS of ULDC scheme of the Northern Region as well as with the expansion scheme of Northern Region planned to be created subsequently..
- (b) Strengthening of communication facilities & integration with existing SCADA/EMS of ULDC of Northern Region as well as with the expansion scheme of Northern Region planned to be created subsequently.

In addition the Consultant will also be responsible for:

- the preparation of inception/concept report, feasibility report, detailed project report, the bidding documents including technical/ commercial specifications, factory acceptance test procedures and site acceptance test procedures.
- assisting in technical / financial bid evaluation,
- providing technical clarifications during pre-bid meetings/ discussion, evaluation of technical queries and respond to clarifications sought by the bidders,
- attending to the contract negotiations,

- working out the detailed engineering and providing technical support during erection, testing and commissioning,
- further integration with the existing 'Unified Load Despatch & Communication (ULDC) System including Northern Regional Load Despatch Centre (NRLDC) and
- the finalization of quality assurance programme of the various manufacturer's / contractors and support during warranty period etc.

As per the optimistic assessment of the Employer, the expansion project will be executed within **26 months**. The Consultant is expected to provide multi-disciplinary Project Management Consultancy services to the Employer so as to complete the Expansion of SCADA/EMS facilities along with the strengthening of the communication requirement of the Project in due time.

The expansion of SCADA/EMS project will be financed by the World Bank loan. Therefore, the bidding procedures will be followed as per the World Bank's procurement procedures and rules.

### **1.1 Background**

Haryana Government as a part of its power sector reforms programme unbundled its State Electricity Board into four independent Power Utilities as State Govt Companies for performing the functions of Generation Transmission and Distribution independently. These companies are respectively named as Haryana Power Generation Corporation Ltd (HPGCL), Haryana Vidyut Prasaran Nigam Limited (HVPNL), Uttar Haryana Bijli Vitran Nigam Ltd. (UHBVN) and Dakshin Haryana Bijli Vitran Nigam Ltd. (DHBVN). HVPNL is the Transmission Licensee for the entire state of Haryana.. The main stated objectives of HVPNL are as under:

- Planning Design, construction, erection and maintenance of transmission lines / sub-stations of 400 KV, 220 KV, 132 KV and 66 KV Voltage Level, Communication facilities and appurtenant works.
- To maintain an integrated and efficient power transmission system.
- Transmission of power in accordance with the policies, guidelines and regulations laid down by the State Government and Haryana Electricity Regulatory Commission (HERC) from time to time.
- Ensuring adequate, safe and economical transmission of electricity, having regard to quality, availability and reliability of service.

To achieve these objectives it, inter-alia, performs the following functions of:

- Monitoring and maintaining grid discipline/ resolving grid issues
- Sourcing funds for plan implementation

- Augmenting or strengthening power transmission capability consistent with the system requirements
- Acting as State Transmission Utility

### **1.1.1 About the State Load Dispatch Centre (SLDC)**

For optimum energy management system and providing better services to consumers, the State Load Dispatch Centre (SLDC) at Panipat, Haryana was established during the year 2001-02 under Unified Load Dispatch and Communication scheme (ULDC) of Northern Region. The ULDC scheme was conceived and implemented in all the states of Northern Region by the Power Grid Corporation of India limited (PGCIL) i.e the Central Transmission Utility.

Under the unified scheme in the Haryana State, one SLDC at Panipat and two Sub-LDC (one each at Narwana & Dadri), along with 41 Remote Terminal Units (RTUs) were commissioned at different Grid Sub-Stations of the voltage level of 66 kV & above. The following real time Data is being acquired through the monitoring systems:

- Bus Voltage, Bus Frequency
- MW & MVAR flows on generators, lines/feeders and Transformers.
- MVAR on Capacitor Banks
- OLTC of the power Transformers
- Circuit Breaker position as Double status
- Isolators positions as Single Status
- Line/Transformer/Bus Protection as Single Status
- SOEs

The analogue values are refreshed in 10/15 seconds cycle and the digital values have time resolution of 1 millisecond.

### **1.1.2 SLDC Functions**

The main function of SLDC is to regulate the state power load dispatching in a manner to sustain /ensure the smooth integrated functioning of the Northern Grid.

The functions of SLDC as per the Electricity Act-2003, Clause-32 & 33 are reproduced as under :

#### **CLAUSE-32**

*(1) The State Load Dispatch Centre shall be the apex body to ensure integrated operation of the power system in a State.*

*(2) The State Load Dispatch Centre shall -*

*(a) be responsible for optimum scheduling and dispatch of electricity within a*

*State, in accordance with the contracts entered into with the licensees or the generating companies operating in that State;*

*(b) monitor grid operations;*

*(c) keep accounts of the quantity of electricity transmitted through the State grid;*

*(d) exercise supervision and control over the intra-state transmission system; and*

*(e) be responsible for carrying out real time operations for grid control and despatch of electricity within the State through secure and economic operation of the State grid in accordance with the Grid Standards and the State Grid Code.*

*(3) The State Load Despatch Centre may levy and collect such fee and charges from the generating companies and licensees engaged in intra-State transmission of electricity as may be specified by the State Commission.*

### **CLAUSE-33**

*(1) The State Load Despatch Centre in a State may give such directions and exercise such supervision and control as may be required for ensuring the integrated grid operations and for achieving the maximum economy and efficiency in the operation of power system in that State*

1.1.3 **Central Electricity Authority (CEA) Guidelines:** As per CEA guidelines only the facilities with regional interest/substations/Power stations i.e. participating significantly in the regional integrated operation of the Grid will be covered by the unified Scheme. Consequently the facilities under control scheme are to include the following:

○ *All the generating stations of 50MW & above*

○ *All 400kV S/stn.*

○ *All 220kV S/stn.*

○ *All 132 kV & 66 kV S/Stns. operated in closed loop or where inter-state tie lines are located.*

1.1.4 After the commissioning of ULDC scheme in Northern Region no further data acquisition of upcoming Substations in Haryana has been carried out and thus the status of coverage of SCADA/EMS areas remain standstill since the time of its commissioning during 2002.

1.1.5 During the period from year 2002 to 2008, there has been enormous expansion of transmission system. At present a total of 46 Sub-stations (41 plus 5 collocated) are being monitored through SCADA and it is intended to extend the facility to cover about 310 sub-stations. The expansion of SCADA/EMS system with the latest technology available in the market is inevitable keeping in view the statutory

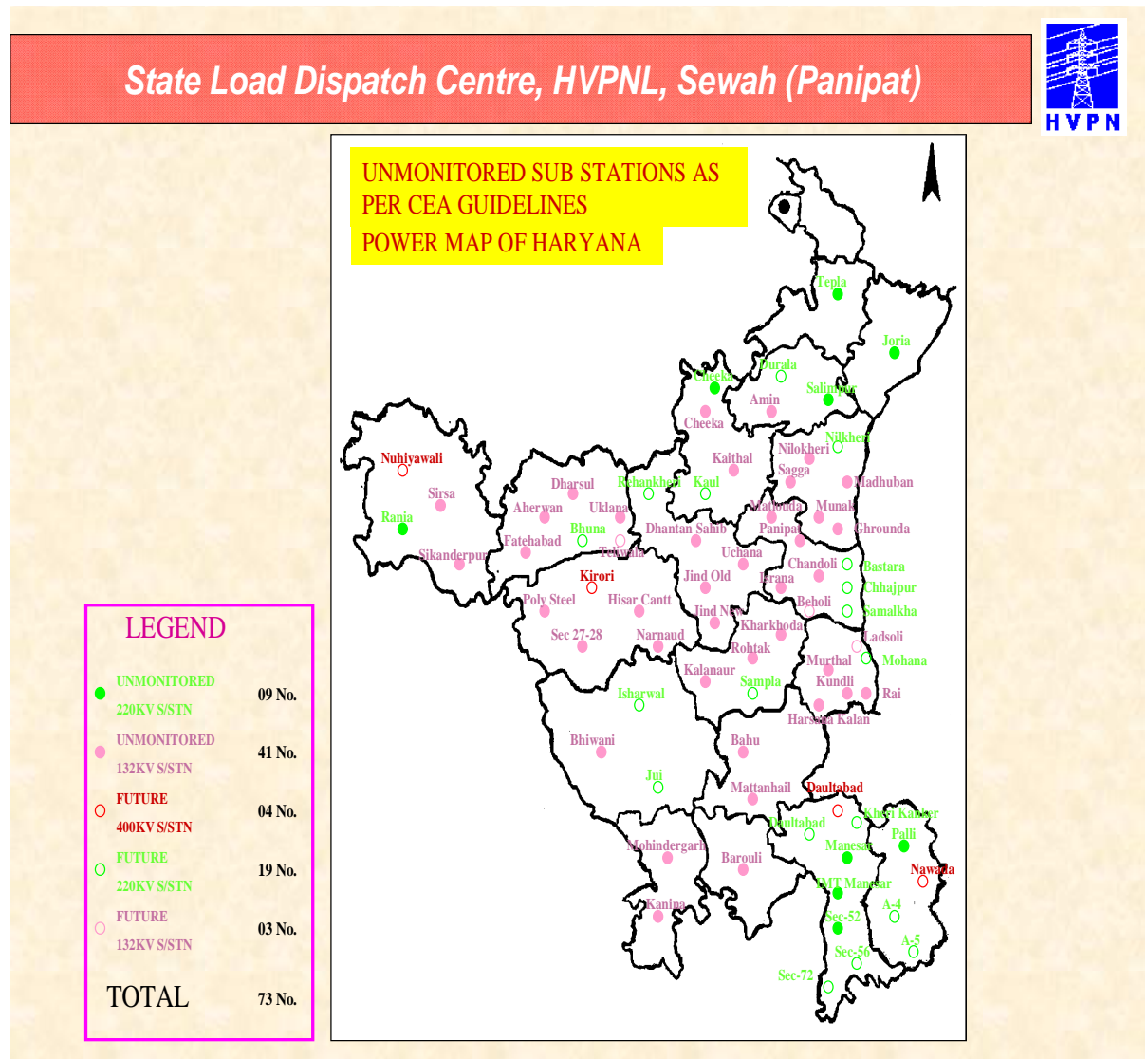
requirements as well as to have an efficient network management of the state grid.

1.1.6 System expansion is required to:

- (a) Meet with the requirement of EA-2003
- (b) Follow the CEA guidelines
- (c) Future transmission network expansion in next 6-8 years.

1.2 Selection of Project Area and Scope

**Project Location:**



**Tentative Substations considered for real time data acquisition are tabulated as under:**

<b>Substations</b>	<b>Quantity</b>	<b>Monitored under ULDC Project</b>	
400 kV	5	-	*The quantity shown here is of the existing and upcoming Substations, which may increase by 20% to accommodate future Substations.
220 kV	52	25	
132 kV	137	19	
66 kV	113	2	
<b>TOTAL</b>	<b>307*</b>	<b>46</b>	

**1.3 “HVPNL IT Plan”** To implement a portfolio of software applications using (i) commercially available ERP packages, (ii) Commercial Over the Shelf (COTS) applications, (iii) Decision Support System using Data Warehouse framework and available tools for ETL and BI applications of Query and Reporting, OLAP, Statistical Analysis and Data Mining etc, (iv) technology solutions for portals, workflow, integration, document management, communication and messaging etc and (v) commercially available power transmission utility specific specialized technical software packages. These applications will run on an enterprise wide secure WAN (VPN). The integration of HVPNL IT applications and information captured from SCADA/EMS system in future into a common IT platform, for a single point access to all utility process information. Introduction of this system can achieve efficient utilization of IT applications as well as SCADA/EMS; for example HVPNL can integrate power flow data acquired from SCADA with the data from GIS application for real-time computation of reliability indices.

## **2 The Objective**

**2.1** The Objective of the Project Management Consultant/Consultancy Services (PMC) is to firm up the Employer’s requirements in respect of development/expansion and construction of the Project consistent with the regulations, codes, standards, rules, statutory requirements, provisions of law and other such relevant references and for enabling the prospective bidders to assess the Project elements and requirements in a clear and predictable manner. PMC shall comply with the provisions and recommendations of the Report of the NRPC on Minimum Standard Requirements for ULDC scheme (Phase-II) December 2009 as a base line.

**2.2** The PMC shall furnish all the necessary information and inputs for this purpose including technical, physical, economic, commercial and financial features of the Project, evaluation/ assessment of the technical feasibility and economic justification and financial viability of the Project, identification of the possible technical/commercial risks together with suggested mitigation options.

### 3 Scope of Work

The scope of consultancy assignments shall be covered in two phases (i.e. Engineering Consultancy and Project Management Consultancy) :

#### ❖ Phase-1 Engineering Consultancy

- Inception/ Concept Report,
- Feasibility report,
- Detailed project report,
- Technical specifications
- **Cost Estimation**
- Bidding documents,
- Assistance during the bid evaluation, contract negotiation and etc.

#### ❖ Phase-2 Project Management Consultancy

- Project Management
- Construction supervision
- Review & detailed comments on vendor/OEM provided Factory acceptance test (FAT)/ Site acceptance test (SAT) procedures
- Commissioning and Testing
- System Trainings
- Progress report
- Coordination
- Finalization of quality assurance programme of the various manufacturers / contractors and support during warranty period.

This assignment will also include all/any other necessary activity to facilitate the expansion of SCADA/EMS project in HVPNL.

#### 3.1 Inception/Concept Report:

The Consultant shall, upon award of the Consultancy, submit an Inception Report containing a further elaboration of the Consultant's submissions towards understanding of the RFP and the Work Plan. The Inception Report shall also include the Consultant's methodology (with different options) for expansion of SCADA/EMS system along with the strengthening of the communication facility.

#### 3.2 Feasibility Report (FR):

The consultant shall be required to prepare a comprehensive Feasibility Report which shall include but not limited to the following:-

- a) The Expansion Requirement of SCADA/EMS & Communication facilities at SLDC, Panipat with different available techno-commercial options for the expansion requirement.
- b) The basic data for the design of the project and surveys reports, if any; site reconnaissance and scheme optimization
- c) Data volumes & data exchange with other entities and existing system. Communication requirements (e.g. Micro wave, Multi access radio, Fiber optic over

ground wire (OPGW), Power line carrier communication (PLCC), third party leased line etc.) & implementation optimization by considering the existing available communication facilities.

- d) Broad functional requirements of the total SCADA/EMS system including the interfaces of the system to other higher level control systems, and design of interfaces to corporate IT facilities
- e) Tools for Porting/mapping of the power system model in the existing system to the proposed SCADA/EMS system.
- f) Design of integration of the system facilities with the planned communication network.
- g) Estimate of the Project cost and schedule.

### **3.3 Detailed Project Report (DPR)**

Based on the feasibility report and the proposal finalized by the Employer, the consultant shall prepare and submit the Detailed Project Report (DPR). The DPR shall include but not limited to the following:

- a) The detailed design of the project.
- b) The detailed functional requirements of the total SCADA/EMS system including the function design of the system, design of interfaces of the system to other higher level control systems, and design of **interfaces to corporate IT facilities**. The detail functional design of the project shall include the following:-
  - **Layout design between the system network** (i.e. SCADA system & sub system) and SCADA field equipment.
  - Installation detailed design for SCADA/EMS computer system in SLDC, substation facilities and field equipment.
  - Design of integration of the system facilities with the planned communication network (e.g. Micro wave, Multi access radio, Fiber optic over ground wire (OPGW), Power line carrier communication (PLCC), third party leased line etc.) & implementation optimization by considering the existing available communication facilities. Data volumes & data exchange with other entities and existing system.
  - Design for fault current, insulation level, lightning surge and weather condition for equipment in substation facilities.
  - **Function design**
    - i. Data acquisition design w.r.t Control Centre, RTU (Remote Terminal Unit) SAS (Substation Automation System)

- ii. Local Display at the Substations.
- iii. Software function design for the project
- iv. Future function design
- **Interface design**
  - i. Interface design between SCADA/EMS and existing facilities such as existing RTUs and Substation facilities
  - ii. Interface design among communication devices, SAS, RTU and Computer systems
  - iii. Interface design among substation equipment such as different types of RTU, CT, PT, SAS, IEDs, relays and battery/battery-charger
  - iv. Interface design with different communication system
  - v. Interface design for Historical Information Storage & Retrieval System with SCADA /EMS System.
- Detailed Bill of Quantity (BOQ)
- Estimated Project cost and Project implementation schedule.

#### 3.4 **Design & Technical Specification**

The consultant shall be responsible for preparation of the detailed design, technical/commercial specifications of each & every elements as spelled out in the detailed project report as well as Guaranteed Technical Particulars (GTP) of the Expansion of SCADA/EMS system and associated communication facility sufficient for tendering process by the Employer.

- 3.5 **Cost Estimates.** The Consultant shall prepare the cost estimates for the Expansion of SCADA/EMS system and associated strengthening of communication system including identification of the costs of the various system elements (e.g., SCADA/EMS computer system (Hardware), SCADA/EMS software applications, LAN/WAN switches, data acquisition field devices (RTU, bay controller etc.), Modems, Transducers, Potential free Contact Multiplying Relays , latching relays, the control and communication system, engineering and project management, supervision and contingencies etc.). The Project costs should be segregated into functional elements and the total costs should comprise: base costs, physical contingencies, price contingencies, financing costs (e.g., interest during construction) etc. That way, the Consultant shall provide a preliminary estimate of the BOQ of equipment and services as a base for the cost estimate for each of the suggested options including the optimal option.

#### 3.6 **Preparation of the World Bank bidding document:**

The Consultant shall prepare the World Bank bidding documents keeping in view the terms & conditions of the world bank latest guidelines and subsequently assist the employer in getting the same approved from the World Bank.

**3.7 Assistance during the Bidding:** The consultant shall assist the Employer for the followings during Bidding stage:

- a) Preparation of scope of work
- b) Preparation of implementation schedule
- c) Preparation of Technical Specifications
- d) Preparation of Technical Schedules along with Bidding Documents and Drawings.
- e) Preparation of the technical clarifications during pre-bid meetings/ discussions.
- f) Technical and commercial evaluation of Bids.

**3.8 Project Management & Construction Supervision**

- a) The consultant shall assist Employer in review and approval of the detailed engineering drawings/documents submitted by the contractors/ suppliers.
- b) The consultant shall assist the employer to ensure that installation/Load Despatch Centres are provided with adequate physical security and safety (fire safety, access control etc.) as per international norms and practices for similar installations.

**3.9 Finalization of FAT/SAT Procedures as well as system testing & commissioning**

- a) The consultant shall review/ give detailed comments on the Factory Acceptance Test (FAT)/Site Acceptance Test (SAT) of the vendors/OEM.
- b) Type tests & FAT/SAT shall be witnessed by the Employer. The consultant shall associate with Employer's engineers for witnessing of **type testing** of standard equipment, participation in factory acceptance tests of systems, in site acceptance testing of integrated systems including interfaces with the communication network, commissioning of facility equipment and systems at the SLDC/Sub-SLDC and at least five of the substation sites.
- c) Similarly, consultant shall associate with employer in witnessing the Global Site Acceptance & Validation Test (GSAVT) for all the facilities/system/subsystem including the integrated component with the different level/third party/RLDC system of the Project.
- d) The Consultant shall assist the Employer in furnishing necessary information for obtaining any statutory approvals/clearances such as from Standing Advisory Committee for Frequency Allocation (SACFA), Wireless Planning & Coordination wing (WPC), Department of Telecommunication (DoT) and Ministry of Aviation etc.
- e) The consultant shall assist the Employer in **preparing the list of defects**.

**3.10 System Trainings**

- a) Provide one training session on the theory and practical skill of SCADA/EMS systems including basic knowledge of the equipment configuration design.
- b) Review of the Contractor plan for training on **the facilities** for Transmission Network Management for Operational acquaintance to the officers/officials.

- c) Categorization of different level of trainings for different level of users & system support officers/officials.
- d) Co-ordinate and arrange a training to learn practical O&M methods for , SCADA/EMS system and efficient Transmission network management work etc.
- e) Advise how Employer can integrate the knowledge acquired through the training for efficient management of SCADA/EMS activity.
- f) Coordinate the discussion with the course coordinator, training institutions and other agencies.
- g) Assist Employer in evolving a mechanism for institutionalizing of SCADA/EMS training activity.

### **3.11 Coordination and Progress Reports**

The Consultant shall assist the Employer in evolving proper MIS reports for effective control and timely completion of the Project. The consultant shall also assist the employer in preparation of progress reports/feedback information required to be submitted to the State Govt./any statutory commercial/financial agency.

3.12 The Consultant shall assist the Employer in finalization of quality assurance programme of the various manufacturers / contractors and support during warranty period. The consultant shall also assist the employer for training by the Contractor for O & M of different modules and preparation of Completion Reports including as-built drawings by the contractor.

3.13 The Consultant shall be responsible for preparing the **technical Schedules** of the Project and for bringing out any special feature or requirement of the Project referred to in the CEA Guidelines/Global Practices or the technical standards applicable for the Project under the Electricity Act 2003 and the Indian Electricity Rules 1956, as amended, or the Regulations on Grid Connectivity, Metering, Construction of Electrical Plants & Electric Lines, and Grid Standards and Safety as notified by the Govt authority from time to time. The details and particulars to be specified in the Schedules shall be in accordance with the provisions of the relevant codes or regulations. Such provisions may be included in the Schedules by reference to the relevant provisions of the said codes/ regulations.

### **3.14 Assessment of System Operation requirements**

The Consultant shall assess the technical standards applicable for the Project under the Electricity Act 2003 and the Indian Electricity Rules, 1956, as amended, and Regulations on Grid Connectivity, Metering, Construction of Electrical Plants and Electric Lines, and Grid Standards and Safety as notified by the Central Electricity Employer. It is assumed that a project of this scope would normally follow international standards, and the National Grid Code and the State Grid Code. ISO recommendations shall govern the quality of project

components, including design, engineering, and equipment fabrication, testing and commissioning. It will be necessary to take into account the need for compatibility with the National and Regional Load Dispatch Centers.

3.15 The Consultant shall also address the following issues related to the implementation of the Project:

- (a) Control Centre Augmentation (Proposed/Future)
  - Software requirement (CIM compliant) for SCADA/EMS functionality
  - Local Control Centre level monitoring equipment
  - Integration of Wide Area Measurement viz. Phasor Measurement Unit (PMUs) data employing synchrophasor technology as a SCADA value with control center.
  - Integration of Special Protection Schemes/ Important protections etc. at Substations with Control Centres.
  - Identification of strategic location for weather stations in the state of Haryana for developing load forecast applications
  - Provision for backup control centre as a part of Disaster Management Plans
  - Auxiliary services like Uninterrupted Power Supply (UPS), DG set.
  - Merging of control centre viz. Sub-LDCs, if considered necessary.
  - Cyber security
  
- (b) Availability Based Tariff (ABT) & Open Access have become the additional requirements for grid operation and the following off line applications shall be required:
  - i. Scheduling of transactions
  - ii. Open Access transactions: receipt of requests & processing the same.
  - iii. Power Exchange (PX) transactions
  - iv. Data warehousing and mining facilities.
  - v. Website hosting along with IT, NMS and perimeter security.
  - vi. System studies (Power flow, Stability, short circuit, EMTP, Relay coordination, transmission charges and loss apportionment etc.)
  - vii. Any other such off line applications etc.
  - viii. Interfacing of existing offline software viz. Metering & settlement system with the other off line applications as mentioned above from i to vii.
  
- (c) As per CEA guidelines, only the facilities with regional interest/substations/Power stations i.e participating significantly in the regional integrated operation of the Grid will be covered by the unified Scheme. Consequently the facilities under control scheme are to include the following:
  - *All the generating station, of 50MW & above*

- All 400kV S/stn.
  - All 220kV S/stn.
  - All 132 kV & 66 kV S/Stns. operated in closed loop or where inter-state tie lines are located.
- (d) preventive and restorative maintenance of the SCADA/EMS system and associated communication facilities;
- (e) requirement of spares;
- (f) ancillary services requirements; and
- (g) methodology for maximizing the availability of SCADA/EMS System & associated communication facilities.
- (h) the Consultant shall ensure the following minimum functions from the SCADA/EMS system:

	<b>Function</b>	<b>Explanation</b>
1	RTU/SAS Data Acquisition	Collection of data from remote monitored system through RTUs (Remote Terminal Equipments) or from Substation Automation System. Accurate model of the monitored system is maintained.
2	Data Processing, Supervisory Control & Exchange	Collected data from monitored systems converted into raw data to engineering units, limit checks are performed. Processes alarms, processes calculations, stores the acquired data, issues control commands, handles SCADA communication problems, and communicates with Loadshed & other EMS Applications.
3	Sequence of Events (SOE)	Whenever there is topological change at substation that will be picked up as SOE, time stamped by the RTU and will be reported to the host. as and when host is available.
4	Calculated data	Calculated data such as energy accounting, max, min, avg., pf etc.
5	Time Synchronization	Satellite time acquired through GPS Clock is made to synchronize the SCADA Data servers, CFE and consequently the complete system network. In the web enabled TCP/IP based application, GPS clock may be provided at RTU for time synchronization and time stamping.
6	Historical Information storage & retrieval (ISR)	Data from field RTUs stored with the help of RDBMS at a certain time intervals for the purpose of generating reports at a later stage.
7	Disturbance Data Collection	HDR files are continuously stored for analysis purposes.
8	State Estimator	Determines the network state with the help of network model (equations and parameters), the network topology (derived from status measurements), available measurements and models of load and generation bus injections
9	Contingency Analysis	Contingency Analysis reports which hypothetical contingencies would cause component limit violations.

		A contingency is a defined set of hypothetical equipment outages and / or breaker operations as well as node outages, substation outages.
10	Security Enhancement	Security Enhancement looks for control changes in order to improve the security and the economics of the power system for the base case network state (current or postulated) for contingent network states. A feasible state is a network solution in which all components operate within their limits.  An optimal state is a feasible state for which the operating cost has been reduced to a minimum.
11	Optimal power flow	By means of this feature, the state of the electrical power system for a given set of conditions at a specific time is determined. It's scope is for any problem that involves the determination of the optimal steady-state operation of an Electric Power Generation-Transmission system.

**3.16 Integration issues with the existing SCADA-EMS system/Sub system:**

- a) The PMC shall workout the integration requirements with third party / other SCADA systems & sub system/ Substation Automation Systems & existing RTUs provided at generating stations / substations. Accordingly, the compatibility of the prevailing protocols with the proposed SCADA/EMS system and Data exchange with existing control centers including RSCC to be implemented with secure protocol i.e ICCP.
- b) The PMC shall ensure the integration of the existing SCADA/EMS of Unified Load Dispatch Scheme of Northern Region as well as with the expansion scheme of Northern Region planned to be created subsequently.

**3.17 Operation and Maintenance Plan.** The Consultant shall prepare the Operation and Maintenance (the “O&M”) plan for the SCADA/EMS Project system. The SCADA/EMS system components, as required, shall be equipped with all the required facilities such as SCADA/EMS software applications, SCADA/EMS system Hardware, communication, measurement, telemetry and interface equipment, probes and compatibility required for inter control center data flow with National & Regional Load Despatch Centre. The Consultant shall also ensure safe, secure, stable, reliable and coordinated operation and maintenance of all the components of SCADA/EMS systems and sub-system covered under the Project. The Consultant is required to suggest comprehensive periodic maintenance schedules for the SCADA/EMS system, including a list of the diagnostic tools and testing equipments, etc. with a view to enabling the achievement of the targeted availability factor established by the Employer.

**3.18 Project Implementation Time Schedule.** The Employer expects to complete the Project within 26 months from the date of signing of PMC Contract. The time line for each activity is tabulated as below:

<b>Description of Activity</b>	<b>Duration in (Months)</b>
<b>PMC Contract Signing</b>	-
<b>Phase-1 Engineering Consultancy</b>	
Inception/Concept report, feasibility report	3*
Preparation of DPR* / Detailed Design	
Preparation of Pre-qualification Document for Pre-qualification of Bidders	
Preparation of tender documents and Tendering	3.5
Evaluation of Bids	2.5
Contract Negotiation	
Contract Signing	
Preparation of L/C opening	<b>9</b>
<b>“A”</b>	
<b>Phase -2 Project Management Consultancy</b>	
Checking and Approval of Drawing and Documents	12
Procurement of Materials	
Delivery of Materials	
Erection / Installation	4
Commissioning & Acceptance Tests	
<b>“B”</b>	<b>16</b>
Completion Report with As Built-drawings/Manuals	<b>1</b>
<b>“C”</b>	
Project Completion Date (**)	
<b>“A”+“B”+“C”</b>	<b>26</b>

\* Excludes the time taken by the Authority in providing its comments on Draft Reports. The Consultant shall get one week for submission of the Final Feasibility Report after comments of the Authority are provided.

(\*\*) Project Completion is defined as completion of commissioning of all components

The Consultant shall deploy its Key Personnel as per the key personnel proposed under Section-6 ‘Consultancy Team’ in line with the time schedules tabulated above. However these schedules and durations may undergo the changes as per the project implementation progress and needs.

#### **4 Deliverables**

**4.1** The Consultant shall deliver the following during the course of this Consultancy. The deliverables shall be so drafted that they could be given to the prospective bidders for

guidance in preparation of their bids. Five hard copies and two soft copies in CDs of all the final reports, drawings, etc. shall be submitted to the Employer. For draft reports only two hard copies and one soft copy in CD shall be submitted to the Employer.

**A. Submission of Inception/Concept Report and Feasibility Report**

- The Consultant shall, upon award of the Consultancy, submit an Inception Report containing a further elaboration of the Consultant's submissions towards understanding of the RFP and the Work Plan. The Inception Report shall also include the Consultant's methodology (with different options) for expansion of SCADA/EMS system along with the strengthening of the communication facility.
- The Consultant shall submit a Feasibility Report where it must clearly spell out the broad strategy for structuring the project in a manner that would ensure its economic viability and justification. For this purpose, the Consultant shall make realistic assumptions relating to costs and revenues. The project components should be so formulated as to make the project viable. In determining its aforesaid strategy, the Consultant shall also seek the advice of the Employer.

The inception report and feasibility report shall be submitted to the Employer within 3 weeks after signing the PMC Contract. The Employer shall convey its comments, if any, on the Inception and feasibility Report within one week of its receipt. The Consultant shall get one week for submission of the Final Feasibility Report after comments of the Employer.

**B. Preparation of Prequalification Documents**

The consultant shall prepare & submit the Prequalification documents containing the terms & conditions for technical qualification of prospective bidders within one month after signings the PMC contract

**C. Detailed Project Report (DPR)**

The Consultant shall deliver to the Employer three hard copies and two soft copies in CDs of the Detailed Project Report and technical Schedules within the time schedule specified in paragraph 3.18 above. The DPR shall include, *inter alia*, all details collected, analyzed, estimated, and compiled in respect of the scope of work specified in paragraph 3 above, including the following:

- (1) *Technical design & Survey Reports*  
Drawings, preliminary designs, preliminary engineering and Survey Reports.
- (2) *Technical and commercial risks*  
Report on technical and commercial risks together with suggested mitigation options.
- (3) *Relevant statutes*

Report on all the relevant regulations, codes, standards, rules, statutory requirements, provisions of law and other such relevant references.

(4) *Preliminary costing*

Report on preliminary costing for each suggested option, including the optimal option, for expansion of SCADA/EMS Project, including indicative BOQs.

(5) *System operation requirements*

Consultant will also incorporate in DPR a report on the envisaged operational requirement of the system for efficient grid operation for the next 7-10 years.

(6) *O&M Plan*

O&M Plan to be submitted by the consultant shall include but not limited to the following aspects:

- Availability of H/W spares for at least 7-10 years
- H/W to be generic in nature instead of vendor's specific
- AMC plan of different components in the most economical manner
- Suggesting manpower to be deployed for efficient working

(7) *Implementation plan and schedule*

- a. Construction period.
- b. Likely delays, if any, on account of other miscellaneous factors.

After the submission of final feasibility report by the Consultant, the DPR shall be submitted within 3 weeks for comments from Employer. The Employer shall convey its comments, if any, on the DPR within minimum possible time of its receipt. The Consultant shall get one week for submission of the Final DPR after comments of the employer are provided.

**D. Schedules of SCADA/EMS Service Agreement (SSA)**

The Consultant shall provide the schedules of the SSA and all the supporting documentation relating to these schedules (refer paragraph 3.12).

**E. FAT/SAT procedures & formats**

The PMC shall provide the Employer with detailed comments on the vendor/ OEM provided project specific factory acceptance test/site acceptance test procedure as well as formats.

**4.2** The Employer shall convey its comments on the Draft Detailed Project Report (DPR) within two weeks of its receipt, following which the Consultant shall finalize and deliver the Final DPR and implementation Schedules of the Expansion of SCADA/EMS Project in accordance with the time schedule indicated in paragraph 3.19 above.

- 4.3 Monthly progress reports:** The project implementation schedule forms the guideline for defining the activity completion schedule of PMC activities and the related outputs. The PMC would be required to submit monthly progress report on work done in specific consultancy service areas in the first week for the progress achieved during the preceding month.
- 4.4 Activity reports:** Apart from the progress reports, the PMC will be required to submit the activity reports within a period of two weeks of completion of each activity. They would also be required to submit the interim reports during the activity period also to appraise the status and issues emerging out of the activities. This would be especially applicable for the baseline and mid-term evaluation studies.
- 4.5** The PMC will submit draft reports in mutually agreed formats (5 hard & soft copies each) along with a power point presentation of findings and recommended actions for discussion with the Steering Committee and other HVPNL officials before finalization. An executive summary shall be provided for all major reports.
- 4.6** Apart from each activity report, the PMC would help the Superintending Engineer/SLDC Design & Construction to prepare guidelines, manuals to facilitate implementation. These submissions will be in line with the implementation schedule of the project activities.
- 4.7** The PMC shall transfer the entire database generated for the purpose of reporting to the Employer and the same shall be updated with collection of new data. The Consultant shall not use the information generated during these PMC services for wider dissemination without the express and written permission of Employer.

## **5. Meetings**

The Employer may review with the Consultant, any or all of the documents and advice forming part of the Consultancy, in meetings and conferences which will be held in Panchkula/Panipat at the Employer's office.

## **6. Consultancy Team**

The Consultant shall form a multi-disciplinary team (the “**Consultancy Team**”) for undertaking this assignment. The responsibilities and minimum Qualification and experience of Key Personnel to be deployed on the Project shall be as under:

**Key Personnel Responsibilities and minimum Qualification & Experience of Key personnel**

Reference Category**	Position of Key Personnel	Terms of Reference/ <b>Responsibilities</b>	Expected Qualification & Experience
F1/ GC-INT	Project Manager - Team Leader (The <b>“Team Leader”</b> )	<p>Shall be overall in-charge of the project in assisting the Employer to implement a well coordinated and efficient project design, construction &amp; implementation of Expansion of SCADA/EMS, integration &amp; communication facilities in HVPNL. Shall assist the Employer in formulating methodologies in efficient &amp; effective usage of the SCADA/EMS system.</p> <p>Shall interact with the implementing contractor to facilitate proper usage of the system.</p> <p>Shall ensure maximum value</p>	<p>An Engineering graduate (post graduate will be preferred) with at least 10 years of working experience in SCADA/EMS Systems &amp; having executed or in the process of executing at least three SCADA/EMS Systems planning, implementation, project management in the last ten years for large power transmission utilities.</p> <p>Shall have knowledge of IT-based tools and MIS packages for project monitoring and control.</p>

		for investment is realized from the SCADA/EMS system.	
		Shall assist the Employer in coordinating the main vendor/s and various sub-system vendors viz., Communication, Software, Hardware, Field Equipment, etc., to orchestrate the smooth and timely completion of expansion project etc.	Shall be knowledgeable on the latest technologies, trends & best practices in SCADA/EMS for power utilities.
		Shall suitably advise the Employer in all related aspects in implementation of SCADA/EMS System expansion.	Shall be adequately knowledgeable in all aspects of SCADA/EMS project components like SCADA, HMI system, Field SCADA equipment and adaptation, Communication and computer systems database etc., Shall be acquainted with the integration requirements of various Data Acquisition systems
		Shall assist the Employer in Contract Management and Project time line management	Shall have experience on major SCADA/EMS Projects in terms of Contract Management, schedule management and budget monitoring.

F2/GC-INT	SCADA/ EMS System Engineer	<p>The Systems Engineer shall assist the Employer in all the technical aspects of SLDC control system design based on the actual requirement. Shall assist the Employer in:</p> <ul style="list-style-type: none"> <li>• System Architecture design</li> <li>• Database sizing</li> <li>• System Sizing</li> <li>• Software Requirements</li> <li>• Hardware requirements</li> <li>• Communication interface requirements</li> <li>• System integration</li> <li>• Integration requirements with third party / other SCADA systems/Substation Automation systems</li> <li>• Global standards used in SCADA/EMS design</li> <li>• Communication protocols in SCADA</li> </ul>	<p>Shall be an electrical / Electronics &amp; Communication engineering graduate (post graduate qualifications preferred) with at least Seven years of experience. He shall have working experience in implementing SCADA/EMS comprises all the responsibilities mentioned for SCADA/EMS system engineer “F2” in at least one large Power Transmission Utility. Should have been a designated Control Systems Engineer of SCADA systems implemented.</p> <p>Should have sufficient knowledge of Inter control centre protocol for exchanging the Data with different level control centre including the RSCC/NLDC etc.</p>
-----------	----------------------------------	--	--

		<p>Shall supervise the SCADA Contractor for compliance of SCADA technical and operational requirements.</p> <p>He shall advise the Employer on the functional ergonomic design of the control room facilities requirements.</p>	<p>Shall have knowledge of Advanced Energy Management System application Functionalities such as Volt-VAR Control, Optimal Power Flow, Control Room Management,</p> <ul style="list-style-type: none"> <li>- Substation Automation,- Contingency Analysis Real Time Study base,</li> <li>-Load shed application,</li> <li>-Advanced Applications</li> <li>-Security enhancement- Historical Information System.</li> <li>-Historical Information Management</li> <li>-Energy Automation Information</li> <li>-SCADA interface with existing intelligent systems</li> </ul>
		<p>Shall advise the Employer on the training requirements for Operating personnel.</p> <p>Prepare training plan and the training schedule for all levels of users / managers.</p> <p>Shall assist the Employer in ensuring the Operating Personnel are adequately trained for System operation related requirements etc.</p>	<ul style="list-style-type: none"> <li>-ABT Applications for scheduling,</li> <li>-Calculation of System Reliability and Quality Indices</li> <li>-Historical Data Retrieval</li> <li>-etc.</li> </ul>
F3/ GC- INT	Communication Systems Engineer	Shall advise the Employer on latest communication technologies available in the	Shall be a graduate Communication / Electronics / telecommunication engineer with at least Five years of experience in the field of communication system used for SCADA/EMS.

		<p>market including the high capacity leased line options and the relative merits-demerits of each.</p> <p>Identify the most appropriate communication media or combination of the communication medias based on a techno commercial approach with the life term cost benefit analysis.</p> <p>Advise the Employer on the interface requirements between SCADA/EMS &amp; Communication systems etc.</p>	<p>He shall be responsible for having implemented communication media in at least one SCADA/EMS project in the last five years.</p>
F4/ INT	GC- SCADA/ EMS Computer Hardware Engineer	<p>Shall advise the Employer on System requirements, Sizing, Configuration of the SCADA/EMS master station, General &amp; Architecture requirements of Master Station, reserve, expansion &amp; upgrade capabilities of</p>	<p>Shall be a graduate Electronics / Computer engineer with at least Five years experience in relevant field</p> <p>Shall have hands on experience as a computer system engineer in at least one SCADA/EMS project in the last five years.</p>

		<p>master station, System availability definition and response times , failover and restart requirements.</p>	
L-1/GC-N	Project Coordinator	<p>Shall be responsible for overall project coordination between the Employer and SCADA/EMS Consultant and their representatives, Design &amp; Engineering Specialists, Existing Field data collection Supervisor, Vendors &amp; main Sub-vendors of SCADA subsystems. Assist the Employer in effectively coordinating the visit of consultants, visits planning, scheduling and procedural Formalities. Shall coordinate the design consultant/s and various sub-system consultants viz., Communication,</p>	<p>An Electrical/Electronics/Communication /Computer Engineering graduate with at least 10 years of working experience in large Transmission Power Utility. Preferably having associated with SCADA/EMS Systems’ planning, implementation, project management for large electric power transmission utilities in India.</p>

		<p>Software, Hardware, Field Equipment, etc., to orchestrate the smooth and timely completion of the project.</p> <p>Shall coordinate weekly meetings between the Employer and all associated agencies for review / progress of work</p> <p>Shall report on progress of activities at project sites on regular basis.</p> <p>Shall assist the Employer in preparation of management reporting on project work progress</p>	
L-2/GC-N	Electrical Engr - Substation	<p>Shall assist Employer in Analyzing the requirements of modification in existing RTU, if any.</p> <p>Identification of Adaptation requirements at substations</p> <p>- Collect the basic data for the design of the project and shall make site surveys.</p> <p>Make the Layout</p>	<p>Electrical engineer with experience of over 10 years preferable in a transmission utility and having worked on Substations system design &amp; equipment installation .</p> <p>Shall have knowledge of RTU/substation automation system. Cabling of CTs/PTs, other protection devices &amp; IEDs for making the connectivity with SCADA/field device etc.</p>

		<p>design between the associated facilities etc. with SCADA field equipment.</p> <p>Study the earthing requirement and design of all the SCADA field equipment locations and advise if changes are required.</p> <p>Monitor the contractors / sub-contractors safety practices at field during implementation.</p>	
L-3/GC-N	Communication Engineer	<p>Shall advise the Employer on the identification of the Communication technology most suitable for Indian conditions including the high capacity leased line options.</p> <p>Shall be well versed with modern communication technologies like GPRS, CDMA apart from Fiber Optic &amp; Radio-Microwave, VSat communications</p>	<p>Electronics / Telecommunication engineer with at least 8 years experience in the field of communication systems for Real-data control and monitoring systems.</p> <p>Shall have work experience of interfacing with the statutory organizations.</p>

		<p>etc.</p> <p>Shall study the vendor offered systems and ensure compliance with the design parameters</p> <p>Shall assist in Site Acceptance testing of the communication system to ascertain its performance.</p>	
L4/GC-N	IT Professional	<p>The IT professional shall assist HVPNL in all the technical aspects of SLDC control system based off-line IT requirements to comply with the statutory requirements in Indian context viz. IEGC, State Grid Code, IEA etc.</p> <p>He shall assist in preparing the specification, design and the implementation of but not limited to the following offline applications:</p> <ul style="list-style-type: none"> <li>• ISR for SCADA/EMS</li> </ul>	<p>Shall be Computer / IT Engineering Graduate (Post graduate qualifications preferred). He shall have at least Five years working experience in design, commissioning &amp; implementing of off-line SCADA/EMS system Applications in Power Utilities.</p>

		<ul style="list-style-type: none"> <li>• Long term &amp; Short term Open Access</li> <li>• Power exchange</li> <li>• ABT</li> <li>• Transaction Schedule</li> <li>• Metering Applications</li> <li>• Management Information</li> <li>• Integration with real time applications of SCADA/EMS</li> <li>• Data warehousing &amp; mining facilities</li> <li>• Website hosting along with IT, NMS and perimeter security</li> <li>• Interfacing between different modules as enlisted above</li> <li>• System studies (Power flow, Stability, Short circuit, EMTP, Relay coordination, transmission charges &amp; loss apportionment etc.)</li> </ul>	
L5/GC-N	Bidding Expert	The professional shall assist the Employer in preparing the World Bank bidding documents as per the latest World Bank	An engineering graduate / MBA / CA / ICWA with sufficient experience in the preparation of World Bank bidding documents and should have experience in carrying out bidding activities for at least ten years.

		guidelines	
--	--	------------	--

**\*\*Reference Category**

GC- INT- [Resident Professional Personnel] would mean the persons with international experience of having worked in/with many countries/international donors through externally aided projects/Programme for the experience required.

GC- N [Resident Support Personnel] would mean the persons with desired experience generated in India.