Quality Assurance Authority

Government of Haryana

Standard Operating Methods and Procedures
For
Power Distribution & Transmission Projects

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Rajeev Arora

FOREWORD

On behalf of the Quality Assurance Authority (QAA), I extend my heartfelt gratitude to the Honourable Chief Minister Sh. Nayab Singh for inspiring and guiding us with his vision and invaluable insights. Under his leadership, Haryana continues to advance toward greater transparency, accountability, and excellence in infrastructure development.

It is with immense pride that I present this comprehensive compilation of Standard Operating Methods and Procedures (SOMPs) to elevate the standards of infrastructure projects across Haryana. These SOMPs represent our unwavering commitment to achieving excellence in infrastructure development, encompassing Roads, Buildings, Water Supply Systems, Sewerage and STP, Irrigation and Canal Systems, Power Transmission, and Power Distribution.

The establishment of the QAA signifies a transformative step in Haryana's journey toward infrastructure excellence. The QAA gratefully acknowledges the vision and leadership of Hon'ble Sh. Manohar Lal, Union Minister, Housing, Urban Affairs, and Power, and the then Chief Minister, Haryana, whose foresight led to the conceptualization of this Authority for institutionalizing process-driven improvements in quality of Engineering Works in the State.

These SOMPs serve as a cornerstone for implementing a robust quality assurance framework, fostering a culture of accountability and continuous improvement in engineering projects. Our focus extends beyond compliance; we are dedicated to driving innovation, sustainability, and long-term reliability across the entire lifecycle of the projects.

These SOMPs are a testament to the collaborative efforts and credible inputs by various State Government departments implementing engineering works and organizations owned and controlled by the State Government. Together, we are committed to building a future where every infrastructure project reflects the values of quality, safety, and sustainability, contributing to Haryana's growth and serving as a model for others.

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INDEX

Sr. no.	Description	Page no.
1.	Standard Operating Methods and Procedures – Power Distribution Projects	2 – 90
2.	Standard Operating Methods and Procedures – Power Transmission Projects	91 – 173

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Quality Assurance Authority
Government of Haryana

Standard Operating Methods and Procedures
For
Technical Quality Assurance
In
Power Distribution Projects

PREFACE

The Quality Control process focuses on detecting and correcting defects in a product or service. It involves identifying quality issues and taking corrective actions to resolve them. This is carried out by quality control inspectors or technicians who conduct inspections, perform tests, and implement necessary corrective measures. Through this systematic approach, defects are identified and corrected to ensure the delivery of a high-quality product or service.

Whereas, Quality Assurance process ensures the delivery of a high-quality product or service throughout its entire life cycle by preventing quality problems from the outset. This comprehensive approach involves the entire organization, from top management to front-line employees, working in tandem to meet quality standards within the timeline and financial outlay. Key aspects of this process include planning, design, execution, delivery, training, documentation, and audits. By focusing on defect prevention, Quality Assurance ensures that the product or service meets the desired standards throughout the deliverable period.

A Standard Operating Methods and Procedure (SOMP) for Power Distribution Projects offers numerous advantages in the construction and operation of power distribution systems:
1. Quality Control – It ensures consistency in construction and installation standards, leading to high-quality infrastructure projects that meet regulatory requirements and industry standards.
2. Efficiency – Standardized procedures streamline project management, resource allocation, and construction processes, resulting in cost-effective and timely completion.
3. Compliance – It aids in adhering to environmental regulations, safety standards, and legal requirements, thereby mitigating potential legal and environmental issues.
4. Safety – It emphasizes safety procedures and guidelines for workers, reducing the risk of accidents and injuries during construction, installation, and maintenance activities.
5. Risk Management – It helps in identifying and mitigating potential risks associated with power distribution projects, from planning and design to execution, promoting proactive approach to problem-solving and strategic decision-making.
6. Documentation and Reporting – It aids in maintaining accurate project records and facilitates reporting for stakeholders, regulators, and quality assurance purposes.

The construction and installation of power distribution systems are conducted in accordance with the standards and specifications established by various national, international, and CEA guidelines. These standards detail the quality of materials and processes required for constructing and maintaining high-quality transmission lines and substations. It is crucial for all stakeholders to ensure that all quality tests are performed at the specified intervals. Comprehensive quality control and assurance protocols, as outlined in relevant guidelines and standards, serve as manuals for quality control in power distribution projects.

In this respect, SOMPs relating to all Technical Quality Assurance parameters, indicators, and sub-indicators required at various stages of power distribution projects have been prepared. These SOMPs have been developed in detailed consultation with the concerned user departments responsible for quality assurance and control in power distribution projects. The QAA is hopeful that State Government departments implementing engineering works and organizations owned and controlled by the State Government will evolve suitable mechanisms to implement the required Quality Assurance plans, with the objective of achieving economic and social development of the State and improving the quality of life for its people.

TABLE OF CONTENTS FOR POWER DISTRIBUTION

Chapter	Description	Page no.
Chapter 1	PART A: Executive Summary	5
	PART B: Responsibilities of Stakeholders	10
Chapter 2	SOMP w.r.t Technical Quality Assurance Parameters	19
Chapter 3	IS Codes and Manuals for Power Distribution Projects	59
Chapter 4	Description of Components of Power Distribution Projects	62
Annexure I	Technical Quality Assurance Parameters	71
Annexure II	Checklists: Part A, B, C	82

CHAPTER 1

PART A: Executive Summary

This comprehensive report outlines the quality assurance measures implemented throughout the power distribution projects in Haryana. It highlights the strategic processes adopted in each phase to ensure high standards of reliability, safety, and efficiency. The focus is on planning and design, execution, inspection, commissioning, safety protocols, project management, environmental sustainability, user feedback, and operation and maintenance to ensure the delivery of a high-quality power distribution network.

1. Planning and Design

In the initial planning and design phase, a structured approach is adopted to ensure the development of a robust and sustainable power distribution system. One of the critical steps involves integrated planning for load growth estimation, which enables a forecast of future energy demands based on urban expansion, industrial growth, population rise, new educational institutions, and AP loads. This ensures the system can handle projected loads and avoid future supply bottlenecks.

Selection of land for substations and transmission lines is crucial and based on accessibility, topography, and proximity to load centers. Once the land is chosen, a meticulous substation (SS) design is developed, including detailed layout plans, equipment specifications, and design drawings that account for the specific power requirements of the region.

Key performance indicators such as quality, reliability, functionality, and maintainability are integral to the planning phase, ensuring that the power distribution system will be efficient and resilient. Detailed load flow studies and short circuit analysis are conducted to ensure network stability and the ability to handle power surges or faults.

Cost analysis, budget planning, and timeline estimates are carried out meticulously to ensure the project stays within financial and temporal constraints. The award of contracts is executed through a turnkey project approach, streamlining the project management process. This includes obtaining administrative and technical approvals from competent authorities, which ensures the legal and regulatory compliance of the project. Major tasks for Planning and Design are listed as follows:

- Conduct integrated planning for load growth estimation based on demographic, industrial, educational, and agricultural load projections.
- Select appropriate land for substations and transmission lines, considering accessibility, topography, and future expansion needs.
- Develop detailed substation design, layout, and equipment specifications, ensuring adherence to performance standards.
- Ensure quality, reliability, functionality, and maintainability of supply through engineering design choices and technology integration.
- Perform load flow studies and short circuit analysis to guarantee network stability and fault management.
- Conduct cost analysis, budget planning, and estimate timelines to ensure the project stays on track financially and operationally.

- Secure administrative and technical approvals from competent authorities, ensuring compliance with regulations.
- Award work under the turnkey project approach to streamline execution and accountability.

2. Execution, Implementation, Inspection, and Testing

The execution phase of the project focuses on maintaining strict quality control over the materials and processes used. All construction materials are carefully selected and tested for durability, compliance with industry standards, and suitability for local conditions. Proper management of civil works, such as the construction of foundations, towers, and buildings for substations, is crucial for the structural integrity of the project.

Execution of electrical works is closely monitored to ensure it aligns with the specifications outlined in the work order. This includes adherence to design layouts, material specifications, and the timeline provided. Inspections and quality checks are conducted regularly at each stage of construction to detect any deviations from the standards and ensure high-quality output.

Testing and functionality checks are essential once the infrastructure is in place. This involves rigorous testing of substation equipment such as transformers, switchgear, and protection systems to ensure they operate efficiently and meet the required performance standards. Thorough inspection and testing ensure that all components function seamlessly before being energized. Major tasks for Execution, Implementation, Inspection, and Testing are listed as follows:

- Procure and ensure the use of high-quality construction materials that meet industry standards.
- Oversee the implementation of civil works, including the construction of substations, foundations, towers, and buildings.
- Prepare & maintain the concrete register walk over survey for route of transmission done by construction wing, operations wing, along with the contractor.
- Execute all civil and electrical works as per the issued work order, ensuring adherence to design layouts, material specifications, and construction methods.
- Perform regular inspections and testing throughout the construction phase to verify compliance with standards and specifications.
- Test all equipment, including transformers, switchgear, and protective systems, to ensure functionality and reliability.
- Gazette notification of survey route and its publication.

3. Commissioning and Handover

The commissioning phase is a critical part of quality assurance, where the performance of the entire power distribution system is tested under real-world conditions. All substations, transformers, and transmission lines undergo performance checks to verify that they meet operational standards. The functionality of all equipment, including transformers, switchgear, and auxiliary systems, is thoroughly evaluated to ensure reliability and safety.

Upon successful commissioning, the asset management plan is submitted along with the completion certificate. This phase also includes detailed documentation covering all aspects of the project, ensuring that the infrastructure is properly managed going forward. The project team guarantees the quality of the work and adheres to approved timelines and budgetary constraints. Any defects found during the handover process are rectified as per the terms of the

guarantee provided by the contractors. Major tasks for Commissioning and Handover are listed as follows:

- Conduct performance testing of substations and all associated equipment to ensure operational efficiency.
- Prepare and submit the asset management plan along with the completion certificate, detailing all aspects of the project's final state.
- Ensure adherence to approved timelines and budgets, resolving any deviations.
- Provide a guarantee of works, ensuring that any defects identified during commissioning are rectified promptly.

4. Safety and Security

Safety is prioritized throughout the project lifecycle. Adherence to safety standards and regulations is non-negotiable during construction and operation, ensuring the well-being of the workers involved in the project. Proper use of personal protective equipment (PPE), safety drills, and strict adherence to construction safety protocols are enforced. Regular audits are conducted to verify that safety measures are being followed.

Specific measures are also in place to ensure the safety of workers during the construction and operation of substations and transmission lines. This includes training on handling high-voltage equipment and working in challenging environments to prevent accidents and ensure compliance with occupational safety regulations. Major tasks for Safety and Security are listed as follows:

- Implement safety measures that comply with relevant safety standards and regulations throughout the project lifecycle.
- Ensure the safety of workers by providing protective gear, safety training, and enforcing best practices on site.
- Conduct regular safety audits and risk assessments to identify potential hazards and mitigate risks.
- Establish an emergency response mechanism to deal with accidents or system failures during construction and operation.

5. Project Management

The success of these power distribution projects heavily relies on effective project management. A turnkey project approach is employed to streamline project execution, ensuring a single point of accountability and seamless coordination between various stakeholders. Advanced project management tools such as SCADA (Supervisory Control and Data Acquisition) and GIS (Geographic Information System) are used for real-time tracking of project progress, resource allocation, and workflow efficiency.

Strong coordination between project teams, contractors, and government authorities ensures that all activities are carried out efficiently and within regulatory frameworks. Transparent communication and progress reporting to relevant authorities ensure alignment with national and state power distribution goals. Major tasks for Project Management are listed as follows:

- Coordinate between project teams, contractors, and government authorities to ensure smooth execution of all project phases.
- Monitor project progress using advanced tools like SCADA and GIS to track real-time data on resource allocation and workflow efficiency.

- Ensure compliance with legal and regulatory frameworks and submit periodic reports to stakeholders.
- Manage timelines, budgets, and resources efficiently to avoid project delays and cost overruns.

6. Environmental Measures

The environmental impact of the power distribution projects is carefully assessed and mitigated to ensure sustainability. Environmental impact assessments are carried out during the planning phase to identify potential risks to ecosystems and local communities. Mitigation strategies, such as reforestation programs, energy-efficient design, and waste management practices, are implemented to reduce the carbon footprint of the project.

Renewable energy integration, such as using solar panels to power substations or utilizing energy-efficient technologies in operations, is explored wherever feasible to ensure long-term sustainability. Major tasks for Environmental Measures are listed as follows:

- Conduct environmental impact assessments to identify potential risks and develop mitigation strategies for the ecosystem.
- Implement environmentally sustainable practices such as using energy-efficient technologies and integrating renewable energy where feasible.
- Mitigate environmental damage through reforestation, proper waste management, and resource conservation measures during construction.
- Continuously monitor the environmental impact of the project and adapt practices to minimize the carbon footprint.

7. User Feedback

A customer-centric approach is adopted to continuously improve the power distribution system. User feedback mechanisms are established to gather information on power reliability, outages, and customer satisfaction. This data helps inform ongoing maintenance and operational improvements. Effective communication with end-users ensures that grievances are addressed promptly, and service quality is consistently improved. Major tasks for User Feedback are listed as follows:

- Establish feedback mechanisms for end-users to report on service reliability, outages, and overall satisfaction.
- Collect and analyze user feedback to inform improvements in service delivery and system performance.
- Address user grievances promptly to maintain trust and improve the customer experience.
- Monitor trends in user satisfaction to identify areas for operational enhancement.

8. Operation and Maintenance

The operation and maintenance phase focuses on ensuring the longevity and reliability of the power distribution system. A preventive maintenance schedule is implemented to identify and rectify issues before they lead to system failures. The timely rectification of defects is essential for maintaining the efficient running of the substations and minimizing downtime. Advanced monitoring systems such as SCADA enable real-time tracking of system performance and prompt resolution of operational issues.

Continuous auditing ensures that all equipment and systems are running efficiently, and any defects that arise post-commissioning are addressed immediately. The goal is to maintain a

high standard of service, reduce system losses, and ensure the effective running of the substations.

In conclusion, quality assurance in Haryana's power distribution projects is achieved through a holistic and systematic approach, covering all phases from planning to operation. The emphasis on safety, efficiency, and sustainability ensures that the power distribution network is capable of meeting the region's growing energy demands, while also being environmentally conscious and user focused. Major tasks for Operation and Maintenance are listed as follows:

- Implement preventive maintenance schedules to regularly inspect and maintain all components of the power distribution system.
- Ensure timely rectification of defects that arise during operation to avoid system downtime and ensure reliability.
- Monitor system performance in real-time using SCADA to detect and resolve issues efficiently.
- Conduct regular audits to assess the condition of the equipment and infrastructure, and implement improvements as needed.
- Ensure the efficient running of substations, minimizing system losses and enhancing the overall performance of the distribution network.

PART B: Responsibilities of Stakeholders

For Quality Assurance (QA) and Quality Control (QC) in Power Distribution Projects, each stakeholder plays a crucial role in ensuring that the work adheres to established standards and specifications, reducing risks and ensuring project success. Below are the detailed responsibilities of each stakeholder:

1. Client Department

The Client Department (UHBVN and DHBVN) are responsible for setting overall project objectives and ensuring that the work meets the required standards. Their responsibilities include:

A. Establishing Quality Standards:

- Define the project specifications, standards, and technical requirements for materials and construction methods.
- Develop and implement a comprehensive Quality Assurance Plan (QAP) aligned with national or international standards (e.g., ISO, IEC).
- Ensure that all legal, environmental, and safety requirements are integrated into the quality management plan.

B. Quality Monitoring and Supervision:

- Assign a dedicated Quality Assurance team to monitor the project's adherence to the set quality standards.
- Ensure regular inspections and audits of the contractor's work, either directly or through third-party agencies.
- Approve and review QA/QC documents such as inspection reports, material test results, and quality certification.

C. Compliance with Regulations:

- Ensure the project adheres to national and local regulations regarding safety, quality, and environmental impact.
- Conduct inspections and audits to ensure compliance with statutory requirements.

D. Review and Approval of Project Plans:

- Review and approve project plans, focusing on safety standards, environmental standards, and compliance with quality benchmarks.

E. Safety Audits:

- Conduct safety audits at different stages of the project and ensure compliance with occupational health and safety regulations.

F. Approval of Testing Protocols and Procedures:

- Ensure that material and equipment testing protocols (factory acceptance tests, site acceptance tests) are properly established and followed.
- Approve the test results of key components such as transformers, switchgear, cables, and conductors.

G. Review and Approval of Submittals:

- Review and approve materials submittals, technical drawings, and shop drawings submitted by the contractor.

- Ensure that the contractor uses materials that meet the required standards and specifications.

H. Reporting and Documentation:

- Maintain comprehensive records of quality inspections, tests, and any corrective actions taken.
- Maintain concrete register.
- Ensure proper documentation of all processes for future reference and audits.

I. Contractor Performance Evaluation:

- Periodically review the contractor's performance regarding quality standards.
- Penalize or terminate contracts in case of consistent quality lapses or non-compliance.

2. Contractor (Executing Agency)

The Contractor is primarily responsible for executing the work according to the specifications laid out in the project plan and ensuring that quality standards are met during construction. Their responsibilities include:

A. Development of Quality Control (QC) Plan:

- Prepare a detailed Quality Control Plan that aligns with the project's Quality Assurance Plan (QAP) set by the Client Department.
- Ensure that QC measures are in place at every stage of procurement, construction, and installation.

B. Procurement and Material Management:

- Procure only approved materials and equipment that meet the specified standards from the approved sources.
- Ensure proper material handling and storage to prevent damage or deterioration before use.
- Provide mill test certificates and inspection certificates for key materials like transformers, cables, conductors, etc.

C. Construction Quality Control:

- Conduct regular inspections of construction work, ensuring that it meets the approved design, standards, and specifications.
- Ensure that construction methods comply with approved procedures and industry best practices.

D. Testing and Commissioning:

- Conduct testing of equipment such as transformers, cables, and switchgear before commissioning and ensure compliance with required standards.
- Submit all testing reports to the Client Department and TPIA for approval.

E. Training and Competence of Workforce:

- Ensure that all workers, including subcontractors, are trained and aware of quality standards and safety regulations.

F. Corrective Actions:

- Take immediate corrective actions in case of any deviations or non-conformances found during inspections.

- Ensure rectification of identified defects before moving forward with further construction activities.

G. Documentation and Reporting:

- Maintain accurate records of inspections, tests, and corrective actions taken.
- Submit daily or weekly quality control reports to the Client Department and TPIA.

3. Third-Party Inspection Agency (TPIA)

The Third-Party Inspection Agency (TPIA) acts as an independent entity to ensure the project meets established quality standards. Their responsibilities include:

A. Independent Verification:

- Independently verify that the contractor adheres to the approved quality management plan.
- Conduct regular inspections and audits of the contractor's work, focusing on critical milestones in the project.

B. Material and Equipment Inspection:

- Inspect materials and equipment supplied by the contractor to ensure they meet the required standards before installation.
- Witness tests like factory acceptance tests (FAT) and site acceptance tests (SAT) of key equipment like transformers, switchgear, and cables.

C. Quality Testing and Reporting:

- Conduct on-site testing of materials and installations, ensuring they comply with the specified design and standards.
- Prepare detailed inspection and test reports, highlighting any non-conformances or areas of concern.

D. Reporting Non-conformances:

- Inform the Client Department of any non-conformances or quality lapses immediately.
- Recommend corrective actions and ensure they are implemented effectively by the contractor.

E. Certification of Work:

- Certify that the work has been completed in compliance with the project specifications and quality standards.
- Issue final quality certification, which is a prerequisite for the contractor to proceed to the next phase of the project.

4. Users (End-Users/Consumers)

Users or end-users of the power distribution network play a crucial role in ensuring the system meets their needs and expectations. Their responsibilities include:

A. Providing Requirements and Feedback:

- Provide detailed information on power requirements, load specifications, and service expectations.
- Offer feedback on service quality, reliability, and any issues encountered with power supply to help in continuous improvement.

B. Compliance with Usage Guidelines:

- Follow any guidelines or regulations regarding safe and efficient use of electrical systems.
- Promptly report any power outages, voltage fluctuations, or safety hazards to the utility provider.

C. Participation in User Surveys and Consultations:

- Participate in surveys or consultations organized by the utility company to provide insights into user satisfaction and areas for improvement.
- Keep the utility company informed about any changes in power consumption patterns or contact details.

D. Cooperation During Inspections and Maintenance:

- Provide access to property for inspections, maintenance, or upgrades as required by the utility company.
- Cooperate with utility personnel during scheduled maintenance or emergency repair work.

E. Adoption of Efficient Practices:

- Implement energy-efficient practices and technologies to reduce overall consumption and support sustainable energy use.
- Stay informed about energy-saving initiatives and programs offered by the utility company.

F. Handling of Electrical Equipment:

- Ensure that all electrical equipment is used properly and maintained according to safety guidelines.
- Regularly check for signs of damage or wear and report any issues to the utility company.

G. Payment and Financial Responsibilities:

- Ensure timely payment of utility bills and any associated charges for maintaining a good service record.
- Understand the billing structure and any additional charges for services or usage to avoid disputes.

H. Participation in Community Initiatives:

- Engage in community programs or initiatives related to energy conservation or infrastructure improvements.
- Participate in community meetings or forums to voice concerns and provide suggestions on improving the power distribution system.

Activities to be performed by the Departmental Officers/Officials and Executing Agency

S No.	Activity	CE	SE	EE	AE	JE	Executing Agency
Planning and Design							
1.	Analysis of the existing Transmission network within a radius of 5-10 km of proposed site, its operational parameters, including loading conditions in reference to transmission and Distribution planning proposal.		✓	✓	✓		
2.	Analyze quantitative and qualitative historical data for at least last 5 years and future assessment for at least 5 years in consultation with all stake holders to determine expected future load growth, considering both long and short term projections including specific scenario, if any.	✓	✓	✓	✓	✓	
3.	Adequacy of design sub-station capacity incorporating for future expansion based upon 1.1.1, and 1.1.2 above	✓	✓	✓	✓		
4.	Adoption of technological intervention including automated tools such as adequate Communication system and IT infrastructure like SCADA, DMS, OMS, AMI etc.	✓	✓	✓	✓		
5.	Adoption of latest simulation software.	✓	✓	✓	✓		
6.	Determination of appropriate Substation capacity, and other system parameters and voltage levels considering maximum loading of Network and equipment based on load flow studies.	✓	✓	✓	✓		
7.	System operation within permissible limits both under normal as well as after probable credible contingencies.	✓	✓	✓	✓		
8.	Approval of Integrated Planning by WTDs UHBVNL & DHBVNL / competent authority.	✓	✓	✓	✓		
9.	Selection of land keeping in view ROW.			✓	✓	✓	
10.	Transfer of ownership of Government/Gram Panchayat land in the name of department. (Resolution of Gram Panchayat)			✓	✓	✓	
11.	Soil bearing capacity report, contour sheet and fixation of FGL of Sub Station before preparation of detail BOQ (Civil)			✓	✓	✓	
12.	Walk over survey of transmission line based on HARSAC submission			✓	✓	✓	✓
13.	Gazette notification of route of transmission lines.		✓	✓	✓	✓	

14.	Selection of grid sub-station is as per site condition such as indoor, outdoor, underground, Air Insulated (AIS), Gas Insulated (GIS) or Hybrid etc.	✓	✓	✓	✓		
15.	Selection of design parameters viz fault level analysis, protection scheme, Civil Design/Electrical Design as per Maximum capacity, Voltage level, fault level, etc. as per the latest CEA guidelines.	✓	✓	✓	✓		
16.	Grounding/earthing design as per site condition to ensure safety of equipment and personnel		✓	✓	✓	✓	
17.	Provision for equipment maintenance without interrupting the entire supply.		✓	✓	✓		
18.	Protection grading, coordinated configuration to ensure the minimum zones are impacted by faults	✓	✓	✓	✓		
19.	Independent circuit breaker control of incoming and outgoing feeders.	✓	✓	✓	✓		
20.	Provision of two or more incoming feeders from two different sources for meeting N-1 contingency for reliability considerations.	✓	✓	✓	✓		
21.	Provision of two or more different transformers for meeting N-1 contingency for reliability considerations	✓	✓	✓	✓		
22.	Provision of spare bay for catering to future load growth.	✓	✓	✓	✓		
23.	Provision of additional transformer of sufficient capacity for future load growth.	✓	✓	✓	✓		
24.	SS to cater to power quality parameters, viz voltage regulation, harmonics, and reactive power within the standard limits.	✓	✓	✓	✓		
25.	Preparation of detailed BOQ as per scope of work approved by Planning wing based on site/GELO data		✓	✓	✓	✓	
26.	Cost Estimate (civil and electrical) based on BOQ (Capital and Operational Expenditure)	✓	✓	✓	✓	✓	
27.	Financial implication with cost index upto implementation period	✓	✓	✓	✓		
28.	Administrative and Technical approvals from the competent authorities	✓	✓	✓	✓		
29.	DNIT preparation, approval and call of tender.	✓	✓	✓	✓		
30.	Evaluation of tender, based on technical and financial bid analysis, and allotment of work order maintaining transparency.	✓	✓	✓	✓		
Execution and Implementation, Inspection and Testing							
31.	Joint survey by Construction Wing along with contractor before permit of work				✓	✓	✓
32.	Verification of regularity compliances by the contractor.			✓	✓	✓	✓

33.	Coordination and clearances with government departments/private that may be necessary.			✓	✓	✓	
34.	Timely handing over of hindrance free land to the executing agency			✓	✓	✓	
35.	Approval of all civil design drawings by the competent authority.	✓	✓	✓	✓		
36.	Placing of Purchase Order/Work Order for various material by the contractor/department	✓	✓	✓	✓		✓
37.	Execution of civil work such as control room building, Tower/ Equipment foundations, earthing, fencing, cable trenches, etc. as per technical specifications and approved design and as per site condition and corresponding standards.			✓	✓	✓	✓
38.	Use of quality materials from approved source and required plant and machinery.		✓	✓	✓	✓	✓
39.	Inspection and testing of material at the supplier's works by Nigam Officer/TPA and quality checks as per relevant standards.		✓	✓	✓	✓	
40.	Sampling of material at site for testing in Government approved/Nigam Empanelled NABL accredited lab, if required.			✓	✓	✓	✓
41.	Checking of test results by execution authority and action thereof.		✓	✓	✓	✓	
42.	Preparation of site inspection and quality control register and concrete register			✓	✓	✓	
43.	Execution as per the plan within specified time period.			✓	✓	✓	✓
44.	Rectification of defects on regular basis and keeping the record			✓	✓	✓	✓
45.	Approval of electrical drawings and SOMP of each equipment.	✓	✓	✓	✓		
46.	Placing of Purchase Order for the material/equipment by the contractor/department and inspection/testing of the same at the manufacturer's works by the department/TPA.	✓	✓	✓	✓		✓
47.	Joint verification report of all electrical material in form of MRC			✓	✓	✓	✓
48.	Sampling and testing of material/equipment in NABL accredited lab, if required (Government approved/Nigam Empanelled)			✓	✓	✓	✓
49.	Checking of test results by execution authority and action thereof.		✓	✓	✓	✓	
50.	Execution of work as per guidelines laid down by Nigam and inspection by Quality Control Wing of Nigam			✓	✓	✓	✓
51.	Monitoring of project by XEN/OP/Construction/Tender Inviting Authority (TIA) on regular basis	✓	✓	✓	✓	✓	

52.	Execution of work as per plan within specified time period.		✓	✓	✓	✓	✓
53.	Rectification of defects on regular basis and maintaining the record				✓	✓	✓
Commissioning and Handover							
54.	Clearance of complete installation from the CEI (Chief Electrical Inspector)			✓	✓	✓	✓
55.	Witness pre commissioning test of equipment by M&P as per standard guidelines.			✓	✓	✓	✓
56.	Commissioning of sub-station as per check list/M&P observations			✓	✓	✓	✓
57.	Post commissioning test of all electrical equipment as per work order/relevant equipment code			✓	✓	✓	✓
58.	Handover of the sub-station to the department by the contractor			✓	✓	✓	✓
59.	Adherence to project timelines and Cost Projections		✓	✓	✓	✓	✓
60.	Completion certificate, plan and manuals submission			✓	✓	✓	✓
61.	Guarantee against defective design, workmanship, and manufacturing defects. withhold of security amount			✓	✓	✓	✓
Safety and Security							
62.	All electrical safety requirements, electrical clearances, fire detection & extinguishing system, earthing & ventilation etc. as per standards.			✓	✓	✓	✓
63.	Conformance to safety requirements by adhering to appropriate design standards.			✓	✓	✓	✓
64.	To adopt regular safety and reliability audits of all major equipment of the network.			✓	✓	✓	
65.	Provision of First aid kit, personnel protective equipment (PPE) viz safety helmet, safety glass, gloves, safety shoes, high visibility clothing, etc, Grounding, clearances, fire protection, fencing, etc).			✓	✓	✓	✓
66.	Conducting regular mock drills to check the response system.			✓	✓	✓	
67.	Work permit and authorization				✓	✓	
68.	Incident response and reporting			✓	✓	✓	
69.	Provision of surveillance to curb unauthorized access			✓	✓	✓	
70.	Display of all important safety instructions, precautions, exist signs, important telephone numbers, etc.				✓	✓	
Operation and Maintenance							
71.	Inspection and maintenance schedule development and its compliance			✓	✓	✓	

72.	Use of software for maintenance scheduling and updates		✓	✓	✓		
73.	Ensuring quality of power and other operational parameters as per SOMP.			✓	✓		
74.	Regular operation and maintenance and replacement of material/equipment by contractor as per Work Order for specified period			✓	✓	✓	✓
75.	Emergency response planning			✓	✓	✓	
76.	Availability of spare parts		✓	✓	✓	✓	✓
77.	Compliance of maintenance schedule			✓	✓	✓	
78.	Grievance redressal and record keeping.			✓	✓	✓	
79.	Adhering to material/equipment guarantee/warranty		✓	✓	✓	✓	✓
80.	Deployment of skilled manpower for O&M	✓	✓	✓			
81.	Deployment of manpower for general maintenance and security			✓	✓	✓	
82.	Substation O&M as per SOMP			✓	✓	✓	
83.	Training and capacity building		✓	✓	✓		
84.	Equipment maintenance and surveillance using latest technology such as thermal camera to detect hotspot, SCADA, etc	✓	✓	✓	✓	✓	

Note 1: Responsibilities for carrying out above activities by the departmental officers shall be governed by the Technical Sanction Powers vested in them by the Government of Haryana.

Note 2: Responsibilities for carrying out pre-inspection for supply of material (Civil/Electrical) at the manufacturer's premises by the departmental officers shall be governed by the Departmental Procedure.

CHAPTER 2

SOMP FOR POWER DISTRIBUTION DRAFT

1. PLANNING AND DESIGN

1.1 Integrated planning for load growth estimation.

1.1.1 Study/Analysis of the Existing Distribution Network

I. Define Study Area:
- Identify and map the existing distribution network within a 5-10 km radius of the proposed site.
- Document the geographic and demographic characteristics of the area.

II. Data Collection and Network Assessment:
- Gather data on the existing distribution infrastructure, including the number of substations, feeders, transformers, and their capacities.
- Obtain details on the current load, peak demand, and load patterns in the area.
- Collect data on ongoing and planned development projects that may affect future demand.
- Evaluate the current condition and performance of the distribution network.
- Identify bottlenecks, voltage drops, and areas with frequent outages or low reliability.
- Map the distribution network using GIS or other suitable tools to visualize the infrastructure and load distribution.

III. Forecast Demand:
- Use historical load data, demographic trends, and economic growth indicators to forecast the expected demand in the area over the next 5-10 years.
- Consider various scenarios, including best-case, worst-case, and most likely demand projections.

1.1.2 Analyse Historical Data for Load Growth Projections

I. Data Acquisition and Analysis:
- Collect historical load data for the last 3-5 years from the distribution network.
- Ensure the data includes hourly, daily, and seasonal load variations to capture peak and off-peak demand.
- Analyse the historical load data to identify trends, seasonal variations, and growth patterns.
- Determine the compound annual growth rate (CAGR) of the load over the past 3-5 years.

II. Load Growth Projections:
- Develop short-term (1-2 years) and long-term (3-5 years) load growth projections based on historical trends.
- Consider factors such as population growth, industrial and commercial development, and government policies that may influence future load growth.

III. Scenario Analysis:
- Create specific scenarios to model the impact of unexpected events, such as economic downturns, policy changes, or the introduction of new technologies.
- Adjust load growth projections accordingly to reflect these scenarios.

1.1.3 Adequacy of Design Substation Capacity

I. Capacity Assessment and Future Expansion Consideration:
- Review the design capacity of existing substations within the study area.
- Compare the existing substation capacity with current and projected future demand.
- Assess the adequacy of the existing substations to handle future load growth.
- Identify opportunities for capacity expansion, including the installation of additional transformers, upgrading existing equipment, or constructing new substations.

II. Redundancy and Reliability:
- Evaluate the redundancy of the current substation configuration to ensure reliable power supply.
- Recommend measures to enhance reliability, such as looped networks or backup power sources.

III. Design Optimization:
- Propose design optimizations to accommodate future demand while minimizing costs.
- Consider modular design approaches that allow for phased expansion as demand grows.

1.1.4 Adoption of Technological Intervention and Automatic Tools

1. Technology Assessment:
   - Identify technological advancements relevant to power distribution, such as smart grids, automated metering infrastructure (AMI), and demand-side management (DSM) tools.
   - Evaluate the feasibility and benefits of adopting these technologies in the study area.
2. Automation Tools:
   - Explore the use of automation tools for network monitoring, fault detection, and real-time load management.
   - Recommend specific tools or software that can enhance the efficiency and reliability of the distribution network.
3. Implementation Plan:
   - Develop a plan for implementing selected technological interventions, including timelines, cost estimates, and resource requirements.
   - Ensure that the plan includes provisions for staff training and system integration.
4. Performance Monitoring:
   - Establish key performance indicators (KPIs) to monitor the effectiveness of the adopted technologies.
   - Regularly review and update the technology adoption strategy based on performance data and evolving technological trends.

1.2 Project Proposal Approval

1.2.1 Administrative and Technical Approvals from the Competent Authorities

I. Identification of Authorities:
- Administrative Authorities: Identify the administrative bodies that need to approve the project, such as local government agencies, environmental bodies, and financial institutions.
- Technical Authorities: Identify technical bodies responsible for approving the project design, safety standards, and compliance with regulations, such as energy regulators, electrical inspectorates, and civil engineering boards.

II. Preparation of Documentation:

- Project Proposal: Prepare a comprehensive project proposal, including the scope of work, cost estimates, technical designs, and impact assessments.
- Compliance Reports: Prepare reports demonstrating compliance with all relevant regulations, including environmental, safety, and construction standards.
- Approval Forms: Fill out and compile all necessary forms and applications required by the authorities.

III. Submission Process:

- Administrative and Technical Approvals:
    - Submit the project proposal and required documents to the administrative authorities.
    - Address any queries or requests for additional information from the authorities promptly.
    - Submit technical designs, drawings, and compliance reports to the technical authorities.
    - Make necessary modifications to the project design if requested by the technical authorities.

IV. Approval Receipt:

- Approval Documentation: Collect and securely store all approval documents and certificates issued by the authorities.
- Record Keeping: Maintain a detailed record of all communications, submissions, and approvals related to the project.

V. Final Review:

- Compliance Check: Before commencing the project, conduct a final review to ensure that all necessary approvals have been obtained and are up to date.
- Stakeholder Communication: Notify all relevant stakeholders, including contractors and suppliers, that the project has received the necessary approvals and can proceed.

1.2.2 Timeline Scheduling Estimation for Different Phases of the Project

- Phase Identification: Break down the project into distinct phases such as planning, design, procurement, construction, testing, and commissioning.
- Task Breakdown: For each phase, identify the key tasks and their dependencies.
- Time Estimation: Estimate the time required for each task based on historical data, industry standards, and expert judgment.
- Resource Allocation: Allocate resources, including manpower, equipment, and materials, to each task.
- Schedule Development: Use project management tools to develop a detailed schedule with milestones and critical paths.
- Review and Adjust: Review the schedule with stakeholders and adjust it as necessary to accommodate any constraints or risks.
- Monitoring: Establish a process for monitoring progress against the schedule and making adjustments as needed.

1.3 Selection of land

1.3.1 Preliminary Survey

I. Survey Planning:

- Identify the key locations that need to be surveyed, including potential substation sites, transmission line routes, and areas of significant load concentration.
- Develop a detailed survey plan, including timelines, required resources, and personnel assignments.

II. Data Collection and Analysis:
- Conduct on-site surveys to gather information on topography, land use, existing infrastructure, and environmental conditions.
- Use tools such as GPS, GIS, and topographic maps to document and analyse the site characteristics.
- Engage with local communities to understand any social, cultural, or economic factors that might affect the project.
- Analyse the collected data to identify suitable locations for substations, transmission lines, and other infrastructure.
- Consider factors such as accessibility, proximity to load centers, environmental impact, and potential obstacles.

III. Reporting: Prepare a preliminary survey report summarizing findings, including maps, site descriptions, and recommendations for further investigation or action.

1.32 Location of Substations

I. Site Selection Criteria:
- Right of Way (ROW): Ensure that the substation location provides adequate ROW for transmission lines without significant legal or environmental obstacles.
- Soil Strength Testing: Conduct geotechnical investigations to assess soil strength and suitability for substation foundations.
- Earth Resistivity: Measure earth resistivity to determine the effectiveness of grounding systems and the need for special grounding measures.
- Load Center Topology: Evaluate the distribution of load centers in the area to ensure the substation location minimizes transmission losses and improves efficiency.

II. Site Evaluation:
- Conduct detailed site evaluations based on the criteria mentioned above.
- Engage with local authorities and stakeholders to ensure the site is appropriate and does not conflict with existing or planned developments.

III. Risk Assessment:
- Perform a risk assessment to identify potential challenges associated with the selected site, such as flooding, seismic activity, or accessibility issues.
- Develop mitigation strategies to address identified risks.

IV. Final Site Selection:
- Based on the evaluation and risk assessment, finalize the substation location.
- Document the rationale for site selection, including the results of soil tests, resistivity measurements, and other relevant factors.

1.3.3 Land Acquisition, Forest, and Other Department Clearances

I. Identify Land Requirements:
- Determine the amount and type of land required for the project, including areas for substations, transmission lines, and access roads.

II. Land Ownership Verification:
- Verify the ownership of the identified land parcels through official records.

- Engage with landowners, local authorities, and stakeholders to initiate discussions on land acquisition.

III. Forest Clearances:
- If the project affects forested areas, submit the required applications for forest clearance to the relevant government department.
- Conduct an environmental impact assessment (EIA) to evaluate the potential impacts on the forest and biodiversity.
- Implement any required mitigation measures as stipulated in the clearance conditions.

IV. Other Departmental Clearances:
- Identify other necessary clearances, such as environmental, wildlife, archaeological, water resource permissions, and railway crossings
- Prepare and submit applications along with supporting documents to the respective departments.
- Monitor the status of applications and respond promptly to any requests for additional information or clarifications.

V. Land Acquisition Process:
- Negotiate compensation with landowners following local laws and regulations.
- Execute land acquisition agreements and ensure all legal documentation is completed.
- Transfer ownership of the land to the Department and ensure it is free from encumbrances.

1.3.4 Grid Substation Design Selection

I. Site Condition Assessment:
- Assess the specific conditions of the selected site, including space constraints, environmental factors, and operational requirements.
- Consider whether the site is in a rural, urban, or industrial area, as this will influence the substation design.

II. Design Options Analysis:
- Indoor Substation: Suitable for areas with limited space or where environmental protection is required.
- Outdoor Substation: Ideal for areas with ample space and where weather conditions do not pose significant risks.
- Air-Insulated Substation (AIS): Typically used where space is not an issue and cost-effectiveness is a priority.
- Gas-Insulated Substation (GIS): Best for space-constrained areas or where environmental factors necessitate a compact, reliable solution.
- Hybrid Substation: Combines elements of AIS and GIS to optimize space, cost, and performance.

III. Cost-Benefit Analysis: Perform a cost-benefit analysis for each design option considering initial costs, maintenance requirements, operational efficiency, and lifespan.

IV. Stakeholder Consultation: Engage with stakeholders, including HVPNL, local authorities, and community representatives, to discuss the proposed design and gather feedback.

V. Final Design Selection:

- Select the grid substation design that best fits the site conditions and project requirements.
- Ensure that the design complies with all relevant standards and regulations.

VI. Documentation and Approval:

- Prepare detailed design documentation, including drawings, specifications, and justifications for the selected design.
- Submit the design for approval by the relevant authorities and stakeholders before proceeding with construction.

1.4 Load Flow Studies and short circuit analysis

1.4.1 Actual Short Circuit Current Value Used to Decide Switchgear Standard Specifications

I. Short Circuit Current Analysis:

- System Study: Perform a detailed fault analysis to calculate the actual short-circuit current values at different points in the distribution network.
- Data Collection: Gather data on network configuration, transformer ratings, line impedances, and fault scenarios to support the analysis.

II. Switchgear Specification:

- Specification Determination: Use the calculated short-circuit current values to determine the appropriate ratings for switchgear, including breaking capacity, making capacity, and short-time withstand current.
- Standards Compliance: Ensure that the selected switchgear meets or exceeds the requirements of relevant standards, such as IEC 62271 or IEEE C37 series, based on the calculated short-circuit currents.

III. Design and Selection:

- Component Selection: Choose switchgear components (circuit breakers, fuses, disconnect switches) that are rated for the calculated short-circuit currents and are suitable for the application environment.
- Safety Margins: Include appropriate safety margins in the switchgear specifications to account for potential variations in short-circuit current over time due to system changes or load growth.

IV. Testing and Verification:

- Factory Acceptance Testing: Ensure that the selected switchgear undergoes rigorous testing, including short-circuit testing, to verify its performance under fault conditions.
- Field Testing: Conduct on-site testing after installation to confirm that the switchgear performs as expected under actual system conditions.

V. Documentation and Reporting:

- Technical Documentation: Document the short-circuit analysis, switchgear specifications, and test results in the substation design records.
- Compliance Reporting: Prepare and submit reports to relevant authorities or stakeholders, demonstrating compliance with standards and design requirements.

1.5 Substation (SS) Design, layout, equipment design and drawing.

1.5.1 Selection of Design Parameters: Fault Level Analysis and Protection System

I. Fault Level Analysis:

- Gather data on the existing and proposed network configuration, including transformer ratings, line lengths, and impedance values.
- Obtain historical fault data from similar substations in the region.
- Perform fault level calculations using software tools or manual methods, considering both symmetrical and asymmetrical fault conditions.
- Calculate the maximum short-circuit currents for different points in the network to determine the fault level.
- Ensure that the calculated fault levels do not exceed the breaking capacity of existing circuit breakers and other protective devices.

II. Protection System Selection:

- Protection Scheme Design:
  - Design the protection system to detect and isolate faults quickly, minimizing damage and maintaining system stability.
  - Select protection relays, circuit breakers, and current transformers with appropriate ratings based on fault level analysis.
- CEA Compliance:
  - Ensure that the protection system design complies with the latest CEA guidelines on protection systems, including relay settings and coordination.
- System Coordination:
  - Coordinate protection devices to ensure that the nearest protection device isolates a fault, avoiding unnecessary tripping of upstream devices.

1.5.2 Selection of Incoming/Outgoing Gantry/Structure of Grid Substation Design

I. CEA Guidelines Review:

- Review the latest CEA guidelines on the design and construction of gantries and structures in grid substations.
- Ensure compliance with guidelines regarding structural strength, safety clearances, and material specifications.

II. Design Considerations:

- Incoming Gantry:
  - Design the incoming gantry to accommodate the maximum number of feeders anticipated in future expansions.
  - Consider wind loading, seismic forces, and thermal expansion in the structural design.
- Outgoing Gantry:
  - Design the outgoing gantry to facilitate easy access for maintenance and future modifications.
  - Ensure proper clearance between phases, earth, and other structures to prevent arcing or flashover.

III. Material Selection: Choose materials that offer durability, corrosion resistance, and ease of maintenance, such as galvanized steel or aluminium.

IV. Documentation: Prepare detailed design drawings and specifications for the gantry and structure, ensuring compliance with CEA guidelines.

1.5.3 Grounding/Earthing Design as per Soil Conditions

I. Soil Resistivity Testing: Conduct soil resistivity tests at the substation site to determine the soil's electrical properties. By using methods such as the Wenner or Schlumberger techniques to obtain accurate soil resistivity measurements.

II. Grounding System Design:
- Design the grounding system based on the soil resistivity results, ensuring that the design provides a low-resistance path to earth.
- Include components such as grounding rods, mats, and grids in the design, optimizing the layout to reduce resistance.

III. Safety Compliance:
- Ensure the grounding system is designed to protect equipment and personnel from electrical faults by limiting touch and step voltages to safe levels.
- Verify that the grounding design meets or exceeds the safety standards specified in the latest CEA guidelines and IEC standards.

IV. Installation and Testing:
- Oversee the installation of the grounding system, ensuring all connections are secure and corrosion-resistant.
- Perform grounding resistance tests after installation to confirm the effectiveness of the system.

1.5.4 Provision for Equipment Maintenance without Interrupting the Entire Supply

I. Redundancy Planning:
- Design the substation layout to include redundant paths for power flow, such as parallel transformers or bus sections, to allow maintenance without full supply interruption.

II. Switchgear Selection:
- Select switchgear that enables isolation of equipment for maintenance while maintaining power supply through alternative routes.
- Ensure the design includes sectionalizing switches or bus couplers to facilitate equipment isolation.

III. Operational Flexibility:
- Implement a design that allows maintenance personnel to perform equipment servicing, testing, and replacement without impacting the entire substation operation.
- Include remote control and monitoring systems to assist in safely isolating and re-energizing equipment during maintenance.

IV. Documentation:
- Develop detailed maintenance procedures and guidelines, specifying how to safely isolate and service equipment without interrupting the power supply.

1.5.5 Protection Grading and Coordinated Configuration

I. Protection Grading Analysis:
- Conduct a protection grading study to ensure proper coordination between the protective devices in the substation and upstream/downstream systems.
- Ensure that the grading minimizes the impact of faults by isolating only the affected zones.

II. Device Coordination:

- Coordinate the settings of protective relays, circuit breakers, and other devices to ensure that the closest device to the fault operates first.
- Implement time grading and current grading principles to achieve effective coordination.

III. CEA Compliance:
- Verify that the protection grading and configuration comply with the latest CEA guidelines on protection system coordination and fault management.

IV. Testing and Validation:
- Perform relay coordination and protection grading tests to validate the configuration, making adjustments as necessary to ensure reliable operation.

1.5.6 Independent Circuit Breaker Control of Incoming and Outgoing Feeders

I. Design Specification:
- Ensure that each incoming and outgoing feeder in the substation has an independent circuit breaker for control and protection.
- Specify the type, rating, and operating mechanism of each circuit breaker based on the feeder's characteristics.

II. Control System Integration:
- Integrate the circuit breakers into the substation's control system, allowing for independent operation and remote control of each feeder.
- Implement safety interlocks and alarms to prevent simultaneous operation of conflicting circuit breakers.

III. CEA Compliance:
- Verify that the circuit breaker selection and control system design adhere to the latest CEA guidelines and industry best practices.

IV. Testing and Commissioning:
- Test each circuit breaker individually and as part of the integrated system to ensure proper operation and control.
- Document the test results and ensure that any issues are addressed before commissioning.

1.6 Quality, reliability, functionality, and maintainability of supply

1.6.1 Provision of Two Incoming 33 kV Lines from Different Sources for N-1 Contingency (wherever feasible)

I. Contingency Planning:
- Objective: Ensure the substation can continue operation even if one 33 kV line fails (N-1 contingency).
- Source Identification: Identify two independent and geographically diverse sources for the incoming 33 kV lines to minimize the risk of simultaneous failure.
- Capacity Verification: Verify that each line has sufficient capacity to handle the entire load in case the other line is out of service.

II. Design and Implementation:
- Line Routing: Design the routing of each 33 kV line to avoid common points of failure, such as shared corridors or crossings.
- Switchgear Configuration: Implement switchgear that allows for seamless switching between sources without interrupting the supply.
- Control Systems: Integrate automatic transfer switches (ATS) or remote-controlled circuit breakers to facilitate quick switching in case of a line failure.

III. Testing and Validation:
- Simulations: Perform simulations and testing of N-1 contingency scenarios to ensure system reliability.
- Real-Time Monitoring: Set up real-time monitoring systems for both incoming lines to detect and respond to issues promptly.

1.6.2 Provision of Additional Transformer Capacity for N-1 Contingency

I. Load Analysis:
- Current and Future Load Assessment: Analyse current load requirements and forecast future demand to determine the need for additional transformer capacity.
- N-1 Contingency Planning: Ensure that the substation has enough transformer capacity to maintain full load supply even if one transformer fails.

II. Transformer Selection:
- Capacity Requirements: Select transformers with sufficient capacity to handle the entire load in the event of a transformer failure.
- Redundancy: Consider installing an additional transformer with the same or greater capacity as the primary transformers to provide redundancy.

III. Installation and Integration:
- Design and Layout: Integrate the additional transformer into the substation layout, ensuring it can be easily connected or disconnected as needed.
- Protection Systems: Implement protection systems that automatically switch to the backup transformer in case of a failure.

IV. Testing and Maintenance:
- Regular Testing: Conduct regular tests to ensure the backup transformer and associated systems are functioning correctly.
- Maintenance Planning: Schedule maintenance during periods of low demand or when backup capacity is available to avoid supply interruptions.

1.6.3 Provision of Additional Transformer and Bay for Future Load Growth

I. Future Load Forecasting:
- Demand Projections: Forecast future load growth based on historical data, urban development plans, and other relevant factors.
- Capacity Planning: Determine the required additional transformer capacity to meet projected future demand.

II. Design and Provisioning:
- Bay Design: Design the substation layout to include an additional bay for future transformer installation.
- Transformer Specifications: Select a transformer that meets future capacity requirements, considering factors such as efficiency, cooling, and operational lifespan.

III. Installation Readiness:
- Infrastructure Provision: Ensure the substation infrastructure (foundations, busbars, switchgear, etc.) is ready to accommodate the future transformer without significant modifications.
- Provision for Connections: Plan for future connections, including cabling, protection systems, and control integration.

IV. Documentation and Approval:

- Project Documentation: Document the design and plans for future transformer installation, including justifications based on load forecasts.
- Regulatory Approval: Obtain any necessary regulatory approvals for future expansion, ensuring compliance with local and national standards.

1.6.4 Provision of Spare 11 kV Panel or Rack (Trolley) for Emergency

I. Emergency Preparedness:
   - Risk Assessment: Identify potential failure points in the existing 11 kV distribution system and evaluate the impact of such failures.
   - Spare Provisioning: Ensure the availability of a spare 11 kV panel or rack (trolley) to quickly replace or supplement the existing system in case of failure.

II. Design and Integration:
   - Panel/Rack Specifications: Select a spare panel or rack with specifications matching the existing system to ensure compatibility.
   - Ease of Access: Store the spare panel or rack in a location that allows for quick deployment and connection.

III. Testing and Maintenance:
   - Routine Testing: Regularly test the spare panel or rack to ensure it is in operational condition and can be quickly deployed.
   - Maintenance Checks: Perform periodic maintenance on the spare equipment to prevent issues that could delay its use during an emergency.

IV. Emergency Procedures:
   - Deployment Plan: Develop and document a clear procedure for deploying the spare panel or rack during an emergency, including roles, responsibilities, and timelines.

1.6.5 Consideration of Power Quality Parameters: Voltage Regulation, Harmonics, and Reactive Power

I. Power Quality Assessment:
   - Voltage Regulation: Monitor and assess voltage levels across the distribution system to ensure they remain within acceptable limits as per regulatory standards.
   - Harmonic Analysis: Perform harmonic analysis to identify and mitigate sources of harmonic distortion that could affect system performance and equipment lifespan.
   - Reactive Power Management: Evaluate the reactive power flow in the system to maintain power factor within the desired range, improving efficiency and reducing losses.

II. Implementation of Control Measures:
   - Voltage Control Devices: Install voltage regulators, tap changers, or automatic voltage control systems to maintain stable voltage levels across the distribution network.
   - Harmonic Filters: Deploy passive or active harmonic filters to reduce harmonic distortion and comply with power quality standards.
   - Capacitor Banks: Install capacitor banks or static VAR compensators (SVC) to manage reactive power, improve power factor, and stabilize voltage levels, APFC

III. Monitoring and Reporting:
   - Power Quality Monitoring: Implement continuous monitoring of power quality parameters using power quality analysers or smart meters.
   - Reporting: Regularly report power quality data to relevant authorities and stakeholders, highlighting any issues and the actions taken to address them.

IV. Compliance and Standards:
- CEA Guidelines: Ensure that all power quality measures comply with the latest CEA guidelines and relevant national/international standards (e.g., IEEE, IEC).
- Regular Audits: Conduct regular audits of power quality performance and take corrective actions as needed.

1.7 Cost analysis, Budget planning, and timeline estimates

1.7.1 Financial Implication with Cost Index Up to Implementation Period

I. Initial Cost Estimation:
- Preliminary Cost Assessment: Conduct a preliminary cost assessment, considering all major components such as equipment, construction, labour, and contingency reserves.
- Cost Index Adjustment: Apply the relevant cost indices to account for inflation, material price fluctuations, and other economic factors expected to occur during the project implementation period.

II. Detailed Cost Analysis:
- Breakdown of Costs: Develop a detailed cost breakdown, including direct costs (materials, labour) and indirect costs (administrative expenses, permits, etc.).
- Inflation Forecasting: Use inflation forecasting tools or data to adjust the cost estimates over the implementation period, ensuring accuracy and accounting for economic changes.
- Scenario Analysis: Perform a scenario analysis to evaluate the impact of potential cost escalations or delays, providing a range of possible financial outcomes.

III. Risk Management:
- Contingency Planning: Include a contingency allowance (typically 5-10% of the total project cost) to cover unforeseen expenses or changes in project scope.
- Cost Monitoring: Establish a cost monitoring process to track expenses against the budget throughout the project, enabling early detection of potential overruns.

IV. Final Financial Report:
- Report Preparation: Prepare a comprehensive financial report that includes the total estimated cost, adjusted for the cost index, and outlines the financial implications over the implementation period.
- Management Review: Submit the financial report to management for review and approval, ensuring alignment with organizational financial goals.

1.7.2 Identification of Funding Agency with Annual Budget Allocation

I. Funding Agency Identification:
- Funding Needs Assessment: Assess the total funding requirement for the project, considering both capital and operational expenses.
- Research Funding Sources: Identify potential funding agencies (government bodies, financial institutions, international organizations, etc.) that align with the project's objectives and financial needs.

II. Funding Proposal Development:
- Proposal Preparation: Develop a detailed funding proposal that includes project objectives, financial requirements, implementation timeline, expected outcomes, and potential risks.

- Alignment with Funding Criteria: Ensure that the proposal aligns with the specific criteria and priorities of the identified funding agency, such as environmental impact, socio-economic benefits, and innovation.

III. Budget Allocation Planning:
- Annual Budget Breakdown: Develop an annual budget allocation plan that aligns with the funding agency's disbursement schedule. This should include phased allocations based on project milestones.
- Cash Flow Analysis: Perform a cash flow analysis to ensure that funds will be available when needed, avoiding delays due to cash flow shortages.

IV. Engagement and Negotiation:
- Engagement with Funding Agency: Engage with the identified funding agency to present the proposal and negotiate terms, including interest rates (if applicable), repayment schedules, and conditions for fund release.
- Approval and Agreement: Secure approval from the funding agency and formalize the funding agreement, ensuring clarity on all financial terms and conditions.

1.7.3 Preparation and Approval of DPR

I. DPR Preparation:
- Detailed Project Report (DPR) Development: Prepare the DPR, including all necessary details such as project scope, technical specifications, financial analysis, risk assessment, and environmental impact assessment.
- Stakeholder Consultation: Engage with key stakeholders (regulatory bodies, funding agencies, community representatives, etc.) during the DPR preparation to incorporate their inputs and ensure alignment with their expectations.
- Special consideration shall be given to horticulture and aesthetic planning

II. Approval Timeline Planning:
- Regulatory Requirements: Identify all regulatory requirements and approval processes necessary for the DPR, including timelines for submission, review, and feedback.
- Approval Process Mapping: Develop a timeline for the DPR approval process, considering the time needed for internal review, external consultations, and formal approvals by regulatory bodies.

III. Submission and Follow-up:
- DPR Submission: Submit the DPR to the relevant authority or regulatory body within the planned timeline, ensuring all required documentation is complete and accurate.
- Follow-Up: Establish a follow-up mechanism to track the approval process, addressing any queries or requests for additional information promptly to avoid delays.

IV. Approval Monitoring:
- Progress Tracking: Monitor the progress of the DPR through the approval process, using project management tools or dashboards to track key milestones.
- Issue Resolution: Address any issues or objections raised during the review process, working with relevant departments to make necessary revisions and resubmitting as needed.

V. Final Approval:
- Approval Confirmation: Once the DPR is approved, obtain formal confirmation and document it in the project records.

- Implementation Handover: Transition from the planning to the implementation phase, ensuring that the project team is fully briefed on the approved DPR and ready to proceed with execution.

1.8 DNIT Approval, and Award of work (Trunkey project)

1.8.1 DNIT Preparation, Approval, and Call of Tender

I. Preparation of DNIT:
- Project Requirement Definition: Clearly define the scope of work, including detailed technical specifications, design requirements, and project timelines.
- Bill of Quantities (BOQ): Prepare a comprehensive Bill of Quantities (BOQ) detailing the materials, labour, and services required for the project, along with estimated quantities and unit rates.
- Terms and Conditions: Draft the general and specific terms and conditions of the contract, including payment terms, project milestones, penalties for delays, and dispute resolution mechanisms.
- Technical Specifications: Include detailed technical specifications and standards that must be adhered to, ensuring compliance with relevant national and international standards.
- Qualification Criteria: Define the eligibility criteria for bidders, including technical qualifications, financial capacity, and previous experience in similar projects.

II. Approval of DNIT:
- Internal Review: Submit the DNIT for internal review by relevant departments, such as legal, finance, and technical teams, to ensure completeness and compliance with organizational policies.
- Management Approval: Present the DNIT to the senior management or project steering committee for final approval before issuing the tender.
- Regulatory Compliance: Ensure that the DNIT complies with all applicable regulatory requirements, including local procurement laws and industry standards.

III. Call of Tender:
- Tender Advertisement: Publish the tender notice in relevant platforms, such as government procurement portals, newspapers, and the company's website, to reach a wide audience of potential bidders.
- Tender Document Availability: Ensure that the tender documents are available for download or purchase by interested bidders, providing clear instructions on how to obtain the documents.
- Pre-Bid Meeting: Organize a pre-bid meeting (if applicable) to clarify any queries from potential bidders and to ensure a uniform understanding of the project requirements.

IV. Tender Submission:
- Submission Guidelines: Provide clear guidelines for the submission of bids, including deadlines, submission formats (online/offline), and required documentation.
- Bid Receipt and Security: Establish a secure and confidential process for receiving bids, including measures to ensure that bids are not opened or tampered with before the official opening date.

1.8.2 Evaluation of Tender Based on Technical and Financial Bid Analysis and Allotment of Work Order

I. Technical Bid Evaluation:
- Bid Opening: Convene a bid opening committee to officially open the received bids in a transparent manner, recording details of each bid received.
- Compliance Check: Conduct an initial review to ensure that all submitted bids comply with the mandatory requirements, such as submission deadlines, bid security, and required documentation.
- Technical Evaluation: Evaluate the technical bids against the predefined criteria, including the bidder's technical capability, compliance with technical specifications, and past performance.
- Scoring System: Use a scoring system to objectively assess the technical bids, assigning points based on the degree to which each bid meets the technical requirements.

II. Financial Bid Evaluation:
- Financial Bid Opening: Only open the financial bids of those bidders who have passed the technical evaluation, ensuring transparency in the process.
- Price Comparison: Compare the financial bids, considering the total cost, unit rates, and any additional financial implications (e.g., discounts, payment terms).
- Cost Analysis: Perform a detailed cost analysis to assess the reasonableness of the quoted prices, ensuring they align with market rates and the project's budget.
- Lowest Evaluated Bid: Identify the lowest evaluated bid that meets both the technical and financial criteria, ensuring the bid offers the best value for money.

III. Pre-Contract Compliance Check:
- Documentation Review: Review the contractor's compliance documents before awarding the contract. This includes verifying licenses, insurance coverage, certifications, and past compliance history.

IV. Allotment of Work Order:
- Approval Process: Prepare a recommendation report based on the technical and financial evaluations and submit it to the management or relevant authority for approval.
- Award Notification: Once approval is obtained, issue a formal work order to the selected bidder, outlining the scope of work, payment schedule, and other contractual obligations.
- Contract Signing: Facilitate the signing of the contract between the organization and the selected bidder, ensuring all legal and financial aspects are clearly defined and agreed upon.
- Project Kickoff: Organize a project kickoff meeting with the selected contractor to align on project expectations, timelines, and key milestones.

2. EXECUTION AND IMPLEMENTATION, AND INSPECTION AND TESTING

2.1 Joint Pre-Survey by Operation and Construction Wing Along with Contractor

2.1.1 Detailed Final Survey

Before Permit of Work

I. Pre-Survey Planning:
- Scheduling: Coordinate and schedule a joint pre-survey involving the Operation Wing, Construction Wing, Civil Wing, and the contractor.
- Documentation Preparation: Ensure all necessary project documents, such as design plans, maps, and site layouts, are available for reference during the survey.

II. Conducting the Pre-Survey:
- On-Site Assessment: Perform an on-site assessment of the project area, verifying the alignment of proposed infrastructure (e.g., poles, transformers, cables) with the actual site conditions.
- Identification of Obstacles: Identify any potential obstacles, such as existing utilities, structures, or environmental concerns, that could impact construction.
- Mutual Agreement: Reach a mutual agreement between the Operation Wing, Construction Wing, and the contractor on the final route, placement of equipment, and any necessary modifications to the original plans.

III. Survey Documentation:
- Survey Report: Document the findings of the pre-survey in a comprehensive report, including maps, photographs, and detailed notes on any changes or concerns identified.
- Approval: Obtain signatures from representatives of the Operation Wing, Construction Wing, Civil Wing, and the contractor to confirm agreement on the survey findings and modifications.
- Gazette Notification: Notification and publication of final route of transmission lines from the feeding substation to the proposed substation.

IV. Permit of Work:
- Work Permit Issuance: Based on the pre-survey findings and mutual agreement, issue a permit of work to the contractor, authorizing the commencement of construction activities.

2.1.2 Verification of Regulatory Compliances for Contractor

I. Regulatory Compliance List:
- Prepare a checklist of all regulatory requirements that the contractor must adhere to, including labour laws, environmental regulations, safety standards, and any project-specific requirements.

II. Ongoing Compliance Monitoring:
- Site Audits: Conduct regular site audits to verify that the contractor is adhering to regulatory requirements, including safety protocols, environmental protection measures, and labour regulations.
- Compliance Reports: Require the contractor to submit regular compliance reports, documenting adherence to regulations and standards, and addressing any violations or concerns.

III. Non-Compliance Management:
- Issue Identification: Identify any instances of non-compliance during audits or site inspections, and document these in a formal report.
- Corrective Actions: Issue corrective action requests to the contractor, specifying the required changes and the timeline for implementation.
- Follow-Up: Monitor the contractor's implementation of corrective actions to ensure full compliance is achieved within the stipulated timeline.

IV. Final Compliance Verification:
- Completion Audit: Conduct a final compliance audit at the end of the project to ensure that all regulatory requirements have been met before project closeout.
- Certification: Issue a final compliance certification, confirming that the contractor has fulfilled all regulatory obligations associated with the project.

2.1.3 Timely Handing Over of Hindrance-Free Land to the Executing Agency

I. Land Preparation:
- Hindrance Identification: Identify and address any potential hindrances on the project land, such as unauthorized structures, debris, or vegetation that could delay construction.
- Legal Clearances: Ensure that all legal clearances (e.g., land acquisition, environmental clearances) are obtained before handing over the land to the executing agency.

II. Coordination with Stakeholders:
- Stakeholder Communication: Communicate with relevant stakeholders, including local authorities and landowners, to ensure that the land is cleared of any disputes or encroachments.
- Hindrance Removal: Coordinate with local authorities or third-party service providers to remove any identified hindrances, ensuring the land is ready for construction.

III. Land Handover Process:
- Site Inspection: Conduct a final site inspection with the executing agency (contractor) to confirm that the land is hindrance-free and ready for construction.
- Handover Documentation: Prepare a land handover document that includes details of the site condition, any existing structures, and confirmation that the site is free of hindrances.
- Formal Handover: Execute the formal handover of the land to the executing agency, obtaining signatures from both parties to confirm the transfer.

IV. Monitoring:
- Ongoing Monitoring: Monitor the site periodically to ensure that no new hindrances arise during the construction period.

2.2 Use of all construction materials

2.2.1 Use of Construction Material as per Relevant Codes and Specifications

I. Material Specifications:
- Code Compliance: Ensure that all construction materials meet the relevant national and international codes and standards, such as IS, IEC, or IEEE specifications.
- Material List: Develop a comprehensive list of approved materials, including specifications for each type of material (e.g., cables, transformers, poles).

II. Procurement Process:

- Approved Suppliers: Source materials from approved suppliers who can provide certificates of compliance with the relevant codes and standards.
- Material Inspection: Upon delivery, conduct a thorough inspection of all materials to verify that they meet the required specifications and are free of defects.

III. Quality Control:
- Testing: Perform or request testing of materials in accredited laboratories to ensure compliance with technical specifications.
- Record Keeping: Maintain detailed records of material tests, certifications, and inspections, ensuring traceability throughout the project.
- Joint Verification of Material (JVR) at the site store of contractor

IV. Material Usage:
- On-Site Verification: Regularly verify that the materials used on-site match those specified in the design and procurement documents.
- Compliance Checks: Conduct random compliance checks during construction to ensure that materials are being used as per the relevant codes and specifications.

V. Non-Compliance Handling:
- Identification of Non-Compliant Materials: Immediately halt the use of any materials found to be non-compliant, and notify the XEN (Project) and contractor.
- Rectification: Arrange for the removal and replacement of non-compliant materials, ensuring that any issues are resolved promptly to avoid project delays.

2.3 Implementation of Civil Works

2.3.1 Approval of All Civil Drawings

I. Submission of Drawings:
- The contractor shall prepare and submit all civil drawings to the Nodal Officer/XEN Project (Civil) for initial review.
- The drawings should be detailed and include specifications, dimensions, materials to be used, and any other relevant information.

II. Review Process:
- The Nodal Officer/XEN Project (Civil) will review the submitted drawings for compliance with project specifications and relevant standards.
- The drawings shall be reviewed in coordination with Nodal Officer/ XEN Project (Electrical) and other relevant departments to ensure alignment with overall project requirements. However, any change in layout shall be approved by the SE (Civil) and CE/PD&C

III. Approval:
- Once reviewed, the CE (HOD) will either approve the drawings or return them with comments for necessary revisions.
- Revised drawings must be resubmitted and approved before any civil work begins.

IV. Documentation:
- All approved drawings must be documented and stored in the project management system for future reference.

2.3.2 Use of Quality Materials from Approved Sources

I. Material Sourcing:
- All materials used in civil works must be sourced from suppliers approved by the Nigam/Procurement Team.

- The Procurement Team must ensure that suppliers provide quality certifications and comply with the specified standards.

II. Material Inspection:
- Upon delivery, materials must be inspected by the QA team to ensure they meet the required specifications and quality standards.
- Any materials that do not meet the standards must be rejected and replaced immediately.

III. Documentation:
- All material certifications, inspection reports, and approval documents must be maintained and stored for future reference.
- A record of all materials used, along with their source and quality certification, should be kept in the project documentation.

IV. Use of Materials:
- Only approved materials should be used in the execution of civil works.
- Any deviation from the use of approved materials must be documented and justified, with necessary approvals obtained before proceeding.

2.3.3 Execution of Civil and Horticulture Work

I. Pre-Execution Planning:
- A detailed work plan must be developed, outlining the scope of work, resources required, timelines, and specific standards to be adhered to during construction.
- All necessary permits and approvals must be obtained before commencing the work.

II. Execution of Work:
- Civil work shall be executed strictly according to the approved drawings and specifications.
- Key activities include the construction of control room buildings, equipment foundations, earthing mat, fencing, grouting, and cable trenches, etc.
- Regular site inspections shall be conducted by the XEN Project (Civil) to ensure adherence to standards and quality requirements.
- Follow proper guidelines for horticulture planning as outlined in the bid document/estimate, keeping in mind the aesthetic appeal, safety, plantation techniques, and maintenance and upkeep.
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III. Compliance with Standards:
- All civil work must comply with the relevant standards, including Haryana PWD building codes.
- Maintenance of concrete register.

IV. Quality Assurance:
- The QC team will conduct inspections at various stages of the construction process to verify the quality of workmanship and materials.
- Any deviations from the approved drawings or standards must be reported immediately, and corrective actions must be taken.

V. Final Inspection and Handover:
- Upon completion of the civil works, a final inspection will be carried out by the XEN Project (Civil).
- Any defects or issues identified during the inspection must be rectified before the work is deemed complete and handed over.

2.4 Implementation of Electrical Works

2.4.1 Approval of Electrical Drawings and Specifications of Each Equipment

I. Submission of Electrical Drawings and Specifications:
- The contractor must submit detailed electrical drawings and equipment specifications to the Tender Inviting Authority/XEN Project (Electrical as well as Civil) for review.
- Submissions should include all relevant technical details, schematics, and material lists.

II. Review Process:
- The Tender Inviting Authority/XEN Project (Electrical), in collaboration with the Engineer in Charge, will review the submitted drawings and specifications to ensure they meet project requirements and adhere to relevant standards.
- If necessary, consultations with other departments, such as safety and quality control, should be conducted.

III. Approval:
- After the review, the Tender Inviting Authority/XEN Project (Electrical and Civil) will either approve the drawings and specifications or return them with comments for revisions.
- All revisions must be resubmitted for final approval before proceeding.

IV. Documentation:
- Approved electrical drawings and specifications must be documented and stored in the project management system.
- Copies should be provided to the relevant teams, including procurement and construction.

2.4.2 Placing of Purchase Orders for Material/Equipment and Inspection/Testing at Manufacturer's Works

I. Selection of Approved Suppliers:
- The contractor/agency, in coordination with the Tender Inviting Authority/XEN Project (Electrical), will ensure that all materials and equipment are sourced from suppliers approved by the department.
- The list of approved suppliers should be regularly updated and maintained.

II. Placing Purchase Orders:
- Once the materials and equipment have been approved, the contractor will place purchase orders with the selected suppliers.
- Purchase orders must include all necessary specifications, delivery timelines, and quality requirements as per the approved documents.

III. Pre-Delivery Inspection and Testing:
- The contractor/agency will arrange for the inspection and testing of the ordered materials/equipment by the department at the manufacturer’s works.
- Inspections should be carried out according to a predefined checklist that includes quality standards, performance criteria, and safety compliance.

- Any issues or non-conformities identified during the inspection must be communicated to the supplier for immediate resolution.

IV. Acceptance and Documentation:
- Upon successful inspection and testing, the QC/TPIA team will submit a testing report of the materials/equipment to the competent authority, for allowing dispatches.
- The Tender Inviting Authority/ XEN Project (Electrical/Civil) will document the inspection report and update the project records and will submit it to CE/HOD for approval.
- Materials and equipment should only be accepted on-site if they pass all inspections and meet the specified criteria.

V. Handling non-conformities:
- If the materials or equipment fail inspection or testing, they must be rejected, and the supplier must be notified immediately.
- The contractor, in coordination with the QC Team/ Tender Inviting Authority/ XEN Project (Electrical), will arrange for replacement or corrective actions as per the contract terms.

2.5 Execution of work as per work order

2.5.1 Execution as per the Plan within Specified Time Period

I. Project Planning:
- The concerned Tender Inviting Authority/XEN Project will prepare a detailed project execution plan, including timelines, resources, and milestones.
- The Site Engineer will ensure that all activities are carried out according to this plan.

II. Execution Monitoring:
- Daily progress should be monitored by the Site Engineer, with weekly reviews by the concerned SE Project to ensure the project stays on schedule.
- Any delays or issues must be immediately reported to the concerned SE Project, and corrective actions should be implemented to mitigate delays.

III. Completion Reporting:
- Upon completion of each project milestone, the Site Engineer must submit a completion report to the concerned SE Project, for review.

2.5.2 Sampling of Material/Equipment during Joint Verification as per Standards

I. Joint Verification Process:
- During material/equipment delivery, joint verification must be conducted by the Site Engineer, QA Team, and the contractor.
- Samples of materials and equipment should be taken according to the specified standards.

II. Documentation:
- All samples taken must be documented in the sampling log, noting the date, material/equipment type, quantity, and standards used for verification.
- The documentation must be signed by all parties involved in the joint verification process.

2.5.3 Testing in NABL Accreditation Labs

I. Selection of NABL Labs:

- The CE/PD&C/Tender Inviting Authority will select NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited labs for testing the samples taken during the joint verification.

II. Testing Process:
- The samples will be sent to the selected NABL labs for testing against the required standards (Government Approved/Nigam Empanelled)
- The lab must follow the specified testing procedures and provide detailed reports.

III. Receiving Test Results:
- Upon receiving the test results, the CE/PD&C/Tender Inviting Authority will review and document the findings, ensuring they meet the project specifications.

2.5.5 Preparation of Site Inspection and Quality Control Register

I. Register Maintenance:
- The Site Engineer is responsible for maintaining a Site Inspection and Quality Control Register.
- This register should document all inspections conducted, materials/equipment received, test results, and any defects identified.

II. Regular Updates:
- The register must be updated regularly, ensuring that all entries are complete and accurate.
- Copies of inspection reports, test results, and rectification actions should be attached to the register.

III. Audit and Review:
- The register will be audited by the QC Team and reviewed by the concerned XEN (Project) periodically to ensure compliance with quality standards.

2.5.6 Checking of Test Results by Execution Authority and Action Thereof

I. Review of Test Results:
- The Execution Authority will review the test results documented in the Site Inspection and Quality Control Register.
- Any non-conformities or issues identified in the test results must be addressed immediately.

II. Corrective Actions:
- The Execution Authority will instruct the Site Engineer and Contractor to implement corrective actions for any non-compliant results.
- A follow-up inspection or testing should be conducted to verify that the issues have been resolved.

III. Documentation:
- All actions taken as a result of test findings should be documented in the Site Inspection and Quality Control Register, with references to the relevant test reports.

2.5.7 Rectification of Defects on Regular Basis and Keeping the Record

I. Identification of Defects:
- The Site Engineer is responsible for identifying any defects during regular site inspections and through the review of test results.

II. Rectification Process:

- The Contractor must rectify any defects identified within a specified time frame, following the guidelines provided by the Execution Authority.
- After rectification, the Site Engineer must re-inspect the work to confirm that the defects have been corrected.

III. Record Keeping:
- A record of all defects identified and rectified should be maintained in the Site Inspection and Quality Control Register.
- Each entry should include the defect description, date identified, rectification action taken, and date of re-inspection.

IV. Final Review:
- The concerned XEN Project will conduct a final review of the defect records to ensure all issues have been addressed satisfactorily before the project is completed.

3. COMMISSIONING AND HANDOVER

3.1 Testing and Functionality of Substation and All Its Equipment and Machinery

I. Initial Inspection:
- The concerned Tender Inviting Authority/XEN Const. will conduct a thorough inspection of the substation and all its equipment to ensure that they are installed as per the approved drawings and specifications.
- Any discrepancies or issues identified during the inspection must be rectified before proceeding with testing.

II. Preparation for Testing:
- Prepare a detailed testing plan that includes all the tests to be conducted, the equipment involved, and the relevant standards to be adhered to.
- Ensure all necessary testing instruments and tools are available and calibrated as per the manufacturer's guidelines.

III. Execution of Testing:
- The testing of substation equipment should be carried out systematically, following the prepared plan.
- Tests should include functional checks, performance tests, and safety tests as required by the project specifications and relevant standards.

IV. Documentation:
- Record all test results in the Test Log, including any observations and anomalies.
- The Test Log must be signed by the Electrical Engineer and reviewed by the XEN (Project).

3.1.1 Pre-Commissioning Testing of Electrical Equipment as per Standards

I. Pre-Commissioning Test Plan:
- The XEN (M&P) will develop a pre-commissioning test plan, in coordination with XEN Project (electrical) detailing the specific tests required for each piece of equipment, referencing the relevant standards (e.g., IEC, ANSI).

II. Conducting Pre-Commissioning Tests:
- Ensure that all tests are performed in accordance with the specified standards and manufacturer recommendations.

III. Evaluation of Test Results:
- The results of pre-commissioning tests must be evaluated against the acceptance criteria provided in the standards and equipment specifications.
- Any deviations or failures should be addressed immediately, with corrective actions implemented before proceeding.

IV. Final Report:
- A comprehensive pre-commissioning test report should be prepared, documenting all test results, any issues encountered, and the corrective measures taken.
- The report must be submitted to the XEN Project Electrical for final review and approval.

3.1.2 Clearance from Chief Electrical Inspector After Completion and Subsequent Handover of Substation to Operation Wing

I. Application for Clearance:
- After the successful completion of pre-commissioning tests, the XEN Project Electrical will apply for clearance from the Chief Electrical Inspector.

- The application should include all relevant documentation, including test reports, equipment specifications, and safety certifications.

II. Inspection by Chief Electrical Inspector:
- The Chief Electrical Inspector will conduct a thorough inspection of the substation, as well as the transmission lines, reviewing all test results, verifying compliance with safety and regulatory standards, and ensuring that the substation is fit for operation.
- Any observations or recommendations made by the Inspector must be addressed promptly.

III. Issuance of Clearance Certificate:
- Upon satisfaction, the Chief Electrical Inspector will issue a clearance certificate, authorizing the substation as well as the transmission lines for operational use.
- This certificate must be documented and filed as part of the project records.

IV. Handover to Operation Wing:
- Once clearance is obtained, the XEN Project Electrical will formally hand over the substation to the Operation Wing.
- The handover process should include a detailed briefing on the substation's operation, maintenance requirements, and any special instructions.

3.1.3 Post-Commissioning Testing of All Electrical Equipment as per Work Order/Relevant Equipment Codes

I. Preparation for Post-Commissioning Testing:
- Develop a post-commissioning test plan, detailing the tests to be conducted after the substation has been energized.
- Ensure that all testing instruments are calibrated and that safety protocols are in place.

II. Conducting Post-Commissioning Tests:
- Conduct tests such as load testing, operational testing under simulated fault conditions, and performance verification of protection systems.
- These tests should confirm that the equipment operates correctly under actual load conditions and that all systems function as expected.

III. Evaluation and Documentation:
- Evaluate the results of post-commissioning tests against the acceptance criteria outlined in the work order and relevant equipment codes.
- Document all results in a Post-Commissioning Test Report, noting any issues and the corrective actions taken.

IV. Final Review and Sign-Off:
- The Post-Commissioning Test Report should be reviewed by the XEN Project Electrical and the Operation Wing.
- Upon approval, the substation is deemed fully commissioned and ready for regular operation.

3.2 Submission of asset management plan and completion certificate and adhering to approved timelines and budget

3.2.1 Submission of Assets Completion Plan and In-Built Drawings by the Agency

I. Preparation of Assets Completion Plan:
- The Contractor/Agency must prepare a detailed assets completion plan upon the completion of the project.

- The plan should include a comprehensive list of all assets installed or constructed, their locations, specifications, and relevant technical details.

II. Preparation of In-Built Drawings:
- The Contractor/Agency is required to prepare in-built (as-built) drawings, reflecting the actual installations and modifications made during the project.
- These drawings should be accurate and updated, showing the final layout of all components as installed on-site.

III. Review and Verification:
- The assets completion plan and in-built drawings must be reviewed by the concerned XEN Project and the QC Team for accuracy and completeness.
- Any discrepancies or required revisions should be communicated to the Contractor/Agency for immediate correction.

IV. Submission:
- The finalized assets completion plan and in-built drawings should be submitted by the Contractor/Agency to the XEN (Project) by the specified deadline.
- A digital and physical copy of the documents should be provided, with the digital version adhering to the required file formats (e.g., CAD files, PDF).

3.2.2 Submission of Completion Report by the Agency as per Approved Format

I. Completion Report Format:
- The Contractor/Agency must prepare the completion report in the approved format provided by the XEN (Project).
- The report should include an executive summary, a detailed description of the work completed, any deviations from the original plan, and a summary of testing and commissioning activities.

II. Content Requirements:
- The completion report must include:
    - Project background and objectives
    - Timeline of key activities
    - Final costs and resource utilization
    - Details of any challenges faced and how they were resolved
    - Certification of work completion by relevant authorities
    - Attachments such as test results, quality control documents, and inspection reports

III. Internal Review:
- Before submission, the report should be internally reviewed by the Contractor/Agency's project management team to ensure all required information is included and that the format is consistent with the approved template.

IV. Submission Deadline:
- The Contractor/Agency must submit the completion report to the XEN (Project) within the specified timeline.
- Both digital and physical copies of the report should be submitted.

V. Approval Process:
- The XEN (Project), along with the QC Team, will review the completion report for accuracy and completeness.
- Upon approval, the completion report will be archived as part of the project's official records.

3.2.3 Ensuring the Timelines

I. Project Timeline Development:
   - At the beginning of the project, a detailed timeline should be developed by the XEN (Project) in collaboration with the Contractor/Agency.
   - The timeline should include all key milestones, submission deadlines, and deliverables.

II. Monitoring Progress:
   - The Execution Authority will monitor the progress of the project against the established timeline.
   - Regular progress meetings should be held with the Contractor/Agency to review the status of deliverables and identify any potential delays.

III. Addressing Delays:
   - If delays are identified, the Contractor/Agency must provide a justification and a revised plan to bring the project back on track.
   - The XEN (Project) may implement corrective actions, such as reallocating resources or adjusting the schedule, to minimize the impact of delays.

IV. Final Review of Timelines:
   - Upon project completion, the XEN (Project) will review the adherence to the project timeline.
   - Any deviations should be documented, including the reasons for delays and the steps taken to mitigate them.

V. Closure and Reporting:
   - After the successful submission of all required documents (assets completion plan, in-built drawings, and completion report), the project timeline should be formally closed.
   - A final report summarizing the project's adherence to the timeline should be prepared and submitted to senior management.

3.3 Guarantee of works

3.3.1 Ensuring the Expenditure Within Approved Awarded Amount

I. Budget Review and Allocation:
   - The XEN (Project), in collaboration with the Finance Wing, must review the approved budget for the project and allocate funds accordingly.
   - Detailed cost estimates should be prepared for each phase of the project, including materials, labour, equipment, and contingencies.

II. Monitoring Expenditures:
   - The Finance Wing will continuously monitor project expenditures to ensure they remain within the approved awarded amount.
   - Regular financial reports should be generated to track spending against the budget.

III. Cost Control Measures:
   - If there are signs of potential budget overruns, the XEN (Project) must implement cost control measures, such as revising the project scope, renegotiating contracts, or optimizing resource allocation.
     - Any necessary changes to the budget must be approved by senior management.

IV. Approval of Payments:

- All payments to contractors, suppliers, and other stakeholders must be processed by the XEN (Electrical/Civil) for approval of CE (HOD) and the Finance Wing, ensuring they are within the budgetary limits.
- Detailed records of all financial transactions should be maintained for auditing purposes.

V. Final Financial Review:
- Upon project completion, a final financial review should be conducted to ensure that the total expenditure does not exceed the approved awarded amount.
- A final financial report should be prepared and submitted to senior management if amount exceeds beyond allowed variations.

3.3.2 Handover of Substation to Operation Wing

I. Preparation for Handover:
- Upon successful commissioning of the substation, the XEN (Project) will initiate the handover process to the Operation Wing.
- The Contractor/Agency should ensure that all necessary documentation, including operational manuals, test reports, and as-built drawings, is complete and ready for submission.

II. Handover Inspection:
- A joint inspection should be conducted by the XEN (Project), the Operation Wing, and the Contractor/Agency to verify that all work has been completed as per the project specifications.
- Any outstanding issues or deficiencies identified during the inspection should be rectified by the Contractor/Agency before the handover.

III. Documentation and Handover Meeting:
- The XEN (Project) should organize a handover meeting where the Contractor/Agency will formally transfer all documentation and operational control to the Operation Wing.
- The Operation Wing should sign a handover certificate, acknowledging receipt of the substation and all related documents.

IV. Training and Support:
- The Contractor/Agency should provide necessary training to the Operation Wing personnel on the operation and maintenance of the substation.
- Any additional support required by the Operation Wing should be agreed upon and documented during the handover process.

3.3.3 Post-Commissioning Monitoring and Support

I. Post-Commissioning Monitoring Plan:
- The XEN (Project), in collaboration with the Operation Wing, should develop a post-commissioning monitoring plan to assess the performance of the substation over a defined period (Guarantee Period).
- The monitoring plan should include regular inspections, performance evaluations, and testing of key equipment.

II. Support and Troubleshooting:
- The Contractor/Agency must provide technical support and troubleshooting services during the post-commissioning period as per the agreed terms in the contract.
- Any issues identified during the monitoring period should be addressed promptly by the Contractor/Agency.

III. Performance Evaluation:

- The Operation Wing should regularly evaluate the performance of the substation and report any concerns to the XEN (Project).
- If necessary, the Contractor/Agency should conduct additional tests or adjustments to ensure optimal performance.

IV. Final Post-Commissioning Report:

- At the end of the post-commissioning monitoring period, a final report should be prepared, summarizing the performance of the substation and any support provided by the Contractor/Agency.
- The report should be reviewed by the XEN (Project) and submitted to senior management for approval.

3.3.4 Withholding of Security Amount

I. Security Amount Agreement:

- The security amount to be withheld from the Contractor/Agency should be clearly defined in the project contract, including the conditions under which it will be released or retained.
- The Nodal Officer ie SE Civil/ SE Const./ XEN Project/Finance Wing with the approval of CE PD&C should ensure that the agreed security amount is withheld from the final payments to the Contractor/Agency or Bank Guarantee of the security amount be obtained from the contractor/agency

II. Release of Security Amount:

- The security amount may be released to the Contractor/Agency after a specified period, typically after the successful completion of the post-commissioning monitoring period, and upon confirmation that no defects or issues have been identified.
- The release of the security amount should be approved by the office of Chief Engineer PD&C and the Finance Wing.

III. Retention of Security Amount:

- If any defects or issues arise during the post-commissioning period that are not rectified by the Contractor/Agency, the XEN (Project) may decide to retain the security amount, either in full or in part.
- The decision to retain the security amount should be documented, including the reasons and any further actions required.

IV. Final Settlement:

- Once all conditions have been met, and the security amount is either released or retained, a final settlement should be prepared by the Finance Wing/DDO.
- The final settlement should be reviewed and approved by the competent authority, and a copy should be provided to the Contractor/Agency.

4. SAFETY AND SECURITY

4.1 Adherence to safety standards and regulations

4.1.1 Electrical Safety Requirements

I. Electrical Safety Requirements:
- Implement and maintain proper insulation and protection measures for all electrical components to prevent exposure to live parts.
- Use appropriate personal protective equipment (PPE) such as insulated gloves, shoes, and tools when handling electrical components.

II. Electrical Clearances:
- Maintain adequate clearances around electrical installations as per regulatory standards to avoid accidental contact.
- Periodically inspect clearance distances to ensure compliance, especially in high-voltage areas.

III. Fire Detection and Extinguishing System:
- Install and regularly test fire detection systems in all areas containing electrical equipment.
- Ensure fire extinguishers suitable for electrical fires (Class C) are readily accessible near electrical installations.

IV. Earthing:
- Design and maintain an earthing system as per national and international standards to ensure effective fault current dissipation.
- Regularly inspect and test the earthing system for continuity and resistance.

V. Ventilation:
- Ensure adequate ventilation in rooms housing electrical equipment to prevent overheating.
- Install ventilation systems that comply with safety standards to facilitate air circulation and temperature control.

4.1.2 Conformance to Safety and Security Requirements

I. Design Standards Compliance:
- Ensure all electrical systems are designed and constructed following the latest standards (e.g., IEC, IEEE, NEC).
- Review and update design standards periodically to align with technological advancements and regulatory updates.

II. Safety Protocols:
- Implement design features that minimize the risk of electrical hazards, such as proper insulation, grounding, and circuit protection.
- Incorporate security measures such as access control and surveillance in areas with critical electrical infrastructure.

III. Documentation:
- Maintain comprehensive documentation of design specifications, safety analyses, and security protocols.
- Ensure documentation is readily accessible for audits and inspections.

4.1.3 Safety and Reliability Audits

I. Audit Scheduling:
- Conduct safety and reliability audits at least annually or as required by regulatory standards.

- Schedule additional audits following any significant equipment failure or incident.

II. Audit Process:
- Employ qualified personnel to perform audits, covering all aspects of safety, operational reliability, and compliance with standards.
- Utilize checklists and audit tools aligned with the relevant safety and reliability criteria.

III. Audit Reporting:
- Document all findings, including non-compliance, potential risks, and recommended corrective actions.
- Submit audit reports to relevant stakeholders and ensure follow-up on corrective actions.

IV. Corrective Actions:
- Prioritize and implement corrective actions based on the audit findings.
- Re-audit areas with significant issues within a specified period to ensure resolution.

V. Continuous Improvement:
- Use audit outcomes to improve safety practices, update procedures, and enhance the reliability of the network.
- Incorporate lessons learned into future training and operational practices.

4.2 Safety measures for workers.

4.2.1 Provision of First Aid, Safety Uniforms, Grounding, Clearances, Fire Protection, Fencing, and Use of PPE

Objective:

To ensure the safety and protection of all personnel by providing appropriate first aid, safety uniforms, grounding measures, clearances, fire protection, fencing, and personal protective equipment (PPE).

Procedure:

I. Adherence to Labour Laws:
- Ensure that all safety measures comply with the provisions outlined in relevant labour laws, such as the Building and Other Construction Workers' Act, and the Occupational Safety, Health, and Working Conditions Code.
- Ensure compliance with specific clauses relating to working conditions, safe machinery, personal protective equipment (PPE), and the right to a safe workplace.

II. First Aid Provision:
- Equip all facilities with first aid kits, ensuring they are accessible and regularly stocked with necessary supplies.
- Train personnel in first aid procedures, including CPR and treatment of electrical shock injuries.
- Clearly display first aid kit locations and ensure all staff are aware of their locations.

III. Safety Uniforms:
- Provide all personnel with safety uniforms that comply with industry standards, including flame-resistant clothing for high-risk areas.
- Ensure that uniforms are well-fitted, regularly inspected for damage, and replaced as necessary.

IV. Grounding:
- Implement a comprehensive grounding system for all electrical installations to ensure safety during fault conditions.

- Regularly inspect grounding connections for integrity and compliance with standards.
- Document and update grounding system plans and testing results.

V. Clearances:
- Maintain required clearances around electrical equipment as per regulatory standards to prevent accidental contact or equipment failure.
- Regularly inspect and document clearance compliance, particularly in high-voltage areas.

VI. Fire Protection:
- Install fire protection systems, including fire alarms and extinguishers, suitable for electrical fires.
- Conduct regular fire drills and ensure personnel are trained in the use of fire extinguishers and emergency procedures.

VII. Fencing:
- Secure all high-voltage areas and critical infrastructure with appropriate fencing to prevent unauthorized access.
- Ensure fencing is well-maintained, with regular inspections to identify and repair any damage.

VIII. Personal Protective Equipment (PPE):
- Provide all personnel with necessary PPE, including insulated gloves, helmets, safety goggles, and hearing protection.
- Mandate the use of PPE in all operational areas, with regular checks to ensure compliance.
- Conduct periodic training on the correct use and maintenance of PPE.

4.2.2 Incident Response and Reporting

Objective:

To establish a clear process for responding to and reporting incidents in the electric power distribution network.

Procedure:

I. Incident Response:
- Establish an incident response team with clearly defined roles and responsibilities.
- Develop and maintain an incident response plan that includes immediate actions, containment, and mitigation strategies.
- Conduct regular drills to ensure all personnel are familiar with the incident response procedures.

II. Incident Reporting:
- Implement a standardized incident reporting system that captures all relevant details, including time, location, nature of the incident, and personnel involved.
- Ensure that all incidents, regardless of severity, are reported promptly.
- Review and analyse incident reports to identify root causes and implement corrective actions to prevent recurrence.

III. Post-Incident Review:
- Conduct a thorough investigation of each incident to determine the cause and contributing factors.
- Document findings and lessons learned, and disseminate this information to all relevant personnel.

- Update safety protocols and training programs based on incident reviews.

4.2.3 Provision of Surveillance to Curb Unauthorized Access

Objective:

To ensure the security of the electric power distribution network by implementing surveillance measures to prevent unauthorized access.

Procedure:

I. Surveillance Systems:
   - Install surveillance cameras at all critical points, including entry and exit points, high-voltage areas, and control rooms.
   - Ensure cameras are functional, with clear visibility, and cover all vulnerable areas without blind spots.

II. Monitoring:
   - Establish a central monitoring station with trained personnel responsible for continuous surveillance.
   - Set up alert systems to notify security personnel of any unauthorized access or suspicious activity.

III. Access Control:
   - Implement access control systems, such as keycards or biometric scanners, to restrict entry to authorized personnel only.
   - Regularly update access permissions and maintain a log of all entries and exits.

IV. Incident Response:
   - Develop procedures for responding to unauthorized access attempts, including alerting security, investigating the breach, and taking corrective action.
   - Maintain records of all incidents related to unauthorized access for review and analysis.

4.2.4 Display of Important Safety Precautions and Instructions

- Safety Precautions and Instructions:
- Display safety instructions and warnings at all entry points, high-risk areas, and near critical equipment.
- Use clear, concise language and symbols that are universally understood.
- Regularly inspect and update safety signage to ensure it remains visible and relevant.

I. Exit Signs:
   - Install illuminated exit signs at all exits and along evacuation routes.
   - Ensure that exit signs are visible even during a power outage by using battery-backed lighting.

II. Important Telephone Numbers:
   - Display emergency contact numbers, including fire department, medical services, and security, in prominent locations.
   - Ensure that contact numbers are up-to-date and accessible to all personnel.

III. Periodic Review:
   - Conduct regular reviews of all safety displays to ensure accuracy and compliance with current standards.
   - Update signage and instructions as necessary, particularly after changes in operations or facility layout.

5. OPERATION AND MAINTENANCE

5.1 Compliance to prescribed deliverable

I. Deliverable Compliance:
- Establish clear performance metrics and deliverables based on regulatory standards and contractual agreements.
- Monitor and evaluate compliance with these deliverables through regular assessments and reporting mechanisms.

II. Power Quality Monitoring:
- Implement power quality monitoring systems to continuously track voltage, frequency, harmonics, and other critical parameters.
- Conduct regular testing and calibration of monitoring equipment to ensure accuracy.

III. Operational Standards Compliance:
- Adhere to SOMP-defined standards for power quality, including maintaining specified voltage levels, minimizing interruptions, and managing load distribution effectively.
- Establish a response plan for deviations from the operational parameters, including immediate corrective actions and root cause analysis.

IV. Reporting and Documentation:
- Document all quality measurements and any incidents of non-compliance, including the steps taken for correction.
- Generate regular reports to review power quality and operational performance against the SOMP standards.

5.1.2 Regular Operation and Maintenance and Replacement of Defective Material/Equipment by Contractor

I. Maintenance Scheduling:
- Develop a comprehensive maintenance schedule covering all equipment and infrastructure, specifying regular intervals for inspections, servicing, and testing.
- Include preventive maintenance activities to address potential issues before they lead to failures.

II. Defective Material/Equipment Replacement:
- Monitor the condition of all equipment and materials, identifying defects or wear that requires replacement.
- Ensure that all replacements are carried out within the timeframe specified in the Work Order and defect liability period.

III. Contractor Responsibilities:
- Clearly define the contractor's responsibilities for maintenance and replacement tasks in the Work Order, including specific timelines and quality standards.
- Conduct regular reviews of the contractor's performance, ensuring compliance with the terms of the Work Order and taking corrective actions if necessary.

IV. Record Keeping:
- Maintain detailed records of all maintenance activities, equipment replacements, and inspections, including the contractor's adherence to the Work Order.
- Use these records for audits, compliance checks, and improving future maintenance strategies.

5.1.3 Use of Software for Maintenance Scheduling and Updates

I. Software Implementation:

- Select and implement a maintenance management software that aligns with the organization's operational needs and capabilities.
- Ensure the software supports scheduling, tracking, reporting, and updating of maintenance activities in real-time.

II. Training:
- Provide training for all relevant personnel on the use of the maintenance software, ensuring they can effectively input data, generate schedules, and interpret reports.
- Offer ongoing support and refresher training to address any issues or updates in the software.
- Maintenance Scheduling:
- Utilize the software to automate the scheduling of regular maintenance activities, ensuring no tasks are overlooked.
- Include alerts and reminders for upcoming maintenance tasks, inspections, and equipment servicing.

III. Updates and Documentation:
- Ensure that all maintenance activities, including inspections, repairs, and replacements, are documented in the software in real-time.
- Use the software's reporting features to generate regular maintenance performance reports, identifying areas for improvement and ensuring compliance with SOMP standards.

IV. Continuous Improvement:
- Regularly review the effectiveness of the software in managing maintenance activities, seeking feedback from users and identifying opportunities for enhancement.
- Update the software as needed to incorporate new features, address emerging challenges, and improve overall maintenance efficiency.

5.2 Timely rectification of defects

5.2.1 Emergency Response Planning

I. Emergency Response Team (ERT):
- Formation: Establish an ERT comprising trained personnel from relevant departments.
- Roles & Responsibilities: Define clear roles, including Incident Commander, Safety Officer, Communications Officer, and Field Response Teams.

II. Emergency Plan Development:
- Risk Assessment: Conduct a thorough risk assessment to identify potential emergencies (e.g., power outages, equipment failures, natural disasters).
- Response Procedures: Develop detailed response procedures for each identified risk.
- Communication Plan: Implement a communication plan that includes internal and external communication channels.
- Resource Allocation: Identify and allocate necessary resources, including personnel, equipment, and materials.

III. Training & Drills:
- Training: Provide regular training to ERT members and relevant staff on emergency procedures and equipment.

- Drills: Conduct regular emergency drills to test the effectiveness of the emergency response plan and update it as necessary.

IV. Documentation:

- Emergency Response Plan: Maintain and regularly review the written emergency response plan.
- Incident Reports: Document all incidents and responses to evaluate performance and improve future responses.

V. Review & Update:

- Periodic Review: Review and update the emergency response plan annually or after significant changes in the distribution network.

5.2.2 Maintenance Schedule Development and Its Compliance

I. Maintenance Schedule Development:

- Inventory Assessment: Compile a comprehensive list of all equipment and components.
- Maintenance Tasks: Identify and define routine maintenance tasks for each equipment/component.
- Frequency: Determine the frequency of maintenance tasks based on manufacturer recommendations, industry standards, and operational needs.
- Scheduling: Develop a maintenance schedule that includes dates, responsible personnel, and required resources.
- Ensure regular trimming, pruning, and pest control of vegetation around the area to not compromise with operational efficiency.

II. Compliance Monitoring:

- Execution: Ensure that maintenance tasks are carried out according to the established schedule.
- Record Keeping: Maintain detailed records of all maintenance activities, including date, task performed, and personnel involved.
- Audits: Conduct regular audits to verify compliance with the maintenance schedule.

III. Issue Resolution:

- Reporting: Report any deviations from the maintenance schedule or issues encountered during maintenance.
- Corrective Actions: Implement corrective actions to address any non-compliance or issues identified.

IV. Review & Improvement:

- Periodic Review: Review the maintenance schedule and procedures regularly to incorporate improvements and address emerging needs.

5.2.3 Availability of Routine Spare Parts and Spare Panel or Rack (Trolley)

- Spare Parts Inventory:
- Inventory List: Maintain an updated list of routine spare parts required for power distribution equipment.
- Stock Levels: Determine optimal stock levels based on usage history and anticipated demand.
- Reordering: Establish a reordering process to ensure that spare parts are replenished before stock levels fall below the minimum threshold.

I. Spare Panel or Rack (Trolley) Availability:

- Inventory Management: Maintain a record of available spare panels or racks (trolleys).

- Condition Check: Regularly inspect spare panels or racks for functionality and readiness.
- Procurement: Procure additional spare panels or racks as needed to meet operational requirements.

II. Storage & Access:
- Storage Conditions: Ensure that spare parts and panels are stored in appropriate conditions to prevent damage.
- Access Control: Implement access control procedures to ensure that only authorized personnel can access spare parts and panels.

III. Documentation:
- Inventory Records: Keep accurate records of spare parts and panels, including usage, procurement, and stock levels.

5.24 Grievance Redressal and Record Keeping

I. Grievance Submission:
- Channels: Provide multiple channels (e.g., online portal, phone, in-person) for stakeholders to submit grievances.
- Form: Ensure a standardized grievance submission form is available for capturing essential details.

II. Grievance Handling:
- Acknowledgment: Acknowledge receipt of grievances within a specified timeframe.
- Investigation: Assign a designated team or individual to investigate and resolve the grievance.
- Resolution: Develop and implement a resolution plan based on investigation findings.

III. Record Keeping:
- Grievance Log: Maintain a grievance log that includes details such as date of submission, nature of the grievance, actions taken, and resolution status.
- Documentation: Document all correspondence and actions taken to resolve grievances.

IV. Review & Improvement:
- Analysis: Regularly analyse grievance records to identify trends and areas for improvement.
- Feedback: Use feedback from grievance resolution to improve services and address recurring issues.

5.3 Effective running of substation

5.3.1 Deployment of Skilled and Unskilled Manpower for Operation and Maintenance

I. Manpower Assessment:
- Conduct an assessment to determine the specific manpower requirements, identifying the roles that require skilled and unskilled personnel.
- Establish clear job descriptions and qualifications for each role, ensuring that skilled positions are filled by personnel with the necessary training and certification.

II. Deployment Planning:
- Develop a deployment plan that aligns with the maintenance schedule and operational needs of the power distribution network.

- Ensure that skilled manpower is allocated to tasks requiring specialized knowledge, such as equipment repair, system diagnostics, and technical troubleshooting.

III. Workforce Allocation:
- Allocate unskilled manpower to support roles, including equipment handling, cleaning, and other non-technical tasks.
- Provide supervision and guidance to unskilled workers, ensuring they operate safely and efficiently under the direction of skilled personnel.

IV. Compliance and Monitoring:
- Regularly monitor the performance of deployed manpower to ensure adherence to safety standards and operational procedures.
- Adjust manpower deployment as necessary based on workload, emergency needs, or changes in operational priorities.

5.3.2 Deployment of Required Number of Staff for Operation and Maintenance

I. Staffing Requirements:
- Determine the optimal staffing levels required for the effective operation and maintenance of the distribution network, considering factors such as system complexity, workload, and maintenance schedules.
- Establish staffing norms based on industry standards and regulatory guidelines.

II. Staff Allocation:
- Allocate staff to specific roles and shifts, ensuring that all critical functions are covered 24/7.
- Implement a rotation system to manage staff fatigue and ensure continuous coverage.

III. Contingency Planning:
- Develop contingency plans to address potential staff shortages due to illness, emergencies, or other unforeseen circumstances.
- Maintain a roster of on-call personnel who can be deployed quickly in case of emergencies.

IV. Performance Monitoring:
- Monitor staff performance regularly to ensure that the number of staff deployed is sufficient to meet operational demands.
- Adjust staffing levels as needed based on ongoing performance evaluations and workload assessments.

5.3.3 Substation Operation and Maintenance as per SOMP

I. SOMP Adherence:
- Ensure that all substation operations and maintenance activities strictly adhere to the established SOMPs, including safety protocols, equipment handling, and operational procedures.
- Regularly review and update the SOMPs to reflect changes in technology, regulations, and best practices.

II. Routine Inspections:
- Conduct routine inspections of substations to identify and address potential issues, including equipment wear, security vulnerabilities, and environmental factors.
- Document all inspections, noting any corrective actions taken or required.

III. Maintenance Activities:

- Schedule and perform preventive maintenance tasks as outlined in the SOMP, including cleaning, lubrication, calibration, and testing of substation equipment.
- Ensure that any maintenance activities that could disrupt service are planned and communicated in advance to minimize impact.

IV. Emergency Response:
- Develop and implement an emergency response plan for substations, including procedures for dealing with equipment failures, fires, and other emergencies.
- Train substation staff in emergency procedures, including the safe shutdown of equipment and communication with emergency services.

V. Record Keeping:
- Maintain detailed records of all substation operations and maintenance activities, including inspection reports, maintenance logs, and incident reports.
- Use these records to inform future maintenance planning and to ensure compliance with regulatory requirements.

5.3.4 Training and Capacity Building

I. Training Needs Assessment:
- Conduct a training needs assessment to identify gaps in knowledge and skills among staff involved in operation and maintenance.
- Prioritize training areas based on operational needs, safety requirements, and emerging technologies.

II. Training Program Development:
- Develop a comprehensive training program that covers both technical and non-technical skills, including equipment operation, safety protocols, emergency response, and customer service.
- Include a mix of classroom training, hands-on workshops, and on-the-job training to ensure practical knowledge application.

III. Certification and Compliance:
- Ensure that all training programs align with industry standards and regulatory requirements, providing certification upon completion where applicable.
- Monitor compliance with mandatory training requirements, ensuring that all personnel complete required courses on schedule.

IV. Continuous Learning:
- Promote a culture of continuous learning by providing access to ongoing professional development opportunities, including advanced training, seminars, and conferences.
- Encourage staff to pursue additional certifications and qualifications to enhance their career development.

V. Training Evaluation:
- Regularly evaluate the effectiveness of training programs through assessments, feedback, and performance reviews.
- Use evaluation results to refine and improve training content and delivery methods.

5.3.5 Equipment Monitoring and Surveillance Using Latest Technology

I. Technology Implementation:
- Deploy the latest technology for equipment monitoring and surveillance, including thermal cameras for detecting hot spots, Supervisory Control and Data Acquisition (SCADA) systems, and other remote monitoring tools.

- Ensure that all monitoring systems are integrated into a central control system for real-time data collection and analysis.

II. Thermal Camera Surveillance:
- Use thermal cameras to regularly inspect equipment for hot spots, which could indicate potential failures or safety hazards.
- Document thermal camera inspections, noting any identified issues and the corrective actions taken.

III. SCADA System Operation:
- Utilize SCADA systems to monitor and control the power distribution network, including real-time data on voltage levels, load distribution, and equipment performance.
- Ensure that SCADA operators are trained to interpret data and respond promptly to any anomalies or alarms.

IV. Data Analysis and Reporting:
- Analyse data collected from monitoring systems to identify trends, predict potential failures, and plan maintenance activities.
- Generate regular reports on equipment performance, highlighting any areas of concern and recommended actions.

V. Continuous Improvement:
- Regularly review and update monitoring and surveillance technology to incorporate new advancements and improve system reliability.
- Conduct periodic audits of the monitoring systems to ensure they are functioning correctly and providing accurate data.

VI. Preventive Actions:
- Use monitoring data to implement preventive maintenance strategies, addressing issues before they lead to equipment failure.
- Maintain a proactive approach to equipment surveillance, continuously seeking ways to enhance monitoring capabilities and improve system resilience.

CHAPTER 3

IS Codes for Power Distribution Project

Category	IS Code	Description
General Requirements	IS 732:1989	Code of practice for electrical wiring installations (first revision)
	IS 16444:2018	Guide for installation of overhead power lines
	IS 1849:1991	Specification for electrical wiring installations in buildings
	IS 8623 (Part 1 to Part 4):1993	Specification for low voltage switchgear assemblies
	IS 2071:1993	Code of practice for electrical installations in buildings
Electrical Equipment	IS 1886:1982	Guide for the design, installation, and maintenance of electrical equipment
	IS 4030:1985 IS 2026 IEC:76	Specifications for power transformers
	IS 13947 (Part 1 to Part 5):2017 IEC:60947	Low-voltage switchgear and control gear
	IS 61439 (Part 1 to Part 3):2011 IEC:60349	Low-voltage switchgear and control gear assemblies
	IS 555:1988	Specification for low-voltage fuses
	IS 2604 (Part 1 to Part 3):1985	Specifications for Current transformers
	IS 2675:1983	Specifications for circuit breakers and switchgear
	IS 10118 (Part 1 to Part 3):1982	Fire protection in electrical installations
	IS 1500:1998	Specification for substations including transformers
	IS 8196 (Part 1 & 2):1998	Insulation coordination for high-voltage equipment
	IS 8468 IEC 214	On load tap changer
Cables and Conductors	IS 1554 (Part 1 to Part 3):1988	PVC insulated (heavy duty) electric cables
	IS 7098 (Part 1 & 2):1988	Cross-linked polyethylene insulated cables
	IS 8130:1984	Conductors for insulated electric cables and flexible cords
	IS 6425:1988	Specification for insulated flexible cables
	IS 10810 (Part 1 to Part 100):2002	Method of testing insulated cables
	IS 13947 (Part 2):2005	Specification for protection devices in low-voltage switchgear

	IS 9436:1998	Guide for installation of cables in buildings and substations
	IS 398 (Part I)	ACSR conductor 0.15 sq inch, 0.2 sq inch, 0.5 sq inch
	IS 2846:1975	Specification for aluminium conductors
Insulation and Testing	IS 3347:1989	Insulating materials – Methods of testing
	IS 3034:1986	Testing of electrical insulators
	IS 6160:1992	Method for insulation resistance testing of electrical cables
	IS 10589:1987	Specification for optical fiber cables
	IS 14494:1998	Guide for insulation and testing of medium voltage cables
	IS 14672:1999	Guide for testing of electrical cables and conductors
	IS 15311:2004	Guide for testing of power transformers
Safety and Protection	IS 3043:1987	Code of practice for earthing
	IS 52 16 (Part 1 to Part 5):2004	Guide for safety in electrical installations
	IS 15783:2008	Specification for safety relays and devices
	IS 10322 (Part 1 to Part 10):2004	Electrical lighting fixtures
	IS 16253:2010	Guide for electrical safety in residential installations
	IS 15885 (Part 1 to Part 4):2005	Safety requirements for electrical installations
	IS 2551-1982	Danger Notice Plate
Substations	IS 1180 (Part 1 to Part 3):1996	Code of practice for installation and maintenance of substations
	IS 1554 (Part 1 to Part 3):1988	Specification for PVC insulated cables used in substations
	IS 8208 (Part 1 to Part 3):2005	Code of practice for installation and maintenance of medium voltage switchgear
	IS 12360:1988	Specification for indoor switchgear assemblies for substations
	IS 16733:2019	Guide for installation and maintenance of substations
Testing and Maintenance	IS 722:1988	Code of practice for testing and maintenance of electrical installations
	IS 14255:1995	Guide for maintenance of electrical equipment
	IS 16100:2012	Guide for maintenance of electrical distribution systems
	IS 16254:2011	Code of practice for maintenance of electrical equipment in buildings
	IS 1807 (Part 1 & 2):1973	Testing methods for electrical equipment
	IS 3146:1985	Guide for maintenance and testing of electrical switchgear
	IS 2705 (Part 1 & 2):1992	Specification for current transformers

Civil Works	Haryana PWD and relevant IS Codes	Specifications for control room building, roads, and foundations for equipment as well as transmission towers

CHAPTER 4

Description of Components of a Power Distribution Project

A power distribution system is responsible for delivering electricity from the transmission system to individual consumers. It includes various components that ensure reliable and efficient distribution of power. Below are the main components:

1. Electrical Equipment:

Electrical equipment is responsible for the control, protection, and regulation of electrical power in a 33 kV system. These devices ensure efficient power flow and protect the system from faults.
Types of Electrical Equipment:
A. Circuit Breakers: Circuit breakers automatically interrupt the flow of current when they detect an abnormal condition such as a short circuit or overload.

- Vacuum Circuit Breaker (VCB): Uses vacuum as the arc extinguishing medium, suitable for medium-voltage systems.
    - Minimal maintenance due to the absence of gas or oil.
    - Suitable for frequent operations and used in substations for 33 kV distribution.
- SF6 Circuit Breaker: Uses sulfur hexafluoride gas to extinguish the arc, ideal for high-voltage applications.
    - High dielectric strength and excellent insulating properties.
    - Often used in high-voltage transmission networks due to its ability to handle high-power faults.
- Air Circuit Breaker (ACB): Uses air as the arc extinguishing medium and is often used for low to medium voltage levels.
    - Effective for indoor applications and provides manual or automatic control of electrical circuits.

B. Isolators: Isolators are mechanical switches used to disconnect a section of the circuit when it is not in use or under maintenance, ensuring safe handling.

- Single Break Isolator: Used for systems with lower fault levels and breaks the circuit in a single point.
    - Easy operation and suitable for areas where space is limited.
- Double Break Isolator: Provides a more secure method of disconnection by opening the circuit at two points.
    - Ensures better safety in high-voltage areas and is used extensively in substations.

C. Switchgear: Switchgear encompasses all devices used for switching, controlling, and protecting electrical circuits in power systems.

- High Voltage (HV) Switchgear: Used for voltages above 33 kV and controls the transmission of power from generating stations to substations.
    - Contains circuit breakers, fuses, and relays to manage high-voltage power.
    - Requires high insulation and reliability due to the voltage levels.
- Medium Voltage (MV) Switchgear: Used for 33 kV systems and other medium voltage networks.
    - Critical for controlling and protecting feeders in the distribution network.

    - Provides reliable operation under both normal and fault conditions.
- Low Voltage (LV) Switchgear: Used for lower voltage systems (up to 1 kV) in residential and commercial applications.
    - Contains circuit breakers, disconnectors, and protection devices to ensure safe operation.

D. Capacitor Banks: Capacitor banks are installed to improve the power factor and maintain voltage stability in the network.

- Shunt Capacitor Banks: Connected in parallel to the network to supply reactive power and improve efficiency.
    - Reduces losses in the network and avoids penalties due to poor power factor.
    - Used in substations and industrial plants to reduce load on the transformers.
- Series Capacitor Banks: Connected in series with transmission lines to improve voltage regulation and transmission capacity.
    - Boosts voltage levels over long distances by reducing line reactance.

E. Reclosers: Reclosers automatically restore power after momentary faults, reducing the duration of outages and minimizing disruption.

- Single-Phase Reclosers: Used in distribution systems where individual phases can be restored independently.
    - Common in rural areas to prevent outages affecting entire lines.
- Three-Phase Reclosers: Used in three-phase distribution networks to simultaneously restore all phases.
    - Provides faster fault clearing and system restoration.

2. Cables and Conductors:

Cables and conductors are vital components of the electrical grid, transmitting power over various distances with minimal losses.

Types of Cables and Conductors:

A. Overhead Conductors: Overhead conductors transmit electrical power through open air, supported by towers or poles. They are typically used in long-distance transmission.

- All-Aluminum Conductors (AAC): Made of pure aluminum, they are lightweight and corrosion-resistant, commonly used in urban areas.
    - Economical and easy to install but less tensile strength compared to steel-reinforced conductors.
- Aluminum Conductor Steel Reinforced (ACSR): Consists of an aluminum conductor with a steel core for added tensile strength, used in long-distance transmission.
    - High strength-to-weight ratio, making it ideal for long spans between towers.
- All-Aluminum Alloy Conductors (AAAC): Alloyed aluminum conductors that provide better corrosion resistance and strength than AAC.
    - Preferred in coastal or industrial areas due to better corrosion resistance.

B. Underground Cables: Underground cables are insulated and buried underground to transmit electrical power, typically used in densely populated or urban areas where overhead lines are not feasible.

- XLPE (Cross-Linked Polyethylene) Cables: Known for their excellent thermal properties and high current-carrying capacity.
    - Widely used for 33 kV and higher systems due to high dielectric strength and thermal performance.
    - Offers high resistance to moisture and environmental factors.
- PVC Insulated Cables: Provide good flexibility and resistance to chemicals, commonly used in low and medium-voltage applications.
    - Cost-effective but limited to lower voltage applications due to thermal constraints.

C. Insulated Busbars: Busbars are metallic strips or bars enclosed in insulation, used to distribute electricity within a substation.

- Copper Busbars: Known for high conductivity and used in areas requiring low impedance.
    - Used in critical sections of substations and switchgear due to their superior electrical and thermal conductivity.
- Aluminium Busbars: Lighter and more economical than copper, suitable for large installations with high current ratings.
    - Common in large distribution substations where weight and cost considerations are essential.

D. Pilot Cables: Pilot cables are special communication cables that run parallel to power cables, used for sending control and protection signals between substations.

- Multi-Core Pilot Cables: Enable the transmission of multiple signals over long distances.
    - Ensures reliable communication between relays and circuit breakers for coordinated protection.
- Fiber Optic Cables: Offer high-speed communication for data transmission and SCADA integration in modern networks.
    - Essential for real-time monitoring and remote control of substations.

3. Insulation and Testing:

Insulation prevents electrical leakage and ensures that electrical current flows along the intended paths. Testing ensures the reliability and safety of insulation and other system components.

Types of Insulation and Testing:

A. Insulation Materials: Insulation materials are selected based on voltage rating, environmental conditions, and mechanical durability.

- PVC Insulation: Commonly used for low to medium voltage cables due to its flexibility and cost-effectiveness.
    - Suitable for indoor installations and areas with limited thermal stress.
- XLPE (Cross-Linked Polyethylene): Used for high-voltage applications because of its high thermal stability and electrical insulation properties.
    - Preferred for underground cables in 33 kV systems due to its moisture resistance and long service life.

- Rubber Insulation: Provides flexibility and resistance to mechanical stress, often used in movable cables or areas exposed to vibrations.
    - Ideal for outdoor and industrial environments.

B. High-Potential (Hi-Pot) Testing: Hi-Pot testing involves applying a high voltage to electrical equipment to ensure insulation strength and detect any breakdown.

- AC Hi-Pot Testing: Used for systems that operate under alternating current.
    - Ensures the system can handle voltage surges without insulation breakdown.
- DC Hi-Pot Testing: Performed on systems that use direct current or to test underground cables.
    - Detects insulation defects by measuring leakage current.

C. Insulation Resistance Testing: Measures the resistance of electrical insulation to determine its effectiveness in preventing leakage currents.

- Megger Test: A commonly used test to measure insulation resistance between conductors and the earth.
    - Helps identify aging insulation or moisture ingress that could lead to faults.
- Polarization Index (PI): A diagnostic test that evaluates the condition of insulation over time.
    - Useful for determining the presence of contaminants such as moisture or dust.

D. Tan Delta Testing: This test measures the dissipation factor or loss angle to assess the quality of insulation materials over time.

- Prevents Failure: Detects aging and degradation of insulation before catastrophic failure occurs.
    - Especially important for high-voltage cables, transformers, and switchgear insulation.

4. Safety and Protection:

Safety and protection systems are essential for ensuring the integrity of the distribution network and protecting both equipment and personnel from electrical hazards.

Types of Safety and Protection Equipment:

A. Fuses: Fuses are devices that provide overcurrent protection by melting and breaking the circuit when excessive current flows.

- HRC (High Rupturing Capacity) Fuses: Can handle large fault currents without causing an explosion.
    - Used in 33 kV systems to protect transformers and feeders from overcurrent or short circuits.
- Cartridge Fuses: A cylindrical fuse used for low to medium voltage systems.
    - Quick and easy to replace, providing reliable protection for distribution circuits.

B. Grounding Systems: Grounding provides a direct path for fault currents to safely dissipate into the earth, protecting equipment and ensuring safety.

- Ground Rods: Metal rods driven into the earth to provide a low-impedance path for fault currents.
    - Used in substations and at various points in the distribution network for safety.
- Grounding Mats: A mesh of conductive materials laid underground, providing a safe grounding area for personnel.

- Common in high-voltage substations to prevent dangerous step potential during faults.

C. Surge Arresters: Surge arresters protect electrical equipment from high-voltage spikes caused by lightning strikes or switching surges.

- Gapless Surge Arresters: Modern surge arresters without a spark gap, which provide continuous protection.
  - Installed on overhead lines and substations to divert transient surges to ground.
- Metal Oxide Surge Arresters (MOSA): Highly effective at absorbing surges, using zinc oxide for energy dissipation.
  - Extensively used for protecting transformers, switchgear, and transmission lines.

D. Differential Protection: Differential protection compares the current entering and leaving an electrical element, such as a transformer or busbar, to detect internal faults.

- Transformer Differential Protection: Detects faults such as winding short circuits within transformers.
  - Operates quickly to isolate the transformer from the system, minimizing damage.
- Busbar Differential Protection: Ensures fast fault clearance in busbars, where multiple circuits converge.
  - Critical in substations where a fault can impact multiple feeders.

E. Distance Protection: Distance protection measures the impedance between the protection relay and the fault location to isolate faults in transmission lines.

- Zone-Based Protection: Divides the transmission line into zones, each with specific impedance settings to localize faults.
  - Ensures precise fault detection and fast isolation of the faulty section.
- Auto-Reclosing: Automatically attempts to restore power after a transient fault by briefly reclosing the circuit breaker.
  - Reduces downtime and improves network reliability.

5. Substations:

Substations are key nodes in the power grid, where voltage levels are adjusted and distribution is controlled. They house equipment for switching, voltage regulation, and system protection.

Types of Substations:

A. Step-Down Substation: A substation that reduces high transmission voltage to lower distribution levels.

- Power Transformers: Step down voltage levels for local distribution, equipped with protective relays to handle faults.
  - Essential for connecting the high-voltage transmission system to lower-voltage distribution networks.
- Control Room: Houses protective relays, SCADA systems, and communication equipment for remote monitoring.
  - Allows real-time control and monitoring of substation operations.

B. Distribution Substation: Provides power at lower voltages (e.g., 11 kV) to distribution lines that supply electricity to homes, businesses, and industries.

- Circuit Breakers and Switchgear: Control and protect feeders that supply electricity to local networks.
    - Ensure reliable operation and allow quick isolation during faults.
- Auxiliary Power Supply: Provides backup power to substation controls and communication systems during outages.
    - Essential for maintaining substation operation during grid disturbances.

C. Mobile Substation: A portable substation used in emergencies or during maintenance to temporarily supply power to affected areas.

- Transportable Design: Equipped with transformers, circuit breakers, and protective relays mounted on a trailer for rapid deployment.
    - Commonly used during outages or system upgrades.
- Temporary Connection: Can be quickly connected to the grid or distribution network to restore power.
    - Ensures minimal downtime during emergencies.

6. Transformers:

Transformers are devices that step up or step down voltage levels, playing a crucial role in power transmission and distribution.

Types of Transformers:

A. Power Transformers: Power transformers handle large amounts of electricity and are used to step down high transmission voltages to lower levels for distribution.

- On-Load Tap Changers: Adjust the transformer's output voltage to match fluctuating demand without interrupting the supply.
    - Critical for maintaining voltage stability in 33 kV distribution systems.
- Cooling Systems: Utilize oil or air to cool the transformer and prevent overheating during operation.
    - Vital for ensuring the reliable operation of large power transformers in substations.

B. Distribution Transformers: Distribution transformers are smaller than power transformers and step-down voltage levels (e.g., 33 kV to 11 kV or 400 V) for consumer use.

- Pole-Mounted Transformers: Installed on utility poles in rural and suburban areas to supply local distribution networks.
    - Provide power to residential and small commercial customers.
- Pad-Mounted Transformers: Installed at ground level in urban areas, often enclosed for safety.
    - Supply power to homes, offices, and commercial buildings.

C. Instrument Transformers: Used for measuring voltage and current in high-voltage systems, providing safe, low-level signals for meters and protective relays.

- Current Transformers (CTs): Step down high current levels to measurable values for metering and protection.
    - Ensure accurate current measurement and protection in high-voltage networks.

- Voltage Transformers (VTs): Step down high voltage to a lower value suitable for relays and meters.
    - Provide essential voltage measurements for protective relays and control systems.

D. Earthing Transformers: Provide a neutral point for grounding purposes in ungrounded delta systems, helping stabilize the system during faults.

- Neutral Grounding: Ensures safe dissipation of fault currents into the ground, preventing damage to equipment.
    - Common in systems where the neutral is not otherwise available, such as delta-connected transformers.
- Resistance or Reactance Earthing: Used to control the magnitude of fault currents by inserting a resistor or reactor between the neutral point and ground.

E. Autotransformers: Autotransformers are more efficient than conventional transformers because they share part of their winding between the primary and secondary circuits.

- Voltage Regulation: Provide small adjustments to voltage levels in long-distance transmission lines to optimize performance.
    - Often used in industrial applications where fine voltage adjustments are necessary.
- Compact Size: Smaller and more economical than traditional transformers, reducing space requirements in substations.

7. Insulators:

Insulators are materials that prevent the unintended flow of electrical current, ensuring that electricity is safely transmitted along conductors without leakage.

Types of Insulators:

A. Pin Insulators: Pin insulators are mounted on poles to support conductors in overhead distribution systems, providing mechanical strength and electrical insulation.

- Porcelain Pin Insulators: Widely used for 33 kV and higher voltage systems, offering high mechanical and electrical strength.
    - Resist the effects of weathering, providing reliable insulation in outdoor environments.
- Composite Pin Insulators: Made from polymer materials, they offer better resistance to environmental degradation.
    - Lightweight and flexible, making installation easier and reducing the risk of mechanical failure.

B. Suspension Insulators: Suspension insulators are used in high-voltage transmission lines to suspend conductors from towers, forming a string of insulators that can handle high voltages.

- Disc Insulators: Multiple discs are used in a series to provide insulation for very high-voltage lines.
    - Each disc adds insulation, allowing for customizable voltage ratings based on the number of discs used.
- Flexible Installation: Can handle both vertical and horizontal tension, making them ideal for long transmission spans.

C. Post Insulators: Post insulators are used in substations to support high-voltage conductors and provide insulation between live parts and the ground.

- High-Strength Ceramic or Composite Materials: Withstand large mechanical and electrical stresses.
    - Common in switchgear and busbar systems within substations.
- Outdoor or Indoor Applications: Used in both open-air and enclosed substations to isolate live equipment.

D. Strain Insulators: Strain insulators are designed to handle the mechanical stresses caused by tension in conductors, typically used at the end of transmission lines or where lines change direction.

- Toughened Glass or Porcelain: Resists mechanical stress and environmental exposure, ensuring long-term durability.
    - Used in areas subject to high tension, such as corners or terminations of transmission lines.
- Resistant to Vibration and Wind: Protect conductors from mechanical failures due to wind or heavy loads.
    - Critical for maintaining the structural integrity of overhead lines in adverse conditions.

8. Control and Communication Systems:

Control and communication systems enable the remote monitoring, control, and automation of the power distribution network, ensuring efficient and reliable operation.

Types of Control and Communication Systems:

A. SCADA (Supervisory Control and Data Acquisition): SCADA systems allow operators to remotely monitor and control electrical equipment, gather real-time data, and manage alarms.

- Remote Control: Operators can remotely open or close circuit breakers, adjust transformers, and manage load distribution.
    - Essential for modern substations and distribution systems to optimize performance and ensure rapid fault handling.
- Real-Time Data Collection: Provides real-time information on voltage, current, and system health.
    - Enables proactive maintenance and quick response to faults.

B. Teleprotection: Teleprotection systems provide fast communication between protection relays to ensure coordinated tripping of circuit breakers during faults.

- High-Speed Communication: Relays exchange data over dedicated communication channels to isolate faults rapidly.
    - Reduces the risk of widespread outages and equipment damage during high-voltage faults.
- Integrated with Fiber Optics: Uses fiber optic networks for fast, secure, and interference-free communication.
    - Common in modern substations to provide reliable and fast fault clearing.

C. Remote Terminal Units (RTUs): RTUs collect data from field devices like circuit breakers, transformers, and relays and transmit this information to the SCADA system for centralized monitoring and control.

- Data Acquisition: Collects real-time data such as current, voltage, and status of equipment.
    - Provides essential information for efficient network operation and fault detection.
- Command Execution: Executes commands from the SCADA system to control field devices, such as opening circuit breakers or adjusting transformer taps.
    - Ensures quick response to network events or faults.

D. Phasor Measurement Units (PMUs): PMUs measure electrical waves on an electricity grid to determine the health of the system and detect potential instabilities.

- Synchrophasors: Provide real-time monitoring of the phase angle between different sections of the grid.
    - Helps in detecting and preventing grid instabilities or faults before they escalate.
- Wide-Area Monitoring: Allows for coordinated monitoring across vast areas of the grid, essential for managing interconnected power networks.

E. Smart Meters: Smart meters provide detailed, real-time information on energy usage and allow for two-way communication between utilities and consumers.

- Real-Time Billing Data: Sends real-time usage data to utility companies for more accurate billing and demand management.
    - Helps in reducing power theft and ensuring better energy management.
- Demand Response Capabilities: Allows utilities to remotely control loads during peak demand to prevent overloading the grid.
    - Promotes energy efficiency and helps manage consumption during peak hours.

ANNEXURE I

Technical Quality Audit Parameters for Power Distribution

S.no.	Parameters	Benchmark	Reference Document	Indicator	Sub-Indicators	Maximum Marks	Marks obtained	Weightage (%)
1	Planning, Design	Technical framework and comprehensive planning	DPR	1.1) Integrated planning for load growth estimation	1.1.1) Analysis of the existing distribution network and its operational situation and its uses.	3		20%
					1.1.2) Analyze quantitative and qualitative historical data for last 3 years and future assessment for at least 5 years in consultation with all stake holders.	3		
					1.1.3) Accurate Substation capacity, voltage level determination keeping in view maximum loading of power transformer.	3		
					1.1.4) Adoption of automated tools like SCADA, DMS, OMS, and latest simulation software etc.	3		
				1.2) Project Proposal Approval	1.2.1) Administrative and Technical Approvals from the Competent Authorities	3		

					1.2.2) Timeline Scheduling Estimation for Different Phases of the Project	3		
				1.3) Selection of land	1.3.1) Preliminary survey.	2		
					1.3.2) The location of Sub-stations keeping in view ROW, Soil Strength testing, earth resistivity, load centre topology of area etc.	2		
					1.3.3) Land acquisition, forest and other dept clearances and transfer of land in the name of department	2		
					1.3.4) Selection of grid sub-station such as indoor, outdoor, underground, Air Insulated (AIS), Gas Insulated (GIS) or Hybrid etc.	2		
					1.3.5) Walk over survey of transmission line based on HARSAC submission	2		
					1.3.6) Gazette notification and its publication of the route of transmission line.	2		
					1.3.7) Horticulture Planning	2		
				1.4) Load Flow Studies and short circuit analysis	1.4.1) APFC switched capacitors Bank on Sub-stations for Reactive Power Compensation at appropriate places as per requirement.	5		

					1.4.2) The actual short circuit current value may be used to decide switchgear standard specifications	5		
					1.4.3) Technical losses for Sub-transmission system as per standards.	5		
				1.5) SS Design, layout, equipment design and drawings	1.5.1) Selection of design parameters like Capacity Voltage level, fault level, etc. And selection of Incoming/Outgoing Gantry Structure	4		
					1.5.2) Fixation of maximum capacity of Sub-stations as per latest CEA standards /Regulations.	3		
					1.5.3) Selection of rating for cable as per site conditions.	3		
					1.5.4) Provision for equipment maintenance without interrupting the entire supply.	3		
					1.5.5) Protection grading, coordinated configuration to ensure the minimum zones are impacted by faults	3		
					1.5.6) Independent circuit breaker control of incoming and outgoing feeders.	3		

					1.5.7) Grounding/Earthing design as per site condition to ensure safety of equipment and personnel	2		
				1.6) Quality, reliability, functionality, and maintainability of supply	1.6.1) Provision of two incoming feeders from two different sources (wherever feasible) for meeting N-1 contingency for reliability considerations.	2		
					1.6.2) Provision of two different transformers for meeting N-1 contingency for reliability considerations.	4		
					1.6.3) Provision of additional transformer of sufficient capacity for future load growth to meet the N-1 condition at the sub-station	3		
					1.6.4) Provision for Spare 11Kv Panel/Rack for Emergencies	2		
					1.6.5) SS to cater voltage regulation should not exceed the standard limits.	3		
				1.7) Cost analysis, Budget planning, and timeline estimates	1.7.1) Financial implication with cost index up to implementation period.	3		
					1.7.2) Identification of funding agency with annual budget allocation.	3		
					1.7.3) Period for DPR approval	3		

					1.7.4) Selection of network equipment based on merits of overall service life to ensure optimization of cost and system reliability.	3		
				1.8) DNIT Approval and Award of work. (Trunkey project) Administrative and Technical approvals from the competent authorities	1.8.1) DNIT preparation, approval, and call of tender	3		
					1.8.2) Evaluation of Tender based technical and financial bid analysis and allotment of work order maintaining transparency.	3		
					TOTAL	**100**		
2	Execution and implementation and inspection and testing	Technical Methodology for implementation	Contract Agreement	2.1) Joint Pre-Survey by Operation and Construction Wing along with Contractor	2.1.2) Pre survey by Operation and Construction Wing along with contractor before permit of work	7		40%
					2.1.3) Verification of regularity compliances for contractor.	8		
					2.1.4) Timely handing over of hindrance free land to the executing agency	7		
				2.2) Use of all construction materials	2.2.1) Use of all construction material as per relevant codes and specifications.	10		
				2.3) Implementation	2.3.1) Execution of civil work such as control room building, foundations, fencing, grouting, cable trenches etc. and execution o	10		

				of Civil and Electrical Works	f all electrical works as per requirement and corresponding standards			
					2.3.2) Use of quality materials from approved source and machinery from approved manufacturer. Factory tests for equipment /material as per SOMP / Relevant technical specification.by contractor/department.	10		
				2.4) Execution of Civil, Horticulture, and electrical work as per work order.	2.4.1) Execution of Civil and Horticulture Works as per the plan within specified time period.	10		
					2.4.2) Sampling of material/equipment during Joint Verification as per standards	7		
					2.4.3) Testing in NABL accreditation labs.	7		
					2.4.4) Preparation of site inspection and quality control register.	7		
					2.4.5) Checking of test results by execution authority and action thereof.	7		
					2.4.6) Rectification of defects on regular basis and keeping the record.	10		
					TOTAL	**100**		

3	Commissioning and Handover	Guidelines for Commissioning and handover of sub-station	Completion Report	3.1) Testing and functionality of substation and all its equipment and machinery.	3.1.1) Pre commissioning testing of electrical equipment as per standards	12		20%
					3.1.2) Clearance from Chief Electrical Inspector after completion and subsequent handover of Sub Station to Operation Wing	10		
					3.1.3) Post commissioning testing of all electrical equipment as per work order /relevant equipment codes.	10		
					3.1.4) Handover of the Substation to the department by the contractor	6		
				3.2) Submission of asset management plan and completion certificate and adhering to approved timelines and budget	3.2.1) Submission of assets completion plan and in-built drawings by the agency	10		
					3.2.2) Submission of completion report by the agency as per approved format	10		
					3.2.3) Ensuring the timelines	10		
					3.2.4) Ensuring the expenditure within approved awarded amount	12		
				3.3) Guarantee of works	3.3.1) Post commissioning monitoring and support.	10		
					3.3.2) withhold of security amount	10		
					TOTAL	**100**		

4	Safety and Security	Guidelines for Safety and Security	Safety Plan	4.1) Adherence to safety standards and regulations	4.1.1) All electrical safety requirements, electrical clearances, fire detection & extinguishing system, earthing & ventilation etc. as per standards.	25		**5%**
					4.1.2) Conformance to safety requirements by adhering to appropriate design standards.	15		
					4.1.3) To adopt regular safety and reliability audits of all major equipment of the network.	15		
				4.2) Safety measures for workers	4.2.1) Provision of First aid kits, safety uniforms, display of all safety related warnings, and all emergency contact numbers, Grounding, clearances, fire protection, fencing, etc.	10		
					4.2.2) Conducting regular mock drills to check the response system	5		
					4.2.3) Work permit and authorisation	5		
					4.2.2) Incident response and reporting	10		
					4.2.3) Provision of surveillance to curb unauthorized access	10		

					4.2.4) Display of important safety precautions and instructions	5		
					TOTAL	**100**		
5	Operation and Maintenance	Procedure for Effective Maintenance	Assets Management Plan	5.1) Compliance to prescribed deliverable	5.1.1) Ensuring quality of power and other operational parameters as per SOMP.	20		100%
					5.1.2) Regular operation and maintenance and replacement of material/equipment by contractor as per Work Order for specified period	15		
					5.1.3) Use of software for maintenance scheduling and updates, and display of maintenance schedule.	10		
				5.2) Timely rectification of defects	5.2.1) Emergency response planning	10		
					5.2.2) Maintenance schedule development and its compliance.	10		
					5.2.3) Availability of spare parts.	5		
					5.2.4) Grievance redressal and record keeping.	5		
				5.3) Effective running of substation.	5.3.1) Deployment of skilled manpower for operation and maintenance.	5		

					5.3.2) Deployment of required no. of staff for operation and maintenance.	5		
					5.3.3) Substation operation and maintenance as per SOMP.	5		
					5.3.4) Training and capacity building.	5		
					5.3.5) Equipment monitoring and surveillance using latest technology, such as thermal camera to detect hot spot, SCADA etc.	5		
					TOTAL	**100**		

Sr. No	Parameter	Marking Criteria	Weightage (%)	Marks Obtained
1	Planning, Design		20*	
2	Execution and implementation and inspection and testing		40*	
3	Commissioning and Handover		20*	
4	Safety and Security		5*	
5	Project management	Adherence to project timelines and cost projection	5	
6	Environmental Measures	Considerations of environment factors like sustainability,	5	

		ecofriendly construction practices.		
7	User Feedback	Feedback from beneficiaries, stack holders to access their satisfaction levels	5	
		Total	**100**	
1	Operation and Maintenance		100*	

Breakup of weightage is given in detail framework for these parameters
Parameters that are not applicable to a specific project will not be considered for audit. The weightage will be adjusted accordingly

ANNEXURE II

Part A: Checklist for Approval of DPR for Construction of 33kV capacity Substation and Lines (Power Distribution)

Name of Division: _____ Location: _____ District: _____

Name of Project: _____ Name of the Feeding Station: _____

Sr. No.	Questionnaire	Yes	No	N/A	Remarks
1.	Existing distribution network analyzed and operational parameters assessed				
2.	Quantitative historical data analyzed for last 3-5 years				
3.	Qualitative historical data analyzed for last 3-5 years				
4.	Automated tools like SCADA and latest simulation software adopted				
5.	Substation capacity determined				
6.	Preliminary survey conducted				
7.	Substation locations determined based on site conditions and ROW				

8.	Land acquisition completed and transfer of ownership in the name of the department completed				
9.	Clearances obtained from I. Railway				
	II. Forest				
	III. PWD/NHAI				
	IV. Lines crossing of HVPNL/Power Grid, etc.				
	V. Other departments if any				
10.	Selection of grid substation type done				
11.	Gazette notification of transmission line and publication				
12.	Walk-over survey of transmission line done				
13.	Design parameters selected as per standards				
14.	Maximum capacity fixation for substations done				
15.	Provision of two or more power transformer to meet with N-1 contingency				
16.	Provision for spare bay for catering to future load growth				
17.	Cable rating based on loading selected				
18.	Provision of protection grading and coordinated configuration made				
19.	Provision for independent circuit breaker control made				
20.	Provision of Grounding/Earthing design made				
21.	Stand by incoming feeders provisioned for reliability				
22.	Provision for additional transformer for future load growth				
23.	Voltage regulation maintained within standard limits				

24.	Provision of APFC switched capacitors bank made				
25.	Provision for short circuit current values used for switchgear				
26.	Technical losses for substation calculated				
27.	Equipment maintenance provision established				
28.	Financial implications assessed				
29.	Funding agency identified				
30.	DPR approval period defined				
31.	Network equipment selected for optimization				
32.	Emergency evacuation plan for substation staff integrated into the design				
33.	Renewable energy integration points considered in the substation design				
34.	Provision for Horticulture Planning				

Note: This checklist is required to be appended with the DPR at the time of approval and duly signed by the concerned officers/officials.

Part B: Checklist for Execution, Inspection and Testing Commissioning & Handover of Construction of 33kV capacity Substation and Lines

Name of Division: _____

Name of Project: _____

Name of Agency: _____

Estimated Cost of Project: _____

Date of Sanction of Project: _____

Date of Award of Contract: _____

Contract Value of the Work: _____

Sr. No.	Questionnaire	Yes	No	N/A	Remarks
1.	Award and signing of contract agreement with the contractor				
2.	Obtain performance bank guarantee (PBG) from the contractor				
3.	Joint inspection conducted by the contractor and project management team at the site				
4.	Hinderance free land handed over to Executing Agency				
5.	All necessary construction permits obtained before commencing work on-site				
6.	Pre-construction surveys conducted by XEN (Project) with the contractor, tests completed, such as soil testing and topographic surveys				
7.	Project site fenced off and secured to prevent unauthorized access				
8.	Civil Work executed as per requirements and as per IS Codes/Haryana PWD Code				
9.	All workers provided with the necessary training on safety protocols and construction standards				

10.	Safety training and awareness programs conducted for all personnel involved in the project				
11.	The appropriate Personal Protective Equipment (PPE) provided to all workers				
12.	System in place to monitor construction progress against planned milestones				
13.	All electrical equipment procured as per specifications from approved manufacturer/sources				
14.	All equipment stored and handled as per safety and environment regulations				
15.	All components, such as cables, transformers, and circuit breakers, inspected and approved before installation				
16.	Foundation concrete samples taken and tested to ensure the required strength is achieved				
17.	Overhead transmission line towers installed as per structural design specifications				
18.	The construction site regularly inspected for compliance with health, safety, and environmental (HSE) requirements				
19.	Factory acceptance tests for major equipment conducted as per the approved quality plan				
20.	Testing done in NABL accredited labs				
21.	Protection relays and circuit breakers properly installed and tested for functionality				
22.	Transformers installed and tested for load capacity and efficiency				
23.	Underground and overhead transmission lines installed as per standards, with proper clearances maintained				
24.	All corrective actions from site inspections promptly addressed and recorded				
25.	The quality control register and concrete register updated with all test and inspection reports				

26.	The earthing system inspected and tested according to design parameters				
27.	Visual inspection and routine electrical testing conducted on all installed equipment				
28.	Insulation resistance tests performed on cables before energizing the system				
29.	All test results reviewed and approved by the site engineer or relevant authority				
30.	Punch-list items identified during inspection resolved before handover				
31.	All project documents and test certificates collected and stored for handover				
32.	All pre-commissioning tests performed for transformers, breakers, and protection equipment				
33.	Commissioning team appointed to oversee the energization and handover process				
34.	Live performance tests conducted on critical equipment like transformers and switchgear				
35.	Clearance from Chief Electrical Inspector obtained				
36.	The system energized step by step to prevent sudden loading				
37.	Protective relays tested in live conditions to ensure fault detection and isolation				
38.	Commissioning reports prepared and submitted to the appropriate authorities				
39.	All as-built drawings reviewed and updated post-commissioning				
40.	Substation handed over timely to the department				
41.	The site cleared of all temporary installations and contractor’s equipment post-handover				
42.	All warranties and guarantees for installed equipment handed over to the operations team				

43.	Maintenance manuals and O&M instructions handed over to the operations team				
44.	The final project documentation, including drawings, test reports, and certificates, handed over to the client department				
45.	All safety systems like fire alarms, emergency shutdowns, and ventilation systems tested				
46.	Safety drills conducted for staff in the event of a fire or electrical hazard				
47.	There is a safety compliance register maintained at the facility				
48.	Access control measures, like ID checks and visitor logs, implemented during construction				
49.	Potential safety hazards identified and mitigation measures established				

Note: This checklist is required to be signed by the Executive Engineer in charge of the work and other officers during their visit.

Part C: Checklist for Operation and Maintenance of 33kV capacity Substation and Lines

Name of Division: _____

Cost of Project at Completion: _____

Name of Project: _____

Date of Completion: _____

Name of Agency: _____

Sr. No.	Questionnaire	Yes	No	N/A	Remarks
1.	Skilled manpower deployed for operation				
2.	Required staff deployed for maintenance				
3.	Quality of power maintained as per SOP				
4.	Regular operation of substation conducted				
5.	Regular maintenance of equipment conducted				
6.	Regular maintenance of horticulture assets conducted				
7.	Work permits and authorizations in place				
8.	Maintenance scheduling software used for updates				
9.	Maintenance schedule adhered to				
10.	Emergency response plan established				
11.	Spare parts available at site				
12.	Grievance redressal system in place				
13.	Substation operation performed as per SOP				
14.	Training and capacity building done				

15.	Equipment monitoring using advanced technology				
16.	Preventive maintenance performed using advanced tools				
17.	Routine inspections and preventive maintenance done				
18.	First aid kits and safety uniforms provided				
19.	Regular mock drills conducted				
20.	Incident response and reporting procedures established				
21.	Surveillance provided to curb unauthorized access				
22.	Maintenance schedule displayed in the control room				
23.	Emergency contact number displayed in the control room				
24.	Safety precautions displayed in the control room				

Note: This checklist is required to be signed by the Executive Engineer in charge of the work and other officers during their visit.

Quality Assurance Authority

Government of Haryana

Standard Operating Methods and Procedures

For

Technical Quality Assurance

In

Power Transmission Project

PREFACE

The Quality Control process focuses on detecting and correcting defects in a product or service. It involves identifying quality issues and taking corrective actions to resolve them. This is carried out by quality control monitors who would conduct inspections, perform tests, and implement necessary corrective measures. Through this systematic approach, the department would be able to identify shortcomings and defects on a real-time basis and shall ensure the delivery of a high-quality product or service.

Whereas the quality Assurance process ensures the delivery of a high-quality product or service throughout its entire life cycle by preventing quality problems from the outset. This comprehensive approach involves the entire organization, from top management to front-line employees, working in tandem to meet quality standards within the timeline and financial outlay. Key aspects of this process include planning, design, execution, delivery, training, documentation, and audits. By focusing on defect prevention, Quality Assurance ensures that the product or service meets the desired standards throughout the deliverable period.

A Standard Operating Methods and Procedures (SOMP) for Power Transmission Projects offers numerous advantages in the construction and operation of power transmission systems:

1. Quality Control – It ensures consistency in construction and installation standards, leading to high-quality infrastructure projects that meet regulatory requirements and industry standards.
2. Efficiency – Standardized procedures streamline project management, resource allocation, and construction processes, resulting in cost-effective and timely completion.
3. Compliance – It aids in adhering to environmental regulations, safety standards, and legal requirements, thereby mitigating potential legal and environmental issues.
4. Safety – It emphasizes safety procedures and guidelines for workers, reducing the risk of accidents and injuries during construction, installation, and maintenance activities.
5. Risk Management – It helps in identifying and mitigating potential risks associated with power transmission projects, from planning and design to execution, promoting proactive approach to problem-solving and strategic decision-making.
6. Documentation and Reporting – It aids in maintaining accurate project records and facilitates reporting for stakeholders, regulators, and quality assurance purposes.

The construction and installation of power transmission systems are conducted in accordance with the standards and specifications established by various national, international, and CEA guidelines. These standards detail the quality of materials and processes required for constructing and maintaining high-quality transmission lines and substations. It is crucial for all stakeholders to ensure that all quality tests are performed at the specified intervals. Comprehensive quality control and assurance protocols, as outlined in relevant guidelines and standards, serve as manuals for quality control in power transmission projects.

In this respect, Quality Framework relating to all Technical Quality Assurance parameters, indicators, and sub-indicators required at various stages of power transmission projects have

been prepared. These SOMPs have been developed in detailed consultation with the concerned user departments responsible for quality assurance and control in power transmission projects. The QAA is hopeful that State Government departments implementing engineering works and organizations owned and controlled by the State Government will evolve suitable mechanisms to implement the required Quality Assurance plans, with the objective of achieving economic and social development of the State and improving the quality of life for its people.

CONTENTS

Chapter	Description	Page no.
Chapter 1	PART A: Executive Summary	95
	PART B: Responsibilities of Stakeholders	100
Chapter 2	SOMP w.r.t Technical Quality Assurance Parameters	110
Chapter 3	IS Codes and Manuals for Power Transmission Projects	149
Chapter 4	Description of Components of Power Transmission Projects	152
Annexure I	Technical Quality Assurance Parameters	155
Annexure II	Checklists: Part A, B, C	165

CHAPTER 1

PART A: EXECUTIVE SUMMARY

The Electrical Power Transmission Projects for voltage level ranging from 66kV to 400kV are designed to provide a robust, reliable, and efficient transmission system to meet current and future energy demands. The project emphasizes quality assurance, safety, environmental sustainability, and operational excellence throughout its various phases. Below is an executive summary outlining the critical aspects of the project's planning, execution, and long-term management.

Planning and Design:

It forms the foundation of the project and begin with integrated planning for load growth estimation to predict future energy demands across various sectors. This step is critical to ensuring that the transmission network can accommodate increased loads over time without compromising efficiency or stability. In addition to this, load flow studies, short-circuit analysis, and stability analysis are conducted to assess the system's capacity to handle varying loads and potential faults, ensuring the network remains stable and resilient under stress. Once the technical studies are completed, administrative approvals for both individual and integrated planning are secured to ensure regulatory compliance.

The next phase focuses on land selection, which involves identifying suitable locations for substations and transmission lines, taking into account geographical, environmental, and cost factors. This is followed by the development of substation (SS) design, transmission line design ,equipment design and drawings, which include detailed technical specifications for major components like transformers, circuit breakers , CT/PTs and other equipment to ensure the infrastructure meets quality, safety, and operational standards. The design also considers the reliability of supply, functionality, maintainability, and simplicity of operation to ensure the system remains efficient and easy to manage. Finally, a thorough cost analysis, budget planning, and timeline estimates are performed to align the project with financial and scheduling requirements, ensuring cost-effective execution within the approved budget. Major tasks for Planning and Design are listed below:

- Perform integrated planning for load growth estimation to forecast future energy demands.
- Conduct load flow studies, short-circuit analysis, and stability analysis to ensure system reliability.
- Obtain administrative approval for both individual and integrated planning from relevant authorities.
- Select suitable land for substations and transmission lines, considering geographical, environmental factors and ROW.
- Develop SS (Substation) design, transmission line design, equipment design and detailed drawings for major components.
- Design transmission lines and substations, prioritizing quality, reliability, functionality, maintainability, and ease of operation.
- Perform cost analysis, budget planning, and set realistic timeline estimates to ensure cost-effective execution.

Execution and Implementation:

This phase is carried out meticulously to ensure the project meets its quality and reliability objectives. The process begins with a detailed and final survey, where the project team verifies actual geographical conditions before issuing a permit to work, ensuring alignment with on-ground realities. Following this, the execution of civil works is initiated, involving the construction of foundations for transmission line towers transformer & other equipments and substation towers and substations. Once civil works are completed, the execution of electrical works begins as per the work order, which includes the installation of transformers, circuit breakers, and other critical electrical components. Each phase of construction is carefully monitored to ensure compliance with design specifications and quality standards. Major tasks for Execution and Implementation are listed below:

- Conduct a detailed and final survey, verifying geographical conditions before issuing work permits.
- Oversee the execution of civil works, including the construction of foundations for transmission towers and substations in accordance with IS codes and specifications.
- Implement the execution of electrical works as per the work order, ensuring high-quality installation of transformers, circuit breakers, and other components in accordance with.
- Perform regular site inspections and tests to ensure compliance with design specifications and construction standards.
- Use advanced technologies like GPS and drones for accurate alignment and inspection.
- Ensure publication of gazette notification for the selected route of transmission line.

Commissioning and Handover:

It involves a series of critical steps to ensure the system is fully operational and ready for long-term use. The first step in this phase is testing the complete functionality of the substation and all its equipment. This includes testing transformers, circuit breakers, and protection systems to ensure they function as intended under real-world operating conditions. Once testing is completed and the system is fully energized, the project team submits a comprehensive asset management plan and completion certificate, ensuring all deliverables adhere to the approved timelines and budget. This documentation includes warranties, final inspection reports, and detailed operational guidelines for the client (HVPNL). Major tasks for Commissioning and Handover are listed below:

- Test the complete functionality of substations and all associated equipment, including transformers, circuit breakers, and protection systems.
- Monitor system performance during commissioning to ensure smooth operation and identify any faults.
- Submit a comprehensive asset management plan and a completion certificate, ensuring adherence to the approved timelines and budget.
- Train the client's operations team and provide detailed documentation, including warranties and operational guidelines.

Safety and Security:

Safety and Security are embedded throughout the project, starting with strict adherence to safety standards and regulations. All personnel are required to follow safety protocols, including

wearing personal protective equipment (PPE) and maintaining safe working distances from high-voltage areas. Safety measures for both workers and users are integrated into the design, including the installation of fire suppression systems, safety zones around substations, and barriers to prevent unauthorized access. These measures ensure the project maintains the highest safety standards for both the construction phase and long-term operations. Major tasks for Safety and Security are listed below:

- Ensure strict adherence to safety standards and regulations during the construction and operational phases.
- Implement safety measures for workers and users, including the provision of PPE, safety zones, and fire prevention systems.
- Secure transmission infrastructure with fencing, surveillance cameras, and remote monitoring systems to prevent unauthorized access.
- Conduct regular safety audits to maintain compliance with all safety regulations.
- Conduct regular safety drills.

Project Management:

It plays a central role in the successful execution of the transmission project. The project management team oversees the coordination between all stakeholders, including contractors, suppliers, and regulatory authorities. Modern project management tools, such as Gantt charts and critical path analysis, are utilized to ensure the project stays on schedule and within budget. Risk management strategies are in place to address potential delays or unforeseen technical issues, enabling proactive problem-solving and timely decision-making. Major tasks for Project Management are listed below:

- Coordinate all project stakeholders, including contractors, suppliers, and regulatory authorities, ensuring smooth communication and workflow.
- Use project management tools like Gantt charts and critical path analysis to monitor timelines and budget adherence.
- Develop and implement risk management strategies to address potential delays, material shortages, or technical challenges.
- Conduct regular progress reviews to ensure the project stays on track with its objectives and milestones.

Environmental Measures:

These measures are taken to minimize the project's ecological footprint. Environmental impact assessments (EIAs) are conducted before construction begins, identifying potential risks such as deforestation, habitat disruption, and noise pollution. Transmission routes are carefully selected to minimize environmental disturbance, and tree plantation initiatives are undertaken to offset any deforestation. Noise control measures are implemented at substations, and waste disposal procedures are followed to manage hazardous materials responsibly. Major tasks for Environmental Measures are listed below:

- Conduct environmental impact assessments (EIAs) to identify risks such as deforestation, habitat disruption, and noise pollution.
- Select transmission routes to minimize environmental impact, especially in ecologically sensitive areas.

- Undertake tree plantation initiatives to offset deforestation and implement noise control measures at substations.
- Follow proper waste disposal practices for managing hazardous materials and construction debris.

User Feedback:

This phase is solicited once the system becomes operational, allowing the project team to assess its performance from the perspective of key stakeholders and end-users. Feedback mechanisms ensure that any operational issues, such as outages or ease of use, are identified and addressed promptly. This feedback loop allows for continuous improvement, ensuring the system meets user expectations in terms of reliability and efficiency. Major tasks for User Feedback are listed below:

- Establish feedback mechanisms for end-users and stakeholders to assess the operational performance of the system.
- Gather input on system reliability, ease of operation, and any operational challenges.
- Use feedback to make continuous improvements to the system and address any issues raised by the users.

Operation and Maintenance:

O&M is structured to ensure the long-term reliability and efficiency of the transmission system. A detailed maintenance plan is developed, which includes regular operation and maintenance and the replacement of materials or equipment by the contractor during the specified period as per the work order. The project team ensures that all maintenance activities comply with the prescribed deliverables, ensuring that the system functions optimally. Timely rectification of defects is prioritized to prevent system downtime, with rapid response mechanisms in place for any issues that arise during the warranty period. Once the contractor's warranty period expires, the regular operation and maintenance are handed over to the Nigam, ensuring compliance with material and equipment guarantees and warranties. The project's SCADA system allows for real-time monitoring and rapid detection of any issues, enabling timely maintenance and repairs to ensure uninterrupted service. Major tasks for Operations and Maintenance are listed below:

- Develop a detailed plan for regular operation and maintenance, including the replacement of materials or equipment by the contractor as per the work order for the specified period.
- Ensure compliance with prescribed deliverables for system maintenance and functionality.
- Prioritize timely rectification of defects to prevent system downtime and ensure optimal operation.
- After the warranty period, transfer the operation and maintenance to Nigam, ensuring adherence to equipment guarantees and warranties.
- Use SCADA systems for real-time monitoring and prompt response to any anomalies in the transmission system.
- Conduct regular training programs for the officers and staff of the department

In conclusion, the Electrical Power Transmission Project up to 400kV is being implemented with a strong emphasis on quality assurance, safety, and environmental sustainability. Through

comprehensive planning, careful execution, and a robust maintenance framework, the project establishes a scalable and reliable transmission network capable of meeting future energy demands. Continuous user feedback, stringent safety protocols, and effective long-term maintenance will ensure the system remains efficient and resilient throughout its operational lifespan.

PART B: Responsibilities of Stakeholders

1. Client Department (HVPNL)

I. Integrated Planning and Design:

The Client Department (HVPNL) is responsible for overseeing the entire project from inception to completion, beginning with integrated planning for load growth estimation. This involves forecasting future power demands based on population growth, industrial expansion, and other relevant factors to ensure that the transmission system can meet future needs. The Client also supervises load flow studies, short-circuit analysis, and stability analysis, ensuring that the system can handle variable loads, prevent short-circuits, and remain stable under operational stress. Additionally, the Client ensures that the project receives administrative approval from regulatory bodies, validating both individual and integrated planning stages.

II. Design and Layout Approval:

The Client Department (HVPNL) reviews and approves the substation (SS) design, including the layout, equipment design, and detailed drawings. They ensure the system prioritizes quality, reliability, functionality, maintainability, and simplicity of operation. This step is crucial for ensuring that the design allows for efficient operations and future expansions, while minimizing downtime for maintenance. They also conduct a cost analysis, budget planning, and timeline estimates, ensuring that the project is financially feasible, cost-effective, and on schedule. The Client also verifies land acquisition processes and approvals.

III. Monitoring Execution:

During the execution phase, the Client ensures that the contractor conducts a detailed and final survey, verifying actual geographical conditions before issuing the permit to work. This verification is necessary to avoid misalignment between the planned design and on-ground realities. They oversee the execution of civil works, such as the construction of transmission line towers foundations, and substations, as well as the execution of electrical works, ensuring that all work follows the approved work order and complies with technical standards.

IV. Commissioning and Testing:

The Client supervises the testing of the complete functionality of the substation and all its equipment. This includes verifying that transformers, circuit breakers, and other critical components are functioning as required under full load. The Client also ensures the timely submission of the asset management plan and completion certificate, confirming that all project deliverables meet the approved timelines, budget, and technical specifications.

V. Post-Commissioning:

After commissioning, the Client takes ownership of the transmission system, overseeing the long-term operation and maintenance. They ensure the network is operating efficiently and provide ongoing support and upgrades as needed. They may also work with Nigam for long-term management of the system to guarantee that power supply remains reliable.

2. Contractor

I. Pre-Execution Planning:

The contractor is responsible for carrying out a detailed and final survey jointly with the officers of the department validating the geographical conditions and site-specific requirements before beginning work. This survey ensures alignment between the actual site and the approved

designs, preventing delays or costly rework. They also ensure that all necessary permits, approvals, and client clearances are in place before starting work.

II. Execution of Civil and Electrical Works:

The contractor manages the execution of civil works, which involves constructing the foundation for transmission towers, substation equipment, and other civil infrastructure, ensuring the structural integrity of the system. Following this, they handle the execution of electrical works, installing components like transformers, circuit breakers, and control systems according to the specifications outlined in the work order. All tasks are performed in compliance with the project's technical and safety standards.

III. Testing and Commissioning:

The contractor conducts extensive testing during the commissioning phase, including the complete functionality of the substation and all its equipment. This includes load tests, short-circuit tests, and stability tests to verify that the entire system performs as required under real-world conditions. Once testing is complete, they submit the asset management plan and completion certificate, documenting all equipment, operational protocols, and warranties.

IV. Adherence to Safety and Security:

The contractor ensures that all activities adhere to safety standards and regulations. This includes providing personal protective equipment (PPE) for workers, conducting regular safety drills, and implementing security protocols to protect workers and users during construction and operation. The contractor also installs safety measures such as fire suppression systems and protective fencing to safeguard both workers and end-users from potential hazards.

V. Defect Rectification:

During the warranty period, the contractor is responsible for addressing any defects that arise. They must ensure timely rectification of defects in materials, equipment, or installations to avoid system downtime. Regular maintenance and necessary replacements of faulty components are also part of their post-commissioning obligations.

3. Supplier/Contractor

I. Material and Equipment Supply:

The supplier provides high-quality equipment such as transformers, circuit breakers, CTs/PTs, and control systems as per technical specifications. They ensure that all materials are manufactured to meet the standards and are delivered on time to avoid delays.

II. On-Time Delivery:

Suppliers/contractor must adhere to the project schedule, ensuring that all materials and equipment arrive on-site according to the project's timeline. This is critical to maintaining the flow of work and avoiding project delays.

III. Support During Commissioning:

Suppliers often provide technical assistance during the commissioning phase, helping with the installation and integration of supplied equipment. They ensure that all supplied components are installed correctly and operate as intended.

IV. Warranty and Replacement:

Suppliers offer warranties on the materials and equipment provided. During the warranty period, they are responsible for replacing or repairing any defective components at no cost to the client.

4. Third-Party Inspection Agency (TPIA) (Optional)

I. Quality Inspections and Approvals:

The TPIA provides an independent assessment of the project's execution. They perform inspections during the planning phase to verify the accuracy of load flow studies, short-circuit analysis, and stability analysis. Throughout construction, they ensure that the civil and electrical works comply with approved design specifications, quality standards, and safety norms.

II. Testing Oversight:

During commissioning, the TPIA oversees the testing of the complete functionality of the substation and equipment. This involves ensuring that transformers, circuit breakers, and protection systems are operating as intended. The TPIA validates the testing process and verifies that all equipment meets technical standards before final acceptance.

III. Compliance Monitoring:

The TPIA ensures that the contractor and client comply with safety standards, regulatory requirements, and environmental guidelines. They report non-conformance and recommend corrective actions to ensure the project meets all legal and quality obligations.

IV. Final Certification:

Upon completion, the TPIA submits report by certifying that the project meets the required quality, safety, and operational standards. They approve the asset management plan and completion certificate, allowing the project to move to the handover phase.

5. Discoms (End Consumers)

I. Feedback on System Performance:

End consumers provide crucial feedback on the system's performance after it is operational. They report any outages, inefficiencies, or issues related to power reliability, allowing the Client Department (HVPNL) to address these problems.

II. Safety Compliance:

Users must comply with safety measures implemented around transmission lines and substations. This includes respecting safety zones, not tampering with equipment, and following the guidelines for using electricity safely.

III. Reporting Issues:

Users report any service disruptions, equipment failures, or safety concerns to the utility provider (Nigam). This helps ensure quick response and resolution, minimizing downtime and maintaining system efficiency.

6. Government and Regulatory Authorities

I. Regulatory Approvals:

Government authorities issue all necessary administrative approvals, including land acquisition, environmental clearances, and construction permits. These approvals ensure the project complies with all applicable laws and regulations.

II. Periodic Inspections:

Regulatory authorities may conduct periodic inspections throughout the project to ensure compliance with national safety, environmental, and technical standards. They verify that the

project adheres to the approved plan and meets public safety and environmental protection requirements.

III. Policy Compliance:

Authorities enforce national policies related to energy transmission, environmental sustainability, and public safety. They ensure the project aligns with the country's broader energy strategy and meets legal obligations.

7. Nigam (Post-Warranty Operations)

I. Post-Warranty Operation and Maintenance:

After the warranty period ends, Nigam takes over the regular operation and maintenance of the transmission system. This includes managing day-to-day operations, performing routine inspections, and ensuring the system remains functional and efficient.

II. Equipment Replacement:

Nigam is responsible for replacing defective or outdated materials and equipment, adhering to the guarantees and warranties provided by the suppliers. This ensures that the system remains reliable and capable of meeting long-term demand.

III. Timely Defect Rectification:

Nigam must ensure timely rectification of defects that arise after the warranty period. Quick response to equipment failures or performance issues is crucial to maintaining an uninterrupted power supply.

IV. Long-Term Asset Management:

Nigam implements the long-term asset management plan provided by the contractor, ensuring that the transmission system is regularly maintained, inspected, and upgraded as necessary. This includes adhering to material/equipment guarantees and warranties, ensuring the system operates efficiently for its full lifecycle.

Activities to be performed by the Departmental Officers/Officials and Executing Agency

S No.	Activity	CE	SE	EE	AE	JE	Executing Agency
Planning and Design							
1.	Analysis of the existing Transmission network within a radius of 5-10 km of proposed site, its operational parameters, including loading conditions in reference to transmission and Distribution planning proposal.		✓	✓	✓	✓	✓
2.	Analyze quantitative and qualitative historical data for at least last 5 years and future assessment for at least 5 years in consultation with all stake holders to determine expected future load growth, considering both long and short term projections including specific scenario, if any.	✓	✓	✓	✓	✓	✓
3.	Adequacy of design sub-station capacity incorporating for future expansion based upon 1.1.1, and 1.1.2 above	✓	✓	✓	✓		
4.	Adoption of technological intervention including automated tools such as adequate Communication system and IT infrastructure like SCADA, DMS, OMS, AMI etc.	✓	✓	✓	✓		
5.	Adoption of latest simulation software.	✓	✓	✓	✓		
6.	Determination of appropriate Substation capacity, and other system parameters and voltage levels considering maximum loading of Network and equipment based on load flow studies.	✓	✓	✓	✓		
7.	System operation within permissible limits both under normal as well as after probable credible contingencies.	✓	✓	✓	✓		
8.	Approval of Integrated Planning by WTDs UHBVNL & DHBVNL / competent authority.	✓	✓	✓	✓		
9.	Selection of land keeping in view ROW.		✓	✓	✓	✓	
10.	Transfer of ownership of Government/Gram Panchayat land in the name of department.			✓	✓	✓	
11.	Soil bearing capacity report, contour sheet and fixation of FGL of Sub Station before preparation of detail BOQ (Civil)	✓	✓	✓	✓	✓	

12.	Walk over survey of transmission line based on HARSAC submission			✓	✓	✓	✓
13.	Gazette notification of route of transmission lines.		✓	✓	✓	✓	
14.	Selection of grid sub-station is as per site condition such as indoor, outdoor, underground, Air Insulated (AIS), Gas Insulated (GIS) or Hybrid etc.	✓	✓	✓	✓		
15.	Selection of design parameters viz fault level analysis, protection scheme, Civil Design/Electrical Design as per Maximum capacity, Voltage level, fault level, etc. as per the latest CEA guidelines.	✓	✓	✓	✓		
16.	Grounding/earthing design as per site condition to ensure safety of equipment and personnel		✓	✓	✓	✓	
17.	Provision for equipment maintenance without interrupting the entire supply.		✓	✓	✓		
18.	Protection grading, coordinated configuration to ensure the minimum zones are impacted by faults	✓	✓	✓	✓		
19.	Independent circuit breaker control of incoming and outgoing feeders.	✓	✓	✓	✓		
20.	Provision of two or more incoming feeders from two different sources for meeting N-1 contingency for reliability considerations.	✓	✓	✓	✓		
21.	Provision of two or more different transformers for meeting N-1 contingency for reliability considerations	✓	✓	✓	✓		
22.	Provision of spare bay for catering to future load growth.	✓	✓	✓	✓		
23.	Provision of additional transformer of sufficient capacity for future load growth.	✓	✓	✓	✓		
24.	SS to cater to power quality parameters, viz voltage regulation, harmonics, and reactive power within the standard limits.	✓	✓	✓	✓		
25.	Preparation of detailed BOQ as per scope of work approved by Planning wing based on site/GELO data	✓	✓	✓	✓		
26.	Cost Estimate (civil and electrical) based on BOQ (Capital and Operational Expenditure)	✓	✓	✓	✓		
27.	Financial implication with cost index upto implementation period	✓	✓	✓	✓		

28.	Administrative and Technical approvals from the competent authorities	✓	✓	✓	✓		
29.	DNIT preparation, approval and call of tender.	✓	✓	✓	✓		
30.	Evaluation of tender, based on technical and financial bid analysis, and allotment of work order maintaining transparency.	✓	✓	✓	✓		
Execution and Implementation, Inspection and Testing							
31.	Joint survey by Construction Wing along with contractor before permit of work				✓	✓	✓
32.	Verification of regularity compliances by the contractor.			✓	✓	✓	✓
33.	Coordination and clearances with government departments/private that may be necessary.			✓	✓	✓	
34.	Timely handing over of hindrance free land to the executing agency			✓	✓	✓	
35.	Approval of all civil design drawings by the competent authority.	✓	✓	✓	✓	✓	
36.	Placing of Purchase Order for various material by the contractor/department	✓	✓	✓	✓		✓
37.	Execution of civil work such as control room building, Tower/ Equipment foundations, earthing, fencing, cable trenches, etc. as per technical specifications and approved design and as per site condition and corresponding standards.			✓	✓	✓	✓
38.	Use of quality materials from approved source and required plant and machinery.			✓	✓	✓	✓
39.	Inspection and testing of material at the supplier's works by Nigam Officer/TPA and quality checks as per relevant standards.		✓	✓	✓	✓	
40.	Sampling of material at site for testing in NABL accredited lab, if required.			✓	✓	✓	✓
41.	Checking of test results by execution authority and action thereof.		✓	✓	✓	✓	
42.	Preparation of site inspection and quality control register and concrete register			✓	✓	✓	✓
43.	Execution as per the plan within specified time period.			✓	✓	✓	✓
44.	Rectification of defects on regular basis and keeping the record			✓	✓	✓	✓
45.	Approval of electrical drawings and SOMP of each equipment.	✓	✓	✓	✓		

46.	Placing of Purchase Order for the material/equipment by the contractor/department and inspection/testing of the same at the manufacturer's works by the department/TPA.	✓	✓	✓	✓		✓
47.	Joint verification report of all electrical material in form of MRC			✓	✓	✓	✓
48.	Sampling and testing of material/equipment in NABL accredited lab, if required.			✓	✓	✓	✓
49.	Checking of test results by execution authority and action thereof.		✓	✓	✓	✓	
50.	Execution of work as per guidelines laid down by Nigam and inspection by Quality Control Wing of Nigam			✓	✓	✓	✓
51.	Monitoring of project by XEN/TS and XEN Civil (project manager) on regular basis			✓	✓	✓	
52.	Execution of work as per plan within specified time period.			✓	✓	✓	✓
53.	Rectification of defects on regular basis and maintaining the record			✓	✓	✓	✓
Commissioning and Handover							
54.	Clearance of complete installation from the CEI (Chief Electrical Inspector)			✓	✓	✓	✓
55.	Witness pre commissioning test of equipment by M&P as per standard guidelines.			✓	✓	✓	✓
56.	Commissioning of sub-station as per check list/M&P observations			✓	✓	✓	✓
57.	Post commissioning test of all electrical equipment as per work order/relevant equipment code			✓	✓	✓	✓
58.	Handover of the sub-station to the department by the contractor			✓	✓	✓	✓
59.	Adherence to project timelines and Cost Projections		✓	✓	✓	✓	✓
60.	Completion certificate, plan and manuals submission			✓	✓	✓	✓
61.	Guarantee against defective design, workmanship, and manufacturing defects. withhold of security amount			✓	✓	✓	✓
Safety and Security							
62.	All electrical safety requirements, electrical clearances, fire detection & extinguishing			✓	✓	✓	✓

	system, earthing & ventilation etc. as per standards.						
63.	Conformance to safety requirements by adhering to appropriate design standards.			✓	✓	✓	✓
64.	To adopt regular safety and reliability audits of all major equipment of the network.			✓	✓	✓	
65.	Provision of First aid kit, personnel protective equipment (PPE) viz safety helmet, safety glass, gloves, safety shoes, high visibility clothing, etc, Grounding, clearances, fire protection, fencing, etc).			✓	✓	✓	✓
66.	Conducting regular mock drills to check the response system.			✓	✓	✓	
67.	Work permit and authorization				✓	✓	
68.	Incident response and reporting			✓	✓	✓	
69.	Provision of surveillance to curb unauthorized access			✓	✓	✓	
70.	Display of all important safety instructions, precautions, exist signs, important telephone numbers, etc.				✓	✓	
Operation and Maintenance							
71.	Inspection and maintenance schedule development and its compliance			✓	✓	✓	
72.	Use of software for maintenance scheduling and updates		✓	✓	✓		
73.	Ensuring quality of power and other operational parameters as per SOMP.			✓	✓		
74.	Regular operation and maintenance and replacement of material/equipment by contractor as per Work Order for specified period			✓	✓	✓	✓
75.	Emergency response planning			✓	✓	✓	
76.	Availability of spare parts			✓	✓	✓	✓
77.	Compliance of maintenance schedule			✓	✓	✓	
78.	Grievance redressal and record keeping.			✓	✓	✓	
79.	Adhering to material/equipment guarantee/warranty		✓	✓	✓	✓	✓
80.	Deployment of skilled manpower for O&M	✓	✓				
81.	Deployment of manpower for general maintenance and security			✓	✓	✓	

82.	Substation O&M as per SOMP				✓	✓	
83.	Training and capacity building		✓	✓	✓		
84.	Equipment maintenance and surveillance using latest technology such as thermal camera to detect hotspot, SCADA, etc	✓	✓	✓	✓	✓	

Note 1: Responsibilities for carrying out above activities by the departmental officers shall be governed by the Technical Sanction Powers vested in them by the Government of Haryana.

Note 2: Responsibilities for carrying out pre-inspection for supply of material (Civil/Electrical) at the manufacturer's premises by the departmental officers shall be governed by the Departmental Procedure.

CHAPTER 2

SOMPs for Power Transmission

1. PLANNING AND DESIGN

1.1 Integrated Planning for Load Growth Estimation

1.1.1 Analysis of the Existing Transmission Network

- Network Mapping: Create a detailed map of the current transmission network, including all substations, transmission lines, and transformers, within a radius of 5-10 km.
- Operational Data Review: Collect and analyze operational data such as load flow studies, voltage levels, and fault occurrences.
- Condition Assessment: Perform physical inspections to assess the condition of key components like transformers, circuit breakers and transmission lines.
- Utilization Review: Analyze the current utilization levels of the network components to identify under or over-utilized assets.
- Gaps Identification: Identify gaps or weaknesses in the current network that could impact future reliability or performance.
- Report: Document the findings and recommendations for improvements or upgrades.

1.1.2 Analysis of Historical Data and Future Assessment

- Data Collection: Gather quantitative and qualitative data for at least past five years, including load profiles, reliability indices.
- Trend Analysis: Analyze the data to identify trends, issues, and patterns in power consumption and network performance.
- Consultation: Engage with stakeholders such as utility companies, and regulatory bodies to gather insights and validate the data analysis.
- Future Assessment: Use the analysed data to project future trends and potential challenges for the next five years.
- Documentation: Prepare a report detailing the historical data analysis and the future projections, including assumptions and scenarios.

1.1.3 Adequacy of Design Substation capacity

- Determine the substation capacity and other parameters based on the analysis of historical data and future load growth with the adoption of technological intervention including automated tools.

1.2 Adoption of Technology and Load Flow Studies And Short Circuit Stability Analysis

1.2.1 Adoption of Automated Tools

- Tool Selection: Identify the automated tools required for the project, such as SCADA (Supervisory Control and Data Acquisition), DMS (Distribution Management System), OMS (Outage Management System), and AMI (Advanced Metering Infrastructure).

- System Integration: Ensure that the selected tools can be integrated with existing IT and communication infrastructure.
- Vendor Evaluation: Evaluate potential vendors for the supply and installation of the automated tools.
- Pilot Testing: Implement a pilot project to test the selected tools in a controlled environment before full-scale deployment.
- Training: Provide training to the personnel who will be using the automated tools.
- Deployment: Roll out the automated tools across the entire network, ensuring minimal disruption to existing operations.
- Monitoring and Maintenance: Establish a process for ongoing monitoring and maintenance of the automated systems to ensure their continued effectiveness.

1.2.2 Adoption of Latest Simulation Software

I. Software Selection:

- Market Research: Conduct a thorough review of the latest simulation software available for load flow, short circuit, and stability analysis.
- Feature Comparison: Compare the features of different software packages, including their accuracy, user-friendliness, and support for contingency analysis.
- Vendor Evaluation: Assess the credibility and support services offered by software vendors.

II. Procurement: Procure the selected simulation software, ensuring that it meets the technical requirements of the project.

III. Training: Arrange training sessions for the engineering team and staff to ensure they are proficient in using the new software.

IV. Integration: Integrate the simulation software with existing IT systems and databases to streamline data input and output processes.

V. Testing and Validation: Conduct a series of test simulations to validate the software's accuracy and reliability before full-scale implementation.

1.2.3 Accurate Substation Capacity and Voltage Level Determination

I. Load Forecasting: Utilize load growth estimates to project the future maximum load demand on the substation.

II. Capacity Calculation: Determine the required substation capacity by considering the peak load, diversity factor, and potential future expansions for example expected residential societies, industrial parks, educational institutes, or any other major AP/DS loads.

III. Voltage Level Determination:

- Analysis: Evaluate the current voltage levels in the area/surroundings and determine the appropriate voltage level for the substation to minimize losses and ensure stability.
- Equipment Rating: Ensure that all substation equipment/switchgear are selected accordingly.

IV. Redundancy Planning: Incorporate redundancy to handle continuity of supply under all exigencies.

V. Documentation: Prepare a detailed report that outlines the determined substation capacity and voltage levels along with the rationale for the decisions made.

1.2.4 System Operation Within Permissible Limits

I. Operational Limits Definition: Define the operational limits for voltage, current, and frequency based on industry standards and regulatory requirements.

II. Real-time Monitoring: Implement real-time monitoring tools to continuously track key parameters such as voltage levels, power flows, and equipment loading, etc.

III. Contingency Planning:

- Contingency Analysis: Conduct regular contingency analysis to predict the impact of potential failures or faults on the system.
- Mitigation Plans: Develop and implement mitigation plans to maintain system stability during contingencies, including automatic reconfiguration or load shedding.

IV. Alarm and Response Systems: Set up automated alarm systems that trigger when parameters approach or exceed permissible limits, along with predefined response protocols.

V. Review and Adjustment: Regularly review system performance and adjust operational limits or strategies as needed to adapt to changing conditions.

VI. Documentation: Keep detailed records of all system operations, contingencies encountered, and actions taken to ensure compliance and inform future planning.

1.3 Project Proposal Approval

1.3.1 Administrative and Technical Approvals from the Competent Authorities

I. Identification of Authorities:

- Administrative Authorities: Identify the administrative bodies (BoD) that need to approve the project, such as local government agencies, environmental bodies, and financial institutions.
- Technical Authorities: Identify technical bodies (WTD) responsible for approving the project design, safety standards, and compliance with regulations, such as energy regulators, electrical inspectorates, and civil engineering boards.

II. Preparation of Documentation:

- Project Proposal: Prepare a comprehensive project proposal, including the scope of work, cost estimates, technical designs, and impact assessments.
- Compliance Reports: Prepare reports demonstrating compliance with all relevant regulations, including environmental, safety, and construction standards.
- Approval Forms: Fill out and compile all necessary forms and applications required by the authorities.

III. Submission Process:

- Administrative Approvals:
    - Submit the project proposal and required documents to the administrative authorities.
    - Follow up with the concerned authorities regularly to track the progress of the approval process.
    - Address any queries or requests for additional information from the authorities promptly.
- Technical Approvals:

- Submit technical designs, drawings, and compliance reports to the technical authorities.
- Participate in any required meetings or site inspections as part of the approval process.
- Make necessary modifications to the project design if requested by the technical authorities.

IV. Approval Receipt:

- Approval Documentation: Collect and securely store all approval documents and certificates issued by the authorities.
- Record Keeping: Maintain a detailed record of all communications, submissions, and approvals related to the project.

V. Final Review:

- Compliance Check: Before commencing the project, conduct a final review to ensure that all necessary approvals have been obtained and are up to date.
- Stakeholder Communication: Notify all relevant stakeholders, including contractors and suppliers, that the project has received the necessary approvals and can proceed.

1.3.2 Timeline Scheduling Estimation for Different Phases of the Project

- Phase Identification: Break down the project into distinct phases such as planning, design, procurement, construction, testing, and commissioning.
- Task Breakdown: For each phase, identify the key tasks and their dependencies.
- Time Estimation: Estimate the time required for each task based on historical data, industry standards, and expert judgment.
- Resource Allocation: Allocate resources, including manpower, equipment, and materials, to each task.
- Schedule Development: Use project management tools to develop a detailed schedule with milestones and critical paths.
- Review and Adjust: Review the schedule with stakeholders and adjust it as necessary to accommodate any constraints or risks.
- Monitoring: Establish a process for monitoring progress against the schedule and making adjustments as needed.

1.4 Selection of Land

1.4.1 Selection of Land Keeping in View Right of Way (ROW)

I. Initial Land Survey:

- Site Identification: Identify potential land parcels based on proximity to the existing transmission network, load centres, and accessibility.
- ROW Considerations: Ensure the selected site has adequate ROW for current and future transmission lines, avoiding residential areas, protected zones, and other restricted areas.
- Environmental and Social Impact: Conduct preliminary assessments to understand the environmental and social impact of the land selection.

II. Legal and Regulatory Compliance:

- Land Ownership Verification: Verify the ownership and legal status of the land, ensuring compliance with local regulations and securing necessary permits.
- Ensure transfer of ownership of government/gram panchayat land in the name of the department.
- Negotiation and Acquisition: Engage with landowners (in case government/GP land is not available) and relevant authorities for land acquisition, negotiating fair compensation where applicable.

III. Finalization:

- Finalize the land selection based on technical, legal, and environmental assessments, preparing the site for further development.

1.4.2 Transfer of Ownership of Government/Gram Panchayat Land in the name of Department

1.4.3 Soil Bearing Capacity Report, Contour Sheet, and Fixation of Finished Ground Level (FGL) of Substation Before Preparation of Detailed BOQ (Civil)

I. Soil Investigation:

- Sampling: Conduct soil sampling and geotechnical investigations at the proposed substation site.
- Laboratory Testing: Perform tests to determine soil bearing capacity, moisture content, soil type, and other relevant geotechnical properties.
- Report Preparation: Prepare a detailed soil bearing capacity report, including recommendations for foundation design.

II. Contour Mapping:

- Surveying: Perform a topographical survey of the site to create a contour map, highlighting the natural terrain and elevation changes.
- Analysis: Use the contour map to assess drainage patterns, identify areas of concern, and plan site grading.

III. Fixation of Finished Ground Level (FGL):

- Determination: Based on the contour map, determine the optimal finished ground level (FGL) for the substation.
- Design Considerations: Ensure that the FGL takes into account flood levels, drainage requirements, and ease of access and design based on available data.
- BOQ Preparation: Use the determined FGL as a baseline for preparing the detailed Bill of Quantities (BOQ) for civil works.

1.4.4 Walk-Over Survey of Transmission Line Based on HARSAC Submission

I. Data Review:

- HARSAC Submission: Review the geospatial data, maps, and reports provided by HARSAC related to the transmission line corridor.
- Route Analysis: Analyze the proposed route, considering environmental, topographical, and land use factors.

II. Walk-Over Survey:

- Site Inspection: Conduct a physical inspection of the proposed transmission line route, noting any potential obstacles, environmental sensitivities, or access issues.
- Stakeholder Engagement: Engage with local communities and stakeholders along the route to understand any concerns or requirements.
- Geotechnical Considerations: Assess the soil and terrain along the route to identify any areas that may require special engineering solutions.

III. Final Route Selection:

- Adjustments: Make necessary adjustments to the transmission line route based on the findings of the walk-over survey.
- Documentation: Prepare a detailed report of the walk-over survey, including the final recommended route, and submit it for approval.
- Planning and Design: Use the final route as the basis for detailed planning, design, and eventual construction of the transmission line.

1.4.5 Gazette Notification and its Publication

- Ensure that route plan for laying of transmission lines is duly notified and published.

1.4.6 Aesthetics and Horticulture Planning in the spare land of Substation

1.5 Design of Transmission Lines/Sub-Station Layout, Equipment And Drawings

1.5.1 Selection of Type of Towers and their Foundations based upon Site Conditions and Right of Way

I. Site Assessment and Survey

- Conduct a detailed topographical and geotechnical survey of the proposed site to gather information about terrain, soil type, water table depth, and environmental conditions.
- Study topographical data to identify any steep slopes, water bodies, forests, or urban areas.
- Analyse soil analysis reports to determine the load-bearing capacity and recommend suitable foundation types.
- Conduct Environmental and RoW assessment to evaluate potential constraints, such as proximity to populated areas or protected zones.

II. Determination of Tower Type Based on Site and Environmental Conditions

- Select the appropriate type of transmission tower (e.g., suspension, tension, or angle towers) based on site conditions, wind pressure zones, and RoW availability.

III. Foundation Selection Based on Soil Conditions and Tower Type

- Based on the soil characteristics and the type of tower selected, choose an appropriate foundation type (e.g., open cast, pile, pier, or well foundation).

IV. Clearance and Right of Way (RoW) Optimization

- Ensure compliance with RoW regulations, including horizontal and vertical clearance requirements, by optimizing the selection of tower height and placement.
- Considerations:
    - Minimize environmental and social impact by adjusting tower locations where possible to avoid densely populated areas or protected ecosystems.

- Ensure that the tower design and placement comply with safety clearances for existing infrastructure, such as roads, railways, or other utility lines.
- If RoW is restricted, consider compact tower designs like monopoles or multi-circuit towers and use of high capacity conductors like HTLS.
- Inter-utility meetings may be held to resolve the ROW issue, if any.

1.5.2 Selection of Grid Substation Type

I. Technical Assessment:

- Load and Capacity Requirements: Evaluate the expected load, future growth, and required capacity.
- Voltage Level: Assess the voltage level requirements and fault levels to choose between Air Insulated Substation (AIS), Gas Insulated Substation (GIS), or Hybrid solutions.
- Space Constraints: Consider space availability, particularly in urban or constrained environments, where GIS or underground substations may be preferable.

II. Economic Analysis:

- Cost-Benefit Analysis: Perform a cost-benefit analysis comparing the capital, operational, and maintenance costs of different substation types.
- Lifespan and Reliability: Consider the expected lifespan and reliability of the substation type in the specific environmental conditions of the site.

III. Environmental and Regulatory Considerations:

- Environmental Impact: Evaluate the environmental impact of the substation type, including emissions, noise, and land use.
- Regulatory Compliance: Ensure the selected substation type meets all regulatory requirements, including safety and environmental standards.

IV. Decision Making: Select the substation type based on a holistic evaluation of technical, economic, environmental, and regulatory factors.

1.5.3 Selection of Design Parameters

I. Civil Design:

- Foundation Design: Foundations be designed based on the soil bearing capacity report and the type of equipment to be installed.
- Structural Design: Develop structural designs for buildings, control rooms, and other civil structures, considering the maximum load, wind speed, and seismic factors.
- Drainage and Access: Design appropriate drainage systems and access roads, ensuring they align with the FGL and site layout.

II. Electrical Design:

- Equipment Specification: Specify the ratings, types, and configurations of transformers, switchgear, busbars, and protection systems based on load, voltage, and fault levels.
- Single Line Diagram (SLD): Prepare a detailed SLD of the substation, showing all electrical connections, protection schemes, and control systems.
- Control and Protection Systems: Design control and protection systems that ensure safe and reliable operation under normal and fault conditions.
- Grounding/Earthing Design: Design earthing system of the substation as per site condition to ensure safety of equipment and personnel.

III. Review and Approval:

- Internal Review: Conduct internal reviews of the design documents to ensure compliance with technical standards and project requirements.

1.6 Design of Transmission Lines/Substation, Considering Quality And Reliability Of Supply, Functionality, Maintainability, Simplicity Of Operation

1.6.1 Provision for Equipment Maintenance Without Interrupting the Entire Supply

I. System Design:

- Redundant Paths: Design the power transmission network with redundant paths (loop or ring configurations) to allow isolation of equipment for maintenance without affecting overall supply.
- Sectionalizing Switches: Install sectionalizing switches or circuit breakers at strategic locations to allow sections of the network to be isolated during maintenance.
- Load Transfer Capability: Ensure the network has the capability to transfer load from one feeder to another, facilitating maintenance activities.

II. Scheduled Maintenance:

- Planning: Schedule maintenance during off-peak hours or low-demand periods to minimize the impact on the power supply.
- Communication: Notify all relevant stakeholders, including consumers and grid operators, about planned maintenance activities.
- Implementation: Isolate the equipment or section needing maintenance using sectionalizing switches and perform the required maintenance tasks.
- Testing and Restoration: Test the equipment after maintenance and restore it to service, ensuring that the load is gradually transferred back to normal operation.

III. Emergency Maintenance:

- Fault Detection: Utilize real-time monitoring systems to detect faults and determine the affected section of the network.
- Isolation: Quickly isolate the faulty equipment or section to prevent the fault from affecting the entire network.
- Repairs: Conduct repairs while maintaining power supply through alternative paths or redundant systems.
- System Restoration: Once repairs are complete, restore the equipment or section to service, ensuring minimal disruption to the power supply.

1.6.2 Protection Grading

Protection Grading, Coordinated Configuration to Ensure Minimum Zones Are Impacted by Faults

I. Protection Grading:

- Grading Analysis: Perform a detailed analysis of protection grading to determine the appropriate settings for relays and circuit breakers.
- Selective Tripping: Configure protection devices to trip only the faulted section, allowing the rest of the network to remain operational.

- Time Coordination: Implement time coordination between protection devices to ensure that downstream devices trip first in the event of a fault, preventing unnecessary tripping of upstream devices.

II. Coordinated Configuration:

- Protection Scheme Design: Design a coordinated protection scheme that integrates overcurrent relays, differential protection, and distance protection.
- Simulation and Testing: Use simulation tools to test the protection scheme under various fault scenarios, ensuring it performs as expected if feasible.
- Installation and Commissioning: Install and commission the protection devices as per the coordinated configuration, ensuring they are calibrated to the correct settings.

III. Regular Maintenance:

- Periodic Testing: Conduct regular testing and calibration of protection devices to ensure they continue to operate within the designed parameters.
- Upgrades: Upgrade protection schemes as necessary to accommodate changes in the network configuration or load patterns.
- Fault Analysis: After any fault event, conduct a thorough analysis to verify that the protection scheme operated correctly and make adjustments if necessary.

1.6.3 Independent Circuit Breaker Control of Incoming and Outgoing Feeders

I. Circuit Breaker Configuration:

- Independent Control: Design the control scheme so that each feeder circuit breaker can be operated independently, allowing isolation of individual feeders.
- Control Panels: Install separate control panels or interfaces for each feeder, providing operators with clear and distinct controls.
- SCADA Integration: Integrate the circuit breakers with the SCADA system for remote monitoring and control, allowing operators to manage feeders from remote/local location.

II. Testing and Commissioning:

- Functional Testing: Conduct functional testing of each circuit breaker to ensure it can be independently operated as designed.
- Interlock Checks: Verify that interlock mechanisms function correctly, preventing simultaneous operation of multiple breakers that could cause unsafe conditions.
- Commissioning: Commission the circuit breakers and control systems, ensuring they are fully operational and integrated with the network.

III. Operational Procedures:

- Routine Operation: Train operators on the procedures for independently controlling incoming and outgoing feeders during normal operations.
- Emergency Operation: Establish clear protocols for the independent operation of feeders in the event of faults or emergencies, minimizing the impact on the network.

1.6.4 Provision of Two Incoming Feeding Lines from Two Different Sources for Meeting N-1 Contingency for Reliability Considerations

I. Source Selection:

- Diverse Sourcing: Select two geographically and electrically independent feeding sources to minimize the risk of simultaneous failures.

- Capacity Assessment: Ensure each feeding source has the capacity to supply the full load in the event of failure of the other source.

II. Network Configuration:

- Dual Feeders: Implement dual feeders from each source to the substation, ensuring that a fault on one feeder does not isolate the substation from the grid.
- Automatic Transfer Switches (ATS): Install ATS to automatically switch the load to the alternative source in the event of a failure in the primary source.
- Protection Coordination: Ensure that the protection schemes are coordinated to allow seamless transfer between sources without causing faults or overloads.

III. Testing and Maintenance:

- Regular Testing: Periodically test the ATS and associated equipment to ensure they operate correctly during an N-1 contingency event.
- Preventive Maintenance: Perform preventive maintenance on feeders and associated equipment to reduce the likelihood of simultaneous failures.
- Contingency Drills: Conduct drills simulating N-1 contingency scenarios to ensure that operators are familiar with the procedures and that the system responds as designed.

1.6.5 Provision of Two or More Transformers for Meeting N-1 Contingency for Reliability Considerations

I. Transformer Selection:

- Diverse Capacities: Choose transformers with capacities that can cover the full load even if one transformer fails, considering both normal and emergency load conditions.
- Specifications: Use transformers with same specifications.

II. Installation:

- Redundant Setup: Install transformers in a redundant configuration, allowing the network to continue operating if one transformer is out of service.
- Separate Bays: Provide separate transformer bays for each unit, ensuring that maintenance on one transformer does not affect the others.
- Protection Systems: Equip each transformer with independent protection systems, ensuring they can be isolated quickly in case of faults.

III. Testing and Operation:

- Load Transfer Tests: Conduct load transfer tests between transformers to ensure that the network can handle the load during an N-1 contingency event.
- Operational Monitoring: Continuously monitor the performance of each transformer, using real-time data to detect early signs of potential issues.
- Contingency Planning: Develop and regularly update contingency plans for the operation of the system under N-1 conditions, ensuring that operators are prepared for transformer failures.

1.6.6 Provision of Additional Transformer of Sufficient Capacity and Line Bays for Meeting Future Load Growth

I. Load Forecasting:

- Growth Projections: Use load growth projections to estimate future demand and determine the required capacity of additional transformers.

- Capacity Planning: Ensure the planned additional transformer has sufficient capacity to handle both current and projected future loads.

II. Transformer Installation:

- Site Preparation: Prepare the site with the necessary civil works and foundation to accommodate the new transformer and associated equipment.
- Transformer Specification: Procure a transformer that meets the required capacity and operational specifications for future load growth.
- Line Bays Installation: Install additional line bays to connect the new transformer to the network, ensuring they are designed for future expansion.

III. System Integration:

- Network Analysis: Perform a network analysis to ensure that the new transformer and line bays are fully integrated into the existing system without causing instability or overloads.
- Commissioning: Commission the new transformer and line bays, conducting thorough testing to ensure they are ready to handle both current and future loads.

IV. Ongoing Monitoring:

- Load Tracking: Continuously monitor the network load and transformer performance, adjusting operations as needed to accommodate increasing demand.
- Capacity Upgrades: Plan for further capacity upgrades as needed, ensuring that the power transmission system can continue to meet future load growth without compromising reliability.

1.6.7 Provision of spare transformer bay for catering to future load growth

- Create a spare bay at the time of construction of substation keeping in view for providing additional transformer and equipment to cater to the future load growth.

1.6.8 Substation to cater to power quality parameters

- The substation to be designed to meet the critical parameters such as voltage regulations, harmonics, and reactive power within the standard limits.

1.7 Cost Estimates, Budget Planning and Timeline Estimates

1.7.1Cost Estimates (Civil and Electrical) Based on BOQ (Capital and Operational Expenditure)

BOQ Preparation:

- Detailed BOQ: Develop a detailed BOQ for all civil and electrical components of the project, including quantities and specifications.
- Market Rates: Use prevailing HVPNL rate list/HSR/Past purchase order of HVPNL/purchase order of other utilities/available market rates/and in case of customized items reasonable budgetary offers from OEMs

1.7.2 Cost Estimation:

I. Civil Works:

- Calculate costs for site preparation, foundations, structures, control room building, roads, drainage, boundary wall, and other related civil works.
- Include contingency amounts to cover unforeseen expenses.

II. Electrical Works:

- Estimate costs for transformers, switchgear, cables, conductors, control panels, protection systems, earth mat, capacitor bank, and other electrical equipment and steel structures.
- Factor in costs for installation, testing, and commissioning.

1.7.3 Capital Expenditure:

- Initial Investment: Calculate the total capital expenditure (CapEx) required for the entire project, combining civil and electrical costs.
- Depreciation: Include depreciation rates for major equipment to estimate the long-term capital cost.

I. Cost Review and Validation:

- Internal Review: Conduct an internal review of the cost estimates to ensure accuracy and completeness.

II. Documentation:

- Cost Estimate Report: Compile a comprehensive cost estimate report, including all assumptions, calculations, and BOQ details.
- Management Review: Present the cost estimate report to senior management for approval before proceeding to the next steps.

1.8 DNIT Approval and Award of Work (Turnkey Projects) Administrative And Technical Approval

1.8.1 DNIT Approval and Award of Work Based on Technical and Financial Bid Analysis

I. Preparation of DNIT:

- Scope Definition: Clearly define the scope of work, including all technical specifications, standards, and requirements.
- Tender Document: Prepare the DNIT, ensuring it includes detailed instructions for bidders, evaluation criteria, terms and conditions, and a clear timeline for submission and execution.
- Legal Review: Have the DNIT reviewed by legal counsel to ensure compliance with procurement laws and regulations wherever required.

II. Approval of DNIT:

- Internal Review: Submit the DNIT to the competent authority for approval ie WTD of HVPNL.
- Revisions: Make any necessary revisions based on feedback from the review committee.
- Final Approval: Obtain final approval of the DNIT from the competent authority before issuing the tender.

III. Tender Process:

- Invitation to Bid: Publicly announce the tender through appropriate channels, inviting qualified contractors to submit their bids.
- Pre-bid Meeting: Conduct a pre-bid meeting to clarify any queries from prospective bidders and provide additional information as needed.
- Bid Submission: Collect and securely store all submitted bids until the opening date.

IV. Bid Evaluation:

- Technical Evaluation:
    - Form a technical evaluation committee to assess the technical aspects of each bid, ensuring compliance with the project specifications.
    - Score each bid based on predefined technical criteria as per provisions in the approved bidding documents.
    - Shortlist technically qualified bids for financial evaluation.
- Financial Evaluation:
    - Open the financial bids of the technically qualified bidders.
    - Analyze the financial bids to ensure they are within the estimated budget and assess the cost-effectiveness of each proposal.
    - Consider the total cost, payment terms, and any contingencies proposed by the bidders.

V. Award of Work:

- Selection of Contractor: Select the contractor out of the technically qualified bidders based on their merit of quoted/offered financial value/cost.
- Contract Negotiation: Negotiate with the shortlisted contractors whose financial bid is opened on the genuineness of prices offered comparing with values adopted in the estimated project cost.
- Contract Award: Issue the contract award letter to the selected contractor, detailing the scope of work, project timeline, and payment terms.
- Kick-off Meeting: Schedule a kick-off meeting with the contractor to discuss project initiation, timelines, and key milestones.

VI. Post-Award Activities:

- Project Monitoring: Establish a project monitoring system to track the progress of the work against the agreed schedule and quality standards.
- Regular Reporting: Require the contractor to provide regular progress reports and updates, facilitating timely identification of any issues or delays.
- Change Management: Implement a change management process to address any modifications to the scope, schedule, or budget during the execution of the project.

2. EXECUTION AND IMPLEMENTATION, INSPECTION AND TESTING

2.1 Detailed/Final Survey and Its Verification on Actual Geographical Conditions Before Permit to Work

2.1.1 Joint Survey by Operation and Construction (TS) Wing along with Contractor Before Permit of Work

I. Coordination**:**

- Team Formation**: Form a joint survey team comprising representatives from the Operation and Construction (TS) Wing and the contractor's team.**
- **Schedule Planning**: Agree on a schedule for the joint survey that accommodates all parties involved.

II. Joint Survey Execution:

- **Site Visit**: Conduct a comprehensive site visit to review the proposed work areas, transmission line routes, and substation locations.
- **Mutual Agreement**: Ensure that all parties agree on the survey findings, including land boundaries, access routes, and any potential challenges.
- **Risk Identification**: Identify any risks or hazards that could affect the project and discuss mitigation strategies with the contractor.

II. Documentation:

- **Joint Survey Report**: Prepare a joint survey report signed by all parties, documenting the findings and agreements made during the survey.
- **Permit Preparation**: Use the joint survey report to prepare the final permit to work, incorporating any adjustments based on the survey findings.

III. Final Approval:

- **Review and Sign-off**: Obtain sign-off from the Operation and Construction (TS) Wing, the contractor, and other relevant stakeholders.
- **Permit Issuance**: Issue the permit to work based on the jointly agreed survey data, ensuring clear communication of expectations to the contractor, subject to verification of regulatory compliance.

2.1.2 Verification of Regulatory Compliance for Contractor

- Objective**: To verify that the contractor complies with all regulatory requirements before commencing work on the project.**

I. Procedure:

- **Pre-qualification**:
  - **Contractor Documentation**: Request the contractor to submit all necessary documentation related to regulatory compliance, including licenses, certifications, and safety records.
  - **Compliance Checklist**: Prepare a compliance checklist covering all relevant regulations, including environmental, safety, labor, and industry-specific standards.
- **Verification Process**:
  - **Document Review**: Conduct a thorough review of the contractor's documentation to ensure compliance with legal and regulatory requirements.

- **Site Inspection**: If necessary, conduct a site inspection to verify that the contractor's equipment, practices, and personnel meet regulatory standards.
- **Compliance Audit**: Perform a compliance audit, focusing on key areas such as safety protocols, environmental management, and labor practices.

II. Approval and Documentation:

- **Compliance Report**: Prepare a compliance report detailing the findings of the verification process and any areas requiring corrective action.
- **Corrective Action**: If non-compliance is found, instruct the contractor to take corrective action before work begins.
- **Final Approval**: Once compliance is verified, issue formal approval for the contractor to commence work.
- **Record Keeping**: Maintain detailed records of all compliance checks, reports, and approvals for future reference.

2.1.3 Coordination and Clearances with Government Departments/Private Entities for Line Crossings

I. Identification of Crossings:

- **Crossing Points**: Identify all potential crossing points where the transmission line will intersect with existing infrastructure such as roads, railways, rivers, or private properties.
- **Stakeholder Identification**: Identify the relevant government departments and private entities responsible for the existing infrastructure at each crossing point.

II. Coordination:

- **Initial Communication**: Initiate communication with the identified stakeholders, providing them with details of the proposed line crossings, including technical specifications and impact assessments.
- **Meetings and Consultations**: Arrange meetings and consultations with the stakeholders to discuss the crossing points and address any concerns they may have.

III. Clearance Process:

- **Submission of Proposals**: Submit detailed proposals, including engineering designs, safety measures, and mitigation plans, to the relevant stakeholders for approval.
- **Review and Feedback**: Work with the stakeholders to review the proposals and incorporate any feedback or modifications required for approval.
- **Obtaining Clearances**: Obtain the necessary clearances or permits from the stakeholders, ensuring that all legal and technical requirements are met.

IV. Documentation and Compliance:

- **Clearance Documentation**: Collect and securely store all clearance documents and permits received from the stakeholders.
- **Compliance Verification**: Verify that all clearances are in place before construction begins and that the executing agency adheres to any conditions set by the stakeholders.

V. Ongoing Coordination:

- **Monitoring**: Monitor the construction/erection process to ensure that the transmission line is installed in compliance with the agreed-upon clearances.
- **Issue Resolution**: Address any issues or conflicts that arise during construction/erection related to the line crossings, coordinating with stakeholders as needed.

2.1.4 Timely Handing Over of Hindrance-Free Land to the Executing Agency

- **Objective**: To ensure that the land required for the project is handed over to the executing agency free of any hindrances in a timely manner.

I. Procedure:

- **Land Acquisition**:
  - **Land Identification**: Identify and secure the necessary land for the project, ensuring it meets all technical and regulatory requirements.
  - **Stakeholder Engagement**: Engage with landowners, local authorities, and other stakeholders to resolve any issues related to land acquisition.
- **Hindrance Removal**:
  - **Assessment of Hindrances**: Conduct a thorough assessment of the land to identify any physical or legal hindrances (e.g., encroachments, legal disputes).
  - **Hindrance Resolution**: Work with relevant authorities and stakeholders to remove any identified hindrances, such as clearing encroachments or resolving disputes.
  - Land Preparation: Ensure the land is cleared, leveled, and ready for construction, including removing any temporary structures or vegetation.
- Handover Process:
  - Handover Documentation: Prepare formal documentation for the handover of the land, including a description of the site, its boundaries, and any conditions.
  - Site Inspection: Conduct a joint site inspection with the executing agency to verify that the land is free of hindrances and meets project requirements.
  - Handover Meeting: Hold a formal handover meeting with the executing agency, during which the land is officially transferred to them.
- Follow-Up:
  - Ongoing Support: Provide ongoing support to the executing agency to address any issues that may arise during the initial stages of construction.
  - Documentation: Maintain records of the handover process, including all agreements, inspections, and correspondences.

2.2 Use of All Construction Materials

2.2.1 Use of quality materials/equipment from approved source by contractor/department as per relevant standard

I. Vendor and Material Approval:

- Vendor Qualification:
  - Maintain an updated list of approved vendors and suppliers who meet the necessary quality, safety, and technical standards.
  - Conduct periodic assessments and audits of vendors to ensure they comply with industry standards and regulatory requirements.
- Material and Equipment Approval:
  - Ensure that all materials and equipment are reviewed and approved by the competent authority before procurement.
  - Verify that all materials and equipment meet the specifications outlined in the project's technical requirements and adhere to international and national standards (e.g., IEC, IEEE, IS, and Haryana PWD Codes).

II. Procurement Process:

- Specification Compliance:
  - Draft detailed specifications for all required materials and equipment, including performance criteria, safety features, and compliance with relevant standards.
  - Include these specifications in all procurement tenders and contracts to ensure clarity and compliance.
- Quality Assurance During Procurement:
  - Implement a quality assurance process along with provisions in the duly approved standard bidding document, for evaluating bids, ensuring that only materials and equipment meeting the specified standards are selected.
  - Conduct pre-delivery inspections, where necessary, at the manufacturer's site to verify compliance with the specifications before shipment.

III. Inspection and Testing:

- Receiving Inspection:
  - Upon delivery, conduct thorough physical checking of all materials and equipment to verify their condition and compliance with the approved specifications.
  - Record and report any deviations or defects found during the inspection to the firms/supplier/purchase wing of HVPNL for immediate action before issue of MRC.
- Testing:
  - Perform pre-dispatch inspection of materials and equipment as per relevant standards to ensure they meet technical specifications/parameters.
  - Utilize accredited testing laboratories or in-house testing facilities equipped with calibrated instruments for accurate results.

IV. Quality Control During Installation:

- On-Site Verification:
  - Ensure that all materials and equipment installed on-site are those that have passed the receiving inspection and testing processes.
  - Assign qualified personnel to oversee the installation process, ensuring adherence to manufacturer guidelines and project specifications.
- Material Handling:
  - Establish proper handling, storage, and transportation procedures for materials and equipment to prevent damage and deterioration.
  - Store sensitive equipment in climate-controlled environments and ensure proper protection against environmental factors (e.g., moisture, dust).

V. Compliance and Documentation:

- Ensure that all materials and equipment comply with relevant industry standards/HVPNL Technical specifications and relevant IEC/ISS.
- Maintain up-to-date knowledge of changes in standards and incorporate these changes into the procurement and installation processes.

2.3 Execution of Civil and Horticulture Works

2.3.1 Execution of Civil Work (Control Room Building, Tower/Equipment Foundations, etc.)

I. Execution Planning

Site Assessment:

- Conduct a detailed site assessment to identify ground conditions, soil characteristics, and any site-specific challenges that may impact construction.

Design Review:

- Review approved civil designs, including structural drawings, foundation plans, and material specifications.
- Ensure that the design complies with relevant codes and standards (e.g., IS codes for civil structures, NBC).

Material and Resource Planning:

- Identify the required materials, machinery, and workforce based on the design specifications and site conditions.
- Prepare a schedule for the procurement of materials and the mobilization of machinery and workforce.

2.3.2 Use of Quality Materials and Machinery from Approved Sources

I. Material and Equipment Approval:

Vendor Selection:

- Select vendors and suppliers from the approved list who meet the necessary quality and technical standards.

Quality Verification:

- Verify the quality of materials through factory acceptance tests (FAT) or pre-delivery inspections.
- In order to ensure quality, material be procured only from reputed approved vendors. Obtain test certificates/documents of material procured. Material received at site be tested either on site or from Government/Nigam approved NABL labs.

On-Site Verification:

- Upon delivery, conduct a thorough inspection of materials to ensure they meet the specified requirements.
- If necessary, conduct additional on-site tests or inspections to verify the quality before usage.

II. Quality Assurance During Construction

Continuous Monitoring:

- Implement a quality control plan that includes regular inspections and tests at various stages of construction.
- Use calibrated and certified testing equipment to ensure accuracy in measurements and assessments.

Non-Conformance Management:

- If materials do not meet the required standards, take immediate corrective actions, including rejecting or replacing defective items.
- Document all instances of non-conformance and the actions taken to resolve them.

2.3.3 Inspection of Material by Nigam Officer/TPA and Quality Checks

I. Scheduling Inspections:

- Schedule inspections with the Nigam Officer/TPA in advance, coordinating with the construction schedule.
- Ensure that all necessary documentation (e.g., test certificates, vendor compliance reports) is available for review during the inspection.

II. Inspection Process:

- Conduct a thorough inspection of all incoming materials at the site.
- Check for compliance with the relevant standards, specifications, and the terms of the contract.
- Inspect for physical condition, conformity to specifications, and adherence to the approved design.

III. Approval and Documentation:

- Obtain approval from the competent authority for materials that meet the required standards.
- Document the inspection results, including any observations, approvals, or rejections.

2.3.4 Process for sampling of Civil material and inspection/testing of civil material at site lab/sending to Govt. agencies as per standard Field Quality Plan.

I. Joint Sampling Procedure:

Pre-Sampling Preparation:

- Notify all relevant stakeholders (Nigam officers, contractors, TPA) of the sampling schedule.
- Prepare all necessary documentation, including standards and specifications, for reference during sampling.

Sampling Process:

- Conduct joint sampling of materials and equipment delivered to the site, ensuring that samples are taken randomly and representatively.
- Adhere to the standards specified by the Indian Standards (IS), or any other relevant standards during sampling.

Sample Documentation:

- Label and document all samples taken, ensuring traceability back to the original batch or lot.
- Record the details of the sampling process, including date, time, location, and participants, in the sampling report.

2.3.5 Testing in NABL Accreditation Labs, if required

I. Testing Process:

Sample Submission:

- Submit the sampled materials or equipment to the selected NABL-accredited labs for testing.

- Include all relevant documentation, such as test specifications, standards to be adhered to, and any specific testing requirements.

Testing and Reporting:

- Ensure that the labs perform the tests according to the specified standards and provide detailed test reports.
- Review the test reports for compliance and take corrective actions if any non-compliance is found.

II. Documentation:

Record Keeping:

- Maintain records of all test reports, including the lab's certification and the date of testing.
- Store these records in the project's documentation system for future reference and compliance audits.

2.3.6 Construction of Civil Work:

I. Foundation Work:

- Excavate and prepare the foundation as per the approved design and site conditions.
- Use quality construction materials (e.g., concrete, rebar) as specified in the design.
- Adhere to the curing time and environmental conditions required for the foundation to achieve the desired strength.

II. Construction of Control Room, Tower Foundation, and Other Structures:

- Construct control room buildings, tower foundations, and other structures following the approved architectural and structural designs.
- Ensure proper alignment, levelling, and finishing of all civil works.
- Incorporate any site-specific modifications into the design, ensuring compliance with relevant standards.

III. Quality Control During Execution:

- Monitor the work continuously to ensure adherence to technical specifications and quality standards.
- Conduct regular site inspections to verify that construction practices align with the approved design and safety regulations.
- Record and address any deviations or issues immediately, consulting with the design team as needed.

IV. Compliance with Technical Standards:

- Ensure that all civil work complies with the applicable technical standards (e.g., IS, BIS) and site-specific requirements.
- Concrete Register: Prepare and maintain a concrete register for all civil works.

V. Documentation and Record-Keeping:

- Maintain detailed records of the execution process, including daily progress reports, material usage logs, and quality inspection reports.
- Document any changes or deviations from the original design, ensuring that they are approved by the relevant authority.

VI. Execution of Horticulture Works as Planned

2.3.7 Preparation of Site Inspection and Quality Control Register

I. Register Preparation:

Design of the Register:

- Design a standardized format for the site inspection and quality control register, including sections for date, time, activities inspected, quality control measures taken, and any observations or remarks.

Register Content:

- Include details of all inspections conducted on-site, including the type of inspection (routine, random, or critical), findings, and any corrective actions taken.
- Document the quality control measures implemented, such as sampling, testing, and material verification.

Regular Updates:

- Require the site supervisor or quality control officer to update the register daily, ensuring that all activities are recorded in a timely manner.

Periodic Reviews:

- Conduct periodic reviews of the register by the project manager (XEN/TS and XEN Civil) to ensure completeness and accuracy.

II. Documentation and Reporting:

- Store the register securely on-site and make it available for inspection by Nigam officials or any other relevant authorities.
- Include the register as part of the final project documentation submitted at project completion.

III. Quality Checks as per IS Codes/Haryana PwD Code:

Compliance with IS Codes/Haryana PwD Code:

- Ensure that all materials and construction practices comply with the IS Codes/Haryana PwD Code.

Regular Quality Audits:

- Conduct regular quality audits during the construction phase to ensure continuous compliance with IS Codes/Haryana PwD Code.
- Address any discrepancies identified during audits promptly, with corrective actions implemented as necessary.

Final Quality Certification:

- Before the commissioning of project ensure a final quality check is performed and certified by the Nigam Officer or designated authority.
- Keep all quality check reports and certifications in the project's documentation for future reference and compliance verification.

2.4 Execution and Implementation of Electrical Works

2.4.1 Inspection and testing of electrical equipment at manufacturer's works as well as at site (MRC).

I. Pre-Dispatch Inspection at Manufacturer's Works:

Inspection Schedule:

- Coordinate with the contractor and manufacturer to schedule inspections before the dispatch of equipment.
- Ensure that Nigam officers or appointed third-party agencies (TPA) are present during the inspection.

Inspection Process:

- Inspect the equipment at the manufacturer's works for compliance with the technical specifications, quality standards, and performance requirements.
- Perform factory acceptance tests (FAT) as per the relevant standards and document the results.

Approval for Dispatch:

- Only approve the dispatch of equipment that passes the inspection and testing process.
- Issue a dispatch clearance certificate, documenting the inspection findings and test results.

II. Site Inspection and Testing:

Receiving Inspection:

- Upon arrival at the site, inspect the equipment for any damage during transit and verify it against the dispatch documents.

Site Testing:

- Perform on-site testing of the equipment as per the relevant standards, including pre-installation checks and post-installation performance tests.
- Document all test results and compare them with the manufacturer's test results to ensure consistency.

III. Documentation and Compliance:

Test Reports:

- Maintain detailed records of all inspections and tests conducted at the manufacturer's works and at the site.
- Include these reports in the project's quality documentation.

Final Acceptance:

- Only accept the equipment for use in the project after it has passed all inspections and tests, both at the manufacturer's works and at the site.

2.4.2 Joint verification report of all electrical material in form of MRC

I. Pre-Delivery Preparation:

Notification of Delivery:

- The contractor or supplier must notify the relevant Nigam officer and TPA (if applicable) of the expected delivery date and time of electrical materials.

Document Preparation:

- Ensure that all relevant documents (purchase order, delivery challan, test certificates, compliance reports) are ready for verification.

II. Joint Verification Process:

- Inspection Team Composition:
- Form an inspection team consisting of representatives from the contractor, Nigam, and TPA (if applicable).

Physical Inspection:

- Upon delivery, the inspection team will conduct a thorough physical inspection of the materials.
- Check for quantity, physical condition, conformity to the technical specifications, and any visible defects.

Verification of Documentation:

- Cross-check the physical materials with the documentation provided, including test certificates, compliance with standards, and other quality-related documents.

Issue Resolution:

- If discrepancies or defects are found, document the issues and take immediate corrective actions, such as rejecting the material or requesting replacements.

III. Material Receipt Certificate (MRC):

Preparation of MRC:

- After successful verification, the inspection team will jointly prepare the Material Receipt Certificate (MRC).
- The MRC should include details such as the material description, quantity, date of receipt, inspection findings, and any remarks on quality or compliance.

Signatures and Approval:

- Ensure that all members of the inspection team sign the MRC to confirm their agreement with the verification findings.
- Submit the signed MRC to the project management team and store it in the project documentation for future reference.

2.4.3 Testing in NABL Accreditation Labs, if required.

I. Testing Process:

Sample Submission:

- Submit the sampled materials or equipment to the selected NABL-accredited labs for testing.
- Include all relevant documentation, such as test specifications, standards to be adhered to, and any specific testing requirements.

Testing and Reporting:

- Ensure that the labs perform the tests according to the specified standards and provide detailed test reports.
- Review the test reports for compliance and take corrective actions if any non-compliance is found.

II. Documentation:

Record Keeping:

- Maintain records of all test reports, including the lab's certification and the date of testing.

- Store these records in the project's documentation system for future reference and compliance audits.

2.4.4 Monitoring of Project by XEN/TS (Project Manager) on a Regular Basis

I. Regular Site Visits:

Site Visit Schedule:

- Develop a schedule for regular site visits, ensuring that the XEN/TS is present at key milestones of the project.
- Increase the frequency of visits during critical phases of the project, such as foundation laying, tower erection, and equipment installation.

On-Site Monitoring:

- During site visits, the XEN/TS will assess the overall progress of the project, ensuring that timelines are being met and quality standards are maintained.
- Interact with on-site personnel, including the contractor and Nigam representatives, to address any immediate concerns or challenges.

II. Progress Tracking and Reporting:

Weekly Progress Reports:

- Require the contractor to submit weekly progress reports detailing completed activities, upcoming tasks, potential delays, and any issues encountered.
- The XEN/TS will review these reports to ensure that the project remains on track.

Monthly Review Meetings:

- Conduct monthly review meetings with the project team to discuss the progress, assess risks, and make necessary adjustments to the work plan.
- Ensure that any issues identified during inspections or site visits are addressed promptly.

III. Issue Resolution and Decision-Making:

Risk Management:

- Identify potential risks that could impact the project's timeline, budget, or quality during monitoring activities.
- Develop and implement mitigation strategies to address these risks, in consultation with the project team and Nigam authorities.

Decision-Making Authority:

- The XEN/TS, with the approval of the competent authority, shall make decisions regarding adjustments to the project plan, resource allocation, and issue resolution to ensure the successful completion of the project.

IV. Documentation and Reporting:

- Document all decisions, actions, and changes made during the project monitoring process.
- Submit regular reports to Nigam's higher authorities, providing an overview of the project's status, challenges, and resolutions.

V. Inspection by Quality Control Wing:

Scheduling Inspections:

- Coordinate with the Quality Control Wing of Nigam to schedule regular inspections at critical stages of the project.

Inspection Process:

- During inspections, the Quality Control Wing will assess the quality of workmanship, compliance with technical specifications, and adherence to safety standards.
- Inspect the materials used, construction techniques, and overall progress to ensure that the work meets Nigam's expectations.

Issue Resolution and Reporting:

- If the Quality Control Wing identifies any issues, the contractor must address them immediately.
- The inspection team will document their findings and recommendations in a detailed report, which will be reviewed by the project manager (XEN/TS).

2.4.5 Preparation of Site Inspection and Quality Control Register

I. Register Preparation:

Design of the Register:

- Design a standardized format for the site inspection and quality control register, including sections for date, time, activities inspected, quality control measures taken, and any observations or remarks.

Register Content:

- Include details of all inspections conducted on-site, including the type of inspection (routine, random, or critical), findings, and any corrective actions taken.
- Document the quality control measures implemented, such as sampling, testing, and material verification.

II. On-site Maintenance:

Daily Updates:

- Require the site supervisor or quality control officer to update the register daily, ensuring that all activities are recorded in a timely manner.

Periodic Reviews:

- Conduct periodic reviews of the register by the project manager (XEN/TS) to ensure completeness and accuracy.

III. Documentation and Reporting:

Record Keeping:

- Store the register securely on-site and make it available for inspection by Nigam officials or any other relevant authorities.
- Include the register as part of the final project documentation submitted at project completion.

2.4.6 Rectification of Defects on Regular Basis

I. Schedule Regular Inspections:

- The maintenance team will perform regular inspections of the power transmission system to identify potential defects.

II. Immediate Rectification:

- Upon identifying any defect, the maintenance team will take immediate action to rectify the defect.
- Record the details of the defect, the rectification method used, and the time taken to resolve the issue.

III. Verification:

- After rectification, the execution authority will verify the effectiveness of the corrective action.
- Conduct re-testing if necessary to ensure the defect has been fully resolved.

IV. Record Keeping:

- Maintain detailed records of all defects identified, the corrective actions taken, and the outcomes.
- Update the maintenance logs and defect tracking systems regularly.

V. Documentation and Record Keeping

Maintain Records:

- Keep all test results, defect records, and corrective action reports in a central database.
- Ensure that records are easily accessible for audits and reviews.

Review and Update:

- The execution authority and QA team should review the records periodically to identify trends or recurring issues.
- Update the SOMP and maintenance procedures as necessary based on the findings.

Audit Compliance:

- The QA team will audit the records and procedures periodically to ensure compliance with this SOMP.
- Non-compliance will be reported to the management for further action.

3. COMMISSIONING AND HANDOVER

3.1 Testing of Substation and All Its Equipment and Machinery

3.1.1 Witness and conduct necessary tests of Sub-Station/equipment by M&P wing before commissioning

I. Prepare Testing Schedule:

- Develop a comprehensive testing schedule for the substation and all associated equipment.
- Ensure that the schedule is communicated to all relevant teams, including M&P and the execution authority.

II. Coordinate with M&P Wing:

- Schedule a meeting with the M&P wing to witness the necessary tests.
- Ensure that all equipment and personnel are ready for the tests as per the pre-established schedule.

III. Witness Testing:

- The M&P wing will witness and, where necessary, conduct specific tests on the substation equipment.
- Ensure that all tests meet the required specifications and standards.

IV. Conduct Initial Testing:

- The M&P team will perform initial testing of all substation components, including transformers, circuit breakers, relays, and other critical equipment.
- Record the test results and compare them with the required standards.

V. Documentation:

- Maintain detailed records of the test procedures, results, and any discrepancies found during the testing.
- Prepare a report summarizing the test outcomes.

VI. Approval for Commissioning:

- The M&P wing will provide a report on the testing process and outcomes.
- Obtain formal approval from the M&P wing to proceed with commissioning.

3.1.2 Clearance from Chief Electrical Inspector (CEI) @ PTCC wing

I. Prepare Documentation:

- Compile all necessary documentation, including test results, M&P reports, and safety compliance records.
- Submit the documentation to the PTCC wing @ CEI for review.

II. Inspection by CEI:

- Coordinate with the CEI's office for an on-site inspection of the transmission lines, substation and equipment.
- Address any observations or requirements raised by the CEI during the inspection.

III. Obtain Clearance:

- Receive clearance from the PTCC wing & CEI to proceed with the commissioning process.
- Document the clearance and maintain it in the project files.

3.1.3 Approval from NRLDC/SLDC

I. Submit Application for Approval:

- Prepare and submit an application for approval to the NRLDC/SLDC for integrating the substation into the grid.
- Include all necessary documentation, such as test reports, CEI clearance, and M&P approval.

II. Coordinate with NRLDC/SLDC:

- Liaise with the NRLDC/SLDC during their review process.
- Address any queries or additional requirements they may have.

III. Obtain Approval:

- Secure formal approval from the NRLDC/SLDC for commissioning.
- Ensure that the approval documentation is stored with the project records.

3.14 Commissioning of Work as Per Checklist/M&P Observations

I. Prepare Commissioning Checklist:

- Develop a detailed checklist based on the M&P observations and test results.
- Ensure that the checklist includes all critical steps and safety requirements.

II. Conduct Final Inspections:

- Perform a final inspection of the substation and equipment in accordance with the checklist.
- Verify that all M&P observations have been addressed.

III. Commissioning:

- Proceed with the commissioning of the substation and equipment, following the checklist rigorously.
- Document the commissioning process and obtain sign-offs from all relevant stakeholders.

3.2 Adhering to Approved Timelines And Budget, And Submission of Asset Management Plan And Completion Certificate

3.2.1 Adherence to Project Timelines and Cost Projections

I. Project Planning:

- Develop a detailed project plan that includes timelines, milestones, and cost projections.
- Ensure that the project plan is communicated to all stakeholders and that roles and responsibilities are clearly defined.

II. Monitoring Progress:

- Use project management tools to monitor progress against the timelines and cost projections.
- Conduct regular progress meetings with the project team to review the status and address any deviations from the plan.

III. Addressing Delays and Cost Overruns:

- If delays or cost overruns are identified, immediately analyze the root causes and develop a corrective action plan.
- Communicate any significant changes in the project timeline or budget to all stakeholders and obtain necessary approvals.

IV. Documentation:

- Maintain detailed records of project progress, including any changes to timelines or budgets.
- Ensure that all changes are documented and approved according to the company's change management procedures.

3.2.2 Completion Certificate, Plan, and Manuals Submission

I. Final Inspections and Testing:

- Before declaring the project complete, conduct final inspections and testing to ensure that all project deliverables meet the required standards.
- Address any outstanding issues identified during the inspections.

II. Preparation of Completion Documentation:

- Prepare the completion certificate, confirming that the project has been completed according to the specified requirements.
- Compile and submit all project plans, as-built drawings, and operation & maintenance manuals to the relevant authorities or stakeholders.

III. Submission Process:

- Submit the completion certificate, plans, and manuals to the appropriate department or client for review and approval.
- Ensure that all documentation is submitted within the agreed-upon timelines.

IV. Record Keeping:

- Store copies of the completion certificate, plans, and manuals in the company's project records for future reference.
- Ensure that all documents are properly indexed and easily retrievable.

3.2.3 Guarantee Against Defective Design, Workmanship, and Manufacturing Defects & Withholding of Security Amount

I. Issuance of Guarantee by the Contractor:

- Provide a written guarantee against any defects arising from design flaws, workmanship, or manufacturing defects.
- Ensure that the guarantee covers a period as stipulated in the contract.

II. Security Amount Withholding:

- Withhold a specified percentage of the contract amount as security against defects, as per the contract terms.
- Ensure that the withheld amount is properly documented and managed by the finance team.

III. Defect Management:

- If any defects are identified during the guarantee period, ensure prompt rectification by the responsible teams.
- Keep detailed records of all defects reported, the corrective actions taken, and the timelines for resolution.

4. SAFETY AND SECURITY

4.1 Adherence to Safety Standards And Regulations

4.1.1 Adherence to Electrical Safety Requirements

I. Compliance with Safety Standards and Labour Laws:

- Ensure that all safety measures comply with the provisions outlined in relevant labour laws, such as the Building and Other Construction Workers' Act, and the Occupational Safety, Health, and Working Conditions Code.
- Ensure compliance with specific clauses relating to working conditions, safe machinery, personal protective equipment (PPE), and the right to a safe workplace.
- Ensure that all electrical installations comply with relevant national and international safety standards, including but not limited to earthing, electrical clearances, and fire safety.
- Reference standards such as IEC (International Electrotechnical Commission) and NFPA (National Fire Protection Association) guidelines.

II. Earthing and Grounding:

- Implement proper earthing systems for all electrical installations to prevent electrical shocks and ensure safe operation.
- Regularly test earthing systems to verify that they meet the required resistance levels and are functioning correctly.

III. Electrical Clearances:

- Maintain appropriate electrical clearances between conductors, equipment, and structures as specified in relevant standards.
- Conduct periodic inspections to ensure that clearances are not compromised by environmental factors or system modifications.
- Hotline inspection may also be carried out to check the healthiness of lines.

IV. Fire Detection and Extinguishing Systems:

- Install fire detection and extinguishing systems in accordance with applicable fire safety standards.
- Regularly inspect and maintain fire protection systems, including alarms, detectors, and extinguishers, to ensure they are fully operational.

V. Ventilation:

- Ensure that all electrical rooms, substations, and equipment enclosures are adequately ventilated to prevent overheating.
- Design ventilation systems to meet or exceed the requirements specified in relevant standards, considering environmental conditions and heat loads.

VI. Documentation and Compliance:

- Maintain detailed records of all safety-related installations, inspections, and tests.
- Ensure that all safety systems and procedures are documented and accessible for audit and review.

4.1.2 Conformance to Safety Requirements by Adhering to Appropriate Design Standards

I. Incorporate Safety in Design:

- Ensure that safety is a primary consideration in the design of all electrical systems and components.
- Use recognized design standards, such as IEC, IEEE, or local codes, to guide the design process and ensure compliance with safety requirements.

II. Design Reviews and Approvals:

- Conduct regular design reviews to verify that safety requirements are incorporated into the design and that all applicable standards are met.
- Obtain necessary approvals from the safety officer or relevant authorities before proceeding with construction or installation.

III. Training and Awareness:

- Provide training to design and engineering teams and staff on the importance of adhering to safety standards and the implications of non-compliance.
- Keep teams updated on any changes to safety regulations or standards that may impact design practices.

IV. Design Change Management:

- Implement a rigorous change management process to ensure that any design modifications are reviewed for safety compliance.
- Document all changes and ensure that safety implications are assessed and mitigated.

4.1.3 Adoption of Regular Safety and Reliability Audits

I. Schedule Regular Audits:

- Develop a schedule for regular safety and reliability audits of all major equipment and components of the power transmission network.
- Ensure that audits are conducted at least annually or more frequently if required by regulations or based on risk assessments.

II. Conducting Audits:

- During audits, evaluate the safety and reliability of equipment, including transformers, switchgear, transmission lines, and protection systems.
- Use a standardized checklist to ensure that all safety and reliability aspects are thoroughly examined.

III. Audit Reporting:

- Prepare detailed audit reports highlighting any safety or reliability issues identified during the audits.
- Include recommendations for corrective actions and assign responsibilities for implementing these actions.

IV. Follow-Up and Corrective Actions:

- Ensure that all issues identified during audits are addressed promptly.
- Conduct follow-up audits to verify that corrective actions have been implemented and that safety and reliability have been restored.

V. Continuous Improvement:

- Use audit findings to identify trends, recurring issues, or areas for improvement in safety practices.
- Regularly update safety procedures and training programs based on audit outcomes and industry best practices.

4.2 Provision of Safety Measures For Workers And Users

4.2.1 Provision of First Aid Kit, Safety Uniforms, Grounding, Clearances, Fire Protection, Fencing, and Use of PPE

I. First Aid Kits:

- Ensure that fully stocked first aid kits are available at all work sites, substations, and other critical locations.
- Regularly inspect and replenish first aid supplies as needed.
- Train employees on the location and use of first aid kits.

II. Safety Uniforms and PPE:

- Provide all employees with appropriate safety uniforms and PPE, including helmets, gloves, safety glasses, high-visibility vests, and insulated boots.
- Ensure that all PPE meets relevant safety standards and is inspected regularly for wear and tear.
- Enforce the mandatory use of PPE in designated areas and during specific tasks.

III. Grounding:

- Implement proper grounding systems for all electrical installations to ensure safe operation and prevent electric shocks.
- Conduct regular inspections and testing of grounding systems to ensure they meet the required standards.

IV. Electrical Clearances:

- Maintain appropriate electrical clearances in accordance with relevant standards to prevent accidental contact with live components.
- Ensure that clearances are clearly marked and that barriers or signage are in place where necessary.

V. Fire Protection:

- Install and maintain fire detection and extinguishing systems at all substations and critical locations.
- Conduct regular fire drills and training sessions for employees on the use of fire extinguishers and evacuation procedures.

VI. Fencing and Barriers:

- Install robust fencing and barriers around substations, transmission towers, and other critical infrastructure to prevent unauthorized access.
- Regularly inspect and maintain fencing to ensure its integrity.

VII. Documentation and Compliance:

- Maintain records of all safety equipment, PPE issuance, and inspections.
- Ensure compliance with all relevant safety standards and regulations.

4.2.2 Incident Response and Reporting

I. Immediate Response:

- In the event of an incident, immediately secure the area to prevent further harm or damage.
- Provide first aid or emergency medical assistance to any injured personnel.

- Isolate any affected equipment or systems to prevent further risks.

II. Incident Reporting:

- Report the incident to the safety officer or designated authority as soon as possible.
- Complete an incident report form, providing detailed information about the incident, including time, location, persons involved, and a description of the event.

III. Investigation and Root Cause Analysis:

- Conduct a thorough investigation of the incident to determine the root cause.
- Involve relevant personnel, including safety officers, maintenance teams, and witnesses, in the investigation process.

IV. Corrective Actions:

- Develop and implement corrective actions based on the findings of the incident investigation.
- Monitor the effectiveness of corrective actions and make further adjustments as necessary.

V. Documentation and Review:

- Maintain detailed records of all incidents, investigations, and corrective actions.
- Conduct regular reviews of incident reports to identify trends or recurring issues.

4.2.3 Provision of Surveillance to Curb Unauthorized Access

I. Installation of Surveillance Systems:

- Install surveillance cameras and monitoring systems at key locations, including substations, control rooms, and access points.
- Ensure that surveillance systems are positioned to cover all critical areas and are equipped with night vision or infrared capabilities if necessary.

II. Monitoring and Access Control:

- Assign security personnel to monitor surveillance feeds continuously.
- Implement access control systems, such as key cards or biometric scanners, to restrict entry to authorized personnel only.

III. Response to Unauthorized Access:

- In the event of unauthorized access or suspicious activity, immediately notify security personnel and the safety officer.
- Follow established protocols for dealing with trespassers, including the involvement of law enforcement if necessary.

IV. Regular Surveillance Audits:

- Conduct regular audits of surveillance systems to ensure they are functioning correctly and covering all necessary areas.
- Review surveillance footage periodically to identify any potential security vulnerabilities.

V. Documentation and Compliance:

- Keep records of all surveillance system installations, maintenance activities, and access logs.
- Ensure that surveillance practices comply with relevant privacy laws and security regulations.

4.2.4 Display of Important Safety Precautions and Instructions

- Safety Precautions and Instructions:
- Display safety instructions and warnings at all entry points, high-risk areas, and near critical equipment.
- Use clear, concise language and symbols that are universally understood.
- Regularly inspect and update safety signage to ensure it remains visible and relevant.

IV. Exit Signs:

- Install illuminated exit signs at all exits and along evacuation routes.
- Ensure that exit signs are visible even during a power outage by using battery-backed lighting.

V. Important Telephone Numbers:

- Display emergency contact numbers, including fire department, medical services, and security, in prominent locations.
- Ensure that contact numbers are up-to-date and accessible to all personnel.

VI. Periodic Review:

- Conduct regular reviews of all safety displays to ensure accuracy and compliance with current standards.

Update signage and instructions as necessary, particularly after changes in operations or facility layout.

5. OPERATION AND MAINTENANCE

5.1 Regular Operation and Maintenance and Replacement of Material/Equipment By Contractor as Per Work Order For Specified Period. Compliance to Prescribed Deliverable

5.1.1 Ensuring quality of power and other operational parameters as per SOMP

I. Compliance with Standards:

- Ensure that the quality of power transmission adheres to all relevant national and international standards, including voltage stability, frequency control, and harmonic distortion limits.
- Monitor key operational parameters regularly using SCADA (Supervisory Control and Data Acquisition) systems or similar tools.

II. Quality Assurance:

- Conduct regular quality audits to verify that all operational parameters are within the prescribed limits.
- Implement corrective actions immediately if any deviations from standard parameters are detected.

III. Documentation:

- Maintain detailed records of power quality assessments and any corrective measures taken to address deviations.

5.1.2 Regular Operation and Maintenance, and Replacement of Defective Material/Equipment

I. Regular Operation and Maintenance:

- Develop a detailed operation and maintenance (O&M) plan that covers all aspects of system performance, including routine inspections, testing, and preventive maintenance.
- Ensure that all O&M activities are carried out as per the schedule and documented properly.
- Ensure regular trimming, pruning, and pest control of vegetation around the area to not compromise with operational efficiency.

II. Replacement During Defect Liability Period:

- Contractor must replace any defective materials or equipment identified during the defect liability period as specified in the Work Order.
- Ensure that all replacements meet the quality standards outlined in the contract and are completed within the agreed timeframe.

III. Contractor Compliance:

- Monitor contractor performance and ensure that all work is completed to the specified standards.
- Document all replacements and repairs carried out by contractors during the defect liability period.

5.1.3 Use of Software for Maintenance Scheduling and Updates

I. Software Implementation:

- Use Computerized Maintenance Management Systems (CMMS) or other specialized software to schedule and track all maintenance activities.

- Ensure that the software is updated regularly to reflect the current status of all equipment and maintenance tasks.

II. Scheduling and Notifications:

- Develop maintenance schedules using the software, ensuring that tasks are prioritized based on criticality and equipment condition.
- Set up automatic notifications and reminders for upcoming maintenance tasks to ensure timely completion.

III. Data Management:

- Use the software to maintain a centralized database of all maintenance activities, equipment histories, and spare parts inventories.
- Generate reports regularly to assess maintenance performance and compliance with schedules.

5.1.4 Emergency Response Planning

I. Emergency Response Plan (ERP):

- Develop a comprehensive emergency response plan that addresses potential scenarios such as equipment failures, power outages, natural disasters, and cyber threats.
- Ensure that the ERP includes roles and responsibilities, communication protocols, and recovery procedures.

II. Training and Drills:

- Conduct regular training sessions for all personnel on the ERP to ensure they are familiar with their roles during an emergency.
- Organize periodic emergency drills to test the effectiveness of the plan and make necessary adjustments.

III. Review and Update:

- Review the ERP regularly to ensure it reflects current risks and best practices.
- Update the plan as needed based on changes in the system, new threats, or lessons learned from drills or real incidents.

5.1.5 Maintenance Schedule Development and Compliance

I. Development of Maintenance Schedules:

- Create detailed maintenance schedules for all equipment based on manufacturer recommendations, operational data, and risk assessments.
- Ensure that schedules include both preventive and predictive maintenance tasks.

II. Compliance Monitoring:

- Monitor compliance with maintenance schedules through regular audits and software tracking.
- Address any delays or deviations from the schedule promptly to prevent equipment failures or operational disruptions.

III. Record Keeping:

- Maintain detailed records of all maintenance activities, including dates, tasks performed, and any issues identified.
- Use these records to evaluate the effectiveness of the maintenance program and make improvements as needed.

5.1.6 Availability of Spare Parts

I. Inventory Management:

- Maintain an adequate inventory of spare parts for all critical equipment to minimize downtime during repairs.
- Use inventory management software to track spare parts usage and reorder items as necessary.

II. Supplier Relationships:

- Establish strong relationships with reliable suppliers to ensure the timely availability of high-quality spare parts.
- Develop contracts or agreements with suppliers to secure priority access to critical components.

III. Stock Audits:

- Conduct regular audits of spare parts inventory to ensure that all items are accounted for and in good condition.
- Update inventory records immediately after any parts are used or received.

5.1.7 Grievance Redressal and Record Keeping

I. Grievance Handling Process:

- Establish a clear process for employees, contractors, and stakeholders to report grievances related to the operation, maintenance, or management of the power transmission system.
- Ensure that all grievances are logged and acknowledged promptly.

II. Investigation and Resolution:

- Investigate all grievances thoroughly, involving relevant personnel as needed.
- Provide a timely and appropriate response to resolve the grievance and prevent recurrence.

III. Record Keeping:

- Maintain detailed records of all grievances, including the nature of the issue, actions taken, and the outcome.
- Use grievance records to identify trends, recurring issues, or areas for improvement in operations or maintenance practices.

IV. Reporting and Review:

- Generate regular reports on grievance handling to inform management of any significant issues or trends.
- Review grievance data periodically to assess the effectiveness of the grievance redressal process and implement improvements as necessary.

5.2 Regular Operation and Maintenance by Nigam After Warranty Period Adhering to Material/Equipment Guarantee/Warranty

5.2.1 Adhering to material/equipment guarantee/warranty

I. Warranty Documentation:

- Ensure that all materials and equipment procured come with detailed warranty and guarantee documentation from the supplier or manufacturer.
- Verify that the warranty documentation clearly specifies the terms, conditions, duration, and scope of coverage.
- Store all warranty documents securely, either in physical files or a digital document management system, accessible to relevant personnel.

II. Warranty Registration:

- Register all warranties with the manufacturer or supplier, if required, to activate coverage.
- Ensure that any necessary documentation, such as proof of purchase, installation reports, or commissioning certificates, is submitted as part of the registration process.

III. Monitoring and Inspection

Performance Monitoring:

- Regularly monitor the performance of all materials and equipment covered under warranty to identify any potential defects or issues.
- Use maintenance logs, inspection reports, and operational data to track the condition and performance of equipment.

Scheduled Inspections:

- Conduct scheduled inspections of equipment to check for signs of wear, damage, or malfunction.
- Document the findings of each inspection and compare them against the warranty terms to determine if a warranty claim is warranted.

IV. Warranty Claims Process

Identifying Warranty Issues:

- When a defect or issue is identified that is covered under warranty, notify the Operations Manager and the Contract Management Team immediately.
- Review the warranty terms to confirm that the issue is eligible for coverage.

Initiating a Warranty Claim:

- Contact the supplier or manufacturer to initiate the warranty claim process. Provide all necessary documentation, including proof of purchase, inspection reports, and a detailed description of the defect.
- Work with the supplier or manufacturer to schedule any required inspections, repairs, or replacements.

Tracking and Resolution:

- Track the progress of the warranty claim to ensure timely resolution.
- Document all communications and actions taken as part of the warranty claim process.

Follow-up:

- After the issue is resolved, conduct a follow-up inspection to ensure that the repair or replacement has been completed to the required standards.
- Update the warranty documentation to reflect any changes or extensions to the warranty period resulting from the claim.

V. Contractual Compliance and Record Keeping

Tracking Warranty Periods:

- Maintain a centralized log of all warranties, including the start and end dates, to ensure that claims are made within the warranty period.
- Use contract management software or tools to set reminders for upcoming warranty expirations.

Compliance with Warranty Terms:

- Ensure that all operations, maintenance, and usage of the equipment adhere to the warranty terms and conditions to prevent voiding the warranty.
- Provide training to relevant personnel on proper handling, operation, and maintenance practices that comply with warranty requirements.

Record Keeping:

- Maintain detailed records of all warranty claims, including the nature of the issue, actions taken, and outcomes.
- Use these records for future reference, trend analysis, and to inform procurement decisions.

VI. Vendor and Supplier Relationships

Communication:

- Maintain open lines of communication with vendors and suppliers to facilitate quick resolution of warranty claims.
- Ensure that contact information for key vendor representatives is readily available.

Feedback and Evaluation:

- Provide feedback to vendors and suppliers on the quality of their products and the responsiveness of their warranty services.
- Evaluate vendor performance as part of the overall supplier management process, considering their handling of warranty claims.

CHAPTER 3

IS Codes for Power Transmission Projects

Category	IS Code	Description
Power Transformer 66 kV	IS 2026 (Part 1-5)	General, Temperature Rise, Insulation Levels, Impulse Tests, etc.
	IS 10028 (Part 1-3) And IEC:76	Installation, Operation, and Maintenance of Transformers
Power Transformer 132 kV	IS 2026 (Part 1-5)	General Specifications for 132 kV class
	IS 12444 And IEC:76	Specification for 132 kV Transformers
Power Transformer 220 kV	IS 2026 (Part 1-5)	Specifications for 220 kV class
	IS 12444 And IEC:76	Specification for 220 kV Transformers
Power Transformer 400 kV	IS 2026 (Part 1-7)	Specification for 400 kV Transformers
	IS 1180	
	IS 12444	
	IEC:76	
66 kV CT (Current Transformer)	IS 2705 (Part 1-4)	General Requirements, Measuring CTs, Protective CTs, and Testing
132 kV CT	IS 2705 (Part 1-4)	Current Transformers for 132 kV Systems
220 kV CT	IS 2705 (Part 1-4)	Current Transformers for 220 kV Systems
400kV CT	IS 2705 (Part 1-4)	Current Transformers for 400 kV Systems
	IS 16227	
	IS 8468 IEC:214	On load tap changer for power transformer

	IEC:60076-7	
66 kV PT (Potential Transformer)	IS 3156 (Part 1-4)	Measurement and Protection at 66 kV
132 kV PT	IS 3156 (Part 1-4)	Measurement and Protection at 132 kV
220 kV PT	IS 3156 (Part 1-4)	Measurement and Protection at 220 kV
400kV PT	IS 3156 (Part 1- 4)	Measurement and Protection at 400 kV
	IS 16227	
66 kV Isolator	IS 9921 (Part 1-5)	High Voltage AC Isolators (Disconnectors) and Earthing Switches for 66 kV systems
132 kV Isolator	IS 9921 (Part 1-5)	High Voltage AC Isolators (Disconnectors) and Earthing Switches for 132 kV systems
220 kV Isolator	IS 9921 (Part 1-5)	High Voltage AC Isolators (Disconnectors) and Earthing Switches for 220 kV systems
400kV Isolator	IS 9921 (Part 1-6)	High Voltage AC Isolators (Disconnectors) and Earthing Switches for 400 kV systems
	IS 2544	
66 kV Bay	IS 12729	Guide for Substation Design with 66 kV Equipment
132 kV Bay	IS 12729	Guide for Substation Design with 132 kV Equipment
220 kV Bay	IS 12729	Guide for Substation Design with 220 kV Equipment
66 kV Circuit Breaker	IS 13118	High Voltage AC Circuit Breakers for 66 kV Systems
132 kV Circuit Breaker	IS 13118	High Voltage AC Circuit Breakers for 132 kV Systems
220 kV Circuit Breaker	IS 13118	High Voltage AC Circuit Breakers for 220 kV Systems
400kV Circuit Breaker	IS 13118	High Voltage AC Circuit Breakers for 400 kV Systems
Common Standard for Circuit Breakers	IS 9431	Common Specifications for Circuit Breakers and Isolators
Common Standard for Electrical Substation	IS 5613 (Part 2)	Code of Practice for Design and Maintenance of Overhead Power Lines/Substations
Capacitor Bank	IS 2834	Shunt Capacitors for Power Systems
	IS 13340	Shunt Capacitors of Self-Healing Type for AC Power Systems Having Rated Voltage up to and Including 650V
	IS 13585 (Part 1-2)	Shunt Capacitors for AC Power Systems Above 650V

Incoming 11 kV Panel	IS 3427	Metal-Enclosed Switchgear and Control gear for Voltages Above 1 kV and up to and Including 52 kV
	IS 12729	Guide for Substation Design with 11 kV Equipment
Outgoing 11 kV Panel	IS 3427	Metal-Enclosed Switchgear and Control gear for Voltages Above 1 kV and up to and Including 52 kV
	IS 12729	Guide for Substation Design with 11 kV Equipment
XLPE Cable 11kv to 33kV	IS 7098 (Part 2)	Specifications for XLPE Cables
XLPE cable 66kV to 220kV	IS 7098 (Part 3)	
XLPE Cable 400kV	IEC 62067	
ACSR Conductor (size 0.15 sq inch, 0.2 sq inch, 0.4 sq inch, 0.5 sq inch)	IS 398 (Part 1) 1996	Specifications for ACSR Conductors
ACSR Conductor – HTLS	IS 398 (Part 5) 1992	
	IS 2551 IS 1982	Danger Notice Plate

Civil Works	Haryana PWD and relevant IS Codes	Specifications for control room, building room, roads, and foundations for equipment as well as other civil works

Manuals as per CEA Guidelines may also be followed along with the IS Codes

CHAPTER 4

Description of components in Power Transmission Projects

Here's a detailed list of key components used in power transmission projects along with their brief descriptions:

1. Transmission Towers

Structures that support overhead power lines, designed to maintain necessary clearances for safety and operational efficiency. They come in various types, including lattice, monopole, and guyed towers, depending on terrain and voltage requirements.

2. Conductors, and XLPE cables

ACSR conductors or XLPE cables used to carry electrical power from generating stations to substations or distribution systems. Common types include ACSR (Aluminium Conductor Steel Reinforced), High Temperature Low Sag (HTLS) Conductor, AAC (All-Aluminium Conductor), and AAAC (All-Aluminium Alloy Conductor). These are selected based on current-carrying capacity and mechanical strength.

3. Insulators

Devices used to prevent the passage of electricity to the transmission tower or other structures. Insulators are typically made of porcelain, glass, or composite materials and are critical in maintaining system integrity by supporting conductors while resisting electrical leakage.

4. Ground Wires (Shield Wires)

Metallic cables installed at the top of transmission towers to protect the system from lightning strikes and ensure safe grounding of fault currents. Often made from galvanized steel or optical ground wire (OPGW) for dual-purpose protection and communication.

5. Transformers

Electrical devices used to step-up or step-down voltage levels between transmission and distribution networks. High-voltage transformers are installed in substations to minimize power losses during long-distance transmission.

6. Substations

Facilities where the voltage is transformed from high to low (or vice versa) for transmission or distribution. Substations contain transformers, switchgear, protection devices, and circuit breakers for managing electrical flow and ensuring system safety.

7. Circuit Breakers

Protective devices used to automatically disconnect a circuit in case of overload, short circuit, or fault conditions. They safeguard equipment and personnel by isolating faulty sections of the power grid.

8. Disconnectors (Isolators)

Mechanical switches used to isolate a section of the transmission line or equipment for maintenance or repair purposes. Unlike circuit breakers, they do not operate under load and are used when the system is de-energized.

9. Surge Arresters

Protective devices designed to divert transient over-voltages, such as those caused by lightning or switching surges, to the ground. They protect transmission lines and equipment from damage due to voltage spikes.

10. Capacitors

Devices used in power transmission to improve power factor and voltage stability by storing and releasing reactive power. Capacitor banks are often installed at substations to manage reactive power and optimize transmission efficiency.

11. Reactors

Inductive components used to limit current flow and manage voltage levels in transmission systems. They help control system stability by compensating for excess reactive power.

12. Control and Relay Panels

Panels housing the control circuitry, relays, and metering instruments used to monitor, control, and protect power transmission systems. These panels ensure real-time monitoring of operational conditions and trigger protective actions in case of abnormalities.

13. Optical Ground Wire (OPGW)

A dual-purpose cable that functions both as a ground wire and a communication medium. It contains optical fibres for transmitting data between substations and control centres while offering protection against lightning strikes.

14. Lightning Rods

Devices installed on towers and substations to intercept lightning strikes and safely divert them to the ground, protecting electrical equipment from potential damage.

15. Static VAR Compensators (SVC)

Equipment used in high-voltage transmission systems to manage reactive power and stabilize voltage levels. SVCs enhance grid reliability by dynamically adjusting voltage during system fluctuations.

16. Power Line Communication (PLC) Equipment

Devices used to send and receive communication signals over transmission lines. These enable real-time data exchange for monitoring and control between remote substations and central control rooms.

17. Dampers (Stockbridge Dampers)

Devices installed on transmission lines to reduce vibration caused by wind. They prevent conductor fatigue and reduce mechanical stress, prolonging the lifespan of the transmission infrastructure.

18. Grounding System

An essential component for ensuring safety, comprising rods, mats, and conductors. Grounding systems protect both personnel and equipment by directing fault currents or lightning strikes safely into the ground.

19. Earthing Switches

Used to ground a section of the transmission system during maintenance or in the event of a fault. These switches ensure that the equipment being worked on remains at earth potential, preventing accidental energization.

20. Voltage Regulators

Devices that automatically adjust voltage levels to ensure consistent and stable delivery of power. Voltage regulators are essential for maintaining system efficiency and protecting equipment from voltage fluctuations.

21. Supervisory Control and Data Acquisition (SCADA) Systems

An automated system used to monitor and control power transmission systems. SCADA collects real-time data on system performance, allowing for remote operation and fault detection, enhancing overall system reliability.

22. Battery Bank:

A system comprising multiple batteries connected to provide backup power to critical equipment in substations or control centres during power outages. Battery banks ensure the continuous operation of control systems, communication devices, and protective relays when the main power supply is interrupted. These banks are typically used in conjunction with DC systems to maintain essential operations until power is restored or emergency generators are activated. Battery banks are vital for maintaining system stability and ensuring reliable communication during faults or maintenance periods in power transmission projects.

23. 11 kV Incoming/Outgoing Panel:

The 11 kV Incoming/Outgoing Panel is a key component in power transmission and distribution systems, designed to manage the flow of electricity in and out of substations at the 11 kV voltage level. These panels are equipped with circuit breakers, protection relays, and metering instruments to control, protect, and monitor the incoming and outgoing electrical feeders. They ensure safe switching, protection from faults, and effective load management.

ANNEXURE I

Technical Quality Audit Parameters: Power Transmission

Pre-Implementation Stage

Sr. No.	Parameters	Benchmark	Reference Document	Indicator	Sub-Indicators	Maximum Marks	Weightage (%)
1	Planning and Design	Technical framework and comprehensive planning	DPR	1.1) Integrated planning for load growth estimation	1.1.1) Analysis of the existing Transmission network within a radius of 5-10 km of proposed site, its operational parameters, including loading conditions in reference to transmission and Distribution planning proposal.	3	25%
					1.1.2) Analyze quantitative and qualitative historical data for at least last 5 years and future assessment for at least 5 years in consultation with all stake holders to determine expected future load growth, considering both long and short term projections including specific scenario, if any.	3	
					1.1.3) Adequacy of design sub-station capacity incorporating for future expansion based upon 1.1.1, and 1.1.2 above	3	
					1.1.4) Adoption of technological intervention including automated tools such as adequate Communication system and IT infrastructure like SCADA, DMS, OMS, AMI etc.	3	
					1.1.5) Adoption of latest simulation software.	2	
				1.2) Load Flow Studies and short circuit, stability analysis	1.2.1) Determination of appropriate Substation capacity, and other system parameters and voltage levels considering maximum loading of Network and equipment based on load flow studies.	4	
					1.2.2) System operation within permissible limits both under normal as well as after probable credible contingencies.	4	

				1.3) Administrative approval of the individual/ Integrated Planning.	1.3.1) Approval of Integrated Planning by WTDs UHBVNL & DHBVNL / competent authority.	3	
				1.4) Selection of land	1.4.1) Selection of land keeping in view ROW.	3	
					1.4.2) Transfer of ownership of Government/Gram Panchayat land in the name of department.	2	
					1.4.3) Soil bearing capacity report, contour sheet and fixation of FGL of Sub Station before preparation of detail BOQ (Civil)	2	
					1.4.4) Walk over survey of transmission line based on HARSAC submission	2	
					1.4.5) Gazette notification of route of transmission lines.	2	
					1.4.6) Aesthetics and Horticulture Planning in the spare land of Substation	2	
				1.5) SS Design, layout, equipment design and drawings	1.5.1) Selection of grid sub-station is as per site condition such as indoor, outdoor, underground, Air Insulated (AIS), Gas Insulated (GIS) or Hybrid etc.	3	
					1.5.2) Selection of design parameters viz fault level analysis, protection scheme, Civil Design/Electrical Design as per Maximum capacity, Voltage level, fault level, etc. as per the latest CEA guidelines.	6	
					1.5.3) Grounding/earthing design as per site condition to ensure safety of equipment and personnel	2	
					1.5.4) Provision for equipment maintenance without interrupting the entire supply.	4	

				1.6) Design of transmission line/Sub Station considering quality and reliability of supply, functionality, maintainability and simplicity of operation	1.6.1) Protection grading, coordinated configuration to ensure the minimum zones are impacted by faults	4	
					1.6.2) Independent circuit breaker control of incoming and outgoing feeders.	2	
					1.6.3) Provision of two or more incoming feeders from two different sources for meeting N-1 contingency for reliability considerations.	4	
					1.6.4) Provision of two or more transformers for meeting N-1 contingency for reliability considerations	5	
					1.6.5) Provision of spare bay for catering to future load growth.	4	
					1.6.6) Provision of additional transformer of sufficient capacity for future load growth.	2	
					1.6.7) SS to cater to power quality parameters, viz voltage regulation, harmonics, and reactive power within the standard limits.	4	
				1.7) Cost analysis, budget planning, and timeline estimates.	1.7.1) Preparation of detailed BOQ as per scope of work approved by Planning wing based on site/GELO data	3	

					1.7.2) Cost Estimate (civil and electrical) based on BOQ (Capital and Operational Expenditure)	3	
					1.7.3) Financial implication with cost index upto implementation period	3	
				1.8) Award of work (Turnkey project) administrative and technical approval from the competent authority	1.8.1) Administrative and Technical approvals from the competent authorities	3	
					1.8.2) DNIT preparation, approval and call of tender.	4	
					1.8.3) Evaluation of tender, based on technical and financial bid analysis, and allotment of work order maintaining transparency.	6	
					TOTAL	**100**	

IMPLEMENTATION STAGE

Sr. No.	Parameters	Benchmark	Reference Document	Indicator	Sub-Indicators	Maximum Marks	Weightage (%)
2	Execution and implementation, inspection and testing	Technical Methodology for implementation	Contract Agreement	2.1) Detailed/final survey its verification on actual geographical conditions before permit to work	2.1.1) Joint survey by Construction Wing along with contractor before permit of work	5	40%
					2.1.2) Verification of regularity compliances by the contractor.	2	
					2.1.3) Coordination and clearances with government departments/private that may be necessary.	4	
					2.1.4) Timely handing over of hindrance free land to the executing agency	6	
				2.2) Execution of all Civil and Horticulture Works	2.2.1) Approval of all civil design drawings by the competent authority.	6	
					2.2.2) Placing of Purchase Order for various material by the contractor/department	6	
					2.2.3) Execution of civil work such as control room building, Tower/ Equipment foundations, earthing, fencing, cable trenches, horticulture, etc. as per technical specifications and approved design and as per site condition and corresponding standards.	6	
					2.2.4) Use of quality materials from approved source and required plant and machinery.	5	
					2.2.5) Inspection and testing of material at the supplier's works by Nigam Officer/TPA and quality checks as per relevant standards.	5	

					2.2.6) Sampling of material at site for testing in NABL accredited lab, if required.	2	
					2.2.7) Checking of test results by execution authority and action thereof.	2	
					2.2.8) Preparation of site inspection and quality control register and concrete register	2	
					2.2.9) Execution of all Civil and Horticulture Works as per the plan within specified time period.	6	
					2.2.10) Rectification of defects on regular basis and keeping the record	4	
				2.3) Execution of electrical works as per work order.	2.3.1) Approval of electrical drawings and SOMP of each equipment.	5	
					2.3.2) Placing of Purchase Order for the material/equipment by the contractor/department and inspection/testing of the same at the manufacturer's works by the department/TPA.	6	
					2.3.3) Preparation of site inspection and quality control register.	2	
					2.3.4) Joint verification report of all electrical material in form of MRC	5	
					2.3.5) Sampling and testing of material/equipment in NABL accredited lab, if required.	2	
					2.3.6) Checking of test results by execution authority and action thereof.	2	
					2.3.7) Execution of work as per guidelines laid down by Nigam and inspection by Quality Control Wing of Nigam	6	
					2.3.8) Monitoring of project by XEN/TS (project manager) on regular basis	4	

					2.3.9) Execution of work as per plan within specified time period.	4	
					2.3.10) Rectification of defects on regular basis and maintaining the record	3	
					TOTAL	**100**	

COMMISSIONING

Sr. No.	Parameters	Benchmark	Reference Document	Indicator	Sub-Indicators	Maximum Marks	Weightage (%)
3	Commissioning and Handover	Guidelines for Commissioning and handover of sub-station	Completion report. As per built drawings manuals	3.1) Testing complete functionality of substation and all its equipment.	3.1.1) Witness pre commissioning test of equipment by M&P as per standard guidelines.	15	15%
					3.1.2) Clearance of complete installation from the CEI (Chief Electrical Inspector)	10	
					3.1.3) Commissioning of sub-station as per check list/M&P observations	15	
					3.1.4) Post commissioning test of all electrical equipment as per work order/relevant equipment code	10	
					3.1.5) Handover of the sub-station to the department by the contractor	10	
				3.2) Submission of asset management plan and	3.2.1) Adherence to project timelines and Cost Projections	15	
					3.2.2) Completion certificate, plan and manuals submission	10	
					3.2.3) Guarantee against defective design, workmanship, and manufacturing defects. withhold of security amount	15	

				completion certificate and adhering to approved timelines and budget			
					TOTAL	**100**	

SAFETY AND SECURITY

Sr. No.	Parameters	Benchmark	Reference Document	Indicator	Sub-Indicators	Maximum Marks	Weightage (%)
4	Safety and Security	**Proper safety and security measures**	Safety Plan	4.1) Adherence to safety standards and regulations	4.1.1) All electrical safety requirements, electrical clearances, fire detection & extinguishing system, earthing & ventilation etc. as per standards.	20	5%
					4.1.2) Conformance to safety requirements by adhering to appropriate design standards.	15	
					4.1.3) To adopt regular safety and reliability audits of all major equipment of the network.	15	
				4.2) Provision of safety measures for workers and users	4.2.1) Provision of First aid kit, personnel protective equipment (PPE) viz safety helmet, safety glass, gloves, safety shoes, high visibility clothing, etc, Grounding, clearances, fire protection, fencing, etc).	15	
					4.2.2) Conducting regular mock drills to check the response system.	5	
					4.2.3) Work permit and authorization	5	
					4.2.4) Incident response and reporting	10	
					4.2.5) Provision of surveillance to curb unauthorized access	10	

					4.2.6) Display of all important safety instructions, precautions, exist signs, important telephone numbers, etc.	5	
					TOTAL	**100**	

OPERATION AND MAINTENANCE

Sr. No.	Parameters	Benchmark	Reference Document	Indicator	Sub-Indicators	Maximum Marks	Weightage (%)
5	Operation and Maintenance	Procedure for Effective Maintenance	Assets Management Plan	5.1) Regular operation and maintenance and replacement of material/equipment by contractor as per Work Order for specified period. Compliance to prescribed deliverable	5.1.1) Inspection and maintenance schedule development and its compliance	10	100%
					5.1.2) Use of software for maintenance scheduling and updates	10	
					5.1.3) Ensuring quality of power and other operational parameters as per SOMP.	10	
					5.1.4) Regular operation and maintenance and replacement of material/equipment by contractor as per Work Order for specified period	10	
				5.2) Timely rectification of defects	5.2.1) Emergency response planning	10	
					5.2.2) Availability of spare parts	5	
					5.2.3) Compliance of maintenance schedule	5	
					5.2.4) Grievance redressal and record keeping.	5	
				5.3) Regular operation	5.3.1) Adhering to material/equipment guarantee/warranty	10	
					5.3.2) Deployment of skilled manpower for O&M	5	

				and maintenance by Nigam after warranty period adhering to material/equipment guarantee/warranty	5.3.3) Deployment of manpower for general maintenance and security	5	
					5.3.4) Sub station O&M as per SOMP	5	
					5.3.5) Training and capacity building	5	
					5.3.6) Equipment maintenance and surveillance using latest technology such as thermal camera to detect hotspot, SCADA, etc	5	
					TOTAL	**100**	

Marking Criteria and Weightage

Sr. No.	Parameter	Marking Criteria	Weightage (%)	Marks Obtained
1.	Planning, Design		25*	
2.	Execution and implementation and inspection and testing		40*	
3.	Commissioning and Handover		15*	
4.	Safety and Security		5*	
5.	Project management	Adherence to project timelines and cost projection	5	
6.	Environmental Measures	Consideration of environmental factors like sustainability, eco-friendly construction practices	5	
7.	User Feedback	Feedback from beneficiaries, stack holders to access their satisfaction levels	5	
		TOTAL	**/100**	
8.	Operation and Maintenance	Provision of a detailed maintenance plan post-construction	100	

ANNEXURE II

Part A: Checklist for Approval of DPR for Construction of 66kV and above capacity Substation and Transmission Lines (HVPNL)

Name of Division: _____

Name of Project: _____

Sr. No.	Questionnaire	Yes	No	N/A	Remarks
1.	Existing network of Substations and Transmission Lines analysed				
2.	Existing voltage level of substations analysed				
3.	Quantitative historical data for last three to five years analysed				
4.	Demand forecast study conducted based on current and future load requirements				
5.	Technical and financial feasibility studies carried out before design initiation				
6.	Load flow study performed to assess system performance under varying conditions				
7.	Environmental impact assessments and mitigation strategies prepared				
8.	Local, state, and national regulations, including ROW considerations, incorporated in planning				

9.	Fault level analysis considered in designing protection equipment like circuit breakers and transformers				
10.	Design parameters for substation structures and transmission towers in accordance with international standards				
11.	Provision of two or more power transformer to meet with N-1 contingency				
12.	Provision of double circuit incoming transmission line from different substations (where feasible)				
13.	Provision for spare bay for catering to future load growth				
14.	Technical losses for the system calculated				
15.	Contingency plan developed to handle unplanned downtime during construction				
16.	Design redundancies added to accommodate future technological upgrades				
17.	Comprehensive risk assessment performed to identify potential threats during construction				
18.	Land acquisition procedures reviewed for compliance with local laws and norms				
19.	Gazette notification of transmission line and publication				
20.	Detailed topographic surveys conducted to identify site constraints				
21.	Clearances obtained from I. Railway				
	II. Forest				
	III. PWD/NHAI				
	IV. Lines crossing of Power Grid, etc				

	V. Other departments if any				
22.	Energy-efficient components, such as low-loss transformers, considered for reducing operational costs				
23.	Geotechnical survey completed to confirm the suitability of soil and foundation design				
24.	Advanced digital control systems included in the design to enhance automation				
25.	Surge protection and lightning arresters design finalized according to regional conditions				
26.	Emergency evacuation plan for substation staff integrated into the design				
27.	Noise reduction measures incorporated into substation designs				
28.	Preliminary project timeline and milestone schedule prepared				
29.	Financial risk assessments completed, considering currency fluctuations and market conditions				
30.	Multi-vendor evaluation conducted to ensure procurement flexibility and competitiveness				
31.	Comprehensive technical specifications for procurement prepared for all major equipment				
32.	Environmental clearances and permits obtained before the final design approval				
33.	Renewable energy integration points considered in the substation design				
34.	Provision for Horticulture Planning				

Note: This checklist is required to be appended with the DPR at the time of approval and duly signed by the concerned officers/officials.

Part B: Checklist for Execution, Inspection and Testing Commissioning & Handover of Construction of 66kV and above capacity Substation and Transmission Lines (HVPNL)

Name of Division: _____

Name of Project: _____

Name of Agency: _____

Estimated Cost of Project: _____

Date of Sanction of Project: _____

Date of Award of Contract: _____

Contract Value of the Work: _____

Sr. No.	Questionnaire	Yes	No	N/A	Remarks
1.	Award and signing of contract agreement with the contractor				
2.	Obtain performance bank guarantee (PBG) from the contractor				
3.	Joint inspection conducted by the contractor and project management team at the site				
4.	Hinderance free land handed over to Executing Agency				
5.	Civil and Horticulture Work executed as per requirements and as per IS Codes/Haryana PWD Code				
6.	All electrical equipment procured as per specifications from approved manufacturer/sources				
7.	All equipment stored and handled as per safety and environment regulations				
8.	All necessary construction permits obtained before commencing work on-site				
9.	Project site fenced off and secured to prevent unauthorized access				
10.	Pre-construction surveys conducted by XEN (Project) with the contractor, tests completed, such as soil testing and topographic surveys				

11.	All workers provided with the necessary training on safety protocols and construction standards				
12.	Safety training and awareness programs conducted for all personnel involved in the project				
13.	The appropriate Personal Protective Equipment (PPE) provided to all workers				
14.	System in place to monitor construction progress against planned milestones				
15.	All components, such as cables, transformers, and circuit breakers, inspected and approved before installation				
16.	Overhead transmission line towers installed as per structural design specifications				
17.	The construction site regularly inspected for compliance with health, safety, and environmental (HSE) requirements				
18.	Foundation concrete samples taken and tested to ensure the required strength is achieved				
19.	Factory acceptance tests for major equipment conducted as per the approved quality plan				
20.	Testing done in NABL accredited labs				
21.	The quality control register and concrete register updated with all test and inspection reports				
22.	All corrective actions from site inspections promptly addressed and recorded				
23.	Protection relays and circuit breakers properly installed and tested for functionality				
24.	The earthing system inspected and tested according to design parameters				
25.	Transformers installed and tested for load capacity and efficiency				
26.	Underground and overhead transmission lines installed as per standards, with proper clearances maintained				

27.	Visual inspection and routine electrical testing conducted on all installed equipment				
28.	Insulation resistance tests performed on cables before energizing the system				
29.	All test results reviewed and approved by the site engineer or relevant authority				
30.	Punch-list items identified during inspection resolved before handover				
31.	All project documents and test certificates collected and stored for handover				
32.	Clearance from Chief Electrical Inspector obtained				
33.	All pre-commissioning tests performed for transformers, breakers, and protection equipment				
34.	The system energized step by step to prevent sudden loading				
35.	Protective relays tested in live conditions to ensure fault detection and isolation				
36.	Commissioning reports prepared and submitted to the appropriate authorities				
37.	All as-built drawings reviewed and updated post-commissioning				
38.	Substation handed over timely to the department				
39.	Commissioning team appointed to oversee the energization and handover process				
40.	Live performance tests conducted on critical equipment like transformers and switchgear				
41.	The site cleared of all temporary installations and contractor's equipment post-handover				
42.	All warranties and guarantees for installed equipment handed over to the operations team				
43.	Maintenance manuals and O&M instructions handed over to the operations team				

44.	The final project documentation, including drawings, test reports, and certificates, handed over to the client				
45.	All safety systems like fire alarms, emergency shutdowns, and ventilation systems tested				
46.	Safety drills conducted for staff in the event of a fire or electrical hazard				
47.	There is a safety compliance register maintained at the facility				
48.	Access control measures, like ID checks and visitor logs, implemented during construction				
49.	There is a dedicated security team on-site for monitoring and enforcing safety measures				
50.	Potential safety hazards identified and mitigation measures established				

Note: This checklist is required to be signed by the Executive Engineer in charge of the work and other officers during their visit.

Part C: Checklist for Operation and Maintenance of 66kV and above capacity Substation and Transmission Lines (HVPNL)

Name of Division: _____

Cost of Project at Completion: _____

Name of Project: _____

Date of Completion: _____

Name of Agency: _____

Sr. No.	Questionnaire	Yes	No	N/A	Remarks
1.	Quality of power maintained as per SOP				
2.	Routine maintenance schedule in place for all major equipment				
3.	Routine maintenance schedule in place for horticulture assets				
4.	Periodic performance evaluations conducted to assess system efficiency				
5.	Maintenance logs updated regularly with details of repairs and replacements				
6.	Spare parts inventory established to ensure quick repairs				
7.	Work permits and authorizations in place				
8.	Training program in place for maintenance personnel on new technologies				
9.	Environmental compliance checks performed regularly to ensure adherence to regulations				
10.	Incident reports generated and analyzed to improve safety measures				
11.	System for tracking equipment performance and alarms				
12.	Communication protocols established for coordinating maintenance activities				

13.	Skilled manpower deployed for operation				
14.	Required staff deployed for maintenance				
15.	Feedback mechanism for staff to report issues and suggest improvements				
16.	First aid kits and safety uniforms provided				
17.	Regular mock drills conducted				
18.	Incident response and reporting procedures established				
19.	Surveillance provided to curb unauthorized access				
20.	Maintenance schedule displayed in the control room				
21.	Emergency contact number displayed in the control room				
22.	Safety precautions displayed in the control room				

Note: This checklist is required to be signed by the Executive Engineer in charge of the work and other officers during their visit.