

Technical Specification for Substation Design Software(s)

(I) Substation Earthing Design Software

Supply, installation, activation and configuration of one (01) perpetual licensed copy of Substation Earthing Design Software for a single user shall form part of the bidder's scope of work under the relevant Schedule of Prices (BPS). The offered software should have in use by utilities, transmission companies, EPC organizations, etc. for grounding system studies and shall meet the following minimum technical requirements:

- (i) Capability to perform earthing design of AIS substations, including modelling of both horizontal grounding conductors and vertical earth rods.
- (ii) Evaluation of uniform as well as multi-layer soil models (more than two layers) and support for symmetrical/asymmetrical grounding grids of any configuration with arbitrarily located ground rods.
- (iii) Capability to perform rigorous Finite Element Analysis (FEA) of ground grid conductors and ground rods for determining:
 - a. Station Ground Resistance (R_g)
 - b. Ground Potential Rise (GPR)
- (iv) Computation and assessment of touch voltage and step voltage and comparison with permissible safety limits.
- (v) Provision for configuring electrical properties of grounding conductors and earth rods as per user-defined inputs, along with a default library containing commonly used materials such as Copper, Mild Steel, etc.
- (vi) Compliance with internationally recognized standards including IEEE Std. 80
- (vii) Provision of 2D and 3D colour graphical visualization of grounding system performance including surface potentials, along with seamless CAD integration. Capability to import CAD drawings/files generated through AutoCAD or equivalent software platforms.
- (viii) Capability to compute and visualize electric and magnetic fields both in air and soil.
- (ix) Provision of a dedicated module for high-frequency earthing analysis of GIS substations and cable installations. Capability to perform transient and steady-state analysis over a frequency range (in the range on MHz) for buried and above-ground current carrying conductor networks.
- (x) Availability of a default software library containing standard GIS and cable models, which can be selected and customized by the user.
- (xi) The offered software shall be supplied with a separate standalone desktop workstation with all necessary hardware & software required for successful operation of Substation Earthing Design Software. Cost of same is deemed included in the quoted price of the software.

The supplier shall also provide **introductory training** on operation and application of the software for a batch of **ten (10) participants**. Supplier shall provide remote/online assistance for installation, activation and initial configuration of the software at POWERGRID Corporate Centre Office, Gurgaon. Apart from the specified support period, the perpetual license shall not require any mandatory recurring subscription fee for continued use of the software.

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The Contractor scope shall include support & maintenance services for a period of one (01) year from the date of software activation. The scope shall include Extended Technical Support and Additions, Enhancements & Updates, covering, but not limited to, the following:

- Software updates and version upgrades.
- New software modules, features and enhancements released during the AMC period.
- Software patches, bug fixes and performance improvements.
- Installation, activation and license management support.
- Technical assistance and guidance for application of the software to specific engineering problems and studies.

Cost for support and training as above is deemed included in the cost of the software. License of Substation Earthing Design Software procured under this contract shall be in the name of POWERGRID.

(II) Intelligent 3D Substation Design & Engineering Software

1. Scope of Work

This technical specification covers supply, implementation, configuration, and post-implementation support of an intelligent, database-driven three-dimensional (3D) design and engineering software suitable for the primary engineering for 765/400/220/132/66/33kV class of EHV/HV substations covering Air-Insulated Switchgear (AIS), Gas-Insulated Switchgear (GIS), and Hybrid configurations including supply of complete package with all required modules, training, support and Innovation & asset management project for Digitalization services for brown field POWERGRID existing substation (quantity as per BPS) including laser scanning.

The software shall be capable of concurrent engineering, engineering automation, substation layout standardisation through templates & reuse of existing project data. The software should have central data editing functionality so that when any of necessary property associated with project is changed, the same shall be reflected in related drawings & document.

A substation project can have more than three voltage levels i.e. 765/400/220/132/66kV with 25-50 bays in 765/400/220/132/66kV in rating.

The software tool shall have the capability for preparation of Layouts (Electrical, Structure, Foundation, Cable Trench & Earthmat) in AUTOCAD from 3-D Substation model. Review of Electrical clearances in 3-D Substation Layout, DSLP layout & Calculation, SCF & Sag tension Calculation, EKD & associated Bill of Material etc. The software should provide 3D Orbit functionality to enable users to rotate, view, and navigate the 3D model through a complete 360° perspective. For initial GIS model, basic modelling of GIS & GIB shall be possible in the solution. The detailed 3D model of the GIS & GIB shall be provided by the owner from the GIS vendor, which is to be imported in the software for further interface & embedding in 3D model of switchyard. The software should provide comprehensive layer management capabilities, allowing users to create, organize, control visibility, and manage layers efficiently during drawing creation.

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Innovation and asset management project includes digitalization services for brown field POWERGRID existing substation (quantity as per BPS) including laser scanning & checking the 3D point cloud. Creation of 3D model from a 3D point cloud via laser scanning.

The maximum deviation of the allowed distances shown in 3D model generated from 3D point cloud (Lidar Scanned images) & actual site equipment/conductors' arrangement shall be as follows:

Item	Requirement
Overall model accuracy	≤ 100 mm
Equipment centreline accuracy	≤ 50 mm
Structure leg location accuracy	≤ 25 mm

Asset data export in Excel sheet & AUTOCAD drawings incl. bay drawings of all bays. The software should generate detailed 2D drawings directly from the 3D model, with automatically linked detail bubbles, position numbers, and corresponding component tables. The software shall support 3D object creation and modification using enabling users to convert and manipulate imported 2D geometry to develop the required 3D models.

The offered solution shall provide a single, integrated environment in which equipment geometry, electrical topology, engineering calculations, and engineering documentation remain intrinsically and continuously linked throughout the design lifecycle.

The solution shall provide an interference-checking functionality to identify clashes and spatial conflicts between equipment, structures, conductors, and other 3D objects. The solution shall provide functionality to identify undefined or missing clamps after completion of the project, enabling them to be incorporated into the final Bill of Materials (BOM). The software shall support interoperability with software for substation lighting design, allowing lighting layouts and illumination requirements to be coordinated with the 3D substation model. The solution provided shall support the connection and disconnection of switches and circuit breakers, enabling users to simulate and visualize different switching states within the 3D substation model. The software shall support VR- based virtual walkthroughs of the substation, enabling users to navigate and inspect the 3D model from different perspectives for design reviews, presentations, training, and maintenance planning.

The scope of supply shall include the requisite number of user licenses, implementation support, training, and post-implementation technical support necessary for adoption across the Employer's engineering teams.

2. Common Baseline Requirements

The following capabilities define the minimum acceptable design environment and represent baseline functionality expected of a substation design software offering.

2.1 Native Design Environment

The software shall operate within a recognized computer-aided design (CAD) or building information modelling (BIM) environment, providing standard 3D modelling, drafting, and

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visualization capabilities suitable for substation layout development. The software should have ERP integration capability with full consistency of ERP & CAD data.

2.2 Standard Equipment Library and Placement

The software shall provide a library of standard substation equipment symbols and parametric blocks (structures, equipment, conductors) up to 765kV that can be placed, oriented, scaled, and arranged within a 3D layout with minor modifications. The bidder is required to develop 100 nos. of equipment models exclusively for the owner. These shall be in addition to already existing library of bidder. It is also expected that bidder develops 3D models for owners use during the extended support period. Number of such models will be as per actual requirement arising during this support period. The software should have provision to incorporate user defined symbols. Legends & notes etc in 2D drawings and BOMs. Standard Equipment models shall also have the provision for adding new parameters which shall be required by OWNER during detailed design stage.

2.3 Drawing and Documentation Output

The software shall be capable of generating General Arrangement (GA) drawings, sections, and elevation views, DSLP Calculation, clearance SCF & Sag tension Calculation, EKD & associated Bill of Material and GIS basic modelling of GIS & GIB from the 3D model and generation of Bill of Material exportable in industry-standard formats (e.g., DWG, PDF, excel etc).

3. Specialized Engineering Requirements

In addition to the baseline capabilities specified at S.no.2 above, the offered solution shall provide the following integrated, domain-specific engineering capabilities natively, as a single unified platform. These capabilities shall not be achieved through external “bridge” utilities, manual data exchange between separate applications, third-party calculation add-ons, or post-processing performed outside the native modelling environment.

3.1 Intelligent, Database-Driven Object Model

The system shall be underpinned by a centralized rational based database architecture in which every substation component is represented as an intelligent object possessing inherent electrical connectivity, phase-aware attributes, and rule-based behaviour, rather than as a static geometric block. Any modification to a component shall be reflected instantaneously across all linked drawings, calculations, and bills of material (BOM). Based on embedded data at a core database level, information regarding manufacturer details, material ratings, and asset maintenance history shall be easily queried or integrated into ERP systems.

3.2 Bay-Based Hierarchical Substation Architecture

The system shall support a dedicated substation hierarchy structured as Voltage Level > Bay > Module > Component. This structure shall enable direct generation of both quantity-based BOMs and bay-wise, position-based parts lists from the engineering model, without manual recompilation.

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3.3 Automated Rule-Based Conductor and Busbar Routing

The system shall provide automated routing logic for conductors and busbars, including automatic snapping, alignment, and intelligent placement of associated clamps, spacers, and fittings, governed by user-defined electrical clearance standards. The tool shall have intelligence for elements snap onto a smart, voltage-dependent spatial grid. Wires and tubes should behave intelligently. If an equipment structure is moved or batch-edited, the attached high-voltage conductors shall automatically stretch, sag, and reconnect to new location of equipment.

3.4 Natively Integrated, Model-Linked Engineering Calculations

The system shall include natively integrated calculation engines, executed within the same modelling environment, covering at minimum:

- a) Lightning protection / shielding studies (in accordance with IS2309/IEC 62305 / IEEE 998);
- b) Sag and tension analysis for conductors and busbars (in accordance with latest IS/ IEC standards.
- c) Short-circuit electrodynamic force calculations (in accordance with IEC 60865).
- d) Software should check voltage-dependent minimum clearances between conductive, insulated, and grounded parts in real time.

These calculations shall be model-linked, such that any subsequent modification to the physical geometry triggers automatic re-validation or alerts, without requiring manual re-entry of data into a separate, standalone calculation tool.

3.5 Comprehensive Earthing/Grounding System Modelling

The system shall natively model the complete earthing/grounding system — including conductors, earth rods, nodes, and connections — fully integrated into the 3D layout and BOM, with the capability to export the earth mat design in DWG format.

3.6 Point Cloud and Brownfield Survey Integration

The system shall natively import and register terrestrial laser scanning (LiDAR) point cloud data, with semi-automatic conversion of survey data into engineering-ready, intelligent parametric objects suitable for retrofit design and interference checking. For Owners requirement of modernizing old substations (brownfield projects) the solution shall provide AI/ML-assisted recognition of substation equipment from LiDAR point clouds and semi-automatic conversion into intelligent parametric 3D objects suitable for engineering reuse. It should analyze LiDAR point clouds, automatically recognize high-voltage equipment, and convert raw scans into intelligent, parametric 3D BIM assets with a few clicks.

The system shall further provide automated clearance validation of proposed new assets against existing site infrastructure captured through survey point clouds.

3.7 Extensive Pre-Engineered Component Library

The software shall include comprehensive libraries covering equipment, structures, clamps, connectors, insulators, fittings, conductors, foundations, cable trenches, earthing components and accessories required for 765/400/220/132/66/33kV substations.

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3.8 Full Model-to-Deliverable Automation and Associativity

The system shall support a multi-user, collaborative engineering environment in which complete associativity is maintained between model objects and all generated deliverables (drawings, BOMs, calculation outputs), such that design changes propagate automatically, without manual reconciliation across separate files.

3.9 Asset-Centric Digital Twin and Lifecycle Data Management

The system shall provide asset-centric digital twin visualization, with a unique identifier assigned to each modelled object, to facilitate continuity of lifecycle data from the engineering phase through to operation and maintenance (O&M). The software tool shall support transition into interactive environments so that it can generate a virtual reality model of the entire substation from the engineering data with one click. Users shall be able to virtually walk through the environment, measure clearances, review construction sequencing, and simulate active switching operations or current flows before any steel is constructed on-site.

The software shall support association of physical assets with IEC 61850 logical nodes, equipment tags and asset identifiers and shall allow export of asset information suitable for Digital Twin and Asset Management systems. This will future-proof O&M integration.

4. As per the Bid Price Schedule (BPS), Supply, Installation and Commissioning (SIC) of the 3D Substation Design & Engineering Software is envisaged for **five (05) user licenses**.

The software shall support deployment through a centralized server architecture, enabling installation on multiple desktops/workstations (more than five, if required), while ensuring that concurrent usage is restricted to the number of licensed users specified in the BPS.

The supplier shall provide complete on-site and/or remote support for installation, activation, configuration, customization and commissioning of the software at the Employer's facilities located at **POWERGRID Corporate Centre, Gurgaon**.

The supplier shall also provide detailed installation manuals, administration guides, user documentation, video tutorials and hands-on knowledge transfer to POWERGRID's IT personnel, enabling them to independently install, activate, configure, administer and customize the software on new desktops or servers in future.

5. The software shall comply to following cybersecurity Requirements
 - Support role-based access control.
 - Support Windows Active Directory authentication.
 - Maintain audit trails.
 - Support encrypted project database.
 - Comply with POWERGRID Cyber Security guidelines.
 - Not require permanent internet connectivity for operation.
6. The software shall be supplied with a **perpetual license**. Continued use of the software after expiry of the support/maintenance period shall not require any mandatory recurring subscription, renewal fee or license activation charges.

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7. All the required computer software (programs, packages, databases, etc.) and the hardware components (other than Employer supplied desktop PCs with Microsoft Windows 11 operating system & AutoCAD software) for successful deployment and operation of this software module shall be deemed included in the contractor's scope.
8. All project models, libraries, templates, databases, customizations and metadata generated under the contract shall be the exclusive property of POWERGRID. No proprietary lock-in shall prevent export or reuse of project data after expiry of support period.
9. Licenses of 3D Substation Design & Engineering Software procured under this contract shall be in the name of POWERGRID.

10. Maintenance, Support and Training Requirement

The Contractor shall provide comprehensive maintenance and support services for a period of two (02) years from the date of software activation. The scope shall include Extended Technical Support and Additions, Enhancements & Updates, covering, but not limited to, the following:

- Software updates, service packs, version upgrades, security patches, bug fixes, troubleshooting and resolution of software defects, errors and performance-related issues.
- Any new modules, functionalities, features and enhancements released by the OEM during the support period without any additional cost.
- License activation, reactivation, migration, re-hosting and license management support, including transfer of licenses in case of workstation replacement, server migration, hardware failure or IT infrastructure upgradation.
- Support for migration of existing projects, databases, models and templates to newer software versions without loss of data integrity or functionality.
- Technical assistance and expert guidance for application of the software in engineering design, 3D modelling, project execution and resolution of project-specific engineering issues
- Periodic updates of equipment libraries, templates, catalogues and other software resources supplied as part of the software package including development of Standard Equipment Library as per Clause 2.2 above
- Testing of patches/updates has to be done in the test environment/lab prior to deployment in the production environment
- Any software update, patch or enhancement released during the support period shall not adversely impact cybersecurity compliance of the Employer's IT infrastructure and shall be supported by appropriate release notes and security advisories.
- Support for compatibility and interoperability with supported versions of AutoCAD, related CAD/BIM platforms, databases and other interfaces
- Support for current and future versions of Microsoft Windows operating systems released during the support period.
- Maintenance and support of all customizations, templates, databases, equipment libraries, parametric models, symbol libraries, reports, utilities and other deliverables developed or supplied under the present contract.

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- Submission of quarterly support reports detailing support activities carried out, issues raised and resolved, updates/upgrades provided, pending issues and implementation status at POWERGRID.
- Any other support, maintenance, corrective action or technical assistance required to ensure reliable, secure and uninterrupted operation of the software throughout the support period.
- Support requests shall be acknowledged and attended within timelines agreed with POWERGRID based on the criticality of the issue.
- The supplier shall also provide training on basic design concepts, operation and application of the software for a total of twenty (20) participants in at least three batches. Supply, installation & configuration of demo-version of the software (if required) for all trainees is deemed included in current scope. The objective of the training shall be to impart skills in creating 3D substation designs. Training shall include assistance for creation of 765/400/220kV substation model in software. Further, the OEM shall also share detailed documentation as well as video tutorials along with several pre-run examples for future use and training of Employer Personnel. The schedule and course content of training shall be submitted by the vendor and shall be approved by POWERGRID before commencement of training.
- Cost for support and training as above is deemed included in the overall cost of the software.