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1.0 Intent of specification

The Transmission Business group (TBG) of BHEL requires an “Engineering calculation platform for project engineering and automation of switchyard design calculation on unified platform” for sub-station / switchyard project engineering.

TBG executes the contracts of 765/ 400/ 220/ 132/ 66/ 33kV switchyards on turnkey basis for various utilities and power stations. The design of the switchyard is done in-house by TBG located at Noida. Design calculations are available in the legacy formats such as .xls, .doc etc. It is intended to facilitate project engineering by automating these design calculations on unified platform ensuring standardisation and reduction in project engineering time. This solution will also facilitate storing and auto- documentation of project specific design calculations for their use for future projects

Existing design calculations used in TBG are based on Excel sheets / templates. These are stored in individual workstations. The templates require regular updation whenever their applicable IS/ IEC/ IEEE standards gets updated. Moreover, as the calculations are stored at user level, the updation has to be done in every workstation and at times becomes difficult to retrieve and reuse of such calculations.

Using the unified advance engineering platform with user friendly front-end interface over the local network will help BHEL TBG in

- Automating and standardizing the switchyard design calculations
- Facilitating highly secure and enterprise wide calculation platform
- Easy updation of design calculations through authorized person only
- Standardising the output format / template with header and footer as per user requirement
- Ease of developing, adding and deploying any new design calculation
- Auto- documentation and retrieval of design calculations as the templates reside in the server and not on local machines.

It is not the intent to specify herein all the details of the system. However, the system shall conform in all respects to high standards of design, and shall be capable of performing to meet the requirements.

2.0 Scope

The scope consists of complete software based automated design solution and shall include the following –

- **Development of advanced engineering calculation platform for Design Calculations:**
Development & Implementation of software platform by converting/ migrating various design programs in Excel / Word (complete design, coding, testing and acceptance testing)
- **Development of front end user interface in VB.Net / MVC 4.0 or later/ Equivalent**
- **Deployment of Calculation Platform** on Intranet which shall also include project-wise storage/ retrieval of database using SQL server.

The vendor should develop an application package in current generation Windows technology. It will be an intranet based solution with Windows Server, Windows SQL server and relevant backbone engine for mathematical calculations.



The Vendor should migrate the calculations from excel, manuscript etc which will be verified and checked by BHEL team. Detailed SRS (software requirement specification) will be designed with vendor on finalisation of the contract.

The application should also provide the following

1. High level of security by storing the calculation templates in the server
2. Should provide auto documentation of the calculations once completed by the user in pdf/MS Word or any other format specified
3. All old calculations should be stored in the SQL server with easy view and retrieve facility.

Other requirements

1. The vendor should provide the source code for the application after the test / implementation stage to BHEL
2. The Vendor should provide maintenance for their switchyard design application during one year warranty post successful handing over of the application.
3. Vendor should provide training on the backbone engine used and how to modify the templates by the BHEL team

Notwithstanding what is specified in this document, it shall be the vendor's responsibility to configure the total solution so that it performs satisfactorily. The vendor shall bring to the notice of BHEL any incompatibilities that could hinder proper operation or additional items that may be required to ensure completeness of the solution offered.

BILL OF QUANTITY

S.No.	Description of Item/ Activity	Unit	Quantity
1.	ADVANCED ENGG PLATFORM for Design Calculations as per detailed BOQ** - Development of Calculation Platform for design calculations - Development of front end user interface in VB.Net / MVC 4.0 or later/ Equivalent - Deployment of Calculation platform on Intranet	Lot	1
2.	Training at BHEL TBG, Noida	Lot	1
3.	Documentation	Lot	1
4.	AMC after Guarantee Period	Year	1

** (1) Quantity variation for the number of design calculations shall be +/-30%. (2) BHEL reserves the right to delete some of the Design Calculations from BOQ during contract execution. (3) Sequence/ Priority of execution for the Design Calculation shall be decided by BHEL after placement of work order on the bidder.

3.0 General

The entire work covered in this Tender shall be entrusted to a **single vendor satisfying the qualifying criteria.**

3.1 Obligations of Bidder & BHEL

Deployment and training shall be at Noida. The developed platform shall be installed on BHEL's Server/computer and its satisfactory operation demonstrated. BHEL reserves the right to ask for replacement of manpower provided by the vendor, in case of unsatisfactory performance.



All the required computer software (Programs, Packages, etc) and the hardware (PCs etc) for development of this module have to be taken care of by the bidder. BHEL does not have any spare facilities to be extended for this project.

Any software package to be procured by BHEL shall be clearly brought out in the technical & commercial bid or during phase 1 of the execution stage. The software package will then be procured by BHEL before final deployment of the software. The software development work will be carried out on the licence of the bidder till the development work is over.

Bidder may visit BHEL TBG office for seeking clarity on the scope and other details prior to bid-submission. No commercial implication will be entertained during contract execution on account of scope clarity.

After placement of order, vendor to regularly visit BHEL TBG office for seeking inputs and share the WIP.

3.2 Technical Bid – Technical Proposal

A detailed technical proposal shall be submitted detailing the following -

1. Approach of work, methodology adopted, list of deliverables with respect to design system automation requirements along with Flow chart / Block Diagram for clear understanding of scope of work
2. Limitations of technical proposal
3. Assumptions / deviations with respect to the technical specs, if any, and expected technical inputs from BHEL team during the project execution.
4. Working modalities indicating computer systems & manpower proposed to be deployed at BHEL for this project.
5. List of all software programs / packages required to be used for the development of the software modules.
6. Proposed work schedule with duration so that total duration of the project does not exceed time schedule as per NIT.

3.3 Migration of existing calculation to advanced engineering platform

TBG has design programs (in Excel/ Word etc) which are to be converted in the proposed knowledge based automated design solution. The design documents as outputs shall be taken from the proposed solution.

The design programs that are to be automated alongwith building database are as follows:

SI No.	Design Programs	Relevant Standard	Complexity Level	Lookup Tables	Type	Program
(i)	Earthmat design	IEEE80	Medium	4	Electrical	Excel
(ii)	DSLIP Calculations	IEEE998 & Razevig method	Medium	0	Electrical	Excel
(iii)	Busbar Sizing for Conductor	IEC60947, 60664, 60439	Medium	7	Electrical	Excel
(iv)	Short Circuit Force on Conductors	IEC60865	High	7	Electrical	Excel
(v)	Cantilever strength analysis for rigid bus.	IEEE605 & IEC60865	High	0	Electrical	Excel

Sl No.	Design Programs	Relevant Standard	Complexity Level	Lookup Tables	Type	Program
(vi)	Sag & Swing Calculations	IS802	Medium	7	Electrical	Excel
(vii)	Soak Pit Design	Relevant Standard	Low	0	Electrical	Excel
(viii)	Battery & Charger Sizing	IEEE485	High	4	Electrical	Excel
(ix)	Aux Power Cable Sizing	BHEL input	Medium	5	Electrical	Word / Excel
(x)	Current and Voltage Transformer sizing	BHEL input	Medium	0	Electrical	Excel
(xi)	Relay Settings Calculations	BHEL input	High	3	Electrical	Excel
(xii)	UPS sizing	BHEL input	Low	1	Electrical	Excel
(xiii)	Aux Transformer sizing	BHEL input	Medium	2	Electrical	Excel
(xiv)	Selection of Lightning Arrester	BHEL input	Low	0	Electrical	Word / Excel
(xv)	NGR Sizing	BHEL input	Low	0	Electrical	Excel
(xvi)	Heat Load Calculation	BHEL input	Medium	0	Mechanical	Excel
(xvii)	Friction Loss Calculation	BHEL input	Low	0	Mechanical	Excel
(xviii)	Pump sizing & Reservoir sizing	TAC	Low	0	Mechanical	Excel
(xix)	Design of Retaining wall	IS456	Medium	0	Civil	Excel
(xx)	Design of Switchyard Structure (Beam, Towers, Equipment Support (Lattice and Pipe))	IS8021/ 1 IS8021/2	High	2	Civil	Excel
(xxi)	Design of foundation (Tower, Equipment Support Structure (Isolated and Combined))	IS456	Medium	2	Civil	Excel
(xxii)	Design of Cable Trench, Road, Drain, Culvert	IS456	Medium	2	Civil	Excel
(xxiii)	BOQ Estimation Sheet – Civil	BHEL input	Medium	0	Civil	Excel

Complexity Level

HIGH – The design calculation involves multiple .xls/ .doc sheets with large number of variants as inputs and/ or intermediate calculations/ values alongwith a few graphical representations in output format.

MEDIUM – The design calculation involves multiple .xls/.doc sheets with less number of variants as inputs and/ or intermediate calculations/ values.

LOW – The design calculation involves single .xls/ .doc sheet with less number of variants as inputs and/ or intermediate calculations/ values.



Relevant standards (IS/ IEC/ IEEE etc) alongwith BHEL inputs shall be given by BHEL to the successful bidder.

The software module shall be highly interactive in nature. User intervention is to be permitted at every stage of the design process.

The software module should have provision for editing / modifying the output results after every stage by the user.

The software module should be amendable for modification by BHEL after installation, if required.

The software module should be compatible with or able to migrate on new versions of the software packages used for development / running of the module.

3.4 System Manuals and CDs

Systematic and detailed documentation (system write-up, inputs, outputs, program logic, program code, assumptions, limitations, etc.) of all the work done shall be prepared and provided by the vendor. User manuals to facilitate easy operation of the customised solution shall also be prepared and provided for each module. 2 CDs shall be prepared for the system supplied. A list of manuals shall be submitted for BHEL's approval.

3.5 User Manual

User manual shall be provided to facilitate learning.

3.6 Acceptance Test Procedure (ATP)

Conducting Acceptance Test at end of each phase shall be the responsibility of the vendor. The vendor shall submit the Acceptance Test Procedure document for BHEL's approval. The output of each design program will be compared with the established reports/ outputs to benchmark each program. Four (4) set of inputs and output for benchmarking shall be provided by BHEL.

3.7 Guarantee - Technical Support of System Supplied

The developed software shall be guaranteed for trouble-free operation for a period of 12 months from its acceptance and installation at BHEL. In case of any defects observed during the operation of this module during this period, the Vendor shall render their services at no additional cost for rectification of the same. If required, the vendor shall physically visit the BHEL office on request.

Scope of technical support shall cover Trouble-shooting and rectification of mal-functioning in the software, fine tuning of software, updating of System documentation and user manuals as well as learning capsule.

3.8 Technical competency of project team


Engineering knowledge tends to be complex and diverse, so it is intended that the execution team involved in the KBE project shall have basic engineering knowledge. The biodata of the team should be enclosed alongwith offer for evaluation by BHEL.



4.0 Deviations Schedule

In case of any deviation from this specification, the same shall be indicated in the enclosed schedule of deviations. In the absence of duly filled schedule it will be assumed that the bid strictly conforms to this specification.

Vendor to note that deviations mentioned elsewhere in the bid, but not listed in the schedule of deviation will not be considered or entertained in the event of order placement.

	Schedule of Deviations				Specification Number:
					Sheet ___ of ___
Clause Number of Specification					
We, the undersigned, hereby certify that the above mentioned are the only deviations.					
Particulars of Vendor/Authorised Representative					
Name	Designation	Signature	Date	Company Seal	

5.0 Payment Terms

Payment shall be made after certification issued by BHEL Project Leader regarding the successful completion of scope of work as per the Payment Milestones defined in the Contract. The BHEL Project Leader shall be specified at the time of award of the Contract to successful Bidder.

Vendor shall submit the invoices to BHEL Project Leader within ten (10) days from the date of successful completion of job.

Payment terms shall be as follows:

Running Bill – 90% of the total value of work done phase wise.

Final Bill - 10 % after completion of total work as per contract agreement (after liquidating all defects and successful launch (i.e. Go LIVE)).

S.No.	Description of Item/ Activity	Remarks
1.	ADVANCED ENGG PLATFORM - Development of Calculation Platform for design calculation - Development of front end user interface in VB.Net / MVC 4.0 or later/ Equivalent - Deployment of Calculation platform on Intranet	} 90%



S.No.	Description of Item/ Activity	Remarks
2.	Training at BHEL TBG, Noida	90%
3.	Documentation	90%

6.0 Completion of Contract

Vendor shall deliver the complete scope of work within 3 months from the date of award of Contract and as per the time schedule approved during award of the contract.

The Vendor will use reasonable care and skill in providing the services and will be responsible for the quality of workmanship and accuracy of the deliverables. Vendor shall implement in-house quality control and shall carry out 100% quality checks before submitting to BHEL for acceptance.

The Contract shall be considered successfully completed upon acceptance of deliverables by the BHEL Project Leader.

Vendor will be responsible for adherence to the material movement and security procedures of BHEL. Vendor shall not utilize services of BHEL employees for carrying out contract jobs. In case of violation of this condition, the contract will be terminated without any notice.

7.0 General terms and conditions – Technical & Intellectual Property Rights

- Vendor shall treat all information that is generated in connection with this assignment as absolutely confidential. All information, analysis, reports and recommendations both in the form of hard copy or on electronic media will be the property of BHEL and must not be used by the vendor for any purpose other than this assignment. All bidders are required to sign non-disclosure agreement with BHEL.
- Vendor shall indemnify BHEL any copyright or legal liabilities that may arise in use of the developed software or the methodology / models / techniques used by the vendor in development / implementation of the software module.
- All source code as well as other deliverables generated under this works will become the property of BHEL.
- Complete confidentiality shall be maintained by the vendor of all information/ documents as well as model data, etc. provided by BHEL for trouble shooting, etc.

8.0 Detailed terms and conditions for Services

- Necessary standardisation, definition of processes for transfers and integration, etc. shall be ensured by vendor.
- Systematic and detailed documentation (system write-up, inputs, outputs, program logic, program code, assumptions, file/data structures, limitations, etc.) of all the customisation done shall be prepared and provided. User manuals to facilitate easy operation of the customised solution shall also be prepared and provided for each module.
- BHEL shall make pro-rata deductions for unsatisfactory support performance.



9.0 Annual Maintenance Clause (AMC)

AMC Period: This shall be with effect from completion of total work as per contract agreement and after guarantee period is over (after liquidating all defects)

AMC Clause:

1. Ensuring the proper functioning of software solution by providing patches for bug fixing, latest version of software.
2. Testing of patches / updates has to be done in the test environment / lab prior to implementation in the live server.
3. Support for current and future versions of windows.
4. Maintenance, improvement and clean-up activities of backend.
5. All customization as part of specification being provided by vendor to BHEL TBG shall be covered under AMC.
6. Report on activities completed by vendor at BHEL TBG as part of AMC has to be submitted at the end of each quarter. List of patches / updates issued by the vendor during the quarter and implementation status at BHEL TBG has to be included in the report.
7. Updation of data/ fields in the form(s) in order to deliver correct output.

AMC Payment Terms:

Payment shall be made after certification issued by BHEL Project Leader at the end of each quarter regarding the successful completion of scope of AMC work

10.0 Training

The vendor shall indicate precise training requirements as per the solution offered. The schedule for training shall be indicated by the vendor and finalised based on mutual agreement between the vendor and BHEL. The vendor shall provide training at BHEL premises.

Complete training programme including contents and course material etc. shall be approved by BHEL before commencement of training. Course material/book and faculty shall be provided by the vendor.

1. Software training shall be imparted by well-qualified and experienced faculty.
2. Training curriculum shall include training on the complete system including new software (if any) so that the engineers are able to operate the system and generated all the deliverables (design document & Training).
3. Complete training programme including contents and course material etc. shall be approved by BHEL before commencement of training.
4. The training shall be conducted at BHEL Noida (approx 25 employees).
5. Minimum hardware configuration to be deployed for training, in case hardware is to be provided by BHEL, to be mentioned.

11.0 Progress Reporting and Review

Fortnightly progress reports shall be submitted by the vendor to BHEL, indicating progress, bottlenecks, resource deployment. Structured review meetings shall be held bi-monthly with BHEL.



12.0 Time Schedule

A tentative time schedule format for project implementation after placement of order is three months (12 weeks) from the date of LOA. The vendor shall provide a detailed schedule for BHEL's approval.

In the event of placement of order by BHEL, immediately on receipt of order, the vendor shall depute technical personnel with requisite specialisation and experience to interact on collection of inputs, details of existing design process, solution proposed, details of interface required for Excel/ Word etc., finalisation of schedule of customisation, etc.

Sl No.	Design Documents	Relevant Standard	Complexity Level	Type	Program	Forms	Output Report	Graphs
1.	Earthmat design	IEEE80	Medium	Electrical	Excel	1	1	N
2.	DSL P Calculations	IEEE998 & Razevig method	Medium	Electrical	Excel	2	1	N
3.	Busbar Sizing for Conductor	IEC60947, 60664, 60439	Medium	Electrical	Excel	1	1	N
4.	Short Circuit Force on Conductors	IEC60865	High	Electrical	Excel	3	1	N
5.	Cantilever strength analysis for rigid bus.	IEEE605 & IEC60865	High	Electrical	Excel	1	1	N
6.	Sag & Swing Calculations	IS802	Medium	Electrical	Excel	1	1	N
7.	Soak Pit Design	Relevant Standard	Low	Electrical	Excel	1	1	N
8.	Battery & Charger Sizing	IEEE485	High	Electrical	Excel	4	1	Y
9.	Aux Power Cable Sizing	BHEL input	Medium	Electrical	Word / Excel	2	1	N
10.	Current and Voltage Transformer sizing	BHEL input	Medium	Electrical	Excel	2	1	N
11.	Relay Settings Calculations	BHEL input	High	Electrical	Excel	4	1	Y
12.	UPS sizing	BHEL input	Low	Electrical	Excel	1	1	N
13.	Aux Transformer sizing	BHEL input	Medium	Electrical	Excel	1	1	N
14.	Selection of Lightning Arrester	BHEL input	Low	Electrical	Word / Excel	1	1	N
15.	NGR Sizing	BHEL input	Low	Electrical	Excel	1	1	N
16.	Heat Load Calculation	BHEL input	Medium	Mechanical	Excel	1	1	N
17.	Friction Loss Calculation	BHEL input	Low	Mechanical	Excel	1	1	N
18.	Pump sizing & Reservoir sizing	TAC	Low	Mechanical	Excel	1	1	N
19.	Design of Retaining wall	IS456	Medium	Civil	Excel	2	1	N
20.	Design of Switchyard Structure (Beam, Towers, Equipment Support (Lattice and Pipe))	IS8021/ 1 IS8021/2	High	Civil	Excel	10	1	N
21.	Design of foundation (Tower, Equipment Support Structure (Isolated and Combined))	IS456	Medium	Civil	Excel	10	1	N
22.	Design of Cable Trench, Road, Drain, Culvert	IS456	Medium	Civil	Excel	5	1	N
23.	BOQ Estimation Sheet – Civil	BHEL input	Medium	Civil	Excel	5	1	N