PSGSG/15 -16/004	**Product Specifications For SOFTWARE FOR CB ANALYSIS**	Drg. No.	
		Date	02/07/15
		Product	**GSM**

1.0 **Application** : Used to design gas circuit breaker, other switchgear modules and analyze their performance for various test duties.

2.0 **Software** : A licensed copy of software to run at BHEL.

3.0 **Configuration** : Configuration of the desktop / workstation with necessary Operating system shall be clearly specified.

4.0 **Quantity** : 1 No.

5.0 **Background to the software Requirements:**

In high voltage substations, whenever there is a fault, SF6 (Sulphur hexa fluoride) gas circuit breaker opens and interrupts the fault current in the order of 1 kA to 100 kA depending on system voltage. During current interruption, circuit breaker contacts open at a speed in the order of 5 to 12 m/s. The interruption of current takes place within a time period of 8 to 30 milli seconds. The healthy breaker shall interrupt the above fault current in this short duration and withstand for a transient recovery voltage specified by standards. Physically when circuit breaker opens, an arc is struck between the contacts. The length of arc is not fixed and increases as time progresses. The arc length changes from 0 to about 200 mm and may be more in higher system voltages in the above time duration. Technically, at each time step, length of arc increases and profile changes depending on short circuit current. Precisely, breaker model also changes due to new positions of contact system at each time step.

6.0

Basic requirements of switchgear analysis :

1. Circuit breaker model is not same at each time step. To analyze circuit breaker, it is required minimum of 15 to 20 time varying models and may be more in higher

voltage systems. Technically, the output of first dynamic model shall be given as input to the second dynamic model.

2. By using the present software it shall be possible to estimate transient thermodynamic properties like gas pressure, temperature, gas flow rate, velocity, density, mach number, electric field levels, voltage withstandable levels etc.

3. It shall be possible to calculate E-field levels accurately across inter-electrode system and from high voltage terminals to grounded enclosures. The software shall have provision to calculate with-stand able voltage of the breaker model, conductivity of arc channel, electric field levels for circuit breaker geometry etc. Suitable provision shall be made to consider ablation of contact / nozzle material and its impact on gas pressure rises, mass flow rate etc.

4. The software shall have provision to consider SF6 gas properties at all temperatures, pressures and densities to calculate distribution of gas pressure rises, densities and gas flow rates. In other words, properties of SF6 gas under various conditions should be available to analyze the gas Circuit breaker model.

5. Most importantly, the modules developed by the vendor shall be integrated and brought out as a one module. Most importantly, during analysis, if design fails at any time instant or at any module, the user shall have provision to optimize the design without going into each sub module. It is also important that all the modules shall be available as single software.

6. The software shall be able to perform hot gas flow analysis at temperatures in the order of 20000K and cold gas flow analysis at room temperatures. The module shall have provision to consider gas properties at all possible gas temperatures and gas pressures.

7. The module shall able to calculate electrostatic field levels across contact system as well as from contact system to ground under arcing conditions. The module shall consider conductivity of media for the estimation of these levels. The module shall also calculate these parameters under normal operating conditions (without arc / small currents like capacitive switching duty)

8. The software shall analyze all three dimensional geometries along with two dimensional geometries for all performance parameters.

9. The module shall also be able to estimate withstandable voltages across inter electrode geometry as well between high voltage and ground parts of switchgear. These results shall be available for all conditions of the switchgear like during arcing, current interruption, normal working conditions etc.

7.0 **Scope of Supply:**

Software shall provide the following modules to analyze gas circuit breakers of various voltage and short circuit current level designs:

- Pre/Post Processor
- CFD Module for Cold Gas Flow Analysis
- CFD Module for Hot Gas Flow Analysis
- Electric Field Analysis Module
- Capacitive Current Interruption Module
- Dielectric Performance Module –I (Phase to Ground)
- Dielectric Performance Module –II (Inter-Electrode)

8.0 **Input and Output Parameters:**

The circuit breaker model will be provided as input with parameters like gas pressure, density, arc current, type of current waveform, arcing time, speed of the contact etc. The

software shall be in a position to import models from CAD drawings like ACAD in the format of .dwg or .dwx or equivalent. Supplier shall specify all possible drawing formats that are possible to import as models.

The software module shall produce results with output parameters of temperature distribution, gas density distribution, gas pressure distribution, withstand voltage across high voltage parts, electric field levels, mach numbers etc. The software shall have provision to carry out post analysis of results.

9.0 **Pre-Qualifying requirements:**

The bidder should have supplied and installed same software for similar applications to other switchgear manufacturers or R&D units. The software shall be proven and should have been in operation for at least 2 years. Bidder shall furnish experience list of at least two recently (last 2 years) executed contracts.

10.0 **Qualifying requirements:**

The bidder shall provide solution document for the sample problem provided by BHEL. The sample problem from BHEL covers a sample design model of circuit breaker which shall be analyzed using the software proposed. Sample problem shall be provided to those bidders who are willing to participate in the bid. Successful bidders offer only will be considered for price bid.

11.0 **Results to be produced for the sample model to evaluate the software capability:**

The bidder shall provide following results for the model provided to the satisfaction of BHEL for technical compliance:

1. Performance parameters like pressure, density, temperature, electric field and mach number distribution at 63 kA full short circuit current (100%) for arcing time of 12 and 21 ms.
2. Performance parameters like pressure, density, temperature, electric field and mach number distribution at 6 kA full short circuit current (100%) for arcing time of 10 and 19 ms.
3. Performance parameters like pressure, density, temperature, electric field and mach number distribution for capacitive current switching of 400 A at arcing time of 6 and 8 ms.
4. Performance parameters like pressure, density, temperature, electric field and mach number distribution under no-load conditions.

Preferably voltage withstandability levels across inter-electrode gap shall be generated for above configurations. A downloadable demo version of the software with a limited life time shall be offered, preferably by the bidder.

12.0 Guarantee Certificate:

Guarantee certificate for the period of 24 Months from the date of installation of software shall be furnished along with the supply.

13.0 Procedure for submission of offer:

Complete detailed technical offer and the price bid offer shall be furnished separately. After complete evaluation and acceptance of technical offer only, the price bid will be opened.

14.0 Documentation:

The bidder shall provide full documentation viz. operating manuals, operating instructions, sample model studies for the software.

15.0 **Training:**

The bidder shall provide sufficient training to BHEL personnel to analyze switchgear designs. The training shall cover aspects of modeling, analysis, overcoming convergence related problems, validation of results, solving sample problems etc. The supplier shall include and state in their tender the training necessary for the above aspects of the software and terms and conditions, if any.

16.0 **Technical support:**

The supplier shall take responsibility to give full technical support for all the software problems or issues related to the supply under the contract. The supplier shall take responsibility for the maintenance of software for the next 5 to 10 years with improvements and new versions, if any. Necessary terms and conditions for the Annual Maintenance of the software shall be indicated in the offer.