Technical Comments and Clarifications - STATCOM

File	Clause	Item	Technical Specifications	Any Exception/Deviation/Clarification	GETCO Reply
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	3	Scope of Work	The total cumulative Capacitive (+ve) and Inductive (-ve) MVAR rated Capacity of STATCOM Station comprising of STATCOM, Coupling Transformer, Coupling Reactor or any filter (if applicable) shall be rated at 1 p.u. voltage, 1 p.u. frequency and 20 deg C ambient temperature at 220 kV Bus (Referred to as “Point of Common Coupling” or PCC).	Bidder would like to clarify that the sign convention for capacitive and inductive operation is chosen as per the VI diagram in Figure 2 and 3 of specification and as per IEEE 1052-2018 i.e., capacitive MVAr as -ve and inductive MVAr as +ve. The guranteed MVAr is provided at a maximum ambient temperature. Kindly provide the maximum ambient temparature of the location.	The respective clause has been amended. Kindly refer the Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	3	Scope of Work	The nominal capacitive and inductive reactive power output of the STATCOM should be as defined in the scope, at 1.0 p.u. ac bus voltage and nominal system frequency, and 20°C ambient temperature (Point A and point B of figure-2).	Bidder understands that he cumulative capacitive and inductive reactive power of the entire statcom station is sized at 1 pu voltage, 1 pu frequency and maximum ambient temperature. Kindly provide the maximum ambient temparature of the location. The harmonic performance of the STATCOM station has to be validated for 0.9 pu to 1.114 pu voltage and for a frequency range of 48.5 Hz to 50.5 Hz. The STATCOM station equipments would be such that it is possible to operate them continuously for the under the worst possible combination of steady state voltage and frequency range of 198 kV to 245 kV and 47.5 Hz – 52.5 Hz. Please confirm our understanding.	For ambient temperature, The respective clause has been amended. Kindly refer the Addendum. The requirement is well detailed in the bid documents and shall be considered accordingly.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	5.1	STATCOM Station Ratings	Temporary Overvoltage (at PCC) & Duration up to 330 kV (1.5pu) 10 seconds up to 387 kV (1.76pu) 100 m sec up to 440 kV (2.0pu) 50 m sec STATCOM Station may be tripped if the respective temporary over voltages as mentioned above persists for more than its respective mentioned duration.	Bidder understands that as per the latest amendment on STATCOM specifications by CEA/CTU, the STATCOM should continue to absorb reactive power for the following Temporary Overvoltage points and durations. Nominal Voltage (pu) Minimum time for remaining connected to the Grid V > 1.50 - Instantaneous trip 1.50 ≥ V > 1.30 - 100 milli seconds 1.30 ≥ V > 1.114 - 10 seconds V ≤ 1.114 - Continuous	The respective clause has been amended. Kindly refer the Addendum.
		Substation Details - 220KV Sagapara SS	Ambient air temperature : 28 ‘C	Bidder requests customer to provide the maximum ambient temperature that is seen in this region. This input is needed to size the STATCOM and its associated outdoor components accordingly.	For ambient temperature, Kindly refer the Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	5.1 f) & 8.1	STATCOM Station Ratings & STATCOM Unit/Branch	The STATCOM Station should be capable of repeating temporary operation as defined in any one of item (d) and (e) as above for at least 3 charging cycles in 60 minutes . & The charging resistor for DC capacitor of STATCOM Sub module should be designed for three charges per hour followed by appropriate cooling time.	Bidder understands that the duration between two consecutive cycles is approximately 19 minutes. (3 cycles in 60mins). The text in IEEE 1052-2018 8.1 i) also says "repeating temporary operation every ___min". Please confirm the duration between two consecutive cycles.	It shall be as per technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	5.1 j)	STATCOM Station Ratings	The injected harmonics by STATCOM Station under the full operating range measured at 220 kV Bus (PCC) in accordance with IEEE 2800 and limiting values of individual harmonic distortions and total harmonic distortion shall be shall be as per Annexure-II.	Bidder understands that a calculation based report is to be submitted during the detailed engineering stage, evaluating the injected harmonics by STATCOM Station under the full operating range calculated at 220 kV Bus (PCC) in accordance with IEEE 2800, and comparing the same with the limiting values of individual harmonic distortions and total harmonic distortion values given in specifications. No site measurement of harmonics is required as per the RFP. kindly confirm the understanding.	The requirement is well detailed in the bid documents and shall be considered accordingly.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.2.1	**Voltage Control mode (Automatic and Manual)**	**Voltage Control mode (Automatic and Manual)**	As per the IEEE 1052, Bidder has considered the Voltage control mode is automatic mode of operation only.	The requirement is well detailed in the bid documents and shall be considered accordingly.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.2.10	Coordinated reactive power control of external devices	To optimize the use of dynamic vars versus steady state vars, control of externally connected shunt capacitor or reactor banks shall be implemented. Such banks will be connected locally to a HV bus or/and at MV bus. For simultaneous control with the supplementary VSC current controller, coordination for the two functions shall be provided. External devices like MSCMSR can be switched ON or OFF to position the steady state operating point of the VSC so as to extend its dynamic range.	Bidder would like to clarify on whether additional control of any external shunt banks are to be included in the statcom controller. If yes, kindly provide the details of the same.	Substation details are already provided in Bid document. However, at present there is no such device connected to the existing bus. But, functionality is required for future use.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.2.13	Control of Direct Current	During STATCOM operations, any flow of direct current to transformer MV side must be less than 25% of transformer magnetizing current. DC current flow in the transformer should be minimized by an independent control function which minimizes DC current. For presence of up to 0.2% second harmonic in 220kV system, the STATCOM control should minimize dc current flow in the transformer.	Clarification: 1. Bidder would like to clarify that instead of providing an independent control function, bidder shall ensure that the coupling transformer is design such that any flow of direct current to the transformer's MV side will not drive the transformer into saturation.	The requirement is well detailed in the bid documents and shall be considered accordingly.

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File	Clause	Item	Technical Specifications	Any Exception/Deviation/Clarification	GETCO Reply
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.3	Under Voltage Strategy	It is essential that the STATCOM Station operates in a robust manner when transmission system under voltages appears. For transmission system voltages down to 0.15 pu, the STATCOM units must operate unrestricted, producing its rated capacitive current. The STATCOM must be designed to operate at transmission system under voltage, even considering that severe voltage unbalance scan appear. The STATCOM must not be restricted by short term negative sequence voltages up to 1.5%, appearing in conjunction with under voltages.	Bidder would like to clarify that the STATCOM will support the grid by injecting availabe capacitive reactive current and it will remain connected to the grid till undervoltage requirements provided in technical specifications. The amount of current an MMC valve can output during these scenarios is fault type dependent where the converter can output rated current for symmetrical faults but less current during unsymmetrical faults (since a portion of the converter capacity will be required for VSC valve DC capacitor balancing). Additionally, bidder would also like to indicate to the customer that the Undervoltage Strategy has been amended by CEA/CTU in the latest technical specification for STATCOM. Hence, kindly amend the same in the present specification as well.	The respective clause has been amended. Kindly refer the Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.4	Over Voltage Strategy	The system should be able to withstand any 3 phase, 5 cycle (100 ms) and single phase 10 cycles (200 ms) fault with consequent loss of a 220 kV double circuit line and loss of a 500 MW generator. The fault duration mentioned above correspond to time assumed for persistence of fault.	Bidder would like to inform that balanced faults will be Investigated in PSSE. Whereas balanced faults and unbalanced faults will be investigated in PSCAD/EMTDC.	GETCO will provide the PSSE base case file, which shall be used for the relevant studies.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.4	Over Voltage Strategy	The 220 kV system and equipment to which the STATCOM Station is connected are designed to with stand switching surge overvoltage up to 2.5 pu and power frequency over voltages up to 1.5 pu with initial value of the temporary overvoltage up to 2.0 pu for 1-2 cycles. Based on arrestor coordination and under the worst case scenario the 220 kV system phase to ground peak over voltages may be expected as follows i) 360 kVp for 03 peaks ii) 315 kVp up to 5 cycles iii) 290 kVp up to 1 second iv) 260 kVp up to 10 seconds	Bidder would like to clarify that the HVRT cycles mentioned in section 5.1 e) (1.3 pu for 10 seconds and 1.5 pu for 100 msec) shall be followed for rating of 220kV system and STATCOM station equipments.	Query is not clear to us. However, the requirement is well detailed in the bid documents and shall be considered accordingly. For control part HVRT shall be followed. Where as for arrestor part, equipment shall be able to withstand the OV condition.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.4	Over Voltage Strategy	The contractor shall demonstrate to the satisfaction of the Employer that STATCOM Station will not excite ferro-resonance and sub-synchronous oscillation in the AC system.	Kindly clarify if the requirement for ferro resonance study is applicable as there are no MSC present in the STATCOM station.	Clause is revised, hence kindly refer the addendum. The requirement is well detailed in the bid documents & addendum and shall be considered accordingly.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.1.4	Over Voltage Strategy	The contractor shall demonstrate to the satisfaction of the Employer that STATCOM Station will not excite ferro-resonance and sub-synchronous oscillation in the AC system.	Bidder would like to clarify that he Unit Interaction Factor (UIF) screening study will be performed initially to determine the possible risk of sub-synchronous Resonance (SSR). Performing SSR would be evaluated based on the results of the UIF screening study.	Clause is revised, hence kindly refer the addendum. The requirement is well detailed in the bid documents & addendum and shall be considered accordingly.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.3	**MV Switchyard**	Medium Voltage (MV) delta bus shall be grounded through a Grounding Transformer (i.e. zig-zag winding Transformer) along with suitable resistor in the neutral.	Bidder would like to clarify that the requirement for Grounding Transformer along with neutral grounding resistor will be evaluated by the bidder based on their selected configuration for STATCOM. However, bidder shall ensure that all the protection zones are covered and the overall protection of the STATCOM Station is not compromised in any way. Kindly accept.	It's ok. The requirement for a grounding transformer will be finalized during detailed engineering.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.4.1	Radio Interference (RI)	With the STATCOM Station operating at any load upto rated value and within the design range of firing angle, the radio interference level from electromagnetic or electrostatic inductions generated by the STATCOM station shall not exceed 100 micro-volts/m, under fair weather conditions, at any point outside the station fence. The RI criteria shall be achieved at all frequencies within the range of 150 kHz to 300MHz and with the STATCOM operation at any level up to and including rated value, the design shall provide correcting measures, should the specified design not being realized in the final installation.	Performing and evaluating radiated emission at a closer distance than the substation length (i.e., inside the near field) is not relevant nor reliable when comes to electromagnetic fields in the range of 100 kHz – 10 MHz (where a STATCOM typically is a considerable source of interference). Additionally, at this distance, corona discharges and sparking from the adjacent substation will heavily inflict on the measurements. Any radio interference requirements at the substation boundary can therefore not be considered by the bidder. Bidder considers that Cigré Technical Brochure 391 is the only applicable standard to evaluate electromagnetic disturbance from a FACTS application and the bidder's VSC solution shall meet the requirements proposed by the same. This relates to levels, distances as well as measurement procedure. The RI limit levels will vary based on the frequency range., Hence the the limits specified in CIGRE 391 std will be fulfilled. Further, it is assumed that the measurements will be done at a distance as clarified in earlier tender. "The level of Radio Interference in the mentioned frequency range shall be guaranteed at the boundary of the substation or 500m from the STATCOM station fence, whichever **distance** is higher."	The respective clause has been amended. Kindly refer the Addendum.

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GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.7.5	Leakage Distances	However, the leakage distance for all AC insulators for outdoor installation shall not be less than 25 mm/kV of the maximum operating phase to earth rms voltage at the insulator. The leakage distance of equipment connected to 220 kV systems shall not be less than 6125 mm.	Bidder understands that insulators and bushings all the equipments, except coupling transformers shall confirm to a minimum creepage distance of 25 mm/kV. Coupling transformers shall confirm to a creepage of 31mm/kV. Kindly confirm.	It shall be as per the price schedule and technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.8.8	**Guaranteed Failure Rate OF Sub modules**	**Guaranteed Failure Rate OF Sub modules** (including all component and electronic): The maximum annual guaranteed failure rate of sub module (including all component and electronic) shall not exceed 1.0% per STATCOM.	In case of failure of any one of the power electronic switches (IGBT or equivalent) within the cell (sub-module), the STATCOM will still operate without interruption (operate in Zero voltage bypass mode) and without derating the rated output capability. Hence, it is not considered as failure, since it is a robust designed control philosophy. However, in the event of any component failure in sub module leading into reduction in STATCOM output capacity will be considered as sub module failure.	The respective clause has been amended. Kindly refer the Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.5	**Audible noise**	1) Valve Hall (Inside 90 dBA) 2) Control Room Building* 60 dBA	1) Access to Valve room is NOT possible during operation. Hence, the sound in this room during operation should not be of interest and during maintainance all the equipments will be in OFF condition. 2) High sound producing sources housed indoors shall be placed in designated separate rooms with the said rooms exempt from overall indoor sound requirement. warning signage and PPE shall be provided by bidder for the said rooms. (Eg. Voltage Stabilizer, Pump skid, UPS/Battery Power System)	1) The values provided are over and above the ambient noise value. It is ok and for valve hall, measurement shall be done at the nearest accessible point. 2) It shall be as per technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.6.2	**Loss Requirements**	The total losses shall include all components, as well as different parts or subsystems of complete STATCOM Station such as coupling transformer, All VSC systems and components, Resistor and Reactors, Control and protection systems, including ancillary devices such as HMI, fault recorders, and SCADA, Auxiliary Power supply systems, Cooling systems, Building ancillary services such as lighting, air conditioning, heating, and ventilation.	Bidder understands that the losses include, besides the main equipment losses, the power required to operate the auxiliary systems necessary for the STATCOM Station's continuous operation. These auxiliary systems include STATOM Station control systems, all cooling equipment for the transformer(s) and the valve and other HVAC system in the building that is essential for STATCOM operation. Losses in switchgear, busbars (inside and outside STATCOM building), cables, connectors, lighting etc. are excluded.	Requirement is clearly mentioned in specification and it shall be as per specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.6.4	**Loss Requirements**	Further for equipment/systems, whose loss measurement cannot be done during Factory Acceptance Test, the same can be measured at site, and a combination of calculation and measurement shall be used to derive the total losses as specified above.During Loss measurement, all fans and pumps; valve room and control room air-conditioning system shall be switched on. However, redundant fans, pumps & air-conditioners shall be kept off during loss measurement.	Bidder understands that there is no site measurement required for losses, if the bidder is able to provide losses of individual equipment either through FAT or by providing a calculation based result for individual equipment losses. The loss evaluation report shall also contain calculation based results of the overall losses of STATCOM Station.	Requirement is clearly mentioned in specification and it shall be as per specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	6.7.1	**Arresters**	All equipment including Transformer Bushing and Winding - SIWL = 1050 kVp	Since the voltage level at HV side is 220 kV, bidder understands that the SIWL requirement is not applicable for this package. Please confirm.	The respective clause will be amend in the Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	7.1	**Design Reports and Design Reviews**	Any other relevant report requested by the Employer	Bidder shall propose a list of project deliverables, which shall be submitted during the tender stage. Based on this list, bidder would like to request the customer to give their comments / inputs / any list of additional documents needed, during the tender stage itself.	Bidder can propose deliverables during bidding stage and supportive documents. But, detailed review of all the deliverables shall be at engineering stage in the event of order as mentioned in specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.1 & 8.7	**STATCOM Unit/Branch & Coupling transformer**	Rated Voltage - 20kV Minimum & The Medium Voltage side of the coupling transformer to couple with the STATCOM shall not be less than 20KV to ensure optimum power transformation.	Considering the reduced size of STATCOM for the subject tender (125 Mvar), bidder requests the customer to allow the selection of Medium voltage as per the bidder's best practice of design.	Requirement is clearly mentioned in specification and it shall be as per Technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.1.3	**Sub module for Modular Multi-Level Topology**	In each fiber optic cable (having multiple fiber cores) used for control/communication purpose of sub-module at least two fiber cores shall remain available as spare for future use.	Alternatively, bidder understands that single core fiber optic cables with sufficient spare fibre optic cables as per OEM's best practice of design is also acceptable.	Requirement is clearly mentioned in specification and it shall be as per Technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.1.5	**STATCOM Valve Cooling system - j) & t)**	The cooling system should be designed and provided to permit work on faulty pump/ faulty fan without shutting down the system. & Replacement of certain cooling equipment (e.g., pumps, fans, cooler unit etc.), if defective, should be possible while the cooling system still operates.	It is not recommended to replace the faulty fan while the cooling system shall be in operation from safety point of view. However, the fan can be replaced during scheduled outage. Additionally as there is redundancy in form of extra fans in the cooler, therefore outage of any single fan will not affect the STATCOM station performance. Request you to kindly confirm.	The intent of specification is that, system should be taken over by redundant pump/fan and should continues running and not the running on fault pump/ fan.

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GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.1.7	**Tests on STATCOM Unit Valve**	All applicable tests i.e. Operational Type Tests (except Short-circuit test), Dielectric Type Tests & Test for valve insensitivity to electromagnetic disturbance shall be done as per latest edition of IEC 62927. Partial Discharge test shall be done during routine test of each sub module without DC Capacitor in addition to other routine/production tests specified in IEC 62927.	As agreed in previous STATCOM tenders, bidder shall offer type tested valves and offered valves shall have same design, sourcing of key components like semiconductor devices, DC capacitor and shall have proven field performance record. It was also agreed that contractor shall submit a type test assessment report to validate the relevancy of previous conducted type tests for the project design offered. Additionally, for the valves being supplied by the bidder from the Indian manufacturing facility, type test reports as per technical specification of valves from manufacturing facility of Collaborator/Parent/Principal of the bidder shall also be acceptable meeting the above requirements. Further to this, it was also agreed that PD test as a part of routine test shall not be applicable if all components of offered submodule (except of DC Capacitor) is not enclosed in a modular case. Bidder requests customer to kindly accept the same provisions from the previous bid in the present bid as well.	There is no any previous tender in recent past. So pl correct the query. Regarding pd test, respective clause has been amended. Kindly refer to Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.3.2 m)	**List of typical Protection functions for STATCOM Station**	**STATCOM TRF HV Bay Protection & STATCOM TRF MV Bay Protection** Directional Overcurrent & Ground over current protection (67, 67N)	Bidder proposes to offer INSTANTANEOUS PHASE OVERCURRENT, TIME DELAYED PHASE OVERCURRENT, INSTANTANEOUS RESIDUAL OVERCURRENT, TIME DELAYED RESIDUAL OVERCURRENT (50/51, 50N/51N) in our protection schematic. Kindly accept the same in place of 67, 67N.	It is very well mentioned in referred clause of specification and addendum. The protection functions listed above represent the typical protection requirements for the STATCOM system. The contractor may propose improved, optimized or additional protection functions based on their design philosophy and engineering practices. The final protection scheme shall be reviewed and finalized during the detailed engineering stage.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.3.2 m)	**List of typical Protection functions for STATCOM Station**	**STATCOM Branch Protection** (i) Redundant STATCOM Valve Differential protection (87 ST)	For Bus Differential protection (87): In STATCOM branch, measurement device of type Electronic Current Transducer(ECT) shall be provided to measure current in VSC legs with high accurracy are used.Conventional CT's are not used due to required measurement accuracy and measurment of DC currents. STATCOMs since 1996 have been designed without differential protection in the VSCs. Protection scheme is well-proven with excellent operational experience. Further, the power eletronic switches (IGBT or equivalent) will quickly be turned-off (e.g. within 1-2 ms) in case high currents flowing through the delta/star connected VSC converter. Such action will effectively convert differential protection into a simple instantaneous OC protection which is anyhow provided. Contractor base solution for protection of VSCs are much faster than a conventional differential protection. Please also refer to IEEE1052TM-2018.	It is very well mentioned in referred clause of specification and addendum. The protection functions listed above represent the typical protection requirements for the STATCOM system. The contractor may propose improved, optimized or additional protection functions based on their design philosophy and engineering practices. The final protection scheme shall be reviewed and finalized during the detailed engineering stage.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.3.2 m)	**List of typical Protection functions for STATCOM Station**	**STATCOM Branch Protection** (iv) Over current protection inside delta (50,51)	Bidder would like to clarify that in STATCOM branch, measurement device of type Electronic Current Transducer(ECT) shall be provided to measure current in VSC legs with high accurracy are used. Conventional CT's are not used due to required measurement accuracy and measurment of DC currents. Further, the power eletronic switches (IGBT or equivalent) will quickly be turned-off (e.g. within 1-2 ms) in case high currents flowing through the delta/star connected VSC converter. Hence, Valve overcurrent protection(VOCP) in statcom control system will provide the necessary overcurrent protection	It is very well mentioned in referred clause of specification and addendum. The protection functions listed above represent the typical protection requirements for the STATCOM system. The contractor may propose improved, optimized or additional protection functions based on their design philosophy and engineering practices. The final protection scheme shall be reviewed and finalized during the detailed engineering stage.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.5 g)	**Air core reactors for STATCOM**	All terminals shall be either tin plated or silver plated.	Bidder requests to also accept Nickel-plated Terminals as it provides better temperature withstand as compared to silver/tin-plated terminals. Please confirm.	The respective clause will be amend in the Addendum.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.7	**Coupling Transformer**	The Coupling Transformer shall be designed based on the design of similar type of Transformer which has been tested successfully for dynamic short circuit type test.	Bidder understands that the similarity of the proposed coupling transformer with a type tested reference transformer can be submitted by using either Annexure - A (Theoretical evaluation of the ability to withstand the dynamic effects of short circuit) or Annexure - B (Definition of similar transformer) of the IEC- 60076-5 standard.	It shall be as per tech. specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.9.2	**Transformer Characteristics**	1.14 (iii) & 1.17 (iv) Switching Impulse withstand Voltage : HV - 850 kVp	Bidder understands that SIWL requirement for voltages below 400 kV is not applicable.	It shall be as per tech. specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.9.2	**Transformer Characteristics**	1.3 Single / Three Phase Design As per Section-Project	Bidder requests the customer to provide the document "Section - Project"	It shall be three phase design.

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GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.10.1	**Circuit Breaker**	The Circuit Breaker shall comply with the IEC and all other relevant Standards, and as specified in this specification	Bidder understands that MV breaker is optional in case only single branch of STATCOM is connected to MV side of coupling transformer.	STATCOM bay configuration, may vary depending on the specific design adopted by the respective OEM. Different OEMs may employ varied technical approaches and configurations to achieve the intended STATCOM performance. Hence, the requirement of MV Breaker will be reviewed and finalized during the detailed engineering, taking into consideration system reliability, protection coordination, and operational flexibility.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.11	**STATCOM Station Auxiliary Power Supply**	The auxiliary AC supply system of each STATCOM Station shall consist of two main incomers and one emergency incomer from DG set. The two main incomers shall be required to be paired to act redundantly to help ensure a certain degree of reliability and availability.	Bidder understands that both Source 1 and Source 2 of the auxiliary power would be provided by the customer in the form of a 11kV feeder, which has to be stepped down by the bidder with two dedicated 11kV/0.415kV, XXX kVA step-down auxiliary transformers. Kindly confirm. Please provide the distance from the 11kV tapping point to the STATCOM boundary for both source 1 and source 2 auxiliary supply.	Scope is very well specified in bid document. However, for further clarity is mentioned hereunder. 11kV Cable up to LT switchyard shall be provided by GETCO. All other aspects shall be in the scope of bidder.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	9.1	**Engineering studies**	Report on main equipment rating and design.	Bidder shall provide the report indicated in Clause 9.1.1 (i) during detailed engineering of the porject. However, reports for (ii), (iii), & (iv) shall be submitted by the bidder along with the bid. Kindly accept	Requirement is clearly mentioned in specification and it shall be as per specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	10.2.1	**Factory test of controls**	The control system should be connected to a digital simulator with adequate representation of the electrical network for various conditions. The STATCOM Station controller needs to be representative of control functions, including basic controllers but inclusive of supplementary controls, firing controls, and protective functions integrated into the controllers.	Control system functional, and FAT will be executed with Thevenin Equivalent model of the external power system only. And, a carefully selected handful of system disturbances which give a good representation of the various controller operations will be studied in RTDS reduced network equivalent. By considering the limitations of RTDS (hardware limitations resulting in limited number of nodes available etc.), the bidder and Customer shall be discussed and agreed on the disturbances list up to 20 (i.e. switching of a load in the vicinity of the STATCOM, line tripping, load shedding, etc.) and the network size limited to 10 bus system.	Pertain to STU and Based on reply from STU department, query reply will be conveyed.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	10.2.2	**Factory test of controls**	The simulator should provide an accurate network representation including network harmonic behavior, as well as synchronous condensers, power stations, generators (with AVRs), and pump storage schemes, existing HVDC, SVCs and STATCOMs, future SVCs and STATCOMs, FSC (fixed series capacitors), and shunt reactors/capacitors/filters. The bidders and vendor should provide information on the simulator studies to the client prior to the tests being undertaken.	The primary objective of control testing is to verify and validate the control codes and logics developed for the operation of the STATCOM. Testing the control on a network equivalent does not provide any additional value compared to testing on a Thevenin equivalent. Historically, bidder has performed control testing on Thevenin Equivalent for all STATCOM projects. Conversely, the performance of the STATCOM system is evaluated through Dynamic Performance Studies, which assess the STATCOM's response to various network scenarios. Therefore, bidder shall perform the control system testing in the Thevinin Equivalent model.	Pertain to STU and Based on reply from STU department, query reply will be conveyed.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	10.3	**Site Pre-commissioning Testing**	q) Loss measurement as per clause No. 6.6	Bidder would like to clarify that the loss measurement of equipments would be carried out during the Factory Acceptance tests of equipments. There is no loss measurement required to be performed by the bidder at site. Please confirm the understanding.	Requirement is clearly mentioned in specification and it shall be as per specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure - I	**B. System Dynamic Performance study**	Studies to evaluate the interaction of the STATCOM controls with the other nearby control systems, other flexible ac transmission systems (FACTS) devices.	Control interaction will be performed in PSSE. Detailed models (nearby STATCOM, SVC and PV etc.) in close proximity to the STATCOM installations are required to be provided to the bidder in PSSE to investigate detailed interaction including dynamic representation (standard library or user written), if needed.	GETCO will provide details with NDA, (i) PSS/E software file for All India Network model file as Load Flow model, (ii) Credible Contingencies of GETCO Network: important / critical transmission elements in the Gujarat network considered. Bidder may also have considered Credible Contingency based on CEA planning Criteria, 2023, (iii) Dynamic file (.dyr) file or data available with GETCO, (iv) if dynamic data is not available for any transmission element, generic data shall be considered based on CEA planning Criteria 2023.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure - I	**B. System Dynamic Performance study**	Studies to verify the operation of any supplementary controls designed to damp power oscillations following system disturbances.	Bidder will perform the studies during dynamic performance study(DPS) given that the requested inputs are available. Following are the inputs required: 1. Full network representation in PSSE including dynamic of all devices contributing to the interarea oscillations modes 2.Modes of oscillation for which the POD controller will be tuned 3. Number of control loops required. 3. Contingencies which cause oscillations at the modes mentioned in 2 and the observed oscillations in the existing network. Please note that Any further tuning after the DPS study and commissioning period shall be separate scope of work.	GETCO will provide details with NDA, (i) PSS/E software file for All India Network model file as Load Flow model, (ii) Credible Contingencies of GETCO Network: important / critical transmission elements in the Gujarat network considered. Bidder may also have considered Credible Contingency based on CEA planning Criteria, 2023, (iii) Dynamic file (.dyr) file or data available with GETCO, (iv) if dynamic data is not available for any transmission element, generic data shall be considered based on CEA planning Criteria 2023.

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File	Clause	Item	Technical Specifications	Any Exception/Deviation/Clarification	GETCO Reply
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.2.1.	Control Equipment	c. Closed loop Controllers: The STATCOM Station controller shall have means to modify the reference set points. This refers to the functionality that will allow all the control parameters to be adjustable within selectable limits and is inclusive of, but not limited to following: o Voltage controller o Q controller (reactive power controller). o Supplementary VSC current controller. o Other supplementary control functions.	Bidder provides HMI with access to all parameters necessary for operation and configuration of the STATCOM. The reference setpoints for the closed loop controllers can be modified from the HMI. However the limit values for these controllers are derived from the deisgn and rating of the STATCOM. Hence they are hardcoded and do not have the feasibility to change them from HMI. To change such limit values, customer must approach bidder for a modified software package.	It shall be as per the technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.2.1. e)	Control Equipment	The Controller shall have at least 10% excess I/O capacity to allow future program upgrades to satisfy the changing requirements of the power systems or future extensions to the STATCOM Stations. As a minimum a control of up to 4 future HV shunt devices (reactors or capacitors) shall be included in the offer.	Bidder shall consider the control of such external banks on HV bus (4 in number) in the offer assuming that the banks are located in the same 220kV bus to which the STATCOM is connected to.10% spare I/O considered as per spec requirement.These spare IO's are calculated based on the present used/consumed IO's as per the equipment/switches in the present SLD.	It shall be as per the technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	8.4	STATCOM Station Fault Recording System	• All analogue signals (output signals) • All digital signals (control outputs, status indications, commands, alarms and trip indications). Internal STATCOM Station control signals/variables to be selectable. • The accuracy of the TFR for event inputs shall be at least 100 ps (sampling rate of minimum 10 kHz). • The TFR shall have provision for remote access and retrieval of recorded information on to a PC. For this purpose, a communication link to the Substation LAN shall be implemented. • The remote software application for the data retrieval shall be included.	Bidder will use the built-in fault recorder that is integrated into the control system. No external fault recorder will be provided. The integrated Transient Fault Recorder (TFR) is a built-in disturbance recorder, which is continuously recording pre-selected signals into a temporary location in the memory area. If a trigger event (trip or other pre-defined condition) should occur, the recorded data is written to files. The format of the fault recorder files is COMTRADE. One of the advantages of using the built-in TFR is that the actual signals that the main controller uses for control and protection will be recorded by default. This includes voltage and current measurements as well as essential internal control system signals. A later request for any internal control system signal to be added for recording can be implemented without adjusting the hardware design (outgoing I/Os and cabling). Only a software update will be required. A high resolution and a medium resolution TFR shall be included in bidder's offer by default. High resolution recordings, normally 10 kHz, are performed in DSPs, whereas normal recordings are sampled and recorded in the Main CPU, typically at a sample rate of 1 kHz.	It shall be as per the technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure I	**D) Electromagnetic transients, control performance, and overvoltage studies**	**b. Study of STATCOM Station protection and protection coordination.**	Bidder would like to clarify that the relay protection refer to physical relays that are outside the control system will be excluded in the models. However protective functions which are performed by the STATCOM Control system will be available in the models. Protection coordination study report based on the relay coordination calculation will be separately provided and is not envisaged to be performed on PSCAD.	The study can be performed by the bidder as per annexyure-1, if required.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure I	**D) Electromagnetic transients, control performance, and overvoltage studies**	Transient overvoltage studies should be performed with the actual controls modeled to verify that the STATCOM Station equipment is adequately protected against over voltages and over currents (including excessive valve recovery voltages) from power system transients resulting from switching, fault clearing events, and credible STATCOM Station mis-operations. Concerns that should be evaluated include the following: a. Study of start-up, including transformer energization, shutdown, switching coordination, and other local area network switching events. b. Study of STATCOM Station protection and protection coordination. c. Faults on the high-voltage (HV) and MV bus (single line-to-ground, phase-to-phase, and three-phase). d. Faults across the VSC, capacitors, and other equipment if used e. Control coordination between two STATCOM station operating on same PCC (220kV Bus), if applicable. f. Control interaction.	Control interaction will be performed in PSSE. Detailed models (nearby STATCOM, SVC and PV etc.) in close proximity to the STATCOM installations are required to be provided to bidder in PSSE to investigate detailed interaction including dynamic representation (standard library or user written), if needed.	The study can be performed by the bidder as per annexyure-1, if required.

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GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure I	**C. Software simulation models**	C. Software simulation models	1. Bidder would like to inform that models will be provided in the most recent versions (PSSE V34, PSCAD V4.6.3). And, IVF compiler XE 14.0.1.139 and will be used to run PSCAD STATCOM Model. 2. Please note that the models and model description report will be provided during project stage for the Bidder's STATCOMs which include the adjustable parameters, operational guidelines. Since the PSCAD and PSSE are block box, it would not be possible for the Bidder to provide detailed documentation.	GETCO will provide details with NDA, (i) PSS/E software file for All India Network model file as Load Flow model, (ii) Credible Contingencies of GETCO Network: important / critical transmission elements in the Gujarat network considered. Bidder may also have considered Credible Contingency based on CEA planning Criteria, 2023, (iii) Dynamic file (.dyr) file or data available with GETCO, (iv) if dynamic data is not available for any transmission element, generic data shall be considered based on CEA planning Criteria 2023.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure I	**C. Software simulation models**	The vendor should provide a detailed STATCOM Station dynamics model for use in (PSS/E33) power flow and stability simulation software. The model detail should be appropriate and complete for positive-sequence power system simulation and analysis that is typically performed with power flow and transient stability programs. All appropriate control features for such analysis will be modeled, and necessary documentation on the theory and use of model should be provided. Stability model should be non-proprietary and freely available for distribution.	It shall be noted that the provided models will be black-boxed. Bidder does not accept that the models can be provided to third parties without permission from bidder due to intellectual property and liability reasons. However, the model can be provided with a joint NDA between the third party and the bidder.	OK.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure I	**C. Software simulation models**	If any other proprietary softwares are used by the contractor for system control design, the contractor shall provide these softwares with perpetual license for use by the Employer.	Bidder will not be able to share the system control design and the perpetual license for the software used for control design as it is proprietary to the OEM. Kindly remove this requirement from specification.	It shall be as per technical specification.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	10.1	Type test	However, in that case, bidder shall have to submit the type test reports of the offered equipments, free of cost, within commencement period, without affecting delivery schedule, in the event of order.	Bidder would like to clarify that there will be no repetition of type tests if the bidder is submitting the valid type test report of the equipment used or if a type test assessment report comparing the equipment used with a previously type tested similar equipment of higher rating is submitted to the customer. Kindly confirm.	It is very well mentioned in the specification that, "TTR of similar equipments of higher ratings shall be considered for bid evaluation only. However, in that case, bidder shall have to submit the type test reports of the offered equipments, free of cost, within commencement period, without affecting delivery schedule, in the event of order". Accordingly, it shall be considered. Otherwise, a fully type-tested product shall be offered.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	3	Scope of Work	Complete Valve Hall and STATCOM control building (with foundation, cable trenches, plumbing, lighting, fire protection and electrical outlets as well as facilities for ambient temperature and humidity control, as required) to accommodate STATCOM valve, its cooling system, control and monitoring unit, protection system, auxiliary systems, service rooms, workshop, control room, LV Room, Battery room etc. shall be in the scope of this tender. In particular the following, but not limited to this, is included in Scope of Works:	Bidder shall consider the required rooms in the STATCOM building as per the clause 3 .If any additional rooms/buildings are required, the same shall be not in bidder's scope of work	Requirement is generic but not limiting. It is the bidders responsibility to consider overall requirement of the project as per their system. Also, civil specification needs to be referred for minimum dimensions of respective amenities.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	Annexure I	**B. System Dynamic Performance study**	Dynamic study model / Stability Model / Transient Model can be considered as generic model or as available with bidder.	Please be noted that generic models of FACTS devices are not available in PSCAD and RSCAD, which is also confirmed by the PSCAD developer. Generic model will be delivered only in PSSE. User-defined model will be delivered both in PSSE and PSCAD.	OK.
PSLD FINAL 220KV SAGAPARA SS.pdf	NA	NA	NA	Bidder understands that they are free to choose between Star or Delta configuration of the STATCOM, based on their best design practice for the requirements stated by the customer. Please confirm.	Bidder agreed to provide delta configuration during discussion.
PSLD FINAL 220KV SAGAPARA SS.pdf	NA	NA	NA	Bidder understands that the STATCOM portion in the PSLD provided is only for a reference. The solution provided by the bidder is allowed to be different from the PSLD provided and is accepted by the customer as long as the functional requirements of the STATCOM package is complied and the equipments that are necessary for the satisfactory operation of STATCOM is offered by the bidder. Please confirm this understanding.	The PSLD provided with the tender represents a typical STATCOM bay configuration, which may vary depending on the specific design adopted by the respective OEM. Different OEMs may employ varied technical approaches and configurations to achieve the intended STATCOM performance. Hence, the requirement of STATCOM will be reviewed and finalized during the detailed engineering, taking into consideration system reliability, protection coordination, and operational flexibility.
GETCO / E / TS –STATCOM 045 / R1 dated 17.08.2024	3	Scope of Work	STATCOM yard earthing system including connection to the existing substation earth mat	Kindly provide the details of the existing substation earth mat.	Attached herewith.

Technical Comments and Clarifications - STATCOM

File	Clause	Item	Technical Specifications	Any Exception/Deviation/Clarification	GETCO Reply
GETCO Price Bid format	Sheet name Supply	B : Supply and Erection of 220kV Materials considering 25mm/kV creepage distance (as per respective technical specifications and relevant special conditions) suitable for Two Main Bus and One Transfer Bus scheme with Twin AL59(61/3.50) conductor	S. No 4: 3T Capacity Split AC (reputed make) Valve Room S.No 5: 1.5T Capacity Split AC (reputed make) 1.SCADA Panel Room Cooling Room	Bidder would like to clarify that the sizing of HVAC shall be taken up by the bidder based on their civil design and layout. Hence, kindly revise the HVAC line items in the BOQ into "LOT/Lumpsum" quantities as it is based on the bidder's specific civil design.	It shall be as per the price schedule and technical specification.
GETCO Price Bid format	Sheet name Supply	BOQ for SPARES AND SPECIAL TOOLS TO BE SUPPLIED WITH 1 No. 220kV / xx kV ± 125MVAR, STATCOM Bay at 220kV SAGAPARA substation	A.STATCOM Power Modules B.STATCOM Equipments C : STATCOM Valve Control & Protection System D.Cooling system K. Tools / Tackles / Kits	Bidder would like to clarify that the spares for the STATCOM Station would be offered based on the RAM calculations only.	It shall be as per the price schedule and technical specification.

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File	Clause	Item	Technical Specifications	Any Exception/Deviation/Clarification	GETCO Reply
	Additional clause	Grid Forming	-	We also request you to consider the below feature in technical requirements which is been implemented by several Utilities Globally. GRID FORMING CONTROL The STATCOM shall be designed with capability of Grid Forming (GFM) functionality, with the core objective to emulate the behavior of a voltage source behind an impedance. This allows the Grid Forming STATCOM to instantaneously respond to changes in the power system (voltage magnitude steps, phase jumps, faults, etc.) and maintain STATCOM control stability during challenging network conditions. The Grid Forming behavior shall have the following characteristics: •Creating (forming) system voltage •Robust operation in grids with high and very low system strength (SCR <1) •Provision of positive- and negative-sequence current during faults, i.e. boost of the positive-sequence grid voltage and decrease the negative-sequence grid voltage •Behavior as L-R circuit for harmonics, similarly to a generator but with higher damping •Contribution to fault level (short-circuit current capability) •Provision of positive damping of oscillations •Prevent adverse control system interactions The Grid Forming STATCOM controller shall be optimized to rapidly control the HV voltage during load rejections and after single-phase, phase-to-phase, and three-phase faults on the transmission system. As well as further reduce the impact of single-phase, phase-to-phase, and three-phase faults while still be within the capability of the converter. It is expected that the Grid Forming STATCOM will inject current during and after a voltage dip to support voltage recovery. The injected current shall have a characteristic that helps to maintain the voltage at the PCC close to the pre-disturbance value while	STATCOM shall conform to the technical specification. In case the bidder intends to offer a Grid Forming Control STATCOM without any financial impact, the proposal will be evaluated and considered during the detailed engineering stage.