

TECHNICAL SPECIFICATION FOR SUBSTATION- ELECTRICAL WORKS

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1. GENERAL

- The Contractor shall ensure that the design, drawings, supply, construction, testing, and commissioning of all equipments, facilities, components, and systems of the Project shall be in accordance with Relevant Indian Standards (IS) and Codes issued by the Bureau of Indian Standards only.
- In case IS and Codes are not available for any specific equipments, the other equivalent internationally recognized Standards, and Codes shall be followed, with prior approval of KTL.
- It shall be the responsibility of all the bidders to acquaint themselves with the existing Kallam PS site conditions, approach road, availability of water & electricity, the area earmarked for Augmentation Work, and other associated necessities for successful commissioning & operation of the system defined in the scope of work.
- The proposed augmentation shall be conventional AIS type generally conforming as per the requirement of Technical Specification, CEA (Technical Standards for Construction of Electrical Plants and Electric Lines) Regulations 2010, as amended from time to time including revised regulations released in 2022.
- The mentioned scope of works shall be executed in accordance with the technical specifications specified below and existing Kallam equipments whose drawings or details shall be provided to bidders if required. However, the tentative SLD and plan layout marking the extension scope of work have been attached for reference purpose.

2. EXISTING CONFIGURATION OF KALLAM PS

Kallam Transmission Limited (KTL) was incorporated on May 28, 2020, for the development of a “Transmission System for evacuation of power from RE projects in Osmanabad area (1 GW) in Maharashtra” with the configuration defined below:

1. 2X500MVA, 400/220kV near Kallam PS
500MVA, 400/220kV ICT – 2 no.
400kV ICT bay – 2 no.
220kV ICT bay – 2 no.
400kV line bay – 4 no.
220kV line bay – 4 no.
2. 1x125 MVAr Bus Reactor – 1 no.
400kV reactor bay – 1 no.
3. LILO of both circuits of Parli (PG) – Pune (GIS) 400kV D/c at Kallam
4. 50MVAr switchable line reactor with 400 ohms NGR at Kallam PS end of
Kallam – Pune (GIS) 400kV D/c line
50MVAr, 400kV Reactor with bays – 2 no.

Additionally, there is an augmentation work that is currently under the execution stage with the configuration defined below:

1. Augmentation of Kallam Pooling Station by 2X500 MVA (ICT-3 & ICT-4)
500MVA, 400/220kV ICT: 2 no.
400kV ICT bay – 2 no.
220kV ICT bay – 2 no.
2. 1x125 MVAr Bus Reactor (BR-2) – 1 no.
400kV reactor bay – 1 no.
3. 220 kV lines (Line-5, Line-6 & Line-7) for RE interconnection
220kV line bay – 3 no.

Please refer to the provided SLD and layout for better understanding of the complete existing system and the tentative present scope of work. Detailed SLD and layout shall be prepared by the contractor and shall be submitted to KTL for review and approval.

The above substation is under construction.

The Kallam Substation is located in the Village- Selu, Tehsil- Washi, District- Osmanabad-413507.

3. SUBSTATION TECHNICAL SPECIFICATION (FOR AUGMENTATION WORK)

The design and specification of substation equipment are to be governed by the following factors:

A. Insulation Coordination:

S. No.	Description of parameters	400/220kV Kallam PS	
		400 kV System	220 kV System
1.	System operating voltage	400kV	220kV
2.	Maximum voltage of the system (rms)	420kV	245kV
3.	Rated frequency	50Hz	50Hz
4.	No. of phase	3	3
5.	Rated Insulation levels		
i)	Impulse withstand voltage for (1.2/50 micro sec.) - For equipments other than Transformers and Reactors - for Insulator Strings	1425kVp 1550kVp	1050kVp 1050kVp
ii)	Switching impulse withstand voltage (250/2500 micro sec.) dry and wet	1050kVp	-
iii)	One-minute power frequency dry withstand voltage (rms)	630kV	-
iv)	One minute power frequency dry and wet	-	460kV

S. No.	Description of parameters	400/220kV Kallam PS	
	withstand voltage (rms)		
6.	Corona extinction voltage	320kV	-
7.	Max. radio interference voltage for frequency between 0.5 MHz and 2 MHz	1000 micro-volts at 266kV rms	1000 micro-volts at 156kV rms
8.	Minimum creepage distance for insulator string/ long rod insulators/ outdoor bushings	13020 mm (31mm/kV)	7595 mm (31mm/kV)
9.	Minimum creepage distance for switchyard equipment	10500mm (25mm/kV)	6125 mm (25mm/kV)
10.	Max. fault current	63kA	50kA
11.	Duration of fault	1 Sec	1 Sec

B. Switching Schemes

The switching schemes, as mentioned below, shall be adopted at various voltage levels of the substation/switchyard:

Substation	400kV side	220kV side
400/ 220kV Kallam PS	One & half breaker (AIS)	Double Main & Transfer (AIS)

Transformers and bus reactors of the same HV rating shall be placed in different diameters (i.e., transformers of the same HV rating shall not be in the same diameter and similarly bus reactors of the same HV rating shall also not be in the same diameter).

C. Substation Equipment and facilities

The switchgear shall be designed and specified to withstand operating conditions and duty requirements. All equipment shall be designed considering the transmission line capacity.

S. No.	Description of bay	400/220kV Kallam PS	
		400kV	220 kV
1.	Bus Bar	4000A	4000A
2.	Line bay	3150A	1600A
3.	ICT bay	3150A	1600A
4.	Bus Reactor bay	3150A	-

D. 400/220kV, 3-Phase Transformer (Not Applicable)

500MVA 400/220/33kV 3 Phase transformer shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" available on the CEA website.

Notes:

- Remote tap changer control and monitoring system including the parallel operation of transformers shall be carried out using a Bay control unit or digital RTCC relay (IEC 61850 compliant) through Substation Automation System.
- The Auto Transformer shall have an ungrounded tertiary with its outdoor tertiary bushing terminals insulated.

For parallel operation, the new transformer shall meet the parallel operating conditions for transformers including the vector group, %age impedance and tap changer.

E. 420kV, 3-ph, Shunt Reactor (Not Applicable)

125 MVar, 420 kV, 3-Phase Shunt Reactor shall conform to CEA's "Standard Specifications and Technical Parameters for Transformers and Reactors (66 kV and above)" available on CEA website.

For each new transformer and reactor, the following fittings and accessories with suitable valves, as per CEA stated above, shall be provided for condition monitoring:

1. Online insulating oil drying system
2. Online DGA
3. Temperature transducer with PT100 sensor for each winding, if not considered already

F. Circuit Breaker (AIS)

The circuit breakers and accessories shall conform with IEC: 62271-100, IEC: 62271-1 and shall be of SF6 Type. The circuit breakers shall be of class C2-M2 (as per IEC) with regard to restrike probability during capacitive current breaking and mechanical endurance. The rated break time shall not exceed 40 ms for 400kV circuit breakers and 60 ms for 220kV circuit breakers. Circuit breakers shall be provided with single phase and three phase auto reclosing. The short line fault capacity shall be same as the rated capacity, and this is proposed to be achieved without use of opening resistors. The controlled switching device shall be provided in 400kV Circuit breaker of switchable line reactor and in Main & Tie circuit breakers of line with non-switchable line reactors and Bus reactors.

For more details, existing CB details must be referred to by the contractor during the detailed engineering.

G. Isolators (AIS)

The isolators shall comply with IEC 62271-102 in general. 400 kV and 220 kV Isolators shall be double break type. All Isolators and earth switches shall be motor operated. Earth switches shall be provided at various locations to facilitate maintenance. Isolators rated for 400kV and 220kV shall be of extended mechanical endurance class-M2 and 220kV isolators shall be **suitable for bus transfer current switching duty**. Main blades and earth blades shall be interlocked, and interlock shall be fail-safe type. 400kV and 220kV earth switch for the line isolators shall be suitable for induced current switching duty as defined for Class- B.

H. Current Transformers (AIS)

Current Transformers shall comply with IEC 61869 in general. All ratios shall be obtained by secondary taps only. Generally, Current Transformers (CT) for

400kV shall have six cores (four for protection and two for metering). 220kV Current Transformers shall have five cores (four for protection and one for metering). The burden and knee point voltage shall be in accordance with the requirements of the system including possible feeds for telemetry. The accuracy class for the protection core shall be PX and for the metering core, it shall be 0.2S. The rated burden of cores shall be closer to the maximum burden requirement of the metering & protection system (not more than 20 VA for metering core) for better sensitivity and accuracy. The instrument security factor shall be less than 5 for CTs up to 400kV voltage class.

For more details, existing CT details must be referred to by the contractor during the detailed engineering.

I. Capacitive Voltage Transformers (AIS)

Capacitive Voltage transformers shall comply with IEC 61869 in general. These shall have three secondaries out of which two shall be used for protection and one for metering. The accuracy class for protection cores shall be 3P and for metering core, it shall be 0.2. The Capacitive voltage transformers on lines shall be suitable for Carrier Coupling. The Capacitance of CVT for 400kV and 220kV shall be 4400/8800 pF depending on PLCC requirements. The rated burden of cores shall be closer to the maximum burden requirement of the metering & protection system (not more than 50VA for metering core) for better sensitivity and accuracy.

For more details, existing CVT details must be referred to by the contractor during the detailed engineering.

J. Surge Arresters (AIS)

336kV Station High (SH type) class gapless type Surge arresters & 216kV Station Medium (SM type) class gapless type Surge arresters conforming to IEC 60099-4, in general, shall be provided for 420kV & 245kV systems respectively. Other characteristics of the Surge arrester shall be chosen in accordance with system requirements. Surge arresters shall be provided near line entrances, transformers & reactors so as to achieve proper insulation coordination. Surge Arresters shall be provided with porcelain/ polymer housing fitted with pressure relief devices. A leakage current monitor with a surge counter shall be provided with each surge arrester.

K. Protection Relaying & Control System

The protective relaying system proposed to be provided for transmission lines, autotransformers, reactors, and bus bars to minimize the damage to the equipment in the events of faults and abnormal conditions, is dealt with in this section. All main protective relays shall be the numerical type with IEC 61850 communication interface and should have Interoperability during the integration of numerical relays to communicate over the IEC 61850 protocol with RTU/SAS/IEDs of different OEMs. All numerical relays shall have a built-in disturbance recording feature.

The protection circuits and relays of the transformer and reactor shall be electrically and physically segregated into two groups each being independent and capable of providing uninterrupted protection even in the event of one of the protection groups failing, to obtain redundancy, and to take protection systems out for maintenance while the equipment remains in service.

i. Transmission Line Protection (As Applicable)

400kV and 220kV lines shall have Main-I numerical three-zone distance protection scheme with a carrier-aided inter-tripping feature. 400kV and 220kV lines shall also have Main-II numerical distance protection schemes like Main-I but from a different make than of Main-I. The Main-I and Main-II protection relays of the same make may be provided only if they are of different hardware, manufacturing platform, or different principle of operation.

However, Line Current Differential relay (with backup distance protection feature) as Main-I and Main-II shall be considered at both ends for short lines (line length below 30km) having Fibre Optic communication link. The differential relay at the remote end shall be provided by the contractor. Associated power & control cabling and integration with SAS at the remote end shall be provided by the respective bay owner.

Further, all 400kV and 220kV lines shall be provided with single and three-phase auto-reclosing facility to allow reclosing of circuit breakers in case of transient faults. These lines shall also be provided with distance to fault locators to identify the location of faults on transmission lines.

The Main-I and Main-II protection relays shall be fed from separate DC sources and shall be mounted in separate panels.

For 400 kV and 220 kV transmission lines, a directional IDMT earth fault relay should be provided as a standalone unit or in-built feature of the Main-I and Main -II feature.

ii. Auto Transformer Protection (Not Applicable)

These shall have the following protections:

- a. Numerical Differential protection
- b. Numerical Restricted earth fault protection
- c. Numerical Back-up Over -current and earth fault protection on HV & IV side
- d. Numerical Over fluxing protection on HV & IV side
- e. Numerical Overload alarm
- f. Numerical Back up Impedance protection (HV Side)

Further, Numerical Back-up Over-current and earth fault protection on the HV & IV side of the autotransformer shall not be combined with other protective functions (except backup Impedance protection) in the main relays and shall be independent relays. Besides these, power transformers shall also be provided with Buchholz relay, protection against high oil and winding temperature and pressure relief device, etc.

iii. 400kV Reactor Protection (Not Applicable)

The reactor shall be provided with the following protections:

- g. Numerical Differential protection.
- h. Numerical Restricted earth fault protection
- i. Numerical Backup impedance protection

Besides these, reactors shall also be provided with Buchholz relay, MOG with low oil level alarm, protection against oil and winding temperatures & pressure relief device, etc.

iv. Busbar Protection

For existing substations, the existing bus bar protection shall be augmented as per requirement.

The Busbar protection Centralized unit and peripheral units (PUs) of each bay under the present scope of work are already available in Kallam PS in a spare panel. These available PUs shall be taken out from that spare panel and shall be mounted in the new CRP panels to be provided by the contractor. This work including integration shall be in the Contractor's scope or work.

v. Local Breaker Backup Protection

This shall be provided for each 400kV and 220kV circuit breakers and will be connected to de-energize the affected stuck breaker from both sides.

Notes:

1. LBB & REF relays shall be provided separately from the transformer differential relay.
2. LBB relay may also be provided as a built-in protection function of distributed bus bar protection scheme; however, in such case, a separate LBB relay shall be provided for tie bays (in case of One and a Half breaker scheme).
3. Over-fluxing & overload protection can be provided as a built-in feature of the differential relay.
4. In the 400kV switchyard, if a spare bay of half diameter is identified as future, the Tie CB relay panel shall be provided with Auto-reclosure feature.

L. Substation Automation System

The Bay control unit is to be provided bay-wise for voltage levels 220kV and above. All bay control units as well as protection units are normally connected through an Optical fiber high-speed network. The control and monitoring of circuit breaker, dis-connector, re-setting of relays, etc. can be done from the Human Machine Interface (HMI) from the control room.

The functions of control, annunciation, disturbance recording, event logging, and measurement of electrical parameters shall be integrated in the Substation Automation System.

Augmentation of existing SAS shall be done for bays under the present scope.

The integration of these new supply items with the existing SAS shall be within the scope of the contractor.

M. AC & DC power supplies

The modules/feeders in LTDB required for the present scope of work are available in the existing Kallam PS. For substation extension/augmentation, existing facilities shall be augmented as further required.

The capacity of existing 220V and 48V batteries is sufficient to cater to the LT load required for the proposed scope of work.

LT cabling (including AC and DC) in complete sense shall be ensured by the contractor for the successful commissioning of the proposed scope of work.

N. Fire Fighting System

Fire-fighting systems for substation including transformer & reactor shall conform to CEA (Measures Relating to Safety & Electric Supply) Regulations.

Further, adequate water hydrants and portable fire extinguishers shall be provided in the substations.

The main header of the firefighting system is suitable for extension to bays covered under the present scope; the necessary piping interface in this regard shall be provided.

At existing substations, the fire-fighting systems including the fire alarm, detection, and extinguishing as available shall be extended to meet the additional requirements of the switchyard and building.

O. Oil evacuating, filtering, testing & filling apparatus (Not Applicable)

To monitor the quality of oil for satisfactory performance of transformers, shunt reactors, and for periodical maintenance necessary oil evacuating, filtering, testing, and filling apparatus would be provided at substation. Oil storage tanks of adequate capacities for the storage of transformer oil would be provided.

P. Illumination System

The complete illumination system including switchyard lighting, street lighting, indoor lighting, JB's, poles, panels etc. shall be provided strictly based on the existing Kallam PS specification/installation/practice.

The lighting of the outdoor switchyard, street lighting, switchyard panel rooms (SPR), and any other building, if any, shall be done by LED based low power consumption luminaries. Indoor illumination shall be as per the requirement of false ceiling and non-false ceilings of buildings.

Firewall mounted Flood Light has been envisaged for Transformers & Reactors.

AC Emergency Lighting in SPR and switchyard area has to be provided.

Stainless steel Panels/Junction Boxes of thickness 1.5 mm for Outdoor application must be considered.

The bottom of the Outdoor Lighting Panels mounting height shall be 1000mm from FGL.

For the Outdoor Switchyard area, LED fixtures shall be installed at gantry structures (For 400kV & below voltage level) & available lightning masts (if any).

For other outdoor areas and street lighting, the lighting poles & nearby buildings (if any) shall be used for the installation of LED fixtures.

Approximately 25 % of lighting fixtures (distributed over all above areas) shall be connected to an AC emergency lighting system.

A suitable heat sink with proper thermal management shall be provided in the luminaries. All LED Luminaries shall be KTL-approved make. The marking on luminaries & safety requirements of luminaries shall be as per IS standards. The Contractor shall supply, store and install the following types of galvanized steel tubular lighting poles required for street lighting:

Type L1 Street Lighting Pole of 6 meters - for SL-L1 type fixture

Type D1 Post top lantern pole of 4 meters - for SI-D1 type fixture

The distance of the center of the pole from the street edge should be approximate 1000 to 1200 mm or as per site conditions.

Earthing of the poles should be connected to the switchyard main earth mat wherever it is available, else, the same should be earthed through 3M long, 20 mm Dia, earth electrode.

Lighting Panels, Receptacles, Junction Boxes, etc. shall conform to the following degree of protection:

- Installed outdoor: IP- 55
- Installed indoor in air-conditioned area: IP-31
- Installed in the covered area: IP-52
- Installed indoor in a non-air conditioned area where the possibility of entry of water is limited: IP-41.

Contractor shall be required to submit LM-79 & LM-80 reports for LED Luminaries.

Lighting panels shall be supplied in accordance with the existing Kallam PS panel and best industry practices.

Q. Control Room and SPRs

Air conditioning shall be provided in the buildings as a functional requirement. Main cable trenches from the existing control room have adequate space provision for laying cables from the control room for all the current scope bays also. However, the existing cable trenches shall be extended in a complete sense till the present area of installation/erection as per the trench sections considered in existing Kallam PS.

1 no. of SPR (12m x 4.5m) shall be provided for present scope of work.

R. Control Concept

All the EHV circuit breakers in substation/switching stations shall be controlled and synchronized from the switchyard control room/remote control center. Each breaker would have two sets of trip circuits which would be connected to separate DC supplies for greater reliability. All the isolators shall have control from remote/local whereas the earth switches shall have local control only.

S. Visual Monitoring System (VMS) for watch and ward of substation premises

At existing substations, the visual monitoring system is available and shall be augmented as per existing or better specifications.

Visual monitoring system for effective watch and ward of substation premises shall cover all the transformers and reactors, all other major AIS Equipment (such as CB, isolators, CT, CVT, SA etc. as applicable), panel room, all the gates of switchyard and all entry and exit points of control room building and accordingly, the location of cameras shall be decided. The camera shall be high-definition color CCD camera with a night vision feature. The VMS data partly/completely shall be recorded (minimum for 15 days) at least @25fps (or better) and stored on the network video recorder. The system shall use video signals from various cameras installed at different locations, process them for viewing on workstations/monitors in the control room and simultaneously record all the cameras. Mouse/keyboard controllers shall be used for pan, tilt, zoom and other functions of the desired camera.

All camera recordings shall have Camera ID & location/area of recording as well as date/time stamp. The equipment should generally conform to Electromagnetic compatibility requirement for outdoor equipment in EHV substation.

T. General Facilities

- a) Gantry/Towers are envisaged for bays under the present scope only. However, for the adjacent future bays, the towers shall be designed for extension (considering Quad conductors for 400kV future lines and single conductor for 220kV future lines) wherever applicable.
- b) Bay extension works at the existing substation shall be executed by the Contractor in accordance with the requirement/provisions mentioned above. However, interface points shall be considered keeping in view the existing design/arrangement at the substation.
- c) Contractor has to arrange for construction power and water on its own.

- d) All outdoor steel structures including anchor/foundation bolts shall be fully galvanized. The weight of the zinc coating shall be at least 610 gm/sq.m.
- e) In the 400kV switchyard, if a spare bay of half diameter is identified as future, all the equipment for Tie & Future Bay shall be designed considering the current rating of the line bay i.e. 3150A.
- f) Fencing, similar to the existing one, shall be provided to contain the proposed scope of work.
- g) The lightning protection of the switchyard shall be provided using the shield wires/spikes on the towers in line with IEEE 998 and the buildings lightning protection shall be provided as per the IEC 62305.

U. PLCC Equipments and FOTE

PLCC and STM-16 (FOTE) equipments shall be in the scope of the remote end line developer. However, the line traps for all the lines under the present scope of work shall be provided by the contractor. For phase-to-phase coupling, the lines under the present scope shall have wave traps installed in any of the two phases or as directed by KTL at the time of detailed engineering.

The line traps shall be broad-band tuned suitable for blocking the complete range of carrier frequencies. Line Trap shall have necessary protective devices such as lightning arresters for the protection of tuning device. A decoupling network consisting of line traps and coupling capacitors may also be required at certain substations in case of extreme frequency congestion.

V. Roads

The new roads and the extension of existing ones shall be as per civil drawings attached and the decision of different widths applicable shall be based on the widths available in the attached existing electrical plan layout.

W. Earthing of Switchyard and Associated works

The earthing system of the existing Kallam PS shall be followed by the contractor for the extension of the main mat and the size of the risers.

X. Post Insulators

The cantilever strength of all types of post-insulators is as follows:

S. No.	Post Insulator Application	400kV	220kV
1	Post Insulators for Isolators	10kN	10kN

S. No.	Post Insulator Application	400kV	220kV
2	Post Insulators for Bus Support	8kN	8kN

The corona ring shall be provided for all 400kV post insulators.

Y. Marshaling and Junction Boxes

The bay marshaling box (BMK) and junction box (JB) for the proposed scope of work shall be as per the existing Kallam PS.

Z. Applicable Tests, Mandatory Spares & Monitoring Instruments

i. Type Tests Validity

The validity of the equipment's type test reports shall be governed by the latest CEA's "Guidelines for the Type Tests for Major Equipment in Power Sector" from the date of LOA of the project to the successful bidder.

ii. Performance Tests

The performance guarantees or ratings/parameters specified in the IEEE/IEC/IS standards or CEA specifications applicable to all the equipments to be supplied under the ambit of the scope of work shall be ensured by the contractor.

iii. Mandatory Spare Parts

The mandatory spares w.r.t extension scope of work shall be provided as per Annexure-B (SOW) and shall not be used by the contractor in consumables during the erection.

iv. Condition Monitoring Instruments (Not Applicable)

Additionally, the list of equipment condition monitoring instruments has been provided in Annexure-C (SOW) which is also part of the supply in this augmentation scope of work.

ANNEXURE-A:
Approved Makes/OEMs
For
Project

4. List of Approved Makes/OEMs & Their Inspection Categories

A. List of Approved Makes for Augmentation in Kallam

- The Makes of equipment already installed in Kallam PS have been listed in the table below and it is recommended to the bidders that the equipments Makes under the augmentation work in Kallam PS shall be the same as the OEM of existing equipments. In case of unavailability of the equipment with the OEM (under-installed makes) in the existing Substation, the Contractor shall refer to Approved Makes/OEM of such equipment.
- Material Inspection shall be carried out as per Material Category defined in the table below.
- The validity of the type test of equipments shall be applicable as per the periodicity (In Years) mentioned in the latest CEA's "Guidelines for the Validity Period of Type Test(s) conducted on Major Equipment in Power Sector" amended time to time from the date of LOA.

S. No.	Equipment	Material Category	Installed Makes in Existing Kallam PS	KTL Approved Makes/OEMs	Remarks
1	Al. Tube	C	Sudal	1.Sudal 2.Banco Aluminium 3.Jindal (Subject to availability of type test reports as per CEA, from date of LOA)	
2	BPI	B	Aditya Birla	1.Modern 2.Aditya Birla 3.IEC 4.Sarvana (Subject to availability of type test reports as per CEA, from date of LOA.)	
3	Capacitive Voltage Transformer	A	Siemens And GE	1.Siemens 2.GE 3.ABB 4.Mehru	

S. No.	Equipment	Material Category	Installed Makes in Existing Kallam PS	KTL Approved Makes/OEMs	Remarks
				5.CGL	
4	Circuit Breaker	A	Siemens And GE	1.Siemens 2.GE 3.ABB	
5	Conductor	A	JSK	1.Apar 2.Lumino (Subject to availability of type test reports as per CEA, from date of LOA.) 3. Gupta Power (Subject to availability of type test reports as per CEA, from date of LOA.) 4.JSK 5.Sterlite	
6	Clamps & Connectors	C	Legion	1.Legion 2.Exalt 3.Vensun Techo	
7	Control & Relay Panel including SAS	A	GE	1.GE 2.Siemens 3.ABB	
8	Current Transformers	A	GE	1.GE 2.ABB 3.Mehru 4.SIEMENS	
9	Earthing Materials	C	Balaji Metacast	1.Swastika 2.VSP 3.SES 4.Balaji Metacast	
10	Fire Protection System	B	AON	1.BCSFL (Subject to availability of type test reports as per CEA, from date of LOA) 2.AON	

S. No.	Equipment	Material Category	Installed Makes in Existing Kallam PS	KTL Approved Makes/OEMs	Remarks
				3.Flowgain	
11	Shield / Earth Wire	C	Nirmal Wire	1.Nirmal Wire 2.Cabcon	
12	Insulator Hardware Fittings	C	Legion	1.Rashtra Udhyog Ltd. 2.Legion 3.ITL	Make of the Insulator and Insulator Hardware should be selected in such a way that combination of two makes are type tested together as a single unit.
13	HVAC System	B	Laxmi cool zone	1.Laxmi cool zone 2.AON 3.Flowgain	1. Component Manufacturer of Following items :- i) High wall split AC ii)VRF Outdoor Unit iii) Compressor iv) Condenser Fan v) Cassette type Indoor Unit shall be from any of the below makes. a) VOLTAS b) HITACHI c) BLUE STAR
14	Illumination System	B	Instapower	1.Forus Electrical 2.Avaids 3.Instapower	Following Makes shall be considered for Luminaires: - PHILIPS/BAJAJ/

S. No.	Equipment	Material Category	Installed Makes in Existing Kallam PS	KTL Approved Makes/OEMs	Remarks
					WIPRO.
15	Isolators/Dis connectors	A	S&S	1.S&S 2.GR Power 3.SS Power	220kV DS Must be Type tested for Bus Transfer Switching Current Capability as per IEC
16	Long Rod Insulators	B	Deccan	1.Deccan 2.Olectra 3.Modern	Make of the Insulator and Insulator Hardware should be selected in such a way that combination of two makes is type tested together as a single unit.
17	LT Cable	B	KEC	1.KEC 2.Nitya 3.Special (Subject to approval of credential by KTL)	
18	Surge / Line Arrester	A	CGL and Oblum	1.Oblum 2.CGL 3.Lamco	
19	VMS (Visual Monitoring System)	C	Delcom	1.Sam Infortech 2.Delcom 3.Toshniwal	
20	Wave / Line Trap	A	GE	1.GE 2.Quality Power 3.Siemens	
21	Power/Auto Transformer	A1	Toshiba And GE	1.Toshiba, 2.Siemens, 3.ABB 4. GE	Component Manufacturers List of Power Transformers &

S. No.	Equipment	Material Category	Installed Makes in Existing Kallam PS	KTL Approved Makes/OEMs	Remarks
22	Reactors	A1	Siemens and GE	1.Siemens 2. GE 3. ABB	Reactors up to 420 KV Class, shall be submitted to KTL for approval.

B. Inspection Plan based on Material/Equipment Category:

Cat A: MQP (Material Quality Plan) is envisaged with its approval by KTL. Inspection by KTL/ KTL's Third-Party Inspection authorized agency. If the Inspection and test results are found satisfactory, formal Clearance is to be issued. Material can be dispatched from the factory based on the clearance issued.

If KTL provides a waiver, Supplier/ Supplier Quality Services shall conduct the inspection and submit the reports for review.

Cat A1: MQP is envisaged with its approval by KTL. In stage Inspection and final inspection by KTL/ KTL's appointed third-party Inspection authorized agency. If the Inspection and test results are found satisfactory, formal Clearance is to be issued. Material can be dispatched from the factory based on the clearance issued.

If KTL provides a waiver, Supplier/ Supplier Quality Services shall conduct the inspection and submit the reports for review.

Cat B: MQP is envisaged with its approval by KTL. Inspection by Supplier/ Supplier's Third- party Inspection authorized agency. Advance inspection call anticipated prior to inspection. The inspection report will be submitted to KTL for clearance.

Cat C: MQP is not envisaged. No Physical Inspection is envisaged. Dispatch clearance shall be provided based on Material Test Reports / Certificates/ Factory Acceptance Test (FAT). Inspection call to be submitted along with Test Certificates. Based on the certificates from Supplier, KTL will provide clearance after reviewing reports.

Important Note(s):

- v. KTL reserves the right to change the inspection category of any material during the project.

- vi. The inspection category of any items required in the project and not explicitly mentioned in the above list shall be decided by KTL and communicated to the Contractor accordingly.