

4. SPARES & MAINTENANCE TOOLS

- 4.1. Maintenance spares as per Schedule-IV.
- 4.2. Maintenance Tools as per schedule-V

5. CONSUMABLES: Not Applicable.

6. SPECIAL FEATURES:

- 6.1. Special features incorporated in the machine, if any, shall be indicated separately in the bid clearly indicating the advantages.

7. DEVIATIONS:

- 7.1. The tenderer shall certify that the offered machine fully meets the specification. Various design features incorporated in the machine to fulfill different technical performance requirements shall be fully explained in the offer. However, minor deviations from these specifications which do not affect or in any way interfere with the stipulated performance standards or would result in improved safety/ reliability or would reduce recurring maintenance/operating cost of the machine, can be considered for acceptance. The tenderer in such eventuality shall clearly indicate the details of these deviations and their implications as per the following format given in Annexure-A at Section-III.

8. INSPECTION AND TESTING AT MANUFACTURER'S WORKS:

- 8.1. The crane shall be inspected and tested during different stages of its manufacture, starting from raw-materials till the completion of the crane, by the Purchaser or his authorized representative at the supplier's or his sub-supplier's works. The Quality Assurance programme will be as per Annexure-I. However, the purchaser or his authorized representative is free to institute any further checks also, if he so desires, and shall be in no way binding on the Purchaser.
- 8.2. All electrical and mechanical equipment shall be tested in accordance with the appropriate Indian Standard at either the crane maker's or equipment manufacturer's works and test certificates provided if required by the Purchaser or his representative.
- 8.3. Railway reserves the right for surveillance inspection of firm after placement of order to assess the ongoing process of manufacturing and facilities available with them. In case the inspection team observes the deficiencies/deterioration in infrastructure/manufacturing capability at the firm's premises, the action can be initiated as considered appropriate on merit.
- 8.4. The complete machine shall be inspected at manufacturer's premises as per approved GA drawing. Inspecting authority shall not carry out the final inspection in case GA Drawing is not approved by the consignee
- 8.5. The Manufacturer shall produce invoices of bought out items/sub-assemblies to ensure genuineness of such products/verification by the Inspecting agency.

9. TRAINING:

- 9.1. Technical experts from manufacturer will fully and adequately provide training to operation and maintenance staff nominated by consignee at the time of commissioning of crane. Minimum 04 man days of training at consignee premises will be provided. This training shall include crane architecture, systematic methods for quick diagnosis of problems and quicker methods to solve them, domain knowledge and safety procedures to be followed while working with crane.

10. GENERAL ARRANGEMENT & RELATED DRAWINGS

10.1. SUBMISSION OF GENERAL ARRANGEMENT & RELATED DRAWINGS FOR APPROVAL:

- 10.1.1. The contractor shall depute their engineer to take accurate measurement of span and other fixed dimensions of gantry at site jointly with consignee before submission of GA drawing and incorporate the dimensions measured at site in the GA drawing to be submitted to consignee for approval.
- 10.1.2. The Contractor will be required to submit the following drawings in 2 copies to consignee as per time schedule after issuance of LOA/PO
- i) The general arrangement drawings containing all information as described at item 24 of Schedule -II.
 - ii) General lay out drawing of the trolley.
 - iii) Assembly drawings of individual drives like hoists, long travel, cross travel.
 - iv) Sub assembly drawings for wheels. Hook blocks and hoist drum.
 - v) Wiring diagram showing the wiring for the complete crane including the following:
 - a) Electrical equipment layout drawings along with rating of items used.
 - b) Current collection arrangement for the crane.
 - c) Power supply arrangement to the trolley and attachments
 - vi) Lubrication system for the complete crane.
 - vii) In addition to the above, the contractor will submit detailed calculations for selection of Motor, Reducer, Brake coupling, Bridge girder, End carriage and their connection to Consignee with their detailed drawings.
- The drawings mentioned at (i), (ii) and (iv) shall be got approved by the contractor from the consignee and cranes supplied by them shall conform to said approved drawings. The drawings should be legible and is minimum A3 size.**
- 10.1.3. The supplier shall furnish to the consignee five prints of all erection drawings showing the marked numbers with weights of various items to be assembled at site, schedule of site bolts, rivets and special welding electrodes, welding techniques and erection instructions.
- 10.1.4. Supplier shall give to the consignee the breakup of weights of different consignments of crane for the purpose of unloading at site.

10.2. APPROVAL OF GA DRAWING

- 10.2.1. To be governed by Time Schedule in clause 7 of section-I and following stipulations. General Arrangement Drawings will be sent by the 'Contractor' to the Consignee as per Time Schedule. The 'Contractor' should ensure that drawings sent to consignee are complete in all respects as specified in technical specification. The GA drawings shall be approved by the consignee and given back to the contractor.
- 10.2.2. **Delays in submission of drawings by Contractor will be added to the delay in supply of machine** in case submission of GA drawing is delayed beyond stipulated time as per time schedule and LD will be levied **as per Stores condition**. Thus the number of days delay in submission of GA drawing plus the number of days delay in supply of machine together will be taken as the delay in supply of machine, However if the contractor supply the machine before original delivery period as per PO the number of days by which machine has been supplied earlier than original delivery period that many days will be subtracted from the delay in submission of GA drawings and LD will be levied accordingly. Delays in approval of the drawings by consignee will not be because of Contractor, except as detailed below.
- 10.2.3. In case Consignee finds some deficiencies in the Drawings and returns the same for rectification to the 'Contractor', the contractor must return the rectified drawings within 30 days from the date of issue of letter by Consignee. This period will not be counted towards LD calculation. The consignee shall ensure that all deficiencies in the Drawings shall be pointed for clarifications to the firm together at one time only instead of piecemeal multiple reference.
- 10.2.4. A repeat back reference(s) by Consignee to Contractor pointing out further defects/deficiencies in the Drawings, will be considered a delay on account of the contractor, unless and until clearly certified by consignee as being on their own account, for special circumstances like change in location, review of arrangement etc. Thus, Contractors must take utmost care in ensuring completeness as per requirements of the Consignee.
- 10.2.5. Where GA Drawing cannot be prepared due to clear site not being available etc., the Consignee must inform Contractor, explaining the exact delay. However, initiative must be taken by Contractor to obtain such a certificate from Consignee.
- 10.2.6. In their own interest, contractor must maintain a log of events in this respect with clear dates and get this countersigned by consignee for submission along with his bills to avoid wrong levy of LD. Consignees must cooperate with Contractors by providing all assistance, including clear information about any expected delays in site availability, promptly and in writing.
- 10.2.7. If an order has been placed on the firm, the firm will have to advise the consignee well in advance regarding requirement of road permit and assistance required from the consignee, if any, so that delay on this account is avoided. Firm should also visit the site before dispatch of crane to assess the condition of path to be used for movement of trailer.

10.3. **DISPATCH OF CRANE FROM MANUFACTURER'S WORKS**

- 10.3.1. The supplier and consignee will ensure that facilities as defined in PO necessary at site for commissioning of crane e.g. clear site with gantry, electrical power from mains to DSL are ready before dispatch of crane. The crane shall be dispatched by the supplier only after all the on-site requirements from supplier side as well as consignee side, for commissioning the crane on arrival, have been made ready. The supplier and consignee shall record a joint note certifying this.

10.3.2. The packing of crane with all components, accessories should be supplied suitably packed.

11. INSTALLATION, COMMISSIONING AND PROVING TESTS:

11.1. **Joint Check** – The contractor or his agent would be required to carry out a joint check at consignee's end, along with the consignee, before unpacking is done, to avoid subsequent complaints regarding short shipment/transit damages. It is necessary that this joint receipt inspection be done immediately on receipt of the machine by consignee & bidder's representative to avoid commissioning delays due to shortages/transit damages. After receipt of the machine as above a Joint Receipt Inspection note (JRI) as per Annexure-C of Section-III shall be prepared by the consignee and the firms representative indicating the tentative time schedule for various activities of installation and commissioning.

11.2. RESPONSIBILITY OF CONSIGNEE AND BIDDER

11.2.1. **Consignee's obligation with regard to erection & commissioning will be limited to the following:**

- i) Supplying following free of cost at the site of work.
- ii) Electricity required for the purpose of erection/ lighting.
- iii) Test loads with slings and tackles for performing the load tests.
- iv) The provision of stepladder at gantry end, for going up the gantry rails.
- v) Supply and erection of cables from mains to DSL (Down shop leads) shall be provided by consignee.
- vi) Safe storing of the material supplied by manufacturer until erection of machine.
- vii) The inspection of foundation, structures etc. shall be done by authorized representative of the consignee (wherever applicable).

11.2.2. Following items of work shall be performed by the Contractor

- i) Unloading and transporting materials free of cost from the manufacturer premises to the work site.
- ii) Checking of alignment of gantry rail at site. Any rectification required, however, will be done by the purchaser.
- iii) Installing of the crane structure and associated machinery in position.
- iv) Complete fitting and wiring of all electrical items.
- v) Fixing of down shop leads wherever required.
- vi) Commissioning of the equipment. The crane performance shall be demonstrated after successful commissioning.

11.3. The contractor shall arrange erection and commissioning of the cranes. Adequate number of teams of technical experts will be made available so that erection and commissioning delays are eliminated. Such personnel will be required to be present immediately as soon as the crane has been received.

11.4. The contractor or his agent shall commission and prove out the crane as per time schedule.

- 11.5. In the interest of early commissioning, the supplier shall ensure that minimum amount of assembly is necessary at site. Site welding and riveting shall be avoided as far as possible. The supplier, before proceeding with design details, shall satisfy himself about the site conditions so as to avoid any difficulty at the time of erection and also check the span of gantry rails.
- 11.5.1. The bidder shall be responsible for meeting all the criteria set by State Pollution Control Board and Central Pollution Control Board, wherever applicable, with respect to air, water, noise, land etc. The bidder shall be responsible for obtaining clearance/certificate for installation/commissioning/operation of the machine/system supplied. The consignee will provide the administrative help, wherever required, for establishment of communication with the Pollution Control Board.
- 11.6. Tenderer shall ensure that weights offered shall be as per information submitted vide schedule II. The bidder shall also ensure in its offer that range of variation in the total actual weight of the crane and quoted value in schedule II will be within $\pm 5\%$. Purchaser reserves the right to verify the total weight of the crane offered by the bidder against information submitted under schedule II.
- 11.7. **Test on Purchaser's Premises.**
 - 11.7.1. Start up and trial Operations Test (Commissioning Test)
 - 11.7.1.1. The contractor shall carry out the start up and trial operation tests (commissioning test) on receipt of authorization from the Purchaser. In addition to tests indicated in IS:3177(latest), the following shall also be shown:
 - i) The earthing of the crane and control equipment, to be tested as per Indian Electricity Rules.
 - ii) The operation of brakes on long travel, cross traverse and hoisting motions.
 - iii) Inching control and creep speed as called for in technical specification.
 - iv) There is no skewness in crane during long travel and cross travel motions, presence of vibrations and unusual noise in operation.
 - 11.7.1.2. The trials shall be carried out initially under no load conditions and on satisfactory completion of these, trials shall be repeated for various loads until the full rated load and operating range are covered.
 - 11.7.1.3. During the trial operation, all necessary adjustments shall be made so as to ensure compliance with the operating characteristics for the complete equipment as stipulated in the technical specifications.
 - 11.8. A Joint Commissioning Note (JCN) to this effect shall be made as per the format at Annexure-D of Section-III. After issue of JCN the performance shall be watched for a period of one month, after which the PTC shall be issued as per format at Annexure-E. The issue of PTC cannot be delayed by more than 60 days from the issue of JCN. If some minor breakdowns are noticed after the issue of JCN, these shall be attended as per warranty obligations.
 - 11.9. If an assembly/sub-assembly requires to be taken back to the manufacturer's premises for repair/replacement either before commissioning or during warranty, the manufacturer or his agent would be required to submit BG of suitable amount. In case the entire machine has to be taken back, a Bank Guarantee for the cost of the machine would have to be submitted. The bank guarantee should be of adequate value so as to cover the cost of the assembly/sub-assembly/paid up cost of the machine.

12. SERVICE FACILITY IN INDIA AND TECHNICAL SUPPORT

- 12.1. The tenderer will clearly spell out in the offer the facilities available with him or his agent for providing adequate after-sales service in India during warranty period in the appropriate section of Annexure 'A'. The complete details such as organization for after sales service, availability of technically competent engineers and warehousing facilities for spares should be clearly indicated. Bidders not offering complete servicing/repair facilities in India to ensure quick response to maintenance/ servicing calls are not likely to be considered.
- 12.2. After the warranty period and AMC period, if any, the manufacturer or his agent shall agree to provide service supports for trouble shooting and obtaining spare parts. The manufacturer shall be obliged to provide spare parts required by the Purchasers for a period of 15 years from the date of delivery of the machine at the ultimate destination to safeguard against obsolescence.
- 12.3. Tenderer who are OEM, shall undertake to supply spare parts for a period of expected life of machine. Other tenderers shall submit undertaking from OEM for supply of spare parts for a period of expected life of the machine.
- 12.4. During warranty period, the supplier or his authorized agent shall attend for break down as soon as possible, but in no case later than 72 hours of receipt of intimation of the breakdown.

13. INFRASTRUCTURE FACILITIES AND BOUGHT OUT ITEMS

- 13.1. The bidder should have minimum infrastructure and manufacturing facilities detailed at Annexure-G of Schedule VI and shall provide information on infrastructure available with them.
- 13.2. The bidder shall furnish along with the offer a list of all critical items/ sub-assemblies which are bought out by the bidder and proposed to be used, along with the manufacturer's name, brand model etc.

S. No.	ITEM	MAKE
1	Motors	ABB / CROMPTON / BBL / SIEMENS / KIRLOSKAR / MARATHON
2	Cables	KEI/LAPP/SIEMENS/POLYCAB/FINOLEX/UNIVERSAL /ICC/KabelSchlepp
3	Contactors	L&T / SCHNEIDER / C&S / SIEMENS / BCH
4	Time relays	SIEMENS / BCH / L&T / SCHNEIDER / C&S
5	Limit Switches	SPEED-O-CONTROL /CCE / ELECTROMAG / C&S / ANAND SYSTEM
6	Master controller	SPEED-O-CONTROL / CCE / ELECTROMAG /C&S / ANAND SYSTEM
7	Overload relays	SIEMENS / BCH / L&T / SCHNEIDER / C&S
8	Moulded case circuit breakers	L&T / SCHNEIDER / C&S/SIEMENS / HAVELLS / BCH / ABB
9	Resistors	SPEED-O-CONTROL / ELECTROMAG /CCE / C&S / ANAND SYSTEM

10	Drag Link Chain system	IGUS / RS COMPONENTS & CONTROL / SILVERLINE / CKS
11	Safe shrouded DSL conductors wherever applicable	INSUL-8 / SAFE TRACK / SAFE LINES / SILVER LINE / SAFE LINK
12	Thrustor brakes	SPEED-O-CONTROL / CCE / ELECTROMAG / GALVI /KATEEL /ANAND SYSTEM
12	Electrical isolators	SIEMENS / L&T / BCH / C&S
14	VVVF Drive	ABB / L&T / YASKAWA / SCHNEIDER / MITSUBISHI ELECTRIC /DANFOSS / FUJI ELECTRICS / TOSHIBA INDIA / CROMPTON GREAVES/ SIEMENS/ ALLEN BRADLEY
15	Bearings	NBC / SKF / FAG / NORMA / NRB / NTN / KOYO/ TIMKEN
16	Wire Rope	USHA MARTIN / BOMBAY WIRE ROPE / MAHADEV

- 13.3. Test certificates of motors, wire ropes, hooks, lifting tackles etc. should be provided by the supplier with proper identification.

14. PAINTING AND COLOUR:

- 14.1. All parts of the crane shall be thoroughly cleaned of all loose mill scales, rust or foreign matter.
- 14.2. All parts inaccessible after assembly shall be painted before assembly.
- 14.3. All parts except motors, gears, thrusters etc. shall be painted with:
- Two coats of red oxide zinc chromate primer to IS:2074 and over the second primer coat, two coats of paint finishing Golden yellow with black strips (Ready mixed oil based paints as per the relevant IS code) shall be given before dispatch by the firm.
 - The contractor shall give touch-up paint wherever required, after erection and testing of crane at site.
 - The interior of all gear box housing shall be painted with two coats of oil resistant enamel paint.
 - All machined pads and bearings surfaces on structures or housing shall be painted with white lead.

15. COMPREHENSIVE WARRANTY

- 15.1. The machine shall be designed for a life of 36 years with regular maintenance and all the structural members of the machine and the foundation shall be guaranteed for 7 years against cracks breakages etc. during the course of normal operations. Tenderer would submit suitable undertaking.
- 15.2. Foreign suppliers who do not have registered office / maintenance facilities in India may authorize an Indian agent, who shall be responsible for maintenance and break down support. In such case, Indian agent should have experience of maintaining any type of five machines after commissioning. The tenderer should submit documentary evidence towards the experience of the Indian agent in maintaining the machines in India, along with the offer. The Indian agent should submit the details of infrastructure and manpower available with them in the bid.

- 15.3. The warranty period would also cover comprehensive preventive maintenance, which will be inclusive of all spares, material and labour cost. All maintenance consumables like lubricants and grease except hydraulic oil/plant coolants shall form part of the scope of the preventive maintenance during the warranty.
- 15.4. The firm shall ensure that in case a failure is reported by a consignee qualified service engineer of the contractor shall visit the site within the prescribed response time from the date and time of complaint for the machine. This response time shall be 48 hours, for upto 06 cases in entire 02 years (or extended warranty period) & Nil thereafter. 48 hours' response time shall be permitted only if 2 successive failures are staggered 3 months apart. Complaints shall be lodged by consignee by fax, phone, e-mail, WhatsApp or per bearer at address given by the tenderer.
- 15.5. The details of preventive maintenance to be provided during warranty period shall be indicated by the tenderer giving details of type of preventive schedule, periodicity on items to be checked, items to be replaced and expected plant down time. Preventive maintenance schedules shall be conducted on weekends as far as possible or any other day through mutual agreement with consignees. Total breakdown hours shall be calculated after discounting response time and preventive maintenance period.
- 15.6. Penalty will be levied on the contractor for breakdown period on hours' basis (including holidays) after discounting for the response time. Penalty will be calculated with full/partial deduction of amount of WBG, which shall be deducted from the WBG deposited with the Railway:

Breakdown Period	Applicable Penalty
Up to 500 hours in entire duration of warranty of 02 years (plus extended warranty period, if any)	Nil
Exceeding 500 hours to 1200 hours in entire duration of warranty of 02 years (plus extended warranty period, if any)	25% of WBG amount
Exceeding 1200 hours to 2100 hours in entire duration of warranty of 02 years (plus extended warranty period, if any)	50% of WBG amount
Exceeding 2100 hours in entire duration of warranty of 02 years (plus extended warranty period, if any)	Full encashment of Warranty Bank Guarantee besides other action like noting adverse performance of the bidder and/or agent for future tenders and their offer in the subsequent tenders will not be considered for placement of any order for next 02 years.

16. COMPREHENSIVE ANNUAL MAINTENANCE CONTRACT (CAMC): OPTIONAL

The contractor shall be required to take CAMC of the entire machine supplied under the scope of contract.

- 16.1. Tenderers are required to quote for a comprehensive Annual Maintenance Contract for the various scope of work supplied post warranty on yearly basis giving the rates for each year i.e. first year, second year....so on., which will be inclusive of all spares, material and labour costs. The duties and taxes as applicable should be indicated separately. All consumables spares and

materials shall form a part of the scope of CAMC excluding Diesel/Fuel, lubricating oils or coolant. Diesel / Fuel, Lubricating oil or Coolant.

- 16.2. CAMC shall be operated, managed and paid by the consignees. The consignee shall indicate the bill payment authority & custodian of the CAMC BG and will intimate to Firm for operating the CAMC after getting approval from competent authority. No further agreement is required for operating CAMC at consignee end.
- 16.3. CAMC is a part of scope of supply, if included in commercial evaluation criteria vide clause 5 of Section-I.
- 16.4. The duration of CAMC shall be 5 years from the date of expiry of warranty. Rates for CAMC as quoted by the tenderer on yearly basis will remain applicable during the duration of CAMC and not subject to any variation except any statutory changes in taxes and duties as compared to quoted rates.
- 16.5. The contractor must provide CAMC services at the consignee location without any precondition. The CAMC should include complete responsibility for the bought out sub-assemblies and components like CNC system, diesel engine, AC unit etc.
- 16.6. The details of preventive maintenance services to be provided under CAMC shall be provided by the tenderer in the following format.

S.No.	TYPE OF PREVENTIVE SCHEDULE	PERIODICITY	ITEMS TO BE CHECKED	ITEMS OF REPLACEMENT	EXPECTED PLANT DOWN TIME

- 16.7. Preventive maintenance shall preferably be conducted on weekends through mutual agreement with the consignee. Each preventive maintenance schedule normally shall not exceed one day (24 Hours). The preventive maintenance regime offered must be aimed at achieving minimum 95% uptime of the plant excluding the plant down time for preventive maintenance schedules.
- 16.8. The tenderer shall ensure that in case a failure is reported by a consignee, qualified service engineer(s) of the contractor shall visit the site within the prescribed response time from the date and time of complaint for the machine. This response time shall be 48 hours for upto only one case per quarter during the period of CAMC & Nil thereafter. 48 hours response time shall be permitted only if 2 successive failures are staggered 3 months apart. Complaints shall be lodged by consignee by fax, e-mail, whatsapp or per bearer at communication given by the tenderer. The responsibility to keep the failure reporting address details current will rest with the tenderer.
- 16.9. Incase preventive maintenance is carried out along with breakdown maintenance schedule; preventive maintenance time will be deducted from breakdown time of the plant.
- 16.10. **Penalty Clause:** Penalty shall be levied on the contractor for maintaining up time below the limit of 95% calculated on working days basis, after discounting for response time and preventive maintenance period. Penalty shall be calculated as % age of quarterly payment and will be deducted from the respective quarterly payments. Penalty calculation will be done over

quarterly payment period.

S.No.	Availability Slab	Applicable Penalty
1.	95% and above	Nil
2.	Below 95%	2.5% for every 1% (or part thereof) reduction in availability of plant below 95%.

- 16.11. For CAMC, a Bank Guarantee (BG) equivalent to 5% of the combined quoted cost of equipment including accessories, shall be deposited by the contractor to the consignee, 90 days before the expiry of warranty. BG will have the validity of 5 years and 6 months. In case, the contractor fails to provide CAMC services successfully, the CAMC BG will be forfeited. This will be in addition to penalty as per Clause 17.10 above.
- 16.12. Up time of less than 75% for two consecutive quarters will constitute complete failure of contractor to provide the CAMC services successfully and will result in forfeiture of CAMC BG, besides other action like noting adverse performance of the bidder and/or agent for future tenders and their offer in the subsequent tenders will not be considered for placement of any order for next 02 years. This will be in addition to penalty Clause 17.10 above for the period of actual performance.
- 16.13. Since CAMC is part of evaluation of offer, it is the sole responsibility of contractor to stock all spares and materials as required for smoother execution of CAMC in order to achieve up time in compliance to plant availability as per stipulated requirements.
- 16.14. In case of damage on account of any external factor, viz., floods, earthquake, fire, arson or sabotage, it shall be the responsibility of the Railways for restoration of the plant to the earlier working order prior to the external factor and the entire cost for repair of the plant shall be borne by the railways.
- 16.15. In case of damage to the plant as mentioned in para 17.14, any spare parts and material necessary to restore the plant to proper working order shall be arranged by the contractor and charged on actual basis duly certified by authorized railway official in the next quarterly bills. The rates charged for such spare parts shall be based upon the spare part rate list provided by tenderer and supported by necessary documents.
- 16.16. In all cases of failure except as mentioned in Clause 17.14 any other spare part or material necessary to restore the plant to proper working order will be arranged by the contractor as a part of CAMC.
- 16.17. Normally quarterly payment (@ 1/4th of the annual quoted rates) under AMC will be made to the contractor within 30 days from the end of that quarter subject to submission of the following documents by the contractor to the paying authority assigned by the consignee:
- Consignee's certificate for work done as per Annexure-H of Section-III with calculation of down time and penalty applicable.
 - A certificate by consignee that no spare part is due with the tenderer as per clause 17.13 above.
 - Bills submitted by the tenderer & accepted by consignee.
 - Attested photocopy of the AMC BG.
- 16.18. In case of failure of the contractor to provide CAMC services as defined in Clause 17.12, the CAMC BG shall be forfeited with levy of other penalties as applicable under advice to the

contractor regarding termination of CAMC

17. SYNCHRONIZED OPERATION OF EOT CRANES:

The tenderer must ensure that both the cranes can be operated in synchronized mode of operation i.e., Tandem operation. Following conditions must be satisfied by the tenderer for the supply of EOT cranes to the consignee:

- 17.1. **Synchronization:** The cranes should be able to operate seamlessly together, with synchronized movements for lifting, lowering, and horizontal travel. This requires precise control systems that communicate effectively to maintain coordination.
- 17.2. **Master-Slave Configuration:** One crane is designated as the "master" and controls the overall operation, while the other crane acts as the "slave" and follows the master's movements. This ensures that both cranes work together harmoniously.
- 17.3. **Load Sharing:** The load distribution between the two cranes must be carefully managed to prevent overloading of one crane and ensure balanced lifting. Load-sharing mechanisms and sensors are often used to monitor and adjust load distribution.
- 17.4. **Communication:** Clear communication channels, such as radio communication or wired interlocks, are essential for operators to coordinate actions and ensure safe tandem operation.
- 17.5. **Safety Features:** Tandem operation requires enhanced safety features, including anti-collision systems that prevent the cranes from colliding with each other or with obstacles. Emergency stop buttons and alarms should also be readily accessible.
- 17.6. **Operator Training:** Operators must be well-trained by experienced engineer in tandem crane operation. They need to understand the complexities of coordinating two cranes and be aware of potential risks.
- 17.7. **Site Planning:** The layout of the working area needs to accommodate the movement of both cranes without hindrance. Consideration should be given to clearances, obstructions, and the overall work environment.
- 17.8. **Load Monitoring:** Load sensors and indicators should be in place to provide real-time information about the load being lifted. This helps prevent overloading and ensures safe lifting.
- 17.9. **Maintenance and Inspections:** Regular maintenance and inspections are crucial to keep both cranes in optimal working condition. Any issues or malfunctions should be addressed promptly to prevent operational disruptions.
- 17.10. **Emergency Procedures:** Clearly defined emergency procedures should be established, covering scenarios such as power failures, communication breakdowns, or equipment malfunctions during tandem operation.
- 17.11. **Environmental Factors:** Consider environmental conditions such as wind, weather, and temperature, which can impact the stability and operation of the cranes during tandem lifting.