



KERALA STATE ELECTRICITY BOARD Ltd

(Incorporated under the Companies Act, 1956)

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ABSTRACT

Supply, complete rewinding, supervision, testing and commissioning of VPI insulated stator winding, replacing pole coil leads with new design, refurbishment of stator core of 60MW Wave wound Generator Unit No.3 including Online Condition Monitoring for PD, Air gap, Temperature and Vibration measurements at Lower Periyar Hydro Electric Project (LPHEP) - DPR - Sanction accorded - Orders issued.

Corporate Office (SBU-G/E)

BO (FTD)No.342/2023(DGE/G3/LP stator winding) 2023

Thiruvananthapuram, Dated: 07.07.2023

Read: 1. Letter No.CEG/AEEI/GCK/LP/U#3-Revival/2022-23/1800 dated 20.03.2023 of the Chief Engineer (Generation), Moolamattom along with DPR and the estimate.
2.Note No.DGE/G3/LP stator winding dated 25.03.2023 to the Full Time Directors.
3. Remarks No.FA/Tender-1/19/2023 dated 30.04.2023 of the Financial Adviser.
4. Counter Remarks dated 12.05.2023 of the Chief Engineer(Generation).
5. Note No. DGE/G3/LP stator rewinding /2023-24 dated 20.05.2023 of the Director (Generation-Electrical) (Agenda item No.55/6/23).

ORDER

The (3x60MW) Lower Periyar Power Station was commissioned during 1997 with three Generators of make M/s BHEL with Francis type reaction turbines. The machines were running smooth, but with signs of core vibration were being reported every year for Generator unit #3 and unit #1. The first Stator winding fault on unit#3 Generator was occurred on 06.12.2021 on the bottom conductor in the slot no.235. Since the particular core joint of Unit#3 machine was continuously exhibiting signs of melting of core insulation materials as large quantities of black & greasy discharge was visible while removing the air coolers during annual maintenance every year. It is observed spattered and peeled off broken pieces of core laminations came out of the core stacks and protruded spikes along the vertical core joint. This phenomenon had been reported by M/s CPRI during ELCID test and also by BHEL during their inspection related to vibration.

Upon carrying out site investigation and rounds of technical discussions at various levels, the faulty portion of the winding was repaired as a temporary solution and the Unit#3 machine was put back into service on 27th January 2022. The condition of stator core of unit #3 is becoming worst as more and more spattering of stator core laminations are visible at the core joint, just behind the replaced stator winding slot no 235., and molten insulation materials getting squeezed out of the core joints at many locations and bracket supports. Earlier investigation conducted by M/s BHEL, the OEM during 2016, had also reported about the shorted stator laminations on Unit #3 machine and reported that it can cause uneven, localized heating which can distort the stator itself. Also this phenomenon had been reported by M/s CPRI during the ELCID test conducted in Feb 2020.

As unit#3 machine is showing signs of stator core lamination defects and subsequent failure of stator conductor was also witnessed, Equipment Monitoring Subdivision, Moolamattom has suggested to re-stack or replace the core for the long-term safe operation of the machine. The machine had a history of high core vibrations at twice line frequency (100Hz) on excitation for

failure of windings due rubbing with the vibrating core. it was recommended to replace the entire stator core with new one. Huge volume of oil is available inside the UGB housing on the upper side of the stator & LGB housing in the lower side of stator which is a potential hazard factor in the event of any fire produced at Stator. Unit#1 machine is also showing similar issues.

Above matter was discussed at higher levels and permission was accorded to assess the condition of the stator core of unit#3 and Unit#1 machines by conducting ELCID test during annual maintenance window and the same was conducted on Unit #3 machine on 20.12.2022 by a third party testing lab M/s Prognosys. According to the final report, 73 slots out of 270 in the stator winding are showing high level of leakage current above 100mA. Further, M/s Prognosys has made their inference that in Slot no. 55, 145 and 235 the ELCID fault currents including Quad and Phase components current are found to be very high, also there is physical damage at the back of core area in these locations. This indicates the core damage in these locations which needs urgent rectification. After reviewing the findings in the preliminary report, Director level meeting held online on 23.12.2022 has taken the decision to bring back unit#3 machine into service by limiting the load to 45MW after providing adequate safety measures and operational restrictions. Also decided to prepare DPR for the capital overhauling for replacing the Stator and associated works. Accordingly, the machine was put in service on 24.12.2022 with load limit of 45MW. Subsequently, DPR for the subject work and an estimate amounting Rs.20 Crore was prepared based on the budgetary offer collected from an experienced and competent firm in this field. The estimate has two parts Part-A (supply and works) estimated as Rs.16,02,15,000/- and Part-B (works) estimated as Rs.87,79,820/-.

Part-A includes dismantling of Generator, supply of complete set of stator winding newly fabricated VPI system of insulated bars, various tests on the newly fabricated VPI bars, supply of stator core punching with new low loss core materials, various tests on core material, Strengthening of dove tail key bars supporting bars by providing vertical ribs, stacking of new stator core, replacement of core locks studs and locking the core, conducting ELCID test on the stator core, rewinding the stator with new bars, bracing the both side end ferrules with 15 % silver bracing technique instead of soldering and conducting final tests on stator, Re-insulation of 18 Nos. rotor poles, replacing all the pole coil leads with new omega design to avoid cut during operation, UT and DPT test on rotor shaft and runner blades, Reconditioning of the slip ring, balancing, Alignment, Assembling of the Generator and Commissioning. Part-B covers Supply, Erection, Testing and Commissioning of Online Conditioning Monitoring facilities on Unit#3 Machine like Online Monitoring of Vibration, Partial Discharge, Air Gap monitoring, Temperature, temperature scanner-64 channel RTD sensors etc. Other important facts to be considered while proceeding with the overhauling of the machine are also specified in the estimate. Finally the total estimate for renewal of unit#3 comes to Rs.20 Crore (Rupees Twenty Crores Only) including GST. The scope of work also includes decoupling and dismantling of the slip ring chamber, upper and lower bracket, bearing assembly and threading out the rotor and placing in the rotor pit, De brazing, De wedging, removal of end connections, replacing pole coil leads with new design to avoid cut during operation and removal of old stator coils. Charges for the supply of stator coils, winding materials, erection, testing, commissioning, reassembling of the rotor, slip ring assembly, etc., are also included in this estimate. Charges for coupling of rotor and turbine, generator aligning and dynamic balancing is also included in the estimate. It is not advisable to club part A and Part B together as the suppliers and contractors involved are of different nature which would cause cost escalation on account of sub-contracting. The period of execution of subject work is estimated is 8 months including procurement of raw materials.

It is reported that, once the revival of unit #3 with 60MW capacity is done, there will be an addition of 15MW capacity. As per the current data, unit#3 machine will run 24 hours for three months and 7 hours for remaining months so that, KSEBL could regain the lost generation adding 15MWx4000hrs equalling to 60MU of electricity. Considering an average price of Rs.5/ unit there will be an additional monetary benefit of Rs 30 Crore in a year. The expenditure to

the year 2024-25. In this regard, the Financial Adviser had offered some comments as per note read 3rd above and the Chief Engineer (Generation) as per letter read 4th above had clarified the comments by explaining the events and circumstances which lead to the subject work.

Under the above circumstances, the Chief Engineer has requested approval for the subject works at Lower Periyar Hydro Electric Project, at an estimate amounting to Rs.20 Crore, in the timelines proposed as per the schedule detailed in the DPR. The above matter was placed before the Full Time Directors as per note read as 5th above.

Having considered the matter in detail, the Full Time Directors meeting held on 23.06.2023 resolved to accord sanction for carrying out the "Supply, complete rewinding, supervision, testing and commissioning of VPI insulated stator winding, replacing pole coil leads with new design, refurbishment of stator core of 60MW wave wound Generator Unit No.3 including Online Condition Monitoring for PD, Air gap, Temperature and Vibration measurements at Lower Periyar Hydro Electric Project (LPHEP)," at an estimate amounting to Rs.20 Crore (Twenty Crore), and also resolved to approve the DPR, attached as Annexure in the Note.

Further, resolved to accord sanction to arrange the work by inviting open tender through a good bidding process by incorporating two criteria (a) minimum period and (b) Cost.

Further resolved to authorise the Chief Engineer (Generation) to carry out the same

Further resolved to avail services of empanelled agencies with Department of Industries if required for the above bidding.

Orders are issued accordingly.

**By Order of the
Full Time Directors**



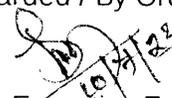
**LEKHA G
Company Secretary**

To:

The Chief Engineer (Generation), Moolamattom.

Copy to: The Chief Engineer (IT, CR&CAPS)/ Financial Advisor/ LA&DEO/ Chief Internal Auditor/ Company Secretary
The TA to the Chairman & Managing Director / Director (Generation-Civil) / Director (Distribution, Safety, SCM & IT) / Director (Transmission, SO & Planning)/ Director (Generation - Electrical, REES, SOURA, Sports & Welfare)
The PA to the Director (Finance & HRM)
The Sr.CA to the Secretary (Administration)
The RCAO/ RAO
Stock File.

Forwarded / By Order



Assistant Executive Engineer