

1.2.4 Guarantees for Turbine Output, Efficiency & Penalties for Shortfall

The Contractors shall provide turbines having the specified ratings and highest feasible efficiencies in the permissible range of operation. The turbine tenderer on tendering stage shall supply supporting documents for the prescribed guarantees by means of displaying results from earlier model tests of the model turbine which conforms as much as possible to the one now offered. The output and the efficiencies shall be guaranteed under penalty as given below.

Efficiencies below 94.5% for Turbine, 98.5% for Generator and 93.08% Overall TG, shall not be accepted. No weightage shall be given during evaluation for efficiencies better than above.

The turbine OUTPUT and EFFICIENCY shall be guaranteed by the Contractor. The following requirements and rules for the guarantees apply:

- a) Rated output at rated net head of 153.3 m.
- b) Maximum continuous output at design net head of 153.3 m
- c) ~~Maximum continuous output at maximum net head of 164.0 m~~
- d) Turbine efficiencies at following net heads in the specified working head range: 153.3 m & ~~164.0 m~~ 163.2m.
- e) Weighted turbine efficiency

The model and the prototype weighted turbine efficiency shall be guaranteed. The weighted average efficiency of the Turbine at rated net head for 110 %, 100 %, 75 % and 50 % rated output shall also be guaranteed as per the formula

$$E_{VT} = K1 * E_{110\%} + K2 * E_{100\%} + K3 * E_{75\%} + K4 * E_{50\%}$$

Where E_{VT} is the weighted average efficiency of the Turbines,

$E_{110\%}$, $E_{100\%}$, $E_{75\%}$ and $E_{50\%}$ are the guaranteed efficiency of the Turbine at the respective percentage of the operation with reference to the rated head and

$$K1 = 0.20, K2 = 0.40, K3 = 0.15, K4 = 0.25$$

The prototype weighted average efficiency will be calculated from the model efficiency stepped-up to prototype efficiency according to ~~IEC 60995~~ IEC 60193, using the same grid of weights as above.

- f) Efficiency guarantee and penalties

If the ~~model~~ weighted average efficiency on ~~model~~ testing is less than the guaranteed weighted average efficiency the Contract Price for payment purposes, be decreased at the rate of Rs 17,00,000 for each one hundredth of one percent drop in efficiency for each unit.

Same amount of penalty shall be payable for each of the other Turbine for shortfall of weighted average Turbine efficiency, i.e. the total amount of Penalty shall be equal to “Penalty against shortfall in weighted average efficiency of Turbine for one unit” multiplied by “total number of units, i.e. three (3) nos”.

Adjustments will, however, not be made until after the Contractor has been given an opportunity to correct the defects in performance. Modifications in design, if

necessary, shall be made within a reasonable time not exceeding 3(three) months so that the guaranteed performance can be obtained and the manufacturing shall commence only after satisfactory results are obtained in the model test. In the event of extra time taken by the manufacturer for rectification of design deficiencies, the delivery schedule as agreed earlier shall be adhered to by the contractor. In case of failure to obtain satisfactory results to ensure guaranteed performance, the purchaser reserves the right to cancel the contract or to accept the same subject to levy of penalty as specified above.

The model weighted average efficiency is the weighted average efficiency calculated from the model test results.

If the model weighted average efficiency falls below the guaranteed figure by more than 1.5 percentage point, then the turbine may be subjected to rejection.

g) Capacity and efficiency tests

The ~~Corporation reserves the right to carry out~~ capacity and efficiency test at different heads and gate opening on the prototype turbine **shall be conducted** within one year after commissioning to verify that the power output and efficiency guarantees of the prototype have been fulfilled.

The turbine efficiency and capacity tests shall be conducted in accordance with the provisions of IEC Publication 600 41, International Code for Field Acceptance Tests of Hydraulic Turbines, ~~under the supervision of a qualified independent expert, unless otherwise mutually agreed upon by the Contractor and the Employer.~~ Any deviation from the IEC-60041 shall be clearly stated in the offer. Efficiency shall be measured by the thermodynamic method or any other applicable method to be decided by the purchaser. Supplier shall furnish details of test method, agency which will conduct the test, provisions to be made for the field testing, calibration of instruments for the purpose of the test and all other relevant details in the offer . **Supplier shall be under obligation to accept these tests for purposes of liquidated damages.**

The Contractor shall make any subsequent adjustments in the turbine working parts as may prove necessary to secure optimum turbine performance.

If the guaranteed performance is not met, all the cost associated with the efficiency test shall be born by the Contractor. If the efficiency test proves that the Contractor met the Functional Guarantees, the cost of the efficiency test will be born by the Employer.

The employer reserves the right to appoint an independent agency for repeating these tests at his own costs. The contractor shall be under obligation to accept these tests for purposes of liquidated damages

h) Capacity guarantee and penalties

The maximum continuous output at rated net head of 153.3 m shall not be less than 69,238 kW. In case of shortfall in the tested values **during field test**, a penalty of Rs 2,25,000 for each kW below the guaranteed value will be applied.

For fractional values of the shortfall the penalty amounts will be computed on pro-rata basis.

The turbines not fulfilling the guarantees will be subjected to penalty by multiplying the penalties for one (1) turbine by the no. of turbines and the total amount of penalty shall be the sum of these two.

1.2.4.1 Cavitation guarantee

The Supplier shall guarantee the guide vanes, runner, discharge ring and other hydraulic passage of the turbine against excessive pitting caused by cavitation for the first 8000 hours of operation, or not over two calendar years after provisional acceptance of the turbine, whichever is the earlier. If the guarantee expires before 8000Hrs of operation the weight loss shall be on pro-rata basis.

The cavitation guarantee shall be as per IEC Publication 60 609.

Excessive cavitation pitting is defined as the removal of metal from the turbine runner, discharge ring, draft tube cone and guide vanes because of removal of material in excess of the weight defined by the following formula:

$W = 0.1 \times D_3^2$ per 1000 Hours of operation during the guarantee period defined above.

Where:

W= total permissible weight of metal in kilograms removed during the period of operation.

D_3 = discharge diameter of the turbine runner in meters

The loss of material shall be measured by the direct measurement according to IEC-Code 60 609. Erosion or damage caused by solid particles in the water and corrosion caused by aggressive chemical substances in water are not intended to be covered by the pitting guarantee. If excessive cavitation pitting occurs, the Contractor shall repair the resulting damage during the turbine guarantee period. All areas where the depth of pitting exceeds 1 mm shall be restored to their original contours by welding with stainless steel and grinding to a smooth surface equal in finish to the adjacent undamaged areas. The Turbine after such modifications, repairs and replacements shall be subject to same cavitation guarantees as per the original equipment. In case of local cavitation damage caused or aggravated by any contour errors, the Contractor shall make the modifications necessary in the turbine parts to prevent its reoccurrence. For field cavitation repairs the Corporation will make the turbine available at a mutually convenient time and will provide proper access to the work. The Corporation will also provide free of charge the use of station power and compressed air. All other items of equipment and materials required for the repairs shall be furnished by the Contractor.

There will be an inspection of the runners during guarantee period to establish whether the cavitation guarantee has been met or not.

1.2.4.2 Limit on Erosion By Silt: With the silt of the given characteristics & quantity suspended in the waters going to the turbines ,the abrasion resistance of the under water parts includign runner of the turbine shall be such that interval between erosion maintenance shall not be less than 12000 hrs of operation.