11.1 INTRODUCTION

This section defines the Performance Guarantees provided by the Contractor for present scope of work, the methods to determine the fulfilment of these guarantees, the time(s) of establishing these parameters, and the calculation of liquidated damages in case of non-fulfilment of the guarantees.

11.2 GUARANTEES

The Guaranteed parameters as stated below to be established by the contractor for Block 1 with 500 MW in parallel operation with existing Block 2 with 500 MW are :-

-Station Power rating
- Availability
- Reliability
- Station Efficiency (Station Loss)
-Thyristor failure Rate
- Guaranteed failure Rate of Relay module/C&P module /components
-Transient Disturbance

The above guarantees shall be given by the Contractor for Pole-1/Block-1 as required by relevant clauses below. The penalties specified shall also be on Block-1 operating on conditions as defined in Chapter 4 as required by relevant clauses below.

Overall capping on the cumulative LD for Availability, Reliability, Station Power Rating, and Outage Schedule shall be 10% of contract Price

11.3 TECHNICAL PERFORMANCE REQUIREMENTS

Clause 11.2 above lists specific Performance Guarantees. The other sections of the Technical Specifications give further requirements on the equipment and on the Station. These requirements must be fulfilled by the Contractor prior to the Employer accepting the Equipment under the scope of contractor as per provisions of the Bidding Document.

11.4 RELIABILITY AND AVAILABILITY OF HVDC SYSTEM

11.4.1 DEFINITIONS

11.4.1.1 Outage Terms

.1 OUTAGE

The state in which equipment or a unit of equipment is unavailable for normal operation due to an event directly related to the same equipment or some unit of equipment.

.2 SCHEDULED OUTAGE

Scheduled outage is an outage which can be scheduled at least one week in advance. This includes planned maintenance, normally conducted on annual basis, and also unplanned maintenance or repair which can be deferred at least one week subsequent to discovery of the need for maintenance or repair. If the outage is extended due to additional work which would have otherwise caused a forced outage, the excess period is counted as a forced outage.

.3 FORCED OUTAGE

The state in which equipment is unavailable for normal operation, but is not in the scheduled outage state, i.e., an outage which is not a scheduled outage.

Note: Subsequent definitions, unless specified otherwise, involving outage apply to both forced & scheduled outages. A disturbance, caused by a failure or mal-operation of the control and/or protection system, that causes a substantial change of dc power & resulting in the transmitted power to be less than or equal to the minimum power level for a duration of less than or equal to 100 ms is defined to be a transient disturbance and shall not be considered as a forced outage. Transient disturbance that develop into outage lasting for more than 100 ms shall be counted as forced outage.

.4 BLOCK OUTAGES

An outage which causes a reduction in the dc power system transfer capacity equal to or less than the power rating of one Block as defined at Clause 4.1.

11.4.1.2 Capacity Terms

.1 MAXIMUM CONTINUOUS CAPACITY (PM)

The maximum HVDC block capacity (MW) for which continuous operation under normal conditions is possible as defined in 4.1.3, i.e., 500 MW.

.2 OUTAGE CAPACITY (PO)

The capacity reduction in MW which the outage would have caused if the HVDC system were operating at its maximum continuous capacity (Pm) at the time of the outage.

.3 OUTAGE DERATING FACTOR (ODF)

The ratio of outage capacity (Po) to maximum continuous capacity (Pm).

$$ODF = Po / Pm$$

11.4.1.3 Outage Duration Terms

.1 ACTUAL OUTAGE DURATION (AOD)

The time elapsed in hours between the start and the end of an outage. The time shall be counted to the nearest 1/10th of an hour. Time less than 1/10 of an hour shall be counted as having duration of 1/10 of an hour.

.2 EQUIVALENT OUTAGE DURATION (EOD)

The actual outage duration (AOD) in hours, multiplied by the outage derating factor (ODF), so as to take account of partial loss of capacity.

EOD = AOD X ODF

Each equivalent outage duration may be classified according to the type of outage involved, i.e., equivalent forced outage duration (EFOD) and equivalent scheduled outage duration (ESOD).

11.4.1.4 Time Categories

.1 PERIOD HOURS (PH)

The number of hours in the reporting period.

In a full year the Period Hours are 8760 h (8784 h for a leap year). If the equipment is commissioned part way through a year the period hours shall be proportionately less than 8760 h. (This shall not be applicable for verification of guarantees).

.2 ACTUAL OUTAGE HOURS (AOH)

The sum of actual outage durations within the

reporting period AOH = □ AOD

The actual outage hours (AOH) may be classified according to the type of outage involved, i.e., AFOH and ASOH.

.3 EQUIVALENT OUTAGE HOURS (EOH)

The sum of all equivalent outage durations within the

reporting period. EOH = □ EOD

The equivalent outage hours may be classified according to the type of outage involved, i.e., equivalent forced outage hours (EFOH) and equivalent scheduled outage hours (ESOH).

If outage duration overlaps the beginning or end of a reporting period, only the EOD which lie within the reporting period shall be included in EOH.

11.4.1.5 Availability and Reliability Terms

.1 ENERGY UNAVAILABILITY (EU)

Energy unavailability is a measure of the energy which could not have been transmitted due to (scheduled & forced) outages. The impact of overload capability of the individual blocks shall not be considered for calculating the Energy unavailability.

Energy Unavailability % (EU) = EOH/PH x 100

Forced Energy Unavailability % (FEU) =

EFOH/PH x 100 Scheduled Energy Unavailability

% (SEU) = ESOH/PH x 100

.2 ENERGY AVAILABILITY (EA)

A measure of the energy which could have been transmitted except for limitations of capacity due to outages, arising from any cause, either forced or scheduled. Principle maintenance period of valve during annual outage is not to be considered for energy availability.

ENERGY AVAILABILITY % (EA) = (100 - EU)

.3 ENERGY UTILISATION (U)

A factor giving a measure of energy actually transmitted over the system.

ENERGY UTILISATION % (U) = [TOTAL ENERGY TRANSMITTED (PM X PH)] X 100]

.4 RELIABILITY

Reliability is expressed in terms of the number of forced outages of curtailment occurrences of Block per unit of time, usually one year.

EOF is the equivalent outage frequency which shall be calculated as follows

EOF = NUMBER OF OUTAGES OF THE 500 MW BLOCK

11.5 SCOPE OF REQUIREMENTS

11.5.1 GENERAL

The back-to-back station shall be engineered to meet "design target" values of availability and reliability, as outlined herein. The Contractor shall also guarantee the availability and reliability at least to the levels of performance as specified herein.

Availability and reliability requirements shall apply to that part of the HVDC system within the Contractor's Scope of Work and shall exclude all other equipment outside his Scope of Work. Reliability and Availability shall be determined for HVDC station and excludes extra conventional AC switchyard, auto-transformer etc.

The terms availability and reliability, as used in these Specifications exclude the effect of certain outages and curtailment events described below which are, in general, beyond the Contractor's control. Hence these effects shall be excluded from the analysis. The outage and curtailment of HVDC system capacity events to be excluded are as follows:

(a) Misuse, operator error or other human causes which contravenes the Contractor's operating and maintenance instructions.

(b) Environmental conditions or ac system conditions outside the design criteria given in these Specifications or as modified during detailed engineering.

(c) External causes beyond the control of the Contractor and Employer
i.e. land slides, earthquake shock beyond the seismic criteria of these Specifications, and fire arising from causes outside the Contractor's equipment and Scope of Work.

Circumstances causing curtailment of HVDC system capacity that shall be included in the availability and reliability assessment and which can lead to a forced outage include, but are not limited to:

a) Failures of equipment.

b) Mal-operation of control and protection system due to

electrical interference, incorrect settings or inadequate interlocks & provisions.

c) Failure to, or delay in, start of the 500MW block.

d) Failure to complete switching sequences.

e) Failure to recover within the times specified following system faults.

f) Reduction of dc power transmission capacity.

Although outages and curtailment of HVDC system capacity caused by failures in equipment outside the Contractor's Scope of work are not included in the availability and reliability assessment, the contractor shall design the HVDC system to function as set forth in these Specifications during known faults and failures in the equipment which interfaces with the equipment within the Contractor's Scope of Work.

If the transfer capacity of the HVDC system is reduced due to equipment not within the scope of the HVDC Contractor, then it shall be considered as if the HVDC system had been operating at rated power for such period. But if any maintenance is carried out during such period then the same shall be counted as an outage for the duration of the maintenance operation.

11.5.2 GUARANTEES REQUIRED

The reliability and availability of 500 MW block (block -1) shall be guaranteed by the Contractor. The operation of the 1x500 MW block- 1 shall be monitored during the guarantee period of minimum 12 months by a data base software developed by the Contractor incorporating details as specified under clause 11.4 to determine whether it meets the guarantees.

The HVDC power transmission capacity of the block to be used in the reliability and availability assessment are stated in section 4. The overload and low ambient capabilities of the HVDC equipment shall not be considered in the analysis made to confirm the design target values.

11.6 DESIGN PRINCIPLES

The objective for the design of the HVDC back-to-back system shall be to achieve high levels of availability and reliability. Except where greater reliability requirements are specified in these Specifications, the design basis for the HVDC system shall be such that no single contingency shall cause station

outage. The design of control and protection, directly associated with the transfer of power over the HVDC back-to-back system, shall be such that the normal failure modes of components shall not result in a reduction in HVDC system capacity nor in a hazardous operating condition for the equipment or the operator.

The Contractor shall design the control & protection equipment, to cause no more than 5 transient disturbances (with a duration exceeding 20 ms) for block-1 per six months. Transient disturbances in connection with events resulting in forced outages shall be excluded from the above. When more than one transient disturbance occurs within a time period of (max.) 10 sec in connection with the same failure or mis-operation, this shall be counted as single transient disturbance.

11.7 AVAILABILITY AND RELIABILITY CALCULATIONS

11.7.1 GENERAL

Definitions of availability and outage state conditions are given in Clause
11.4.1. The period basis for availability and reliability calculations shall be 12 consecutive months (one year). The period over which the guarantees are to be in effect shall be twelve (12) months (i.e. one year), or any valid extension thereof, commencing six months after successful completion of trial operation of 500 MW block (i.e. Pole-1). Annual Planned schedule maintenance (generally once in a year) outages shall not be included in the evaluation of availability. The Contractor shall provide calculations to demonstrate that the design shall meet the specified guaranteed and design target values of availability and reliability for the HVDC system during the bid. The Contractor shall indicate the maintenance duration for annual planned maintenance activities.

The calculations shall show the expected availability & reliability of
installation based on the Contractor's recommended availability spares.

Outage times for repair, maintenance and replacement of components, shall be based on the premise that all items in the Contractor's lists of availability spares are on hand, that all Contractor's schedules of recommended maintenance are adhered to and that maintenance personnel (a maximum of 20 men for the down time of 40 hours) shall be on hand to effect repairs immediately on a normal 6 day, 48 hour week basis. It shall be assumed that outside of normal working hours the maintenance personnel shall be available in 2 hours at

converter station. The effect of already consumed spares shall also be considered assuming reasonable spare reorder and delivery time.
Reliability calculations shall be made and shall be presented as the expected frequency of occurrence of unscheduled loss of HVDC power transfer capacity in amounts corresponding to the capacity of the block (i.e. Pole-1) . For simultaneous occurrence of events, for either of which a loss of capacity would result, the longer repair time shall be counted.

The HVDC equipment and all associated facilities shall be assumed to be utilized 100% of the time at 100% load, regardless of the actual power and energy transmitted by the system. Hence the reliability and availability assessment shall be based on the capability of the facility to transmit power and energy and provide service, regardless of whether it is actually in service or not and regardless of whether other system(s) outside Contractor's scope are available or not. The circuit elements which are not used at 100% load but provided to be used at less than 100% load shall be considered that as if these were used continuously. The Contractor shall submit a detailed report to the Employer substantiating the system design. The report shall document the Contractor's reliability and availability calculation procedures and state his data on component failure rates along with their basis. The Contractor shall provide details of calculations to substantiate the design of the equipment insofar as reliability and availability are concerned, prior to the commencement of manufacture of the equipment.

These calculations shall clearly show the component failure rates assumed and the subsystem availability calculations and forced outage rates.
The Contractor shall submit his detailed calculations in readily assimilated formats suitable for engineering use in verifying applications in the design. The data shall include both Contractor's preliminary design calculations and the final calculations based on the finalized equipment design. Revisions shall be submitted to the Employer whenever required by modifications that may affect the calculations prior to the acceptance of the equipment and system.

11.7.2 SCHEDULED MAINTENANCE OUTAGES

Scheduled preventative maintenance by the Employer shall be in accordance with the following:

a) Performed with the interval between maintenance as

prescribed in Contractor's proposal. The Contractor shall submit a comprehensive maintenance plan, listing the activities to be carried out by the Employer's maintenance staff.

b) Executed according to the Contractor's instructions and following a schedule to be mutually agreed upon. The Contractor shall be informed at least 10 days in advance regarding schedule maintenance of station and have the right to witness and advise during the availability guarantee period. The Contractor shall bear the costs for any such witnessing.

c) Executed with a qualified working crew of the size prescribed, properly trained according to the Contractor's prescribed training program. The maintenance shall be executed during consecutive days with a shift time per day of 8 hours (plus a maximum of 4 hours overtime) to fulfil the maintenance program. For intervals between the two consecutive working shifts the HVDC system may be put into service (and then shall be regarded as available during this time) provided that the prescribed maintenance schedule would allow the part of the HVDC system on which maintenance is being carried out to be brought back into operation after the working shift.

11.7.3 OUTAGE AND CURTAILMENT TIME

When determining the duration of an outage or curtailment covered by the availability guarantee, the following time elements shall be excluded:

a) Unreasonable lengths of time required to obtain access to a piece of equipment for repair or maintenance including time for permits to de-energize or disconnect equipment, time to get physical access to equipment location, delivery, transport and erection of ladders or lifting facilities (however for calculation purposes, 1 hour for obtaining access shall be assumed). Reasonable times shall be established during the Contractor's operator and maintenance training program and during initial operation. These times shall be deemed included in the unavailability calculations.

b) Time of unavailability of operating, maintenance or repair staff during the normal 6 day 48 hour week and in excess or 2 hours if outside of normal working hours.

c) Time of unavailability of specified tools/repair equipment/repair facilities.

d) Unreasonable waiting time to locate spares in

Employer's stock. The following shall be included in outage duration:

a) Time required to determine the cause of an outage and to determine which equipment/unit must be repaired/replaced.

b) Time required for disconnection, grounding of equipment, preparation of repair and reconnection after repair.

c) Time required for movement of spare.

d) Time required for repair.

e) Time required for acquiring spare parts, tools or test equipment whose acquisition was not recommended by the Contractor in his Bid.

The times when replacements have to be ordered shall be specified, for each type of spare, by the Contractor during the guaranteed period of operation of the system to ensure that sufficient spares are on hand when required.
The Employer shall keep and make available to the Contractor, during the availability guarantee period, operation records so as to make a determination of the cause of any curtailment or outage as well as the sub-division of the total outage time into specified time elements. The basic data and general format of the above operation records are to be mutually agreed upon prior to commencement of the guarantee period or acceptance test for operation of the HVDC system.

11.8 AVAILABILITY REQUIREMENT

11.8.1 REQUIREMENTS

The calculated energy availability (EA) of the block under scope (i.e. Block I) considered on a Six (consecutive) months basis and based on the Contractor's availability spare parts/equipment shall be equal to or shall exceed the specified value given below. Also, subject to the terms and conditions specified, the availability per year, considering forced outages, shall be equal to or exceed the guaranteed value.

- The Guaranteed Minimum Energy Availability Requirement (EA) of the HVDC block shall not be less than **99.8 %.**
- The design target shall be **99.9 %.**

11.8.2 FULFILLMENT OF AVAILABILITY GUARANTEE

The availability of the block shall be monitored during the

availability guarantee period. A preventative maintenance check shall be carried out immediately before the start of the said period.

The Employer shall maintain records of the number and duration of forced outages, and the amount of HVDC system capacity reduction for any reason attributable to present scope resulting from each outage.

Classification of outages into transient, forced and scheduled outages shall be in accordance with definitions given in Clause 11.4.1.

The availability of dc power transfer capability shall be calculated half yearly. If availability levels achieved are below the target/guaranteed levels, the Contractor shall make a thorough analysis of the cause and take appropriate remedial action to improve the performance. Implementation of corrective actions shall be subjected to the approval of the Employer. All costs towards such implementation of corrective actions shall be borne by the Contractor. All scheduled outages thereby required shall be included in the calculation of the scheduled outage times for the affected pole or poles.

For fulfilment of the guaranteed energy availability, the following shall apply:

(a) If the annual energy availability, averaged over the 12 months (one year) guarantee period, proves to be below the guaranteed value, the guarantee period shall be extended by six months. If at the end of this six months, the one year average energy availability, disregarding the half year (any 6 consecutive months) with the lowest availability is equal to or higher than the guaranteed value, then the availability guarantee shall be considered as fulfilled.

(b) If the annual energy availability averaged over the best one year period is still below the guaranteed value, the Contractor shall correct all design deficiencies and equipment defects at no cost to the Employer.

(c) After correction of such deficiencies and defects, if the

annual energy availability averaged over a further half year period (excluding the previous one and half year period and the period for correcting such deficiencies) is still below the guaranteed value, liquidated damages calculated as given below shall be paid by the Contractor to the Employer.

Liquidated damages = Rs. 30 million for each 0.1 % or part thereof for the shortfall below 99.8% down to 98 (for block under scope)

(d) In case average annual energy availability as described in Para (c) above, is found to be below 98% the system (under present scope) shall be rejected by employer. The system rejection shall be governed as per provision of contract.

11.9 RELIABILITY REQUIREMENT

11.9.1 REQUIREMENTS

In the assessment of reliability, the following events, in addition to those listed in Clause 11.4, shall be considered to constitute a forced outage:

a) 500 MW block-1 shutdown.

b) A reduction of HVDC system capacity for any reason attributable to present scope.

The calculated reliability of the HVDC system shall be equal to or shall exceed the following design target values. Also, subject to the terms and conditions specified, the reliability per 6 months shall be equal to or exceed the guaranteed values stated in the Contractor's Bid.

The average number of forced outage and curtailment occurrences per 6 months for the HVDC system, shall not exceed the following values

Curtailment in HVDC system	**Number of occurrences/six months**	
Capacity corresponding to	Design Target Value	Acceptable Value
EOF Block I	0.5	1

11.9.2 FULFILLMENT OF RELIABILITY GUARANTEE

As stated above, the Employer shall monitor the operation of the HVDC system during the guarantee period for the block under scope (i.e. Pole-1).

An annual appraisal of reliability performance shall be jointly made by the Employer and the Contractor to determine whether correction of design deficiencies, if any, is warranted. Evaluation of EOF and transient disturbance shall be made separately. With respect to the guaranteed reliability values for curtailment in HVDC system capacity, the following shall apply:

(a) If the number of occurrences/six monthly (EOF/TD) averaged over the 12 months (one year) guarantee period exceeds the guaranteed value, the guarantee period shall be extended by six months. If, at the end of the extended period the one-year average number of occurrences/6 months, disregarding any six consecutive months with the highest number of occurrences/6 months, is equal to or lower than the guaranteed number of occurrences/6 months then the reliability guarantee shall be considered as fulfilled.

(b) If the number of occurrences/6 months averaged over the one-year period exceeds the guaranteed value, the Contractor shall correct all design deficiencies and equipment defects at no cost to the Employer.

(c) After correction of such deficiencies and defects, if the number of occurrences/6 months over a further half year period (excluding the previous one and half year period and the period for correcting such deficiencies) is still above the guaranteed value, liquidated damages calculated as per the formula below shall be paid by the Contractor to the Employer:

= Rs. 1 Million for each EOF or part thereof above the guaranteed value.

= Rs. 0.5 Million for each transient disturbance or part thereof above the guaranteed value

11.10 Block 1 Losses and Loss Evaluation

11.10.1 Definitions

11.10.1.1 No Load Losses

These are the losses when the HVDC converter station is energized but with the converters blocked and all auxiliary equipments corresponding to immediate start up power connected with at least one cooling group of transformer, valve cooling system and valve hall ventilation system in service. No load loss shall be guaranteed corresponding to converter transformer set at principal tap with nominal ac system voltage (400 KV Both Side at 50 Hz) and at 40^0 C ambient temperature and 50 % ambient humidity level. Principal

tap is the Tap Position of converter transformer when HVDC converter shall be delivering 1 p.u. power (500MW) at nominal DC voltage at rectifier, keeping AC system voltage 400 KV (Eastern Side) and 400KV (Southern Side), at 50 Hz and 40^0 C ambient Temperature for Pole 1.

11.10.1.2 Total Station Losses for Block 1

The total station loss is the sum of all operating losses and the corresponding auxiliary losses at the specified power levels with nominal AC system voltage 400 KV (Eastern Side) and 400KV (Southern Side), at 50 Hz and 40^0 C ambient Temperature and 50 % ambient humidity level for Block 1 &2.

11.10.1.3 Load Losses

These are the losses which vary with the load current. The load losses for the specified power levels shall be derived by subtracting the no load losses (as guaranteed as per 11.10.1.1) from the total station losses at that power level (as per 11.10.1.2).

Equivalent Load Losses (for block-1)

The equivalent load losses shall be determined as:- Equivalent load losses = (Load loss at 50 MW in KW * 0.1 + Load loss at 100MW in KW * 0.2 + Load loss at 250 MW in KW * 0.3 + Load loss at 500 MW in KW * 0.4)

11.10.2 METHODOLOGY FOR DETERMINATION OF LOSSES

11.10.2.1 General

The total converter station losses shall be calculated from the losses of the individual items of equipment with the equipment loading conditions being determined from the ambient temperature and operating conditions of the entire converter station. For those items of equipment where the losses or electrical characteristics are measured at the factory under standardized ambient or other operating conditions, the losses under the actual specified operating conditions shall be submitted by the Contractor and approved by the Employer.

For calculating load losses, it shall be assumed, unless specified otherwise, that all equipment's at the specified dc load/ power level, are operating as per the performance requirements at 40^oC ambient temperature. Station service and auxiliary

equipment loads shall be included as required at the appropriate dc load/ power level for the cases as defined in 11.10.2.2. The losses shall be determined for Block 1 operation under nominal conditions of ac Busbar voltage (400 KV), dc voltage (at the rectifier), frequency (50.0 Hz), commutating reactance and firing angles, and with reactive compensation equipment connected from the installed banks and sub banks so as to result in as close to unity power factor operation of the converter station as a whole as possible subject to achieving the harmonic performance levels specified.

Unless specified otherwise, the losses shall be determined as described in IEC Standard 61803 “Determination of power losses in high voltage direct current (HVDC) ".

The Contractor shall calculate the equivalent station load Losses assuming, for the purposes of this calculation only, that the HVDC system shall operate at the following load levels for the percentages of time listed:

Station Power (for Block -1)	**Duration**
50 MW	10% of time
100 MW	20% of time
250 MW	30% of time
500 MW	40% of time

11.10.2.2 DETERMINATION OF LOSSES

The total losses of the HVDC converter station shall be calculated as the sum of the losses determined for each individual equipment. The major components to be included in the loss calculation and guarantees and the method of assessment for each component shall be as follows:

a) Thyristor Valves

All the losses shall be first determined on a per valve basis. The total valve losses shall be the summation of individual loss components. Factory measurements shall be utilized wherever possible for compilation of data for loss calculation as well as overall verification of valve losses. The broad categories of losses considered as per IEC 61803.

Auxiliary power requirements shall be calculated from the rated kW and efficiency of all motors necessary to provide the required cooling,
but excluding redundant motors. The auxiliary power requirements of the cooling towers shall be included

11.10.3 Guaranteed Losses

A For Block 1

The Contractor shall guarantee the no-load losses and equivalent load losses (as defined in Clause 11.10.1) at the specified power level for HVDC Block 1. No tolerance shall be considered on the submitted figures. The guaranteed losses shall not be greater than the losses quoted by the contractor in his bid.

The losses of the HVDC Block 1 to be supplied by the Contractor shall be determined in accordance with Clause 11.10.2, above.

The Contractor shall submit to the Employer comprehensive loss calculation study report giving losses as measured for the HVDC equipment's during type test/Routine tests as per actual design values of per item losses for thyristor valve. For other equipment the values of calculated losses (where measurements are not possible) shall be indicated in the equipment specification and shall indicate tolerance limits for individual items. If the losses, for Block 1 as determined in accordance with Specification, exceed the guaranteed values then the Employer shall reduce the value of the contract as liquidated damages (LD) for the losses in excess of the guaranteed values at the rate stipulated in the table below :

	LD in INR/ kW
For Block-1	
No-Load Losses	8, 00,000
Equivalent Load Losses	4, 00,000

The HVDC Block 1 no load losses and equivalent load losses, shall not be more than 15 % above the respective guaranteed values.

If the no load losses and the equivalent load losses as

determined at specified power level individually exceeds more than 15 % above the respective guaranteed values, relevant Provision of GCC Clause shall be applicable.

11.10.4 EVALUATION OF LOSSES

The Employer undertakes to make an evaluation of no load and Equivalent Load Losses stated by the Bidder in his bid. No tolerance shall be considered on the submitted figures.

Evaluation of losses shall be done as follows:

Evaluated Losses in (INR) = No load loss in KW * 600000 + (Load Loss at 50 MW in KW * 0.1 + Load loss at 100 MW in KW*0.2+ Load loss at 250 MW in KW * 0.3 + Load loss at 500 MW in KW*0.4) X 300000

11.11 STATION POWER RATING GUARANTEE

The Contractor shall guarantee that the rated capacity of the system under present scope is in conformance with the requirements specified in section 4.1 of this specification.

The necessary field tests shall be performed after the trial operation period to demonstrate that the performance of the HVDC System with respect to basic operating modes and continuous ratings are in conformance with the Specification and are not less than the levels quoted by the Contractor in his bid.

Both block-1 individually and as a system jointly with existing Block-2 shall run at the nominal maximum power transfer limit for at least 12 hours continuously. If any interruption occurs, the test shall be repeated until such time that uninterrupted operation is achieved.

The power transfer capabilities of the system shall be measured using metering instrumentation as per TS Clause 4.1.3.

Measurement shall also be made simultaneously at the ac bus of the Rectifier using metering accuracy instrumentation for purpose of Employer's information.

The penalties for not meeting the required power transfers shall be as follows:

Shortfall in the total power transfer capability (500 MW) joint operation of Block-1 with exiting Block-2 & (500 MW) for Block-1	INR 200,000 for each KW, or part thereof

~~a)~~ Compensation shall be paid up to a maximum **500** Million INR due to shortfall in total power transfer capability (500 MW) for Block-1.

b) Compensation shall be paid up to a maximum of **1000** Million INR for joint operation of Block-1

Maximum limit on compensation payable under (a) and (b) above in aggregate shall be 500 Million INR~~.~~

However, if the station rating is less than **98 %** of rated continuous power, **plant rejection as per** the Provision of **contract** shall be applicable

11.12 GUARANTEED FAILURE RATE OF THYRISTORS

.1 The maximum guaranteed thyristor level (as defined in Chapter 6.1) failure rate (defined per six months) shall not exceed 0.1 % per 12 pulse valve group except first unit failure. The failure rate shall not include failures directly attributable to operating and maintenance errors.

.2 Just before the start of guarantee period, the faulty thyristors shall be replaced and thereafter faulty thyristors may be replaced after each 6 month period only. In case, it is desired by the Contractor that thyristor be replaced in between the 6 month period, the guarantee period shall be counted a fresh again from that time. Till the expiry of guarantee period, all replacement for failed thyristors shall be supplied by the Contractor free of cost.

.3 The thyristor failure rate shall be monitored over a period of 12 months starting at the end of six months following trial operation of the HVDC system. If the average failure rate of thyristors, over a period of these 12 months proves to be within the guaranteed value the guarantee shall be considered as fulfilled otherwise the guarantee period shall be extended by six (06) months. If the average failure rate of thyristors at the end of the extended period, the one year average number of occurrences/6 months, disregarding any six consecutive months with the highest thyristor

failure rate is equal to or lower than the guaranteed value then the thyristor failure rate guarantee is considered to be fulfilled..

If the average thyristor level failure rate averaged over the best two nos. of six months period is still above the guaranteed value the Contractor shall supply, without any additional cost to the Employer, additional spare thyristors equal to twenty (20) times the difference between the actual annual failure rate averaged over the best two numbers of six months periods and the guaranteed annual failure rate. (0.1 % per 12 pulse valve group).

11.13 GUARANTEED FAILURE RATE OF RELAY MODULE/C&P MODULE/COMPONENT

The guaranteed failure rate of relay module/C&P module/component shall not be more than 0.5% except first unit failure. The failure directly attributable to operation & maintenance errors and other incidents unrelated to the DC system shall not be included in the calculation.

Just before the start of the guarantee period, all the faulty relay module/C&P module/component shall be replaced. Till the expiry of the guarantee period, all the replacements of failed relay module/C&P module/component shall be supplied by the contractor free of cost.

The relay module / C&P module/ Component failure rate shall be monitored over a period of six months starting at the end of six months after trial operation of HVDC system. If the failure rate of each type of relay module/C&P module/component averaged during these twelve months proves to be within the specified value, the guarantee shall be considered as fulfilled otherwise the guaranteed period shall be extended by six months. If the averaged relay module/C&P module/component failure rate calculated, individually for each type, for two out of three nos. of six (06) months, disregarding the six monthly with the highest failure rate is equal to or lower than the specified value of the failure rate, the guarantee shall be considered to be fulfilled.

If the annual failure rate averaged over the best two out of three nos. of six months is still above the specified value for any type of the relay module/C&P module/component, the contractor shall supply, without any additional cost to the owner additional spare relay module/C&P module/component as applicable equal to 20 times the difference between the actual failure rate averaged over the two six monthly and specified failure rate. The performance calculation shall be done for each type of relay module/C&P module/component separately.