

Before

UTTARAKHAND ELECTRICITY REGULATORY COMMISSION

Petition No. 12 of 2019 (Suo-Moto)

In the matter of:

Suo-moto proceedings in the matter of finalization of Station Heat Rate of Gas based Combined Cycle Power Plant of Gama Infraprop Pvt. Ltd. and Sravanthi Energy Pvt. Ltd. located at Kashipur, Uttarakhand.

In the matter of:

Uttarakhand Power Corporation Ltd.

... Respondent

CORAM

Shri Subhash Kumar Chairman

Date of Order: April 05, 2019

The Order relates to the suo-moto proceedings initiated by the Commission in the matter of determination and finalization of Station Heat Rate of Gas based Combined Cycle Power Plant of Gama Infraprop Pvt. Ltd. and Sravanthi Energy Pvt. Ltd. located at Kashipur, Uttarakhand.

1. Background and submissions

- 1.1 The Commission vide its Tariff order dated 16.05.2017, in the matter of determination of Tariff for FY 2015-16 & for the control period from FY 2016-17 till FY 2018-19 for supply of power to UPCL from 214 MW Gas based Combined Cycle Power Plant of Gama Infraprop Pvt. Ltd. (hereinafter referred to as "Generator 1" or "GIPL") located at Kashipur, directed UPCL to appoint an expert Committee/Consultant for establishing the design Station Heat Rate (SHR) of the Gama's plant for the contracted capacity and submit a report on the same within 3 months of the issuance of the aforesaid Order. The relevant portion of the Order dated 16.05.2017 is reproduced hereunder:

"Accordingly, so as to arrive at a precise design SHR of the plant, the Commission directs the Respondent to appoint an expert Committee/Consultant for establishing the design heat rate of the

Petitioner's plant for the contracted capacity and submit the report on the same within 3 months of the issuance of this Order. The Petitioner is also directed to provide all the relevant documents/certificate and also to provide necessary assistance to the Respondent in this regard."

- 1.2 Similar direction was given by the Commission in the Tariff Order dated 24.10.2017, in the matter of determination of Tariff for the control period from FY 2016-17 till FY 2018-19 for supply of power to UPCL from 214 MW Gas based Combined Cycle Power Plant of Sravanthi Energy Pvt. Ltd. (hereinafter referred to as "Generator 2" or "SEPL") located at Kashipur, wherein UPCL was directed to appoint an expert Committee/Consultant for establishing the design Station Heat Rate (SHR) of SEPL's plant for the contracted capacity and submit a report on the same within 3 months of the issuance of the aforesaid Order. The relevant portion of the Order dated 24.10.2017 is reproduced hereunder:

"Accordingly, so as to arrive at a precise design SHR of the plant, the Commission directs the Respondent to appoint an expert Committee/Consultant for establishing the design heat rate of the Petitioner's plant for the contracted capacity and submit the report on the same within 3 months of the issuance of this Order. The Petitioner is also directed to provide all the relevant documents/certificate and also to provide necessary assistance to the Respondent in this regard."

- 1.3 The Generators, i.e. M/s GIPL and M/s SEPL, through their written submission on various dates, represented before the Commission that the time frame allowed by the Commission to UPCL for submitting the report on SHR of the two gas plants had already elapsed and the pendency in the matter is causing financial hardship to them.
- 1.4 The Generator 1, i.e. M/s GIPL, further requested the Commission to provisionally approve the recovery of energy charges at the actual gas bills raised by the fuel supplier till the finalization of the design SHR of their plants by the Commission, to mitigate the financial burden on account of delay in finalization of design SHR.
- 1.5 The Commission took note of the submissions of the Generators and asked UPCL to submit the compliance report in the matter, in response to which UPCL submitted before the Commission that they had approached NTPC to provide the consultancy in the matter of determination of design SHR of the gas plants, and further sought additional time for finalizing the same. UPCL also submitted that they being an interested party, have limitations in scrutinizing the documents submitted by the Generators and reaching to a

conclusion and therefore decided to appoint an independent and neutral expert agency.

- 1.6 The Commission analyzed the submissions of the Generators and UPCL and observed that the SHR was provisionally allowed by the Commission with an intent that UPCL would finalise the same within the time frame given in the Tariff Order dated 16.05.2017 and 24.10.2017. However, UPCL was unable to comply with the directives of the Commission and had time and again sought time extension for the same, causing financial hardship to the Generators.
- 1.7 The Commission vide its Order dated 28.11.2017, in exercise of the powers conferred under Regulation 104 of the MYT Regulations, 2015, i.e. Power to Remove Difficulties, provisionally allowed M/s GIPL to recover the fuel bills at actual from UPCL from the month of November, 2017, till finalization of design SHR by UPCL.
- 1.8 Further, based on the request made by M/s SEPL, to allow them recovery of gas bills on actual basis till the finalization of design SHR, the Commission, vide its letter dated 06.11.2018 provisionally allowed M/s SEPL to recover fuel bills at actual from UPCL from the month of November, 2018 till the finalization of design SHR in line with its Order dated 28.11.2017 in case of M/s GIPL.
- 1.9 UPCL vide its letter dated 10.07.2018 submitted its report on the SHR of the gas based plant of M/s GIPL and M/s SEPL. The report submitted by UPCL was forwarded to both the gas based Generators for their comment. The relevant findings of the report submitted by UPCL and the comment of the Generator have been discussed at subsequent paras of this Order.
- 1.10 The Commission based on the report submitted by UPCL & comments of the Generators on the same and also in the light of views of Hon'ble ATE in its Judgement dated 10.04.2008, decided to appoint an external consultant to assist the Commission in determination of SHR of the Gas based plants of M/s GIPL and M/s SEPL located at Kashipur and to suggest measures to improve the same over a period of time.

2. Commission's views and decision

- 2.1 The Commission having analysed the submissions made by UPCL and the Generators in the matter observed that the approach of UPCL in dealing with the issue of finalization of

design SHR has been lackadaisical. As per the directions issued by the Commission in its Order dated 16.05.2017 in case of M/s GIPL and subsequently in the Order dated 24.10.2017 in case of M/s SEPL, UPCL was required to finalise the design SHR within 3 months from the date of said Orders, however, UPCL finally submitted its report in the matter on 10.07.2018.

- 2.2 UPCL in its report dated 10.07.2018 regarding establishment of SHR for gas based CCPP of M/s GIPL and M/s SEPL, submitted that in compliance of the directions issued by the Commission, a three member committee was constituted for the purpose which deliberated upon the issue and took into consideration the various correspondences and also the documents supplied by the Generators to arrive at the SHR of Gas based plants of M/s GIPL and M/s SEPL.
- 2.3 UPCL further submitted that considering the expertise of M/s NTPC & M/s GAIL in the field, it had requested them to assist and provide necessary consultancy in the matter, however, M/s GAIL did not respond in the matter and M/s NTPC though initially expressed its reservation in giving consultancy in determination of SHR for the private Generator, after pursuance agreed to take action after receipt of relevant documents.
- 2.4 UPCL submitted that M/s NTPC kept on asking for certain specified documents and it appeared that the documents submitted by M/s GIPL were either not complete or were not to the satisfaction of M/s NTPC, though M/s GIPL insisted that all the documents have been provided to M/s NTPC except certain old documents provided by OEM or EPC contractor. UPCL submitted that after numerous communications, M/s NTPC informed that relevant papers were still pending, in response to which M/s GIPL committed to provide the desired papers to M/s NTPC and UPCL, however, UPCL did not receive any such papers. UPCL submitted that, subsequently M/s NTPC refused to respond inspite of various efforts by UPCL to communicate with M/s NTPC.
- 2.5 UPCL further submitted that meanwhile the tariff order of M/s SEPL was also issued by the Commission on 24.10.2017 wherein UPCL was again directed to establish the SHR of Gas based CCPP of M/s SEPL within three months from the date of Order and UPCL again requested the Commission to grant additional time so that the SHR of both the plants could be considered and established together.

- 2.6 UPCL submitted that the Committee took into consideration the various documents filed by the Generators so as to establish the Gross SHR of both M/s GIPL and M/s SEPL keeping in mind the fact that both the plants are located in the same vicinity having similar ambient conditions and also the fact that Gas Turbines of both the plants are supplied by the same manufacturer.
- 2.7 UPCL submitted that on examining the documents of M/s GIPL, it was observed that M/s GIPL provided letters from M/s LUNA Infraprop (P) Ltd. (EPC contractor for the project), wherein, in the first letter, the EPC contractor gave the guaranteed SHR as 1832.30 kCal/kWh and in second letter the EPC contractor submitted the calculation for converting the SHR based on NCV to SHR based on GCV and accordingly had calculated the SHR on GCV as 2033.85 kCal/kWh. Moreover the parameters taken for input in HMBD (Heat Mass Balance Diagram) were mentioned as 1 GT at 100% load and 1 ST at 50% load which was not acceptable and not as per the requirement. Further the data was in complete mismatch with the one provided by M/s SEPL. It was noticeable that both the plants were located in close proximity at identical location and having same class of machines with common manufacturer.
- 2.8 UPCL submitted that on examining the documents of M/s SEPL, it observed that M/s SEPL had filed HBD (Heat Balance Diagram) prepared with 2 GTs working at 100% load and 1 ST at 100% load and accordingly had derived 52.19% gross plant efficiency. From the said data provided by Toshiba (as submitted by M/s SEPL), Station Heat Rate at LCV/NCV was shown as 1647.83 kCal/kWh and Gross Station Heat rate as per Regulation 47(3) of UERC MYT Regulations, 2015, was calculated as 1917.08 kCal/kWh. Further, as per Guaranteed Plant Performance Data sheet the EPC contractor had guaranteed the gross combined cycle Station Heat Rate at LHV as 1675 kCal/kWh which, as per provisions of UERC MYT Regulation, 2015, translates to gross combined cycle Station Heat Rate at GCV as 1948.69 kCal/kWh [GSHR at LHV \times 1.108 \times 1.05] at ISO conditions. UPCL in the report further submitted that, M/s SEPL for the purpose of establishing the GSHR, submitted its representation to allow 2113 kCal/kWh or actual GSHR achieved by the plant whichever is lower for tariff calculations.
- 2.9 UPCL submitted that orders of CERC for plants having generators similar to M/s GIPL

and M/s SEPL operating in other parts of the country were also referred for the purpose of determination of SHR of Gas based plants of M/s GIPL and M/s SEPL. UPCL submitted, that the committee after getting acquainted with the propositions and factual matrix of such generating stations and also the stand of CERC in such matters, which clearly shows that contentions of M/s GIPL and M/s SEPL about station heat rate other than the one guaranteed by the OEM cannot be considered, decided to assess the submissions of EPC contractors also as both the plants comprised of mix of manufacturers, i.e. Gas Turbines were supplied by GE while Steam Turbine and HRSG by other manufacturers. Further for comparison of actual Station Heat Rate (as both the plants are running for past more than one year and there is sufficient data to analyze the actual station heat rate of both the plants) for which the Committee gathered the generation data from the bills submitted by M/s SEPL and M/s GIPL and derived the average Gross SHR for FY 2017-18 as 1975.67 kCal/kWh and 1975.08 kCal/kWh for M/s GIPL and M/s SEPL respectively without considering the data for January, February & March 2018, as there was no generation during these months.

- 2.10 UPCL submitted that the Committee also took into consideration the facts that there were various aspects of running the plant which required efficiency on the part of the generator and because of which fixed criteria for determining the normative SHR was provided in the Regulations so that generating stations do not derive any benefit for their inefficiency, as permitting the actual SHR would include in it the inefficiency and will not promote any enthusiasm in the generators to obtain the desired efficiency.
- 2.11 UPCL submitted that it had analysed the submission of M/s SEPL with respect to various factors as follows:

Ambient air temperature: The Committee is of the view that at times the temperature may increase and where as at other times the average temperature for the particular year may go down, so the temperature which will take up all such variations in any case has to be estimated and taken for defining, and this is the precise exercise done by the EPC contractor while selecting the ambient temperature for the purpose of guaranteeing the design energy.

Dust, Husk, Soot and Smog in ambient air: The committee observed that the reasons

given by M/s SEPL and the contentions are only a statement not supported by any document. Moreover, M/s SEPL has not done any study to derive and evaluate the impact of such conditions upon the performance of the plant and the EPC contractor while designing the plant must have taken all such factors into consideration.

Plant Start up and shut down and part load operation: The committee was aware of the fact that the plant functioning is in initial stages and therefore certain adjustments would be required to be done. It is pertinent to note that the trippings and back down are not permanent feature and all the generating plants come across such conditions. The committee from the performance of the plant for the last year or so has observed that both M/s SEPL & M/s GIPL have been able to achieve their 85% PLF. It is surprising that the generator is considering even the back down instructions of SLDC and also meeting the requirement of grid as the justification for claiming the higher SHR. The committee is of the view that for the statutory requirement and authority no benefit can be claimed by the generator. Moreover the gas based generating stations are best suited to match the load requirement as they have the facility to quick start up and shut down.

Other external factors: The Committee observed that the generator has not given any justification but has only stated that pigging causes clogging of gas filters and thus decreasing gas supply pressure for which at times plant has to be either stopped or operated at part load affecting the SHR. The factors stated are the usual attribute of gas supply. Moreover no data or assessment regarding the details of occurrence and its impact has been submitted by the generator. If the generator is claiming that GAIL is not providing services upto the standard or that there is any deficiency then M/s SEPL need to take up the matter with the appropriate authority and correct the mistake rather than obtaining any benefit for the same by penalizing the consumers of the State and on the contrary if the phenomenon is usual, then obviously M/s SEPL is not entitled to claim any benefit for such reason. This phenomenon also like other factors is not fixed and determinable with certainty hence, no consideration for the same can be taken permanently.

2.12 UPCL in the report of the Committee has submitted that both M/s GIPL and M/s SEPL have insisted that the SHR of the plants, if not on actual should atleast be considered as

that certified by CEA for the purpose of PSDF Scheme. UPCL further submitted that the committee considered their submissions and noticed that even when the generators have stated to be going through the toughest phase for achieving best Station Heat Rate and also that both the plants are new plants, yet the SHR derived on actual basis is far less than the SHR certified by CEA because of which the committee was constrained to request the generators to provide basis and the methodology applied by CEA for determining the SHR. However both the generators could not provide any data to substantiate the same. Moreover they also could not give any reasonable justification for the difference in the actual Station Heat Rate and the SHR certified by CEA. UPCL submitted that the committee cannot go behind the logic and the reasons which CEA may have considered while certifying the SHR of these plant during PSDF Scheme. However there is no denying the fact that special conditions existed which definitely must have been taken into consideration by CEA to certify the SHR much higher than the design Station Heat Rate and even more than what the generators are getting as per actual. The officials of UPCL visited the CEA office and gained from CEA that this particular PSDF scheme has not laid down any guideline or criteria for calculating design SHR of generating stations and had simply considered the SHRs as declared by the respective generators. During discussions with CEA officials, it had come to the knowledge that the scheme was to be executed within a very short span of time and hence CEA had not taken the burden of calculating the SHR values but had considered the values provided by the generators for the purpose of the scheme as it is. Therefore special criteria if any, taken into consideration by CEA for the purpose of a particular scheme does not have any justification, hence, the Station Heat Rate considered by CEA particularly for the purpose of the scheme cannot be considered.

2.13 UPCL in the report of the Committee dated 10.07.2018 regarding establishment of SHR of M/s GIPL and M/s SEPL concluded as follows:

“That the committee has carefully considered all the submissions and the documents of the generators and has with open and impartial mind tried to reconcile them with provisions of the relevant Regulations and the mandate of the Hon’ble Commission given vide order dated 16.5.2017 and 24.10.2017.

That the committee has further taken note of various factors and peculiar situation in the matter and has comprehensively deliberated upon the same in their reasoning above. The

committee also observed that the provisions of the relevant Regulations are very specific and do not specifically mention as to whose guarantee for the purpose of Regulation is to be considered. However the Hon'ble Commission in its orders dated 16.5.2017 & 24.10.2017 has categorically directed to establish the Station Heat Rate as guaranteed by the original equipment manufacturer. Therefore the committee has no option but to fulfill the mandate of the Hon'ble Commission. The fact remains that the generating stations comprise of equipment supplied by different OEMs and the Hon'ble Commission itself had noted that no manufacturer can guarantee the Station Heat Rate in such a situation.

Therefore from the facts and circumstances mentioned above and thoughtful discussions and deliberations done by the committee under the facts and circumstances mentioned *ibid*, the committee in compliance of order of the Hon'ble Commission establishes the Station Heat Rate as hereunder:

Regarding SEPL: Station Heat Rate claimed by M/s SEPL as mentioned hereunder:

1. 1917.08 kCal/kWh at GCV at site ambient condition, which is the SHR mentioned in the Heat Balancing Diagram provided by Toshiba and a copy of which was provided by M/s SEPL with the Tariff petition and on the basis of which the said heat rate was claimed by M/s SEPL.
2. 1675.00 kCal/kWh at LCV (ISO condition) as has been claimed to be guaranteed by EPC (which comes to GSHR as 1948.69 kCal/kWh at GCV at ISO).
3. 2012.7 kCal/kWh based upon normative SHR fixed by CEA for bidding under PSDF support Scheme or on actual whichever is less.

From above SHRs, the SHR mentioned above at point number 1 shall be the normative GSHR for M/s SEPL in view of various reasons mentioned *ibid*.

Regarding GIPL: Station Heat Rates claimed by M/s GIPL are mentioned hereunder:

1. 1832.00 kCal/kWh at LCV (Site ambient condition), claimed to have been guaranteed by the EPC contractor. (which comes to GSHR as 2131 kCal/kWh at GCV at site condition).
2. 2001.00 kCal/kWh based upon normative SHR fixed by CEA for bidding under PSDF Support Scheme.

As has already been mentioned by the committee, with the facts and the circumstances of the case, it is appropriate and just that SHR of 1917.08 as established above for M/s SEPL shall also be considered for M/s GIPL."

2.14 The Commission forwarded the copy of the aforesaid report of UPCL on SHR, to respective Generators, i.e. M/s GIPL and M/s SEPL, for seeking their comments on the

same, in response to which replies were submitted by both M/s GIPL and M/s SEPL vide their letter dated 22.10.2018 and 05.10.2018 respectively.

2.15 M/s SEPL in its submissions, referred to Hon'ble ATE Judgement dated 10.04.2008 in Appeal No. 86 & 87 of 2007, the relevant portion of which is reproduced hereunder:

"30.The Commission, during the course of the hearing, submitted that the Appellant had not provided details of design heat rate and heat rate degradation curve as per the original equipment manufacturer's recommendation. The Commission has explained that it had compared SHR of similarly sized and vintage units across the country on the basis of the report of the Central Electricity Authority (CEA). The Commission has further explained that a selective comparison of SHRs approved by various other electricity regulatory commissions cannot be made, with which we fully agree. We have observed that different commissions adopt different practices and considerations while determining the allowable SHR level. Hence, a comparison without considering all the factors leading to determination of allowable SHR for a particular station is neither meaningful nor advisable.

31.We are of the opinion that if the SHR allowed by the Commission is not achievable, then the same would not be in anybody's interest; entity would suffer by not recovering its reasonable cost of supply of the electricity and the consumers would not get the right signal about the pricing of the product they would be using. It is as much essential for the consumers to know the right price of the product they are using, as much as it is for the entity to recover its cost of operations. Unless the consumer knows the true price of the product, he will not be able to take an informed decision about the quantum of his consumption, particularly the industrial and commercial consumers who recover such costs from their consumers. Determining right price is also essential to send signals to the prospective developers/investors in the sector enabling them to take decision about the investment potential in the sector.

32.Under the circumstance, we feel that the Commission either on its own or through the Appellant engage appropriate independent agency(ies), who can carry out a study in a time bound (preferably within three months) manner to reasonably assess the achievable SHR of the plants owned by the Appellant. Such agency may also be asked to suggest measures to improve the SHRs over a period of time."

2.16 M/s SEPL accordingly in line with the above Order of Hon'ble ATE submitted a technical report from an independent consultant (M/s Desein Private Limited) on study and derivation of SHR for their Gas based CCPP located at Kashipur, and accordingly

requested the Commission to approve the Gross SHR as 2010 kCal/kWh based on the aforesaid technical report.

- 2.17 M/s GIPL submitted details of SHR calculations considering various factors viz, design heat rate by OEM, class of gas turbines, ambient temperature, relative humidity, exhaust pressure, GT degradation, start/stops, partial loading factor etc. and requested the Commission to consider the Design SHR of 2030 kCal/kWh with an AEC of 3% for determination of Gross SHR of their Gas based CCPP.
- 2.18 With respect to the comments on the report of the Committee constituted by UPCL, both the generator's submitted that they had submitted all the requisite documents to UPCL for establishment of SHR. Further, with respect to UPCL's contention that both the generator's are having similar machines and are located in same vicinity, M/s GIPL submitted that although plants of both M/s GIPL and M/s SEPL are in same vicinity still the gas plant of M/s GIPL is operating only on one GT and steam turbine at 50%, therefore, there should be marginally higher heat rate due to part load operation of their plant.
- 2.19 With respect to comment of UPCL that SHR data submitted by M/s GIPL through various documents was at variance and also the same was in complete mismatch with the one provided by M/s SEPL, M/s GIPL submitted that the documents as provided by the EPC contractor were submitted to UPCL and moreover, since they had a contracted capacity of 107 MW, therefore, the relevant HMBD considering 1 GT at 100% load and 1 ST at 50% load was submitted.
- 2.20 With respect to the comment of UPCL that there is no evident reason for such a vast deviation between the guaranteed design heat rate of plants of M/s GIPL and M/s SEPL, considering the fact that even the manufacturer of the Gas Turbines are same and also both the Generators belong to Class F category, M/s GIPL submitted that Heat rate of plants of both M/s SEPL & M/s GIPL shall be comparable except that M/s GIPL is operating Steam Turbine at 50% capacity due to part PPA and hence there is an incremental increase of 45 kCal/kWh on Heat rate of their plant.
- 2.21 With respect to UPCL comment that there is no efficiency degradation due to utilization of just 50% capacity of the steam turbine, M/s GIPL submitted that they had submitted the technical justification that part load will affect the performance of Steam turbine. Further,

with respect to UPCL's comment, that the factors which have been claimed by M/s SEPL to be affecting their plant has no effect at all upon the plant run by M/s GIPL which shows that the grounds given by M/s SEPL are unjustified, M/s GIPL submitted that these are the important factors that affect the Heat Rate of power plant. Further, M/s SEPL on this issue submitted that the facts and justification provided by M/s GIPL regarding the Heat Rate is completely their prerogative and M/s SEPL does not have any reason to comment on the engineering design, etc. which impacts the efficiency parameters of M/s GIPL. Further, the altered conditions at the site and the corrections being made to arrive at the efficiency at prevailing site conditions are all factual in nature and substantiated by an independent party report, i.e. Desein appointed by M/s SEPL for studying the SHR of their Gas based CCPP.

2.22 UPCL in the report of the Committee submitted that the generating stations are equipped with one of the best in class machines for which huge O&M charges are being paid, which in turn justifies to encourage the Generators to be more efficient. That the plants of both the Generators are stranded units and may have some initial issues with regard to their operations, the performance will improve after some fine tuning and with colder months into considerations and a little more effort from the generators, the required normative SHR could easily be achieved and it would be in the interest of the stakeholders especially common public that generator should make all the efforts for achieving maximum efficiency. In this regard, M/s GIPL submitted that UPCL had observed that the performance would improve after sometime as the plant progresses its generation whereas the document submitted by the OEM suggested that with time and major overhaul the plant performance degrades. Further, M/s SEPL in this regard submitted that even though plant remained stranded for some period, it always remained unfired and in a brand new condition till the same was commissioned. While all the necessary efforts are always there from the operations team to extract the best out of the equipments, it would be pertinent to note that the period of operations, i.e. 2 years is a sufficient time to reflect upon the parameters and the change in conditions that impact the productivity and efficiency of the plant based on the defined technical parameters which were very scientific in nature and not arbitrary.

2.23 M/s GIPL, with respect to various orders of other gas based power plants referred to by

UPCL, submitted that the plants referred to by UPCL in its report have different geographical location and capacity and such a comparison with their power plant has no relevance. Further, M/s SEPL in this regard submitted that every Project would have its own dynamics in terms of operating parameters and the engineering design would be different for each plant that significantly determines the plant efficiency.

- 2.24 With respect to comment of UPCL that M/s SEPL itself calculated the gross SHR as per the MYT Regulations as 1917.08 kCal/kWh, M/s SEPL submitted that the earlier provided Heat rate of 1917.08 kCal/kWh was based on the HBD from Toshiba and the same was not the Guaranteed Heat Rate and also there was no historical data to evaluate the same and assess the impact of change in ambient conditions.
- 2.25 With respect to the comment of UPCL stating the average Gross SHR of M/s SEPL for FY 2017-18 as 1975.08 kCal/kWh based on the bills submitted by the Generator, M/s SEPL submitted that the figures submitted by UPCL are at variance with the data available with M/s SEPL.
- 2.26 Further, M/s SEPL submitted that UPCL did not factor in the effect of ambient temperature on Station Heat Rate on technical grounds. Also the effect of dust, smog on the Gas Turbine inlet air filters was significant and the same affected the continuous operation of the machine which leads to increase in the Station Heat Rate. Further, with respect to issue of frequent start/stops, M/s SEPL submitted that if the number of instance was more than one, then the effect on Station Heat Rate was 8.2 kCal/KWh. M/s SEPL also submitted that the PLF for FY 2017-18 was 57% for their plant and hence, it would be grossly incorrect on the part of UPCL to state that the plant achieved 85% PLF during operations and there was insignificant impact on the Station Heat Rate due to start/stops.
- 2.27 With respect to comment of UPCL that the guaranteed value claimed by EPC contractor would never be less than the OEM guarantee as the EPC contractor would include certain margins over and above the guarantee given by the OEM, M/s SEPL submitted that since plant performance had significant financial implications, the Guaranteed Heat Rate was always provided by the EPC Contractor after considering the standard Heat Rate margin to account for the radiation losses, heat loss due to leakages, passing, etc and piping losses

across the main equipment, fuel quality, heat transfer capacity of HRSG vis-a-vis dust accumulation.

- 2.28 M/s SEPL submitted that the approach adopted by UPCL to evaluate the submissions made by M/s SEPL and arriving at the conclusion that there should not be any change in SHR under the altered site conditions as technically established by M/s Desein, was unfair and merits re-consideration.
- 2.29 The Commission took note of the submissions made by UPCL and the Generators and observed that the Generators didn't agree with the report submitted by UPCL and their claims for SHR was at variance from that suggested by UPCL. The Commission also observed that report submitted by UPCL was based on recommendation of an in-house committee constituted by UPCL for the purpose, whereas, as per the directions of the Commission, UPCL was required to appoint an expert Committee/Consultant for establishing the design heat rate of the Generators plant for the contracted capacity and submit the report on the same before the Commission.
- 2.30 The Commission is of the view that if the SHR allowed by the Commission is not achievable, then the same would not be in anybody's interest as on the one hand the Generators would suffer by not recovering reasonable cost of supply of the electricity and on the other hand the consumers would not get the right signal about the pricing of the electricity they are consuming. Moreover, determining right price is also essential to send signals to the prospective developers/investors in the sector enabling them to take decision about the investment potential in the sector. The same was also in accordance with the Judgment dated April 10, 2008 of Hon'ble ATE as reproduced above.
- 2.31 The Commission in order to bring transparency and express an unbiased view in the matter of determination of Station Heat Rate, appointed an external consultancy firm, i.e. M/s Powertec Engineering Private Ltd. (hereinafter referred to as "the Consultant") to assist the Commission in determining the SHR of the two gas based plants of M/s GIPL and M/s SEPL and also suggesting measures to improve the same over a period of time. The Consultant appointed by the Commission, requested certain documents and drawings which were duly provided to them by the Generators for their study and analysis. The Consultant after initial review and analysis of the documents and reports, visited the plant

site of both the Generators to discuss & collect feedbacks from the operation teams of both the plants and to inspect the condition of the plant and equipments and also to assess the environmental conditions which were reported to be adverse to the performance of the station and its Heat Rate. Subsequently, a report dated 22.03.2019 was submitted by the consultant in the matter, the relevant finding of which is discussed in the following paras.

2.32 The Consultant summarized the plant related basic information of both the generating stations as follows:

Table 1: Project information of Gas based CCPP of M/s SEPL and M/s GIPL

S. No.	DESCRIPTION	Project - I	Project - II
1.	Project	2 x 225 MW (ISO) gas based combined cycle power plant	225 MW (ISO) gas based combined cycle power plant
2.	Project Authority	M/s Sravanthi Energy Private Limited	M/s Gama Infraprop Private Limited
3	Project Location	Kashipur, Dist.- Udham Singh Nagar, Uttarakhand	Kashipur, Dist.- Udham Singh Nagar, Uttarakhand
4	Longitude	78°58'29"E	78°58'29"E
5	Latitude	29°09'18"N	29°09'18"N
6	Site Altitude	221 M (above MSL)	221 M (above MSL)
	FGL	223.050 M (MSL)	222.050 (MSL)
	FFL - HRSG	223.550 M (MSL)	222.350 (MSL)
	FFL - STG Building	223.550 M (MSL)	222.350 (MSL)
7	Ambient Temperature		
	Maximum	42.0 ° C	42.0 ° C
	Minimum	3.0 ° C	3.0 ° C
	Design	23.0 ° C	23.0 ° C
	Revised Design (based on Actual average ambient)	25.0 ° C	25.0 ° C
8	Relative Humidity		
	Maximum	97.0 %	97.0 %
	Minimum	45.0 %	45.0 %
	Design	75.0 %	75.0 %
9	Rainfall		
	Mean annual rainfall	1071.9 MM	1071.9 MM
	Maximum intensity of rainfall	492.0 MM	492.0 MM
10	Wind		
	Terrain Category	Seismic zone - IV	Seismic zone - IV (Tropical, Hot , Humid)
	Basic Wind speed for design	5 m / sec	5 m / sec
11	Nearest Railway Station	Kashipur	Kashipur
12	Nearest Airport	Pant Nagar	Pant Nagar
13	Access road	NH -74 (Haridwar to Bareilly)	NH -74 (Haridwar to Bareilly)

Table 2: Various Ambient conditions

Sl. No	Description	ISO Condition	Design Condition	
			Design	Corrected Design
1.	Pressure	1.01325 bar	0.987 bar	0.987 bar
2.	Temperature	15°C	23° C	25° C
3.	Relative Humidity	60 %	75 %	75 %

2.33 The Consultant submitted that the Guaranteed Heat Rate at ISO was derived from the performance data/parameters (ISO) provided by OEM, viz the Heat Consumption and Power output in OEM documents. The Consultant further submitted that it was a general practice for EPC contractors, who integrate different OEMs equipments, to include some margin while furnishing guarantee parameters in order to take care of commercial liabilities due to various unforeseen factors, hence, the EPC contractor margin of 2.5 % is taken in to consideration while arriving at the Design Heat Rate, and, accordingly the Guaranteed Heat rate of 1675 kCal/kWh declared by EPC contractor of M/s SEPL for ISO condition has been accepted and considered.

2.34 The Consultant submitted as per OEM document, the major factors for which corrections for Gross heat rate is envisaged & the same is provided for in ASME Performance Test codes, subsequent to PG tests at site are as follows:

- (i) Ambient temperature
- (ii) Ambient relative humidity
- (iii) Ambient barometric pressure
- (iv) GT inlet air pressure drop
- (v) GT exhaust gas pressure difference
- (vi) Fuel gas composition/LHV
- (vii) Fuel gas supply temperature
- (viii) GT fired hours degradation

The Consultant further submitted that apart from the above, the other two factors which will affect the station heat rate but are very difficult to quantify and compute are as follows:

- (i) Part load operation below a certain value over a period of time.

(ii) Frequent Shut downs & start up (Start / Stops) of the plant.

2.35 The Consultant with respect to ambient temperature stated that the Guaranteed SHR (HHV) at Design condition, i.e. 23°C & 75% RH is 1890.3598 kCal/kWh. In view of the difference of at least 2°C between the ambient temperature considered in design and the actual ambient temperature recorded since COD, a correction on Heat rate for this 2°C difference is a reasonable claim of the generators that should be accepted, and hence the site (design) ambient temperature may be taken as 25°C in place of 23°C, accordingly, after applying the correction factor of 2°C, the Design SHR (HHV) works out to 1893.3844 kCal/kWh.

2.36 The Consultant, with respect to ambient relative humidity, submitted that as there was no change in relative humidity between design & actual site condition, therefore, no correction was required on account of same. Further, with respect to ambient barometric pressure, the Consultant submitted that as there was no change in site altitude therefore there was no change in Barometric Pressure (0.987 bar), accordingly, no correction on this account was required for calculation of Heat Rate.

2.37 Further, with respect to GT Inlet air pressure drop difference, the Consultant submitted that as per GE Performance Guarantee Parameters, pressure drop across air filter considered is only 64 mmWC, whereas it was observed that the pressure drop was always above this value due to site environmental condition. Further, both the Generators were facing difficulties in overcoming this problem more so during summer harvest seasons and winter foggy conditions. The Consultant suggested some measure that the Generators may take to address these issues which are reproduced hereunder:

“Issue: Inlet Air Filter - High differential pressure

It is noted that the problem of inlet air filter getting clogged and causing a high differential pressure across the filter is a real problem faced by the Generators, which is hampering the performance of the station at certain periods. During our site visit, we observed the environment and atmosphere to be clean and dust free, yet it was reported that O&M staff are regularly covering the suction duct of the filter with an additional filter cloth which also gets clogged within a couple of days ...

Suggestion:

Since the cause of issue or the problem pertains to environmental condition during certain periods, the only remedy available is to see how best we should overcome the effect of it. Regular & Periodic maintenance/replacement & modification of Inlet Air Filtration system with the provision of Pulsation/Static type Inlet air Filter arrangement. This will improve the performance of GT and also will avoid any trip due to high differential pressure.

Issue : High ambient Air Temperature during hot weather conditions

The performance of the station is dependent upon the Inlet air temperature. When the ambient air temperature increases beyond the design temperature, its density reduces thereby reducing the mass of air flow into the Compressor, which in turn reduces the power output and increases the Station Heat rate.

Suggestion:

Subject to availability of space and feasibility in layout, it is suggested to implement an Evaporative ambient air cooling system at the suction end and operate the cooling system during hot weather conditions. Evaporative cooling works by employing water's large enthalpy of vaporization. The temperature of dry inlet air can be dropped significantly through the phase transition of liquid water to water vapor evaporation. Quantum of Actual improvement can be computed only after discussions with OEM's/ suppliers and after detailed Techno economic analysis. At this juncture, it can be pointed out that there will be considerable improvement in Station Heat Rate if this system is implemented."

- 2.38 Further, with respect to GT Exhaust pressure difference, the Consultant submitted that this criteria was not raised by any of the two Generators and as such no data was available for actual operating conditions and hence no correction was required on this aspect.
- 2.39 The Consultant, with respect to fuel composition & fuel supply temperature submitted that no change in fuel supply temperature between design & actual condition was observed. Further, there was not much difference between fuel composition between design & actual condition and H/C ratio remained same, therefore, no correction in Heat Rate was required on this aspect.
- 2.40 The Consultant with respect to GT degradation submitted that degradation in the performance of any machine was a normal phenomenon and in case of Gas Turbine it was an established norm and therefore Gas turbine manufacturers, OEM's furnish a degradation curve indicating the "deterioration in performance Vs the number of Fired

hours". The Consultant submitted that based on the documents submitted by the Generators it was observed that M/s GE, i.e. OEM of Gas Turbine, had furnished a curve of Fired hours Vs Performance loss along with a "degradation table for 72000 fired hours viz nine years of operation" corresponding to 1st, 2nd and 3rd Major overhauls of 72000 fired hours each. The Consultant further submitted that the table indicates degradation in % for Heat Rate and output and it was anticipated that after each major overhaul the performance of the GT comes back to its initial condition but with an offset termed as "non-recoverable performance loss" which is converted into equivalent kCal/kWh.

Further, M/s GE recommended that the Generators should undertake such periodic maintenance and overhauls as per GE operation & maintenance procedures in order to ensure that the machine performance is as designed. Accordingly, the Consultant recommended that since the performance degradation is not under the control of Generators suitable correction for Heat Rate may be given based on fired hours for the "Non-recoverable loss" as detailed in the table given below, and no correction is required for recoverable loss.

S.No.	Description	SEPL
1.	Design Fired hours	200 hours
2.	Actual GT -1 fired Hours	14330 hours
3.	Actual GT -2 fired Hours	13865 hours
4.	Heat rate Degradation factor	1.1 %

The Consultant submitted that in order to compute a correction factor for degradation, they have considered a factor corresponding to 14,000 hours of fired hours, as on the date of report the machines have clocked 14000 operation hours, and if "equivalent operating hours (EOH)" considering the total number of starts/stops are also taken into account, it may be more. Further, each start consumes around 20-25 equivalent operating hours (EOH), which has not been taken into account for any correction. The Consultant further submitted that as per GE's correction table, degradation in heat rate corresponding to 14000 Fired hours is 18.425 kCal/kWh, considering the factor of 1.011 over guaranteed HR 1675 kCal/kWh @ LHV. Further, the total degradation in SHR till the 1st Major inspection at 72000 fired hours is 39.3625 kCal/kWh and around 50% of this value has been considered for correction due to degradation as on the date of report. The Consultant also submitted that the degradation table furnished by M/s GE does not indicate whether the

correction factor corresponds to ISO condition or design condition, and therefore they have considered the lower of the two, i.e. design HR value viz 1675 kCal/kWh and applied the correction for degradation.

- 2.41 Further, the Consultant with respect to part load operation submitted that the SHR may suffer when the GT is operating on part loads for long durations, however, this being an operational requirement of the grid and moreover this may not be a regular and frequent occurrence, this factor has not been considered for any correction, with the presumption that SLDC will ensure operation of the stations at around 90%, so that the Generators may not be burdened on account of this factor.
- 2.42 The Consultant with respect to frequent shut downs & start up (start/stops) of the plant submitted, that the Generators furnished details regarding the reason & number of the starts/stops that was necessitated since COD and expected some corrections in SHR for stoppages due to UPCL restriction. The Consultant submitted that after analyzing the data furnished, it was observed that during the initial stabilization period of 6 months, the number of starts/stops were high which reduced considerably over a period of time.

The Consultant further submitted that whenever the unit is started, depending on whether it is a "Cold/Warm/Hot start", one has to follow start up sequence allowing the waiting period in each step. Further, the heat input consumed till the unit is synchronized will not be accounted for, since during this period there will be no power output from the unit but fuel consumption will be there. Similarly, when the unit is raised from "no load to full load", there will be gradual predetermined increase in power output when the fuel consumption will not commensurate with the load. Similarly, only after the 1st stream of GT/HRSG/ST is put into operation, it is possible to start the 2nd Stream and bring it to the full load. Hence, after a considerable duration of time, the entire station can be brought into desired load and during this period Station Heat Rate will suffer considerably.

The Consultant submitted that it is a normal practice in GTs that OEMs correlate each "Cold/Warm/Hot start" start up with equivalent Operating Hours (EOH) and account it in degradation and follow maintenance schedules. Further, there is no thumb rule or indication available from their documentation to bring out the quantum of SHR on account of each starts neither there is any restrictions on the number of starts/stops.

Further, in normal parlance, as per the maintenance schedule, if the number of starts crosses 450 it is considered as equivalent to 12000 hours of operation and corresponding maintenance is to be done.

The Consultant further submitted that since lot of analysis and reliable OEM inputs are needed to compute the effect of each start on SHR, it cannot be done at this stage and needs to be done as a separate exercise. The Consultant also suggested measure that may address the issue of frequent starts/stops, which is reproduced hereunder:

“Issue: Frequent Start/Stop

It is seen that the number of Start/Stops was very much on the higher side during the initial period of commissioning & operation. Over a period of time, when the station got stabilized, the number of Start/stops got reduced to 1-2 per GT per month.

Suggestion:

Start/Stops needs to be restricted as much as possible and we believe that SLDC is fully aware of its implications and would not resort to such operation unless otherwise called for. However some guideline to SLDC in this regard from the Hon'ble commission would be very beneficial.”

2.43 The Consultant stated that weighted average actual SHR for CCPP of M/s SEPL is around 2005 kCal/kWh since COD and the same works out to about 1989.17 kCal/kWh, after discarding the initial stabilization period of 5 months. The Consultant, accordingly, based on various factors submitted the detailed calculation of sustainable Station Heat Rate as summarized in the table given below:

Table 4: Sustainable Station Heat Rate

S. No.	Description	Values	Remarks
1	Station Heat rate (LHV)- ISO, kCal/kWh	1675	@ 15°C & 60% RH
2	Temp Correction factor	1.0164	15°C to 23°C
3	RH Correction factor	1.0015	60% RH to 75% RH
4	LHV to HHV Conversion factor	1.1087	10.87 %
5	Design Station Heat Rate, kCal/kWh	1890.3598	Sl.No (1 x 2 x 3 x 4)
6	Temp Correction factor	1.0016	23°C to 25°C
7	GT Degradation factor	1.011	@ 14000 Fired hours
8	Corrected Design Station Heat rate, kCal/kWh	1911.809	Sl.No. (5 x 6) + Sl.No.1x 0.011
9	Correction factor as per MYT Regulation	1.05	
10	Corrected Gross Station Heat rate in kCal/kWh considering MYT Regulation factor of 1.05	2007.4	Sl.No (8 x 9)

2.44 The Consultant further submitted that the CCPP of M/s GIPL is almost same as that of M/s SEPL with respect to module configuration, rating & ISO heat rate, identical GT & ST, & other similarities in all equipments, design & environmental conditions, except that they have started commissioning the station in the FY 2015-16 and are operating the station with one GT & ST at 50 % load. However, the sustainable Station Heat Rate derived for CCPP of M/s SEPL shall also be applicable for M/s GIPL station also and hence the same SHR, i.e. 2007.4 kCal/kWh is recommended for CCPP of M/s GIPL as well. The relevant portion of Consultant report in this regard is reproduced hereunder:

"7.0 Conclusion

After careful considerations of all the submissions and technical documents of SEPL, GIPL, the report of the Committee constituted by UPCL and discussions/feedbacks during site visit, PEPL has with an open and unbiased manner worked on the assignment entrusted to them by the Hon'ble Commission and submit the final recommendation as below for SEPL

- *Corrected Design Station Heat Rate* = 1911.809 kCal/kWh
 - *Gross Station Heat rate* = 2007.4 kCal/kWh
- (considering MYT Regulation factor of 1.05)*

Since the GIPL's Station is almost same as that of SEPL in regard to Module configuration, Rating & ISO heat rate, identical GT & ST, & other similarities in all equipments, design & Environmental conditions, except that they have started commissioning the station in the FY 2015-16 and are operating the station with one GT & ST at 50 % load, high number of Starts and their AEC will be slightly more than the SEPL project. However, the Sustainable Station heat rate derived for SEPL will be applicable for GIPL station also and hence the same SHR is recommended as below:

- *Corrected Design Station Heat Rate* = 1911.809 kCal/kWh
 - *Gross Station Heat rate* = 2007.4 kCal/kWh
- (considering MYT Regulation factor of 1.05)*

"

2.45 In this regard, the Commission is of the view that the report submitted by the Consultant in the matter of determination of SHR of the Gas based CCPP of M/s GIPL and M/s SEPL can be adopted and, accordingly, the Commission approves the Design Station Heat Rate as 1911.809 kCal/kWh and Gross Station Heat Rate (considering MYT Regulation factor of 1.05) as 2007.4 kCal/kWh, for gas based CCPP of both the Generators, i.e. M/s GIPL & M/s SEPL, located at Kashipur, Uttarakhand, from the date of their respective CODs.

- 2.46 The Commission further directs both the Generators i.e., M/s GIPL and M/s SEPL to follow the suggestions given by the Consultant for improvement of Station Heat Rate as discussed at para 2.37 above after carrying out a cost-benefit analysis, based on discussion with OEMs/suppliers and Techno economic analysis etc., and also after getting the same approved by the Commission.
- 2.47 Further, as discussed at para 2.42 above, the Commission directs the State Load Dispatch Centre to restrict the starts/stops of the Gas plants of M/s GIPL and M/s SEPL to the bare minimum unless otherwise called for, and also work out an operating procedure jointly with UPCL and the Generators to deal with this issue and submit the same before the Commission within one month of the date of Order.
- 2.48 Further, the Station Heat Rate is a controllable factor the performance of which can be optimized by the Generators through efficient operations. The MYT Regulations states that, the variation in the performance of the Generators with respect to controllable factors is subject to sharing of gain/loss. In this regard, the Commission is of the view that for the purposes of sharing of gain/loss, on account of efficient operation with respect to achievement of the optimum actual Station Heat Rate by the Generators, the same shall be evaluated based on the Gross SHR of 1988.05 kCal/kWh which is nothing but the actual SHR achieved post stabilisation period as per Consultant's report. In other words, the two generators will be eligible for incentives on account of lower SHR if the same is below 1988.05 kCal/kWh and disincentives if the actual SHR exceeds 2007.4 kCal/kWh. There will be no incentive or disincentive in the range of 1988.05 kCal/kWh to 2007.4 kCal/kWh. This will motivate the Generators to optimize the performance of their respective plants in an efficient manner and keep a check on wasteful expenditure. However, for the purposes of periodic billing by the Generators on UPCL, the Gross Station Heat Rate shall be considered equivalent to 2007.4 kCal/kWh as discussed in above paras.
- 2.49 Further, the GSHR as approved in this Order shall be squarely applicable from billing period commencing on 1st April, 2019 and any adjustment for the prior period, i.e. from COD till 31st March, 2019 shall be considered in the next Tariff proceedings.
- 2.50 The provisional arrangement allowed to the Generators by the Commission for recovery of gas bill on actual basis till the determination of final SHR, vide Order dated 28.11.2017 in

case of M/s GIPL and vide letter dated 06.11.2018 in case of M/s SEPL, shall cease from the date of this Order without prejudice to bills raised by the Generators on UPCL for the period prior to 01.04.2019.

3. Ordered accordingly.

(Subhash Kumar)
Chairman