Chhattisgarh State Electricity Regulatory Commission
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Petition No.25 of 2006(M)

In the matter of determination of power factor incentive/penalty

1. M/s Jayaswals NECO Ltd.

2. Chhattisgarh State Electricity Board

.....Respondents

O R D E R
(Passed on 10/10/2006)

In the order passed on 5/10/2005 in Petition No. 19/2005(M), this Commission had decided to examine the matter regarding the power factor (PF) incentive and penalty in detail, in view of the wider issues involved. The petitioner in this case M/s Jayaswals Neco Ltd (M/s JNL, hereafter) had pleaded in that case that PF penalty should be levied on the maximum demand or on the energy consumption, but not on both, as was the practice before this Commission's first tariff order (for 2005-06) passed on 15/06/2005. In the order passed on 5/10/2005 aforementioned, the Commission had observed and decided as under:-

"It is seen that power factor penalty as well as incentive have been introduced on both maximum demand and consumption. In the earlier tariff there was provision of levy of penalty/incentive on either of the two. Hence, the issue needs to be studied in detail by the Commission to consider if as per the request of the petitioner levy of penalty should be either on consumption or on maximum demand and not on both. Since, incentive is also being given on both maximum demand and consumption, any decision on disincentive will affect incentive, which will also have to be restricted to either of the two. This will have effect on a much wider spectrum of tariff and hence the Commission would like to consider this issue separately. Till then the petitioner will make payment of power factor penalty as per the tariff order dated 15/06/2005." (Para 13 of the order)

M/s JNL had preferred an appeal against this order to the Hon'ble Appellate Tribunal for Electricity, under Section 111 of the Electricity Act, 2003 (the Act, for short). In their order passed in appeal No. 186 of 2005 on 5/4/2006, the Hon'ble Appellate Tribunal had taken note of our decision to examine the issue in detail as above and had rejected the plea of the appellant on the ground that it was premature for the appellant to approach the Tribunal in this issue. This suo motu petition has been instituted in pursuance of our order of 05/10/2005 with a view to examine the whole matter in detail. It was the Commission's intention to pass orders in this case before the tariff order for 2006-07 was passed, especially in view of the fact that the matter was agitated on the basis of the tariff order for the year 2005-06. However, the examination of the matter could not be completed before the tariff order for 2006-07 was passed on 13th Sept. 2006 [Petition No.24 of 2006 (T)]. Based on the inputs available to the Commission while considering the tariff application submitted by the CSEB, the Commission has passed an order regarding PF incentive/penalty as part

of the tariff order. The order in this case is being passed on further and detailed examination of the various issues involved.

2. We have heard the CSEB as also M/s JNL. Detailed technical inputs on the matter have been submitted by the CSEB vide their letter dated 31/05/2006 and their additional submission made on 28/07/06. M/s JNL submitted a rejoinder to the CSEB's submission on 21/06/2006. For wider consultation the HT consumers' associations, i.e. Urla Industries Association, C.G. Mini Steel Plant Association, C.G. Udyog Mahasangh, Biomass Developers' Association were noticed to submit their comments and suggestions on the CSEB's letter of 31/05/2006 which raised many technical issues. But none of these associations submitted any comments nor appeared for hearing. We have also consulted the Central Electricity Authority since certain technical issues have been raised by the CSEB.

3. While M/s JNL had made a limited plea that power factor incentive/penalty should be on either maximum demand or on consumption but not on both, CSEB contended on technical grounds that PF incentive as structured at present should be discontinued and that only penalty should be retained. The Commission accordingly framed the following three issues with regard to PF in this case:

(i) Should there be a levy towards PF incentive/ penalty on HT consumers?

(ii) Should only PF penalty be imposed and no incentive given for improved PF beyond 0.95?

(iii) In either of the above two cases, should PF incentive/penalty be levied on both maximum demand and energy consumption or on only one of these?

4. The CSEB in its submission dated 31/05/06 has stated that incentive and penalty on power factor being above/below a certain prescribed level has been provided based on the considerations that (i) power factor affects generation, line and equipment capacity (ii) impacts on losses in the system and (iii) a good PF contributes to maintenance of a good voltage profile.

With regard to the effect of PF on generation it has been stated that a 100 MW generator can generate 100 MW active power between a power factor of 0.9 lagging (corresponding to value of 60 MVR) to 0.98 leading (corresponding to value of approximately 15 MVR). In case the power factor is below 0.9 lagging or 0.98 leading the generator can accommodate the demand of reactive power only by reducing the generation of active power. This is very costly and not desirable. Thus, if power factor is below 0.9 it is harmful for the generator. In order to allow the generator to generate its rated MW capacity, the reactive power requirement has to be kept limited corresponding to 0.9 lagging and 0.98 leading. This is the reason why power factor incentive and disincentive is required to be imposed on the consumer. However, it is also to be noted that even if the power factor is improved to unity the generator's MW capacity does not increase and therefore the CSEB's argument is that there is no reason why power factor incentive should be given for improving the power factor beyond 0.9. With regards to impact on losses it has been stated by the CSEB that the reduction of losses on the lines can take place only if actual current reduction takes places on the line carrying load. Taking the example of a 220 KV line of 200 Km length it has been stated that this line will generate approximately 30 MVR capacitive VAR (reactive power) on charging. If the line is

carrying a load of 50 MW and the reactive MVR is 20 (lagging), the net VAR flow on the line will be 30-20=10 MVR only. If compensation of load is improved so that lagging VAR is reduced to 10 MVR only, the net VAR flow on the line will be 30-10=20, thus increasing the VAR flow from 10 to 20. Contrary to the belief that this will bring down the loss this will in fact increase the losses. Thus, the loss cannot be brought down in all cases simply by enhancing the power factor of the load. Further, the transmission system typically operates at a power factor of 0.97/0.98 and therefore, enhancing power factor to more than 0.95 does not contribute to any rise in power factor in transmission network. Hence, the CSEB has argued that there is no ground to give incentive to the consumer in such cases. However, low power factor may cause voltage drop in local distribution network and increased losses, for which penalty needs to be levied. If the power factor is maintained at 0.9 the distribution system efficiency i.e. voltage drop or losses are minimal and improvement of power factor from 0.95 onwards does not contribute to any significant reduction in voltage drop and in losses. With regard to voltage profile, the CSEB has stated that maintenance of voltage at the consumer premises is entirely the responsibility of the supplier for which necessary voltage improvement devices such as power transformer with on load tap changer and capacitor banks are installed. These equipments help in improvement of power factor. The CSEB has on the above grounds has requested that the power factor penalty which was introduced in the tariff order for the year 2005-06 needs to be maintained while grant of incentive on power factor above 0.95 may be discontinued. In the additional submission made on 28/07/06, the CSEB has stated that low power factor in a system causes several problems such as, (i) increased losses (ii) low voltage profile (iii) fictitious loading of equipments and lines reducing their capacity and (iv) excessive temperature rise. This reduces the system's operating efficiency as a whole and therefore the imposition of penalty has been the practice since the inception of the electricity industry. The CSEB, has further stated that the best way of charging for PF is to bill KVArh units which takes care of power factor incentive/disincentive.

5. M/s JNL, on the other hand, has pleaded that around 10% increase in real power generation is possible with change in the operating power factor from 0.9 to 1.0 and has suggested that consumers should be encouraged to make necessary capital investment with suitable incentive, in order to maintain of power factor above 0.9. As regards reduction in losses M/s JNL has stated that line loss is a function of MVA flow which is controllable only through power factor adjustment. Improved power factor means a generating station can meet the active power (MW) requirement of consumers with reduced MVA flow which will lead to reduced line loss. The nearer it is to 1.0 power factor (unity), it is better. As regards voltage profile, M/s JNL has stated that the question of VAR injection into the licensee's network arises only when the consumer overcompensates his VAR flow from the network. Overcompensation requires additional investment without any commensurate benefit to the consumer. Hence the question of VAR injection does not arise as long as the consumer's power factor is inductive, be it 0.7 or 0.99. In conclusion it has been stated by M/s JNL that any amount of improvement in power factor releases some capacity in the network and the network can meet the active power requirement with reduced MVR flow which, in turn, brings down the line losses, which is advantageous to the Board. In their rejoinder to the reply of CSEB, M/s JNL has stated that the Central Electricity Authority (CEA) Grid Connectivity Regulations do not stipulate maintenance of 0.98 power factor by the customer. Due to practical difficulties all the customers normally cannot maintain 0.98 power factor without having shunt capacitors. If the consumers install shunt capacitors to avail

incentive, the Board will have to make less investment on capacitor installation and maintenance.

6. The Commission has considered the arguments of M/s JNL and CSEB. The observation of M/s JNL that a 100 MW generation with 0.9 PF lag can be loaded to 100/0.9 = 111 MW at unity PF is not technically correct. As regards reduction in losses, indiscriminate injection of capacitive VAR into the system does not always improve the situation in respect of losses or voltage. It depends upon the system loading and existing system parameters. This is why the Indian Electricity Grid Code has provided for penalty for capacitive VAR injection into the system when voltage is more than 103%. The consumer injects VAR into the system without the knowledge of its effect on the system condition. The contention of M/s JNL that over compensation results due to installation of over capacity capacitor bank is not correct. This depends on load cycle, PF at maximum and minimum load and its duration. Distribution licensees have to install a sizeable capacity of capacitors towards system compensation each year. The consumer is obliged to improve the PF to 0.9 only, which is the threshold value for avoiding PF penalty. Any EHV system has to operate at a PF not less than 0.97. Hence, further system improvement has to be done by the licensee only.

7. The Central Electricity Authority (CEA) in its Grid Connectivity Regulations, 2004 has made maintenance of power factor to 0.98 compulsory. Apart from that, in view of the fact that technical issues have been raised in the matter, it was referred to the CEA for their views and comments. In their reply dated 22/08/06, the CEA has clarified that though improvement in power factor in the distribution system may not create additional capacity in generation, maintenance of the power factor has to be done at all the network nodes and it is the responsibility of the consumer/distribution licensee to ensure that reactive power is balanced at each node and there is no drawal of reactive power by the consumer. This is required in order to maintain the regulation of voltages, reduction of losses etc. It has been suggested by the CEA that withdrawal of incentive from consumers for increase of power factor above 0.95 would not be desirable. The Commission would like to be guided by the opinion of the CEA which is the nodal agency for all technical issues of the electricity industry as per the Act.

8. The Commission has surveyed the practice obtaining in other States and has in this connection seen the tariff orders issued by various State Regulatory Commissions. It is observed that in the States of MP, Orissa, Maharashtra, Assam, UP, etc. both incentives and disincentives are given for improved/poor power factor. In AP, Karnataka, Gujarat, HP, Uttaranchal etc. no incentive is given for better power factor. While MP, Maharashtra, Assam, HP, Uttaranchal, UP have provided for incentives/disincentives only on energy charge, States like Orissa, AP and Gujarat levy this charge both on demand and energy. Thus, there is no uniformity in the practice being followed across the States and the position obtaining in various States may not be a guide in the matter.

9. The CSEB while submitting the tariff petition for the year 2006-07 had proposed that power factor incentive should be discontinued on the ground that increase in the power factor beyond a value say 0.95 does in any way create additional capacity in generation as its MW capacity is fixed by the prime mover. Subsequently, they suggested that incentive should be given only when the power factor is improved beyond 0.98 which should be limited to demand charge only. In their submission, the CSEB pleaded for levy of penalty at KVA demand only. In

course of public hearing of the tariff petition this issue came up for discussion and there was strong plea by consumers to continue the power factor incentive. This Commission after giving considerable thought to the various issues raised by the CSEB and the suggestions received in the public hearing, decided in its tariff order for the year 2006-07 passed on 13/09/2006 to continue both incentive and penalty but limiting it to energy charge only.

10. In view of the discussion above, the Commission comes to the conclusion that power factor incentive and penalty is in the best interest of health of the power system and network and hence should be continued. In view of the considered advice of the CEA, we do not agree with the CSEB that the incentive should be discontinued while the penalty may stay. The only other issue for consideration is whether the incentive/penalty should be levied on both demand charge and energy charge or only on one of them. We have already addressed this issue in the tariff order for 2006-07. The CSEB had proposed to levy PF incentive/penalty on demand charge only. This was not considered by the Commission in view of the fact that KVA demand has in-built composition of power factor and demand charge is levied on KVA basis and also since for a particular active power, KVA demand varies according to the PF. We have, therefore, decided on provision of PF incentive/ penalty on energy charge only. We confirm that position in this order.

11. M/s JNL has pleaded that since it is they who had petitioned to the Commission that PF penalty should be levied only on demand charge and not on both, in a petition for review of the tariff order for 2005-06 and the Commission vide its order dated 05/10/05 passed in Petition No. 19 of 2005 (M) had decided to defer consideration of the issue, in so far as they are concerned the Commission's present decision to limit PF penalty to energy charge only should be made applicable w.e.f. 01/07/05, the date of application of tariff of the year 2005-06. The Commission has given careful consideration to this and is of the view that giving retrospective effect to this order for M/s JNL alone would not be justified. Our intension in para 13 of the order dated 05/10/05 aforementioned was not acceptance of the plea of M/s JNL. We had only held that the matter could not be considered in isolation for a single industry and that it had wider implications which had to be examined. Secondly, it would not be practicable to make the present provision for PF penalty effective from the date of last tariff order for one industry as a large number of consumers have either been penalized for poor load factor or given incentive for improved load factor, on the basis of the earlier order. Morever, in our order of 05/10/05, we had not indicated that any decision on this issue would be given retrospective effect. Since, it was a part of the tariff order for the year 2005-06, it applied uniformly to all consumers. We, therefore, do not propose to give retrospective effect to the present provision only for M/s JNL. Such a dispensation in favour of one consumer shall be contrary to the provision of Section 62 (3) of the Act. This provision has already been made applicable as part of the tariff order for the year 2006-07, w.e.f. 01/10/06.

Sd/- Sd/-

Member **Chairman**

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(N.K.Rupwani)
Secretary