ORISSA HYDRO POWER CORPORATION LTD.

JANPATH, BHUBANESWAR-751 012

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PUBLIC NOTICE

Publication of Application for Approval of Revised Design Energy of Hydro Stations filed by M/s Orissa Hydro Power Corporation before the Orissa Electricity Regulatory Commission, Bhubaneswar

1. M/s Orissa Hydro Power Corporation (in short OHPC), a generating company, incorporated under the Companies Act, 1956, has submitted an Application to the Orissa Electricity Regulatory Commission, Bhubaneswar on 31.05.2008 for approval of Revised Design Energy of its power stations, which has been registered as **Case No. 121/2009.**

2. The Commission has decided to dispose of the matter through a Public Hearing.

3. Based on OHPC's filing, the Commission has prepared a Concept Paper consisting of the background, need for reassessment of design energy, methodology adopted in the exercise and other related aspects. Copies of the aforesaid Concept Paper is available at OHPC's Corporate Office, Vani Vihar Chowk, Janpath, Bhubaneswar. This public notice along with the Concept Paper is available at OHPC's website www.ohpcltd.com as well as at Commission's website www.orierc.org.

4. (a) Interested persons may go through the concept paper and the summa;ry of the relevant records pertaining to the matter and take notes thereof at the corporate office of OHPC during office hours on working days on or before **09.11.2009** by making a plain paper application to Director(Operation), OHPC.

   (b) The concept paper will be posted in the Commission's website after **22.10.2009** for general reference.

5. Suggestions/objections, if any, together with supporting materials may be filed before the SECRETARY, ORISSA ELECTRICITY REGULATORY COMMISSION, BIDYUT NIYAMAK BHAVAN, UNIT-VIII, BHUBANESWAR-751012 in person or through Registered Post/Courier Services only so as to reach him on or before **10.11.2009** positively. A copy of the said suggestions/objections along with relevant documents shall also be served on the undersigned.

   (a) The suggestions/objections should be filed in six copies and should carry full name and postal address of the person/ organizations/ institutions sending the suggestions/objections and shall be supported by an affidavit.

   (b) There shall be clear indication if the suggestions/objections are being filed on behalf of any organization/institution representing any category of consumers. It should also be specifically mentioned if it is to be heard in person by the Commission.

(c) Suggestions/objections received after the date mentioned above or those which will prove deficient on any or more of the above points may not be admitted for hearing. Only those objections/suggestions supported through affidavit will be taken up for hearing.

6. As directed by the Commission the dates of hearing shall be duly published in the Newspapers and also communicated to the parties whose objections are admitted.

The reassessed Design Energy of different Power Stations

Sl. No	Name of the Hydro Electric Project	D.E. in the DPR (MU)	D.E. in the Current study (MU)	Remarks
1.	Upper Kolab	832	643.86	22.6% reduction
2.	Upper Indravati	1962	1703.82	13.16% reduction
3.	Balimela	1183	928.56	21.51% reduction
4.	Rengali	525	669.96	27.61% increase
5.	Hirakud	1174	*957.43	18.45% reduction
	* It consists of HPS Burla HPS Chipilima		601.27 356.16	

DIRECTOR (OPERATION)
OHPC

Dated 23.10.2009

Note:

The above public notice is available in OHPC's website www.ohpcltd.com as well as the Commission's website www.orierc.org.

Concept Paper on Reassessment of Design Energy of Hydro Power Stations under OHPC

Back Ground: -

OERC in its Order dated 09.07.2001 vide Case No.-15/2000 had directed OHPC to approach CEA for review of hydrology and design energy of all the Hydro Projects under its control in view of the changed circumstances, new commercial environment and latest norms of GoI.

2. After several correspondence and discussions with CEA by OHPC, no positive response was received from CEA to carry out the field job as CEA was finalizing the guidelines for revision of design energy. Hence OHPC during hearing of its application for approval of tariff for the FY 2004-05 apprised the Commission about the difficulties for carrying out the reassessment of design energy by CEA. Taking into consideration of all the facts, the Commission in its Tariff Order dtd.10.06.2005 for the FY 2004-05 in Case No.153 of 2004 had indicated "that the reassessment has not been possible despite several initiatives taken by OHPC for which the Commission desires that the reassessment should be done by appointing an independent group of consultants under the auspices of this Commission before November, 2005."

3. In the meantime a Committee constituted by CEA submitted its report on the "Guidelines for submission on the proposal for revision of design energy of Hydro Electricity Power Stations" on 11.08.2004.

4. During the visit of OHPC engineers to CEA, New Delhi on 17.11.2005 & 18.11.2005 regarding the methodology for reassessment of design energy, CEA made it clear that till date none of the central PSUs had gone for reassessment of design energy especially for storage type reservoirs. Member (hydro) CEA, opined that CEA being the agency to vet the assignment, it can not take the job of consultancy. Instead, OHPC has to take the assistance of an independent agency for reassessment of design energy as per the guidelines issued by CEA.

5. The Commission had also regularly monitored and hold meetings with OHPC for early completion of the reassessment of design energy and advised OHPC to take effective steps to award the job to any eligible agency by 31.10.2006. Accordingly, moving with due procedure for awarding the contract, OHPC awarded the work order to M/s SPARC, a consultancy agency to carry out the job of reassessment of design energy of its power stations based on the guidelines issued by CEA.

6. The Commission vide its tariff order dtd.20.03.2008 had directed OHPC to file the final reports on determination of design energy of its power stations duly vetted by OHPC Board. Accordingly, after getting approval from its Board of Directors, OHPC had submitted the reports before the Commission for consideration and approval.

7. As advised by the Commission, OHPC had made a presentation before the Commission on the said reports and had also submitted the report and made a presentation on the matter before CEA. CEA, vide letter No.3/81/HP&I(1)-2009/20 dtd. 07.01.09, had opined that the reports on reassessment of design energy furnished by

OHPC have been broadly in line with the guidelines issued by CEA. However, authenticity/accuracy of the various data adopted for the review may be ascertained by OERC. Since, the reassessment of design energy has the repercussion on hydro tariff, the Commission desires to dispose of the matter through a Public Hearing.

Need for Reassessment of Design Energy (DE) :-

8. The hydro projects in most cases are planned with a set of hydrological observations and some statistically projected data of spatial similarities. After finalization of the project planning, upstream basin undergoes land use changes by increased irrigation coverage and interventions. These changes possibly impact the yield, so also the variations of rainfall pattern. With the passing of time and change in human needs, there are variations in crop diversification, irrigation requirement and the pattern of land use in the command area undergoes drastic changes. A largely growing population much in excess of planning stage and increased industrial activities led to increase in domestic and industrial (D&I) need, which is possibly met from the reservoirs.

9. The current recognition of aquatic environmental protection and flushing assumes great relevance in deciding the utilization pattern of reservoir water. The reservoirs have been experiencing silting leading to loss of the potentially usable (live) storage affecting water availability.

10. In the above context, performance relating to input and output parameters of hydro projects need to be looked into so as to reassess the design energy (DE) under prevailing situation.

Methodology adopted by M/s SPARC:-

11. The approach methodology adopted for reassessment of DE of Hydro Power Stations of OHPC is described below:

a) **Study of Project Details:-** The study of salient details of projects includes reservoir, Power House and Irrigation system. The basic characteristics of reservoir basins are hydrology, Rainfall pattern, Runoff, land use and physiography. The project features and highlights of details project report (DPR) include the present operation practices in power generation, Irrigation and reservoir operation.

b) **Collection of Data:-**

- Assessment of Data need
- Data Collection

c) **Revision of Area-Elevation- Capacity Curve:-**

- Selection of cloud free satellite images at different level (regular interval from DSL to FRL)
- Rectification and geo-referencing of images
- Water spread area estimation at different levels
- Computation of live storage capacity
- Revision of Elevation –Area-Capacity-Curve

d) **Hydrological Assessment:-**

- Station consistency check using double mass curve, computation of weighted average rainfall and comparison with rain fall at DPR stage
- Compilation of Inflow data, consistency check by rainfall- runoff co-relation, homogeneity test by Fisher's 'F' test and Student's 't' test
- Computation of dependable yield

e) **Assessment of Committed need for Non power sector:-**

- Irrigation
- Domestic and Industrial (D&I)
- Environmental

f) **Reassessment of D.E:-**

- Study of power generation history
- Study of power house details
- Computation of water availability for power generation in conjunction with Irrigation, D&I, Pan-evaporation and environmental need
- Preparation of monthly working table through simulation study.
- Reassessment of D.E.

On the basis of simulation study, the reassessed design energy as per the 90% dependable generation year is found out.

Observations:-

12. For assessing the Design Energy of Hydro electric projects of OHPC, a comprehensive analysis of hydro-meteorological data of the basin and generation performance of the power station covering a long period has been carried out.

The key observations that emerged from the study are:

(a) Upper Kolab Hydro Electric Project:-

(i) The average rainfall over Upper Kolab basin has been showing a decreasing trend from 1415 mm (in the DPR stage) to 1233 mm in the current study (12.86% reduction)

(ii) Because of decreased rainfall experienced after 1978, the yield of the basin has undergone significant reduction (22.56%)

(iii) There is a reduction in live storage capacity of only 36.78 Mm^3 out of the original capacity of 935 Mm^3 in 1988, a loss of 3.93%.

(iv) At the DPR stage there was no provision for D &I demand, current assessment of D & I need is 30 Mm^3 which is to be directly met from the reservoir.

(b) Hirakud Power System:-

(i) The average rainfall over the Mahanadi basin above Hirakud Dam has exhibited no perceptible change.

(ii) The average runoff shows 36.09% reduction in comparison to study conducted in the DPR stage. The reduction is attributed to interception of

23000 Km^2 catchment by building big dams, conversion of fallow land to agricultural land in Chhatisgarh and increasing demand of D & I sector in Orissa.

(iii) There is 18.68 % reduction in live storage capacity of the reservoir due to silting in last 50 years.

(iv) The reservoir is currently required to provide D & I need of 616.5 Mm^3 (0.5 MACft), which was not considered during DPR stage.

(c) <u>Balimela Hydro Electric Project:-</u>

(i) The average rainfall over the sileru basin (Balimela) has exhibited no perceptible change with only 9.29% reduction from the value used for fixation of Design Energy in 1972. In the post DPR stage, although very heavy rainfall in few years and very low rainfall in a large number of years has resulted in a change of the basin yield trend.

(ii) The average runoff (yield the basin) shows 16.14% reduction because of the rainfall-runoff factor adopted in the DPR stage (computed from 1955 Km^2 catchment of Jalaput reservoir) is very erratic. There were very high run-off in the DPR stage when the run-off is in excess of 5000 Mm^3 in 3 out of 11 years, which never happened in the post DPR stage.

(iii) By using remote sensing data, sedimentation deposit in the reservoir has been studied. The study shows a reduction of only 152.88 Mm^3 in the live storage out of the original capacity of 1676 Mm^3 in 1972. The loss of 5.71% in 34 years shows a low to moderate erosion trend in the catchment.

(iv) The reservoir is not required to provide any D & I need.

(v) The basin is exhibiting a much lower 90% dependable flow from 2575.75 Mm^3 against 3065 Mm^3 (during assessment of DE in 1972), a reduction of 15.95% thereby impacting generation potential.

(vi) The reduction in Design Energy attributed to the present method of computation based on 90% dependable yield.

(d) <u>Upper Indavati Hydro Electric Project:-</u>

(i) The overage rainfall over Upper Indavati basin has exhibited no perceptible change, but a very high rainfall in few years and a very low rainfall in a large numbers of years has resulted in decrease in 90% dependable runoff (32.12% reduction).

(ii) The live storage capacity of the reservoir shows 2.75% reduction with reduction of only 40 Mm^3 in the live storage.

(iii) The irrigation demand is estimated at 1464 Mm^3 from the 2227 Mm^3 estimated during DPR stage. The reduction of irrigation demand attributed to change in cropping practice and reduction in cropping intensity.

(iv) A provision of 72 Mm^3 for the environmental flow need has been considered as it is a trans-basin project.

(v) Reduction in Design Energy is attributed to the present method of computation based on 90% dependable yield, which was not the case during DPR stage, where only three years average data was considered for arriving at firm power. Due to erratic rainfall, reduction in 90% dependable yield is a major influencing factor.

(e) <u>Rengali Hydro Electric Project:-</u>

(i) The average rainfall shows 6.85% reduction, which is natural and such variation occurs in due course of time.

(ii) The average yield shows 12.51% reduction mostly attributable to upstream irrigation projects in the upstream catchment and D & I abstraction after construction of Rourkela steel plant.

(iii) The 90% dependable runoff shows 8.11% increase because of less erratic yield series at post DPR stage than the computed yield series at DPR stage.

(iv) Reservoir sedimentation study shows 6.54% reduction in the live storage capacity of the reservoir.

(v) The phenomenal growth of industries / power plant in the Brahmani Basin resulting in 600 Mm^3 D&I need, which is directly met from the reservoir.

(vi) Increase in Design energy attributed to the present method of computation of design energy based on 90% dependable yield. In the DPR, the Design Energy was arrived at by considering generation of firm power i.e. 60 MW only, though the install capacity is 250 MW (Secondary generation is not taken into consideration). Increase in design energy is also attributed to increase in 90% dependable run-off and higher generation in monsoon from available flow.

(f) The design energy of all Power Houses has been reduced except Rengali due to the following reasons:

a. Low yield due to upstream abstractions and interception of catchment area.
b. Change in land use and cropping pattern in the upstream side.
c. Change in requirement of water for irrigation due to change in cropping pattern.
d. Requirement for D&I (Domestic and Industrial) use has been increased.
e. Reduction in live storage capacity due to siltation.
f. Marginal reduction in rainfall of the basin.

(g) In the present simulation study ageing of the power plants has not been taken into consideration while reassessment is being done.

Table-1

The reassessed Design Energy of different Power Stations are given below:-

Sl. No.	Name of the Hydro Electric Project	D.E. in the DPR stage	D.E. in the current study	Remarks
1.	Upper Kolab	832 Mu	643.86 Mu	22.61% reduction
2.	Upper Indravati	1962 Mu	1703.82 Mu	13.16% reduction
3.	Balimela	1183 Mu	928.56 Mu	21.51% reduction
4.	Rengali	525Mu	669.96 Mu	27.61% increase
5.	Hirakud	1174 Mu	*957.43 Mu	18.45% reduction
* It consists of HPS Burla HPS Chiplima			601.27 Mu 356.16 Mu	

Table-2

Comparison of Revised D.E. with Actual generation upto 2008-09 is presented below

Sl. No.	Name of the Hydro Electric Project	No. of years considered	Achievement of present D.E.	Achievement of Revised D.E.
1.	Upper Kolab	15 Yrs	4 Yrs	9 Yrs
2.	Upper Indravati	8 Yrs	6 Yrs	7 Yrs
3.	Balimela	32 Yrs	14 Yrs	26 Yrs
4.	Hirakud	19 Yrs	4 Yrs	10 Yrs
5.	Rengali	17 Yrs	17 Yrs	15 Yrs

Financial Implication:-

13. The tariff of a hydro power station is fixed based on the DE of the power stations. Thus any revision in design energy has got direct impact on the tariff of the power stations.

14. Two-part tariff structure i.e. recovery of Annual Fixed Cost (AFC) through capacity charge and energy charge have already been implemented at Upper Indravati Power Station since FY 2005-06 and subsequently extended to all old power stations of OHPC from the FY 2007-08 onwards.

15. As per the Central Electricity Regulatory Commission (Terms and Conditions of tariff Regulations) 2009-14, the fixed cost of a hydro generating station shall be computed on annual basis and recovered on monthly basis under capacity charges and energy charges.

16. In the CERC Regulations, 2009 the concept of primary and secondary energy have been done away with the term 'energy' only. Similarly the concept of Capacity Index is replaced with Normative Annual Plant Availability Factor (NAPAF). The annual fixed cost of a generating station is apportioned into capacity charge and

energy charge on 50:50 basis. Further, in the context of OHPC power stations the concept of free power to home state does not apply. Hence, the Energy Charge Rate (ECR) for OHPC power stations shall be computed with the following formula.

ECR = AFC x 0.5 x 10 / { DE x (100 – AUX) x 100

Where,

DE = Annual design energy specified for the hydro generating station, in MWh

AUX = Normative auxiliary energy consumption in percentage

Accordingly, the Commission had approved the rate of energy charge and the capacity charge of OHPC power stations for FY 2009-10 as summarized in the table below:

Table-3

Energy Charge and Capacity Charge for 2009-10

Name of the Power Stations	Annual Fixed Cost (Rs. crore)	Capacity Charge (Rs. crore)	Energy Charge (Rs. crore)	Energy Charge Rate (P/U)
Rengali HEP	**30.26**	**15.130**	**15.130**	**29.11**
Upper Kolab HEP	**20.75**	**10.375**	**10.375**	**12.60**
Balimela HEP	**66.36**	**33.180**	**33.180**	**28.33**
Hirakud Power System	**75.51**	**37.755**	**37.755**	**32.48**
Upper Indravati HEP	**142.47**	**71.235**	**71.235**	**36.68**

Effect of Revised Design Energy on Tariff

17. Had we accepted the revised design energy for FY 2009-10, the energy charge rate (ECR) would have increased with decrease in design energy in all power stations of OHPC except Rengali where ECR would have reduced as illustrated in the table below:

Table-4

Name of the Power stations	Capacity charge (Rs. in Cr.)	Energy charge (Rs. in Cr.)	Energy charge Rate (p/u) Original DE	Energy charge Rate (p/u) Revised DE
Rengali H. E. Project	15.130	15.130	29.11	22.81
Upper Kolab H.E. Project	10.375	10.375	12.60	16.28
Balimela H.E. Project	33.180	33.180	28.33	36.09
Hirakud Power System	37.755	37.755	32.48	39.83
Upper Indravati H.E. Project.	71.235	71.235	36.68	42.31

The principle to be adopted while determining tariff for FY 2010-11 will also be in line with the same principle adopted for FY 2009-10 i.e. two part tariff structure in line with the CERC Regulations, 2009.

Conclusion:-

18. The reservoir basins of all Hydro Power Stations of OHPC have undergone considerable changes e.g. rainfall, upstream abstractions, resulting in reduction in yield of the basin although the decadal average rainfall has not changed sharply except in case of Upper Kolab basin. The sedimentation of reservoirs has also resulted in reduction in live storage capacity of the reservoirs as compared to those estimated at the DPR stage. Simultaneously, growing population and need for industrialization has also increased the D&I demand considerably which is met from the reservoirs. This has necessitated the Re-assessment of design energy of Hydro Power Stations under OHPC, taking into account the present requirement of irrigation, D&I demand upstream abstractions and environmental flow.

19. Actual generation from different hydro stations from 2005-06 to 2008-09 is given for reference and to take a view regarding the proposed revised designed energy.

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