

ORISSA ELECTRICITY REGULATORY COMMISSION
BIDYUT NIYAMAK BHAWAN
UNIT-VIII, BHUBANESWAR - 751 012

Present : **Shri B. K. Das, Chairperson**
Shri K.C. Badu, Member
Shri B.K. Misra, Member

Case No.65/2010

IN THE MATTER OF: Approval of NAPAF (Normative Annual Plant Availability Factor) of Hydro Power Stations under OHPC for the control period from 1.04.2009 to 31.03.2014.

Orissa Hydro Power Corporation Ltd.
Vanivihar Chouk, Janpath, Bhubaneswar- 751022

.... **Petitioner**

Vrs.

01. Chairman and Managing Director, GRIDCO Ltd., Bhubaneswar -22.
02. Managing Director, M/s WESCO, Burla, Sambalpur- 768017.
03. Managing Director, M/s NESCO, Januganj, Balasore- 756019.
04. Managing Director, M/s SOUTHCO, Courtpetta, Berhampur-760004.
05. Managing Director, M/s CESU, 2nd Floor, IDCO Tower, Bhubaneswar -22.
06. Sambalpur District Consumers Federation, Balaji Mandir Bhawan Khetraj pur, Sambalpur 768003.
07. Sri Jaydev Mishra, N-4/98, Nayapalli, Jaydev Vihar, Bhubaneswar -15
08. Sri R. P. Mohapatra, Plot No.775, Lane-3, Jaydev Vihar, Bhubaneswar-751013
09. Shri Ramesh Chandra Satpathy, Plot No- 302 (B), Behera Sahi, Nayapalli Bhubaneswar -12
10. M/s Utkal Chamber of Commerce & Industry, N/6, I.R.C. Village, Nayapalli, Bhubaneswar -15.
11. Sr. GM (PS), M/s SLDC, Mancheswar Railway Colony, Bhubaneswar - 17

.... **Respondents**

Date of Hearing: 28.08.2010

Date of Order: 02.11.2010

ORDER

1. The Commission, in its Tariff Order dtd. 20.03.2009 for the FY 2009-10 (Case No. 64/2008) and dtd. 20.03.2010 for the FY 2010-11 (Case No.-147.2009) had provisionally approved the Normative Annual Plant Availability Factor (NAPAF) of OHPC's power stations for the FY 2009-10 & 2010-11 as mentioned below:

NAPAF (%) Provisionally approved for FY 2009-10 & 2010-11

Name of the Power Station	HHEP	CHEP	BHEP	RHEP	UKHEP	UIHEP
2009-10	80		85	80	85	85
2010-11	82	70	85	75	85	87

2. The Commission, at Para-168 of the said tariff order dated 20.03.2010 for the FY 2010-11, had directed OHPC to file a separate petition before the Commission for approval of NAPAF of its individual power stations within 60 days of issue of the order.
3. Accordingly, OHPC had filed the petition on 20.05.2010 for approval of NAPAF of its power stations for the control period 01.04.2009 to 31.03.2014.
4. The petition was registered as Case No. 65/2010 and heard on 20.07.2010 on the question of admission. Shri Daitari Sethi, DGM (Elect.), Shri Malaya Kumar Swain, DM (Elect.) of OHPC Ltd., Shri J. K. Dash, Sr. GM(PP) and Shri Laxmidhar Mohapatra, AGM of GRIDCO Ltd., Shri S D Bhanja, DGM (RA & Legal), NESCO, Shri P K Sahoo, SE (RA), WESCO, Shri B K Lenka, COO, CESU, Shri S K Das, GM (SLDC) and Shri R.P. Mahapatra were present. Nobody was present on behalf of M/s SOUTHCO, M/s Sambalpur District Consumers Federation, M/s Utkal Chamber of Commerce, Shri Jayadev Mishra and Shri Ramesh Chandra Satpathy. The representative of WESCO had stated that they had not received the copy of the petition for which they could not file their reply and prayed to serve them a copy of the same. Shri R.P. Mohapatra prayed 2 weeks time for filing of his reply. The case was admitted and the prayer was allowed. The Commission had directed to serve the copy of the petition to the DISCOMs. The DISCOMs, SLDC and other respondents were directed to file their counter reply within 2 weeks serving copy to the petitioner. The next date of hearing was fixed on 28.08.2010 and the Director (Operation), OHPC Ltd was advised to be present on the next date of hearing positively.
5. The Commission heard the parties on 28.08.2010. Shri D. K. Sahoo, Sr. GM (Elect.), OHPC, Shri A.C. Mallick, Director (Comm), Shri J. K. Dash, Sr. GM(PP) and Shri Laxmidhar Mohapatra, AGM of GRIDCO, Sri A.K. Bohra, CEO(Com), CSO for WESCO, NESCO & SOUTHCO, Sri A.K. Mohanty, GM (R&T), SLDC, Shri R.P. Mahapatra and Shri Ramesh Ch. Satpathy were present. Nobody is present on behalf of M/s CESU, M/s Utkal Chamber of Commerce, Shri Jayadev Mishra and for M/s Sambalpur District Consumer Federation.

6. Shri D. K. Sahoo, Sr. GM (Elect.), OHPC submitted that:

As per Regulation 27 (i) of CERC (Terms and Conditions of Tariff) Regulations, 2009

(1) *Normative Annual Plant Availability factor (NAPAF) for hydro generating stations shall be determined by the Commission as per the following criteria.*

i. *Storage and Pondage type plants with head variation between full reservoir level (FRL) and Minimum Draw Down Level (MDDL) of up to 8%, and where plant availability is not affected by silt: 90%.*

ii. *Storage and Pondage type plants with head variation between FRL and MDDL of more than 8%, where plant availability is not affected by silt: Plant specific allowance to be provided in NAPAF for reduction in MW capacity as reservoir level falls over the months. As a general guideline the allowance on his account in terms of multiplying factor may be worked out from the projection of annual average of net head, applying the formula:*

$$(Average\ head / Rated\ head) + 0.02$$

Alternatively in case of difficulty in making such projection, the multiplying factor may be determined as:

$$(Head\ at\ MDDL / Rated\ Head) \times 0.5 + 0.52$$

iii. *Pondage type plants where plant availability is significantly affected by silt: 85%.*

iv. *Run-of-river type plants: NAPAF to be determined plant-wise based on 10-days design energy date where available/relevant.*

(2) *A further allowance may be made by the Commission in NAPAF determination under special circumstances, e.g. abnormal silt problem or other operating conditions and known plant limitations.*

(3) *A further allowance of 5% may be allowed for difficulties in North East Region.*

(4) *In case of a new hydro electric project the developer shall have the option of approaching the Commission in advance for fixation of NAPAF based on the principles enumerated in sub-clauses (1), (2) and (3) depicted above.*

7. The past performance data of OHPC power stations of previous years should form a basis for determination of NAPAF. Based on the actual month wise performance of power stations in terms of average daily peak in MW and outage of machines in machine hours, the availability of OHPC power stations from 2005-06 to 2009-10 are as given below:

Availability (in %)

Sl. No	Name of the Power Station	2005-06	2006-07	2007-08	2008-09	2009-10	Average for last 5 years
1	HHEP	65.41	68.94	82.26	86.65	90.21	78.69
2	CHEP	47.98	53.21	46.08	68.50	85.25	60.2
3	BHEP	87.18	88.74	89.51	86.89	86.15	87.69
4	RHEP	81.16	70.65	86.47	75.44	70.20	76.78
5	UKHEP	76.50	80.90	92.00	87.58	90.41	85.48
6	UIHEP	68.86	89.00	90.24	89.17	95.07	86.47

8. **High Head Power Stations:**

OHPC has 3(three) operating high head power stations namely Upper Indravati, Upper Kolab and Balimela. The FRL (Full Reservoir Level), MDDL (Minimum Draw Down Level) and head available at FRL and MDDL for generation are given below:

Name of the power station	FRL	MDDL	Avg. Tail race level	Head at FRL	Head at MDDL	Rated head	Head loss	% Head variation
Upper Kolab	858 Mt	844 Mt	592.00 m	266 m	252.0 m	241.72 m	12.48 m	5.5 %
Balimela	1516 Ft 462.10 Mt	1440 Ft 438.90 Mt	165.0 m	297.1m	273.90 m	274 m	10.8 m	8.4 %
Upper Indravati	642 Mt	625 Mt	263.445 m	378.55 m	361.55 m	360 m	18.80 m	4.7 %

The above stations have no silt problem and the head variation from FRL to MDDL is within 8% for Upper Kolab and Upper Indravati, and 8.4 % for Balimela. As per para 27(i)(1)(ii) of CERC Regulation, the multiplying factor for head variation above 8% will be as follows.

$$\begin{aligned}
 \text{M.F for Balimela} &= \frac{\text{Head at MDDL}}{\text{Rated head}} \times 0.5 + 0.52 \\
 &= \frac{273.90 - 10.8}{274} \times 0.5 + 0.52 \\
 &= 0.48 + 0.52 = 1.0
 \end{aligned}$$

Hence, the NAPAF for these power stations could be 90% considering the benchmark NAPAF as set by CERC.

9. However, considering the actual performance of these power stations for last 5 (five) years, the availability is between 85% to 87% due to the following reasons.

- Balimela Power Station is more than 35 years old and causing loss of availability due to frequent forced outage of the existing 6 (six) old Units.
- Even though Upper Kolab Power House is around 20 years old, it requires frequent maintenance for availability of the BHEL make generating units.
- Though commissioned in the year 2001, the machines at Upper Indravati were procured in the eighties, and have been inundated in the flood and refurbished to bring them to the present shape. There is loss of availability due to breakdown of critical equipments, as happened due to rotor pole insulation failure. There is also complete shutdown of unit for a week once in a year due to cleaning of trash rack with logs. Considering the above facts, 5% allowance may be allowed in NAPAF of these high head power stations and it may be fixed at 85%.

10. Low Head Power Stations:

The low head power stations of OHPC are HHEP, RHEP and CHEP. The details of FRL (full reservoir level), DSL (dead storage level), head at FRL and MDDL in respect of HHEP and RHEP are given below.

Name of the power station	FRL	DSL	Avg. Tail race level	Head at FRL	Head at MDDL	% variation
HHEP, Burla	630 ft 192.024 m	590 ft 179.830 m	520 ft 158.50 m	33.52 m	21.33 m	57.00
RHEP, Rengali	123.50 m	109.72 m	82.5 m	41.0 m	27.22 m	50.00

The head variation is more than 8%, applying the multiplying factor for head variation.

$$\text{Multiplying for head variation} = \frac{\text{Head at MDDL}}{\text{Rated head}} \times 0.5 + 0.52$$

11. NAPAF for Hirakud Hydro Electric Project:

The rated head of units are different for HHEP, Burla. Hence the M.F for different units given below:

Name of the power station	% Head variation	Unit No.	Rated Head	Head at MDDL	M.F	NAPAF 90% x M.F
HHEP, Burla	57%	1 & 2	31.6 m	21.33 m	0.86	77.40
		3 & 4	30.78 m	21.33 m	0.86	77.40
		5, 6 & 7	26.50 m	21.33 m	0.90	81

The NAPAF has been calculated for different units considering the benchmark NAPAF of 90% as per CERC norms and it varies from 77.40% to 81.00%. The NAPAF for whole power station is calculated based on the weighted average of all units.

$$\begin{aligned} \text{NAPAF} &= \frac{77.40 \times 2 \times 49.50 + 77.40 \times 2 \times 32 + 81.00 \times 3 \times 37.50}{275.50} \\ &= 78.87\% \end{aligned}$$

Hence, the NAPAF for HHEP may be considered as 78 %.

12. NAPAF for Rengali Hydro Electric Project:

The head variation of RHEP is 50%, rated head of 40M and head at DSL of 27.22 m.

$$\begin{aligned} \text{M.F} &= \frac{\text{Head at MDDL}}{\text{Rated head}} \times 0.5 + 0.52 \\ &= \frac{27.00}{40} \times 0.5 + 0.52 \\ &= 0.34 + 0.52 = 0.86 \end{aligned}$$

Considering the benchmark NPAF of 90% as per CERC norms, the NPAF of RHEP would be $90 \times 0.86 = 77\%$.

However, in para 33.12 (ii) of SOR report of CERC Tariff regulation 2009, the NPAF has been calculated based on expected daily 3- hrs peaking capacity for Tehri H.E. Project. Calculating the NPAF for RHEP on similar lines, considering the average head available in the month for last seven financial years, the NPAF varies from 69 to 75%.

Hence, the NPAF for RHEP may be considered at 72% (average of 69 & 75 %)

13. NPAF for Chiplima Hydro Electric Project:

The head variation in case of Chiplima Hydro Electric Project is minimal, hence no consideration for head variation. However, from the initial stage of commissioning of CHEP, since 1963, the maximum generation of CHEP is restricted to 64.77 MW (89.95 % of rated capacity) due to restricted water carrying capability of power channel i.e. 12500 cusec.

The average plant availability for last 5 (five) years from 2005-06 to 2009-10 is 60.20%. This reduction in plant availability is due to inherent weed problem in the power channel.

Considering the benchmark NPAF of 90%, the NPAF comes to 81% ($90\% \times 0.8995$) taking special consideration to plant limitations i.e choking of trash rack due to weed, a further allowance of 15% may be allowed. Because 15% of the availability of machines were lost due to cleaning of weeds.

Hence, the NPAF for CHEP may be considered at $81\% \times 0.85 = 68.85\%$ (rounded off to 69%).

14. In the CERC (Terms and conditions of Tariff) regulations 2009, the annual fixed cost (AFC) is apportioned to capacity charge and energy charge on 50:50 basis. In the years of hydrology failure, OHPC will not be able to recover the full energy charge. In the event of less availability of power stations than the Normative Annual Plant Availability Factor (NPAF), the capacity charge will be reduced. In such a situation, OHPC power stations may not be able to recover their Annual Fixed Cost. Therefore, NPAF may be fixed judiciously basing on the past performance parameters of OHPC power stations and considering the various plant limitations as enunciated in the previous paras, so that the targeted NPAF is practically achievable.
15. OHPC prayed to approve the NPAF (in %) as proposed in the table below for the control period from 1.04.2009 to 31.03.2014.

Name of the power station	UIHEP	BHEP	UKHEP	HHEP	RHEP	CHEP
NAPAF (%)	85	85	85	78	72	69

16. Shri L D Mohapatra, AGM, GRIDCO submitted that out of six hydro generating stations of OHPC, three stations such as Balimela, Upper Kolab and Upper Indravati are high head plants and Rengali and Burla are low head plants. Based on the head at FRL and MDDL the percentage head variation are as indicated below:

Name of the Stations	FRL (in mt)	MDDL (in mt)	Head at FRL (in mt)	Head at MDDL (in mt)	% variation
Upper Kolab	858	844	266	252	5.26
Balimela	462.08	438.91	297.10	273.90	7.80
Upper Indravati	642	625	378.55	361.55	4.49
Rengali	123.5	109.72	41	27.22	36.60
HHEP, Burla	192.024	179.830	33.52	21.33	36.36

17. As per the CERC norms, since the head variation of all the three high head plants are well within 8%, the NAPAF for these stations should be 90%. However, as the Balimela is in operation for last 30 years and the Upper Kolab is in operation for last 27 years, GRIDCO proposes the NAPAF of UIHEP at 90%, Balimela at 87% and Upper Kolab at 87%.
18. As per GRIDCO's calculation, the head variation in case of the low head plants i.e. HHEP, Burla and Rengali are 36.36% and 33.60% respectively as against the calculation of OHPC i.e 57% and 50% respectively. In case of Rengali the multiplying factor using the second formula of CERC comes to 0.86 and thereby the NAPAF comes to 77%. Using the first method of CERC Regulation based on the data of FY 2008-09, the average head of Rengali Power Station is 34.88 meter and the rated head is 40 meter. Hence, the multiplying factor comes to 0.892 and the NAPAF comes 80.28%. Similarly, as per the first method of CERC the NAPAF of Rengali from 2003-04 to 2009-10 varies from 78 to 83%. So the NAPAF of Rengali may be fixed at 80%.
19. OHPC may furnish the calculation of NAPAF by adopting the first method of CERC for HHEP, Burla and Rengali. As per second method of CERC, the NAPAF calculated by OHPC for Burla Power Station is 78.87%. However, GRIDCO proposes the NAPAF of 82% for HHEP, Burla as allowed by the Commission in its Order dtd. 20.03.2010.

20. CHEP, Chipilima is base load having firm power of 55 MW. The renovation of Unit-I and Unit-II of Chiplima have been completed and the cost has been capitalized. The renovation scheme envisages better performance and more generation of power. Hence, the availability of the units bears prime importance to utilize the discharge of Hirakud generating station. The maximum generation of CHEP is restricted to 64.77 MW due to restricted water carrying capability of power channel. Further head variation is minimal in case of Chiplima. Considering the benchmark NAPAF of 90%, the NAPAF comes to 81% ($90\% \times 0.8995$). Considering the shutdown of units due to weeds problem and allowing 5% allowance the NAPAF may be fixed at 76% for CHEP.

21. GRIDCO proposes NAPAF of hydro stations under OHPC as follow:

Name of the power station	UIHEP	BHEP	UKHEP	HHEP	RHEP	CHEP
NAPAF (%)	90	87	87	82	80	76

22. OHPC in the calculation of plant availability factor for the month (PAFM) of low head power stations like HHEP and Rengali varies the installed capacity with that of head. GRIDCO is of the view that while determining NAPAF, the head variation has already been taken into consideration, so again reduction of installed capacity with that of head for computation of PAFM for the month is not justified. OHPC vide its Lr. No. 3085 dtd. 07.05.2010 has requested Director (Engg.), OERC for determining the methodology of calculation of PAFM of low head power plants. The Commission may decide the methodology of computation of PAFM of low head plants.

23. Shri R P Mohapatra submitted that the NAPAF for Hydro Generating Stations should be determined based on the Regulation 27 of CERC (Terms and Conditions of Tariff) Regulations, 2009 which shall be effective from 01.04.2009 for a period of five years. As per CERC norm the NAPAF for storage and pondage type plants, with head variation between FRL and MDDL of upto 8% and where the plant availability is not affected by silt, should be 90%. If the head variation is more than 8% and the plant availability is not affected by silt, NAPAF should be 90% multiplied by the multiplying factor which may be worked out from the formula (i) $(\text{Average head} / \text{Rated Head}) + 0.02$ or (ii) $(\text{Head at MDDL} / \text{Rated Head}) \times 0.5 + 0.52$. The second formula may be used as the projection for first formula involved a lot of difficulties in view of the operation of reservoir in different years based on the inflow.

24. Since none of the hydro generating stations in Orissa are affected by silt requiring added maintenance time. Further, for the high head power stations, the head variation is within 8%, hence the NAPAF for these stations should be taken as 90%. The submission of OHPC for reduction of 5% considering the operational constraints should not be accepted.
25. The submission of OHPC regarding frequent maintenance of the machines at Upper Kolab Power House because of the BHEL make is totally unacceptable. The rectification of the machines and modification of tailrace channel were carried out and the plant was operating satisfactorily. UKHEP has achieved an availability of 92% in 2007-08 and 90.41% in 2009-10. Therefore, the NAPAF of UKHEP should be determined as 90%.
26. The old machines of BHEP are able to generate full power with head variation where the two new units are sensitive to variations of head. The power plant is in operation for a period of 34 years. Any renovation required should be carried out by now. BHEP has achieved the availability of 89.51% in 2007-08. Therefore, the NAPAF of BHEP should be determined as 90%.
27. The machines at UIHEP were commissioned in 2001. The life of the Plant is to be calculated from the date of COD. The machines were re-furbished after the inundation due to failure of the tunnel gate. At no stage, OHPC had submitted that the machines have not been re-furbished to their original conditions, even though heavy expenditure was incurred. The availability of BHEP for the year 2007-08 and 2009-10 was 90.24% and 95.07% respectively. Therefore, the NAPAF for UIHEP should be determined as 90%.
28. For low head power stations i.e. HHEP Burla, RHEP Rengali and CHEP Chipilima the multiplying factor has to be calculated. Projection of three hours peaking capability by OHPC for determination of NAPAF of Rengali Power Stations should not be accepted. For Rengali the head at MDDL may be taken as 30.50 meter instead of 27 meter as taken by OHPC and the corresponding NAPAF works out to 81.10%. RHEP has achieved availability of 81.16% in 2005-06 and 86.47% in 2007-08. Therefore, NAPAF for Rengali may be considered as 81%.
29. For HHEP Burla, the rated head and the capacity of different machines are different. The Commission may determine the capacity charge for machines 1 & 2, 3 & 4 and 5, 6 & 7 separately for last four years the MDDL at Burla is being maintained at 595 ft

against the designed MDDL 590 ft. Hence, the multiplying factor should be based on the MDDL of 595 ft. The MF of Unit-1 and 2 works out to be 0.882 and the NAPAF will be 79.38%. The MF of Unit-3 and 4 works out to be 0.891 and the NAPAF will be 80.20%. The MF of Unit-5, 6 & 7 works out to be 0.951 and the NAPAF will be 85.60%. The HHEP has achieved availability of 86.65% in 2008-09 and 90.21% in 2009-10. Therefore, NAPAF for HHEP may be considered as 85%.

30. At CHEP Chipilima there is no head variation, therefore, the NAPAF should be 90%. However, due to restriction in the capacity of the power channel, the NAPAF may be multiplied by 0.8995 and the NAPAF works out to 81%. The availability of CHEP was 85.25% during 2009-10. Hence the NAPAF of Chipilima should be 81%.
31. The Commission may direct SLDC to verify the daily availability projected by OHPC by scheduling operation for at least three hours during the day at peak availability.
32. Shri Ramesh Ch. Satpathy stated that the generation and machine availability of OHPC has been reduced due to poor maintenance and inefficiency of the Management. The Commission should appropriately fix the normative plant availability factor for OHPC power stations and should not allow any reduction in NAPAF as proposed by OHPC.
33. Some objectors asked for some more time to file their written submission and the Commission allowed them to file their written note of submission, if any, within seven days. Only Shri R P Mohapatra has filed its written submission to the Commission on 06.09.2010 and OHPC has submitted its additional submission responding to the views of the objectors on 15.09.2010. No other respondents have filed any written submission.
34. In its additional submission OHPC has complied the views of the objectors as given below:

- (a) OHPC has calculated the head variation as per the following formula.

$$\% \text{ head Variation} = \frac{\text{Head at FRL(Mt)} - \text{Head at MDDL(Mt)}}{\text{Head at MDDL}} \times 100$$

Hence the % of head variation for different power stations are as follows:

Name of the P.H.	Head at FRL(M)	Head at MDDL (M)	% Head variation
UKHEP	266	252.00	5.5%
BHEP	297.10	273.90	8.4%
UIHEP	378.55	361.55	4.70%
HHEP	33.52	21.33	57.00%
RHEP	41.00	27.22	50.00%

However, tabulation for variation of head presented by GRIDCO may be accepted as in the present case it has no impact on determination of NAPAF.

- (b) Due to various constraints of the power stations the Commission may consider a lower NAPAF for these high head power stations.

Based on the past performances of high head power stations, OHPC is proposing the following NAPAF.

Name of the power station	Proposal of OHPC	Provisionally approved	
		2009-10	2010-11
UIHEP	85%	85%	87%
UKHEP	85%	85%	85%
BHEP	85%	85%	85%

The proposal of GRIDCO to approve the NAPAF of 90%, 87% and 87% for UIHEP, BHEP and UKHEP is on the higher side for OHPC to recover the full capacity charge. Though, OHPC is striving hard to achieve a higher availability of its units, the average availability of machines for the last five (5) years may be considered to decide upon NAPAF, so that, OHPC will be able to recover full capacity charge.

- (c) The various constraints of high head power stations are given hereunder:-
- UIHEP:-** Due to choking of intake gate trash rack by logs and debris, there is complete shutdown of the plant for a week in summer for removal of debris and logs from trash rack.
 - UKHEP:-** The BHEL make generating units of UKHEP requires frequent maintenance for maintaining availability. There was major breakdown of Unit-4 due to stator winding failure. The equipments are giving frequent trouble which requires shutdown for maintenance. Also, in case of UKHEP, there is frequent hydrology failure and it is not able to recover its full energy charge due to generation much below the Design Energy.
 - BHEP:-** Balimela Power Station is more than 35 years old and there is frequent forced outage of the old units, resulting in loss of availability. The output of unit-7 & 8 is 72.4 MW at rated net head of 274 Mt. Though, these new units are high head units, it has considerable capacity variations with the head i.e .from 65 MW to 78MW from MDDL to FRL with allowable guide van opening. These

two units have at least 30% of the total capacity of the plant. Hence additional allowance for availability may be considered for such variation to recover the C.C.

- (d) OHPC is of the view that the head variations are 57% and 50% for HHEP and RHEP respectively considering the denominator as head at MDDL. However, % head variation is only for demarcation, to specify whether the station is below 8% or above 8% and not for calculation of M.F, hence the NAPAF. Hence the views of GRIDCO may be accepted.

However, calculation of M.F using 1st method may not be considered as the average head is dependent upon the maximum reservoir level achieved for a particular year. The calculation of M.F using the second method is more practical as it depends upon the design parameters.

- (e) The maximum generation of CHEP is restricted to 64.77 MW (89.95% of rated capacity) restriction of water carrying capacity in the power channel to 12500 cusec.

However, allowance is to be considered due to the following constraints in operating Chiplima Power House.

- i) After installation of TRCM, the weed problem is reduced substantially. However TRCM is meant for all the three units and its schedule annual maintenance will result in forced outage of all the three units.
 - ii) Chiplima switchyard is very old. There is frequent trouble in Breakers, CTs and 11KV cables.
 - iii) Unit-3 of Chiplima Power House is more than 45 years old. The various components of Turbine and Generator are giving frequent problem resulting in forced outage of the units.
 - iv) Although Unit-2 is renovated, there is problem in the BHEL make governor.
 - v) In view of the above, OHPC prays the Commission to give a further allowance of 15 % from the NAPAF benchmark of 81% of Chiplima Power House.
- (f) OHPC of the view that fixation of NAPAF of power stations should not be fixed solely upon design parameters. It may lead to a dent on the capacity of

OHPC to recover the NAPAF hence the ARR. This will be further compounded in the year of hydrology failure affecting financial viability of the organization. Therefore, OHPC prays the Commission to fix the NAPAF of OHPC power stations, based on past performance, operating constraints of the power houses, vintage of equipments, nature of operations.

- (g) At para 33 of CERC (Terms and Conditions) of Tariff) Regulations, 2009, Statement of Objects and Reasons, the NAPAF of Central Sector Power Stations has been determined based on past performance, constraints in operation of power stations. Hence, the past performance has to be taken as a key indicator for fixation of NAPAF of OHPC power stations.
- (h) As proposed by GRIDCO, the Commission may decide on the methodology of computation of PAFM of low head plants.
- (i) As per CERC norms, the benchmark NAPAF for high head power stations is 90%. However, OHPC prays the Commission to consider allowance in NAPAF due to various constraints in operation of the power plants as enumerated above.

a) **UKHEP:**

- In case of Upper Kolab Power House, the modifications of tailrace channel were carried to reduce the excessive vibration in the machines. It has not improved the availability of the machines. OHPC of the contention of reduced availability due to frequent maintenance of BHEL make units.
- In the year 2005-06 and 2006-07 the power plant achieved on availability of 76.50% and 80.90% respectively, which has not taken in to account by the objector..

b) **BHEP:**

- In the year 2009-10 Balimela has achieved an NAPAF of 84.5%.
- Due to frequent breakdown of old Units, there is reduction in availability of Units.
- OHPC has initiated process for phase wise renovation and modernization, initially Unit-1&2 .It will take 9(nine) year to complete the renovation of all six units, Hence, frequent maintenance of old units will persist till completion of R&M of all six units.

c) **Upper Indravati:**

- Power House achieved COD in the FY 2001-02 with concerted effect from OHPC after transfer from GoO. The machines were procured in the eighties, and has been refurbished to its present shape. There is also complete shutdown of power house for week to clean the debris in the trashrack.
- Based on above factors, an allowance of 5% may be allowed and NAPAF shall be fixed at 85%.

d) **HHEP:**

- Capacity charge is determined for a particular power station considering all the unit of plant. Suggestion of the objector on Capacity Charge for separate units is not feasible because it includes O&M expenditure, ROE and working capital requirement.
- Reservoir level is being maintained as per the decision of Hirakud Co-ordination Committee, hence assuming 595 ft as MDDL for Hirakud is not justified.
- There is different rated head for different units of Hirakud therefore multiplying factor is also different. Hence, to arrive at a single NAPAF weighted average has been considered. As per CERC norms it comes to be 78%.
- Hence the NAPAF should be fixed at 78% for HHEP.

e) **RHEP:**

- The NAPAF of RHEP has been arrived based on calculation given in the SOR report of CERC (Terms and Conditions of Tariff) Regulation 2009. Since, RHEP has considerable head variation, calculation based on design parameter will not given the actual projection, in view of the operation of the reservoir based on in-flow , which is different for different years.
- The average tail race level of 82.5m has been considered in calculation of the net head at MDDL. The detail calculation of NAPAF has been submitted in the original application.

f) **CHEP:**

- The maximum generation of CHEP is restricted to 64.77 MW (89.95% of rated capacity) due to restriction in water carrying capacity of the power channel to 12500 cusec. Considering the benchmark NAPAF of 90%, the NAPAF comes out to be 81% ($90\% \times 0.8995$).

However, further allowance should be given due to the following constraints in operating Chiplima Power House.

- After installation of TRCM, the weeds problem is reduced substantially. However TRCM is meant for all the three units and its regular maintenance will result in outage of all the three units.
- Chiplima switchyard is very old. There is frequent trouble in Breakers, CTs and 11KV cables.
- Unit-3 of Chiplima Power House is more than 45 years old. The various components of Turbine and Generator are giving frequent problem resulting in forced outage of the units.
- Although Unit-2 is renovated, there is persistent problem in the BHEL make governor resulting in reduction in maximum generating capacity.

- (j) At present, the capacity charge payable by GRIDCO is on the basis of certification from SLDC.
- (k) In the application for approval of NAPAF of Hydro Power Stations of OHPC, it has been prayed before the Commission for fixation of NAPAF at a lower level than the benchmark norm fixed by CERC considering the ground realities.
- (l) While fixing the NAPAF of Central Sector Power Plants, CERC has considered the actual operating condition, constraints of the power stations individually. This has been explained at para-33 of the CERC (Terms and Conditions) Regulations, 2009 Statement of Objects and Reasons.
- (m) OHPC prays the Commission to fix the NAPAF of power stations based on past performance, operating constraints of power houses, vintage of equipments. Suitable allowance may be considered in respect of NAPAF fixed as per CERC norms, so that power stations shall be able to achieve realistic NAPAF so that Capacity Charge can be recovered & required fund shall be available for proper operation and maintenance of power house, which will

benefit both OHPC and the consumers of state as a whole. If OHPC is not able to recover the full capacity charge in the ARR, the revenue gap shall further increase in the year of hydrology failure. Non recovery of full capacity charge will led to a reduction of budget for O&M of power stations that may deteriorate the healthiness of power station equipments.

- (n) Due to contribution of low cost power from OHPC to the state grid, it becomes possible for GRIDCO to maintain the BSP to a minimum level. As a result of which, the consumer of state of Orissa are being benefited. Encouragement is required for availability of low cost power from OHPC.

35. In another written submission on 20.09.2010 Shri R P Mohapatra has stated that the compliance to the suggestions of the respondents by the Petitioner vide its letter 6167 dtd. 15.09.2010 to the Commission may not be taken into consideration since it is submitted at a very late stage repeating its original submission and perhaps with the intention of confusing the issue.
36. The Commission took note of the oral and written submissions of the petitioner and respondents including the additional submission of the petitioner. Before issue of the order, the Commission feels it appropriate to consider all the views and facts available with the Commission.
37. The tariff for OHPC power stations is being determined from the FY 2009-10 as per CERC Tariff Regulations, 2009, where the annual fixed cost is apportioned to Capacity Charge and Energy Charge on 50:50 basis. If the power station achieves the Normative Annual Plant Availability Factor (NAPAF) it would be able to recover the normative capacity charge (i.e. 50% of the Annual Fixed Cost) and if it achieves the design generation, it could recover the normative energy charges (i.e. balance 50% of AFC). If the generation is less than design energy, it would not be able to recover its total energy charges and hence the total AFC. However, as per the Commission's earlier order, the revenue earned by OHPC from sale of excess energy than the design energy in the year of good hydrology shall be utilized to replenish the short fall in revenue in the years of less generation by OHPC power stations due to hydrology failure. In case the actual plant availability is more than the NAPAF fixed by the Commission, the generator will get additional capacity charge as incentive over and above the normative value and if the actual availability is less than the NAPAF, the generating stations will get less capacity charge and will not be able to recover its Annual Revenue Requirement.

38. The Commission agrees with the views/suggestions of the respondents not to give undue relaxation to OHPC stations while determining the NAPAF so that they will get higher capacity charge than the normative as an incentive. At the same time the Commission has also to consider the submission of OHPC in respect of the operating conditions and known plant limitations while determining the NAPAF of its generating stations. OHPC stations are supplying low cost power to the State and help to maintain the BSP at a lower level. In case OHPC stations could not achieve the NAPAF fixed by the Commission, OHPC would not be able to recover its normative capacity charge and hence the Annual Revenue Requirement. This may lead to lower expenditure towards O&M of its old machines and consequently more outage and less plant availability which will further reduce the capacity charge and reduction in recovery of ARR.
39. Therefore, while determining the NAPAF of OHPC generating stations for the FY 2009-10 to 2013-14, the Commission has to take a realistic view considering the submissions of both the petitioner and the respondents along with guidelines provided in CERC Tariff Regulations, 2009 and the Statement of reasons thereon, as the tariff of OHPC stations is being determined based on the CERC norms.
40. As per Regulation 27 of the CERC (Terms & Condition of Tariff) Regulations, 2009:
- (1) *Normative Annual Plant Availability factor (NAPAF) for hydro generating stations shall be determined by the Commission as per the following criteria.*
- i. *Storage and Pondage type plants with head variation between full reservoir level (FRL) and Minimum Draw Down Level (MDDL) of up to 8%, and where plant availability is not affected by silt: 90%.*
 - ii. *Storage and Pondage type plants with head variation between FRL and MDDL of more than 8%, where plant availability is not affected by silt: Plant specific allowance to be provided in NAPAF for reduction in MW capacity as reservoir level falls over the months. As a general guideline the allowance on his account in terms of multiplying factor may be worked out from the projection of annual average of net head, applying the formula:

$$(\text{Average head} / \text{Rated head}) + 0.02$$
Alternatively in case of difficulty in making such projection, the multiplying factor may be determined as:

$$(\text{Head at MDDL} / \text{Rated Head}) \times 0.5 + 0.52$$*
 - iii. *Pondage type plants where plant availability is significantly affected by silt: 85%.*
 - iv. *Run-of-river type plants: NAPAF to be determined plant-wise based on 10-days design energy date where available/relevant.*

- (2) *A further allowance may be made by the Commission in NAPAF determination under special circumstances, e.g. abnormal silt problem or other operating conditions and known plant limitations.*
- (3) *A further allowance of 5% may be allowed for difficulties in North East Region.*
- (4) *In case of a new hydro electric project the developer shall have the option of approaching the Commission in advance for fixation of NAPAF based on the principles enumerated in sub-clauses (1), (2) and (3) depicted above.*

41. As per para 33.1 of the Statement of objects and reasons on above CERC Regulations 2009, the CERC had directed the Central Sector Hydro Generating Companies to furnish the information in respect of each of its hydro electric generating stations presently in operation, to enable the Commission to take a view on the determination of values of Normative Annual Plant Availability Factor (NAPAF). On the basis of the performance data made available by various hydro generating companies for the period 2003-04 to 2007-08, plant availability of each station has been assessed. Chamera –I and Chamera-II stations of NHPC which had consistence performance in terms of providing peaking capability during last 4-5 years and where plant availability is not affected by silt are considered as the bench mark stations. NAPAF of these stations has been considered at 90%. Further, based on the practical difficulties and known operational constraints of the Central generating stations, CERC has made allowance while determining the NAPAF for the individual station and fixed the same for pondage and storage type of Central Hydro Stations which varies from 69% to 90%.

42. Since, we are following the CERC Tariff Regulations, 2009 for determination of tariff of OHPC power stations, the NAPAF of individual power stations of OHPC should be determined based on the CERC Regulations.

43. As per CERC norms, Plant Availability Factor (PAF) in relation to a generating station for any period means the average of the daily Declared Capacities (DCs) for all the days during that period expressed as a percentage of the installed capacity in MW reduced by the normative auxiliary energy consumption.

Where Declared Capacity (DC) in relation to a generating station means, the capability to deliver ex-bus electricity in MW declared by such generating station in relation to any time-block of the day or whole of the day, duly taking into account the availability of fuel or water and subject to further qualification in the relevant regulations.

44. The percentage of annual availability furnished by OHPC for its power stations is the machine availability based on the outage of machines in machine hours, but not the MW availability considering the head variation and de-rating of the machine output, if any. These figures of machine availability may be closure to the MW availability for high head power stations where variation in MW output is very minimal with head variation. But for the low head power stations where MW output varies with head variation, the machine availability shown by OHPC is not the same as MW availability. But as per CERC norms plant availability is computed based on the ex-bus MW availability. Hence the past availability data submitted by OHPC is exactly not the PAF. The PAF would be lower than these figures specifically for low head stations like HHEP Burla and RHEP Rengali. Hence, it may not be considered while determining NAPAF of these stations.
45. From the submissions of the petitioner as well as the respondents it is observed that the plant availability of OHPC power stations is not affected by silt and for high head power stations, like UIHEP, BHEP and UKHEP, the head variation between FRL & MDDL is within 8%. Hence, the NAPAF for these power stations could be 90% considering the benchmark NAPAF set out by CERC.
46. However, the petitioner has submitted that
- i) Though commissioned in the year 2001, the machines at Upper Indravati were procured in the eighties, and has been inundated in the flood and refurbished to bring them to the present shape. There is loss of availability due to breakdown of critical equipments, as happened due to rotor pole insulation failure. Due to choking of intake gate trash rack by logs and debris, there is complete shutdown of the plant for a week in summer for removal of debris and logs from trash rack.
 - ii) Balimela Power Station is more than 35 years old and there is frequent forced outage of the old units, resulting in loss of availability. The out put of Unit-7 & 8 is 72.4MW at rated net head of 274 Mt. Though, these new units are high head units, it has considerable capacity variations with the head i.e .from 65 MW to 78MW from MDDL to FRL with allowable guide van opening. These two units have at least 30% of the total capacity of the plant.
 - iii) The BHEL make generating units of Upper Kolab Power House is more than 20 years old and requiring frequent maintenance for maintaining availability of the machines.

47. Considering the above factors and the observations at para-38 above and with reference to Regulation 27(i)(2) of the CERC (Terms & Condition of Tariff) Regulations, 2009, the Commission would like to provide 2% allowance to UIHEP and 5% allowance to BHEP and UKHEP due to aging of the machines and fix NAPAF at 88% for UIHEP and 85% for both BHEP and UKHEP.
48. As per CERC norms for Storage and Pondage type plants with head variation between FRL and MDDL of more than 8%, where plant availability is not affected by silt; Plant specific allowance to be provided in NAPAF for reduction in MW capacity as reservoir level falls over the months. As a general guideline the allowance on this account in terms of multiplying factor may be worked out from the projection of annual average of net head, applying the formula, $(\text{Average head} / \text{Rated head}) + 0.02$. Alternatively in case of difficulty in making such projection, the multiplying factor may be determined as $(\text{Head at MDDL} / \text{Rated Head}) \times 0.5 + 0.52$.
49. The Commission observed that, there is difficulty in the 1st formula to compute the average head in view of the operation of reservoir in different years based on the inflow, hence the second formula, $\text{MF} = (\text{Head at MDDL} / \text{Rated head}) \times 0.5 + 0.52$ may be used to compute the multiplying factor While determining the NAPAF of the low head power stations of OHPC.
- (a) **RHEP:** From the above formula, the MF for RHEP, Rengali works out to be 0.86 and thereby the NAPAF comes to 76.54% or say 77%. Allowing 2% due to aging of the machines, the NAPAF of RHEP is fixed at 75%.
- (b) **HHEP:** The generating units of HHEP, Burla are of the different size having different rated head. Consequently, the MF and NAPAF as per the CERC formula will be as follows considering the benchmark NAPAF of 90%.

Unit No.	Rated Head	Head at MDDL	M.F	NAPAF 90% x M.F
1 & 2	31.6 m	21.33 m	0.86	77.40
3 & 4	30.78 m	21.33 m	0.86	77.40
5, 6 & 7	26.50 m	21.33 m	0.90	81

Taking the weighted average, the NAPAF of the station comes to 78.87% or say 79%. As unit-1 to Unit-4 of HHEP, Burla has already renovated and unit-5 to unit-7 are the old units, the Commission allows only 1% reduction in NAPAF due to ageing of machines and fixes the NAPAF of HHEP, Burla at 78%.

50. **Chiplima Hydro Electric Project (CHEP)**

The head variation at CHEP, Chiplita is negligible. Hence the NAPAF could be 90% taking the benchmark fixed by CERC. However, due to restriction of water carrying capability of the power channel, the maximum capability of CHEP is restricted to 64.77 MW i.e. 89.95% of the rated capacity of 72 MW. Considering this limitation the NAPAF of Chiplita comes to 81% (90% x 0.8995). OHPC has submitted for a special consideration to plant limitations and operating conditions as per Regulation 27 (i) (2) providing an allowance of 15% in the NAPAF of 81% of CHEP due to the following reasons. They have submitted that though the weeds problem at CHEP has been reduced after installation of Trash-Rack Cleaning Mechanism (TRCM), its regular maintenance will result in outage of all the three units. Further, Unit-3 of Chiplita is more than 45 year old and giving frequent forced outage. Considering the above submissions of OHPC, the Commission allowed only 6% allowance on the computed NAPAF of 81%. Hence, the Commission fixes the NAPAF of Chiplita at 75%

51. Summary of NAPAF thus fixed by the Commission for OHPC power stations for the control period of FY 2009-10 to 2013-14 is given below:

Name of the Power Stations	NAPAF (%) proposed by OHPC	NAPAF (%) proposed by GRIDCO	NAPAF (%) proposed by Sri R.P. Mahapatra	NAPAF (%) approved by the Commission
UIHEP	85	90	90	88
BHEP	85	87	90	85
UKHEP	85	87	90	85
HHEP	78	82	85	78
RHEP	72	80	81	75
CHEP	69	76	81	75

52. However, for the FY 2009-10, the HHEP, Burla and CHEP, Chiplita were considered as a single unit as Hirakud Power System (HPS) and in the tariff order for the FY 2009-10 the Commission had fixed the NAPAF of 80% for HPS (Burla and Chiplita combined together) on provisional basis. Since the year has already been passed, now it may be difficult to compute the plant availability for Burla and Chiplita separately. Therefore, the Commission decides that the provisional NAPAF of 80% earlier fixed for the FY 2009-10 in respect of HPS (both Burla and Chiplita) shall be applied for computation of capacity charges of HPS for the FY 2009-10 only.

53. GRIDCO in its submission had stated that OHPC in the calculation of monthly plant availability factor (PAFM) of low head power stations like HHEP, Burla and RHEP, Rengali has considered the capability of the machines with variation of head, instead of installed capacity as per the CERC norms for computation of monthly plant availability factor. GRIDCO is of the view that while determining NAPAF, the head variation has already been taken into consideration, so again reduction of installed capacity with that of head for computation of PAFM for the month is not justified. The Commission agrees with the views of GRIDCO and advised that while computing the monthly plant availability factor, the installed capacity shall be taken into consideration.
54. However, the capacity of the generating units under Renovation and Modernization shall not be considered in installed capacity while computing the plant availability factor. Further, while computing the plant availability, the capacity of the generating units under capital maintenance requiring maintenance period of more than 45 days may also be deducted from installed capacity after due approval of the Commission.
55. The Commission directs SLDC to verify the daily declared capacity of the OHPC power stations and certify the monthly plant availability factor of each power station of OHPC as per the guidelines provided in this order.
56. Accordingly, the case is disposed of.

Sd/-
(B.K. Misra)
Member

Sd/-
(K.C. Badu)
Memer

Sd/-
(B.K. Das)
Chairperson