Proposal for a 500 mw power plant in Tripura using natural gas

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1. Tripura is the smallest State in the North Eastern Region surrounded by Bangladesh in three sides having only outlet through Assam connecting with the rest of the country by National Highway (NH 44). The road NH 44 passess through difficult terrain in the hilly region having numbers of SPT Bridges & Culverts limiting the probability of transporting heavy consignments. More-over number of hair pin curves have restricted the movement of long tailors. As a result, setting up of Large Industries in Tripura due to the difficulty in transportation of heavy consignments by NH-44, has become a restriction since long.

2. The State is not industrially developed for various reasons like inadequate transport facilities and road conditions, power shortage, availability of raw natural resources like natural gas & un-tapped minerals, forestry and water resources etc.

3. In spite of all practical difficulties, ONGC started drilling activities in TRIPURA from mid 70's. Initially they started drilling in BARAMURA structure but subsequently they spread their activities throughout the State like ROKHIA, AGARTALA DOME, GAJALIA, TICHNA and also in NORTH DISTRICT. Their effort is still going on and by now they have achieved good result in respect of harnessing natural gas at different gas fields.

4. ONGC has invested huge amount of money in TRIPURA over two & half decades by drilling activities apart from other Socio-Welfare Schemes, but they are not getting proportionate return by marketing the natural gas in Tripura in absence of sizeable Industries using natural gas.

5. Only three Nos. Gas Based power Stations have so far come up – one at BARAMURA (16.50 MW) in 1986, one at ROKHIA (48 MW) in 1990 & the last one at RAMCHANDRANAGAR (84 MW) in 1998 of which the consumption of natural gas, is noticeable at ROKHIA & RAMCHANDRANAGAR. ONGC being a Commercial Organisation, accountability in respect of annual turnover is an important factor for them.

Expansion scope for utilization of natural gas in Tripura may be a satisfactory answer but due to reasons, already discussed, Gas Based Industries could not be set up in Tripura by different agencies though initially they have shown interest.

6. In the event of Major Industries are not coming up in Tripura mainly due to transport bottleneck for heavy consignment and absence of other infrastructural facilities etc., the first alternative is transportation of gas from Tripura keeping 1/3rd reserved for the State to West Bengal and other neighbouring States for its utilization. It is unfortunate to mention once again that due to hilly and difficult terrain laying of high pressure gas pipe line and its subsequent operation and maintenance would be a big task and supply of gas

to the end consumers/Industries would be unstable too. As a result this would not be a commercially viable proposition being high capital intensive but of low reliability.

The second alternative is Generation of Power within the state and Transmission of the same through High Voltage Tower Line to be connected to National Power Grid for its sale/distribution among the deficit states. It is needless to mention that Transmission of Power would be easier than transporation of gas through pipe line. But once again the question of transporation of heavy consignment, required for Large size Power Plant to be set up in TRIPURA may pose problem since National Highway, NH-44, connecting the state with rest of the country is not capable for transporation of heavy consignments. Recently, Border Roads Organisation made lot of improvement of NH-44 including its Bridges, Culverts & Approaches, still transportation of heavy consignments more than 30 to 40 tonne on regular basis may not be permissible.

7. NEEPCO, as a special case for its 4 x 21 MW, RAMCHANDRANAGAR PROJECT has transported single consignment weighing up to 98 tonne through NH-44 during last year in the dry spell with special care and arrangements wherever it required on the way. This is a good example that by making temporary support to the weak Bridges or through diversion during dry spell, heavy consignments occasionally may also be transported through same road up to Agartala. This idea could be gainfully utilized for the future Industries / Power Stations to be set up in Tripura.

8. The Unit size, 100 to 120 MW Gas Turbine can be dismantled and transported upto the site which would be assembled once again as done in case of ROKHIA & BARAMURA PROJECTS. But the heavy consignment is the Generator / Roter which may weigh up to 100 to 135 tonne in fully assembled condition. For easy transportation, Roter should be transported with minimum assembly as required and Roter strips accessories etc. shall be fabricated at works and sent to site separately. In fact the Generator manufacturer has to establish a sub-assembly shop at site which is a common practice in case of Large Power Stations and final assembly of the Roter including its testing etc. would be done by them at site.In this way the problem of transportation of heaviest consignments may be overcome. In case of Power Transformer, three number Single Phase Transformers shall be preferred and connected externally at site to convert it into three phase one.

9. The other alternative of transportation of heavy consignments is through Bangladesh as one time case for which the matter may be taken up with Bangladesh Authorities at appropriate level through Government of India. In case Bangladesh agrees to buy Power from this Project, it will be further easy to get their cooperation on this issue.

10. The present power scenario in the country:

The present installed capacity throughout the country comprising of Power Stations in different Electricity Boards/Government/Private Sectors etc. is over 83,000 MW of which more than 50% is on Thermal. The average Plant Load Factor achieved for Thermal

Power Station is as low as 51 to 54% except one in Vijayware (AP). The country is facing acute shortage of Power (MW) during peak load hours.

Against the requirement of 48,000 MW of new capacity addition in Power Plant during 8th Plan Period as assessed by Central Electricity Authority (CEA), the target was scaled down to 30,538 MW only. Even at the end of 8th Plan Period, the realistic assessment made shows that the capacity addition during 8th Plan Period is only 17,000 MW as against 21,401 MW in the 7th Plan Period. As such the country faced energy shortage of 14% and peak shortage (MW) of 28% by March, 1997. The shortfall is however, spread over throughout the country.

To meet the shortage, the Central Electricity Authority (CEA) has projected a requirement of 62,000 MW additional Generation Capacity during the 9th Plan Period. Taking into account the investment required for new Generation Project with matching Transmission and distribution together the level of investment will have to be made of the order of Rs. 60,000 Crores in the coming years which is three times more than the present level of investment. This is a huge investment and as such would be unrealistic since this will have effect of curtailing down the fund allocation in other sectors of development. Accordingly, the Planning Commission is working out the modalities of investment in different sectors with an aim to raise Generation Capacity at least to the tune of 27,000 MW in the 9th Plan Period.

While discussing short fall country-wide, it is relevant to mention that the North Eastern Region of the country is facing this problem severely in the peak demand (MW) through not much short by energy generation (MU).

Only Meghalaya is the surplus State whereas shortage in MW results severe load-shedding in Tripura, Mizoram, Assam etc.

Peak demand and energy requirement for Tripura is assessed by the CEA from 1999. 2000 to 2010 to 2011 is reproduced below : -

Energy requirement in mkwh and peak demand in mw for Tripura throughout the years 1999-2000 to 2010-2011.

YEAR	ENERGY (MKWh)	PEAK DEMAND (MW)
1999-2000	611	150
2000-2001	681	165
2001-2002	757	183

2002-2003	837	201
2003-2004	923	220
2004-2005	1014	240
2005-2006	1110	260
2006-2007	1210	282
2007-2008	1315	305
2008-2009	1423	327
2009-2010	1535	351
2010-2011	1965	438

From the above Table it may be seen that unless the Generation Capacity in the State is considerably enhanced within 3-4 years time, Tripura shall suffer very huge shortage of Power, both in Peak Demand (MW) and Energy requirement (MKWh).

Since the shortage will remain in the National level i.e. throughout the country, assistance from central Sector Power House may not be adequate to supplement the shortage of Tripura in full. Therefore, it is now the high time for making a policy decision and to explore the scope of setting up of new power station adequate enough to meet the shortfall/ growing demand of the state.

All India Energy requirement & Peak Demand is mentioned below:

Year	Energy (MKWHr)	Peak Demand
2001-2002	569650	95757
2006-2007	781863	130944
2011-2012	1058440	176647

The installed capacity (MW) shall be 40% higher than the peak demand if we consider max. plant availability is 60%. It seems a wide gap exists in All India level between Peak Demand and Installed Capacity as such load shedding in near future can not be avoided.

Requirement of gas would be 3 Million M^3 of CV 9000 Kcal/ M^3 (approx) per day for a 500 MW C.C. Plant.

According to the Policy of Government of India for utilization of Natural Gas, first priority goes to Fertiliser Industries, second priority is for Petro-Complex and Power is the third priority. In the event of Fertiliser & Petro-Chemical Industries are not coming in near future in Tripura, a 500 MW Power Station seems to be feasible if the gas available is allotted for Generation of Power, With the progress of drilling activities even up to 1000 MW. Availability of natural gas as envisaged by the Geologist in Tripura if harnessed would be good enough for further bigger size of Power Station or large Industries coming at a later date.

On the other hand, if any Heavy Industry like Fertiliser, Petro-Chemical etc. are planned to be set up a substantial quantum of Power will also be required to run those Industries apart from their own captive Power Station.

12. Water availability:

Such a large size Combination Cycle Power Plant would require huge water availability which can only be fed by the river Gumti having a Hydel Power Station in the upstream and regulated water discharge in the down stream of Jatanbari to the tune of 600 to 800 cusec round the clock. Therefore, Power Station need be located on the bank of the river Gumti or near by.

In the event of shortage of water required for combined Cycle Power Station of 500 MW, one may go for air-cooled condenser instead of water cooled which will reduce the requirement of water substantially. In that case only make up water will be required to make good the steam lose.

13. A 1000 MW Power Station is therefore proposed in Tripura in two phases. Initially 500 MW and in Phase II, with load growth, an-other 500 MW totaling to 1000 MW. It is needless to mention that the Power Station should be combined cycle i.e. exhaust heat recovery boiler to run steam turbine. This will increase the Plant efficiency and reduce fuel consumption by $1/3^{rd}$ of the Plant capacity since Power availability through exhaust heat is approximately 50% of the open cycle turbine rating without any extra fuel.

14. Layout and design of the Power Plant shall be done for 1000 MW combine cycle to be constructed as 500 MW (C.C.P) in Phase I and another 500 MW (C.C.P) in Phase II. The advantage is capacity addition shall be matching the growth in Demand, requirement of fund will be gradual not at a time in full. Again the Phase I could be splitted in two

parts, like, open cycle portion in first three years upto its commissioning, Combine cycle portion, i.e. installation of four Nos. W.H.R.B. & two Nos. STG sets one by one for three Nos Gas Turbines by next two years and so on for Phase II also. The advantage is that Power Generation to the tune of 200 MW will start by 3rd year giving some return of capital invested.

15. Size of the Units = Phase I :

The size of the Gas Turbine Unit shall preferably 100 MW so that 4 (four) Nos. of Gas Turbines (open cycle) followed by 2 Nos. of 100 each steam Turbine with waste heat recovery boilers would be good proposition to generate 500 MW Power even at 40 degree centigrade ambient temperature. In winter days the Plant will generate more when ambient temperature will be low.

For installation of 4 Nos. 100 MW open cycle Gas Turbine a period of three years may be considered adequate. By the end of third year the Plant will generate at least 250 MW to 300MW of Power when the 4th unit will be under commissioning.

After commissioning of all the four units, installation of Steam Turbine Generators and Waste Heat Boilers one by one would be followed so that installation of two Nos. 100 MW Steam Turbines with Waste Heat Boilers will be completed by next two years time when Generation of Power will also be available to the tune at least 200MW.

On completion of the six Unit, the project will deliver 500 MW of Power from sixty year onward.

16. Transmission :

The responsibility of evacuation of Power through National Grid is on PGCIL. The mater may be taken up with them for construction of 400 KV Transmission Line from Agartala to a place called ‘Misa’ in Assam which is only 600 Km from Agartala. Power thus Generated would be feed to National Grid for sale/distribution among the States having shortage of Power.

17. It would not be out of place to mention that our neighbouring State, Bangladesh is also having Power shortage problem. According to reports, the National Grid Corporation of India has proposed a single grid between he two countries to face the Power problems and to ensure better management of the electricity of the two countries. Bangladesh is facing a Power shortage of about 300 to 400 MW daily, causing load shedding that disrupt Industrial production.

The Bangladesh Energy Ministry responding positively has examined the Indian proposal and suggested formation of a Technical Committee, if needed, would visit India to ascertain the Power situation and also to identify the points from where the two National Grids could be connected with each other. National Grids could be connected

from four different points of the two countries. These points are RAJSHAHI & KUSHTIA in Bangladesh and MEGHALAYA and TRIPURA in India (Sources : ELECTRICITY INDIA, 15th September, 1996). If Bangladesh buy this Power from TRIPURA, Transmission Line Length would be less than 50 Km.

18. Agencies for Execution & Resources there of :

Since the capacity of the proposed Power Plant would be substantially high, the first priority goes to NTPC who is capable for construction, commissioning and subsequent operation & maintenance etc. In case NTPC does not come forward for this Project. NEEPCO is the second agency, in line who may prefer to take up this Project for execution, operation & maintenance etc.

It is anticipated that a fund to the tune of 2500 Crores would be required for setting up the 500 MW Gas Based Power Plant and an other Rs. 3000 Crores with price escalation in 2nd Phase excluding Matching Transmission Line of 600 Km- 400 KV which is to be dealt by PGCIL from their own Budget.

In the event of fund constrain and other difficulties, the third alternative is to form a consortium by ONGC, NEEPCO, Government of Tripura, machine manufacturers/suppliers and a Financial Institution, so that different Agencies jointly raise the fund for the Project.

It is not out of place to mention that out of 1 lakh MW to 1.25 lakh MW Power Plant manufacturing capacity throughout the world, order is available to the tune of 30,000 MW to 35,000 MW in a Year and that too also from the 3rd world countries. As a result there is a huge competition globally not only in its price but other facilities like long term repayment facilities with soft and low rate of interest etc. Generating Plants are also offered by some companies on lease basis where cost of Plant, machineries are allowed to be refunded by sale of Power after commissioning the Plant over a period of twenty years or more at low rate of interest. These facilities can also be availed by the Project Authority against global tender.

The final alternative is for global tendering/private parties participation for Generation of Power in Tripura (India) under liberalized Industrial Financing policy.

19. <u>Cost of Generation of 500 MW combined cycle Power Plant in TRIPURA</u> :

(i) Cost of the Project (500 MW) = Rs. 2,500 Crores

(ii) Cost of per KW of Installed = Rs. 50,000/- Capacity.

(iii) Fixed Charges :

a) Interest on Capital @ 10% p.a.

b) Depreciation @ 6% p.a.

c) O/M Spares & @ 1.5% p.a. consumables

d) Pay & Allowance @ 1.0% p.a. of staff

Total : 18.5% p.a.

i.e. Rs. 50,000 x 18.5% = Rs. 9,250/-

(iv) Considering 7000 hrs of operation out of 8760 hrs, in a year, unit Generated per KW of installed capacity = 7000 Kwhr.

(v) Auxiliary consumption @ 1.5% = 7000 x 1.5% = 105 Kwhr

(vi) Net Unit available per KW of installed capacity = 7000 – 105 = 6895 Kwh

(vii) Fixed Charges per Kwhr $\frac{9250}{}$ = Rs. 1.3416

(viii) Fuel cost/Kwhr : 6895

a) Cost of Natural Gas = Rs. 1203/- per 000 M^3

b) S.T. @ 12% = Rs. 144.36

c) Royality @ 10% = Rs. 120.30

Total Rs. 1,467.66

Cost of Fuel/Kwh = $\frac{3300 \text{ (Heat rate/Kwh)}}{9000 \text{ (L.H.V)}} \times \frac{1467.66}{1000}$

= Rs. 0.5381

(ix) Cost of Generation as open

Cycle = Rs. 1.3416 + Rs. 0.5381 = Rs. 1.8797 per Kwhr

(x) Cost of Generation at H.T. bus as combined

Cycle Power Plant

$\frac{2}{}$ $\frac{1}{}$

= Rs. 1.8797 x 3 + Rs. 1.3416 x 3

= Rs. 1.2531 + Rs. 0.4472

= Rs. 1.7003 paise

Add 3.5% profit as per Venkatraman's Committee's

Report = Rs. 1.7003 x 1.035

= Rs. 1.7598

= Rs. 1.76 paise per Kwh.

Cost of Power for sale = Rs. 1.76 paise per Kwhs

The above prices of Rs. 1.76 per Kwhs is much cheaper than the other Project now in operation in the North Eastern Region.

20. Finally it appears that this proposal is highly prospective for utilization of Natural Gas to the tune of 3 (three) million Cubic Meter per day for Generation of 500 Mw Power by combined cycle Power Plant and by sale of this Power, Government of Tripura will also achieve sufficient Tax & Royalities apart from employment generation. On the other hand if this Power is sold to Bangladesh, heavy consignments for the Power Project could be transported through Bangladesh under the agreed terms of contract and length of Transmission Line to be constructed upto Bangladesh obviously would be less capital intensive. The above benefits in respect of Phase I are of immediate nature.

21. To achieve this it is proposed that ONGC may form a Team/Task Force for liason, co-ordination & persuasion with different Department in Government of India level and with State Government.

22. A consultant may also be appointed by the ONGC for preparation of pre-feasibility report required to move with different Authorities and if finally decided 'Detailed Project Report' shall be prepared subsequently for sanction and implementation.

N.B. The Author has served 32 yrs in Power Sector of which more than 20 yrs in various power plants like Generation, Transmission etc. He was in charge if 1st gas based power project in Tripura (commissioned on March '1986) for its Erection, Testing and Commissioning and its operation and maintenances for next 10 yrs. He represented the state of Tripura in various important meeting in Regional and Govt of India level.

This paper was presented by the Author in a Seminar on **“Utilization of Natural Gas in Tripura “** at Rabindra Bhavan during **June ‘1999** organized by the Institutions of Engineers (India) Agartala local centre and O.N.G.C.Tripura assets as such database is also old.

Surprisingly it appears relevant even today and seems to be the base paper of Mega Power Projects now under construction at Monarchak (NEPCO) and Palatana (OTPC).