BEFORE THE JOINT ELECTRICITY REGULATORY COMMISSION FOR THE STATE OF GOA AND UNION TERRITORIES

FILING NO.: ____________

CASE NO.: ___________

Petition before the Joint Electricity Regulatory Commission for the state of Goa and Union Territories

IN THE MATTER OF THE APPLICANT:

Goa Sponge and Power Limited,
542, Rafael House, Ponguirval,
Curchorem, Goa

AND

IN THE MATTER OF:

Petition for determination of tariff for supply of surplus power from co-generation power plant of Goa Sponge and Power Limited to Goa Electricity Department under Section 62 (1) (a) and 86 (1) (a) to (e) of The Electricity Act, 2003

GOA SPONGE & POWER LIMITED ("The Petitioner") RESPECTFULLY SUBMITS AS FOLLOWS:

Goa Sponge & Power Limited (hereinafter referred to as "the Petitioner" or "GSPL") is a limited company registered under the Indian Companies Act, 1956 with its registered office at 21/6 west patel nagar, new Delhi. . Established in March 2004, the Petitioner is one of the leading manufacturers of high quality Sponge Iron.

The Petitioner operates a co-generation power plant (CPP) with an installed capacity of 12 MW. The power plant has been developed with a vision to promote environmental sustainability, effective waste utilization and energy security. The CPP has an 8 MW Waste Heat Recovery Boiler (WHRB) and 4 MW Fluidized bed combustion (FBC) boiler. The FBC unit utilizes the Dolachar produced during the sponge iron production process (along with supplementary firing of coal) whereas the WHRB utilizes the hot exhaust gasses which are a by-product of the sponge iron manufacturing process.

The power produced in the power plant is utilized in the sponge iron manufacturing process and the induction furnaces in the steel melting shop. The facility also consumes power from the state grid at times based on total requirement of the facility and CPP generation. However at an overall level, the power generated from the CPP is in general more than the power imported from the grid, making the Petitioner a net exporter of power to the state grid. **The Petitioner supplies surplus power available with it (around 1 MW) to the Goa Electricity Department.**

The Petitioner entered into a power purchase agreement on the August 24, 2007 with the Government of Goa, for feeding the surplus electrical energy (around 1 MW) into the grid at 33 kV at Santona, Sanvordem. As per negotiations and the then prevalent fuel cost, the tariff was fixed as per clause 5.1 of the said power purchase agreement.

"(5.1) Tariff: The applicable tariff for the delivered energy by GSPL to the Government shall be Rs 2.40 per kWh till the expiry of the period of this Agreement. ***However, the tariff is subject to revision by the appropriate Regulatory Commission on a later date and such revised tariff shall be applicable from prospective date****. In the event of such revision of tariff, if the Government is unwilling to purchase the power at the rates determined by the appropriate Regulatory Commission, then the GSPL shall be permitted to sell energy to third parties."*

The Petitioner submits that the existing tariff of Rs 2.40 per kWh being paid by the Government of Goa, now under the purview of the Goa Electricity Department (GED), is very low as compared to the prevalent fuel costs and tariff payable to other generating stations. Considering the provisions of the power purchase agreement, the Petitioner submitted a petition () before the Hon'ble Commission on November 7, 2011 for revision of tariff applicable for sale of power to GED under Section 86 (1) (a) to (e) of the Electricity Act, 2003.

The Hon'ble Commission on analysing the petition, however, noted discrepancies/ information gaps in the petition. The Hon'ble Commission vide its letters dated December 5, 2011 and April 19, 2012, asked the Petitioner to submit a revised petition after addressing the discrepancies observed in the tariff petition. The Hon'ble Commission noted the following defects in the petition:

1. The petition is not in the form (JERC-2) prescribed in Chapter II of the JERC, Conduct of Business Regulations.
2. The petition is also not in the format as prescribed by the Commission in Chapter III of JERC (Terms and Conditions for Determination of Tariff) Regulations, 2009
3. As per the Regulations, the fee for the purpose amounts to Rs 5.0 lakhs. The balance fee may be remitted.

The Petitioner is now filing its revised petition for determination of generation tariff for supply of surplus power (of around 1 MW) to Goa Electricity Department from its co-generation power plant after correcting for the deficiencies pointed out by the Commission.

Observation of the Commission	Correction made
1. The petition is not in the form (JERC-2) prescribed in Chapter II of the JERC, Conduct of Business Regulations.	The petition has been made as per format JERC-2 of the JERC, Conduct of Business Regulations
2. The petition is also not in the format as prescribed by the Commission in Chapter III of JERC (Terms and Conditions for Determination of Tariff) Regulations, 2009	The formats for filing of petition for a generating plant – Format 1G to Format 12G as prescribed by the Commission are enclosed in Appendix A. -
3. As per the Regulations, the fee for the purpose amounts to Rs 5.0 lakhs. The balance fee may be remitted.	As per Point 12 of the Schedule of Conduct of Business Regulations the following fee is payable for Determination of tariff under the provisions of clause (a) of sub-section (1) of Section 62: *"Non-conventional & Renewable Sources of Energy, including co-generation - Rs. 1,00,000 installed capacity of MW or Rs. 5,00,000 for capacity above 10 MW."* The petition filing fee is being paid by way of demand draft No. XXXXX dtd XXXXXX issued in favour of Secretary, Joint Electricity Regulatory Commission for the State of Goa & Union Territories.

The details of the methodology and principles used by the Petitioner for calculation of generation tariff for the co-generation power plant are detailed in Section 10 and 11 of this petition.

PRAYERS TO THE HON'BLE COMMISSION

The Petitioner respectfully prays that the Hon'ble Commission may:

1. Accept the Petition for determination of tariff for supply of surplus power from co-generation power plant of Goa Sponge and Power Limited to Goa Electricity Department under Section 62 (1) (a) and 86 (1) (a) to (e) of The Electricity Act, 2003;

2. Approve a revised tariff for the years FY 2013-14 to FY 2021-22 for supply of surplus power from co-generation power plant of Goa Sponge and Power Limited to Goa Electricity Department;

3. Condone any inadvertent omissions, errors, short comings and permit GSPL to add/ change/ modify/ alter this filing and make further submissions as may be required at a future date; and;

4. Pass such other and further Orders as deemed fit and proper in the facts and circumstances of the case.

BEFORE THE JOINT ELECTRICITY REGULATORY COMMISSION FOR THE STATE OF GOA AND UNION TERRITORIES

FILE NO. ______________

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IN THE MATTER OF THE APPLICANT:

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AND

IN THE MATTER OF:

Petition for determination of tariff for supply of surplus power from co-generation power plant of Goa Sponge and Power Limited to Goa Electricity Department under clause (a) of sub-section (1) of Section 62 of The Electricity Act, 2003

Affidavit

I, Sh./Smt. _____________ , (S/o, W/o, D/o) Sh._____________(aged ______ years), (occupation) ___________ , residing at), the deponent named above do hereby solemnly affirm and state on oath as under:-

1. That the deponent is the Managing Director/ Director who is authorized as per the resolution of the company dated _____ (In case the Petitioner is a Company) and is acquainted with the facts deposed to below.

2. I, the deponent named above do hereby verify that the contents of the paragraph Nos. 1 of the affidavit and those of the paragraph No. ....of the accompanying petition are true to my personal knowledge and those of the paragraph Nos. .....of the accompanying petition are based on the perusal of records and those of the paragraph Nos.......... of the accompanying petition are based on information received and those of the paragraph Nos. .... of the accompanying petition are based on the legal advice which I believe to be true and verify that no part of this affidavit is false and nothing material has been concealed.

(Deponent)

I, ___________ Advocate,___________, do hereby declare that the person making this affidavit is known to me through the perusal of records and I am satisfied that he is the same person alleging to be deponent himself.

Advocate

Solemnly affirmed before me on this day ....of......... 2013 at ....a.m. / p.m. by the deponent who has been identified by the aforesaid Advocate.

I have satisfied myself by examining the deponent that he understood the contents of the affidavit which has been read over and explained to him. He has also been explained about section 193 of Indian Penal Code that whoever intentionally gives false evidence in any of the proceedings of the Commission or fabricates evidence for purpose of being used in any of the proceedings shall be liable for punishment as per law.

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Introduction to GSPL

1. Company overview

1.1. Goa Sponge & Power Limited (hereinafter referred to as "the Petitioner" or "GSPL") is a limited company, registered under the Indian Companies Act, 1956 with its registered office at 21/6 west patel nagar, new delhi. Established in March 2004, the Petitioner is one of the leading manufacturers of high quality Sponge Iron, with its plant located at Survey No. 58/59/60, Village Santona, Taluka Sanguem, Goa. The plant is an integrated facility incorporating a Direct Reduction Iron (DRI) kiln for production of sponge iron, a steel melting workshop and a captive co-generation power plant.

1.2. The Petitioner's primary business is the manufacturing and sale of sponge iron. The sponge iron plant has a production capacity of 350 MT per day (TPD) using a **Direct Reduction Iron (DRI) kiln**, which can produce approximately 90,000 MT sponge iron per annum. South African, Indonesian or Indian coal is used for the process. Iron ore and coal are crushed and screened in the raw material preparation plant to get the required size and sent to respective bins. From the bins, a mix of iron ore, coal and dolomite is fed into the kiln through conveyor belts for firing. After the completion of all the stages, the final product i.e. sponge iron is produced from the kiln. One of the primary by-products of the sponge iron production process is dolachar. The dolachar produced in this process has a significant amount of calorific value and is therefore sold in the open market as well as used in the power plant (FBC Boiler) for power generation as a measure of waste minimization. The facility also has a fly ash brick unit for effective utilization of fly ash recovered as by-products from the production of sponge iron.

1.3. The Petitioner's facility at Santona also has a 90,000 MT per annum capacity **steel melting shop**, which comprises of two 12 ton/hr **induction furnaces**. The sponge iron produced in the DRI kiln is melted in the induction furnace with pig iron and scrap. Majority of the sponge iron being produced from the DRI kiln is being sold whereas the rest is melted in the steel melting shop for billet production.

1.4. Apart from these two plants, the Petitioner also has a **co-generation power plant (CPP)** within its facility with an installed capacity of 12 MW. The power plant has been developed with a vision to promote environmental sustainability, effective waste utilization and energy security. The CPP has an 8 MW Waste Heat Recovery Boiler (WHRB) and a 4 MW Fluidized bed combustion (FBC) boiler for producing steam. It also has a 12 MW capacity steam turbine for generating power. The FBC unit utilizes the dolachar produced in the sponge iron production process (along with supplementary firing of coal) and the WHRB utilizes the hot exhaust gasses emanating out of the Direct Reduction Iron (DRI) kiln. A brief snapshot of the entire process has been captured in Figure 1: GSPL's process overview.

1.5. The power produced in the power plant is utilized for running the auxiliaries in the DRI kiln and the induction furnaces in the steel melting shop. The facility also consumes power from the state grid at times based on the total requirement of the facility and CPP generation. However, at an overall level the power supplied to the Goa Electricity Department (GED) is in general more than the power imported from the grid, making the Petitioner a net exporter of power to the State grid. The Petitioner supplies its surplus power, which is generally around 1 MW and as per the power purchase agreement signed between the two parties, to the Goa Electricity Department.

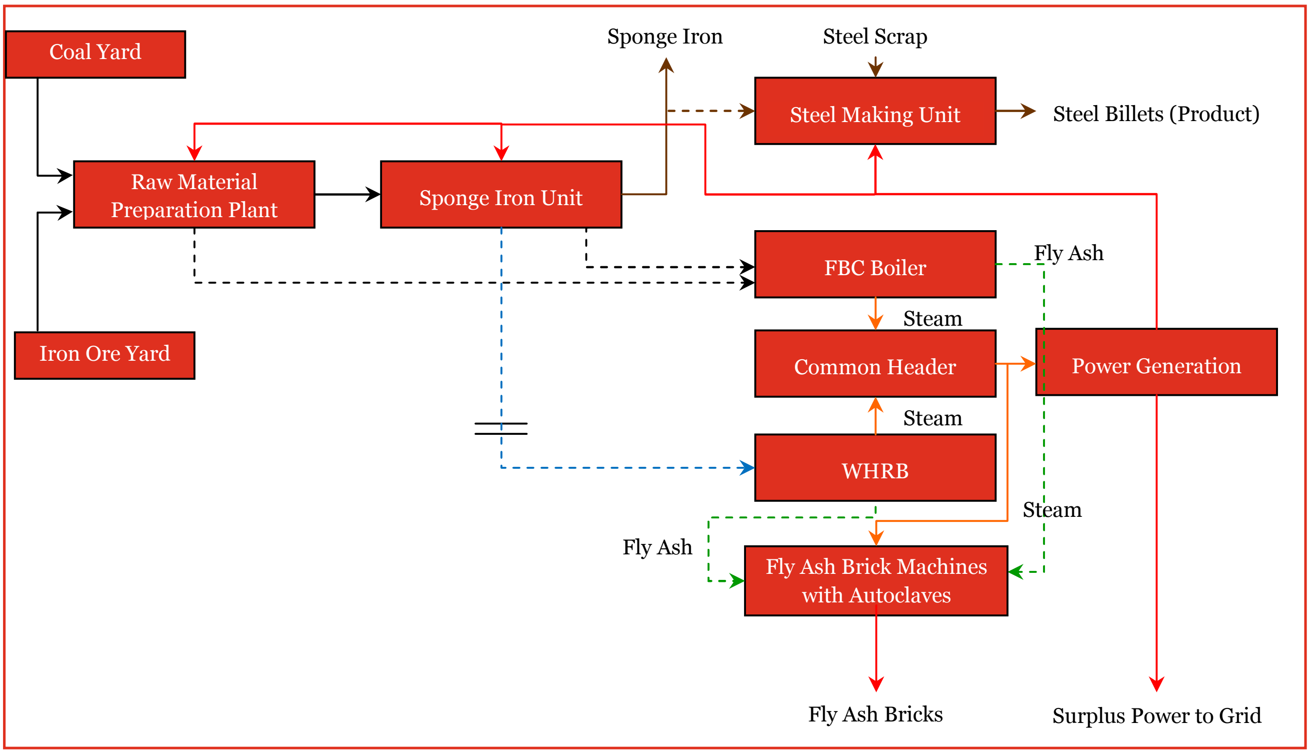


Figure 1: GSPL's process overview

2. *Co-generation plant*

2.1. *Plant overview*

2.1.1. The Petitioner has a total of 12 MW captive power generation capacity, wherein 8 MW is generated from the Waste Heat Recovery Boiler (WHRB) and 4 MW from the Fluidized bed combustion (FBC) boiler. The power plant has a steam turbine of 12 MW capacity.

2.1.2. The WHRB generates steam by using the sensible heat carried out by the waste gas of the DRI kiln. On an average, about 22 to 32 tonnes per hour (TPH) steam is generated, depending upon the quantity and temperature of the waste gas produced from the sponge iron plant's kiln.

2.1.3. The steam generated in the WHRB is supplemented by the FBC boiler for the purpose of maintaining a constant power generation. The FBC boiler generates power by firing a mix of dolachar generated from the DRI kiln, domestic coal and coal fines produced from the coal handling plant. The Petitioner has also obtained a coal linkage of 20,000 MTPA from Western Coal fields for running the FBC. The coal fines and dolachar stored in the feed bunkers are pneumatically blown into the combustion furnace, and the heat generated from the combustion produces steam in the boiler. The steam generated from both boilers is then fed into the turbine inlet through a common header.

2.2. *FBC overview*

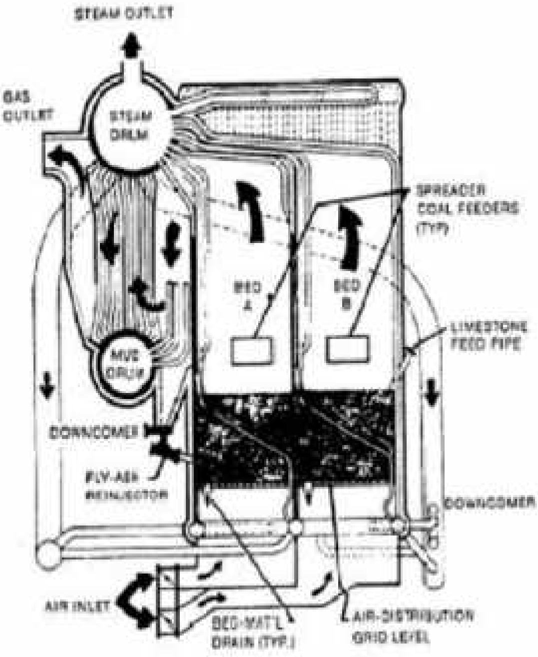
2.2.1. The FBC boiler is an Atmospheric classic Fluidised Bed Combustion System (AFBC) bubbling type boiler (capacity 4 MW), and operates by creating a fire bed produced by a mixture of silica sand and ash through which air is blown to maintain the particles in suspension. Heat is applied to this bed to raise its temperature to around 600°C by charcoal. At this temperature, coal and/or waste is fed into the bed, which is controlled to operate at 800–900°C. Water-cooling surfaces are incorporated into this bed connected to the water system of the boiler. Details of the technical specifications, working conditions and the design output of the FBC boiler have been provided as a fact sheet by Cethar Vessels Pvt. Ltd (CVPL), the EPC contractors for the CPP, as Appendix B. -

***Fuel used:** Mix of dolachar, Indian coal from Western Coalfields Ltd coal linkages, and imported coal fines from the sponge iron plant*

FBC principles of operation

When evenly distributed air or gas is passed upward through a finely divided bed of solid particles, such as sand supported on a fine mesh, the particles are undisturbed at a low velocity. As the air velocity is gradually increased, a stage is reached when the individual particles are suspended in the air stream. Further, increase in velocity gives rise to bubble formation, vigorous turbulence and rapid mixing and the bed is said to be fluidized. If the sand in a fluidized state is heated to the ignition temperature of the coal and the coal is injected continuously in to the bed, the coal will burn rapidly, and the bed attains a uniform temperature due to effective mixing. Proper air distribution is vital for maintaining uniform fluidisation across the bed. Ash is disposed by dry and wet ash disposal systems. In AFBC, coal is crushed to a size of 1-10 mm depending on the rank of coal and type of fuel fed into the combustion chamber.

A significant advantage is that such boilers are less selective in fuels and can cope with a wide range of solid-fuel characteristics.



2.3. *WHRB overview*

2.3.1. The WHRB (capacity 8 MW) is a single drum water tube type with radiant chamber, and is designed to suit individual applications ranging through gases from furnaces, incinerators, gas turbines and diesel exhausts. The prime requirement however, is that the waste exhaust gases must contain sufficient usable heat to produce steam or hot water at the conditions required. The waste gases from the sponge plant meet this requirement and therefore are recovered by the WHRB for useful steam production and subsequent power generation. Details of the specifications as provided by Cethar Vessels Pvt. Ltd (CVPL), the EPC contractors for the CPP, are given as Appendix C. -

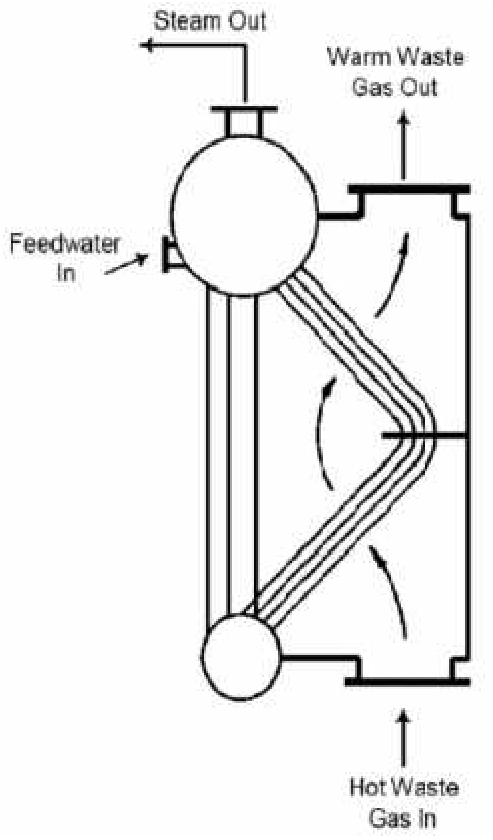
WHRB principles of operation

Waste heat is generated by way of fuel combustion or chemical reaction and then dumped into the environment even though it might be used for some useful and commercial value. Boilers, kilns, ovens and furnaces generate large quantity of flue gases. A WHRB works on the principle of recovering some amount of this waste heat.

Waste heat boilers are usually water tube boilers in which hot exhaust gases from gas turbines, incinerators etc. pass over a number of parallel tubes containing water. The water is vaporised and collected in a stream drum, later drawn for heating or processing steam. The pressure and rate of steam production depends upon the temperature of waste steam.

Advantages:

- Heat recovery adds to the process efficiency thereby decreasing fuel costs and energy consumption requirements;
- Lesser high temperature waste flue gases are emitted into the atmosphere reducing thermal and air pollution;
- Lower fuel consumption reduces the size of the control and security equipment required for fuel handling;
- Reduced equipment sizes results in reduction in auxiliary energy consumption.



2.3.2. A crucial condition for the WHRB to be able to generate its rated power therefore is that requisite waste gases should be available, which is completely dependent on the production pattern of the sponge plant. Due to this very reason, the Petitioner would like to submit that the WHRB cannot be used as the only source of power and WHRB's are always installed in addition to a FBC boiler.

Fuel used: *Waste heat recovered from the exhaust flue gases produced during the manufacturing of sponge iron*

2.4. Turbine overview

2.4.1. For converting the steam produced from the FBC and the WHRB to useful power, the power plant is also fitted with a 12 MW Siemens turbine. The supplied gear box is a Reducer Type Gearbox with its high speed shaft coupled to the turbine by means of a flexible coupling. The low speed shaft end of the turbine is coupled directly to the alternator. Torque is transmitted at the low speed end due to the additional force generated by the butting of the two shafts. Details of the turbine have been given in Appendix D. -

Approach to filing

3. Background and procedural history

3.1. The Petitioner had submitted a proposal to the Government of Goa for setting up a CPP of 12 MW capacity with Waste Heat Recovery Boiler using flue gas emanating from the Sponge Iron plant and fluidised bed combustion boiler utilising waste coal fines and char as fuel, at Santona, Sanguem Taluka, South Goa District, State of Goa. The proposal was subsequently approved by the High Power Coordination Committee of the Government of Goa in its meeting held dt. November 15, 2002 and vide letter No. IND/DEV/HPPC/DIM/9524, dt. November 22, 2002.

3.2. The Petitioner's total power generation from the CPP has been designed to be primarily dependent upon the availability of waste heat from the sponge plant and therefore varies in tandem with the sponge iron production. As per the installed captive power requirements of various equipments, machineries and plants within the facility of the Petitioner, an excess capacity of approximately 1 MW, equivalent to an electrical energy of 8.7 million units per year, is available with the Petitioner.

3.3. The Petitioner therefore subsequently entered into a power purchase agreement (Appendix E. - on August 24, 2007 with the Government of Goa, for feeding the surplus electrical energy into the grid at 33 kV at Santona, Sanvordem. The Agreement was deemed to have come into force from the Commercial Operation Date (COD), August 01, 2008 (Appendix F. -) and shall remain in force for a period of 15 years from the COD. As per negotiations and the then prevalent fuel cost, the tariff was mutually agreed as per clause 5.1 of the said power purchase agreement.

"(5.1) Tariff: The applicable tariff for the delivered energy by GSPL to the Government shall be Rs 2.40 per kWh till the expiry of the period of this Agreement. ***However, the tariff is subject to revision by the appropriate Regulatory Commission on a later date and such revised tariff shall be applicable from prospective date.*** *In the event of such revision of tariff, if the Government is unwilling to purchase the power at the rates determined by the appropriate Regulatory Commission, then the GSPL shall be permitted to sell energy to third parties."*

3.4. The power purchase agreement with the Government of Goa also provided for the Petitioner to draw start up power from the grid free of charge during the period of commissioning of the project. After the COD, any energy drawn by GSPL from the grid is being arrived at on the basis of the prevalent tariff for HT industry.

3.5. The Petitioner submits that the existing per unit charges of Rs 2.40 per kWh being paid by the Government of Goa, now under the purview of the Goa Electricity Department (GED), for purchasing the surplus power is very low as compared to the prevalent fuel costs and tariff payable to other similar generating stations. The Petitioner submits that the per unit energy charges being paid by the GED are also much lower than what is being charged by the GED for supplying power to the Petitioner.

3.6. As per Clause 5.1 of the power purchase agreement, it was mutually agreed between the Petitioner and GED that the agreed per unit tariff to be levied on GED for purchase of surplus power from the Petitioner would be as per the tariff determined by the appropriate Commission, i.e., the Hon'ble JERC (hereinafter referred to as "the Commission".

3.7. Considering the provisions of the power purchase agreement, the Petitioner submitted a petition before the Hon'ble Commission on November 7, 2011 for revision of tariff applicable for sale of power to GED under Section 86 (1) (a) to (e) of the Electricity Act, 2003. The Hon'ble Commission on analysing the petition, however, noted discrepancies/ information gaps in the petition. The Hon'ble Commission vide its order dated December 5, 2011 and April 19, 2012 asked the Petitioner to submit a revised petition after correcting the discrepancies observed in the tariff petition.

3.8. The Petitioner is now filing its revised petition for determination of generation tariff for supplying power to GED of approximately 1 MW capacity.

4. Legal provisions for filing the petition

4.1. Provisions of Electricity Act, 2003 and other statutes

4.1.1. The Electricity Act, 2003 ("Act"), provides for approval of tariff for sale of electricity by a co-generation power plant to a Distribution Licensee by the respective State Electricity Regulatory Commissions, under Section 61, Section 62 (1) (a), 86 (1) (e).

a) **SECTION 61 (h)** of the Act empowers the State Commission to specify the terms and conditions for the determination of tariff for generating companies and promote co-generation of electricity. Section 61 of the Act states that:

"Section 61. (Tariff regulations):

The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely:-

(a) the principles and methodologies specified by the Central Commission for determination of the tariff applicable to generating companies and transmission licensees;

(b) the generation, transmission, distribution and supply of electricity are conducted on commercial principles;

...

(h) The promotion of co-generation and generation of electricity from renewable sources of energy"

b) **SECTION 62 (1) (a)** empowers the State Commission to determine a tariff for supply of electricity by a generating company to a distribution licensee. Section 62 of the Act states that:

"Section 62. (Determination of tariff): --- (1) The Appropriate Commission shall determine the tariff in accordance with the provisions of this Act for –

(a) supply of electricity by a generating company to a distribution licensee:

Provided that the Appropriate Commission may, in case of shortage of supply of electricity, fix the minimum and maximum ceiling of tariff for sale or purchase of electricity in pursuance of an agreement, entered into between a generating company and a licensee or between licensees, for a period not exceeding one year to ensure reasonable prices of electricity;

(b) transmission of electricity ;

(c) wheeling of electricity;

(d) retail sale of electricity: "

c) **SECTION 86 (1)** empowers the State Commission to determine tariff for generation of electricity and to promote co-generation and renewable sources of energy. Section 86 of the Act states that:

"Section 86. (Functions of State Commission): --- (1) The State Commission shall discharge the following functions, namely: -

(a) determine the tariff for generation, supply, transmission and wheeling of electricity, wholesale, bulk or retail, as the case may be, within the State:

Provided that where open access has been permitted to a category of consumers under section 42, the State Commission shall determine only the wheeling charges and surcharge thereon, if any, for the said category of consumers;

...

(e) Promote co-generation and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee."

d) **SECTION 6.4** OF THE NATIONAL TARIFF POLICY 2005, refers to the setting of preferential tariff pertaining to the non-conventional sources of energy generation along with co-generation. The specific clause is as follows:

"(1) Pursuant to provisions of section 86(1)(e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentage for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 1, 2006.

It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.

(2) Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.

(3) The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non–conventional sources, to be followed in cases where such procurement is not through competitive bidding."

e) **SECTION 5.12** OF THE NATIONAL ELECTRICITY POLICY 2005, also refers to promotion of co-generation and non-conventional energy sources by reducing project capital costs and energy costs through competition. The sub-section (3) specifically refers to the Petitioner's case:

"5.12.3 Industries in which both process heat and electricity are needed are well suited for cogeneration of electricity. A significant potential for cogeneration exists in the country, particularly in the sugar industry. SERCs may promote arrangements between the co-generator and the concerned distribution licensee for purchase of surplus power from such plants. Cogeneration system also needs to be encouraged in the overall interest of energy efficiency and also grid stability."

5. Regulations of the Hon'ble Commission and the Central Electricity Regulatory Commission

5.1. The Hon'ble Commission has notified "Joint Electricity Regulatory Commission for the State of Goa and Union Territories (Terms and Conditions for Determination of Tariff) Regulations, 2009" (hereinafter referred to as "JERC Tariff Regulations, 2009") for determination of tariff of generating stations and other licensees in the State of Goa and the Union Territories of Andaman and Nicobar Islands, Chandigarh, Dadra and Nagar Haveli, Daman and Diu, Lakshadweep and Puducherry. The said regulations, however, do not specify the terms and conditions for determination of tariff for the electricity generated from co-generation power plants.

5.2. In absence of separate tariff regulations/terms and conditions for determination of tariff for the electricity generated from co-generation power projects in the state of Goa, the Petitioner has referred to the "Central Electricity Regulatory Commission (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2009" (hereinafter referred to as "CERC Renewable Energy Tariff Regulations, 2009"). The scope and extent of the said regulations is reproduced below:

*"**3. Scope and extent of application***

These regulations shall apply in all cases where tariff, for a generating station or a unit thereof based on renewable sources of energy, is to be determined by the Commission under Section 62 read with Section 79 of the Act.

Provided that in cases of wind, small hydro projects, biomass power, non-fossil fuel based cogeneration projects, solar PV and Solar Thermal power projects, these regulations shall apply subject to the fulfilment of eligibility criteria specified in regulation 4 of these Regulations."

5.3. While the CERC Renewable Energy Tariff Regulations, 2009, do not specify norms for co-generation power plants based on waste heat recovery, the normative parameters and methodology considered for determination of tariff of other renewable technologies have been adopted by the Petitioner for calculation of tariff for its power plant wherever appropriate. However, where no normative value is available for the parameters in the CERC Renewable Energy Tariff Regulations, 2009, the Petitioner has relied upon the actual cost incurred/ normative value of the parameters as given in the JERC Tariff Regulations, 2009.

6. Co-generation of electricity

6.1. **SECTION 2 (12)** of the Electricity Act 2003, defines co-generation as:

"Cogeneration means a process which simultaneously produces two or more forms of useful energy (including electricity)"

6.2. **THE MINISTRY OF POWER** in its resolution (no. A-40/95-IPC-I) dated November 6, 1996, on the promotion of co-generation plants, recognizes the need to open an alternative route, other than Private Generating Company, where the industries themselves will be interested to meet their own power demand by pooling resources together.

6.3. **SECTION 2.1** of the said resolution defines cogeneration as:

"A cogeneration facility is defined as one which simultaneously produces two or more forms of useful energy such as electric power and steam, electric power and shaft (mechanical) power etc. Cogeneration facilities, due to their ability to utilize the available energy in more than one form, use significantly less fuel input to produce electricity, steam, shaft power or other forms of energy than would be needed to produce them separately. Thus by achieving higher efficiency, cogeneration facilities can make a significant contribution to energy conservation."

6.4. **SECTION 5.1** of the said resolution further identifies two co-generation cycles – topping cycle and bottoming cycle:

*"**i. Topping Cycle**: Any facility that uses fuel input for power generation and also utilizes for useful heat for other industrial activities. In any facility with a supplementary firing facility, it would be required that the useful heat, to be utilized in the industrial activities, is more than the heat to be supplied to the system through the supplementary firing by at least 20%.*

***ii. Bottoming Cycle**: Any facility that uses waste industrial heat for power generation by supplementing heat from any fossil fuel."*

6.5. The Petitioner submits that as per the above clause, it can be categorised as a **'Bottoming Cycle'** co-generation power plant, which uses waste industrial heat produced in the furnace for production of sponge iron for power generation, while supplementing heat with coal firing.

Operational performance

7. Production overview

7.1. The Petitioner submits, as already mentioned above, that within its industrial facility, it has a sponge iron plant with an annual production capacity of 90,000 MT, a billet manufacturing plant with an annual capacity of 90,000 MT, and a co-generation plant of 12 MW capacity with 8 MW being generated from waste heat recovered from the sponge plant, and 4 MW from conventional fuel i.e. a mix of coal and dolachar.

7.2. The Petitioner's actual production of Sponge Iron and Billets, and generation of electricity from the co-generation plant, since FY 2007-08 has been given below.

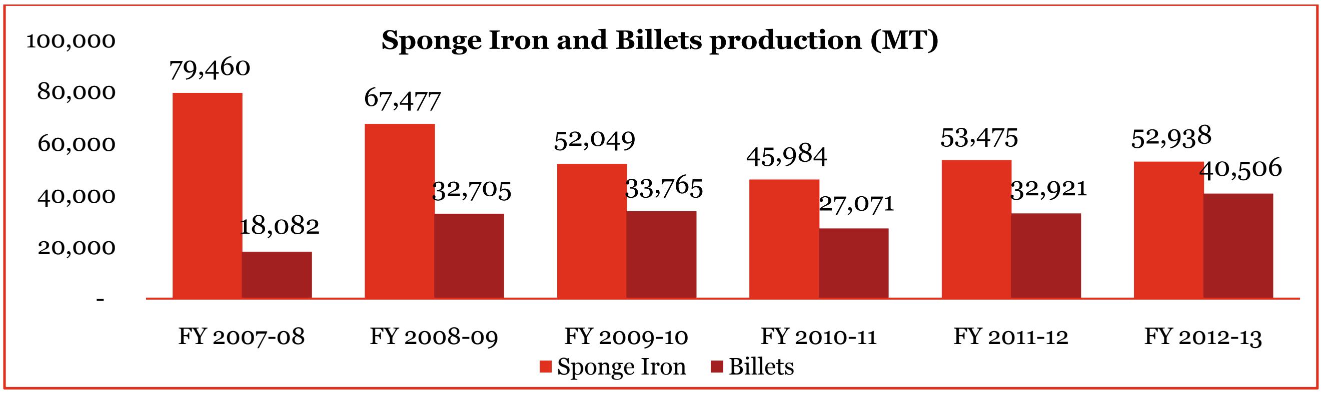


Figure 2: Sponge Iron and Billets actual production

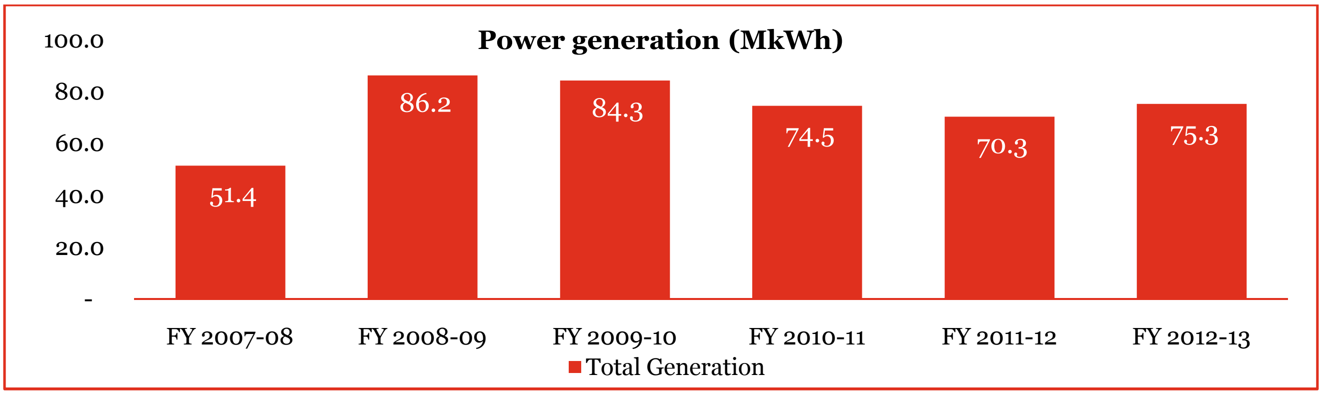


Figure 3: Electricity generation from the co-generation plant

7.3. The Petitioner submits that it can be seen that the total electricity generated from the co-generation plant typically follows the trend of production of sponge iron. The reason behind this is that the WHRB's requirement of input heat for generating steam is completely met by the exhaust gases from the sponge iron plant's kiln, and therefore on sponge iron production. The Petitioner would like to therefore clarify that the WHRB cannot be relied upon solely for producing power and meeting the Petitioner's complete requirement, for which the FBC boiler has also been installed.

7.4. Furthermore, the sponge iron plant generates huge quantities of Dolochar (almost equivalent in quantum to the production of sponge iron) which has considerable residual calorific value. In addition to this, a small proportion of imported coal fines unsuitable for the sponge iron kiln are also used. These coal fines and Dolochar are suitable for being used as fuel for power plant boiler, which is the reason for installing an FBC boiler. However, the Petitioner has since the past two years started using Indian coal post its linkage with Western Coalfields Ltd instead of imported coal fines.

8. Co-generation plant generation and performance

8.1. Specific operating parameters for the power plant for FY 2012-13 have been tabulated below. These values have been taken for the determination of variable costs of generation from the two boilers separately.

Parameter	Units	WHRB	FBC	Turbine
Boiler capacity	kgs/hour	38,000	22,000	-
Maximum power output	kW	8,000	4,000	12,000
Steam Enthalpy	kCal/kg	808.63	808.63	-
Pressure specifications	Ata	65	66	64
Temperature specifications	ºC	485	485	480
Feed water temperature	ºC	126	126	-
Boiler efficiency	%	79.4%	79.4%	-
Steam flow	Tonnes/hour	-	-	49.5

Table 1: Co-generation plant – Technical specifications

8.2. The following table gives the Petitioner's month-wise electricity generation from its CPP since the plant's COD on August 01, 2007. It is reiterated here that the variations in the total generation is actually linked to the production of sponge iron from the Petitioner's plant, which is market driven.

Month	FY 2007-08	FY 2008-09	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13
April	-	8.08	8.59	5.02	7.70	4.54
May	-	8.25	7.53	7.73	3.75	8.14
June	2.42	4.99	6.29	7.11	6.24	7.78
July	2.91	6.00	8.82	7.33	6.85	8.28
August	3.60	7.98	6.84	5.50	3.10	2.71
September	4.39	7.99	5.68	5.00	6.10	5.79
October	5.20	4.69	8.10	7.39	2.65	7.22
November	2.99	7.50	7.80	4.09	6.66	6.18
December	7.78	8.87	4.49	5.83	6.34	6.68
January	8.19	5.32	7.44	7.85	5.46	6.33
February	8.13	7.67	5.23	5.58	7.95	5.33
March	7.70	8.91	7.49	6.12	8.45	6.29
Total	**53.30**	**86.28**	**84.30**	**74.53**	**71.24**	**75.27**

Table 2: Co-generation plant – Total monthly gross electricity generation (MkWh)

8.3. The following two tables show the break-up of gross generation from the two boilers.

Month	FY 2007-08	FY 2008-09	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13
April		5.275	5.081	3.261	4.149	2.39
May		5.338	3.974	4.462	1.647	4.56
June	2.419	2.948	3.306	3.815	2.933	4.54
July	2.908	2.964	5.205	4.00	3.471	4.89
August	3.599	4.981	3.573	2.351	1.501	2.10
September	4.388	5.425	2.541	2.286	3.043	4.39
October	3.678	1.465	4.759	3.937	1.169	3.82
November	1.345	4.661	4.685	2.160	3.062	3.64
December	5.177	6.665	1.552	2.705	3.166	3.49
January	5.485	2.103	4.188	4.316	2.888	3.16
February	5.474	5.209	2.405	2.578	4.468	2.49
March	4.899	5.993	4.412	2.805	4.676	3.23
Total	**39.372**	**53.027**	**45.681**	**38.676**	**36.173**	**42.69**

Table 3: WHRB monthly gross electricity generation (MkWh)

Month	FY 2007-08	FY 2008-09	FY 2009-10	FY 2010-11	FY 2011-12	FY 2012-13
April		2.805	3.508	1.755	3.553	2.15
May		2.922	3.555	3.263	2.104	3.58
June		2.066	2.982	3.294	3.310	3.24
July		3.040	3.616	3.331	3.378	3.39
August		2.996	3.264	3.151	1.595	0.61
September		2.569	3.137	2.709	3.056	1.41
October	1.521	3.221	3.342	3.455	1.485	3.40
November	1.645	2.837	3.117	1.931	3.602	2.55
December	2.602	2.208	2.936	3.121	3.174	3.19
January	2.703	3.214	3.251	3.537	2.567	3.17
February	2.653	2.459	2.827	3.00	3.477	2.84
March	2.799	2.917	3.079	3.311	3.768	3.05
Total	**13.923**	**33.254**	**38.614**	**35.858**	**35.069**	**32.58**

Table 4: FBC monthly gross electricity generation (MkWh)

8.4. The performance of the co-generation power plant w.r.t. gross generation, auxiliary consumption and PLF has been submitted in the table below. The Petitioner submits that the auxiliary consumption for the entire plant has always remained within the range of 10 to 13%. The actual observed plant load factor (PLF) of the plant however varies over the years, which is evident by observing the difference in the PLF of the WHRB and the FBC boiler separately. WHRB's low PLF is attributable to low amounts of input heat from the sponge iron plant.

Year	Gross Generation (MkWh)	Auxiliary consumption (MkWh)	Auxiliary consumption (%)	Net Generation (MkWh)	PLF – Entire Plant (%)	PLF – WHRB (%)	PLF – FBC Boiler (%)
FY 2007-08	51.38	5.21	10.1%	46.18	48.7%		
FY 2008-09	86.25	8.73	10.1%	77.52	82.0%		
FY 2009-10	84.27	10.64	12.6%	73.64	80.2%		
FY 2010-11	74.55	10.00	13.4%	64.54	70.9%		
FY 2011-12	70.27	9.32	13.3%	60.95	66.7%		
FY 2012-13	75.27	10.00	13.3%	65.27	71.6%	60.9%	93.0%

Table 5: Operational parameters for the power plant

8.5. The Petitioner would also like to humbly submit that since entering into the PPA with the Government of Goa dt. August 24, 2007 (now under the purview of the Goa Electricity Department), the Petitioner has on an average supplied 27.6 % of its annual net generated power to GED. The entire quantum of electricity has been sold at a per unit rate of Rs 2.40/kWh.

Year	Gross Generation (MkWh)	Furnace consumption (MkWh)	DRI consumption (MkWh)	Auxiliary consumption (MkWh)	Export to GED (MkWh)	Export (%) of gross generation
FY 2007-08	51.38	24.08	7.11	5.21	14.57	**28.4%**
FY 2008-09	86.25	44.44	8.35	8.73	24.44	**28.3%**
FY 2009-10	84.27	45.45	7.10	10.64	21.60	**25.6%**
FY 2010-11	74.55	36.69	6.49	10.00	23.19	**31.1%**
FY 2011-12	70.27	45.66	7.67	9.32	13.14	**18.7%**
FY 2012-13	75.27	51.07	7.20	10.00	10.11	**13.4%**

Table 6: Generation, captive consumption and sale of power to GED*

**Note: The difference between gross generation and the consumption/sale of power is being fulfilled by drawing GED's power from the grid through the Petitioner's connection of 4.5 MW connected load. The above table also does not include losses due to transmission of power.*

8.6. The Petitioner submits that although at the time the power purchase agreement was signed keeping in view that a minimum surplus of 1 MW or 8.76 MU of electricity would be available for for sale to GED annually, the above table clearly shows that the minimum power supplied to GED has been much higher. Given the comparatively higher costs of generation viz the agreed power purchase price, this agreement has turned financially unviable for the Petitioner. The cost of generation indicating the same has been determined in the following section.

Determination of tariff

9. Approach to tariff determination

9.1. The Petitioner submits that as per the general approach for determining generation tariffs, the total cost of generation has been segregated into two parts, a fixed cost and a variable cost. The approach to determining both these cost components for the entire 12 MW plant have been submitted below. For the purpose of tariff determination, the costs for the period of the PPA with the GED i.e. 15 years starting from FY 2007-08 and upto FY 2021-22, have been worked out. The Petitioner submits that the levellised tariff for the fixed and variable costs using the cost plus methodology, however, has been determined for the period from FY 2013-14 onwards only.

10. Determination of fixed costs

10.1. Based on the methodology adopted by the Commission for determination of tariff in case of other generating power plants under its jurisdiction, the Petitioner has adopted a cost plus approach towards determination of tariff for the co-generation power plant.

10.2. In absence of separate tariff regulations/terms and conditions for determination of tariff for the electricity generated from co-generation power projects in the state, the Petitioner has referred to the CERC Renewable Energy Tariff Regulations, 2009 and the normative parameters and methodology considered for determination of fixed cost have been adopted as per the said regulations. Accordingly, a levellised tariff for fixed cost has been worked out using the cost plus methodology. Wherever, no normative value is available for the parameters in the CERC Tariff Regulations, 2009, the Petitioner has relied upon the actual cost incurred/ normative value of the parameters as given in the JERC Tariff Regulations, 2009.

10.3. Capital Cost

10.4. The CERC Renewable Energy Tariff Regulations, 2009 and JERC Tariff Regulations, 2009 do not specify any norms for capital cost of a waste heat base co-generation power plant. In absence of any norms, the actual capital cost of the power plant has been used for calculation of fixed cost. The capital cost for the co-generation based power plant has been separated from the capital cost of the main plant of GSPL for the purpose of calculation of fixed cost. The total cost of the plant as on date of commercial operation of the plant was Rs 5,185.89 lakhs. The break-up of the original fixed cost of assets is given in the table below:

Sr. No.	Particulars	Gross Block
1)	Land & Site Development	127.84
2)	Building	1,043.55
3)	Plant & Machinery	3,902.26
4)	Pipe Line Fitting	35.42
5)	Office Equipment	0.12
6)	Electric Installation	68.06
7)	Furniture& Fixture	1.17
8)	Laboratory Equipment	0.10
9)	Computer	1.34
10)	Communication Equipment	6.03
	Grand Total	**5,185.89**

Table 7: Capital cost of power plant as on COD (Rs lakhs)

10.5. The auditor's certificate, certifying the capital cost of the power plant is attached in Appendix G. - In the subsequent years, the Petitioner has incurred additional capital expenditure of Rs 433 lakhs upto 31 March 2013. However, the Petitioner has not included the same for the purpose of calculation of fixed cost.

10.6. *Financing of capital cost*

10.6.1. As per Clause 13 of the CERC Renewable Energy Tariff Regulations, 2009, in case of project specific tariff, the proportion of debt in a project shall be capped at 70%. The relevant clause of the said regulations in quoted below:

"13. Debt Equity Ratio

(2) For Project specific tariff, the following provisions shall apply:-

If the equity actually deployed is more than 30% of the capital cost, equity in excess of 30% shall be treated as normative loan.

Provided that where equity actually deployed is less than 30% of the capital cost, the actual equity shall be considered for determination of tariff"

10.6.2. The Petitioner financed the capital expenditure for the project through a combination of debt and equity. The Petitioner availed loans of Rs 3,404.72 lakhs (i.e. 66% of the capital cost) from commercial banks for financing of the project. The remaining capital cost was financed through equity funding.

10.6.3. However, in line with the provisions of the CERC Renewable Energy Tariff Regulations, 2009, the Petitioner has considered a debt equity ratio of 70:30 for the purpose of calculation of tariff for the co-generation power plant. The amount of debt and equity considered for the purpose of calculation of tariff is given in the table below:

Particulars	Value
Original fixed cost of assets	5,185.89
Debt @ 70%	3,630.12
Equity @ 30%	1,555.77

Table 8: Amount of debt and equity (Rs lakhs)

10.7. *Interest on loan*

10.7.1. As per the CERC Renewable Energy Tariff Regulations, 2009 the interest on loan shall be calculated on a normative basis as prescribed in Clause 14 of the said regulations.

"14. Loan and Finance Charges

(1) Loan Tenure. For the purpose of determination of tariff, loan tenure of

10 years shall be considered.

(2) Interest Rate

(a) The loans arrived at in the manner indicated above shall be considered as gross normative loan for calculation for interest on loan. The normative loan outstanding as on April 1st of every year shall be worked out by deducting the cumulative repayment up to March 31st of previous year from the gross normative loan.

(b) For the purpose of computation of tariff, the normative interest rate shall be considered as average long term prime lending rate (LTPLR) of State Bank of India (SBI) prevalent during the previous year plus 150 basis points.

(c) Notwithstanding any moratorium period availed by the generating company, the repayment of loan shall be considered from the first year of commercial operation of the project and shall be equal to the annual depreciation allowed."

10.7.2. The Petitioner has calculated the loan amount for each year in accordance with the methodology prescribed by CERC. The repayment of loan has been considered equal to the depreciation during the year and is it is considered that the loan shall be repaid within the 10 years of commercial operation of the project i.e. FY 2016-17. The rate of interest on loan has been considered equal to the actual average SBI LTPLR during the previous year plus 150 basis points upto FY 2013-14. The average SBI LTPLR for FY 2012-13 has been used for projection of interest expenses in the future years. The table below contains the calculation of interest on debt for each year.

		1	2	3	4	5	6	7	8	9	10
		FY08	FY09	FY10	FY11	FY12	FY13	FY14	FY15	FY16	FY17
A	Year beginning loan	3,630.12	3,267.11	2,904.10	2,541.08	2,178.07	1,815.06	1,452.05	1,089.04	726.02	363.01
B	Year end loan	3,267.11	2,904.10	2,541.08	2,178.07	1,815.06	1,452.05	1,089.04	726.02	363.01	0.00
C	Repayment of loan	363.01	363.01	363.01	363.01	363.01	363.01	363.01	363.01	363.01	363.01
D	Average SBI PLR during previuous year (%)	12.25	12.69	12.67	11.87	12.16	14.40	14.62	14.62	14.62	14.62
E	Normative Rate of interest (SBI PLR+150bps) (%)	13.75	14.19	14.17	13.37	13.66	15.90	16.12	16.12	16.12	16.12
F	**Interest on Loan Capital**	**474.18**	**437.85**	**385.79**	**315.48**	**272.73**	**259.74**	**204.81**	**146.29**	**87.78**	**29.26**

Table 9: Interest on loan (Rs lakhs)

10.8. *Return on equity*

10.8.1. The CERC Renewable Energy Tariff Regulations, 2009 have prescribed that the return on equity shall be allowed on the approved equity base on a normative basis. The relevant clause of the said regulations is quoted below.

"16. Return on Equity

(1) The value base for the equity shall be 30% of the capital cost or actual equity (in case of project specific tariff determination) as determined under Regulation 13.

(2) The normative Return on Equity shall be:

a) Pre-tax 19% per annum for the first 10 years.

b) Pre-tax 24% per annum 11th years onwards."

10.8.2. The Petitioner has calculated the return on equity as per the norms prescribed by CERC as noted above.

10.9. Depreciation

10.9.1. The Petitioner has calculated the depreciation expenses for each year on a normative basis as prescribed in Clause 15 of the CERC Renewable Energy Tariff Regulations, 2009. Depreciation has been calculated on capital cost of the power plant using Straight Line Method. The salvage value of the asset has been considered as 10% and depreciation shall be allowed up to maximum of 90% of the Capital Cost of the asset.

10.9.2. The depreciation rate for the first 10 years of the Tariff Period (FY 2007-08 to FY 2016-17) has been taken as 7% per annum and the remaining depreciation has been spread over the remaining useful life of the project from 11th year onwards. The useful life of the project has been taken as 20 years.

10.10. Operation and maintenance expenses

10.10.1. Clause 18 of the CERC Renewable Energy Tariff Regulations, 2009 specifies that the Operation and Maintenance or O&M expenses shall comprise (1) repair and maintenance (R&M), (2) establishment including employee expenses, and (3) administrative and general expenses. However, no norms have been specified by the Commission for O&M expenses for waste heat based co-generation power plant. In absence of any norms the Petitioner has relied upon the actual O&M expenses of the power plant for arriving at the O&M expenses for the power plant.

10.10.2. Further, as per the CERC Renewable Energy Tariff Regulations, 2009, operation and maintenance expenses are determined for the Tariff Period based on normative O&M expenses specified by the Commission for the first Year of Control Period. The allowed expenses for the first year are then escalated at a specified escalation rate. The Petitioner has calculated the O&M expenses using a similar methodology. The O&M expenses for FY 2007-08 and FY 2008-09 have been taken equal to the actual expenses during the year. The O&M expenses for the first year complete year of operation i.e. FY 2008-09 have been taken as the base expenses for projection of O&M expenses for the remaining part of the tariff period.

10.10.3. It may be noted that the Petitioner operates the co-generation power plant, the steel induction furnace and the blast furnace for production of sponge iron as an integrated unit at its facility in Goa. Therefore, many of the services of the employees, offices etc are shared between the three operations. As such it is not feasible to identify separately the employee and administrative expenses of the power plant. The Petitioner has, therefore, allocated the total employee and administrative expenses of the GSPL (as per the audited accounts) between the co-generation power plant and the steel plant of the GSPL on generally accepted norms and principles. The Petitioner has allocated the total employee and administrative expenses of the GSPL to the power plant based on the ratio of the gross fixed assets of the power plant to the gross fixed assets of total GSPL plant.

10.10.4. The same basis of allocation cannot be used for allocation of repair and maintenance expenses of the plant as the sponge iron plant and the induction furnace are of a higher vintage and demand greater repair and maintenance. Thus using the ratio of gross fixed assets of the power plant to the gross fixed assets of total GSPL plant for segregation of costs would lead to excessive cost being passed on to the consumers. The Petitioner has however identified the actual repair and maintenance expenses incurred on the power plant based on the materials, works and service contracts have been identified separately. The auditor's certificate certifying the R&M expenses for the power plant are given in Appendix H. -.

10.10.5. The O&M expenses of the power plant for FY 2007-08 and FY 2008-09 estimated using the above methodology are shown in the table below.

Particulars	FY 2007-08	FY 2008-09
R&M expenses	221	297
Administrative expenses	165	187
Employee expenses	74	100
O&M expenses for the power plant	**459**	**584**
Original fixed cost of assets	5,185.89	
% O&M expenses for the power plant to GFA	8.85%	11.27%

Table 10: Operation and maintenance expenses (Rs lakhs)

10.10.6. The O&M expenses for FY 2007-08 and FY 2008-09 have been taken equal to the actual expenses during the year. The O&M expenses for the first year complete year of operation i.e. FY 2008-09 have been taken as the base expenses for projection of O&M expenses for the remaining part of the tariff period. For projecting the O&M expenses for future years an escalation rate of 8.06% (equal to the average increase in CPI and WPI during FY 2008-09 to FY 2012-13) has been considered. The calculation of the escalation rate is given in Appendix I. -

10.11. *Interest on working capital*

10.11.1. It is submitted that CERC Tariff Regulations, 2009, and JERC Tariff Regulations, 2009 do not specify any normative formula for calculation of working capital requirement of a fossil fuel based co-generation power plant. In absence of any such norms, the Petitioner has relied upon formula prescribed by CERC for Co-generation power plants based on other technologies for calculation of working capital.

10.11.2. The formula for working capital has been given by the Petitioner in Regulation 17 (2) of CERC Tariff Regulations, 2009 as given below.

a) Fuel costs for four months equivalent to normative PLF;
b) Operation & Maintenance expense for one month;
c) Receivables equivalent to 2 (Two) months of fixed and variable charges for sale of electricity calculated on the target PLF;
d) Maintenance spare @ 15% of operation and maintenance expenses

10.11.3. The interest on working capital has been calculated at interest rate equivalent to average State Bank of India short term PLR during the previous year plus 100 basis points.

10.11.4. The table on the following page contains the calculation of fixed cost for the fifteen year period from FY 2007-08 to FY 2021-22. The levellised fixed cost for FY 2013-14 to FY 2021-22 for the plant is equal to Rs 2.60/kWh.

		1 FY08	2 FY09	3 FY10	4 FY11	5 FY12	6 FY13	7 FY14	8 FY15	9 FY16	10 FY17	11 FY18	12 FY19	13 FY20	14 FY 21	15 FY 22
A	Interest on Loan Capital	474.18	437.85	385.79	315.48	272.73	259.74	204.81	146.29	87.78	29.26	0	0	0	0	0
B	Depreciation (assuming useful life of 20 yrs)	363.01	363.01	363.01	363.01	363.01	363.01	363.01	363.01	363.01	363.01	103.72	103.72	103.72	103.72	103.72
C	Return on Equity	295.60	295.60	295.60	295.60	295.60	295.60	295.60	295.60	295.60	295.60	373.38	373.38	373.38	373.38	373.38
D	Operation & Maintenance Expenses	459.19	565.09	610.66	659.91	713.13	770.64	832.79	899.95	972.53	1,050.96	1,135.71	1,227.30	1,326.28	1,433.24	1,548.82
E	Interest on Allowed Working Capital	145.07	157.91	161.84	159.93	160.48	185.75	196.72	205.47	214.88	224.97	231.73	244.92	258.94	273.85	289.73
F	**Total**	**1737.04**	**1819.46**	**1816.9**	**1793.92**	**1804.95**	**1874.73**	**1892.93**	**1910.33**	**1933.79**	**1963.8**	**1844.55**	**1949.32**	**2062.32**	**2184.19**	**2315.65**
	Net Generation	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69
	Fixed Cost (/kWh)	**2.30**	**2.40**	**2.40**	**2.37**	**2.38**	**2.48**	**2.50**	**2.52**	**2.56**	**2.59**	**2.44**	**2.58**	**2.72**	**2.89**	**3.06**
	WACC (ROE*30%+RoI* 70%)	15.33%														
	Discount factor							1.00	0.87	0.75	0.65	0.57	0.49	0.43	0.37	0.32
	PV of fixed cost	-	-	-	-	-	-	2.50	2.19	1.92	1.69	1.38	1.26	1.16	1.06	0.98
	Levelised fixed cost	**2.60**														

Table 11: Calculation of fixed cost (Rs lakhs)

11. Determination of variable costs

11.1. Based on the methodology adopted by the Commission for determination of tariff in case of other generating power plants under its jurisdiction, the Petitioner has adopted a cost plus approach towards determination of tariff for the co-generation power plant. The Petitioner has estimated separately the variable costs of generation from the FBC boiler and the WHRB.

11.2. For firing the FBC boiler, primarily a mix of dolachar (by-product from sponge iron production) and Indian coal is used. Coal fines were also being used as a supplementary fuel prior to 2011 (when the coal linkage was obtained). The cost of FBC can therefore be directly attributed to the costs of dolachar, Indian coal and coal fines (if used).

11.3. At present, the FBC boiler is fired through a mix of dolachar and coal. The Petitioner obtained its coal linkage for Indian coal from Western Coalfields Ltd., through a 'Coal Supply Agreement' (attached in Appendix M. -), for a contracted quantity of 20,000 tonnes per annum (TPA) on July 21, 2011, valid for a period of five years. Grade of the coal supplied by WCL is 'E' grade, which is generally used in power plants.

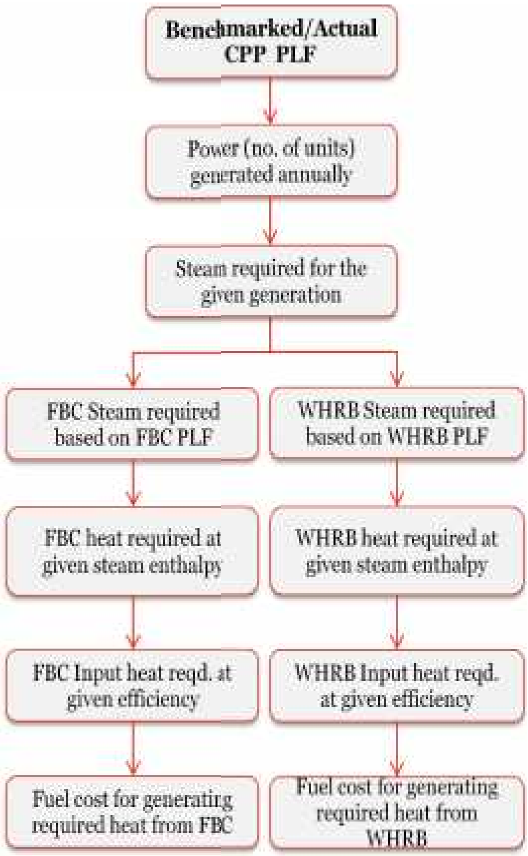


Figure 4: Approach for determining overall variable cost

11.4. The WHRB on the other hand uses exhaust flue gases generated from the sponge iron production process. It is however imperative to determine the indirect variable costs associated with firing the WHRB as the power generated with the steam produced in the WHRB substitutes power procured from other sources, and therefore has an opportunity cost associated to it. Further, the heat content of the flue gases may be priced in terms of the cost of the input coal that is used for production of these hot gases in the sponge iron production process. Infact, in several developed countries the heat from flue gases of such high temparatures, due to the associated high heat properties, has a well developed market wherein the heat from such gases/ steam produced therein is sold for use in other industries.

11.5. The overall approach for determining the variable cost has also been captured in Figure 4. The Petitioner has taken the standard approach to arrive at variable cost wherein it has, as a first step, calculated the steam needed from each of the two boilers for the requisite quantum of generation. The amount of steam needed for producing the required amount of generation for the entire power plant (Actual PLF – 71.6% and Design PLF – 80%, refer Table 12) has been estimated by multiplying the steam requirement (49.5 tonnes per hour) for running the plant at full capacity (60,000 tonnes/hour of boiler capacity) multiplied by the required PLF. Additional steam requirements for running the auxiliary processes (maintaining feed water temperature etc) have been taken at 4.5 tonner/hour (Refer Table 12 below). Next, the heat output of the two boilers has been derived by multiplying the respective enthalpy difference (683 kcal/kg for both boilers) in the oputput steam and the input feed water of each boiler separately. The quantum of input heat into each of the two bolilers has then been arrived at separately by using the efficiencies of each of the boiler respectively. Finally, the quantum and cost for supplying this input heat to each of the two boilers has been calcualted using the weighted average GCV and cost of the fuel used respectively. Detailed derivations of the fuel costs for each bolier are given in the following section.

Parameter		Units	Design	Actual (FY 2012-13)
Turbine specifications				
Turbine output		kW	12,000	12,000
Steam flow required		Tonnes/hour	49.5	49.5
Power plant				
Total installed capacity of the co-gen plant		kW	12,000	12,000
Plant Load Factor (PLF)		%	80.0%	71.6%
Power output of the plant		kW	9,600	8,592
Gross Generation		MU	84.10	75.27
Auxiliary consumption		%	10.0%	13.3%
Net generation		MU	75.69	65.27
Steam specifications				
Pressure specifications of steam required		Ata	66	62
Temperature specifications of steam required		ºC	485	485
Desired Steam Enthalpy		kCal/kg	809	809
Feed water temperature		ºC	126	126
Feed water Enthalpy		kCal/kg	126	126
Boiler specifications				
FBC: Boiler Capacity		kg/hour	22,000	22,000
WHRB: Boiler Capacity		kg/hour	38,000	38,000
Total capacity of the boilers		kg/hour	60,000	60,000
Boiler efficiency of FBC @ 100% imported coal		%	79.4% +/-1%	-
Boiler efficiency of FBC @ 100% dolachar		%	77.0% +/- 2%	-
Boiler efficiency of FBC, actual @ 15% Indian coal & 85% dolachar		%	-	78.0%
Boiler efficiency of WHRB		%	79.4%	78.0%
Heat output				
Boiler capacity	A	kg/hour	60,000	60,000
Plant Load Factor (PLF)	B	%	80.0%	71.6%
Steam flow requirement at full capacity utilisation per hour	C	Tonnes/hour	49.5	49.5
Total annual steam requirement	D=(A*B*24*C+4.5#)*365	Tonnes	348,539	312,119

Table 12: Design and actual parameters of the co-generation plant

#Additional steam requirements for running the auxiliary processes (maintaining feed water temperature etc) have been taken at 4.5 tonner/hour.

11.6. It may be noted that the JERC Tariff Regulations, 2009 and the CERC Renewable Energy Tariff Regulations, 2009 do not specify any norms for technical parameters of the boiler, turbine etc. for a waste heat recovery based co-generation power plant. In absence of any prescribed norms, the Petitioner has calculated the variable cost of generation based on both the design technical specifications of the plant (which signifies the highest level of efficiency that can be achieved by the plant) as well as the actual values of these operational parameters. The above table shows the various parameters, both design and actual, used for carrying out the calculations for the CPP.

11.7. *Determination of variable costs for FBC*

11.7.1. The fuel cost incurred for generating power through the steam produced by the FBC boiler, has been calculated by estimating the cost of fuel incurred for producing the requisite input heat to generate the given quantity of steam. The exercise has been carried out at both the design specifications and at the actual operational parameters in the following manner:

a) The plant's total steam requirement, at the respective PLF's, has been distributed between the requirement from the FBC boiler and the WHRB. For the design scenario, the segregation has been done by considering that the FBC boiler is run at 100% its capacity and the residual steam (and therefore generation) is obtained from the WHRB. In the actual scenario, the segregation has been done based on the actual amount of steam produced from the two boilers during FY 2012-13. From this step, we get the quantum of steam produced annually from the FBC boiler.

b) Next, the quantum of steam produced from the boiler is multiplied with the enthalpy difference of the steam produced and the feed water. This gives the heat output required for the FBC boiler to produce the requisite steam amount.

c) Using this heat output of the FBC boiler and the boiler's efficiency, (Actual – 78.0%, Design – 79.4%) the total heat input into the boiler has then been calculated. This has been done in order to estimate the cost of fuel required for generating this heat.

d) Next, the input heat when divided by the weighted average Gross Calorific Value (GCV) of the fuel used, gives the annual weighted average quantum of fuel required. For calculating the weighted average GCV, a proportion of coal (15%) and dolachar (85%) has been taken, which is in accordance with the actual ratio of the two fuels used in FY 2012-13[1]. (The details of the quantum of dolachar and coal used in FY 2012-13 are given in Appendix J. -)

e) This weighted average quantum of fuel as derived above is multiplied with the weighted average cost of the fuels to arrive at the total variable cost of generation from the FBC boiler.

Parameters for FBC	Units	Calculation	Design	Actual
Boiler capacity	Kgs	A	22,000	22,000
Steam required annually	Tonnes	B	145,224	135,106
Gross generation attributable	MkWh	C	35.04	32.58
Difference of enthalpy of steam and feed water	kCal/kg	D	683	683
Heat Output	MkCal	E=C*D	99,135	92,227
Boiler Efficiency	%	F	79.4%	78.0%
Heat Input	MkCal	G=E/F	124,814	118,240
Fuel mix: Indian coal	%	H	15.0%	15.0%
Indian coal GCV	kCal/kg	I	4,638	4,638
Indian coal rate	Rs/Tonne	J	3,348	3,348
Fuel mix: Dolachar	%	K	85.0%	85.0%
Dolachar GCV	kCal/kg	L	3,085	3,085
Dolachar coal rate	Rs/Tonne	M	2,200	2,200
Wt. Average GCV	kCal/kg	N=H*I+K*L	3,318	3,318
Wt. Avg. fuel cost	Rs/Tonne	O=H*J+K*M	2,372	2,372
Fuel required annually	Tonnes	P=G/N	37,618	35,637
Fuel cost annual	Rs lakhs	Q=O*P	892.4	845.3
Per unit cost of generation	Rs/kWh	R=Q/C	**2.55**	**2.59**

Table 13: FBC – Calculations for estimating per unit fuel cost

11.7.2. The above table shows per unit cost of gross generation. The per unit fuel cost, ex-bus, for the entire 12 MW plant has been determined later by reducing the auxiliary generation of the entire plant from the sum of gross generation attributable to both boilers.

11.8. *Determination of variable costs for WHRB*

11.8.1. The fuel cost incurred for generating power through steam produced from the WHRB boiler has similarly been calculated by estimating the cost of input heat which is required to generate the requisite steam.

[1] The amount of dolachar consumed in FY 2012-13 was 85% of the total fuel used. The GCV's of the two fuels used for firing the FBC boiler are 4,638 and 3,085 kCal/kg for Indian coal and dolachar respectively. The GCV, rate/tonne of coal and dolachar as well as the weighted average GCV and cost of fuels is shown in Figure 5.

a) As mentioned above, the steam requirement attributable to the WHRB, in the design scenario, has been taken as the steam required for meeting the difference between the steam generated by the power plant and that generated by the FBC boiler. In the actual scenario, the WHRB steam generation has been taken as per the actual values for FY 2012-13.

b) Next, the heat output of the WHRB boiler has been estimated by multiplying the quantum of steam produced in the boiler with the enthalpy difference of the steam produced and the feed water.

c) Using this heat output of the WHRB boiler and the boiler's efficiency (Actual – 78.0%, Design – 79.4%), the total heat input into the boiler has been calculated.

d) Since no benchmark and precedence is available for estimating the variable/fuel cost for generation through a heat recovery process in India, the Petitioner has followed two approaches to determine the same. These two approaches are as follows:

i. ***Approach I – Determination of WHRB's variable cost through a 'Shadow Pricing' mechanism:*** The per unit cost of producing steam through the WHRB has been considered to be equal to that of the FBC boiler. Thus the cost attributable to WHRB per unit essentially reflects the avoided cost of generation through the FBC. This method of determining cost in economic theory is called 'Shadow Pricing'. After determining the input heat required for the WHRB, the equivalent amount of fuel required to generate this amount of heat had the FBC been fired, has been calculated (at the same weighted average GCV of the fuel used for the FBC). All parameters for both the design and the actual scenarios have been taken for the WHRB, and only the GCV of the fuel used and the unit cost of fuel has been taken as taken for the FBC boiler. The Petitioner submits that in this approach, the respective design and actual per unit cost of firing the boilers are determined to be equal for the FBC boiler and the WHRB as the respective parameters in both scenarios are the same for both the boilers.

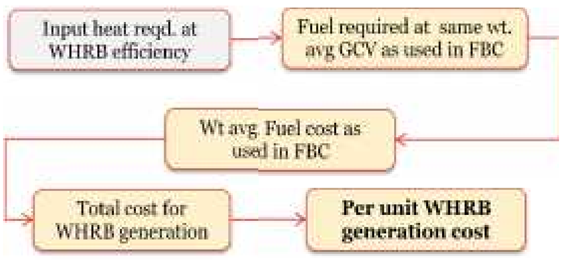


Figure 5: Approach I for determining WHRB's variable cost: Shadow Pricing

ii. ***Approach II – Determination of WHRB's variable cost through the 'Derived Cost' approach:*** In this approach, the cost attributable to source and feed the fuel to the WHRB has been considered. Exhaust heat, required to fire the WHRB, is generated during the production of sponge iron. The input heat to the WHRB is given out by the flue gases recovered from the DRI kiln of the sponge plant. Further, the DRI kiln is fired through a mix of imported and Indian coal. The total cost of firing the DRI kiln (which generates the flue gases fed as input to the WHRB) of the sponge plant, i.e. the total cost of input coal, has been calculated as per actual values for FY 2012-13. Next, the total heat input to the DRI kiln has been calculated based on the weighted average quantum and GCV of the coals used. This total fuel cost is divided by the total input heat to the sponge plant to determine the per unit input heat cost. Finally, the cost per unit of input heat is multiplied with the total heat input required for the WHRB to arrive at the total cost of

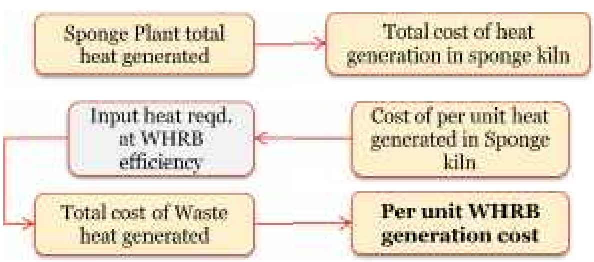


Figure 6: Approach II for determining WHRB's variable cost: Derived Cost

firing the WHRB. Finally, spreading this total input heat cost over the gross generation attributable to the WHRB, gives the per unit variable cost of generation from the WHRB.

e) The following table captures the calculations for the determination of variable cost of generation through the WHRB considering both the approaches.

Parameters for WHRB	Units	Calculation	Design	Actual
Boiler capacity	Kgs	A	38,000	38,000
Steam required annually	Tonnes	B	203,314	177,013
Gross generation attributable	MkWh	C	49.06	42.69
Difference of enthalpy of steam and feed water	kCal/kg	D	683	683
Heat Output	MkCal	E=C*D	138,789	120,835
Boiler Efficiency	%	F	79.4%	78.0%
Heat Input	MkCal	G=E/F	174,739	154,916
Approach I: Shadow Pricing				
Wt. Average GCV of fuel used in FBC	kCal/kg	H (derived as N in Table 13)	3,318	3,318
Wt. Avg. cost of fuel used in FBC	Rs/Tonne	I (derived as O in Table 13)	2,372	2,372
Fuel required annually	Tonnes	J=G/H	52,665	46,690
Fuel cost incurred annually	Rs lakhs	K=I*J	1,249.3	1,107.6
Per unit cost of generation	Rs/kWh	L=K/C	**2.55**	**2.59**
Approach II: Derived Cost				
Sponge Plant coal input	Tonnes	M	75,549	75,549
Wt. Avg. per unit coal cost	Rs/tonne	N	5,022	5,022
Sponge Plant total coal cost	Rs lakhs	O=M*N	3,794	3,794
Avg. GCV of coal used in Sponge Plant	kCal/kg	P	5,641	5,641
Sponge Plant heat input from coal	Mkcal	Q=M*P	426,174	426,174
Per unit cost of input heat	Rs/MkCal	R=O/Q	890.22	890.22
Total annual cost of WHRB input heat	Rs lakhs	S=G*R	1,555.6	1,379.1
Per unit cost of generation	Rs/kWh	T=S/C	**3.17**	**3.23**

Table 14: WHRB – Calculations for estimating per unit fuel cost

11.9. The Petitioner submits that as per the above discussed methodology, the average variable per unit cost for the entire plant, determined through the four routes are as below.

Parameters for the plant	Units	Shadow Pricing approach for WHRB		Derived Cost approach for WHRB	
		Design	*Actual*	*Design*	*Actual*
FBC (4 MW)					
Attributable gross annual generation	MkWh	35.04	32.58	35.04	32.58
Total variable cost	Rs lakhs	892.4	845.3	892.4	845.3
Per unit cost of generation	Rs/kWh	2.55	2.59	2.55	2.59
WHRB (8 MW)					
Attributable gross annual generation	MkWh	49.06	42.69	49.06	42.69
Total variable cost	Rs lakhs	1,249.3	1,107.6	1,555.6	1,379.1
Per unit cost of generation	Rs/kWh	2.55	2.59	3.17	3.23
Entire Co-Generation Plant (12 MW)					
Gross annual generation	MkWh	84.10	75.27	84.10	75.27
Auxiliary consumption	MkWh	8.41	10.00	8.41	10.00
Net annual generation	MkWh	75.69	65.27	75.69	65.27
Total variable cost	Rs lakhs	2,141,7	1,953.0	2,447.9	2,224.5
Per unit variable cost	Rs/kWh	**2.55**	**2.59**	**2.91**	**2.96**

Parameters for the plant	Units	Shadow Pricing approach for WHRB		Derived Cost approach for WHRB	
		Design	*Actual*	*Design*	*Actual*
Net per unit variable cost	Rs/kWh	**2.83**	**2.99**	**3.23**	**3.41**

Table 15: Summary of co-generation plant variable cost of generation

11.10. The Petitioner submits that although values determined for the actual scenario for the co-generation plant are higher, for the purpose of this tariff petition and considering the highest possible levels of operational efficiency, the per unit variable costs as per the design operational parameters are being considered. Further, for estimating the variable cost of generation through the WHRB, the shadow pricing approach has been taken. Therefore, the overall per unit variable/fuel cost for the co-generation plant is calculated to be Rs 2.83/kWh for FY 2012-13.

11.11. In order to arrive at a levelised per unit total cost of generation for the period from FY 2013-14 to FY 2021-22, an annual escalation rate of 5% has been taken, the base year value being for FY 2012-13 i.e. Rs 2.83/kWh. The projections have been given in the following table.

Parameter	Units	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY 21	FY 22
Gross Generation	MkWh	84.10	84.10	84.10	84.10	84.10	84.10	84.10	84.10	84.10
Net Generation	MkWh	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69
Per unit variable cost	Rs/kWh	2.67	2.81	2.95	3.10	3.25	3.41	3.58	3.76	3.95
Net per unit variable cost	Rs/kWh	2.97	3.12	3.28	3.44	3.61	3.79	3.98	4.18	4.39

Table 16: FY 2013-14 to FY 2021-22, variable cost of generation projections

12. Determination of total costs

12.1. The total cost of generation for the Petitioner's 12 MW plant, for the period of the Petitioner's PPA with the GED from FY 2007-08 to FY 2021-22, have been given in Table 17. The Petitioner submits that the variable cost of generation for all years have been calculated on the basis of design parameters, taking the shadow pricing approach for pricing WHRB's variable generation cost. The generation for FY 2007-08 is lower due to the lower PLF of the plant on account of its number of operation days. Considering the above methodology and factors, and considering a discounting rate equivalent to the WACC of 15.33%, the levelised tariff determined for the period from FY 2013-14 to FY 2021-22, is Rs 6.08 per kWh.

Parameter	Units	FY14	FY15	FY16	FY17	FY18	FY19	FY20	FY 21	FY 22
Gross Generation	MkWh	84.10	84.10	84.10	84.10	84.10	84.10	84.10	84.10	84.10
Net Generation	MkWh	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69	75.69
Per unit fixed cost	Rs/kWh	2.50	2.52	2.56	2.59	2.44	2.58	2.72	2.89	3.06
Per unit variable cost (ex-bus)	Rs/kWh	2.97	3.12	3.28	3.44	3.61	3.79	3.98	4.18	4.39
Total per unit cost	Rs/kWh	**5.47**	**5.64**	**5.83**	**6.03**	**6.05**	**6.37**	**6.71**	**7.07**	**7.45**
Discount factor		1.00	0.87	0.75	0.65	0.57	0.49	0.43	0.37	0.32
Levelised variable tariff	Rs/kWh	**3.48**								
Levelised fixed tariff	Rs/kWh	**2.60**								
Levelised total tariff	Rs/kWh	**6.08**								

Table 17: Levelised tariff for the Petitioner's CPP

12.2. The Petitioner humbly submits that as per a recent order issued by the Appropriate Commission, JERC, dt. October 25, 2013 (against petition no. 61/2012), the Goa Electricity Department (GED) can now after submitting a certificate from GEDA about suitability, use the power procured from co-ogeneration plants towards meeting its non-solar RPO. Since the Petitioner is a supplier of co-generation power to the GED, GED can use this power (which is a mix of power generated from WHRB and FBC) to fulfil it non-solar targets, thereby making the Petitoner eligible for a preferential tariff. In such an event, the true cost of per unit generation must be estimated. Furthermore, although there is no direct variable cost associated with the waste heat recovered from the production of sponge iron, indirect costs are present.The Petitioner therefore prays to the Commission to approve a revised tariff for supply of surplus power from co-generation power plant of Goa Sponge and Power Limited to Goa Electricity Department under clause (a) of sub-section (1) of Section 62 of The Electricity Act, 2003.

Appendix A. - Data formats (JERC formats)

Appendix B. - FBC specifications

Appendix C. - WHRB specifications

Appendix D. - Turbine specifications

Appendix E. - Power purchase agreement

Appendix F. - COD certificate

Appendix G. - Auditor's certificate for capital costs

Appendix H. - Auditor's certificate for R&M expenditure

Appendix I. - Escalation rates for O&M costs

Year	Avg. WPI	% Inc	Avg. CPI	% Inc
FY 2007-08	117		133	
FY 2008-09	126	8.05%	145	9.10%
FY 2009-10	131	3.81%	163	12.37%
FY 2010-11	143	9.56%	180	10.45%
FY 2011-12	156	8.94%	195	8.39%
FY 2012-13	168	7.36%	215	10.44%
Avg. Increase	0.80	**7.54%**	0.20	10.15%
Weighted Avg. inflation FY09-FY13				**8.06%**

Appendix J. - Accounts of coal stock

Year	Opening Stock (MT)	Purchase (MT)	Transfer (MT)	Total Stock (MT)	Consumption (MT)	Handling Loss (MT)	Closing Stock (MT)	Consumption Share (%)
COAL FINE								
FY 2008-09	-	-	3,142	3,218	2,972	170	-	7.5%
FY 2009-10	-	-	2,017	2,017	1,997	20	-	4.3%
FY 2010-11	-	-	1,738	1,738	1,721	17	-	4.2%
FY 2011-12	-	-	1,070	1,722	1,047	10	-	2.8%
FY 2012-13	-	-	-	(0)	-	-	-	0.0%
COAL								
FY 2008-09	-	-	-	-	-	-	-	0.0%
FY 2009-10	-	-	-	-	-	-	-	0.0%
FY 2010-11	-	-	-	-	-	-	-	0.0%
FY 2011-12	-	2,918	12	5,533	2,881	29	-	7.6%
FY 2012-13	-	7,624	-	25,295	5,317	53	-	15.3%
DOLACHAR								
FY 2008-09	-	17	38,233	38,447	36,412	1,838	-	92.5%
FY 2009-10	-	13,109	31,744	44,854	44,410	444	-	95.7%
FY 2010-11	-	5,100	34,881	41,028	39,589	393	-	95.8%
FY 2011-12	-	3,484	30,700	42,873	33,779	338	-	89.6%
FY 2012-13	-	7	38,000	119,648	29,386	294	-	84.7%
TOTAL for POWER PLANT								
FY 2008-09	-	17	41,375	41,664	39,384	2,008	-	-
FY 2009-10	-	13,109	33,761	46,871	46,407	464	-	-
FY 2010-11	-	5,100	36,620	42,766	41,310	410	-	-
FY 2011-12	-	6,402	31,782	50,128	37,707	377	-	-
FY 2012-13	-	7,631	38,000	144,943	34,703	347	-	-

Appendix K. - Annual accounts

Appendix L. - Detailed Project Report

Appendix M. - Fuel supply arrangement with WCL

Appendix N. - EPC contract with CVPL