Inland Power

— Imagine. Integrate. Impact.—

To,

Date – 24.01.2023

The Secretary,
Jharkhand State Electricity Regulatory Commission
New Police Line Road,
Kanke Road
Ranchi – 830048

Sub: Reply to additional data required pertaining to 2nd deficiencies observed in the Petition for Multi Year Tariff for FY 2021-22 to FY 2025-26 of Inland Power Limited (vide letter dated 02nd December 2022

Respected Sir,

In response to the Comments submitted by JSERC on the above captioned petition, we hereby submit our responses for your kind consideration. Our responses are attached as part of Annexure – 1 of this letter.

We request you to kindly inform us in case of any further queries on the same.

Yours Faithfully,

Bordia

(Authorized Signatory Name and Designation for IPL)

Anand Bordia (CFO)

Enclosed *– Annexure 1 - IPL Response to Comments by JSERC on Petition Filed by Inland Power Limited for for Multi Year Tariff for FY 2021-22 to FY 2025-26*

For Inland Power Ltd.

Bordia

Inland Power Ltd.

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Plant Office :
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Annexure – 1: IPL Response to 2nd deficiencies observed by JSERC on Petition Filed by Inland Power Limited for Multi Year Tariff for FY 2021-22 to FY 2025-26

Sl. No.	Particulars
1.	The Petitioner is directed to submit the basis of projecting the Growth Factor (Gn) equal to 4.0% in its MYT Petition. Also, the Petitioner is required to submit the projected Y-o-Y increase in employee strength throughout the control period.

IPL Response

IPL humbly submits that as per MYT Regulations, 2020:

15.40

The O&M Expenses for the Base Year of the Control Period shall be approved by the Commission taking into account the audited accounts of FY 2015-16 to FY 2019-20, Business Plan filed by the Generating Company, estimates of the actual for the Base Year, prudence check and any other factor considered appropriate by the Commission.

15.41

The O&M expenses permissible towards ARR of each year of the Control Period shall be approved based on the formula shown below:

O&Mn = (R&Mn + EMPn + A&Gn) + Terminal Liabilities

Where,

R&Mn – Repair and Maintenance Costs of the Generating Company for the nth year;

EMPn – Employee Costs of the Generating Company for the nth year excluding terminal liabilities;

A&Gn – Administrative and General Costs of the Generating Company for the

nth year.

15.42

a).....

b)

EMPn + A&Gn = [(EMPn-1)* (1+Gn) + (A&Gn-1)] * (INDXn / INDXn-1)

Where,

EMPn-1 – Employee Costs of the Generating Company for the (n-1)th year excluding terminal liabilities;

A&Gn-1 – Administrative and General Costs of the Generating Company for the (n-1)th year excluding legal/litigation expenses;

INDXn – Inflation factor to be used for indexing the employee cost and A&G cost. This will be a combination of the Consumer Price Index (CPI) and the Wholesale Price Index (WPI) for immediately preceding year before the base year;

Gn – is a growth factor for the nth year and it can be greater than or lesser than zero based on the actual performance. Value of Gn shall be determined by the Commission in the MYT Order for meeting the additional manpower requirement based on the Generating Company Filing, benchmarking and any other factor that the Commission feels appropriate;

IPL further states that it had computed the Growth Rate for Employee Expenses based on the Total Employees Expenses growth rate (excl. terminal liabilities) as per the Actual of FY2019-20 and the Estimated expenses as per APR filing of FY2020-21

Particulars	**Actual (Submitted as per True Up of)**	**Estimated as per APR of**	**Growth Rate (rounded off)**
	FY2019-20	**FY2020-21**	
Total Employee Expenses excl. Contribution to Terminal Benefits	**6.98**	**7.28**	**4% (7.28 divided by 6.98)**

IPL further states that it has projected the employee strength during the control period to be as per follows:

Sl. No	Particulars	Control Period									
		FY 2021-22		FY 2022-23		FY 2023-24		FY 2024-25		FY 2025-26	
		Working Strength At The Beginning Of The Year	Sanctioned Strength At The Beginning Of The Year	Working Strength At The Beginning Of The Year	Sanctioned Strength At The Beginning Of The Year	Working Strength At The Beginning Of The Year	Sanctioned Strength At The Beginning Of The Year	Working Strength At The Beginning Of The Year	Sanctioned Strength At The Beginning Of The Year	Working Strength At The Beginning Of The Year	Sanctioned Strength At The Beginning Of The Year
1	Manager & above	30	30	30	30	30	30	30	30	30	30
2	Up to Officer level	117	117	117	117	117	117	117	117	117	117
3	Casual Labour	216	216	216	216	216	216	216	216	216	216
	Total	363	363	363	363	363	363	363	363	363	363

2.	The Petitioner is directed to submit the basis of the assumption of an escalation factor of 3% for the Rate of Coal, 5% for the Rate of Coal Rejects and 10% for water Charges in its MYT Petition.

IPL Response

IPL humbly submits that it has considered the following philosophy for projecting the growth rates of coal and coal rejects:

Physical Parameters	Units	Previous Years					Growth Rate (Rounded Off)	Formula
		2015-16 (Actual)	2016-17 (Actual)	2017-18 (Actual)	2018-19 (Actual)	2019-20 (Actual)		
Rate of Coal/MT	Rs./MT	2,742.69	2,793.23	2,615.59	3,460.24	3,030.26	3%	(CAGR between FY2015-16 and FY2019-20)
Rate of Coal Rejects / MT	Rs./MT	916.31	1,067.57	1,080.28	1,710.78	2,069.16	5%	Conservative Estimate

As can be seen from the above table, the rate of coal has been projected based on CAGR of Rate of Coal / MT between FY2015-16 and FY2019-20. However there has been a vide variation in the rate of coal rejects from FY2015-16 till FY2019-20 (CAGR of 23%). Thus, IPL has conservatively estimated the rate of coal rejects to grow at 5% to avoid a drastic increase in coal prices in its projection.

IPL would also like to bring to the kind attention to the Hon'ble Commission that the actual coal blending ratio and prices have changed significantly from the projections proposed in its MYT Petition. The Covid-19 Pandemic, global geo-political scenario as well as the coal supply situation for CBFC power projects has led in high variation and prices for coal which are beyond the control of IPL. IPL humbly submits the proposed coal blending ratio and prices projected in MYT petition as well as the actual coal blending ratio and prices for FY2020-21 and H1 of FY2021-22.

Parameters	Units	Base Year: FY2020-21		FY2021-22	
		Estimated	Actual (Submitted in True Up)	Projected in MYT	Actual - H1 FY2021-22
Ratio of Coal in Primary Fuel (Coal-Coal rejeccts-Dolochar) Mix		0.29	0.34	0.35	0.45
Ratio of Coal rejects in Primary Fuel (Coal-Coal rejeccts-Dolochar) Mix		0.71	0.66	0.65	0.55
Ratio of Dolochar in Primary Fuel (Coal-Coal rejeccts-Dolochar) Mix		0.00	0.00	0.00	0.00
Weighted Average GCV of Coal	k.cal/kg	3632.37	3628.50	3551.26	3525.04
Weighted Average GCV of Coal rejects		2189.21	2049.14	1916.24	1820.75
Weighted Average GCV of Dolochar	k.cal/kg	0.00	0.00		0.00
Weighted Average GCV of Primary Fuel	k.cal/kg	2604.41	2579.80	2488.50	2587.68
Rate of Coal/MT	Rs./MT	2762.56	2727.54	2669.54	2843.56
Rate of Coal rejects/MT	Rs./MT	1869.53	1686.51	1476.18	1396.55
Rate of Dolochar/MT	Rs./MT	0.00	0.00	0.00	0.00
Rate of Primary Fuel/MT	Rs./MT	2126.45	2036.30	1893.86	2047.69
Transit Loss of Primary Fuel	%	0.01	0.01	0.01	0.01

As can be seen in the table above the projected ratio of Primary Fuel projected in MYT for FY2021-22 had changed from proposed 35:65:0 for Coal: Coal Rejects: Dolochar to 45:55:0. Also the rate of primary fuel in H1 of FY2021-22 has increased on an overall basis from projection of Rs. 1893.86 / MT (before transit loss) to Rs. 2047.69 / MT

(before transit loss) which represents an increase of 8% in the rate itself. The geo-political situation persistent since February 2022 and the coal supply situation in India has also led to increase of over 100% in coal prices discovered through E-Auction in some cases. The impact of these price increase would be visible in the filings of True Up for FY2021-22 and APR of FY2022-23. IPL humbly requests to the Hon'ble Commission to consider the actual coal supply situation which is drastically different from the projections proposed in MYT petition due to reasons beyond the control of IPL.

Further, IPL submits that, IPL also submits that the price for drawing water is set by Damodar Valley Corporation (DVC) and total water consumption is based on actual plant operation. IPL also submits that as per the tariff notification issued by DVC, the water tariff is expected to increase by 10% annually for the ensuing years. (***refer Annexure- Water Tariff Notification: Point 3(i) Escalation Rate for Industrial Water Use***.).

In light of the above facts, IPL, therefore, has projected the expenditure due to water charges during the MYT Control Period with an escalation of 10% on year-on-year basis based on estimated value for FY 2020-21.

However IPL humbly submits to the Hon'ble Commission to approve the above projections for MYT petition and approve the actual rate of coal, rate of coal rejects and water charges at the actual incurred rate during truing up for respective control period years.

3.	**The Petitioner is directed to provide the detailed computation for claiming the MAT Rate of 17.47%.**

IPL Response

IPL humbly submits the breakup of MAT as per follows:

Tax on Book Profit @15% u/s 115 JB
Add: Surcharge @ 12%
Add: Education & Secondary Cess @ 4%

MAT Rate = 15%*(1+12%)*(1+4%) = 17.472%

4.	The Petitioner is directed to submit the basis of the projecting rate of oil (Rs./kl) in its MYT Petition. The Petitioner had been directed to submit the DPR in the previous note on Discrepancies/ Data gaps in respect of the MYT Petition. The Petitioner has responded by replying, *"IPL humbly submits that the analysis for substitution of HSD with LDO has already been submitted to the Hon'ble Commission vide letter dated 29. I 2.2020. Considering that more than 22 months have passed since the report on substitution of HSD with LDO had been submitted there has been a high variation in the fuel prices globally as well as probable impact on the estimated capital expenditure for the proposed project. IPL humbly submits to the Hon'ble Commission that as per the latter's order on True Up for FY20/9-20 dated 04th November 2022 IPL has been directed to submit the detail proposal for the proposed project before the Commission for approval within two months from the date of this Order. Hence, IPL will submit a revised detailed proposal of the same based on the current price projections within the timeframe required by the Commission.* *IPL humbly submits that the detailed cost and cost and revenue model for Expansion of Fly Ash Brick Plant has been submitted to the Commission on 30.12.2020"*

	In line with Regulation 6.6 of the JSERC Generation Tariff Regulation, 2020, the Petitioner is required to submit an efficiency improvement, Cost Benefit Analysis associated with the proposed Capital Expenditure (Installation of LDO System, Fly Ash Brick Manufacturing Unit) read with the directive of the JSERC Order dated 22-09-2020 wherein the Commission has directed the Petitioner lo submit DPR along with all necessary details of works. In view of the above shortcomings, the Petitioner is again directed to submit the requisite details in support of its CAPEX claims. The Petitioner in this regard is directed to re-submit the DPR along with all necessary details of works and the Cost Benefit Analysis associated with the proposed Capital Expenditure with regard to the installation of the LDO System and Fly Ash Brick Manufacturing Unit

IPL Response

IPL humbly submits that as per the DPR submitted to the Hon'ble Commission and its MYT Petition HSD is preferred during cold seasons compared to LDO due to high viscosity of LDO. Relevant portion of the DPR is reproduced below:

> *"During cold seasons due to high viscosity, it may become difficult to pump, hard to light the burner and tough to operate. LDO contains high carbon residue 1 percent or more. High carbon residue results in poor atomization, formation of carbon deposits on the burner tips and on the nozzles walls which leads to frequent flame failure and ultimately requires more time to light up boiler. Using of HSD causes less pollution as well light up of boiler takes in shorter duration which in turns give more availability of Plant for Power Generation. Considering to the environment aspects, more availability of plant for power generation and to avoid cold end corrosion due to SO2, It is recommended to use HSD instead of LDO for the cold start up, flame stabilization of boiler."*

Thus IPL humbly submits that basis the projected timeframe for proposed capex of conversion of LDO system to HSD , the power plant was initially envisaged to run on HSD from 1st April 2021 for 150 Days till LDO system is installed. Then 30 Days shutdown would be required till switchover of SS APH Tubes was completed. Then for next 185 days, t it will run on LDO for 95 days and HSD for 90 days (during cold season). From 1st April 2022 onwards, plant will run on LDO except for Rainy and Winter seasons (5 months) as HSD is recommended during that time for boiler life.

Based on the above projection philosophy IPL had considered the rate of Oil as below:

Physical Parameters	**Units**	**Control Period**				
		2021-22	**2022-23**	**2023-24**	**2024-25**	**2025-26**
Rate of Oil/KL	Rs./KL	74,197.82	66,422.38	66,422.38	66,422.38	66,422.38
		=((81553.84*240)+(55614.2*95))/(240+95) (HSD operations for 240 days and LDO operations for 95 Days)	=((81553.84*5)+(55614.2*7))/12			

The petitioner also submits that the landed price of LDO considered for the purpose of determination of ARR for the MYT Control Period is Rs. 55,614.20/KL which included GST @18% and approximate transportation cost of Rs. 1,700/(ex- budge budge). The price for Oil has been considered at Rs. 81553.84 / litre which was the prevailing cost per litre. As the prices of LDO and HSD are decided by the Oil Marketing Companies and are subject to vide variation, IPL has not considered any escalation in the rates.

IPL humbly prays to the Hon'ble Commission to approve the projections as per its MYT Petition and approve the approve the actual oil at the actual incurred rate during truing up for respective control period years.

IPL further submits that it is submitting the revised DPR along with cost benefit analysis for switchover of HSD system to LDO with this **reply (Annexure – DPR for HSD to LDO).**

As per the cost benefit analysis (the details of which are available on Page 12 and 13 of the DPR, the total capital cost for the switchover would be Rs. 18.99 Crore approximately.

IPL further submits that it had submitted the Fly Ash Manufacturing DPR to the Hon'ble Commission on 30.12.2020 which has been the basis of expansion of the Fly Ash Unit by IPL. IPL submits that the Fly Ash Unit has been commissioned during FY2021-22 the details of which were submitted to the Hon'ble Commission as part of its APR Petition for FY2021-22.

Anx - 5

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DAMODAR VALLEY CORPORATION
दामोदर घाटी निगम

OFFICE OF THE CHIEF ENGINEER (CIVIL),
P. O.- MAITHON DAM, DHANBAD, JHARKHAND, PIN.- 828207

Ref. No. : CE -17/51-1120 Date: 23rd July 2019

To,
The Dy. General Manager (Coml.), Inland Power Limited, C/218 Road No.-2 Ashok Nagar, Ranchi, Jharkhand , Pin.- 834 002

NOTICE

REVISION OF WATER TARIFF FOR SUPPLY OF RAW WATER FOR INDUSTRIAL & DOMESTIC USES

Damodar Valley Corporation (DVC) has revised, vide Resolution No.- 8900 (Agenda Item No. - 10) of 641 meeting of Corporation held on 25th June 2019, the rate for Industrial & Domestic Water Supply of raw water with effect from 01.04.2019 in exercise of its power under section 15 of the DVC Act 1948 & as per Clause No.- 11(a) of the agreement executed between DVC & Consumers based on the allocation of water by DVRRC (Damodar Valley Reservoir Regulation Committee). To stress upon the need for reducing water pollution, a scheme of incentive has been continued for 'Zero Effluent Discharge'. **All future bills for consumption of Industrial & Domestic raw water with effect from 1st April 2019 will be preferred at the Revised Water Tariff given below.**

REVISED WATER TARIFF FOR DOMESTIC/MUNICIPALITY/PHED AND INDUSTRIAL WATER SUPPLY

1. Damodar Valley Corporation has revised Water Tariff of Raw Water for Industrial & Domestic supply w.e.f. **01.04.2019**

2. The Revised water tariff for drawal of water from DVC sources as under:

SOURCES OF DRAWAL	INDUSTRIES	DOMESTIC/MUNICIPALITY/PHED
	Revised Rate	Revised Rate
Reservoir / River (Per KL)	Rs. 10.64	Rs. 1.725
Extra Charges for drawing water from water supply canal (Per KL)	Rs. 0.52	

3. The Tariff will be enhanced annually at the end of every financial year (i.e. w.e.f. 1st April) as follows:

(i) For Domestic/Municipality/PHED use - 05% shall be increased in raw water tariff annually.
(ii) For Industrial use - 10% shall be increased in raw water tariff annually.

4. The water supply bills shall be raised on the basis of actual drawal of water for all the consumers with the tariff as indicated above.

5. As incentive @ 10% on the monthly bills shall be allowed to those industries who have taken appropriate measures for " Zero Effluent Discharge". The said incentive shall be made applicable only if the payments are made within due date and on production of requisite certificate from **State Pollution Control Authority.**

All previous orders in this regard stand modified to the above extent.

For and on Behalf of
DAMODAR VALLEY CORPORATION
CHIEF ENGINEER (CIVIL),
MAITHON DAM, DHANBAD, JHARKHAND

Copy to- 1. The Director, Inland Power Limited, Vill- Tonagatu, P.O.- Seram, P.S.- Gola, Distt.- Ramgarh, Jharkhand, Pin.- 829 110

2. Inland Power Limited, P-221/2, Strand Bank Road, Kolkata, West Bengal, Pin- 7000 001

Anx-5

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DAMODAR VALLEY CORPORATION
CHIEF ENGINEER (CIVIL),
MAITHON DAM, DHANBAD, JHARKHAND

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2. Inland Power Limited, P-221/2, Strand Bank Road, Kolkata, West Bengal, Pin- 7000 001

2023

EVALUATION REPORT For USES OF HSD Vs LDO 1x63 MW THERMAL POWER PLANT FOR INLAND POWERLTD, RAMGARH, JHARKHAND

HONCHEE ENERGY PVT. LTD. RAIPUR.

12/1/2023

HONCHEE ENERGY PVT. LTD. RAIPUR.

1/12/2023

COMPANY PROFILE:

M/s Inland Power Ltd. is a 1x63MW coal-based power generating plant having a 250TPH CFBC Boiler. Usually during the start up the Boiler HSD is used as light up fuel to preheat the combustion chamber to induce self-ignition of fuel. Here we are analyzing the possibility of using LDO as an alternate light up fuel and effects of heat exchanger & pollution control equipment's life also analyzed as per the directives issued by the Hon`ble Commission, JSERC vide order dated 22nd September 2020.

LOCATION OF THE PLANT
7th Km Stone on Gola Sikidri road off N123, Village: Tonnagatu & Beyang, Block: Gola, District: Ramgarh, State: Jharkhand.

DETAILED SPECIFICATION OF PLANT EQUIPMENT'S

Steam Turbine:

Steam Turbine is supplied by Hangzhou Steam Turbine Co Ltd, China, capacity of 1x63 MW with 105 Bar and 535°C.There are 5 bleeds 2 bleed for LPH, 2 bleed for HPH and 1 bleed for De-aerator.

Fuel Handling System

Coal handling plant is one of the important energy consumers station with capacity of 250TPH and contains the following energy consuming equipment.
1. Primary Crusher – 90 kW
2. Fuel Conveyors - BC-1, RBF, 2A & 2B,3,4,5A& 5B,6& 7, RSBC # 01 & 02
3. Secondary Crusher-200 kW

Fans
Air is one of the major elements in the thermal power plant which is used for combustion and fuel supplying into boiler.

ID fan: are used for evacuating the boiler flue gases. In addition to this performance of ID fan and draft system plays vital role in the loading of the thermal power plant. Specification of ID fan Supplied by: FLAKT(I) Pvt. Ltd. Design Flow: 355,312 m^3/hr, Static Pressure: - 730mmWC, Electrical drive:920kw,690V and controlled through VFD which is supplied by Danfoss.

SA Fan: External fans are provided to give sufficient air for combustion. The forced draft fan takes air from the atmosphere and, first warming it in the air preheater for better combustion, injects it via the air nozzles on the furnace wall. Specification of SA Fan Supplied by: FLAKT(I) Pvt. Ltd. Design Flow: 76,010m^3/hr, Static Pressure: 988mmWC, Electrical drive:300kw,690V and controlled through VFD which is supplied by Danfoss.

PA Fan: Primary air fans are second high power consuming fans in a thermal power plant. Though the quality of air delivered by the PA fans is less when compared to SA fans, the discharge air pressure is high. Specification of SA Fan Supplied by: FLAKT(I) Pvt. Ltd. Design Flow: 119,197 m^3/hr, Static Pressure: 1,550 mmWC, Electrical drive:780kw,690V and controlled through VFD which is supplied by Danfoss.

Boiler Feed pump:
The Plant is installed with 3 Nos BFP per unit out of which 2 are running during operation and Its Motor operated feed pump. Make: KSB Pump Flow: 172m^3/hr Head in Meter:1775m Electrical Drive: ABB Motor,1150kW,690V which is controlled through VFD.

Condenser and Cooling Tower:
4 cooling towers, of hyperbolic counter draft type are provided for each unit, in which 3 working and 1 standby with capacity 14,400m^3/hr, range is 10°C with wet Bulb temperature as 28.5°C.

Each cell has separate fan which has Fiber resin blade (FRB). Blade angle is 18° with electrical motor capacity as 90KW at 690V.
Ejector suck incondensable gas and to maintain Vacuum it's supplied by HTC. Design Vacuum at 0.10 ATA design inlet temperature at 32°C and outlet temperature at 40°C.

RO Plant:
RO Plant is supplied by Thermax with capacity 21m^3/hr. raw water is taken from Sanaghara Nala which is 1.5km away from plant and 2X55KW pumps used to pump water in to reservoir.

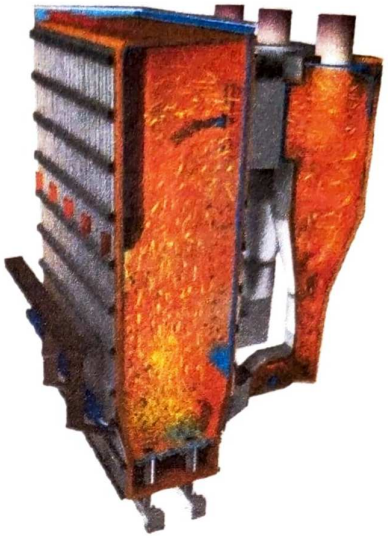
Compressor:
There are 2 instrument compressors in which 1 running with capacity 2679 CFM pressure setting loading 5.5kg/cm^2 and unloading 6.5kg/cm^2 with storage tank capacity of 10m^3.

Service compressors are only used for ash conveying from the ESP, Economizer and APH to Ash silo. There are 3 service compressor in which 2 is running condition with capacity 15000 CFM pressure. Setting loading 4.1kg/cm^2 and unloading 4.6 Kg/cm^2 with three storage tank of 2X10m^3 and 1X5m^3.

Pumps:
Following Water pumping are installed in this plant.
- Condensate extraction pumps
- Boiler feed water pumps
- DM water pumps
- Make up water pumps
- Air conditioning plant pumps
- Cooling tower pumps

About The CFBC Boiler:

The boiler is 250 TPH circulating fluidized bed (CFB) Boiler supplied by WUXI Huaguang Boiler & CO with capacity of 250TPH with 535°C and 11.1MPa (gauge), which adopts water cooled air chamber and furnace made by membrane wall. The Mid-super heaters are platen super heaters. The tail vertical flue gas duct consists of membrane enclose wait and the casing wall in which the high temperature and low temperature super heaters. The economizers and air preheaters are placed. The super heaters adopt tube hanging structure. The economizer and air-preheaters as well as the cyclone separators adopt supporting structure.



The boiler is equipped with 2 high temperature cyclone separators made of 38 tubes, and 2 material returning devices. The velocity of the flue gas inside the furnace is high and there are a lot of back firing masses. So, the density of material in furnace is also high. The furnace is in the positive pressure.

- Designed feed water inlet temperature – 240 Deg C
- Deigned flue gas exit temperature should not exceed 145 Deg c
- Fuel size designed for 0-10mm
- And boiler was designed for low GCV coal of 2,690.

About HSD & LDO Firing

Characteristics	HSD	LDO
Ash By mass, Max	0.01	0.02
Pour Point, Max	6 Deg C for Winter	12 Deg C for Winter
	18 Deg C for Summer	21 Deg C for Summer
Sediments, % by mass, Max	0.05	0.1
Total Sulphur, % by Mass, Max	0.25	1.8
Water content, % by Volume, Max	0.05	0.25
GCV, Kcal/kg	10800	10400

HONCHEE ENERGY PVT. LTD. • RAIPUR (C.G.) •

HSD	LDO
Density is 845 kg/m3	It is heavier than diesel oil. Density is 920 kg/m3. So pumping of fuel is hard as compared to HSD
HSD contains detergents that enhance combustion through a process of cleaning up of fuel injectors that are blocked with harmful deposits	Injectors might have chance for blocking with carbon deposits and thus increased boiler startup time
Since density is low, atomisation can be well done for better burning	Atomisation is poor which in turn cause carbon deposits in heating surface. Later which may have chance for explosion. Steam or air requirement for atomisation will be more. New line is required
HSD have good cetane number 56-60. So it have better combustion thereby achieving good performance as well as cleaner emissions	LDO have cetane number ranging from 45-55. It emits black smoke while combustion
Because of its low viscosity and high volatility it has good combustion	Because of its high viscosity and low volatility it has poor combustion
Low Sox emission	High Sox emission. Since the exit temperature of boiler is low during startup, ducting system tend to have sulphur corrosion

1. Pour point
2. Sediments
3. Total Sulphur & water content.

A. <u>POUR POINT</u>

LDO is more viscous than HSD. It influences the degree of pre-heat required for handling, storage and satisfactory atomization. During cold seasons due to high viscosity, it may become difficult to pump, hard to light the burner and tough to operate. So, we need to arrange heat tracing through steam/electrical heaters. This leads for additional operating and maintenance cost.

B. <u>SEDIMENTS</u>

LDO contains high carbon residue, double the quantity as compared to HSD. High carbon residue results in poor atomization, formation of carbon deposits on the burner tips and on the nozzles walls which leads to frequent flame failure and ultimately requires more time to light up boiler with the existing burner.

As the sediment is high, need to add, sediment separation equipment like multi cone centrifuge of Kraus Maffei or Alfa Laval make.

C. *TOTAL SULPHUR & WATER CONTENT*

Sulphur content in LDO is double as compared to Sulphur in HSD. While firing LDO for light up, then the life of Economizer, Air preheater, ESP and downstream ducts life will come down.

As Sulphur and water content both are high in LDO, will lead for high level of H2SO4 forming at low operation temperatures. Here is the comparison between the production of Sox between HSD & LDO.

Flue gas composition summary of HSD			
		Wet by vol %	**Dry by vol%**
	Carbon di oxide	**= 10.7 %**	**= 12.465 %**
	Water vapour	**= 14.15 %**	**= 0 %**
	Sulfur di oxide	**= 0.01 %**	**= 0.014 %**
	Oxygen	**= 3.14 %**	**= 3.654 %**
	Nitrogen	**= 72 %**	**= 83.867 %**
SOx emission			
Sox emission in ppm	**ppm**	**119.2**	0.01192 x 1000000
Milgrams of SOx per kg of fuel	**mg/kg of fuel**	**5000**	0.00500 x 1000000
Nm3 of gas per kg of fuel	**Nm3/kg of fuel**	**15.03021**	19.083 x 22.3/ 28.44
SOx emission in mg/Nm3	**m3/Nm3 wet**	**332.7**	5000 / 15.03021

Flue gas composition summary of LDO			
		Wet by vol %	**Dry by vol%**
	Carbon di oxide	**= 11.19 %**	**= 12.894 %**
	Water vapour	**= 13.22 %**	**= 0 %**
	Sulfur di oxide	**= 0.09 %**	**= 0.101 %**
	Oxygen	**= 3.15 %**	**= 3.633 %**
	Nitrogen	**= 72.35 %**	**= 83.373 %**
SOx emission			
Sox emission in ppm	**ppm**	**872.7**	0.08727 x 1000000
Milgrams of SOx per kg of fuel	**mg/kg of fuel**	**35960**	0.03596 x 1000000
Nm3 of gas per kg of fuel	**Nm3/kg of fuel**	**14.37385**	18.378 x 22.3/ 28.64
SOx emission in mg/Nm3	**m3/Nm3 wet**	**2501.8**	35960 / 14.37385

For the above calculation fuel ultimate analysis was taken from our backup data's, and from the above calculation it clearly comes to know that the production of **Sox will be 7 times higher** as compared with HSD.

During boiler startup flue gas temperature after economizer will be below 100 Deg C, with this condition corrosion of tubes and ducts will be very high and it will lead for forced acid induced corrosion failures.

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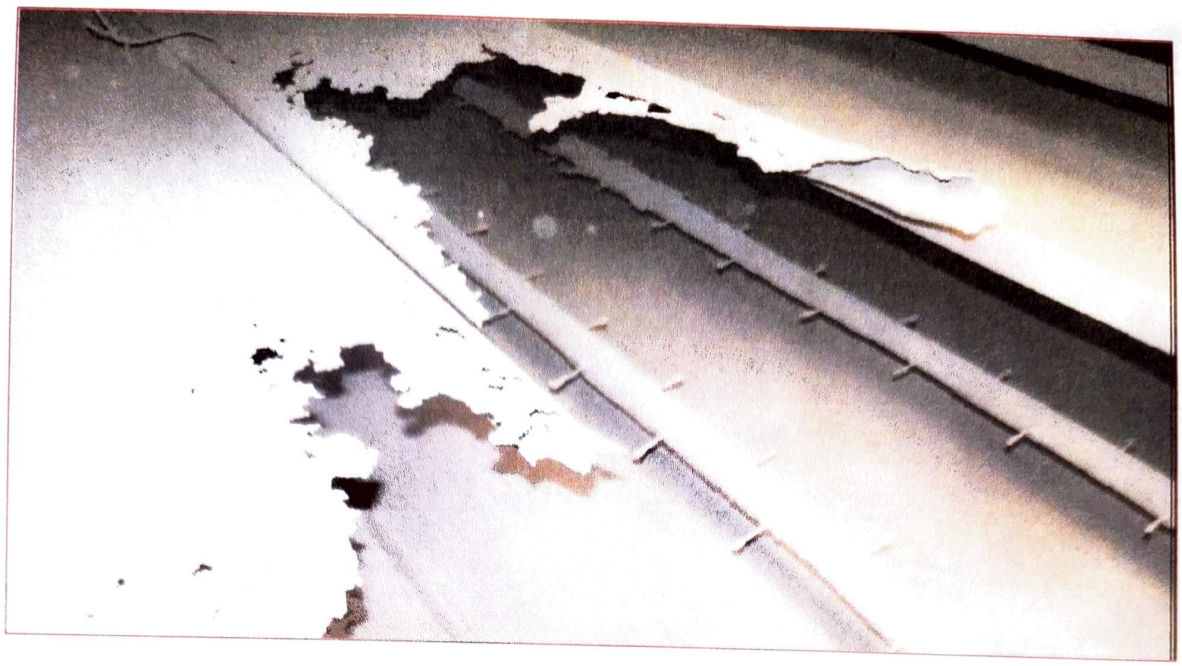
Due to low temperature in downstream, Economizer tubes, cold end of APH, ESP casing and electrodes & ID fans ducts and impeller also damages severely. Some of the acids in corrosion failure images were added as below.

While going through the GCV of HSD and LDO, not much difference in between. But it will lead to higher operating, maintenance and Capital investment cost.

Acid induced corrosion failure in Air preheater tubes.

Acid corrosion failure of economizer.



Corrosion of ESP collecting plates due acid induced corrosion.

Corrosion of GD screen & ESP casing due to acid condensation.

Typical corrosion in ESP supports.

Preference of High Speed Diesel (HSD)

HSD is used as start-up fuel and for flame stabilization. Gross Calorific Value of HSD is 10800 Kcal/Kg and that of LDO is 10,400 kCal/kg. The Sulphur content in HSD is 0.05-0.25% which is quite lower than the Sulphur content in LDO, which is in the range of 0.5%-1.8%. Sulphur on burning produces Sulphur Dioxide gas (SO2). SO2 is very harmful for environment and when sulfur dioxide combines with water and air, it forms sulfuric acid, which is the main component of acid rain. Acid rain can cause deforestation, acidify waterways to the detriment of aquatic life. Also it accelerates the corrosion of equipment which may lead to premature failure of Boiler pressure parts, Air preheater tubes, Flue gas path, Electrostatic Precipitators (ESP), Chimney etc. LDO is more viscous than HSD. It influences the degree of pre-heat required for handling, storage and satisfactory atomization. During cold seasons due to high viscosity, it may become difficult to pump, hard to light the burner and tough to operate. LDO contains high carbon residue 1 percent or more. High carbon residue results in poor atomization, formation of carbon deposits on the burner tips and on the nozzles walls which leads to frequent flame failure and ultimately requires more time to light up boiler. Using of HSD causes less pollution as well light up of boiler takes in shorter duration which in turns give more availability of Plant for Power Generation. Considering to the environment aspects, more availability of plant for power generation and to avoid cold end corrosion due to SO2, It is recommended to use HSD instead of LDO for the cold start up, flame stabilization of boiler.

INSTALLATION OF SEPARATE LDO SYSTEM,

LDO can be used as an alternate fuel due to lower cost.

LDO can be stored in separate storage tank of Capacity 23 KL with suitable heating arrangement and oil purification system. One high speed multi cone centrifuge of Kraussmaffei or Alfa laval make is recommended.

In order to prevent the corrosion due to Sulphur,

- APH Series tubes needs to be replaced with SS304 Grade.
- Bottom 5 loops of Economizer tubes shall be converted in to SS304
- Planning to replaced ESP inlet & Outlet ducts in the interval of 2 years
- GD screen, Collecting & Emitting electrode may need for replacement in 3 years period.

Boiler parameters and APH zone parameters to be maintained as per designed value to prevent any deterioration. Close monitoring is required during boiler cold start-up and normal operation.

Close monitoring of temperature & pressure at APH zone to be done during boiler cold start-up and during boiler normal operation.

To overcome the Cold Corrosion problem, APH Bypass system will be recommended during cold startup of Boiler or Replacement of APH tubes to SS304 tubes for complete prevention.

Cost analysis of New LDO system installation was checked and tentative cost estimation sheet is annexed. 1. Based upon current market price.

SUMMERY:

By switching to LDO system needs high Capital investment and additional Maintenance cost in comparison to saving in LDO, ultimately increasing the Operation & Maintenance Cost.

Reviewing the cost analysis of the both LDO and HSD system, it is recommended to continue with presently HSD System which is for betterment of Boiler.

ANNEXED:

1. **Cost Analysis Sheet based upon current market price**
2. **Bar Chart for Implementation of LDO System**

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COST ANALYSIS FOR LDO SYSTEM					
	FOR INSTALLATION OF LDO SYSTEM				
SN	**DESCRIPTION**	**UNIT**	**QTY.**	**RATE in Rs.**	**PRICE in Rs.**
A	**LDO STORAGE SYSTEM**				
1	OIL TANK, CAPACITY: 23 KL	No	1	490,000.00	490,000.00
2	BALL VALVE, SIZE: 50 NB Nos.	No	6	2,800.00	16,800.00
3	CIVIL FOUNDATION OF TANK	L/S	1	105,000.00	105,000.00
4	DRAINAGE SYSTEM & BOUNDARY		1	140,000.00	140,000.00
5	HIGH SPEED MULTICONE CENTRIFUGE	No	1	700,000.00	700,000.00
				TOTAL	**1,451,800.00**
B	**LDO TRANFER SYSTEM**				
6	BALL VALVE, SIZE: 50 NB	Nos	4	2,800.00	11,200.00
7	CHECK VALVE, SIZE: 40 NB	Nos	2	2,800.00	5,600.00
8	BALL VALVE, SIZE: 40 NB	Nos	3	2,100.00	6,300.00
9	BASKET TYPE STRAINER: 50 NB	Nos	2	3,500.00	7,000.00
10	BALL VALVE, SIZE: 15 NB	Nos	4	1,400.00	5,600.00
11	GATE VALVE, SIZE: 15 NB	Nos	4	1,400.00	5,600.00
12	TRANSFER PUMP, GEAR TYPE, CAPACITY: 2.5 TPH, HEAD 35 kg/cm^2s.	Nos	2	184,800.00	369,600.00
13	MOTOR, 5 HP, 3000 RPM, FLP TYPE	Nos	2	30,240.00	60,480.00
14	PRV: SIZE: 15 NB	Nos	1	3,500.00	3,500.00
15	CS SEAMLESS PIPE, SIZE: 50 NB, SCH # 40 Mtr. 30	Nos	30	525.00	15,750.00
16	CS EQUAL TEE, SIZE: 50 NB	Nos	1	252.00	252.00
17	CS ELBOW 90°, SIZE: 50 NB	Nos	10	252.00	2,520.00
18	CS REDUCER, SIZE: 50 NB*32 NB	Nos	4	259.00	1,036.00
19	CS REDUCER, SIZE: 50 NB*25 NB	Nos	4	259.00	1,036.00
20	CS EQUAL TEE, SIZE: 40 NB	Nos	4	252.00	1,008.00
21	CS ELBOW 90°, SIZE: 40 NB	Nos	10	252.00	2,520.00
22	CS REDUCER, SIZE: 40 NB*25 NB	Nos	4	259.00	1,036.00
23	CS SEAMLESS PIPE, SIZE: 40 NB, SCH # 40	mtr	30	490.00	14,700.00
24	CS SEAMLESS PIPE, SIZE: 15 NB, SCH # 40 Mtr. 6 1 50.00 9 00.00	mtr	6	210.00	1,260.00
				TOTAL	**515,998.00**
C	**LDO UNLOADING SYSTEM**				
25	BALL VALVE, SIZE: 50 NB	Nos	3	2,800.00	8,400.00
26	CHECK VALVE, SIZE: 40 NB	Nos	2	2,800.00	5,600.00
27	BALL VALVE, SIZE: 40 NB	Nos	3	2,100.00	6,300.00
28	BASKET TYPE STRAINER: 50 NB	Nos	1	3,500.00	3,500.00
29	BALL VALVE, SIZE: 15 NB	Nos	1	1,400.00	1,400.00
30	TRANSFER PUMP, GEAR TYPE, CAPACITY: 5 TPH, HEAD: 4 kg/cm^2	Nos	2	105,000.00	210,000.00
31	MOTOR, 3 HP, 1450 RPM, FLP TYPE	Nos	2	25,900.00	51,800.00
32	PRV: SIZE: 15 NB	Nos	1	3,500.00	3,500.00
33	CS SEAMLESS PIPE, SIZE: 50 NB, SCH # 40	Mtr	30	525.00	15,750.00
34	CS EQUAL TEE, SIZE: 50 NB	Nos	1	252.00	252.00
35	CS ELBOW 90°, SIZE: 50 NB	Nos	10	252.00	2,520.00
36	CS EQUAL TEE, SIZE: 40 NB	Nos	1	252.00	252.00
37	CS ELBOW 90°, SIZE: 40 NB	Nos	10	252.00	2,520.00
38	CS SEAMLESS PIPE, SIZE: 40 NB, SCH # 40	Ntr	30	490.00	14,700.00
39	CS SEAMLESS PIPE, SIZE: 15 NB, SCH # 40	Mtr	6	210.00	1,260.00
40	ISMC 100 MM	mtr	0.25	60,200.00	15,050.00

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				TOTAL	**342,804.00**
D	**DELECTRICAL CABLE & FITTING AND INSTRUMENTATION**				
41	ELECTRICAL FITTING CABLE/ PRESSURE GAUGE ETC.	L/S	1	49,000.00	49,000.00
42	2KW HEATER FOR HEATING THE LINE/TANK	L/S	2	56,000.00	112,000.00
				TOTAL	**161,000.00**
E	**AIR PRE HEATER COIL GRADE TO BE REPLACED**				
43	TUBE, MOC: SS304, SIZE: 42.5 MM OD, 3.5 MM THK	Nos	1080	8,442.00	9,117,360.00
44	TUBE, MOC: SS304, SIZE: 40 MM OD, 2.2 MM THK	Nos	16560	5,628.00	93,199,680.00
				TOTAL	**102,317,040.00**
F	**INSTALLATION & ERECTION COST**				
45	INSTALLAION COST OF TANK, EQUIPMENT, FITTING & PIPE LINE		1	350,000.00	350,000.00
46	APH TUBE INSTALLATION COST PER TUBE		17640	553.00	9,754,920.00
				TOTAL	**10,104,920.00**
	GRAND TOTAL(A+B+C+D+E+F)				**114,893,562.00**
	GENERATION LOSS DURING HOOKUP OF LDO SYSTEM				
1	COST DUE TO GENERATION LOSS FOR 30DAYS SHUTDOWN for APH Tube Replacement	L/S			**75,000,000.00**
	GRAND TOTAL				**189,893,562.00**

COST COMPARISION FOR HSD Vs LDO FIRING (Rs/Kwh)

				HSD		LDO		
		UM	**QTY.**	**Rate**	**Price**	**Rate**	**Price**	
1	Rates of HSD/ LDO	Rs/ Ltr			94.28		81.5	
2	HSD/LDO for Load on each KWh	Rs/Kwh			0.094		0.0815	
3	Total Capex recovery in 1 years due to end of PPA	Rs	189,893,562				0.42	
	Total				0.094		0.499	
	Additional cost on use of LDO						0.404	
	NET ANNUAL LOSS by Switching from HSD to LDO						**184,074,815.22**	**Rs/Yr**

Assumption		
PLF considered	%	82.5
Total power Generation yearly	Kwh	455301000
Annual HSD/LDO Consumtion	Ltr	455301
Rate of HSD	Rs/Ltr	94.28
Rate of LDO	Rs/Ltr	81.5

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BAR CHART FOR SWITCHOVER TO LDO SYSTEM IMPLEMENTATION

Sl. No.	Description	Period in Days	10	20	30	40	50	60	70	80	90	100	120	130	140	150	160	170	180
1	Drawing and Engineering for LDO system	10																	
2	Approval of Drawings	10																	
3	Preaparation of BOQ with specification	10																	
4	Tender floating	20																	
5	Technical evalution	10																	
6	Issue of Purchase Orders	10																	
7	Award of Contract	10																	
8	Receiving of Material	60																	
9	Installation of LDO System	10																	
10	Replacement of SS APH Tubes during Boiler Shutdown	30																	
11	Hookup of LDO System	5																	
12	Commissioning of LDO system	1																	

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