

Technical Paper on ISSUE 24 - Form1

This is a joint paper by Mr. Narendra Mohan Majhi and Ms. Madhusree Maji

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Form1

Format for Information regarding Total Energy Consumption and Energy Consumption per Unit of Production

General Information

			Remarks on the format given
1.	Name of the Company	Indian Oil Corporation Limited	
2	Name of the Unit	Barauni Refinery	Name of unit may be added to identify the specific plant
2a	Year of Establishment of the unit	1964	This will indicate the age of industry.
3	The Sector to which the company belongs	Oil Refinery	This will help in identifying the setor
4	Contact Person, Name, designation, address, telephone number, fax no.& E-Mail	N.M.Majhi, Chief Technical Services Manager Barauni Refinery, Begusarai – 851114 Phone No : 06243 140154 E-Mail: majhin@iocl.co.in	
5	Complete Address of Plant	At/PO: Barauni Refinery Dist: Begusarai – 851114 Bihar	

A. Power and Fuel Consumption**1. Electricity Consumption and Cost**

Sl No	Description	Unit	2004-05	Remarks / comments
(a)	Purchased Electricity	Lakh kWh	33.8	
(i)	Total cost of purchased electricity	Rs Lakhs	200.0	
(ii)	Contract Demand with utility	kW	2337.5	Contract demand is 2750 kVA
(iii)	Plant connected Load	kW	52000	The term plant connected load may be defined in instruction.
(b)	Own Generation			
(i)	Through DG sets		-	
	Annual generation	kWh	-	
	Annual Diesel consumption	Kilo Liters	-	
	Total Fuel cost	Rs in Lakhs	-	

(ii)	Through steam turbine Through Gas Turbine	Lakh kWh/yr Lakh kWh/yr	673 2172	
(ii)a	Total own generation	Lakh kWh/yr	2845	
(ii)b	Type of Fuel used	LSHS/Coal /Gas etc)	Internal Fuel Oil & Naphtha	
(ii)c	Fuel used in TG (IFO) for power generation Fuel used in GT for power generation (Naphtha)	KL / Year KL / Year	29734 53883	
(ii)d	Fuel cost through STG Fuel cost through GT Total Fuel cost	Rs Lakhs Rs Lakhs Rs Lakhs	2957 7189 10146	
(c)	Electricity supplied to the Grid / Others (Areas on non refinery operations viz. Township, Pipelines, Marketing etc)	Lakh kWh	734	
(i)	Revenue recovered	Rs Lakhs	3223	
(d)	Net Electricity consumption (a)+(b)(ii) a - (c)	Lakh kWh	2145	
(e)	Total cost of electricity consumption in the plant (a) (i) + (b) (ii)d – (c) (i)	Rs Lakhs	7123	

Fuel Used for Process

2	Coal			
	Annual consumption	MT		
	Gross calorific value	Kcal / kg		
	Total cost	Rs Lakhs		
2 (a)	Other solid fuel (Coke in RFCC Unit)			
(i)	Coke consumption	MT/Year	80871	
(ii)	Calorific Value	Kcal / kg	8500	
(iii)	Total Heat value 2 (a) (i)x(ii)x10 ⁻³	Million Kcal / Year	687404	
(iv)	Annual Cost	Rs Lakhs	*	See Remarks
3	Oil			
(i).	Furnace Oil (Internal fuel oil) consumption	Kilo Liter / Year	89590	
(i)a.	Calorific Value	Kcal / liter	8740	
(i)b	Total heat value (3a x 3a (i) x 10 ⁻³)	Million Kcal / Year	783017	
(i)c	Annual cost	Rs Lakhs	8909	
(ii)	Low Sulphur Heavy	Kilo Liter /	-	All liquid may be

	Stock (LSHS) used	Year		expressed in KL
	Calorific Value	Kcal / Liter	-	
	Annual cost	Rs Lakhs	-	
(iii)	Heavy Stock used	Kilo Liters/ Year	-	
	Calorific Value	Kcal / Liter	-	
	Annual cost	Rs Lakhs	-	
4	Diesel Oil / Naphtha			
(i)	Diesel+ Naphtha used for process	Kilo Liter / Year	37653	
(i)a	Calorific Value	Kcal / Liter	7802	
(i)b	Total Heat value 2 (a) (i)x(ii)x10 ⁻³	Million Kcal / Year	293769	
(i)c	Annual cost	Rs Lakhs	5024	
(ii)	Light Diesel Oil (LDO) used	Kilo Liter / Year	-	
	Calorific Value	Kcal / Liter	-	
	Annual Consumption	Kilo Liter	-	
	Annual cost	Rs Lakhs	-	
5.	Gas			
(i)	Compressed natural Gas (CNG) used	Lakh NM3		
	Gross calorific Value	Kcal / 1000 NM3		
	Annual cost	Rs Lakhs		
(ii)	Liquified Petroleum Gas (LPG) used	MT / Year		
	Gross calorific Value	Kcal / Kg		
	Annual cost	Rs Lakhs		
(iii)	Piped Natural Gas used	Lakh NM3/Year		
	Gross calorific Value	Kcal / NM3		
	Annual cost	Rs Lakhs		
(iv)	Refinery gas	Lakh NM3 / Year	1578	
(iv) a	Calorific value	Kcal / 1000 NM3	8061375	
	Total Heat value (iv)x (iv)a x(ii)x10 ⁻⁴	Million Kcal / Year	1272085	
	Annual Cost	Rs Lakhs	**	See Remarks
6.	Biomass		-	
	Average moisture content	%	-	
	Gross calorific Value	Kcal / kg	-	
	Annual Consumption	MT	-	
	Annual cost	Rs Lakhs	-	

8	Total Thermal Energy used for process (2a (iii) + 3(i)b + 4 (i)b + 4 (iv) a)	Million Kcal / Year	3036275	
9	Total cost of Thermal Energy used for process (3(i)c + 4(i)c)	Rs Lakhs	13933	
10.	Product Mix			
	LPG	MT	245133	
	MS (Normal)	MT	524137	
	MS (Premium)	MT	24029	
	Naphtha	MT	189286	
	SKO	MT	829430	
	HSD	MT	2232394	
	HSD (ULS)	MT	200460	
	HSD (EURO III)	MT	7833	
	LDO	MT	9110	
	LSHS	MT	66305	
	RPC	MT	147113	
	CBFS (High BMCI)	MT	12899	
	SLACK WAX	MT	-	
	PARAFIN WAX	MT	-	
	SULPHUR	MT	6215	

Specific Energy Consumption

11	Crude oil processed	MT	5082546	For Oil Refineries
12	Specific consumption of Electricity	KWh / Mt crude oil processed	42.2	
13	Specific consumption of thermal energy for process	Million Kcal / MT	0.597	

Specific Energy Cost

14	Crude Through put	Bbl (MT/0.860/.159)	37169416	Density of crude will vary from refinery to refinery.
15	Specific energy cost (Electricity) (e) / (9)	Rs / MT of crude T'put	140.15	

16	Specific energy cost (Thermal) / 9	Rs / MT of crude T'put	274.13	Excluding cost of fuel gas which is by product and RFCCU coke which is process energy generated and consumed in the plant itself.
17	Specific energy cost (Electricity) (e)x10 ⁵ /45.31/ (9)	\$ Per bbl of crude process	0.42	Exchange rate considred is 45.31 Rs / \$
18	Specific energy cost (Thermal) / 9	\$ Per bbl of crude process	0.83	

Remarks:

- * RFCCU coke has not been valued as it is part of process. It is generated and consumed in the process itself.
- ** Valuation of fuel gas has not been done, as it is a by-product of the plant.

Comments / Suggestions for FORM 1

Comments

1. Name of the unit may be added to identify the specific plant as indicated in serial number 2 under general information.
2. Year of establishment may be added as in serial number 2a. This will indicate the age of the plant and may be a potential plant for modernisation.
3. The sector to which the plant belongs may be included as in serial number 3.
4. Instruction may be given to fill up the format explaining the terms. For example the term "COONNECTED LOAD" is misinterpreted by industry.
5. The connected load in serial number 1(a) is the capacity of power generating equipments, which operates during normal operation of the plant. For example the break up of 52000 kW is (GT 20000 x 2 + STG 12000 x 1) = 52000 kW.
6. Some plants give the figures after adding the rated power in kW of all the motor installed. This point may be clarified.

7. For Oil Refineries, it is recommended to use quantity of crude oil processed in MT per year instead of products. However oil refineries may submit the information on type of products produced.

Suggestions

1. It is suggested to use EXCEL SPREAD SHEET for input data and BEE may have standard formats as input sheet with remaining cells protected.
2. The spread sheet can have history programmed to store the past data on the input cells as comments which are protected and can not be overwritten by the participating plant or industry.
3. The INPUT sheets may have validation sheet programmed in the spreadsheet. The plant submitting data has to validate the data being reported to BEE.
4. The spreadsheet can have built in system for analysing % variation of the data during validation. Comments should appear automatically on validation for % deviation and provision is to be made for nullifying the comments by the industry.
5. The valuation of RFCCU coke and fuel gas can be done in terms of incremental fuel cost for estimating thermal energy cost for all Oil Refineries.
6. Specific energy cost may be added as indicated in serial number 15 to 18.

Form – 2

Format for reporting status of energy conservation measures implemented based on business plan of the company

Year 2003-04

Sl. No.	Description of measure	Category ¹	Investment (Rs Lakhs)	Verified savings ² (Rs Lakhs)	Verified energy savings quantity	Units ³ of energy saved	Fuel ⁴
1	Effective utilization of HRSG	T6	2220	1753.0	18448	KL	O
2	Installation on new vacuum ejector in AVU-II for eliminating circulating water system for barometric condenser	O1	425	149.6	1658	KL	O
3	Commissioning of Air Coolers in AVU-II for minimizing circulating water consumption	O1	200	60.0	632	KL	O
4	Commissioning of APC in AVU I/II/III	P3	71.25	200	2105	KL	O

Year 2004-05

1	Trimming of impellers of feed pump in Coker-B.	E6	Minor	31.7	960000	kWh	E
2	Insulation of four LSHS tanks	T10	60	86.5	870	KL	O
3	Revision of stack damper of AVU-I	R9	Minor	1.4	14	KL	O
4	Installation of HERO oil guns in AVU-I	R3	3.3	3.2	32	KL	O
5	Installation of coalescers in AVUs	L3	51	1.0	7.5	KL	O

¹ Use "C" number of form 3 as reference

² First year

³ Use conventional energy, volume or mass units with proper prefix k = 10³, M = 10⁶, G = 10⁹

⁴ State which type of fuel or energy was saved (C = coal, B = biomass, O = oil, G = gas, E = electricity). If coal was saved state which grade i.e. C/I = imported, or C/F coal of grade F.

Comments / Suggestion on Format 2

1. It is suggested to use this form for energy conservation projects already implemented during at least previous two years.
2. This form will indicate the type and category of energy saved.
3. A list of categories is to be supplied to industries as FORM 3 for identifying categories.
4. Investment and savings may be reported as Rs Lakhs as indicated in the form.
5. There was no difficulty faced during in filling up this form.
6. This form is based on experience in Oil Refinery and it may differ with that of other industries.
7. This form may have one more sheet for indicating ongoing energy conservation projects with target.

Form - 3

Executive Summary of appraised Energy Conservation potential as identified in energy auditor report
As on 31.03.2005

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ¹ savings (MT/Year)					First year cost reduction ² , Lakh Rs.					Life cycle years ³
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
T10	Insulation of nine numbers of RCO / LSHS tanks	136	1800					180					10
P1	Installation of BMS in TPS boilers	712	180					18					15
L3	Recovery of Reactor Blow Down in Coker-B	117	1200					120					25
T5	Recovery of heat from hot brine ex desalters in AVU I / li	32	600					60					20
T5	Heat recovery from RFO stream in Coker-A	106	1700					170					20
M3	Hydrogen recovery from CRU off gas	488	8000					1200					20
L2	Flare Management system	57	1200					120					20
L3	Installation of TPI in ETP	110	150					15					20
E2	Stoppage of CRU cooling Tower by integrating with Process Cooling Tower	66	390					39					20

¹ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

² Anticipated cost savings in the first year based on anticipated fuel savings.

³ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

Form - 3

**Executive Summary of appraised Energy Conservation potential as identified in energy auditor report
As on 31.03.2005**

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ⁴ savings (MT/Year)					First year cost reduction ⁵ , Lakh Rs.					Life cycle years ⁶
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
M1	Yield and Energy optimization in AVU I / II	4000	6400					640					25
R3	Installation of LP burners in AVU III	25	920					95					15
T5	Routing of CBD flash steam ex boilers to deaerator	30	200					20					20
T15	Recovery of steam condensate in CRU	8	100					10					20
T15	Revamp of steam condensate facility from old process units and offsite	200	480					48					20
L1	Installation of flare gas recovery system	800	1500					155					20
T1 / T9	Replacement of old steam turbines with new TG & boiler	15000	1200					124					25

⁴ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

⁵ Anticipated cost savings in the first year based on anticipated fuel savings.

⁶ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

Form – 3 (List of Categories)

Executive Summary of appraised Energy Conservation potential as identified in energy auditor report

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ⁷ savings (MT/Year)					First year cost reduction ⁸ , Lakh Rs.					Life cycle years ⁹
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
T	Thermal Energy												
1	Replacement of inefficient boiler with efficient one												
2	Replacement of inefficient furnace with efficient one												
3	Installation of steam reboilers instead of inefficient furnace (Example steam reboilers for naphtha splitter reboiler furnaces)												
4	Recovery of waste heat from furnaces / boilers / Waste heat Boilers (installation of economizer and APH/ revamp of APH)												
5	Recovery of waste heat from process heat (Flash steam recovery, recovery from hot products etc.)												
6	Heat recovery from power generation (Exhaust of Gas Turbine)												
7	Heat integration between process units or between Thermal Power Plant and Process Units)												
8	Low level heat recovery (for production of cold water for process / Air conditioning)												

⁷ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

⁸ Anticipated cost savings in the first year based on anticipated fuel savings.

⁹ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ¹⁰ savings (MT/Year)					First year cost reduction ¹¹ , Lakh Rs.					Life cycle years ¹²
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
T	Thermal Energy												
9	Improvement of prime mover performance such as gas, steam, water turbines or internal combustion engines.												
10	Improved insulation on hot / cold pipe hot or cold pipes / equipments (Example - Mineral wool to calcium silicate or PERLITEMP for steam pipes for hot)												
11	Up gradation of insulation in furnaces / boilers (Ceramic fibers/ insulation brick)												
12	Application of ceramic coating in furnace												
13	Use of combustion improvers like fuel oil additive.												
14	Online cleaning of convection banks in furnaces / boilers												
15	Installation / Modernization of condensate recovery system												
16	Improvement in steam distribution system												

¹⁰ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

¹¹ Anticipated cost savings in the first year based on anticipated fuel savings.

¹² Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ¹³ savings (MT/Year)					First year cost reduction ¹⁴ , Lakh Rs.					Life cycle years ¹⁵
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
S	Energy Substitution												
1	Substitution of fuel oil with natural gas for energy cost reduction												
2	Substitution of electricity use in specific equipment with renewable energy source e.g. solar, wind etc.												
R	Retrofitting												
3	Retrofitting of low excess air oil / gas burners												
4	Modification of oil preparation and heating system												
5	Replacement of defective steam traps												
6	Installation of glandless valves in steam service												
7	Installation of steam traps in copper tubings												
8	Replacement of damaged insulation												
9	Other Retrofittings												

¹³ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

¹⁴ Anticipated cost savings in the first year based on anticipated fuel savings.

¹⁵ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ¹⁶ savings (MT/Year)					First year cost reduction ¹⁷ , Lakh Rs.					Life cycle years ¹⁸
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
O	Resource Optimization												
1	Reduction of water consumption in plant												
2	Recycling of effluent water for reuse												
P	Process Monitoring / Instrumentation & control												
1	Combustion control system in boilers / furnaces												
2	Distributed Digital Control System for process Units / Thermal power plant												
3	Advance process control for process units												
4	Installation of online oxygen analyzer in boilers and furnaces												
5	Installation of online temperature measuring instruments												
6	Installation of meters for fuel and utilities												

¹⁶ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

¹⁷ Anticipated cost savings in the first year based on anticipated fuel savings.

¹⁸ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ¹⁹ savings (MT/Year)					First year cost reduction ²⁰ , Lakh Rs.					Life cycle years ²¹
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
M	Modernization / Revamp												
1	Yield and Energy optimization in process units												
2	Revamp of heat exchanger network in process units												
3	Recovery of hydrogen from fuel gas system												
L	Hydrocarbon Loss control												
1	Installation of flare gas recovery system												
2	Installation of fuel gas header pressure management for minimizing flare loss												
3	Action plan for minimizing slop generation												
H	Better House Keeping Measures / Improved operation & Maintenance Practices												
1.	Leak Detection & Repair System (LDAR) for utilities (steam/air/water) / Online sealing of steam leaks.												
2	Leak Detection & Repair System (LDAR) for hydrocarbon												

¹⁹ Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

²⁰ Anticipated cost savings in the first year based on anticipated fuel savings.

²¹ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

C. No.	Area of improvement and modification	Investment Lakh Rs.	First year energy ²² savings (MT/Year)					First year cost reduction ²³ , Lakh Rs.					Life cycle years ²⁴
			oil	gas	coal	electricity	other	oil	gas	coal	electricity	other	
E	Electrical Energy												
1	Measures in the area of lighting												
2	Sizing, changing and controlling electric motors including variable speed drives												
3	Retrofitting, modification or sizing of fans, blowers, pumps, including duct systems												
4	Performance improvement of compressors and compressed air distribution system												
5	Loss reduction in transformers and power distribution within firm												
6	Trimming of pump impellers												
7	Installation of FRP blades in cooling tower fan and Air Fin Coolers												
8	Replacement of low efficient motors with high efficient motors												
9	Installation of capacitor banks Improvement in power factor												

²² Use commercial units of litre, kg, tons, normal cubic meter, kWh or MWh and indicate the unit. Indicate the anticipated potential in energy savings.

²³ Anticipated cost savings in the first year based on anticipated fuel savings.

²⁴ Estimate the predicted life of the measure, meaning the number of years the level of first year energy savings or even larger amounts will materialise.

Name of the company : Indian Oil Corporation Limited
Name of the Unit / Plan : Barauni Refinery
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:
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:
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Comments / Suggestion

1. Format three may be used in two purposes. One as report as on end of financial year or as on date of audit and the second as list of identified energy saving opportunities.
2. The list of categories indicated above is typical for Oil Refinery.
3. There was some level of difficulty faced for filling up the categories.