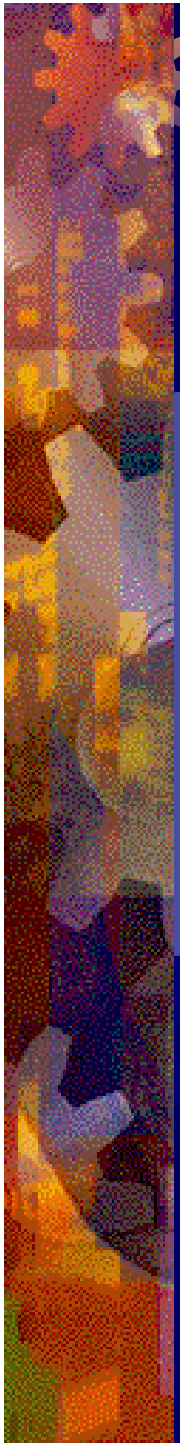
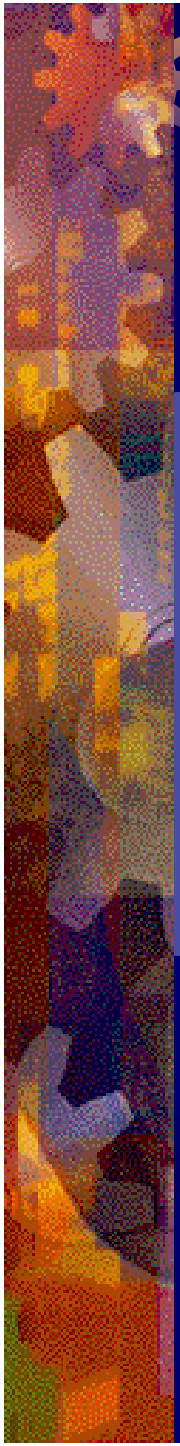


Turbine Cogeneration Technology for Energy Efficiency in Industry

TurboTech Precision Engineering Private Limited

Bangalore



The Problem

ELECTRICITY COSTS ARE RISING RAPIDLY, SQUEEZING OPERATING MARGINS

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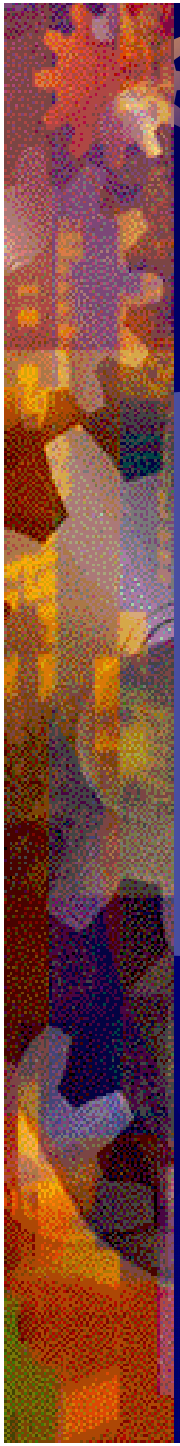

The Solution

MAKE THE PLANT AS ENERGY EFFICIENT AS POSSIBLE, PREFERABLY USING EXISTING RESOURCES

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Cogeneration: Best Option for All Process Industries

- COmbined GENeration of heat and power
- Most steam users can now benefit from cogeneration, regardless of size
- Promoted by all national and international agencies involved in energy efficiency

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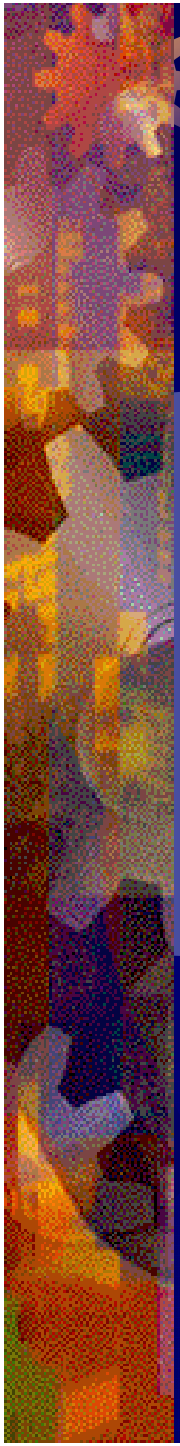

The Hidden Resource

- Steam is generated in industry at higher than required pressure
- Usage pressure is generally much lower than generation pressure due to constraints in steam generation
- In a typical case high pressure saturated steam is obtained at 16 bar and is used at 3.5 bar Saturated for process
- Steam is let-down in a Pressure Reducing Desuperheting Station (PRDS)from HP Header Pressure to the Usage Pressure

The Hidden Resource (contd)

- The Pressure Energy (Potential Energy) is converted to useless Turbulence & Noise in the PRV
- This Pressure Energy can be converted to Useful Electrical Power by passing the steam through a Back Pressure Steam Turbine (BP Turbine)

Current Scenario

NO POWER GENERATED

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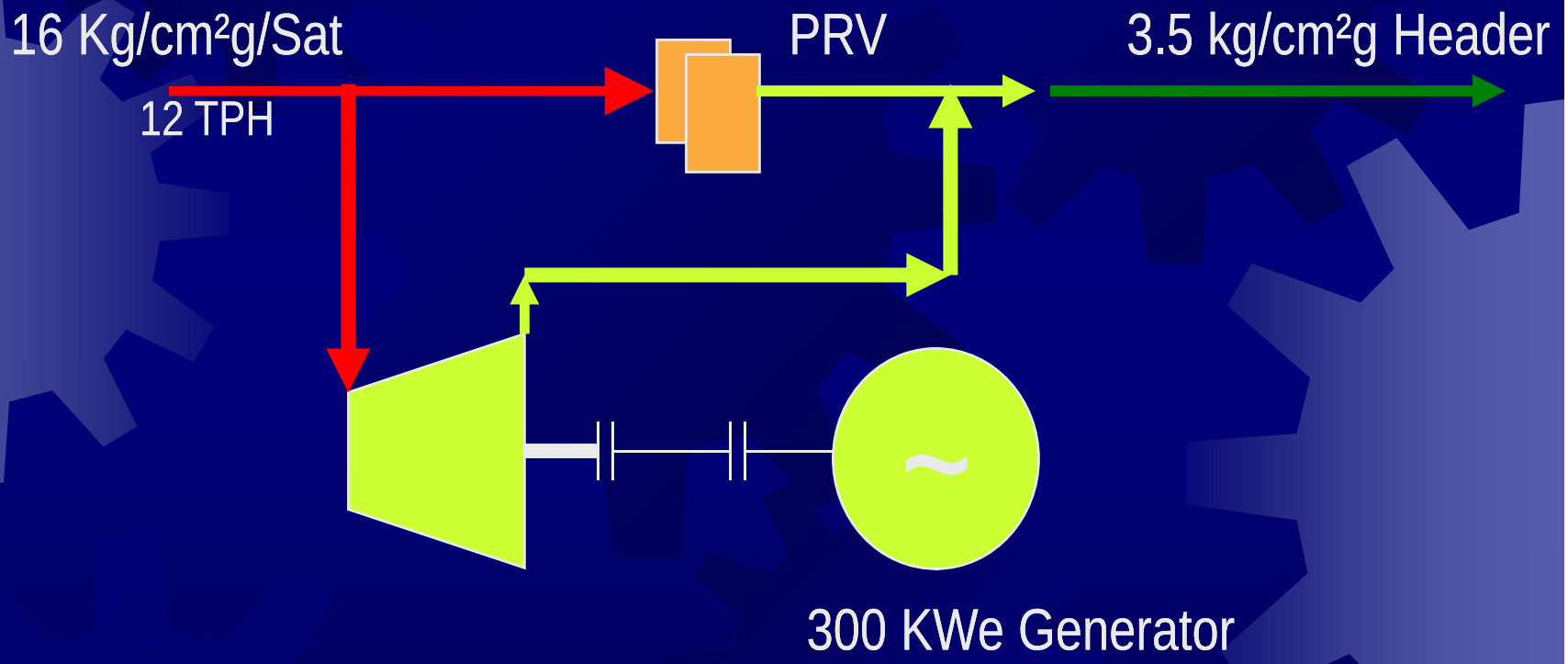
TurboTech Solution



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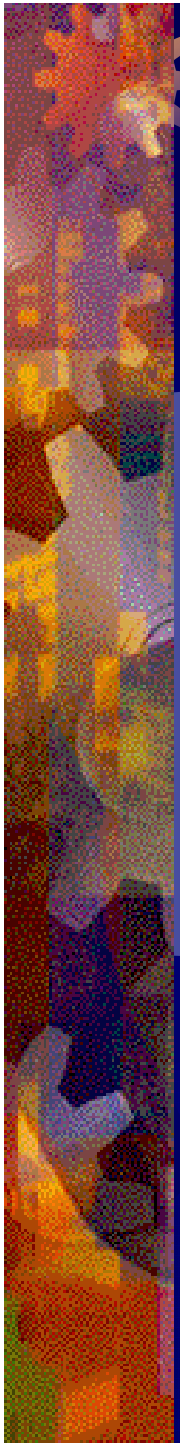

TurboTech Solution

- Install back pressure steam turbine for incidental power
- Steam from 16 kg/cm²g/Saturated is brought down to 3.5 kg/cm²g @ 12 TPH for Process
- In the process generate Incidental Power of 300 Kwe
- Save Rs. 105.0 Lakhs annually on power (Based on current cost of power of Rs. 5 per unit)

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TurboTech Solution

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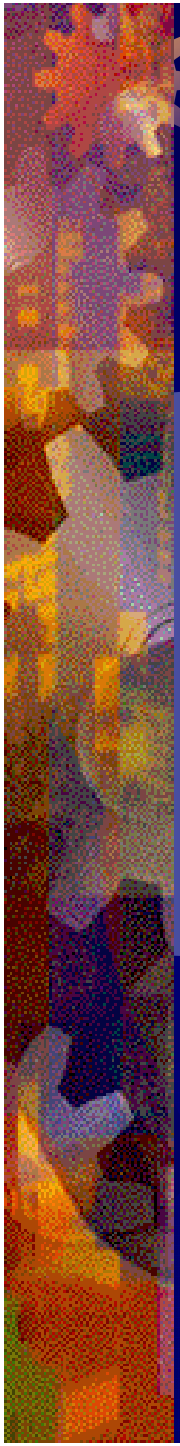

Operating Principles of a Simple BP Steam Turbine

- Pressure Energy in the steam is converted to high velocity in the nozzle (about 1,800 km/hr)
- The high-velocity steam is impinged on the blades on the turbine wheel, which are thus given a “kick” (impulse)
- The turbine wheel rotates the generator to produce electricity

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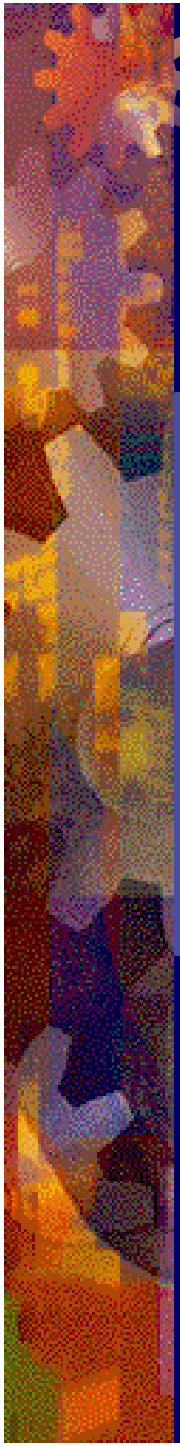
What Happens to the Steam?

- The steam pressure is reduced to the controlled usage pressure, and then flows to the process



Desirable Features for a Process Steam Turbine

- Must operate on any Steam
- High efficiency for min. payback period
- Light-weight and compact for ease of installation in cramped space
- Precisely controlled back pressure to plant

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ECT Steam Turbines

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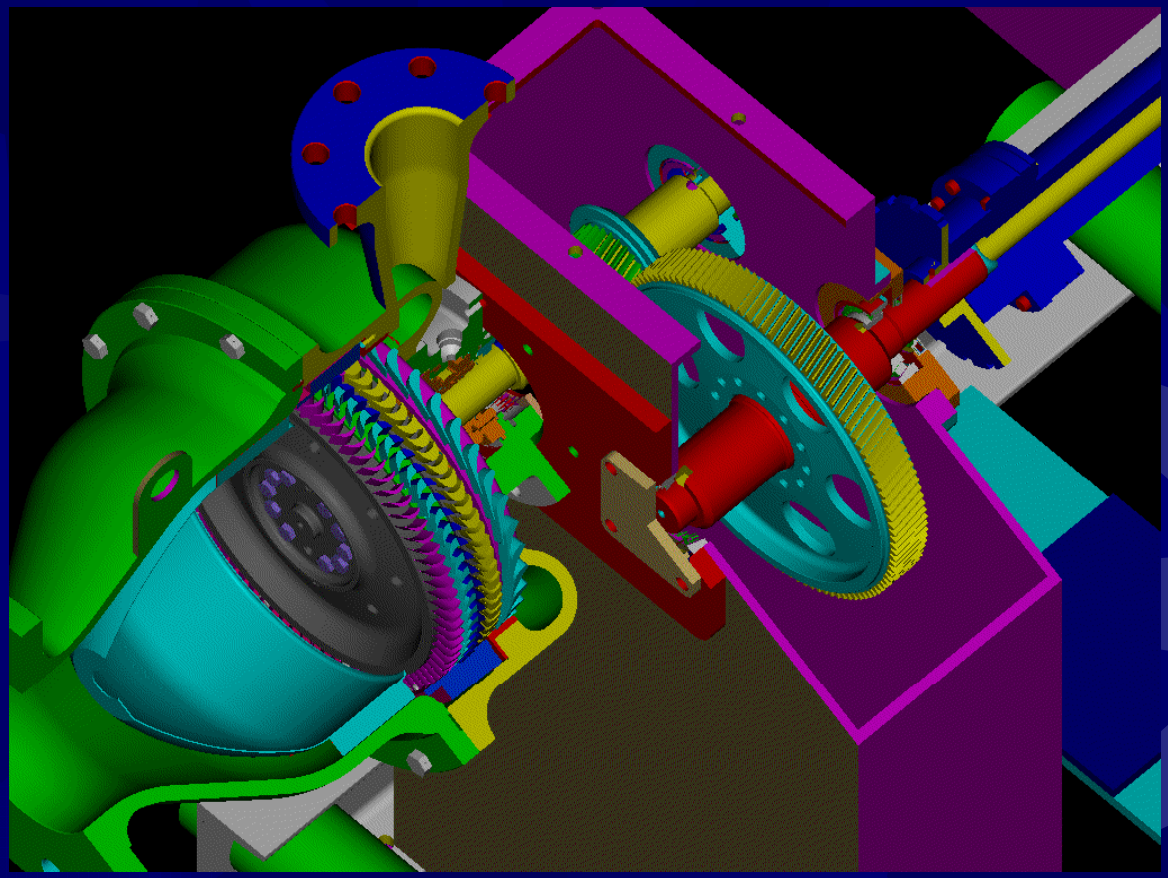
ECT Steam Turbines



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The ECT: Precisely Designed for Industry

- Operates using existing Steam available(Minimizes investment)
- Best efficiency in its size class (10 – 20% better)
- Less than 3 tonnes weight and very compact (W x L x H : 5’ x 10’ x 6’)
- Precise Plant Steam Control

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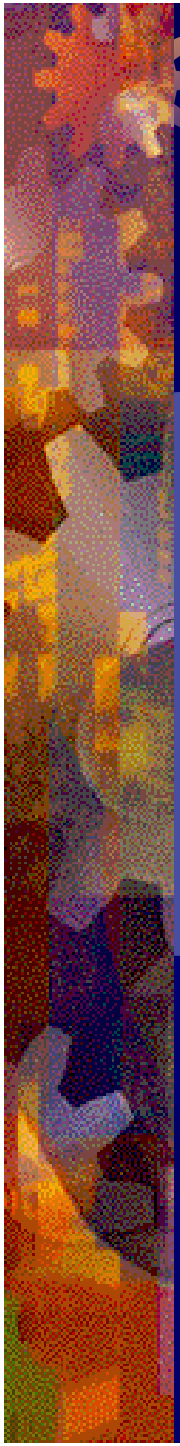

Description of ECT

- Impulse/ Curtis Stage turbine, directly coupled to Step-Down Gearbox, driving an Generator
- Power Rating: 75 to 500 kW
- All steam-wetted parts are Stainless Steel for long corrosion-free life
- Turbine is machined from a solid Hardened Stainless Steel forging for maximum life in any Steam service
- Precision CNC milled aerodynamic blading

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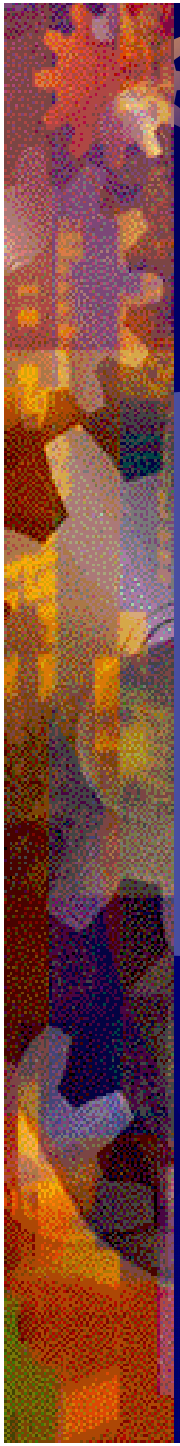
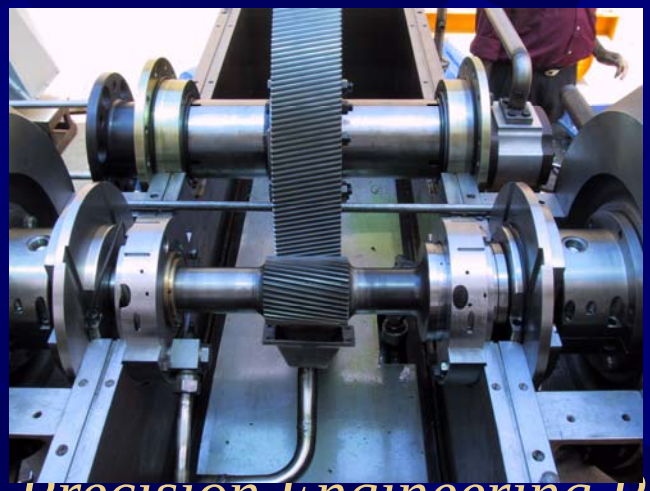


Description (contd.)

- Hardened and ground Precision Helical Gears for long-life, low noise and high efficiency
- Unitary Skid for all equipment, single compact unit, factory assembled, aligned and tested, ready for hook-up to steam and electrical services at site
- No civil work foundations required, as skid is mounted on Anti-Vibration Rubber Mounts

Description (contd.)



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Description (contd.)

- Minimum plant impact, with steam pressure control within +/- 0.1 kg/cm^2
- PLC Controls for maximum ease of use
- Redundant in-built safety features
- Multi-sensor Fail-safe trip system
- Fully automated, No dedicated operator required

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Payback Details

- Investment:
  - ECT system
  - IBR Piping
  - Electrical hookup
  - Services : water, instrument air
- 80% Depreciation allowed in First Year according to current IT Rules
- Payback : 9 Months – 2 Years

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Project Cost

300 Kwe Installation

Rs.in lakhs

Turbine basic cost	39
E.D(16.32%)	6.36
C.S.T(4%)	1.81
Supervision of Erection	3
Freight	0.2
Expansion Bellows	0.6
Turbine Erection	1
Electric Cabling	1
Steam Piping etc.	2
Civil Work	0.5
Miscellaneous	1
Less modvat	6.36
TOTAL INVESTMENT	50.11

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Payback Analysis

Power cost	5.0 Rs./unit
No.0f hours per year	7200 hrs.
Power generated	300 kw
Savings in power per year	108 Rs.(lakhs)
Cost of machine + installation	50.11 Rs.(lakhs)
Payback	**6 months**

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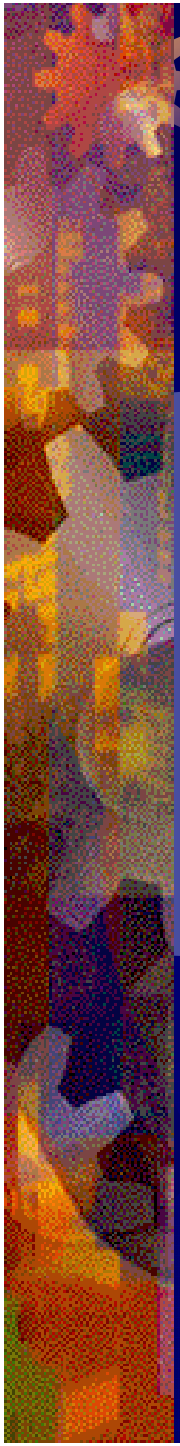

Why 300 KW ECT Now And Not 2 MW COGEN Later?

- Cost of 2 MW power plant would be Rs. 5.0 + cr.
- Delivery and time for commissioning would be 24 months approx.
- During this time ECT would generate Rs.1.5 cr. Approx. after paying itself back
- ECT could be then used to generate atleast 150 KW of extra power across the deareator PRV saving another Rs. 50 lakhs p.a.

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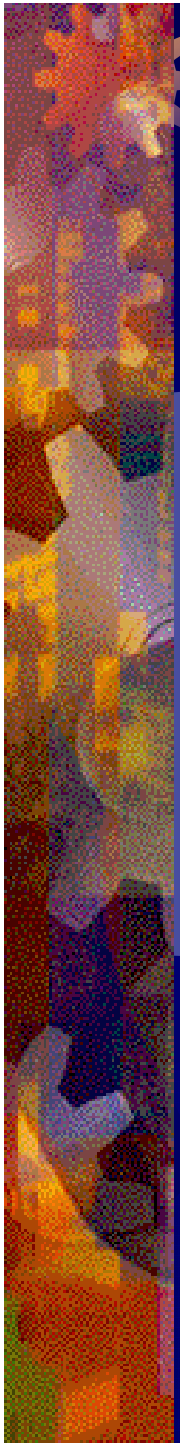

Why Sat. Steam Turbine and not Super Heated Turbine

- Super heated(SH) turbine requires a superheater in the boiler. Hence Cost
- SH turbine requires a desuperheater down stream as all processes use sat steam. Involves investment and running cost
- SH boiler requires de-min water. Again investment and running cost
- Lastly and not least INCREASE IN FUEL CONSUMPTION in SH steam boiler (approx. 15-22% increase)

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Comparison of power generation with Sat steam and SH Steam

COST COMPARISION FOR SATURATED V/S SUPERHEATED STEAM				
	Parameters	Units	Superheated steam	Saturated steam
1	Inlet pressure into turbine	kg/cm2g	42	42
2	Inlet temp. into turbine	Deg.C	440	sat(238.3)
3	Outlet pressure out of turbine	ata	3.5	3.5
4	Inlet enthalpy of steam	KJ/kg	3305	2800
		kcal/kg	789.5365504	668.8963211
5	Enthalpy of feed water	kcal/kg	50	50
6	Heat added in boiler	kcal/kg	739.5365504	618.8963211
7	Fuel used	bagasse		
8	Calorific value of fuel	kcal/kg	2200	2200
9	Efficiency of boiler	%	68	68
10	Nett energy required in boiler	kcal/kg	1087.553751	910.1416486
11	Amount of steam generated from a kg of fuel	kg	2.022888523	2.41720616
12	Cost of fuel per kg	Rs./ton	1000	1000
		Rs./kg	1	1

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Comparison of power generation with Sat steam and SH Steam

13	Cost of steam	Rs./kg	0.494342614	0.413700749
14	Water treatment costs	Rs./kg	0.2	0.1
15	Total steam cost	Rs./kg	0.694342614	0.55837038
16	Exhaust Enthalpy of steam	KJ/kg	2972	
		kcal/kg	709.9856665	
17	Amount of heat lost in desuperheating	kcal/kg	41.08934544	
18	Total heat in desuperheating	kcal	410893.4544	
19	Nett steam generated in desuperheating	kg./hr	614.2857143	
20	Boiler capacity	TPH	10	10
21	Nett steam generated	TPH	10.61428571	9.2
22	Wetness of steam	%		0.92
23	Loss of steam generation			0.8
24	Amount of fuel required for amount of steam prod	kg./hr	4943.426139	4137.007494
25	Amount of steam per unit of power	kg/kw-hr	12.48739496	15.20661157
26	Cost of steam for power alone	Rs.	1359.722341	446.6963038
27	Power generated	KW	850	605
28	Cost of power	Rs./unit	1.599673343	0.738340998
29	**Extra Power due to superheated steam**	KW	245	
30	Cost of Extra Power due to superheated steam	Rs./unit	**5.549887108**	

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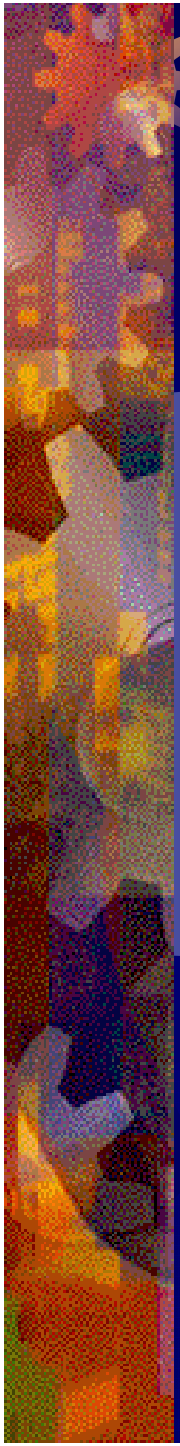

Acknowledgement

- We have 62 installations in operation nation-wide and 20 more in execution. We gratefully acknowledge the encouragement and support of our customers.

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Conclusion

- Turbine Cogeneration Technology offers exciting opportunities for energy cost savings to Industry.

- TurboTech is committed to servicing the needs of the Industry, with innovative and cost-effective products.

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