Heavy Water Plant (Manuguru)

Introduction

Heavy Water Plant, Manuguru is an ISO-9001(2000) & 14001(1996) Certified Organisation, owned by Heavy Water Board, Mumbai, Department of Atomic Energy, Government of India. It produces 185 MT/year of Nuclear Grade Heavy Water (D_2O) with high Safety, Quality and Environment standards. The main aim of the organisation is to ensure Safe & Efficient operation of the plant, Compliance of Statutory Requirements and Protection of the Environment.

Location

HWP(M) is situated on the banks of river Godavari, at Mittagudam village, about 12 kms away from Manuguru, in Khammam district of Andhra Pradesh. The nearest railway station is Manuguru which is about 6 kms away from the site by road. The geographical location of the plant lies in between the latitudes 18^0 - 52' N and 18^0 - 53'N & Longitudes 80^0 - 51' E and 80^0 - 52'E. The average elevation from the mean sea level is 60.5 M.

Neighbourhood Industries

The following major industries are located within 50 km from the site.

a) Singereni coal fields at about 12 km. in NW direction.
b) ITC Bhadrachalam Paper Board at about 25 km in SE direction.
c) Kothagudam Thermal Power Station at about 40 km in southern direction.
d) Nava Bharath Ferro Alloys at about 45 km in southern direction.

Principal customers

The principal customer for our product in our country is M/s Nuclear Power Corporation of India Limited (NPCIL) who use our product in their pressurised heavy water based atomic power plants as a coolant and moderator. We have also exported our product to South Korea and China.

Organisation Profile

The brief profile of our work force includes various categories of man power such as Engineers, Supervisors and Operators who are recruited on merit basis. Chief General Manager is overall in-charge of the plant who is assisted by Senior DGM(Operations & Maintenance), DGM(Process), DGM(Utilities), DGM(Engineering Services), Chief Administrative & Accounts Officer and Stores Officer.

Details of our staff, their qualification & skills

Sl.No	Category	Education qualifications	Total
1.	Scientific Staff	Any Degree in Engineering/M.Sc.	140
2.	Technical Staff	Diploma in Engineering/ Degree in Science /Intermediate /ITI	807
3.	Administrative staff	Degree/Intermediate /SSC	85
4.	Auxiliary staff	Basic education qualifications.	343
5.	CISF	SSC/Inter/Degree	242
	Total		1617

In addition to the above, about 500 contract workers are also working daily. The freshly recruited persons are trained for one year in various plant aspects including one month exclusive training in Safety & Environment. Further regular training is imparted by conducting a monthly three days seminar on Safety, Environment and Fire aspects in which about 25-35 employees of Operation & Maintenance sections participate. Specific qualification programme exists for operating and maintenance personnel where the staff undergoes written tests, walk through interview and final qualification interview.

Energy conservation commitment, policy and set up

In energy intensive industries like Heavy Water plants, where energy constitutes about 70 - 80% of the operating cost, it is extremely important to reduce specific energy consumption by all means to reduce unit cost of the product. Heavy water plant (Manuguru) is committed to well defined energy policy formulated by Heavy Water Board. The policy in our case is to pay focussed attention to all aspects of plant operation and maintenance activities with a view to reduce energy consumption and also identify and implement plant modifications that can result in energy saving with specified limit on pay back period for the capital invested. The energy policy was translated into specific objectives and these objectives are given wide publicity in the plant. Matching action plans are evolved for implementation of energy objectives.

Year 1999-2000 was declared as "**Energy Conservation Year**" with a target of reduction in overall specific energy consumption by 10% over the best achieved earlier and the plant could achieve specific energy reduction of 11 %. This was possible due to various Energy conservation measures like maximising the production by operating the equipment at full capacities and also utilising the margins available in the equipment capability, by fine tuning of operating system/process parameters for optimal values, by reducing the plant trips and downtime by good operation and maintenance practices, by maintaining high efficiency of heat recovery exchangers and by implementing energy saving modifications like re-use of treated effluents on a large scale, reduction of the excess heads developed by rotating equipment.

Well defined organisation for energy conservation is set up with an apex committee at site comprising senior officers and Chief General Manager of the plant. The plant is in constant interaction with Heavy Water Board for effective implementation of policy and achieving the objectives. Awareness programmes for all the employees are organised in the form of workshops where experts from various fields of energy conservation were invited to discuss with the employees.

The implementation of the energy conservation is primarily vested with the Chief General Manager who in turn through his team keeps a complete control on energy consumption figures. The Technical Services Group of the plant assist in carrying out periodic energy audits and implement ENCON measures. The responsibility of data compilation, validation and evolving appropriate monitoring parameters lies with the Technical Services Group of the plant. The section also reviews all the modifications and plant trips with participation of senior officers from Operation and Maintenance sections and action plans are identified. Implementation of the identified action plan lies with the Operation and Maintenance sections. The Technical Services Group monitors execution status and feed back of modifications. Coordination of capital schemes aimed at conserving energy are also being implemented by the Technical Services Group in liaison with Design group in Heavy Water Board.

Energy consumption pattern and specific energy consumption figures are reported in the weekly and monthly performance reports of the plant prepared by Technical Services Section. For enhancing the awareness of plant personnel about energy conservation, loss indicators are identified and widely publicised.

Annual Specific Energy targets are fixed by Heavy Water Board. Action plans for achieving the same are worked out by the plant. This includes improving the efficiency of the operations and incorporating energy conservation modifications.

As a result of consorted efforts, the plant could bring down the specific energy as given below .

Year	Specific Energy GJ/Kg	% Reduction over Previous best
2002-2003	35.0	7.4
2003-2004	34.7	0.9
2004-2005	32.0	7.3

It is planned to form a dedicated energy conservation cell at each of the plants of Heavy Water Board with an intent of auditing the Heavy Water plants as well as for providing energy auditing services for the various industrial units.

Environment and safety

Heavy Water Plant (Manuguru) uses dual temperature H_2S – H_2O isotopic exchange process, followed by vacuum distillation, for manufacturing nuclear grade heavy water. About 370 MT of Hazardous Hydrogen Sulphide gas is always in closed re-circulation in the system. It calls for very stringent safety requirements for plant as well as for the public around the plant. The Plant takes care of the environmental aspect by firm commitment to Environment Protection and effective implementation of total quality & environmental management system. Plant obtained ISO-9001(2000) & ISO-14001(1996) re-certification recently.

1.5 KM radius area around the plant, termed as " Exclusion zone" is fenced and is in total control of the plant. No outside inhabitation is allowed in this area. 5 KM radius area around the plant, termed as "Sterilisation zone" is in the control of state authorities and population growth in this area is controlled by the state authorities. The population in the sterilisation zone is included in the plant awareness programme and regular interaction is maintained.

During Design stage, adequate precautions are taken in view of the hazardous nature of H2S gas handled in the plant. Salient safety features are listed below :

- Plant is located in remote area having low population density.
- Plant lay out according to the predominant wind direction.
- Elaborate H_2S monitoring system at on-site & off-site areas with audio visual alarm facilities at control room as well as in the field.
- Remote isolation & emergency scram facility for quick isolation and shut down of any section to facilitate safe disposal of H_2S during emergency with a dedicated emergency scram air/instrument air net work.
- Closed vent and drain systems to avoid excursion of H_2S into the atmosphere.
- Breathing air system consisting of 7 nos. of Emergency Breathing Air Shelters which can cater breathing air for 2 hours in case of emergency.
- Sealant facility for pumps and valves for positive isolation/sealing to avoid H_2S excursion into the atmosphere.
- High integrity double disc gate valves with provision of sealing facility for effective isolation.
- Emergency power supply (DG sets & U.P.S.) provision for all critical equipment.
- Two nos. of flare stacks (one Standby) connected to closed vent system to avoid any ground level releases.
- Suitable material selection to withstand the corrosive nature of H_2S.

- Effective communication system to tackle emergencies.
- Well established fire protection and prevention system.
- Elaborate Effluent Treatment facility.
- Well laid out On-Site and Off-Site emergency Plans.

Effluents and Environmental Monitoring

Liquid effluents from the plant : Liquid effluents from the plant consist of treated effluent water from the Effluent Treatment Plant, treated effluent water from neutralisation pits of DM Plants, storm water sewers in Main Plant & CPP and ash pond out let. All storm water drains of Main Plant & CPP including plant wash outs join with ETP guard pond out let and ash pond outlet before discharging into the river Godavari. This is known as combined effluent. Sampling & analysis of this combined effluent is done once in a month. The average values of the various parameters along with the legal limits are given below.

Sl.No	Parameter	APPCB Limits	Achieved Average Values		
			2002	2003	2004
1.	pH	5.5-9.0	8.2	7.8	7.8
2.	Suspended solids (mg/l)	100	31.3	23.76	7.6
3.	Total dissolved solids (mg/l)	2100	302	293.53	234.23
4.	COD (mg/l)	250	24.8	21	11.7
5.	BOD (mg/l)	30	2.5	2.0	3.3
6.	Oil and Grease (mg/l)	10	1.4	1.0	1.0
7.	Sulphide as S^-	2 mg/l	<50 ppb	<50 ppb	<50 ppb
8.	Sulphate as SO_4^{--} (mg/l)	1000	76.2	39.96	48.04
9.	Chlorides (mg/l)	1000	81.9	85.4	45.3

Stack Emissions from Captive Power Plant : The flue gases of two boilers (366 Te/hr each) after being passed through high efficiency Electro Static Precipitators are discharged through the stacks at 110M height. The internal diameter of each chimney is 3.16 M at the top and 5.9 M at the bottom. The main pollutants are NO_x, SPM. Ammonia dosing in the inlet of Electro Static Precipitators (ESP's) was started to increase their efficiency from January-1999. This has resulted in bringing down SPM concentration in flue gas from 250-450 mg/Nm^3 to 80-90 mg/Nm^3 which is well within the prescribed limits of 115 mg/Nm^3 set by APPCB. Monitoring of the stacks is done once in 15 days. The achieved average values of stack emissions during 2002-2004 and the prescribed limits of APPCB are given below.

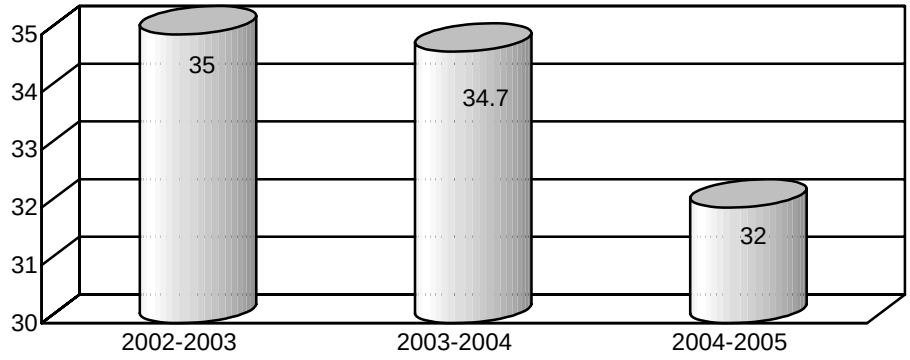
Sl.No.	Parameter	APPCB Limit	Measured Average Values		
			2002	2003	2004
1.	SPM (mg/M^3)	115	97.59	98.0	89.0

Ambient Air Quality Monitoring : Ambient air quality is monitored for SPM, SO_2, NO_x and H_2S within the sterilisation zone of the plant site. 8 numbers of sampling stations are installed for this purpose and monitoring is being carried out continuously for 48 hours at two sampling stations one in upwind direction and other in the downwind direction for each parameter with respect to the plant. This ambient air quality monitoring is done by an authorised agency recognised by APPCB. The frequency of sampling is once in a month. The measured average values from 2000 onwards along with the prescribed limits by APPCB are given below.

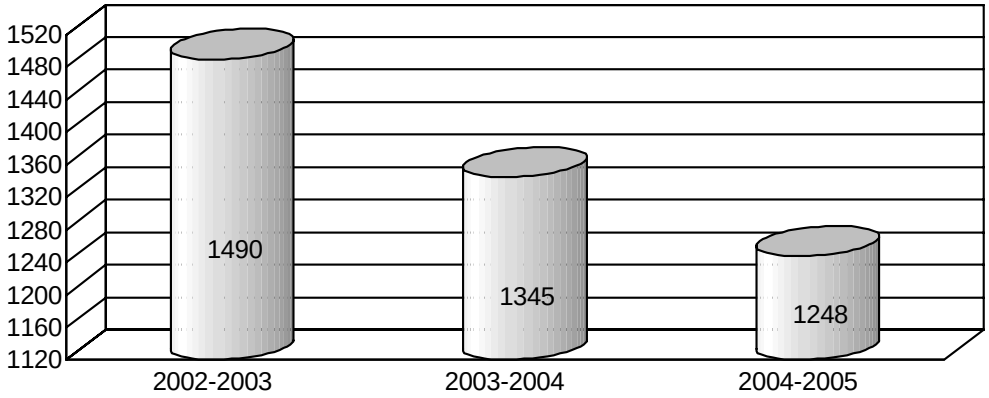
Sl.No.	Parameter	APPCB Limit	Achieved Average Values		
			2002	2003	2004
1.	SPM ($\mu g/M^3$)	200	95.8	94.42	92.02
2.	NO_x ($\mu g/M^3$)	80	9.2	10.08	8.9
3.	SO_2 ($\mu g/M^3$)	80	5.6	6.05	4.7
4.	H_2S ($\mu g/M^3$)	6.9	0.09	0.075	Below detectable limits

The plant energy consumption and cost profiles are given in the following pages.

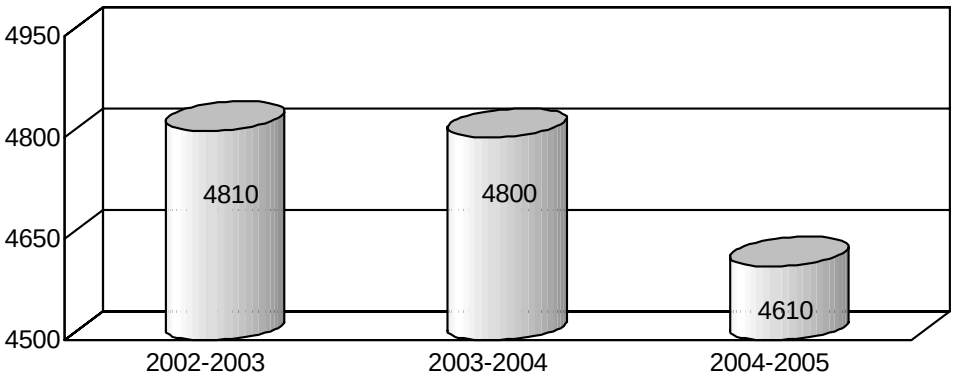
Plant Specific Energy, GJ/Kg



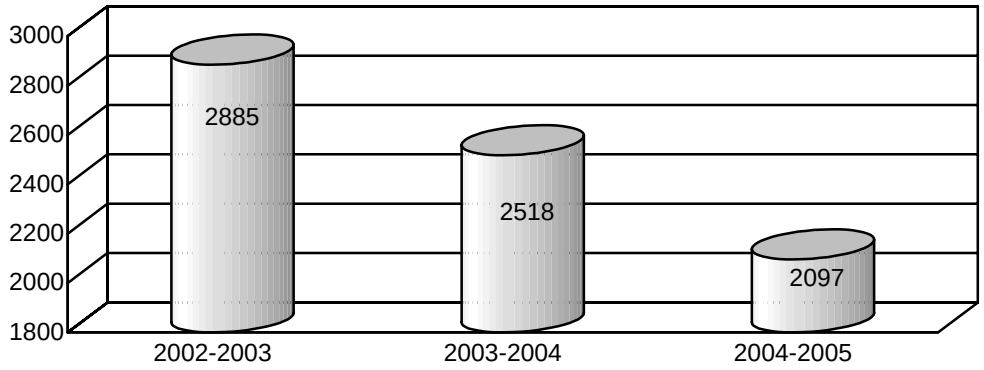
Plant Specific Electrical Energy Consumption, KWH/Kg



Plant Specific Thermal Energy Consumption, MCal/Kg



Specific Electrical Energy Cost, Rs./Kg



Specific Thermal Energy Cost, Rs/Kg