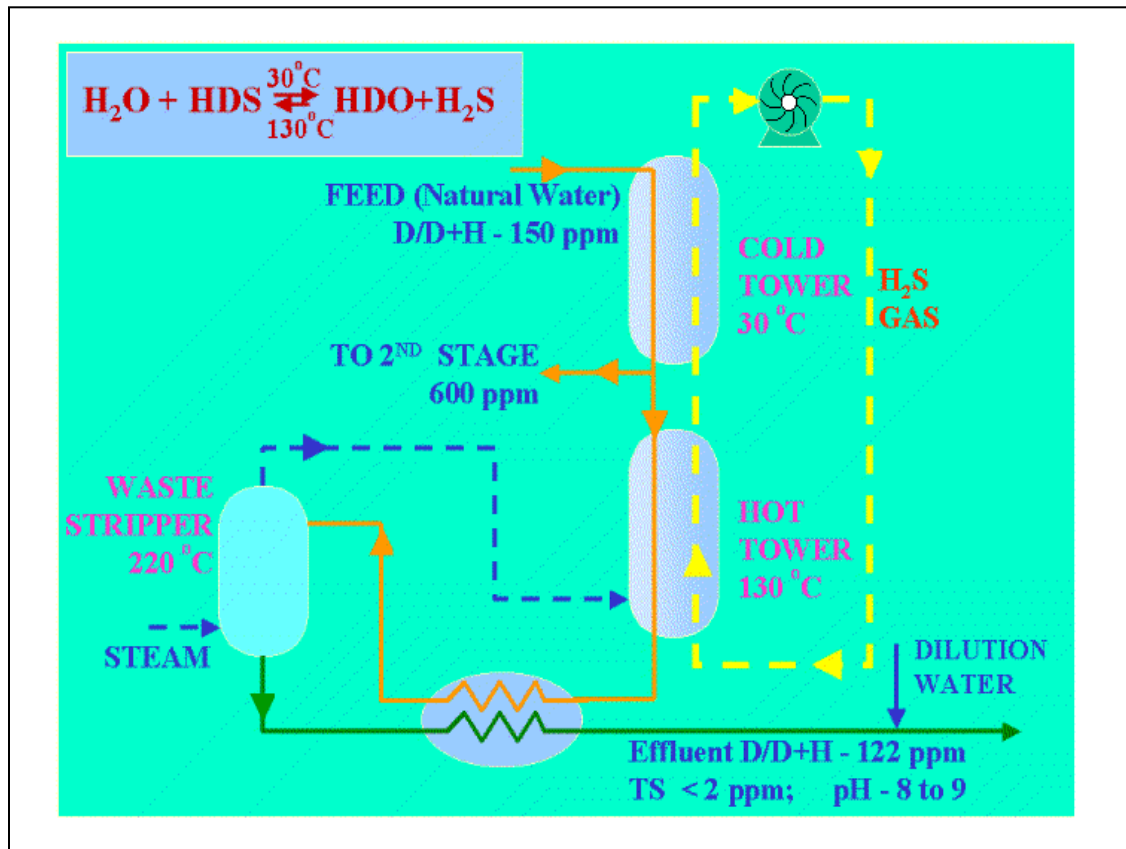


## HEAVY WATER PLANT (KOTA)

### UNIT PROFILE

Heavy Water Plant(Kota), one among the six operating heavy water plants under Heavy Water Board is engaged in the production of heavy water. The heavy water produced is used in natural uranium based Pressurized Heavy Water Reactor (PHWR). Its excellent moderation properties and low neutron absorption cross section make it specially suited for functioning as a primary coolant as well as moderator in the reactors. Plant is located at Anushakti near Rana Pratap Sagar (RPS) reservoir (close to Rawatbhata / Gandhisagar road) in Chittorgarh District of Rajasthan State, about 60 kms by road from Kota City.

The Water drawn from river Chambal containing 150 ppm  $D_2O$ , is demineralised, purified for suspended and dissolved impurities, is fed as process feed water in Exchange Unit & is enriched up to 15% by chemical exchange with  $H_2S$  in Exchange Unit Towers and followed by vacuum distillation to produce >99.9%  $D_2O$ . The exchange unit is arranged in a 3-stage cascade with first stage handling large quantities of process water and  $H_2S$  gas and consisting of three pairs of cold and hot towers operating at  $30^\circ C$  and  $130^\circ C$  respectively. The second and third stages each consist of one pair of cold and hot towers.



The purified water enters the top of cold tower and travels down while hydrogen sulphide gas entering the bottom of the tower meets the water in counter current way on tower internals and the exchange of deuterium takes place. In cold tower the water gets enriched with respect to deuterium while gas gets depleted in deuterium concentration. In hot tower the reverse reaction takes place viz the gas

gets enriched instead of liquid.

The hot tower bottom liquid coming from the first stage is divided into two parts. One part is recycled to the top of humidification section located at the bottom of hot tower for heat recovery while the other part constitutes the waste. Before discarding the waste to the environment it is necessary to recover the H<sub>2</sub>S dissolved in the waste. For this purpose waste stripper is provided to strip H<sub>2</sub>S by direct steam stripping and the evolved gas and steam is put back to first stage hot towers.

The enriched water (1000N i.e. 15% D<sub>2</sub>O) from the 3<sup>rd</sup> stage is stripped off its H<sub>2</sub>S in a product stripper and fed to the distillation unit for further enrichment up to nuclear grade. The dynamic hold up of H<sub>2</sub>S is about 200 Te and extreme care has been taken in the design of the plant, selection of equipment and materials adhering to stringent fabrication procedures and codes to ensure the production of heavy water in a safe manner. H<sub>2</sub>S gas is just a carrier gas and is always in circulation. Periodic make up is done as and when required.

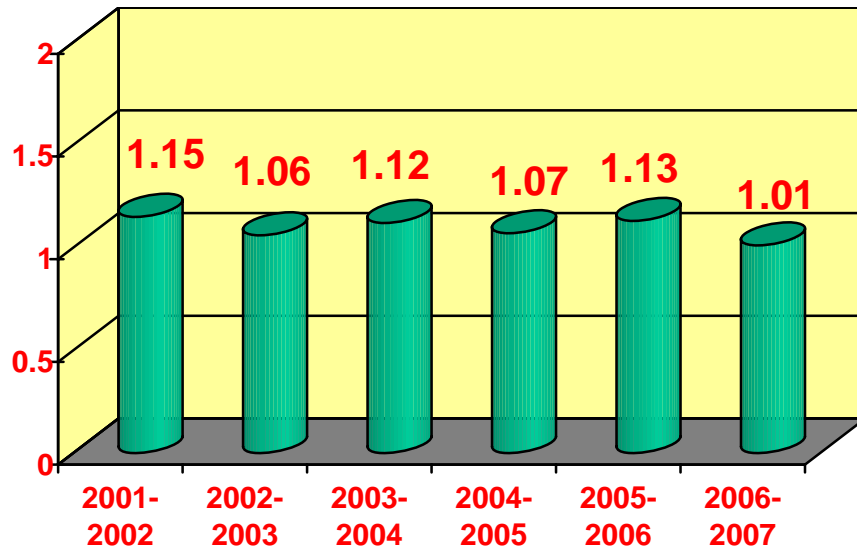
### **ENERGY CONSUMPTION**

Production of heavy water is an energy intensive process. The plant consumes about 103 MT/hr steam & about 13 MW of electrical power. Major part of energy is consumed because of the irreversibility's in the process. Our efforts on reducing their irreversibility is on & we at Heavy Water Plant(Kota) are highly energy conscious. Due to continuous and consistent efforts made by our engineers towards energy conservation programme, Heavy Water Plant, Kota has brought down its specific energy consumption drastically during last few years. The annual consumption of Electricity and steam for the years and total energy for production of one Kg of Heavy Water is given below :-

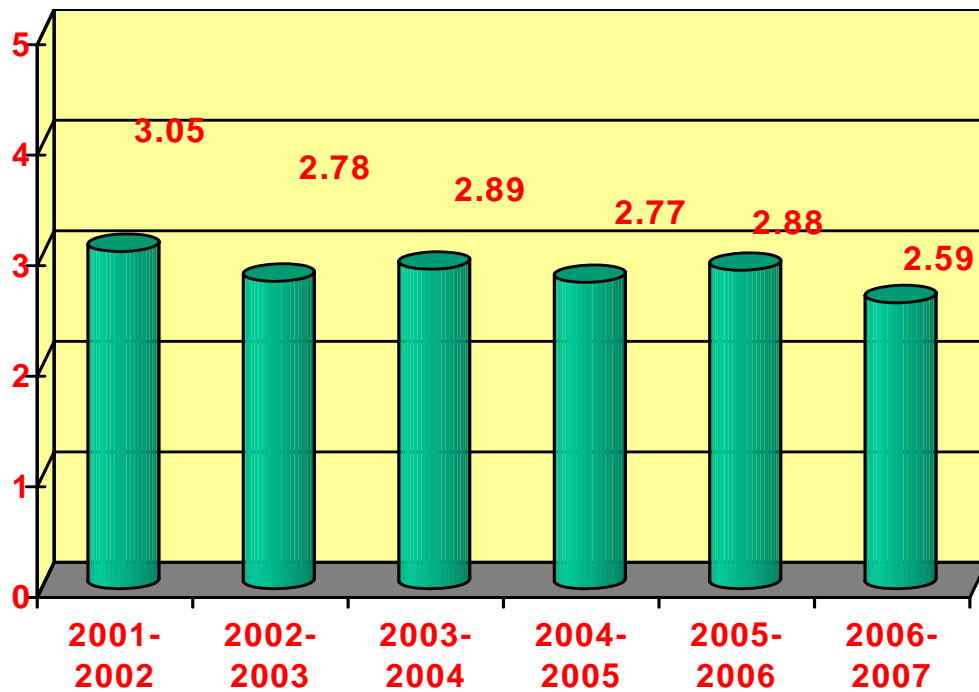
#### **Consumption per Kg of D<sub>2</sub>O production**

	2001-2002	2002-2003	2003-2004	2004-2005	2005-2006	2006-2007
Electricity MWH	1.15	1.06	1.12	1.07	1.13	1.011
Steam MT	8.92	8.05	8.31	7.97	8.21	7.53
(equivalent) MWH	1.90	1.72	1.77	1.70	1.75	1.575
Overall Sp. Energy MWH	3.05	2.78	2.89	2.77	2.88	2.586

TREND OF ELECTRICITY CONSUMPTION  
MWH/ Kg D<sub>2</sub>O

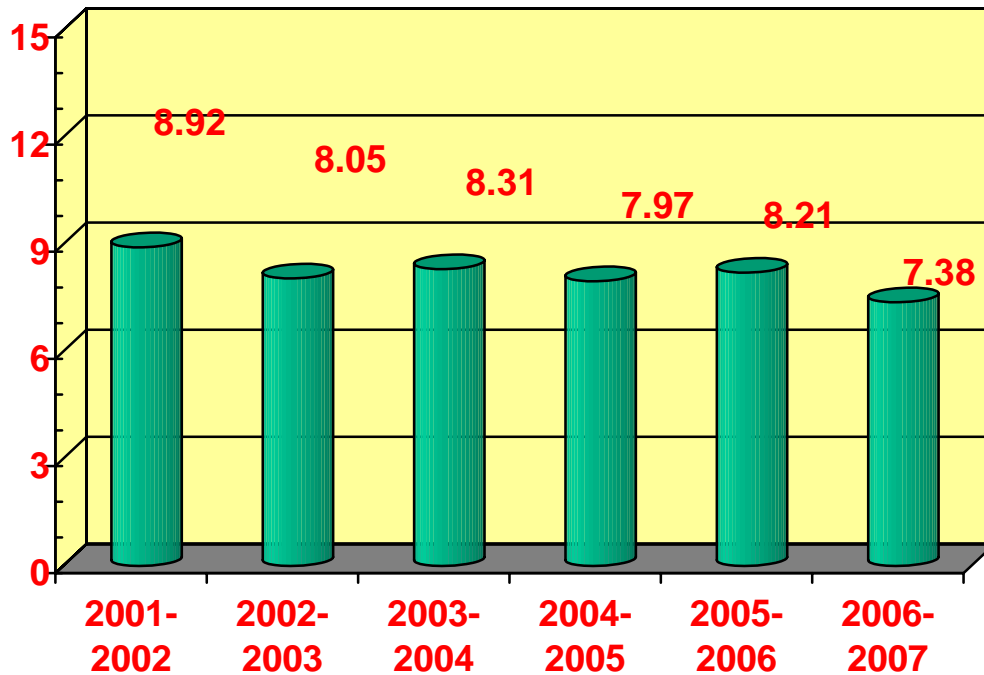


Note: There was major turn around in the year 2005-2006 (once in four year).



TREND OF OVERALL SPECIFIC ENERGY  
CONSUMPTION MWHR/Kg D<sub>2</sub>O

Note: There was major turn around in the year 2005-2006 (once in four year).



### ENERGY CONSERVATION COMMITMENT, POLICY AND ORGANIZATIONAL SET UP :

HWP – Kota being an energy intensive plant, achievement of excellence in the field of Energy Conservation is our policy. HWP-Kota has been continuously striving towards minimizing energy consumption.

Energy conservation campaign was given a boost by declaring the year 1999-2000 as energy conservation year. Subsequently every year new target is set for energy conservation and strategies are worked out to meet these targets. To fulfil the commitments towards energy conservation and realize the targets set, following programmes are continuously formulated and implemented.

**A) Awareness Programmes:**

To create awareness for Energy Conservation among all the employees of the plant, publicity through banners at strategic locations of the plant and organization of slogan and poster competition was done. Display of energy consumption parameters viz. steam, electricity and specific energy consumption was done on daily, weekly and monthly basis at strategic locations. Various training programmes for different level of employees through professional organizations were organized to expose the employees to professional approach towards managing energy conservation.

**B) Group Interaction for worker participation:**

To encourage small group activities entire plant was divided into eight plant sections and small group of employees including operations, maintainers, supervisors and engineers were formed to interact among themselves and suggest possible measures to reduce energy consumption.

**C) Sectional and Plant Level Energy Conservation Review Committee:**

Plant maintenance review committee and plant operational review committee was constituted to review major energy consumers like pumps, compressors, etc., to monitor energy consumption versus duty performed, set target for energy consumption on weekly basis and formulate action plan for achieving the said targets.

Plant level energy conservation review committee is headed by General Manager himself and monitoring of energy consumption on daily basis is done. In-house energy audit was conducted once in a year. The merits as well as investments needed verses payback periods in the form of energy savings are discussed in detail.

**ENERGY CONSERVATION ACHIEVEMENTS :**

The untiring efforts put by plant personnel and encouragement provided by the corporate office particularly by the Chief Executive, Heavy Water Board energy conservation programme has resulted in cumulative 39.0 % reduction in specific energy consumption progressively in the last years taking 1998-1999 as the base year. Most of the energy saving potentials has been exploited during initial three years.

To achieve this, a number of modifications have been implemented. Some of the operational practices and modifications implemented towards energy saving are listed below:

**(a) Operational Practices Implemented:-**

- (1) Re-optimization of operating parameters at its best energy efficiency points taking into consideration the cost of energy and other constraints. This required operation of hot towers at 120°C against design operating temperature of 130°C.

- (2) Sequential and timely startup of machines to minimize idle running.
- (3) Converting steam tracing to electric heat tracing.
- (4) Installation of VFDs to numbers of Electrical Motors.
- (5) To increase stream hours of plant operation, alternate steam line has also been laid from RAPS unit 3/4.

**(b) Modifications completed during 2006-2007:**

S.No.	Energy Conservation Scheme	Saving achieved
1	Two solar heaters (total capacity 1500 ltrs/day) have been provided in canteen to supply hot water. These heaters are design to increase the temperature of water by 40 Deg. C. for 10 months in a year.	69.78 kWh/day (equivalent energy)
2	Replacement of 2280 m <sup>3</sup> /h raw water pump at RAPS with 700 m <sup>3</sup> /h.	150 kW
3	Replacement of filter water transfer pumps with high efficiency large capacity pumps.	20 kW
4	Variable Speed Drive for 3102-PM-25 & 26 XU pump motors.	40 kW
5	Impeller trimming ( 5% ) of 3202-P 5.	26 kW

**ACHIEVEMENTS**

There has been a consistently decreasing trend in the specific energy consumption i.e. MWH/ kg of heavy water produced at HWP-K, as a result of which the plant has achieved –

Heavy Water Plant (Kota) is certified for

- ISO 9001
- ISO 14001
- IS 18001 (OHSMS) (first among DAE units)

Various Awards won by HWPK are listed below:

1. **BEST PLANT PERFORMANCE AWARD** consecutively three years 2001, 2002 & 2003.
2. **Atomic Energy Regulatory Board (AERB) INDUSTRIAL SAFETY AWARD** for its best safety performance among all operating units of Dept. Of Atomic Energy for the year 2000.
3. “**NATIONAL ENERGY CONSERVATION AWARD – 2001**” second prize in Chemical Sector by “Ministry of Power” Government of India.
4. “**NATIONAL ENERGY CONSERVATION AWARD – 2002**” **CERTIFICATE OF MERIT** in Chemical Sector by “Ministry of Power” Government of India.
5. “**GOLDEN GREENTECH INDUSTRIAL SAFETY AWARD**” for the consecutive year 2002-2003 & 2003-2004 among chemical sector by “**GREENTECH FOUNDATION**”.

6. GOLDEN GREENTECH ENVIRONMENT EXCELLANCE AWARD for the year 2002-2003.
7. GREENTECH INDUSTRIAL ENVIRONMENT EXCELLENCE GOLD AWARD 2003-2004.
8. YOGYATA-PRAMAN PATRA from 'National Safety Council of India' in year 2004.
9. "FIRE SAFETY AWARD-2004 by AERB.
10. "SHRESTHA SURKSHA PURASKAR" by "National Safety Council" for the year 2005.
11. RAJ BHASHA SHIELD for the year 2004-05.
12. "SAFETY INNOVATION AWARD" by "Institution of Engineers (India)" for 2006.
13. BEST PLANT PERFORMANCE Award for the year 2005.

***In Year-2007 Heavy water Plant Kota has received –***

- I. "BEST PLANT PERFORMANCE AWARD by HWB, for the year 2006.
- II. "SHRESTHA SURKSHA PURASKAR" by "National Safety Council" for the year 2006.
- III. "SAFETY INNOVATION AWARD" by "Institution of Engineers (India)" for 2007.
- IV. "GOLDEN PEACOCK AWARD" by "Institute of Directors, New Delhi & World Environment Foundation " for Environment Management-2007.
- V. NAGAR RAJ BHASHA SHIELD for the period from January 2007 to June 2007 by Town Official Language Implementation Committee, Kota (out of 70 total Government Office).

**ENERGY CONSERVATION PLANS AND TARGETS**

To achieve further reduction in the specific energy consumption the following modifications are proposed:

<b>Sr. No</b>	<b>Proposed Scheme</b>	<b>Energy saving potential on Annual basis</b>	<b>Present status</b>
1.	Installation of steam turbo generator.	15000 MWh/year	(2.7 mW power generation). civil job is in progress expected date of commissioning Dec'07
2.	Installation of Vapour Absorption Refrigeration Plant using effluent heat.	Increase production of heavy water without taking extra energy will reduce specific energy consumption by @ 2 %.	ECD-Dec'07
3.	VFD for two no. cooling tower ID fans.	353 mWh/year	ECD-Jan'08
4.	Replacement of low efficient fire water pumps with efficient pump.	50 mWh/year	ECD-Jul'08
5.	Replacement of reciprocating instrument air compressor with screw type efficient compressor with low noise level.	610 mWh/year	ECD-Mar'08

6.	Mist spray type effluent cooling tower	225 mWh/year	2008-2009
7.	VFD (four nos.) for CT1 & CT2 Recirculation pumps.	750 mWh/Year	2008-2009
8.	Sodium Sulphate Solution concentrator using effluent heat.	1200 MT/year	2008-2009

### **ENVIRONMENT AND SAFETY**

Environmental protection is given the prime importance in this plant and for this very reason lot of engineered safety features, pollution monitoring equipment and control check points have been provided as a part of normal plant operational routines. Plant effluents are discharged only after adequate treatment. Two independent agencies i.e. Environmental Survey Laboratory situated at Bhabha Nagar and Rajasthan Pollution Control Board monitor these discharges at regular intervals within the plant premises and outside the plant, ensuring that the effluent quality is well within the specified limits. The H<sub>2</sub>S in air/ air quality and plant liquid discharges are monitored continuously with the help of on-line instruments in the plant. Ambient air quality is also regularly monitored as per the guidelines issued by Rajasthan Pollution Control Board.

HWPK is certified by ISO-9001, ISO-14001 and IS-18001 Occupational Health and Safety Management System(OHSMS).

### **Greenery in and around heavy water plant**



To conserve the ozone layer, Refrigeration plant having CFC has been stopped completely. This is being replaced with Vapor absorption refrigeration system utilising effluent heat.

15 meter wide belt on each side of approach road between outer barrier to main guard house has been fenced and the area is being developed as green belt. Planting of trees/shrubs are in progress. Significant number of plants/trees have developed.



**MASS TREE PLANTATION AT PLANT SITE BY THE EMPLOYEES.**



**Rally on World Environment Day**



**AWARENESS ABOUT ENERGY CONSERVATION TO SCHOOL CHILDREN DURING PLANT VISIT AT PLANT SITE**

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