1.0 INTRODUCTION

A study was conducted by CPRI for MERC in the years 2008-09 and 2009-10 to assess the level of achievable technical performance parameters for all stations of MSPGCL except the newly installed 250 MW units. CPRI has recommended schemes into three broad categories (based on the time required to implement and the cost involved) to meet the targeted performance parameters:

- Immediate : below 12 months
- Medium term: 2-3 years
- Long Term : over 3 years

The objective of the study is to assess the implementations of various measures for improvements in achievable performance parameters at Maharashtra State Power Generating Company Ltd (MSPGCL) thermal power stations.

This report pertains to the study of Khaperkheda TPS (Units 1-4).

1.1 Design unit heat rates (UHR) & station heat rates (SHR)

Table 1 (see Annex 2) gives the design UHRs and SHRs of the station for the units under study. Table 2 (see Annex 2) gives the capacity and age of units.

1.2 Performance against targets

Table 3 gives the petitioned, approved and achieved key performance indices (KPI) including SHR for FY 2009-2010, FY 2010-2011 and FY 2011-2012 (till date) for the station under study.

2. STUDY & FIELD VISITS

The study of the MSPGCL is taken up in Khaperkheda during January 1st-2nd week 2012.

3. STUDY & FINDINGS

3.1 Assessment of the overall action plans for implementation of measures and benefits projected and accrued

The measures are classified as:

i. Immediate measures without financial implication (See Annex 3)
ii. Immediate measures with financial implication (See Annex 4)
iii. Medium term measures (See Annex 5)
iv. Long term measures (See Annex 6)

The schemes have been classified into 14 areas for better project management as given in Table 4 (Annex 2).

The summary of the implementation for KhTPS is given as follows:

CPRI Recommendations	Total Nos.	Implemented	Balance
Immediate term – having no financial implication (NFI).	60	59	1
Immediate term – having financial implication (FI).	187	117	70
Medium term measures.	64	30	34
Long term measures.	45	24	21
Not indicated.	198	158	40
Total	554	388	166

The percentage implementation for the total number of measures is 70 %.

The Benefits accrued by the station areas follows

With reference to above subject please find herewith CPRI recommendation data for information and necessary action.

A) 1.**CPRI recommended and implemented CAPEX schemes**:-

Sl. No.	Scheme	Improvement
1	Replacement of HP Heater No.6 in Unit-1 in Jan-2010	Availability of Heater increased
2	Replacement of HP Heater No.6 in Unit-2 in Sept-2010	Availability of Heater increased
3	Replacement of LP Heater No.3 in Unit-2 in Sept-2010	Availability of Heater increased
4	Replacement of Economizer & LTSH coils in Unit-1 in Jan-2010	BTL Reduced
5	Replacement of Economizer & LTSH coils in Unit-2 in Sept-2010	BTL Reduced
6	Replacement of Economizer coils in Unit-3 in May-2011	BTL Reduced
7	Replacement of Economizer coils in Unit-4 in Jan-2011	BTL Reduced
8	Replacement of C.T. Fan blades with FRP blades in Unit-1	Energy Saving

2. Implemented CPRI recommendations:-

a. **Grab cranes for removal of stones from the wagon tippler area**:- Hyva - make, pedestal mounted hydraulic knuckle boom crane with rock grapple unit for picking / lifting of stones from wagon tippler No. 1 hopper is received and work is executed on 8/2/2011.

b. **Rotary pneumatic or electrical hammers may be used for crushing coal lumps at the wagon tippler in place of manual hammering:-** Electrical hammers are put in service at wagon tippler as well as at Track Hopper for breaking coal lumps.

c. **Install the separate flow meter for DM water for each unit:-** DM flow meters are installed in Dec09.

d. **Zero ash leak policy may be adopted:-** AHP- Already in Practice New pipes received consumed. Pipe replacement by used pipes in progress. Further Pipe procurement from H.O .is in process.

e. **Replacement of AVR (automatic voltage regulator) by digital voltage regulator (DVR):-** Material received, being commissioned for U1 in AOH in Jan12.

f. **Implementing fogging dust suppression system at all level from wagon tippling to bunkering:-** i)Fogging system of W/T - 1 & 2 found effective. However proposal is initiated for up gradation/modification of existing DFW make dust suppression system of wagon Tripler. ii) Due to addition of spray nozzles at discharge chutes of RRS/Wobbler feeder i.e incoming chute of all crusher dust level is reduced. iii) Effect / improvement can be seen only after successful installation & commissioning of new Dust Extraction system at crusher house &bunkers at unit 1&2.DPR under process.

g. **Improving the BFP efficiency by overhauling of pump & motors:-** Already in practice. BFP 1A and 3A cartridge replaced. Action plan is prepared for Unit no. 4 BFP.

h. **Formation of quality circles at Khaperkheda TPS:-** Quality circles are formed. Willpower QC of TM got Excellence award & Green belt QC of WTP got Distinguish award at National level competition held at Hyderabad in Dec11.

B) Status of measuring schemes:-

1) Belt weighers:-

A)Belt weighers of Conv. 6A & 6B are in service since April-2007 & Oct-2008 respectively.

B)Belt weighers for Conv. 3A & 3B for total coal to crusher are already installed & commissioned in May-2009.

C) Belt weighers for Conv. 3A & 3B for blended imported coal are installed & commissioned in 3A on 3/12/2010and 3B on 8/12/2010 D) Belt weighers for Conv. 9 & 10 are installed and commissioned for con No 9&10 on dated 25/11/2010

2) Fully automatic pit-less in motion weigh bridges/ wheel impact load detector (WILD) for measurement of coal:-

As per survey of M/s IPA representative along with M/s. Weightech ,40 mtr straight length is required on both directions of pit-less in-motion weigh bridge and the site i.e. Pt. No. 11 of rail track is not feasible. However process to install the same is initiated on trial basis.

3) Wagon Tripler 1 & 2 is integrated in SAP. BOBR will be integrated with SAP in feb 2012.

4) Oil flow meter:- Oil flow meters are installed at Unit No 2,3 & 4. Readings are available at PCR but requires calibration and further tuning. Oil flow meters for unit No 1 is being installed during AOH in Jan 2012.

Fuel oil tank level measurement meters are installed on all tanks. Reading are available at local and through LAN. Software development for determining the oil consumption is in progress.

C) <u>Steam path audit</u>:- Not carried out in any unit.

D) <u>Energy audit</u>:-

Energy audit of CWP, GS Pump and BFP was carried out in Nov 2010 by M/S ERDA.

E) <u>Operational optimization</u>:-

Following practices are being adopted for operational optimization-

a) Booking of generation loss in proper category.
b) Operation of unit on sliding pressure mode.
c) Regular changeover of auxiliaries.
d) Optimization of CBD blow down timings.
e) Stopping of one CWP out of four during winter.
f) Optimizing CT fans during winter as per requirement.
g) Improvement in housekeeping.

F) <u>Zero coal/water /steam leakage policy</u>:-

1) MDV, MOE, MPO are replaced completely during AOH and PF pipes procurement in progress. On line leakage attending contract is already in service. Coal leakages through coal pipes during unit running are attended by cementing. Team is available round the clock.

2) On line leak attending is already in practice for turbine & boiler. The steam/water leakages at OHP & main are attended by availing possible opportunity. On line leakage attending contract is already in service.

3) Weekly review of steam/water /coal/oil leakages is taken in planning meeting and leakages are attended on top priority.

3.2 Assessment of the action plans for implementation of Immediate measures (without financial implication) and benefits accrued

The summary of implementation of the immediate measures (without financial implications) are as follows:

CPRI Recommendations	Total Nos.	Implemented	Balance
Immediate term – having no financial implication (NFI).	60	59	1

The percentage implementation for immediate measures (w/o FI) is 98 %.

Operational changes: Operation in sliding pressure operation in normal operation and use of ATRS during starts has been implemented.

Operational optimization: Operational optimization is being done through monitoring the parameters through GCR. A strong program must be launched for operational optimization (OO) for measure-control through operations-control through maintenance-measure based on the PDCA cycle with close intervals of monitoring and control to 4-6 hours. There should also be close monitoring of DM water make up which reflects on the steam lost through the system.

Leak reduction: Leak reduction is a critical area for the station in improving the performance. Importance must be given to quick response to leaks in steam, water, coal, ash, etc.. A strong leak reduction plan must be in place.

Cleanliness: A cleanliness improvement must be put into place to maintain the cleanliness level from coal dust, ash, etc.

3.3 Assessment of the action plans for implementation of immediate measures (with financial implication) and benefits accrued

The summary of implementation of the immediate measures (with financial implications) is as follows:

CPRI Recommendations	Total Nos.	Implemented	Balance
Immediate term – having financial implication (FI).	187	117	70

The percentage implementation for immediate measures (with FI) is 62 %.

Hardware changes: many hardware changes like changing of heat exchangers, boiler coils, installation of VFDs, etc., have been successfully implemented.

IEDs: A decision is taken to procure only digital smart and intelligent transmitters and sensors in preference over analog systems. The same is being implemented.

Energy efficient option vs. maintenance comfort: Whenever there is some maintenance inconvenience on account of installation of energy efficiency measures or reduction of additional redundancy, the same may be viewed critically and a balanced view of the benefits vis-à-vis the inconvenience may be taken before a decision is taken on deferment of a measure.

3.4 Assessment of the action plans for implementation of medium term measures and benefits accrued

The summary of implementation of the medium term measures is as follows:

CPRI Recommendations	Total Nos.	Implemented	Balance
Medium term measures.	64	30	34

The percentage implementation for medium term measures is 47 %.

Traditional replacements: Replacements must not be based on traditional replacements but energy efficiency options must be used because over a period of 20-25 years many new energy efficient hardware options have been evolved. Replacement of old and obsolete technology may not give the full benefits.

Coal weighment: The in motion weigh bridges are yet to be installed. Since they are low value items, the same may be given priority. The belt weighers are yet to

be installed. Since they are low value items, the same may be given priority. The gravimetric feeders of rotary type or belt type are yet to be installed. Since they are high value items, some delay can be expected. However, the same needs to be expedited.

Steam path audits: Steam path audits have not been carried out during COH. The same may be rigorously followed to quantify the losses and restore the steam path to normalcy for getting the benefit of improved UHR.

3.5 Assessment of the action plans for implementation of long term measures and benefits accrued

The summary of implementation of the long term measures is as follows:

CPRI Recommendations	Total Nos.	Implemented	Balance
Long term measures.	45	24	21

The percentage implementation for long term measures is 54 %.

3.6 Reasons for delay, root cause of delay in implementation.

The reasons for delay are as follows:

- Procedure for finalization of Capex Schemes :-

  a. Lot of confusion amongst section in-charges for selection of capital items. Earlier we had a list of 20 items. Also, Go-No-Go policy about items e.g. Digital AVR.

  b. M/s KPMG Consultant was appointed for training on DPR preparation after 1 year of M/s CPRI Energy Audits.

  c. Financial Model for Pay back periods was not flexible & stable. Problems of IDC calculation, user friendliness. Non-availability of Trained manpower for use of financial model.

  d. Methodology for submitting Capex – Procedural change of course to reduce delay, viz. submission & finalization of QR.

- Clubbing of NTPC, CPRI recommendations & defer till R&M of the Units.

  August-11 MORM directives vide C-1.

- Carrying out recommendations during Unit AOH / COH. Few recommendations viz. Eco. Coil / RH coil replacement need planning. Reducing Δp in ESP etc. Escaping the opportunity due to processing, of P.O. / QR will get shifted to next AOH / COH.
- Few recommendations need performance trial at one of TPS. e.g. Water canon furnace cleaning system, Combustion Optimisation System etc.
- Strategic decision for use of VFDs, gravimetric feeders, intelligent motor controllers. Lot of complexities by solution provider. Also, lot of price variation by various manufacturers for same specific product.

3.7 Avoidable delays in implementation.

Excessive reliance on OEM: While the views of the OEM are indisputably of primary importance to the operation, maintenance and safety of the plant, lack of commercial interest in many cases has led to the conclusion that the OEM is not favorable to a particular scheme. This has resulted in e avoidable time delay.

Monsoon preparedness: Better monsoon preparedness could have resulted in some time saving.

What if? –apprehension: The fear of things going wrong and individuals not taking responsibility was present for some period. Now, MSPGCL has formed groups/ expert teams, etc. for different schemes rather than laying onus for implementation on individuals. Many more such groups/ expert teams cutting across the stations of MSPGCL need to be formed to collectively involve in implementation of the schemes in areas of boiler, turbine, C & I, etc., through technology assessment and technology evaluation.

Management model: The management model for implementation involved the traditional procedures which take time. Procedural delays could be minimized by operating in the ***fast track*** or ***mission mode*** for implementation, demonstrating and achieving the objectives of the schemes.

Streamlining of purchase cum authorization processes: Streamlining at the station level by cutting across the hierarchy/proper channel route for movement of papers and approvals (within the MSPGCL framework of rules), could have resulted in reduced process time.

Vendor development program: A strong vendor development program involving a search for prospective vendors, study of the technological options available in the market, preparation of generalized specifications without giving undue advantage to any one vendor, detailed study of costs including POs issued to the vendor from other organizations, etc., needs to be in place for successful procurement and implementation. Haphazard vendor development has resulted in time delay in the

actual procurement process in the form of non-responsiveness, non-conformance, re-tendering, etc.. This results in process delay.

Apprehensions of pass through: These have got to be clarified at an early date.

Measures with intangible or tacit benefits: These have suffered the most because of inability to convince the internal controllers. Life cycle approach could be a possible solution.

AOH & COH: These must be done as per schedule at the frequency of annually and once in five years respectively or as per any drawn out schedule. Skipping of overhauls results in degradation.

Uneven inter-station DPR initiating process: Co-ordination of common schemes required at different power stations got delayed because of different times taken by different stations. Some stations have taken almost 6 months more than others. While stations like Khaperkheda have shown a proactive stand to implementation stations like Kordi and Parli have been slow and the process has slowed down.

High processing time: Inspite of considerable improvement in procurement processing, the processing time is still much on the higher side for which station level process of procurement and authorization need to be re-looked. Higher procurement processing time and limited number of items identified under capex has led to avoidable delays.

Ambiguity created by E-R & M: The decisions to go in for E-R & M has created an ambiguity whether to continue with the medium term and long term measures in the present or to club it with E-R & M. In cases where E-R & M is envisaged, it is clubbed with E-R & M.

Full time central monitoring and time frames: Though central monitoring was being done to some extent, strong HO monitoring is required for control of the implementation processes with time frameworks. The time frames have not been set or time targets have not been given for implementation of the simple, medium term and long term measures. As a result the progress is differential in different stations.

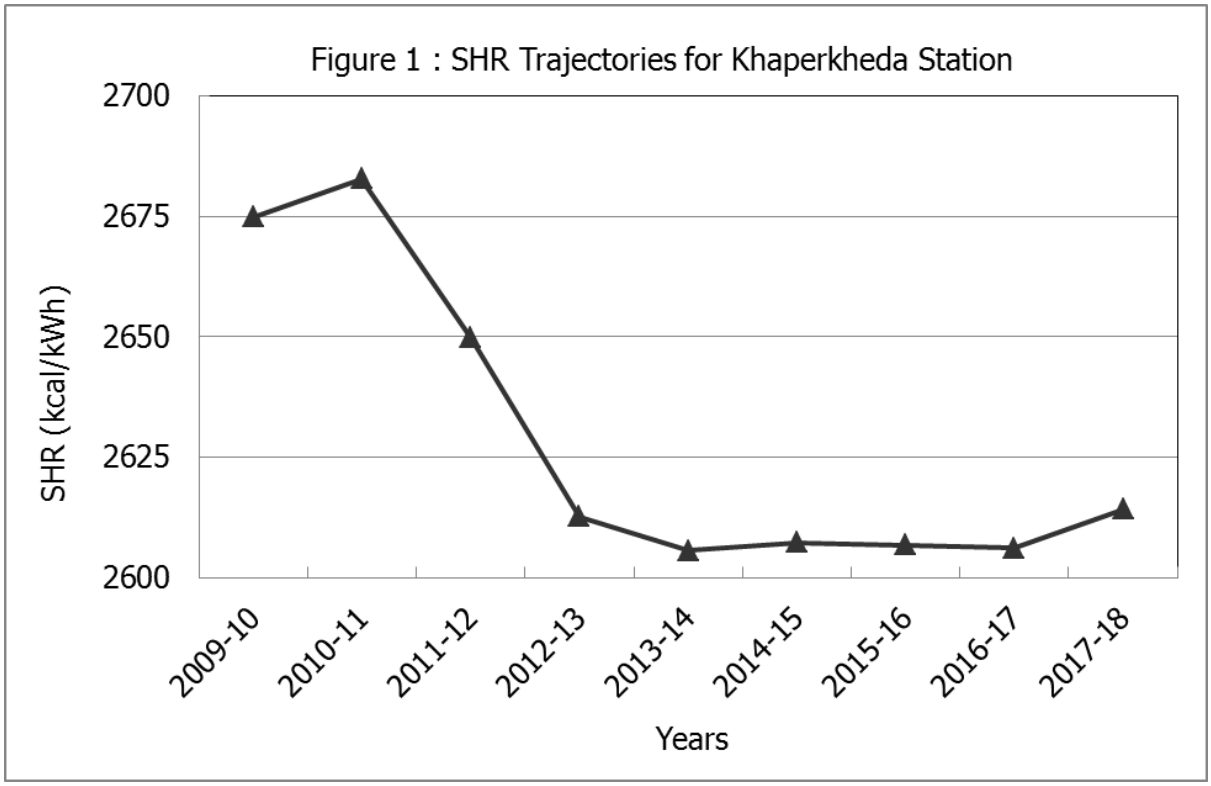
Co-ordination in implementations between two sections: In the case of technologies which involves implementation between two or more sections and their integration or inter-section co-ordination was not done by any one section, as a result of which the implementation was one sided.

Higher involvement of top management or mentoring by seniors to juniors: Mentoring would have reduced some delay.

4. REVISION OF PERFORMANCE TRAJECTORIES

4.1 Test SHRs and degradation rates measured and revised performance trajectories

Station	Overall Station
Degradation rate as per CPRI test TG HR	
	%/year
Khaperkheda	0.30

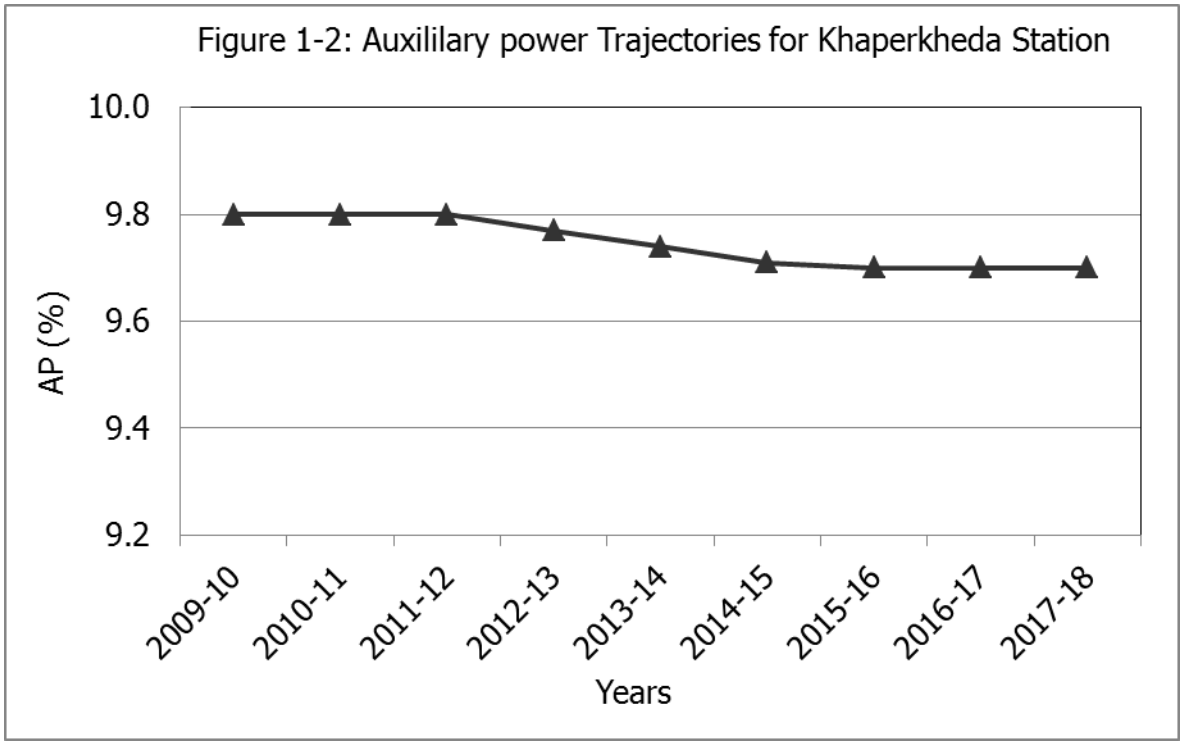


KHAPERKHEDA								
Year	Previous year heat rate, kcal/kWh	Degradation @ 0.3 % / year	Immediate measures	Medium term measures	Long term measures	EER&M benefit on SHR, kcal/kWh	Annual overall SHR, kcal/kWh	Comments
2009-10	2653	21.7					2675	[1]
2010-11	2675	8.0					2683	[2]
2011-12	2683	8.0	-11.0	-30			2650	[3]
2012-13	2650	8.0	-30.0	-15			2613	[4]
2013-14	2613	8.0		-15			2606	[5]
2014-15	2606	8.0			-6.40		2607	[6]
2015-16	2607	8.0			-8.53		2607	[7]
2016-17	2607	8.0			-8.53		2606	[8]
2017-18	2606	8.0					2614	[9]

Comments	Comments
[1]	Date of test on 05 - 02 - 2009; Test PLF was 87 %. Adjusted to 80 % PLF;
[2]	
[3]	
[4]	
[5]	
[6]	U2 HP Module Replacement
[7]	U1 HP Module Replacement
[8]	U3 module replacement
[9]	

KHTPS	Module replacement plan		PROJECTIONS		
Unit No.	2014-2015				
1	2642	12	31704		
2	2610	9	23490		
3	2642	12	31704		
4	2642	12	31704		
		45.00	118602.00	2635.60	-6.40
Unit No.	2015-2016				
1	2610	9	23490		
2	2610	12	31320		
3	2642	12	31704		
4	2642	12	31704		
		45.00	118218.00	2627.07	-8.53
Unit No.	2016-2017				
1	2610	12	31320		
2	2610	12	31320		
3	2610	9	23490		
4	2642	12	31704		
		45.00	117834.00	2618.53	-8.53

4.2 Test auxiliary power measured and revised performance trajectories



Year	Previous year AP, %	Immediate measures	Medium term measures	Long term measures	EER&M benefit on AP, %	Annual overall AP, %	Comments
2009-10	9.95					9.80	[1]
2010-11	9.8					9.80	[2]
2011-12	9.80					9.80	[3]
2012-13	9.8		-0.03			9.77	[4]
2013-14	9.77		-0.03			9.74	[5]
2014-15	9.74		-0.03			9.71	[6]
2015-16	9.71		-0.01			9.70	[7]
2016-17	9.7					9.70	[8]
2017-18	9.7					9.70	[9]

Comments	Comments
[1]	Change in Aux Cons. (Inclusion of generator transformer loss in the estimate)
[2]	
[3]	
[4]	U2 CT Fan Blade Replacement
[5]	U3 CT Fan Blade Replacement
[6]	U4 CT Fan Blade Replacement
[7]	VFD for Belt Conveyers
[8]	
[9]	

5. CONCLUDING REMARKS

i. The Khaperkheda TPS has shown initiative in implementation of the energy saving measures.

ii. For many schemes implementation is done in one unit in a station as a pilot the benefits are divided by the overall station performance and hence show smaller savings.

iii. Measures of a non-financial nature such as operational optimization, leak reduction, minimizing DM water make up, cleanliness in the power house, etc., need to be taken more seriously and with vigour to achieve and sustain the heat rates.

iv. The installation of in-motion weigh bridges needs to be expedited.

v. The detailed progress and the trajectories are given in the text.

vi. The reasons for delay are due to initial time lost in gearing up for the program and uncertainties regarding the program. Now, the processes of implementation of schemes have been streamlined and progress is expected to be achieved. Strong monitoring would help in reduction of implementing time.

vii. The performance is not as per the original trajectories because the implementation program has been taken up on a pilot basis for one unit or unit station in many cases and afterwards proposed to be taken up in other units. Also, many medium and long term measures have been clubbed. Hence the trajectories will be linked with these schemes of module replacements.