Project Summary

01	**Title:**	Assessment of implementations of various measures for improvements in achievable Performance Parameters at Maharashtra State Power Generating Company Ltd (MSPGCL) Thermal Power Stations
02	**Work Order No.**	MERC/Appeal-199/case 140-2011/2011-2012/02108
03	**Sponsoring agency:**	Maharashtra Electricity Regulatory Commission 13th Floor, Centre No. 1, World Trade Centre, Cuffe Parade, Colaba, Mumbai-400 005
04	**Contact Person (sponsorer):**	Mr. S.R. Karkhanis, Regulatory Expert, Maharashtra Electricity Regulatory Commission, 13th Floor, Centre No. 1, World Trade Centre, Cuffe Parade, Colaba, Mumbai-400 005.
05	**Contact Person (MSPGCL-HO):**	Shri.Jadhao S. S. Chief Engineer (Regulatory & Commercial Department), & O.S. D. to Director (Operation) Tel:9819653364 E-mail:rcgen@mahagenco.in
06	**Contact Person (MSPGCL-TPS):**	Shri.A.M. Bondre, Dy.CE, BTPS, Tel:9422277801, E-mail:dycebasl@mahgenco.in
07	**Project implementing agency:**	Central Power Research Institute, P.B. No. 8066, Sir C.V.Raman Road, Sadashivanagar Sub-P.O., Bangalore-560080 Tel:080-23604682, 23604736 FAX: 080-23604682, 23601213
08	**Contact Person (project implementing agency):**	M. Siddhartha Bhatt, Additional Director (EC & DD) Central Power Research Institute, P.B. No. 8066, Sir C.V.Raman Road, Sadashivanagar Sub-P.O., Bangalore-560080 Tel: 080-23604682, 23604736 FAX: 080-23604682/23601213 E-mail:msb@cpri.in; msbhatt1@yahoo.co. in
09	**Group Co-ordinator :**	M. Siddhartha Bhatt, Additional Director Tel: 080-23604682, 23604736 FAX: 080-23604682/23601213 E-mail: msb@cpri.in; msbhatt1@yahoo.co. in

10	**Energy audit team : (At site)**	M. Siddhartha Bhatt, Additional Director Rajashekar P. Mandi, Engineering Officer N. Rajkumar, Engineering Officer S. Jothibasu, Engineering Officer
11	**Objectives:**	Assessment of implementations of various measures for improvements in achievable Performance Parameters at Maharashtra State Power Generating Company Ltd (MSPGCL)Thermal Power Stations
12	**Scope of work:**	1: Assessment of the overall action plans for implementation of measures occurs for Immediate, Medium and Long term measurements. 2: Reasons for delay, root cause of delay in implementation Assessment of the action plans for implementation of measures and benefits accrued. 3: Avoidable delays in implementation Assessment of the action plans for implementation of measures and resulting in degradation in performance. 4: Revision of performance trajectories. 5: Preparation and submission of report
13	**Report No.:**	ERED/EA/112/2012
14	**Power station:**	Bhusawal Thermal Power Station, Bhusawal
15	**Date of issue of report:**	February 2012
16	**Signature of Energy Audit Team Leader:**	
17	**Signature of the Division Head:**	

EXECUTIVE SUMMARY

An assessment of the implementation of the energy efficiency and improvement measures has been conducted for the station. The details of the implementation of schemes is as follows:

CPRI Recommendations	Total Nos.	Implemented	In practice	Not Feasible	Pending at Station	Pending for HO guidelines
IMMEDIATE TERM - Having NO FINANCIAL IMPLCATIONS (NFI)	170	4	117	11	0	38

CPRI Recommendations	Total Nos.	Implemented thru Capex/ Revenue	Processed thru DPR	Processed thru Non DPR	Processed thru Revenue/ Capex	Schemes to be covered in DPR/Non DPR/Capex/Revenue	Not Feasible / Not required	Pending for HO guidelines
IMMEDIATE TERM - Having FINANCIAL IMPLCATIONS (FI)	88	13	27	1	2	17	9	19
MEDIUM TERM MEASURES	38	11	13	2	1	5	3	3
LONG TERM MEASURES	17	6	5	0	1	3	2	0
TOTAL	143	30	45	3	4	25	14	22

The percentage implementation is 71 % for non-financial measures and it is 20 % for financial measures

An assessment of the benefits of energy efficiency measures indicate that there is progress in both technical schemes as well as managerial process improvements. In the non-financial schemes operational optimization and DM water control need to be strengthened.

The Bhusawal TPS was not geared up to handle a massive energy efficiency overall improvement process in a corporate mode. Evidence of the attempts to change over to corporate culture is noticed during the assessment in the form of the station's outlook.

The TPS has attempted to implement the energy schemes in steps. Many non-technical recommendations related to purchase process improvements, authorization processes, administrative processes, etc., have been implemented and time for purchase is reduced.

Immediate measures of both financial and non-financial involvement have been implemented. Also, medium term and long term measures have been clubbed with or incorporated into R & M schemes. Hence, R & M schemes must now be an integral part of the long term performance trajectories.

CONTENT (Volume 1)

			Page Nos.
1.0 INTRODUCTION			**1**
	1.1	Design unit heat rates (UHR) & station heat rates (SHR)	**1**
	1.2	Performance against targets	**1**
2.0 STUDY & FIELD VISITS			**1**
3.0 STUDY & FINDINGS			**1**
	3.1	Assessment of the overall action plans for implementation of measures and benefits projected and accrued	**1**
	3.2	Assessment of the action plans for implementation of Immediate measures (without financial implication) and benefits accrued	**4**
	3.3	Assessment of the action plans for implementation of Immediate measures (with financial implication) and benefits accrued	**5**
	3.4	Assessment of the action plans for implementation of medium term measures and benefits accrued	**6**
	3.5	Assessment of the action plans for implementation of long term measures and benefits accrued	**6**
	3.6	Reasons for delay, root cause of delay in implementation	**7**
	3.7	Avoidable delays in implementation	**7**
4.0 REVISION OF PERFORMANCE TRAJECTORY			**9**
	4.1	Test UHRs & SHRs and degradation rates measured and revised performance trajectories	**10**
	4.2	Test auxiliary power measured and revised performance trajectories	**13**
	4.3	Secondary oil consumption and comments on the same	**15**
5.0 CONCLUSIONS			**15**

Abbreviations/Nomenclature

ABT	Availability based tariff
AC	Alternating current
AFB	As fired basis
AHP	Ash handling plant
AOH	Annual overhaul
AP	Auxiliary power (MW or MWh for a time period)
APH	Air pre-heater
ARW	Aerial ropeway
AVF	Availability factor (%)
BDV	Breakdown voltage
BFP	Boiler feed pump
BTL	Boiler tube leakage
C	Capacity of the unit or station (design or operating, MW)
C & I	Control and instrumentation
CA	Chemical Analysis
CC	Carrying capacity
CEP	Condensate extraction pump
CHP	Coal handling plant
COH	Capital overhaul
CT	Current transformers
CW	Cooling water
DA	Deposit analysis
DC	Direct current
DCS	Distributed control system
DIM	Dimensional measurement
DT	Destructive test
ECO	Economizer
ERP	Enterprise resource package
ESP	Electrostatic precipitator
ESV	Emergency stop valve
FDF	Forced draft fan
FO	Furnace oil
F/O	Forced outage
GCR	Generation control room
GCV	Gross calorific value (kcal/kg or MJ/kg)
H	Time period block (hours)
HCV	Higher calorific or heating value (kcal/kg or MJ/kg)=GCV
HGI	Hardgrove Index of coal
HP	High pressure
HPT	High pressure turbine
HT	High tension (6.6 kV and above)
HV	High voltage
HVOF	High velocity oxyfuel flame
IBR	Indian Boiler Regulation
ID	Inside diameter
IDF	Induced draft fan

IED	Intelligent electronic device
IP	Intermediate pressure
IPT	Intermediate pressure turbine
KPI	Key performance indicators
LDO	Light diesel oil
LE	Life extension
LP	Low pressure
LPT	Low pressure turbine
LT	Low tension (415 V)
Max.	Maximum
MCCB	Moulded case circuit breaker
MCR	Maximum continuous rating of the unit
Min.	Minimum
MIS	Management information system
MOD	Merit order dispatch
MS	Main steam
NDT	Non-destructive test
NF	Natural frequency
NRV	Non return valve
O & M	Operation and maintenance
OD	Outer diameter
OEM	Original equipment manufacturer
p	Pressure (kPa or MPa)
P	Power output (MW)
PADO	Performance analysis, diagnostics and optimization
PAF	Primary air fan
PC	Personal computer
PLF	Plant load factor (%)
PT	Potential transformers
R & M	Renovation and modernization
RH	Reheat
RLA	Remaining life assessment
RR	Railway receipt
SAIDI	System average interruption duration index
SAIFI	System average interruption frequency index
SEC	Specific energy consumption (kWh/t)
SFC	Specific coal consumption (kg/kWh = t/MWh)
SH	Superheater
SHR	Station heat rate ((kcal/kWh)
SOC	Secondary specific fuel oil consumption (ml/kWh)
SPM	Suspended particulate matter
SR	Steaming rate (t of steam /t of coal)
SSC	Specific steam consumption (kcal/kWh=t/MWh)
T	Temperature (^{0}C)
TDBFP	Turbine driven boiler feed pump
UHR	Unit heat rate (kcal/kWh)
v	Velocity (m/s)
VI	Visual inspection

WTP	Water treatment plant
Greek letters	
α	Excess air factor (dimensionless: 1.0-3.0)
δ	Leakage rate (dimensionless: 0 to 1.0), deviation in heat rate
Δ	Difference
η	Efficiency (dimensionless or %)
Subscripts	
a	Ambient
av	Average
A	Auxiliary
B	Boiler
BA	Bottom ash
e	Electric
f	Flame
G	Generator
in	Input
m	Mechanical
max	Maximum
min	Minimum
O	Gross overall
ref	Reference
S	Steam
T	Turbine
Units of power inputs/outputs	
MW	Electrical power
MW_m	Mechanical shaft power output rate
MW_t	Rate of energy change in water or steam (heat input/output rate)