

INDO-GERMAN ENERGY FORUM

Report No. 3: Flexibility Assessment and Implementation Plan for the 525 MW Unit 2 at Maithon Power Plant



8 December 2021



Document Control

Client:	GIZ / IGEF Task Force Flexibility
Project No:	18.9022.7-003.00
Report Title:	Flexibility Assessment and Implementation Plan for the 525 MW Unit 2 at Maithon Power Plant
Report No:	3 IGEF Flexibility
Authors:	Rainer Aulfinger (Siemens Energy), Burkhard Henstorf (Siemens Energy), Denis Tschetschik (Siemens Energy), and Dr. Claudia Weise (vgbe)
Date of Issue:	December 2021

Action	Responsible (Name, Function)	Signature	Date
Released by the Lead Author	Dr. Claudia Weise, vgbe Project Director		
Approved by	Dr. Oliver Then, vgbe Managing Director		



This report is dedicated to Mr Samir Pandab, who was torn from life by Covid19 and who we sorely miss. His spirit and attitude have guided us through the entire project and will enlighten our future activities too.

As the Head of Performance & Efficiency at Maithon Power Ltd., Mr Samir Pandab acted as the Tata Project Leader from July 2020 to March 2021.

TABLE OF CONTENTS

List of Abbreviations	5
List of Figures	6
List of Tables.....	7
1 Introduction	8
2 Executive Summary	10
3 Execution of the Test Runs	12
3.1 Minimum Load Tests	13
3.1.1 Test Execution on 22 July.....	13
3.1.2 Test Execution on 23 July.....	18
3.1.3 Findings of the Minimum Load Tests	23
3.2 Details of Load Ramp Tests	24
3.2.1 Test Execution on 27 July.....	26
3.2.2 Test Execution on 27 July.....	37
3.2.3 Findings of the Load Ramp Tests	44
3.3 Efficiency Calculations.....	44
3.4 Nox.....	46
3.5 Make-up water.....	47
4 Recommendations and Implementation Plan.....	50
4.1 Mandatory Measures for Minimum Load Operation	50
4.1.1 Boiler Model for Temperature Optimization.....	50
4.1.2 Control Optimization and Feedwater Recirculation Valves.....	51
4.2 Mandatory Measures for Ramp Rate Improvement	52
4.2.1 Control Optimization	52
4.3 Further Measures for Flexibility Enhancement.....	53
4.3.1 Control Solutions	53
4.3.2 Coal Flow Balancing	54
4.3.3 Condition Monitoring.....	55
4.3.4 Sootblower Optimization.....	57
4.4 Cost and Implementation Time.....	58

List of Abbreviations

ACV	Auxiliary Control Valve
APH	Air Preheater
BFP	Boiler Feed Pump
CMC	Coordinated Master Control
CEP	Condensate Extraction Pump
EOH	Equivalent Operating Hours
ESH	Equivalent Starting Hours
FD fan	Forced Draft Fan
GCV	Gross Calorific Value
HP	High Pressure
HPBP	High Pressure Bypass
HRH	Hot Reheat
ID fan	Induced Draft Fan
LOFA	Lower OFA
LTSH	Low Temperature Superheater
MCV	Main Control Valve
MDBFP	Motor Driven Boiler Feed Pump
MPL	Maithon Power Plant
MS	Main Steam
MTM	Metal Temperature
OFA	Overfire Air
PRDS	Pressure Reducing and Desuperheating System
RH	Reheat
SAD	Secondary Air Damper
SADC	SAD Control
SCAPH	Steam Coil Air Preheater
SCC	Specific Coal Consumption
SH	Superheater
TDBFP	Turbo Driven Boiler Feed Pump
TGCHR	Turbine Generator Cycle Heat Rate
WC	Water Column
UOFA	Upper OFA

Abbreviations referring to companies and institutions as well as common measurement units (e.g. MW, min) are not included in this list.

List of Figures

Figure 1: Representatives from CEA, POSOCO ERLDC (Eastern Region Regional Load Dispatch Centre), IGEF SO, EEC and MPL during the test runs. Source: IGEF SO.....	8
Figure 2: Steam and feed water parameters during the tests on 22 July.....	14
Figure 3: Drum level and flame intensity at 210 MW.....	15
Figure 4: Minimum load test overview, 22 July.....	16
Figure 5: Screenshot of major process values at 190 MW:.....	20
Figure 6: Minimum load test overview, 23 July.....	21
Figure 7: Parameters for 1-hour test period, 23 July.....	22
Figure 8: Parameters during the ramp rate test, 26 July.....	25
Figure 9: Parameters during the ramp rate test, 27 July.....	26
Figure 10: MTMs during first ramp rate test, 26 July.....	28
Figure 11: MTMs during second ramp rate test, 26 July.....	30
Figure 12: MTMs during fifth ramp up test, 26 July.....	35
Figure 13: Main parameters during ramp rate test, 27 July.....	44
Figure 14: NO _x emissions and load during the minimum load tests.....	46
Figure 15: NO _x emissions over load during the minimum load tests.....	47
Figure 16: Make-up water consumption and load during the test period.....	48
Figure 17: Make-up water consumption over load during the test period.....	48
Figure 18: Specific make-up water consumption over load during the test period.....	49
Figure 19: Overview of a boiler fatigue monitoring system.....	56
Figure 20: Schematic overview of the thermodynamic model approach.....	57

List of Tables

Table 1: Main design of MPL	12
Table 2: Overview of the test program	12
Table 3: Coal composition during the first test series	13
Table 4: SCAPH operation on 22 July.....	14
Table 5: Load ramps achieved during the tests.....	24
Table 6: Parameters during the first ramp down, 26 July	27
Table 7: Parameters during the first ramp up, 26 July	28
Table 8: Parameters during the second ramp down, 26 July.....	29
Table 9: Parameters during the second ramp up, 26 July	30
Table 10: Parameters during the third ramp down	31
Table 11: Parameters during the third ramp up, 26 July.....	31
Table 12: Parameters during the fourth ramp down, 26 July	32
Table 13: Parameters during the fifth ramp down, 26 July	33
Table 14: Parameters during the sixth ramp down, 26 July	33
Table 15: Parameters during the fourth ramp up, 26 July.....	34
Table 16: Parameters during the fifth ramp up, 26 July	35
Table 17: Parameters during the sixth ramp up, 26 July	36
Table 18: MTMs at different ramp rates	36
Table 19: Parameters during the first ramp down, 27 July	37
Table 20: Parameters during the second ramp down, 27 July.....	38
Table 21: Parameters during the third ramp down, 27 July	38
Table 22: Parameters during the forth ramp down, 27 July	39
Table 23: Parameters during the first ramp up, 27 July	39
Table 24: Parameters during the second ramp up, 27 July	40
Table 25: Parameters during the third ramp up, 27 July.....	40
Table 26: Parameters during the fourth ramp down, 27 July	41
Table 27: Parameters during the fifth ramp down, 27 July	41
Table 28: Parameters during the sixth ramp down, 27 July.....	42
Table 29: Parameters during the seventh ramp down, 27 July.....	42
Table 30: Parameters during the fourth ramp up, 27 July.....	43
Table 31: Parameters during the fifth ramp up, 27 July	43
Table 32: Efficiency values during the tests	45
Table 33: Implementation cost and time.....	58

