सत्यमेव जयते

Report of the Comptroller and Auditor General of India on Expansion and Utilisation of Power Equipment Manufacturing Capacity in Bharat Heavy Electricals Limited For the year ended March 2012

Union Government
Ministry of Heavy Industries and Public Enterprises
(Department of Heavy Industry)

No. 26 of 2013
(Performance Audit)

Report of the
Comptroller and Auditor General of India
on
Expansion and Utilisation of Power Equipment Manufacturing Capacity in Bharat Heavy Electricals Limited

For the year ended March 2012

Union Government
Ministry of Heavy Industries and Public Enterprises
(Department of Heavy Industry)

No. 26 of 2013
(Performance Audit)

Index

Preface

The Audit Report has been prepared in accordance with the Performance Audit Guidelines and Regulations on Audit and Accounts, 2007 of the Comptroller and Auditor General of India.

In order to accelerate the growth, Government of India (GOI) laid emphasis on efficient and rapid growth of power sector with large private investment. The Planning Commission also increased (June 2008) targets for capacity addition in generation of Power in XI Plan as compared to targets fixed for X plan so that the objective of National Electricity Policy (February 2005) to provide access to electricity for all households is achieved. To achieve these power generation targets, existence of adequate power equipment manufacturing capacity with equipment manufacturers in the country was equally important. Bharat Heavy Electricals Limited (BHEL), a Maharatna Central Public Sector Enterprise and one of the largest engineering and manufacturing enterprises in the country, had planned to enhance its power equipment manufacturing capacity from 10,000 MW per annum to 20,000 MW per annum in line with the increasing power generation targets in the country.

Audit took up the performance audit of BHEL to examine economy, effectiveness and efficiency of expansion of manufacturing capacity and its utilisation. The Audit Report examined the adequacy and results of efforts of BHEL from conceptualisation to execution of manufacturing capacity expansion and its utilisation during 2007-2012.

Audit wishes to acknowledge the co-operation received from BHEL, the Ministry of Heavy Industries and Public Enterprises and the Ministry of Power at each stage of the audit process.

Executive Summary

Executive Summary

Introduction

Development of energy resources plays a vital role in the growth of an economy. An accelerated growth of power sector is imperative for the overall growth of the country. In order to accelerate economic growth of the country, Government of India (GOI) laid emphasis on efficient and rapid growth of power sector with large private investment. The Planning Commission also increased (June 2008) targets for capacity addition in generation of power in XI Plan compared to targets fixed for X plan so that the objective of National Electricity Policy 2005 to provide access to electricity for all households was achieved. To achieve these ambitious power generation targets, availability of commensurate power equipment manufacturing capacity in the country was equally important.

Bharat Heavy Electricals Limited (BHEL), a Maharatna Central Public Sector Enterprise (CPSE) under the administrative control of Department of Heavy Industry, Ministry Heavy Industries and Public Enterprises (Ministry), is one of the largest engineering and manufacturing enterprises in India in energy-related/infrastructure sector. At the end of March 2013, BHEL had supplied utility power generating sets equivalent to 1,15,500 MW which accounts for 57 *per cent* of the overall installed power generation capacity in India. Central Electricity Authority (CEA) in their latest report of May 2013 acknowledged technical superiority of equipment manufactured by BHEL as compared to some other competitors from abroad. BHEL implemented three capacity expansion programmes in phases[1] to meet projected power equipment requirements during X, XI and XII Plans respectively. In this backdrop, performance audit of power equipment manufacturing capacity expansion and utilization of BHEL was taken up to assess the adequacy and results of efforts of BHEL in capacity expansion and its utilization for meeting the power generating capacity addition requirement in the country.

(Para 1.1)

Audit Scope and Sample

The performance audit examined the process of conceptualization to execution of 17 schemes (valuing ₹.4156.17crore) out of 22 schemes (valuing ₹.4737.41 crore) undertaken by BHEL during Phases–II and III during 2007-12 for raising the power

---

[1] ***To augment power equipment manufacturing capacity from 6,000 MW per annum to 10,000 MW per annum (Phase-I for X Plan), From 10,000 MW per annum to 15,000 MW per annum (Phase-II for XI Plan) and From 15,000 MW per annum to 20,000 MW per annum (Phase-III for XII Plan).***

equipment manufacturing capacity from 10,000 MW per year to 20,000 MW per year. The extent of capacity utilisation achieved by BHEL was examined in respect of delivery of 10 major power equipments (contributing 62.67 *per cent* or ₹. 1.05 lakh crore of the total turnover of ₹. 1.67 lakh crore during the period 1 April 2007 to 31 March 2012 of BHEL).

(Para 2.1)

Major Audit Findings

Significant audit findings are discussed below:

(i) Preparedness for capacity expansion in XI and XII plans

While CEA had identified power generation capacity addition requirements of 67,439 MW for XI Plan in the country in November 2003 itself, the Task Force to recommend capacity augmentation was constituted by BHEL only in July 2006. BHEL decided during January 2007 to September 2008 to increase its manufacturing capacity from 10,000 MW per annum to 15,000 MW (Phase-II) to be completed by December 2009. BHEL declared completion of Phase-II capacity addition programme in March 2011.

Thus, the manufacturing capacity expansion, which was required to be planned and completed in the initial years of XI Plan, was declared to have been completed by BHEL only towards the end of the Plan.

{ Para 3.1.(i)}

Apart from the need for better preparedness, capacity augmentation in different segments was also required to match Plan requirements. Against the projected requirements of 8,200 MW and 31,860 MW for the country in supercritical thermal segment during XI and XII Plans, the capacity augmentation planned by BHEL was only 5,280 MW and 18,000 MW respectively. However, in the case of subcritical thermal segment, against projected XII Plan requirements of 12,640 MW for the country, capacity augmentation in BHEL was planned at 44,898 MW indicating creation of surplus capacity. While Management stated that new machines installed under capacity expansion schemes could be used for manufacture of large size super critical sets, details of actual utilization of new subcritical machines to manufacture supercritical sets (other than boilers), if any, were not provided by Management to Audit.

{ Para 3.1.(ii)}

(ii) System of award of purchase orders

(a) In 59 out of 174 selected purchase orders, in the absence of laid down procedure for preparation of cost estimates in units, the estimates were based on rates available in the Feasibility Reports (FRs) which, in turn, were based on offers received from prospective vendors and were 18 to 36 months old from the date of calling of bids for these purchase orders.

(b) Only seven *per cent* of the selected purchase orders were finalized within 75 days. Units of BHEL took more than 12 months in finalisation of purchase orders in 31 *per cent* cases. Audit observed that delay in placing purchase orders had contributed to the delivery dates getting delayed in 23 out of 174 purchase orders much beyond the scheduled date of completion of respective manufacturing capacity augmentation schemes.

(Para 4.1 and 4.5)

(iii) Execution of Manufacturing Capacity Expansion Schemes

(a) Implementation of the Capacity expansion programmes for XI and XII Plans (covered in Audit) disclosed delays between 07 months and 62 months in 17 selected schemes out of 22 schemes approved in 2007-12. 5 out of 22 schemes of Phase II and Phase III are yet to be completed (September 2013). Apart from some uncontrollable factors like poor response to tenders or high prices quoted by bidders, factors like non fixation of targets for vendors for erection and commissioning of machines, delay in replacement of damaged equipment that were largely controllable by the Management through proper planning and monitoring, had significantly contributed to delays.

(Para 5.1)

(b) Further, CEA in its Annual Report 2004-05 indicated new benchmarks for commissioning and synchronization of thermal units as 37 months and 28 months in case of 500 MW and 250 MW respectively whereas, actual time taken by BHEL for the same was 42 and 34 months which was much higher than the new benchmarks indicated by CEA. BHEL planned to meet the benchmarks indicated by CEA for commissioning and synchronisation of thermal units by reducing manufacturing cycle time upto 10 percent as a part of Phase II Capacity Augmentation Scheme which was approved during January 2007 and September 2008 after a delay of 21 months (April 2005 to January 2007). This was not achieved as the capacity expansion schemes were still (September 2013) under implementation.

{Para 5.2(i)}

(iv) Utilisation of Manufacturing Capacity of Major Power Equipments

(a) BHEL's installed capacity for Turbines and Generators remained underutilized during 2007-08 to 2010-11, whereas production exceeded the installed capacity in case of Turbines during the year 2011-12 only.

Installed capacity for boilers was overutilised during 2007-08 to 2010-11.This was due to outsourcing which ranged between 54 and 57 percent. The issue was discussed in the second Exit conference (September 2013) with the Management where Audit concern that only own equipment manufacturing capacity should be included for shop production capacity of BHEL was appreciated by the Management. Management further admitted that due to bunching of orders and some constraints in respect of facilities at the Haridwar unit, outsourcing of some core components had also to be resorted to.

In HEEP Haridwar, there was scope to improve the system of outsourcing by carrying out a cost benefit analysis at the time of outsourcing of fully machined components procured with materials. During the second Exit Conference (September 2013) it was impressed upon Management that any system of outsourcing should ensure that outsourcing was cost effective for the Company and in-house capacity, if any, for the outsourced components did not remain idle.

(b) out of 151 generating sets[2] delivered by BHEL during 2007-12, delivery of 126 generating sets to customers was delayed for periods ranging between 7 and 68 months. Delays were also due to controllable factors like non adherence to BHEL's internal schedules for supplies of various modules/parts of the equipments, non sequential supplies in 132 out of 217 test checked cases of generating sets supplied by Hyderabad and Haridwar units, delays in finalization of engineering drawings, acceptance of sub-vendors' delivery period beyond BHEL's own delivery schedule, delay in placement of indents and conversion of indents into purchase orders. Due to delay in deliveries of orders, customers had deducted liquidated damages (LD). BHEL had to bear LD of ₹ 1280 crore during 2007-13.

(Para 6.1, 6.2 and 6.5)

(v) Market share of BHEL

Market share of BHEL (based on projects commissioned/likely to be commissioned during the Plan period) declined from 65 *per cent* at the end of X Plan to 59 *per cent* at the end of XI Plan and was likely to come down to 58 *per cent* at the end of XII Plan (based on CEA data on projects likely to be completed in XII Plan). Despite uncertainties related to coal availability leading to dampening effect on fresh orders during 2011-12 and 2012-13 as stated by the Management, there was scope for arresting decline in the order book through timely acquisition of technology/manufacturing capacity, improvement in cost estimation for tenders and control of wage costs to increase competitiveness of products. In view of inadequate orders booked (6715 MW) by BHEL in 2012-13 as compared to manufacturing capacity of 20,000 MW created, there was a challenge for BHEL to optimally utilise its capacity.

(Para 6.3, 6.3.1, 6.3.2 and 6.3.3)

(vi) Technical collaboration agreements with foreign partners and R&D expenditure

For design and manufacture of various types of equipments, BHEL entered into 10 Technology Collaboration Agreements (TCAs) and two Memoranda of Understanding (MoU) during August 1976 to November 2010 with foreign Original Equipment Manufacturers (OEM) for 14 major products. The TCAs did not contain provisions to provide source codes and 'know why' of the technology. BHEL expressed difficulty in obtaining source codes as well as 'know why' from technology partners under the TCAs as the OEM were not willing to transfer technology. In the absence of arrangements to absorb

[2] Generating set comprises of boiler, turbine and generator

technology from foreign partners, in-house R&D assumes significant importance so as to reduce dependence on technology partners under TCA in the long run.

R&D expenditure remained at 1.12 *per cent* of turnover against 3.20 to 5.11 *per cent* spent by its competitors. BHEL would benefit by focussed R&D efforts and increased R&D outlay.

(Para 7.2 and 7.3)

(vii) Performance of BHEL against MOU Targets

BHEL had signed MOUs with its administrative ministry regularly. There was scope for fixing appropriately challenging targets and evaluation of performance more objectively in line with DPE guidelines.

(Chapter 8)

(viii) Monitoring Mechanism

Though a system for monitoring implementation of capacity expansion schemes and delivery of equipments in scheduled time existed, there was scope for expediting the implementation of capacity expansion schemes and delivery of ordered equipments which were delayed due to factors like non-fixation of targets for vendors for erection and commissioning of machines, acceptance of sub vendors' delivery schedules beyond BHEL's own delivery schedule that were possible to be controlled.

(Para 9.1.1 and 9.1.2)

Audit Recommendations

Based on the audit findings, the following recommendations are made:

Ministry of Heavy Industries

1. Ministry may consider reviewing performance parameters and fix challenging targets in MOU to provide a more realistic and objective basis for assessment of performance of BHEL.

BHEL

2. BHEL may review the pricing mechanism of its equipment to make it more competitive by adopting appropriate costs including employee costs.
3. BHEL may work out a time bound programme for increasing outlays on R&D activities, particularly in core areas so as to convert these into advantages in competition.
4. Monitoring mechanism may be strengthened to minimize controllable delays in project execution and delivery by fixing periodicity and levels of monitoring up to the Board of Directors.

CHAPTER-1

Introduction

1.1 Company Profile

Bharat Heavy Electricals Limited (BHEL), established in 1964, is a Maharatna[1] Central Public Sector Enterprise (CPSE) under the administrative control of Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises (Ministry). It is one of the largest engineering and manufacturing enterprises in India in energy-related/infrastructure sector. Turnover of BHEL increased to ₹ 50,157 crore in 2012-13 from ₹21,401 crore in 2007-08. At the end of March 2013, BHEL had supplied utility power generating sets equivalent to 1,15,500 MW which accounts for 57 *per cent* of the overall installed power generation capacity in India. Technical superiority of equipment manufactured by BHEL as compared to some other competitors from abroad was acknowledged by Central Electricity Authority (CEA) in their latest report of May 2013.

1.2 Energy Sector Scenario

Development of energy resources plays a vital role in the growth of an economy. An accelerated growth of power sector being one of the energy resources is imperative for the overall growth and increase of Gross Domestic Product (GDP) of the country. In order to accelerate the economic growth of the country, Government of India (GOI) laid emphasis on efficient and rapid growth of power sector with large private investment. National Electricity Policy 2005, aimed at achieving availability of over 1,000 units of per capita electricity by year 2012 and estimated that for this purpose capacity addition of more than 1,00,000 MW would be required. The Planning Commission also increased (June 2008) targets for capacity addition in generation of Power in XI Plan compared to targets fixed for X plan so that the objective of National Electricity Policy, 2005 to provide access to electricity for all households and increase annual per capita consumption of electricity to 1,000 units by 2012, is achieved. To achieve these power generation targets, it was equally important that there was adequate power equipment manufacturing capacity available with equipment manufacturers in the country. Details of capacity addition targets of power generation through Thermal, Hydro, Nuclear and Renewable Energy, set by the Planning Commission for the country for last three Plan periods upto XI Plan, achievement there against and available manufacturing capacity with BHEL during these Plan periods were as detailed in Table 1:

[1] ***The Government has, vide DPE OM No.22(1)/ 2009-GM Dated 01.02.2013, granted more autonomy and delegation of powers to selected Navratna public sector enterprises called Maharatna which include, inter-alia, the decision making authority for mergers and acquisitions in core area of functioning of CPSE.***

Table-1

	IX Plan	X Plan	XI Plan
Targets for power generation capacity addition in the country (in MW)	40,245	41,110	78,700 (Revised to 62,374 in July 2010)
Actual power generation capacity addition[2] in the country (in MW)	19,119	21,180	54,964
Percentage Achievement	**47.51**	**51.52**	**69.84(88.12[3])**
Targeted manufacturing capacity[4]	No target	No target fixed	63,134
Declared capacity of BHEL[5] to deliver power equipment (in MW)	31,500	31,960	61,919
Power equipment supplies by BHEL for power generation capacity addition (in MW)	12,605	13,723	25,405
Contribution of BHEL in the power generation capacity addition in the country (%)	65.93	64.79	46.22

(Source: As per CEA data and databank of BHEL)

As is evident from above, there was a decline in percentage contribution of BHEL in power generation capacity addition in the country from 65.93 *per cent* in IX Plan to 46.22 *per cent* in XI Plan. The share of other domestic suppliers[6] in power generation capacity additions was 3911 MW in XI Plan and the balance was met through foreign suppliers. There was thus, scope and necessity for BHEL, being the largest power equipment manufacturer in the country, to maintain its share and increase its capacity to manufacture power equipment. Management stated (September 2013) that their performance in terms of their own targets was satisfactory.

1.3 Preparedness of BHEL to Plan requirements

BHEL, being the main domestic power equipment manufacturer, planned three capacity expansion programmes to meet projected power equipment requirements during X, XI and XII Plans as detailed in Table 2.

Table 2

Plan	Planned power equipment manufacturing capacity augmentation	Plans approved	Planned for completion by	Augmentation of installed capacity declared completed by BHEL in
X	From 6,000 MW per annum to 10,000 MW per annum **(Phase-I)**	Between 2004 and 2006	December 2007	December 2007
XI	From 10,000 MW per annum to 15,000 MW per annum **(Phase-II)**	Between January 2007 and September 2008	December 2009	March 2011
XII	From 15,000 MW per annum to 20,000 MW per annum **(Phase-III)**	In June 2009	December 2011	March 2012

[2] ***As per Central Electricity Authority***
[3] ***This is with respect to revised target.***
[4] ***Based on the targets for completion of capacity expansion schemes approved by the Board of Directors of BHEL***
[5] ***Sum total of Annual Declared manufacturing capacity at the end of the each financial year of the XI Plan as per BHEL's Annual Accounts.***
[6] ***Like Alstom, VA Tech and L&T, etc.***

With a view essentially to examining the preparedness of BHEL in supply of power equipment for meeting the power generating capacity addition requirement in the country, a performance audit of BHEL was undertaken in accordance with audit objectives discussed in Chapter 2.

CHAPTER-2

Audit Approach

2.1 Scope of Audit and Audit Sample

The performance audit covers the adequacy and results of efforts of BHEL for capacity expansion and its utilization as detailed below.

(i) **Capacity expansion:** Audit examined records of BHEL commencing from conceptualization to execution of manufacturing capacity expansion (in Phases –II and III for raising the BHEL's capacity for manufacturing power equipment from 10,000 MW per year to 20,000 MW per year) during 2007-2012 as summed up in Table 3.

Table 3

Details of Schemes		Number of Schemes taken up by BHEL	No of schemes selected in Audit for examination
Ongoing schemes of Phase I as of 1 April 2007		7	Not selected as these relate to Phase I.
New schemes approved and taken up during 2007-12	Phase-II (10,000MW to 15,000 MW)	17	14
	Phase-III (15,000 MW to 20,000 MW)	5	3
Total		29	17
Unfinished schemes as of March 2012 out of the total schemes approved and taken up during 2007-12	Phase-II	13	12*
	Phase-III	5	3*

* Included in total 17 selected schemes.

17 schemes (valuing ₹ 4156.17 crore) pertaining to manufacturing capacity expansion in 10 major power equipments[7] were selected out of total 22 schemes (valuing ₹ 4737.41 crore) approved and taken up by BHEL during 2007-12. Details of selected schemes are given in ***Annexure I***. Various stages of contract management, including cost estimation, tendering process, award of contracts and post-award execution of purchase orders in respect of selected 174[8] high value purchase orders for the above 17 selected schemes were examined so as to assess the overall efficiency of system of award of purchase orders for capital equipment. Details of the selected sample of purchase orders are summarized in Table 4:

[7] ***Steam/Nuclear Turbines, Gas Turbines, Generators, Hydro Turbines, Hydro Generators, Boilers, Power Transformers, Control panels/equipments, Switchgears and Pump Sets.***

[8] ***HEEP-Haridwar(23), HEP-Bhopal(23), TP-Jhansi (13),HPEP- Hyderabad (44), HPBP-Trichy (48) and EDN Bangalore (23). Purchase orders in respect of HEEP Haridwar, EDN Bangalore and HPBP Trichy were selected on Random basis using 'Random number seed 1965' through IDEA 8 software. However in case of HPEP Hyderabad and TP Jhansi nearly 100 per cent orders were selected. In HEP Bhopal high value orders were selected.***

Table 4

Unit Name	No of Schemes selected	Total Population		Selected Sample		Percent	
		No of POs	Value ₹ in crore	No of POs	Value ₹ in crore	PO	Value
EDN Bangalore	1	103	40.45	23	25.04	22.33	61.90
HPBP Trichy	3	235	533.47	48	371.68	20.43	69.67
HPEP Hyderabad	5	45	517.81	44	351.95	97.78	67.97
HEP Bhopal	1	26	57.40	23	49.79	88.46	86.74
HEEP/CFFP Haridwar	6	154	986.88	23	714.98	14.94	72.45
Transformer Plant Jhansi	1	13	38.29	13	38.29	100.00	100.00
Total	17	576	2174.30	174	1551.73	30.21	71.37

(ii) Capacity utilization: The extent of capacity utilisation achieved by BHEL was examined in respect of delivery of 10 major power equipments[9] (contributing 62.67 *per cent* or ₹ 1.05 lakh crore of the total turnover of ₹ 1.67 lakh crore during the period 1 April 2007 to 31 March 2012 of BHEL). However, erection and commissioning of equipment has not been covered in this Performance Audit as this activity involves readiness of associated civil works and Balance of Plant[10] (BOP) like ash handling, coal handling plants, cooling water system, *etc.* which are either in the scope of work of others or beyond the direct control of BHEL. All eight units manufacturing these 10 major power equipments apart from three marketing units, Corporate R&D unit, Balance of Plant unit, a Repair plant and Corporate office, were covered in performance audit (***Annexure II)***.

In addition, the performance audit also assessed (i) the adequacy of efforts made in development of technology; and (ii) achievements with reference to targets set by Ministry in the Memoranda of Understanding (MOUs), as these aspects have a significant impact on the achievement of capacity utilization and expansion.

Audit of Procurement system in BHEL was last carried out in 2010-11 and the results of Audit had been included in Chapter VI of C&AG's Report No. 10 of 2010-11. As efficiency and effectiveness of procurement system impacts cost effectiveness of a company, Audit also followed up adequacy of action taken by BHEL on the observations and recommendations contained in Chapter VI of C&AG's Report No. 10 of 2010-11.

[9] ***Steam/Nuclear Turbines, Gas Turbines, Generators, Hydro Turbines, Hydro Generators, Boilers, Power Transformers, Control panels/equipments, Switchgears and Pump Sets.***

[10] ***Equipment other than main plant equipment of Turbines, Boilers and Generators required for a Power plant is called Balance of Plant.***

2.2 Audit Objectives

The objectives of performance audit were to assess the:-

- economy, effectiveness and efficiency of planning for expansion of manufacturing capacity including the system of award of contracts;
- effectiveness and efficiency of execution of manufacturing capacity expansion schemes;
- extent of utilisation of manufacturing capacity including adequacy of steps taken to prevent decline in market share;
- results of efforts towards development of technology;
- fixation and extent of achievement of targets in MOU with administrative ministry; and
- effectiveness of monitoring mechanism.

2.3 Audit Criteria

Audit criteria adopted for the performance audit were derived from:

- Reports of Ministry of Power / Ministry of Heavy Industries and Public Enterprises/ Planning Commission/ Central Electricity Authority;
- Agenda and Minutes of the meetings of the Board of Directors and its Sub Committees;
- Purchase Policy, Organization Methods Instructions and Supplier Evaluation, Approval & Review Procedure;
- Production Plans and Scheduling of Floor Shop;
- Internal guidelines in respect of Outsourcing; and
- Guidelines of Department of Public Enterprises (DPE) in respect of MOUs and incentive payments.

2.4 Audit Methodology

An entry conference was held on 23 September 2011 with the Management of BHEL at its Corporate Office, where the scope, objectives, criteria and methodology of audit were discussed and agreed upon. Audit examined the relevant records in the Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises, (Ministry), Ministry of Power (MOP) and selected units /offices of BHEL during September 2011 to February 2012. Audit process involved collection of data, discussion with Management, issue of draft Report to each concerned unit and issue of Consolidated draft Report to the Corporate Management of BHEL after suitably incorporating replies of Management. Report was also issued to Ministry on 29 January 2013 incorporating reply of Corporate Management of BHEL. Management furnished its reply to the Ministry on 02 April 2013 with a copy to this office which was duly incorporated in draft Report. An Exit conference to discuss significant audit findings and recommendations with the Management was held on 05 April 2013. Ministry forwarded (30 April 2013) the reply of Management of 02 April 2013 without their specific comments on

the issues raised in the draft report. Ministry was again requested (15 May 2013) to furnish their specific comments to the audit observations pertaining to fixation and achievement of MOU targets included in the Chapter 8 of draft performance audit report as the Ministry was actively involved in fixation of targets and evaluation of performance of BHEL. Ministry thereafter endorsed (June 2013) the reply submitted by BHEL in respect of Chapter 8 of the performance audit report.

Draft performance audit report was modified considering the replies of the Management, Ministry and discussions held in the Exit conference (April 2013) with the Management. Modified draft report was again issued to the Ministry as well as Management on 05 August 2013 for their comments. Reply of the Management to the revised draft report was received on 9 September 2013 which was followed by a second Exit Conference with the Management as well as Ministry on 16 September 2013 mainly to ensure better understanding and appreciation of technical issues as well as genuine concerns of BHEL. In the second Exit conference (September 2013) Ministry endorsed the reply dated 9 September 2013 of the Management. The present report incorporates the views expressed by the Ministry and Management in their replies forwarded to Audit and views expressed at various stages as detailed above.

2.5 Audit Findings

Audit findings are discussed in the succeeding chapters as detailed below:

- Chapter-3: Planning for Expansion of Manufacturing Capacity;
- Chapter-4: System of Award of Purchase Orders;
- Chapter-5: Execution of Manufacturing Capacity Expansion Schemes;
- Chapter-6: Utilisation of Manufacturing Capacity and trend of Market Share;
- Chapter-7: Development of Technology;
- Chapter-8: Fixation and Achievement of MOU Targets;
- Chapter-9: Monitoring Mechanism; and
- Chapter-10: Conclusion and Recommendations.

2.6 Acknowledgement

Audit acknowledges the co-operation extended by the management of BHEL, Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises and Ministry of Power (MOP) in facilitating the conduct of this performance audit.

CHAPTER-3

Planning for expansion of Manufacturing Capacity

3.1 Planning by BHEL

BHEL took up (2004-06) 18 schemes during X Plan, for expansion including modernisation of its manufacturing capacity from 6,000 MW to 10,000 MW per annum (Phase-I) for completion in December 2007. Recognizing the need for further capacity augmentation of its manufacturing facilities, BHEL constituted (July 2006) a Task Force[11] to reassess the capacity available after implementation of ongoing expansion/modernisation schemes of X Plan and to recommend further capacity augmentation needed as per the requirements of XI and XII Plans. Based on the recommendations of the task force[12], feasibility reports for 17 capacity augmentation schemes for increase in capacity from 10,000 MW per year to 15,000 MW per year (Phase–II) in XI Plan were approved by the Board of Directors (between January 2007 and September 2008) at a total cost of ₹ 3144.60 crore. The schemes were to be implemented by December 2009. As regards capacity expansion for XII Plan, the Board of Directors, based on the feasibility reports received from units, further approved (June 2009) five capacity expansion schemes of 5,000 MW (*i.e.* Installed Capacity from 15,000 MW per annum to 20,000 MW per annum referred to as Phase-III by BHEL) to be implemented by December 2011 at a total cost of ₹ 1592.81 crore. All the capacity expansion schemes of Phase-II and Phase-III were declared completed by BHEL in March 2011 and March 2012 respectively. Expenditure on these schemes was funded by BHEL from its internal resources.

Audit observed the following relating to the planning of the capacity expansion by BHEL:

(i) Adequacy of preparedness for capacity expansion in XI and XII Plans

X Plan (2002-07) envisaged a power generation capacity addition of 41,110 MW in the country.

BHEL, planned the manufacturing capacity addition during X Plan from 6,300 MW per annum to 10,000 MW per annum (Phase-I) during 2004-06 for completion up to December 2007. This capacity addition was declared completed in December 2007.

While CEA had identified power generation capacity addition requirements of 67,439 MW for XI Plan in November 2003 itself, the Task Force was constituted by BHEL only in July 2006. BHEL decided during January 2007 to September 2008 to increase manufacturing

---

[11] ***Task force consisted of 10 AGMs/ Sr. DGMs of HEP-Bhopal, HPEP-Hyderabad, HPBP-Trichy TP-Jhansi, BAP-Ranipet, EDN-Bangalore, Marketing wings (Power Sector, Industry Sector and International Operation) and Corporate office. The GM, HEEP -Haridwar was its Chairperson.***

[12] ***Reviewed by another committee in June 2008.***

capacity from 10,000 MW per annum to 15,000 MW (Phase-II) to be completed by December 2009. BHEL declared completion of Phase-II capacity addition programme in March 2011.

Thus, the manufacturing capacity expansion, which was required to be planned and completed in the initial years of XI Plan, was declared to have been completed by BHEL only towards the end of the Plan. A 'White Paper' on Strategy for XI Plan prepared (August 2007) by CEA and Confederation of Indian Industry (CII), stated that dismal performance of 'Thermal Power' segment at 47.6 *per cent* in achievement of X Plan targets of power generation capacity addition was mainly due to the fact that most of the coal based backup projects did not fructify because of supply constraints on the part of power equipment manufacturers, especially BHEL. The 'White Paper' recommended augmentation of existing indigenous manufacturing facilities and creation of additional capacity by new players for main plant equipments. Working Group on Power constituted by Planning Commission for XI Plan also recorded (February 2007) that there was delay in supercritical technology tie-up by BHEL for manufacturing of six units of 660 MW each to be taken up by NTPC Limited. This resulted in non-commissioning of these projects in X Plan as originally envisaged.

The order booking position of BHEL *vis a vis* the available manufacturing capacity to execute orders is summarized in Table 5. This would indicate that BHEL did not have enough capacity to execute the orders available and booked during 2007-11.

Table 5

Year	Orders Booked	Available manufacturing Capacity	Orders booked in excess of available capacity
	In MW	In MW	In MW
2007-08	16,639	9,675	6,964
2008-09	19,545	10,632	8,913
2009-10	20,949	10,632	10,317
2010-11	18,367	15,490	2,877
2011-12	3,934	15,490	(-)11,556

Ministry of Power, GOI encouraged supply of power equipments for mega power projects by foreign suppliers by abolishing (October 2009) price preference of 15 *per cent* to CPSEs on tariff based competitively bid power projects. This was in addition to the incentive of 'Nil' customs duty on supplies of power equipment for mega power projects since May 1999. Parallely, a Committee under the chairmanship of Shri Arun Maira, Member (Industry), Planning Commission (Maira Committee) was constituted (October 2009) by Planning Commission to examine and suggest options and modalities to take care of disadvantages suffered by the domestic power manufacturers keeping in view factors like 'Nil' customs duty and withdrawal of 15 *per cent* price preference to CPSUs. Maira committee in its report (February 2010) stated that domestic manufacturers suffered disadvantages to the tune of around 14 *per cent* on account of Sales tax/VAT (5 to 6 *per*

cent), higher financing cost (2.4 to 3.2 *per cent*), low customs duty on foreign competitors' supplies (5 *per cent*) and lack of quality infrastructure and dependence on foreign sources for critical raw materials and components. Based on the active initiative taken by BHEL and deliberations in the Committee of Secretaries on the Maira Committee report, a uniform import duty comprising 5 *per cent* basic customs duty, 12 *per cent* countervailing duty (CVD) and 4 *per cent* special additional duty (SAD) was imposed with effect from September 2012 on power equipment imported for mega power projects as well as other power projects. The results of these fresh measures taken by GOI on recommendations of Maira committee remains to be seen. Thus, considering the specific supply constraints on the part of BHEL identified by CEA and changed business environment that facilitated entry of private players in the market, there was a need for BHEL to have a timely relook at its preparedness for XI Plan for capacity augmentation. Further, BHEL also lagged behind its competitors on account of (i) delay in acquiring technology for manufacturing supercritical power equipment, (ii) delivery constraints, and (iii) higher manufacturing cost as discussed subsequently in Chapters 5 and 6.

Management stated (April 2013/ September 2013) that:

- The XI Plan target was firmed up by the Government only in 2007, though certain preliminary indications could have been available in November 2003. The decision for manufacturing capacity expansion was taken by BHEL only after definite policy initiatives and rational indications in the business enhancement were visible to provide sufficient assurance for future opportunity on sustainable basis.

- BHEL's scope of work in a power project is only 45 *per cent* as it mainly supplies Boiler-Turbine-Generator (BTG) as demanded by the power generation utilities. The other 55 *per cent* is on account of Balance of Plant (BOP) like ash handling, coal handling plants, *etc.* and civil works which are in project developer's or others' scope. Invariably delays in the 55 *per cent* segment are also attributed to BHEL.

- From 2007-08 onwards, there were other private sector organizations which announced the formation of Joint Ventures for setting up additional manufacturing base in this country, such as Alstom-Bharat Forge, L&T-MHI, JSW-Toshiba, *etc*. Price preference to domestic suppliers was available till December 2009. In spite of such benefits, other domestic suppliers preferred a 'wait and watch' approach as enough opportunities were not available. Only BHEL took initiative of capacity addition to meet country's capacity addition requirement.

- Maira Committee had concluded that the domestic industry conservatively faced a disadvantage of 14 *per cent* compared to imports. The Committee of Secretaries

had recommended 5 *per cent* basic customs duty, 12 *per cent* countervailing duty and 4 *per cent* special additional duty. The recommendation was implemented only in September 2012. Imposition of customs duty by Government on power equipment, which was required to take place simultaneously with withdrawal of price preference in December 2009, actually took place in September 2012, during which period lot of business was lost to foreign suppliers due to disadvantages faced by BHEL. Further, Maira committee had recommended basic customs duty of 10 per cent, CVD of 'Nil' and SAD of 4 per cent. Therefore, even after the imposition of 5 per cent customs duty, 12 per cent CVD and 4 per cent SAD in September 2012, the disadvantage still continued and the matter was being pursued with the Ministry.

While the calculations provided by the Management indicated that there may be a likely overall disadvantage to domestic manufacturers after considering higher financing cost (2.4 per cent) and Sales Tax (5 per cent), the reply of the Management is to be viewed against the following facts:

- When the issue was discussed in the second exit conference (September 2013) the specific details of definite policy initiatives and rational indications of business enhancement in the country that were considered by BHEL to decide the timing of their capacity expansion plans were not made available to Audit. It is reasonable to assume that professional approach would demand that capacity addition requirement should be identified as early as possible for ensuring smooth convergence with tentative XI Plan targets which were available and known in November 2003 itself.
- This performance audit report is regarding adequacy of planning for capacity augmentation of power equipment (Boiler-Turbine-Generator) manufacturing and delivery by BHEL, which is covered generally within the stated 45 *per cent* of total scope of work of a project and is well within the control of BHEL. Audit observed delay on the part of BHEL in delivery of equipment even within its scope of work as discussed in para 6.1 subsequently.

(ii) Planning excess capacity compared to requirement

Audit observed that even after considering the targets set by itself, BHEL planned its manufacturing capacity (particularly in thermal sector for XII Plan) much in excess of projected market share as depicted in Table 6:

Table 6

(Figures in MW)

Category of capacity addition	Power equipment manufacturing capacity requirement of country for utility segment as per		Expected BHEL's Market share to utilise manufacturing capacity on the basis of assumption of Task Force/ Committee.			Manufacturing Capacity Planned by BHEL for utility segment[13]		Excess manufacturing capacity planned by BHEL	
	XI Plan	XII Plan	Percentage	XI Plan	XII Plan	XI Plan	XII Plan	XI Plan	XII Plan
Thermal	46,114	44,500	78	35,969	34,710	36,469	62,898	500	28,188
Hydro	17,189	30,000	51	8,766	15,300	11,250	11,250	2,484	(-) 4,050
Nuclear	3,160	12,000	50	1,580	6,000	2,508	3,150	928	(-) 2850
Total	**66,463**	**86,500**		**46,315**	**56,010**	**50,227[14]**	**77,298[15]**	**3,912**	**21,288**

Manufacturing capacity for thermal power equipments planned by BHEL would thus, remain underutilized as orders for thermal power equipments required in the country would be around 44,500 MW during XII Plan against production capacity of BHEL of 62,898 MW. Audit observed that capacity augmentation was planned by BHEL based on the assumption of retaining its existing market share of 78 *per cent* in thermal sector. The basis of this vital assumption despite mounting competition from private players and capacity addition in joint ventures was not indicated in the proposals for capacity augmentation.

Management stated (September 2013) that BHEL had successfully faced international competitive bids and had demonstrated a capability to garner 78 per cent market share in the past.

However, plans, if any, to ensure optimum utilization of surplus capacity were not furnished to Audit.

(iii) Inadequate capacity expansion planned in supercritical segment

CEA constituted a Committee in September 2001 to decide on the optimal size of thermal units based on various techno economic considerations. The Committee which *inter alia* included representatives of CEA, Planning Commission, BHEL, NTPC, and State Electricity Boards recommended (November 2003) that higher unit size from 800 MW to 1000 MW should be adopted in the country with super critical technology[16] depending upon site specific techno-economics for deriving maximum efficiency gains. In the XI Plan, Planning Commission also envisaged generation capacity addition of 8200 MW through

---

[13] ***After excluding capacity for (i) captive power plants, (ii) international operations and (iii) Renovation & Modernisation /bunching of orders.***

[14] ***Worked out on the basis of existing capacity of 10,415MW taken into account from 2007-08 to 2009-10 and enhancement of capacity to 15,500 MW taken into account from 2010-11 to 2011-12 as recommended (March 2007) by the Task force i.e. (10415*3+13950(90% of 15,500MW) *2).***

[15] ***Worked out on the basis of capacity recommended (June 2008) by Task Force for XII Plan (90%* 20,215)*5).***

[16] ***Supercritical Technology means technology with minimum steam parameters at steam turbine inlet with main steam pressure 247 kg/sq cm main, steam temperature as 535 degree Celsius and reheat steam temperature as 565 degree Celsius.***

supercritical technology out of total thermal generation capacity addition of 46,114 MW for the country.

Considering the emphasis on development of supercritical technology over the next few years, it was necessary for BHEL to plan commensurate capacity expansion in supercritical segment. Manufacturing capacity planned by BHEL for supercritical and subcritical[17] segments *vis a vis* requirement of XI and XII Plan was, however, as per Table 7.

Table 7

(Figures in MW)

Category of capacity addition in thermal segment	Manufacturing capacity requirement[18] for the country as per		Manufacturing capacity planned by BHEL and implemented through expansion schemes	
	XI Plan	XII Plan	XI Plan [19]	XII Plan[20]
Supercritical	8,200	31,860	5,280	18,000
Subcritical	37,914	12,640	31,189	44,898
Total	46,114	44,500	36,469	62,898

Planned manufacturing capacity under thermal category for supercritical segment remained less than the requirement during both the Plans whereas capacity under sub critical segment was planned in excess during XII Plan.

Management stated (April 2013/September 2013) that

(a) BHEL had planned for a particular product mix comprising different ratings covering both supercritical and subcritical thermal, gas, nuclear and hydro sets.

(b) Though CEA had indicated that all thermal sets from XIII Plan should be based on supercritical technology, many small developers with limited requirement would continue to opt for smaller capacity sets in the sub-critical range as also the customers for captive power plants and international markets.

(c) Care has been taken to ensure that new machines were usable for large size supercritical sets also and BHEL had one Test Bed for 800 MW Turbine Generator which was capable of meeting the requirement of 12 supercritical sets of 660/800MW Turbine Generators per annum.

[17] ***Subcritical Technology means technology with steam temperature as 235°C to 250°C.***

[18] ***Requirement of Equipment and material for development of Power Sector- Generation and Transmission Projects of XI and XII Plan prepared by Central Electricity Authority Planning Wing New Delhi November 2006.***

[19] ***As per Report of Task Force- March 2007.***

[20] ***As per Report of Committee -June 2008.***

Reply is to be viewed against the facts that:

(a) available product mix assumed by BHEL for manufacturing subcritical and supercritical equipment was not as per the Plan projections and has accordingly resulted in creation of lower capacity in supercritical segment as compared to requirements. This is evident from the position of actual orders booked by BHEL during 2008-12 *vis a vis* its available manufacturing capacity and orders booked by other competitors as summarized in Table 8

Table 8

(in MW)

Year	Available manufacturing capacity of BHEL in supercritical segment	Orders for supercritical equipment booked by BHEL	Orders for supercritical equipment booked by other competitors
2008-09	880	1320	6880
2009-10	880	1980	9290
2010-11	1760	6400	15180
2011-12	1760	1320	4380
Total	**5280**	**11020**	**35730**

Thus, actual available manufacturing capacity in the Company during XI Plan was inadequate to meet the orders placed in the market.

(b) With progressively increased emphasis on use of large power generating sets by CEA and total planned capacity addition only through supercritical sets from XIII Plan, it was not clear as to how the Management has assured itself that small developers would be able to provide enough business to BHEL to optimally utilize its subcritical equipment manufacturing capacity. In response to a specific audit query (5 June 2013) requesting for analysis/study, if any, forming of the basis of this assumption, Management forwarded (September 2013) a general response indicating various types of plants that would be using subcritical equipment. The response was not supported by any specific data regarding likely order inflows of such plants that would ensure optimal utilization of the capacity created.

(c) Details of actual utilization of subcritical equipment manufacturing machines for manufacture of supercritical equipment when called for by Audit (6 May 2013) were provided by the Management (September 2013) in respect of two boiler manufacturing machines at Trichy unit. However, in respect of other products like turbines and generators, the Management agreed in second exit conference (September 2013) that there was necessity and more scope for recording/capturing data on inter-usability of machines.

CHAPTER-4

System of Award of Purchase Orders

BHEL framed (October 1998) a purchase policy (Policy) laying down broad directions and guidelines to be followed by all its units as well as delegation of financial powers (for procurement of materials/equipment and related services). The units had also formulated their unit specific Organisation and Methods Instructions (OMIs) and/or departmental procedures for various purchase activities, defining the duties and responsibilities of executives of various groups.

Audit examined implementation of 17 schemes valuing ₹ 4156.17 crore (***Annexure I***), out of 22 schemes valuing ₹ 4737.41 crore approved during 2007-12 for capacity augmentation from 10,000 MW to 20,000 MW during XI and XII Plans. Various stages of contract management, including *inter-alia*, cost estimation, tendering process, award of contracts, post-award implementation of purchase orders in respect of selected 174 high value purchase orders[21] for capital items were examined in audit to evaluate the system of award of purchase orders for capital equipments. This revealed areas requiring strengthening and refinement of procedures as discussed in subsequent paras.

4.1 Inadequacies in cost estimation

Cost estimates are prepared to establish benchmarks for bid evaluation and to assess reasonableness of cost of award of purchase orders. Therefore, it is essential that the estimates are worked out in a realistic and objective manner by taking into account latest costs.

During review of 174 selected purchase orders, it was observed that in 59 purchase orders[22], in the absence of laid down procedure for preparation of cost estimates in units, the rates were based on rates available in the Feasibility Reports (FRs) which, in turn, were based on budgetary offers and were 18 to 36 months old from the date of calling of bids for these purchase orders. Tender evaluation committees, which recommended the award of purchase orders, were not able to assess reasonableness of rates quoted by the bidders as the latest realistic cost estimates were not available for evaluation of rates offered by bidders. Audit observed that the price variations between budgetary offers and awarded price of 59 purchase orders ranged between (-) 63 *per cent*[23] to (+) 40 *per cent* as given in Table 9.

---

[21] ***HEEP-Haridwar(23), HEP-Bhopal(23), TP-Jhansi (13),HPEP- Hyderabad (44), HPBP-Trichy (48) and EDN Bangalore (23) Purchase orders in respect of HEEP Haridwar, EDN Bangalore and HPBP Trichy were selected on Random basis using 'Random number seed 1965' through IDEA 8 software. However in case of HPEP Hyderabad and TP Jhansi nearly 100 per cent orders were selected. In HEP Bhopal high value orders (average value above ₹two crore) were selected.***

[22] ***HEEP-Haridwar (23), HEP- Bhopal (23) and TP-Jhansi (13)***

[23] ***Implies that the purchase orders were awarded at a price which was up to 63 per cent less than the budgetary offers.***

Table 9

Price variation between budgetary offers and awarded price (in *per cent*)	HEEP Haridwar	HEP Bhopal	TP Jhansi	Total
	(Figures in Numbers)			
20 to 40	2	1	0	3
20 to (-) 20	12	17	3	32
(-) 20 to (-) 40	7	3	4	14
(-) 40 to (-) 63	2	2	6	10
Total	23	23	13	59

Audit appreciates that guidelines on Estimates and Price Reasonability under Purchase Policy have been issued by Management on 3 August 2012 so as to reflect current market price and to improve the system. The revised guidelines stipulate that estimates should not be worked out just by applying a uniform yearly compounded escalation over the similar equipment purchased earlier and should be worked out on the basis of indicative market rates/budgetary offers/ last purchase prices economic indices, etc. However, there is scope for bringing more objectivity and transparency by laying down order of preference among various sources of information to be used for estimation of prices.

The Management added (September 2013) that order of preference among various sources of information cannot be specified as a holistic view had to be taken considering available information.

The reply of the management is to be viewed against the fact that the estimated cost and the system underlying the same are important in ensuring transparency and accountability in the procurement process.

4.2 Violation of Purchase Policy

As per the Clause No 4.3 of purchase policy of BHEL, bids for capital goods, where specifications of requirement are generally not very clear, may be invited in two parts viz., (i) Technical bid and (ii) Price bid. While both the bids were to be invited simultaneously, technical bids were to be opened first followed by opening of price bids of technically qualified bidders.

Audit observed that out of 23 purchase orders[24] of capital goods selected for examination, bids for 10 purchase orders valued ₹ 358.35 crore were called through expression of interest-cum-technical bid from Original Equipment Manufacturers (OEM). Price bids were called after technical qualification of bidders as per technical parameters which was against the purchase policy of BHEL. Accordingly, the interested technically qualified bidders submitted their price bids for these 10 purchase orders. Thus, the procedure of inviting above 10 bids through 'Expression of Interest-cum-technical bid' followed by

[24] ***In HEEP, Haridwar***

HEEP-Haridwar was in violation of the procedure prescribed in the Purchase Policy of BHEL. This resulted in reduction in competition amongst bidders for submission of price bids as in seven out of ten cases only one or two bidders each were found to be technically qualified.

Management stated (April 2013) that in eight cases 'two part' bids were invited after inviting Expression of Interest (EOI). However, in two cases, price bids were invited subsequent to techno commercial bids. The approval note for calling two part bids was not clear on the process of EOI. In the new purchase policy issued in April 2013, a clause dealing with purchase through EOI route has been inserted as per CVC guidelines. Management added (September 2013) that limited tenders after calling EOI would also be addressed to shortlisted parties as well as those who had responded to the EOI.

Reply of the Management is to be viewed against the fact that even in eight cases where two parts bids were invited, technical evaluation of offers was completed at the stage of calling for 'Expression of Interest' itself and subsequent two part bids (comprising supplementary technical bid and price bid) were called for from only bidders who were found technically qualified during 'Expression of Interest' stage. This amounted to calling technical and price bids separately. However, Audit appreciates the corrective action taken by the Management to improve the systems as per CVC guidelines.

4.3 Evaluation of bids

As per instruction no. 5.8 of Purchase Work Instruction of HEEP- Haridwar, whenever negotiations are held with any vendor, the committee must prepare either minutes of the meeting or record notes of discussions immediately after negotiations are over. As per CVC instructions of March 2007, justification and details of negotiations with the L-1 should be duly recorded and documented, without any loss of time.

Audit observed that HEEP, Haridwar unit had conducted negotiations in 11 purchase orders valued at ₹ 420.57 crore. Minutes of meetings were, however, signed by the members of the Committees much after negotiation dates (after 3 to 8 days of negotiation).

The Management accepted (April 2013) the audit observation for compliance.

4.4 Delay in placement of purchase orders

With a view to monitoring the performance of units, BHEL has been following a system of 'Balance score card'[25] indicating targets and achievements of units against identified parameters. Balance Score card 2008-09 for HEEP-Haridwar included a parameter for conversion of purchase indent to purchase order within 75 days. HEP-Bhopal, HPEP-Hyderabad and TP-Jhansi units did not fix any norms for the same. A review of 174 purchase

[25] ***'Balance Score Card' is the system for judging the achievement of the Units for the year***

orders[26] in respect of capital items procured by these four units revealed that there were delays in conversion of purchase indent to purchase orders. Table 10 has the details.

Table 10

Sl. No.	Time taken from Indent to Purchase Order	No. of Purchase Orders						
		HEEP-Haridwar	HEP-Bhopal	TP-Jhansi	HPEP-Hyderabad	EDN-Bangalore	HPBP-Trichy	Total (percentage)
1	Upto 75 days	1	2	0	3	2	4	12(7)
2	Between 76 days to 4 months	0	1	0	1	4	1	7(4)
3	Between 4 to 6 months	1	2	0	2	12	8	25(14)
4	Between 6 to 12 months	13	12	7	9	4	31	76(44)
5	Between 12 to 18 months	7	5	5	11	1	3	32(18)
6	Above 18 months	1	1	1	18	0	1	22(13)
	Total	23	23	13	44	23	48	174 (100)

Thus, only seven *per cent* of the selected purchase orders were finalized within the norm of 75 days. Units took more than 12 months in 31 *per cent* cases. Audit observed that delay in placing purchase orders had contributed to the delivery dates getting delayed in 23 purchase orders[27] much beyond the scheduled date of completion of respective manufacturing capacity augmentation schemes with consequent delays in completion of the capacity expansion schemes as detailed in Table 11:

Table 11

Name of Scheme	Scheduled date of commissioning of scheme	Date of placement of last purchase order (PO Number) for scheme	Date of delivery as per purchase order/actual delivery
Steam turbine augmentation at HPEP Hyderabad	December 2009	27 February 2010 (M209PO1026)	15 July 2011
New Blade shop at HPEP Hyderabad	December 2009	18 June 2010 (M 209P003)	15 October 2010
Increase in manufacturing capacity of control equipment EDN Bangalore	December 2009	January 2011 (4000031392)	6 April 2011
Enhancement of manufacturing capacity for power transformer up to 220 KV class from 8500 MVA to 15000 MVA TP Jhansi	October 2009	16 March 2010 (7198186)	5 March 2011

[26] ***HEEP-Haridwar(23),HPEP- Hyderabad(44), HEP- Bhopal(23),TP Jhansi(13) EDN Bangalore (23) and HPBP-Trichy (48)***

[27] ***HPEP Hyderabad (7), EDN Bangalore (5) HEEP-Haridwar (2), HEP- Bhopal (3) and TP Jhansi (6)***

New Block for manufacturing of 765 KV class HVDC and higher rating transformers HEP Bhopal	June 2008	23 June 2009 (8090002)	25 October 2009
Steam turbine including advance blade facilities augmentation to 10,020 MW HEEP Haridwar	October 2009	27 January 2010 (C9T6570)	29 February 2012

Examination in Audit revealed:

- Delay in completion of pre-ordering activities *viz.*, change in technical parameters and scope of the equipments in 14 cases (HEEP Haridwar: 10 cases, EDN, Bangalore: one case and TP Jhansi: three cases)
- Delay in resolving technical issues due to mismatch in technical parameters offered by bidders with reference to BHEL's parameters as substantial time was taken in seeking and furnishing clarifications by BHEL/ vendors in 15 cases (HEEP, Haridwar: eight cases, TP Jhansi: five cases and HEP, Bhopal: two cases) as detailed in Table 12

Table 12

PO NO	Date of opening technical bid	Date of resolution of technical issues and opening of price bid
HEEP Haridwar		
6611	19 July 2008	11 November 2008
6368	12 February 2009	3 August 2009
6570	20 July 2009	12 January 2010
6419	31 October 2007	18 March 2008
6006	22 July 2008	26 December 2008
6557	26 July 2008	22 October 2008
6738	7 June 2008	22 October 2008
6265	12 February 2009	18 May 2009
TP Jhansi		
7198121	29 July 2008	27 February 2009
7198128	10 December 2008	11 May 2009
7188106	6 June 2008	15 December 2008
7198186	30 December 2008	8 January 2010
7198126	25 April 2008	18 February 2009
HEP Bhopal		
8070E76	15 May 2007	6 December 2007
8070D94	10 May 2007	6 October 2007

- Long delivery periods quoted by vendors against the period mentioned in the indents by 'end users' departments in 14 cases (HEEP, Haridwar: 7 cases, TP Jhansi: 4 cases and HEP Bhopal: 3 cases) which BHEL had to agree after discussions as indicated in Table 13.

Table 13

PO No	Delivery period as per Indent (in months)	Delivery period agreed as per Purchase order (in months)
HEEP Haridwar		
6738	17	24
6265	22	26
6365	25	29
6419	12	14
6345	22	23
6611	2	18
6335	25	26
TP Jhansi		
7198124	7	8
7198121	8	13
7188106	6	14
7198126	7	9
HEP Bhopal		
8070029	11	22
8070012	11	13
8070004	11	13

Management noted the observation and stated (April 2013) that delays were attributable to finalization of technical specifications, technical evaluation and retendering.

CHAPTER-5

Execution of Manufacturing Capacity Expansion Schemes

5.1 The status of implementation of manufacturing capacity augmentation schemes for XI and XII Plans in BHEL against the targets is summarized in Table 14:

Table 14

Plan	No of Schemes planned to be executed	Capacity equivalent target of planned schemes	BHEL's target date of completion of all planned schemes	Declared date of completion of all schemes by BHEL in its Annual Accounts/Directors' Report.	Actual status (March 2013) of completion of schemes as per Monthly progress reports submitted by units to Corporate office of BHEL
XI	17	15,000 MW p.a.	December 2009	March 2011	3 out of 17 schemes were yet to be completed (September 2013). These three schemes are likely to be completed by December 2014. (Details in ***Annexure I***)
XII	5	20,000 MW p.a.	December 2011	March 2012	2 out of 5 schemes were yet to be completed (September 2013). These two schemes were likely to be completed by December 2014. (Details in ***Annexure I)***

Thus, achievement of manufacturing capacity addition targets of (i) 15,000 MW per annum by March 2011 as declared by BHEL in its annual accounts for 2010-11 and (ii) 20,000 MW in March 2012 as per the Directors' Report 2012 did not match actual achievements. There were delays ranging between 7 months and 62 months in implementation of 17 out of 22 schemes selected for Audit *(**Annexure I***) in seven units of BHEL. Main reasons for delays were:

- No targets (in terms of time) were specified for vendors for erection and commissioning of machines procured under 16 Schemes. Consequently, longer time was taken by vendors in commissioning of machines compared to that planned by the Management as indicated in Table 15. Further, liquidated damages were not possible to be levied by the units as no such clause was incorporated in purchase orders issued to vendors.

Table 15

Name of scheme	Time taken in erection
Enhancing the manufacturing capacity of pumps HPEP-Hyderabad	28 months
To augment facilities for manufacture of 47 generators HPEP-Hyderabad	40 months
Augmentation of capacity of steam turbines HPEP-Hyderabad	52 months
Capacity augmentation of boiler shops and valve shops HPBP-Trichy	23 months

- Re-tendering for the equipments had to be resorted to in three schemes (one each executed in HPEP-Hyderabad, TP-Jhansi and HEEP-Haridwar) due to high price and single response to tenders, which took further time in award of purchase orders.
- Delays occurred in replacement of damaged equipments in execution of seven schemes at HEEP- Haridwar and one scheme at HPEP-Hyderabad.

Management stated (April 2013) that delay in installation of a few machines did not tantamount to non achievement of capacity or objective of the schemes which was borne out by the fact that physical turnover of 15,055 MW was achieved for 2010-11 corresponding to expanded capacity/ capability. Management added that some vendors had taken abnormally long time in delivering the supplies. In order to address delays in erection and commissioning, new guidelines had been implemented since May 2012 and for addressing damages in transit, packaging requirements were being reviewed. Management further stated (September 2013) that BHEL had already installed facilities mandatorily required by CEA/NTPC to be installed by JVs/tenderers to facilitate manufacture of supercritical boilers, turbines and generators.

Reply is to be viewed against the fact that physical turnover of 15,055 MW achieved by BHEL for 2010-11 included outsourcing and off loading of manufacturing activities by BHEL as discussed subsequently in para 6.1. CEA/NTPC had listed broad facilities required and not detailed list of machines. Actual capacity to manufacture to the extent of 15,000 MW and 20,000 MW was yet to be achieved as 5 out of 22 schemes remained to be completed.

5.2 Analysis of individual cases of delay in capacity augmentation under the schemes

(i) Annual Report of CEA for 2004-05 indicated new benchmarks for synchronization of thermal units. Actual time of commissioning of thermal plants by BHEL as compared to CEA benchmarks are detailed in Table 16.

Table 16

S. No.	Turbine	Cycle time for production in months		
		Actual time taken by BHEL	CEA benchmarks for synchronisation	Proposed cycle time after Phase-II capacity augmentation schemes planned during January 2007 to September 2008.
1	500MW	42	37	36
2	250 MW	34	28	28

As actual time taken by BHEL for manufacturing thermal plants was significantly higher than CEA benchmarks, it was essential for BHEL to plan and initiate action for achieving improvement in this direction. BHEL planned to reduce manufacturing cycle time by 10 *per cent* for major assemblies such as- Turbine Generator Stator Body (500 MW and 210 MW), Low Pressure Inner Outer (500 MW) and Low Pressure Outer Casing (210 MW) of thermal plants to levels matching with CEA benchmarks as part of capacity augmentation schemes (Phase-II). These were approved between January 2007 and September 2008 for likely commissioning by December 2009. Thus, BHEL had decided to compress cycle time for commissioning of thermal plants after 21 months from CEA benchmarking. This, however, was partly achieved as the schemes were not completed due to reasons stated in paragraph 5.1 above. It is pertinent to note that BHEL stated in reply to an audit query that despite being L_1, they had lost three orders aggregating ₹ 16,998.60 crore during 2007-08 and 2008-09 (which represented 15.46 *per cent* of total orders of ₹ 1,09,948 crore booked during this period) to their competitors on account of longer delivery period quoted by them as compared to their competitors. Thus, delayed planning and preparedness for the market requirements impacted the business prospects of BHEL.

While agreeing that its own track record of delivery performance must be further improved, Management stated (April/September 2013) that:

- The manufacturing cycle of various major assemblies was reduced by over 10 *per cent*, for *e.g.* Turbine Generator stator body and low pressure inner outer casings in the case of projects like Chandrapur-Unit 8, Vallur-Unit 3 and Vizag-Unit 2 projects of 500 MW. Similarly, in the case of 210/250 MW projects, synchronization was achieved in 26 months for Raichur-Unit 7 and 30½ months in Trombay. In respect of other projects, more time was taken due to change in shop floor priorities. However, actual time taken for specific job was within the targeted reduced cycle time. As such, the objective of reduction in cycle time had been achieved.
- As per Report of Bank of America-Merrill Lynch (January 2011), Chinese deliveries were nowhere close to promise and the suppliers were quoting 6-12 months faster deliveries than BHEL just to win orders.
- In respect of orders lost, in one case (1X600 MW TNEB / Mettur order), BHEL did not accept the tender condition of paying penalty of ₹107 crore per month beyond contractual delivery schedule as it would have led to huge penalty, in case of any delay. In the case of another order (6x600 MW KSK Energy / Wardha), the customer

placed order on Chinese firm without assigning any reasons. Further, in the remaining order (4x12 MW STG of Cairn Energy India Ltd.), was not lost solely on delivery considerations.

Reply of the Management is to be viewed against the facts that:

- Targets for reduction of manufacturing cycle time was partly achieved only in 2012-13 when Turbine Generator Stator (500 MW) was manufactured in reduced time cycle in three out of total 11 cases and Low Pressure Inner Outer Casing (500 MW) in one out of total 11 cases. Reduction in manufacturing cycle time of 210/250 MW machines was achieved only in two out of 11 cases. In respect of remaining projects, details of specific jobs which were stated to have been completed within the targeted reduced cycle time were not provided to audit. The objective of reduction in cycle time was yet to be fully and effectively achieved.

- Report of Bank of America Merrill Lynch examined delays in commissioning of projects and not the delivery of equipment. Further, CEA data[28] also indicates a commissioning time ranging between (i) 27 and 48 months for projects requiring 300 MW sets and (ii) 37 and 48 months for projects requiring 600 MW sets taken by other vendors including Chinese vendors. As against this, time taken by BHEL, only for delivery of sets ranged between (i) 28 and 46 months for 250 MW sets and (ii) 33 and 50 months for 500 MW sets. Considering the normal time of 24-36 months[29] between shop production/delivery and commissioning of the project, time taken by BHEL was longer than its competitors. Further, the Management also admitted in its Agenda for 397th meeting (30 July 2007) of their Board of Directors that market requirement was for compressed delivery cycle with penalties for delayed delivery. The capital investment proposal for steam turbines was justified to reduce the existing cycle time of BHEL to match the market demand.

(ii) To meet the internal demand for casting and forging to match the manufacturing capacity of equipment of 15,500 MW per annum as per XI Plan targets, Steel Melting Shop (SMS) at CFFP- Haridwar required a capacity of processing 48,000 MT of liquid metal per annum. While the existing Electric Arc Furnace (EAF) at CFFP Haridwar was capable of meeting the primary requirement of 48,000 MT metal, the secondary refining capacity stood restricted to 36,000 MT per annum *inter alia* due to (a) limitation of secondary refining, as only one Vacuum Arc Degassing (VAD) unit was operational for refining Liquid Metal, (b) limitation of handling of Liquid Steel, and (c) limited availability of Vacuum Degassing (VD) Tanks for Forge Ingot.

To overcome the above problems, the CFFP- Haridwar submitted (June 2011) a 'De-bottlenecking Scheme in Steel Melting Shop' with a capital investment of ₹ 43.44 crore. The

---

[28] ***based on CEA data as of December 2010 for projects completed during XI plan updated by Audit to March 2012 from data compiled by BHEL***

[29] ***as stated by the Management in their reply dated 2 April 2013.***

scheme envisaged VAD to suit the requirements and was scheduled for completion by March 2013. After detailed analysis at corporate office, it was established that the scheme would provide a Return on Investment (ROI)[30] of 21.62 *per cent* (after tax) and Internal Rate of Return (IRR)[31] of 24.09 *per cent* with payback period of 49 months. In the proposal for debottlenecking and its internal evaluation by the Management it was indicated that liquid metal produced after debottlenecking would be used for making large size rotors and hydro shafts which were being procured by the BHEL units from overseas sources. However, the scheme was yet to be approved (September 2013).

Audit observed that:

- Debottlenecking of facilities required a lead time of 21 months from the date of approval of scheme, to its completion. As debottlenecking was necessary to match the casting and forging capacity with manufacturing capacity of 15,500 MW (target for XI Plan) targeted for commissioning by December 2009, it was required to be planned in 2008 as part of the capacity expansion schemes. CFFP-Haridwar, however, delayed planning of debottlenecking scheme by more than three years (from 2008 to 2011).
- After delayed initial planning, the final decision on approval or otherwise of the scheme had also not been taken so far (September 2013). Even if the scheme is approved at this stage it would take another 21 months for completion *i.e.* would be ready by March 2015. Capacity augmentation schemes under XI Plan had been declared completed in March 2011. Unless the production capacity of CFFP-Haridwar gets increased to 48,000 MT after debottlenecking, the sister units would be forced to procure castings and forgings of 3450 MT per annum from outside sources (based on projections in the Feasibility Report) leading to a production loss of ₹ 66.12 crore *per annum* till the facility is completed. This is evident from the fact that units of the BHEL had actually procured large size rotors from outside during 2011-13.

Management stated (April/September 2013) that considering the present product mix and future projections, there was no production loss as full requirement of secondary refining had been met with the available capacity and would continue to be met in 2013-14 also. Further, entire requirement of BHEL units had not been envisaged to be met through CFFP-Haridwar only. The techno-commercial issues regarding establishing stand alone viability of the proposed SMS debottlenecking had since been finalised.

Reply is to be viewed against the fact that in the proposal for debottlenecking and its internal evaluation by the Management it was indicated that liquid metal produced after debottlenecking would be used for making large size rotors and hydro shafts which were

---

[30] ***ROI = (Gain on Investment – Cost of Investment) / Cost of Investment***

[31] ***IRR is the discount rate at which the net present value of costs of the investment equals the net present value of the benefits of the investment.***

being procured by the BHEL units from overseas sources. Based on the details provided by the Management, it was observed that large size rotors aggregating ₹ 751.78 crore were procured by BHEL from outside during 2011-13. This indicates that there is a scope for minimizing procurement of large size rotors from outside to the extent of production capacity of CFFP Haridwar after completion of debottlenecking scheme and likely loss of production due to delay in implementation of scheme beyond its originally proposed completion in March 2013 cannot be denied. Data in the feasibility report further indicated that the production achieved through debottlenecking scheme was likely to generate an average post tax return of 19.78 *per cent* for BHEL which has been lost due to sourcing material from outside instead of in-house manufacture by CFFP Haridwar.

5.3 Assessment of manufacturing capacity

Capacity expansion schemes were based on existing capacity of each unit. This would make it imperative that capacity of each unit is assessed objectively and realistically. Audit observed instances of incorrect assessment of existing capacity as detailed in Table 17. This would have an adverse impact on overall production planning and capacity expansion to 20,000 MW.

Table 17

Unit	Equipment	Capacity declared by the Management	Audit observation	Management Reply	Further Remarks
HEEP-Haridwar	Steam Turbines manufacturing equipment	10,020 MW (As of March 2011 as per annual accounts of BHEL for 2010-11)	Capacity was declared commissioned in March 2011 without actual commissioning of 24 out of 135 machines.	Management stated (April 2013) that BHEL had achieved capability to supply the envisaged physical capacity in terms of MW. Actual turnover of 10,271 MW during 2010-11 at HEEP Haridwar establishes this fact.	The reply only indicates achievement of 'capacity to supply' (which also includes supply managed through outsourcing of parts) and not 'capacity to manufacture'. Full benefit of capacity expansion can only be achieved after installation and commissioning of all machines. As 24 out of 135 machines were not commissioned by March 2011, the declared capacity did not reflect true installed manufacturing capacity.
HPBP-Trichy and BAP Ranipet	Boiler and Valves manufacturing facilities	10,000 MW (December 2009)	Facilities were actually completed in July 2012 as per	Management stated (June 2012/April 2013) that due to complex nature of	The reply is to be viewed against the fact that Management was aware about

			Monthly Progress reports submitted by the Unit to Corporate Office of BHEL The delay of up to 290 days was due to late ordering and up to 690 days due to late installation.	equipment and delay in vendors responding to queries, considerable time was taken for finalizing the orders.	complexity of the machines and accordingly timely action to freeze the technical requirements was required to be initiated well in advance to meet the targets.
HPBP-Trichy	Supercritical boiler manufacturing facility	One boiler per annum in December 2007 and two boilers per annum in December 2009	Out of 4 super critical boilers due for delivery against orders received in 2008-09, the unit supplied only one boiler (Sept 2012), that too after a delay of 14 months. This indicated that though HPBP- Trichy had declared (December 2009) enhancement in its capacity, from one to two boilers, it was yet to fully absorb the technology of producing super critical boilers.	Management stated (April/Sep 2013) that there was delay in absorption of knowledge by supervisors as super critical boiler manufacturing was being done for the first time. Training for engineering and design group was completed in 2007-08 and training in manufacturing was availed in 2009-10 when manufacturing was taken up.	Reply of the Management is to be viewed against the fact that training available under the Technical Collaboration Agreement (28th October 2005) for manufacturing process of supercritical boilers was availed only in 2009-10 *i.e.* after more than three years and much after orders of super critical boilers were received in 2008-09. Thus, the process of acquiring manufacturing knowledge was delayed.

Execution of manufacturing capacity augmentation schemes was thus, delayed and whatever capacity was declared commissioned up to March 2011 was not actually physically commissioned. It is clear that, BHEL would benefit through institution of a system of declaration of installed manufacturing capacity that matches physically commissioned capacity.

CHAPTER-6

Utilisation of Manufacturing Capacity and Trend of Market Share

6.1 Utilisation of Manufacturing Capacity

Table 18 below depicts the installed manufacturing capacity and actual production declared by BHEL in their audited annual accounts in respect of main power generation equipments *viz.,* Turbines, Generators and Boilers.

Table 18

Name of the Equipments	2007-08		2008-09		2009-10		2010-11		2011-12	
	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production
Turbines (in MW)	**9,675**	**5,920**	**10,632**	**7,913**	**10,632**	**5,225**	**15,490**	**7,684**	**15,490**	**15752**
Generators (in MW)	9,610	5,029	10,197	7,589	10,197	5,381	15240	6,813	15,240	12,278
Boilers (in MT)	1,08,000	3,05,423	4,11,497	4,39,187	4,81,162	5,45,045	4,81,162	5,95,939	7,14,538	6,86,602

Details of unit wise, year-wise and scheme wise utilization of installed manufacturing capacity are given in ***Annexure III***.

The declared overall installed capacity of BHEL for manufacturing turbines and generators remained underutilized during 2007-11 as could be observed from Table 18. The capacity of boilers (mainly at HPBP Trichy) was shown over utilised during 2007-11 mainly due to inclusion of production through outsourcing that ranged between 54 and 57 *per cent* of total production figures. Further, actual production of boilers in 2011-12 was 96 *per cent* of installed capacity and out of actual production, outsourcing/offloading was to the extent of 58 *per cent*. Installed capacity for production of boilers thus, remained underutilized to the extent of 60 *per cent* during 2011-12. Mainly boiler structurals such as column assemblies, ceiling girders, metallic expansion bellows, ducting, dampers, oil systems, *etc.,* were outsourced.

Management stated (September 2013) that high tech core components (30 per cent) are manufactured by company in own shop and low tech parts (70 per cent) are outsourced. When the company declares capacity it includes shop production plus sub contracting.

The issue was discussed in the second Exit conference (September 2013) with the Management where Audit concern that only own equipment manufacturing capacity should be included for shop production capacity of BHEL was appreciated by the Management.

As regards turbines, BHEL manufactures three types of turbines viz. steam/nuclear turbines, hydro turbines and gas turbines. Steam/nuclear turbines are manufactured at HEP Bhopal, HPEP Hyderabad and HEEP Haridwar, while hydro turbines and gas turbines are

manufactured only at HEP Bhopal and HPEP Hyderabad respectively. Generators are manufactured in all the three units. Utilisation of production capacity at these units was as follows:

(i) HEP Bhopal: Against the declared installed capacity of manufacturing one steam turbine of 250 MW, HEP Bhopal manufactured one steam turbine of 250 MW in 2007-08. Thereafter, in the absence of orders no steam turbine was manufactured till 2009-10. Subsequently, against an order for four steam turbines received by the unit during 2010, the unit completed two and a half turbines aggregating 666 MW during 2011-12 partially through outsourcing as the unit did not have Balancing facility and Hollow Guide Blades. The load analysis report indicated that machines were more than 40 years old, had lost their accuracies and dropped cutting parameters by more than 50 *per cent*. As regards production of generators, the installed capacity at HEP Bhopal remained underutilized during 2007-12.

Management stated (September 2013) that there was a plan for modernization of old machines in stages as the load picked up. Meanwhile old machines were used for rough machining operation where accuracy demand was not high.

The reply only indicates that there was scope for reassessment of installed manufacturing capacity at the unit.

(ii) HPEP Hyderabad: Production of steam turbines was significantly higher than the declared installed capacity in all the years except 2008-09 and 2009-10. Manufacturing capacity of generators remained underutilized except during 2007-09. Audit observed that production activities were outsourced by the unit. However, the details regarding quantum of outsourcing in physical terms and cost benefit analysis of the items outsourced were not provided by the Management.

Management stated (September 2013) that subcontracting is normally carried out for non-core and low value addition items and it was not possible to quantify the volume of outsourcing in physical terms.

The issue was discussed in second exit conference (September 2013) where Audit suggestion that maintenance of outsourcing details in physical terms in MIS, wherever feasible, would provide a useful tool for analysis of capacity utilization, was appreciated by Management.

(iii) HEEP Haridwar: Out of total installed capacity of 15,490 MW of BHEL for manufacture of turbines and generators, HEEP Haridwar accounted for the largest share of 10,020 MW. The installed capacity for manufacturing turbines as well as generators remained underutilized by 13.74 *per cent* to 71 *per cent* in HEEP Haridwar throughout the period of 2007-12 (except turbines and generators in 2011-12).

As the existing capacity remained largely underutilized and orders booked during 2012-13 were also not adequate to optimally utilise the manufacturing capacity as discussed in para 6.3, it appears likely that capacity of turbines and generators added under ongoing

capacity expansion programme (Phase III- upto 20,000 MW per annum) would also remain underutilized resulting in increase in overhead costs rendering the manufactured equipments expensive.

Management stated (April/September 2013) that figures of actual production reported in annual reports and indicated in Table 18 above were less than actual production because Haridwar unit had declared actual production on the basis of completion of trial operation of the equipment which occurred after 2-3 years of the actual manufacturing. Considering the actual production of Haridwar unit, BHEL had achieved full production capacities during 2009-12 in turbine and generators. Actual production of BHEL for turbine and generators in 2008-09 was, however, less than installed capacity mainly due to non availability of required orders of hydro sets.

Reply of the Management is to be viewed against the facts that:

(i) Production figures of turbines and generators claimed by the Management in respect of HEEP, Haridwar were inclusive of outsourcing/offloading of manufacturing activities in open market for machining of raw/semi finished product as well as procurement of finished machined items. In the second Exit Conference (September 2013) Management admitted that due to bunching of orders and some constraints in respect of facilities such as weld overlay, groove stelliting system, etc. at the unit, outsourcing of some core components had also to be resorted to. Reply confirms that manufacturing of the equipment was completed through outsourcing/offloading. However, as details of outsourcing in physical terms were not furnished, Audit could not confirm the production figures claimed. Similar data in respect of outsourcing/offloading in respect of boilers is, however, being maintained at HPBP, Trichy where outsourcing was between 54 and 58 *per cent* of total production during 2007-12.

(ii) Audit has taken installed manufacturing capacity and actual production figures from audited annual accounts which were duly certified by the Management. Further, opening and closing balances of finished items, if any, were disclosed as 'Nil' in the accounts.

Apart from underutilization of capacity, Audit also observed delayed supply of equipment to customers which is depicted in Table19:

Table 19

Period of Delays	2007-08	2008-09	2009-10	2010-11	2011-12	Total
	Figures in Number of Sets					
7 to 12 months	13	15	3	11	19	61
12 to 24 months	19	4	2	8	12	45
24 to 48 months	4	1	0	3	10	18
48 to 68 months	0	0	0	2	0	2
Total	36	20	5	24	41	126

Delay in delivery of equipments ranged between 7 and 68 months in 126 out of 151 sets delivered by BHEL during 2007-12. Specific instances of delay in delivery of equipment are discussed below.

6.2 Delay in supply of equipments

In order to manufacture and supply equipment to customers as per contracted schedule, Central Planning Department of each unit draws up detailed internal targets and sequence called L2 Network for supply for different stages/ modules of equipment. Monitoring the compliance of L2 Network and supply of different modules/auxiliaries and spares of the equipment as per the sequence of L2 Network is, therefore, a pre-requisite for completion of project delivery, erection and commissioning as per schedule. L2 Networks also need to be updated periodically in view of difference in actual dates of completion as compared to planned dates of different activities.

Audit observed that the Management neither updated the L2 networks with actual dates after completion of respective activities nor prepared deviation reports for reviewing the status of actual activities *vis a vis* planned activities and taking appropriate remedial measures for ensuring timely project delivery.

Audit also observed departures from the declared timetable for delivery of various modules/parts (L2 Networks) resulting in non-sequential supplies and consequent delays in completion of projects. Delays had mainly occurred in finalization of engineering drawings, finalization of purchase orders after issue of indents and acceptance of sub-vendors' delivery period beyond BHEL's own delivery period of equipment to customers.

Unit wise analysis of delay in delivery of equipment by BHEL is summarized in Table 20:

Table 20

Unit	No. of completed orders /Projects during XI Plan and selected for audit	Status of orders completed	Audit observation	Management reply	Further Remarks
HEEP Haridwar	90 Turbines/ Generators (2007-12)	78 Turbines/Generators were completed with delay ranging between 1 and 20 months.	In 61 cases, the supply of different modules was found to be non-sequential as compared to L2 Network[32] resulting in delayed completion of	Unit Management stated (March 2012) that exact production of modules depended on several factors like availability of material from suppliers and availability of	Reply is to be viewed against the fact that delay in 78 out of 90 cases (87 *per cent* cases) indicates inadequate planning and scheduling by the Management.

[32] ***L2 Network stands for detailed internal targets to ensure delivery of equipments at agreed date as per contract agreement.***

			equipment. Further, remaining 17 cases[33] were delayed due to delay in manufacturing of equipment in 9 cases, supply of damaged material in 8 cases, transportation problem in 5 cases and diversion of supply in one case.	machining facility.	
HPEP Hyderabad	127 cases selected in Audit.	Unit supplied orders within the scheduled time (or with marginal delay of 70 days) in respect of equipment equivalent only to 2,987 MW *i.e.,* 33 *per cent* of total 9,080 MW capacity manufactured during 2007-12.	(i) Unit concentrated on manufacturing of major equipments like turbines, generators, and pumps so as to meet the turnover targets and ignored 'Balance of Plant' items which resulted in non-sequential delivery of material in 71 out of 127 cases. (ii) Delays were noticed in completion and submission of engineering drawings in 66 cases. (iii) Acceptance of sub vendors' delivery period beyond BHEL's own delivery period of equipment to customers were noticed in 33 cases.	Unit Management stated (February 2012) that delay in delivery was due to various reasons such as (i) delay in receipt of inputs from customers, (ii) delay in getting parts/ sub-assemblies from vendors, (iii) inadequate manufacturing capacity and (iv) bunching of deliveries in a particular period. There were many levels in BHEL which monitor and expedite the progress of the project to meet the expected commissioning dates.	Reply is to be viewed against the fact that the factors attributed to delay were routine managerial issues and were possible to be controlled by the Management through effective and well documented monitoring. Multiple levels for monitoring, did not help arrest controllable factors for delay.
HPBP-Trichy	152 boilers	3 boilers completed in time, 21 boilers delayed up to 70 days, 121 boilers delayed beyond 70 days and 7 held up	Delay was due to delay in completion and submission of engineering drawings in 16	Management stated (Feb 2012/Sep 2013) that the delay in Government approvals, coal	The reply is to be viewed against the fact that the reasons like coal linkages and government

[33] ***Difference in the total and the break up is due to multiple reasons for each case.***

		due to customer disputes.	cases, delay in indenting and conversion of indents into purchase orders in 11 cases, delay in procurement in 5 cases and non synchronization of equipment in 10 cases.	linkages and customer approval resulted in delays in finalisation of engineering inputs and project take off.	approvals are pre-order activities and are completed by customers at their end before placing orders on BHEL.
HEP Bhopal	138 orders	21 orders completed on time and 93 orders delayed between 6 months and three years.	88 purchase orders were placed on sub vendors after the scheduled completion date of work orders. Accordingly, receipt of material from sub vendors started after the scheduled completion dates of work orders.	Management stated (January 2012) that delayed supplies had not hampered the erection and commissioning schedule of the projects.	Reply of the Management is to be viewed against the fact that the customers had withheld ₹ 344.94 crore as on 31 March 2012 on account of liquidated damages, on account of delay in delivery as well as delay in commissioning of projects, against which a provision of ₹ 217.19 crore for doubtful debts was created by BHEL.

Management stated (April 2013) that L1 network was the main contractual document with customer and L2 networks were derived documents from L1 network and as such L2 networks were generally not updated. However, the progress of supplies for various projects was critically reviewed during the monthly review meetings, *viz.* pre-Management Committee Meetings, Management Committee Meetings, and also with the customers on a regular basis. Therefore, even if L2 networks were not updated its contents were reviewed and corrective actions, if any, taken. Management further added (September 2013) that main reasons for delays in supplies (not attributable to BHEL) included delays in approval from customers, delays in transportation of heavier consignments and delays in inspection by customers.

Reply is to be viewed against the facts that

- L2 network indicates the detailed internal targets to ensure delivery of equipment on agreed date as per L1 network. The purpose of preparing L2 network to serve as an internal monitoring and control tool is not fully achieved if it is not updated timely.

- due to delay in deliveries of orders, customers had deducted liquidated damages (LD). While LD amounting to ₹ 1696 crore was waived by customers and

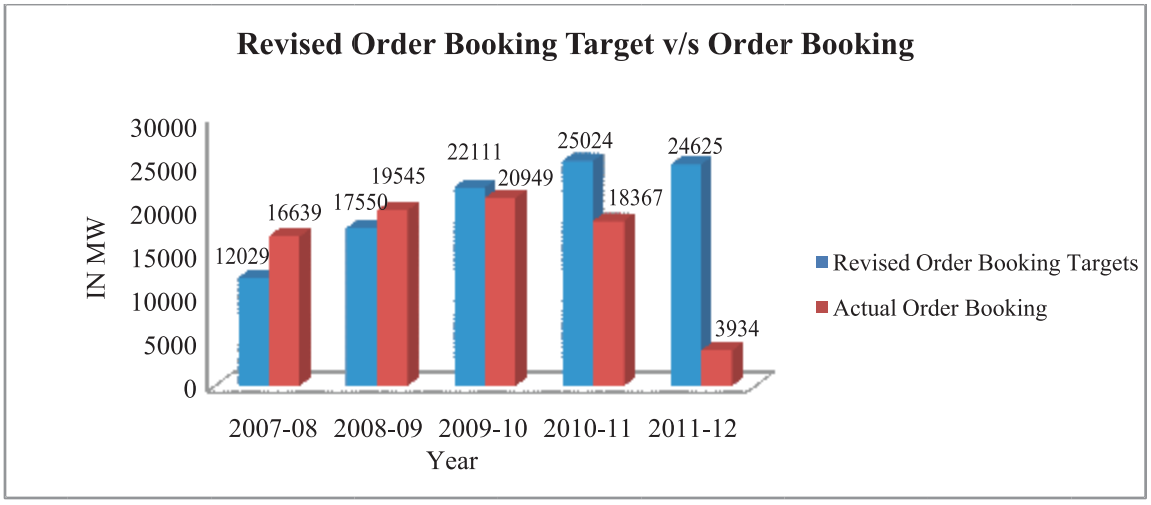
consequent provision was written back by BHEL during 2007-13, LD amounting to ₹ 771 crore was finally borne by BHEL. In addition, ₹ 509 crore had been deducted by customers as automatic price reduction in lieu of LD due to delayed delivery by BHEL of which it was unable to realize any amount during 2007-13. Thus, effectively BHEL had to bear LD of ₹ 1280 crore (₹ 509 crore *plus* ₹ 771 crore).

It is apparent that BHEL would further benefit by ensuring timely delivery of equipment so as to minimize payment of LD.

6.3 Evaluation of Marketing Plan

In view of national target fixed for power sector capacity addition of 78,700 MW (revised to 62,374 MW) during XI Plan, BHEL fixed order booking targets in its Strategic Plan 2007-12. These targets were subsequently revised annually in accordance with the market demand. Actual orders booked as compared to revised order booking targets in the five year period ended March 2012 are as shown in the Chart 1:

Chart 1



It is evident from the above that BHEL secured more orders as compared to its revised order booking targets during 2007-08 and 2008-09 whereas there was sharp decline in actual orders booked against revised targets during 2010-11 and 2011-12. Audit observed that the orders booked by BHEL during 2012-13 improved to 6,715 MW (mainly due to bulk ordering by NTPC and DVC) but still remained inadequate as compared to the manufacturing capacity added by BHEL.

The market share of BHEL (based on the projects commissioned/likely to be commissioned during the Plan period), fell from 65 *per cent*[34] at end of X Plan to 59 *per*

[34] ***As per annual report of BHEL for the year 2006-07***

cent[35] at the end of XI Plan and was likely to come down to 58 *per cent* at the end of XII Plan[36] (based on CEA data on projects likely to be completed in XII Plan).

Management stated (April/ September 2013) that

- due to various uncertainties related to coal availability and other issues associated with land acquisition, funds constraints, *etc*. only a limited number of power projects could materialize for ordering during 2011-12. It was basically the subdued business environment which was resulting in less order inflow.
- dip in the market share of BHEL in projects commissioned was due to the fact that most of the orders were placed by power companies on Chinese suppliers, on negotiation basis without any competition.

Reply of the Management is to be viewed against the facts that

- BHEL secured orders aggregating 3,934 MW (1,320 MW supercritical plants from private power generators, 2,405 MW subcritical plants from private power generators and 209 MW subcritical plants from public sector power generators) constituting only 32 *per cent* out of total orders aggregating 12,359 MW awarded by power generators in 2011-12. BHEL cannot completely absolve itself of the responsibility in decline in its order book position which was also due to (i) longer delivery period quoted by BHEL as compared to their competitors as discussed in para 5.2 above (ii) delay in preparedness by BHEL for acquiring capacity/ technology for supercritical equipment (discussed in Para 3.1), (iii) uncompetitive prices offered by BHEL (discussed in Para 6.3.1), and (iv) Higher Wage Cost (discussed in Para 6.3.3).

- BHEL has obtained 46 out of total 123 power sector orders secured by it during last five years ended March 2012 on negotiation basis.

Thus, there was scope for BHEL to further improve the order book position through timely delivery of equipment to customers, acquisition of technology for supercritical equipment and appropriate marketing strategy.

6.3.1 Uncompetitive prices

Cost estimates against customer enquiries are prepared by Units based on likely design of the equipment required by customers and approved by the Head of the respective Unit. Approved estimates are sent by Units to Corporate Office for submitting tenders/ quotes in response to customer enquiries. Reasons for unsuccessful tenders *viz.* higher cost estimates, longer delivery period or rejection due to technical reasons are ascertained by the Marketing Division of Corporate office and are intimated to the concerned unit. Product committees

[35] ***As per annual report of BHEL for the year 2011-12***

[36] ***Share of BHEL amongst total turbine generator packages awarded to different power equipment manufacturers for likely benefit during XII Plan as per CEA Data.***

have been constituted at Unit level to analyse the reasons further in their meetings required to be held thrice a year as per Corporate Engineering & Product Development (CEPD) Manual.

A sample check of 44 meetings of product committees in respect of seven products[37] held at five units[38] during 2007-12, revealed that these committees did not hold regular meetings and in the minutes of the meetings that were held, the reasons for lost tenders and lessons learnt for future were not discussed and recorded in 43 out of 44 meetings.

With a view to assessing the competitiveness of prices of BHEL as compared to its competitors, Audit reviewed (i) 249 orders for power projects awarded for ₹ 2,53,567 crore and (ii) 94 orders for power projects valuing ₹ 56,535.53 crore lost during the period April 2007 to March 2012. Audit found that BHEL lost 48 orders (equivalent to 10,003 MW) valuing ₹ 22,788.10 crore during 2007-08 to 2011-12 due to difference in price (ranging between 0.4 *per cent* and 51.47 *per cent*) compared to the price quoted by L_1 competitors. Further, in a presentation to Board of Directors in their 433rd meeting held on 7 and 8 May 2011, it was stated that core equipment[39] of BHEL was costlier by 10 to 50 *per cent* in comparison to rates offered by competitors. Thus, it cannot be denied that uncompetitive prices played a significant part in declining market share of BHEL.

Management stated (June 2012/ April 2013) that

- product committee meetings are held at least twice a year and tender opening results along with performance comparisons are discussed at appropriate level with a view to maintaining overall confidentiality.
- prices offered by BHEL were market driven and depended on likely competition, market conditions and it was, therefore, not correct to say that BHEL prices were uncompetitive.
- orders were lost due to (i) new entrants (competitors) in the field which quoted substantially low rates, (ii) loadings on account of deviations taken by BHEL, and (iii) rates for 800 MW units were quoted for the first time.

Reply of the Management is to be viewed against the facts that:

- Minutes of 43 of 44 meetings of Product committees provided to audit did not contain evidence of analysis of lost orders.
- The issue of competitive pricing was discussed by Board of Directors in 433rd meeting held on 7 and 8 May 2011 where it was presented that equipments manufactured by BHEL were costlier with reference to market rates in respect of Steam Turbine Generator by 10 to 15 *per cent*, Heat Recovery Steam

[37] Gas turbines, electrical machines, boilers, control equipment, hydro turbines, Steam turbines/condensers, transformers.

[38] HPEP Hyderabad, HEP Bhopal, HPBP Trichy, EDN Bangalore, HEEP Haridwar.

[39] Core equipment viz., BTG (Boiler, Turbine and Generator set) account for about 60 per cent of the total project cost of a power plant and rest is called as Balance of Plant Equipments.

Generator by 20 to 25 *per cent*, Boiler by 20 to 25 *per cent* and Transformer by 20 to 50 *per cent* and that BHEL lost the orders on this account.

- reasons for loss of orders indicated by Management itself indicates that there was scope for quoting competitive rates. Actual cost incurred on 102 out of 151 orders completed by BHEL during 2007-08 to 2011-12 was much less (ranging between 0.35 *per cent* and 45.38 *per cent*) than the estimated cost which formed the basis for quotes of BHEL for these orders.

6.3.2 Cost estimation for rate quotations

Inadequacies in cost estimation for quoting rates were observed in different units of BHEL that would appear to render the quotes of BHEL uncompetitive and are discussed below:

(a) In Hyderabad Unit, one of the reasons for higher prices in cost estimates was adoption of more labour hours than standard hours required for production of turbines as shown in Table 21 below:

Table 21

Project	Number of direct labour hours included in the estimate	Number of standard hours required as intimated by Management (September 2013)	Excess hours taken in estimates	Per centage of excess labour hours in estimates to standard hours
(1)	(2)	(3)	(4) = (2) – (3)	(5)
Nalco 9 & 10 (2x120 MW)	1,80,000	1,62,000	18,000	11.11
GIPCL Surat Lignite (2x125MW)	1,80,000	1,62,002	17,998	11.11
NEC Kosti Project SUDAN (4x125MW)	3,60,000	3,20,000	40,000	12.5
Pipavav (2x350 MW CCP)	2,96,000	1,94,000	1,02,000	52.58

Management stated (April /September 2013) that in Pipavav project, a higher margin in labour hours was provided during estimation since the offered model was the first of its kind.

Reply is to be viewed against the fact that the proposals for approval of quotations framed by BHEL did not specifically indicate the reasons for adoption of higher labour hours as compared to standard labour hours. Thus, there was a scope for better estimation while quoting rates by BHEL.

(b) In HEEP- Haridwar, due to non availability of old feasibility reports of manufacturing equipment, Audit compared the estimated labour hours with actual labour hours and observed

that labour hours included in estimates for similar 250 MW sets manufactured by the Unit varied widely from actual hours utilized as given in Table 22.

Table 22

Year in which project completed	No. of 250 MW Units	Average labour hours per unit included in estimates	Average labour hours actually utilized to complete a unit
2007-08	8	2,17,801	1,94,606
2008-09	10	3,21,219	1,56,581 (51 *per cent* less than estimates)

It is evident from the above that estimated average labour hours for projects completed during 2008-09 were 47.48 *per cent* higher than those in 2007-08 and actual labour hours were significantly less than the estimated labour hours in both the years.

Management stated (April, 2013) that

- till 2007-08, standard norm hours was taken as 'estimated hours'. However, from the year 2008-09 onwards, the standard norm hours were adjusted with efficiency factor (70 *per cent* over standard hours). After adjusting the average norm hours of year 2007-08 with efficiency factor, there was a variation of only 5 *per cent* in estimates of 2008-09 *vis a vis* estimates of 2007-08.

- estimates were worked out considering complete manufacturing from in-house plant. However, during manufacturing process outsourcing was resorted to after considering plant load and supply commitments. The difference in actual hours as compared to estimates was mainly due to outsourcing of activities.

Verification of the reply in audit disclosed that

- estimates during 2007-08 were also prepared based on 70 *per cent* efficiency level as indicated in Finance guidelines of the unit provided by the Management[40].

- there was no practice of estimating quantum of outsourcing involved in manufacturing of equipment while preparing estimates. When specifically requested (12 April 2013) to provide information about details of outsourcing in these cases, the Management provided (September 2013) details in respect of 14 out of 18 sets mentioned in Table 22 above. The details provided by Management indicated that there was overestimation by 42.44 per cent in the estimates even after considering hours for work carried out through subcontracting/outsourcing. Further, the Management did not analyse the reasons like efficiency, outsourcing, *etc.*, that accounted for significant variations in the actual labour hours utilised *vis*

[40] ***On 4 May 2013 in reply to audit requisition No 2 dated 12 April 2013.***

a vis estimates. BHEL should avail the benefit of lessons learnt from such an analysis for refining estimation and tendering process.

(c) The estimated value of components was higher by 10 to 147 *per cent* than the actual expenditure incurred on 19 completed boilers (out of 120 completed boilers during 2007-11) manufactured by HPBP-Trichy test checked in audit as given in Table 23:

Table 23

Sl.No.	Range of higher estimation (in Percentage)	Number of Cases
1	0 to 50	6
2	50 to 100	9
3	100 to 147	4

Management stated (April 2013) that the variation was within 10 *per cent* in majority of cases.

The reply is to be viewed against the fact that in 18 out of 19 cases checked in audit the variation was more than 10 *per cent*. Details are given in ***Annexure IV.***

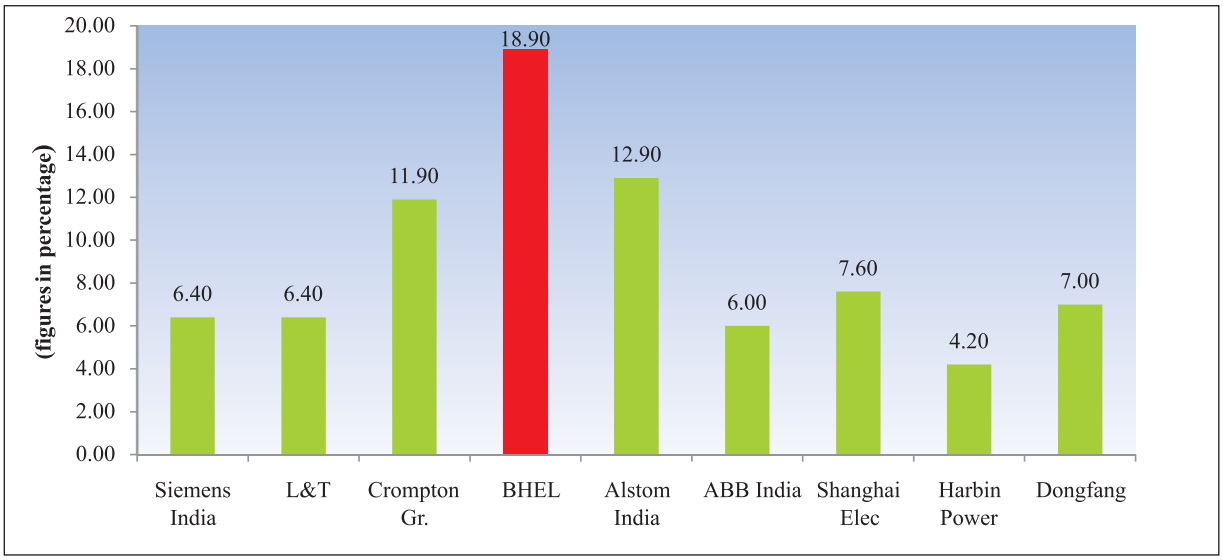
There is need for BHEL to critically evaluate and revisit the system of estimation of costs to ensure better internal control so that rates quoted are competitive.

Management stated (April 2013) that the system of cost estimation was being further examined for enhancing competitiveness.

6.3.3 Higher Wage Cost

BHEL incurred higher wage cost than its competitors which is evident from Chart 2 given below:

Chart 2



Source: Presentation on Strategtic Plan 2017, presented during 433rd Meeting of the Board of Directors held on 7th & 8th May,2011

Management stated (April 2013) that the wage cost in any industry depended primarily on (a) nature of the industry and (b) labour intensity. This was stated to be especially true in the case of BHEL which is not only highly labour intensive but is also a manufacturing company.

Reply of the Management is to be viewed against the fact that the data used in Chart 2 for comparison of wage bill of BHEL with those of its competitors was the same data that was presented to Board of Directors of BHEL in their 433rd meeting held on 7-8 May 2011. It is reasonable to assume that the fundamental factors like nature of industry and labour intensity had been considered by the Management in presenting the comparative labour costs for consideration of their Board of Directors. Further, it cannot be denied that the nature of industry is similar for competitors as well and BHEL in its Strategic Plan recognized the need to control its manpower costs during 2012-17.

Reasons for higher wage cost were further examined in audit and the following issues emerged:

(i) Irregular payment of allowances:

Audit had already highlighted irregular payments to staff vide para No. 11.1.2 of C&AG Report No 11 of 2007 regarding non compliance of DPE guidelines on encashment of leave based on 30 days a month. BHEL has taken action to comply with the DPE guidelines regarding encashment of leave except at Trichy and Bangalore units where the subject matter is stated to be *sub judice*.

(ii) Special Incentive Scheme of HPEP- Hyderabad, HEEP- Haridwar and HEP- Bhopal

As per the Personnel Manual (Vol. I - Para 2.4) approved by the Board of Directors of BHEL in January 2001, no new incentive scheme apart from the existing Corporate Plant performance payment scheme is to be introduced in any Plant. However, in contravention of these provisions of the Personnel Manual, Special Incentive Schemes (in addition to the ongoing Corporate Plant performance payment Scheme) were introduced in May 2001 in HPEP- Hyderabad and in 2008 in HEP- Bhopal with the approval of their respective Heads of Units. The schemes were stated to have been introduced with the aim of improving operational efficiency with respect to available machine capacities and meeting targets for completion of jobs. A similar scheme was also being operated in HEEP- Haridwar but orders for and approval of Head of Unit for introduction of the Scheme were not provided by the Management. As the Personnel Manual that had been approved by the Board of Directors expressly prohibited the introduction of such schemes and there was no explicit delegation of powers to Heads of Units in this regard, the payment of ₹ 67.66 crore disbursed under the Special incentives schemes without approval of Board of Directors under these schemes was irregular.

Moreover, the unit level incentive schemes over and above duly approved Corporate Plant performance scheme of BHEL tantamounted to rewarding the same performance twice. Double payment under two schemes added costs to BHEL without commensurate benefit.

Management accepted (April 2013) the audit observation and assured to devise a uniform incentive scheme covering all the units of BHEL after approval of Board of Directors.

Audit appreciates assurance given by the Management, the implementation of which would be verified in due course.

(iii) Avoidable Overtime Expenditure

The Factories Act, 1948 provides payment of overtime allowance to those who work beyond normal working hours. As overtime allowance is payable at a rate higher than the normal hourly wage rate of workers, it is essential to put a system in place to curb the not unusual tendency to extend normal duty hours for earning this allowance. The manufacturing units of BHEL, without any exception, have witnessed a high growth in this expenditure. Year-wise details of amount paid by BHEL as overtime allowance are indicated in Table 24.

Table 24

(₹ in crore)

Year	2007 – 08	2008 – 09	2009 – 10	2010 - 11	2011-12	Total
Overtime allowance paid to Industrial Workers	77.53	106.69	237.87	184.28	205.65	812.02
Overtime allowance paid to Supervisors	10.32	14.34	27.42	27.35	25.96	105.39
Total	87.85	121.03	265.29	211.63	231.61	917.41

Section 64 of the Factories Act, 1948 *inter-alia* provides that overtime shall not exceed 50 hours per employee per quarter (*i.e.* 200 hours per employee per year). Audit selected 7 major production units[41] for examination and observed that average overtime (in hours) paid per year for 5 units[42]ranged between 316.48 hours and 1121.43 hours per worker per year, which is much higher than the statutory limit of 200 hours/year (300 hours/year for HPBP-Trichy as per permission granted by the Government). This resulted in payment of excess overtime of ₹ 225.79 crore in these five units which was in violation of the provisions of the Factories Act, 1948.

Payment of overtime allowance has also to be viewed against the fact that actual available man power of industrial workers in above five units (except Units at Haridwar) was almost in line with the required man power as budgeted by Man Power Planning Section as shown in Table 25.

[41] ***HPEP - Hyderabad, HEP- Bhopal, BAP- Ranipet, HPBP-Trichy, EDN-Bangalore, HEEP Haridwar and CFFP -Haridwar***

[42] ***BAP- Ranipet, HPBP-Trichy, EDN-Bangalore, HEEP-Haridwar and CFFP -Haridwar***

Table 25

Units	2007 – 08		2008 – 09		2009 – 10		2010 – 11		2011-12	
	Workers strength as per Planning Section	Actual Strength	Workers strength as per Planning Section	Actual Strength	Workers strength as per Planning Section	Actual Strength	Workers strength as per Planning Section	Actual Strength	Workers strength as per Planning Section	Actual Strength
HEEP (Haridwar)	3601	3392	3772	3616	3492	3786	3600	3480	3741	3741
CFFP (Haridwar)	810	810	786	786	760	760	749	686	740	740
HPBP-Trichy	5930	6368	6527	6983	6574	6944	6596	6932	7404	7404
EDN-Bangalore	863	863	867	867	1036	1033	1190	1166	1176	1176
BAP-Ranipet	1448	1484	1532	1573	1631	1493	1729	1638	1840	1840

Management noted (April 2013) the audit observation and has issued necessary instructions to manufacturing units to keep over time within prescribed statutory limits.

Audit appreciates the corrective action taken by the Management. However, the fact remains that overtime in excess of statutory ceilings was paid during 2007-12.

6.3.4 High material cost

As already pointed in para 6.6.1 of C&AG's Report No. 10 of 2010-11, cost of material *vis a vis* turnover in BHEL increased from 45.69 *per cent* in 2006-07 to 55.66 *per cent* in 2008-09. Management attributed (January 2010) this to the rising trend in price of inputs and change in product mix. Audit further reviewed the position for the period 2009-10 to 2011-12 and observed that the percentage of cost of material *vis a vis* net turnover including spares was 60 *per cent*.

Management stated (June 2012) that BHEL could not reduce its material cost in spite of resorting to reverse auction procurement which increased from 4.20 *per cent* in 2006-07 to 31.50 *per cent* in 2011-12 of the total procurement.

Despite increase in reverse auction and increase of vendor base, the Management procured material up to 94.10 *per cent* and 90.00 *per cent* through Limited/Single tenders during 2009-10 and 2010-11 respectively. Thus, BHEL could not take advantage of increased vendor base. Further, extensive procurement by BHEL through single and limited tender had already been pointed out in Chapter VI titled Procurement system of BHEL in C&AG's Report No. 10 of 2010-11. Audit, therefore, followed up the action taken on main audit findings and recommendations contained in Chapter VI of C&AG's Report No. 10 of 2010-11 and observed that out of 20 main audit findings and five recommendations given therein BHEL has taken corrective action in respect of eight audit findings and two recommendations *viz.* (i) review of supplier performance and rating system of the units, (ii) review of product material directory for deleting inactive vendors, (iii) audit observation and recommendation on picking of vendors registered with CII/CEA to widen the vendor base, (iv) newspaper advertisement to increase vendor base, (v) sharing of vendors data among the units, (vi)

hosting the banned and delisted vendors on corporate web site (vii) review of existing vendors by Material Identification and Supplier Control Committee and Unit Supplier Review Committee and (viii) procurement through reverse auction. However, final action in respect of 12 audit findings and three recommendations was still pending ***(Annexure-V)*** despite lapse of two years as interim action taken by the Management has not reached a logical conclusion in most of these audit issues.

6.4 International operations

Phase-II and III capacity expansion programmes of BHEL included planned capacity for production of equipment for international markets based on the projected order bookings during XI and XII Plan periods. Parallely, the Strategic Plan 2007 of BHEL fixed year-wise targets for order booking through international operations, envisaged opening of marketing offices during 2007-12 in different countries and entering into manufacturing joint ventures/formation of subsidiaries to address concerns arising out of local laws.

Audit observed that no action plan was formulated and no timelines were fixed for achieving the goals as per the Strategic Plan. Actual orders booked by BHEL in international operations *vis a vis* Strategic plan targets as well as planned production capacity for international operations during 2007-12 are detailed in Table 26.

Table 26

Year	Strategic Plan Target (in MW)	Planned Production Capacity for International Operation Division (in MW)	Actual international orders booked (in MW)
2007-08	1145	1045	1087
2008-09	1280	1295	782
2009-10	1530	1280	1935
2010-11	1877	1502	1436
2011-12	2195	1195	27
Total	**8027**	**6317**	**5267**

It is evident from above that actual orders secured were significantly less than Strategic Plan targets projections except 2009-10. Actual orders booked also fell short of planned production capacity during 2008-09 and 2010-12.

Management stated (April 2013) that shortfall in achievement of targets was due to unprecedented global meltdown, political turmoil in Middle East and North Africa as well as European crisis.

While Audit does not deny the effect of problems indicated by BHEL, reply of the Management is to be viewed against the fact that BHEL had also lost international orders for 670 MW, 100 MW and 555 MW during 2008-09, 2010-11 and 2011-12 respectively on account of higher prices offered by BHEL as compared to those of its competitors.

In order to improve its presence in international market, BHEL would do well to increase the effectiveness of cost control measures to ensure competitive prices of its products.

6.5 Outsourcing

6.5.1 BHEL's policy for outsourcing

Procurement in BHEL is based on the philosophy of centralized policy making and decentralized purchasing and contract administration. BHEL's corporate office has, however, not issued any policy guidelines/instructions for subcontracting and procurement of finished machine items for customers. Outsourcing is done generally for activities like fabrication and basic machining jobs and these are identified by concerned units without any internal guidelines. Audit observed that in HEEP Haridwar, there was no system in place to carry out a cost benefit analysis at the time of outsourcing of fully machined components with materials. During second Exit Conference (September 2013) it was impressed upon Management that any system of outsourcing should ensure that in-house capacity, if any, for the outsourced components did not remain idle and outsourcing was cost effective for the Company.

Management stated (April 2013) that considering the need and suggestions of Audit, guidelines for outsourcing were issued on 8 February 2013.

6.5.2 Outsourcing due to capacity constraints of CFFP, Haridwar

In order to meet the internal demand for casting and forging to match the manufacturing capacity equipment of 15,500 MW per annum as per XI Plan targets, CFFP Haridwar required augmentation of its casting forgings, foundry facilities and debottlenecking of facilities in its Steel Smelting Shop. Towards this end, BHEL decided to implement three capacity augmentation schemes at CFFP, Haridwar as detailed in Table 27.

Table 27

Scheme	Date of Approval	Scheduled date of commissioning	Status
Capacity Augmentation proposal of Foundry Group	Sept 2007	Dec 2009	Completed in July 2013.
Capacity Augmentation for Forging	April 2008	Dec 2009	Yet to be completed (September 2013).
Capacity Augmentation of Casting	April 2009	March 2010	Yet to be completed (September 2013)
Debottlenecking of Steel Smelting shop	Scheme not approved	-	-

Audit observed that while overall capacity augmentation of BHEL from 10,000 MW to 15,000 MW was planned to be completed and commissioned by December 2009, the capacity augmentation of castings facilities had been planned to be commissioned only in March 2010. Actual commissioning of these facilities was further delayed beyond their scheduled commissioning targets. Audit observed that delay in commissioning of schemes

was due to delay in placement of purchase orders and lack of clarity in criteria fixed for assessing the financial and technical soundness of vendors. The scheme for debottlenecking of Steel Smelting shop had not been approved so far (September 2013) as already discussed in para 5.1 supra. As none of the capacity augmentation schemes had been completed by March 2012, CFFP Haridwar faced capacity constraints to meet the requirements of castings and forgings of HEEP Haridwar, HEP Bhopal and HPEP Hyderabad. Consequently, these three units had to resort to outsourcing of their castings and forgings requirements to the extent of ₹ 127.34 crore during 2010-11 and 2011-12.

Management attributed (June 2012) the delay in completion of capacity augmentation schemes at CFFP Haridwar to time taken in assessment of technical and commercial parameters of offers, low response to tenders and delay in supply of equipment by vendors due to clarifications needed at designing stage of equipment. Management added (April 2013) that tender documents had already been improved in line with the audit observations and tenders were now being floated with very objectively defined criteria for turnover, submission of income tax returns, *etc*. Management further added (April/ September 2013) that outsourcing was resorted to due to breakdown of transformer and for meeting the production schedule of 2010-11 and 2011-12 considering the lead time for ordering of forgings.

Reply of the Management is to be viewed against the facts that (i) the delays were possible to be minimized by finalizing technical requirements of equipments beforehand to minimize time taken in subsequent evaluation of technical offers and designing. (ii) Further, breakdown of transformer affected production only during April 2010 to September 2010 and outsourcing beyond September 2010 (outsourcing at HEP Bhopal and HPEP Hyderabad during 2011-12 was ₹ 71.20 crore due to capacity constraints at CFFP Haridwar) was possible to be minimised by timely completion of schemes. However, Audit appreciates action taken by Management to improve the quality of tender documents.

CHAPTER-7

Development of Technology

7.1 Introduction

Availability and development of technology is an integral part of capacity expansion programme of any manufacturing enterprise. While considering and approving the Phase-II and III capacity expansion programmes, Board of Directors considered the status and further requirements for technology to sustain the proposed capacity expansion schemes. Accordingly, audit examined the adequacy of Research and Development efforts of BHEL to acquire and absorb contemporary technology in its production process.

BHEL was ranked (July 2011) ninth in Forbes List of World's most innovative companies and was also awarded SCOPE[43] meritorious award for R&D, Technology Development and innovation in 2011-12. With a view to developing necessary skills and technology base for product engineering, product development and field engineering, BHEL established (August 1973) Corporate Research and Development (R&D) Division[44] at Hyderabad. All production units of BHEL also undertake limited R&D activities in respect of the equipments being manufactured by them.

7.2 Technical Collaboration Agreements

For design and manufacture of various types of equipments, BHEL entered into 10 Technology Collaboration Agreements (TCAs) and two Memoranda of Understanding (MoU) during August 1976 to November 2010 with foreign Original Equipment Manufacturers (OEM) for 14 major products[45] including one for exploration of oil well as detailed in ***Annexure VI***. The TCAs did not contain provisions to provide source codes and 'know why' of the technology to BHEL. On an Audit query about the efforts made to obtain 'know why', BHEL expressed difficulty in obtaining source codes as well as 'know why' from technology partners under the TCAs as the latter were not willing to transfer technology. In the absence of arrangements to absorb technology from foreign partners, in-house R&D assumes significant importance so as to reduce dependence on technology partners under TCA in the long run.

---

[43] ***Standing Conference of Public Enterprises***

[44] ***In addition to five specialized institutes viz., Welding Research Institute at HPBP-Trichy, Centre for Electric Traction and Hydro Laboratory at Bhopal, Ceramic Technological Institute at Bangalore, Pollution Control Research Institute at Haridwar and Amorphous Silicon Solar Cell Plant (ASSCP) at Gurgaon.***

[45] ***Natural Circulation Waste Heat Steam Generators , Steam Turbines, Generators, Gas Turbines, Once through Boilers, Pulverisers , Pumps, Forging of rotors & generators, Centrifugal Compressors, Oil Rigs, Gera Boxes for pulverisers and bowl mills, Variable pitch Axial flow fan, C&I Automation and water treatment Equipment.***

Management stated (June 2012) and further explained (April 2013) that

- the concept of encouraging indigenous manufacture of supercritical equipment in the country took roots with the conceptualization of Bulk Tender (11 nos. 660 MW sets and 9 nos. 800 MW sets) floated by NTPC Ltd. and Damodar Valley Corporation in October 2009 based on a Cabinet decision, which *inter-alia* mandated the need for complying with technology absorption and a commitment by all bidders for adopting a phased manufacturing programme to participate in the bids. Several domestic companies formed Joint Venture entities with global Original Equipment Manufacturers (OEMs) for this purpose.

- With the intent of allowing various utilities to gain familiarity with new super-critical technology, CEA had framed guidelines for eligible bidders which *inter-alia* specified that all bidders must, along with their bid for Boilers and Steam Turbine-Generators (STGs) submit, a Deed of Joint Undertaking (DJU) in which all the executing parties (*i.e.* the bidder, the technology provider, the Indian manufacturing company and the Indian promoter of the JV-as applicable) shall be made jointly and severally liable to the Purchaser for successful performance of the Contract. Certain domestic tenders for supercritical power projects insist on submission of a DJU. As BHEL gets qualified only by virtue of technical collaboration agreements, the submission of DJU by technology provider becomes mandatory for BHEL's qualification in the tenders. Insistence of compliance with the specific conditionality of DJU places BHEL in a disadvantageous position *vis-a-vis* its technology collaborators, as such conditionalities are used by the collaborators to negotiate a larger share of business from BHEL in the contracts awarded, though BHEL has the requisite capabilities.

Reply of the Management is to be viewed against the fact that purchasers had insisted on DJU wherever the bidders did not meet the specified qualifying criteria of designing and manufacturing supercritical sets on their own. Thus, there is a need for BHEL to acquire and upgrade to contemporary technology for its core business activities.

Audit examined the R&D expenditure and activities of BHEL and units as discussed in the following paragraphs.

7.3 R&D Expenditure

Working Group on Power constituted by Planning Commission for XI Plan (Working Group) compared R&D Expenditure of BHEL with GE, Siemens, Alstom, Hitachi and Mitsubishi Electric during 2003-05 and observed (February 2007) that expenditure on R&D incurred by BHEL ranged between 1.007 *per cent* and 1.211 *per cent* of turnover while the corresponding expenditure of other organizations ranged between 1.8 *per cent* and 6 *per cent* of their turnover. Working Group *inter alia* added that since technology advancements and R&D had not so far been properly addressed, manufacturing organizations (BHEL, ABB and

Siemens) must enhance their budget allocations for R&D substantially by providing 3 to 4 *per cent* of turnover for technology development.

Details of R&D expenditure incurred by BHEL during 2007-12 as percentage of turnover are shown in Table 28.

Table 28

Year	R&D Expenditure[46] (₹ in crore)	Turnover (₹ in crore)	Percentage of R&D Expenditure to Turnover.
2007-08	295.79	19304.64	1.53
2008-09	421.09	26212.33	1.61
2009-10	369.88	32861.11	1.13
2010-11	421.73	41566.13	1.01
2011-12	444.24	47228.00	0.94
Total	**1952.73**	**167172.21**	**1.17**

Expenditure on R&D was, thus, not only less than the desired levels as envisaged by the Working Group but also declined as a percentage of turnover over the last three years ended March 2012.

Management stated (April 2013) that as per annual reports, R&D expenditure for the previous five years was ₹ 464 crore, ₹ 690.01 crore, ₹ 829.27 crore, ₹ 981.86 crore, ₹ 1198.82 crore for the years 2007-08, 2008-09, 2009-10, 2010-11 and 2011-12 respectively.

Reply of the Management is to be viewed against the fact that figures taken by the management were as per the Directors' Report included in the annual report and not as per the audited annual accounts of BHEL. On verification by Audit, it was observed that the figures indicated by the Management also included expenditure of ₹ 167.62 crore, ₹ 268.92 crore, ₹ 459.39 crore, ₹ 560.13 crore and ₹ 754.58 crore for the years 2007-08, 2008-09, 2009-10, 2010-11 and 2011-12 respectively, incurred by way of modifications, design and development to meet customer-specific requirements to execute their orders and were thus billed to customers as part of turnover. As per Accounting Standard 26 (Para 6) 'Development has been defined as application of research findings or other knowledge to plan or design for the production of new or substantially improved materials ……. prior to the commencement of commercial production or use'. The expenditure incurred to meet customer specific requirements under contracts in the process of order execution is a part of commercial production and is, therefore, not Research and Development expenditure as per Accounting Standard 26. Thus, there was a need for matching and reconciliation of figures of Directors' Reports with the annual accounts of BHEL.

Management agreed (September 2013) to include suitable clarifications in the Directors' report from financial year 2013-14.

Audit further observed that R&D expenditure incurred by BHEL as a percentage of its turnover and also in absolute terms was significantly less than that incurred by its competitors

[46] ***As per Annual audited accounts of respective years***

during the last four years (for which data was available based on the annual reports of the competitors[47]) as shown in the Table 29.

Table 29

Sl.No	Particulars	SIEMENS	ABB	ALSTOM	BHEL
1	Main Business	Energy, Industry, Healthcare (in Million Euro)	Energy (in Million US$)	Energy, Transportation (in Million Euro)	Energy, Industry, Transmission, (in₹ crore)
2	Turnover/ Revenue[48]	296,471	136,286	79,246	1,47,868
3	R&D Expenditure	15,167	4,517	2,529	1657
4	Percentage of R&D to Turnover	5.12	3.31	3.19	1.12

Expenditure of BHEL on R&D (1.12 *per cent*) was, thus, the lowest in relation to its turnover compared to main international competitors. This was despite availability of adequate cash reserves[49] as well as directions of the Board of Directors (May 2009) to enhance R&D expenditure upto 4 *per cent* of turnover. Further, Principal Scientific Advisor to Prime Minister also emphasized (August 2011) that BHEL needed to bridge the knowledge gaps in core and specialized areas required for indigenous R&D, especially in knowledge economy regime.

Management stated (September 2013) that during 2011-12, R&D expenditure of BHEL was 2.42 per cent which was much higher than the corresponding figures of companies in the similar field like L&T, Siemens (India), ABB (India), Thermax, Crompton Greaves, *etc.*

While Audit appreciates that the expenditure incurred by the company was higher than Siemens (India), ABB (India), etc as stated by the Management, a better comparison would be possible with global manufacturers and international competitors of the company as against only Indian subsidiaries of the these competitors. The Board of Directors of BHEL in their 433rd meeting held on 7 and 8 May 2011 themselves recognized that the R&D expenditure of BHEL was significantly less as compared to its international competitors like Siemens, ABB, Alstom, *etc.* Further, in a reply to audit query BHEL informed (March 2012) that 8 orders aggregating ₹ 6725.86 crore in respect of power equipment equivalent to 2,104 MW were lost (even after emerging as the lowest in terms of quoted price) during 2007-08 to 2011-12 due to superior operational parameters of the equipment like higher output, lower fuel cost, offered by competitors. This underscores the need for taking measures including more focused and result oriented R&D efforts to match the operational parameters of

[47] ***Annual accounts of (i) Siemens (years ended Sept 2008, 2009, 2010 and 2011); (ii) Alstom (years ended March 2009, 2010, 2011 and 2012);(iii) ABB (years ended Dec 2008, 2009, 2010 and 2011)and (iv) BHEL (years ended March 2009, 2010,2011 and 2012).***

[48] ***Source: Balance Sheets of respective companies***

[49] ***Cash reserves held by BHEL at the end of March 2009, 2010, 2011 and 2012 were ₹ 8364.16 crore, ₹8925.00 crore, ₹9186.53 crore and ₹6311.62 crore respectively.***

customers. This would help improve the order book position and consequent capacity utilization of BHEL.

Management stated (April 2013) that there was loading to the quoted price of BHEL by customers due to various operational parameters (not related to technology gaps) or contractual aspects and no contract was lost due to inadequacy of technology.

Reply of the Management is to be viewed against the fact that in response to audit query, Management informed that loadings in cases pointed out by Audit were on account of higher fuel cost, lower output of offered sets, higher cost per KW and other boilers offered in place of CFBC[50] boilers. Board of Directors in their 433rd meeting held on 7 and 8 May 2011 recognized the need for immediate acquisition of cost effective CFBC technology. BHEL would only gain by recognizing the need for further upgradation of technology and devising an appropriate strategy to continuously match superior operational parameters offered by competitors.

7.4 Strategic Plan

(i) Setting up of new Centers of Excellence – Welding Research Institute

Strategic Plan of BHEL for the period 2007-12 was prepared in May 2007. The draft Roadmap for Strategic Plan for 2007-12 envisaged that HPBP- Trichy was to set up a new Centre of Excellence for Advanced Fabrication Technology (COE)[51] by the end of March 2010 in two phases. The COE was envisaged to increase productivity in manufacturing and product quality through introduction of advanced welding technology in various units of BHEL. Accordingly, Corporate Office approved (May 2008) the proposal submitted (April 2007) by HPBP Trichy for Phase-I of COE at a cost of ₹ 16.60 crore.

Audit observed that Phase I of COE was completed in July 2011 as against the scheduled date of March 2010. While delay of 6 months out of the total delay of 16 months (March 2010 to July 2011) in completion of Phase I of the COE was on the part of foreign vendor for one of the equipments, delay of 10 months was due to delay on the part of BHEL in finalization of vendors and placement of orders. Corporate Office decided (September 2010) to commence Phase-II after conducting welding process and technology audit in all units of BHEL. Accordingly, after completion of welding process and technology audit, the proposal for ₹ 49.07 crore under Phase-II, to be completed within 24 months from the date of approval, was submitted by HPBP Trichy (October 2011). The proposal envisaged acquisition of 12 new technologies for increased productivity and product quality. The proposal was yet to be approved by Corporate Office of BHEL (September 2013).

Management stated (April 2013) that some of these facilities leading to enhanced capabilities and technologies had immediately been commissioned and are operational since

---

[50] ***Circulating fluidized bed combustion***

[51] ***New Center of excellence envisaged to increase the productivity in manufacturing and product quality through introduction of advanced welding technology in various units of BHEL [i.e. Ranipet, Hyderabad, Bhopal, Jhansi, Haridwar, Trichy (valves), Trichy (Welding research institute)]***

2010 at the respective intended units of BHEL and benefits of Phase-1 were indeed being availed by BHEL. Management added (September 2013) that delay in Phase I was also due to damage of an equipment in transit.

Reply of the Management is to be viewed against the fact that apart from damage of one of the equipments in transit, there were ordering delays in four out of 10 equipments envisaged in Phase-I. Similarly, the benefit of 12 new technologies envisaged in Phase-II remained to be availed.

Thus, benefits have been reaped only partially so far and the project which envisaged increase in productivity in manufacturing and product quality through introduction of advanced welding technology in 2010-11 is yet to be completely implemented (September 2013).

(ii) Non-induction of Qualified and Experienced Experts at Lateral Levels

Strategic Plan 2007-12, *inter-alia*, envisaged lateral recruitment for desired competencies required for specific positions and functions in specialized areas. The Board of Directors of BHEL also suggested (May 2009) that the organizational structure of R&D should be reviewed keeping in view the need for rationalization of manpower with highly qualified experts with minimum non-technical staff.

After assessment of manpower requirements, a requirement of 178 experts to be recruited through lateral entry was approved (November 2010) by CMD, BHEL. Against this only six experts had been laterally inducted up to March 2012 and another 42 experts were recruited in August 2012. Remaining 130 posts were yet to be filled up (March 2013).

Management stated (April/September 2013) that despite best efforts, only 42 qualified persons joined against 172 planned due to non-availability of qualified candidates. Research and development activity was being complemented by a team of 261 qualified subject matter experts engaged in full time R&D at Corporate R&D, Hyderabad.

The fact remains that 130 additional experts planned to be recruited through lateral entry were not appointed which underlines the need for strengthening R&D effort and take on the challenges in technology and innovation effectively.

7.5 System for incurring R&D expenditure

BHEL formulated R&D Management System in 1970's which was revised in November 2005 and was further replaced with a system document namely "Corporate Engineering & Product Development (CEPD) Management System Manual" in March 2011. As per requirements of CEPD Manual, BHEL has set up technical committees and product committees for different products at Unit level. Technical Committee *inter alia* scans recent developments in technology in the world and their potential application to products of BHEL and decides action plan for bridging identified technical gaps. Product committee *inter alia* evaluates and recommends new R&D projects and raises Project Initiation Reports (PIRs) for product development, up gradation and quality improvement. PIRs for projects upto ₹ 25 lakh are approved by Head of the Unit and those of higher amounts are submitted to Corporate R&D and Corporate office of BHEL for approval as per delegation of powers.

Audit observed that there were no time limits for evaluation and taking decision on PIRs proposed by Unit level committees on identified technical gaps. During 2007-08 to 2010-12, Corporate Office took between 31 and 898 days for sanctioning expenditure in respect of 106 out of the 176 PIRs referred to it. Further, CEPD Manual does not contain any criteria and guidelines for taking decision about Technical Collaboration, Collaborative R&D and outsourcing R&D activities.

The Management stated (April/September 2013) that all projects committed as per Strategic Plan 2017 are monitored for timely initiation and completion through IT enabled tool. There is a constant endeavour to expedite the approval process. Management added that new R&D Policy stipulated the criteria for arriving at decisions through tools like value-ability matrix which would enable the most suitable choice between technical collaboration, in-house development/outsourcing/collaborative development, *etc*. to be made.

Audit appreciates the efforts made by Management in this regard. However, there is also a need to fix time limits for taking decisions on proposed PIRs to effectively monitor the progress.

7.6 R&D Activities

As indicated in para 7.1 *supra*, R&D activities were mainly carried out by Corporate Research and Development (R&D) Unit[52] at Hyderabad. Besides this, production units of BHEL also undertook limited R&D activities in respect of the equipments being manufactured by them. Audit reviewed records at Corporate Office and Corporate R&D Hyderabad. Table 30 summarizes the details of various types of projects undertaken by Corporate R&D unit Hyderabad during 2007-12:

[52] ***In addition to five specialized institutes viz., Welding Research Institute at HPBP-Trichy, Centre for Electric Traction and Hydro Laboratory at Bhopal, Ceramic Technological Institute at Bangalore, Pollution Control Research Institute at Haridwar and Amorphous Silicon Solar Cell Plant (ASSCP) at Gurgaon.***

Table 30

A – No. of projects; B – Outlay (₹ in crore)

Sl. No	Category of Projects	2007-08		2008-09		2009-10		2010-11		2011-12		Total	
		A	B	A	B	A	B	A	B	A	B	A	B
1	Cost Reduction	4	0.55	1	0.81	2	1.02	3	1.53	2	1.90	12	5.81
2	Quality Improvement	21	5.87	12	3.63	35	17.21	30	11.63	35	15.01	133	53.35
3	Import Substitution	1	0.47	--	--	1	0.42	1	0.45	0	0	3	1.34
4	New Product	15	9.43	9	10.06	17	28.51	11	10.35	19	16.77	71	75.12
5	Enhancing Business Potential	11	4.96	11	7.02	12	13.29	15	11.19	11	8.51	60	44.97
6	Basic Research	5	0.79	--	--	3	0.83	2	0.39	3	0.68	13	2.69
7	Knowledge Management	3	0.57	1	0.20	--	--	--	--	0	0	4	0.77
Total		**60**	**22.64**	**34**	**21.72**	**70**	**61.28**	**62**	**35.54**	70	42.87	**296**	184.05

Audit examined the above 296 projects and observed that R&D activities carried out by Corporate R&D unit at Hyderabad related mainly to peripherals/ components/ sub-systems of major equipments. Projects relating to up-dation/ upgradation/development of a major product, as a whole, were not taken up.

The unit Management stated (January 2012) that the observation of Audit was factual. The corporate Management added (April/September 2013) that holistic development plans are indeed pursued by BHEL through Mission projects and Technology plan projects under the Strategic Plan 2017. However, Indian utility operators have always insisted on proven designs/technology choices making it impossible for indigenously developed new designs to be tried out and evaluated.

While Audit appreciates action proposed to be taken under Strategic Plan 2017, further professionalization of R&D efforts for major products would help BHEL to more effectively take on competition by remaining in the forefront of technology and strengthen its order book for better utilization of its manufacturing capacity.

CHAPTER-8

Fixation and Achievement of MoU Targets

8.1 Memorandum of Understanding

Memorandum of Understanding (MOU) as applicable to the Central Public Sector Enterprises (CPSEs) is a negotiated document between the Government of India (*i.e.* the concerned administrative Ministry) and the Management of the CPSE specifying clearly the objectives of the Understanding and the obligations of both parties. MOU is meant to evaluate the operating performance of the CPSE which includes the progress of project implementation through fixation of targets for various parameters.

8.2 Performance of BHEL against MOU Targets

DPE issues guidelines every year for drafting and finalization of MOUs between CPSEs and respective administrative Ministries according to which all CPSEs are required to sign MOU with the respective administrative Ministry failing which their performance is liable to rated as 'Poor'. BHEL has been signing MOU with its administrative Ministry, *viz.* Ministry of Heavy Industries (Department of Heavy Industries, herein after referred to as Ministry) every year.

Composite scores and corresponding MOU ratings achieved by BHEL during the last five years *i.e.* 2007-08 to 2011-12 were as detailed in Table 31.

Table 31

Year	Composite Score	MOU Rating
2007-08	1.19	Excellent
2008-09	2.64	Good
2009-10	1.17	Excellent
2010-11	1.02	Excellent
2011-12	1.08	Excellent

Targets against each parameter are specified in the MOU by MHI for BHEL as a whole. Based on MOU targets, BHEL on its own, works out parameter wise targets in respect of its Units for judging their performance internally every year.

Audit examined the adequacy of the (i) system of fixation of performance targets for various parameters under MOU for the period of five years *i.e.* 2007-08 to 2011-12 and (ii) assessment of actual performance against the targets fixed with a view to obtaining an assurance on the extent of actual achievement of objectives mainly related to capacity utilisation and Research and Development. Audit findings on these issues are discussed in paragraphs 8.3 and 8.4 respectively.

8.3 Fixation of targets

8.3.1 Need for rational fixation of Non Financial Parameters

A CPSE can select non-financial performance parameters in consultation with the administrative Ministry/Department which are considered crucial to its functioning and fulfilment of its objectives. However, non-financial performance parameters fixed should be SMART (Specific, Measurable, Attainable, Results-oriented, Tangible) and consistent with the Annual Plan/ Budget/Corporate plan of the CPSE. MOU signed by BHEL included 12 main non-financial parameters[53]. These parameters and targets were fixed after deliberations with BHEL by the Task force constituted by Ministry.

Audit examined fixation of targets for three main non financial parameters pertaining to capacity utilisation and Research and Development and observed following inadequacies:

(i) Delivery index of 'on-time' deliveries in customer projects

The number of projects considered for evaluation under this parameter and the total number of projects scheduled for delivery (as per contracts with customers) during the respective years are indicated in Table 32 below:

Table 32

Year	Number of Projects (Capacity in MW) scheduled for delivery during the year	Number of Projects (Capacity in MW) considered for performance evaluation in the MOU parameter	Percentage of number of projects (percentage of capacity in MW) considered in MOU target
2007-08	70 (16,121 MW)	9 (1,504 MW)	13 (9)
2008-09	58 (17,571 MW)	18 (3,268 MW)	31 (19)
2009-10	52 (18,054 MW)	28 (6,151MW)	54 (34)
2010-11	43 (20,750 MW)	22 (7,118 MW)	52 (34)
2011-12	73 (39,143 MW)	58 (12,201 MW)	80 (31)

MOUs were, thus, based on performance of lesser number of projects (13 to 80 *per cent*) than required to be executed by BHEL during these years and did not comprehensively reflect the ability of BHEL to deliver the projects timely during these years compared to their original delivery schedule. Further, though number of projects covered in MOUs increased over the period 2007-12 from 13 to 80 *per cent,* their significance in terms of capacity addition (in MW) to be delivered ranged from only 9 to 34 *per cent* of total capacity (in MW) planned to be delivered. Minutes of the meetings or other records for negotiations of MOU targets in the respective years between Ministry and BHEL did not contain any recorded reasons for excluding or including particular projects.

Management noted (September 2013) the audit observation and stated that DPE is the final authority for selection of projects for fixation of targets under MOU.

---

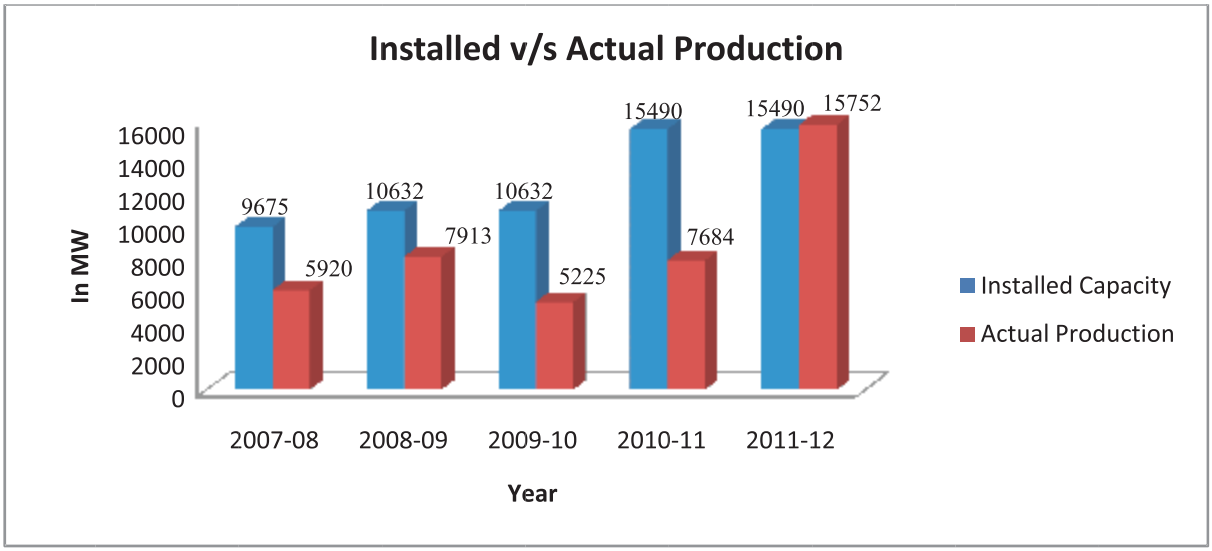
[53] ***Quality and Customer satisfaction, Human Resources, Engineering and R&D, Project Implementation (Modernization and Expansion), Capital expenditure, Extent of globalization, Technology Development of projects, Delivery Index of on time deliveries in customer projects, JV agreements to be signed, Corporate Social Responsibility, Sundry Debtors & Inventory and Enterprise specific objective}***

The fact remains that the projects included for evaluation under the parameter should capture a significant part of the capacity planned to be delivered during the year, in order to make targets challenging.

(ii) Non inclusion of capacity utilization in physical terms as MOU parameter

MOUs for five years ending 31 March 2012 were mainly based on achievement of turnover by BHEL and no weightage was given for capacity utilization[54] of its manufacturing units which remained below the installed capacity[55] (except 2011-12) as shown in Chart 3:

Chart 3



Actual production has been adopted as one of the key parameters in MOUs signed by other CPSEs like NTPC Limited, SJVN Limited with weightage of 7 *per cent* and 5 *per cent* respectively.

Management stated (September 2013) that proposal of BHEL for inclusion of physical performance was not considered by the Task force in MOU 2013-14.

The fact remains that inclusion of physical performance being a significant parameter is likely to capture the overall performance of the Company in a more comprehensive manner.

8.4 Defects in assessment of performance against MOU parameters

Audit observed deficiencies in assessment of performance against the following parameters with respect to the DPE Guidelines as discussed below.

(i) Delivery index of 'on time' deliveries in customer projects

Delivery index of 'on time' deliveries measures performance of the Company in achievement of milestones of selected projects in the MOU. Audit examined the details of working of the delivery index furnished by the Management and observed

[54] ***As per Annual accounts of respective years***

[55] ***Based on the installed capacity (in MW) of three manufacturing units viz HPEP-Hyderabad, HEP-Bhopal and HEEP-Haridwar as reflected in the Annual Accounts of BHEL for respective years.***

that some activities of the selected projects considered for calculation of delivery index were actually completed either during previous year or after the MOU period. The index was thus, not worked out correctly by including only the activities that were completed during the relevant year.

Management stated (April/September 2013) that the parameter of delivery index developed in 2007-08 was validated in 2008-09 and accepted by the DPE Task Force. The principle of calculation of delivery index takes into account all the milestones of the project with corresponding weightages irrespective of the year in which project activity/milestone was completed. Accordingly, the targets were set and the performance scores were evaluated during the year.

Reply is to be viewed against the fact that the objective of MOU is to evaluate the performance of the Company for a particular year. Inclusion of activities which relate to years other than the year under reference is against the basic objective of evaluation of the performance for that year. Further, the Company did not provide the basis of finalizing the formula and weightages for calculation of delivery index. In the absence of basis of formula and weightages adopted for different milestones, it was not possible for Audit to work out the impact of this inadequacy on the overall MOU score of the Company.

(ii) Recognition of Revenue Expenditure in respect of R&D

Targets fixed by Ministry for achievement of 'excellent' rating in the MOUs for in house R&D expenditure and actual expenditure claimed by BHEL against these targets during 2007-12 are given in Table 33.

Table 33

(₹ in crore)

Target	2007-08	2008-09	2009-10	2010-11	2011-12	Total
Target fixed for excellent rating in MoU (R&D Exp)	210	340	494	600	900	2544
R&D Expenditure Claimed in performance of MOU	463.41	690.01	829.27	981.86	1198.82	4163.37
R& D expenditure as per Annual Audited Accounts[56]	295.79	421.09	369.88	421.73	444.24	1952.73

As per guidelines of DPE, MOU evaluation of CPSE is to be done based on the audited accounts and CPSEs have to submit self evaluation report based on audited data. BHEL, however, claimed expenditure under R&D in MOUs in excess of the amount shown in audited annual accounts resulting in over assessment of its achievement. Audit examined the details of ₹ 2852.29 crore out ₹ 4163.37 crore claimed as R&D expenditure under MOUs during 2007-12 and observed that R&D expenditure claimed in MOU performance included expenditure of ₹ 2210.64 crore

[56] ***As per Annual audited accounts of respective years and expenditure incurred on fixed assets for R&D Activities (building, Plant & Machinery and software), and lease rent paid for R&D office, etc.***

on 'development against contracts' which mainly represented modifications carried out as part of specific commercial orders of customers and were not booked as R&D expenditure in the accounts of the Company.

Management stated (April /September 2013) that apart from activities which are captured in the annual audited accounts, a number of other R&D activities are undertaken and captured separately. Customer orders involved new designs and R&D efforts to meet the customers' specific requirements and modification of existing modules. Expenditure incurred on these activities was thus, considered as R&D expenditure.

Reply of the Management is to be viewed against the fact that guidelines of DPE specify that the actual figures in the MOU performance should be as per the audited accounts of the Company. Expenditure incurred by way of modification, design and development of processes to meet customer specific requirements are part of order execution which are billed to customers and recognized as turnover towards main equipment. This is not a part of R&D expenditure as per AS-26 as already discussed in para 7.3 *supra*.

BHEL, thus, claimed benefit in composite score by 0.08 points during all the three years from 2009-10 to 2011-12 respectively on account of R&D expenditure.

To sum up, there was scope for fixing appropriately challenging targets and evaluation of performance more objectively in line with DPE guidelines.

Management stated (April 2013) that targets against each financial parameter of MOU are finalised during negotiations with the DPE task force. Department of Heavy industries is also involved in these negotiations. DPE task force which negotiates the parameters is the same task force which is responsible for evaluation of the performance against the targets fixed in the MOU. Ministry endorsed (June 2013) the reply of Management.

The reply is to be viewed against the fact that it is the responsibility of BHEL as well as the Ministry to ensure that the MOU targets are fixed as well as evaluated as per the prescribed guidelines of DPE. Non-compliance of the guidelines defeats the purpose of objective and transparent evaluation of the performance of a CPSE.

CHAPTER-9

Monitoring Mechanism

9.1 Monitoring Mechanism

Significant aspects of monitoring mechanism adopted by BHEL to monitor implementation of its capacity expansion schemes, securing and delivery of orders are discussed below.

9.1.1 Monitoring of capacity expansion schemes

While approving the capacity expansion programmes, the Board of Directors directed (May 2007) that progress of implementation of these programmes should be reviewed by a Committee of Directors to ensure timely implementation without time and cost overrun. BHEL introduced (July 2007) a monthly information report to be furnished by the units to Corporate office for review of implementation of capacity expansion programmes. The units were advised to take corrective action wherever there were delays consequent to review of monthly information reports. Audit observed delays ranging between 7 and 62 months in implementation of 17 schemes selected for audit out of total 22 schemes implemented under Phase II and Phase III as indicated in Table 34.

Table 34

Period of delay	Number of schemes
7-12 months	1
12-24 months	2
24-36 months	9
36-62 months	5
Total	**17**

As already discussed in paras 4.5 and 5.1 *supra*, the following controllable factors had also contributed to delays:

- Delay in completion of pre-ordering activities *viz.*, change in technical parameters and scope of the equipments in 14 cases (HEEP Haridwar: 10 cases, EDN, Bangalore: one case and TP Jhansi: three cases)
- Delay in resolving technical issues due to mismatch in technical parameters offered by bidders with reference to BHEL's parameters as substantial time was taken in seeking and furnishing clarifications by BHEL/ vendors in 15 cases (HEEP, Haridwar: eight cases, TP Jhansi: five cases and HEP, Bhopal two cases).
- Non fixation of targets for vendors for erection and commissioning of machines in all the 174 selected cases resulting in longer than anticipated time taken by vendors in commissioning the machines.

- Delay in replacement of damaged equipment in execution of 7 out of 17 schemes.

Management stated (April 2013) that as a means to bringing about corrective action, they have reviewed the capacity expansion status on regular basis at the level of Unit Heads and in the Management Committee. Management added (September 2013) that system improvement has been done by way of implementation of new guidelines in May 2012 strengthening prequalification criteria and time period for erection and commissioning to prevent delays in future.

The fact remains that there was scope for expediting the implementation of capacity expansion schemes to the extent these were delayed due to factors that were possible to be controlled as stated above. However, Audit appreciates the action initiated by the Management to improve the systems.

9.1.2 Monitoring of securing and delivery of orders

Based on inputs from various sources *viz;* CEA, customers, media reports, applications filed for coal linkages/environment clearances, expansion plans of the customers, a comprehensive list of possible projects is prepared by BHEL. Thereafter based on the progress of various factors, the probability of materialisation of these projects is worked out, so that advance planning for bidding for these projects is carried out. The list of projects so prepared is included in the Agenda of monthly Management Committee Meeting (MCM) chaired by CMD, BHEL and is attended by Heads of all the Units and Functions. Inputs are also provided by senior members of MCM through their own contacts, which are incorporated in the regular status report.

Orders which materialise after the above process (bidding/negotiation) are reported through updated 'order booking sheet' which is monitored by Director (Power), Head Corporate Planning & Development, Head Corporate Finance, MCM Members and CMD on monthly basis. A monthly report is also sent to the Ministry for review. Corporate Finance wing of BHEL prepares the consolidated order book based on inputs from PS-Marketing and other business sectors for the quarterly/annual results.

In addition, review of progress of supplies of critical equipment to Power Utilities is carried out by Ministry through monthly progress reports from BHEL. Ministry also periodically reviews the progress of projects along with Ministry of Power and concerned customers (SEBs/PSUs).

As discussed in para 6.1 *supra*, out of 151 sets delivered by BHEL during 2007-12, delivery of 126 sets to customers was delayed for periods ranging between 7 and 68 months (disaggregated details in para 6.1) mainly due to controllable factors like non adherence to BHEL's internal schedules for supplies of various modules/parts of the equipments, delays in finalization of engineering drawings, acceptance of sub-vendors' delivery period beyond BHEL's own delivery schedule, delay in placement of indents and conversion of indents into purchase orders.

Audit observed that delayed delivery of orders for power sector projects resulted in progressive accumulation of uncleared orders of customers from 151 in April 2007 to 230 at the end of March 2011 which came down to 197 as of March 2012 as detailed in Table 35.

Table 35

Year	Opening balance of orders in hand	Orders received during the year	Orders delivered during the year	Closing balance
2007-08	151	50	36	165
2008-09	165	40	26	179
2009-10	179	51	11	219
2010-11	219	38	27	230
2011-12	230	18	51	197
Total		**197**	**151**	

Reduction in closing balance of orders as of March 2012 was partly due to lesser inflow of orders as compared to previous years.

Management stated (September 2013) that deliveries under a project are spread over a period from about 8/10 months to 33/36 months. It was, therefore, difficult to conclude that there was accumulation of orders during the year as pointed out in Table 35.

The reply is to be viewed against the fact that opening balance of 151 outstanding orders as of April 2007 alongwith 90 orders received during 2007-09 were required to be delivered latest by March 2012 considering the maximum time of 36 months for deliveries indicated by the Management. As against 241 orders (151 + 90) that were required to be delivered during 2007-12, only 151 orders were delivered which is indicative of slow delivery rate and progressive accumulation of orders.

Thus, there was scope for expediting delivery of projects/orders.

CHAPTER-10

Conclusion and Recommendations

10.1 Conclusion

10.1.1 BHEL is a Maharatna CPSE, under the Department of Heavy Industry, Ministry of Heavy Industries and Public Enterprises. Being a major domestic power equipment manufacturer, BHEL planned power equipment manufacturing capacity expansion schemes in line with the increasing power generation targets envisaged in X to XII Plans. During X Plan, BHEL planned (2004-06) capacity augmentation programme to increase its power equipment manufacturing capacity from 6300 MW per annum to 10,000 MW per annum (Phase-I) to be completed by December 2007. Similarly for XI and XII Plans two more programmes comprising 22 schemes for further augmentation of capacity from 10,000 MW to 15,000 MW (Phase-II) and from 15,000 MW to 20,000 MW (Phase-III) respectively were planned during January 2007 to June 2009 for completion by December 2009 and December 2011 respectively. Though the schemes under Phase–II and Phase –III were declared completed by BHEL in March 2011 and March 2012 respectively, actual status reported by units indicated that 5 out of 22 schemes were yet to be completed (March 2013). It was necessary to expedite and complete the capacity augmentation schemes in time so as to avail the opportunity thrown open by XI Plan.

10.1.2 Capacity expansion programme also envisaged reduction in time cycle of delivery of power equipments by BHEL to meet market demand. This was not fully achieved as capacity expansion schemes were still (March 2013) under implementation. There was scope for BHEL to strengthen its preparedness in planning and implementation of capacity augmentation to effectively meet competition and requirements of the national power plans.

10.1.3 Apart from the need for better preparedness, capacity augmentation in different segments was also required to be matched with Plan requirements. Against the projected requirements of 8,200 MW and 31,860 MW for the country in supercritical thermal segment during XI and XII Plans, the capacity augmentation planned by BHEL was only 5,280 MW and 18,000 MW respectively. However, in case of subcritical thermal segment, against projected XII Plan requirements of 12,640 MW for the country, capacity augmentation in BHEL was planned at 44,898 MW indicating creation of surplus capacity. While Management stated that new machines installed under capacity expansion schemes could be used for manufacture of large size supercritical sets, details of actual utilization of the new machines to manufacture supercritical sets (other than boilers), if any, were not provided to Audit by Management. It is, therefore, likely that the capacity created for turbines and generators under sub critical segment may not be optimally utilized.

10.1.4 Implementation of capacity expansion programmes for XI and XII Plans (covered in Audit) disclosed delays between 07 months and 62 months in 17 selected schemes[57] out of 22 schemes approved in 2007-12. Apart from some uncontrollable factors, delays due to factors like non-fixation of targets for vendors for erection and commissioning of machines, replacement of damaged equipment and delay in pre-ordering activities were possible to be minimized through improvements in market research, planning and monitoring.

10.1.5 Existing installed manufacturing capacity for turbines, generators and boilers during 2007-11 remained largely underutilized. There was considerable scope for improved utilization. Though capacity utilization picked up during 2011-12, there is a need to maintain and further improve it in order to achieve the benefits of ongoing capacity augmentation. In view of inadequate orders booked by BHEL in 2012-13 as compared to manufacturing capacity created, there was a challenge for BHEL to optimally utilise its capacity. Further, Audit observed delay in delivery of equipments ranging between 7 and 68 months in 126 out of 151 sets delivered by BHEL to its customers during 2007-12 (Disaggregated details in para 6.1).

10.1.6 Market share of BHEL (based on projects commissioned/likely to be commissioned during the Plan period) declined from 65 *per cent* at the end of X Plan to 59 *per cent* at the end of XI Plan and was likely to come down to 58 *per cent* at the end of XII Plan (based on CEA data on projects likely to be completed in XII Plan). Despite uncertainties related to coal availability leading to dampening effect on fresh orders during 2011-12 and 2012-13 as stated by the Management, there was scope for arresting decline in the order book through timely acquisition of technology/manufacturing capacity, improvement in cost estimation for tenders and control of wage costs to increase competitiveness of products. BHEL would gain further through focused R&D efforts and increased R&D outlay.

10.1.7 There was scope for providing more appropriate and challenging targets for evaluating performance through various parameters in the MOU.

10.2 Recommendations

Ministry of Heavy Industries and Public Enterprises

1. Ministry may consider reviewing performance parameters and fix challenging targets in MOU to provide a more realistic and objective basis for assessment of performance of BHEL.

BHEL

2. BHEL may review the pricing mechanism of its equipment to make it more competitive by adopting appropriate costs including employee costs.

3. BHEL may work out a time bound programme for increasing outlays on R&D activities, particularly in core areas so as to convert these into advantages in competition.

[57] ***Disaggregated details in Annexure I***

4. Monitoring mechanism may be strengthened to minimize controllable delays in project execution and delivery by fixing periodicity and levels of monitoring up to the Board of Directors.

In respect of the first recommendation, Management stated (April/September 2013) that setting up of targets and evaluation of performance was carried out by independent Task Force. Management accepted (April 2013) the remaining recommendations and stated (September 2013) that steps were being taken by them in that direction.

(USHA SANKAR)
Deputy Comptroller and Auditor General
and Chairperson, Audit Board

New Delhi
Dated : 29 November 2013

Countersigned

(SHASHI KANT SHARMA)
Comptroller and Auditor General of India

New Delhi
Dated : 29 November 2013

Annexure

Annexure I

(Referred to in Paras No 2.1 (i), 4.1 and 5.1)

Capacity Augmentation Schemes at BHEL (Phase – II)

₹ in crore

S. No.	Name of Unit	Capital Investment Scheme	Estimated cost of the Scheme	Scheduled time for completion	Actual / anticipated month of completion	Delay in months	Whether Selected for Audit
1	HEEP-Hardwar	Capital investment proposal for Steam Turbine including advance blades facilities augmentation to 10020 MW	774.23	Oct' 2009	Dec' 2014	62	Yes
2	HEEP-Hardwar	Capital investment proposal for "Turbo-Generator facilities augmentation to 10020 MW	220.27	Oct' 2009	Oct' 2014	60	Yes
3	HPEP-Hyderabad	Capital investment proposal for "Augmentation of capacity for Steam Turbines"	191.96	Dec' 2009	Nov'2012	35	Yes
4	HPEP-Hyderabad	Capital investment proposal for "Establishment of new blade shop"	105.96	Oct' 2009	Sep' 2012	36	Yes
5	HPEP-Hyderabad	Enhancing the manufacturing capacity of pumps from 187 nos. to 280 nos.	88.17	Oct' 2009	Aug'2012	35	Yes
6	HPEP-Hyderabad	To augment the facilities for manufacture of 47 Generators aggregating to 2720 MW per annum.	92.6	Dec' 2009	Dec' 2012	35	Yes
7	TP-Jhansi	Enhancement of manufacturing capacity for power transformer upto 220 KV class from 8500 MVA to 15000 MVA	94.2	Oct' 2009	Aug' 2012	34	Yes
8	HEP-Bhopal	Capital investment proposal for "New block for manufacture of 765 KV class, HVDC and higher rating transformers	131.55	Jun-08	May' 2011	35	Yes
9	HPBP-Trichy	Capacity Investment proposal for "Capacity augmentation of Boiler Shops"	731.72	Dec' 2009	Jul-12	31	Yes
10	HPBP- Trichy	Capacity enhancement of valve shops from 7850 MT to 13800 MT and to enhance capacity to build valves for higher rating boilers and OSTC	93.39	Dec' 2009	July'2012	31	Yes
11	CFFP-Haridwar	Capacity Augmentation proposal of Foundry Group, RMS, QM and Service	48.64	Dec'2008	Feb' 2013	50	Yes
12	CFFP-Haridwar	Capacity Augmentation for Forging	48.63	Dec'2009	Dec'2013	48	Yes
13	CFFP-Haridwar	Capacity Augmentation of Casting- phase-II	13.11	Mar'2010	July'2013	40	Yes
14	EDN Bangalore	Increase in manufacturing capacity of Control Equipment	29.49	Dec'2009	March 2011	15	Yes
Total			**2663.92**				

Capacity Augmentation Schemes at BHEL (Phase – III)

₹ in crore

S. No.	Name of Unit	Capital Investment Scheme	Estimated cost of the Scheme	Scheduled time for completion	Actual / anticipated month of completion	Delay in months	Whether Selected for Audit
1	HEEP-Haridwar	Capacity augmentation of Thermal sets from 10020 MW to 13020 MW	309.16	Dec.' 2011	Dec' 2014	36	Yes
2	HPBP-Trichy	Capital investment proposal for capacity augmentation of boiler and valve shops phase – III	485.29	Dec' 2011	Aug' 2012	07	Yes
3	HPEP-Hyderabad	Augmentation of manufacturing capacity of HPEP corresponding to BHEL capacity of 20000 MW	697.8	Dec'2011	June' 2013	17	Yes
Total			**1492.25**				
Grand Total (Phase II+ Phase III)			**4156.17**				

Annexure II

{Referred to in Para No 2.1 (ii)}

Unit- selected for review

(a) Marketing Unit:

(i) Power Sector

(ii) Industry Sector

(iii) International Operation Division

(b) **Corporate Office**

(c) **Manufacturing Unit:**

(i) Heavy Electrical Equipment Plant (HEEP) and Central Foundry Forge Plant (CFFP), Haridwar,

(ii) Heavy Electrical Plant (HEP), Bhopal,

(iii) Transformer Plant (TP), Jhansi,

(iv) Heavy Power Equipment Plant (HPEP), Hyderabad,

(v) High Pressure Boiler Plant & Seamless Steel Plant (HPBP), Trichy,

(vi) Boiler Axillaries Plant (BAP), Ranipet and

(vii) Electronics Division (EDN), Bangalore

(d) Corporate R& D, Hyderabad

(e) **BOP Unit**: Project Engineering Management (PEM), Noida

(f) **Repair Plant**:-Heavy Equipment Repair Plant (HEPRP), Varanasi

Annexure III
(Referred to in Para No 6.1)

Declared Installed Capacity and its Utilisation

S. No	Name of the Equipments	Units	2007-08		2008-09		2009-10		2010-11		2011-12	
			Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production
1	Steam/Nuclear Turbine (in MWs)	**HEP, Bhopal**	250	250	250	0	250	0	250	0	250	666
		HPEP, Hyderabad	695	1156	1140	1118.87	1140	797.4	1630	1913	1630	1818
		HEEP, Haridwar	5750	2530	5750	4960	5750	2355	10020	2900	10020	11762
TOTAL			**6695**	**3936**	**7140**	**6078.87**	**7140**	**3152.4**	**11900**	**4813**	**11900**	**14246**
2	Hydro Turbine (in MWs)	**HEP, Bhopal**	2500	1284	2500	835	2500	785	2500	1149	2500	854
		HEEP, Haridwar (Hydro Sets)	0	304	0	0	0	0	0	0	0	0
TOTAL			**2500**	**1588**	**2500**	**835**	**2500**	**785**	**2500**	**1149**	**2500**	**854**
3	Gas Turbine (in MWs)	**HPEP, Hyderabad**	480	396	992	999.1	992	1287.7	1090	1722	1090	652
		TOTAL	**480**	**396**	**992**	**999.1**	**992**	**1287.7**	**1090**	**1722**	**1090**	**652**
Grand TOTAL OF Turbines			**9675**	**5920**	**10632**	**7912.97**	**10632**	**5225.1**	**15490**	**7684**	**15490**	**15752**
4	Generators (in MWs)	**HEP, Bhopal**	2500	869	2500	658	2500	1399	2500	1286	2500	380
		HPEP, Hyderabad	1360	1630	1947	1971	1947	1627	2720	2627	2720	2418
		HEEP, Haridwar	5750	2530	5750	4960	5750	2355	10020	2900	10020	9480
TOTAL			**6610**	**5029**	**10197**	**7589**	**10197**	**5381**	**15240**	**6813**	**15240**	**12278**
5	Boilers (in MT)	**Trichy**	108000	305423	411497	439187	481162	545045	481162	595939	714538	686602
TOTAL			**108000**	**305423**	**411497**	**439187**	**481162**	**545045**	**481162**	**595939**	**71458**	**686602**
6	Power Transformers (in MVA)	**HEP, Bhopal**	15000	11986	15000	15483	30000	14231	30000	18805	30000	23160
		TP, JHANSI	5500	5974	5500	6221	5500	4571	15000	7397	15000	9585
TOTAL			**20500**	**17960**	**20500**	**21704**	**35500**	**18802**	**45000**	**26202**	**45000**	**32745**
7	Control Panels & Equipments	**HEP, Bhopal (control equipments + control panels) (in Nos)**	1200	1589	1200	1473	1200	1693	1200	1975	1200	1987
		EDN, Bangalore (Control equipments) (in Cubicle)	2500	3058	4300	4073	4300	5897	4500	6649	7000	6109

S. No	Name of the Equipments	Units	2007-08		2008-09		2009-10		2010-11		2011-12	
			Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production	Installed Capacity	Actual Production
8	Switchgear (in Nos)	**HEP, Bhopal**	3000	4000	3000	3270	3000	2920	3000	2952	3000	4214
TOTAL			**3000**	**4000**	**3000**	**3270**	**3000**	**2920**	**3000**	**2952**	**3000**	**4214**
9	Pump Sets (Nos)	**HPEP, Hyderabad**	126	200	187	201	187	227	280	341	280	351
TOTAL			**126**	**200**	**187**	**201**	**187**	**227**	**280**	**341**	**280**	**351**

Annexure IV

{Referred to in Para No. 6.3.2 (c)}

Details of variation between estimates and actual costs of components in respect of HPBP Trichy

Sl.No	PO Nos	Estimate	Actual	Variation	
		Amount (₹ in lakh)	Amount (₹ in lakh)	Amount (₹ in lakh)	*Percentage*
1	2	3	4	5(3-4)	6(5/4)
1	**I3/1400**	1223.17	942.54	(-) 280.63	(-) 29.77
2	**I3/1401**	1223.17	661.99	(-) 561.18	(-) 84.77
3	**I3/1402**	1223.17	660.81	(-) 562.36	(-) 85.10
4	**I3/1403**	1223.17	693.24	(-) 529.93	(-) 43.32
5	**U2/0387**	1965.38	1120.92	(-) 844.46	(-) 75.34
6	**U2/0388**	1965.38	1021.93	(-) 943.45	(-) 92.32
7	**U5/0635**	7594.55	4187.10	(-) 3407.45	(-) 81.38
8	**U5/0637**	7594.55	3668.43	(-) 3926.12	(-) 107.02
9	**U1/0162**	950.56	863.90	(-) 86.66	(-) 10.03
10	**U0/0435**	433.98	345.07	(-) 88.91	(-) 25.77
11	**U5/0649**	4584.80	3783.26	(-) 801.54	(-) 21.19
12	**U2/0385**	1965.38	912.69	(-) 1052.69	(-) 115.34
13	**U2/0386**	1965.38	796.73	(-)1168.65	(-) 146.68
14	**U5/0639**	4817.61	3157.18	(-)1660.43	(-) 52.59
15	**U5/0640**	4817.61	2988.78	(-) 1828.83	(-) 61.19
16	**U5/0656**	4244.76	2863.22	(-) 1381.54	(-) 48.25
17	**U5/0647**	5330.83	3210.58	(-) 2120.25	(-) 66.04
18	**U5/0648**	5330.83	2628.19	(-) 2702.64	(-) 102.83
19	**U5/0645**	5639.58	3562.73	(-) 2076.85	(-) 58.29

Annexure –V

(Referred to in Para No. 6.3.4)

Issue wise details of audit observations and deficiencies noticed in the follow up action in Chapter VI of Audit Report No. of 2010-11

Sl. No.	Observation	Management Reply	Further Remarks
1	**Purchase Policy and Purchase Procedure** Due to various deficiencies noticed in the purchase policy and procedures, it was recommended that BHEL needs to develop comprehensive guidelines/ policy on procurement to be followed uniformly by the units. Management in their ATN report (October 2011) intimated that revised purchase policy was under approval. However as per further reply (January 2012) of the Management, the revised purchase policy had been kept on hold in view of proposed Public Procurement Act. Thus, due to non approval of revised purchase policy no action on the audit observation/ recommendation was taken by the Management. *(Refer Para no* 6.6.2 *and Recommendation no* 6.1 *of Report-10 of 2010-11*).	Management stated (September 2013) that revised purchase policy-2013 has since been approved by the Board of Directors on 22 March 2013 and has since been issued on 8 April 2013.	The Management had assured (January 2010) that constitution of Purchase Committee will be made mandatory for all procurements exceeding ₹ five crore whereas as per clause no. 11.2 of the purchase policy 2013, formation of purchase committee is mandatory for tenders above ₹ 20 crore.
2	**Procurement by Limited/ Single tender** Audit had observed that 94 *per cent* contracts were awarded on Limited/ Single tender basis during 2006-09. Further review of procurement made during 2009-10 and 2010-11 revealed that the procurement through Limited/ Single tenders was 94.10 *per cent* and 90.00 *per cent* respectively. As such there was no improvement in the Procurement system. *(Refer Para no. 6.6.3.1 of Report-10 of2010-11).*	Management stated (September 2013) that the revised Purchase policy 2013 clause no. 3.0 provides thrust on vendor base expansion, especially where there are less than four vendors for an item in the Product Material Directory (PMD). Further clause 5.2.2 (Limited Tender) provides that "whenever the number of registered suppliers in PMD is less than four, it should be recorded that the process as in clause 3.4 is being followed." Purchase through Single tender where there is only one registered supplier in the PMD is permitted only	No further remarks. However, implementation of revised policy would be watched in Audit.

		subject to fulfilment of the following {cl. 5.3.1(j)}: (i) Process at cl. 3.4 is being followed. (ii) In case the estimated value of the tender is more than Rs 20 lakh, it shall be recorded that Open Tender for procurement has been resorted to in the last financial year and there was no qualified response. Purchase policy-2013 also specifies a review mechanism for specific Single tender purchases.	
3	**Inconsistency in loading for deviation in tender evaluation** Audit had observed that uniform guidelines for loading for deviation in delivery system, interest to be loaded in case of deviation in prescribed payment terms were not existing in BHEL due to which different units had adopted different procedures for evaluation of tenders. BHEL in their action taken note (April 2010) intimated that guidelines on uniform loading criteria for tender evaluation were at advance stage of approval. Audit observed that the proposed guidelines are yet to be approved. As such, no improvement in tender evaluation system has been made till date. *(Refer Para no Para no. 6.6.3.2 of Report-10 of 2010-11)*	Management stated (September 2013) that the proposed guidelines are under discussion with the concerned groups and are planned to be issued by Dec 2013.	Management agreed to issue guidelines on evaluation of techno-commercial deviation and uniform loading but same are still under approval.
4	**Cost Estimate** Audit had observed various shortcomings in the estimation procedures adopted by units (Transmission Business Group and Project Engineering Management Unit) as estimates prepared for procurement of material were based on either budgetary quote or last purchase price of similar items without uniformity in allowing price escalation. Management has not issued cost estimation guidelines even	Management stated (September 2013) that considering nature & wide spectrum of purchases, order of preference among various sources of information cannot be specified as holistic view has to be taken considering available	Audit appreciates the action taken by the Management to improve the system. While the revised guidelines stipulate that estimates should not be worked out just by applying a uniform yearly compounded escalation over similar equipment purchased earlier and should be worked out on the basis of indicative market

	after giving assurance (January 2010) for the same. *(Refer Para no.*6.6.3.3 *of Report-10 of 2010-11).*	information. The guidelines are intended to enable the indentor to take an objective view while framing the estimates.	rates/ budgetary offers/ last purchase prices/ economic indices, etc., there is a scope for bringing more objectivity and transparency by laying down order of preference among various sources of information to be used for estimation of prices.
5	**Limited Vendor Base** Audit had observed the units of BHEL had a very limited vendor base and Bhopal, Haridwar, Hyderabad, Project Engineering Management Noida and Tiruchirappalli units had single vendor register for 538, 286, 16, 302 and 8 material groups respectively. Audit reviewed the present position of vendor registration and noticed that even though BHEL had increased its vendor base by 3455 during 2010-11 but still BHEL is dependent on single vendor for large number (1120) of material categories. Thus, BHEL procurement is still dependent on single vendor and lacked competition as 90 percent of the procurement (₹ 27187 crore) was made through limited/single tender during the year 2010-11. Resultantly the Recommendation that "BHEL needs to review its limited tendering policy in view of thin vendor base and also to bring in more competition", is yet to be fully implemented. *(Refer Para no* 6.6.4.2 *and Recommendation no* 6.2 *(a) of Report-10 of 2010-11).*	Management stated (September 2013) that constant thrust is being given to increase the vendor base resulting in addition of new vendors 1700 in 2011-12 & 1900 in 2012-13 respectively for enhanced competition. Material cost has further come down to the tune of 57.7 *per cent* of Gross Turnover less Excise duty.	There is a requirement to enlarge the vendor base to promote competition.
6	**Delay in Vendor Registration** In respect of delay in registration of vendors pointed out in the audit report, Audit analysed the information furnished (January 2012) regarding supplier registration as on 30 September 2011 and noticed that out of 783 applications pending for registration, 284 applications (36 *per cent)* were more than six months old. This shows that delay in registration of vendors still persisted in substantial number of applications. *(Refer Para no* 6.6.4.4 *(b) of Report-10 of 2010-11)*	Management stated (September 2013) that with a view to bring improvement, this has been made part of Balance Score Card of all units for the year 2013-14.	While we appreciate the action taken by Management, Management has not intimated about the targets fixed to avoid delays in vendor registration. Further, Management was requested to provide the Balance Score Card (BSC) of all units for the year 2013-14, which is yet to be provided (September 2013).

7	**Deficiency in Vendor Data Base and Non Updation** Following deficiencies were pointed out in the Audit Report: • Placement of purchase order on vendor which was not listed in Product Material Directory (in Transmission Business Group), • Material code wise registration of vendors not being allotted for different size/ capacity within the same material category (Haridwar, Hyderabad and Tiruchirappalli) and • Revision of supplier list required to be undertaken once in three years was not being done (PSWR Nagpur) • Centralised vendor database should be made more comprehensive and integrated, so as to enable monitoring of vendors' performance, *(Refer Para no* 6.6.4.5 *(c) &* *(d) and Recommendation no* 6.3 *of Report-10 of 2010-11)*	Management stated (September 2013) that supplier registration system is being developed for centralised web based and planned for hosting by Dec. 2013, which will ultimately lead to centralised vendor database management system in a phased manner.	Audit would verify action taken in due course..
8	**Delay in Tender Processing** As per policy (Clause IS), the units should evolve and fix norms for purchase lead time (i.e. from the date of indent, raising enquiry, order placement and receipt of material) for different types of materials/ component depending on the complexity of the product. No such norms had been fixed by units except Trichy where targets of 60 days to 120 days for conversion of purchase requisitions into purchase orders had been fixed. Management in their action taken note (May 2011) stated that above provision of purchase policy have been reiterated to the units during the Material Head Meeting and units have also been communicated to initiate the time scale mapping of purchase indent (PI) to purchase order (PO) conversion. Audit however, observed that no effect was visible as review of the data of Project	Management stated (September 2013) that considering the importance, target for conversion of purchase indent to purchase order within 75 days has been taken for materials in MOU 2013-14 and is being monitored regularly.	While we appreciate the action taken by Management, Management was requested to provide the Balance Score Card (BSC) of all units for the year 2013-14, which is yet to be provided (September 2013).

	Engineering Management unit, relating to 1949 purchase orders placed during the year 2010-11 revealed that in 802 purchase orders (valuing more than Rs ten lakh) the conversion of PI to PO took more than 90 days. Hence, BHEL needs to evolve and fix norm for purchase lead time. *(Refer Para no* 6.6.5.1 *of Report-10 of 2010-11).*		
9	**Non Placement of Repeat Order** In Haridwar unit an extra expenditure of ₹ 29.09 crore was pointed out due to non placement of repeat order (as per policy) for four products (covering six selected purchase orders valuing ₹ 139.06 crore). As no specific reply was given by the management in their ATN (May 2011) issue is still to be addressed by the management *(Refer Para no 6.6.5.3 of Report-10 of 2010-11).*	Management stated (April 2013) that repeat order cannot be placed as a matter of routine. It is guided by the prevailing market conditions.	The reply is to be viewed against the fact that the audit observation was made on the basis of clause of Repeat order in the existing purchase policy. Management action is required to be taken as per provisions in the existing policy.
10	**Placement of Purchase Order beyond the Delivery Dates** Audit had observed 310 purchase orders (55 in Hyderabad unit, 77 in Trichy unit, three in PSWR Nagpur, five in PEM Noida and 170 in Bhopal) were placed by these units beyond delivery schedule indicated in the indent raised as well as schedules committed to the customers resulting in payment of liquidated damages. Management in their ATN (May 2011) repeated the reply furnished in January 2010 which was duly considered in the report. Management, however, further stated that introduction of ERP implementation across BHEL will provide for common platform for monitoring project schedule and material planning more accurately. Since ERP is yet under implementation the improvement envisaged by the management can be viewed after its implementation. *(Refer Para no* 6.6.5.4 *of Report-10 of 2010-11).*	Management noted (April/ September 2013) the audit observation.	ERP system is still under implementation in BHEL. Hence, same can be reviewed only after its implementation.

11	**Post Award Relaxation of Delivery Period** In Bhopal, Hyderabad, Nagpur, Transmission Business Group New Delhi and Trichy Units, there were delays in delivery by the suppliers and in 237 cases delivery period agreed as per purchase orders was subsequently relaxed up to a maximum of 20 months which led to delay in supplying of materials to the customers. Management in their ATN (May 2011) intimated that extension of delivery is granted only on case to case basis after analyzing the production/ project requirements. Reason for delay, however, needs to be monitored through Budget and Moving Ahead through Performance (MAP) so as to arrest the avoidable delays. *(Refer Para no 6.6.5.7 of Report-10 of 2010-11).*	Management stated (September *2013*) that punitive action for two consecutive delays by the supplier has been proposed in the revised draft guidelines on suspension of business dealing, which is under approval.	Action is yet to be taken since the proposed revised draft guidelines on suspension of business dealing are under approval.
12	**Non Adherence to Rotation Policy in Sensitive Departments** As per Corporate guidelines, employees should be transferred from sensitive areas after four years. These guidelines are yet to be implemented due to non identification of sensitive areas as same is under progress as per latest ATN (October 2011). *(Refer Para no 6.6.6 of Report-10 of 2010-11)*	Management stated (September 2013) that action is under progress (likely by Dec 2013)	Final corrective action on this is still awaited.

Annexure VI

(Referred to in Para No. 7.2)

List of Technical Collaborators Agreements / Memorandum of Understandings

Sl.No.	Name of Technical Collaborator	Date of Agreement and its present validity	Name of Product Covered	Number of Products covered
1	M/s Vogt Power International Inc., USA	8 November 1988 and valid upto March 2017	For Manufacturing of Natural Circulation Waste Heat Steam Generator	1
2	M/s Siemens AG, Germany	August 1976 and valid upto September 2021	For Manufacturing of Steam Turbines and Generators	2
3	M/s. General Electric Co., USA	July 1986 and valid upto October 2016	For Manufacturing of Various Models of Heavy Duty Gas Turbines	1
4	M/s Alstom, France	27 October 2005 and valid up to 26 October 2020.	For Manufacturing of Once Through Boilers and Pulverisers for Power Plants with Supercritical parameters	2
5	M/s Mitsubishi Heavy Industries Ltd.	31 May 2007 and valid upto May 2017	For Manufacturing of various types of Pumps	1
6	M/s Sheffield Forge Masters International Limited (SFIL)	5 February 2010 and valid upto February 2020	For forgings upto 500 metric tonne ingot weight to meet the requirement of large rotor forgings upto 1000 MW rating and matching generators.	1
7	M/s NP, Italy	15 June 2010 and valid upto June 2020	For Manufacturing of Centrifugal Compressors only	1
8	M/s National Oilwell Verco (NOV), USA (MOU)	22 May 2010 and valid upto May 2013	For manufacture of Oil Rigs	1
9	M/s. Flender, Germany (MOU)	30 October 2004 and valid for five years	For technical assistance in manufacturing of Bevel Planetary Gear Boxes for pulverisers and Bowl Mills	1
10	M/s TLT Gmbh, Germany	19th April 2002 and valid upto May 23rd 2020.	For Manufacturing of Variable pitch Axial Flow Fans for FD, PA, ID and Dry Scrubber application	1
11	M/s Metso Automation Inc. Finland.	18th December 2000 and valid to September 2019	For Manufacturing of New Generation C&I Automation Platform	1
12	M/s GE India Industrial Private Limited, India	November 2010 and valid upto November 2017	For Manufacturing of Water Treatment Equipment	1