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Report of the Comptroller and Auditor General of India on Competitiveness of BHEL in Emerging Markets

Union Government (Commercial)
Ministry of Heavy Industries and Public Enterprises
Report No. 29 of 2017
(Performance Audit)

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Table of Contents

Preface

The Performance Audit Report has been prepared under the provisions of Section 19-A of the Comptroller and Auditor General's (Duties, Powers and Conditions of Service) Act, 1971, as amended in 1984. The audit has been carried out in line with the Regulations on Audit and Accounts-2007 and Performance Audit Guidelines-2014 of the Comptroller and Auditor General of India.

The decade ended 2010 had posed numerous challenges to BHEL including increase in intensity of competition, squeezed delivery schedules and issues related to climate change. In the face of these challenges, BHEL's turnover declined sharply after 2012-13 and profitability also turned negative for the first time in 2015-16. Keeping this in view, a performance audit on 'Competitiveness of BHEL in Emerging Markets' was carried out. The performance audit covers activities of all four power sector regional offices, eight out of 17 manufacturing units and three non-manufacturing units of BHEL during the period 2011-12 to 2015-16.

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

Executive Summary

INTRODUCTION

Established in 1964, Bharat Heavy Electricals Limited (BHEL) is India's largest engineering and manufacturing company engaged in design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for the core sectors of the economy. Orders secured by all three business sectors (power, industry and international operations) are executed through a network of 17 manufacturing units, four regional offices, eight service centres and 15 business offices.

The decade ending 2010 had posed challenges to BHEL in the form of climate change, increased competition and squeezed delivery schedules with emergence of new competitors. In the face of these challenges, BHEL's turnover declined sharply post 2012-13 and the Company reported a loss in 2015-16. In this context, a performance audit on 'Competitiveness of BHEL in Emerging Markets' was carried out.

MAJOR AUDIT FINDINGS

Power sector continued to account for the bulk (76.46 *per cent* to 80.53 *per cent*) of BHEL's turnover during the period under review (2011-12 to 2015-16). As the Company had not effectively diversified into new/less operated business areas, both its turnover and profitability declined sharply with slowdown in power sector. BHEL's turnover which was ₹49510 crore in 2011-12 declined to ₹26587 crore in 2015-16; while profits of ₹7040 crore in 2011-12 turned into a loss of ₹913 crore in 2015-16.

(*Para 3.3.1*)

BHEL had fixed Strategic Plan targets for the period 2012-17 with focus on diversification and innovation. However, BHEL did not set year wise milestones for implementation of the envisaged strategies. BHEL could not achieve any of the strategic plan targets till 2015-16; shortfall ranging between 23.33 and 113.91 *percent* against specific goals.

(Para 1.3)

BHEL could not bridge the technology gap in the core power sector; in particular, Circulating Fluidized Bed Combustion, Gas Turbines, Dry Type Transformers and 500 MVA Inter Connecting Transformers. BHEL could not avail of the opportunities in the 765 KV segment of Gas Insulated Substations which is being increasingly adopted to reduce Right of Way requirement for transmission lines and overcome constraints in availability of land for substations. As R&D projects related to 400/ 420 kV technology were delayed, R&D for 765 kV technology

could not be taken up. Out of 25 tenders for 765 kV GIS issued during 2012-13 to 2015-16, BHEL could participate only in seven tenders with equipment sourced from other OEMs.

(Para 4.2.1)

Though BHEL had quoted below production cost in 13 cases, 11 of them were being executed with profit margins. In case of other nine orders, the ordered prices were above production cost by 0.57 to 18.59 *per cent*, yet the projects were implemented with higher profit margins. This indicates that costing data used by the manufacturing units/ regional offices of BHEL for bidding was not reflective of the actual position and that the prices quoted by BHEL in case of lost tenders could have been further rationalised which in turn would have enhanced the competitiveness of BHEL.

(Para 5.2.1)

Analysis of BHEL's success rate in securing turbine generator (TG) orders against competition revealed that BHEL's success rate declined from 80.44 *per cent* in 2013-14 to 43.95 *per cent* in 2014-15 and to zero *per cent* in 2015-16. BHEL could not secure any of the four tenders (involving TG component) finalised against competition during 2015-16. It was noticed that BHEL had quoted 4.36 *per cent* to 73.85 *per cent* higher than the L1 prices.

(Para 5.5.1)

To maintain growth in a changing business environment, BHEL needed to enhance its competitiveness through cost reduction. Rationalisation of manpower according to level of operation was essential to maintain margin, competitiveness and business growth as manpower cost constituted significant component of the Company's expenses. Despite slowdown in power sector since 2010-11 and dampening investment sentiments, BHEL inducted 9346 employees in the calendar year 2011 and 2012 as against retirement of 5844 employees during this period. As a result the percentage of employee cost to turnover increased consistently from 11.04 *per cent* in 2011-12 to 20.84 *per cent* in 2015-16.

(Para 5.5.3)

There was no improvement in the performance of BHEL in project erection as per customer surveys carried out over the period 2012 to 2014. In respect of 24 out of 25 sub-activities of 'Project installation and management function', BHEL's scores were less than those of its competitors. Only in respect of 'technical capability of site engineers' BHEL scored marginally above its competitors in the 2014 survey. BHEL did not carry out customer surveys after 2014.

(Para 5.7.2)

BHEL could not complete any of the projects selected for performance audit within scheduled completion time. All 53 selected projects were commissioned with delays of three to 84 months. As a result, customers withheld ₹1966.07 crore towards liquidated damages (LD) against 37 of these projects.

(Para 6.1.2)

Production units of BHEL are required to supply material/equipment compliant with quality standards to ensure intended performance level and the Company does not face delays in erection and commissioning due to repairs/ re-work. However, quality/ workmanship issues were noticed at all stages of project execution, which led to Trichy and Haridwar units incurring ₹138.44 crore towards cost of re-work in the sample projects selected for review by Audit.

(Para 6.5)

Contracts entered into by BHEL with eight private project developers provided that payments shall be released to BHEL through Letter of Credit (LC). It was, however, observed that BHEL did not ensure compliance of this contract provision and not only initiated supplies without establishment of LC but also continued supplying material even after recurrent failures of private developers. All eight projects were subsequently declared 'on-hold' and outstanding dues under these projects accumulated to ₹2660.77 crore. Besides, inventory relating to these projects worth ₹458.51 crore is lying at different BHEL units.

(Para 7.4.1)

Orders secured by BHEL for execution of power projects provide for release of the final 5 to 10 *per cent* of contract amount upon successful completion of Performance Guarantee (PG) tests and completion of pending works/ punch points. It was, therefore, imperative that BHEL conduct PG tests immediately after commissioning and clear the punch points at the earliest. Out of 52 units of 29 thermal power projects commissioned during 2011-16, PG tests of only 18 units were completed (July 2016) after considerable delays of seven to 50 months post commissioning. PG tests in respect of the remaining 34 units were yet to be completed though two to 70 months had elapsed (up to July 2016) since their commissioning. Loss of interest on the outstanding dues which could not be realized on this account as on 31 March 2016 worked out to ₹1457.11 crore.

(Para 7.4.5)

RECOMMENDATIONS

The following recommendations are made for enhancing competitiveness of BHEL in emerging markets

- BHEL needs to develop its own products that excel over competitors through R&D initiatives. Expeditious efforts should be made to forge technological tie ups in new business areas.
- 'One BHEL' ERP system should be implemented expeditiously for processes and systems improvement and better coordination between units of BHEL.
- More orders need to be finalised by BHEL through open tender system. Purchase Indent to Purchase Order cycle time should be reduced to ensure competitive and timely procurement of inputs.

- Action plans need to be developed and implemented by BHEL within stipulated timeframe to address its weak areas vis-à-vis competitors as identified during customer surveys and as per reports of task forces constituted in this regard.
- Quality controls at both BHEL manufacturing units and vendors' works may be made more effective to avoid failure of equipment during commissioning and warranty period.
- To safeguard BHEL's financial interest, dispatches, particularly to private parties, should be made against establishment of Letter of Credit. Completion of Performance Guarantee tests immediately after commissioning and completion of balance punch points in a time bound manner in close coordination with customers needs to be ensured.
- Revenue billing and debtor management systems need to be strengthened and made more effective to ensure timely billing and collection of revenue.

Chapter I Introduction

1.1 Company profile

Established in 1964, Bharat Heavy Electricals Limited (BHEL), is India's largest engineering and manufacturing company engaged in design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for the core sectors of the economy, *viz.*, Power, Transmission, Industry, Transportation, Renewable Energy, Oil and Gas, Defence etc. To address the growing demand for power generation equipment, BHEL enhanced its power equipment manufacturing capability during the Strategic Plan period (2007-12) from 6000 MW per annum to 20000 MW per annum in phases with a capital investment of ₹ 6246 crore.

BHEL has three main business sectors namely, (i) Power, (ii) Industry, and (iii) International Operations, with primary marketing responsibility[1] for major system/product sales. Orders secured by all three business sectors are executed across India and abroad through a network of 17 manufacturing units, four regional offices, eight service centres and 15 business offices (***Annexure 1.1***). BHEL comes under administrative control of Department of Heavy Industry (DHI), Ministry of Heavy Industries and Public Enterprises (MHI & PE).

As on 31 March 2016, paid up share capital of BHEL was ₹489.52 crore; of which 63.06 *per cent* was held by Government of India (GoI), 13.95 *per cent* by Foreign Institutional Investors, 15.68 *per cent* by Banks, Financial Institutions and Insurance Companies and the remaining 7.31 *per cent* by others including general public. In line with its policy to grant more autonomy and delegation of power to selected public sector enterprises, GoI conferred 'Maharatna' status on BHEL in February 2013.

1.2 Working results

The working results of BHEL for the last five years ended 31 March 2016 were as under:

Table 1.1: Working results of BHEL for the last five years ended 31 March 2016

(₹in crore)

Particulars	2011-12	2012-13	2013-14	2014-15	2015-16
Turnover (Gross)	49510	50156	40338	30947	26587
Profit before tax	10302	9432	5013	2140	-1477
Profit after tax	7040	6615	3460	1419	-913

1.3 Corporate plan targets and achievements

BHEL formulated its 'Strategic Plan-2017', covering the period 2012-17, and the performance up to 2015-16 is tabulated below:

[1] ***Power Sector (PS) secures orders from power utilities in the country; Industry Sector (IS) secures orders for captive power plants from different industries in the country and from sectors like Transportation, Renewable Energy, Oil and Gas, Defence etc. and International Operation (IO) sector secures orders from outside the country***

Table 1.2: Achievements up to 2015-16 against Strategic Plan 2012-17 targets

Description	Target	Achievement by 2015-16	Shortfall (*per cent*)
Turnover by 2016-17 (₹ crore)	101600	26587	73.83
Profit before tax by 2016-17[2] (₹ crore)	18012	(-) 1477	108.20
Return on Capital Employed[3] during 2012-17 (*per cent*)	> 35	(-) 4.87[4]	113.91
Contribution to India's generation capacity during 2012-17 (*per cent*)	60	46	23.33
Annual R&D investment by 2016-17 (₹ crore)	2625	893	65.98

BHEL could not achieve any of the strategic plan targets till 2015-16. BHEL did not prepare any document detailing year-wise milestones for implementation of strategies envisaged in Strategic Plan 2017.

Ministry stated (May 2017) that due to various unexpected developments like cancellation of coal blocks, policy logjam, delay in implementation of planned projects, Supreme Court's stay on hydroelectric projects on river Ganga *etc*. and increased volatility in business environment, BHEL depended more on annual assessment of business situation and fixed targets accordingly, which were also accepted by MOU Task Force. After the exit conference, Management provided additional information (June 2017) stating that concerted efforts and increased production coupled with faster execution have resulted in significant improvement in performance in the year 2016-17 and that the Company has achieved profit before tax of ₹628 crore against loss of ₹1164 crore in 2015-16 (Ind-AS adjusted).

However, BHEL did not formulate strategies to deal with fluctuations as part of normal market scenario. Actual turnover for the years 2014-15 and 2015-16 was short of annual budgeted targets by 32.13 per cent and 19.43 per cent, respectively.

1.4 Organisational setup

The management of BHEL is vested in a 16 member Board of Directors consisting of six full-time Functional Directors[5] including Chairman and Managing Director (CMD), two part-time Official Directors and eight part-time Non-official (Independent) Directors. Audit observed that during the period covered in performance audit, charge of Director (Power), Director (Engineering, R&D), Director (IS & P) and Director (Finance) remained with other functional Directors for two to 20 months. Further, against the requirement under Listing Regulations and DPE guidelines of having eight independent Directors on Board, BHEL did not have more than six independent Directors during the period covered in performance audit and from June 2012 to December 2015, there were only two or three independent Directors.

Ministry stated (May 2017) that BHEL was in constant communication with DHI for appointment of requisite number of independent Directors on the Board.

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[2] ***Double the Profit Before Tax of 2010-11 (₹9005.67 crore)***
[3] ***Return on Capital Employed = Gross Profit/Capital Employed x 100***
[4] ***Return on Capital Employed during the period: 32.78 per cent (2012-13), 15.53 per cent (2013-14), 7.10 per cent (2014-15) and (-)4.87 per cent (2015-16)***
[5] ***Director (Finance), Director (Human Resources), Director (Industrial System & Products), Director (Power) and Director (Engineering, Research & Development)***

Chapter II Audit Framework

The present audit reviews the 'Competitiveness of BHEL in Emerging Market' in securing orders for projects/equipment, accelerated project execution and debtor management during the five years 2011-16.

2.1 Audit objectives

Objectives of performance audit were to assess whether:

- BHEL responded effectively to the changing business environment for enhancing its competitiveness;
- Cost estimation system for preparation of bids was effective in securing orders;
- Planning, co-ordination, manufacturing, supply and execution of project orders was done efficiently in time;
- Procurement of inputs for execution of projects was done efficiently, economically and effectively;
- Monitoring of execution of orders was effective; and
- Mechanism for revenue realisation and debtor management was efficient and effective.

2.2 Audit scope

This performance audit covers review of activities of four power sector regional offices, eight manufacturing units located at Trichy, Ranipet, Haridwar[6], Bhopal, Hyderabad, Jhansi and Bengaluru, and three non-manufacturing units, *viz.,* Project Engineering Management (PEM) at Noida, Industrial Systems Group (ISG) at Bengaluru and Corporate R&D at Hyderabad. Brief profile of these units is given in ***Annexure 2.1.*** Marketing activities of three business sectors were covered for the period from 2012-13[7] to 2015-16 while execution activities were covered from 2011-12 to 2015-16.

2.3 Audit methodology

In order to explain the objectives, scope and methodology, an Entry Conference with BHEL Management was held on 06 June 2016. Field audit was conducted from June to November 2016 and records maintained at Corporate Office, and units/offices of BHEL selected for performance audit were reviewed. After considering the responses to preliminary observations issued during the course of audit, wherever received, a consolidated draft Performance Audit Report was issued to BHEL Management on 02 January 2017. Reply to the draft Report received on 20 February 2017 and results of discussions in the Exit Conference with BHEL Management held on 22 February 2017 were suitably incorporated in the Report. Subsequently, the draft Report was issued to the Ministry on 10 March 2017. An Exit Conference with the Ministry was held on 14 June 2017. The

[6] ***Two units are located at Haridwar i.e. Heavy Electrical Equipment Plant (HEEP) and Central Foundry Forge Plant (CFFP)***
[7] ***Marketing activities up to 2011-12 were covered in Audit Report No.26 of 2013***

views expressed by the Ministry in its written replies and in the Exit Conference were also considered while finalising the Report.

2.4 Audit criteria

Audit criteria adopted for the performance audit included:

- Guidelines/norms for cost estimation for preparation of bids;
- Agenda and minutes of meetings of Board of Directors and its sub committees; Functional Directors Meetings, Management Committee meetings, Plant Council Meetings of units, etc.;
- Strategic Plan 2012-17;
- Memorandum of Understanding (MoU) entered into with Administrative Ministry;
- Research and Development Policy;
- Reports of Ministry of Power/Ministry of Heavy Industries and Public Enterprises/Central Electricity Authority;
- Bidding documents against which bids are submitted;
- Works and Purchase Policies and Supplier evaluation, approval and review procedure
- Terms and conditions of the agreements entered into with customers and vendors/contractors;
- Production Plans and Scheduling of Floor Shop;
- Guidelines on withheld dues and projects on-hold;
- Policy/procedures for billing and collection of revenue and debtor management;

2.5 Audit sample

The sample for the audit was selected applying a risk based approach. The sample selected for audit is given in **Table 2.1.**

Table 2.1: Sample selected for performance audit

Description	Total (Nos.)	Sample selected	
		Nos.	Per cent
Projects secured by Power Sector	43	43	100
Projects secured by International Operations	16	16	100
Projects secured by Industry Sector	1838	90	5
Projects commissioned by all three Business Sectors	135	53	39
Projects 'on-hold'	31	31	100
Total*	**2063**	**233**	**11**

** Includes 10 projects appeared in more than one categories.*

2.6 Acknowledgement

Audit wishes to acknowledge the cooperation and assistance extended by BHEL Management and Ministry of Heavy Industries and Public Enterprises.

Chapter III Business Environment and Emerging Markets

3.1 Change in business environment and emerging market of BHEL

While preparing its Strategic Plan for the period 2012-17, BHEL had assessed (November 2011) that there would be a definite change in its business environment. From the second half of financial year 2010-11, investment sentiments had dampened due to slow down in project finalisation, coal availability for existing and new projects, poor financial position of State Electricity Boards (SEBs) etc. It was also acknowledged that the past decade ending 2010 had posed challenges to BHEL in the form of (a) climate change; (b) increase in intensity of competition with emergence of new competitors; and (c) squeezed delivery schedules.

3.1.1 Climate change

With growing environmental concerns, the Central Electricity Authority (CEA) recommended (November 2003) adoption of larger unit size of 800-1000 MW with supercritical parameters, visualising that adoption of large size units would provide much needed fillip to the pace of thermal capacity addition and would also result in reduced impact on environment due to efficiency enhancement. During that time, BHEL did not have experience in supercritical technology. Further, as per commitment under United Nations Framework Convention on Climate Change (UNFCCC), GoI adopted (June 2008) a National Action Plan on Climate Change (NAPCC) which stressed the need to launch a National Solar Mission to significantly increase the share of solar energy in total energy mix. Accordingly, GoI launched (January 2010) Jawaharlal Nehru National Solar Mission (JNNSM) with ambitious target of adding 20000 MW solar power capacity by 2022. This target was subsequently enhanced (June 2015) to 100000 MW. Capacity of BHEL in the area of solar power was limited.

3.1.2 Increase in competition

Consequent upon decision of CEA to adopt higher unit sizes with supercritical technology, a number of Indian companies formed joint ventures[8] (JVs) with supercritical technology providers and established manufacturing facilities in the country. This pointed to more intense competition in future.

3.1.3 Squeezed delivery schedule

The average commissioning schedule of BHEL for a typical 500 MW project was 47 months which was higher than the Central Electricity Regulatory Commission (CERC) norm of 42 months. However, other suppliers were able to adhere to the CERC stipulated norm. These suppliers could reduce erection time by supplying prefabricated structures while BHEL used welding of structures which involved delays as well as quality issues.

Ministry stated (May 2017) that BHEL has been making necessary improvements in erection area and adopting new innovative practices. It has also adopted bolted and prefabricated structures in the recent supercritical sets of 660/800 MW.

[8] ***(i)L&T-MHI, (ii) Alstom-Bharat Forge, (iii) BGR-Hitachi, (iv) Toshiba-JSW, (v) Thermax-Babcock & Wilcox and (vi) Ansaldo-Gammon***

3.2 Government support to BHEL

In the same period, GoI supported BHEL through the following decisions:

(i) In order to help indigenous manufacturers including BHEL, GoI, through CEA, issued (February 2010) an advisory to incorporate the condition of setting up of phased indigenous manufacturing facilities in bids to be invited by Central/State sector Thermal Power Generating Companies. This reduced competition for BHEL from international power equipment manufacturers who were not interested in setting up manufacturing facilities in India.

(ii) Ministry of Power (MoP) issued (September 2009) directives regarding evaluation and award criteria to be followed for bulk tendering of 11 units[9] of 660 MW each and nine units[10] of 800 MW each, with assured orders to BHEL even if it was not L1. In both these bulk tenders, BHEL was not L1, but by virtue of these directives, could secure orders for 6500 MW Steam Generator (SG) packages and 4240 MW Steam Turbine Generator (STG) packages valuing ₹16063.34 crore between March 2012 and February 2014.

(iii) BHEL was granted (February 2013) 'MAHARATNA' status which delegated enhanced powers to BHEL Board to incur capital expenditure on purchase of new item or for replacement without any monetary ceiling; enter technology JVs or strategic alliances; obtain technology and know-how by purchase or other arrangements; make equity investment to establish financial JVs and wholly owned subsidiaries; and undertake mergers and acquisitions in India or abroad.

Ministry stated (May 2017) that the condition of phased indigenous manufacturing facilities was introduced by GoI for fast introduction of supercritical technology. Though BHEL got Boiler and TG packages of two projects through Bulk Tenders, it was not in a position to execute one of the projects (Raghunathpur Project) as the project was put 'on-hold'. Thus, the project has not contributed to BHEL's turnover or profitability. It is also added that all major Original Equipment Manufacturers (OEMs), excluding Chinese companies, have set up the manufacturing facilities and after Bulk Tender, the competition has intensified.

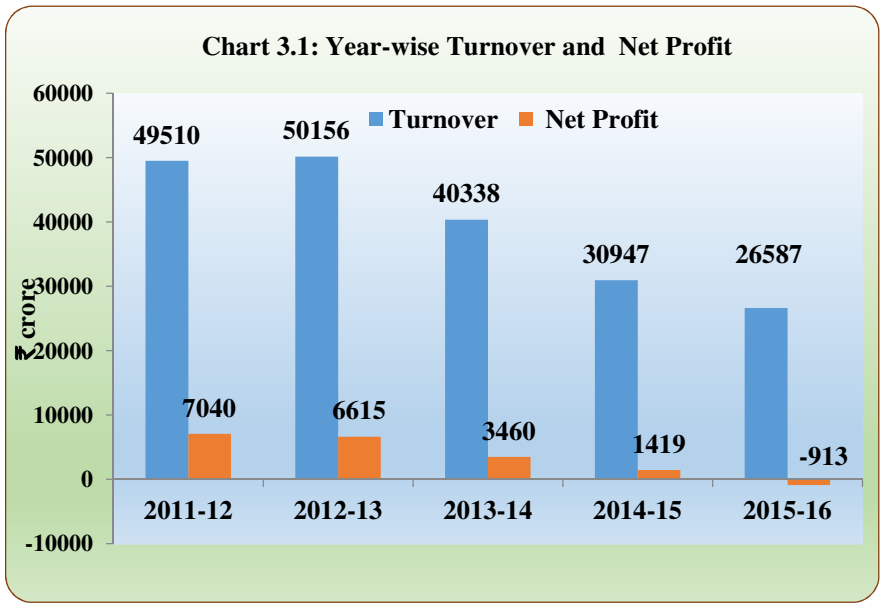
While appreciating that competition intensified with introduction of bulk tenders, the assurance for securing orders by BHEL even when it did not win the bid, supported the Company. In fact, BHEL has already booked a turnover of ₹479 crore from Raghunathpur project up to 31 March 2016 for which it was not the L1 bidder.

[9] ***NTPC/Sholapur (2 units), NTPC/Mouda (2 units), Meja-Urja Nigam Private Limited (50:50 JV between NTPC and UPRVUNL)/Meja (2 units), Nabinagar Power Generating Company Private Limited (50:50 JV between NTPC and Bihar State Power Holding Company Limited) /Nabinagar (3 units) and DVC/Raghunathpur (2 units)***

[10] ***NTPC/Lara (2 units), NTPC/Gadarwara (2 units), NTPC/Darlipali (2 units) and NTPC/Kudgi (3 units)***

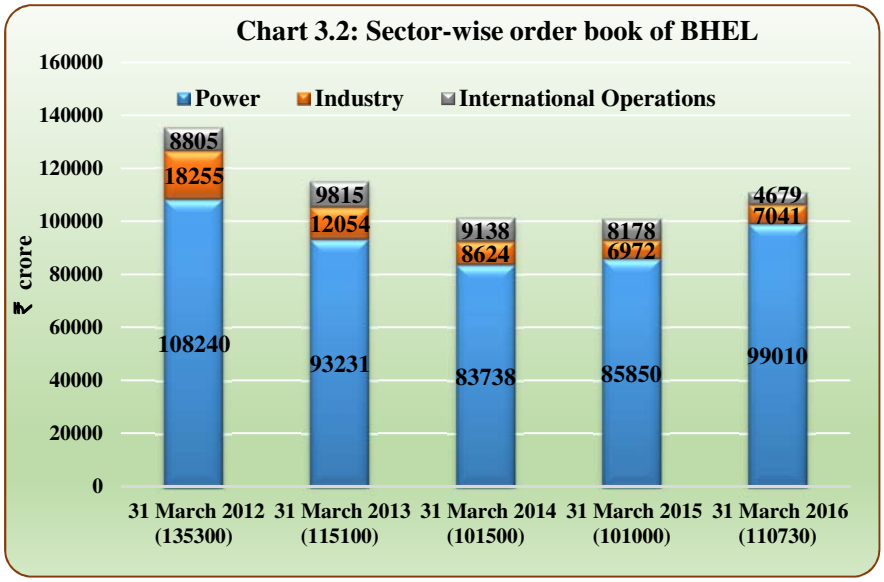
3.3 Impact of changing business environment on BHEL

3.3.1 Impact on working results



Power sector continued to account for the bulk (76.46 *per cent* to 80.53 *per cent*) of BHEL's turnover during 2011-12 to 2015-16. The Company had not effectively diversified into new/ less operated business areas (as discussed in Chapter IV). Chart 3.1 indicates year wise turnover and net profit of BHEL during five years ended 31 March 2016. BHEL witnessed sharp decline in both turnover and profitability, with its revenue skewed towards a single segment.

Ministry stated (May 2017) that several attempts were made to diversify the company's product offerings and these efforts were still on going, which were likely to bring positive outcomes in times ahead.



The reply, however, is to be viewed against the fact that BHEL could not implement strategic approaches[11] *envisaged in Strategic Plan 2012-17 in potential growth areas, viz., transportation, transmission and industrial products.*

3.3.2 Impact on order book

Order book or order backlog, which is an indicator of level of customer demand and future financial stability, declined from ₹135300 crore to ₹101000 crore between March 2012 and March 2015. Though the reported order book position of BHEL improved by March 2016, it included an order worth ₹17950 crore against which no advance had been received. As per the Company's own decision (March 2011), only those orders are accounted for against which initial advances have been received. In fact, the initial advance in respect of this project has not been

[11] ***The Strategic Plan provided for forging global tie-up/JV for Electric Multiple Unit (EMU) / Mainline Electric Multiple Unit (MEMU) / Distributed power trains/ High speed Locos/ Metro projects as well as merger and acquisition for niche technology in transportation business, technology sourcing for Circulating Fluidized Bed Combustion (CFBC) boilers, collaboration for advanced Gas Turbines with higher efficiencies, strategic tie-up for new products, hastening development of 400 kV and 765 kV Gas Insulated Switchyard (GIS) equipment etc.***

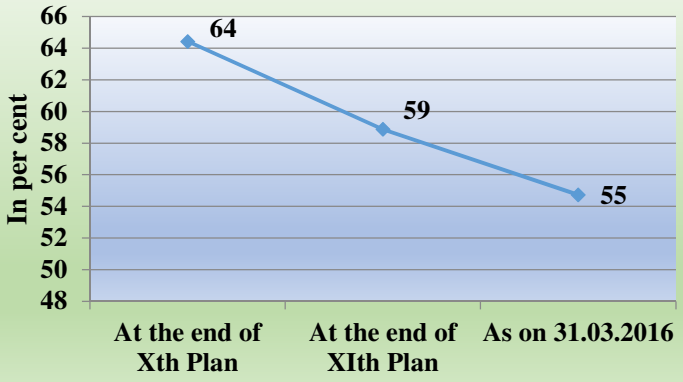
received so far (March 2017) for want of environment clearance. The chart 3.2 depicts BHEL's total and business sector-wise order book at year end from 2011-12 to 2015-16.

Declining Turnover-Order Book ratio[12] between 2012-13 (37.07 *per cent*) and 2015-16 (26.32 *per cent*) indicated that all orders secured by BHEL were not effective orders. It was noticed in Audit that order book of ₹110730 crore as on 31 March 2016 included 'On Hold' projects amounting to ₹50645 crore. Thus, around 45.74 *per cent* orders included in the order book of BHEL as on 31 March 2016, were non-executable.

Management stated (February 2017) that due to constraints like lack of coal linkage/ coal block allocation, acute shortfall in availability of gas, delay in environment clearance, delay in land acquisition and funds issues, the sector encountered decline in average order finalisation. As a result despite improvement in market share, BHEL's outstanding order book also declined. Management also stated that holds on projects were temporary in nature. Ministry added (May 2017) that efforts were being made to revive the 'on-hold' projects. Post exit conference, Management added (June 2017) that BHEL was focused on reviving the on-hold projects and nine projects with unexecuted order value of ₹17411 crore have been revived till 31 March 2017. With this, the executable order book has increased to ₹65663 crore as on 31 March 2017.

While the efforts at reviving the 'on-hold' projects is appreciated, it needs to be kept in view that dampening investment sentiments had been considered in the Strategic Plan which had intended (November 2011) to focus on diversification in new business areas to maintain the growth path.

Chart 3.3: Share of BHEL supplied sets to total installed capacity



3.3.3 Impact on BHEL's share in installed capacity of the country

In the core power sector, BHEL was the leader in the engineering and supply of Drum Type Boilers[13]. With introduction of higher unit size / supercritical technology and enhanced competition (with Indian companies establishing manufacturing facilities in the country in association with supercritical technology providers), share of BHEL supplied sets witnessed a sustained decline since end of X Five Year Plan as depicted in chart alongside. As on 31 March 2016, in the supercritical segment, against 33 units (including 10 units under four on-hold projects) under implementation by BHEL, 45 units were being implemented by its competitors which may further depress the share of BHEL in its core sector.

Management stated (February 2017) that BHEL has maintained its market leadership in the segment though with rise in competition, it was natural for the share of existing player to fall. Ministry added (May 2017) that during XII Plan period, BHEL achieved capacity addition of 45274 MW, surpassing the target by 9 *per cent.* BHEL remained the single largest contributor to the country's capacity addition.

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[12] ***Turnover for a year as per cent of Order Book at the beginning of that year***

[13] ***Drum boilers are also called sub-critical boilers because they have to operate below the critical point of water to make sure that there is a density difference between the steam and water allowing for separation***

3.3.4 Impact on market valuation of BHEL

The market valuation of BHEL, which was ₹97940.71 crore at the beginning of April 2011, was reduced to ₹37533.95 crore (as on 16 February 2017) representing a drop by 61.68 *per cent.* Consequently, the market value of GoI holding in BHEL also decreased by ₹38092.50 crore. During the above period, Bombay Stock Exchange (BSE) Capital Goods Index increased from 13255.14 to 15267.22 and BSE PSU index remained almost at the same level[14], but BHEL's share price declined sharply from ₹412.17 per share to ₹153.35 per share.

Ministry stated (May 2017) that because of 'on-hold' power projects already in order book and slowdown in inflow of orders due to policy logjams, like environmental clearances, fuel supply agreements, power purchase agreements etc., the coal-based power plant equipment manufacturers were severely affected and this was reflected in BHEL's share price.

[14] ***BSE PSU index was 8960.08 at the beginning of April 2011 and 8461.74 as on 16 February 2017***

Chapter IV Diversification and Innovation

4.1 Need for diversification and innovation

Recognising that utility power plant business was plagued by sector specific issues like lack of adequate coal linkages, mounting losses of state utilities, land issues and financing, BHEL fixed Strategic Plan targets for the period 2012-17 with focus on diversification and innovation. Thus, challenge before BHEL was not only to safeguard its core business, but also to focus on diversified areas like defence, solar, wind and water businesses and also involve R&D to attempt breakthrough developments. As such, BHEL Board approved (November 2011) the following strategies:

- Adopt strategies aimed at bridging technology gaps especially in Circulating Fluidized Bed Combustion (CFBC) area, leverage Engineering, Procurement and Construction (EPC) capability, attempt new areas like coal washery reject based power plants etc.
- Adopt Strategic Business Unit (SBU) structure and forging alliances in Renovation and Modernisation (R&M) business with focus to target BHEL supplied sets included in the CEA plan for XII plan period.
- Pursue both development and strategic tie-ups routes for maximising share in transmission business which was identified as a potential area of growth.
- Pursue proposed factories by Indian Railways at Dankuni, Kanchrapara, Marhowra and Madhepura either on PSU model or in association with a lead bidder, considering "Transportation" as a potential area to become second largest contributor in company's top line in future.
- Pursue opportunities in Solar and Wind areas by expanding Photovoltaic (PV) capacities as well as leveraging on tie-ups already in place.
- Implement in set timeframe Enterprise Resource Planning (ERP)/ "ONE BHEL" in view of need to manage mammoth size of company's business volume.

BHEL's efforts for diversification and innovation during 2011-16 are discussed in succeeding paragraphs.

4.2 Inadequacy of efforts for diversification

4.2.1 Failure to bridge technology gap

(i) **Circulating Fluidized Bed Combustion (CFBC):** CFBC constituted 70 *per cent* of Captive Power Plant (CPP) business. Despite the decision (May 2013) to offer cost effective CFBC solutions in 150 MW and below sets, BHEL has not been able to bridge technology gaps in this business area. In 2015-16[15], BHEL lost a tender in this area valuing ₹170 crore (L1 price) due to higher weight of BHEL's boiler package, higher auxiliary consumption of BHEL equipment and longer commissioning period.

[15] ***As per departmental procedure of Industry Sector of BHEL, lost tender files were required to be maintained for one year. As such, records relating to lost tenders for the year 2015-16 could only be reviewed in audit***

(ii) **Gas Turbine package**: Efficiency of Frame 6 (Fr6) model of Gas Turbine offered by BHEL was 5 to 6 *per cent* lower than Siemens and Hitachi models, attracting substantial technical loading[16] on BHEL. In case of supply of 2x25 MW Gas Turbine Generator (GTG) and Heat Recovery Steam Generator (HRSG) against an EPC tender issued by M/s Rashtriya Chemical and Fertilizers Limited, BHEL offered Fr6B GT model with output of 43 MW owing to non-availability of GT model having output of 25 MW. Due to lower efficiency of Fr6B GTG offered by BHEL, there was substantial technical loading (₹114.64 crore) on BHEL, which rendered BHEL's offer uncompetitive.

(iii) **Photovoltaic (PV) modules:** Efficiency of BHEL's Photovoltaic (PV) modules (15.20 *per cent)* was lower in comparison to that of its competitors (15.90 *per cent*). On account of this, BHEL lost (2013-14 and 2015-16) two orders for solar PV project, Belarus.

(iv) **Current Transformers (CT) up to 220 kV:** BHEL-Jhansi unit has the capacity to manufacture dead tank type CTs, which are costlier compared to live tank CTs. BHEL participated in 63 orders for supply of up to 220 kV CTs during 2012-16 and lost nearly all of them (60 orders) valuing ₹87.15 crore.

(v) **Dry Type Transformers (DTT):** BHEL manufactures Cast Resin Type Transformers which are costlier compared to Resin Impregnated DTTs. During 2012-16, BHEL lost all the ten tenders for supply of DTT, valuing ₹7.36 crore.

(vi) **765 kV GIS based substations:** In order to reduce Right of Way requirement for transmission lines and overcome constraints in availability of land for substations, 765 kV Gas Insulated Switchyard (GIS) is being increasingly adopted. However, BHEL has not been able to develop 765 kV GIS technology.

(vii) **500 MVA Inter Connecting Transformers (ICTs)**: 500 MVA Inter Connecting Transformers (ICTs) of BHEL did not qualify for substation projects as these were not Dynamic Short Circuit tested. Out of total 139 tenders for sub-stations of capacity 220 kV and above (new and extension) finalized during 2012-13 to 2015-16, BHEL participated in only 31 (22.3 *per cent*) tenders and secured 19 (61.29 *per cent)* orders.

Management stated (February 2017) that discussion for technology collaboration for CFBC Boilers was under progress with prospective collaborators. BHEL was making efforts along with its technological partner to explore ways to offer higher efficiencies of GTs to address the market requirements. BHEL has since attained a higher level of efficiency of PV modules and 132 kV Live Tank CT has been designed, manufactured and tested in-house successfully. BHEL plans to take up development of 765 kV GIS after present efforts once 420 kV GIS are completed successfully and efforts were on for clearing the Dynamic Short Circuit test for BHEL make 500 MVA ICTs. Ministry added (May 2017) that several attempts were made to diversify the company's product offerings and these efforts were still going on, which were likely to bring positive outcomes in times ahead.

The reply indicates that efforts are ongoing in BHEL for correction of identified technology gaps. However, technological tie-ups and product developments in these areas were expected to be achieved in initial period of Strategic Plan (2012-17) so that decrease in turnover of core power sector could have been supplemented.

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[16] Technical loading is the process of assigning higher cost at a pre-determined rate due to inferior technical parameters offered at the time of evaluation of bids to bring at par the bids of different parties

4.2.2 Non-finalization of business tie-up for R&M business

Renovation and modernization (R&M) was seen as a cost-effective option for additional generation from the existing thermal power stations due to its lower cost and shorter gestation period. Management Committee (MC) in June 2012 had raised concerns about BHEL's inability to execute R&M projects, mainly due to lack of service engineering set-up. MC specifically instructed (2012) Management to expedite business tie-up for service cooperation with a suitable partner for R&M business which is yet to be finalised. Audit noticed that BHEL completed R&M of six units during 2011-12 to 2015-16 with time overruns ranging from 13 to 61 months.

Management stated (December 2016) that during 2011-2015, only two comprehensive R&M projects, *viz*., 210 MW Unit 5 of Bandel thermal power station (TPS) and 210 MW unit 6 of Koradi TPS, were finalised in the country and BHEL secured (May 2013) one of them (R&M of Koradi TPS). For Bandel TPS, BHEL did not participate as boiler was non-BHEL make. Management further stated (February 2017) that due to depleting R&M business in India and development of in-house capability for taking up comprehensive R&M, actions initiated for the business tie-up for service cooperation was not continued. Further, the Government of India, in line with focus on the cleaner efficient plants, was encouraging replacement of inefficient older power plants, which BHEL plans to address. Ministry added (May 2017) that the reasons for delay in completing R&M works were not totally attributable to BHEL.

Audit noticed that non-compliance of delivery schedule by BHEL for shutdown requirement was a major concern identified in customer perception survey. It is important to note that BHEL's inability to timely execute R&M projects had been raised as a concern by the MC as early as 2012 which was not effectively addressed by BHEL.

4.2.3 Non-participation in Indian Railways projects

As per the Strategic Plan 2012-17, BHEL was to participate in tenders for setting up JV for manufacture, supply and maintenance of locomotives/rail coach factories at Dankuni, Kanchrapara, Marhowra and Madhepura, either on PSU model or in association with a lead bidder, considering "Transportation" as a future potential area.

4.2.3.1 For Diesel Loco Manufacturing Facility at Marhowra-Bihar, BHEL decided (March 2012) to supply equipment from its existing facilities to GE (India) which in turn would supply to the JVC of Indian Railways. This decision, was not in line with the vision of the Strategic Plan which envisaged technology partnership. Audit noticed that GE was keen to include BHEL as consortium partner initially. Subsequently, GE secured (November 2015) the contract. Agreement between BHEL and GE regarding sourcing equipment from BHEL's existing facilities was not on record.

Ministry stated (May 2017) that GE quoted on its own during the initial Request for Qualification (RFQ) stage of the tender and stated that BHEL would be included during Request for Proposal (RFP) stage. Indian Railways, however, did not allow inclusion of BHEL during RFP stage.

The reply does not consider the fact that BHEL (in the 442nd meeting of BHEL Board) decided against setting up of JV with GE, much before the RFP stage. Thus, BHEL's decision of not becoming consortium partner was irrespective of the decision of Indian Railways in this regard.

4.2.3.2 For Electric Loco manufacturing factory at Madhepura, Bihar, BHEL did not participate as it could not meet "Technical Capacity" qualification criteria of RFQ document. Setting up of factory at Madhepura was awarded to M/s Alstom (November 2015). Similarly, BHEL could not meet the "Technical Capacity" qualification criteria of RFQ for the Kanchrapara Rail Coach Factory project.

Management stated (February 2017) that BHEL could not participate in the Madhepura project as it did not meet the qualification criteria for the RFQ. Ministry added (May 2017) that BHEL made efforts from 2013 to forge global tie-up/JV through letters of cooperation.

Audit noticed that efforts made by BHEL for appropriate global tie-ups were inadequate. Against the tender floated in May 2013 by Indian Railways for Madhepura project, BHEL made efforts to contact global players in this field only on 04 October 2013 and requested responses by 15 October 2013 which proved unsuccessful. In case of Kanchrapara project, BHEL issued EOI for tie-ups in August 2016 against the RFQ issued by Indian Railways in October 2015.

4.2.3.3 The Strategic Plan 2012-17 envisaged participation in metro projects on consortium basis, and forging global tie-up/JV for EMU/MEMU/Distributed power trains/High speed locos/Metro projects. However, no tie-ups have yet (May 2017) been achieved in this business area. Though BHEL participated in 2013-14 in the tender for supply of metro coaches to Delhi Metro in consortium with M/s Hitachi, it could not succeed due to higher price.

Ministry stated (May 2017) that BHEL started making efforts for coach manufacturing by forging global tie-ups through EOI floated in March 2012. Though it participated in consortium with M/s Hitachi in Delhi Metro tender, no breakthrough could be achieved because of higher price of BHEL-Hitachi consortium. BHEL had discussions with M/s Hitachi to lower the costs to attempt future projects. However, no results materialised. Thereafter, global EOI for long term tie-ups were re-floated in December 2015.

The efforts made by BHEL in this regard have not been consistent. One EOI was issued in March 2012, followed by another in December 2015. During this period, a number of metro projects have been under development in India and BHEL lost the opportunity to participate in them.

4.2.4 Ineffective tie-ups in solar energy area

To supplement its expertise in Concentrated Solar Power (CSP) plants, BHEL signed an MoU with M/s Abengoa (January 2011) having a validity of two years (up to 13 January 2013) for identifying business opportunities in CSP and submit joint EPC bids. The MOU was extended thrice, up to 13 January 2016. As per the MOU, if any party decided not to participate in a certain joint offer, it could do so by communicating in writing to other party; and the said party, thus, would be free to submit that offer by itself or with a third party without taking prior consent from the party not interested in quoting the opportunity. The MoU, therefore, did not bind M/s Abengoa to submit joint bids with BHEL. Audit observed that during validity of the MOU, BHEL and M/s Abengoa quoted independently for two tenders (100 MW) and BHEL's offer was not accepted due to lack of reference. Thus, BHEL could not convert tie-up with M/s Abengoa into orders.

Ministry stated (May 2017) that BHEL quoted independently in terms of CSP to explore the possibilities of increasing the business in this sector.

The reply, however, has to be viewed against the fact that BHEL entered into an MoU owing to its lack of expertise in CSP and therefore, quoting independently negated the purpose of entering into

MOU. Besides, the MoU provisions allowing independent bid submission by BHEL and M/s Abengoa were counter-productive.

4.2.5 Municipal solid waste-based power plants

In the 48th Product Committee meeting (25 September 2013), Industry Sector presented the outlook on emerging market for Municipal Solid Waste (MSW) based power plants. Based on available data for 2010-11, the power generation potential from MSW was estimated at 370 MW which was expected to over 500 MW by 2016-17. Most of the equipment for this business segment were in BHEL's manufacturing range except the firing system, for which technology needed to be tied up. Toward this end, Expression of Interest was proposed to be floated before December 2013. However, BHEL did not take any steps on the matter till date (May 2017).

Management stated (February 2017) that competing technologies, *viz.,* enviro-friendly plasma pyrolysis vis-à-vis pollution intensive conventional incineration process has been a matter of concern in making the right choice for municipal bodies and equipment manufacturers alike, which contributed to the slowdown/delay.

The existence of competing technologies in the area does not explain inaction on part of BHEL to assess their suitability and adopt appropriately.

4.2.6 Late response to emerging opportunities

Jawaharlal Nehru National Solar Mission (JNNSM) was launched by GoI in January 2010, setting a target of 20000 MW solar power capacity by 2021-22. This target was enhanced to 100000 MW in June 2015. Though BHEL had been in the renewable energy sector since 1983, its production capacity (8 MW for PV cells and 26 MW for PV modules) was insignificant compared to these ambitious targets. The Strategic Plan 2012-17 envisaged (November 2011) enhancing Photovoltaic (PV) module production capability progressively to 100 MW by 2014-15 at its Electronic Division (EDN), Bengaluru which could be completed only by January 2017. Due to delayed expansion of production capacity, BHEL could not participate actively in the first phase of the mission. Ministry of New and Renewable Energy also observed (December 2012) that while a large number of big and small organisations had participated in first phase of the mission, BHEL had contributed only marginally. Up to May 2016, the country added a solar capacity of 7564.86 MW under JNNSM, while BHEL commissioned only 105.5 MW (1.39 *per cent*) during this period.

Management stated (February 2017) that most of the capacity addition out of the 7564.86 MW happened through tenders in developer mode, which entail sourcing of land, signing of PPA with utilities etc., where BHEL does not directly participate. BHEL participated in all tenders where developers brought out EPC tenders. Currently BHEL's market share on EPC tenders was around 15 to 18 *per cent*. Hence BHEL's contribution cannot be directly compared vis-a-vis the capacity added. Ministry added (May 2017) that capacity of the manufacturing facilities was decided based on the installed manufacturing capacity in the country and to address the projects which require domestically manufactured cells and modules and to reduce dependence on other domestic manufacturers.

The response of the Management does not address steps that would need to be taken by BHEL to bridge the considerable gap the Company faces in solar power.

4.3 Innovation

In the pursuit of Strategic Plan targets, Board desired (November 2011) that:

- Each technology plan developed for realising 15 identified mission projects must also reflect timeframe and investment; and
- Implementation of ERP/'ONE-BHEL' be done in set timeframe.

Audit reviewed the initiation and completion of Project Initiation Reports (PIRs) with reference to technology development plan in connection with mission projects. Observations of Audit in this regard are discussed in succeeding paragraphs.

4.3.1 Delay in completion of R&D activities of mission projects

Under the 15 mission projects of BHEL, 517 Research and Development (R&D) projects were initiated. Of these, 492 R&D projects relating to 12 mission projects[17] were completed during 2011-12 to 2016-17 of which 31.17 *per cent* (156 projects) could not be completed within schedule. Out of these 156 projects, three projects were completed after a delay of more than three years, 15 projects were completed with delay of 1 to 3 years and 28 projects were completed with delay between six months and one year. Besides, 25 R&D projects relating to five mission projects were in progress as on 31 March 2017.

Ministry stated (May 2017) that some of the R&D projects were delayed due to extraneous factors, *i.e.,* non-availability of site for field trial, delay in procurement of non-standard items, testing at reputed National/ International laboratories and uncertainties in new technological development.

The contention of the Management that the R&D projects were delayed due to extraneous factors needs to be viewed against the fact that such factors were not brought to the notice of MC which expressed concerns regarding the delays repeatedly.

4.3.2 Delay in development of Advanced Ultra Supercritical Technology

In order to reduce dependence on foreign technology, an MoU was entered (August 2010) into between Indira Gandhi Centre for Atomic Research (IGCAR), NTPC Limited and BHEL for development of Advanced Ultra Supercritical (AUSC) Technology for thermal power plants. This project called 'Mission 2017 for Thermal Power Plants planned enhancement of plant efficiency to 45-46 *per cent*, and reduction of coal consumption and CO_2 emissions by ~20 *per cent*. As per MoU, IGCAR was to develop the new materials required for the technology, BHEL was to design, manufacture and commission the equipment and NTPC was to implement the project. The design and development was estimated for 2½ years, manufacturing and installation for a further 4½ years from the date of sanction of this project by GoI. BHEL's Strategic Plan 2012-17 also proposed development of R&D capability for AUSC technology by 2017, so as to meet likely demand from 2017-18 onwards.

Audit noticed that:

- There has been considerable delay in conception and approval of the project. BHEL took three years to conceive the R&D projects which were approved by BHEL Board in December 2013 (estimated cost of ₹1019 crore). Though DHI communicated (October 2014) the approval of Expenditure Finance Committee for this project, the Cabinet approval of the

[17] ***No R&D project was initiated against Mission Project No. 3, 4 and 13***

project involving estimated expenditure of ₹1554 crore (BHEL-₹270 crore, NTPC-₹50 crore, IGCAR-₹234 crore, Department of Science and Technology-₹100 crore and GoI-₹900 crore) was received only in August 2016. The fund required for the project was released from April 2017 onwards.

- The Monitoring Committee for effective coordination and supervision of progress of project execution, such as Over Arching Committee and Project Management Council, is yet to be constituted (December 2016).
- To achieve the objective of the AUSC technology project, timely completion of R&D was essential, especially when the same technology was under development in European Union, United States of America, Japan and China. The delay would defer the development (by seven years as per approved timelines).

Management stated (February 2017) that Government took 3½ years in approving the project. Ministry stated (May 2017) that presently the AUSC technology was under development stage. No commercial plants were operated anywhere in the world with AUSC technology. Government has approved the R&D mission project for development of AUSC technology by the consortium of BHEL, NTPC and IGCAR.

The reply does not address the delay in initiating the project.

4.3.3 Delay in development of 765/ 800 kV technology for Power Transmission Sector

Strategic Plan 2012-17 provided for hastening development of 400 kV Gas Insulated Sub-station (GIS) and in-house development of equipment for 765 kV GIS. Audit noticed that:

- Corporate R&D Division executed five PIRs for development and design of 400/420 kV GIS technology during 2011-12 to 2015-16. Out of these, two[18] PIRs were completed with delays of two and 45 months and three[19] PIRs were in progress (December 2016).
- As these projects were to be developed and tested in series, delay in development of 400 KV GIS Circuit Breaker and Modules resulted in cascading delay in development of 765 kV technology.
- The PIRs for 765/ 800 kV technology were raised in December 2015 but have not yet been approved by BHEL Corporate Office (November 2016). This delay has also adversely impacted the presence of BHEL in 765 kV GIS. As a result, BHEL could participate only in seven out of the 25 tenders (with equipment sourced from OEMs) issued during 2012-13 to 2015-16 for 765 kV GIS.

Ministry stated (May 2017) that development of 420 kV GIS circuit breaker and other modules had been taken up by BHEL and progressively completed by March 2012. No opportunities were lost, but completion got delayed as concept of single break dual circuit breaker was developed for the first time and these was lack of third party certification and non-availability of short circuit testing facility in India.

[18] ***(i) Development of 400 KV GIS Circuit Breaker and Modules and (ii) Development of Single break Gas Circuit Breaker for 400 kV GIS application using Spring Hydro Drive***

[19] ***(i) Development of Gas insulated surge arrester module for 420 kV GIS, (ii) Development of Gas-to-Cable termination module for 420kV GIS and (iii) Development of 63 kA Single break Gas Circuit Breaker for 420 kV GIS Application***

Audit however noticed that development of 420 kV GIS circuit breaker and other modules was completed after a delay of 45 months. Delay in development and commercialisation of 420 kV technology and consequent delay in initiation of R&D projects for development of 765 kV technology affected opportunities for BHEL in the transmission sector, which was identified as one of the potential growth areas in Strategic Plan 2012-17.

4.3.4 Absence of ERP assistance to meet business challenges for sustaining competitiveness

To streamline and standardise business processes and to meet business challenges for sustaining competitiveness, BHEL Board accorded (November 2010) in-principle approval for implementation of Enterprise Resource Planning (ERP) in the Company. ERP was to be implemented within 36 months from Board's approval, i.e., by November 2013. The ERP system is yet to be fully functional (June 2017). Audit noticed the following issues regarding implementation of ERP in BHEL:

- Management took more than two years in appointing (June 2012) a consultant (M/s PricewaterhouseCoopers-PWC) for studying existing systems and platforms, preparation of RFP documents and implementation and supportive hardware. RFP documents could be finalised only in August 2013.
- BHEL introduced a tender condition of 'joint and several' responsibility and consortium agreement between ERP-OEM and Implementation Partner (IP) against the advice of the consultant. Though BHEL invited tenders with these conditions twice (September 2013 and April 2014) and subsequently altered it with additional safeguarding conditions in July 2015, no responses were received.
- During discussions between RFP Committee and OEMs held on 12.5.2016, it emerged that primary concern of bidders was that they were not able to negotiate on the license buying schedule from the ERP-OEM as per BHEL's proposed licenses Procurement Schedule (based on roll outs across units). A revised RFP was yet to be approved (February 2017).

Ministry stated (May 2017) that in order to minimise the risk and cost, BHEL included certain special conditions in tender documents. But due to various market conditions and resistance of vendors, there was no response even after multiple tenders. BHEL was already having SAP-ERP at Hyderabad, Trichy, Bengaluru units, and robust in-house and integrated systems at other major units. While ONE-BHEL tendering process had been underway, many critical and corporate applications[20] were developed in-house to address the missing links with respect to applications in Business Sectors, Power Sector Regions and Corporate and to meet the business challenges for sustaining competitiveness in the market. Further, integration was also undertaking and systems were being continuously updated.

Thus, even after seven years of in-principle approval, BHEL could not implement a company-wide ERP system which would have promoted streamlining of business process, better checks and controls and ensured better transparency in operations. Information Technology systems on uniform platform is essential for a large entity like BHEL where real-time and end-to-end visibility of information on multiple dimensions like projects, financials, inventory, customers, vendor database etc. would add value.

[20] ***Site Construction Management System, SAR/CAR/MDR Systems, Corporate Quality System, Order Book Liquidation, Debtors Management System etc.***

Chapter V Cost Estimation and Competitiveness

5.1 Procedure for cost estimation and pricing approval

The procedure followed for preparation and submission of bids in BHEL included the following steps:

- Receive/collect tenders and wherever required, forward to the manufacturing units and executing agencies concerned for clarification/queries;
- Receipt of cost estimates and other details from manufacturing units/regions; and
- Consolidation of cost estimates and submission of bids by business sector concerned.

Before submission of bids, the price proposed to be quoted by business sector was to be approved by the competent authority as per BHEL's approved Delegation of Power[21] (DOP).

5.2 Cost estimation

Audit examined the process of cost estimation and pricing approval in BHEL vis-a-vis provisions of DOP in three business sectors [22]and observed as under:

5.2.1 Cost estimation not reflective of actual position

Estimated costs submitted by BHEL units to Power Sector (PS)-Marketing included costs under five levels:

- Level-1: Incremental cost;
- Level-2: Direct cost;
- Level-3: Production cost;
- Level-4: Unit level cost; and
- Level-5: Corporate level cost.

Review of the assessed costs and quoted/ ordered prices for orders secured and lost by PS-Marketing revealed that out of 44 PS-Marketing orders, the detailed five-level costing information was made available to Audit for 22 cases. It was seen that BHEL had quoted below Level-3 cost in 13 cases (nine cases between Level 3 and 2; two cases between level 2 and 1 and two cases below Level-1). However BHEL indicated that 11 of these projects were being executed with profit margins. In case of the other nine orders, the ordered prices were above Level-3 costs (by 0.57 to 18.59 *per cent*) though the projects were implemented with higher profit margins. This indicates that the costing information used by manufacturing units/ regional offices of BHEL for bidding was

[21] ***If price to be quoted recover all-in-cost plus 10 per cent margin, then pricing approval would be given by Executive Director; if margin proposed to be recovered was less than 10 per cent, approval of sector chief {i.e. Director (Power) in case of power sector orders, Director (IS&P) in case of industry sector orders and CMD in case of International Operation orders} was to be obtained; and if price below all-in-cost was to be quoted, then approval of both Director (Finance) and CMD was required. As per revised (November 2012) DOP, in respect of International Operations, Head of this business sector had full powers for submitting offers up to ₹500 crore value. Offers exceeding ₹500 crore required approval of all functional Directors and CMD***

[22] ***Power Sector, Industry Sector and International Operations***

not reflective of the actual position and that the prices quoted by BHEL in cases of lost tenders could have been further rationalised which in turn would have enhanced competitiveness of BHEL.

Ministry stated (May 2017) that there was well laid down rational procedure for cost estimation which was followed while quoting for tenders. Price for tenders were based on market information, competition level, tender conditions and other strategic considerations, while estimates from Units/Regions were considered as guiding factor. Further, when volume was high, cost got distributed over more orders. Over the period of execution, Management focused on reducing overall cost and efforts were made to improve upon material and other costs.

The reply is not convincing in face of the quoted price for projects being much below the costs estimated by BHEL to execute them and the fact that BHEL made a profit in such projects even where the quoted prices were below direct costs (below Level-2/ Level-1).

5.2.2 Non approval of pricing for bids

During 2012-16, PS-Marketing bid for 62 orders of which it secured 44 and lost 18. Audit noticed that in the 62 orders that PS-Marketing bid for, five cases required approval from Director (Power) while another 51 cases required approval of both Director (Finance) and CMD as per Delegation of Power (DOP) in BHEL. However, approval from Director (Power)/Director (Finance) and CMD was not obtained in these cases before submitting bids. This resulted in violation of the Company's own Delegation of Power.

Management stated (February 2017) that prices were discussed and quoted after obtaining consent of competent authority. However, due care was now being taken to have the approval of the competent authority on record. Ministry added (May 2017) that the Company has taken up the system improvements in this area.

Audit appreciates that management has taken up system improvements, which will be verified though Action Taken Notes.

5.2.3 Lost tender analysis

As per information furnished by BHEL management, business sector-wise success rate in securing orders against competition[23] during 2012-16 are summarised in **Table 5.1**.

Table 5.1: Business sector-wise success rate against competition during 2012-16

Business Sector	Orders secured (₹ crore)	Orders lost (₹ crore)	Success rate (*per cent*)
Power Sector	38602	29797[24]	56.44
Industry Sector	16045	17318	48.09
International Operation	3633	3184	53.29

Though Management carried out lost tender analysis after loss of every tender, details were not available on record. Management furnished broad reasons for losing the tenders. **Table 5.2** summarises them over 2012-16.

[23] ***Excluding projects secured against nomination basis or projects where BHEL was the only bidder***

[24] ***Based on evaluated price of L1, except Shongtong Karcham HEP where read out price of L1 was considered and Gongri HEP and Ratle HEP where BHEL's evaluated price was considered as management did not furnish L1 evaluated price stating that bids were opened in camera***

Table 5.2: Reason-wise details of tenders lost by three business sectors during 2012-16

Reasons for lost tenders	Lost Tenders							
	Power Sector		Industry Sector		International Operation		Total	
	No.	Value (₹crore)	No.	Value (₹crore)	No.	Value (₹crore)	No.	Value (₹crore)
Pricing	8	6857	288	13776	14	2633	**310**	**23266**
Delivery	-	-	41	871	-	-	**41**	**871**
Technical	-	-	33	1587	1	80	**34**	**1667**
Price and Delivery/ Technical and Commercial loadings	5	15811	16	925	2	361	**23**	**17097**
Customer preference	3	1219	3	89	1	110	**7**	**1418**
BHEL bid disqualified	2	5910	17	70	-	-	**19**	**5980**
Total	**18**	**29797**	**398**	**17318**	**18**	**3184**	**434**	**50299**

The most significant reasons for losing tenders were pricing followed by price and delivery/ technical and commercial loadings. Together they account for 85.29 *per cent* orders (in terms of value) that were lost. Audit noticed that

- BHEL's price[25] was higher than L1 price by 4.36 to 71.08 *per cent* in 13 out of 18 tenders lost by PS-Marketing. In case of two lost tenders, variation of BHEL quoted price from L1 price could not be computed as BHEL's bid was disqualified in first stage itself. In three cases, orders were not placed on BHEL in spite of it being L1 up to read-out price stage. In these cases, BHEL was not considered due to customer preference.

- In tenders lost by Industry Sector (IS) too, BHEL's price was up to over two and a half times higher than its competitors[26]. In eight cases of lost tenders in IS (listed in ***Annexure 5.1***) though IS-Marketing indicated market level prices to the Manufacturing Units (MUs) concerned, the MUs could not match their estimates with market level prices. It was observed that BHEL's price was higher mainly due to higher material and overhead costs. IS-Marketing lost five tenders (details in ***Annexure 5.2***) due to technological reasons as technology offered by BHEL was either not as per requirement of customer or was outdated one. Six orders (four Captive Power Plant orders and two Transmission Business Group orders) were lost because of shorter delivery period offered by competitors (details in ***Annexure 5.3***).

- In 15 out of 18 lost tenders by International Operations, BHEL's price was higher than L1 by 5.69 to 98.17 *per cent*. In two cases, variation in BHEL's quoted price with reference to L1 price could not be ascertained due to non-availability of L1 price, whereas in one case, price of BHEL and L1 was the same and BHEL lost the tender on techno-commercial ground.

Management /Ministry stated (February/ May 2017) that

[25] ***Evaluated price in 12 cases and read-out price in four case (Shongtong Karcham HEP, Gongri HEP, Ratle HEP and Bajoli Holi HEP) due not non-availability of evaluated price***

[26] ***Difference was 0 to 10 per cent in 93 tenders, 10 to 20 per cent in 86 tenders, 20 to 50 per cent in 85 tenders, 50 to 100 per cent in 30 tenders and more than 100 per cent in 11 tenders***

(i) While working out BHEL's success rate against competition, 2x660 MW RRVUNL Chhabra EPC project was not considered, where BHEL became L1 while the project was placed to L2 bidder. In addition, ICB bids such as 1x800 TANGEDCO North Chennai, 1x500 MW NTPC Vindhyanchal SG & TG etc. have also not been considered. These bids were open for participation by other competitors and BHEL emerged as the sole bidder due to its competitive edge.

(ii) Business sector and manufacturing units had together put best efforts to match cost estimates with market level prices.

The reply is not acceptable as:

(i) Audit has discussed success rate of BHEL where it competed with other parties and secured orders. Though BHEL emerged as L1 for Chhabra project, it could not secure the order as the tender conditions did not allow award of more than one project to BHEL. Hence, Chhabra project was not considered as a 'lost tender' to work out the success rate.

(ii) The contention of Management that best efforts had been put to match cost estimates with market level prices has to be seen against the failure of BHEL units to match the market level prices despite intimation of market level price by concerned Business Sectors. In many cases, the competitors bid for the projects with prices close to the market-level prices indicated by the marketing departments.

5.3 Inaccurate estimation of quantities

Cement and steel are two major materials required for execution of civil works relating to power projects. Power sector regions of BHEL procured these material for issue to civil sub-contractors. It was, however, observed that PS-Northern and Western regions did not realistically estimate quantities of various types of steel (like Steel SS, Liner, Steel STR, Steel Rebar) and cement required for three projects. As a result, actual quantities consumed far exceeded estimated quantities as detailed below:

Table 5.3: Estimated and actual quantities of steel and cement

Name of project	Material	Estimated quantity	Actual quantity	Excess quantity		Rate	Additional expenditure
		MT	MT	MT	%	₹/MT	₹ crore
Anpara D (PS-NR)	Steel SS	0	250	250	-	170000	4.25
	Steel Liner	0	16059	16059	-	38131	61.23
	Steel STR	30500	42500	12000	39	47685	57.22
	Steel Rebar	15500	42400	26900	174	43893	118.07
	Cement	90000	165400	75400	84	4142	31.23
Bawana (PS-NR)	Steel STR	15000	19675	4675	178	41628	19.46
	Steel Rebar	10000	20900	10900	109	41291	45.00
	Cement	75000	92550	17550	23	4099	7.19
Pipavav (PS-WR)	Structural and Reinforced steel	12000	22889	10889	91	46634	50.78
Total							**394.43**

Thus, BHEL incurred additional expenditure of ₹394.43 crore due to inaccurate estimation of quantities. It is pertinent to mention that Anpara-D projects on which BHEL incurred additional expenditure of ₹272 crore, was completed at a loss of ₹210.28 crore.

Management stated (February 2017) that the deviations could not be foreseen as construction of power plant on abandoned ash ponds, up to 13 meters in depth, in Anpara-D was taken up for the first time in India. In Bawana project also, deviations occurred as per actual requirements. Pipavav project was executed with new technology having frame 9FA Gas Turbine in combined cycle mode, which BHEL executed for the first time and Bill of Quantities (BOQ) prepared based on preliminary study could not have been covered all unforeseen challenges. Ministry did not offer any comments.

The difference between BOQ and actual quantities was substantial and ranged between 23 and 178 per cent. Even if the projects were undertaken for the first time, excess consumption of material to such high levels was not expected and it led to losses.

5.4 Bid price lowered without approval benefiting private party

M/s SPEC Power Private Limited (SPEC) invited (28.09.2012) Request for Pre-Qualification (RFPQ) for setting up 1x525 MW thermal power station-Stage IV at Tuticorin on build, own and operate basis. BHEL entered (29.10.2012) into an MOU with M/s Megha Engineering and Infrastructures Limited (MEIL) for manufacture and supply of Boiler, Turbine and Generator (BTG) for the project. M/s MEIL was awarded the project at a total price of ₹2901 crore (18.11.2013).

Audit noticed that in line with the MOU, BHEL had submitted (17.04.2013) its techno-commercial offer for BTG portion to M/s MEIL with firm prices of ₹1473 crore (including taxes and duties). Subsequently, however, BHEL agreed to accept (07.12.2013) a lower price of ₹1108 crore (excluding cost of mandatory spares of ₹42 core), which was 88.62 *per cent* of the cost estimates. As per Delegation of Power (DOP) of BHEL, approval of Director (Finance) and CMD was required in this case which was not found on record.

Ministry stated (May 2017) that the final price was discussed and quoted after obtaining consent of competent authority and formal approval was taken *post-facto.* MEIL was understood to have obtained offer from other (Chinese) manufacturers also. The final quoted price was for reduced scope (excluding electrical packages) and the same was considered in the price approval note dated 26.11.2013.

The reply of Ministry is not acceptable. Approval, not consent, of the competent authority was required as per Company's own DOP. Even the post-facto approval was submitted only up to ED (PS-Marketing) and not submitted to Director (Finance) and CMD as required under DOP. Though MEIL submitted initial RFP with BTG sourced either from BHEL or M/s Doosan, the final bid was submitted indicating BTG tied-up with BHEL, confirming that the price offered (₹1473 crore) by BHEL was competitive compared to M/s Doosan offered price. Moreover, there was no mention of competition from Chinese firm in the price approval note dated 26.11.2013. Thus, the reduction in price was made against non-existent competition. The reduction in scope was also not significant to justify the price reduction, since the 'all-in-cost' estimation of BTG made in August 2015 was ₹1232.08 crore as against initial 'all-in-cost' estimate of ₹1250.26 crore.

5.5 Decreasing competitiveness and inadequate efforts for increasing competitiveness

To maintain growth in a changing business environment, BHEL needed to enhance its competitiveness through cost reduction, faster project deliveries and better management of working capital. It was, however, noticed that:

5.5.1 Capacity addition by a power equipment manufacturer is determined on the basis of MW of Turbine-Generator (TG) supplied and commissioned by that manufacturer. To assess the competitiveness of BHEL, Audit analysed TG orders secured and lost by it during 2012-16 and observed that:

(a) BHEL's overall success rate in securing orders for TG packages was 68.97 *per cent* during 2012-16. However, 40.52 *per cent* TG orders during above period were awarded to BHEL on nomination basis. Success rate of BHEL in securing TG orders against real competition (i.e., where price bids of other bidders were also opened[27]) was 49.66 *per cent.*[28]

(b) Year-wise analysis of BHEL's success rate in securing TG orders against competition revealed that BHEL's success rate during last three years ended 31 March 2016 declined consistently from 80.44 *per cent* in 2013-14 to 43.95 *per cent* in 2014-15 and to zero *per cent* in 2015-16.

(c) BHEL could not secure any of the four tenders (involving TG component), three for thermal projects and one for hydro project, finalised against competition during 2015-16 where BHEL's quoted prices were 4.36 *per cent* to 73.85 *per cent* higher than L1 prices.

Ministry stated (May 2017) that Audit has not considered orders (i) where no other bidders participated although the same were open to all (ii) placed on negotiated basis and (iii) order of Karimnagar project of NTPC (SG package) in order to correctly reflect the success rate of BHEL. Non-participation by other bidders was largely due to low probability of securing orders against competition from BHEL. Developers were placing orders on negotiated basis considering the advantage they had on placing orders on BHEL. It was also stated that success rate in securing TG orders against competition has declined to *zero per cent* in last three years ended 2015-16 was not correct.

The reply, however, has to be viewed against the fact that Audit has considered all the orders secured by BHEL and worked out overall success rate of 68.97 per cent. However, Audit highlighted the declining trend of success rate in tenders where BHEL competed with other bidders. Though orders were secured on negotiated or nomination basis during 2015-16, BHEL could not succeed in any of the four tenders where it actually faced competition from others during this period. Karimnagar order was not considered since it was not a TG package order.

5.5.2 Competitiveness is not only about ability to secure orders; it is also about the capability to execute orders within time comparable to or even faster than competitors and with profit margins. It was, however, observed that orders with anticipated losses (as per AS-7 information[29]) have consistently increased during the last five years ended 31 March 2016 as detailed below:

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[27] Excluding cases where tender was finalised based on single price bid of BHEL.
[28] After including TG orders secured against Bulk tenders where BHEL was not L1, but secured order because of tender conditions
[29] BHEL prepares profitability of projects under construction as per Accounting Standard 7-Accounting for Construction Contracts, issued by the Institute of Chartered Accountants of India

Table 5.4: Number of orders under execution with anticipated loss

Year ended 31 March	Number of orders under execution with anticipated losses	Amount of anticipated losses (₹ crore)
2012	1	2
2013	3	56
2014	14	1115
2015	18	1581
2016	20	2104

It is pertinent to note that the actual losses would be much more as the amount of anticipated losses indicated were without taking into account unit and corporate level overheads. Further, anticipated losses in the same project increased year after year[30], indicating that management's claim (paragraph 5.2.1) that it focused on reducing overall cost and efforts were made to improve upon material and other costs during execution was not correct in all cases.

Ministry stated (May 2017) that in most of the cases, AS-7 factor has improved (profit has increased/losses have come down) as a result of various process improvements, as the execution progressed, except for few cases listed by Audit.

The reply, has to be viewed against the fact that Audit has pointed out cases which were likely to incur significant losses (more than ₹100 crore up to 31 March 2016). Out of 20 loss making projects as on 31 March 2016, 18 projects were under execution for more than two years. While in 12 out of 18 projects (67 per cent) the losses increased year after year, in five projects the losses were reduced marginally and only in one case, loss of ₹ 37 crore in 2014-15 turned to a profit of ₹ 76 crore in 2015-16.

5.5.3 Rationalisation of manpower according to level of operation was essential to maintain margin, competitiveness and business growth. Manpower cost constituted significant part of BHEL's total expenses and the same as percentage of turnover increased consistently from 11.04 *per cent* in 2011-12 to 20.84 *per cent* in 2015-16, as detailed in table below:

Table 5.5: Year-wise turnover and employee cost in BHEL

Year	Turnover (₹ crore)	Manpower* (numbers)	Employee cost (₹ crore)	Turnover per employee (₹crore)	Employee cost to turnover (*per cent*)
1	**2**	**3**	**4**	**5=(2/3)**	**6=(4/2*100)**
2011-12	49510	47546	5466	1.04	11.04
2012-13	50156	48876	5753	1.03	11.47
2013-14	40338	47449	5934	0.85	14.71
2014-15	30947	45537	5450	0.68	17.61
2015-16	26587	42784	5541	0.62	20.84

**** As on 01 January of the respective financial year.***

[30] ***North Karanpura: anticipated loss increased from ₹256 crore as on 31 March 2014 to ₹465 crore as on 31 March 2015 and to ₹622 crore as on 31 March 2016; Anpara D: anticipated loss increased from ₹151 crore as on 31 March 2014 to ₹195 crore as on 31 March 2015 and to ₹210 crore as on 31 March 2016; NTPC/Mouda: anticipated loss increased from ₹127 crore as on 31 March 2014 to ₹343 crore as on 31 March 2015 and to ₹378 crore as on 31 March 2016; New Nabinagar SG package: anticipated loss increased from ₹73 crore as on 31 March 2015 to ₹163 crore as on 31 March 2016***

In this regard, Audit observed that:

- BHEL management was aware about signs of slowdown in Indian economy and problems in power sector since second half of 2010-11 itself.
- The order book position of BHEL showed the signs of slowdown. Value of average annual orders booked during 2011-16 was ₹31259 crore as against ₹60507 crore during 2010-11. As a result, the order book position declined from ₹135300 crore in 2011-12 to ₹110730 crore in 2015-16. Further, considerable amount of orders were in the nature of 'on-hold' projects and no work was being carried out against these projects. At the end of 2010-11, the value of works to be executed under 'on-hold' projects was ₹5842 crore (5 projects), which consistently increased to ₹8477 crore (7 projects) at the end of 2011-12, ₹17804 crore (15 projects) at the end of 2012-13, ₹18563 crore (17 projects) at the end of 2013-14 and ₹20408 crore (19 projects) at the end of 2014-15 and to ₹50645 crore (25 projects) at the end of 2015-16.
- Though Strategic Plan 2012-17 set to achieve turnover of ₹100000 crore by 2017, Management was not convinced of achieving this target in view of slowdown in power sector. This apprehension was put on record at the time of finalisation of the Strategic Plan.
- Despite slowdown in power sector since 2010-11 and more and more projects becoming 'on-hold' since 2008-09 due to dampening investment sentiments, BHEL inducted 9346 employees in calendar year 2011 and 2012 as against retirement of 5844 employees during this period. Though the intake of new employees was controlled since 2013 compared to the retirements, management initiatives for diversification and innovation was not evident (as discussed in Chapter 3 and 4), which resulted in lower productivity parameters as indicated in the table above. Similarly, increased manpower cost also affected BHEL's competitiveness as it lost considerable number of tenders due to higher cost compared to competitors (as discussed in the preceding paragraphs).

Ministry stated (May 2017) that in 2011-12, there were visible signs of slowdown in power sector, with BHEL registering positive year-on-year turnover growth of 14.20 *per cent* in 2011-12 and 1.30 *per cent* in 2012-13. The manpower intake was cautiously controlled in 2012-13 in view of shrinking thermal business. The manpower intake was further reduced in forthcoming years of plan period 2012-17 despite large scale retirement to the tune of 11100 numbers in order to rationalise manpower in sync with business scenario.

However, the Strategic Plan document itself indicated that the power sector was on a slowdown since second half of financial year 2010-11. Generally, tendering process for a power project takes about 1½ years and the order booked in a particular financial year, therefore, pertains to the projects bid for before 1 to 2 years. The signs of slowdown was evident even before 2010-11 as the orders booked from power sector declined significantly to ₹ 14012 crore in the year 2011-12 from average orders of ₹ 44143 crore during 2007-08 to 2010-11[31]*. Similarly, data relating to finalisation of main plant equipment of utility sets declined from 36478 MW in 2009-10 to 24551 MW in 2010-11 and to 8482 MW in 2011-12.*

[31] ***Power Sector orders booked: ₹ 41069 crore in 2007-08, ₹ 47167 crore in 2008-09, ₹ 41982 crore in 2009-10 and ₹ 46393 crore in 2010-11***

5.6 Acceptance of orders with less than 10 per cent advance in contravention of BHEL corporate finance guidelines

In order to avoid situation of 'cash crisis' in BHEL in the light of prevailing cash crunch across country and mounting debtors and inventory position in BHEL, Corporate Finance, BHEL directed (October 2008) that (i) no order should be accepted with payment terms which did not provide for minimum 10 *per cent* advance; (ii) without receipt of full amount of advance, zero date should not be agreed; and (iii) any deviation from above directives would require specific approval of Director (Finance) and CMD before acceptance of order. To ensure compliance of these directives, responsibility was assigned on respective business sectors. It was, however, observed that orders were accepted by PS-Marketing with less than 10 *per cent* advance or with advance to be received in instalments and accepting a date prior to date of receipt of full amount of advance as 'zero date' (details are in ***Annexure 5.4***). However, approvals of Director (Finance) and CMD were neither found on records made available to Audit nor did management furnish such approvals to Audit separately. Audit also noticed that six out of nine orders listed in the above Annexure 5.4 subsequently had to be put on hold due to payment related issues.

Management stated (February 2017) that based on commercial prudence, certain orders had been accepted by business sector with less than 10 *per cent* advance. Ministry added (May 2017) that the note dated 13.04.2012 conveyed the decision of the competent authority.

The reply, however, has to be viewed against the fact that the note referred to in the reply stated that any such decision should be as per approved Delegation of Power (DOP). As per the DOP approved in October 2008 regarding receipt of advance along with customer orders, approvals of Director (Finance) and CMD was required for accepting orders with less than 10 per cent advance, which were not obtained in the cases indicated in the Annexure 5.4.

5.7 Poor perception about BHEL in customer surveys

As per MOU with the Administrative Ministry, BHEL commissioned customer surveys for evaluating its performance for the years 2012, 2013 and 2014. The surveys indicated Customer Satisfaction Indices (CSI) of BHEL at 65, 67 and 71 *per cent* for 2012, 2013 and 2014, respectively against CSI of 69, 70 and 74 *per cent*, respectively of competitors. While working out CSI, marketing, project engineering management, supplies, project installation and management, service and after sales and brand image aspects were considered. Since 'marketing' and 'project installation and management' were relevant to this performance audit, activity-wise and sub activity-wise scores obtained by BHEL and competitors under these two functions were reviewed in audit.

5.7.1 Marketing function

Activity-wise performance of BHEL and competitors in respect of marketing function during 2012-2014 reflected in customer surveys were as under:

Table 5.6: Activity-wise performance under marketing function of BHEL and competitors

(in per cent)

Activities	Year	BHEL	Competitors (Average)	L&T (Main competitor)
Pre-sales	2012	52	68	79
	2013	54	45	52
	2014	49	68	72
Sales	2012	47	54	48
	2013	55	55	67
	2014	56	70	81
Contract Management	2012	45	56	59
	2013	38	51	54
	2014	55	67	70

In respect of all activities relating to marketing function, BHEL was far behind its competitors. Competitors scored better than BHEL in respect of 11 out of 15 sub-activities of marketing function on a scale of five (where five was the maximum score) in the latest customer survey of 2014 as detailed in ***Annexure 5.5***.

5.7.2 Project installation and management function

Activity-wise performance of BHEL and competitors in respect of project installation and management function reflected in customer surveys of 2012-14 were recorded as under:

Table 5.7: Activity wise performance under Project installation and management function of BHEL and Competitors in three customer surveys

(Figures in per cent)

Project installation and management activity	Year	BHEL	Competitors (Average)	L&T (main competitor)
Project erection	2012	46	61	83
	2013	43	72	78
	2014	45	70	78
Pre-commissioning of project	2012	51	55	77
	2013	42	60	56
	2014	45	65	71
Commissioning of project	2012	51	61	77
	2013	47	65	67
	2014	54	64	69
Project closure	2012	33	45	53
	2013	31	57	60
	2014	39	62	60

Sub-activity wise mean scores on a scale of five scored by BHEL and competitors, as detailed in ***Annexure 5.6***, indicated that BHEL's scores were less than those of its competitors in respect of 24 out of 25 sub-activities as per the latest customer survey of 2014.

From the above it is observed that:

(a) BHEL did not show any improvement in 'project erection' over the period 2012 to 2014;

(b) On the front of Pre-commissioning of project, BHEL's position deteriorated during last two customer surveys as compared to first survey of 2012;

(c) In respect of 'Commissioning of project' and 'Project closure', though customers' liking for BHEL marginally improved during the latest customer survey of 2014, customers' liking in favour of competitors was much higher.

(d) Only in respect of 'technical capability of site engineers' BHEL scored marginally over its competitors in 2014 survey. Sequential supplies by manufacturing units was one sub-activity in respect of which score difference between BHEL and competitors was the maximum.

The results of customer surveys indicated areas where BHEL needed to improve in order to increase overall customer satisfaction. Instead of undertaking measures for improving customer satisfaction indices and monitor them in subsequent years, BHEL failed to carry out customer surveys after 2014.

Ministry stated (May 2017) that BHEL being the largest agency among multiple agencies working on a project, project owner/developer generally turned to pass on the blame to BHEL to cover up their own delays, setting a distorted perception. Project execution had remained a focus area for BHEL and significant improvement had happened over a period of time. As result, it could commission capacity of more than 10000 MW for four consecutive years.

Chapter VI Project Delivery

For timely execution of projects, it is important to accurately assess time required for completion of each activity, criticality of each activity and the sequence of activities to be initiated. A typical thermal power project executed by BHEL involves supply of equipment from a network of its 17 manufacturing units. Some material and equipment not manufactured by BHEL are procured from vendors. Services like civil construction and structural works, erection etc. are also outsourced.

Execution of projects are carried out through regional power sector offices under overall supervision of Project Management Group at corporate office. The manufacturing units/Regional Offices are required to prepare detailed timelines and sequence called L2 network. This is to ensure that availability of materials/equipment at site is not delayed in order to avoid any cascading impact on project execution, no supplies are made in advance of their actual requirement and the customer accepts the invoice raised as per billing schedule. Thus, monitoring of L2 network as per pre-decided sequence was necessary for timely project delivery.

6.1 Project execution by BHEL

6.1.1 There were considerable delays in project execution by BHEL as detailed below:

- **Power sector:** 43 projects/orders were secured by Power Sector during 2012-13 to 2015-16, of which, 40 were on-going (March 2016). Audit noticed that in respect of 28 of these projects, 193 major milestones had fallen due by November 2016. Of these, only *seven* major milestones could be achieved within respective due dates, another 98 major milestones were achieved with delays ranging from one to 51 months while 88 milestones were yet to be completed (as on 30 November 2016) even after lapse of one to 36 months since their due dates.
- **Industry sector:** Out of 90 project/ orders secured by Industry Sector, 14 orders were completed within scheduled completion time, while 30 orders were completed with delays ranging from one to 21 months.
- **International operations:** Out of 16 orders secured by International Operations, three orders were subsequently cancelled by customers. Out of the remaining 13 projects, one was commissioned within scheduled completion time and another one was commissioned with delay of two months. The completion schedule of the balance 11 projects was beyond 31 March 2016.

6.1.2 Review of project-wise status of scheduled and actual commissioning of 32 Power Sector (PS) projects, 16 Industry Sector (IS) projects and five International Operation (IO) projects selected for performance audit revealed that BHEL could not complete any of the projects within scheduled completion time. The projects were commissioned with delays of 3 to 84 months. As a result, customers withheld ₹1966.07 crore towards liquidated damages (LD) against these projects as detailed below:

Table 6.1: Business sector-wise withheld amount on account of Liquidated Damages

Name of business sector	No. of projects commissioned	No. of projects in which customer withheld amount on account of LD	Amount of LD withheld (₹ crore)
Power sector	32	27	1923.63*
Industry sector	16	8	38.44
International operation	5	2	4.00
Total	**53**	**37**	**1966.07**

**including ₹496.70 crore which were withheld by customer but got released by submitting Bank Guarantees of equal amounts.*

Reasons for delay in project execution were attributed to both customers and BHEL. Reasons attributable to customers included delays in handing over site, approval of drawings and vendors, availability of fuel, water and power evacuation system etc. Reasons for delay attributable to BHEL included un-synchronised deliveries and site activities[32] by BHEL units/agencies, delay in site opening, delay in finalisation of Balance of Plants[33] and other enabling and mechanical contractors, delay in transportation, lack of coordination between different BHEL units, inadequate mobilisation of resources (manpower, construction equipment etc.) by BHEL and its sub-contractors. Project-wise reasons of delay attributable to BHEL, as noticed in Audit, are given in ***Annexure 6.1***. For reasons attributable to customer or force majeure conditions, BHEL gets time extension. Audit noticed that Management has not lodged any claims on customers.

Ministry stated (May 2017) that for making true assessments, overall context of customer references and related activities ought to be analysed. During execution, there were several interfaces of information, inputs and erection fronts between BHEL and the customers including other contractors. Sometimes, delays were due to force majeure conditions making it difficult to quantify claims on account of delays in intermediate project activities. Comprehensive time extension and delay analysis was taken up only during later stage of the project when discussion on reasons that had caused delay and LD waiver was carried out as a part of commercial settlement. BHEL also lodged claims in case projects were delayed due to reasons attributable to customers and has been compensated in 4x250 MW Nabinagar, 5x270 MW Nasik Phase-I and 2x660 MW Banharpalli projects.

While Audit appreciates that some project delays were attributable to the customers or force majeure conditions, it was noticed that out of 53 projects commissioned with delays, customers had withheld amounts towards liquidated damages in 37 projects indicating that the customers held BHEL responsible for the delay in these projects. In fact, Audit noticed that in 17 projects, customers finalised LD of ₹512.16 crore, out of which BHEL has written off ₹378.41 crore. In respect of 32 power sector commissioned projects selected for audit, no compensation claim was pursued by BHEL, except one project (2x270 MW GVK Goindwal) which subsequent to commissioning was put on-hold. BHEL was deprived of fund inflow from these projects and also sustained interest loss.

[32] ***Delay in supply of critical material required for erection, supply of material much in advance of requirement at site***

[33] ***Balance of Plants are the products, systems and services which may not be in the manufacturing range of BHEL, but which form part of BHEL's scope of project requirement***

Case Study 1: Undue favour to private party (M/s GVK Power Limited)

The work of construction of 2x270 MW Goindwal Sahib TPS was awarded (November 2007) to BHEL by M/s GVK Power Goindwal Sahib Limited (GPGSL) at a cost of ₹1155 crore. After synchronisation of the two units on 06.7.2012 and 04.3.2014, respectively, BHEL put the project on hold (20.05.2014) due to non-availability of coal and non-payment of outstanding dues. Following a high level meeting (03.12.2015) between M/s GVK and BHEL in presence of Minister of State (HI &PE) and Joint Secretary (MHI), it was agreed to revive the project on condition that GVK would (i) release all outstanding dues (₹47.08 crore against this project and ₹50 crore against Srinagar Hydropower Project, which was to be paid in four equal instalments by March 2016); (ii) furnish a Corporate Guarantee of ₹110 crore; (iii) give time extension up to June 2016 without levy of LD; and (iv) additional claims and counter claims submitted by BHEL would be settled by 15.1.2016.

M/s GVK released (10.12.2015) ₹42.34 crore and submitted (16.2.2016) a Corporate Guarantee but did not confirm time extension without levy of LD, neither cleared the dues against Srinagar project nor addressed BHEL's claims for time over run. Despite non-fulfilment of these conditions by M/s GVK, BHEL resumed project activities and achieved full load of Unit-1 on 14.2.2016 and Unit-2 on 15.3.2016. On 15.3.2016, BHEL put the project again on hold citing non-fulfilment of commitments by M/s GVK (extension of time without LD, payment of dues against Srinagar project and settlement of claim/counter claims).

The resumption of the project by BHEL led to completion and commissioning of the project. Since April 2016, the project was in operation and generating electricity (as per generation data available on CEA's website, the project generated 223.91 GWh power from April to August 2016). BHEL, however, could not encash the guarantee as it had not completed the performance guarantee test. Audit noticed that BHEL had accepted a corporate guarantee of ₹110 crore in place of the committed Bank Guarantee which was financially imprudent. Resumption of the project activities and subsequent commissioning without resolving the un-fulfilled commitments proved detrimental to the interests of BHEL.

Management stated (February 2017) that (i) BHEL accepted Corporate Guarantee of GVK energy on no choice basis; (ii) In the interest of project and to utilize the available resources at site, the 2nd unit was commissioned on 15.3.2016, (iii) After putting the hold on project on 15.3.2016 there has been no involvement of BHEL in any commissioning activity at project site. Ministry added (May 2017) that based on the agreement (07.12.2015), BHEL has been able to liquidate the outstanding due as on the date of the agreement and also has a legally enforceable Corporate Guarantee for bills raised after lifting the hold.

The reply is not acceptable. By accepting corporate guarantee in place of Bank Guarantee, Management compromised BHEL's interests as it was aware of financial condition of GVK. Ministry's reply that all outstanding dues on the date of agreement were liquidated is incorrect. Out of the total dues of ₹ 47.08 crore against this project and ₹ 50 crore against the Srinagar project, only ₹ 42.34 crore was paid with ₹ 54.74 crore still outstanding.

6.2 Non-compliance of conditions leading to delayed receipt of advances for orders

Orders secured by PS-Marketing generally provided for payment of interest free advance equal to 10/ 15 *per cent* of supply component of contract price. BHEL would be eligible for the advance following satisfaction of a set of pre-conditions, namely, submission of advance bank guarantee (BG), performance BG and BG against Deed of Joint Undertaking (DJU). In the sample studied, Audit observed that in case of four orders, BHEL took substantial time in fulfilling such conditions leading to delayed receipt of advance.

Ministry stated (May 2017) that several rounds of negotiations were held with the collaborators to seek settlement of contractual issues and finalisation of best price/ terms. This resulted in some delay in submission of DJU and BG by the collaborators.

The reply, however, has to be viewed against the fact that BHEL could not obtain the interest free advances on time in these cases.

6.3 Advance/ Delayed supplies

L2 Network date mandates the date of supply of component items of a project. Adherence to this date is important for protecting the financial interests of the Company, early dispatch may lead to avoidable blocking of funds and consequent higher interest during development, while late dispatch may result in levy of liquidated damages on the Company. Audit reviewed the dates of scheduled vis-à-vis actual dispatch for work orders related to sample projects at BHEL manufacturing units and noticed as under:

(i) In Trichy unit, the purchase orders for material were not placed in line with the L2 network schedule. 2119 purchase orders (POs) valuing ₹201.11 crore were placed after terminal date with 78 of these placed three years after delivery date. At the same time, 12454 POs valuing ₹220.93 crore were placed before requirement. In fact, 42 POs valuing ₹25.43 crore were placed 900 days before terminal date, the earliest PO being placed 1593 days in advance.

(ii) In Hyderabad unit, 121 dispatches valuing ₹765.65 crore were made six to 31 months in advance of the L2 network date (out of a sample of 477 dispatches above ₹1 crore, valuing ₹2269 crore studied in Audit). On the other hand, out of 7638 work order wise dispatches valuing ₹5461 crore (above ₹10 lakh value), 6183 valued at ₹4133 crore were dispatched with over three to 84 months delay from the L2 Network date.

(iii) In Industrial Systems Group, Bengaluru, of 1369 dispatches, 838 dispatches were made six to 44 months in advance from the L2 Network dates. On the other hand, 531dispatches were made with delays of three to 78 months from L2 Network dates. Value of such delayed supplies worked out to ₹286.83 crore.

Ministry stated (May 2017) that utmost care was taken that delay in supplies do not affect completion of the project. Also, time extension was generally granted by customers for reasons not attributable to BHEL/its subcontractors/ vendors. In respect of project for which advance supplies were made, the customer had given necessary clearances and documentation required for dispatch of materials, accepted the same and made payment as per contractual terms.

The reply needs to be seen against the considerable mismatch in actual vs scheduled delivery dates which has a significant financial impact on BHEL.

6.4 Project execution by BHEL vis-à-vis competitor

Rajasthan Rajya Vidyut Utpadan Nigam Limited (RRVUNL) awarded (March/April 2013) contracts for commissioning four units of 660 MW each at its Chhabra project in Suratgarh (Rajasthan) on Engineering, Procurement and Construction basis. The contract for two of these units (unit 5 & 6) was awarded to M/s L&T while the balance two (unit 7 & 8) was awarded to BHEL. Unit # 5 and Unit #7 were to be commissioned by September 2016 while Unit #6 and #8 were to be commissioned by December 2016. Audit noticed that none of these units have been commissioned yet (June 2017). However, L&T could synchronise Unit #5 in October 2016 (02.10.2016) preparatory to commissioning. BHEL has been unable to synchronise Unit #7 till date (June 2017).

Management stated (February 2017) that each project has different peculiarities such as locational impediments, availability of resources, interfacing systems etc. Chhabra unit # 5 & 6 were yet to be commissioned; delay in execution of Suratgarh project was attributed to change in layouts, delay in finalisation of drawings, delay in vendor approval/ sub-vendor approval of Balance of Plants.

Ministry added (May 2017) that a patch of land between intake water pump house and raw water reservoir through which pipeline carrying water required for commissioning had to be erected was not acquired by the customers. As a result, synchronization of Unit#7 was delayed. The land was handed over to BHEL on 04 March 2017.

The reply has to be viewed against the fact that both the projects were awarded on EPC basis at the same time and with same terms and conditions. Audit noticed that non-availability of land was not discussed in the meeting of June 2016 when BHEL committed to complete synchronisation of Unit #7 by December 2016.

6.5 Quality issues of BHEL supplies

Production units of BHEL are required to supply material/equipment compliant with quality standards, so that these perform at intended performance level and the Company does not face delays in erection and commissioning due to repairs/ re-work. BHEL had traditionally scored over its competitors on quality. However, Audit observed quality/ workmanship issues at all stages of project execution, viz., (i) manufacturing stage, (ii) commissioning stage, and (iii) operational stage/ during warranty period. Quality/ workmanship related issues noticed in PS, IS and IO are given in ***Annexure 6.2.*** These issues led to Trichy and Haridwar units incurring ₹138.44 crore towards cost of re-work in the sample projects selected for review by Audit.

Management stated (February 2017) that cost of re-work/rejection as mentioned by Audit works out to less than one *per cent* of turnover of Trichy and Haridwar units for five years (2011-16). Ministry stated (May 2017) that quality issues noticed during erection/ commissioning/ warranty period were addressed/ being addressed.

Considering that a sample check has indicated re-work cost of ₹ 138.44 crore, the actual cost may be higher. In view of the reducing margins of BHEL, the re-work cost cannot be neglected.

6.5.1 Resolution of quality complaints

To assess the resolution of complaints regarding quality of BHEL supplies, the Trichy manufacturing unit was reviewed. The Quality Assurance Department receives complaints relating to the problems faced during erection of the materials/items/components supplied by the Trichy unit. In case the materials sent by Trichy unit require modification/rework, at the time of disposition, Quality Assurance Department requests concerned BHEL site to carry out re-work and modification work on cost debit to Trichy unit.

Audit noticed that over 2011-12 to 2015-16,

- 80 *percent* of the complaint cases and their cost debits have been accepted by the Trichy unit (5705 cases out of 7168 complaints). Further review of the accepted complaint cases indicated that the majority of them (~60 *percent* cases) were on account of design and engineering defects.
- 730 out of 7168 complaints were attributable to sub-contractors/vendors. As per the outsourcing contract, if any work had been executed with unsound, imperfect or bad workmanship or with materials of inferior quality, the fabricator/vendor is responsible for rectifying it in whole or in part at their own cost. In the event of failure to do so within reasonable period, BHEL would rectify or re-execute the work at the risk and cost of the fabricator/vendor. However, the details of such costs incurred by the unit on behalf of sub-

contractors/ vendors were not found on record. No incidence of recovery made from sub-vendors/action taken on third party inspection for the period under review was furnished to Audit.

- The Site Action Reports (SARs) and Commissioning Action Reports (CARs) were to be disposed within ten days' time. In 28 *percent* of SARs (over 2011-16) and 52 *percent* of CARs (2015-16), the time taken for the disposal was beyond this stipulation.

Management stated (September 2016/ February 2017) that complaints took more than ten days for disposal as they were cleared with the involvement of vendors. Most of the cases pertained to bought out items which involve lot of persuasions and follow-ups with vendors. Management assured that adequate measures would be taken to strengthen the quality and utmost care would be exercised to minimise recurrence of such defects in future. Ministry added (May 2017) that as against 28 *per cent* SARs and 52 *per cent* CARs disposed beyond ten days during 2011-12 to 2015-16 on an average, 9.31 *per cent* SARs and 52.50 *per cent* CARs were disposed beyond 10 days in 2016-17. Ministry stated that a provision was made in Trichy local system to generate a report of SAR cases involving cost recovery from vendors. Besides, filling of the field 'actual cost incurred by the site' has been made mandatory in the BHEL corporate SAR/CAR system in February 2017 to capture the actual cost incurred by the sites in attending the re-work/repair at site. Thus, SAR/CAR cases involving cost recovery from vendors would be effectively dealt with by the units

Audit appreciates the corrective action taken by the management, effectiveness of which would be verified in future.

Case Study 2: Loss of ₹24.70 crore due to poor quality of Bushings

Bushing is a vital component that connects the transformer with the associated electrical system of bulk electrical power transmission. Bushings are used as terminal insulators for transformers/reactors of various ratings. Bushing failure were reported in Generator Transformers (GTs) of ratings above 200 MVA since 2010.

Based on a study, the failure of Bushings was due to the phenomenon called 'Thermal Run away'. BHEL decided (May 2014) to recall all Bushings installed in GTs which had been commissioned during last three years and replace them with equivalent bushings procured from outside sources. Till April 2015 BHEL Bhopal unit procured 236 Bushings (192 Nos. of 420 kV 1250 Ampere rating Bushings and 44 Nos. of 420 kV 2000 Ampere rating Bushings) at a total cost of ₹14.87 crore.

Audit noticed that based on the recommendations of a task-force, the problem of Bushings of higher current application has now been resolved (April 2016). Type-test on such improved Bushings were under progress. However, between October 2013 and January 2015, six GTs under three projects were damaged due to Bushings failure and BHEL had to incur ₹9.83 crore on repair of such damaged GTs. Thus, BHEL suffered loss of ₹ 24.70 crore (₹ 14.87 crore + ₹ 9.83 crore) due to replacement of Bushings and repair of GTs

Ministry stated (May 2017) that the manufacturing process for 420 kV Bushings for GTs has been improved upon by improving the vacuum drying process, and quality of insulating paper by procuring paper from imported sources.

However, issues relating to failure of Bushings were resolved in 2016 as against the failures reported since 2010, that is, after six years.

6.6 Procurement of material

BHEL procures materials/ equipment for its manufacturing units/ projects. The following issues were noticed in procurement of material by BHEL.

6.6.1 Item-wise quantity variations

As per 'Variation of Contract Value' of General Conditions of Contract (GCC) used for procurement of material by BHEL, prices shall remain firm for any increase or decrease in the order/contract value up to 30 *per cent* within two years unless specified otherwise. In the sample of 155 purchase orders (POs) selected for review in Project Engineering Management/Noida, Audit noticed that only 38 POs included this clause. It was seen that in the contracts where this clause was included, the 30 *per cent* variation was considered vis-à-vis the overall contract value, rather than item-wise. This meant that the positive variation in some items were adjusted against the negative variations in other items. Audit further noticed that 14 POs, where final quantity variations had been approved by management, included 128 items with positive variation beyond 30 *per cent* (ranging from 31.25 to 1950 *per cent*) and 61 items with negative variation beyond 30 *per cent* (ranging from 33.20 to 100 *per cent*). This indicated that the Bill of Quantitates (BOQ) was not assessed appropriately.

Ministry stated (May 2017) that considering audit observation, a circular has been issued (April 2017) to the Units/Regions to restrict variations in both contract value and quantities to a minimal level based on past experience.

Audit appreciates the corrective action in this regard, implementation of which would be reviewed in future audits.

6.6.2 E-procurement in BHEL units

e-Procurement was identified as a priority area in the Strategic Plan 2012-17 of BHEL. In November 2011, a target of 80 *per cent* e-procurement (by value) was set. BHEL Corporate Office instructed (23.03.2013) units to speed-up implementation of e-Procurement and directed that 100 *per cent* single-part bids from 01.04.2013 be issued mandatorily through e-Procurement. Audit noticed that:

- Trichy unit could achieve 60 *per cent* of total procurement through e-Procurement till 2015-16.
- Hyderabad unit could achieve only 8.07 *per cent* of total value of procurement through e-Procurement till 2015-16.
- Bengaluru units (Electronic Division and Industrial Systems Group) could achieve 17.25 *per cent* and 10.72 *per cent,* respectively of total procurements through e-Procurement till 2015-16.

Management explained (February 2017) that during implementation, e-Procurement had its own challenges, viz., variety of templates, customisation requirements for variety of procurements, testing, bug removals, updates, course corrections, tardy vendor response to Digital Signature requirements and resulting change management did affect the actual achievements vis-à-vis targets. To induce faster implementation, stretched targets were included in the Balance Score Cards. Ministry did not offer any comment on this.

None of the BHEL units could achieve the target envisaged in the Strategic Plan 2012-17.

6.7 Low vendor base for procurement

6.7.1 As per Purchase Policy 2013, whenever the number of registered suppliers in Product Material Directory (PMD) is less than four, Management should resort to registration of additional

vendors through publication on website of the unit and BHEL and the fact of such publication on website are to be advertised at least once in a year in minimum two national dailies. It was, however, noticed that during 2012-13 to 2015-16, three BHEL units (PEM/Noida, Ranipet, Trichy) finalised 5292 orders valuing ₹2324.69 crore[34] based on one/two/three vendor base. Another unit, Industrial Systems Group (ISG)/Bengaluru, did not issue advertisements inviting applications for registration of vendors except once in the year 2011-12.

Ministry stated (May 2017) that most of the procurements were made through open tendering and all qualified vendors against open tender were approached for vendor registration and accordingly, registration in PMD was done. However, advertisement for inviting vendor registration for one/ two/ three material category shall be published from this year onwards.

The assurance of the Ministry is noted and would be verified in future audits.

6.7.2 Delay in processing vendors' registration

As per Supplier Evaluation, Approval and Review Procedure (SEARP) 2010, on receipt of a potential vendor's self-assessed form, evaluation should be completed within three months in case visit to the vendor premises is not required, and within four months in case a visit to the vendor premises is required. Audit reviewed records related to registration of vendors and noticed considerable delay in registration of vendors

- **Project Engineering Management (PEM), Noida**: During 2012-13 to 2015-16, PEM registered 343 new vendors. However, 255 vendors (74.34 *per cent*) were registered after three months' time. Management took up to 341 days more than prescribed time for registration of vendors. Besides, percentage of vendors registered within prescribed time decreased from 41.34 *per cent* in 2013-14 to 21.11 *per cent* in 2014-15 and 14.08 *per cent* in 2015-16, in spite of repeated emphasis of Management Committee[35] for faster disposal of pending applications within stipulated time frame of SEARP.
- **Boiler Auxiliary Plant (BAP), Ranipet**: During 2013-14 to 2015-16, registration of 50 *per cent* (103 out of total 206 cases) vendors were finalised with delay of more than 90 days.
- **High Pressure Equipment Plant (HPEP), Hyderabad:** Out of 926 applications received during 2011-12 to 2015-16 for registration, 29 were processed taking a period of more than 2 to 4 years as against the prescribed period of three months. In 124 cases, registration process took 1 to 2 years and in 243 cases, registration was completed in a period of 6 months to 1 year.

Management stated (February 2017) that as per SEARP, only 15 days were to be given to suppliers for submission of documents. However, many suppliers do not submit documents for registration within this time frame. After recommendation of survey by respective Material Identification and Supplier Control Committee (MISCC), availability and readiness of supplier was also the reason for delay in registration. However, to reduce delay in registration of new vendor, steps like development

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[34] ***Project Engineering Management/Noida- 90 POs valuing ₹154.66 crore, Boiler Auxiliary Plant/Ranipet- 2325 POs valuing ₹1548 crore, High Pressure Boiler Plant/Trichy- 2877 POs valuing ₹622.03 crore***

[35] ***287th Management Committee meeting held on 19.8.2011 emphasized quick liquidation of pending vendor registration and expeditious disposal of large number of development and trial codes and implementation of guidelines in SEARP. 288th MCM held on 22.9.2011 reiterated for faster disposal of pending applications within stipulated time fame in SEARP. 294th MCM held on 11.4.2012 stated that specific targets be drawn to add vendors in single vendor/two vendor/three vendor categories and high value items. 330th MCM held on 22-25 July 2015 desired that there was need for a system of auto registration/rejection beyond 3 months***

of IT system to monitor and ensure that registrations within time have been initiated. Ministry did not offer any comment.

Audit noticed that in BAP, Ranipet, operation of an online system from 01 April 2015 for vendor registration did not result in desired improvement as 91.17 per cent vendors were registered after 90 days in 2015-16.

6.7.3 Delayed action for expansion of vendor base for Auxiliary Oil Pump

Auxiliary Oil Pumps (AOPs) are critical for successful commissioning and operation of thermal power plants as any outage of AOP will lead to consequential damages to main turbine. It was observed that various projects (NTPC and Non-NTPC) commissioned by BHEL complained high level of vibrations in the AOPs even during warranty period. Since the supplier of AOPs, M/s Kirlosker Brothers Limited (KBL), did not undertake any rectification measures, BHEL replaced 19 out of 37 AOPs and incurred extra cost of ₹1.27 crore. Audit noticed that though BHEL took up the matter with KBL, no rectification measures were proposed and undertaken by KBL for more than three years. Despite this, BHEL did not explore alternative suppliers and continued to depend on KBL. Only in January 2015, BHEL decided to replace the AOPs.

Management stated (February 2017) that one more vendor (M/s KSB AG) was added in the vendors list for supply of AOPs. Ministry stated (May 2017) that repair for two pumps have been undertaken and after successful testing of these repaired pumps, repair of remaining 16 AOPs shall be undertaken by M/s KBL at the rate of two AOPs per month (total 8 months).

6.8 High Purchase Indent to Purchase Order cycle

6.8.1 As per Purchase Policy, all BHEL units should evolve and fix norms for purchase lead time[36] for different types of materials/components, depending on complexity of product. BHEL Board, while approving (November 2011) Strategic Plan 2012-17, directed to reduce Purchase Indent (PI) to Purchase Order (PO) cycle time of 75 *per cent* orders in 60 days by 2016-17. In the sample selected by Audit, the following was noticed:

- ***PEM Noida:*** Out of 155 orders, ten orders (6.45 *per cent*) were converted from PI to PO within 60 days.
- ***Power Sector Northern Region (PSNR) Noida***: Out of 64 orders, 11 orders (17.19 *per cent*) were converted from PI to PO within 60 days
- ***Power Sector Eastern Region (PSER) Kolkata***: Out of 89 orders, 32 orders (35.95 *per cent*) were converted from PI to PO within 60 days.
- ***BAP Ranipet***: Out of 2879 orders, 697 orders (24.21 *per cent*) were converted from PI to PO within 60 days.

Management stated (February 2017) that PI to PO conversion depends on the complexity of the items being procured by individual units and spectrum of purchases in BHEL varies widely. Ministry stated (May 2017) that PI to PO conversion in 60 days benchmark was 63.90 *per cent* in 2013-14, 62.40 *per cent* in 2014-15, 63 *per cent* in 2015-16 and 64.30 *per cent* in 2016-17.

The reply, however, has to be viewed against the fact that the conversion of PI to PO in the sample examined in audit was much lower than the target (75 per cent) set in the Strategic Plan.

[36] ***Time from the date of indent raising enquiry, order placement and receipt of material***

6.8.2 Award of Balance of Plant packages beyond CEA prescribed timeframe

As delay in finalisation of Balance of Plants (BOPs) packages would adversely affect commissioning of units of power projects later, CEA had instructed (February 2009) BHEL to finalise BOP packages within 7-10 months of zero date. It was, however, observed that in 17 projects, PEM Noida awarded 32 BOP packages 12 to 75 months after zero date. It was noticed that out of 17 projects against which BOP packages were awarded with delay, ten projects were completed with delay ranging from three months to 38 months, while the remaining seven projects were still under construction.

Management stated (February 2017) that in case of BOP items, the requirements were finalised after receipt of inputs from various units/regions, site progress etc. Further, there were multiple interfaces with customers which involved necessary approvals. Ministry added (May 2017) that online input exchange system has been revisited and implemented covering all running projects and catering to all major units.

Expeditious sharing of inputs among various units/regions of BHEL and co-ordination with customer need to be ensured for timely finalisation of BOP packages.

6.9 Limited tendering

Strategic Plan 2012-17 envisaged efficiency of operation by ensuring availability of inputs on time at competitive cost through scale up of procurement activities, competitive buying, tie-up for critical inputs and healthy vendor base. Purchase Policy of BHEL further provided for open tendering in all cases where order value is above ₹20 crore. Audit noticed that:

- In PEM Noida, out of 155 purchase orders selected, only 20 purchase orders (i.e., 12.90 *per cent*) were finalised through open tender. 13 cases ought to have been finalised through open tender, their value being more than ₹20 crore. PEM Noida, however, did open tendering in four cases.
- In HPEP Hyderabad, out of 80 purchase orders, only two orders (i.e., 2.50 *per cent*) were finalised through open tender. No open tendering was resorted to in 20 POs which were over ₹20 crore each.

Management stated (February 2017) that BHEL does not float open tender for every requirement since the vendor registration process was open throughout the year. All vendors get an opportunity to get inducted into the PMD and thereby supply to BHEL. Ministry added (May 2017) that Units/Regions were being advised to mandatorily include requirement of registration of new suppliers in all press advertisement for open tenders.

The reply does not address non-compliance to the procurement policy of the Company.

6.10 Supplier/Vendor evaluation

As per Supplier Evaluation, Approval and Review Procedure (SEARP), supplier performance was to be assessed by taking into account quality (weightage: 60), delivery (weightage: 30) and service (weightage: 10) for each consignment/purchase order. If the score of a vendor is less than 60, business dealings with that supplier will be suspended. Audit reviewed the supplier performance system and the observations are discussed below:

6.10.1 PEM Noida:

- The sample of 155 POs selected for audit included 98 POs for Bought out Items (BOI) and 57 POs for Balance of Plants (BOPs). While execution of BOI packages was done through PEM, execution of BOP packages was done through Power Sector Regional Offices. Audit observed that PEM evaluated performance of BOI vendors and score obtained by the suppliers were used for deciding on future awarding. However, similar system was not found in place for evaluation of BOP vendors.

- Out 98 BOI packages awarded by PEM Noida, 80 packages were completed by 31 March 2016. 31 out of these 80 packages were completed with delays ranging from one to 59 months. However, poor delivery rating[37] in case of these vendors did not impact their suitability for further awarding as minimum score required (60 marks) for award consideration was met through 'Quality' parameter only.

Accepting the observation, Management stated (February 2017) that issues regarding weight of quality, delivery and service parameters were under review for improvement. Management also stated (March 2017) that a task force has been constituted to formulate processes for performance evaluation of BOP vendors. Ministry did not offer any comments.

Audit appreciates the corrective measure proposed by the Management.

6.10.2 Trichy unit:

During 2011-12 to 2015-16, Trichy unit placed 28755 POs on 1130 vendors. Review of Vendor Performance Rating (VPR) revealed that in 110 POs awarded to 68 vendors, the vendors had VPR of less than 60 *per cent*. However, 57 of these 68 vendors were not suspended from future award of purchase orders. Though the Trichy unit is on SAP, necessary control parameters to block the vendors with poor performance and prohibiting further awards to them were not in place.

Management stated (December 2016) that VPR was calculated annually for purchases made in the preceding year and not PO-wise as analysed by Audit. The Supplier Development Cell would initiate suitable provision in SAP module to block vendors with less than 60 *per cent* score from getting further POs. Management further stated (February 2017) that all vendors with less than 60 *per cent* rating (for the years prior to 2015-16) have since been weeded out.

Audit appreciates the corrective action taken by the management.

[37] ***0-5 in three cases, 5-10 in four cases, 10-15 in two cases, 15-20 in eight cases and 20-30 in 13 cases***

Chapter VII Management of Receivables

Management of receivables or debtor management is required to ensure collection of money when it is due. Good debtor management is essential to maintain healthy cash flow on one hand and avoid bad debts on the other.

7.1 Billing and cash collection system

Contracts entered into by BHEL generally provided terms of payment as under:

- 5 to 20 *per cent* of ex-works price component as initial advance on award of contract;
- 60 to 65 *per cent* of ex-works price on dispatch of material and on submission of dispatch documents, Test Certificates and Material Dispatch Clearance Certificates (MDCC) issued by customer;
- 15 to 20 *per cent* of ex-works price on receipt of material at site and on submission of Material Receipt Certificate (MRC) issued by the customer;
- 2.5 to 5 *per cent* of ex-works price on successful commissioning of the facility and on submission of trial operation protocol issued by customer; and
- 2.5 to 5 *per cent* of ex-works price on successful completion of Performance Guarantee (PG) tests and on submission of final PG test report approved by customer.

In some contracts, instead of payments against dispatch and MRC, activity-wise milestone payments were specified.

Accounting of revenue was done using percentage completion method. Under this method, revenue is recognised as the contract activity progresses based on the stage of completion reached. The costs incurred in reaching the stage of completion are matched with this revenue, resulting in the reporting of results which can be attributed to the proportion of work completed. Customers, however, are billed as per terms of contract which could be different from the revenue accounted. The difference is recognized in accounts as 'Valuation Adjustment[38].

Manufacturing units of BHEL raise invoices as per billing schedule approved by customers. Manufacturing units follow up for payment and realisation of sales proceeds. While outstanding invoices against progressive payments are pursued by units, deferred bills and issues relating to liquidated damages are pursued by Business Sectors.

Receivables from customers, on a specified date, include

(i) Collectible dues,

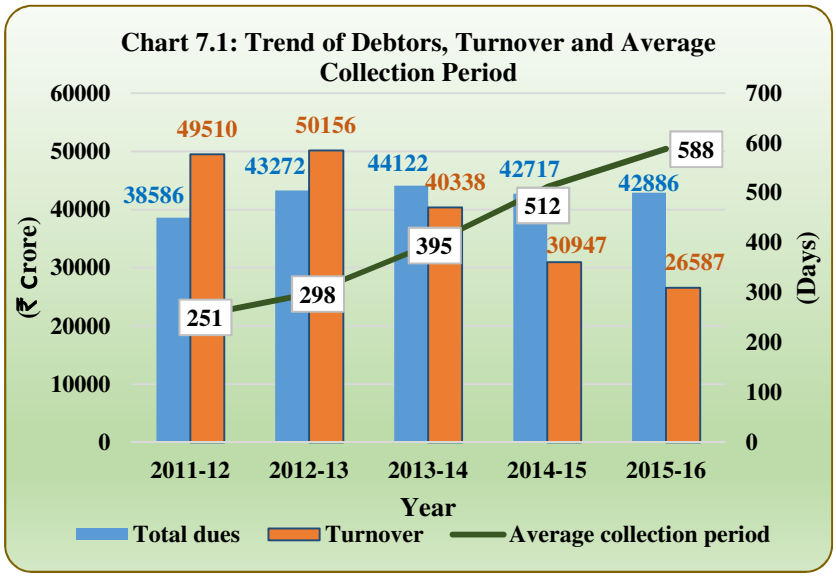
(ii) Deferred dues[39],

(iii) Accrued revenue[40].

[38] ***The difference between the billed value and intrinsic value of dispatches is booked as valuation adjustment***
[39] ***Consisting of MRC, milestone and final payments***
[40] ***Comprising of Goods Dispatched Pending Billing (GDPB), Price Variation Claim (PVC) and Valuation Adjustment***

7.2 Debtors position in BHEL

The trend of turnover and average collection period (for collectibles, deferred and accrued dues) at year end for the period 2011-16 is depicted in the chart alongside. The average collection period increased steadily from 251 days in 2011-12 to 588 days in 2015-16. As a result, outstanding amounts increased from ₹38586 crore to ₹42886 crore despite turnover dropping by 46.30 *per cent* during this period (2011-16).



Management stated (February 2017) that efforts were being made to realise the dues from customers and that specific focus groups like Project Closure Synergy Group (PCSG), Contract Closing Group (CCG) have been formed to address all the issues in holistic manner for realisation of dues. Post exit conference, Management added (June 2017) that total debtors as on 31 March 2016 included ₹20750 crore (around 48 *per cent*) towards deferred debts and others, which were not due for payment and hence not billed to customers. While assuring that regular actions were being taken to improve realisation of debtors, Management informed that the average collection has reduced by 57 days to 531 days in 2016-17.

7.3 Age-wise analysis of collectible dues

Age-wise analysis of collectible dues of BHEL during five years ending 31 March 2016 was as under:

Table 7.1: Age-wise analysis of collectible dues at the end of 2012-13 to 2015-16

(₹in crore)

Description	2012-13	2013-14	2014-15	2015-16
Less than 1 year	14229	11385	10454	8348
More than 1 year but less than 2 years	3987	4359	2964	3176
More than 2 years but less than 3 years	1421	3445	2808	2273
More than 3 years	2659	3617	5920	8132
Total	**22296**	**22806**	**22146**	**21929**
Turnover	**50156**	**40338**	**30947**	**26587**

Audit noticed that:

- Collectible debts outstanding under highest age slab, i.e., outstanding for more than three years, increased steadily over the period covered under performance audit. These debts, as a percentage of total collectible debts, increased from 11.93 *per cent* in 2012-13 to 37.08 *per cent* in 2015-16.

- While the turnover of the Company decreased by 46.99 *per cent* during 2012-13 to 2015-16, the collectible debt remained almost at the same level. This indicates that debt realisation was not effective.
- Average collection period of collectible dues has doubled during the period 2012-13 to 2015-16, from 155 days in 2012-13 to 303 days in 2015-16.

Ministry stated (May 2017) that the dues of ₹8132 crore pertaining to more than three years were the amounts withheld by customers towards LD and other reasons and the amount held up in projects on-hold. The amount withheld towards LD would be liquidated at completion of the project on detailed analysis of reasons of delays. Further, the amount outstanding for more than three years has been reduced to ₹7358 crore as on 31 March 2017. Two projects, *viz.*, Ennore and Bhadradri, where total dues of ₹425 crore approximately were outstanding have also been revived.

However, the dues for more than three years as on 31 March 2017 were still almost three times of dues outstanding in the same category as on 31 March 2013. There were significant increases due to supply of equipment to private developers without establishment of Letter of Credit, their subsequent failure to make payment eventually leading to these projects becoming 'on-hold' and non-completion of pending punch points/balance works even after performance guarantee test of projects which could have been controlled by BHEL.

7.4 Analysis of debtor management

Audit analysed debtor management system in BHEL and observations in this regard are discussed in succeeding paragraphs.

7.4.1 Supply of material to private parties without establishment of Letter of Credit

During 2007-11, PS-Marketing secured orders from private developers to commission 6850 MW capacity under eight (seven thermal and one hydro) power projects[41]. Subsequently, these projects were put on-hold between April 2011 and July 2013 by BHEL. From review of records audit noticed that:

(i) Contracts entered into by BHEL with private project developers provided that payments shall be released to BHEL through Letter of Credit (LC). It was, however, observed that BHEL did not ensure compliance of this contract provision and not only started supplies without establishment of LC, but also continued supplying material even after recurrent failures of private developers.

(ii) BHEL dispatched material even in cases where customers had not opened LC. Some instances noticed by Audit are detailed below:

- Monnet Power Company Limited (MPCL), in its reference dated 02.9.2013, stated that in violation of the contract, BHEL supplied material worth ₹133 crore in March 2013, which was not in sequential order and also without the establishment of irrevocable LC, though the same was essential for the lender to satisfy himself that the supplies made were as per project requirement and in sequential manner.

[41] ***(i) 2x525 MW Malibrahmani TPS, (ii) 2x210 MWRaichur TPS/Surana Power Ltd., (iii) 2x600 MW Raigarh Project/Visa Power Ltd., (iv) 5x270 MW Nasik Phase-II/ RattanIndia Power Ltd., (v) 5x270 MW Amravati Phase-II/ RattanIndia Power Ltd., (vi) 2x270 MW Chandwa Phase-I/Abhijeet Infra Pvt. Ltd., (vii) 2x270 MW Chandwa Phase-II/Abhijeet Infra Pvt. Ltd, (viii) 10x40 MW SMHPCL Maheshwar HEP***

- In case of Nasik Phase II and Amravati Phase II projects, customer {M/s Indiabulls Power Limited (IPL)} informed (17.6.2011) BHEL that though financial closure for the project had been completed, due to need for completing some more formalities, establishment of LC would not be feasible by end September 2011 and, therefore, proposed to make payment by cheque against proforma invoices on readiness of materials till end of September 2011. BHEL accepted the proposal of M/s IPL and continued supplies without insisting for opening LC even after September 2011. However, M/s IPL did not release payment against proforma invoice and outstanding dues mounted to ₹90.3 crore up to 15.11.2011. As BHEL continued supplies without ensuring payments, outstanding dues rose to ₹160 crore by 03.1.2012 and further to ₹230 crore by 06.2.2012.

(iii) Due to supply of material without establishment of LC and subsequent declaration of projects 'on-hold', outstanding dues of BHEL accumulated to ₹2660.77 crore (31 March 2016). Besides, inventory relating to these projects amounting to ₹458.51 crore has been lying at different BHEL units. Interest loss to BHEL due to blockage of funds in outstanding dues and inventory amounted to ₹1099.56 crore[42] up to October 2016.

Ministry stated (May 2017) that as the customer had paid advance and payment were being released regularly, supplies in some cases were made without LC. Moreover, LC provisions, wherever available, were for dispatch payments only and payments towards milestones, price variation, taxes and duties were generally direct payments. The projects were put on-hold due to unforeseen events. Due care of such eventualities were being taken and guidelines in this regard have been issued. Further, out of ₹ 2661 crore outstanding, there was unadjusted advance and valuation adjustment (credit) of ₹1339 crore.

BHEL supplied materials without opening LC as envisaged in the contracts/work orders, despite the fact that the Board Level Audit Committee of the company, while considering an Audit Paragraph (paragraph 11.1.1 of CAG's Report No.11 of 2008), recommended (July 2008) that, as a normal practice, payment against dispatches for private customers should be against LC or payment in advance, prior to dispatch. In some projects, nearly entire amounts were tied up with LCs, examples being the Chandwa project (Phase I & II) where all payments except initial advance were to be made through LC or in Maheswhar and Monnet Power projects, where direct payment option was available only at the stage of commission to the extent of 5 to 10 per cent.

7.4.2 Acceptance of zero date before receipt of initial advance

M/s DB (Power) MP Limited (DBMPL) awarded (27.06.2011) work of 2x660 MW power project in Singrauli District in Madhya Pradesh to BHEL at a cost of ₹3631.50 crore. As per terms of Letter of Award, (LOA), BHEL agreed for zero date to be the date of receipt of first instalment of initial advance of ₹50 crore. BHEL received the advance on 29.9.2011 which was treated as the zero date. Audit noticed that as per circular issued (20.10.2008) by Corporate Finance, at least 10 *per cent* advance should be obtained before agreeing for zero date. In the instant contract, BHEL agreed for zero date on receipt of ₹50 crore, which worked out to 1.38 *per cent* of order value. BHEL was to receive the remaining 10 *per cent* advance progressively by 28.03.2012 which was not received. The project was put on hold in November 2012 due to non-receipt of coal linkage and environmental clearance besides financial constraints. By that time, an inventory worth ₹66.82 crore was created

[42] ***Worked out based on minimum SBI base rate, i.e., 8.50 per cent since the date of putting the projects 'on-hold'***

against this project, which could not be dispatched. Thus, reckoning of zero date in violation of internal guidelines resulted in avoidable creation of inventory against which BHEL did not hold adequate advance.

Management/ Ministry stated (February/ May 2017) that availability of Fuel Supply Agreement (FSA) and environmental clearance were not prerequisites for the commencement of project activities by BHEL and the same were generally obtained/ tied-up by the developer during the course of the project execution. Further, these agreements/clearances were under various intermediate stages of approval and hence was not a pre-condition for order booking.

The reply is not acceptable. In the instant case, zero date was reckoned before receipt of 10 per cent initial advance which proved detrimental to BHEL's own interests.

7.4.3 Non-compliance to contract provisions regarding MDCC while dispatching material

Contracts entered into by BHEL provided for payment of 60 *per cent* of ex-works component of the contract price for each identified equipment upon dispatch of equipment from manufacturer's works on pro-rata basis on production of invoices and satisfactory evidence of shipment, including Material Dispatch Clearance Certificate (MDCC) issued by the Employer's representative. However, Trichy unit did not comply with above at the time of dispatch of material, which consequently affected realisation of bills in the following cases.

Table 7.2: Cases where MDCC was not obtained (Trichy unit)

Name of Project	Audit observation
Bongaigaon 1-3 (SG)	Trichy unit dispatched material and billed ₹1.11 crore during March 2009 to December 2010, but payment was pending for want of MDCC.
2x800 MW Darlipali	Between October 2015 and March 2016, Trichy unit dispatched goods worth ₹127.96 crore, which, however could not be billed for want of MDCC from customers.
1x500 MW Unchahar TPP Stage-IV	
2x800 MW Gadarwara STPP	
1x800 MW Kothagudem TPS	
3x660 MW North Karanpura STPP	
3x660 MW Nabinagar STPP	
NBPPL	
3x660 MW Barh-I	
1x500 MW Unchahar TPP Stage-IV	Trichy unit dispatched goods worth ₹3.32 crores but could not bill even after 180 days for want of MDCC from customer; and turnover was reversed in the books of accounts.
3x660 MW Nabinagar SG Package	
2x800 MW Darlipali SG Package	
2x800 MW Gadarwara SG Package	

Management stated (February 2017) that to avoid any difficulty in raising the bills, it has been decided not to dispatch any material without MDCC, wherever MDCC was required as per contract. Ministry did not offer any comment.

7.4.4 Dispatch/procurement of material after putting projects 'on-hold'

Whenever any project was put on hold, Business Sector concerned instructed units not to undertake any work relating to such projects after the date of hold; and resumption of activities should take place only after intimation from the Business Sector. However, it was noticed that units of BHEL placed purchase orders, received and/or dispatched material in contravention to the said instructions.

7.4.4.1 Material dispatched to projects

BHEL secured an order for construction of 4 x 270 MW Bhadradri TPS for Telangana State Generation Corporation (TSGENCO) on 21.3.2015 at a cost of ₹5044 crore. Audit noticed that subsequent to an order (12.12.2015) of Hon'ble National Green Tribunal (NGT) stopping all the works of the project till environmental clearance for the project was obtained, TSGENCO informed (14.12.2015) BHEL to stop all the works immediately till further instructions. Accordingly, Power Sector-Marketing instructed (14.1.2016) all the units concerned to put the project 'on-hold'. However, BHEL units continued with the manufacturing activities and incurred expenditure ₹209 core against this project between January 2016 and March 2017.

Management stated (February 2017) that NGT's order putting the project on hold was dated 12.12.2015 and the same was given to BHEL by customer on 11.01.2016. Immediately on receiving customer letter, BHEL imposed hold on this project. All steps were taken to stop dispatches as soon as hold was imposed by Business Sector and communication time was being minimized through system improvements. Ministry added (May 2017) that environmental clearance was received and TSGENCO has given clearance to restart the work (March 2017).

Even considering that the order was communicated to BHEL only in January 2016, the reply does not explain continuation of manufacturing and dispatch against the project till March 2017.

7.4.4.2 Placement of purchase orders against on-hold projects

Bhopal unit placed eight purchase orders (POs) valuing ₹8.81 crore in respect of five 'on-hold' projects after these projects were put on hold. Similarly, Hyderabad unit issued 203 POs valuing ₹10.87 crore, in respect of 12 projects which were put 'on hold'. Audit also observed that unit managements failed to implement the decision (21.1.2013) of the Management Committee to build a 'lock' into the system for raising of indents and placement of POs against 'on hold' projects as BHEL units continued the practice even after January 2013.

Management explained (February 2017) that orders have been issued after the Business Sector advice as order placed was common for multiple projects or there was gap in business sector communication in reaching the concerned purchase officer. However, in order to avoid any such eventuality in future, system based implementation of advice for 'hold' was being implemented. Ministry did not offer any comment.

7.4.5 Delay in completion of Performance Guarantee tests and pending punch points

Orders secured by BHEL for execution of power projects provide for release of last 5 to 10 *per cent* of contract amount upon successful completion of Performance Guarantee (PG) tests. It was, therefore, important that BHEL conduct PG tests immediately after commissioning. It was, however, noticed in audit that:

(i) Out of 52[43] units of 29 thermal power projects commissioned during performance audit period, PG tests of only 18 units were completed by July 2016. PG tests of these 18 units were completed 7 to 50 months after commissioning.

(ii) PG tests in respect of 34 units were yet to be completed though 2 to 70 months had elapsed (up to July 2016) since their commissioning.

[43] ***Except Harduaganj unit #8&9, the details of conducting PG tests of which were not furnished to audit, though management stated in its reply (February 2017) that PG test was conducted on unit #8***

(iii) PG test reports in respect of seven units of five projects were under approval with customers at the end of July 2016, though more than six months have elapsed since conducting of these tests. PG test report of Lakwa proejct had been under approval with customer since October 2012 because of shortfall in Boiler and Turbine Generator output. Customer's approval of PG test reports in respect of Parichha project were also pending for more than three years.

(iv) As a matter of prudence, all applicable PG tests {i.e., PG tests of Boiler, Turbine Generator (TG), Electro-Static Precipitator (ESP) and Mills}, should be conducted together. However, only in case of seven units, all PG tests were conducted within one months' time. In case of eleven units, time gap between PG tests conducted first and last ranged from 2 to 25 months. In eight out of these eleven cases, more time gap between first and last of the PG tests was due to delays in conducting PG tests of ESP.

(v) In 301st MC meeting held on 19 November 2012, Power Sector –Technical Services (PSTS) informed the Management that customers were not giving clearance for conducting PG tests unless issues of punch points were resolved. MC directed that all efforts should be made for resolution in order to complete PG test before commissioning. It was, however, observed that BHEL's record in clearing punch points was very poor. Contracts for execution of power projects provided for completion of facilities within three months of commissioning of last unit and in any case one year was more than sufficient for clearing punch points/pending works. However, punch points/pending works were not cleared by BHEL till 31 March 2016, even in respect of projects commissioned as back as in 2006-07. This shows that BHEL overemphasized commissioning of generating units (to achieve maximum capacity addition during a financial year) instead of project completion.

As a result, BHEL sustained interest loss on the amount held up in these projects. Loss of interest[44] on the outstanding dues as on 31 March 2016, which could not be realized on account of delay in completion of PG tests and clearing pending works/punch points in respect of commissioned projects selected for performance audit as well as the projects pending closure as on 31 March 2016 worked out to ₹1457.11 crore.

Management stated (February 2017) that for resolving the PG Tests issues, efforts had been synergized by formation of a group coordinated by PSTS[45] with representation from PS-Marketing, Project Management Group, all Regions and units. It was also pointed out that interest loss calculated by Audit was only notional as payments become due after completion of PG test. Management also stated that execution of PG test was beyond the control of BHEL as well as customer, as PG test require unit to be run at rated capacity of machine but the running of unit was guided by grid demand. Ministry added (May 2017) that besides non-availability of grid demand and punch points, PG test conductance was delayed due to other reasons attributable to customers like non-availability of plant shutdown, design coal/coal shortage, power evacuation problem etc.

However, PG tests in respect of 34 thermal units were yet to be completed though two to 70 months had elapsed (up to July 2016) since their commissioning. Had PG tests and punch points been completed within stipulated time, the outstanding amounts could have been realized. Audit also noted that a special task force was constituted for realization of dues. Delays in conducting PG tests up to 50 months cannot be solely due to non-availability of grid demand and other reasons.

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[44] Calculated at 8.50 per cent (minimum of SBI base rate prevailing during 2011-16). Period for interest calculation is worked out after allowing one year from project commissioning for clearing pending issues

[45] Power Sector Technical Service

7.4.6 Ineffective implementation of debtors monitoring mechanism

In order to ensure reduction in time to realize debts, Board Level Audit Committee (BLAC) of BHEL suggested (January 2012) a monitoring mechanism for debtors through an Apex Committee with Director (Finance) as Chairman and Executive Directors of business sectors as other members, to identify problems, lay down a clear time bound action plan and monitor progress on monthly basis. This Committee was to apprise the status to BLAC on quarterly basis. BLAC also suggested formulating detailed action plan (focusing on liquidation of top 10 debtors and non-moving debts in each unit) with assignment of clear responsibilities for collection of debts in respect of each project to a specified senior official. Unit-wise responsibility for collection of debts was also suggested to be fixed. The Apex Committee was constituted in March 2012 (from August 2013, the Committee was renamed as 'Cash Collection Review Meetings'). The following shortcomings in implementation of debtor monitoring mechanism were noticed:

(i) Against requirement of apprising status of sundry debtors to BLAC ***on quarterly basis***, during the 16 quarters from April 2012 (when first meeting of Apex Committee held), up to March 2016, status of Sundry Debtors was submitted to BLAC five times[46] only.

(ii) From September 2012 to July 2013, no record notes of debtors' review were furnished to Audit. After the Cash Collection Review Meeting in August 2013, these meetings were not held for 17 months between September 2013 and January 2016[47].

(iii) Based on information made available, a comparison of cash collection targets and achievement for seven months in 2013-14 and eleven months each in 2014-15 and 2015-16 was made. It was noticed that Power Sector could not achieve cash collection target in any of these 29 months and monthly shortfall ranged between 27 to 75 *per cent*. Industry Sector also did not achieve the monthly targets except one month in 2013-14, while other sectors (other than Power and Industry sectors) achieved targets in five out of 29 months. As such, overall cash collection targets could also not be achieved in any of the months and actual overall collection fell short of targets by 30 to 64 *per cent*.

(iv) In 3rd meeting of Apex Committee held on 04.08.2012, business sectors agreed to work on a focused plan during the year for liquidation of dues against 22 old projects. Business sectors also stated that they would submit their plan for liquidation within one month. However, no action plan was formulated /implemented. Outstanding dues in respect of 17 out of 22 old projects amounting to ₹515 crore out of ₹ 1227 crore (after adjusting ₹248 crore towards LD written off against one project) were yet to be realised (31 March 2016).

Ministry stated (May 2017) that presentation on debtors was given to BLAC periodically. Meeting of cash collection with business sectors was held every month, however, the practice of preparing formal record notes of the meeting was in place at present. Stretched targets were given to business sectors for maximizing cash collection and the old outstanding debtors of 22 projects reduced from ₹1404 crore as on 31.03.2012 to ₹481 crore as on 28.02.2017. Significant part of these amounts were towards withheld amount by customers for various reasons including LD. The liquidation in case of old dues was slow.

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[46] ***Once each in 2012-13, 2014-15 and 2015-16 and twice in 2013-14***

[47] ***September 2013, December 2013 to May 2014, July 2014, February 2015, April 2015 to June 2015, August 2015, and October 2015 to January 2016***

The reply, however, has to be viewed against the fact that the reduction of outstanding debts to ₹ 481 crore was not purely on realisation of debts from customers, but also due to write off of ₹ 378 crore. In fact, only ₹ 545 crore (38.82 per cent) from ₹1404 crore could be realised during the last five years.

7.4.7 Violation of guidelines on 'Conversion of collectible dues to withheld dues'

For guidance of units and business sectors, Apex Committee on Debtors approved (August 2012) guidelines on conversion of collectible dues to withheld dues[48]. These guidelines aimed to address:

- Reasons for conversion of collectible dues to withheld dues;
- Approval of conversion of collectible dues to withheld dues;
- Regular review of withheld dues; and
- Timely action on liquidation.

To achieve the above aims, the guidelines provided that collectible dues should be converted to withheld dues after approval from the business sector, so that business sectors could monitor taking of timely action and coordinate with customers for liquidation of withheld dues.

The following table indicates the turnover, collectible dues and withheld dues during 2012-13 to 2015-16:

Table 7.3: Year-wise details of turnover, collectible dues and withheld dues

Year	Turnover	Collectible dues at year end	Withheld dues at year end	Percentage of withheld dues to collectible dues
	(₹crore)			
2012-13	50156	22296	4960	22.25
2013-14	40338	22806	5637	24.72
2014-15	30947	22146	6031	27.23
2015-16	26587	21929	7170	32.70

From the above, it is noticed that:

(i) While the collectible dues remained at same level during 2012-13 to 2015-16, withheld dues increased from ₹4960 crore in 2012-13 to ₹7170 crore in 2015-16 and registered an increase of 44.56 *per cent*.

(ii) PS-Marketing, which contributed 76.46 *per cent* to 80.53 *per cent* of annual turnover during 2011-12 to 2015-16, did not approve any case for conversion of collectible dues to withheld dues till March 2016. It was informed (September 2016) that no regular requests were received for conversion of collectible dues to withheld dues from the units concerned.

(iii) As per guidelines, unit heads were required to send a quarterly review report on withheld dues indicating action taken for liquidation of withheld dues and action plan for future to the Corporate Debtor Group for review and submission to Apex Committee. Audit, however, observed that project-wise details of withheld dues were submitted before Cash Collection Review Meetings held on 11.11.2013, 04.6.2014, 04.8.2014 and 03.12.2014 only, that too without indication of action taken for liquidation of withheld dues and action plan for future as required.

[48] ***Amounts withheld by customers on account of LD for performance, LD for delay, disallowance of ED/Service Tax/CST/VAT/CD, PVC/ERV claims, payment held up for pending punch points/contract reconciliation, payment held up for shortages/damages/rejection, extra claims disallowed etc.***

(iv) Action plans for liquidation of withheld dues were not submitted to Cash Collection Review Meetings even after its specific instruction to this effect in the meeting held on 04.8.2014.

Management noted the audit observation and stated (February 2017) that as in case of 'withheld towards LD', other outstanding payment shall also be classified as 'withheld dues' on the advice of Business Sector in case of composite projects. Report on project level withheld dues along with major reasons for withheld was sent by units on monthly basis. Due to large number of projects and several units involved, the said report was uploaded by units in the system. Ministry added (May 2017) that all units and Business Sectors have been again intimated to comply the guidelines of withheld dues as advised by Apex Committee for classification of withheld dues and for review and submission of report.

7.4.8 Ineffective functioning of task forces for realisation of dues

For quick realisation of outstanding dues from State Electricity Boards (SEBs), State-wise GM level Task Forces were constituted (17.8.2013) with representatives from Contract Closing Group (CCG), Project Management Group (PMG), Corporate Debtors Group and Power Sector-Marketing. Task Forces identified 45 projects comprising 16 on-going projects and 29 projects where trial operation had been completed. The Task Forces fixed (February 2014) target for completing pending works on the projects, where trial operation had been completed, between March 2014 and December 2014 and to realise the outstanding dues ₹2604.45 crore pending against these 29 projects by December 2014.

Audit, however, noticed that the Task Forces could not liquidate dues within the target dates and ₹2388.10 crore (*91.69 per cent of outstanding dues as on 01 February 2014*) were still (31 March 2016) outstanding. It was also observed that though task forces notified pending works in projects to units concerned and received their commitments to complete such pending works as per target dates, completion of pending works by the units were not monitored. Further, the non-fulfilment of targets by the units along with reasons and fixing responsibility for such slippages was not taken up with MC by the Task Forces.

Management stated (February 2017) that in line with the MC discussion, coordinated efforts were made by PS-Marketing, PMG and CCG for liquidation of dues. In order to give further thrust to contract closing activities and liquidation of outstanding, Project Closure Synergy Group (PCSG) has been formed. Ministry added (May 2017) that the issues and agencies responsible for non-achievement of target were identified and discussed in MC meetings. The realisation takes time as significant amount of dues were withheld pending completion of delay analysis and waiver of contractual LD. As a result of continuous effort, during current year, around ₹500 crore was realised from SEBs.

7.4.9 Delayed raising of invoices

Considering the financial implications involved, invoices should be raised promptly when they become due as per contract. Any delay in billing would result in delay in realisation. Generally billing (invoicing) was done in the same month of dispatch. However, audit noticed substantial delays in raising invoices to customers as discussed in ensuing paragraphs.

7.4.9.1 In the ten projects reviewed in the audit sample, Ranipet unit raised invoices for ₹ 1882 crore. Of this, invoices worth ₹ 540.10 crore (28.70 *per cent*) were raised after 30 days of dispatch of materials. Audit noticed that non-receipt of documents like Lorry Receipt copy, Material Dispatch Clearance Certificate (MDCC) etc. were the main reasons for delayed billing.

Management stated (December 2016/ February 2017) that earlier there was considerable delay in raising invoices, but presently billing delay has been reduced for current projects through measures like review of GDPB (goods dispatched pending billing) done every week and invoices were raised weekly, centralised documents receipt and monitoring, and obtaining of MDCC on dispatch. Ministry added (May 2017) that generally invoices were raised within one month of dispatch and billing delay observed were stray cases due to non-receipt of documents.

Audit notes the corrective action/ proposed action. Delays in invoicing were noticed in 7 out of 10 projects, quantum of delayed invoices to the total invoices raised being in the range of 12.39 per cent to 78.08 per cent cannot be treated as stray cases.

7.4.9.2 Trichy unit raised invoices in respect of 48921 deliveries valuing ₹2617.78 crore with a delay of more than 30 days. Maximum delay noticed was of 1774 days.

Management stated (February 2017) that 85 *per cent* billing was done within first month of dispatch, despite some perennial issues like obtaining MDCC, Billing Break-Up approval etc., which led to delay in other cases. Ministry added (May 2017) that such cases were hardly one per cent of total billing towards specific issues varying from project to projects. However, efforts were continuously on to reduce such delays and the views expressed by Audit were taken for improvement.

7.4.10 Price Variation as per contractual terms not claimed

Uttar Pradhesh Rajya Vidyut Utpadan Nigam Limited (UPRVUNL) placed (April 2008) order for 2x500 MW Anpara-D project on BHEL. As per the contract, in case of any variation in the import component on account of exchange rate variation (ERV), UPRVUNL would be liable for upward variation up to 5 *per cent* and downward variation up to 10 *per cent*. Variation in foreign exchange and corresponding custom duty (CD) variation was to be computed as per prescribed formula and billing was to be done 18 months after zero date (12.01.2008) in one lot. However, the same was not claimed by Trichy Unit even after lapse of seven years.

Management stated (February 2017) that ERV and CD claims were slightly complicated and the customers do not admit the claims readily. The requirement of documents vary from customer to customer. Hence, provisional claim was raised. In this case, the provisional claim submitted was not accepted by customer. As per advice of PS-Marketing, this would be taken up during final reconciliation and a commercial settlement would be reached. Ministry added (May 2017) that efforts were always made by BHEL to settle the claims as and when they were raised. However, often the customer consolidate issues and take up the same at the end of the contract.

However, price variation billing was not done as per contractual provisions. Interpretation of contractual provisions and/or requirement of specific documents, if any, should have been settled at the time of finalisation of contract. Keeping settlement of price variation bills pending till contract closure could weaken the possibility of their realisation.

7.4.11 Supply beyond contractual scope

Ranipet unit dispatched material valuing ₹22.65 crore to 11 projects[49] as supplies beyond scope of contract. Trichy unit also dispatched 1184 items in 22 boilers at a cost of ₹23.44 crore, but did not raise invoices for the same on the customer.

Management stated (February 2017) that in respect of material dispatched from Ranipet unit, efforts were on for collection of outstanding dues from customer. In case of Trichy unit, Management stated that in line with Audit views, value of such items was now being included in the regular billing break-up approval process. Ministry did not offer any comment.

[49] ***Bellary 3 (₹2.54 crore), NTPC Solapur ESP package (₹0.30 crore), Shree Singaji (₹4.64 crore), HNPCL-Vizag (₹4.29 crore), Vallur (₹0.24 crore), Anpara-D (₹6.28 crore), Koderma (₹1.65 crore), GGSR-Bhatinda (₹0.08 crore), MPPGCL Satpura-10 (₹0.60 crore), Santaldih-6 (₹0.58 crore) and Hindalco (₹1.45 crore)***

Chapter VIII Conclusion and Recommendations

8.1 Conclusion

8.1.1 BHEL, India's largest engineering and manufacturing company, is engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for power and other core sectors of the economy. While preparing its strategic plan for the period 2012-17, BHEL had assessed (November 2011) that there would be a definite change in its business environment. BHEL acknowledged that the past decade ending 2010 had introduced challenges in the form of climate change; increase in intensity of competition with emergence of new competitors; and squeezed delivery schedules. Recognising the challenges in the business environment, BHEL had fixed Strategic Plan targets for the period 2012-17 with a focus on diversification and innovation. The challenge before BHEL was not only to safeguard its core business, but also to focus on diversified areas like defence, solar, wind and water businesses and also involve R&D to attempt breakthrough developments. Audit noticed that the efforts for diversification and innovation were inadequate and BHEL could not make headway in any of the identified areas; - bridging technological gap in the core power sector, renovation and modernisation, Indian Railway projects, solar energy etc. Research and Development initiatives also did not bring significant results. In the core power sector, an initiative towards development of Advanced Ultra Supercritical Technology for enhancing the plant efficiency and reducing coal consumption and CO_2 emission did not achieve the desired outcome due to considerable delay in approval of the project.

8.1.2 Competitiveness of BHEL in core business area has been an area of concern as its success rate against competitors declined from 80.44 *per cent* in 2013-14 to 43.95 *per cent* in 2014-15 and to zero *per cent* in 2015-16. Lost tender analysis in audit revealed that the most significant reasons for losing tenders were pricing and technical/ commercial loadings, which together account for 85.29 *per cent* orders (in terms of value) that were lost. Costing information used by manufacturing units/regional officers of BHEL for bidding was not reflective of the actual position. In fact, the price quoted by BHEL in lost tenders could have been further rationalised, which in turn could have enhanced competitiveness. Audit noticed that market level prices, though intimated to the manufacturing units were not used at the time of cost estimation.

8.1.3 Considerable delays were noticed in execution of both ongoing and commissioned projects. In the case of commissioned projects, customers withheld ₹1966.07 crore towards liquidated damages in 37 out of 53 projects selected. BHEL had traditionally scored over its competitors on quality. However, Audit observed quality/ workmanship issues at all stages of project execution - manufacturing, commissioning and operational stage. Trichy and Haridwar units incurred ₹138.44 crore towards re-work in the sample projects selected for review by Audit. BHEL could not achieve the e-Procurement targets and failed to expand its vendor base. Purchases against indents raised were delayed as were awards of balance of plants packages.

8.1.4 Management of receivables is required to maintain healthy cash flow on one hand and avoid bad debts on the other. Audit, however, noticed that BHEL's performance in this regard was not impressive. The average collection period (for collectibles, deferred and accrued dues) increased steadily from 251 days in 2011-12 to 588 days in 2015-16. As a result, outstanding amounts increased from ₹38586 crore to ₹42886 crore even as the turnover dipped by 46.30 *per cent* during this period (2011-16). Collectible debts that remained outstanding for more than three years increased steadily over the period covered under performance audit indicating that debt realization was not effective.

8.1.5 Analysis of receivables management further revealed that due to supply of material to projects of private developers without establishment of LC and subsequent declaration of projects 'on-hold', outstanding dues of BHEL against such projects accumulated to ₹2660.77 crore while inventory of ₹458.51 crore remained at different BHEL units. Interest loss to BHEL due to blockage of funds in outstanding dues and inventory amounted to ₹1099.56 crore up to October 2016. Audit noticed that in some cases where the projects were put 'on-hold', manufacturing units of BHEL continued with procurement of material, manufacture and supply of equipment to these projects. Audit noticed that there were considerable delays in completion of performance guarantee tests and pending punch points of commissioned projects. Out of 52 units of thermal power projects commissioned during the period covered in performance audit, performance guarantee test of 18 units were completed with a delay up to 50 months. Performance guarantee tests in respect of 34 thermal units were yet to be completed though two to 70 months had elapsed (up to July 2016) since their commissioning.

8.1.6 Audit also noticed ineffective monitoring of receivables management. Outstanding dues in 17 old projects amounting to ₹515 crore were yet to be realised (31 March 2016). The state-wise Task Forces constituted for liquidating mounting receivables from State Electricity Boards could not liquidate dues within the target dates and ₹2388.10 crore (*91.69 per cent of outstanding dues as on 01 February 2014*) remained outstanding as on 31 March 2016.

8.2 Recommendations

(i) BHEL needs to develop its own products that excel over competitors through R&D initiatives. Expeditious efforts should be made to forge technological tie ups in new business areas.

(ii) 'One BHEL' ERP system should be implemented expeditiously for processes and systems improvement and better coordination between units of BHEL.

(iii) More orders need to be finalised by BHEL through open tender system. Purchase Indent to Purchase Order cycle time should be reduced to ensure competitive and timely procurement of inputs.

(iv) Action plans need to be developed and implemented by BHEL within stipulated timeframe to address its weak areas vis-à-vis competitors as identified during customer surveys and as per reports of task forces constituted in this regard;

(v) Quality controls at both BHEL manufacturing units and vendors' works may be made more effective to avoid failure of equipment during commissioning and warranty period.

(vi) To safeguard BHEL's financial interest, dispatches, particularly to private parties, should be made against establishment of Letter of Credit. Completion of Performance Guarantee tests immediately after commissioning and completion of balance punch points in a time bound manner in close coordination with customers needs to be ensured.

(vii) Revenue billing and debtor management systems need to be strengthened and made more effective to ensure timely billing and collection of revenue.

Ministry stated (May 2017) that recommendations of C&AG has been noted for necessary action.

(NAND KISHORE)
Deputy Comptroller and Auditor General
and Chairman, Audit Board

New Delhi
Date 10 July 2017

Countersigned

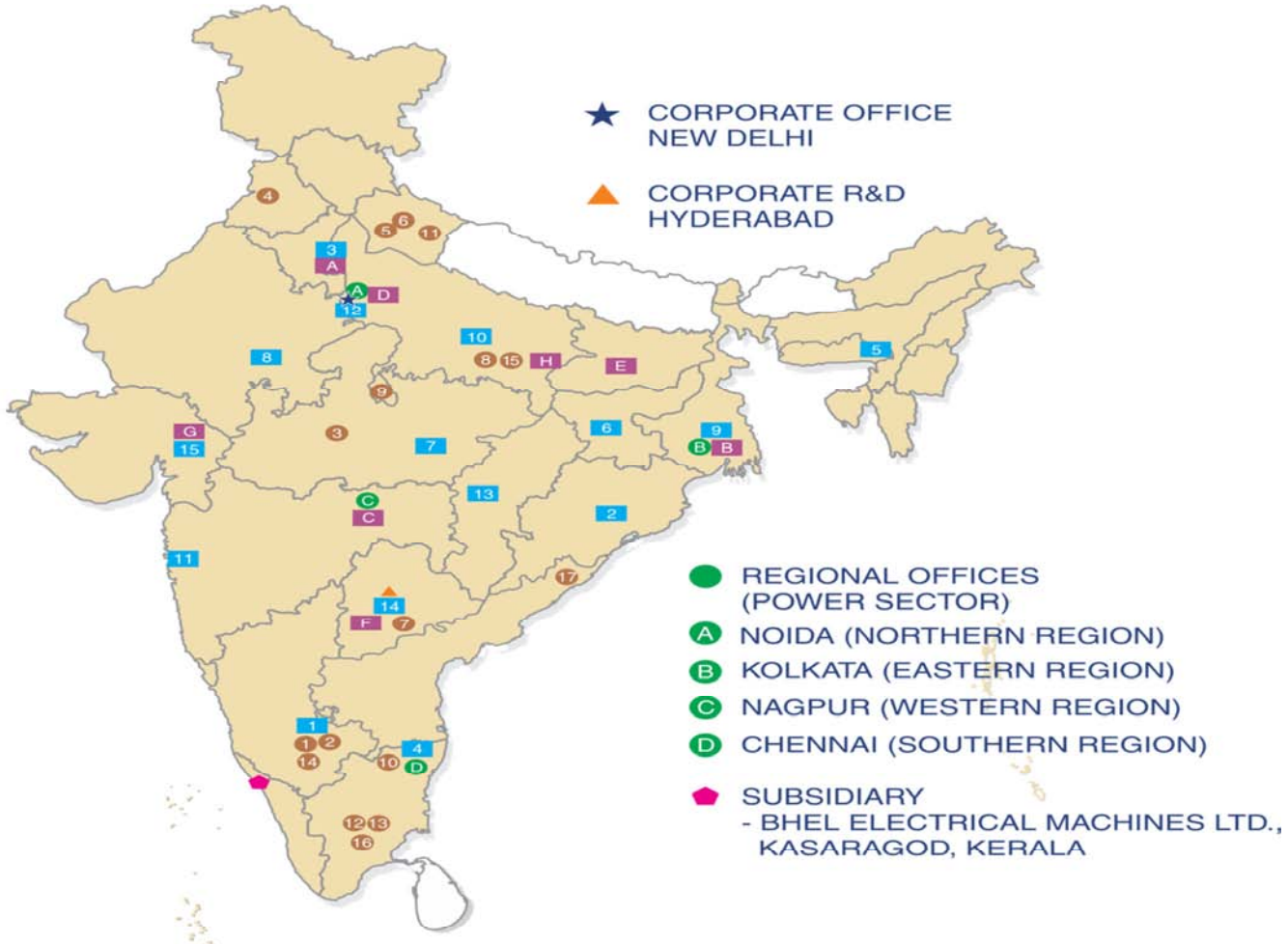
(SHASHI KANT SHARMA)
Comptroller and Auditor General of India

New Delhi
Date 11 July 2017

Annexures

Annexures

Annexure 1.1
(As referred to in paragraph 1.1)



BUSINESS OFFICES

1 BENGALURU
2 BHUBANESWAR
3 CHANDIGARH
4 CHENNAI
5 GUWAHATI
6 RANCHI
7 JABALPUR
8 JAIPUR
9 KOLKATA
10 LUCKNOW
11 MUMBAI
12 NEW DELHI
13 RAIPUR
14 SECUNDERABAD
15 VADODARA

MANUFACTURING UNITS

14 1 2 BENGALURU
3 BHOPAL
4 GOINDWAL
5 6 HARIDWAR
7 HYDERABAD
15 8 JAGDISHPUR
9 JHANSI
10 RANIPET
11 RUDRAPUR
12 13 TIRUCHIRAPPALLI
16 THIRUMAYAM
17 VISAKHAPATNAM

SERVICE CENTRES

A CHANDIGARH
B KOLKATA
C NAGPUR
D NOIDA
E PATNA
F SECUNDERABAD
G VADODARA
H VARANASI

Annexure 2.1
(As referred to in paragraph 2.2)

Brief profile of BHEL units selected for Performance Audit

Sl. No.	Name of Manufacturing Unit/Regional Office	Products/Activities
1	High Pressure Boiler Plant (HPBP), Trichy	Manufacturing of Boiler, Valves, Shoot Blowers and Seamless steel tubes.
2	Boiler Auxiliary Plant (BAP), Ranipet	Manufacturing of Boiler auxiliaries.
3	Heavy Power Equipment Plant (HPEP), Hyderabad	Manufacturing of Utility sets (60 MW), Small & Medium sets, Pumps & Heaters, Compressors, Gas Turbine, Bowl Mills, Heat Exchangers, Breakers, Oil Rigs.
4	Electronics Division (EDN), Bengaluru	Manufacturing of Control Equipment, Semi-Conductors, Power devices, Photovoltaic Cells & Modules and Defence Simulator Equipment.
5	Industrial Systems Group (ISG), Bengaluru	Execution of Coal Handling Plant, Ash Handling Plant, Raw material handling system.
6	Heavy Electrical Equipment Plant (HEEP), Haridwar	Electrical machines, Industrial control panels, Turbine Modules, Turbo generator modules, Hydro sets, Super Rapid Gun Mount, Gas turbine.
7	Central Foundry Forge Plant (CFFP), Haridwar	Steel casting, NF casting, Medium & heavy steel forging.
8	Heavy Equipment Plant (HEP), Bhopal	Switchgear, Control gear, Rectifier, Capacitors, Bushings, Power Transformers up to 400 kV, Reactors, Traction Motors for AC, DC & Diesel system, Large Electrical Machines, Water wheel alternators & water turbines & mini micro turbines and generators, Turbo Alternators & Steam turbines, Heat Exchangers.
9	Transformer Plant (TP), Jhansi	Power transformer and special transformers, ESP Transformer, AC EMU Transformer, Freight Loco transformers, Instrument transformers, Bus Duct, Dry type transformer, Diesel shunting locomotives, AC Loco.
10	Project Engineering Management (PEM), Noida.	Providing total engineering solutions for power projects as well as processing of LOI for non-BHEL systems & equipment, i.e. Balance of Plant items.
11	Power Sector Northern Region (PSNR)	Erection and commissioning of power projects in respective region of the country and/or power projects in other regions of the country or abroad as per allotment by Power Sector-Marketing Division of BHEL. Issue of Letter of Award and execution of BOP packages processed by PEM.
12	Power Sector Eastern Region (PSER)	
13	Power Sector Southern Region (PSSR)	
14	Power Sector Western Region (PSWR)	

Annexure-5.1
{As referred to in para 5.2.3}

List of lost tenders where Manufacturing Units failed to match market level prices indicated by IS-Marketing
(₹crore)

Sl. No.	Business Group	Description of work/order	Market price level indicated by IS- Marketing	Cost Estimates submitted by Manufacturing Units	Price quoted by L1 bidder
1	Captive Power Plant	1x35 MW STG Supply and E&C-Nirani Sugar	15 to 20	21.51	18.00
2	Captive Power Plant	1x16 MW STG Supply and E&C of -Anjani Cement	8	13.83	10.24
3	Captive Power Plant	1x20 MW STG Supply and supervision - GokulMauli	10 to 11	14.63	12.00
4	Captive Power Plant	1x12 MW STG Supply and E&C -Nirma Ltd.	26.56	32.42	22.00
5	Captive Power Plant	Supply and E&C of 1x14 MW STG-Nirma Ltd.	18.78	26	17
6	Captive Power Plant	1x33 MW STG Supply and supervision of E&C -Shamli Sugar	13.15	18.45	11.40
7	Renewable Energy and Water Group	91 MLD pre Treatment Plant- NTPC Tanda	28 to 29	48.65	31.34
8	Renewable Energy and Water Group	3 MLD RO based ETP-NTPC Jhanor	20 to 21	31.58	19.09

Annexure-5.2
{As referred to in para 5.2.3}

List of tenders lost in IS-Marketing due to techno-commercial reason

Sl. No.	Name of Business Sector & Business area	Description of work/order	Price offered by L1 bidder *(₹crore)* & name of L1 bidder	Reason for loss of tender
1	IS- CPP	1x16.5 MW STG supply and supervision MWV-RBY Mecon	16 (M/s Shin Nipon)	BHEL quoted for the duck size as 14.5-meter x 6.5 meter as against 13.5-meter x 5.5 meter (Machine offered by L1 being impulse type was smaller and could be accommodated in this space). Customer asked BHEL to explore possibility to offer machine module with smaller size and inform in 2 weeks, but BHEL did not inform to customer.
2	IS- CPP	1x410 MW TPH CFBC Boiler supply and E&C – Nirma Limited	170 (M/s ISGECF)	➢ BHEL's boiler package weight was 11700 Tons against Competitor's boiler weight of 8000 to 9000 tons. ➢ BHEL quoted auxiliary consumption of 7200 KW while competitor quoted 6300 KW to 6900 KW.
3	IS-CPP	2x25 MW GTG & HRSG – supply, E&C and civil works on EPC basis – Rashtriya Chemical & Fertilizers Ltd	445.94 (M/s Thermax)	Due to non-availability of GT model having net output of 25 MW, BHEL offered Fr6B GT model with ISO output 43 MW. Due to part load operation and lower efficiency of Fr6B GTG vis-à-vis M/s Thermax (i.e. Siemens SGT 700 GT model) there was substantial technical loading of ₹114 crore on BHEL.
4	Transmission Business Group	(i) Extension of 400/220 kV Damoh Extension of 400 kV Rajgarh Substation, (ii) extension of 400 kV Solapur Sub-staition under Solapur STPP Part-A and (iii) Extension of 400 kV Sujalpur Substation	79.45 (M/s Techno Electric & Engg. Limited)	Non-availability of Dynamic short circuit tested BHEL make 500 MVA ICT as required for the project, outsourcing from OEMs was required
5	Transmission Business Group	400/220 kV Powergrid Substation at Rewa	139.92 (M/s Alstom)	Non-availability of Dynamic short circuit tested BHEL make 500 MVA ICT as required for the project, outsourcing from OEMs was required. BHEL depends on OEMs for 500 MVA Transformers as BHEL product was not qualified.

Annexure-5.3
{As referred to in para 5.2.3}

Details of tenders lost in IS-Marketing due to longer delivery and/or higher price

Sl. No.	Business area	Description of work/order	Delivery/commissioning period offered by (months)		Price of BHEL *(₹crore)*	Value of order (L1) *(₹crore)*
			BHEL	Competitor		
1	Captive Power Plant	Gokul Mauli S&S 1x20 MW STG	14	12	16.86	12.00
2	Captive Power Plant	Narmada Sugar S7S 1x30 MW STG	12	8.50	18.08	12.00
3	Captive Power Plant	1x410 MW TPH CFBC Boiler supply and E&C – Nirma Limited	24	18 to 20	343.00	170.00
4	Captive Power Plant	Supply and supervision of 1x15 MW STG- Bidar SK	12	8	11.27	7.70
5	Transmission Business Group	Powergrid 400/220 kV substation at MP Kunta	Competitor quoted shorter delivery period of 12 months		73.17	65.07
6	Transmission Business Group	Powergrid 400/220 substation at Rewa	Competitor quoted shorter delivery period of 14 months		140.18	139.92

Annexure 5.4
(As referred to in paragraph 5.6)

List of orders accepted in violation of BHEL's Corporate Finance Guidelines

Sl. No.	Name of Project	Date of award	Condition regarding advance
1	1 X 600 MW Avantha Bhandar TPP- KWPCL	07.3.2009	Initial Advance: 7.5 *per cent*
2	5 x 270 MW TPP phase II, Amravati of Indiabulls Power Limited	11.10.2010	Initial Advance: 5 *per cent*
3	5 X 270 MW RattanIndia Power Ltd (previously known as Indiabulls Power Limited)/ Nasik phase II	08.10.2010	Initial Advance: 5 *per cent*
4	2x660 MW DB Power Project at Singrauli, MP of M/s DB (MP)P Limited	07.3.2011	• ₹50 crore shall be paid as an initial interest free advance after LOA acceptance by BHEL. Zero date shall be the date of receipt of initial advance. • ₹50 crore shall be paid within three months from zero date. • 3.34 *per cent* shall be paid within four months from zero date. • Remaining portion of 10 *per cent* shall be paid within six months from zero date.
5	1x300MW TPS, Vishakhapatnam-Abhijeet Projects Ltd.	11.1.2012	• 5 *per cent* as first advance shall be paid within 30 days (date of receipt of this advance to be reckoned as Zero Date) • 20 *per cent* second advance shall be paid within 15 days from zero date.
6	2x600 MW Raigarh project of Visa Power Ltd.	28.6.2010	• ₹100 crore after LOA acceptance by BHEL (Date of release of this advance was to be reckoned as zero date) • ₹64.75 crore within four months from zero date. • ₹64.75 crore (to complete 10 *per cent* advance) within seven months from zero date.
7	Pranahitha-Chevella lift irrigation scheme	12.05.2008	• 5 *per cent* to be paid as interest free advance along with the order. • 5 *per cent* to be paid within 3 months of the issue of LOA.
8	1x525 MW Tuticorin TPS-MEIL/SEPC	07.12.2013	• 5 *per cent* first initial advance and • 5 *per cent* on commencement of supply to project.
9	1 x 800 MW Wanakbori TPS Extension Unit no. 8-GSECL	05.09.2014	• Advance: 5 *per cent* to be paid in first month from zero date, which was indicated in the notice to proceed. • 1 *per cent* on placement of orders on Alstom within 6 months from zero date. • 1 *per cent* on placement of orders on Siemens within 8 months from zero date.

Annexure 5.5
(As referred to in Para 5.7.1)

Mean scores on a scale of five in respect of marketing sub-activities during customer surveys of 2012, 2013 and 2014

Marketing sub-activities	BHEL all total			Competitors all total		
	2012	2013	2014	2012	2013	2014
Availability of information about BHEL's latest product technologies	3.2	3.5	3.49	3.5	3.4	3.88
BHEL's response for any assistance required by customer during finalization of tender specifications	3.6	3.5	3.68	3.5	3.4	3.74
Accessibility of BHEL concerned person	3.5	3.7	3.73	3.7	3.4	3.92
Your preference to place orders on BHEL on negotiated basis	3.5	3.6	3.54	3.5	3.3	3.68
Overall score for pre-sales	**3.5**	**3.6**	**3.46**	**3.7**	**3.4**	**3.96**
Completeness of offer with respect to tender requirements	3.6	3.8	3.75	3.9	3.7	4.1
Acceptability of quoted prices with respect to estimated budget of the project	3.3	3.5	3.49	3.5	3.5	3.6
Understanding of Marketing representatives about product and services	3.5	3.6	3.69	3.7	3.6	3.86
Understanding of Marketing representatives about commercial terms and conditions	3.5	3.7	3.9	3.5	3.6	3.76
Promptness of the Marketing team in response to customer queries during tender	3.5	3.6	3.75	3.6	3.6	4.11
Flexibility during pre-award discussions	3.4	3.4	3.62	3.5	3.4	3.53
Overall score for sales	**3.4**	**3.6**	**3.48**	**3.6**	**3.6**	**3.95**
Completeness and accuracy of invoicing and billing	3.8	3.9	3.95	3.9	3.9	3.93
Flexibility in resolution of contractual issues	3.4	3.4	3.42	3.5	3.6	3.7
Ease of making changes in scope of work or other terms and conditions	3.1	3.2	3.43	3.3	3.2	3.40
Frequency of meetings with marketing representatives	3	3.1	3.33	3.5	3.1	3.52
Promptness in financial reconciliation and commercial closing of contracts	3.2	3.3	3.34	3.6	3.5	3.43
Overall score for contract management	**3.2**	**3.3**	**3.5**	**3.5**	**3.4**	**3.93**

Annexure 5.6
{As referred to in Para 5.7.2}

Mean scores on a scale of five in respect of sub-activities of project installation and management function during customer surveys of 2012, 2013 and 2014

Sl. No.	Sub-activities	BHEL all total			Competitors all total		
		2012	2013	2014	2012	2013	2014
1	Project planning and documentation	3.4	3.3	3.52	3.7	3.8	3.7
2	Timely & effective resource mobilization/deployment	3.1	3.1	3.24	3.7	3.7	3.57
3	Safety provisions at work	3.1	3.1	3.36	3.6	3.8	3.72
4	Effectiveness of Safety management system at site	-	3.1	3.34	-	3.7	3.73
5	Work executed in erectable sequence	3.4	3.4	3.48	3.7	3.7	3.68
6	Timely periodic review meeting to meet L1/L2 schedule	3.2	3.1	3.29	3.6	3.5	3.59
7	Selection of sub-contractors	3.2	3.1	3.3	3.6	3.6	3.59
8	Performance of BHEL sub-contractors	3.2	3.1	3.22	3.6	3.6	3.65
9	Commitment to project milestones (erection)	3.1	3	3.11	3.6	3.5	3.56
10	Technical capability of BHEL site engineers	3.6	3.6	3.87	3.7	3.8	3.83
11	Adherence to statutory requirements	3.5	3.6	3.71	3.7	3.7	3.72
12	Sequential supply by manufacturing units	-	2.8	3.06	-	3.6	3.66
Overall score for project erection		**3.3**	**3.3**	**3.52**	**3.7**	**3.8**	**3.83**
1	Quality and adequacy of technical man power	3.3	3.4	3.65	3.7	3.6	3.75
2	Timely inspection of each component	3.2	3.3	3.52	3.6	3.5	3.73
3	Speed of response of customer complaints during commissioning	3.2	3.3	3.44	3.5	3.6	3.65
4	Accessibility of Site Personnel	3.6	3.7	3.73	3.7	3.7	3.84
5	Commitment to commissioning mile stones	3.2	3.1	3.31	3.5	3.5	3.74
6	Availability & quality of commissioning procedure	3.4	3.5	3.64	3.6	3.6	3.75
7	Effective trouble shooting of technical problems	3.5	3.4	3.63	3.6	3.6	3.71
8	Timely replacement of failed components during commissioning	3.3	3.2	3.31	3.5	3.5	3.62
9	Timely conduct of PG tests	3.2	3.2	3.39	3.5	3.5	3.62
Overall score for commissioning of project		**3.5**	**3.4**	**3.6**	**3.7**	**3.7**	**3.67**
1	Timely execution of punch lists	3	3.1	3.34	3.50	3.6	3.57
2	Timely execution of punch list related to manufacturing (supplies)	-	3.1	3.31	-	3.6	3.57
3	Submission of project closure documentation	3.2	3	3.36	3.70	3.5	3.72
4	Conducting effective customer review meetings for project closure	3.1	3	3.37	3.60	3.6	3.69
Overall score for project closure		**3.00**	**3.00**	**3.23**	**3.50**	**3.50**	**3.72**

Annexure 6.1
(As referred to in Para 6.1.2)

Project-wise delays attributable to BHEL

Name of Project	Description
Power Sector	
1x37.2 Lakwa Waste Heat Recovery Plant-(APGCL)	Report has been received from site that you are only dumping the materials from your different units at the project site and none of your foundations are ready for installation within next couple of months. You were requested time & again to make up the lags towards timely completion of the EPC contract. (APGCL letter dated 26.7.2007)
	Though the major supplies pertaining to Boiler and TG/Auxiliaries have already been dispatched, a proper schedule was never maintained. The materials that would be required at a later stage were sent earlier and vice versa. (APGCL letter dated 29.10.2007)
	Though it is not directly related to PG test of the plant but non-completion of all pending activities of the project including BOP area remain as a great concern for APGCL. As such BHEL should give top priority to complete the project in all respect along with completion of PG test. (APGCL letter dated 23.8.2012)
	You are aware that certain part of the commissioning works of Lakwa TPS has been left undone, resulting lesser generation of unit. This has resulted strong observation from the Regulators of the State. (APGCL letter dated 16.9.2015)
1 x 350 MW Hazira CCPP - (GSEGL)	GSEG expressed serious concern on slow progress of liquidating punch points and balance jobs which are essential to make unit available for sustainable operation. (Minutes of meeting held on 07.5.2013)
	GSEG invoked termination clause of contract and issue noticed that in case of non-completion of balance works within 30 days of issue of notice it will opt for alternative actions and complete the pending jobs either by self or other third parties, solely at BHEL's cost, risk and/or consequences, including additional financial consequences to GSEG. (GSEG letter dated 02.12.2013)
1 x 500 MW Bokaro 'A' TPS-DVC	Progress of structural construction and erection activities of Boiler at BTPS 'A' are held up for non-supply of Boiler Drum. (DVC letter dated 21.6.2011)
	a) BHEL Haridwar supplied IP Turbine, LP turbine, condenser materials etc. TG top deck casting was already completed. TG hall EOT crane is yet to be supplied by BHEL b) BHEL-Jhansi dispatched UAT which is required during synchronization. BHEL Bhopal not yet submitted data sheet of Station Transformer which is required for startup power c) Drawing/Document of ID fan motor/FD fan motor are presently under the process of finalization due to delayed submission of necessary input by BHEL Trichy, whereas BHEL-Bhopal dispatched Mill Motor long back. BHEL-ISG supplied DG set long back which is required during synchronization of the unit. DG Building Drawing is yet to be finalized. (DVC letter dated 06.1.2012) BHEL –Ranipet not responding to supply minor items required for commissioning of different sub systems (ESP, FD fan etc.)- DVC letter dated 31.8.2015
	Coal synchronization and full load achieved on 22.3.2016. However, BHEL continuously shifted target date for COD with the latest one being 25.10.2016. DVC vide letter dated 01.6.2016 informed BHEL that as per CERC Regulation 2014-19, COD of the unit is required to be declared within 6

	months from the synchronization; BHEL shall be liable for any commercial impact to be faced by DVC for the same in future. (DVC letter dated 01.6.2016)
1 X 600 MW Avantha Bhandar TPP-KWPCL	BHEL should appreciate the fact that KWPCL has been one of the best paying customers in the times when BHEL had worked for this plant in peak times and has every time got supported by us and even got paid for all non-sequential supplies (up to the tune of 18000 MT for more than 2 years). You should appreciate the fact that KWPCL has incurred a lot of burden in carrying that dead inventory for years. BHEL's failure in supplying and erecting material for our project has been one of the major reasons for the situation where we are into today - KWPCL letter dated 19.6.2014 Unit can run continuously without standby equipment. However, according to the condition of trial operation as laid down in contract, all standby equipment should be ready. (Mail dated 04.7.2014 from BHEL-PSWR)
North Chennai TPS Stage-II Unit 1 and unit 2 - TANGEDCO	The fire protection system could not be put into auto mode due to tapings of fire water for other purposes regularly in following areas: (i)Bottom ash chocking and cleaning purpose, (ii) Coal Handling areas and conveyors towers for chocking and clearing, (iii) Mill Plant rejection area and Bunker chocking purposes, (iv) Civil work purposes by BHEL contractors, (v) A/c line water requirement in emergency situations, (vi) Fly ash cleaning purposes at ESP areas, (vii) Generally in all areas, bathing, hand washing and any other cleaning purposes by all contractors and workers. Due to tapping of water for above purposes from fire hydrant line, adequate pressure could not be maintained in the fire hydrant line and the fire protection system could not be put into auto mode. Further, it is brought to your kind notice that in NCTPS, Stage-II already faced some fire incidents. It is requested to establish service water to the above mentioned important plant areas and to commission the fire protection system in auto mode immediately to safeguard the plant in case of any eventuality of fire.- TANGEDCO letter dated 4.6.2014.
1x500 MW Bellary Unit-2 - KPCL (EPC)	BHEL Haridwar diverted material for Bellary 2 on the plea that TG deck was not casted at site. (BHEL /PMG letter dated 30.6.2009)
	Supply of condenser not as per condenser erection requirement. (BHEL-PMG IOM dated 9.9.2009)
	As per BHEL Haridwar priorities, supplies needed for achievement of the Feb. 2010 milestone are likely to be completed around October 2010. As a result, the delay in the project execution would be about 8 months. (BHEL Note dated 12.11.2009)
2 x 250 MW Bina TPS – Jaiprkash Power Ventures Limited	JPVL furnished details of delay in completion of facilities: Completion of delivery of mandatory spares which was to be done by 19.9.2011 is still incomplete - JPVL letter dated 18.3.2015
2x 500 MW Anpara 'D' TPS-UPRVUNL	BHEL had committed for synchronization of unit-7 in September 2015 and full loading by October 2015. We have instructed all concerned to ensure compliance of the above commitments. However, due to huge quantity of material cannibalization for unit -7 to unit-6 at the last moment, there is going to be some delay in meeting our earlier committed schedule.(BHEL letter dated 06.7.2015)
	UPRVUNL enclosed list of critical materials which were to be supplied by different BHEL units, these materials are urgently required to run the unit 6 & 7 on full load.(UPRVUNL letter dated 17.3.2016)
1x700 MW Bellary unit no. 3 EPC- KPCL	In view of the poor progress/stoppage of civil works by BHEL since past one year on the regular path of CHP (required for feeding required quantity of coal for full load operation of the Unit), we are forced to withdraw the civil portion work pertaining to the dedicated path of CHP excluding Electro-Mechanical works of the unit -3 from the scope of BHEL and get the works carried out at the risk and cost of BHEL in the interest of early commissioning of the unit to achieve COD.- KPCL letter dated 24.6.2016
4x600 MW	Whatever supplies were made to us were highly non-sequential. As a result, when the work at site re-commenced in November 2011, the erectability

Jindal STPP, Raigarh-JPL	status of available material was very poor. (JPL letter dated 27.2.2012)
2x351 MW Project at Pipavav, Gujarat- GPPC	BHEL had performed full load operation of our Pipavav Unit -2 in April 2013 and Unit-1 in February 2014 to achieve capacity addition in the year 2013-14 by performing bare minimum commissioning activities and also using many of the equipment and spare parts of Unit-2 in Unit-1 which means that all the supplies of equipment and spares for both the units have not been completed. Therefore, we have been following up with BHEL on continuous basis, to supply such equipment and spares which were taken out from Unit-2 for achieving full load operation of Unit-1. (GPPCL letters dated 08.10.2014 & 25.6.2015)
	Many of the critical issues observed in unit-2 main plant as well as BOP areas during the operation of unit-2 are yet to be rectified by BHEL. Further, critical commissioning activities like Load Rejection Test / Islanding operation, Gas Turbine IDLN Tunning, PG test etc., are pending for unit-2 which are essential for issuing Provisional Acceptance Certificate (PAC)- Principal Secretary, Govt. of Gujarat letter dated 09.3.2016
726 MW HRSG project, Palatana - OTPC	Construction of Unit-2 is suffering due to unavailability of several critical materials and shortage of manpower from BHEL and its sub-contractors. However, in spite of repeated assurances, no effort is visible from BHEL to arrange replacement of material, to augment manpower and to expedite commissioning of the project - OTPC letter dated 05.11.2012
	In spite of repeated request, BHEL has not provided Operation & Maintenance personnel as per requirement of contract in order to facilitate pre-commissioning and commissioning activities.- OTPC letter dated 01.11.2012
1x800 MW Kothagudem project- Telangana State Power Generation Corporation (TSGENCO)	It is observed that L2 schedule of material is not being followed at KTPS (1x800 MW) and BTPS (4x270 MW) Projects. The works at site are not progressing as per L2 schedule in certain areas of project activities and also certain material are being dispatched to site well in advance of stipulated L2 schedule. This is leading to huge expenditure towards increase in IDC component of the project. CMD/TSGENCO Note dated 18.2.2016 to Chief Engineers of concerned projects
	I am strained to remind that even after 15 months from the zero date, BHEL has not yet finalized the agencies for critical systems, viz, TG Erection, DM Plant, Pre-treatment Plant, CW treatment Plant, Firefighting System, HP Turbine Casing, AC Plant, Compressor House, Switch yard works etc. Even for NDCT, recently finalized vendor has not yet commenced the work. It is pertinent to inform that it may take at least 18 to 20 months for completion of Cooling Tower.- CMD/TSGENCO letter dated 06.5.2016
1 x 800 MW Wanakbori TPS Extension Unit no. 8-GSECL	The work is being delayed due to poor coordination of different units of BHEL. This shows that since beginning, BHEL fails to maintain the schedules as committed mainly due to problems of coordination amongst different units of BHEL, in particular ISG. GSECL expressed its deep concern regarding delay of EPC projects awarded to BHEL and hope that the same history shall not be repeated for prestigious Wanakbori project - GSECL letter dated 23.12.2014
	Vide our letters dated 13.7.15, 30.7.15 and 28.9.15, it was requested to ensure sequential supply of material by various BHEL units to project site. However, it seems that all BHEL units are not following the sequential supply schedule and dumping the material at site. BHEL Ranipet unit has supplied the ESP material during early days and now AHP Baskets, which are going to utilize after years and material gets deteriorated. This may require replacement/recoupment due to loss and damages at the time of actual utilisation. This results in delay of the project. Moreover, BHEL to note that there are space constraints due to dumping of non-sequential supply. Material deterioration is an issue which may be the cause of performance shortfall.- GSECL letter dated 20.10.2015

4x270 Bhadradri (Manuguru) TPS - TSGENCO	CMD/TSGENCO stated that the works at site are not progressing as per L2 schedule in certain areas of project activities and also certain material are being dispatched to site well in advance of stipulated L2 schedule. This is leading to huge expenditure towards increase in IDC component of the project- CMD/TSGENCO note dated 18.2.2016.
2 x 520 MW TPP at Vizag-Hinduja National Power Corporation Limited	Prior to start of TO procedure and list of test to be conducted during TO duly approved by HNPCL are required. HNPCL is requesting BHEL to submit the procedure since Dec. 2015. BHEL PSER submitted the procedure on 28.4.2016. Final procedure incorporating HNPCL comments is still awaited. Prior to start of trial operation all the equipment with standby are to be made ready for operation and testing for initial operation by BHEL PSER, ISG and TBG. Even today all the equipment are not put in service. - HNPCL letter dated 01.6.2016.
2x270 MW GVK TPS-GVK Power Limited	BHEL could not complete the supply of required equipment as per agreed schedule. In fact substantial quantum of the equipment is yet to be supplied from Trichy, Ranipet, Hyderabad, Chennai, Noida, Haridwar and Bengaluru units of BHEL. Even today non-availability of certain critical equipment, material and insufficient manpower at site has been affecting the site progress continuously.- GVK letter dated 29.10.2012
Durgapur power station unit-8 of Durgapur Projects Limited	DPL furnished status of activities and stated that all the activities were being delayed. Major jobs could easily be completed by end November 2014. Even, parallel activities would help to squeeze the time.- DPL letter dated 10.11.2014
	Due date of commissioning was 27.1.2014 (42 months). BHEL is unable to conduct Trial Run Operation because the Dry Ash System not yet ready. PSER along with assistance of DPL has even tried to do Trial Operation 3 times with an alternate arrangement of disposal of Ash but have not been successful. DPL has categorically mentioned that as per directives from their State Govt. further payments will not be released unless Dry Ash evacuation system is commissioned and T.O. successfully completed.- ED/Mktg. note dated 13.11.2014 to ED/PEM&ISG and ED/PMG.
Neyveli Lignite Corporation Limited NNTP-NTA-1SG Package	Kindly consider the difficulties we are facing in receiving and storing materials which are required nearly a year after start of ESP erection. Besides occupying huge storage area, we may have to spend quite a good amount on preservation of these materials. In addition, pilferage and theft of such material are adding further to our expenses. By marking a copy of this letter, we are requesting PMG to make a realistic assessment of site, keeping the approved L2 schedule as benchmark while according dispatch clearance.- PSSR letter dated 09.9.2014 to BAP Ranipet.
2x660 MW OPGCL/IB Valley BTG Package	There is at least 3 months' delay in BHEL's start of erection of Power house structure due to late finalization and mobilization of the contractor. There is also a delay of about 3 months in BHEL's progress of erection of unit 3 boiler, primarily due to EDAC's lack of resources-manpower and equipment. The project is receiving materials from different manufacturing units of BHEL in a non-sequential manner and to the best of our knowledge, many of such materials will not be required for erection for almost a year from now. We request BHEL to dispatch the materials matching BHEL site requirements and readiness to unload and store the materials properly at site, ensuring smooth and fast execution of the project. We feel that the project is not being managed by BHEL as per Contract Coordination Agreement and Project Execution Plan. BHEL's individual manufacturing units and site continue to communicate with OPGC without required internal coordination among themselves. (OPGCL letter dated 07.4.2015)

Industry Sector	
80 MW Monnet Ispat	Non-synchronization of supply with civil work by BHEL.
153 MW G.G.S.R Ltd.	Unit-I, Boiler erection was started with delay of 4 months, Hydro test was conducted with delay of 5 months, Safety Valve floating with delay of 11 months. In case of STG-1, Oil flushing, barring gear and Rolling & Synchronization was done with delays of 13, 14 and 15 months, respectively. In case of GT-1, open cycle commissioning with delay of 11 months (scheduled August 2010 and actual July 2011). In case of HRSG-1, Safety Valve floating with delay of 11 months (Schedule September 2010 and Actual Aug 2011).
150 MW OPG Gujrat, Unit-1	Delay in supply of boiler pressure parts from Trichy and10 months delay in supply of ID/FD fans by Ranipet and Hyderabad units. Inordinate delay in award of boiler erection contract by Power Sector Western Region (PSWR). Delay of two months in opening of site office. Delay in finalization of enabling contractor. Delay in finalization of mechanical contractor. Delay in construction of storage shed. Delay in supply of main Turbine, Generator stator LP bypass, LP bypass valves, cross around pipe, economizer, RH&SH Header and FD&PA Fan etc.
50 MW India cement Ltd	Delay in finalization of Bus duct layout.
223.8 MW Anrak Aluminium Ltd.	Non-sequential supply, non-compliance of SEZ formalities.
105.32 MW IOCL Barauni	Boiler drum was lifted with delay of 8 months, 27 months delay in Boiler light up due to delay in supply of materials. 19 months delay in supply of Turbine barring gear.
25 MW ACC Wadi	Delay in receipt of material from Uttar Pradesh Steels leading to delay in supply of turbine. Delay in supply of casting and forging due to over load of vendors.
101.25 MW Opel Dahej, GTG-1,2&3	Delay in submission of drawings, award of sub- contracts & ordering of various bought out-items, and delay in site mobilization.
33 MW Aditya Birla Chemicals India Ltd.	Delay in supplies of various BOI items by sub-vendors.
23 MW Paradeep Phosphate Ltd	Non-supply of outer casing by CFFP-BHEL/Hardwar as it was new design. After manufacturing at Hyderabad unit, material was supplied in January 2014.
12 Nos 160 MVA, 220/66	Delay in supply of equipment due to delay in submission of initial drawings by BHEL-Jhansi. Against schedule date of completion of 31.3.2012, work was completed on 8.8.2013. Due to delay, M/s PSTCL withheld ₹2.20 crore on account of

KV Power Transformers, 12 Nos. NIFPS & 6 Nos. spares for PSTCL, Punjab	Liquidated Damages.
International Operation Sector	
4x125 MW Kosti Thermal Power Plant, Sudan:	Delay in completion of civil works (by sub-vendor M/s MAM), delay in dispatch of critical TG material, delay in laying of river water intake pipe. Due to lack of VASAVI manpower (sub-contractor) or delay in deployment of manpower by VASAVI. Delays in transportation: In June 2009, Vessel "Atlant Triana" carrying important material on board suffered breakdown at Colombo port and took more than 2 months to reach Port Sudan. Container shipments took a minimum of 30-35 days transit time. Non-availability of engineering goods like structure hardware, cable lugs, gases etc. such basic items had to be procured from India and transported to site which was a time consuming affair. A lot of material (esp. C&I panel and switchgear) got damaged due to improper material handling at Port Sudan. Arranging replacements and their transportation to site was a time consuming affair.
	Delay in providing Mobile concrete pump and Automated Batching plants as the same was required by the Customers for entire concrete work from the start, however, BHEL was able to provide the same in 2008/2009. BHEL in the past has only used such equipment for main works and for bigger foundation.
	Delay of 31 months in supply of equipment (Generator Transformer, Bus duct, UATs, STs & spares for these equipment) by BHEL-Jhansi unit.
126 MW Qarn Alam-3, PDO, Oman	Generator with adopter box, exciter and AVR delivered by Siemens were delayed due to unprecedented snowfall in Europe, the cargo could not be shipped. Supply items like Accessory base, Gas Valve Module, Air Blast oil cooler, load coupling, and exhaust diffuser etc. were delayed in shop manufacturing at BHEL units. Supply items like GT & GTG Fire Protection system, Generator control & Relay panel and BNC vibration monitoring system were delayed due to manufacturing delayed by various vendors. Supply items like Exhaust ducting, Guillotine Damper, Diverter Damper, hydraulic power pack got delayed due to change in design by customer. Out of 13 months' delay, 3 months' delay was granted through time extension by customer. Customer also raised issues like delay in PO placement, delay in engineering drawing approval, quality issues like improper welding, painting, received in bent & dent condition, non-compliance quality parameter by vendors.
Tendaho Sugar-STG Package, Ethiopia	Delay in supplies by BHEL
Bihai HEP, Taiwan	Delay in supply of material by BHEL

Annexure 6.2
(As referred to in paragraph 6.5)

Project-wise quality and workmanship related issues observed in commissioned power projects selected for performance audit

Name of Project	Description
Power Sector	
1x37.2 MW Lakwa Waste Heat Recovery Plant- (APGCL)	APGCL's major concern of rotor stuck problem since commissioning was eliminated by BHEL, PSER during April 2012 by correcting the wrongly erected steam drain pipes and traps. During erection and commissioning same were wrongly erected. The present problem of gland steam fluctuation may be the result of internal damage in the gland area for those rotor stuck problem. (**APGCL letter dated 11.10.2012**)
	As per recommendation of the Task Force of BHEL, some corrective activities had been taken up in the year 2014 and 2015 that resulted in marginal improvement of around 2 to 3 MW. However, the designed capacity of the unit could not be achieved even after the corrective measures. The unit is presently generating around 30 MW against 37.2 MW. (**APGCL letter dated 21.3.2016).** Further, HPEP, Hyderabad did not dispatch 195 items of mandatory spares to customers even by September 2016.
North Chennai TPS Stage-II Unit 1 and unit 2 - TANGEDCO	LP Bypass (LPBS)'s left valve of Unit-1 became (October 2013) inoperative due to oil leak which had to be attended through the O Rings supplied by HEEP, Haridwar. Besides, one number of Condenser Vacuum Pump, out of total 4, had to be replaced/cannibalized from Unit-2 of the Project, due to its failure (October 2013). Both of these items adversely affected the continuous and trouble free operation of the Unit. TANGDECO (the Customer) asked BHEL for their replacement/rectification for safe running of the Unit during the Project Review Meeting of 25.09.2013 and reiterated their request vide letter dated 07.10.2013.(HEEP-Haridwar)
	Till date 7 Nos. cooling water pumps have failed out of 12 Nos. pumps in both Unit 1 & II due to failure of abutment ring. Further Unit I of NCTPP Stage 2 was under forced shutdown from 01.6.2014 due to failure of abutment ring. **(TANGEDCO Letter dated 9.6.2014).** Customer also demanded (09.6.2014) immediate replacement of necessary items for rectification of all CW pumps.
	Both Oil Vapour Extraction Fans of Main Oil Tank supplied for the Unit-1 were found defective at site due to crack noticed on motor base and stopping on high vibrations. They were immediately taken out of service and customer asked for war footing action from BHEL for their replacement/rectification for safe running of the Unit, during the Project Review Meeting of 24.10.2013 and reiterated their request vide letter dated 25.10.2013. (HEEP-Haridwar)
	Auxiliary Oil Pump (AOP) supplied by the HEEP-Haridwar under Package no. BT003 –Drawing No. 2430530014 for Unit-1 failed at site and also reflected problem of dimensions mismatching with Main Oil Tank (MOT) opening flange. HEEP Management got the material repaired at site with debiting cost by the site to the HEEP.
	Front Bearing Pedestal Drain Pipe (Package no.75601/1) and HP Module Jack Bolts supplied by HEEP, Haridwar for Unit-1 was having manufacturing defects which had to be repaired/modified at site (October 2011).
	Repeated failure of intermediate conveyor of Bottom Ash Handling System has led to forced outage of both units at NCTPP Stage II. As the design & Engineering vests with the execution, it is the responsibility of BHEL to install standby system also for trouble free uninterrupted operation of the system. **(TANGEDCO letters dated 28.4.2014, 16.6.2014, 23.7.2014 & 18.8.2014)**
	JPL desired to know reasons of blade failure at North Chennai and possible preventive actions at their 600 MW project site. It was informed to them that North Chennai-1 Turbine is under dismantling and BHEL experts are at site to examine and analyze reasons for failure. It there

	are any actions emerging from this analysis, same will be implemented at other project sites also. **Summary of discussions held with MD & CEO, JPL on 18.11.2014 relating to 4x600 MW Jindal STPP, Raigarh-JPL**
1x500 MW Bellary Unit-2 - KPCL (EPC)	Reply of BHEL regarding deviation in TG alignment from approved field quality plan is not acceptable and we request to arrange necessary corrective measures before rolling and synchronizing of the unit. This was due to certain imperfections in the coupling faces of both HP IP coupling half faces and IP-LP coupling half faces. **(KPCL letter dated 05.1.2012 and BHEL' Synopsis)**
	LP Rotor supplied by HEEP in above project was purchased with deviation after acceptance from M/s Siemens (technical collaborator) and HEEP issued additional guarantee of 50000 EOH for LP Rotor as the KPCL was not ready to accept the LP Rotor with deviation without additional guarantee. However, additional guarantee taken from the vendor or M/s Siemens for above deviation was not found on record. Further, HEEP supplied IP Inner casing with technical defects, had to be repaired by deputing HEEP, Haridwar team at site. BHEL site office has, however, incurred ₹ 1, 08,000/- on above repair. However, cost of deputing above team was not found on record. HEEP incurred an amount of ₹ 75.78 lakh on repair & maintenance and short supply against the above project. **(HEEP-Haridwar)**
	Bellary unit-2 was shut down due to failure of Boiler tubes on 26.11.2012. After Radiography tests conducted on 1200 joints in Economizer zone 393 weld joints were found defective. About 25 days time was taken for rectification of these joints. After synchronisation on 27.11.2012, the unit force tripped on 08.1.2013 (after 11 days) due to failure of Boiler tubes in LTSH zone. Frequent failure of boiler tubes of new unit which is under reliability operation stage is a matter of great concern. The unit has tripped 9 times since first synchronisation on 25.3.2012 on account of Boiler tube Failure only.**(KPCL letter dated 11.1.2013)**
	Failure of Exciter Rotor on 26.1.2013 while carrying out of commissioning activities **(KPCL letter dated 09.3.2013).** BHEL agreed to hand over a new Exciter Rotor assembly of similar type to KPCL
	On conducting the root cause analysis, it was found that indigenous Blower assembly was the root cause of the failure of the exciter rotor. In order to rectify the problem, we have replaced the blower assembly with imported version from Czechoslovakia, which is technically superior to former.- **BHEL E mail dated 8.6.2016**
	Deviation in alignment of Turbine during erection. Deviations in vibration were to be corrected to be within acceptable limits by BHEL during the first overhaul. BHEL had agreed to give an additional warranty for three years from COD if the vibration is beyond permissible limits due to run out deviation after carrying out correction during overhaul During last overhaul (Sept-Oct 14) the same could not be corrected by SAS, BHEL. In this connection a letter is also addressed to SABG, BHEL, Bangalore by CE(O&M) BT on 12.6.2015 informing that the vibration of TG bearings 5, 6, 7 and shaft vibrations have doubled compared to pre-overhaul values In view of persisting vibration problem we once again request your immediate action to address the issue and immediately arrange to furnish additional warranty for three years from COD as committed by you vide letter dated 21.2.2012 from ED(Marketing) addressed to MD, KPCL.-**KPCL letter dated 23.6.2015**
2 x 250 MW Bina TPS – Jaiprkash Power Ventures Limited	For restoration of the boiler Unit-1 (shut down on 21.11.2012 due to tube leakage) we required about 16 nos. of bends PGMA 16-275. These bend tubes were supposed to have been supplied by BHEL as part of mandatory spares already included in the contract. As such this shut down (generation loss of ₹22.3 crore) is totally attributable to BHEL. **(JPVL letter dated 28.11.2012)**
	Extra consumption of oil was attributed to improper commissioning/performance of BHEL Steam Generator **(JPVL letter dated 30.11.2012)**

	Unit 1 for which COD was declared on 31.8.2012 had to be shut down on 21.11.2012 due to tube leakage. This shows poor workmanship during erection and welding of pressure parts at site. **(JPVL letter dated 28.11.2012)**
	JPVL points out to uneconomical and inefficient operation of unit -1 and request BHEL for carrying out PG test. JPVL also asked BHEL to complete insulation work of Unit-1 and Unit-2 and take action to improve heat rate for Unit-2 **(JPVL letter dated 24.7.2013)**
	Supply of mandatory spares, completion of some works are still pending. PG test of ESP was not conducted on full load due to restriction of SLDC (regulatory board). Hence the PG test of ESP may be re-conducted. - **JPVL letter dated 18.12.2015**
2x 500 MW Anpara 'D' TPS-UPRVUNL	During execution, the chimney (which is part of BHEL's scope and sub contracted by BHEL to M/s Lanco) was constructed wrongly and required demolishing of the same and reconstruction of the chimney.(**Power Sector Marketing Note dated 1.11.2011)**
	MD/ UPRVUNL expressed deep concern over the delay in full load stabilization of both units leading to excessive oil consumption and consequent burden due to IDC. **(Record note of meeting held by MD, UPRVUNL with BHEL on 25.4.2016)**
1x700 MW Bellary unit no. 3 EPC-KPCL	On the ground that there had been alleged delay on the part of BHEL in completing project (1 x 250 MW Raichur Thermal Power Station – Unit no. 8), faulty workmanship on the part of BHEL and latent defects encountered after handing over of the unit, KPCL had alleged that it had consequently suffered an economic loss of ₹ 223.21 crore. BHEL had denied and disputed the said demand of KPCL but KPCL proceeded to recover the said amount from another contract with BHEL namely, the contracts for Bellary TPS Unit-3.(**BHEL letter dated 26.7.2016)**
1x250 MW unit no. 8 of Durgapur Power Station-DPL	Prior to 'Trial Operation' of the main plant, it was confirmed by BHEL-ISG that their system with contingency arrangements will be able to evacuate about 80 tons of fly ash per hour. Unfortunately, during operation of the plant, the system could evacuate about 15 to 20 tons of fly ash only, which resulted in high accumulation of ash in ESP hoppers and Intermediate Surge Hopper.(**DPL letter dated 10.10.2014)**
	Test synchronisation of the units was done on 28.3.2014. But till date, trial operation of the unit could not be done. The unit was lighted up on number of occasions but generation could not be continued for more than 7 to 11 days due to failure of Ash Handling System.**(DPL letter dated 12.11.2014)**
	Unit was commissioned on 31 March 2014, is still not operational at full load due to non-functional of Ash evacuation system. Requested to intimate the action plan for completion of Ash evacuation systems to achieve Trial Operation and realisation of payments in July 2015. **(GM(I)/Marketing IOM dated 08.6.2015 to ED/ISG)**
4x600 MW Jindal STPP, Raigarh-JPL	Core looseness was detected first time in Unit-1 generator at both Turbine End & Exciter End. The same was repaired by BHEL/Haridwar team at site. Further JPL requested BHEL to check core looseness in generators of Unit-2, 3 &4. On checking it was found that core looseness in generators of Unit-2, 3 &4 was more severe than Unit-1. Customer also intimated that "the nature of defect, in spite of rectification at site during warranty period does not fully eliminate the chances of failure. The risk as perceived is substantiated by the fact that similar defect has led to catastrophic failure in JITPL generator. It is evident that the situation has arisen out of serious and unusual manufacturing defect at BHEL's end and therefore, JPL is well within its rights to invoke the Clause No. 33 of GCC for Supply Contract, i.e. Rejection and Defective Plant." With the above, as a remedial measure, JPL requested BHEL to extend the warranty of all four generators of the Project for 10 years from the date of commissioning of respective units and asked BHEL to accept the same **(JPL letter dated 28.8.2015)**
	Frequent failure of ID Fan motor journal bearings. Already 4 nos. Journal bearing damaged. **(Minutes of meeting held on 17.6.2015)**
	In the recent past, there have been few failures of BHEL make Generator Transformers which resulted in outage and generation loss to the

	utilities. These failures have been examined in detail and RCA (Root Cause Analysis) indicates that these GTs have failed due to di-electric failure of bushings.**- GM(TCB), BHEL letter dated 7.1.14 addressed to ED, Power Sector (TS)**
	We have supplied 12 Nos 250 MVA Generator Transformers. Failed GTs are being repaired by us as an obligation under the contract. Spare GT is also in advance stage of manufacturing & expected for readiness for testing by 2nd week of Aug 2014.- **BHEL, Bhopal letter dated 18.7.2014**
	Failure of two No. GTs SL: 6006876 & 6006875-first GT has been repaired and will be ready for final testing by mid of Aug 14. Second failed GT is presently in transit to BHEL Bhopal. **(BHEL /Bhopal letter dated 9.8.2014)**
2x351 MW Project at Pipavav, Gujarat-GPPC	GPPC is incurring huge financial losses and commissioning due to quality control lapses during assembly of GT at BHEL Hyderabad factory of BHEL/GE. GPPC has already taken up with BHEL to supply new Balanced Compressor rotor and new compressor stator vanes at the earliest. **(GPPC letter dated 14.6.2012)** However, BHEL (HPEP, Hyderabad) did not replace the same as repair facilities were available at GE, Singapore
	In GPPC's board meeting dated 29.12.2012, it was decided that BHEL will be allowed to reassemble the GT-1 with blended rotor blades subject to submission of undertaking by BHEL providing for unconditional replacement of the affected rotor blades by brand new rotor blades free of cost basis to GPPC and an extended warranty for affected compressor rotor blades till the time these affected compressor rotor blades are replaced by new rotor blades by BHEL. **(PS-Mktg. note dated 18.12.2013)**
	We acknowledge your concern over damage occurred in GTC 2 during re-commissioning process on 11.3.2015. BHEL Haridwar has been directed categorically to dispatch the required material. **(BHEL letter dated 21.3.2015)**
	MD/GPPC raised quality issues experienced during re-start of Unit#2 like insert cover failure of Generator, bearing failure of Steam Turbine, bearing failure of CW Pump, Cooling Tower fan shaft failure etc. **(Summary of discussions dated 18.9.2015)**
726 MW HRSG project, Palatana-OTPC	GTG Rotor supplied by HEEP, Haridwar for the Unit-2 of the Project caught fire in February 2011 at DSTPS stores, where it was actually unloaded and stored. BHEL's representative examined damaged rotor at site and advised to bring it back to Haridwar works for detailed investigation and reconditioning.
	BHEL's representative has examined the damaged rotor at site and advised for bringing back to Haridwar works for detailed inspection and reconditioning.**(BHEL e mail dated 23.2.2011)**
	During the course of trial run of unit-1, two Gas Booster Compressors (GBCs) were damaged extensively, needing urgent repairs for which the GBCs have to be transported to BHEL, Hyderabad. In the absence of GBCs, the unit -2 cannot be commissioned**. (OTPC letter dated 7.8.2013)**
	Since 22.10.2013 when unit-1 was first synchronised with Grid in combined cycle mode, pre-commissioning test of unit-1 in integrated manner was started by BHEL. Before pre-commissioning tests could be completed and trial operation could be started, HRSG developed major defect in the form of hotspots leading to shutting down of unit 1 on 14.2.2013. In joint inspection it was found that problem has occurred due to installation of incorrect material by BHEL. Since, incorrect materials were installed by BHEL, responsibility for failure of HRSG and delay on account of failure of HRSG lies solely with BHEL. **(OTPC letter dated 20.11.2013)**
	Full load of STG#1:The matter of shortfall in performance is being analysed by cross-functional team of BHEL.- **BHEL letter dated 20.3.2014**

2x600 MW Shree Singhaji (Malwa)	On 6 April 2014 when execution of unit 2 was in full swing, during steam blowing operation, steam blowing device got failed. The rectified/ repaired parts came back to site in the month of August 2014 and the system was restored in September 2014. (**Management's reply referred to in PSSR report)**
Pragati Power Bawana	One Generator Transformer of 220 MVA 3-Ph 400 KV failed on 24.3.2015 during warranty period. Cost of repair of ₹4.40 crore was borne by BHEL
Santaldih TPP Extension (1x 250 MW) Unit-6 - WBPDCL	Details of major outages since commissioning (October 2011) up to 31.3.2013: Turbine vibration and over speed problem- failure of HP Turbine and Thrust Bearing due to manufacturing defects of the HP cylinder cashing. Finally, HP and LP Turbine was replaced by BHEL Hardwar Failure of boiler pressure parts (Economizer Stub Joint Failures)-failure suspected due to poor workmanship/improper welding and heat treatment procedure during manufacturing at BHEL Trichy workshop (iii) ID Fan 6A Shaft failure (iv) Turbine vibration TG Vibration balancing. (**status by WBPDCL as on 31.3.2013)**
Sikka TPP Extension 2 x250 MW, Unit 3 & 4 - GSECL	Station Service Transformer of unit 3 (commissioned on 29.3.2015) tripped on earth fault protection on 28.6.2015. Transformer could be sent to BHEL-Jhansi in 3rd week of May 2016 due to non-availability of handling system. This is a design defect of the Plant. **(GSECL letter dated 24.6.2016 addressed to GM/In-charge BHEL (PMG), New Delhi)**
	One 320 MVA, 3 –Ph. 235 KVA Generator Transformer failed due to winding on 24.3.2015 during warranty period. BHEL borne cost of repair of ₹ 35 lakh.
	Unit 3 was synchronized on 9.3.2015. Since then many modifications have been carried out by experts from BHEL but still we are unable to raise the load beyond 150 MW due to problem of heavy unburnt carbon in bottom ash and other problems. **(GSECL letter dated 16.10.2015)**
	Unit 4 was synchronized on 30.8.2015, but we are unable to put up in continuous operation due to problem in the milling system, bottom ash and other pending works. **(GSECL letter dated 16.10.2015)**
1x800 MW Wanakbori TPS Extension Unit no. 8-GSECL	Regarding balance project works of 1x500 MW Ukai Unit no. 6 and 2 x 250 MW Sikka unit 3 & 4, it is our grave concern that the work entrusted to BHEL ISG unit is not getting any momentum in any project. Also, the quality related issues are being faced by us which are getting resolved at later date - **GSECL letter dated 23.12.2014.**
2 x 250 MW Harduaganj unit 8 & 9- UPRVUNL	During operation of unit#9 at around 210 MW at 8:20 AM on 08.10.2012 two number of ESP-B pass hoppers have fallen down along with the associated structures. ESP internals collecting electrodes with frame have been deformed, fallen down and cable Gallery on right side of ESP has also fallen down causing tripping of 6.6 kV supply & auxiliaries on right side of boiler (ID fan-B, PA fan B)- Incidence report of ESP Hoppers damaged of unit#9 dated 08.10.2012
	We have already given reply to BHEL within the stipulated period of 04 weeks, as mentioned in the clause 15.8 of LOA, that trial operation has not been completed along with reasons vide UPRVUNL letter dated 20.10.2012 and 22.10.2012. This clause no. 15.8 of LOA supersedes the clause 25.3.3 of GCC as per article of Contract. BHEL has mentioned that to meet the operational requirement load of the machine was reduced is attributable to BHEL, as due to poor performance of the milling system mill got choked and load was reduced In view of the above BHEL has failed to achieve the full continuous load condition during the trial operation period of Unit 9.- **UPRVUNL**

	letter dated 05.11.2012
	Stator winding was damaged due to internal fault in the generator stator winding and not due to wrong synchronization of the unit.- **UPRVUNL letter dated 17.11.2012**
	To resolve the issue of "Un-burnt carbon in bottom ash and fly ash were on higher side" it was agreed on 24.7.2015 that BHEL/Trichy will depute expert for inspection and recommendation- **MOM held on 30.12.2015**
2 x 520 MW TPP at Vizag- Hinduja National Power Corporation Limited	It is to inform that most of the time Unit-1 was out of grid due to frequent problems in Boiler, Turbine, Switch yard, CHP and AHP. December 15: Line -4 isolator damaged, Boiler Tube Leakage and MOP breakdown; HP Casing Top bottom temperature difference, C&I Malfunction; Fire Protection acted due to wire looseness, C&I Malfunction January 2016: Boiler Tube Leakage (Economizer right side- 9 tubes); CPU-1 View glass damaged and heavy leakage of Resin from tank; MDBFP #1 Non-Drive end high vibrations; Low level in MOT and vacuum dropped in condenser February 2016: Economizer Coil Leakage; Condenser Tube Leakage; MDBFP #1 Non Drive end high vibrations The availability of unit-1 during Dec.15, Jan and Feb, 16 was 28%, 56% and 75% respectively. Though there is increasing trend in the availability of unit but it is yet to reach a level to be ready for Trial Operation of 720 hrs.- **HNPCL letter dated 01.6.2016**
2x270 MW GVK TPS-GVK Power Limited	Unit 2 stop valve actuator got damaged during commissioning of the valve prior to steam blowing. BHEL is yet to come out with a programme for rectification of damaged actuator. Turbine shaft vibrations for bearings 2, 4 and 7 were observed to be very high. Not safe to operate the unit continuously at high load. BHEL stated that matter is being referred to BHEL Haridwar with all details.- **GVK letter dated 11.3.2014**
	ESP LTMSB panels: - Unit-2 complete set will be sent back to M/s Spaceage works, in which 8 out of 11 panels are in damaged condition. - **Minutes of meeting between GVK and BHEL on 29.4.2013**
Santaldih TPP Extn. Unit-6 (1 x 250 MW)-West Bengal Power Development Corporation Limited (WBPDCL).	From 31.5.2012 to 17.12.2012 (for 6 months and 17 days) the Unit remained under shut down due to high vibrations of turbine supplied by the HEEP. Due to this shut down the WBPDCL had to suffer a production loss of 915 Million Unit electricity. BHEL's experts made an assessment of the problem at site and observed that – (i) Throttle governing amplifier module was found faulty needing replacement; (ii) Cracks on the LP Base plate were observed; and (iii) Rolling of Turbine on tracking device and abnormal sound from generator could not be observed since the Unit was under shut down.
	Turbine vibration- Failure of HP Turbine and Thrust bearing was complained due to manufacturing defects of the HP Cylinder casing (balance leak off hole not through). Same was rectified at BHEL, Haridwar and refitted.
	Turbine vibration and over speed problem – Suspected passing of valves for supply of test oil to Emergency governors, but no problem was found. Subsequently mechanical strikers suspected of not operating properly (spurious over speed trip) was also sent to Haridwar for testing and rectifications.
	Turbine vibration – From 1.06.2012 to 07.08.2012 the machine was rolled 13 times, but high vibrations were persisting. It was decided to open the HP (High Pressure) Turbine casing. On opening of the same 1st stage blade was found melted and pasted on cylinder. Finally, after replacement of HP and LP Turbine by BHEL, Haridwar, the Unit could be re-started.
	TG vibration balancing – After synchronization, bearing 2 & 4 shown high vibration. BHEL again inspected the bearings 1, 2, 3 & 4 and machine was again synchronized on 12.12.2012.

2x660 MW OPGCL/IB Valley BTG Package	Due to inadequate safety supervision of BHEL, an unfortunate fatality occurred in early January 2016. This incident was discussed at higher level meetings to bring seriousness on safety front. To our dismay another near miss accident occurred in early February 2016 where several tons of steel fell from 83 meters height to the ground. **(OPGCL letter dated 08.3.2016)**
2x800 MW Yeramaras-RPCL	One No. 315 MVA, 1-Ph 400 kV Generator Transformer (GT) failed on 17.9.2016 during warranty period due to failure of winding. GT is presently under repair in BHEL factory (December 2016).
Industry Sector	
12 Nos 160 MVA, 220/66 KV Power Transformers, 12 Nos. NIFPS & 6 Nos. spares for PSTCL, Punjab	Delay in supply of equipment due to delay in submission of initial drawings by BHEL-Jhansi. Against schedule date of completion of 31.3.2012, work was completed on 8.8.2013. Due to delay, M/s PSTCL withheld ₹2.20 crore on account of Liquidated Damages.
OPG Gujarat Unit 1	After commissioning of project, Unit # 1 was facing problems like lube oil leak from the Generator front and rear bearing from the day Unit# 1 synchronized (13 February 2015). Unit was kept in continued operation making some temporary arrangement to collect the leaking oil in drums (customer letter dated 18 April 2016). BHEL-HPEP also did not complete punch points as per contract,
	Issues like frequent failure of ESP HVR, procurement of ESP transformer materials, service charges for ESP transformer materials, procurement of Thyristro Capsule assembly for ESP etc. BHEL-Ranipet stated that two numbers of ESP HVRs were reported malfunctioning at OPG Polimer Gujarat Private Limited from unit-I. Based on site feedback, matter was taken up with supplier M/s Hind Rectifiers, Mumbai and these ESP HVRs were rectified and again put in to operation in Unit-I.
India Cement Limited	Items like rotor assembly, front housing assembly, Rear housing assembly, front bearing journal, rear bearing journal and steam chamber were sent back to BHEL for carrying out the rectification work.
	STG was initially commissioned on 18 July 2013 but due to high vibration turbine was brought to BHEL RC-Puram for repair and rectification and again re-commissioned at site on 30 November 2013. Finally, PG test was carried out on 05 May 2015
Anrak Aluminium Limited	Automatic Voltage Regulator (AVR) supplied by BHEL could not regulate the power factor and power factor went to the lead. As a result, the demand exceeded beyond 8.8 Mega Volt Ampere (MVA) and touched 24.8 MVA. In view of this, as per norm of R&C measures of EPDCL a penalty of ₹1.37 crore has been imposed on Customer. Customer vide letter dated 2 July 2013 stated that Unit-1 was synchronised on 22 April 2013 under the control of commissioning expert by BHEL-EDN and also stated that when Company found that AVR was not functioning, the Company should have stopped the commissioning process.
	During MOM dated 25 February 2016 it was agreed to rectify the problems of wheel chamber pressure of TG 1&2 showing 50 % lower than designed value during planned shutdown of TG units # 1&2. The expense incurred for rectification work will be shared between AKII and BHEL
SAIL IISCO Burnpur 3	Boiler #3 which was commissioned on December 2012, exploded in 12 March 2013. Customer awarded (31.03.2014) work for restoration of Boiler #3 power blowing station at value of ₹20 crore to BHEL. BHEL stated (April 2015) that Boiler #3 was commissioned on 5 December 2012 and was in commercial use by SAIL-ISP for more than 3 months until explosion in Boiler took place on 12 March 2013 due to prolonged wrong operation of Boiler by SAIL-ISP. Against this the customer responded (13 April 2015) that the trial run was done with

	LDO, any balance fuel line like COG, CBM & BOF/BFG were neither erected nor ready for firing. As such as per terms of contract, the criteria for commissioning was not achieved. There was no protocol signed between customer and BHEL for Trial run operation
	There were noises at 3 turbo blowers supplied by BHEL, Hyderabad during November 2015. The vendor (Filter Manufacturing Industries Private Limited) did not carry out the works required to reduce the noise at site. By September 2016, HPEP, BHEL had manufactured the duct required for controlling noise pollution and same was ready for despatch.
My Home Industries	Turbine gear problem, Turbine parting plane steam leakage, servo motor oil leakage and problems of AVR etc. as per customer to which BHEL agreed in MOM dated 24.01.2013. After opening of machine on 19.01.2013, the machine was thoroughly inspected by BHEL team and decided to shift the machine to Hyderabad for repair. Equipment such as Rotor Assembly, Inner casing, Guide blade carrier were sent back to HPEP, BHEL (04.06.2013) for rectification work. After opening the Turbine at unit, lot of sand stone in inner casing nozzle found, all BP gland fins on rotor were damaged and all fins were slightly bent in top guide blade carrier etc. Equipment were re-commissioned at site on 28.06.2014. In view of the repairs, the Customer adjusted back charges towards repair and handling charges of ₹1.76 crore from the dues.
	Even after re-fining/repair on rotor guide blade carriers and top and bottom with the spares, problems in machines like turbine gear problems higher steam consumption and AVR problems etc. was again mentioned by the customer.
	Since commissioning there had been 23 trippings and 833 hours of shutdown because of STG problems. Higher specific steam consumption to the tune of 4 *per cent* resulting in higher cost of generation leading to loss of about 4 crore per annum. BHEL agreed to replace items like steam traps, pilot valve body, HP heater -2 level transmitter and control valve hunting, AVR problem of frequent failure and higher extraction temperatures etc. BHEL agreed to conduct P.G. Test once again to clear any problems regarding performance of Turbine.
International Operations Sector	
Nyabarongo HEP, Rwanda	Temperature rise in 6.6 kV, Weld crack on liner plate and leakages from Radial Gate and issue of Generator Air Gap & Vibration of Lower Guide Bearing unit-1. Management vide letter dated 31 August 2016 had assured Customer to rectify the problems like weld crack on liner plate and leakage from Radial Gate would be attended during shut down of plant.
4x125 MW Kosti Thermal Power Plant, Sudan-M/s NEC	Rejection of Boiler Foundation work done by Civil contractor M/s MAM, Peeling off of the paint from the Boiler structure supplied by BHEL from India which were sand blasted and re-painted before erection resulting in additional cost.

Abbreviations

Sl. No.	Abbreviation	Full form
A		
	AIA	Authorised Inspection Agencies
	AOP	Auxiliary Oil Pumps
	AS	Accounting Standard
	AUSC	Advance Ultra Super Critical
B		
	BAP	Boiler Auxiliary Plant
	BBU	Billing Break Up
	BEL	Bharat Electronics Limited
	BG	Bank Guarantee
	BHEL	Bharat Heavy Electricals Limited
	BLAC	Board Level Audit Committee
	BOI	Bought Out Items
	BOP	Balance of Plant
	BSC	Balance Score Card
	BSE	Bombay stock Exchange
C		
	CAR	Commissioning Action Report
	CCG	Contract Closure Group
	CD	Custom Duty
	CEA	Central Electricity Authority
	CEPD	Corporate Engineering and Planning Division
	CE&PD Manual	Corporate Engineering and Product Development Manual
	CERC	Central Electricity Regulatory Commission
	CFBC	Circulating Fluidized Bed Combustion
	CFFP	Central Forge and Foundry
	CMD	Chairman and Managing Director
	CPP	Captive Power Plant
	CSI	Customer Satisfaction Indices
	CSP	Concentrated Solar Power
	CT	Current Transformer
	CTC	Continuously Transposed Copper
D		
	DBMPL	DB (Power) MP limited
	DDR	Design Document Release
	DGFT	Director General of Foreign Trade
	DHI	Department of Heavy Industries
	DJU	Deed of Joint Undertaking
	DOP	Delegation of Power
	DTT	Dry Type Transformer
	DU	Dispatchable Unit

E		
	E&C	Erection and Commissioning
	EDN	Electronic Division
	EMU	Electric Multiple Unit
	EPC	Engineering, Procurement and Construction
	EPF	Employees Provident Fund
	ERP	Enterprise Resource Planning
	ERV	Exchange Rate Variation
	E, R&D	Engineering, Research and Development
	ESP	Electro Static Precipitator
F		
	FES	Field Engineering Service
	FSA	Fuel Supply Agreement
	FSCTR	Fire Side Corrosion Testing Rig
	Fr6	Frame 6
G		
	GDPB	Goods Dispatch Pending Billing
	GIS	Gas Insulated Switchyard/Sub-Station
	GoI	Government of India
	GPGSL	GVK Power Goindwal Sahib Limited
	GT	Gas Turbine/Generator Turbine
	GTG	Gas Turbine Generator
	GWH	Giga Watt Hour
H		
	HEP	Hydro Electric Project/Heavy Equipment Plant
	HEEP	Heavy Electricals Equipment Plant
I		
	ICT	Inter Connecting Transformer
	IDC	Interest During Construction
	IGCAR	Indira Gandhi Centre for Atomic Research
	IGCC	Integrated Gasification Combined Cycle
	IO	International Operations
	IR	Indian Railways
	IS	Industry Sector
	ISG	Industrial Systems Group
	IS&P	Industrial System and Products
J		
	JNNSM	Jawaharlal Nehru National Solar Mission
	JV	Joint Venture
	JVC	Joint Venture Company
K		
	KBL	Kirloskar Brothers Limited
	KHI	Kawasaki Heavy Industries
	kV	Kilo Volt

L		
	LC	Letter of Credit
	LD	Liquidated Damages
	LOA	Letter of Award
	LPT	Low Pressure Turbine
M		
	MCM	Management Control Meeting
	MDCC	Material Dispatch Clearance Certificate
	MEIL	Megha Engineering and Infrastructure Limited
	MEMU	Mainline Electric Multiple Unit
	MHI & PE	Ministry of Heavy Industries and Public Enterprises
	MISCC	Material Identification and Supplier Control Committee
	MM	Material Management
	MNRE	Ministry of New and Renewable Energy
	MOU	Memorandum of Understanding
	MPCL	Monnet Power Company Limited
	MPPGCL	Madhya Pradesh Power Generation Company Limited
	MRC	Material Receipt Certificate
	MSW	Municipal Solid Waste
	MUs	Manufacturing Units
	MVA	Mega Volt Ampere
	MW	Mega Watt
N		
	NAPCC	National Action Plan on Climate Change
	NCEF	National Clean Energy Fund
	NGT	National Green Tribunal
O		
	OA	Overall Availability
	OEM	Original Equipment Manufacturer
	ONGC	Oil and Natural Gas Corporation Limited
P		
	PC	Product Committee
	PCSG	Project Closure Synergy Group
	PEM	Project Engineering Management
	PG	Performance Guarantee
	PGCIL	Power Grid Corporation of India Limited
	PIR	Project Initiation Report
	PMD	Product Material Directory
	PMG	Project Management Group
	PO	Purchase Order
	PPA	Power Purchase Agreement
	PRC	Project Review Committee
	PRM	Project Review Meeting
	PSER	Power Sector Eastern Region
	PS	Power Sector
	PSSR	Power Sector Southern Region
	PSTS	Power Sector-Technical Services

	PSU	Public Sector Undertaking
	PSWR	Power Sector Western Region
	PV	Photovoltaic
	PVC	Price Variation Claim
	PWC	Price Waterhouse Coopers
R		
	RCA	Root Cause Analysis
	R&D	Research and Development
	REIL	Rajasthan Electronics and Instruments Limited
	RFP	Request For Proposal
	RFQ	Request For Qualification
	RFPQ	Request For Pre-Qualification
	R&M	Renovation and Modernization
	RoW	Right of Way
	RRVUNL	Rajasthan Rajya Vidyut Utpadan Nigam Limited
S		
	SAR	Site Action Report
	SBU	Strategic Business Unit
	SEARP	Supplier Evaluation, Approval and Review Procedure
	SEBs	State Electricity Boards
	SECL	Solar Energy Corporation of India Limited
	SG	Steam Generator
	SIPS	Special Incentive Package Scheme
	SJVN	SJVN Limited
	SPV	Solar Photovoltaic
	SRGM	Super Rapid Gun Mount
	SSL	Sambhar Salt Limited
	STG	Steam Turbine Generator
T		
	TANGEDCO	Tamil Nadu Generation and Distribution Corporation Limited
	TC	Technical Committee
	TED	Terminal Excise Duty
	TPS	Thermal Power Station
	TSGENCO	Telangana State Generation Corporation
U		
	UNFCCC	United Nations Framework convention on Climate Change
	UPRVUNL	Uttar Pradesh Rajya Vidyut Utpadan Nigam Limited
V		
	VPR	Vendor Performance Rating
W		
	WHRP	Waste Heat Recovery Plant

Glossary

Technical Term	Meaning
Advanced Ultra Supercritical Technology	Advanced Ultra Supercritical (AUSC) Technology for thermal power plants is meant for enhancement of plant efficiency to 45-46 *per cent*, and reduction of coal consumption and CO_2 emissions by ~20 *per cent*.
Balance of Plants	Balance of Plants are the products, systems and services which may not be in the manufacturing range of BHEL, but which form part of BHEL's scope of project requirement.
BSE PUC index	This index consists of major Public Sector Undertakings listed on BSE. The S&P BSE PSU Index is displayed on-line nationwide.
Enterprise Resource Planning (ERP)	ERP provides an integrated and continuously updated view of core business processes using common database maintained by a database management system
Drum Boiler	Drum boilers are also called sub-critical boilers because they have to operate below the critical point of water to make sure that there is density difference between steam and water allowing for separation.
Photovoltaic Cell	Semiconductor device that converts sun light into Direct Current (DC) electricity
Photovoltaic Module	PV Module consists of PV cells circuits sealed in environmentally protective laminate and are the fundamental building block of PV system
Photovoltaic Panels	PV Panel includes one or more PV modules assembled as a pre-wired, field-installable unit
Plasma Pyrolysis	In Plasma pyrolysis, waste is incinerated using plasms technology. Plasma is the state of matter obtained by breaking down atoms into ions and electrons by the process if ionization. Plasma can quite easily reach temperature of 10000 degree Celsius.
Percentage completion method of recognizing revenue	Under percentage completion method, revenue is recognized as the contract activity progresses based on the stage of completion reached. The cost incurred in reaching the stage of completion is matched with this revenue, resulting in the reporting of results which can be attributed to the proportion of work completed. As per the principle of 'prudence', revenue is recognized only when realized, under this method, the revenue is recognized as the activity progresses even though in certain circumstances it may not be realized.
Supercritical technology	A supercritical steam generator is a type of boiler that operates at supercritical pressure, frequently used in the production of electric power. In contrast to a subcritical boiler in which bubbles can form, a supercritical steam generator operates at pressures above the critical pressure – 3200 psi or 22 MPa.

Technical loading	Technical loading is the process of assigning higher cost at a pre-determined rate due to inferior technical parameters offered at the time of evaluation of bids to bring at par the bids of different parties.
Valuation adjustment	Difference between the billed value and intrinsic value of dispatches is booked as valuation adjustment