NATIONAL PERSPECTIVE PLAN

FOR
RENOVATION, MODERNISATION
AND LIFE EXTENSION OF
THERMAL POWER STATIONS
(UP TO 2016-17)

Government of India

Central Electricity Authority

December, 2009

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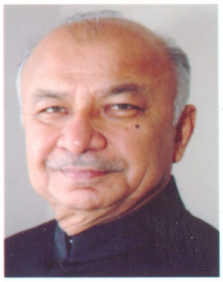

MESSAGE

The country today have an installed generating capacity of more than 152,000 MW. However, due to growing power demand, the shortages in energy and peaking requirements continue to exist. The Government of India has embarked upon an ambitious plan to add 78,700MW during the 11th Plan and 94,431MW during the 12th Plan. However, in view of high investment requirement in green field power stations, resource constraints and environmental concerns, there is an urgent need for optimal utilisation of existing generating capacity as well. In this context, Renovation and Modernisation (R&M) and Life Extension (LE) of existing old power plants is considered an economical option.

A large potential exists for achieving increased generation and efficiency improvement through Energy Efficient R & M (EE R&M) along with Life Extension beyond normal design life. The Central Electricity Authority in consultation with state power utilities and other stake holders have prepared a National Perspective Plan for Renovation and Modernisation and Life Extension of thermal power stations upto the year 2016-17.

This document on R&M of Thermal Power Stations includes identification of the thermal units for R&M/Life Extension work during the 11th and 12th Plans, the estimated funds requirement & anticipated benefits along with guidelines to facilitate the implementation. I am sure that this document will be quite useful to all concerned for successfully implementing the R&M programme.

SUSHIL KUMAR SHINDE
Union Minister of Power

MESSAGE

With a view to improve performance of underperforming thermal power stations in the country, Government of India initiated Renovation & Modernisation programme in a structured way in the year 1984. During the initial stage emphasis was on improving generation of electricity from such units. Today a large number of units especially larger size units of 200 MW capacity and above are performing well in terms of plant load factor but need life extension and also there exist scope of efficiency improvement. Thus, there is an urgent need to achieve increased generation and efficiency improvement. Accordingly, Energy Efficient R & M (EE R&M) along with Life Extension beyond normal design life has been envisaged for implementation.

National Perspective Plan for Renovation and Modernisation and Life Extension of thermal power stations upto the year 2016-17 provides a road map for increased generation and improved performance from existing stations.

BHARATSINH SOLANKI

Union Minister of State for Power

MESSAGE

The coal based thermal plants are the backbone of Indian power sector. Most of the old smaller size non-reheat type units are on the verge of retirement. Though the 200 MW and above size units, barring a few, are performing at the national average PLF, however, some of these units have crossed their economic life of 25 years and are also having high specific fuel consumption. It is of prime importance to improve their performance level in terms of efficiency in order to not only save fuel but also to reduce environmental impact. Such units provide a good opportunity for capacity uprating and extended period of operation. Renovation and Modernisation (R&M) and Life Extension (LE) of existing old power plants is considered as an economical option to supplement the capacity addition programme for increased power availability.

The document "National Perspective Plan for Renovation and Modernisation and Life Extension of thermal power stations upto the year 2016-17" prepared by CEA which inter-alia identifies potential units for R&M / Life Extension work would enable all the stakeholders in successfully implementing the R&M programme.

H.S. BRAHMA
Secretary, Power
Government of India

F O R E W O R D

In order to meet the growing power demand in the country, Govt. of India have taken number of initiatives which inter-alia include new multi modal generation capacity addition. Coal based Thermal generation continues to be the dominant source of power generation. However, to minimize its impact on the environment, various measures such as adoption of more efficient super critical technology and advanced emission control measures are being adopted. Other clean coal technology options are also being explored. To further supplement the above efforts in the area of efficient power generation, Renovation & Modernisation (R&M) and Life Extension (LE) of the existing old power stations have been recognized as one of most cost effective option by virtue of its short gestation period and low cost. Accordingly, approach to R&M and Life Extension & Uprating (LE&U) has shifted from primarily 'generation maximization' to 'performance enhancement' with efficiency improvement and plant uprating as an integral part.

Presently, 200/210/250/500 MW thermal units which contributes about 60 % of total generation in the country are performing better in terms of their plant load factor and availability. However, a large number of such 200/210 MW units have or are near completing their normal operating life and need modernization and life extension. There exists a potential for enhancing their rated capacity by 4 – 8 % and efficiency by 8 to 10% in various 200/210 MW LMZ machines. Few such units have been taken up as pilot projects under Energy Efficient R&M (EE R&M) programme through funding support from World Bank and KfW, Germany.

Based on the discussions held with Ministry of Power, various utilities, PFC and BHEL, CEA have prepared a 'National Perspective Plan for R&M and Life Extension & Uprating (LE&U) upto 2016-17' and also revised the guidelines on R&M. In the Perspective Plan, 53 units (7318 MW) for LE works and 76 units (18965 MW) for R&M works have been identified in 11th Plan and for 12th Plan 72 units (16532 MW) for LE work and 23 units (4971 MW) for R&M work. There are 66 units (13720 MW) of 200 / 210 MW LMZ design units installed in India which are potential candidates for EER&M.

I hope that the document will be useful to SEBs/ utilities and other stake holders in overall planning, implementation and monitoring of R&M / RLA/ LE programmes for the thermal power stations in the country.

RAKESH NATH
Chairperson
Central Electricity Authority

TABLE OF CONTENT

Chapter - 1

Introduction

1.1 At the time of independence, the total installed capacity in the power sector was 1362 MW of which steam power plants contributed 756 MW, hydro plants 508 MW and diesel sets 98 MW. The installed generation capacity has since grown manifold.

The total installed capacity as on 31.3.2009 was 147965 MW with the following breakup:-

Thermal (Coal)	:	77649	MW
Thermal (Gas / Diesel)	:	16076	MW
Hydro	:	36878	MW
Nuclear	:	4120	MW
Non-conventional	:	13242	MW
Total Capacity	:	147965	MW

1.2 Barring a few exceptions, initially thermal power stations were put up with units sizes of the order of 10 to 15 MW or less. Majority of units were non-reheat type with low design efficiency. The first 200 MW unit of Russian (LMZ) design was commissioned at Obra TPS in 1977. Thereafter, the unit size of 200/210MW became the standard unit size till 1984 when first 500 MW unit was commissioned at Trombay TPS. From 1983 onwards, KWU design 210MW units with higher steam parameters and improved heat rate were installed. Today, 200/210/250/300MW and 500 MW units (57237 MW) consisting 75 % of total thermal installed capacity form the backbone of Indian power industry.

1.3 Many of the thermal power plants are not operating to their full potential. Also large numbers of thermal units are old and outlived their normal life. Renovation and Modernisation (R&M) and Life Extension (LE) of existing old power stations have been recognized as an effective option to achieve additional generation from existing units at low cost and short gestation period. Besides generation improvement and life extension,

other benefits achieved from R&M include improvement in environmental emissions and improvement in availability, safety and reliability.

1.4 Presently, a large number of 200/210 MW units have completed or are near completion of their normal design life. The perspective R&M programme aims at extending their operating life further and also up grade their performance through Energy Efficient R&M (EE R&M).

Chapter - 2

R&M Activities in the Past

2.1 Renovation and Modernisation (R&M) Phase-I

R&M programme in a structured manner was initiated in 1984 as a centrally sponsored programme for 34 numbers of thermal power stations covering 163 thermal units in the country. The programme was successfully completed in the year 1992 and an additional generation of about 10,000 MU/ annum was achieved.

2.2 Renovation and Modernisation (R&M) Phase-II

The Phase-II R&M programme for 44 thermal power stations was taken up in the year 1990-91. Loan assistance was provided to the State Electricity Boards (SEBs) through Power Finance Corporation (PFC) for the R&M works. However, this programme could not progress as per schedule mainly due to non-availability of funds and poor financial condition of State Electricity Boards (SEBs).

By the end of 8th Plan i.e., March 1997, an additional generation of about 5000 MU/year was achieved. Also, Life Extension works on 4 units of Neyveli TPS aggregating to 300 MW capacity were completed. An amount of Rs. 862 crore was incurred during 8th Plan.

2.3 R&M works during 9th Plan

During the 9th Plan Programme, 127 units (17306 MW) at 29 power stations at an estimated cost of Rs. 913 crore were taken up for R&M. In addition, another 25 units (1685 MW) for Life Extension at an estimated cost of Rs.1700 crore were taken up. Additional generation of 14500 MU/ annum was achieved.

2.4 R&M works during 10th Plan

During the 10th Plan period, life extension works on 11 units (985 MW) at an approximate cost of Rs. 948 crore were completed. There was additional generation of 2000 MU per

year from these units. In addition, R&M works on 57 units (14270MW) to sustain / improve their performance at an estimated cost of Rs. 1080 crores were taken up and works on 14 units (2460 MW) were completed during the 10th plan.

2.5 Additional generation upto 10th Plan from R&M/ LE programme.

The R&M programme implemented during the above plan periods primarily focusing on improving plant availability met with limited success due to various reasons such as reluctance to take unit shutdown, delayed supplies of material, fund constraints etc. The results in terms of additional generation and equivalent MW obtained during the above periods are given below:-

TABLE- 1

S.No.	5-Year Plan	No.of Units	Capacity (MW)	Additional Generation Achieved MU/Annum	Equivalent MW
1	7th Plan	163	13570	10000	2000
2	8th Plan (R&M) (LEP)	198 (194) (4)	20869 (20569) (300)	5085	763
3	9th Plan (R&M) (LEP)	152 (127) (25)	18991 (17306) (1685)	14500	2200
4	10th Plan (R&M) (LEP)	25 (14) (11)	3445 (2460) (985)	2000	300

Chapter - 3

Present Approach to R&M / Life Extension

3.1 The main objective of R&M of thermal generating units is to make the operating units well equipped with modified / augmented latest technology equipment and systems with a view to improving their performance in terms of output, reliability and availability, reduction in maintenance requirements, ease of maintenance and minimizing inefficiencies.

The R&M programme is primarily aimed at generation sustenance and overcoming problems arising due to:

- Generic defects.
- Design deficiencies/modifications
- Non-availability of spares because of obsolescence of equipment/components.
- Poor quality of coal.
- Stringent environmental regulation.
- Safety requirements etc.

3.2 The life extension (LE) programme on the other hand focuses on plant operation beyond their original design life after carrying out specific life assessment studies of critical components. The equipment subjected to fatigue stresses and creep due to high temperatures such as turbine rotor and casings, HP piping, boiler headers, boiler pressure parts, boiler drum, main steam piping and valves, feed discharge lines etc. are designed for a given fatigue life of about 25-30 years of operation. However, many equipment/ components might become prematurely weak metallographically due to various operational stresses like frequent temperature and pressure excursions, full load trippings, frequent start and stops etc. and accordingly there is need to check the remaining life of these components after about 20 years of life or ***1,60,000*** hours of operation lest it may result into serious failures. A detailed condition assessment along with performance evaluation

of various systems / sub-systems is carried out to identify the modifications / replacements required to enable plant operation for a longer period. At this time it is a good practice to examine whether a plant requires a viable modernisation intervention so that during the extended life the **plant operates efficiently and delivers the rated or higher capacity with improved heat rate.**

3.3 Today, a large number of 200/210 MW machines and few 500 MW machines are in operation for 15-25 years or more.

The age wise distribution is as follows:

TABLE- 2

Description	Total number of units as on 31.3.2009	No. of units more than 25 yrs. of operation as on 31.3.2009	No. of units more than 15 yrs. but less than 25 years of operation as on 31.3.2009
200/210 MW LMZ Units	66	36	28
200/210 MW KWU Units	98	9	48
250 MW KWU Units	29	-	-
500 MW KWU Units	40	1	17

Such machines through efficiency integrated R&M provide a good opportunity for performance enhancement through technology intensive R&M / LE. Plant specific energy audit studies and techno-economic analysis are proposed to be carried out for defining & implementing efficiency integrated R&M/LE scheme.

3.4 The approach to National R&M programme for the 11th Plan period & beyond lays greater emphasis on plant efficiency improvement and tends to make it an integral part of R&M/Life Extension work. Energy Efficient R&M of generation units would go beyond restoration of original generation capacity, life-extension and improved availability. It

would enable the unit to operate at higher outputs with lower required fuel inputs. Accordingly, the design of Energy Efficient R&M is driven by the following objectives :

- Extension of life of generation unit by 10-15 years.
- Improvement of availability of the generation unit.
- Sustained achievement of near-design (or better) maximum continuous rating (MCR)
- Improvement in energy efficiency of boiler, turbine, generator and auxiliaries, resulting in improvement of unit heat rate.
- Achievement of lower secondary oil consumption through reduction in number of trippings, faster start-up and stable combustion at even lower levels of load.
- Overcome the problem of aging of critical components (leading to lower reliability and shorter residual life) and non-availability of critical spares (due to obsolescence).
- Incorporation of advanced control and instrumentation systems.
- Reduction in emissions and improved environmental control.
- Facilitate adoption of improved operations and maintenance practices.

3.5 Various policy documents such as National Electricity Policy, Integrated Energy Policy etc. provide broad frame work which lay emphasis on integrating energy efficiency in the future R&M programme.

National Electricity Policy on R&M:

The provisions in the above policy documents read as under:

Para- 5.2.21

One of the major achievements of the power sector has been a significant increase in availability and plant load factor of thermal power stations specially over the last few years. Renovation and Modernization for achieving higher efficiency needs to be pursued

vigorously and all existing generation capacity should be brought to minimum acceptable standards. The Government of India is providing financial support for this purpose.

Para - 5.2.22

For projects performing below acceptable standards, R&M should be undertaken as per well-defined plans featuring necessary cost-benefit analysis. If economic operation does not appear feasible through R&M, then there may be no alternative to closure of such plants as the last resort.

Integrated Energy Policy (December 2008)

The provisions in the above policy document under the heading 'Increasing Efficiency of Coal-Based Power Plants' read as:

> "Rehabilitation of existing thermal stations could raise capacity at least cost in the short run. Similarly rehabilitation of hydro stations could yield much needed peak capacity at negligible cost. Both the steps should be taken up urgently."

3.6 Focus on Energy Efficiency integrated R&M (EE R&M)

3.6.1 There are 66 no. of 200/210 MW capacity LMZ (Russian design) machines in India. These LMZ machines have lower design efficiency and have scope of capacity & efficiency uprating. Similarly, early design of KWU machines can also be considered for up rated performance. During the 11th Plan, 10 number of 200/210 MW capacity LMZ units and 7 numbers of KWU units have been identified for life extension programme.

3.6.2 Energy Efficiency R&M of some thermal power plants is already being taken up through external co-operation from Germany and World Bank. Contract has been awarded for preparation of DPRs in respect of three stations at Bokaro, Kolaghat and Nasik TPS through KfW funding. Some other units, namely Bandel TPS Unit-5 (210 MW), Panipat Units- 3&4 (2x110 MW) and Koradi Unit 6 (210 MW) have been identified for EE R&M

through World Bank funding. The Energy Efficient R&M programme through external assistance is intended to be taken up in few more units also. The potential units have been identified which may be take up during 12th Plan and beyond. Government of Japan, through JBIC / METI have also shown keen interest in few units.

3.6.3 The list of LMZ design 200/210 MW units installed in the country which are potential candidates for EE R&M are given in Appendix- III.

Chapter - 4

Perspective Plan for R&M

4.1 CEA held discussions with various utilities including UPRVUNL, PSEB, HPGCL,TNEB, APGENCO, NTPC, DVC regarding R&M programme. Based on the discussions, the units to be taken up for R&M / LE during 11th Plan & 12th Plan period were identified. The discussions were also held with other stake holders such as PFC, REC and BHEL to work out the other inputs in preparing the perspective plan.

4.2 Objectives of the National Perspective Plan.

The broad objectives of future R&M national plan include:

a) Identification of thermal units requiring Life Extension (LE) during 11th and 12th Plans in order to extend their useful economic life for another 15-20 years beyond their designed economic life of 25 years.

b) Assessment of total investment required during 11th and 12th Plans for life extension programme.

c) Identification of potential candidates for Energy Efficient R&M programme and assessment about external funding and other sources of financing during the 11th and 12th Plan.

d) Providing a road map for smoother implementation of R&M/LE schemes.

e) Projection of expected benefits from these schemes.

4.3 R&M Programme for 11th Plan and present status.

Units to be taken up for LEP during the 11th Plan include 53 numbers (7318 MW) out of which 33 numbers (4524 MW) are in state sector and 20 numbers (2794 MW) are in central sector. Similarly for R&M works, a total number of 76 units (18965 MW) out of which 27 units (6015 MW) in state sector and 49 units (12950 MW) in central sector have been identified for implementation during the 11th Plan.

During the 11th Plan period upto August 2009, life extension works on Ukai- unit 1 (120 MW), Panipat unit -1 (110 MW), Obra unit 1 &2 (2x40 MW) and partial LE works on unit- 6 (94 MW) of Obra TPS & unit 5 (60 MW) of Harduaganj TPS have been completed. Similarly, R&M works on 20 units (4690 MW) have been completed so far. Works on another 5 units in state sector (465 MW) and 38 units in central sector (NTPC) of total capacity 9640 MW are in progress.

The broad details of the 11th Plan programme are given as under :

TABLE- 3

Particulars of works	No. of TPS	No. of Units	Capacity (MW)	Estimated cost (Rs. Crores)	Expected Benefits after completion of works		Works completed upto August'09. no. of units (MW)
					Additional Generation (MU/annum)	Life Extension	
L.E. Works	**23**	**53**	**7318**	**12433**	**9755**	**15 Years**	**6 (464 MW)**
R&M Works	**21**	**76**	**18965**	**4487**	**4250**	**-**	**20 (4690 MW)**

The station-wise details are given in Appendix- I-A and I-B.

4.4 Programme for 12th Plan

Under 12th Plan, life extension works have been identified on 72 thermal units of total capacity 16532 MW. This includes 30 units (5860 MW) from state sector and 42 units (10672 MW) from central sector. R&M works have been identified on 23 units (4971 MW) during the 12th Plan, out of this 11units (4050 MW) are from NTPC, 9 units (291 MW) are from NEEPCO and rest are from state sector.

The broad details of the programme are given as under:

TABLE- 4

Particulars of works	No. of TPS	No. of Units	Capacity (MW)	Estimated cost (Rs. Crores)	Expected Benefits after completion of works	
					Additional Generation (MU/annum)	Life Extension
LE Works	**32**	**72**	**16532**	**28868**	**6900**	**15 Years**
R&M Works	**8**	**23**	**4971**	**4971**	**Generation sustenance only ***	**-**

* As most the units covered are operating at high PLF (80-85%), the broad objective is to sustain the performance.

The station wise details are given in Appendix- II.-A and II-B.

Chapter - 5

Methodology of Implementation of R&M and LE&U Schemes.

5.1 Implementation by the utilities

The generating company / State Electricity Board would implement scheme and arrange for the necessary investment required. The power utility would also continue to operate the plant themselves

R&M Works

It has been observed that the power utilities are adopting following two main variants in implementation of R&M programme.

i) As a rolling plan in which the whole scope of work is conceptualized based on condition assessment, plant operation data & feed back from O&M engineers / OEM / Consultant recommendations or compliance to statutory norms and then implemented in a phased manner. Such approach results in minimizing unit shut down requirement and thereby loss in generation. However, it results in extended execution over a long period of time and benefits accrued can not be co-related with the activities carried out and investment made.

ii) As a comprehensive scheme implemented in a single stretch and taking unit's planned shutdown after ensuring all inputs and supply of materials. (The option of comprehensive scheme is preferable due to well definable & quantifiable benefits.)

LE&U Works

In order to implement LE&U works following methodology may be adopted :

a) In order to facilitate the implementation of LE&U works, utilities may appoint reputed consultant for rapid life assessment study, condition assessment, energy auditing, thermal performance test, environmental study, preparation of DPR etc.

RLA studies to be conducted on the major plant and equipment through agencies of repute.

b) Based on DPR, a detail technical specification & contract document may be prepared.

5.2 Implementation through Private Sector Participation

5.2.1 In view of the liberalized economic policy of Government of India, private investment including foreign investment, are now allowed in all areas of the power sector. A memorandum was issued by Ministry of Power vide letter no. R-1/94-IPC dated 28th October, 1995. Following alternative options appear practical and feasible for private investment in R&M schemes. However, states/ power utilities may have other innovative options which could also be considered.

(i) Option 1:- Lease, rehabilitate, operate and transfer (LROT)

Under this option, the private promoter (PP) would take over the power station on a long -term lease, say 10 years or more. PP would invest and carry out the R&M of the power station and would takeover its operation and maintenance. Normally, the station would revert to the power utility after completion of the contracted period of lease or may be renewed on terms to be specified. However, legal title and ownership of the plant will remain with the utility throughout. This option would require a detailed lease agreement covering all aspects of financing, performance parameters, use of existing resources, sale of generated power etc.

(ii) Option 2:- Sale of Plant

Power utilities could offer power stations for outright sale to private parties. The present worth of the plant would have to be assessed which could be the reserve price for the sale.

(iii) Option 3:- Joint Venture between Power utility and public or private companies.

In this option, a new company will be formed as a joint venture (JV) of the state power utility/ State Government and selected private/public collaborator. The JV company would undertake the R&M/ LE works and own, operate and maintain the power station. The private collaborator could also be an equipment supplier. Each partner shall hold minimum 26% equity in the JV company.

This vehicle was used to form a JV between the State Government of Bihar and NTPC namely KBUNL (Kanti Bijlee Utpadan Nigam Limited) for Muzaffarpur Thermal Power Station.

5.2.2 There have been limited success in regard to private sector participation so far mainly due to following :

- ❖ Reluctance of state power utilities to form JVs due to legal and procedural difficulties.
- ❖ Uncertainty on return in investment due to various risks involved in R&M.

5.3 Need for revised policy guidelines

5.3.1 With a view to expediting the R&M/LE works during the 10th Plan period, Govt. of India, Ministry of Power issued guidelines vide letter No. 12/6/99-Th-3 Dated 12.1.2004 and subsequent clarification dated 3.2.2004. However, need has been felt to revise the above guidelines in view emphasis on improving existing plant performance in terms of higher generation as well as efficiency enhancement. Further,

i) A large number of units of 200MW capacity and above are becoming due for R&M/LE works necessitating need for more agencies.

ii) The objective is shifting from 'generation maximization' to 'performance optimization and generation maximisation' with efficiency enhancement and plant uprating becoming an integral part of the life extension programme.

iii) Constraints are being experienced in supply of materials resulting in time/cost overruns.

The above requirements call for new approach towards implementation of R&M/LE works by the utilities through identification of optimized R&M options, compressed and definite time schedule and encouraging increased participation from various executing agencies including private sector. Accordingly, the earlier guidelines have been revised to account for the above. Detailed guidelines for implementation of R&M / LE & U programme is enclosed at Annexure - A

5.4 In-principle prior approval from Regulators

Some of the power utilities go for capitalization of expenditure incurred due to R&M / LE works. It would be prudent to obtain in-principle prior approval of the R&M / LE scheme from the Regulator. For this purpose the utility shall make a Detailed Project Report giving complete scope, justification, cost-benefit analysis, estimated life extension, financial package, phasing of expenditure, schedule of completion, estimated completion cost and any other information considered to be relevant by the generating company.

Chapter - 6

Financial Forecasting

The estimated requirement of funds for R&M and LEP during 11th and 12th Plans are given as under :-

TABLE - 5 **Rs. crores**

Plan	R&M Works (@ Rs. 1 Cr. / MW)	Life Extension Works			Total
		LE with out up-gradation (@ Rs. 1.25-1.5 Cr./MW)	LE with up-gradation (EE R&M) (@ Rs. 1.5 to 2.0 Cr./MW)		
			Indigenous Funding	With external funding	
11th Plan (April 2009 onwards)	950	2334	2356	450	6090
12th Plan	630	-	4640	8760	14030
Total	1580	2334	6996	9210	20120 *
Funding from own resources (20% of estimated cost)	316	467	1399	1842	4024
Fund requirement from indigenous financial institutions like PFC/REC/ etc.	1240	1867	5597	-	8728
External Assistance	-	-	-	7368 (~1535 millionUSD **)	7368

** Assuming 1 USD = Rs. 48, 1 Euro = Rs.70.

Note : * Excludes fund requirement for central sector units of NTPC, NLC & NEEPCO.

Total fund requirement during 11th and 12th Plan from indigenous financial institutions would be around Rs. 8728 crore.

Out of above fund requirement for EE R&M during 11th &12th Plan, funding from external agencies to the tune of 96 million Euro from KfW for 3 units (630MW) and 180

million USD from World Bank have been committed. Further fund requirement of the order of 1210 million USD is planned for 16 units (3330 MW) for carrying out EE R&M under external funding.

The station- wise details of funds requirements are given in Appendix - IV-A & B.

Chapter - 7

Projected Benefits

(a) The increase in availability and reduction in partial loss of the unit after R&M works will result in additional generation from those units which at present are operating at low PLF. However, those units which are already operating at higher PLF say around 80% & above, R&M would aim for generation sustenance. The environmental upgradation will also be taken up in some cases on case to case basis.

(b) After carrying out the LE works, the units would get restored to their rated capacity and some units will also get uprated (higher output) resulting in increased generation. The economical useful life of the units will get extended by another 15-20 years.

(c) The projected benefits in terms of additional generation and life extension capacity are as under:

TABLE - 6

Five Year Plan	Increase in Annual Generation (MU)			Equivalent capacity addition at 80% PLF (MW)
	R&M	LEP (incl. EE R&M)	Total	
11th Plan	4250	9755	14005	2000
12th Plan	Generation sustenance	6900	6900	985
Total	4250	16655	20905	2985

(d) Additional Benefits :

It is expected that there will be efficiency improvement of the order of 8% to 10% after EE R&M works thus resulting into less fuel consumption and reduced CO_2 emission. The auxiliary power consumption would also reduce. Availability and reliability of the units also get improved due to such measures.

Chapter - 8

Key Issues

8.1 During the progress of various activities being under taken for EE R&M programme some issues as discussed hereunder have emerged.

(a) In order to make R&M investment more cost effective and self sustaining, the option of integrating plant efficiency improvement with the R&M scheme is being proposed where ever it is found to be techno economically viable. The external financial assistance like KfW, World Bank, JBIC etc. is forth coming for such efficiency enhanced R&M. Any barriers to early implementation of such R&M works need to be identified and resolved.

(b) In many of the thermal units, R&M works are assigned to OEM supplier (indigenous manufacturer). As an OEM, there is a need for augmenting its manufacturing capacity to cater to R&M works besides meeting the requirement of new generation projects.

(c) R&M works at a particular unit comprises of large number of schemes targeted for various equipments and sub-systems. In some cases, such schemes are implemented through one or more agencies selected through tendering and implemented in phased manner in such a way so as to call for minimum shut down of the plant. However, such an approach some times leads to extended implementation and also there are difficulties in establishing performance guarantees.

(d) LE works require detailed plant study through RLA and energy audit. Based on these studies a detailed project report is prepared to evaluate techno-economics. Subsequently, bid documents are prepared, bid finalized and contract is awarded. This process is observed to be a long drawn resulting in delays in start of work. In addition, there is poor response from the bidders due to lack of experienced

agencies to execute the work resulting in delayed award of contract. There is need to wider participation by consulting agencies & implementing agencies.

(e) Many a times when the unit is opened up for carrying out the R&M/LE works, new defects or damaged components are noticed resulting in delayed procurement & rectification. The contract document should address such technical surprises. Under Technical Assistance (TA) provided to CEA by the World Bank such issues are expected to be addressed and a standard bid document would be prepared.

8.2 To give more thrust on R&M activities in India and to address some of the issues as identified, CEA, through specific consultancy studies is entrusted with developing the barrier reduction strategy for the roll out of larger R&M programme. The World Bank is providing a grant of US $ 1.1 million to CEA for technical support to address such barriers in R&M interventions in thermal power plants in India under the project "coal fired generation rehabilitation project : India." This relates to Technical Assistance Support to CEA for carrying out studies through appointment of consultants in the following areas:

i) Consultancy Support for overall Implementation of the Technical Assistance Component.
ii) Reduction of barriers to R&M interventions in India
iii) Developing markets for implementation of R&M in India.
iv) Review of experience from Pilot R&M intervention.
v) Strengthening institutional capacity at CEA in the field of R&M.
vi) Capacity strengthening interventions based on the above study on strengthening institutional capacity at CEA.

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LIST OF UNITS PROGRAMMED FOR L. E. WORKS DURING 11TH PLAN .

APPENDIX-I-A
(Sheet 1 of 4)

1. STATE SECTOR

Status as on Oct 2009

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
Northern Region										
1	Uttar Pradesh	UPRVUNL	Obra	1	1967	40	TPE	TPE		**Work completed in May 2009**
2	Uttar Pradesh	UPRVUNL	Obra	2	1968	40	TPE	TPE		**Work completed, unit synchronised in March 2009.**
3	Uttar Pradesh	UPRVUNL	Obra	6	1973	94	BHEL	BHEL		**Work has been completed and unit has been commissioned in March 2008.**
4	Uttar Pradesh	UPRVUNL	Obra	9	1980	200	BHEL	BHEL	LMZ	Contract agreement signed with BHEL in Feb, 2007. Unit -9 taken under shut down on 2nd November 2008.
5	Uttar Pradesh	UPRVUNL	Obra	10	1979	200	BHEL	BHEL	LMZ	
6	Uttar Pradesh	UPRVUNL	Obra	11	1977	200	BHEL	BHEL	LMZ	
7	Uttar Pradesh	UPRVUNL	Obra	12	1981	200	BHEL	BHEL	LMZ	
8	Uttar Pradesh	UPRVUNL	Obra	13	1982	200	BHEL	BHEL	LMZ	
9	Uttar Pradesh	UPRVUNL	Harduaganj	5	1977	60	BHEL	BHEL		**Work completed, unit synchronised in May'08.**
10	Uttar Pradesh	UPRVUNL	Harduaganj	7	1978	110	BHEL	BHEL		Meeting with BHEL held on 28 January'09 for price negotiation. LOI issued to BHEL on 25.03.09, advance payment made in June 2009.
11	Uttar Pradesh	UPRVUNL	Parichha	1	1984	110	BHEL	BHEL		Price negotiation with BHEL is in process.
12	Uttar Pradesh	UPRVUNL	Parichha	2	1985	110	BHEL	BHEL		
13	Uttar Pradesh	UPRVUNL	Panki	3	1976	105	BHEL	BHEL		BHEL has been asked to furnish scope of work. Order will be placed during 11th Plan, completion in 12th Plan.
14	Uttar Pradesh	UPRVUNL	Panki	4	1977	105	BHEL	BHEL		

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
15	Uttar Pradesh	UPRVUNL	Anpara	1	1986	210	BHEL	BHEL	KWU	BHEL has been asked to furnish scope of work. Order will be placed during 11th Plan, completion in 12th Plan.
16	Uttar Pradesh	UPRVUNL	Anpara	2	1986	210	BHEL	BHEL	KWU	
17	Uttar Pradesh	UPRVUNL	Anpara	3	1988	210	BHEL	BHEL	KWU	
	Sub Total			**17**		**2404**				
18	Punjab	PSEB	Bathinda	3	1978	110	BHEL	BHEL		Order placed on BHEL on 06.11.2006. Work likely to be started in August 09 in unit #4. There after Unit #3 will be taken up. Rs. 471.56 Crore has been sanctioned by REC.
19	Punjab	PSEB	Bathinda	4	1979	110	BHEL	BHEL		
20	Punjab	PSEB	Ropar	1	1984	210	BHEL	BHEL	KWU	RLA completed, DPR prepared, Order expected to be placed in 2009-10. Completion in 12th Plan.
21	Punjab	PSEB	Ropar	2	1985	210	BHEL	BHEL	KWU	
	Sub Total			**4**		**640**				
22	Haryana	HPGCL	Panipat	1	1979	110	BHEL	BHEL		**Unit synchronised on 4th Nov'08.**
	Sub Total			**1**		**110**				
Sub Total Northern Region				**22**		**3154**				
Western Region										
23	Gujarat	GSECL	Ukai	1	1976	120	BHEL	BHEL		**Unit synchronised on 24th May 2008.**
24	Gujarat	GSECL	Ukai	2	1976	120	BHEL	BHEL		Unit taken under s/d for LE on 12th August'08.
25	Gujarat	GSECL	Gandhinagar	1	1977	120	BHEL	BHEL		LOI for LE works placed on BHEL on 12.10.2006. Order awarded to BHEL on 28 May 2007. Tendering process for all the BOP packages are under progress.
26	Gujarat	GSECL	Gandhinagar	2	1977	120	BHEL	BHEL		
	Sub Total			**4**		**480**				

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
27	Madhya Pradesh	MPPGCL	Amarkantak Ext.	**1**	**1977**	**120**	BHEL	BHEL		Works on 11 packages out of 12 completed. Order for Turbine package placed on NASL in July 07. Completion schedule in 2009-10.
28	Madhya Pradesh	MPPGCL	Amarkantak Ext.	2	1977	120	BHEL	BHEL		
	Sub Total			**2**		**240**				
	Sub Total Western Region			**6**		**720**				
Eastern Region										
29	Bihar	BSEB	Barauni	6	1983	110	BHEL	BHEL		Unit #6 has been restored by BHEL under Rashtriya Sam Vikas Yojana. Scope of work finalised.
30	Bihar	BSEB	Barauni	7	1985	110	BHEL	BHEL		
31	Bihar	KBUNL	Muzaffarpur	1	1985	110	BHEL	BHEL		Unit #1 has been restored under RSVY. Scope of work for LE works finalised.
32	Bihar	KBUNL	Muzaffarpur	2	1986	110	BHEL	BHEL		
33	West Bengal	WBPDCL	Bandel	5	1982	210	AVB	BHEL	LMZ	Taken up under World Bank programme, NIT floated.
	Sub Total Eastern Region			**5**		**650**				
	SUB TOTAL STATE SECTOR			**33**		**4524**				

2. CENTRAL SECTOR

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
1	NTPC	Badarpur	4	1978	210	BHEL	BHEL	LMZ	Scheme finalised. NIT floated in June '08.
2	NTPC	Badarpur	5	1981	210	BHEL	BHEL	LMZ	
3	NTPC	Singrauli STPS	1	1982	200	BHEL	BHEL	LMZ	Scheme under finalisation
4	NTPC	Singrauli STPS	2	1982	200	BHEL	BHEL	LMZ	
5	NTPC	Korba STPS	1	1983	200	BHEL	BHEL	KWU	Scheme under finalisation .
6	NTPC	Ramagundam STPS	1	1983	200	Ansaldo	Ansaldo	KWU	Scheme under finalisation
7	NTPC	Dadri GT	1	1992	131	SIEMENS			Scheme finalised.
8	NTPC	Dadri GT	2	1992	131	SIEMENS			
9	NTPC	Dadri GT	3	1992	131	SIEMENS			
10	NTPC	Auraiya GT	1	1989	111.19	MHI, Japan			Scheme finalised.
11	NTPC	Auraiya GT	2	1989	111.19	MHI, Japan			
12	NTPC	Auraiya GT	3	1989	111.19	MHI, Japan			
13	NTPC	Anta GT	1	1989	89	ABB			Work in progress. Likely to be completed during 11th Plan
14	NTPC	Anta GT	2	1989	89	ABB			
15	NTPC	Anta GT	3	1989	89	ABB			
16	NTPC	Kawas GT	1	1992	106	GE			Scheme finalised.
17	NTPC	Kawas GT	2	1992	106	GE			
18	NTPC	Kawas GT	3	1992	106	GE			
19	NTPC	Gandhar GT	1	1994	131	ABB			Scheme under advance stage of finalisation.
20	NTPC	Gandhar GT	2	1994	131	ABB			

Sub Total Central Sector	**20**		**2794**	

TOTAL OF 11TH PLAN (LE) :
NUMBER OF UNITS : 53

CAPACITY (MW) : 7318

LIST OF UNITS PROGRAMMED FOR R&M WORKS DURING 11TH PLAN.

APPENDIX-I-B
(Sheet 1 of 4)

1. STATE SECTOR

Status as on Oct 2009

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Remarks
							Boiler	TG	
Northern Region									
1	Uttar Pradesh	UPRVUNL	Anpara'B	4	1993	500	BHEL	BHEL	Scope of work yet to be finalised
2	Uttar Pradesh	UPRVUNL	Anpara'B	5	1994	500	BHEL	BHEL	
3	Uttar Pradesh	UPRVUNL	Obra	7	1974	100	BHEL	BHEL	Scope of work yet to be finalised
4	Uttar Pradesh	UPRVUNL	Obra	8	1975	100	BHEL	BHEL	
	Sub total			**4**		**1200**			
5	Punjab	PSEB	Ropar	1	1984	210	BHEL	BHEL	Work completed
6	Punjab	PSEB	Ropar	2	1985	210	BHEL	BHEL	Work completed
7	Punjab	PSEB	Ropar	3	1988	210	BHEL	BHEL	Work completed
8	Punjab	PSEB	Ropar	4	1989	210	BHEL	BHEL	Work completed
9	Punjab	PSEB	Ropar	5	1992	210	BHEL	BHEL	Work completed
10	Punjab	PSEB	Ropar	6	1993	210	BHEL	BHEL	Work completed
	Sub total			**6**		**1260**			
11	Delhi	IPGCL	Rajghat	1	1989	67.5	BHEL	BHEL	19 packages out of 55 no. completed so far.
12	Delhi	IPGCL	Rajghat	2	1989	67.5	BHEL	BHEL	
	Sub total			**2**		**135**			
Total Northern Region				**12**		**2595**			

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Remarks
							Boiler	TG	
Western Region									
13	Maharahtra	MAHAGENCO	Koradi	5	1978	200	BHEL	BHEL	Work completed
14	Maharahtra	MAHAGENCO	Koradi	6	1982	210	BHEL	BHEL	Work completed
15	Maharahtra	MAHAGENCO	Koradi	7	1983	210	BHEL	BHEL	Work completed
16	Maharahtra	MAHAGENCO	Chandrapur	1	1983	210	AVB	BHEL	Work completed
17	Maharahtra	MAHAGENCO	Chandrapur	2	1984	210	AVB	BHEL	Work completed
18	Maharahtra	MAHAGENCO	Chandrapur	3	1985	210	BHEL	BHEL	Work completed
19	Maharahtra	MAHAGENCO	Chandrapur	4	1986	210	BHEL	BHEL	Work completed
20	Maharahtra	MAHAGENCO	Chandrapur	5	1991	500	BHEL	BHEL	Work completed
21	Maharahtra	MAHAGENCO	Chandrapur	6	1992	500	BHEL	BHEL	Work completed
22	Maharahtra	MAHAGENCO	Parli	3	1980	210	BHEL	BHEL	Work completed
23	Maharahtra	MAHAGENCO	Parli	4	1985	210	BHEL	BHEL	Work completed
24	Maharahtra	MAHAGENCO	Parli	5	1987	210	BHEL	BHEL	Work completed
	Sub total			**12**		**3090**			
Total Western Region				**12**		**3090**			
Eastern Region									
25	Jharkhand	JSEB	Patratu	9	1984	110	BHEL	BHEL	Restoration work being carried out by BHEL,
26	Jharkhand	JSEB	Patratu	10	1986	110	BHEL	BHEL	
	Sub total			**2**		**220**			
27	West Bengal	DPL	Durgapur	6	1985	110	AVB	BHEL	Work in progress.
	Sub total			**1**		**110**			
Total Eastern Region				**3**		**330**			
TOTAL STATE SECTOR				**27**		**6015**			

2. CENTRAL SECTOR

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Remarks
						Boiler	TG	
1	NTPC	Unchahar	1	1988	210	BHEL	BHEL	12 packages out of 36 no. completed so far.
2	NTPC	Unchahar	2	1989	210	BHEL	BHEL	
3	NTPC	Tanda	1	1988	110	BHEL	BHEL	205 packages out of 225 packages completed so far.
4	NTPC	Tanda	2	1989	110	BHEL	BHEL	
5	NTPC	Tanda	3	1990	110	BHEL	BHEL	
6	NTPC	Tanda	4	1998	110	BHEL	BHEL	
7	NTPC	Rihand	1	1988	500	BHEL	BHEL	Work in progress, 9 packages out of 29 no. completed so far.
8	NTPC	Rihand	2	1989	500	BHEL	BHEL	
9	NTPC	Farakka	1	1986	200	BHEL	BHEL	41 packages out of 46 no. completed so far.
10	NTPC	Farakka	2	1986	200	BHEL	BHEL	
11	NTPC	Farakka	3	1987	200	BHEL	BHEL	
12	NTPC	Farakka Stg-II	4	1992	500	BHEL	BHEL	Scope of work under finalisation by NTPC.
13	NTPC	Farakka Stg-II	5	1994	500	BHEL	BHEL	
14	NTPC	Singrauli	1	1982	200	BHEL	BHEL	86 packages out of 117 no. completed so far.
15	NTPC	Singrauli	2	1982	200	BHEL	BHEL	
16	NTPC	Singrauli	3	1983	200	BHEL	BHEL	
17	NTPC	Singrauli	4	1983	200	BHEL	BHEL	
18	NTPC	Singrauli	5	1984	200	BHEL	BHEL	
19	NTPC	Singrauli	6	1986	500	BHEL	BHEL	
20	NTPC	Singrauli	7	1987	500	BHEL	BHEL	
21	NTPC	Korba STPS	1	1983	200	BHEL	BHEL	60 packages out of total 69 packages completed so far.
22	NTPC	Korba STPS	2	1983	200	BHEL	BHEL	
23	NTPC	Korba STPS	3	1984	200	BHEL	BHEL	
24	NTPC	Korba STPS	4	1987	500	BHEL	BHEL	
25	NTPC	Korba STPS	5	1988	500	BHEL	BHEL	
26	NTPC	Korba STPS	6	1989	500	BHEL	BHEL	

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Remarks
						Boiler	TG	
27	NTPC	Vindhyachal	1	1987	210	USSR	USSR	25 packages out of 27 packages completed so far.
28	NTPC	Vindhyachal	2	1987	210	USSR	USSR	
29	NTPC	Vindhyachal	3	1989	210	USSR	USSR	
30	NTPC	Vindhyachal	4	1990	210	USSR	USSR	
31	NTPC	Vindhyachal	5	1990	210	USSR	USSR	
32	NTPC	Vindhyachal	6	1991	210	USSR	USSR	
33	NTPC	Ramagundem	1	1983	200	ANSA	ANSA	52 packages out of 56 no. packages completed so far.
34	NTPC	Ramagundem	2	1984	200	ANSA	ANSA	
35	NTPC	Ramagundem	3	1984	200	ANSA	ANSA	
36	NTPC	Ramagundem	4	1988	500	USSR	USSR	
37	NTPC	Ramagundem	5	1989	500	BHEL	BHEL	
38	NTPC	Ramagundem	6	1989	500	BHEL	BHEL	
39	NTPC	Talcher TPS	5	1982	110	BHEL	BHEL	
40	NTPC	Talcher TPS	6	1983	110	BHEL	BHEL	
41	NTPC	NCTPP, Dadri	1	1992	210	BHEL	BHEL	scope of work finalised by NTPC, likely placement of order in May 2009.
42	NTPC	NCTPP, Dadri	2	1992	210	BHEL	BHEL	
43	NTPC	NCTPP, Dadri	3	1993	210	BHEL	BHEL	
44	NTPC	NCTPP, Dadri	4	1994	210	BHEL	BHEL	
45	NTPC	Kahalgaon	1	1992	210	BHEL	BHEL	scope of work under finalisation by NTPC.
46	NTPC	Kahalgaon	2	1994	210	BHEL	BHEL	
47	NTPC	Kahalgaon	3	1995	210	BHEL	BHEL	
	Sub Total		**47**		**12610**			
48	DVC	Durgapur	3	1966	130	B&W, UK	GE,USA	Work completed
49	DVC	Durgapur	4	1984	210	BHEL	BHEL	Work completed
	Sub Total		**2**		**340**			
TOTAL CENTRAL SECTOR			**49**		**12950**			

TOTAL OF 11TH PLAN (R&M) :
NUMBER OF UNITS : 76
CAPACITY (MW) 18965

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
11	Maharashtra	MAHAGENCO	Koradi	5	1978	210	BHEL	BHEL	LMZ	
12	Maharashtra	MAHAGENCO	Koradi	6	1982	200	BHEL	BHEL	LMZ	Being taken up under W.Bank EE R&M programme.
13	Maharashtra	MAHAGENCO	Bhusawal	2	1979	210	BHEL	BHEL	LMZ	
14	Maharashtra	MAHAGENCO	Bhusawal	3	1982	210	BHEL	BHEL	LMZ	
15	Maharashtra	MAHAGENCO	Chandrapur	1	1983	210	BHEL	BHEL	LMZ	
16	Maharashtra	MAHAGENCO	Chandrapur	2	1984	210	BHEL	BHEL	LMZ	
17	Maharashtra	MAHAGENCO	Parli	3	1980	210	BHEL	BHEL	LMZ	
	Sub Total			**9**		**1880**				
18	Chattisgarh	CSEB	Korba (West)	1	1983	210	BHEL	BHEL	KWU	
19	Chattisgarh	CSEB	Korba (West)	2	1984	210	BHEL	BHEL	KWU	
	Sub Total			**2**		**420**				
20	Madhya Pradesh	MPPGCL	Satpura	6	1979	200	BHEL	BHEL	LMZ	
21	Madhya Pradesh	MPPGCL	Satpura	7	1979	210	BHEL	BHEL	LMZ	
	Sub Total			**2**		**410**				
	Sub Total Western Region			**17**		**3530**				
Southern Region										
22	Tamil Nadu	TNEB	Tuticorin	1	1979	210	BHEL	BHEL	LMZ	
23	Tamil Nadu	TNEB	Tuticorin	2	1980	210	BHEL	BHEL	LMZ	
	Sub Total			**2**		**420**				

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
							Boiler	TG		
18	Chattisgarh	CSEB	Korba (West)	1	1983	210	BHEL	BHEL	KWU	
24	Andhra Pradesh	APGENCO	Dr. N.T. TPS (Vijaywada)	1	1979	210	BHEL	BHEL	LMZ	
25	Andhra Pradesh	APGENCO	Dr. N.T. TPS (Vijaywada)	2	1980	210	BHEL	BHEL	LMZ	
	Sub Total			**2**		**420**				
26	Karnataka	KPCL	Raichur	1	1985	210	BHEL	BHEL	KWU	
27	Karnataka	KPCL	Raichur	2	1986	210	BHEL	BHEL	KWU	
	Sub Total			**2**		**420**				
	Sub Total Southern Region			**6**		**1260**				
Eastern Region										
28	West Bengal	WBPDCL	Kolaghat	1	1990	210	AVB	BHEL	LMZ	
29	West Bengal	WBPDCL	Kolaghat	2	1985	210	AVB	BHEL	LMZ	
30	West Bengal	WBPDCL	Kolaghat	3	1984	210	AVB	BHEL	LMZ	Taken up under KfW funded EER&M programme.
	Sub Total			**3**		**630**				
	Sub Total Eastern Region			**3**		**630**				

SUB TOTAL STATE SECTOR	**30**		**5860**					

2. CENTRAL SECTOR

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
1	NLC	Neyveli M/C	1	1988	210	TE	FT	KWU	
2	NLC	Neyveli M/C	2	1987	210	TE	FT	KWU	
3	NLC	Neyveli M/C	3	1986	210	TE	FT	KWU	
	Sub Total		**3**		**630**				
4	DVC	Bokaro 'B'	1	1986	210	ABL	BHEL	LMZ	Taken up under KfW funded EER&M programme. Feasibility study report / DPR under preparation
5	DVC	Bokaro 'B'	2	1990	210	ABL	BHEL	LMZ	
6	DVC	Bokaro 'B'	3	1993	210	ABL	BHEL	LMZ	
7	DVC	Durgapur	4	1982	210	BHEL	BHEL	LMZ	
	Sub Total		**4**		**840**				
8	NTPC	Singrauli STPS	3	1983	200	BHEL	BHEL	LMZ	
9	NTPC	Singrauli STPS	4	1983	200	BHEL	BHEL	LMZ	
10	NTPC	Singrauli STPS	5	1984	200	BHEL	BHEL	LMZ	
11	NTPC	Singrauli STPS	6	1986	500	BHEL	BHEL	KWU	
12	NTPC	Singrauli STPS	7	1987	500	BHEL	BHEL	KWU	
13	NTPC	Korba STPS	2	1983	200	BHEL	BHEL	KWU	
14	NTPC	Korba STPS	3	1984	200	BHEL	BHEL	KWU	
15	NTPC	Korba STPS	4	1987	500	BHEL	BHEL	KWU	

APPENDIX-II-A
(Sheet 5 of 6)

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
16	NTPC	Korba STPS	5	1988	500	BHEL	BHEL	KWU	
17	NTPC	Korba STPS	6	1989	500	BHEL	BHEL	KWU	
18	NTPC	Ramagundam STPS	2	1984	200	Ansaldo	Ansaldo	KWU	
19	NTPC	Ramagundam STPS	3	1984	200	Ansaldo	Ansaldo	KWU	
20	NTPC	Ramagundam STPS	4	1988	500	BHEL	BHEL	KWU	
21	NTPC	Ramagundam STPS	5	1989	500	BHEL	BHEL	KWU	
22	NTPC	Ramagundam STPS	6	1989	500	BHEL	BHEL	KWU	
23	NTPC	Farakka Stage-I	1	1986	200	BHEL	BHEL	KWU	
24	NTPC	Farakka Stage-I	2	1986	200	BHEL	BHEL	KWU	
25	NTPC	Farakka Stage-I	3	1987	200	BHEL	BHEL	KWU	
26	NTPC	Vindhyachal	1	1987	210	USSR	USSR	LMZ	
27	NTPC	Vindhyachal	2	1988	210	USSR	USSR	LMZ	
28	NTPC	Vindhyachal	4	1990	210	USSR	USSR	LMZ	
29	NTPC	Vindhyachal	5	1990	210	USSR	USSR	LMZ	
30	NTPC	Rihand	1	1988	500	ICL (UK)	GEC(UK)	KWU	
31	NTPC	Rihand	2	1989	500	ICL (UK)	GEC(UK)	KWU	

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		LMZ / KWU	Remarks
						Boiler	TG		
32	NTPC	Dadri GT	GT-4	1992	131	SIEMENS			
33	NTPC	Auraiya GT	GT-4	1989	111.19	MHI, Japan			
34	NTPC	Kawas GT	GT-4	1992	106	GE			
35	NTPC	Gandhar GT	GT-3	1994	131	ABB			
36	NTPC	Faridabad CCPS	GT-1	1999	143	Siemens			
37	NTPC	Faridabad CCPS	GT-2	1999	143	BHEL			
38	NTPC	Rajiv Gandhi CCPS	GT-1	1998	115	GE			
39	NTPC	Rajiv Gandhi CCPS	GT-2	1999	115	BHEL			
40	NTPC	Anta GTPS	ST-1	1990	149	ABB			
41	NTPC	Auraiya CCPS	ST-1	1989	109	MHI, Japan			
42	NTPC	Auraiya CCPS	ST-2	1990	109	MHI, Japan			
	Sub Total		**35**		**9202.19**				
	SUB TOTAL CENTRAL SECTOR		**42**		**10672.19**				

TOTAL OF 12TH PLAN (LE) :
NUMBER OF UNITS : 72
CAPACITY (MW) : 16532.19

LIST OF UNITS PROGRAMMED FOR R&M WORKS DURING 12TH PLAN.

APPENDIX-II-B

1. STATE SECTOR

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make	
							Boiler	TG
Northern Region								
1	Punjab	PSEB	Ropar	5	1992	210	BHEL	BHEL
2	Punjab	PSEB	Ropar	6	1993	210	BHEL	BHEL
	Sub total			**2**		**420**		
3	Haryana	HPGCL	Panipat	6	2001	210	BHEL	BHEL
Total Northern Region				**3**		**630**		
TOTAL STATE SECTOR				**3**		**630**		

2. CENTRAL SECTOR

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make	
						Boiler	TG
1	NTPC	Unchahar	3	1999	210	BHEL	BHEL
2	NTPC	Unchahar	4	1999	210	BHEL	BHEL
3	NTPC	Vindhyachal	7	1999	210	BHEL	BHEL
4	NTPC	Vindhyachal	8	2000	210	BHEL	BHEL
5	NTPC	Simhadri	1	2002	500	BHEL	BHEL
6	NTPC	Simhadri	2	2002	500	BHEL	BHEL
7	NTPC	Kahalgaon	4	1996	210	BHEL	BHEL
8	NTPC	Talcher STPS	1	1995	500	BHEL	BHEL
9	NTPC	Talcher STPS	2	1996	500	BHEL	BHEL
10	NTPC	Talcher STPS	3	2003	500	BHEL	BHEL
11	NTPC	Talcher STPS	4	2003	500	BHEL	BHEL
	Sub Total		**11**		**4050**		

Sl. No.	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make
12	NEEPCO	Kathalguri CCGT	GT-1	1995	33.50	Mitsubishi, Japan
13	NEEPCO	Kathalguri CCGT	GT-2	1995	33.50	Mitsubishi, Japan
14	NEEPCO	Kathalguri CCGT	GT-3	1995	33.50	Mitsubishi, Japan
15	NEEPCO	Kathalguri CCGT	GT-4	1995	33.50	Mitsubishi, Japan
16	NEEPCO	Kathalguri CCGT	GT-5	1996	33.50	Mitsubishi, Japan
17	NEEPCO	Kathalguri CCGT	GT-6	1996	33.50	Mitsubishi, Japan
18	NEEPCO	Kathalguri CCGT	ST-1	1998	30.00	BHEL
19	NEEPCO	Kathalguri CCGT	ST-2	1998	30.00	BHEL
20	NEEPCO	Kathalguri CCGT	ST-3	1998	30.00	BHEL
	Sub Total		**9**		**291.00**	
TOTAL CENTRAL SECTOR			**20**		**4341.00**	

TOTAL OF 12TH PLAN (R&M) :
NUMBER OF UNITS : 23

CAPACITY (MW) : 4971

DETAILS OF LMZ UNITS INSTALLED IN THE COUNTRY
(POTENTIAL CANDIDATES FOR EE R&M)

APPENDIX - III
(Sheet 1 of 6)

Sl. No.	State / Utility	Name of TPS	Unit No.	Capacity (MW)	Date of Comm.	Make		Age (Years) as on 31.3.09	Remarks
						Boiler	T.G.		
1	UPRVUNL	OBRA	11	200	31/12/77	BHEL	BHEL	31.3	Being taken up during 11 th Plan, Order placed on BHEL
2	MSPGCL	KORADI	5	200	15/07/78	BHEL	BHEL	30.7	Identified for 12th Plan
3	NTPC	BADARPUR	4	210	02/12/78	BHEL	BHEL	30.3	Identified for 11th Plan.
4	UPRVUNL	OBRA	10	200	14/01/79	BHEL	BHEL	30.2	Being taken up during 11 th Plan, Order placed on BHEL
5	GSECL	UKAI	3	200	21/01/79	BHEL	BHEL	30.2	Identified for 12th Plan
6	GSECL	UKAI	4	200	28/03/79	BHEL	BHEL	30.0	Identified for 12th Plan
7	MPEB	SATPURA	6	200	30/03/79	BHEL	BHEL	30.0	Identified for 12th Plan
8	MSPGCL	NASIK	3	210	26/04/79	BHEL	BHEL	30.0	Identified for 12th Plan, under KfW funded EE R&M programme.
9	TNEB	TUTICORIN	1	210	09/07/79	BHEL	BHEL	29.7	Identified for 12th Plan
10	MSPGCL	BHUSAWAL	2	210	30/08/79	BHEL	BHEL	29.6	Identified for 12th Plan
11	APGENCO	VIJAYAWADA	1	210	01/11/79	BHEL	BHEL	29.4	Identified for 12th Plan
12	UPRVUNL	OBRA	9	200	27/01/80	BHEL	BHEL	29.2	Being taken up during 11 th Plan, Order placed on BHEL

APPENDIX - III
(Sheet 2 of 6)

Sl No.	State / Utility	Name of TPS	Unit No.	Capacity (MW)	Date of Comm.	Make		Age (Years) as on 31.3.09	Remarks
						Boiler	T.G.		
13	MSPGCL	NASIK	4	210	10/07/80	BHEL	BHEL	28.7	Identified for 12th Plan
14	MPEB	SATPURA	7	210	20/09/80	BHEL	BHEL	28.5	Identified for 12th Plan
15	MSPGCL	PARLI	3	210	20/09/80	BHEL	BHEL	28.5	Identified for 12th Plan
16	APGENCO	VIJAYAWADA	2	210	10/10/80	BHEL	BHEL	28.5	Identified for 12th Plan
17	TNEB	TUTICORIN	2	210	17/12/80	BHEL	BHEL	28.3	Identified for 12th Plan
18	MSPGCL	NASIK	5	210	31/01/81	BHEL	BHEL	28.2	
19	UPRVUNL	OBRA	12	200	28/03/81	BHEL	BHEL	28.0	Being taken up during 11 th Plan, Order placed on BHEL
20	DVC	DURGAPUR	4	210	12/05/81	BHEL	BHEL	27.9	Identified for 12th Plan
21	NTPC	BADARPUR	5	210	25/12/81	BHEL	BHEL	27.3	Identified for 11th Plan.
22	NTPC	SINGRAULI	1	200	14/02/82	BHEL	BHEL	27.1	Identified for 11th Plan.
23	MSPGCL	KORADI	6	210	30/03/82	BHEL	BHEL	27.0	Identified for 12th Plan, under W.Bank funded EE R&M programme.
24	TNEB	TUTICORIN	3	210	16/04/82	BHEL	BHEL	27.0	

APPENDIX - III
(Sheet 3 of 6)

Sl No.	State / Utility	Name of TPS	Unit No.	Capacity (MW)	Date of Comm.	Make		Age (Years) as on 31.3.09	Remarks
						Boiler	TG		
25	MSPGCL	BHUSAWAL	3	210	04/05/82	BHEL	BHEL	26.9	Identified for 12th Plan
26	UPRVUNL	OBRA	13	200	21/07/82	BHEL	BHEL	26.7	Being taken up during 11 th Plan, Order placed on BHEL
27	WBPDC	BANDEL	5	210	10/08/82	AVB	BHEL	26.7	Identified for 11th Plan, under W. Bank funded EE R&M programme.
28	NTPC	SINGRAULI	2	200	25/11/82	BHEL	BHEL	26.4	Identified for 11th Plan.
29	MSPGCL	KORADI	7	210	13/01/83	BHEL	BHEL	26.2	
30	MPEB	SATPURA	8	210	25/01/83	BHEL	BHEL	26.2	
31	NTPC	SINGRAULI	4	200	11/02/83	BHEL	BHEL	26.2	Identified for 12th Plan
32	NTPC	SINGRAULI	3	200	28/03/83	BHEL	BHEL	26.0	Identified for 12th Plan
33	MSPGCL	CHANDRAPUR	1	210	15/08/83	AVB	BHEL	25.6	Identified for 12th Plan
34	WBPDC	KOLAGHAT	3	210	24/01/84	AVB	BHEL	25.2	Identified for 12th Plan
35	NTPC	SINGRAULI	5	200	26/02/84	BHEL	BHEL	25.1	Identified for 12th Plan
36	MPEB	SATPURA	9	210	27/02/84	BHEL	BHEL	25.1	
37	MSPGCL	CHANDRAPUR	2	210	17/07/84	AVB	BHEL	24.7	Identified for 12th Plan

Sl No.	State / Utility	Name of TPS	Unit No.	Capacity (MW)	Date of Comm.	Make		Age (Years) as on 31.3.09	Remarks
						Boiler	TG		
38	GSECL	UKAI	5	210	30/01/85	BHEL	BHEL	24.2	
39	MSPGCL	PARLI	4	210	26/03/85	BHEL	BHEL	24.0	
40	MSPGCL	CHANDRAPUR	3	210	03/05/85	BHEL	BHEL	23.9	
41	WBPDC	KOLAGHAT	2	210	16/12/85	AVB	BHEL	23.3	Identified for 12th Plan
42	MSPGCL	CHANDRAPUR	4	210	08/03/86	BHEL	BHEL	23.1	
43	DVC	BOKARO “B”	1	210	24/03/86	ABL	BHEL	23.0	Identified for 12th Plan
44	TNEB	METTUR	1	210	04/01/87	BHEL	BHEL	22.3	
45	NTPC	VINDHYACHAL	2	210	20/07/87	USSR	USSR	21.7	Identified for 12th Plan
46	NTPC	VINDHYACHAL	1	210	10/10/87	USSR	USSR	21.5	Identified for 12th Plan
47	TNEB	METTUR	2	210	01/12/87	BHEL	BHEL	21.3	
48	MSPGCL	PARLI	5	210	31/12/87	BHEL	BHEL	21.3	

Sl No.	State / Utility	Name of TPS	Unit No.	Capacity (MW)	Date of Comm.	Make		Age (Years) as on 31.3.09	Remarks
						Boiler	TG		
49	NTPC	VINDHYACHAL	3	210	03/02/89	USSR	USSR	20.2	
50	TNEB	METTUR	3	210	21/03/89	BHEL	BHEL	20.0	
51	NTPC	VINDHYACHAL	4	210	01/01/90	USSR	USSR	19.3	Identified for 12th Plan
52	TNEB	METTUR	4	210	16/02/90	BHEL	BHEL	19.1	
53	NTPC	VINDHYACHAL	5	210	21/03/90	USSR	USSR	19.0	Identified for 12th Plan
54	DVC	BOKARO “B”	2	210	11/07/90	ABL	BHEL	18.7	Identified for 12th Plan
55	WBPDC	KOLAGHAT	1	210	15/08/90	AVB	BHEL	18.6	Identified for 12th Plan
56	NTPC	VINDHYACHAL	6	210	01/02/91	USSR	USSR	18.2	
57	WBPDC	KOLAGHAT	5	210	17/03/91	BHEL	BHEL	18.1	
58	TNEB	TUTICORIN	5	210	31/03/91	BHEL	BHEL	18.0	
59	NTPC	KAHALGAON	1	210	31/03/92	USSR	USSR	17.0	

Sl No.	State / Utility	Name of TPS	Unit No.	Capacity (MW)	Date of Comm.	Make		Age (Years) as on 31.3.09	Remarks
						Boiler	TG		
60	TNEB	TUTICORIN	4	210	02/11/92	BHEL	BHEL	16.4	
61	WBPDC	KOLAGHAT	6	210	16/01/93	BHEL	BHEL	16.2	
62	DVC	BOKARO "B"	3	210	31/03/93	ABL	BHEL	16.0	Identified for 12th Plan, under KfW funded EE R&M programme.
63	WBPDC	KOLAGHAT	4	210	28/12/93	BHEL	BHEL	15.3	
64	NTPC	KAHALGAON	2	210	17/03/94	USSR	USSR	15.0	
65	NTPC	KAHALGAON	3	210	24/03/95	USSR	USSR	14.0	
66	NTPC	KAHALGAON	4	210	18/03/96	USSR	USSR	13.0	
		TOTAL		**13720**					

FUND REQUIREMENT FOR R&M / L. E. WORKS IN STATE SECTOR DURING 11TH PLAN .

APPENDIX-IV-A

1. R&M WORKS

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Estimated Cost (Rs. Cr.)	Expenditure incurred (Rs.Cr.)	Balance fund requirement (Rs. Cr.)	Remarks
1	Uttar Pradesh	UPRVUNL	Anpara'B	4	1993	500	750.00	0.00	750.00	
2	Uttar Pradesh	UPRVUNL	Anpara'B	5	1994	500				
3	Uttar Pradesh	UPRVUNL	Obra	7	1974	100	200.00	0.00	200.00	
4	Uttar Pradesh	UPRVUNL	Obra	8	1975	100				
	SUB TOTAL R&M WORKS			**4**		**1200**	**950.00**	**0.00**	**950.00**	

2. LE WORKS WITHOUT UPGRADATION

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Estimated Cost (Rs. Cr.)	Expenditure incurred (Rs. Cr.)	Balance fund requirement (Rs. Cr.)	Remarks
1	Uttar Pradesh	UPRVUNL	Parichha	1	1984	110	275.00	0.00	275.00	
2	Uttar Pradesh	UPRVUNL	Parichha	2	1985	110				
3	Uttar Pradesh	UPRVUNL	Anpara	1	1986	210	787.50	0.00	787.50	
4	Uttar Pradesh	UPRVUNL	Anpara	2	1986	210				
5	Uttar Pradesh	UPRVUNL	Anpara	3	1988	210				
	Sub Total			**5**		**850**	**1062.50**	**0.00**	**1062.50**	
6	Punjab	PSEB	Ropar	1	1984	210	800.00	1.94	798.06	DPR prepared
7	Punjab	PSEB	Ropar	2	1985	210				
	Sub Total			**2**		**420**	**800.00**	**1.94**	**798.06**	
8	Gujarat	GSECL	Gandhinagar	1	1977	120	429.40	28.50	400.90	Order Placed
9	Gujarat	GSECL	Gandhinagar	2	1977	120				
	Sub Total			**2**		**240**	**429.40**	**28.50**	**400.90**	
10	Madhya Pradesh	MPPGCL	Amarkantak Ext.	1	1977	120	124.30	51.38	72.92	Order Placed
11	Madhya Pradesh	MPPGCL	Amarkantak Ext.	2	1977	120				
	Sub Total			**2**		**240**	**124.30**	**51.38**	**72.92**	
	SUB TOTAL LE WORKS WITH UPGRADATION			**11**		**1750**	**2416.20**	**81.82**	**2334.38**	

3. LE WORKS WITH UPGRADATION

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Estimated Cost (Rs. Cr.)	Expenditure incurred (Rs. Cr.)	Balance fund requirement (Rs. Cr.)	Remarks
	INDIGENOUS FUNDING									
1	Uttar Pradesh	UPRVUNL	Obra	9	1980	200	1635.00	646.00	989.00	Order Placed
2	Uttar Pradesh	UPRVUNL	Obra	10	1979	200				
3	Uttar Pradesh	UPRVUNL	Obra	11	1977	200				
4	Uttar Pradesh	UPRVUNL	Obra	12	1981	200				
5	Uttar Pradesh	UPRVUNL	Obra	13	1982	200				
6	Uttar Pradesh	UPRVUNL	Harduaganj	7	1978	110	392.00	0.00	392.00	Order Placed
7	Uttar Pradesh	UPRVUNL	Panki	3	1976	105	550.00	0.00	550.00	
8	Uttar Pradesh	UPRVUNL	Panki	4	1977	105				
	Sub Total			**8**		**1320**	**2577.00**	**646.00**	**1931.00**	
9	Punjab	PSEB	Bathinda	3	1978	110	465.36	40.65	424.71	Order Placed
10	Punjab	PSEB	Bathinda	4	1979	110				
	Sub Total			**2**		**220**	**465.36**	**40.65**	**424.71**	
	Sub Total			**10**		**1540**	**3042.36**	**686.65**	**2355.71**	
	EXTERNAL FUNDING									
11	West Bengal	WBPDC	Bandel	5	1982	210	450.00	0.00	450.00	W. Bank funded
	Sub Total			**1**		**210**	**450.00**	**0.00**	**450.00**	
	SUB TOTAL LE WORKS WITH UPGRADATION			**11**		**1750**	**3492.36**	**686.65**	**2805.71**	
	SUB TOTAL LE WORKS			**22**		**3500**	**5908.56**	**768.47**	**5140.09**	
	TOTAL OF R&M AND LE WORKS			**26**		**4700**	**6858.56**	**768.47**	**6090.09**	

Note :
For above calculation units where works have been completed or nearing completion have not been considered.
The units of Muzaffarpur and Barauni TPS for which funding from RSVY (Planning commission) have been sanctioned.

TENTATIVE FUND REQUIREMENT FOR R&M / L. E. WORKS DURING 12TH PLAN AND SOURCES.

APPENDIX-IV-B

1. R&M WORKS

Status as on July 2009

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Estimated Cost (Rs.Cr.)	Remarks
							Boiler	TG		
1	Punjab	PSEB	Ropar	5	1992	210	BHEL	BHEL	210.00	
2	Punjab	PSEB	Ropar	6	1993	210	BHEL	BHEL	210.00	
3	Haryana	HPGCL	Panipat	6	2001	210	BHEL	BHEL	210.00	
	TOTAL R&M					**630**			**630.00**	

2. LE WORKS WITH UPGRADATION

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Estimated Cost (Rs.Cr.)	Remarks
							Boiler	TG		
INDIGENOUS FUNDING										
1	Rajasthan	RRVUNL	Kota	1	1983	110	BHEL	BHEL	220.00	
2	Rajasthan	RRVUNL	Kota	2	1983	110	BHEL	BHEL	220.00	
3	Gujarat	GSECL	Wanakbori	1	1982	210	BHEL	BHEL	420.00	
4	Gujarat	GSECL	Wanakbori	2	1983	210	BHEL	BHEL	420.00	
5	Chattisgarh	CSEB	Korba (West)	1	1983	210	BHEL	BHEL	420.00	
6	Chattisgarh	CSEB	Korba (West)	2	1984	210	BHEL	BHEL	420.00	
7	Madhya Pradesh	MPPGCL	Satpura	7	1979	210	BHEL	BHEL	420.00	
8	Andhra Pradesh	APGENCO	Dr. N.T TPS (Vijayawada)	1	1979	210	BHEL	BHEL	420.00	
9	Andhra Pradesh	APGENCO	Dr. N.T TPS (Vijayawada)	2	1980	210	BHEL	BHEL	420.00	
10	Karnataka	KPCL	Raichur	2	1986	210	BHEL	BHEL	420.00	
11	Tamil Nadu	TNEB	Tuticorin	1	1979	210	BHEL	BHEL	420.00	
12	Tamil Nadu	TNEB	Tuticorin	2	1980	210	BHEL	BHEL	420.00	
	SUB TOTAL			**12**		**2320**			**4640.00**	

APPENDIX-IV-B

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Estimated Cost (Rs.Cr.)	Remarks
							Boiler	TG		
EXTERNAL FUNDING										
1	***Haryana***	***HPGCL***	***Panipat***	***3***	***1985***	***110***	***BHEL***	***BHEL***	***220.00***	***W. Bank funded***
2	***Haryana***	***HPGCL***	***Panipat***	***4***	***1985***	***110***	***BHEL***	***BHEL***	***220.00***	***W. Bank funded***
3	Gujarat	GSECL	Ukai	3	1979	200	BHEL	BHEL	400.00	yet to be decided
4	Gujarat	GSECL	Ukai	4	1779	200	BHEL	BHEL	400.00	yet to be decided
5	***Maharashtra***	***MAHAGENCO***	***Nashik***	***3***	***1979***	***210***	***BHEL***	***BHEL***	***420.00***	***KfW funded***
6	Maharashtra	MAHAGENCO	Nashik	4	1980	210	BHEL	BHEL	420.00	yet to be decided
7	Maharashtra	MAHAGENCO	Koradi	5	1978	210	BHEL	BHEL	420.00	yet to be decided
8	***Maharashtra***	***MAHAGENCO***	***Koradi***	***6***	***1982***	***200***	***BHEL***	***BHEL***	***400.00***	***W. Bank funded***
9	Maharashtra	MAHAGENCO	Bhusawal	2	1979	210	BHEL	BHEL	420.00	Likely W.B.fund
10	Maharashtra	MAHAGENCO	Bhusawal	3	1982	210	BHEL	BHEL	420.00	yet to be decided
11	Maharashtra	MAHAGENCO	Chandrapur	1	1983	210	BHEL	BHEL	420.00	Likely W.B.fund
12	Maharashtra	MAHAGENCO	Chandrapur	2	1984	210	BHEL	BHEL	420.00	yet to be decided
13	Maharashtra	MAHAGENCO	Parli	3	1980	210	BHEL	BHEL	420.00	Likely W.B.fund
14	Madhya Pradesh	MPPGCL	Satpura	6	1979	200	BHEL	BHEL	400.00	yet to be decided
15	Karnataka	KPCL	Raichur	1	1985	210	BHEL	BHEL	420.00	Likely W.B.fund
16	West Bengal	WBPDCL	Kolaghat	1	1990	210	AVB	BHEL	420.00	yet to be decided
17	West Bengal	WBPDCL	Kolaghat	2	1985	210	AVB	BHEL	420.00	yet to be decided
18	***West Bengal***	***WBPDCL***	***Kolaghat***	***3***	***1984***	***210***	***AVB***	***BHEL***	***420.00***	***KfW funded***
	Sub Total			**18**		**3540**			**7080.00**	

Sl. No.	State	Name of Utility	Name of Station	Unit No.	Year of Comm.	Capacity (MW)	Make		Estimated Cost (Rs.Cr.)	Remarks
							Boiler	TG		
EXTERNAL FUNDING										
DVC Projects										
19	Jharkhand	DVC	Bokaro'B	1	1986	210	BHEL	BHEL	420.00	yet to be decided
20	Jharkhand	DVC	Bokaro'B	2	1990	210	BHEL	BHEL	420.00	yet to be decided
21	***Jharkhand***	***DVC***	***Bokaro'B***	***3***	***1993***	***210***	***BHEL***	***BHEL***	***420.00***	***KfW funded***
22	West Bengal	DVC	Durgapur	4	1982	210	BHEL	BHEL	420.00	yet to be decided
	Sub Total			**4**		**840**			**1680.00**	
	SUB TOTAL (External)			**22**		**4380**			**8760.00**	
	TOTAL OF LE			**34**		**6700**			**13400.00**	
	TOTAL OF R&M AND LE			**37**		**7330**			**14030.00**	

Note : Italics indicate units where fund tied up from external agencies.

ANNEXURE-A

Government of India
Ministry of Power
Central Electricity Authority

GUIDELINES FOR RENOVATION AND MODERNISATION / LIFE EXTENTION WORKS

OF

COAL/LIGNITE BASED THERMAL POWER STATIONS

October 2009

T A B L E O F C O N T E N T S

1.0 BACKGROUND

1.1 Coal based thermal power generation provides a major share of power availability in the country. More than 69 % of total generation comes from coal/ lignite based power plants. At present, the maximum thermal generation (73 % of thermal generation) comes from coal / lignite units of 200/210MW and above capacity. The first 200 MW unit was installed at Obra in 1977. Prior to that, the units were of smaller size and many of these were of non-reheat type with lower efficiency. Over a period of past few decades there has been growth in the size of thermal units and in steam parameters resulting in plant's better efficiency.

1.2 Renovation and Modernisation (R&M) and Life Extension (LE) have been recognized as cost effective options to achieve additional generation from existing units at low cost and in shorter period.

1.3 A centrally sponsored R&M Programme was launched in 1984 as Phase-I programme for which financial assistance for implementing R&M works was provided by Govt. of India. The R&M programme continued albeit in a different form subsequently during 9^{th} & 10^{th} plan periods with resultant improved performance from thermal generating units.

1.4 Presently, a large existing capacity i.e. 129 units of total capacity 26283 MW and 95 units of total capacity 21212 MW has been identified for R&M/LE works during 11^{th} plan and 12^{th} plan period. The old and small size units of early post-independence period were based on technology as available at that time having a very low efficiency. These units are therefore near obsolescence. The LMZ Russian design larger size units (200/210MW) and initial KWU design machines are now in fag end of their economic life span. Further, though there has been gradual improvement in plant load factor over the years, there exists a lot of scope for further improvement. These groups of 200/210 MW machines (LMZ design and early KWU design machines) constitute a major chunk of R&M/LE programme in the 11^{th} plan and beyond.

2.0 INTENT OF RENOVATION & MODERNISATION (R&M)/LIFE EXTENSION (LE) PROGRAMME

2.1 There has been substantial increase in capacity addition in the successive five year plans of the country, yet there still exists a gap between demand and availability of power. The new installation being capital intensive, it is considered prudent to maximise the generation from the existing power stations to ensure optimal utilisation of resources. This would involve replacement of the existing obsolete items of equipment in operation with those with more efficient and of latest designs incorporating the state-of-the-art technologies and improved metallurgy.

2.2 Many thermal power stations in the country were designed for a given quality of coal, which has deteriorated over a period of time. The design PLF was also based on the norms prevailing at that time which is below rated value. The capacity of the raw coal feeding system, pulverizers, primary air fan system, ash handling system etc., for these power stations may have to be augmented to maintain the rated capacity of the boiler, provided the furnace size is adequate to burn the coal

of deteriorated quality.

2.3 The environmental regulations are becoming more and more stringent day by day. The plants which were designed earlier were provided with less effective environmental systems which do not meet the present day standards, requiring either refurbishing the systems or complete replacement.

2.4 The R&M/LE programme may be designed in such a way so as to improve the plant performance and efficiency enhancement.

3.0 NEED FOR REVISED POLICY GUIDELINES

3.1 The Government of India have accorded a high priority to the R&M and Life Extension of thermal power stations to maximise generation and improve their overall performance.

With a view to expediting the R&M/LE works during the 10^{th} Plan period, Govt of India, Ministry of Power issued guidelines vide letter No. 12/6/99-Th-3 Dated 12.1.2004 and subsequent clarification dated 3.2.2004.

3.2 However, necessity has been felt to revise the above guidelines due to the following:

i) There have been delays in achieving the desired completion targets.
ii) Constraints are being experienced in supply of materials resulting in time/cost overruns.
iii) A large number of units of 200MW capacity and above are becoming due for R&M/LE works necessitating need for more agencies to carryout R&M/LE works.
iv) The objective is shifting from 'generation maximization' to 'performance optimization and generation maximisation' with efficiency enhancement and plant uprating becoming an integral part of the life extension programme.

3.3 The above requirements call for new approach towards implementation of R&M/LE works by the utilities through identification of optimized R&M options, compressed and definite time schedule and encouraging increased participation from various executing agencies including private sector. Accordingly, the earlier guidelines have been revised to account for the above.

4.0 CONCEPT OF R&M AND LIFE EXTENSION PROGRAMME OF THERMAL (COAL/LIGNITE BASED) POWER STATIONS

4.1 RENOVATION AND MODERNISATION (R&M) PROGRAMME

4.1.1 The main objective of R&M of power generating units is to make the operating units well equipped with modified / augmented latest technology equipment /components/ systems with a view to improving their performance in terms of output, reliability and availability to the original design values, reduction in

maintenance requirements, ease of maintenance and enhanced efficiency.

4.1.2 However, R&M is not a substitute for regular annual or capital maintenance/overhaul which forms a part of operation and maintenance (O&M) activity. Middle life R&M come up preferably after 100000 hrs. of operation.

4.1.3 The R&M programme is primarily aimed at generation sustenance and overcoming problems due to:

- Generic defects.
- Design deficiencies /modifications.
- Avoidance of inefficient operation
- Non-availability of spares because of obsolescence of equipment / components.
- Poor quality of coal.
- Major replacements of equipment arising due to unforeseen failures and /or generation sustenance not covered under regular O&M.
- Stringent environmental regulation.
- Safety requirements etc.

4.2 R&M PROGRAMME WITH LIFE EXTENSION (LE) & UPRATING (LE&U)

4.2.1 The equipment subjected to fatigue stresses and creep due to high temperatures such as turbine rotor and casings, HP piping, boiler headers, Boiler drum, main steam piping and valves, feed discharge lines etc. are designed for a given fatigue life of about 25-30 years of operation. However, many equipment/ components might become prematurely weak metallographically due to various operational stresses like frequent temperature and pressure excursions, full load trippings, frequent start and stops etc. and accordingly there is need to check the remaining life of these components after about 20 years of life or ***1,60,000*** hours of operation lest it may result into serious failures. A systematic study called the Residual Life Assessment (RLA) study involving non-destructive and destructive tests would reveal the remaining life of various critical components of plants and equipment so as to take steps to extend the life of the plant by a further period of about 15-20 years by appropriate repairs/replacements. A RLA study may be carried out earlier, say after 15 years or 1,00,000 hrs. of operation if the plant condition so necessitates and as stipulated in IBR 391 A.

4.2.2 The LE programme is a major event in the thermal power station's history, as it envisages extension of life over a considerable period of time beyond its designed life. At this time it is a good practice to examine whether a plant requires a viable modernisation which has not been carried out earlier so that during the extended life the plant operates efficiently and delivers the rated or higher capacity with improved heat rate. Adoption of improved and proven technology can play an important role in plant upgraded output & higher efficiency. There are cost-effective options to uprate the machines for higher output and improved efficiencies thus making it economically viable to integrate life extension programme with uprating.

4.3 WORKS NOT RELATING TO R & M / LIFE EXTENSION:

4.3.1 In general, works usually done under routine maintenance and annual or capital maintenance do not fall under the purview of R&M Programme. The repetitive nature of activities having the frequency once in five year or less is covered under O&M.

4.3.2 The following works should not be included as a part of R&M / LE programme:

i) Infrastructural development work such as town ship, welfare measures etc., general civil works within the plant such as boundary wall, roads, drainages etc. However, technological structure works required for equipments / structure based on RLA done as per design criteria (such as turbine deck, foundation etc.) shall be part of LE.

ii) Procurement of spare equipments.

iii) Routine repairs/replacements during annual/capital overhauls.

The expenditure on such works which are of O&M in nature is to be met from O&M charges recovered through tariff for sale of electricity as notified by regulatory commission. O&M ought to be attended on a regular basis lest the condition of the unit should deteriorate to such an extent resulting in major breakdowns requiring huge expenditure.

5.0 RETIREMENT OF VERY OLD UNITS:

A very large number of small size units of 100 MW or less capacity are in operation. The average Plant Load Factor of most of these units is very low, even less than 50%. These units are of non-reheat type having very low design efficiencies. Further, because of their ageing & technological obsolescence, these units are performing at further lower efficiency than their design value. Such units need to be retired in a phased manner. The following approach for non-reheat units and other higher size reheating units may be followed for the purpose :

- Consider for retirement of all non-reheat units of 100 MW or less rating. However, those units on which major R&M/LE activities have been undertaken and are performing well, such units may continue to operate for another 10 years from the date of post R&M/LE to enable them to recover the expenditures incurred.
- Larger size units can also be considered for retirement on economically non-viability on case to case basis.
- The retirement may be prioritized according to their level of performance, say unit heat rate deviating more than 20% to be retired first and subsequently those units with deviation of 15% & 10% from their design heat rate.
- The SEBs/ GENCOs may identify new generating capacity to be added as substitute for older units so that overall installed capacity is not affected.

6.0 METHODOLOGY OF IMPLEMENTATION OF R&M AND LE&U SCHEMES

6.1 R&M Works

It has been observed that the power utilities are adopting following two main variants in implementation of R&M programme.

i) As a rolling plan in which the whole scope of work is conceptualized based on conditions assessment, plant operation data & feed back from O&M engineers / OEM / Consultant recommendations or compliance to statutory norms. Thereafter, the various activities/schemes, so identified are implemented in phases depending on the availability of particular system/unit shutdown. Such approach results in minimizing unit shut down requirement and thereby loss in generation. However, it results in extended execution over a long period of time and benefits accrued can not be co-related with the activities carried out and investment made.

ii) A comprehensive scheme is implemented in a single stretch and taking unit's planned shutdown after ensuring all inputs and supply of materials.

The methodology for implementation is to be decided by the utility. However, the option of comprehensive scheme is preferable due to well definable & quantifiable benefits.

6.2 LE&U Works

In order to implement LE&U works following methodology may be adopted.

i) In order to facilitate the implementation of LE&U works, utilities may appoint reputed consultant for rapid life assessment study, condition assessment, energy auditing, thermal performance test, environmental study, preparation of DPR etc. RLA studies to be conducted on the major plant and equipment through agencies of repute.

ii) Based on DPR a detail technical specification & contract document may be prepared. The contract document, inter-alia shall include provisions of changed scope of work which may come up when the machine / equipment is opened or are identified during detailed RLA studies (as a part of scope of work) to meet the stipulated performance guarantees.

iii) The responsibilities with regard to implementation of LE & U works may be shared as under:

- MOP : Govt. inputs, policy decisions.
- CEA : To follow up/ monitor with Utilities.
- Consultant(s) : To assist the utilities, if required, to carry out RLA, energy audit, preparation of DPR, bid specifications, selection of executing agency, implementation & performance evaluation. One or more consultants may be engaged by the utilities depending on the scope of work.

- Financial Institutions : To provide funds as loans.

- Executing Agency : Project authorities to carryout the field work.

iv) The following time frame may be adopted for implementing the LE&U schemes:

a) Appointment of consultant by utilities	-	3 months
b) RLA / Energy Audit	-	6 months
c) Freezing the scope of work /activities for LE&U	-	3 to 4 month
d) Preparation of DPR	-	6 to 8 months
e) Placement of order of LE&U	-	6 to 8 months
f) Supply of critical spares	-	16 to 20 months from placement of order.
f) Shut down of unit	-	6 - 8 months.

The above requirements call for a new approach towards implementation of R&M/LE works by the utilities by revisiting the existing procedures being adopted by each utility / stake holders / approving authority and to simplify them to meet the compressed time schedule and encouraging increased participation from various executing agencies.

v) The utility shall appoint a Nodal Officer of the rank of Chief Engineer who will be responsible for monitoring & coordination with all concerned relating to LE&U scheme.

vi) The selection of the executing agency/bidder may be carried through the process of competitive bidding.

vii) The Life Extension & Uprating work will be declared complete on successful continuous running of the unit for 14 days and at least 72 hours at full rated / uprated capacity after recommissioning of the unit.

viii) Life Extension work without the element of uprating (rated capacity and / or efficiency improvement beyond original design values) may be undertaken only in specific cases where uprating is not found techno-economically viable.

ix) The utilities may approach the Government for additional allocation of power to the extent possible from unallocated quota of central sector power stations during the period of shut down of units for comprehensive life extension works.

6.3 Monitoring the progress of implementation of R&M/LE schemes.

(i) **R&M / LE&U schemes of Rs.100 Crore and above shall be monitored by MOP/CEA.**

(ii) The utility shall also have a system of close monitoring of the physical and financial progress of various activities to ensure timely implementation of R&M/ LE&U programme.

(iii) Physical and financial progress report in prescribed format shall be submitted to CEA regularly on quarterly basis.

7.0 COST ESTIMATES

7.1 The estimated cost of the R&M/LE&U scheme has to be worked out based on the estimated cost of the identified individual works. The estimated cost should be, as far as possible, realistic and should be based on current market rates/budgetary offers from the supplying agencies including all taxes and duties. The import content along with the country from where the equipment etc. imported, should be identified. The source of funding is also to be mentioned. The yearly phasing of funds required for implementation of the scheme will have to be given which would help in monitoring the physical and financial progress of the scheme.

7.2 The cost of LE &U works shall not exceed 50% of the EPC cost of a new generating unit of indigenous origin (BHEL). If the LE&U works is limited to BTG, the cost ceiling shall be restricted to 50% of the new BTG unit only. However, a detailed study should be carried out to ensure its techno-economic viability. The pay back period may be limited to 5-7 years.

7.3 In cases, where the cost is estimated to exceed the above limits, a detailed cost comparison & cost benefit analysis shall be carried out between the R&M/LE work and that of setting up a new green field plant.

8.0 COST BENEFIT ANALYSIS

8.1 The investment decision on R&M/LE&U scheme should be driven by economic sensitivity analysis on cost of generation. The benefits in term of increase in PLF (including additional generation and availability, reduction in forced outages), increase in efficiency, reduction in auxiliary power consumption and fuel consumption, improvement in plant safety and environmental up-gradation expected to be achieved after implementation of R&M/LE&U scheme should be clearly brought out. The techno-economic viability will be established in terms of internal rate of return, net present value, pay back period etc. The pay back period for R&M / LE&U should be about 5-7 years.

8.2 The Empowered sub-Committee of the Committee on Infrastructure in its meetings held on 11th January, 2008 and 2nd April 2008 under the chairmanship of Deputy Chairman, Planning Commission has included R&M of power stations under the definition of infrastructure. All kind of financial concessions / relaxation towards

infrastructure projects as notified by Ministry of Finance from time to time shall also be applicable for R&M / LE&U works.

9.0 PARTICIPATION OF PRIVATE SECTOR IN LE&U PROGRAMME

9.1 In view of the liberalized economic policy of Government of India, private investment including foreign investment, are now allowed in all areas of the power sector. Following alternative options appear practical and feasible for private investment in R&M schemes. However, states/ power utilities may have other innovative options which could also be considered.

(i) Option 1:- Lease, rehabilitate, operate and transfer (LROT)

Under this option, the private promoter (PP) would take over the power station on a long -term lease, say 10 years or more. PP would invest and carry out the R&M of the power station and would takeover its operation and maintenance. Normally, the station would revert to the power utility after completion of the contracted period of lease or may be renewed on terms to be specified. However, legal title and ownership of the plant will remain with the utility throughout. This option would require a detailed lease agreement covering all aspects of financing, performance parameters, use of existing resources, sale of generated power etc.

(ii) Option 2:- Sale of Plant

Power utilities could offer power stations for outright sale to private parties. The present worth of the plant would have to be assessed which could be the reserve price for the sale.

(iii) Option 3:- Joint Venture between Power utility and public or private company.

In this option, a new company will be formed as a joint venture (JV) of the state power utility/ State Government and selected private/public collaborator. The JV company would undertake the R&M/ LE works and own, operate and maintain the power station. The private collaborator could also be an equipment supplier. Each partner shall hold minimum 26% equity in the JV company.

9.2 As a general rule, choice of private promoter should be made through competitive bidding. The above modes are illustrative. Any other mode as may be found suitable by the utility with in the above broad principles may be adopted by the utility.

9.3 Depending on the options preferred by the power utility, the detailed procedure and bid documents may be prepared by the utility/consultant in line with their procurement policies.

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