EXECUTIVE SUMMARY

0.1 Boilers suitable for electric power generation of 110 MW and above with operating pressures above 130 kg/cm^2 are classified as high pressure boilers.

0.2 There are two major suppliers of high pressure boilers in India, viz. i) Bharat Heavy Electricals Ltd. (BHEL) a public sector undertaking and ii) ACC Babcock Ltd. (ABL) which is a joint sector undertaking formerly known as ACC-Vickers Babcock Ltd. BHEL are, however, the leading suppliers of high pressure boilers in India and only a few boiler installations have been supplied by ABL. BHEL has vast experience of over two decades in the design, manufacture, erection and commissioning of high pressure boilers. Although ABL has also supplied high pressure boilers for over two decades, the number of high pressure boilers supplied by them is far less compared to BHEL. ABL have had their financial difficulties and because of this they had closed down operations for some time. However, the firm has since resumed its operations but on a much lower scale compared to BHEL.

0.3 BHEL has collaborated in the past with leading overseas manufacturers for high pressure boilers and accessories. Through these collaborations BHEL has now acquired complete know-how in the field of high pressure boilers and accessories. Many of the collaborations of BHEL have now expired and have not been renewed due to their acquiring the requisite know-how in the related fields and only selective collaborations in specific areas are being continued. ABL still has a collaboration with Babcock Power, UK and other reputed manufacturers for the manufacture of high pressure boilers and accessories.

0.4 It is the general experience that boilers normally contribute upto about 50% of the total forced outage of a complete power plant. Hence the reduction in the forced outage of boilers is of prime importance in improving the availability of any thermal power plant. The availability of high pressure boilers in India is generally in line with the availability achieved in advanced countries.

0.5 Utilities have generally expressed their satisfaction with the services provided by BHEL and ABL the major manufacturer of high pressure boilers in the country. However, some utilities have expressed that BHEL's delivery of spares should improve and also that information on the problems experienced in one particular thermal power unit and solutions adopted for the same should be shared with the other utilities operating similar units in order to avoid recurrence of similar problems

in other units. This will help in improving the performance and availability of the units in general.

0.6 The quality of Indian coals is significantly poorer compared to the quality of coal obtained in other countries. Indian coals are also more abrasive in nature. This results in higher erosion of heat transfer surfaces. There have been several indigenous developments to successfully burn Indian coals such as liberal sizing of furnaces, introduction of cassette baffles to reduce erosion of superheater and economiser bends, use of ceralin bends to prevent erosion in coal pipes, use of improved materials of construction of coal mills and use of tube mills. With these developments, the availability of high pressure boilers in Indian thermal power stations is generally comparable with those operating in Western countries.

0.7 The coal quality received at the various thermal power stations in the country has been inconsistent, with varying coals of grade being supplied. The varying coal quality makes the boiler inconsistent in operation and lowers the availability. Hence efforts should be made to ensure that the coal supplied to the power stations is of consistent quality. This will help in improving the performance and availability of the units in general.

0.8 Coal beneficiation would help in reducing the undesirable impurities being received at the site along with the coal. This would reduce the erosion on mill components and improve the availability of the milling system and consequently, the availability of the power plant. Hence, installation of coal beneficiation plants at the mine mouth would be prudent.

0.9 Most of the components required for the manufacture of high pressure boilers are generally available indigenously. Only boiler quality plates, some special stainless steels and alloy steels are being imported presently by BHEL. ABL are importing drum plates, alloy tubes, piping and headers and heavy structural sections. However, the import of these special materials is less than 10% of total steel requirement and hence indigenous manufacture of these steels may not be viable unless other users are found out for these materials. All the capital equipment required for the manufacture of high pressure boilers are either available indigenously or have already been imported by BHEL and ABL. Hence the present import of capital equipment is limited to very sophisticated and special machinery.

0.10 BHEL has exported High Pressure Boilers to other countries like Malaysia and Libya. However, the export market for high pressure boilers is limited, since the power plant additions in advanced countries are almost saturated and the competition in the Asian and African market is

stiff with many reputed manufacturers vying for orders. BHEL has been able to secure orders against such stiff competition. As per the information furnished by ABL they have exported only a few small capacity oil fired package boilers to African countries and have not exported high pressure boilers to other countries.

0.11 In view of energy shortage in India the domestic demand for high pressure boilers in the country is expected to be good particularly since an addition of 4000 MW per year of generating capacity is envisaged in the eighth five year plan period and is currently executing a contract for 2 nos. of 30 MW boilers to Egypt.

0.12 The status of technology in India regarding high pressure boilers is generally on par with the status prevailing in advanced countries and, therefore, there is no major technological gap between India and the advanced countries. In fact, BHEL has exported boilers with a total generating capacity of 1100 MW to Malaysia and two 120 MW boilers to Libya.

0.13 Even though thermal units upto a power generation capacity of 1000 MW and above have been built abroad, the capacity of the high pressure boilers on coal firing has been limited to about 660 MW with a single cell furnace size of 20M x 20M. Leading overseas manufacturers have indicated that with appropriate modifications their boilers upto 700 MW capacity could be adopted to suit boiler designs required for 800 MW power generating unit. Presently, power units upto 500 MW capacity have been installed in our country. The size of the next generation units is expected to be in the range of 750-800 MW considering the suitability of the grid conditions, status of available technology and owing to the advantage of reduced capital cost/KW with increasing unit sizes.

0.14 Presently, the high pressure boilers in the country operate at subcritical steam pressures and the normal limit for the highest preferred subcritical pressures have already been reached. Super-critical units will have improved turbine cycle heat rates and cycle efficiencies resulting in substantial saving in fuel costs. In view of this, super-critical units are likely to play an important role in the future power generation programme in India.

0.15 Once through boilers in the subcritical range do not offer any significant advantage over the drum type steam generators presently used. The main advantage of once through boilers has been their faster response to the load changes. Since most of the power units in the country are generally

base loaded, faster response to load changes is not an essential requirement, hence drum type boilers have been preferred. Further, once through boilers require better water treatment facilities (like condensate polishing unit) and a more sophisticated control system compared to drum type units. Hence drum type boilers are more popular in the country. However, all super-critical units are essentially once through type, hence installation of once through subcritical units at the present stage would be of advantage since the experience gained with such once through subcritical boilers would be helpful when super-critical boilers are installed in future with about 750-800 MW power turbine generators. Two 500 MW sub-critical once through boilers are presently under installation at Talcher Thermal Power Station in Orissa.

0.16 Presently,most of the power stations in the country are designed for base load operation. However, as the nuclear power generation share increases and more thermal power generating stations are installed, it would be necessary for the future thermal power generating units to operate under part load conditions and consequently, the future high pressure boilers should be suitable for two shift operation and sliding pressure operation for achieving higher part load performance. Provision of variable speed drives for ID fans would be of advantage while operating the SG at lower loads.

0.17 The requirement of the present day pollution requirements regarding particulate matter (150 mg/Nm^3) is being satisfactorily met by electrostatic precipitators. In view of this, bag house filters are likely to have a limited use in the country unless the pollution regulation stipulations become more stringent requiring a particulate emission limit of less than 100 mg/Nm^3. The combustion technology for NOx emission control is generally available with the leading manufacturers of high pressure boilers in the country. Regarding sulphur dioxide emission, it is to be noted that the Indian Coals have a low sulphur content and as per the present day stipulations only space provision has to be made for installation of a flue gas desulphurisation (FGD) plant at a later date if required. Hence, unless the pollution control stipulations become more stringent, FGD plants are likely to have limited use in the country.

0.18 The quality of coal available for power generation has been deteriorating over the years. The ash content in Indian coals is high and is abrasive in nature. In view of this and in order to counter against erosion of heat transfer surfaces, adoption of single pass boilers (tower type boilers) where all the heat transfer areas are located in the first pass of the boiler would be preferred. In a conventional two pass boiler, the centrifugal

effect due to change of direction in the flue gas flow results in the solid particles in the flue gas impinging on the heat transfer elements located in the horizontal and second pass of the boiler. Adoption of single pass design eliminates the location of heat transfer surfaces in the area where change of direction of flue gas flow takes place thus avoiding erosion on the heat transfer surfaces. However, single phase boilers are higher in cost by about 10% compared to conventional two pass boilers. Single pass boilers are in operation in India at Vijayawada and Neyveli Thermal Power Stations. Further feed back is necessary with regard to the operation of these boilers before a policy decision regarding adoption of this technology is taken.

0.19 Direct ignition of pulverised coal (DIPC) results in substantial oil savings during unit startups and low load operation and are of prime interest to India in view of the scarcity of oil. In this regard, BHEL has already commissioned DIPC system at Satpura and Vijayawada Thermal Power Stations and the same is presently under commercial operation. A committee appointed by Ministry of Industry (DGTD) is examining the performance of DIPC system to enable further decision regarding future installation of DIPC systems in the country.

0.20 Advanced technologies like fluidised bed combustion, slagging combustor and magneto-hydrodynamics offer better efficiencies and versatility in utilizing different grades of coal and consequently better utilisation of the available coal resources. Fluidised bed combustion boilers can also utilize fines generated from coal beneficiation plants. Hence these technologies can play an important role in the future power generation programme in India. Fluidised bed combustion boilers of smaller capacities are already in operation in India. BHEL is discussing with world leaders for a tie-up for fluidised bed combustion (FBC) boilers and this technology is likely to be introduced by BHEL shortly. Research is also being carried out by BHEL in slagging combustors and magneto-hydrodynamics.

0.21 Coal water fuels are basically used abroad for conversion of existing oil fired boilers to coal firing. However, the coal water fuel technology offers scope for utilising the fines in coal beneficiation plants and also to reduce load on the existing rail/road transport system by transporting the coal in a slurry form through pipes. As coal beneficiation plants come up in the country, coal water fuel technology may become relevant to India for utilising the coal fines from these beneficiation plants. Presently, coal slurry transport is being tried on an experimental basis in Maharashtra State and if the experiment proves successful, coal slurry transport and use of coal water fuel may become more prevalent.

0.22 Solar thermal repowering, where solar boilers supplement the steam generation in fossil fuel fired boilers, are not existent in India. Even abroad, solar boilers are in an infant stage and exist in only small capacities. The absence of fuel costs make solar boilers an attractive proposition and hence solar boilers may become a commercially and technically feasible proposition in future with the improvement in solar energy technology.

0.23 Considering the future power generation programme in the country, collaborations appear necessary in the near future in the following areas:

- Super-critical pressure boilers.
- Pressurised fluidised bed combustion boilers.

0.24 Considering the long term perspectives and the likely-hood of more stringent pollution laws in future, collaborations may be necessary in the following areas at a later date :

- Bag house filters
- Pollution control technology for limiting sulphur dioxide emissions
- Solar boilers.

0.25 In addition to the above, further thrust is necessary in the following areas :

- Ensuring supply of uniform quality of coal to the various thermal power stations in the country
- Installation of coal beneficiation plants after necessary techno-economic study.
- Utilisation of fines generated in coal beneficiation plants.
- Sliding pressure technology and variable speed fan drives.

0.26 Further feed back is necessary in regard to the following technologies :

- Operation of once through boilers being installed at Talcher Thermal Power Station.
- Operation of single pass boilers installed at Vijayawada and Neyveli.
- Slagging combustor technology both from abroad and from experiments being conducted by BHEL.

– Other uses for the boiler quality plates, special stainless steels and alloy steels which are being imported presently to determine whether it would be viable to manufacture these items indigenously.

0.27 RECOMMENDATIONS

(i) New Collaboration with reputed overseas manufacturers for the design and manufacture of high capacity (over 500 MW) super-critical boilers. It is understood that BHEL are already discussing with leading boiler manufacturers for collaboration of high capacity super critical boilers. ABL are in active interaction with contemporary manufacturers and collaborators to absorb and adopt the state-of-art technology.

(ii) New Collaborations with over seas manufacturers for adoption of technology in India in view of the ability of these technologies to burn a wide range of coals, particularly the low grade ones efficiently.

(iii) BHEL has already installed a prototype 6 MW slagging combustor at their works in Tiruchirapally and conducted trials on a few Indian coals. BHEL may conduct extensive studies on efficient burning of different grades of Indian coals in the slagging combustor to enable adoption of this technology to Indian conditions. Further feed back is also to be obtained by BHEL from other countries on the operation of slagging combustors through the on going US AID programme.

(iv) Direct ignition of pulverised coal (DIPC) results in saving of large quantity of oil in the thermal power plants. Cold/warm/hot start-up trials carried out at Vijayawada TPS unit no.3 has shown positive results. Hence DIPC is of immense importance to the country. Assessment of the committee appointed by Ministry of Industry (DGTD), and through Central Electricity Authority, retrofitting of DIPC in existing plants and introduction of DIPC as original equipment in the future installations in the country can be recommended.

(v) Before adoption of single pass boiler technology, complete assessment of operation of single pass boilers installed would be done at Vijayawada and Neyveli Thermal Power Stations.

(vi) Sliding pressure operation of boilers and variable speed fan drives in boilers are likely to be of significant relevance to India in the future. Technology in this regard is available with BHEL while ABL would be able to offer the same with back up from their collaborators. BHEL and ABL may keep in touch with the latest trends in advanced countries on these technologies.

(vii) In view of the total saving in fuel cost, solar boilers may become relevant to the country from a long term power generation programme point of view. Hence, BHEL and ABL may be requested keep in touch with the latest trends in advanced countries regarding solar boilers.

(viii) Experience of Maharashtra State Electricity Board on experimental coal slurry transport system would be considered before adopting coal slurry transport system. Coal India Ltd., and others concerned would consider to take up the task of progressive installation of coal beneficiation plants. BHEL and ABL would also keep themselves abreast of the latest trends and know-how on coal water fuel firing technology for adoption on trial basis when slurry transport system becomes operationally successful.

(ix) Presently, material for most of the components required for high pressure boilers are available in India. However, boiler quality plates, heavy structural sections some special alloy steels and stainless steels are being imported. High pressure boiler manufacturers and reputed steel manufacturers would initiate to identify the other uses for these steels and to review whether these steels could be progressively indigenously manufactured to reduce the dependence on imports.

(x) Coal companies and other appropriate authorities would take up the task of ensuring uniform quality of coal supplied to thermal power stations. In addition the establishment of coal beneficiation plants can be considered after necessary techno-economic studies.

(xi) Even though the users have generally expressed their satisfaction with the operation of the boilers supplied by BHEL, some users have expressed that the feed back obtained by BHEL on the performance/ operation/ improvements made in any unit is generally kept confidential and is not passed onto other users. BHEL would renew the availability data programme which was being earlier arranged by BHEL whereby problems encountered in any unit and the remedial measures adopted for the same are made known to other users operating a similar plant so as to avoid recurrence of similar problems in other units.

(xii) Even though there is a general satisfaction among the users with regard to the deliveries by manufacturers, some users have expressed their dissatisfaction regarding delivery of spare parts. Manufacturers may increase their efforts in delivering the spare parts promptly so that power generation does not suffer on this account.