Report on the Round Table Meeting on

"Thermal Power Energy Efficient Rehabilitation and Modernization (EER&M)"

Held on April 4, 2016

At the Corporate Office, West Bengal Power Development Corporation Limited (WBPDCL), Kolkata

(Organized by WBPDCL under the World Bank-supported Fired"IndiaGenerationRehabilitationCoal Project")

1. Background

The West Bengal Power Development Corporation Limited (WBPDCL) has implemented the pilot project for Energy Efficient Renovation and Modernization (EE R&M) work at the 210 MW Unit-5 of Bandel

Thermal Power Station (BTPS) under the ongoing ' jointly by the World Bank and the Global Environment Facility (GEF). The R&M implementation was

completed in November 2015 and the unit at BandelTPS is operational since then. The other implementing partners of this World Bank-supported project are the Ministry of Power, Central Electricity Authority, Maharashtra State Power Generation Company Ltd (MSPGCL) and Haryana Power Generation Corporation Limited (HPGCL).

A high-level Roundtable was organized by WBPDCL in Kolkata on April 4, 2016 to share the implementation experience from Bandel TPS and to brainstorm on issues around the potential for scaling up R&M of similar TPS units in India, estimated to be in the range of 25,000 MW.

This Round Table was followed by a site visit to Bandel TPS on April 5, 2016 (Tuesday).

2. Scope

The Roundtable was inaugurated by Mr. Manish Gupta, the Honorable Minister-in–Charge (MIC), Power & NES of the Government of West Bengal. The event was chaired by Mr. Santanu Basu, Chairman and Managing Director (CMD) of WBPDCL. The participants included high-level representatives, decision-makers and practitioners from various key and relevant national level organizations and state utilities involved in power sector in India. These included Ministry of Power (MOP), Government of India (GoI); NITI Aayog; Central Electricity Authority (CEA); Central Electricity Regulatory Commission (CERC); National Thermal Power Corporation (NTPC); Bharat Heavy Electricals Limited (BHEL); Excellence Enhancement Centre for Indian Power Sector, GIZ; MSPGCL; HPGCL; along with the WBPDCL and the

World Bank team. International experts from JCOAL (Japan), JICA and the International Energy Agency' Clean Coal Centre (United Kingdom) also graced the occasion.

The Roundtable Agenda is provided in Annex 1. In addition to presentations, there were open discussions and interactions on various topics ranging from technologies, costs, practices and modalities, procurement issues, execution experiences, implementation uncertainties, lessons learned, barriers and

solutions in the context of experience at Bandel TPS and Indian power sector as well as drawing from the global experiences in this field.

The complete list of participants is provided in Annex 2.

3. Summary of the Roundtable Discussions

The CMD of WBPDCL in his welcome speech thanked all for participating in the Roundtable and introduced the delegates to the company profile of WBPDCL followed by the introduction to the energy efficient (EE) renovation and modernization (R&M) works carried out at Unit-5 of Bandel thermal power station (BTPS) funded jointly by the World Bank and Global Environment Facility (GEF). He also highlighted the three options that are available with the state generating utilities for units of old to very old vintage :(i) shutdown the plant, (ii) undertake R&M works or (iii) put up supercritical plants at the same location. In addition to the presentation, a video of the EE R&M works at Bandel TPS was shown later in the Roundtable.

The round table was formally inaugurated by Mr. Manish Gupta, the Honorable Minister-in–Charge (MIC), Power & NES of the Government of West Bengal. In his speech, he emphasized on the fact that the energy security should be looked at from short term as well as long term perspective. EE R&M is only one of the various options to ramp up power generation. Under the 12^{th} Five Year Plan, even with increased renewable energy and thermal power plants, there will be an importance for EE R&M of older plants. However, he specifically noted that the experience of R&M project during construction phase of Bandel (BTPS, U-5)was not very encouraging and lessons learned should be used to avoid similar problems in the future. He further suggested that replication of such EE R&M projects should be undertaken only after carefully analyzing the reasons for the delays (time overruns) and cost overruns and as well as technical problems faced at Unit-5, BTPS. He further stated that cost of EE R&M of old thermal power plants should be restricted within half or less of the cost of setting up new power plant to make it an attractive option for decision makers. He also highlighted the importance of cost of financing such R&M works.

Mr. A Sarkar, Task Team Leader (TTL) of the World Bank Team stated that the objective of the Roundtable Meeting was to share knowledge and candidly discuss the lessons learned from the project experiences at Bandel TPS (and also ongoing work at Koradi TPS of MSPGCL) with the key stakeholders of Indian Power Sector and international experts to find out a way forward for the 25,000 MW potential of EE R&M in India. He suggested that the conclusions of the Roundtable may be used as inputs by the key decision makers such as MOP, CEA, CERC, etc for determining the future action plan of EE R&M of thermal power plants in India.

Mr. Bhai Lal, Chief Engineer (TRM) and his team from CEA highlighted that since inception of the R&M plan by GoI, the objectives of R&M works has shifted from generation maximization to generation optimization with energy efficiency. He stated that power utilities were showing limited interest in R&M due to extension of shutdown of the units caused by the delay in erection work and also for unavailability of alternate power to serve the load of the unit under consideration for shutdown. Apart

from these, the other issues to consider are merit order dispatch policy, integration of variable renewable energy generation, recent environment standards, long time required for preparation of DPR and its approval, and transportation of coal. It was also brought to attention that smaller units (below 110 MW) are expected to be retired soon (along the same lines as China did). CEA also discussed options around the comprehensive R&M versus need based R&M and vis-a-vis life extension (LE) prospects of old units. CEA also gave clarification on the new Environment Notification 2015 and its possible impacts of Generation Companies and the course of action suggested.

A video and presentation of U-5, Bandel TPS was made to the audience. Mr. Jayanta Banerjee, ED (OS), WBPDCL mentioned that without the R&M project; the plant would continue to generate electricity less than its installed capacity in an inefficient manner and with carbon emissions of higher intensity. He also emphasized on R&M of other old units (4 X 60 MW) of BTPS as those units having quick start up availability are helpful for restoring normalcy during islanding operation. He mentioned that by adopting NDCT (Natural Draft Cooling Tower) technology, present open cycle operation of BTPS could be renovated to closed cycle system as per requirement specified for old units by the Notification dated 7th December, 2015 of the Ministry of Environment, Forest & Climate Change. Furthermore, he mentioned that variable cost of generation of U-5 in Post R&M period is substantially less than that of in Pre R&M period. If R&M is compared with installation of new plant (after demolition of old unit) then R&M has emerged as a better technocommercial solution for BTPS, U-5.

Mr. A.K Sood, Director (Generation), HPGCL, advised that the EE R&M should be undertaken for the units of TPS that are closer to the mines so that the power generated from such units could be listed higher on merit order dispatch. He further mentioned that EE R&M will be economical for the states that are power surplus.

Dr. A Minchener, General Manager, IEA, Clean Coal Centre, United Kingdom gave a presentation on International experience of R&M of thermal power plants where he shared successful implementation of R&M at Jeffrey Energy Center, USA; Arnot plant of South Africa; Farge plant of Germany; Guru Nanak Dev plant at Punjab in India; AECO Sabarmati D Station of India; and, Waigaoqiao plant at China. He concluded that the smaller the size of the project, the lower the efficiencies achieved will be.

Ms. Fumiko Yamada, Asst. Director, Business Development Department, JCOAL, gave a presentation on experience of R&M of thermal power plants in Japan where she shared successful implementation of R&M at Takasago coal-fired power plant. Further, it was highlighted that in Japan, O&M of the TPS is done on regular basis (both major and minor works) as the useful life of TPS is considered as 50 years and hence there are not many cases of R&M. Based on this, the plants draw a long-term O&M plan that extends over the useful life of the plant.

Mr. Rajeev Srivastava, ED, SSBG, BHEL stated that problem faced in R&M work was unique for each plant. However, he expressed the common problem faced everywhere was the nonavailability of sub-surface drawings leading to surprisesmidway in execution of works and cost implications.

Mr Anil Jain, Advisor, Niti Aayog highlighted that the Niti Aayog is in process of revising the National Energy Policy with a focus on moving towards the market framework and an increased focus on

adhering to environmental standards. He proposed that public-private partnership (PPP), may be exploredin R&M space alsoand to examine the option of private sector investment model based on 'turnkey implementaoperation'solutions and business model(for R&M or green field power plants),similar along the lines of performance contracting implemented by private Energy Service Companies (ESCOs).

Mr. R. K. Jain, Technical Consultant, World Bank also highlighted that if in case its decided to replace old units with supercirtical units, then availability of adequate space is required. This might require shutting down 3-4 smaller units (illustrative). Further, dismantling of old units and installation of new units is likely to take about two years and four years, respectively. Hence, loss of generation over this period should also be factored in while making a decision.

Mr.A.R.Joshi, SE(Projects & Planning), MSPGCL presented the R&M work of Koradi, Unit-6 of MSPGCL in detail. Mr. V. Ramesh, AGM (R&M), NTPC presented the list of R&M work performed by NTPC. He and representatives of CERC discussed the success story of R&M of Tanda &Talcher TPS. Mr. S Gupta, Deputy Chief Engg, CERC also presented that both recovery of R&M expenditure as well as Provision of "Special Allowance"ofR&M wasinintroducedlieuin tariff Regulation by CERC in 2009-14. However this relief is only available to Central Sector Power Stations now. Mr. K. B. Upadhaya, AGM-SSBG-(R&M), BHEL presented the list of R&M work performed by BHEL, which follows a need-based "packaged" R&M approach for retrofitting power generation units.

All other delegates present in the Roundtable took active participation during the open discussion sessions after each presentation.

The presentations by various speakers are provided in Annex 3, along with pictures of the Roundtable and Bandel TPS Site visit and additional resources by IEA and CEA in the area of R&M.

4. Recommendations and Next Steps

Based on the active discussions and interactions at the Roundtable, around the topic of lessons learned and replication potential for EE R&M of thermal power stations in India, the following key suggestions and salient points have emerged:

1. To explore various models where private sector could be engaged and PPP approaches could be applied in scaling up the implementation of R&M.
2. To address the uncertainities and implmentation difficulties involved in R&M, it is important to have anintelligent risk sharing mechanism between the various stakeholders, namely the generation utility , design consultant and the equipment supplier.
3. To make the DPRs related to EE R&M more robust and avoid mismatch of perception between DPR consultants and equipment suppliers, it isimportant to shift part of the responsibility of the success of R&M to the design consultants who draft the DPR by making them a partner throughout the process including implementation of the R&M works.

4. To learn from the experience of the past R&M projects, it is important to have a repository of information that is to be made publicly available for the state generating utilities. CEA mentioned that under the World Bank project, such as attempt is being undertaken but the state generating utilites are reluctant to part with the information without which the entire exercise may be futile. It was also mentioned that since U-5, Bandel TPS has started generating revenues for the utilites, it is important for WBPDCL to keep record of the revenues pre- and post-R&M, and the finnacial and econmic analysis should be done with and without the cost and time overruns.
5. It was also advised to explore the options of continuous O&M (that may result in rise in tariff and hence losing the status on merit order dispatch list) or undertaking R&M (that will reflect in reduced tariff with increase in efficiencies and hence finding a place on merit order dispatch list). These options are available for new units. Hence, resulting cost of generation along with merit order dispatch should be the basis for taking the appropriate decision.
6. O&M should be given priority and appropriately incentivised. Adequate training should be provided to the employees at regular periods for undertaking periodic O&M.
7. The participants agreed that it would be a challenge to meet up the new environment norms (that is, Environment Notification 2015) by the generation utilities for all sub-critical units within the time limit of 2 years keeping in view the merit order in scheduling for dispatch of power after R&M. However, R&M would be one of the ways to meet the new environmental requirements as has happened in other countries like China.
8. It was suggested that each plant is unique and R&M work should be undertaken on a case-by-case basis, only based on RLA report and O&M practice feedback for the particular plant and decision will always be based on factors such as environmental norms, tariffs vis-à-vis merit order dispatch, proximity to the coal supply, etc. However with change of policy climate with time there is a need for also developing standardization of decision making process for R&M vis-a-vis retirement of old thermal units and developing a standardized implementation/business model.
9. It was also debated whether EE R&M should be more reasonable in non-reheat units only and/or plants which are located far away from coal mines where coal transportation cost is much higher or not. However, in view of several advantages in favor of existing sites, these sites should be utilized for installation of new energy efficient units of bigger capacity depending on availability of size of land.
10. The option of carrying out renovation works in stages during major overhaul time should be considered to avoid major shut downs required for comprehensive EER&M program.
11. Bulk tendering could be considered as one of the options to have economies of scale. This is specifically true for the large fleet BHEL make equipment that form a substantial proportion of the units being considered for R&M. BHEL can explore the idea to prepare an umbrella scope of works required for such units that could be tailored into specific needs at each unit.

The meeting ended with all the participants lauding the joint effort of WBPDCL and World Bank in organizing the Roundtable discussion and the field visit to Bandel TPS which was undertaken the next day.

Annex I

Round Table Meeting on Thermal Power Energy Efficient Rehabilitation and Modernization (EER&M)		
Kolkata, April 4, 2016		
Timing	**Topics**	Anchor
10:30 AM –11:00 AM	WELCOME & INAUGURATION	WBPDCL
11:00 AM –11.20AM	PRESENTATION: Importance and Role of Thermal Power R&M in India (followed by comments from Niti Ayog and MoP)	CEA, Niti Ayog and MoP
11:20 AM –12 Noon	VIDEO & PRESENTATION: Experience of WBPDCL in EE R&M of Bandel TPS	WBPDCL
12 Noon - 12.25 PM	PRESENTATION: Global Experiences in the Area of Clean Coal and Thermal Power R&M	Dr.Minchener, IEA
12.25 PM - 12.40 PM	PRESENTATION: Japan's experience in Thermal Power R&M	Ms. Yamada, JCOAL / Mr Furukawa, JICA
12.40 PM- 01.00 PM	PRESENTATION: Sharing experience of R&M of Koradi TPS	Mahagenco
1.00 PM-1.30 PM	Q&A; Open Discussion	All Participants
1.30 PM -2.30 PM	LUNCH	
2.30 PM –3.00 PM	DISCUSSION: Financial Institutions –Experience and Perspectives for funding R&M	WB / J-COAL / JICA/ GIZ
3.00 PM - 3.20 PM	PRESENTATION: R&M in NTPC: The Road traversed so far and future Plans	NTPC
3.20 PM -4.00 PM	DISCUSSION: (1) EE R&M versus new/Supercritical plants at the same location (2) Views and Strategies of GoI on the necessity of R&M of old power plants	CEA; Niti Ayog; MoP; All Participants
4.00 PM - 4.30 PM	DISCUSSION: Experience of R&M from Regulatory Perspective	CERC
4.30 PM - 5.15 PM	OPEN DISCUSSION: (1) Issues and mitigation measures for EE R&M (2) Lessons Learned and Way Forward for EE R&M (3) Experiences, Potential and barriers to scaling up R&M in India	All Participants
5.15 PM-5.30 PM	Key Takeaways from the Roundtable and Future Recommendations	MoP, CEA, WBPDCL, World Bank

Annex 2

Sl. No.	List of Participants	Organization
1.	Mr. Manish Gupta	Honorable Minister-in–Charge (MIC), Power & NES of the Government of West Bengal
2.	Mr. Santanu Basu	Chairman and Managing Director, WBPDCL
3.	Mr. S S Sen	Director (O&M), WBPDCL
4.	Mr. Jayanta Banerjee	Executive Director (OS), WBPDCL
5.	Mr. Ambar Roy	General Manager (BTPS), WBPDCL
6.	Mr. M Maji	General Manager (OS), WBPDCL
7.	Mr. Ashok Sarkar	Task Team Leader, World Bank
8.	Ms. Suravi Goyal	World Bank
9.	Mr. R.K Jain	World Bank
10.	Md. Iqbal	World Bank
11.	Mr. Simon Stolp	World Bank
12.	Mr. A.K. Jain	Advisor, Niti Aayog
13.	Mr. Rajeev Srivastava	ED, HEAD, SSBG
14.	Mr. Suman Majumdar	Under Secretary, Ministry of Power
15.	Mr. Bhai Lal,	Chief Engg. (TPRM) CEA
16.	Mr. Prabir Kumar,	Dy. Director CEA
17.	Mr. Parth Sen	Deputy Chief Finance, CERC
18.	Mr. Sukanta Gupta	Deputy Chief Engg, CERC
19.	Mr.Sameer M. Joshi	Dy. Executive Engineer Koradi R&M Project, MSPGCL
20.	Mr.A.R.JOSHI	SE(Projects & Planning), MSPGCL
21.	Dr. A Minchener	OBE, Innt n'l Energy Agency UK
22.	Ms. Fumiko YAMADA	Asst. Director, Business Development Dept. JCOAL
23.	Mr. Naoto Furukawa	Representative, JICA
24.	Mr. A.K.Sood	Director (Operation), HPGCL
25.	Mr. S BhatNagar	Chief Engg. HPGCL
26.	Mr. O.P. Maken	CEO, Excellence Enhancement Centre for Indian Power Sector, GIZ
27.	Mr. P K Mondal	GM (R&M-Engg), NTPC
28.	Mr. P Majumdar	AGM (OS), NTPC
29.	Mr. V Ramesh	AGM (R&M), NTPC
30.	Mr. K B Upadhaya	AGM-SSBG-(R&M), BHEL, NOIDA
31.	Mr. S Ghosh	GM-SSBG-BHEL, KOLKATA
32.	Mr. S. K. Sarkar	AGM-SSBG-BHEL, KOLKATA
33.	Mr. D. K. Maiti	Deputy GM (Engg.), Corporate, WBPDCL
34.	Mr. S Panja	Deputy GM (R&M), BTPS, WBPDCL
35.	Mr. Dipankar Sen Gupta	Sr. Manager (PS), Corporate, WBPDCL

Annex 3

Powerpoint presentations by all the participants and photos of the round table conference are uploaded to website www.wbpdcl.co.in

The IEA Report suggested by Dr. Minchener and the CEA Report can be found at -
http://www.cea.nic.in/reports/quarterly/trm_quarterly_review/2015/trm_qrr-12.pdf