

भारत हैवी इलेक्ट्रिकल लिमिटेड
Bharat Heavy Electricals Limited



कॉर्पोरेट डिजिटल ट्रांसफॉर्मेशन
CORPORATE DIGITAL TRANSFORMATION (CDT)

**CDT Hall, 2nd Floor, HRD & ESI Complex, Plot No. 25,
Sector 16A, NOIDA, U.P.-201301**

Expression of Interest (Eoi)

FOR

**Supply, Installation, Implementation and Maintenance of Analytical Tools as
development platform for Remote Monitoring and Diagnostic System (RMDS) of
thermal power plants**

Eoi Ref. No. AA:CDT:RMDS-003 Dated: 30th Jan 2018



भारत हैवी इलेक्ट्रिकल लिमिटेड
BHARAT HEAVY ELECTRICALS LIMITED
कॉर्पोरेट डिजिटल ट्रांसफॉर्मेशन
Corporate Digital Transformation

Ref. No.: AA:CDT:RMDS-003

Date: 30th Jan 2018

Dear Sir / Madam,

Sub: Expression of Interest (Eoi) for Supply, Installation, Implementation and Maintenance of Analytical Tools as development platform for Remote Monitoring and Diagnostic System (RMDS) of thermal power plants

Prospective bidders are invited to submit their offer for Supply, Installation, Implementation and Maintenance of Analytical Tools as development platform for Remote Monitoring and Diagnostic System (RMDS) of thermal power plants as per the terms and conditions of this Eoi.

Any corrigendum / notifications issued by BHEL, related to this Eoi, shall be available / hosted on www.bhel.com. Hence all bidders are expected to keep visiting www.bhel.com for any corrigendum / notification in their own interest.

The bidders are expected to examine all instructions, formats, terms, specifications, conditions and all other information in the bidding documents.

Please ensure that your response complete in all respect in requisite format with necessary enclosures is delivered on or before the due date & time i.e., **13th Feb 2018 at 1600 hrs.**

Bids shall be addressed to:

DGM (CDT)
Bharat Heavy Electricals Limited,
CDT-Hall, 2nd Floor, HRD & ESI Complex,
Plot no. 25, Sector-16a, Noida (UP) – 201301.

Thanking you,
Yours faithfully,
For and on behalf of BHEL

DGM (CDT)

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1. Introduction:

BHEL is the largest engineering and manufacturing enterprise in India in the energy-related/infrastructure sector, today. BHEL was established more than 50 years ago, ushering in the indigenous Heavy Electrical Equipment industry in India - a dream that has been more than realized with a well-recognized track record of performance. The company has been earning profits continuously since 1971-72 and paying dividends since 1976-77.

BHEL manufactures over 180 products under 30 major product groups and caters to core sectors of the Indian Economy viz., Power Generation & Transmission, Industry, Transportation, Telecommunication, Renewable Energy, etc. The wide network of BHEL's 17 manufacturing divisions, four Power Sector regional centers, over 100 project sites, eight service centers and 18 regional offices, enables the Company to promptly serve its customers and provide them with suitable products, Systems and services. The high level of quality & reliability of its products is due to the emphasis on design, engineering and manufacturing to international standards by acquiring and adapting some of the best technologies from leading companies in the world, together with technologies developed in its own R&D centers.

BHEL's vision is to become a world-class engineering enterprise, committed to enhancing stakeholder value. The company is striving to give shape to its aspirations and fulfill the expectations of the country to become a global player.

2. Objective :

The objective is to cover the supply of predictive analytics and diagnostic software solution for two units including engineering, customization, installation, development, implementation, training and conducting User Acceptance Test (UAT) for a power plant at BHEL Centre for Monitoring & Diagnostics at BHEL, EDN, BANGALORE, Mysore Road – 560026 (Karnataka).

3. Pre-Qualification Requirements (PQR):

Following information are required to be provided for Analytical Tools for RMDS:

S No	Description	Bidder's Compliance (Yes / No)
1	The year the company was founded.	
2	Last 3 years financial turnover	
3	Name and award date of projects where analytical tools for RMDS implemented.	
4	Plant/Fleet wide "Go-live" / completion date	
5	Maximum numbers of tags / signals handled at a time.	



6	Number and types of units being monitored	
7.	Compatible to integrate with other model based diagnostic system	
8	The year the vendor entered its first commercial contract with any company for Analytics Solution.	
9	Organisation Structure of the company for RMDS project. If implementation is through an associate / partner, the above details of partner shall also be furnished.	
10	The number of customers currently and actively using the software in power plant.	
11	The total number of units monitored by the software	
12	Rating of the largest power plant the software has monitored	
13	The reference where the bidder has implemented the solution with standard DCS system, if any.	
14	Total number of service center / units of company in India with name and address .	
15	Name of Systems / equipments of power plants monitored through Analytical Tools (From Annexure-1).	

4. Project Description:

BHEL intends to develop a **Remote Monitoring and Diagnostic System (RMDS)** for real-time monitoring and providing diagnostic support to its customers for the equipment's supplied by BHEL. RMDS system shall be capable of real-time prognosis of performance, pre-empting surprise outage/failures/breakdown through predictive analytics, minimizing risk of unplanned shutdown events & thereby reduction in life cycle cost, optimal operation of plant and reduction in operation cost with advisory supports by experienced BHEL domain experts. RMDS should have provision for integrating annual/capital maintenance plan with requirement of spares well in advance.

The platform offered by bidder should provide the capability of integrated data management for real-time as well as batch processing, predictive analytics & forecasting and visualization tools that gives a comprehensive, unbiased view of real time parameters with capabilities for effective, data-driven decisions and action.

BHEL will have the intellectual property rights of the developed system. Drawings/ documents and any other information provided by BHEL in any manner for realizing the intended functions mentioned elsewhere in this document are the sole property of BHEL and should not be used by bidder or their associates without obtaining written consent from BHEL.

The developed project specific Application software on bidder's platform is the sole property of BHEL and should not be copied or used in any form by the bidder or their associates without obtaining written permission from BHEL. BHEL on its own discretion shall file Patent, Copyright, Design, Registrations etc. on the developed applications using analytical softwares for BHEL by bidder.



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Project will be commissioned in two phases:

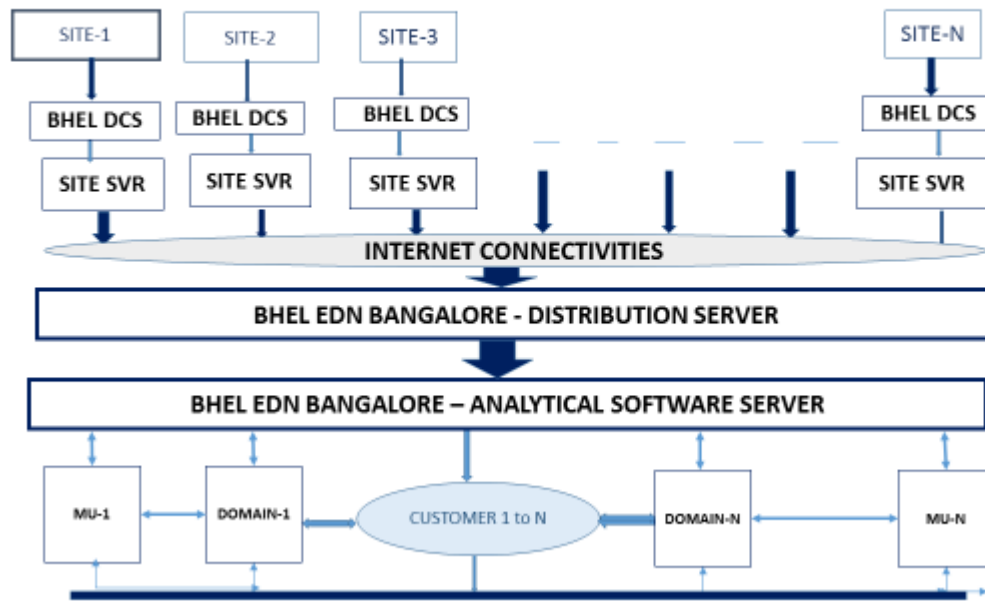
- Phase-I: Implementation of the software for identified system from the Annexure - I for 500 MW and verification of expected result as per Annexure – II (A&B).
- Phase-II: After successful completion of Phase-I for 500 MW, implementation of the same software will be carried out for remaining systems of 500 MW as per Annexure - I and verification of expected result as per Annexure – II (A&B). In addition, implementation of 250 MW will also start in parallel with phase II.

5. Brief description of the project:

- 5.1 To establish an IT enabled Centralized Monitoring and Diagnostic Centre at BHEL EDN Bangalore.
- 5.2 The Monitoring and Diagnostic software solution shall work with the power plant online data from CSV files provided by BHEL.
- 5.3 Provide early warning signals (before alarm / trip values) to power plant operators by analysing parameter trends of different equipment/systems.
- 5.4 To enable RMDS (Remote Monitoring and Diagnostic System) centre at BHEL to assist the O&M staff at power plants in critical situations, troubleshooting and event analysis by accessing live data.
- 5.5 Participate in major commissioning or critical operational activities like start-up/ shut down and provide support/ guidance from remote.
- 5.6 Use analytical and decision-making tools combined with cause-effect diagrams for holistic understanding of process/ parameter disturbances for early detection of faults and provide guidelines (Prescriptive analysis) to operator for corrective action.
- 5.7 Predicting the life and behaviour of equipment using statistical tools and collated data. This will help in taking informed decisions and thereby reducing life cycle cost of the equipment by avoiding major failures.
- 5.8 This software solution will be applied for the purpose of improving efficiency of operations.
- 5.9 Condition monitoring of various assets in the power plant and early detection of failure.
- 5.10 Outage Analysis.
- 5.11 Generate quick insights from the streaming data, updates key performance indicators and display results through dashboards, or other mechanisms.
- 5.12 Automatic report generation on daily, weekly and monthly basis.
- 5.13 Cost saving calculations.
- 5.14 Comply total technical requirements like root cause analysis, predictive analysis, equipment and overall system models, transient analysis, Alarm and trending, alert and notifications, configuration of points and display, system scalability and other features, Equipment template, Web based component, sensor and validation, system security and data base, documentation.



RMDS STRUCTURE



6. Scope of work:

- 6.1 Bidder will provide Analytical software with Supply, Installation, Implementation and Maintenance of Analytical Tools as development platform for Remote Monitoring and Diagnostic System (RMDS) of thermal power plants. AMC for three year after completion of one year warranty period is also included in the scope of work. The Analytical software license will be perpetual, non-revocable and will be used in two units (500 MW and 250 MW).
- 6.2 Total hardware are excluded from the bidder scope of work. However, bidder have to provide complete configuration of hardware required for successful implementation of the Analytical Softwares.
- 6.3 Analytical software for RMDS will be applied initially for one unit of 500 MW & one unit of 250 MW thermal power plant. The project execution for the first 500 MW Unit will be carried out by bidder along with BHEL Engineers. On successful completion, it will be extended to other power plants (250 MW) by BHEL. BHEL may engage bidder for execution of subsequent project. However, BHEL reserve the right to execute subsequent project without engaging bidder.
- 6.4 Commissioning of analytical software for RMDS system will be carried out in two phase. In Phase – I, Turbine & Generator set for 500 MW from Annexure - I will be completed along with User Acceptance Test (UAT) and in Phase – II, the balance system of 500 MW and 250 MW thermal power plants from Annexure - I will be completed.
- 6.5 Real-time software solution to continuously monitor health and performance of critical equipment's.
- 6.6 Access the key system performance indicators at system level such as heat rate, plant and equipment efficiency, controllable losses from software system called Performance Analysis Diagnosis and Optimisation (PADO) software developed by BHEL.
- 6.7 Developing, deploying and maintaining specific equipment models and overall system models.
- 6.8 Advanced Analysis Techniques and machine learning algorithm to identify subtle changes in system and equipment behaviour based on current and historical data.

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- 6.9 Evaluate system and component performance degradation to detect worn or near to failure condition of the plant equipment.
- 6.10 Expert System Diagnostics for quick identification of problems, pinpointing to the component level defects. The system shall complement with the diagnosis module of PADO to utilise the performance diagnostics covered under diagnostics module of PADO. PADO system will be provided by BHEL and its output to be integrated by vendor in its system.
- 6.11 Analytical and Decision Making tools combined with cause-effect diagrams for holistic understanding of process/ parameter disturbances.
- 6.12 Statistical Analysis of process variables.
- 6.13 Development of Asset and Plant Graphics by Dashboard or any equivalent solution.
- 6.14 Generation of Alarms.
- 6.15 Provision of Alarms Prioritizing.
- 6.16 Trending of the data.
- 6.17 Alerts & Notifications to targeted users through SMS / email.
- 6.18 Work-flow management towards creating Incidents/task both with-in BHEL as well as across BHEL and customer for monitoring them towards closure.
- 6.19 The system shall have on-line communication facility for conversing across the identified users of the system (BHEL) and customers. Typically, this shall be used for faster issue resolution, etc.
- 6.20 User Acceptance Test, functionalities of the analytic software solution shall be demonstrated during the acceptance test. UAT procedures shall be prepared by bidder and approved by BHEL. UAT shall be carried out as per approved procedures.
- 6.21 **Training:** Bidder shall provide Training to BHEL Engineers on the offered software solution at BHEL premises. It is included in the scope of works.

7. Payment Terms

Bidders shall agree to the payment terms as mentioned below.

Payments will be released progressively FOR INDIVIDUAL UNITS as follows:

- 7.1 No advance payments will be made.
- 7.2 35% payment of total sub cost will be released on successful completion of activities related to Phase - I.
- 7.3 25% payment of total sub cost will be released on successful completion of 50% activities of phase II.
- 7.4 30% payment of total sub cost will be released on successful completion of 100% activities of phase II.
- 7.5 10% payment of total sub cost will be released on successful completion of one year warranty period.
- 7.6 Successful completion of any phase will be considered only after achieving UAT.
- 7.7 Total Sub cost is sum of license cost, service charges including implementation and development, UAT and warranty period for two units. AMC cost is excluded from total sub cost.



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- 7.8 Total cost to BHEL will be consider for vendor evaluation, it includes software cost, service cost including implementation, development and warranty period of one year, AMC cost for 3 year, taxes, duties, GST, etc.

8. Instructions to bidders

- 8.1 Bids shall be addressed to the official inviting bids by name and designation and sent at the following address:
- DGM (CDT)**
Bharat Heavy Electricals Limited,
CDT Hall, 2nd Floor, HRD & ESI Complex, Plot No. 25,
Sector – 16A, Noida (UP) 201301
Telephone no.: (0120) 2416462 / 2416496
Email : ajay.bagati@bhel.in / shivali@bhel.in
- 8.2 Bids can also be delivered in person to the official inviting Bids and shall be dropped in the tender box at the address mentioned above.
- 8.3 Bids submitted by post shall be sent by "REGISTERED POST" only and shall be posted with due allowance for any postal delay. Bids received after the Due Date and Time of submission will be summarily rejected.
- 8.4 The EOI process involves seeking willingness of interested parties who make an application in response to this EOI.
- 8.5 Any request for further information or clarification on the EOI document may be submitted to shivali@bhel.in / anwar.h@bhel.in within 7 days from date of issue of EOI.
- 8.6 Responses to EOI are to be submitted in English only. Supporting documents, as required, should also be in English language. In case of some documents being available in languages other than English, the Applicant shall necessarily provide duly authenticated translated version of the same in English.
- 8.7 Duly authorized representative of the Applicant(s) shall sign on each page of the document. Response to EOI should be prepared in such a way so as to provide a straight forward, concise description of Applicant's capabilities.
- 8.8 Notwithstanding anything contained in this EOI, BHEL reserves the right to accept or reject any Application and to annul the EOI Process in whole or part, at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons thereof.
- 8.9 BHEL reserves the right to verify all statements, information and documents submitted by the Applicant in response to the EOI. Any such verification or lack of such verification by BHEL shall not relieve the Applicant of his obligations or liabilities hereunder nor will it affect any rights of BHEL.
- 8.10 The EOI process shall be governed by, and construed in accordance with, the laws of India and the Courts at New Delhi shall have exclusive jurisdiction over all disputes arising under, pursuant to and/ or in connection with the EOI process.
- 8.11 All costs incurred for participation in the EOI shall be borne by the Applicant (s).

9. List of Annexures:

Annexure-1 – Total system for 500 MW and 250 MW

Annexure-II(A) - Expected result

Annexure-II(B)- Typical for Phase-1



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Annexure – I			
(Total System for 500 MW and 250 MW)			
S.N	System (1X 500 MW & 1x 250 MW THERMAL POWER PLANT)	No of Signals	Frequency/ logging time
PHASE - I			
1.	Turbine & Aux a. HPT, IPT, LPT, Generator Condition b. HPT, IPT, LPT, Generator bearing temperature c. Turbine lube oil system d. Turbine governing system e. Turbine steam path and extraction system Generator & Aux a. Generator b. Seal oil system c. Primary water System * d. Generator Gas System e. Excitation System	1800	Turbine: 1 sec
2.			Generator : 1 sec
	Total KPI (Models) in Phase-1	100	
PHASE - II			
1.	LT,HT switch gear ,Bus duct and Transformer	500	1 sec
2.	Condensate System Condenser a. Condensate extraction system b. Vacuum pump system	200	1 minutes
3.	Heaters: a. Low pressure heaters b. High pressure heater c. Dearator	500 in total covering all heaters	1 minutes
4.	Boiler feedwater System a. Motor driven BFP and its auxiliary (minimum 01 to maximum 03 nos) b. Turbine driven BFP and its auxiliary* c. (minimum zero to maximum 02 nos) d. Feed water control station	200 200	1 Second 1 Second



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		50	1 Second
5.	Rotating Equipments		
	a. Forced draught fans and its auxiliaries (02 Nos)	40 per fan	1 Sec
	b. Primary air fans and its auxiliaries (02 Nos)	40 per fan	1 Sec
	c. Induced draft fans and its auxiliaries (02 Nos)	40 per fan	1 Sec
	d. VFD (04 Chanel)	105 per fan	1 Sec
	e. Air pre heaters (APH) and its auxiliaries (02 sets)	55 per APH	1 Sec
	f. Seal air fans and its system (02 nos)	10 per fan	1 Sec
	g. Scanner air fans and its System (02 nos)	10 per fan	1 Sec
	h. Mills and its Auxiliaries (minimum 7 and maximum 10 nos)	55 per Mill	1 Sec
	i. Boiler circulating pump (03 nos)*	50 per	1 Sec
6.	Boiler		
	a. Economiser	10	1 minutes
	b. Evaporator and Drum	25	1 minutes
	c. SH sections	300	1 minutes
	d. RH Sections	320	1 minutes
	e. Fuel firing system	50	1 minutes
	f. Windbox and SADC	120	1 minutes
	g. Air and flue gas sensors	50	1 Minutes
	h. Water chemistry	60	1 minutes
	i. Water and steam cycle	300	1 minutes
7	ESP and ash handling system (Total 120 fields are considered.)	1500	1 Minutes
8	Fuel oil System	50	1 Minutes
9	Cooling water System covering CW, ACW and ECW	200	1 minutes
10	PADO system	200	1 minutes
11	Control panels and equipment data	100	1Sec
12	Additional systems	250	1 minutes
	Total KPI (Models) in Phase - II	900	
TOTAL MODELS		500 MW	250 MW
Total KPI/ MODELS in Phase - I		100	85
TOTAL KPI / MODELS PHASE-II		900	750

TOTAL FOR ONE UNIT OF 500 / 250 MW	1000	835
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Note:

- Few systems (*) of 500 MW set is not applicable for 250 MW. 2c,4b,5i applicable for 500 MW set only. All other systems are applicable with less number of models in 250 MW.
- The field sensor as mentioned in Annexure-I should have different static attributes like, maximum value, minimum value, dynamic attributes like rate of change etc. These values need to be configured in data analytics system.
- The field sensor data has both analog value and digital states (like ON, OFF ,HIGH ,LOW, OPEN, CLOSE etc)
- There should be features to manually intervene the available sensor data from field, like changing or forcing certain value in place of real field value.
- The manual interventions as mentioned above should be automatically recorded and reported to system administrator.
- There should be an option for changing frequency of recording the sensor data at the data analytics system.
- The number of sensor data as mentioned above are tentative only and alteration during actual implementation are likely.
- To complete the total system, total no of KPI (Models) may vary upto 10 % in both Phase-I and Phase-II respectively.



Annexure – II (A)	
Expected results	
1	Comparison and deviation results from Design curve giving due consideration to aging and maintenance
2	Comparison and display of deviations of actual running parameters from historical running data in similar conditions through intelligent models and machine learning algorithms
3	Generation of alerts based on rate of change of data as and when it approaches towards alarm limits
4	Generation of patterns of data for similar operating condition
5	Capturing event based data, storing and displaying them on call
6	Cycle efficiency for different systems and the entire system as a whole
7	Notifications and highlighting the losses in efficiency in any system
8	Sensor data validation and indication of sensor failure
9	Analysis of operator actions for indicating operational issues
10	Operator interface for updating unstructured data
11	Generation of alerts in the form of SMS and Emails to specified experts on certain critical events
12	Suggest predictive actions based on operating data to avoid unscheduled breakdowns
13	Indicate predictive and accurate limitations on machine capability/ stress based on deviations of operating parameters
14	Mobile interface in the form mobile APP for KPI
15	Predictive analytics should avoid unwanted / false alert generation
16	Predictive analytics should have the feature to compare multiple units data with each-other respectively
17	Web access of Key performance indicators (KPI) through secure credentials
18	Historical and live trend of data should be available for viewing
19	Features for exporting data in MS Excel format with time stamping



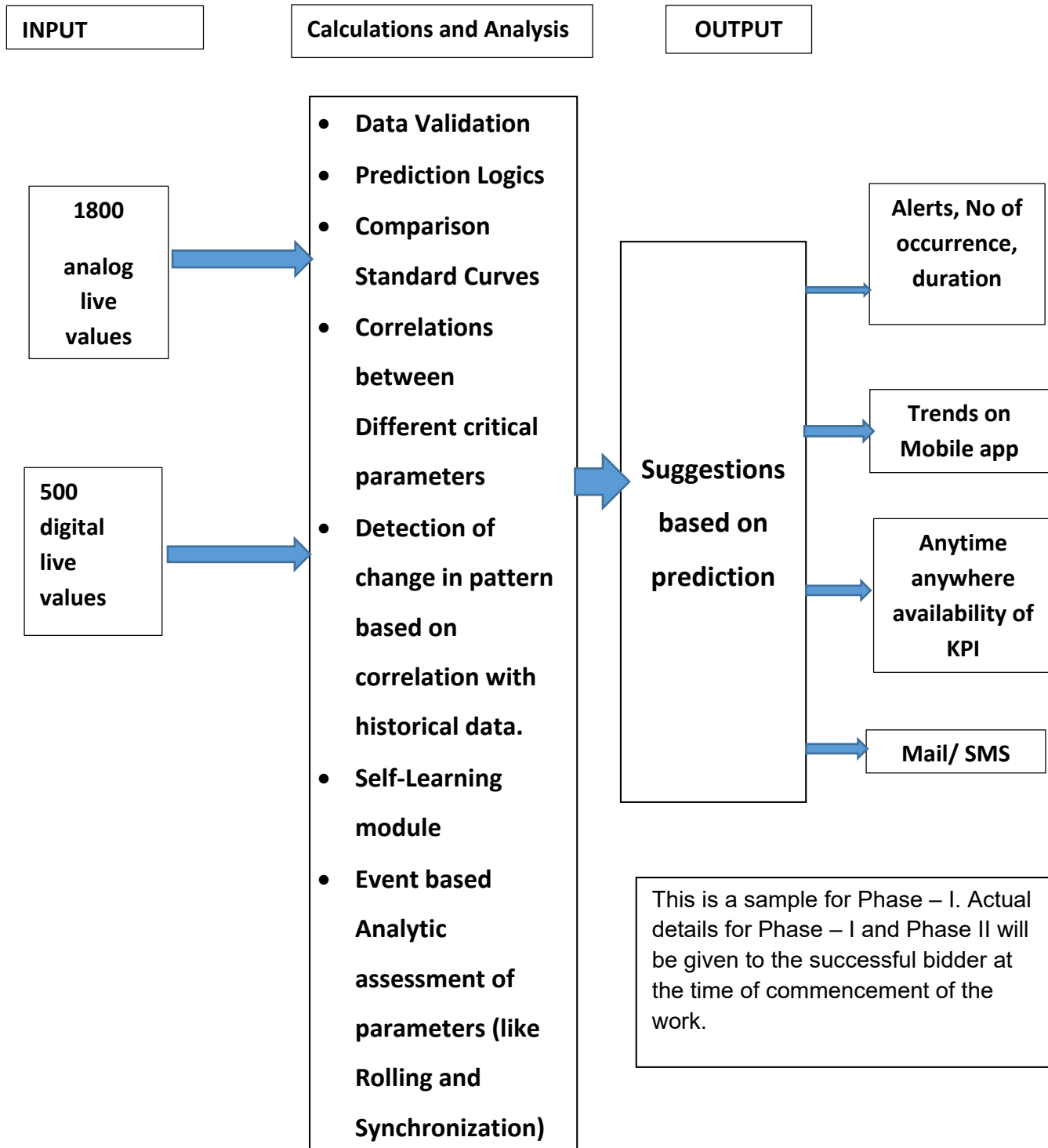
20	Facility for exporting customizable reports in MS Word, PDF format for external viewing. This feature should be controlled with authorization
21	System should be time synchronized with remote plant control room
22	Ease of developing, testing and implementing customizable machine models, reports, prediction logics and trends
23	Facility to restore system models in case system crash
24	Facility to take back up of system in external storage devices
25	Facility to take back up of old data in external storage devices. The system should have the feature to retrieve and compare data in external storage devices within any time frame either offline and on line data
26	The system should be scalable for any other unit without any major alteration to the models



Annexure – II (B)

Typical for Phase - I

Product: Turbine & Generator



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