IMTMA – ACE MICROMATIC

Productivity Championship Awards - 2025

ENTRY FORM	
Organization :	**BHARAT HEAVY ELECTRICALS LIMITED**
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Designation:	**DY. ENGINEER**
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ABSTRACT OF CASE STUDY
(Before filling the form please read the guidelines and rules)

1.	**Industry Sector:** (Choose from the dropdown)	**PSU**		
		Others(Specify) :	Manufacturing of Power Generation equipments.	
2.	**Size of the industry**	**MICRO & SMALL ENTERPRISE (Unit level turnover <100 Crores. Excludes SBUs of large corporates)** ○	**LARGE AND MEDIUM COMPANIES (Unit level / SBU level turnover > Rs.100 Crores)** ◉	Turnover (in Rs. Cr) 22,921
3.	**Title : Developed an Impeller Blade Bearing Assembly Fixture to Reduce Cycle Time in Axial Profile Fans.**			
4	**Is the Project under continuous operation YES ✓ NO ☐**			
5.	**Scope of the Project:**	**Localized Point Improvement** ☐	**Line Improvement** ✓	**Companywide Improvement** ☐
5.	**Date:(must be implemented after January 2021)**	**Start Date : 02.12.2023**	**Completion Date : 01.04.2024**	
6	**Team Composition / Structure**	**Department resources** ☐	**CFT – Cross Functional Team (Company resources)** ✓	

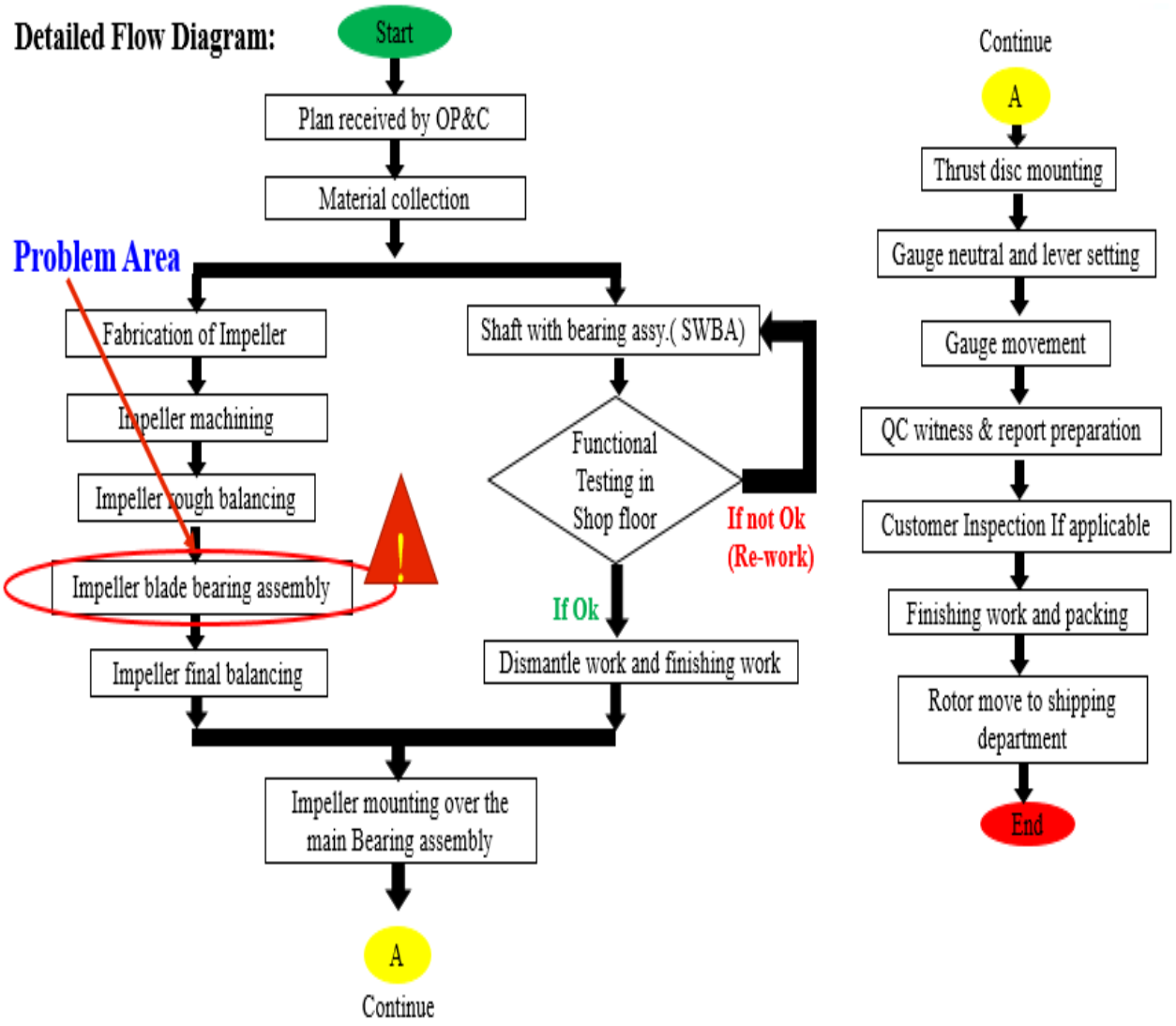
7. Streams

Manufacturing System Redesign	Optimizing Metal Working Process	Better Asset Utilization	Productivity Through Quality Improvement	Productivity Improvements in Small & Medium Enterprises (SME)	Others if any (Specify)
Cellular manufacturing, ✓	Metal removal process ☐	Maximize overall equipment efficiency ✓	**Quality cost**	To recognize SMEs which have taken up productivity improvement projects and to join the productivity movement, an exclusive stream has been slotted. ☐	
Factory within factory ✓	Metal forming process ☐	Space optimization ☐	Appraisal ☐		
Reducing throughput time ☐	Forging ☐	Inventory management ☐	Internal failure ☐		
Minimize setup/load/unload times ✓	Die casting ☐	Smart application of CAD / CAM / Software tools ☐	External failure ☐	SMEs can compete under SME stream or any of the other streams ☐	
Tool management ☐	Heat treatment ☐	Leveraging IT ✓	Real time/in-process metrology ☐		
Work holding ☐	Plating ☐	Product Redesign ✓	POKA- YOKE ✓		
	Painting ☐	Process redesign ✓	Zero defect ✓		
	Surface coating ☐				
	Assembly ☐				
	Finishing operations ☐				

8.	**Reason for problem selection?**		Responsive ☐		Proactive ✓
	Brief description: The impeller blade bearing assembly in axial profile fans was previously a labor-intensive, time-consuming process that required manual alignment and fastening. The old method caused frequent misalignment, seal damage, and hydraulic leakage, leading to increased cycle time and rework. A new fixture was developed to address these inefficiencies, reducing cycle time and improving overall assembly accuracy.				
9.	**Uniqueness of the project if any?**	**Approach**	New concept ✓	Breakthroughs ✓	Patents ✓
		Results	**Improvement % to base line**		
			20 – 30% ☐	30-40% ☐	40-50% ✓	>50% ☐
			Status		
			First time in the company ✓	First time in industry ☐	Trend setter ☐
10.	**Tools used,** (7 QC Tools , New 7 QC Tools, 6 Sigma , DOE , Theory of Constraints, Shainin Techniques, Project Management tools, Lean approach, Manufacturing system redesign, Digital manufacturing, TQM approach, TRIZ) (Based on the tools used in the project, multiple options can be selected from the given dropdowns)		**7 QC Tools**		Choose an item.
			Manufacturing system redesign		Choose an item.
			Lean approach		Choose an item.
			Digital manufacturing		Choose an item.
			Others(Specify):		

11.	**A brief insight into the Project (Not exceeding 500 words)**	
	11.1	**Reason for choosing the project:** The existing assembly method for impeller blade bearings relied on manual alignment and fastening, leading to high cycle time, inconsistent quality, and frequent rework. The project was chosen to enhance precision, reduce cycle time, and improve manufacturing efficiency.
	11.2	**Objectives/ Target set for the project: (Outcome to be quantified)** • Achieve **co-axial alignment** between the impeller hub and blade shaft. • **Reduce cycle time** for blade bearing assembly by at least **49%**.
	11.3	**Implementation details in brief (Not exceeding 200 words)** To improve the impeller blade bearing assembly process, a Blade Bearing Assembly Fixture was developed. This fixture securely holds the blade shaft in place, eliminating misalignment issues and reducing manual effort. A support stand was introduced to ensure co-axial alignment between the blade shaft and impeller hub, preventing seal damage and hydraulic leakage. This eliminated the trial-and-error method previously used for alignment. The traditional manual fastening method, which was time-consuming and inconsistent, was replaced with a pneumatic gun or ratchet to externally tighten the locknut. This provided uniform torque application, reducing operator fatigue and ensuring a standardized process. With these improvements, the new system ensured repeatability, consistency, and enhanced productivity, leading to a 49% reduction in cycle time, improved safety, and better quality control.

11.4 **Overall schematic flow diagram for the project from start to completion:**



11.5 **Operational Benefits – Covering Productivity, Quality, Cost, Delivery, EHS (To be quantified)**

i) **49%** reduction in cycle time.

ii) Elimination of seal damage preventing rework and hydraulic failures.

iii) Enhanced safety by reducing manual intervention.

iv) Consistent alignment improving assembly precision.

v) Enhance the Quality of product

11.6	**Business Benefits: Cost benefit ratios, Savings one time & recurring, Investment vs Return, Market share** **Cost Benefit Ratios:** I. The developed fixture significantly reduces cycle time and enhances assembly precision in impeller blade bearing assembly processes used in axial profile fans. II. Reduced cycle time 49% **Savings one time & recurring:** We have achieved one-time savings of ₹24 lakhs and recurring annual savings of ₹67 lakhs through the implementation of the blade bearing assembly fixture. **Investment vs Return:** We generated the idea and invested only ₹5,318 for the fabrication of this fixture, which delivered significant benefits such as easier alignment, improved co-axial accuracy, and elimination of rework through this innovative solution. **Market share:** Reducing product cycle time significantly boosts productivity and operational efficiency. Our innovative blade bearing assembly fixture developed for BHEL streamlines the alignment process, ensures co-axial accuracy, and minimizes manual effort. This leads to faster assembly, reduced operator fatigue, and a major decrease in rework. As a result, more units can be produced in less time, improving throughput without extra investment. Improved quality and reduced rework enhance customer satisfaction and reliability. Faster delivery and consistent performance help BHEL gain a competitive edge, leading to increased orders and market presence. Overall, this cycle time reduction supports business growth and market share expansion.
12.	**** We Certify that we are classified as a Micro / Small with the Udyam Registration Certificate number: _____with the Major Activity as_____ [Please ignore if it is not applicable to your company]**

Company Authorization

We certify that the project described here is factually correct and is in continuous operation. We confirm that we have read the rules and guidelines governing this competition and agree to abide by the same.

Name : SIVAPRAKASAM P **Designation : GM / OPRN, ENGG, PC and P&MS** **Signature :**

Date : 24.04.2025

பெ. சிவப்பிரகாசம்
पी. शिवप्रकाशम् / P. SIVAPRAKASAM
महा प्रबंधक (प्रचालन) /General Manager (Operations)
बीएचईएल बीएपी, रानीपेट / BHEL, BAP, Ranipet-Ua

*All future communication will be the principal author/project leader through email at this email ID
**If you are competing under SME stream, please certify your status as an SME, else you may leave it blank

fwd.

Fd. to Cmo

"Developed an Impeller Blade Bearing Assembly Fixture to Reduce Cycle Time in Axial Profile Fans."

Brief description of the project:

Bharat Heavy Electricals Limited (BHEL) is a **Maharatna Public Sector Undertaking (PSU)** under the Ministry of Heavy Industries, Government of India. Established in **1964**, BHEL is India's largest engineering and manufacturing enterprise in the **energy and infrastructure sectors**.

With a legacy of over five decades, BHEL is a pioneer in the development of indigenous heavy electrical equipment and has played a key role in powering India's growth. The company has a widespread presence across the country with **17 manufacturing units**, **2 repair units**, **4 regional offices**, **8 service centers**, and a large number of project sites spread across India and abroad.

BHEL's core business areas include:

- **Power Generation Equipment** (Thermal, Hydro, Nuclear, and Gas-based)
- **Transmission Systems**
- **Renewable Energy Solutions (Solar, Wind)**
- **Industrial Systems and Products**
- **Defence and Aerospace Components**
- **Transportation (locomotives, metro coaches)**
- **Oil & Gas Equipment and Services**

BHEL is known for its end-to-end capabilities from design, engineering, manufacturing, testing, and commissioning of products and systems. Over **50% of India's installed power generation capacity** is supported by BHEL-supplied equipment.

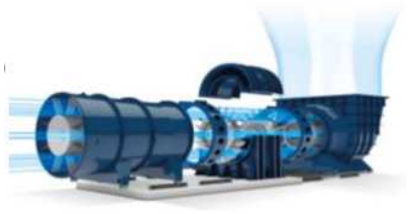
The company is committed to **Make in India**, **self-reliance**, and sustainable development through continuous innovation, process improvement, and a strong focus on **R&D**.

With a rich project execution track record and strong engineering capabilities, BHEL continues to be a key contributor to India's infrastructure and industrial development.

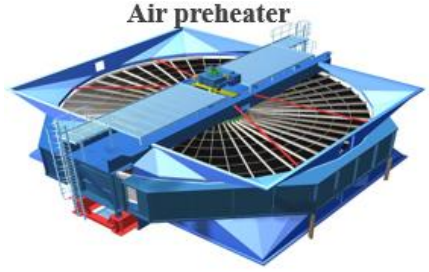
Our unit, **Boiler Auxiliaries Plant (BAP), Ranipet, Tamil Nadu**, is a critical manufacturing hub specializing in the production of Industrials Fans, Electrostatic Precipitators, Air Preheaters, Gates and Damper, Flue Gas Desulphurisation (FGD) and other essential boiler auxiliaries for thermal and industrial power plants. BHEL BAP Ranipet plays a vital role in

supporting the country's energy backbone by delivering high-performance auxiliaries to both domestic and international customers. The plant is equipped with specialized facilities for fabrication, machining, assembly, and testing of large and complex components.

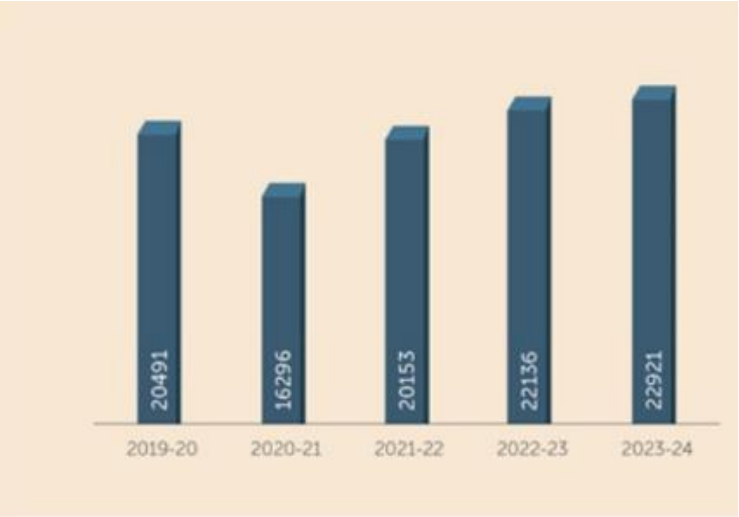
Axial profile fan



Air preheater



Financial Performance: For the fiscal year ending March 31, 2024 (FY24), BHEL reported revenues of ₹22921 Crore, marking a 3.5% increase compared to ₹22136 Crore in the previous fiscal year.



At our F1 Bay facility, we manufacture all three types of TLT model industrial axial profiles fans used in thermal power plants—Induced Draft (ID), Forced Draft (FD), and Primary Air (PA) fans. The process includes fabrication, precision machining, dynamic balancing, and complete assembly are completed here. The impeller is assembled with the shaft main bearings assembly to form the Rotor Assembly, which is then delivered to the site for final installation. We also provide brief descriptions and technical specifications for each fan type ID, FD, and PA.

Induced Draft (ID) Fans: Used in boilers to remove flue gases, ensuring proper ventilation and maintaining negative pressure by pulling air through the system. This fans are designed to operate at speeds of 750 RPM, depending on their application and site requirements.

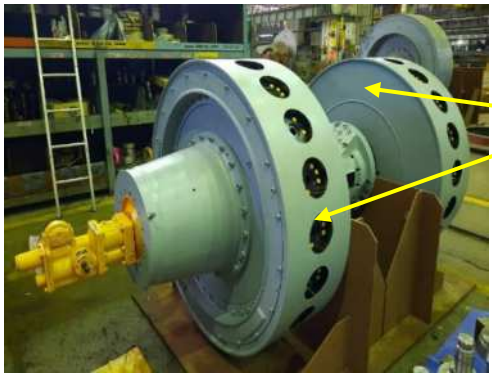
Two stage Impeller (Rotor Assembly)

Shaft with bearing assembly.

Forced Draft (FD) Fans: Push air into combustion systems (e.g., furnaces), maintaining positive pressure to ensure proper airflow and efficient combustion. This fans are designed to operate at speeds of 1000 RPM, depending on their application and site requirements.

Single stage Impeller (Rotor Assembly)

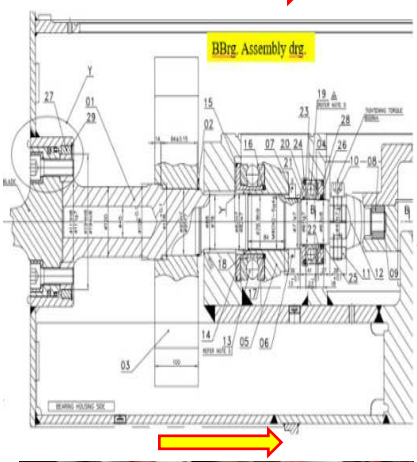
Primary Air (PA) Fans: Used to transport pulverized coal from the mills to the furnace in thermal power plants. This fans are designed to operate at speeds of 1500 RPM, depending on their application and site requirements.

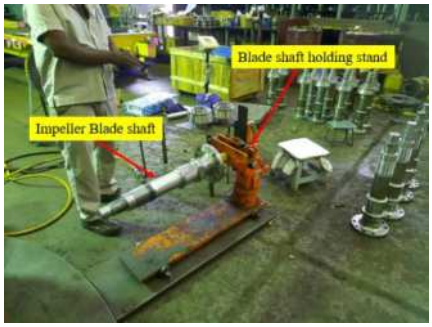


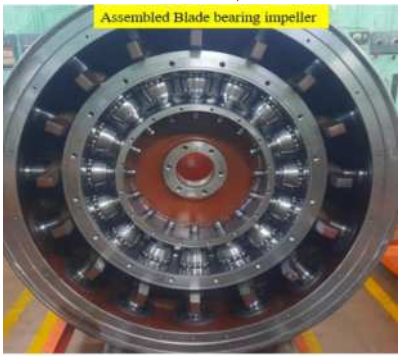
Two stage Impeller (Rotor Assembly)

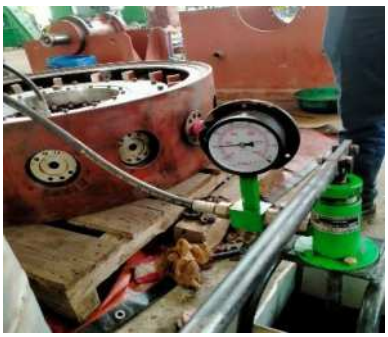
This project focuses on improving the **impeller blade bearing assembly process** used in **axial profile fans**, primarily for thermal power plant applications. Traditionally, the assembly involves complex, time-consuming manual steps that often lead to misalignment, seal damage, rework, and increased cycle time.

Sequences of work process:









To overcome these challenges, an **innovative fixture** and **assembly method** have been developed. The fixture ensures **precise co-axial alignment** between the blade shaft and impeller hub, significantly reducing manual effort and human error. It also allows external tightening of the locknut using a **ratchet or pneumatic gun**, enhancing safety and consistency.

This improved method results in a **49% reduction in cycle time**, elimination of rework, better quality control, and overall improvement in operational efficiency—leading to substantial **cost savings and increased productivity** in the assembly process.

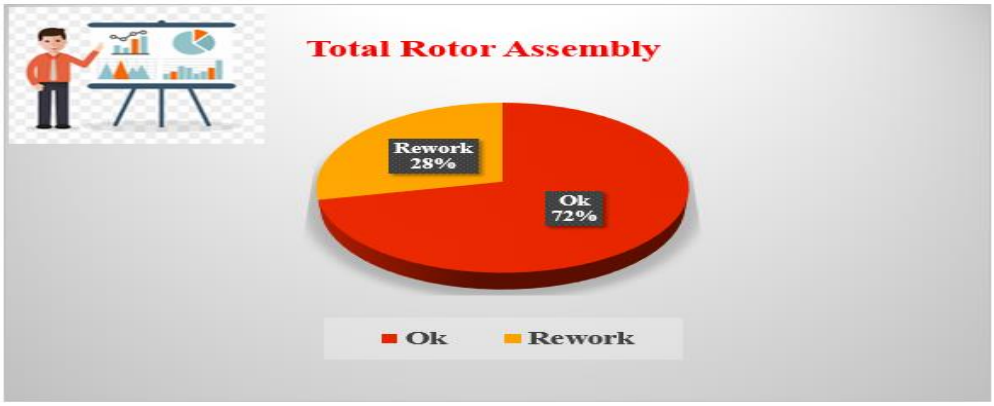
2. Trigger for the Project:

The assembly of impeller blade bearings in axial profile fans, especially in thermal power plants, is traditionally a complex, manual, and time-consuming process. It often results in misalignment, increased cycle time, operator fatigue, and frequent rework due to seal or O-ring damage. The lack of a dedicated system for ensuring precise co-axiality between the blade shaft and impeller hub further contributes to inefficiencies and performance issues. The following data reflects the various reasons for impeller reworks which is shown below.

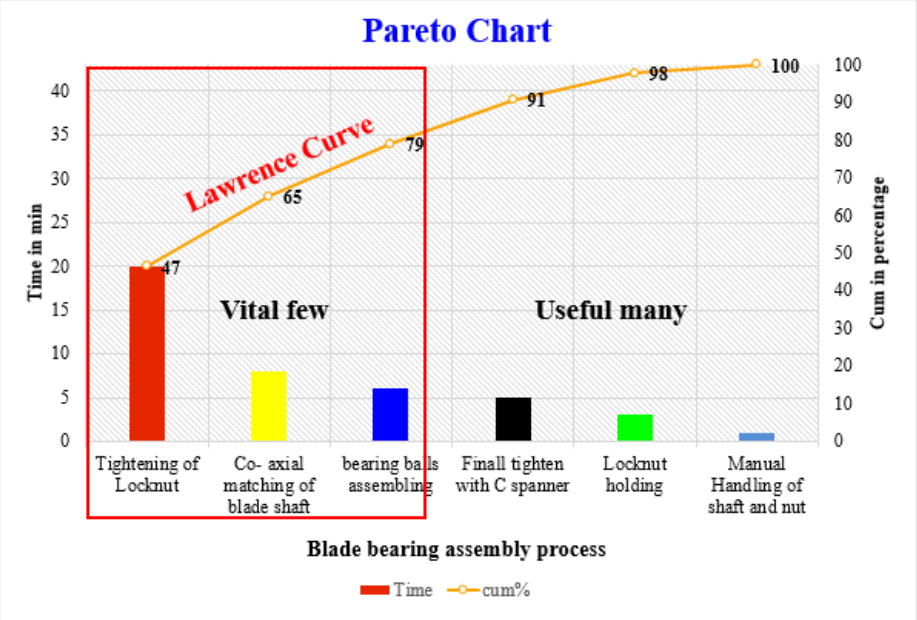
The data collected for the production completion plans of the rotor assembly for February and March 2024 highlights the rows that had rework during assembly.

Sl No.	Work Order	Part	Customer	Rework
1	G512-380-1-55287	2/2	NTPC KAHALGN	No rework
2	G514-380-1-55287	1/2	NTPC KAHALGN	Oil leaks due to O ring cut
3	G801-410-1-55287	1/2	KOTHAGUDEM	No rework
4	R540-027-7-FM999	2/2	NTPC VINDHYACHA	No rework
5	R652-033-7-FM999	2/2	IB VALLEY	Seal cut
6	R538-018-7-FM999	1/1	RIHAND-III SWBA	No rework
7	G203-295-1-55286	1/2	NTPC NABINGR	No rework
8	R540-027-7-FM999	1/1	NTPC VINDHYACHAL	No rework
9	G801-410-1-55287	2/2	KOTHAGUDEM	Locknut stuck up
10	G203-295-1-55286	2/2	NTPC NABINGR	No rework
11	G513-380-1-55287	1/2	NTPC KAHALGN	Locknut stuck up
12	G513-380-1-55287	2/2	NTPC KAHALGN	No rework
13	G514-380-1-55287	2/2	NTPC KAHALGN	No rework
14	R802-013-7-FM999	1/1	YERAMARUS	No rework

The pie chart illustrates that 28 percent of the assembly process involves rework.



We can easily identify the major time-consuming processes in the bearing assembly through a Pareto chart.



3. Solution generation:

To address the challenges in assembling impeller blade bearings in axial profile fans, this project introduces a specialized fixture designed to ensure precise co-axial alignment between the blade shaft and the impeller hub. The **solution generation** focuses on reducing manual effort and assembly errors by integrating an adjustable support stand and enabling external locknut fastening using a pneumatic gun or ratchet, thereby cutting down cycle time and minimizing operator fatigue.

The project brings several **innovative** elements, such as the temporary fixture attachment to the blade shaft, a fine alignment mechanism, and a dual-purpose design that supports both assembly and dismantling processes. This image sequence shows the dismantling of the impeller blade bearing assembly without any stuck-up. This approach has drastically reduced the cycle time and material wastage during the dismantling of impellers received for repair from the site.

These advancements not only improve assembly accuracy but also prevent common issues like seal and O-ring damage during hydraulic testing. However, the project involves considerable **complexity**, requiring a robust yet adjustable design capable of handling heavy components, integrating with existing systems, and maintaining consistent performance in demanding industrial environments. This combination of thoughtful engineering and practical innovation significantly enhances the efficiency, safety, and reliability of fan assembly operations in thermal power plants. Based on the data collected from the previous two months, there were no instances of rework attributed to blade bearing assembly misalignment. The recorded data clearly indicates that rotor assembly was carried out without any rework requirements, confirming proper alignment and assembly integrity throughout the process.

We have data collected for the production plans in April and May 2024 and observed that no rework in assembly process.

SL No.	Work Order	Part	Customer	Rework
1	G513-380-1-55287	2/2	NTPC KAHALGN	No rework
2	G517-085-1-55287	2/2	NTPC SIPAT	No rework
3	G215-380-1-55287	2/2	KAHALGAON	No rework
4	B883-005-6-55997	1/1	NTPC DADRI	No rework
5	G518-085-1-55287	1/2	NTPC SIPAT	No rework
6	G518-085-1-55287	2/2	NTPC SIPAT	No rework
7	R673-901-6-55997	1/2	BHUDAVAL	No rework
8	R680-901-6-55997	1/2	PANKI	No rework
9	G802-125-1-55287	1/2	NORTH CHENNAI	No rework
10	G802-125-1-55287	2/2	NORTH CHENNAI	No rework
11	R673-901-6-55997	1/2	BHUDAVAL	No rework
12	R680-901-6-55997	2/2	PANKI	No rework
13	G204-295-1-55286	1/2	NTPC NABINGR	No rework
14	G204-295-1-55286	2/2	NTPC NABINGR	No rework
15	R834-950-3-55216	1/2	NTPC TELENGANA	No rework
16	R665-943-3-55216	1/2	KRISHNAPATANUM	No rework
17	G213-380-1-55287	1/2	KAHALGAON	No rework
18	R834-460-1-55328	1/2	NTPC TELENGANA	No rework

Results:

Before implementation:

Data collected and its shows that, on average, 43 minute's time are required to complete a single blade bearing assembly. The total time required for a single rotor assembly with 20 blade shafts is 14.3 hours (equivalent to 2.5 shifts). Total **858** mins. required for Single Imp. Assembly.

Before implementation:

We have collected data and found that the average time required to complete a single blade bearing assembly is **22 minutes**. Therefore, the total time required for a single rotor assembly with **20 blade** shafts is **7.3 hours** (equivalent to one shift). Total **438** mins. required for Single Imp. Assembly now.

Tangible Benefits:

- Increase Productivity (2 day shifts saved per Shaft with Blade Bearing Assy.)
- Saving through this project 24 lacs in finance year.
- Reduced Cycle time by 49% (By 32X2=64 Man hours per Impeller Blade bearing assy.)
- Cost reduction due to reduce cycle time in blade bearing assy.
- Improve safety (Nil Accidents)
- Timely delivery of product (Zero Minute delay)
- Materials saving (Rs. 14.079 Lakhs annually)

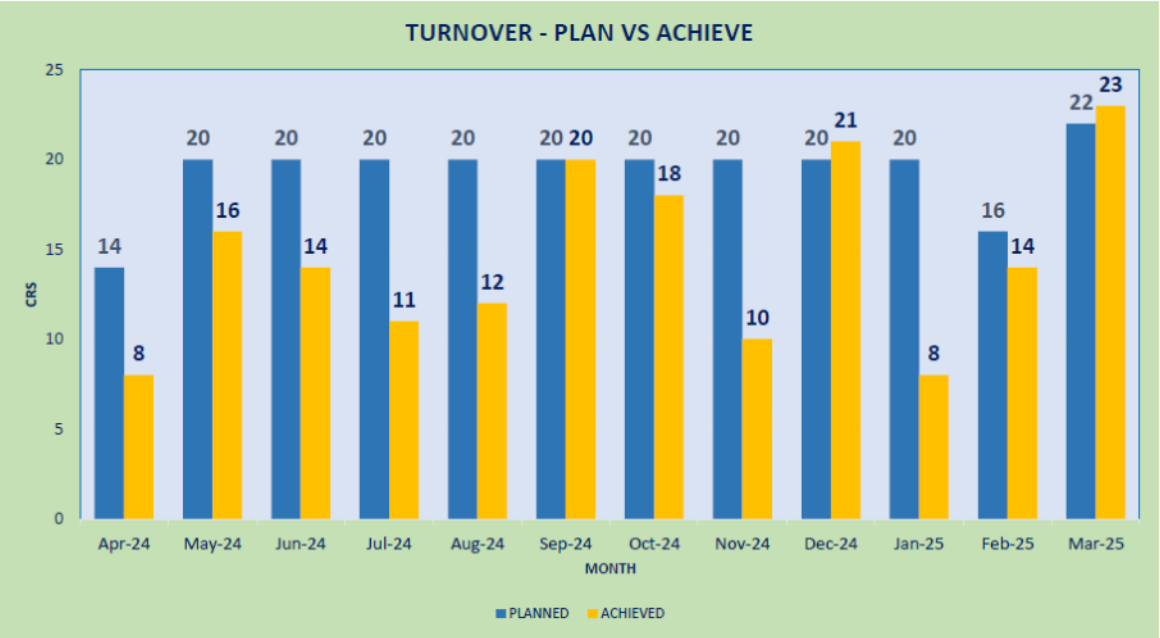
BAY COMPLETION IN FY 2024-2025

YEAR	FY 2023-2024		VS. FY 2024-2025	
PRODUCT	TONNAGE (MT)	TURNOVER (Crores)	TONNAGE (MT)	TURNOVER (Crores)
ROTORS PART (MAIN)	180	35.5	294	95.5
ROTORS PART (SPARE)	198	97.5	186	76.5
Total	378	133	480	172

FANS ROTOR –F1 BAY TURNOVER

YEAR	FY:2023-24	FY:2024-25
PHYSICAL TURNOVER	375 MT	480MT
	VS.	
FINANCIAL TURNOVER	133 CRS	172 CRS

FINANCIAL TURNOVER : MONTLY - PLAN VS ACHIEVE



KKK &TLT :AP ROTORS IN FY 2024-25

	Type	Rotor (Nos)	Impeller (Nos)
TLT	ID	18	26
	FD	10	10
	PA	3	6
KKK	ID	0	0
	FD	0	4
	PA	3	6
	TOTAL	34	52

AXIAL PROFILE FAN

- 34 AP Rotors (TLT & KKK Type) are Handed over FY 2024-25.
- 52Nos Axial profile impellers are manufactured to meet 32 rotors.

Market share:

Reducing product cycle time significantly boosts productivity and operational efficiency. Our innovative blade bearing assembly fixture developed for BHEL streamlines the alignment process, ensures co-axial accuracy, and minimizes manual effort. This leads to faster assembly, reduced operator fatigue, and a major decrease in rework. As a result, more units can be produced in less time, improving throughput without extra investment. Improved quality and reduced rework enhance customer satisfaction and reliability. Faster delivery and consistent performance help BHEL gain a competitive edge, leading to increased orders and market presence. Overall, this cycle time reduction supports business growth and market share expansion.

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Mugunthan V	Addl. Author	6041310	Technician
Prabhu M	Addl. Author	6130321	Artisan Gr.I
Bijaysen Sahu	Addl. Author	6050115	Engineer

Our team won the **CCQC 2024 Gold Award** in the **Hosur Chapter** and received the **Par Excellence Award** at the **National Quality Circle Convention (NCQC) 2024**. In recognition of these achievements, our beloved **Executive Director conferred the Republic Day Awards** on **26th January 2025**.

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