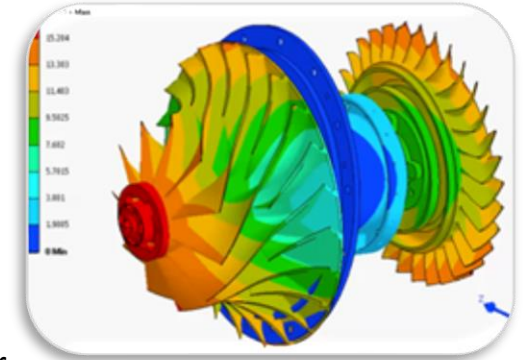


# Design & Analysis of Gas Turbine

## Challenge

- Rotor dynamics challenges in turbine test
- Engine vibrations
- GD & T & Manufacturing Quality Plan

ANSYS, FLUENT,  
CATIA  
Aero Meanline  
Design in-house Tool

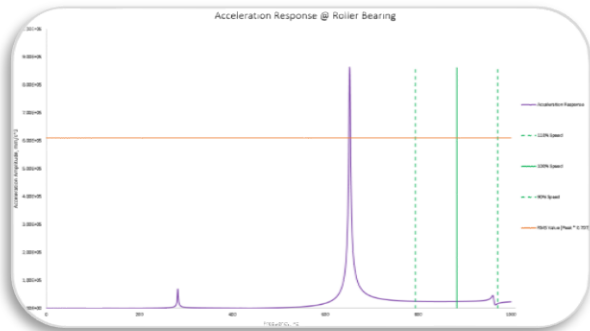


## Solution

- Structural & Thermo-Mechanical analysis for compressor & turbine assembly
- Vibration analysis - rotor dynamics, critical speed, unbalance harmonic analysis
- Casing structural & dynamic analysis
- Test data correlations

## Benefits

- Successfully resolved critical speed issues
- Successful test run with expected results
- \$150K/engine cost saving to customer



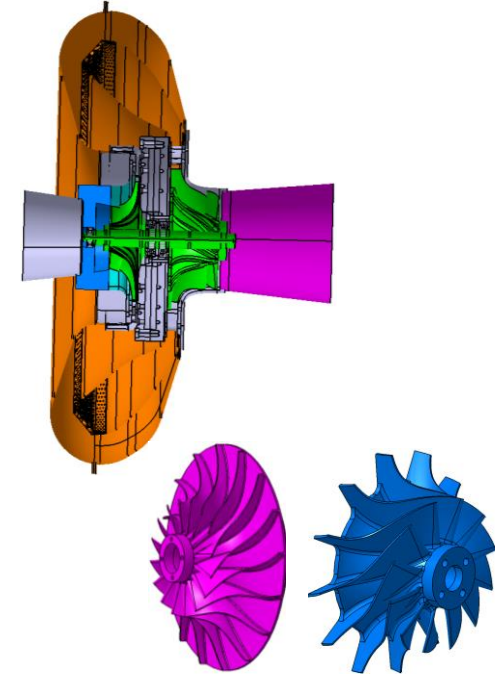
## Concept to Completion

# Design & Analysis of Micro Gas Turbine

## Challenge

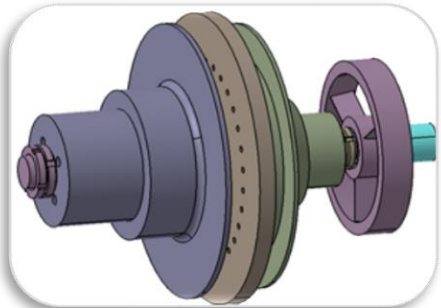
- Design & Development of Micro Gas Turbine
- Design from clean sheet of paper
- First of kind product in India
- Concept to Completion

ANSYS, FLUENT,  
CATIA  
Aero Meanline  
Design in-house Tool



## Solution

- Worked with customer to finalize Technical Requirements
- Engaged industry experts
- Aero & detailed design of compressor & turbine
- Bearing selection & rotor dynamics
- Validated with field data



## Benefits

- Became the design partner for customer
- Delivered final solution 2.5 months ahead of schedule
- Trained customer's 10 engineers in gas turbine
- \$120K cost saving to customer

## Technology Development & Adoption

# Design & Development of PTO Shaft

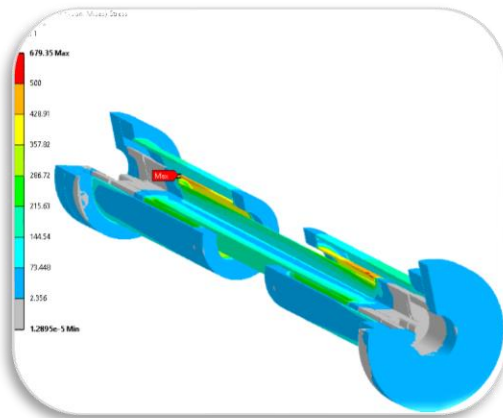
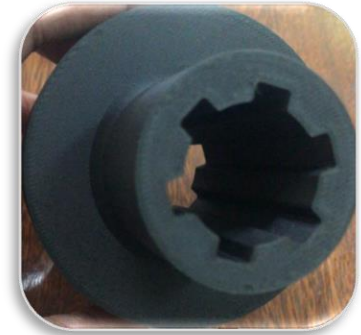
## Challenge

- Development of low-cost light weight Power Take Off Shaft
- Challenging space constraints
- Technology development & maturation with limited available data

## Solution

- Proposed composite after thorough benchmarking
- Sizing for torque and misalignment loading
- Composite layering and orientation, carbon contents
- Stiffness estimation for two gearboxes
- Testing - Torque, misalignment, endurance & dynamics response

ANSYS, SolidWork  
Composite 3D  
Printing  
Testing @ BMS  
College



## Benefits

- Became design partner for customer
- 45% weight reduction
- \$15K/engine cost saving to customer

## Technology Development & Adoption

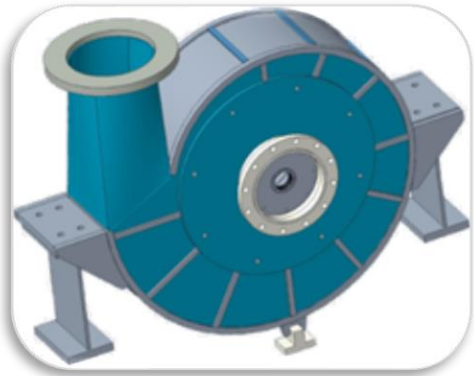
# Design & Development of a Radial Compressor

**Challenge**

- High mass flow rate compressor
- Compressor vibrations
- Stringent product cost target

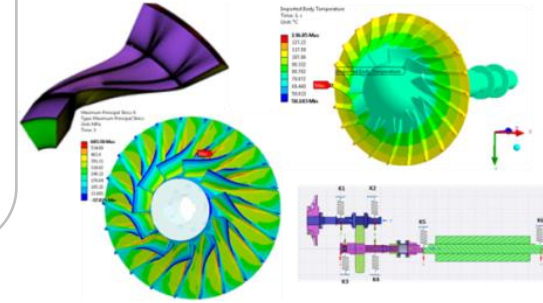
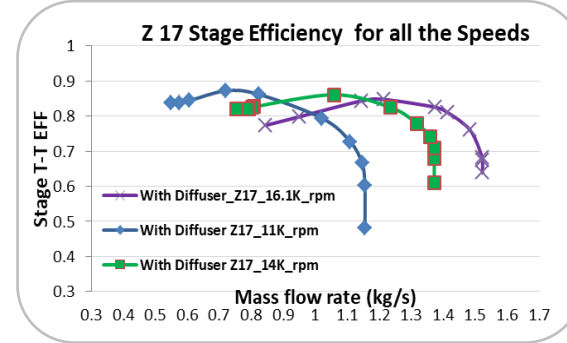
**Solution**

- Compressor design, thermodynamics calculations
- Design trade studies
- Diffuser, casing, shaft & sealing design
- Bearing design and selection
- Transmission & drive design & selection



**Benefits**

- Successfully installed Compressor at customer location
- Successful test run with desired performance
- \$7K/compressor cost saving to customer



**Concept to Completion**

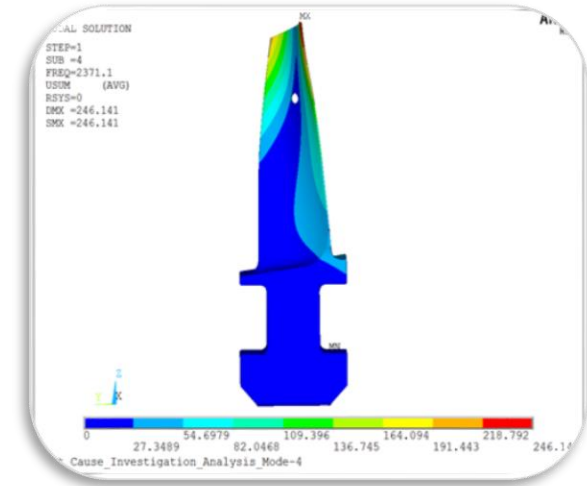
Aero Meanline Design in-house Tool  
ANSYS, BladeGen, FLUENT, CATIA

# LP Turbine Blade Failure Investigation

## Challenge

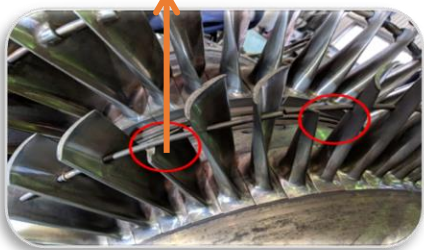
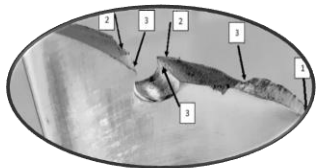
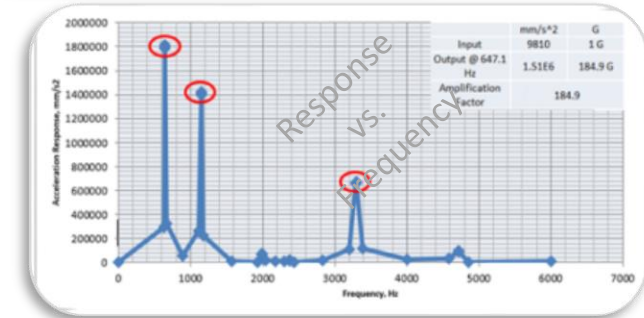
- Root cause investigation to resolve multiple LP Turbine blade failures for 35MW steam turbine power plant
- Inconsistent test data
- Multiple service provider tried to resolve

ANSYS, CATIA



## Solution

- Detailed rotor dynamics analysis
- Unbalancing and torsional analysis
- Proposed solution to fix the problem
- Variations in the electrical load fluctuations are captured in the numerical modeling



## Benefits

- Customer successfully implemented proposed solution
- Blade failure reduced to zero since last 1 year
- \$2.2M cost avoidance by eliminating down time

# Technical Excellence Demonstration

# Gear Box Failure Investigation

## Challenge

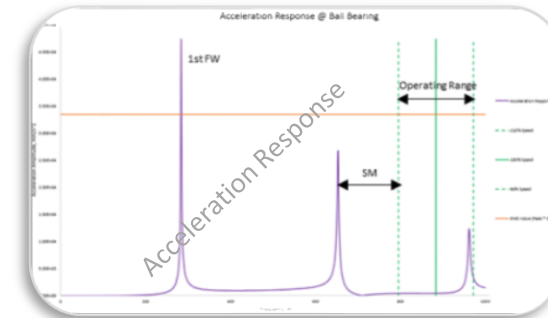
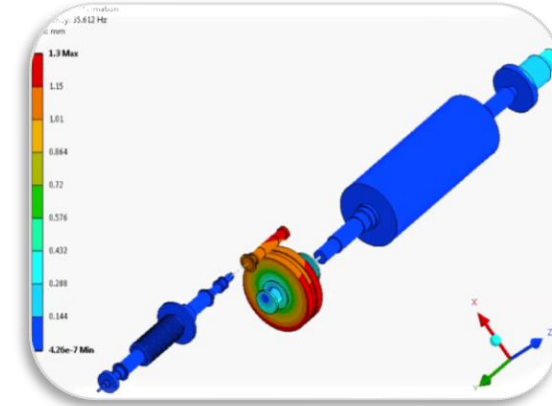
- Root cause investigation to resolve the planetary gearbox failure for 5MW steam turbine power plant in Kurnool
- Keeping power plant running
- Remote location of customer

## Solution

- Detailed root cause analysis
- Simulated gearbox failure with mathematical model
- Proposed solution to fix the problem
- Supported manufacturing
- Successfully installed new gear box and corresponding support structure

## Benefits

- Customer successfully implemented proposed solution
- Plant running successfully with new Gear Box
- \$1.0M cost avoidance by eliminating down time



# Technical Excellence Demonstration

Fish Bone Diagram  
ANSYS, SolidWork

# Aircraft Fuselage Design

**?**  
**Challenge**

- Complex composite modeling
- New product development
- Stringent product cost target

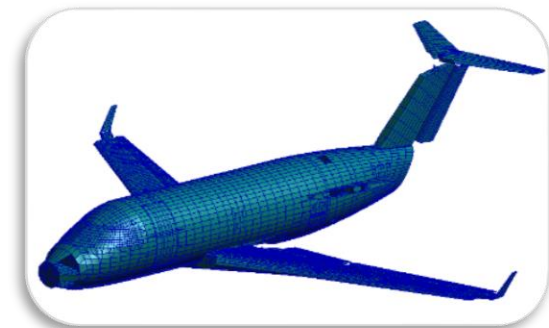
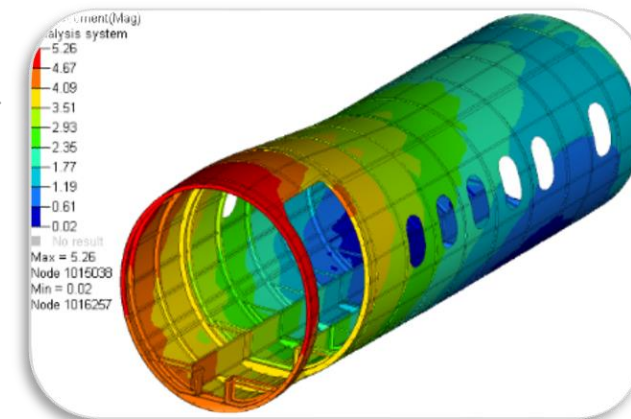
**Solution**

- Developed composite modeling technique
- 3D Modeling & Assembly
- System integration & interface definition
- Successfully completed DDR



**Benefits**

- Developed detail Product Technical Specification
- Manufacturing drawing release
- \$20K/fuselage cost saving wrt cost target to customer



**Co-Development of New Product**

# Re-Engineering of Fuel Pump

## Challenge

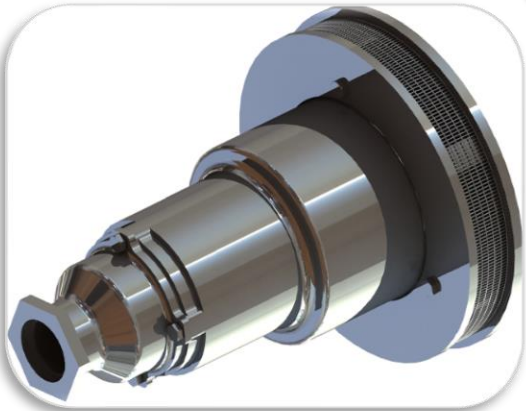
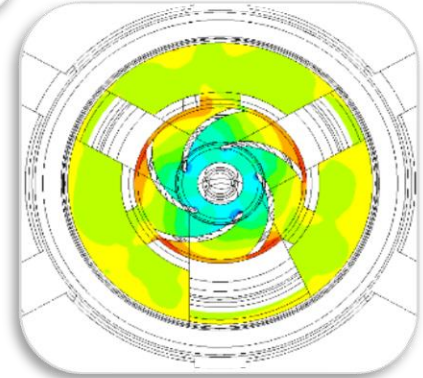
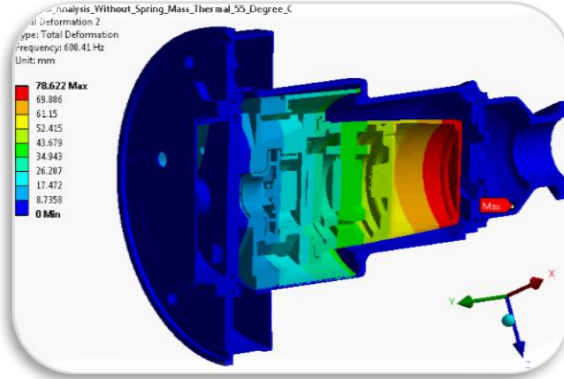
- Original vendor closed the business
- Limited technical information about product
- Meet or exceed performance parameters
- Unknown material

## Solution

- Task force to re-engineer the product
- Simulated entire assembly using CFD & Ansys
- No changes to interfaces
- Alternative design to improve performance
- Successfully completed DDR

## Benefits

- Developed detail Product Technical Specification
- Manufacturing drawing release
- 18% Weight reduction
- \$0.25M/helicopter cost saving to customer



Performance Improvement with Same Interfaces

FLUENT  
ANSYS, SolidWork

Scope: Design, Analysis & Development of TVC GPU System for Multirole Fighter Aircraft for calibration of the TVC System

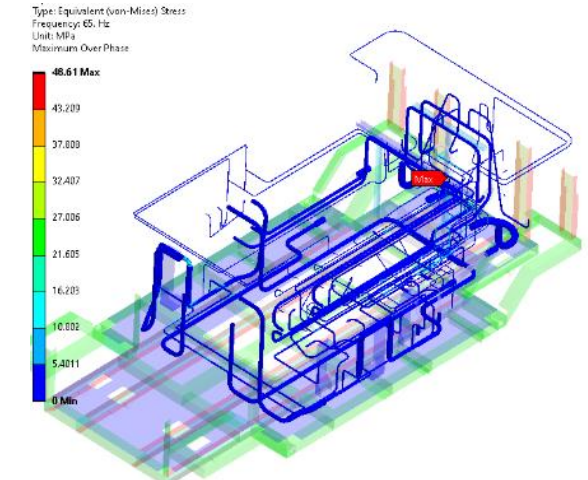
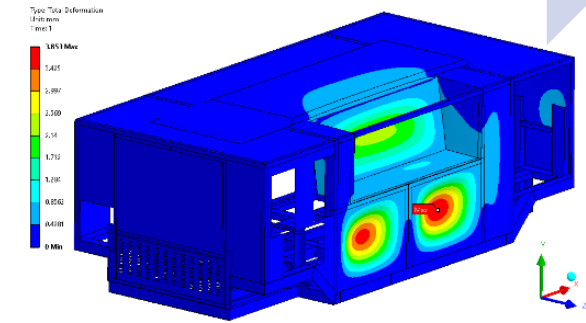
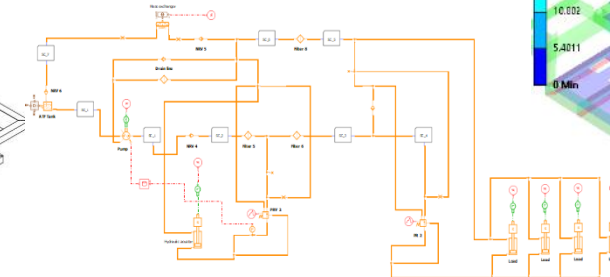
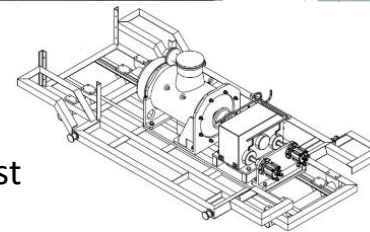
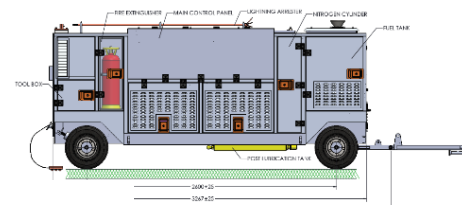
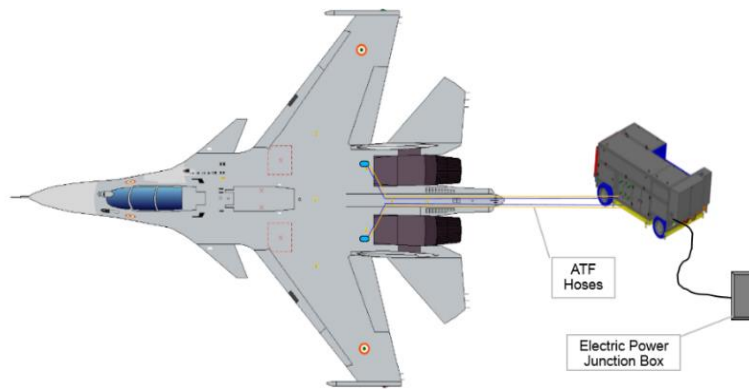
Product Requirements/Concept Evaluation/Detail Design

Design Validation – CFD and FE Analysis

Prototype Development

- PRD and CRD realization
- Concept evaluation
- Detail design – 3D modelling and manufacturing drawings
- DFMEA and MTBF estimation
- Performance compliance : MIL-STD-810F

- CFD Analysis: Flow and thermal analysis using 1D and 3D software
- Hydraulics and pneumatics design
- Multiphysics analysis – overlapping CFD and pressure loads for hydraulic components
- Dynamic analysis – shock, random, harmonic and torsional analysis
- Fatigue life estimation



## Key Accomplishments:

- Hydro-mechanical closed loop GSE system is designed for the first time in India
- Reliability of the aircraft engine is improved by 800hrs
- Fuel cost reduction by 36%