Concepts NREC

The Experts in Turbomachinery

Improving the design and manufacturability of compressors, pumps, gas turbines, steam turbines, fans, blowers, and turbochargers.

• Engineering • Software • Manufacturing • Training

Concepts NREC

For over 50 years, Concepts NREC has been partnering with the world's leading OEMs to improve the performance and manufacturability of their turbomachines. We are the only company in the world whose in-house capabilities span the entire process - from conceptual design through manufacturing, testing, and installation. This unique perspective creates powerful synergies that drive innovation across our entire offering. Our clients benefit from having a trusted partner who can see the big picture and provide valuable insights that save them time and money.

We are ISO 9001:2008 certified and committed to providing our customers with products and services that meet international quality standards.

Advancing the State of the Art in Turbomachinery

Concepts NREC maintains a robust in-house research and development program. We hold over 70 patents worldwide, with numerous patents pending. Concepts NREC is also the leader of the global *Advanced Centrifugal Pump and Compressor Consortium for Diffuser and Volute Design*, an internationally sponsored research venture dedicated to advancing diffuser and volute design.

We push past what *has* been done to explore what *can* be done. Concepts NREC has the vision to create great designs and a hard-earned reputation for delivering them.

Engineering

- Design Optimization
- Design Services
- Engineering Audits
- Equipment Rerates and Upgrades
- Feasibility Studies
- Laboratory Testing

Software

- 3D CFD Flow Analysis
- 5-Axis CNC Machining
- Design Optimization
- FEA Stress and Vibration Analysis
- Integrated Preliminary and Detailed Design Solutions
- Rotordynamics

Manufacturing

- Balance Testing
- CMM Inspection
- Component Assembly
- Concurrent Engineering/Manufacturing
- Modal Analysis
- Prototypes
- Reverse Engineering
- Short or Long Production Runs

Training

- Customized Training
- Design Software Workshops
- Free Webinar Series
- Manufacturing Software Workshops
- Professional Development Courses
- Textbooks

Engineering

Our highly-trained engineering team works closely with clients to understand their performance, reliability, manufacturability, and cost goals. Concepts NREC analyzes alternative design approaches and provides vital insight into the interdependencies between hardware design and operating requirements. We suggest improvements, develop designs, supply retrofit components, and provide complete equipment solutions.

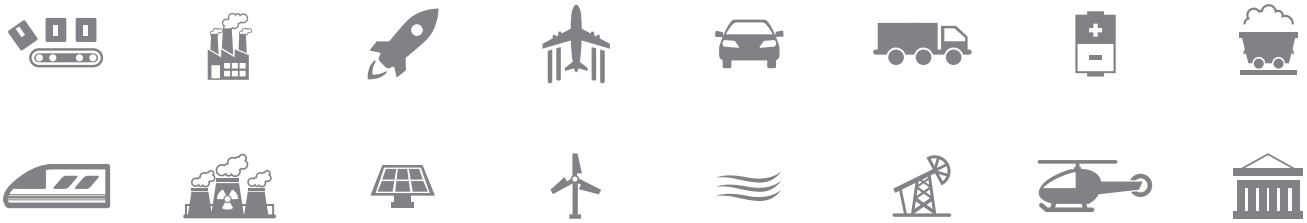
Capabilities

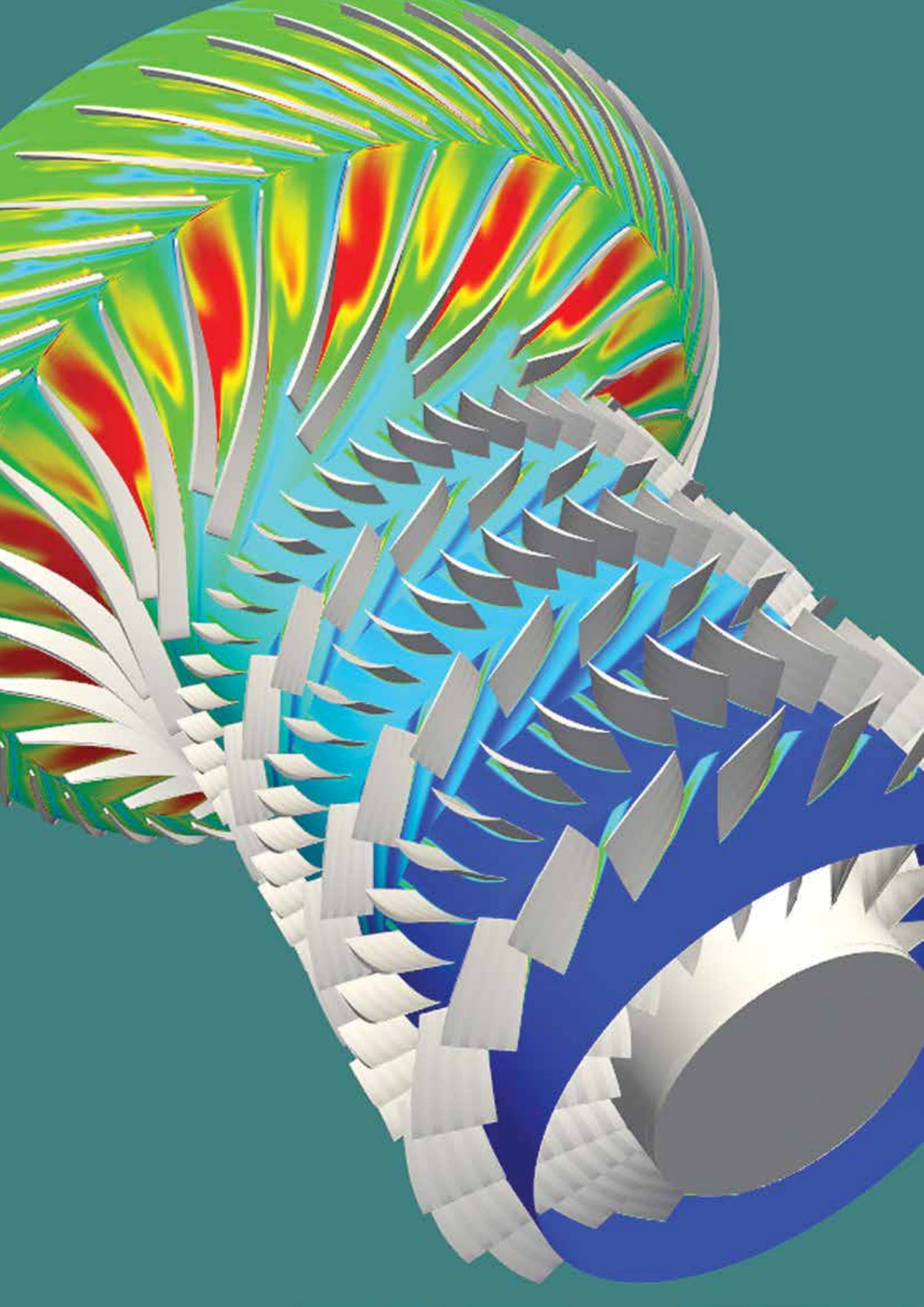
- Feasibility Studies
- Initial Design
  - Aerodynamic
  - Mechanical Analysis
  - Thermal Cycle Analysis
- Engineering Audits
- Laboratory Testing
- Equipment Rerates and Upgrades

Client Profiles

- Manufacturers designing their next generation of rotating equipment
- Industrial plants converting waste heat to electric energy
- Commercial aviation companies seeking to improve the performance of their turbines
- Formula One racing teams wanting that winning edge from their turbocharging systems
- Engineering companies bringing novel approaches for energy storage to market
- Green technology companies harvesting energy from the earth, wind, water, or sun
- Aerospace firms developing advanced rocket and space propulsion
- Maintenance and Repair Organizations (MROs) looking for help with their rerates and rebuilds
- Turbomachinery OEMs needing to validate their designs through independent laboratory testing
- Government agencies sponsoring advanced research and development projects
- Refrigeration companies looking to expand their range of chiller compressors
- Companies and universities training tomorrow's engineering leaders

Industries Served





Software

The Agile Engineering Design System® is a specialized suite of programs for Computer-Aided Engineering (CAE) and Computer-Aided Manufacturing (CAM) of turbomachinery. The seamlessly integrated CAE modules cover the entire design process - from preliminary sizing through fluid dynamics and mechanical stress and vibration analysis. Final designs can be easily imported into our industry-leading CAM software to create efficient 5-axis machining strategies.

CAE Software

Our preliminary design suite uses a meanline approach to rapidly size and analyze single or multistage machines. Each specialized module features a design wizard that leads users through the process. Our preliminary design modules are:

- **COMPAL®** - Radial and mixed-flow compressors.
- **PUMPAL®** - Centrifugal, mixed-flow, and axial pumps.
- **RITAL™** - Radial and mixed-flow turbines.
- **FANPAL™** - Axial, radial, or mixed-flow fans for single and multiple stages.
- **AXIAL™** - Multistage axial compressors and gas, steam, and hydraulic turbines.

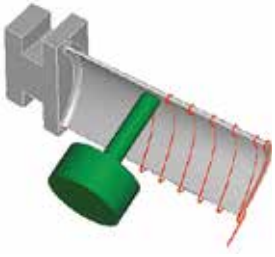
Our detailed design modules provide well-defined 3D geometry for rotating and stationary blade rows and associated flow paths and structures. We offer the following detailed design modules:

- **AxCent®** - Detailed 3D geometric design and rapid 2D flow analysis of single and multistage axial and radial turbomachinery.
- **Pushbutton CFD®** - Specialized 3D flow analysis that provides advanced CFD.
- **Pushbutton FEA™ -** Specialized 3D FEA analysis with highly automated preprocessing and postprocessing functions.
- **TurboOPT II™ -** Holistic optimizer for meanline, streamline curvature, quasi-3D CFD, full 3D CFD, and stress analysis.
- **CTAADS™ -** Cooled Turbine Airfoil Agile Design System for advanced 3D modelling of cooling systems for axial turbine vanes and blades.

CAM Software

The MAX-PAC® suite of software enables users to produce high-quality components in less time and at a lower cost. The benefits scale dramatically with higher-volume production. MAX-PAC offers several modules focused on different milling strategies:

- **MAX-5™** - Flank Milling module provides significant cost savings by enabling the entire blade surface to be machined in one pass.
- **MAX-AB™** - Point Milling module for machining complex CFD-influenced blade shapes that can be difficult or timely to cut with general use CAM software.
- **MAX-SI™**- Integral Shroud Milling module delivers single piece impellers with stronger shroud joints and fewer process steps. MAX-SI is also used for large axial compressor blades and blisks using a side entry machining approach.
- **MAX-SB™** - Single Blade module generates tool paths for rapid 5-axis machining of single blade parts. It is specifically designed for flat/torus cutters that are more efficient than a ball tool. MAX-SB also provides optimized angles for the smallest cusp to avoid gouging in concave areas.



In addition to its proprietary software, Concepts NREC partners with other developers to offer state-of-the-art tools for cycle performance analysis, rotordynamic analysis, Multi-Disciplinary Optimization (MDO) procedures, and smooth interfacing with a wide variety of CAD packages.

Manufacturing

Concepts NREC's manufacturing center is much more than a typical job shop. Our broad-based expertise enables us to incorporate more efficient manufacturing methods and to suggest materials, processes, and features that lower client costs. Our specialty is quickly delivering both prototypes and short production runs of our clients' most challenging parts.

Capabilities

- 5-axis machining of blades, blisks, inducers, propellers, impellers, and other pump, fan, turbine, and compressor parts
- Component assembly
- Concurrent manufacturing/engineering
- Coordinate Measuring Machine (CMM) inspection
- Dynamic balancing and modal analysis
- Prototypes and short production runs
- Higher-volume production runs

Specialty Products

CN300™ Turbogenerators for Waste Heat Recovery - Concepts NREC has over 35 years of experience designing, building, and testing Organic Rankine Cycle (ORC) systems. We can provide a system for virtually any heat recovery/power generation application, including:

- Biomass
- Geothermal
- Ocean Thermal Energy Conversion (OTEC)
- Waste Heat from Engines and Industrial Processes

Projects under 1 megawatt (MW) are designed using the CN300 turbogenerator, a commercially proven unit engineered for minimal footprint, low maintenance, and low life-cycle costs. For projects over 1 MW, we provide a custom-designed machine for the specific application. We can also provide full thermal cycle analyses and balance-of-plant equipment for a turnkey system.

VAROC® Air Dynamometers - We make the world's only air dynamometer for testing turboshaft engines. Three models provide an accurate, easy to use, easy to maintain, compact, lightweight, portable, and highly reliable way to test engines up to 18,000 horsepower.

The VAROC Air Dynamometer can be installed in fixed test-cell installations or in mobile field applications without extensive support equipment. The VAROC can operate in any climate, including extreme temperatures, and does not produce any by-products requiring disposal. We also offer compatible torquemeters and full servicing and rebuilds of our dynamometers.

Training

Professional Development Courses

Concepts NREC offers professional development courses geared towards engineers, managers, marketers, and sales professionals in the turbomachinery industry. Courses are taught by educators distinguished in their fields. They address a full range of technologies - from basic fluid mechanics and thermodynamic principles to structural and vibration analysis, computational fluid dynamics, advanced materials, and the current state of the art in turbomachinery design methodologies.

Design and Manufacturing Software Workshops

Concepts NREC provides hands-on software workshops throughout the year to meet the needs of both novice and experienced users. Participants interact directly with software developers and other users to provide a complete exploration of the software's capabilities. Workshop schedules and registration forms are listed on our website **www.conceptsnrec.com.**

Textbooks

Concepts NREC specializes in mechanical engineering textbooks for both industry and academia. As practicing engineers themselves, the authors understand the needs of the turbomachinery industry. They address those needs with academically rigorous, design-oriented texts that are useful to students and professional engineers alike. Titles available include:

- Advanced Experimental Techniques in Turbomachinery
- Axial and Radial Turbines
- Centrifugal Compressor Design and Performance
- Centrifugal Pump Design and Performance
- Compressor Surge and Stall
- Design of Highly Loaded Axial-Flow Fans and Compressors
- Diffuser Design Technology
- Fundamentals of Turbocharging
- Hydrodynamics of Pumps
- Introduction to Dynamics of Rotor-Bearing Systems
- Introduction to Turbomachinery

Concepts NREC

The Experts in Turbomachinery

★ Worldwide and regional headquarters. We also have sales offices and representatives strategically located throughout the world to support our global clients.

We Offer

- CAE Software
- CAM Software
- Design Audits
- In-house Laboratory Testing
- Manufacturing Services
- Precision Prototypes/Products
- Research and Development
- Scoping Studies
- Specialized Products

Our Focus

- Air Dynamometers
- Axial and Radial Turbines
- Compressors
- Fans and Blowers
- ORC Turbine Generators
- Pumps
- Refrigeration Chillers
- Superchargers
- Turbochargers

Concepts NREC

Corporate Headquarters
217 Billings Farm Road
White River Junction, VT 05001

Phone: +1 802-296-2321
Email: info@conceptsnrec.com
www.conceptsnrec.com