



Specialized Software for Turbomachinery Components and Systems that Encompasses and Integrates the Entire Engineering Process

Agile Engineering Design System[®]

Concepts NREC's Agile Engineering Design System[®] is a complementary suite of programs for Computer-Aided Engineering (CAE) and Computer-Aided Manufacturing (CAM). This includes a strategic partnership with NUMECA International that enables us to cover the entire design process from preliminary sizing through final design, with full fluid dynamics, mechanical stress, and vibration analysis. The full power and benefit of our software suite is realized when the various modules are used together.

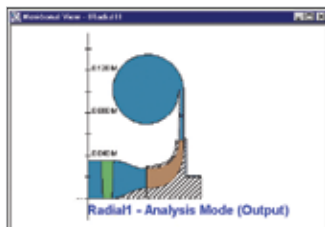
The system also offers best-in-class specialized 5-axis machining software, automated optimization, and a smooth transfer of data to CAD packages.

- Solutions integrate CAE/CAM tools with process management and manufacturing.
- Simulate virtual performance, reliability, durability, and lowest cost production
- Build, test, and refine the actual product based on standards and best practices
- Accelerate development to best capture opportunities for market success
- Predict product behavior for PLM, quality assurance, and process certification
- Growing knowledge base drives rapid innovation and best-in-class products

Preliminary Design

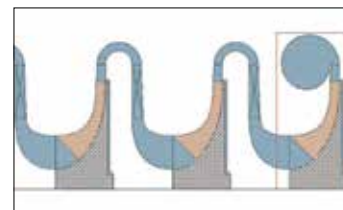
COMPAL[®]

Perform meanline analysis and design optimization for centrifugal or mixed-flow compressors. Unique design wizards lead the user through the design, analysis, and data reduction processes for open or closed 2D or 3D impellers including radial or axial inlet guide vanes, seals, diffusers, and exit elements.



PUMPAL[®]

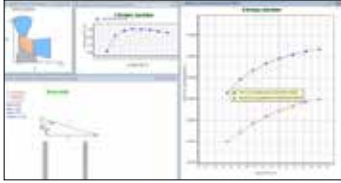
Perform meanline analysis for axial, centrifugal and mixed-flow pumps. Engineers can design the stage, analyze its performance, and reduce laboratory data for any type of pump system. Real fluid properties can be calculated using optional D.B. Robinson real fluid property routines.



Preliminary Design, cont'd

RITAL™

Perform one-dimensional analysis of radial and mixed inflow turbine stage performance. The same built-in model for design, analysis, and data reduction modes supports inlet volutes, rotor and nozzle diffusion/losses, disk friction, and other phenomena of subsonic turbine performance.



FANPAL™

Perform meanline analysis and design optimization for axial, centrifugal, and mixed-flow fans and blowers. Design the stage, analyze performance, and reduce laboratory data to refine input parameters using a variety of qualified performance modeling approaches.



AXIAL™

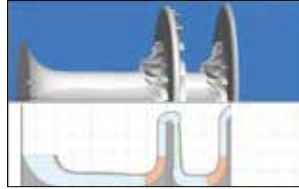
Perform design point and off-design meanline performance modeling for subsonic and supersonic designs. The system supports single and multistage axial impellers including compressors, gas turbines, steam turbines, hydraulic turbines, pumps, and fans.



Detailed Design

AxCent®

Design and analyze three-dimensional stage geometries for axial, mixed-flow, and centrifugal compressors, pumps, fans, and turbines. AxCent combines the capabilities of the most widely used turbomachinery codes to design any single or multistage turbomachine.



Computational Fluid Dynamics

FINE/pbCFD™ & FINE™/Turbo

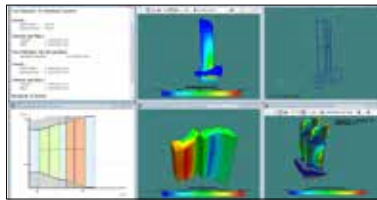
These efficient full Navier-Stokes CFD modules support all types of turbomachinery analysis and design. They quickly generate design-level CFD calculations and are seamlessly integrated with AxCent. FINE/pbCFD is a base level module and FINE/Turbo is the advanced level module.



Finite Element Analysis

Pushbutton FEA™

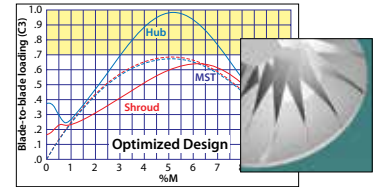
Perform flexible parametric modeling and stress analysis of radial and mixed-flow compressor and pump impellers, axial and radial turbine geometries, plus axial fans. See solid models with meshing, boundary conditions, aerodynamic loading, and material model.



Optimization

TurboOPT II™

This next-generation solution effectively converges on an optimum design for the attributes most desired and integrates completely with the Agile system for compressors, pumps, fans, and turbines, including radial, mixed-flow, and axial machinery.



Computer-Aided Manufacturing

MAX-PAC™

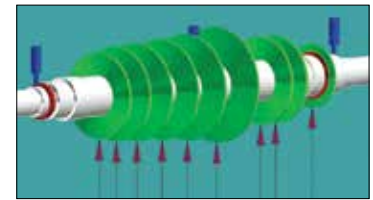
Create 5-axis NC machining instructions for turbomachinery impellers including MAX-5™ for flank milling of ruled-surface components, MAX-AB™ for point milling of arbitrary- or ruled-surface components, and MAX-SI™ for milling integrally shrouded components.



Rotordynamics

Dyrobex™

This powerful tool for the dynamic modeling and comprehensive analysis of rotor-bearing systems is based on finite element analysis (FEA). The system provides accurate predictions of natural frequencies, forced response, and rotor stability.



Concepts NREC's Agile Engineering Design System®		Radial	Centrifugal	Mixed-Flow	Axial	Compressor	Pump	Fan	Turbine
CAE Preliminary Design									
Meanline Approach	AXIAL™								
Meanline Approach	COMPAL™	✓							
Meanline Approach	FANPAL™		✓						
Meanline Approach	PUMPAL™			✓					
Meanline Approach	RITAL™				✓				
CAE Detailed Design									
3D Geometric Design	AxCent®	✓	✓	✓	✓	✓	✓	✓	✓
CFD Option for AxCent	FINE™/Turbo™	✓	✓	✓	✓	✓	✓	✓	✓
Pre- & Post-Processor for AxCent	jobPost™	✓	✓	✓	✓	✓	✓	✓	✓
FEA Option for AxCent	Pushbutton FEA™	✓	✓	✓	✓	✓	✓	✓	✓
CAE Specialized Design Software									
Gas Turbine Blade Cooling	CSTAADS™								✓
Optimization	TurboOPT II™	✓	✓	✓	✓	✓	✓	✓	✓
Rotor Dynamics	Dyrobex™	✓	✓	✓	✓	✓	✓	✓	✓
Gas Turbine Cycle Analysis	GasTurp™								✓
CAM Toolpaths									
Base Platform	MAX-PAC™	✓	✓	✓	✓	✓	✓	✓	✓
Flank Milling Option	MAX-5™	✓	✓	✓	✓	✓	✓	✓	✓
Point Milling Option	MAX-AB™	✓	✓	✓	✓	✓	✓	✓	✓
Closest Impeller Option	MAX-SI™	✓	✓	✓	✓	✓	✓	✓	✓
Single Blade Option	MAX-SB™	✓	✓	✓	✓	✓	✓	✓	✓
3+2 Roughing Option	3+2 Roughing	✓	✓	✓	✓	✓	✓	✓	✓

*Offered in partnership with NUMECA International® as part of the FINE/Agile™ integrated suite.



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