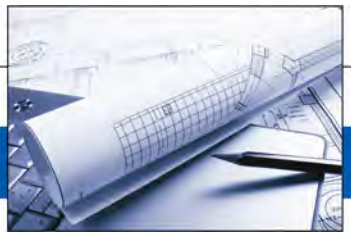
wright · line

professional services

statement of work



1.0 Computational Fluid Dynamics (CFD) Modeling Service

Contents

Executive Summary 1
Details of Service 3
Assumptions 6
Scope of Responsibility 6
Other CFD Services 7
Custom CFD Services 8
Pricing 8
Terms and Conditions 8

Executive Summary

Improve data center energy performance

As organizations fill data center enclosures with increasing numbers of high density servers, our customers are looking to us for help and advice on:

- ✓ How to add high density servers and increase rack density in an energy efficient way.
- ✓ Analyzing data center energy performance and potential improvements.
- ✓ Determining efficient data center cooling methods.
- ✓ Discovering problems with energy profiles of existing data centers and predicting design limitations of new or expanding facilities.

It all adds up to increased performance and a more energy efficient data center with the added benefit of knowing that Wright Line has energy efficiency and savings at the core of our service delivery and expertise.

What you don't know can hurt you

By modeling the airflow, temperature, static pressure, and energy profiles of various dynamic critical environments, the CFD Services provided by Wright Line can compare and substantiate which design decisions will maximize your data center flexibility, scalability, and resilience. Creating a CFD baseline model addresses your existing facility concerns today, and more importantly your baseline can be revisited and quickly updated in the future. This valuable service allows you to explore your best options for IT and facility growth, create a calculated plan, and avoid major capital commitments or costly design or implementation mistakes.

Measurement is the key. There is no question that the correct approach to reducing energy consumption is to begin by measuring, establishing a baseline, and tracking performance for your facility.

Computational Fluid Dynamics (CFD) Modeling

The Wright Line CFD Service constructs a virtual representation of your data center, modeling the impact of load distribution within the facility as well as the flow of hot and cool air within the space. The CFD modeling analysis is essential for fine tuning your current facility to optimize its efficiency, and can demonstrate how to increase your rack densities and server installations without creating additional hot spot and airflow issues. Wright Line is assisting data center operators to make scientifically based decisions aimed at improving operational efficiency and reliability.

Additional CFD services offered by Wright Line are listed in the Other CFD Services section on page 7.

Features	Benefits
Trained and Certified CFD Service Professionals	Ensures that the customer's CFD requirements and schedules are met on or ahead of time.
Experienced and Knowledgeable Team	The CFD Service Team is comprised of personnel with cross-disciplinary experience that has made us leading experts at working in live critical environments.
World Class Manufacturing Support	The CFD Service Team is backed by the entire manufacturing and engineering capability of Wright Line to meet demands in short cycle times and keep project schedules intact.
Predictive Analysis	The CFD Service Team is engaged to deliver a focused plan for improving the lifecycle of your data center environment and resolving potential problems before they arise.

Details of Service

Wright Line's experienced team is certified and trained on state-of-the-art CFD modeling software. The Wright Line CFD 1.0 Service offers customers a virtual three-dimensional model of their data centers, individual rooms, rows, and/or racks.

> *Wright Line's computational fluid dynamics service lets customers choose from preset service levels or customize the service to meet their specific needs. The level of CFD Service determines how much information is available about the performance of your data center environment and accuracy of recommended data center solutions. A thorough and detailed site audit provides better analysis of current conditions and more precise modeling of proposed changes.*

The service level and deliverables are described in the following table.

CFD 1.0 Scope of Work	
Service Level	**Description**
CFD Analysis using Customer Provided Site Audit	Cooling Units Audit: ▪ Manufacturer and model number. ▪ Type of unit chilled water, direct expansion. ▪ Cooling specification. ▪ Airflow delivery method. ▪ Dimensions, location, and orientation. UPS and PDUs: ▪ Manufacturer and model number. ▪ Power specification. ▪ Dimensions, locations, and orientation. Rack / Enclosure Audit: ▪ Rack / cabinet size. ▪ Location (normally provided on a floor plan). ▪ Orientation. ▪ Estimate of rack power dissipation as heat rejection. ▪ Height of rack above raised floor, otherwise assumed to be half an inch.

Service Level	Description
CFD Analysis using Customer Provided Site Audit (continued)	Architectural Details: ▪ Room dimensions (Length x Width x Height). ▪ Major obstructions including posts and columns within the internal space only (not including plenum space). ▪ Smaller obstructions such as cable and pipe mappings are not included in the standard service, but can be added as part of custom service. Floor Details: ▪ Height of raised floor from structural floor. ▪ Location of perforated floor tiles and grates. ▪ Estimated percentage of floor grate opening. ▪ Open holes or cutouts in raised floor. Ceiling Details: ▪ Height of suspended ceiling from raised floor. ▪ Height of plenum space from suspended ceiling to structural ceiling. ▪ Location of ceiling egg crates. ▪ Estimated percentage of ceiling egg crate opening.
Output	**Description**
CFD Model Creation	CFD model details: ✓ Models will be based on power consumptions on a per rack/enclosure basis only. ✓ Data center layout and design. ✓ Input data into CFD Modeling software. ✓ Calculate cooling airflow supply. ✓ Calculate rack airflow demand.

	✓ Customer validation of data.
Output	**Description**
CFD Written Analysis and Recommendations	A three dimensional baseline model of the data center based on the existing data center design the following will be depicted: ✓ Rack level maximum inlet temperatures. ✓ Volumetric airflow rate from each perforated tile in a raised floor environment. ✓ Stream line plot of Datacenter airflow characteristics. ✓ Planar Views of Temperature plot. ✓ Conditioned air delivery and capacity. ✓ Above-floor air flow analysis. ✓ Bypass air flow analysis. ✓ Recirculated airflow analysis. ✓ Provide a comprehensive report identifying existing problems and recommendations to correct and optimize the data center environment.

Assumptions

Customer satisfaction is Wright Line's top priority. This includes timely, accurate, and complete delivery of services. To provide a superior level of service, Wright Line makes the following assumptions when developing a price quote and setting the expectation of service delivery:

1. Customer will provide a single point of contact to assist with Wright Line Data Center Audit form.
2. All customer supplied data points will be assumed to be 100% complete and accurate.
3. If data points are incomplete and require data collection or validation to be performed by Wright Line a new service agreement must be made with the end-user prior to proceeding further.
4. An estimated delivery date will be issued once 100% of customer supplied data is in possession of Wright Line.
5. Service will be provided during normal weekday business hours on a 5x8 basis unless otherwise noted and agreed to with the customer.
6. For some customer locations, sources of radiant heat (i.e. lighting, solar loading, weather data, and occupancy levels) can be important. These will be assumed to be insignificant unless advised otherwise by the client.
7. If facility infrastructure information is unavailable Wright Line may be able make assumptions to supplement the data. Useful results are still likely to be obtained, although accuracy may be compromised.

Scope of Responsibility

Wright Line Scope of Responsibility:

- Provide a Wright Line point of contact to the customer.
- Confirm the level of CFD service is per customer's request.
- Conduct work in a timely manner.
- Identify any open issues.
- Manage any site-based issues affecting service delivery.

Customer Scope of Responsibility:

- Provide an authorized point of contact to the Wright Line CFD Service team for scheduling and on site coordination.
- Complete and return the Wright Line Data Center Audit forms.
- The facility information should be provided in hard and soft copy CAD drawings. Along with any written design specifications. MEP drawings as well as detailed floor plan as-built drawings are preferred.
- Notify Wright Line CFD Service Team of any barriers, such as security clearance, insurance requirements, non-disclosure agreement, or any special training, safety, or induction sessions required (and fees if required) prior to pricing CFD Service.
- Disclose any building restrictions that need to be met such as loading dock scheduling, elevator scheduling and any other building facility management requirements.
- All time lines are based upon complete and accurate information delivered from the customer and received by Wright Line. Any delay in providing complete and accurate facility information can jeopardize the delivery date of receiving CFD analysis and reports.

Other CFD Services

Wright Line offers the following levels of CFD service:

1.1 Provides a baseline CFD analysis of the customer facility. Data collection and submission provided jointly between Wright Line and the customer. Modeling calculations are based on power per equipment rack. Specific rack mounted equipment is not modeled.

2.0 Provides a baseline CFD analysis of the customer facility with the addition of specific rack mounted equipment modeling and corresponding report data. All data collection and submission is completed by the customer.

2.1 Provides a baseline CFD analysis of the customer facility with the addition of specific rack mounted equipment modeling and corresponding report data. Data collection and submission provided jointly between Wright Line and the customer.

Custom CFD Services

Wright Line offers other customized CFD services. Some sample services are listed below but other services may be offered through consultation with Wright line professional services.

- **Failure Mode Analysis** – Failing component(s) within baseline model and indentifying steady state thermal properties and capacities with respect to the changes.
- **Simulated Solution Modeling** – Modeling a recommended or alternative solution as a retrofit or upgrade to existing baseline model.
- **Validation of Measured Data** – Gather measured data within data center and compare to existing baseline model
- **Application of Measured Data** – Rework baseline models based on captured measured data
- **Transient Behavior** – Calculate real time thermal behavior from baseline models if either a CRAC(s) or Chiller were to fail.
- **Virtual Walk Through** – An animated walk through illustrating the airflow dynamics within the data center.

Pricing

Pricing for Wright Line CFD Services is available on an order-by-order basis. A pre-quote consultation and/or walk-through by a Wright Line CFD Team member is advised to determine the scope and level of CFD service. Changes in the CFD Service agreement or changes in the assumptions or CFD Service Specifics after the original Wright Line scope/statement of work is set may require a new CFD Service agreement. Contact your Wright Line Sales Representative for a quote according to your specific requirements.

Terms and Conditions

Standard Wright Line Terms and Conditions apply, available in the sales quote package, at www.wrightline.com, or by contacting your Wright Line Sales Representative.