Spring 2009

AIRFLOW SCIENCES CORPORATION

The Airflow Update

ASC Helps Advance Ocean Research

The Monterey Bay Aquarium Research Institute (MBARI) performs advanced ocean research in the areas of benthic processes, ocean observations and measurements, ocean biogeochemistry, CO_2 issues, submarine volcanism, marine ecology, sea floor imaging, and pH shifts in the upper ocean.

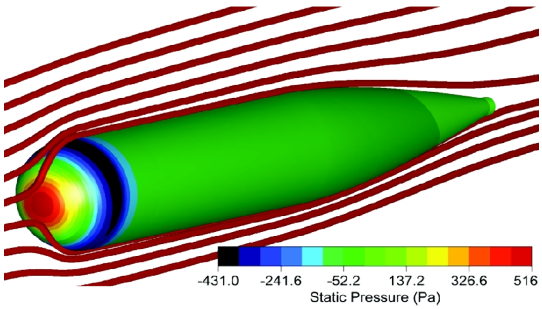
MBARI utilizes autonomous underwater vehicles (AUVs) to support its research programs. On-board computer controls allow vehicles to navigate the ocean for long periods of time, periodically surfacing to transmit acquired data via wireless telemetry.

The AUVs provide MBARI with an efficient and cost-effective alternative for performing deep water research. However, because these vehicles carry their own on-board power sources such as batteries and fuel cells, their travel range is limited. At this time, they cannot perform long-duration missions, such as wide ocean surveys or under-ice polar explorations.

During 2007, the MBARI development team began research into a long-range AUV (LR-AUV). The goal was to minimize hydrodynamic drag - allowing the vehicle to use the energy saved to travel further.

Initially, the project focused on use of modeling and simulation tools to determine whether a long-range, high speed vehicle was feasible based on current energy storage technology. They requested ASC perform CFD simulations to define body shapes exhibiting minimum drag over the range of expected vehicle speeds. This included an analysis of the boundary layer behavior along the length of the vehicle as well as the interaction of the flow with the aft-mounted propeller.

By modifying the shape of the vehicle's nose and after body regions, uniform flow conditions were achieved that minimized skin friction and form drag and presented the propeller with inlet conditions that improved its efficiency.



The project has been successful, and fabrication of the initial LR-AUV prototype was completed last summer. Jim Bellingham, MBARI's Chief Technologist stated "The ability to ask 'what if' questions with respect to the hydro dynamic performance of vehicle design has been immensely useful. Not only has it allowed us to expand vehicle diameter, simultaneously making packaging simpler and reducing drag, but it has also let us better optimize vehicle propulsion. CFD modeling is addictive." Testing of the prototype is currently underway.

ASC Papers & Presentations

Have you ever wondered which was better: CFD or physical flow modeling? Well we have the paper for you! ASC Engineering Manager **Dr. Kevin Linfield, P.E.** and Vice-President **Robert Mudry, P.E.** co-authored a paper "Pros and Cons of CFD and Physical Flow Modeling". It is sure to answer all of your questions.

ASC co-founder, **James Paul, P.E.** has co-authored a paper on the application of CFD and wind tunnel testing to railroad aerodynamics. The article, which was written with **Robert Yates** of Greenbriar Companies, was published as part of a collection called The Aerodynamics of Heavy Vehicles II: Trucks, Buses and Trains by Springer-Verlag.

Papers and presentations can be found at www.airflowsciences.com.

ASC Continues to Grow...

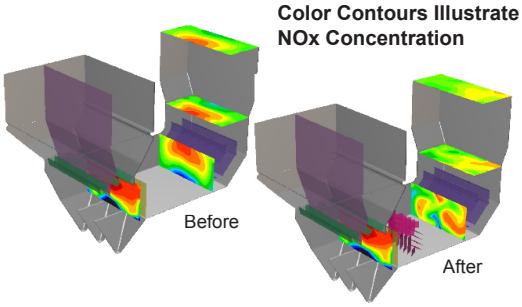
There are some new faces around the ASC office! **Bryan Wilemon**, **John Nitz**, **Kanthan Rajendran** and **Jeffrey Everett** have joined our team. We hope that you have the opportunity to work with them soon.

Four beautiful new additions were made to the ASC Family. **Dennis Manning** and his wife **Amy** welcomed son **Wyatt Douglas** in July. **Dr. Paul Harris** and his wife **Jennifer** welcomed son **Luke Dell** in September. **Holly Skelton** and husband **Bryndon** welcomed daughter **Brier Mae**, in December. And most recently, **Jason Tolfree** and wife **Amanda** welcomed their daughter **Gabbrielle Marie** in March. Congratulations to all!

Optimizing SCR Performance

In Spring 2008, Tampa Electric's Big Bend Unit 3 SCR became operational. Airflow Sciences performed modeling to design flow devices that optimize SCR performance. Others involved in the SCR system design included: Cormetech (catalyst supplier), Sargent & Lundy (AE), Sulzer (AIG/mixer supplier), and Tampa Electric. This SCR was particularly complex from a fluid dynamic view, with the following performance goals:

- Provide a uniform ammonia-to-NOx ratio at the catalyst, despite the fact that NOx stratification at the boiler exit was severe.
- Achieve minimum system ΔP to save operational costs and capital for new fans.
- Generate a uniform velocity profile at the catalyst to promote maximum NOx reduction.
- Since Big Bend Unit 3 is a coal fired plant, avoid areas where coal flyash will settle out in the duct work when operating at reduced loads.



CFD model of the boiler exit region. Uniformity of NOx was achieved with the installation of a static mixer.

To meet these goals, a 1:12 scale physical flow model was fabricated and used to design the SCR system. A CFD model was also used for a portion of the design. To mix the highly stratified NOx, ASC designed a custom mixer located in each boiler exit duct. This provided reasonably uniform NOx in the location of the ammonia injection nozzles. Two static mixers, designed by Sulzer, promoted mixing of the injected ammonia such that the stoichiometric ratio of ammonia and NOx at the catalyst inlet was within the uniformity goal of 5% RMS. ASC's optimization, performed with the physical model, generated a final design that was robust despite the non-uniform boiler exit flows.

When the system started up in Spring 2008, Cormetech's emissions measurements indicated close correlation to model results. Particularly, the measured ammonia distribution at the catalyst inlet closely matched the model's profile.

Unit 3 is the second SCR to operate at Big Bend. Unit 4, also modeled by ASC and designed by the same team, started up successfully in Spring of 2007. Construction of the Unit 1 & 2 SCRs, using the same design for flow control devices, is underway. ASC was pleased to be part of such an important project for Tampa Electric and all the design participants.

Physical Model of the Big Bend Unit 3 SCR.

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Airflow Events

We hope to see you at future trade shows and conferences:

Electric Power
May 12-14, Chicago, IL

APC/PCUG Conference
July 12-17, Woodland, TX

COAL-GEN
Aug 19-21, Charlotte, NC

ASM: Heat Treat
Sept 14-17, Indianapolis, IN

Your Office
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