Advanced Maritime Emissions Control System (AMECS®)

Advanced Cleanup Technologies, Incorporated

Hazardous Waste Management & Emissions Control Specialists

Environmental Systems Development Division

The Problem

The PROBLEM (continued)

The Exhaust Capture System must accommodate various stack geometries

The PROBLEM (continued)

The system must be able to treat various fuel types, handle various exhaust flows and exhaust temperatures

The Solution

Emissions Control Technology

ACTI's Emissions Control Technology consists of two types of systems:

- Advanced Locomotive Emissions Control System (ALECS) designed to capture and treat the exhaust emissions from railroad locomotives
- Advanced Maritime Emissions Control System (AMECS) designed to capture and treat the exhaust emissions from ocean-going vessels
  - Barge-Based System
  - Shore-Based System
  - Multi-Capture and Treatment System

Emissions Treatment Subsystem

Picture of the Actual System Demonstrated and Tested in Roseville, California

Successful Demonstration Program

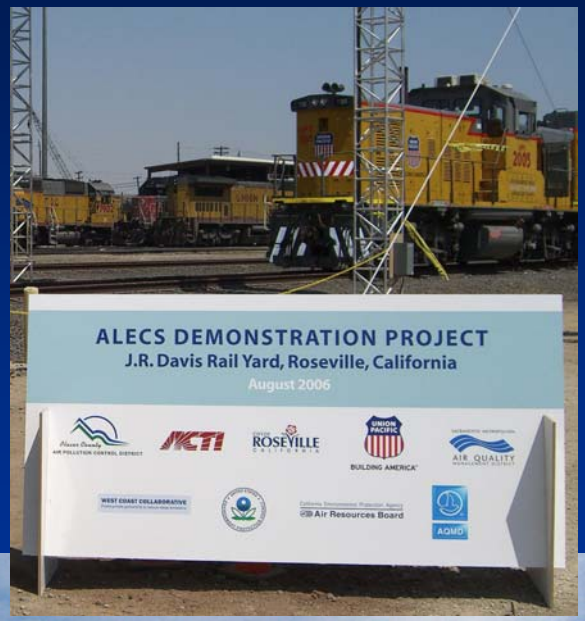
- The objective of the tests at Union Pacific Railroad's J. R. Davis rail-yard in Roseville, California was to demonstrate ALECS capability to:
  - Remotely attach to a railroad locomotive around the exhaust opening
  - Capture the exhaust gas and direct it via the overhead manifold system into the Emissions Treatment Subsystem

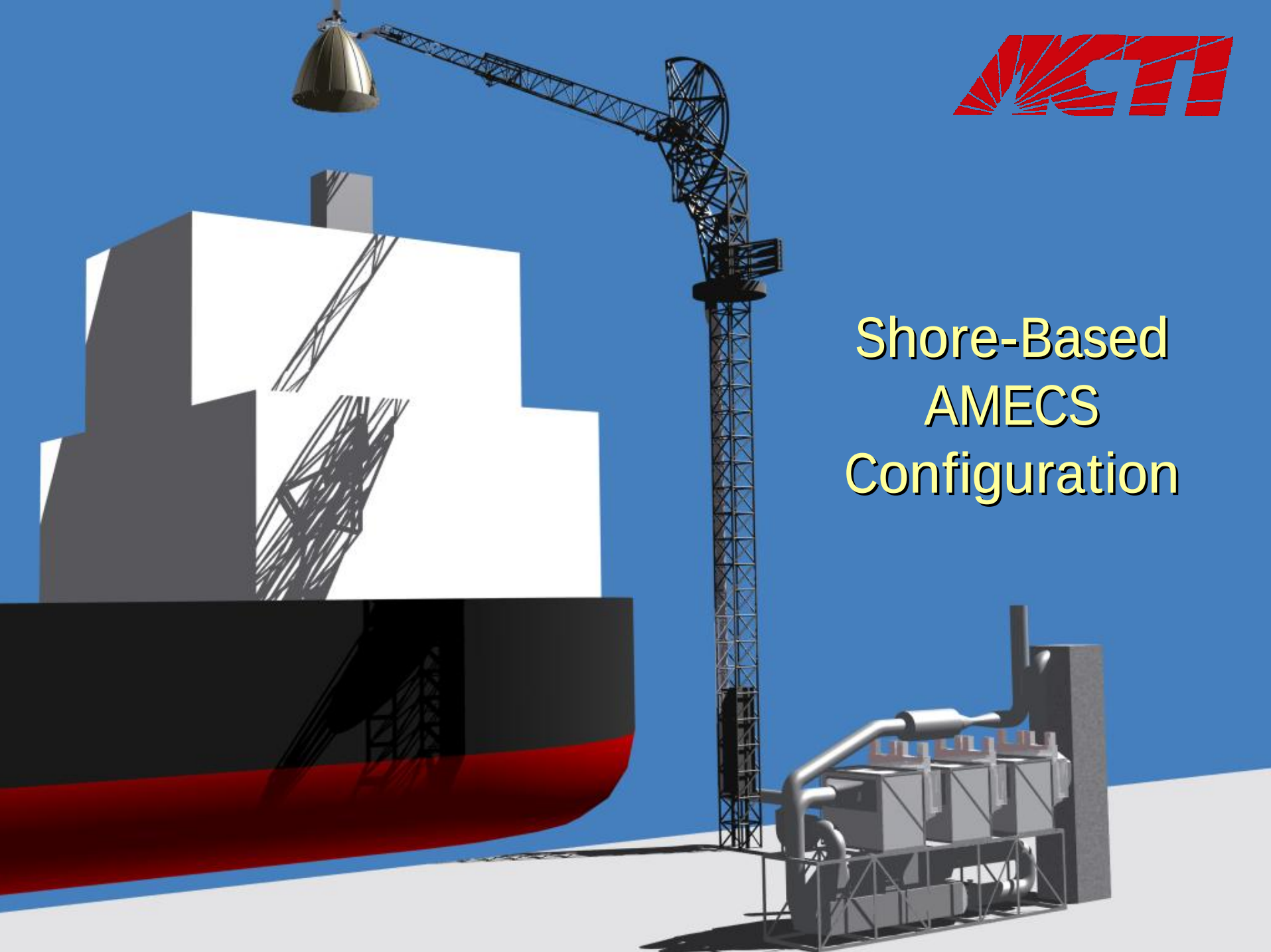
Successful Demonstration Program (continued)

- Maintain attachment and exhaust capture while the railroad locomotive is underway within designated area within the rail yards

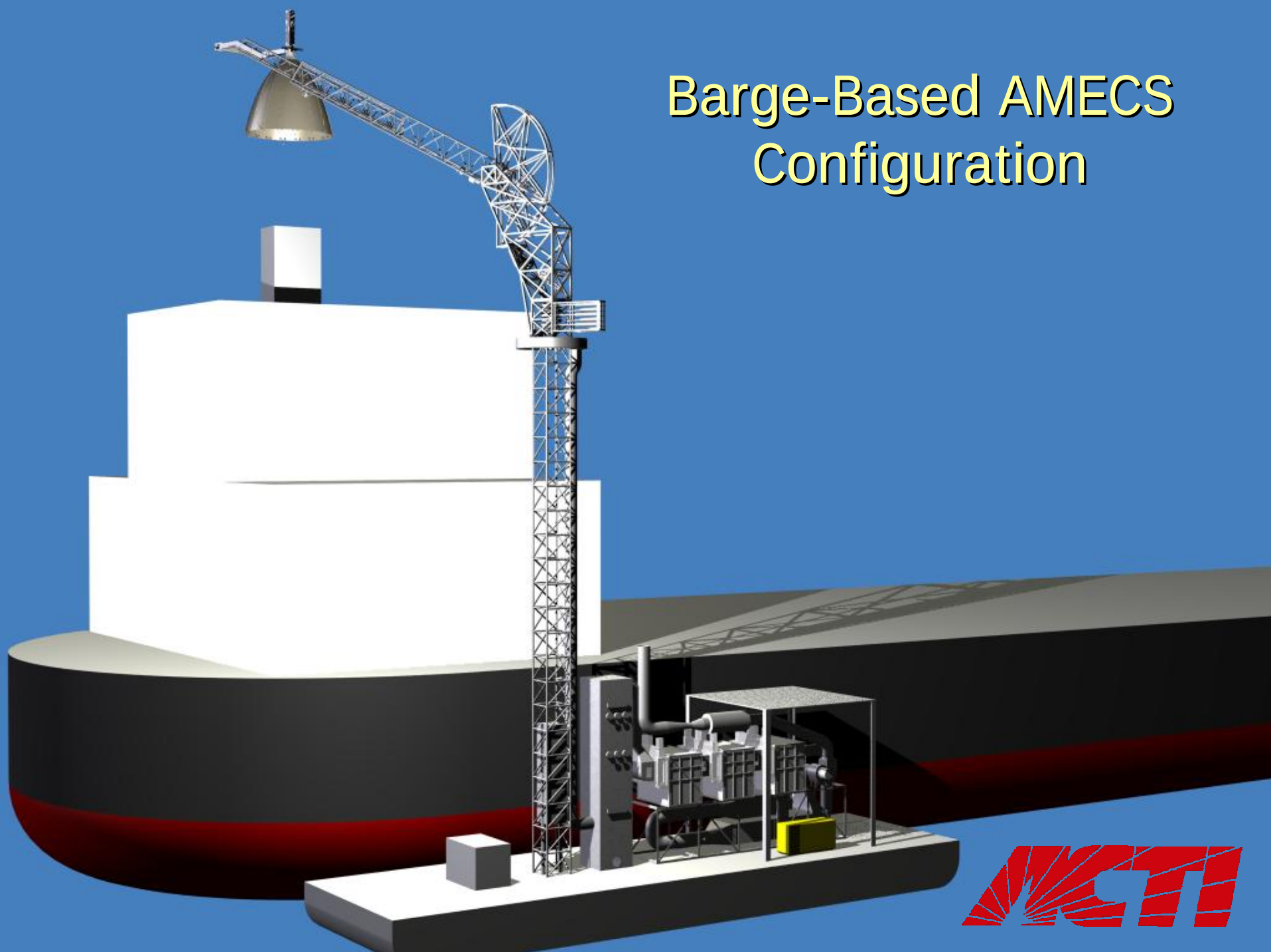
- The test of ALECS was a success, meeting all the goals described above and more
- The same treatment system is used on AMECS

Successful Demonstration Program (continued)

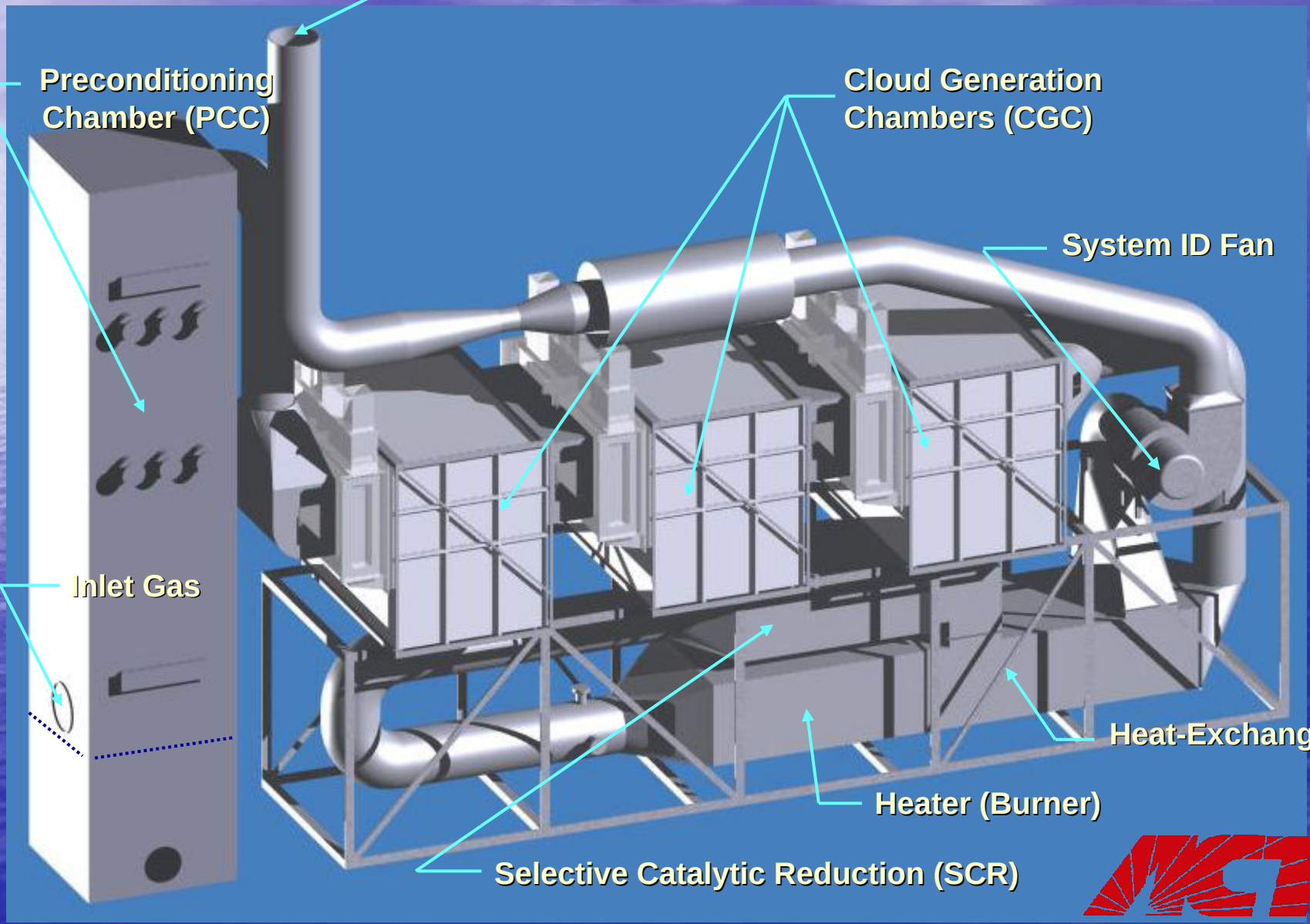



Shore-Based
AMECS
Configuration

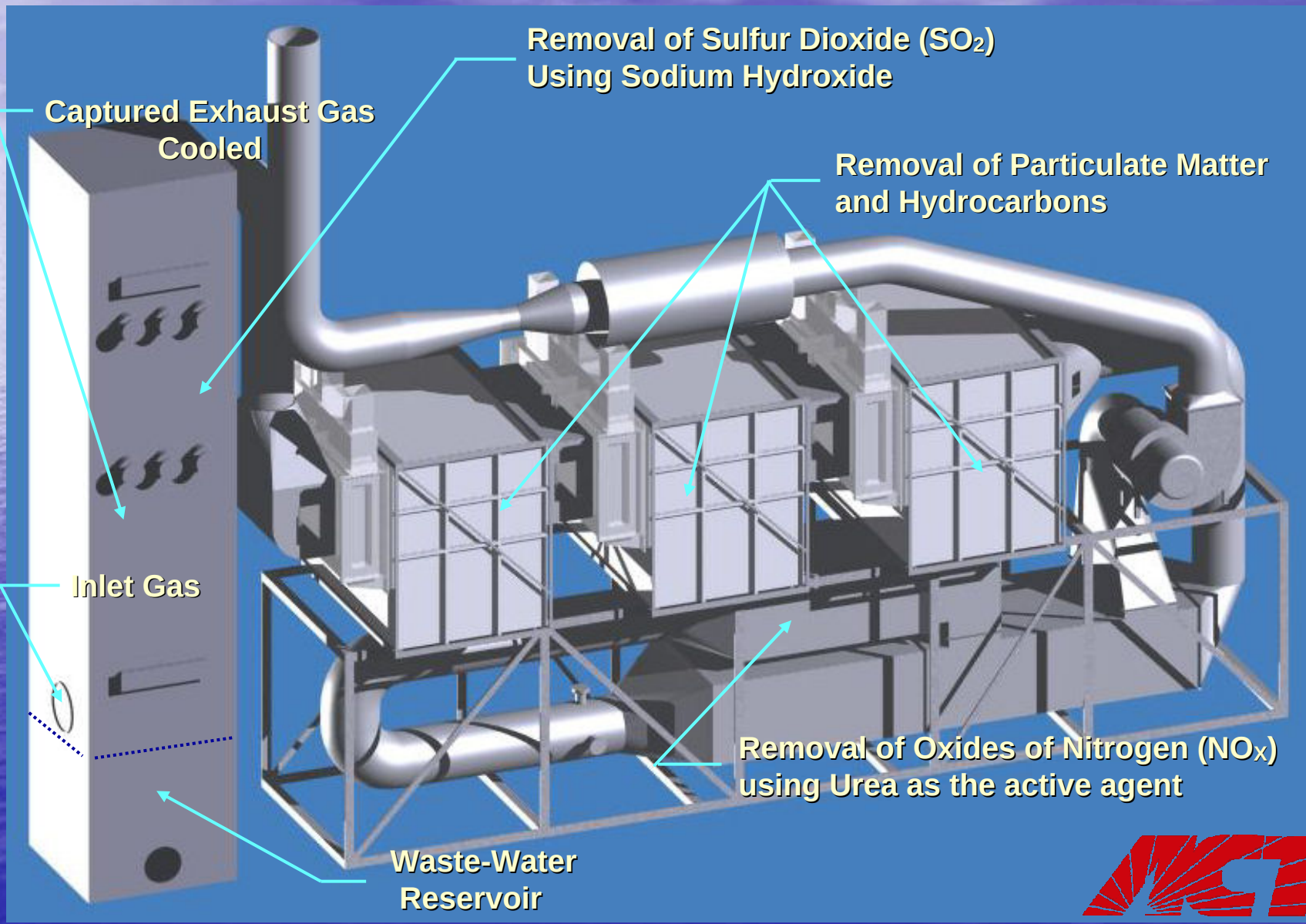
Barge-Based AMECS Configuration



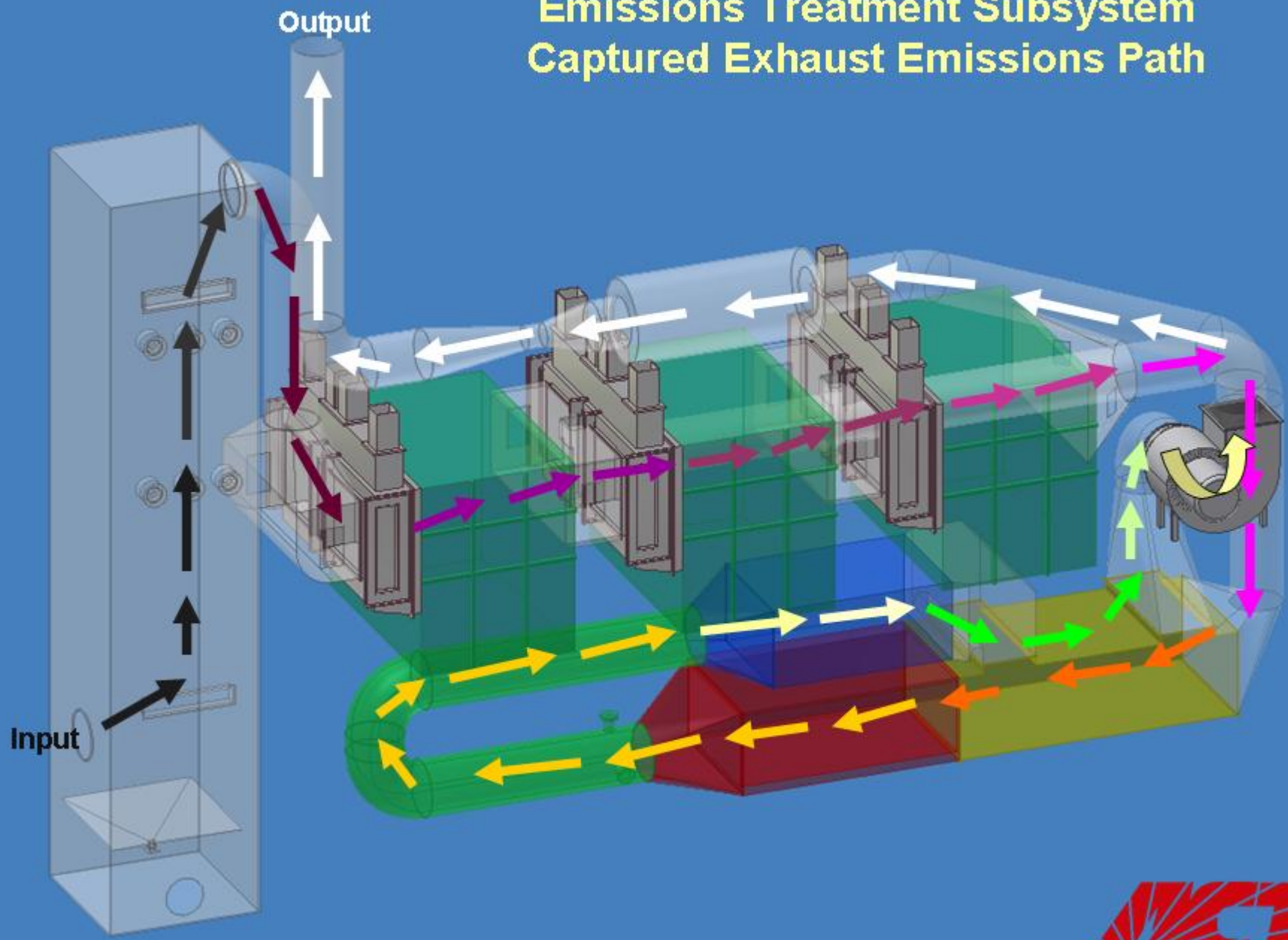
Emissions Treatment Subsystem



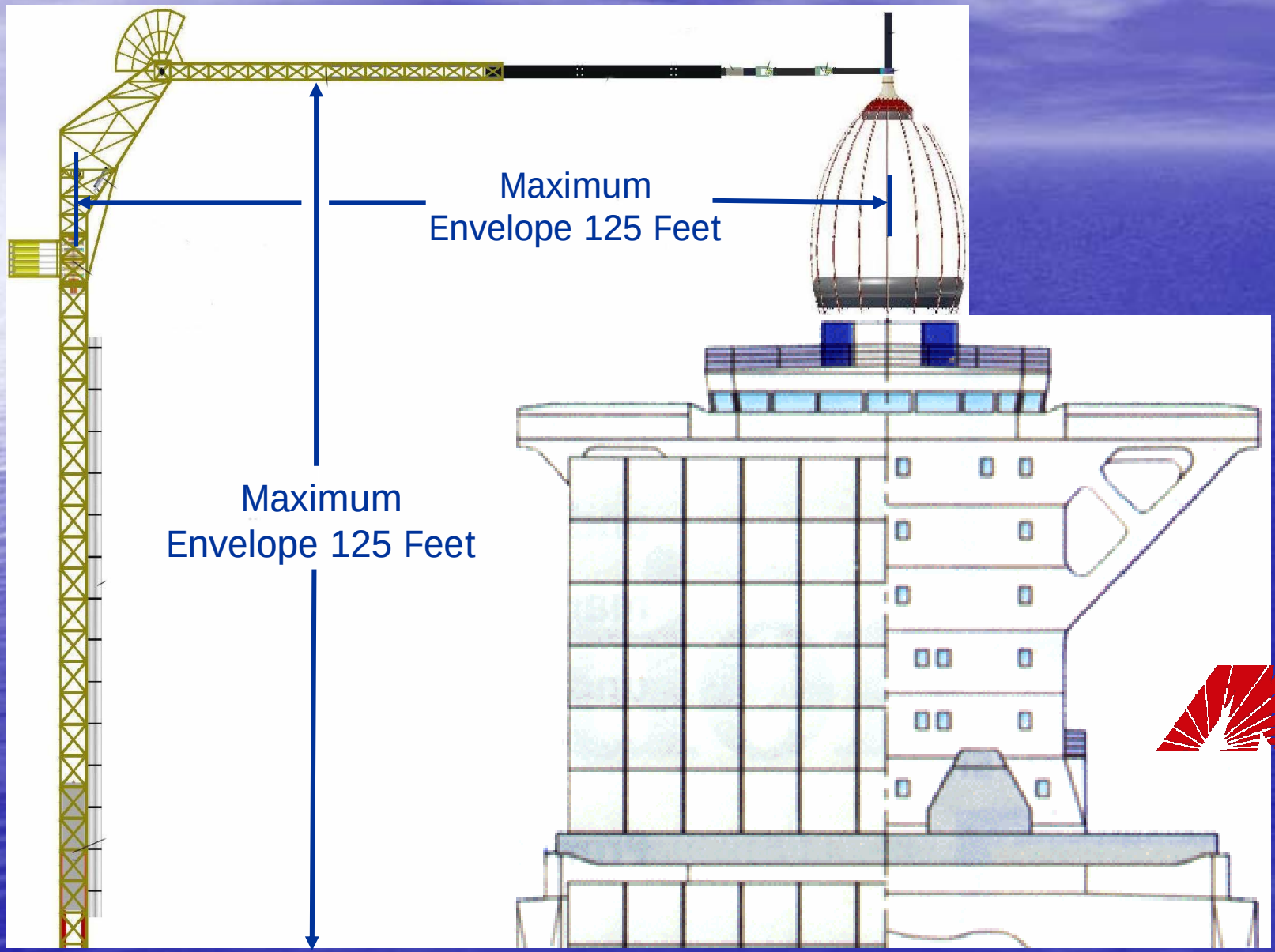
Emissions Treatment Subsystem



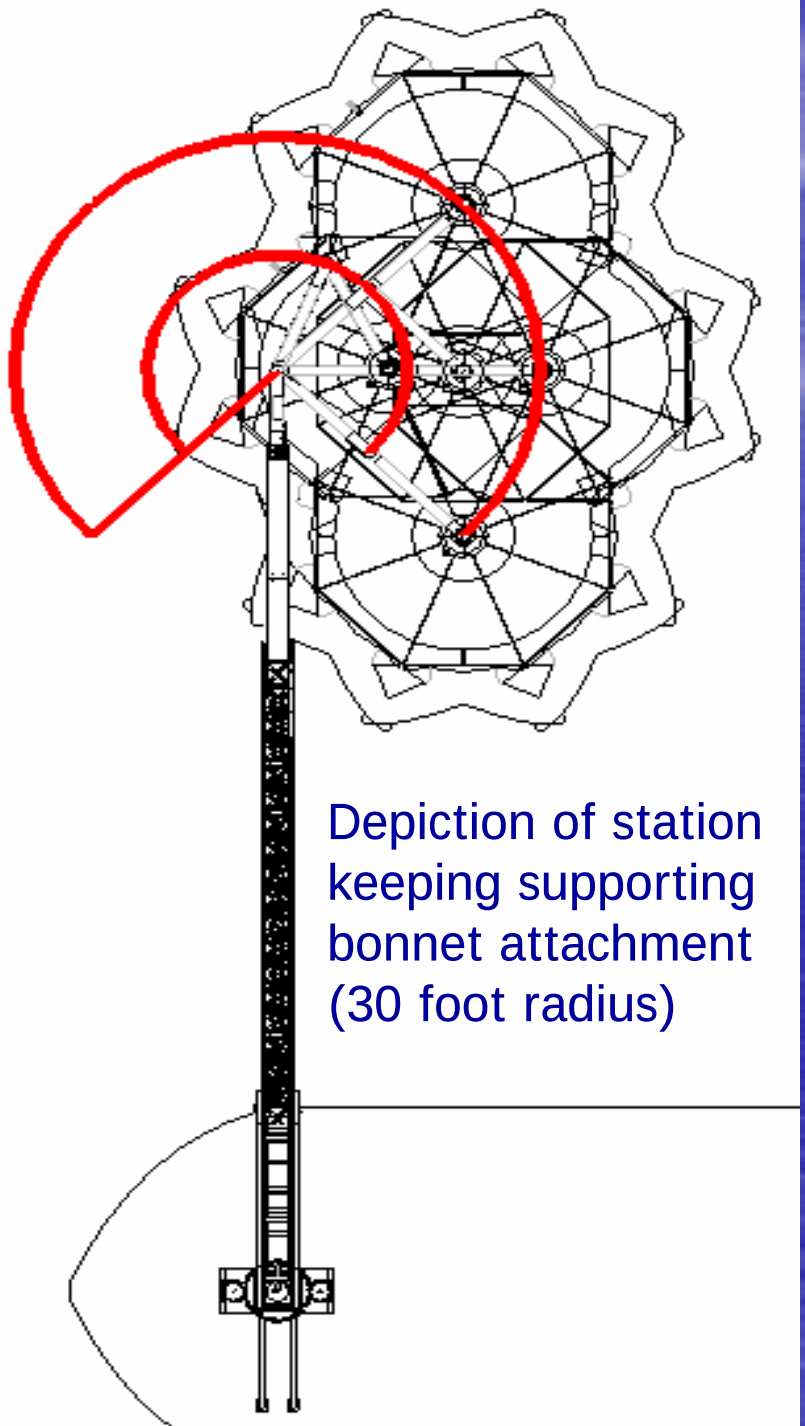
Emissions Treatment Subsystem
Captured Exhaust Emissions Path



Emissions Capture Subsystem

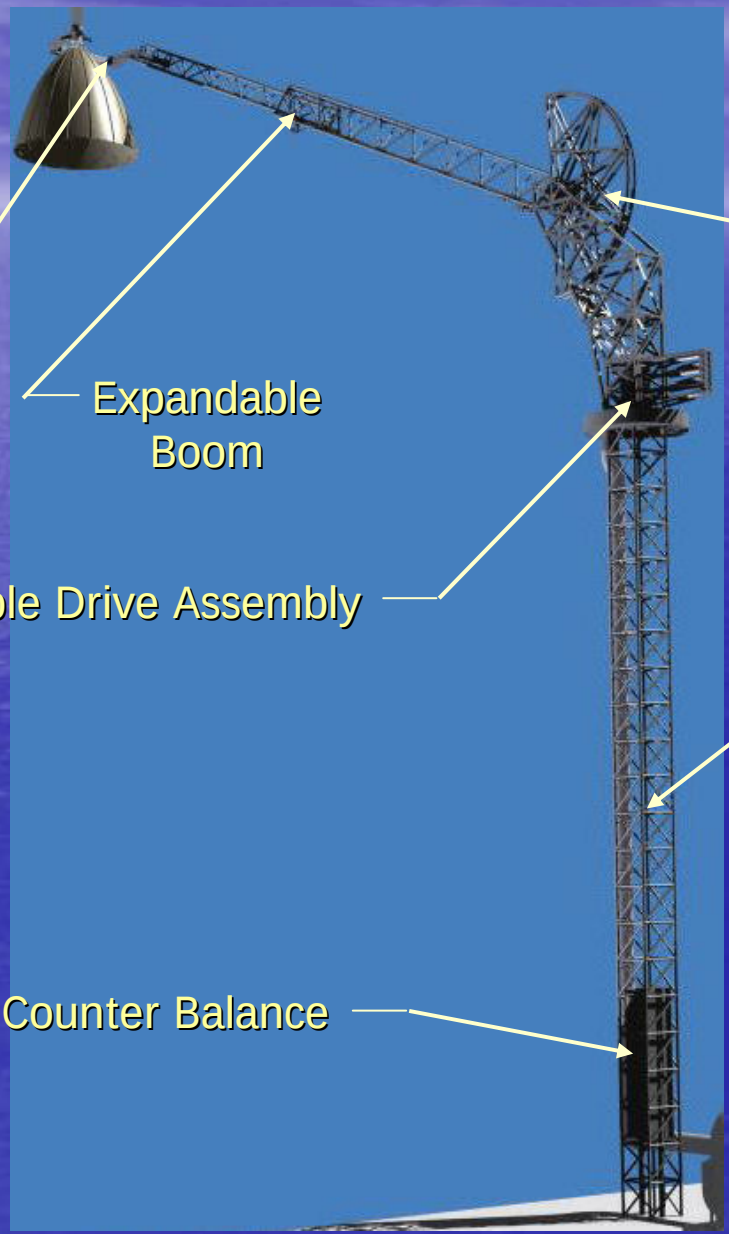


Articulating Arm & Placement Tower shown with Exhaust Intake Bonnet (EIB)

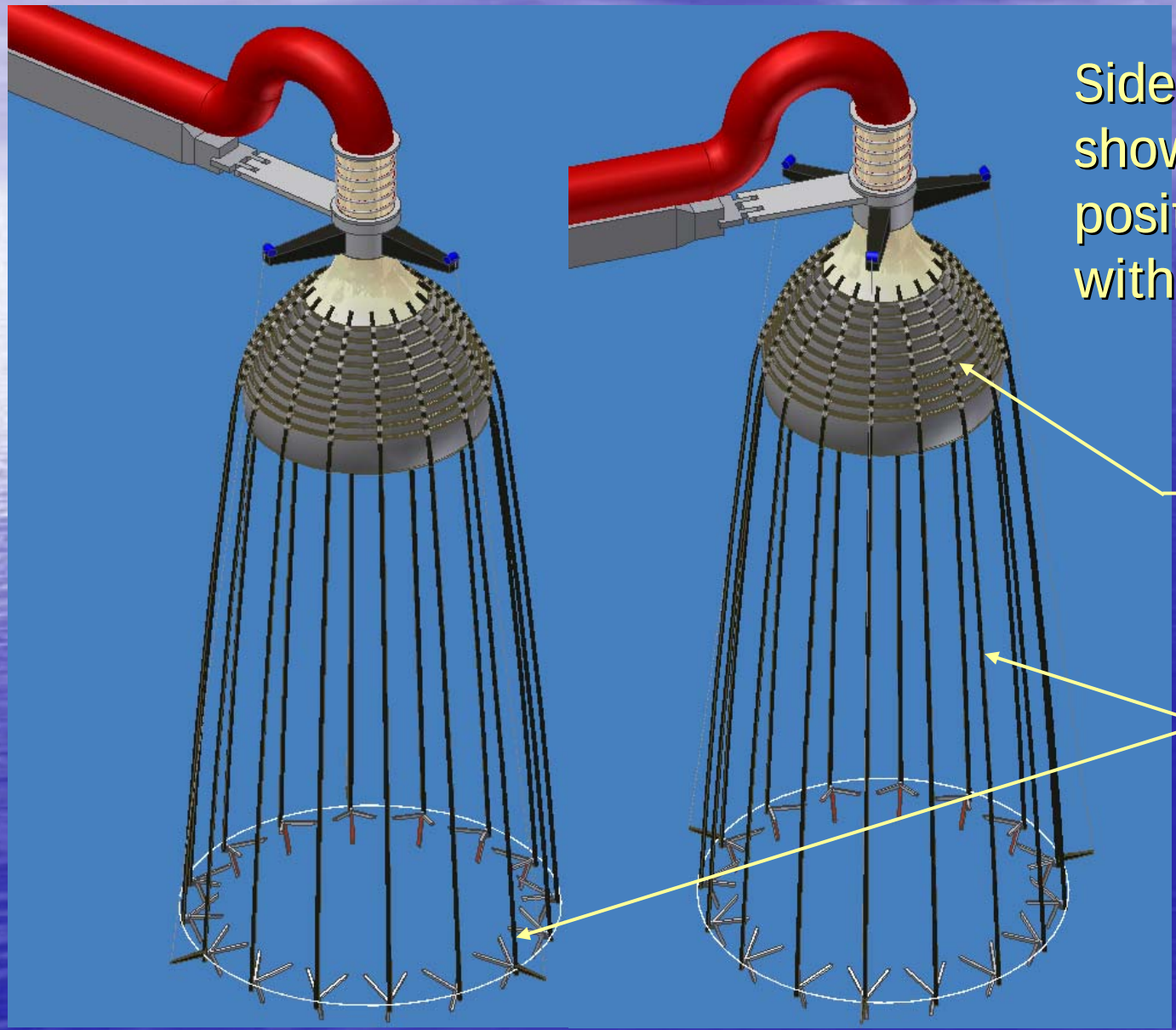


Depiction of station keeping supporting bonnet attachment (30 foot radius)

Articulating Arm & Placement Tower



Emissions Intake Bonnet (EIB)

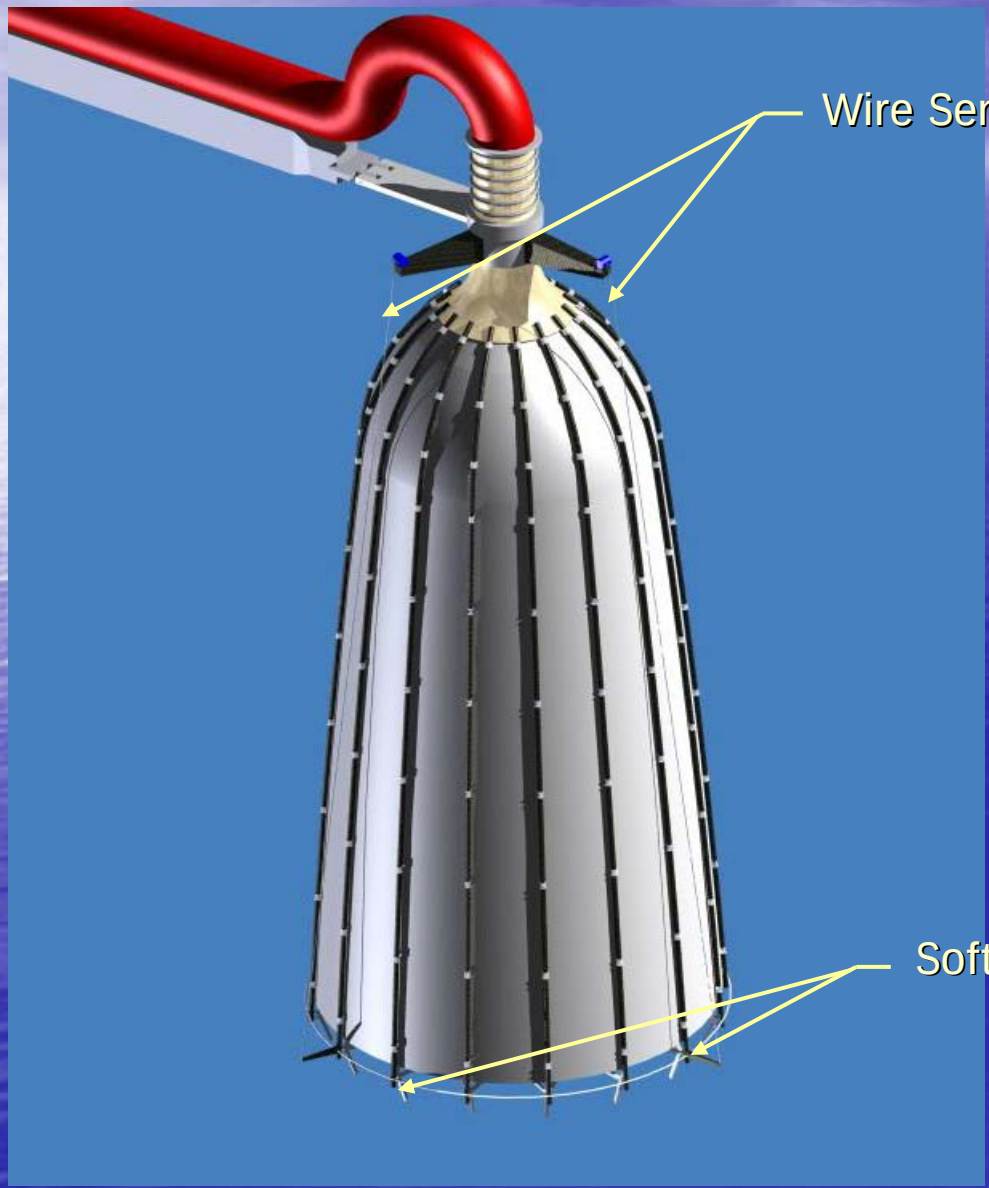


Side Views of EIB, shown in closed position with Shroud withdrawn

High temperature Shroud

Carbon Fiber Ribs

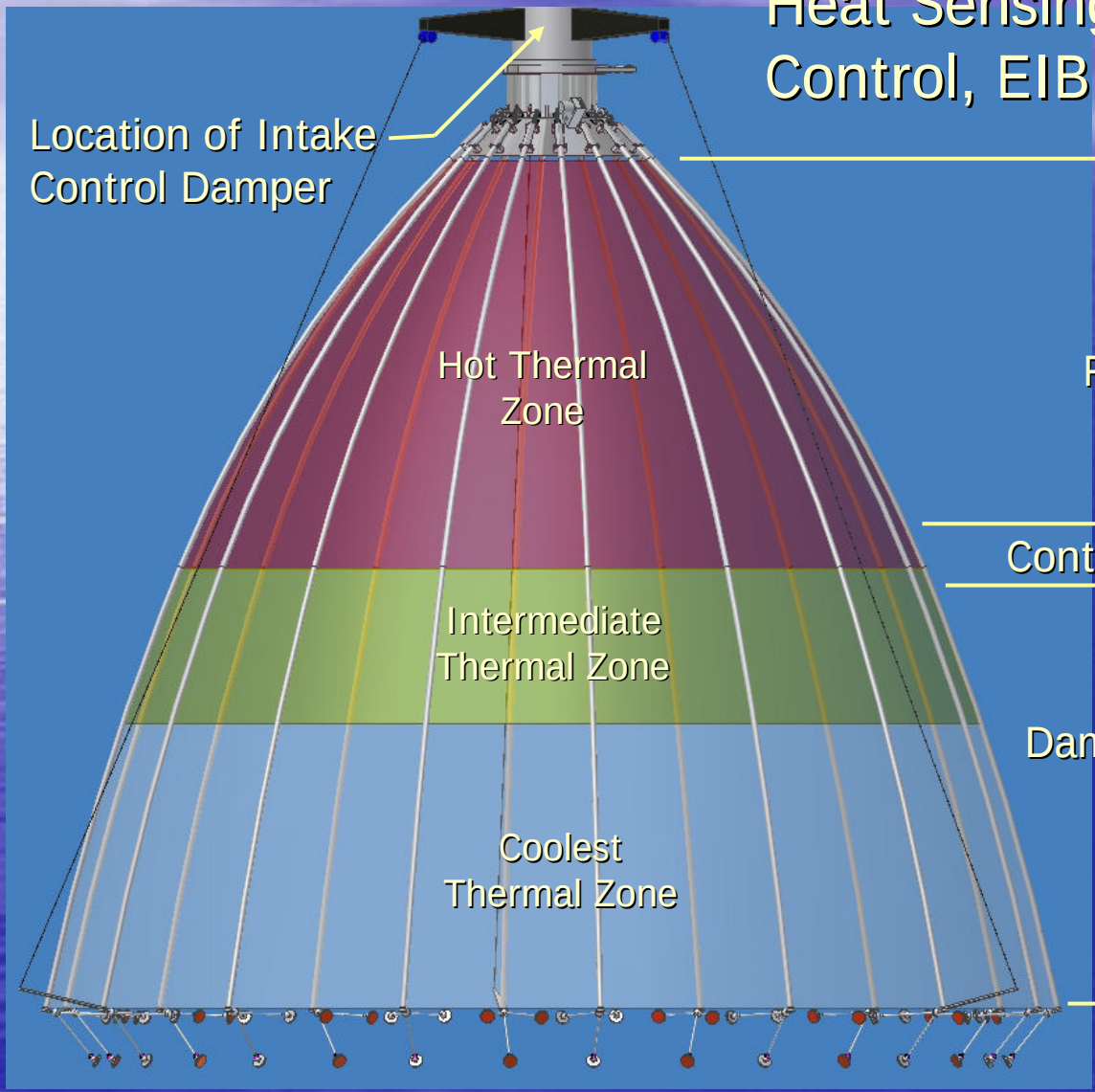
EIB Station Keeping



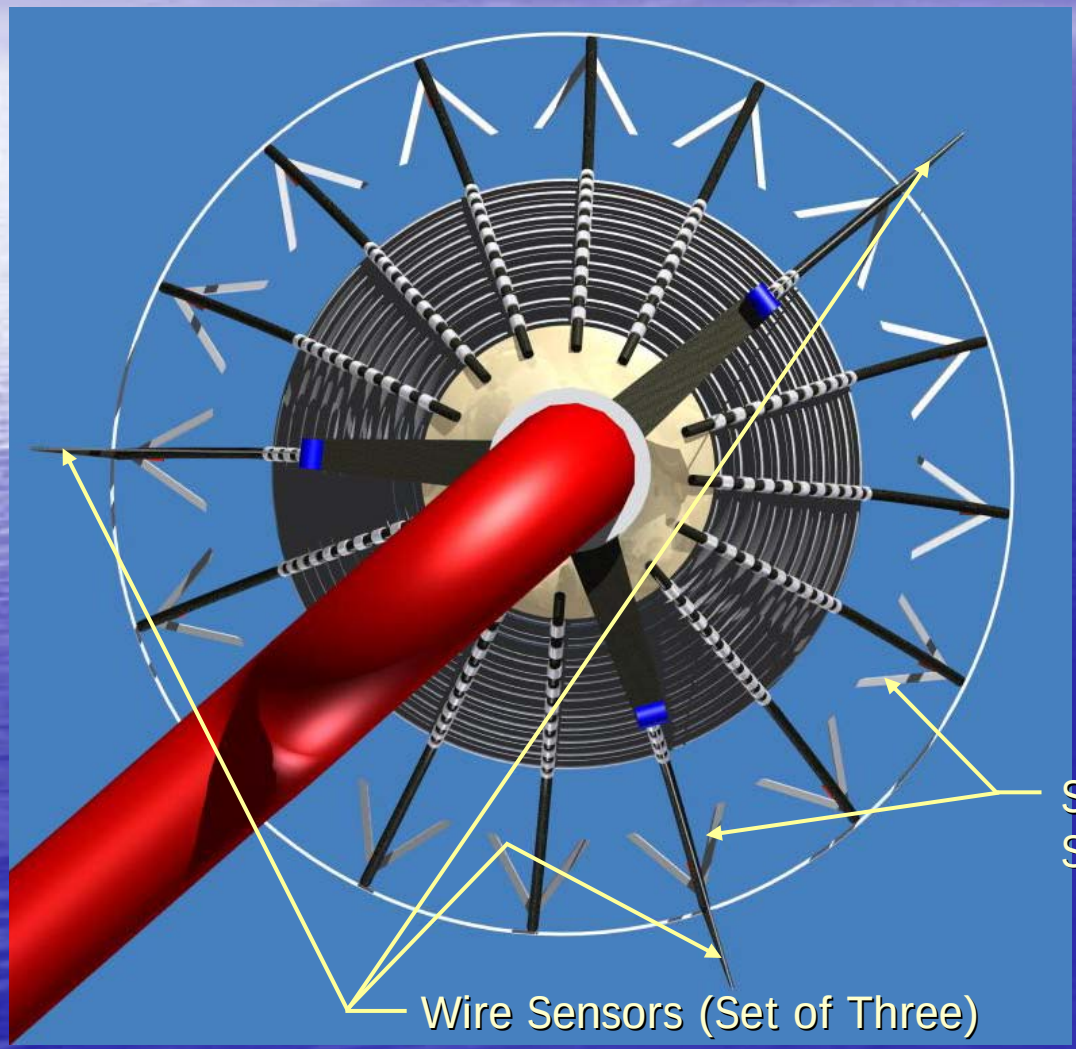
- Three fixed stack points connected to floating arm measure stack position (EIB shown in closed position)
- Wire sensors allow for rapid and accurate arm adjustment

EIB Exhaust Control

Heat Sensing Device Intake Exhaust Control, EIB shown in open position

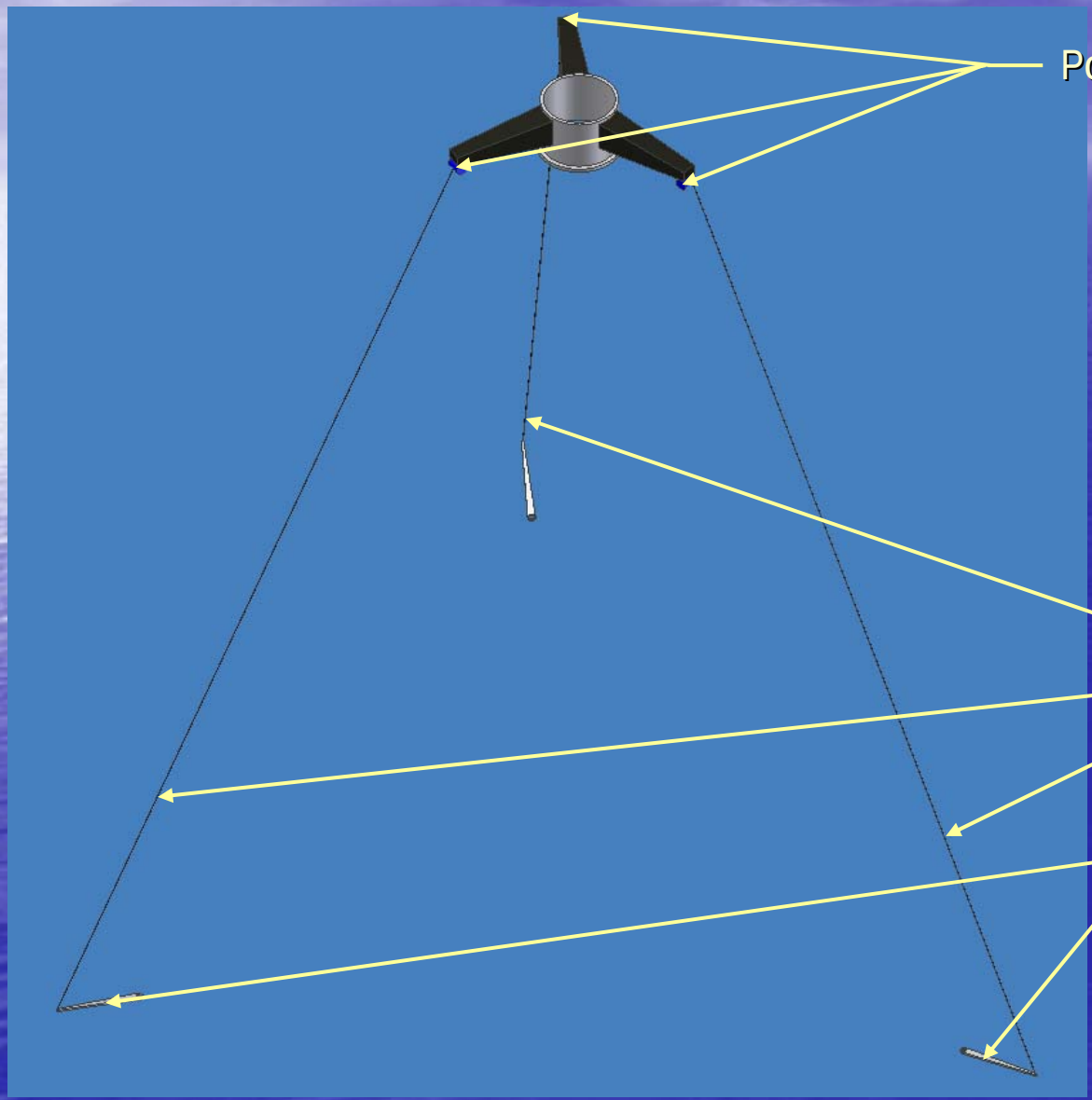


EIB Wire Position Sensors (Station Keeping)



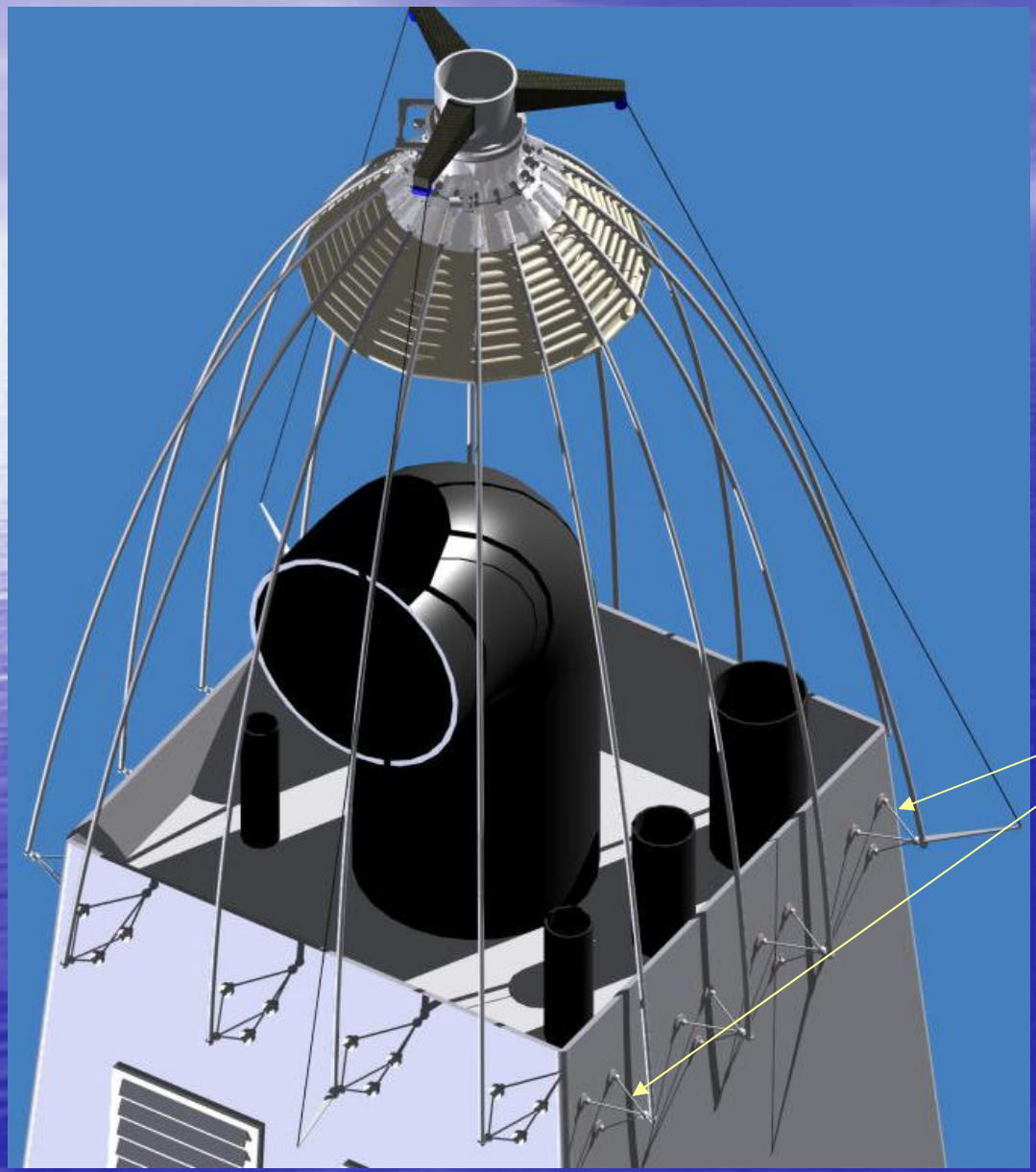
- Three fixed stack points connected to floating arm measuring stack position
- Wire sensors allow for rapid and accurate arm adjustment
- Wire Sensor designed and manufactured by Micro-Epsilon

EIB Station Keeping Sensor System



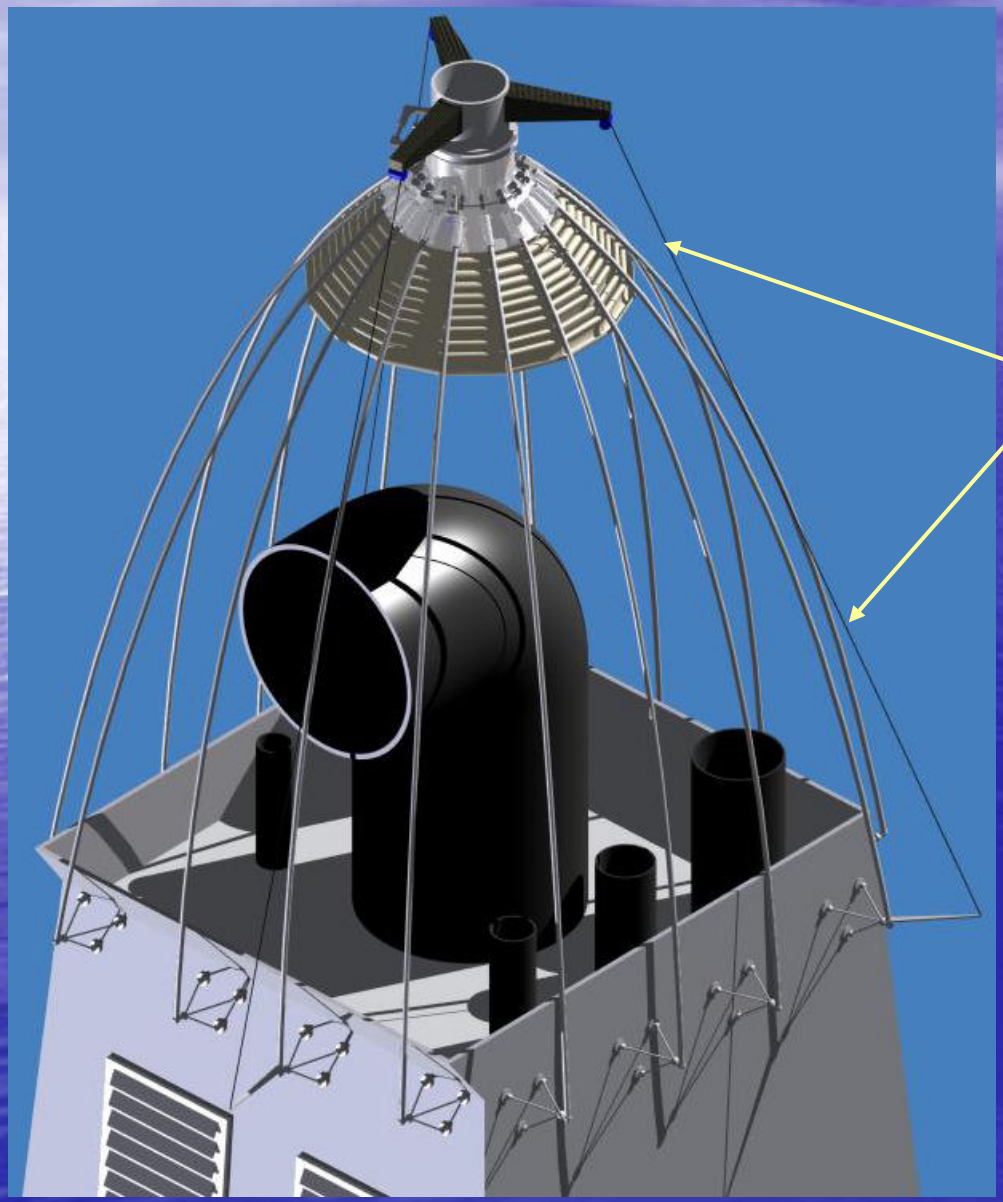
- Wire sensors accurate to within ± .1 inches
- Determines arm position relative to stack within one inch

Emissions Intake Bonnet



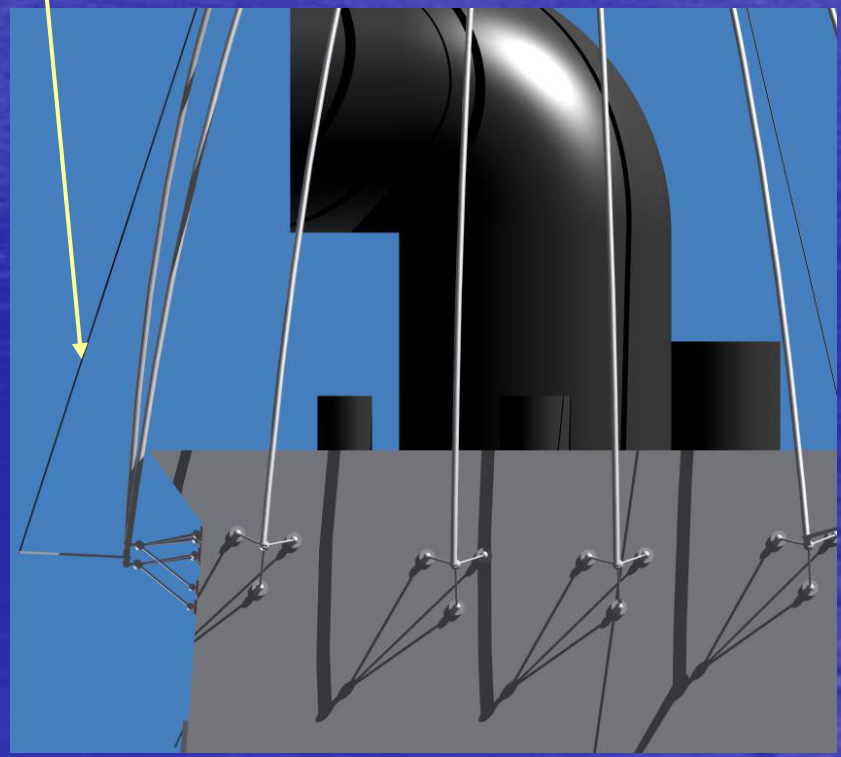
Depiction of the EIB being placed onto a typical strait ships stack

Emissions Intake Bonnet



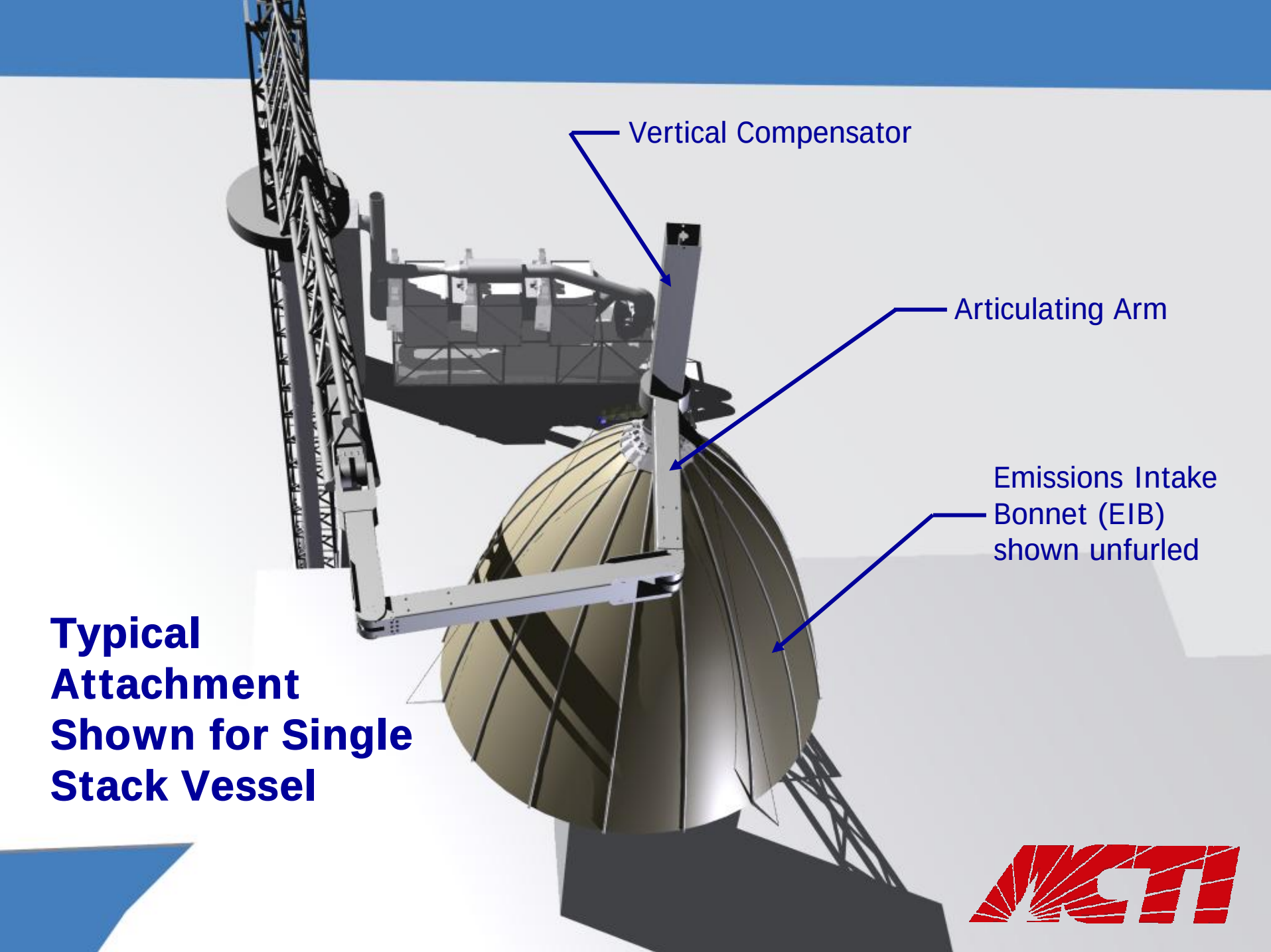
Depiction of the EIB being placed onto lip style stack

Station Keeping Wire Sensors

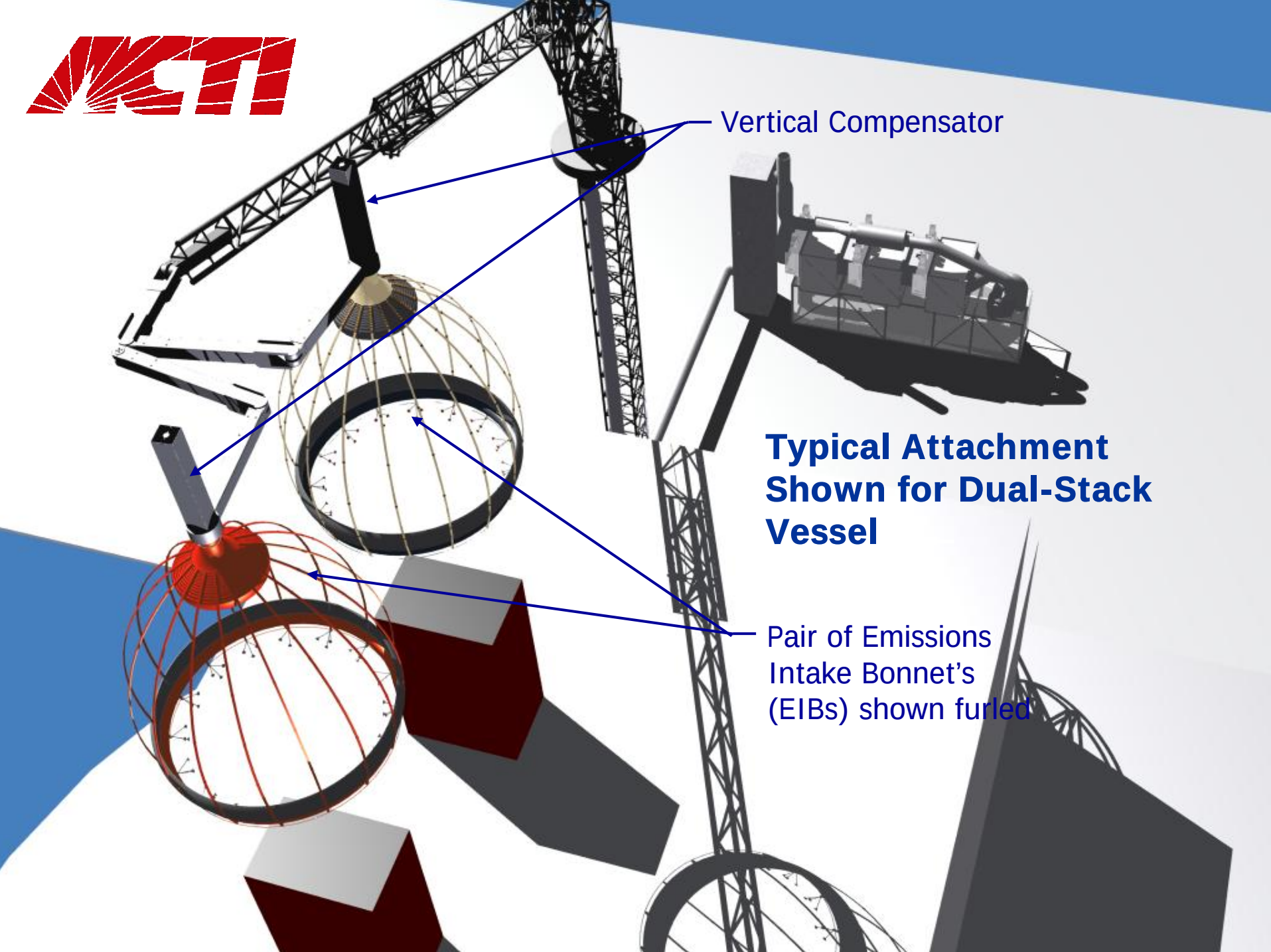



Minimal Impact, if any, on Port Operations
Ease of access to stack
Unobtrusive Barge Location

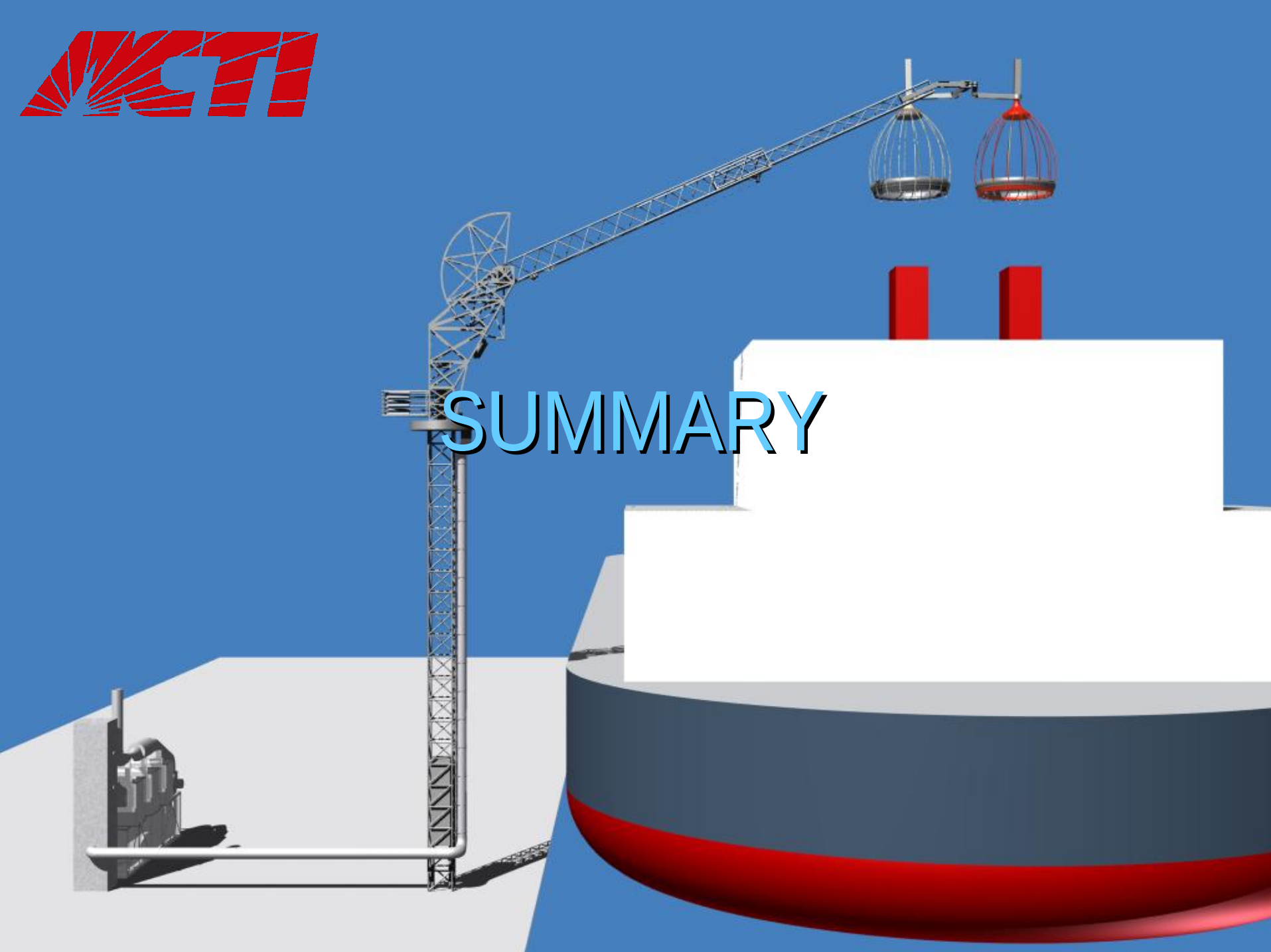
Depiction of Attachment While Anchored



Typical Attachment Shown for Single Stack Vessel


Vertical Compensator
Typical Attachment Shown for Dual-Stack Vessel
Pair of Emissions Intake Bonnet's (EIBs) shown furled

SUMMARY



Advanced Maritime Emissions Control System (AMECS®)

Advantages:

- No ship modification required
- Substantial Reduction of Harmful Pollutants
  - Removal percentages of sulfur dioxide (SO2), particulate matter (PM), oxides of nitrogen NOX) all above 95%, depending on fuel type
  - Over 60% removal of Hydrocarbons
- Can capture and treat exhaust emissions while ships are berthed and anchored waiting to be berthed
- Provides a Cost-Effective solution

Questions & Answers

Advanced Cleanup Technologies, Incorporation

Hazardous Waste Management Specialists

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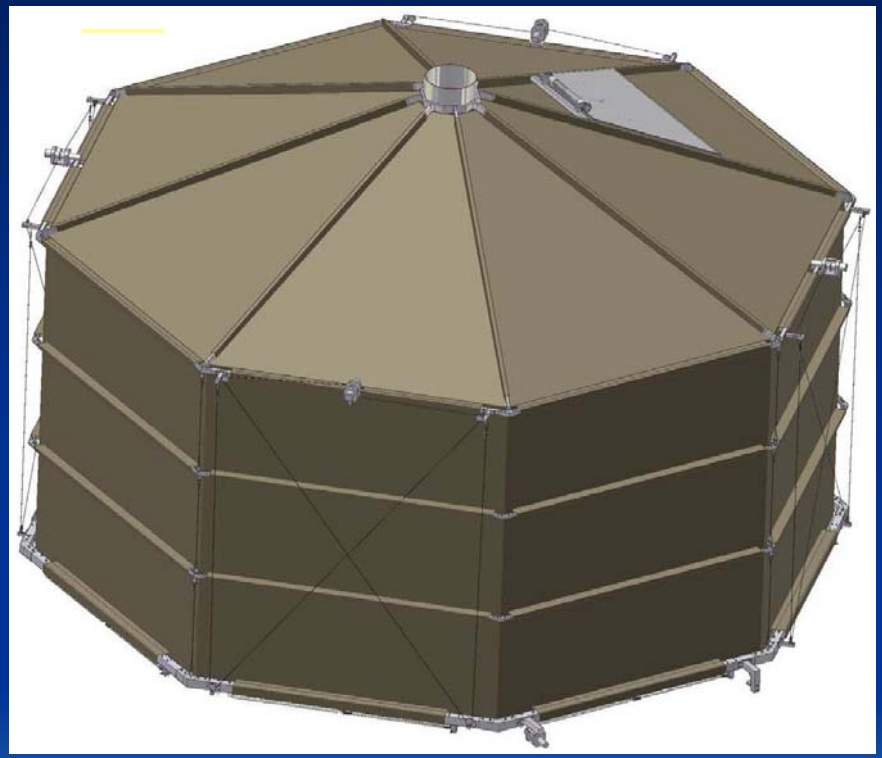
Rancho Dominguez, California 90221-5612
310 763-1423

Supporting Data

The following slides contain additional information regarding ***ACTI's*** Advanced Maritime Emissions Control System (AMECS), and will only be used as required to respond to questions

EIB Light Wind Applications

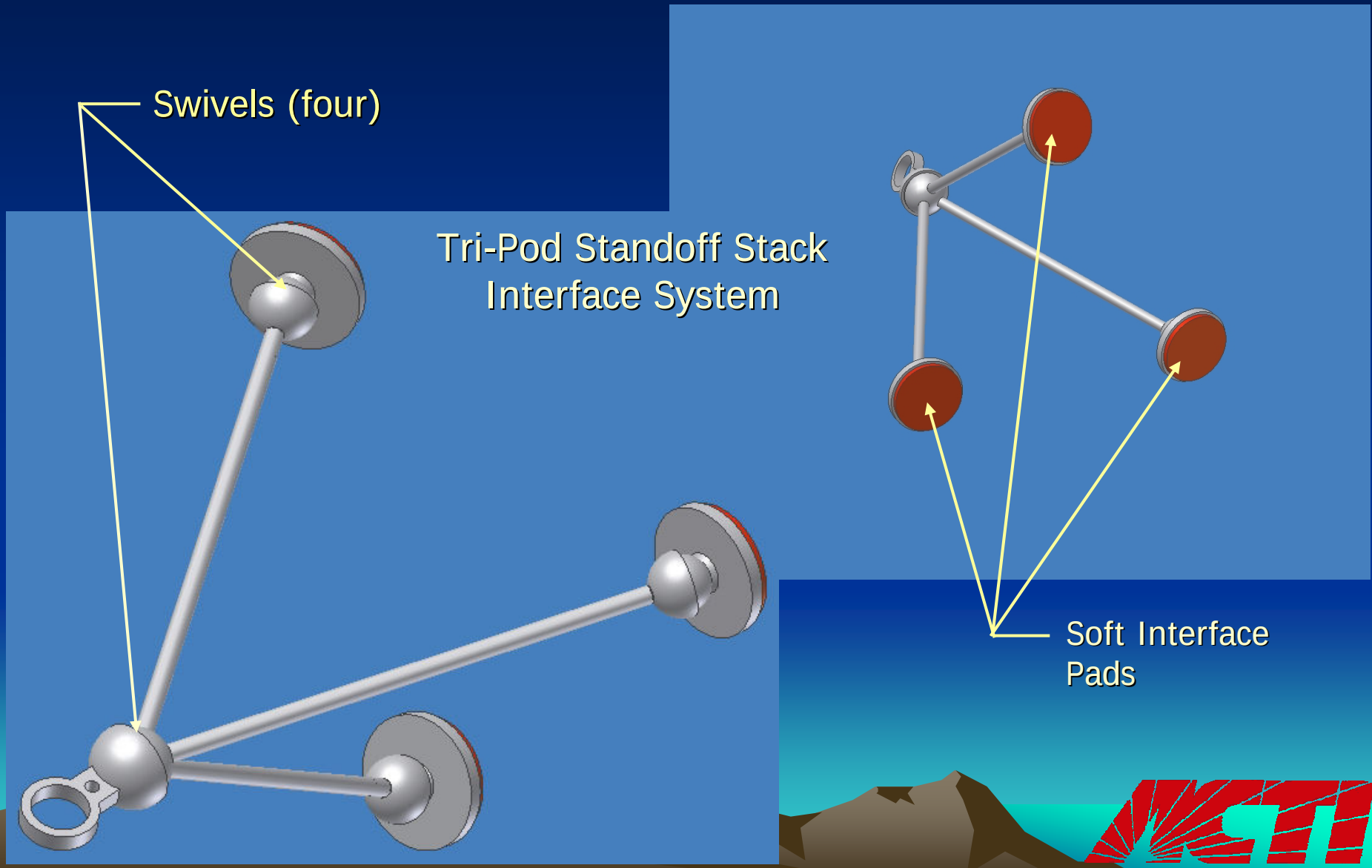


Top-View

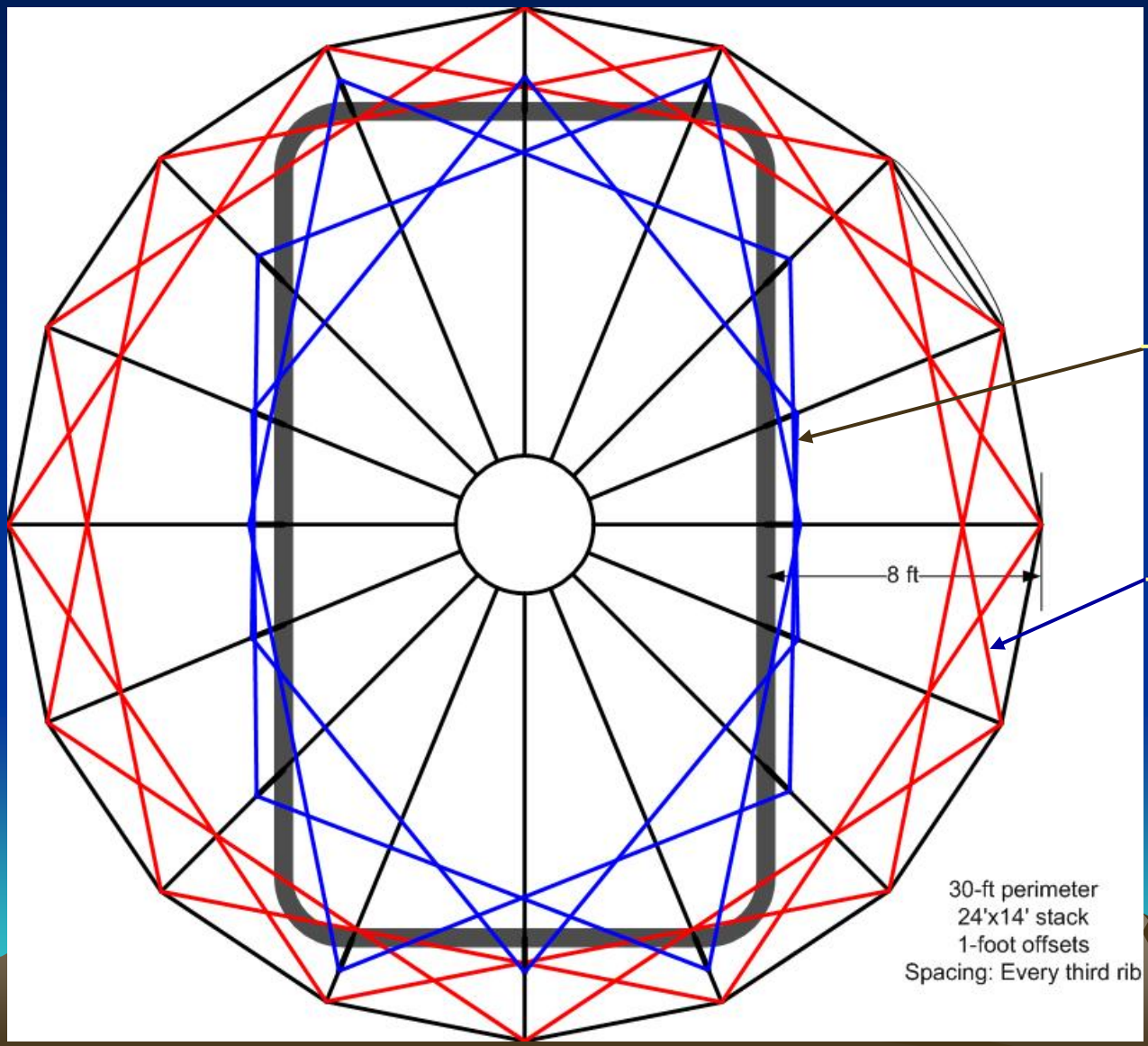
Bellows Bonnet Designed for Light Wind Applications

Side-View

EIB Stack Interface System



EIB Securing & Release System

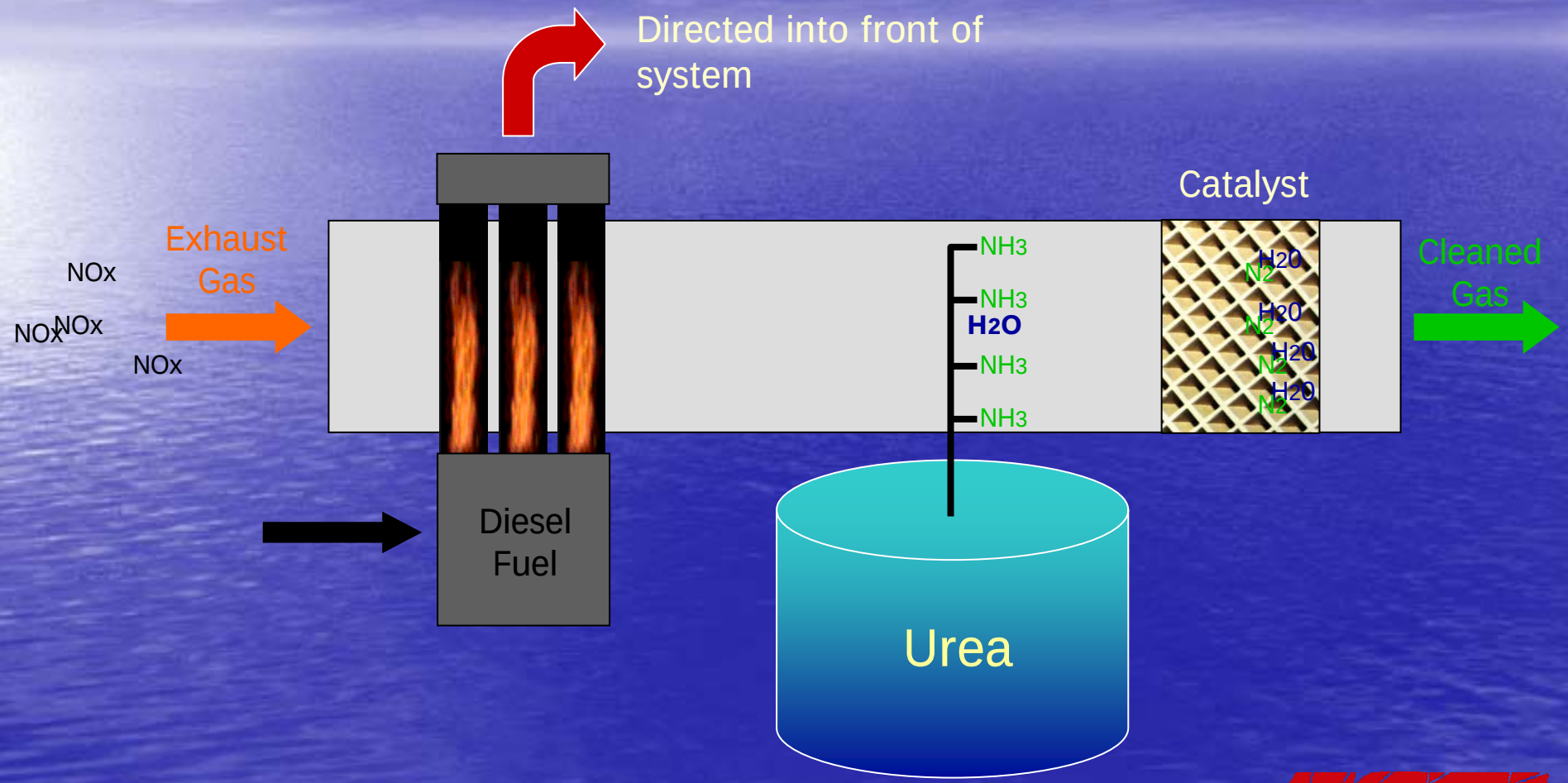


Securing System

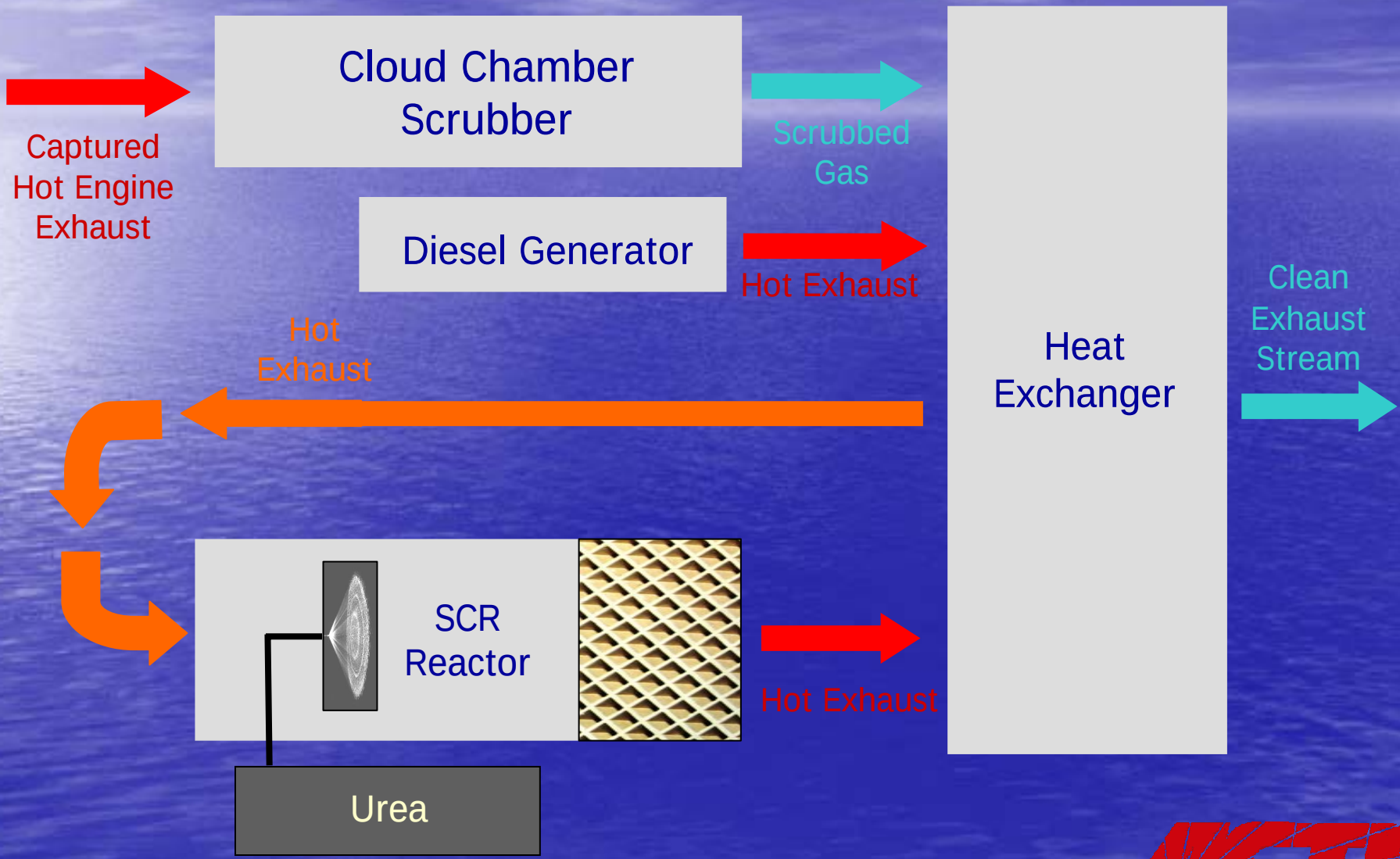
Cinching Cables (sown in blue) after attachment

Cinching Cables (shown in red) prior to attachment

SCR Reactor, Injection System & Burner

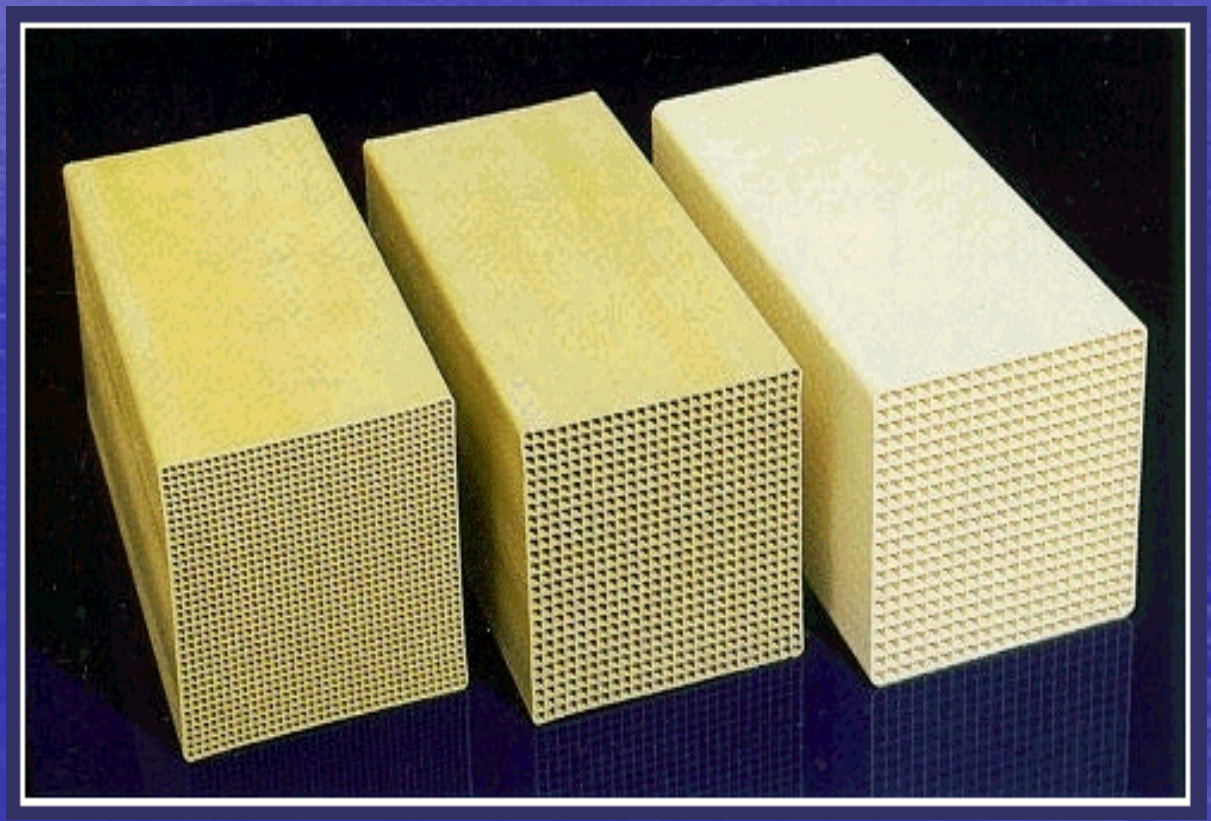


Thermal Management System

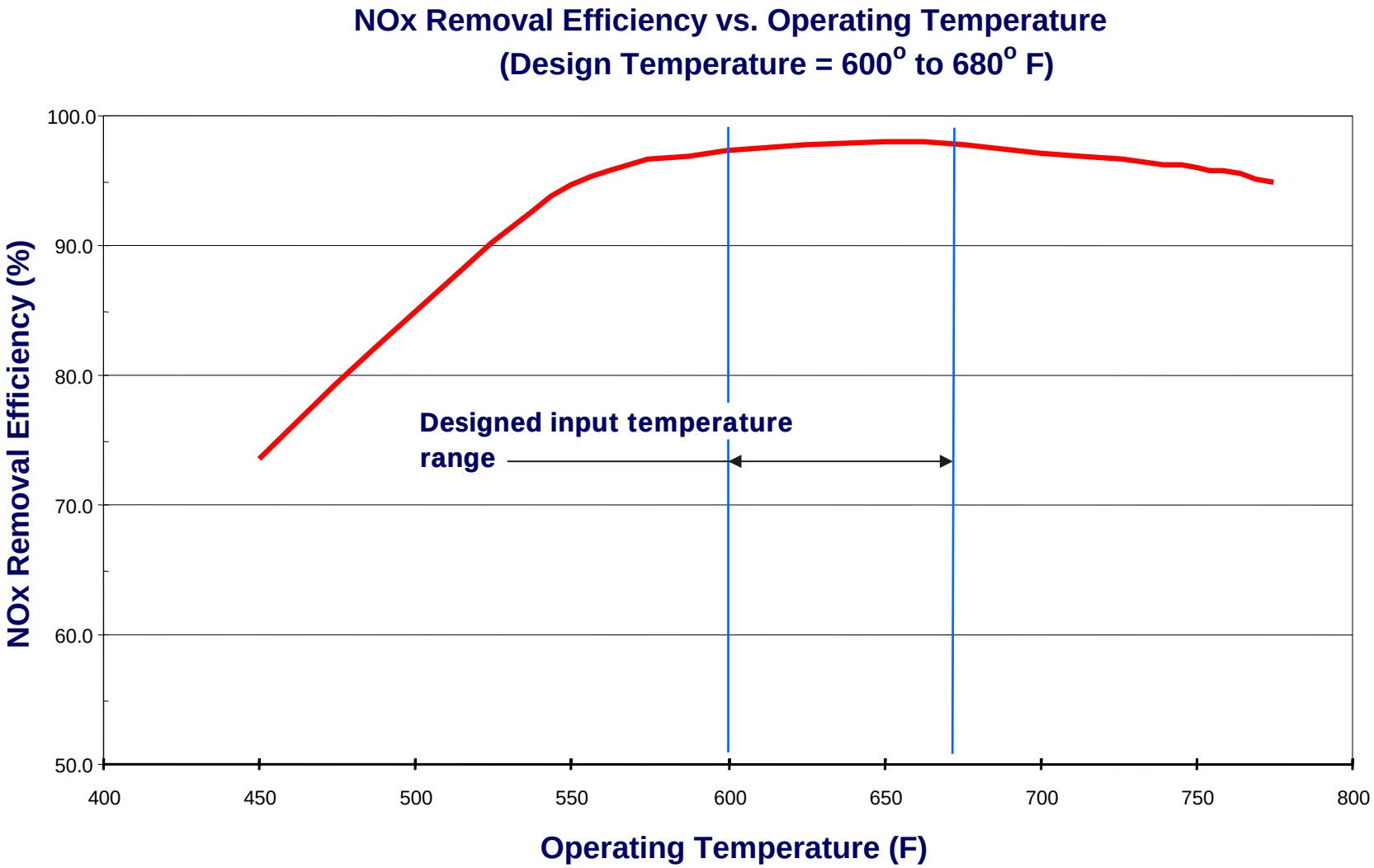


SCR Reactor – Argillon Catalyst

- Titanium – Vanadium Oxide Ti-V_2O_5 Based
- Ceramic Substrate
- Homogeneous
- Honeycomb



SCR Catalyst Performance



AMECS Improvements

Under Lessons Leaned:

The following two improvements are under consideration as a result of the Demonstration and Testing Program in Roseville, California

- Create one common housing partition between the Selective Catalyst Reduction (SCR) Reactor and the Thermal Management System (shown in the next slide). This would increase thermal efficiency and reduce the system cost.

- Continuous Emissions Monitoring System (CEMS); the system deployed seems to require a greater amount of technical skill then we believe is necessary. In addition, the system cost seems to be high. We will evaluate other systems.

- We developed a much better understanding of rail yard operations and the type of exhaust capture system that would most likely work without interfering with railroad operations.

AMECS Improvements (continued)

Thermal Management System