Enabling the Assessment of a High CO_2 – Low pH Ocean:

Is a Free Ocean CO_2 Enrichment (FOCE) Experiment Possible ?

Peter Brewer Bill Kirkwood Jim Barry Rachel Dunk
Ed Peltzer Peter Walz Dale Graves Jim Scholfield
Mike Conway Doug Pargett Cheri Everlove

- Atmospheric CO_2 and Ocean pH
- FACE Experiments
- FOCE Concept & Prototype Design
- Tank Test – Video Clip
- First Field Trials – Video Clip & Data
- Lessons Learned & FOCE II
- Acknowledgements
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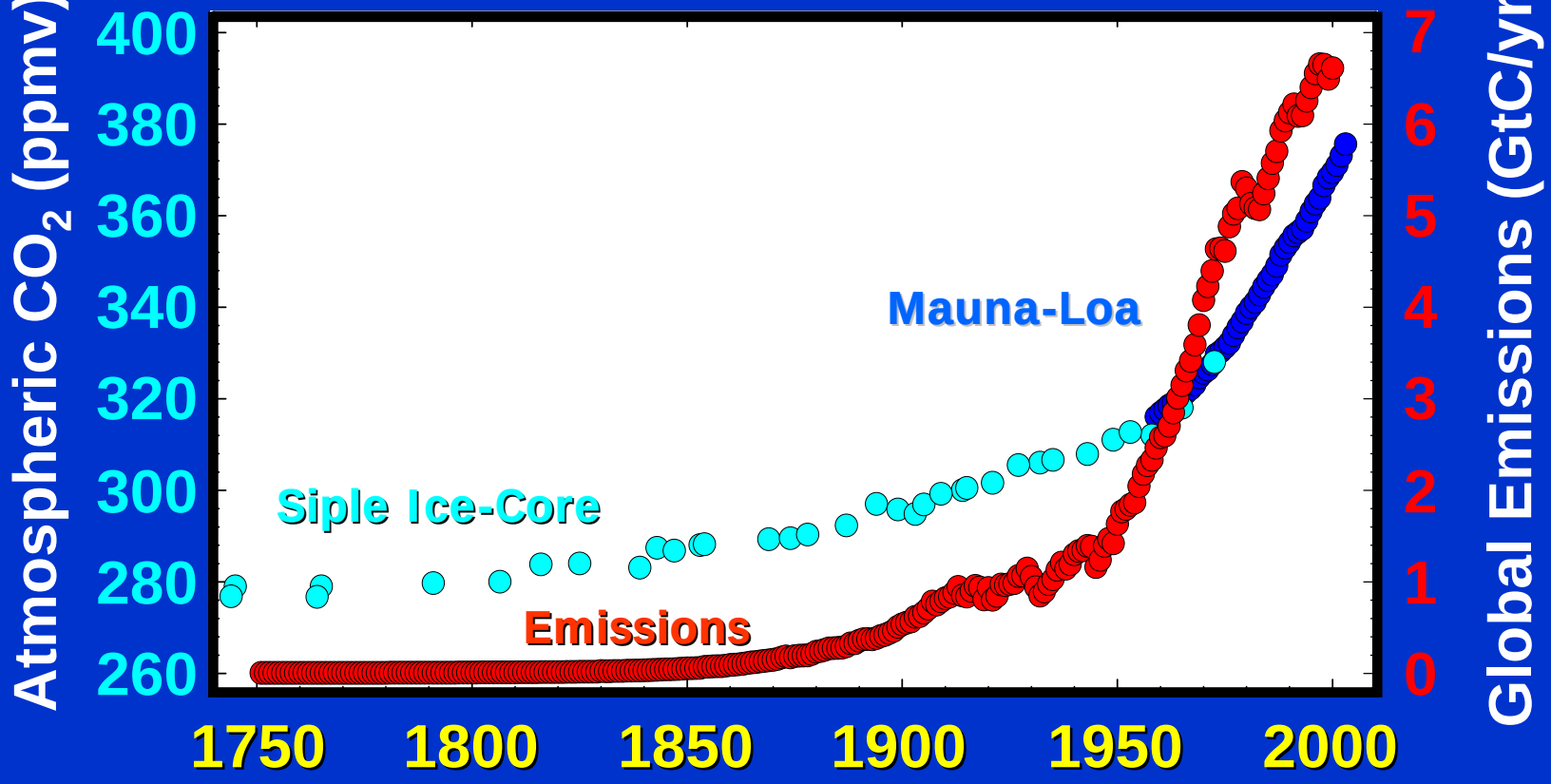
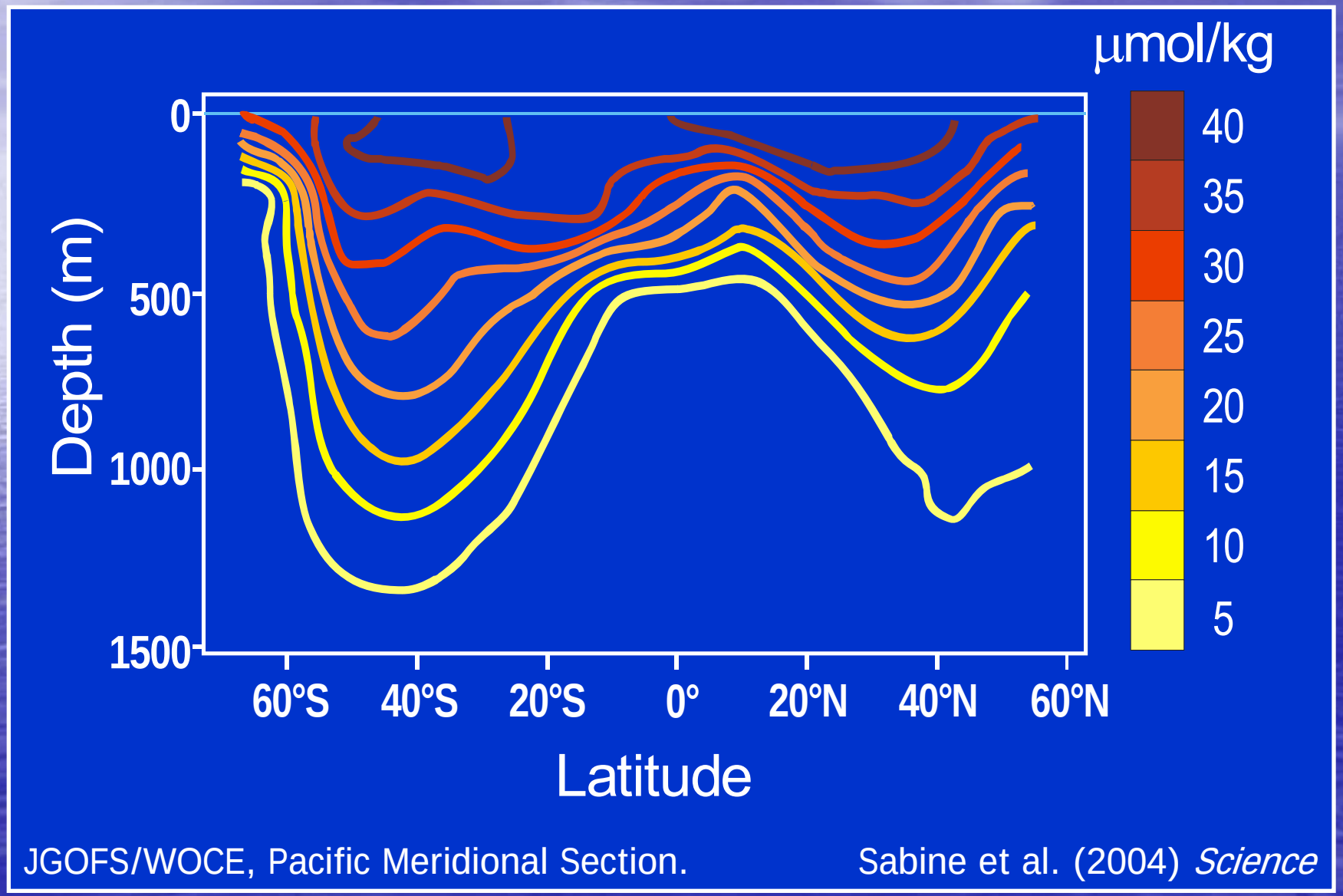
C Emissions & Atmospheric CO_2



Siple Ice-Core: Neftel et al. (1994)
Mauna-Loa: Keeling & Whorf (2004)
Emissions: Marland et al. (2003)

Trends: A Compendium of Data on Global Change. CDIAC, ORNL.
http://cdiac.esd.ornl.gov/trends/trends.htm

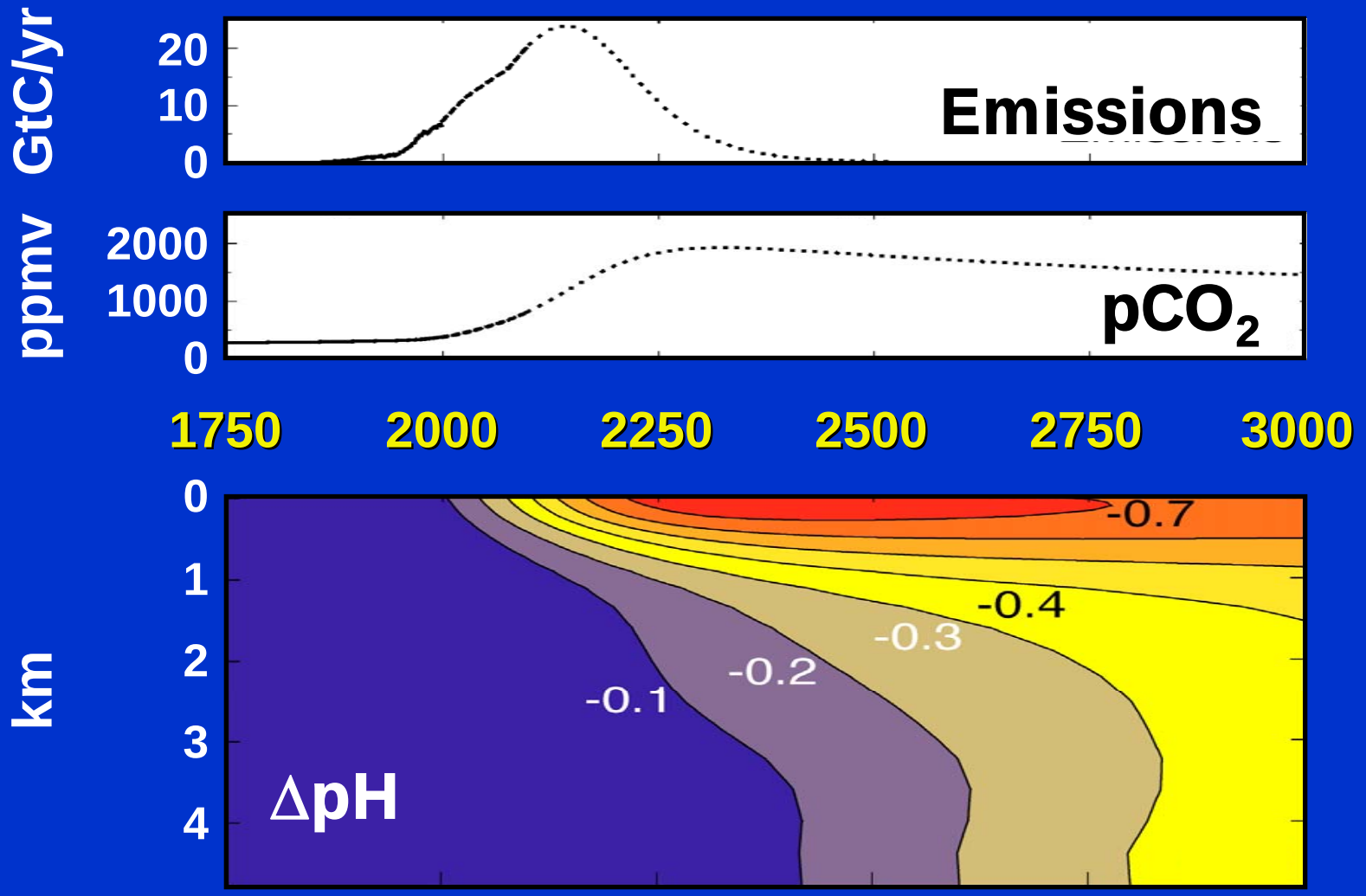
Fossil Fuel CO_2 Invasion



JGOFS/WOCE, Pacific Meridional Section.

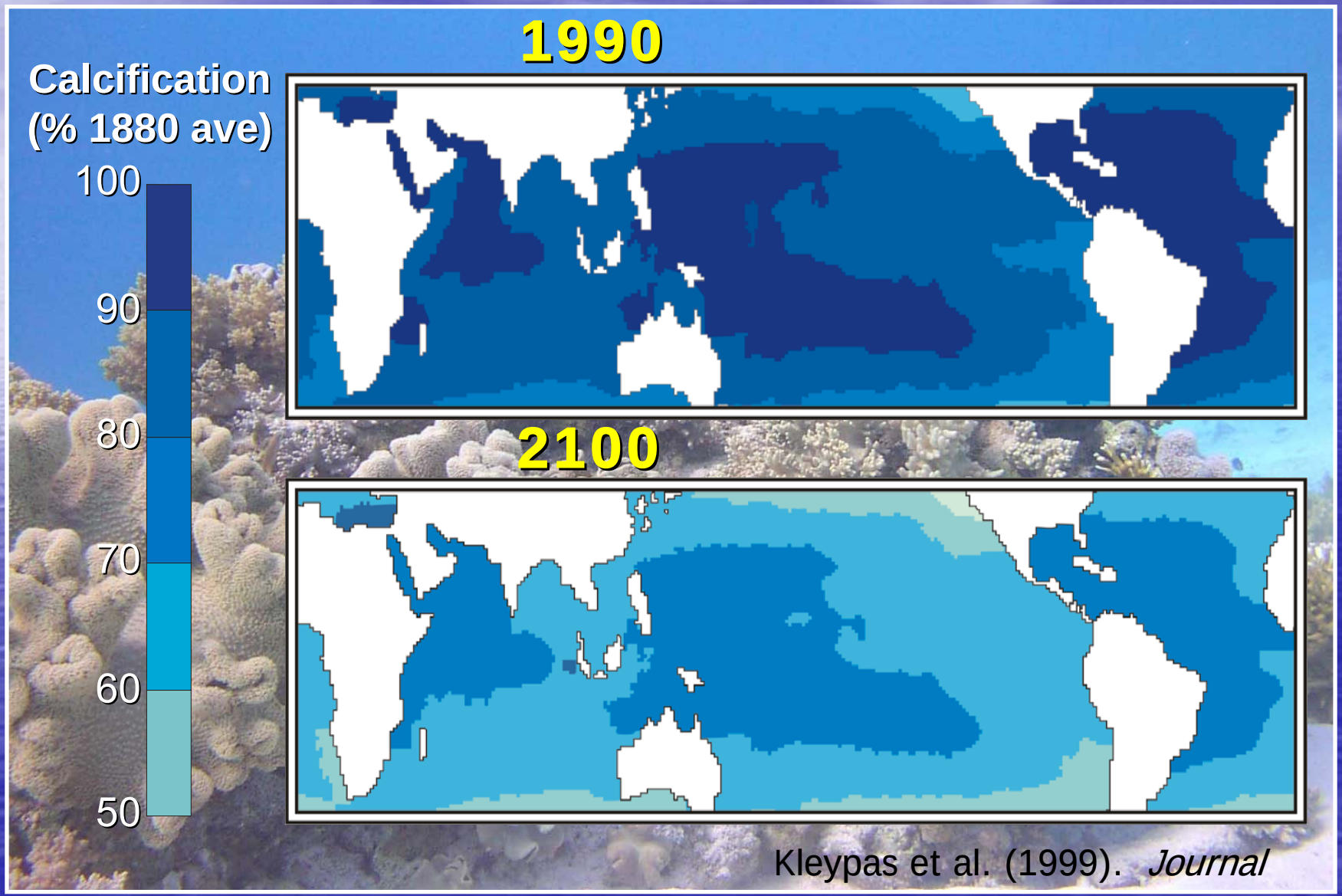
Sabine et al. (2004) *Science*

Fossil Fuel CO_2 & Ocean ΔpH



Caldeira & Wickett (2003) *Nature*

Impact on Coral Reef Calcification



Kleypas et al. (1999). *Journal*

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Aspen FACE

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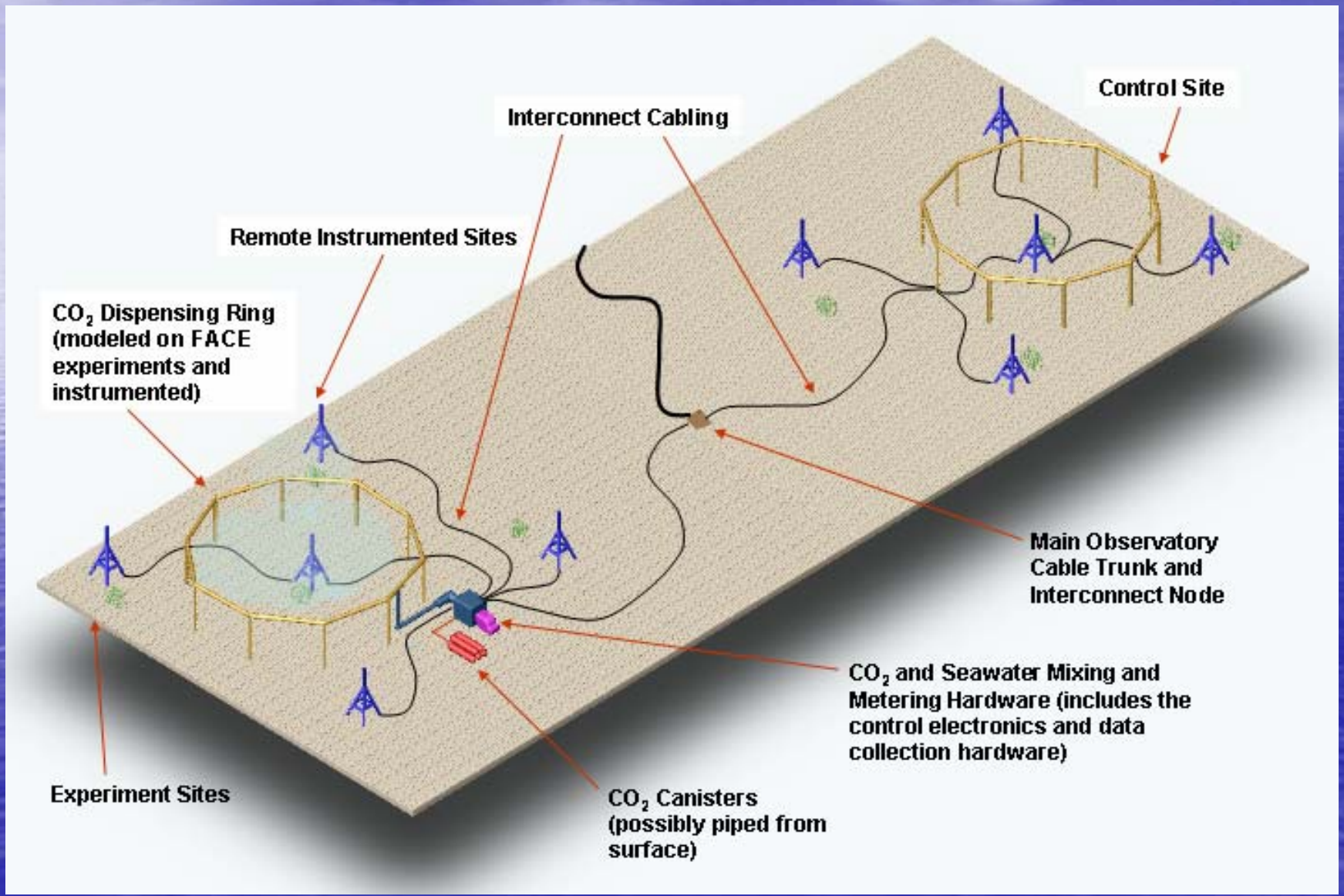
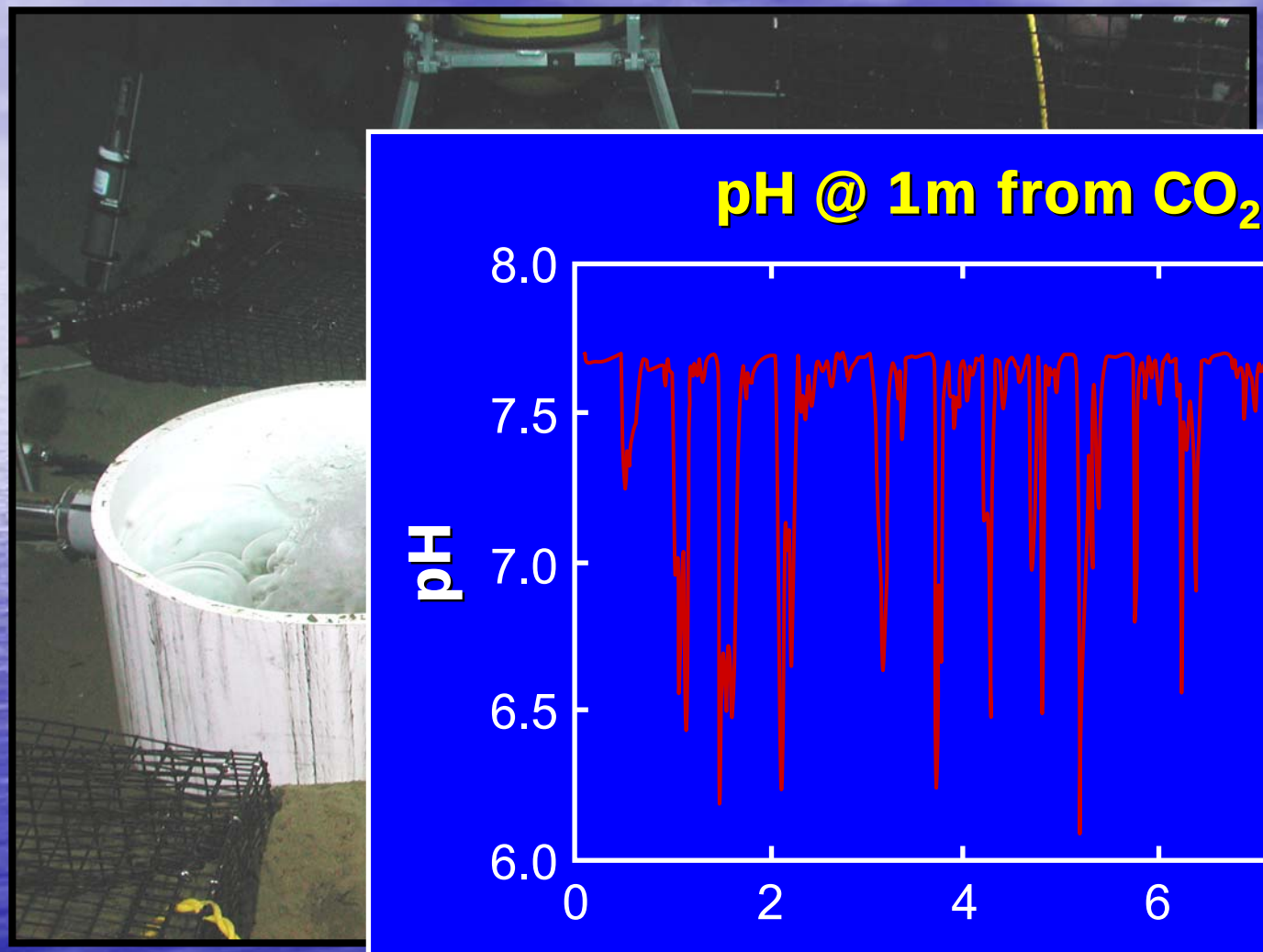
The FOCE Concept



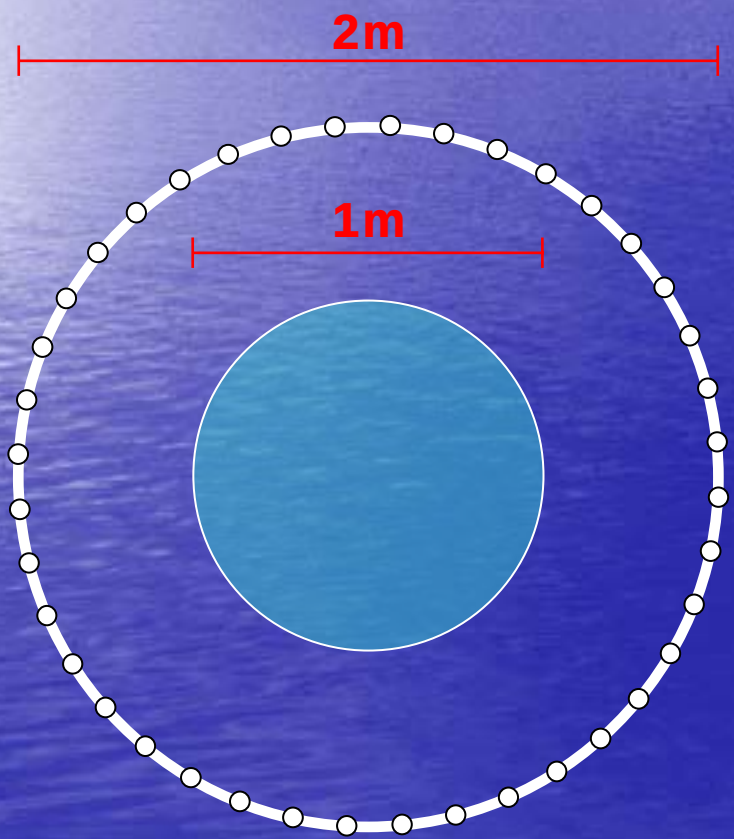
‘Uncontrolled’ CO_2 Release

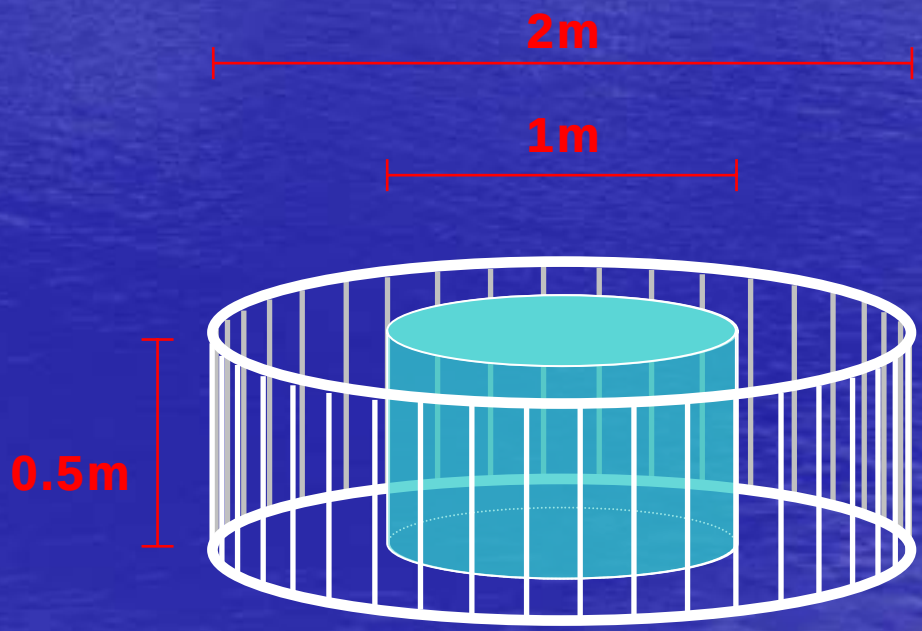


FOCE Prototype: Design Criteria

- TO BE FILLED IN

FOCE Prototype: Dimensions



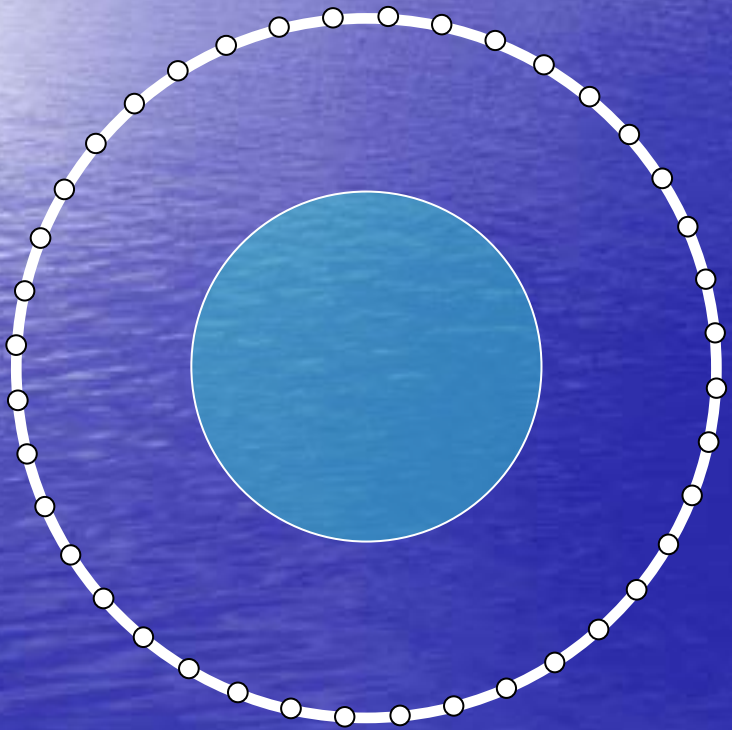


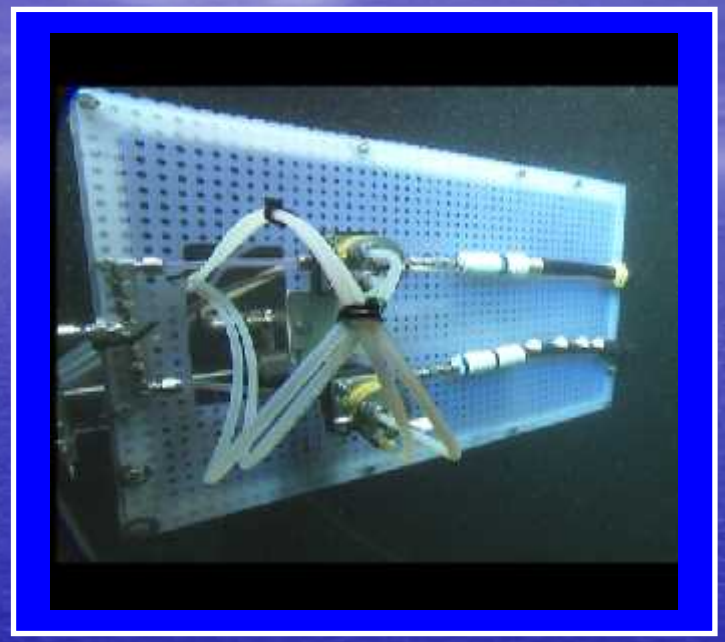
FOCE Prototype: Emitters

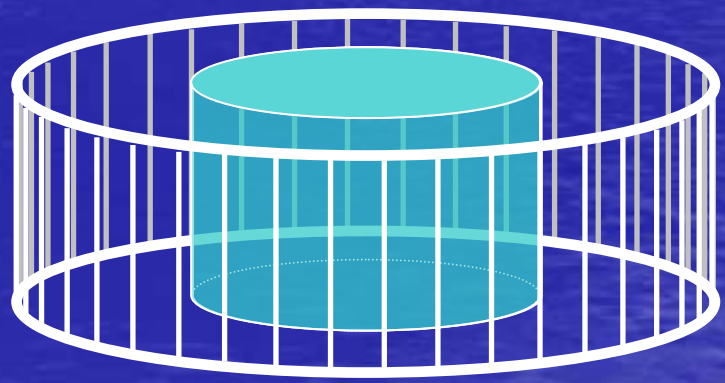
Tested 2 Emitter Types

(1) Diffuse Source – soaker hose

(2) Point Source – nozzle emitters

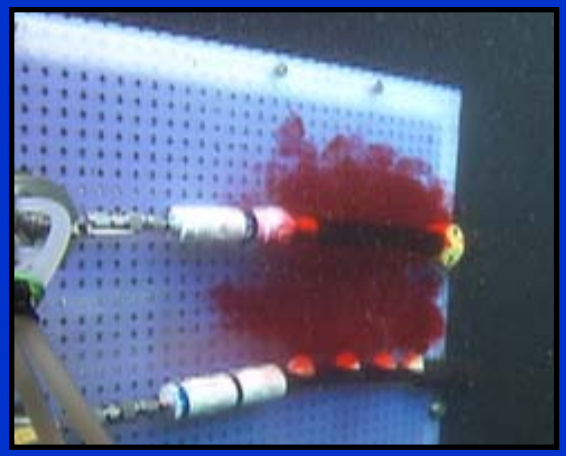


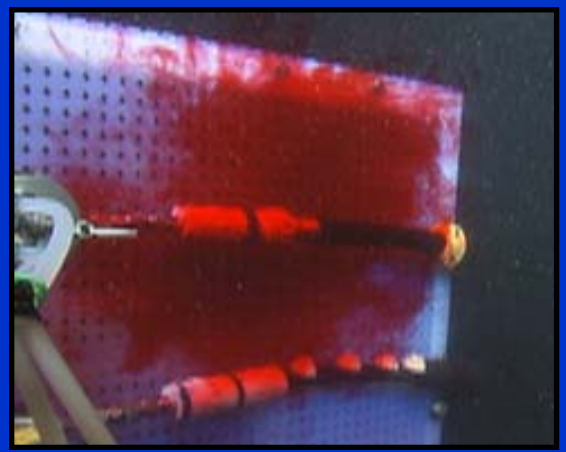




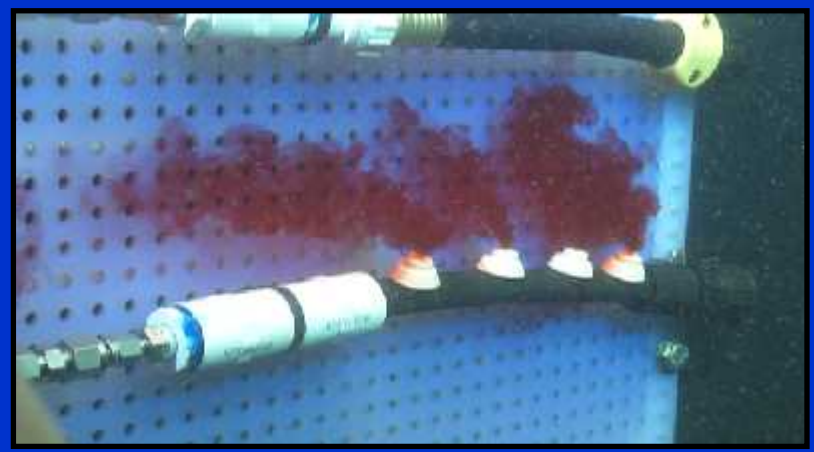
FOCE Prototype: Emitters

Diffuse Source





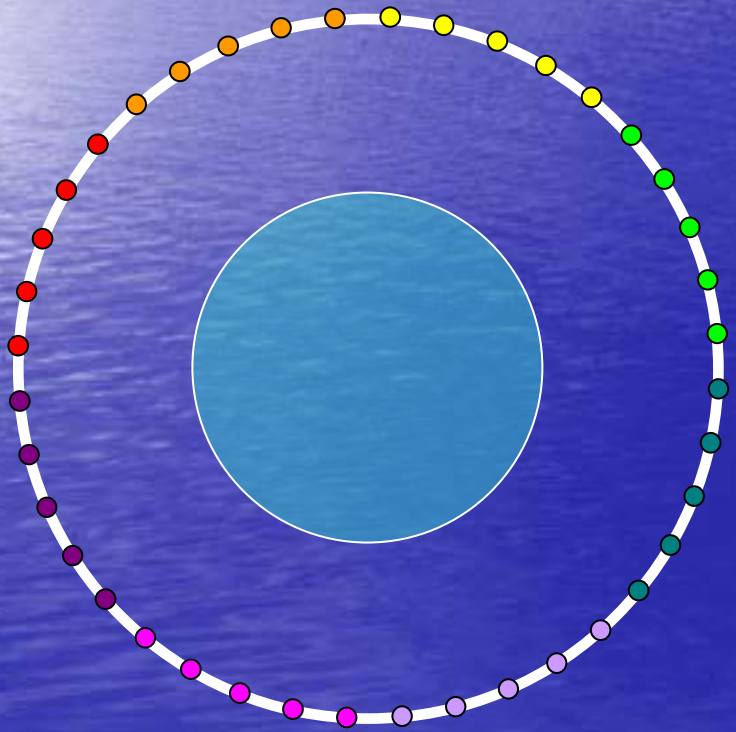
Point Source

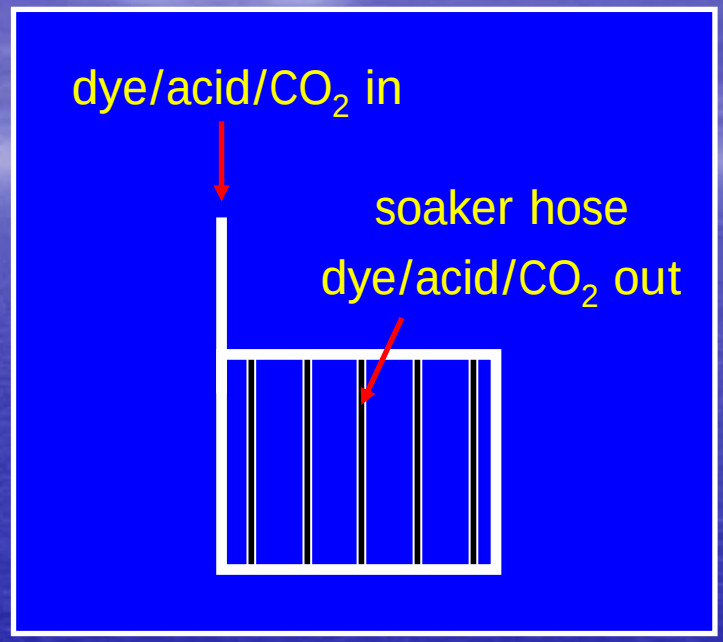


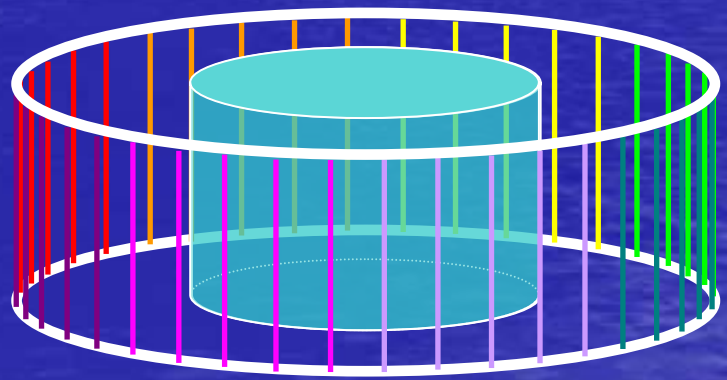
FOCE Prototype: Emitters

Soaker Hose = Best Mixing

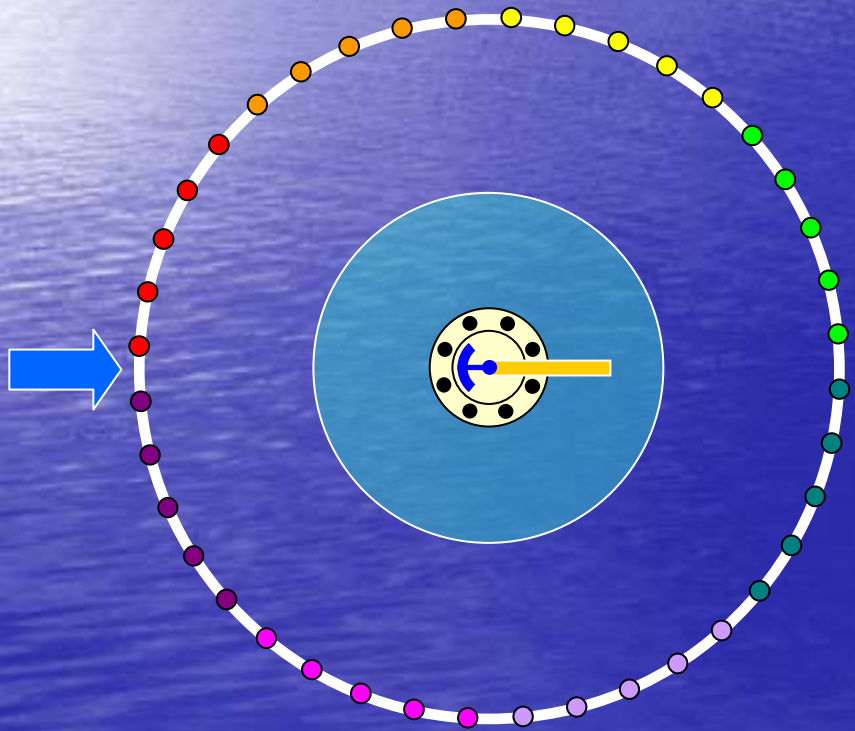
Emitter Ring: 40 emitters
8 sections
5 emitters per section

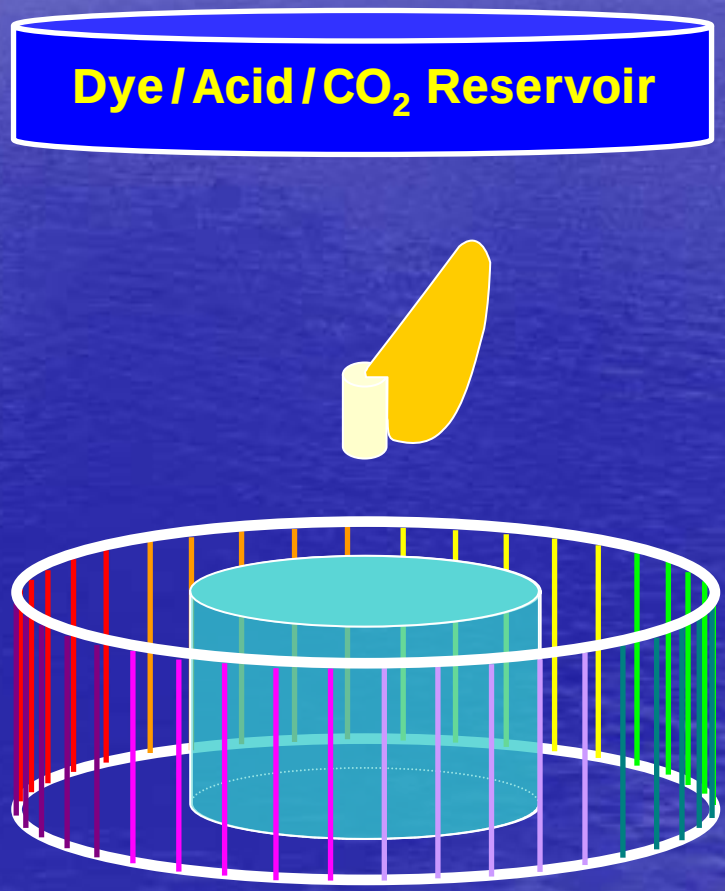






FOCE Prototype: Delivery System





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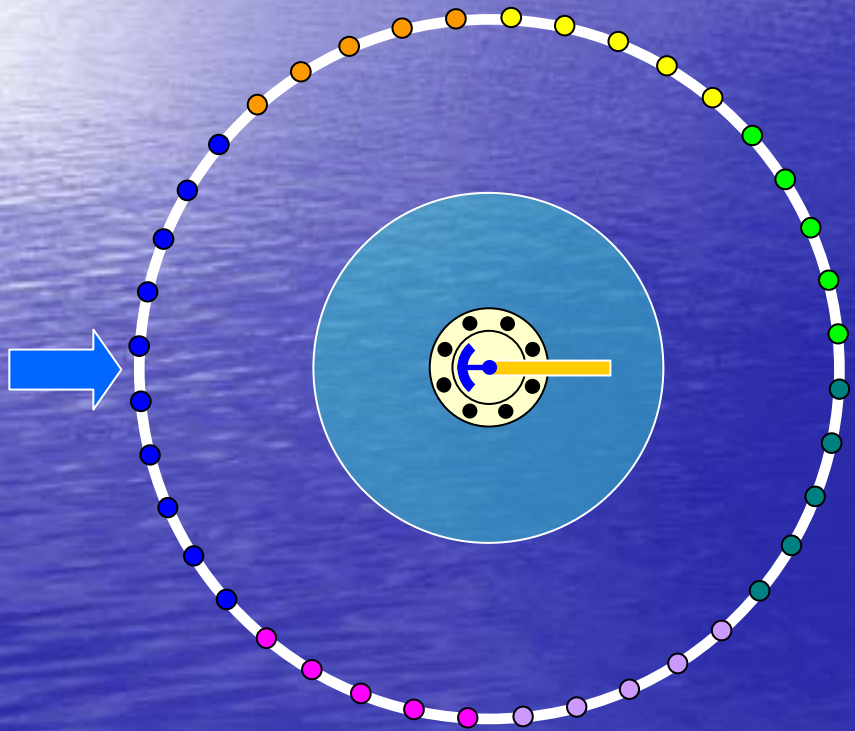

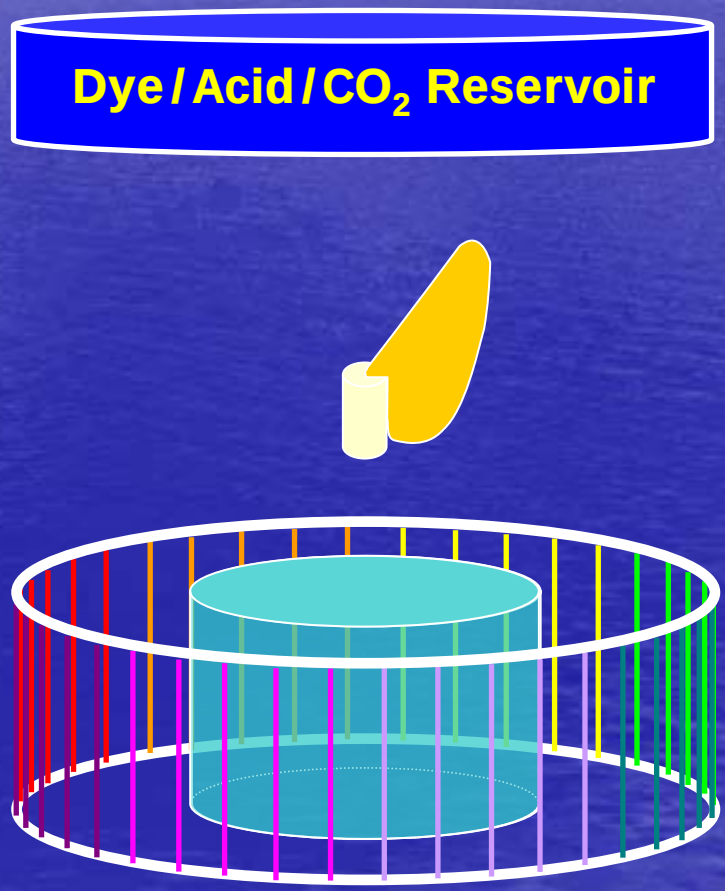

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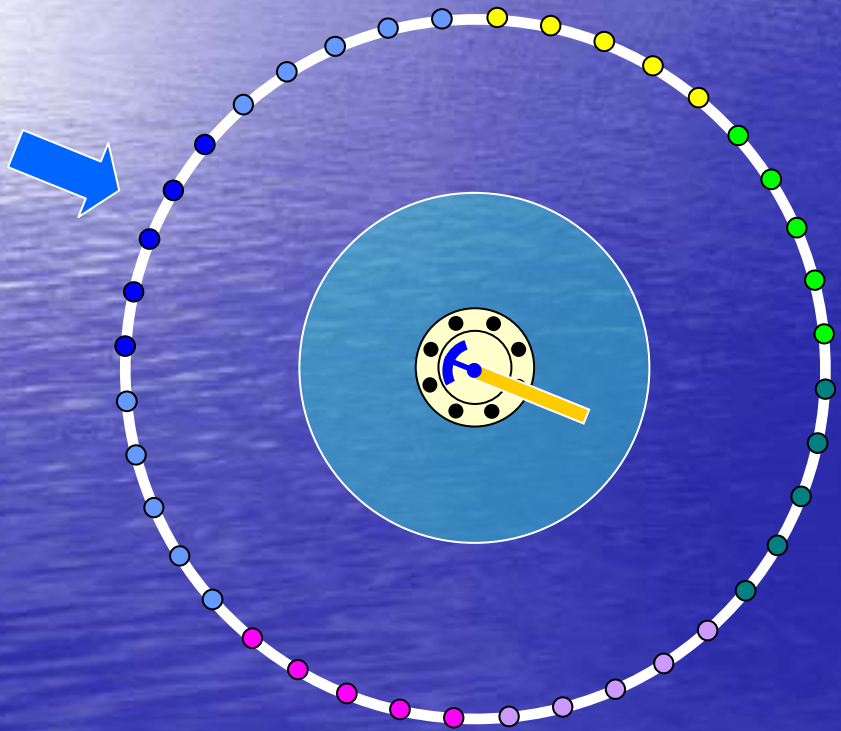

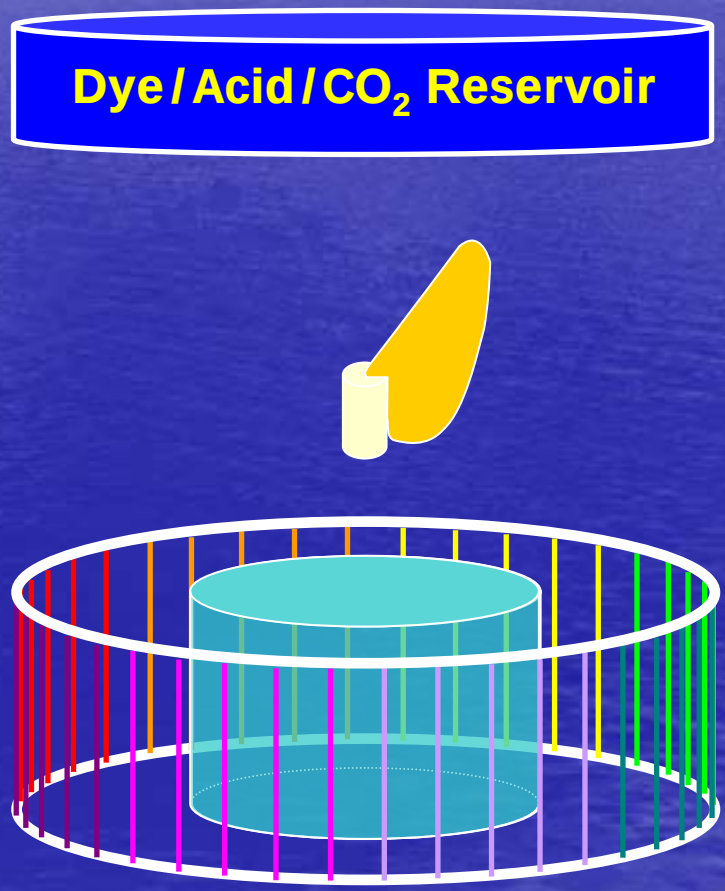

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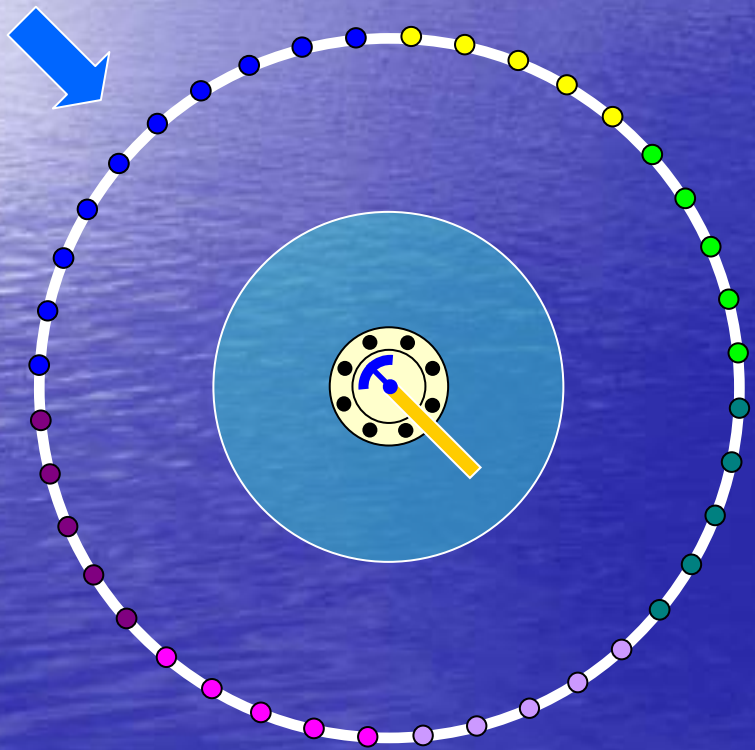
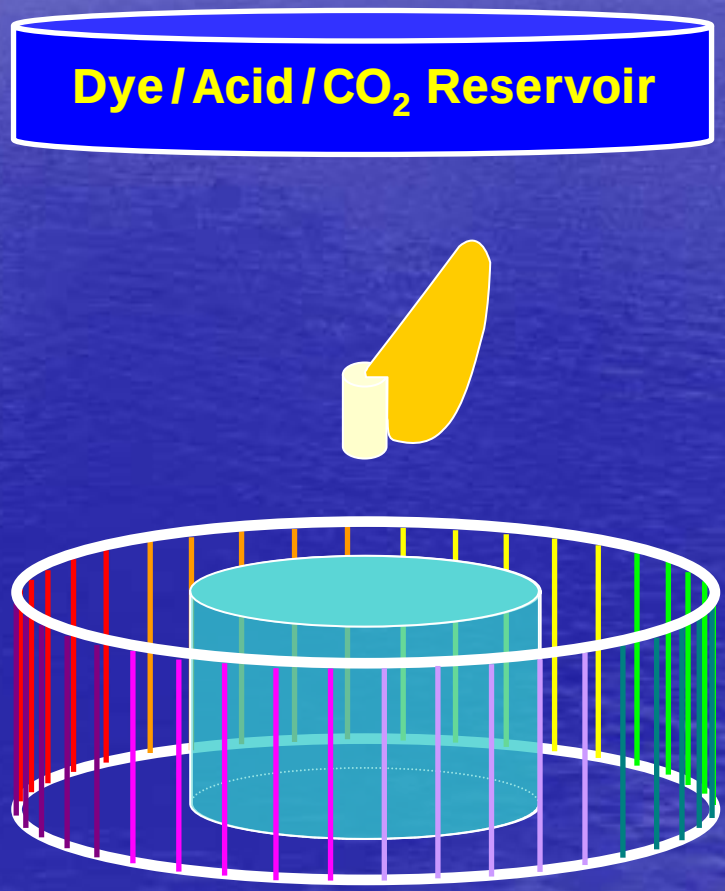
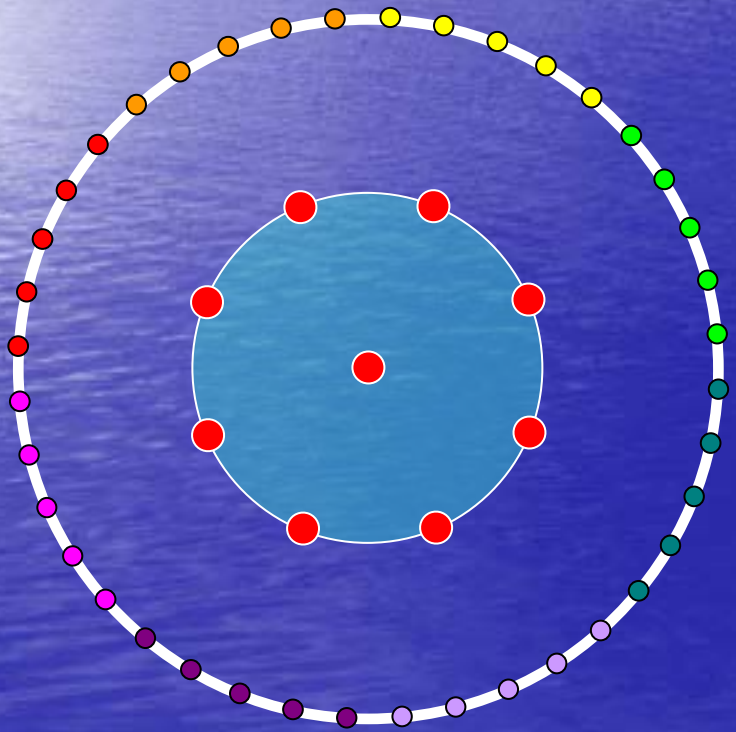
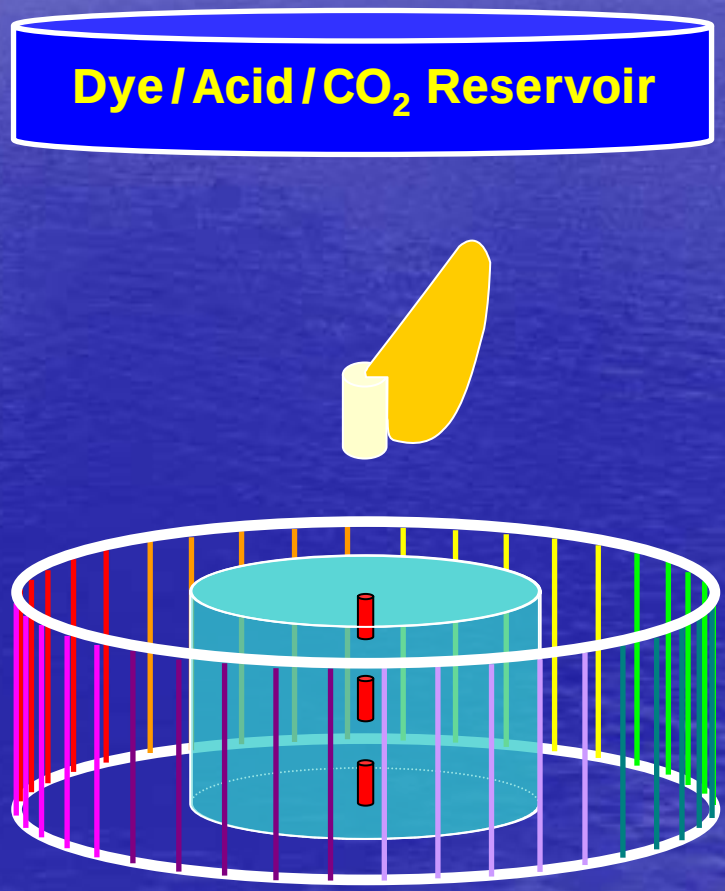




FOCE Prototype: Control System

Next two slides to be completed + addition of Bills info





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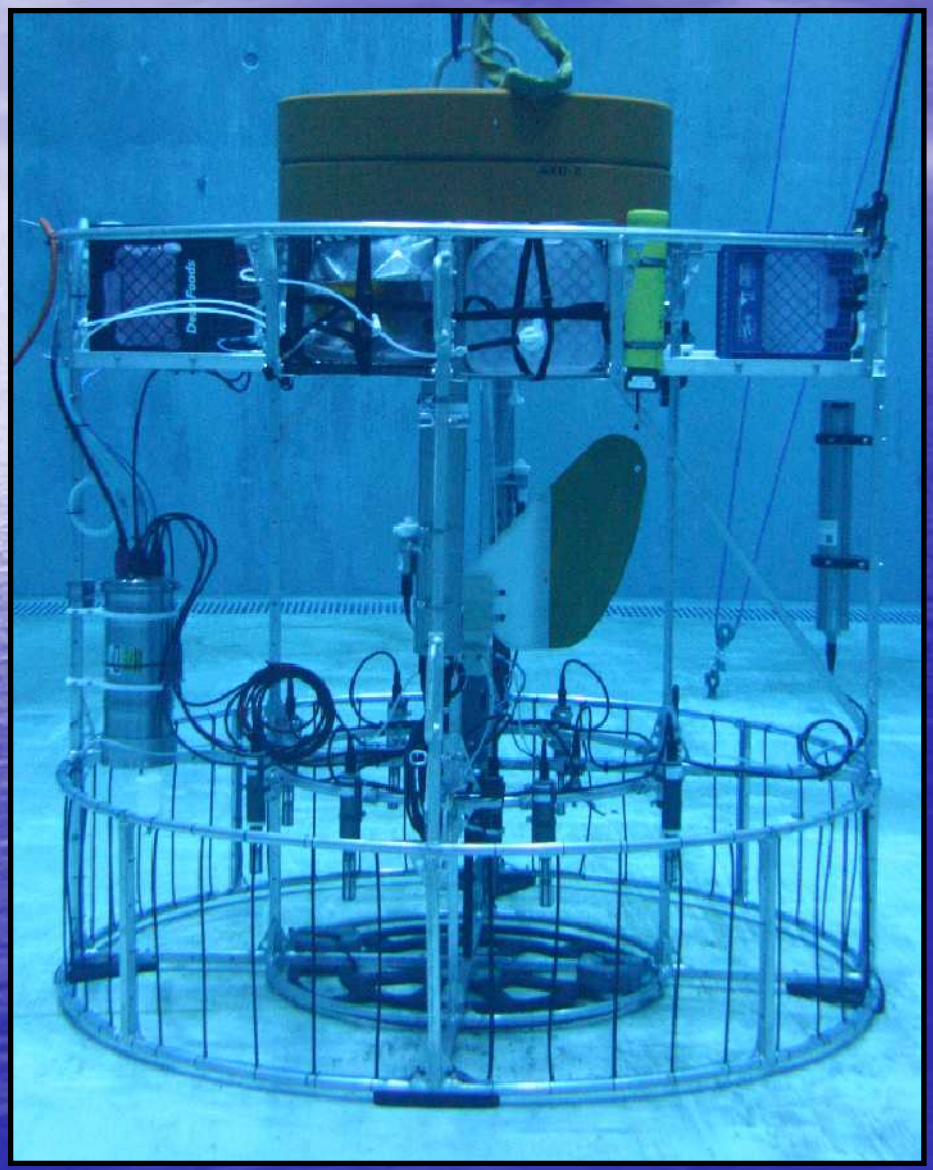
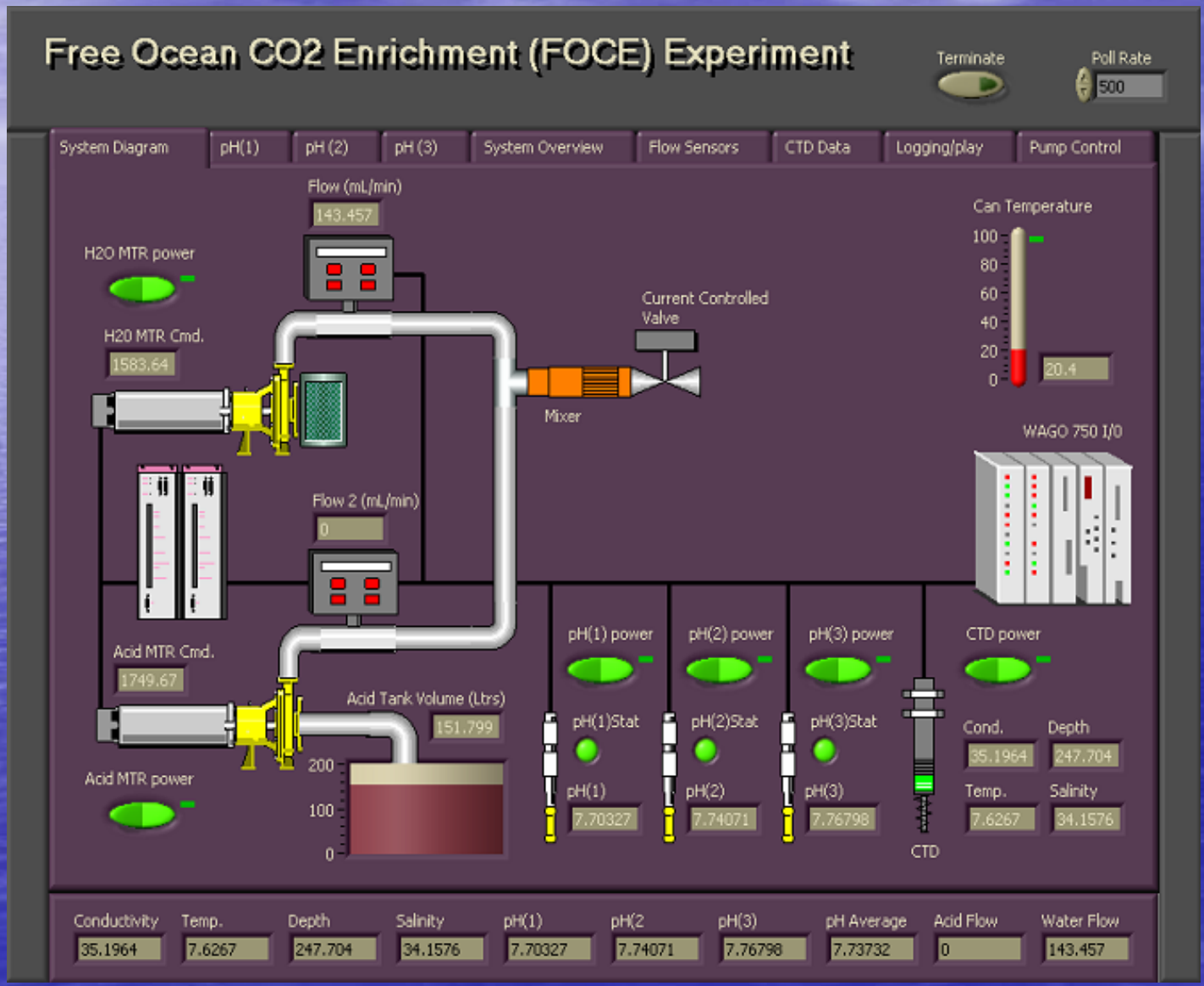


FOCE Prototype: Control GUI



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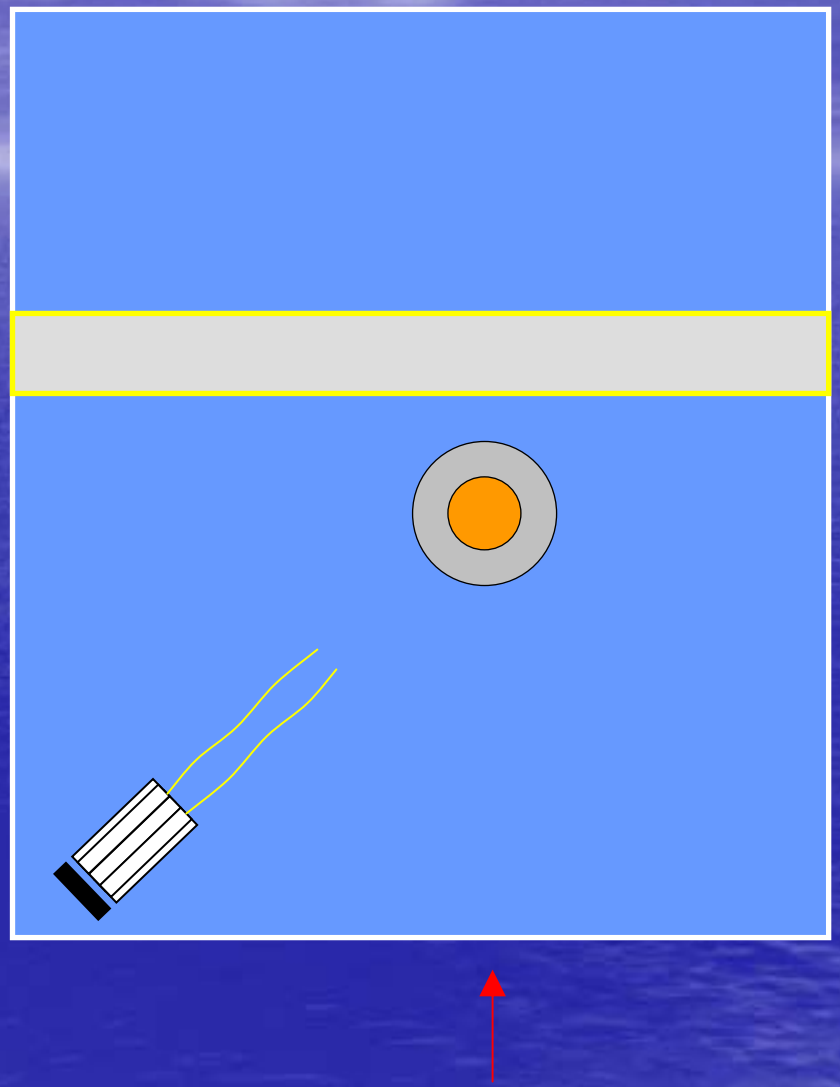
Test Tank Dye Release



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Field Trial: Location

Monterey Bay National Marine Sanctuary

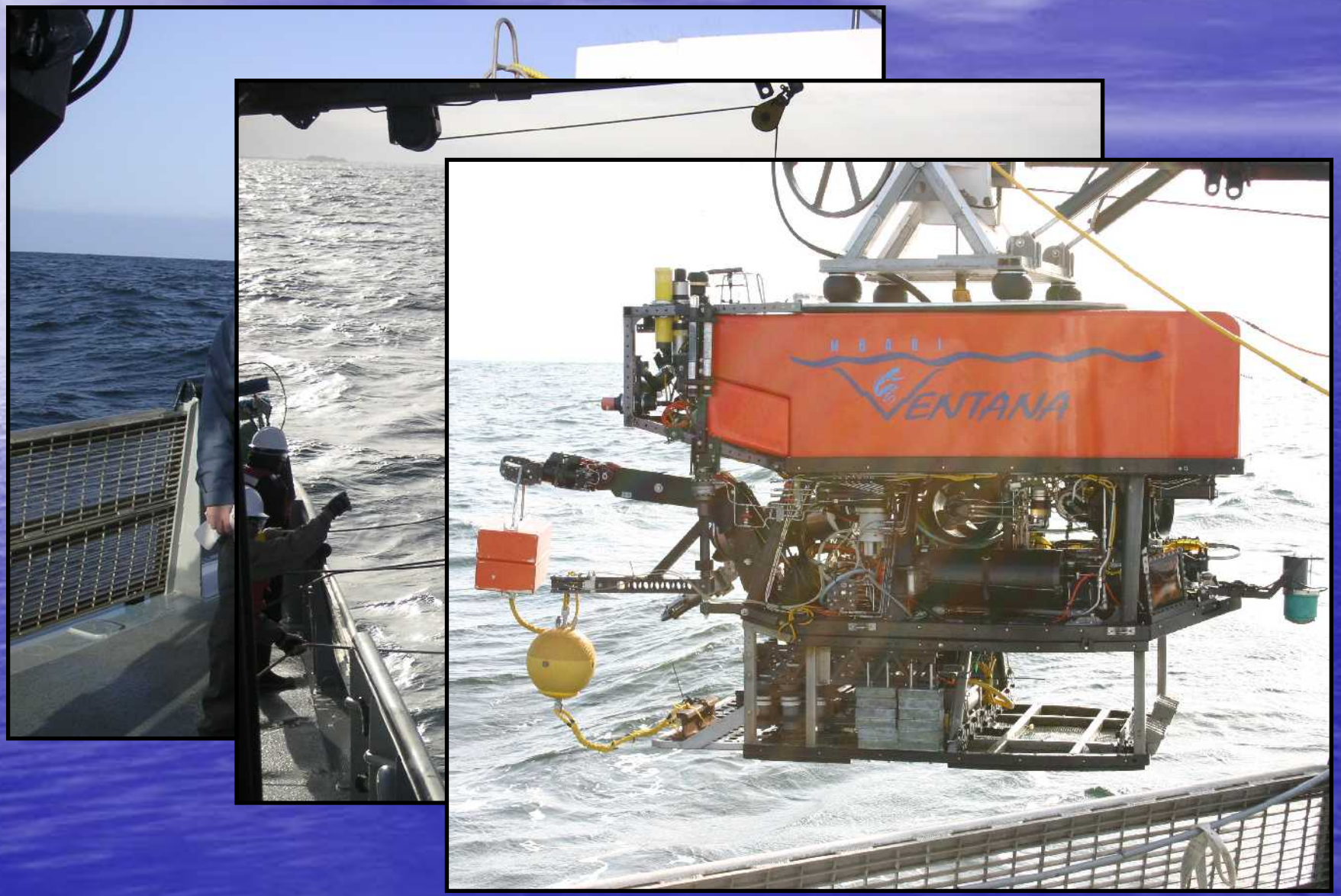
MBNMS / NOAA Permit for limited release of:

CO_2

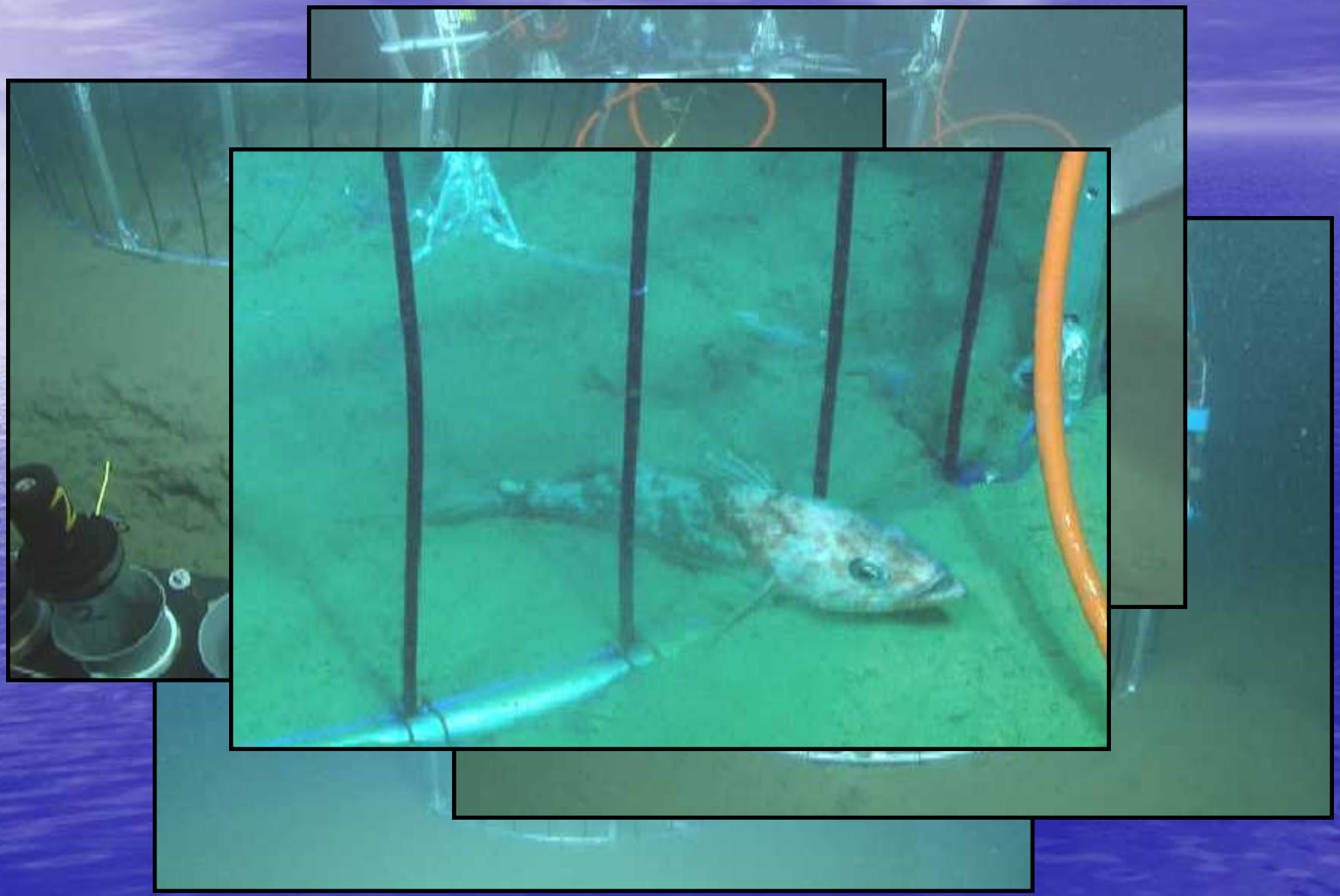
HCl

non-toxic dye

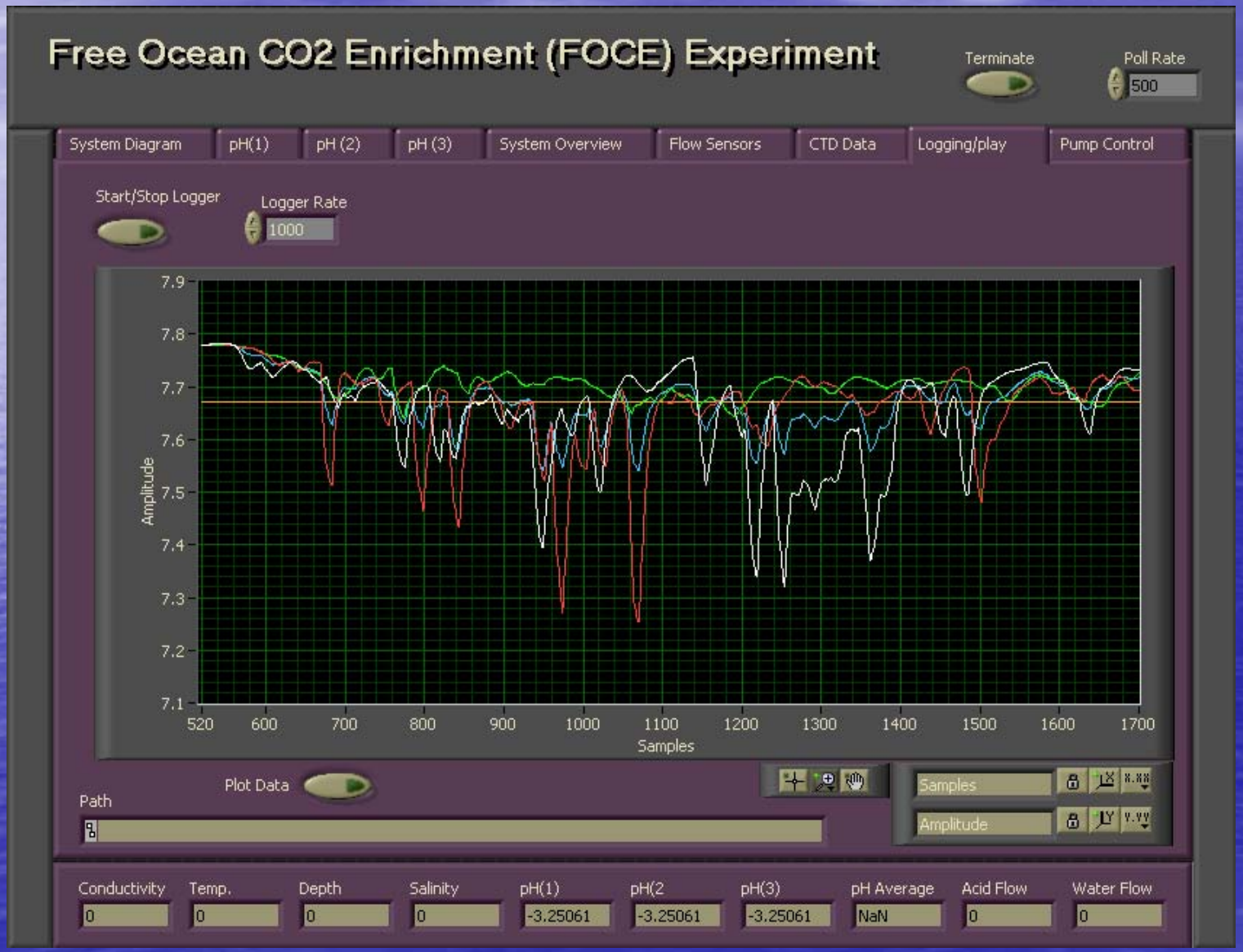
Field Trial: Deployment



Field Trial: On the Seafloor



Field Trial: Data & pH Control



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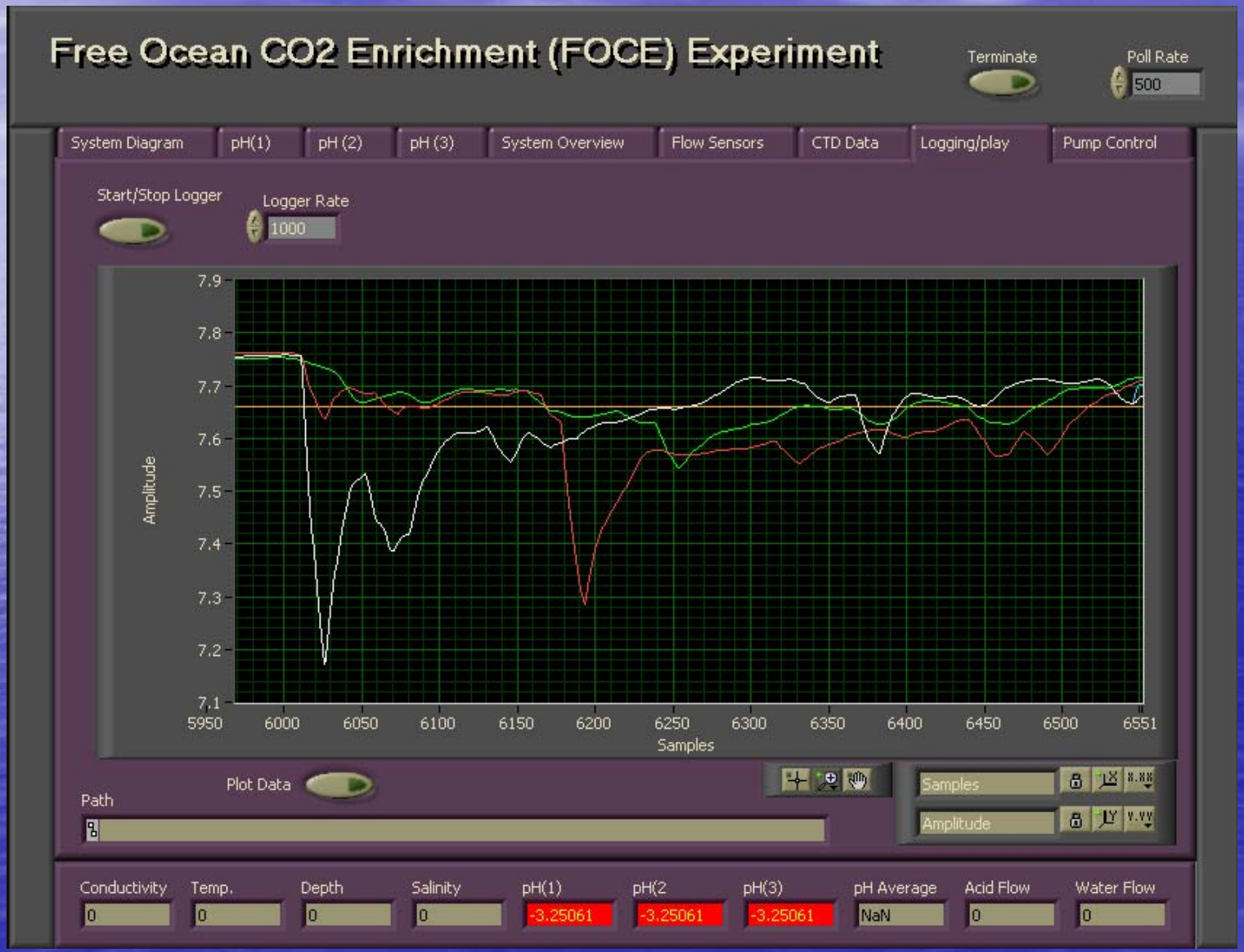

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Lessons FOCE II

A bullet point text slide covering points discussed in meeting

Acknowledgements

- The MBARI Machine Shop (Ray Thompson)
- Crew of Pt Lobos & Pilots of Ventana
- Video: Todd Walsh
- Packard Foundation
- US Department of Energy (DE-FC26-00NT40929).

Questions ?