

Development of an Adaptable Monitoring Package for Marine Renewable Energy

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Monitoring



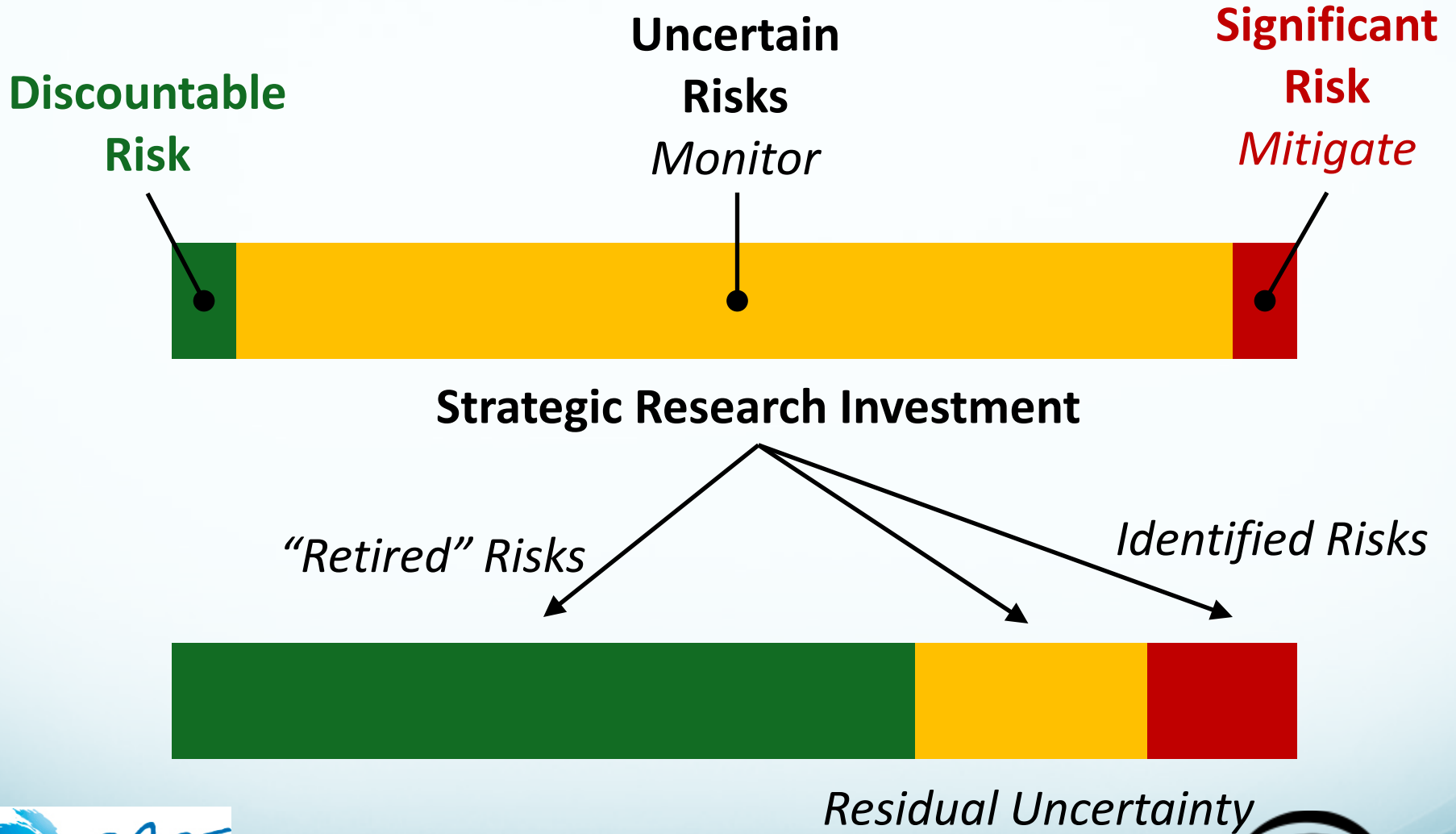
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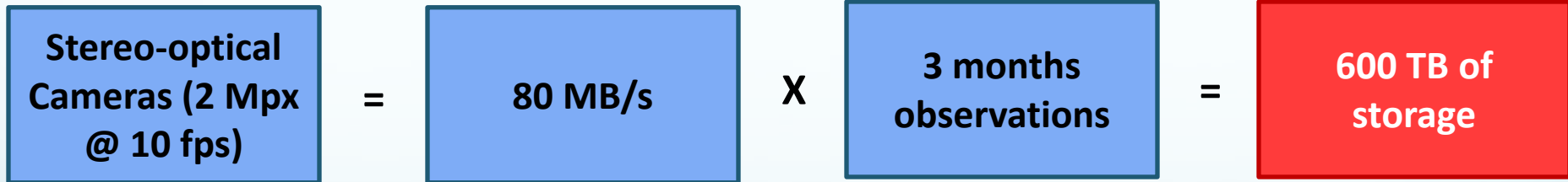


Environmental Risk Uncertainty



Reducing Risk Uncertainty

- Severe outcomes are likely to rarely occur
- Observing interactions may require spatially *comprehensive* and temporally *continuous* monitoring
- Strategy likely to generate “data mortgages”



Example: Continuous stereo-optical monitoring for a single camera pair. Comprehensive monitoring would require multiple pairs.

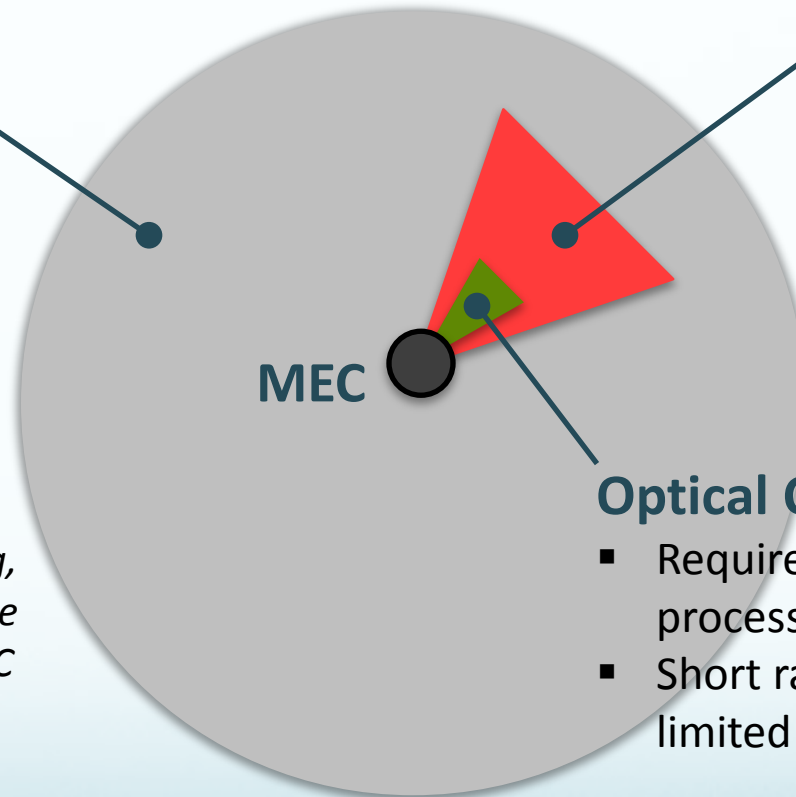
Integrated Instrumentation Packages

- Need low-cost and near-term approaches to improve ratio of information gained to data archived

Passive Acoustic Detection

- Processing in near real-time
- Omni-directional coverage at ranges on the order of 1 km

Example: Detection, tracking, and identification of a marine mammal approaching a MEC



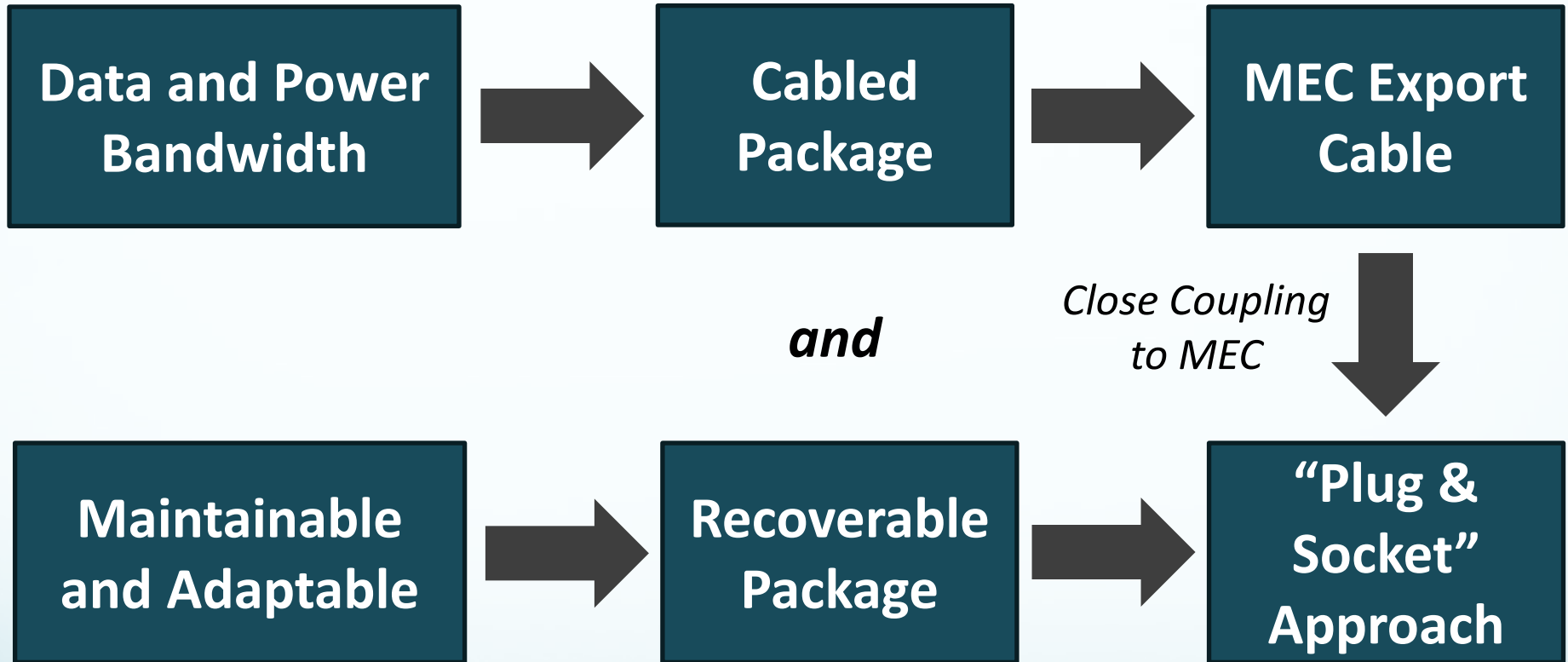
Multi-beam Sonar

- Processing in near real-time
- Tracking capability at ranges out to 100 m

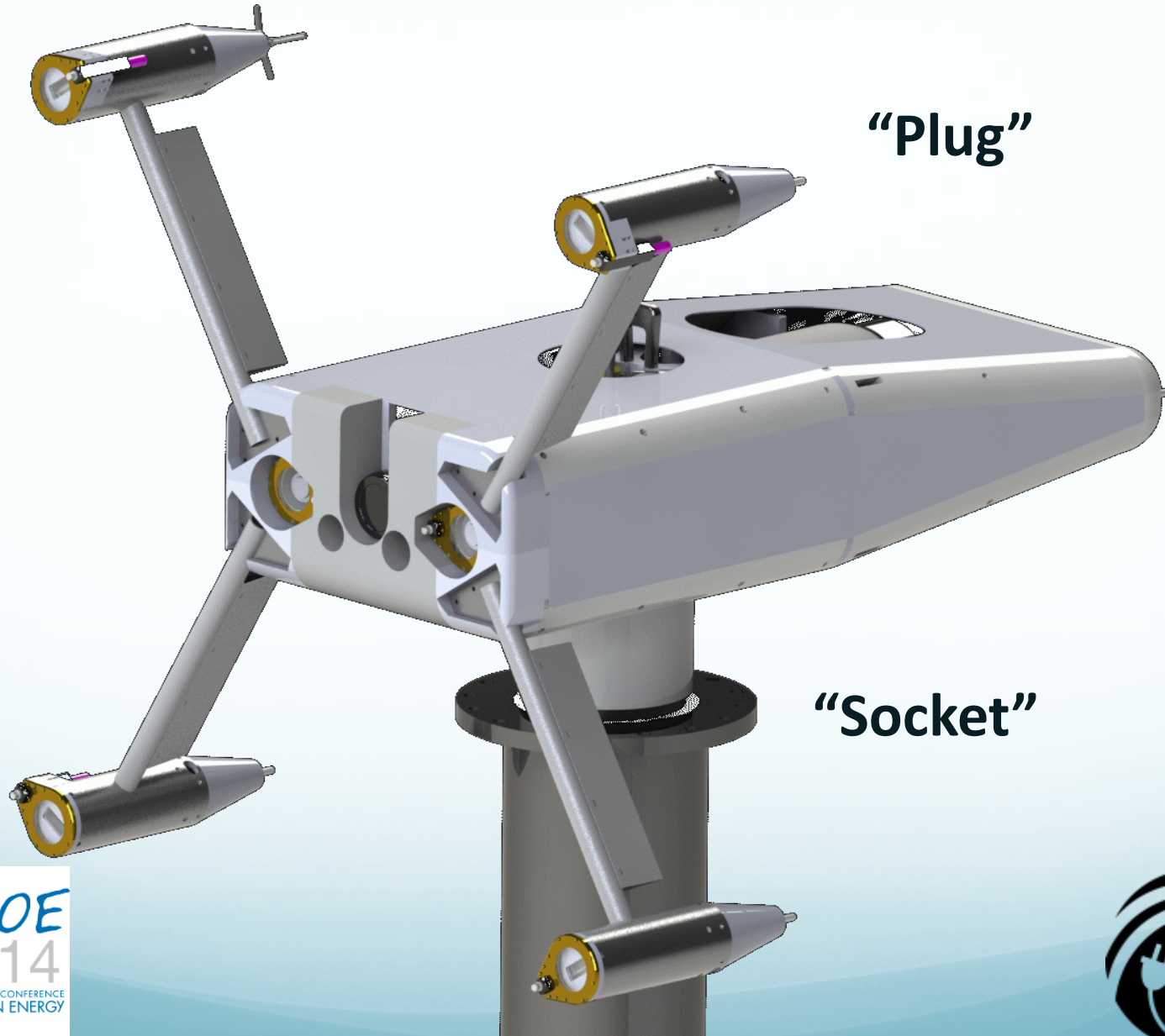
Optical Camera

- Requires archival processing
- Short range and limited field of view

Constraints for Integrated Instrumentation

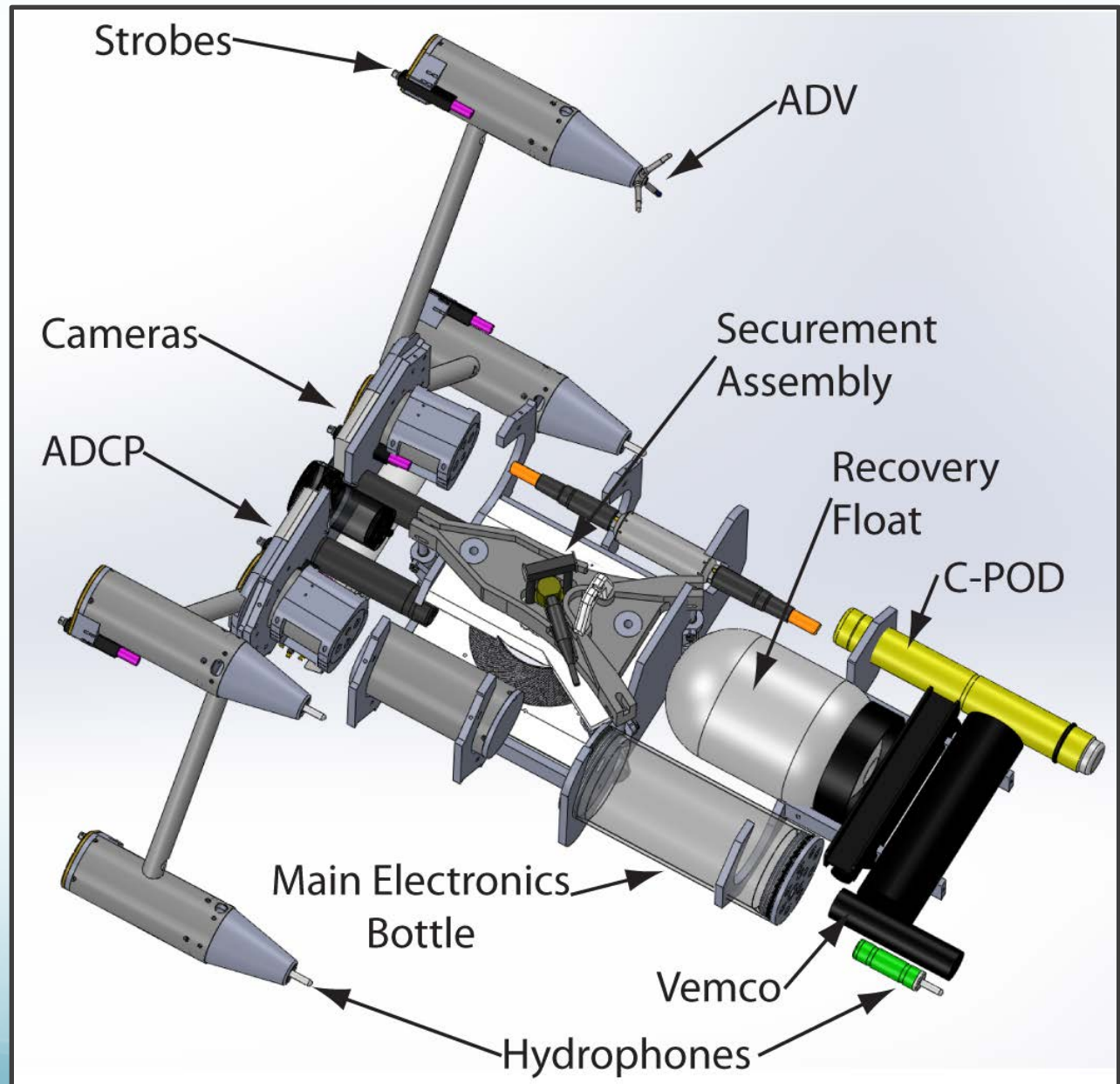


Adaptable Monitoring Package (AMP)

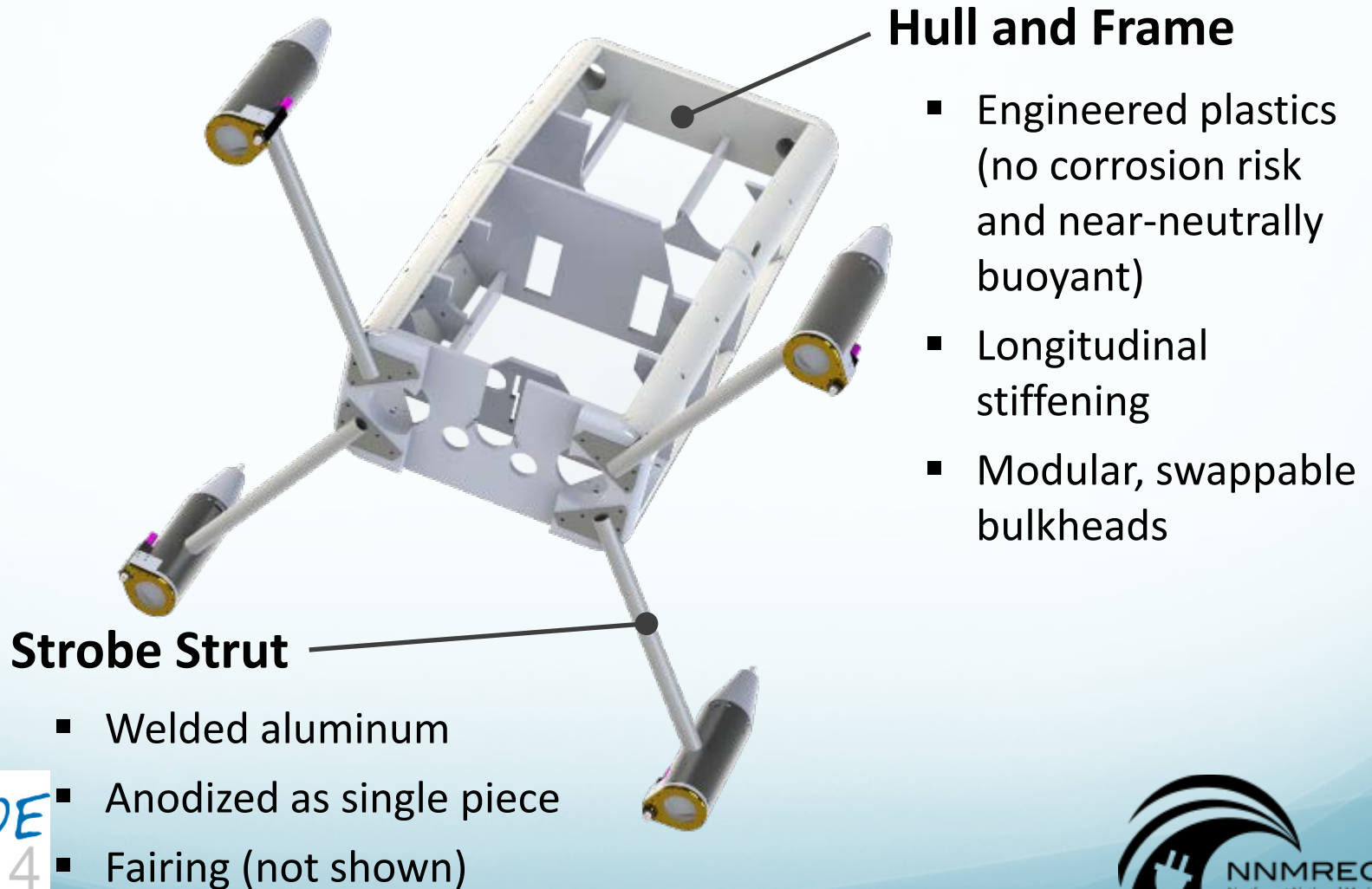


AMP Infrastructure and Instrumentation

- Power and data infrastructure
- Securement and recovery system
- Instruments



Package Mechanical Design



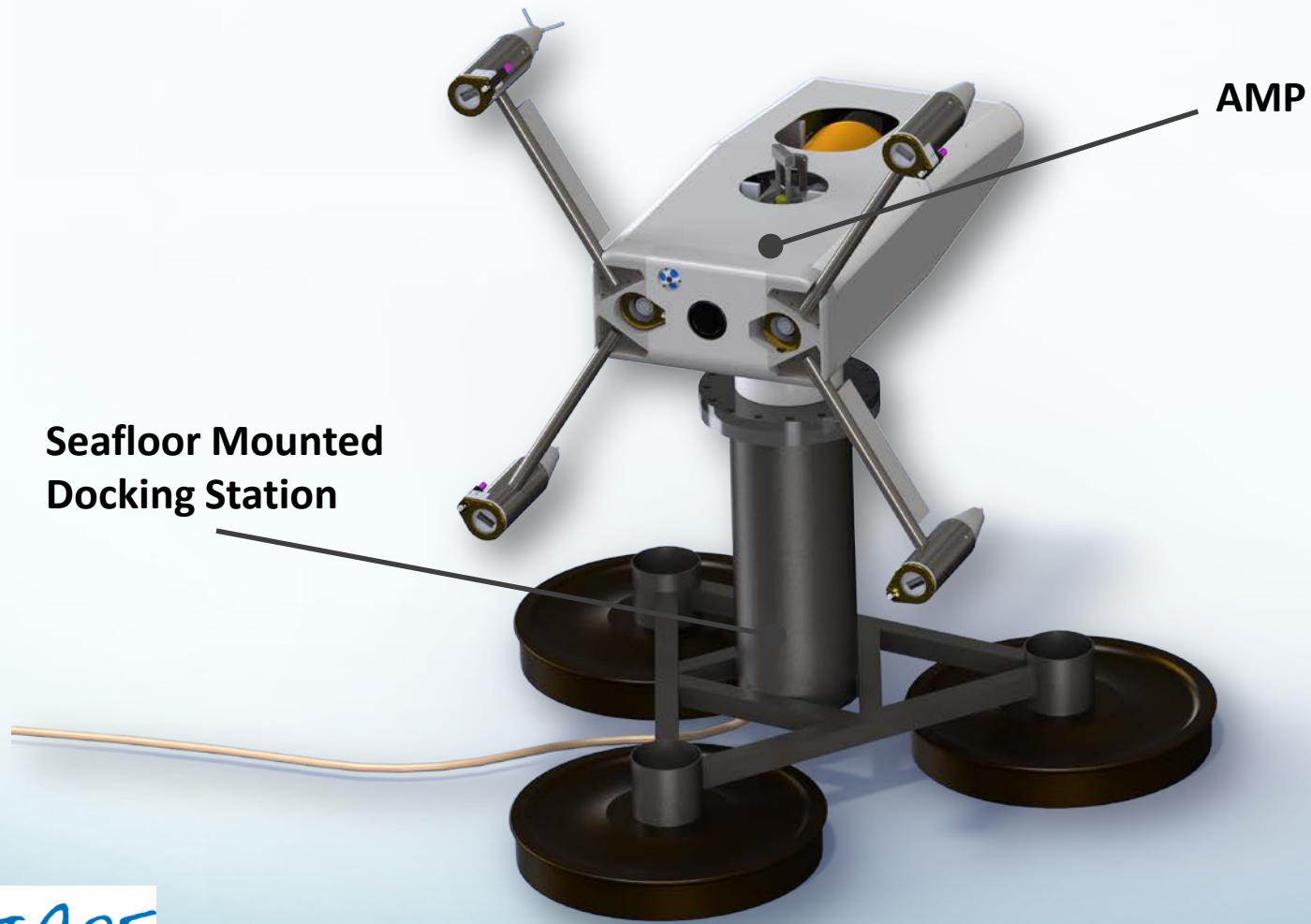
Hull and Frame

- Engineered plastics (no corrosion risk and near-neutrally buoyant)
- Longitudinal stiffening
- Modular, swappable bulkheads

Strobe Strut

- Welded aluminum
- Anodized as single piece
- Fairing (not shown)

AMP Integration: Cabled Docking Station



Recovery/Deployment Options

Divers

- Short work windows
- Human safety risk

Converter Recovery

- Can be expensive and risky

Subsea Winch

- Moving parts in the ocean
- Winch failure can cause catastrophic system failure

ROV Servicing

- Short work windows

AMP Operations Concept: ROV Deployment

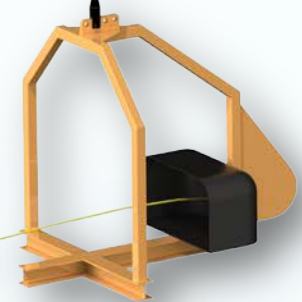


Load
Bearing
Umbilical

AMP and
Deployment ROV



ROV
Umbilical



Launch
Platform

Cabled Docking
Station



Current Direction →

“Millennium” Falcon Deployment System

SAAB Seaeye Falcon

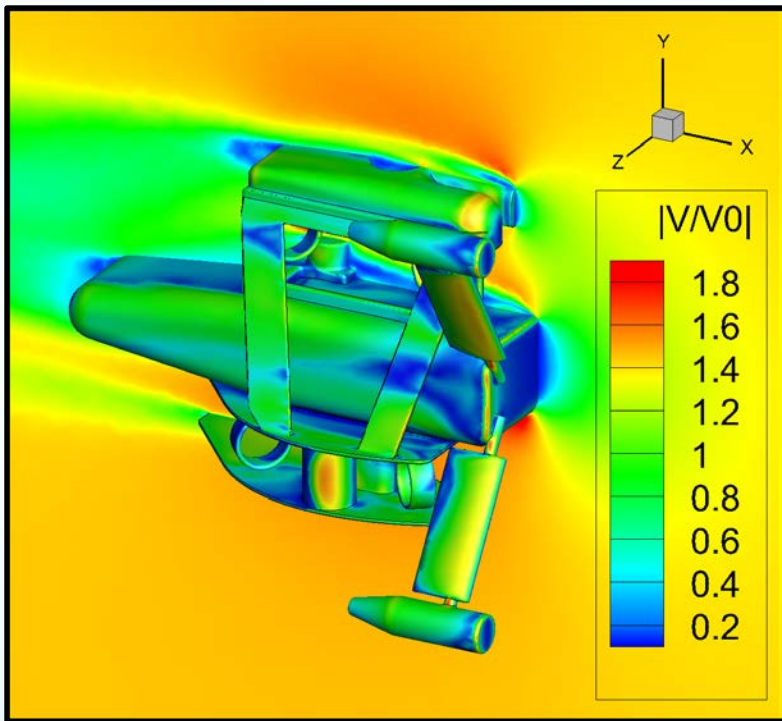
- Inspection-class ROV
- 4 Vectored Thrusters



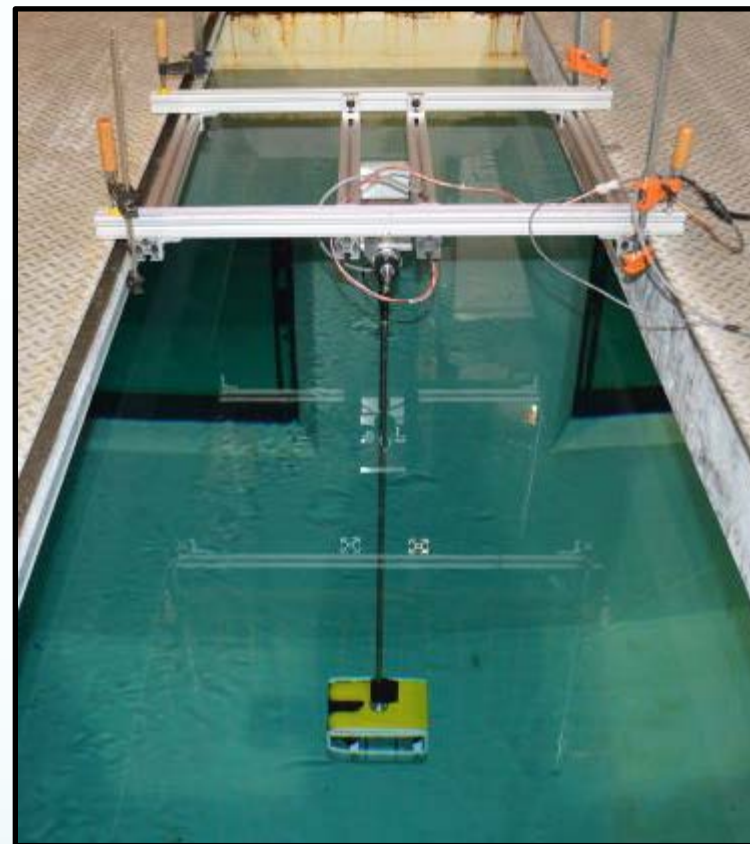
“Millennium” Skid

- 6 Thrusters
 - 4 Vectored
 - 2 Vertical
- Docking alignment
- Securement actuators
- Power and comms (SeaView)

Simulation and Experiments



*Normalized velocity around the
"Millennium" Falcon and AMP during
deployments*



*Pendulum test setup in the
Oceanography test tank*

System Stability

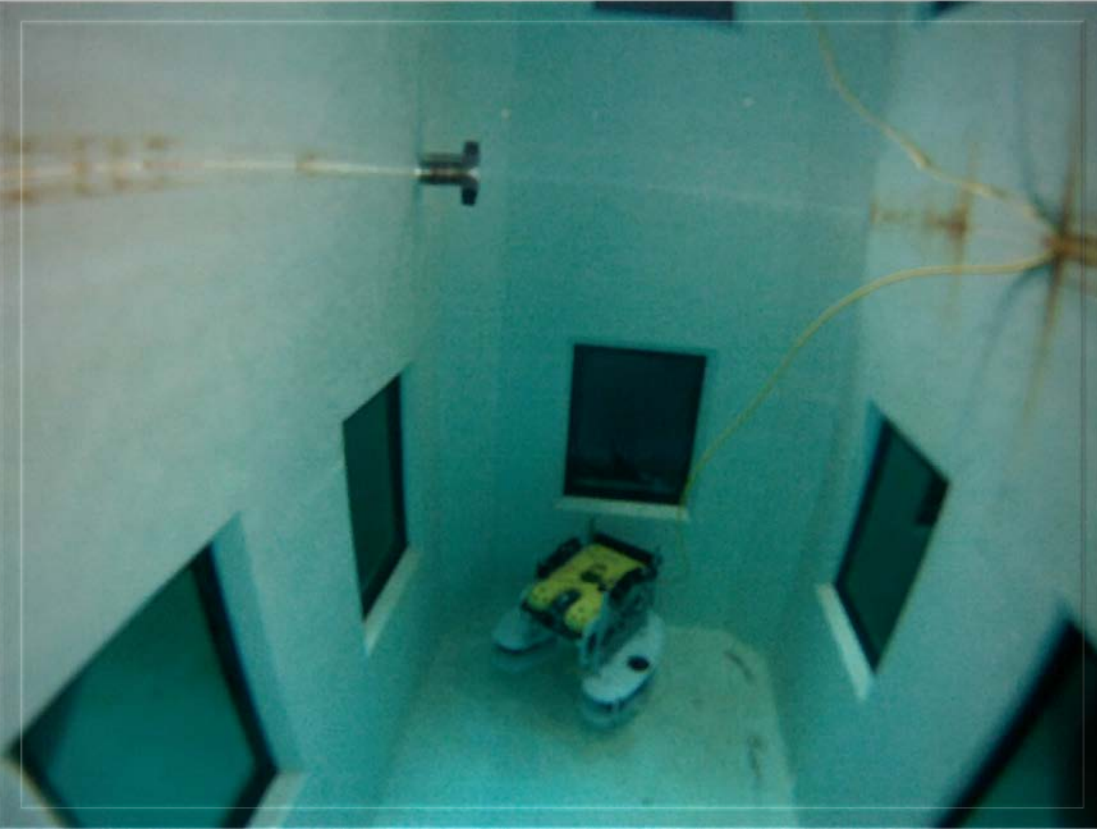


Center of Thrust

Center of Pressure

- **Dynamic Analysis during Deployments**
 - Coefficients from simulations and experiments.
 - Centers of pressure, thrust, mass, and buoyancy.
 - Loading from turbulent currents at marine energy sites.
 - Umbilical drag effects.

Summary



Millennium Falcon preliminary tank testing

- **Integrated instrumentation packages will play a critical role in reducing environmental risk without incurring large data mortgages**
- **Package design requires a significant systems engineering effort**

Acknowledgements



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