



AquaEnergy Group

Harvesting the Motion of the Ocean

Alla Weinstein, AquaEnergy Group

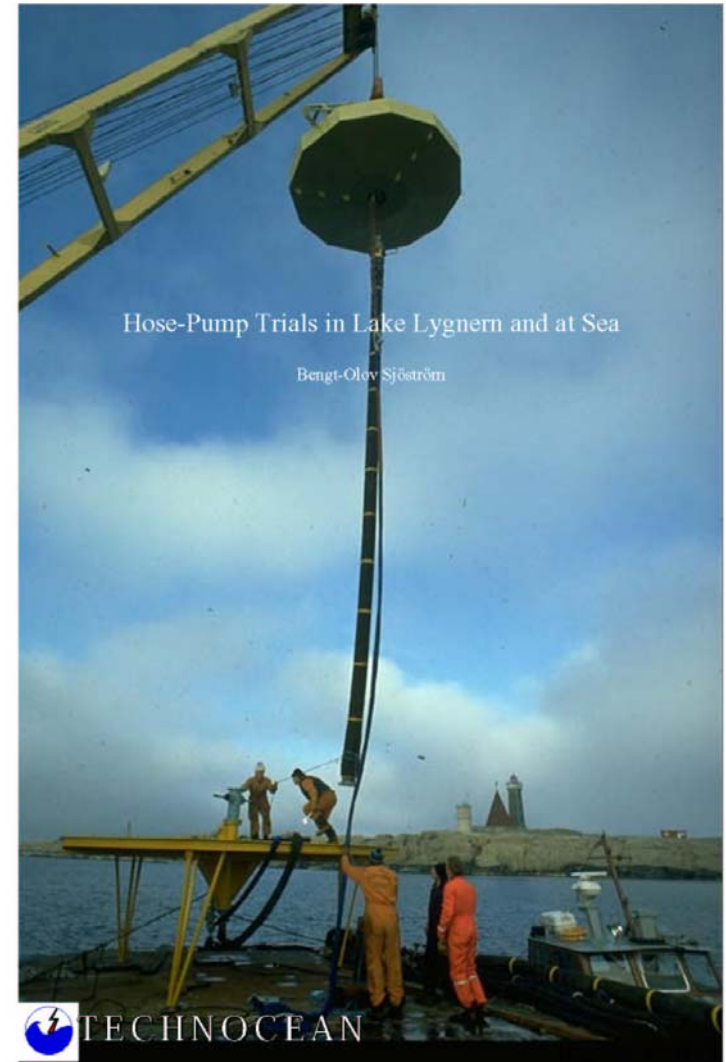
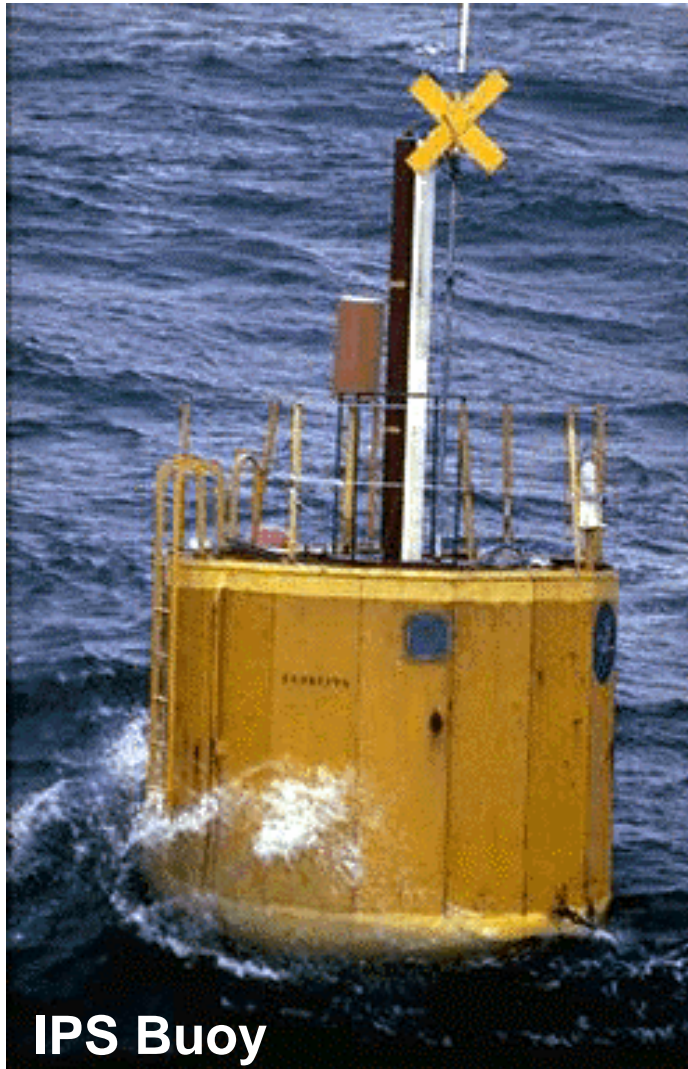


Overview

- **AquaBuOY – technology**
- **Makah Bay Offshore Pilot Plant**
- **US Permitting Requirement**
- **Conclusion**



Predecessor Technologies





IPS Buoy – Ocean Trials

Simple

Proven

Patented

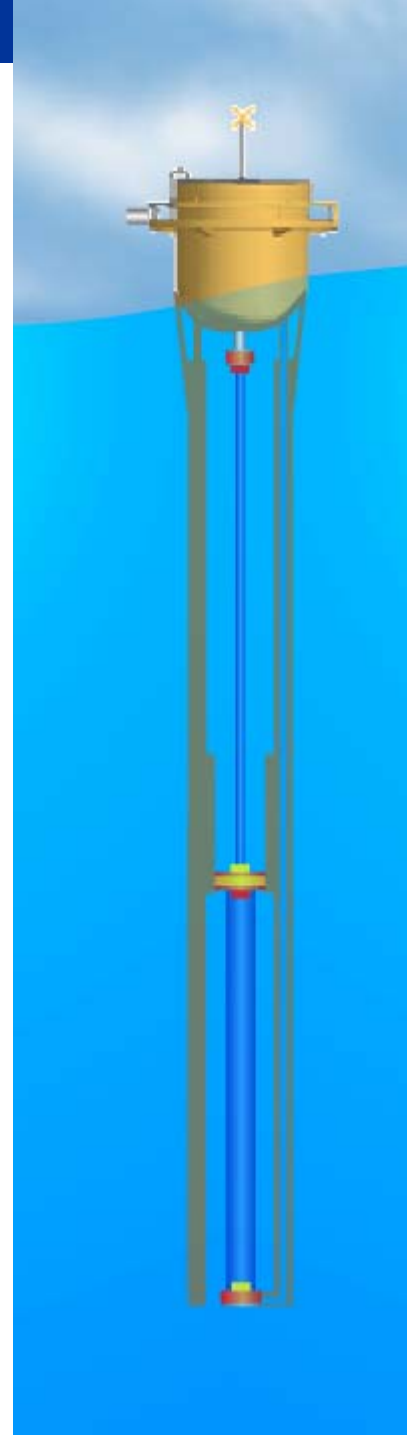
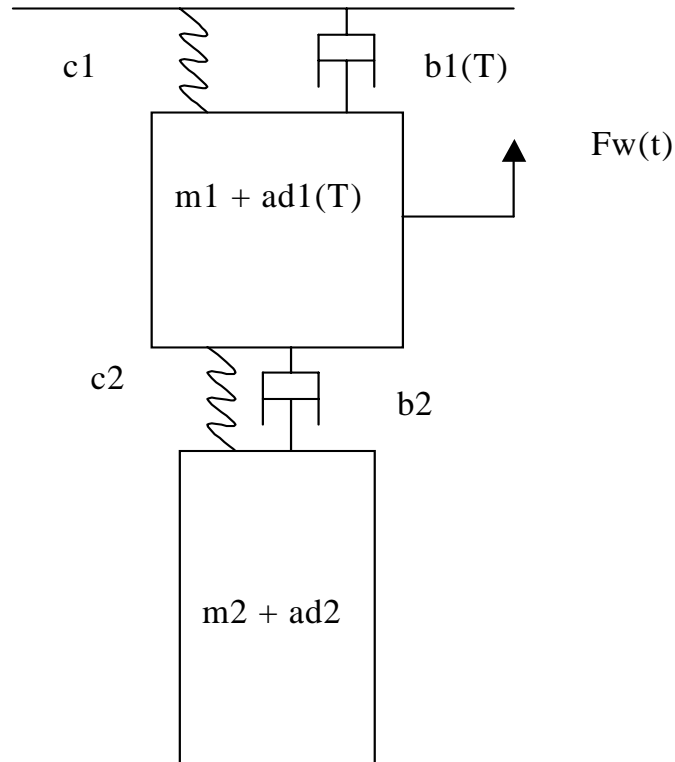
Clean





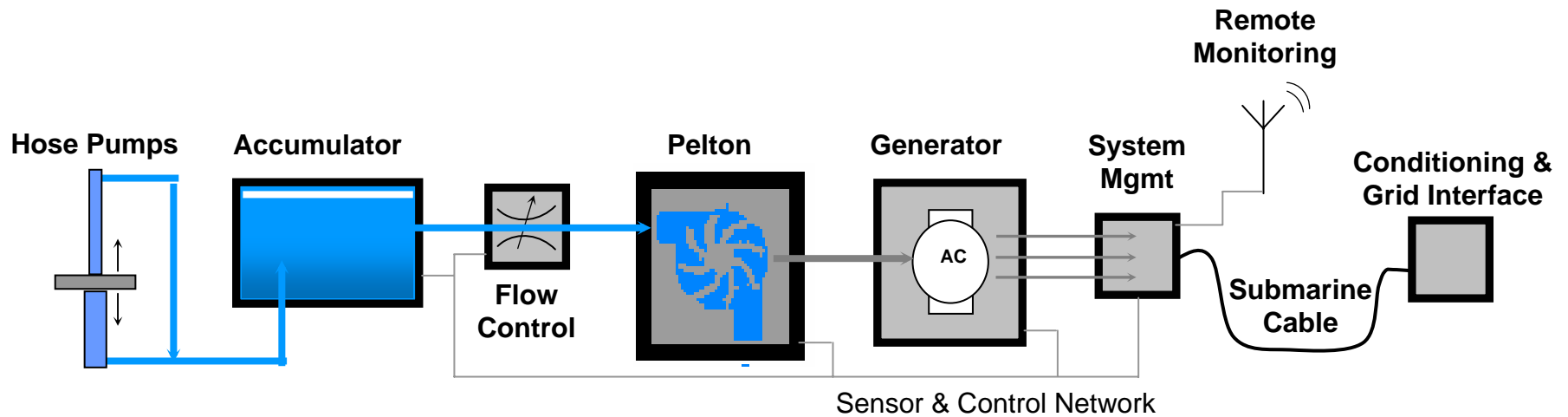
AquaBuOY Operation

- **2 vertically oscillating masses**
 - Float (buoy)
 - Water mass in the acceleration tube
- **Forces affecting float**
 - Wave force \sim wave amplitude
 - Hydrodynamic damping \sim float velocity
 - Float acceleration \sim added mass



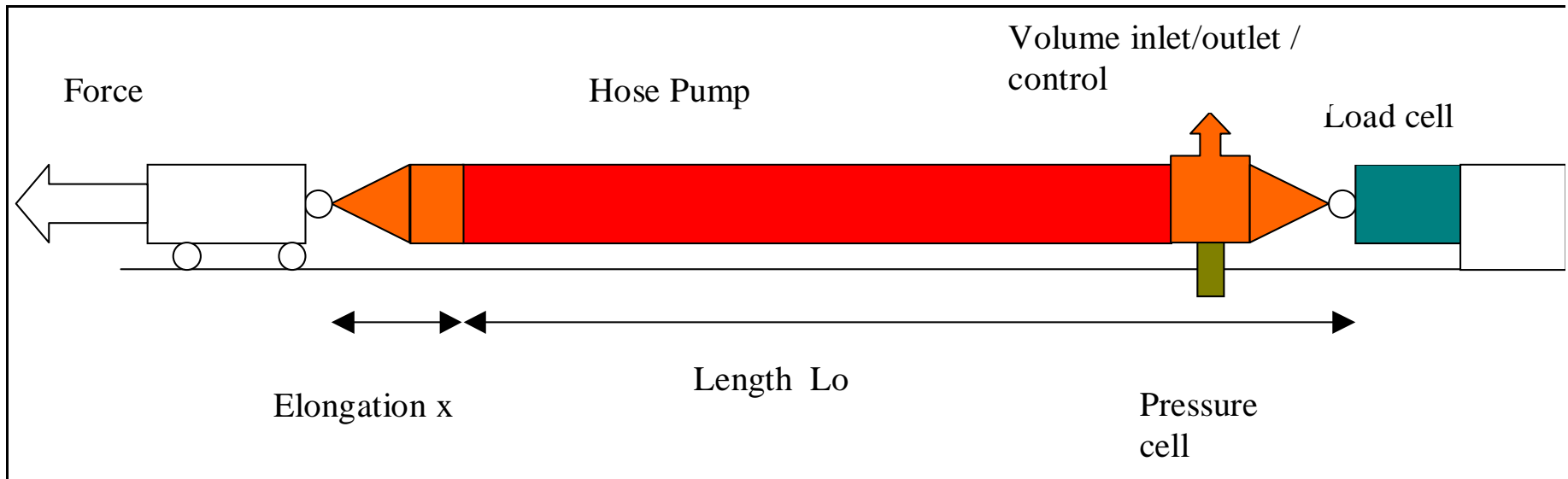


AquaBuOY – Process Flow





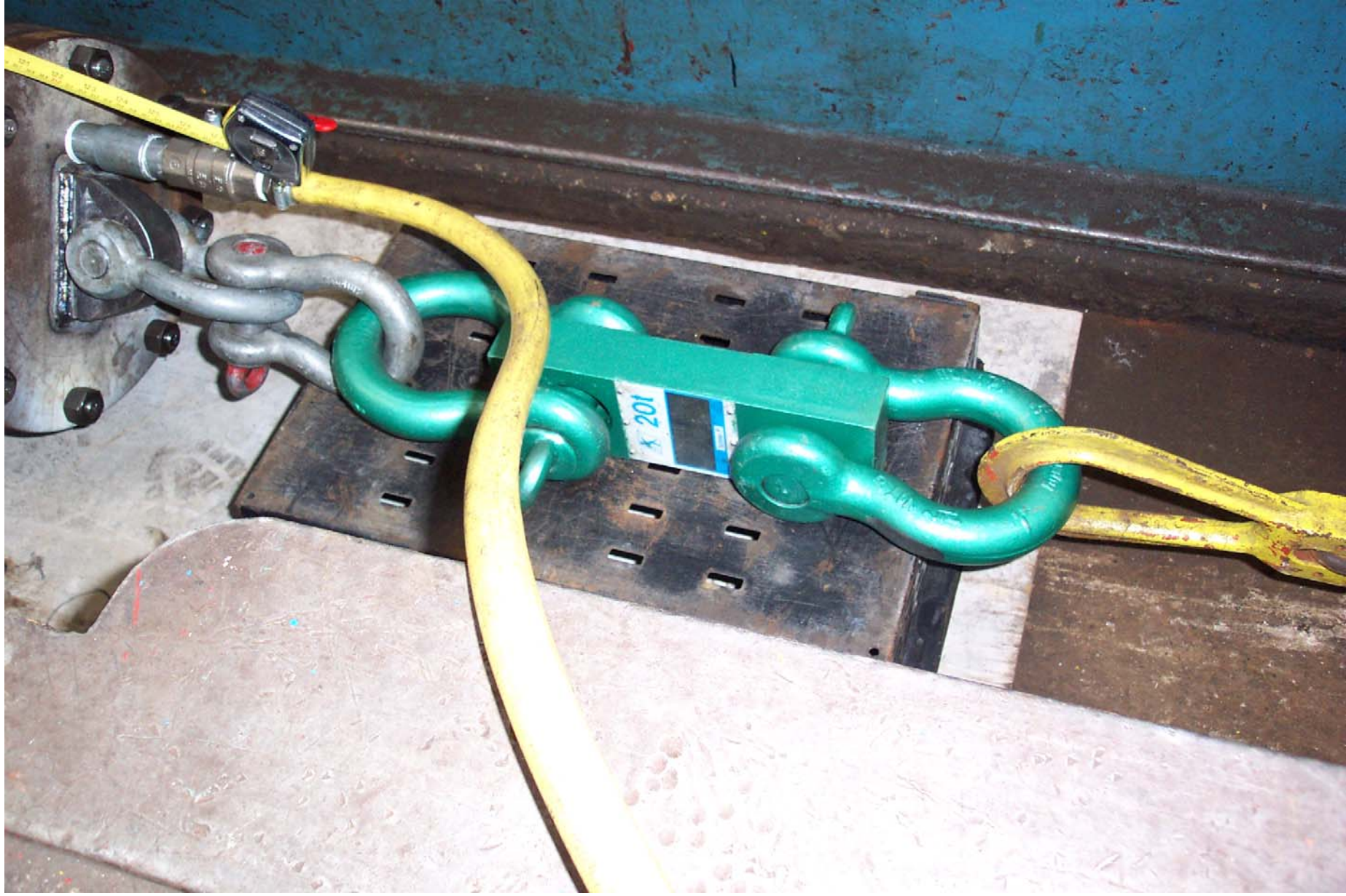
Quasi-Static Test Set-Up





H-P Test Sample





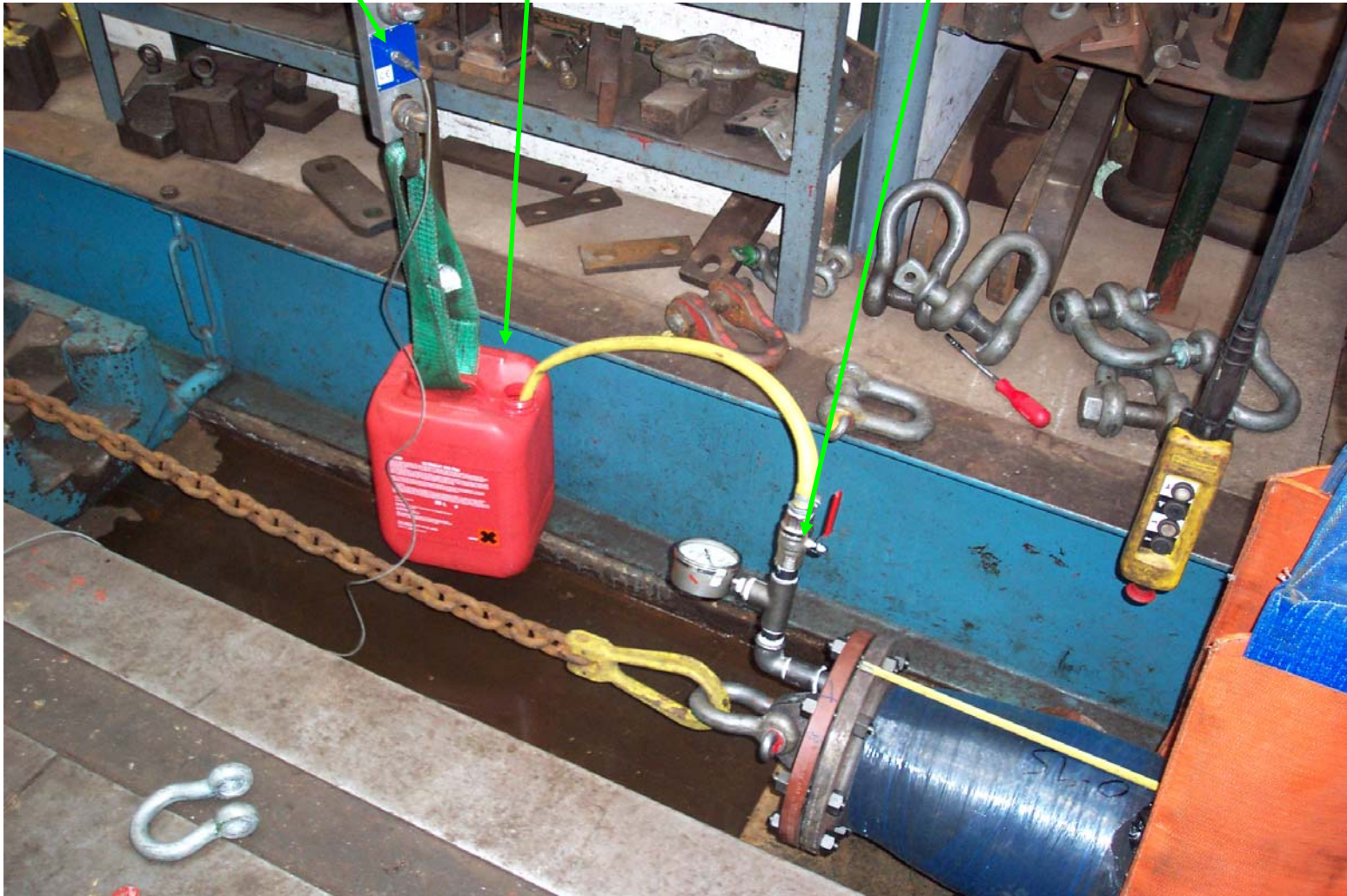


H-P Test Sample/ Test Set-Up

10 ton load

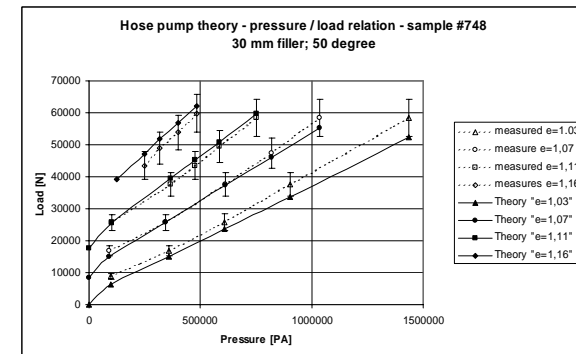
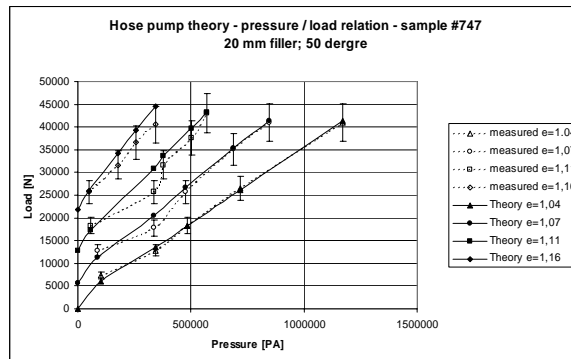
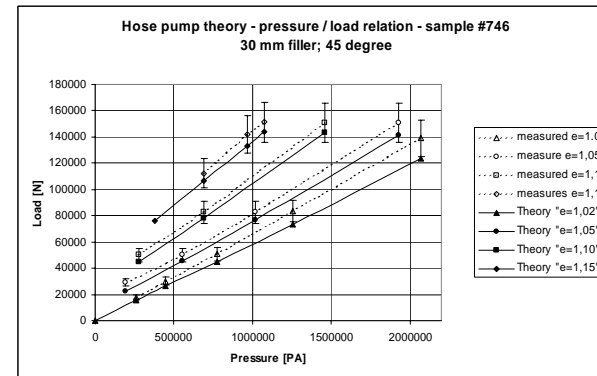
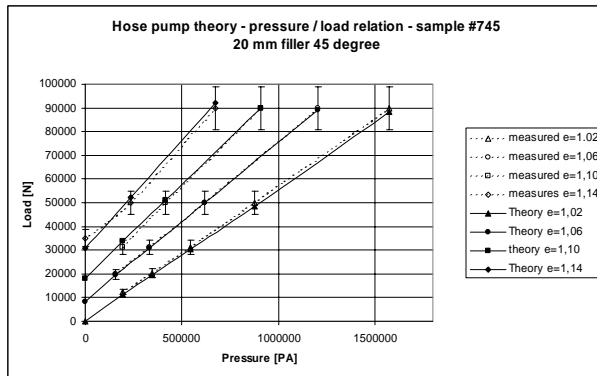
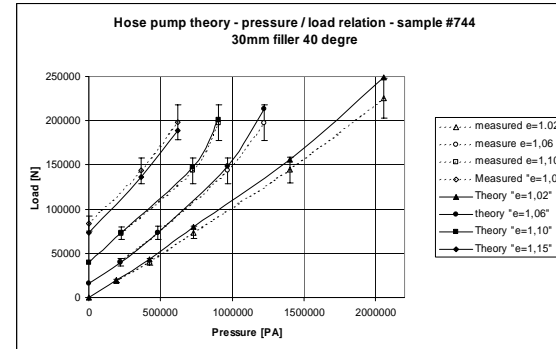
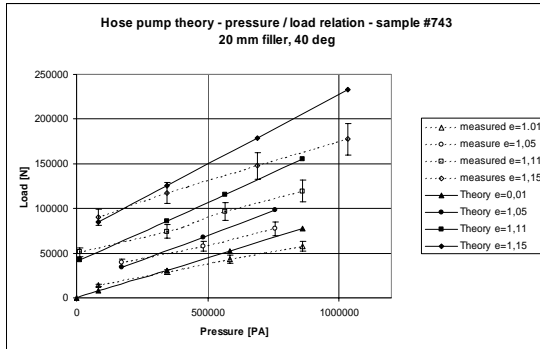
20 liter container

OUTPUT + VALVE & PRESSURE GAUGE



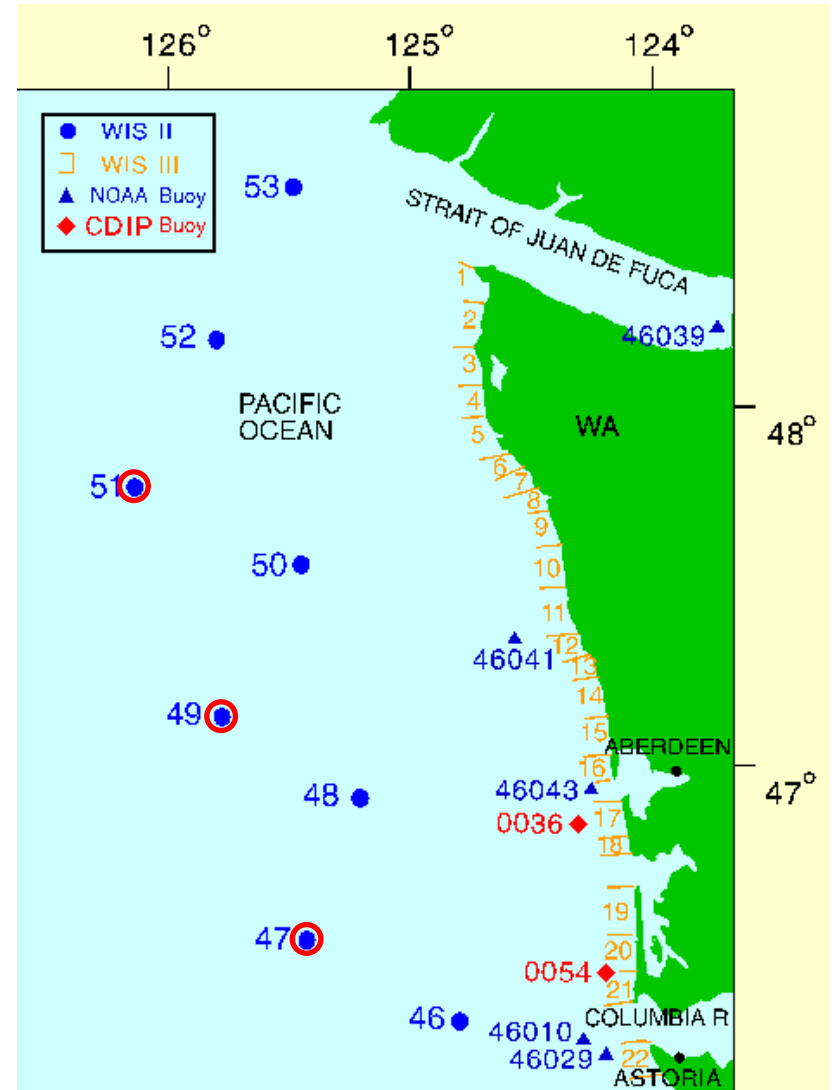
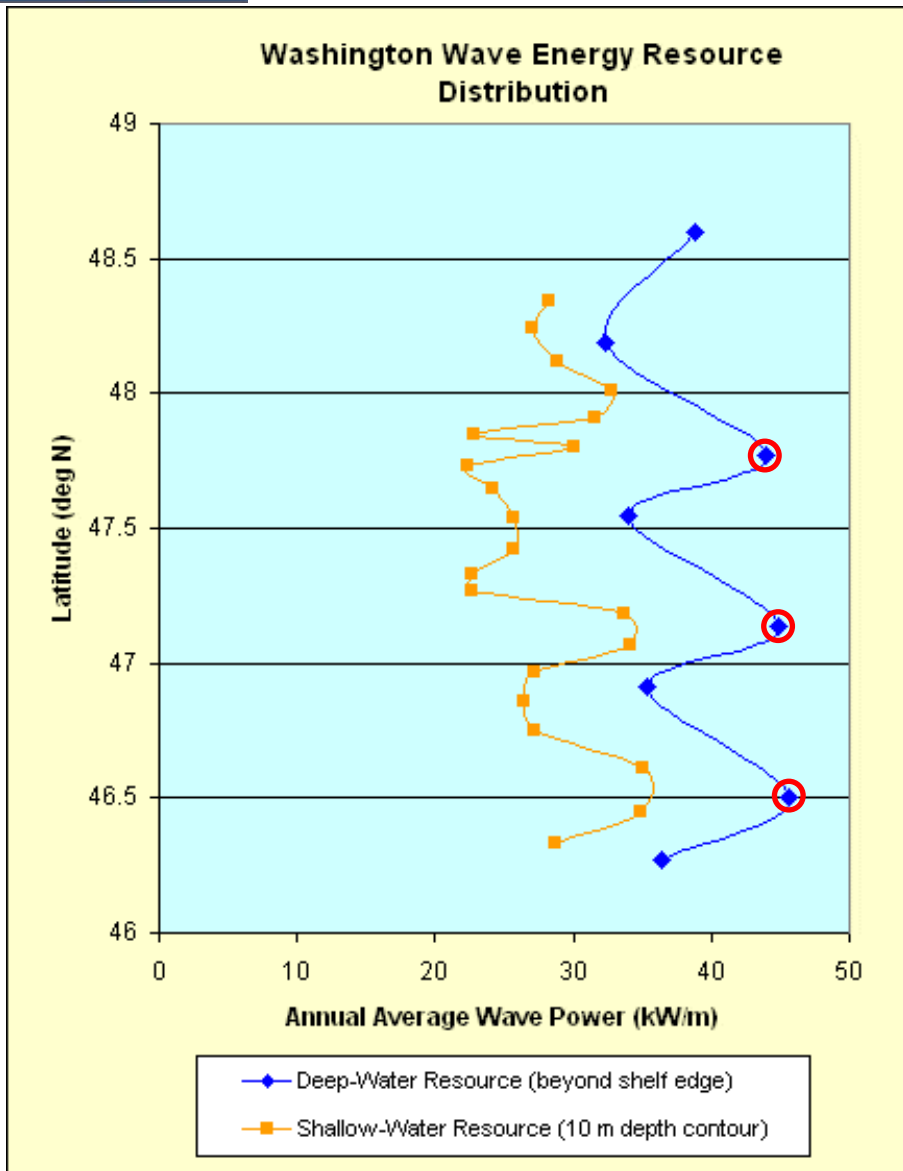


H-P Static Test Results





Offshore vs. Nearshore Wave Power



EPRI/E2I



Makah Bay Pilot Power Plant

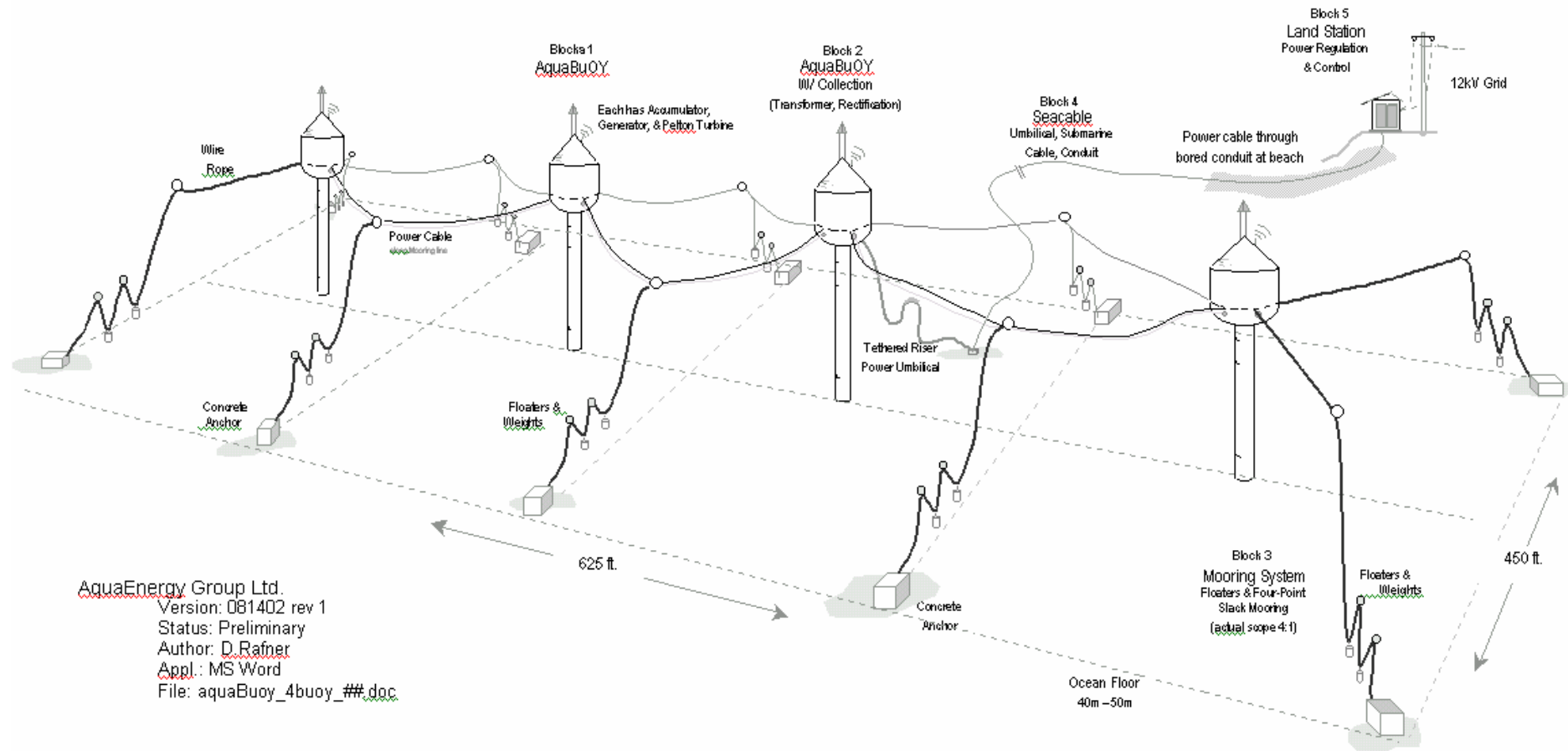




Makah Bay Plant Diagram

**Wave Energy Conversion (WEC) Buoy in
Multi-Buoy Configuration w/ Onboard
Turbine and Generator.**

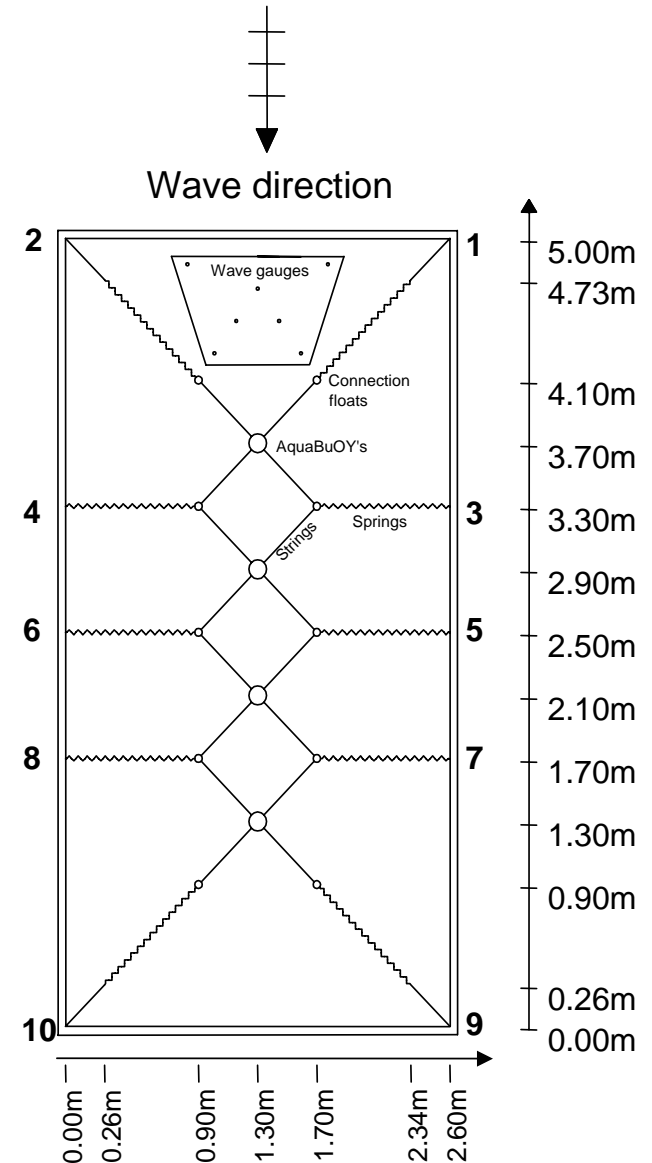
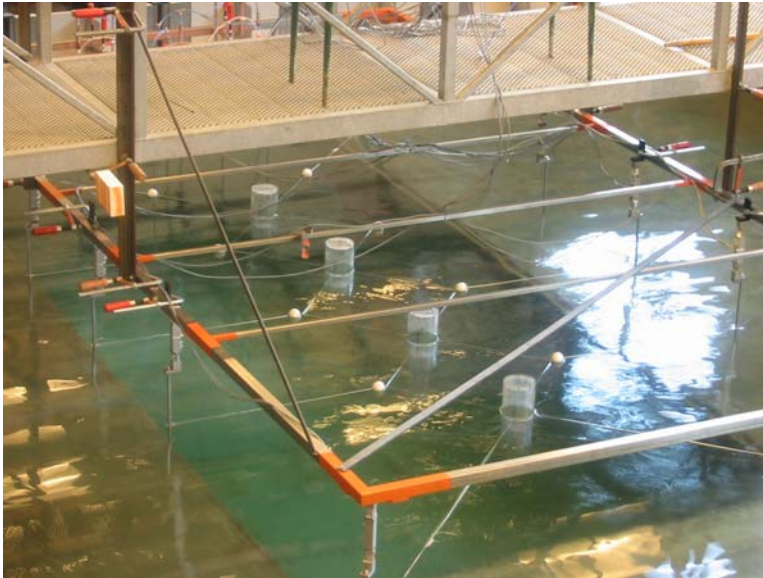
Dimensions and distances not to scale.
Refer to block descriptions for details.



AquaEnergy Group Ltd.
Version: 081402 rev 1
Status: Preliminary
Author: D.Rafner
App: MS Word
File: aquaBuoy_4buoy_###.doc



4 AquaBuOY Formation Testing





Projected performance – Makah Bay

| Frequency domain model of Average Power Absorption (kW_{fluid}) | | | | | | | | | | |
|---|----------|-----|-----|-----|-----|-----|-----|-----|-----|----|
| Hs (m) | Tp (sec) | | | | | | | | | |
| | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 17 |
| 5.5 | | | 250 | 250 | 250 | 250 | 250 | 211 | 172 | 92 |
| 5 | | | 250 | 250 | 250 | 250 | 214 | 175 | 142 | 77 |
| 4.5 | | | 223 | 250 | 239 | 208 | 173 | 142 | 115 | 62 |
| 4 | | 122 | 176 | 198 | 188 | 164 | 137 | 112 | 91 | 49 |
| 3.5 | | 93 | 135 | 152 | 144 | 126 | 105 | 86 | 70 | 38 |
| 3 | 54 | 68 | 99 | 111 | 106 | 92 | 77 | 63 | 51 | 27 |
| 2.5 | 37 | 47 | 69 | 77 | 73 | 64 | 54 | 43 | 36 | 19 |
| 2 | 24 | 30 | 44 | 49 | 47 | 41 | 34 | 28 | 23 | 12 |
| 1.5 | 13 | 17 | 25 | 27 | 26 | 23 | 19 | 15 | 12 | 7 |
| 1 | 6 | 8 | 11 | 12 | 11 | 10 | 8 | 7 | | |



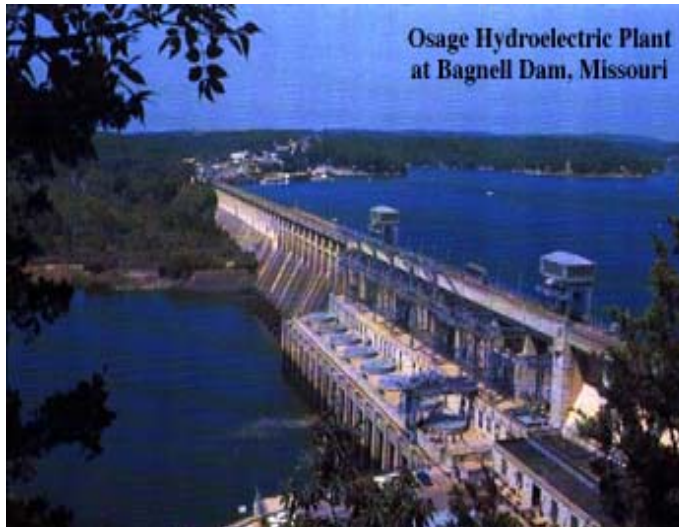
Makah Bay Plant - Characteristics

- **Each AquaBuOY**
 - Wave energy resource (yearly average) 33kW/m
 - Buoy diameter 6m
 - Nameplate capacity 250kW
 - Average power produced 63kW
 - Yearly energy produced ~540MWh
- **Makah Bay AquaBuOY Plant**
 - Number of AquaBuOYs 4
 - Yearly energy produced ~2200MWh

~ 220 households @ 10MWh yearly consumption



What's Wrong With This Picture?



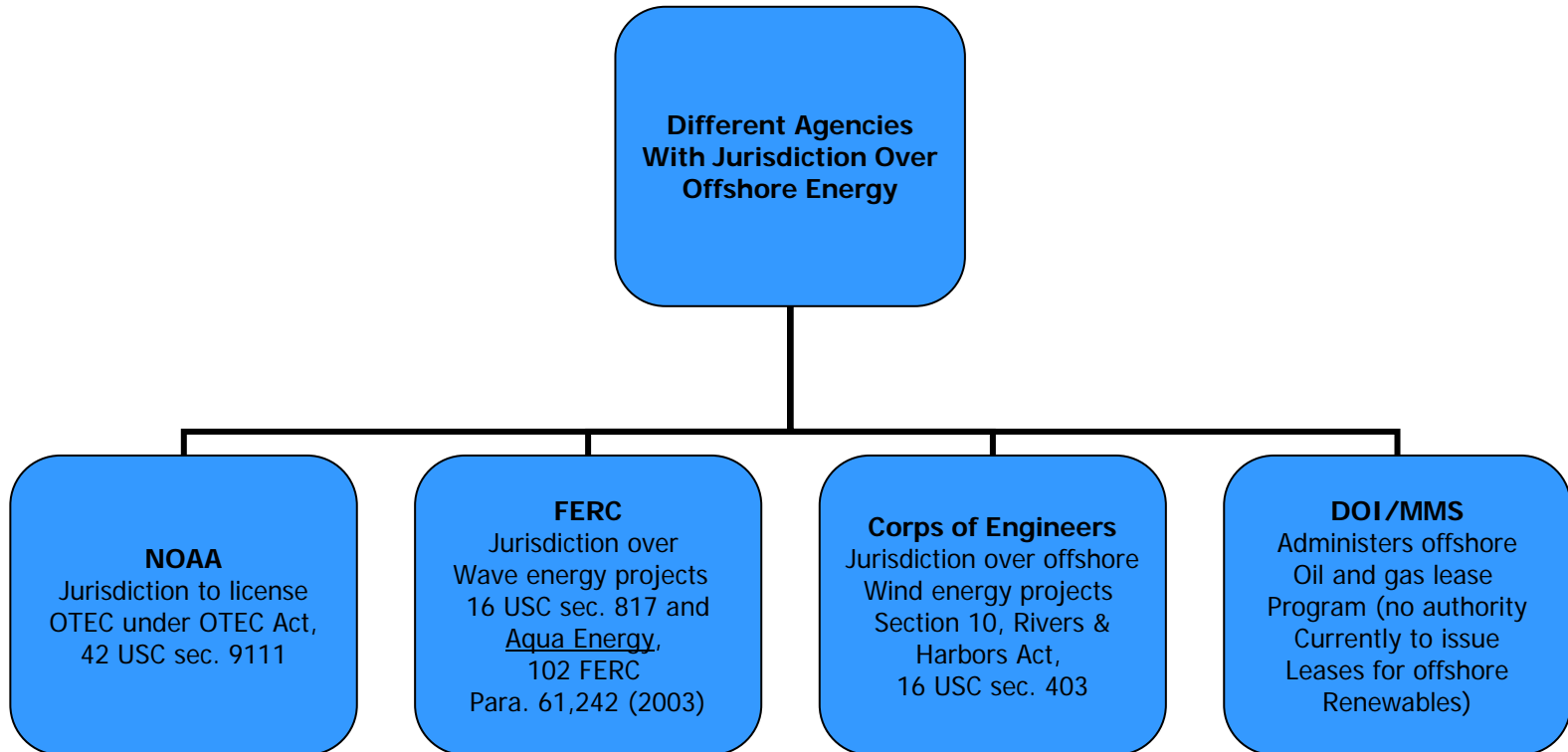


Regulatory Barriers in the US

- **Confusion and disparity as to applicable licensing agency**
- **No exemptions for pilots or prototypes**
- **No certainty as to property rights**
- **Lack of clarity on benefits available for ocean energy generation**



State of Disarray: Who is in Charge?





Required Permits

- | | |
|---|--|
| 1. FERC | 8. Makah Indian Nation |
| 2. U.S. Coast Guard | 9. Tribal Historical Preservation Office (THPO) |
| 3. U.S. Fish and Wildlife Service | 10. WA State Dep of Ecology |
| 4. U.S. Bureau of Indian Affairs | 11. WA State Office of Archeological and Historical Perspective |
| 5. NOAA/OCNMS | 12. WA State Dep of Fish and Wildlife |
| 6. USACE | 13. WA State Dep of Natural Resources (WDNR) |
| 7. National Marine Fisheries Service | |

Makah Bay Status: Preparing PEA



Conclusion - US Activities

- **Resource assessment / EPRI**
 - Complete
- **Regulatory overview / LOCE**
 - Complete
- **Ocean Energy Programs**
 - The National Energy Bill FINALLY includes OE as a renewable energy resource
 - DOE program can now be initiated
- **Progress Forward Requires**
 - Money
 - Money
 - Money



AquaEnergy Group Ltd.

