

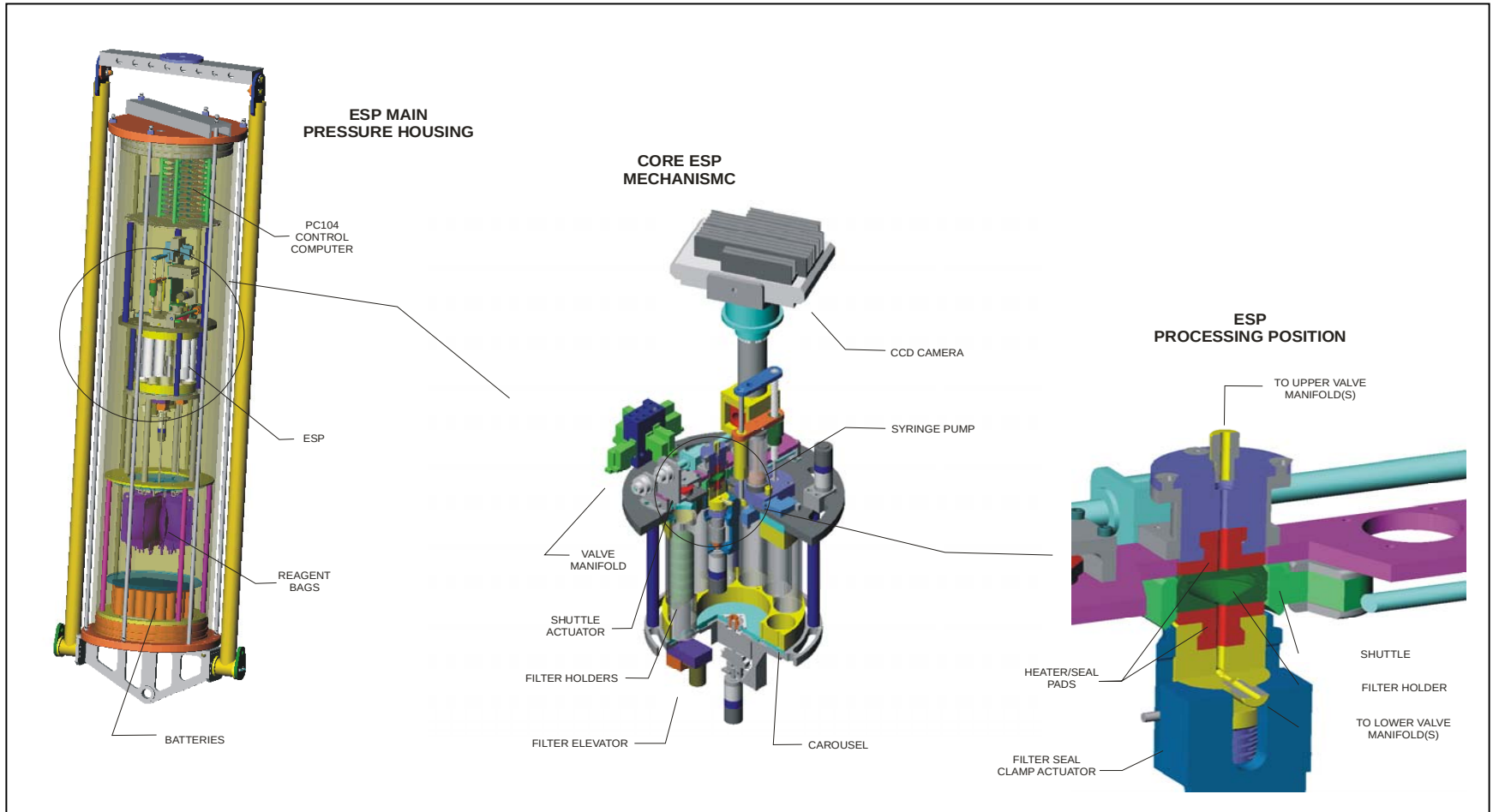
A Compliant Mooring for a non- Robust Wave Zone Instrument

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Monterey Bay Aquarium Research Institute

ONR/MTS Buoy Workshop
April 9-11, 2002
Seattle, Washington

THE INSTRUMENT

ENVIRONMENTAL SAMPLE PROCESSOR

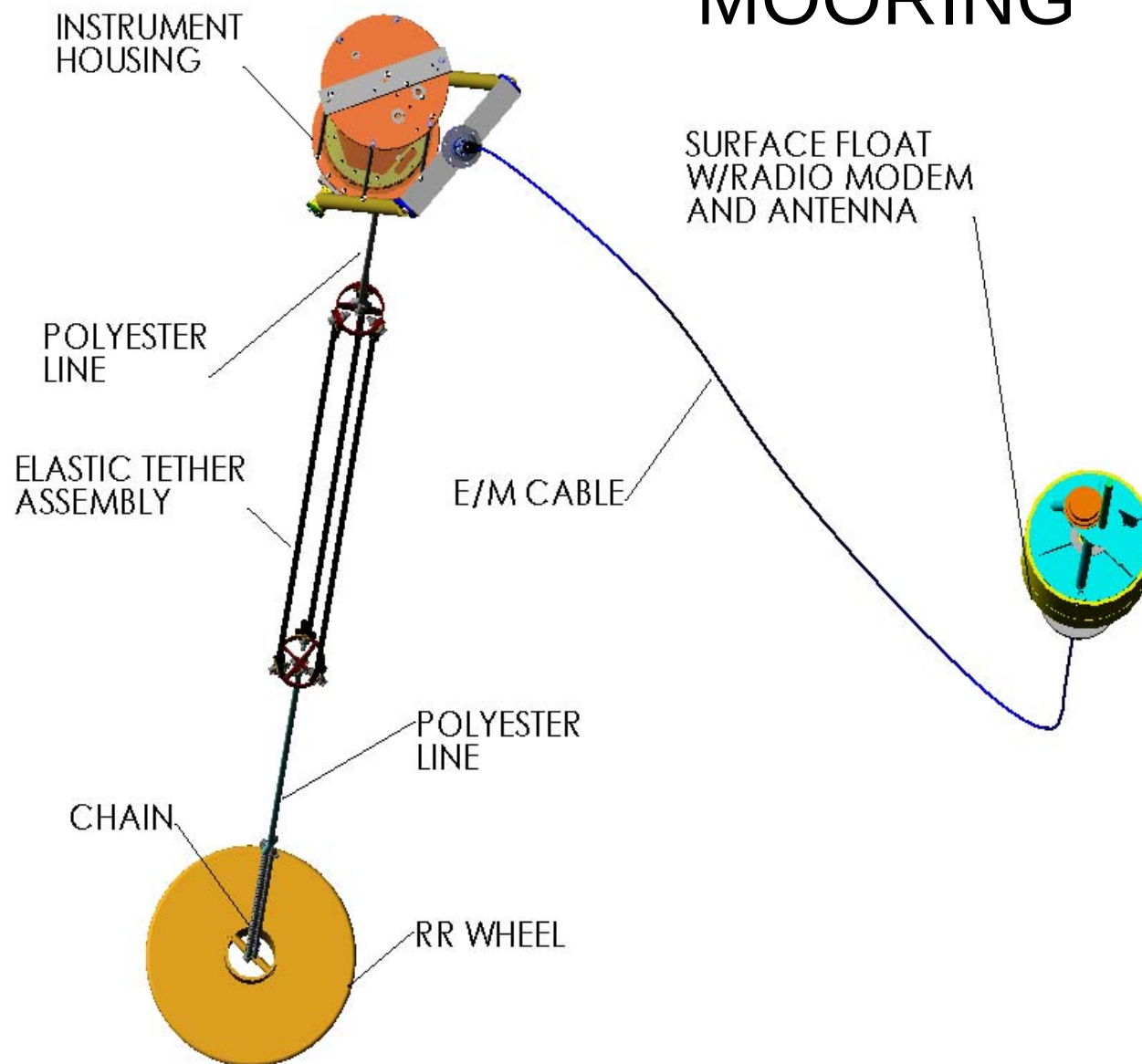


ESP MOORING FUNCTIONAL REQUIREMENTS

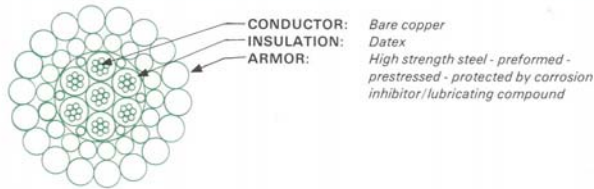
- SHALLOW WATER <35m
- DEPLOYMENTS UP TO 1 MONTH, 1 YEAR GOAL
- POSITION THE ESP 3-5m BELOW SURFACE AT LOW WATER
- SURFACE BUOY FOR TELEMETRY ANTENNA
- MINIMIZE SHOCK AND TILT
- DEPLOYABLE FROM A COASTAL RESEARCH VESSEL <15m e.g., Shana Rae, Asterias
- DIVER SUPPORT AVAILABLE IF NECESSARY
 - LIMITED TO 100 FEET

ENVIRONMENTAL SAMPLE PROCESSOR

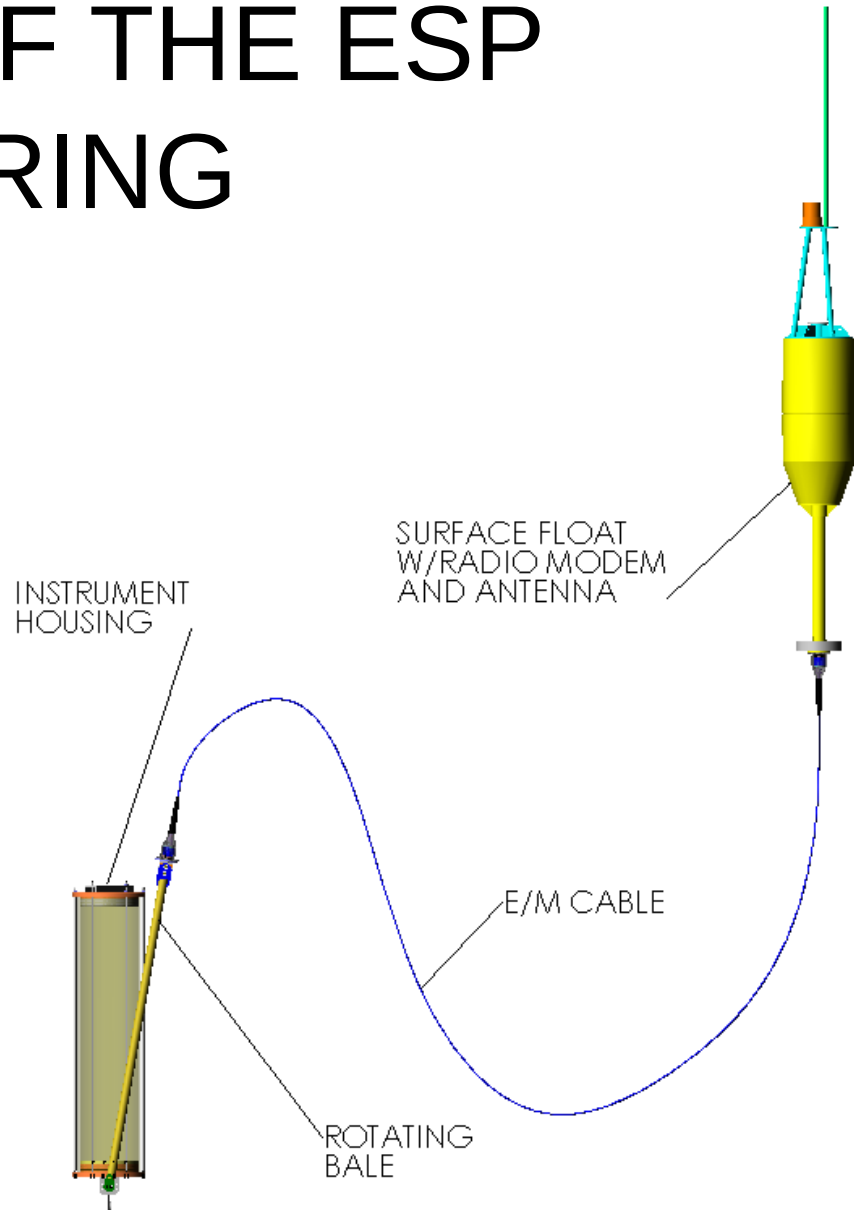
MOORING



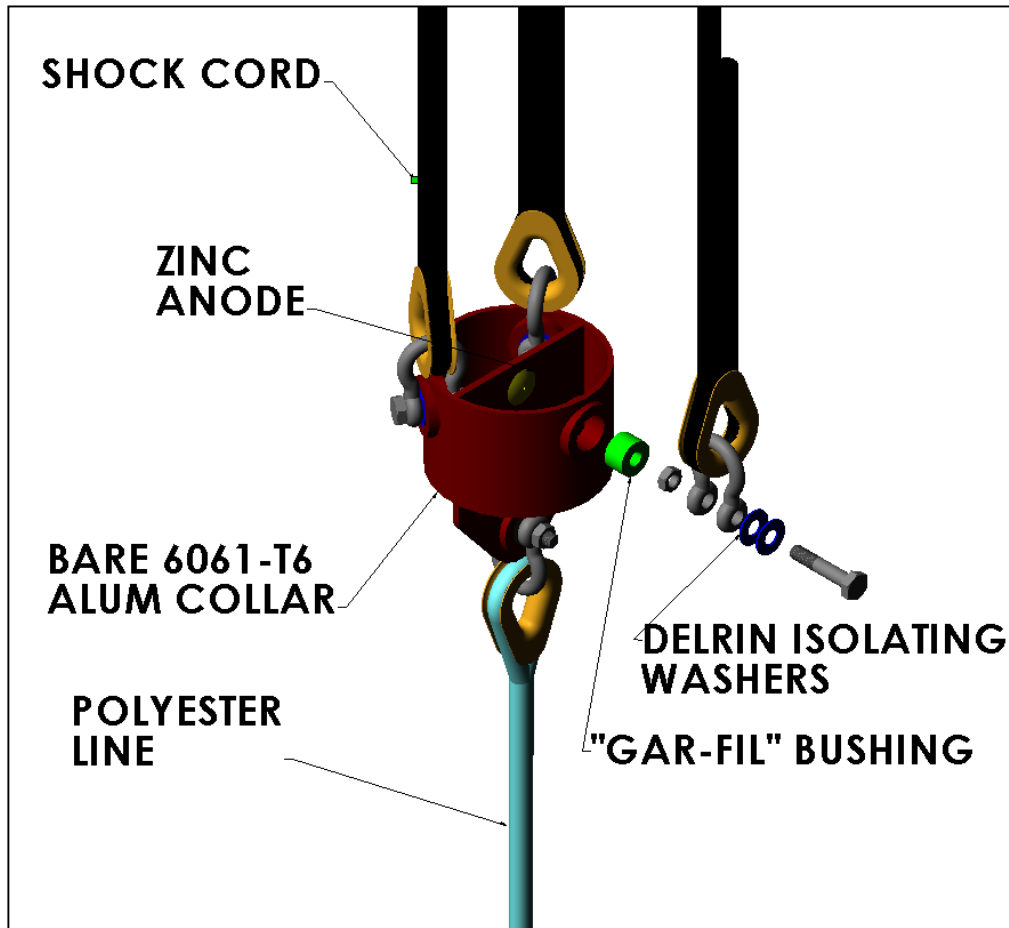
TOP END OF THE ESP MOORING



- E/M CABLE - 7X #20AWG, 71kN BS, 0.473 kg/m IN AIR, 0.281 kg/m IN WATER
- INSTRUMENT HOUSING – 1.5m HIGH, .33m OD
- SURFACE FLOAT - GILMAN SOFTLITE FOAM
 - 707 N/m³ (4.5 lbf/ft³)
 - 0.9m HIGH, 0.4m OD
 - GM = 0.4m
- ROTATING BALE ALLOWS INSTRUMENT HOUSING TO REMAIN VERTICAL REGARDLESS OF FLOAT WATCH CIRCLE

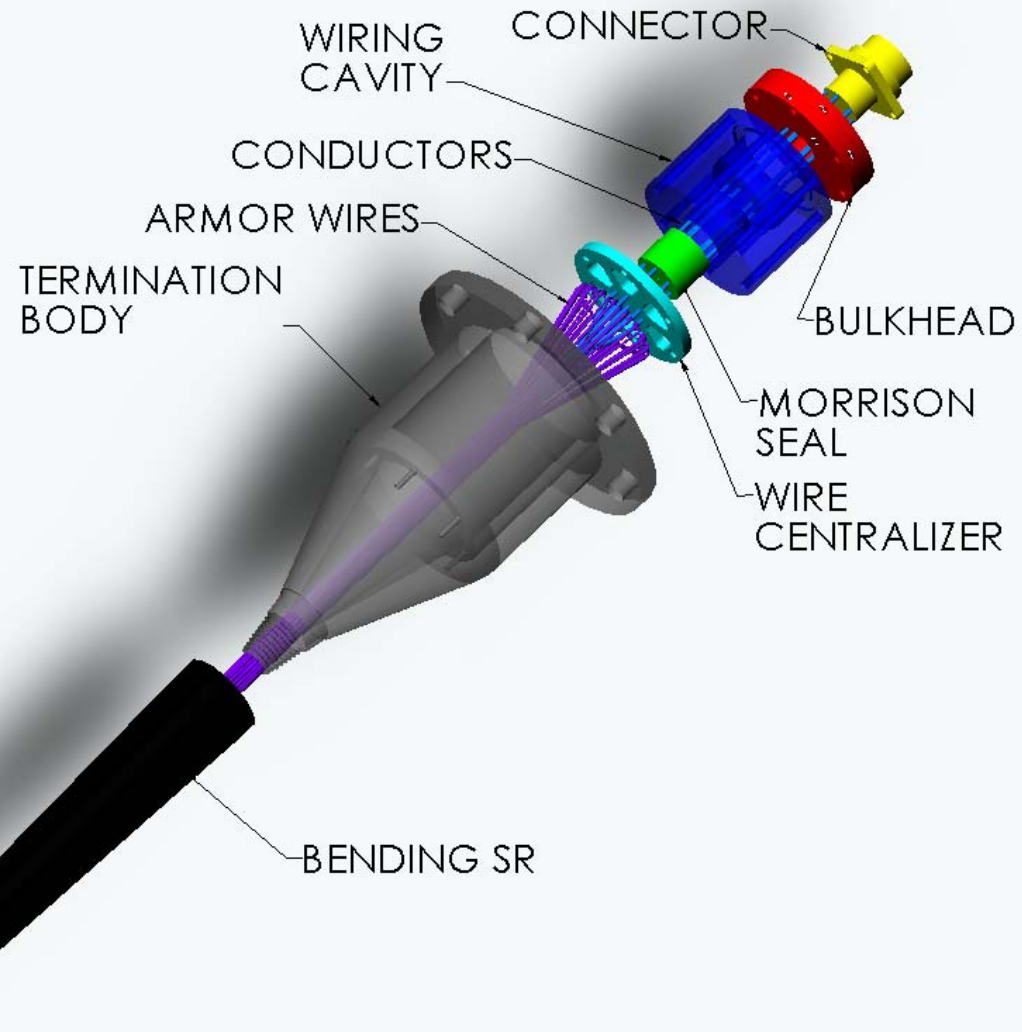


COMPLIANT TETHER ASSEMBLY

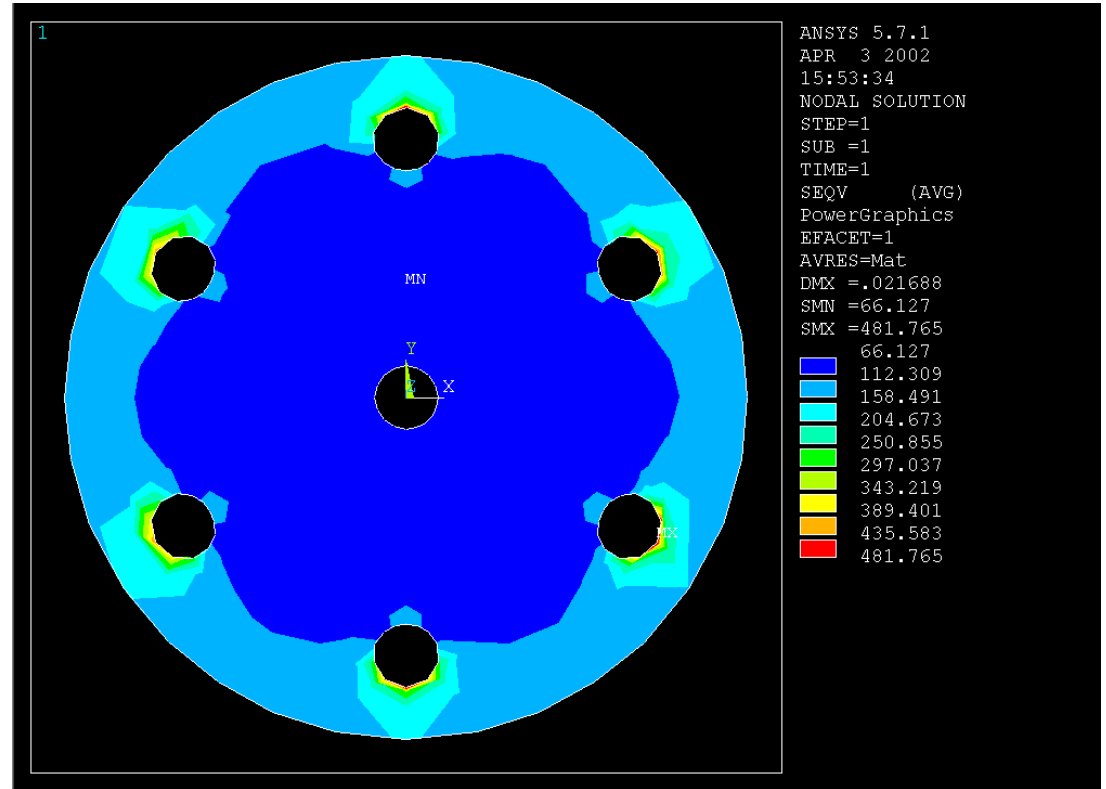
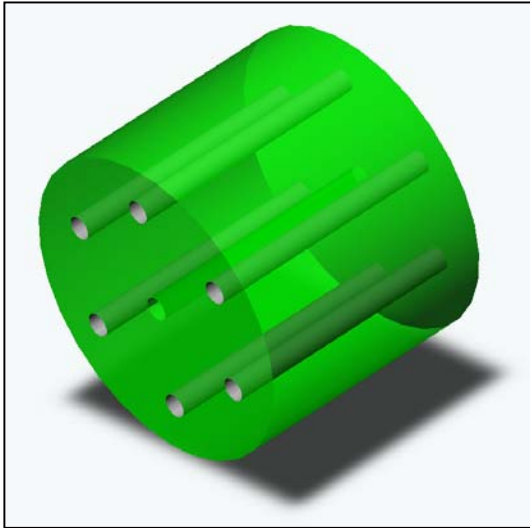


- 3X $\frac{3}{4}$ " DIA SHOCK CORDS
- AGG. SPRING RATE = 176 N/m (12.1 Lbf/ft)
- GAR-FIL BUSHING CAN SUPPORT STD $\frac{1}{4}$ " to $1\frac{1}{2}$ " SHACKLE LOADS

E/M CABLE TERMINATION

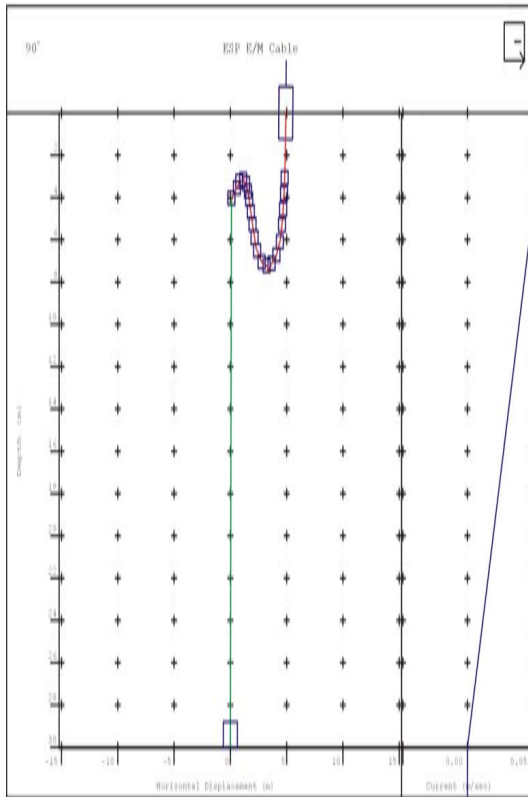


MORRISON SEAL DETAIL



- SEAL OD > BORE ID SEAL HOLE ID < WIRE OD
- SILICONE RUBBER WITH POISSON RATIO = .499
- INITIAL SQUEEZE IS MAINTAINED OVER AND ABOVE EXTERNAL PRESSURE

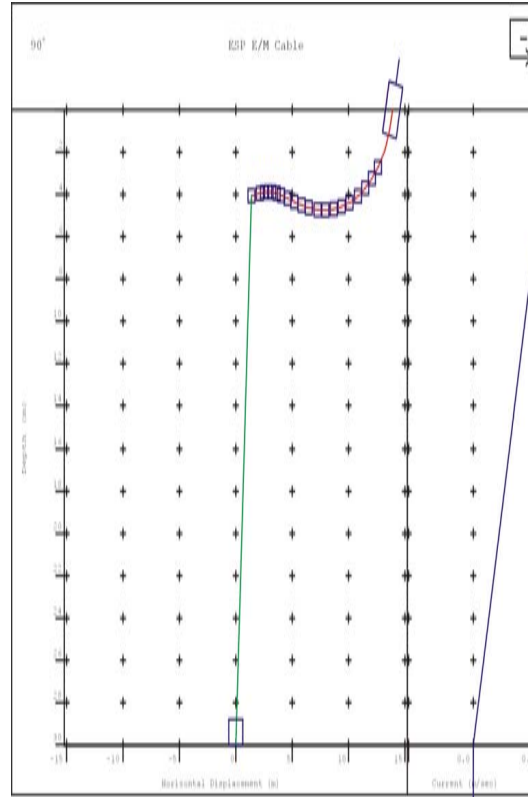
S-TETHER



0.05 m/s (0.1 kts)

2m vertical ticks

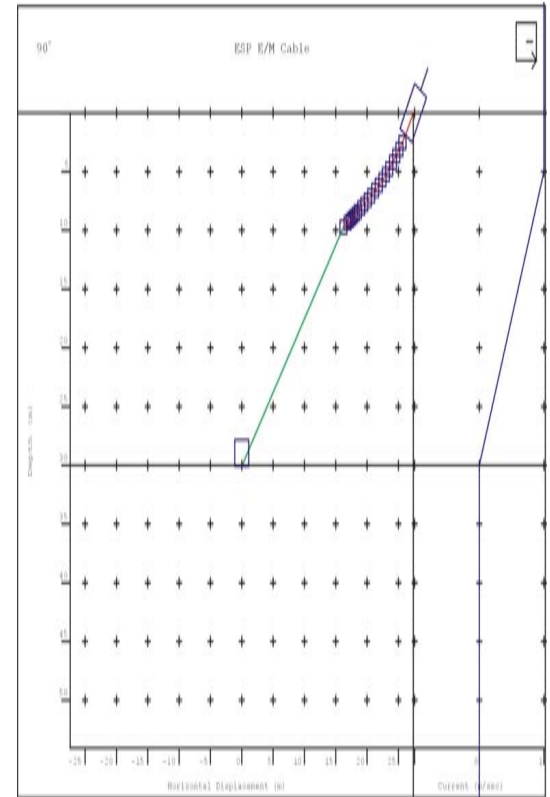
5m horizontal ticks



0.2 m/s (0.4 kts)

2m vertical ticks

5m horizontal ticks

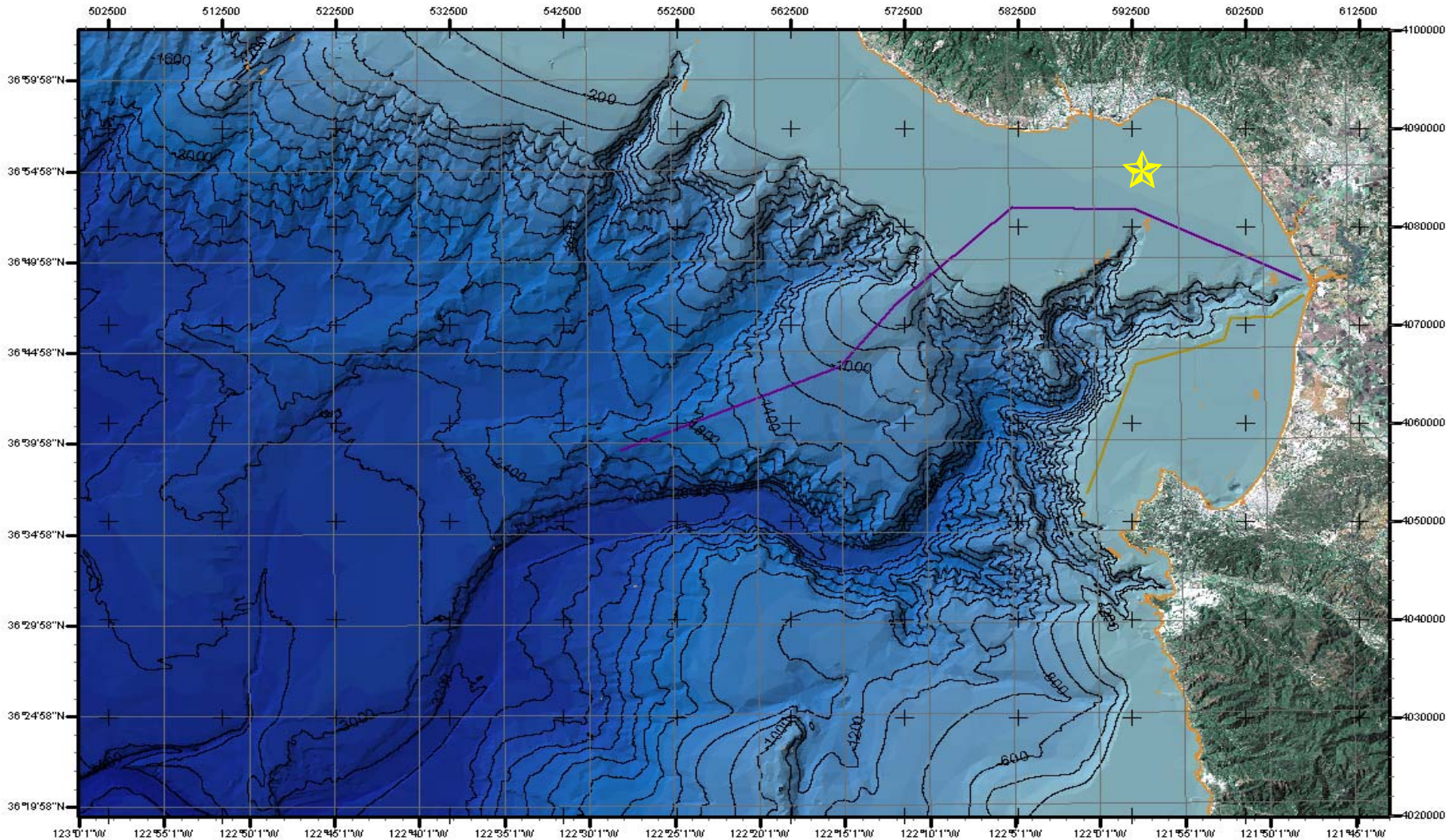


1.0 m/s (2 kts)

5m vertical ticks

5m horizontal ticks

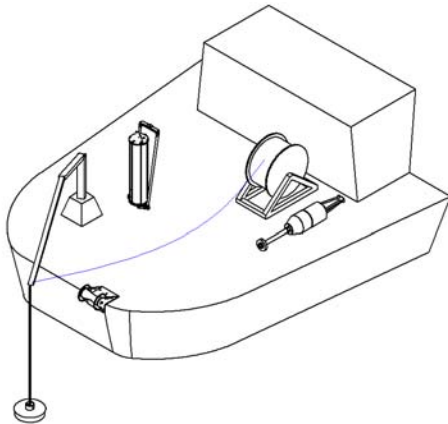
MONTEREY BAY DEPLOYMENTS



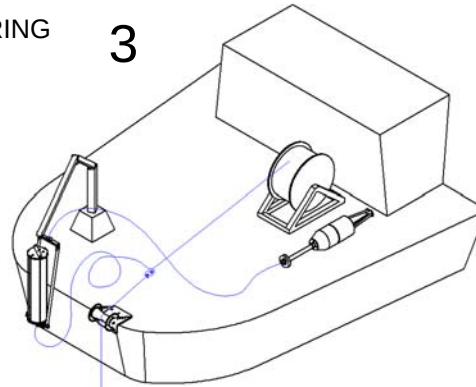
DEPLOYMENT SEQUENCE

- STAGE UPPER "HALF" OF MOORING (SHOCK CORD ASSY UP) IN BOX, SURFACE FLOAT IN CRADLE
- LOWER SECTION OF MOORING AND SEPARATE LOWERING LINE ON WINCH
- CRANE ANCHOR OVER THE SIDE ON CHAIN HOOK

1

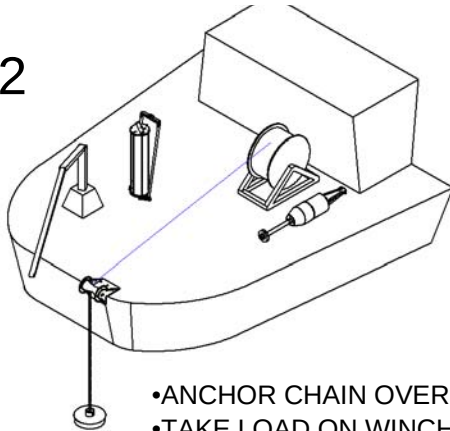


3



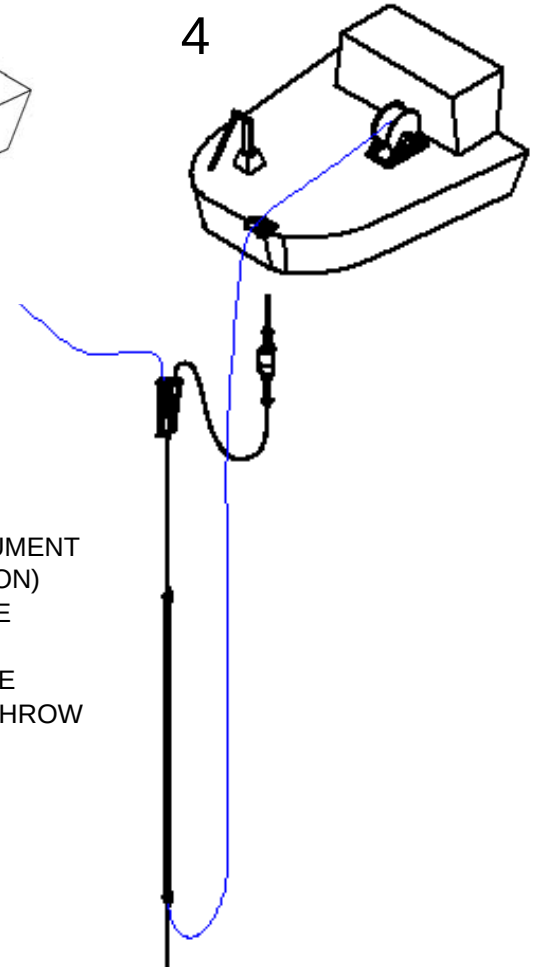
- LOWER MOORING STRING TO MASTER LINK BELOW SHOCK CORD ASSEMBLY
- ATTACH UPPER "HALF" OF MOORING
- POSITION VESSEL ~3 MINUTES UP DRIFT OF TARGET

2



- ANCHOR CHAIN OVER STERN ROLLER
- TAKE LOAD ON WINCH
- REMOVE CRANE CHAIN HOOK

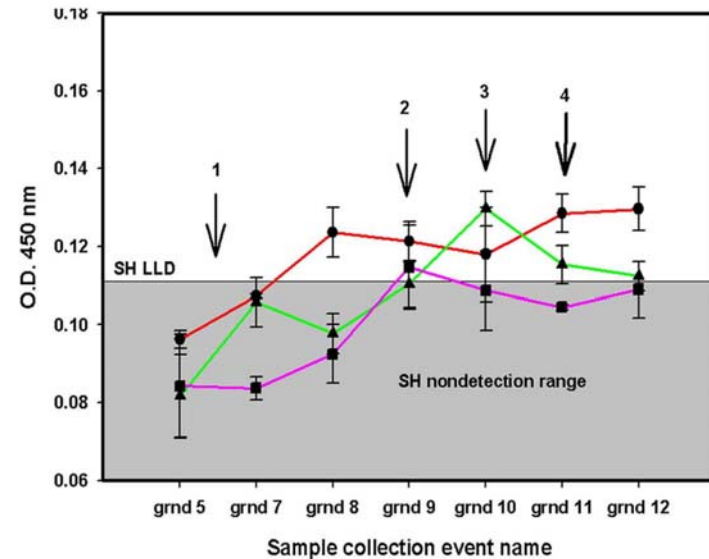
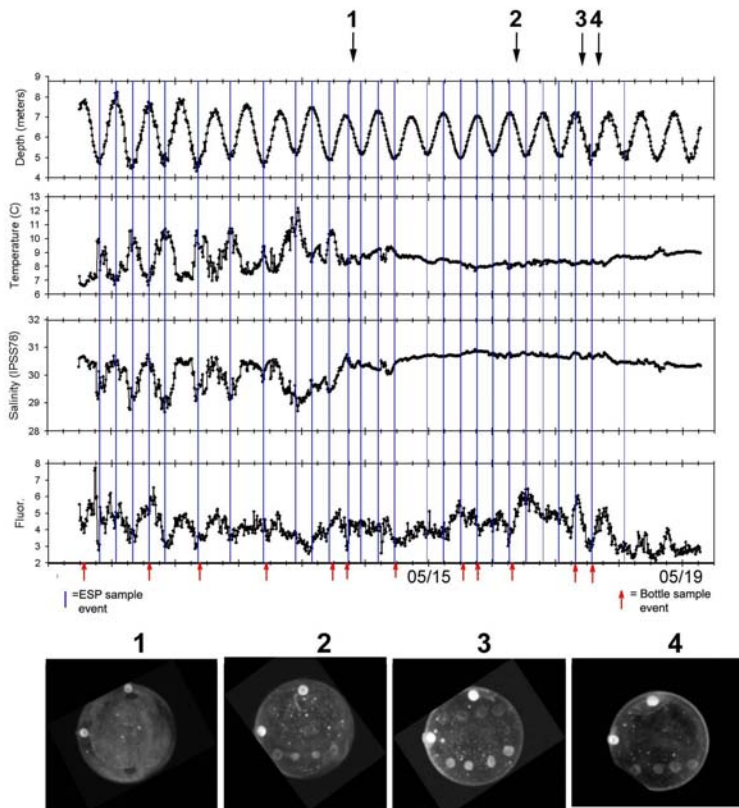
4



- LOWER ANCHOR TO BOTTOM AND INSTRUMENT INTO WATER (UNDER SHOCK CORD TENSION)
- THROW OFF INSTRUMENT LOWERING LINE
- HEAVE SURFACE FLOAT OVERBOARD
- STEAM AWAY PAYING OUT LOWERING LINE
- BUOY OFF END OF LOWERING LINE AND THROW OVERBOARD
- RECOVER LINES WITH DIVERS

INITIAL RESULTS

- 3 DEPLOYMENTS – 2 MONTEREY BAY (1 ENGINEERING TEST), 1 GULF OF MAINE AS PART OF ECOHAB
- ~2 WEEKS EACH

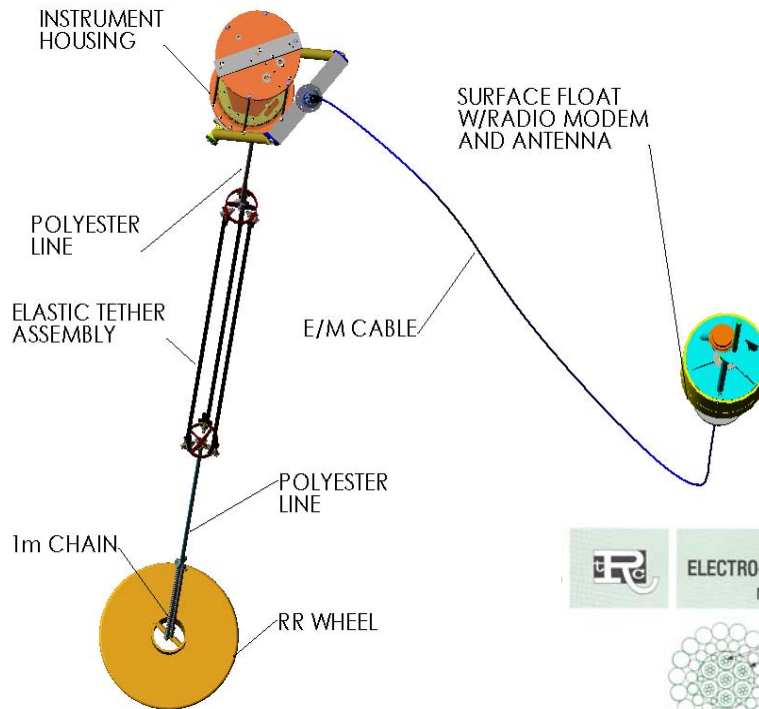


RED: ALEXANDRIUM tamarens

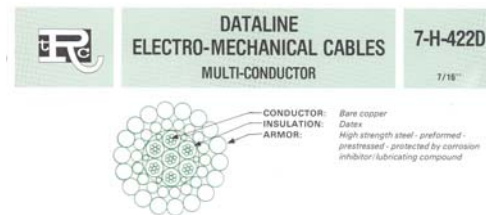
GREEN: PSEUDO-NITZSCHIA australis

PURPLE: P. multiseriis

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