BOS R2018A Concept Discussion

901704 NEXT GENERATION OBSERVATION PLATFORM

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Summary

- Discuss Functional Requirements
- Finalize Derived Requirements
  - System Performance
  - Telecommunication
  - Power
  - Operational
- Updated Trade Study

Functional Requirements

- Must be able to be deployed from ships of opportunity
- Must be a tethered system
- Must have a load bearing tether
- Must be able to launch and recovery quickly
- Must be able to operate in sea state two
- Must be able to land on rocky habitats with as little impact as possible
- Must be able to stay on bottom for five minutes
- Must be able to hopscotch (be towed) between sites during each dive
- Must have swappable bases for multiple sea floor types

Functional Requirements

- Must be able to record stereoscopic video in (near) 360 degrees
- Must have the ability to remotely control iris/ISO of the cameras
- Must provide adequate lighting for all cameras
- Must have the ability to add in contextual sensors
- Must be able to attach transponder onto lander
- Must have a downward looking camera to assist with positioning
- Must provide downward video and lander depth to bridge and winch operator
- Must be able to provide live video topside
- Must be able to record topside
- Must provide synchronization between the multiple cameras
- Must combine meta-data (telemetry) into one file for each recording session
- Altimeter sensor for safe approach operations

Telemetry Requirements

- Integral sensors: lander depth and lander directional orientation
  - Lander pitch and roll are nice to haves
- Connections for up to 4 additional sensors
  - Power: 12Vdc
  - Comms: Serial
- Sensor data viewable in real time topside
- Live video from all 9 cameras available in real time topside
  - Recording performed topside
  - Downward looking camera available to bridge and winch operator
  - Primary reason for move to fiber, as 8 HD streams are ~11.6Gbps

Power Requirements

- Using 480VAC for power transmission down tether
  - 1:4 topside transformer from shipboard 110VAC
- Maximum power draw for lander no more than 1300 watts
  - 1300 watts -> 11 amps topside 110VAC
  - Worst case lights: 215 watts each (x5)
  - Nominal draw probably around 900 watts
- Subsea AC:DC converters
- Define acceptable power/voltage loss in tether
  - 4:1 subsea transformer; <10 volt loss on 110VAC subsea line
- Cross sectional area of Copper vs power loss vs overall tether diameter
  - Minimum Cu: 16AWG: 1 pair, 18/20AWG: 2 pair, 22AWG: 3 pair

Tether Electrical Requirements

- 16AWG Cu minimum requirement for single pair.

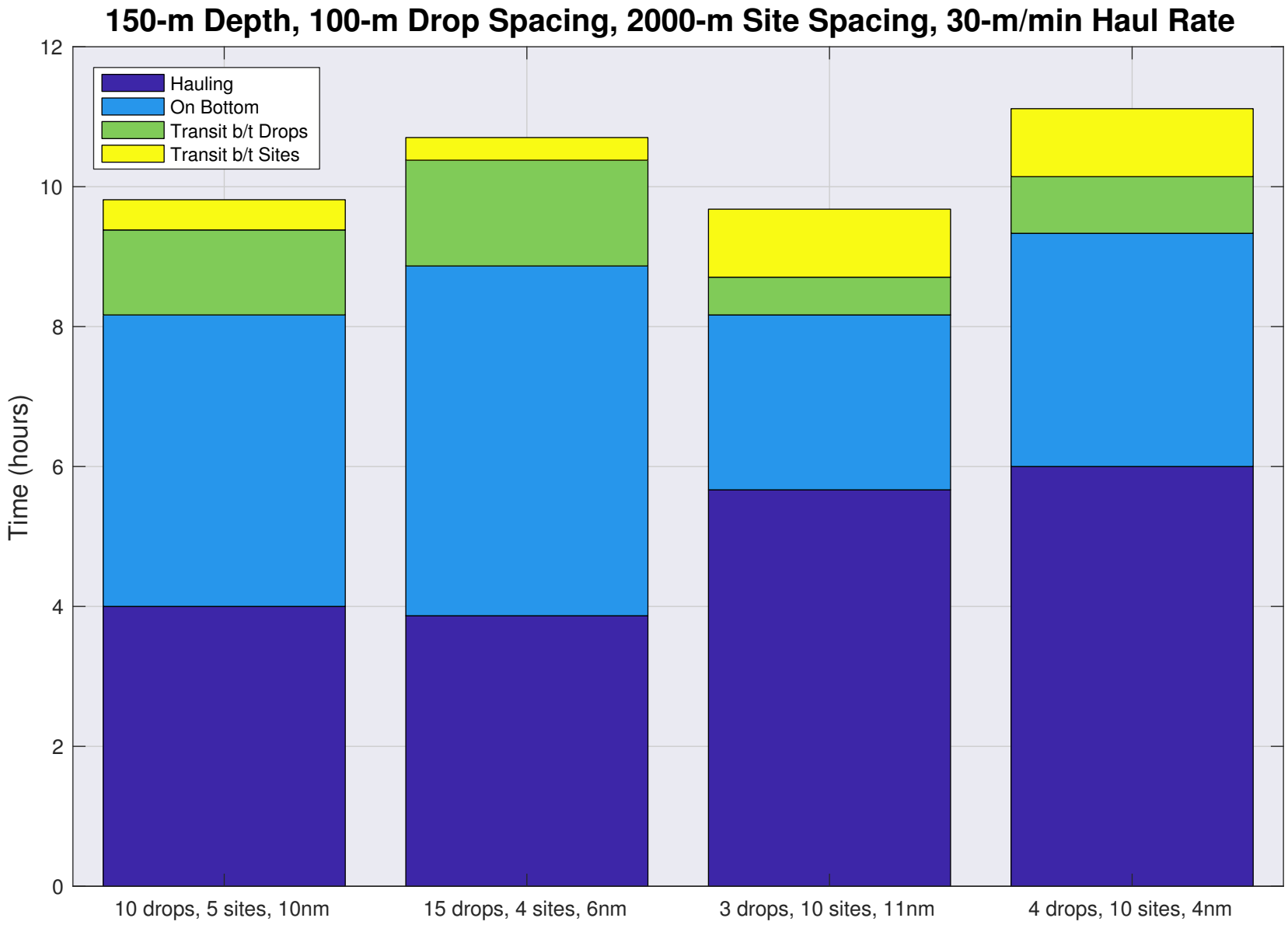
Copper Losses

Wire Gauge	Pairs	Total Area (in^2)	Max Loss (W) (@ 1300W)	480V V Drop (Volts)	120V V Drop (Volts)
22	1	0.001006	323	119	29.75
22	2	0.002012	162	60	15
22	3	0.003018	108	40	10
22	4	0.004024	81	30	7.5
20	1	0.001608	202	75	18.75
20	2	0.003216	101	37	9.25
20	3	0.004824	67	25	6.25
20	4	0.006432	51	19	4.75
18	1	0.002560	127	47	11.75
18	2	0.005120	64	23	5.75
18	3	0.007680	42	16	4
18	4	0.010240	31	12	3
16	1	0.004060	80	29	7.25
16	2	0.008120	40	15	3.75
16	3	0.012180	27	10	2.5
16	4	0.016240	20	7	1.75

* Calculated using a length of 400 meters

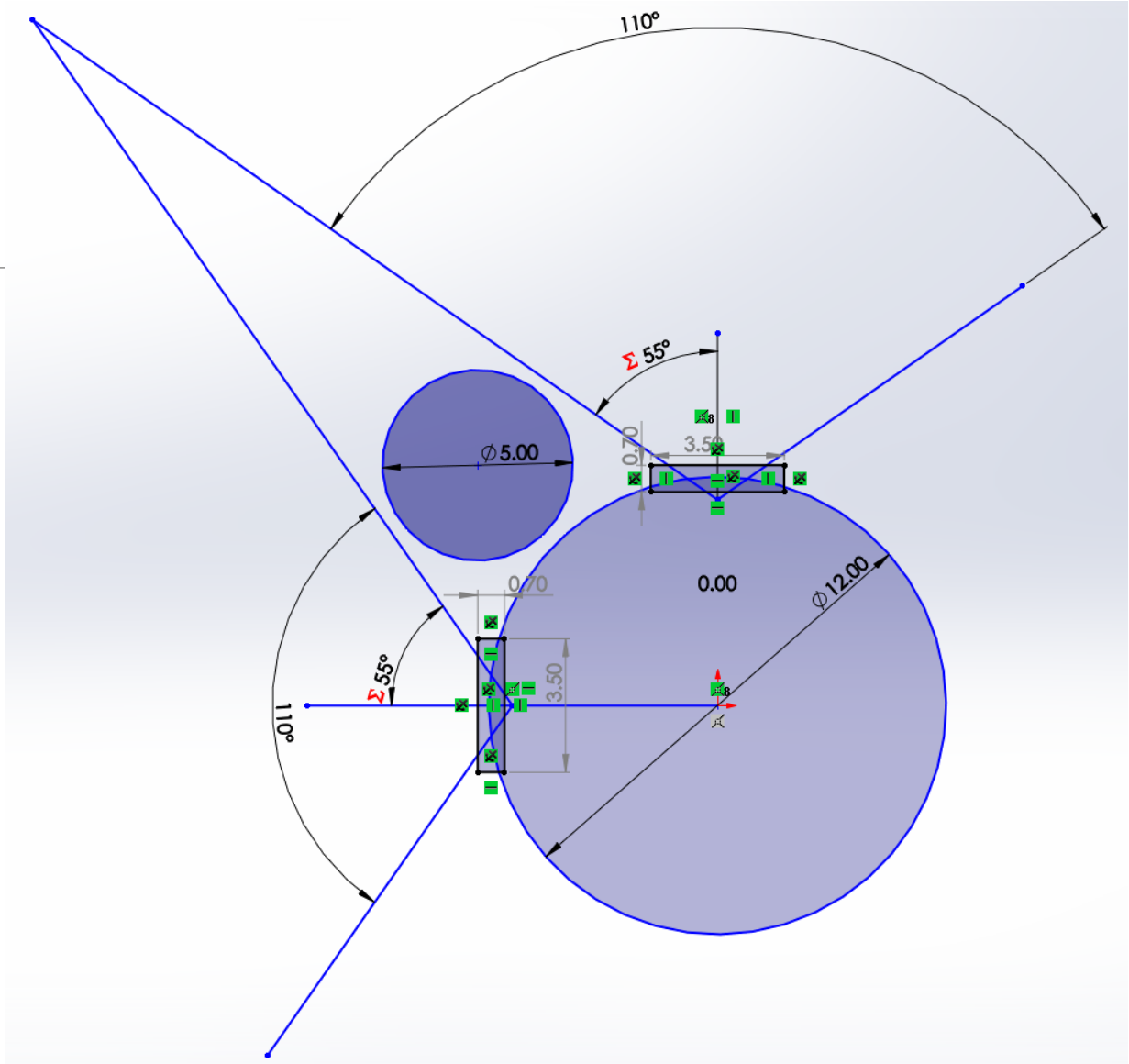
Operational Requirements

- Operate in 6-8 Foot Seas (SS2), 15 knots wind.
- Conduct Surveys with 10-15 *drops* per *site* without bringing the BOS onboard.
- A 12 hour day should achieve 5-10 *sites*
- No more than 5-minutes per *drop*.
- This leads to a requirement for how fast we can tow and how fast we can haul.
- Haul Speed directly affects the specification of any winch/lifting system power rating.


150-m Depth, 100-m Drop Spacing, 2000-m Site Spacing, 30-m/min Haul Rate
Hauling
On Bottom
Transit b/t Drops
Transit b/t Sites
Time (hours)
0
2
4
6
8
10
12
10 drops, 5 sites, 10nm
15 drops, 4 sites, 6nm
3 drops, 10 sites, 11nm
4 drops, 10 sites, 4nm

Payload

- Room for some as shown
- Will still need handles in 2 of the 4 sectors
- Displacement of 2 filled sectors ~40 lbs
- Best to remove lead for weight added.



Top Down View BOS Main Housing

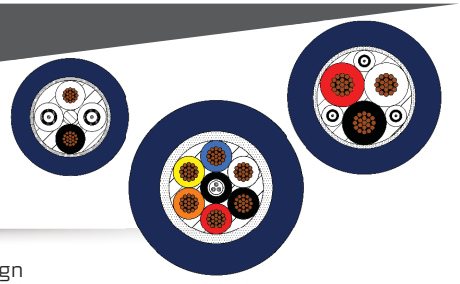
Tether Strength Selection

- Max Design weight is 350-lbs
- Working from existing design and adding a ~40-lbs payload margin, the tether will have a minimum working load of 530-lbf (SF 1.5) and a minimum breaking load of 2,700-lbf (SF 5xSWL).
- Towing of the system should not exceed 5-knots.
- At speeds greater than 2.5-knots, tow forces may begin to exceed the static lifting requirements of the system.

Potential Tether

FM021814-2

- Doubled NBL (2,800-lbs) brings diameter to 0.394-in
- Min Bend Radius 6-in
- $4,880.00 for 400-m
- Meets All Requirements



Xtreme-Marine® EO

Subsea Electro Fiber-Optic Cables

Application

Falmat's subsea fiber + power cable designs can be used for a multitude of underwater applications from shallow, rugged shorelines to deepwater installations (to depths of 6km). A sample offering of our more common designs below can also be modified with additional fibers, larger conductors, higher voltage, increased workloads or addition of steel armoring.

Design

Tried and proven materials are carefully chosen for long-term exposure and submergence in marine environments of sea or fresh water, polar to tropical, fully water-blocked with pressure resistant designs to 6km depths.

Cable Properties

Fiber Optics:	Single-mode type SMF28E 9/125 micron, multi-mode 62.5/125 micron and 50/125 micron. Fiber components: Xtreme-Light® PUR Simplex fiber, Xtreme-Light® PUR Multi-fiber (3, 4 or 6 fibers) or stainless steel tube (3 to 72 fibers).
Conductors:	Insulated with premium copolymer insulation with excellent long-term moisture resistance. -20C to 90C, 600VDC typical with 1kv, 1.5kv, 3kv, 4.5kv to 3.5kb also available. Higher temperature insulations are offered at 105C, 125C, 150C, 200C
Strength Members:	Synthetic fibers of Kevlar® or Vectran® in braid or torque-balance served layers. Typical BS values for marine instrumentation as listed. Higher strength designs up to 36k lbs can be ordered. Steel armor, GIPS dual-serve can also be added.
Jackets:	Xtreme-Marine® grade Polyurethane 90C is standard. Other available jackets of HDPE, light-weight TPE, foam jackets for buoyancy. Also available: High temperature jackets 105C, 125C, 150C, 200C

PART NUMBER	FIBER OPTIC	POWER COND.	VDC	STRENGTH (LBS.)	WALL	DIA.
FM021814-1	2x SMF Xtremelight	2x 18AWG	2.0 kv	1,400	0.055	0.360
FM021814-2	2x SMF Xtremelight	2x 16AWG	1.0 kv	1,400	0.065	0.380
FM021814-3	2x SMF Xtremelight	2x 14AWG	600 v	2,700	0.065	0.392
FM021814-4	3x SMF Xtremelight	3x 12AWG	4.0 kv	2,700	0.075	0.625
FM021814-5	3x SMF Xtremelight	3x 10AWG	3.6 kv	2,700	0.090	0.655
FM021814-6	3x SMF Xtremelight	3x 8AWG	3.6 kv	4,000	0.090	0.670
FM021814-7	3x SMF SS-Tube Core	6x 22AWG	600 v	2,700	0.052	0.292
FM021814-8	3x SMF SS-Tube Core	6x 20AWG	300 v	2,700	0.070	0.332
FM021814-9	3x SMF SS-Tube Core	6x 18AWG	1.0 kv	4,000	0.080	0.455
FM021814-10	3x SMF SS-Tube Core	6x 16AWG	1.0 kv	4,000	0.090	0.475

Rev. 04.18.17

* This preliminary product data release is under engineering review and values are subject to change before official release.

FALMAT CUSTOM CABLE TECHNOLOGIES
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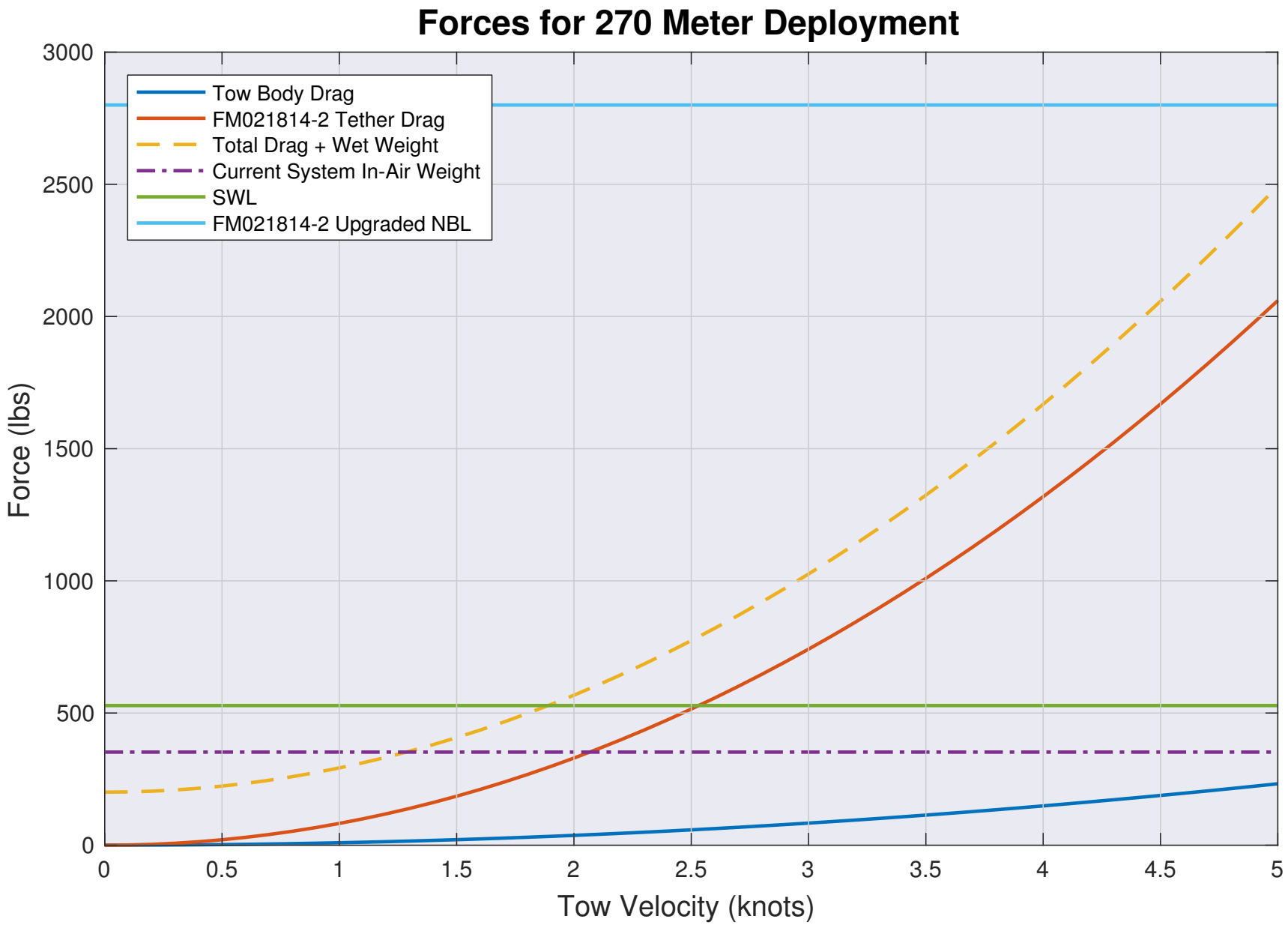
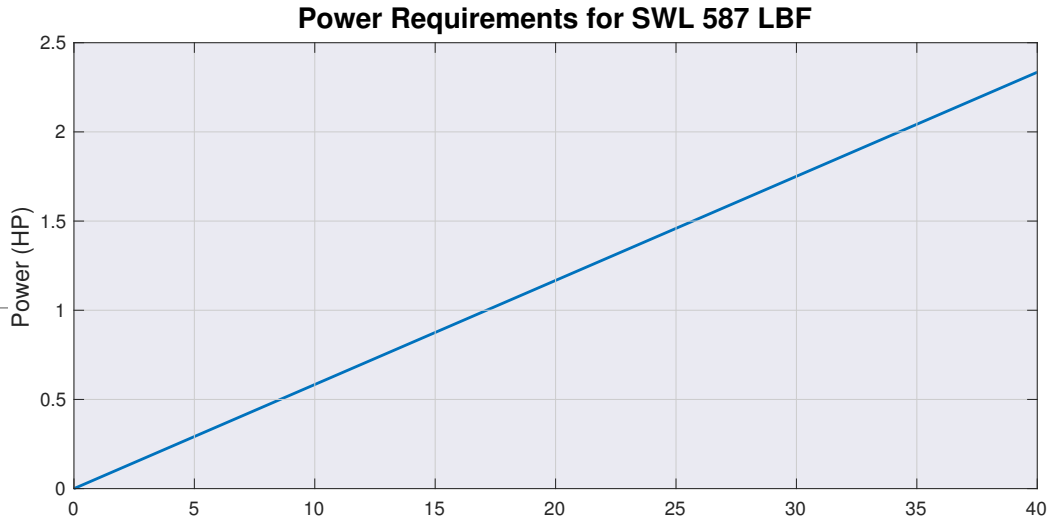
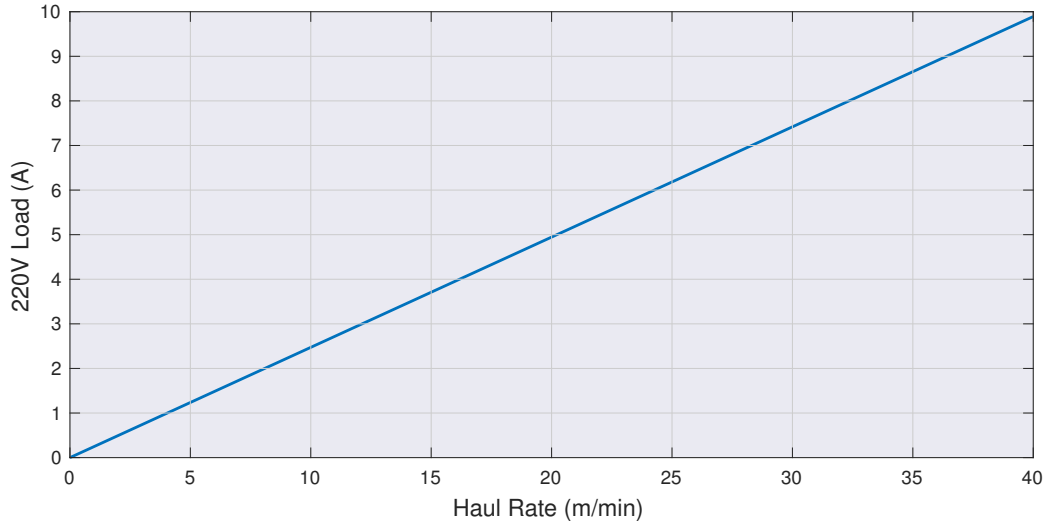

Forces for 270 Meter Deployment
Tow Body Drag
FM021814-2 Tether Drag
Total Drag + Wet Weight
Current System In-Air Weight
SWL
FM021814-2 Upgraded NBL
Force (lbs)
Tow Velocity (knots)
0
500
1000
1500
2000
2500
3000
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5

Lift Specs

- Derived Requirements:
  - Must lift with force greater than SWL 600-lbf
  - Must lift with minimum speed 30-m/min
  - Must brake higher than tether NBL 3,000-lbf
  - Storage of 400-m cable (includes working length & 2 re-terminations)
- Power Demand:
  - < 2HP required
  - < 10A likely for a electric winch on 220VAC1Ø.





220V1Ø AC current assuming a 75% electromechanical efficiency

Winch Minimum Ratings

Specification	Minimum Rating
Mechanical Power	2-HP
Dead-Lift Capacity	530-lbs
Haul Rate	30-m/min
Winch Brake Rating	2,700-lbs
Primary input	1Ø 220-V or 110-V AC 60-Hz
Payout Counter	Desired
Drum Capacity	1300-ft of 0.394-in OD PUR hybrid fiber/copper tether
Drum & Sheave Diameter	??13-in¿¿
Slip Ring	2-pass 16-AWG Electrical 1-pass SM Optical

Winch Solution Trades

LINE HAULER

- Pros:
  - Removes slip-ring need
  - Essentially a Capstain solution
  - Low-cost ($3,000)
- Cons:
  - Bucket storage
  - Significant Weight reduction demanded.
  - Limited to 1/2” Cable
  - Manual Payout Counter

TRADITIONAL WINCH

- Pros:
  - Self contained
  - Safe
  - Bolt-down installation
- Cons:
  - Higher Cost
  - Higher Maintenance Requirement
  - Requires Slip-ring

The End

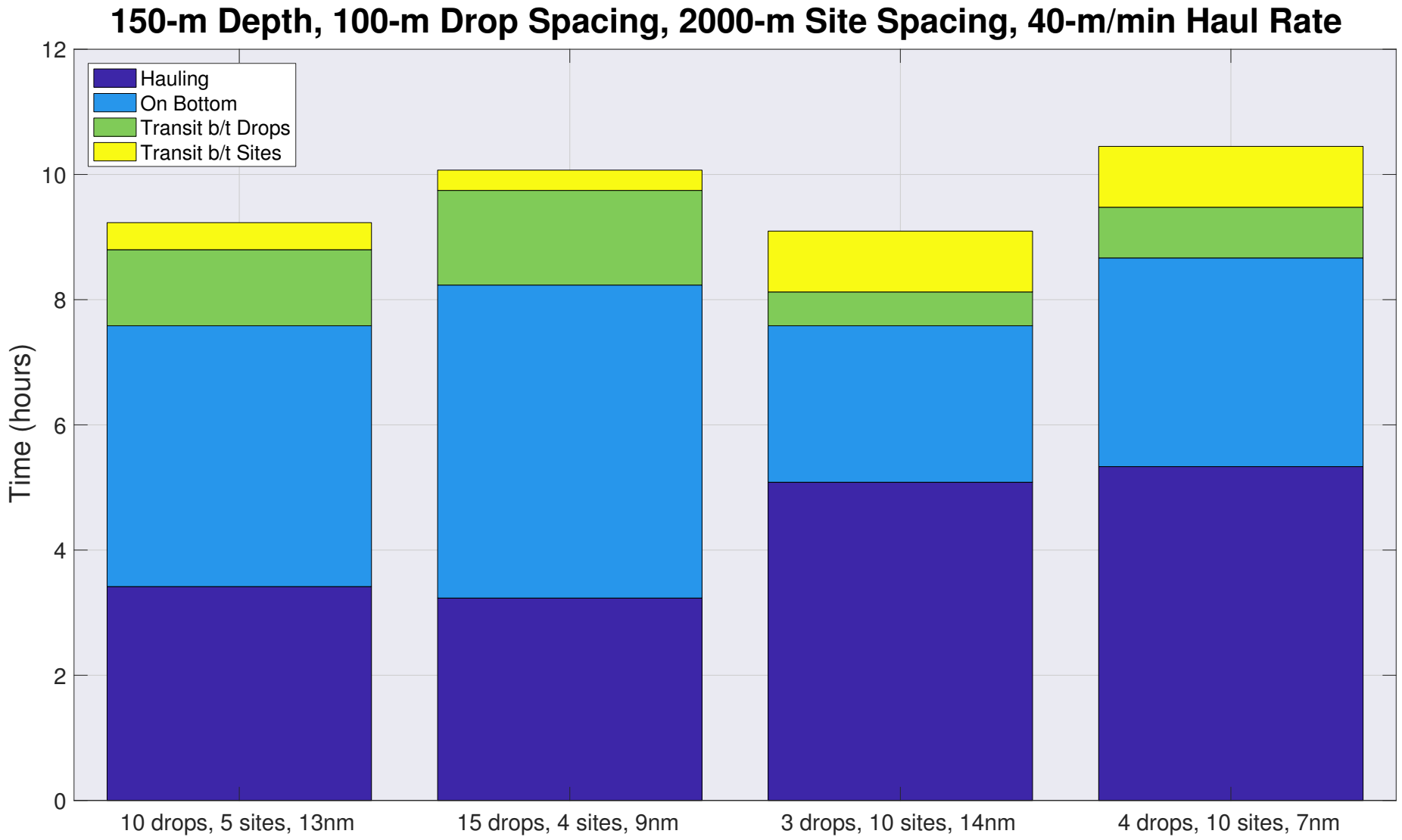
Supplementary Slides

Okeanus (frm. SOS) ECO-2000

- 5HP
- Meets all other specs

Width:	52 in. (1,320 mm)
Length:	53 in. (1,346 mm)
Height (including local joystick):	43 in. (1,092 mm)
Std. Drum flange diameter: 2	4 in. (610 mm)
– core diameter:	12.75 in. (325 mm)
– width between flanges:	22 in. (560 mm)
Capacity -0.252 in. (6.4 mm) cable:	6,560 feet (2,000 m)
-0.322 in. (8.2 mm) cable:	5,150 feet (1,570 m)
-0.420 in. (10.7 mm) cable:	2,750 feet (840 m)
Weight (pending options):	1,200 lbs. (545 kg)
Input Power:	220 VAC three phase, 50/60 Hz
– optional 400 VAC three phase, 50/60 Hz	
Maximum Bare Drum Line Pull:	2,000lbs (454kg)

Monterey Bay Aquarium Research Institute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3 drops, 10 sites, 14nm
4 drops, 10 sites, 7nm