Ocean Class SMR Input
Gear Handling over the side, towing, winches, wire & cranes

Robert Knox - SIO

1 Physical Oceanography

Ocean circulation - But I'm going to use this form mainly to insert some overall observations or workshop discussion items into the mill, based on my reading of inputs thus far (7/1/02)

Over the side handling

See J. Christensen plea for hands-off CTD. If that, or similar-size package, could be done well, and if the system could adapt to other packages of roughly similar size/weight, this could make for safer/better operations into worse weather. How best to accomplish? What implications for winch/crane/overboarding system/auxiliary retraints? Good topic for further thought.

Towing

Instrument towing (e.g. Seasoar) is not a major design driver; heavy-duty towing appears not to be an issue.

Winches

Needs to be considered together with wire (#13) and overboarding gear (#15). Seems as if two "CTD" or next-generation CTD winches and one trawl winch are needed. Can any of these readily be used for "clean" work (e.g., trace metal) or must that be a separate winch system?

Wire

Current UNOLS effort to specify next-generation wires is important here - may imply different winches.

Crane

Various functional requirements emerge - self-loading of vans from pier, small relocatable cranes to serve deck gear and hatches, use of main crane(s) as overboarding/coring/towing equipment (suitable crutch or restraint). Some numbers for load/reach limits will be needed, as well as definition of crane performance at sea vs in port (dynamic effects).

Ed Carpenter - SFSU

Biology

phytoplankton ecology, nutrient cycling

Over the side handling

Need to launch and recover sediment traps in uncluttered deck area.

Towing

Winches

Need conducting cable winch for CTD Rosette. We typically work just in upper 300 m but of course should have ca 5000 m of wire. We still use old non conducting hydro cable for towing 1 m dia plankton nets to collect larger phytoplankton.

Wire

Crane

Need for loading & unloading. Should have a simple setup for launch & recovery of a Zodiac.

Anthony Michaels - USC

Biology	Role of biological community structure in the cycling of biogenic elements in the ocean.

Over the side handling

Towing

Occasional dragging for stuck mooring with trawl wire and drag.

Winches

Standard kinds of winches. Simultaneous usability for CTD, hydrowire, trawl (conducting?), mooring recovery, and specialized trace-metal winch (user provided). We usually ask for this full mix at one time on our bigger cruises for CTD ops, plankton tows, MOCNESS, trace metal sampling, mooring recovery/deployment, piston cores and the occassional dragging for dead moorings.

Wire

The usual

Crane

loading, unloading. Sometimes used at sea instead of A-Frame

Paul Hargraves - URI

Biology	phytoplankton

Over the side handling

hero pltfm

Towing

<1kt or drift

Winches

light

Wire

for Niskin or CTD

Crane

Grace Klein-MacPhee - URI

Biology | Fishery Science

Over the side handling

side deployment of CTD and smaller MOCNESS

Towing

Winches

at least 3, A trawl winch, dual drum winch, hydrographic winch for MOCNESS up to 10 meters

Wire

Crane

2 cranes

Edward Durbin - URI

Biology | Zooplankton

Over the side handling

Motion compensated winch for heavy gear.

Towing

Winches

Wire

Optical fiber for VPR

Crane

Joan Bernhard - South Carolina

Biology	Benthic ecology and physiology of meiofauna and microorganisms. This necessitates collection and maintenance of live material (i.e., temperature sensitive).

Over the side handling

Existing A frames are often too small (narrow and / or throw-- angle of extension) to accommodate newer / larger sampling gear (e.g., MC800 multicorer). Width of A frame needs to be at least 15 feet.

Towing

To applicable to my work to date

Winches

Nothing out of the ordinary required (NOOTOR)

Wire

NOOTOR

Crane

NOOTOR

Bess Ward - Princeton University

Biology	microbial ecology/ biogeochemistry

Over the side handling

nothing special

Towing

Winches

things that can handle CTD, box core, individual bottles

Wire

see above

Crane

just for loading

Richard Barber - UNC/Duke	
Biology	primary productivity regulation

Over the side handling

conventional

Towing

n/a

Winches

in addition to conventional hydroline conducting, a Kevlar/teflon-coated winch and wire is needed

Wire

Kevlar

Crane

n/a

William Cochlan - SFSU	
Biology	Phytoplankton and bacterial productivity, nitrogenous nutrition

Over the side handling

ridgid inflatable(s) for special sampling requirements

Towing

Winches

2 standard winches for CTD/rosette (stardboard) and 1-2 located aft for net hawls, etc.

Wire

standard conductivity cables for upper 500 meters

Crane

Ability to lauch/recover standard rosettes with bottles/CTD as well as wire sampling.□Also a boom 'outrigger-typ'e system to hang over the side for deployment of underway sampling systems (i.e., trace-metal clean sipper system)

Sharon Smith - RSMAS

Biology | zooplankton ecology

Over the side handling

good aft A frame, as present Thomas Thompson

Towing

maintain steady 2kts.

Winches

capable of towing MOCNESS nets of all sizes, hydrowinch

Wire

0.68 conducting; 0.32 conducting,regular hydrowire

Crane

as present Thomas Thompson

Elizabeth Venrick - SIO

Biology; Chemical | Physics, chemistry and biology of the California Current with emphasis on fishery oceanography, planktonic ecosystem structure and function and climate-ocean interactions

Over the side handling

Rear A-frame, dedicated CTD launching system, hydro boom. May in future need buoy tending capabilities.

Towing

Winches

trawl winch, hydrowinch, CTD winch. May, in future, need ability to tow SeaSoar or underway CTD

Wire

Crane

Mostly for loading and unloading in port. Occasional use at sea for lauching skiffs, moving equipment. May in future be needed for tending moorings.

James Meehan - NMFS

Biology/Other	Living Marine Resources life histories, population structures, and stock assessments. Ecology and dynamics of Large Marine Ecosystems. Identification and description of Essential Fish Habitats and endangered species Critical Habitats

Over the side handling

Extendable beams or frames (A,U,J)
Capable of handlin 910 kg plus 5,000 meters of 8.2 mm or 9.5 mm electromechanical wire.
Outboard extention at least 3 m from side shell

Towing

Winches

Two autocompensating trawl winches to support trawling to a depth of 1,800 m.; Third wire winch with cable length compatible with maximum trawl warp scope.; Oceanographic winch w/a working depth of 5,000 m; Two hydrographic winches w/a working depth of 5,000 m

Wire

Trawl winches - 28 mm trawl cable; 14.3 mm wire rope (3x19 torque balanced); Oceo winch - 14.3 mm wire rope; 15.9 mm mechanical wire; " 17.3 mm electromechanical wire or fiber optic cable"
"Hydro winches 8.2 mm or 9.5 mm electromechanical wire"
" 6.35 mm mechanical wire rope"

Crane

Aft working deck -
Dockside static load - 3650 kg at 9 m
At sea dynamic load - 4550 kg at 6 m
2275 kg at 15 m
250 kg at 20 m

Rana Fine - RSMAS

Chem. Oc.	Tracer Oceanography

Over the side handling

for hydrography

Towing

Winches

for hydrography 36 place rosette

Wire

for hydrography, 7000 m

Crane

Frank Sansone - Hawaii

Chemical Oceanography	Hydrothermal plume biogeochemistry; trace gas biogeochemistry

Over the side handling

Towing

Ability to perform tow-yo operations with CTD-rosette

Winches

Ability to perform tow-yo operations with CTD-rosette

Wire

Ability to perform tow-yo operations with CTD-rosette; 4 conductors for CTD cable

Crane

Knuckle crane or similar for deploying/recovering floats and attached sample arrays

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John Christensen - Bigelow Laboratory

Chemical Oceanography	Nutrient and hydrographic distributions in shelf and slope areas, benthic rates of metabolism and release.

Over the side handling

Why can't CTD/rosette packages be deployed and recovered withiout manually clppping lines to them? Why cant the operation be fully untouched? Free swinging heavy gear is dangerous. Similarly, boxcores and other devices of similar size and weight should also be made hands-free in deployment and recovery.

Towing

none

Winches

Boxcores require deep-sea winches. CTD/rosette. Ability to deploy benthic landers via capstan and A-frame.

Wire

box cores usually the heaviest gear deployed.

Crane

Craig McNeil - URI

Chemical Oceanography | Dissolved gases, biogeochemical cycling

Over the side handling

rigid inflatables for at sea operations

Towing

Winches

CTD/rosette, starboard and stern

Wire

full ocean depth, power and coms (RS-232/485)

Crane

mooring deployment/recovery

Bob Collier - OSU

Chemical Oceanography | Marine Biogeochemistry, Trace Element Chemistry, Hydrothermal Systems

Over the side handling

Ability to launch a workboat.

Towing

Winches

Full ocean CTD winch (em.322), enable mission-based science operators (like WHOI ships), ability to tow-yo up to 1.5 knots on stbd., ability to place a second winch for special purpose use (clean wire),□trawl winch for coring ops (piston, box, etc.),□fiberoptic em wire for ROV and camera ops - support of Observatory service and science ops.□Utility Pango winch or traction winch for mooring / equipment recovery and deployment.

Wire

Crane

Shipboard crane capable of placing science vans and picking from shore (reasonable distance).□□

Mark Altabet - Massachusetts

Chemical Oceanography	marine biogeochemistry; oceanic nitrogen cycling, N and C isotope biogeochemistry

Over the side handling

CTD/Rosette, in situ large-volume pumps, MOCNESS, multicore, gravity core, piston core

Towing

Sufficient for MOCNES

Winches

1 hydro (1 backup) , 2 for CTD/Rosette, 1 trawl with possible backup

Wire

Hydro sufficient for 30-l Nisking bottle and in-situ pump deployments; acoustical wire sufficient for CTD/Rosetter; trawl wire sufficient for MOCNESS;□also interested in multicore, gravity core, and piston coring capability.

Crane

Sufficient for handling coring operations and MOCNESS towing if used instead of A-frame

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Stephen Miller - SIO

G & G	mid-ocean ridges seafloor mapping databases and archives

Over the side handling

Towing

Winches

dredge, rov

Wire

dredge, rov

Crane

James Cochran - LDEO

G & G	lithospheric/crustal creation andevolution, rifting processes - both at mid-ocean ridges and continental rifts

Over the side handling

motion compensated frames for launch and recovery in rough seas

Towing

seismic ship needs to be able to handle 6+ km streamer, perhaps multiple streamers, and large air gun array. Requirements are less for general purpose ships

Winches

Wire

dredge, coring, ROV

Crane

Carey Steven - URI

G & G	volcanology and volcaniclastic sedimentation

Over the side handling

deployment of piston coring equipment

Towing

suitable for towed side-scan sonar survey

Winches

suitable for deployment of standard piston core and dredging equipment

Wire

suitable for deployment of ROV (fiber-optic cable)

Crane

Robert Pockalny - URI

G & G | Seafloor Mapping and Underway Geophysics

Over the side handling

Towing

ability to tow magnetometer or perhaps a towed mapping system (

Winches

sufficient to put DSL120 or Jason II types instruments over the side

Wire

Conductor and/or fiber optic

Crane

Daniel Fornari - WHOI

G & G | Mid-Ocean Ridge, oceanic transform, and seamount research, including hydrothermal vents, basalt geochemistry, submarine volcanology, seafloor mapping

Over the side handling

better hydrobooms, better controls and viewability between work area and control station and with BRIDGE video views and direct views

Towing

for ROVs and towed packages, controlled speeds of 1/4 to 1 kt w/DP

Winches

current Agor 24 class OK, better traction winches?

Wire

current std wires OK, improved FO cable including FO hydrographic cable

Crane

similar to current capabilities but with MUCH better reliability and design for at sea operations/maintainence

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John Collins - WHOI

G & G | Seismology

Over the side handling

Big A-frame aft + stbd. A-frame

Towing

Capability to tow 6 airguns

Winches

2 entirely independent winches, 2 drums 2 traction motors. Must be able to switch between fiber and trawl.

Wire

> 40,000 lbs, fiber, coax, and trawl.

Crane

Articulated crane on fantail + portable crane (e.g. Hiab)

Fred Spiess - SIO

G & G | seafloor deformation measurement, seafloor work systems, plate tectonics, etc.

Over the side handling

Assume this includes over the stern - large A frame capable of moving 10 ton load from inboard to outboard. 3 or more suspension points.

Towing

tow FLIP

Winches

dredge & em cable - capanbility of shifting from one to the other easily. at least 9 km of wire CTD or light coring winch.

Wire

3 fibers & 3 copper. 3Kv. 15kvA. at least 15,000 lbs working load

Crane

Peter Lonsdale - SIO

G & G	structure and geomorphology of oceanic crust, defined by geophysical surveys

Over the side handling

Towing

small booms for towing aigun arrays and seismic streamer (looking ahead, multiple streamers) plus mag

Winches

9/16" main winch plus a standard hydro

Wire

9/16" + hydrowire

Crane

John Hildebrand - SIO

G & G	Marine Geodesy - study of crustal movements using acoustics and GPS

Over the side handling

A frame with 20-30 Klb rating

Towing

Winches

Wire

Fiber optic cable and appropriate shieves, capable of changing to dredge wire with minimal down time.

Crane

Robert Ballard - URI

G & G; Other | Deepwater Archaeology

Over the side handling

ability to launch 3,000 lbs ROV

Towing

towing side-scan sonar system at 1-3 knots

Winches

traction winch

Wire

0.68 inch fiber optic wire for working in 6,000 meters

Crane

ability to launch 3,000 lbs ROV

John Orcutt - Scripps Institution of Oceanography

G & G; other | Marine seismology

Over the side handling

A-frame as above. Load should exceed crane significantly; e.g. 10 tons.

Towing

Tow a single multichannel (2.g. 24 channels or less) streamer and modest airgun array.

Winches

EM and fiber optical cable capability to as great a length as possible - perhaps 8-9km.

Wire

3 optical fibers and 3 copper conductors. 18,000 lb working load. High voltage conductors (e.g. 3kV).

Crane

At least a 2-ton working load at full extension on fantail. A-frame desireable for larger loads.

Sean Wiggins - SIO

G & G; other | Marine Geophysics & Oceanographic Instrumentation

Over the side handling

A-Frame

Towing

Winches

fiber optics and coax

Wire

Crane

launch and recovery of small instruments

John Bash - URI

Other | Research Vessel Management

Over the side handling

Motion compensated frame for handling equipment in heavy seas

Towing

Winches

Wire

Crane

Joe Coburn - WHOI

Other | Research Vessel Management

Over the side handling

Stern frame, side hydrobooms port & starboard; one of which rated for cable with broadest bandwith (currently .680 FO). Motion compensated system - specs to be determined.

Towing

Should not be a defining requirement - 10,000# @ 6 knots

Winches

2 Hydrowinches, 1 traction winch with capability of changing between trawl wire and FO, not necessary to carry both simultaneously.

Wire

Next generation of oceanographic cables. Fiberoptic.

Crane

Cargo-type crane to load from dock to key deck locations. Portable (relocatable) articulated crane for handling AUV, ROV, etc.

Marc Willis - OSU

Other | N/A

Over the side handling

Account for multiple towed instruments (eg. towed profiler + acoustic towfish + surface sampler).□Large, high-capacity A-frame.

Towing

Not a defining requirement

Winches

Deep-sea winch for towing/coring, Intermediate winches (2), for CTD cable, light trawling wire and/or project wires - interchangeable drums

Wire

Forward-thinking to next generation cables high-power/FO

Crane

At least one telescoping-boom crane, placed for towing over-the-side in crutch, one or more knuckle-boom cranes for deck work and loading - size and place cranes to handle loaded containers/ship's winch drums, serve all open deck areas

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Richard Pittenger - WHOI	
Other	NA

Over the side handling

Hydro booms Port and Starboard, A-frame, U-frame (including AUVs) in a sea way

Towing

10 meter MOCNESS, mid-water trawl.

Winches

2 hydro winches, convertible traction dredge / .680 fiber optic

Wire

Standard UNOLS .322, .680, 9/16

Crane

Hyab knuckle crane, 20,000 lbs.

Paul Ljunggren - LDEO	
Other	Marine Operations

Over the side handling

STern Aframe- rated 30 tons or capable of exceedign breaking strength of wire to be employed on it. 25 ft vertical clearance. 15 ft horizontal clearance. CApable of reachin 12-15 ft inboard or outboard of vessel. STarboard side hyrderboom

Towing

Winches

All winches wire, tension, speed read outs.
Capacity of 10,000m of UNOLS standard wire or electromechanical cable
Winches to include:
CTD/hydro winch
Core winch

Wire

Crane

Three cranes-
1-Small portable articualted crane capable of being positioned to support over the side oeprations.
1-Articulated crane with 40 boom rated for 3000 lbs at 40 ft.
1-Large telescoping boom crane- capable of handling 15000-20000lb containers

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Thomas Rossby - URI

Phys. Oc.	Ocean circulation with emphasis on the Gulf Stream and North Atlantic Current system. Perhaps work farther north in future.

Over the side handling

Long rail on starboard side for access to water line for recovery ops.

Towing

Winches

Wire

Crane

Terrence Joyce - WHOI

Physical Oceanography	Ocean general circulation, mesoscale variability

Over the side handling

recovery/deployment of 3m discus buoy for meteorology, standard surface and intermediate moorings

Towing

A-frame for towing SeaSoar

Winches

trawl winch, 2 hydro winches

Wire

standard UNOLS wire for above (8000m)

Crane

lift capability for standard container vans, specialized for science labs [hydro]

James Ledwell - WHOI

Physical Oceanography | Tracer release experiments

Over the side handling

Low freeboard to deploy sleds, bottles and instruments on wire, deploy and recover profilers; launch 10-meter long floats

Towing

Low tow speeds, 0 to 2 knots, 6000 pound maximum tension with CTD cable

Winches

CTD winch, with backup, for 10,000 meters of CTD cable; Computer control

Wire

Present 0.322" CTD wire is marginally OK; go stronger; add optical fiber

Crane

Light - for launchin delicate floats at sea

Dave Hebert - URI

Physical Oceanography | Mixing processes

Over the side handling

State-of-the-art handling where minimal tag lines, etc. are needed. A system such as Wiebe's is a good start.

Towing

Towing - 10000 lbs at 6 kts

Winches

Wire

Crane

Able to load gear from dock to all points on the ship.

Bill Johns - RSMAS

Physical Oceanography	Large-scale Ocean Circulation, Western Boundary Currents and Mesoscale Processes

Over the side handling

CTD boom and all-weather hangar

Towing

Winches

Trawl winch w/ 12000 m wire; hydro winch 7000m wire; twin (fully-redundant) motion compensated CTD/profiling winch 7000m cable

Wire

Crane

articulated crane back deck, standard crane midships/aft able to reach all deck/stowage areas

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Tetsu Hara - URI

Physical Oceanography	Air-sea interaction

Over the side handling

Towing

Winches

Wire

Crane

Able to load research platforms (e.g., buoys) from dock to the deck, and to deploy them from the deck.

David Farmer - URI

Physical Oceanography | Upper Ocean Physics, Internal Waves, Coastal Processes

Over the side handling

Need to be able to easily recover drifting intruments over the side.□Must be good visibility from bridge and Excellent manoeverability.

Towing

Tow-yo CTDs are the primary application.

Winches

Standar CTD winch meets requirements,i.e. similar set-up to Ocean class vessels.

Wire

As for #12

Crane

Sufficient for standard current meter moorings etc.□Present Ocean class capability sufficient.

Mark Wimbush - URI

Physical Oceanography | Western Boundary Currents, esp. Kuroshio

Over the side handling

See 15 above

Towing

none

Winches

Conducting-wire CTD winch for hydrographic profiling to 7,000 m.

Wire

See 12 above

Crane

normal -- able to reach at least 6 ft over the fantail and side.

Jack Barth - OSU

Physical Oceanography	coastal physical oceanography especially fronts and jets

Over the side handling

Towing

Tow SeaSoar vehicle at 7 knots on user-supplied cable and winch. Tow bioacoustics package off stern quarter at 7 knots using a tow wing or crane-in-crutch system.

Winches

full-ocean depth CTD/rosette capable winch; trawl winch for mooring ops

Wire

full-ocean depth CTD/rosette capable wire; non-conducting 10K lb wire for emergency dragging for lost gear or unresponsive moorings.

Crane

Large crane for loading from shore. Articulating crane for moving relatively small packages around the deck at sea.

John Toole - WHOI

Physical Oceanography	observational physical oceanography

Over the side handling

stern A-Frame and midships J- or A-frame, low freeboard aft with uncluttered rail to facilitate pickup of drifting instrumentation

Towing

none

Winches

2 .322" conducting wire, 1 trawl wire, ability to mount mooring winch

Wire

see above

Crane

stern A-frame, midships J- or A- Frame, full deck coverage w/ main crane(s) capable of lifting loaded vans

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Michael McCartney - WHOI

Physical Oceanography | Abyssal circulation, thermocline ventilation, convection, and climate change

Over the side handling

I like the arrangement on the knorr (the extensible boom) better than a variety of J-frames and side A frames that I have used on other ships.

Towing

none

Winches

Winch and wire for CTD operations at least at the capacity of the Knorr.□I believe a somewhat greater actual power might be needed as I believe in some circumstances it is the potential overheating of the winch that limits haul in, not tensions.

Wire

CTD cable is still my only real need.

Crane

I believe the primary crane pair on the Knorr has been fine for all my mooring operations.□I do not do massive surface buoys, so will defer to those like Wellers folks that do.

Brian Guest - WHOI

Physical Oceanography | Neutrally Buoyant floats and subsurface moorings

Over the side handling

Crane and A frame for mooring launch and recovery. CTD launch and recovery. Towed sled requiring crane, CTD winch and another winch with 1 ton lifting.

Towing

slow speed tows of 2 knots or less

Winches

CTD with backup, trawl and something that can handle a 4 ton or larger lift with non conductive wire.

Wire

3 conductor CTD cable, fiber optic for future use.

Crane

10-20 ton to any part of main deck

Charles Flagg - BNL

Physical Oceanography	Continental Shelf Processes, Shelf-ocean exchange, fronts

Over the side handling

A-frame amid-ships for CTD and coring work and a large a-frame on the stern for mooring and towing.

Towing

Towing requirements include constant slow speed for MOCNESS (~2-3 kts) and higher speeds for SEASOARs (~8 kts).

Winches

There should be the standard suite of winches permanently available and the big winch should be below the main deck if possible. The number of pulleys over which the wire passes should be minimal while the pulleys themselves should be as large as practicable. Winches that are roll compensated would be nice for hydrocasts but I am more worried about winches doing things autonomously outside the control of an operator to support their inclusion in the suite of equipment.

Wire

I'm uncertain what the strength requirements are for the various packages but clearly the ship should be able to do coring, tow SEASOARS and MOCNESSs, do vertical hauls, and hydrographic casts with large rosettes.

Crane

Articulated cranes should be able to reach all areas of the deck and storage areas on top of the deck houses. They should be able to self load items the size of storage and science vans.

Craig Lee - UW

Physical Oceanography	upper ocean and mesoscale dynamics

Over the side handling

- Large A-Frame.
- I-beam or J-frame
- Relatively low freeboard... accept wet fantail for easier handling of delicate gear.

Towing

Winches

- Hydro and trawl winches.
- Might also think about a towed profiling/multi-purpose winch with electro-optical cable.

Wire

- Standard cables and wire ropes
- Ability to handle electro-optical tow cables (no standards yet)

Crane

- Handle loaded containers sited alongside the ship.
- Cranes with ample scope to cover the entire ship.
- Articulating crane to supporting the fantail.

Ruth Curry - WHOI

Physical Oceanography	Water mass properties and ocean circulation in the context of global and regional climate

Over the side handling

Standard for CTD / floats /

Towing

none

Winches

Hydro winch for CTDs. For subsurface mooring work, we generally bring our own.

Wire

Standard conducting wire capable of lowering CTD and large volume rosette package

Crane

For loading/off-loading dockside.

Al Plueddemann - WHOI

Physical Oceanography	air-sea interaction and upper ocean dynamics

Over the side handling

crane lifts over stbd or port rail

Towing

H-bit and capstain adequate

Winches

hydro winch, trawl winch

Wire

> 15,000 lb, comm's for CTD wire

Crane

one or more deck cranes able to load vans, reach to fantail and one rail

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John Whitehead - WHOI

Physical Oceanography	Ocean Circulation and dynamics

Over the side handling

Towing

Winches

2 moderate strength, one occasionally for dragging

Wire

ctd strength, 4000 lbs for anchors , power for ctd

Crane

fantail and side for ctd

Randy Watts - URI

Physical Oceanography	dynamics of large scale current systems

Over the side handling

CTD; testing acoustic releases and other packages; deploying moorings

Towing

Sea-Soar and nets and acoustic packages

Winches

1 CTD winch; 1 higher bandwidth-capable winch might look to the future; 1 non-conductive hydro winch; 1 trawl winch

Wire

see above; CTD, faster, and non-conductive (to hang things inexpensively in the water)

Crane

1 able to load 20-ft containers from dockside;

Rob Pinkel - Scripps Institution of Oceanography

Physical Oceanography; other	mesoscal& sub-mesoscale processes at low & high latitude

Over the side handling

Towing

can tow FLIP

Winches

electro-optical capability

Wire

Crane
