Load Handling System Workshop
(FIC Meeting – March 2005)

GOAL

“ Develop a conceptual design for the “next-generation” over-the-side load handling system for the UNOLS fleet.”

Committee Members:

Matt Hawkins, Chair

Tom Althouse

Andy Bowen

Marc Willis

Jim Holik

Load Handling System Workshop
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- One year effort.
- Joint-funded by NSF and ONR.
- Focused on ship visits and field evaluations of existing systems.
- Must also address:
  - Loading Handling System design standards
  - Incorporation of “Next-generation” UNOLS wire
  - “Next-generation” science packages
  - Motion compensation
  - “Hands-free” deployment and recovery
  - Size/Weight: “Scale-able” to different vessel classes

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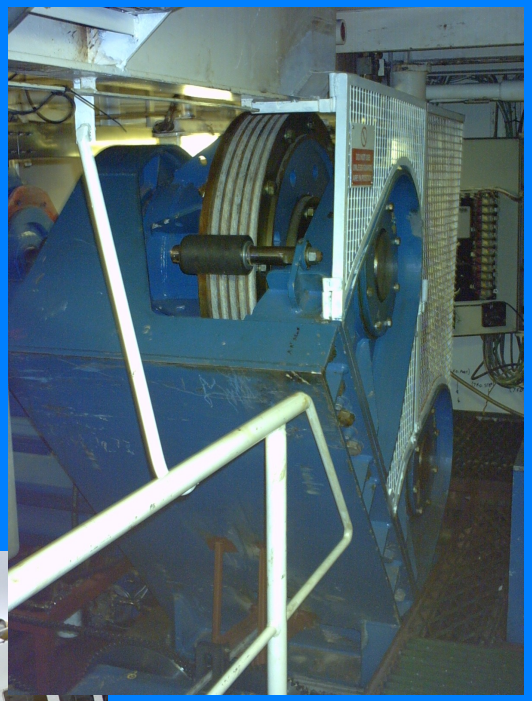
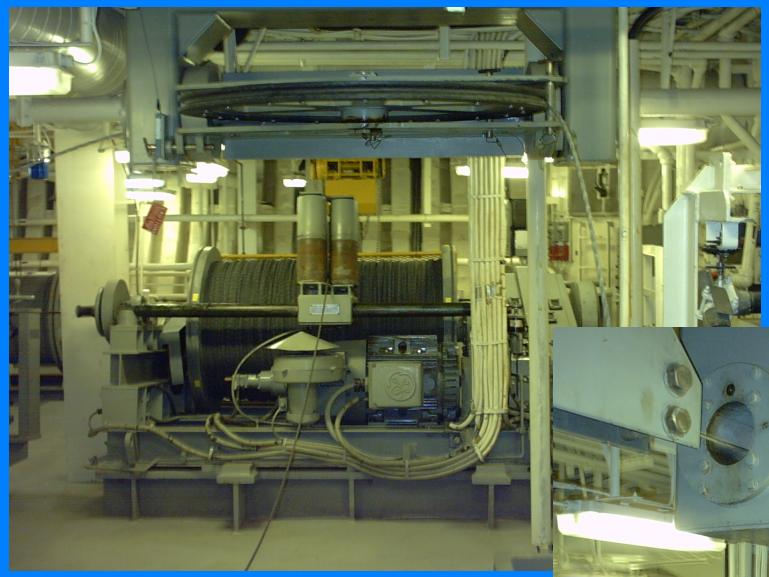
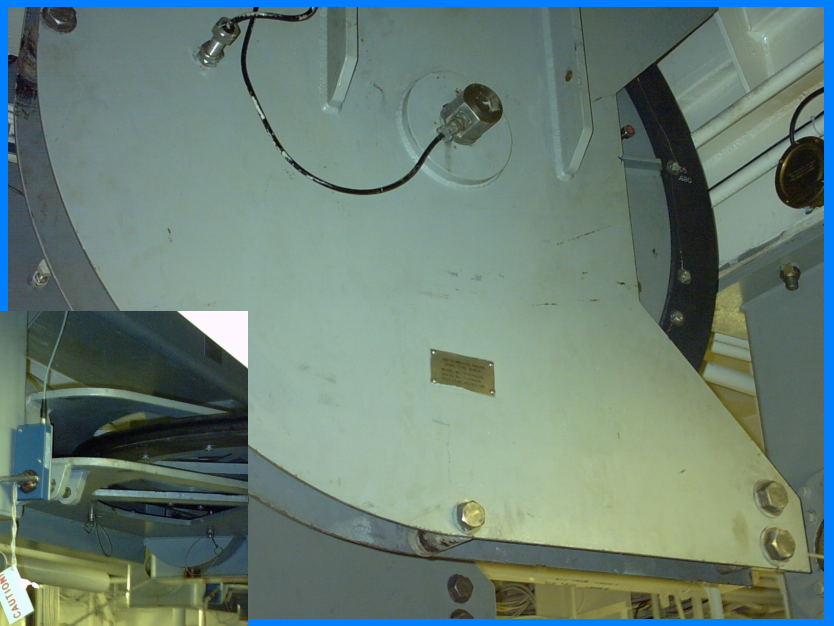
- LHS Workshop addressed handling moderately-sized, fairly common, science packages over the side and stern:
  - CTD's
  - AUV's and ROV's
  - Scanfish and Triaxis
  - Mocness
- Does not address, or attempt to replace, the stern A-frame.
- Does not address, or attempt to investigate, highly specialized or large handling systems like long-coring.

RRS *DISCOVERY* (CALEY)

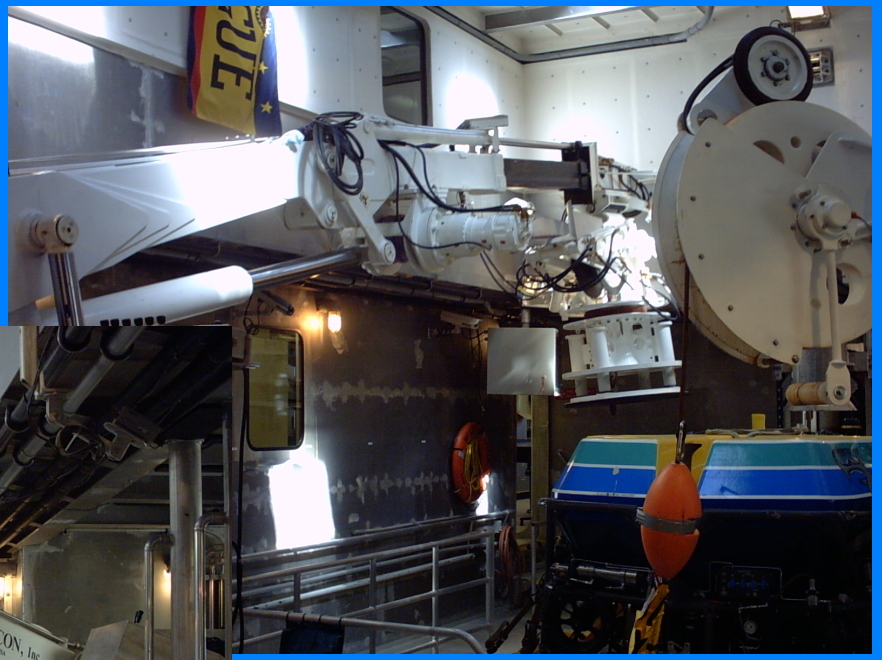


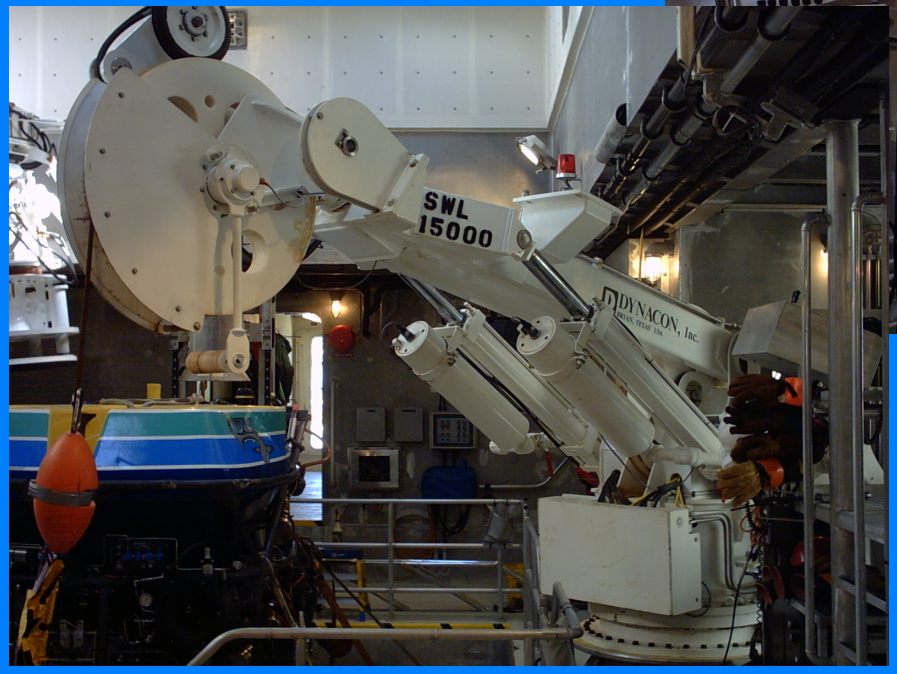
USCG *HEALY* (InterOcean)



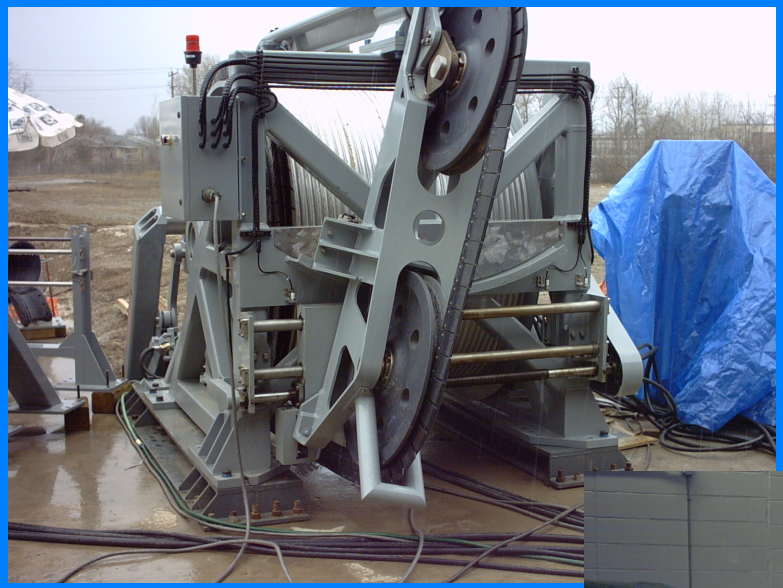


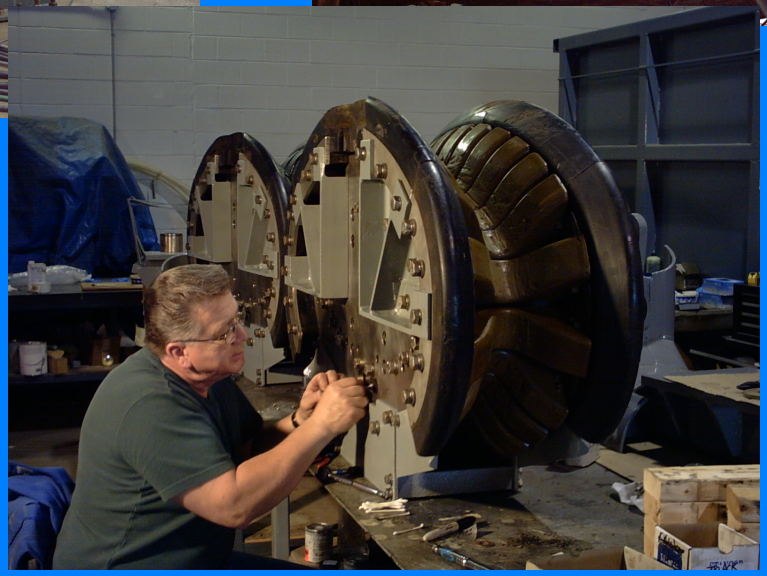
R/V *WESTERN FLYER* (Dynacon)



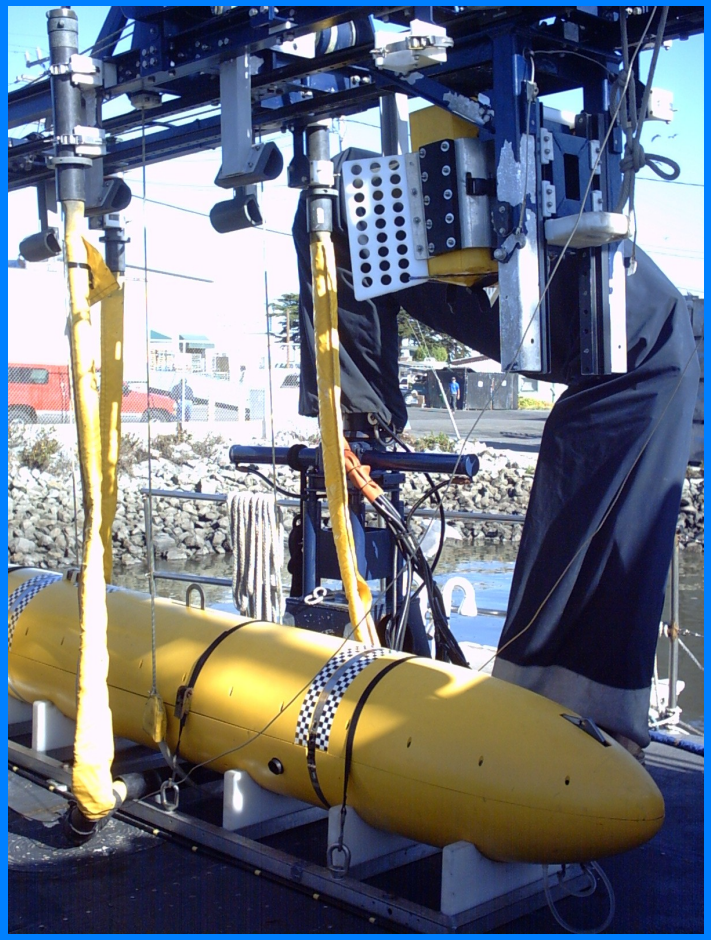


ODIM-Spectrum

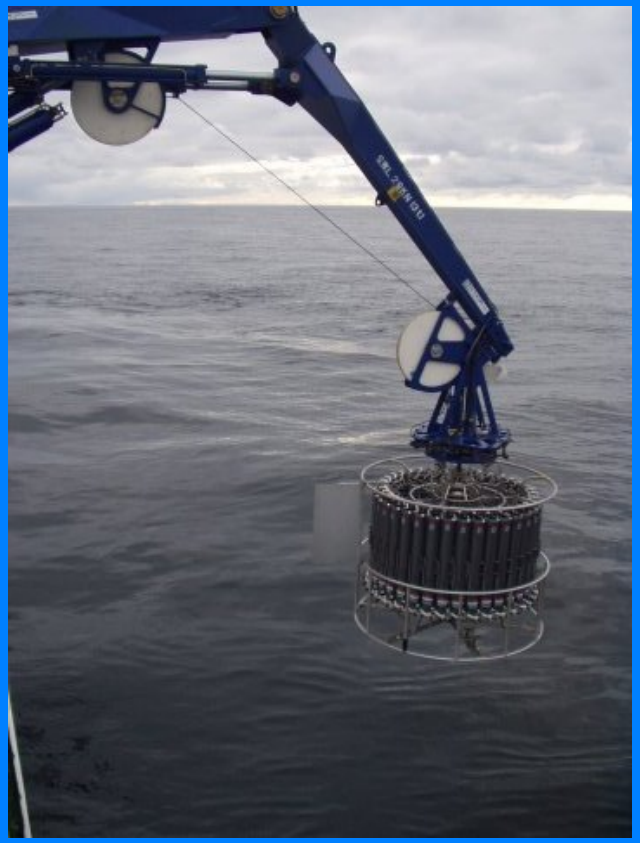




R/V *ZEPHYR* (Brooke-Ocean)



JAMSTEC
(MIRAI and SHOYU MARU - Dynacon)



G.O. SARS
(TTS? MacArtney?)

R/V CELTIC EXPLORER
(Triplex/Rapp-Hydema)

Load Handling System Workshop
FINDINGS

- KILO MOANA “issues” are not unique – but represent the broader issues seen on all UNOLS vessels. KILO MOANO was simply a timely and illustrative example of the problems!
- Recommended solution for KILO MAONA illustrates the broader solution for the fleet.
- The potential solution is (as suspected) a COMBINATION of design features and capabilities from many vessels and manufacturers.
- The broad survey, combined with KILO MOANA as a case study was essential.
- Though the proposed system has many advanced and automated functions - it is essentially MANUALLY operated. **Judgment of the operator still employed.**

Load Handling System Workshop
The Handling Apparatus

- Generally speaking, an articulated crane
- Three different arrangements – but CONCEPTUALLY the same:

  -"Aft Deck" – much like Dynacon system and standard articulated cranes used by many operations today.

  -"Side" – much like CTD handling system on CELTIC EXPLORER with other features added. No slewing capability (simpler).

  - "Overhead" – NEW. Modified squirt boom.
- Able to reach VERY NEAR the water surface – boom geometry and extensions.
- Incorporates an interchangeable docking head with bolting flange for Owner-supplied "bumper". Science packages secured by cable tension (universal).
- Tow-capable by use of a forward stay.

Load Handling System Workshop
The Winch

- May be electric or hydraulic depending on vessel - as long as capable of meeting “Functional Requirements”
- May be direct pull or traction depending on vessel and use – as long as capable of meeting “Functional Requirements”
- Should be co-located with handling apparatus if at all possible to simplify cable path. If winch is “below decks” it should be directly below - NOT multiple decks below or separated by multiple compartments.
- All advanced capabilities are done by the winch itself – no other external system components other than handling apparatus.

“SMART WINCH”

Load Handling System Workshop
"SMART Winch" Capabilities

- **"Auto Tension"** – Used only for deployment and recovery. Holds science package in docking head by cable tension. *(Done by ODIM. Similar by Dynacon on Western Flyer for ROV at surface – but not in docking head)*
- **"Motion Compensation"** – All motion compensation done by winch pay-in/pay-out and a Motion Reference Unit (MRU) on the boom. "Active System" - Not reliant on cable tension which is not always representative of vessel motions. No additional system components (less weight). *(Done by CALEY on DISCOVERY).*
- **"Slip Mode"** – Allows payout of winch under tension when either SWL of winch or apparatus is exceeded (precisely calibrated). Cable breaking strength is no longer the "weak link" in the system. *(Done by CALEY on DISCOVERY. Done by both fishing and towing industries for years)*

Load Handling System Workshop
A bit on Design Standards
(The Crux of it All!)

- We tend to focus solely on 46 CFR, Sub-Part 189.35-9(c)(1) – "Wet Weight Handling Gear" which makes the wire or cable the "weak link" in the system. **The cable parts first**. Minimum FS on yield = 1.5
- Developed in 1970's before we had synthetics and cables designed with high breaking strengths solely due to band width requirements.
- Can drive size, weight , and cost of the winch and handling system.
- Why do we want cables to part at all? (dangerous, loss of science package)
- Still suitable for some "heavy" systems – i.e. long coring?

Load Handling System Workshop
Design Standards

- Fortunately, the authors of Sub-chapter U were somewhat forward thinking – believe it or not!!
- Alternate standards **ARE** allowed by Sub-Chapter U itself:

  - Subpart 189.35-1(b) - Systems placed under ABS rules for cargo handling "assumed to have meet the intent of this sub-part". *Problem is that these rules deal mostly with cable jib booms, etc.*

  - Subpart 189.35-3(a) - "Intent": In recognition of the special nature of R/V's, maximum flexibility given to the owner/operator in complying with safety requirements.

  - Subpart 189.35-13 – "Special Cases": If above safety standards defeat the purpose of any piece of weight handling gear, relaxation of the standard will be considered.

- **UP TO US (AS A COMMUNITY) TO DECIDE.**
- Discussed during working group at 2004 RVOC.

  - Winch "slip" (as long as adequately calibrated and built in redundancy) was deemed as one acceptable means of strain relief by most operators.

Load Handling System Workshop

- Classification Society Standards (ABS, DNV, Lloyds) all tend to use "maximum anticipated operating load" as the design loading, and assign differing factors of safety depending on the type of stress (i.e. bending, shear, compression, tension, etc). This method is more standard engineering practice and allows for design optimization.
- By focusing of Sub-part 189.35-9(c)(1), we have simply defined the "maximum anticipated operating load" as ALWAYS being the cable breaking strength!
- Do we really want to do that for ALL systems?
- Doubtful – as long as we can ensure safety in another way through sound engineering design and operating practice.