



Alternate Blocking Materials

NSRP Panel Project PP 23-018

Outline

- DM Consulting Introduction
- Introduction to Drydocking
- Use of Divers
- Block Indicator System
- Recent Case Studies
- Implementation, Testing, & Deliverables
- Technology Transfer



DM Consulting – Dry Dock Experts

- Established 2000
- Certified Dock Masters
 - 5000+ Drydocking operations.
 - 150+ Years Combined Experience
- Training, Consulting
- Dry Dock Acquisitions
- Technology Advocates
 - 3D Scanning
 - Software Development
 - Modern Supports
 - Monitoring Systems



Drydocking



Drydocking



Use of Divers

- Divers used for verification of ship placement & block contact
- Most commercial dockings do not use divers unless extenuating circumstances or the client require
- Diver reports are sometimes unreliable



Block Indicator System

Objective:

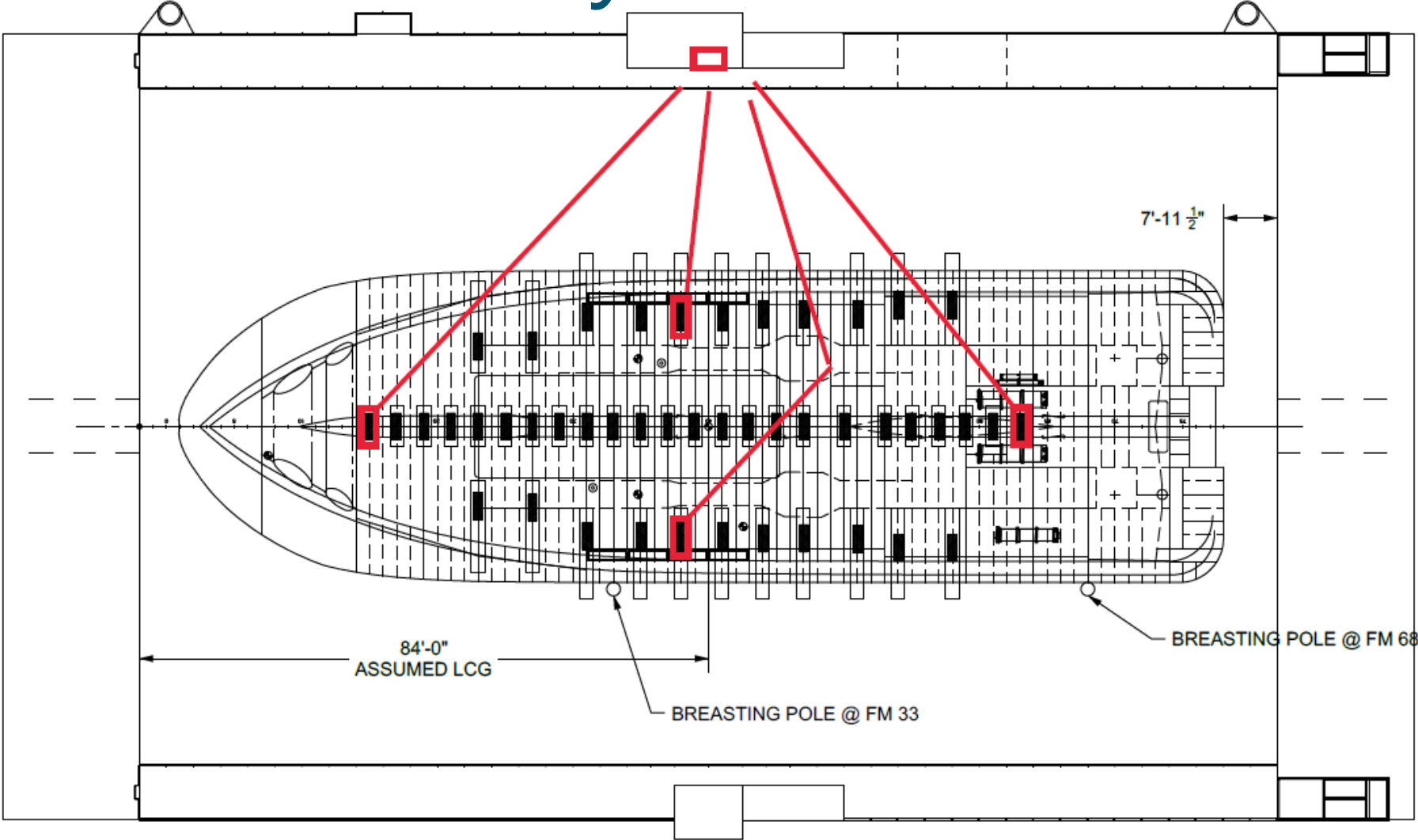
- Detect ship contact with the blocks the blocks

Components:

- Linear switches at key/critical blocks
- Receiver in control room to display reading
- System power supply
- System instrument cables



Block Indicator System

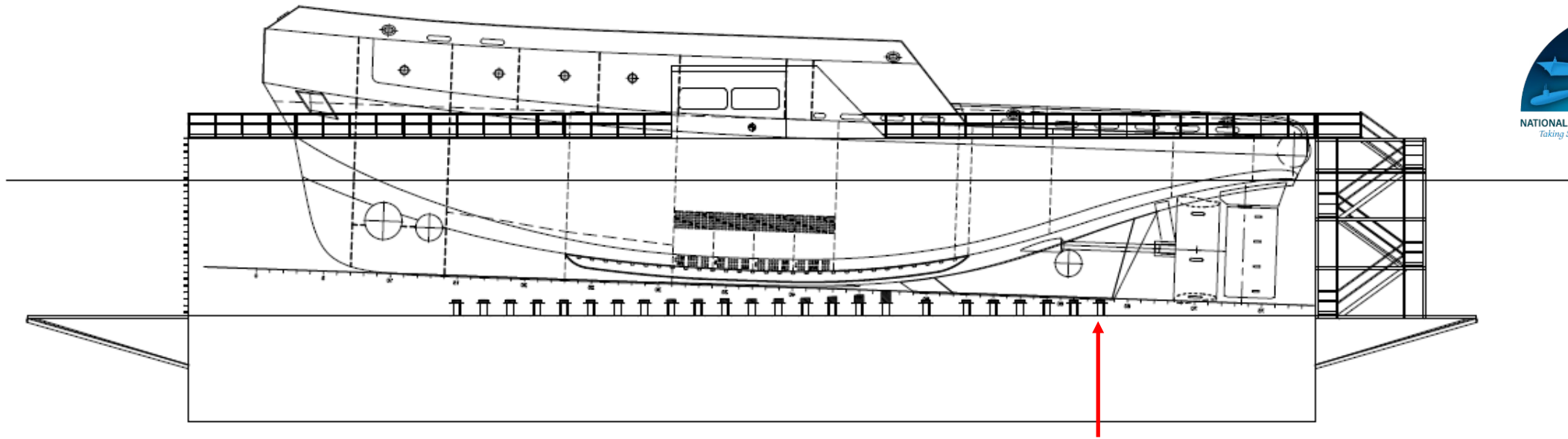


Benefits

- Can detect ships approaching or contacting blocks without the use of divers
- Can be used on all dockings instead of just key dockings
- Provides direct feedback to Dock Master
- Can be used to reduce diver time and direct diver activities when divers are used



Knuckling Failure Case Studies



$$\text{Knuckle Load Reaction, } R_{kn} \text{ (LT)} = \frac{MTI'' * trim * 12}{k * X_{kn}}$$

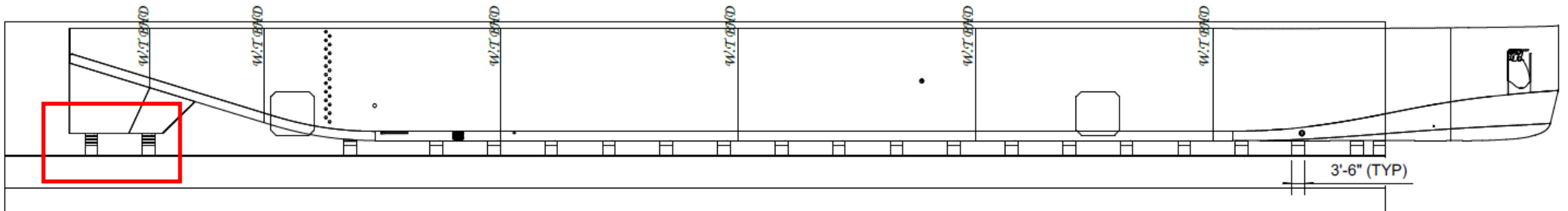
Knuckling Failure Case Studies

- Case 1: Knuckling on ship skag
 - Ship and floating dry dock were not trimmed to match.
 - Resulted in un-planned knuckle reaction, causing additional loading into the ship skag.
 - Result: Damage to ship skag (buckled sides).
 - Total damage to ship (direct cost): \$250,000
- Block Indicator System
 - Indicator system would have detected the contact between the ship and the skag blocks and would have indicated that the other blocks were not contacted.
 - Dock master could have cancelled the docking prior to damaging the ship.



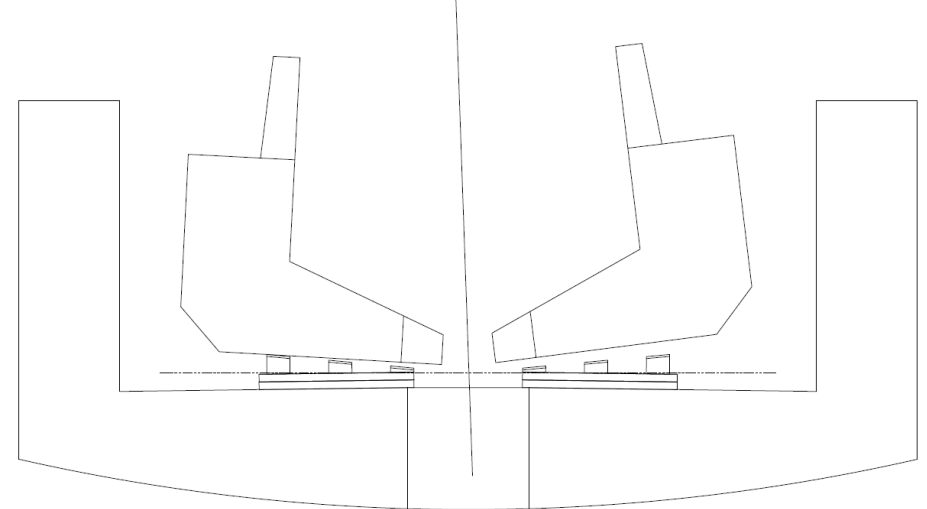
Knuckling Failure Case Studies

- Case 2: Barge skag blocking built too high
 - Flat bottom barge with higher skag blocks
 - Block builders lowered the flat bottom blocks but forgot to reduce the higher skag blocks by the same amount.
 - Result: Buckled dry dock transom
 - Total dry dock repair cost: \$50,000 (direct cost)
- Block Indicator System
 - Indicator system would have detected the contact between the ship and the skag blocks and would have indicated that the other blocks were not contacted.
 - Dock master could have cancelled the docking prior to damaging the ship.



Listing Case Study

- Case: Split Hopper Dredge
 - Dredge heeled when split, but unnoticed by docking personnel.
 - Resulted in contacting blocks on one side instead of all block simultaneously.
 - Divers got lost while inspecting and could not accurately describe the blocking issue.
 - Result: Extended docking evolution from 4 hours to 9 hours, multiple diver inspections, and unquantifiable customer angst.
 - Total cost: \$62,500
- Block Indicator System
 - Would have detected one side contacting before the other side.



Cost of System

- Switches: \$11,000
- Microprocessor & HMI: \$13,000
- Wires, power supply, misc.: \$1,000
- Total material cost: \$25,000

- Labor to install: \$5,000

- Total Installed cost: \$30,000



Implementation

- Gulf Copper Shipyard, Port Arthur, TX
- Navy Station Graving Dock, San Diego, CA



System Evaluation



- Key Factors:
 - Installation time
 - Train dock masters in use and understanding of the system
 - Confirm system function with bench testing, field testing, and system use.
 - Design blocking plans to indicate key blocks to be monitored.
- Observe switches and wires after docking to confirm service life.

Deliverables

- All results will be compiled into one single, final research paper.
- Paper will contain project description, drawings, costs, photographs, lab results, etc.



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DMC will immediately inform the public of project award by posting information concerning the award on the DMC website and the quarterly dry dock newsletter circulated by DMC to professionals in the drydocking industry throughout the world. These same public information methods will be used for major updates throughout the project. Finally, the results of the testing will be published using the same methods as well as presented at marine industry conferences and trade shows. All technical information, research, and results will be made available for public use without restriction (See deliverables section of this document).



