# Replacement Towing Machine Controls Tug Cheraw



# Problem

- The original controls had been of marginal utility to begin with and their condition had degraded over time
- The machines were the product of an unsuccessful attempt to expand into the towing machine market by the vendor and they were therefore “orphans”
- The controls had become unreliable and the crew no longer trusted them

# Procurement Strategy

- Design-Build vs. Design-Bid-Build selected
  - ►Positive experience with Design-Build on other controls projects
  - ►Time constraints
  - ►Allowed for vendors to propose solutions based on their experience
  - ►Made the vendors responsible for the result of satisfactory operation of the towing machine



# Solicitation

- Description of the existing system
- Standards/References
- Definition of the required end state
- Constraints
- Requirements for spare parts and documentation

# Existing System

- PLC controller
- Equipment controlled
  - ► Hydraulic motor for paying out and hauling in
  - ► Hydraulic cylinder for the clutch
  - ► Hydraulic cylinder for the brake
  - ► Auxiliary pump for emergency clutch and brake release
- Control stations
  - ► Pilothouse
  - ► Aft Upper Deck
  - ► At the Machine

**NOTE: The automatic tensioning system original to the machine was not to be retained**



# Standards/References

- Corps of Engineers Safety Manual, EM385-1-1 (latest edition and updates as of the date of solicitation of this contract)
- IEEE Standard 45, Recommended Practice for Electric Installations on Shipboard (latest edition)
- National Electric Code
- NFPA (National Fluid Power Association) standard practices

# Desired End State 1 of 4

Functions to do the following shall be provided at each control station:

- Turn the auxiliary hydraulic pump on/off (the pump used to release the brake and/or release the clutch when the prime mover is off)
- Pay out and haul in under power (main hydraulic motor control). Pay out and haul in speeds shall be continuously adjustable over the entire speed range of the drum.
- Set/release the clutch (clutch cylinder control)
- Set/release the brake (brake cylinder control)
- Abort the tow (turn on the auxiliary hydraulic pump, override all other inputs and release the clutch and disengage the brake)



# Desired End State 2 of 4

NOTE: The abort button shall be “hot” at all stations at all times regardless of which station is in control

NOTE: Main system electrical power on/off shall be controlled from the pilothouse control station via a switch on the panel.

# Desired End State 3 of 4

Readouts/Indicators at each station:

- Line paid out in feet (zero point will be with the eye at the end of the tow cable 3 feet past the bitt at the aft of the machine)
- Hydraulic pressures, both main power pressure and control pressure
- Tow aborted light (red in color)
- Auxiliary hydraulic pump on light (green in color)
- Station in control



# Desired End State 4 of 4

Alarms at each station:

- Tow slippage alarm (ties into the line paid out readout), both audible and illumination. Silencing this alarm would be only from the pilothouse control station.
- Loss of hydraulic pressure, illumination only
- Operation on battery back up power, illumination only

Power Supply:

- The electrical power supply for the control system shall have a battery back-up for a minimum of 1 hour of operation.

# Constraints 1 of 4

Three (3) new control stations shall be located, one at each of the current control station locations. Each control and indicator shall be clearly labeled with engraved plates, white background and black lettering with the lettering being a minimum of ¼" tall.

- Control types shall be as follows:
- The pay out and haul in control shall be by a single axis joystick with a center locking collar and bi-directional motion
- The clutch and brake set and release controls shall be by two push buttons, one for each operation. The system software shall retain current commanded positions when station transfer is made during towing operations.
- The tow abort control shall be a red guarded toggle switch so that aborting the tow will require lifting the red guard before toggling the switch to the abort position. The guard shall be drilled and safety wired in place with light copper wire.



# Constraints 2 of 4

Displays shall be as follows:

- Digital indicators for line paid out in feet, main hydraulic pressure in psi and control hydraulic pressure in psi
- System power on light, green in color
- System operating on battery back up power, amber in color
- Tow aborted light, red in color
- Clutch released light, blue in color
- Brake released light, white in color

# Constraints 3 of 4

Components and Execution of Work:

- All components shall meet the requirements of the above referenced standards.
- All electrical components and enclosures shall be UL listed.
- Particular attention is to be paid to insuring that the electrical cables comply with the IEEE standard 45 requirements and shall have low smoke insulation jacket and fully tinned conductors.
- The existing control wire runs may be re-used if desired by the contractor. If used, these components will be warranted as part of the new system.
- The exterior control stations shall be weatherproof (NEMA 4X) and be provided with a vandal resistant lockable cover.
- The pilothouse control station enclosure shall be of the open drip proof type (NEMA 3R).



# Constraints 4 of 4

Components and Execution of Work: (continued)

- All switches shall be of waterproof construction.
- The directional control valves for operation of the cable drum motor, clutch and brake shall be replaced with ones that incorporate a manual override.
- A new encoder shall be provided for measuring the amount of cable on the drum. The new encoder shall have the capability of measuring up to 1,500 feet of cable.
- Any components placed in the engine room shall be rated for normal sustained operation in a minimum 120 degree F environment.
- The location of components shall not interfere with operation of the tug. Particular attention shall be paid to components placed in the engine room.

# Spare Parts

The following spare parts shall be included as shelf spares for the tug:

- 1 each of all electronic components (PLCs, Input/Output modules, Communications modules, etc) Note: PLCs shall be pre-programmed
- 1 each of each type of replacement directional control valves
- 2 each of each type of switches, indicator lights, push buttons, etc
- 5 each of each type of indicator light bulbs used
- 2 each of each type of digital indicator display used
- 1 spare encoder
- 1 spare joystick controller

Note: The phrase “Each type of component used” refers to items that are installed in multiple locations. e.g. If the exact same switch is used for both setting and releasing the brake and setting and releasing the clutch on each of 3 control stations for a total of 6 installed uses of this switch, only 2 spare switches will be required.

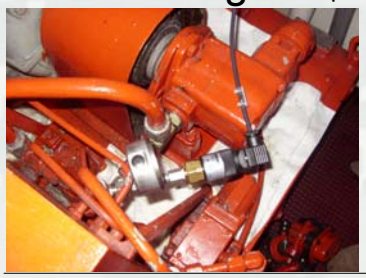


# Documentation

- Three sets of documentation shall be provided. At a minimum, the documentation shall include the following:
- Manufacturers cut sheets for all components supplied
- As-built electrical schematics
- As-built control station drawings
- Documentation of all software programming

# Results

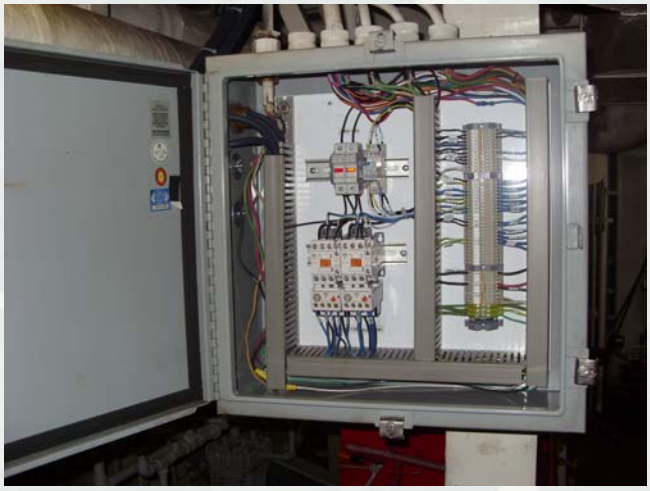
- Contractor- Fluid Power Service
- Cost- $94,000
- Modified contract to add engine room monitoring for $59,702





# PLC Panel

# I/O Rack





# Control Station Panels & Screens

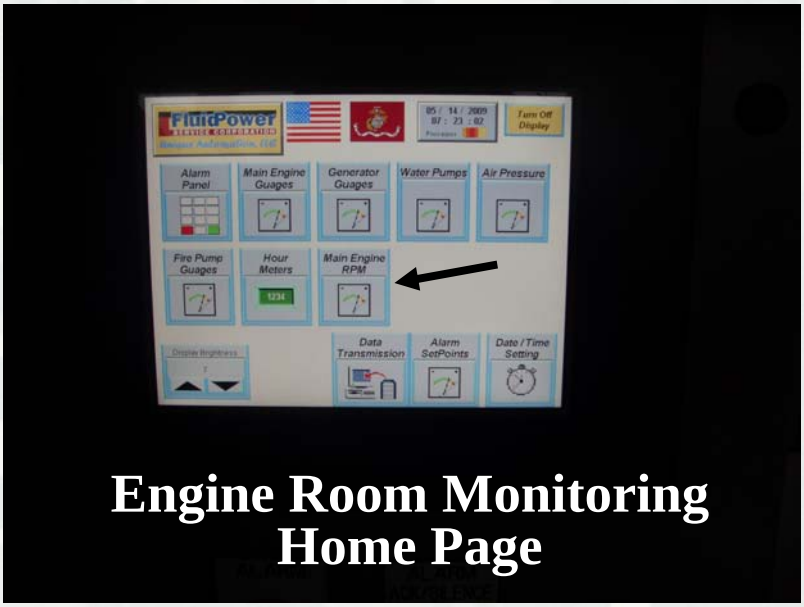

LOW LEVEL
TOW SLIPPAGE
HYD. PRESS LOW
CAPSTON PUMP
BRAKE SET
CLUTCH SET
AUX. PUMP ON
BATTERY BACKUP
BRAKE SET
CLUTCH SET
AUX. PUMP OFF
STATION CONTROL
POWER ON
BRAKE RELEASE
CLUTCH RELEASE
ABORTED
ABORT




No Fault Messages
26PSI
26Feet

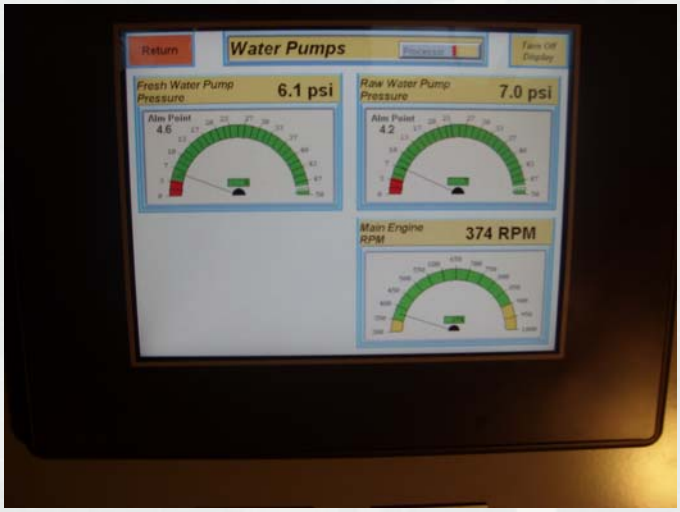
# Pilothouse Control Station



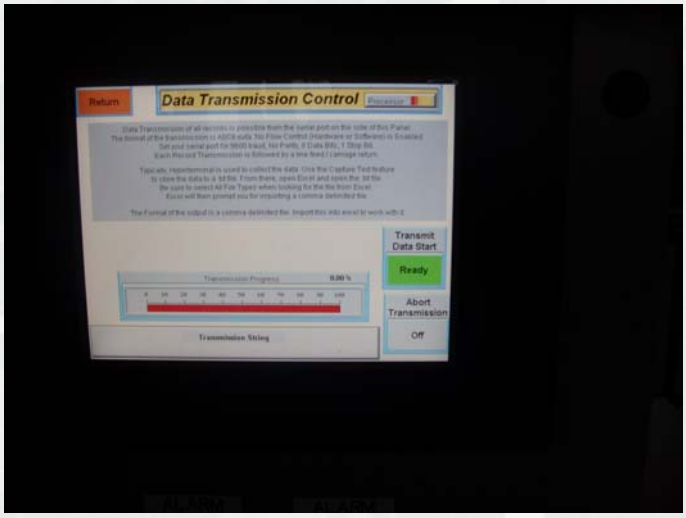

# Engine Room Monitoring Home Page

# Main Engine Gages

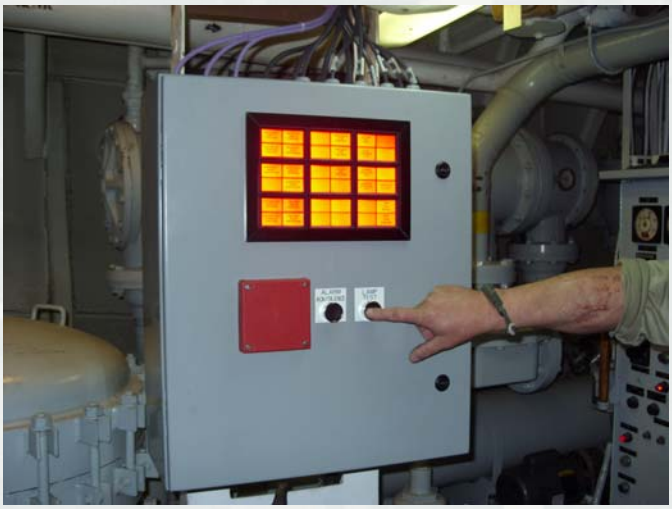





# Data Transmission



# Engine Room Alarm Panel





# Questions?