RVSS Appendix A Overview

Presented at

RVOC 2009

by

Rich Findley

rfindley@rsmas.miami.edu

Definitions

- *WINCH OWNER: The party or their representative who is normally responsible for the* operation, inspection, maintenance, and testing of the winch. This could be the vessel operator or **the scientific party**.
- *ROPE: A woven, flexible tension member with no internal conductors. It may be made* from natural fibers, synthetic fibers, or metal.
- *CABLE: A woven, flexible tension member with internal conductors or other means of* transmitting data such as glass fiber.
- *TENSION MEMBER:* Generic name used to describe a rope or cable in service for over the side work.

Definitions (cont.)

- *FIXED ENDS (FE):* Both ends of the cable being fixed without the ability to swivel. Most wire rope and cable NBL values are based on FE. An example of a fixed end application is towing a MOCNESS.
- *FREE TO ROTATE: (FTR)* The end of the cable is free to rotate either because a swivel is at the end of the tension member or the package at the end of the cable can rotate freely. Wires and Cables used in free to rotate applications have a NBL below the fixed end NBL. An example of a free to rotate application is a lowered CTD package.
- *INDUCED ROTATION :* Induced rotation occurs when external forces cause torque to be applied to the tension member. An example of an induced rotation situation would be a tow vehicle that spins while being towed but a swivel is not in place to decouple the vehicle from the tension member. This situation could develop if the tail fin was bent. Induced rotation should never be allowed to occur on a tension member that has not been specifically designed for this purpose.

Definitions (cont.)

- *ULTIMATE LOAD (UL): The theoretical load that produces failure. For the purposes of* this standard, the “Ultimate Load” is assumed to be either the Nominal Breaking Load(NBL) or the Tested Breaking Load (TBL) as defined below.
- *NOMINAL BREAKING LOAD (NBL): Manufacturer’s minimum published breaking load* for a rope or cable.
- *TESTED BREAKING LOAD (TBL): The actual load required to pull a rope or cable to* destruction as determined by testing.
- ***ASSIGNED BREAKING LOAD (ABL):*** Will be the lowest of the Ultimate Load, Nominal Breaking Load and Tested Breaking Load. In practice ABL will be equal to NBL used unless testing shows TBL to be less than NBL. A value greater than the NBL may never be used. Depending on the intended use of the tension member there may be two ABLs for fixed end and free to rotate conditions.

Definitions (cont.)

- *SAFE WORKING LOAD (SWL): The maximum load that is allowed to be supported* during normal operation.
- *FACTOR OF SAFETY (fs):*NORMALY defined as the Ultimate Load/Safe Working Load
- ***FACTOR OF SAFETY (FS):*** For the purpose of this document defined more conservatively as Assigned Breaking Load / Safe Working Load.
- SWL = ABL / FS For the purposes of this standard, FS shall be considered the value selected by the operator. Because there may be two different ABL (fixed end & free to rotate) there may be two SWL. Section 6.0 defines the minimum standards that must be met to select specific FS value.

Definitions (cont.)

- “D” = The root diameter of the sheave.
- “d” = The outside diameter of the cable or rope.
- “d1” = The diameter of largest strand in a rope or cable armor.

Definitions (cont.)

- *TRANSIENT LOADS: Loads induced which are temporary by nature, including the* weight of entrained mud, weight of entrained water, pull out loads, drag due to package characteristics and/or winch speed, etc.
- *DYNAMIC LOADS: Loads induced due to vessel motion (heave, roll, pitch, etc.)*
- “g” = The vertical acceleration due to gravity. For normal static loading (no dynamic effect), “g” is equal to 1.0. To take into account dynamic effect due to ship’s motion and package drag, the simple static load is multiplied by a factor higher than 1.0 under ABS standards: normally 1.75 or 2.0 for vertical accelerations depending on application.

General Concept

- OPERATING REQUIREMENTS – FS of ……..:
- Ropes and cables of *steel construction may be operated to a nominal FS = x.x on the ABL, including transient and dynamic loads, as long as the following precautions* in this section are adhered to.
- The deployment must be halted, or the next level of standards described in Table 6.n adhered to, when the subsequent SWL is reached. To some extent this will depend upon sea conditions and the resulting ship motion. Thus the trend in prevailing weather should be assessed before committing to a deployment, which could approach the limits specified above.

OPERATING REQUIREMENTS
FS of 5.0 OR GREATER

Tension Monitoring	• Tension may be determined by calculation, including transient and dynamic loads, as long as the Owner is confident that a FS of 5.0 will not be exceeded. If no other precise information is available on package drag and/or vessel accelerations, the Vessel Operator should use the ABS "g" factor of 1.75 as a minimum.
Sheave(s)	• D/d ratio must be equal to or greater than the manufacturer's recommendations.
Deck	• Personnel on deck should follow good safety practices when working in the vicinity of cables and ropes during use.
Testing	• No routine break testing is required. Wires shall only be tested every two years to the desired SWL along with the handling system.
Logbooks	• The Owner shall establish an inspection and cutback procedure. At a minimum, the Owner shall maintain logs showing cutbacks and maximum loading (as determined by monitoring system or by calculation for each cast) for the full service life of the rope or cable. The wire log shall transfer with the cable if it is removed and placed in storage, or transferred to another system (winch) or Owner.
Operator	• The Owner and the Master of the vessel must deem competent in writing all winch operators. "Deemed Competent" means that both the Owner and the Captain are confident, given the particulars of the winch and the overall operational scenario (weather conditions, equipment being deployed, etc.), that the Winch Operator has the necessary experience to operate the winch safely.

OPERATING REQUIREMENTS
FS of 5.0 to 2.5

Tension Monitoring	• Tension in the cable or rope must be monitored at the winch operator's station with a display resolution of at least 3 Hz (every 330 mS). The system must also be capable of logging tension data at a minimum frequency of 3 Hz (every 330 mS).
Sheave(s)	• For ropes and cables of steel construction the D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. Grooving of the sheaves should be as close to "d" as practicable, and generally no larger than 1.5d.
Deck	• The Operator should identify "Danger Zones" around ropes and cables under tension. To the extent possible, given the nature of operations involved, all personnel should be excluded from these zones such that a sudden failure cannot result in injury.
Testing	• Samples shall be sent for testing every two (2)years and generally in conjunction with handling system SWL tests. If a 10% decrease in ABL is detected, then the testing shall be increased to annually.
Logbooks	• The Owner should maintain logs showing cutbacks **and load test results** for the full service life of the rope or cable. The archived tension data shall become part of the log and be maintained for the full service life of the cable. The wire log shall transfer with the cable if it is removed and placed in storage, or transferred to another system (winch) or Owner
Operator	• The Winch Owner must certify that all Winch Operators are competent. By "Certified Competent" it is meant that the Owner must have written documentation in place showing that the operator has been through and successfully passed a formal owner/operator developed training program on the winch, handling apparatus, and monitoring system. The system vendor or the Owner, depending on the complexity of the system, may conduct a formal training program. The certification must be renewed annually. The master shall verify qualifications and designate the approved winch operators.

CABLE OPERATING REQUIREMENTS

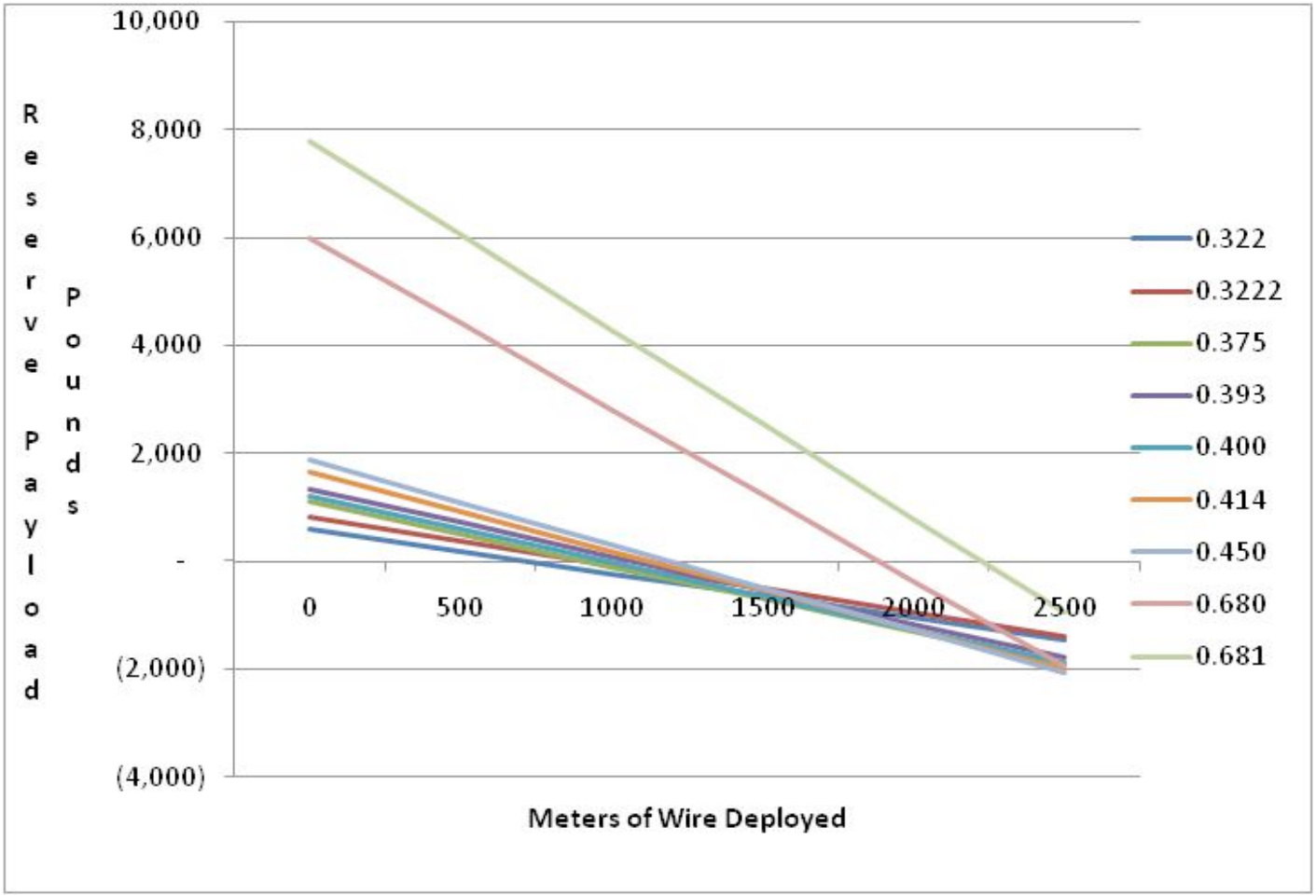
FS of 2.5 to 2.0

Tension Monitoring	• Tension in the cable or rope must be monitored at the winch operator's station with a display resolution of at least **10 Hz (every 100 mS).** The system must also be capable of logging tension data at a minimum frequency of **20 Hz (every 50 mS**). **Tension must be continuously monitored using a "tension trending" graph at the winch operator's station.**
Alarms	• **The handling system shall be fitted with both audible and visual tension alarms that sound and/or illuminated prior to reaching 45% (FS = 2.2) of a cable's Actual Breaking Load (ABL).**
Sheave(s)	• The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. **Grooving should be per HANDBOOK OF OCEANOGRAPHIC WINCH, WIRE AND CABLE TECHNOLOGY, Third Edition, Chapter 1, and Section 11.0 to provide adequate support.**
Deck	• The Operator should identify "Danger Zones" around ropes and cables under tension. To the extent possible, given the nature of operations involved, all personnel should be excluded from these zones such that a sudden failure cannot result in injury. **Warning notices should be displayed at points of access indicating the danger. Physical and/or visual barriers should be erected as needed. Existing doors and accesses to the area should be secured when possible.**
Testing	• **Wire Samples from the end closest to the termination shall be sent for testing annually. If a 10% decrease in ABL is detected, then the testing shall be increased to every six months. Alternately, the Owner may cut back to and re-test a new representative length.**
Logbooks	• Same
Operator	• Same

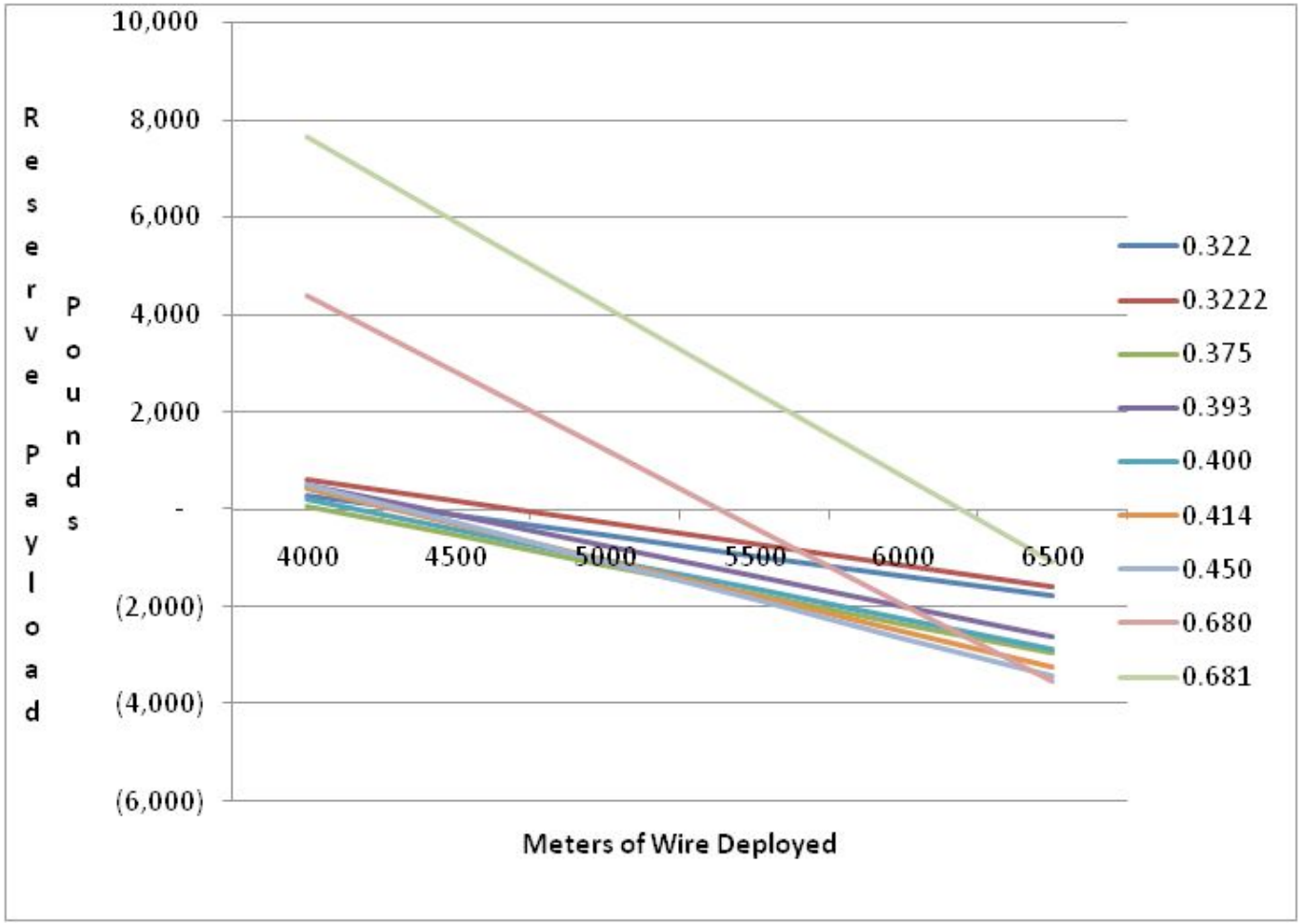
Wire OPERATING REQUIREMENTS
FS of 2. to 1.5

Tension Monitoring	• Tension in the cable or rope must be monitored at the winch operator's station with a display resolution of at least **10 Hz (every 100 mS).** The system must also be capable of logging tension data at a minimum frequency of **20 Hz (every 50 mS**). **Tension must be continuously monitored using a "tension trending" graph at the winch operator's station.**
Alarms	• **The handling system shall be fitted with both audible and visual tension alarms that sound and/or illuminated prior to reaching 60% (FS = 1.7) of a wire's Actual Breaking Load (ABL).**
Haul Back	• **Once a FS = 2.0 is exceeded a regular check on cable loading shall be performed. This will require halting a deployment at regular intervals (~ 500 m) and conducting a slow haul until the nominal and peak tensions are established and verified. A decision on whether to proceed must then be based upon the limiting value of 1.5.**
Sheave(s)	• The D/d ratio must be at least 40:1 or 400d1 (whichever is greater) throughout. **Grooving should be per HANDBOOK OF OCEANOGRAPHIC WINCH, WIRE AND CABLE TECHNOLOGY, Third Edition, Chapter 1, and Section 11.0 to provide adequate support.**
Deck	• The Operator should identify "Danger Zones" around ropes and cables under tension. To the extent possible, given the nature of operations involved, all personnel should be excluded from these zones such that a sudden failure cannot result in injury. **Warning notices should be displayed at points of access indicating the danger. Physical and/or visual barriers should be erected as needed. Existing doors and accesses to the area should be secured when possible.**
Testing	• **When using a FS of 2.0 to 1.5, samples shall be sent for testing annually. If a 10% decrease in ABL is detected, then the testing shall be increased to every six months.**
Logbooks	• Same
Operator	• Same

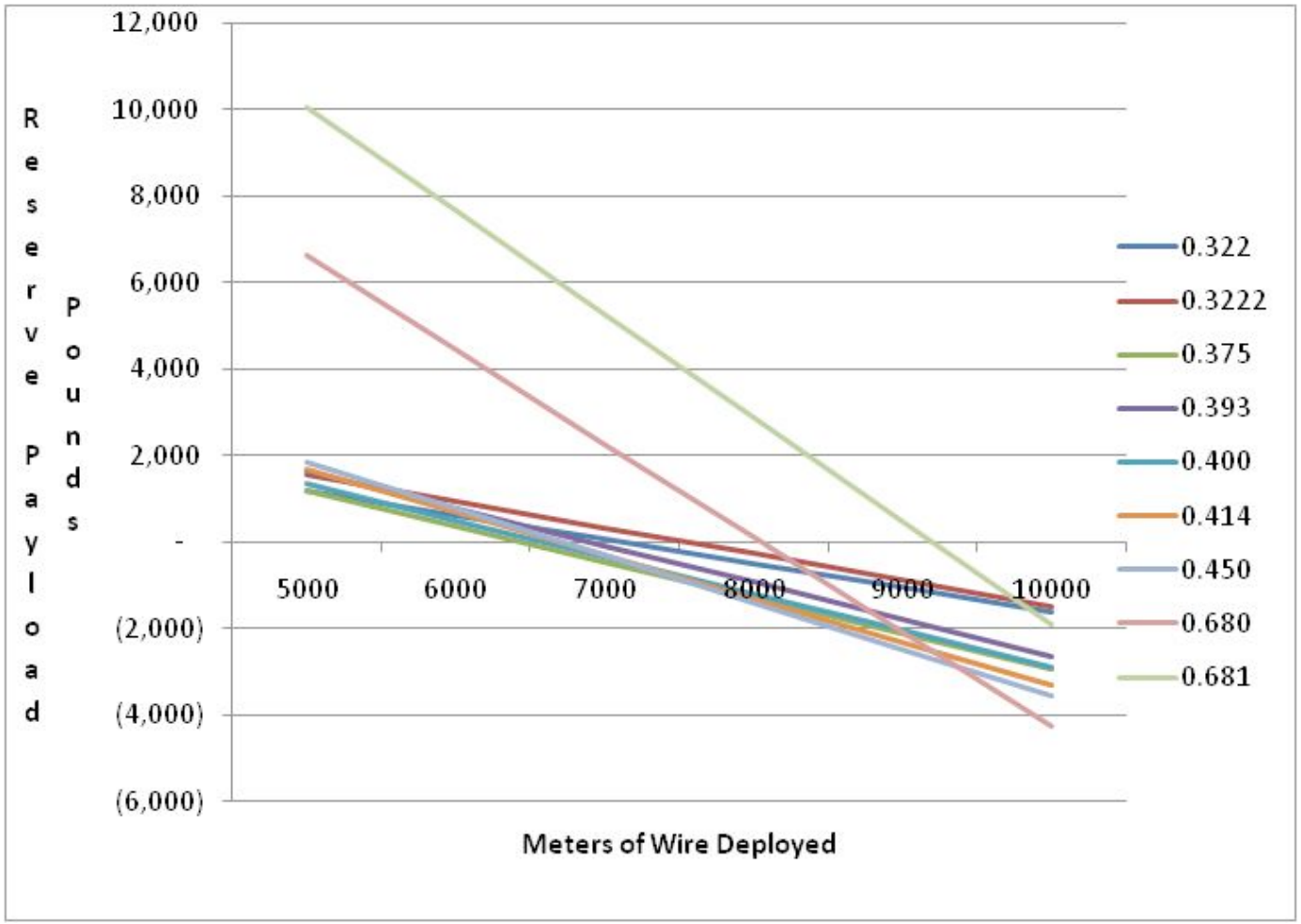
Cables FS 5
Package Wt 800 lbs., g=1.75



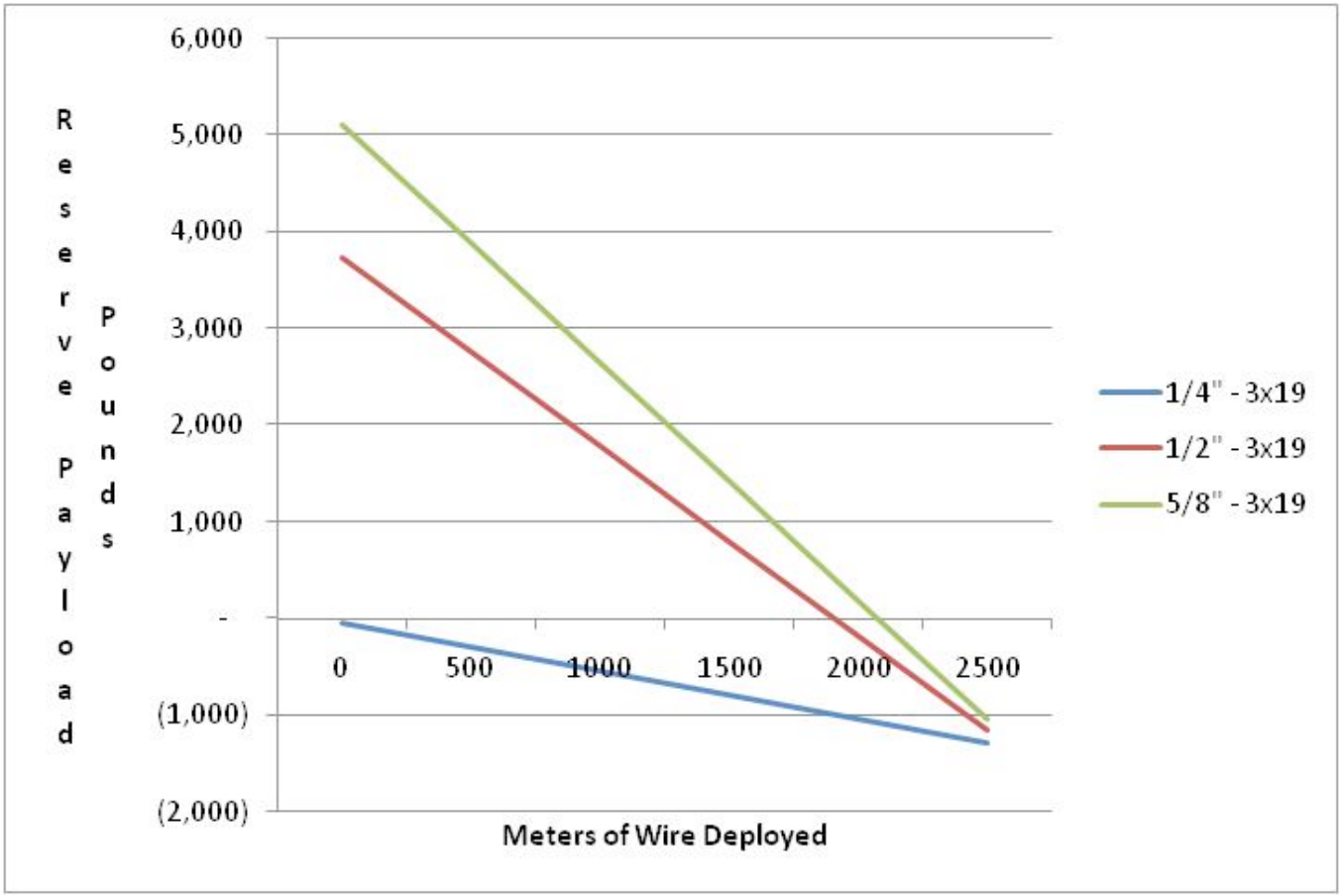
Cables FS 2
Package Wt 800 lbs., g=1.75



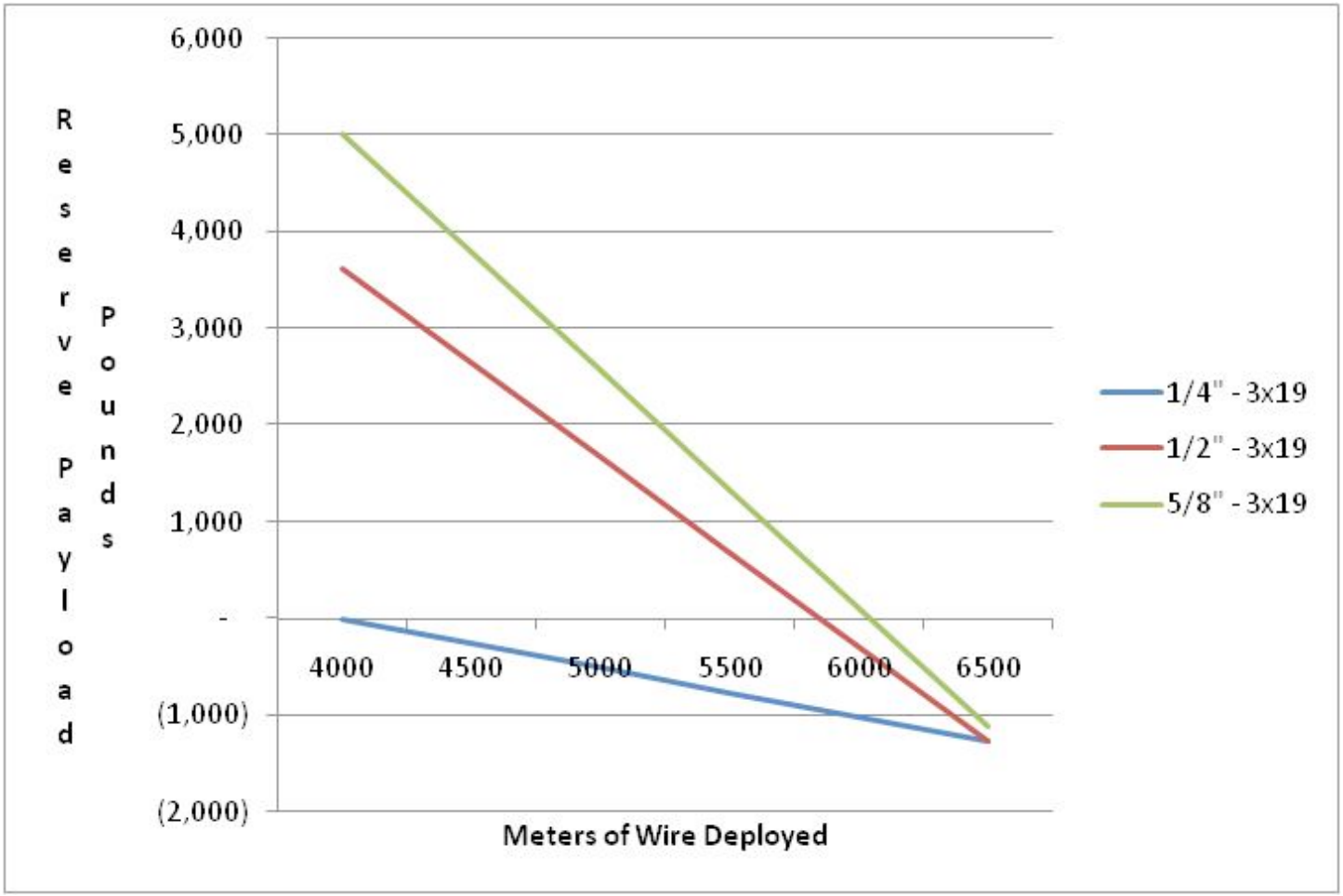
Cables FS 2
Package Wt 800 lbs., g=1.2



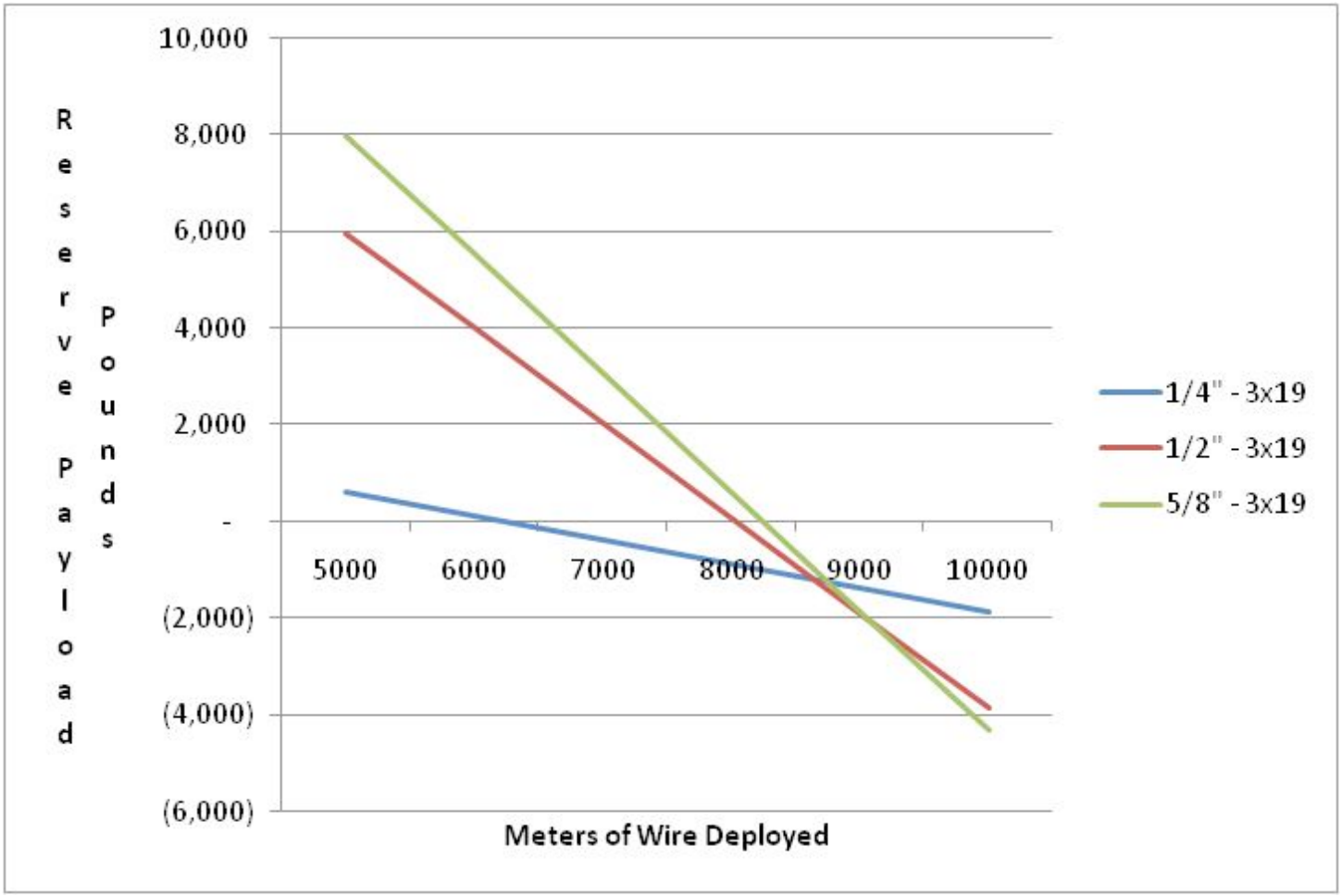
Wire Rope FS 5
Package Wt 800 lbs., g=1.75



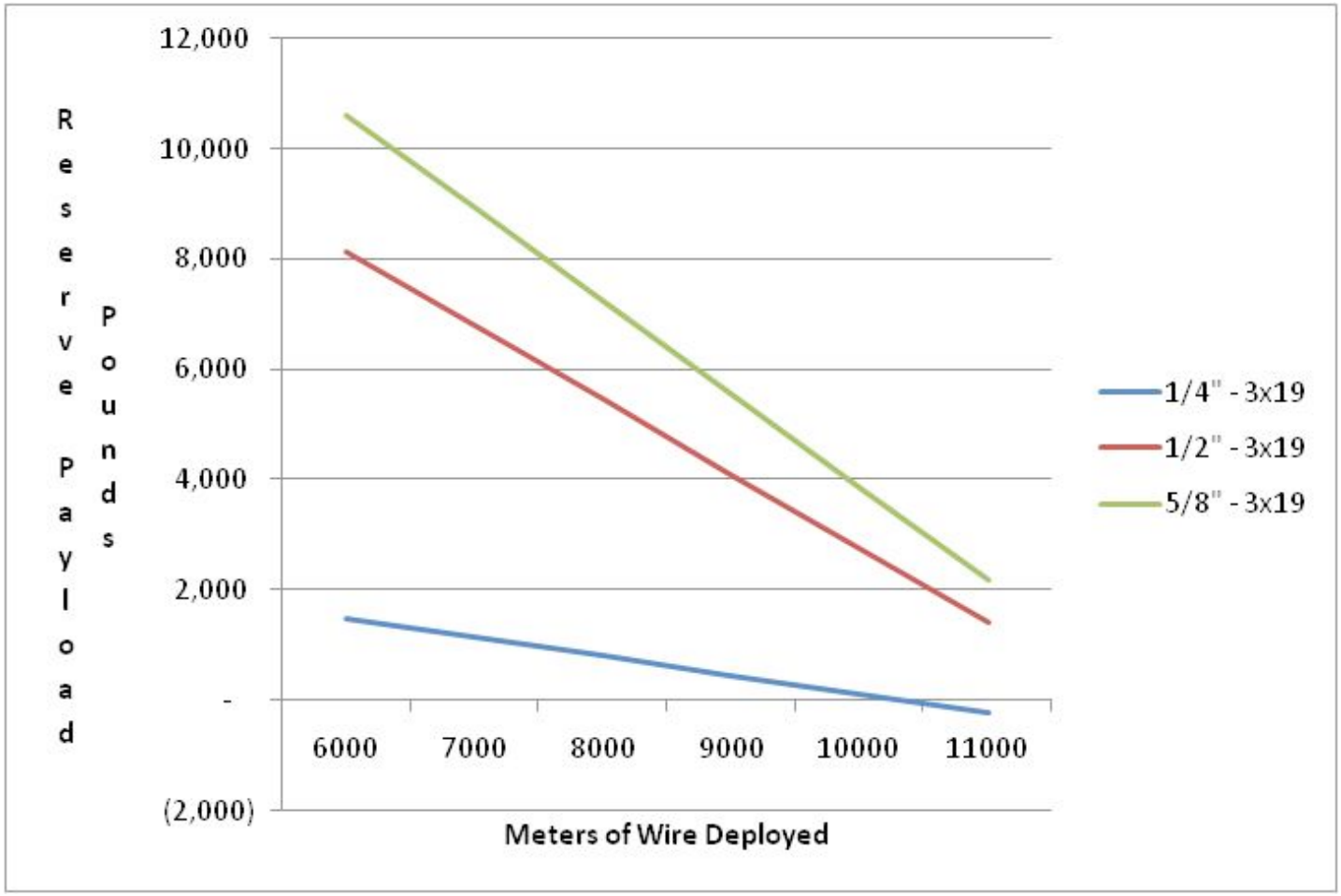
Wire Rope FS 2
Package Wt 800 lbs., g=1.75



Wire Rope FS 1.5
Package Wt 800 lbs., g=1.75



Wire Rope FS 1.5
Package Wt 800 lbs., g=1.2



Implications

- Limited to FS of 5 if tensiometer fails!
- Applies to all winches and tension members including those supplied by scientists!
- No logbooks -- you can not operate!

How Soon?

- This standard will be phased as soon as the appropriate equipment can be funded and purchased and no later than 18 months after the published date of this revision of the RVSS.

SWL Pre-cruise Estimator

SWL Estimator

General Information	Value	Units
Wire Description	.322 Cond FTR	
Manufacturer	Rochester	
Manufacturer Part Number	A30159	
Type (Cond or 3x19)	Cond	
UNOLS Serial Number		
Manufactrer's Breaking Load Specification	10,000	pounds
Actual Breaking Load	10,000	pounds
Weight of wire in seawater lb/meter	0.144	pounds/foot
Diameter of cable/wire (d)	0.322	inches
Diameter of largest strand (d1)	0.0375	inches
Manfacturer Recommended Sheave Diameter	12	inches
Weight of equipment package in seawater	600	pounds
Dynamic Load "g"	1.75	
Transient Load (e.g. pullout)	-	pounds
Winch Operator Status	Certified Competent	

Typical Values

.322 Cond FTR	.322 Cond FE	.680 Cond FE	.680 Cond FTR	.681 Cond FE&FTR	3/16" 3 x 19	1/4" 3 x 19	1/4" 3 x 19	5/16" 3 x 19	Trawl 1/2"	Trawl 9/16"
Rochester	Rochester	Rochester	Rochester	Rochester		WireCo	WireCo		WireCo	WireCo
A30159	A30159	A301241	A301241	A30251		RP041070	RP041070		0	0
Cond	Cond	Cond	Cond	Cond	3x19	3x19	3x19 Nor-Lok 2-H26	3x19	3x19	3x19
10,000	11,600	40,000	37,000	46,000	4,000	6,750	6,750	10,300	25,700	32,500
							7,240			
0.144	0.144	0.553	0.553	0.608		0.0867	0.0867		0.341	0.428
0.322	0.322	0.680	0.680	0.681		0.250	0.250	0.313	0.5	0.5625
0.0375	0.0375	0.060	0.060			0.031	0.031		0.058	0.066
12	12	28	28	48		12.5	12.5		23.5	26.5

Scope	Weight of Wire	Static Load inc. package	Dynamic Load Included	Total Load Including Pullout	Reserve				
					FoS	5	2.5	2	1.5
					% of ABL	20%	40%	50%	66.7%
Meters	Pounds	Pounds	Pounds	Pounds	Max Load	2,000	4,000	5,000	6,667
0	0	600	1050	1050		950	2,950	3,950	-
1000	472	1072	1877	1877		123	2,123	3,123	-
2000	945	1545	2703	2703		(703)	1,297	2,297	-
3000	1417	2017	3530	3530		(1,530)	470	1,470	-
3500	1653	2253	3943	3943		(1,943)	57	1,057	-
5000	2362	2962	5183	5183		(3,183)	(1,183)	(183)	-
6000	2834	3434	6009	6009		(4,009)	(2,009)	(1,009)	-
7000	3306	3906	6836	6836		(4,836)	(2,836)	(1,836)	-
8000	3779	4379	7662	7662		(5,662)	(3,662)	(2,662)	-
9000	4251	4851	8489	8489		(6,489)	(4,489)	(3,489)	-
10000	4723	5323	9316	9316		(7,316)	(5,316)	(4,316)	-
Min Sheave Diameter (Larger is always better)						12.00	15.00	15.00	15.00

Instructions

Copy the data for the specific cable you are working with from the table above

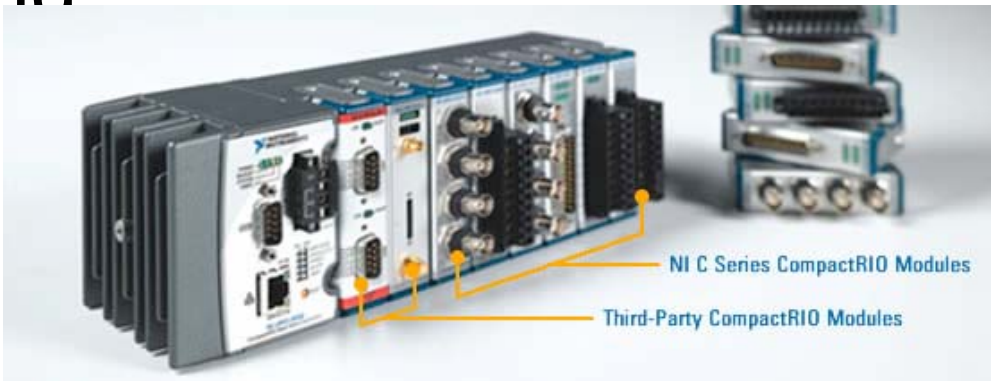
Paste it over cells e3 through e13

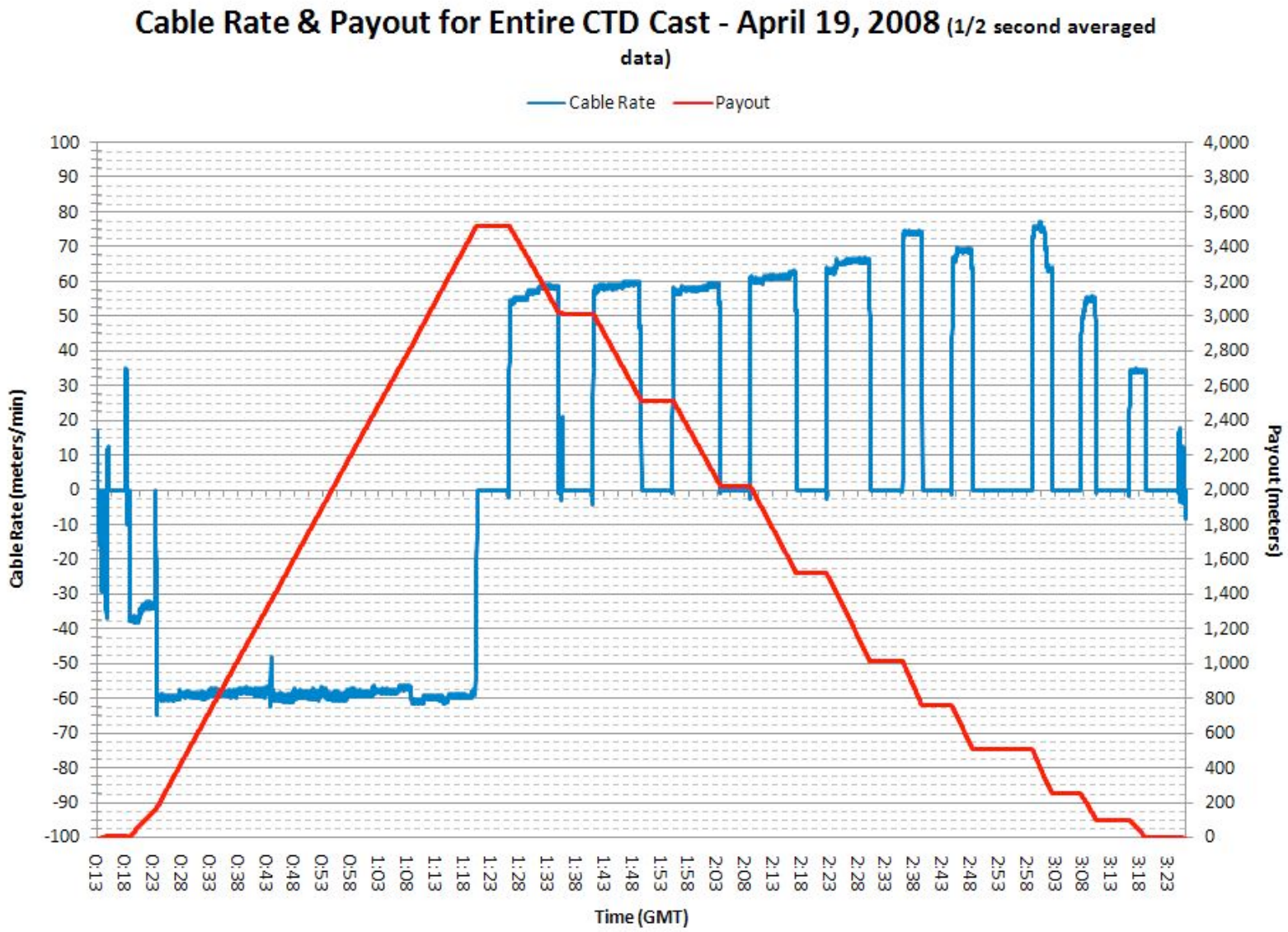
If the cable you selected does not have a value in e9, you will have to make an estimate based on e8

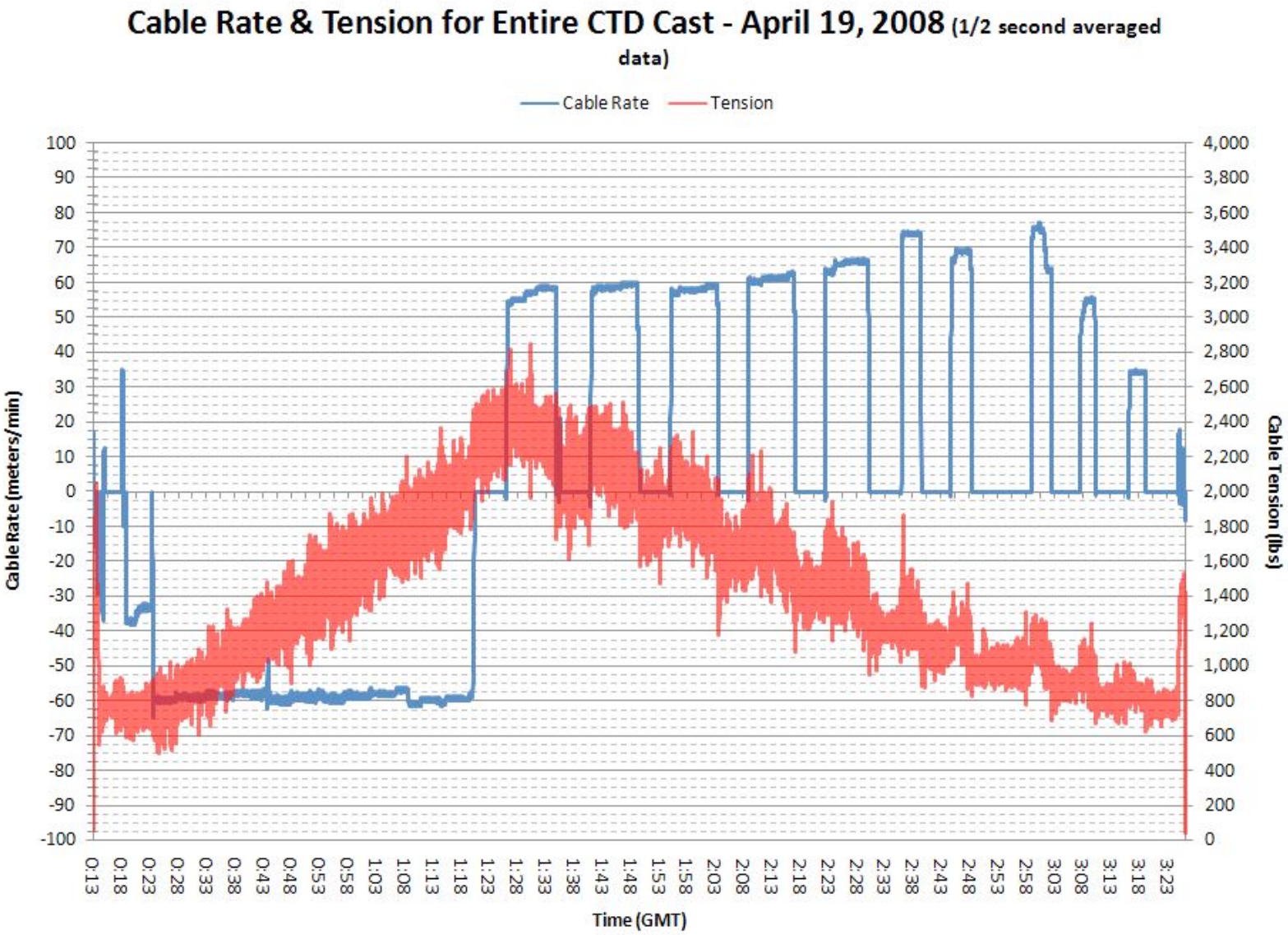
Enter the appropriate values in cells e14 and e16

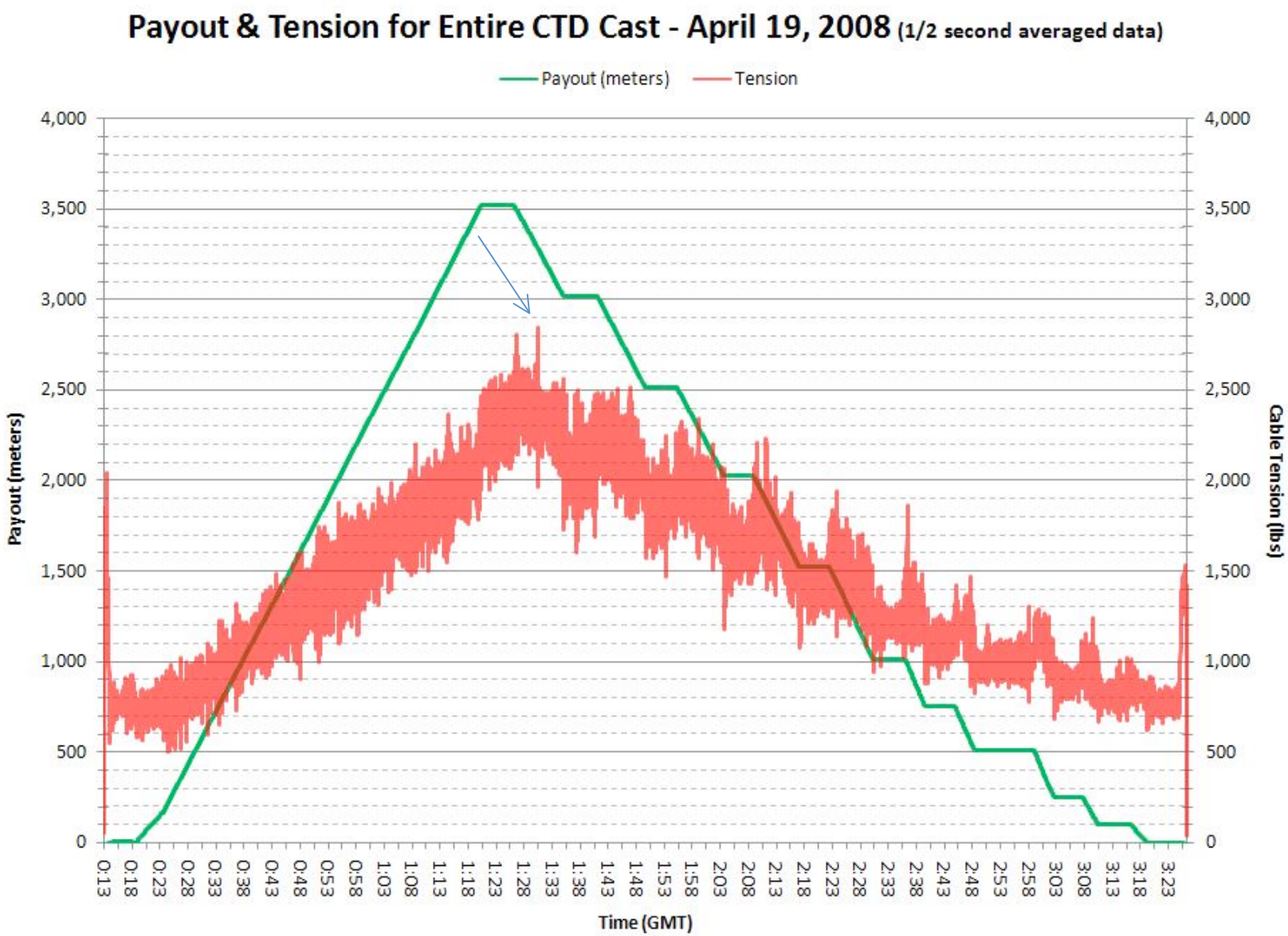
Real World Test

- 12 x 12 Carousel with dual LADCP
- Weather conditions moderate SS 2-3
- Deployed 3500 meters of cable, calculated tension of 2253 pounds.
- National Instruments cRIO data acquisition 20 samples/second
- $3,600

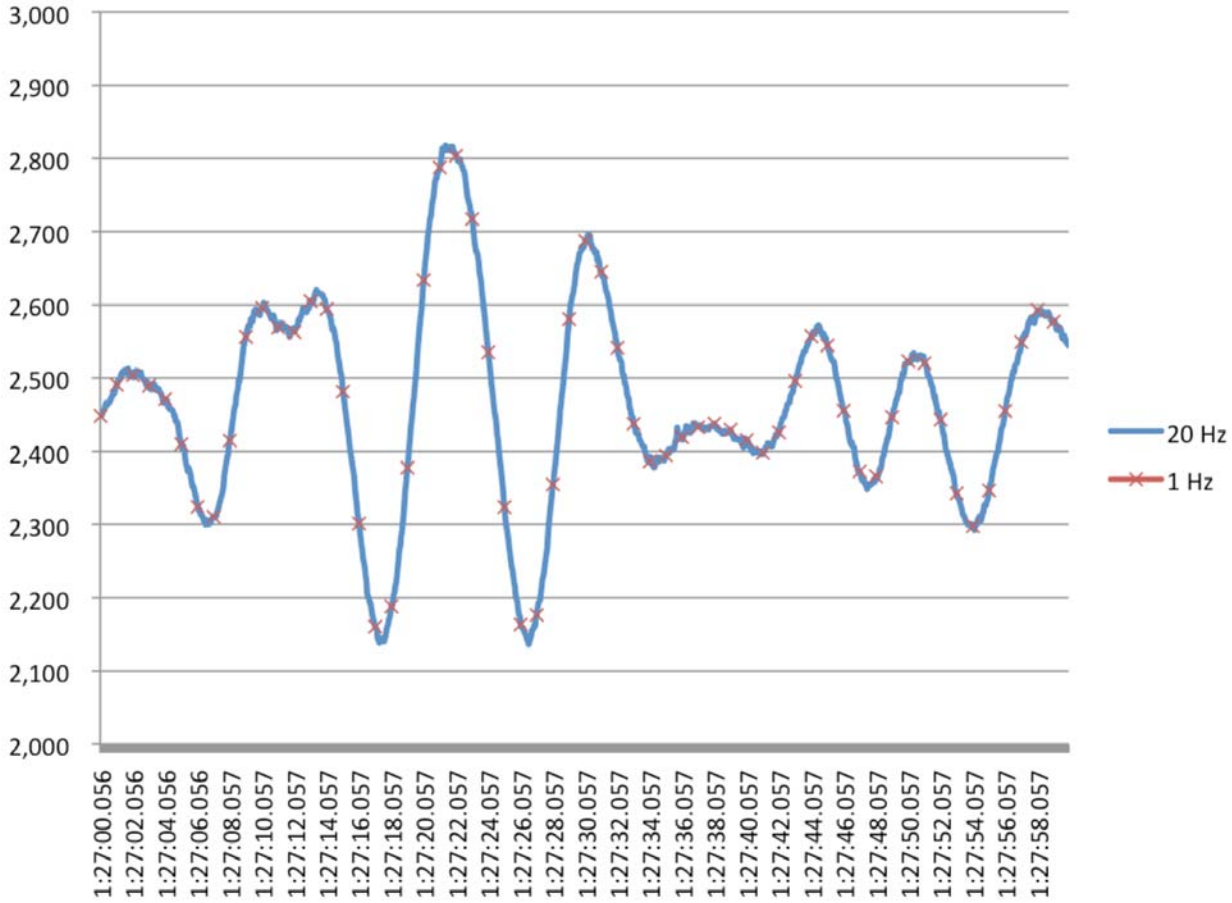



Cable Rate & Payout for Entire CTD Cast - April 19, 2008 (1/2 second averaged data)
Cable Rate
Payout
Cable Rate (meters/min)
Payout (meters)
Time (GMT)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0:13
0:18
0:23
0:28
0:33
0:38
0:43
0:48
0:53
0:58
1:03
1:08
1:13
1:18
1:23
1:28
1:33
1:38
1:43
1:48
1:53
1:58
2:03
2:08
2:13
2:18
2:23
2:28
2:33
2:38
2:43
2:48
2:53
2:58
3:03
3:08
3:13
3:18
3:23

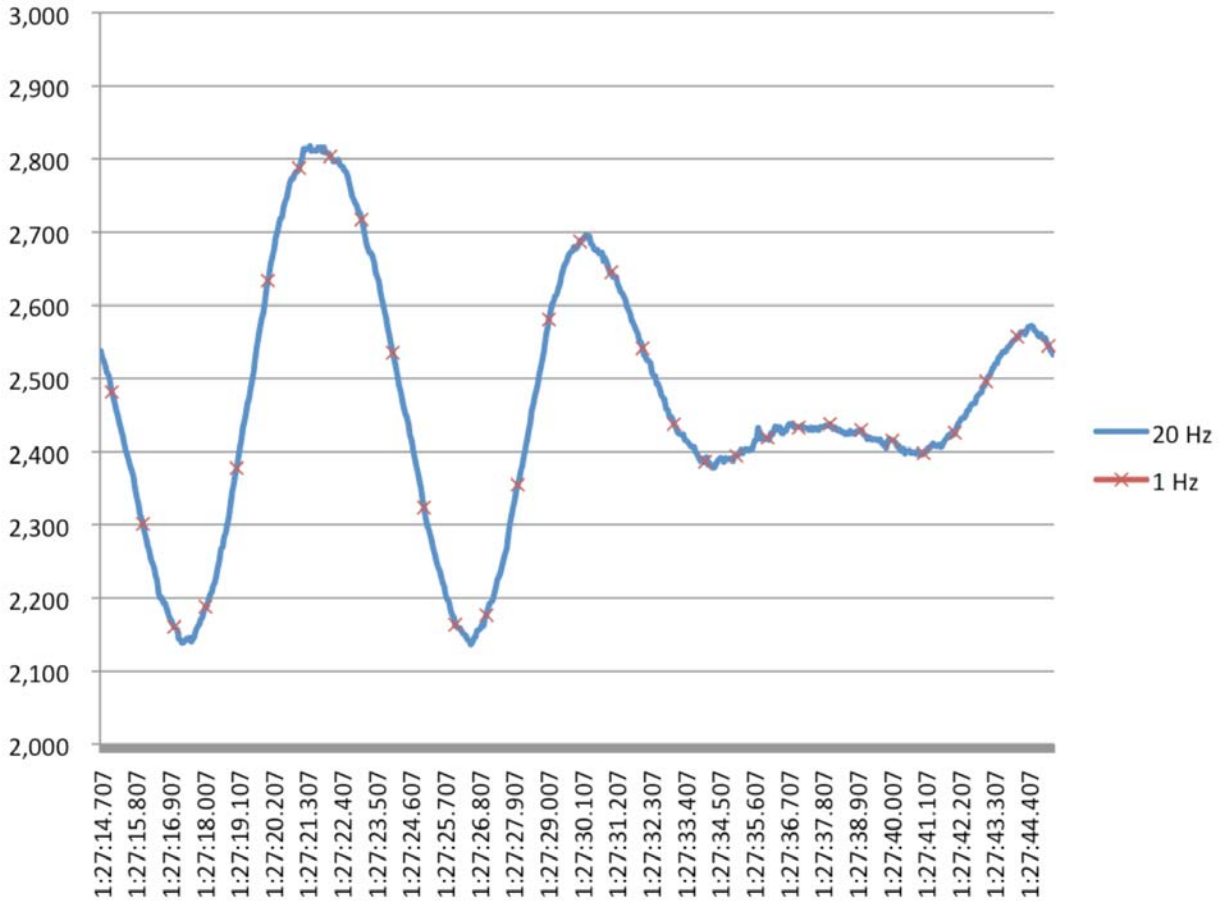

Cable Rate & Tension for Entire CTD Cast - April 19, 2008 (1/2 second averaged data)
Cable Rate
Tension
Cable Rate (meters/min)
Cable Tension (lbs)
Time (GMT)
100
90
80
70
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
4,000
3,800
3,600
3,400
3,200
3,000
2,800
2,600
2,400
2,200
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
0:13
0:18
0:23
0:28
0:33
0:38
0:43
0:48
0:53
0:58
1:03
1:08
1:13
1:18
1:23
1:28
1:33
1:38
1:43
1:48
1:53
1:58
2:03
2:08
2:13
2:18
2:23
2:28
2:33
2:38
2:43
2:48
2:53
2:58
3:03
3:08
3:13
3:18
3:23


Payout & Tension for Entire CTD Cast - April 19, 2008 (1/2 second averaged data)
Payout (meters)
Tension
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
Payout (meters)
Cable Tension (lbs)
0:13
0:18
0:23
0:28
0:33
0:38
0:43
0:48
0:53
0:58
1:03
1:08
1:13
1:18
1:23
1:28
1:33
1:38
1:43
1:48
1:53
1:58
2:03
2:08
2:13
2:18
2:23
2:28
2:33
2:38
2:43
2:48
2:53
2:58
3:03
3:08
3:13
3:18
3:23
Time (GMT)

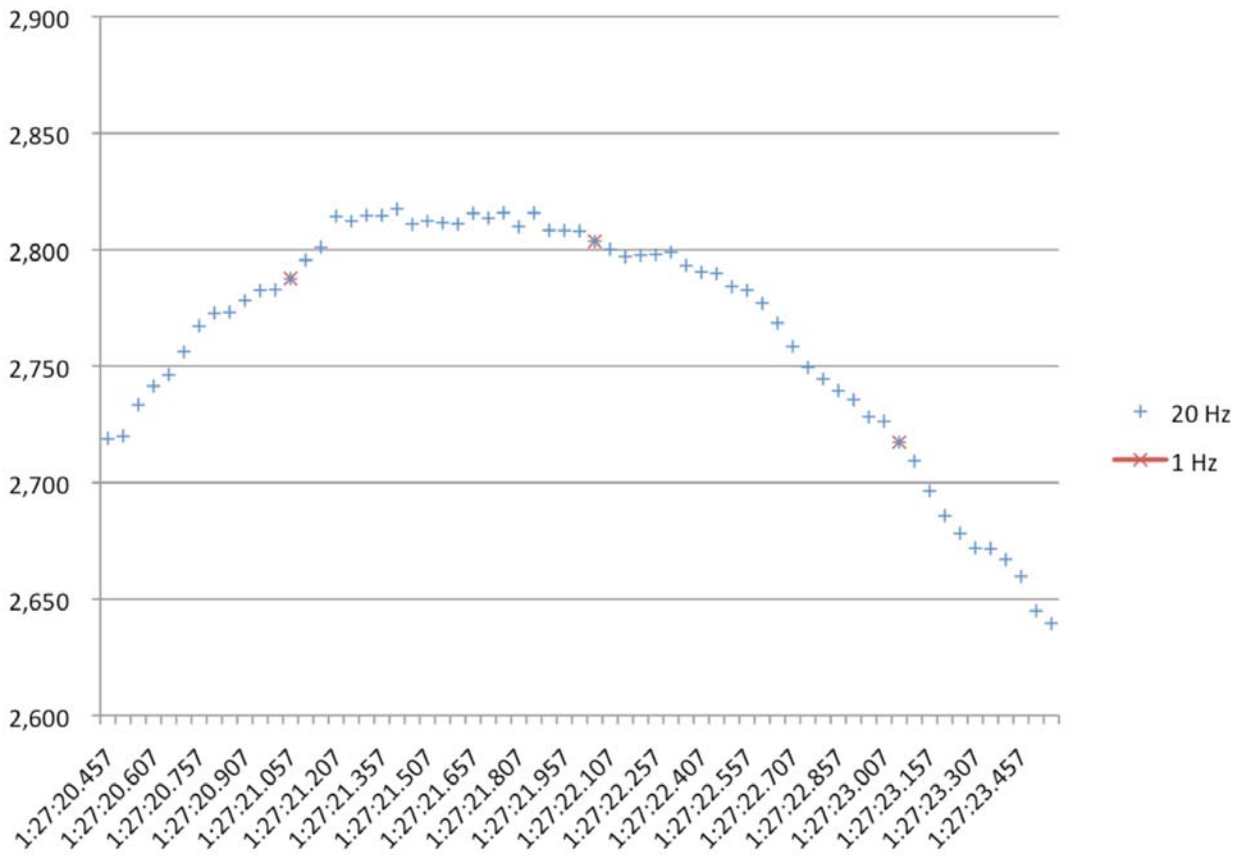
60 Seconds


3,000
2,900
2,800
2,700
2,600
2,500
2,400
2,300
2,200
2,100
2,000
1:27:00.056
1:27:02.056
1:27:04.056
1:27:06.056
1:27:08.057
1:27:10.057
1:27:12.057
1:27:14.057
1:27:16.057
1:27:18.057
1:27:20.057
1:27:22.057
1:27:24.057
1:27:26.057
1:27:28.057
1:27:30.057
1:27:32.057
1:27:34.057
1:27:36.057
1:27:38.057
1:27:40.057
1:27:42.057
1:27:44.057
1:27:46.057
1:27:48.057
1:27:50.057
1:27:52.057
1:27:54.057
1:27:56.057
1:27:58.057
20 Hz
1 Hz

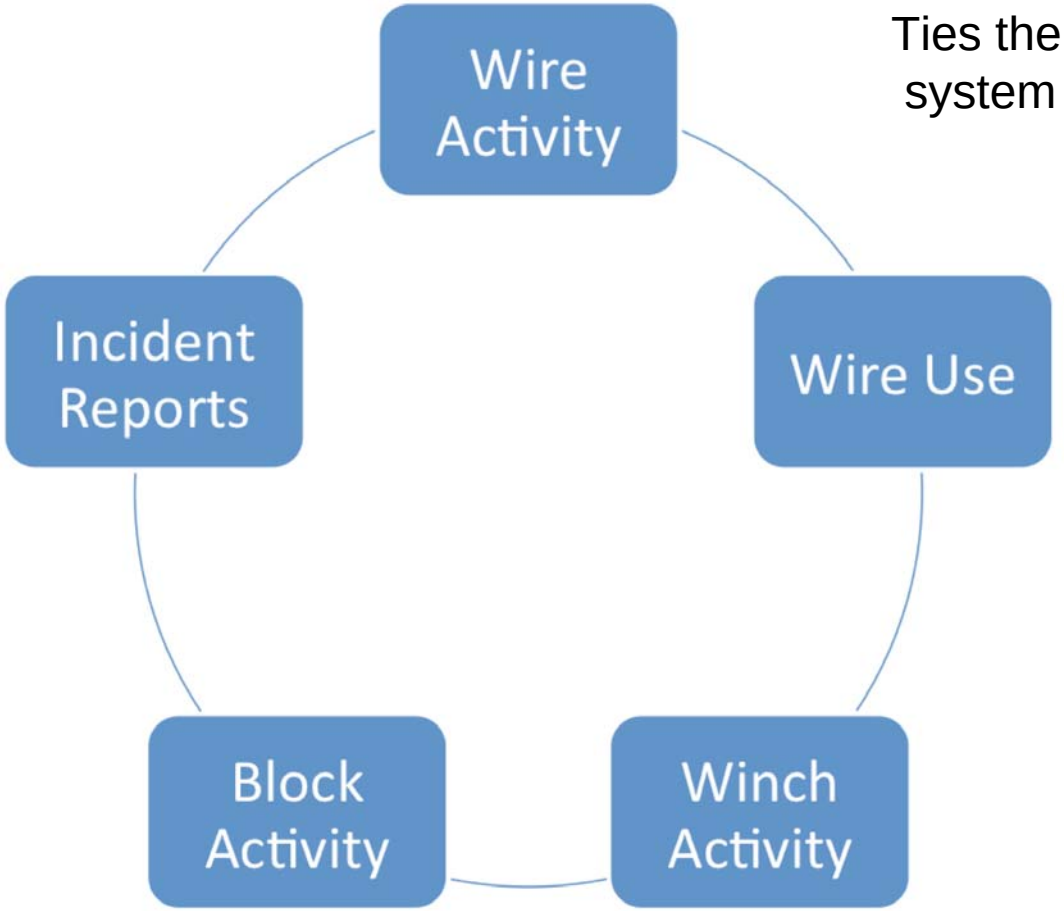
30 Seconds


3,000
2,900
2,800
2,700
2,600
2,500
2,400
2,300
2,200
2,100
2,000
1:27:14.707
1:27:15.807
1:27:16.907
1:27:18.007
1:27:19.107
1:27:20.207
1:27:21.307
1:27:22.407
1:27:23.507
1:27:24.607
1:27:25.707
1:27:26.807
1:27:27.907
1:27:29.007
1:27:30.107
1:27:31.207
1:27:32.307
1:27:33.407
1:27:34.507
1:27:35.607
1:27:36.707
1:27:37.807
1:27:38.907
1:27:40.007
1:27:41.107
1:27:42.207
1:27:43.307
1:27:44.407
20 Hz
1 Hz

4 Seconds


2,900
2,850
2,800
2,750
2,700
2,650
2,600
1:27:20.457
1:27:20.607
1:27:20.757
1:27:20.907
1:27:21.057
1:27:21.207
1:27:21.357
1:27:21.507
1:27:21.657
1:27:21.807
1:27:21.957
1:27:22.107
1:27:22.257
1:27:22.407
1:27:22.557
1:27:22.707
1:27:22.857
1:27:23.007
1:27:23.157
1:27:23.307
1:27:23.457
20 Hz
1 Hz

Winch & Wire Handbook, 3rd Edition
Chapter 7 - Instrumentation Lowering System Documentation



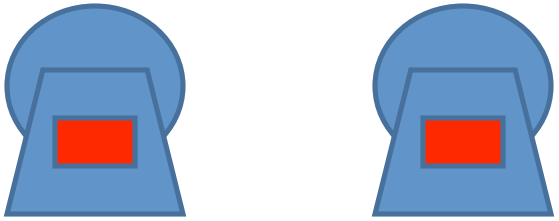
Ties the entire handling system together.

Challenge

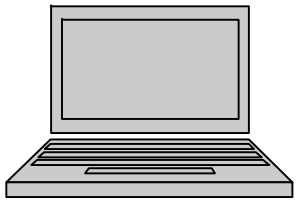
- New responsibilities for ship operators & winch operators to be able to operate at lowest FS
- If you don’t keep required records you can not meet the scientist’s needs
- Solution is to integrate and automate

Network Nodes

Web browser display, one control multiple view



Operator



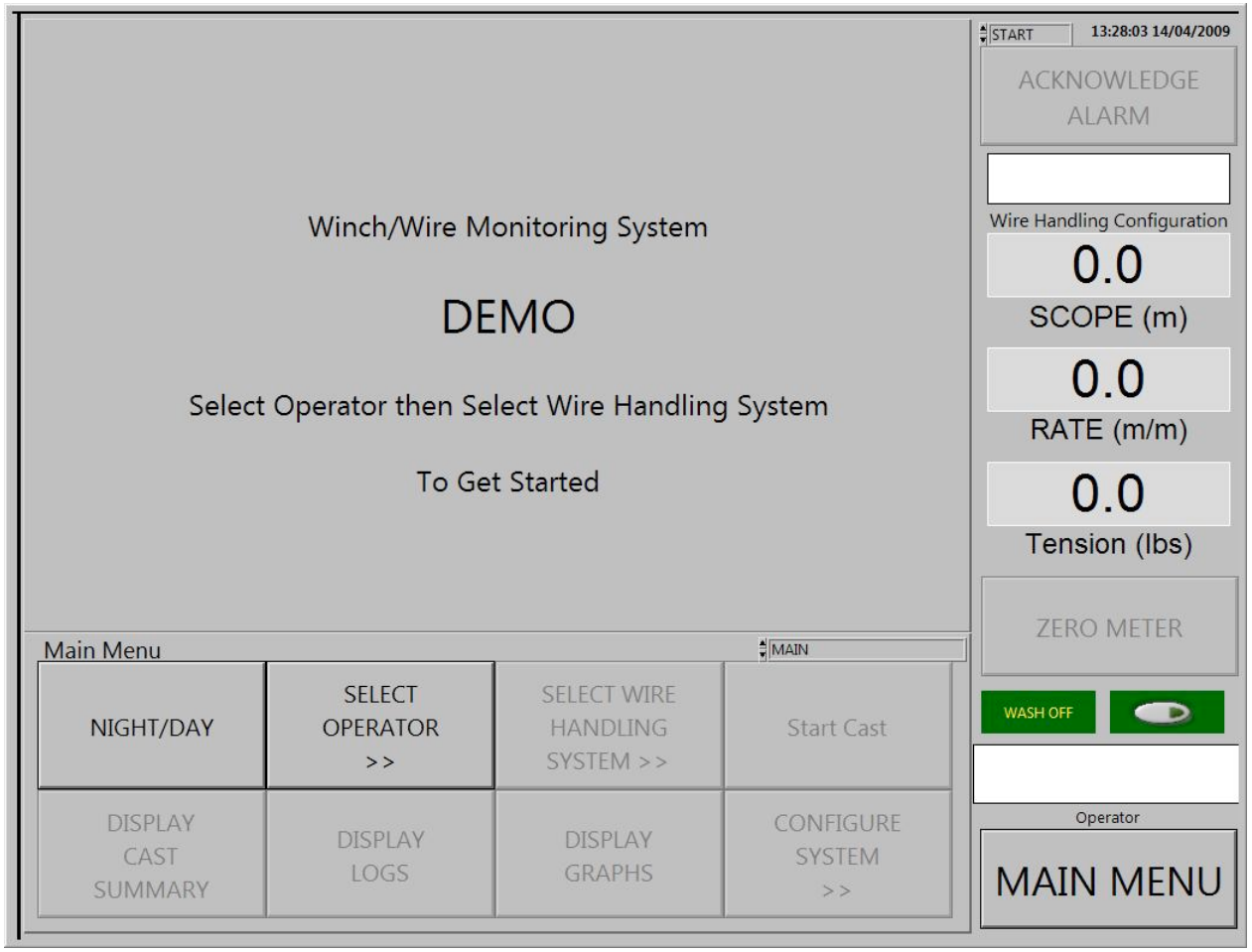
General Description

- Acquisition/logging system attached to winch
- Compatible with installed sensors
- Combination of solid state hard drive and Compact Flash memory
  - Hard drive holds wire log, **stays with wire** (characteristics, test results, deployments, tension, cut backs, etc.)
  - CF holds winch logs, **stays with winch** (SWL, tensiometer cals, sheave characteristics, lubrication etc.)
- Ship network storage holds ship related logs, **stays with ship** (operator certifications, sheave characteristics, frame SWL)
- Outputs - NMEA 183, NMEA 2000, Ethernet, UDP

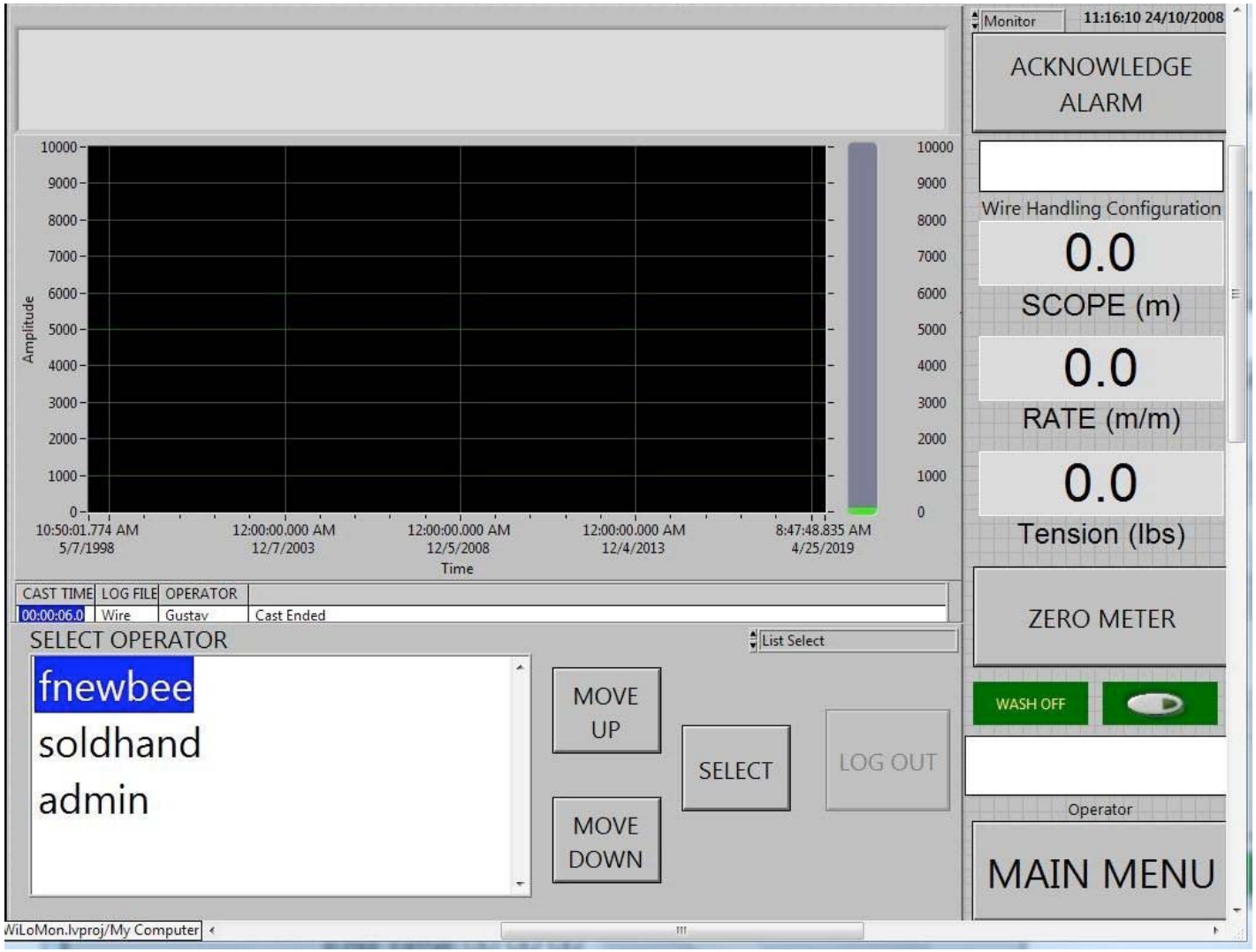
Capabilities

- Takes all the information available and shows real time minimum FS
  - Operator qualification
  - Last determination of ABL
  - Blocks within specification
- Displays current Operating Requirements
  - Deck cleared, physical barriers etc.
- Predicts load – deviation would indicate approach of slack wire
- Logs everything –winch operator, winch, blocks in use and suitability, bending cycles
- Controls fresh water spray bar
- Could control hydraulic by pass valve for auto render

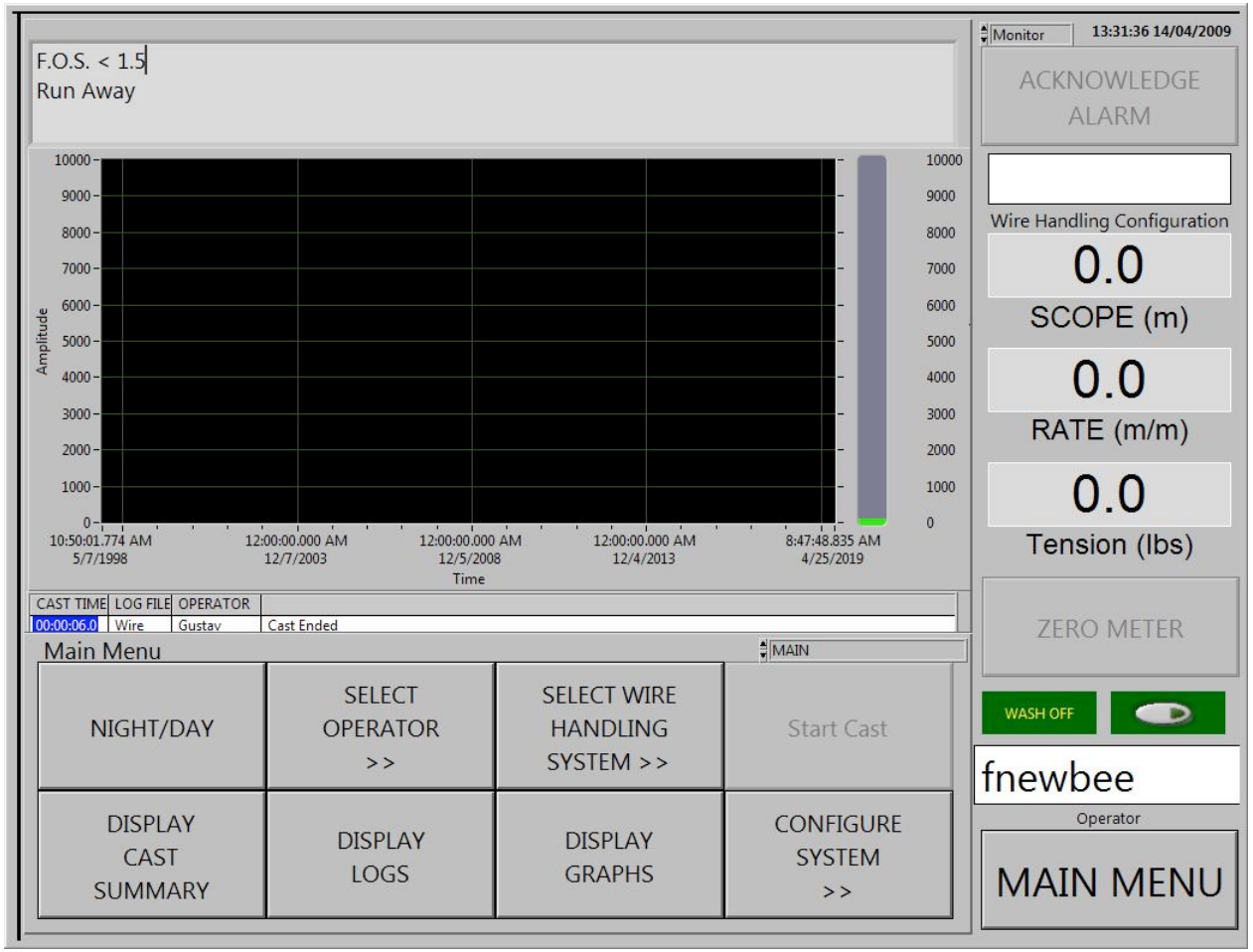
Start Menu


START
13:28:03 14/04/2009
ACKNOWLEDGE ALARM
Wire Handling Configuration
0.0
SCOPE (m)
0.0
RATE (m/m)
0.0
Tension (lbs)
ZERO METER
WASH OFF
Operator
MAIN MENU
Winch/Wire Monitoring System
DEMO
Select Operator then Select Wire Handling System
To Get Started
Main Menu
MAIN
NIGHT/DAY
SELECT OPERATOR >>
SELECT WIRE HANDLING SYSTEM >>
Start Cast
DISPLAY CAST SUMMARY
DISPLAY LOGS
DISPLAY GRAPHS
CONFIGURE SYSTEM >>

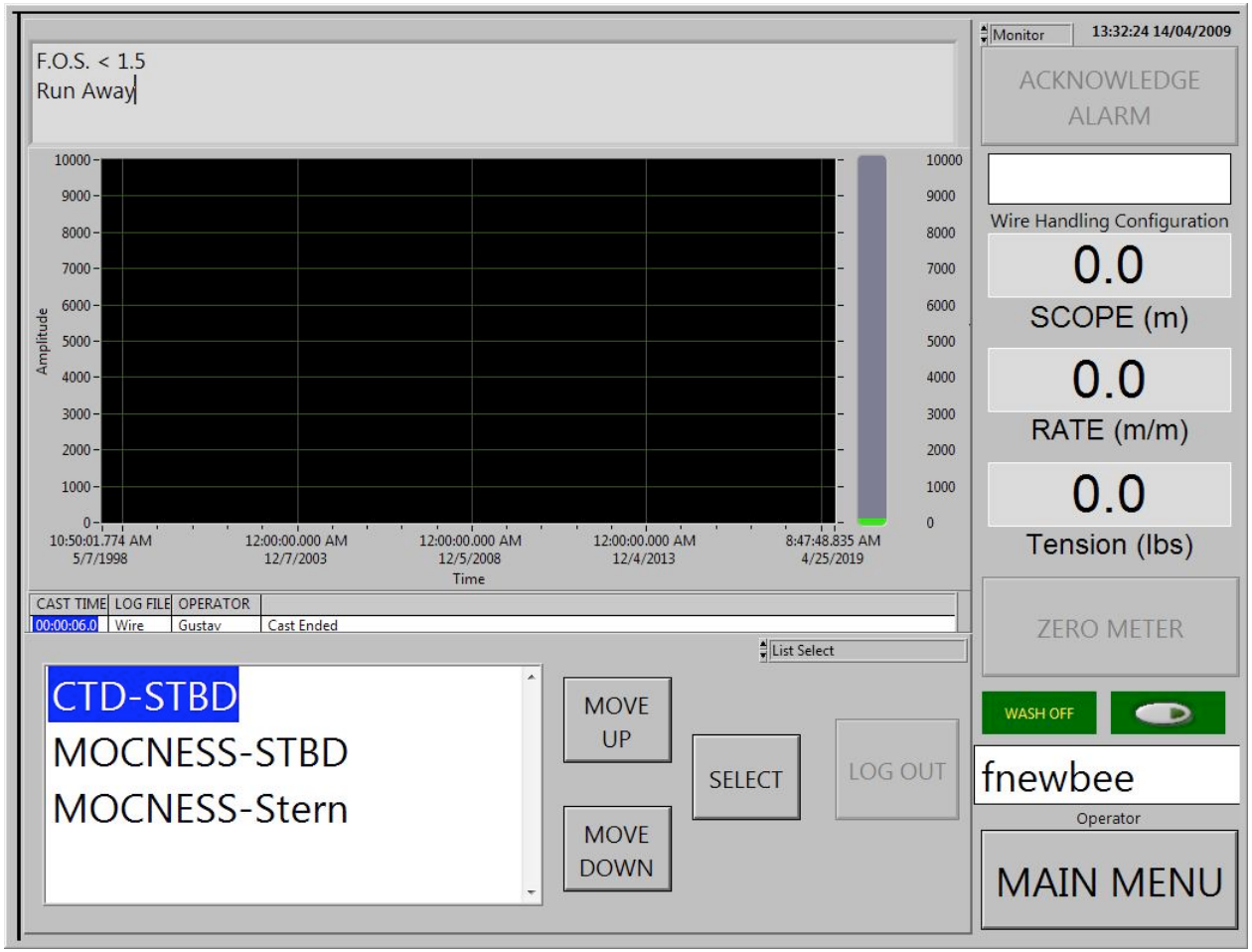
Select Operator



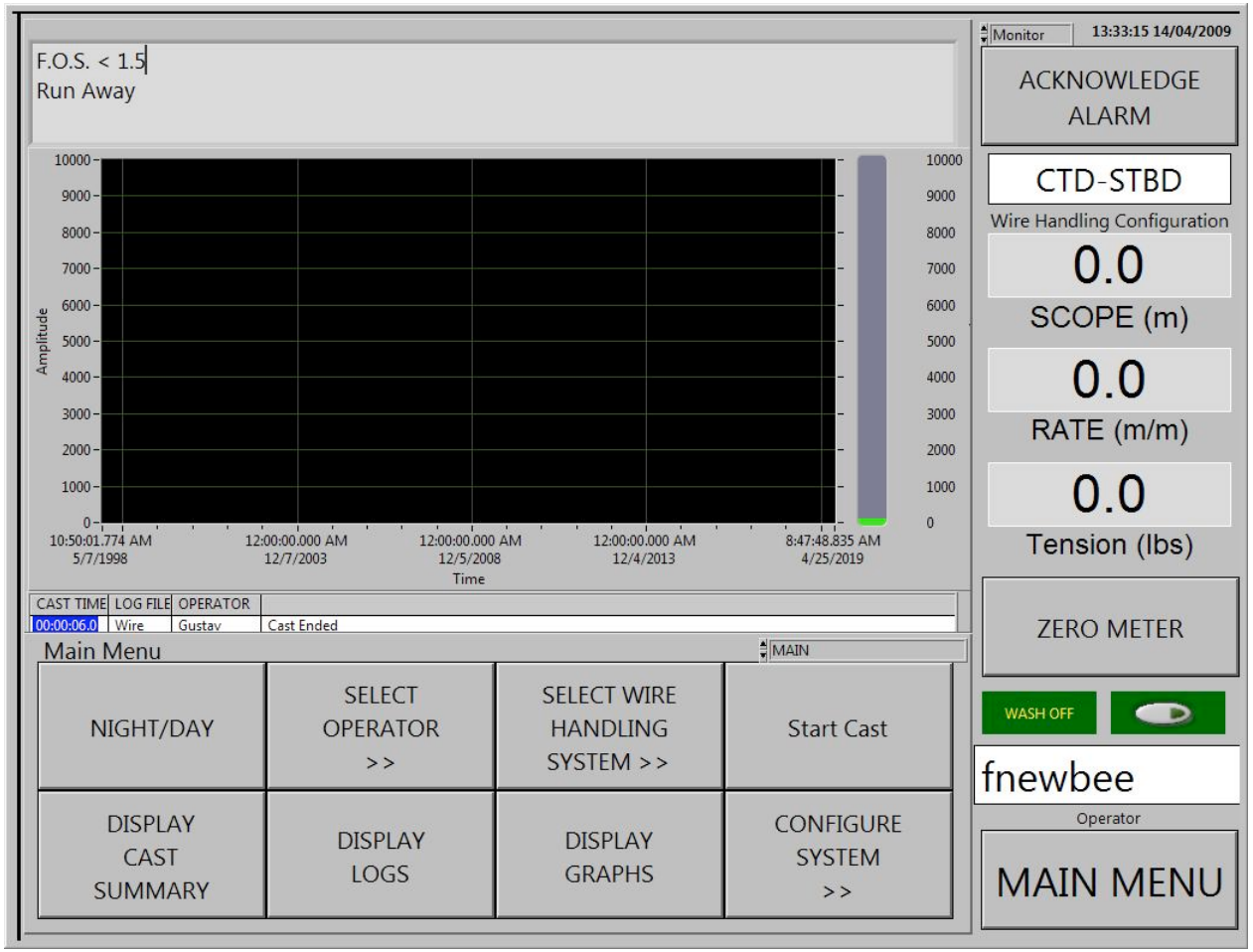
Operator Selected



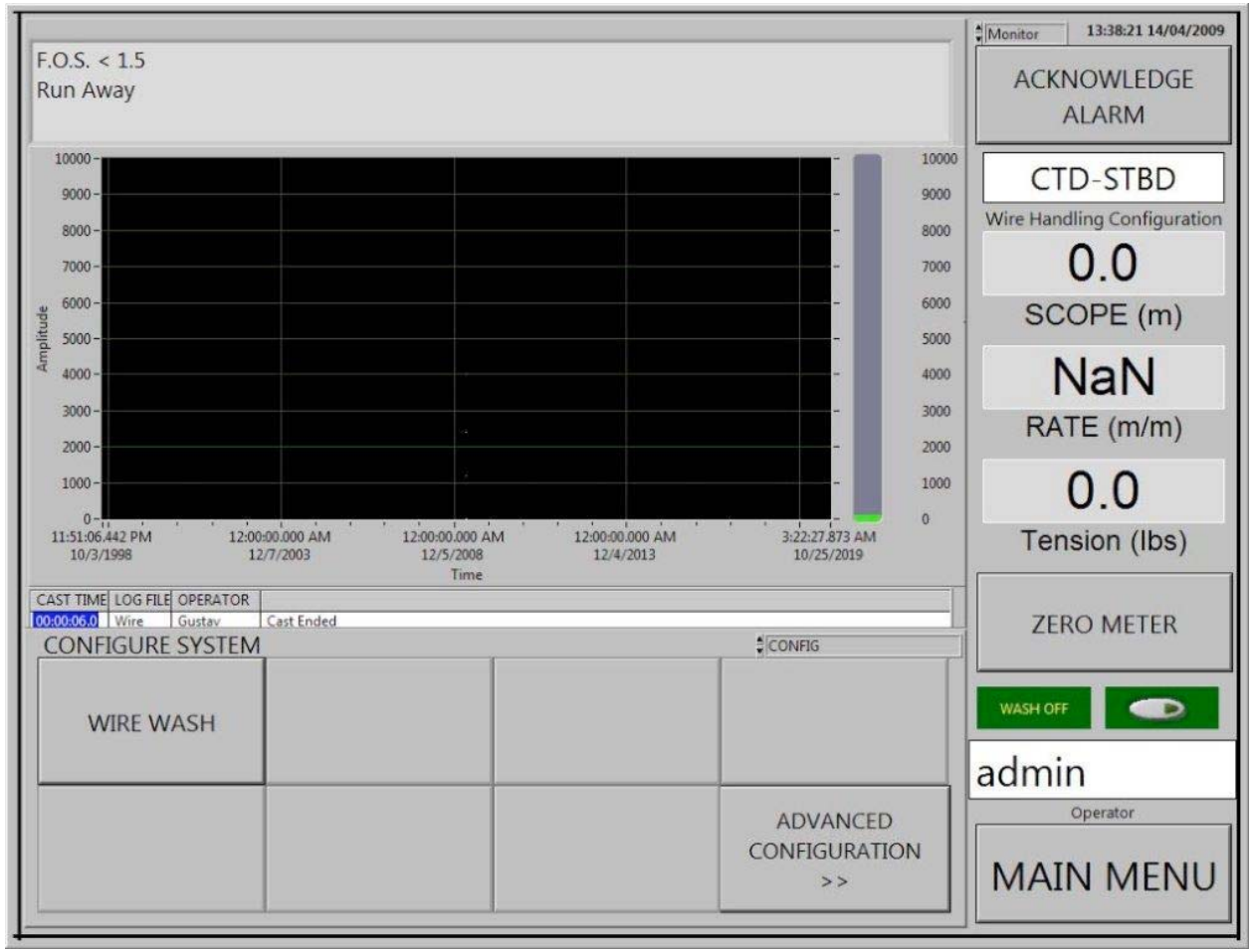
Select Handling System



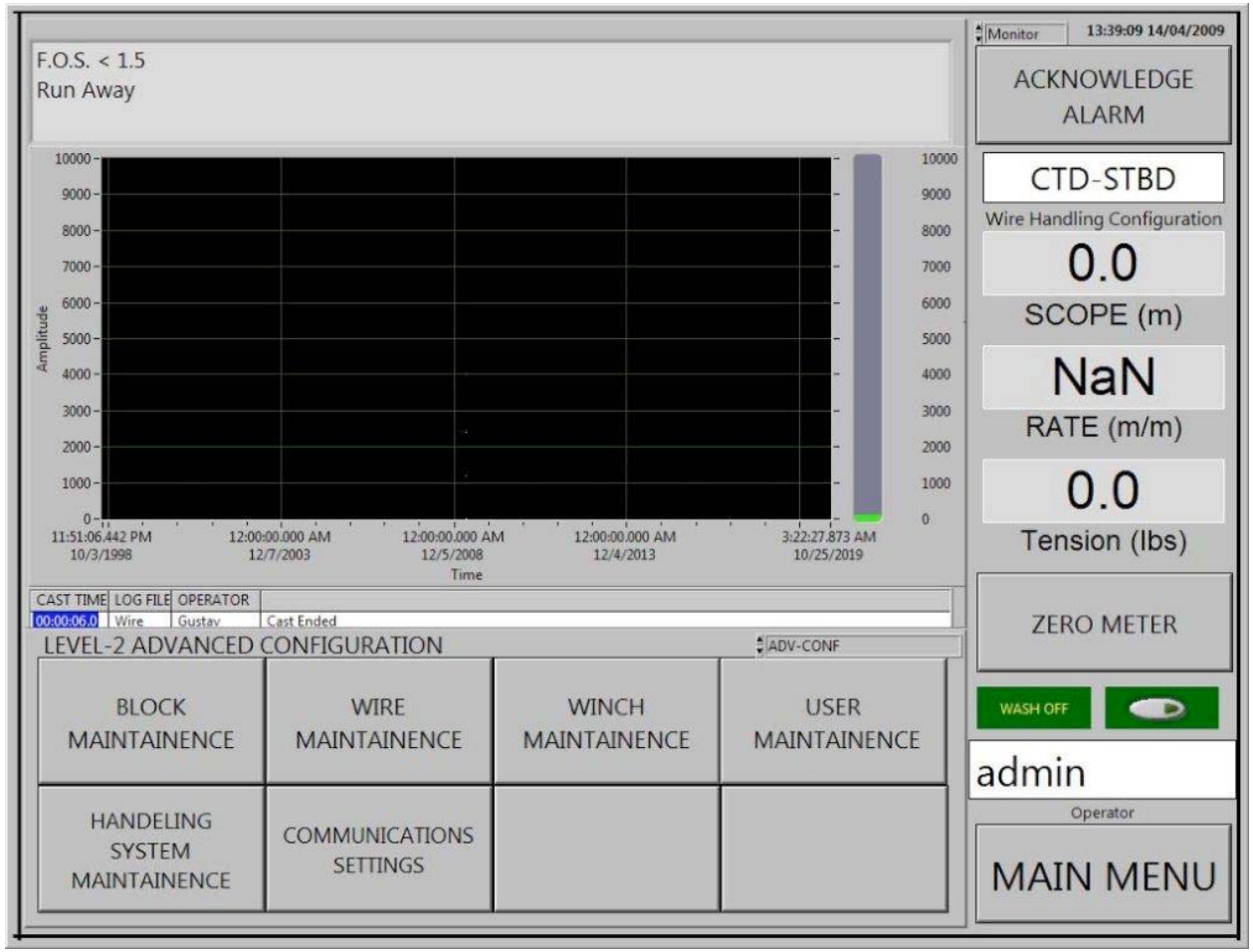
Ready to Start Cast



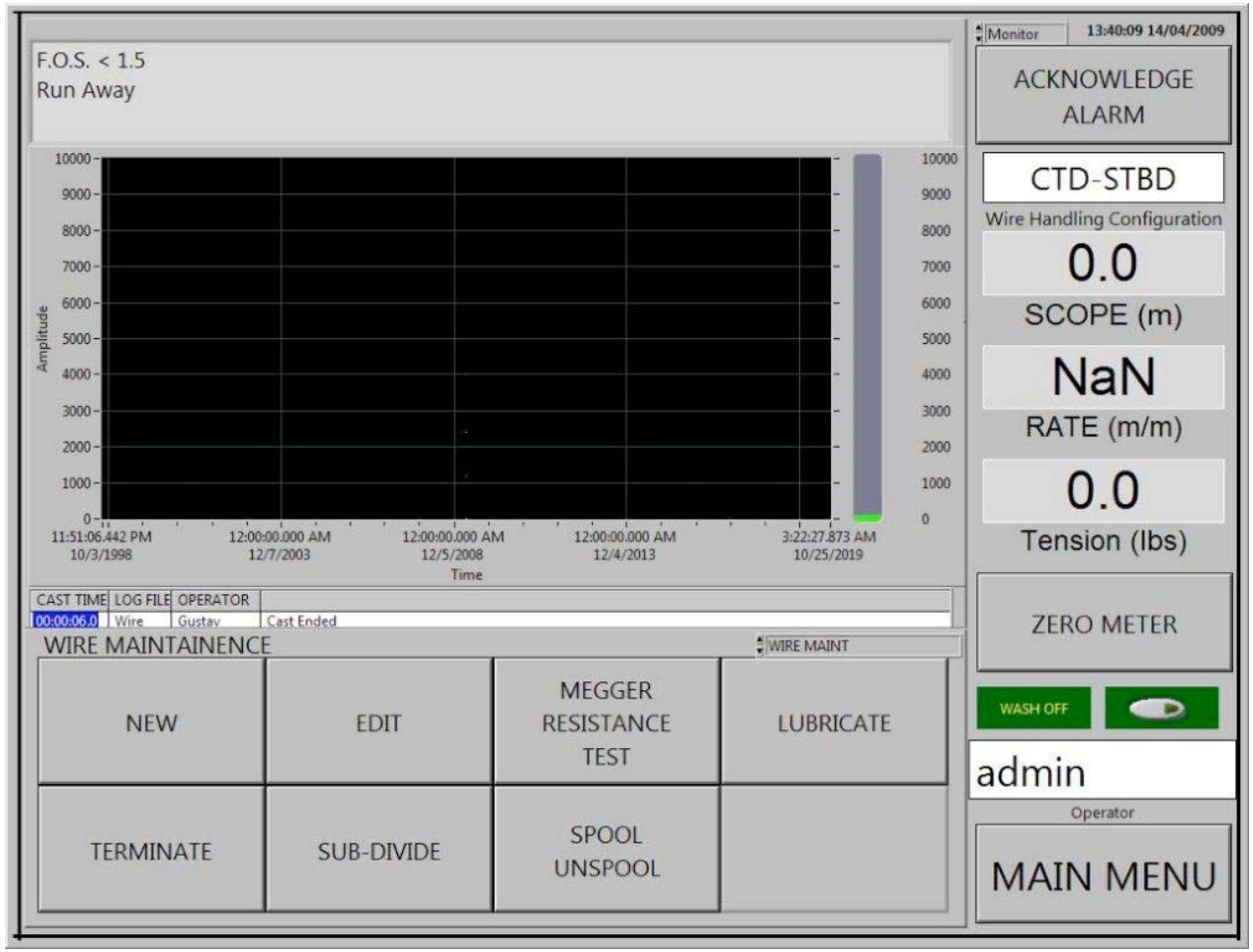
Configuration Level 1



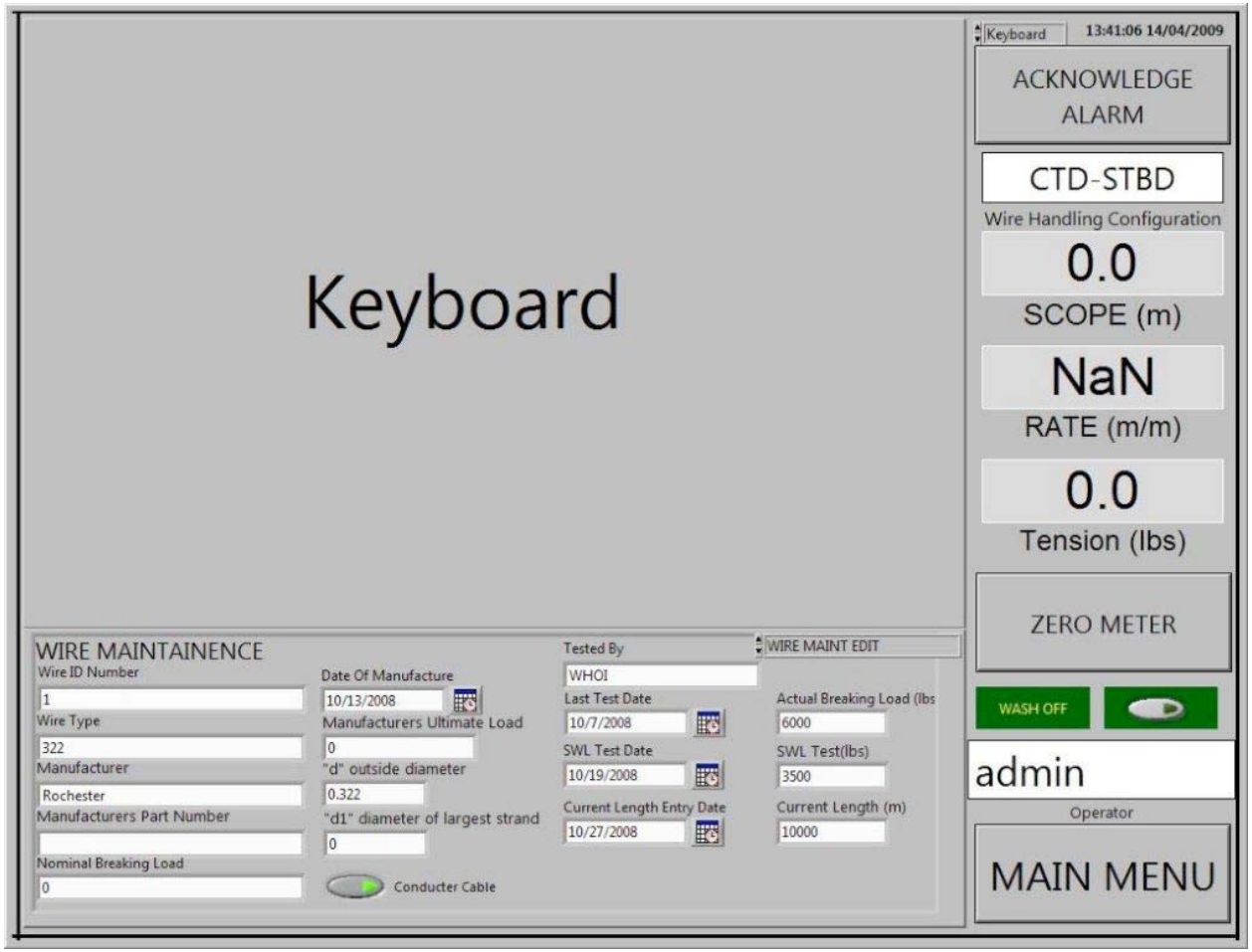
Configuration level 2



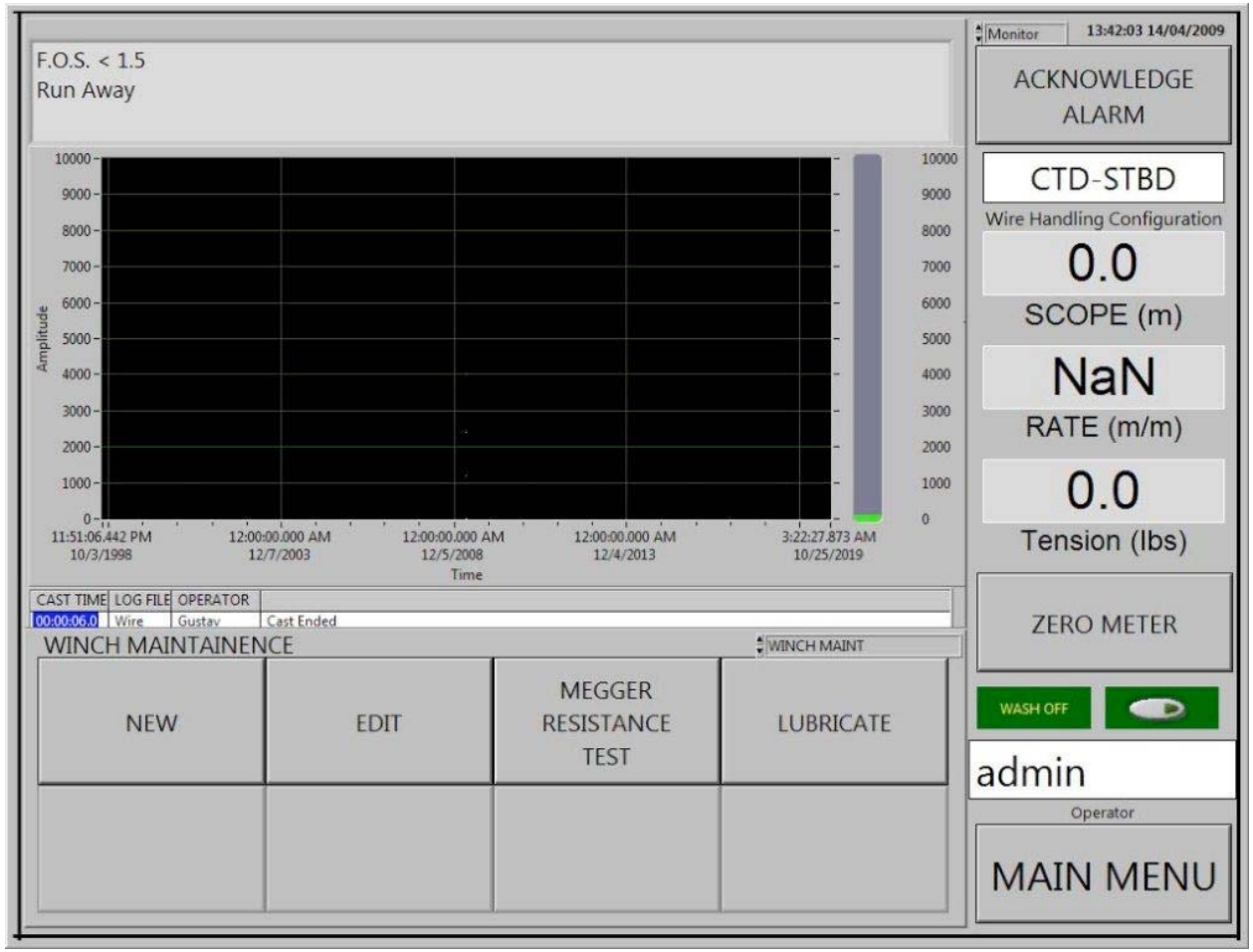
Wire Maintenance Menu



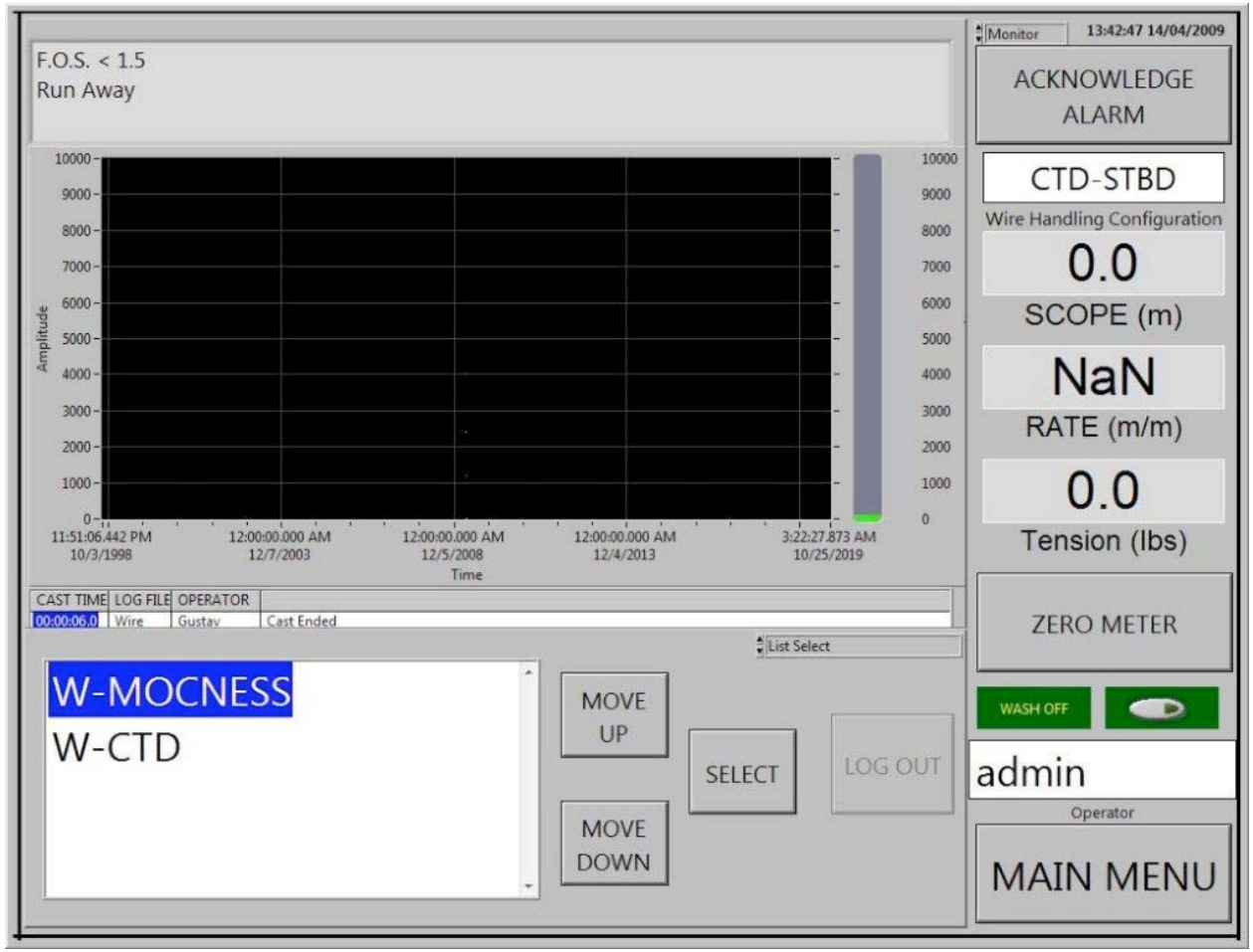
Wire Maintenance Edit



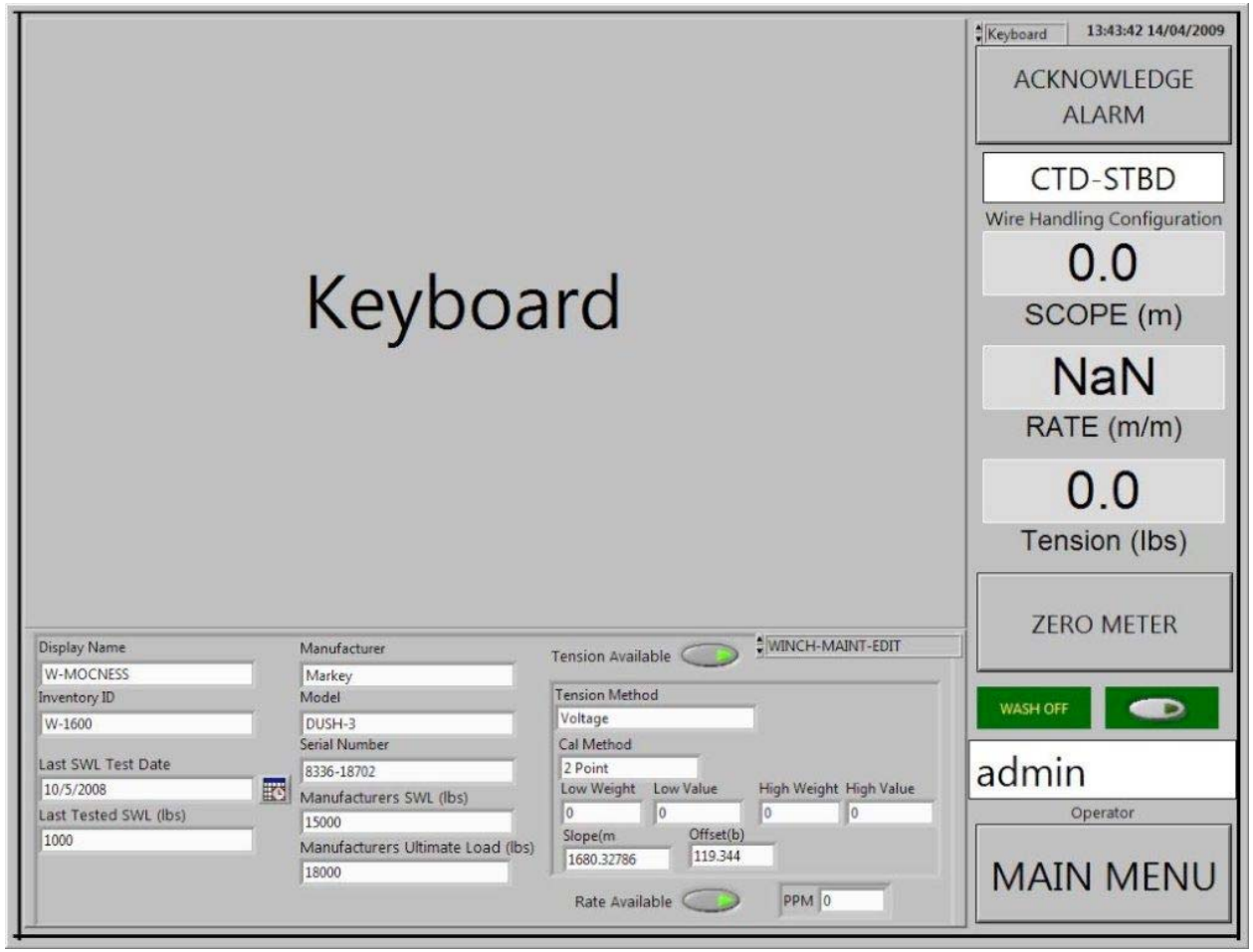
Winch Maintenance Menu



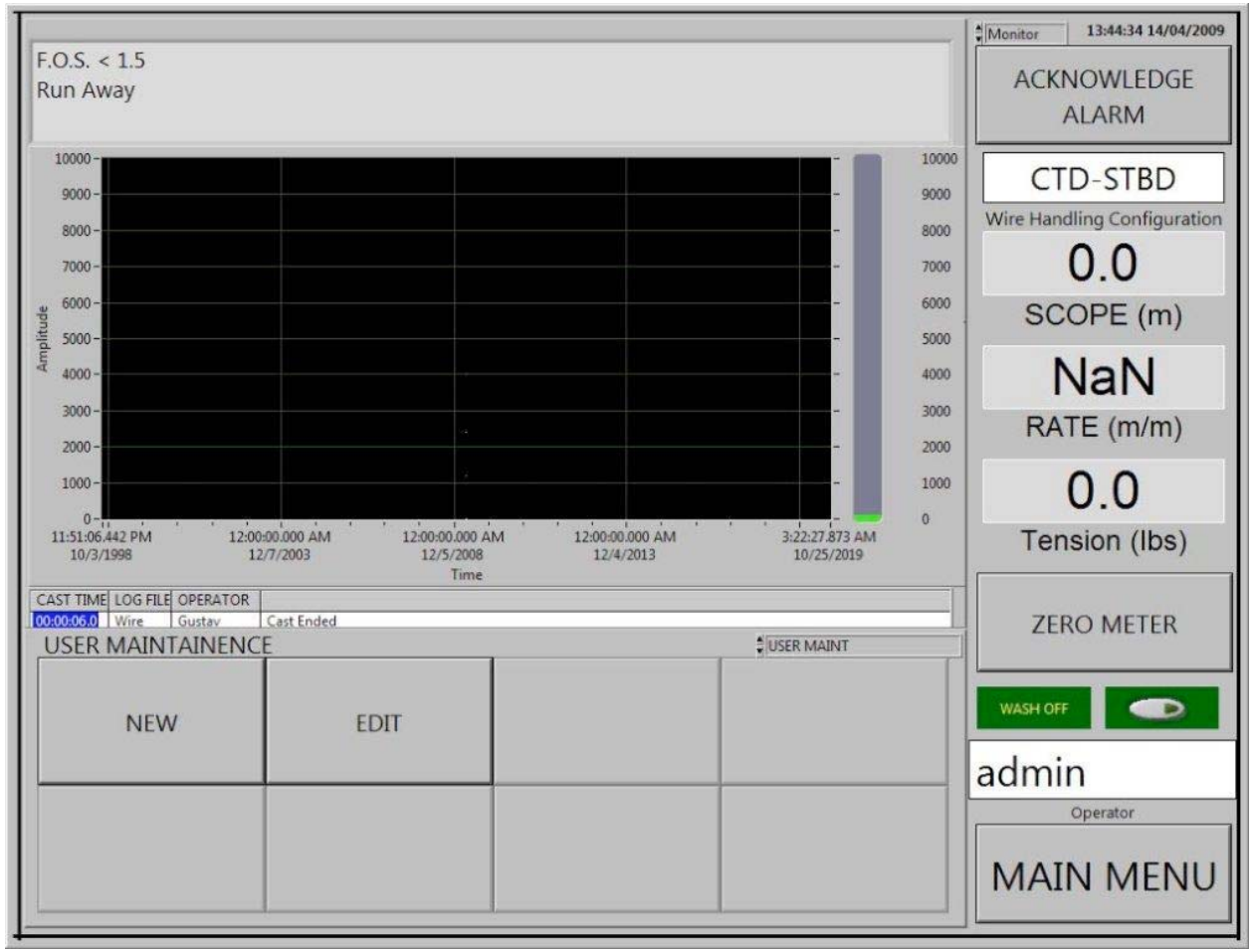
Winch Maintenance Select



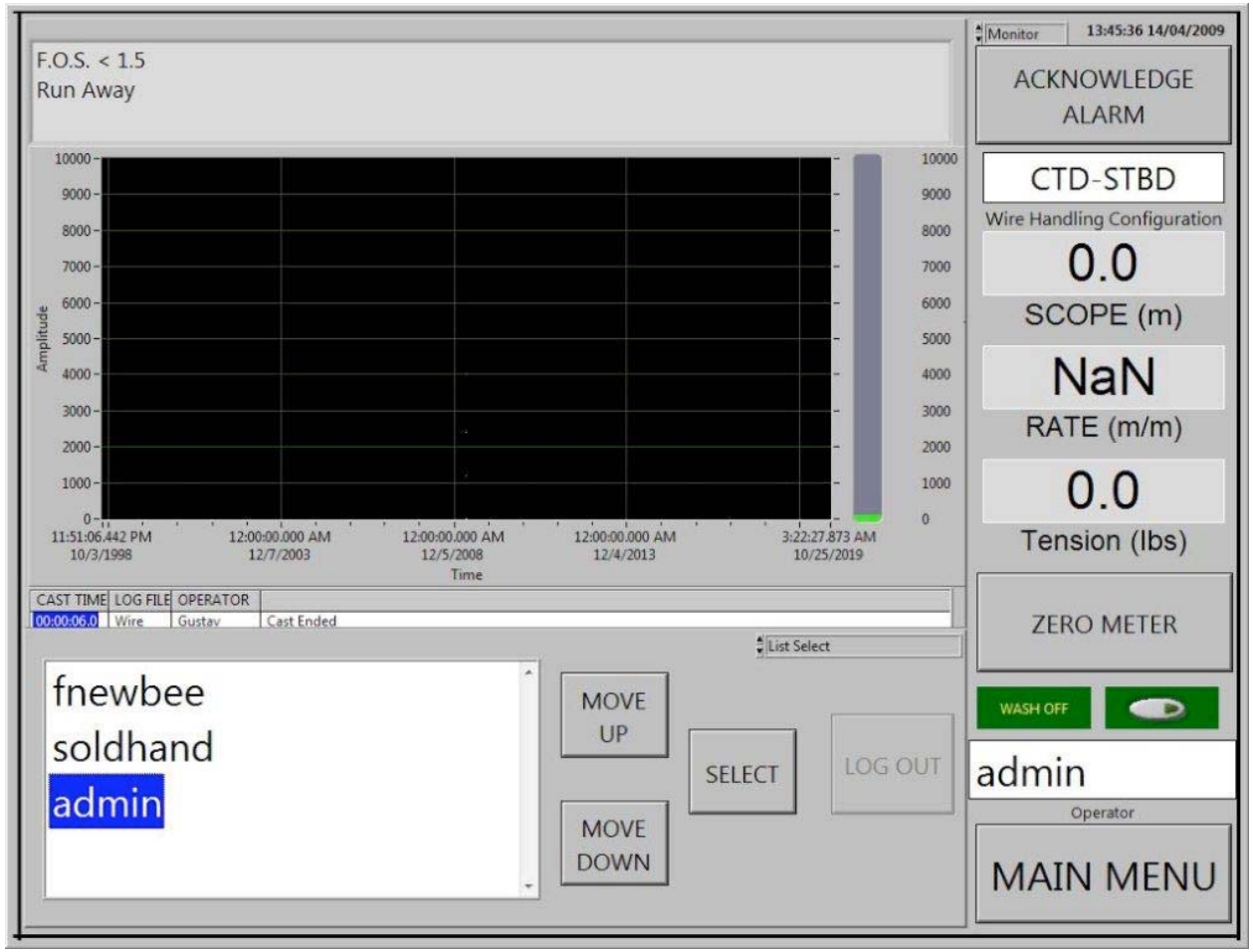
Winch Maintenance Edit



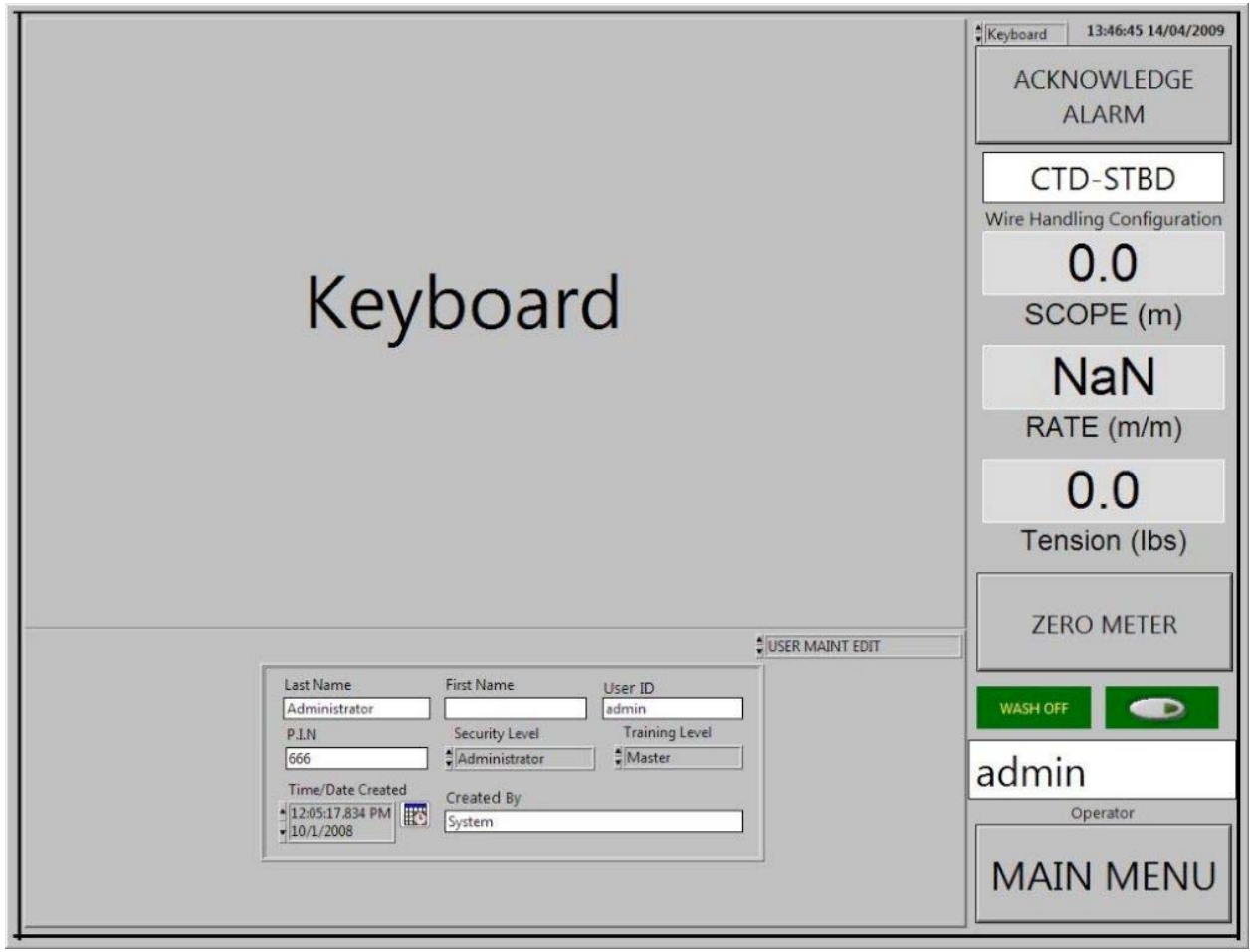
User Maintenance



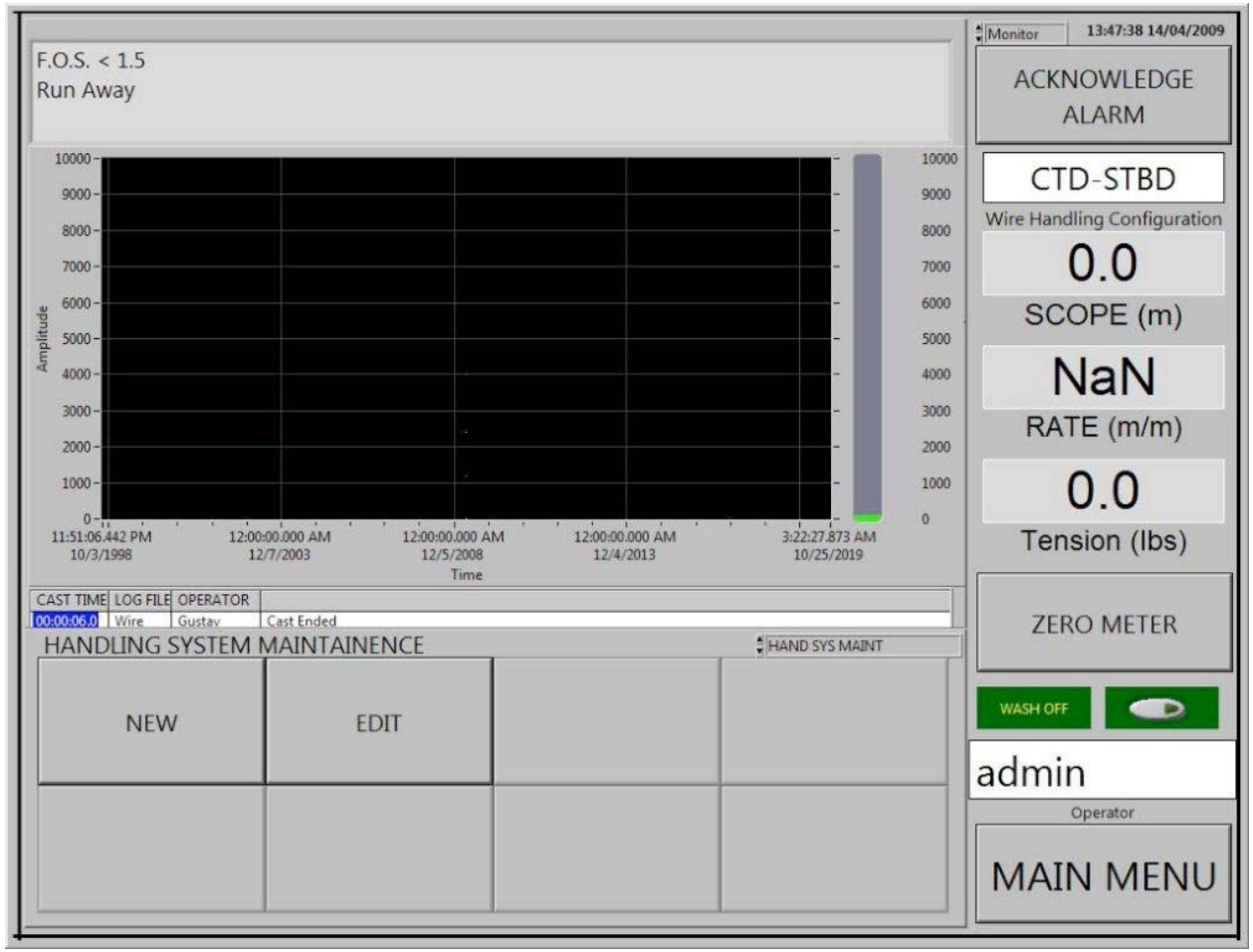
User Select


F.O.S. < 1.5
Run Away
Monitor
13:45:36 14/04/2009
ACKNOWLEDGE ALARM
CTD-STBD
Wire Handling Configuration
0.0
SCOPE (m)
NaN
RATE (m/m)
0.0
Tension (lbs)
ZERO METER
WASH OFF
admin
Operator
MAIN MENU
Amplitude
Time
11:51:06.442 PM 10/3/1998
12:00:00.000 AM 12/7/2003
12:00:00.000 AM 12/5/2008
12:00:00.000 AM 12/4/2013
3:22:27.873 AM 10/25/2019
CAST TIME
LOG FILE
OPERATOR
00:00:06.0
Wire
Gustav
Cast Ended
List Select
fnewbee
soldhand
admin
MOVE UP
MOVE DOWN
SELECT
LOG OUT

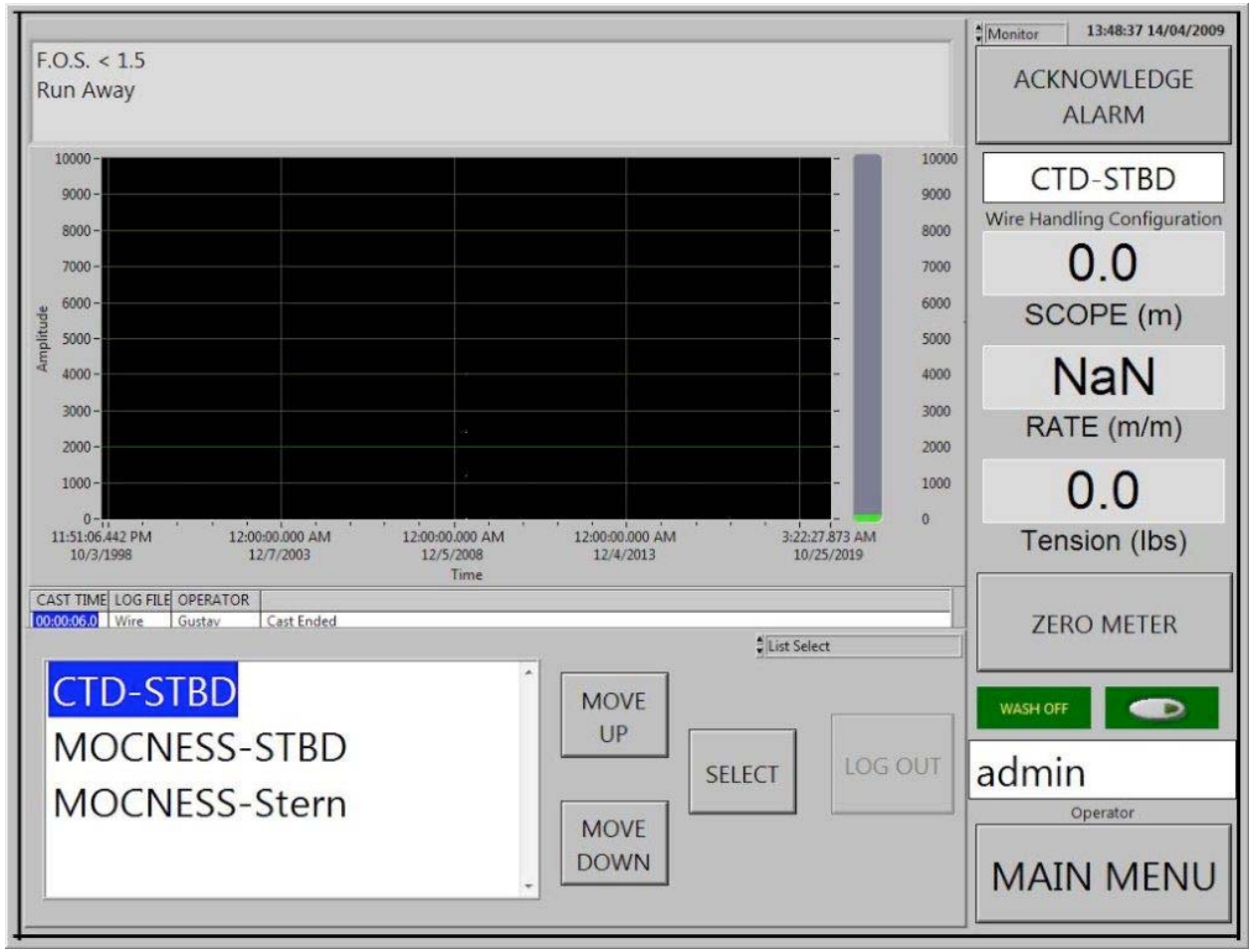
User Maintenance Edit



System Maintenance Menu

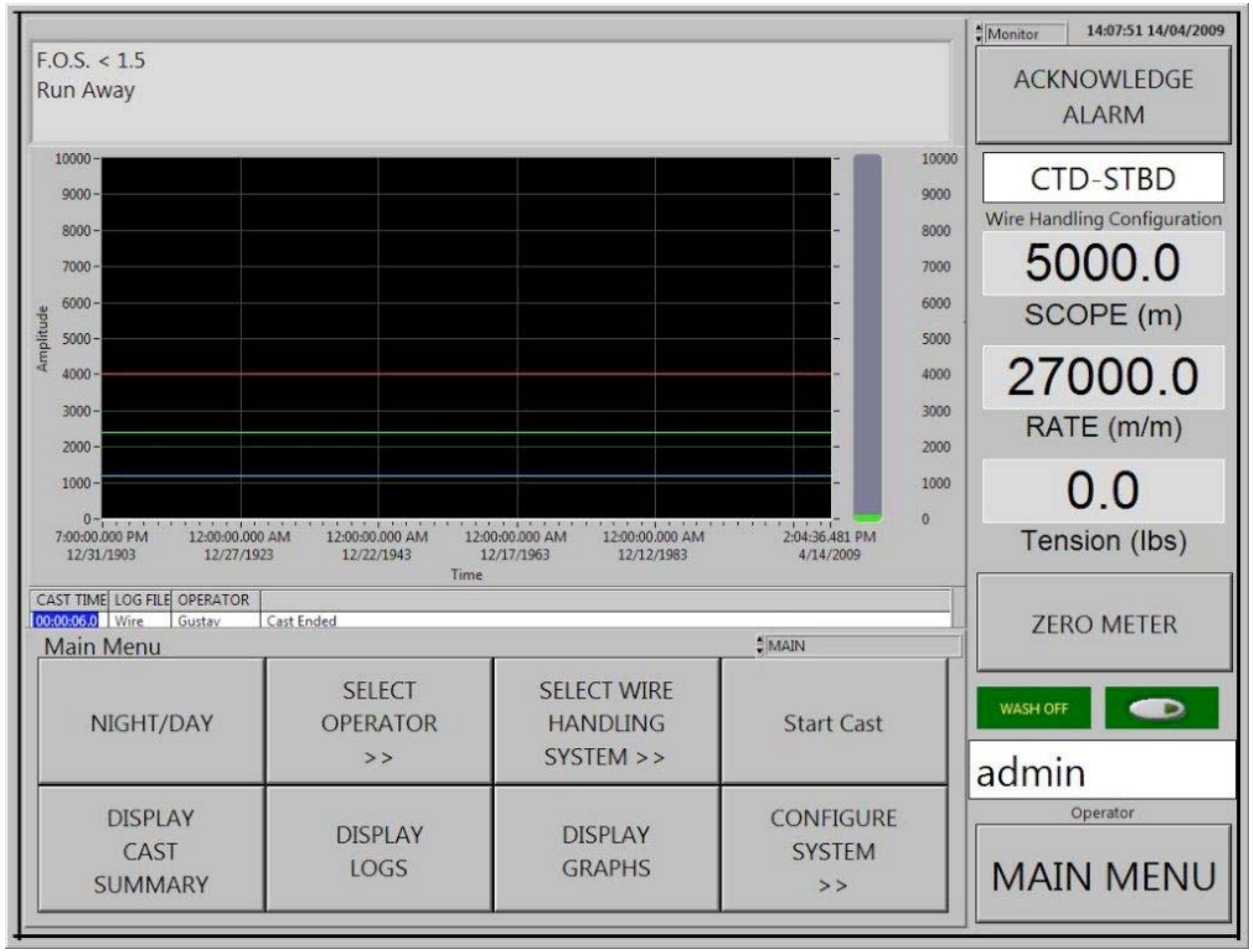


System Maintenance Select



System Maintenance Edit

Cast Running



Display Logs