

Users Manual



TMS Drill System

DEI + NAV & DEI-X User's Manual

Thunderbird Mining Systems

User's Manual

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USER'S MANUAL

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1.0 GENERAL INFORMATION

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1.1 Authorized Use Permission

NOTICE:

THE RECIPIENT OF THIS DOCUMENT WILL NOT REPRODUCE OR DISTRIBUTE IT, IN WHOLE OR IN PART, WITHOUT THE PRIOR WRITTEN CONSENT OF THUNDERBIRD MINING SYSTEMS. THE RECIPIENT WILL PERMANENTLY KEEP CONFIDENTIAL ALL INFORMATION CONTAINED HEREIN.

1.2 Points of Contact

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1.3 Introduction

The purpose of this manual is to provide an explanation of the basic operation of the Thunderbird Mining Systems (TMS) Drilling Systems.

There are two basic systems:

The DEI-X, which includes a drill monitoring and information logging system only.

The DEI+ NAV, which includes a drill monitoring and information logging function, as well as real time high precision navigation.

Included will be description and visual aid in the function and navigation through the system.

Also included will be a basic troubleshooting guide, which can be used by on-site personnel to identify basic hardware and I/O issues.

1.4 System Overview

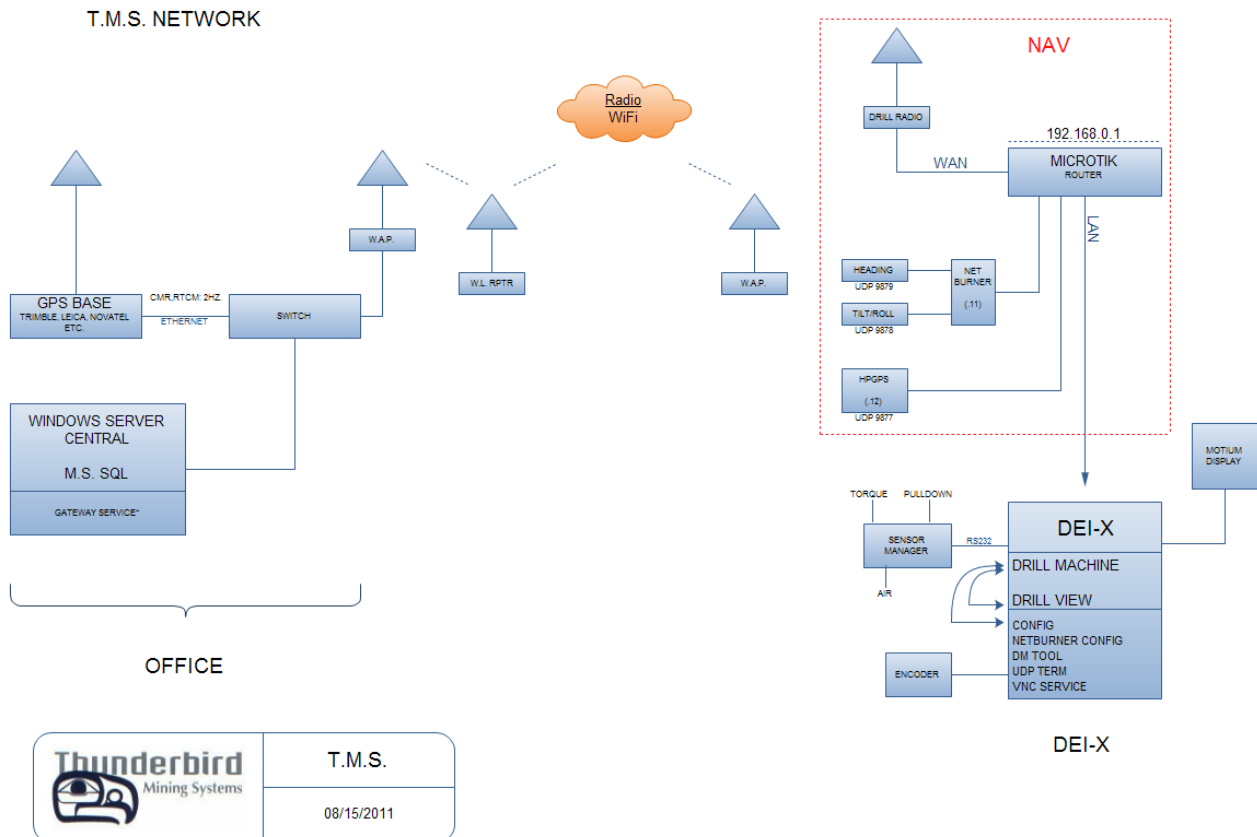
The following outlines the system and its functions:

- The TMS at your mine is comprised of several physical systems, software packages and processes that allow the system to operate smoothly. Some components require input from either operators or office staff, while most are carried out automatically by the system. The IMS system is designed to provide the operator with enough information to drill by combining sophisticated three dimensional viewing of the drill and pattern with high-precision GPS navigation, or manually select designed hole locations for capture of KPI. In order to give the operator everything they need, there are certain requirements. Patterns must be loaded and the database must be filled with the relevant information such as operator IDs, consumables information, delay codes, etc.
- Both systems are designed for use in a mine with wireless infrastructure and a designated server for TMS Data Portal office software, although the wireless network is not a firm requirement for the DEI-X. Responsible organization.
- The key components are the DEI-X Module and Display, which can operate as a standalone system and the DEI+NAV components (DEI+Nav Module and GPS Mast assembly), which can be added to the DEI-X to make a complete navigation system. The Sensor Manager kit can be added to either the DEI-X or DEI+NAV system.
- DEI System Features:
 - Basic drill monitoring
 - HPGPS Drill Guidance
 - Strata recognition using Specific Energy of Drilling Algorithm
 - Interface to drill PLC systems
 - Camera ready for added safety
 - Rock Recognition
 - Drill-to-Drill communication – know status of all holes
 - Show multiple drill locations
 - Real-time office updates of drill data
 - Drill status available in the field
 - 2 Way text messaging with dispatch and support personnel

- **System Layout:**
Understanding the basic infrastructure of the system will be helpful in grasping the fundamentals of the system's operation. The following two images display the network and hardware of the system.

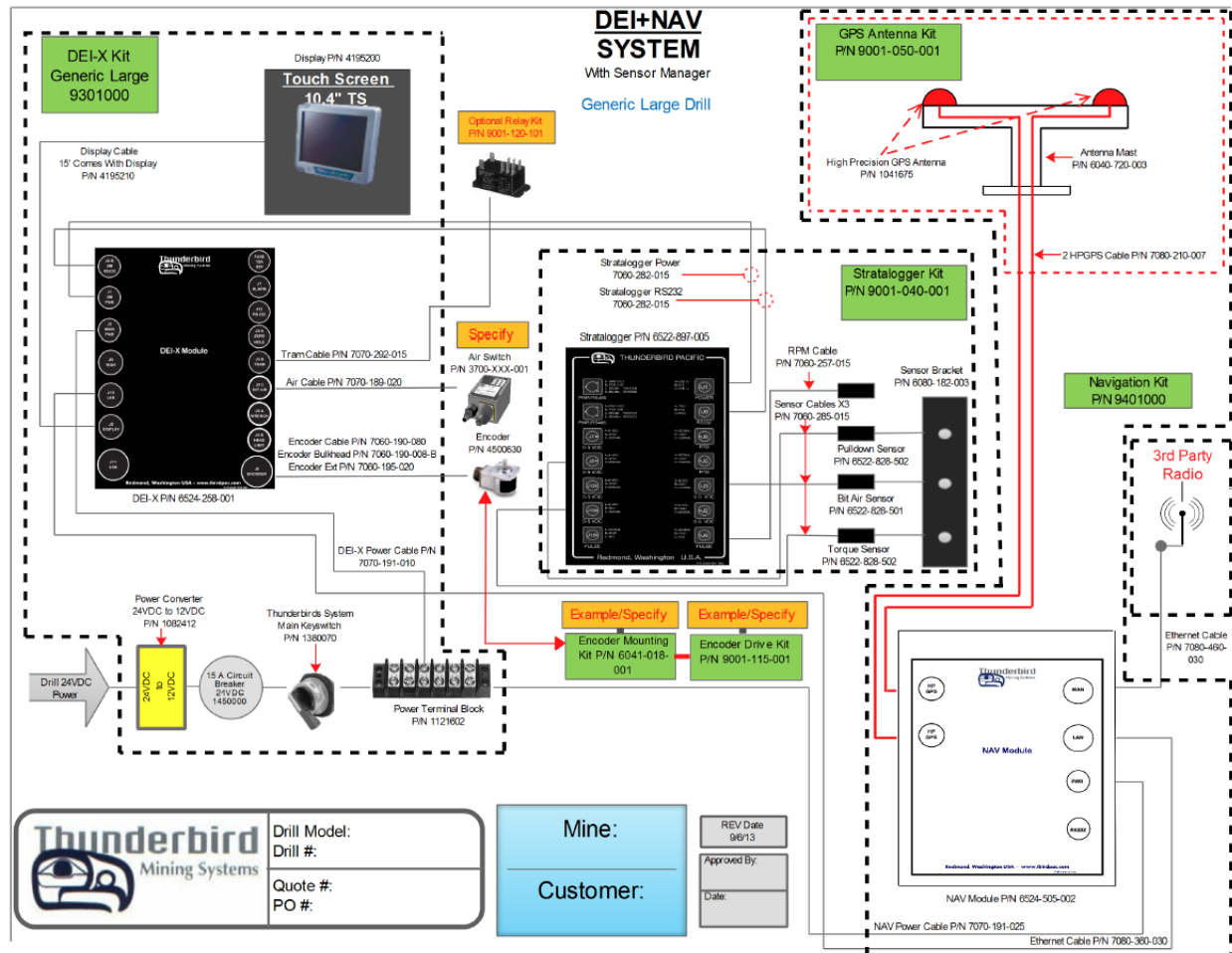
The first image shows the layout from an Administrative and Operations standpoint, and includes the office system through to the drilling system.

- **Network Overview**



The second image is a generic system block diagram, which includes all hardware necessary for a properly functioning system.

- Onboard Components (complete DEI+NAV with a Stratalogger-Sensor Manager)



1.5 Organization of the Manual

This manual will be broken out into sections as follows:

Section 2.0 – Mobile GUI Overview

This section will explain the function and navigation through all of the GUI features.

Section 3.0 – Using the DEI-X

This section will explain the use of the DEI System without navigation and positioning.

Section 4.0 – Using the DEI + NAV

This section will explain the use of the DEI System with the aid of navigation and positioning.

Section 5.0 – Quick Reference Step Guides

This section contains printable step guides of both applications for use by operators and trainers in the aid of everyday system use.

Section 6.0 – System Components

This section outlines the physical components of the system and their function. Included is suggested maintenance schedule and routines.

Section 7.0 – Troubleshooting Guide

This section provides step by step guidance in the identification and repair of faulty system components.

2.0 MOBILE GUI OVERVIEW

2.0 MOBILE GUI OVERVIEW

The following will outline the function of the DEI + NAV features and functions.

The features of Thunderbird's DEI + NAV Guidance System have set a new standard for blast hole drill instrumentation. The DEI+Nav has been designed from the ground up by a team that pioneered the development of the first drill monitoring and GPS navigation systems. This experience has allowed us to develop a product that is more intuitive and less hands on, leaving more time for production.

The key to using the system efficiently is understanding the function of the system, its uses and benefits, and proper navigation through the Graphic User Interface (GUI).

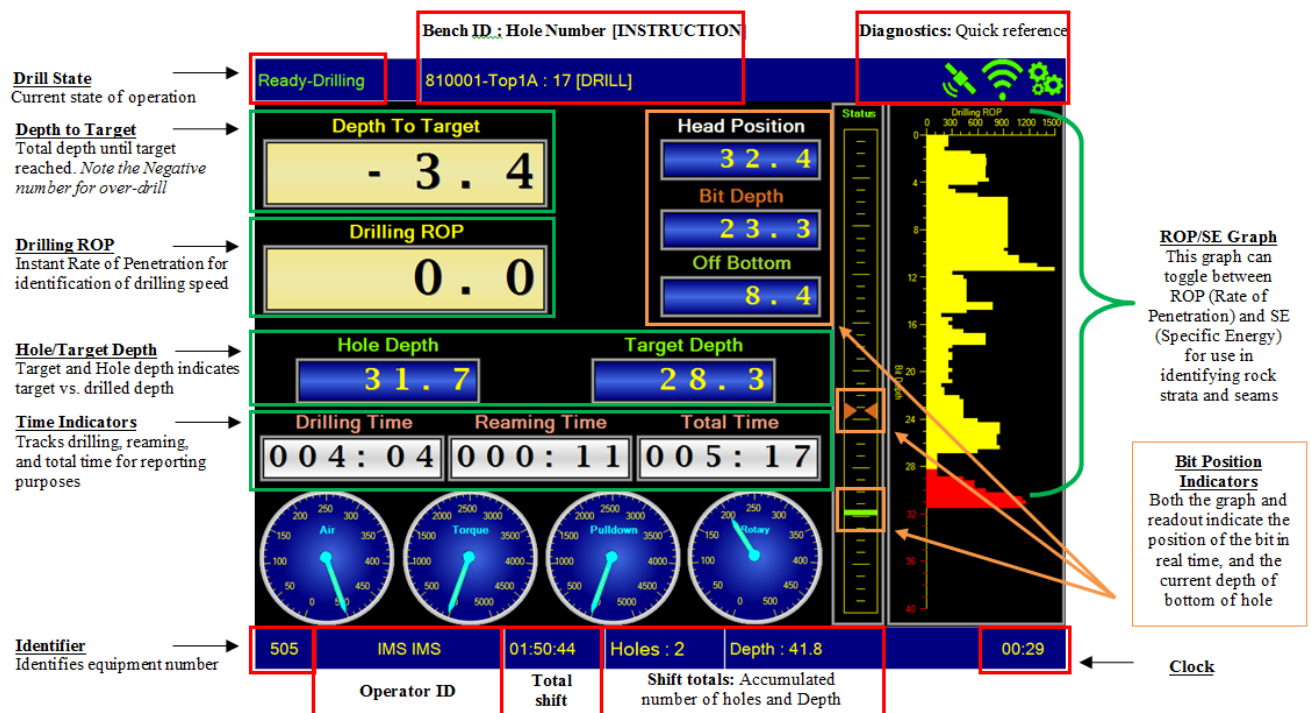
We have developed the system so that it may still be used if one or more components of the system fail, and automated many functions that were previously left to the operator.

The following sections will cover all of the GUI "buttons" and their functions.

2.1 Mobile GUI

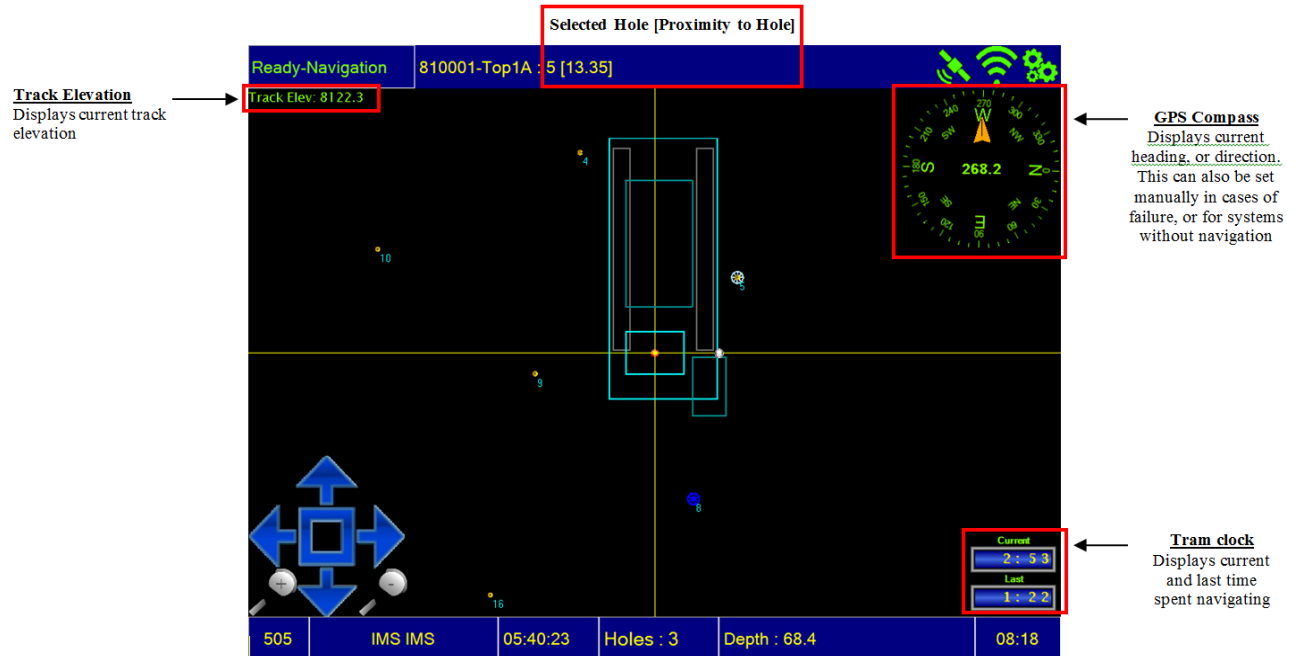
2.1.1 Drilling Screen

The following screen shot is a view of the Main Screen Layout in Dashboard mode. This is the screen which the operator will view while in drilling mode, and the screen that the operator will spend the most time looking at. Let's examine some of the information which is displayed and can be used.



2.1.2 Navigation Screen

Navigation mode begins when drilling ends. Switching the drill into “tram”, or “propel” triggers the change. This view displays a typical shot (pattern). The operator can tram to a hole on the pattern using the navigation screen or manually choose any hole number on the selected pattern. Again, we will highlight the features of this screen.

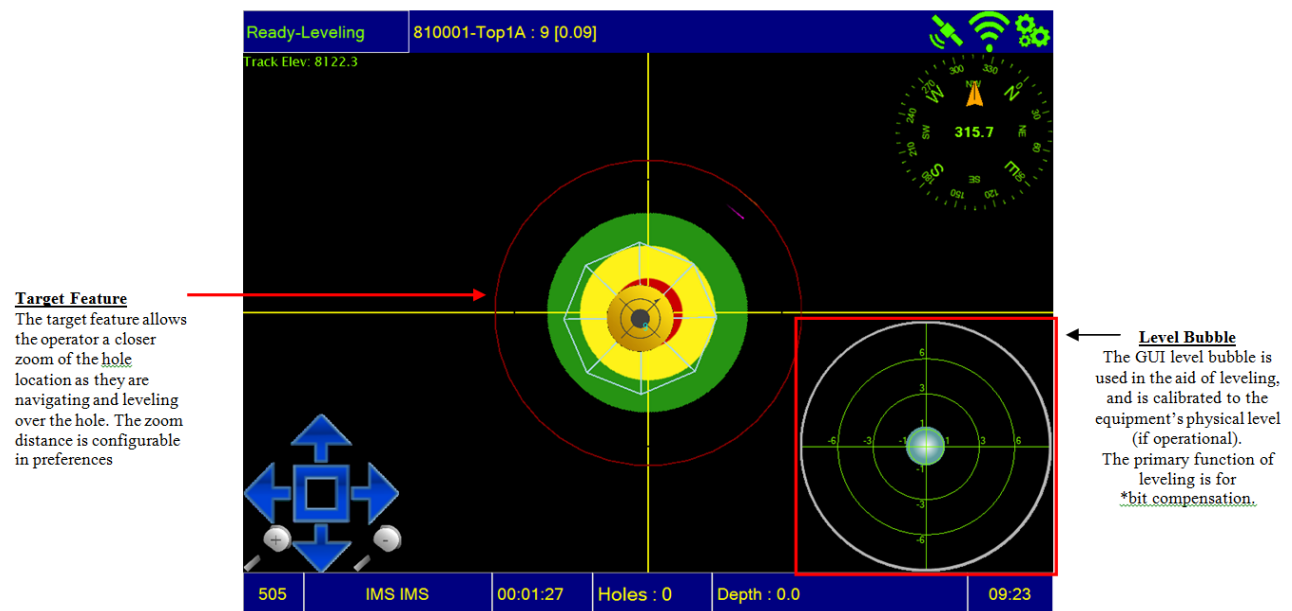


Notice also the color of the hole location:

- **Yellow** for planned hole locations – Not yet drilled.
- **Blue** for hole locations already drilled. *NOTE: These indicate holes drilled by ANY unit currently on the network.*
- **White** for hole location that has been locked on by the system. This allows for holes to be counted even if the operator cannot zero over the hole. In these cases, the hole will automatically be marked as “Moved”.

2.1.3 Leveling Screen

The Leveling mode occurs once the drill has centered over a chosen hole, and the operator has switched the drill from propel, or tram, and into levelling. Switching the drill from propel to leveling triggers state change automatically. This mode is only used for leveling indicator, and is the next logical step before drilling is initiated by encoder input. Below is a screenshot of leveling mode, and a brief explanation of features.



*Bit compensation is an algorithm designed to determine bit location during navigation based upon projected bit position while level. This allows for more accurate locations even on the worst bench.

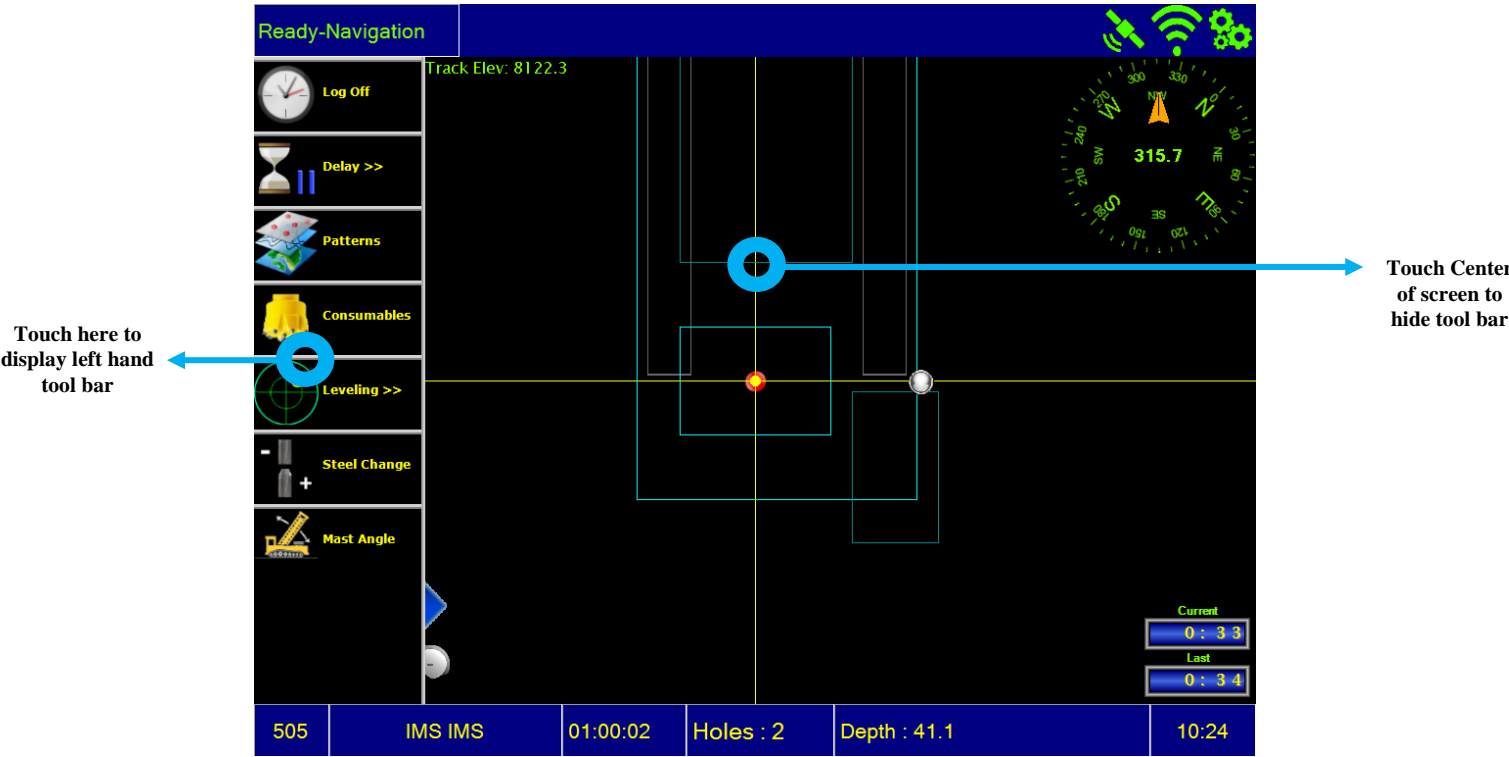
2.2 Navigating the GUI

The following will outline the basic functions available to the operator, and give brief explanations of all “buttons” available on the mobile software touchscreen. These “buttons” are normally hidden from view unless the right or left side of the screen is touched by the user.

Some buttons are used to manually manipulate the function of the system in the event of component failure. These processes will be explained in full.

2.2.1 Touchscreen and Buttons Overview

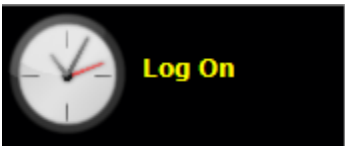
This image displays the GUI with the left hand tool bar displayed. To display the tool bar, simply touch the side of the screen near the middle. To hide, touch anywhere in the center of the touch screen.



2.2.2 Detailed Button Functions (Left Side Bar)

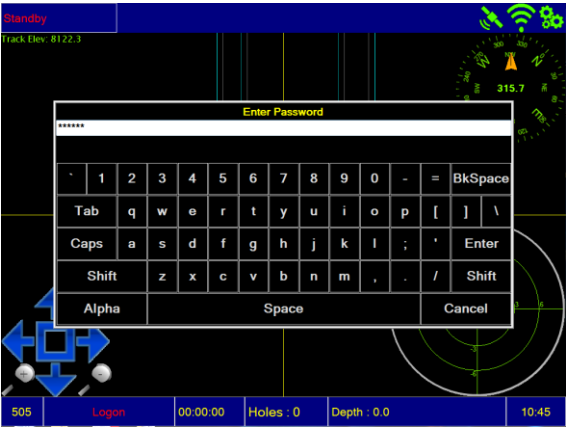
The next section will examine each button displayed on the **left side** of the screen, and describe each function.

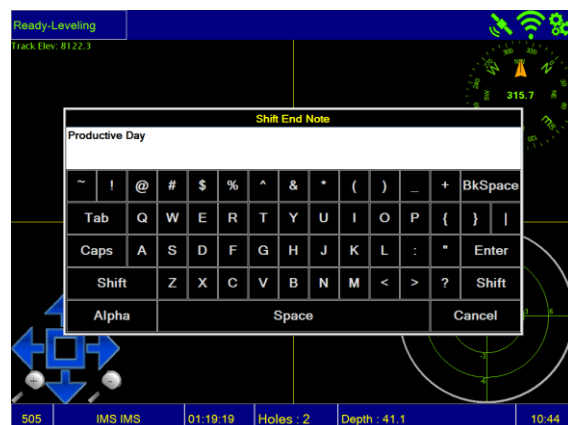
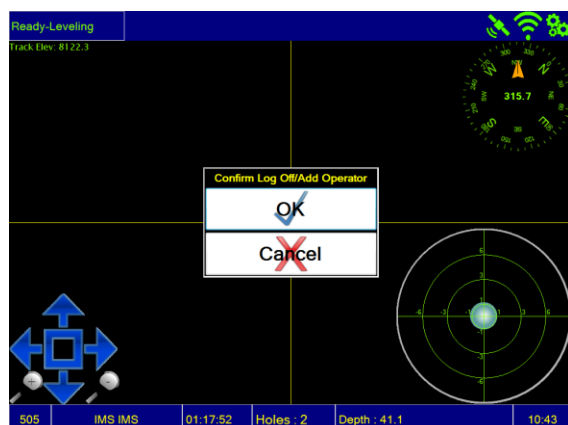
➤ LOG ON



To log on, simply press the button, and enter company provided access password (Typically your employee ID).

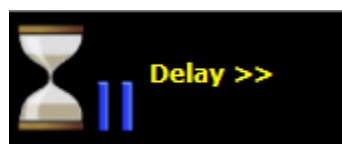
‘Log On/Log Off’ - Brings up the Log On/Off screen. This button allows the operator to log on or off of the system.



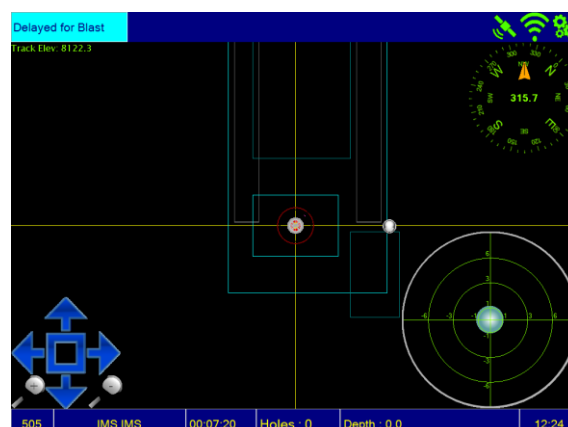
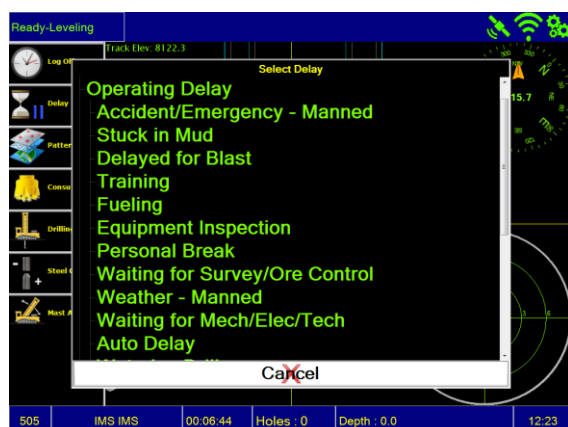


To log off, touch the “Log Off” button, confirm log off, and enter any shift notes as required.

➤ DELAY



‘Delay’ – Pushing this button causes the operating time is to be paused and the recording of the delay time commences. The operator is presented with a dialog box where he can select the reason for the delay (blasting, fueling, water truck, bit change, etc.)



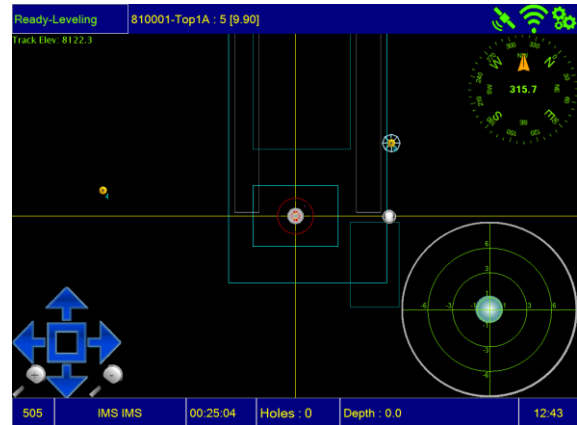
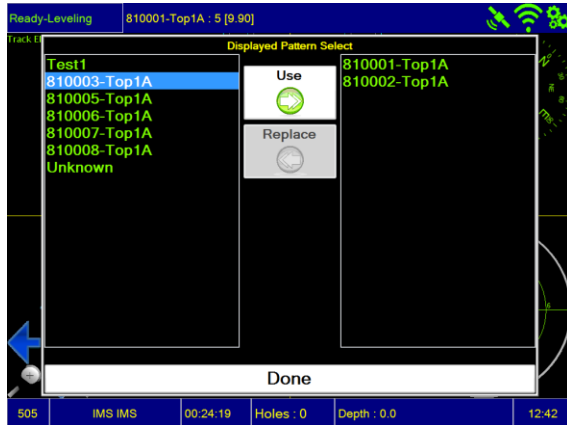
To activate a delay, touch the “Delay” button, choose a delay from the table, and touch selection. To remove a delay, touch the flashing blue delay icon in the uppermost left corner of your screen.

➤ PATTERNS



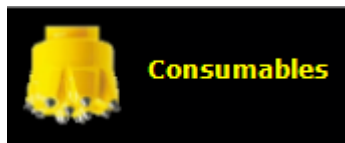
‘Pattern Selector’ - Displays a list of available pattern maps based on new and partially completed pattern files entered into the system.

To select a pattern, touch the “Patterns” button and select the desired pattern. You may keep as many patterns as you wish in the active window. Customer systems equipped with Navigation will automatically choose the correct pattern based upon HPGPS location.



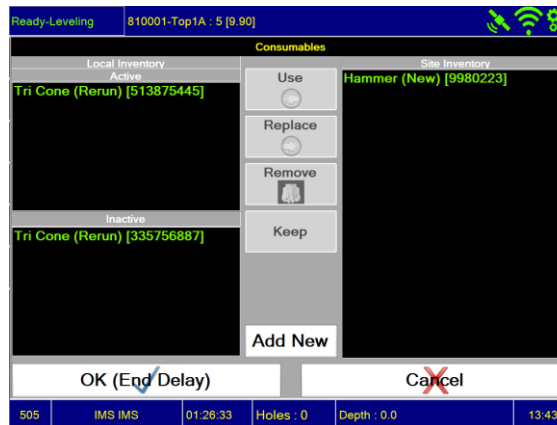
Highlight and choose the correct pattern, or patterns that you may be using through the course of the shift, and touch “Use”. Once moved over to the active window (on right), press “Done”. If your drill is in the vicinity of the selected pattern, it will display on the Navigation screen.

➤ CONSUMABLES



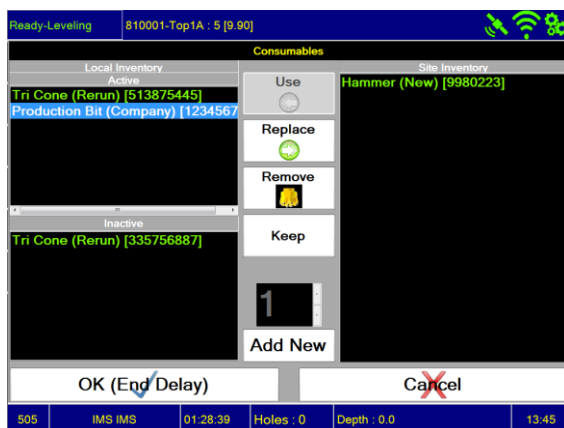
This screen allows you to *Use* consumables from **Site Inventory**, *Replace* from **Active Inventory**, or *Keep* from **Site Inventory** or **Active Inventory** for future use. When the consumable is in the **Active** list, it will be tracked against time and depth for bit wear analysis.

‘Consumables’ – Brings up consumables selection and entry screen.

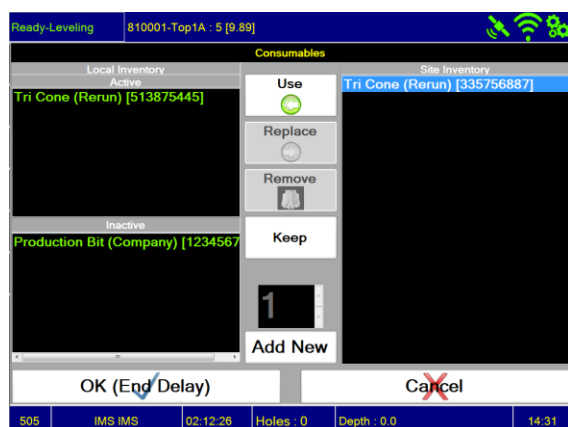


If the consumable is either in **Active** or **Inactive Local Inventory**, it is not available to other site equipment. **Site Inventory** is available to all equipment in the Thunderbird Network.

To use the consumables selector, there are three separate scenarios:

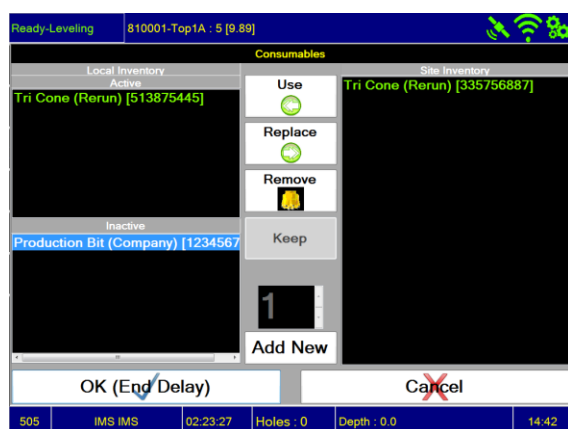


- 1) **Selection from Active Local Inventory:**
By highlighting an active consumable, you are given three options. You may *Replace* to **Site Inventory**, *Remove* from **Local and Site Inventory**, which will remove it for all equipment use (Local and Site), or *Keep* in **Inactive Local Inventory** for re-use.



2) Selection from Site Inventory:

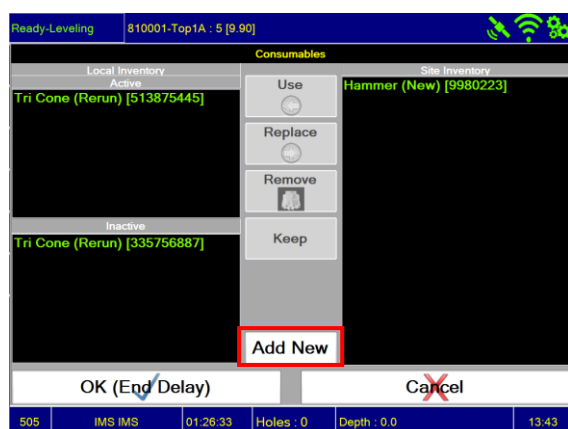
By making a selection from **Site Inventory**, you are choosing a consumable that is available to ALL equipment on the Thunderbird Network. Once selected, you may *Use*, which will place in in **Active Local Inventory**, or *Keep*, which will place it in **Inactive Local Inventory** for future use.



3) Selection from Inactive Local Inventory:

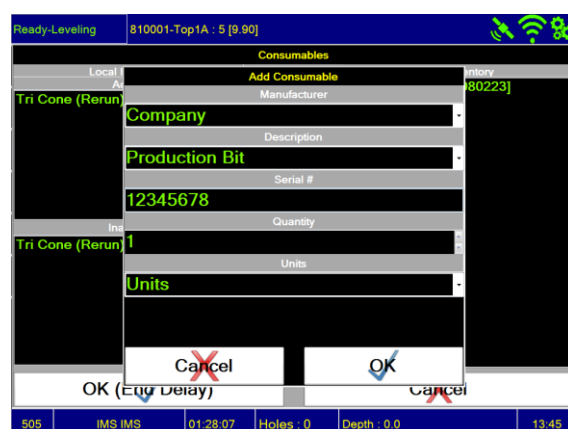
When choosing from **Inactive Local Inventory**, you are selecting a consumable that has been held on your equipment for future use. At this point, you may *Use* as your **Active consumable**, *Replace* into **Site Inventory**, or *Remove* from **Local and Site Inventory**, which will remove it for all equipment use (Local and Site).

One final feature that will be covered is the *manual input* of consumables by the operator or shift supervisor. This is one of two ways to enter consumables into the system. The second being entry through our Administrative UI (User Interface). If your site does not enter consumables through the UI, then you should become familiar with the manual entry as demonstrated below.



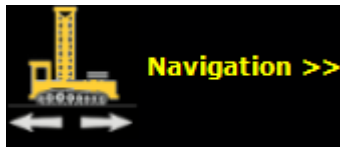
To add a new consumable, bring up the consumables screen and touch **Add New**.

Once added, the new consumable will be added to **Active Local Inventory**. From there, you may *Use* or *Keep* in **Local Inventory**, or *Add* to **Site Inventory**. Be mindful of Naming and Serial Numbers.



The **Add Consumables** dialogue will appear. Enter required information and press OK.

➤ MANUAL STATE CHANGE



These three icons all appear in the same location on the side bar depending upon the state of the system. *The function of these icons is to manually change the system state in the event of component failure.*

For example: If the system is currently in Drill Mode, the Navigation icon will appear in the side bar. If in Navigation Mode, the Leveling Icon will appear in the side bar, and if in Leveling Mode, the Drilling Icon will appear in the side bar.

Logical state change flow is as follows:

DILLING >> NAVIGATION >> LEVELING >> DRILLING

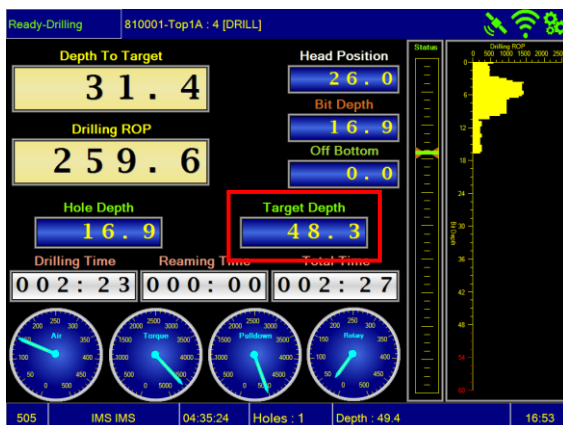
The benefit, as mentioned in the above paragraph, is that if some component that automates state change fails, such as a relay, the system can still be used by manual input.

➤ STEEL CHANGE

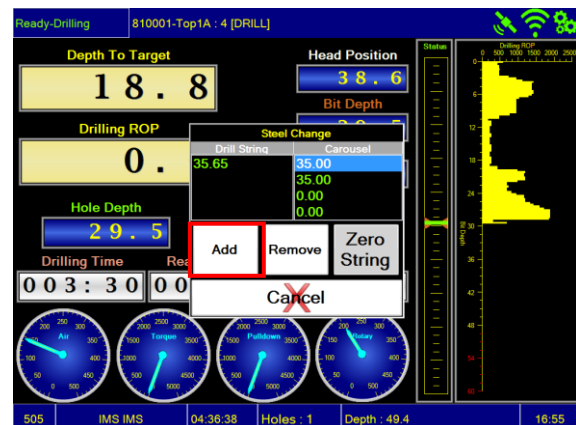


'Steel Change' - Displays Add/Remove Steel dialogue. Manual input initiates the Add/Remove Steel delay under the following circumstance: When multi-pass drilling and automatic steel change fails, or is unavailable as an option.

Add Steel Dialogue is triggered when the target depth exceeds the potential drilling depth of the equipment with starter steel alone. Starter steel includes main steel, steel savers, and subs combined. If the target depth exceeds potential, the dialogue appears (either add or remove) when the power head reaches a pre-determined distance from the drilling deck, or from the upper stop limit.



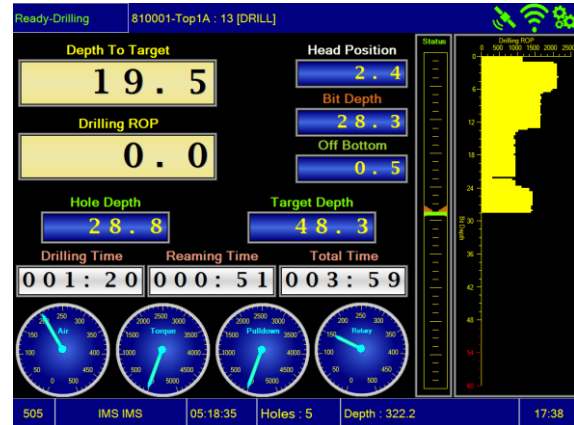
Note target depth. This depth exceeds potential depth for first steel. This now meets criteria for add/remove steel logic.



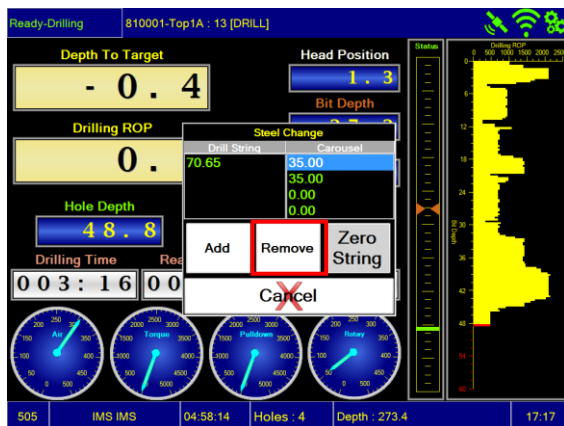
Head position now within trigger point. This initiates Steel Change dialogue. Once displayed, "spin off" first steel and press **Add**.



Once **Add** has been pressed, it places the system in a delay, and freezes bit depth. Bring the power head up and “spin on” second steel. Once steel is secured, press the blue **Add Steel** Icon.



After **Add Steel** has been pressed, resume drilling. Note bit depth versus head position.



The Remove Steel dialogue is triggered in the same way Add Steel is. When drilling with multiple steel and power head reaches the upper limit, Steel Change is triggered once again. With added steel in deck wrench, press **Remove**. This will initiate remove steel.

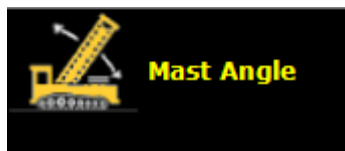


Once the second steel is in the carousel, and the lead steel is reconnected to the power head, press the blue **Remove Steel** Icon and resume completion of the hole.



The last feature to be covered is the Zero String Button. If for any reason a 2nd steel has been added by mistake, this button will remove all steel that has been added via software. This is especially useful if the operator has forgotten to remove steel before navigating to the next hole. In this case, a Pipe In Hole alarm will be triggered and will cause alarm (optional) if this steel is not removed.

➤ MAST ANGLE



‘Mast Angle’ – This button allows the user to change the angle of the mast. The purpose of this feature is to project bit position based on bearing. Currently this feature is under development.

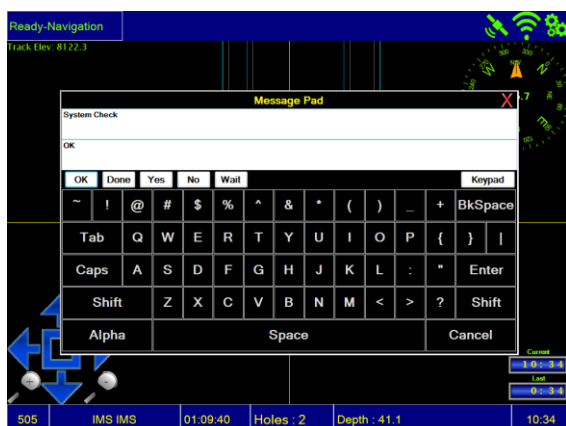
2.2.3 Detailed Button Functions (Right Side Bar)

The next section will examine each button displayed on the **right side** of the screen, and describe each function.

➤ MESSAGE PAD



‘Message Pad’ – Displays the keyboard for bi-directional texting via remote viewing software.



To use the Message Pad, personnel from Dispatch, Administration, or Service must initiate communication. This feature is used primarily for support. The messages are not archived.

There are several “hot keys” to provide ease of use. Note the keys labeled **OK**, **Done**, **Yes**, **No**, and **Wait**- Pressing these buttons will give the one word response to questions from service or dispatch. In most cases, Thunderbird support will strive to ask questions which can be answered with these buttons.

➤ AXIS GUIDES

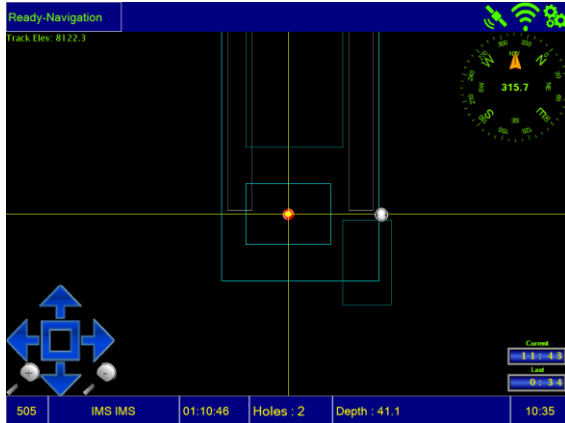


‘Axis Guides’ - Turns on/off display guidelines on the map allowing for easier alignment on the target hole.

This feature can be toggled on or off at the press of a button. To enable or disable, press the button, and it will go to the next logical state.

There are two options displayed on the next page. The first shows Axis Guides on, the second shows Axis Guides off.

The grid lines can assist in alignment during navigation, but is left for the operator to decide preference.



Axis Guides On



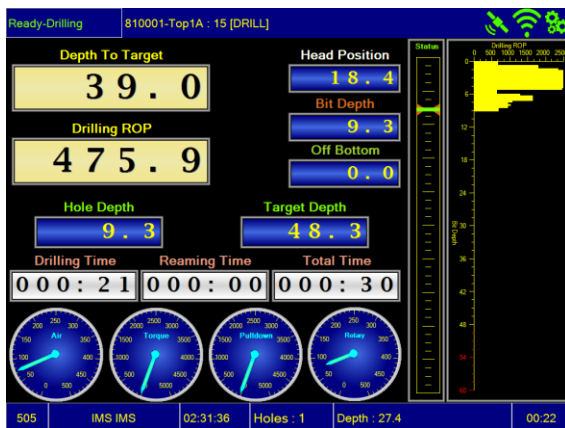
Axis Guides Off

➤ DASHBOARD



‘Dashboard’ - Turns on/off level and view controller, toggles to navigation screen while in drilling mode.

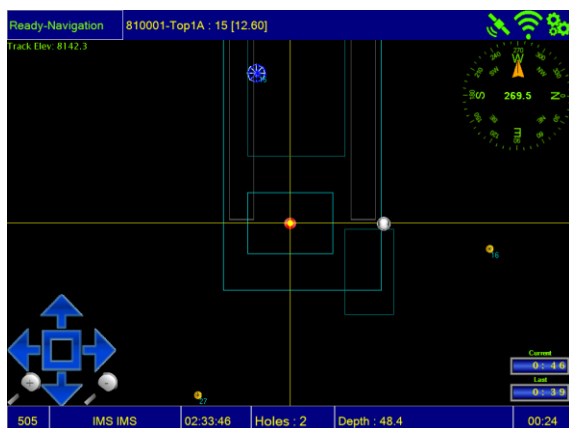
The following screen captures show examples of each drills system state with dashboard on and off. Be very mindful of using this feature, as it is “sticky” and can confuse users that are unfamiliar with the system. Pay special attention to the “state” in the upper left corner, particularly in Drill Mode.



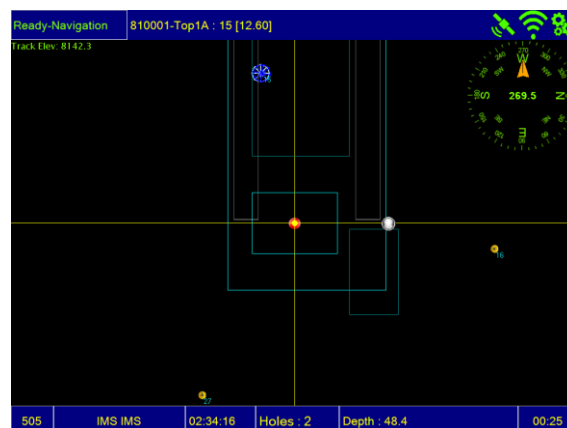
System in Drill Mode with Dashboard on.



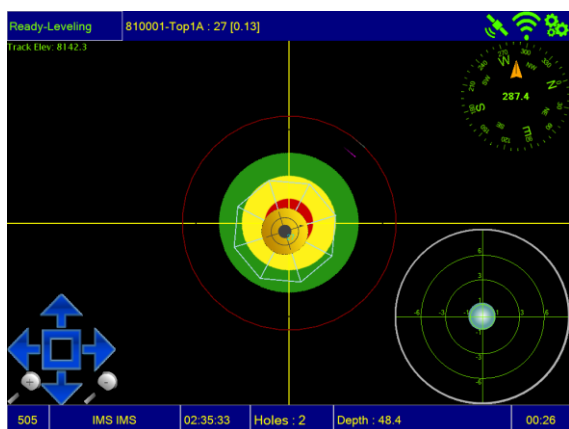
System in Drill Mode with Dashboard off.
The benefit of this feature is the ability to view the current pattern while in drilling mode.



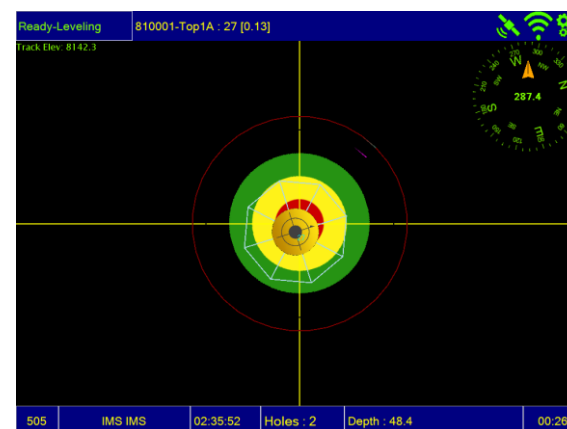
System in Navigation Mode with Dashboard on.



System in Navigation Mode with Dashboard off.



System in Leveling Mode with Dashboard on.



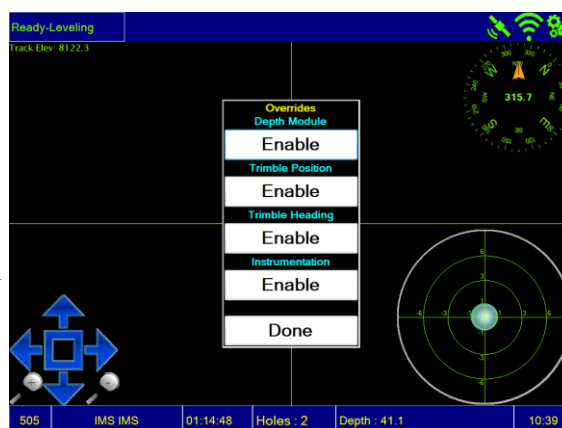
System in Leveling Mode with Dashboard off.

➤ Overrides

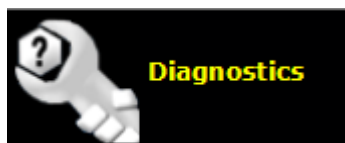


Overrides are password protected. It allows a system user to override a component of the system to enable features of manual function. To disable, touch **Enable** beneath the desired component. This feature is a toggle, so simply press the button under the component to re-enable.

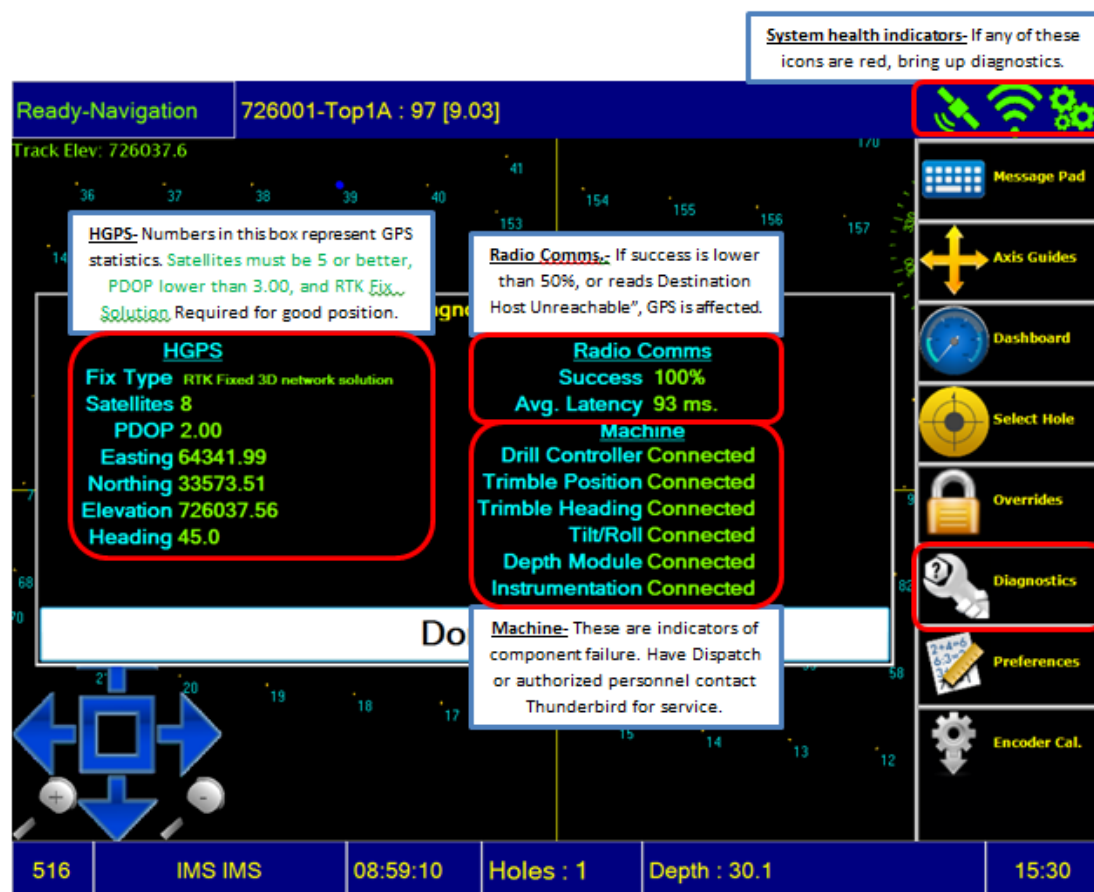
‘Overrides’ – Allows the user to override portions of the system which may have failed.



➤ DIAGNOSTICS

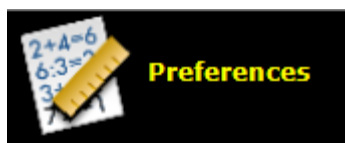


‘Diagnostics’ – Used to assist in identifying simple communications, navigation, or “machine” issues.

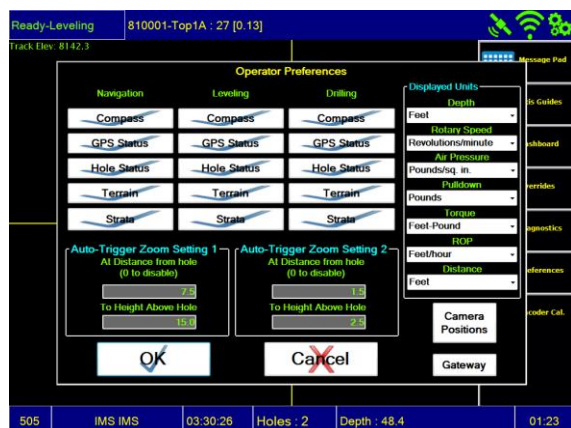


The guide above will assist you in determining issues with your system. The icons on the top right are the first indicator. The first icon represents GPS, the second represents Communication, and the third represents Machine Interface. If any one of these is red, you may have an issue with your system, and it will not function as expected.

➤ PREFERENCES



‘Preferences’ – Displays a list of preferences. These preferences range from what the user wants to see on the screen, to the units of measure, to auto trigger or snap values. This screen is password protected

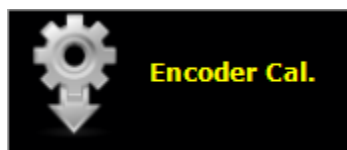


Displayed is a screen shot of the Preferences page. Typically, these will be set by your Thunderbird Representative and should not be adjusted without consultation.

In the case that changes are made, pressing the **Preferences** button will prompt password entry. Once in, any change made must be followed by pressing **OK** for the change to take effect.

If an entry is made erroneously, pressing the **Cancel** button will exit the Preferences screen and no change will be made to the system.

➤ ENCODER CAL



Encoder Cal - Displays the Depth Encoder head position calibration screen. It is also used for the initial encoder calibration. (This portion is password protected)



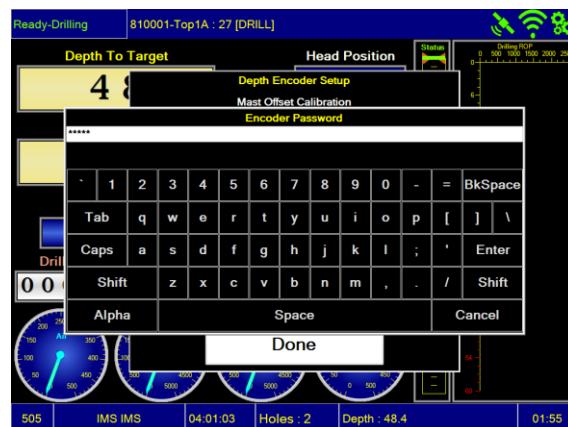
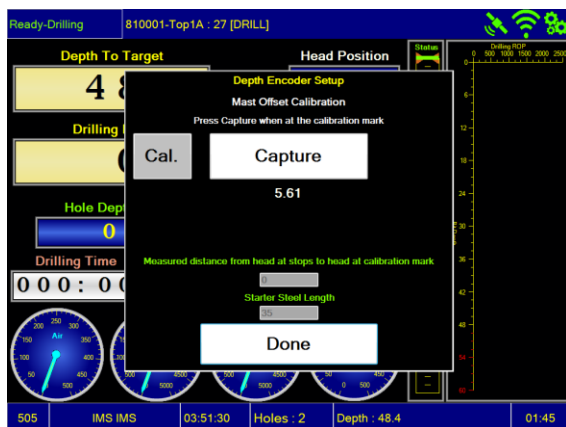
Encoder Cal. is displayed at startup of the system, and can be used at any time the operator feels it necessary. To re-calibrate, touch Encoder Cal. button.



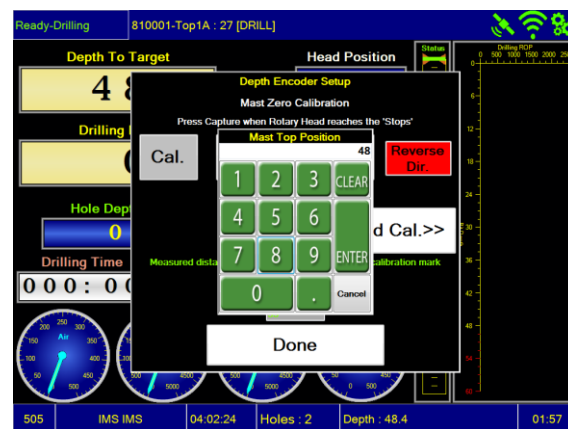
Bring power head to uppermost limit. Once at the upper stops, press Capture, then Done. The encoder is now calibrated at 0.

The following instructions should be performed by trained personnel only

The next steps will provide instruction in calibrating the encoder in cases where re-calibration is needed. Typically the encoder calibration will be performed by a Thunderbird Representative upon commissioning of the system. If calibration fails, contact a Thunderbird Service Technician for assistance.

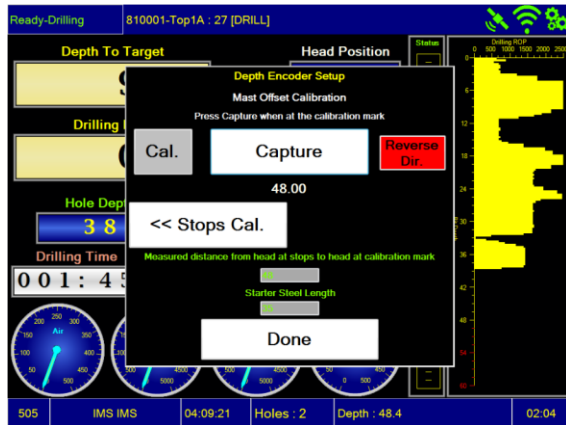


When the calibration window appears, press “cal” and enter your password.

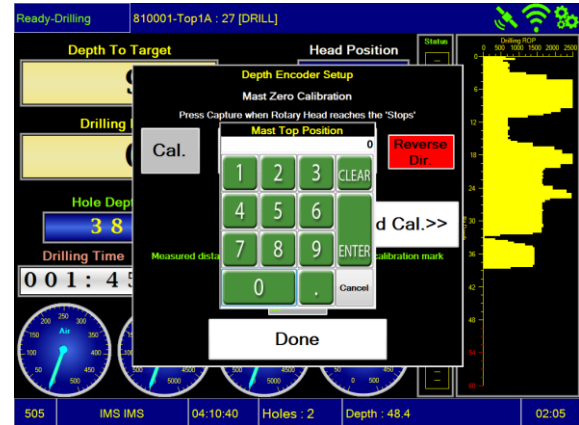


Once the password is entered, you will have a new screen- This mode is for initial system encoder calibration during setup, and should not be used for regular operator calibration. Bring the rotary head to the upper stops. The rotary head should be at the absolute top of its stroke. Once at the upper stops location, press “Capture”. This should reset the encoder position to “0”.

Once this has been done, press the “Standard Cal” button, and click the text field for “Measured distance from head at stops to head at calibration mark”. Enter the total distance travelled from the upper stops to the lower stops.



Once this number has been entered, bring the rotary head to the lower stops position. Once in position, press “Capture”. The measured distance that was entered into the text field should appear under “Capture” indicating that the measurement has been accepted. Complete by pressing “Done”.



As a final step, bring the Calibration screen up once again to return the calibration number to “0” for normal operator calibration. Repeat the procedures lined out in steps 1-4, and enter the number “0” into the text field. Once complete, press “Done”.

Finish the entire process by bringing the rotary head to the upper stops, bringing up the Encoder Cal screen once again and pressing “Capture”. This calibrates the encoder at the “0” position and is now ready for use by the system.

This concludes the Mobile GUI Overview section.

3.0 USING THE DEI+NAV

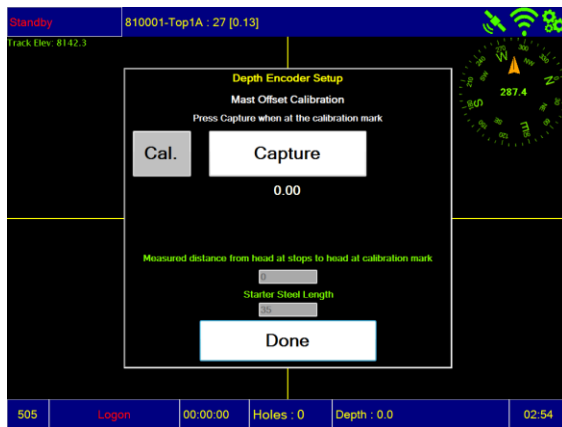
3.0 USING THE DEI+NAV

This section will review the operation of a DEI+NAV System.

System operation consists of 14 steps from start of shift to end of shift. Most functions are automatic if Navigation is installed.

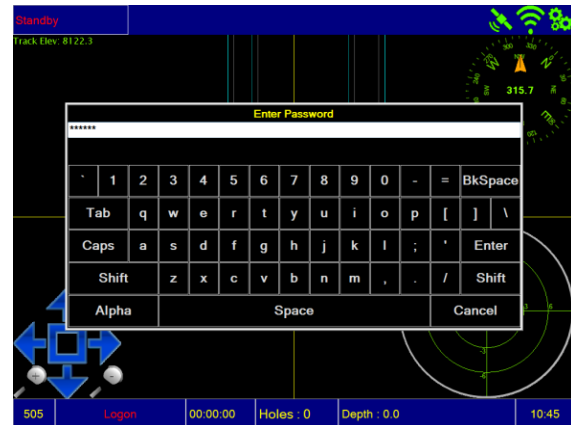
The steps are as follows:

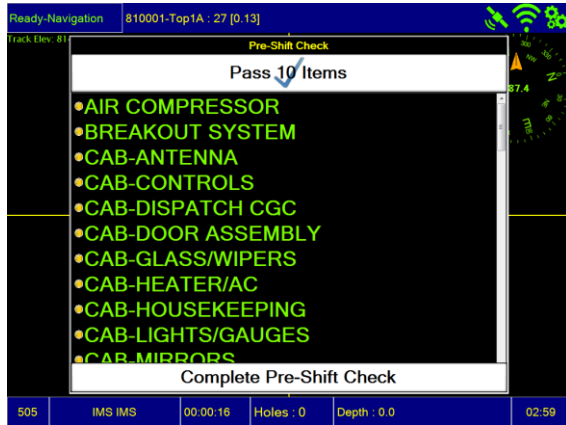
1. Start the drill. Be sure the In-dash Key Switch for the System is in the **off** position.
2. Power on Thunderbird system, wait for the Thunderbird application to load on the display.



3. Move head to maximum upper stop. Press capture, Press done. Head position is now calibrated and depths will be accurate.

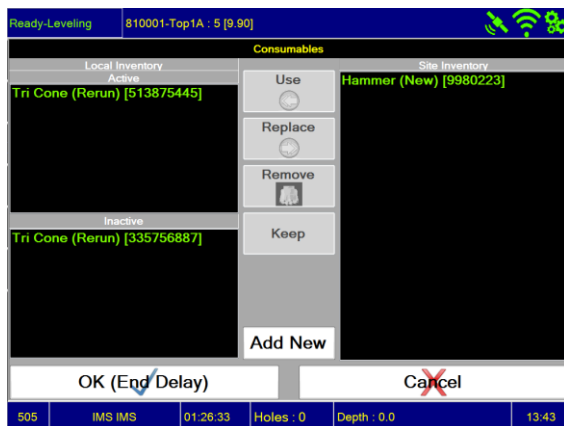
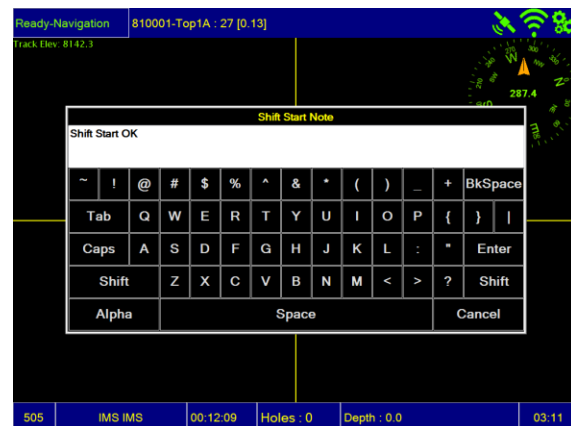
4. Log on to system using employee number (company provided). Enter a comment if necessary.





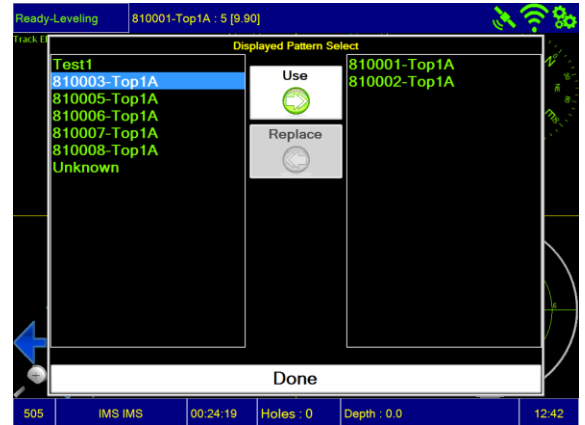
5. Complete Pre-shift Check list – follow company procedures for failed items. You may either check each item individually, or pass batches of 10 items each. Once completed, press **Complete Pre-Shift Check**.

6. Enter shift notes if necessary. Notes will be saved to the database.



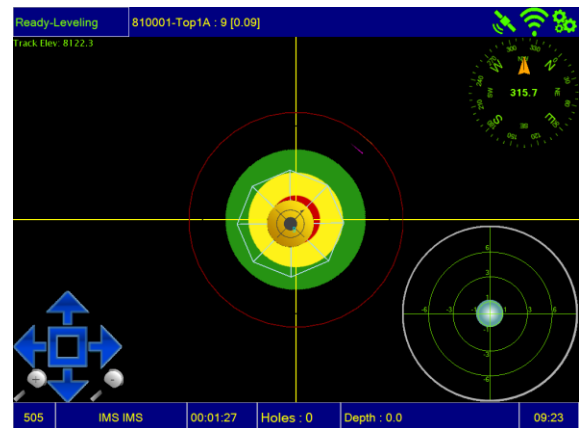
7. Consumables Check list – Verify that proper drill bit and/or hammer serial numbers are in the **Active** list. Manually enter details for drill bit and/or hammer using **Add New** if not listed.

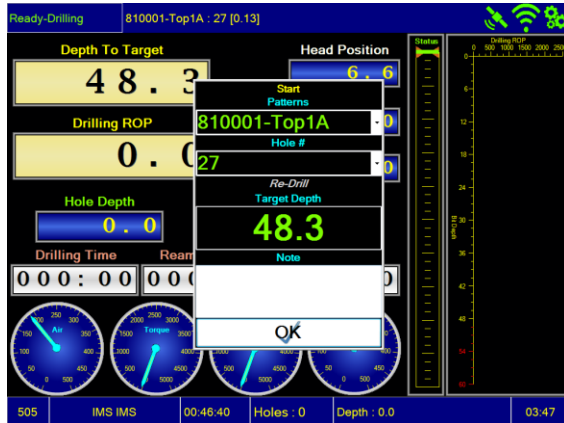
8. Select Pattern Map - If the correct pattern is not in listed, be patient, it may take a short time for patterns to upload from the central service. If patterns do not upload after a short period of time, contact dispatch or your shift supervisor for further assistance.



9. Navigation:
Put machine into propel or tram operation's mode: Thunderbird system will change state automatically to the Navigation screen.
Navigate drill to the designated target hole: Thunderbird system will zoom in twice as you get approach to the target hole.
When the drill pipe on the screen is centered over the target hole, switch to drill mode, the Thunderbird System will automatically change state to Leveling.

10. Leveling:
Level drill by using on-board GUI level bubble. Once level, begin drilling. The Thunderbird System will automatically switch to Drilling Mode.

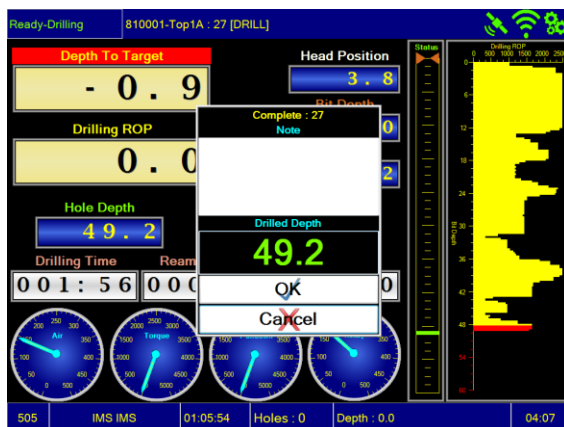
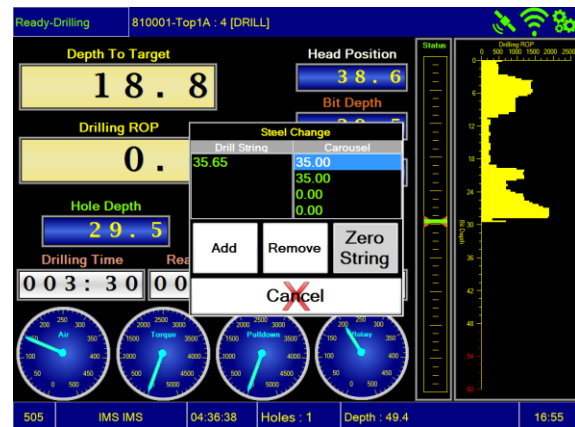




11. Drilling:

Lower the drill bit to the ground. In the event operator does not manually start the hole, the system will indicate that drilling has commenced and hole will auto start (Navigation System Only). Auto start occurs when the bit goes beneath track elevation.

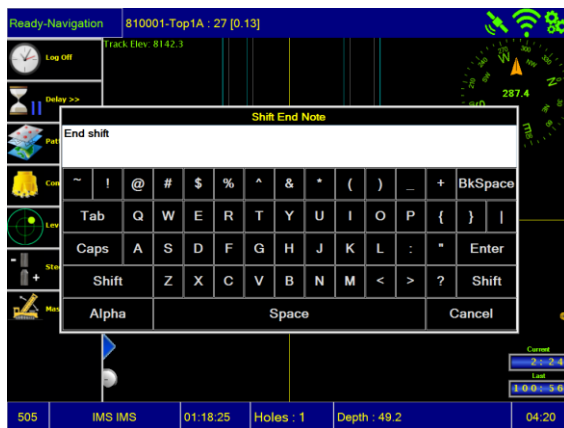
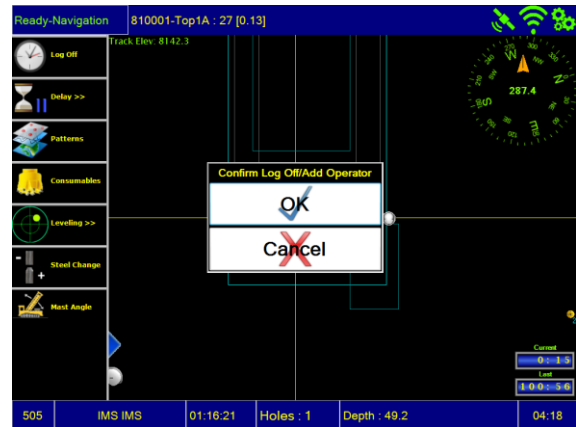
- **Steel Change** Dialogue is triggered when the target depth exceeds the potential drilling depth of the equipment with starter steel alone. If the target depth exceeds potential, the dialogue appears (either add or remove) when the power head reaches a pre-determined distance from the drilling deck, or from the upper stop limit. If equipped with bailing air triggers, the adding and removing of steel will be automatic.



- The end hole dialogue will appear when target depth has been reached. Over drilled amounts will appear in red. Switching to propel and moving to the next hole will automatically end the hole and add depth to shift totals.

12. End Shift / Log off

Select Log Off from the Side Bar on the left hand side of the screen.



- Enter any end shift notes if necessary. Notes will be saved to the database.

13. Power off Thunderbird system

14. Shut machine down

4.0 USING THE DEI-X

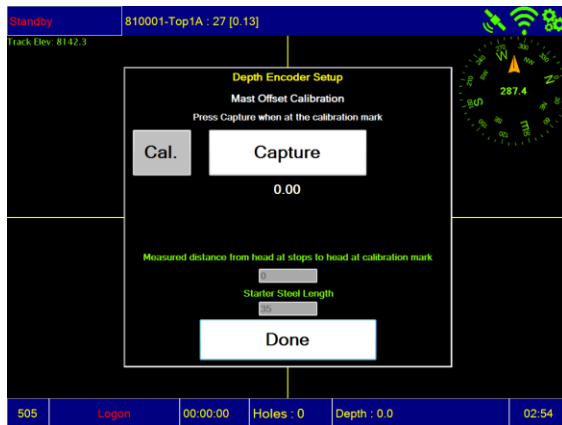
4.0 USING THE DEI-X

This section will review the operation of a DEI-X System.

System operation consists of 15 steps from start of shift to end of shift. Some functions are automatic, but some will require operator input.

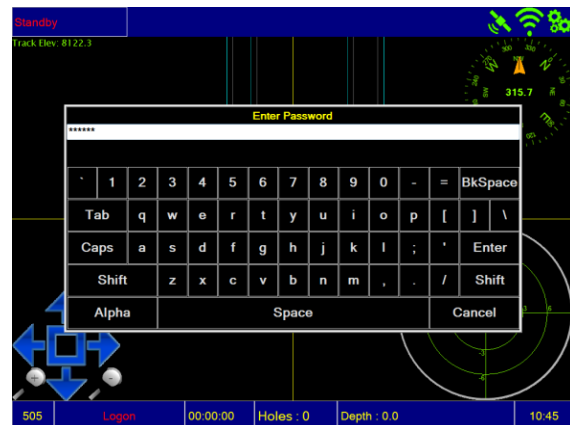
The steps are as follows:

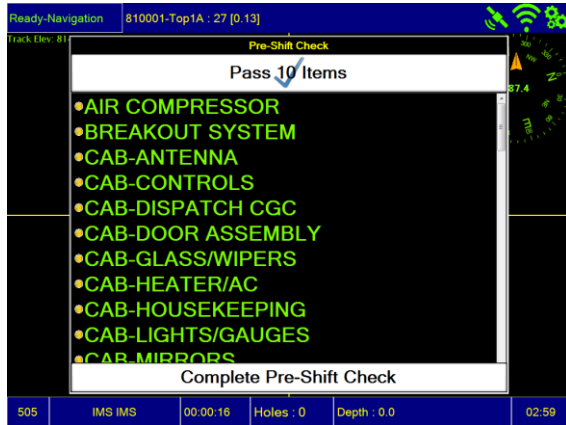
3. Start the drill. Be sure the In-dash Key Switch for the System is in the **off** position.
4. Power on Thunderbird system, wait for the Thunderbird application to load on the display.



4. Move head to maximum upper stop. Press capture, Press done. Head position is now calibrated and depths will be accurate.

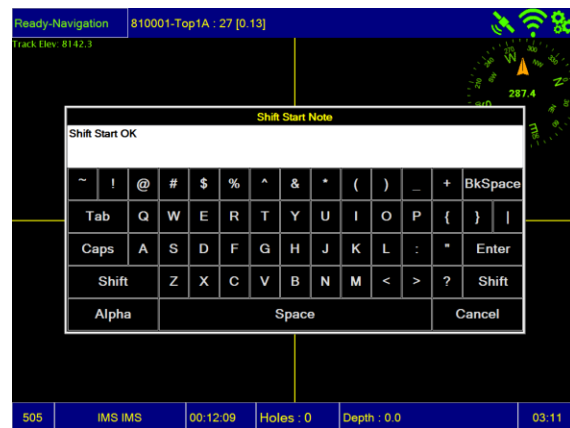
5. Log on to system using employee number (company provided). Enter a comment if necessary.



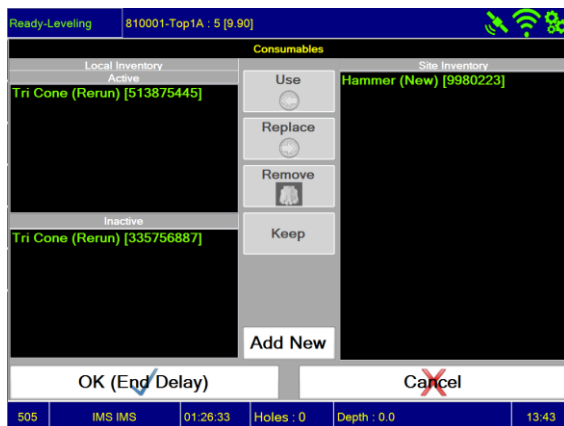


6. Complete Pre-shift Check list – follow company procedures for failed items. You may either check each item individually, or pass batches of 10 items each. Once completed, press **Complete Pre-Shift Check**.

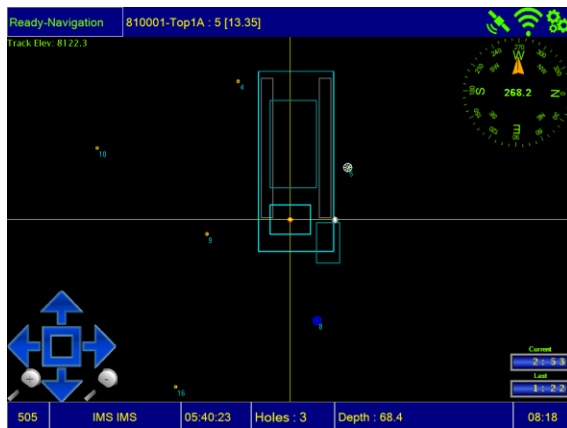
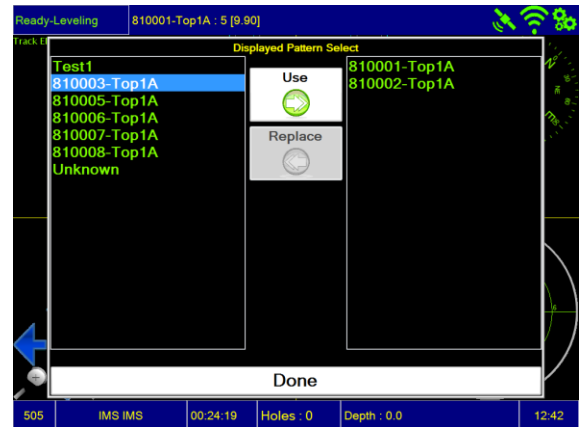
7. Enter shift notes if necessary. Notes will be saved to the database.



8. Consumables Check list – Verify that proper drill bit and/or hammer serial numbers are in the **Active** list. Manually enter details for drill bit and/or hammer using. **Add New** if not listed.



10. Select Pattern Map - If the correct pattern is not in listed, be patient, it may take a short time for patterns to upload from the central service. If patterns do not upload after a short period of time, contact dispatch or your shift supervisor for further assistance.

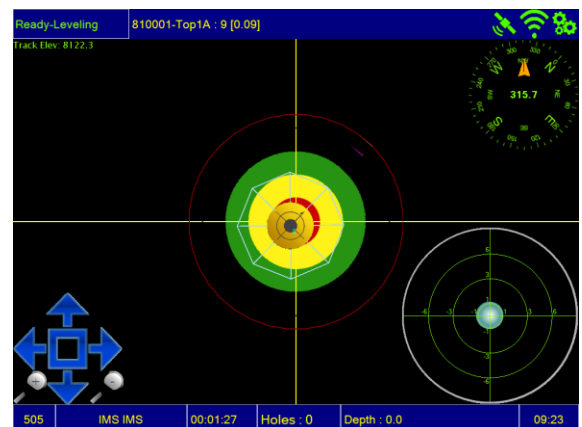


11. Navigation:

The Navigation feature is non-functional and should not be relied upon for positioning. Put machine into propel or tram operation mode: Thunderbird system will change state automatically to the Navigation screen. Once the target has been reached, switch to drill mode, the Thunderbird System will automatically change state to Leveling.

11. Leveling:

The on-board GUI level bubble is non-functional and should not be relied upon for leveling indication. Once level, begin drilling. The Thunderbird System will automatically switch to Drilling Mode.

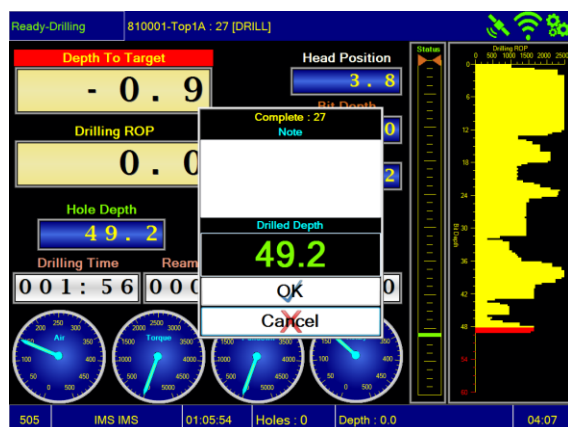
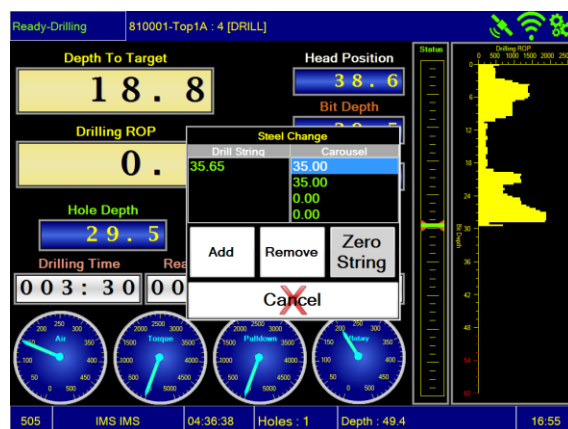




12. Drilling:

Lower the drill bit to the ground. Once the system senses encoder movement, the hole select dialogue will appear. Select hole manually, enter target depth if necessary, and press OK when ready to drill. *Auto start is not enabled for the DEI-X system. The hole will not start unless OK is pressed.*

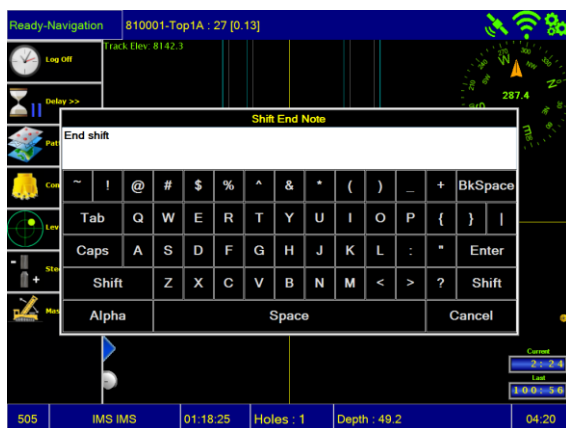
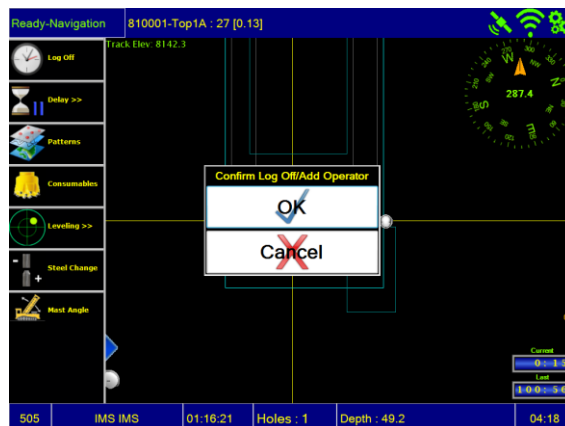
- **Steel Change** Dialogue is triggered when the target depth exceeds the potential drilling depth of the equipment with starter steel alone. If the target depth exceeds potential, the dialogue appears (either add or remove) when the power head reaches a pre-determined distance from the drilling deck, or from the upper stop limit. If equipped with bailing air triggers, the adding and removing of steel will be automatic.



- The end hole dialogue will appear when target depth has been reached. Over drilled amounts will appear in red. Switching to propel and moving to the next hole will automatically end the hole and add depth to shift totals.

13. End Shift / Log off

Select Log Off from the Side Bar on the left hand side of the screen.



- Enter any end shift notes if necessary. Notes will be saved to the database.

15. Power off Thunderbird system

16. Shut machine down

5.0 QUICK REFERENCE STEP GUIDES

5.0 DEI+NAV QUICK REFERENCE GUIDE

System operation consists of 14 steps from start of shift to end of shift. Most functions are automatic if Navigation is installed. The steps are as follows:

1. Start the drill. Be sure the In-dash Key Switch for the System is in the off position.
2. Power on Thunderbird system, wait for the Thunderbird application to load on the display.
3. Move head to maximum upper stop. Press capture, Press done. Head position is now calibrated and depths will be accurate.
4. Log on to system using employee number (company provided). Enter a comment if necessary.
5. Complete Pre-shift Check list – follow company procedures for failed items.
 - You may either check each item individually, or pass batches of 10 items each. Once completed, press **Complete Pre-Shift Check**.
6. Enter shift notes if necessary. Notes will be saved to the database.
7. Consumables Check List – Verify that proper drill bit and/or hammer serial numbers are in the **Active** list. Manually enter details for drill bit and/or hammer using. **Add New** if not listed.
8. Select Pattern Map - If the correct pattern is not in listed, be patient, it may take a short time for patterns to upload from the central service. If patterns do not upload after a short period of time, contact dispatch or your shift supervisor for further assistance.
9. Navigation:
 - Put machine into propel or tram operation's mode: Thunderbird system will change state automatically to the Navigation screen.
 - Navigate drill to the designated target hole: Thunderbird system will zoom in twice as you get approach to the target hole.
 - When the drill pipe on the screen is centered over the target hole, switch to drill mode, the Thunderbird System will automatically change state to Leveling.
10. Leveling:
 - Level drill by using on-board GUI level bubble. Once level, begin drilling. The Thunderbird System will automatically switch to Drilling Mode.
11. Drilling:
 - Lower the drill bit to the ground. In the event operator does not manually start the hole, the system will indicate that drilling has commenced and hole will auto start (Navigation System Only). Auto start occurs when the bit goes beneath track elevation.
 - **Steel Change** Dialogue is triggered when the target depth exceeds the potential drilling depth of the equipment with starter steel alone. If the target depth exceeds potential, the dialogue appears (either add or remove) when the power head reaches a pre-determined distance from the drilling deck, or from the upper stop limit. If equipped with bailing air triggers, the adding and removing of steel will be automatic.
 - The end hole dialogue will appear when target depth has been reached. Over drilled amounts will appear in red.
 - Switching to propel and moving to the next hole will automatically end the hole and add depth to shift totals.
12. End Shift / Log off Select Log Off from the Side Bar on the left hand side of the screen.
 - Enter any end shift notes if necessary. Notes will be saved to the database.
13. Power off Thunderbird system.
14. Shut machine down

5.1 DEI-X QUICK REFERENCE GUIDE

System operation consists of 14 steps from start of shift to end of shift. Most functions are automatic if Navigation is installed. The steps are as follows:

1. Start the drill. Be sure the In-dash Key Switch for the System is in the off position.
2. Power on Thunderbird system, wait for the Thunderbird application to load on the display.
3. Move head to maximum upper stop. Press capture, Press done. Head position is now calibrated and depths will be accurate.
4. Log on to system using employee number (company provided). Enter a comment if necessary.
5. Complete Pre-shift Check list – follow company procedures for failed items.
 - You may either check each item individually, or pass batches of 10 items each. Once completed, press **Complete Pre-Shift Check**.
6. Enter shift notes if necessary. Notes will be saved to the database.
7. Consumables Check List – Verify that proper drill bit and/or hammer serial numbers are in the **Active** list. Manually enter details for drill bit and/or hammer using. **Add New** if not listed.
8. Select Pattern Map - If the correct pattern is not in listed, be patient, it may take a short time for patterns to upload from the central service. If patterns do not upload after a short period of time, contact dispatch or your shift supervisor for further assistance.
9. Navigation:
 - **The Navigation feature is non-functional and should not be relied upon for positioning.**
 - Put machine into propel or tram operation mode: Thunderbird system will change state automatically to the Navigation screen.
 - Once the target has been reached, switch to drill mode, the Thunderbird System will automatically change state to Leveling.
10. Leveling:
 - **The on-board GUI level bubble is non-functional and should not be relied upon for leveling indication.**
 - Once level, begin drilling. The Thunderbird System will automatically switch to Drilling Mode.
11. Drilling:
 - Lower the drill bit to the ground. Once the system senses encoder movement, the hole select dialogue will appear. Select hole manually, enter target depth if necessary, and press OK when ready to drill. *Auto start is not enabled for the DEI-X system. The hole will not start unless OK is pressed.*
 - **Steel Change** Dialogue is triggered when the target depth exceeds the potential drilling depth of the equipment with starter steel alone. If the target depth exceeds potential, the dialogue appears (either add or remove) when the power head reaches a pre-determined distance from the drilling deck, or from the upper stop limit. If equipped with bailing air triggers, the adding and removing of steel will be automatic.
 - The end hole dialogue will appear when target depth has been reached. Over drilled amounts will appear in red.
 - Switching to propel and moving to the next hole will automatically end the hole and add depth to shift totals.
12. End Shift / Log off Select Log Off from the Side Bar on the left hand side of the screen.
 - Enter any end shift notes if necessary. Notes will be saved to the database.
13. Power off Thunderbird system.
14. Shut machine down

