



**Innovation in electric power.**

**inoRAC1™ Remote Racking Device  
Instruction Manual**

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# in RAC 1™

**More than Just a Racking Device**

**Instruction Manual**



## Contents

1. **Introduction**
  1. Description
2. **Setup**
  1. Shipping & Receiving
  2. Moving & Lifting
3. **Operation**
  1. Basic Operation
  2. Racking a Circuit Breaker
  3. Rack to Test Lockout for LV Circuit Breaker
  4. Push-button Operation
  5. Manual Trip/Close
  6. Extraction
  7. Emergency Stop
  8. Profile Fault
  9. Overcurrent Fault
  10. Encoder Failure
  11. Drive Fault
  12. System Fault Procedures
  13. Lock Pin Failure
  14. Horizontal Motor Position Failure
4. **Maintenance & Technical Data**
  1. Typical Maintenance
5. **Troubleshooting**
  1. Alarms
  2. Technical Support Contact

## Introduction

The design of medium voltage metal clad switchgear and low voltage switchgear commonly incorporates a manual method of operating the circuit breakers while physically positioned in front of the circuit breaker. This includes:

1. Circuit Breaker Racking
2. Push Button Operator
3. Manual Trip/Close

The operation of switchgear circuit breakers, in particular breaker racking, is most often performed with the switchgear energized due to facility operational requirements. This manual work subjects the operator to severe Arc Flash hazards. An electrical failure in the circuit breaker or switchgear during the racking process can result in serious injury or death of the operator.

The inoRAC™ is an electromechanical device designed for the specific purpose of operating medium voltage and low voltage switchgear circuit breakers while allowing the operator to be at a safe distance from the energized switchgear and circuit breaker. The inoRAC™ utilizes the latest technology for position control and to monitor and protect the circuit breaker and switchgear from damage during operations.



## inoRAC1™ Description

The inoRAC™ consists of the following:

1. A completely self-contained circuit breaker operating system
2. A motor, which is vertically adjustable by the operator, via a detachable touch screen panel.
3. A digital encoder on the motor for position control and sensing.
4. Controls are physically mounted within the inoRAC™ frame.
5. Controls are through a portable touch screen panel connected to the inoRAC™ via a 75' cable.
6. The inoRAC™ utilizes standard 120 VAC power, and does not require any interconnection with the switchgear wiring or controls.
7. Remote push button option operated through the portable touch screen panel
8. Adapters as required to operate circuit breakers from all major manufacturers
9. Variable frequency drive to control and power the motor.
10. Actuator to supply vertical adjustment for the motor assembly.
11. Programmable logic controller (PLC) to control and monitor the system.
12. Operators panel touch screen with ON/OFF switch for operator control and monitoring.
13. Wheel brakes that lock the unit in place, allowing the motor to move horizontally with the breaker.
14. Spring-assisted motor that applies force towards the breaker to operate interlocks and ensure the coupling between the breaker connection tool and the breaker.

When connected to the circuit breaker/cell racking mechanism via breaker connection tool, the motor is operated as required to perform the racking in or out of the circuit breaker. Direction, speed, over current limits, ramp up and down times, etc. are automated via the PLC and variable frequency drive. Most of these values can be set via the touch screen panel.

The operator defines the circuit breaker starting position via the touch screen panel. The circuit breaker movement and location are monitored and controlled as it moves from one position to the other to an accuracy of .001 inches. Travel and stop points are set via the operators panel touch screen.

As the racking torque required for a circuit breaker varies widely depending on its location (free travel, shutter operation, finger cluster engagement, etc), it is difficult to establish one over torque level that will adequately protect the circuit breaker and cell during the racking process. The inoRAC™ addresses this problem with its torque profile protection. Utilizing the motor encoder and the variable frequency drive the PLC generates a torque vs. position record for each type of circuit breaker operated. This torque vs. position record (Torque Profile) is stored in the PLC memory. When a circuit breaker is racked in or out the PLC compares the active torque with the stored torque (Torque Profile) for that type of circuit breaker.

If the active torque is sufficiently greater than the stored torque a “Profile Fault” is initiated and the operator is prompted. The “Torque Profile” can be updated via operators panel touch screen commands. The level at which the “Profile Fault” is initiated can be set via the operators panel touch screen.

The system via the operators panel touch screen will give notification and procedures for the following situations:

- Emergency Stop
- Profile Fault
- Overcurrent Fault
- Encoder Failure
- Drive Fault
- Lock Pin Failure (Only for ABB - ITE type HK circuit breakers)
- Horizontal Motor Position Failure

The operators panel touch screen supplies the interface between the inoRAC™ system and the outside world. In addition to the data input described above the operators panel touch screen does the following:

- Displays circuit breaker position.
- Displays circuit breaker encoder count.
- Displays motor current.
- Provides motor jog function.
- Provides motor assembly vertical adjustments up and down.
- Provides identification of the circuit breaker to be racked.
- Provides racking initiation and stop.
- Provides the option of mimicking existing racking procedures.

## Setup

You should receive the racking unit on a pallet with all necessary tools and equipment needed to start up the device. If your shipment is damaged or something is missing, call inoLECT immediately.

## Shipping & Receiving

If the need should arise that the unit be sent back to inoLECT or to another location, please follow the proper palletizing instructions below:



### Needed Equipment:

1. 1 - solid top pallet
2. 2 - 2x4x24" boards
3. 2 - 2x4x boards
4. 4 - 7 1/4" all-thread bolts with nylock nuts
5. 2 - 6"x24" pieces of cardboard
6. Drill
7. Fork Lift
8. 120VAC extension cord



1. Place unit in center of pallet.
2. Lock Unit wheels.
3. Place (1) 2x4x24" board in front of unit legs, and (1) 2x4x24" behind Unit wheels.
4. Screw 2x4x24" to Pallet in 2 places, preventing forward or backward movement.

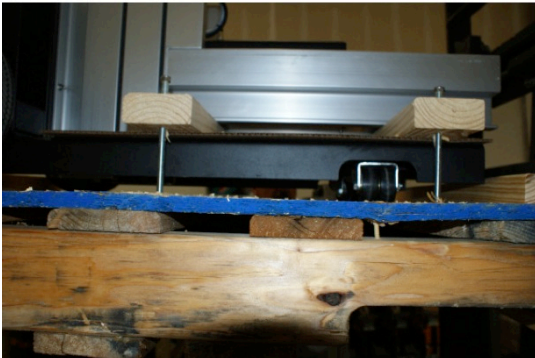


5. Using 120VAC extension cord, provide power to the unit & switch unit "on". Raise motor tray to around 10" from bottom.
6. Place (1) piece of cardboard on top of each leg.
7. Place (1) 2x4x24" board on legs, under front of motor tray and 2x4x24" board under back of motor tray.





8. Lower motor tray to hold 2x4x24" boards in place. Switch unit "off" and unplug.
9. Drill holes from top of 2x4x24" into pallet, insert 7/4" All-thread with nylock nut and secure tightly.
10. Repeat for other side.
11. Lift unit with forklift to allow for working space underneath.



12. Using 1 1/4" paddle bit, drill recessed holes in bottom of pallet, lining up with the 7/4" all-thread bolts.
13. Slide the 7/4" all-thread bolt down and secure to pallet, repeat for all four bolts.

14. Tighten all 4 - 7/4" all-thread bolts until legs of unit are bound tightly and secure to pallet.

15. Lower unit to ground level.



16. Place tie-strap over top of motor tray, around 2x4x24" and under unit.

17. Wrap tightly with plastic wrap and place cover on unit (if supplied with one).

**STEPS FOR MOVING AND LIFTING:**

**Method of Lifting 1:**

Optional Lifting Eyes for moving with crank or hoist.

Optional Lifting Eyes



**Method of Lifting 2:**  
Manual lifting using specific Lift Points.

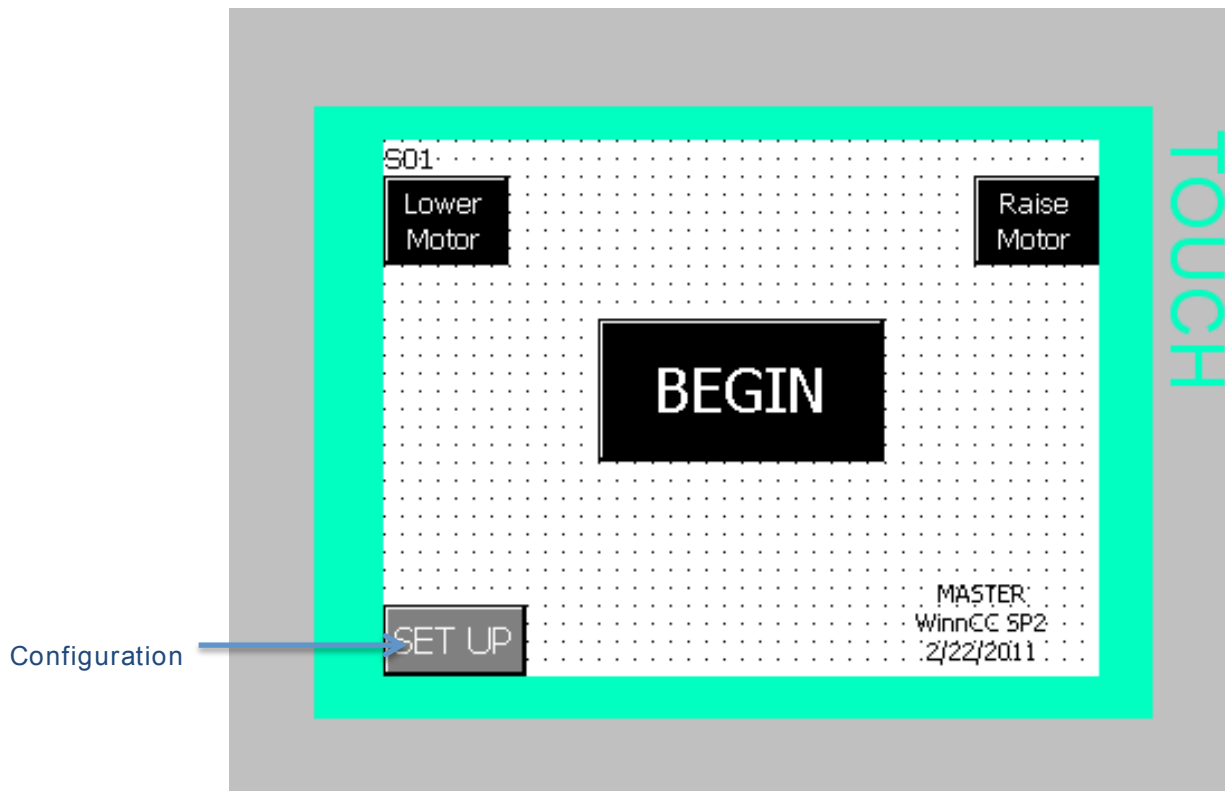


## Basic Operation

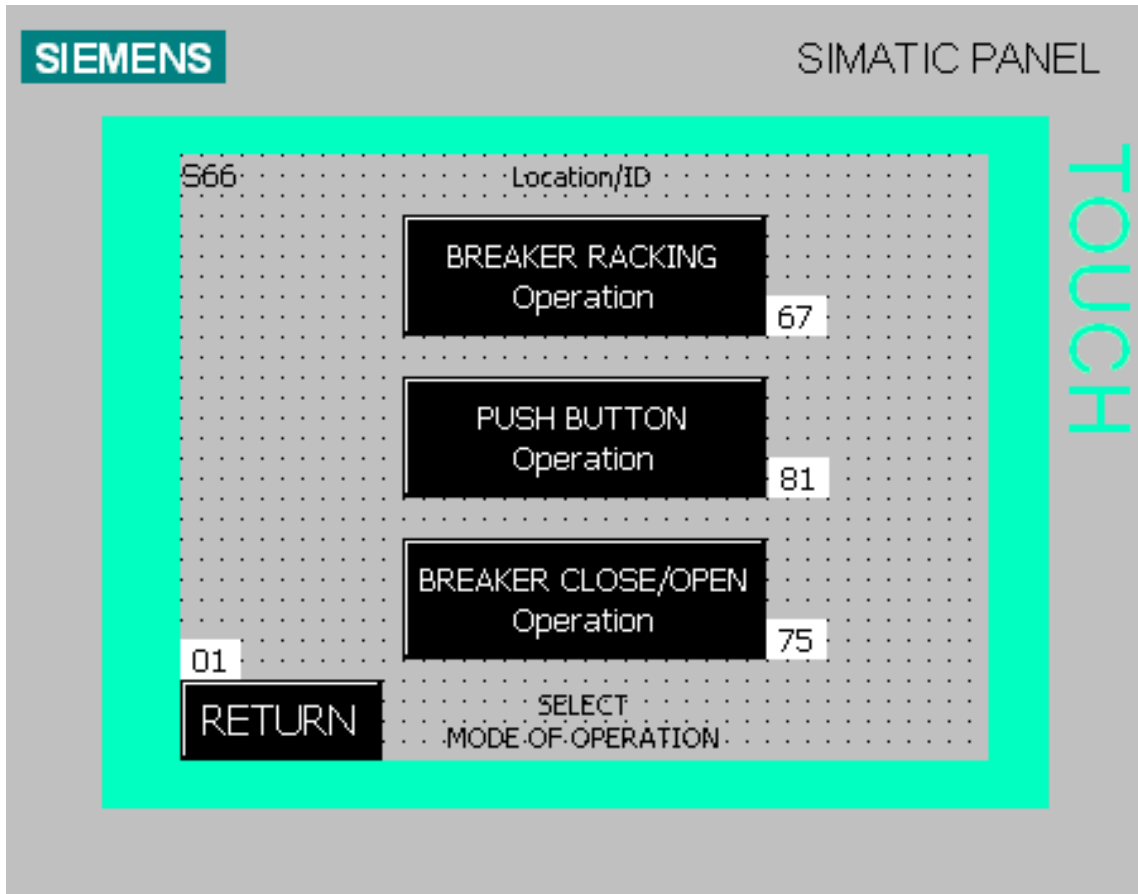
1. Connect 120 VAC to the inoRAC™ via the control box receptacle.
2. Power up the inoRAC™ by putting ON/OFF switch on operators panel touch screen in “ON” position.
3. Start using the inoRAC™ by pressing the “BEGIN” button on the first screen on operators panel touch screen.
4. Select the operation to be performed. In this case “BREAKER RACKING OPERATION”.
5. Select the manufacturer and type for the object circuit breaker to be racked.
6. Adjust and connect the inoRAC™ with the circuit breaker racking mechanism. Use appropriate adapter as required and set brakes.
7. Check to assure that the object circuit breaker is open position. This is typically indicated by the mechanical indicator on front of the circuit breaker.
8. Select the desired operation for the object circuit breaker. (Either rack in/up or rack out/down.)
9. Check to assure that the brakes on the inoRAC™ are set.
10. “ENGAGE and SET” the inoRAC™ if required before racking.
11. Move to a safe location outside the arc flash hazard zone with operators panel touch screen before racking the object circuit breaker.
12. Using operators panel touch screen initiate the racking operation.
13. When operators panel touch screen indicates racking is complete, press “NEXT”.
14. Disconnect the inoRAC™ from the circuit breaker by putting ON/OFF switch on operators panel touch screen in “OFF” position and return the inoRAC™ to storage.

Object Circuit Breaker – Circuit breaker that operator using inoRAC™ intends to operate.

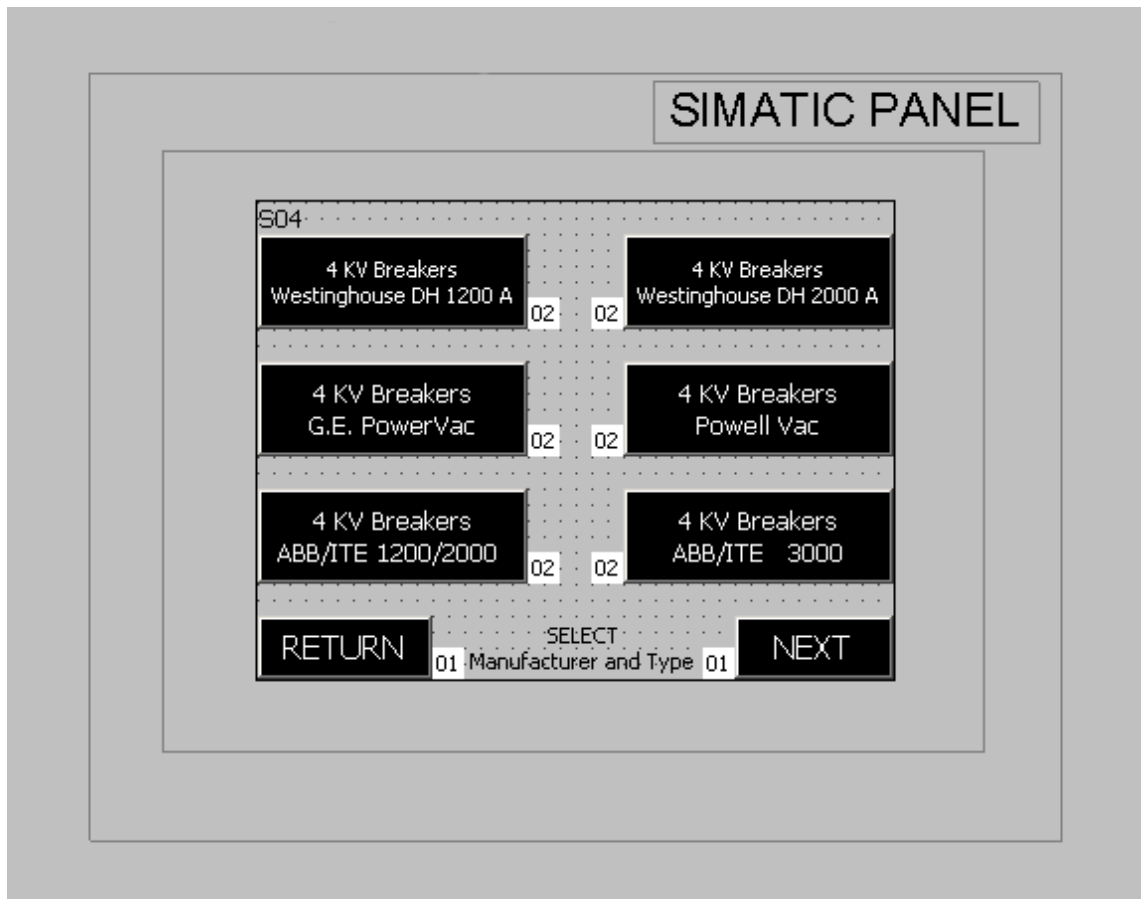
## Racking a Circuit Breaker



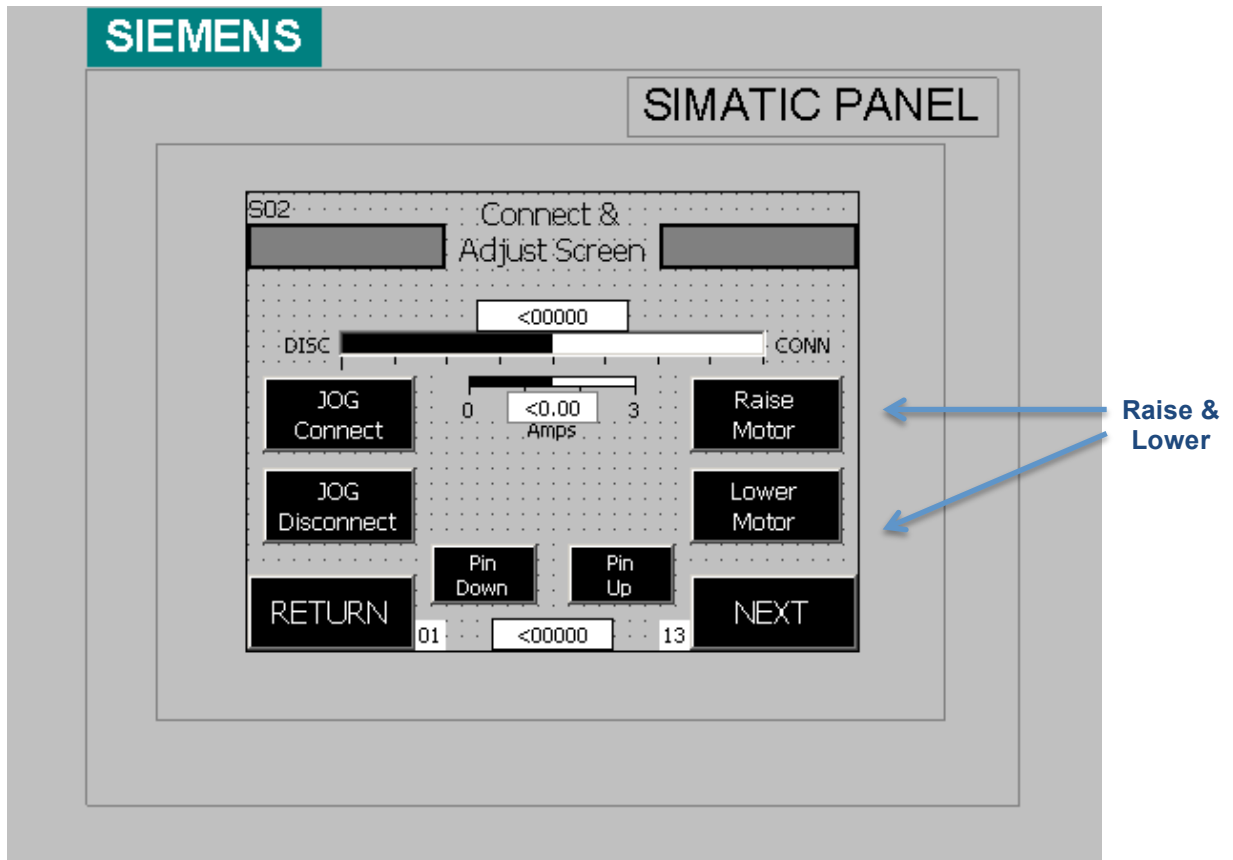
1. Connect 120 VAC to the inoRAC™ via the control box receptacle using a standard 120 VAC extension cord.
2. Power up the inoRAC™ by putting ON/OFF switch on operators panel touch screen in “ON” position. “ON” is indicated by appearance of the screen above on operators panel touch screen. (Screen 01.) Please note that on the operators panel touch screen the term “Breakers” or “Breaker” is equivalent to circuit breakers or circuit breaker.
3. To start using the inoRAC™ press the “BEGIN” button on the operators panel touch screen to go to following screen 66 shown on next page. (Screen 66)
  - a. Note: The “SET UP” button is for use in start up of the inoRAC™ and for changing system parameters. **It is extremely dangerous to change “SET UP” unless trained to make these changes.**



4. Press the "BREAKER RACKING Operation" to select the racking operation and to go to screen 67.

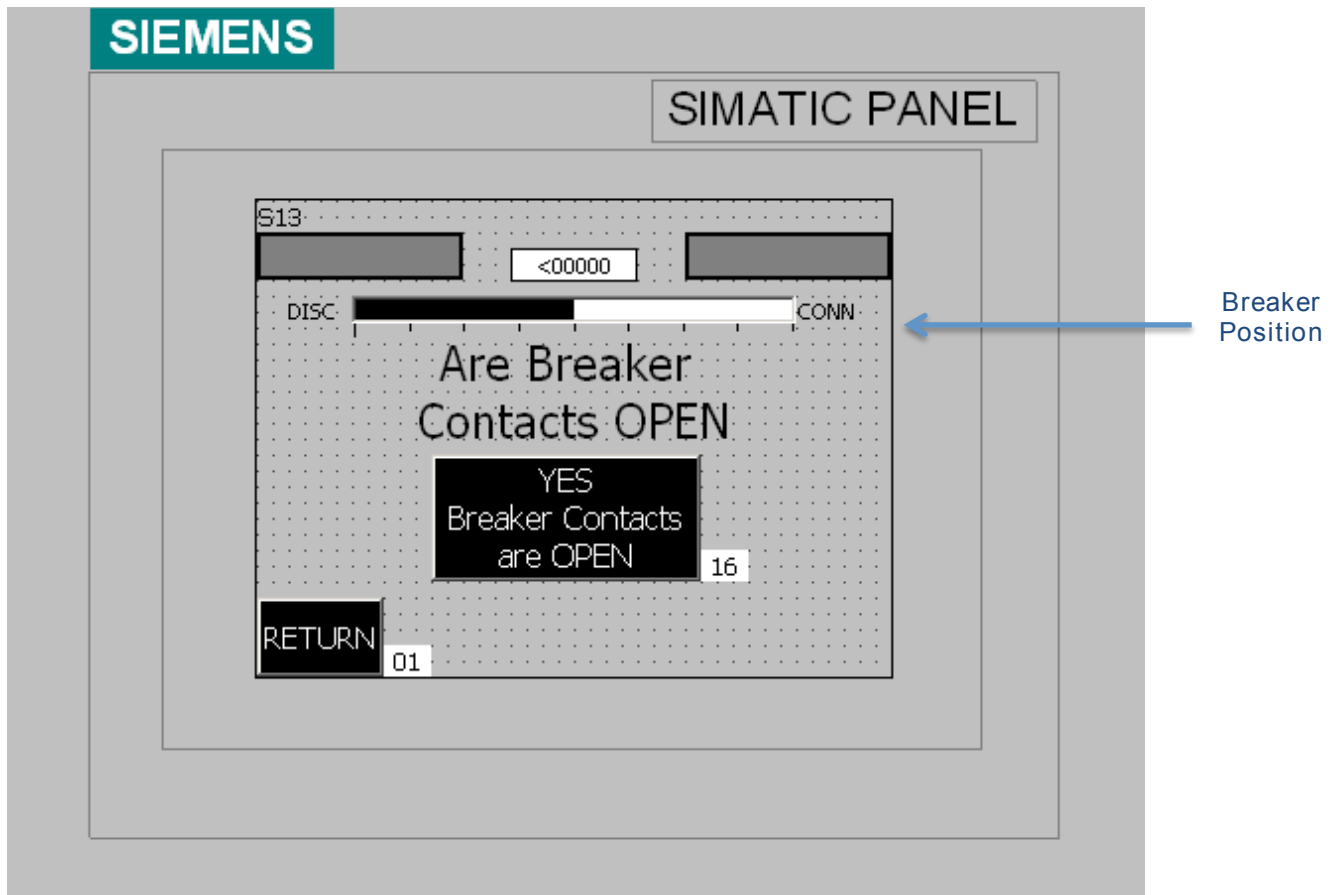


5. Press the button for the manufacturer and type of circuit breaker that identifies the object circuit breaker to be racked. This will load the data for the object circuit breaker and go to screen 02 shown on the next page.

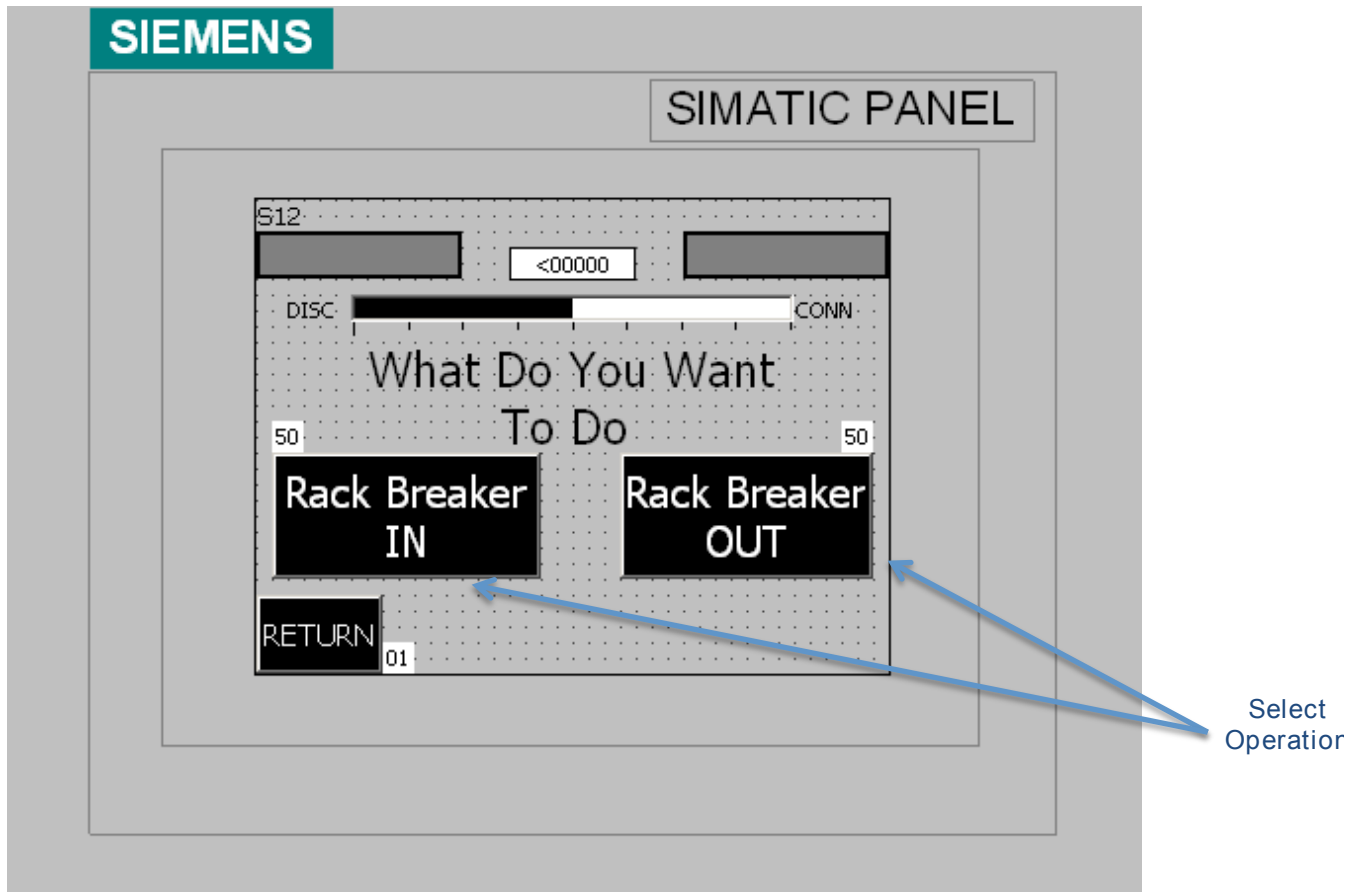


1. This screen gives the operator the ability to raise and lower the motor assembly so it can be aligned with the circuit breaker racking mechanism. It also gives the operator the ability to jog the motor clockwise or counter clockwise to align and engage the inoRAC™ circuit breaker adapter with the circuit breaker racking mechanism.
  - a. Engage the inoRAC™ circuit breaker adapter and the circuit breaker racking mechanism. Position the inoRAC™ so that the motor carriage can move as required for the object circuit breaker. Use the “Raise Motor”, “Lower Motor”, “JOG Connect”, and “JOG Disconnect” functions to assist in alignment and engagement of the inoRAC™ with the circuit breaker. When the inoRAC™ is successfully connected to the desired circuit breaker press the “NEXT” button to go to screen 13.
    - i. Note: The “Raise Motor”, “Lower Motor”, “JOG Connect”, and “JOG Disconnect” buttons function as momentary buttons. Press and hold the button until the desired location is achieved releasing the button stops the action.
    - ii. There are four additional buttons that can show up on this screen. These are described below:
      1. “Move To Disconnect” – This button is for use in the event that power to the inoRAC™ is lost during the racking process. After restoring power source this allows the operator to return to this screen and by simply pressing this button return the object circuit breaker to the disconnected position. The system will remember the object circuit breaker location when power was lost.

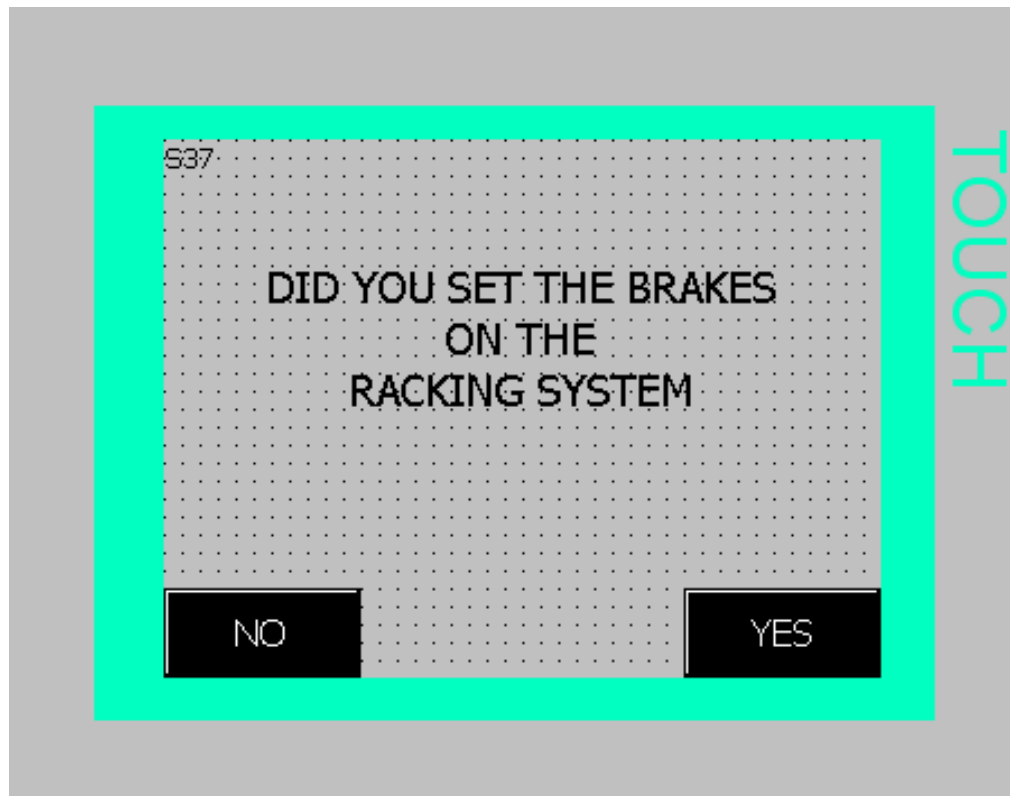
2. "Move To Connect" – **"DO NOT USE THIS BUTTON"**.
3. "Pin Down" and "Pin Up" – These buttons operate the interlock actuator for the ABB – ITE type HK 5kV and 15kV circuit breakers



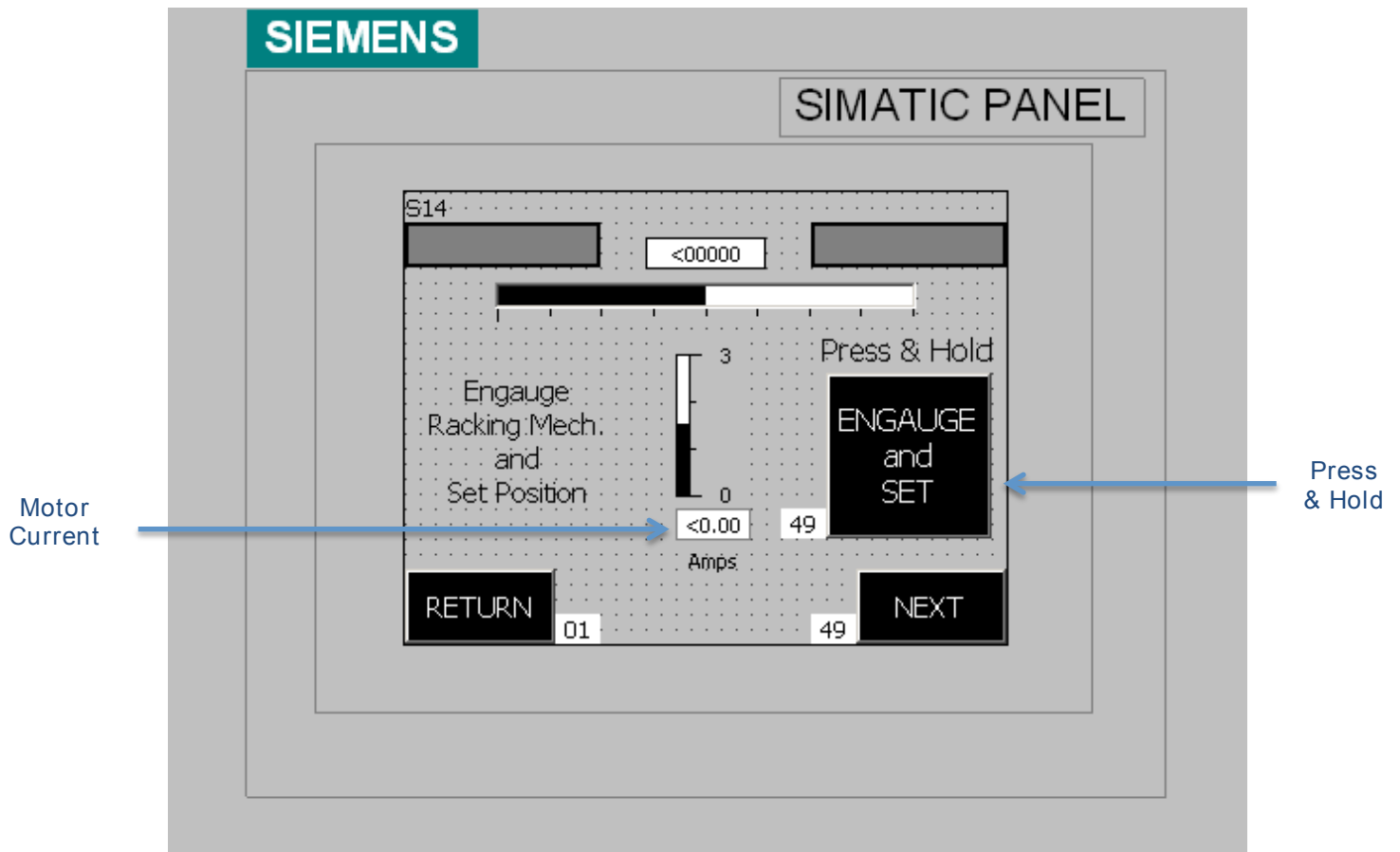
2. This screen is a safety reminder to the operator to be sure that the object circuit breaker is open before attempting to rack the circuit breaker.
  - a. Check to assure that the object circuit breaker is in the open condition and press the "YES – Breaker Contacts OPEN" button to go to screen 16. This is typically indicated by green indicating light on circuit breaker cell panel front or by viewing mechanical indicator on front of circuit breaker.



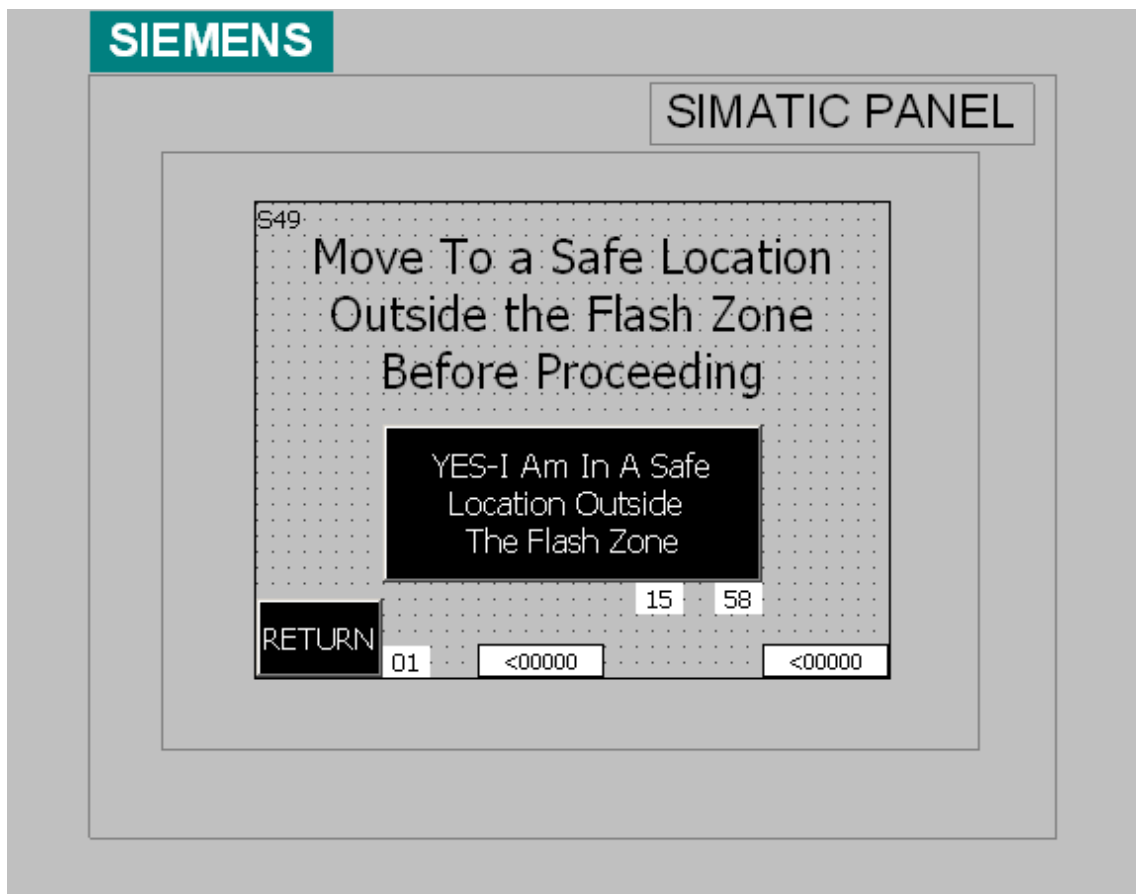
3. This screen defines the action desired by the operator on the object circuit breaker
  - i. To “Rack” the object circuit breaker from the disconnected position to the connected position press the “Rack Breaker IN” button.
  - ii. To “Rack” the object circuit breaker from the connected position to the disconnected position press the “Rack Breaker OUT” button.
- b. Pressing either button will go to screen 37 shown on the next page.



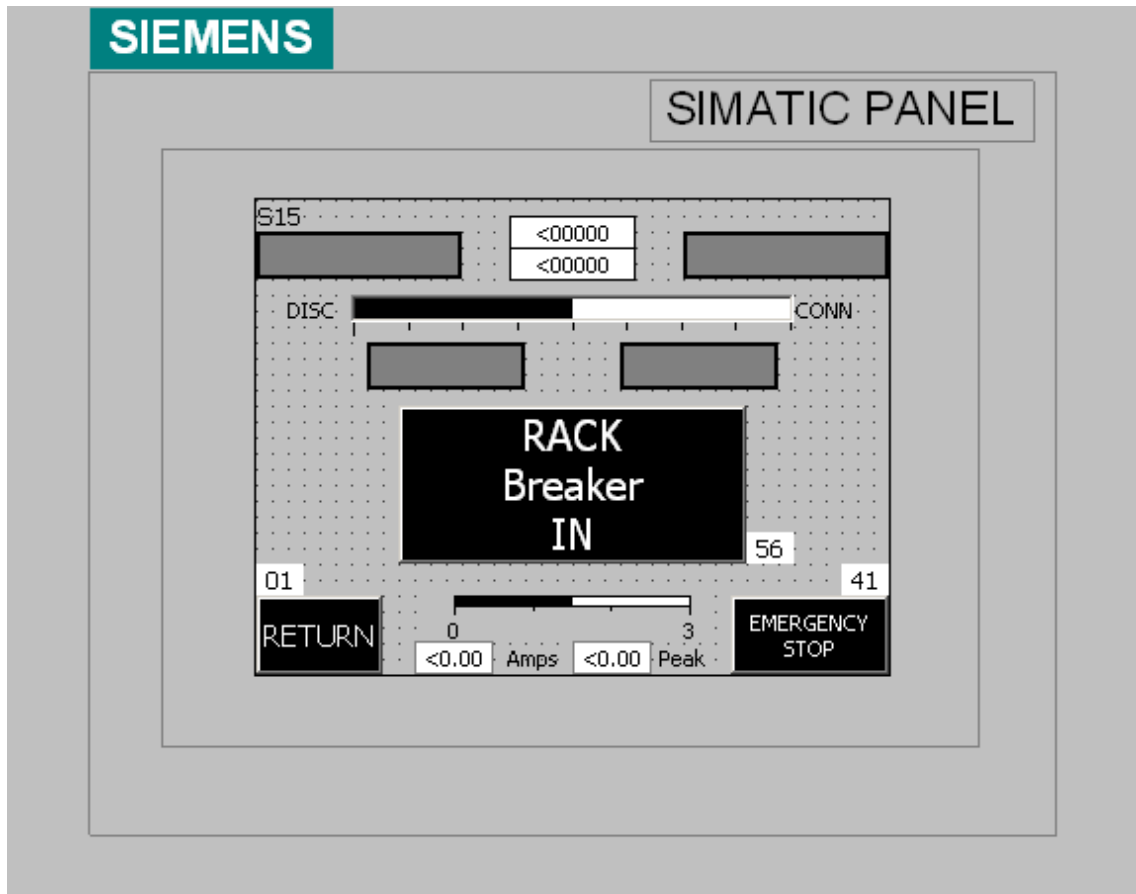
4. This screen is a safety check to ensure that the brakes on the inoRAC™ have been set.
  - a. Confirm that inoRAC™ brakes are set and press the “YES” button to go to screen 14 or screen 49 depending on the object circuit breaker type.



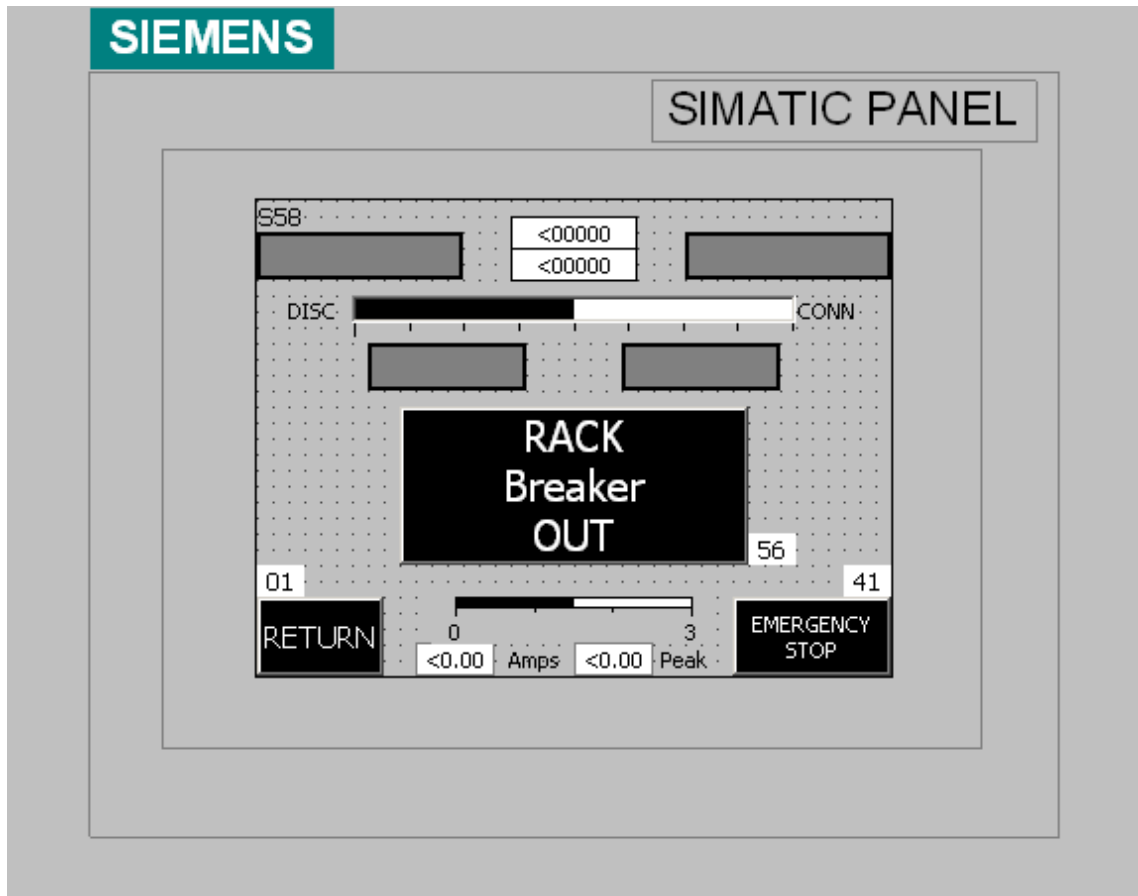
5. If the object circuit breaker requires this screen it is used to ensure the engagement and proper position of the object circuit breaker.
  - a. Press and hold the “ENGAGE and SET” button until the inoRAC™ stalls and stops turning and there is current to the motor and the screen goes to screen 49.
    - i. Pressing and holding the “ENGAGE and SET” button will cause the inoRAC™ to turn slowly until the circuit breaker racking mechanism is engaged and the object circuit breaker is in the defined position.
    - ii. If the starting position of the object circuit breaker is disconnect, the inoRAC™ will turn to further disconnect the object circuit breaker. If the starting position of the object circuit breaker is connect, the inoRAC™ will turn to further connect the object circuit breaker. When engagement and position are set, the inoRAC™ will stall and stop turning, but there will continue to be current to the motor. When the inoRAC™ stalls and stops turning and there is current to the motor, engage and set is complete. At this point the operators panel touch screen will go to screen 49.



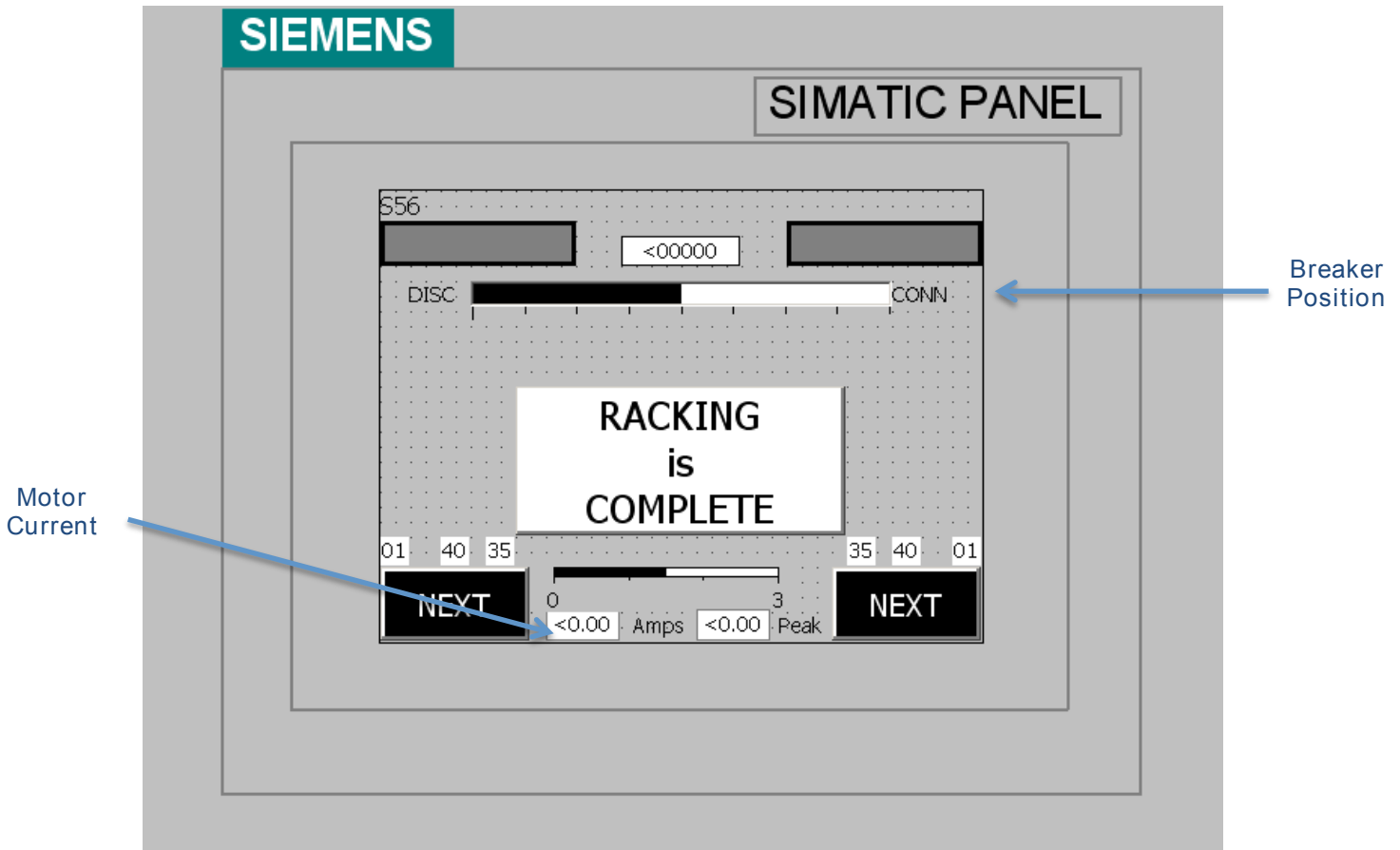
6. Depending on the circuit breaker type requirements pressing the “YES” button on screen 37 (“DID YOU SET THE BRAKES ON THE inoRAC RACKING SYSTEM” screen) or when the action performed automatically on screen 14 (“ENGAGE and SET” screen) is completed will bring up the screen above.
  - i. This screen is a safety reminder screen to remind the operator to move to a safe location before initiating the racking process for the object circuit breaker.
  - b. Move to a safe location and press the “YES-I Am In A Safe Location Outside The Flash Zone” button to go to screen 15 or screen 58 depending on operators selected action.



7. Pressing the “YES-I Am In A Safe Location Outside The Flash Zone” button will bring up the screen shown above if a “Rack Breaker IN” action is the selected action.
  - a. Press the “RACK Breaker IN” to initiate this action. When the racking in operation is complete the screen will go to screen 56 to indicate that the racking operation is complete.

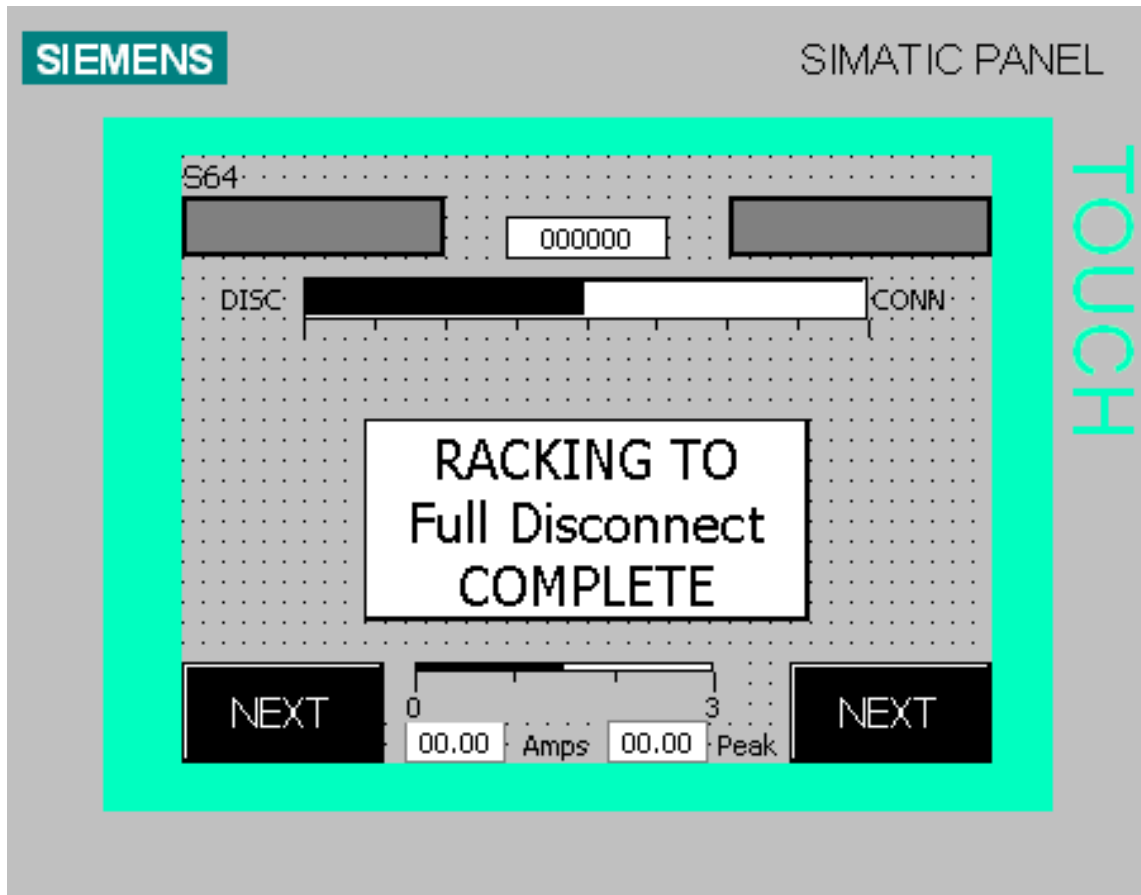


8. Pressing the “YES-I Am In A Safe Location Outside The Flash Zone” button will bring up the screen shown above if a “Rack Breaker OUT” action is the selected action.
  - a. Press the “RACK Breaker Out” to initiate this action. When the racking out operation is complete the screen will go to screen 56 to indicate that the racking operation is complete.

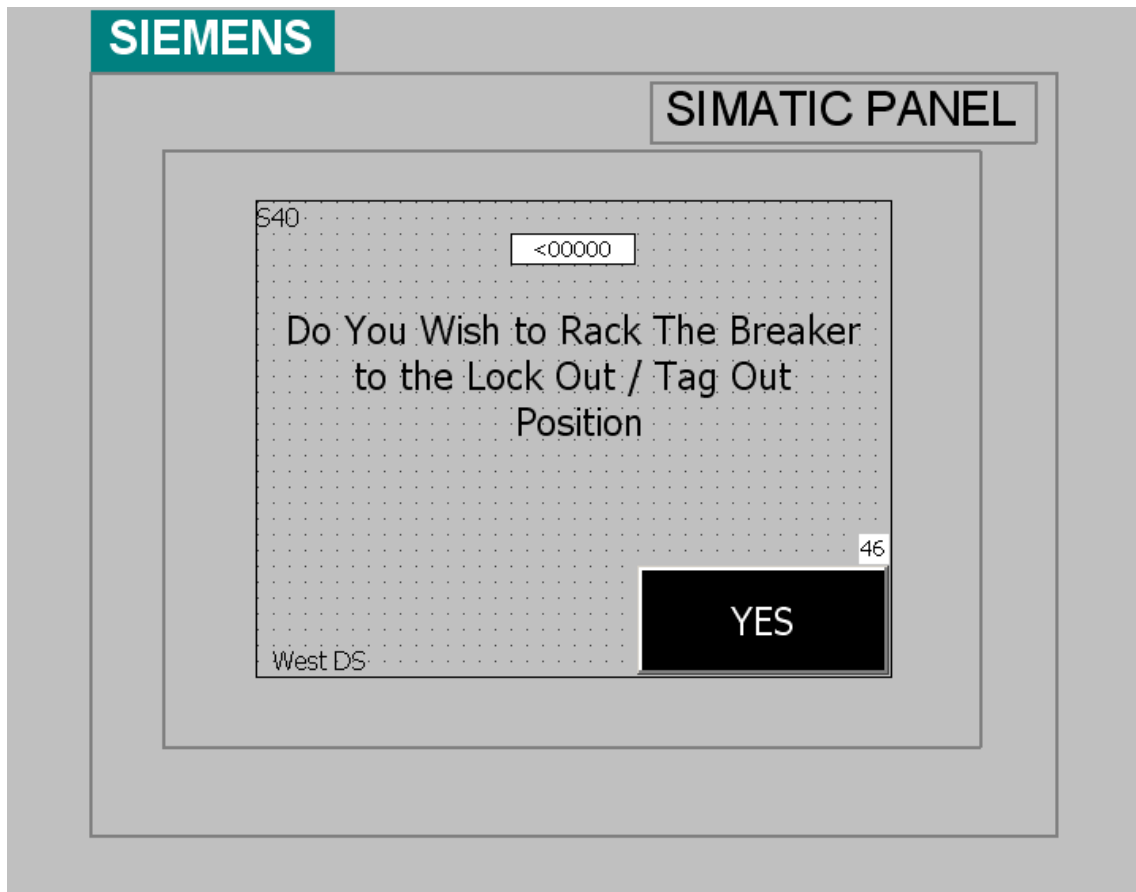


9. When Racking is complete, the screen shown above will appear. Press "NEXT" to go to screen 01.

**Rack to Test Lock Out for Low Voltage Circuit Breaker**



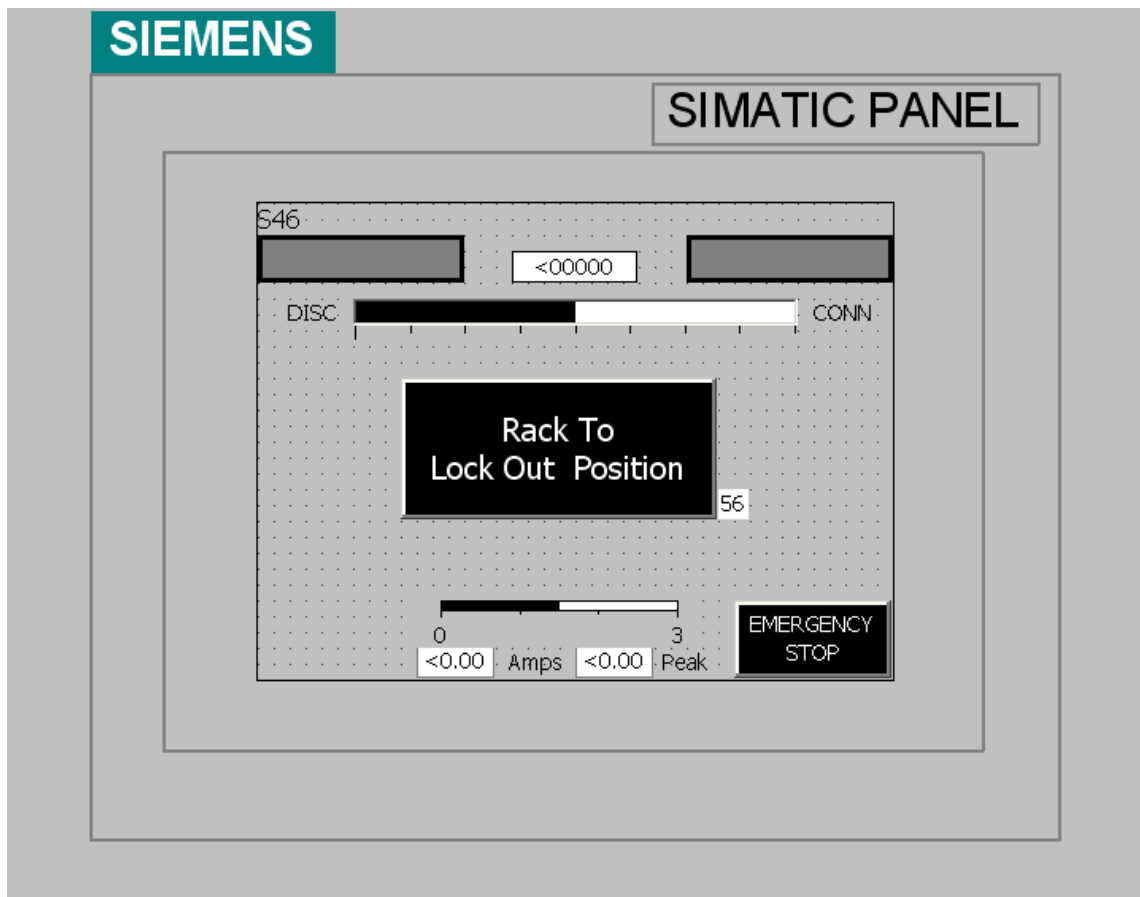
For certain low voltage circuit breakers pressing the “NEXT” button on screen 56 will allow the ability to rack to test lock out position. In these cases screen 64 shown above or screen 40 shown on the next page will be shown. If the circuit breaker type is required to completely rack the circuit breaker out to the disconnect position and then rack the circuit breaker in to the test lock out position screen 64 will appear first. Upon completion of screen 64 action pressing “NEXT” button will go to screen 40 and perform action as required. If the circuit breaker type only requires racking out to the test lock out position only screen 40 shown on the next page will appear.



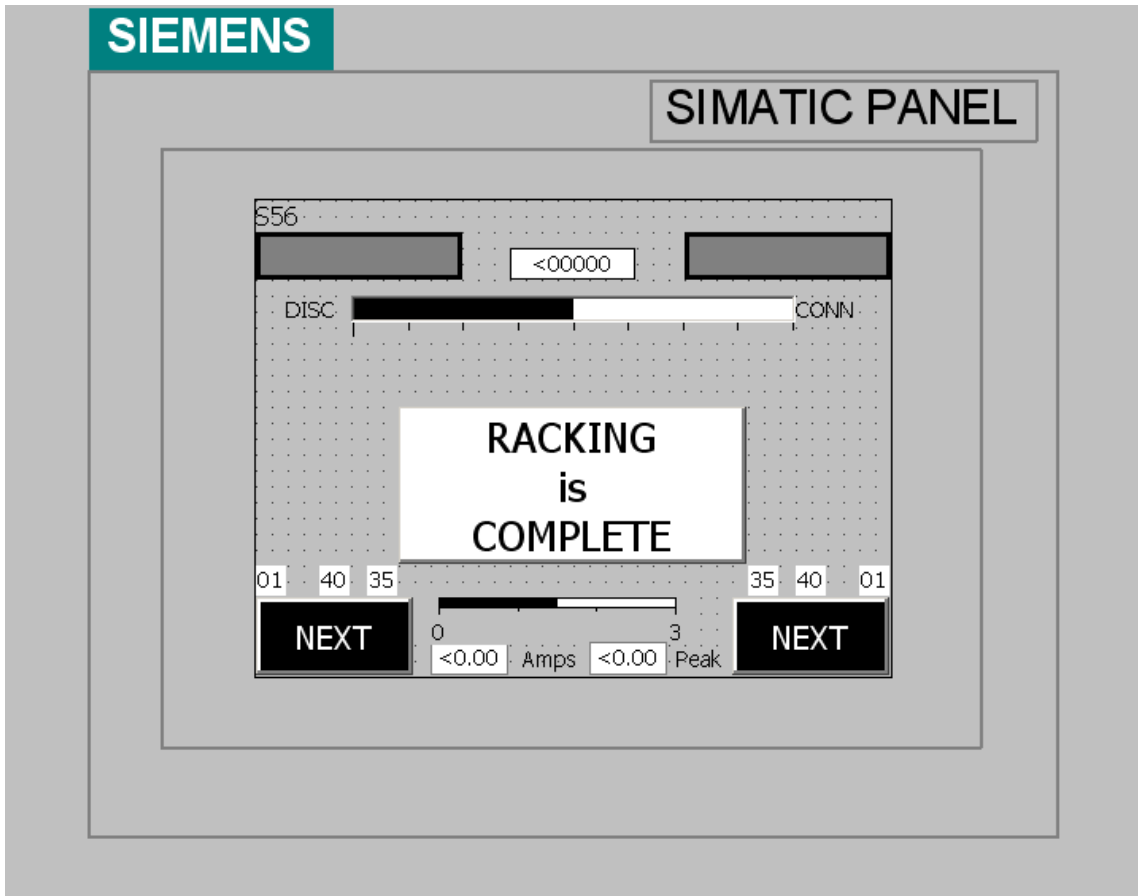
Screen 40 actions are as follows:

The object circuit breaker has been fully racked to the fully racked out position, discharging the closing springs in the circuit breaker.

This gives the operator the ability to rack the object circuit breaker into the "Lock Out" position with the charging springs discharged. Pressing the "YES" button will go to screen 46.

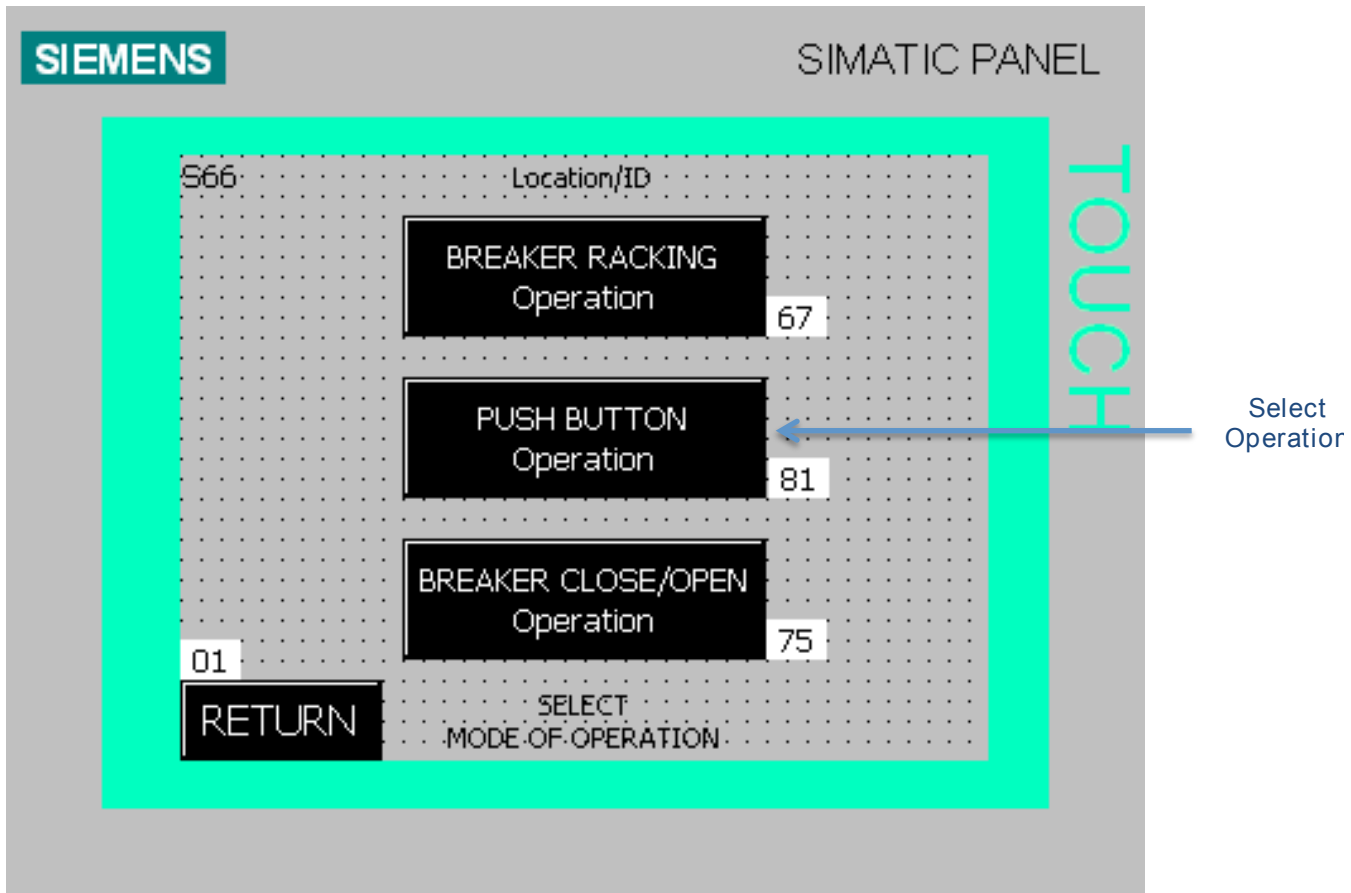


Press the “Rack To Lock Out Position” button to initiate this operation. When the racking in operation is complete the screen will go to screen 56 indicating that the racking operation is complete. Screen 56 shown on next page.

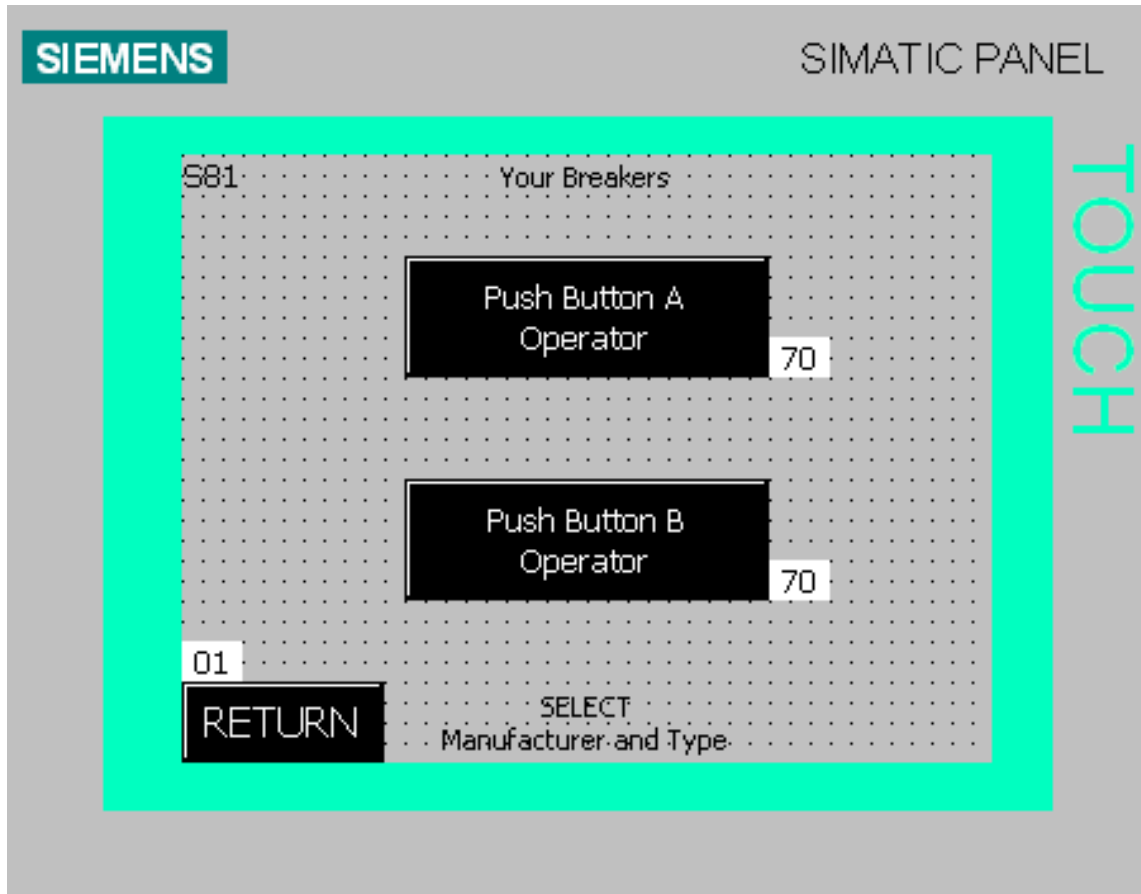


Rack to test lock out position is complete. Press "NEXT" to go to screen 01.

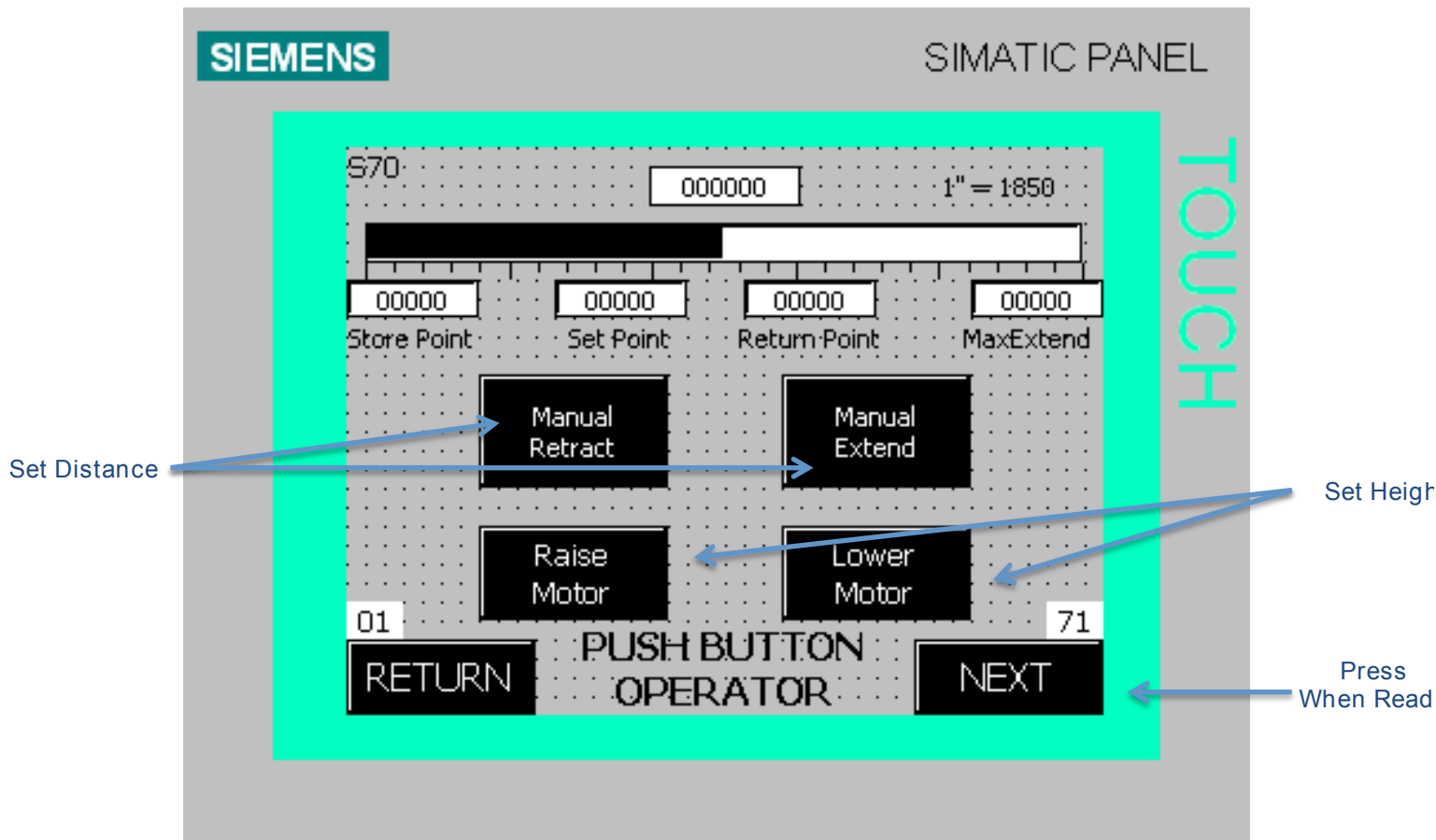
## Push Button Operation



In cases where remote push button option is desired, and equipment is provided on the inoRAC™. Perform the following actions:  
Press "PUSH BUTTON Operation" on screen 66 which will go to screen 81 shown on the next page.



Select the button type by pressing the required button which will go to screen 70 shown on the next page. Screen 81 allows the operator to select the button type to be operated on. The push buttons are custom programmed. For example "Push Button-A Operator" may be programmed for one type of button "Push Button-B Operator" for another type.



Screen 70 allows the operator to operate the remote push button with direct manual control over push button bumper action. Actions allowed are as follows:

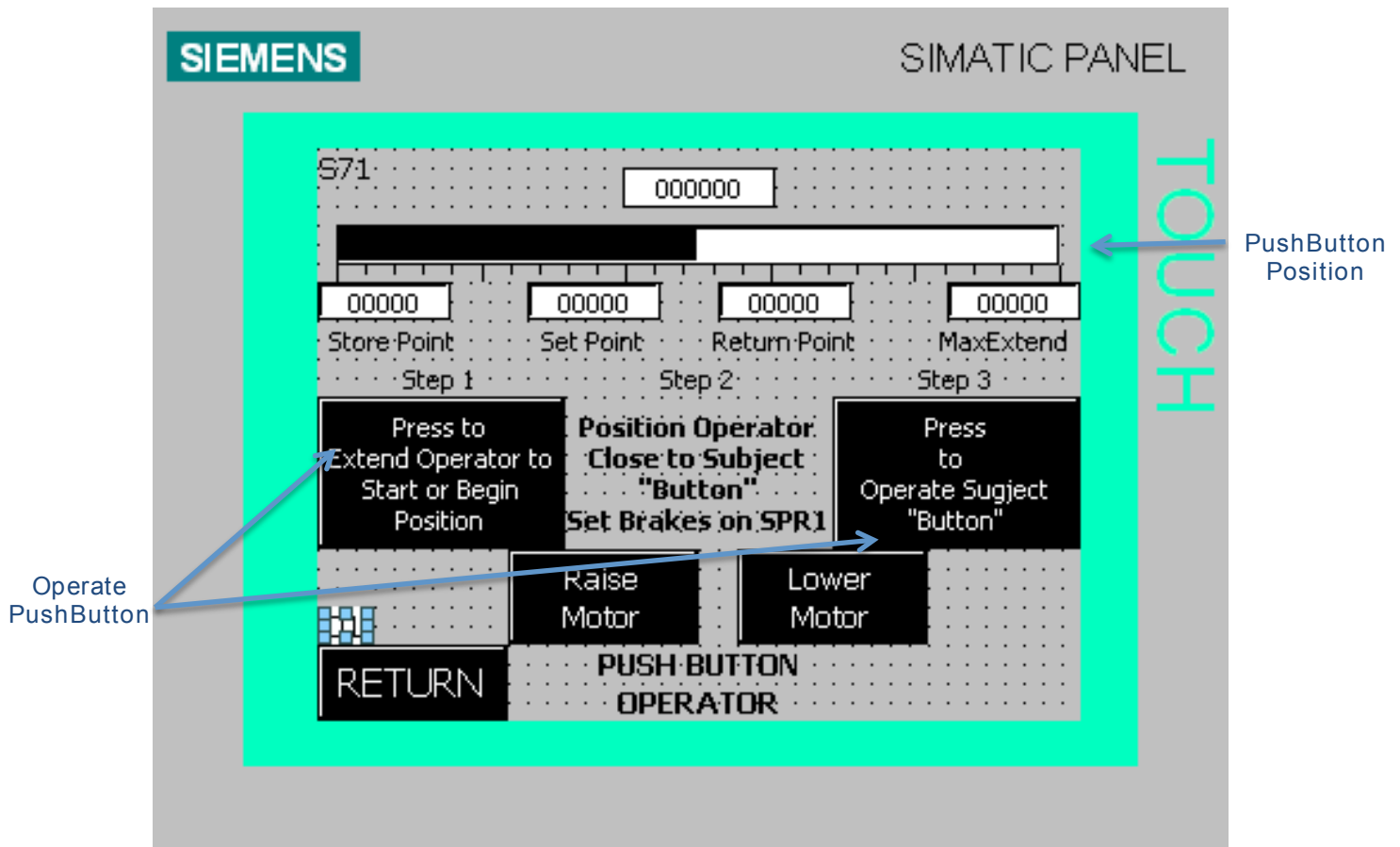
“Manual Retract” momentary button function. Press and hold the button to move the push button bumper towards the inoRAC™. Releasing the button stops the action.

“Manual Extend” momentary button function. Press and hold the button to move the push button bumper away from the inoRAC™. Releasing the button stops the action.

“Lower Motor” momentary button function. Press and hold the button to move the remote push button assembly lower. Releasing the button stops the action.

“Raise Motor” momentary button function. Press and hold the button to move the remote push button assembly higher. Releasing the button stops the action.

For automatic push button bumper control press the “Next” button to go to screen 71 described on next page.



Step 1 “Press to Extend Operator to Start or Begin Position”. This automatically sets position horizontally of push button bumper.

Step 2 “Position Operator Close to Subject “Button” Set Brakes on inoRAC” Manual control is required to do the following:

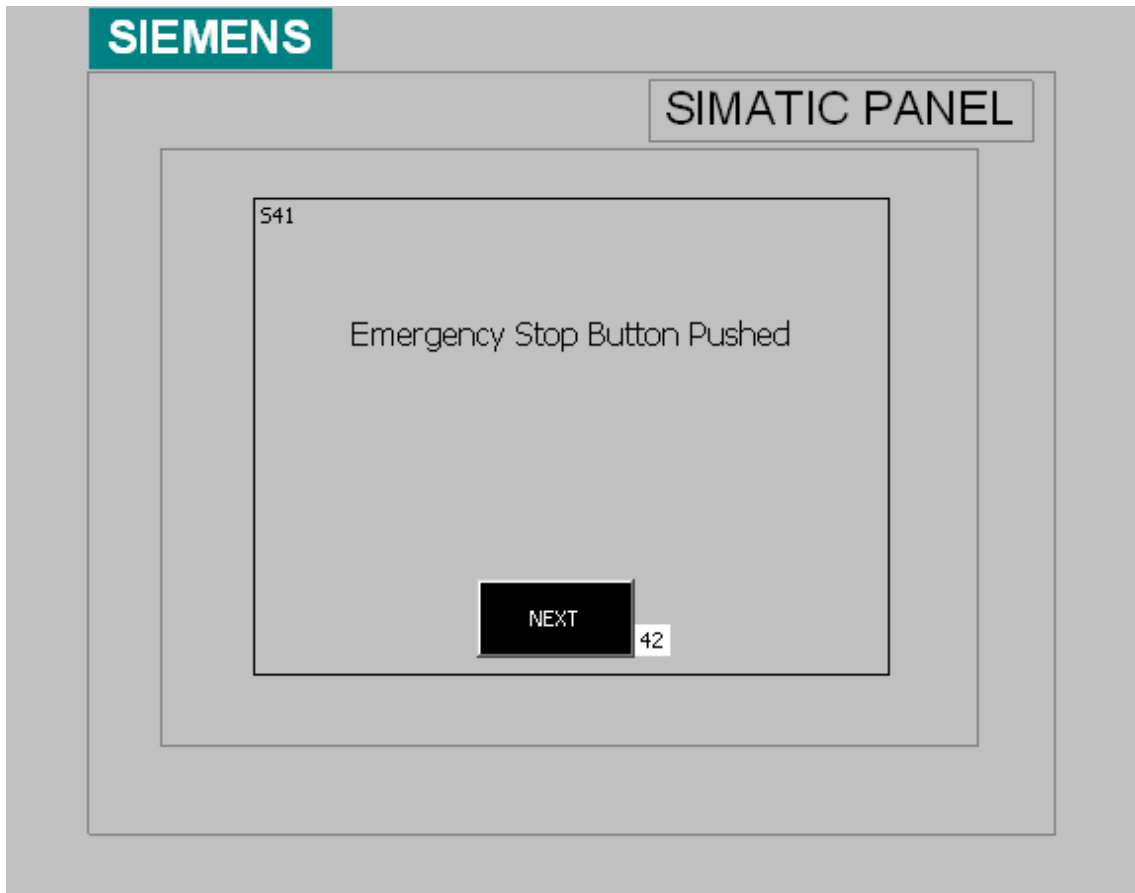
Physically locate push button bumper in proximity to button to be pushed, by maneuvering inoRAC™ as required.

“Lower Motor” momentary button function. Press and hold the button to move the remote push button assembly lower. Releasing the button stops the action.

“Raise Motor” momentary button function. Press and hold the button to move the remote push button assembly higher. Releasing the button stops the action.

Step 3 “Press to Operate Subject “Button””. This automatically operates push button bumper to extend and retract as required.

## Emergency Stop

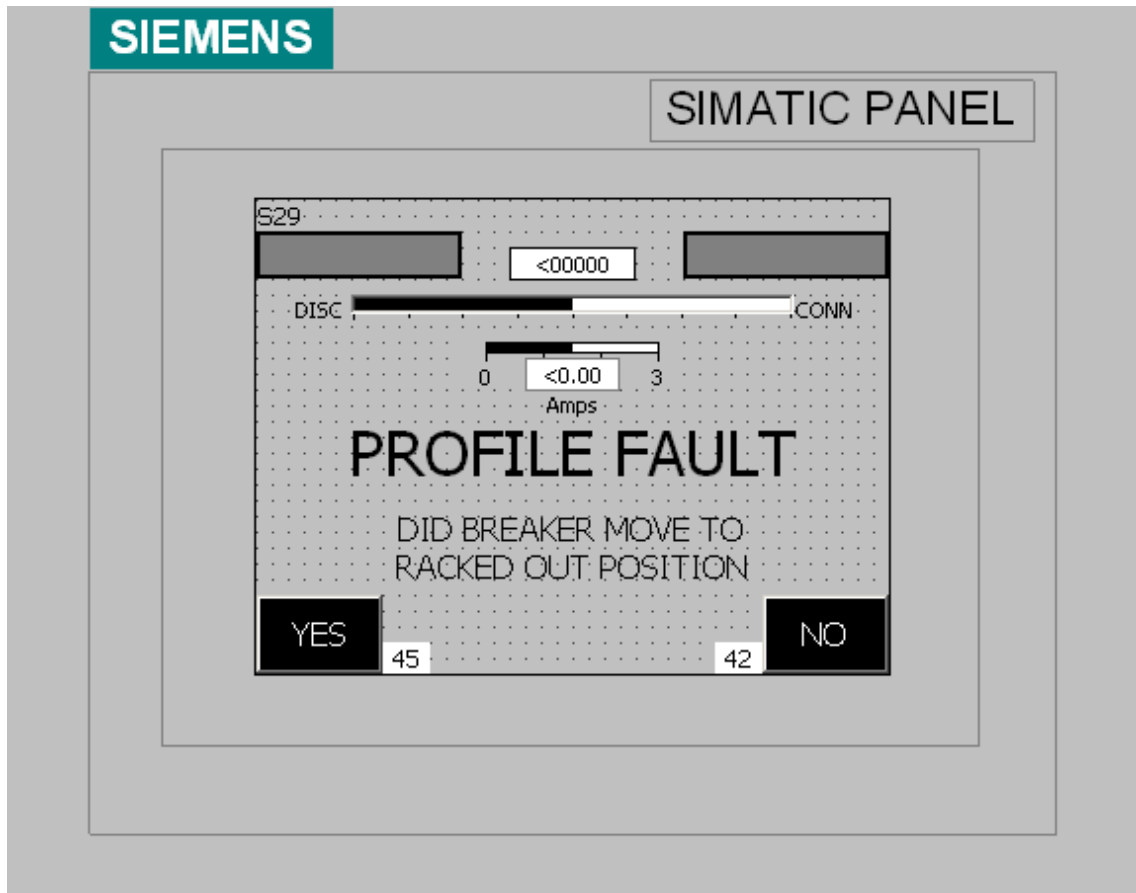


Pressing the “EMERGENCY STOP” button on screen 15 or screen 58 will bring up the screen shown above.

- a. This screen indicates that “EMERGENCY STOP” button was pressed. If the button was accidentally pressed the operator must go to the System Fault Procedures Screens beginning with screen 42.

Press the “NEXT” button to go to the “System Fault Procedures” screen 42. For instructions on “System Fault Procedures” please continue to that section in this instruction manual.

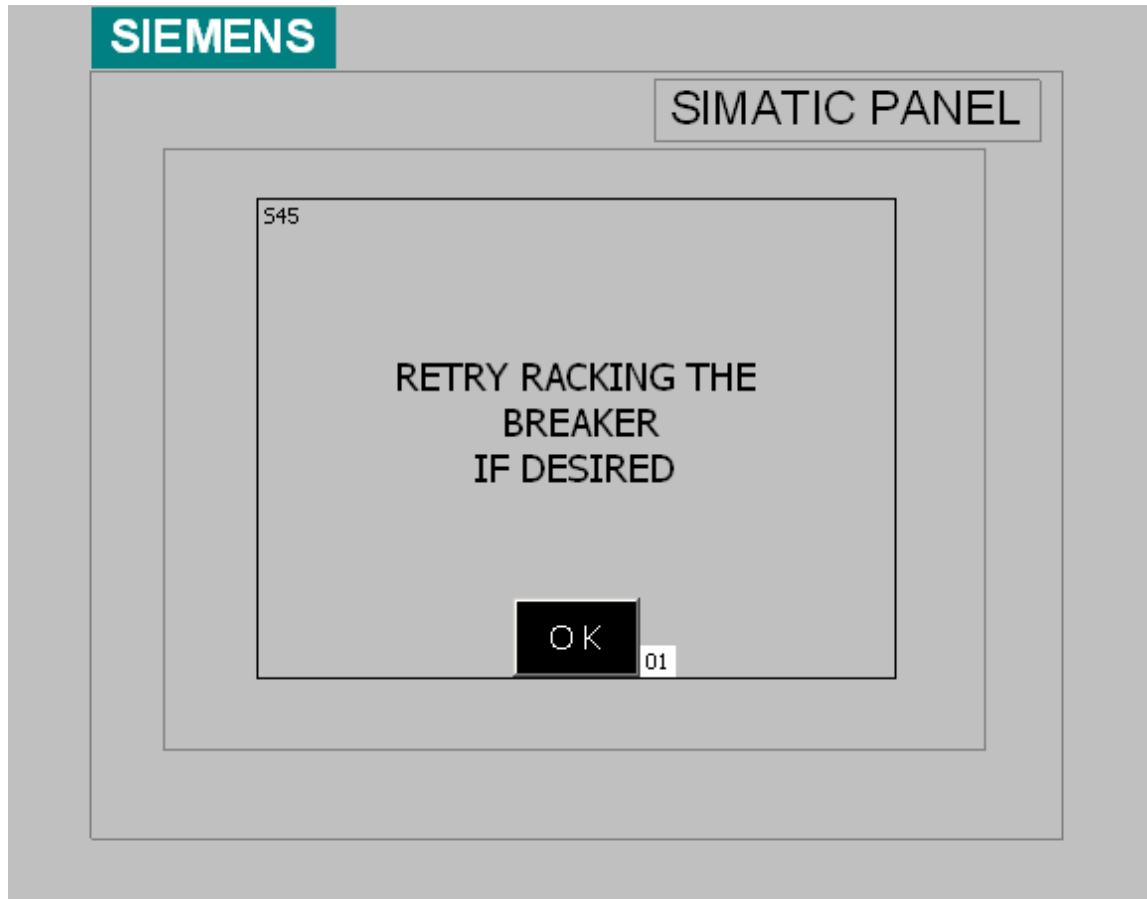
## Profile Fault



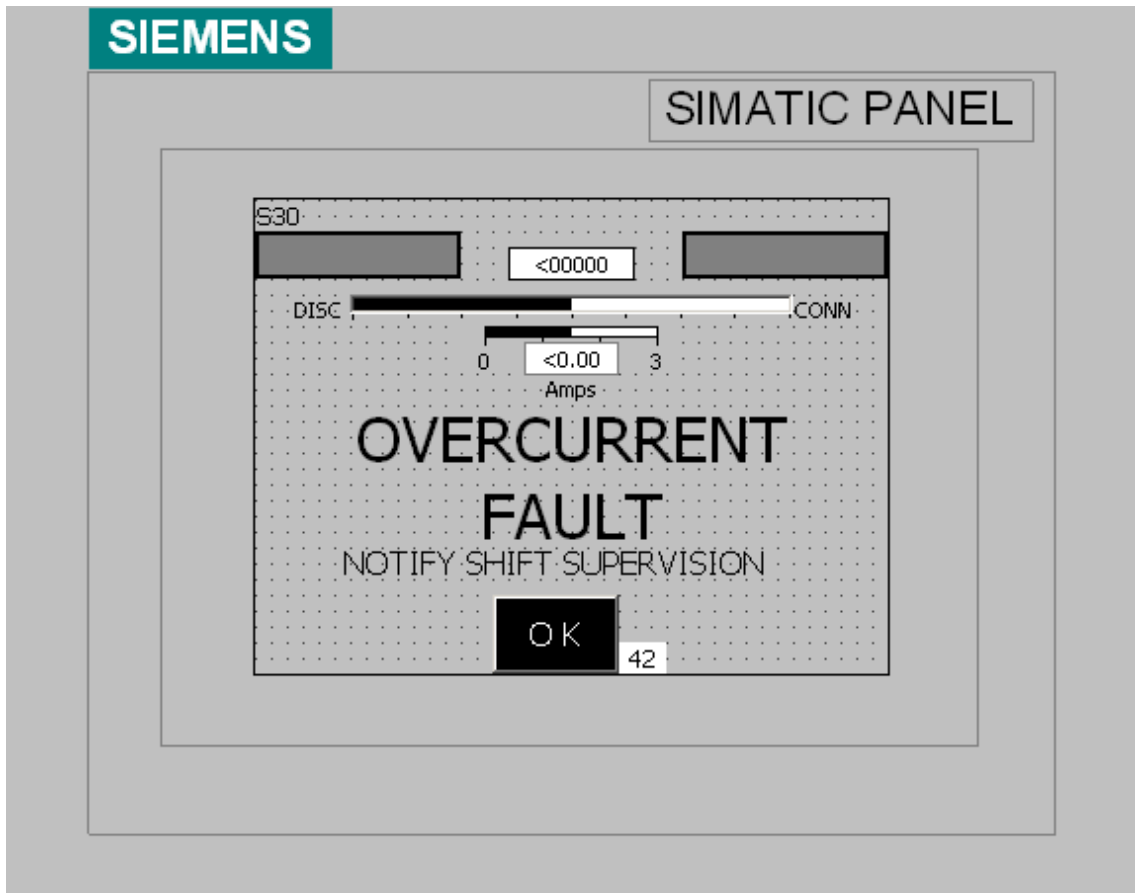
In the event of a “PROFILE FAULT” (see Operating Basics section for explanation) the operators panel touch screen will produce the above screen for “PROFILE FAULT”. The resulting action will be that the inoRAC™ will come to a stop and attempt to rack the object circuit breaker to the disconnect position.

If the object circuit breaker returns to the disconnect position press the “YES” button to go to screen 45. This is shown on next page.

If the object circuit breaker does not return to the disconnect position press the “NO” button to go to the “System Fault Procedures” screen 42. For instructions on “System Fault Procedures” please continue to that section in this instruction manual.



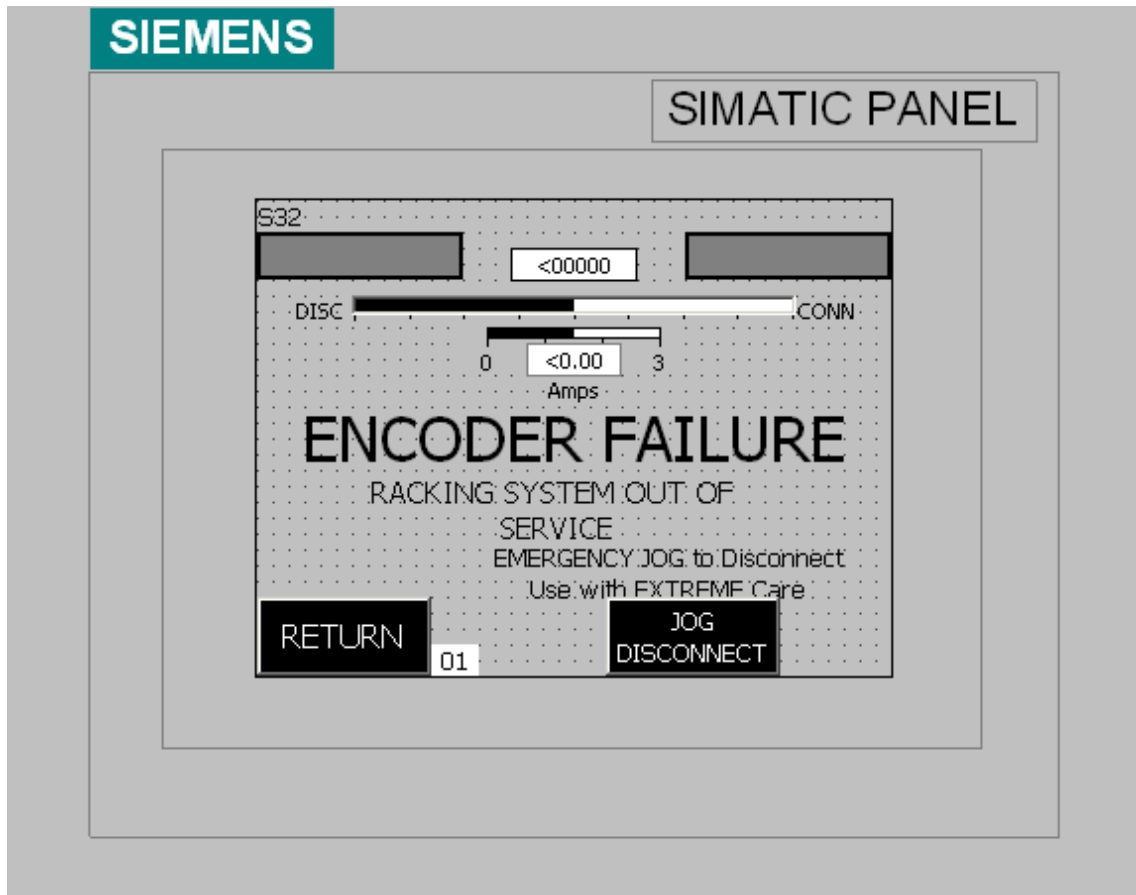
## Overcurrent Fault



In the event of an “OVERCURRENT FAULT” the operators panel touch screen will produce the above screen for “OVERCURRENT FAULT”. The resulting action will be that the inoRAC™ will immediately stop all action.

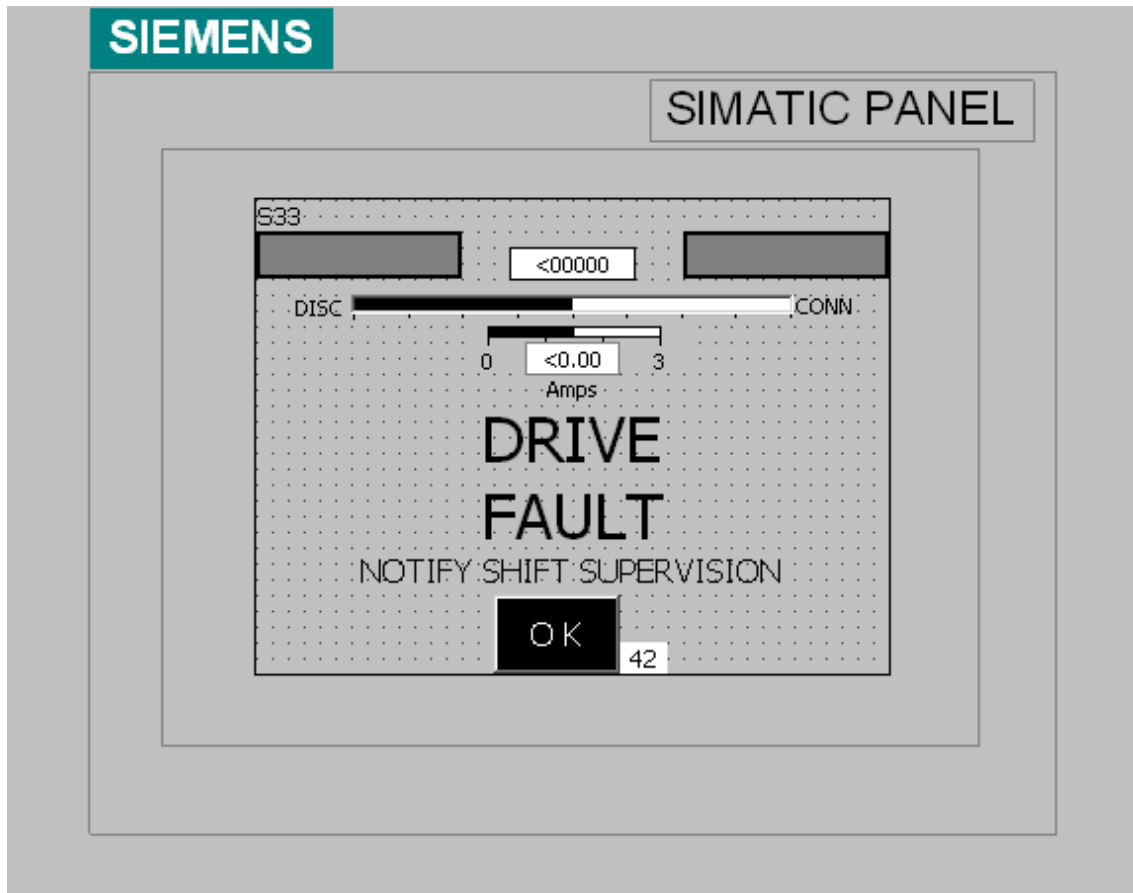
1. The operator shall notify shift supervision.
2. Shift supervision personnel shall acknowledge the fault by pressing “OK” button on the operators panel touch screen which will then go to the “System Fault Procedures” screen 42. For instructions on “System Fault Procedures” please continue to that section in this instruction manual.

## Encoder Failure



In the event of an “ENCODER FAILURE” the operators panel touch screen will produce the above screen for “ENCODER FAILURE”. The resulting action will be that the inoRAC™ will immediately stop all action. The inoRAC™ cannot be used on any circuit breakers with a failed encoder. Remove the inoRAC™ from the object circuit breaker and make repairs as required to the inoRAC™. If the object circuit breaker must be racked before the inoRAC™ can be repaired, conventional flash protection must be used and the circuit breaker racked manually.

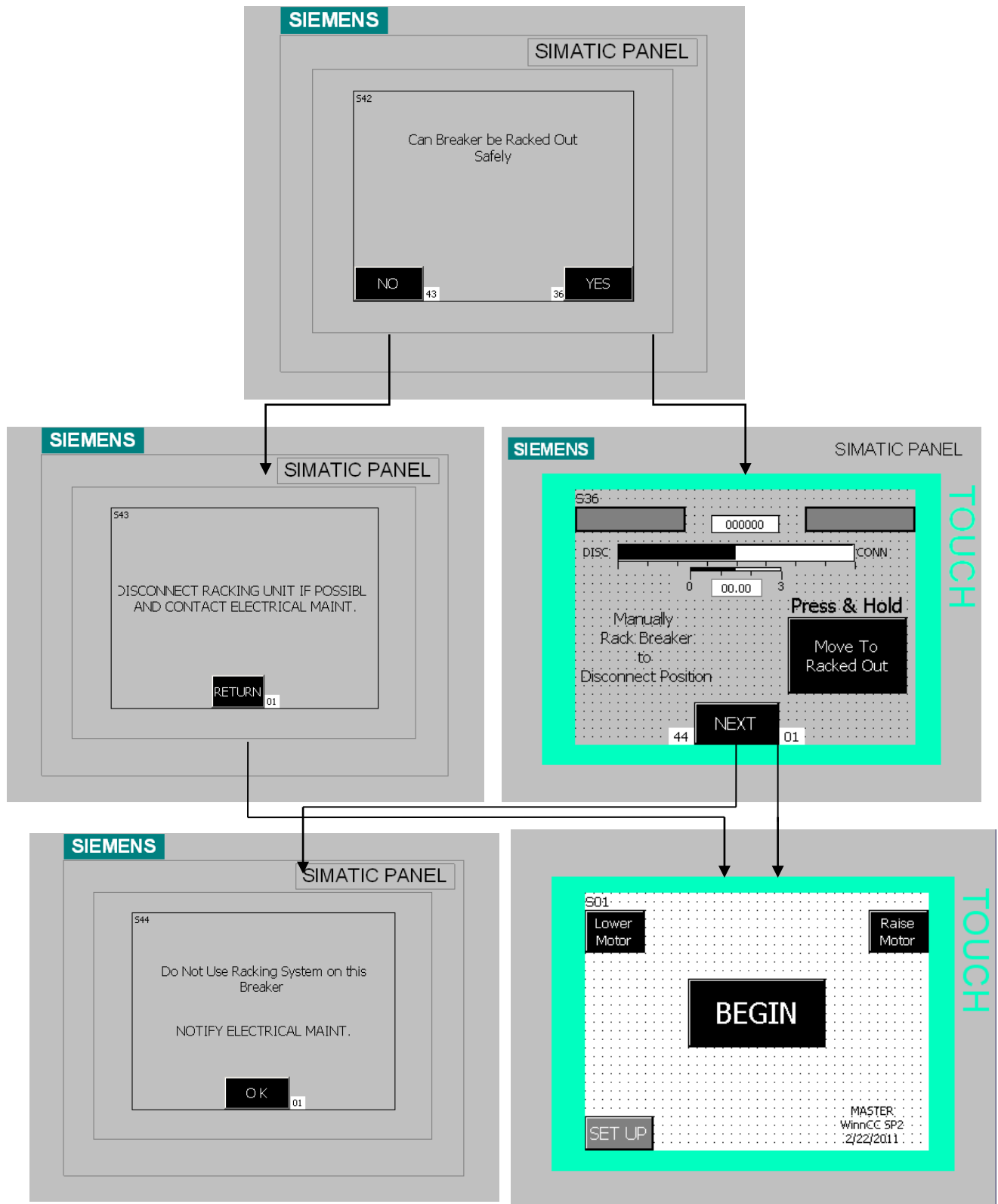
## Drive Fault



In the event of a “DRIVE FAULT” (Variable frequency drive fault) the operators panel touch screen will produce the above screen for “DRIVE FAULT”. The resulting action will be that the inoRAC™ will immediately stop all action. The operator shall notify shift supervision.

Shift supervision personnel shall acknowledge the fault by pressing “OK” button on the operators panel touch screen which will then go to the “System Fault Procedures” screen 42. For instructions on “System Fault Procedures” please continue to that section in this instruction manual.

**System Fault Procedures**



The following description is mirrored by the flow chart on the previous page.

Screen 42 is the first screen of the System Fault Procedures, the following screens can bring you to this screen:

Screen 41 “Emergency Stop Button Pushed” “NEXT” button.

Screen 29 “PROFILE FAULT” “NO” button.

Screen 30 “OVERCURRENT FAULT” “OK” button.

Screen 33 “DRIVE FAULT” “OK” button.

For screen 42 determine the condition of the object circuit breaker and the circuit breaker cell and the ability to safely rack the circuit breaker to the disconnect position for further investigation.

Select and press the appropriate button based on object circuit breaker and the circuit breaker cell inspection.

Pressing the “NO” button causes the system to go to screen 43.

Pressing the “YES” button causes the system to go to screen 36.

Pressing the “YES” button causes the system to go to screen 36.

This screen directs the operator to rack the object circuit breaker to the disconnect position after a problem has been detected with the racking of the object circuit breaker.

Press and hold the “Move To Racked Out” button until the object circuit breaker has traveled to the disconnect position. The object circuit breaker will stop automatically when it reaches the disconnect position.

When the object circuit breaker has reached the disconnect position and stopped, release the “Move To Racked Out” button and press the “NEXT” button to proceed.

If the System Fault Procedures was initiated by the “Emergency Stop” button the system will return to screen 01.

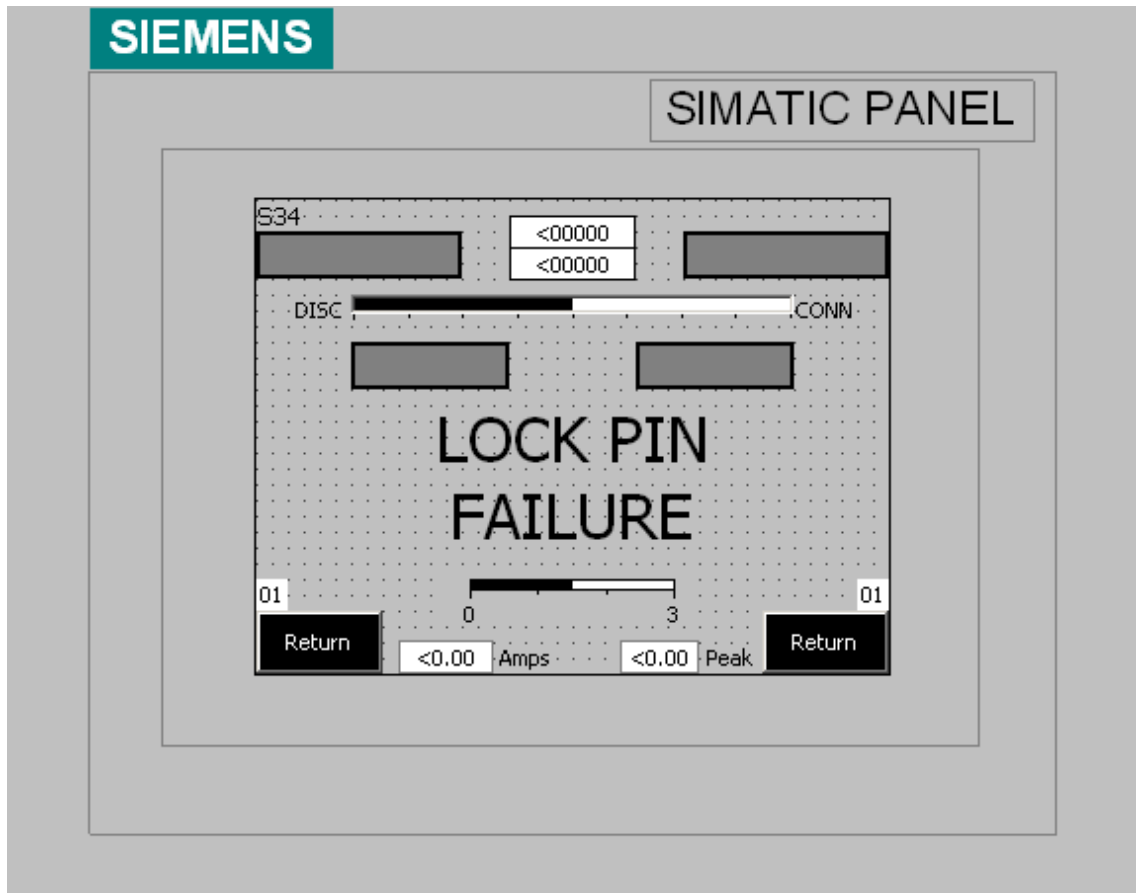
If the System Fault Procedures was initiated by the other faults described above the system will go to screen 44.

Screen 43 instructs the operator to disconnect the inoRAC™ if possible and contact those responsible for electrical maintenance. This indicates that the inoRAC™ has determined that it is unable to operate the object circuit breaker and repairs are required on the object circuit breaker. Acknowledge by pressing the “RETURN” button to go to screen 01.

Screen 44 instructs the operator that problems object circuit breaker and / or the circuit breaker cell dictate that the inoRAC™ not be used on the object circuit breaker until the problems with are corrected. Acknowledge by pressing the “OK” button to go to screen 01.

The final step in System Fault procedures has either returned the object circuit breaker to its disconnect position, or defined the circuit breaker as unable to be racked with the inoRAC™ until the problems are corrected. The operator is now returned to screen 01 so that the object circuit breaker can be tried again if permitted (this assumes operator will not retry circuit breaker racking operation with circuit breaker that has resulted in screen 44) or another circuit breaker can be racked.

## Lock Pin Failure



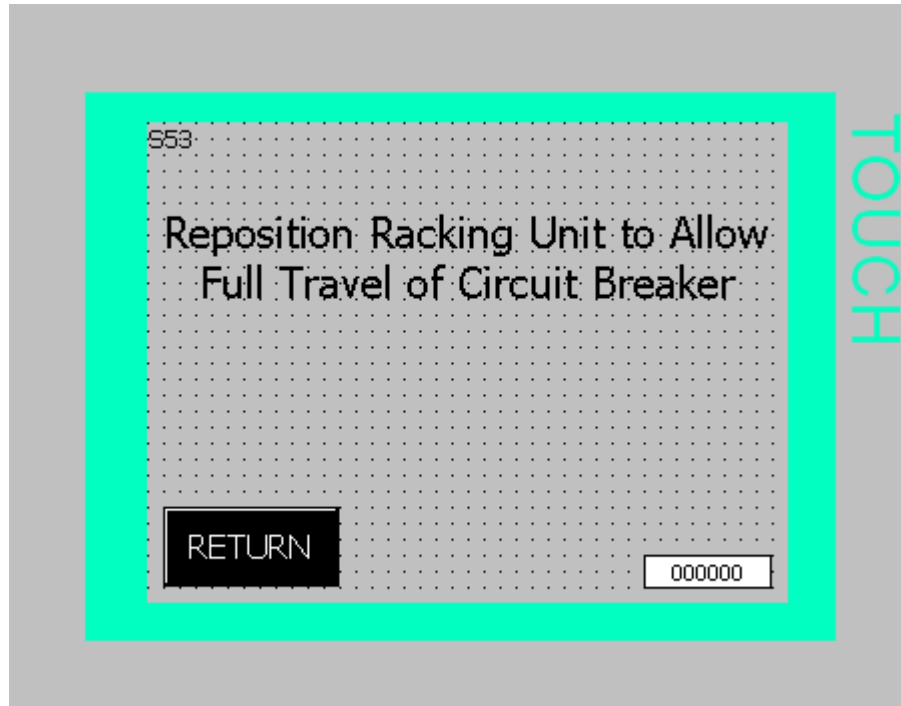
This screen applies to the racking of ABB – ITE type HK 5kV and 15kV circuit breakers. The “LOCK PIN FAILURE” screen will appear when the inoRAC™ detects that the object circuit breaker position lock pin has not released to permit racking of the object circuit breaker.

Press the “Return” button to go to screen 01.

Repeat circuit breaker racking instructions beginning at screen 01 except at screen 02 and use the “Pin Down” or “Pin Up” buttons to free and test the position lock pin to ensure operation.

Continue racking process.

## Motor Position Failure



The “Motor Carriage Position Failure” screen will appear if and when the inoRAC™ detects that the motor carriage is not in the proper position to allow for full travel of the object circuit breaker. Reposition the inoRAC™ to allow for travel of the object circuit breaker and motor carriage for the selected operation. Press the “RETURN” to go to screen 01 and begin again.

## **inoRAC™ Maintenance**

The inoRAC™ is designed to be a very low maintenance device. However as with all equipment it should be checked for proper operation and condition on a periodic basis.

The following maintenance items should be performed on a periodic basis.

- Power up the inoRAC™ to operated a circuit breaker without connecting the inoRAC™ to an actual circuit breaker.
- Check that all hardware and fasteners are in good condition and check for tightness.
- Lubricate actuator lift chain.
- Mobilgrease® 28 lubricant is recommended.
- Lubricate wheels and casters.
- Mobilgrease® 28 lubricant is recommended.
- Check actuator lift track slides for hardware tightness and for smooth, free operation. Lubrication is not required.
- Check motor base slides for hardware tightness and for smooth, free operation. Lubrication is not required.
- Check linear springs for wear or damage. Check hardware for tightness.
- Check brakes for loose or damaged hardware. Check brakes for proper adjustment.
- Check the cable to the operators panel touch screen for wear or damage.
- Inspect the control components in the control box for loose or damaged items and for loose or damaged wiring.

The first maintenance period should be 6 months after receiving inoRAC™ and then continue at 12 month intervals.

## **Troubleshooting**

### **Technical Support Contact**

In the event that an error occurs or a part breaks, please notify inoLECT immediately. For troubleshooting assistance, please call 225-751-7535.