# Recommended Vital Design Guidelines for Self-Restoring Switches in Traffic Control Systems

Revised 2025 (7 Pages)

## A. Purpose

This Manual Part recommends vital circuit design guidelines on fail-safe principles and practices for design of self-restoring switches in traffic control territory.

## B. General

1. The primary objective of the vital circuit design guidelines provided in this Manual Part is to ensure switch locations with self-restoring capability will operate as intended and not jeopardize the safe operation of train movements.

2. The vital circuit design guidelines provided in this Manual Part shall also apply to equivalent vital application software.

3. The vital circuit design guidelines provided in this Manual Part represent one method of design for self-restoring switch installations. Some features of the circuit design may vary depending on the design practices of the individual railroad.

4. A pushbutton or equivalent device should be located at the designated location to permit train crews to operate the switch to the desired position.

## C. Design

The following vital circuit design criteria are necessary to ensure the safe operation of the self-restoring switch control circuits (see Figures 1663A-1 through 1663A-4):

1. Loss-of-shunt protection shall be provided on the Over Switch Track (OST), the line approaches (EA & WA) and the Release Track (RT) with the use of the Time Element Repeater Stick Relay (TEPSR).

2. Detector locking shall be provided by the inclusion of an OSTR contact in the Lock Relay (LR) circuit.

3. Approach locking shall be provided by the inclusion of both the EAR & WAR contacts in the TEPSR circuit and a TEPSR contact included in the LR circuit.

4. The switch locking circuit shall only release for facing point movements when the train movement has occupied the release track. The length of the release track should be no greater than 300 ft (91.44 m) and no less than 150 ft (45.72 m). The time release on the track should be of sufficient

duration to allow the OSTR to be de-energized prior to the time elapsing for a train movement of 15 mi/h (24.14 km/h) or more.

5. The switch may be released for movements onto the main track provided there are no trains approaching the switch and no routes are established at the adjacent controlled locations onto the main track.

6. The self-restoring switch shall only return to the normal position after the following sequence: occupancy of both the detector and release tracks, the detector track section is vacated and a predetermined loss-of-shunt time has elapsed.

7. Circuits shall be arranged to prevent permissive aspects from being displayed into the block in which the self-restoring switch is located when:

   a. Switch points are in other than the normal position

   b. The detector track is occupied

   c. The release track is occupied

   d. The pushbutton door switch is left open after a request has been made

   e. The switch machine is placed in the hand throw position

8. Pushbutton position shall be checked to protect against the possibility of a pushbutton sticking. Contacts of the Pushbutton Check Relay (PBCHKR) shall be placed to assure the pushbutton has returned to the non-requesting position and is operating as intended.

9. A door switch contact shall be placed in the pick path of the correspondence relays to reduce the possibility of unauthorized use by not allowing the reverse switch indicator to display and a signal from being lined into the block until the door is closed.

10. Switch overload protection should be provided to prevent unnecessary loading on the switch machine when the points are obstructed.

11. A switch indicator circuit shall be used to advise an approaching train that the switch is lined and locked in either the normal or reverse position.

12. Indicator lights may be mounted with the pushbutton or equivalent device to verify the status of the external switch correspondence indicators.

## D. Operation

The typical operation for changing routes is as follows:

1. A facing point movement occupies the RT and after the approach release time, the timer (TEPSR) energizes.

2. The crew then operates the reverse pushbutton thus energizing the Reverse Switch Request Relay (RWZR). The RWZR de-energizes the Normal Switch Request Relay (NWZR) and then remains stuck through a NWZR contact. The de-energizing of the NWZR, de-energizes the normal correspondence relay (NWCR).

3. The LR is now energized providing the OST is not occupied.

4. With the LR energized, the Reverse Switch Control Relay (RWR) is then energized and the switch is thrown reverse.

5. Once the switch is lined and locked in the reverse position and the door is closed, the Reverse Switch Correspondence Relay (RWCR) is energized and the reverse indicator shall be displayed. The LR relay is de-energized again.

6. The train now occupies the OST energizing and sticking the Restore to Normal Request Relay (R-NWZR). The R-NWZR remains energized through the stick path after the RT is unoccupied.

7. After the OST becomes unoccupied and the loss of shunt time has expired, the TEPSR is energized, allowing the NWZR to energize.

8. With the NWZR energized, the RWZR and RWCR become de-energized and the LR energizes.

9. The R-NWZR being a slow-release relay, maintains the picking energy for the NWZR until the RWZR has become de-energized thus maintaining the stick path. The switch is then thrown to the normal position when the LR energizes.

10. When the switch is lined and locked in the normal position, the NWCR is energized and the LR is again de-energized, de-energizing the R-NWZR.

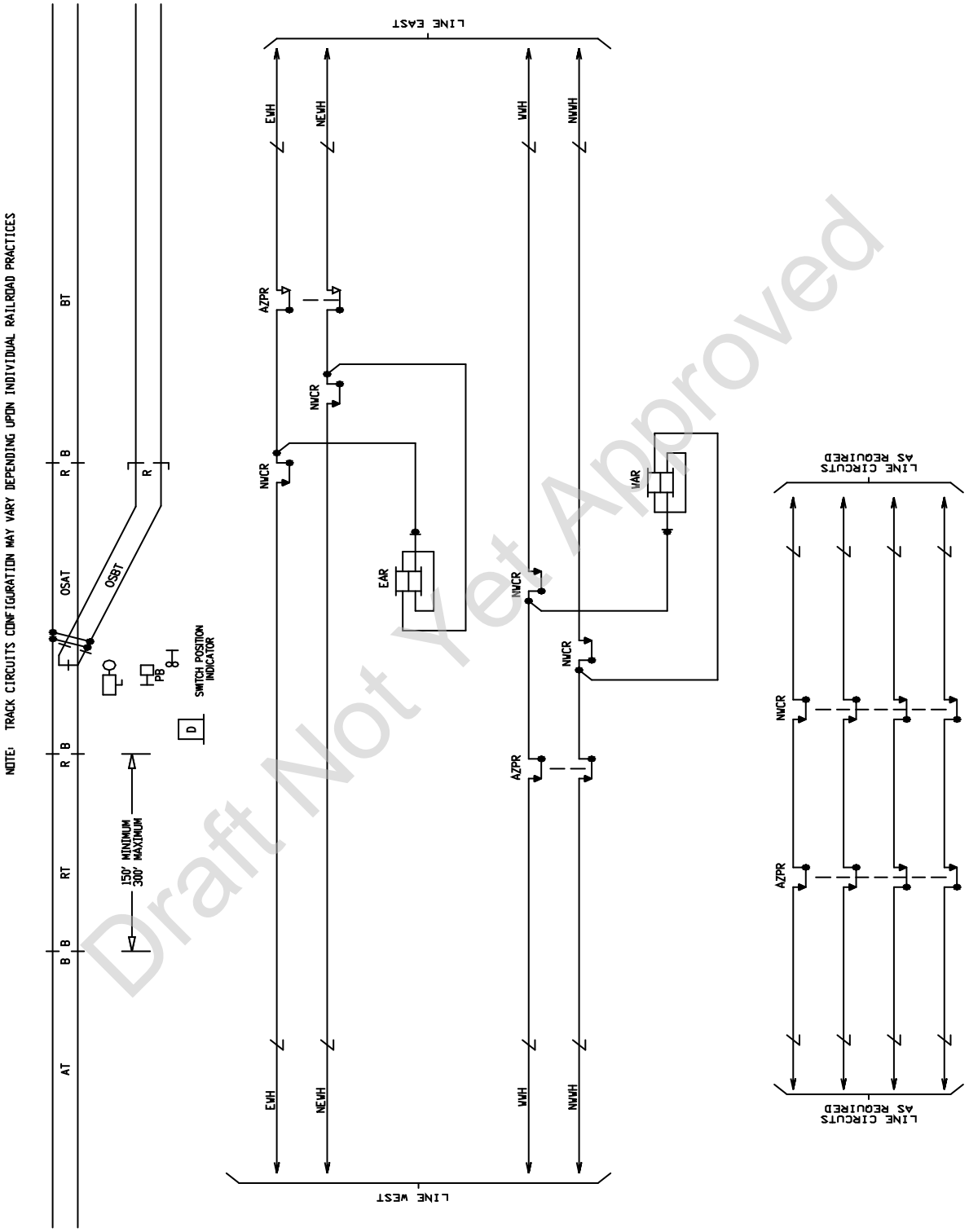




**Figure 1663A-1: Layout and Traffic Circuits**

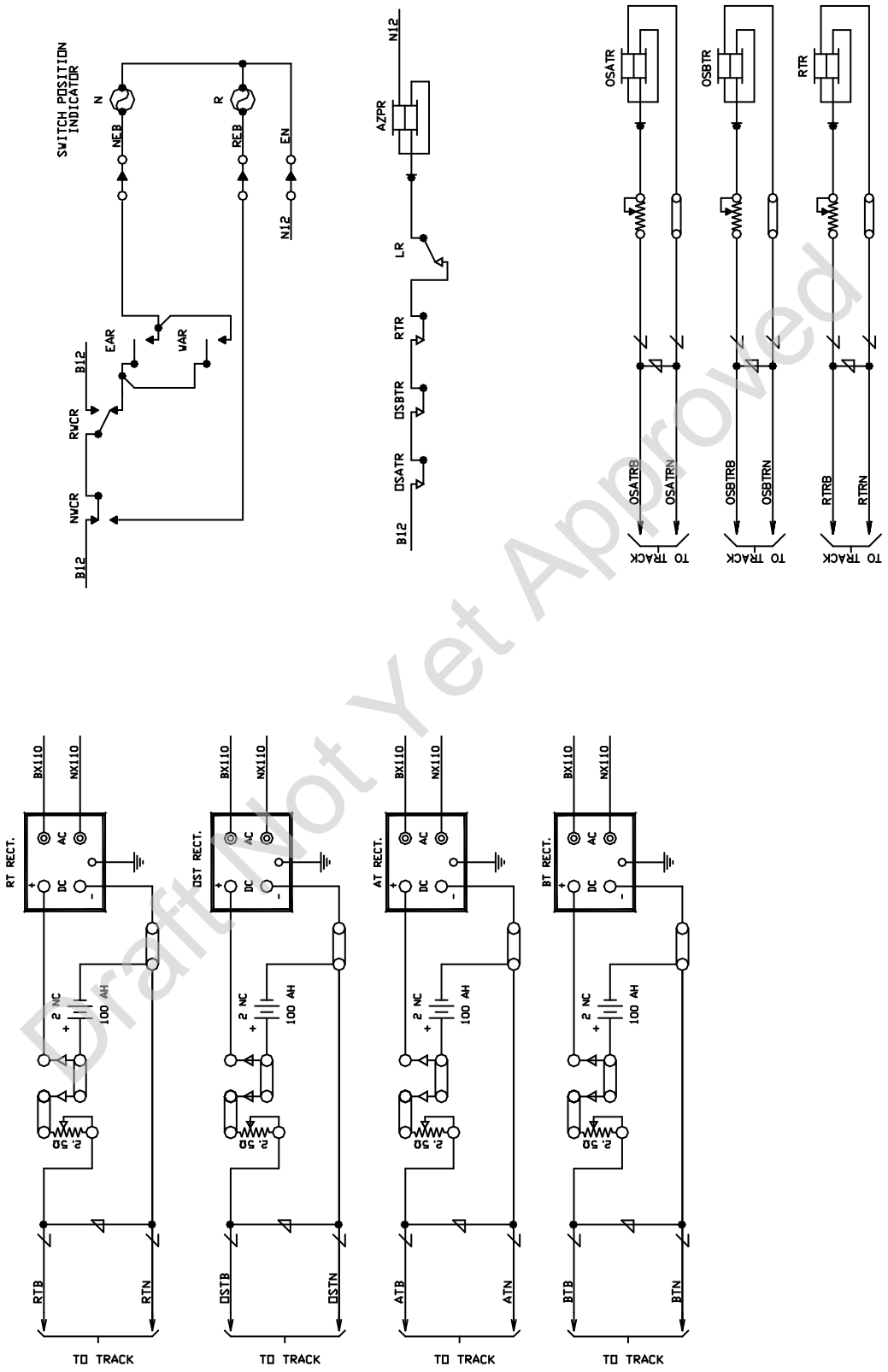


**Figure 1663A-2: Track and Switch Position Indicator Circuits**

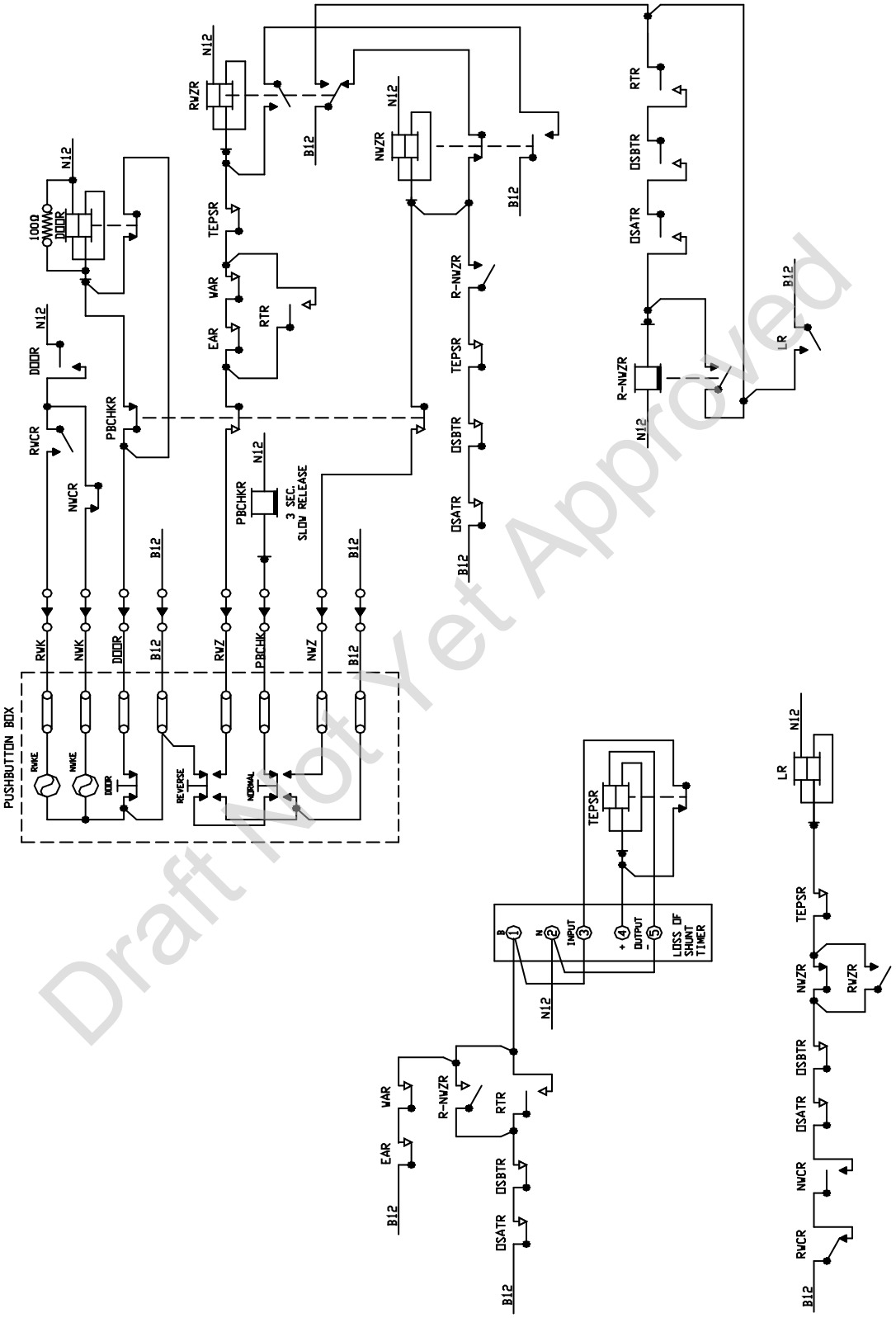


Figure 1663A-3: Switch Control Circuits

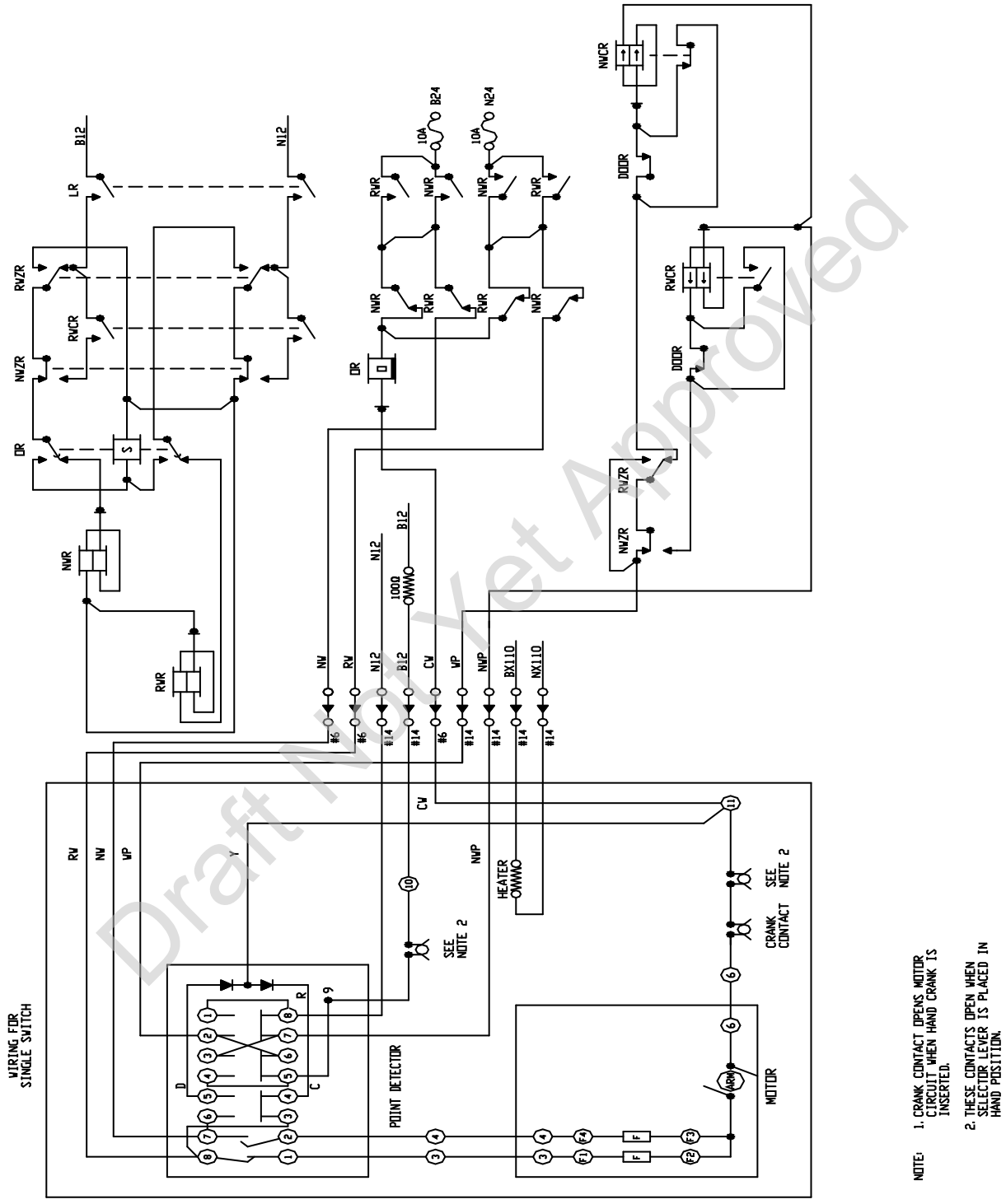




**Figure 1663A-4: Switch Operating Circuits**