Signals

Thank You
For 5 years development
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Veronica Taylor
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What we will cover

- Why Signals
- What the Signals Mean
- Where you will find Signals
- Operating Rules
- Technology
- Failures
- Next Generations
- Review of the Basics
Strategy -- Signaled Bi-Directional Track

Half the Cost
Twice the Reach
Twice as Fast
Twice the Ride
Three Lamps

Stop on Solid Red .... Repeat - STOP !!

Go on Anything Else
Green = GO  
Tracks are Clear

**Flashing Yellow**
there is a reason to stop 1200-1800’ ahead  
The next signal is Yellow

**Yellow**  
there is a reason to stop 600-1200’ ahead. The next signal is Red, Flashing Red, or a Yard Entry with Lunar White

**Flashing Red**  
there is a reason to stop less than 600’ ahead.  
Proceed “on-your-own”. Be Prepared to Stop.

**Solid Red**  
STOP !!  
Do Not Pass This Signal
Stop on Solid Red .... Repeat - STOP !!

Go on Anything Else
Bi-Directional Operating Rules

- Rules
  - Cell phones are required north of Farmersville Circle where FRS radios will not reach in an emergency.

  - No Trains over 140’ N of Farmersville

  - Metal wheels and uninsulated metal axles are required N of Farmersville

  - Trains may not reverse on Bidirectional track except to back up into a Wye at the Wye or to back up into a Siding at the Siding.

  - Trains must always back up into Wyes.

  - Trains cannot enter a Siding if there is already an opposing train in it…. Go to the far end and back up to get in the Siding.
Operational Failures

• **Train moves beyond the Signal while waiting on Red Light.**
  – Operator has fouled the Main
  – Current of Traffic cannot be reversed
  – Operator will wait forever

• **Train too long to fit in 140’**
  – Train will foul the Main someplace
  – then Current of Traffic will not reverse

• **Train backs onto Mainline and Reverses Direction**
  – Will see solid Red lights
  – Will need to get off the main and re-enter… usually by backing into a Wye or Siding, then push the button & depart forward.
## Wait Times in Minutes

<table>
<thead>
<tr>
<th>Speed - MPH</th>
<th>Average Wait Time For 3000’ train trip</th>
<th>Maximum Wait Time For 3000’ Train Trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 MPH</td>
<td>5.7</td>
<td>11.4</td>
</tr>
<tr>
<td>4 MPH</td>
<td>4.3</td>
<td>8.5</td>
</tr>
<tr>
<td>5 MPH</td>
<td>3.4</td>
<td>6.8</td>
</tr>
<tr>
<td>6 MPH</td>
<td>2.8</td>
<td>5.7</td>
</tr>
<tr>
<td>7 MPH</td>
<td>2.5</td>
<td>4.9</td>
</tr>
</tbody>
</table>

**Etiquette = Go Quickly, Keep Moving**
Four Basic Track Structures

- Queuing Track
- Mainline Meet Track
- Siding
- Storage Track
- Wye
Queuing Tracks --- like Farmersville
Always Leave a Siding Going Forward
Wyes

Always Back into Wyes, Leave going forward
Mainline Meet Tracks

North Bound Track

South Bound Track

fl South Bound Track

North Bound Track ‡
Track Segments

• Bi-Directional track starts with a Queuing Track

• Every 3000’ there is a Mainline Meet Track

• And there is an End.
Blocks

- Track Segments are broken into up to 6 Blocks of about 600’ each
  - Farmersville to Witcombe Mainline Meet Track - 2500’ - 4 Blocks
  - Witcombe Mainline Meet Track to Cougar Mainline Meet - 1500’ - 3 Blocks
  - Cougar to Cooper Junction - 1900’ - 3 Blocks

ABS Signals at Block Boundaries
- Communicate using pulses through the rails
- Requires Bonded Track
- 255 Second Rule
Pulses Through the Rails

Transmit are positive

Received are negative

1 Second = 512 clock pulses

Data

Time between Pulses is Data

Clock Pulses between leading edges = (Code x 16) + 8

Code = 2, Clock Pulses = 40
Code = 6, Clock Pulses = 104
Forward Codes

- 13
- 12
- 11
- 10
- 9
- 8

R

G
Rearward Codes
Control Point Boards - CP Boards

- One at each
  - Queuing Track
  - Wye
  - Siding
  - Mainline Meet Track

- Controls Track Authority and Current

- Communicates
  - to nearest CP Boards and ABS Boards with Track Pulses
  - to Computer by Radio
Radio Network
Computer

- Displays Modelboard
  - Signal Status
  - Current
  - Authority

- Allows Manual Control

- Optimizes Throughput
  - Farmersville Queue -- Witcombe Meet -- Cooper Junction

- Isolates Technical Difficulties
Components

- 1 CP Board --- 3 software flavors
  - Queuing Track
  - Siding/Wye
  - Mainline Meet Track

- 3 ABS Boards
  - Master
  - Slave
  - Passive (used with CP Boards)

- Solar Panels
- Radios
- Computer
Technology Failures

• Lightning

• Bonding Fails in a Siding or Wye
  – Line on Computer Screen does not turn red

• Bonding Fails on a Queuing Track or Mainline Meet Track
  – Will only detect trains on the Signal side of the bonding failure

• Bonding Fails or An ABS Intermediate Master Board Fails
  – In the Segment with the Failure, Traffic can flow in the direction it was going at Failure, Not in the other direction.
  – Line on Computer Screen does not turn red
  – Nearby ABS signals will timeout, go dark
  – Catastrophic in terms of Function
  – No loss of protection

• A CP Board Fails
  – Catastrophic at the individual Siding/Queue/Wye/Meet
  – Cannot negotiate traffic in either direction
  – Rest of Railroad works fine.

• Computer Fails or Radio Fails
  – Everything works
  – No loss of Protection
  – Lost ability to throttle traffic when there are lots of 140’ trains
Future Releases

- Web Interface
- Online Troubleshooting
- Better Test Instruments
- Switch Detectors
- Possibly Silent Radio at Signals
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**Solid Red**
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