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RAILROAD PREEMPTION

In establishing timings for railroad preemption, one must determine if enough time exists for the signal to clear motorists off the tracks before the train arrives. The best way to illustrate how to make this determination is through an example:

Figure 1 shows the intersection of Main Street and Union Street. This intersection is controlled by a simple two phase signal having railroad preemption. The signal has the following basic settings:

	Phase 1 - Main St.	Phase 2 - Union St.
Initial Green:	8 sec	6 sec
Yellow:	4 sec	3 sec
All Red:	1 sec	2 sec
WALK:	5 sec	0 sec
FDW:	12 sec	0 sec
Recall:	Min.	None

The signal also has the following preemption settings:

Track Clearance Phase = Phase 2
Delay Before Preemption = 0.5 sec
Track Clearance Green (TCG) = 4 sec
Yellow After TCG = 3.5 sec
All Red After TCG = 1.5 sec
Dwell Phase(s) = Phase 1
Exit Phase = Phase 2
Abort FDW: On

Since railroad companies are required to provide 20 seconds of warning time before the train arrives at the road, the important question is: **"If vehicles on Union Street are queued across the railroad tracks when the train activates the preemption circuit, will 20 seconds be enough warning time for the signal to clear the vehicles off the track?"** Not only do we want the answer to this question to be "yes", but we also want a "yes" answer regardless of what interval the signal was in when the preempt call was received. Therefore we must look at the worst case scenario, which occurs when the train activates the preemption circuit just after the signal begins timing the initial period for the conflicting phase (phase 1). In other words, just after the signal turns green on Main Street.

Since controllers will not abort an initial interval or a change interval to serve the track clearance phase, if the signal just turned green on Main Street it could take up to 13 seconds for the track clearance green to de displayed to Union Street (8 initial + 4 yellow + 1 all red).

Additional time is then required to move the queue so that the vehicle situated on the tracks can move off. Assuming 25 feet per vehicle, about 5 vehicles would be located in front of the vehicle on the tracks. Since research has indicated that 85% of the time it takes less than 1.4 seconds per vehicle to move the queue, the queue movement time is calculated to be 8.4 seconds (6 vehicles x 1.4 seconds/vehicle).

Finally, any preemption delay time that is programmed into the controller must be added in. In this case, 0.5 seconds.

Adding 8.4 seconds, 13 seconds, and 0.5 seconds yields **21.9 seconds**, which the worse case total time to move the vehicle off the tracks. Since 21.9 seconds is greater than 20 seconds, we have a problem. This problem could be solved by reducing the main street initial period by 2 seconds (from 8 seconds to 6 seconds), which would produce an acceptable total time of 19.9 seconds.

Some controllers allow the operator to program a special preemption initial interval that is immediately substituted for any original initial interval that might be timing when a preemption input is received. For this example, if a preemption interval of 5 seconds is programmed into the controller, this value would substitute for the 8 second initial and the total time would fall to an acceptable 18.9 seconds (5 + 4 + 1 + 8.4 + 0.5).

Unfortunately, as the distance between the stop line and the railroad track increases, it becomes more and more difficult to clear vehicles from the tracks within 20 seconds without shortening initial and change intervals to unsafe levels. At some point, the 20 second criterion cannot be met and measures must be used to keep vehicles from stopping on the tracks in the first place. Such measures might include advanced signal heads or queue-activated flashing "DO NOT STOP ON TRACKS" signs.

FIGURE 1