

April 18, 1999

## **RED/YELLOW VERSUS RED/RED FLASHING OPERATION**

An intersection is placed into flash by the conflict monitor when certain operational problems occur, such as absence of signal or conflicting green indications. During "conflict flash" it is common practice to display flashing yellow indications to the main street thru movements and flashing red indications to the side street movements and, if there is protected-only left turn phasing on the main street, to also display flashing red to these left turn movements. When this display pattern occurs, motorists are required by law to treat the intersection as a two-way STOP controlled intersection with the main street thru traffic having the right-of-way. Motorists turning left from the main street and motorists entering from the side street are forced to wait for acceptable gaps in main street traffic. If main street traffic volumes are high, negotiating the intersection can be particularly difficult for side street vehicles attempting to either turn left or go straight across the intersection. If this is the case then these motorists may be forced to turn right and then make a U-turn at the next intersection to get to their desired location.

At certain intersections, it may be preferable to display a flashing red indication to all movements. When this display pattern occurs, motorists are required by law to treat the intersection as an all-way STOP controlled intersection with each movement having equal claim to the right-of-way. This type of operation reduces the wait for side street motorists but forces all main street motorists to stop.

The question becomes: "What factors should be considered in deciding whether to use red/red flash or the more traditional red/yellow flash?" The answer to this question has both safety and congestion related consequences. If red/yellow flash is used when red/red flash is needed, dangerous traffic conditions could result during conflict flash. On the other hand, if red/red flash is used when red/yellow flash is warranted, main street traffic congestion could become excessive with the result being extensive queuing in the main street thru lanes and high delay. This extensive queuing could, in turn, produce its own set of dangerous traffic conditions.

Although there are currently no hard-and-fast rules or numerical warrants for deciding when to use red/red flash instead of red/yellow flash, the following guidelines are offered for consideration:

Red/red flashing operation should be considered when one or more of the following conditions apply. This listing is in priority order with the more important conditions listed first.

1. The side street is a major roadway with high traffic volumes. The intersection of two major streets is a perfect candidate for red/red flashing operation.
2. The side street has a sight distance restriction that makes it difficult to judge gaps in the main street traffic stream. Without red/red flashing operation, the potential for accidents would be high.
3. The intersection has complex geometrics, such as a 5-leg intersection or an intersection with signalized frontage roads. When complex geometrics exist, waiting side street motorists often have a difficult time deciding who has the "rights" to the next available gap in main street traffic. Wild and erratic maneuvers by frustrated side street motorists often result.
4. The side street has more than one phase. This would include side streets having a separate left turn phase or having a split phase. Multiple side street phases are an indicator of a high level of operational complexity and, the more complex an intersection is, the higher the need for red/red flash.

5. The intersection controls a freeway off-ramp and the ramp length is such that peak period traffic volumes could back onto the freeway mainline under yellow/red flashing operation. Stopped-traffic on a freeway mainline is potentially dangerous and should be avoided whenever possible.
6. The main street has dual left turn lanes with heavy left turn volumes. If there are insufficient gaps in the opposing traffic stream then these left turns could overflow their storage lane, blocking main street thru traffic.
7. Pedestrian signals exist at the intersection and they are heavily used by pedestrians crossing the main street. With no way to stop main street traffic, pedestrians would be forced to cross moving traffic with no protection under yellow/red flashing operation.
8. An active railroad track is present on the side street and is located close enough to the intersection such that side street queues sometimes extend across the tracks. Red/red flashing operation reduces the probability of vehicles being trapped on the tracks.
9. The intersection is wide, requiring side street motorists to cover a long distance in order to cross the main street. Wide intersections require more time to cross than narrow intersections, making it more difficult for side street motorists to find an acceptable gap. However, if a wide enough median exists, side street motorist can temporarily "store" in the median, completing the crossing in two short movements instead of one long one.

If none of these conditions are met, then traditional yellow/red flashing is probably in order. Yellow/red flashing should also be used if main street traffic volumes are so high that forcing all main street traffic to stop will cause extensive queuing on the main street, queuing that could spill-over into other intersections along the corridor, producing gridlock. It should be kept in mind that all-way STOP control can produce erratic motorist behavior at large multi-lane intersections, such as the intersection of a six lane road and a four lane road. Motorists seldom encounter all-way STOP control at multi-lane intersections and, consequently, are not accustomed to dealing with this situation.

Since it is often the case that certain factors point towards red/red flash while other factors suggest yellow/red flash, considerable judgment is needed to make the right call for a particular intersection.

The fact that any given signal goes into conflict flash infrequently (at least we hope so!) makes it difficult to decide which type of flash to use based on field observation. (And it may not be a good idea to intentionally send an intersection into flash to see how motorists react.) However, if one is lucky enough (or maybe I should say, unlucky enough) to have a signal go into flash under high volume conditions, the responding technician should definitely document how well the existing flashing operation worked in handling traffic. In other words, technicians should be trained to record this information for subsequent analysis. The information will be valuable in deciding whether to keep or modify the type of flashing operation that is in effect at the intersection.

Since traffic volumes vary considerably throughout the day, red/red flashing operation might be best for peak periods while yellow/red operation might be best for off-peak periods - at least at some intersections. Unfortunately, I am not aware of any controller/cabinet configurations that allow this to occur. The type of flashing operation is usually hard-wired into the cabinet from the factory with no capability for changing the type of operation by time-of-day or day-of-week.

The bottom line is that flashing operation during conflict periods should be determined through a careful analysis of all relevant factors, not by edict or by wrote.