California DOT Motorist Warning System

Freeways in the Stockton-Manteca area of San Joaquin County, California are prone to low visibility conditions. Visibility is reduced by wind-blown dust in the summer and dense, localized fog in the winter. In the past low visibility has contributed to numerous chain-reaction collisions in the San Joaquin Valley. To improve roadway safety on southbound Interstate 5 and westbound State Route 120, the California Department of Transportation (DOT)—also known as Caltrans—implemented an automated system to warn motorists of driving hazards.

System Components: Traffic and weather data are collected from 36 vehicle detection sites and nine Environmental Sensor Stations (ESS) deployed along the freeways, as shown in the figure. Detection sites are comprised of paired inductive loop detectors and Caltrans Type 170 controllers, which run software with speed measurement algorithms. Each ESS includes a rain gauge, a forward-scatter visibility sensor, wind speed and direction sensors, a relative humidity sensor, a thermometer, a barometer, and a remote processing unit. Traffic and environmental data are transmitted from the field to a networked computer system in the Stockton Traffic Management Center (TMC) via dedicated, leased telephone lines. The central computer system automatically displays advisories on nine roadside Dynamic Message Signs (DMS).

California DOT ESS

System Operations: Three central computers control operation of the motorist warning system. A meteorological monitoring computer records and displays ESS data. A traffic monitoring computer uses a program developed by Caltrans operations staff to record, process, and display traffic volume and speed data. Through interfaces with the monitoring computers, a DMS control computer accesses environmental and average speed data to assess driving conditions. Based upon established thresholds for vehicle speed, visibility distance, and wind speed; proprietary control software automatically selects and displays warnings on DMS as shown in the table. TMC operators also have the capability to manually override messages selected by the system.

California DOT Motorist Warning System Messages

Conditions	Displayed Message
Average speed between 11 and 35 mph (56.3 kph)	“SLOW TRAFFIC AHEAD”
Average speed less than 11 mph (17.7 kph)	“STOPPED TRAFFIC AHEAD”
Visibility distance between 200 and 500 feet (152.4 meters)	“FOGGY CONDITIONS AHEAD”
Visibility distance less than 200 feet (61.0 meters)	“DENSE FOG AHEAD”
Wind speed greater than 35 mph	“HIGH WIND WARNING”

When visibility falls below 200 feet these advisory strategies are supplemented by vehicle guidance operations carried out by the Department of Emergency Management. On major freeway routes, California Highway Patrol officers use flashing amber lights atop patrol vehicles to group traffic into platoons, which are lead at a safe pace (typically 50 mph or 80.4 kph) through areas with low visibility.

Transportation Outcome: The motorist warning system improved highway safety by significantly reducing the frequency of low-visibility crashes. Nineteen fog-related crashes occurred in the four-year period before the system was deployed. Since the system was activated in November 1996, there have been no fog-related crashes. Vehicle guidance operations improve also safety by minimizing crash risk.

Implementation Issues: Designers considered local conditions and potential safety benefits to assess the feasibility of a warning system. Limited sight distances, converging traffic patterns, and frequent low visibility events factored into the decision to deploy a motorist warning system on selected freeways. These factors also guided development of system requirements. The system had to have the capability to continuously and automatically collect, process, and display information. System designers examined historical crash data to establish a baseline for evaluation of the motorist warning system.

System components include commercially available products as well as hardware and software developed by Caltrans operations staff. The meteorological monitoring system was procured as a turnkey solution. The ESS manufacturer installed field devices, the monitoring computer, and proprietary processing software. Caltrans personnel designed and installed the traffic monitoring and DMS control components using standardized and commercial off-the-shelf products to minimize procurement costs and deployment time. Because display technologies had to be visible in adverse conditions, incandescent DMS were selected based upon their readability in low visibility conditions. After system elements were procured, installed, and calibrated operational procedures were developed, maintenance schedules and contracts were arranged, and traffic operations personnel were trained.

Future system expansion was taken into account by designers. Anticipated enhancements include the integration of the monitoring and control computers into a single workstation, incorporation of a Closed Circuit Television surveillance system for visual verification of roadway conditions, inclusion of a Highway Advisory Radio system to supplement visual warning messages, and testing of Variable Speed Limits and pavement lights. An interface to the California Highway Patrol information system is also expected.

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