

sierra research



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**Task Order Contract
for Emissions
Inventory Projects
Final Report**

prepared for:

**California Air Resources Board
Contract No. A096-214**

January 27, 1994

prepared by:

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**TASK ORDER CONTRACT
FOR EMISSIONS INVENTORY PROJECTS
FINAL REPORT**

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Vehicle Operating Characteristics and Emissions, SR-94-01-02

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SUMMARY

Under Contract No. A096-214, Sierra Research Inc. (Sierra) was retained by the California Air Resources Board (ARB) to conduct the following tasks related to improving ARB's inventory of emissions from motor vehicles: 1) document in-use vehicle activity; 2) investigate radio transponders; and 3) help oversee and direct evaporative emissions tests. In addition, the contract called for conducting other unspecified (general) tasks.

Task 1 originally called for the development and use of a portable vehicle instrumentation package. At the direction of ARB's Mobile Source Division, this task was modified to provide a less portable but more comprehensive instrumentation package and to install it in a state-owned Chevrolet Lumina. A summary of that instrumentation work is provided below and a detailed report entitled, "Development of an Onboard Data Acquisition System for Recording Vehicle Operating Characteristics and Emissions," is provided as an attachment to this report.

Task 2, investigation of radio transponders, specified the investigation and demonstration of the use of vehicle-based transponders to relay on-board emission control related information to a roadside base station or receiver, and the analysis of legal issues surrounding possible use of transponders. A legal analysis of transponder technology covering licensing, liability, constitutional and other issues was prepared under this task and was submitted to ARB on June 23, 1993. A copy of the report is included as an appendix to this report.

The technical investigation and demonstration of transponder use under Task 2 was redirected by ARB Mobile Source Division staff to focus on reading and transmitting "fault codes." Reading of fault codes from the Lumina's onboard electronic control unit, including sample data, was investigated and demonstrated, as described in Section 5.1 of the vehicle instrumentation report (attached). Transmitting fault codes without dedicated transponder equipment designed for that purpose was investigated but was found to be impractical within the budget constraints of the current project. A transponder and base station system capable of determining whether a vehicle's malfunction indicator light (MIL) is illuminated will be delivered to ARB by Sierra's subcontractor, Hughes, as soon as the terms of a bailment agreement between ARB and Hughes have been successfully finalized.

Task 3 directed Sierra to help oversee, direct and interpret results of evaporative testing conducted by ATL under ARB sponsorship. Detailed test results from this program have been provided to ARB under separate cover.

Task 4 provided resources for miscellaneous emissions inventory related support to the ARB. At the direction of ARB Mobile Source Division staff, these resources were used to augment Task 1 in order to pursue further specific elements of the vehicle instrumentation package described above.

As outlined above, work performed under the contract covered four specific areas:

- Development of an Enhanced Vehicle Instrumentation Package for the Characterization of In-Use Vehicle Operation and Its Effect on Emissions;
- Investigation, Including Legal Analysis, of the Use of Vehicle Transponders to Obtain and Transmit On-Board Data;
- Investigation of the Feasibility of On-Board Vehicle Location Systems; and
- Overseeing, Direction and Interpretation of Evaporative Emissions Testing by ATL for ARB.

In addition, the following miscellaneous motor vehicle emissions inventory related tasks were performed: 1) obtained an "Autoscope" unit that can be used to monitor various traffic parameters; 2) performed analysis to assist ARB staff in their on-road motor vehicle cycle development work; and 3) performed I/M related analyses.

The remainder of this report provides summary descriptions of the work performed. The appendix and attachments to this report document the detailed information, methods, and findings from the investigations conducted under the contract. Information relating to testing by ATL has been submitted to ARB under separate cover and will not be discussed further in this report.

Development of an Enhanced Vehicle Instrumentation Package for the Characterization of In-Use Vehicle Emissions

This section first describes the initial set-up (sponsored by ARB under an earlier agreement) of a simple data acquisition system in a state-owned Chevrolet Lumina, followed by a description of improvements made to that system prior to the current contract and then significant enhancements under the current contract.

Under a previous contract with the ARB (Contract No. A164-074), Sierra developed an improved vehicle instrumentation system for a vehicle

originally loaned to Sierra by the Mobile Source Division (MSD) to serve as a "target" vehicle for Sierra's "chase car", which was equipped with a laser range finder to collect data under a contract with the ARB's Research Division. To assist in the development of the hardware and software used with the chase car, the Lumina was originally equipped with a relatively simple system for collecting second-by-second information on speed and manifold air pressure. A laptop computer was used along with a relatively simple 4-channel data acquisition program called "Labtech Acquire."

After the successful development of instrumentation for the chase car, MSD staff asked Sierra to modify the Lumina to add throttle position information at a sampling rate greater than one Hertz. In addition to these changes, Sierra sought to improve the reliability, utility and operational simplicity of the data acquisition system to facilitate routine and quick start up use by untrained personnel. To this end, Sierra equipped the Lumina with a much more powerful data acquisition system called "Labtech Notebook" and configured the system to measure and record several other key aspects of vehicle and engine operation. Specifically, the hardware and software were configured to record the following on a second-by-second basis: vehicle speed, manifold air pressure sensor voltage, engine speed (RPM) and throttle position sensor voltage. Lateral and longitudinal acceleration as well as oxygen sensor voltage were measured at a rate of 10 Hertz; readings were block-averaged and stored at a one Hertz rate. The laptop computer was replaced by an 80386-type desktop computer which was positioned in the vehicle's trunk. The computer's power supply was modified in a custom manner to utilize the 12 volt supply from the vehicle and to provide power for a 110 volt AC cathode ray tube display monitor which was located in the passenger compartment of the vehicle.

The initial development efforts summarized above resulted in a complete, functioning test vehicle that could be used to document vehicle and engine performance parameters during in-use operation¹. Subsequent to this instrumentation work, ARB's MSD staff expressed an interest in the development of a "substantially enhanced instrumentation package" and directed Sierra Research to pursue such development under a revised Task 1 agreement (augmented by Task 4)². The revised Task 1 calls for paying less attention to the portability of the instrumentation package contemplated under the original Task 1 and redirecting funds from Task 4 to help support the development efforts for the enhanced instrumentation as described below.

Under the revised task, Sierra designed, installed, tested and demonstrated new hardware and software that substantially expanded the data acquisition system and other capabilities of the Lumina as a test vehicle. Specifically, the following changes were made to the Lumina's instrumentation package under the revised Task 1:

* Superscripts denote references provided after this Summary.

- A portable four-gas analyzer (MPSI PGA 9000) was installed and linked to the data acquisition program for real-time display and recording of exhaust gas concentrations of carbon monoxide, hydrocarbons, carbon dioxide and diatomic oxygen.
- Labtech Notebook was replaced with Labtech Control, an updated data acquisition program that does not require a hardware copy protection key for use, and Control was configured for data collection in the Lumina.
- A liquid crystal display (LCD) screen was installed in the passenger compartment, using a rugged custom mounting bracket. The LCD screen is powered through a dedicated video driver board installed in the trunk-mount PC to provide greater reliability than was previously available with a separately powered CRT.
- A seven-megabyte (MB) battery-backed ROMdisk was installed and configured to allow routine bootstrap start up and continuous data collection without requiring the use of vibration-intolerant moving parts (mechanical disk drives) and to provide for nonvolatile data storage in the event of vehicle shutdown or other power interruption.
- The speed of the on-board computer processing was increased by adding an 80387 floating point coprocessor chip.
- DOS version 5.0 was upgraded to the latest version, DOS 6.0, and configured for "doubledisk" operation, effectively increasing the ROMdisk storage capacity to more than 10 MB.
- Accelerometers were moved from the original trunk-mount location to a location on the floor of the passenger compartment between the driver and the front passenger to better reflect the onroad accelerations measured at the front wheels, potentially improving the accuracy of grade measurements.
- Lead-in wires from the Lumina's electronic control module (ECM) were connected to the trunk area to allow measurement of "service engine soon" (SES) light illumination (necessary to read fault codes when the ECM is placed in diagnostic mode), gear changes, manifold air temperature sensor voltage and coolant temperature sensor voltage.
- A remote isolating relay was installed in the glove compartment of the Lumina to allow activation of the diagnostic mode in the ECM under program control (by means of Labtech Control) in order to read ECM fault codes or for sending one bit of data (e.g., the state of the SES light) to a radio transponder that can be mounted in the vehicle (see discussion of Task 2, below).

- Voltage dividers and other circuitry and data acquisition system software configurations were provided to allow the data logger to measure and display in real time any of three or four digital inputs (three gear changes or two gear changes and the service engine soon light).
- A FORTRAN program was developed to post-process Lumina data to obtain both second-by-second mass emissions for carbon monoxide and hydrocarbons, and to smooth and screen grade data. This program was provided previously to the ARB under separate cover.³
- Sample data were collected for a series of drives in Sacramento demonstrating the collection and analysis of second-by-second data on pollutant concentrations and the post-processing of those data to provide second by second mass emissions, as well as cumulative mass emissions on a grams per mile basis, for each drive. These data were provided previously to the ARB under separate cover.⁴

Under this task, the Lumina was also investigated for possible installation of a laser range finder like the one custom developed for Sierra for a Chevrolet Caprice⁵. As reported to the ARB ("Development of an Onboard Data Acquisition System for Recording Vehicle Operating Characteristics and Emissions", Section 5.5), such installation was found to be feasible only within certain practical constraints. Most notably, the Lumina was found to have inadequate front grill depth (between the grill and the radiator) to allow an inconspicuous, nonprotuding installation.

In summary, under this task, a significantly enhanced data acquisition system, including exhaust emissions measurement, was designed, installed, tested and demonstrated on ARB's instrumented Chevrolet Lumina. A detailed report documenting the development and design and use of the instrumented Lumina is provided as an attachment to this report. Software, product manuals and documentation pertaining to software and hardware installed in the Lumina have been provided to ARB under separate cover.⁶ The Lumina was turned over to the ARB on December 3, 1993.

Investigation, Including Legal Analysis, of the Use of Vehicle Transponders to Obtain and Transmit Onboard Data

Under this task, an agreement was pursued whereby a transponder system developed by GM Hughes Electronics, consisting of two vehicle-mountable transponders and one roadside transponder ("reader"), would be transferred to ARB staff for its use.

Work conducted earlier under the first task provided for a vehicle-mountable transponder to be interfaced to the computer onboard the ARB's

Chevrolet Lumina. Under this task, a portable laptop computer was purchased (to conduct a transponder demonstration), configured with GM Hughes' custom software to control and obtain data from the roadside "reader," and delivered to ARB staff in El Monte on May 17, 1993. Subsequently, it was determined, with the concurrence of the ARB's MSD staff, that an in-vehicle demonstration of the transponder was a lower priority task compared to analyzing the feasibility of transmitting ECM fault codes. Accordingly, Sierra was directed to investigate the feasibility of transmitting fault codes from the Lumina via the GM Hughes transponder system. Sierra, in consultation with GM Hughes Electronics, investigated the feasibility of transmitting fault codes and reported to ARB in July 1993.⁷

Also under this task, Sierra prepared a report entitled, "Legal Aspects of Transponder Technology," which documents licensing, liability, constitutional and other issues related to the use of in-vehicle radio transponder systems. The report was provided to ARB on June 23, 1993. A copy is included as an attachment to this report.

Investigation of the Feasibility of Onboard Vehicle Location Systems

Using resources from Task 4, Sierra first explored the three main options for vehicle location systems, as specified in the modified task order agreement: global positioning systems (GPS), LORAN (long-range radio navigation), and "dead reckoning." A fourth approach called "Teletrac" was also examined. The investigation found that the principal competing vehicle location systems for the Los Angeles area were GPS and Teletrac.

GPS is satellite based and Teletrac is ground based. Both systems rely on radio triangulation to determine vehicle location. Based on information provided by vendors and users in LA, the two systems provide comparable accuracy, coverage, reliability and cost. However, Teletrac was suggested by Sierra as the preferred approach, primarily because it provides position not only as latitude and longitude (the normal output of GPS systems), but also as street names and addresses. The latter is an extremely valuable feature for vehicle positioning to determine road type, one of ARB's critical interests.

A report entitled "Vehicle Location Systems," which describes the investigation and findings, was prepared by Sierra and submitted to ARB in August 1993. A copy of Sierra's report is provided as an attachment to this report.

REFERENCES

1. "Performance of Analysis and Research Tasks for the California Smog Check Program (DRAFT)," prepared for the California Air Resources Board by Sierra Research, May 3, 1993.
2. "Development of a Vehicle Instrumentation Package for the Characterization of In-use Vehicle Operation," Revised Task 1 (augmented by Task 4), prepared for ARB by Sierra Research, February 24, 1993.
3. Provided to ARB on September 9, 1993, with the draft final report entitled, "Development of an Onboard Data Acquisition System for Recording Vehicle Operating Characteristics and Emissions," (draft report dated September 8, 1993).
4. Provided to ARB on September 9, 1993, with draft report, Ibid.
5. "Design and Operation of an Instrumented 'Chase Car' for Characterizing the Driving Patterns of Light-Duty Vehicles in Customer Service," prepared by Sierra Research for the U.S. Environmental Protection Agency, February 28, 1992.
6. Provided to ARB on September 9, 1993, with draft report, Ibid.
7. "Feasibility Study of an Alternative System for Reading Fault Codes from Vehicles Travelling in the Los Angeles Basin," Task Order Contract for Emissions Inventory Projects, Proposed Task 4 Subtask, prepared for ARB by Sierra Research, July 13, 1993.

APPENDIX

Legal Aspects of Transponder Technology

Legal Aspects of Transponder Technology*

Introduction

Task 2 of Sierra Research's 1992-1993 Task Order contract with the California Air Resources Board (ARB) requires Sierra to undertake Feasibility Assessment, Fabrication and Demonstration of Radio Transponders for Inspection and Maintenance. In the Task Order approved by the ARB, Sierra committed to provide a legal analysis of transponder technology covering licensing, liability, constitutional and other issues. This report is provided in fulfillment of that commitment.

Licensing

Equipment - The prototype transponder equipment under evaluation consists of two separate two-way units designed by GM Hughes: a roadside reader and a small transponder for placement onboard a vehicle. The system uses a digital time division multiplexing/"slotted aloha" protocol to provide high-speed, accurate transmissions, and is capable of retrieving information from 12 lanes of bumper-to-bumper traffic travelling over 100 miles per hour. The reader will transmit at a maximum of 100 milliwatts, and the transponder at a maximum of 10 milliwatts. These are very low power signals, with a maximum range for the reader of about 150 feet.

Both units will be "spread spectrum" devices configured to broadcast in a frequency band of 915 ± 13 MHz. This band was selected for its superior propagation characteristics. Spread spectrum devices have the capability of operating on different frequencies within a relatively wide band of available frequencies. The frequency used may vary from one transmission to the next. Different codes are also available to send messages on any given frequency, and the system includes a cyclic redundancy check (CRC) function to check for proper transmission of messages and repetition of messages not properly transmitted. In combination, these features allow the system to resist interference from other, higher-power signals using the same frequencies. Frequency assignment can be by random frequency hopping, by direct sequencing, or a combination (hybrid) approach. The prototype will principally use

* This report has been principally prepared by Sierra's in-house legal counsel. It is not written as a formal, definitive legal opinion, but is intended to establish legal parameters and identify issues in a fashion that will guide the ARB in deciding whether and what kind of transponder program it should adopt.

direct sequencing, but also has the capability of random switching between three separate frequencies. Spread spectrum technology is well suited to roadside monitoring because it allows the use of low-cost systems capable of reliably sending and receiving signals within a limited area, such as across several lanes of traffic.

The signal would transmit information stored in vehicle on-board diagnostic (OBD) systems. The information could simply be an indication of whether a fault code has been recorded, or could include actual fault code data.

For use in production units, Hughes is planning to upgrade the reader unit to 4 watts, and the transponder to about 100 milliwatts. The signal would be converted from spread spectrum to a coherent signal at 915 ± 6 MHz. This approach is expected to extend the range of the system to cover all road configurations that might be encountered in actual use.

Spread Spectrum Requirements - Under the spread spectrum rule as revised in 1990 by the Federal Communications Commission (FCC; 47 CFR 15.247), spread spectrum transmitters that operate within three specific bandwidths (902-928 MHz, 2400-2483.5 MHz and 5725-5850 MHz) with no more than 1 watt peak power output fall within the "public range" and are exempt from user licensing. The spread spectrum rule was revised in 1990 to increase the maximum power limit to 1 watt in a specific attempt to encourage commercial development of low-power, short-range spread spectrum communications, but in doing so, the FCC also imposed new requirements relating to power density, processing gain, and minimum bandwidth separation, in order to prevent interference with licensed signals. The intent of the FCC spread spectrum regulation is to encourage innovative uses. Other examples of spread spectrum technology include cordless telephones, wireless inventory systems in warehouses, automated pricing systems in grocery stores, electronic clipboards in hospitals, fire and burglar alarms, and cableless office PC networks. New products are emerging on a regular basis.

According to the FCC, unlicensed spread spectrum broadcasts operate on a "noninterference" or permissive basis, meaning they have no rights if they cause interference with any kind of licensed signal. If an actual conflict develops, the spread spectrum user is responsible for eliminating the interference.

The prototype equipment has been designed to meet all FCC spread spectrum specifications. Thus, the prototype system will not require licensing of either the reader or transponder unit. If this equipment is retained in production units, the ARB as well as vehicle manufacturers and owners will not be required to license any equipment. However, the manufacturer of any spread spectrum equipment used in an ARB transponder program must obtain a Grant of Equipment Authorization from the FCC before sale or use of spread spectrum equipment (see Subpart J of Part 2 of 47 CFR). The grant requires a formal application, with test data showing compliance with FCC spread spectrum specifications.

Interference Issue - Spread spectrum technology shares its 902-928 MHz band where the ARB transponder system would operate with many other forms of radio transmission, including government agency signals, industrial/scientific/medical (ISM) users, and radiolocation devices, thus raising the question of interference. In a note to its spread spectrum rule, the FCC states:

NOTE: Spread spectrum systems are sharing these bands on a noninterference basis with systems supporting critical Government requirements that have been allocated the usage of these bands, secondary only to ISM equipment operated under the provisions of part 18 of this chapter. Many of these Government systems are airborne radiolocation systems that emit a high EIRP which can cause interference to other users. Also, investigations of the effect of spread spectrum interference to U.S. Government operations in the 902-928 MHz band may require a future decrease in the power limits allowed for spread spectrum operation.*

Because this note has implications not only with respect to the feasibility of a vehicle emissions transponder program, but with respect to the liability question discussed below, Sierra contacted the FCC** to ascertain whether interference is, in fact, a significant problem. Theoretically, a spread spectrum transmission could interfere with any licensed broadcast on the same frequency, such as a commercial broadcast signal, government agency signal, police transmission, or even a traffic light control signal. However, the FCC presently has no proposals to constrict spread spectrum use, whether in the form of reduced maximum power requirements or otherwise. Its current position is that meaningful interference with licensed signals is "extremely unlikely", for several reasons. First, interference with other signals will be minimized by low power requirements. The prototype system being tested by the ARB vendor, GM Hughes, will be operating at no more than one-tenth the allowable maximum power. Second, the interference caused by a low-power spread spectrum system mainly appears as "noise" to more powerful external systems operating on the same frequency — i.e., the range of the external system may be somewhat affected, but direct interference ("butting-in") will not occur. Thus, interference caused by an ARB transponder system would become an issue only if the reader were located very close to a licensed receiver that is in a fringe reception area, and then only if both systems use identical or nearly identical frequencies at the same time. The ability of the ARB to relocate its readers should allow it to eliminate quickly any chance

* Afternote to 47 CFR 15.247. This admonition was apparently added to address concerns expressed by the National Telecommunications Information Administration (NTIA) that spread spectrum transmissions might interfere with government and military radio usage, which is the area regulated by the NTIA.

** Telephone interview with David Means, FCC Authorization and Evaluation Division Laboratory, Columbia MD, (301) 725-1585, ext. 206; May 17, 1993.

interference that might occur.* The FCC has also noted that any such interference would be extremely difficult to detect.

GM Hughes has conducted extensive field trials of the prototype system and found no serious interference problems. The most notable form of interference, with cellular telephones on vehicles, will be addressed by horizontal polarization of the transponder antenna, thereby minimizing interference with vertically polarized telephone antennas. Testing has been limited to use of the reader as a stationary roadside unit. The potential for interference if the reader is used in a roving mobile unit has not, to our knowledge, been explored. However, based on the considerations discussed above, interference with other licensed transmissions due to mobile operation is not expected to be a significant problem.

According to the FCC, use of spread spectrum technology has not caused interference problems to date, with one exception. The exception pertains to Automatic Vehicle Monitoring (AVM) broadcasts. AVM is a newer licensed two-way technology (up to 300 watts power) that is used to locate and communicate with vehicles; its primary use currently is for communications with commercial vehicles to locate cargo. AVM technology, under its official new FCC name of Location and Monitoring Service (LMS), is being considered for many other uses, including personal locators, navigation, safety, and Intelligent Vehicle Highway Systems (IVHS). IVHS use includes traffic congestion management, which is expected to include many of the transportation control measures required under federal and state clean air laws. Under FCC regulations proposed in response to a petition from Pactel Teletrac (58 FR 21276-21277, April 20, 1993; often referred to as the "Teletrac Proceeding"), the FCC has slotted LMS transmissions to occupy the 902-928 MHz band. The issue of spread spectrum transmissions causing interference with LMS has specifically been flagged in the FCC proposal:

Some LMS systems have already experienced interference from Part 15 [unlicensed] devices. This will likely be a continual concern as new consumer-oriented Part 15 devices, including the new spread spectrum cordless telephones, which can operate with up to one watt, are introduced. (FCC Notice of Proposed Rulemaking, PR Docket No. 93-61, adopted March 11, 1993; FCC 93-141, at p.6)

The FCC proposal goes on to address the issue by suggesting an alert or warning be issued to LMS users. But perhaps the most significant statement in the FCC proposal is the following:

LMS licensees could require some time to identify a source of interference and take action to eliminate the problem. As LMS systems are being marketed to public safety entities such as police and ambulance services, this potential interference is of special concern. We request comment from LMS operators

* Although primarily intended to operate as a stationary roadside unit, the GM Hughes reader is a portable, battery-powered device that can easily be moved from one operating site to another.

regarding measures that should be taken to protect against potentially life-threatening failures of LMS systems due to interference from other, lower priority users of the band. (Ibid.)

One commenter in the Teletrac rulemaking, Cylink, has suggested that the FCC should accord greater rights to Part 15 unlicensed users. If the FCC adopts this view, the ARB system would probably be protected. But the FCC could decide that restricting, rather than protecting, unlicensed users is the preferred approach. A decision by the FCC is expected by the end of this year.

According to GM Hughes, the prototype spread spectrum system is designed to mitigate this kind of interference, and actual interference is not expected to occur beyond a distance of about 50 feet. Nevertheless, interference could occur each time a LMS-transmitting or receiving vehicle passes near an ARB roadside reader unit (or possibly a vehicle transponder unit as well) that is simultaneously transmitting on the same frequency. This is an area of potential conflict that will have to be monitored by ARB.

If production transponder and reader units are upgraded to 100 milliwatts to 4 watts and converted from spread spectrum signals to a coherent signal at 915 MHz, the potential for interference with LMS transmissions (and other higher priority transmissions) may be increased due to higher transmitting power and loss of the ability to transmit on different frequencies. In addition, each reader unit will have to be licensed by the FCC, which opens up the possibility of the interference issue being raised by the FCC or an outside party as an objection to licensing. GM Hughes believes that any interference with LMS signals generated by a 4 watt unit would be brief and geographically confined enough such that actual disruption would not occur; CRC technology built into LMS systems, for example, should be able to overcome any minor interference that might occur. Nevertheless, it would seem advisable to undertake a thorough evaluation of the risk of interference with other signals, and to make direct contacts with the FCC, prior to making a commitment to upgrade the system as proposed.

Another possible source of conflict arises in connection with California's automated toll collection system. CalTrans recently issued uniform regulations governing two-way automated toll collection systems in the state based on transponder transmissions between vehicles and toll booths in the frequency band of 915±13 MHz, which would overlap the band where the ARB transponder system would operate.* GM Hughes indicates that the ARB system operates in a sufficiently different

* See new Articles 1-4 in Chapter 16 of Title 21, Code of California Regulations. CalTrans was given authority to set state-wide specifications and standards for automatic vehicle identification systems used by all toll collection operators in the state by SB 1523, which was passed in 1989 and codified as Streets and Highways Code Sections 27564 and 27565. Because no equipment is currently available to meet CalTrans requirements, the regulations contain a five-year "exemption."

manner such that its transmissions cannot interfere with CalTrans' system; likewise, CalTrans' system will be able to put an ARB transponder on alert, but will not trigger data transmission, when a vehicle is within 10 feet of a tollbooth. CalTrans has also expressed an interest in coordinating its system with the ARB system, as well as with other systems under consideration by the California Highway Patrol and the Department of Motor Vehicles, and has suggested the use of a single transponder unit that can transmit different data streams and be accessed by several agencies.* Coordination with CalTrans' system, and possibly with other agencies' systems, may require use of a different RF technology than that being currently developed for ARB by GM Hughes. Also, as discussed below, multiagency access to vehicles may raise additional Fourth Amendment privacy concerns.

The discussion above addresses mainly the problem of interference with higher priority transmissions caused by an ARB transponder program. The other form of interference would be where a stronger external signal disrupts transmissions from an ARB reader or transponder unit. According to GM Hughes, the prototype spread spectrum equipment proposed for the ARB program is relatively "immune" to higher power signals; such signals are coherent rather than spread spectrum, and the spread spectrum system has the capability of working around any such interference by changing codes, switching frequencies and resending the message if a signal corruption is detected by CRC. GM Hughes has not observed problems of this nature in its field testing. If production reader units are upgraded to 4 watt coherent signal units, interference from other signals may become a more significant issue. ARB should therefore require thorough field testing of such units before making a commitment to using them.

RECOMMENDATIONS: ARB should follow the FCC proceedings on LMS transmissions to be sure that no decision is made that is adverse to the type of equipment proposed for use in the transponder program (both prototype and production). Prior to any upgrade of the reader unit to transmit a coherent signal at 4 watts of power, the FCC should be contacted to confirm the feasibility of licensing. Field testing to look for interference by other stronger signals should also be undertaken. Confirmation that there will be no significant interference with CalTrans tollbooth signals should also be obtained from CalTrans, and the opportunity for coordination with CalTrans, CHP and DMV systems should be explored. ARB should work with its equipment vendors to develop internal guidelines on use of transponder equipment, such as location, time of day, portability, etc., that will minimize the chance of interference with licensed transmissions.

* The CalTrans contact is Les Kubel, Chief of the Office of Electrical and Electronic Engineering, CALNET # 497-2405.

Liability

Overview - It is difficult to predict every avenue of liability that might result from a transponder program. In general, the potential hazards associated with transmitters would include property damage, personal injury or death resulting from:

- Interference with another electronic device on the vehicle (e.g., engine computer, speedometer, carphone or radio);
- Interference with an external electronic device or transmission, such as a traffic light radio signal, emergency vehicle transmission, or other higher priority licensed signal; or
- Distraction of drivers by monitoring equipment or activities contiguous to the roadside.

However, it does not appear that use of GM Hughes transponder technology in the manner proposed will actually create substantial risks in any of these categories. Extensive field testing indicates that transponder signals will not interfere with vehicle equipment, and roadside activities should not be more distracting than other kinds of activities presently encountered along the state's streets and highways. The only concrete form of risk, as discussed above, would be injury caused by interference with some critical external signal, such as a police, traffic, medical or aviation signal, and even that risk appears low based on GM Hughes testing and statements from FCC staff. Liability to a commercial user of a licensed LSM system would also be conceivable, although the more likely remedy would be to merely eliminate the interference by relocating ARB equipment or implementing a technical solution. Overall, the potential for injury associated with the proposed system appears to be minimal.

Tort Claims Act - The low-risk nature of a transponder program is reinforced by the limited circumstances under which California law permits governmental agencies (and employees) to be held liable. Liability of state agencies begins with the proposition that the state is immune from liability except where immunity has been expressly waived by statute or constitutional provision. The California Tort Claims Act (Government Code Sections 810-895.8) is the primary statute of interest.* The principal basis for any liability under the Tort Claims Act in this case would be negligence, i.e., a claim asserting that the failure of ARB or its employees to exercise due care caused injury to a person or property to which ARB or its employees had a legal duty to use due care. This is not a strict liability standard; the mere causation of injury will not necessarily result in liability. There must be a showing that ARB had the requisite duty and failed to act reasonably

* For a comprehensive discussion of the California Tort Claims Act, see "California Government Tort Liability Practice", Third Edition, California Continuing Education of the Bar, Berkeley, CA, 1992.

under the circumstances.* If ARB uses its public hearing process preceding the adoption of a transponder program to consider and act on any safety concerns, a strong reasonableness defense will be created. Compliance with all FCC requirements would also help demonstrate due care.

Further, there are several immunities that appear to be applicable. Under the Tort Claims Act, immunities prevent liability even where negligence may exist. Sections 818.2 and 821 of the Tort Claims Act provide that state agencies and employees are not liable for an injury caused "by adopting ... an enactment." This immunity, known as the legislative immunity, applies to the adoption of rules and regulations. Assuming ARB would impose a transponder requirement by amending its OBD regulations in Title 13, Code of California Regulations, this immunity would be directly applicable.

A second form of immunity is contained in Sections 818.4 and 821.2 of the Tort Claims Act, where public agencies and employees, respectively, are insulated from injuries resulting from the issuance or denial of a permit, license or certificate. This immunity could protect ARB from liability for certifying vehicles as in compliance with its transponder regulations. However, an important limitation is that this immunity only applies where the agency "is authorized by enactment to determine whether or not such authorization should be issued", i.e., where the decision is discretionary and not merely ministerial. It is not clear whether a court would view the ARB certification process as discretionary or ministerial, but a good case can be made that enough judgement is involved in the certification process to make it discretionary.

RECOMMENDATION: ARB regulations should require vehicle manufacturers to certify that the transponder will not adversely affect the safety of vehicle operators, passengers or equipment, or persons or equipment external to the vehicle, under normal use conditions. Manufacturers should also be required to provide specified information regarding transponder safety; for example, by submitting test results (or at least a statement) indicating that interference with any standard or optional onboard electronic equipment will not occur. We also recommend that the regulation be stated, to the extent feasible, as a performance standard. For example, the regulation could simply state that the device must be capable of sending and receiving a specified kind of signal, and leave to the manufacturer the task of determining the design and placement of the transponder. This approach would tend to transfer any responsibility to vehicle manufacturers, who are in the best position to address such decisions, and also help characterize the certification process as discretionary rather than ministerial.

* The fact that transponders are operating within FCC-approved limits would be strong and possibly convincing evidence of due care in a case alleging liability caused by interference with an external signal.

Civil Rights Claim - There is one additional potential source of liability: a claim under the Federal Civil Rights Act (42 U.S.C. Section 1983). Section 1983 makes persons who are acting under color of any state law or regulation liable for injury caused by depriving another person of his or her federal constitutional "rights, privileges or immunities." Section 1983 also provides for equitable relief, such as injunction. It is possible that a claim could be filed under the Civil Rights Act by a person who believes that unconsented surveillance of a vehicle emissions control system by means of a transponder device violates his or her Fourth Amendment right to be free from unreasonable searches and seizures, or some other constitutional right such as the right to privacy. The risk of liability under Section 1983 is difficult to assess but is probably fairly low; the discussion of constitutional issues below provides some insight into the kinds of risks involved.

A critical feature of Section 1983 actions is that they may not be brought against the state itself or against state employees acting in their official capacity*, but they may be brought against a state employee individually for actions taken while implementing a state law or regulation. Thus, ARB board members and staff are at risk, rather than ARB itself. Since Section 1983 operates as a basis for liability separate from the California Tort Claims Act, none of the limitations or immunities in that act can be used defensively. However, federal law does recognize a "qualified immunity" for state government officials who are not violating "clearly established statutory or constitutional rights that a reasonable person would have known."** This immunity may protect ARB members and employees because there are no clearly established rules prohibiting transponder surveillance of vehicles; in fact, as explained below under the analysis of Fourth Amendment issues, requiring transponders may well be constitutionally permissible.

Constitutional Issues

Introduction - There are two primary approaches to the use of transponder technology to read vehicle OBD codes: as part of the regular inspection procedure at licensed smog inspection stations, or as a separate program covering vehicles while they travel on public streets and highways. The question addressed here is whether either approach imposes an unjustifiable intrusion or imposition on individual Constitutional rights.

Because questions of constitutional rights are often involved, electronic surveillance by government has always been subject to close review by the courts, and court-ordered restrictions are often applicable. Constitutional law, which applies broad, fundamental tenets of governance to specific situations, and often involves unpredictable

* This prohibition is based on the 11th Amendment, which bars federal suits by private parties seeking to impose liability that would be paid out of state treasury funds.

** Harlow v. Fitzgerald, (1982) 457 U.S. 800.

"balancing" of competing interests or vague tests of "reasonableness", does not lend itself to mechanistic analysis and predictive certainty. This section will hopefully alert ARB to certain features of the transponder program that might encounter difficulty if subjected to court review, or that might cause public or legislative disfavor.

Use At Smog Check Stations - In the case of transponder use during smog inspections required on fixed occasions (biennially and on transfer of ownership or initial registration) at fixed sites (licensed Smog Check stations) by licensed inspectors, constitutional rights are not expected to be of direct concern. A vehicle would enter or pass by a test lane, where, instead of taking the time to physically connect the BAR analyzer to a data transfer port on the OBD system, the inspector would merely send a radio signal to activate the transponder and receive a radio transmission containing information stored in the OBD system memory. That information would tell the inspector whether fault codes existed, and also possibly what those codes are. The presence or absence of fault codes, or the nature of the code, could then be used to help determine what inspection or test procedures to run while the vehicle is at the station (e.g., an EGR fault code might trigger a specific functional check, or the absence of any fault codes might allow a shortened test procedure). A fault code could also be used to help generate a recommended diagnosis or repair in the case of failed vehicles, and thereby reduce errors in vehicle problem diagnosis.

From a legal viewpoint, the key factors are that automated retrieval of OBD data is occurring with the vehicle owner's knowledge (and with the owner's actual or implied consent), at a fixed station, under a set procedure, by a qualified person who applies the procedure in the same manner to all vehicles with equal frequency. Under these circumstances, transponder technology is being used only as a modification to the established inspection and test procedure to improve its accuracy and efficiency. The information obtained relates primarily to vehicle emissions components; the transponder is not being used to obtain personal information about vehicle owners or drivers. There is no added element of surprise, either as to the requirement for an inspection or the scope of the inspection. Transponder technology is being used to obtain the same information that would be obtained under the current program with scan tools that physically connect to the vehicle, only with greater efficiency and accuracy.

The U.S. Supreme Court has made it clear that it is permissible for states to conduct inspections of vehicles for valid safety and other regulatory purposes, where the inspection does not involve random stopping of vehicles or other procedures that give state officials "standardless and unconstrained discretion" or unduly threaten vehicle owners. See, for example, Delaware v. Prouse, 440 U.S. 648 (1979) (court banned completely random stopping of vehicles by police to inspect licenses); U.S. v. Martinez-Fuerte, 428 U.S. 543 (1976) (allowing stopping of vehicles at fixed stations near the border to inspect for customs and immigration violations); and Michigan St. Police Dept. v. Sitz, 496 U.S. 444 (1990) (allowing roadblocks to stop all vehicles and inspect drivers for signs of intoxication). Periodic inspection of vehicles at licensed Smog Check stations would appear to fall well within the scope of these cases, and modifying the Smog Check

station inspection procedure to provide for transponder data acquisition does not add any new threat to personal rights.

On-the-Road Use of Transponders - Application of transponder technology to obtain information from vehicles as they travel on the road is another matter. In the on-the-road scenario, the transponder on the vehicle would be activated by a signal from a roadside reader as the vehicle is moving along the roadway. Once the two devices have a confirmed link, data would be transferred from the vehicle to the roadside reader. The data would consist of the VIN (Vehicle Identification Number) and certain information stored in the OBD system of the vehicle. The whole process would take place in milliseconds. No advance notice would be given to the motorist. No stopping of the vehicle would occur, and unless the system had a built-in activation alert (or the driver happened to see and recognize the roadside reader unit), the driver of the vehicle would be completely unaware that surveillance of his or her vehicle had just occurred. An illuminated malfunction indicator light on the vehicle dash might warn the driver that the vehicle would provide a fault code if probed by radio, but would not provide an actual warning of a remote access event.

The data from such a program could be used simply for research purposes; for example, to help monitor effectiveness of the regular I/M program or OBD systems. However, the data could be used to implement an automated enforcement procedure. The simplest approach would be for the transponder information to be screened by ARB within several weeks after acquisition. Correction notices would then be sent by mail to owners of vehicles with valid readings of fault codes. The notices would require an out-of-cycle certificate of compliance from a Smog Check station to be obtained within a specified time period, e.g., 30 days. A record of the notice would be sent to DMV, and DMV would withhold re-registration of the vehicle at the next annual re-registration date unless a certificate of compliance covering the transponder incident accompanied the application for re-registration. A monetary penalty for failure to obtain the out-of-cycle certificate of compliance in a timely fashion could also be imposed, either through DMV or by forwarding notices to local courts if a certificate of compliance were not sent to ARB within 30 days (like a parking ticket).

More aggressive enforcement techniques would also be available. If data from a vehicle indicate that a fault code has been stored, that information, along with identification of the vehicle from its VIN, could be relayed to a CHP/ARB roadside team further down the road on a real-time basis. The team could then stop the vehicle and issue a correction notice requiring an out-of-cycle smog check. The roadside team could issue the correction notice based on the transponder reading alone, or conduct a confirmatory underhood inspection of the vehicle on the spot. The inspection could be further expanded to include a tailpipe emissions test.

From an emissions control perspective, on-the-road surveillance of OBD information has definite advantages. If a vehicle has a malfunctioning emissions component, a network of transponder readers, possibly including roving mobile readers, operating on a regular basis on major urban thoroughfares will provide a means for detection and repair within

a matter of days or weeks for many vehicles. Under the current biennial program, it could take up to two years for the malfunction to be detected and repaired. The potential emission benefits of a transponder program will be addressed in a subsequent report by Sierra.

However, use of transponder technology in on-the-road applications, such as those described, would introduce a number of new program elements, not present in the existing fixed-station I/M program, that raise Constitutional questions:*

- Motorists will typically not be informed before monitoring takes place.
- Motorists will not know that a surveillance has occurred (except through receipt of a correction notice after a fault code has been recorded).
- Vehicle owners may have no opportunity to monitor or record conditions during a surveillance, or to have a contemporaneous confirmatory test done by a Smog Check station, and thus will be precluded from obtaining information that might be used to rebut a claim of violation by the government.
- There will be no restriction on the number of times a vehicle is monitored, or on the frequency of surveillance; some vehicles will be monitored frequently, others hardly at all, depending on the routes they are driven.
- More frequent detection of OBD fault codes could result in more frequent inspection and repair obligations, and thus greater cost and inconvenience to motorists.
- Whether used or not for this purpose, reading the VIN will allow transponder equipment to monitor the whereabouts of specific vehicles.

* These questions also raise public policy issues that could be controversial and arouse the interest of special interest groups and the state Legislature. An informal poll of Sierra employees, taken during the course of preparing this report, resulted in a large majority not favoring electronic monitoring. Last year the Legislature passed SB 1447, which amended CalTrans' authority to establish an automated vehicle identification system for tollbooths to give motorists "the option of using the automatic toll collection system with a passenger vehicle in a manner that does not identify the user, vehicle operator, vehicle owner, or vehicle at the time the occupant pays the tolls or lawfully uses the facility." SB 1447 was vetoed by the Governor. If this provision had been enacted into law, it would have effectively eliminated CalTrans' ability to implement an enforceable toll collection program. If a similar prohibition were imposed on the ARB transponder program, it would have the same effect, and limit the program to data gathering.

- The same system could be expanded to gather other data such as maximum speed, total time in excess of a given speed, mileage, and route information; to monitor the condition of certain safety-related equipment such as tires and brakes; and to collect roadway use fees.
- The emission benefits of the program in some cases may be limited due to poor correspondence between fault codes and actual defects in emission control equipment or actual excess emissions.

Fourth Amendment - Search and Seizure. The Fourth Amendment to the U.S. Constitution states:

"The right of the people to be secure in their persons, houses, papers and effects, against unreasonable searches and seizures, shall not be violated..."

Identical language appears in Article I, Section 19, of the California Constitution.

It is well established that the Fourth Amendment applies to vehicles, even though vehicles are not specifically mentioned in the language of the amendment. However, the U.S. Supreme Court has made it clear that vehicles are subject to a "diminished expectation of privacy" compared to a residence or personal effects. (See U.S. v. Knotts, 460 U.S. 276 (1983), where the Supreme Court allowed police to monitor the location of a vehicle by hiding an electronic beeper in a drug container carried in the vehicle; New York v. Class, 475 U.S. 106 (1986), where the Supreme Court allowed police, without cause or issuance of a warrant, to examine the vehicle identification number (VIN) of vehicles on the street; and California v. Carney, 471 U.S. 386 (1985), where the court allowed a warrantless inspection of a mobile home.) In the Carney case, the court noted that the "automobile exception" to the right to privacy derived from the need to allow greater latitude for government inspection due to both the "mobility" of automobiles as well as the "pervasive regulation of automobiles." This exception is especially relevant to the ARB program, because the ARB is seeking information about the vehicle, and not about the person owning or driving the vehicle.

With this diminished expectation of privacy in mind, a number of constitutional law treatises and U.S. Supreme Court cases on Fourth Amendment rights were reviewed. One basic conclusion stands out: where there is no physical trespass of a person's property, technologically enhanced governmental surveillance will usually be allowed. Or, as recently stated by a 9th Circuit District Court:

Time and again, the United States Supreme Court has held that police utilization of extra-sensory, non-intrusive equipment...to investigate people and objects does not constitute a search for the purposes of the Fourth Amendment. (U.S. v. Penney-Feeney, 773 FS 220 (1991), allowing police to use an infrared detector device to read the heat signature of

a residence where operation of a marijuana hothouse was suspected.)*

Use of transponder technology to obtain remote readings of the condition of vehicle emission control systems would clearly fall within this category of "non-intrusive" investigations.

In deciding such cases, the Supreme Court uses a sequence of two questions: 1) Did the conduct of the individual exhibit an actual expectation of privacy? and 2) Was the individual's expectation of privacy one that society is prepared to recognize as reasonable? (first iterated in Katz v. United States, 389 U.S. 347 (1967)). Under this approach, the court has allowed numerous kinds of non-intrusive technology-enhanced searches to take place, including monitoring vehicle movement by means of an electronic beeper (United States v. Knotts, 460 U.S. 276 (1983)), aerial surveillance of private property (California v. Ciraolo, 476 U.S. 207 (1986) and Florida v. Riley, 488 U.S. 445 (1989)), and use of a "pin register" to record numbers called from a private telephone (Smith v. Maryland, 442 U.S. 735 (1979)). Most of these cases have been disposed of under the first question, i.e., by determining that the individual did not have an actual expectation of privacy. In the Knotts case, for example, the court concluded that a person cannot expect to keep the movements of a vehicle private when it is driven on public streets, and that the beeper merely augmented the ability of drug enforcement officers to follow the vehicle visually.

Assuming that the approach used by the Supreme Court in these cases would be governing in any constitutional challenge to a transponder program, there is some assurance that a transponder program would pass constitutional muster. The answer to the first question in the Katz test should be in the negative — i.e., no expectation of privacy would be found. Since the surveillance applies to vehicles, a reduced expectation of privacy would be applicable in the first instance under the cases cited previously. Moreover, as transponder technology will not enable the state to obtain more information than it would otherwise be able legitimately to obtain by simply increasing the frequency or scope of the current fixed-station I/M program, no unique invasion is being created. It would be very difficult for a California motorist to establish an actual expectation of privacy as to the condition of his or

* Also see Rotunda and Nowak, "Treatise on Constitutional Law", 2d Ed., West Publishing Co., 1992, at pages 372-382. The authors' main conclusions are that "The Supreme Court has not yet held that the right to privacy limits governmental powers relating to the collection of data concerning private individuals." (at page 372), and that the Supreme Court has "narrowed" the Fourth Amendment right of privacy only to cases where individuals have a "legitimate expectation of privacy" strong enough to be analogous to a "legally cognizable property right" (at page 379, fn. 74).

her vehicle's emission control system given the pervasive vehicle emission regulatory program in the state.²

Even if the first question is answered in the affirmative, there is a likelihood that the second would not. California's air pollution problems are recognized as the worst in the nation, and the contribution of vehicle emissions to that problem have earned California the unique right to establish its own vehicle emission control program under a waiver of federal preemption in the federal Clean Air Act (42 U.S.C. 7543). Similar recognition of the need for special efforts to control vehicle emissions is contained in state law (see Part 5 (commencing with Section 43000) of Division 26 of the Health & Safety Code). Under these conditions, a court may well find that there is an overriding societal interest in clean air.

However, there is one important caveat as to the applicability of these cases: in each case, surveillance was initiated on the basis of pre-existing suspicion of an individual or small group of individuals, whereas the transponder program would apply to motorists at large. The cited cases are factually the most closely allied that could be found among those decided by the Supreme Court, but Sierra could not identify any Fourth Amendment cases involving mass surveillance. By proposing a program involving suspicionless electronic surveillance of a large number of citizens, the ARB appears to be opening the door to a broader use of technology than has been reviewed by the Supreme Court to date. Thus, constitutional review of a transponder program would involve novel circumstances, and a novel set of decisional factors could evolve. It is possible that the court would use a different, less permissive test where information is electronically obtained without prior suspicion.

There is another important aspect of the transponder program that could become an overriding factor. If owners of vehicles with on-board transponders are informed in advance of the presence of the device and how it will operate through an appropriate admonition in the owner's manual, DMV registration or licensing procedures, or through other consumer information, the defense of actual or constructive consent would be raised. If consent is found, Fourth Amendment claims would be avoided altogether.³

The primary public concern about a transponder program may, in fact, not be its use to monitor the status of vehicle emissions control equipment,

² The fact that all emission data are viewed as public information under the California Public Records Act (Government Code §§ 6250 et seq.), while not directly applicable, would help support this position.

³ In United States v. Karo, 468 U.S. 705 (1984), the Supreme Court explicitly decided that neither the secret installation of an electronic beeper in a canister of drugs prior to delivery to a buyer, nor the subsequent transfer of the canister to the buyer without informing him of the beeper, constituted a "search or seizure" under the Fourth Amendment. It is uncertain whether the same ruling would result in the case of a transponder installed without informing the vehicle owner and without prior cause or suspicion of the vehicle owner.

but rather its introduction of a technology with the potential to monitor many other aspects of vehicular travel. As noted above, a number of other state agencies have expressed an interest in using the same technology, including CalTrans, the CHP and the DMV. Expansion of the system to access data on vehicle speed, mileage, passenger load, weight, safety equipment, registration date, etc., would be useful to these agencies. We have already noted CalTrans' new regulations to collect tolls by means of transponder signals. The ARB itself might want to explore expanded use of transponders to implement or enforce certain traffic control measures for emission reduction purposes. The same transponder data that are gathered for emissions purposes would, in the hands of a criminal investigative agency, enable that agency to determine whether a particular vehicle has passed by certain checkpoints on a daily basis; by the simple expedient of acquiring a few mobile reader units, an investigative agency would have access to technology that would be able constantly to monitor the vehicular movements of selected individuals along any number of routes, or readily locate vehicles. To some, these uses would appear Orwellian.

In the Knotts case cited above, the Supreme Court specifically considered and rejected the claim that allowing surreptitious use of electronic beepers would make possible "twenty-four hour surveillance of any citizen of this country...without judicial knowledge or supervision." While acknowledging the possibility of such use, the court said that "reality hardly suggests abuse", and that "if such dragnet-type law enforcement practices as respondent envisions should eventually occur, there will be time enough to determine whether different constitutional principles may be applicable" (460 U.S. at pp. 284 and 285).⁴ Since the ARB transponder program, by itself, would not involve such expansive surveillance, the mere potential for creation of a larger program through coordination with other agencies would not appear to create additional risks. However, ARB should evaluate such risks before linking its system to uses sought by CalTrans, CHP, DMV or any investigative agency. While the views expressed in the Knotts case seem dispositive, the court could distinguish the Knotts case as one involving a search and seizure based on cause or prior suspicion, and apply a more restrictive rule in the case of a transponder program applied broadly to suspicionless persons.

In order to maintain public support for its program, Sierra believes that ARB should be mindful of the legal uncertainties associated with expanded use of transponder technology, and consider steps to limit use of transponder equipment and data by ARB employees and other governmental agencies. Although not yet required by the Supreme Court, such limitations have been mentioned as critical in a number of concurring or minority opinions, which could someday become a majority

⁴ This is consistent with the Supreme Court's rule that it will not rule on facts or issues not actually before it. Also see Whalen v. Roe, 429 U.S. 589 (1977) where the court noted that the "mere possibility" that personal data on prescription drug use would be used improperly did not invalidate a law requiring pharmacists and doctors to provide copies of prescriptions containing certain narcotics.

position.⁵ Such limitations may also help prevent harsh legislative oversight and reaction.

A final question is whether the Fourth Amendment principles discussed above might apply differentially if the program is conducted purely for the purpose of research or data-gathering, with no application of sanctions against motorists. Sierra could locate no directly applicable court rulings. The Fourth Amendment is mainly raised as a defense by criminal defendants, and the reported cases thus involve criminal sanctions. However, by its own terms, the Fourth Amendment comes into play whenever the government conducts an unreasonable search or seizure, and does not require application of criminal or other sanctions. A "search" would almost certainly be found when transponder data is accessed. So it is likely that a research-based transponder program would trigger Fourth Amendment protection. The issue then becomes whether limiting use of transponder data to non-enforcement purposes affects the determination of whether a search is reasonable. As noted in the previous paragraph, some members of the Supreme Court have viewed how data are used as a relevant factor, so it is possible that the court would allow a search for data-gathering purposes but disallow the same search if information obtained in the search can lead to sanctions.

If the program is expanded to include stops by on-the-road inspection teams, an intrusive element is added. However, as long as the initial electronic data access is ruled reasonable and the subsequent inspection portion of program meets the requirements announced by the Supreme Court in its roadblock cases, cited above, there should be no Fourth Amendment infirmity. Because an inspection team will stop only vehicles with emissions-related OBD fault codes, the prohibition against random stops will not be applicable. A team will also be using specific inspection procedures and calibrated equipment, and thus will not be exercising "standardless and unconstrained discretion." If there is one area of concern, it would be the scope or duration of the inspection. It is possible that a court would rule an on-the-road inspection unreasonable if the procedure is too detailed (e.g., involving disconnection of the evaporative system or tailpipe measurements at various engine RPMs) or takes too long to complete.⁶

⁵ See, for example, Justice Brennan's concurring opinion in Whalen v. Roe, 429 U.S. 589, at pp. 606-607.

⁶ ARB is currently conducting roadside snap-idle and inspection tests on commercial heavy-duty Diesel vehicles when they stop at CHP weigh stations. The tests take several minutes to complete. In the context of highly regulated commercial vehicles, already stopped for other purposes, an additional stop of several minutes duration may be reasonable. See Michigan v. Sitz, 496 U.S. at 454, where the court noted that trucks may be subject to "further detention" for safety and regulatory inspection at roadside weigh stations. But stopping a private citizen driving his or her personal light-duty vehicle on personal business may be viewed as a more sensitive intrusion. In Michigan v. Sitz, for example, the court noted that "Detention of particular motorists for more extensive field sobriety testing may

(continued...)

RECOMMENDATIONS: To assure the integrity of a transponder program under the Fourth Amendment, ARB should consider implementing the following safeguards:

1. Consent - By regulation, ARB should require manufacturers to inform vehicle owners in the owners' manual and in a consumer notice provided at the time of first sale that a vehicle has a transponder on board and that by purchasing the vehicle they are consenting to emissions equipment surveillance by roadside units. The admonition might be worded as follows:

This vehicle is equipped with an electronic transponder unit. When signaled by a roadside reader, this unit will send data from the vehicle's on-board emission monitoring system identifying the vehicle and indicating whether any emission control equipment has malfunctioned (or been tampered) and is in need of repair. The transponder unit may be signaled to send such data at any time while it is being driven on public streets or highways. BY PURCHASING OR USING THIS VEHICLE, YOU ARE CONSENTING TO THE TRANSMISSION OF SUCH EMISSIONS-RELATED INFORMATION.

2. Limitations On Use of Data - By regulation, ARB should require its staff to treat transponder data as confidential and, except for data required by court warrant, prohibit dissemination of such data to private persons. Transmission of ARB data to other agencies for official use could be allowed, if the agency provides similar confidentiality safeguards. Transponder equipment could also be programmed automatically to erase transmissions, including the VIN, if no fault code is received.
3. Other Safeguards - There are other measures available to address some of the issues noted earlier. The concern about secretly obtaining information could be addressed by having a light come on or beeper sound when a transponder is accessed by a reader, or even by providing a LCD readout to the driver of the nature of the fault, thus giving motorists the opportunity to run confirmatory tests or make early repairs. The Hughes prototype equipment already has indicators built in. Such measures would probably not reduce program effectiveness.

Right to Privacy - The U.S. Constitution does not explicitly refer to a right of privacy. Many Fourth Amendment cases speak of protecting individual privacy, but in such cases, the term seems to be used only as a shorthand reference to the right against unreasonable searches and seizures, and not a separate, independent right. The Supreme Court has recognized an independent right of privacy; however, it has been invoked only in certain limited circumstances involving "fundamental rights" or

⁶(...continued)
require satisfaction of an individualized suspicion standard" (496 U.S. at 451).

highly personal areas, such as lifestyle, sexual activity and pregnancy⁷. In such cases, the Supreme Court typically determines that an independent right to privacy derives from the Fourth Amendment, as well as other constitutional rights such as the Fourteenth Amendment right to due process, an unenumerated right "retained by people" under the 9th Amendment, and as an element of "liberty" preserved by the Constitution. But, in general, the court has not been sympathetic to abstract privacy claims asserted in cases involving governmental access to data or information concerning individual citizens where an important or compelling public need for the data can be demonstrated.⁸ In view of the reduced expectation of privacy criterion that has been applied to automobiles in the past by the Supreme Court in Fourth Amendment cases, we believe there is virtually no chance of the court striking down a transponder program as violative of an independent right to privacy.

In California, however, there definitely is an independent right to privacy. The California Constitution provides in Article I, Section 1, that

All people are by nature free and independent, and have certain inalienable rights, among which are those of ... pursuing and obtaining safety, happiness and privacy.
(Emphasis added; emphasized words added by Initiative in 1972)

This raises the question whether privacy, because it is an explicitly mentioned right in the state Constitution, enjoys a higher status in California. Two treatises examining this question have concluded that at least some degree of additional protection is afforded under the California Constitution, and possibly a great deal more protection.⁹ As an example of the difference between federal and California law in this area, compare Valley Bank v. Superior Court, 542 P.2d 977 (1975), where the California Supreme Court decided that private bank records could not be discovered in a civil case, with U.S. v. Miller 425 U.S. 435 (1976), where the U.S. Supreme Court allowed the subpoena of private bank records in a criminal investigation. The different result in these two decisions may be explained by the fact that the former merely involved civil discovery, while the latter addressed a more important need for governmental information in a criminal case. Nevertheless, it appears that the explicit right to privacy in California will require a compelling justification for any intrusion occasioned by a transponder program, instead of the less onerous balancing or "reasonableness" approach used under the Fourth Amendment of the federal Constitution. A transponder program may, in fact, satisfy a constitutional test in California requiring a compelling public need, because it would contribute to reducing the state's serious air pollution problem.

⁷ See, e.g., Griswold v. Connecticut, 381 U.S. 479 (1965) (state prevented from regulating birth control in private homes); Roe v. Wade, 410 U.S. 113 (1973) (preventing certain state regulation of abortion).

⁸ See Rotunda and Nowak, cited in fn 6, at pp. 372-382.

⁹ See 13 Cal Jur 3d at Sec. 237, and 19 Pepperdine Law Review 327, 329 (1992).

Due Process/Equal Protection - To meet the due process requirement of the Fourteenth Amendment to the U.S. Constitution, a government enactment must meet a basic "fairness" test (procedural due process) and be rationally related to a valid public purpose (substantive due process).¹⁰ Equal protection under the Fourteenth Amendment to the U.S. Constitution likewise allows enactments that do not differentiate on the basis of "suspect" categories or that do not involve "fundamental" liberties, to treat categories of persons differently as long as there is a rational basis for differentiation.¹¹ Similar due process and equal protection requirements apply under Article 1, Section 7, of the California Constitution.

Readers in a transponder program will be located mostly in urban areas, and mostly on heavily travelled freeways and through streets. Persons who drive on such roads may have their vehicle monitored every day. In contrast, those who drive on side streets or in less populated areas may escape monitoring altogether. Urban drivers, whose vehicles are frequently monitored, may claim that the program is singling them out and, for that reason, discriminatory. Sierra does not believe that focusing the program where most vehicles travel will create a due process or equal protection constitutional infirmity. The "discrimination" in this case does not single out persons based on a suspect classification, and bears a rational relationship to the problem addressed, in that focusing on heavily travelled roads also focuses on the areas of greatest vehicular emissions.

ARB regulations will have to address the problem of a vehicle that regularly travels a frequently monitored roadway (e.g., the Santa Monica freeway in Los Angeles) on a daily basis, and that could receive repeated notices for the same equipment defect once its OBD system has stored a fault code. A data screening system will have to be put in place to prevent notices from going out for the same vehicle over a relatively short time frame (e.g., 60-90 days). If this is not done, we believe a court would question, under tenets of procedural due process, the fairness of the program.

Another potential problem relates to "false positive" OBD readings, i.e., issuing notices based on fault codes stored when there is no detectable or repairable defect in emissions equipment, when the defect is transitory or self-correcting, or when the defect does not cause a significant emissions increase. ARB's OBD II requirements are very extensive and require sensors to be highly sensitive to changes in emission-related operating parameters. "False positives" could result from a conservative design approach that results in a fault code being set when the vehicle is still meeting applicable standards, or from a fault caused by operation of a vehicle under abnormal conditions rather than an actual failure of an emission control system component.

If problems of this nature are pervasive, and result in too many vehicles being inspected with no defect being found, a transponder

¹⁰ See Rotunda and Nowak, cited at fn 6, Vol. 2 at pp. 408-415.

¹¹ Ibid., Vol. 3 at pp. 20-28.

program could be subject to a due process challenge in court.¹² For such a challenge to succeed, it would have to be shown that the program is so flawed that it does not reasonably relate to the objective of reducing emissions from vehicles. Sierra does not believe ARB would face a high risk of losing such a case; the greater risk might be before the legislature. Nevertheless, we believe ARB should have confidence that the reliability and effectiveness of the transponder program, both in terms of avoiding false positives and having demonstrable emission benefits, is well established prior to public implementation.

RECOMMENDATIONS:

1. Screening Of Data - ARB regulations should include a procedure for screening of transponder data so that vehicle owners are not sent repeated notices for the same fault code. Setting a 60-90 day minimum limit between notices on the same vehicle would be one way to accomplish this. As noted above, an automated electronic screening technique could be used.
2. Reliability - Before the public is required to make repairs based on data obtained in a transponder program, ARB should review its OBD II regulations and conduct a pilot or experimental program to ascertain what fraction of the vehicle population will be receiving notices based on transponder data. The program should also examine the incidence of "false positives" and the ability of mechanics to find and repair defects flagged under the program. If necessary, changes to ARB OBD II regulations should be made.

Authority to Adopt

Introduction - A final issue is whether ARB has the authority under its current statutory delegation to implement a transponder program, or whether legislation is needed.

Sierra assumes that ARB would implement a transponder program by amending its OBD regulations (currently codified in Sections 1968 and 1968.1 in Title 13, California Code of Regulations) to add a requirement for vehicle manufacturers to install a transponder unit capable of reading, storing and transmitting certain OBD data, plus other information such as the VIN. The transmission requirement would include performance specifications that assure compatibility with ARB's roadside

¹² Any case challenging the transponder program on these grounds would also very likely claim that the regulation is invalid under Article 7 of the California Administrative Procedure Act (Government Code Sections 11350-11356) and/or a mandamus or administrative mandamus proceeding under Sections 1085 or 1094.5 of the California Code of Civil Procedure. These provisions require state agency regulations to be supported by "substantial evidence."

readers as well as compliance with FCC spread spectrum regulations. The regulations would also specify durability, certification and warranty requirements.

As currently written, the statutes relating to ARB regulatory powers do not specifically mention OBD systems or a transponder program. Thus ARB authority will have to be inferred from more general grants of legislative authority. Sierra has identified several areas, discussed below, where existing ARB authority could be interpreted to include authority to implement a transponder program.

Emission Standards - A number of sections in the Health & Safety Code direct ARB to adopt and enforce "emission standards" for motor vehicles.¹³ Of particular relevance would be ARB's authority in Section 43101 to prescribe emission standards for the I/M program, since monitoring vehicles via transponder technology would operate like an expansion of the current I/M program. The term "emission standards" is defined in Section 39027 as "specified limitations on the discharge of air contaminants into the atmosphere". There is some question under this definition whether OBD and transponder requirements are an emission standard, but it is possible that a court could reach the conclusion that they are. ARB relied on its power to set emission standards as one of the sources for its authority to impose its OBD II requirements in 1990.

Test Procedures - It is possible to interpret ARB's OBD regulations as a form of "test procedure" for determining compliance with its emission standards. See Sections 43102 and 43104. This authority was also cited by ARB in support of its OBD II regulations in 1990.

In-Use Performance Standards - Section 43013 authorizes ARB to adopt motor vehicle "in use performance standards" which are "necessary, cost-effective, and technologically feasible to carry out the purposes of this division." This broad grant appears to fit an OBD-based transponder program better than the term "emission standards", in that the program is, in fact, designed to assure proper performance of in-use vehicles. This section was also cited by ARB in adopting its OBD II regulations.

"Whatever Actions Are Necessary...." - Sierra believes Section 43018 contains ARB's strongest legislative authority for a transponder program. This section, in relevant part, states:

(a) The state board shall endeavor to achieve the maximum degree of emission reduction possible from vehicular and other mobile sources in order to accomplish the attainment of the state standards at the earliest practicable date.

(b) Not later than January 1, 1992, the state board shall take whatever actions are necessary, cost-effective, and technologically feasible in order to achieve, not later than December 31, 2000, a

¹³ See, for example, Sections 43000, 43010, 43101, 43102, 43104. All subsequent code references are to the Health & Safety Code unless otherwise indicated.

reduction in the actual emissions of reactive organic gases of at least 55%, a reduction in emissions of oxides of nitrogen of at least 15 percent from motor vehicles... The state board shall also take action to achieve the maximum feasible reduction in particulates, carbon monoxide, and toxic air contaminants from vehicular sources.

(c) In carrying out this section, the state board shall adopt standards and regulations which will result in the most cost-effective combination of control measures on all classes of motor vehicles and motor vehicle fuel, including, but not limited to, all of the following:

....
(2) Reductions in emissions from in-use emissions [sic] from motor vehicles through improvements in emission system durability and performance.

.... (Emphasis added)

This provision, with specific reference to emissions from in-use vehicles and emission system performance, gives ARB wide discretion to adopt regulations that will achieve the stated emission reductions from motor vehicles. A transponder program, assuming it meets the required necessity, cost-effectiveness and feasibility constraints, would be consistent with this mandate.

In lieu of relying on these existing statutory provisions, ARB could sponsor legislation granting it specific authority to implement a transponder program. The risk of such legislation being rejected or qualified in a manner unacceptable to ARB argues strongly against such an approach.¹⁴

RECOMMENDATION: ARB should rely on its existing statutory authority to implement any transponder program.

¹⁴ In Clean Air Constituency v. California Air Resources Board, 11 Cal 3d 801 (1974), the California Supreme Court cited the failure of the Legislature to pass a number of bills proposing to give ARB explicit authority to delay the NOx retrofit program as one basis for concluding that ARB did not have the implied authority to institute such a delay.