CLEAN AIR RESEARCH AND DEVELOPMENT PROGRAMS

SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT

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SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT 1992

RTD

GENERAL MANAGER'S MESSAGE

The Southern California Rapid Transit District, one of the nation's most efficient and cost-effective public transportation providers, is also the world leader in the research and development of alternative fuels and technologies for buses. We have filled this role because we recognized nearly a decade ago that public sentiment, and good judgment, demanded we do everything we could to reduce emissions from diesel buses and to take other environmentally sound actions.

In 1983, the SCRTD began investigating the clean-fuel technologies then in existence. We told all state, federal and local agencies with environmental and energy responsibilities, as well as the private sector, that the SCRTD was willing to test with them any technology that might be effective in reducing harmful pollutants. In the ensuing years we have written the book on the proper operation and maintenance of clean-burning methanol-powered buses. We made them work where others said it couldn't be done. We also are conducting demonstration projects using natural gas and testing particulate trap buses that run on conventional diesel. We are studying the use of electricity to power buses, either traditional trolley buses that get their power from overhead wires or from a new, fuel-cell technology.

We also are testing the use of non-cholorofluorocarbon (CFC) refrigerants in our bus air-conditioning units that will eliminate the further depletion of the earth's ozone layer by CFC refrigerants.

The SCRTD continues to look to the future. We have formed a team of young experts who operate without pre-conditioned prejudices toward any technology. This team is the envy of the industry. Energy and environmental experts from throughout the country and many foreign nations have come to the SCRTD Central Maintenance Facility to review our testing facilities and programs.

The Southern California Rapid Transit District has committed financial resources, staff time and facilities to the task of reducing pollution and promoting clean air in the Los Angeles basin. This booklet provides a detailed description of the pioneering efforts of our alternative fuels program.

Alan F. Pegg

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DESCRIPTION OF NEED

Since its inception in 1983, the SCRTD's alternative fuels program has been molded to meet clean air standards that were made law in March of 1989. After five years of work by the South Coast Air Quality Management District (AQMD) and the Southern California Association of Governments (SCAG), an Air Quality Management Plan (AQMP) was designed to achieve the National Ambient Air Quality Standards.

In 1991, the AQMP was updated to reflect new state and federal clean air requirements. It addresses global climate change issues, stratospheric ozone depletion, and evaluates the problem of air toxics.

The goals of the AQMP include extensive use of clean fuels, rapid introduction of clean emission vehicles, conserving natural gas and electricity, reducing emissions from all sources and reducing vehicle miles traveled and trips taken.

SCRTD recognizes the hard work, dedication and teamwork on which the AQMP is based. It is a reasonable, and yet assertive, step forward to clearing our skies again. SCRTD is proud to be a leader in the ongoing quest to meet these challenges.

SCRTD'S ALTERNATIVE FUELS TEAM

SCRTD's Alternative Fuels Team had modest beginnings in 1983. One senior engineer was assigned to be the District's liaison with the California Air Resources Board (ARB) to help design a prototype particulate trap development test.

In the nine years that followed, a steady stream of some of the most competent and knowledgeable people in the alternative fuels field came to SCRTD to contribute to the growing clean-air effort. By 1989, the Alternate Fuels Section was born with one methanol engineer, five warranty equipment mechanics and one secretary.

By this time, SCRTD was well on its way toward unveiling its fleet of 30 methanol-powered buses. In August, 1989, three more staff members were added to assist with the landmark project.

As the District has expanded its alternative fuel demonstrations, experts have arrived to oversee the projects. The Emissions Testing Facility, opened in August, 1991, and the compressed natural gas bus demonstration are each directed by some of the best minds in their fields.

Today, SCRTD's Alternative Fuels Team is 18 members strong and still growing as research intensifies.

DISCUSSION OF TECHNOLOGIES

SCRTD saw the need for alternatively fueled buses coming long before any of the clean air guidelines actually became law.

There are two ways to approach an impending challenge. The first is to do nothing, then deal with it when it arrives. The second method, which is the path SCRTD chose to take, is to prepare years in advance to meet the challenge head-on.

SCRTD's foresight in its decision to move ahead with alternative fuels research and development has proven to be well-founded. Clean air rules are now in place and getting more rigid as time progresses. But SCRTD's research and experiments with alternative fuel technologies have prepared the District, and thus the transit industry as a whole, to readily comply with the ever-changing guidelines.

Many people have beaten a path to the research lab of SCRTD's Alternative Fuels Program since 1983, carrying with them their various formulas and ideas for cleaning the air.

SCRTD is always willing to experiment with an idea that has merit. Because of the volume of proposals its staff receives, the District created a unique screening process entitled, "Transit Bus Aftermarket Emissions Control Product Evaluation Procedures." The 14-point set of requirements separates the "snake oil salesmen" from proven methods of improving bus emissions.

Anyone who comes to SCRTD with a proposed alternative fuel or clean air technology must document that using the product results in a level of emissions that meets current clean-air standards; that it is cost-effective, and that it is reliable enough to use in a large fleet of buses. These three basic characteristics — emissions, reliability and cost — are the primary measurement criteria for determining whether SCRTD will use an alternative fuel or clean emission technology. Anecdotal information and testimonials are not considered in evaluations.

Emissions measurements include levels of oxides of nitrogen (NOx), particulates, carbon monoxide, hydrocarbons and aldehydes that an engine discharges into the atmosphere. All of these emissions are potential polluters and health hazards. State and federal regulatory agencies have set limits for each in vehicle emissions.

Cost considerations include extra parts and their availability, required technical training and special facilities construction.

There are many reliability gauges, including how long the bus is in service between major overhauls, weight of the bus, fuel mileage, and maintenance history.

The SCRTD procedure also helps evaluate the results of an alternative fuels project once it is undertaken. It is designed to help set consistent guidelines for testing in order to get the most useful results.

There are several alternative fuels being considered. SCRTD's staff is trained to carefully scrutinize any new technology before investing the considerable resources needed for a full-scale demonstration project. Following is a summary of those technologies that passed muster.

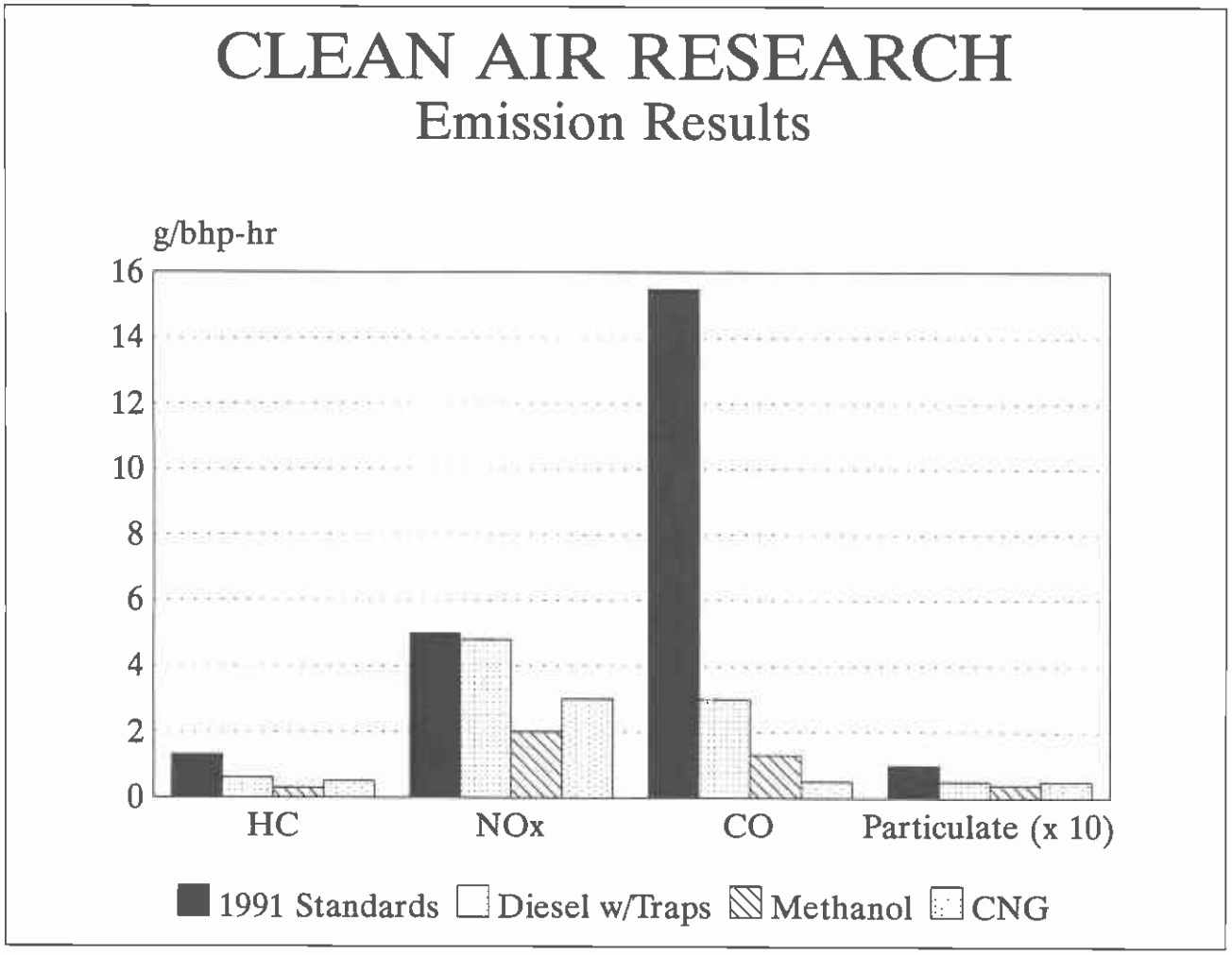
METHANOL

An exhaustive two-year demonstration project conducted by SCRTD from 1989 to 1991 proved to the District's satisfaction that so far, methanol is the alternative fuel that best meets the three criteria of emissions, reliability and cost effectiveness.

In 1989, SCRTD unveiled a fleet of 30 new buses, one of the first buses ever to be designed and built to run exclusively on methanol, a low-emission liquid fuel made from natural gas or coal. At that time, it was the largest fleet of alternatively-fueled buses anywhere in the world. The stage was set for a two-year demonstration project.

Following months of fine-tuning and close monitoring, the demonstration showed that using methanol could meet state and federal clean-air laws, while keeping costs within reasonable bounds. Among the findings:

- Particulate emissions were significantly reduced. Tests have shown that methanol engines emit only a fourth of the particulates of a conventional diesel engine.
- Oxides of nitrogen (NOx) emissions, which is a major precursor in the formation of atmospheric ozone, is reduced by approximately 50 percent with methanol.
- SCRTD increased methanol's fuel economy roughly 10 percent through the implementation of several engineering modifications.



SCRTD's 30 methanol-powered buses have performed for more than 2.2 million miles in revenue service, successfully integrating the technology into the normal maintenance operations.

SCRTD recognizes that the use of methanol may eventually prove to be a transitional fuel. The study of the fuel remains in a research and development mode. But the excellent results of the test have established the fact that methanol technology can be used on a cost-efficient, reliable basis in everyday transit service while complying with clean air regulations. These findings led SCRTD to purchase 303 more methanol-fueled buses.

Because no service manual existed for the proper maintenance of methanol-powered bus engines, SCRTD's engineers had to create one. Using the knowledge gained over the two-year project, SCRTD's alternative fuels team created a maintenance manual that already has been shared with many other transit properties.

COMPRESSED NATURAL GAS

Compressed natural gas is the second of the two alternative fuels SCRTD is demonstrating. While the District believes CNG has a promising future as an alternative fuel, there are still numerous fueling infrastructure and bus weight obstacles that must be overcome before it can be a viable option for a bus fleet the size of SCRTD's:

- Fueling and maintenance facility issues must be resolved in order for natural gas to be a viable fuel. In April, 1992, SCRTD began a "fast-fueling" CNG facility demonstration project to determine whether refueling efficiency could be performed at an acceptable level. Historically, refueling a CNG-powered bus took up to eighty minutes, which would severely impact SCRTD's ability to roll out a fleet of CNG buses on time. This new CNG fueling facility, designed by SCRTD bus facility

engineers with the help of the Southern California Gas Company, is built to perform the refueling of a CNG bus in 10 minutes.

- Unlike methanol engines, federal and state regulatory agencies have not certified the emissions of natural gas engines as of this date.
- Oxides of nitrogen (NOx) emissions levels, while currently within acceptable pollution standards, are higher when using natural gas than when using methanol.
- Bringing CNG maintenance facilities in compliance with local fire codes would be very expensive.
- The on board fuel tanks that hold CNG add about 3,300 pounds to the weight of each bus, resulting in increased fuel consumption and additional equipment and tire capacity requirements as well as reduced passenger carrying capacity.
- The current price of CNG is relatively attractive as compared to other alternate fuels, however this is a fast moving and volatile area of constant change.

The District put a fleet of 10 CNG-powered buses into service in 1990 as part of another demonstration project to find out if CNG reliability can be improved, and thus become another viable fuel for the future.

PARTICULATE TRAPS

If the current trend remains unbroken, new diesel fueled buses probably will become obsolete during the next decade. In the meantime, most public transportation providers, including the SCRTD, will still be operating existing diesel buses for some years to come.

In an effort to help diesel buses meet clean air regulations, SCRTD is testing two emissions-reducing technologies. The first is the diesel particulate trap, the second is the methanol/ Avocet retrofit.

Experiments with particulate traps, or exhaust filters, were among SCRTD's earlier clean-air projects. The District began looking at ways to trap diesel particulate emissions as early as 1983 and is currently testing two kinds of particulate trap filters, a monolithic ceramic filter system and a ceramic fiber filtering system. With the recent addition of 33 new particulate-trap equipped buses, SCRTD now has nearly 50 in its fleet.

Particulate traps are metal-clad ceramic filters that remove the soot or particulate matter from diesel exhaust. The captured particulate matter is oxidized to carbon dioxide and water vapor. When installed onto a diesel engine in place of the muffler, they reduce up to 80 percent of the diesel particulate emissions, while having no major adverse effects on performance or noise level. Particulate traps however, have no effect on reducing NOx emissions and NOx emissions are a very important consideration in the South Coast Air Basin because the Basin has the worst non-attainment record for air quality NOx levels in the United States.

SCRTD's experience with diesel particulate trap reliability has been improving. The cost per particulate trap system is relatively expensive at approximately $20,000.

METHANOL/AVOCET ADDITIVE

SCRTD's alternative fuels team also has found that a diesel engine can be modified to run on methanol. The secret to this feat is a special fuel additive called Avocet, which is manufactured by an England-based company called Imperial Chemical Industries.

It costs approximately $17,000 to convert one diesel engine to be able to run on the methanol/Avocet mixture, while fuel consumption and fuel costs are relatively high.

However, methanol/Avocet has performed more reliably than particulate traps and CNG in the dozen buses SCRTD is running so far. Also, emissions tests conducted on the buses have shown that it is possible to meet 1991 bus emissions standards with a 1980-vintage diesel engine bus using methanol/Avocet.

The results of this project will also be of great interest to other transit properties who will have to meet EPA proposed rebuilt engine emission requirements in 1995 or may not wish to immediately invest in a completely new fleet of buses built specifically to run on alternative fuels.

ELECTRIC TROLLEY BUSES

Electric trolley buses (ETBs) represent an old technology with a very relevant application to today's environmental issues. ETBs have been around for more than 100 years, and have served the Los Angeles area on two previous occasions.

Encouraged by the success of ETB systems in cities such as Vancouver, B.C., Seattle and San Francisco, the Los Angeles County Transportation Commission (LACTC) in September, 1991, decided to invest $8 million in bringing ETBs back. Since then, SCRTD has conducted a series of community meetings to determine where the first ETB lines could be built. The first demonstration lines could be in service by 1995.

INSPECTION AND MAINTENANCE OF DIESEL

SCRTD continously looks for ways to improve the performance of its diesel engines while cutting emissions levels as much as possible.

Chevron recently introduced its Special Diesel, a low-sulfur, high cetane, diesel fuel reformulated to reduce exhaust emissions and enhance vehicle performance. It has been available since June of 1990, and SCRTD is using it in its fleet.

NON-OZONE DEPLETING AIR CONDITIONING REFRIGERANT

The engine isn't the only part of the bus that can affect the environment. In recent years, research has shown that the chlorine contained in chlorofluorocarbon refrigerants used in automotive and bus air conditioning units are major ozone depletors.

SCRTD is nearing agreement on a demonstration project to integrate HFC-134a, an alternative refrigerant that does not contain chlorine, into a bus's air conditioning system. Good results have been reported with HFC-134a in autos, but there is little known about its use in heavy-duty vehicles such as buses.

Southern California, with its temperature extremes, is an ideal proving ground for an air-conditioning test. SCRTD hopes to demonstrate that this new low-emissions air conditioning technology can work in a commercial fleet application, thus keeping riders cool and the stratospheric ozone layer intact.

FUTURE PROJECTS

SCRTD is not resting on its laurels. There are several additional technologies that show promise and the District wishes to experiment with:

LIQUIFIED NATURAL GAS (LNG) — SCRTD proposed a demonstration project to test the benefits of liquified natural gas. The project would begin literally from the ground up: We would design and mock-up a prototype LNG-powered bus, run initial tests, then manufacture additional LNG buses for service.

LIGHTWEIGHT BUSES — Last April, Los Angeles Mayor Tom Bradley and Congressman Glenn Anderson (D-San Pedro) proposed the allocation of $4 million in federal funds to research the use of aerospace technology to construct buses and light rail vehicles. SCRTD would conduct the research on lightweight buses that would be more fuel efficient. The goal is to apply aerospace technology to the construction of public transportation vehicles, using similar materials.

PHOSPHORIC ACID FUEL CELLS — SCRTD has been chosen as a demonstration site for the testing of a phosphoric acid fuel cell, another promising non-polluting power source that could work in buses. The District is cooperating with the AQMD, Georgetown University, and the Federal Department of Energy on launching a demonstration project slated to begin in 15 to 18 months.

The benefits of fuel cells include lower maintenance requirements, less noise and vibration, and smoother acceleration and deceleration. Fuel cells have better thermal efficiency than internal combustion engines, and can operate on a variety of fuels, including methanol, ethanol, natural gas, and gaseous or liquid hydrogen while emitting zero or near-zero pollutants to the atmosphere.

To be used efficiently in public transportation vehicles, fuel cells must have high-power density, rapid start-up, be able to resist shock and vibration, and be responsive to frequent load changes.

SCRTD'S EMISSIONS TESTING FACILITY

In August, 1991, after years of preparation, SCRTD opened an emissions testing facility for large commercial vehicles, the only one serving the western United States.

The $2.3 million facility is used to test heavy-duty vehicles in order to verify that the emission reductions made by SCRTD buses and other large vehicles meet clean air standards.

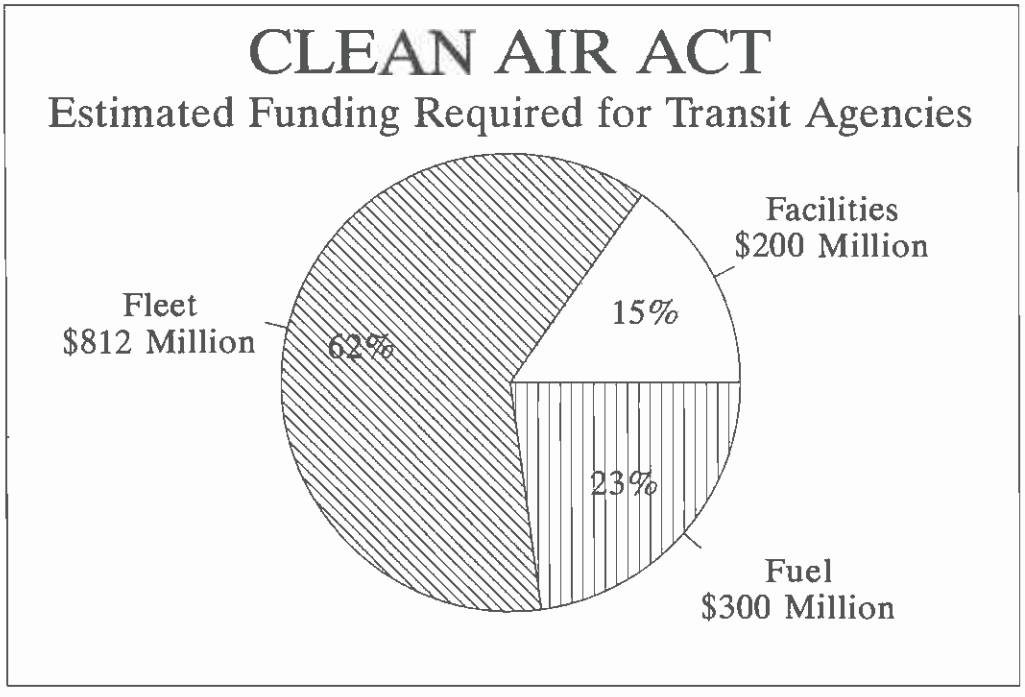
The vehicle's wheels are locked onto the rollers of the chassis dynamometer and the exhaust system is connected to a dilution tunnel. An emissions analyzer in the control room samples the diluted exhaust and is able to measure the levels of pollutants that are being emitted. The control room is able to simulate the actual on-road conditions and provides the SCRTD with a valuable tool in determining the true effectiveness of each technology in reducing heavy-duty engine emissions.

SCRTD'S NATIONAL COST SURVEY

In response to the federal Clean Air Act of 1990, and in preparation for funding issues for the 1991 Intermodal Surface Transportation Efficiency Act (ISTEA), SCRTD conducted a nationwide survey of U.S. public transit properties to find out the costs associated with converting diesel buses to alternatively fueled or low emission buses.

The purpose of the survey was not only to provide policymakers with the best available fleet data and cost estimates of the impact of the Clean Air Act on the nation's public transit providers. It also demonstrated the urgent need for Congress to authorize the appropriate funds to transportation agencies so that public transit could comply with the Act's mandates.

The preliminary results of the survey indicate that the nation's fleet of approximately 39,000 buses in air quality non-attainment areas, will require $1.3 billion to meet the requirements in the Clean Air Act. The breakdown is estimated to be $200 million for fueling and maintenance facility conversions and construction, $812 million to purchase clean air buses, and $300 million per year in fuel costs.



CHRONOLOGY OF SCRTD'S ALTERNATIVE FUEL AND LOW EMISSION BUS PROGRAM

1982: Groundwork for Emissions Testing Facility outlined in Central Maintenance Facility construction designs.

1983: SCRTD appoints liaison with California Air Resources Board (CARB) concerning the prototype particulate trap developmental testing.

1984: Methanol project proposal written.

SCRTD begins work with CARB on controlling diesel smoke caused by improper maintenance.

1985: Testing of a Southwest Research Institute particulate trap system begins on SCRTD bus.

1986: SCRTD participates with private industry in the development of a compressed natural gas (CNG) engine.

1987: Methanol-fueled bus specification developed.

1988: SCRTD works with CARB to formulate low-sulphur diesel and bus inspection and maintenance programs to reduce emissions.

SCRTD and Southern California Gas Company select Cummins L-10 engine for compressed natural gas prototype.

1989: ***April*** — SCRTD hires seven additional staff assigned to carry out methanol and methanol/Avocet demonstration projects.

May — SCRTD accepts first 30 methanol buses.

First methanol/Avocet conversion completed.

June — Methanol buses enter revenue service.

August — SCRTD hires one additional engineer and three technicians to maintain expanded 30 methanol bus fleet and emissions test facility.

November — SCRTD, in conjunction with CARB, installs first Donaldson wallflow particulate trap system on an SCRTD bus.

CHRONOLOGY OF SCRTD'S ALTERNATIVE FUEL AND LOW EMISSION BUS PROGRAM

1990: ***February*** — SCRTD hires two additional staff members: one to initiate Emissions Testing Facility and one to begin CNG and fueling facility demonstration projects.

April — SCRTD adds three staff members to begin work on retrofitting metha nol/Avocet and particulate trap buses.

May — First ceramic fiber particulate trap system installed on an SCRTD bus.

June — Construction begins on CNG fast fueling facility.

September — Methanol/Avocet additive retrofits completed on 12 buses; particulate trap retrofits completed on 16 buses.

October — Voluntary Compliance Program developed with CARB for heavy-duty vehicle smoke inspection.

December — SCRTD's fleet of 30 Methanol buses reaches 1 million miles of revenue service.

1991: ***February*** — SCRTD places tenth compressed natural gas bus into revenue service.

May — Methanol demonstration project completed.

August — Emissions Testing Facility opened.

December — SCRTD Board of Directors, based upon SCRTD staff recommendation that methanol be selected as a fuel source for the District, approves District's first large clean-fuel bus purchase of 303 more methanol-powered buses.

1992: ***January*** — Methanol fleet reaches 2 million miles of revenue service.

April — CNG fast fueling facility operational.

SCRTD accepts 33 diesel Flxible buses equipped with ceramic fiber particulate trap systems.

May — SCRTD's methanol/Avocet fleet of 12 retrofitted buses reaches 500,000 miles of revenue service.

BIBLIOGRAPHY OF TECHNICAL PAPERS

SCRTD's alternative fuels research has led to a number of technical papers that have laid the groundwork for other transit agencies to begin their own alternative fuel programs:

1. "Methanol Transit Bus: Research and Development to Operational Reality," George Karbowski and Vincent Pellegrin, SAE 911632, August, 1991.

2. "Demonstration of Durable Retrofit Diesel Particulate Trap Systems on an Urban Bus and Class B Truck," Kong Ha, Vince Pellegrin, Dan Quigg, Mike O'Connor and Steve Albu, SAE 910332, February,1991

3. "Transit Bus Operation with a DDC 6V-92TAC Engine Operating on Ignition-Improved Methanol," Paul Wuebben, Stefan Unnasch, Vince Pellegrin, Dan Quigg and Ben Urban, SAE 902161, October, 1990.

4. "The Use of a Chassis Dynamometer for Urban Transit Bus Preventive Maintenance Inspection," Vince Pellegrin, L.R. Davis and H. Porter, SAE 872269, November, 1987.

5. "Correlation of Smoke Levels with Engine-Lubricating-Oil Solids in Metropolitan Transit Buses," Vince Pellegrin and Alvin Lowl, Jr., SAE 872251, November, 1987.

6. "The Retrofitting of a Catalytic Trap Oxidizer to a Metropolitan Transit Coach," Vince Pellegrin, SAE 860135, February, 1986.

AGENCIES IN PARTNERSHIP WITH SCRTD

PUBLIC

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT
- Avocet program
- Fuel cell buses
- Emissions testing facility/engine dynamometer

CALIFORNIA AIR RESOURCES BOARD
- Methanol emissions test program
- Emissions testing facility/chassis dynamometer
- Voluntary compliance program
- Asahi particulate trap

CALIFORNIA ENERGY COMMISSION
- California fuel methanol reserve
- Methanol bus issues

LOS ANGELES COUNTY TRANSPORTATION COMMISSION
- Particulate trap project funding
- Electric Trolley Bus Project funding

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
- Clean Air Act issues, retrofit requirements
- Emissions testing procedures
- Workshops
- Methanol bus testing

DEPARTMENT OF TRANSPORTATION — FEDERAL TRANSIT ADMINISTRATION
- Grants for demonstrating Clean Air Technologies
- Development of all technologies
- SCRTD as test ground for clean fuel initiatives

UNITED STATES DEPARTMENT OF ENERGY
- Fuel cell buses
- Work with Georgetown University

CALIFORNIA HIGHWAY PATROL
- Highway Department motor carrier inspector alternative fuels training

LOS ANGELES FIRE DEPARTMENT
- Alternative fuel bus training
- Firefighting techniques on alternative fuel properties

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
- Test site for methanol and formaldehyde exposure testing with regard to service attendants and mechanics

AMERICAN PUBLIC TRANSIT ASSOCIATION
- Various clean-air workshops
- Committee memberships

PRIVATE

CUMMINS ENGINE CORPORATION

- Field testing of Cummins natural gas engine

DETROIT DIESEL CORPORATION

- Field test of methanol bus fleet
- Largest order of methanol buses to date
- Formulation and publication of methanol engine service manual
- Development of programs and procedures for advancing clean fuel technologies

DONALDSON CORPORATION

- Particulate trap project

SOUTHERN CALIFORNIA GAS COMPANY

- Compressed natural gas bus and refueling project

IMPERIAL CHEMICAL INDUSTRIES

- Methanol/Avocet diesel bus conversion program

CELANESE

- Methanol fuel supplier

3M CORPORATION

- Particulate trap project

CHEVRON OIL COMPANY

- Chassis dynamometer baseline emissions testing of clean fuel buses

SOUTHWEST RESEARCH

- Emissions testing
- Compressed natural gas project
- Short test program — diesel bus emissions

LUBRIZOL CORPORATION

- Field testing of methanol buses, supplies methanol fuel additive

BATTELLE
AMERICAN METHANOL INSTITUTE
PALL FILTER CORPORATION
TMC
FLXIBLE

SCRTD SHARES RESEARCH WITH OTHER NATIONS

Notable visitors from all corners of the earth have come to SCRTD to learn more about how to operate a fleet of clean-air transit buses. Following is just a partial list of recent guests:

- VIP Russian delegation
- VIP Swedish delegation
- VIP Japanese delegation
- Steve Barsony, Federal Transit Administration
- Sam Romano, Georgetown University
- Vince DeMarco, Federal Transit Administration
- Japanese New Energy Development Office
- Japanese Automotive Research Institute
- Canadian Ministry of Transportation
- Petrodiamond Corporation (Mitsubishi)
- Carl Covitz, California Secretary of Transportation
- Environmental Protection Agency
- Scandinavian Technological Group
- British Broadcasting Corporation
- Tokyo Gas Company
- California Air Resources Board
- Admiral Watkins

PRESENTATIONS

- Earth Day methanol bus display
- Eco Expo methanol bus display
- Urban Consortium Energy Task Force
- Federal Transit Administration Advisory Committee, Washington, D.C.
- Technical Transportation Conference, Las Vegas
- Interview with consumer advocate David Horowitz
- Bay Area Metropolitan Transportation Commission
- California Air Resources Board New Bus Emission Standards workshop
- APTA Workshop on Clean Air

AWARDS AND APPOINTMENTS

AWARDS

RTD: 1990 APTA Management Innovation Award (April 1990)

RTD: 1991 SCAQMD Clean Air Award

RTD: 1991 Award of Appreciation from the U.S. EPA

L. RICH DAVIS: 1991 U.S. Department of Transportation, Administrator's Award for Excellence in Creative use of Technology

RTD: 1992 "TRANNY" Award from California Transportation Foundation for the RTD's Alternate Fuels Program (May 1992)

APPOINTMENTS

L. RICH DAVIS: Inaugural Chairman, APTA Bus Equipment Maintenance Committee; FTA Technology Development Advisory Committee

JEFF JOHNSON: Vice Chairman, APTA Electric Trolley Bus Task Force

VINCE PELLEGRIN: Chairman, APTA Powertrain Committee

ALAN F. PEGG
General
Manager

ARTHUR T. LEAHY
Assistant General
Manager - Operations

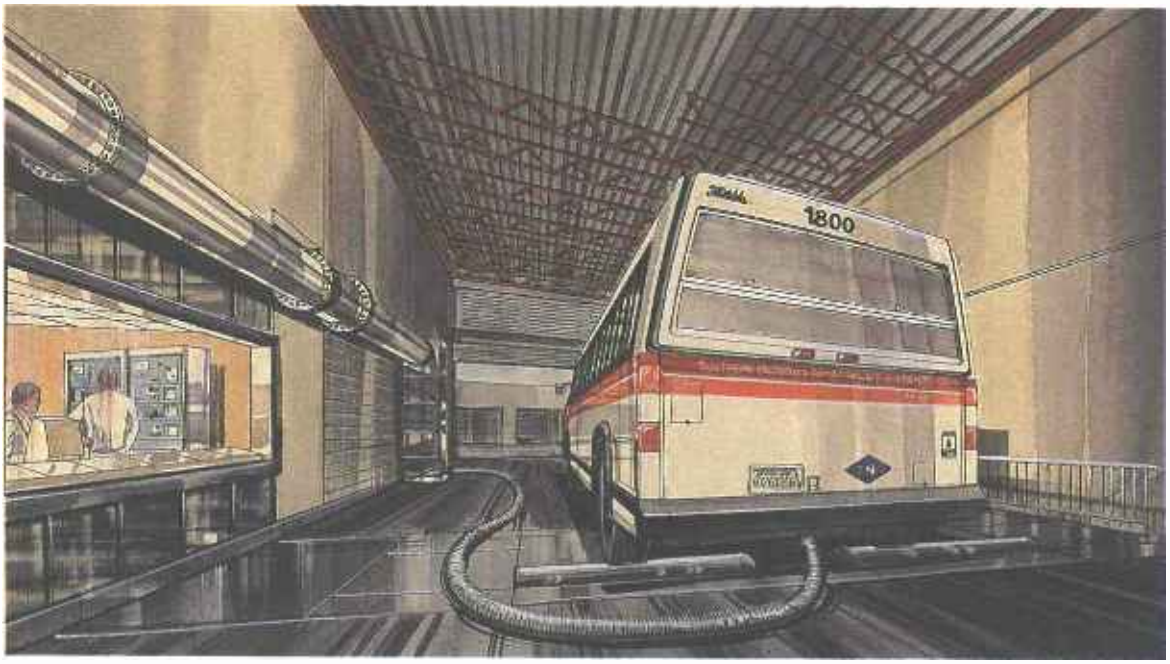
RTD

L. RICH DAVIS
Director of
Equipment Maintenance

JEFF JOHNSON
Supervising
Engineer

VINCE PELLEGRIN
Senior Engineer -
Alternate Fuels

LAUREN S. DUNLAP
Emissions Testing
Engineer



The Emission Testing Facility will allow the District to quantify the heavy-duty engine emissions reduced by utilizing alternative fuels in the transit industry.