Exhibit 5

TRANSIT TECHNOLOGY

AS OF

JUNE 1969

A REPORT

BY

THE TRANSIT TECHNOLOGY REVIEW BOARD

OF THE

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT

Exhibit

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SOUTHERN CALIFORNIA
RAPID TRANSIT DISTRICT

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June 1969

Mr. Samuel B. Nelson
General Manager
Southern California Rapid Transit District
1060 South Broadway
Los Angeles, California 90015

Dear Mr. Nelson:

Submitted herewith is our report entitled "Transit Technology As of June 1969" surveying the state of the art in the mass rapid transit field.

This has been a most interesting and challenging assignment and we appreciate this opportunity to have been of service.

If we can be of further assistance in the future, we shall be happy to respond to such an invitation from you.

Respectfully,

Transit Technology Review Board

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ACKNOWLEDGEMENTS

In carrying out its assignment, the Transit Technology Review Board wishes to express its great appreciation to the many private firms, public agencies, and civic organizations, and to the developers of mass transit systems which so generously gave of their time and effort in explaining their systems and ideas, answering questions and offering constructive suggestions.

The Board also wishes to acknowledge the assistance of Kaiser Engineers/Daniel, Mann, Johnson & Mendenhall, the District's Joint Venture Engineering Consultants, whose representatives attended all the technology presentations which were made before the Board and contributed to the discussion sessions, and who furnished this Board with a summary of the presentations.

I. INTRODUCTION

The District's Final Report on a recommended system of mass transportation for the Southern California Rapid Transit District, which comprises the southerly half of Los Angeles County was issued in May 1968. Although the proposal received over one million favorable votes in the November 1968 general election, it and all other propositions on that ballot were rejected by the voters in this county in an atmosphere of resistance to additional bonding and taxes. However, the District's Board of Directors is still facing the mandate of the State Legislature which prescribed in 1964, that:

> There is an imperative need for a comprehensive mass rapid transit system in the Southern California area, and particularly in Los Angeles County. Diminution of congestion on the streets and highways in Los Angeles will facilitate passage of all Californians motoring through the most populous area of this state and will especially benefit domiciliaries of that county who reside both within and without the rapid transit district.

However, prior to submitting another mass transit proposal to the electorate, the District Board has directed that the original proposal be carefully reconsidered. A re-evaluation of the quality and effectiveness of the recommended system technology is one of the key facets involved in this reappraisal.

II. PURPOSE

In accordance with the objectives of the District's Board of Directors as set forth on Page 2 of this report, the General Manager proceeded to create and appoint the members to this Transit Technology Review Board and assigned to it the task of reviewing the state of the art in mass transit technology and advising the General Manager and the District's Board of Directors of its findings--in the effort to insure that no important technological innovations or imminent advances in mass rapid transit would be overlooked.

This Board desires to stress the fact that its review has been aimed primarily at assessing the technical and cost effectiveness and feasibility of different types of transit systems.

The particular transit systems to be used by the District must be selected on the basis of the capacities to be accommodated, performance characteristics, construction and operation costs and other relevant factors.

III. PROCEDURE

In carrying out its assignment, this Board considered the reviews of transit technology made by consultants to the U. S. Departments of Housing and Urban Development and Transportation, as well as survey reports on the state of the art made for other agencies by various engineering consultants within the past year.

From these reviews, the Board selected a number of organizations and advocates of particular types of transit technology who gave presentations at the Board's request.

In performing this task, this Board has been in weekly sessions for a period of five months.

IV. GENERAL DISCUSSION

There are hundreds of systems for moving people on land. All of those warranting serious consideration at this time are supported in either of two ways: by wheels or by air cushion. These methods of support will probably remain the most practical over the next two decades.

The principal examples of wheel-supported (rolling) systems are:

1. Rubber on roadways (e.g., buses)
2. Rubber or steel on guideways (e.g., trains)
3. Continuous belts (e.g., moving sidewalks)

The last two examples require a separate, fixed guideway, while the first one can use conventional automotive roadways.

All proposed applications of the air cushion principle to mass transportation require the use of a special guideway.

The systems with the greatest potential for both station-to-station speed and high passenger capacity--the two factors most essential to high volume mass rapid transit in metropolitan areas--are the guided, wheeled and the air cushioned types, essentially, tracked vehicles. Wheeled systems can use traditional (i.e., frictional), as well as more advanced propulsion methods. However, the air cushion systems require advanced (contact-free) propulsion methods which,

IV. GENERAL DISCUSSION (Continued)

at this time, appear inherently more expensive than the powering methods for wheeled vehicles. The wheeled systems use a traditional and tested technique, whereas the air cushioned system has not yet been demonstrated or used in urban transit service.

TYPES OF PROPULSION SYSTEMS

The following table shows the basic types of propulsion systems, on-board prime movers and on-board energy sources currently feasible or now under development.

BASIC TYPES OF PROPULSION SYSTEMS

Contact Drive	Contact Free Drive		
Frictional	Aerodynamic	Electromagnetic	Gravity
Wheel	Propeller	Linear Induction	Inclined Guideways
	Jet		
	Differential Air Pressure		

ON-BOARD PRIME MOVERS

Electric Motor	Heat Engines
AC	Internal Combustion
Variable Frequency	Diesel or Gasoline,
Fixed Frequency	Piston or Gas Turbine
DC	External Combustion
Continuous	Steam or Freon, Turbine or Piston
Discontinuous (Chopped)	

ON-BOARD ENERGY SOURCES

Gasoline, Kerosene, Propane, Liquified Natural Gas

Batteries

EXTERNAL ENERGY SOURCES

(NOTE: Many systems, especially electrically powered, will use public or private power generation sources. The nature of this power generation (hydro-electric, nuclear-electric, etc.) is not relevant to the design of the transportation system itself.)

TYPES OF GUIDEWAYS

Guideways may be constructed above-ground, on the surface or underground. Most guideway systems can use any of these locations. The actual selection of guideway locations is influenced much more by aesthetics and land and construction economics than by technological factors.

V. CONCLUSIONS AND RECOMMENDATIONS

The Transit Technology Review Board considers that it has been exposed to and has become familiar with a comprehensive set of system categories and types of propulsion used and proposed for mass public transportation.

The Board strongly acknowledges that the aesthetic aspects of transportation--especially noise and pollution--must be considered central in the selection of any mass transit system, and that this may involve a cost penalty which would be well justified on the human scale.

Based upon its review of the technological and major economic characteristics of these systems in meeting the public transportation needs of the metropolitan region, the Board has concluded that, at this point in time:

A. For High-Volume, High-Speed, Trunk Line Mass Transit Service:

All high volume transit systems must provide an effective compromise between accessibility, represented by frequency of station stops and overall average speed.

Where such spacing will provide maximum door-to-door travel speeds and convenience for the majority of the potential users, stations should be located two to three miles apart--giving the high-volume, high speed (80 to 100 miles per hour) trunk line equipment the chance to perform in accordance with its capabilities. Or, express ("skip-stop") service should be planned.

A. For High-Volume, High-Speed, Trunk Line Mass Transit Service: (Continued)

In those areas where street congestion, inadequate parking facilities and a substantial requirement for medium to short trip rapid transit service exists, station spacing should be modified accordingly.

1. Steel Wheels on Steel Rails

Steel wheels running on dual steel rails using a grade separated configuration offer the highest capacity, speediest, least-cost, safest and most comfortable mode of mass transportation presently available. However, with such system, a new method of propulsion power should be used consisting of single phase, alternating current, with regenerative braking. These features will reduce power cost and subway temperatures and station air conditioning costs.

2. Air Cushioned Vehicles on Guideways

The other trunk line system which appears most likely to be available in the future (say, within five to ten years) is the air cushion vehicle operating on a guideway and propelled by a linear induction motor (TAC-LIM). This system is the subject of current, intensive research.

The full operational testing of a complete, low-speed, small-car, TAC-LIM system is hoped for within the next 18 months.

2. Air Cushioned Vehicles on Guideways (Continued)

This type of system offers the advantages of greater cleanliness, less noise and more safety (no "hot" third rail).

The power consumption characteristics and braking and acceleration capabilities have yet to be determined with larger cars operating at 80 to 100 miles per hour, and there are as yet no data on maintenance costs. These items and the overall system cost may prove to be critical.

3. Gravity-Vacuum Tube

Of all the mass transit concepts presented to this Board, the one which is claimed to have the potential for moving large numbers of people at the highest speeds is the gravity-vacuum tube. Its higher speeds are due to a higher lineal acceleration. It is claimed that only half of this acceleration is perceived by the passenger because of the simultaneous combination of forward and gravitational accelerations. This Board stresses, however, that this same acceleration effect can be achieved with any transit system using inclined guideways.

The unconventional elements involved in the gravity-vacuum tube system raise serious questions as to its overall economic effectiveness and its attractiveness to commuters. Also, the Board is most concerned

3. Gravity-Vacuum Tube (Continued)

about the safety aspects of this system, as well as the technical feasibility of some of the design features and its construction costs. Subsequent to the presentation made by the proponents of the GVT System, the Board developed a series of questions which were put to the designer.

The answers provided by the system developer have eliminated some of our questions, however, there is still concern relative to the system cost factors, switching, guideway tolerances and concern as to whether or not the perceived acceleration-deceleration effects would be acceptable. We believe these matters will only be resolved by a full-scale trial of this system.

B. For Medium Volume, Low-Speed, Auxiliary Transit Service:

To be successful in meeting the urgent needs of metropolitan areas, public mass transportation service must be planned, designed and operated so that it is a strong and effective competitor of the automobile for commuter patronage. Those responsible for public mass transportation must think beyond the "trunk line" stage and face the fact that reasonably fast (20 to 30 miles per hour) collection and distribution systems at both the origin and destination ends of the trunk line are equally as important parts of the individual's complete trip as is the high-speed trunk portion itself. The total door-to-door time and costs are the most important factors. It is the degree of convenience at the ends of the trip which often determines whether or not mass transit can attract the commuter.

B. For Medium Volume, Low-Speed, Auxiliary Transit Service: (Continued)

In high density areas, local, intra-area movement and the distribution and collection services for the trunk line transit system can and should be provided by means of auxiliary, low speed, medium volume transit systems.

1. Battery-Powered Vehicles

Small, two to four-passenger, user driven vehicles, battery powered (using nickel-cadmium or lithium, quick charge batteries now under development) will be technically feasible within the next five to seven years. However, it is questionable as to whether or not such vehicles will be available in the numbers and at the costs which will make them competitive with the conventional gasoline powered automobile. Further, the question of ownership, management, and maintenance of such vehicles would have to be resolved.

2. Computer-Routed Small Buses

The development and testing of computerized, dynamically scheduled systems such as "Dial-a-Bus" or the "DART" (Demand Activated Rapid Transit) should be carefully studied.

One or two such systems are now being tried in the east. Essentially, these vehicles (carrying 10 to 12 passengers) are intended to provide a type of

2. <u>Computer-Routed Small Buses (Continued)</u>

commuter service midway in trip cost per passenger (for the shorter, intra-area trips) between the private auto or taxi and the less expensive 50-passenger bus.

Such systems proposes that the small buses, radio controlled and computer routed, would circulate through residential districts picking up passengers who have telephoned in for service and carry them to the nearest transit station.

3. <u>Continuous Loop Systems on Guideways</u>

Where continuous loop type, auxiliary distribution transit systems are required to adequately serve the destination ends of commuter trips--generally within concentrated centers of business, industrial or commercial activity and in educational centers, but also in high density residential areas--a frequent stop, low-speed medium volume guided system may be justified. Examples of such a system are the air-cushioned small car with the linear induction motor, or a small car supported on a beam, or where pedestrian traffic is heavy, continuous belt conveyors.

While the conveyor systems are much lower in speed (1-1/2 to 4-1/2 miles per hour), they do have their place and could be used separately or in conjunction with the other auxiliary systems.

3. <u>Continuous Loop Systems on Guideways (Continued)</u>

The technology for all of these systems has progressed to the point where the respective developers will enter into contracts to install these systems and guarantee their performance.

C. <u>Buses in Combination with High Volume Rapid Transit</u>

Progress in the improvement of the bus as a transit vehicle has lagged, quite possibly because the size of the market has not stimulated research and development on such vehicles. However, within the last year or so, some important development work has been in progress on a 70-passenger, articulated bus, an experimental gas turbine bus, a battery powered bus, and buses powered by external combustion engines--all in various stages of development. Such units should be tried on suitable routes as soon as they become available. However, every effort must be made to make these units outstanding in comfort and attractiveness.

With regard to the 50-passenger bus of the type seen on our streets today, clearly such equipment has a necessary and important place in a "balanced" transportation system. However, here again, attention must be given to seating size and spacing arrangements, comfort and style if such units are to be fully effective in attracting riders.

C. Buses in Combination with High Volume Rapid Transit (Continued)

In addition to the traditional place of the motor bus in furnishing local transportation on city streets, two important uses for buses in providing the proper "balance" in mass transportation are:

1. Bus Feeder Service

When the regular type of motor bus is used to pick up passengers along the collector and major streets in the outer, less densely populated portions of the metropolitan area, they can be very effective in providing full load, feeder service to and from trunk line transit stations.

2. Busways in Freeway Medians

Improved units of this type are needed to provide a high level of comfort and performance in express service on exclusive busways which, it is hoped, will be located in the medians of those future freeways where a need for expedited, high volume transit services is expected to materialize, but where the use of high-capacity, trunk line rapid transit service is not initially justified.

D. <u>Continuing Effort Required</u>

Since the rate of transit development appears to be accelerating and new systems will be proposed and important innovations are in the offing for existing systems, we believe this Board should meet "on call" in the future as such instances require and if that is the District's wish, we shall be happy to do so.

We hope our contribution to this effort will be of assistance to the Southern California Rapid Transit District in endeavoring to provide the people of this region with the quality of mass transportation system which the area must have if it is to retain its dynamic character.