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HIGH-SPEED GROUND AND WATER DEMONSTRATION PROJECT

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HEARING

BEFORE THE

SURFACE TRANSPORTATION SUBCOMMITTEE

OF THE

COMMITTEE ON COMMERCE

UNITED STATES SENATE

NINETY-SECOND CONGRESS

SECOND SESSION

ON

S. 4023

TO DIRECT THE SECRETARY OF TRANSPORTATION TO MAKE A COMPREHENSIVE STUDY OF A HIGH-SPEED GROUND TRANSPORTATION SYSTEM BETWEEN WASHINGTON, DISTRICT OF COLUMBIA, AND ANNAPOLIS, MARYLAND, AND A HIGH-SPEED MARINE VESSEL TRANSPORTATION SYSTEM BETWEEN THE BALTIMORE-ANNAPOLIS AREA IN MARYLAND AND THE YORKTOWN-WILLIAMSBURG-NORFOLK AREA IN VIRGINIA, AND TO AUTHORIZE THE CONSTRUCTION OF SUCH SYSTEM IF SUCH STUDY DEMONSTRATES THEIR FEASIBILITY

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DECEMBER 7, 1972

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HIGH-SPEED GROUND AND WATER DEMONSTRATION PROJECT

THURSDAY, DECEMBER 7, 1972

U.S. SENATE,
COMMITTEE ON COMMERCE,
SUBCOMMITTEE ON SURFACE TRANSPORTATION,
Washington, D.C.

The subcommittee met, pursuant to notice, at 9:30 a.m., in room 5110, New Senate Office Building, Hon. J. Glenn Beall, Jr., presiding.

Present: Senator Beall.

OPENING STATEMENT BY SENATOR BEALL

Senator BEALL. Ladies and gentlemen, I would like to welcome everybody to our hearing this morning.

We have a good deal of ground to cover, so we will get started, even though some of our witnesses haven't arrived yet.

Today, the committee meets to consider S. 4023, the Bicentennial Advanced Technology Transportation System Demonstration Act.

First, I want to express my deep appreciation to Chairman Magnuson and Senator Hartke, chairman of the Surface Transportation Subcommittee, for scheduling these hearings.

I introduced S. 4023, on September 25, 1972, along with 14 other Members of the Senate. Joining me in introducing this measure were Mr. Case, Mr. Dominick, Mr. Eagleton, Mr. Goldwater, Mr. Gravel, Mr. Hatfield, Mr. Hughes, Mr. Humphrey, Mr. Javits, Mr. Mathias, Mr. Metcalf, Mr. Randolph, Mr. Scott, and Mr. Schweiker.

This bill authorizes a feasibility study of the combined land and water transportation system consisting of a tracked air-cushion vehicle or other high-speed ground transportation system, operating between Washington, D.C., and Annapolis, Md., and a surface effect ship or other high-speed marine transportation system, operating between the Baltimore-Annapolis area of Maryland and the Yorktown-Williamsburg-Norfolk area in Virginia. The feasibility study, which is to be completed no later than 9 months after enactment, will determine the feasibility, social advisability, economic impact, and economic practicability of the marine and land transportation system. During this investigation, the Secretary of Transportation is expected to consult closely with State and local governments.

Staff member assigned to this hearing: Thomas Allison.

The Nation's bicentennial observation is only a little over 3 years away. If we are going to have this exciting and futuristic transportation system, envisioned by this proposal, in place for our 200th birthday, time is of the essence.

It is important, therefore, that we build a record that will permit early action in the new Congress. S. 4023 not only authorizes the feasibility study, but also authorizes the construction of this system if the study demonstrates its feasibility and if the Secretary of Transportation recommends the establishment of the system. This procedure is necessary because of the very real time problem. I would point out and emphasize that the interest of the Nation and the prerogatives of the Congress are adequately protected since the Secretary must give approval to proceed with the construction and secondly, the Congress will have the final decision through the appropriation process.

In the past months, the Washington area, on a number of occasions, suffered under a blanket of pollution. Fortunately, to the great relief of the area's residents, nature came to our rescue, and the pollution was ultimately pushed away. In addition, traffic congestion continues to plague our citizens as they inch their way to work each day.This combination of pollution and congestion here and in other metropolitan areas are daily reminders of the desperate need to accelerate our search for alternate and better means of moving citizens particularly in and around the population centers.

During the bicentennial, the Washington area will play host to millions of Americans and foreign visitors who will come to the Capital City. Should we fail to prepare adequately for the influx of people, the result will be chaotic.

Thus, the bicentennial events and the transportation needs of the Nation combine to give us a unique opportunity to create a transportation showplace that will provide the many visitors to the Capital area with an exciting means of seeing the historical cities and sights of the region, as well as the opportunity to provide a practical demonstration of a technologically advanced transportation system which will attract national and international attention and recognition and demonstrate to the world that the United States will continue its leadership in the world of tomorrow.

Historically, transportation has not only played an important role in the development of this Nation, but has also figured importantly in major world expositions throughout the last of the century, particularly when the term is broadened as it should be to include the provisions of transportation arteries sufficient to handle the traffic generated by the world exposition. A study of such major world expositions indicates that numerous permanent facilities were designed and constructed in time to serve these events and they then became integral features of the area's transportation network. As early as 1885 the world renowned Champs d'Elysees was massively redesigned and enlarged to service the Paris Fair of that year. More recently, the 1962 Seattle Fair brought a successful monorail system to that city. The monorail was immensely successful as a public attraction and service, so that its full cost of construction, $3.5 million, was amortized during the exposition. Today the monorail remains as a link and an attraction, primarily benefiting tourist and convention attendees who use the Seattle center facilities. The 1967 Montreal

Expo resulted in an entirely new metro being completed and the 1968 Mexico City Olympic games served as a catalyst for the installation of a new subway system and highways. These are but a few of the significant "spill-overs" from these events, and all still remain to serve the people of their respective areas. The recent Transpo indicated the strong public and national interest in transportation.

Few would deny that we desperately need breakthroughs in the transportation area. A tracked air cushion vehicle operating between the District of Columbia area and Annapolis in conjunction with a high-speed marine vessel between the Baltimore-Annapolis area and the Williamsburg area will permit American citizens and our many foreign visitors to travel in the transportation of tomorrow to view the historical sights of this region, after which they will be allowed to walk in and enjoy the rich history and heritage of this Nation.

Our forefathers in 1776 thought "big" in terms of their "vision" for this Nation. It behooves us nearly 200 years later to have the same vision and the same imagination. I believe that the demonstration of a transportation system of tomorrow is a project that will capture the imagination of the American public and not only serve as a practical and exciting means of moving many bicentennial visitors, but also help to catapult transportation into the 21st century.

Finally, I want to say a brief word about the history of this particular legislation. This proposal originated with the AFL–CIO Maritime Committee and I want to give special thanks to Mr. Hoyt Haddock and Mr. Joseph Salzano who have devoted countless hours on this project. The committee, along with representatives of the Federal and State Governments and transportation industry will be with us today to explore the proposal and the present state of the art.

On behalf of the Commerce Committee, I extend a warm welcome to our witnesses and I am sure that their testimony will be of great value to us as we seek to provide for our bicentennial celebration and to achieve the much needed breakthroughs in transportation. I would add that the bipartisan support that this measure received in the last Congress is indeed encouraging. It is my hope that these hearings will increase the interest in and support for this proposal and that the Senate will move swiftly toward the favorable consideration of this measure in the new Congress.

Now, as I said initially, we have numerous witnesses with us today and therefore a long day. We hope to give everybody the opportunity to be heard.

I would appreciate it if witnesses when they are heard would not emulate my example and would keep their remarks as brief as possible.

Although I want to give everyone the opportunity to express their sentiments fully, I would hope that everybody would try to limit their prepared remarks to around 15 minutes. I think that would give an opportunity to have a good presentation and for questions and answers for all of the witnesses.

(The bill and map of proposed routes follows:)

92D CONGRESS
2D SESSION

S. 4023

IN THE SENATE OF THE UNITED STATES

SEPTEMBER 25, 1972

Mr. BEALL (for himself, Mr. CASE, Mr. DOMINICK, Mr. EAGLETON, Mr. GOLDWATER, Mr. GRAVEL, Mr. HATFIELD, Mr. HUGHES, Mr. HUMPHREY, Mr. JAVITS, Mr. MATHIAS, Mr. METCALF, Mr. RANDOLPH, Mr. SCHWEIKER, and Mr. SCOTT) introduced the following bill; which was read twice and referred to the Committee on Commerce

A BILL

To direct the Secretary of Transportation to make a comprehensive study of a high-speed ground transportation system between Washington, District of Columbia, and Annapolis, Maryland, and a high-speed marine vessel transportation system between the Baltimore-Annapolis area in Maryland and the Yorktown-Williamsburg-Norfolk area in Virginia, and to authorize the construction of such system if such study demonstrates their feasibility.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That this Act may be cited as the "Bicentennial Advanced Technology Transportation System Demonstration Act".

SEC. 2. (a) For the purpose of providing the millions of citizens of the United States and foreign nations who will visit the National Capital area during the Bicentennial of American Independence celebration with a pleasant, efficient, and unique way of seeing the historic cities and sights of such area and providing practical demonstrations of technologically advanced transportation systems which will attract national and international attention and recognition and demonstrate to the world that the United States will continue its leadership in the world of tomorrow, the Secretary of Transportation is hereby authorized and directed to make an investigation and study for the purposes of determining the feasibility, social advisability, environmental impact, and economic practicability of (1) a tracked air-cushioned vehicle or other high-speed ground transportation system between Washington, District of Columbia, and Annapolis, Maryland, with appropriate intermediate stops, and (2) a surface effect vessel or other high-speed marine transportation system between the Baltimore-Annapolis area in Maryland and the Yorktown-Williamsburg-Norfolk area in Virginia.

(b) In conducting such investigation and study, the Secretary—

(1) shall consult with appropriate Federal, State, local, and District of Columbia agencies; and

(2) may enter into contracts or other agreements

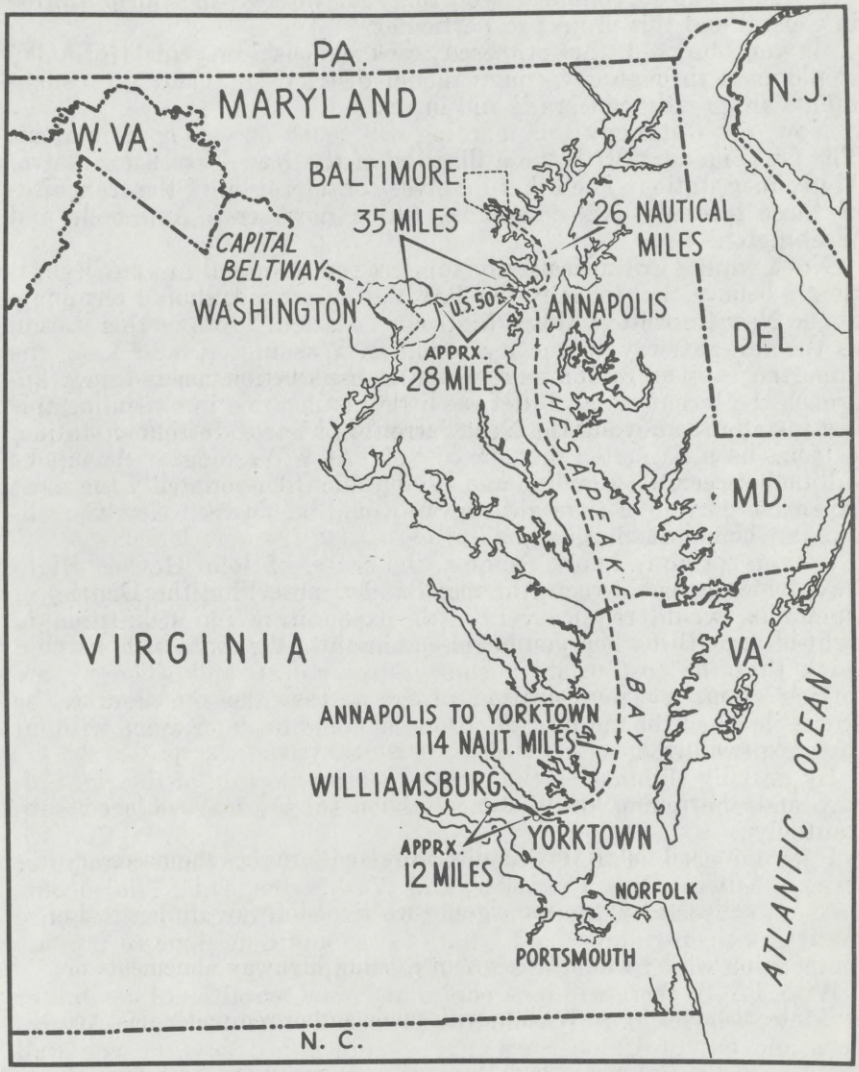
with public or private agencies, institutions, organizations, corporations, or individuals without regard to sections 3648 and 3709 of the Revised Statutes (31 U.S.C. 529; 41 U.S.C. 5).

(c) The Secretary shall report the results of such investigation and study together with his recommendations, to the President and the Congress no later than nine months after the enactment of this Act.

SEC. 3. If after carrying out the investigation and study pursuant to section 2, the Secretary of Transportation recommends the establishment of either the transportation system described in subsection (a) (1) or (a) (2) of such section or both such systems, he may, to the extent funds are appropriated for the purpose of this section, enter into such contracts and other arrangements as necessary for the construction and operation of such system or systems, except that the system described in such subsection (a) (1) may not be constructed unless the State of Maryland furnishes the necessary rights-of-way, to the extent such rights-of-way are presently owned by such State within existing highway alinements or acquired by such State with funds authorized under this Act and determined usable for such system by the Secretary of Transportation.

SEC. 4. There are authorized to be appropriated such amounts as are necessary to carry out the provisions of this Act.

PROPOSED ROUTES OF LAND AND WATER VESSELS



Senator BEALL. Now our first witness today is my good friend and former colleague in the House of Representatives, who represents the surburban Washington area, and the Prince Georges County Fifth Congressional District. He is a man who obviously has a great interest in the transportation needs of this area and is interested in this particular piece of legislation because this proposal would pass through his congressional district.

I am happy to have our good friend from Maryland with us, Congressman Larry Hogan.

Congressman Hogan?

STATEMENT OF HON. LAWRENCE J. HOGAN, U.S. REPRESENTATIVE FROM THE FIFTH DISTRICT OF MARYLAND

Mr. HOGAN. Thank you, Senator. I appreciate the opportunity to be here.

I would like to commend you for your interest in transportation in general and this project in particular.

As you observed, this proposed track air cushion vehicle (TACV) would pass through my congressional district, so I and my constituents are greatly concerned and interested in it.

Now, my testimony this morning will touch on two specific areas. The first one deals with the utilization of the New Carrollton Metro/Metroliner station. The other involves consideration of the franchises of those intercity bus companies which now serve Annapolis and Washington.

Now, while I enthusiastically support this proposal in your legislation, I believe that initially the TACV, if approved, should terminate at the New Carrollton Metro/Metroliner station. I foresee this station as the rail gateway to the metropolitan Washington, and I see the importance to us responding to our transportation needs as we approach the bicentennial. But I see little justification in extending this test installation beyond the New Carrollton Metro/Metroliner station.

It has been estimated that the cost of TACV Washington-Annapolis will be between $150 million and $200 million. Undoubtedly the most expensive portion of the right-of-way would be between New Carrollton and Union Station.

As you certainly know, Senator, the center of John Hanson Highway, which runs between Annapolis and approaching the District of Columbia, would require very little expenditure for acquisition of right-of-way. But when you begin coming into the city itself, I would think that the cost would become astronomical, and when we are talking about a demonstration program, that doesn't seem to be advisable when the merit of the proposal could be determined without these expenditures.

By initially eliminating the most expensive portion of the right-of-way and shortening the distance, the cost could be reduced substantially.

I see no need of TACV competition with Metro and commuter services between New Carrollton and Washington, D.C. The encouragement of riders on Metro is going to be one of our difficulties once the trains begin running and I hate to see anything done to provide competition which would lessen the ridership.

With TACV there will be a choice at New Carrollton of commuter or Metro service into Washington proper. Commuter service operations and out of Union Station are handicapped now, as you well know, with the $30 per railroad car assessment. This makes it difficult to run commuter trains, for example, between Baltimore and Washington at a fare that is attractive enough for the cummuters because Union Station charges $30 in and $30 out for every railroad car. TACV to Union Station would be a costly and unnecessary duplication of already existing or planned services.

Secretary of Transportation John Volpe wrote to me last June of his desire for "useful operation" of TACV and his suggestion of the ill-fated Dulles proposal. I was privileged to serve on the District

of Columbia Committee in the 90th Congress, and at that time we had the proposal for the aircushion vehicle between Washington and Dulles. It was rejected out of hand by the Congress on the basis that it would be too expensive. So I do think that while this is an outstanding idea, the practical aspects of getting such an approval from Congress—we ought to try to reduce the cost of it, and to do so, I would say we ought to terminate it at this point, at the New Carrollton station.

I note that the New Carrollton-Annapolis distance is less than the 30-mile distance to Dulles. I understand it is about 20 miles. So the cost should be less than that proposal.

The Annapolis test would serve well the two sizable communities of Annapolis and Bowie. Many commuters from the two cities come into the city every day and I think this would be a tremendous boon to them.

I note, too, that Metro proposes eventually to serve Dulles. Accordingly, if there is to be a test, then New Carrollton to Annapolis seems the more feasible route.

It is essential, if a TACV test is to be undertaken, that the New Carrollton station be modified to accommodate it. A $5 million facility is now being planned to serve the needs of Metro/Metroliner users with ample space for parking and other combined station facilities. It would seem to me that there would be minimum additional cost if TACV needs are included at this planning stage. I have appended to my statement a drawing of proposed facility modification for your interest.

Presumably in addition to those who would use Metro to the District of Columbia, many of the users of the proposed TACV will be individuals desiring to use the Metroliner to the Northeast. Obviously it would not make sense to request them to go into Union Station to ride the Metroliner.

As you know, we have a Metroliner station at this New Carrollton site now, and usage there is very popular because of the ease of access and the secure parking facilities which are available at New Carrollton and not available at Union Station.

The time from New Carrollton to l'Enfant Plaza is estimated at 19 minutes by Metro. The time by Metro to the Pentagon from New Carrollton is expected to be 27 minutes. Consequently, savings in time by extending TACV to Union Station would be minimal for most commuters and in my opinion this does not warrant the additional expense, at least at this time.

Now I would like to turn to the other point I want to make. That is, if approved, the TACV should provide for the franchise rights of established intercity bus companies.

Bus service between Annapolis and Washington would be adversely affected by TACV. I am concerned that the rights of the bus companies might not be considered in this demonstration period. For example, WMA now serves Prince Georges County and parts of Anne Arundel and Charles Counties. It provides service in and out of Annapolis. The portion of bus service in Prince Georges County will be acquired by Metro as a result of legislation passed recently by Congress, leaving the services in Charles and Anne Arundel Counties still to be operated by WMA.

If this new proposal further aggravates the financial plight of these bus companies, I can predict with absolute certainty that these companies would come to the same fate as all other bus companies, they would have to go out of business.

It is likely that WMA or its successor company will try to continue to operate such service, if it is feasible to do so.

The TACV operation should consider whether or not it should acquire the franchise rights for the Annapolis portion of the service or in some way compensate the bus companies for the loss of ridership.

In conclusion, I trust that action can be prompt. Just yesterday I was notified that the Department of Transportation had awarded a contract for architectural and engineering services to the Washington Metropolitan Area Transit Authority in the amount of $360,000 for Metroliner station engineering. For many months I have been urging the Secretary of Transportation to combine the design of the Metro/Metroliner stations.

It seems to me it would be an unwarranted duplication of facilities to have in the immediate proximity two stations with the expense of building both of them. So DOT has agreed and has now cleared the way for the design and engineering studies for a combined Metro/Metroliner station at New Carrollton I think it would make eminent sense to include TACV in these—in this station at the same place. I reiterate what I said earlier, the time to make that decision is now, while we are still in the planning stage with the combined Metro/Metroliner station at New Carrollton.

I thank you for the opportunity of coming, Senator, and again, I commend you for your interest in this. I think it will respond to a great need for the commuters from the Annapolis, Bowie, General John Hanson corridor and I hope it passes and I hope it will be successful.

Senator BEALL. Thank you, Congressman Hogan, for your testimony. Let me say that with regard to your suggestion that the New Carrolton Metro Station be used as a terminus point, it has never been my intention that this demonstration project be brought all the way into the District of Columbia.

We think it should be coordinated with some of the existing transportation facilities in the area to provide the kind of coordination and balance that is needed to move people at high speeds for some distances.

As you know from previous conversations we had talked about Ardmore as a possible location.

Mr. HOGAN. This is the Ardmore site. It has been renamed New Carrolton.

Senator BEALL. I understand that.

Mr. Hogan. It is the Ardmore site we discussed.

Senator BEALL. The AFL–CIO Maritime Committee also suggested Fort Lincoln. But one of the purposes of the feasibility study is to determine where the terminus should be. Obviously your suggestion is very logical, because it coordinates with the rest of the system.

Do you believe that, once the bicentennial is over, this system will generate the kind of ridership that would be necessary to sustain it as a viable operating vehicle?

Mr. HOGAN. Absolutely, Senator. I have no question whatsoever about this.

The growth of Anne Arundel County and Prince Georges County alone would insure the success and the high number of riders. But another factor I would like to mention is the much beleaguered but much necessary sports arena which will be built in Prince Georges County, and it has easy access to the Metroliner station and the Metro station which I referred to, and to give the people of Anne Arundel County a link to this sports facility would enhance the success of the arena and open up the recreational opportunity for the people of Anne Arundel.

Senator BEALL. For the record, it is interesting to note, and we checked yesterday with the Naval Academy at Annapolis, that the Academy has estimated that annually they play host to one and a half to two million visitors a year. This is a tremendous number of people who are obviously traveling from other points, generally from the Washington area, to visit the Naval Academy at Annapolis.

This level of visitors would certainly indicate a degree of ridership that would sustain this kind of activity.

Mr. HOGAN. As one who rides those roads, John Hanson particularly, during rush hour, and sees the bumper-to-bumper conditions which are getting worse and worse, I assure you that there will be ample ridership for TACV.

Senator BEALL. How do you feel about Federal and State governments subsidizing the operation and maintenance of systems such as this when the revenues aren't sufficient to pay the total cost.

Mr. HOGAN. I think that we have reached a time where it is absolutely impossible for a private company, privately financed, to operate a public transportation facility. That has been demonstrated in every city in the United States.

Now, whether or not the city or State government or Federal Government ought to take up this slack is subject to question. You know as well as I the financial plight of the States and cities, and the Federal Government, which has a better facility for raising revenue—I think this is one area for revenue sharing to help with local transportation.

I definitely feel that there is a need for public money to support public transportation. And I find no philosophical problem in coming to this conclusion, because it is just as important for us to have good bus service to take people off the highways as it is to have public money furnish and maintain the highways.

Some people choose to get to work by automobiles on highways which are built by and maintained by tax money. Other people choose to go by bus or hopefully by TACV, and that also ought to be provided and maintained by public tax money.

Senator BEALL. Thank you very much.

Mr. HOGAN. Thank you, Senator.

Senator BEALL. Our next witness is secretary of transportation from the State of Maryland, the Honorable Harry Hughes.

I am happy to welcome Secretary Hughes for several reasons. First of all, we had a personal association when we each served together in the Maryland General Assembly, so I have known Secretary Hughes for a number of years.

Second, Maryland, a few years ago, recognized the necessity for a coordinated transportation system, and recognized that if we are going to have the kind of attention brought to coordination that

would be necessary, all facets of transportation must be combined in the administrative department. Two years ago the State of Maryland created a department of transportation and granted this department all the responsibility for providing transportation. The State is very fortunate to have as its first secretary of that department Harry Hughes.

Now, I am happy to say my office and the Maryland delegation have had a very close and good relationship with Secretary Hughes. I am happy to welcome you here today, Harry. We will be happy to hear your testimony.

STATEMENT OF HON. HARRY R. HUGHES, SECRETARY, STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION, BALTIMORE, MD.

Mr. HUGHES. Thank you, Senator.

You didn't point out, in your personal relationship that you were minority leader and I was majority leader.

Senator BEALL. I will point out that he was majority leader and I was minority, but fortunately of different bodies. He was the so-called Upper House, and I was in the so-called Lower House. I have much more respect for upper houses now than I did at that time.

Mr. HUGHES. It is a pleasure to be here this morning. As you have already mentioned, I am secretary of transportation of the State of Maryland.

I am not an expert on TACV. These do not necessarily follow each other, as you may understand.

I have come here this morning to reiterate Maryland's support of Senator Beall's proposal to initiate feasibility studies of a high-speed transportation system demonstration project which would be in operation during the bicentennial observances in 1976. Coupled with this support is our offer of technical assistance during the study and our willingness to make existing right-of-way available where feasible for the ground construction portion of the project. Finally, I am here to mention some of Maryland's recent experiences in the construction of new mass transportation systems for your consideration.

Governor Mandel and I have enthusiastically endorsed the concept of a federally-financed TACV demonstration project for the bicentennial since the project was first proposed by the AFL–CIO Maritime Committee. We believe in the continuous refinement of innovative ideas for mass transit systems.

The basic technology of American transit systems on exclusive rights-of-way—steel wheel on steel rail—has been in existence for over a century. Although this technology continues to be effectively refined and applied, there is a growing realization that new forms of technology will have to be introduced in the near future if transit is to maintain its competitive position with other modes of transportation. Perhaps the most promising new transit technology employs linear induction motors for its propulsion system and an air cushion for its suspension system. This technology—popularly termed TACV—is, of course, the subject of today's hearing. The Maryland Department of Transportation certainly endorses efforts by the Federal Government to further develop this promising new technology.

We believe that this technology affords the opportunity to effect a quantum increase in the speed, comfort, and environmental quality of intercity transit.

We are pleased that Maryland is being considered as a possible site for the TACV and we welcome the potential contribution to our State's transportation system.

I believe that it is appropriate that the entire project be federally funded since the potential benefits of the TACV technology will be enjoyed by the entire Nation, and, indeed, the world. However, we in Maryland have experienced and well-trained transportation professionals, with a knowledge of the State's topography, and a working relationship with local government officials and private citizens. These professionals will certainly be available to assist the Federal Department of Transportation in any way possible.

The State of Maryland also owns a substantial amount of right-of-way in the proposed TACV corridor between Washington and Annapolis, principally along U.S. Route 50. If a feasibility study indicates the desirability of a project on this alinement, we would make the right-of-way available.

The Washington-to-Annapolis route alinement, however, is not without its problems and I feel that everyone's interests would be best served if these problems are acknowledged and openly discussed from the beginning.

One of the major problems is that of scheduling. Much of the justification of this route is the connection of the historical areas of Washington and Annapolis for the bicentennial celebration in 1976. However, current construction timetables for the rapid transit systems in Baltimore and Washington indicate that this schedule is not feasible, even for projects with steel wheel on steel rail.

One doesn't have to believe in the sanctity of tried-and-true technology to acknowledge that the implementation of innovative technologies is likely to encounter unanticipated delays, making the construction timetable for TACV lengthier than for a traditional system. Thus, achievement of the 1976 deadline will require an extraordinary level of commitment to this project by all levels of government and a willingness to accord this project the highest priority, possibly at the expense of other, also highly desirable, projects.

Another major problem area is the question of environmental impact, particularly at the Annapolis terminal of the route. Discovering an environmentally acceptable location for the interface between the TACV and the hovercraft to Williamsburg will be quite difficult. It may be necessary to substitute a shuttle bus service in place of a direct interface.

Included in the environmental impact of such a project are the desires and interests of the affected communities and local jurisdictions. There will be social, economic, and ecological factors to be considered at each level.

A third problem area, less substantial, is the successful integration of TACV and Route 50 in the existing highway corridor. In order to avoid having one facility impose a safety or environmental impact on the other, careful design work will be required. However, there is no reason to believe that this cannot be accomplished.

The potential problem areas which I have briefly outlined plus the possibility of other problems connected with such a project strongly

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indicate the need for a feasibility study. My support of such a study is without reservation. You can be sure that Maryland will cooperate fully and will assist in any way we can.

Thank you, Senator.

Senator BEALL. Thank you, Secretary Hughes, for your statement and for your support for this project.

We recognize that there are some problems connected with the implementation of a program such as this, not the least of which is the time frame in which we are operating.

I know that you deal daily with the problems of cutting through the redtape and getting various projects off the ground, from the drawing board into the construction stage. I would like to think that we do have the capability of taking care of all the preliminary planning and expediting projects such as this so that we can get them finished in a reasonable length of time.

I would hope that not only could we use this as a demonstration of a new transportation system, but we might also be able to use it as a demonstration of how a government can react to a situation when it is absolutely necessary to do so, and cut through the redtape. I believe too often today that we are forcing ourselves into much higher costs of construction of all kinds because of the interminable delays that are caused at various levels of government and because of the various impediments thrown up in the way of projects today.

Mr. HUGHES. I couldn't agree more. I think what you say is absolutely true. If that could be a result of this, it would be of great benefit because we are facing tremendous delays in construction of public projects.

I am convinced that if all levels of government cooperated to the degree they should and procedures were made standard and uniform, that much of the delay could be eliminated; and if that kind of a situation could be brought about on this project, I think the timetable could be met.

Senator BEALL. As I observed in my opening statement, it has been true in the case of other expositions and demonstrations that when you do have something of the character of an exposition such as the World Fair in Seattle or Olympic Games or a bicentennial event, this tends to serve as the kind of catalyst that is necessary to break down the barriers to progress and allow things to be done in a hurry. Hopefully, this would be the case with this project.

Mr. HUGHES. I think there is one other point that I did not have in my prepared remarks that is important, and that is the visibility of this kind of a project.

With the amount of money that would be spent on it, it seems to me that one important consideration would be the site, the location, of the project, so that it is in such a location that the public can see it, can ride on it, and it is easily accessible to them.

I cannot think of any better site for that kind of visibility than the Nations Capital area.

Senator BEALL. Do you have any reservations, as I asked Congressman Hogan, about the Federal and State Governments stepping in to pick up operating and maintenance expenses if it is necessary to make a system of transportation work?

Mr. HUGHES. In this country, I think we are rapidly moving toward subsidy of operating expenses of public transit. Maryland has probably moved as rapidly as some of those in the forefront of this.

If a project is a successful project—I am not talking about whether it makes a profit or operates in the black, but is serving a transportation need—I have no problems at all with Federal and State Government subsidizing the operation of that because I happen to think that transportation is one of those things that today is essential and necessary—an important factor to everybody. Government has no problem subsidizing a lot of other things, education and welfare, you name them. I think transportation is in a similar category and is such a necessity that government subsidy doesn't bother me at all.

Senator BEALL. Thank you for your testimony and for coming here today. I know you are operating under a very tight schedule.

Mr. HUGHES. Thank you for the opportunity.

Senator BEALL. The next witness is the representative of the AFL–CIO Maritime Committee, Mr. Hoyt Haddock, who has been so active in the formulation of this project, and prior to this retirement served as executive director of the Maritime Committee.

Mr. Haddock, we not only thank you for your patience here today, but also we thank you for your dedication and energy in moving this project along as far as it has gone. We welcome your testimony.

STATEMENT OF HOYT S. HADDOCK, AFL–CIO MARITIME COMMITTEE

Mr. HADDOCK. Thank you, Mr. Chairman, and thank you for permitting me to appear and giving us all the help you have in this matter.

My name is Hoyt S. Haddock. I am appearing here for the AFL–CIO Maritime Committee in support of S. 4023. I wish to thank you for the opportunity to appear.

Also, I wish to commend Senator Beall and the other forward-locking Senators who have joined in sponsoring this legislation.

This bill provides for the practical demonstration of high-speed land and water transportation systems—demonstrations which are essential to the development of the systems to meet the transportation needs of the Nation.

In 1967, Mr. Joseph Salzano, a retired member of the National Maritime Union, came to the AFL–CIO Maritime Committee. His purpose was to discuss the need for utilizing advanced transportation technology; that is, surface effect ships, air-cushion vehicles, and hydrofoil vessels along inland waterways and elsewhere. This, to help solve the increasing transportation problems affecting millions of people.

Discussions also included the advantages of this advanced technology in achieving a maritime renaissance through the use of high-speed ships in commercial operations.

With that beginning and inspriation, I, as executive director of the committee, now retired, used every opportunity to promote the idea.

Together with Mr. Salzano, many letters were written and meetings held with literally hundreds of people. Everyone who might have an interest in this much-needed development was contacted.

On November 23, 1971, the AFL–CIO Maritime Committee wrote the Honorable John A. Volpe, Secretary of Transportation, to recommend that a tracked air cushion vehicle (TACV) be put into operation between Washington and Annapolis, Md., combined

with fast surface effect ships (SES) from Annapolis, Md., to Yorktown, Va., and the pollution-free buses to Williamsburg, Va.

It was indicated that the total system linking these historic areas could be operated in time for the 1976 bicentennial.

Since this letter was sent, a significant number of U.S. Senators and Congressmen have expressed their interest and support for this proposed transportation demonstration.

Further, the State of Maryland has indicated a willingness to fully cooperate in these matters. Maryland has requested their congressional delegation to do whatever possible to further the project.

One of the Nation's most pressing needs is to develop new advanced transportation systems—systems to move masses of people to and from their jobs and to accommodate them as tourists during their holiday periods.

People in all walks of life have become increasingly aware of the environmental, social, and transportation problems which affect them daily. Often these problems are directly related to one another and appear to pick up momentum as time goes on.

Some efforts are being made to solve these problems. Development of a D.C. subway system is one. It would appear that some less costly alternate steps should be taken to demonstrate new systems which will benefit the public and industry.

The Washington area, in a sense, is the window of the Nation and a center of world attention. There are approximately 20 million visitors a year to the Nation's Capital.

Some 45 million tourists are expected for the bicentennial in 1976. Many of the visitors are young people who will some day be responsible for our Nation's future. Certainly these young people, as well as their parents, would be captivated by a demonstration of new transportation systems. Tracked air-cushion vehicles and surface effect ships would make such a demonstration that could meet in part future transportation needs.

A practical demonstration of advanced transportation systems in our Nation's Capital would provide a basis for improving transportation systems which would raise living standards for years to come.

Certainly the lack of planning and building concept require change. The misuse of so much of our valuable and beautiful land to develop an ever-expanding megalopolis sprawl needs to be stopped.

Expensive highways designed to bring an ever-increasing population into metropolitan work centers, with limited and costly parking facilities and increased pollution, should be curtailed.

Surely, present planning concepts must give way to an enlightened era which will encourage the orderly development of satellite cities.

This can be accomplished by linking large metropolitan employment centers with smaller cities and towns through use of advanced high-speed, pollution-free transportation systems.

Development of these systems would benefit those satellite cities in need of high-speed transportation. Such development would also reduce the cost of living for those who work in, but cannot afford the high cost of living in, large metropolitan centers.

In addition, the systems would provide new business to American industry when foreign and domestic orders are placed for the equipment demonstrated.

Much-needed employment for engineers and others whose training is essential to this high technology field will be provided in both the building and operation of these systems.

Facilities now exist for construction of surface effect ships in Takoma, Wash., and New Orleans, La. Others will be developed as the demand for such vessels grows.

The visit to historic Williamsburg would be a pleasant surprise to many and be in line with bicentennial celebrations. Other benefits could accrue by accommodating the thousands of commuters who daily drive between Washington and Annapolis, and reduce vehicle pollution and parking problems which are created.

In the final analysis, the fast ships and TACV service could prove invaluable as a reliable security backup system in the event conditions warrant.

Since mankind's progress is often measured by the deeds of dedicated men, it is important that a start be made to demonstrate and develop new technically advanced transportation systems to move people in a fast, efficient manner.

It has often been said that today is the tomorrow we wished for yesterday. The tomorrow of our children will require a conservation of resources, reduction of environmental pollution, and drastic reduction of the annual carnage on our highways. It is important that constructive efforts be made now to improve conditions.

The American people have immediate necessity for high-speed transport systems in several areas. Such systems will provide convenient transportation wherever developed.

A demonstration of the tracked air-cushion vehicle and the surface effect ships in the Nation's Capital will give the greatest possible exposure of the systems to the American people. At the same time, the project will begin providing needed high-speed transportation which is essential to present and future needs of our country.

Mr. Chairman, I of course heard the witnesses who preceded me. As you indicated in your colloquy with Congressman Hogan, all of his suggestions fit in completely with our concept of this system. I am not personally familiar with the New Carrollton metro site that he mentioned. However, any adequate connecting-up with the metro system we would, of course, favor. With respect to Secretary Hughes of the Maryland Transportation Department, I think all of his suggestions are good ones. Certainly all of his suggestions should be considered in connection with the development of the plans and program for this type of a system.

I personally would certainly want all of those questions to be considered and dealt with at the earliest possible moment so they would not come up during the development of the system after it has gotten under construction.

Senator BEALL. Thank you, Mr. Haddock. I appreciate your testimony. I agree, I think we are all concerned that we develop a balance in our transportation system. We are not interested in duplicating, but rather in supplementing and improving systems that exist.

Would you, for the record, tell us about the AFL–CIO Maritime Committee? What is the AFL–CIO Maritime Committee?

Mr. HADDOCK. The AFL–CIO Maritime Committee is an organization that was begun back in 1937 as the CIO Maritime Committee.

And when the merger took place between the CIO and the AFL–CIO, it became the Maritime Committee for the AFL–CIO. And it had as its membership—I think I could remember them all—the American Radio Association, the International Longshoremen's Association, the National Maritime Union, the Marine Engineers Beneficial Association, the Master Mates and Pilots, and the United Steel Workers of America.

Senator BEALL. Thank you. Do you have any estimate of overall costs of a project such as this?

Mr. HADDOCK. We have discussed this with representatives of Maryland, with the Federal Department of Transportation, and with some of the companies in this field. And we have the feeling that the tracked air vehicle system would run between 150 and 200 million dollars.

The marine vehicle, of course, is a much cheaper system, because you do not have to develop roadbeds for it to travel over. You have waterways which it would travel over. The only facilities that would be costly at all are the actual vehicle plus the terminals.

And those, of course, would vary in accordance with wherever they are put and the amount of use that is expected from them.

Senator BEALL. You heard Secretary Hughes and I talking about the time frame in which we were operating and the necessity to expedite things. How do you feel about getting this done by 1976?

Mr. HADDOCK. I would agree with Secretary Hughes, that unless the Federal Government moves along on this fairly rapidly and commits unequivocally its resources to get the job done, that it could not be done in time. Time is of the essence.

Senator BEALL. Thank you very much, Mr. Haddock.

Mr. HADDOCK. Thank you, Mr. Chairman.

Senator BEALL. Our next witness is the Deputy Administrator of the Federal Railroad Administration, Mr. Henri Rush. We are happy to have Mr. Rush with us this morning for many reasons. It is always nice to have a representative of the Federal Railroad Administration, but also to have one who formerly sat on this side of the table, as a member of staff of the committee.

He performed very well in that capacity and now is performing very well in his new role with the Federal Railroad Adminitration. Mr. Rush?

STATEMENT OF HENRI RUSH, JR., DEPUTY ADMINISTRATOR, FEDERAL RAILROAD ADMINISTRATION, DEPARTMENT OF TRANSPORTATION; ACCOMPANIED BY MILTON KLEIN, ASSOCIATE ADMINISTRATOR FOR RESEARCH, DEVELOPMENT, AND DEMONSTRATIONS

Mr. RUSH. Thank you, Senator. It is a real pleasure to be here. And following your injunction, I would like to take about 2 minutes and give the remainder of my time to Mr. Milton Klein, who will present the principal statement on technology.

Also, I wonder, might the record be corrected to show that he did accompany me, and make that statement.

Mr. Chairman and Members of the Committee:

Secretary Volpe asked me to represent him at this hearing to underscore his personal commitment to and interest in the development of

advanced high speed ground technology. Under his leadership, significant advances have been made by the Department in the development of high speed ground transportation systems as well as in many other areas.

I have with me Mr. Milton Klein, Associate Administrator for Research, Development and Demonstrations, who has responsibility for all of FRA's research and development work. He will outline for you in some detail, the state of technology relevant to the subject of today's hearing.

Much of this advanced work, as you know, is being carried out at the High Speed Ground Test Center in Pueblo, Colo. This is a departmental facility operated by FRA to support, not only our research and development activities relating both to conventional equipment and advanced systems, but also similar programs of the Urban Mass Transportation Administration.

For example, testing is currently underway at Pueblo on the 300 m.p.h. Intercity Tracked Air Cushion Vehicle program of FRA and is planned for the 150 m.p.h. UMTA TACV program. That will be commenced in the near future. Mr. Klein will, of course, be happy to answer any questions you may have concerning FRA's program and can answer general questions with respect to the UMTA program.

By way of personal note, I am delighted to be back in this hearing room, albeit on the other side of the witness table. This is my first time back, in that role. I would like to add a further note that reflects my very deeply held convictions.

Recognizing that I may have some prejudice both for this committee and the Department of Transportation, I firmly believe that those two entities working together in the next Congress and in succeeding Congresses, could represent the most constructive force for the improvement of surface transportation in the history of the country to date. Together I am convinced we can find solutions to the troublesome problems affecting transportation and particularly the railroad industry.

If we are able to do this, then there will be enough credit to go around for everybody. If we fail to do it, I think each individual party involved will have to take individual responsibility for the resulting catastrophe, and in my opinion, it will be just that.

I must say, we have had what we believe to be extremely close and cordial relationships with the committee during the 92d Congress. We look forward to working even more closely with this committee in the 93d Congress.

Also, of course, when I say committee, I am referring not only to the distinguished and able Senators who sit on the committee, but also to the dedicated and professional staff that supports them. And now I would like to present Mr. Klein to give our statement on technology.

Senator BEALL. Thank you, Mr. Rush. Mr. Klein?

Mr. KLEIN. Thank you, Mr. Chairman. I, too, appreciate this opportunity of appear here and describe the work of the Department of Transportation in the field of high-speed ground transportation.

The Federal Railroad Administration, through its Office of Research, Development, and Demonstrations, is responsible for the technological and system investigations which serve as the foundation for these future systems.

We view the area of high-speed ground transportation as very important to our Nation's growing transportation demands. It is a mode that was relatively neglected for some time. Yet, it is a mode which offers great promise in alleviating growing congestion in other modes and is very attractive from environmental and land-use standpoints. And, like other transportation advances in the past, it could well provide new opportunities for our future economic and social development.

Before proceeding into a more specific discussion of high-speed ground transportation systems and their status, I believe it would be useful to place in perspective of several systems upon which we are working. Present day passenger trains in this country, as all of us know, operate at speeds generally below 100 miles per hour, with only the Metroliner and the Turbo train, developed under the Department's demonstration program, operating at or slightly above 100 miles per hour. The top speed today tends to be limited by the roadbed condition and its alinement. However, we believe that today's state-of-the-art permits the design of new wheel-on-rail trains to operate at speeds of approximately 150 miles per hour in a number of areas with relatively modest roadbed improvements.

While the 150-miles-per-hour range is not necessarily the maximum potential speed of a wheel-on-rail vehicle, considerations of safety and ride comfort at practical levels of roadway maintenance dictate use of a different kind of system for speeds substantially above 150 miles per hour. Such a system is the tracked air cushion vehicle, or more generally, to use a fancy name, a tracked levitated vehicle.

Of course, in the range of 150 miles per hour both types of systems are possible. Generally speaking, if there is a basically adequate railroad already existing on a route, a wheeled vehicle would likely be the choice in that speed range because of the already existing facility. On the other hand, if such a railway is not present, then a tracked levitated vehicle could well be the choice.

The speed one should operate on a particular transportation route is, of course, an important question. The answer is dependent upon the specifics of the route—such factors as distance between stops, alignment possibilities, and service needs. And, of course, the economic practicality of any of these systems is also dependent on the specifics of the case: relatively high usage is necessary for any such system to be economically attractive.

Now, I would like tc describe briefly the status of the several technologies involved and our programs for their development. With respect to wheel-on-rail systems, you are familiar, I am sure, with our Metroliner and Turbo train demonstration programs which have shown that modern, good, and reliable service can attract people back to the trains, at least in the highly traveled corridors. Based upon this experience and technology, and the technology which has been developed in other countries, we are initiating the design of an improved passenger train. This program is intended to take advantage of the best of today's state of the art to design a self-powered train system to cruise at about 150 miles per hour with relatively modest roadbed improvements. Such a train is expected to have an improved suspension system which can take curves safely and comfortably at speeds substantially above those possible with standard passenger trains to-

day and can cruise with good ride quality at high speed on well maintained straight sections.

An essential companion to the rolling stock development is our work on track. The track structure and the cost of maintaining it are limiting factors in train speed and ride comfort, even with the new train designs which can better handle less than perfect track. In FRA, we have underway activities aimed at a better understanding of existing track structures and the development of improved structures. And, although railroads have been in operation for a long, long time we know all too little about the important interaction between wheels and rails. So, we are making substantial effort to better understand that interaction, including the construction of a unique dynamics laboratory at our High Speed Ground Test Center in Pueblo, which Mr. Rush mentioned.

Our more advanced work is primarily devoted to the class of system we call the tracked levitated vehicle. Such a vehicle does not ride on wheels, but rather is suspended a fraction of an inch or a few inches above its guideway, or track, and has no contact with the guideway while in motion. Since there is no physical contact with the guideway, superior ride quality is possible, and, by properly designing the guideway, safe high speed travel can be attained. We believe that such a vehicle will be able to operate at speeds as high as 300 miles per hour. The principal effort in tracked levitated vehicles has been devoted to air cushion levitation and guidances, the TACV. This system rides on a cushion of air on a specially constructed guideway. Tracked air cushion vehicles have already been tested in experimental service in France at a speed of about 170 miles per hour for several years. The technology is, therefore, available for TACV in the 150, or perhaps slightly above, mile-per-hour range. Indeed, the Department's Urban Mass Transportation Administration has under construction a passenger carrying prototype 150-mile-per-hour vehicle which is scheduled to go into test operation at the Pueblo Test Center next year.

However, there is no actual operating experience for speeds above the 150- to 170-miles-per-hour range. To obtain that experience FRA has designed and built a tracked air cushion research vehicle (TACRV) to explore operating characteristics up to 300 miles per hour. That research vehicle is now undergoing low speed tests at Pueblo.

A variation of the tracked levitated system is the so-called magnetic levitation system. In such a system, the vehicle is supported above its guideway by magnetic forces rather than by a cushion of air. Work on this approach, however, is not as far along as that on air cushion vehicles but appears quite promising in the long term. We have thus far performed analytical and laboratory studies and small-scale experiments to examine the principal feasibility questions involved. Such work is also underway in other countries, as of course is true for TACV. The work thus far has demonstrated the technical feasibility of the concept, at least at relatively low speeds. The next step is work aimed at obtaining engineering data over the speed range of interest.

Now, the conventional traction motor which feeds power to wheels is, of course, not suitable for these noncontacting levitated vehicles. Therefore, we have been developing a propulsion unit called a linear motor which uses electromagnetic forces to propel the vehicle along

its guideway. A test vehicle propelled by such a motor is in operation at Pueblo and has already operated at 188 miles per hour, the highest speed any such motor has propelled a vehicle, to our knowledge. Such a propulsion unit has no moving parts, and, therefore, low noise. Suitably powered, it also has very good antipollution characteristics.

The principle of the linear motor is the same as that of a conventional electric motor in which electromagnetic forces spin the rotor. In the linear motor, the motor windings are arranged in a line rather than cylindrically, and installed in the vehicle. The other part of the motor is installed on the track or guideway and called in this case a reaction rail. I should point out that there are variations of this approach, but this is the approach we are primarily working on in this country. When electric power is fed to the motor windings on the vehicle, magnetic forces are set up between the windings and reaction rail, propelling the vehicle.

In the research vehicle being tested at our test center, and in the vehicle being built in the urban-tracked air-cushion program, the reaction rail is a hollow aluminum plate installed in a vertical position down the center of a conventional railroad track. For the research vehicle, that reaction rail is about 22 inches high. Inverted U-shaped motor windings on the vehicle ride along the reaction rail.

I should not conclude this brief description of high-speed ground transportation without at least mentioning tube vehicles.

Senator BEALL. Excuse me. At that point, it is adaptable to current roadbeds?

Mr. KLEIN. In the case—the linear motor can be used on a wheel-on-rail vehicle. Indeed, the system we are testing out at Pueblo is a wheel-on-rail vehicle propelled by a linear motor.

Of course, a tracked air-cushion vehicle propelled by a linear motor would require a new type of guideway. As I indicated, the linear motor is being developed principally for the TACV or a magnetic levitation type of system, these noncontacting types of systems. Now, depending on the specific situation, the guideway could use existing rights-of-way at least in part.

Senator BEALL. Where are we with regard to this technology?

Mr. KLEIN. Very well along. The vehicle that has been tested and is still undergoing tests at Pueblo has worked very well. It has operated very stably and with good performance up to 188 miles an hour at this point, and I might say that that speed was only limited by the length of test track we have and the time it takes to get up to that speed. So the system is working quite well.

I shouldn't conclude this brief description of high-speed ground transportation without at least mentioning tube vehicles; that is, levitated vehicles operating in a partially evacuated tube. One can envision a speed of about 500 miles per hour with such a concept. Such a system is a very long-term development, with only research studies, particularly on its aerodynamic characteristics, underway at this time. The ultimate practicality of such a system is dependent, in our view, on substantial reduction in the cost of constructing tunnels and it is there that our principal efforts are placed today. Tunnel cost reduction, as you know, and as mentioned this morning, also can have more immediate payoff in today's transportation needs.

I have only touched on the highlights of our important high-speed ground transportation program. It represents in our view a very prom-

ising potential as well as an exciting challenge. I would be pleased to answer any questions you might have, Mr. Chairman.

Senator BEALL. In your statement, Mr. Klein, you state that relatively high usage is necessary for the air-cushion vehicle to be economically attractive. What do you mean by relatively high usage?

Mr. KLEIN. Mr. Chairman, the answer to that question is quite dependent upon the specifics of the route. What does it cost to construct a route, what problems do you encouter on the route? And what kind of vehicle system do you need for that route?

So, it is not possible to give a precise answer to that question. If one were to generalize, and this is a very general answer, we probably would be talking on the order of low millions of trips per year for it to break even for the distances involved.

Mr. RUSH. I might add, if I may, Senator, as Mr. Klein suggested, this is totally cost dependent, and based on a theory that we are still following, that the cost of putting in the infrastructure should be recaptured.

Now, this is not necessarily the case with other modes, as you well know. But this is our predicate in making the statement, a statement such as this.

Senator BEALL. This legislation, as you know, contemplates a feasibility study. I have been informed that sometimes it takes as much as 6 months to let the contract or a feasibility study at DOT. Is this true?

Mr. RUSH. Maybe, Senator, but for this reason, the sort of study that would take 6 months is the study where we would be commissioning a contractor to study the United States.

All of these situations are, and I think appropriately so, let on a competitive bidding situation. There are certain delays inherent in that, getting the proposal out, getting the responses back, evaluating technically the various people who have bid. And I can assure you we are as anxious as you would be to cut the leadtime in these contracts, but where you go competitively, there is a certain delay inherent.

I would think if we came in in 6 months time getting the award made in all instances, we would not be doing too badly.

Senator BEALL. But in certain instances, you can speed up the process?

Mr. RUSH. Yes, sir.

Senator BEALL. Do you think we could have a system like this in operation in time for the bicentennial celebration?

Mr. KLEIN. I think, Mr. Chairman, that it is technically feasible to be ready. But the controlling factor in my mind would be the time it takes really to build the infrastructure, the route, the guideway, and of course how quickly one can get started. It is a tight time scale in any event.

Senator BEALL. Do you have any feelings as to the type of ground system that would be suitable as a demonstration project for the bicentennial?

Mr. KLEIN. Certainly we do look to a demonstration program at some point for these systems. We believe in general that a demonstration is very important before such a system will go into widespread use, that it is necessary to go through a demonstration step.

We are doing limited demonstrations in a sense at Pueblo; for example, the urban tracked air-cushion vehicle will be out there next year. But an in-service demonstration is also useful, and of course there are a number of candidate sites that look possible to us.

Senator BEALL. Is that what you plan after Pueblo?

Mr. KLEIN. That would normally come after Pueblo, yes, sir.

Mr. RUSH. Were you talking about advanced, systems, Senator? Because there are some other things that will be happening in that time frame.

Senator BEALL. I said ground transportation, but I was thinking in the way of advance systems.

Mr. RUSH. The improved passenger train concept, using what we have today to provide improved service, we hope will be operational by then. Other projects which will have developed by then, like New Carrollton and hopefully Union Station, while not specifically designated as bicentennial projects, could be available within that time frame.

Senator BEALL. That is refreshing and encouraging news. You mentioned pollution. I suspect you mentioned that with reference to air pollution. What about noise pollution with systems of this sort?

Mr. KLEIN. The tracked air-cushion vehicle noise, we believe, will be no greater than noise of trains today. Of course, we must make clear that the information on this kind of system is at this point largely analytical. We have not actually operated such a system so we can't be sure of our data. But it appears that it is of the same order as present day trains.

Senator BEALL. Thank you very much.

The next witness will be Admiral Halvorson, who is the program coordinator of surface ships acquisition.

STATEMENT OF REAR ADM. GEORGE G. HALVORSON; ACCOMPANIED BY CAPT. ROBERT K. RIPLEY, DEPARTMENT OF THE NAVY

Admiral HALVORSON. Good morning, Senator.

Senator BEALL. Good morning, Admiral. The Navy has had a long continuing interest in the subject of high-speed marine vessels, and since part of this proposed legislation envisions a water link on the Chesapeake Bay between the Baltimore, Annapolis, and Norfolk areas and since there is a considerable spinoff from military activities to the civilian sector, our record would not be complete unless we had an appraisal from the Navy. We are happy to have you here with us today.

Admiral HALVORSON. Thank you Senator Beall, gentlemen. I am Rear Admiral Halvorson, on the Staff of the Chief of Naval Operations, where I am the coordinator for the Surface Ship Acquisition programs, and in particular, in the last several months, I have been spending a great deal of my time working on the Navy's high-speed ship programs, of which there are several. It is a pleasure to be here today to briefly outline the Navy's interest in high-speed ships and craft of advanced design and to discuss the status of these developments, for the committee, which we think are very important to the future of the U.S. Navy.

As you know, the Navy has been conducting research and development for many years in hydrofoils and air-cushion marine vehicles, and has sponsored extensive efforts in industry to develop these technologies to their present status. With the strong support of the Congress, our program has reached the point that we are confident in the feasibility and utility of hydrofoils and air-cushion vehicles for a variety of naval uses.

We believe, in several respects, that the United States has achieved world leadership in these technologies and therefore, that we have the opportunity now to move ahead of other countries in both naval and commercial applications.

Of course, my purpose today, is not to advocate the Navy's programs as such. These are well covered each year in the Military and Appropriations Committees. It may be useful to you, however, to have a brief report on the status of our programs and our future plans which we believe offer revolutionary possibilities in naval warfare comparable to the advance from sail to steam, or from fossil fuel to nuclear power.

The Navy's high-speed ship program is principally in three categories; hydrofoils, air-cushion vehicles, and a variation of the latter, the so-called surface effect ship.

Of these, the hydrofoil is the most advanced as a practical reality. We have had experimental hydrofoils in service for several years, including the 120-ton *High Point*, delivered by Boeing in 1962; and the 320-ton *Plainview*, delivered by Lockheed, in 1968.

We have also had in service, as patrol gunboats, the Grumman-built, 50-ton *Flagstaff*, and the Boeing-built, 60-ton *Tucumcari*. Both *Flagstaff* and *Tucumcari* have seen operational service and evaluation in Southeast Asia. *Tucumcari* has also conducted operational demonstrations in the Mediterranean and northern European Waters.

Based on the experience with these craft, we are now engaged with the German and Italian navies in a cooperative project to build patrol hydrofoils equipped with guided missiles and other weapons for use in the Mediterranean, the Baltic Sea, or other narrow seas of military interest, about the world.

The NATO patrol hydrofoil, at a little over 200-tons displacement, and carrying long-range, surface-to-surface missiles, we believe, will be a relatively inexpensive, but highly effective addition to our Navy and to the navies of our NATO allies.

This program has been about 3 years in formulation. The ship is essentially a scaled-up version of the Boeing-built *Tucumcari*. It will be propelled by a large gas turbine engine and waterjet, and will employ the canard configured, fully submerged, automatically controlled foils that have proven so successful in *Tucumcari* and *High Point*.

Development costs for the PHM are being shared with Germany and Italy. Two lead ships are being built for the U.S. Navy inventory, and Germany and Italy each intend to obtain their lead ship in the United States.

Following evaluation of the lead ships, the cooperative acquisition program is planned to provide additional PHMs for all three navies and others who are likely to join.

While the PHM is being designed as a warship, and therefore, includes many features not required for passenger service, the basic

technologies involved have, of course, direct application to a commercial design of similar size; and I would consider a passenger-carrying hydrofoil craft to be completely within the state of the art today. I understand the Boeing Corporation has such a craft under development now, and perhaps there are others.

The second major effort in the Navy's program deals with the use of the air cushion vehicle as a high-speed and highly capable amphibious landing craft. These craft will be similar in principle to the air cushion vehicles that have been developed in other countries, particularly in Great Britain where the term "Hovercraft" is used.

As you know, several British Hovercraft are in regular service, both as commercial and military vehicles. An example here is the British SRN–4, which operates daily across the English Channel carrying up to 150 passengers, and as many as 30 motor vehicles at a time.

Our amphibious, air cushion landing craft will be about the same size as the British SRN–4. We have two of these craft under development; one at the Bell Aircraft Corp., and one at Aerojet General.

The craft will have a range of over 200 miles, and will travel at about 50 knots. They are driven by gas turbines with air screws, or propellers, which can also be used for directional control. They will carry a 75-ton payload with a roll-on, roll-off capability at each end of the craft. They will be capable of negotiating the surf line onto the beach for unloading their cargo. If the terrain is suitable, they will also be capable of moving some distance inshore.

We expect to have the two prototype craft available for operational testing in 1976. They will be evaluated for compatibility with our amphibious ships, LPD and LSD, as well as wih our new LHA.

As you can well imagine, our Marine Corps is particularly excited over the prospects these advanced craft offer for high-speed transit from a point well at sea, over the horizon, to the amphibious landing area where they will also provide an over-the-beach capability.

As with the hydrofoil, the air cushion landing craft development is aimed at military application. However, the basic features of hull, propulsion, and air cushion lift systems would be directly applicable to a commercial, passenger-carrying vehicle.

While we have confidence that these landing craft developments will prove successful, it should be noted that these are the first hovercraft of this size to be developed in this country. A parallel commercial development, while entirely feasible, would therefore be subject to some degree of risk, inasmuch as it could not be based upon proven prior accomplishments in the United States.

Our surface effect ship program is, perhaps, the most far reaching of the three developments in high-speed ships. The objective of this program is to extend the use of the air cushion principle to large ships of ocean-going size.

The surface effect ship concept utilizes solid sidewalls that are integral with the ship's structure, with flexible seals, fore and aft. This approach permits the use of either waterjet propulsion or semi-submerged propellers in the sidewalls, either of which are more efficient than air screws at the speeds these vessels will operate.

The solid sidewalls also permit added stability in heavy seas, and allow the ship to ride a greater height above the water, thereby improving its capability to operate in heavy seas. Ocean-going, surface effect ships will be capable of speeds of 100 knots or more, and of

carrying a useful military payload comparable to that of conventional ships.

In principle, the efficiency of surface effect ships increases significantly with increasing size. The Navy visualizes future possibilities for surface effect ships ranging in size from an ocean escort of 2,000 to 3,000 tons, to major warships of 10,000 tons, or larger.

Our current program is centered on two 100-ton test craft that have been constructed by Aerojet and Bell. These craft have been operating for about 6 months. They have both suffered from a number of prosaic electrical, and mechanical problems that have impeded testing in the past; however, they are both clearly confirming the surface effect, peculiar technology that is involved. Their tests have already established the design data base needed by the Navy for the preliminary design now underway for 2,000-ton, oceangoing, prototype ships.

We have four major industrial teams under contract for a 1-year preliminary design effort on the 2,000-ton ship. These four teams are led by Aerojet, Bell, Lockheed, and Litton, who are each supported by several additional firms where special expertise is needed.

Based on these preliminary designs and upon completion of the ongoing 100-ton testing, the Navy plans to develop two 2000-ton prototype ships. With two prototypes, the Navy will have the opportunity to evaluate differing approaches to propulsion, lift systems, stability, and control techniques, and to make choices for future ship construction, based on actual operational experience.

By investing in two prototypes, we will insure that future surface effect ship construction will be based upon the best available technology and that we will have a competitive industrial base for our future program.

While the two 100-ton craft now operating, were designed as test craft for use in the ongoing development effort, their basic features also lend themselves to the design of commercial, passenger-carrying vehicles. With the present propulsion and lift system techniques, payloads are possible on the order of 20 to 25 tons, a range of at least 300 miles, and depending upon sea state, speeds as high as 80 to 100 knots.

I believe the technological base is adequately established in U.S. industry for passenger-carrying, high-speed marine vehicles in the size range of 50 to 200 tons displacement; but time is very short, as other witnesses have noted, this morning, to achieve a realistic capability in hand by 1976.

The choice of which of the three technologies, or combination thereof, would best serve in the Chesapeake and Potomac River areas is a matter that requires careful study. Proposed designs must be reviewed and certified by the U.S. Coast Guard, or the Department of Transportation.

The study should take into account, among other things, the hydrographic aspects of these waterways, and the added requirements for safe navigation at high speeds, where each of these three types of vehicles may have its own peculiar problems. Similarly, the design of terminal facilities and logistics support requirements will have to be established.

These considerations, as well as the economic viability of high-speed marine vehicles will, I am sure, be given close attention in the study that your bill proposes.

These prerequisite studies take time, however, and their results must justify the necessary ongoing investment to design and construct the craft and the facilities that would make up the transportation system. In the case of the hydrofoil, much of this has already been done and a craft is being developed now which could be in regular service by 1976.

In my opinion, air cushion craft, however, are more than likely a longer term problem, and I would estimate that at best they could only be available for demonstration purposes by 1976.

Senator, this concludes my presentation. I thank you for the opportunity to take part in these hearings and to provide you with an overview of the Navy's programs for high-speed ships as they may concern your proposed bill, and your plans for the bicentennial celebration.

I am sure that the Navy stands ready to assist in any way that may be desired. I will be pleased to answer any questions you may have.

Senator BEALL. Thank you, Admiral.

At the conclusion of your statement, you mentioned that you thought we could have an air cushion vehicle ready by 1976 for demonstration purposes.

Admiral HALVORSON. Yes; we have to move rapidly.

Senator BEALL. You do this in your statement, but for the record could you describe the differences between an air cushion or hovercraft vehicle, the hydrofoil, and surface effect ship?

Admiral HALVORSON. I would be happy to, sir.

The hydrofoil rides on foils which can either be partially submerged under the water and partially protruding, in which case we would call them surface piercing foils—they are the type of hydrofoil that has been most common over the past 20 years in small pleasure craft—or fully submerged foils.

The Navy's hydrofoils, are the fully submerged type. Here, the foil is completely beneath the surface of the water and the ship is supported by struts up above the water. The ship has a control system built into it to sense its position above the water and to control by automatic means, the foils beneath the water, thereby maintaining its altitude and stability.

Hydrofoils in the Navy are all propelled by gas turbine engines, similar to aircraft, jet-type engines.

Now, the air cushion vehicle, in effect, rides upon a bubble of air. The air is supplied through a large capacity fan that pulls the air in from the atmosphere and forces it down into a bubble beneath the ship where it is confined by a flexible skirt, surrounding the keel line of the ship.

As the air is pumped in and the ship begins to move, it rises until it is riding entirely upon the bubble of air with just the slightest contact of this flexible skirt in the water, Thereby, friction is reduced to virtually nothing, and when it achieves that condition, very high speeds are possible.

The surface effect ship is a variation of that principle, wherein the flexible seal is at the bow and at the stern, but the ship's structure is extended down the sides into the sidewalls which penetrate down beneath the surface of the water a short distance.

But, again, when the ship is up to speed and is riding on a cushion of air, with low friction, it is capable of very high speeds.

Senator BEALL. Do you have an opinion as to which of these approaches holds the best, long-term prospect for the design of high-speed ships?

Admiral HALVORSON. I have opinions. I am not an expert to that degree, but we definitely feel that in the Navy, for ships of ocean-going size, transoceanic-type ships, the sidewall surface effect ship holds the greatest promise. In principle, it can be, we believe, built in any size conceivable.

In fact, the larger it is, the more efficiently it will operate. I think, for inland waterways, such as the Chesapeake Bay or similar waterways, that any of these three vehicles are entirely practicable.

And the hydrofoil will not go as fast, perhaps, as the surface effect ship, but as I mentioned in my testimony, I think it is more advanced today as a practical reality. We know more about hydrofoils.

Senator BEALL. I suspect you therefore think that the hydrofoil is the one that is most likely to be operable, if we have a July 4, 1976, date?

Admiral HALVORSON. We have hydrofoils—there are plenty of hydrofoils operating now.

Senator BEALL. But if we want an operational system by 1976, do you feel that the hydrofoil is so far advanced that it is the one to meet the tight deadlines we have in mind?

Admiral HALVORSON. I understand that the status of passenger carrying hydrofoils is at the point, today, where one could put into service a large number of them, and have a regular operating, passenger service, including many vehicles, a regular transportation line, by 1976.

I am inclined to doubt that it would be practicable to have that extended service available in the form of these other craft by that time. I think, of course, that one or two could be built for demonstration purposes.

Senator BEALL. Demonstration is feasible?

Admiral HALVORSON. Yes; others might differ with me.

Senator BEALL. Have we been using high-speed craft in Southeast Asia?

Admiral HALVORSON. Yes, but not extensively of the hydrofoil or air-cushion principle. We have had air-cushion vehicles in Southeast Asia which the Navy and Marines have used for operating in the rivers, and we have had, of course, high-speed planning-type craft, conventional craft.

As I mentioned, the *Tucumcari* and the *Flagstaff* have both operated there, over periods of time. I think that is the extent of our experience, operationally, in Southeast Asia with this craft.

Senator BEALL. What advantages do they have, other than speed?

Admiral HALVORSON. The air-cushion type, of course, is essentially amphibious. They can go in very shallow water, and, in fact, go where there is no water at all, or through marshes and swamps. That is a great advantage in an area like Southeast Asia. The hydrofoil, of course, requires a safe depth of water to operate in.

Senator BEALL. You mentioned that to do this feasibly on the Potomac River or Chesapeake Bay, you would have to study the hydrographic effects of the area.

What are some hydrographic effects?

Admiral HALVORSON. In the case of hydrofoils, the depth of the water is an important factor. As this ship is riding along at high speeds, the foils would be, typically, 3 or 4 feet beneath the surface of the water while the ship is riding well up above the water.

But, should there be an engine failure, or for any reason at all, a ship may have to come to a stop, and come down off the foils, onto the hull, then these foils would be, perhaps 10 , 12, or 15 feet deep in the water.

Thus they would require good water to that depth at least for safe operation. Hydrographically speaking, any of these ships that travel at 50, 60, 70, or 80 knots in a restricted waterway have to have both onboard the ship, and on the shoreline, good navigation facilities in order to be safe.

I don't think at present, some of the areas of the Chesapeake Bay, and certainly the Potomac River are adequately safe for ships of this speed, until further work has been done on the navigational facilities there. There are, here in the room, this morning, officers from the Coast Guard, who would be more qualified than I, to speak on that.

Senator BEALL. How about debris in the water?

Admiral HALVORSON. Of course, it depends on how big the debris is. The debris is a problem for a hydrofoil, possibly, although a ship. of this size would not be bothered by ordinary debris.

A large, floating tree, or a submerged large obstacle, that wasn't charted, could cause an accident. But the foils on these hydrofoils are very strong, and moving fast, they would cut through debris quite well.

We have had experience with that.

Senator BEALL. Thank you very much, Admiral.

Our next witness is Adm. Ralph James. Admiral James is a resident of Annapolis, Md., a retired Naval officer and former head of the Bureau of Ships. He has had an early interest in high-speed maritime vessels and certainly his experience will aid the committee in making a determination on the feasibility of this project.

Admiral James, we are happy to have you with us today.

STATEMENT OF REAR ADM. RALPH K. JAMES, U.S.N. (RETIRED), PRIVATE MARINE CONSULTANT

Admiral JAMES. Thank you, Mr. Chairman. I will read my statement and then perhaps will be privileged to supplement it briefly.

Mr. Chairman, I am Rear Admiral James, a private marine consultant. I appreciate the privilege of appearing before this committee in support of S. 4023.

If enacted, this bill would provide the Washington, D.C., area residents and visitors to our Nation's Capital with high speed transportation from Washington, Baltimore, and Annapolis, Md., to Williamsburg and Norfolk, Va., using in part the uncongested smog-free marine highway of the Chesapeake Bay.

I would like to take a moment briefly to review high-speed marine history to qualify myself to comment on various aspects of the proposed legislation.

For the period 1959–63 I served the U.S. Navy as Chief of the Bureau of Ships, having been appointed to this office by President Eisenhower. My various responsibilities included the responsibility to

execute research and development programs to provide the Navy with high-speed ships capable of fulfilling the Navy's future needs.

It was as far back as the 1890's when Alexander Graham Bell first tested a hydrofoil craft. Even with this long interval of development, acceptance by our Navy was not significant due primarily to the vulnerability of the so-called surface-piercing foil systems that characterized hydrofoils of that period.

In 1958 a successful Navy development gave us the controlled submerged foil and made possible contracts by the Bureau of Ships for construction of such landmark hydrofoils as the USS *High Point*, *Plainview*, and *Tucumcari*.

These ships are the forerunners of ongoing Navy programs of today in the 40- to 50-knot speed regimes.

Hydrofoil technology was and maybe still is inhibited in development of speed and size. I think of them as being speed-limited to about 50 to 60 knots, with potential maximum size of about 1,000 tons or even less.

They also continue to have vulnerability of their submerged foils, to mechanical damage, from floating or submerged debris.

Nevertheless, having moved the Navy into this high-speed regime—I say high-speed because displacement ships seldom achieve speeds above 40 knots—hydrofoil limitations forced us in the Bureau of Ships to continue the search for other types of high-speed marine vehicles.

About this time a Britisher, Sir Christopher Cockrell, patented the hovercraft. He importuned Prince Phillip of Britain to ride the first craft across the English Channel. Published photos of this trip stimulated my interest and curiosity and prompted an inspection trip to England in 1960.

This visit served to encourage me to persist until the Navy authorized construction of a prototype hovercraft in this country, a craft to permit study of the military and civilian potential application of high-speed water transportation.

The craft known as *Skimmer I* was built by Bell Aerospace Co. and, until very recently, remained the largest and vastest hovercraft ship built in this country. Only recently has Bell built a larger and faster ship, the SES–100B which has been or will be, and has very recently been, described by other witnesses.

The British have continued development of the hovercraft. One British company alone has over 80 such vehicles in continuous service. Their emphasis seems to have been in the civilian market, providing high-speed passenger vehicles such as those now regularly plying the English Channel on 30-minute crossings instead of several hours. This has been going on for many years using the SRM4.

In this country, our Navy has been the principal customer to date for hovercraft in the commendable drive toward acquisition of the 100-knot Navy. This is a speed easily attainable by many projected United States hovercraft now being built or being designed.

In service today are Bell-built hovercraft capable of moving about 150 persons at 50 to 60 knots speed. One such craft is known as *Voyageur*. Other hovercraft being built for the Navy such as the SES–100B and the amphibious landing craft, Jeff–B, could be adapted for commercial purposes and provide more commodious, faster service by the time the other shore installations are in place.

I would have to challenge the statement of the previous witness that these would not be demonstration vehicles; these would be commercial, established, proved vehicles that have already been in service for an excess of 5 years.

With this background, then, let's consider the feasibility of the transportation system proposed by S. 4023.

I will limit my remarks to the marine transport aspects, except to note that at least two major candidates for the land travel from the District of Columbia to Annapolis certainly should be studied; namely the tethered, high-speed experimental hovertrain or, as we heard today, identified as the levitated train, and the well-developed monorail train.

Either system could operate in the median strip of Highway U.S. 50 to Annapolis with a marine terminal located perhaps on the South River just outside of Annapolis.

From such a terminal marine hovercraft could operate perhaps originating their service in Baltimore and making a comfortable run using craft available today, to Jamestown adjacent to Williamsburg in about 2 hours' time.

The state of the art in hovercraft technology today would permit craft being employed that could keep the sea in virtually all weather encountered on the Chesapeake Marine highway, giving passengers embarked a comfortable, interesting ride on its air cushion in complete safety and away from the frustrations encountered on the clogged land highways.

In 2 to 3 more years, more capable hovercraft can be built and put into service to replace the earlier versions.

The feasibility of accomplishing construction of the proposed transportation system in time to serve the Bicentennial celebration in 1976, in my opinion, can be demostrated anticipating early enactment of S. 4023 and with an all-out application of this Nation's tremendous industrial capability to the project.

If I may address this, you have been questioning previous witnesses on this point almost to the complete number that have been before you, and I think it is the Achilles' heel of the project. I think, therefore, that we must be reminded, and I had in mind when I stated this Nation's tremendous industrial capability, which if applied in the manner of perhaps a Project Manhattan or even the Polaris submarine, with which I am very familar, we can accomplish this kind of task. Because, as Mr. Klein said today, with relation to the land vehicle, the technology is here today, and I can assure you gentlemen that it is my conviction, so is it with respect to the hovercraft, or the marine transportation.

So with this deep personal conviction I hereby note for the record my desire to reserve two seats for the Washington to Williamsburg inaugural run in June 1972, and I have just been asked by Mr. Hoyt Haddock to include his name among those who would prefer similar treatment.

Senator BEALL. We will certainly record that four seats are needed for this inaugural run. I hope I am in a position to help you acquire these seats. That may be of more value than you think.

Thank you, Admiral, for your testimony.

We have heard talk now of the hydrofoil and the hovercraft and the surface effect ships. I don't want to ask you to draw any conclusions

that maybe you don't want to draw, but which do you think is the most practical for a service operation such as we have in mind in the Chesapeake Bay region?

Admiral JAMES. I will answer that, but first let me define what I mean by the term "hovercraft."

There are many names that have been applied to this new and unique vehicle. Admiral Halverson defined the difference between what I call the air cushion vehicle or the purely amphibious craft or the surface effect ship, which has the solid side walls that contain much of the air, with, of course, solid sidewall structure, hence it needs greater depths of water.

Today I would answer your question unequivocally. The hovercraft of the amphibious variety, similar to those employed across the English Channel, similar to those which Bell Aerospace Co. has developed in a craft known as *Voyageur*.

I have respect and regard for the hydrofoil. In fact, I consider myself to have been a major factor in the introduction of the hydrofoil technology to our Navy. It has caught on faster than hovercraft because it was in 1962, when we delivered the *High Point*. So it has been more completely tested and tried by our Navy. Hence their enthusiasm for the proven and the demostrated in the sense that those craft are in being.

But we have to look abroad for the hovercraft technology demonstrations which have been fabulous and which I have followed ever since I have retired from the Navy. I have ridden the SRN 4 across the English Channel, and to respond to one question that has been raised, I have ridden a hovercraft, the SRN–6, from Cowes to the Isle of Wight, when we threaded our way through many dozens of small pleasure craft with no problem whatsoever.

Because of the fact that as I remember my frustrations as a small boat owner in Annapolis of having to be banned from the Chesapeake Bay after hurricane Agnes cluttered our beautiful bay with the debris from all the way inland up into Pennsylvania that those kinds of hazards inhibit the confident use of the hydrofoil type of craft.

Perhaps my experience is colored by the fact that even while exploiting the hydrofoil technology I went abroad and rode many versions of these types of craft when they were in high production abroad. I mean primarily, the so-called surface piercing type. Once when in the harbor of Rotterdam, in a demonstration vehicle, we hit a large bulk log that was afloat. Down we came on one shoulder, and we were a wee bit distressed with that situation. This problem has been reduced by the development of the continuously controlled submerged foil, but it has already been pointed out that they would require much greater depths of water to operate safely.

They do continue to have danger from floating or submerged debris which a hovercraft does not have. The hovercraft is my No. 1 candidate.

Senator BEALL. Do you have any idea what it would cost to have an operational system of the kind we have in mind under this particular piece of legislation?

Admiral JAMES. If you will limit your question to the marine aspects of this, yes, I do have. You could put into service perhaps a fleet of as many as—well, let's just ponder that briefly for a moment. Perhaps a

fleet of six such hovercraft would be sufficient with terminals in Baltimore, Annapolis, and Jamestown—where you would bus into Williamsburg—and in Norfolk, a total of four terminals.

I would say that the fleet of six craft and terminals would be under $50 million, with the market price of these vehicles that are being offered for sale today.

Senator BEALL. What kind of problems do you run into? You mentioned small boats a minute ago. What kind of problems do you run into as far as safety is concerned when you are traveling waters that are fairly heavily populated with small boats? Do you have to develop traffic patterns?

Admiral JAMES. Because of the speeds of these craft being in the regime of 60 to 80 knots, the answer to your question is "Yes, you ought to have prescribed routes." But being a small boater, I know we small boaters completely disregard these restrictions when they get out on the bay.

I would say, therefore, that it would have to be done primarily from the vehicle itself, by avoidance. The development of high-speed radar for traffic avoidance is part of the developmental program to bring on these craft to the full degree of safety that would be required in heavy passenger service.

Senator BEALL. What kind of limitations are imposed by weather?

Admiral JAMES. If it were weather alone, none, because the hovercraft could operate or any craft could operate with its radar and find its way from point to point. It would obviously require a reduction in the maximum speed. But I am reminded of the fact that just 2 years ago I flew into London intending to ride the hovercraft across the English Channel. We were the last plane from Lisbon to land on the airport in London in a heavy snowstorm. I was unable to get out of London by rail or by car to Dover from where the hovercraft was operating. But the hovercraft didn't miss a single one of its scheduled trips.

So by contrast with other transportation systems, this is pretty good.

Senator BEALL. Do you see any problems with the public acceptance of this mode of transportation?

Admiral JAMES. You have to reserve seats in advance to get on the channel hovercraft and perhaps that is the answer to your question.

Senator BEALL. I have been advised that one of them recently overturned on one run.

Admiral JAMES. One did on the run from Cowes to the Isle of Wight, with a brandnew pilot making his first run. The weather was beyond acceptable limits. That was one of the few times that the pilot was on that run. He was counseled to consider carefully whether or not to take such a trip. He nonetheless started. When he got out into the open sea area he was aware of the excessive high waves for his size of craft, and so he executed a reverse maneuver which was perhaps less than the most judicious maneuver. In doing so he caught a wave just at the time he was in a very high-speed turn, and it flipped him. I believe four people lost their lives.

Senator BEALL. Thank you very much, Admiral. I appreciate your testimony.

We have heard all of the witnesses scheduled for this morning. We had planned to keep going until 12 o'clock and come back at 1 and hear the industry representatives.

However, I understand there may be witnesses who weren't scheduled who would like to have 5 minutes of the committee's time. We would now be happy to give them that time, if they would identify themselves and come forward.

STATEMENT OF VICE ADM. LAWSON P. RAMAGE, U.S.N. (RETIRED)

Admiral RAMAGE. I am Vice Adm. Lawson P. Ramage, U.S. Navy, retired.

Having served, just prior to my retirement, as commander, Military Sea Transportation Service during the 3 peak years of our military sealift to Vietnam, I am quite familiar with many of the major transportation problems confronting us today. Therefore, I am very pleased to have this opportunity to appear before you this morning in behalf of the proposed high-speed transportation links between Washington and Annapolis and between Annapolis and Williamsburg.

First, let me say, that in 1960 while serving in the Office of the Chief of Naval Operations, I introduced the first operational requirement for hydrofoil craft which eventually led to the contract which the Bureau of Ships awarded to the Boeing Co. for the High Point. This craft proved to be invaluable as a test vehicle, and provided much of the essential operational data required for subsequent developments.

During the past 10 years, significant improvements, not only in hydrofoils but also in surface effect ships and air-cushioned vehicles, have proven the feasibility and reliability of such craft for both military as well as commercial transportation purposes. Their speed and size have been increased to the point where commercially profitable payloads can be projected. In fact, they offer the most promising solutions to our burgeoning inter-urban transportation problems.

Over and above the problem of crowded highways and congested city traffic, there are many other related factors that impact on this appalling situation. As our population continues to grow, more and more people are forced into the suburbs, adding to the ever-increasing demands for transportation.

Then, as the growing fuel crisis becomes a reality and drives transportation costs upward, more and more people will be obliged to turn to the low-priced foreign economy cars. Both of these factors have an adverse effect on our already heavy deficit in balance of payments.

Also, as highway traffic rises, so do traffic fatalities. It is estimated that 58,000 people will die on our highways this year, up dramatically from last year, and far more than all the casualties we have suffered during 10 years of war in Vietnam.

On the other side of the coin, we are beginning to see the impact of the environmentalists and the clean-air enthusiasts in these areas. It may well be that they will succeed in severely curtailing much of the free-wheeling transportation we have become accustomed to. All this will put an unbearable load on our already inadequate public transportation system.

So it is obviously apparent to all that alternate means of transportation are already overdue. Further delay can only compound existing problems.

It is now a question of what mode or modes of transport will best meet our future needs and how best they can be implemented. Certainly these new types of vehicles which we have mentioned offer an immediate and most attractive solution to some of our needs.

We have the requisite technical knowledge and experience to proceed with an initial commercially viable system. With the annual influx of 20 million visitors to the Capitol and the prospects of twice that number during the forthcoming Bicentennial celebration, there could be no more appropriate location for such a system than that now being proposed between Washington, Annapolis and Williamsburg.

Not only will it serve to move greater numbers of people expeditiously but it will also provide a most convincing demonstration of its feasibility to all who use it.

In addition, with a minimum of stops, it could tie in several satellite cities with the greater metropolitan areas.

It is for these reasons that I am particularly enthusiastic about the future of tracked air-cushioned vehicles and high-speed hydrofoils. I most heartily commend this committee for the interest you have shown in holding these hearings, which I am confident will lead to some positive and timely action.

Thank you very much.

Senator BEALL. Thank you.

You mentioned the inclusion of high-speed hydrofoils. Are you indicating that you prefer hydrofoils to the air-cushion or hovercraft-type vehicle?

Admiral RAMAGE. We have seen the *Tucumcari* perform under very difficult circumstances and it is very impressive in its maneuverability. It certainly has stood up to many contacts with surface debris. It is a very impressive operation.

We have these data. I am thinking as the previous witnesses have indicated that we are looking for something that we can get soon and into operation by the time the bicentennial comes. This is one area.

Of course, as we move into this field of transportation, developments will come very rapidly and improvements will be hard to keep up with.

Senator BEALL. But for demonstration purposes, you feel that the hovercraft is a viable vehicle, also?

Admiral RAMAGE. Yes, indeed. They are very effective, as Admiral James pointed out, and they are certainly here today, and commercially profitable.

The surface-effect ships also are rugged and impressive. I think that we need to get into this system one way or the other. But each one of these systems has specific advantages and attractions.

Senator BEALL. Thank you very much, Admiral.

Do we have another 5-minute witness?

If not, we will recess the hearing until 1 o'clock and resume at that time.

AFTERNOON SESSION

Senator BEALL. Ladies and gentlemen, we will commence the afternoon session of the hearing.

Our first witness is Mr. John Burcham, vice chairman of the Washington Suburban Transit Commission, and I might also say a member of the Prince George's County Council.

Naturally, in both capacities, he has a great interest in the urban mass transit problem generally and this project specifically because it traverses the area he represents and concerns the many people he represents.

Mr. Burcham, we are happy to have you with us and you may proceed with your testimony.

STATEMENT OF JOHN B. BURCHAM, JR., VICE CHAIRMAN, WASHINGTON SUBURBAN TRANSIT COMMISSION

Mr. BURCHAM. Thank you very much, Mr. Chairman.

My name is John B. Burcham, Jr. I am a member of the Prince George's County Council in Maryland. I also presently serve as vice chairman of the Washington Suburban Transit Commission, a bicounty agency of the State of Maryland that serves to coordinate the inputs of the Maryland suburbs of Washington, D.C., to the regional body building the 98-mile rapid transit system for the Greater Washington, D.C., area.

In addition, I represent Prince George's County as the alternate member of the board of directors of the Washington Metropolitan Area Transit Authority, Metro.

I am here to testify in support of the proposal to authorize the Secretary of Transportation to undertake a feasibility study of a combined land and water transportation system in this region as outlined in Senate bill 4023.

There is no question in my mind that this Nation must begin to put into operation demonstration projects to examine and illustrate the practical use of high speed-public transportation systems between our urban areas as an alternative to the automobile and, in many cases, to the airplane.

And now is the time and this is the place to initiate a demonstration project of this type which affords the opportunity to combine historical bicentennial activity with convenient accessibility to both the Washington metropolitan area and the Nation's northeast corridor.

It is certainly necessary that the major areas of concern to be addressed in the proposed feasibility study result in positive findings before we agree to continue with the design and construction of the project.

Should the results of the study prove positive it would then take close coordination among local, State, and Federal governments to assure its completion in time to be of service to our region by the 1976 Bicentennial celebration.

The remainder of my remarks will address only the portion of the system described in Senate bill 4023 between Annapolis and Washington; that is, the proposed track air-cushioned vehicle, TACV.

Again, the proposal for a high-speed system between urban areas is one which I find most attractive. But I wish to state that there may be troubles in finding an appropriate alinement for such a system through the urban area in Washington to an agreed upon terminus within the city.

It is for this reason that I would urge those who would perform the feasibility study to seriously consider and to evaluate the system based on an intermediate stop in the Bowie area and termination in the vicinity of the New Carrollton Metro Station which is located just inside the Washington Beltway adjacent to U.S. Route 50, the major highway between Washington and Annapolis.

With the coming of Metro and the ancillary supportive feeder bus system, along with the combined Metroliner-Metro Station and the adjacent highways, the Washington Beltway and U.S. Route 50, it is obvious to all those involved in transportation planning in this region that the New Carrollton Metro Station area will become a transportation center for the region, serving as a terminus or interchange point for Metro, Metroliner, local and regional buses, automobile traffic from the highways, and possibly the proposed TACV system from Annapolis.

I would again urge serious consideration of this as a terminus for the TACV system, with the sincere hope that all these modes of transportation could be integrated into a smoothly operating transportation center in time to serve the transportation needs of people from the Nation's northeast corridor to the Washington area for the Bicentennial.

I would like to commend and congratulate the sponsors of this forward-looking legislation. When one looks at the imagniative transportation systems being designed, and in fact in operation in some parts of Europe, to serve the general public, it is high time that we in the United States become imaginative.

We need to propose means of solving our transportation problems through exploration of various alternative modes rather than simply to perpetuate a single mode.

This kind of legislation encourages efforts to advance the state of the art as one additional alternative means of solving the transportation problems of our Nation.

Thank you very much, Mr. Chairman.

Senator BEALL. Thank you, Mr. Burcham. We appreciate your coming here today and taking time out of your busy schedule to come in and testify.

I think that there was general agreement this morning that the New Carrollton Station would be a good terminus for any TACV demonstration project that travels between the Washington area and Annapolis, because we are all interested in a balanced transportation system. Of course, the actual location will be determined by the feasibility study. We want to have systems to complement and not duplicate each other. We appreciate your suggestion in that regard.

Also, I would agree with your comment about the feasibility study being just that. We are looking for a study that if it proves positive it will indeed require the close cooperation of all levels of government, and some of us are sure it will prove positive and look forward to getting the kind of cooperation that is necessary to make the demonstration project become a reality.

I gather that you feel that a project of this sort would have adequate utilization at the conclusion of the Bicentennial, which would justify its construction for the Bicentennial.

Mr. BURCHAM. I certainly do, Mr. Chairman. I don't think it would be a one-shot project. I think it would continue to be operationally successful at a period of time passed by the bicentennial.

Senator BEALL. Thank you very much.

Now we will proceed with the regular alinement of afternoon witnesses as announced on the program. I know that some of the statements are very detailed, and we are operating under some time limitations. We would be happy if you could summarize your statement, and we will put the entire statement in the record so we can review the testimony.

Again, I would hope that we can limit prepared statements to 15 minutes, if possible.

Out first witness this afternoon, on the schedule of witnesses this afternoon, is Mr. Joseph A. Cannon, director of marketing for Bell Aerospace in New Orleans.

Mr. Cannon?

STATEMENT OF JOSEPH A. CANNON, DIRECTOR OF MARKETING, BELL AEROSPACE, NEW ORLEANS, LA.

Mr. CANNON. If you are referring, sir, to my prepared statement, I am not going to read from it.

Senator BEALL. I wasn't referring to yours. I was making a general statement.

Mr. CANNON. We represent the first of the industry team that is here this afternoon to try to bring to you our thoughts about the state of the art and how it can contribute to the basis of this program.

We have been in this business in Bell since about 1958. We have done $50 million of business for the Government. Our business is high speed at sea.

We are not interested at the moment in the TACV portion of this experiment, nor in the hydrofoil potential, but in air-supported vehicle applications.

So, I am going to run briefly through some viewgraphs and some slides, and point out here that it has taken a long time to break this barrier of 25 to 30 knots or so, and about getting the hull essentially out of the water, either on foils or by a cushion of air. Then we can expect to see speeds above 50 knots—we will be talking about crafts with speeds above 60 knots today.

(Slide.) This overview attempts to show various vehicles that we have worked on at Bell that can give us a technology base for the successful applications to the experiment.

On the upper left, that is an SRN5 derived from England, a Skimmer I, *Voyageur*—all of these are in my text—the SES100 ton is in test; LC–Jeff, a large amphibious craft is under construction. The SRN4 outlined in the dark line represents the largest vehicle operating today. The other outlines are sizes of vehicles that our Navy is now studying with us and with other industry for the future in the 1980's.

They are confident and we are confident that the technology is here.

We are going to be talking today about two kinds of air-supported vehicles.

(Slide.) On the right my chart shows the surface effect ship as our Navy knows it, a solid sidewall nonamphibious vehicle, and on

the left is the ACV. They both have missions to do and both have capabilities and disadvantages.

(Slide.) We will try to show that we think the study and the outputs of the study will determine the vehicle best suited for this particular application.

We are going to talk first about the kind known as the SES.

(Slide.) Let me show you a short film clip of our current craft.

(Slide.) This is what it looks like running 35 to 50 knots.

(Film clip shown.) We have been testing this test bed for the past year. Its objective, of course, is to get high-speed information as a scale model for large craft in the future, perhaps 2,000 tons, or 2,500 tons in size; 35 knots, which isn't too fast, actually scales out to about 65 to 70, and when we run it at 50 knots we are scaling the 80- to 90-knot operational speeds of large ships in the future.

Inside, data is being collected. We are gathering data on all of the vehicle parameters. The recorder shown here is recording all these things so the craft can be used to assure us that we could build a 2,000 ton or more ship.

This air shot shows the craft running at higher speeds, and moving on up to 50 knots.

Above 50 knots, the speed of these crafts is classified since the Navy will be developing operational ships using this configuration.

However, even these runs at 45 to 50 show that the craft behaves well.

One of the things we are talking about today is pollution and one of the things we don't do with this craft is make waves. These vehicles have a shallow draft and they can run in areas that are quite narrow such as certain portions of the Chesapeake route without making erosion of the shore a problem.

Once again, I think they will be a good neighbor. There is a relatively low noise level. We have had runs at about 50 knots passing close by our chase boat and we find the noise levels are very acceptable since the noise generating propellers are essentially beneath the surface.

(Slide.) This is a shot of the craft doing somewhat in excess of 50 knots.

Where do we go? This is an artist's concept of a 2,200-ton escort ship.

(Slide.) This is a 10,000 ton transport ship. Of course, these are larger than what would be required for your project, but on the other hand it does point out that we can get there from here.

We think if we can go to 2,000 tons effectively we can certainly build ferries that will serve your purpose.

(Slide.) On the other side of the coin is the amphibious vehicle.

(Slide.) Here are SK5 craft similar to those which were in operation in Vietnam.

(Film shown.) Sometime ago in the mid 1960's we had the pleasure of running the first experimental ACV airport access program. There was a short trial by HUD back in 1966. The program involved running across the bay and doing somewhat the same job in airport access as the helicopters did. At speeds of 50 to 60 knots.

The three things we wanted to find out were operational feasibility, which I think was fairly well proven five years ago, economic feasibility, which was not, because the craft were small and we were in a

very strange environment with respect to fare structure, and finally passenger acceptance, which generally was good.

However, we did have complaints about the ride, and those are the things that we have been concentrating on.

We have been looking at ride control, to give John Q. Public, who is used to riding in a comfortable motorcar or in a jet airplane a smoother ride. This can be accomplished by dynamic cushion control.

One of the Navy's approaches to the ACV, flexible side wall type of craft, in the mid 1960's was Skimmer I. Skimmer I did 70 knots, just to give you some idea of the speeds available. Her main role was to show our Navy how it could land amphibiously. One could land through the surf, come up on dry land and unload troops or cargo.

I point this out because I think that the study, as you proceed in it, may have to look at different kinds of port support. And this affects initial costs.

One of the things that may dictate the kind of craft which might be selected is whether or not you want to use existing dockage. If so, the craft could be docked there as a conventional boat. If on the other hand a beach were available, you could take advantage of a site that would require minimal preparation, and this might affect your choice of chart.

We are pointing out to you gentlemen that several kinds of craft exist. The technology is here and it could do the job.

Using this technology Navy is now constructing several large 160-ton amphibious craft. Here is a full-scale mockup of the Bell LC Jeff(B).

Though they are basically cargo carriers there is no reason why passenger versions can't be derived with no breakthroughs required in technology.

Of course the main objective is to get through the surf and up on the beach high and dry. In England, this is being done ferrying cars. As shown in this motion picture clip of the British SRN–4. There was some testimony about it earlier today. Four of them are operating. They have carried perhaps 3 million passengers. Their job is not quite the same as the Navy landing craft. Their job is to carry passengers and equipment across the channel. They have done a good job in acquiring some 30 percent of the total channel traffic.

Again, I point this out, that the size of the craft envisioned for the Chesapeake Bay project will be dictated again by the study results; how many people you want to carry, the journey time, the frequency. Those things will dictate as to whether these should be as big as the SRN–4 which carries 550 to 600 passengers, in an all-passenger version, and around 200 passengers and 30 or so cars in the version currently in operation.

The SRN–4 channel ferry has been so successful that one of the operators is now stretching one of their craft to almost 200 tons, to get more capability. As it was said this morning, you have to wait to get a ticket ahead of time. You can't walk down to get a ticket. So once again it is not that we are saying that the British craft is the vehicle for us, but it points out that in other places in the world there are viable commercial operations where profits are being made and the transportation of people is being solved in a new and novel way. The craft comes up on the shore, here, and it doesn't require docks. In this particular case there are very high tides which create a real

problem unloading at a conventional dock. Here you can come right up on the beach ramp.

Incidentally, the SRN–4 is quite quiet. Local traffic, as I mentioned in my paper, from trucks and buses on the highway nearby are perhaps 5 decibels higher in noise than this craft.

Our Coast Guard is involved in ACV's and from the standpoint of safety, they have been operating these vehicles for about 2 years. They are becoming very familiar with the characteristics. As a result they are quite well qualified, I think, as a body who would advise the industry about safety at sea, and can really give us knowledgeable assistance.

My final section of this briefing will concern a craft that is not being build here in this country. It is being built by our Canadian subsidiary. It is a little small for the task involved, but again, it is hardware that is running and will show people that the technology is here.

This is a short film clip taken this past winter in Toronto where we were doing trials for vehicle certification.

(Film presentation.) It is operating on Lake Ontario, from a small sland airport. These craft are gathering more and more operational information. We are in production now. By the time this new program gets underway they will be in use throughout the world in commercial application. We are building six more craft now and we expect about a dozen more this next year or so.

Senator BEALL. What do they cost?

Mr. CANNON. About $1.3 million in the cargo version and the passenger version will be about $1.5. They can be used for many uses. We are interested in pollution control, in smaller ferries, or in an intermodal system, where you don't get off the bus when you board the ferry.

I think really if we look at this artist's concept of an AGV terminal, we can say this might be the kind of a terminal that could be developed, and again the study will dictate that.

What we can say is that we don't really know which craft is the right craft. Each has certain advantages. On one side the amphibious craft may give us better operations, say, in shoal water—it may shorten the route. It is the safest as far as hazards from debris. We can run over almost anything. Finally, they have quite high speed, about 25 percent higher speed than other air supported vehicles.

On the right-hand side of the chart, when we talk about the SES, we can say they are more efficient. They are slower, but they have the lowest noise level. Again it is a trade off. Those are the factors we are studying and will be prepared to evaluate when the route and operational requirements are determined.

Therefore we think perhaps in the context of my chart that I showed earlier, the proposed ferry might be about this size. It might be around 200 to 250 passengers. In size, slightly larger than the LC Jeff (B).

(Slide.) It might be around a hundred feet long and perhaps 50 to 60 feet wide. It would fall within the technology that we feel exists today.

In closing, I think our position is that yes, we can develop a family of vehicles, to do the job and again the size and type will be dictated by the study. The requirements of safety, reliability, and those things that influence you and I who ride in them I think are pretty well in hand.

But whether you make it a big or fast vehicle or whether you want to have it amphibious or not will really depend on the outputs of the study and how these vehicles can best serve the requirements for this.

Finally in closing we would like to say that, we think such a vehicle can be developed to be operational in 1976 but we have to move out rapidly and we need some answers from the study perhaps by the end of 1973.

Senator BEALL. Thank you very much, Mr. Cannon. I think you have answered my first question.

I was going to ask you how long it would take you to deliver a vehicle once the study was completed.

Mr. CANNON. Two to two and a half years.

Senator BEALL. What would be the cost of the vehicle in the 100- to 200-foot passenger range, either version?

Mr. CANNON. Really there isn't much difference between versions. When you develop a craft of a given size and speed and passenger convenience and the like, how you do it doesn't really make too much difference. We think in the area of $3 to $5 million.

Senator BEALL. Per vehicle?

Mr. CANNON. Per vehicle.

Senator BEALL. On an individually produced basis?

Mr. CANNON. You get a learning curve type of thing, when you build many of them, and you might end up with reductions of 20 to 30 percent after 10 or 20 vehicles. Again we would like to really look at the thing in detail. We think that around perhaps $30 a pound in production is a fair—off the cuff—look-see at hulls, empty weight. That says a hundred tonner would probably weigh about 60 tons or 120,000 pounds, empty. Therefore $30 or so times that is around $3½ million, approximately. I think that is about right.

I think more important than the first cost is operating cost, and the DOC's, cost per seat-mile. I think, as has been proved by the large aircraft manufacturers, it isn't whether you pay $25 million for the first cost, it is the cost per seat-mile that makes the vehicle viable.

Senator BEALL. Did I understand you to say that the air-cushion-type vehicle is more expensive to operate than the other type vehicle?

Mr. CANNON. No; I say most any of them are about the same for size and passenger convenience. I will give you an example.

Senator BEALL. For operation?

Mr. CANNON. Yes.

Senator BEALL. As well as additional cost?

Mr. CANNON. Yes, let's take an example. With the 550-passenger version of the SR–4, which has been in operation 4 years, the DOC is about 4 cents a seat-mile. A little craft, about like *Voyageur* that I showed a moment ago, that might be 15 to 20 cents a seat-mile.

We think that craft of this Chesapeake Bay size will be probably 7 cents or so a seat-mile. Approximately that. That would mean that the fare would be competitive to even air fare. The air fare from, for instance, Baltimore down to Norfolk is about $28 first class, and we think the cushion borne fares would be less than that. If they were, you would certainly capture, which is the important thing, you would capture people from other transportation systems.

Senator BEALL. Do you envision weather problems in the operation of these vehicles?

Mr. CANNON. We think these craft can handle that problem. We have looked very carefully at sea state, weather conditions and so on in the Chesapeake area. We find it is a pretty good area for a pilot operation, as a matter of fact.

As I understand it, there are days, less than 8 percent per year, when the visibility is less than 500 yards, so almost any day you could see the shore and people would enjoy ride.

Traveling at 60 knots you would have to do something about collision avoidance and good radar is a requisite. We were just operating the other day on Lake Pontchartrain when a fog bank came in and we were able to navigate back completely on the radar. So that is a key instrument.

We don't think weather is a problem in this particular area for these kinds of craft.

Senator BEALL. From your experience how long do you think a feasibility study ought to take?

Mr. CANNON. As I understand, it is around 9 months. I don't think it needs to be much longer than that. As a matter of fact, we are embroiled right now on a very complex Navy program, a study of a 2,000 tonner, and it is only 9 months long. I think that would be an average time.

Senator BEALL. You would require 3 years for delivery of the vehicle?

Mr. CANNON. I would say 2½ years, perhaps.

Senator BEALL. Where would you produce these vehicles?

Mr. CANNON. We would produce these vehicles in New Orleans, which is our main facility.

Senator BEALL. You are using gas turbine engines?

Mr. CANNON. Yes; we are, sir.

Senator BEALL. How about the air emission?

Mr. CANNON. These are the things that, since they are basically aircraft engines, there are already programs underway to get better burning. In fact, the airlines are now doing this. We think we will benefit from this kind of emission control in time. I think we can take the engines that are available.

Now, generally, a turboshaft engine, which is a variation of the turbojet engine, does burn relatively cleaner. We have had good luck with our large 4,500-horsepower engines. I can't quote specifically what the emission standards are, but they don't really smoke things up too much, considering the power level.

Senator BEALL. What is the estimated life of your vehicle and of the engine in the vehicle?

Mr. CANNON. Well, I think experience has proven that aircraft and their engines have amazing life. We are not in the large commercial aircraft business so other witnesses could testify on that. I would certainly think that 20 years for a marine gas turbine is within the realm that may be possible, or maybe even longer than that. But as long as they are overhauled periodically and parts that require being replaced are replaced on schedule, there is no reason they shouldn't last as long as the hull last itself.

Now, how long does the hull last? Again, I don't think we could think of the DC–3's as lasting as long as they have, and they have lasted a long time. As long as these boats are maintained on schedule,

everything is periodically inspected, the hulls are taken care of, their life should be as good as any other vehicle—20 or 25 years.

Just offhand, for determination of total operating costs of vehicles, we have considered 10 to 12 years' life to 20 percent residual value for amortization purposes.

Senator BEALL. Have you examined the revenue-producing capabilities of a project of this sort? Do you have any idea of how many runs would be required to make something like this break even?

Mr. CANNON. I am a little new on this particular area, sir, and I am not really qualified to discuss it. I think that others can, perhaps, that have looked at it closer.

Senator BEALL. If someone in the company could provide something for the record, it would probably be helpful.

Mr. CANNON. We will take a look at it. We do have a model of an effectiveness study on transportation that we can plug in the factors for this project.

Senator BEALL. Thank you very much, Mr. Cannon.

(The statement follows:)

STATEMENT OF J. A. CANNON, DIRECTOR OF MARKETING, BELL NEW ORLEANS OPERATION, BELL AEROSPACE DIVISION OF TEXTRON

Mr. Chairman, Bell Aerospace appreciates the privilege of appearing before this committee in support of the proposed bill which would authorize the Department of Transportation to undertake a study of a high-speed marine transportation system in the Chesapeake Bay area.

We recognize that the complete high-speed-transportation system envisioned in your proposal would embrace both land and water borne vehicles. Bell's forte, interest, and experience in high-speed transportation involves waterborne vehicles using air cushion supported technology and our remarks and observations will be limited to these craft.

Bell has been actively engaged in the design and construction of these types of craft since 1958. Numerous tests and analytical study programs have been conducted for the Bureau of Ships, Office of Naval Research, and the Surface Effect Ships Project Office as well as on a company-sponsored basis. In these past 14 years, Bell has completed contractural and company-sponsored programs in excess of $50 million.

In the performance of its numerous contracts, Bell has gained considerable depth of experience in structures, air cushion systems, marine diesel engines, marine gas turbines, gearboxes, and shafting with associated drives, propellers, et cetera. These systems have been mounted and proved on ACV's. In addition, cushionborne craft design capability is enhanced through a British Hovercraft Corporation/Bell Aerospace technical interchange and license agreement. Through this agreement, Bell has licensing rights to certain BHC designs and patents, including BHC skirts and seals and has access to the outstanding research and development achievements of BHC in this field. For example, Bell can, at its discretion, acquire the engineering drawings of the SR.N4 if it is beneficial to its current or expected programs. During our long experience with this unique form of transportation, some 18 vehicles have been constructed and tested. Furthermore, Bell has been active in research and preliminary design studies of cushionborne craft for many applications.

Current DOD programs, whose technology impacts directly on this most important undertaking, are the SES–100B Test Craft Program and the Amphibious Assault Landing Craft Prototype Program, both under development by Bell for the U.S. Navy. In 1969 Bell was awarded a contract for the detail design and fabrication of a 100-ton test craft for the Joint Department of Commerce (MARAD) and the Navy. In 1971, the program was transferred to the Naval Material Command where emphasis is now being placed on purely military applications. This 72-foot supercavitating propeller driven craft was first launched in July 1971 and is now deep in its test and evaluation phase. Data from this solid sidewall vehicle, designed to ride on a cushion of air, at speeds approaching 100 knots, will be used to validate the design of future high speed multi-thousand ton ships.

In early 1971, Bell was awarded the design and development contract for two prototypes of a modified C150–50 configuration. These craft have a nominal payload of 60 tons at 50 knots and an overload capability of 75 tons. Design is well under way, tooling has begun and a launch is scheduled for late 1973.

In addition to our major Navy programs, we are in production on the Voyageur class of air cushion vehicle in our Canadian facility. This twenty ton payload, 138 passenger cargo ferry will be in quantity use by commercial operators by 1975 and might serve as an interim demonstrative vehicle for the project.

We are particularly delighted to see at long last our country's recognition of the potential of this new family of vehicle in a peaceful application which can do much for our national image, since in Europe hydrofoils and hovercraft have been used in commercial service for many years. This country's only experience with an experimental high speed marine transportation system involved a Housing and Urban Development sponsored San Francisco, Oakland Airport, Feeder Service during the mid 60s. This bold experiment participated in by Bell attempted to evaluate the potential of the embryonic air cushion vehicle in a competitive environment with the accepted helicopter service.

The developments in cushionborne aircraft technology which have occurred since this pioneering experiment now make possible a more confident approach to high speed water transportation and make the proposed bill particularly timely.

The factors involving craft design for this forthcoming proposal appear to be broken down into two areas. The first involves those items most important to the passengers well being; namely, safety, reliability, noise pollution, and passenger comfort, and a second group which is dictated to by route structure and passenger volume and involves vehicle size, speed, cushion configuration, port support impact and costs.

This afternoon we will briefly touch on these factors as we now see them in light of today's technology.

SAFETY

Throughout the past ten years of operational vehicle usage, we feel the cushionborne craft has had a remarkable safety record. More than three million passenger miles of commercial and military operation have been accumulated in varying applications throughout the world.

In the early days of commercial applications of the amphibious ACV, several instances of craft overturn have been recorded with ensuing international discussions on the subject. Comprehensive tests and design modifications to the skirt systems of these vehicles have now made them impossible to overturn if proper operational procedures are followed. Most recently, however, a commercial vehicle in England was operated far beyond its operational limitations with high winds, rough seas and improper operational techniques resulting in a vehicle overturn with some loss of life.

We think you can understand that any craft improperly operated beyond its limiting boundaries could result in a possible capsizing or incurrence of hull damage. A recent case of this occurred when a military hydrofoil was improperly operated in shoal water and resulted in the forward foil being severely damaged.

As you know, our U.S. Coast Guard, the regulatory body for safety at sea here in our country, has been operating the ACV type of high speed marine vehicle for the past two years, has become very familiar with its operational procedures and design characteristics, and is in an excellent position to monitor and advise during vehicle construction if this type of craft is selected. Therefore, from a safety standpoint, we can be assured that industry working closely with our Coast Guard can produce a craft of high safety factor regardless of specific configuration.

RELIABILITY

Reliability in the cushionborne type water craft has continued to be improved as more and more operational hours pile up and a better understanding of those components which have caused problems evolves. The move toward gas turbine engines by the aircraft industry resulted in greatly increased reliability as far as propulsor contribution, and variations of these same type of engines have been used and will be used in this waterborne class of vehicle. Better reliability with regard to cushion containment seals is being realized through better materials design and fabrication as well as methods of attachment. Skirt life has increased from perhaps the 100 hours of five years ago to better than 1,000 hours of today.

NOISE POLLUTION

Bell recognizes that in order for this proposed high speed water transportation to survive, it must live within the increasingly srtict environmental pollution standards that are being set forth. In particular, we would like to address the noise problem which from time to time has appeared to impact on air propeller driven cushion craft operations. When earlier versions of commercial air cushion vehicles were introduced some five to seven years ago, existing aircraft propellers were used for propulsion and which were not specifically designed to minimize noise. High propeller tip speeds resulted in sometimes unacceptable noise levels and in England several early operations were terminated because of the noise impact on the nearby populace. Noise impact on environment was taken into consideration in the design of British SR.N4 and this giant of the ACV world with some 14,000 installed horsepower is accepted as a friendly neighbor in the ports from which it operates. This is due to incorporation of large propellers rotating at low speed which produce must less noise or at least produces noise in a frequency spectrum more palatable to the public.

Recently SR.N4 noise measurements were made around one of the operating terminals while the ship was being maneuvered under high power. Maximum noise did not exceed 80 db 1,000 feet which was measured on the periphery of the landing pad. The general traffic noise in the area around the terminal and especially heavy trucks operating on a nearby road exceeded the SR.N4 noise level by some 5 db. Since the 1975 noise criteria for automobiles in the United States have been set at 80 db at 50 feet and for trucks at 90 db at 50 feet, it would appear that possibly 80 db at 500 to 1,000 feet would likely be a logical limit for high speed waterborne craft. It would appear to us that it is within the technology to produce high speed waterborne craft using air propulsion in which noise could be controlled by utilizing larger, low velocity propellers or by ducting the propellers with ducts using the tuned resonator principle. If the results of the proposed study set operational criteria where water propulsors would be more desirable from the efficiency standpoint, these will not present noise pollution problems.

The SES–100B which is an example of current technology, using water propulsors, is a craft of approximately 100 tons in size with high installed horsepower. Noise measurements of this vehicle during high speed runs in Lake Ponchartrain appear to fall well below the previously mentioned limits.

PASSENGER COMFORT

One of the limitations of any high speed marine vehicle is in its sea-keeping or ride capabilities. Displacement hulls generally have adequate ride capabilities, but are limited to relatively slow speeds and have not been considered for this study. Planing hulls have notoriously poor riding capabilities due to hull impacts with the waves and resultant high vertical accelerations imposed on the passengers. The solution, therefore, lies in operating the hull physically out of the water as is done either by application of hydrofoils or an air cushion containment system of one type or another.

Current cushionborne craft up until now have relied upon the low cushion pressures from 0.3 to 0.6 of a PSI to attenuate the wave impacts. However, as higher seas are reached, especially by craft of the size to be considered here, the cushion does transmit vertical accelerations into the hull. Air Force studies of vertical acceleration criteria, from the human factors standpoint, show that for military operational applications, vertical accelerations should certainly be no more than .1 g for any sustained operations. For the passenger who is now used to riding in softly sprung automobiles so common in America or a smooth ride in a jet transport at 30,000 feet, these criteria must be substantially modified.

Current studies indicate that passengers will expect riding qualities wherein the vertical accelerations do not exceed .05 g's. Small air cushion supported craft using passive cushion systems will exceed these values in significant wave heights of six feet or more. Recent investigations by Bell and others show that dynamic cushion control systems can be installed which modulate cushion pressure as a function of wave action. Reductions in vertical accelerations of greater than 50 percent are available by incorporation of such a system which will bring the cushionborne craft riding qualities down to below the .05 g level. This should make cushionborne vehicle travel appealing to the most critical rider.

The factors of vehicle design influenced by the route structure will be discussed next. Obviously, cushionborne high speed marine vehicles become more efficient

with size; that is, their operating cost per seat mile becomes significantly lower and results in lower fares for a given stage length. A key element of the study will, therefore, be an analysis of the passenger journey frequency, overall passenger daily flow, capture ratio from other transport systems and will determine the optimum size of the vehicle to be selected.

An example of this can be shown in an existing ACV such as the SR.N4. This vehicle in an all passenger configuration with luxury refreshment stands and other passenger comforts would carry approximately 550 passengers at 60 knots and would result in a seat mile cost of approximately four cents. Similar vehicles of perhaps 50 passengers, in capacity, might result in seat mile cost of 12 to 15 cents, but a large vehicle operating at a very low load factor is a financially inefficient device. Since its net seat mile costs could exceed the smaller vehicle, a proper balance between the passenger flow, departure frequency, journey time and resultant costs of fares must be met. These factors will determine the vehicle size.

With respect to speed, generally the higher speed the higher the productivity and the lower the seat-mile costs, with other factors constant. But higher speed generally means higher drag, higher horsepower requirements, higher maintenance costs: so again, a trade-off is required.

Bell would recommend that for a family of air cushion supported vehicels a 60-knot operational speed be considered. This falls within the technology available today and represents a significant advancement in waterborne speed over existing vehicles.

Factors affecting the configuration of the vehicle as to whether it is amphibious or not are dependent upon the characteristics of the marine waterway over which the vehicle must travel and whether existing port facilities will be utilized or whether new ones are to be built. Consideration should be given to whether an amphibious craft could minimize port construction costs by using existing beaches, thus lowering the overall system costs and whether routes through shoal waters might save appreciable time by shortening the distance.

With respect to vehicle cost, Bell Aerospace does not expect to see any gross difference in vehicle initial cost or maintenance in vehicles of the same size, same speed, same stage length and same passenger conveniences. Bell would expect that these type of craft regardless of configuration could be constructed for $20 to $30 per pound of empty weight, with some reductions in production quantity costs due to learning curve applications.

Thus, Bell Aerospace sees no overriding technical bottleneck in the development of vehicles for this proposed high speed marine transportation program. The proposed Chesapeake Bay site selection appears to be moderate in its temperature and weather excursions. The general Chesapeake Bay area experiences moderate northwest winds during the winter months and southwest during the summer. The sea states are moderate with significant wave heights above five feet experienced less than 20 percent of the time and days with visibility less than 500 yards are limited to less than eight percent of the time. This environment should make the introduction of this new transportation system pleasant to the traveler from the sea state standpoint and the general good visibility should allow an exciting panorama of historical sites to be viewed as he journeys the Chesapeake at unprecedented water speeds.

Bell supports the bill in that it creates an industry incentive toward the development of the high speed vehicles which existing technology will allow.

In conclusion, these are Bell's observations regarding the technology of cushion-borne high speed marine vehicles with respect to the proposed S4023 bill:

1. A family of vehicles derived from current U.S.N. SES/ACV programs can be developed to efficiently serve the S4023 proposed program.
2. The requirements for safety, reliability, passenger comfort and environmental pollution control can be met with designs evolving from the technology available today.
3. Choice of vehicle size, performance, cushion containment configuration and propulsor will evolve from the peculiar requirements resulting from the study.
4. Vehicle availability in 1976 is dependent upon study completion and requirements definition by the end of 1973.

Senator BEALL. Our next witness is Mr. William Shultz, manager of Commercial Jetfoils Group, from Seattle, Wash.

STATEMENT OF WILLIAM SHULTZ, MANAGER, COMMERCIAL JET-FOILS GROUP, BOEING CO., SEATTLE, WASH.; ACCOMPANIED BY RALPH PATTERSON

Mr. SHULTZ. I am William Shultz, manager of the commercial hydrofoils, The Boeing Co.

I am going to summarize the prepared statement that I have given you, and also with your previous agreement, part way through this, I am going to introduce Mr. Ralph Patterson, who will also make a few remarks.

We appreciate the opportunity to appear before you today with regard to S. 4023. It appears to us that the bill has several objectives, the principal one, of course, to move people rapidly with safety, flexibility, without congestion, at a reasonable cost to both the user and taxpayer.

Obviously the equipment should be capable of consistent, reliable operation; comfort and convenience must also be inherent considerations, or people simply will not use the system no matter how well it meets any of the other objectives.

In keeping with the theme of the bicentennial and the area in general, it would be counterproductive if smoke, pollution, and noise were part of the system, either internally or externally. The equipment should pollute neither air nor water, nor otherwise impose itself on the community it intends to serve. In other words, it must be a good neighbor.

A second objective would appear to be that of demonstrating an intermodal system. Senate bill 4023 gives particular focus to an advanced ground system, interfacing with an advanced marine transportation system.

One weakness of our whole transportation scheme of things is the lack of overall integration, effective from a user's standpoint, of the various modes of transportation. This bill would provide the specific opportunity for demostrating two advanced fundamental modes in joint operation. With other systems that exist to feed into both the ground and water systems, a much broader intermodal integration can probably be accomplished as the detailed planning and implementation actually takes place.

I would like to move directly now to the many different kinds of marine vehicles that have been built. All have had their problems and there were always times when the water conditions caused travel to be suspended.

Some of the time, travelers got sick and water travel was uncomfortable, undependable, and slow. It is little wonder then, as other forms of transportation developed, offered greater comfort, schedules, and higher speeds, that people left the water and went to land or air for their transport.

Our current problems of population growth, traffic congestion, and pollution demand that we again take a look at the potential that water passenger transit has to offer, because cities have major waterways that are unused, and undeveloped. These water freeways are available with a minimum of property condemnation or community disruption, and destruction.

Water rights-of-way are inexpensive to maintain and water systems are flexible. In theory, at least, water passenger transit should have much to offer society and community development.

But the key question is, Can marine vehicles be made available that will meet the demand of comfort, dependability, and high speed within ecological constraints, and be a good neighbor to other users of the waterways and those living on the shore? And, if so, can they be economically viable, since many transit systems are losing money.

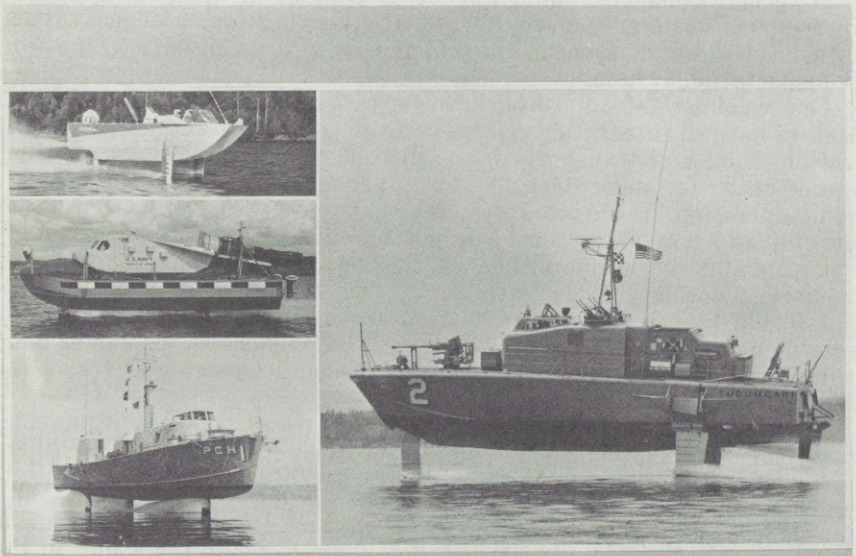
We feel that the most economic, critical factor in any transportation system is passenger acceptance. As I said, no system is worth much if the people it is intended to serve won't use it.

I have contended that other marine systems have been unacceptable, because they were uncomfortable, undependable, and slow. We can only conclude that what is needed is to provide one, then; comfortable, dependable, and fast. If the water never got rough, it would be a very easy job to do, but unfortunately, wind blows, water gets rough, so this must be taken into account.

Now, there have been a number of vehicle types mentioned here, today, such as hovercraft, SES, and hydrofoils. I would like to point out that with only one exception, all of these vehicles are what we call surface followers.

In other words, the vehicle motions will essentially follow the wave motions with some modification. Now, that exception is the fully submerged foil, autostabilized hydrofoil.

The Boeing Co. has been working on this concept of a marine craft for nearly 14 years. Much of this work has been in conjunction with the U.S. Navy, as you heard before, and we have built four different hydrofoils during that time.



LITTLE SQUIRT
FRESH
PCH 1

PGH 2 TUCUMCARI

I will quickly mention what they are.

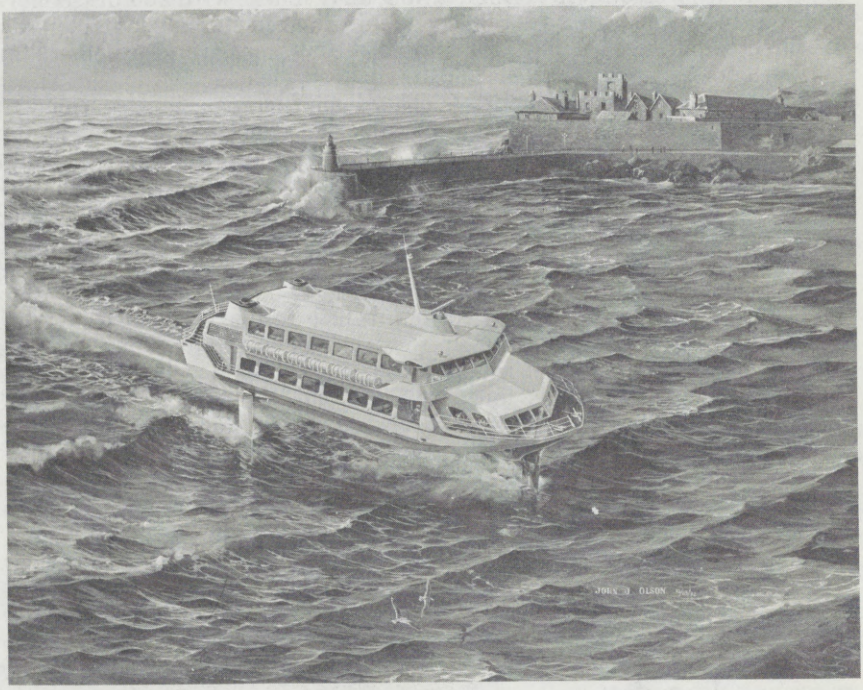
The one in the upper left was the first water, jet-propelled hydrofoil. The next one is an experimental hydrofoil. And, that is the fastest hydrofoil in the world, having gone over 90 miles an hour, and as far as I know, it is the fastest marine vehicle in the world.

The next one down is the PCH, and that is the oldest operational hydrofoil in the United States. It has already been running 8 years, and it is still in service, and as a matter of fact, we have just remodified it for the Navy and it is about to go back in the water.

The one on the right is the *Tucumcari*, and in a minute, I will show you a film clip of that boat in operation.

Over $15 million has been spent in research on the foils and the auto-stabilization, and control systems, and the propulsion systems.

All the information we have gathered has been incorporated in our commercial passenger-carrying jetfoil. This is a sketch of the jetfoil.



The key element in the design is very much a part of the reliability; and the propulsion system and the stabilization system are the key ones.

In the application of waterjet propulsion to high-speed marine craft, the Boeing Co. can actually lay claim to being the leader in the world. The proof of this experience is amply demonstrated by the performance of the *Tucumcari*, that I mentioned before.

And the first film clip will show the vehicle taking off, rising up out of the water.

(Film.) You will be able to see the waterjet propulsion units coming out of the bottom. I might mention that all of the technology, the materials, the control system, and the propulsion techniques that have

been proven in this boat, after nearly 5 years of operation, are the ones that are going into our commercial design.

Now, the mechanical simplicity of the waterjet, with no complex gears or drive trains, or propellers to be maintained, lubricated, or repaired, provides for extreme reliability, and an easily maintained vehicle; in fact, easier than can be found in any other transportation system.

The foil system is fully retractable, permitting operation out of shallow harbors and the foil tips do not extend beyond the hull edge; then you can utilize regular docks, too. To give you some feel, on the hull, fully extended, the foils draw only 16 feet of water, and with the foils and struts up, it draws less than 5 feet of water, so it could go into any dock that you could get a pleasure boat into.

The passenger accommodations are arranged in three cabins to provide a comfortable, pleasant, air-conditioned interior. All of the aisles are 30 inches wide and in configuration, shown here with 250 passengers in the three cabins, there is 56 cubic feet of cabin space per passenger, which is classified as superb for trips up to 2½ hours, and excellent for trips up to 5½ hours.

The propulsion system consists of two gas turbines, each coupled to a waterjet pump. Water enters an inlet, travels up the duct to the pumps, and is discharged through nozzles in the hull bottom. I would mention at this point, that these gas turbines are actually free turbines. They are turboprop—turboengines that have been in development for many years, having over 50 million hours of proven running time on them, and, as a result, they are very clean and quiet. I will give you some ecological data in just a second.

Now, the jetfoil is designed to maintain a foilborne, cruising speed of 45 knots in all sea conditions up to waves 12 feet high. That is cruise speed. Obviously it will go much faster than that in calm water.

What we need to do is find out what the boat will do under all conditions because that is the speed you have to schedule it at in order to have a successful transit system.

Now, the boat meets or exceeds all of the applicable safety regulations of the U.S. Coast Guard and SOLAS. And, in fact, the design has already been approved by the Coast Guard for all of its safety features, and incidentally, UMTA has qualified it for the capital grant program.

The foilborne control system is completely failsafe and it is totally dualized, so if any channel goes out, the boat will continue to fly. The foil system is designed for floating-debris impact without damage or passenger discomfort,

Now, the next slide shows the environmental considerations.

ENVIRONMENTAL - POLLUTION

AIR EMISSIONS:

No visible smoke (Ringleman Zero)
Hydrocarbons & Oxides of N < 5 grams/BHP hour
CO < 25 grams/BHP hour

Proposed California Standard - 1975
for vehicles over 6001 pounds

WATER POLLUTION:

No contaminate discharge from vehicle

These have been very much in our mind in designing this boat. The external noise level at 50 feet from the centerline of the boat at rated power, will be less than 85 dba, and to give you a feel for what that is, that is about the same as one of today's passenger cars driving down a freeway at 60 miles an hour.

Now, the air emissions are very low. There will be no visible smoke. The hydrocarbons and oxides of nitrogen emission will be less than 5 grams. If you look up there, you will find that the standard is 14, and we are at 5. The carbon monoxide emission will be less than 2 grams while the standard is 20.

So, this is a very clean boat. There will be no contaminated fluids or wastes of any kind to be discharged in the water.

Now, some other important features of this type of vehicle. If you are going to operate it in congested areas, particularly where there are other users of the waterway, I would like to show these.

(Film.) First, this boat makes no wave when it is operated at cruise speed. As you can see, as it goes by, there is nothing here to disturb other boats or to come up on the shoreland and give you a problem there.

Another thing about it is that normal stops—from 45 knots—can be accomplished in less than 500 feet. If you want to stop quicker, you can tell the control system to dive into the water, and with that, you can stop very fast. Deceleration in this particular stop is no bigger than what you feel in a jet airplane when it uses its thrust reversers on landing. It looks spectacular.

Precise maneuvers can be made in all seas and at all speeds. The reason for this is that the craft banks into all turns, just like an airplane does, and the result is that the forces on the passenger are very low.

To give you some feel for this, once you initiate a turn, the boat can be turned at 6 degrees a second—6 degrees a second within 5 seconds. And you can keep that running.

The next most important feature of this vehicle is its ability—because it is decoupled from the surface of the sea—to give an outstanding ride, regardless of the water conditions.

Now, this shows it coming down Puget Sound one night after a test. These are very steep, short waves, for a confined body of water. I am sure you can get these kinds of things in your Chesapeake Bay. As you can see, there is a camera mounted forward on the forward deck.

In a second, I will show you what the camera saw while the run was on. You can judge for yourself the stability of the boat. You will see in a second, it starts to make a turn. This is at cruise speed—about 50 miles an hour.

The commercial jetfoil is currently in production in our factory in Renton, Wash. The first one will be operating in Puget Sound 1 year from now. The first operational passenger-carrying service will be between Hong Kong and Macao, starting in July of 1974, and the first domestic service is scheduled to be in the Hawaiian Islands commencing in the fall of 1974.

At this point I would like Mr. Patterson to make his remarks because they will be the poeple who will be using this commercial jetfoil.

Mr. PATTERSON. Mr. Chairman.

My name is Ralph Patterson. I represent Kentron—Hawaii, Ltd.

Kentron is a technical services contractor, and among our current contracts is a contract to the Department of Transportation for the operation and maintenance of the Pueblo Test Center, which was mentioned in testimony this morning.

In the field of water transportation, in 1968, we began an in-house study of advanced marine transportation methods in Hawaii. At that time, we studied all types of vehicles, including hydrofoils and hovercraft, and had no particular bias as to the particular type of vehicle that would be most suitable for operation in the islands.

We did have some criteria that we looked at in making this study.

CRITERIA

- CONVENIENCE
  - —TRANSFERS
  - —ACCOMMODATIONS
  - —COMFORT
  - —TERMINALS
- FLEXIBILITY
- FARES
- SERVICE
- COMMUNITY ACCEPTANCE
- ECONOMIC FEASIBILITY

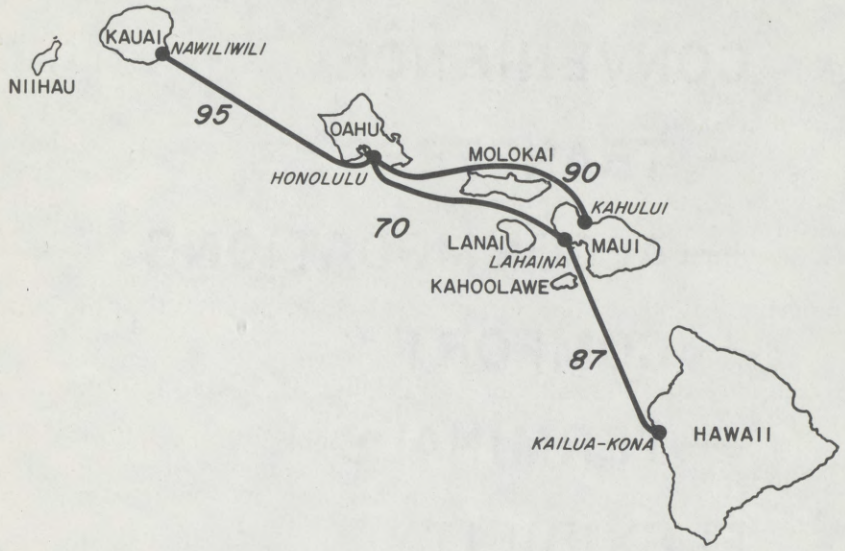
As shown in this slide, upon examination of all the available vehicles, our conclusion was that the submerged-foil hydrofoil was the only possible vehicle suitable for use in the rough waters which we find around the Hawaiian Islands at most times of the year.

We then proceeded to obtain the various permissions of the State government, the licenses, looked into financing, and so forth.

In October of this year, after several public hearings at which the reception for this type of a system in Hawaii was quite favorable, we were granted a license to proceed with the system by the Public Utilities Commission of the State of Hawaii.

We are now in the process of obtaining the corporate approval and the financing to actually build these, and we have signed a preliminary agreement with the Boeing Co. to build them for us.

HAWAIIAN ISLANDS



As you can see by this map, the numbers represent the distances between the islands which we intend to serve in Hawaii. Our current plans are to begin this interisland service with three of the jetfoils in 1974. Although our exact schedules are not firm, the general idea is to serve the smaller islands in the chain at least once daily with most trips being about 2 hours in duration.

Other ports in the islands could easily be served as interisland travel expands or travel time is changed. The flexibility of the jetfoils in being able to serve many areas without extensive port preparations was an important factor in the choice of this particular vehicle.

For Hawaiian service, the jetfoils will carry 190 passengers. All passenger baggage will be carried in the craft in special containers designed to provide fast and convenient service, without delays caused by excessive handling.

It is our belief that the alternative of flying by water in Hawaii would improve all of Hawaii's travel, with no condemnation for rights-of-way, no destruction of property or utilization of land or roads or tracks, and no conflict with other needed land uses.

A small facility at each end of the run is all that is required.

Mr. SHULTZ. In conclusion, Mr. Chairman, we have done our preliminary assessment—I would like to emphasize the work, "preliminary"—of the proposed water routes of this bill. That assessment indicates that a service of about 3 hours would be provided between Annapolis and Norfolk at a one-way fare of about $5. This compares to the present airline fare of $22, tourist class. The foregoing rates would permit a private operator to cover his overhead costs plus allow for a possible profit of 20 percent. These assumptions are based upon capital acquisition by the Federal Government per this bill.

The trip times between Baltimore and Annapolis and between Norfolk and Williamsburg, if this were of of interest, would be about half an hour and the cost would be approximately $1.50, based on the same economics.

Now, we believe the jetfoil could meet the needs of the bicentennial, and would also remain a viable alternative transit system for continued use after the centennial is over. I agree with Mr. Cannon that the results of the study should really determine what is needed in terms of size or vehicle type for the routes and connections that have to be made, based on the local conditions that exist, including all such things as wind, water, weather, roughness, et cetera.

Nevertheless, regardless of the outcome, we feel that Senate bill 4023 provides an opportunity to create an effective intermodal system for the area, as part of the bicentennial, but, perhaps, of much more importance, to provide a lasting transit system for future residents and visitors to this area.

Thank you.

Senator BEALL. Thank you, Mr. Schultz.

You didn't mention the cost of this vehicle.

Mr. SHULTZ. It is between $3.5 to $4 million, depending upon the configuration that you get, whether it is a commuter or whether it is the passenger tourist version, with baggage, or whether you have galleys and food service, all sorts of things.

Senator BEALL. You indicate the vessel is already in production. What is the delivery time?

Mr. SHULTZ. At the present time, someone signing a contract today, the delivery is 2 years. That will compress, because, of course, the leadtime gets shorter and shorter as you build more boats.

Senator BEALL. Where do you produce the vessels?

Mr. SHULTZ. Renton, Wash. It is actually in one of our aircraft hangers right on the lake.

Senator BEALL. It makes the chairman of this committee very happy, I can assure you.

Mr. SHULTZ. I imagine so.

Senator BEALL. Suppose one was ordered next year. When could you make delivery on it?

Mr. SHULTZ. If it was ordered next year, I would assume—we could have it well before 1976.

Senator BEALL. What is your estimate of the life of these vehicles?

Mr. SHULTZ. As I say, the PCH, the boat that I showed you on the screen, that has the same materials that we are talking about here—that has already run for 8 years, and we have refurnished it. It is just like it was when it was new.

As Mr. Cannon pointed out, it has been properly taken care of, the bottom painted, cleaned, and all that sort of thing. If you do that, there is no reason it should not last you 20 years.

Senator BEALL. Admiral James, this morning, talked about the vulnerability of foils to submerged objects. How do you contend with this?

Mr. SHULTZ. The foils, themselves, are really not vulnerable. We can build the foils and struts so strong that you are not going to break them unless you run into the beach. What has been a problem with debris has been propellers and shafts, and gear trains.

We have eliminated all of those from this boat, so that the first thing we did to solve the debris problem. Now we recognized that you might hit something, and you might hit something big.

While you can make the foils and struts as strong as you want to, the people have to not be thrown around. And you don't want to strap them in. In this boat, we do have a unique feature. We designed a structural fuse into the design. And what that fuse does is that when the acceleration value gets to four-tenths of a g. this fuse takes on—somewhat like the fuse in your house circuit. If you overload it, the fuse pops so the house doesn't burn down. Four-tenths of a g. is that force you feel when you reverse an airplane on landing. And this fuse is resettable. The foils and struts don't break or anything like that; they move, now. To give you some idea of what it takes to trigger this fuse—this is an energy management problem.

You have to hit a log 3 feet in diameter, 40 feet long, before the fuse will even trigger. Below that value, you will break the log and not exceed four-tenths of a g. Because we are a 106-ton boat going at 50 miles an hour and that is a mighty sharp ax up in the front.

Incidentally, I might point out that all of these numbers I have given you, first of all, have been reviewed by the Coast Guard, and they have essentially concurred in them.

We have an approval. They are all based on data, because we have hit over 200 objects with our boats in Puget Sound. I might point out, we have never hit any out of Puget Sound. That may not make the chairman very happy.

Senator BEALL. In you statement, you mentioned that one of the weaknesses in our transportation system is the lack of effective integration of the various systems. Have you given any thought to the integration or coordination of this water transportation, with the TACV at Annapolis or its terminus? How would you connect the two and provide for the transferability among the systems?

Mr. SHULTZ. We have not specifically studied this. What I have in mind is that generally, in most areas, the systems are quite independent. Their schedules are not matched; you cannot get common-fare tickets, or any of that type of thing.

It is really an imposition on the passenger. To be successful as an intermodal system, it has to accommodate all of this. One of the most—of course, one of the particular things, is to be sure that when you get the TACV over to the dock, that there is something there to take the people on. But, we have not specifically given that a study.

Senator BEALL. Thank you very much.

Mr. SHULTZ. Thank you.

(The statement follows:)

STATEMENT OF WILLIAM M. SHULTZ, MANAGER, COMMERCIAL HYDROFOILS, NAVAL SYSTEMS DIVISION OF THE BOEING COMPANY

Mr. Chairman, Members of the Committee on Commerce: I am William M. Shultz, Manager, Commercial Hydrofoils, Naval Systems Division of The Boeing Company. We appreciate the opportunity afforded to appear before you today with regard to Senate Bill 4023. It appears to us that Senate Bill 4023 has several objectives. The principal one appears to be to move people, and in moving people, to move them in a manner that gives appropriate consideration to the following factors:

The capability to move them rapidly, with safety.

The capability to move them flexibly, without congestion.

The capability to do this at a reasonable cost to both user and taxpayer.

Reliability must also be a factor. Obviously, the equipment should be capable of consistent reliable operation.

Comfort and convenience must also be inherent considerations or people simply will not use the system, no matter how well it meets other objectives.

In keeping with the theme of the Bicentennial and the area in general, it would be counterproductive if smoke, pollution, and noise were part of the system, either internally or externally. The equipment should pollute neither air nor water, nor otherwise impose itself on the community it intends to serve. In other words—it must be a good neighbor.

A second objective would appear to be that of demonstrating an inter-modal system. Senate Bill 4023 gives particular focus to an advanced ground system interfacing with an advanced marine transportation system. One weakness of our whole transportation scheme of things is the lack of overall integration, effective from a user's standpoint, of the various modes of transportation. This Bill would provide the specific opportunity for demonstrating two advanced fundamental modes in joint operation. With other systems that exist to feed into both the ground and water systems, a much broader intermodal integration can probably be accomplished as the detailed planning and implementation actually takes place.

In examining the system elements required to implement the objectives of this Bill, it seems very clear that the following must be considered:

First, there is the ground transportation system element, the alternatives for which must be defined and evaluated. Boeing has had an opportunity in working with the Department of Transportation to share in two very advanced ground transportation projects—the advanced rail transit system through our Vertol Division at Morton, Pennsylvania; and the personal rapid transit system at the University of West Virginia, Morgantown, West Virginia, through our Surface Transportation Systems organization. Advanced ground systems ccntinue to evolve, based on the specific geography, traffic, and objectives. There is considerable work still to be done in this area, and obviously we will continue to support studies, solutions, and applications of our many ground movement problems. This, however, is not my particular area of activity and I am not qualified to discuss it before this Committee.

The other major system element is the water transportation system. I will present what we believe to be the key water system requirements, since this is my area of responsibility.

Finally, there must be an overall comprehensive plan. The Bill does provide for this to be undertaken and appears to allow a reasonable time for this to be accomplished.

WATER SYSTEM REQUIREMENTS

Some of the principal requirements of the water transportation system element are:

It should be capable of reliably and efficiently moving large numbers of people.

It should be attractive, modern, and comfortable.

It should be safe.

It should be capable of economical and effective use, either as an element of a retained service on the same routes or by re-deployment to other applications after the Bicentennial peak has passed.

And, it should provide an advancement over systems designed by other nations.

Since the first man decided to climb onto a floating log to hitch a free ride downstream, waterborne travel has exerted a major influence on the progress of civilization. Most of the world's large cities were located to provide easy access to water transportation. For centuries water transport was the major mode within many countries, and the only mode of travel between continents.

Many different kinds of marine vehicles have been built. Some are better than others, but all have had their problems. There were always times when water conditions caused travel to be suspended. On other occasions a reduction in speed or change in course, or both, was essential for the safety of the passengers, ship and crew. Some of the time travelers were sick or the crew had difficulty in doing their jobs. Water travel was uncomfortable, undependable, and slow. It is little wonder that as other forms of transportation developed, offering greater comfort, reliable schedules and higher speeds, that people left the water to commerce and trade and went to land and air for their transport.

Current problems of population growth, traffic congestion and pollution demand that we again take a hard look at the potential benefits that water passgener transit has to offer, especially for our major cities. Sixty precent of the population

of this country lives adjacent to water, and nine of our fifteen largest cities are coastal. These cities generally have main waterways that are under-used and underdeveloped, particularly in relation to other transit right-of-ways. These water freeways are available with a minimum of property condemnation or community disruption and destruction. Water right-of-ways are inexpensive to maintain and water systems are flexible.

In theory, at least, water passenger transit systems should have much to offer modern society and community development. The key question is can marine vehicles be made available that will meet the demands of comfort, dependability and high speed within ecological constraints and be a good neighbor to other users of the waterways, and those living on the shore? And if so, then can they be economically viable since there are already too many transit systems that are losing money at an increasing rate.

The most critical factor in economic viability for any transportation system is passenger acceptance. No system is worth much if the people it is intended to serve won't use it. This concern is especially true for water systems, where it is contended that many past systems weren't acceptable to people and were discontinued for that very reason. Therefore, the problem starts with people, their foibles and their characteristics.

Passenger acceptance of *any* transportation system depends on the general acceptability of the system concept, plus specific acceptance of the individual elements. Of particular importance are: need; economic and social considerations; comfort; dependability; and convenience. Since it has been contended that other marine systems have been unacceptable to people because they were uncomfortable, undependable and slow—we can only conclude that what is needed is to provide marine vehicles that are confortable, dependable and fast.

If the water surface never got rough or the wind never blew, it would be a relatively easy job to evaluate marine vehicles for transit systems.

In the past little was done about rough water performance because there wasn't much that could be done about. it. If the water got too rough—the vehicle stopped operating. This might be acceptable for some operations, but if we are considering a transit system that is going to provide a sensible alternative to commuters and to the community, it has to be able to go every day—not simply when the water is calm.

Marine vehicles come in a wide assortment of sizes, shapes and types. It is primarily the type that is of interest here. There are conventional craft, surface effect vehicles and hydrofoils. Within each type there are different kinds to further compound and confuse all but the most knowledgeable observer. Conventional craft include all normal displacement craft that depend on the bouyancy of the water for support and include catamarans and planing craft which obtain some dynamic lift as the craft increases speed. SES's include Hovercraft and sidewall craft which employ cushions of air to provide lift. Hydrofoils depend on dynamic foil lift and are either surface piercing or the fully submerged type. With only one exception these vehicles are surface followers in which vehicle motions will follow the waves. That exception is the fully-submerged foil, automatically stabilized hydrofoil. The Boeing Company has been working on this concept of marinecraft for nearly 14 years. Much of this work has been done in conjunction with the United States Navy and we have built four different hydrofoils during that time. (Figure 1) Over $15 million has been spent in research on the foils, the automatic stabilization and control systems, and the propulsion systems. All of the information gathered during this time has been incorporated in our commercial passenger-carrying JETFOIL (Figure 2) to insure a ship that will perform in all types of weather and sea conditions while maintaining both speed and ride comfort. Key elements in the JETFOIL design that are very much part of the reliability of the craft are the propulsion system and the automatic stabilization system. In the fields of automatic control of submerged foil hydrofoils and the application of waterjet propulsion to high speed marine craft, The Boeing Company can lay claim to being the world leader. The proof of this experience has been amply demonstrated by the performance of the U.S. Navy TUCUMCARI (Film clip) which has been more reliable than could reasonably have been expected of a totally new concept in Naval ships.

The mechanical simplicity of the waterjet propulsion, with no complex gear or drive trains or propellers to be maintained, lubricated or repaired, provides for a reliably and easily maintained system not found in other types of hydrofoils.

The foil system is fully retractable, permitting operation out of shallow harbors and the foil tips do not extend beyond the hull edge, thereby permitting existing docks to be utilized.

The passenger accommodations are arranged in three cabins to provide a comfortable, pleasant, air-conditioned interior. All aisles are 30 inches wide.

In the commuter configuration shown in Figure 2, 56 cubic feet of cabin space per passenger is provided which is classed as "superb" for trips up to 2½ hours and "excellent" for trips up to 5½ hours.

Space is available for food and beverage service if desired.

The propulsion system consists of two gas turbines each coupled to a waterjet pump. Water enters a ram inlet at the aft foil, travels up the strut duct to the pumps, and is discharged through nozzles in the hull bottom. A hull inlet provides for water entry when the foil system is retracted. Thrust vectoring and reversing buckets are provided on each nozzle for hullborne maneuvering. A bow thruster is provided for difficult docking maneuvers.

The 929 JETFOIL is designed to maintain a foilborne cruise speed of 45 knots in all sea conditions up to waves 12 feet high.

The JETFOIL meets or exceeds all of the applicable safety regulations of the U.S. Coast Guard and SOLAS. The hull provides two-compartment subdivisions and a high degree of stability. Life rafts and life jackets are provided for ocean service. The foilborne control system is completely fail-safe. The foil system is designed for floating debris impact without damage or passenger discomfort.

ENVIRONMENTAL CONSIDERATIONS (FIGURE 3)

The external noise level of the JETFOIL at rated power will be less than 85 db A.

The 929 JETFOIL's air emissions are extremely low. There will be no visible smoke; hydrocarbons and oxides of nitrogen emissions will be less than 5 grams per brake horsepower hour; and carbon monoxide emission will be less than 2 grams per brake horsepower hour. EPA Standards are shown in Table 2.

No contaminated fluids or wastes of any kind will be discharged in the waters while underway or dockside.

Some other very important features of this type of vehicle are:

It leaves no wake when operating at foilborne speeds to disturb other boaters or residents on shore.

Normal stops from 45 knots can be accomplished in less than 500 feet. In an emergency situation much shorter stops are possible with no discomfort to the passengers.

Precise maneuvers can be made in all seas and at all speeds. The craft banks into all turns so that forces on the passenger are very low as in an airplane. The 45 knot turning radius is less than 1000 feet.

The most important feature of the JETFOIL however, is the outstanding ride quality even in rough water. This can only be appreciated by seeing the result and this series of film clips has been prepared to demonstrate that feature.

The JETFOIL is currently in production in our factory in Renton, Washington. The first one will be operating in test in Puget Sound one year from now. The first operational passenger carrying service will be between Hong Kong and Macau starting in July 1974. The first domestic service is scheduled to be in the Hawaiian Islands commencing in the Fall of 1974.

Our preliminary assessment of the proposed water routes of this Bill indicate that a service of about 3 hours could be provided between Annapolis and Norfolk at a one-way fare of about $5. This compares to the present airline fare of $22.00 tourist class. Trip times between Baltimore and Annapolis and between Norfolk and Williamsburg would be about ½ hour and the cost would be approximately $1.50.

The Boeing JETFOIL would meet the needs of the Bicentennial and would remain a viable alternative transit system for continued utilization after the Bicentennial.

While the JETFOIL interfaces effectively with almost any docking area or arrangement, detailed planning and procedures development will be required to assure the intermodal effectiveness objective of this Bill.

Senate Bill 4023 provides an opportunity to create an effective intermodal system for this area of the United States as part of the Bicentennial, but perhaps of much more importance, to provide a lasting transit system for future residents and visitors.

Jetfoil Specifications

Design cruise velocity:	
Calm water (knots)	48
Rough water (knots)	45
Displacement (tons)	106
Overall length (feet)	90
Maximum beam (feet)	31
Draft:	
Foilborne cruise (feet)	5
Hullborne—Foils down (feet)	16
Hullborne—Foils up (feet)	5

Propulsion: 80° temperature at the water: 6,600 horsepower gas turbine waterjet.
Crew—USCG requirement: Two operators and two cabin attendants.
Capacity: 190 passengers with baggage to 250 commuter passengers.
Endurance: 4 hours with full load.

Environmental Considerations

Air pollution: The model 929 Jetfoil, when operating in a normal manner, shall be designed to meet the EPA gas turbine air pollution standard as follows:
No visible emissions; CO emission equals less than 20 grams/horsepower-hour; and HC plus NO^2 emission equals less than 14 grams/horsepower-hour.
External noise: The external noise of the Jetfoil shall not exceed 85 DBA measured 50 feet from the centerline of the craft when the Allison gas turbine engines are operated at rated power or less.
Contaminant Discharge: None. A recirculating liquid system for the water closet with a holding tank for waste and lavatory drains, pumps and discharge for shoreside sewer connection shall be provided.
Wake: No significant ship generated waves during any foilborne operations.

Senator BEALL. Our next witness is Dr. Clive G. Whittenbury, president of the Hoverlift Applications, Inc., Arlington, Va.

STATEMENT OF DR. CLIVE G. WHITTENBURY, PRESIDENT, HOVERLIFT APPLICATIONS, INC.

Dr. WHITTENBURY. Good afternoon, Mr. Chairman.

Senator BEALL. Good afternoon, sir.

Mr. WHITTENBURY. My name is Clive Whittenbury. I am president of Hoverlift Applications, Inc. We are an engineering and applications consulting firm which specializes in the introduction of advanced technology to transportation needs.

One of our main interests is in the application of air cushion systems to commercial and industrial needs, examples of which are best known to this committee through the use of self-propelled hovercraft or surface-effect ships.

Although this is the industry portion of the hearing, I would like to say that we do not manufacture nor do we sell self-propelled hovercraft or surface-effect ships.

My appearance before this committee does not constitute an endorsement of any specific vehicle or system that has been presented to you, or which may be under consideration. Our professional background is directly related to the analysis and evaluation of such systems and in the type of decision that is of interest to this committee—namely, which of the transport systems under consideration are best suited for the uses envisioned.

Nevertheless, our chosen fields of interest place us in an advocacy position for the technology itself because it promises a dramatic contribution to transportation needs in undeveloped parts of the country while being kind to the environment.

I am, therefore, here today to speak in support of the proposed legislation, and to give particular endorsement to that phase of the program in which a comprehensive analysis of the transportation options before you is proposed, and in the language of S. 4023, * * * "the feasibility, social advisability, environmental impact, and economic practicability * * *" of the proposed transportation system is to be examined.

The bill singles out three high-speed marine transport systems and my comments will be on this part of the program. These may be considered as being either competing or complementary, depending on their use. Each system has its advantages and disadvantages for environmental, economic, and operational reasons. The bill wisely recommends a study, not a plunge toward hardware before the opportunity is understood.

It is essential that the merits and demerits of each of the three systems cited—namely—the hydrofoil vessel, the surface-effect ship, and the air cushion vehicle, be examined carefully in the context not only of the direct intent of S. 4023, but also in the context of what may follow as an attractive and pace-setting transportation network following the tradition of the early settlers of this part of the United States.

Our region is laced with waterways which provide access to places which today are difficult to reach by road. Advocates of the full-shirted hovercraft or air-cushion vehicle may well point to the savings in route investment and terminal facilities that would give access to the many areas of interest in the region, going in those places where there is water, whether it is a few inches deep or whether there is just plain mud alongside.

Terminals might be chosen anywhere there is a sloping beach. Docks and piers are not required and no deepwater moorings need be established. The facilities would be simple passenger boarding shelters, and the transfer process is compatible with any type of land transportation system, a parking lot, a rail spur, a TACV terminal, or even an airfield in reasonable proximity even to unnavigable waters.

We would, however, caution against an enchantment with the technology in and of itself. Hovercraft are dramatic in their performance, carrying passengers at well over 50 knots directly to their destination possibly with their automobiles, and the largest are quite impressive to see.

Problems with some of the commercial aspects, or introduction of systems before the market for its use or the hardware itself was ready, have inhibited the growth of opportunities for these systems. I am sure that it would be of interest to the committee to see that, through the bill, the possible introduction of such systems would be on a sound and practical basis. This would be a pioneering step which might significantly influence the health of the technology.

Although our experience centers on air-cushion vehicles, I do not want to ignore the impressive progress made in hydrofoils, the success the Navy has had with these craft, and the desirable characteristics of contemporary versions which I am sure will be described to the committee today—and indeed, they have been. There may be a role for both hydrofoils and air cushion vehicles, but this should be one of the problems for the study to resolve.

We believe the study should carefully address the "postbicentennial" market that could develop in the region if the system became available. The system's viability, social acceptability, and economic feasibility must be considered after the special market introduced by the thousands of visitors to the area has relaxed. The relative benefits to the entire Chesapeake littoral should be examined in the context of matters such as:

Are the system characteristics for the Bicentennial contradictory to its utility as an element in a major regional transportation network?

What are the uses and advantages of the system on an all-year, all-season basis?

Example thoughts on these points include the fact that Norfolk is emerging as a major east coast terminal for passenger cruise ships. These cruises are all-year in nature and are most concentrated in the winter when the Caribbean trade is the highest.

A Bicentennial operation might be shifted from the tourist centers of Jamestown, Williamsburg, and the Yorktown area to fast direct service from Baltimore to Annapolis and Norfolk. Fast trans-Chesapeake Bay service could be instituted with a large hovercraft or SES ferry, such as pioneered by the SRN–4 and VT–1 in the Unitee Kingdom. Service originating at, for example, Annapolis could servd any one of a dozen Eastern Shore points with passenger vehicle transportation without the investment in a bridge, and without any major investment in piers and docks. Loading could be done ashore or on a ramp with the craft off-cushion.

Your study will not lack for technically-acceptable inputs from operators and industry. Hovercraft services exist in Europe by the score; hydrofoils have demonstrated their commercial viability from Hong Kong to Lake Como, although direct interpretation of such uses could lead to wrong conclusions.

People take hydrofoils to Macau because they want to gamble, and Hong Kong provides no legal manner for them to do so; the inflated fare structure on the English Channel provides incentive for hovercraft operations, plus the desire of most people to cross the sometimes rough channel as quickly as possible. Hovercraft service using an excellent craft, on the other hand, failed to compete with the Denmark-to-Sweden ferry service for several reasons, ranging from a noncompetitive fare structure, to parking restrictions at the terminals, to the desire of the travelers for a leisurely cruise during which time they patronized the duty-free kiosks on the ferries—an attraction lacking on the speedy hovercraft.

Our confidence in air cushion technology is based on our knowledge of its use in many different applications. We have worked with Government agencies and strictly commercial groups from the exciting opportunities of air cushion systems in Alaska, where they are kind to the surface and ecology, to their promise in industrial development.

While the technology developed early and most strongly in the United Kingdom, a U.S. industry is emerging which is doing its own pioneering—witness the commercial initiative of Bell with its Voyageur. The technology is now at the point where it can provide safe, comfortable, and fast transport.

We support the bill and we are most pleased at the forward thinking and interesting initiative shown by its sponsors. I appreciate your invitation and the privilege of addressing my comments to this distinguished committee.

Thank you, Mr. Chairman.

Senator BEALL. Thank you, Dr. Whittenbury. You have made some very interesting comments. Since you are primarily interested in the study phase of this, what kind of time do you think would be required to make a feasibility study such as we have envisioned here?

Dr. WHITTENBURY. Well, I think, Mr. Chairman, that it is the need of the intent of the bill that should pace the study effort itself, and perhaps my colleagues in the study business would not appreciate the suggestion that no more than 3 months should be budgeted for a first cut, that of the basic concept of the traffic in the Chesapeake Bay and how it would tie into the other modes; that another 3 months should be allowed for the final briefing on the study; and that another 3 months be budgeted to answer questions which would have come out of that final briefing on things that should be looked at further. I do not think it should be a study that enters a 9-month operation and then you listen to the results at the end of that period.

Now, parallel to the study—and I have not made these comments in my prepared testimony—I think the committee might want to consider seriously the idea of introducing a demonstration program to investigate just how this type of service might be accepted by people who are already traveling to the areas and the points of interest that are going to grow during the Bicentennial, but certainly are here today. And if one started in the spring of next year, not very far, with a demonstration program, 6 months to cover the season, to find out where the traffic might be generated, how well these systems might be accepted in principle, to calibrate some of the things that would be coming out of a quick study, that this might provide a very sound footing upon which the orders for the specific systems would come through at the end of 1973 or early 1974.

That is a fast-paced program but you have got to be ready by 1976, and 2 years might be all that you can allow for an industry to come back with the actual vehicle itself to satisfy the requirement.

Senator BEALL. Do you think that we can have operational a demonstration project using either hovercraft or jetfoil by 1976?

Dr. WHITTENBURY. I thought you were going to say "by the spring of next year," and I was going to say yes to that from the point of view of the air cushion vehicle. The type of vehicles that exist today can be adapted certainly by 1976.

I would not say anything for the hydrofoil system, but in the air cushion field, those vehicles have been here for 10 years.

The difference now is that we are building a U.S. technology and that is a question of the responsiveness of the U.S. industry to these requirements.

Senator BEALL. That is a very important consideration because under the terms of the Jones Act, of course, the passenger-carrying vehicles, unless we change the act, have to be built in this country.

Dr. WHITTENBURY. That is right. So my answer is in the affirmative, perhaps because I do not have the responsibility for running a factory.

Senator BEALL. What is the possibility for ocean commerce in surface-effect ships?

Dr. WHITTENBURY. I think that was a subject of earlier studies and hearings and there are considerably divided opinions on that subject. I think that the most important thing is that we are dealing in the technology that provides performance completely out of the class of existing transportation systems and we are going to see these systems develop their own market, and in the same way that everybody wondered where are the passengers to fill the 747's when they were ordered and conceived, we have had no problem. There is a new market entirely that is answering these new technologies, and this is the sort of thing that we are going to see in the Chesapeake. Where are the markets today? They are not there because the technology is not these; and when the technology is there, it's going to be exploited in the same way that we are going to rebuild 100 percent more cities. Where are they going to be? What will they look like? We will find out when we do it, and that is what is so important about this particular bill. That the vision has been shown by its sponsors not to say, how do we do something, oh, "a little bit better," but how do we introduce a brandnew opportunity to a whole new market for leisure and for exploring that part of the country which is almost impossible to get to today?

Senator BEALL. Thank you very much, Doctor.

Our next witness is Mr. James G. Wenzel, assistant general manager and director, ocean systems, Research and Development Division, Lockheed Missiles & Space Co., Inc., in Sunnyvale, Calif. For the record, I understand you are accompanied by Mr. John H. Kennedy, who is vice president of Hovermarine Corp.

STATEMENT OF JAMES G. WENZEL, ASSISTANT GENERAL MANAGER, OCEAN SYSTEMS, RESEARCH AND DEVELOPMENT DIVISION, LOCKHEED MISSILES & SPACE CO., INC.; ACCOMPANIED BY JOHN H. KENNEDY, VICE PRESIDENT, HOVERMARINE CORP.

Mr. WENZEL. Good afternoon, Mr. Chairman.

Senator BEALL. Good afternoon.

Mr. WENZEL. My name is James Wenzel, assistant general manager and director, ocean systems, Research and Development Division, Lockheed Missiles & Space Co., Inc. I, too, will hold my remarks to within the allocated 15 minutes and I will introduce my colleague in a moment.

We are indeed pleased and honored to have the opportunity to appear before this distinguished committee and hopefully to contribute to the initiation of the exciting transportation project outlined in S. 4023. We at Lockheed have been heavily involved for years in applying aerospace technology to the development of advanced marine systems. These developments have ranged from deep-diving research submarines to oceanographic data buoys and high-speed surface ships such as a large experimental Navy hydrofoil.

In the area of high-speed surface-effect ships, our efforts at Lockheed have been concentrated primarily on military applications of these craft. However, I have with me today Mr. John H. Kennedy,

vice president of Hovermarine Corp., located in Pittsburgh, Pa., a company which is associated with us in our surface-effect ship development activities, and one representing many years of experience in commercial transport applications of this concept. I will include Mr. Kennedy's comments in my remarks and he will also be available for questions.

(Slide.) Surface-effect ships can be placed in two categories; namely, air cushion vehicles and rigid-sidewall craft. The former are fully airborne, amphibious, generally air propeller driven, and representative of most of the early work done in this country and abroad. The rigid-side wall craft has flexible airseals in the bow and stern areas only, with sidewalls generally submerged, water jet or water propeller driven and capable of somewhat more efficient lift/drag performance.

Development work on surface-effect ships in this country began in the early 1960's. These efforts placed emphasis on critical technology requirements and the construction of small testbed vehicles. A program office, initially sponsored by both the U.S. Navy and the Department of Commerce, was formed in 1966 to pursue surface-effect-ships development. The objective of the project is to determine the feasibility of building and operating large oceangoing ships of 4,000 to 5,000 ton displacement based on the surface-effect principle and capable of speeds greatly in excess of conventional surface ships and submarines. Phase I of the project involves testing of two 100-ton craft that have already demonstrated the feasibility of SES operations in relatively sheltered waters of Lake Pontchartrain and Puget Sound.

(Slide.) Lockheed and several other companies are currently under contract to the Navy to conduct preliminary design studies of an intermediate size, 2,000-ton prototype SES. A typical concept shown here is approximately 250 feet long and 106 feet in beam, and is powered by gas turbine engines driving either waterjets or supercavitating water propellers. Crew accommodations for approximately 100 to 125 men, plus two helicopters and a full weapon suite are being included in the prototype design. In performing these design studies, LMSC is working closely with our Lockheed Shipbuilding & Construction Co., particularly in the area of producibility, construction methods, and costs. Our in-house team for the 2,000-ton program has been complemented by the addition of the Hughes Aircraft Co., Rosenblatt, and the Hovermarine Corp.

Critical development areas for a large, high-speed, open-sea Navy vessel of this type are stability, control, and habitability in rough seas, and propulsion system design including the propulsor and power transmission, bow and stern seal design. Technology being developed on the Navy program will be available for direct support of the proposed transportation system demonstration and will provide a sound technical foundation for the program outlined in S. 4023.

(Slide.) This fact is perhaps more clearly shown in this development program outline. However, there is a caution area indicated here, for you will note that the final construction and early test and evaluation of the 2,000-ton prototype will occur during the Bicentennial period. This should show that to allow adequate time for shakedown, test, and debugging such a commercial transport to assure operational reliability, and a creditable demonstration, the schedule is tight. There

is precious little time to spend in taking the proposed action to initiate the appropriate studies.

(Slide.) This would appear negative until one examines more closely the differences between the development concerns for a very high speed military vessel for open-sea operation and a vehicle appropriate for the Bicentennial transport demonstration. The upper part of this chart depicts the military requirement resulting in larger, higher performance vehicles, with a high technology content. For commercial transport operations in relatively sheltered coastal and inland waters, smaller medium-speed vessels are more appropriate when one examines the required transport economics. Attention here must be focused more on cost per seat-mile, passenger comfort, and safety. There are no questions of technical feasibility of surface-effect ships in the 20 to 200 ton, 50-knot-speed class, as has already been shown by the Navy's 100-ton program and by advanced design operational commercial vessels such as Hovermarine's HM–2 shown here.

(Slide.) Time permitting, I have a short film clip of this vessel in operation which I can show you.

When one is contemplating development of a high-speed transportation system both initial development costs and direct operating costs have major significance.

(Slide.) This chart illustrates initial cost trends based on actual sales and projected vehicle prices for several types of vessels. The increased cost associated with high speed is basically related to larger powerplants, tighter weight control requirements on structure, and more sophisticated controls. Because the construction of surface-effect ships is more closely akin to that done in conventional shipyards, the initial cost of this type of vessel tends to fall below other types of vehicles with above 35-knot capability.

(Slide.) Typical direct operating costs for surface-effect ships in commercial service are shown here based on the performance of the 60-passenger HM–2. The costs represented in this data include the operating and maintenance crews, maintenance materials, fuel, and lubrication. The direct operating costs of rigid-sidewall surface-effect ships are competitive with all other forms of high-speed marine transportation.

(Slide.) Speaking in strong support of S. 4023, we are on the threshold of an exciting advancement in high-speed marine transportation, with all that can mean in increased mobility for our Navy and efficient high-speed commercial operations. There are 11 small craft of this type now in worldwide service which have logged over 5 million fatality-free passenger miles with a high mechanical reliability. These craft have demonstrated the advantages of the SES concept over competing high-speed marine systems in the areas of operating economics, high maneuverability, shallow draft, and a lower wake and noise levels for operation in crowded inland waters. The bicentennial transport could be a simple scaleup of existing craft, assuring a high probability of a successful demonstration.

(Slide.) Here is an artist's sketch of how a future high-speed SES transport might appear. With the Navy's aggressive program laying the required technology foundation, we have a real opportunity to once again assume national leadership in commercial maritime operations.

As to the marine transport aspects of S. 4023, I would summarize my comments by repeating that there is no question of technical feasibility of the surface effect craft; the concept is proven. The proposed feasibility study should be directed more toward the economic aspects of the transportation system, with emphasis on optimum sizing of the craft for the expected passenger density of the route structure and costing of appropriate passenger handling facilities on shore. The schedule is very tight if one is to assure an efficient and reliable system in time for the Bicentennial, and prompt action on the study therefore is required. The concept of the demonstration is sound and it could have a significant effect on the role of high-performance marine transportation in this country.

Mr. Chairman, that concludes my remarks, with the exception of a 3-minute film clip of the commercial HM–2 in operation which I would like to show if you have the time and, which Mr. Kennedy will discuss.

(Film.)

Mr. KENNEDY. The 60-passenger, 35-knot, sidewall-surface-effect craft manufactured by Hovermarine is operating in European waters. Eleven of these craft are in current commercial service throughout the world and they are operating at a high degree of reliability.

This shows the leading edge of the forward sidewall and the flexible seal and forward part which contains the air cushion.

This shows the afterseal between the two sidewalls which is the after containment boundary for the air cushion. It operates with conventional marine propellers as shown and uses conventional marine diesels which are certified for pollution standards for highway operation.

This short clip shows one of the commercial services operating in the waters of southern England. This particular service was initiated in 1968 and it has been operating until very recently. As you see, it is a common method of transportation in Europe and England, and there is no reason why it could not be in this country with a great degree of passenger acceptance and comfort.

The maneuverability is excellent. As you can see, it turns in its own length in the displacement mode. It gets upon the bubble very rapidly. It creates a very minimal wake so it can operate in confined water as would be found in Chesapeake Bay.

Senator BEALL. Thank you, Mr. Kennedy and Mr. Wenzel.

As I have asked everybody else, if you received an order for a vehicle to be used in the Bicentennial, how long would it take you to deliver it?

Mr. KENNEDY. Perhaps I could answer that. We currently do not manufacture craft in the United States. Our production facility is in Southampton, England, at this time. We are currently negotiating with a number of yards in the United States to build the craft you saw in the 60-passenger size.

We feel that in the Chesapeake Bay a larger craft on the order of 140 passengers would be required and this craft could be built in a number of yards throughout the country. It represents no great increase in technology and we feel we have a good choice and could do this within a period of approximately 2 years.

Senator BEALL. At what cost?

Mr. KENNEDY. The projected cost of the 140-passenger craft would be approximately $1 million.

Senator BEALL. Do you have any figures on operating costs?

Mr. KENNEDY. Well, the direct operating ccsts of this craft would be approximately 2.5 cents a seat-mile.

Senator BEALL. Do you have projections that show the kind of traffic you would have to develop?

Mr. KENNEDY. We have not really looked into the route structure in great enough depth to project the passenger traffic in Chesapeake Bay.

Senator BEALL. What is the life of your vehicles, generally?

Mr. KENNEDY. We use approximately a 10-year period for our amortization and depreciation. The craft have currently been in operation—our first craft—since 1967, and it shows no sign of deterioration. Very likely it could have a greater life on the order of 20 or 25 years.

Senator BEALL. How about the noise pollution problem?

Mr. KENNEDY. The noise level of these craft is very low. They are comparable to a twin-screw-power craft. They use conventional marine propellers and the actual measured noise level in the cabin is approximately 80 db and the noise level at a 100-foot radius outside the cabin is also approximately 80 db.

Senator BEALL. And there is no ride problem? It is a smooth ride?

Mr. KENNEDY. It is a smooth ride. It is a sheltered water craft, the craft we saw. We operate currently throughout the world—our operators do, that is—in up to 5-foot waves with that craft, and the passengers will buy tickets at that state, so that indicates that the ride is comfortable.

Senator BEALL. How about debris damage?

Mr. KENNEDY. Debris damage was an early problem when we used bronze propellers. Since we went to stainless steel propellers we have had no disruption of operation in the many, many miles we have operated.

Senator BEALL. No operational problems from weather? Does weather pose problems of any significance?

Mr. KENNEDY. With respect to weather, it is strictly a function of how heavy the fog is. Again, we have radar on each one of the craft. We do have to slow down in confined waters and use the radar if the visibility is very low. Essentially, as restricted by the seas, we will either slow down or suspend services if it is beyond the capability of the craft.

As I say, for the Chesapeake Bay operation proposed, we believe that a 140-passenger craft approximately 80 feet in length would adequately operate for over 90 percent of the weather conditions encountered there.

Senator BEALL. Thank you very much, gentlemen.

Out next witnesses are Mr. Gerald J. Tobias, vice president, aerospace, Mr. George Prytula, marketing manager, and Mr. John Quady, manager of advanced marine technology, of the Rohr Industries, in Chula Vista, Calif.

We placed Rohr in the middle of this afternoon's proceedings because they are going to testify on both the water and the land vehicles and this is kind of a good transition to move from sea to shore. I think Rohr also has a contract with the Washington Metro System, with local significance, so your testimony is particularly interesting in view of that work that you are doing here.

STATEMENT OF GERALD J. TOBIAS, VICE PRESIDENT, AEROSPACE AND MARINE SYSTEMS GROUP; ACCOMPANIED BY GEORGE PRYTULA, MARKETING MANAGER, TRANSPORTATION SYSTEMS-EASTERN REGION; AND JOHN QUADY, MANAGER OF ADVANCED MARINE TECHNOLOGY, ROHR INDUSTRIES, INC.

Mr. TOBIAS. Thank you, Mr. Chairman, for the opportunity to present our views on S. 4023. I am Gerald J. Tobias, vice president, Aerospace and Marine Systems Group, of Rohr Industries, Inc., and my testimony will cover both the land and water modes in this proposed bill. I have with me today, Mr. George Prytula, marketing manager, transportation systems-eastern region, who will be available for answering any questions you might have concerning the land mode; and Mr. John Quady, manager of advanced marine technology, who will perform the same function for the water mode.

First, I would like to give you a brief overview of Rohr Industries. Our corporation is headquartered in Chula Vista, Calif., just south of San Diego. In the past 3 to 4 years, the corporation has grown from the role of a principal supplier of aerospace products particularly engine nacelles and thrust reversers, to a balanced transportation company. Our areas of transportation business now include urban transit vehicles, such as BART and Washington Metro; the Flxible line of city buses, personal transportation systems, such as Monocab and Railbus; and magnetic levitation programs which we identify as ROMAG. Along with these transportation activities, we have also expanded into a number of other industrial activities, such as postal systems, automated warehouses, antenna systems, and prestressed concrete structures. We have, of course, continued our activities in aerospace and have expanded our product lines into areas such as advanced marine vehicles including the concept I will discuss today. To support these activities, Rohr has grown from a base of four plants to a total of 22, currently, and employment is now approximately 10,000.

(Slide.) Concerning the tracked air cushion vehicle (TACV), the technology will be ready for the Bicentennial. Rohr has utilized the 10 years of experience accrued in France and approximately 4 years ago formed a U.S. subsidiary, Aerotrain Systems, Inc., which is jointly owned with Societe de l'Aerotrain and Bertin et Cie, the developers of the French technology.

(Slide.) Aerotrain, unlike any other train, has no wheels. Instead, it is suspended above its guideway on a thin cushion of air. This cushion eliminates friction with the guideway, thus requiring relatively little driving power. High rates of acceleration and deceleration are achievable without concern for sliding wheels. Above all, air cushion suspension gives the passenger a very smooth and safe high-speed ride. A new means to drive the vehicles was needed since it has no contact with the guideway and is designed to travel at speeds beyond that of practical propulsion by wheels.

(Slide.) Therefore, a linear induction motor (LIM), powered from wayside rails, was part of Aerotrain prototype development. All of these features have been successfully demonstrated and are ready for operational service. Over the past 4 years Aerotrain Systems has developed a broadly based TACV systems engineering team with specialists in all of the major disciplines.

(Slide.) The 44-passenger prototype suburban vehicle (S–44)—the only operating linear motor powered TACV—is in the advanced development state and operates on a 1.8-mile guideway at Gometz, France.

(Slide.) The 80-passenger prototype intercity vehicle (I–80) completed endurance testing in the spring of 1971. Thousands of hours, and over 100,000 miles of test running, have been successfully concluded. The I–80 vehicle has been demonstrated to over 5,000 passengers during the course of its development program, operating on an 11-mile-long guideway at Chevilly, France. It is anticipated that the Government of France will award a contract to Societe de l'Aerotrain for a revenue TACV system in the Paris area between La Defense and the new city of Cergy, a distance of 16½ miles. It will offer an outstanding opportunity for transfer of valuable experience to the U.S. urban TACV program as this new system progresses. In the United States, Rohr has been working with the Urban Mass Transportation Administration, the Federal Railroad Administration, and the Transportation Systems Center of the Department of Transportation. Here is a summary of the DOT program in which Rohr is playing a key role.

Phase I of the DOT TACV program consisted of the engineering design of a 60-passenger prototype vehicle propelled by a linear electric motor, design of site-independent aspects of facilities for a complete system including guideway, wayside power distribution, wayside control system, passenger and baggage handling facilities, and a vehicle maintenance facility. Also included in phase I was the construction of a full-scale mockup of the vehicle.

(Slide.) The mockup was on display this summer at the International Transportation Exposition at Dulles Airport.

(Slide.) The phase II contract was awarded to Rohr Industries after a preliminary design competition, and included the fabrication of a prototype vehicle.

(Slide.) Components and subsystems have been tested prior to assembly in the vehicle and the complete vehicle is now being checked out both statically and dynamically, and soon operational tests on a short guideway section of about 500 feet in Chula Vista, Calif., will begin. Final documentation is to include engineering drawings and design specifications in sufficient detail for competitive procurement of a vehicle and related facilities by a local public agency. This phase will also require the delivery of inplant vehicle test results, system engineering design studies, cost analyses, and a system test plan. Phase II will be completed in the spring of 1973. Phase III, not yet awarded, consists of acceptance tests and system tests of the prototype vehicle at the U.S. Department of Transportation's High Speed Test Center in Pueblo, Colo. Modification of the vehicle during test operations to improve performance, safety, and reliability would be expected. Test operations could cover up to a 1-year period of time. Rohr has been selected by the U.S. Department of Transportation to design the test guideway and to manage its construction.

(Slide.) We envision the Aerotrain vehicle that could be used on the Washington-to-Annapolis run would feature a 60-passenger cabin of lightweight aircraft-type construction. Two passenger access doors are located on one side of the vehicle at platform height. First-class

appointments are evident in comfortable two-and-two seating, 22-inch-wide seats, carpeting throughout, and controlled lighting levels. Uniform air conditioning would maintain a comfortable environment in hot or cold weather. Safety belts secure the passengers for high-speed service. Depending upon traffic requirements, a smaller, lower cost 25-passenger vehicle is also worthy of consideration. The guideway is shaped like an inverted T. The horizontal slab can be poured-in-place concrete or prestressed beams. The vehicle support air cushions react against the horizontal member. The vertical element in the center of the guideway is made of aluminum and acts both as the motor reaction rail as well as the lateral guidance member. Tracked air cushion vehicles have been operated for a number of years in excess of the 150 miles per hour planned for this application. We have every confidence that the vehicle system and its linear motor propulsion will perform satisfactorily and safely. Therefore, on the subject of TACV, Rohr is confident that an operational vehicle can be made available for the 1976 bicentennial, and that Senate bill 4023 offers the opportunity to resolve the system's aspects.

(Slide.) I would like now to outline Rohr's background and qualifications in the field of marine construction and advanced marine technology, and comment on the proposed high speed marine system under consideration here. Evidence of Rohr's long-time interest in watercraft and marine transportation is shown in the following slides which illustrate several different types of Rohr-built, conventionally designed, all welded, aluminum boats.

(Slide.) The first shows one of the 86-foot warping tugs during construction for the U.S. Navy.

(Slide.) The next shows the tug nearing completion, and the next picture (slide) is one of the 35-foot Navy utility boats underway in San Diego Bay.

(Slide.) Several aluminum patrol craft were also built for the California Fish and Game Commission, one of which is shown nearing completion, and (slide) the large 105-foot sport fisherman, *Qualifier*, is shown being launched.

(Slide.) The next slide shows the launching of one of the 61 all-steel welded LCM–8 landing craft Rohr is building for the U.S. Navy which also demonstrates our production capability with steel.

(Slide.) Rohr's interest in marine construction was further augmented by company-sponsored research and development programs in advanced marine systems. This work consisted of engineering studies, model testing, and larger scale testing involving high speed planning vehicles, vehicles making use of the surface effect phenomena, and hybrid, aerodynamically and hydrodynamically supported planing vehicles.

(Slide.) This next slide shows Rohr's RX–2 experimental, hybrid tunnel hull craft undergoing high speed maneuvering tests in the ocean.

(Slide.) Rohr's interest in surface effect phenomena and high speed surface craft led to our successful bid on the Navy's SES program involving the use of the 18-ton XR–1B captured air bubble test craft, shown here in the Bay near the Coronado Bridge. The XR–1B was the testcraft used in the development and test program on water jet propulsion system inlet designs. This SES development work began in the spring of 1970 and has been continuing.

(Slide.) Our present contract involves modification of the XR–1B to the 1C configuration, which involves the installation and testing of new front and rear flexible seals. In progressing from the more conventional marine aluminum construction experience to working with weight critical, high speed, surface effect craft, the importance of utilizing more advanced materials and efficient structures in a broad range of aerospace products, coupled with our XR–1B and in-house R. & D. experience, generated additional enthusiasm for surface effect vehicles in a commercial as well as military role. Our enthusiasm for this promising new mode of transportation led us into a teaming arrangement with Litton Industries to work on the Navy's 2000-ton SES preliminary design program.

(Slide.) Now, regarding that part of the proposed transportation demonstration act involving the high speed marine link, Rohr Industries has made a cursory study of this concept and has drawn conclusions as well as raised some questions.

First: Rohr believes that it is technically feasible to design and construct high speed passenger carrying surface effect ships which could ply the route between the Baltimore-Annapolis area and the Williamsburg-Newport area, a number of times a day, covering the approximately 160 water miles in about 3 hours running time. Such ships could be sized to make a round trip in about 8 hours (allowing about 2 hours for docking, loading, unloading, fueling, etc.). Therefore, each vehicle could accomplish, without much difficulty, two round trips per day, allowing 8 hours for maintenance and cleanup prior to the next day's operation. However, in order to estimate average and peak passenger loads, and to determine the best mix of ship size, capacity, and number of ships required, some carefully thought-out traffic studies will be required.

(Slide.) As an illustration of what could be done, however, we show here an artist's rendering of our concept of a 1,500-passenger and 70-automobile capacity surface effect ship, at the dock, unloading and loading cars and passengers.

(Slide.) This ship displaces approximately 1,000 long tons and is capable of cruising at speeds on the order of 66 knots, shown here underway. A surface effect ship of this capacity would be about 200 feet long and 89 feet in beam. It would require approximately 50,000 shaft horsepower for both the propulsion and lift systems. Our studies show that the optimum size should be as large as practicable, consistent with demand, because both speed capability and efficiency increase with size. The next question to address is: Is it possible to perform the feasibility study, the preliminary design, the detail, and fabricate and test the appropriate number of surface effect ships of one class, in time to celebrate the bicentennial anniversary?

(Slide.) Assuming, as a minimum, that a two-ship program is required, the schedule shown in this slide illustrates approximately those steps which we believe must be accomplished, and the timing necessary in order to make these high speed marine vehicles available in time for use during the bicentennial year. As can be seen, under the very optimistic circumstances assumed in this schedule, it would take about 3 years to perform the design and complete the construction and trials of the first ship. This means that the detail design and construction contract award must be made by mid-1973, with a prior

predesign program running concurrently with the feasibility studies proposed in bill 4023. The assumption is made that the design effort would be sufficiently far along for the first ship construction to start about 11 months from contract award and be completed by March of 1976, tested for 4 months, and be available for use on July 1, 1976. The second ship would be available for use about 1 month after the first ship.

Any delays in starting the feasibility study and predesign phase, or funding delays, or delays caused by technical difficulties—at this point not foreseen—would, of course, cause the schedule to slip accordingly. If the timing conditions indicated on the schedule could be met, we believe it is technically feasible, though optimistic, to design and build two large surface effect ships in approximately the timespan indicated.

However, there are some other important considerations besides technical ones which still need to be answered and which necessitate performing the preliminary design program which is shown on the chart starting at the same time as the feasibility study. These questions are concerned with safety, navigation, and ship certification requirements. We have assumed in our schedule that certification could be accomplished during the 4 to 5 months trial period. If this is not sufficient time, the schedule would have to be lengthened. These ships are intended to travel at relatively high speeds (65 to 70 knots) up and down the well-traveled Chesapeake Bay, ferrying large numbers of passengers and automobiles. Safety considerations are of prime importance for both the SES and other craft. Rights-of-way will have to be established and ship operators educated. Perhaps well marked navigation channels could be reserved for the SES, with rules for crossing these channels established to assure safe operation. New regulations concerning operation of these fast vehicles would be required to be worked out well in advance of ship completion so that their readiness and fitness for public transportation could be certified.

This ends my testimony relative to the technology and schedule aspects of both TACV and surface effect ships. In summary, it is our conclusion that a feasibility study of the system as outlined in the proposed legislation is warranted and should be undertaken. We would further suggest that predesign activities in both the land and water elements of the system be conducted simultaneously with the feasibility study.

Senator BEALL. Thank you, Mr. Tobias.

I guess to keep this in its proper context, we will ask a few questions about the water vessel first and then move to land.

You have pretty well answered the questions about deliverability in your statement, but you did not cover costs.

Mr. TOBIAS. Obviously, we have done some parametric work in this area, but I think without any doubt, the sizing of the vehicles involved are probably the most significant factor; and without knowing or studying—in fact, executing the study, I think that any estimates of cost at this time would be quite out of the blue and probably misleading.

So I think on the subject of costs, one of the very important elements of the study would be to go into depth in that area.

Senator BEALL. Well, can you be more specific with regard to costs on the air cushion land vehicle, the 60 versus the 25 passenger?

Mr. TOBIAS. I think George can answer that.

Mr. PRYTULA. On the 60-passenger TACV, we are building a prototype under a $5 million contract with the U.S. Department of Transportation. Subsequent orders, depending on the size of the order, would bring that cost down substantially; I would hope quite close in the direction of $1 million per copy. Cost is very heavily dependent on the quantity of the order.

Senator BEALL. I missed the first figure you gave.

Mr. PRYTULA. The $5 million is the contract that we have now to build the first prototype.

Senator BEALL. Do you have any estimates of what it would cost to put a complete system in, exclusive of the vehicle cost, to put the guideways and whatever else you have to have?

Mr. PRYTULA. I am asked that question very frequently. The work that we are doing at Pueblo, as Mr. Tobias mentioned, is a contract for the design and construction of the test guideway at Pueblo. We are taking bids for the construction so we will have better numbers, real numbers, at hand to know what costs will be.

When we get those numbers, we will have to be very cautious because they are for a relatively few number of miles, on the order of 4 or 5 miles, and, again, it is the first of its kind out there in the middle of the desert. Different numbers of cost would be expected here in this situation where we are talking about 30 or 35 miles.

The study of costs that you are proposing would bring the results, of course, that you are looking for. Mr. Haddock, this morning, mentioned a number which is well within reason in our opinion for the total system.

Senator BEALL. What happens when one of the vehicles we saw in the pictures going at high speed loses power?

Mr. PRYTULA. It comes down, of course, off its cushion of air—not catastrophically—and keep in mind that it is only about an inch or inch and a half above the guideway, so it is not a very severe drop. At those speeds, however, there is a rate of deceleration which is greater than our emergency rate, on the order of 5 miles per hour per second reduction in speed. So probably, for that reason more than any other, we would suggest that the passenger be belted in for his short journey.

Senator BEALL. What damage does this cause?

Mr. PRYTULA. There is no damage to the vehicle structure itself. There are skids on the underside of the vehicle which we use for setting down onto ordinarily at a station stop, and these, of course, would be abosorbed in an emergency stop and might have to be replaced.

Senator BEALL. How long would it take to get a system into operation after a contract was awarded?

Mr. PRYTULA. It depends, of course, on how the contract is awarded. From the vehicle standpoint, there is no problem at all in that construction could be accomplished in a year to year and a half, again depending on numbers of vehicles. The biggest problems are in the design and in the construction of the guideway, the availability right-of-way, and any particular problems that may occur with regard to necessity for bridges and crossings over existing highways. As far as

the time scale is concerned, we could make the Bicentennial. However, it is all very crucial as to when we start the study and expeditiously move on to engineering design. As Mr. Tobias suggested, we might do some of this concurrently. For example, some preliminary engineering in conjunction with the feasibility study.

Senator BEALL. You are talking about two different studies. Are you talking about the feasibility study we make here—your work being done in conjunction with that—or are you talking about after we have decided something is feasible?

Mr. PRYTULA. Well, I would be concerned, Mr. Chairman—I have heard the number of 9 months for a feasibility study. I would be concerned after that 9-month study that there be a period of examination of those results and then a period of proceeding with procurement procedures into the next phase. I would hope there would be some way that this could be accordioned so that some of these studies could go on concurrently.

Senator BEALL. I agree, but it seems to me that first of all we have to decide on the feasibility of the whole project and then decide which contractor is going to perform.

Mr. PRYTULA. Then I would suggest that we not talk in terms of 9-month studies. If at all possible, say 4 to 6 months at the most.

Senator BEALL. I would point out to you that the bill says up to 9 months, and I would hope that that would be the outside figure rather than the inside.

Mr. PRYTULA. I would hope so.

Mr. TOBIAS. On that subject, I might state that we do agree with Dr. Whittenbury that the short side of that 3- or 4-month period would be very desirable.

Senator BEALL. Well, we are hopeful that the fact that it is connected with the Bicentennial will give us the motivation to cut out a lot of the redtape that might normally accompany a project such as this.

What about the noise levels?

Mr. PRYTULA. The noise levels that we have experienced, of course, are in the French vehicles that we have the background on, which indicate that the highest noise level, say at cruise speed, measured at a 50-foot distance, a standard measurement, would be substantially less than the quietest rail systems in operation in the United States today.

Senator BEALL. I have not run into a quiet rail system recently, so I do not know. Which rail system do you consider quiet?

Mr. PRYTULA. Well, the Bay Area Rapid Transit, of course, is the most recent, and I mention that for a particular reason, Mr. Chairman.

Senator BEALL. With respect to the operation in France, when do you expect the contract to be awarded on that?

Mr. PRYTULA. The latest system that we have heard about is the one that would go out to the new town of Cergy, and the contracts, I understand, may be placed as early as January.

Senator BEALL. This is a new town?

Mr. PRYTULA. This is a new town to be connected to an industrial office complex called La Defense in the Paris suburbs.

Senator BEALL. What population are you talking about?

Mr. PRYTULA. I'm afraid I do not have that.

Senator BEALL. Could you supply that figure for the record? I think that is some interesting information that is useful.

Mr. PRYTULA. Yes, sir.

Senator BEALL. And why it was selected?

Mr. PRYTULA. Yes, sir.

Senator BEALL. All right. Thank you very much, gentlemen.

(The following information was subsequently received for the record:)

DATA FOR THE PROPOSED LA DEFENSE-CERGY TRACKED AIR CUSHION VEHICLE (TACV) LINE

1. The 14½ mile line will link the new city of Cergy with the La Defense business center. At this point, it will connect with the express metro to Paris proper.
2. This line was selected for the TACV because there are no existing direct means of transportation between the two points. Further, that right-of-way is relatively available since the route is through government-owned parkland and some farmland.
3. The capacity requirements of the system is 5,000 passengers per hour in each direction in 1978, with capability to increase to 8,000 by 1985. The population of Cergy is expected to reach 200,000 by 1975, and 350,000 by the year 2000.
4. The scheduled completion date based on go ahead of January, 1973, is late 1976.
5. The 80 passenger vehicles will have a peak speed of 110 mph. They are to be Linear Induction Motor (LIM) powered and air cushion suspended and guided. The initial system will consist of 20 vehicles.
6. The French government has given preliminary study contracts to survey the line and do some predesign of the cars. These studies are presently being reviewed by the French government and a contract for the system is expected.

Senator BEALL. Our next witness is Mr. Parker M. Bartlett, vice president of market development, the Garrett Corp., Los Angeles, Calif. Mr. Bartlett, you have also come a long way and we appreciate your appearance here today.

STATEMENT OF PARKER M. BARTLETT, VICE PRESIDENT, MARKET DEVELOPMENT, THE GARRETT CORP.; ACCOMPANIED BY MICHAEL RACHLIN

Mr. BARTLETT. Thank you, Senator. On behalf of the Garrett Corp., I wish to express appreciation for the opportunity to appear before this hearing to present its views on the proposed Bicentennial Advanced Technology Transportation System Demonstration Act.

I have with me today, assisting on the view graphs, Mr. Michael Rachlin, of our Washington Government relations office.

Garrett is proud to have been a major participant in the advancement of transportation technology over the last decade. Many of these technologies that have been developed by ourselves and others in the industry and on which the U.S. Government has spent considerable money have not yet been put to practice. The occasion of the Bicentennial and the suggested location in our Nation's Capitol where transportation and pollution problems continue to grow are most fitting for a demonstration of some of these accomplishments.

It seems clear that the inertia to change and the financial restraints resulting in reluctance to commit to new, unproven concepts by many in the surface transportation operations make it almost mandatory that the Government perform the catalytic role of sponsoring the the initial operational demonstration.

Based on our experience as a major U.S. developer of propulsion for advanced technology surface transportation vehicles, it is appropriate that we address ourselves to where we are in the development cycle and whether such systems are indeed ready.

Garrett believes that the technology now is available and that the task at hand of providing the proposed transportation link between Washington, D.C., and Annapolis, Md., is primarily one of application engineering.

In support of this position, if the proposed study should confirm that a linear induction motor (LIM) powered tracked air cushion vehicle (TACV) is the best system, this type of electric motor in the required power range has been developed by Garrett under Department of Transportation Federal Railroad Administration contract and has been under test at the DOT High Speed Test Facility, Pueblo, Colo., for the past year and one-half. It was recently operated at a speed of almost 190 miles per hour.

This LIM research vehicle, incidentally, is a steel wheel on steel rail system and the research testing we are conducting for the DOT also includes gathering data on the special high-speed trucks and their dynamic interaction with the rails.

This linear induction motor is so named because it is based on a conventional induction motor unrolled from a cylindrical configuration with the resulting stator windings mounted on the vehicle and the equivalent of the rotor becoming a strip of extruded aluminum stretching the length of the track. Unlike a wheeled traction vehicle which must transmit its thrust through friction at the wheel contact point, with a linear induction motor, the vehicle is thrust forward by the electromagnetic forces between this stator mounted on the vehicle and the "unrolled rotor" or reaction rail mounted on the track.

Without conventional wheels, an air cushion vehicle or a magnetically levitated vehicle which is free of any contact with the ground or guideway must transmit its propulsive forces by some other means. The linear induction motor is one of the best candidates for electrically powered systems.

The LIM in the previously shown research vehicle is designed for speeds up to 260 miles per hour and is the equivalent of about 3,000 horsepower.

A much more powerful linear induction motor capable of speeds of at least 300 miles per hour has been developed by Garrett under another Department of Transportation contract for installation in the Grumman tracked air cushion research vehicle. The guideway for test of this vehicle is now being installed at the high speed test center in Colorado and testing of this complete vehicle propulsion system should start next year. I may stand corrected on that because I think it was mentioned earlier that tests have already started.

This 300-miles-per-hour TAC–RV vehicle requires 8,000 to 10,000 horsepower linear induction motors for full performance. Since a vehicle of this type must be lifted off the ground or guideway, it is very weight sensitive, similar to an airplane. In designing this equipment, Garrett has drawn upon its extensive aerospace technology background to achieve the necessary "flight" weight objectives.

Operation of levitated, electrically propelled vehicles presents the need for more sophisticated collection of the power from the wayside distribution system.

Conventional electric trains drawing their power from an overhead wire cannot travel faster than about 200 miles per hour because of cable vibration that can cause high-voltage arcing and maintenance problems.

Electrified trains using an ordinary third rail have a practical operating limit of about 130 miles per hour because the spring loaded connector bounces at higher speeds.

Again, under contract to the Department of Transportation, Federal Railroad Administration, Garrett has developed a system capable of handling up to the 17-megawatt power requirements of the TAC–RV. We recently completed testing of this system on a rocket sled at the Naval Ordnance Test Station, China Lake, Calif., at speeds in excess of 300 miles per hour.

If the study phase of this proposed high speed link between Annapolis and the Capitol City includes other surface transportation systems—other than the TAC–V which has been predominantly mentioned—it is anticipated that magnetic levitation systems would be studied. Although this technology appears to be slightly behind that of air cushion vehicles, it is advancing very rapidly.

Experimental test vehicles have been demonstrated in Europe. A small scale test system using liquid helium cooled superconducting magnets was demonstrated under Department of Transportation FRA contract just this past month at the Stanford Research Institute, Menlo Park, Calif. A somewhat similar system was demonstrated in Japan earlier this year.

Aside from the lifting magnets and their control, much of the propulsion and vehicle design technology coming out of the Department of Transportation sponsored LIM and air cushion vehicle programs will be directly applicable.

Although the above-mentioned transportation systems represent some of the most advanced and more glamorous concepts, any broad study of candidate systems should also consider the economics of the more conventional rail systems. One influencing factor will be the number of station stops desired between Annapolis and Washington, D.C. The greater the number of stops to accommodate the suburban commuters, the less practical it becomes to incorporate a very high-powered high speed, for example, over 100 miles per hour, transportation system because of the short distances between stops.

The Urban Mass Transportation Administration, through its systems contractor, the Vertol Division of Boeing, is implementing a program for the creation of a new family of advanced rapid transit cars. The first of these, the state-of-the-art car (SOAC) is presently under test at the DOT High Speed Test Center, Pueblo, Colo. This car was built by the St. Louis Car Division of General Steel Industries under contract to the Boeing Vertol Division. It is equipped with the latest Garrett electric traction motor propulsion equipment.

During this next year, this car will visit the various transit cities of Chicago, Philadelphia, Boston, Cleveland, and New York for demonstrations.

This car has been designed to achieve maximum of rider comfort and appeal within the state-of-the-art of existing equipment.

Following immediately behind this program under the Vertol Divission systems management responsibility to UMTA, is the advanced

concept train (ACT). Garrett, as well as three other firms, has recently completed contract design studies for this more advanced design vehicle. Garrett, in its design, has embodied all of the latest concepts of car body design, interior styling, carpeting, diffused lighting, and air conditioning. Particular emphasis has been placed on structural design for safety. The propulsion and braking system has been integrated with a new energy storage flywheel system which provides substantial reduction in total power consumption.

A modern mass transportation system in a large city is a very large consumer of the electrical power generated by the utilities. With the ever increasing concern over the electrical power generating needs of this country, we feel that the power savings associated with this on-board energy storage flywheel are significant.

Garrett is currently equipping two R–32 cars from the New York subway with this type of energy storage flywheel units. To explain the system in a little greater depth, consider a typical subway or rapid transit system. A large amount of energy consumed is that required to accelerate the cars from the station stop up to operating speed. Presently, this energy is dissipated in the process of braking to a stop at the next station. This dissipated energy turns into heat which causes gradual heating of the subway which, in turn, requires more power consuming ventilation and more power consuming air conditioning for the cars and so on in an ascending spiral. By pumping the braking energy to a spinning flywheel on-board the car, a large portion of this energy is stored and is available to be pumped back to the electric traction motors during the next acceleration out of the station.

This program has the enthusiastic support of Dr. William J. Ronan, chairman of the New York Metropolitan Transportation Authority and is being supported by UMTA grant to that authority. These cars will be completed at Garrett's AiResearch Manufacturing Division, Torrance, Calif., and tested at the DOT High Speed Test Facility, Pueblo, Colo. They will then be delivered for operational tests in the New York subway system by mid-1973.

Another transportation system which may be considered, if there is to be substantial emphasis on suburban commuter utilization, is represented by the gas turbine electric train. Again, under the enthusiastic support of Dr. Ronan, Garrett has been developing the concept of a dual mode car— one which can be operated on conventional electrified track such as, for example, that portion of the Long Island Railroad system which is in close to New York City, by electrical power from the third rail powering the electric traction motors. At the extremities of the system, where the track has not been electrified and traffic levels do not warrant the investment of electrical substation and distribution systems, the car carries its own lightweight gas turbine electric power generating system.

Garrett is under contract with the New York MTA to deliver four prototype cars having this capability. These cars will be equipped with Garrett electric motor traction equipment and will also have mounted in the roof of the car two compact 500 horsepower Garrett gas turbine engines driving lightweight high-speed generators. This installed gas turbine electric power generating capacity will be adequate to duplicate the acceleration performance of the cars when operating off of the third rail and will permit operation up to 100 miles per hour.

Turning to the proposed water link between Annapolis and Baltimore and between Annapolis and the Yorktown-Williamsburg-Norfolk area, the candidate transportation systems would be hydrofoils or surface effect vessels, as has been adequately stated earlier today. Here, again, the technology has been fairly well proven in the form of fast hydrofoils within the U.S. Navy in the form of the Grumman *Flagstaff*, the Boeing *Tucumcari*, and the Lockheed *Plainview*. In addition there are current U.S. Navy air cushion vehicle programs now under development with Bell Aerospace Corp. and Aerojet General Corp. in this country. Also, the current daily commercial operation of the British-built Hovercraft across the English Channel is adequate demonstration of the technology status of these types of vehicles.

Looking to the future with vehicles of this type, the U.S. Navy has recently awarded Garrett a contract for the development of a 5,000 horsepower advanced marine propulsion gas turbine engine specifically aimed toward high speed vessels of this type.

In addition, in our traditional equipment manufacturing business, Garrett has been actively working with all the companies which are designing and building hydrofoil and air cushion or surface effects vessels. This includes gas turbines for the auxiliary power supply, lift fan systems, stability and control systems and air-conditioning equipment.

One final observation we would like to submit is that this proposed demonstration program for the 1976 Bicentennial Anniversary will be a "show case" operation. It must be reliable and operate on schedule. The visiting tourist, the public, the commuter, the traveling businessman and the press will all be critical of any failure to maintain scheduled operations with good service and comfort.

We have expressed our positive opinion that the technology is available. Furthermore, we have no dobut that any of the advanced transportation systems to be considered are capable of reliable operation within a mature system. The biggest danger is failure to plan for and to accommodate the initial operational teething problems inevitably associated with any new transportation system.

Garrett has had firsthand experience almost directly related to one element of the proposed system. As the sales and service distributor for the Grumman Dolphin Hydrofoil several years ago, it attempted to support a private capital operation in the U.S. Virgin Islands. This involved a daily scheduled operation between the islands of St. Thomas and St. Croix. Only a single vessel was available and it was the first vessel built. This is in context with the discussions on the scheduling and timing of an attempt to start off any kind of a demonstration with the first vehicle off the production line with no track down or anything else.

In this particular case, this hydrofoil incorporated the latest advanced technology including lightweight gas turbine propulsion, fully submerged lift foils with a sophisticated garrett developed automatic stability and control system. It had a 50-knot cruising speed and comfortable 80-passenger seating capability with an air-conditioned cabin. It had all the elements of the vessel described earlier this afternoon by the Boeing group in practically all respects but simply smaller.

But much of what they stated on the characteristics of their proposed vessel are incorporated here; the comfort characteristics of the fully submerged lift foils which are outstanding, and the ability to stop very rapidly by so-called dive to the water was demonstrated as well as you saw in the Boeing movies. Incidentally, the military version of this particular vessel is the *Flagstaff* which is the sister ship of the *Tucumcari*.

This program was not a success because the financial aspects did not allow for sufficient backup equipment in the form of at least one additional vessel to assure scheduled operations at all times.

When an airline introduces a new airplane into its system, as has been the recent case with the widebodied jets, it may start schedule operations as soon as it has only one of this new model available, but it will always have on hand an older airplane ready to substitute on short notice in the event of any unanticipated difficulties with the new model. Thus, the public does not observe these teething problems. Over a period of time, the operating and maintenance people become more experienced with the new airplane and as other unforeseen problems are worked out, the airplane progresses along a curve of increasing reliability until it reaches its mature operating condition.

Because this proposed transportation system with respect to both the high speed land link between Washington, D.C., and Annapolis and the water links to Baltimore and to the Yorktown-Williamsburg-Norfolk area, will not have had any prior background of experience in these particular links and because there will be no older operating backup equipment in the system, it is imperative that the planning of the system allow for a substantial period, as much as 6 months, of trial operations prior to exposure to the public and that the financial budgeting of the system include a very conservative number of backup vehicles including maintenance and support equipment together with a very substantial operating and maintenance organization.

Thank you.

Senator BEALL. Thank you, Mr. Bartlett.

Accepting your recommendation that there be a 6-month trial period, do you think we can do this by the time of the Bicentennial?

Mr. BARTLETT. I think it will be a very tight schedule.

In the case of the water link, I think there was a constructive suggestion made this afternoon with the suggestion that maybe some currently available vessels might be obtained and started on an operational test earlier. I don't know just at the moment or have any specific vehicles in mind, but it is something I would say that would be very well worthwhile once a decision is made to proceed with the program.

This would start the building of the operational organization. It would then at least get through the teething problems of the facilities and operating and maintenance procedures and everything else.

In the case of the ground link, I would say this. The tightest part of the problem is the schedule.

I could just comment, I think, on some of the cost figures that were cited earlier again. We would endorse the $50 million figure that I believe was mentioned. It would be probably a pretty representative figure on the water link, and the $150 million to $100 million figure I think is a reasonable budgetary type number to cope with in what I have just suggested.

Senator BEALL. What about the cost of the cars? Would they be about the same as other companies testified?

Mr. BARTLETT. Well, the TACV, I think the Rhor people just mentioned some of the costs or the figures. We would have no reason to question those figures. The same with the water vehicles. I think the vehicles, per se, in the land link would represent the smaller portion of the cost. The guideway, right-of-way, safety facilities would represent the larger portion of the cost. So the vehicle cost is less significant——

Senator BEALL. What is the delivery time of the vehicle?

Mr. BARTLETT (continuing). Well, which type of vehicle?

Senator BEALL. For your land vehicle, the TACV vehicle.

Mr. BARTLETT. Well, the TACV vehicle, again, since we are not specifically designing any TACV type of vehicle, I am not in a position to really comment. I feel it would be a schedule that would follow behind the current activity that has been sponsored by UMTA and would probably be something that could be scheduled adequately if placed on order.

Senator BEALL. You mentioned safety. What safety problems do we have to contend with?

Mr. BARTLETT. Well, on the water link there is no question that radar is required. Also, good hydropilot systems are necessary, but these tools are available to cope with the physical control of the vehicles. I am not in too good a position to comment on just how you would cope with keeping small boats disciplined in the water link. This is something again for which, as it was suggested earlier, it would be very appropriate to start testing that kind of a system on the river or on the bay.

Then those kinds of problems would be learned early and could be coped with. I feel they could be coped with once they are recognized.

But the interfaces with the Coast Guard and the safety requirements and some of the rules and procedures may not all be self-evident without the study as is proposed. And so I would be hesitant to comment specifically on all aspects of safety.

On the ground link, an elevated, completely separated guideway system I think can be dealt with, with all the degrees of safety required. I do not think that for the distance that we are talking about, that we are going to have multiple vehicles trained in block sections. The reason for this is that if this is on a 150-mile-an-hour system, you only have a 10-minute run between one point and the other.

So it is very difficult for me to conceive that you would have two vehicles on the guideway at the same time. I am presuming a dual guideway, one each way. On that basis, then I think that there is no question that the guideway safety and the vehicle safety on the guideway could be properly designed.

Senator BEALL. Does power represent any potential hazard?

Mr. BARTLETT. Not one that cannot be properly coped with. Again, it is a separated, isolated guideway for these kinds of speeds. The current Pennsylvania Railroad System, of course, has overhead power. If anyone wants to throw at a wire pole or hold onto it, he can electrocute himself.

But, by and large, we do not consider that a safety hazard.

Senator BEALL. Assuming you have got different traffic at different periods, are these cars amenable to numbers of units moving at the same time in the same direction? In other words, can you hook them up so that more than one——

Mr. BARTLETT. I would almost like to defer to the Rohr people who are at the moment designing this type of air cushion vehicle and perhaps they can better discuss whether they have worked out the train lining problems of multiple vehicles. I do not know.

Senator BEALL. I do not know if they are still in the room or not.

Mr. TOBIAS. That was originally included as part of the phase I study, but was eventually dropped, that is, the trainability of one car to another. We see no problem but it is not being designed into the present system.

Senator BEALL. Should it be?

Mr. TOBIAS. If you had a line that required the capacity, I think it should be because a high-speed train of 150 miles per hour takes a large block of space, a long guideway, in which you would not want another train ahead of you or behind you. So while you are occupying that space, if you had more passengers, more seats and, therefore, more cars in there, you are using that space more efficiently.

So I think that if your capacity demands it, the trainability ought to be made a part of the study.

Senator BEALL. Thank you very much, Mr. Bartlett. The next witness is Dr. W. J. Hesse, who is vice president-development and marketing, and Mr. J. P. Ward, program manager-tracked air cushion vehicles, LTV Aerospace Corp., Ground Transportation Division.

These gentlemen have come from Texas. We appreciate your coming the long distance to give the information, expertise, and experience you all have in this field.

STATEMENT OF DR. WALTER J. HESSE, VICE PRESIDENT, DEVELOPMENT AND MARKETING; ACCOMPANIED BY J. P. WARD, PROGRAM MANAGER, TRACKED AIR CUSHION VEHICLES, LTV AEROSPACE CORP., GROUND TRANSPORTATION DIVISION, DALLAS, TEX.

Dr. HESSE. Mr. Chairman, ladies and gentlemen, Mr. Ward and I are very pleased to be here today and to offer you testimony on the subject bill. I noticed, being at the last of the program, the screen was almost removed before I had a chance to get up here.

Senator BEALL. You have to watch for that.

Dr. HESSE. Our organization is fairly active in the field of ground transportation. Right now, our largest contract is for the automatic people mover (AIRTRANS) at the new Dallas-Fort Worth Airport. This system consists of 68 vehicles, completely automated, operating over 13 miles of guideway and will be operating next year.

The subject at hand, of course, is the TAC vehicle. We have been active in that field for about 5 years. I will show you today several designs of vehicles that we have evolved over that period of time and comment briefly on how we judge the existing technology as related to the bicentennial year of 1976.

This first figure represents the design of the TACV that we evolved under contract with the Department of Transportation. It is a fairly conventional design. It floats on a cushion of air similar to the one discussed previously. It is in a U-shaped concrete guideway. The center rail is a reaction rail for the linear induction motor. It is approximately 12 feet wide and the vehicle cruise speed is 150 miles per hour, with a potential of higher rates and carries 60 passengers. We also built a mockup of this vehicle under the same contract.

This second figure shows the interior of the vehicle. It is similar to first-class aircraft accommodations.

The next figure shows a photograph of the actual hardware mockup. Again, it shows the U-shaped guideway. The mockup was built in Fort Worth, Tex., and was on display at Transpo during this past year. This next figure shows people inside the vehicle. We have had many, many visitors out there. The comments of the people, I think, would be of interest. Generally, you can conclude that they anxiously await the availability of this type of vehicle someplace in the United States.

Now, unfortunately, the Department of Transportation was unable to fund the development and the building of an actual prototype of this design, so we applied some additional corporate funds and came up with a truly second generation vehicle; one that significantly advances the technology over what you have seen here and in the prior discussions.

Specifically, our new design greatly reduces turn radius. We think that is very important if you are going to operate in a true urban environment. It makes switching very simple, and, of course, when you have any type of vehicle that operates at these speeds and carries 60 passengers, switching becomes important.

And perhaps the most important feature of all is that it significantly reduces guideway costs. In the TACV application, the costs of guideway is a predominant part of the total system cost.

Now, to better understand the importance of turning radius, please note the next viewgraph, which is a map of Dulles International Airport. The terminal is shown down at the lower lefthand side. With the old style design, the red route would be required as typical of a 1,500-foot turning radius. You see, it becomes rather difficult to get in and out of the station.

With our new design, we can achieve a turning radius of one-tenth of the former, down to 150 feet. So then the vehicle becomes truly a good neighbor in your urban environment. I think that is important.

I would like now to show you a viewgraph of this new vehicle design and this, again, is truly a second generation design. First of all, the guideway now is a simple, flat flush piece of concrete about 12 feet wide. And on the extremities or ends, there is a steel angle that captures our guidance devices which, in this case, are magnets.

Down the middle of the guideway, shown in the gray area, is the single-sided LIM reaction rail. So by these techniques, without the side walls or center rails, we have just a flush piece of concrete with angles on the side.

The guideway then has the flexibility to be used for dual purposes. You can even drive automobiles or trucks on that guideway in off hours. In fact, you may even put rails flush with that guideway and operate rail vehicles. We think that is a significant advantage.

But, the biggest advantage is reduced cost over the older style air cushion guideways.

A little bit now, on how we guide: Formerly, we had air cushions down the complete length of the vehicles. Now, we do this by four magnets per truck. There are two trucks, and a total of eight magnets. Those magnets actually wrap around and go underneath the steel angle and, in so doing, they prevent the vehicle from flying upward and getting off the guideway or track. We have a gap-sensing circuit on both sides of the vehicle so that as the vehicle gets closer to one angle than the other, appropriate magnetic force is applied to center the vehicle on the guideway.

The air cushions are confined to just those regions where the magnets are, so we effectively have a truck that is rotatable relative to the total vehicle, similar to trucks on railroad cars. This is the feature that gives us our very sharp turning radius.

The other element, of course, was the guideway costs. You asked this question of every other person. We believe that a one-way guideway cost for this concept would be about a half million dollars per mile which is significantly less than our older design. We are currently negotiating for a contract with the Department of Transportation for the development of this particular vehicle and they are, hopefully in the budget request for fiscal 1974 for funds to build a prototype of this particular design.

I would like now to summarize briefly the key items that relate to technology for TACV as we see them applied to the Bicentennial application.

On technical risks, we do not see any real problems. We think the technology is in hand, even for this advanced TACV, to have an operating system by 1976. Now, I am assuming here that we will get this Department of Transportation continued funding for the development of this particular design.

As for noise, these vehicles are very quiet. We have calculated that at a 50-foot distance from the vehicle, the noise level will be about 73 decibels. That is the level of noise you get inside a small subcompact car. The principal noise from this vehicle is the wind resistance. There is hardly any noise.

As for pollution, this vehicle is electronically powered. There is virtually no pollution except that which is generated back at the powerplant. We have done some calculations on that, and we find that with a full load, it takes about 50,000 B.t.u.'s per passenger on trips between Washington and Annapolis.

In contrast, a typical automobile with four passengers inside, would take 60 percent more energy per passenger and, of course, the pollution generated by automobile engines, per B.t.u., is significantly more than an electric powerplant.

On safety, as I mentioned before, it is impossible for this vehicle to jump the rails since the magnets are wrapped around the flanges on the steel angles. Automatic control features are already available to separate vehicles one from the other. If you should lose the air cushion, the vehicle gently floats down to the guideway and runs on wooden or other type skids. We have a redundant braking system. If one fails, we are backed up by secondary brake systems.

I have already mentioned the guideway costs. I think in the application between Washington and Annapolis, as was mentioned earlier,

the biggest problem in terms of getting the job done on time will be with right-of-way acquisition.

So in conclusion, Mr. Chairman, I would like to say it has been our pleasure to present this brief report to you. We believe the application can be met in time with the technology that is available in our country today as has been experienced by our corporation and as it is projected forward.

Thank you very much.

Senator BEALL. Thank you, Dr. Hesse.

You used the figure of $500,000 per mile for a one-way guideway system. Do you have any estimate of the total cost of this system between Washington and Annapolis including the necessary vehicles for a two-way system?

Dr. HESSE. I really do not since we did not actually study the application in any detail. I would suggest that it should be a two-way guideway so that you are talking about a million dollars a mile for an at-grade guideway.

If you have elevated guideway systems, the cost goes up appreciably.

Senator BEALL. That is at-grade cost.

Dr. HESSE. If you build an elevated structure, the cost goes up. The cost I gave is what we call at-grade or right on the ground. You have to protect the guideway from animals and passersby by fences. If you can use existing rights-of-way where you do not have to buy land, then, of course, that cost becomes free.

Senator BEALL. Well, Maryland's secretary of transportation very generously offered to contribute the right-of-way, so that was one.

Dr. HESSE. I think that is very desirable. Again, as I mentioned before, with this guideway concept, since it is a flat flush piece of concrete, it can be used, say, in off hours for other kinds of traffic, for example, trucks, automobiles, and buses. If you can get dual purpose from these guideways, you just get that much more total advantage out of the investment cost.

We have looked in some detail at a TACV system connecting Dallas-Fort Worth with the new airport. In fact, the city councils of the big cities have gone on record that they would like to see that done. That is about a 30-mile length and if your staff is interested in that, I could make those cost estimates available to them.

Senator BEALL. We would be interested in them.

Dr. HESSE. We'll go ahead and do that.

Senator BEALL. Do you think it is possible to do this by the Bicentennial?

Dr. HESSE. Yes, sir; I do, except that I cannot answer that authentically in terms of the rights-of-way availability. The technology of the vehicle, even this advanced state-of-the-art vehicle, is available and can be done, and here I am assuming there that we get this continuing funding from the Department of Transportation; without that, it would be somewhat difficult.

We would estimate that these vehicles can be built, again once the prototype is completed, in a little over a year, and the cost would be somewhere between $1 and $1.5 million each and would carry 60 passengers very comfortably.

Senator BEALL. You indicated that your experience at Transpo showed you that the public generally is actually awaiting something of this sort.

Dr. HESSE. Yes, sir. I think they are extremely interested and would like to see this kind of thing, being something like an airplane, but something that operates at or near the ground. It is still amazing that there are still a lot of people in this world that are somewhat afraid to fly. They are comfortable right at ground level. I think we are exposed to those kinds of clients.

Senator BEALL. Thank you very much, Dr. Hesse.

Dr. HESSE. You are most welcome.

(The statement follows:)

STATEMENT OF W. J. HESSE, VICE PRESIDENT—DEVELOPMENT AND MARKETING AND J. P. WARD, PROGRAM MANAGER—TRACKED AIR CUSHION VEHICLES LTV AEROSPACE CORPORATION—GROUND TRANSPORTATION DIVISION

Mr. Ward and myself represent the Ground Transportation Division of LTV Aerospace Corporation located in Dallas, Texas. We appreciate very much the opportunity to present to you the knowledge we have pertaining to air cushion vehicles so that this information may be considered in your deliberations of this Bill.

Our organization has pursued the field of tracked air cushion vehicles for the past five years. We have monitored the development of air cushion vehicles in France and in England and have conducted independent design studies of air cushion vehicles which would be appropriate to the Washington-Annapolis route. Inasmuch as we have not studied this specific application, we will confine our comments to the status of air cushion vehicle technology.

First I would like to show you some drawings of the vehicles which we have designed. Then I will discuss the status of technology associated with such designs. Figure 1 is an artist's rendering of a vehicle which we designed under contract to the Department of Transportation. Figure 2 shows the interior of this vehicle. Incidentally, we produced a full scale mock-up of this vehicle which we displayed at Transpo earlier this summer. Some of you perhaps visited this display. Figures 3 and 4 are photographs of this mock-up.

We were particularly impressed by the comments of the public as they passed through. In general, the public anxiously awaits the availability of such vehicles. While the Department of Transportation was unable to fund the development of this vehicle, the experience gained in this design has been invaluable, and over the past year we have applied our own resources to advancing this design towards a truly second generation tracked air cushion vehicle—one which represents a meaningful advancement over the European technology, which is now some eight to ten years old. Based on our prior experience, we felt that a true second generation vehicle, one which can truly operate in an urban environment, should offer substantial advancement in: (1) turn radius; (2) switching; and (3) reduction of guideway costs. The vehicle previously designed was limited to turn radii of 1500 feet. Application studies which we have conducted indicate that most routes will require radii much smaller. The same application studies reflect a need for vehicle switching that is reliable and safe and this means switching hardware at least as simple as rail systems. Third, we feel that guideway construction costs, which I am sure you will recognize represent the largest part of the system acquisition cost, must be reduced to approach those of rail systems. We are pleased to report we have evolved a vehicle design which satisfies these needs. In an artist's rendering of this vehicle, shown in Figure 5, you will note that this vehicle is levitated by air cushions but guided by magnetic devices. Also, the double sided linear induction motor has been replaced by a single sided linear induction motor. As you can see in the Figure the guideway has been reduced to a simple slab shape with structural steel angle sections attached to the sides. We are currently negotiating with the Department of Transportation a contract to pursue the development of this vehicle.

With this background we believe that there are certain aspects to the technology of primary interest to you.

TECHNICAL RISK

We sincerely believe that the technology associated with air cushion vehicle is in hand. State-of-the-art technology is employed in each of the technical disciplines involved in the design. These technologies are simply integrated into one vehicle for the first time.

NOISE

These vehicles are designed to a specification which limits noise to a level of 73 db(a) at a distance of 50 feet from the vehicle. This is about the same loudness as that inside the passenger compartment of a typical sub-compact car.

POLLUTION

A non-polluting electrical propulsion system is employed in this vehicle. Sometimes, the point is raised that electrical propulsion is not "non-polluting" because the electric generating plant does in fact, pollute. A generalized answer to this point is difficult to develop because of the many variables involved (such as type of electrical generating plant, etc.). An interesting data point, however, for this comparison is offered. The TACV would require approximately 50,000 BTUs per passenger trip from Washington to Annapolis. By private automobile each passenger trip would require 60% more energy. This comparison, coupled with the acceptable observation that an electrical generating plant can be controlled to produce less pollution per BTU than in internal combustion engine, conclusively illustrates that the TACV would have a favorable impact on the environment.

SAFETY

Many design features have been incorporated into the tracked air cushion vehicles to enhance the personal safety of its passengers. Perhaps most importantly the dedicated guideway reduces collision probabilities to a minimum. Automatic control features are incorporated to maintain adequate separation distance between vehicles. In addition, a failure analysis was conducted to ensure that subsystem failures will not cause an unsafe condition. The analysis points out that the danger of fire is greatly reduced because there are no flammable liquids carried on the vehicle. In the event of the loss of air cushion pressure, air pressure resulting from vehicle forward speed is sufficient to prevent the vehicle from suddenly contacting the guideway. Redundancy is built into the braking system so that failures of the propulsion system or levitation system or even a complete loss of electrical power cannot interfere with safe operation of the brake system.

GUIDEWAY COSTS

While exact guideway costs cannot be supplied since we have not examined the proposed route, previous studies provide us with some rule of thumb estimating factors. Assuming that the soil in this area is typical, one might assume that guideway costs, including electrification, will average 500 thousand dollars per mile for a one-way guideway.

We hope that the information provided herein is of some value in your deliberation. We again would like to express our appreciation for the opportunity to provide this information, and if the decision is favorable we hope someday to contribute to this program.

Senator BEALL. There are no other scheduled witnesses. Anybody else who desires to be heard before we conclude for the day?

We have a statement from Mr. R. W. Schumann, Jr., senior engineer, CrenCo, Inc. His statement will be put in the record.

(The statement follows:)

STATEMENT OF R. W. SCHUMANN, JR., SENIOR ENGINEER, CRENCO INC.

To meet the increasing needs for efficient and attractive urban and interurban transportation, the potential of the protected and inland waterways of the country has been largely neglected. This is not becuase the waterways are not suitable; it is rather that the available watefcraft are too slow and too inconvenient to

compete with the private automobile or even with buses and other public transportation. Any transportation system to be accepted by the public must, through its combination of speed, convenience, comfort and economy, compete favorably with the other available systems. The choking of the highways, the increasing shortage of urban parking, the huge investment required for rail and underground systems, and finally, the increased concern about air and water pollution offer a renewed opportunity to exploit our waterways.

Normally, one thinks of ferry boats when he thinks of water transport and he can validly observe that the ferry boat population is decreasing as bridges and tunnels span more and more of the crossings. There are a few places where the volume of traffic or topography are not suitable for other means of crossing and ferries can survive, but most such places are well equipped with craft and facilities.

It is only when one considers transportation along a waterway or across a body of water too large to bridge or tunnel that one begins to see the potential of the waterways. The broad, unobstructed avenue presented by a river running parallel to the transport arteries is enticing to the harried motorist trapped in the rush hour bumper-to-bumper jams flowing along its bank, but for him to leave his car at home and "go by boat", the cost, comfort and time involved must be competitive. He is involved in individual point-to-point transport, usually from his home to his office, and the system he accepts must solve his problem. It must work in reverse also! But if the system can work to transport him from his home to his office and return competitively with his car, he might well prefer to "read his way to work" in the comfort of a well designed watercraft.

Assuming that the home-to-embarkation portion can be handled with his personal automobile and the debarkation-to-office portion by urban public transportation, the speed and comfort of the waterborne segment is the key to acceptance of such a system. It was the realization of this fact that caused The Crenshaw Company to apply itself to the search for a better solution than conventional watercraft design.

The many technical advances of recent years offer much improvement in performance and permit the design of a watercraft dramatically superior in performance to conventional vessels. The advantages and benefits of each of the following were considered in developing the concept for the CrenCo Waterbus:

Air cushion vehicle, catamaran, planing hull, captured air bubble, hydro-ski, and hydrofoil.

A hybrid design borrowing from nearly all of these types was selected as the most suitable when all phases of the craft's use were considered. In our CrenCo Waterbus design, the twin hulls of the Catamaran reduce resistance and lend stability, particularly during loading and unloading; the best features of the planing hull are incorporated in the hull details; the Captured Air Bubble permits shallow water operation and reduces drag, particularly before the craft is "on her skis", and the Hydro-ski mode of operation gives a smoother ride at a much lower cost than would be involved in a pure Hydrofoil design. Many details of the design, such as jet steering, thrust reversal and trim adjustment hydrofoils are not shown in the conceptual sketches but are a part of the design.

The use of pump-jets is chosen to permit operation in debris-clogged waterways with extensive shallows and gas turbines will provide for high power at light weight with a non-volatile fuel—can also provide bleed air for supplying the bubble.

It is anticipated that this hybrid design will permit high speed operation in relative comfort up to moderate wave heights. This speed can be achieved with a minimum of wave making and it will, therefore, be suitable for use in inland waterways.

Based upon competing consideration of size, payload, economics and passenger comfort, a 100-passenger size was chosen and a 45 m.p.h. (39 knots) sustained speed required. The general characteristics of our design are shown on the attached sheet.

It is our conclusion that the CrenCo Waterbus concept is sound and could be the basis for an attractive and efficient transportation system.

Characteristics of Cren Co Waterbus

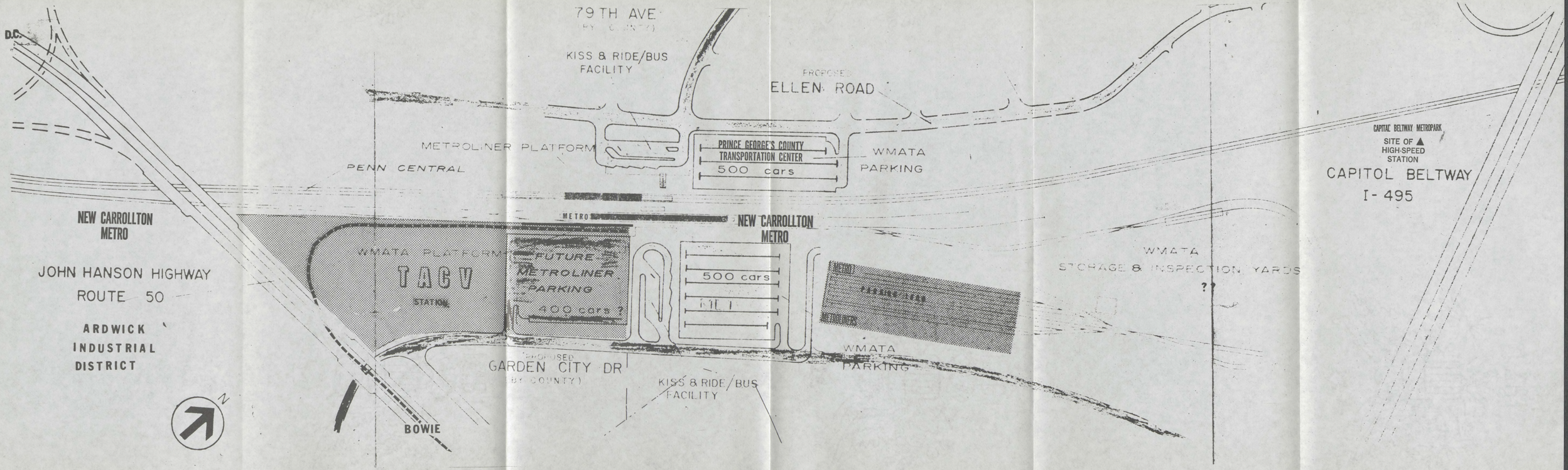
Passengers: Seated	97
Crew	3
Length overall (feet)	80
Beam (feet)	26
Full-load weight (pounds)	85, 000
Draft: Displacement:	
No bubble (feet)	5
On bubble—0 (feet)	3
On skis—39 (feet)	3
Operational speed 39 knots (45 miles per hour)	39
Range at op. speed (nautical miles) knots	250
Fuel	
Power:	
Propulsion (horsepower)	1, 335
Bubble air (horsepower)	200
Auxiliary (horsepower)	65
Total (horsepower):)	1, 600

Senator BEALL. If no one else desires to be heard, we thank you all for being with us today. It has been a very helpful and very educational hearing, and we appreciate your contributions.

We hope to have perhaps some additional hearings and, more particularly, we hope for early action on the part of the Senate and hopefully the House also on this legislation.

If there are no further witnesses, the hearing is concluded.

(Whereupon, at 3:15 p.m., the hearing was adjourned.)


D.C.
79TH AVE
(BY COUNTY)
KISS & RIDE/BUS FACILITY
PROPOSED
ELLEN ROAD
METROLINER PLATFORM
PENN CENTRAL
PRINCE GEORGE'S COUNTY TRANSPORTATION CENTER
500 cars
WMATA PARKING
CAPITAL BELTWAY METROPARK
SITE OF ▲ HIGH-SPEED STATION
CAPITOL BELTWAY
I-495
NEW CARROLLTON METRO
METRO
NEW CARROLLTON METRO
WMATA PLATFORM
TACV
STATION
FUTURE METROLINER PARKING
400 cars ?
500 cars
METRO
METROLINERS
WMATA
STORAGE & INSPECTION YARDS
?
WMATA PARKING
PROPOSED
GARDEN CITY DR
(BY COUNTY)
KISS & RIDE/BUS FACILITY
BOWIE
NEW CARROLLTON METRO
JOHN HANSON HIGHWAY
ROUTE 50
ARDWICK INDUSTRIAL DISTRICT
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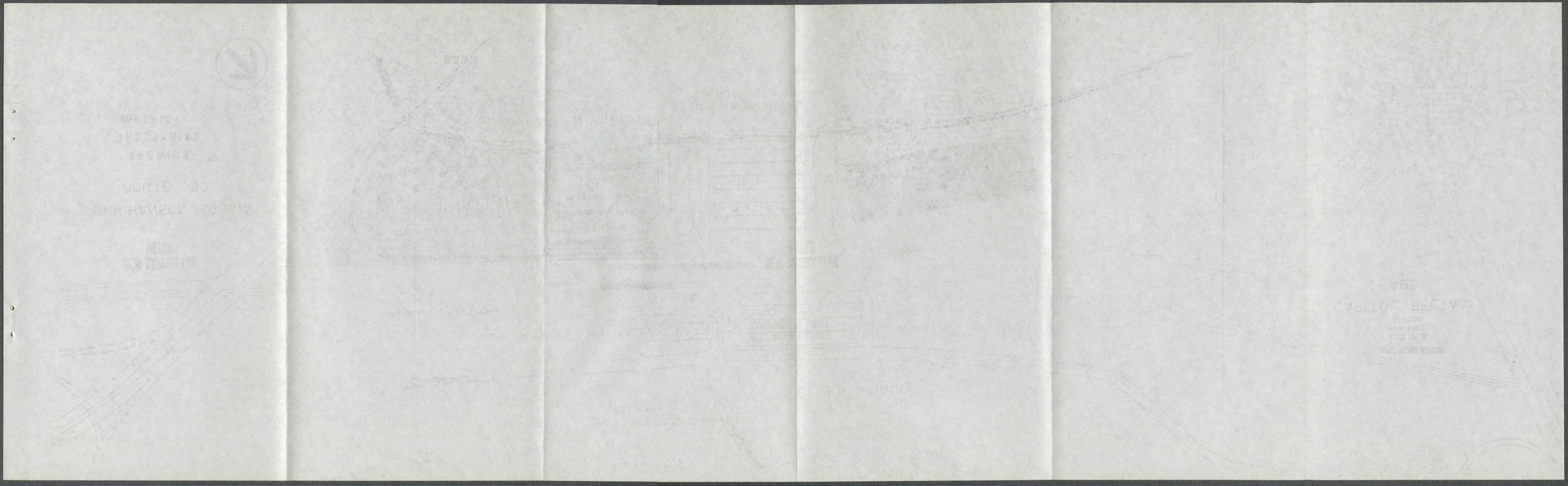


METRO is coming to Maryland . .

New Carrollton—Prospect for Modern Transportation Center—**1976**

The New Carrollton (formerly Ardmore) Metro station offers a unique opportunity for a sophisticated transportation center, in combination with the relocation of the Penn Central Metroliner Hi-speed station, coordinated feeder bus service and adequate parking facilities.

The entire New Carrollton Metro alignment on the Maryland side is under final design, including the stations at Cheverly, Landover and New Carrollton. Construction is expected to begin in 1973, with operations scheduled to commence in 1976.

The Federal Railroad Administration has approved design funds for design of a new Metroliner station facility adjacent to the New Carrollton Metro station. The design will be performed by the same firms under contract with WMATA for Metro's station design and the station will conform to Metro's design standards.

The New Carrollton station will be located east of the Penn Central Railroad tracks approximately one-half mile northeast of John Hanson Highway or approximately halfway between the John Hanson Highway and the Capital Beltway. The station will have a 600-foot long center platform.

A mezzanine containing fare equipment will be located under the platform near the center. Two access points are proposed; one southeast of the station and the other northwest of the railroad tracks. The two access points will be connected to the mezzanine by a pedestrian tunnel. Three escalators will connect the mezzanine to the platform.

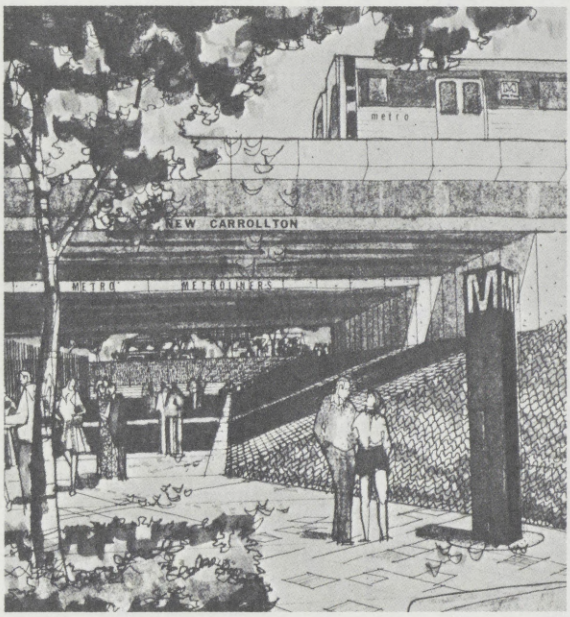
Automobile passenger loading areas, bus facilities and auto parking lots will be located adjacent to both access points. Each will have six bus bays, a 30-space kiss-and-ride facility including space for taxicabs, and approximately 500 parking spaces.

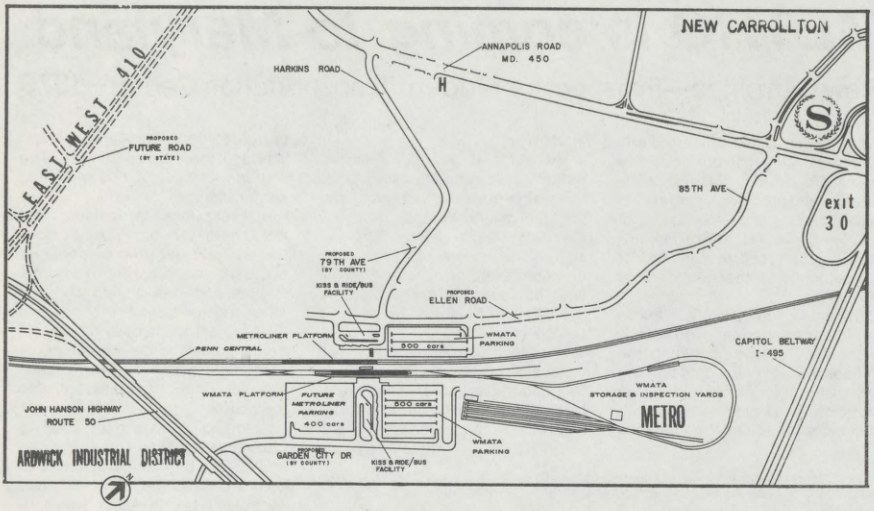
The WMATA 1990 traffic forecast projects that approximately 18,800 people would be using the New Carrollton station daily, with 3,000 entering or leaving the station during the peak hour.

Extensive street improvements are necessary to insure efficient, safe and convenient pedestrian and vehicular circulation both in the immediate area of the station and throughout its service area. Both the Prince George's Department of Public Works and the State Highway Administration will be involved in construction of new roadways in the area, as well as improvements to existing roads (see map). Although it will be a difficult task, every effort is being made to assure that these necessary roads are constructed in time for the opening of the New Carrollton line.

The New Carrollton line will be the first of the four Metro alignments to serve Prince George's County. Total projected daily ridership in 1990 originating at the three Maryland stations on the line is 40,000.

Artist's concept of pedestrian walkway connecting the two access points to the New Carrollton Metro station. Appropriate landscaping will enhance the appearance of the area.





NEW CARROLLTON STATION
1976

Marburger Steps Down...

John H. Marburger, Jr., a representative of Prince George's County on the WSTC, has resigned after six years of continuous service. He was one of the original members appointed to the Commission when it was created in 1965.

As Administrator of the County's Public Works Department and a registered professional engineer in Maryland and the District of Columbia, Mr. Marburger brought to the Commission an extensive background in transportation. Prior to joining the county government, his career included service with the engineering department of the B&O Railroad and engineering service with the Office of Defense Transportation, relating to railroads, waterways, motor and other forms of transportation.

After having served also on the "shadow board" leading up to the official birth of the Washington Metropolitan Area Transit Authority, Mr. Marburger was sworn in as an alternate member of the charter Board of Directors of WMATA.

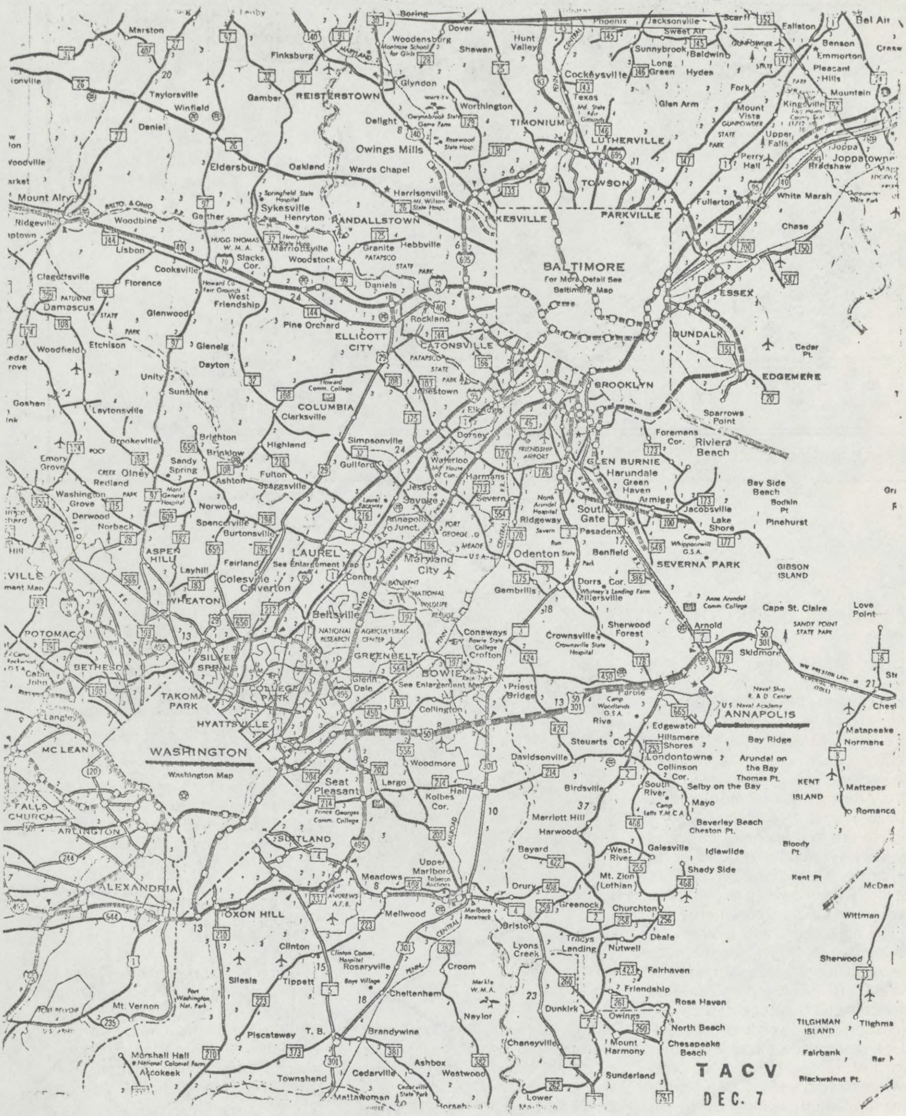
WSTC Vice Chairman John Burcham presents Certificate of Appreciation to John Marburger following his resignation from the Commission.

Selected in 1970 as one of the "Top Ten" public works men in the country by the American Public Works Association, his work, in the opinion of the panel of judges, "reflects the highest standards of professional conduct . . . and achievements."

Fortunately, the Commission will continue to work with Mr. Marburger in his continuing capacity as Public Works Administrator for Prince George's County.

. . . Courtemanch Appointed

Edgar E. Courtemanch of Greenbelt has been appointed by Prince George's County Executive William Gullett to fill the unexpired term of John Marburger. Mr. Courtemanch is a senior planner with AMTRAK, the National Railroad



BALTIMORE
For More Detail See
Baltimore Map
WASHINGTON
Washington Map
ANNAPOLIS
Bel Air
Fallston
Jacksonville
Phoenix
Sweet Air
Hunt Valley
Cockeysville
Timonium
Lutherville
Towson
Parkville
Reisterstown
Owings Mills
Glyndon
Finksburg
Westminster
Taylorsville
Eldersburg
Sykesville
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White Marsh
Olney
Laurel
Beltsville
Greenbelt
Bowie
Wheaton
Silver Spring
Bethesda
Potomac
Takoma Park
College Park
Hyattsville
Mc Lean
Falls Church
Arlington
Alexandria
Oxon Hill
Suitland
Upper Marlboro
Seat Pleasant
Odenton
Severna Park
Crownsville
Arnold
Edgewater
Riva
Davidsonville
Mayo
Galesville
West River
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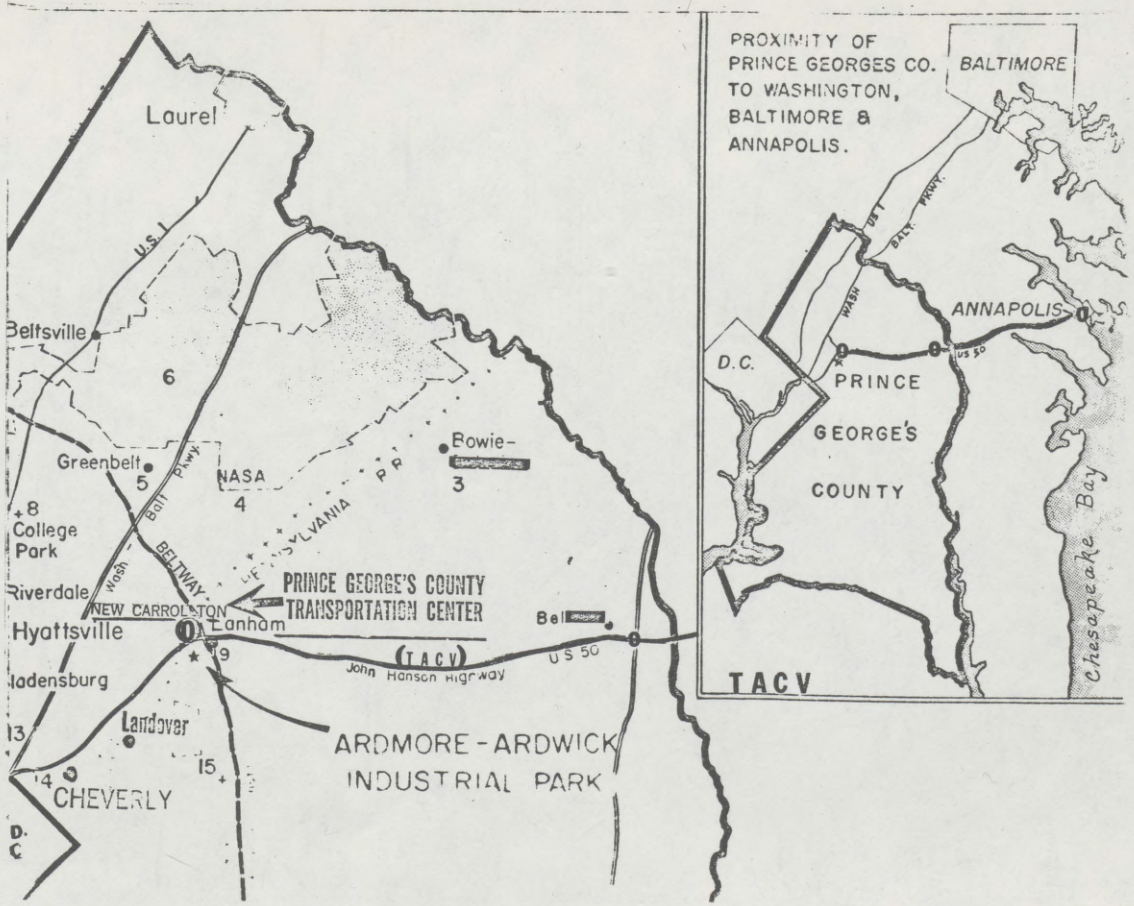
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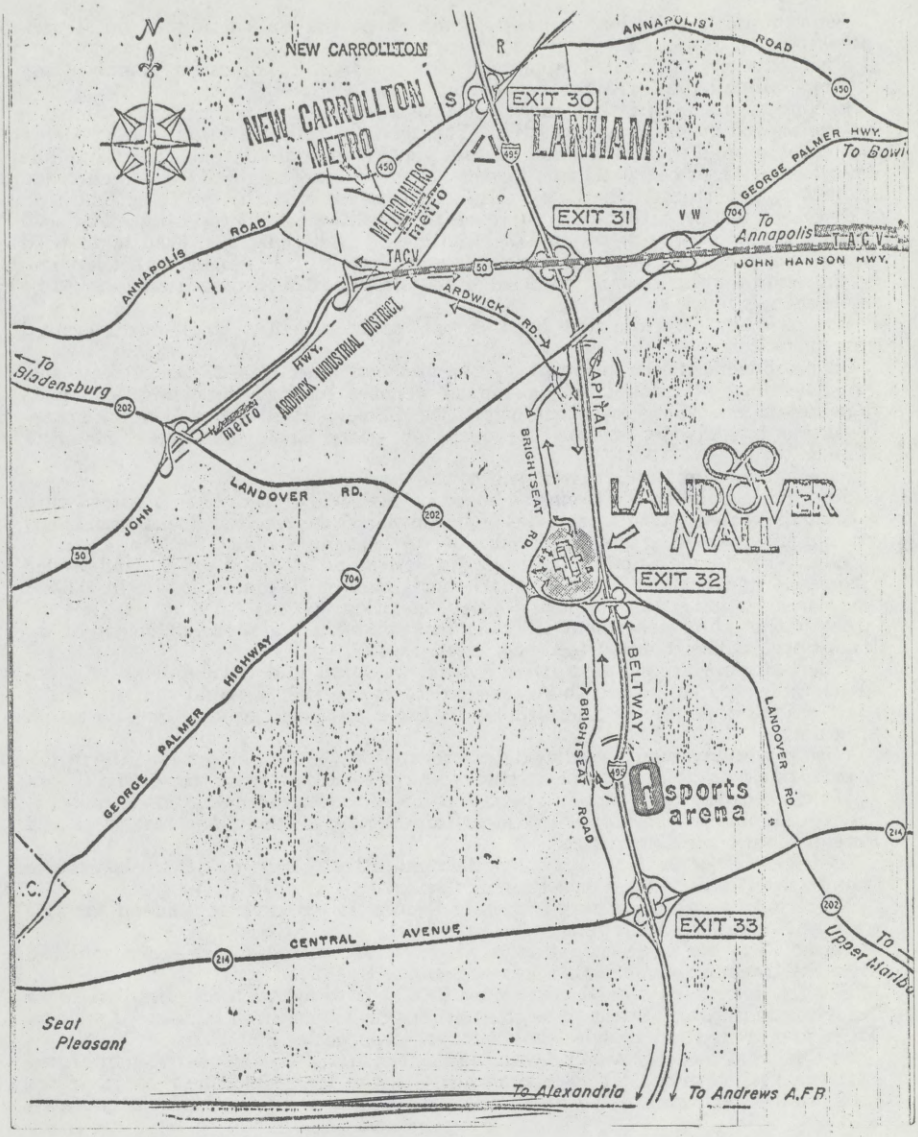
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To Alexandria
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STATEMENT OF HON. J. J. PICKLE, U.S. REPRESENTATIVE FROM TEXAS

Senator Beall and distinguished members of the Subcommittee on Transportation.

First, I must say that I appreciate the opportunity to express some of my feelings on high-speed ground transportation to the Committee.

Second, I am elated that these hearings have focused the public's attention on high-speed ground transportation. This mode of transportation is so vital—to our economy and to our evironment. And yet, I sometimes despair that the public knows so little, or cares so little, for the development of non-polluting, high-speed ground transportation. So I say thank you, Senator Beall, for these hearings.

I do not testify with direct reference to S. 4023—a bill proposing high-speed ground transportation between Washington and Annapolis, and then high-speed water transportation between Annapolis and Norfolk. I do not because I have no background for this specific proposal. I do think S. 4023 has merit and should be explored vigorously.

My primary concern has been in the broader field of high-speed ground transportation.

This broader concern encompasses the first portion of S. 4023, and believe me, the feasibility of tracked, air-cushioned vehicles between here and Annapolis depends on one thing—whether or not the Office of High-Speed Ground Transportation can develop within the next few years an operational high-speed vehicle.

I feel competent to address myself to this question.

Since my service in the Congress began in late 1963, I have been involved with solving the transportation problems of this nation. I am convinced that high-speed ground transportation is a major solution to these problems.

When President Lyndon Johnson proposed the creation of a High-Speed Ground Transportation Office in the Federal Railroad Administration in 1965, I was a sponsor and strong supporter of the legislation.

Every time the Department of Transportation has asked for an extension of the High-Speed Office, I supported these extensions.

When appropriations were made for the research and development of high-speed vehicles, I supported those appropriations. In fact, I would support, and I urge, a greater financial commitment to the high-speed ground transportation program.

With my involvement developed a concern, however—a concern that the development of a workable, high-speed, tracked-air vehicle was going too slowly.

My concern led me to urge an investigation of the high-speed ground transportation program by the House Investigations Subcommittee of the Interstate and Foreign Commerce Committee.

As a member of this Investigations Subcommittee, I have made two inspection trips to the Pueblo High-Speed Proving Grounds.

My first trip was made approximately 18 months ago, and my second the last week of November of this year.

Please allow me to describe briefly where we are with our high-speed vehicles, since the tracked air vehicle is a key element to S. 4023.

The tracked air-cushioned vehicle, or TACV, powered with an electrical linear induction motor, or LIM, is to be this nation's first generation high-speed vehicle. These first generation vehicles should travel at speeds of 300 miles per hour.

At Pueblo, I recently rode a few hnudred feet in a TACV. Congressman David Satterfield of Virginia, Mr. Ben Smethurst of the Investigations Subcommittee staff, and I were among the first non-employees of DOT to ride in a levitated TACV.

Two discouraging facts were noted, however. One, the TACV was being powered by turbo-jet engines, not a LIM; and two, no real length of TACV guideways, or tracks, have been laid.

I have also learned that tremendous technological difficulties remain to be surmounted in developing TACVs.

Senator Beall, I am sure Maryland, and you, would like to see TACVs running between here and Annapolis within three years. I would want such a development within two years; but I know this is impossible.

And I am apprehensive when I try to forecast when our second generation high-speed vehicles—the 600-mile per hour tube vehicles—will be ready. At this time we don't even have an experimental vehicle of this nature.

It may sound as if I think S. 4023 is Polyanna thinking. On the contrary, I feel the public impetus that could be created by legislation such as S. 4023 may be the major spur to overcoming the financial and technological difficulties of America's high-speed program.

Later on, a full report of Congressman Satterfield's and my findings at Pueblo will be made to the Chairman of the House Interstate and Foreign Commerce Committee, the Honorable Harley Staggers of West Virginia. If this Committee would want a copy of this report, I am sure one could be provided.

In conclusion, I want to urge all those concerned with S. 4023 to be involved with making TACVs realities. I hope that my statement has succinctly shown the link between the high-speed program in Pueblo and S. 4023, for the success of S. 4023 ultimately depends on the Pueblo program.

Thank you.

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