

**DEVELOPMENT OF THE NATIONAL
ADVANCED DRIVING SIMULATOR
RESULTED IN SUBSTANTIAL COST
INCREASES AND SCHEDULE DELAYS**

*National Highway Traffic Safety Administration
Federal Highway Administration*

*Report Number: IN-2001-104
Date Issued: September 28, 2001*




U.S. Department of
Transportation
Office of the Secretary
of Transportation
Office of Inspector General

Memorandum

Subject: ACTION: Report on Development of the
National Advanced Driving Simulator Resulted
in Substantial Cost Increases and Schedule Delays
IN-2001-104

Date: September 28, 2001

Reply to
Attn. of: JA-30

From: Alexis M. Stefani 
Assistant Inspector General for Auditing

To: National Highway Traffic Safety Administrator
Federal Highway Administrator

This report presents the results of our review of the state-of-the-art motor vehicle driving simulator being developed by the National Highway Traffic Safety Administration and the University of Iowa. Through use of the National Advanced Driving Simulator, drivers will be put in simulated yet realistic problem situations, such as the sudden appearance of a child in the road, a skid on glare ice, or an oncoming vehicle driving over the centerline. The use of advanced technology and actual motor vehicle cabs will simulate imminent crashes without the unwanted and unsafe consequences of highway crashes.

The objectives of our review were to determine (1) the reasons for increased development costs and the potential for additional Federal funding for the simulator, (2) whether the simulator will begin operating as scheduled, and (3) whether the cooperative agreement ensures the simulator will be used efficiently and effectively.

We obtained comments on a draft of this report from the National Highway Traffic Safety Administration (NHTSA), Federal Highway Administration (FHWA), and the University of Iowa (University), and used the comments in preparing this final report. Exhibit A describes the scope of our review and the methodology used to achieve our objectives.

RESULTS IN BRIEF

The National Advanced Driving Simulator became available for research in June 2001 - more than 3 years later than originally estimated. NHTSA owns the simulator while the University owns the simulator building and land. The University will manage the operation of the simulator and will set user fees to recover costs and provide funds to upgrade simulator components.

The simulator's cost grew to \$80.8 million or more than twice the original estimate of \$36.5 million. DOT's contribution increased to \$65.3 million, or 80 percent of total costs, while non-DOT contributions totaled only \$15.5 million, or 20 percent. NHTSA provided only \$14.5 million of DOT funding out of their own appropriation for the simulator. Congress earmarked the other \$50.8 million (78 percent) of DOT funding for the simulator through FHWA's Intelligent Transportation Systems and Surface Transportation Research budgets. The following table shows actual simulator costs paid with DOT and non-DOT funds:

Simulator Cost (in millions)	
DOT FUNDING	Total
Pre-construction costs	\$12.5
Construction contract	\$34.0
Construction contract changes	\$17.0
Post construction (operational support)	\$1.8
Total	\$65.3
NON-DOT FUNDING	
University contribution	\$11.6
Other non-DOT contribution	\$3.9
Total	\$15.5
GRAND TOTAL	\$80.8

NHTSA did not effectively control project costs. Specifically, NHTSA:

- allowed the cost of the contract with the private sector construction contractor to increase by 50 percent, or \$17 million, for hardware and software revisions, program management, installation and testing, and other costs. In October 1995, NHTSA suggested reducing items, such as the motion base size and the number of vehicle cabs, to prevent cost growth of \$3 million. However, NHTSA subsequently agreed with the University and did not make these changes because they believed it would result in reduced demand for using the simulator and threaten the University's ability to operate the simulator on a self-sustaining basis.

- did not follow congressional directives for (1) obtaining one-third of the simulator's cost from non-DOT sources and (2) determining the fee to be paid for using the simulator.
 - NHTSA used \$7.6 million in DOT funds to pay a portion of the non-DOT cost share. Congress and the Secretary of Transportation required that one-third of the simulator's cost be paid by sources other than DOT. Based on the cooperative agreement between NHTSA and the University, we calculated that non-DOT cost sharing contributions of \$15.5 million fell short of \$23.1 million required. During Fiscal Year 2000 Appropriations Hearings, NHTSA advised the House of Representatives Committee on Appropriations that they were unable to secure additional cost share funds to offset cost increases. At this point, in the absence of congressional direction, it may not be feasible for NHTSA to recover DOT funds used to pay non-DOT costs.
 - Despite the large Federal contribution, NHTSA agreed to pay the same rate to use the simulator as other users. The issue of user fees was addressed in House and Senate reports on DOT appropriations for Fiscal Year 1997. However, the House and Senate Committees on Appropriations provided conflicting guidance on user fees, and the Conference Report for Fiscal Year 1997 was silent on the issue.

The House Committee on Appropriations (Report 104-631) provided a directive to DOT to re-examine the user fee charged by the University because they did not believe it was appropriate that Federal Government users be charged the same rate as other simulator users. However, the Senate Committee on Appropriations (Report 104-325) expressed concern that (1) any additional reduction in the hourly rate for NADS might jeopardize NADS being self-sustaining, and (2) the hourly rate charged to the Government should not cause higher costs to other private users and should be sufficient to allow the simulator to both operate efficiently and take advantage of technology advances.

NHTSA took no action to either clarify this conflicting information or address the issues raised on user fees. Furthermore, in commenting on a draft of this report, NHTSA stated they never contemplated that the Federal Government would be charged a lower user fee than other simulator users, and that charging a lower fee to Federal Government users would be self-defeating because it would reduce the market for private sector research. However, NHTSA's comments are not supported by what is actually happening in the private sector.

Specifically, we believe the University should be able to increase the user fee for private sector users without affecting demand. The simulator is the only simulator that provides state-of-the-art technology and reduces motion sickness. This should create demand from the private sector. Also, the cost to use this state-of-the-art simulator is substantially less than what the private sector pays to use other simulators. The University's current user fee of \$1,000 per hour is less than half the \$2,300 per hour user fee charged by Daimler-Chrysler, which operates a less-sophisticated simulator.

The Federal Government made a significant investment of Federal funds, including payment of some of the non-DOT cost share, to ensure the development of the simulator. Because NHTSA is guaranteed up to two-thirds of the simulator's available research hours, they could be paying \$2.3 million or more per year to use the simulator once it reaches full operational capacity. Under the existing cooperative agreement, NHTSA's user fee will increase at the same rate as private sector users when the University's cost to operate the simulator increases.

The March 1993 cooperative agreement between NHTSA and the University requires that (1) the University establish a user fee that will recover the direct and indirect costs to operate the simulator; and (2) NHTSA pay an amount in accordance with the University's normal fee schedule. The University set the user fee at \$1,000 per hour to recover direct operating costs for Calendar Year 2001. However, the University can unilaterally increase that rate after the first year to offset increases in operational costs. The University previously computed indirect costs for Federal research grants at an average of 28 percent of direct costs. As a result, NHTSA could be required to pay a user fee of at least \$1,280 per hour starting in Calendar Year 2002.

The simulator became ready for research in June 2001, 40 months later than the original estimated completion date (February 1998). NHTSA originally planned to award a construction contract in January 1995. However, the contract was delayed until February 1996 because Congress (1) initially did not fund the simulator and (2) subsequently prevented simulator construction until the General Accounting Office (GAO) certified that non-DOT funds of \$11 million (or one-third of the cost at that time) were obtained. In June 1995, GAO reported that NHTSA had obtained \$11.6 million in non-DOT funds.

The operational date (June 2001) is 25 months later than the revised estimated completion date (May 1999). This schedule delay is attributable to NHTSA's and the private sector construction contractor's inability to deliver simulator components that worked according to performance specifications. Specifically, (1) the motion and visual hardware systems frequently required technical

adjustments to deliver the required precision, (2) software code required numerous modifications, (3) installation of the motion system at the University took longer than expected, and (4) problems with integrating the various simulator components delayed acceptance testing.

It is critical that the simulator produces reliable and valid research, given the substantial amount of DOT funds spent on development. The cooperative agreement does not provide for international quality assurance certification. Both NHTSA and the University agreed that international quality assurance certification would help market the simulator as “world-class” and provide simulator users greater confidence in the reliability and validity of simulator research results.

Recommendations

We recommend that the NHTSA Administrator:

- Obtain clarification from the House and Senate Committees on Appropriations regarding the Federal Government’s fee for using the simulator.
- Include in NHTSA’s annual budget request for simulator research studies: (1) potential costs and benefits of research to be conducted, (2) actual costs and benefits of the prior year’s research, and (3) price structure for determining the simulator fee paid by DOT and non-DOT simulator customers.
- Work with the University to ensure that the simulator’s quality assurance standards are either certified or developed based on universally recognized international standards.

Management Response and OIG Comments

In preparing this report, we used written comments obtained from NHTSA on a draft of this report and included the comments as Appendix A to this report. NHTSA agreed with the recommendation that quality standards be certified. NHTSA disagreed with a recommendation contained in our draft report to recover Federal funds used for the non-DOT cost share through reduced fees for Federal users. At this point, in the absence of congressional direction, it may not be feasible for NHTSA to recover non-DOT developmental costs from the University or other non-DOT simulator users. However, for the reasons stated in this report, we continue to believe NHTSA should take action to address the Federal Government’s user fee for the simulator. Consequently, we revised the report to recommend that NHTSA: (1) obtain clarification from the House and Senate

Committees on Appropriations on setting the Federal Government's user fee and (2) include cost, benefit, and price structure information in their annual budget request for simulator studies.

Based on NHTSA's comments, we changed the report to show (1) the simulator became operational in June 2001, (2) the original cost estimate was \$36.5 million instead of \$32 million, (3) NHTSA and the University were concerned that reducing the simulator's performance capability would decrease demand to use the simulator and threaten the University's ability to operate the simulator on a self-sustaining basis, and (4) the House and Senate Committees on Appropriations provided conflicting guidance on simulator user fees.

We also used written comments obtained from the University on a draft of this report and included the comments as Appendix B to this report. The University was concerned the draft report implied they were responsible for controlling simulator development costs. They clarified that their Scenario Definition and Control software component was not accepted for cost share credit. The University also disagreed with the recommendation to recover DOT funds used to pay for non-DOT costs because they believed it would result in the simulator not being self-sustaining. Based on the University's comments, we changed the report to clarify that NHTSA hired a private sector contractor to develop the simulator. We also removed a recommendation that NHTSA recover DOT funds used to pay for non-DOT costs and software development because the simulator is operational and the University did not receive a cost share credit for the software.

We also used oral comments obtained from FHWA on a draft of this report. Based on FHWA's comments, we changed the report to show that FHWA provided funds for the simulator through their Intelligent Transportation Systems and Surface Transportation Research budgets.

We request NHTSA's position on the first two recommendations that we revised.

BACKGROUND

NHTSA's mission is to save lives, prevent injuries, and reduce traffic-related health care and other economic costs. To accomplish this mission, NHTSA administers vehicle/highway safety programs that entail research, development, testing, and evaluation. In November 1989, the Secretary of Transportation assigned NHTSA the responsibility for developing the National Advanced Driving Simulator. NHTSA, assisted by the National Science Foundation, conducted a national competition and selected the University of Iowa in January 1992 to operate and manage the simulator.

NHTSA awarded a contract to build the simulator to a private sector contractor in February 1996. The simulator is intended to be a unique research asset for the public and private sectors. Simulator users will conduct multi-disciplinary investigations and analysis on a wide range of issues, such as driver and vehicle response in emergency situations; effectiveness of highway designs and roadway signs; and effects of aging, fatigue, and drugs and alcohol on driver performance.

NHTSA has priority to use up to two-thirds of available research hours. The simulator's research capacity is 3,500 hours per year. However, the University plans to limit research time during the first year to 1,400 hours to allow training of University personnel on how to use the simulator and to ensure that initial studies generate quality research results. The University has signed 2 research contracts with NHTSA for 945 hours and 3 research contracts with non-DOT customers for 355 hours. NHTSA's research projects include examining driver impairment associated with various levels of blood alcohol content and driver distraction caused by various devices such as cell phones and automated guidance systems.

FINDING AND RECOMMENDATIONS

Simulator's Cost Increased Significantly

The simulator cost \$80.8 million, more than twice the original estimate of \$36.5 million. DOT funds increased by 156 percent to \$65.3 million from \$25.5 million while non-DOT funds increased by only 41 percent to \$15.5 million from \$11 million. Despite spending a substantially higher amount of DOT funds, NHTSA has agreed to pay the same \$1,000 per hour user fee, and subsequent fee increases, as other users who provided little or no funds for development.

Total Project Costs Increased from \$36.5 Million to \$80.8 Million

NHTSA's original estimate for the total cost of the simulator, as defined in the 1992 Acquisition Plan, was \$36.5 million. This estimate included \$32 million for the simulator facility cost and \$4.5 million for pre-construction costs such as planning studies and project support contracts. In 1992, GAO reported that the original \$32 million facility cost estimate (\$21 million in DOT funds and \$11 million in non-DOT cost share funds) was uncertain because it (1) was made in early 1990 and had not been adjusted to reflect any future cost changes, and (2) was based on a conceptual design that did not identify the specific equipment, computer hardware and software, and building size. NHTSA officials responded

to the report by stating that a more specific cost estimate would be developed after the planned design phase was completed.

The original 1990 facility cost estimate remained unchanged until August 1995, when design contractors submitted more precise project requirements. The facility cost estimate was updated from \$32 million to \$49 million (\$34 million in DOT funds and \$15 million in non-DOT cost share funds). However, since NHTSA wanted the estimate to include only direct costs to build the simulator, they did not include pre-construction costs of \$12.5 million for design and project support contracts and preliminary planning studies and other administrative costs; and post construction costs (operational support) of \$1.8 million. Consequently, the revised estimate did not accurately portray the true potential cost of the simulator.

In February 1996, NHTSA awarded a \$34 million cost-plus-fixed-fee contract to a private sector contractor to build the simulator. The subsequent \$17 million cost increase in construction changes, paid entirely by DOT, can be attributed to:

- \$8.9 million for additions and changes to hardware components,
- \$2.9 million for contractor revision of University software,
- \$2.3 million for contractor program management costs,
- \$1.5 million for simulator installation and testing, and
- \$1.4 million for other costs.

Congress earmarked \$50.8 million, or 78 percent, of DOT simulator funding through FHWA’s Intelligent Transportation Systems and Surface Transportation Research budgets. Only \$14.5 million came from NHTSA’s budget. The following table shows actual costs paid with DOT and non-DOT funds.

Simulator Cost (in millions)		
DOT FUNDING		Total
Pre-construction costs:		\$12.5
Design contracts	\$2.7	
Project support contracts	\$4.4	
Studies & other costs	\$5.4	
Construction contract		\$34.0
Construction contract changes		\$17.0
Post construction (operational support)		\$1.8
Total		\$65.3
NON-DOT FUNDING		
University contribution		\$11.6
Other non-DOT contribution		\$3.9
Total		\$15.5
GRAND TOTAL		\$80.8

NHTSA did not award a fixed-price contract because they had limited experience in contracting and believed contractors would bid \$100 million to develop a highly technical and unique simulator. Cost-plus-fixed-fee contracts are allowed under the Federal Acquisition Regulation (FAR) when uncertainties involved in contract performance do not permit costs to be estimated with sufficient accuracy. The FAR also requires Government oversight during contractor performance to provide reasonable assurance that effective cost controls are used.

NHTSA did not effectively control costs. In October 1995, NHTSA made \$3 million in cost saving suggestions to the University. These suggestions included reducing the size of the motion base from 20x20 meters to 14x14 meters, eliminating the contractor's operational support to the University, reducing the number of vehicle cabs from four to two, and reducing the capability of the simulator's fixed base facility. However, the University consistently disagreed with changes to performance specifications because the cooperative agreement required the University to pay for performance upgrades after the simulator began operating. The University considered withdrawing from the project because of concerns with potential reductions in performance capability.

In March 1996, one month after the construction contract was awarded, NHTSA agreed that the simulator's performance capability would not be reduced. This agreement prevented NHTSA from determining whether state-of-the-art technology used in the simulator was cost-efficient. For example, an analysis of the \$8.9 million in hardware component changes showed that the private sector construction contractor issued a change order in July 1997 to substitute an advanced image generator system for an older model. The advanced system provided vastly improved performance--at an additional cost of \$494,000. However, subsequent technical problems with the advanced system resulted in an additional \$872,000 increase, mainly due to the purchase of additional computer processors to achieve the required video resolution of 60 frames per second.

Congressionally Directed Cost Share Commitments Were Not Met

DOT funding increased from \$25.5 million to \$65.3 million. This can be attributed to significant cost increases in the private sector construction contract and to NHTSA using DOT funds to pay for part of the non-DOT cost share. *The Congress, Secretary of Transportation, and cooperative agreement required that two-thirds of the simulator funding come from DOT funds and one-third from non-DOT cost share funds.* In addition, the cooperative agreement included a clause stating that any project costs exceeding \$32 million would be paid in the ratio of two-thirds DOT funds and one-third non-DOT cost share funds.

The cooperative agreement provided that NHTSA and the University share responsibility for obtaining cost share contributions from non-DOT sources. However, as early as October 1995, NHTSA and the University were aware that non-DOT cost sharing contributions would be limited. As development costs began to escalate, NHTSA and the University approached several private and public sector organizations to contribute, but received no commitments. While the cooperative agreement was not officially changed, NHTSA agreed in March 1996 to change the cooperative agreement and assume the *leadership responsibility for securing additional non-DOT cost sharing commitments*. However, NHTSA had little success in obtaining additional contributions, except for a \$300,000 commercial tractor-trailer truck cab donated by a private corporation.

Although the simulator's cost was \$80.8 million, we used a project cost basis of \$69.2 million for calculating the non-DOT cost share. We reduced the \$80.8 million by \$11.6 million for project support contracts, pre-construction studies and administrative tasks, and post construction (operational support) costs because in the cooperative agreement NHTSA agreed these items would not be included in the cost share.

The non-DOT cost share should have been \$23.1 million. However, NHTSA obtained only \$15.5 million, a \$7.6 million shortfall. Our analysis of the \$15.5 million in non-DOT cost share contributions showed that:

- the University contributed \$11.6 million by providing simulator software valued by GAO at \$4.8 million, the simulator building and land valued at \$6 million, and \$750,000 in cash;
- the contractor contributed \$3.6 million by donating part of their fee, as promised in their cost proposal; and
- a private corporation donated a \$300,000 commercial tractor-trailer truck cab.

Because NHTSA obtained only \$15.5 million in non-DOT funds, \$7.6 million in DOT funds was used to pay for non-DOT costs. Consequently, NHTSA funded the entire non-DOT portion of the cost increase -- contrary to the requirements of Congress, the Secretary of Transportation, and the cooperative agreement.

NHTSA Cannot Control Future Simulator Fee Increases

NHTSA agreed to pay the University the same user fee as other simulator users who provided little or no funds to develop the simulator. Both NHTSA and the University are concerned that the simulator will fail if NHTSA is charged a rate below the cost to operate the facility. The issue of user fees was addressed in House and Senate reports on DOT appropriations for Fiscal Year 1997. However,

the House and Senate Committees on Appropriations provided conflicting guidance on user fees, and the Conference Report for Fiscal Year 1997 was silent on the issue.

The House Committee on Appropriations (Report 104-631, Fiscal Year 1997) directed DOT to:

reexamine the business arrangements with the University of Iowa to reduce participation costs. The Committee does not believe that it is appropriate that government users be charged the same rates as other users of the NADS given the Federal Government's sizable financial contribution (two-thirds of the total) to this project.

The Senate Committee on Appropriations (Report 104-325, Fiscal Year 1997) stated it was concerned that:

any reduction in the hourly operational rate of NADS would jeopardize the ability of the NADS to operate without a subsidy. The projected hourly rate for NADS is one-third the rate of the Daimler-Benz facility, a lower fidelity simulator than NADS from which DOT purchased time in the past. Any additional reduction in the hourly rate for NADS might jeopardize the ability of NADS to be self-sustaining. The original hourly rate allowed for the continuous maintenance and technology upgrades of the facility over the life of the project. The Committee recognizes that advances in this technology will take place at a rapid rate which will require state-of-the-art improvements. Thus, the hourly rate charged to the Government should not cause higher costs to other private users and should be sufficient to allow the facility to both operate efficiently and take advantage of technology advances. The hourly rate should be periodically examined with those factors in mind.

NHTSA took no action to either clarify this conflicting information or address the issues raised on user fees. Furthermore, in commenting on a draft of this report, NHTSA stated they never contemplated that the Federal Government would be charged a lower user fee than other simulator users, and that charging a lower fee to Federal Government users would be self-defeating because it would reduce the market for private sector research. However, NHTSA's comments are not supported by what is actually happening in the private sector.

Specifically, we believe the University should be able to increase the user fee for private sector users without affecting demand. The simulator is the only simulator that provides state-of-the-art technology and reduces motion sickness. This should

create demand from the private sector. Also, the cost to use this state-of-the-art simulator is substantially less than what the private sector pays to use other simulators. The University's current user fee of \$1,000 per hour is less than half the \$2,300 per hour user fee charged by Daimler-Chrysler, which operates a less-sophisticated simulator.

The Federal Government made a significant investment of Federal funds, including payment of some of the non-DOT cost share, to ensure the development of the simulator. Because NHTSA is guaranteed up to two-thirds of the simulator's available research hours, they could be paying \$2.3 million or more per year to use the simulator once it reaches full operational capacity. Under the existing cooperative agreement, NHTSA's user fee will increase at the same rate as private sector users when the University's cost to operate the simulator increases.

The March 1993 cooperative agreement between NHTSA and the University requires that (1) the University establish a user fee that will recover the direct and indirect costs to operate the simulator; and (2) NHTSA pay an amount in accordance with the University's normal fee schedule. The University set the user fee for the first year at \$1,000 per hour to recover direct costs. The University will begin charging indirect overhead costs in Calendar Year 2002. The indirect costs charged by the University for Federal research grants average 28 percent of direct costs. Therefore, even if direct costs do not increase and there is no increase in demand, the user fee would increase to \$1,280 per hour. However, the user fee could increase even more because direct costs (salaries and fringe benefits) will probably increase annually.

NHTSA agreed to pay for simulator use in accordance with the University's normal schedule of fees; therefore, NHTSA is vulnerable to increased costs to use the simulator. According to University officials, they plan to set the user fee based on supply and demand once the simulator's operational capacity is reached. Although the University is a non-profit organization, this strategy is intended to maximize revenue and support upgrades to maintain the simulator's state-of-the-art quality. Since NHTSA can use up to two-thirds of available research hours, research time for the private sector will be limited. As a result, the user fee could increase if there is a significant private sector demand to use the simulator but only a limited amount of time available for the private sector.

Simulator Not Developed Timely

The simulator became available for research in June 2001, 40 months after the original estimated completion date (February 1998) and 25 months after the

revised estimated completion date (May 1999). The Acquisition Plan for the simulator, approved by the Deputy Secretary in January 1993, provided for a construction contract to be awarded in January 1995 and the simulator to be operational by February 1998.

The construction contract, awarded in February 1996, provided for the simulator to be operational in May 1999. The delay in awarding the contract can be attributed to funding issues. Specifically, in Fiscal Year 1994, Congress did not provide funding for the simulator and there was a delay in securing non-DOT funding. The Conference Report on Department of Transportation and Related Agencies Appropriations for Fiscal Year 1995 also stated that simulator construction could not start until GAO certified that non-DOT funding of \$11 million was obtained. In June 1995, GAO reported that NHTSA had obtained \$11.6 million in non-DOT funding.

The simulator's development was also plagued with various technical problems. The following timeline shows the length and cause of the 25-month delay from the revised estimated completion date (May 1999) to the date the simulator became ready for research (June 2001).

- May 1999 to April 2000 - 11 months to address technical problems related to the development of system components, installation of the simulator at the University, and the development of integration testing procedures.
- May 2000 to September 2000 - 5 months to correct unacceptable temperature variations in the concrete foundation, revise software code, integrate the visual system, and fix technical problems with vehicle cabs.
- October 2000 to June 2001 - 9 months to correct technical problems with the motion and visual systems encountered during simulator component testing and to complete overall system acceptance testing. The motion system was vibrating at low speeds and was shutting down when it approached motion limits instead of adjusting automatically as intended. The visual system problem involved computer processors that were not providing the required video resolution of 60 frames per second. These problems contributed to a delay in acceptance testing.

Quality Assurance Standards Not Considered

Our review of the cooperative agreement showed that NHTSA and the University did not consider pursuing international quality assurance certification. This can be attributed to their focus on simulator development. During our visit to an aircraft

simulator facility, the quality assurance manager advised us that international quality assurance certification would help market the simulator as a “world-class” facility. Certification would also provide simulator users, such as automobile manufacturers and pharmaceutical companies, more confidence in the reliability and validity of simulator research.

The International Organization for Standardization (ISO) is a worldwide federation of national standards. It promotes development of universal standards to support international exchange of goods and services and to develop cooperation in intellectual, scientific, technological, and economic activity. The ISO provides a framework for quality management and quality assurance.

NHTSA and the University agreed that having the international quality assurance certification would be beneficial. Although the University is funding \$27,000 to develop simulator quality assurance standards, it currently has no plans to apply for certification until customers demand it as a condition of using the simulator.

RECOMMENDATIONS

We recommend that the NHTSA Administrator:

- Obtain clarification from the House and Senate Committees on Appropriations regarding the Federal Government’s fee for using the simulator.
- Include in NHTSA’s annual budget request for simulator research studies: (1) potential costs and benefits of research to be conducted, (2) actual costs and benefits of the prior year’s research, and (3) price structure for determining the simulator fee paid by DOT and non-DOT simulator customers.
- Work with the University to ensure that the simulator’s quality assurance standards are either certified or developed based on universally recognized international standards.

MANAGEMENT RESPONSE

We received written comments on a draft of this report from NHTSA and the University and oral comments from FHWA. We used the comments in preparing this final report and included NHTSA’s and the University’s written comments in their entirety as appendices to this report.

NHTSA agreed with the recommendation that quality standards be certified. NHTSA disagreed with the recommendation to recover Federal funds used for the non-DOT cost share through reduced fees for Federal users. NHTSA disagreed with the recommendation, stating that recovering Federal funds would: (1) retroactively change the Cooperative Agreement; (2) undermine the University's ability to operate the facility on a self-sustaining basis, as required by the Cooperative Agreement; and (3) require recovering funds for software development that was not part of the University's cost-share contribution.

The University was concerned the draft report implied they were responsible for controlling simulator development costs. They clarified that their Scenario Definition and Control software was not accepted for software cost share credit. The University also disagreed with the recommendation to recover Federal funds used to pay for non-DOT costs because they believed it would result in the simulator not being self-sustaining.

OFFICE OF INSPECTOR GENERAL COMMENTS

Now that the simulator is operational, it may not be feasible for NHTSA to recover non-DOT developmental costs from the University or other non-DOT simulator users. However, for the reasons stated in this report, we continue to believe NHTSA should take action to address the Federal Government's user fee for the simulator. Consequently, we revised the report to recommend that NHTSA: (1) obtain clarification from the House and Senate Committees on Appropriations regarding the Federal Government's user fee and (2) include cost, benefit, and price structure information in their annual budget request for simulator studies.

Based on NHTSA's comments, we changed the report to show (1) the simulator became operational in June 2001, (2) the original cost estimate was \$36.5 million instead of \$32 million, (3) NHTSA and the University were concerned that reducing the simulator's performance capability would decrease demand to use the simulator and threaten the University's ability to operate the simulator on a self-sustaining basis, and (4) the House and Senate Committees on Appropriations provided conflicting guidance on simulator user fees. NHTSA also expressed concerns that charging a different fee to the private sector would retroactively change the cooperative agreement. However, the cooperative agreement provides for modifications to be proposed at any time during the period of performance by either NHTSA or the University, and becomes effective upon approval by both parties.

The funding, cost sharing and project estimate issues have been part of the congressional hearings during NHTSA's annual budget process. Although funding was provided, Congress consistently has been concerned about the growing cost of the simulator and the cost share contributions. The conference report accompanying the Fiscal Year 1995 DOT appropriations bill directed NHTSA to provide the House and Senate Committees on Appropriations with a new estimate of the total project cost. In Fiscal Year 1997, the Chairman of the House Committee on Appropriations questioned NHTSA as to why they did not comply with the congressional directive to provide the total cost for the simulator. NHTSA subsequently provided total cost estimates to the Committee.

Based on the University's comments, we changed the report to clarify that NHTSA hired a private sector contractor to develop the simulator. We also removed a recommendation that NHTSA recover DOT funds used to pay for non-DOT costs and software development because the simulator is operational and the University did not receive a cost share credit for the software.

Based on FHWA's oral comments, we changed the report to show that FHWA provided funds for the simulator through their Intelligent Transportation Systems and Surface Transportation Research budgets.

ACTION REQUIRED

In accordance with Department of Transportation Order 8000.1C, we would appreciate receiving your written comments on the first two revised recommendations within 30 days. If you concur with the recommendation, please indicate the specific action taken or planned and the target dates for completion. If you do not concur, please provide your rationale. Furthermore, you may provide alternative courses of action that you believe would resolve the issues.

We appreciate the courtesies and cooperation of the Department's representatives during this review. If I can answer any questions or be of further assistance, please feel free to contact me at (202) 366-1992 or Thomas J. Howard, Deputy Assistant Inspector General for Maritime and Highway Safety Programs, at (202) 366-5630.

Attachments (4)

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Exhibit A. SCOPE AND METHODOLOGY

Our review covered simulator development from planning in 1990 to completion in 2001. We reviewed congressional appropriation hearings and conference reports to identify Federal funding and congressional requirements for the simulator. We analyzed construction contract costs and change orders to identify causes of cost increases and schedule delays. This included an analysis of the contract's work breakdown structure and trends in associated cost variances. We analyzed progress reports to determine whether the project will meet deadlines and to identify problems that could delay the operational date. We reviewed the University's pricing strategy and cost estimates for operation, maintenance, and upgrading of the simulator. We examined NHTSA and the University's plans for marketing the simulator. Finally, we observed the FHWA driving simulator and visited an aircraft simulator facility to observe its flight simulators and discuss operational issues.

We obtained written comments on a draft of this report from NHTSA and the University and oral comments from FHWA. We used the comments in preparing this final report.

The review was conducted from April 2000 through April 2001, in accordance with Government Auditing Standards prescribed by the Comptroller General of the United States, and included tests of internal controls as we considered necessary. Activities visited or contacted follow.

United States Department of Transportation

Office of the Secretary, Washington, DC
National Highway Traffic Safety Administration Headquarters, Washington, DC
 Office of Driver Behavior Research and Simulation
 Office of Contracts and Procurement
Federal Highway Administration Headquarters, Washington, DC
 Office of Research, Development, and Technology
 Turner-Fairbank Highway Research Center, McLean, Virginia

University of Iowa

National Advanced Driving Simulator and Simulation Center
Office of the Vice President for Research
Office of Financial Management and Budget

Exhibit B. MAJOR CONTRIBUTORS TO THIS REPORT

THE FOLLOWING INDIVIDUALS CONTRIBUTED TO THIS REPORT.

<u>Name</u>	<u>Title</u>
Gary E. Lewis	Program Director
Kerry R. Barras	Project Manager
Alvin B. Schenkelberg	Auditor
Kyle V. Miller	Analyst



U.S. Department
of Transportation

Memorandum

**National Highway
Traffic Safety
Administration**

July 10, 2001

Subject: NHTSA Comments on DOT/IG Draft Report, Project No. 00T3007T000, "Development of the National Advanced Driving Simulator Resulted in Substantial Cost Increases and Schedule Delays"

From: L. Robert Shelton
Executive Director

To: Alexis M. Stefani
Assistant Inspector General for Auditing

On Thursday, May 3, 2001, the NHTSA IG Liaison Officer received a copy of a revised Draft Report on the National Advanced Driving Simulator (NADS) program from the DOT/IG Office with a request for NHTSA review and comment. This memorandum responds to that request. Each of the major findings and recommendations in the Draft Report will be addressed. Attached to this memorandum is a list of document references in support of NHTSA's comments.

Background

NHTSA's Vision for NADS:

Accident causation studies conducted by NHTSA and others in the 1980's showed that human error is a major contributor in up to 90 percent of all traffic crashes. Very little was known about how and why drivers committed these errors. NHTSA was essentially precluded from conducting human factors research under real world conditions because of the potential of exposing subjects to serious risk of injury. Controlled experiments on proving grounds had been attempted, but with poor results due to the artificial nature of the environment. Few driving simulators existed at the time, and they were mainly low-level desk-top devices.

The NADS was envisioned to be a complex device utilizing cutting edge technologies in motion system cuing, high speed parallel processing, computer graphics, and image display systems. It was intended to be a unique research asset for the public and private

sectors and also advance U.S. leadership in simulation technology. Simulator users could conduct multi-disciplinary investigations and analyses on a wide range of issues, such as driver and vehicle response in emergency situations; effectiveness of highway designs and roadway signs; and effects of aging, fatigue, and drug and alcohol use on driver performance. With such a sophisticated tool, human factors research into fundamental causes of driver error could finally be conducted within the safe and repeatable confines of the research laboratory.

NHTSA's Management Approach

Feasibility Study

NHTSA conducted a technical feasibility study, which was completed with a positive finding in 1990 (Ref. 1) to confirm that the simulator technology base was sufficiently advanced. Because of the major investment of public funds that developing this simulator would entail, NHTSA decided that the NADS should be a *national research asset* available to both public and private sector safety researchers alike. To ensure accessibility of the device to the widest spectrum of users, NHTSA decided to locate the facility at a major transportation research university, rather than at one of its own government laboratories. The NADS concept was presented to the Secretary of Transportation in November 1991, and the Secretary approved the project. NHTSA subsequently engaged the National Science Foundation to conduct a nationwide competition among qualifying universities to become the host institution for the NADS. The University of Iowa was ultimately selected to operate the NADS because of their technical expertise in simulation and because of their impressive cost-sharing pledge.

Three-Phase Acquisition Strategy

NHTSA's three-phase acquisition strategy was designed to mitigate technical risk and to minimize the development schedule time. The Phase I design competition was a one-year effort conducted under a fixed-price contract. At the end of the Phase I competition, NHTSA assembled a panel of simulator technical experts from National Aeronautics and Space Administration (NASA), Federal Aviation Administration (FAA), Coast Guard, and the U.S. Army to assist in selecting the winning design. TRW was selected as the winner and in February 1996 was awarded a cost-plus-fixed-fee contract to conduct detailed design, construction, integration, installation, and acceptance testing of the device at the University of Iowa. TRW worked closely with the University in developing design requirements for the unique NADS facility building. The Phase II development of the NADS is now complete, and the facility will begin operations in June 2001. NHTSA will enter into the third and final phase of the acquisition, which will provide operational support to the University from the development contractors for training, spares, troubleshooting, and maintenance. This is a one-year Level-of-Effort contract.

NHTSA’s Comments on Findings

Finding: “The simulator’s cost of \$80 million was two and one half times the original estimate of \$32 million.”

Comments: NHTSA believes that the report’s cost comparison is invalid. The report comparison was made between the FY 1989 estimated cost of *only* the *hardware and building* and the *FY 2001 entire cost of the project*. One component was compared to the *sum of five* components. It is also inappropriate to use the original \$32 million figure because it was recognized as an early attempt, without the benefit of a design, to estimate an order of magnitude for the hardware and building. In fact, the final acquisition strategy included a Phase I design effort which was intended to provide a cost estimate, based on a detailed design and technology assessment. In 1996, before the award of the Phase II for hardware and building, a cost estimate, based on a design approach and assessment of available technology, was made. This is the estimate that should be used as the yardstick for evaluating cost performance for the NADS acquisition.

An accurate cost comparison can be made between either: (1) the total costs of the 1996 estimates of \$63.8 million and the draft report findings of \$80.9 million; and/or (2) the Phase II 1996 estimate of \$49.9 million and \$66.6 million in the draft report for the construction costs. The following table illustrates this comparison:

	1989 Estimates	1996 Estimates	IG Report	2001 Actuals
Feasibility		\$5.4	\$5.4	\$3.237
Program Mgmt Support	\$4.5	\$4.0	\$4.4	\$4.331
Phase I		\$2.7	\$2.7	\$2.700
Phase II	\$32.0	\$49.9	\$66.6	\$66.453
Phase III		\$1.8	\$1.8	\$1.800
TOTAL	\$36.5	\$63.8	\$80.9	\$78.521

NHTSA notes that there is approximately a \$2.3 million discrepancy between the total project costs of \$80.8 million, as contained in the Draft Report, and the total project costs of \$78.521 million from the above table. NHTSA is unable to reconcile this difference further because of lack of detail provided in the report.

The NADS is a state-of-the art driving simulator. Therefore, it is not surprising that cost growth would occur because of the sophisticated technology. Over the past ten years, advances in this technology took place at a rapid rate, which required state-of-the-art improvements. Any reductions in NADS performance would have exposed it to competition from existing mid-level simulators and compromised its ability to perform high fidelity driving simulator research. In addition, this would have jeopardized the University of Iowa's ability to operate the NADS on a self-sustaining basis.

Finding: "... the revised estimate did not accurately portray the true potential cost of the simulator."

Comment: Because NHTSA chose to distinguish between the simulator development cost, i.e., the Phase II construction, and the total project cost, the report implies that the agency was dealing in less than good faith with the Department of Transportation and the Congress. Since the inception of the NADS program, NHTSA has distinguished between these two costs. In its original 1992 submission to the TSARC (Ref. 2), NHTSA included a breakdown of total estimated project cost and simulator construction cost. In addition, the 1995 GAO report, analyzing NADS cost-sharing (Ref. 3), noted the distinction between the simulator development cost and the total project costs. Moreover, beginning in FY 1996, NHTSA has provided to the Congress, on an annual basis, a detailed cost breakdown table that reflects both the total project cost, as well as the cost of construction of the simulator. This information is included in the Department of Transportation and Related Agencies Appropriations Hearings in the Congressional record and is available for review.

Finding: "NHTSA was not able to effectively control costs."

Comments: The report faults NHTSA for agreeing with the University of Iowa not to compromise the performance capability of the NADS as a means of containing the simulator cost. In 1995, prior to the award of the construction contract, a vigorous debate took place between the University and NHTSA technical staff concerning the NADS essential performance specifications. Much of this debate centered around reducing the size of the x-y motion base from 20x20 meters to 14x14 meters and reducing the number of cabs from 4 to 2 as cost-saving measures. NHTSA's ultimate agreement with the University's position to leave the NADS performance specifications unaltered was based on extremely important technical and business/economic reasons.

A major technical reason was the crucial issue of simulator-induced sickness. As noted in the National Research Council's Report (Ref.4) "Estimating Demand for the National Advanced Driving Simulator," problems of simulator sickness have been "... a major concern in aircraft and space simulators for decades." The report also noted that simulator sickness could also be "a major impediment to the widespread application of *driving simulator* technology for research, training, and evaluation" and that "a lower incidence of simulator-induced sickness would be likely with a *large excursion motion base*." The origin of this problem is not fully understood, but it is generally believed that it comes about as sensory conflict within the higher centers of the brain, when visual, auditory, motion, or tactile cues are not all fully coordinated.

The original NADS feasibility study (Ref. 1) focused at great length on this issue. It appeared that the greatest potential for cue conflict occurred between the visual and motion cuing. Additional studies on sizing of the motion system were done at NASA Ames (Ref. 5) and at NHTSA's Vehicle Research and Test Center (VRTC) (Ref. 6), as well as by the Phase I design contractors. As a result, a 20x20 meter motion base was proposed as the most effective way of minimizing simulator sickness. NHTSA ultimately agreed with the University of Iowa that reducing the motion base size would seriously jeopardize the success of the NADS project by greatly increasing the potential for simulator sickness. Consequently, the agency agreed to retain the full size system.

Another major consideration was the economic viability of the NADS facility and whether there would be sufficient research demand for this type of simulator. The University of Iowa was aware that there were a number of mid-level simulators that could be used to conduct research under fairly benign driving situations, but believed that these were not a competitive threat to a high end simulator such as the NADS. However, they were very concerned that if the NADS performance specifications were degraded, it would put at risk their ability to be competitive with existing mid-level simulators. This, in turn, would threaten their ability to operate the simulator on a "self-sustaining basis" as was required by the Cooperative Agreement (Ref. 7). For these reasons, NHTSA agreed to leave the NADS performance specifications unchanged.

The Report states, "... the University consistently disagreed with any changes to performance specifications because the cooperative agreement required the University to pay for performance upgrades that would be required after the simulator began operating." The report misinterprets the intent of the language related to facility upgrades that is contained on page 12 of the Cooperative Agreement. The Cooperative Agreement refers to Iowa's proposal to "... contribute 50% of indirect charges on NADS revenues to upgrade the NADS and keep it at the state-of-the-art.

This contribution is valued at \$11.6 million over the first ten years of NADS operation, and will continue throughout the life of the NADS.” The goal of this requirement was to provide for an efficient and continuous means of upgrading the NADS without securing funding through the Federal appropriations process. The objective was to keep the NADS at the cutting edge of technology, as the NADS facility aged, particularly with regards to computers and computer graphics. The Cooperative Agreement was never envisaged as a mechanism to force the University to finance upgrades to the facility to compensate for degraded performance specifications adopted in Phase II.

Finding: **NHTSA’s agreement with the University of Iowa was not to reduce the simulator’s performance capability. This prevented the agency “from determining whether state-of-the-art technology used in the simulator was cost-efficient.”**

Comments: The report cites NHTSA’s decision to approve a proposed upgrade to the NADS image generator as evidence. In TRW’s Phase II Proposal, its image system subcontractor, Evans and Sutherland (E&S), proposed to use a model ESIG 4530 image generator. At the time, this technology was over a decade old and was approaching the end of its competitive life. Evans and Sutherland announced that the next generation image generator, known as the “Harmony” system, was in the final stages of product release and that the ESIG 4530 system would begin to be phased out as the Harmony came on-line. NHTSA was advised that in the long-term life span of the NADS, spares for the older system would become costly and difficult to obtain.

In addition to offering vastly superior performance, the Harmony image generator also allowed E&S to configure the driving field of view to a full 360 degrees horizontal. The older technology configuration allowed for only 200 degrees of forward field of view and 60 degrees of rearward field of view. Thus, the older technology would have resulted in blank panels on the driver’s left and right sides. This would have precluded the use of the left and right outside mirrors in simulation experiments, which is a major limitation, particularly for research involving heavy trucks. These were the fundamental technical considerations that led NHTSA to make the decision to upgrade to the new Harmony image generator.

Finding: **“Congressionally directed cost share commitments were not met.”**

Comments: The Department’s and NHTSA’s intent was for NHTSA to secure one-third funding from non-DOT sources for hardware and building, not one-third funding of total project costs from the University of Iowa. The Cooperative Agreement requires the University to “Coordinate actions with NHTSA to secure the balance of cost sharing contributions required

from non-DOT sources to support the NADS development. Iowa's actions to secure this cost-sharing balance, estimated to total \$5.75 million, do not convey any assumption of financial liability for securing such an amount upon the State of Iowa, nor the University of Iowa. Costs incurred by Iowa in conducting this activity shall be reimbursed by NHTSA."

In its submission to the TSARC (Ref.1) in 1992 for project approval, NHTSA committed to the "two-thirds government - one-third non-DOT" cost sharing split for only the hardware and building cost of the NADS. On several occasions NHTSA notified the Congress about its efforts to secure cost sharing from non-federal sources. Subsequently, the agency informed Congress of its inability to secure further cost sharing to cover the cost growth in the NADS program. This information was conveyed at briefings with subcommittee staff, as well as record responses provided as part of the House Hearing Records for FY 1998, 1999, and FY 2000 (see attachment A). After Congress was notified, it provided appropriations to cover increased costs. Congressional approval was also obtained for reprogramming of funds to cover increased costs in FY 2000.

Finding: **"NHTSA absolved the University from performing additional work and transferred responsibility for correcting the software to the contractor."**

Comments: In the Cooperative Agreement, the University of Iowa agreed to provide NHTSA with the following two software packages: (1) Real Time Recursive Dynamics (RTRD) and (2) Core software. The Core software, in turn, consisted of nine components and was developed by the University for use on their earlier Iowa Driving Simulator (IDS). To determine the extent to which the University of Iowa's Core software could be transferred for use on the NADS, NHTSA and the University agreed that it would be submitted to both of the Phase I contractors for a technical evaluation. Of the nine components of the Core software, both contractors concluded that all but one could be used on the NADS. The one software component that was determined to be unacceptable for the NADS was the Scenario Control package.

In 1995, the Congress directed the GAO to conduct a validation of the cost sharing contributions that NHTSA indicated it had secured, including the contributed University of Iowa software. In its report (Ref. 3), the GAO assigned a fair market value to all of the Iowa software components except the Scenario Control package. *No value was given for the Scenario Control software, and the University of Iowa received no cost-sharing credit for it.* The GAO determined that even without getting credit for the Scenario Control package, NHTSA had met the cost-sharing requirements of DOT and the Congress. On this basis, the NADS development was allowed to proceed.

The GAO report noted that “Use of this version of Scenario Control was designated not applicable because both contractors stated that the current version does not fully meet NADS requirements.” It further stated that “The new version of Scenario Control that the University will develop with part of its \$750,000 cash contribution is expected to better meet NADS requirements.” The University, in fact, did not develop a new version of Scenario Control but instead used its additional \$750,000 contribution to upgrade the other components of the NADS software. Since the University of Iowa received no cost-sharing credit for Scenario Control software, the report is inaccurate when it concludes that the University had agreed to provide this software as a non-federal cost share contribution. Subsequently, TRW determined that it was most cost effective to have the University develop a new Scenario Control package that was suitable for the NADS, because of their prior experience in developing this type of software for the earlier Iowa Driving Simulator.

Finding: “NHTSA agreed to pay the same user fee as other simulator users.”

Comments: The issue of reduced federal user fees for NADS was discussed at several hearings of the House Appropriations Subcommittee on Transportation (1993, 1994, and 1997). However, the 1997 House and Senate records (Ref. 8) provide conflicting direction from the transportation committees, and the Conference report remains silent. In the House Report, the Subcommittee Chairman directed “... the Department to reexamine the business arrangement with the University of Iowa to reduce participation costs,” stating that “The Committee does not believe that it is appropriate that government users be charged the same rates as other users of the NADS given the Federal Government’s sizable financial contribution (two-thirds of the total) to this project.”

In contrast, in the Senate Report, the Subcommittee Chairman expressed concern “...that any reduction in the hourly operational rate of NADS would jeopardize the ability of the NADS to operate without a subsidy;” that “... any additional reduction in the hourly rate for NADS might jeopardize the ability of NADS to be self-sustaining;” and “... the hourly rate charged to the Government should not cause higher costs to other private users and should be sufficient to allow the facility to both operate efficiently and take advantage of technology advances.”

In its submission to the TSARC (Ref.1) in 1992 for project approval, NHTSA committed to the “2/3 government - 1/3 non-DOT” cost sharing split for only the construction cost of the NADS. However, NHTSA also proposed in its Mission Need Statement that the host university “would receive user fees for services performed once the research facility becomes operational.” On this basis, the Department approved the initiation of the

NADS program. It was never contemplated that the government would receive a discount for use of the NADS.

In 1992, NHTSA conducted two NADS requirements studies (Refs. 9, 10) by two independent contractors, to determine the types of research that non-government organizations might conduct and the technical requirements for the simulator to be able to perform this research. These studies also addressed the cost-utilization issue with these potential users. The findings on this latter point were that the upper limit of cost that non-government users would be willing to pay to conduct research on the NADS was about \$1,000 per hour. If the NADS cost rate exceeded this amount, the user base essentially went to zero. If the Federal Government were to receive a discount for conducting its research due to its capital investment in the facility, this discount would have to be offset by higher charges to other customers. The cost impact to these users would be disproportionate because the government intends to utilize two-thirds of the NADS operating hours and would, in effect, eliminate the market for industrial-based research by increasing costs significantly higher than \$1000 per hour cost. NHTSA believes that implementing such a policy would be self-defeating.

Finding: **“Require the University’s simulator quality standards to be either certified or developed based on universally recognized international standards.”**

Comments: NHTSA is not entirely sure of the meaning of this recommendation. If the IG is recommending that the University of Iowa adopt the ISO 9000 Standard for quality business management, then NHTSA concurs. Although the University believes it currently has in place its own quality standards for conducting business, NHTSA will encourage it to take steps to secure full ISO 9000 certification.

If, on the other hand, the IG is suggesting that the NADS be certified in the same way as flight simulators are certified by the FAA and other foreign regulatory bodies, then NHTSA does not agree with the recommendation. The reason for this is that flight simulators are invariably training devices, and the organizations that use them world wide must be assured that they conform precisely to the aircraft for which they will be providing training, e.g., a 747 flight simulator operated by United Airlines provides the same training environment as one operated by Air France. The NADS however is a research simulator and as such must have the maximum flexibility to simulate all manner of vehicles and at various levels of fidelity. Hence, flight simulator type certification for the NADS is not appropriate.

Summary

Based on the above comments on the findings cited in the report, NHTSA does not concur with the recommendations to reduce fees for federal users, and to recover \$9 million from the University of Iowa to correct University-developed software (\$1.4 million) and to pay for non-federal costs (\$7.6 million). NHTSA does not agree with these recommendations because: (1) they would retroactively change the Cooperative Agreement; (2) they would undermine the University of Iowa's ability to operate the facility on a self-sustaining basis as required by the Cooperative Agreement; and (3) recovering funding for the software in question, i.e., Scenario Control, was not part of the University of Iowa's cost-sharing contribution and, therefore, the University had no obligation to provide it cost-free to NHTSA.

References

1. "Feasibility Study and Conceptual Design of a National Advanced Driving Simulator", March 1990, DOT HS 807 596 - Final Report.
2. "National Advanced Driving Simulator (NADS)", TSARC Submission 92-10, December 21, 1992.
3. "National Advanced Driving Simulator, Non-DOT Contributions and Commitments Have Been Secured", June 1995, GAO Report GAO/AIMD/RCED-95-211.
4. "Estimating Demand for the National Advanced Driving Simulator", 1995, Transportation Research Board, National Research Council, National Academy Press.
5. "A Demonstration of Motion Base Design Alternatives for the National Advanced Driving Simulator", October 1992, McCauley, et. al., NASA Technical Memorandum 103881.
6. "Sizing the Motion Base of the National Advanced Driving Simulator", March 1993, Garrott, R, Vehicle Research and Test Center, DOT HS 807 979 Final Report.
7. NHTSA cooperative Agreement No. DTNH22-93-Y-07237, March 19, 1993.
8. Department of Transportation and Related Agencies Appropriations Bill, 1997, Senate Report 104-325, p. 120 and House Report 104-631, pp. 108-109.
9. "National Advanced Driving Simulator (NADS) Requirements Study", November 1991, Systems Technology Inc, DOT HS 807 827.
10. "National Advanced Driving Simulator (NADS) Requirements Study", September 1991, Dynamic Research Inc, DOT HS 807 825.

Attachment A

Answers to House Hearing Questions Provided for the Record

FY 1998 House Hearing Record (p. 780)

“Mr. Wolf. Congressional directive requires that one-third of the total cost of NADS had to be borne by outside users. Because the cost to build the simulator and transition it to the university had risen substantially (to \$16,347,000), last year NHTSA testified that it had been unable to meet the one-third cost sharing requirement from outside sources. At that time, the agency was seeking \$1,231,000 from non-DOT sources. Please bring the Committee up-to-date on the agency’s ability to seek additional nonfederal dollars for this project. Has the one-third cost share been met? If so, by who? If not, has NHTSA been able to acquire any additional dollars since the agency testified last year? If so, by who?”

[The information follows:]

The agency has not received any further firm commitments for non-federal cost sharing of the NADS. However, NHTSA is currently exploring cost sharing with a major truck manufacturer. Preliminary discussions indicate that the manufacturer may be interested in providing a cab and vehicle engineering and dynamics data which have an estimated value of between \$600,000 and \$700,000. A meeting is planned for April 1997 to discuss the potential for a firm commitment.”

FY 1999 House Hearing Record (p. 154)

“Mr. Wolf. Congressional directive requires that one-third of the total cost of NADS had to be borne by outside users. Because the cost to build the simulator and transition it to the university had risen substantially (to \$16,347,000), last year NHTSA testified that it had been unable to meet the one-third cost sharing requirement from outside sources. At that time, the agency was still seeking \$1,231,000 from non-DOT sources. Please bring the Committee up-to-date on the agency’s ability to get additional nonfederal dollars for this project. Has the one-third cost share been met? If so, by who? If not, has NHTSA been able to acquire any additional dollars since the agency testified last yet? If so, by who?”

[The information follows:]

NHTSA has secured additional cost sharing from the Freightliner Corporation in the form of a contributed Century Class Commercial Trunk Cab and associated engineering data and technical support. The estimated value of this cost sharing is approximately \$300,000. No other cost sharing has been secured. Due to the increased cost of the NADS development, the additional cost sharing required to meet the one-third Congressional directive is approximately \$2,500,000.”

FY 2000 House Hearing Record (p. 740)

“Mr. Wolf. Congressional directive requires that one-third of the total cost of NADS must be borne by outside users. Because the cost to build the simulator and transition it to the university had risen substantially, last year NHTSA testified that it had been unable to meet the one-third cost sharing requirement from outside sources. Please bring the Committee up-to-date on the agency’s ability to meet the cost-share requirement for this project.

[The information follows:]

The agency has been unable to secure any additional cost sharing to offset the cost increases experienced on the TRW development contract.”

June 8, 2001

Mr. Kenneth Mead
Inspector General
U.S. Department of Transportation
400 7th Street, S.W.
Washington, D.C. 20509

Dear Mr. Mead:

Thank you for transmitting a copy of the undated draft report concerning the NADS. Although we believe discussions with University representatives should have preceded provision of drafts to Congress and the press, we are pleased to have an opportunity to correct what we believe to be fundamental errors and generally flawed recommendations before further damage is done.

We will not mince words: The draft report calls for the federal government to breach clearly understood commitments made in its Cooperative Agreement with the University of Iowa. If those commitments are breached, the NADS project will fail, with the resulting loss of a substantial investment of federal dollars and wrongful injury to the State of Iowa.

This disaster can and should be prevented. It should be prevented because the report rests upon fundamental misconceptions concerning the background to and the provisions of the Cooperative Agreement, which will be detailed in what follows. The most fundamental misconception relates to the role of the University in the procurement process. Because it was possible that the University could have been a subcontractor to the NADS prime contractor, federal attorneys and procurement officials insisted the University have no responsibility for the procurement process to avoid any potential conflict of interest. Although we believed our Iowa Driving Simulator experience would have contributed to a cost-effective NADS development, we acquiesced, as detailed below, in the view of DOT officials that the development task should be competed to an experienced industrial concern. To have the IG now seek to hold the University responsible for cost growth in the NADS procurement is without basis and is extraordinarily misdirected.

* * *

Before addressing the flaws in the draft report, there are some factors which are not mentioned in the report, but which you should know as background.

The University has long been proud to have been associated with the mission of the National Highway Traffic Safety Administration. We believed and hoped that NHTSA's highway traffic safety research would be the heart of NADS facility. As much as we focus on the technological and engineering promise of the NADS, the overwhelming public policy

interest is human life. The figures NHTSA cites in terms of deaths, irreversible disabling injuries, and economic and social costs of highway crashes are appalling. From this research we know that of the three major factors contributing to vehicle crashes (motor vehicle performance, highway environment and human behavior), human behavior is a contributing factor to over 90% of crashes and yet is the least studied. I mention this especially because one of the news stories concerning the IG report also carried a quote from a former DOT official who said that she considered such studies a waste of money. In her estimation the Department should generate more studies of crash worthiness rather than crash avoidance. Our willingness to participate in this project was based on a different view. We believe in crash worthiness research, but believe there is a need for crash avoidance research, as well. Nevertheless, we are reminded by this news story that the draft report has been prepared within the context of a larger debate going on in the Department.

The quote of the former NHTSA official carried in the news story focusing on the IG report and its recommendations echoed previous quotes from an official of the Insurance Institute. In his estimation simulation research itself was unsound. In his view NHTSA should concentrate on crash worthiness research of the kind conducted by the Institute. Here again, our willingness to participate in this project was based on a different view. Even a cursory review of the scientific literature underpinning simulation in the air and space industry provides a stunningly different conclusion. I know there have been Transportation Research Board members with scientific simulation backgrounds, who would provide a very focused view of ground transportation research and of the benefits of simulation in crash avoidance studies. As an academic institution, the University could not be associated with research that was not systematically developed, reported, published and widely disseminated in the scientific community.

The University believes NHTSA's proposal to create a National Advanced Driving Simulator was scientifically and technologically sound. The technological aspects of the project have been recognized and reported. Moreover, the Department's decision to hold a nationwide host site competition designed and administered under an agreement with the National Science Foundation was critical. This is because the legitimacy of highway safety research and the public policy recommendations that might arise from it depend upon the soundness of the design and conduct of the research. The Department chose the National Science Foundation precisely because of its reputation for scientific integrity. Outstanding universities with highly specialized expertise in this field participated in this competition. Though much has been made of the political rivalry associated with this project, the academic collegiality among the engineers and scientists stands in stark contrast. We hope that every one of the academic institutions involved in the competition ultimately will join with us in collaborative research projects. Two in particular, the University of Michigan and the University of Texas at Austin, have already done so. The point is that the Department should be commended for its decision to place this facility in an academic setting and to signal the country that the research integrity of the facility would be protected.

At the outset of the competition the University believed that it was competing to develop the NADS. We believed that subsequent to the competition the winning institution would sit down with NHTSA and negotiate a development contract to design and produce the NADS. In fairness to NHTSA, to my knowledge this was never expressly stated in the request for proposals. Nevertheless, we would have been prepared to negotiate a fee for service contract with NHTSA, which would have left the University with total responsibility for its development and costs within the terms of the contract. We learned subsequently that the University would host the NADS in the sense of maintaining, operating, marketing and upgrading the facility on a self-sustaining basis, but the University in fact was barred from competing to develop and construct the NADS. I mention this point because the Congressional record related to the report certainly gave rise to the perception that the University had been awarded the development contract and hence was responsible for the cost growth of the project. The IG auditors had the same perception when they arrived on campus. I learned from reading the report that it assigns responsibility for cost growth to NHTSA and its efforts to meet the University's expectations for the operational phase of the project. This was a different reason than the one suggested by the record and the press.

Though we have much to criticize about the report, we would like to commend the IG auditors who visited the University of Iowa campus. They were workmanlike and thoroughly professional in their conduct and demeanor. In particular, if the assertion concerning scenario control software was contributed by the auditors, we believe it arose from an honest error on their part. In this regard we believe the methodology of the study placed them at a distinct disadvantage. When they arrived on the University of Iowa campus, they believed that they would be talking with the development contractor. When NADS staff told them that this was not the case, they then asked who the development contractor was and where the company was located. Apparently, they had been dispatched to the University as their first stop without talking to NHTSA. NHTSA could have provided them with an overview and very detailed information about the project at the outset. Additionally, we believe the team could not have had knowledge of the prior IG study of the project before they began. They did not have engineers to augment their team in order to consider the technological appropriateness of decisions by the development contractor. I did not realize until I read the report that they never visited with the development contractor at all.

Finally, I did not realize until I read the report the prominent place the Federal Highway Administration has in it. This did not appear in the Congressional record nor in the press coverage of the report. Nevertheless the report, if accurate, makes it clear that the FHA might well have a legitimate grievance and considerable disappointment that its funds were diverted away from its own priorities to finance the project of another agency. In this context alone the Secretary might have had reason to order an IG inquiry to provide a basis to resolve a grievance that one DOT agency had with another. Indeed, FHA might have had reason to recommend such action. If this is the case, it is particularly problematic in that we believe the Department was correct in considering this project to have multimodal applications, including the design of safe highways, rail crossings and even ground movement at airports. In NHTSA's defense, neither NHTSA nor the University had

requested the diversion of these funds. All this has the appearance of a draft report generated not to consider the benefits of the project in relation to its costs, or even the appropriateness of the costs, but rather to justify operational phase rate reduction recommendations that had been arrived at before the study began.

Though these factors may lie outside the immediate focus of the draft IG report, we do believe you should take them into account as you revisit the draft report and its recommendations.

* * *

I must turn now to three particular points within the report which are of special importance to the University and which would be critical to the project's future: (1) that NHTSA should take steps to negotiate rental rates applicable to NHTSA which would be below the level necessary to maintain and operate the facility; (2) that NHTSA should "recover" from the University a 1/3rd share of the cost growth arising from the private development contractor's actions; and (3) specifically, that a part of these funds include \$1.4 million which the contractor wrongfully paid to the University of Iowa. Though the first recommendation is the most destructive to the NADS project as a whole, the last assertion is the most egregious with respect to the reputation of the University itself.

(1) This recommendation uses the term negotiation, but is in fact a recommendation that the Secretary direct NHTSA to unilaterally break its previous Cooperative Agreement with the University. It is unfortunate that this recommendation was provided to Congress and subsequently reported in the press before it was vetted within the Department. The draft report does not seem to indicate that the hourly rates themselves are unreasonable. We agree. The rate is set based on the University's actual, out-of-pocket costs of operating the NADS. The current rate of \$1,000 per hour is less than half of that charged by Daimler-Chrysler for its own simulator customers. This facility has far less capability than the NADS, but the last figures we have for this facility show \$2,700 per hour for company divisions and \$3,600 for outside customers. The report focuses instead upon the University's intent to charge industry the same hourly rental rate as NHTSA. The logic is that Industry would have the benefit of its use, without having invested in its development costs. The report argues that rates be reduced for NHTSA because of NHTSA's investment in the project. The practical consequence of the recommendation would be that the more the facility conducted NHTSA's research, the further into the red the facility would go. This would drive the project into the ground. This recommendation is directly contrary to the concept from the very beginning of the project that NADS would be operated in a manner that fully recovered its on-going costs and thus would make the facility self-sustaining. It was on this premise that the State of Iowa agreed to contribute \$6 million in land and cash for the construction of the building in which the NADS is located. It was on this same premise that the University contributed the important software for the project, valued at \$5.6 million, as well as thousands of hours of management attention and scientific and engineering expertise. It was on this same basis that the University assembled a staff of highly qualified engineers and support staff in anticipation of the opening of the facility. The promises made to federal and state legislators and to the

public concerning the self-sustaining nature of the NADS project cannot, and will not, be broken. Yet this is what the draft report's recommendations would require. This is unacceptable.

(2) The recommendation to derive funds from the University in order to make up for cost growth incurred by the development contractor does not seem to be made on the basis that the University had been in a position to control these costs directly. Indeed we could not. The report implies on a more general level that the University should be held accountable because it had strongly recommended to NHTSA, and NHTSA had agreed, that the prime contractor should be required actually to develop the NADS in accordance with the performance levels that were specified in the contract it had signed and in the proposal upon which the contract had been won. In the University's view, with which NHTSA agreed, the achievement of these performance levels would have a critical impact on the operational phase of the project, and hence on the ability of the University to carry out its obligations under the Cooperative Agreement. By contrast, a failure to develop the NADS in accordance with these performance levels would have violated the representations made to potential users and unfairly shifted the basis of the competition, upon which one company won the competition for the development contract and the other lost.

(3) Most disturbing to the University is the report's assertion that the \$1.4 million, which TRW had requested for software development, and NHTSA had authorized, should be recovered from the University of Iowa. The reasoning seems to be that the University of Iowa had been obligated to provide this software (scenario control), failed to do so, and was subsequently (wrongfully) paid to do so. The University was never obligated to provide this software. This software was voluntarily offered, but not accepted, for cost share credit as reflected in the GAO report of June 1995. The terms of this offering specified that competing contractors would define what percentage of the software items would be used, and the GAO in turn placed a value on this percentage according to a standard formula. Contractors had the choice of accepting, rejecting, or accepting in part and rejecting in part some or all of the items contributed. In this case, as stated on page 15 of the GAO report, this item was neither accepted nor rejected. It was deemed "not applicable." The note on page 15 explains that it was deemed "not applicable" because contractors believed it would not "fully meet" NADS requirements. "Fully meeting" NADS requirements at this point in the development of the contract would have been impossible. The contract to develop the NADS had not even been let. The University had offered the software blind, having not seen the specifications and requirements the contractors were proposing. This in no way implied that the University had failed in an obligation to develop this software. Competing contractors had the option to develop this software themselves, or give it to a subcontractor for development. TRW, the winning contractor, recommended the University of Iowa as the subcontractor because of its demonstrated experience in developing software of this kind. In large measure, this judgement must have been based on the evaluation of the very scenario control software we had offered.

* * *

Though we offer these points as to the specifics of the draft report, the most important point that we must bring to your attention is that if the Department breaks the Cooperative Agreement as is now recommended, the NADS project will not be able to operate on a self-sustaining basis, as has been contemplated from the beginning. Should that occur, the NADS project will fail and its promising prospects for saving lives and lessening the billions of dollars of yearly economic harm will be lost. It is unfortunate that this implication did not strike the authors of the draft and that the recommendations were provided to and endorsed by Congressional members before it had been vetted within the Department. If the report was developed in an effort to provide redress for cost growth incurred by a private contractor, while at the same time resolving a budgetary grievance within the Department by imposing punitive financial sanctions upon the University of Iowa, we believe this motivation would be improper and destructive. Because of the important ramifications of what I have just outlined, before the draft of the report becomes final, we urge that you and other Department officials meet with officials of the University of Iowa and NHTSA.

Sincerely,

Mark E. Schantz
General Counsel

cc: John H. Fleherty
L. Robert Shelton

Appendix B
(6 pages)

JA-30:G.Lewis:09/28/2001 11:23 AM
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