

The Crescent Project:

An Evaluation Of An Element Of The HELP Program

Working Documents

- Motor Carriers - Involvement and Communications
- Technology Evolution, Performance and Standards
- Crescent Operations and Maintenance Issues
- Program Budget and Funding
- Program Goals and Schedule

February 1994

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Forward

The Crescent Project element of the HELP Program is a bi-national multi-jurisdictional cooperative research and demonstration initiative involving the public and private sectors in an application of advanced technologies for the creation of an integrated heavy vehicle management system. This initiative is a leading example of the commercial vehicle operations (CVO) aspect of the Intelligent Vehicle Highway Systems (IVHS) concept. Some of the advanced technologies demonstrated in this project include: (1) automatic vehicle identification (AVI); (2) weigh-in-motion (WIM); (3) automatic vehicle classification (AVC); and (4) data communications networks and systems integration.

The HELP program, initiated in the early 1980s, consisted of three phases which included assessing the feasibility of the concept, technical studies involving laboratory and field tests, and lastly, a demonstration phase. Perhaps the most significant activity of this project centered on the subject of institutional arrangements, associated with the integration of emerging technologies with current operational policies and practices, within both government and industry sectors.

The demonstration element of the program, referred to as the Crescent Demonstration Project, began in 1991 and involved six U.S. states and one Canadian province. This project was phased into full scale operation over a three year period.

This document is one of several cited below which comprise the evaluation of the Crescent Project. The complete evaluation is reported in the following list of documents:

***The Crescent Project: An Evaluation of an Element of the HELP Program:
Executive Summary***

Appendices:

- A. On-Site Analysis of HELP Technologies and Operations Evaluation Report***
- B. State Case Study Evaluation Report***
- C. Motor Carrier Case Study Evaluation Report***
- D. Crescent Computer System Components Evaluation Report***
- E. Crescent Demonstration Office Evaluation Report***
- F. State Line Beacon Project User Case Studies***

The Evaluation team consisted of the following groups:
WHM Transportation Engineering Consultants, Inc. (lead group)
Castle Rock Consultants
Western Highway Institute, ATA Foundation

In addition, the evaluation team was supported in this effort by:
Lockheed Information Management Systems
Booz-Allen & Hamilton Inc.

The team members wish to acknowledge the participation and support of the many individuals and organizations who provided guidance, assistance and encouragement during the evaluation process. While the team members are solely responsible for the content accuracy of these evaluation documents, the process would have been greatly impaired without the recognition of the importance of this effort by all who contributed and their desire to promote efficiency and productivity in future freight systems. To all we are greatly appreciative and indebted.

C. Michael Walton
Chairman, Evaluation Team

Working Document

MOTORCARRIERS-INVOLVEMENT
AND COMMUNICATIONS

by

Western Highway Institute / ATA Foundation

HEAVY VEHICLE ELECTRONIC LICENSE PLATE PROGRAM

Crescent Demonstration

Working Document Series

MOTOR CARRIERS - INVOLVEMENT & COMMUNICATIONS

Western Highway Institute

San Bruno, California
December 1993

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CETAPTER 1. MOTOR CARRIER INVOLVEMENT

INTRODUCTION

The HELP/Crescent project is frequently cited as having been a government/industry partnership venture. With substantial industry involvement, it is tempting to believe that communications with motor carriers should flow free and easy. Number 1 lesson learned – don't fall into that trap. The purpose of this paper is to document the involvement opportunities offered and the communication mechanisms used to promote motor carrier awareness and interest. The objective is to record the nature of the motor carrier response to the various approaches and to gauge which of these initiatives were seemingly most successful.

The first portion of the paper addresses the motor carrier involvement strategies used during both the study phase (Pre-Crescent) and the demonstration. The pre-Crescent motor carrier involvement will be highlighted initially. A section tracking the recruiting activities associated with the demonstration follows and concludes with a synopsis of the efforts undertaken to encourage continuing motor carrier participation during the Crescent evaluation. A discussion of the evaluation observations citing the need for an aggressive communication effort follow and the final section outlines those characteristics believed essential to a successful outreach program, i.e., the lessons learned.

INVOLVEMENT STRATEGIES

The HELP initiative began as a technical study program designed to define the technology issues, develop and test prototype equipment standards, address system integration concepts, and formalize a demonstration plan. Motor Carrier involvement at this (Pre-Crescent) stage was quite limited and largely advisory, although the dimensions of the industry/government partnership were thoroughly explored. Equal industry/government representation became a matter of official policy, but as a matter of practice only a few carriers were found able or willing to make commitments beyond occasional meeting attendance. The one notable exception to strictly advisory participation occurred in Oregon where the Oregon Department of Transportation teamed with the Oregon Trucking Association to recruit carriers and equip trucks for a pre-demonstration verification of WIM/AVI integration.

As the HELP program changed focus to the Crescent Demonstration, greater emphasis was placed on recruiting the significantly larger number of motor carriers required to provide transponder-equipped trucks for systems assessment. The recruiting efforts expanded the initial industry awareness of the project. Even so, throughout most of the demonstration period, little

was actually done to insure more than the passive participation of those who volunteered. The evaluation process ultimately spurred the necessity for developing a dialog.

CHAPTER 2. PRE-CRESCENT INVOLVEMENT

Perhaps the most unique feature of the HELP research program at its inception was the dedication to assuring motor carrier involvement on an equal partner basis with government. Early informal arrangements required each participating state to recruit a counterpart motor carrier participant. This concept was ultimately formalized in the organizational charter that evolved.

MOTOR CARRIER ASSOCIATIONS

With Oregon the only exception, the motor carrier participation invitation was extended by each state DOT to the state trucking association (STA) of that state. Oregon DOT worked through the Oregon Trucking Association to have individuals from operating companies designated for participation. The early HELP organizational meetings focused on establishing the framework and ground rules for the research effort. With a motor carrier representative appointed to head the charter development effort, Western Highway Institute (WHI) was asked to assist and became the scribe assigned to translate concepts to content.

The charter as finally adopted provided for equal government and industry representation on both the policy direction and working-level committees, i.e., the Policy Committee and the Executive Committee. Another charter provision authorized the Western Highway Institute to participate as an ex officio trucking industry (technical) representative in each of the organizational bodies. To encourage and enable participation at these committee and other authorized meetings, funding was designated to underwrite the out-of-pocket expenses incurred by the appointed representatives of both government and industry.

As might be expected, the responses of the original 12 state trucking associations differed considerably. In four instances, the STA executives elected to become the sole industry representative for their state. Two STA executives retained the Policy Committee representation and designated a motor carrier to serve on the Executive Committee. Two others appointed individual motor carriers to serve-one on each parent committee, and four STAs nominated a single motor carrier to serve on both committees. During the course of the study program two of the Crescent STAs officially dropped out although they eventually reinstated. Two other (non-Crescent) STAs effectively dropped out by not participating.

STUDY COMMITTEE STRUCTURE

At the Executive Committee level, working subcommittees were formed to determine and pursue the research agenda in each of the technical study areas. The number of committees eventually grew to include: AVI Test Coordination, WIM Performance Specification, Satellite Reference Study, Motor Carrier Services Plan, System Design, Rules, Policy, and the Crescent Implementation Group. The Rules Subcommittee had a relatively short life as its charge was primarily the development of the organizational charter and a supplemental set of operating rules.

The Operating Rules dictated that each subcommittee could have up to seven voting members. As a matter of general policy, the subcommittee chair was determined by the government/industry sector with primary responsibility or interest and the remainder of those appointed represented government/industry in equal number. Provision was also made to permit unrestricted non-voting subcommittee appointments. This enabled every individual to participate as desired, but insured that decision making was not heavily biased by either interest. However, with only 12 states participating initially and each state having only two Executive Committee representatives (one state, one industry), each person ended up with multiple subcommittee assignments. This led to a consecutive rather than concurrent general meeting format and enabled everyone to participate as desired. The downside of this openness was the inevitable ad hoc pre-meetings in which many actions were formulated for later ratification.

MOTOR CARRIER SERVICES PLAN

The principal functions of the Motor Carrier Services Plan Subcommittee were to (1) develop and provide motor carrier perspective on system development issues, (2) explore and develop the research basis for applications of specific interest to motor carriers, and (3) provide input to and oversight of the motor carrier recruiting activities associated with the demonstration.

Principal areas of subcommittee interest and involvement included:

- June 1987 Motor Carrier Workshop. The subcommittee developed the RFP, selected the consultant, and supported the conduct of a “focus group” assessment of the potential trucking industry utilization of the HELP application proposals.
- Active participation in the System Design ad hoc group which guided the selected consultant in formulating and presenting the application concepts.
- Work toward the adoption of a HELP policy statement endorsing a “universal” transponder and pledging work toward achieving that end.

- RFP development, consultant selection, and certification of the conduct of the On-board Computer Study which investigated the potential for integrating “beacon passage” records transmitted from the roadside.
- Initiation of a corridor-based “motor carrier recruitment” proposal which was rejected in favor of a decentralized approach.
- Promotion for adoption of a HELP policy statement endorsing “mainline screening” as the ultimate weigh scale pre-clear objective with “within site” bypass to be viewed only as an interim solution.
- Endorsement of Lockheed’s “State Entry Beacon” proposal as the means for initiating a limited OBC/Beacon demonstration and monitored the consultant’s conduct of the project.

OREGON DOT: PIKE-DEMO FEASIBILITY TEST

In July 1983, as a lead-in to the HELP program, the state of Oregon initiated an experiment with automatic vehicle identification devices and weigh-in-motion systems. The experiment integrating AVI (General Railway Signal transponders), AVC, medium and high-speed WIM, and a data base management system was made operational in April 1984. While the program included other elements as well, the AVI integrators were placed at two mainline and two port-of-entry sites. Twenty-five trucking firms installed some 200 transponders on their vehicles for this experiment. ODOT’s process of recruiting and dealing with the motor carriers was particularly successful. Following is an extract from a 1989 presentation made on the subject by ODOT’s principal “recruiter,” Barbara Koos Fraser.

“In Oregon, we found the key to getting trucking companies involved in our AVI/WIM project was the dissemination of information. Our efforts included education, personal contact, and the willingness to listen to and learn from others. Actually, these endeavors were extended to other agency personnel, legislative representatives, and service organizations as well as industry representatives.

“‘Anytime three or more truckers get together, go tell them about the program.’ This was the advice we got from Ken Self, retired Chairman of the Board of Freightliner Corporation. This became the trucker recruitment motto for our demonstration project. We were fortunate that we could call on Ken, who describes himself as a trucker with a good government perspective, to help us spread the word. He arranged the first meeting between representatives of 12 Oregon trucking firms and our state highway engineer, chief weighmaster, and chief highway economist. The idea of combining weigh-in-motion and automatic vehicle identification into a highway management program was explained to them followed by a question and answer period. All of the companies agreed to participate. This was the beginning of a six month effort to educate and encourage

participation in the demonstration project. We followed Ken's advice and spoke at many trucker and associated industries meetings (shipper groups, truck stop operators) as well as service organizations (Rotary, Kiwanis). We were occasionally asked to attend company meetings to explain the project to the drivers. We never turned down an invitation to go out and explain what was happening.

"We are fortunate in our state to have the cooperation of the Oregon Trucking Association (OTA). Mike Meredith, the Executive Vice President, assisted in our initial recruitment and has been supportive throughout. This support has taken many avenues, from advice on the selection of our representatives to the HELP Policy and Executive Committees, to arranging meetings with individual company representatives, and publishing articles in the OTA magazine about the project. I send OTA a copy of the 12 report weekly activity summary for their use. We also had a graphics program of the summary material developed by Oregon State University. We supply this to OTA, and other interested parties, on request.

"We found it important to keep the personnel that are responsible for truck size and weight enforcement fully aware of the goals and progress of the project. These people, in their daily contact with truckers, need to be able to explain how the system works. It is amazing what the driving population perceive as the reason and possible uses for the installations. Also, the people who work with the truckers in this capacity often know which companies regularly use the route that needs to be targeted.

"Additionally, we sought and welcomed media coverage. Some of this revolved around ribbon cutting ceremonies and then, of course, our public affairs office put out press releases.

"Once we had enough volunteers, the transponders were distributed by the weighmaster personnel in each area. They not only delivered the transponders, they offered to assist with the installation. Most often, they wanted to put them on themselves at the time the vehicles were in the shop for servicing. We distributed the installation information and then followed up by checking the readings. If after a reasonable time had elapsed, we were not getting readings, we contacted the person responsible for installing the device. If the device had been installed and we were not getting readings, we had a weighmaster go out to see what the problem was and help correct it.

"We started sending out a copy of a bimonthly report we developed which gave the company the 'reading' information that was pulled from the computer at each site. For the first eight months these reports were developed by hand. We had a Truck Information Retrieval program developed to do this job automatically on the computer. The program was designed to allow our office to access the information by company, date, vehicle number, or site. Additionally, the trucking company has the ability, with an identification code, to access the information about their vehicle activity. I took a portable computer around to each business and showed them how to use it. Unfortunately, this is a slow program to run over long distance phone lines and has not been used very often by the companies. The bimonthly reports are used by about 80% of the participants, generally the safety officer has the most interest.

"Besides demonstrating the information program, I go out periodically to the companies to discuss the Oregon project and bring them up to date on HELP. The most

important activity that occurs at these meetings is that I get feedback about the program and I listen to their concerns. The concerns voiced are not always about the project and sometimes are not even about the Department of Transportation. If there is an appropriate action I can take in response to a concern, I always follow through. If they have a complaint, compliment or suggestion, I pass it on to someone who can deal with it. We feel that their input is important and I let them know that we appreciate hearing from them.”

Ms. Fraser’s report went on to include a number of specific recommendations for formulating the HELP recruiting effort.

CHAPTER 3. CRESCENT INVOLVEMENT

Once the basic system design parameters had been established, the developmental aspects of the software and hardware became very much the domain of the governmental sector for an extended period of time. Motor carriers pushed for the decision to utilize a third party system integrator specifically charged with establishing appropriate data security relative to observed motor carrier movements. Once made, the stage was set for undertaking further work toward a demonstration project. However, the issue of potential transponder proliferation threatened the still somewhat tenuous relationship between government and industry.

Toll agency decisions to move forward with alternate technologies and the transport industry (sea, rail, ATA) endorsement of a less complex (ISO container) RF standard tag created considerable friction and heat during this period and might well have become a stumbling block for the entire program. The eventual HELP agreement to endorse the single-transponder concept and to work toward a technical resolution within the HELP program became a significant step toward building industry-participant trust.

Since this period was also marked by uncertainty due to the scale of the financial obligation envisioned, side projects such as the OBC/Stateline Beacon demonstration were put on hold and there developed little incentive or opportunity for active motor carrier involvement. Absence of a plan for recruiting motor carriers for the eventual demonstration was cited as a concern, but persistent pressures associated with transponder development, production, and testing made consultant staff assistance in the creation of a “straw man” recruiting plan a back-burner item.

RECRUITING

The Motor Carrier Services Plan (MCSP) subcommittee was assigned the initial responsibility for the formulation of a concept plan for the motor carrier recruiting effort. However, the Crescent Implementation Group (CIG), a working committee made up of state and industry people from the six demonstration states, was eventually given the responsibility for formalizing and implementing the recruiting effort.

Initial input was provided to both the MCSP and CIG by Oregon DOT via the July 1989 report cited earlier. As noted, the report included specific recommendations concerning the conduct of a broader multistate recruiting program.

ODOT/WHI Proposal

Building on the ODOT experience and mindful of the MCSP mandate concerning a concept recruiting plan, Loyd Henion of ODOT and Ken Heald of WHI collaborated to produce a single-page proposal titled “Implementation Strategy for Trucking Recruitment.” The proposal was forwarded to the chair of the MCSP, by him to the CIG and to “HELP News,” where it was reproduced as the lead article in the September 1989 issue of the organizational newsletter.

That proposal featured a formal Motor Carrier Recruiting Team with each state effort led by a designated DOT person working with and supported by an industry advisor. Corridor subcommittees within the Recruiting Team would jointly target candidate motor carriers so that the transponder distribution would appropriate two-thirds to the I-5 and one-third to the I-10 corridors. Interstate carriers were to receive the highest priority recruiting with a smaller intrastate component sought to increase local awareness of the program. A copy of the “HELP News” article is included in the Appendix.

CIG Recruiting Strategy.

Following the July 1989 ODOT presentation, each CIG state was asked to designate a representative responsible for trucker recruitment. By August 18, the next scheduled CIG meeting, Washington and Texas had appointed STA leads; Oregon, California, and New Mexico had appointed state government leads; and Arizona had made a joint DOT/STA appointment. At the August meeting the staff consultant, Castle Rock Consultants (CRC) also presented a first draft of their “Working Paper on Trucker Recruitment.”

CRC suggested the allocation of a “guideline” number of transponders to each state based on the number of heavy truck registrations reported with the emphasis placed on enlisting carriers within general operational categories. Comments from motor carrier participants were requested and the report, with minor adjustments, was accepted in March 1990 as the basis for the CIG recruiting plan. However, a strong conviction was expressed that the STAs should be endorsed as the primary recruiters and the CIG accepted that recommendation. Nothing in the record indicates that a formal recruiting implementation plan was ever adopted, but by agreement the I-5 corridor was to be given first priority with respect to formalizing the record keeping and issuing transponders since facility development was considerably more advanced.

State Trucking Association Recruiting.

In delegating the recruiting responsibility to the STAs, the CIG overlooked what perhaps should have been obvious from its own constituency. STAs, like the state DOTs, ha

levels of interest and commitment, differing political agendas, and only rarely the resources to undertake unexpected new projects. As a result, STA response was mixed.

Washington Trucking Association. The Washington Association was very successful in soliciting trucker participation. Washington is the northern U.S. terminus of the very active west coast freight corridor and, as a result, is the home of a fair number of coast-oriented interstate trucking operations. Many operate into or through Oregon and have a high level of familiarity with Oregon's use of the technology to. This may partially explain WTA succ. On the other hand, Washington truckers tend to be very provincial and typically demand trucking association approval of involvement solicitations. The fact that an association representative personally made all the solicitation contacts was the apparent key to success. The assigned quota of 500 transponders was fully subscribed in a short period of time; however, the WTA offer to recruit further was unfortunately declined.

Oregon DOT/Oregon Trucking Association. Oregon started the Crescent carrier recruiting with a strong carryover from their earlier project. While the actual recruiting was an ODOT effort, OTA offered and arranged recruiting opportunities at association meetings throughout the state. The association published ODOT-prepared promotional material in the association newsletter and, perhaps of more importance, prepared member carriers for subsequent ODOT contact. ODOT made few, if any, "cold calls." Oregon truckers appear to have a high level of awareness of the governmental dedication to efficient truck regulation and control, and the government/trucker relationships there show a history of general cooperation. That the Weighmasters (Oregon's size and weight enforcement agency) were actively involved in developing, installing, and using the technology also seemed to give the truckers considerable assurance of program purpose. Even so, without continued Weighmaster participation in recruiting, ODOT managed to obligate only approximately 600 of the 1000 transponders allocated.

California Trucking Association/Lockheed. CTA's recruiting stance is interesting because of the flip-flop that occurred relative to participation in the project. Within the first several years of the original project, CTA decided that one governmental objective for HELP was to facilitate the collection of mileage taxes and thereby to interest more states in moving toward such taxes. That being the antithesis of the CTA's mileage tax policy, the decision was made to withdraw from the project. (The Texas and Nevada associations did likewise although Nevada never formally communicated its decision.) A year or so later, CTA decided to reinstitute its participation.

When the time came for recruiting carriers for the demonstration, CTA was cooperative but not proactive. That is, CTA did provide several recruiting platforms, it did participate in user

observation checks on I-5, it did provide contact information for membership observed traveling I-5, and its HELP motor carrier representative did make several recruiting contacts that eventually resulted in commitments. As a whole, however, CTA engaged in virtually no individual contact work on its own initiative.

Lockheed shouldered the presentation responsibilities at numerous opportunities afforded by CTA. Among those opportunities was the provision of booth space at the International Truck Show for several consecutive years. For those occasions, Lockheed developed promotional materials which included a fold-up, mail-back “expression of potential interest” form for return to CTA. Copies of this material are included in the Appendix. The final number of returns is unknown, but all were forwarded to Lockheed for follow-up. In attempting to be responsive, Lockheed essentially became the field recruiter for California.

Overall, the California Trucking Association’s participation in the effort has to be viewed as a failure. Because of the large truck registration potential, California had been allocated 2300 transponders. At the time of the Crescent evaluation, only 432 transponders had actually been assigned to California-based trucks; and over 200 of those came from other than CTA efforts.

Arizona Motor Transport Association (AMTA) Arizona does not have a large base-state trucking population, and the recruiting expectations were correspondingly low – only 250 transponders were allocated. AMTA’s approach to recruiting was similar to that of CTA. Several opportunities were given Lockheed to make presentations to the association membership, but there was no direct AMTA involvement with individual carrier contact.

Recruiting in Arizona was undertaken somewhat later than in the I-5 states. Even so, the effectiveness was handicapped by the lack of any operational HELP facilities with which carriers could identify and/or interface. The result was predictable – not a single Arizona-based carrier completed the transponder registration process as a direct result of AMTA participation.

New Mexico Motor Transport Association (NMTA) The New Mexico Association was, through much of the HELP program, one of the most consistent industry contributors. However, personnel, policies and priorities all went through several changes during the early stages of the Crescent Demonstration. As a result, NMTA was unable to pick up the recruiting gauntlet until the evaluation was well underway. Even at that point, it was reported that the association, acting on its own initiative, failed to locate a single New Mexico-based carrier traveling the I-10 Crescent segments consistently with the same tractors. As in Arizona, the number of base-state registrations is relatively low and the recruiting target was set at only 250 transponders. However, not a single transponder had yet been delivered to a New Mexico carrier by the time the evaluation work had been completed.

Texas Motor Transport Association (TMTA). The Texas DOT involvement in the HELP/Crescent project was primarily related to data collection associated with the WIM equipment. In fact, Texas DOT withdrew from active participation in HELP following the study phase when neither they nor TMTA found any constructive purpose being served from a Texas perspective. The DOT ultimately returned to the project and became the only I-10 state with facilities in place and operational during the evaluation period. TMTA followed suit somewhat later and nominated a representative of an operating company to represent them in all aspects of the project, including recruiting.

At one point, TMTA did assign a staff person to assist in recruiting, but other priorities and a personnel change ultimately defeated those original good intentions. Acting largely on his own, the designated motor carrier rep was successful to some extent. Texas had been assigned a 500-transponder target and ended up with 233 transponders issued, the majority of which resulted from the single-person effort on behalf of TMTA.

Lockheed Recruiting.

Nothing in its contract required Lockheed to become directly involved with the motor carrier recruiting process. As the Crescent Demonstration Operator, Lockheed was to provide for and facilitate the motor carrier “enrollment” process. As envisioned, Lockheed would receive the referral of a carrier agreeing to participate. Lockheed would then make the contacts necessary to create the desired carrier and vehicle data base records and, in turn, provide the carrier with transponders and installation instructions. A substantial delay in the production of the original transponders frustrated the intended process and, in turn, minimized its responsiveness to the recruiting leads.

Lockheed found itself in the position of having the software mechanics nearly ready to go and yet having to periodically contact and explain the transponder delay to those carriers in the enrollment pipeline; i.e., those principally from Washington and Oregon. On the other hand, recruiting in California did not materialize as expected, and Lockheed acted to assist CTA with its promotional effort. Once embroiled, Lockheed committed personnel resources to the California recruiting effort. From this came a contact with the National Private Truck Council (NPTC) offering assistance with its membership in the six Crescent states. NPTC mailed out Lockheed developed recruiting materials and a mail-back interest response from which Lockheed was eventually provided a substantial number of referrals for follow-up.

What began as an additional part-time recruiting assistance assignment finally led to the commitment of a near full-time field contact person for a period of four to five months. His charge was to pursue the NPTC referrals while at the same time pursuing and developing

prospects within CTA, AMTA, and NMTA. The full-time recruiting commitment was finally terminated when all the referrals had been pursued and the success rate associated with its independent prospecting efforts proved unacceptable.

OTHER INTERACTIONS

During the course of the demonstration, Lockheed apparently sought and took advantage of virtually every opportunity offered to present the “HELP” story to trucking groups. It also reportedly contacted participating carriers by telephone on a periodic basis either to solve a problem or as a means of keeping carriers aware of the demonstration. However, the HELP organization itself never developed a program of information dissemination so as to keep carriers informed of either the developmental progress being made or the applications work being undertaken. The following sections discuss the principal activities that became the vehicles by which interaction with the motor carriers was maintained.

HELP News.

The HELP organization had a long-standing sense of the necessity to publicize and promote the overall project. This aspect of the work was handled through the “Policy Consultant” contract and included provisions for the preparation and dissemination of an organizational newsletter, “HELP News.” As it developed, the newsletter eventually became a quarterly publication incorporating general reports of work completed, concepts of the demonstration’ status of facilities development, organizational matters, and reports of other related projects in the same general field of interest.

Although widely distributed and used extensively as a promotional handout, the benefits of circulation to individual motor carriers, as they were recruited for demonstration participation’ were initially overlooked. This oversight was finally rectified in July 1992; but the opportunity to acknowledge motor carrier participation’ enhance project awareness, and disseminate progress information was identified too late to be of much value for the evaluation.

WHI/Evaluation Projects.

The formal HELP evaluation began in late 1991 with authorization given to the consultant team to proceed with detailing the approved concept plan. One of WHI's first actions, in conjunction with Oregon DOT, was to facilitate a workshop of Oregon-based motor carriers to explore desired applications. The November 1991 workshop was held in Portland, Oregon and led by the HELP Policy Consultant with high-level support from the Lockheed staff. Several

good technical suggestions emerged, but one early point of discussion established the need of motor carrier managers for (1) more and better information concerning governmental facility development plans, and (2) some “positive” driver-oriented promotional materials to help establish an industry attitude of cooperation. Two good points, neither of which was actively pursued on other than a piecemeal basis. A copy of the Memo recording significant points resulting from the Motor Carrier Workshop is included in the Appendix.

Motor Carrier Database. Once the Evaluation Plan had been formalized and approved, WHI obtained a copy of the Crescent motor carrier registration files as developed and maintained by Lockheed. The Lockheed file at that time was a simple inventory control mechanism with each entry containing only the contact information for the entity shipped transponders, the issue count and the licensing base state. Every transponder issued was accounted for-including those given to various state officials for facility testing purposes. No steps had yet been taken to either request or record any other information about the organizational and operational characteristics of the carriers involved.

The initial WHI effort was therefore devoted to defining, designing, and developing a computerized database to support the evaluation effort. For convenience, WHI’s custom-designed membership database system was adapted to provide the operational frame with various fields redefined as necessary to meet additional data needs. This allowed data entry to proceed on the creation of the basic corporate and executive records while a telephone contact questionnaire was being developed to solicit and record the considerable amount of user-specific data which had not yet been captured.

Two concurrent areas of Crescent project development and concern were also integrated in the questionnaire as it evolved. First, the original Crescent database interface concept presumed that all authorized data access would take place electronically via modem. Some three months earlier, Lockheed had formalized the process by which database access was to be accomplished and had distributed to all participating motor carriers a packet of information concerning the user capabilities facilitated. Included in the packet were instructions for system use, the hardware and software interface requirements, and an Access Request form for use in establishing the required password protection with Lockheed. Since few carriers had responded at that point, the WHI telephone contact questionnaire was designed, among other things, to find out why and to encourage follow-through where appropriate. Each carrier’s data access intention was of particular interest since Case Study work as envisioned required some data inspection and verification.

The second area of overall project concern had to do with the apparent under recording of transponder observations. In order to help establish some ball park observation expectations, the

questionnaire elicited from each carrier an estimate of the typical weekly trips made by its transponder-equipped trucks over major Crescent route segments. These data were collected primarily for Lockheed's use and were ultimately found to be the most difficult to obtain of all information sought.

Two separate telephone questionnaires were developed. A short form for those having returned the Access Request form and a longer version for the remainder. As questionnaire development approached finalization, a letter was mailed to each contact of record introducing WHI as their evaluation contractor and informing them of the impending telephone survey. Included with the mailing was a Crescent Route Segment diagram and a worksheet for use in gathering the requested trip information. A copy of the mailing and the script of the telephone questionnaire are included in the Appendix.

Sixty-three company contacts were sent letters in the original mailing. Telephone teams began work one week later. As might be expected, only a small portion of the basic interviews were completed in a single call. Returned calls were the exception rather than the rule. Quite a number of the contacts denied having received the first mailing and furnished updated address information. A few phone numbers were wrong, and quite a number of calls were redirected to another phone number or to another person. Once a connection was made, addresses were verified, job titles were obtained, and similar information was recorded for an alternate contact where available. The resulting expanded database was furnished to Lockheed, became the motor carrier mailing list for "HELP News," and was maintained throughout the project for use in other mailings.

The telephone interviews revealed that, of the original 63, eight contacts had since been replaced by another person, seven contacts made referrals to an alternate person, four contacts consolidated to two when multiple operating companies were identified, and four companies claimed to have already canceled their participation. This first cut at creating the HELP motor carrier database was considerably more time consuming than originally envisioned due largely to the dynamic character of the industry -- and this was only the beginning of what became a yearlong tracking and communication effort.

Survey Pre-tests. On two occasions, small groups of carriers were recruited to serve as sounding boards for the survey instruments being developed. In each case, telephone contact provided participation concurrence, a letter of confirmation was sent, and draft materials were forwarded. Meeting locations had been pre-selected so as to assure reasonable accessibility for those recruited.

The poor turnout at the first of the two meetings led WHI to believe that a "just prior reminder call might be in order since the "no shows" were all very apologetic. However, even with the additional phone call, the second group managed only three out of five.

Both meetings provided considerable constructive feedback. Even so, the WHI experience suggests several observations. First, motor carriers tend to be over-committed; and meeting attendance necessarily yields to other priorities. Therefore, if numbers are important always recruit well beyond your objective. Second, even in small groups, the interchange desired may be difficult to elicit. One-on-one interactions, as labor-intensive as they are, tend to dig through to the "meat" more directly. Multiple individual meetings, each building on the prior, seemingly provide a better platform for insight development.

Orientation Package. One provision of the evaluation contract authorized the development of a project information package specifically for motor carriers. This provision resulted from the observation that existing HELP literature tended to be more promotional than pragmatic. The objective was to tell it like it is, warts and all, while at the same time attempting to establish the basis for a vision of what HELP might become. Considerable effort was put into truncating the verbiage and reducing the concepts to diagrams and pictures. The resulting paper was distributed to carriers along with a pre-notification concerning the survey form which was to follow. For the Case Study carriers, the package was forwarded along with a letter of verification for the first meeting scheduled with our field contact representative.

Extracts from the orientation package were also used as a "discussion tool" with the Case Study carriers on the first round of visits. What WHI discovered with the Case Study Carriers, and verified in subsequent visits with all the other carriers, was that very few had done more than glance at the material that had been mailed to them. While the effort bore considerable fruit in helping to boil down the project for presentation purposes, mailing the package to the carriers was largely a waste of time and money.

WHI Newsletters. As contacts with the carriers developed, it became apparent that HELP should have established some well-greased communication pipeline with its over-the-road partners. Even with a product to sell, sales efforts cannot be ignored. In this case, product development was seemingly so protracted that even the most obvious potential "stakeholders" were left wondering what happened.

WHI attempted to partially fill that gap. The 19 Case Study carriers were added to the circulation list for the near monthly single-page WHI Newsletter. While not every issue included a reference to HELP, several incorporated short progress reports and occasionally a single page attachment was appended to cover a significant HELP milestone. It is unclear that this

abbreviated communication effort was of particular significance, but it was the model envisioned for a broader based effort which was proposed but not authorized as a sponsored undertaking.

Woodburn Bypass. Early-stage visits with the evaluation Case Study carriers revealed that few of the managers thought their trucks had been successfully bypassing the Woodburn SB Port of Entry. As a result, WHI's field evaluation representative requested and received a demonstration briefing at the site. The essence of that briefing ultimately became the subject of a special mailing to all HELP trucking participants, a copy of which is found in the Appendix.

The objectives of that mailing were as follows:

1. To increase motor carrier awareness of the HELP program.
2. To provide some general information concerning the demonstration and the various types of facilities under development.
3. To provide managers a vehicle for communication with their drivers concerning the HELP program.
4. To provide assurance that one particular operational facility did in fact work.
5. To provide specific information about how the facility actually works so that it might be used more effectively.
6. To assure both the carriers and their drivers that the agency operating the scale was interested in and involved with making the HELP system work.

The Woodburn operational description was intended to be the first of a series of bulletins which would focus on the distinctives of each new enforcement facility as it came on line. Unfortunately, no other such station progressed to "on line" status during the course of the evaluation effort. Even so, the "series" concept seemingly has considerable merit and should, in WHI opinion, be pursued further as a means of keeping carriers informed about developmental progress.

Lockheed/Transponder Replacement.

As the motor carriers evaluation process was beginning to take shape, Lockheed continued working with both the transponder vendor and selected motor carriers to try to determine why and to what extent the observation data being collected was being under reported. Having ruled out other alternative explanations, it was judged that as many as one-quarter of the original-issue transponders were no longer functional. The resulting vendor's recommendation was that all original transponders should be replaced by a new, more durable model. Once accepted, this recommendation necessitated a considerable delay in and restructuring of the

evaluation process. It did, however, provide the opportunity for Lockheed to try another approach to handling motor carrier interaction.

By the time the first batch of replacement transponders was ready for distribution, timing had become critical from the evaluation perspective. Expediency and cost-effectiveness dictated finding a new approach to the distribution process. The Lockheed concept that evolved centered around six regional meetings. Carriers were invited to attend a “show and tell” briefing session which included lunch and concluded with the delivery of new transponders. The series of meetings began in the Northwest in mid October 1992 and were completed with the Texas meeting held in mid December. Carriers failing to attend were shipped transponders and installation instruction following each meeting.

Lockheed indicates that the regional meeting attendance was poor in all states except Oregon, Arizona, and Texas. Even so, the meetings were said to have produced many positive comments and suggestions for the Crescent Program. While only marginally effective as a hardware-delivery mechanism, the public relations aspects led Lockheed to believe that regional meetings held several times a year might help to strengthen customer support and assist with further recruiting.

CHAPTER 4. WHI OBSERVATIONS AND COMMENTS

As the Evaluation Team consultant for the motor carrier aspect of the HELP/Crescent evaluation, WHI had an opportunity to try several different techniques for working with and eliciting support. The delays resulting from the need for transponder replacement forced changes in the original plan, however, that, in the long run, necessitated direct personal involvement with more carriers and undoubtedly improved the final product. What follows are observations about aspects of the program beyond just the evaluation. Most of these observations stem directly from the one-on-one work with the carriers -- but a few have roots in the prior experiences of the evaluation team.

GENERAL OBSERVATIONS

Motor Carrier Recruiting.

Prior experience suggests that trucking associations frequently have a difficult time recruiting their own members for any “studies,” “research,” or “demonstrations” in a deregulated operating environment. This is true even if the project happens to be industry-sponsored. It is difficult to get carriers involved in research where they cannot see a direct link to improving their day-to-day operations. Having said this, it is still necessary to involve associations in any attempt to recruit their members. The faxes, phone calls, or letters from association staff may at the least “open doors” for the researcher who ultimately has to work directly with motor carriers. It was quite apparent that evaluation participation typically reflected the nature of the original recruitment contact. While the HELP problems with motor carrier responsiveness were numerous, WHI suggests that they stem largely from the initial failure to establish governmental recruiting accountability, to provide supplemental personnel resources where needed to assist with recruiting, and finally to implement some mechanism for regular communications with the carriers about the developmental status of the project.

Corridor Demonstration.

One obstacle to the involvement of several carriers was the “corridor” nature of the demonstration. Corridors are important for some trucking operations (long haul TL and some LTL) but not of much significance to many others. The fact that tractors are only rarely dedicated to specific routes proved to be a significant recruiting deterrent in the LTL sector.

For several other carriers, the “corridor” nature of the demonstration actually detracted from their involvement. For example, (1) Baxter Health Care has 40 or so vehicles in the Los

Angeles/San Diego area and found that the HELP sites were virtually all outside its service area, (2) Central Freight Lines in Texas, an intrastate carrier at the time, found that the westerly HELP sites in Texas really meant that the few observations recorded were of no use, (3) L.S. Transport dropped out of the demonstration primarily because it was so far off the corridor that the data from the few trips on I-5 were not significant enough to warrant evaluation bother, and (4) Swan Transportation, a Texas carrier with 50 transponders, had only seven observations in a four-week period. In retrospect, it might have been better to screen potential participants more carefully to ensure that their operations had enough trips through enough Crescent sites so as to make participation meaningful.

Demonstration Relevance.

One of the problems with motor carrier participation in the Crescent demonstration was the lack of clear objectives (maybe this should be stated as “the lack of clearly understood” objectives). Most carriers interviewed understood that HELP and Crescent had something to do with bypassing. But when it came to such things as “providing information to industry for use in fleet management and tax compliance reporting” not many seemed to understand how HELP/Crescent might apply. The suggestion that “a HELP system . . . could . . . yield long-term benefits in . . . tax compliance reporting” was particularly unclear to most carriers. Does it mean that a HELP system will provide carriers with data that states will accept in their audits? Or does it mean that a HELP system will provide carriers with data which will reduce the administrative burden of reporting to tax agencies? If the latter, how?

With respect to fleet management, perhaps part of the problem was that many people, including those who organized HELP, tend to think of “truckers” as homogeneous entities. They seem to have the long-haul, TL carrier (J.B. Hunt type) in mind. Most of these carriers do need information showing them the location of their trucks for use in dispatching fleets and/or organizing routes. But this is not necessarily true for many other carriers, and it was not immediately clear why they should need all this information. For these carriers, it was never really clear what “fleet management” meant in HELP terms and, more importantly, how HELP technology could possibly fit into their type of “fleet management.” The failure to see the relevance of the potential applications being suggested (other than bypassing), was perhaps the biggest single reason for the “lukewarm warm” responses received, for the unwillingness to monitor, and for the “piles of unread HELP/Crescent material” encountered.

Unless or until one can spell out objectives and/or applications in more detail, there is always going to be a bit of “fuzziness” in dealing with motor carriers in terms of the evaluation of a demonstration project. While not much could have been done to change this, the key

“characteristic of success” would have been to have the evaluation done after the “system” was actually operational. As it turned out, the evaluation had to be done on the basis of hypothetical questions. Both objectives and applications need to be clearly spelled out and understood.

Truth in Advertising.

Communications are important to the success of a project such as the evaluation of Crescent. Yet it is clear that carriers will not read “research” reports or long-winded “technocratic” letters. A lot of work has to go into the writing. This does not necessarily mean “over simplify,” but it does mean that efforts have to be made to eliminate jargon and long-winded explanations about process, committees, bureaucracies, etc. Keep it simple, accurate, and straight to the point.

While there are no empirical measures for this, the tendency to exaggerate and gloss over in some of the HELP/Crescent writing got in the way of the evaluation. For example, one “carrier/government” problem which surfaced concerns confidentiality. Carriers were told: “All individual carrier and vehicle data are confidential. Only summary reports are issued to states.” In fact, this statement may have been true. But at least one carrier was upset to learn that Oregon was using the transponders to record which of its trucks passed scales/POEs. The fact is that Oregon records the passing of trucks in any case and may eventually use this information when conducting an audit of a carrier. All Oregon did was use the transponder-generated information rather than the manual notations of weigh-scale officer. From Oregon’s point of view, there really was nothing new happening --just some saving in labor. But, from the one carrier’s point of view, this action seemed at odds with the commitment made about confidentiality. The point is not so much whose perspective is “right” or “wrong,” rather, the point is there was a failure to communicate with motor carrier fully about what “confidentiality” means.

After enrolled to participate, an obstacle to the full involvement of two carriers was the fact that no arrangement had been made to integrate the issuing of trip permits into the Crescent demonstration. In the case of these two carriers, their understanding was that participating in Crescent would let them bypass permit trucks at weigh scales. They were frustrated (in one case, angry) to find out that there was no provision made to “input” the permits they purchased into the Crescent computer. Were they oversold, or did they just misunderstand?

One of the “glossier” pieces of recruiting materials was a pamphlet, “Did we keep you waiting today?” In three or four places the pamphlet alludes to the fact that participating in Crescent will “greatly reduce the amount of time that trucks must spend at the scales and ports.” This was distributed at a time when: (1) only one Crescent site (Woodburn SB) was actually bypassing, (2) most carriers did not realize how Woodburn SB worked and were not aware of the

fact that a transponder on their truck had anything to do with getting a green light, and (3) the few drivers/managers who did realize anything was happening at Woodburn SB were, perhaps, saving a minute or so per bypass. The “promotional tone” of the pamphlet was greatly different than the “reality” and may have helped foster a degree of cynicism among carriers.

Short newsletters concerning the demonstration with a slant toward motor carrier interests might have been helpful. “Simple, accurate, and straight to the point” applies here too. The limited-distribution WHI Newsletters followed that philosophy. While there is little evidence to support this contention, WHI suggests that a “frank” discussion of problems, pitfalls and progress is probably healthy in terms of carrier involvement.

MOTOR CARRIER PARTICIPATION

Contact.

The “lesson” learned (if not already known) is that it takes a great deal of effort to get a motor carrier to agree to participate in an evaluation -- especially so if no commitment was required in conjunction with recruitment. Beyond this, in several cases the commitment to participate in the evaluation came from “higher ups” (i.e., Domino’s, Frito Lay, UPS, [at least as far as the Phoenix terminal was concerned], Sessler, Willamette, and Inco.) This meant that the person actually dealing with the evaluation was, perhaps, less committed to the involvement. The solution to this problem is as yet unclear, but the person assigned the job needs somehow to be fully integrated from day one.

Project Duration.

HELP suffered from the inability to bring a defined “system” on line for either demonstration or evaluation. Some of the facilities advertised never even materialized. While significant “facility voids” were evident on some segments of the demonstration route, the transponder problem may have been even more deleterious. Without addressing the issue of “what went wrong” or “who was to blame,” it has to be recognized that the length of time it took to replace the transponders had an impact on the interest, or level of involvement of some carriers.

First, the fact that many of the original transponders did not work contributed to the waning lack of interest in a few carriers. Second, the length of time it took to replace the transponders meant that some of the initial commitment to participate was gradually eroded. Further, trucking is generally a very “fluid” industry. Companies here today are frequently gone tomorrow, and people move around even faster! This too had an impact. Personnel changes over

the duration of the project detracted from the evaluation in several instances (United Groceries in Portland, Timber By-Products, Thrifty).

The Interview Process.

Fact-to-face meetings are expensive, in terms of consulting budgets, but result in a better quality of evaluation material than just telephone interviews or mail-out surveys. Actually, based on the HELP example, the best procedure is probably to use all three techniques (face-to-face, telephone, mail).

A second observation is that the length of time a research person can reasonably expect a motor carrier to give to an evaluation interview is short. In many cases, there was pressure to “hurry up” so the person could get on with their business (Swan Transportation, Domino’s in Seattle, WeigandButton L.S., KKW). The “lesson” here is this: the field work, or on-site survey work for a project of this nature has to be designed to be flexible. The interviewer has to be prepared to adapt his/her approach on a case-by-case basis. Sometimes this may mean: (1) a relatively long interview with two or three people, (2) short interviews with follow-up correspondence, or (3) a mixture of interview and telephone call-backs.

Driver Perspective.

Pre-test of the survey instruments gave fair warning that management personnel would likely be unable to provide much information about the experience of their units at weigh scales. However, there was substantial reluctance expressed to ask all drivers to participate. Following the advice given, WHI aimed this portion of the evaluation at drivers rather indirectly by asking carriers to nominate one driver each for experience-recording purposes.

If in fact the primary function of HELP technology is to bypass weigh scales and POEs, much more evaluation effort might well have been targeted toward the drivers. For example, we should perhaps have been more aggressive in driver contact (acquiring names and telephone numbers of all drivers of transponder-equipped trucks operating through Woodburn SB). In many firms, owner-operators are used, drivers are paid by the mile or drivers are paid on a “fixed route” basis. If recruiting and retaining good drivers is a management priority, it’s entirely possible that the driver’s opinion on what a bypass is “worth” could well become the carrier’s opinion. The real key to whether or not a HELP technology is “salable” may well be the driver.

Evaluation/Sales.

The motor carriers evaluation proceeded from the philosophy that the only way to obtain an objective assessment of the potential applications was to establish a rapport with the participat-

ing carriers that was clearly based on the fact that the evaluation team was not part of the government and not part of Lockheed (or others) trying to sell the system. WHI's experience suggests that motor carrier cooperation diminishes significantly when objectivity can be questioned.

EVALUATION TECHNIQUES

Mail-Out Surveys.

Mail-out surveys probably have to be used, but motor carrier response rates will typically be low. The survey WHI used was perhaps too imposing; even so, the telephone follow-up found very few that indicated a refusal to cooperate. Most expressed good intentions, but their follow-through was miserable. In addition, WHI found that, no matter how much care is taken in wording questions, there are always "interpretation" problems. It is almost essential that a "mail out" be accompanied by a "quick visit" (for both "arm twisting" and "interpretation" purposes) and/or a telephone call-back.

Contact Work.

It is critically important that a person going out to talk to motor carriers knows what he/she is talking about. Motor carriers are generally an impatient group and are quick to resent the "waste" of their time. On the one hand, one needs to know something about the trucking business. This helps both to pull out the real responses and, in some cases, to sort out the wheat from the chaff in the responses. On the other hand, one has to know his/her own subject inside and out. Based on WHI's experience, it would be extremely difficult for an "outsider" to come onboard something like the Crescent demonstration and to work "up the learning curve" strictly on the basis of the written documents. By sitting in on two of the HELP meetings, our field representative became more attuned to the nuances of what was happening and more aware of the variety of perspectives that are brought to bear on this new technology.

WHI also learned with the Case-Study carriers that it is imperative to maintain the contacts. "Out of sight, out of mind," aptly describes motor carrier participation in an evaluation effort. Even so, the one "involvement strategy" which did not work well was the attempt to have the Case Study carriers monitor three aspects of their participation. Few carriers could see the purpose or gain from monitoring. The root of this problem has several possible explanations: (1) carriers will not monitor, (2) the consultant did a bad job, (3) the interminable delays in replacing the transponders doomed the effort from the start, or (4) there was a general lack of appreciation about the need for HELP/Crescent. While we are unable to pin-point the problem with

monitoring, the relationships resulting from continuous contact typically established the platform for a thoughtful evaluation assessment.

Ranking/Rating.

As it turned out, the “Ranking/Rating” part of the survey was undoubtedly the best method for getting carriers to tell us what they thought of potential applications. To put this in perspective, consider that often times when asked a question, say on the potential value of using hidden transponders for tracing stolen vehicles, the response could well be “positive,” i.e., “Yep, that sounds like a good idea.” It was not until the carrier actually took pen in hand, at the end of the interview, to complete the ranking/rating exercise that you would finally find that this potential application was not that important.

CHAPTER 5. CHARACTERISTICS OF SUCCESS

Alternative titles for this chapter might be “Summary Conclusions” or “Lessons Learned.” These observations stem from the HELP/Crescent experience of working with motor carriers as developmental partners initially and later as demonstration evaluators. In any dealings with the motor carrier industry, diversity is perhaps the single, most challenging characteristic that must be recognized and somehow accommodated. The type, size, and nature of motor carrier operations vary so extensively that many have little in common other than the trucks they use, the taxes they pay, and the multiplicity of constraints they are subjected to by governmental regulation and control. As a result, any discussion of the characteristics of successfully involving and relating to ‘motor carriers can only be characterized as broad generalizations.

DEVELOPMENTAL INVOLVEMENT

Ideally, people directly affiliated with operating companies bring to any developmental project the perspective desired to explore both productivity constraints and the potential tools for resolution. As a matter of practice, however, few operating companies can afford the luxury of a significant personnel commitment to research projects, even when well-defined, directly relevant long-term goals of the industry are being addressed. Particularly in the arena of government/industry relations, the extent of consistent industry involvement will likely be determined by the priorities, objectives, and resources of the related industry associations. Depending upon the project, either individual state trucking associations or the national trucking association will usually step forward to assist. Other, more user-specific associations may also choose to contribute if not overlooked.

Most association people are where they are because they are good communicators. They understand their clients and their clients’ needs, but they likely will not have had experience in an operating company. A project like HELP/ Crescent needs both voices. A joint industry/government research project has to have the support and participation of the appropriate motor carrier associations in order to insure the consistency of industry involvement. On the other hand, the litmus test of operating company experience is an essential participatory qualification for the verification and validation of industry involvement. Active association participation teamed with operating company personnel support bodes well for effective industry representation.

DEMONSTRATION CONCEPT

By definition, a demonstration must demonstrate something, and that something should be something that somebody wants and/or needs. HELP began as a technology development and integration exercise given only some rather vague notions of how the product might be used and whom it might serve. The system design study component struggled to put more “meat” on the application “bones” but ultimately focused more on the requirements for a “global” implementation than on the reality of the process required for transformation to functional utility. The system design represented a necessary preliminary undertaking, but it was not an adequate “blueprint” for a demonstration commitment.

As demonstration planning proceeded, no steps were taken to specifically define and detail the motor carrier applications that had been suggested. This status continued on into the early stages of the evaluation planning, at which point no resources remained for further development. The result was the necessity for an “evaluation” based upon motor carrier responses to “what if questions framed around rather “fuzzy” concepts of potential applications.

The “lessons learned” here are fairly obvious: First, considerable more market research needed to be undertaken initially to clearly define motor carrier application objectives and to develop achievable goals for each. Once given a developmental frame on which to build, further research might have been undertaken to validate the cost effectiveness of the various applications so as to guide the allocation of developmental resources. As an alternative, one or more selected applications might have been detailed and developed for demonstration and evaluation. A less obvious lesson might be seen as the apparent inability of, or the perceived lack of need for, the industry participants to “force” the issue concerning motor carrier application development.

Another observation concerns the distinction between system applications and prototypical demonstration. Promotional literature about HELP typically alludes to system-wide potential capabilities. The Crescent Demonstration, on the other hand, never progressed much beyond illustrations of what might constitute prototypical installations. The lesson here is: be extremely careful about harmonizing promotional performance claims with demonstrated or achievable on-the-road capabilities.

From a motor carrier perspective “prototypical” would probably fly if advertised as such, fully defined and it actually achieved something worthwhile. However, even “prototypical” has to make some predictable change in the norm to be recognizable. Given a set of site-specific performance objectives, the goal might have been to make things work as advertised.

DEMONSTRATION RECRUITING

The recruiting of motor carriers for demonstration participation will be labor-intensive but could also be of relatively short duration if properly handled. Politically, the process must work with and through the state trucking and other related associations. On a partnership basis, associations should be given the freedom to go as far along the commitment path as they are willing so as to maximize the private sector contribution. However, as seen in the HELP/Crescent experience, accountability and ultimate responsibility must be clearly established as a public-sector responsibility or the effort may flounder.

To be most effective, the government lead assigned the recruiting responsibility should come from the agency charged with size and weight compliance enforcement. That accomplishes several purposes: (1) agency recruiting leadership infers agency buy-in -- this alone should help assure that the demonstration capabilities are more fully defined and become fully operational, (2) agency recruiting leadership gives the project a measure of legitimacy with the motor carriers, and (3) agency recruiting leadership brings with it a dedication of the resources necessary to get the job done.

As a precursor to undertaking recruitment, state trucking associations can be helpful by (1) placing advanced publicity in the membership newsletters and (2) making platforms available for presentations at various meetings. Information dissemination is important; however, rhetoric has to be matched by performance. As recruiting gets underway, it is essential to have facilities operational that carriers (and drivers) can identify with to see how they work. That implies, of course, that all aspects of the developmental prototypes have to be operational – including the transponders.

Further, evaluation planning must precede recruiting. Assuming that the recruiting effort focuses on applications with significant potential motor carrier involvement, much of the assessment of effectiveness and receptivity will have to come from the industry partners. Don't keep that a secret -- lay it out from the start. The HELP/Crescent experience suggests that enlisting and obtaining after-the-fact motor carrier participation in an evaluation program significantly increases the level of effort required to obtain a meaningful response.

Recognizing that recruitment objectives may be broader than that of just "system" validation, consideration must still be given to insuring a significant level of facilities involvement by participating carriers. Corridor demonstrations complicate the realization of that objective somewhat unless recruitment efforts are targeted toward observed repetitive users. While targeting will likely limit the types of users approached, placing transponders on trucks you don't often see frustrates the basic purpose of the entire demonstration.

An effective recruitment effort should never degenerate to a “canvassing” or “cold call” approach. Hopefully, carrier referrals will come as the result of a pre-contact expression of interest. Even then, some salesmanship will likely be required to seal the commitment and acquire the required registration documentation. Phone calls and correspondence may be the “easy” way to go, but these are a poor substitute for one-on-one, face-to-face contact as demonstrated by the early pre-Crescent Oregon experience. In conjunction with this, the HELP/Crescent experience suggests that the “system operator” tends to make a good “presenter” but a somewhat less effective “recruiter.” Effective recruitment seemingly comes as a result of the direct involvement of one or both of the principal partners -- industry or government.

One further observation: Demonstration recruiting most frequently takes place, as it should, in the upper echelons of trucking company management. Once the participation agreement is consummated, however, further carrier involvement is frequently passed down to someone more involved with operations. From an evaluation perspective, the operational person delegated responsibility for dealing with the transponders needs to be brought into the information loop beginning at day one. When this was recognized in HELP/Crescent, contact information was developed and maintained for both levels of management involvement. Additionally, a “primary contact” tag was keyed to the person assigned the job. This enabled the circulation of general information to both parties while facilitating a more specific relationship with the person directly involved.

DEMONSTRATION CONDUCT

Based on the HELP/Crescent experience, the likelihood of having all aspects of a demonstration up and running for a ribbon-cutting ceremony is slim. On the other hand, the carrier participants need to be apprised of what is happening and where they might expect to see demonstration activity. Generally speaking, carriers needed more and better information about facility development plans -- both demonstration and non-demonstration related. This need surfaced when problems with driver/management communications concerning the project became evident. WIM facilities are easily identifiable on the road. The drivers see what’s happening; managers probably do not; and the threat of unacknowledged “system” expansion tends to foster considerable driver suspicion. This also pointed to the continuing need for “positive” driver-oriented promotional materials.

Periodic progress reports and bulletins describing the mode of operation of new facilities as they come on line are essential parts of the communication process. Keep them short, keep them simple, and keep them honest. Lockheed’s one-time experiment with regional information meetings might also merit further consideration for maintaining motor carrier interest.

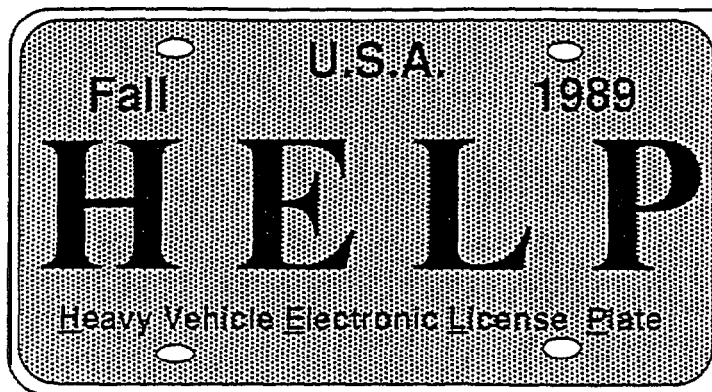
DEMONSTRATION EVALUATION

Mail-out surveys may serve a purpose, but primary reliance should not be placed on them for evaluation purposes. The Crescent experience suggests that the field interview will likely be an essential part of the evaluation process. Even then, flexibility is a key ingredient. Supplemental follow-up may be required to fill in “holes” necessitated by the “rushed” interviews often afforded.

The ranking and rating technique utilized in the Crescent evaluation is a viable method for gauging how motor carriers react to prioritized alternative service options. Initial exploratory questioning during the interview served to further project understanding and to clarify misconceptions that had developed. As the final step of the interview process, the ranking and rating exercise provided the tool necessary to accurately engender and record the true motor carrier perspective.

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Vol. 3 No. 3

QUARTERLY PUBLICATION

SEPTEMBER 1989

IMPLEMENTATION STRATEGY FOR TRUCKING RECRUITMENT: A CONCEPT PROPOSAL

The following proposal was prepared by Loyd Henion, Oregon DOT, and Ken Heald, Western Highway Institute, for consideration by the Motor Carrier Services Plan Subcommittee chaired by Jerry Eiler.

The primary objective of the HELP motor carrier recruiting effort is to secure commitments from an adequate number of trucking firms that indicate a willingness to participate in the Crescent Demonstration Project. Each candidate will be asked to voluntarily install transponders upon an agreed number of units and to participate in the evaluation process.

A. Recruiting Team

Each governmental agency directly involved in the Crescent Demonstration Project is to designate a specific staff person to assume responsibility for the motor carrier recruiting effort in their jurisdiction. Whenever possible, a trucking industry person should be solicited to advise and/or work with the governmental "lead".

The composite group of designated government and industry participants is referred to as the Crescent Motor Carrier Recruiting Team. This team is to be headed by the Crescent Demonstration Manager (or his appointed representative) with primary advisory support provided by Oregon DOT.

B. Corridor Emphasis

Since the overall objective is to maximize the number of potential interactions between "transponder" equipped trucks and demonstration facilities, the recruiting team will function as two corridor-specific subcommittees, i.e., and I-5 subcommittee and an I-10 subcommittee. The purpose of each subcommittee is to jointly target candidate motor carriers and to coordinate the corridor recruiting efforts of the individual states.

C. Allocation of Transponders

Based on relative truck VMT, two-thirds of the transponders will be allocated to the I-5 corridor and one-third to the I-10.

The primary consideration for the assignment of transponders is use of the corridor. Interstate carriers having a propensity to regularly reverse major portions of either

corridor should be given the highest recruiting priority. A smaller number of transponders may need to be reserved for intrastate carriers so as to increase motor carrier awareness of the demonstration program within each state.

D. Contacting Interstate Carriers

Strategy meetings will be required for each recruiting subcommittee to organize and coordinate the recruiting effort. Each group should develop a composite list of the most viable interstate carriers identified as operating in their respective corridor.

Other items for each group to determine include: 1.) some "rule-of-thumb" guideline for individual carrier transponder allocation; 2.) which state is to contact each prospective interstate carrier

Only top-level trucking managers having either regional or corporate-level responsibilities should be approached concerning demonstration participation and then only one of the designated state recruiters.

E. Evaluation Process

During the course of the solicitation interview for involvement in the HELP project, each carrier will be advised of the requirement to assist in an evaluation process. Details of this process are to be determined by the HELP Productivity and Efficiency Subcommittee and may involve some fairly extensive record keeping relative to demonstration-related experiences.

These preliminary guidelines were contributed by Jerry Eiler, President, Oregon Freightways and Chairman of the Motor Carrier Services Plan Subcommittee. The plan for recruitment, which is to be overseen by the Motor Carrier Services Plan Subcommittee is still in the developmental stages and input from the public and private sectors is very much needed and welcomed. If you or your organization would like to provide comments or have any questions regarding the recruitment of the trucking industry into the HELP Program please contact: Jerry Eiler, Oregon Freightways (503) 664-6657; Barbara Koos, Transportation Analyst-Oregon DOT, (503) 378-2142 or Mike Walton, HELP Policy Consultant, (512) 473-8343.

Heavy Vehicle License Plate Project

The Heavy Vehicle License Plate (H.E.L.P.) project, a joint project of several state transportation departments and the trucking industry, has developed an electronic system to supplement the use of license plates and paper vehicle licenses in heavy trucks.

This system, which uses a vehicle-mounted transponder and electronic readers at various locations along with a computer system, is capable of identifying vehicles as they pass by those points. This vehicle identification (AVI), along with weigh-in-motion scales installed either in traffic lanes or on conventional scale approaches and the ports of entry into various states, has the potential of greatly reducing the amount of time that trucks spend in both the scale lanes and the ports of entry. In actual operation a transponder-equipped truck will be weighed, measured and identified either on the main line highway before reaching the exit, or the approach road into the scale or P.O.E. If the vehicle is legal, it will get a green light and return to the highway without stopping. The exact method of operation will vary from state to state and from scale to scale depending on state needs.

H.E.L.P. is now entering a phase known as the "Crescent Demonstration." During the demonstration it will be our goal to place 5,000 transponders on vehicles operating on I-5 between British Columbia and Los Angeles, and I-10 from Los Angeles through Texas.

In the first phase, we will be recruiting carriers that have trucks running across the Santa Nella scales on I-5 and a main line highway reader that will be located on I-5, two miles north of state route 12. This phase is scheduled to begin in late July or early August. The next phase will continue the project north to the Canadian border. This should be operating by early 1991. After the northern segments are finished, the route will be opened to the south and east through Arizona, New Mexico and Texas. The purpose of this demonstration will be to test the feasibility of the system and to determine if there are, or could be, long term benefits to the states and the trucking industry. The central computer system will be operated by a private contractor, and all individual carrier data will be held in confidence with only summary reports being issued by the contractor. Vehicle specific reports will be available to the carrier.

If you have equipment that is operating in this I-5, I-10 corridor and are interested in helping us prove future technology, please fill out the attached form and return it to the C.T.A. booth at the Truck Show - or mail to California Trucking Association, 1251 Beacon Blvd., West Sacramento, CA 95691-3461.



Carrier Response Form

- ☐ YES, I am willing to equip my trucks with transponders. I understand that the transponders for the demonstration will be furnished to me at no charge.
- ☐ YES, I am interested, but would like more information.

Carrier Name: _____

Contact Person: _____

Address: _____

City: _____ State: _____ Zip: _____

Telephone: () _____ FAX: () _____

Number of power units operated on I-5, I-10 _____

Type of operation (TL, LTL, etc.) _____

Major parts of routes covered _____

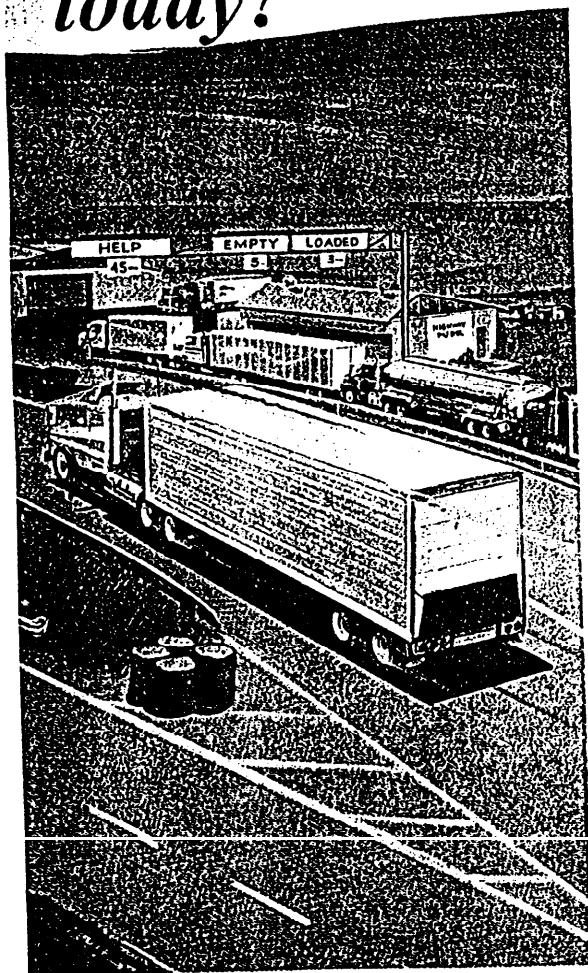
California Trucking Association
1251 Beacon Blvd.
West Sacramento, CA 95691-3461

HEAVY VEHICLE

H.E.L.P.

ELECTRONIC LICENSE PLATE

Did we keep you waiting today?



One dollar per minute....

That's a conservative estimate of what it costs to keep a "typical" five axle combination idling, unable to move because of traffic congestion, weigh station or port of entry lines, and other delays. Multiply that by the tractors on the road or the tractors in your fleet. Multiply that by three or four (or more) times per shift per day.

Overwhelming Costs of Delay

It is estimated that by the year 2000 there could be an additional 11 BILLION vehicle hours of delay on urban highways and some 500 MILLION additional vehicle hours of delay on arterial highways. Those numbers are so huge they are nearly overwhelming even at today's cost of fuel and cost of labor. They are mentioned simply to lend some perspective to the need to begin to reduce costly idle time today and begin to prepare for the future.

If you could do something today to help reduce that idle time and get a

better handle on your own operation at the same time would you be interested?

Intelligent Vehicle Highway Systems

There is a new system under development which will go a long way toward accomplishing increased efficiency and improved traffic management. Intelligent Vehicle Highway Systems (IVHS) technology is already here and the trucking industry is in position to become the first beneficiary.

Electronic License Plate

IVHS is the collective description of advanced technology in the fields of computers, communications, display and control systems which have been adapted for the special needs of vehicles and highways. The Heavy Vehicle Electronic License Plate (HELP) is the most advanced of the IVHS projects. As a joint project of the trucking industry, state DOTs and the governments of both Canada and the United States, HELP has concentrated on research, development and testing of technologies to help expedite the flow of heavy vehicle traffic.

The Crescent Project

The HELP Program has now reached the demonstration phase known as the Crescent Project. Crescent is an integrated regional system being installed in the corridor from British Columbia, south along I-5 from Washington to Los Angeles, then east across I-10 through Texas. The system will use a vehicle-mounted transponder for identification and electronic readers at approximately 40 sites. This vehicle identification (AVI) along with weigh-in-motion scales (WIM) installed in weigh stations and ports of entry can greatly reduce the amount of time that trucks must spend at the scales and ports.

Electronic Inspection

In actual operations, a transponder-equipped truck will be weighed, measured, identified and have its tax and regulatory credentials electronically inspected either on the highway before reaching the scale or on the approach road to the scale or POE. If the vehicle is in compliance, it will get a "green light" and can return to the highway without having to stop. Of course the exact method will vary according to state

needs and procedures and participation can not guarantee that the vehicle will not have to stop at times for safety purposes, for example.

Data Security

All individual carrier and vehicle data will be confidential. Only summary reports will be issued to the states. Vehicle reports will be made available to the individual carriers to assist in their evaluation of the program and provide the key to a new dimension of fleet management and vehicle record keeping. All this will be done under the strictest protection of competitively sensitive information.

Crescent is a demonstration.

By participating you also agree to evaluate the project and tell government whether it has proven that the technology works and that there is a benefit to industry.

Government is putting money where its mouth is and challenging you to get in on the ground floor.

Want to learn more?

Motor carriers are now being recruited on a voluntary basis to equip their vehicles with transponders. The transponders are available free of charge and the first phase of system implementation will begin in a few weeks. If you are excited about participating on the ground floor of a project defining the vehicle technology of the future please contact:

Elmer Brown

California Trucking Association
1251 Beacon Blvd.
West Sacramento, CA 95691
(916) 373-3550

Don Norris

Crescent Demonstration Office
777 N. First St., Suite 220
San Jose, CA 95112
(408) 987-4649



WESTERN HIGHWAY INSTITUTE
1200 Bayhill Drive, San Bruno, CA 94066 - 415/952-4900

M E M O R A N D U M

DATE: November 12, 1991

TO: Mr. Bob Bothman, HELP Executive Director
HELP Management Team
Participating Carriers

FROM: Ken Heald

SUBJECT: Motor Carrier Workshop - November 6, 1991 - Portland, Oregon

1. Motor carriers need help from government in dealing with their drivers; i.e., negative driver attitudes are becoming a big problem.
 - Carriers need to know where and why various state agencies are putting in "observation stations" -- before they happen. Drivers are in a position to observe what's going on and suspect the worst if not kept informed,
 - Carriers need some "positive" driver promo materials for use in organizational "safety" meetings to help develop support. Several carriers reported instances of drivers attempting to circumvent observation by driving the shoulders to bypass detector loops.
2. Mainline screening at enforcement scales would be a much more viable and effective way of demonstrating to both drivers and carriers the advantage of carrying a transponder.
3. Carrier ability to update the data base directly via ED1 and have information quickly validated electronically by state agencies:
 - would enable "normal course" registration changes to be made easily
 - would be particularly valuable if it eliminated/reduced the paper work required for obtaining and displaying permit credentials
 - might help overcome the observed reluctance of some states to accept safety inspections performed by others.
4. It was suggested the "hidden" backup transponders might assist in the recovery of stolen equipment -- both tractors and trailers.
5. Carriers need more information concerning alternative mounting locations for transponders. Some carriers utilize "movable" license plates in order to deal with clearance problems and this precludes the installation suggested.
6. Transponders are too fragile -- the "ears" in particular are too skimpy.

CRESCENT EVALUATION - Phase B, Task 6.3.1

June 11, 1992

NAME
COMPANY
ADDRESS
CITY, STATE ZIP

Dear :

Western Highway Institute, a trucking-industry-supported nonprofit research group, has been retained by the H.E.L.P./Crescent Demonstration' Program to assist motor carrier participants in helping to evaluate the capabilities offered from their perspective. Contractually, our evaluation effort began June 1, 1992 and must be completed by December 31, 1992. As the project develops, we will be asking each carrier *to* become involved to some extent. Several possible levels of evaluation assistance are envisioned; and, depending upon your company's involvement and willingness to cooperate, your input will be accorded some varying level of significance.

Lockheed IMS, the Crescent Demonstration Operator, has provided us with your contact information with respect to the transponders installed on your trucks. To get the evaluation project started, we need to know a bit more about your company, i.e. Private/For-hire, Intrastate/Interstate, General Freight/Special Commodity, and Number of Classes 7 & 8 units you operate. We will also need to know what portions of the Demonstration Route your transponder-equipped trucks use and approximately how many one-way trips normally occur on each route segment in a typical week. A sketch of the Demo Route with the route segments indicated is enclosed to assist you in providing the trip data.

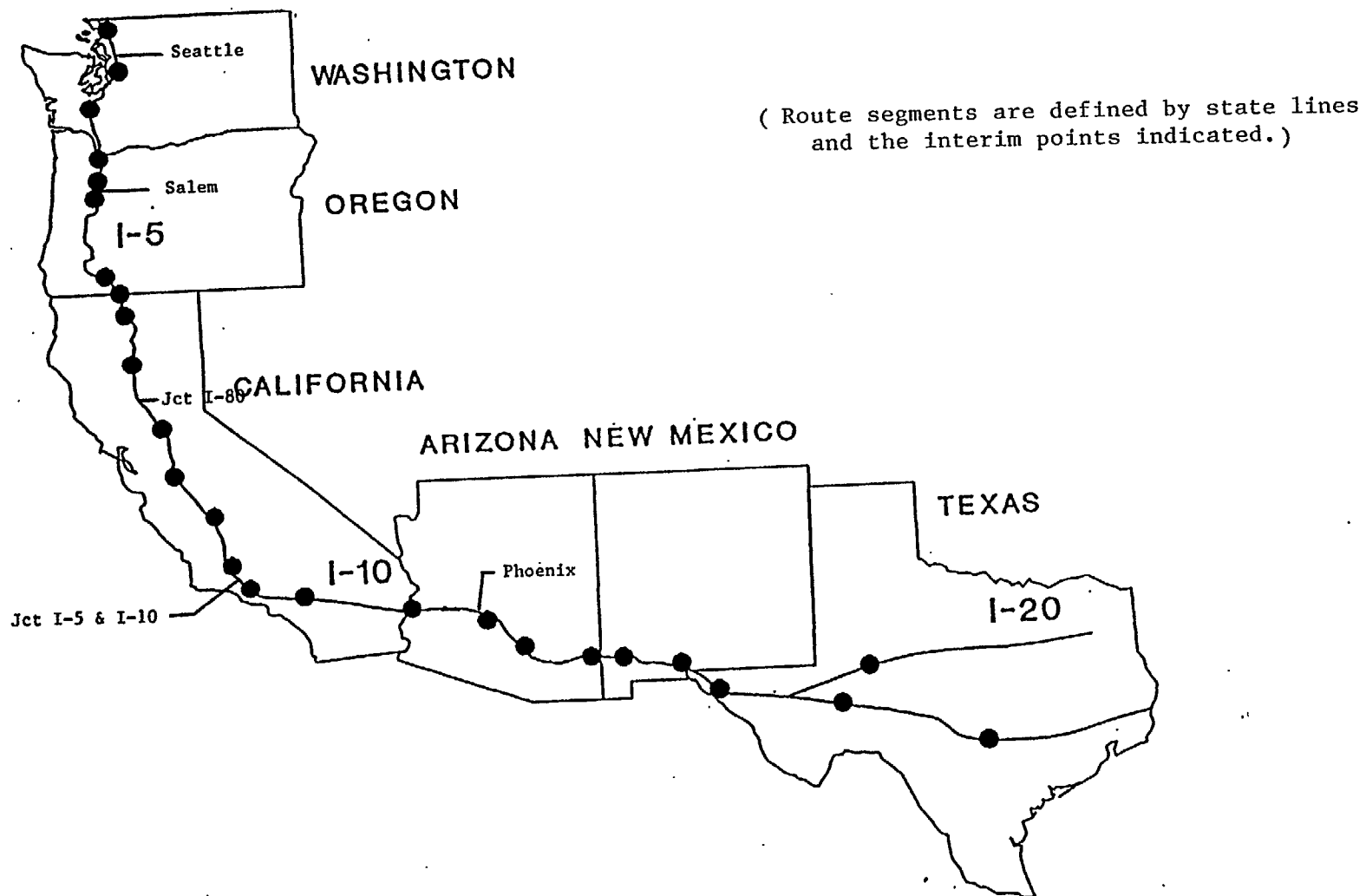
In order to move quickly into the next phase of the evaluation, someone on our staff will be contacting you by telephone within the next week or so to obtain the information requested from you. The phone number provided by L.I.M.S. is . If this is incorrect, could I ask you to please call me personally with the correct number.

Sincerely,

Kenneth L. Heald
Chief Engineer

KLH/lb

H.E.L.P. / CRESCENT DEMONSTRATION ROUTE & SITES



W O R K S H E E T

Route Segment Use
H.E.L.P./Crescent Demonstration

*Estimated
Weekly One-Way Trips
 (Round trip counts as
 two one way)

Route SegmentsI-5

FOR _____ TRANSPONDER
 EQUIPPED UNITS

- 1a: Canada-Seattle
- 1b: Seattle-Oregon stateline
- 2: Washington stateline-Salem
- 3: Salem-California stateline
- 4: Oregon stateline-Jet I-80
- 5: Jct I-80-Jet I-10

I-10 .

- 6: Jct I-S-Arizona stateline
- 7: California stateline-Phoenix
- 8: Phoenix-New Mexico stateline
- 9: Arizona stateline-Texas stateline
- 10a: I-10 in Texas
- 10b: I-20'in Texas

*Include all transponder-equipped units using some portion of the segment indicated. We will also want to know: (1) if any of your transponder-equipped units are no longer using the demonstration route and (2) if you are aware of any of your assigned transponders that are either missing or are no longer functional.

Interviewer: _____

#1

H.E.L.P. Motor Carrier I.D. Survey

Information Label
with date included *(Have
modern
I.D.)*

Mailing
Label

Date of Contact: _____ Follow-up Notes: _____

Introductory explanation: Did you receive our 5/11/92 letter? Yes ___ No ___

(If yes, proceed to Question #1)

(If no) Would you check your address with me so we can remail? We'll
allow another week for delivery then call you back. (Date remailed _____) 1

Questions to be asked:

1. To complete our records, what is your current job title?

2. Was the letter correctly addressed? Yes ___ No ___

(If yes, proceed to Question #3)

(If no, obtain corrections and note on mailing label above)

3. a. (If 2nd name on "info") A second name from your firm was given to
us: _____

Should he/she be considered an alternate contact? Yes ___ No ___

(If no, proceed to 3b)

(If yes) What is his/her job title?

- b. (If no 2nd name on "info") Is there another person knowledgeable re
your transponders whom we could contact if you should
be unavailable later? Yes ___ No ___

(If no, proceed to Question #4)

(If yes, list name and title)

4. Information provided by Lockheed IMS indicates that you have _____ trucks with transponders? Do you verify? Yes ___ No -

(If yes, proceed to Question #5)

(If no) How many transponders did you actually receive? _____

5. Are all trucks on which transponders mounted still using some portion of the I-5/I-10 Demonstration route? Yes ___ No ___

(If yes, proceed to Question #6)

(If no) How many are no longer using the demo **route**? _____

6. Are any assigned transponders now missing? Yes ___ No ___

(If no, proceed to Question #7)

(If yes) How many? What do you think happened to them?

7. Do you have reason to suspect that any of the transponders currently installed are not actually working? Yes ___ No ___

(If no, proceed to the next section)

(If yes) How many do you think are bad? _____ What makes you suspect them? _____

For statistical purposes, we would like to know more about your trucking operation as related specifically to your use of Class 7 and 8 trucks:

8. Are you an Interstate carrier? Yes ___ No -

(If yes, proceed to Question #9)

(If no) Is your operation essentially local/metro? Yes ___ No ___

9. Are you a For-Hire carrier? Yes ___ No ___

10. Are you a Special Commodity carrier? Yes - No -

(If no, proceed to Question #11)

(If yes) What commodities do you typically transport? _____

11. Do you operate strictly fixed (regular) routes? Yes ___ No ___

(If yes, proceed to Question #12)

(If no) Are you all variable route? Yes ___ No ___

12. How many Class 7 and 8 vehicles does your company operate? _____

* (Code when complete: Membership Category _____, Dues Scale _____)

13. a. Regarding the "H.E.L.P/Crescent Route Segment" worksheet,
did you get a chance to work through it? Yes ___ No ___

(If no, proceed to 13b)

(If yes) Was it clear what we are looking for? Yes ___ No ___

b. (Explain to extent indicated, then work through)

o Verify # of transponder-equippped trucks included in data

o Record responses on sample worksheet attached.

14. According to the Lockheed records, you have requested & received the
User I.D. necessary to access the Crescent Activity Database.
Have you been able to dial into the system successfully? Yes ___ No ___

(If yes, proceed to wrap-up)

(If no) Could we have someone from Lockheed contact you or another
person in your firm to help'resolve the problem? Yes ___ No **I**

(If yes) Other name: _____ Phone #: _____

Wrap-up

Thank you for helping us get started with the motor carrier's evaluation process. As the project develops, it is likely that we will be contacting you again to explain the motor carrier evaluation "needs" further and to determine how your experiences and opinions can best be integrated into the overall assessment.

Do you have any questions about the HELP/Crescent Demo that we might be able to answer for you at this point? Yes - No -

(If no -- done)

(If yes and can't answer) Good question, but I'll have to have Ken Heald call you back to discuss it with you.

Ken to call back Yes ___ No -

H.E.L.P. Motor Carrier I.D. Survey

Information Label
-no date indicated

(No Modern
I.D.)

Mailing
Label

Note: Re #2 Scenario, questions 1 - 13 identical, Question 14 and following below.

14. According to the Lockheed records we've been given, you have not yet requested access to the Crescent Activity Database. Did you receive the blue Lockheed packet re the database and its operation that was mailed out about April 1, 1992? Yes ___ No ___

15. Do you have a modem-equipped computer that could be used to access the database? Yes ___ No ___

(If yes) Lockheed has now set the data system up with a toll-free telephone number. Could you in some way be convinced to sign up with Lockheed for computer access authorization in order to see what's being offered? Yes ___ No ___

(If no, proceed to wrap-up)

(If yes) Do you need another access request form? Yes ___ No ___

(If no, proceed to wrap-up but add to list for Lockheed follow-up)

(If yes, date mailed: _____)

(If no) Lockheed now has the database set up for access via a toll-free telephone number. There is now no cost to the carrier involved for use. The data system is envisioned by HELP as an additional "fleet management" tool. Is it possible that you might somehow be convinced to install the necessary hardware and software so as to investigate its capabilities? Yes ___ No ___

(If no) Proceed to wrap-up.

(If yes) Would it be helpful if we had someone from Lockheed call you concerning what's required? Yes ___ No ___

(If no, proceed to wrap-up)

(If yes, date added to list for Lockheed: _____)

wrap-up

Thank you for helping us get started with the motor carrier's evaluation process. As the project develops, it is likely that we will be contacting you again to explain the motor carrier evaluation "needs" further and to determine how your experiences and opinions can best be integrated into the overall assessment.

Do you have any questions about the HELP/Crescent Demo that we might be able to answer for you at this point? Yes ___ No ___

(If no -- done)

(If yes and can't answer) Good question, but I'll have to have Ken Heald call you back to discuss it with you.

Ken to call back

Yes ___ No ___

Western Highway Institute

MEMORANDUM

DATE: December 17, 1992
TO: Motor carriers participating in HELP Demonstration
FROM: Kenneth L. Heald, Chief Engineer
SUBJECT: Motor carrier "benefits" I

Happy Holidays and "good news" --

As you undoubtedly realize, the Heavy Vehicle Electronic License Plate program's Crescent Demonstration never really had a "ribbon cutting" ceremony. Although the calendar said "go," a substantial number of the planned installations still have not been activated, still don't work properly, or are now being upgraded. Even so, when Lockheed gets your replacement transponders to you (and you get them mounted), your drivers should begin to see some weigh scale installations working as originally advertised.

In fact, Oregon's southbound POE at Woodburn has been "transponderized" for some time. To date, however, we've heard of only a few motor carriers that acknowledge successful "empty lane" bypass. The replacement transponders should solve part of this problem, but perhaps knowing how to make the system work may be equally as important.

Enclosed is an Oregon Weighmaster description of the Woodburn SB operation. Please pass this information on to the drivers of your transponder-equipped trucks. We all need their help to find out if this "stuff" really works! (Sometime after the first of the year, WHI will need to ask you what your drivers found out as part of the motor carriers' evaluation.)

During the motor carrier evaluation period (through February 1993), WHI will attempt to keep you posted when additional "locations of significance" come on line. You should be aware, *however*, that (1) several *of* the HELP pilot projects, i.e., CA-Santa Nella/NB and OR-Ashland POE; will require special alternative *or* additional hardware and (2) Oregon Weighmasters are working on mainline weight screening systems which do not currently recognize or utilize transponders.

1993 should prove interesting! Don't hesitate to call if HELP questions arise.

DATE: December 1992

TO: Managers and Drivers of Trucks Equipped with
Heavy Vehicle Electronic License Plate (HELP) Transponders

FROM: Oregon State Weighmaster

SUBJECT: How to Bypass the Static Scale at Woodburn

Oregon

DEPARTMENT OF
TRANSPORTATION

Transportation Research
523 13th Street NE Rm 605
Salem, Oregon 97310
(503) 378-3422
Fax (503) 3785770
FILE CODE:

PLA 9-2

Truckers should now **be** seeing results from the new technology the Oregon Department of Transportation and the HELP program have been working on for the past several years. For example, both of the Woodburn facilities, the southbound POE and the northbound scale, are **now** equipped with devices enabling trucks to bypass the static scale lane. These devices include weigh-in-motion (WIM) scales, HELP transponder readers, and an electronic eye height scanner.

The effectiveness of the bypassing process, however, depends on how the drivers proceed across the sensing devices in the approach lanes. The following notes explain how the **system** works and how transponder-equipped trucks can take full advantage of the static scale bypass capability.

The system works with the help of the weighmaster's computer which scans the sensing devices in the approach lane. Any of the following conditions ("flags") can result in a truck being called in to the static scale:

1. **TAILGATING:** Drivers should maintain a minimum distance of one truck length behind the truck in front of them. If they don't, this flag is activated.
2. **LANE POSITIONING:** If a truck doesn't hit the sensing equipment just right, it will be called in. Stay dead center while in the approach lane so you don't hit the off-scale detectors.
3. **APPROACH SPEED:** **This** flag is activated if the truck is moving too slowly. Drivers should maintain a constant speed somewhere between 20 and 35 mph while in the approach lane.
4. **SPEED CHANGE:** If a truck changes its speed significantly *on* the approach lane, this flag is triggered. Don't brake while passing over the sensing equipment.
5. **AXLE/AXLE GROUP WEIGHT:** The "moving **weight**" of the combination must be legal on all axles. Remember, WIM scales don't give the same readings as static scales, so sometimes a **truck** with legal weights will be called **in**.
6. **GROSS WEIGHT:** Without a HELP transponder, this flag is triggered when the **wim** gross weight exceeds 50,000 pounds. With a transponder (and a permit), gross weight can be as high as 105,500 pounds before a truck is called in.
7. **OVER HEIGHT** An electronic eye detects anything over 14 feet. The eye is actually set slightly higher, but it is very sensitive - sometimes a flapping tarp can set it off.

If it is congested, the weighmaster has the ability to disable some of these flags and thereby allow a greater number of trucks to proceed down the bypass lane back to the freeway.

BF:ds

WHI Note: If you have the 12/92 transponder installed and still experience problems bypassing Woodburn **SB** in the empty lane -- call (at his invitation):

Neal McCallister
District Manager
Weighmaster Unit - 503/982-0804



Transportation Building
Salem, OR 97310

Working Document

TECHNOLOGY EVOLUTION,
PERFORMANCE AND STANDARDS

by

Castle Rock Consultants

**HEAVY VEHICLE ELECTRONIC LICENSE
PLATE (HELP) PROGRAM**

**TECHNOLOGY EVOLUTION, PERFORMANCE
AND STANDARDS**

**Lessons Learned through the
HELP Program**

**Chlistopher J. Hill, PhD.
Castle Rock Consultants**

February 1994

DISCLAIMER

The contents of this paper reflect the views and opinions of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the U.S. Department of Transportation, the HELP Program, or its participating states. This paper does not constitute a standard, specification, or regulation. The United States Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear herein only because they are considered essential to the objective of this document.

1. INTRODUCTION

This paper is one of a series which discusses various lessons learned as a result of the Heavy Vehicle Electronic License Plate (HELP) program and the Crescent Demonstration. This document discusses issues relating to the evolution, performance and standardization of the technology components of the HELP system.

The paper describes the background to the definition of technology needs for HELP. It also considers the original views on the areas where technology standardization was appropriate. The paper goes on to discuss how these components were specified, tested and procured.

The paper also discusses the impact that other external standardization initiatives had on the program, and how HELP responded to these. In addition, the performance and reliability of the procured HELP technology is described.

The paper concludes by considering why technology issues have always been central to the HELP program. It describes the program's accomplishments in the technology area, and identifies where mistakes were made in technology selection and development.

2. BACKGROUND

At its inception, technology development issues were the focus of the HELP program. Among the preliminary documentation of the concept, the "Proposal for a National Heavy Vehicle Tracking System" [1] lists the following elements of the program:

- design, develop or obtain an onboard vehicle identification transponder;
- design and develop an integrated weigh-in-motion (WIM) system and data collection program;
- design a national, regional and state-level tracking algorithm;
- install and test a single site prototype system; and
- install and test a multi-site system.

These elements were repeated in the request for proposals (RFP) for a heavy vehicle tracking system feasibility study [2]. The goal of this study was to "conduct a feasibility study for the development and implementation of a national automatic heavy vehicle tracking system. This will include definition of the system, including detailed objectives; alternative methodologies; statistical sampling frames; state and federal benefits and costs; and options for implementation strategies."

The RFP states that if the study demonstrates the feasibility of such a system, the following phases of the project will begin:

- develop and test first-generation identification and monitoring equipment;
- develop and test second-generation identification and monitoring equipment;
- develop heavy vehicle tracking capability;
- develop an implementation program for the national heavy vehicle tracking system.

The feasibility study final report [3] reinforced the emphasis of the HELP program on technology issues and clearly set the direction of future R&D and testing activities. The feasibility study begins by defining “the aims and objectives of developing and implementing a system” and as such has an initial focus on the potential applications of the system. These applications are identified as:

- transportation planning;
- vehicle taxation;
- size and weight enforcement;
- hazardous materials monitoring;
- truck fleet management and control; and
- crime detection.

For each application, the study identifies a series of valid problems or difficulties associated with performing the task and goes on to recommend technological solutions to these. It is at this point that the definition and selection of automatic vehicle identification (AVI), WIM and automatic vehicle classification (AVC) in combination with an appropriate communications and data processing network are established as the agenda for a continuing HELP program.

The remainder of the feasibility study report was principally concerned with reviewing the current capabilities of AVI, WIM, AVC and communications technology. This led to some fundamental conclusions which set the course of the HELP program for the following several years. These conclusions were:

- that “standardization is imperative for AVI systems, to provide compatibility between different states and manufacturers”;

- that compatibility is a “constraint that does not apply to the choice of WIM systems. The aim of the HELP program is therefore to evaluate options and develop alternatives without necessarily reaching definitive, unique specifications”;
- that “a program of research and development is recommended . . . to develop a definitive approach to AVC through field testing, simulation and appraisal”;
- “a parallel design study is recommended to assess the potential” of satellite location systems as the vehicle identification component of the system; and
- “the design and commissioning of the data transmission system is a major task to be undertaken later in the HELP project . . . after clear definition of user needs, data flow and system hardware.”

In parallel with the feasibility study, Oregon Department of Transportation (ODOT) performed a Phase IB, Demonstration of Concept [4]. This demonstration installed a microwave-based AVI system at four test sites “to demonstrate the concept of AVI to both the public and private sector, as well as providing valuable information on the requirements of a nationally operated system. The tests would help define the performance of the present technology and the magnitude of the research and development program that will be required to implement a national system.”

The next major step in the definition of the HELP program was the Phase IC, System Selection. The RFP for this study [5] identifies the following goals:

- “to recommend three HELP systems for appraisal in the testing program (Phase II);
- to develop detailed testing procedures and criteria;
- to conduct meetings with governmental agents that could be involved in Phase III, the Crescent study;
- to develop a set of standard vehicle identification codes with a view towards establishing international electronic license plate codes;
- to perform detailed cost-benefit analyses of three preferred systems; and
- to formulate an implementation strategy for Phase III from discussions with relevant governmental agencies.”

Early in the IC study, the first HELP meeting was held in Portland, Oregon, February 14, 1985, followed by meetings in Portland on February 20, Las Vegas on March 28, Sacramento on May 15, and at the National WIM conference in Atlanta, Georgia on May 20-24. These meetings were particularly important in bringing together a group of states interested in pursuing the HELP concept, but also in identifying the need for the active participation of the motor carrier industry in the initiative.

While this essentially established the organizational approach which continued throughout the life of the .HELP program, it also resulted in modification of the objectives of Phase IC. Most importantly, Phase IC was changed from the “system selection” phase to the “concept development” phase, mainly in recognition of the remaining research and testing activities to be performed, and the need to ensure broader support from both government and industry prior to selecting an ultimate system design.

A principal product of the Phase IC, Concept Development Study final report [6] was the development of work outlines for eight constituent projects of the research and testing phase of the HELP program. These comprised:

- AVI testing;
- system design study;
- motor carrier services plan;
- satellite reference system design;
- site selection study;
- development of a WIM performance specification;
- development of a low-cost automatic weight and classification system; and
- management consultant services.

Each of these is briefly described.

1. The IC study had concluded that existing commercial AVI systems would not fully meet HELP system users’ needs and performance requirements, and had developed an outline performance specification for AVI (see Appendix A). The AVI testing component of the program was intended to assess previous testing and operating experience with AVI to assess the validity and accuracy of existing data and to determine the need for additional data. Following this assessment, track, laboratory and field trials would be performed on commercial AVI systems to assess the capabilities of alternative technological approaches in respect of the outline specification. Using these data, the HELP program would prepare its own preferred AVI system specification and procure equipment for the Crescent project.
2. The system design study, funded directly by the Federal Highway Administration (FHWA), was intended to assess system management and information access issues; data communications and processing systems; and data verification systems. In particular, the study aimed to define, evaluate and prioritize user information needs from a HELP system and to propose a management structure that would protect the

accessibility of information; to investigate and specify the appropriate communications media, protocols and computer system hardware required to implement the HELP system; and to evaluate and recommend approaches for data checking and validation within the system.

3. The motor carrier services plan component recognized the critical involvement of the industry participants and their concerns that industry benefits had not been well formulated. This part of the program would seek to identify and quantify these potential benefits.
4. The satellite reference system design aimed to determine the economic and technical feasibility of a satellite-based traffic monitoring system. The intent was to consider alternative system implementation strategies that would satisfy the needs of the HELP system, and, for each alternative, assess the costs and benefits to government and industry. In particular, a cost comparison with a ground-based AVI system was required.
5. The objective of the site selection study was to establish guidelines and criteria allowing states to effectively locate HELP sites along appropriate highway corridors.
6. The aim of the WIM component of the HELP program was to examine system options which have, or could have, given the necessary development, the required features to satisfy the needs of the HELP system users. The approach to this effort was to evaluate systems through field and laboratory tests, and to develop a WIM performance specification to be utilized by states in the selection of systems.
7. The development of a low-cost automatic weight and classification system was ultimately performed outside the HELP program by the States of Iowa and Minnesota, although the study was considered an adjunct to HELP and the research results were provided to the program. The research was intended to assess the performance of piezo-electric axle sensors as a low-cost weight sensor and to evaluate the accuracy of these sensors in both concrete and asphalt pavements.
8. The management consultant effort had two components. The first was to establish a management plan for the HELP program, including the definition of goals and objectives, organizational structure, detailed workplans and budgets, and an overall program schedule. The second part was to provide ongoing management support, such as the monitoring of the various R&D components, and to assist in the preparation of RFPs, consultant selection and equipment procurements.

An additional research component was subsequently added to the program. This aimed to assess the linkage between the HELP system and truck onboard computers (OBCs). This effort was also intended to consider institutional arrangements and report formats that would allow OBC logs to replace conventional reports.

A final important aspect of the IC, Concept Development Study was the definition of a preliminary architecture for the HELP system. Essentially, this defined four site types, ranging from port-of-entry/weighstation sites to portable monitoring sites, each linked to a central state computer. In turn, several state computers would be linked to a regional computer system. Carriers and state government agencies would obtain information and data via modem and dial-up telephone access. This original proposed approach formed the basis of the Crescent system implemented by Lockheed. However, the final system design developed by Lockheed was larger in size and scope than the demonstration system envisioned at the time of the IC study.

3. STANDARDIZATION NEEDS

As described above, from the earliest stages of the HELP program, it was believed that standardization of AVI technology was imperative, while this was not the case with WIM and AVC. The AVI research program was therefore designed to follow a course of both performance specification and standardization of data transmission and coding structures. The WIM and AVC research and testing, on the other hand, aimed only at establishing performance requirements.

The rationale for this approach was quite clear. All equipment components of the HELP system must meet certain defined user requirements. These, for example, relate to the system accuracy (e.g., axle weight accuracy; ability to correctly identify a vehicle; etc.), system reliability and durability (e.g., mean time between failures; mean time to repair; etc.), or the capabilities of the system to operate in the real-world environment (e.g., to identify vehicles in a multi-lane situation; to operate at highway speeds; to operate in concrete and asphalt pavements, etc.). If these user requirements are clearly established and providing the equipment supplied meets or exceeds these specifications, the equipment component will satisfy the overall requirements of the HELP system design; no matter which vendor supplies the equipment.

For WIM and AVC equipment that is fixed in one location, these performance requirements are all that is needed to ensure that accurate vehicle weight and classification data are obtained for that site. The situation with AVI is rather different, however. An AVI system has both a fixed component (the antennas and reader on the highway) and a mobile component (the vehicle-borne transponder). If it is assumed that multiple vendors will develop and sell AVI equipment, it is clearly impossible to believe that a transponder from one vendor will only ever need to be identified by a reader from the same vendor. For an interstate trucking system like HELP, a vehicle must be identified at multiple locations potentially crossing many states or the entire country.

In this scenario, there must be compatibility between the transponders and the readers of all system vendors. That is, the reader manufactured by one vendor must be able to read a transponder manufactured by another. As with WIM and AVC systems, all AVI equipment must meet or exceed user-defined performance requirements, but in addition, equipment from one vendor must be able to communicate data to that of another vendor. The HELP program's approach in AVI development, therefore, was also to specify the characteristics of the

communications medium and the data coding formats. Any AVI equipment procured for the HELP system would be required to meet both the technical and performance requirements, and compatibility would, therefore, be assured.

This approach remains wholly rational and appropriate for a multi-state, multi-site system like HELP. This is particularly true when you consider the state of the AVI market in 1984/85. At that time, few commercial AVI systems were available, and those that were, had been developed for significantly different applications. Many developmental or prototype systems were beginning to emerge, however, these too could not be demonstrated to meet the exacting requirements of the HELP system, especially in the aggressive environment of the highway.

The objectives for AVI, WIM and AVC specification were clearly logical and considered the best interests of the HELP program. Unfortunately, the approach to AVI specification contained a fundamental flaw. Early reports of the HELP AVI testing program state that the final HELP AVI specification will likely become a de-facto standard for this application [7]. However, the AVI research and specification activities were performed completely internal to the HELP program and involved a subset of the HELP participating states. No efforts were made initially to seek broader consensus or, more importantly, to seek the involvement of a standardization body like ANSI or SAE. By the time the HELP program had developed its preferred system specification, other related standardization activities had already overtaken. In addition, a number of vendors had developed successful commercially-available AVI systems during this period and were disinclined to support a specification that was different to their own technological solutions. The HELP program had quite clearly been naive in believing its preferred approach would be welcomed as a widespread standard for AVI.

4. TESTING, SPECIFICATION AND PROCUREMENT APPROACH

This section will discuss the following components of the HELP system:

- the AVI system;
- the WIM and AVC equipment; and
- the Crescent system.

a. The AVI System

The initial HELP AVI program involved a multi-phase testing and specification effort followed by two rounds of equipment procurement. An overall test coordination component was included to advise on the testing procedures and to develop a system specification [8].

The initial phase of the AVI testing comprised a controlled test track evaluation of several commercial or prototype AVI systems. These tests were performed by ADOT personnel at the Ford high-speed proving ground in Yucca, Arizona. The tests resulted in the selection of three alternative technological approaches for further testing [9].

The subsequent testing phases were performed in parallel. Field trials were performed at two *highway sites in Oregon by ODOT and Oregon State University [10] and controlled laboratory tests were performed by Caltrans at the Transportation Laboratory in Sacramento [11] As a result of the testing, a preferred technological approach was specified [12]. This system specification was developed to meet the identified user needs and varied from all of the AVI systems tested in the field and lab in several major technological respects.

This preferred system specification formed the basis of an RFP for a limited equipment procurement [13] This was intended to verify the performance of the system specifications and to undertake any required fine-tuning prior to procurement of equipment for the entire Crescent Demonstration. These preferred system tests were performed by Castle Rock Consultants and Virginia DOT on the Dulles Toll Road in Virginia. A final system specification was developed as a result of this work [14].

The final specification was used as the basis of a contract for all of the AVI equipment for the Crescent Demonstration [15]. This procurement was undertaken by ADOT and allowed any HELP state to purchase equipment and installation services through the resulting contract. This mechanism allowed ADOT to place a substantial order with the selected vendor, Vapor Canada (now Mark IV), in 1989 on behalf of all six Crescent states. Each state was subsequently billed by ADOT for the actual equipment and support they received.

b. WIM and AVC Equipment

An RFP for the development of a WIM performance specification was released in 1985 [16] This led to a three-phase testing and specification effort. The first phase of this study involved an evaluation of various commercially-available WIM systems at field locations in several states. This was followed by a laboratory testing phase on the same commercial WIM systems. Finally, a specification was developed which defined the WIM performance requirements for alternative HELP site types [17]. These site types comprise:

- Type I - Automatic port-of-entry: AVI, AVC and high-precision WIM;
- Type II - Fixed site: AVI, AVC and low-cost WIM;
- Type III - Fixed site: AVI and AVC only; and
- Type IV - Portable site: AVI, AVC and WIM.

These specifications were made available to the Crescent states in 1989 to be used as the basis of individual state procurements of WIM/AVC equipment. However, it is important to note that WIM procurements in some of the Crescent states proceeded well in advance of the completion of the HELP performance specifications. In fact, the minutes of the HELP steering group meeting held on February 20, 1985, report that the installation of WIM equipment was to be accelerated “in response to the pressure to be doing something.”

WIM procurements therefore were undertaken by individual states with no central coordination of technical requirements, installation procedures, or location selection. WIM/AVC equipment remained the responsibility of the individual states throughout the HELP program and Crescent Demonstration. Unlike AVI, there was never a central maintenance contract for the WIM and, most importantly, no formal relationship between the WIM vendors and the provider of the Crescent system. However, outside of the formal HELP WIM research, Caltrans developed a standard WIM data format through agreement with the participating states and WIM vendors.

c. The Crescent System

A federally-funded system design study was undertaken as the first step in developing an overall architecture for the HELP system. According to the RFP [18] this study would “define the communications and infrastructure required to connect individual WIM./AVI sites into a regional or national system.” The study would consider “system management and access requirements for public and private sector applications, . . . and communications systems design and computer systems analyses for data processing and utilization.”

The resulting system design study [19] placed an initial focus on identifying user needs and requirements and, in cooperation with an ad-hoc committee, developed a series of generic scenarios for the implementation of HELP system applications. The study also reviewed communication network and system configuration options for a widespread system implementation. Finally, the study presented alternative options for a “Crescent Demonstration Base System.”

The final report made no definitive recommendations on the system design for the Crescent. The study reached the following conclusions:

- the Crescent system could be either centralized with a mainframe computer linked to local nodes at state offices, or distributed with minicomputers in each of the Crescent states;
- an existing database product would be adequate for the Crescent system;
- system data would be dumped to a storage device for subsequent analysis, rather than providing real-time access;

- the communications media could be either a simple public data network or a packet switched/value added network; and
- one-stop shopping, POE facilitation, transportation planning and fleet management applications could be facilitated through the Crescent system.

The original intent of the system design study was to provide the basis for procuring software, hardware and communications equipment for the Crescent Demonstration. Considering the general nature of the resulting final report and the lack of specific recommendations or a system design, the Crescent Implementation Group (CIG) was formed to take over responsibility for developing detailed system applications and the preparation of an RFP for the Crescent system.

The resulting RFP was issued in May 1989 [20] The scope of the work was described as “a complete and operational turnkey computerized communications system to integrate existing and proposed WIM, AVC and AVI equipment for the Crescent Demonstration system.” The RFP was extremely nonprescriptive in its approach, describing a three-phase approach to implementing the Crescent system and outlining a series of applications developed by the CIG. The three phases were to (1) develop a pilot project in two states; (2) undertake the full system implementation in six states; and (3) optionally operate the Crescent system for twelve months. In each phase, the contractor would be responsible for providing the necessary hardware and software, coordinating the communications links, and providing training and maintenance. The available budget for this contract was \$282,000.

The RFP clearly had a number of limitations. The most important of these was that the number of Crescent sites and equipment configuration at each was not ultimately defined. This resulted from the approach of charging each individual state with responsibility for selecting their sites, designing the site layout with respect to the Crescent equipment, and procuring the WIM/AVC systems themselves. This led to little consistency in approach and, unfortunately, no control over scheduling. With hindsight the entire Crescent system design and procurement might more effectively been undertaken as a single turnkey operation or, as a minimum, the procurement of hardware, software and communications systems should have been delayed until final site designs were available.

However, there are two key factors to consider that played into the Crescent RFP approach:

1. Prior to the preparation of the RFP, the Crescent Demonstration had been envisioned as more limited in scope. While it had always been the intent to deploy the demonstration in the six Crescent states, it had not been planned to operate the Crescent as a system. Instead, the demonstration would assess the feasibility of obtaining the necessary data to support certain applications using the AVI, WIM and AVC equipment. This would be done by using dial-up phone lines to the sites to obtain the data as required. Indeed, the minutes of the December 1987 CIG meeting confirm that real-time data would not generally be available through the Crescent because of the cost implications.

The RFP, however, was written in such a way that did not make this intention clear. The reason for this is first indicated in the September 29, 1988 CIG meeting minutes. These state that there was “interest from large firms to help fund” the Crescent Demonstration and indicate that the RFP should be prepared in such a way as to allow these firms to provide expanded services.

2. Since specific final site designs were not available and also because of a desire to use the resulting contract to allow for future expansion of the Crescent, the site descriptions were prepared in a generic manner. That is, six site types were defined as follows:

- Type A - Remote mainline site with WIM and AVC;
- Type B - Remote mainline site with WIM, AVC and AVI;
- Type C - Site at or adjacent to a POE or weighstation with WIM and AVC;
- Type D - Site at or adjacent to a POE or weighstation with WIM, AVC and AVI;
- Type E - Site with AVI equipment only (includes site on state line with Type 3 (beacon) AVI); and
- Type F - State-level computer.

In responding to the RFP, contractors were required to prepare costs for providing each of these site types, allowing additional sites to be added in the future. Again, this is a logical approach, but can only be effective if each site of a particular type is identical in terms of equipment, layout, interfaces and operational procedures. This was not the case.

A single response was received to the RFP from Lockheed. The total proposed cost of \$4.2 million was well in excess of the budgeted amount. A technical and price negotiation was undertaken with Lockheed over a six-month period, resulting in an initial Phase IA contract using the available \$282,000. A request for funding assistance was subsequently submitted to FHWA for the remaining monies (plus some additional AVI research funds). This application was successful and set the course for the future deployment of the Crescent Demonstration.

5. INFLUENCE OF OTHER STANDARDIZATION INITIATIVES

During the course of the HELP program, a number of external standardization activities in the area of AVI were undertaken. These efforts impacted the program to varying degrees, as described in this section.

a. ISO TC104 Freight Containers - Standard for Automatic Identification

In March 1989, the HELP AVI subcommittee was made aware of proposed international standard N136 “Freight Containers - Automatic Identification.” This draft standard had been developed by Working Group (WG) 3 of the International Standards Organization (ISO) Technical Committee (TC) 104, and was in its final approval stages at this point in time. TC104/WG3 included two task forces. Task Force 1 was to consider freight container industry needs and requirements, while Task Force 2 was to consider appropriate AVI technology to meet those needs.

The HELP program reviewed the draft documents relating to N136 to identify areas of overlap and common interest with HELP’s work on AVI standards. The review identified *a* number of potential concerns with the TC104/WG3 process, as follows [21]:

- it took no account of HELP requirements for freight identification developed by joint industry and government representatives from 14 U.S. states;
- it was not a result of scientific evaluation of alternative technologies and systems such as that carried out by states within the HELP program;
- it was apparently based on a proprietary technology developed by a particular vendor, which was understood to be protected by patents and/or other restrictions on intellectual property rights;
- it would cover both containers and freight vehicle chassis, and therefore overlaps substantially with HELP program requirements for tractor/trailer identification;
- it should not be developed or accepted in isolation from consideration of standards for automatic vehicle identification (freight vehicle management) required by highway agencies, motor carriers, and toll authorities; and
- it should not be developed or accepted in isolation from consideration of the more general requirements for automatic identification standards covering all types of road and rail vehicles, including automobiles and rail cars.

These concerns were circulated to Task Force 2 of TC104/WTG3. A HELP representative attended their plenary session in London in April 1989. Four main points were presented to the Task Force [22]:

1. “The HELP program is very positive toward establishment of national and international AVI standards. HELP wishes to play a positive role in cooperating with other organizations and working toward agreement of such standards.

2. However, there are three major areas of concern with the proposal contained in N136. The first of these is that the system proposed would be proprietary. The HELP program is strongly opposed to any standard which ties users into use of one manufacturer's system. HELP's aim of developing an open, nonproprietary AVI standard has been followed throughout its extensive research and testing program, and will lead to a competitive market in which system users can have a choice of equipment suppliers.
3. The second major area of concern is that the proposal is not compatible with the draft HELP AVI specification, or with other proposed specifications. As a minimum, standards should ensure noninterference between AVI systems operating in similar application areas. Beyond this, a degree of compatibility across a range of road traffic applications would be strongly preferable. The N136 proposal would meet neither of these conditions.
4. The third important area of concern is that formulation of a technical AVI standard for freight containers may be premature at this stage. The N136 proposal takes no account of major AVI initiatives currently in progress in closely-related areas, such as those taking place in HELP, the U.S. toll industry, the European toll industry and the European DRIVE program. A period of consultation is therefore needed before a draft standard is agreed, in which the views and evidence from all these initiatives can be considered and taken into account."

Some Task Force members agreed that important issues had been raised concerning the acceptability of the N136 proposal. However, the Chairman of the Task Force indicated that discussion of the merits of N136 had taken place in previous meetings, and its ability to meet container industry requirements had been affirmed. Further discussion of N136 was therefore said to be outside the scope of this meeting, in spite of the issues raised. The Chairman indicated that the brief of the meeting was solely to consider the two alternative proposals to N136 against container industry requirements.

As a result of this consideration, the Task Force approved the draft standard and recommended approval by the full TC104 at their meeting in June 1989.

In addition to preparing the urgent comments and submitting these to TC104, the HELP AVI subcommittee proposed two additional actions:

- to ask the Policy Committee Chair, Robert Bothman, to request the assistance of U.S. Secretary of Transportation Skinner in supporting the program's efforts with ISO and other AVI standards issues; and
- to take quick action on standards issues to stay ahead of these developments.

The letter from Mr. Bothman to Secretary Skinner described the HELP concerns and recommended that a federal committee be appointed to coordinate the federal position on

standards [23]. A response from Federal Highway Administrator Farris noted FHWA's continuing interest in the HELP program, but explained that it was considered more effective for states to make the case to ISO and recommended that HELP designate a representative to present its concerns directly to ISO.

In the area of taking quick action on AVI standards, the AVI subcommittee proposed a motion to the HELP Executive Committee at their April 1989 meeting [25] that "the HELP Management and Policy Consultants should work together to promote the HELP AVI standard." One member of both the Executive and AVI committees objected to this approach, stating that it was inappropriate to promote the HELP AVI standard which reflects the interests of "the trucking industry and associated state government agencies" but not "toll agencies, vehicle manufacturers, ... or other potential users of AVI technology." [26] The adopted motion reflects these concerns and states that the "Policy and Management Consultants work together to inform others of the HELP AVI standard and to work with other interested groups with the objective of arriving at a uniform, open standard for all highway purposes" [25].

Resulting from this federal and HELP Executive Committee direction, the AVI subcommittee established an AVI Working Group comprising HELP participants and other interested parties. This meeting was held on July 20 and 21, 1989, and in addition to HELP members included representatives from FHWA, Federal Railroad Administration, American Trucking Associations (ATA), International Bridge, Tunnel and Turnpike Association, Institute of Transportation Engineers, Association of American Railroads, Association of Identification Manufacturers, ISO and the European DRIVE program.

The following purpose and objectives were established for the meeting [27]:

- bring together representatives of transportation industries planning use of radio frequency identification (RFID) devices in their operations;
- discuss each industry's current activities and plans for RFID use;
- identify differing RFID needs among industries;
- assess the potential for interference among these systems;
- propose and discuss possible solutions to the interference problem;
- explore the potential for a "standard" capable of meeting industry needs and addressing the interference question;
- identify the elements of a "standard"
 - performance requirements
 - data format
 - security issues
 - future enhancements

- open vs. proprietary technology
 - multisourcing
 - mechanics of proposing/adopting; and
- where do we go from here?

The meeting generated a lot of positive discussion but only resulted in an agreement to meet again. The chair of this initial meeting, Ron Cunningham, was unable to commit to leading further meetings due to time and cost constraints. Regrettably, without a champion, the AVI Working Group failed to make further progress and did not meet again. An important early opportunity to begin addressing the broad needs of a highway-based AVI standard was therefore lost.

b. ATA RFID Standard

The ATA began development of an industry standard for RFID equipment in 1988 [28]. ATA initially expressed concern of the development of conflicting RFID standards to the HELP program in May 1989 [29]. Subsequently, ATA representatives participated in the July 1989 AVI Coordination Meeting at which they stressed the need for one standard [27]. Subsequently, an ATA representative attended the HELP Executive Committee meeting in Portland, Oregon, in July 1989. At the following meeting in Phoenix, Arizona, November 1989, it was agreed that HELP and ATA would hold two meetings to discuss potential cooperation. One would focus on technical issues, and the other on policy concerns.

The technical meeting was held in conjunction with the TRB Annual Meeting in January 1990. At this meeting, it was identified that the principal impediment to the HELP program of the ATA RFID standard was the lack of an in-pavement antenna [30]. The meeting concluded that “in the view of all of the participants, the acceptability and utility of a highway electronic identification standard would be enhanced if a single technical standard could be achieved.”

In parallel with this activity, a joint HELP/ATA policy group, under the stewardship of the Western Highway Institute, developed a proposed resolution. With minor modification, this policy statement was adopted at a joint meeting of the HELP Policy and Executive Committees. This states [31]:

“It is the intent of HELP and its member organizations to continue work on an AVI performance specification which will insure that a single transponder per vehicle component can ultimately satisfy recognized international, highway and intermodal transportation requirements.”

The minutes of the March 8, 1990 AVI subcommittee meeting report for the first time on the direction that would be followed during the remainder of the HELP program in seeking AVI compatibility. In its original form, this was described as a research effort to develop a “dual

mode reader capable of reading both (HELP and ATA) transponder types.” A subsequent committee meeting in May determined that this would be best accomplished as a collaborative project between HELP and ATA [32].

Over the following twelve months, a research proposal was prepared and a contract executed with Castle Rock Consultants to develop a compatible AVI system specification capable of meeting the needs of both ATA and the HELP program. The approach taken in this initiative was to develop functional specifications outlining the needs and requirements of ATA and HELP from AVI equipment; solicit loaned equipment from commercial AVI vendors; and test this equipment against the functional requirements at highway test sites [33]. The functional requirements adopted by the HELP AVI subcommittee (which included ATA representation) are presented in Appendix B. The testing and evaluation of systems against these requirements continued through the remainder of the HELP program. The results are presented in a final report [34].

Beyond the formal research, a verbal agreement was obtained from the two principal AVI vendors (Mark IV for HELP and Amtech for ATA) to develop a joint system. Unfortunately, this did not come to fruition and, in fact, Amtech was unable to participate in the research effort due to problems in finding a test site.

However, during the course of the research, a meeting was held with the two vendors, together with representatives of HELP, Advantage I-75, FHWA and Mitre Corporation, to discuss the issues associated with this type of compatibility. These included the following [35]

- the specific needs of the complete motor carrier industry and associated government agencies should be established. It was felt that the current perceived needs were speculative and based on only a small sector of the market;
- initial analysis should determine whether a compatible tag (that could be read by both ATA and HELP readers) or a reader (that could read both HELP and ATA tags) should be developed;
- even if a compatible tag or reader was developed, there would still be problems with users participating in multiple systems due to the different tag data storage requirements and non-interconnected databases. This means that a tag would have to be registered separately in each system; and
- the data content of the tag should be standardized to contain all information required by all potential systems in which the vehicle participated.

The meeting concluded by recommending that FHWA undertake a comprehensive study to address these issues. Following approval of this approach by the HELP Board of Directors [36], a formal request was sent to the Associate Administrator for Safety and Systems Applications [37]. No written reply was received, however, FHWA representatives indicated that a related effort was underway with the Lawrence Livermore National Laboratory [38].

6. EQUIPMENT PERFORMANCE AND RELIABILITY

This section considers the principal technology components of the HELP system: AVI and WIM/AVC

a. AVI Equipment

As described earlier, the AVI research component of the program included an initial limited preferred system procurement. This was used to verify the HELP AVI specification prior to the larger procurement for the full Crescent system. In addition, formal acceptance tests were performed on the Mark IV AVI equipment during the course of the Crescent implementation.

These acceptance tests were performed in June and October, 1991, and were designed to verify compliance with certain critical aspects of the HELP AVI specification. Seven categories of tests were undertaken, as follows:

- placement tests;
- speed tests;
- multi-lane tests;
- multi-tag tests;
- external interference tests;
- environmental or adverse weather condition tests; and
- radio frequency emissions measurements.

The results of these tests were recently reported in the Crescent evaluation report [39]. These results showed that the Mark IV AVI system complied with the relevant sections of the specification. Only in respect to operation with the antenna submerged below two inches of 0.1 molar saline solution was there any noticeable degradation of performance (i.e., a reduced number of handshakes per read). However, even in this situation, 100 percent read accuracy was obtained.

However, during the course of the Crescent Demonstration, there were repeated concerns about the reliability of the AVI equipment, as evidenced by the weekly Crescent status reports. The acceptance test results indicate that there are no fundamental problems with the selected AVI technology. It is reasonable to assume, therefore, that the problems

principally resulted from a lack of routine maintenance of the equipment, covering both preventive and corrective actions to ensure that the equipment would operate reliably in a real-world environment.

The original AVI RFP, since only for limited research quantities, did not contain any maintenance provisions. Unfortunately, when the procurement for the Crescent was negotiated with the vendor, maintenance clauses were again omitted. This was a significant oversight. However, based on experience with WIM and AVC equipment, a maintenance agreement with a specific equipment vendor is not necessarily the best approach anyway. In this scenario, since there is no formal relationship between the Crescent Demonstration Operator (CDO) and the vendor or the state that procured the equipment, it is difficult to make the vendor responsive to the needs of the CDO, who relies on the operation of the site equipment for the overall performance of the Crescent system.

This problem was overcome during the course of the Crescent by subordinating the contract with the AVI vendor to the CDO contract. The CDO then had overall responsibility for ensuring the operations, maintenance and, where appropriate, upgrades to the AVI equipment, along with their existing responsibilities for the communications system, computer hardware, and software.

Perhaps the most significant reliability problem with the AVI equipment related to the failure or apparent failure of the vehicle-borne transponders. As reports of these problems began to surface in July 1992, Mark IV undertook an analysis of the reasons behind the failures. The vendor concurred that a number of units had failed “due to mechanical stress leading to water ingress into the transponder box, or due to mechanical movement of the transponder battery causing broken connections” [40]. The vendor reported that “both the ultrasonic sealing and mechanical retention of the battery processes have been considerably improved from the first production batch” [40]. The vendor agreed that this “rate of failure was unacceptable” and subsequently replaced all 4,700 transponders supplied to the program.

However, equally important, Mark IV determined that a number of the apparent AVI transponder failures were due to unrelated circumstances. These included [41]:

- transponders mounted on the vehicle grill above the front bumper with no clear view of the antenna. A thick steel plate was shielding the tag from the road surface and inhibiting the ability of the tag to be read;
- most of the maintenance, supervisory and driver personnel visited during the assessment had little or no knowledge of the function of the transponder, the purpose of the system, or how to report damaged, missing or defective tags;
- installation instructions were not clearly communicated to local maintenance personnel resulting in improperly placed transponders; and

- some equipped vehicles were no longer traveling the Crescent route, had been wrecked or had been sold without the transponders being removed.

So, while it is clearly important to ensure satisfactory quality control of the actual device, it is equally important to develop appropriate procedures for distributing, ensuring correct installation, and maintaining accurate records of the AVI transponders. Lockheed recognized this as an issue and took responsibility for visiting groups of carriers during the replacement of the transponders [42], although individual visits were originally planned.

b. WIM and AVC Equipment

As described earlier, the specification, procurement, operation and maintenance of WIM/AVC equipment was the responsibility of the individual Crescent state agencies throughout the demonstration. Although WIM performance specifications were developed by the HELP program, these were used only at the discretion of the states.

The evaluation of the Crescent equipment led to two important results [39]:

- more than half of the WIM systems assessed have weighing accuracies outside those desired by the HELP WIM performance specification; and
- the assessment of AVC systems indicated that none of the systems evaluated achieved the desired HELP AVC specification accuracies. However, the majority of AVC system accuracies were higher than would be reasonably expected from manual classification methods.

Previous experience with the testing and evaluation of WIM and AVC systems clearly shows that there is no inherent reason why these system accuracies should not be achieved [17]. It is reasonable to assume, therefore, that the accuracy problems relate to inadequate maintenance (both of the system and the adjacent roadway) or irregular and infrequent recalibration of the system.

As noted in the previous section, repair and maintenance of the WIM/AVC equipment had impacts on the overall Crescent system. Again, the CDO had to rely on the state or WIM vendor to repair the equipment, and often this was not timely. In addition, unlike the situation that ultimately existed between the AVI vendor and the CDO, there was no formal contractual relationship between the WIM vendor and the CDO that could be used to expedite the solution of the problems. In future system deployments, this is a situation which should clearly be corrected.

During the Crescent on-site evaluations, weighstation and POE personnel were asked for their perceptions of the Crescent system. A common concern related to the performance and

effectiveness of the equipment, with many believing that the system data were unreliable and inaccurate. Together with a general feeling that there was no higher-level management support for the system, this probably accounts for the widespread situation of the Crescent system simply not being integrated into the normal operating practices at the site. A major effort is clearly required to ensure that the equipment is adequately maintained and performs accurately, but also this must be demonstrated to the personnel responsible for using the system on a day-to-day basis.

7. CONCLUSIONS AND RECOMMENDATIONS

The HELP program and Crescent Demonstration was the first initiative in the U.S. seeking to combine WIM, AVC and AVI technologies with a computerized communications system to support automated motor carrier management applications. Indeed, when the HELP concept was first formulated in 1983, the technologies for these applications either did not exist or did not have a proven history of performance in the highway environment.

With the benefit of hindsight, it is easy to be critical of the technology focus of the HELP program, particularly with respect to the program's schedule. However, the very nature of the initiative means that it has borne much of the overhead associated with the testing and evaluation of technologies, and the design and specification of a system. Subsequent related programs have obviously benefited from this experience.

It is the author's opinion that the program has, in general, followed a logical and appropriate course over the last ten years. That is certainly not to say that no mistakes were made, and a number of lessons can be learned from the program's approach.

- It is important to differentiate between research tasks and system deployment. In its early stages, the HELP program was clearly a research effort. By its very nature, a research program will have setbacks; not everything will go according to plan and there must be some flexibility in the schedule to allow for these problems.

Difficulties occur when you try to run research tasks in parallel with deployment tasks and expect them to fit together at key points. In the case of HELP, it would have been more appropriate to truly conclude the research portion before endeavoring on full implementation. This approach was inherent in the original goals of the program, which set a course of technology research followed by a modest system evaluation. If this had been followed, many of the problems associated with system design, equipment performance, and site layout could have been solved prior to installing a full Crescent system and expecting it to operate. However, in this scenario, the evaluation would be concerned only with equipment performance and may not have addressed the broader issues of system benefits which were challenged by the carriers at the completion of the feasibility study.

The author believes that the HELP program perceived an opportunity to leverage funding through the involvement of a large system integrator and with the support of FHWA, which would allow the program to move ahead much more rapidly. This, however, was premature and did not recognize the full implications of undemonstrated technical verification.

- The approach adopted for specifying the AVI component of the program remains as valid today as it was in 1984. That is, to ensure a system that can be utilized in multiple locations and potentially from multiple vendors, both performance specifications and technical specifications relating to communications media, protocols and data formats are required. It should be recognized, however, that the nature of the HELP system requires specifications far more stringent and rigid than many other AVI system applications.

However, to ensure broad-based support for the resulting specification (not necessarily standardization) there must be adequate and appropriate outreach and consensus building with other interested parties. The author does not believe that the HELP Executive Committee's resolution to "inform" others of its activities was sufficient. Widespread and active "promotion" of the needs and requirements of the particular HELP application was really required. While this may seem overly aggressive, it is clear that others with similarly parochial interests will follow this approach.

It is also important to begin this consensus building process at a much earlier stage in the program than HELP considered necessary. For example, an initial effort to establish the complete industry and associated public agency needs should be undertaken. This will help establish a network of relevant parties that will be key to the definition of a system specification or standard. This will undoubtedly support the subsequent efforts to define interfaces, tag data content, protocols, etc.

Finally, it must be recognized that this type of standardization process is intensive and time-consuming. The AVI coordination efforts within HELP showed initial promise but failed for lack of a champion. Dedicated personnel were needed to accomplish this. Also, strong federal leadership would have been extremely beneficial to the effort. It was not effective to delegate this responsibility to the states. Even a regional consortium like HELP had neither the resources or the influence to have a true impact in this area. The federal government is currently playing a strong role in the definition of a national M-IS system architecture. A similar approach would be valuable in AVI standards.

- The WIM/AVC performance specification approach used in HELP was also appropriate; relating performance standards to the application of a site. However, the approach can only be effective if the states use the specifications and, most importantly, ensure the specified performance levels are maintained. More than any other component of the HELP system, the WIM/AVC component will produce data that are only as good as the calibration of the system and the maintenance of the

highway in which it is installed. The states must recognize this ongoing commitment to maintain the quality of the pavement surface surrounding the sensors, and to maintain and regularly recalibrate the system itself.

- As described above, it is essential to use the research phase of the program to address research-related design issues. For example, site configuration and equipment layout issues have been identified as having a critical impact on the performance of the Crescent system. These aspects should be investigated on a limited basis, well in advance of trying to deploy a full system.

Once this is done, then a complete system design should be prepared with a high degree of centralized coordination, and based on the research results. It is inadvisable to succumb to the pressure of “being seen to do something” if this will result in a poorly-designed or inconsistent system approach.

The benefit of having generic site configurations for different purposes or applications is clear. However, this will only be effective if the sites are truly identical (at least within the physical constraints of the site). Otherwise, you will end up “paying” for every variation from the generic design at a particular site.

- For a regional system deployment like the Crescent, a single turnkey approach appears to be most effective. Some of the most significant problems arose in developing interfaces between the AVI, WIM/AVC and the communications network, since different vendors were responsible for each. These problems would have been eliminated from the perspective of the states if one vendor had been responsible for the supply, installation and commissioning of the entire system.

A similar issue applies to the preventative and corrective maintenance of the equipment components. A turnkey contract should include all of these maintenance functions.

- Ongoing support to motor carrier participants of the systems should be viewed as a critical operational procedure. Instruction on the installation, repair and replacement of the vehicle-borne equipment should be provided to maintenance, supervisory and driver personnel on a regular basis. Ultimately, the action to be taken in the event of an AVI problem will become as routine as how to change a tire. However, this will only occur if these carrier personnel recognize why the AVI transponder is needed and what it does for them.

Similarly, the system operator should implement procedures to identify performance anomalies. For example, to recognize when a particular vehicle is no longer identified by the system, and to be able to determine through contact with the carrier that this is due to an equipment fault, wrecked truck, or simply a truck that has been sold or no longer travels the route.

- Finally, equipment accuracy and reliability perceptions have a significant impact on the willingness of weighstation and POE personnel to use the system. Together with a perceived lack of management commitment, this is a critical factor in why the Crescent system has not been accepted as part of normal, everyday operational procedures. An ongoing training and education program is clearly warranted.

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APPENDIX A

AVI OUTLINE PERFORMANCE SPECIFICATION (from the Phase IC: Concept Development Study Final Report)

The following performance specification is intended for preselection of AVI systems suitable for testing in the laboratory, track and field appraisals of alternatives.

1. The AVI system must have the capacity to monitor multi-lane highways such as those encountered on major routes in the U.S.
2. The AVI system must be able to distinguish between tags in different lanes simultaneously passing the reader site, and identify which tag is in which lane.
3. The system must be able to read reliably at vehicle speeds of at least 70 mph. It should be noted that a higher speed (possibly 100 mph) may be specified for the ultimate system.
4. It must be able to function accurately and reliably under all ambient climatic conditions likely to be encountered in the U.S. These include heavy rain, snow, slush, and a wide range of temperatures. If heating or air conditioning is required in any part of the system, its cost and power consumption must be clearly indicated.
5. The AVI system must be capable of functioning reliably and accurately under a variety of highway pavement conditions. In particular, systems should be capable of operating on reinforced concrete, mass concrete and asphalt constructions.
6. The presence of dirt or spilled commodities at the reader site must not affect the operation of the system.
7. The system must be capable of distinguishing between separate tags on truck and trailer combinations and tags on trucks closely following one another.
8. The truck tag must be a sealed unit which is resistant to unauthorized tampering, moisture incursion, vibration, and other environmental effects.
9. The truck tag must be capable of being easily and securely fixed to a vehicle.
10. The AVI reader and antennas must be compact and visually unobtrusive, bullet proof, and ultimately capable of adaptation to a portable form.
11. The radiated power levels of the system must conform, as a minimum, to federal regulatory limits, OSHA and ANSI standards, and other internationally applied limits. A substantial margin around those standards would be strongly preferred.

12. As a minimum, the AVI system must be capable of utilizing a fixed tag code of eleven alphanumeric characters for the basic system with security features which could double the code length. It should also have the potential for an enhanced system with part-variable code comprising at least eleven fixed code characters plus ten variable characters, which may again need to be doubled to allow for system security.
13. A two-way communications capability may ultimately be desirable for the enhanced AVI system.
14. The AVI system will need to be capable of incorporating a range of security coding features.
15. The system must encompass sophisticated error detection and/or corrective facility. As a minimum, this should meet the requirement that at least 99% of the tags that are read differently than encoded will be detected as incorrectly read tags.
16. The maximum proportion of incorrectly read tags should not exceed 1 in 10,000. Taking this figure in conjunction with that specified in item 15 implies a maximum rate of acceptance of incorrect identity by the system of one in a million.
17. Any power supply to the truck tag must be independent of the truck's own electrical circuits. In the enhanced version, certain features may utilize the truck's power supply, but with default operation in the basic independent mode as above.
18. The AVI system must meet HELP system cost targets. These are, for a national system:

\$50 per tag, with an absolute maximum of \$100
\$10,000 per reader station (including antennas)

It should be noted that these are maximum costs and that the program aims to develop a system to fulfill its needs at lowest possible cost. Lower cost systems will therefore be strongly preferred.

The final specification for the AVI component will only be developed after the testing phase of the development program.

APPENDIX B

HEAVY VEHICLE ELECTRONIC LICENSE PLATE (HELP) PROGRAM FUNCTIONAL REQUIREMENTS FOR A COMPATIBLE AVI SYSTEM

**Prepared by
Castle Rock Consultants**

November 199 1

Introduction

This document details the draft functional requirements for an AVI system compatible with both HELP and ATA's functional requirements. It has been prepared for a HELP AVI research project aiming to identify a joint highway standard for AVI equipment. These requirements have been produced in collaboration with the ATA and by utilizing HELP and ATA AVI specification documents.

The requirements describe an AVI system utilizing a vehicle-borne tag and a roadside reader unit that can be used in a variety of applications. Current applications include high-speed freeway operation and vehicle access control.

Functional requirements

1. The AVI system shall have the capacity to monitor vehicle activities on multi-lane highways and at gates, terminal locations, and other carrier-related locations.
2. The cost of system installation is an issue, therefore, systems not requiring major construction or reconstruction are preferred.
3. The AVI system shall be able to distinguish between tags in different lanes simultaneously passing the reader site, and shall identify the lane in which the tag is traveling.
4. The system shall be able to read tags passing through the antenna read zone at speeds of up to 100 mph (161 kmh).
5. The system shall provide a basic operating mode whereby each passage of a tag through the read zone, at any operating speed up to 100 mph (161 kmh), results in a single read

record indicating the vehicle passage and its identification number. A user-selectable mode shall also be available in which the system provides multiple reads proportional to the amount of time the tag spends in the read zone. This feature may be used for future system enhancements such as congestion monitoring.

6. Two equipment interface options must be provided depending on the application. First, for equipment installed at HELP sites, the AVI reader unit must interface to WIM/AVC equipment, retrieve truck records and, if any, match them to their AVI record or records. This process should match tags from the same vehicle combination with the relevant WIM./AVC record. For this option, the equipment must also interface to a modem to allow remote retrieval of truck AVI and WIM/AVC records which are temporarily buffered within the AVI reader. For the second option, data recorded by the reader from a passing tag shall be output on a suitable interface to allow simple connection to the user's computer system.
7. The reader system shall be able to discriminate individual tags and record the passage of properly presented tags passing through the read zone separated by a distance of 5' (1.5m).
8. The AVI system shall function accurately and reliably under all ambient climatic conditions likely to be encountered during operation.
9. The AVI system shall be capable of functioning reliably and accurately when installed in the range of operating environments likely to be encountered. Materials normally encountered in the vicinity of the antenna installation should not prevent the system from meeting these requirements.
10. The presence of normally-occurring substances such as dirt, sand, salt, precipitation, etc., in the antenna field shall not adversely affect the operation of the system.
11. The tag shall be designed to operate properly within the temperature range of -49°F (-45°C) to +185°F (+85°C). The tag shall maintain the integrity of stored, data at temperatures of -76°F (-60°C) to +185°F (+85°C).
12. The tag shall meet appropriate test standards for long-term physical, radio frequency, thermal and ultraviolet exposure.
13. The tag shall meet the requirements of Military Standard 8 10D for immersion leakage, sand and dust. The tag shall survive and operate through the shock, vibration, and chemical contaminants experienced in road, rail and maritime service which fall under Military Standard 8 1 OD.
14. The tag shall survive and maintain the integrity of its stored data in the prolonged presence of radio frequency sources that will normally be encountered, such as voice communications equipment.

15. In normal use, a minimum of 90 percent of tags shall remain functional after 5 years with 80 percent still functioning after ten years of operation.
16. The tag attachment method shall be the choice of the user, bearing in mind mounting position, the roadway environment and life expectancy of the tag. The tag shall be capable of permanent mounting and shall have nominal dimensions which do not exceed 11.8 x 2.36 x 0.79 inches (30.0 x 6.0 x 2.0 cm).
17. The tag and reader shall not produce interference with or be susceptible to interference from any source of rf power likely to be encountered. This shall include but not be limited to electrical generators and telecommunications equipment such as cellular telephones, mobile pager units and two-way radios.
18. The radiated power levels of the system shall conform to federal regulatory limits as applicable. As a minimum the radiated power levels shall conform to ANSI C95.1 - 1982 where appropriate.
19. The AVI reader and antenna shall be compact, robust, and preferably bullet proof.
20. The AVI reader and antenna shall be available in a portable form.
21. The basic tag shall allow for at least 104 bits of user-encodable information. Additional bits should be used for security, synchronization, error checking and other system fields. Enhanced tag types shall allow 56 of the 104 bits to be variable message bits and be programmable by the AVI reader. A tag type field shall be used to indicate tag capabilities and quantity of data stored on the tag.
22. The system shall be capable of enhancement to provide a two-way communications facility between the roadside and in-vehicle equipment via the tag. In this scenario, the tag shall interface to an onboard computer or similar device.
23. The AVI system shall be capable of incorporating a range of security coding features that will allow users to prevent unauthorized reading of their coded tags. Security considerations shall be adequately accounted for in the physical design of the tag. Tag construction and component selection shall minimize the possibility of tag forgery, copying or fixed-code alteration.
24. The maximum number of correctly functioning and presented tags that are missed or incorrectly read shall not exceed 1 in 10,000. For those tags incorrectly read, error detection should be employed to ensure that at least 99.9 percent are identified as incorrect. When combined, these requirements indicate that no more than 1 in 1 0,000,000 incorrect tag identifications will be accepted by the system.
25. Any power supply to the tag shall be independent of the vehicle's own electrical circuits. In the enhanced version, certain features may utilize the vehicle's power supply, but with

default operation to the basic independent mode as above. The tag can be passive, deriving any necessary power from the reader emissions; or semiactive, utilizing an internal battery triggered on approach to the reader site.

Working Document

CRESCENT OPERATIONS AND
MAINTENANCE ISSUES

by

Lockheed IMS

HEAVY VEHICLE ELECTRONIC LICENSE PLATE PROGRAM

CRESCENT DEMONSTRATION

WORKING DOCUMENT SERIES

CRESCENT OPERATIONS
AND MAINTENANCE ISSUES

LOCKHEED IMS

SANTA CLARA, CALIFORNIA
FEBRUARY 1994

Crescent Operations and Maintenance Issues

The Crescent Demonstration Project was performed by Lockheed under contract from the Arizona Department of Transportation. Arizona was representing the consortium of states known as "HELP". Because it was a demonstration program, and due to funding constraints, Lockheed was asked to perform the demonstration at minimum cost. Hardware was employed which would not have been adequate for an operating system and in some cases data was processed by hand to spare the expense of writing data transfer programs. All of this tended to make maintenance of the Crescent Demonstration System harder than we would expect maintenance of a operational system to be.

The Crescent Demonstration System has three sectors of operation: (1) motor carrier and vehicle enrollment, (2) weigh station operations and vehicle pre clearance, and (3) AVI/WIM (Automatic Vehicle Identification/Weigh In Motion) data collection from weigh stations and mainlines. Each sector generates a maintenance requirement that touches Crescent's communications network, databases, and host computers. Maintenance is necessary for four areas: (1) system administration, (2) database administration, (3) application administration, (4) mainline and weigh station polling. Maintenance in general is manually performed and labor intensive due to operational characteristics which are dictated by the Crescent's system configuration. This problem is compounded by maintenance at remote locations, which require extensive travel time to reach.

Motor carrier and vehicle enrollment

Funds were not available during the Crescent Demonstration Program to electronically interface the Crescent host computers to the various state agencies that maintained the registrations, permits, and licenses that were required to be checked in order to validate a pre clearance. Each motor carrier as part of its enrollment was asked to furnish in written form the registrations, permits, and licenses information. This information was orally (telephonically) verified with the appropriate agency and then manually input into the host computers. Because the input was manual, an electronic accuracy of data transfer check could not be obtained.

Weigh station operations and vehicle pre clearance

The Crescent Demonstration Program utilized existing weigh stations that were not revised or remodeled to conform to Crescent

Demonstration requirements. These weigh stations might contain no other computer equipment and were unlikely to conform the environmental standards associated with computer and similar equipment. The problem was especially acute in the roadside cabinets, which in some cases became homes for wild animals. Electrical power to some of the weigh stations proved to be less uniform in voltage and amperage than typical city power.

The weigh stations were also required to continue to perform their primary function (as working weigh stations) during the Crescent Demonstration, which limited the access to the weigh stations by Lockheed personnel. State personnel were unlikely to have either the time nor the training to service pre clearance equipment, which meant travel to the weigh station by Lockheed or a Lockheed subcontractor was usually required when a problem developed.

Weigh stations were also subject to the hazards of the roadway. One was actually destroyed by a runaway truck during the demonstration.

Telephone line communication with remote sites was provided by Pacific Bell and AT&T. The quality of the service was inconsistent, and both Pacific Bell and AT&T provided poor responses to requests for assistance. The most reliable communications link was to the main computer in Oregon. Distance was not a factor in the quality of service -- in California lines were on the average poorer than out of California lines.

AVI/WIM data collection

At both mainline and weigh station sites, existing WIM equipment was utilized. AVI equipment was obtained from Mark IV and deployed. The Mark IV roadside AVI system consists of an antenna, embedded in the highway, that receives signals from passing trucks and a reader that processes information from the antenna. In addition to the roadside equipment, 4,750 on bumper AVI "electronic license plates" were deployed by Lockheed and additional AVI "electronic license plates" were deployed by British Columbia. To give a "go/no go" signal to the trucks, Lockheed designed and deployed 850 of the "EXPRESS" [upper case TM] dashboard mounted systems. Mark IV AVIs were maintained by replacement when they failed. A reserve of EXPRESS boxes were available to replace any EXPRESS that failed, however, only three (3) EXPRESS failed. [Even these three EXPRESS may not have failed -- Lockheed has been unable to examine the units.] Near the end of the demonstration, this was further complicated by integrating the Mark IV "PASS" system into the Crescent Demonstration, allowing vehicles with

Mark IV "PASS" AVI (which was altogether different from the AVI Mark IV sold to Crescent) to be identified and to receive a "go/no go" signal.

Lockheed experienced a high failure rate for roadside AVIs, primarily due to power supply and RF module failure. There appears to be a single Mark IV employee who services these AVIs for the entire country. As a result, some sites have been inoperative or partially operable for a considerable length of time. It is known that International Road Dynamics, Inc., also has the capability to service this equipment, but IRD was not part of the Crescent Demonstration until the very end.

This phase of the demonstration also produced the Crescent maintenance nightmare: the original Mark IV bumper mounted AVI was **not** watertight and failed in impressive numbers when exposed to the real highway conditions of snow, rain, sleet, and mist. This problem was subsequently corrected in a Lockheed aided redesign. Irate Lockheed personnel insisted on an AVI that could survive a trip through a dish washer -- and now have one. Not one of the second generation Mark IV AVIs has failed.

The WIM system consists of loops and weighing plates that are embedded in the highway. These process weights, lengths, and speeds of vehicles and pass that information to the AVI. Since WIM information is received only through the AVI, the only indication of WIM failure is via AVI reports (or the lack of AVI reports). In Oregon, this process is reversed: the AVI feeds the WIM and data is collected from the WIM. Individual states have been responsible for WIM maintenance with a large variation in response time. However, overall, once properly installed, the WIMs proved reasonably reliable, with the exception of the Pizeo Electric devices. All Pizeo Electric devices, whether they were used as WIMs or AVCs (Automated Vehicle Classification), had unreasonably high failure rates and downtime. Both PAT and IRD WIMs were involved in the demonstration.

System administration

Crescent is composed of four Motorola Delta 3400 computers, five Everex Intel 80386 based IBM compatible PCs running the Interactive UNIX System V release 3.2 operating system and Informix (weigh stations), fifteen Mark IV readers (mainlines), and a SNA link to the Oregon Department of Transportation's IBM mainframe. The four Motorola Delta 3400 computers are configured as one regional host and three state hosts. They are linked through a local area net using TCP/IP. The five Everex PCs running UNIX and Informix are linked through leased phone lines to specific state hosts using SLIP protocol.

The fifteen AVI readers are linked through dial-up phone lines to specific state hosts. In addition to the Everex PCs and readers, there are six leased phone lines to specific state hosts for Crescent state representatives and ten dial-up phone lines to the regional hosts via a terminal server for user access.

Maintenance on the Motorola Delta 3400 computers, for both hardware and software, has been provided by Motorola. Response time has been excellent, which has resulted in minimum down time.

System administration is complicated because there are nine discreet UNIX systems and fifteen AVI readers. Each UNIX system has system accounting, temporary scratch space, three to five file systems, and resource use which needs to be monitored and serviced on a regular basis. Five of nine systems are remote weigh stations and sometimes inaccessible due to system or phone line failures. What would be a simple maintenance issue at the central facility is often a critical event at the weigh stations.

The selection of Everex as the IBM compatible, Intel 80386 based, PC vendor complicated the maintenance situation. The Everex motherboard had some technical difficulties and the bankruptcy of Everex created some support difficulties. Finally, an armor plated MIL SPEC computer might have been a better choice for the dusty, hot, insect and rodent infested environment at the sites. The systems in the Lockheed offices had virtually no failures, but at the sites the failure rate was high.

Interactive also proved a poor choice for UNIX maintenance.

Database administration

Database administration is labor intensive because of constrained resources due to Crescent's technical success. Currently the system processes between 50,000 and 75,000 AVI/WIM records daily for all sites, which exceeds the original daily estimates. Crescent maintains six state databases on three state hosts, Arizona and California on one, Oregon and Washington on the second, and New Mexico and Texas on the third. California and Oregon state database AVI and WIM tables need to be unloaded every three weeks because collected records fills available disk space. Washington, Arizona, and Texas databases overrun disk space every six weeks. Unloading and deleting an average of two million records per database takes two days. There is an additional data base for British Columbia trucks which is maintained in and by British Columbia. Lockheed sends British Columbia data on British trucks observed in the Crescent system and receives from British Columbia data

on Crescent trucks observed in British Columbia. This information is stored in the regional host.

Before any of the AVI/WIM records can be unloaded and deleted from the state databases, they must be summarized into statistical tables. The volume of records and process activity on the state hosts causes the summarization process to run several hours daily. Although records are unloaded and compressed, eventually they must be archived to tape. Maintenance takes more time for the state databases because of a lack of an interactive database access tool on the state hosts. Maintenance routines must be put in the form of a script and submitted as a batch process to the database engine. This increases time to perform these routines by one third in comparison to the same routines done on the regional host.

Application administration

Applications maintenance is necessary when changes are made to the databases. When a change occurs each application at a minimum must be recompiled. Sometimes it is necessary to edit the source code of each application to accommodate changes. Crescent's operational tempo demands that this type of activity take place during off peak periods and that the changes be thoroughly tested before placing the applications back on-line.

Polling

Monitoring of the AVI readers for mainline polling is difficult due to a lack of active diagnostics for the readers. Testing the status of a reader is a manual and time consuming task. A reader is dialed into and interrogated for status and data through a series of commands. Each command may need to be issued several times. There is no indication of command acceptance by the reader other than reader response. If the command is accepted, the reader will issue a response. Each response is noted and the entire session is analyzed to obtain the status of a reader. Sometimes it is necessary for several status checks to be issued over a period of time to obtain an accurate status.

Attached to eleven of the fifteen AVI readers is a data link to a weigh in motion device (WIM). There is no direct means to trouble shoot a WIM or the data link to a WIM. Nor can they be calibrated by Lockheed; Lockheed can not even change the date and time on the WIM. Status is obtained indirectly by analyzing data from the AVI reader over an unspecified period of time.

Working Document

PROGRAM BUDGET AND FUNDING

by

Castle Rock Consultants

**HEAVY VEHICLE ELECTRONIC LICENSE
PLATE (HELP) PROGRAM**

PROGRAM BUDGET AND FUNDING

**Lessons Learned through the
HELP Program**

**Christopher J. Hill, Ph.D.
Castle Rock Consultants**

February 1994

DISCLAIMER

The contents of this paper reflect the views and opinions of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the U.S. Department of Transportation, the HELP Program, or its participating states. This paper does not constitute a standard, specification, or regulation. The United States Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear herein only because they are considered essential to the objective of this document.

1. INTRODUCTION

This paper is one of a series which discusses various lessons learned as a result of the Heavy Vehicle Electronic License Plate (HELP) program and the Crescent Demonstration. This document discusses the issues of the program budget and funding.

The paper discusses the budget estimates for the HELP program and the variances between actual and estimated expenditures. It also describes the various funding sources used during the course of the program. Finally, in this area, the financial administration processes are considered.

2. PROGRAM FUNDING

a. Budget Estimates

The initial estimates for the HELP program budget are presented in a confidential draft report from Arizona Department of Transportation (ADOT) prepared during the course of the Phase IA: Feasibility Study [1]. At this point in time, two activities were already funded: the feasibility study using a \$50,000 Federal Highway Administration (FHWA) grant, and the Phase IB: Concept Demonstration in Oregon funded at \$200,000 using highway planning and research (HP&R) funds and including a \$50,000 additional grant from FHWA. The remaining funding required was estimated as follows:

Expenditure Item	Amount	Source
Phase IC: System selection	\$50,000	ADOT HP&R
Phase 2A: Laboratory and test track trials	\$750,000	Private sector \$350,000 Public sector \$400,000
Phase 2B: Field tests	\$500,000	Private sector \$300,000 ODOT HP&R \$200,000
Phase 2C: Specify preferred system	\$50,000	ODOT HP&R
Phase 2D: Test preferred system	\$700,000	Private sector \$450,000 ODOT/FHWA \$250,000
Total	\$2,050,000	

The ADOT report [1] further recommends that Phase 3 of the program, the Crescent Demonstration, be performed using an approved NCHRP (National Cooperative Highway Research Program) project, 86-G-1 0.

At the first HELP meeting, in Portland, Oregon, February 1985, it was reported that the total cost of the program would be approximately \$6 million [2]. It was stated that \$500,000 was currently available for the project from NCHRP and that an additional request would be made to NCHRP. At that point, FHWA had agreed to provide a further \$250,000 grant for a system design study. Finally, the group agreed that they should establish an HP&R pooled fund to support other program costs.

By the time of the third meeting in Las Vegas, Nevada, March 1985, a preliminary budget had been prepared based on this approach [3]. This showed a total program cost of \$6,470,000. This budget is reproduced as Appendix A.

The Phase IC: Concept Development Study [2] identified the component elements of the development phase of the program, and for each of these prepared workscope outlines. These program components comprised the following:

- management consultant services;
- policy consultant services;
- AVI testing program;
- WIM performance specifications development;
- site selection study;
- motor carrier services plan;
- satellite reference system design;
- development of a low-cost automatic weight and classification system; and
- system design study.

Several of these items were compiled into a first year (FY 1985-86) workplan [4] and an associated budget was prepared. This is presented in Appendix B, and shows a first year budget of \$1,195,000. Minor modifications increased this amount to \$1,199,000, and this budget was adopted by theHELP Executive Committee [5]. This budget was the first to identify the lead state's administration time, travel and other direct costs, as well as travel for the participating states.

Associated with this budget was an income statement showing funding by source[6]. This is reproduced as Appendix C . It is interesting to note that by this time, the states of Iowa and Minnesota had agreed

to take on the development of a low-cost automatic weight and classification system, in lieu of a direct contribution to the program budget. This project was formally accepted as part of the HELP program in November 1985. Iowa and Minnesota were granted full membership of the Policy and Executive Committees and were authorized travel budgets [7].

The next major revision to the first year program budget was shown in the January 1986 Work Program [8]. This added technical studies to the first year plan, increasing the budget to \$1,459,000. A tentative second year budget was also prepared at this stage, requiring additional income of \$1,095,000. This budget package is included as Appendix D.

Revisions were subsequently made to the proposed FY 1986-87 budget to reflect lower contributions from Alaska and Texas than originally anticipated. Specifically, the Alaska HP&R contribution reduced from \$100,000 to \$25,000, and the Texas HP&R contribution reduced from \$200,000 to \$50,000. The FY 1986-87 budget was balanced by deferring the motor carrier services plan study to the following year and by reducing the funding for the AVI testing program [9].

A proposed FY 1987-88 budget was presented to the Executive Committee in September 1987 for approval [10]. The proposed budget amount was **\$620,700**. The budget package also included reconciled budgets for FY1985-86 and FY1986-87 showing actual income and expenditures for each of those years. The actual FY1985-86 budget was shown to be \$1284,000 and the actual FY1986-87 budget was shown to be \$931,000. This information is included as Appendix E.

During 1988, as the technical studies became less of a focus for the HELP program, emphasis was placed on budgeting for the Crescent Demonstration. This process involved three principal components: costs to be shared between the Crescent and non-Crescent states (i.e., software and AVI transponders); hardware that would be procured by the individual Crescent states (mainly WIM and AVC equipment); and hardware that would be procured centrally on behalf of the Crescent states (mainly AVI roadside equipment). The first of these elements was incorporated into the pooled fund budget. The second component was the responsibility of each Crescent state. The final part was not included in the pooled fund budget was administered by ADOT. The estimated amounts for each of these are shown in a budget package presented to the Executive Committee in April 1989, which includes the adopted FY1988-89 budget [11]. This is included as Appendix F. The final version of the FY 1989-90 budget is included as Appendix G [12].

The proposed FY1990-91 HELP budget included the recent commitment of federal funding assistance to support the Crescent Demonstration and certain AVI research tasks [13] (see Appendix H). The \$5 million funding commitment was received in response to a request from the HELP program [14]. This document is particularly interesting as it details both the actual and in-kind contribution to the HELP program since its inception. This showed a total cost of the program estimated through the completion of the Crescent of more than \$12.5 million. The relevant sections of this proposal are excerpted as Appendix I.

The proposed FY 1990-91 budget initially showed a \$1.5 million federal contribution. However, this was insufficient to fund both Phase IB and II of the Crescent contract with Lockheed which were due to begin during that fiscal year. A further request was made to FHWA to allow an additional \$1.5 million to be

brought forward from FY 1991-92 to support these activities [15]. This was accepted and a revised FY 1990-91 budget was developed [16] (see Appendix j).

A proposed FY 1991-92 budget was presented for approval at the Policy and Executive Committee meeting in July 1991 [17] (see Appendix K).

The Executive Director's report of January 1992 indicates for the first time that additional funding support may be required [18] This notes that Phase III of the Crescent was due to start on October 1, 1991, but due to delays in commissioning the Crescent sites would not actually begin until February 1992. Since a full twelve months of operation was desired, an additional cost of \$150,000 per month would be incurred to cover system operating costs.

During 1992 there were extensive discussions relating to the duration of the Crescent Demonstration and its evaluation, completion of the HELP program, and planning for continuing activities beyond the program. All of these had significant impacts on the budget for FY1992-93. A proposal to the HELP Board of Directors in July 1992 stated that Crescent operations and HELP administration should continue until September 30, 1993 [19].

As a result of these discussions, a proposed budget for FY 1992-93 was prepared that sought an additional \$1.5 million of federal funding assistance. This would cover the continuation of Crescent operations, a proportion of the Crescent evaluation costs, in-vehicle equipment for mainline bypassing at the Santa Nella weighstation, and start-up costs for the proposed HELP, Inc. organization [20] (see Appendix L). In response, FHWA declined to fund the Santa Nella equipment or the HELP, Inc. costs, but agreed to an additional grant of \$850,000. The resulting revised budget [21] is included as Appendix M.

This budget remained in effect through the rest of the HELP program. Final budgeting efforts focused on identifying outstanding funding contributions and developing a budget scenario in case these contributions were not received. This budget was presented at the final HELP meeting in September 1993 [23] and is included as Appendix N.

b. Funding Sources

Other than a small amount of initial direct federal funding, the early stages of the HELP program were supported by HP&R funds from the participating states. The regional HP&R pooled fund was established following an initial proposal submitted to FHWA by the states of Alaska, Arizona, California, Nevada, New Mexico, Oregon, Texas and Washington in June 1985 [23].

A letter accompanying the proposal noted that this program would involve a sizable commitment of HP&R funds by the participating states. It went on to say: "Because of the potential we believe this particular will have within this region, and because of our desire to ensure the success of this study, we request that the fund matching requirement be waived" [24]. A memorandum dated July 12, 1985 [25] records FHWA's acceptance of the proposal. Further, it

confirms that work directly related to the pool-fund project will be 100 percent federally funded. Other Crescent state activities that are not part of the pool-fund project would be handled at the state's regular pro-rata share. Participating states would provide funds to the pool by executing a PR-2A form, Federal Aid Project Agreement, and forwarding it to the appropriate FHWA Division Office.

The memorandum also defines the role of Arizona in administering the pool-fund project as follows [25]:

“The lead State, Arizona, will manage the contractual arrangements and direct the work of the consultant using normal Federal-aid practices and procedures for contracted studies they initiate and support with HPR funds. These contracted efforts will be coordinated with the Policy Committee/Executive Committee Structure which has been established by the Crescent States. The Arizona Division will oversee FHWA's technical interest in the study and approve payment requests for completed work. Reimbursements to Arizona DOT will be made by the Office of Fiscal Services, Finance Division.”

The responsibilities of Arizona as the lead state were defined in the HELP Organization Charter [26]. This states that the lead state shall:

- draft RFPs, develop consultant selection processes and develop qualified lists;
- provide management of consultants, including preparation of contract documents, recommendations regarding change order requests, and making progress payments;
- provide progress reports to the Executive Committee;
- administer a management budget, including travel and per diem payments to members of the Policy and Executive Committees; and
- hire a management consultant.

A copy of this original organization charter is included as Appendix 0.

The first wholly non-federal funds provided to the HELP program were received from the Port Authority of New York and New Jersey, who joined the program in December 1986 [27]. Since these funds could not be commingled with the HP&R funds, a separate donation funds account was established by ADOT for administering these monies. Subsequently, this account was used for state funds received from Alaska during FY 1987-88 and from Utah starting in FY 1990-91.

A further issue of the use of non-HP&R funds arose during the planning for the Crescent Demonstration. As noted earlier, three funding areas had been identified. These comprised shared costs covering software development, regional hardware and AVI transponders, state costs such as AVI roadside equipment that would be procured centrally, and individual state costs such as WIM and AVC equipment. The participating Crescent states had all reported that they would

be unable to fund major items such as these with only HP&R monies. The Program Manager was requested to pursue alternative funding sources [28].

The Program Manager requested a determination on the applicability of federal I-4R construction funds for the Crescent Demonstration costs. An initial response from FHWA Headquarters personnel stated that “hardware can be purchased, including AVI transponders for a limited demonstration, but the funds may not be used for software development” [28]. A further request was submitted to FHWA Region 9 to allow I-4R funds to be used for software development as well as other hardware, including AVI transponders.

A final response from FHWA allowed I-4R funds to be used for WIM, AVC and AVI roadway equipment providing it was demonstrated to form part of a state’s “size and weight enforcement program” [29]. AVI transponders and software development, however, were ineligible for I-4R funds, but could be purchased with HP&R funds. As a result of this decision, software development and AVI transponders were budgeted into the pool fund expenditures. AVI roadside equipment was procured on behalf of the Crescent states by ADOT using its contract with Vapor Canada. Each state was subsequently billed by ADOT for the equipment and services it had received. These transactions were administered outside of the pool fund since principally state funds were involved.

The final major funding source was the federal grant of \$5,850,000 received for the Crescent Demonstration. This funding was provided by FHWA from intelligent vehicle-highway system (IVHS) monies. As such, there was a requirement for a twenty percent hard match (i.e., twenty percent of total project costs must be derived from non-federal funding sources or must comprise equipment or dedicated personnel provided to the project which did not include any federal funding).

Since most contributions by the states had comprised HP&R funds (which are principally federal funds and therefore contribute only a soft match), a major effort was undertaken to identify hard matching sources. Ultimately, this was demonstrated in the funding request to FHWA through the value of state-procured WIM/AVC equipment and the value of time of the program participants, especially the motor carrier committee members and the volunteer trucking firms that would install AVI equipment on their vehicles [14].

The provision of IVHS funds to the HELP program led to a far more active involvement by FHWA personnel in coordination and liaison with the program. Administration of the grant remained with ADOT, however, as defined in the Cooperative Agreement [15] (see Appendix P) and as illustrated in a letter from the Federal Highway Administrator in July 1990 [30]:

“We understand the HELP members prefer these project funds be directed and administered through the Arizona Department of Transportation. If this is agreeable, funds will be transferred to our Region 9 Office when our 1991 budget is approved. Authorization authority for the use of the funds will be with the FHWA Arizona Division Office. Appropriate transfers will be made for 1992 when the year’s budget is approved.

The overall management and coordination of FHWA's IVHS program are performed by our Headquarters staff. This includes items such as policy issues, national standards, system design and evaluation goals, and project funding. To assure national coordination of our participation, we are designating Mr. Ed Kashuba, HPM-30, as the FHWA Headquarters' liaison to the HELP.

The various FHWA field offices are responsible for liaison and/or approval, as appropriate, of the development of plans, designs, and implementation activities related to specific IVHS projects. The field offices' duties include project monitoring and direct liaison with the public and private agencies involved.

Thus, the day-to-day administrative oversight of the Crescent Demonstration by FHWA will be through our Region 9 Office, as well as the Arizona and California Division Offices. By copy of this letter, I am directing the Region 9 Administrator to lead the coordination with the other FHWA Regions affected by the Crescent Demonstration."

The first paragraph quoted highlights a major cashflow problem that subsequently occurred. Delays by Congress in reauthorizing the federal highway bill would hold up receipt of the initial grant [31]. In particular, this would impact Phase IB of the Crescent contract with Lockheed which was due to start on October 1, 1990. As this time drew nearer, a letter from Policy Committee chair Robert Bothman to the Federal Highway Administrator requested support as follows [32]:

"We need your assistance to provide the additional funding through innovative or flexible funding mechanisms to allow the program to proceed without delay regardless of timing of Congressional action. For example, allowing us to proceed with Phase 1B with authorization for reimbursement for project expenses incurred beginning October 1, 1990 would help us meet our schedule."

With no formal response forthcoming, Lockheed was notified of the risk associated with their continuing work on the project beyond October 1 [33]. To their credit, Lockheed proceeded with contract activities despite the possibility that they may not be reimbursed for their work. This situation recurred on other occasions, in particular while Congress worked on passage of the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991.

For all of these various funding sources, the budgets, payment and reimbursement processing, and contractual responsibilities were handled by the Transportation Planning Division of ADOT using the state's financial management system, known as TRACS. Expenditures were then applied against the program's restricted cash fund account or the FHWA HP&R or IVHS funds, via a federal reimbursement revolving account. In the case of the HP&R pool fund, FHWA would allocate reimbursements against each state's participating amount in the ratio it bears to the total HP&R funding.

During 1991, an ADOT internal audit was performed on the HELP program accounts [34, 35]. This reported that "expenditures were properly supported, program related, and in compliance

with program policies and applicable federal regulations; and program revenues are properly recorded, controlled, and in accordance with federal regulations, excepted as noted.” It is also stated that “certain internal control conditions” merited attention of the program management.

The key findings were as follows:

- there was no policy for the allocation of expenditures between funding sources. This meant that during day-to-day financial administration all expenditures were being applied to the HP&R pooled fund rather than the restricted state funds account;
- cash receipts (i.e., state or donation fund contributions) were not adequately documented as to source and spending restrictions;
- fixed assets purchased by the program should be subject to a policy for controlling their ownership and establishing criteria for their disposition when no longer needed or when the program is terminated;
- controls were required to ensure that program expenses are properly recorded to correct project accounts; and
- improved monitoring and reporting of HP&R contributions received from the states was required to ensure that commitments were being met.

3. ISSUES AND LESSONS

The budgeting process does not appear to have been an impediment to the HELP program. In particular, during the development phase, program expenses were easily met by the resources of the participating state contributions. Increases in the estimated budgets over time were generally due to expansions in the scope of technical activities rather than unforeseen circumstances.

Perhaps the most significant “underestimate” of program costs came with the Crescent contract with Lockheed. However, it is fair to say that this was due to a fundamental change in the scope of the demonstration project rather than poor budget estimating. (See companion paper by Hill for further discussion of this issue [36].) Even in this situation, the program participants acted quickly and effectively with a successful proposal to FHWA.

However, the same argument cannot be made for the majority of the cost increases that occurred during the course of the Crescent Demonstration. In the most part, these were due to delays in commissioning sites or equipment that led to an extension of the demonstration period to provide a full twelve months of operation. These costs could have been minimized with a program structure that could exert more control over the activities of the individual states and contractors. A part-time management staff was not adequate for this.

Finally, the area where the greatest number of lessons can be learned is in the financial administration. The author believes that ADOT did an outstanding job in administering the program over a ten-year period, especially considering that many of the contractual and financial approaches were innovative and almost entrepreneurial. This was mainly due to a small number of individuals who were dedicated and committed to the success of the program. However, the following recommendations are made for future programs of this type:

- A dedicated administrative staff committed full-time to the program is essential. This type of program with multiple contracts and procurements of different types, and funding derived from multiple sources over a number of federal regions, is simply too complex to assign to personnel as an addition to their normal duties.
- Rigorous financial controls and reporting procedures are required. Policies for income tracking should be developed - it is not adequate to rely on the verbal commitments of the program participants to provide funding. Instead, a procedure should be developed to ensure that copies of the PR2A forms are obtained from each of the FHWA Division Offices and these compared with the available funds reported by FHWA Headquarters. Also, a single point of contact should be established for receiving cash receipts and for ensuring that these are deposited to a restricted account.

Likewise procedures are needed to ensure that expenditures are recorded to the project numbers and fund sources. Program participants should be required to submit standard form invoices for their travel and per diem reimbursements. Each should be assigned the appropriate project number against which their expenses will be charged and should be required to show this on their invoices. Equally, consultants and contractors should prepare their invoices in a standard form. In addition to indicating the project account number on their invoices, separate work orders should be issued for additional work that utilizes a different funding source. Invoices would then be submitted for each work order.

- Regular management reports should be prepared showing actual income and expenditure versus budget. This would permit cashflow monitoring and would avoid the need for the administrative lead state to periodically “bankroll” the program.

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APPENDIX A

PRELIMINARY CRESCENT DEMONSTRATION PROJECT COST ESTIMATES (In Thousands of dollars)

March 7, 1985

FISCAL YEAR 1985

<u>Item</u>	<u>Description</u>	<u>Pool</u>	<u>FHWA</u>	<u>NCHRP</u>	<u>ARIZ</u>	<u>OREG</u>	<u>OTHER STATE</u>	<u>INDUS</u>	<u>TOTAL</u>
1	System Selection Study				50				50
2	Site Selection	25							25
3	Write RFP For AVI Spec	5							5
4	Write RFP for WIM Spec	5							5
5	Write RFP for SYS Desi	5							5
6	Write Detail Mgt Plan	75							75
7	Travel & Contingency	20							20
	TOTAL	135	0	0	50	0	0	0	185

FISCAL YEAR 1986

<u>Item</u>	<u>Description</u>	<u>Pool</u>	<u>FHWA</u>	<u>NCHRP</u>	<u>ARIZ</u>	<u>OREG</u>	<u>OTHER STATE</u>	<u>INDUS</u>	<u>TOTAL</u>
1	AVI Lab & Field Tests				250	200		650	1100
2	AVI Perf Spec (FCC)				100	50			150
3	WIM-Develop Perf SP	150							150
4	Low Cost Wim – WSDOT						75		75
5	System Design Study		250						250
6	Management – Consultant	200							200
7	Travel & Contingency	75							75
	TOTAL	425	250	0	350	250	75	650	2000

APPENDIX A

FISCAL YEAR 1987

<u>Item</u>	<u>Description</u>	<u>Pool</u>	<u>FHWA</u>	<u>NCHRP</u>	<u>ARIZ</u>	<u>OREG</u>	<u>OTHER STATE</u>	<u>INDUS</u>	<u>TOTAL</u>
1	Test Preferred AVI System				50	160		450	660
2	Demonstration Project								
	A. Install WIM/AVC Equip.						850 ¹		850
	B. Install AVI Equipment						850 ²		850
	C. Install Transponders	400							400
	D. Comm/Process	85 ³							85 ³
	E. Install Reg. Sys.	300 ³							300 ³
3	Geo Star Feasib.			40					40
4	Evaluation of Crescent & Economic Eval. Study			200					200
5	Management – Consultant	200							200
6	Travel & Contingency	100							100
	TOTAL	1085	0	240	50	160	1650	450	3635

FISCAL YEAR 1988

<u>Item</u>	<u>Description</u>	<u>Pool</u>	<u>FHWA</u>	<u>NCHRP</u>	<u>ARIZ</u>	<u>OREG</u>	<u>OTHER STATE</u>	<u>INDUS</u>	<u>TOTAL</u>
1	National Expansion Study			500					500
2	Management – Consultant	100							100
3	Travel & Contingency	50							50
	TOTAL	150	0	500	0	0	0	0	650

GRAND PROJECT TOTAL

	<u>Pool</u>	<u>FHWA</u>	<u>NCHRP</u>	<u>ARIZ</u>	<u>OREG</u>	<u>OTHER STATE</u>	<u>INDUS</u>	<u>TOTAL</u>
TOTAL	1795	250	740	450 ⁴	410 ⁴	1725 ¹	1100	6470

- 1** Depends on individual state commitment.
Site costs approximately \$5,000 - \$100,000
- 2** Depends on individual state commitment.
Site costs approximately \$15,000 - \$30,000
- 3** Depends on results of system design study.
- 4** Arizona's and Oregon's contribution in
Lieu of pool funded contribution

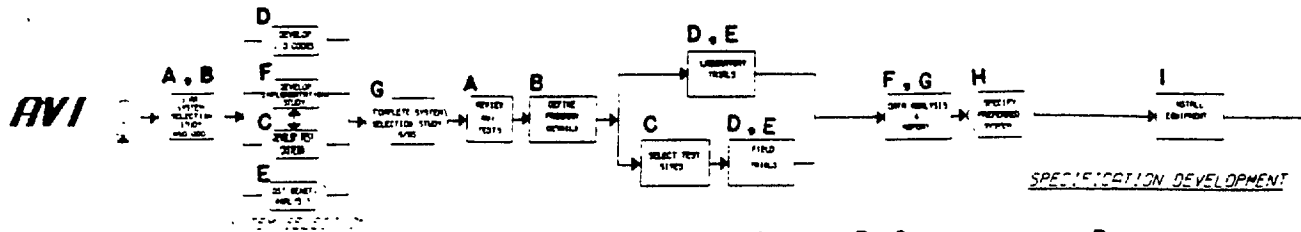
APPENDIX B

PROPOSED TENTATIVE FY 1985-86 H E L P BUDGET

	\$\$\$ BUDGET	\$\$\$ EXPENDITURES THIS MONTH	\$\$\$ EXPENDITURES THIS YEAR	% OF YEAR BUDGET/ CONTRACT	+/- YEARS BUDGET/ CONTRACT
D H E L P Management Expenditures:					
o Adm. Time-ADOT	15,000	.....	.....	.....	.....
o Travel	10,000	.....	.....	.....	.....
o Misc. Expenses	5,000	.....	.....	.....	.....
o Mgt. Consultant Expenses	215,000	.....	.....	.....	.....
o Policy Consultant Exp....	35,000	.....	.....	.....	.....
Subtotal:	\$280,000	\$0	\$0	0.00%	\$0
D H E L P Technical Consultant					
o A V I Testing.....	337,000	.....	.....	.....	.....
o W I M Perf. Spec.	150,000	.....	.....	.....	.....
o Site Selection.....	25,000	.....	.....	.....	.....
o Motor Carrier Pl.	37,500	.....	.....	.....	.....
o StateWide Studv.....	20,000	.....	.....	.....	.....
Subtotal:	\$569,500	\$0	\$0	0.00%	\$0
C H E L P FHWA Study					
o Systems Design Study	\$250,000	.....	.....	.....	.....
Subtotal:	\$250,000	\$0	\$0	0.00%	\$0
C H E L P Other States Travel					
o Alaska	14,000	.....	.....	.....	.....
o Arizona	10,000	.....	.....	.....	.....
o California	10,000	.....	.....	.....	.....
o Nevada	10,000	.....	.....	.....	.....
o New Mexico	10,000	.....	.....	.....	.....
o Oregon	14,000	.....	.....	.....	.....
o Texas	10,000	.....	.....	.....	.....
o Washington	10,000	.....	.....	.....	.....
Subtotal:	\$88,000	\$0	\$0	0.00%	\$0
D H E L P Other Expenses					
o Misc. (W./Specifications)	5,000	.....	.....	.....	.....
o Capital	2,500	.....	.....	.....	.....
Subtotal:	\$7,500	\$0	\$0	0.00%	\$0
GRAND TOTAL:	\$1,195,000	\$0	\$0	0.00%	\$0

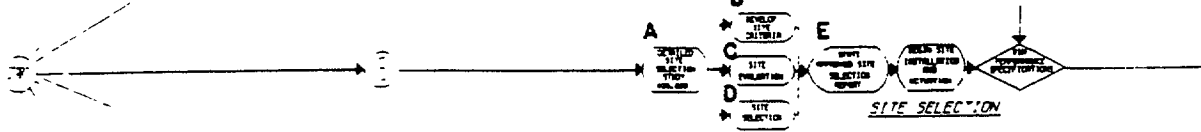
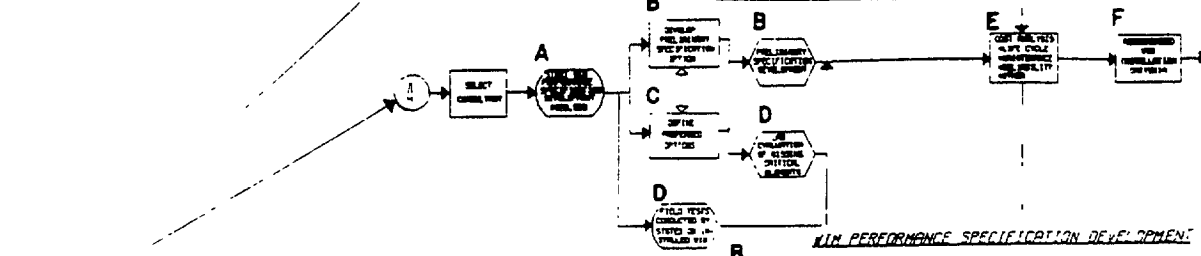
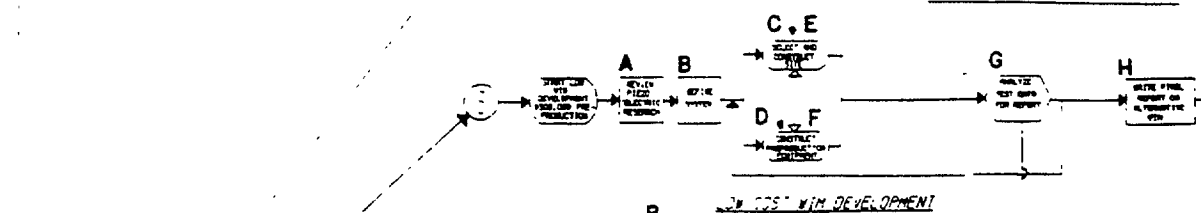
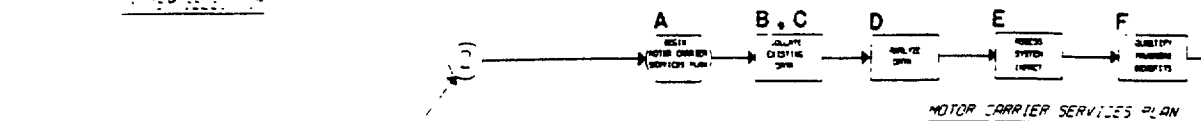
HELP SYSTEM DEVELOPMENT PROGRAM

PERT CHART

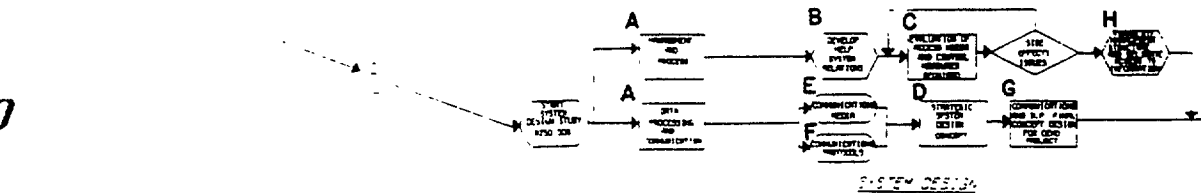


MCSP

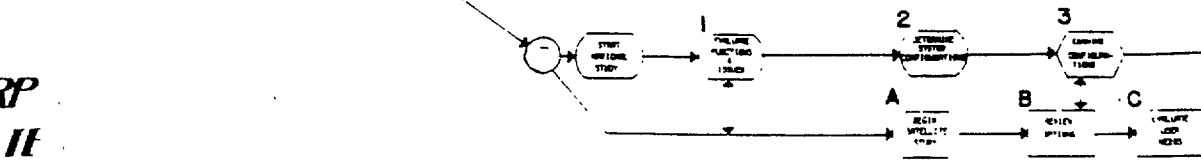
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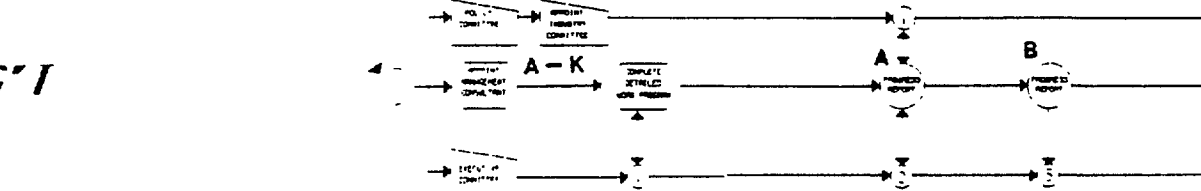
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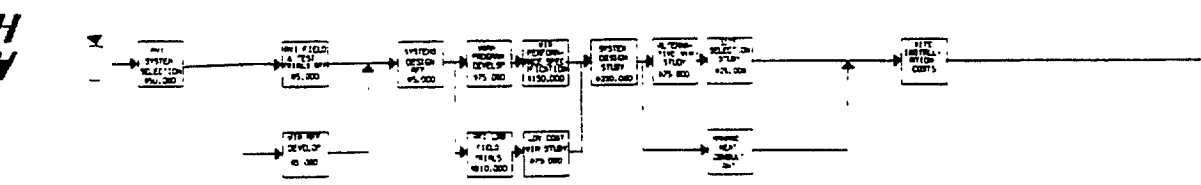
**NCHRP
SAT'ITE**



HANG'IT



**CASH
FLOW**



1965 1966



Heavy Vehicle Electronic License Plate H.E.L.P. Program

ARIZONA DEPARTMENT OF TRANSPORTATION
TRANSPORTATION PLANNING DIVISION

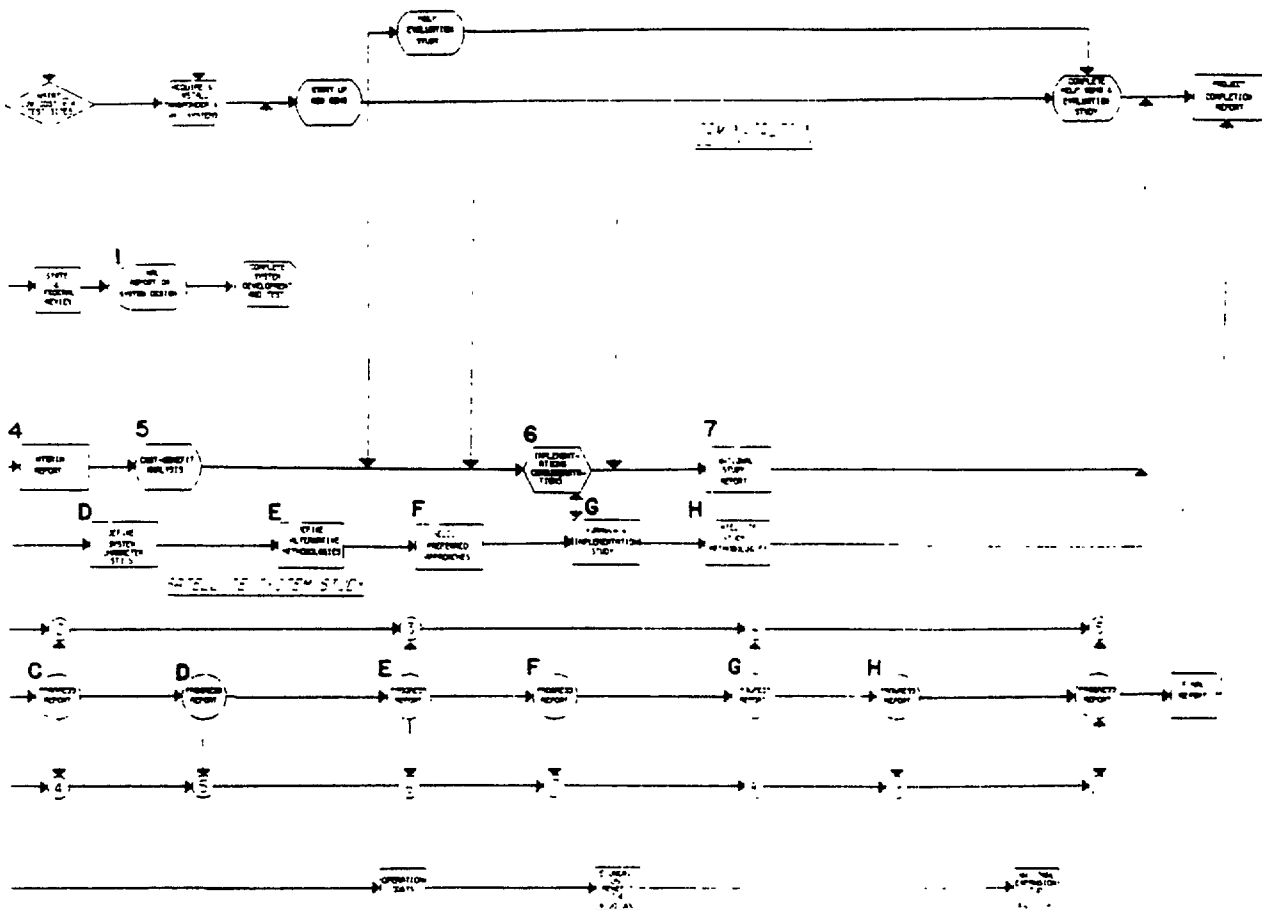
Revision ~~AB~~ EFGH

Date: 8-8-85

Designed
L A Schmitt, P E

Notes:

- (1) Under contract to CRC Corporation
Corvallis, Oregon
- (3) Underway w/ IOWA, MINN., & FHWA
as a working group



APPENDIX C

HELP SYSTEM DEVELOPMENT PROGRAM ANNUAL BUDGET BY FUND SOURCE (THOUSANDS OF DOLLARS)

	1986	1987	1988	TOTAL
ALASKA HPR	100	100	100	300
ALBERTA HPR	30	-	-	30
ARIZONA HPR	250	150	100	500
BRITISH COLUMBIA HPR	30	-	-	30
CALIFORNIA HPR	125	125	125	375
IDAHO HPR	25	-	-	25
IOWA HPR	**	-	-	0
MINNISOTA HPR	**	-	-	0
NEVADA HPR	25	25	25	75
NEW MEXICO HPR	70	50	30	150
OREGON HPR	204	160	30	394
PENNSYLVANIA AHP	25	-	-	25
TEXAS HPR	150	200	50	400
WASHINGTON HPR	25	25	50	100
TOTAL HPR:	1,059	835	510	2,404
FHWA:	250	---	---	250
TOTAL GOV:	1,309	835	510	2,654
INDUSTRY:	650	450	3,170	4,270
GRAND TOTAL:	1,959	1,285	3,680	6,924
31-Oct-85	** IN KIND PROGRAM			

APPENDIX D

TABLE 6.2 PROJECTED TOTAL HELP EXPENDITURE

Technical Studies

AVI Testing - Coordination	150,000	
Laboratory	146,000	
Track	104,000	
Field	300,000	700,000
WIM Performance - Coordination	150,000	
Specification State efforts	150,000	300,000
Low cost WIM (AWACS - Iowa/Minnesota)		300,000
Systems Design Study		250,000
Site Selection Study		25,000
Satellite Reference System Design		40,000
Motor Carrier Services Plan		75,000
	Sub-total	1,690,000

HELP Management and Administration

Management Consultant	575,000
Policy Consultant	145,000
Administration - ADOT	112,500
States travel	444,000
Sub-total	1,276,500

Crescent Demonstration Project

Crescent hardware	2,600,000
Crescent evaluation	500,000
Private sector contributions	1,100,000
Sub-total	4,200,000
TOTAL	\$7,166,500

TABLE 6.3 REVISED by 1985-86 HELP BUDGET (\$000s)

<u>INCOME</u>		<u>EXPENDITURE</u>	
Alaska	100	<u>Technical Studies</u>	
Alberta	30	AVI Testing	331
Arizona	250	WIN Perf. Spec.	150
British Columbia	30	Site Selection	25
California	125	Motor Carrier S.P.	375
Idaho	25	Satellite R.S.D.	20
Iowa	50*	Low-cost WIM	100
Minnesota	50*	Reserve	50
Nevada	25		
New Mexico	70		
Oregon	204		
Pennsylvania	35	Sub-total	713.5
Texas	150		
Washington	25		
		<u>HELP FHWA-Studies</u>	
		Systems Design	250
		Low-cost WIM	50
		Sub-total	300
		<u>HELP Management</u>	
		Admin time - ADoT	15
		Travel	10
		Misc. Expenses	5
		Management Consultant	215
		Policy Consultant	45
		Sub-total	290
		<u>HELP States Travel</u>	
		12 states at \$10k	120
		2 states at \$14k	28
		Sub-total	148
		<u>Other Expenses</u>	
		Misc (W/Specs)	5
		Capital	25
		Sub-total	7.5
		TOTAL GOVERNMENT	1459

* Low-cost WIM (AWACS:

** \$250k for SDS plans
\$ 50k for AWACS

Approved 1-27-86

San Bardi

TABLE 6.4 TENTATIVE FY 1986-87 HELP BUDGET (\$000s)

<u>INCOME</u>		<u>EXPENDITURE</u>	
Alaska	100	<u>Technical Studies</u>	
Alberta	30		
Arizona	150	AVI Testing	244
British Columbia	30	WIM Perf. Spec.	150
California	125	Motor Carrier S.P.	37.5
Idaho	25	Satellite R.S.D.	20
Iowa	50	Low-cost WIM	100
Minnesota	50	Reserve	63
Nevada	25		
New Mexico	50		
Oregon	160	Sub-total	614.5
Pennsylvania	25		
Texas	200		
Washington	25	<u>HELP FHWA Study</u>	
		Low-cost WIM	50
Total HPR	1045		
		Sub-total	50
FHWA	50		
		<u>HELP Management</u>	
		Admin time - ADoT	15
		Travel	10
		Misc. Expenses	12.5
		Management Consultant	200
		Policy Consultant	45
		Sub-total	282.5
		<u>HELP States Travel</u>	
		12 states at \$10k	120
		2 states at \$14k	20
		Sub-total	148
		TOTAL GOVERNMENT*	1095

* Excluding hardware

APPENDIX E

00021

RECAST FY 1985-86 HELP BUDGET (\$000s)
July 1, 1985 through September 30, 1986

INCOMEEXPENDITURETechnical Studies

Alaska	100	AVI Consultant	150
Arizona	250	AVI Track Testing	55
California	125	WIM Consultant	150
Idaho	25	Satellite Study	100
Iowa	-		
Minnesota		Sub-total	455
Nevada	25	<u>FHWA Studies</u>	
New Mexico	70	Systems Design	250
Oregon	204		—
Pennsylvania	35	Sub-total	250
Texas	150	<u>HELP Administration</u>	
Virginia	25	Admin. time-ADOT	7.5
Washington	25	Travel	5.0
	—	Misc. Expenses	4.0
Total	1034	Mgmt. Consultant	265.0
FHWA	250	Policy Consultant	45.0
	—		—
Total Gov.	1284	Sub-total	327.5

HELP States Travel

Sub-total	64
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Other Expenses

Sub-total	6.5
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Carry Forward	121
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TOTAL GOVERNMENT	<u>1,284</u>
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RECAST FY 1986-87 HELP BUDGET (\$000s)
October 1, 1986 through September 30, 1987

INCOME

Alaska	25
Arizona	150
California	125
Idaho	25
Iowa	
Minnesota	40
Nevada	25
New Mexico	50
Oregon	160
Pennsylvania	25
Texas	50
Virginia	25
Washington	25
PANYNJ	25
Total HPR	750
Reserve carried forward from FY 85-86	181
Total	931

EXPENDITURE

Technical Studies

AVI Field Testing	125
AVI Lab Testing	129
WIM Testing (States)	150
Motor Carrier SP	38
Site Selection	25
SDS Overspend	42
Sub-total	509

HELP Administration

ADOT Admin	6
ADOT Travel	4
Misc. Expenses	6
Management Consultant	209
Policy Consultant	45

Sub-total	261
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HELP Travel,

Sub-total	90.3
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Reserve	70.7
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Total	931
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PROPOSED FY 1987-88 HELP BUDGET (\$000s)
October 1, 1987 through September 30, 1988

<u>INCOME</u>		<u>EXPENDITURE</u>	
		<u>Technical Studies</u>	
Alaska	25	Available for technical studies	250
Arizona	100		
California	125		
Idaho	25		
Iowa		<u>HELP Administration</u>	
Minnesota	20	ADOT Admin	6
Nevada	25	ADOT Travel	6
New Mexico	25	Misc. Expenses	4
Oregon	30	Management Consultant	160
Pennsylvania	25	Policy Consultant	75
Texas	50		251
Virginia	25		
Washington	50	<u>HELP Travel</u>	
PANYNJ	25	Sub-total	
Total	550	Contingency	18.4
Reserve carried forward from FY 86-87	70.7		620.7
	620.7		

HELP States Travel FY 1987-88

Alaska	\$ 13,000
Arizona	6,000
California	4,500
Idaho	5,000
Iowa	7,000
Minnesota	4,000
Nevada	4,000
New Mexico	5,000
Oregon	14,000
Pennsylvania	8,000
Texas	4,000
Virginia	8,000
Washington	7,800
WHI	5,000
Port Authority NY & NJ	6,000
	<u>\$ 101,300</u>

STATE TRAVEL
FY1988-89
(Revised 02/25/89)

Arizona	\$ 2,000
California	6,000
Colorado	4,000
Idaho	5,000
Iowa	4,000
Minnesota	4,000
Nevada	4,000
New Mexico	5,000
Oregon	10,000
Pennsylvania	8,000
Texas	4,000
Virginia	6,000
Washington	4,000
PANYNJ	4,000
WHI	<u>4,000</u>
	\$74,000

~~ADOPTED~~

PROPOSED FY1988-89 HELP BUDGET (\$000s)
October 1, 1988 through September 30, 1989

<u>INCOME</u>		<u>EXPENDITURE</u>	
Arizona	178.00	AVI Transponders	175.00
California	125.00	Crescent RFP	280.00
Colorado	25.00	(2 yr. budget)	
Idaho	25.00	Admin. Costs	4.00
Iowa	25.00	Admin. Travel	6.00
Minnesota	30.00	Misc. Expenses	4.00
Nevada	30.00	Outreach	2.50
New Mexico	91.75	Management Consultant	150.00
Oregon	100.00	Policy Consultant	75.00 65.00
Pennsylvania	25.00	Policy Consultant Travel	10.00
Texas	50.00	State Travel	74.00
Virginia	45.00	(see separate sheet)	
Washington	25.00		
PANYNJ	<u>25.00</u>		
	799.75		
		Sub-total	<u>770.50</u>
Reserve carried forward from FY87-88	<u>16.50</u>	Reserve	<u>45.75</u>
	<u>816.25</u>		<u>816.25</u>

STATE TRAVEL
FY1989-90

Arizona	\$ 4,000
California	6,000
Colorado	4.000
Idaho	5,000
Iowa	4,000
Minnesota	4,000
Nevada	4.000
New Mexico	5,000
Oregon	10.000
Pennsylvania	8.000
Texas	4,000
Virginia	6,000
Washington	4,000
PANYNJ	4.000
WHI	4,000
	<u>\$76.000</u>

TENTATIVE FY1989-90 HELP BUDGET (\$0000S)
October 1, 1989 through September 30, 1990

INCOME

Arizona	-
California	125.00
Colorado	25.00
Idaho	25.00
Iowa	25.00
Minnesota	30.00
Nevada	30.00
New Mexico	25.00
Oregon	50.00
Pennsylvania	25.00
Texas	50.00
Virginia	45.00
Washington	25.00
PANYNJ	<u>25.00</u>
	505.00

Reserve carried
forward from
FY87-88

45.75

550.75

EXPENDITURE

AVI transponders	175.00	
Admin. Costs	4.00	
Admin. Travel	4.00	
Misc. Expenses	4.00	
Outreach	2.50	
Management Consultant	160.00	
Policy Consultant	75.00	65.00
Policy Consultant Travel		10.00
State Travel (see separate sheet)	76.00	
Sub-total	<u>500.50</u>	

Reserve

50.25

550.75

CAPITAL EXPENDITURE ON EQUIPMENT
FOR CRESCENT DEMONSTRATION PROJECT

The following figures have been included at the request of the Executive Committee. The figures represent actual and/or estimated state expenditures on WIM equipment at Crescent sites plus estimated expenditure on AVI equipment.

Washington	\$227,500
Oregon	\$360,540
California	\$700,000
Arizona	\$303,000
New Mexico	\$133,500
Texas	\$665,000

APPENDIX G

Heavy Vehicle Electronic License
Plate (HELP) Program

Pool Fund Budget

Consolidated Financial Statement
July 1, 1985 through September 30, 1990

RECAST FY 1985-86 HELP BUDGET (\$ 000s)
 July 1, 1985 through September 30, 1986

INCOME

Alaska	100.0
Arizona	250.0
California	125.0
Idaho	25.0
Iowa	
Minnesota	
Nevada	25.0
New Mexico	70.0
Oregon	204.0
Pennsylvania	35.0
Texas	150.0
Virginia	25.0
Washington	25.0
Subtotal	<u>1,034.00</u>
FHWA	250.0
Total	<u>1.284.0</u>

EXPENDITURE

AVI consultant	150.0
AVI track testing	53.3
WIM consultant	150.0
Satellite study	100.0
System design	250.0
Admin. time	6.5
Admin. travel	6.0
Misc. expenses	4.0
Mgmt. consultant	265.0
Policy consultant	45.0
State travel	64.0
Other costs	6.5
Subtotal	<u>1.101.3</u>
Reserve	182.7
Total	<u>1.284.0</u>

RECAST FY 1986-87 HELP BUDGET (\$ 000s)
October 1, 1986 through September 30, 1987

INCOME

Alaska	25.0
Arizona	150.0
California	125.0
Idaho	25.0
Iowa	
Minnesota	40.0
Nevada	25.0
New Mexico	50.0
Oregon	160.0
Pennsylvania	25.0
Texas	50.0
Virginia	25.0
Washington	25.0
PANYNJ	25.0
Subtotal	<u>750.0</u>
Reserve carried forward from FY 85-86	182.7
Total	<u>932.7</u>

EXPENDITURE

AVI field testing	125.0
AVI lab testing	126.9
WIM testing (states)	78.5
WIM consultant	50.0
Motor carrier workshop	37.7
Site selection study	35.0
SDS extension	42.3
Admin. time	2.5
Admin. travel	2.0
Misc. expenses	6.0
Mgmt. consultant	200.0
Policy consultant	45.0
State travel	86.5
Subtotal	<u>837.4</u>
Reserve	95.3
Total	<u>932.7</u>

RECAST FY 1987-88 HELP BUDGET (\$ 000s)
October 1, 1987 through September 30, 1988

<u>INCOME</u>		<u>EXPENDITURE</u>	
Alaska		AVI consultant	100.0
Arizona	100.0	AVI field testing	75.0
California	125.0	AVI pref. equip	78.0
Idaho	25.0	Onboard computer	25.0
Iowa		Management options	10.0
Minnesota	20.0		
Nevada	25.0	Admin. time	0.5
New Mexico	25.0	Admin. travel	1.0
Oregon	30.0	Misc. expenses	8.5
Pennsylvania	25.0	Mgmt. consultant	160.0
Texas	50.0	Policy cons. (NEI)	11.0
Virginia	25.0	Policy cons. (WHM)	54.0
Washington	50.0	Policy cons. (travel)	10.0
PANYNJ	25.0		
		State travel	63.5
Subtotal	<u>525.0</u>	Subtotal	<u>596.5</u>
Reserve carried forward from		Reserve	23.8
FY 86-87	95.3	Total	<u>620.3</u>
Total	<u>620.3</u>		

RECAST FY 1988-89 HELP BUDGET (\$000s)
October 1, 1988 through September 30, 1989

INCOME

Alaska	
Arizona	175.00
California	125.00
Idaho	25.00
Iowa	25.00
Minnesota	30.00
Nevada	30.00
New Mexico	91.75
Oregon	100.00
Pennsylvania	25.00
Texas	50.00
Virginia	45.00
Washington	25.00
PANYNJ	25.00

Subtotal	<u>771.75</u>
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Reserve carried
forward from
FY 87-88

23.80

Total	<u>795.55</u>
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EXPENDITURE

Admin. time	1.00
Admin. travel	8.00
Misc. expenses	6.00
Mgmt. consultant	150.00
Policy consultant	65.00
Policy cons. (travel)	10.00

State travel	71.00
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Subtotal	<u>311.00</u>
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Reserve	484.55
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Total	<u>795.55</u>
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RECAST FY 1989-90 HELP BUDGET (\$ 000s)
October 1, 1989 through September 30, 1990

<u>INCOME</u>		<u>EXPENDITURE</u>	
Arizona		AVI transponders	350.00
California	125.00	Crescent Phase IA	282.00
Colorado	25.00		
Idaho	25.00	Admin. time	0.50
I owa	25.00	Admin. travel	7.50
Minnesota	25.00	Misc. expenses	16.00
Nevada	30.00	Mgmt. consultant	160.00
New Mexico	25.00	Policy consultant	65.00
Oregon	50.00	Policy cons. (travel)	10.00
Pennsylvania	25.00		
Texas	50.00	State travel	87.00
Virginia	45.00		
Washington	25.00	Subtotal	<u>978.00</u>
PANYNJ	25.00		
		Reserve	6.55
Subtotal	<u>500.00</u>	Total	<u>984.55</u>
Reserve carried forward from FY 88-89	484.55		
Total	<u>984.55</u>		

RECAST HELP STATE TRAVEL (\$ 000s)

	FY 85/6	FY 86/7	FY 87/8	FY 99/9	FY 89/90	TOTAL
AK	8.0	12.0	-	-	-	20.0
AZ	6.0	1.0	1.0	4.0	4.0	16.0
CA	6.0	4.5	10.0	10.0	10.0	40.5
CO	-	-	-	-	4.0	4.0
ID	3.0	5.0	5.0	6.0	6.0	25.0
IA	3.0	7.0	4.0	3.0	5.0	22.0
MN	3.0	4.0	4.0	7.0	6.0	24.0
NV	5.0	2.0	2.5	2.0	4.0	15.5
NM	5.0	4.0	7.0	3.5	5.0	24.5
OR	8.0	14.0	10.0	10.0	12.0	54.0
PA	4.0	8.0	8.0	8.0	8.0	36.0
TX	5.0	-	-	4.0	4.0	13.0
VA	3.0	6.0	6.0	2.5	4.0	19.5
WA	5.0	8.0	4.0	5.0	7.0	29.0
WHI	-	5.0	2.0	4.0	4.0	15.0
PANYNJ	-	6.0	2.0	2.0	4.0	14.0
TOTAL	64.0	86.5	63.5	71.0	87.0	372.0

TOTAL STATE CONTRIBUTIONS TO
THE HELP PROGRAM (\$ 000s)
July 1, 1985 through September 30, 1990

Alaska	125.00
Arizona	675.00
California	625.00
Colorado	25.00
Idaho	125.00
Iowa*	50.00
Minnesota*	115.00
Nevada	135.00
New Mexico	261.75
Oregon	544.00
Pennsylvania	135.00
Texas	350.00
Virginia	165.00
Washington	150.00
PANYNJ	100.00
Total	3,580.75

*Excludes in-kind funding provided through the AWACS study.

APPENDIX H
PROPOSED FY 1990-91 HELP BUDGET (\$000s)
October 1, 1990 through September 30, 1991

<u>INCOME</u>		<u>EXPENDITURE</u>	
Arizona	50.00	Crescent Phase IB*	1.204.55
California	125.00	(Approved)	
Colorado	25.00	AVI compatible system*	125.00
Idaho	25.00	(Approved)	
Iowa	25.00	AVI beacon system	120.00
Minnesota	25.00	(approved)	
Nevada	30.00		
New Mexico	25.00		
Oregon	50.00	Admin. time	0.50
Pennsylvania	25.00	Admin. travel	8.00
Texas	50.00	Misc. expenses	6.00
Virginia	25.00	Mgmt. consultant	160.00
Washington	25.00	Policy consultant	65.00
Utah	25.00	Policy cons. (travel)	10.00
PANYNJ	25.00		
FHWA	<u>1.500.00</u>	State travel	<u>91.00</u>
Subtotal	2.055.55	Subtotal	<u>1.790.05</u> =====
Reserve carried forward from FY 89-90	<u>6.55</u>	Crescent Phase II**	1.131.14
		(proposed)	
		AVI/OBC study**	80.00
Total	2.061.00	(proposed)	<u> </u>
		Subtotal	<u>1.211.14</u> =====
		Total expenditure	<u>3.001.19</u>
		(shortfall)	(939.64)

* Contingent on receipt of %1.5M of federal assistance

** Contingent on receipt of additional federal assistance proposed for FY 1991-92

APPENDIX I

5. RESOURCES FOR THE CRESCENT DEMONSTRATION

Introduction

This section and the following section identify the income, expenditure and other contributions that can be attributed to the Heavy Vehicle Electronic License Plate (HELP) program since its inception in 1984. This first section provides estimates of the resources that will be needed for the Crescent Demonstration in addition to any funding provided by the FHWA.

The contributions related to the Crescent Demonstration include capital expenditure on equipment purchase and installation by individual states, and estimates of the value of time input by state and trucking industry personnel during the demonstration period. This demonstrates the commitment and scale of contributions by all parties involved in the Crescent. It clearly shows that the FHWA is not being asked to exclusively shoulder the burden of funding the Demonstration, but is being requested to become a member of the unique public/private partnership dedicated to the success of the HELP concept.

Prior to making this proposal to the Federal Highway Administration, the HELP program actively sought other sources of funding. These included additional contributions by individual states to the HP&R pool fund and requests for funding to private industry participants. It was accepted, however, that these parties had previously, and continued to make, significant commitments to the limit of their ability and so the substantial extra funds for the Crescent must be found elsewhere.

Contributions

Contributions toward the Crescent Demonstration to date (estimates of funding levels or funding which has been committed but not yet expended for the Crescent Demonstration period are shown in brackets):

WIM/AVC equipment (see detail A)	\$2,962,356	
AVI field equipment (see detail B)		(\$608.375)
AVI transponders installation/ initialization (see detail C)		(\$280.000)
Participating trucker contribution during one-year demonstration		(\$400,000)
Individual state commitment (see detail D)		(\$1,588.000)
Total	%2,962.356	(\$2.876.375)
Total on completion		\$5.838.731

Detail A - Individual state commitments for WIM/AVC equipment purchase and installation to date. This is expenditure by individual states on capital equipment for use in the Crescent Demonstration.

Cost Detail

State	# of Sites	State Funds	Federal(*) Funds	Total Expenditures
Washington	4	\$210,000	-----	\$210,000
Oregon	7	\$86,189	5853,167	\$939,356
California	10	\$70,000	5630,000	\$700,000
Arizona	8	\$30,300	5272,700	\$303,000
New Mexico	1	\$11,000	\$134,000	\$145,000
Texas	4	\$66,500	\$598,500	\$665,000
TOTALS	34(**)	\$473,989	\$2,488,367	\$2,962,356

(*) Includes 4R and HP&R funding

(**) Excludes state level computer sites (one per state) and sites in British Columbia (three, including state level computer)

NOTE: This equipment will continue to contribute to a weight enforcement program beyond the Crescent Demonstration.

Detail B - AVI field equipment purchase. This is expenditure committed by individual states on AVI reader equipment for the Crescent Demonstration. This equipment will form part of a weight enforcement program

	State Funds	Federal Funds (*)	Total
34 AVI readers @ \$7,500 each	\$25.500	5229,500	\$255,000
6 portable readers @ \$6,000 each	3,600	32,400	36,000
94 Type 1 antennas @ \$1,850 each	17,390	156,510	173,900
94 Type 3 antennas @ \$2,325 each	21,855	196.695	218,550
	-----	-----	-----
	\$68.345	5615,105	\$683.450

(*) Includes 4R and HP&R funding

NOTE: Type 1 AVI equipment has a one-way (vehicle-roadside) communications capability. Type 3 AVI equipment has a two-way (vehicle-roadside & roadside-vehicle) communications capability.

Detail C - Transponder installation/initialization. This represents a contribution that will be made by volunteer motor carriers in the Crescent Demonstration in installing transponders and completing the necessary initial paperwork.

5,000 transponders @ \$31/installation	= 5155.000
5.000 transponders @ \$25/initialization	= 5125.000
Total	5280,000

Detail D - Individual state commitment for personnel and out-of-pocket expenses during the demonstration period. This comprises an estimate of staff costs and other direct expenses that states will meet outside of their contributions to the HELP HP&R pool fund.

State	Personnel Expenses	Out-of-Pocket Expenses	Total Expenses
Washington	\$135,000	\$25,000	\$160,000
Oregon	\$120,000	\$20,000	\$140,000
California	\$240,000	\$20,000	\$260,000
Arizona	\$144,000	\$8,000	\$152,000
New Mexico	\$67,000	\$25,000	\$92,000
Texas	\$96,000	\$8,000	\$104,000
Non-Crescent (*)	\$600,000	\$80,000	\$680,000
TOTALS	\$1,402,000	\$186,000	\$1,588,000

ix Indicates estimated personnel and out-of-pocket expenses for non-Crescent states during the Crescent Demonstration period.

6. TOTAL CONTRIBUTIONS TO THE HELP PROGRAM

This section identifies the total income, expenditure and other contributions to the HELP program as a whole

Income to the HELP program has been divided into two categories. The first is the direct financial contributions to date made by state departments of transportation and the Port Authority of New York and New Jersey to the HELP pool fund. The second category seeks to estimate contributions that will be made by the same organizations during the fiscal year 1990-1991.

The expenditure category is broken into four areas. The first of these identifies completed and committed expenditures from the HELP program pool fund on technical studies. The second category estimates expenditures from the HELP pool fund on technical studies during the fiscal year 1990-1991. Similarly, the third and fourth categories cover committed expenditure of pool funds on administration to date and anticipated expenditures on administration for FY 90-91 respectively.

The third section of the paper identifies other contributions to the HELP program, and is divided into three areas. The first of these seeks to estimate contributions made by state and industry participants who attend meetings and other program activities: by commercial equipment vendors who have provided loaned equipment and engineering support during specific testing and evaluation phases of the program: and by other organizations which have made significant contributions to some aspect of the HELP program.

The second category estimates the value of other directly related contributions. These include the results and experience gained from highly relevant related technical studies.

Finally, it should be noted that many of the indirect and related contributions are impossible to determine accurately. This paper aims only to indicate the scale of contributions and to demonstrate the commitment of the participants to the goals of the HELP program.

Income

1. Direct pool fund contributions from HELP participants. July 1985 through September 1990 (all contributions are HP&R funds unless otherwise stated):

Alaska	\$155,000
Arizona	\$678,000
California	\$625,000
Idaho	\$125,000
Iowa	\$ 50,000
Minnesota	\$120,000
Nevada	\$135,000
New Mexico	\$261,750
Oregon	\$544,000
Pennsylvania	\$135,000
Texas	\$350,000
Virginia	\$165,000
Washington	\$150,000
PANYNJ (non-HP&R)	\$100,000
TOTAL	<u>\$3,593,750</u>

2. Proposed pool fund contributions from HELP participants during the period of the Crescent Demonstration. October 1990 through September 1992. These contributions will continue to be used for program administration. Travel and for evaluations. (all contributions are HP&R funds unless otherwise stated):

Arizona	\$200,000
California	\$250,000
Colorado	\$50,000
Idaho	\$50,000
Iowa	\$50,000
Minnesota	\$60,000
Nevada	\$60,000
New Mexico	\$50,000
Oregon	\$100,000
Pennsylvania	\$50,000
Texas	\$100,000
Virginia	\$50,000
Washington	\$50,000
PANYNJ (non-HP&R)	\$50,000
TOTAL	<u>\$1,170,000</u>

GRAND TOTAL INCOME (July 1985 - Sept 1991)\$4,763,750

Expenditure

1. Direct expenditure of pool funds on technical studies to date
(Figures in brackets represent pool funds which have been committed but have not yet been expended):

AVI Consultant	\$250,000	
AVI track tests	\$53,000	
AVI lab tests	\$126,858	
AVI field tests	\$200,000	
AVI equipment (draft specification)	\$78,000	
AVI transponders (see detail A. p29)		(\$376,200)
WIM consultant	\$200,000	
WIM field tests		
- Idaho	\$25,000	
- Illinois	\$37,500	
- Oregon	\$37,500	
Satellite study	\$100,000	
Site selection study	\$35,000	
Motor carrier workshop	\$37,731	
OBC study	\$25,000	
Management options study	\$10,000	
System design study extension	\$42,304	

Crescent Phase IA contract		(\$282,000)
Total	\$1,245,843	
Total on completion		\$1,904,043

2. Direct expenditure of pool funds on administration to date:

Administrative time	\$14,500
Administrative travel	\$17,000
Miscellaneous expenses	\$26,000
Management Consultant	\$918,798
Policy Consultant	\$210,205
Policy consultant travel	\$20,000
State travel	\$368,500
Other capital expenditure	\$4,732

Total on completion	\$1,579,735

4. Anticipated (uncommitted) expenditure of pool funds on administration during the course of the Crescent Demonstration (FY 90-91 and FY91-92):

Administrative time	\$4,000
Administrative travel	\$12,000
Miscellaneous expenses	\$13,000
Management Consultant	\$320,000
Policy Consultant	\$130,000
Policy Consultant travel	\$20,000
State travel	\$160,000
Total	<u>\$659,000</u>

GRAND TOTAL EXPENDITURE TO DATE	\$2,825,578
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GRAND TOTAL EXPENDITURE TO END FY91	\$4,142.778
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Other contributions

1. Estimated value-of-time contributions to the HELP program to date:

HELP state representatives	\$650,000
HELP trucking industry participants	\$500,000
WIM/AVI vendors (1)	\$100,000
Ford Motor Company assistance (2)	\$50,000
Virginia DOT AVI testing (3)	\$25,000
Total	<u>\$1,325,000</u>

2. Other related contributions to date (estimated totals to complete projects, where appropriate are shown in brackets):

HELP Feasibility Study (4)	
- FHWA funding	\$38,700
- Arizona DOT funding	\$4,300
Proof of concept demonstration (5)	
- FHWA funding	\$180,000
- Oregon DOT funding	\$20,000
System design study (6)	
- FHWA funding	\$250,000
AWACS project (7)	
- consultant contract	\$250,000
- IADOT/MNDOT staff time	\$270,000
Total	<u>\$1,013,000</u>

GRAND TOTAL \$2,338,000

Detail A - Final specification AVO transponders. These 5,000
Transponders will be procured from the HELP HP&R pool fund
For use during the Crescent Demonstration.

4,700 Type 1 transponders @ \$66 each	=	\$310,200
300 Type 3 transponders @ \$220 each	=	\$66,000
Total		<u>\$376,200</u>

NOTES

- 1 Assistance in terms of equipment loan and engineering support was provided by AVI equipment vendors during the track, laboratory and field testing phases of the AVI program and by WIM equipment vendors during the laboratory and field testing phases of the WIM program.
- 2 Ford Motor Company provided free use of the Yucca Proving Ground to Arizona DOT personnel during the AVI track test program.
3. Virginia DOT has funded the installation of the HELP preferred system AVI equipment on the Dulles Toll Road and has provided equipment and staff support for testing and evaluation.
4. The original HELP Feasibility Study was funded by the FHWA and Arizona DOT.
5. A proof of concept demonstration involving installation of AVI and WIM equipment at the Woodburn POE and at Jefferson, Oregon was funded by the FHWA and Oregon DOT.
6. Funding was provided by the Federal Highway Administration to undertake an initial HELP system design study.
7. The AWACS (automatic weight and classification system) project was funded by the states of Iowa and Minnesota and the FHWA. Iowa and Minnesota DOTs used the AWACS project as in-kind funding for participation in the HELP program during fiscal years 1986/87 and 1987/88.

Cost Summary

Costs from the inception of the HELP program through the completion of the Crescent Demonstration can be summarized as follows:

1.	HP&R pool funds:	
	Federal funds	\$4,613,750
	PANYNJ (non-federal funds)	\$150,000
2.	System design study (federal funds)	\$250,000
3.	Motor carrier industry staff time (non-federal funds)	\$1,180,000
4.	State personnel staff time (non-federal funds)	\$2,238,000
5.	Virginia AVI testing (non-federal funds)	\$25,000
6.	Miscellaneous vendor support (non-federal funds)	\$150,000
7.	WIM/AVC equipment:	
	Federal funds	\$2,488,367
	Non-federal funds	\$473,989
8.	AVI equipment:	
	Federal funds	\$991,305
	Non-federal funds	\$68,345

TOTAL

Federal funds	\$8,243,422
Non-federal funds	\$4,285,334

APPENDIX J

ITEM 4

FY 1990-91 HELP BUDGET (\$000S)
October 1, 1990 through September 30, 1991

INCOME

Arizona	50.00
California	125.00
Colorado	25.00
Idaho	25.00
Iowa	25.00
Minnesota	25.00
Nevada	30.00
New Mexico	25.00
Oregon	50.00
Pennsylvania	25.00
Texas	50.00
Washington	25.00
Utah	25.00
PANYNJ	25.00
Subtotal	555.00
Reserve carried	
Forward from	
FY89-90	<u>6.55</u>

Total	561.55

FHWA COMMITMENT

FHWA	3,000.00
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EXPENDITURE

Admin. Time	8.50
Admin. travel	8.00
Misc. expenses	6.00
Mgmt. Consultant	160.00
Policy consultant	65.00
Policy cons. (travel)	10.00
State travel	<u>91.00</u>
Subtotal	348.50
Reserve carried	
Forward to	
FY 91-92	213.05

FHWA EXPENDITURE ITEMS

Crescent IB	1,204.55
AVI compatible system	125.00
AVI beacon system	120.00
Crescent Phase II	1,131.14
(subject to contract)	
AVI/OBC study	<u>80.00</u>
(subject to contract)	

Total	2,660.69

Funds available for	
Currently unspecified	
Expenditure or to	
Be transferred to	
FY91-92	<u>339.31</u>

APPENDIX K

PROPOSED FY 1991-92 HELP BUDGET (\$000S) October 1, 1990 through September 30, 1991

INCOME

Arizona	50.00
California	125.00
Colorado	25.00
Idaho	25.00
Iowa	25.00
Minnesota	25.00
Nevada	30.00
New Mexico	25.00
Oregon	50.00
Pennsylvania	25.00
Texas	50.00
Virginia	25.00
Washington	25.00
Utah	25.00
PANYNJ	<u>25.00</u>

Subtotal 555.00

Reserve carried forward
from FY90-91 213.05

Total 768.05

EXPENDITURE

Admin. time	5.00
Admin. travel	8.00
Misc. expenses	6.00
Mgmt. consultant	160.00
Policy consultant	65.00
Policy cons. (travel)	10.00
State travel	<u>91.00</u>
Subtotal	345.00
Reserve	<u>423.05</u>

FHWA COMMITMENT

FHWA 2,000.00
(subject to
availability
of funding)

FHWA EXPENDITURE ITEMS

Crescent Phase III (subject to approval)	1,594.21
Systems integration support (subject to approval)	125.00
Funds available for currently unspecified expenditure from FY90-91	<u>249.31</u>
Funds available for currently unspecified expenditure in FY91-92	280.79

APPENDIX L

Heavy Vehicle Electronic License Plate (HELP) Program
Budget fiscal year 1992-93
October 1, 1992 - September 30, 1993

HP&R pooled fundsIncome

Arizona	75,000.00
Iowa	35,000.00
Minnesota	35,000.00
New Mexico	25,000.00
Oregon	65,000.00
Pennsylvania	25,000.00
Texas	25,000.00
Virginia	25,000.00
Washington	25,000.00

Brought forward from FY 91-92	<u>302,523.27</u>
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Total	\$637,523.27
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Expenses

Administrative:

Administrative time	10,000.00
Executive Director (personal services)	30,000.00
Executive Director (expenses)	20,000.00
Miscellaneous expenses	15,000.00
Management consultant	160,000.00
Policy consultant (FY92 contract)	22,000.00
Policy consultant (travel) (FY92 contract)	3,500.00
Policy consultant (FY93 contract)	43,000.00
Policy consultant (travel) (FY93 contract)	<u>6,500.00</u>

Subtotal	310,000.00
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State travel:	84,000.00
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Technical:

AVI transponders'	77,550.00
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Summary

Total income	637,523.27
Total expenses	<u>471,550.00</u>

Contingency	\$165,973.27
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Notes

'These AVI transponders are those already received from Vapor for the Crescent. These funds were originally budgeted and committed in FY1988-89. This is the currently unexpended amount, awaiting final acceptance of the equipment.

Heavy Vehicle Electronic License Plate (HELP) Program
 Budget fiscal year 1992-93
 October 1, 1992 - September 30, 1993

State funds

Income

California	375,000.00
Colorado	35,000.00
Idaho	35,000.00
Nevada	35,000.00
Texas	25,000.00
Utah	25,000.00
Washington	10,000.00
Brought forward	<u>~ 131,860.06</u>
Total	\$671,860.06

Expenses

Crescent Phase B evaluation (partial)	365,000.00
Vapor installation ²	35,000.00
AVI equipment costs ³	26,000.00
Santa Neila mainline	<u>250,000.00</u>
Total	670,000.00

Contingency \$1,860.06

Notes

¹This item together with funds from the federal funds will cover the cost of the Crescent evaluation Phase B.

²This item is for installation support budgeted in FY 1991-92. Payment will be made when all equipment is received and accepted.

³This item was originally budgeted in FY 1991-92 for items including a programmer and new EPROMS. Payment will be made after full receipt and acceptance of the equipment.

Heavy Vehicle Electronic License Plate (HELP) Program
 Budget fiscal year 1992-93
 October 1, 1992 - September 30, 1993

Federal funds

Income

Funds available from FY 1991-92	910,720.08
New request	<u>1,500,000.00</u>
Total	2,410,720.08

Expenses

Crescent Phase IIIB ¹	900,000.00
Crescent Phase B evaluation (partial) ²	720,000.00
Lighting control ³	178,573.00
AVI transponders	150,000.00
Santa Nella on-vehicle equipment	125,000.00
HELP, Inc. start-up	<u>200,000.00</u>
T0t2.1	\$2,273,573.00
Contingency	\$137,147.08

Notes

¹Phase IIIB will provide a twelve-month extension to Crescent operations to ensure that the operational test and its evaluation occur over a full twelve months. This period will also allow time to develop proposals for the future operation of the Crescent and the HELP program as a whole. The Phase IIIB cost includes 12 months of system maintenance.

²This item together with state and HP&R pool funds will cover the remainder of the Crescent evaluation Phase B.

³This item was budgeted in FY1991-92 and was contracted to LISC. Payment will be made during the current fiscal year.

Heavy Vehicle Electronic License Plate (HELP) Program
Budget fiscal year 1992-93
October 1, 1992 - September 30, 1993

Year End Financial Statement - Pessimistic Scenario

SPR pooled funds

Income

Arizona	56,000.00
California	417,500.00
Colorado	35,000.00
Idaho	35,000.00
Iowa	35,000.00
Minnesota	35,000.00
New Mexico	25,000.00
Oregon	65,000.00
Pennsylvania	25,000.00
Texas	25,000.00
Virginia	25,000.00
Washington	25,000.00
HELP, Inc. revenue1	140,000.00
Brought forward from FY 91-92	<u>315,925.46</u>
Total	\$1,259,425.46

Note

1A HELP, Inc. revenue line item and associated expenditure line item was approved by the Board at the March 1993 meeting. The revenue shown here comprises that received as SPR as follows: Idaho \$35,000; Oregon \$35,000; Texas \$35,000; Washington \$35,000. Funds have also been committed by Colorado (\$35,000) and New Mexico (\$35,000) but have not been received. In addition, a California contribution for FY 1993 of \$35,000 will be paid in FY1994, and an Arizona contribution of \$35,000 has been made as an in-kind contribution.

Expenses**Administrative:**

Administrative time ¹	20,000.00
Administrative travel	5,000.00
Executive Director (personal services)	30,000.00
Executive Director (expenses)	20,000.00
Miscellaneous expenses	15,000.00
Management consultant	160,000.00
Management consultant (expenses)	9,550.00
Policy consultant (FY92 contract)	22,000.00
Policy consultant (travel) (FY92 contract)	3,000.00
Policy consultant (FY93 contract)	43,000.00
Policy consultant (travel) (FY 93 contract)	<u>6,500.00</u>

Subtotal	334,550.00
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HELP, Inc.	140,000.00
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State travel:	\$4,000.00
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Technical:

AVI transponders ²	77,550.00
AVI maintenance/upgrades'	79,000.00
Crescent Phase B evaluation (partial)	216,000.00
Santa Nella Mainline	<u>400,000.00</u>

Subtotal	772,550.00
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Summary

Total income	1,259,425.46
Total expenses	<u>1,331,100.00</u>

Contingency	(\$ 7 1,674.54)
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Notes

1The administrative time budget currently includes the HELP, Inc. Interim Director salary costs. These will be broken out when a HELP, Inc. budget for FY 1992-93 is adopted.

2These AVI transponders are those already received from Vapor for the Crescent. These funds were originally budgeted and committed in FY 1988-89. This is the currently unexpended amount, awaiting final acceptance of the equipment.

'This contract is with LISC, with Mark IV as a subcontractor, to maintain and upgrade all AVI sites on the Crescent.

Heavy Vehicle Electronic License Plate (HELP) Program
Budget fiscal year 1992-93
October 1, 1992 - September 30, 1993

Year End Financial Statement - Pessimistic Scenario

Federal funds

Income

Funds available from FY 1991-92	1,673,713.49
Funds for FY 1992-93	<u>850,000.00</u>
Total	2,524,713.49

Exnenses

Crescent Phase II	14,320.00
Crescent Phase III	505,936.00
Crescent Phase IIIB	1,082,638.00
Crescent Phase IIIB maintenance	125,000.00
Crescent Phase B evaluation (partial)	645,000.00
AVI consultant4	<u>151,443.00</u>
Total	\$2,524,337.00
Contingency	\$376.49

Notes

‘Phase IIIB will provide a twelve-month extension to Crescent operations to ensure that the operational test and its evaluation occur over a full twelve months. This period will also allow time to develop proposals for the future operation of the Crescent and the HELP program as a whole. This funding amount includes an interim extension to the LISC Phase III contract in the amount of \$225,000 to continue operations of the Crescent between October 1, 1992 and December 15, 1992.

‘This item together with state and SPR pool funds will cover the remainder of the Crescent evaluation Phase B.

‘This item represents the remaining funds in the CRC AVI research contract.

Heavy Vehicle Electronic License Plate (HELP) Program
Budget fiscal year 1992-93
October 1, 1992 - September 30, 1993

HP&R Pooled Funds

Income

Arizona	75,000.00
Iowa	35,000.00
Minnesota	35,000.00
New Mexico	25,000.00
Oregon	65,000.00
Pennsylvania	25,000.00
Texas	25,000.00
Virginia	25,000.00
Washington	25,000.00
Brought forward from FY 91-92	<u>333,925.46</u>
Total	\$668,925.46

Expenses

Administrative:

Administrative time ¹	20,000.00
Administrative travel	5,000.00
Executive Director (personal services)	30,000.00
Executive Director (expenses)	20,000.00
Miscellaneous expenses	15,000.00
Management consultant	160,000.00
Management consultant (expenses)	9,550.00
Policy consultant (FY92 contract)	22,000.00
Policy consultant (travel) (FY92 contract)	3,500.00
Policy consultant (FY93 contract)	43,000.00
Policy consultant (travel) (FY93 contract)	<u>6,500.00</u>
Subtotal	334,550.00

State travel: 84,000.00

Technical:

AVI transponders ²	77,550.00
AVI maintenance/upgrades ³	79,000.00
Crescent Phase B evaluation (partial)	<u>90,000.00</u>
Subtotal	246,550.00

Summary

Total income	668,925.46
Total expenses	<u>665,100.00</u>
Contingency	\$ 3,825.46

Notes

¹The administrative time budget currently includes the HELP, Inc. Interim Director salary costs. These will be broken out when a HELP, Inc. budget for FY1992-93 is adopted.

²These AVI transponders are those already received from Vapor for the Crescent. These funds were originally budgeted and committed in FY 1988-89. This is the currently unexpended amount, awaiting final acceptance of the equipment.

³This contract is with LISC, with Mark IV as a subcontractor, to maintain and upgrade all AVI sites on the Crescent.

Heavy Vehicle Electronic License Plate (HELP) Program
 Budget fiscal year 1992-93
 October 1, 1992 - September 30, 1993

State funds

Income

California	525,000.00
Colorado	35,000.00
Idaho	35,000.00
Nevada	35,000.00
Texas	25,000.00
Utah	25,000.00
Washington	10,000.00
Brought forward	<u>131,860.06</u>
Total	\$821,860.06

Expenses

Crescent Phase B evaluation (partial) ¹	350,000.00
Santa Nella mainline	400,000.00
New Mexico site upgrades	<u>11,900.00</u>
Total	761,900.00

Contingency \$59,960.06

Notes

¹This item together with funds from the federal funds will cover the cost of the Crescent evaluation Phase B.

Heavy Vehicle Electronic License Plate (HELP) Program
 Budget fiscal year 1992-93
 October 1, 1992 - September 30, 1993

Federal funds

Income

Funds available from FY 1991-92	1,674,713.49
New request	<u>850,000.00</u>
Total	2,524,713.49

Expenses

Crescent Phase II	14,320.00
Crescent Phase III	505,936.00
Crescent Phase IIIB ¹	900,000.00
Crescent Phase IIIB maintenance	125,000.00
Crescent Phase B evaluation (partial) ²	645,000.00
Crescent training	4,065.00
Lighting control ³	178,573.00
AVI consultant ⁴	<u>151,443.00</u>

Total	\$2,524,337.00
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Contingency	\$376.49
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Notes

1Phase IIIB will provide a twelve-month extension to Crescent operations to ensure that the operational test and its evaluation occur over a full twelve months. This period will also allow time to develop proposals for the future operation of the Crescent and the HELP program as a whole. This funding amount includes an interim extension to the LISC Phase III contract in the amount of \$225,000 to continue operations of the Crescent between October 1, 1992 and December 15, 1992.

2This item together with state and HP&R pool funds will cover the remainder of the Crescent evaluation Phase B.

3This item was budgeted in FY1991-92 and was contracted to LISC. Payment will be made during the current fiscal year.

4This item represents the remaining funds in the CRC AVI research contract.

APPENDIX 0
HEAVY VEHICLE ELECTRONIC LICENSE PLATE (H.E.L.P.) PROGRAM
ORGANIZATION CHARTER

INTRODUCTION

A consensus is needed on Pooled Study project management in order to assure that participating states and provinces agree on the mechanics of the project's work flow and responsibilities. This charter presents a strategy for project management to meet these requirements.

1. POLICY COMMITTEE

The purpose of the Policy Committee is to develop the Pooled Study's budget, approve the work program and appoint the Executive Committee. The Policy Committee will have a voting membership consisting of department heads or their designees from states/provinces involved in the H.E.L.P. Study as well as a representative of the motor carrier industry from each participating state and other members deemed appropriate. Ex-officio members may be appointed to the Policy Committee from national, international or regional transportation research organizations. The Policy Committee is responsible for organizing itself and will be able to conduct business with a quorum of members present.

1.1 Project Management

The Policy Committee will adopt such project management policies and procedures as the committee deems appropriate.

1.2 Funding

Pooled project funding will be derived from contributions by individual states. It is anticipated that states' contributions will come from pooled HPR funds. Similar treatment of funding mechanisms is needed from provinces and/or the Canadian Government. A uniform treatment of funding is assured under existing FHWA mechanisms for pooled funding projects.

1.3 Appointments

The Policy Committee is responsible for appointing the Executive Committee.

1.4 Budget and Work Program

The Policy Committee will approve a budget and a three-year work program for the Pooled Study after consideration of submissions from the Executive Committee.

1.5 Executive Committee

The purpose of the Executive Committee is to select a +policy consultant, approve a technical consultant contracting plan, approve RFPs/consultant selections, update the project's budget/work program, and make recommendations to the Policy Committee.

2.0 MEMBERSHIP AND ORGANIZATION

All participating states, public bodies and national/regional research groups participating in project funding are eligible for membership on the Executive Committee. In addition, the Policy Committee may appoint such non-funding states, public bodies, research organizations and motor carrier interest groups to the committee as they deem appropriate. Non-funding appointees will serve as ex-officio members. The lead state's representative will not chair the Executive Committee. The lead state's project manager will serve as an ex-officio member of the committee.

The Executive Committee is responsible for organizing itself and forming such subcommittees as are required by the work program. The large, multi-faceted scope of the project may require the creation of a number of subcommittees for different areas or components of investigation.

2.1 Policy Consultant Selection

The Executive Committee is responsible for selection of a policy consultant who will serve as staff to the committee in addition to other duties (see item 2.4 below) and who will report to the chairperson.

2.2 Approval of RFPs/Selection Processes

Subcommittees of the Executive Committee will approve RFPs to assure their consistency with the work program and budget. Subcommittees will also meet to select consultants, after consideration of a list of qualified consultants prepared by the lead state. Subcommittee consultant selection will assure consistent treatment of consultants and that the qualified list is consistent with the approved consultant selection process.

2.3 Review Products/Select Alternatives

Subcommittees will be responsible for establishing a degree of expertise in their given areas of research. This expertise will allow in-depth analysis and detailed presentations before the Executive Committee.

2.4 Product Acceptance

The Executive Committee is responsible for acceptance of final products from consultant teams.

2.5 Coordination and Education

The Executive Committee is responsible for maintaining a high degree of coordination with impacted parties and for creating educational programs to increase awareness of the needs, benefits and impacts related to heavy vehicle monitoring.

2.6 Studies By Individual States

With the approval of the Executive Committee, individual states may undertake projects at their own expense as part of the Pooled Study. In such instances credit against individual state's shares of project funding may be recognized.

3. LEAD STATE

3.1 Draft Consultants Selection Process/Develop Qualified Lists

The project manager is responsible for drafting developing a consultant selection process for the Executive Committee's approval, distributing ranking proposals and presentation of lists of consultants to subcommittees of the Executive Committee.

3.2 Consultant Management

The project manager will assure that contracts, schedules, workplans and product descriptions are followed. The project manager will also be responsible for quality control and evaluation, recommendations regarding change order requests, preparation of contract documents, and making progress payments.

3.3 Reports to Executive Committee

The project manager is responsible for providing contract progress reports to the Executive Committee.

3.4 Management Budget

The project manager is responsible for administering a including travel and per diem payments ody members on the Policy and Executive commit&es. Per diem and travel will be administered for each state consistently with that state's prevailing per diem and travel policies.

3.5 Project Management Consultant

The lead state may hire a project management consultant to help coordinate technical studies and to prepare and administer Policy/Executive Committee meeting agendas.

4. POLICY CONSULTANT

4.1 Policy/Executive Committee Staff

As staff to the committees, the policy consultant will assist with preparation of the budget and work program.

4.2 Coordination/Education

The policy consultant is responsible for management of all coordination/education responsibilities of the Executive Committee including interaction with the media.

5. TECHNICAL CONSULTANTS

5.1 Report To Lead State Project Manager

The technical consultants will report to the project manager who will approve invoices.

5.2 Briefings

Under the direction of the project manager, the technical consultants will make presentations and briefings to subcommittees of the Executive Committee. The technical consultants will be responsible for presenting their draft final products to the Executive Committee for acceptance.

NOTATIONAL LOG

1. Passed:

Executive Committee	5/15/85
Policy Committee	6/9/85

2. Amended:

(a) Delete the following from the Operating Charter:
"Policy Committee members will not sit on the Executive Committee.*"

(b) Change references in the Operating Charter from:
The "Crescent Program" to the "Heavy Vehicle
Electronic License Plate Program (HELP)."

Executive Committee	11/4/85
Policy Committee	11/25/85

Project No. _____

Heavy Vehicle Electronic License Plate Program
 Cooperative Agreement Between
 The Federal Highway Administration
 and
 The State of Arizona Department of Transportation

The Federal Highway Administration (FHWA) hereby approves the request of the State of Arizona (State) dated February 12, 1990 for Federal assistance funding for the Heavy Vehicle Electronic License Plate Program (HELP) pursuant to 23 U.S.C. '307.

1. Estimated Cost. The State shall be reimbursed for allowable costs incurred in the performance of work under this award in an amount not to exceed \$5,000,000 as follows:

FY'91	Phase 1B	\$1,500,000	
	Phase 2	\$1,500,000	
FY'92	Phase 3	\$2,000,000	(subject to availability of funds)
	Total	<u>\$5,000,000</u>	

2. Responsibility of the State. The State shall perform the work, or cause it to be performed, in compliance with the approved Work Orders which, by reference, are made a part hereof. In addition, the State shall perform, or cause to be performed, the following:

(a) The prime contractor performing work under this Agreement shall present one session of the Crescent Overview course in Washington, D.C., for interested officials from the FHWA and other States.

(b) The work performed under this Agreement shall include the implementation and evaluation of State line beacons and the "one-stop shopping" concept. Implementation is defined as full actual use of these concepts by one or more carriers.

(c) As the HELP Program progresses, new vehicle-to-road concepts and developing communication standards shall be monitored and accommodated where appropriate.

3. Work Orders. Individual activities agreed to be performed by the State and/or caused to be performed by the state shall be incorporated in Work Orders. Each phase of the work to be performed under this Agreement shall be the subject of a separate Work Order.

Each Work Order will specify the type and amount of assistance which will be provided by the FHWA and the work and goals to be accomplished by the State and/or caused to be accomplished by the State. Each Work Order must include a description of the work, completion dates for the work, and the signatures of the FHWA Division Administrator and an authorized representative of the State indicating acceptance of the Work Order. Each completed Work Order shall be accepted in writing by the FHWA prior to any work described therein. Issuance of a Work Order does not constitute a promise, either expressed or implied, that the FHWA will issue further Work Orders or provide additional assistance pursuant to this Agreement.

4. Period of Performance. The period of performance is as stated in the Work orders.

5. FHWA Participation. FHWA shall be considered as a full participant in the HELP Project. As such, the Region 9 Federal Highway Administrator shall be a voting member of the Policy Committee. The Associate Administrators for Safety and Systems Applications, Research and Development, Policy, and Motor Carriers shall be ex-officio members of the Policy Committee. The FHWA Headquarters Liaison to the HELP Program shall be a voting member of the Executive Committee. The FHWA Headquarters Liaison and the FHWA Field Office Coordinator shall be ex-officio members of all subcommittees, working groups, task forces, and other such groups related to the HELP program. FHWA will provide names, addresses, and phone numbers for each of these individuals to the HELP Program Manager.

6. Committee Documents. In addition to copies of reports, correspondence, meeting announcements, and other documents supplied to ex-officio members, an additional copy of all subcommittee materials shall be provided to the designated staff person for each of the FHWA Headquarters Associate Administrators noted above. FHWA will provide names, addresses, and phone numbers of these staff members to the HELP Program Manager. On a quarterly basis, the HELP Program Manager shall prepare a listing of all reports, correspondence, and other significant documents for the previous quarter and shall submit this listing to the FHWA Headquarters Liaison and the FHWA Field Office Coordinator.

7. Evaluation of Work. FHWA will participate in the evaluation of each phase. This includes the development and review of the evaluation plans for each phase as well as the review and assessment of the actual evaluations. Funding for each phase will be dependent on the successful completion of the previous phase. That determination will be based, in large part, on the evaluation of each phase.

8. Programmatic Chances. The State must obtain the prior approval of the FHWA whenever any significant change is anticipated. These include, but are not limited to:

(1) Any revision of the scope or objectives of the project (regardless of whether there is an associated budget revision requiring prior approval).

(2) Need to extend the period of availability of funds.

(3) Changes in key personnel, program manager, or prime contractor.

9. Technology Transfer. The FHWA shall have unlimited rights to the work developed in performance of this Agreement. Unlimited rights are defined as the right to use, disclose, reproduce, prepare derivative works, distribute copies to the public, in any manner and for any purpose and to have or permit others to do so in accordance with the requirements of the DC0 (Crescent Demonstration Operators) contract. The State shall make available to the FHWA copies of all work developed in performance of this Agreement, including but not limited to software, training manuals, and systems design. The State agrees to place the work developed in performance of this Agreement in the public domain unless otherwise stipulated in the DC0 contract.

10. costs. The State shall limit its progress claims and final claims to those costs incurred in accordance with this Agreement and to submit its final claim within 90 days after the project is completed.

11. Additional Requirements. The State shall comply with all laws, regulations and FHWA requirements applicable to this Agreement and with the general provisions set forth in Appendix A hereto.

12. Certification Regarding Lobbying. By executing this Agreement, the State makes the certification regarding lobbying which is attached hereto as Appendix B.

13. Termination. The State shall notify FHWA immediately of any intent to terminate this Agreement.

14. Effective Date. This Agreement is effective upon execution by both parties to this Agreement.

Federal Highway Administration

Edward A. Huete
(Division Administrator)

Date _____

Arizona Department of Transportation

Harry Reed
(Title: Asst.)
Date _____

GENERAL PROVISIONS FOR HELP AGREEMENT

1. General Provisions: The State will comply with all requirements imposed by FHWA concerning special requirements of law, program requirements, and other administrative requirements.
2. Regulation Requirements: The State hereby assures and certifies that it will comply with the regulations, policies, guidelines, and requirements, and applicable OMB circulars No. A-102 and A-87 as they relate to the application, acceptance, and use of Federal funds for this federally-assisted project.
3. Modifications: This Agreement may be amended at any time by a written modification properly executed by both the FHWA and the State.
4. Retention and Custodial Requirements for Records:
 - (a) Financial records, supporting documents, statistical records, and all other records pertinent to this instrument shall be retained for a period of 3 years, with the following exception:
 - (1) If any litigation, claim, or audit is started before the expiration of the 3-year period, the records shall be retained until all litigation claims, or audit findings involving the records have been resolved.
 - (2) Records for nonexpendable property, if any, required with Federal funds shall be retained for 3 years after its final disposition.
 - (3) When records are transferred to or maintained by FHWA, the 3-year retention requirement is not applicable to the recipient.
 - (b) The retention period starts from the date of the submission of the final expenditure report.
 - (c) the Secretary of Transportation and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any pertinent books, documents, papers, and records of the recipient, and its contractors and subcontractors, to make audits, examinations, excerpts, and transcripts.

5. Equal Employment Opportunity:

The applicant/recipient agrees to incorporate in all contracts having a value of over \$10,000, the provisions requiring compliance with Executive Order 11246, as amended, and implementing regulations Of the United States Debartinent of Labor at 41 CFR 60, the provisions of which, other than the standard EEO clause and applicable goals for employment of minorities and women, may be incorporated by reference.

(b) The applicant/recipient agrees to ensure that its contractors and subcontractors, regardless of tier, awarding contractors and/or issuing purchase orders for material, supplies, or equipment over \$10,000 in value will incorporate the required EEO provisions in such contracts and purchase orders.

(c) The applicant/recipient further agrees that its own employment policies and practices will be without discrimination based on race, color, religion, sex, national origin, handicap, or age; and that it has an affirmative action plan consistent with the Uniform Guidelines on Employee Selection Procedures, 29 CFR 1607, and the Affirmative Action Guidelines, 29 CFR 1608.

6. Copeland Act: All contracts in excess of \$2,000 for construction or repair awarded by recipients and its contractors or subcontractors shall include a provision for compliance with the Copeland "Anti-Kick Back" Act (18 U.S.C. 874) as supplemented in Department of Labor regulations (29 CFR, Part 3). This Act provides that each contractor or subcontractor shall be prohibited from inducing, by any means, any person employed in the construction, completion, or repair of public work, or give up any part of the compensation which he is otherwise entitled. The recipient shall report all suspected or reported violations to FHWA.

- Davis-Bacon Act: When required by the Federal program legislation, all construction contracts awarded by the recipient and its contractors or subcontractors of more than \$2,000 shall include a provision for compliance with the Davis-Bacon Act (40 U.S.C. 276a to a-7) and as supplemented by Department of Labor regulations (29 CFR, Part 5). Under this Act, contractors shall be required to pay wages to laborers and mechanics at a rate not less than the minimum wages specified in a wage determination made by the Secretary of Labor. In addition, contractors shall be required to pay wages not less than once a week. The recipient shall place a copy of the current prevailing wage determination issued by the Department of Labor in each solicitation and the award of a contract shall be conditioned upon the acceptance of the wage determination. The recipient shall report all suspected or reported violations to the G/CAO.

8. Contract Work Hours and Safety standards Act: Where applicable, all contracts by recipient in excess of \$2,500 that involve the employment of mechanics or laborers, shall include a provision for compliance with sections 103 and of the Contract Work Hours and Safety Standards Act (40 U.S.C. 327-330) as supplemented by Department of regulations (29 CFR, Part 5). Under Section 103 of the Act, each contractor shall be required to compute the wages of every mechanic and laborer on the basis of a standard workday of 8 hours and a standard workweek of 40 hours.

Work in excess of the standard workday or workweek is permissible provided that the worker is compensated at a rate of less than 1 1/2 times the basic rate of pay for all hours worked in excess of 8 hours in any calendar day or hours in the workweek. Section 107 of the Act, if applicable to construction work, provides that no laborer or mechanic shall be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous to his health and safety as determined under construction safety and health standards promulgated by the Secretary of Labor. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

9. Access to Records: All negotiated contracts (except those of \$10,000 or less) awarded by recipients shall include a provision to the effect that the recipient, FHWA, the Comptroller General of the United States, or any of their duly authorized representatives, shall have access to any books, documents, papers, and records of the contractor which are directly pertinent to a specific program for the purpose of making audits, examinations, excerpts, and transcriptions.
10. Civil Rights Act: The recipient shall comply with Title vi of the Civil Rights Act of 1964 (P.L. 88-352), and in accordance with Title VI of that Act, no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under any program or activity for which the recipient received Federal financial assistance and shall immediately take any measures necessary to effectuate this Agreement. It shall comply with Title VI of the Civil Rights Act of 1964 (42 U.S.C. 2000d) prohibiting employment discrimination where:
 - (a) The primary purpose of and instrument is to provide employment, or,
 - (b) Discriminatory employment practices will result in unequal treatment of persons who are or should be benefiting from the grant-aided activity.

11. Nondiscrimination: The applicant/recipient hereby agrees that, as a condition to receiving any Federal financial assistance from the Department of Transportation, it will comply with Title VI of the Civil Rights Act of 1964 (78 Stat. 252, 42 U.S.C. 2000d), related nondiscrimination statutes, and applicable regulatory requirements to the end that no person in the United States shall, on the grounds of race, color, national origin, sex, handicap, or age, be excluded from participation in, be denied the benefits of, or otherwise be subjected to discrimination under any program or activity for which the applicant/recipient receives Federal financial assistance. The specific requirements of the United States Department of Transportation standard Civil Rights assurances with regard to the States' highway safety programs (required by 49 CFR 21.7 and on file with the U.S. DOT) are incorporated in this grant agreement.
12. Rehabilitation Act: 8 The recipient shall comply with Section 504 of the Rehabilitation Act of 1973, as amended (29 U.S.C. 794, P.L. 93-112), and all requirements imposed by or pursuant to the regulations of the Department of Health, Education, and Welfare (45 CFR, Parts 80, 81, and 84), promulgated under the foregoing statute. It agrees that, in accordance with the foregoing requirements, no otherwise qualified handicapped person, by reason of handicap, shall be excluded from participation in, be denied the benefit of, or be subject to discrimination under any program or activity receiving Federal financial assistance, and that it shall take any measures necessary to effectuate this Agreement.

Certification Regarding Lobbying

By execution of this Cooperative Agreement, the undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an office or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an office or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

DISCLOSURE OF LOBBYING ACTIVITIES

Approved: [Redacted]
0348-0046

Complete this form to disclose lobbying activities pursuant to 31 U.S.C. 1352
(See reverse for public burden disclosure.)

1. Type of Federal Action: ☒ a. contract ☐ b. grant ☐ c. cooperative agreement ☐ d. loan ☐ e. loan guarantee ☐ f. loan insurance	2. Status of Federal Action: ☒ a. bid/offer/application ☐ b. initial award ☐ c. post-award	3. Report Type: ☒ a. initial filing ☐ b. material change For Material Change Only: year _____ quarter _____ date of last report _____
4. Name and Address of Reporting Entity: ☒ Prime ☐ Subawardee Tier _____, if known: ARIZONA DEPARTMENT OF TRANSPORTATION 206 SOUTH 17TH AVENUE PHOENIX, ARIZONA Congressional District, if known: 1	5. If Reporting Entity in No. 4 is Subawardee, Enter Name and Address of Prime: N.A. Congressional District, if known:	
6. Federal Department/Agency: U.S. DEPARTMENT OF TRANSPORTATION FEDERAL HIGHWAY ADMINISTRATION	7. Federal Program Name/Description: FEDERAL AID - HIGHWAY CFDA Number, if applicable: N.A.	
8. Federal Action Number, if known: N.A.	9. Award Amount, if known: \$ **5,000,000.00**	
10. a. Name and Address of Lobbying Entity <i>(if individual, last name, first name, MI):</i> N.A.	b. Individuals Performing Services (including address if different from No. 10a) <i>(last name, first name, MI):</i> N.A.	
(attach Continuation Sheet(s) SF-LLL-A, if necessary)		
11. Amount of Payment (check all that apply): N.A. \$ _____ ☐ actual ☐ planned	13. Type of Payment (check all that apply): ☐ a. retainer ☐ b. one-time fee ☐ c. commission ☐ d. contingent fee ☐ e. deferred ☒ f. other, specify: N.A.	
12. Form of Payment (check all that apply): ☐ a. cash ☐ b. in-kind; specify: nature _____ value _____		
14. Brief Description of Services Performed or to be Performed and Date(s) of Service, including officer(s), employee(s), or Member(s) contacted, for Payment Indicated in Item 11: N.A.		
(attach Continuation Sheet(s) SF-LLL-A, if necessary)		
15. Continuation Sheet(s) SF-LLL-A attached: ☐ Yes ☒ No		
16. Information requested through this form is authorized by title 31 U.S.C. section 1352. This disclosure of lobbying activities is a material representation of fact upon which reliance was placed by the tier above when this transaction was made or entered into. This disclosure is required pursuant to 31 U.S.C. 1352. This information will be reported to the Congress semi-annually and will be available for public inspection. Any person who fails to file the required disclosure shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.		
Signature:  Print Name: LOUIS A. SCHMITT, P.E. Title: DEPUTY DIRECTOR - TPD Telephone No.: 602-255-7433 Date: 1-26-91		

Working Document

PROGRAM GOALS AND SCHEDULE

by

Castle Rock Consultants

HEAVY VEHICLE ELECTRONIC LICENSE PLATE (HELP) PROGRAM

PROGRAM GOALS AND SCHEDULE

Lessons Learned through the HELP Program

**Christopher J. Hill, Ph.D.
Castle Rock Consultants**

February 1994

DISCLAIMER

The contents of this paper reflect the views and opinions of the author, who is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the official policy of the U.S. Department of Transportation, the HELP Program, or its participating states. This paper does not constitute a standard, specification, or regulation. The United States Government does not endorse products or manufacturers. Trademarks or manufacturers' names appear herein only because they are considered essential to the objective of this document.

1. INTRODUCTION

This paper is one of a series which discusses various lessons learned as a result of the Heavy Vehicle Electronic License Plate (HELP) program and the Crescent Demonstration. This document discusses two issues: the program goals and objectives, and the program schedule.

The paper describes the evolution of the goals from the earliest stages of concept development through the completion of the Crescent Demonstration. The goals of both the HELP concept or system, and of the program itself are assessed. The paper also considers the extent to which these various goals were achieved during the program.

The second section of the paper examines the program schedule. It describes how the original schedule was developed and what major changes and revisions took place during the course of the program. A discussion of the effectiveness of the program schedule as a management tool is included.

2. GOALS AND OBJECTIVES

a. Feasibility and Concept Development Phase

The earliest surviving documentation of the HELP concept is a "Proposal for a National Heavy Vehicle Tracking System" [1]. The document lists the goals of the system in a section entitled "Why Implement a System?":

- to support a national weight-distance tax, if implemented;
- to reduce the high costs of operating ports-of-entry
 - reduce state costs
 - reduce vehicle operating costs;
- to aid in the development of an interstate system of super heavy duty vehicle roads;
- to provide an economical method for the uniform enforcement of weight, speed and vehicle length laws; and
- to recognize interstate trucking as an interstate activity and treat it as such.

The proposal continues by defining the goals of a program:

“What needs to be accomplished?

- Design, develop, install, and test a national heavy vehicle tracking system.

Component program elements:

- Design, develop, or obtain an onboard vehicle identification transponder for under \$50 per unit;
- Design and develop an integrated weigh-in-motion (WIM) system and data collection program;
- Design a national, regional and state level tracking algorithm;
- Install and test a single site prototype system; and
- Install and test a multi-site system.”

However, by the time the request for proposals (RFP) for the “Heavy Vehicle Tracking System Feasibility Study” [2] was released in June 1984, the initial goal of “supporting a national weight-distance tax” had been deleted. All other goals remained identical.

Additionally, the RFP includes narrative which further expands the goals of the project:

“Current methods for collecting data on the movement of trucks on Arizona’s highway systems are very costly to both the state and the trucking industry. Despite this, they are often ineffective. A technique is needed to acquire information economically on the characteristics of specific heavy vehicles and to provide a data base which can be used for improved highway planning, design and management.

This Scope of Work addresses a program to develop and implement a national automatic heavy vehicle tracking system capable of collecting truck weight and classification data as well as identifying and tracking individual vehicles.”

Building on this direction established in the RFP the feasibility study final report [3] defined detailed objectives of the HELP system. These were to provide truck data which can be used for a variety of purposes, including:

- enforcement and monitoring the enforcement of vehicle and axle weight limits;
- enforcement/monitoring of heavy vehicle axle spacings (bridge formula) rules;
- enforcement/monitoring of vehicle length and trailer configuration regulations;
- enforcement/monitoring of maximum speed limit compliance;

- monitoring and control of the movement of oversize and/or overweight permit vehicles;
- determining heavy vehicle usage patterns by functional highway system, for the planning and design of highway improvement schemes;
- satisfying FHWA-mandated vehicle weight and speed monitoring programs;
- establishing trends in truck characteristics such as body type, size, weight and axle configuration for geometric design and highway safety studies;
- obtaining axle load/frequency data and trends for pavement design;
- assessing cost responsibilities of different truck types, for the determination of more equitable road user taxes;
- providing an input to pavement monitoring and management systems; and
- allowing the implementation and enforcement of weight-distance tax provisions, where such legislation has been enacted.”

The technical R&D and system design portions of the HELP program continued to focus on these project objectives for several years. Although there was clearly an evolution during the course of the program, these items are generally consistent with the ultimate actual and potential applications of the Crescent system.

During the Phase IC, Concept Development, an initial series of HELP program meetings were held. These meetings in Portland, Oregon, February 14 and 20, 1985 and in Las Vegas, Nevada, March 28, 1985, together with a presentation at the WASHTO meeting in Phoenix, Arizona, March 12, 1985, led to decisions by several states to actively participate in the program and to commit the necessary resources [4].

The WASHTO presentation encapsulated the HELP/Crescent goals based on the feasibility study, as follows [5]:

1. Develop performance specifications for automatic vehicle identification and classification and weigh-in-motion technology capable of being implemented on a national level;
2. Demonstrate automatic vehicle identification and classification and weigh-in-motion technology to determine benefits to the public and private sectors; and
3. Evaluate and report to the public and private sectors the results of both the development and demonstration phases of the project,”

To this point in time, the goals and objectives were of an almost exclusively technical nature and were principally driven by the needs of the states. Following the WASHTO meeting, an awareness rapidly developed of the need to involve the motor carrier industry in a meaningful way. Correspondence and minutes from the time [6, 7, 8] note a need to have “a better reading or understanding of the trucking industry’s position,” and establish an agenda item to identify “the items the trucking industry would like to see studied and evaluated.”

The concept development phase of the program can be said to conclude with the publication of the first HELP work program in September 1985 [9]. The Executive Overview contained in this document neatly summarizes the goals of both the HELP system and the HELP program as envisioned at the conclusion of the conceptualization phase. It is interesting to note that the development of institutional arrangements to support the HELP system are acknowledged for the first time:

“The Heavy Vehicle Electronic License Plate (HELP) system is an integrated truck traffic monitoring system. It combines automatic vehicle identification (AVI), weigh-in-motion (WIM), and automatic vehicle classification (AVC) technologies with a computerized data communications network.

The HELP system will give the trucking industry information needed for fleet management and control and for business planning. It will give government information needed for: facility planning and management; vehicle taxation; size, weight and speed enforcement; crime detection; and monitoring and managing hazardous materials movements.

The HELP System Development Program will demonstrate the viability of the HELP System concept and will provide a realistic assessment of both costs and benefits. It involves (1) developing and testing HELP System hardware, software and institutional arrangements; and (2) installing and evaluating the HELP System on a major truck route running from British Columbia to Southern California, and from there to Texas.”

b. Development Phase

The development phase is considered to comprise the period during which the individual HELP technical research and testing projects were being undertaken. Although there is some period of overlap, this phase was completed when activities focused on the implementation of the Crescent Demonstration.

During the development phase, each project had its own specified goals and objectives. These are felt to be subordinate to the overall goals of the HELP program and, therefore, are not discussed in this paper. An overview of each technical study is provided in a companion paper by Hill [10].

In January 1986, an overall workplan [1 1] for the HELP program was adopted. This delineated each of the technical studies and provided a detailed project schedule, and a multi-year budget. The workplan also presented formal project objectives as follows:

“The overall aim of the HELP Development Program is to produce a system which will bring the maximum benefits to states and truckers at least cost. Within this framework the following detailed objectives can be identified:

1. To fully explore the public and private applications of HELP, in order that the system is configured to be of greatest use to the greatest number.
2. To develop an automatic vehicle identification system specification which produces the required characteristics in a HELP system context.
3. To develop performance specifications for the weigh-in-motion and automatic vehicle classification components of the HELP system.
4. To investigate related technology areas which could be used to supplement and enhance the HELP system.
5. To produce an overall system design which takes account of user needs, and institutional, technical and economic constraints.
6. To develop a site location strategy which will locate HELP sites for maximum utility and greatest economic benefit.
7. To undertake an operational assessment of the fully developed HELP system in a realistic multi-state implementation - the Crescent Project.
8. To evaluate the benefits of the fully developed HELP system from operating experience in the Crescent Project.”

During the development phase, two principal activities were undertaken leading to the definition and adoption of formal goals for the HELP program. These comprised a survey of HELP program participants by the Policy Consultant and the development of objectives for the Crescent Demonstration by the Crescent Implementation Group (CIG).

As an early task, the Policy Consultant, Neely-Walton Venture, undertook surveys of the government and industry representatives of the HELP program. The results of the first survey were presented at the Policy and Executive Committee meetings in Austin, Texas, March 1987 [12] A follow-on survey was performed and presented at the Executive Committee meeting in Boise, Idaho, June 1987 [13].

The survey had two major objectives, as follows [12]:

“to review the project budget and work program within the context of the goals and objectives set by the Executive Committee; and

- propose for Executive and Policy Committee consideration a work program and budget consistent with the consensus agreement of both committees.”

Respondents were asked if the overall program objective, presented earlier in this section, was consistent with the present program direction. Over 71 percent answered yes to this question. Further, almost 79 percent of the survey participants felt that the overall objective did not need to be redirected. However, several people stated a need to specifically “identify the benefits” that are referred to in the overall objective.

The survey also considered the detailed objectives of the program and asked three key questions [12]:

- “what is the relative importance of each detailed objective in meeting the overall program objective?
- are they consistent with the overall objective?
- are they all necessary, applicable or feasible?”

Almost 86 percent of respondents felt that the detailed objectives were consistent with the overall program objective and that were still necessary, applicable or feasible. In ranking the detailed objectives, however, a different prioritization than that implied in the Work Program [11] became apparent:

Rank:

1. Explore public and private applications of HELP
2. Operational assessment of fully developed HELP system - the Crescent Project
3. Produce an overall system design addressing user needs within institutional, technical and economic constraints
4. Evaluate the benefits of a fully-developed HELP system
5. Develop performance specifications for WIM and AVI components
6. Investigate related technology areas
7. Develop an AVI system specification
8. Develop a site location strategy.

The initial survey concluded that the general direction of the program was in line with the stated objectives, although the participants could identify a clear priority objective. There was also a recommendation to examine the scope of the individual work elements and to realign budgets to reflect the importance of specific tasks.

The follow-on survey [13] focused on two main areas. The first considered the emphasis on various work program elements, and the second examined incentives to motor carriers.

The survey reported that 60 percent of the respondents felt that the work element emphasis should be changed. Recommendations included the following:

- standardize AVI coding and transmission technology;
- increase the effort in examining onboard computers;
- begin planning for the Crescent Demonstration;
- include extensive publicity to the motor carrier industry and analyze costs and benefits of each study component;
- increase the emphasis on satellites; and
- focus the system design study into the current program schedule.

The identified incentives for motor carrier participation in the Crescent were summarized as:

- border transparency with no stopping at ports-of-entry;
- reduced registration fees during the Crescent;
- free or low-cost access to management information;.
- one-stop shopping; and
- an assurance that the information gathered during the demonstration will not be used for citation purposes.

The second major influence at this time was the formation of the CIG. This group was established by resolution of the Executive Committee in June 1987 [14] and held its first meeting in Seattle, Washington in July [15].

The preliminary meeting focused on a Crescent implementation issues paper [16] which covered aspects including the Crescent system design, equipment requirements, institutional issues, and recruitment of participants. Much of the discussion on this paper centered on the functional design and identified the following potential demonstration applications:

- data collection states and industry;
- hazardous materials monitoring;
- oversize/overweight permits;
- no stops at POEs;
- paperwork reduction;
- one-stop shopping;
- transparent borders;
- electronic log books;
- toll collection;
- vehicle management;
- electronic broker; and
- crime detection.

Of these, only electronic broker and crime detection functions were rejected as having no opportunity for demonstration within the Crescent. Of the remaining applications, the meeting participants ranked no stops at POEs and paperwork reduction as the two prime targets for the Crescent. However, the Western Highway Institute (WHI) was still critical, stating that the “discussion in essence reaffirmed the governmental ‘blue sky’ approach by expressing the intent to demonstrate, to some degree, all of the functions except for (electronic broker and crime detection)” [17]

The minutes also reflect extensive discussions regarding institutional issues. The WHI representative “expressed concern that the enforcement and other industry-related state agencies are not being considered active participants in the demonstration project. From an industry perspective, demonstrating only technical capabilities fails to meet the stated objectives of the HELP project” [153. It was agreed that some effort should be made to address these issues, and the Management Consultant was directed to draft an additional paper on objectives for the Crescent.

The resulting paper [18] was presented to the CIG at their September 21 meeting in Sacramento, California. This reported on the selected applications of the Crescent Demonstration system and recommended demonstration project objectives under three broad headings [18]

- benefit evaluation “the first objective of the Crescent is to assess and evaluate potential benefits and applications of a national HELP system.”
- operational assessment - “the second major objective of the demonstration phase of the HELP program is to assess the practical operation of the HELP system. Each of the system elements will have been tested before implementation either through HELP or through related testing programs. However, the Crescent will be the first time that the AVI, WIM, AVC and data communications technologies have been interfaced into a larger scale operational situation.”
- institutional assessment - “the final major objective of the Crescent Demonstration will be to permit the assessment of institutional barriers to a more widespread implementation. Both state and industry barriers are very evident . . . The demonstration will continue the process of addressing these issues and will clarify the difficulties to be anticipated from further extensions or applications of the HELP concept.”

This paper also contains specific details on the nature of the evaluation of these objectives. From this perspective, it is important in assessing the extent to which the ultimate Crescent evaluation followed this direction. The Demonstration Project Objectives section of the paper is therefore excerpted and included as Appendix A to this paper.

On review of the paper at the following meeting of the CIG, it was decided that these objectives would be translated into measurable evaluation criteria [19]. A CIG working group met again in Phoenix during October to establish specific goals, objectives and evaluation criteria/measures of effectiveness for the Crescent [20]. The full CIG met in Los Angeles during November and prepared a final set of goals and objectives of the Crescent Demonstration for presentation to the Executive Committee. These were stated as follows:

Crescent Demonstration Project

Goal: Viability of technology in the highway environment

Objectives: Reliability
Accuracy
Life cycle cost of equipment;

Goal: Improving institutional arrangements

Objectives: One-stop shopping
Preclear
Border transparency
Demonstrate alternative management options;

Goal: Demonstration of efficiency and productivity

Objectives: Safety
 Reduced administration
 Electronic audit
 State data collection efficiency
 Value of AVL
 Value of toll collection;

Goal: Identify additional applications of technology

Objectives: Identify additional private sector applications
 Identify additional public sector applications.

These goals and objectives were unanimously adopted by the Executive Committee at the December 1987 meeting [21]. It was determined that these goals and objectives, together with potential Crescent Demonstration applications should also be proposed for adoption at the next Policy Committee meeting [22].

There was extensive discussion of the goals and objectives at the Policy Committee meeting [23]. Some minor wording changes were made to the specific goals and an additional objective was added. However, two significant items resulted from this review. First, the individual goals were prioritized, and second a preface was added which formally changed these goals from those of the Crescent Demonstration to those of the HELP program overall. The adopted goals read as follows:

“HELP PROGRAM GOALS

The feasibility of the program will be determined by progress in achieving the following goals:

Priority

I. Goal: Improving institutional arrangements

Obj: Demonstrate border transparency
Obj: Demonstrate alternative management options

I. Goal: Assess the viability of technology in the highway environment

Obj: Reliability
Obj: Accuracy
Obj: Life cycle cost of equipment

II. Goal: Measure of efficiency and productivity

- Obj: Preclear
- Obj: Safety and enforcement
- Obj: Reduced administration
- Obj: Value of AVL
- Obj: Value of toll collection
- Obj: Electronic audit

III. Goal: Identify additional applications for technology

- Obj: Identify additional private sector applications
- Obj: Identify additional public sector applications.”

These statements remained the formal goals and objectives of the HELP program until its completion in 1993.

c. The Crescent Demonstration Phase

The HELP program goals and objectives described above, and the associated Crescent system applications, were used to develop an RFP for a “complete and operational turnkey computerized communications system to integrate existing and proposed WIM, AVC and AVI equipment for the Crescent Demonstration system” [24].

A single response was received to the RFP from Lockheed. The total proposed cost of \$4.2 million was well in excess of the budgeted \$282,000. A request for funding assistance was therefore submitted to FHWA for the additional monies. The request again described the goals and the potential Crescent applications and stated that “these would demonstrate how the technologies developed during the R&D phase of the program when coupled with the interstate and government/industry cooperation facilitated through HELP can significantly benefit governmental agencies and the motor carrier industry alike” [25].

The request goes on to say: “however, these gains can only be realized through a major demonstration program covering a wide geographic area and broad range of potential system applications. If HELP and the Crescent are to achieve their objectives an appropriately funded multi-state demonstration must be performed”; and “it is only through a demonstration program that the technologies, their applications and the facilitation of institutional improvements can be evaluated.” Finally, the funding request noted that the proposal “response from Lockheed indicated that a much more substantial figure (than the \$282,000 budgeted) would be needed to fully achieve the goals and objectives of the Crescent through a multi-state demonstration.”

The request was subsequently approved by FHWA in July 1990 [26]. While the formal program goals and objectives were equally applicable to this expanded effort, it is clearly different in

intent to the demonstration that was envisioned earlier in the program. (For a fuller treatment of this subject, see companion paper by Hill [10].)

d. The Crescent Evaluation Phase

The evaluation phase can be seen to overlap almost entirely with the Crescent Demonstration phase. Planning for the evaluation began at the same time as the drafting of the Crescent system RFP and the reporting of the evaluation is being completed after the conclusion of the demonstration. An initial working paper on the Crescent evaluation was presented to the CIG in August 1988 [27]. This paper initially established a series of objectives to ensure adequate planning for the evaluation. These comprised:

- Determine the criteria by which each Crescent Demonstration application may be evaluated. This will cover both technical and institutional areas.
- Determine quantitative or qualitative measures by which each criterion may be evaluated.
- For each criterion, identify the data to be collected by state or industry for the evaluation.
- Define data to be collected through “before” studies by state and industry and determine a predemonstration data collection program.
- Determine a data collection program for the course of the demonstration.
- Assign responsibility for reviewing data collection efforts and subsequent evaluation of each application to particular subcommittees.
- Plan for the final evaluation of the Crescent Demonstration and the Final Report of the HELP Program.

The paper then examined each Crescent application in turn and developed evaluation criteria and measures of effectiveness. The timing of this paper coincided with the reorganization of the HELP subcommittee structure [28]. A series of new subcommittees were created to reflect the priorities established by the HELP program goals adopted in March 1988. These subcommittees were titled:

- Efficiency and Productivity;
- Technical Performance;
- Institutional Arrangements; and

- Additional Applications.

Recognizing the role that these new subcommittees would play in the evaluation, the paper also assigned each proposed evaluation task to a specific subcommittee. The evaluation working paper is included as Appendix B to this document.

The working paper was reviewed at an evaluation meeting in January 1989, attended by HELP staff members and representatives of the four subcommittees [29]. A principal conclusion of this meeting was that the CIG would be responsible for providing the necessary data to the four evaluation committees; the individual Crescent state representatives being charged with obtaining the data requested by the committees. It was further agreed that ultimately an integrated evaluation plan would be developed, however, preliminary plans would focus on the interest areas of the individual subcommittees. The Management and Policy Consultants would have a major involvement in the planning tasks, with the Management Consultant supporting the Technical Performance and Efficiency and Productivity subcommittees, and the Policy Consultant supporting the Additional Applications and Institutional Arrangements subcommittees.

A series of working papers was prepared for the Technical Performance and Efficiency and Productivity subcommittees [30, 31, 32, 33, 34, 35]. These became increasingly detailed in the evaluation approach, definition of data categories and possible evaluation sites. These papers focused on data to be collected at Crescent sites by state personnel. Associated papers [36, 37] considered the same evaluation criteria by examining the data needed from motor carrier industry participants.

This set of papers ultimately culminated in a single proposed evaluation plan for the technical components of the Crescent [38]. While the earlier papers were predicated on all data collection being undertaken by state representatives or industry participants, Castle Rock Consultants (CRC) had raised flags in each paper regarding the practicality of this approach. Specifically, concerns were raised regarding consistency of data collection methodologies and the timely availability of personnel resources. The subcommittees recognized this issue and directed that this overall plan should include a workscope for contractor support of the evaluation tasks.

The evaluation plan was presented to a joint meeting of the Efficiency and Productivity and Technical Performance subcommittees in July 1991. Committee members were requested to review the plan and provide comments. In addition, CRC was invited to submit a proposal to undertake the work [39]. Subsequently at the Board of Directors meeting, it was noted that the evaluation plan should be expanded to include institutional and organizational issues, as well as technical issues. Considering this change, it was determined that the evaluation contractor team should be expanded to include WHM Transportation Engineering Consultants (the Policy Consultant) and WHI, together with CRC (the Management Consultant) [40].

Subsequent to the meeting, some reservations to this approach were expressed by FHWA [41]. HELP representatives were asked how the independence of the evaluation would be assured. At a meeting in August, a group of HELP and FHWA representatives agreed “that the use of existing program resources for the evaluation would ensure complete familiarity with HELP and

would avoid the need for a costly and time-consuming RFP process” [42]. It was further agreed that the overall evaluation would be divided into two major areas. “These would address system performance, including technical performance and data quality; and system applications, covering data uses, case studies and institutional changes.” A plan covering these areas was developed following the meeting [43].

This plan was presented to the newly-formed Evaluation Committee, made up from the Efficiency and Productivity, Technical Performance, and Institutional Arrangements subcommittees [44]. The approach and objectives of this evaluation plan were described as follows [43]:

“The evaluation approach will examine the Crescent experience from two viewpoints: a quantitative-technical approach and a qualitative perceived performance approach. The technical assessment will provide a measure of how well the equipment supplied is able to perform its required function within the Crescent. The qualitative assessment will assess the extent to which the originally conceived and subsequently identified functions can provide applications with identifiable benefits.

The technical assessments will follow evaluation formats which have been discussed extensively in previous evaluation working papers. The qualitative data will be generated from a number of state and motor carrier case studies.

The state case study approach will provide insight into the integration of the system applications from the institutional viewpoint. It is apparent that the demonstration project during Phase III of the Crescent will not have a significant effect on institutional policies and procedures within and among the participating governmental entities; however, the experiences gained during this period afford a unique opportunity to capture an understanding of the potential of such a system as represented by the Crescent activities. Therefore, the case study approach will attempt to document the experiences, impressions, issues and opportunities of selected key state government personnel from a cross-section of involved agencies.

In order to gain an understanding of system performance from an industry-user perspective, the case study approach will attempt to document the specific experience, impressions, issues and opportunities that result from demonstration participation. These studies will span the range of interface involvement from driver and carrier to that of state and regional trucking associations. As appropriate at each interface level, the studies will focus on specific system functions and applications.

The evaluation process will be carried out in two phases. The first of these, Phase A, primarily addresses the planning and programming activities for the evaluation. This has already commenced with further detailing of the overall evaluation workplan as described. The phase also includes an assessment of each Crescent site to ascertain the precise nature of applications that will be implemented. The information collected will subsequently be used to classify and select the precise functions and applications that will be evaluated and to construct detailed plans and schedules for this process.

The second phase, Phase B, will consist of the implementation of the evaluation plans developed in Phase A. This will include final planning for the logistical activities necessary for the implementation of the various data collection tasks. This data collection will include on-site measurements, case studies, assessment of Crescent Demonstration support functions, and evaluation of Crescent system components. The data collected from these efforts will be integrated and cross-referenced during a detailed assessment. Where possible, suitable cost-benefit prediction methods will be utilized. The second phase will culminate with the production of a final report delineating the results obtained during the evaluation and analyzing them in the context of broader fleet management and IVHS scenarios.”

The evaluation plan was accepted by the Evaluation Committee and the Board of Directors [44, 45]. However, it was noted that funding was available only for Phase A of the plan. A request was therefore made to FHWA for additional funding to support the Crescent evaluation tasks [46]. On submission and review of the detailed evaluation plan for Phase B [47], FHWA approved the request for extra funding. One subsequent change to the evaluation was the addition of an independent oversight consultant, requested by FHWA, primarily responsible for evaluating the DCO functions and system integration [48].

e. Conclusions

This final section will revisit the various defined goals and objectives established at various times during the HELP program. This will cover the goals of both the program and system it was seeking to develop.

In reviewing the earliest goals of the program, it is clear that the majority of technical goals have been achieved. For example, the feasibility study final report [3] specified system objectives to be able to measure truck axle weights, spacings, length and speed, to monitor permits, and to use these data for a variety of purposes. The Crescent system evaluated during 1992 and 1993 is able to satisfy these objectives. (For a discussion of the accuracy associated with the Crescent equipment and the operational usage of the system, see companion paper by Hill [10].)

Perhaps the most significant divergence from the earliest program goals is that the Crescent system has remained a regional activity. The earliest program statements promote a national heavy vehicle tracking system. While this has not been achieved directly, it is reasonable to say that the HELP program has served as the catalyst for other regional operational tests or system proposals, such as Advantage I-75 and the I-80 Corridor project. The I-80 proposal, in particular, recognizes the need to connect the other two corridors and thereby create what amounts to a nationwide CVO system.

The first major set of objectives adopted within the HELP program are those presented in the Work Program, January 1986. As prioritized through the HELP participants survey, these read:

“The overall aim of the HELP Development Program is to produce a system which will bring the maximum benefits to states and truckers at least cost. Within this framework the following detailed objectives can be identified:

1. Explore public and private applications of HELP
2. Operational assessment of fully developed HELP system - the Crescent Project
3. Produce an overall system design addressing user needs within institutional, technical and economic constraints
4. Evaluate the benefits of a fully developed HELP system
5. Develop performance specifications for WIM and AVI components
6. Investigate related technology areas
7. Develop an AVI system specification
8. Develop a site location strategy.”

The first objective represents one of the key achievements of the HELP program. Both the Crescent evaluation case studies and experience gained during the implementation and operation of the Crescent system have identified system applications that have high utility to the government and industry. In particular, preclearance functions and roadside size and weight compliance applications were ranked highest by state and motor carrier participants in the Crescent evaluation [49].

The second, third and fourth objectives can be grouped together and to a significant degree have been accomplished during the course of the HELP program. Over two years of operating experience of the Crescent system was obtained during the course of the program. This period of operation, together with the Crescent evaluation, highlighted a series of issues with the system. These ranged from major problems, such as the configuration of site level equipment not providing the necessary timings to allow weighstation personnel to use the system data, to relatively simple findings, such as the desire of the industry participants to receive printed reports of their fleet activities. All of these issues have been identified during the course of the program, and have either been solved or strategies have been identified to resolve them.

Related to this issue is one of the major achievements of the program, that is the government/industry partnership that has developed. This has been a long-held implicit goal of the program. The fact that the Crescent system remains fully-operational despite the problems described above clearly demonstrates the commitment of the partners. More importantly, it shows that these participants, with their extensive experience and understanding of the objectives of a fully-operational system, truly believe that the Crescent has demonstrated the potential to satisfy their needs and requirements.

Objectives 5, 6 and 7 are technology-related. There is no question that the HELP program has made major achievements in research, testing and specification in these areas. The most important activity now is to ensure that the states use the equipment specifications developed by the program, and, in particular for the WIM/AVC equipment, make sure that the equipment is maintained to level that it continues to meet these performance requirements.

With respect to the final objective, it is true to say that the HELP program did develop a site location strategy [50]. However, based on experience of evaluating the Crescent, these guidelines have either been ignored or were not sufficiently informative in the first instance. In either case, it is recommended that serious attention be given to developing site location guidelines that will position sites for maximum benefit to both government and industry participants, and that ensure that specific site configurations will provide the applications intended.

The next important set of goals are those adopted by the Policy Committee in March 1988. While these are described as the HELP program goals, they were developed specifically to represent the goals of the Crescent Demonstration project and in reality are more applicable to the Crescent than the HELP program as a whole. These goals are stated as:

“HELP PROGRAM GOALS”

The feasibility of the program will be determined by progress in achieving the following goals:

Priority

I. Goal: Improving institutional arrangements

Obj: Demonstrate border transparency

Obj: Demonstrate alternative management options

I. Goal: Assess the viability of technology in the highway environment

Obj: Reliability

Obj: Accuracy

Obj: Life cycle cost of equipment

II. Goal: Measure of efficiency and productivity

Obj: Preclear

Obj: Safety and enforcement

Obj: Reduced administration

Obj: Value of AVL

Obj: Value of toll collection

Obj: Electronic audit

III. Goal: Identify additional applications for technology

Obj: Identify additional private sector applications

Obj: Identify additional public sector applications.”

Considering the first goal, a significant portion of the Crescent evaluation focused on identifying institutional issues. This was accomplished through state agency and motor carrier surveys. In particular, the evaluation results indicate that cooperation between state agencies has greatly improved as a result of the HELP program. However, further cooperation is needed and a mechanism is required to ensure that these groups continue working together [49]. In addition, the Crescent demonstrated the effectiveness of private sector operation of the system. The operation of the system by government agencies has always been a concern to the motor carrier industry, and so demonstrating this system management capability has overcome a major institutional barrier as perceived by the industry.

The Crescent evaluation has also placed significant emphasis on the goals of assessing the viability of the technology and of measuring efficiency and productivity gains. Once again, the HELP program can justifiably claim certain success in these areas. Overall, the HELP system technologies are adequate and not a barrier to the implementation of HELP applications. However, equipment accuracy needs to be improved. An important finding of the evaluation is that maintenance and calibration of the principal equipment components appears to be unsatisfactory [49].

In terms of measuring efficiency and productivity gains, results have been assessed based on cost/benefit analyses which extrapolate data obtained on site. These results show that it is reasonable to accept that benefits will accrue from preclearance, safety and enforcement applications and through reduced administration, providing that sites are correctly configured, that a sufficiently large network of sites exists, and that the Crescent system is integrated into normal site operations.

The efficiency and productivity gains of AVL systems, automated toll collection, and electronic audits were not assessed during the evaluation. These applications could not be incorporated into the Crescent system during the course of the demonstration or evaluated through relevant adjunct projects. An important lesson is to be realistic in the scope of the activities that can be accomplished within a project. To include goals relating to items that could not assuredly be included in the system opens the program to criticisms of failing to make as much progress as it had expected.

The final goal relates to additional technology applications. The HELP program has continued to respond to emerging opportunities throughout its life. For example, onboard computer assessments, the stateline entry beacon, and a mainline weighstation bypassing are all valid additions that have been facilitated by the capabilities of the individual technology components or the integrated Crescent system. This process is continuing rapidly as HELP, Inc. is defining a series of motor carrier safety applications that will benefit both government and industry participants, and are being facilitated by the Crescent system [51].

In summary it is reasonable to accept that the HELP program has generally achieved its goals and objectives. Those goals that are explicitly defined, such as to develop WIM and AVI performance specifications, have quite obviously been accomplished and success can be measured easily. In general, it is easier to see where progress has been made with technical system goals.

For example, measuring the performance of the technology in the highway environment is straightforward, and even if the results do not demonstrate the level of performance required, the shortcomings are explainable and a clear route for resolving these problems can be seen. Similarly, even though efficiency and productivity gains could not be directly measured due to the constraints of the Crescent system implementation, there is sufficient evidence and understanding to extrapolate data and infer the level of success that will ultimately be achieved.

Finally, it appears that the goals relating to institutional improvements are the most amorphous. However, stepping back and examining the program as a whole shows that is certainly where the greatest accomplishments have been made. Reviewing early documentation in preparing this paper reminded the author of the rocky road that the HELP program has traveled: the opposition of the Owner-Operators, Independent Drivers Association to the program, viewing it as a mechanism to introduce mandatory AVI and weight-distance taxes; the withdrawal of motor carrier participants from California, Nevada and Texas; and the withdrawal of the State of Texas during the Crescent planning phase, are good examples. Yet despite these problems, the government and industry participants work together in a unique and unprecedented partnerships. Their commitment to HELP and their desire to continue the operation of the Crescent system through HELP, Inc. is surely the greatest measure of success.

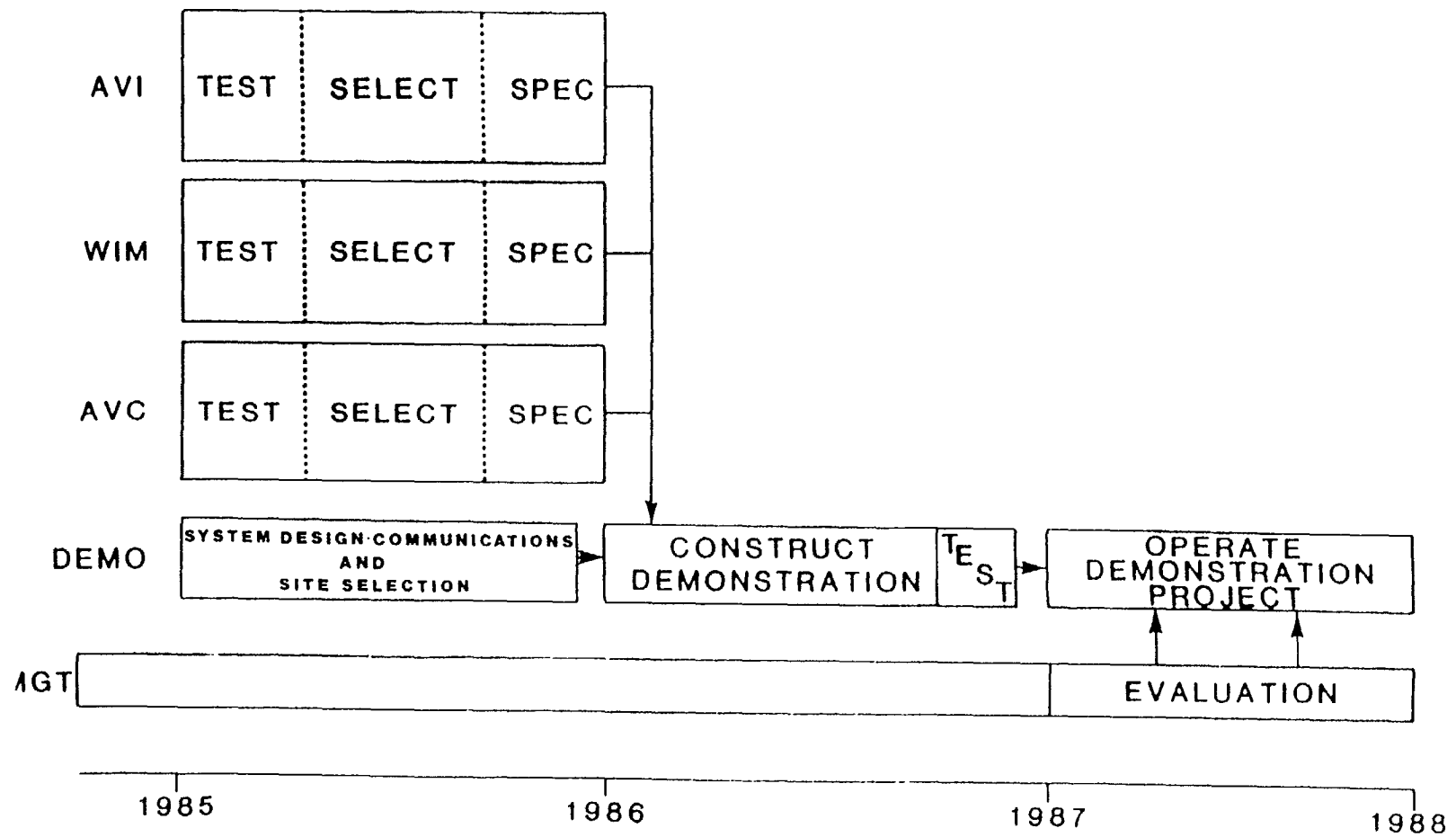
3. PROGRAM SCHEDULE

a. Background

The first discussion of a schedule for the HELP program is reported in the Phase IC, Concept Development final report [4]. This refers to the initial meetings held in Portland, Oregon on February 14 and 20, 1985. An overall schedule of three years was proposed for the development and the demonstration phases. This schedule was schematically illustrated in the support materials for a HELP Policy Committee meeting in June 1985 [52] and is included as Figure 1.

Initial detailing of this schedule, showing the component elements on a PERT chart, was included in the request to FHWA to establish a regional pooled-fund program [53]. The completion was still shown at three years. Further detailing of the program schedule was undertaken by CRC when retained as the Management Consultant. This involved “creating detailed networks for each of the program elements (and) by assigning durations to the activities the critical path has been established with start and finish times for each activity” [54]. This is included as Appendix C.

Figure 1. Crescent Demonstration Project Program Schedule



In the HELP Work Program, January 1986 [11], the duration of the program was extended by twelve .months. This effectively moved the Crescent evaluation tasks from being in parallel with the implementation of the demonstration to a separate period following the equipment deployment and commissioning tasks. The Work Program also introduced the barchart presentation of the HELP schedule which was used in all committee support materials for several years.

Changes to the schedule started with Revised Plan A in April 1986. These changes generally represented delays in awarding and starting the development phase contracts. Revision A, for example, extends the duration of the program by twenty-one days to reflect the actual start date of the system design study contract [55]. With revised Plan A, the completion of the Crescent stood at October 27, 1989.

Revised Plan A also includes an interesting alternative to implement an “Early Crescent.” This would be achieved by reducing the time available to supply and commission the roadside equipment and to install the AVI, WIM and AVC concurrently in all states. The effect of this would save five months on the overall program schedule. It was noted that this approach “might not be realistic” [56] and therefore was not pursued.

Major revisions to the schedule occurred with Revised Plan H [57] Three principal elements went into this. The first was the addition of a motor carrier workshop to the activities of the Motor Carrier Services Plan subcommittee. The second, and more important element, was delays occurring in the WIM performance specification activities. Delays in starting the field tests placed this item close to the critical path. The most important consideration, however, was delays in the approval and bidding of an AVI laboratory test contract. AVI was generally a critical path activity throughout the development phase, and so any delays in this component affected the program overall. The results of these delays moved completion of the Crescent to June 8, 1990.

No bids were received on the AVI laboratory testing contract, and direct negotiations took place with Caltrans to undertake this work. The effect of this delay moved the Crescent completion to November 21, 1990 [58]. AVI equipment delivery problems subsequently introduced delays to this component, moving overall completion back to January 23, 1991 [59].

With Revised Plan L, a number of the development phase projects which had been completed were eliminated and additional detailing of the Crescent Demonstration took place. For the Crescent new activities were added as follows [60]:

- inclusion of activities for finalizing and approving a Crescent system design;
- inclusion of specification and approval activities for software; and
- inclusion of procurement and supply activities for all hardware and software.”

The result of these changes delayed Crescent completion until April 26, 1991,

Revised Plan N again shows the effect of delays in the AVI component which continued to lie on the critical path [61]. In this instance, the problems were associated with the procurement process to obtain the preferred system equipment for final testing. With these activities the completion of the Crescent moved to September 17, 1991.

Subsequent revisions to the plan reflected the delays in developing the RFP for the Crescent system. Revised Plan Q [62] shows the actual distribution and receipt dates of the Crescent RFP, which moved Crescent completion to January 2, 1992.

Revised Plan S once again introduces delays due to the AVI component [63], this time due to the delivery schedule of AVI equipment for the Crescent. This moved the completion of the Crescent to March 17, 1992.

Major changes took place with Revised Plans T and U [64]. This plan included the actual schedule and phasing of the Crescent contract with Lockheed. Information on actual installation dates for WIM equipment were also added. A significant delay until April 26, 1993 for the completion of the Crescent was introduced.

At this point, major schedule issues focused on the Crescent Demonstration and the Lockheed contract. The overall HELP program schedule prepared and updated by the Management Consultant was therefore abandoned with Revised Plan W. Revised Plan W showed the April 26, 1993 completion date for the Crescent.

From this point on, the principal delays resulted from problems in commissioning the individual Crescent sites. According to the Executive Director's report of January 1992 [66], "this has been due to a variety of factors, including state and vendor activities, equipment performance and unforeseen site operation inconsistencies." As a result of these problems and to provide for a sufficient period of operation during which the evaluation could be performed, the completion date of the Crescent Demonstration was moved to September 30, 1993.

b. Conclusions

It is quite apparent that the original three-year schedule for the HELP program was overly optimistic, especially considering the degree of research and testing required on the fundamental technologies. However, it is also clear that the actual duration of eight years could have been reduced with greater control over certain program elements.

The delays that occurred during the development phase can in the most part be justified. These principally resulted from problems in issuing RFPs or negotiating the resulting contracts. This type of administrative delay is extremely common and is generally a result of the workload of the contracting personnel than any inherent complexities in the task.

The exception to this was the procurements for both the AVI equipment and the Crescent system. The RFPs for these were of a reasonably technical nature. However, the problems of developing the RFPs were compounded by the extensive review and revision process imposed by the nature of the HELP organization structure. Multiple reviews by the relevant subcommittee (AVI or CIG) and subsequent review and approval by the Executive Committee added considerably to the delays in issuing the RFP.

In spite of these problems, the HELP program schedule served as an effective tool for managing the project. The magnitude of the delays could be easily predicted (i.e., usually the time between committee meetings), and the effects could be assessed quickly using the computerized scheduling tool. The Executive Committee could therefore be kept informed of the impacts of each specific delay.

One area of delays that was not foreseen was the need for certain “global” Crescent tasks such as the preparation of a system design, and specification and procurement of hardware and software. Originally, it had been intended that much of this would be accomplished through the federally-funded system design study. As it became clear that this would not be achieved, appropriate tasks were added to the Crescent portion of the schedule. This added significantly to the program duration.

As the program moved from the development to the demonstration phase, the nature of scheduling problems changed. Two major issues became the focus of the problems: the first related to the AVI equipment supply, and the second to states’ responsibility for procuring, installing and commissioning the other equipment.

The delays in the AVI equipment supply were generally known in advance to the program staff and delivery dates were in fact negotiated through contract amendments. Again, this perhaps reflects on the optimism of the program participants for obtaining newly-developed technology. It is, of course, possible that the program could have been more aggressive or assertive in the negotiations to obtain earlier delivery dates. There was certainly concern expressed periodically by program staff that the AVI vendor treated the HELP procurement as something that could be put off in order to deal with other priorities.

The final issue relates to equipment procurement and installation tasks that were performed by individual Crescent states outside of the formal HELP program structure. This is a focus of discussion relating to technical system design issues in the companion paper by Hill [IO]. From the perspective of the program schedule, this approach also had a major effect. The single biggest problem was that HELP program staff had no direct control over the activities of the state. It must, of course, be recognized that the different objectives and operations of a state must be honored, and are unlikely to be changed for a limited system demonstration. However, not only did this lead to a lack of effective central coordination, but it created a general feeling of frustration and powerlessness to change the situation. Once again, control of these elements under a single, turnkey contract would have led to an overall program schedule developed by the contractor. This could have been a valuable management tool for the program staff.

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APPENDIX A

DEMONSTRATION PROJECT' OBJECTIVES

From "Crescent Demonstration Project Implementation. Objectives and Progress." by P. Davies, Castle Rock Consultants, September 1987.

Before too much progress is made in defining the nature and scope of the Crescent Demonstration Project, it is important to review the principal objectives of the demonstration and update these where necessary. The objectives of the demonstration were originally identified in the HELP System Feasibility Study of December 1984 and further expanded in the Concept Development Study (June 1985).

The Crescent Project, as developed over the past three years, will seek to establish the feasibility of monitoring vehicles over long distances. It will also provide better estimates of operating costs and any tangible benefits to users of the system, as well as other useful information for assessing the future of the concept. Perhaps most importantly, it will give an indication of the level of acceptance among the trucking firms, state and federal agencies, and the public as a whole. For any national system to be implemented there would need to be support from the majority of users before the system could succeed.

The general aim of a demonstration phase such as the Crescent Project is to provide a multi-state demonstration and evaluation of the heavy vehicle electronic license plate (HELP) system concept. A small-scale concept demonstration has already taken place in Oregon during Phase IB of the HELP program. This consisted of installing one AVI system at four test sites throughout the state and fitting transponders to operational trucks. In each case, AVI was combined with WIM to provide the same type of data as proposed with the HELP system. This phase was helpful in presenting the concept to states, the FHWA and the trucking industry.

However, a multi-state demonstration project could provide much more than a simple equipment demonstration. Its aims are likely to cover essentially three areas. The first of these is to permit a realistic evaluation of the potential benefits and applications of an integrated HELP system. The others are to identify institutional and operational difficulties associated with a relatively widespread application of such a system before any wider implementation is considered. These aims can only be met by undertaking a trial of the HELP concept in a multi-state situation.

Benefit Evaluation

The first objective of a demonstration phase is to assess and evaluate the potential benefits and application of a national HELP system. The functions most likely to be demonstrated have been described in the initial part of this paper. A demonstration phase such as the Crescent will enable

some degree of practical and realistic assessment of potential benefits and losses to be made in each area finally included.

Potential transportation planning benefits accruing from the HELP concept are long-term in nature. For this reason, it will not be possible to make a fully quantitative evaluation of them over the relatively short duration of a demonstration such as the Crescent Project. What such a project can do, however, is provide a realistic demonstration of the transportation planning applications of the HELP program in a multi-state situation, enabling qualitative assessment to be made of both intra- and interstate benefits. Limited quantification may also be practicable by extrapolation from the Crescent database.

Data collection by industry is considered to be a very limited application of the HELP concept. The severely restricted coverage afforded by the initial demonstration through both time and space will further limit the potential for demonstrating this aspect.

Hazardous waste monitoring is another function identified by the Implementation Group. The aim of the demonstration project in this application area could be to set up a database to track hazardous loads for emergency response planning. Other potential applications such as monitoring compliance with routing restrictions could also be examined.

Permit issuance has long been considered a potential area for application of the HELP concept. One aim of the Crescent, therefore, is to demonstrate and evaluate the applicability of the HELP system in saving time spent by both motor carriers and state governmental personnel in the issuance and checking of permits. A multi-state program will allow the benefits to be evaluated under a number of different state legislative and administrative frameworks. This, in turn, will enable a realistic assessment to be made of the overall possible benefit from delay reductions through the HELP concept.

The aim of the demonstration phase with regard to the key function of automatic ports-of-entry could be made to demonstrate and evaluate time savings to both state government and the trucking industry. This potential application of the HELP system is necessarily interstate in character. A multi-state program with existing ports-of-entry would be ideal' for its demonstration. The outcome of the evaluation study should be a quantitative assessment of actual time savings achieved.

Paperwork reduction is a second key function identified by the Crescent Implementation Group. The evaluation study could examine progress made in this area in each of the several states, considering cost reductions and time savings to industry and government personnel. The study should also consider whether government is better or worse able to carry out its various functions with the reduced level of paperwork facilitated by the HELP concept.

One-stop shopping is the third key area of potential recognized by the Crescent Implementation Group. The evaluation study would examine the provision for single-point contact for operators of equipped vehicles within each state. Representative motor carriers could be studied in states which achieve this goal to identify the magnitude of benefits to operators from one-stop shopping.

Transparent borders would extend the concept of one-stop shopping between states through compatible procedures for taxation and registration, leading to single points of contact for meeting several states' requirements. The evaluation study could examine any progress in this area in a similar way to that described above.

Electronic log-books are already being demonstrated in limited situations and might be linked to two-way AVI within the HELP framework. As only a small subset of vehicles would be involved, evaluation would be mostly qualitative, rather than quantifying benefits specific to particular firms.

Toll collection will be demonstrated in parallel with the Crescent and would likely be the subject of separate evaluation. Probable aims of this functional evaluation are not discussed here.

Vehicle management will probably be demonstrated only in the limited context of a small subset of vehicles at certain sites during specified periods. For this reason, a qualitative demonstration could be more appropriate than quantitative assessment, given the limited scope of this aspect of the project.

Satellite location/communications would only be demonstrated if satellite firms are ready to provide parallel demonstrations of vehicle location and communications technology. The potential for evaluating comparisons between satellite and ground-based systems will depend upon the extent of this aspect of the program.

Operational Assessment

The second major objective of the demonstration phase of the HELP program is to assess the practical operation of the HELP system. Each of the system elements will have been tested before implementation either through HELP or through related testing programs. However, the Crescent Demonstration phase will be the first time that the AVI, WIM, AVC and data communications technologies have been interfaced in a larger-scale operational situation.

Operational difficulties can be anticipated during the early stages, either through technical glitches or through management and coordination problems. The implementation of the HELP system in a multi-state demonstration and evaluation program therefore provides an important opportunity to identify problems with the system, locate their cause and eliminate them.

Assessment of the technical operation of the HELP system is one of the prime goals of the demonstration phase. Under the HELP program, for example, the automatic vehicle identification element of the complete system will have undergone a three-stage development process. Testing under operational conditions in a multi-state demonstration project is the best way to terminate this program and ensure that the AVI equipment is wholly satisfactory.

Weigh-in-motion is now a well-established technology and many states have their own WIM systems already in operation. However, the HELP program encompasses development of a performance specification for the WIM component of the system, to ensure that each system used for HELP purposes conforms to a minimum standard of accuracy and reliability. Similar efforts are being undertaken for the development of low-cost options combining AVC and WIM functions.

Although considerable effort is being put into designing a HELP system, minor difficulties arising from matters such as interfacing the various sets of equipment are still probable. The demonstration phase will enable these difficulties to be identified at an early stage and any necessary modifications made to achieve the required system characteristics.

Aside from operational problems concerned with component interfacing, the demonstration phase will be valuable in assessing other technical aspects of the HELP system. Small-scale field trials of the specified AVI system, in particular, will have been carried out prior to this phase of the program. However, with 5,000 to 10,000 trucks fitted with tags over an anticipated duration of approximately 12 months, this phase constitutes a sufficiently large-scale trial of the system to provide a good statistical database. Characteristics such as system reliability, accuracy and durability can then be calculated at a reasonable level of confidence by analysis of that database. Similarly, figures for system downtime can be analyzed to pinpoint any weak links in the system technology.

A second goal under the operational assessment heading is to examine the efficiency of the management and coordination system of the Crescent Demonstration. Through study of the way in which the various management and coordination mechanisms work over the duration of the demonstration project, much will be learned which will help to determine the feasibility of a more widespread implementation.

Institutional Assessment

The final major objective of the Crescent Demonstration will be to permit the assessment of institutional barriers to a more widespread implementation. Both state and industry barriers are very evident to those who have been involved in the developments of the last three years. The demonstration will continue the process of addressing these issues and will clarify the difficulties to be anticipated from further extensions or applications of the HELP concept.

In summary, the demonstration phase will serve three principal functions. The first of these is to provide a realistic evaluation of the benefits of the HELP system, which are summarized in Table 1. All of the potential benefits can be evaluated to some extent during the course of this phase, indicating that the demonstration project will be worthwhile for its own sake, given proper and complete evaluation. The second function of the demonstration project will be to evaluate the operational characteristics of the final HELP system, including interfacing of the various system components, data communications system aspects and the efficiency of the management

system. These are key system factors upon which the demonstration phase will provide valuable feedback for consideration in any further extensions. Finally, the least tangible and perhaps most important function will be to highlight institutional barriers, and show up alternative ways forward.

Table 1. Potential Evaluation of Benefits in the Crescent Demonstration

	Quantitative Evaluation	Qualitative Evaluation	No Evaluation
Transportation planning		*	
Data for industry		*	
Hazardous waste monitoring		*	
Permit issuance	*		
Paperwork reduction	*		
One-stop shopping	*		
Transparent borders	*		
Electronic log-books		*	
Toll collection**	(*)		
Vehicle management		*	
Satellite AVL/C		*	
Any functions not demonstrated			*

** probably outside the mainstream Crescent Project.

These are ambitious goals in an ambitious program. Considerable progress has been made. Careful planning must now continue to ensure that the momentum of the past three years keeps the program right on track. The Implementation Group seeks the authority of the Executive and Policy Committees to continue resolving these issues and objectives over the implementation and demonstration periods.

APPENDIX B

CRESCENT DEMONSTRATION PROJECT

Project Evaluation

**Prepared for
John Van Berkel
Technical Manager
Heavy Vehicle Electronic
License Plate (HELP) Program**

**by
Castle Rock Consultants**

August 1988

Introduction

The objective of this discussion paper is to consider the evaluation of the Crescent Demonstration Project in relation to the proposed subcommittee restructuring of the HELP program and the potential applications to be demonstrated. Each of the proposed subcommittees will take responsibility for reviewing the ongoing and final evaluation of various elements of the demonstration.

This paper aims to establish the criteria and methodology that will be used for evaluation of the Crescent Demonstration. This will include identifying the data to be collected by state and industry before and during the course of the demonstration. Support in monitoring, coordinating and advising on this data collection effort is provided by the Management Consultant. The ultimate data analysis, evaluation and report preparation are currently unassigned but could also be performed by the Management Consultant through an appropriate contract extension beyond the course of the Crescent Demonstration.

The success of the Crescent Demonstration will depend to a great extent on the care that is taken in determining the means for performing the evaluation at this stage of the program. To ensure this success the following elements of work need to be performed:

1. Determine the criteria by which each Crescent Demonstration application may be evaluated. This will cover both technical and institutional areas.
2. Determine quantitative or qualitative measures by which each criterion may be evaluated.
3. For each criterion, identify the data to be collected by state or industry for the evaluation.
4. Define data to be collected through 'before' studies by state and industry and determine a pre-demonstration data collection program.
5. Determine a data collection program for the course of the demonstration.
6. Assign responsibility for reviewing data collection efforts and subsequent evaluation of each application to particular subcommittees.
7. Plan for the final evaluation of the Crescent Demonstration and the Final Report of the HELP Program.

This paper takes each Crescent application in turn and identifies potential evaluation criteria. Additionally, measures to evaluate each criterion are listed and the need for 'before' studies identified. Detailing of data collection programs is beyond the scope of this initial discussion

document. Finally, a recommendation is made on the assignment of the various application elements to particular subcommittees.

State Data Collection

All Crescent sites equipped with WIM, AVC and/or AVI will have the capability of improving state data collection efforts. In particular, since all sites will be permanent; the volume of data that can be collected will typically be increased over that available from existing methodologies. Sites will be able to collect data on truck gross weights, axle weights, axle spacings, vehicle class, speeds, traffic volumes, date and time. In addition, for AVI equipped vehicles and appropriately equipped sites, origin-destination data can also be obtained.

Evaluation Criteria

- * Availability of data previously not available

measure: Determine and compile the traffic/vehicle data currently collected by the various state agencies through a before study. Perform comparative studies during and after the demonstration to identify additional data.

responsibility: Efficiency and Productivity Subcommittee.

- * Increased use of data

measure: Determine current uses of data collected through a before study (eg. transportation planning, pavement engineering). Perform comparative studies during and after the demonstration to identify uses that additional data are being put to (eg. compliance monitoring of hazardous material routing).

responsibility: Efficiency and Productivity Subcommittee/Additional Applications Subcommittee.

- * Improved compliance (weight, routing)

measure: Determine current levels of compliance with weight limits and routing restrictions through a before study. Monitor improvements in compliance during and after the demonstration.

responsibility: Efficiency and Productivity Subcommittee.

* Accuracy of data collected

measure: For states using existing equipment for data collection (eg. portable WIM) determine accuracy of data through before studies (manual classification v. automatic classification, etc) or through previous experience. Perform similar studies for newly equipped sites during the demonstration.

responsibility: Technical Performance Subcommittee.

* Improved data collection efficiency

measure: Determine volume of data that can currently be collected and cost of collecting and analyzing data (labor costs, equipment, life cycle costs, etc). During course of demonstration, perform comparative studies using Crescent equipment.

Additional equipment-related evaluations could also be performed (eg mean time between equipment failures, downtime, maintenance costs, etc).

responsibility: Efficiency and Productivity Subcommittee/Technical Performance Subcommittee.

Fixed Site Weight Screening

Weigh stations with WIM and AVC equipment installed on the entry ramp can be used to sort trucks. Trucks with potentially illegal weights or configurations, as determined by the WIM/AVC, are directed to static scales. Legally loaded trucks, within certain tolerances, are directed back to the highway.

Evaluation Criteria

* Time savings by vehicles

measure: Perform studies at various weigh stations before WIM equipment is installed to determine average time taken by a truck to pass through. Undertake a comparative study at the weigh station after equipping to determine average vehicle time savings.

responsibility: Efficiency and Productivity Subcommittee.

* Accuracy of screening

measure: During the demonstration, determine percentage of legally loaded vehicles that are being stopped for a static weighing to measure accuracy of WIM equipment and suitability of screening tolerances. In addition, perform a statistically valid data collection program to estimate the percentage of illegally loaded trucks being directed to proceed without static weighing.

responsibility: Technical Performance Subcommittee.

* Improved weigh station operation

measure: Determine if screening operations allow weigh station personnel to perform additional checks on compliance. Previously these may have been given less attention due to time taken with static weighing. This can be measured qualitatively by interviewing weigh station personnel.

responsibility: Efficiency and Productivity Subcommittee.

* Acceptance of weight screening concept

measure: Determine if screening operations are considered acceptable to weight enforcement officers and industry in place of static weighings by undertaking qualitative interviews.

responsibility: Institutional Barriers Subcommittee.

Weight Enforcement Using SWIM Scales

It is possible that slow-speed weigh-in-motion equipment installed at weigh stations could be used for weight enforcement purposes. Vehicles found to be overweight on a SWIM scale could be issued a citation without any further need for a static weighing.

Evaluation Criteria

* Time savings by vehicles

measure: Perform a before study to determine average time taken for a vehicle to pass through a weigh station before a SWIM scale is installed, i.e., when all vehicles require static weighing.

Perform a comparative study after installation of the SWIM scale to determine average vehicle time savings.

responsibility: Efficiency and Productivity Subcommittee.

- * Accuracy of SWIM equipment

measure: Perform a statistically valid data collection program to compare SWIM weights with static weights and so determine the accuracy of the SWIM equipment.

responsibility: Technical Performance Subcommittee.

- * Improved weigh station operation

measure: As for fixed site weight screening.

responsibility: Efficiency and Productivity Subcommittee.

- * Acceptance of SWIM weight enforcement concept.

measure: Determine if weight enforcement using SWIM scales is considered acceptable to weight enforcement officers and industry in place of static weighing by undertaking qualitative interviews.

responsibility: Institutional Barriers Subcommittee.

Automatic Clearance - Weights and Lengths

On entering a weigh station or POE, WIM equipment will determine the individual axle weights and gross weight of a vehicle. AVC equipment determines axle spacings and the overall length of the vehicle. If it is determined that a vehicle has a weight length violation it will be directed to static scales. Legally loaded trucks will be directed back to the freeway without stopping.

Evaluation Criteria

- * Time savings by vehicles

measure: As for fixed site weight screening.

responsibility: Efficiency and Productivity Subcommittee.

* Accuracy of Screening

measure: As for fixed site weight screening.

responsibility: Technical Performance Subcommittee.

* Improved weigh station operation

measure: As for fixed site weight screening.

responsibility: Efficiency and Productivity Subcommittee.

* Acceptance of automatic clearance - weight and length - concept.

measure: As for fixed site weight screening.

responsibility: Institutional Barriers Subcommittee.

* Improved safety

measure: Determine average queue lengths of trucks at particular locations waiting for static weighing through a before study. Perform comparative studies during the course of the demonstration to identify any reductions in queue length. In addition, determine frequency with which queue back-ups reach or approach the main highway both before and during the demonstration.

responsibility: Efficiency and Productivity Subcommittee.

Automatic Clearance - Registration, Safety Inspection, Permit, Mileage

AVI equipped trucks participating in the demonstration will be uniquely identified on entry into a weigh station or POE. The vehicle is looked up in a computer database. If the truck's registration status is in order; it has a current CVSA safety inspection; it has the appropriate overweight or overdimension permits; and it has approval from the appropriate state agencies through paying mileage costs in advance, then it may be automatically cleared and allowed to proceed without further inspections.

Evaluation Criteria

* Time savings by vehicles.

measure: Perform before studies at various weigh stations/POEs to determine the average time for the various inspections and checks to take place on a truck. Undertake a comparative study at the weigh station after equipping to determine average vehicle time savings.

responsibility: Efficiency and Productivity Subcommittee.

* Improved weigh station operation.

measure: Determine if automatic clearance operations allow weigh station personnel to perform additional checks on compliance. This can be measured qualitatively by interviewing weigh station personnel.

responsibility: Efficiency and Productivity Subcommittee.

* Acceptance of automatic clearance concept.

measure: Determine if automatic clearance operations are considered acceptable to weigh station/POE personnel, industry, and personnel from other agencies who receive and distribute the data from industry. This will be undertaken through qualitative interviews.

responsibility: Institutional Barriers Subcommittee.

* Reduced administration.

measure: Determine if automatic clearance procedures result in reduced administrative work for state agencies and/or industry. This may be measured reduction in the amount of paperwork that has to be completed or the number of different locations that have to be visited by a carrier for the submission of information. This can be achieved by interviewing state and industry representatives.

responsibility: Efficiency and Productivity Subcommittee.

* Improved safety.

measure: As for automatic clearance - weight and length.

responsibility: Efficiency and Productivity Subcommittee.

Automatic Clearance - Weight/Distance Tax Administration

Trucks equipped with 2-way AVI equipment and onboard computers record data on mileage and vehicle weight. This information is automatically downloaded to a roadside computer at POE's. Weight/distance information is passed on to the appropriate state agencies for audit purposes. Carriers would not be required to keep separate records to be audited later.

Evaluation Criteria

- * Reduced administration.

measure: As for Automatic Clearance - Registration, Safety Inspection, Permit, Mileage.

responsibility: Efficiency and Productivity Subcommittee.

- * Acceptance of automatic clearance concept.

measure: As for Automatic Clearance - Registration, Safety Inspection, Permit, Mileage.

responsibility: Institutional Barriers Subcommittee.

- * Equipment accuracy.

measure: Design a test program for evaluating the accuracy and efficiency of the two-way AVI equipment when it becomes available during the course of the demonstration.

responsibility: Technical Performance Subcommittee.

Additional Applications

During the course of the Crescent Demonstration it is anticipated that both state and industry will discover additional applications of the equipment and altered institutional arrangements. By their very nature, these applications are as yet undefined and, therefore, evaluation criteria cannot be delineated. However, the evaluation of these applications will be the responsibility of the Additional Applications Subcommittee.

As state and industry representatives discover additional applications they should be reported to the subcommittee. The subcommittee will then take the appropriate action to define criteria and an evaluation program.

Conclusion

As stated in the introduction, the aim of this paper is to take the initial steps in defining an evaluation program for the Crescent Demonstration and for assigning responsibilities. It is requested that this paper is reviewed by the Crescent Implementation Group and other interested members of the HELP program. Feedback on this material is requested as an urgent priority so that the definition process may progress to the next level of detail. In particular it is essential that any before studies are performed in advance of commissioning the Crescent.- Additionally, if the evaluation is to be performed in an efficient manner, the restructured subcommittee must be fully aware of their responsibilities at the earliest possible stage.

APPENDIX C

HEAVY VEHICLE ELECTRONIC LICENSE PLATE (HELP) PROGRAM

CRITICAL PATH ANALYSIS

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Job	Code	Description	Dur	Early Start	Late Start	Total	float
			pcpl	Early Fin	Late Fin		
1	help	START	0	01-01-86	01-01-86	0	
10	la	AVI Project	100	12-31-85	12-31-85		
101a	s	AVI Project	520	01-01-86	01-01-86	0	
11	lar	AVI Field and Lab test review	100	12-29-87	12-29-87		
11	lar	AVI Field and Lab test review	5	01-01-86	01-22-86	15	
12	abr	AVI Define additional data	100	01-07-86	01-28-86		
12	abr	AVI Define additional data	3	01-08-86	01-29-86	15	
17	acr	AVI Advise on Field Test site selection	100	01-14-86	02-04-86		
17	acr	AVI Advise on Field Test site selection	5	01-08-86	05-21-86	95	
17	acr	AVI Advise on Field Test site selection	100	01-14-86	05-27-86		
14	ad	AVI Advise on initial equip. installation for Lab.	15	02-19-86	02-19-86	0	
14	ad	AVI Advise on initial equip. installation for Lab.	100	03-11-86	03-11-86		
15	ad	AVI Advise on ongoing equip. installation for Lab.	0	03-12-86	11-19-86	180	
15	ad	AVI Advise on ongoing equip. installation for Lab.	100	03-11-86	11-18-86		
16	ae	AVI Plan Lab tests	15	01-15-86	02-05-86	15	
16	ae	AVI Plan Lab tests	100	02-04-86	02-25-86		
17	ae	AVI Plan Field Tests	15	01-15-86	05-28-86	95	
17	ae	AVI Plan Field Tests	100	02-04-86	06-17-86		
18	ae	AVI Plan Track tests	15	01-15-86	05-28-86	95	
18	ae	AVI Plan Track tests	100	02-04-86	06-17-86		
19	ae	AVI Approve Lab test plans	10	02-05-86	02-26-86	15	
19	ae	AVI Approve Lab test plans	100	02-18-86	03-11-86		
20	ae	AVI Approve Field test plans	10	02-05-86	06-18-86	95	
20	ae	AVI Approve Field test plans	100	02-18-86	07-01-86		
21	ae	AVI Approve Track test plans	10	02-05-86	06-18-86	95	
21	ae	AVI Approve Track test plans	100	02-18-86	07-01-86		
22	ae	AVI Coord. Lab tests	80	03-12-86	03-12-86	0	
22	ae	AVI Coord. Lab tests	100	07-01-86	07-01-86		
23	ae	AVI Coord. Field tests	80	07-02-86	07-02-86	0	
23	ae	AVI Coord. Field tests	100	10-21-86	10-21-86		
24	ae	AVI Coord. Track tests	80	07-02-86	07-02-86	0	
24	ae	AVI Coord. Track tests	100	10-21-86	10-21-86		
25	af	AVI Analyze Lab Data	90	03-26-86	07-16-86	80	
25	af	AVI Analyze Lab Data	100	07-29-86	11-18-86		
26	af	AVI Analyze Field Data	90	07-16-86	07-16-86	0	
26	af	AVI Analyze Field Data	100	11-18-86	11-18-86		
27	af	AVI Analyze Track Data	90	07-16-86	07-16-86	0	
27	af	AVI Analyze Track Data	100	11-18-86	11-18-86		
28	au	AVI Make recommendations	10	11-19-86	11-19-86	0	
28	au	AVI Make recommendations	100	12-02-86	12-02-86		

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Job	Code	Description	Dur	Early Start	Late Start	Total
			pcd	Early Fin	Late Fin	float
22	ag a	AVI Approve recommendations -	10	12-03-86	12-03-86	0
		End of Phase One	100	12-16-86	12-16-86	
26	ag	AVI Prepare Interim Report	0	01-08-86	02-25-87	295
			100	01-07-86	02-24-87	
31	ag	AVI Finish Interim Report	50	02-11-87	02-25-87	10
			100	04-21-87	05-05-87	
32	au	AVI Approve Interim Report -	10	05-06-87	05-06-87	0
		End of Phase Two	100	05-19-87	05-19-87	
33	ah	AVI Draft Specification	10	12-17-86	12-17-86	0
			100	12-30-86	12-30-86	
34	ah	AVI Negotiate with	20	12-31-86	12-31-86	0
		Manufacturers	100	01-27-87	01-27-87	
35	ah	AVI Approve Draft	10	12-31-86	01-14-87	10
		Specification	100	01-13-87	01-27-87	
37	at	AVI Final Specification	10	01-28-87	01-28-87	0
			100	02-10-87	02-10-87	
37	ai	AVI Initial advice on	5	07-15-87	10-28-87	75
		Preferred Equip. Installation	100	07-21-87	11-03-87	
38	ai	AVI Diquing advice on	0	07-22-87	11-04-87	75
		Preferred Equip. Installation	100	07-21-87	11-03-87	
39	aj	AVI Plan Lab, Field and Track	30	05-20-87	05-20-87	0
		Trials	100	06-30-87	06-30-87	
40	ad	AVI Commission Lab equipment	10	02-26-86	02-26-86	0
			100	03-11-86	03-11-86	
42	aj	AVI Approve Lab, Field and	10	07-01-87	07-01-87	0
		Track Trials Plans	100	07-14-87	07-14-87	
43	aj	AVI Coord. Lab, Field and	60	07-15-87	07-15-87	0
		Track Trials	100	10-06-87	10-06-87	
48	ak	AVI Analyze Lab, Field and	70	07-29-87	07-29-87	0
		Track Data	100	11-03-87	11-03-87	
51	al	AVI Final Report Preparation	0	05-20-87	11-04-87	120
			100	05-19-87	11-03-87	
52	al	AVI Finish Final Report	40	11-04-87	11-04-87	0
			100	12-29-87	12-29-87	
53	al	AVI FINAL APPROVAL	10	12-30-87	12-30-87	0
			100	01-12-88	01-12-88	
54	ah	AVI Manufacture preferred	60	02-11-87	02-11-87	0
		system	100	05-05-87	05-05-87	
55	ad	AVI Obtain Laboratory	35	01-01-86	01-01-86	0
		equipment	100	02-18-86	02-18-86	

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Job	Code	Description	Dur	Early Start	Late Start	Total
			lpc1	Early Fin	Late Fin	float
56	ad	AVI Obtain Track and Field equipment	35	01-01-86	04-23-86	80
			100	02-10-86	06-10-86	
57	ad	AVI Advise on initial equip. install. for Field and Track	15	02-19-86	06-11-86	80
			100	03-11-86	07-01-86	
58	ad	AVI Advise on ongoing equip. install. for Field and Track	0	03-12-86	11-19-86	180
			100	03-11-86	11-18-86	
59	ad	AVI Commission Field and Track equipment	10	02-26-86	06-18-86	80
			100	03-11-86	07-01-86	
60	dar	WIM Review	15	01-01-86	01-01-86	0
			100	01-21-86	01-21-86	
61	abr	WIM Define outline Performance Criteria	15	01-22-86	01-22-86	0
			100	02-11-86	02-11-86	
62	bc	WIM Develop Lab tests	15	02-12-86	11-05-86	190
			100	03-04-86	11-25-86	
63	bc	WIM Develop Field tests	15	02-12-86	02-12-86	0
			100	03-04-86	03-04-86	
64	bc	WIM Approve Lab test plans	10	03-05-86	11-26-86	190
			100	03-18-86	12-09-86	
65	bc	WIM Approve Field test plans	10	03-05-86	03-05-86	0
			100	03-18-86	03-18-86	
66	bd	WIM Implement Lab tests	60	03-19-86	12-10-86	190
			100	06-10-86	03-03-87	
67	bd	WIM Implement Field tests	230	03-19-86	03-19-86	0
			100	03-03-87	03-03-87	
68	be	WIM Analyze Lab data	70	04-16-86	01-07-87	190
			100	07-22-86	04-14-87	
69	be	WIM Analyze Field data	250	04-30-86	04-30-86	0
			100	04-14-87	04-14-87	
70	bf	WIM Refine Performance Specification	15	04-15-87	04-15-87	0
			100	05-05-87	05-05-87	
71	bf	WIM Approve Performance Specification	10	05-06-87	05-20-87	10
			100	05-19-87	06-02-87	
72	bg	WIM Prepare Final Report	0	01-22-86	05-06-87	335
			100	01-21-86	05-05-87	
73	bg	WIM Annotated Report	20	05-06-87	05-06-87	0
			100	06-02-87	06-02-87	
74	bg	WIM Approve Annotated Report	10	06-03-87	06-03-87	0
			100	06-16-87	06-16-87	
75	bg	WIM Finish Final Report	10	06-17-87	06-17-87	0
			100	06-30-87	06-30-87	

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Job	Code	Description	Dur	Early Start	Late Start	Total
			lpcd	Early Fin	Late Fin	float
76	bg	WIM FINAL APPROVAL	10	07-01-87	07-01-87	0
			100	07-14-87	07-14-87	
77	b	WIM project	390	01-01-86	01-01-86	0
			100	06-30-87	06-30-87	
80	car	SDS Help Review	20	01-01-86	01-01-86	0
			100	01-28-86	01-28-86	
81	cbr	SDS Define User needs	40	01-29-86	01-29-86	0
			100	03-25-86	03-25-86	
92	cc	SDS Evaluation and	40	03-26-86	03-26-86	0
		Prioritization	100	05-20-86	05-20-86	
93	cl	SDS Approval of Eval/Prior.	10	05-21-86	06-04-86	10
			100	06-03-86	06-17-86	
94	cdr	SDS Finish Strategic System	100	06-18-86	06-18-86	0
		Design	100	11-04-86	11-04-86	
95	cer	SDS Investigation of	160	07-16-86	07-30-86	10
		Communications Media	100	02-24-87	03-10-87	
96	cfr	SDS Investigation of	160	07-16-86	07-30-86	10
		Communications Protocol	100	02-24-87	03-10-87	
97	cgr	SDS System Analysis	120	11-19-86	11-19-86	0
			100	05-05-87	05-05-87	
98	chr	SDS Formulate Management	120	11-19-86	11-19-86	0
		Structure	100	05-05-87	05-05-87	
99	ci	SDS Preparation of Final	0	01-29-86	05-06-87	130
		Report	100	01-28-86	05-05-87	
90	ci	SDS Finish Final Report	40	05-06-87	05-06-87	0
			100	06-30-87	06-30-87	
91	cl	SDS FINAL APPROVAL	10	07-01-87	07-01-87	0
			100	07-14-87	07-14-87	
92	cc	SDS Prepare Strategic System	20	05-21-86	05-21-86	0
		Design	100	06-17-86	06-17-86	
93	cd	SDS Approve Strategic Systems	10	11-05-86	11-05-86	0
		Design	100	11-18-86	11-18-86	
94	c	SDS Systems Design	390	01-01-86	01-01-86	0
			100	06-30-87	06-30-87	
100	dar	SSS Site Location Strategy	10	03-03-86	03-17-86	10
		Review	100	03-14-86	03-28-86	
101	db	SSS Consultations with State	20	03-03-86	03-03-86	0
		and Federal Agencies	100	03-28-86	03-28-86	
102	db	SSS Prepare Priorities	10	03-31-86	03-31-86	0
		Document	100	04-11-86	04-11-86	

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Job	Code	Description	Dur	Early Start	Late Start	Total
			pcd	Early Fin	Late Fin	fload
103	ldb	SSS Approve Priorities	10	04-14-86	04-14-86	0
		Document	100	04-25-86	04-25-86	
104	ldc	SSS Establish Strategic Plan	20	04-28-86	04-28-86	0
			100	05-23-86	05-23-86	
105	ddr	SSS Detail Survey Guidelines	20	04-28-86	04-28-86	0
			100	05-23-86	05-23-86	
106	de	SSS Preparation of Final	0	03-31-86	05-26-86	40
		Report	100	03-28-86	05-23-86	
107	de	SSS Finish Final Report	5	05-26-86	05-26-86	0
			100	05-30-86	05-30-86	
108	de	SSS FINAL APPROVAL	10	06-02-86	06-02-86	0
			100	06-13-86	06-13-86	
109	u	SSS Site Selection Study	65	03-03-86	03-03-86	0
			100	05-30-86	05-30-86	
120	ear	MCSP Review of Potential Help	20	03-03-86	04-28-86	40
		Benefits	100	03-28-86	05-23-86	
121	ebr	MCSP Collect and Collate	60	03-03-86	03-03-86	0
		Government data	100	05-23-86	05-23-86	
122	edr	MCSP Collect and Collate Motor	60	03-03-86	03-03-86	0
		Carrier data	100	05-23-86	05-23-86	
123	edr	MCSP Analyze data	50	05-26-86	05-26-86	0
			100	08-01-86	08-01-86	
124	eer	MCSP Assess Help impact	70	07-07-86	07-07-86	0
			100	10-10-86	10-10-86	
125	efr	MCSP Benefit Analysis	80	09-29-86	09-29-86	0
			100	01-16-87	01-16-87	
126	eg	MCSP Prepare Final Report	0	05-26-86	01-19-87	170
			100	05-23-86	01-16-87	
127	eg	MCSP Finish Final Report	30	01-19-87	01-19-87	0
			100	02-27-87	02-27-87	
128	eg	MCSP FINAL APPROVAL	10	03-02-87	03-02-87	0
			100	03-13-87	03-13-87	
129	e	MCSP Motor Carrier Services	260	03-03-86	03-03-86	0
		Plan	100	02-27-87	02-27-87	
140	far	SRSD Consultations with	40	03-03-86	03-10-86	5
		Government and Industry	100	04-25-86	05-02-86	
141	fbr	SRSD Literature and Product	25	03-03-86	03-03-86	0
		Review	100	04-04-86	04-04-86	
142	fc	SRSD Evaluation of Trucking	60	04-07-86	04-07-86	0
		Industry data needs	100	06-27-86	06-27-86	

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Job	Code	Description	Dur	Early Start	Late Start	Total
			pcd	Early Fin	Late Fin	float
143	fc	SRSD Approval of Trucking	10	06-30-86	06-30-86	0
		Industry Data needs	100	07-11-86	07-11-86	
144	fdr	SRSD Define System	60	07-14-86	07-14-86	0
		Characteristics	100	10-03-86	10-03-86	
145	fer	SRSD Define Alternative	60	07-14-86	07-14-86	0
		Methodologies	100	10-03-86	10-03-86	
146	fr	SRSD Select Technical Approach	50	10-06-86	10-06-86	0
			100	12-12-86	12-12-86	
147	fgr	SRSD Formulate Implementation	40	12-15-86	12-15-86	0
		Strategy	100	02-06-87	02-06-87	
148	fh	SRSD Prepare Final Report	0	04-28-86	02-09-87	205
			100	04-28-86	02-06-87	
149	fh	SRSD Finish Final Report	15	02-09-87	02-09-87	0
			100	02-27-87	02-27-87	
150	fh	SRSD FINAL APPROVAL	10	03-02-87	03-02-87	0
			100	03-13-87	03-13-87	
151	f	SRSD Satellite Reference	260	03-03-86	03-03-86	0
		System Design Study	100	02-27-87	02-27-87	
160	gar	AWACS Review	10	01-01-86	01-01-86	0
			100	01-14-86	01-14-86	
161	gb	AWACS Define test program	5	01-15-86	02-05-86	15
			100	01-21-86	02-11-86	
162	gb	AWACS Approve test program	10	01-22-86	02-12-86	15
			100	02-04-86	02-25-86	
163	gc	AWACS Develop Site Selection	10	01-15-86	03-19-86	45
		Criteria	100	01-28-86	04-01-86	
164	gc	AWACS Form Site list for Iowa	5	01-29-86	04-02-86	45
			100	02-04-86	04-08-86	
165	gc	AWACS Form Site list for Minn.	5	01-29-86	04-02-86	45
			100	02-04-86	04-08-86	
166	gc	AWACS Approve Site list for	10	02-05-86	04-09-86	45
		Iowa	100	02-18-86	04-22-86	
167	gc	AWACS Approve Site list for	10	02-05-86	04-09-86	45
		Minn.	100	02-18-86	04-22-86	
168	gd	AWACS Design Weight sensors	10	01-15-86	01-15-86	0
			100	01-28-86	01-28-86	
169	gd	AWACS Build prototype Weight	20	01-29-86	01-29-86	0
		sensors	100	02-25-86	02-25-86	
170	gd	AWACS Lab test prototype	40	02-26-86	02-26-86	0
		Weight sensors	100	04-22-86	04-22-86	

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Job	Code	Description	Dur	Early Start	Late Start	Total
			pccl	Early Fin	Late Fin	float
171	gd	AWACS Manufacture Weight	20	07-16-86	07-16-86	0
		sensors	100	08-12-86	08-12-86	
172	gd	AWACS Design Signal processing	20	01-15-86	01-15-86	0
			100	02-11-86	02-11-86	
173	gd	AWACS Produce prototype Signal	30	02-12-86	02-12-86	0
		processing techniques	100	03-25-86	03-25-86	
174	gd	AWACS Lab test Signal	20	03-26-86	03-26-86	0
		processing techniques	100	04-22-86	04-22-86	
175	gd	AWACS Manufacture Signal	20	07-16-86	07-16-86	0
		processing equipment	100	08-12-86	08-12-86	
176	gd	AWACS Approve equipment	10	08-13-86	08-13-86	0
			100	08-26-86	08-26-86	
177	ge	AWACS Install Iowa	10	08-27-86	08-27-86	0
			100	09-09-86	09-09-86	
178	ge	AWACS Install Minn.	10	08-27-86	08-27-86	0
			100	09-09-86	09-09-86	
179	ge	AWACS Calibrate Iowa	20	09-10-86	09-10-86	0
			100	10-07-86	10-07-86	
180	ge	AWACS Calibrate Minn.	20	09-10-86	09-10-86	0
			100	10-07-86	10-07-86	
181	gf	AWACS Develop test procedures	10	04-23-86	08-13-86	80
			100	05-06-86	08-26-86	
182	gf	AWACS Approve test procedures	10	05-07-86	08-27-86	80
			100	05-20-86	09-09-86	
183	gf	AWACS Test Iowa	140	09-17-86	09-17-86	0
			100	03-31-87	03-31-87	
184	gf	AWACS Test Minn.	140	09-17-86	09-17-86	0
			100	03-31-87	03-31-87	
185	gg	AWACS Analyze Iowa data	140	11-19-86	11-19-86	0
			100	06-02-87	06-02-87	
186	gg	AWACS Analyze Minn. data	140	11-19-86	11-19-86	0
			100	06-02-87	06-02-87	
187	gh	AWACS Initial equipment	10	08-27-86	05-20-87	190
		support for Iowa	100	09-09-86	06-02-87	
188	gh	AWACS Ongoing equipment	0	09-10-86	06-03-87	190
		support for Iowa	100	09-09-86	06-02-87	
189	gh	AWACS Initial equipment	10	08-27-86	05-20-87	190
		support for Minn.	100	09-09-86	06-02-87	
190	gh	AWACS Ongoing equipment	0	09-10-86	06-03-87	190
		support for Minn.	100	09-09-86	06-02-87	

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Job	Code	Description	Dur	Early Start	Late Start	Total
			pcd	Early Fin	Late Fin	float
191	gi	AWACS Prepare Final Report	01	01-15-86	06-03-87	360
			100	01-14-86	06-02-87	
192	gi	AWACS Finish Final Report	20	06-03-87	06-03-87	0
			100	06-30-87	06-30-87	
193	gi	AWACS FINAL APPROVAL	10	07-01-87	07-01-87	0
			100	07-14-87	07-14-87	
194	gd	AWACS Field test prototype	60	04-23-86	04-23-86	0
		Weight sensors	100	07-15-86	07-15-86	
195	gd	AWACS Field test prototype	60	04-23-86	04-23-86	0
		Signal processing techniques	100	07-15-86	07-15-86	
196	g	AWACS project	390	01-01-86	01-01-86	0
			100	06-30-87	06-30-87	
200	h1	CRESCENT Installation of	30	05-06-87	05-06-87	0
		System	100	06-16-87	11-17-87	110
201	h2	CRESCENT Installation of	30	05-06-87	05-06-87	0
		System (Oregon)	100	06-16-87	06-16-87	
202	h3	CRESCENT Installation of	15	05-06-87	06-24-87	35
		System (British Columbia)	100	05-26-87	07-14-87	
203	h4	CRESCENT Installation of	30	05-06-87	06-17-87	30
		System (Washington)	100	06-16-87	07-28-87	
204	h5	CRESCENT Installation of	30	05-06-87	07-15-87	50
		System (California)	100	06-16-87	08-25-87	
205	h6	CRESCENT Installation of	30	05-06-87	08-12-87	70
		System (Arizona)	100	06-16-87	09-22-87	
206	h7	CRESCENT Installation of	30	05-06-87	09-09-87	90
		System (New Mexico)	100	06-16-87	10-20-87	
207	h8	CRESCENT Installation of	30	05-06-87	10-07-87	110
		System (Texas)	100	06-16-87	11-17-87	
210	h2	CRESCENT Installation of	130	06-17-87	06-17-87	0
		AVI/WIM/AWACS Equipment	100	12-15-87	12-15-87	
211	h3	CRESCENT Installation of	20	06-17-87	06-17-87	0
		AVI/WIM/AWACS Equipment (Oreg)	100	07-14-87	07-14-87	
212	h4	CRESCENT Installation of	10	07-15-87	07-15-87	0
		AVI/WIM/AWACS Equipment (BCol)	100	07-28-87	07-28-87	
213	h5	CRESCENT Installation of	20	07-29-87	07-29-87	0
		AVI/WIM/AWACS Equipment (Wash)	100	08-25-87	08-25-87	
214	h6	CRESCENT Installation of	20	08-26-87	08-26-87	0
		AVI/WIM/AWACS Equipment (Cal)	100	09-22-87	09-22-87	
215	h7	CRESCENT Installation of	20	09-23-87	09-23-87	0
		AVI/WIM/AWACS Equipment (Ariz)	100	10-20-87	10-20-87	

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Critical path analysis

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Job	Code	Description	(Dur)	Early Start	Late Start	Total
			(pct)	Early Fin	Late Fin	(float)
216	hm	CRESCENT Installation of	20	10-21-87	10-21-87	0
		AVI/WIM/AWACS Equipment (NM)	100	11-17-87	11-17-87	
217	hm	CRESCENT Installation of	20	11-18-87	11-18-87	0
		AVI/WIM/AWACS Equipment (Tex)	100	12-15-87	12-15-87	
221	ho	CRESCENT Coordinate Crescent	20	12-16-87	12-16-87	0
		Demonstration	100	01-12-88	01-12-88	
231	hp	CRESCENT Implement Crescent	260	01-13-88	01-13-88	0
		Demonstration	100	01-10-89	01-10-89	
241	hq	CRESCENT Evaluation Report	80	01-11-89	01-11-89	0
			100	05-02-89	05-02-89	