Appendix E:

Crescent Demonstration Office

Evaluation Report

by

The Crescent Evaluation Team

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The Crescent Evaluation

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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

OVERVIEW

The following sections provide assessments of Crescent Demonstration Office functions. The discussion will evaluate the performance from the user's perspective and identify enhancements that could be desirable in a long-term, system-wide application. Issues include enrollment procedures, quality and quantity of stored information and equipment, site evaluations, carrier concerns, views of CVO agency representatives, adequacy of reports, data security, and future integration of technology. Opinions have been expressed by both the operators of CVO technology as well as motor carriers and other prospective users. Based on these interests and concerns, the team has established recommendations to improve the reliability and effectiveness of these operations.

CARRIER ENROLLMENT ASSESSMENT

The following commercial vehicle functions were reviewed at the Crescent Demonstration Office in order to evaluate their performance:

- recruitment of motor carriers,
- processing of enrollment applications,
- processing fleet vehicle data,
- distribution, replacement and accountability of transponders,
- processing change of information requests from motor carriers,
- processing motor carrier license information,
- processing permit information, and
- verifying appropriate data with state authorities.

The purpose of the review was to conduct a limited audit to determine how well the CDO functions perform from the user perspective and what enhancements might be considered desirable or required in a long-term, system-wide operation.

The CDO has established well documented procedures dealing with carrier and vehicle enrollment and credentials entry processes. On the following pages are a series of flow Diagrams outlining the various processes conducted by the CDO in carrying out this responsibility. These diagrams were provided by Lockheed during the review period. The evaluation team concludes that these procedures are effective and that the CDO carries out its responsibilities in accordance with these established procedures.

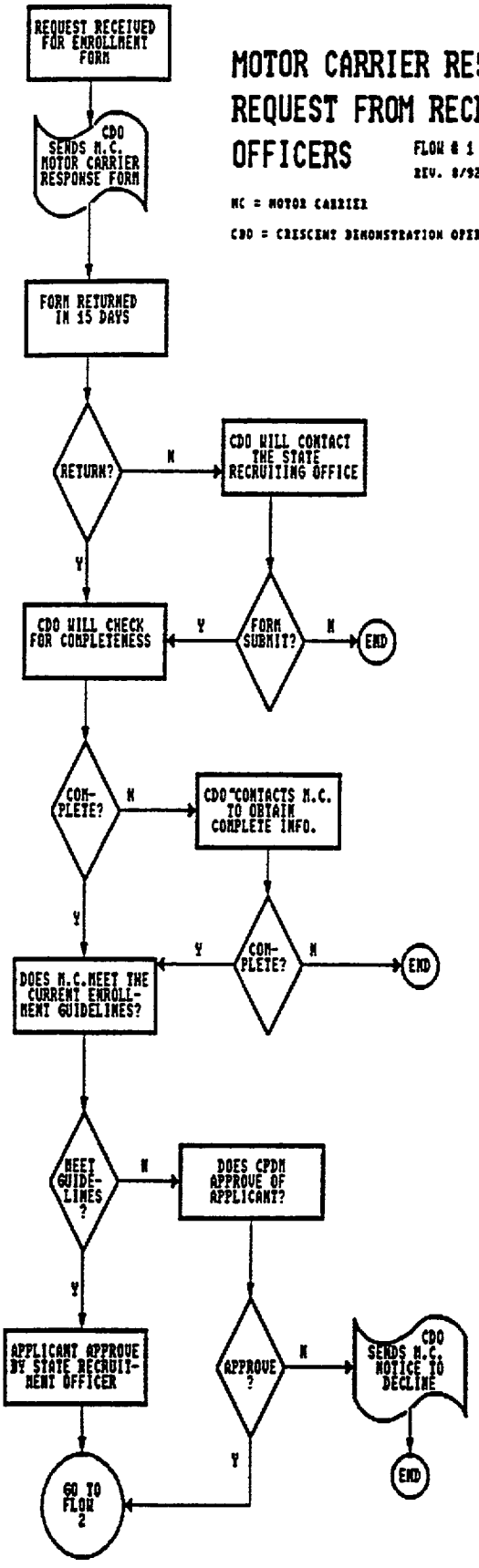
MOTOR CARRIER RESPONSE FORM REQUEST FROM RECRUITMENT OFFICERS

FLOW # 1

REV. 8/92

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR



ENROLLMENT APPLICATION

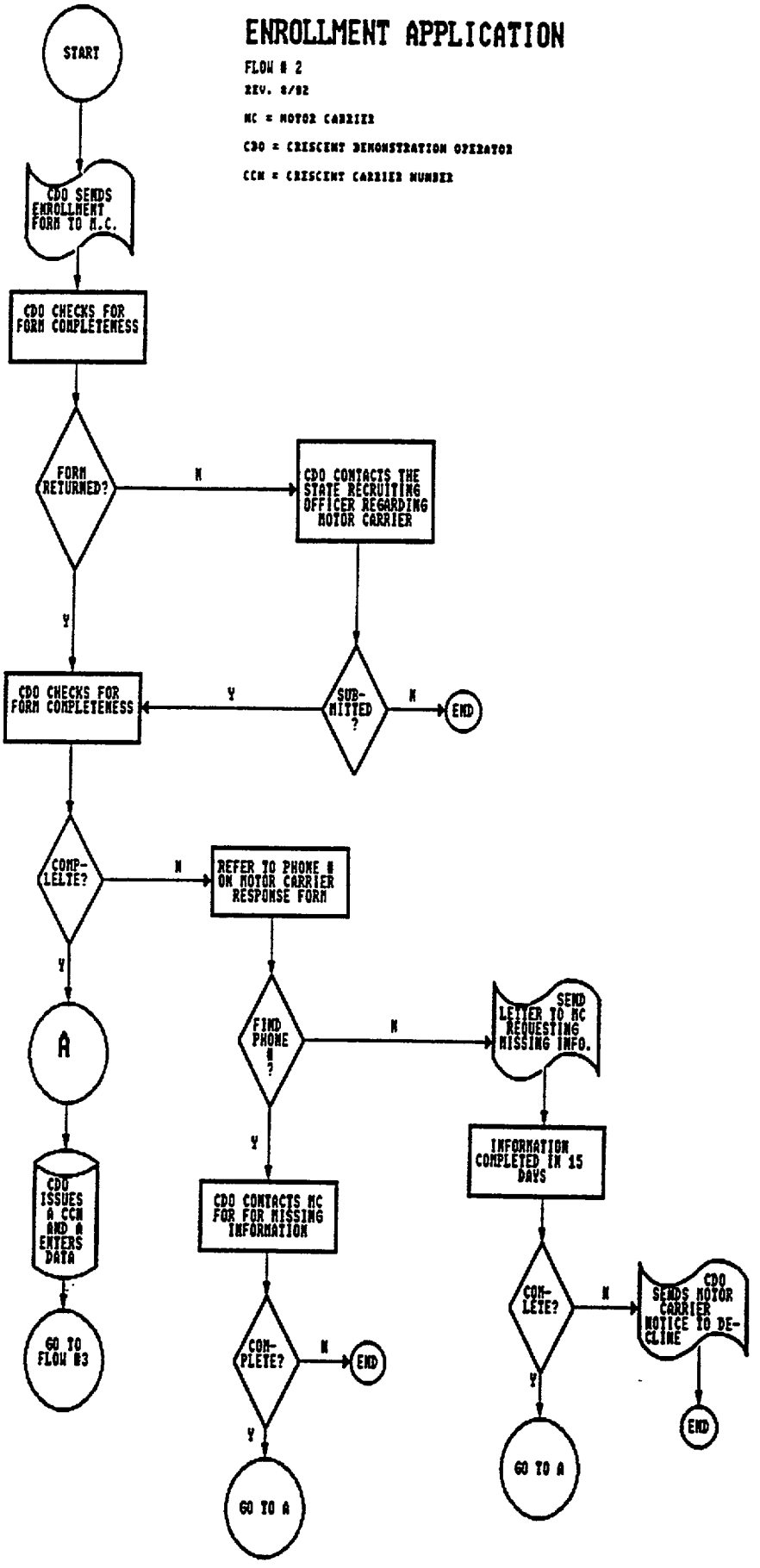
FLOW # 2

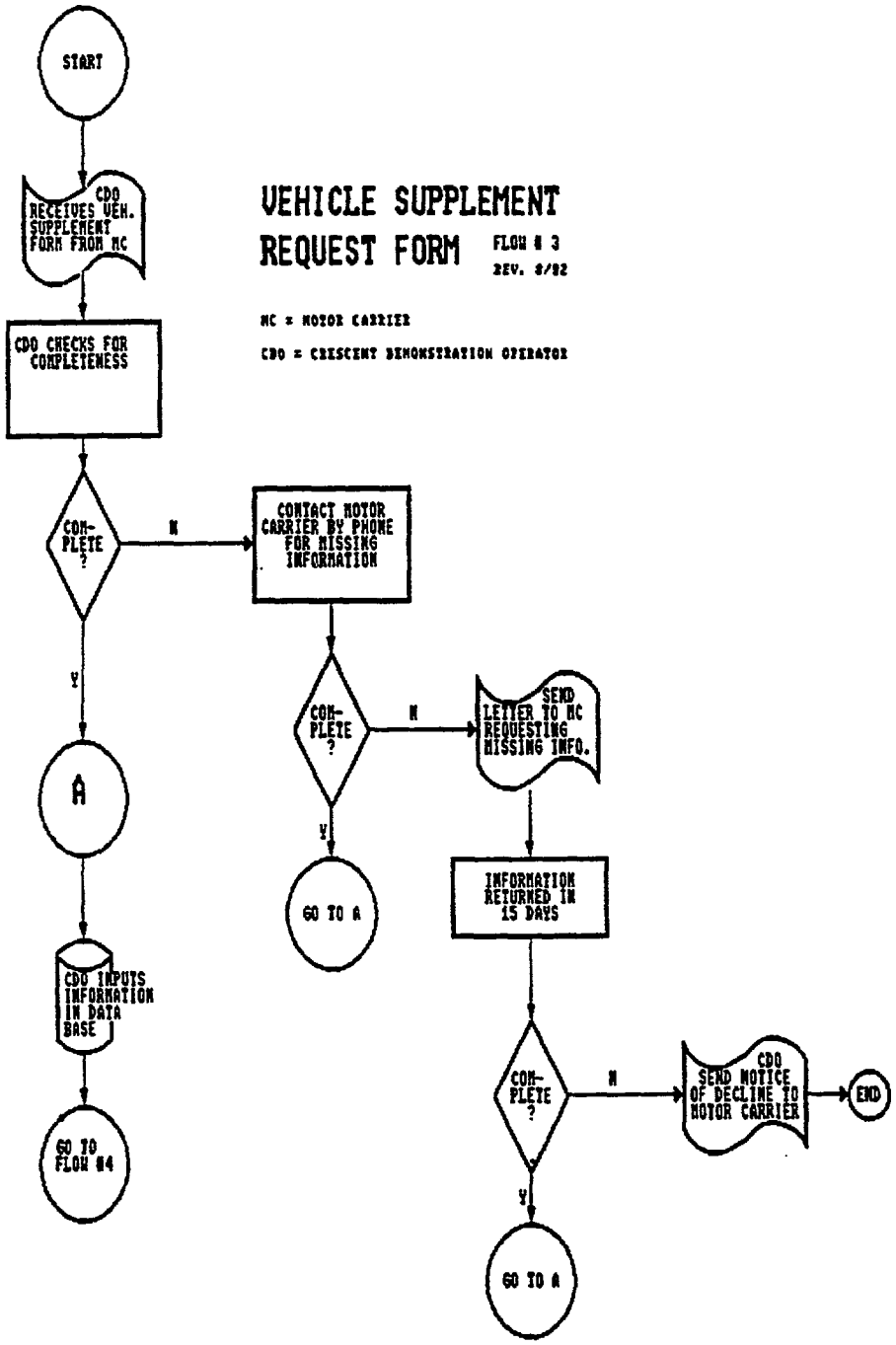
REV. 8/92

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR

CCN = CRESCENT CARRIER NUMBER





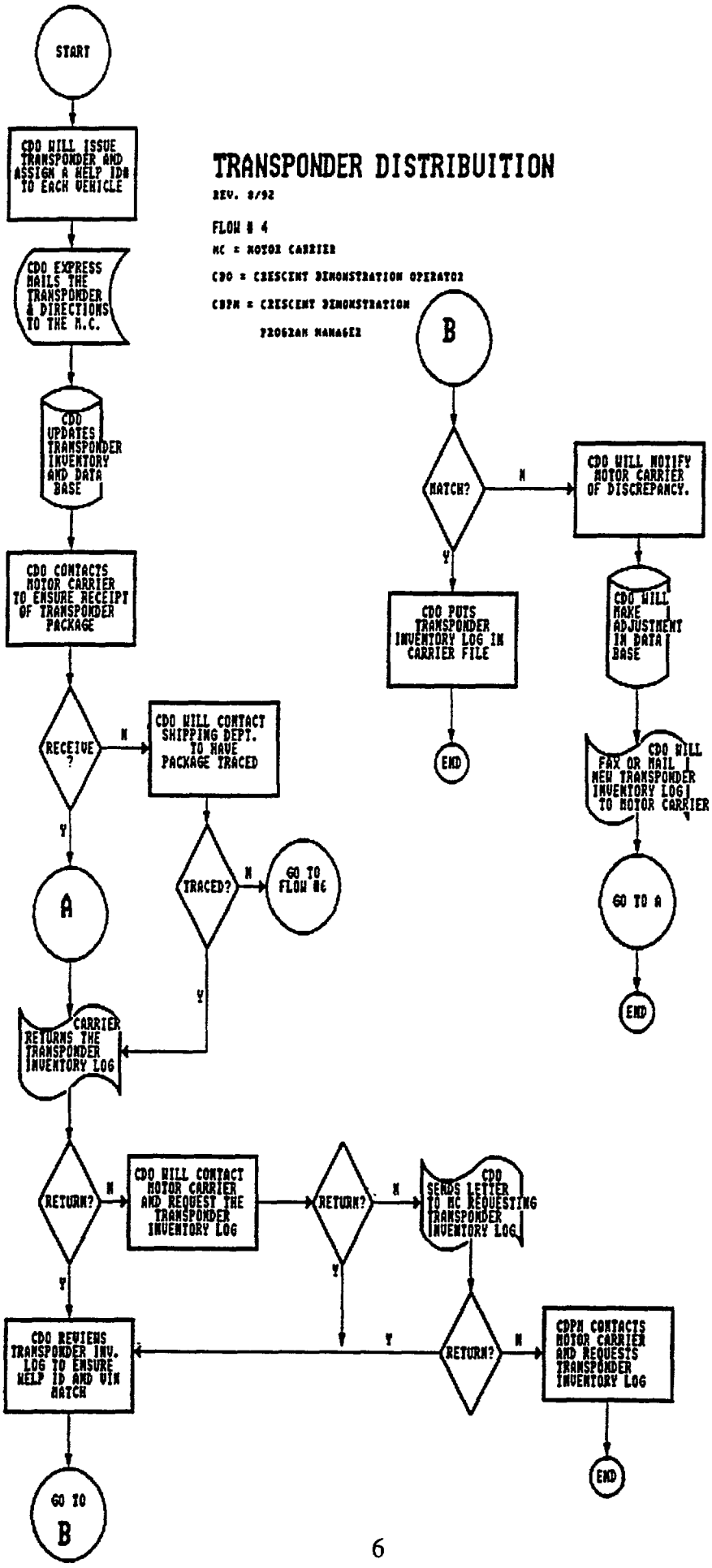
VEHICLE SUPPLEMENT REQUEST FORM

FLOW # 3

REV. 8/92

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR


TRANSPONDER DISTRIBUITION
REV. 8/92
FLOW # 4
MC = MOTOR CARRIER
CDO = CRESCENT DEMONSTRATION OPERATOR
CDPM = CRESCENT DEMONSTRATION PROGRAM MANAGER
START
CDO WILL ISSUE TRANSPONDER AND ASSIGN A HELP ID# TO EACH VEHICLE
CDO EXPRESS MAILS THE TRANSPONDER & DIRECTIONS TO THE M.C.
CDO UPDATES TRANSPONDER INVENTORY AND DATA BASE
CDO CONTACTS MOTOR CARRIER TO ENSURE RECEIPT OF TRANSPONDER PACKAGE
RECEIVE ?
N
CDO WILL CONTACT SHIPPING DEPT. TO HAVE PACKAGE TRACED
TRACED?
N
GO TO FLOW #6
Y
Y
A
CARRIER RETURNS THE TRANSPONDER INVENTORY LOG
RETURN?
N
CDO WILL CONTACT MOTOR CARRIER AND REQUEST THE TRANSPONDER INVENTORY LOG
RETURN?
N
CDO SENDS LETTER TO MC REQUESTING TRANSPONDER INVENTORY LOG
Y
Y
CDO REVIEWS TRANSPONDER INV. LOG TO ENSURE HELP ID AND VIN MATCH
Y
RETURN?
N
CDPM CONTACTS MOTOR CARRIER AND REQUESTS TRANSPONDER INVENTORY LOG
END
GO TO B
B
MATCH?
N
CDO WILL NOTIFY MOTOR CARRIER OF DISCREPANCY.
Y
CDO PUTS TRANSPONDER INVENTORY LOG IN CARRIER FILE
END
CDO WILL MAKE ADJUSTMENT IN DATA BASE
CDO WILL FAX OR MAIL NEW TRANSPONDER INVENTORY LOG TO MOTOR CARRIER
GO TO A
END

CHANGE OF INFORMATION REQUEST FORM

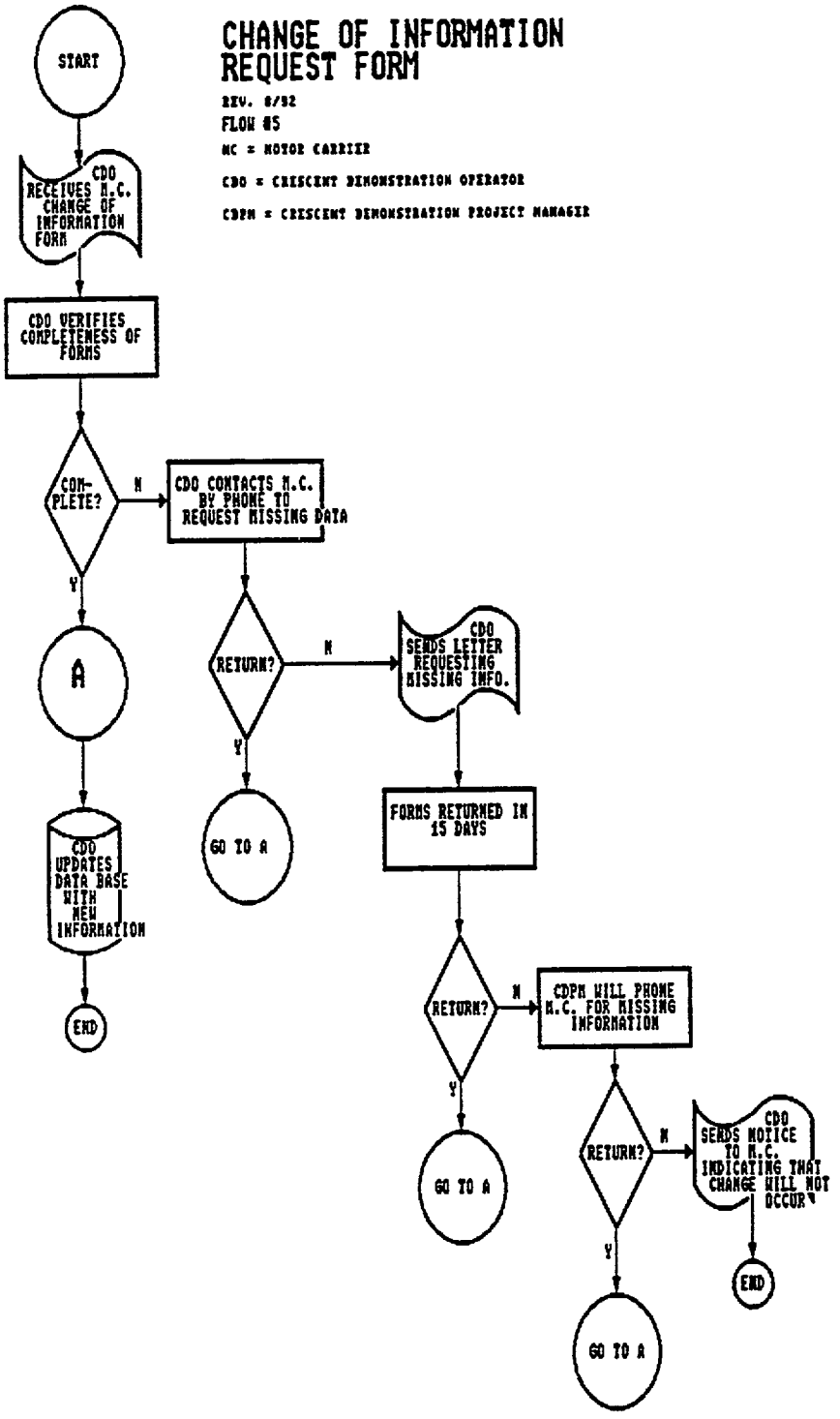
REV. 6/92

FLOW #5

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR

CDPM = CRESCENT DEMONSTRATION PROJECT MANAGER



TRANSPONDER REPLACEMENT

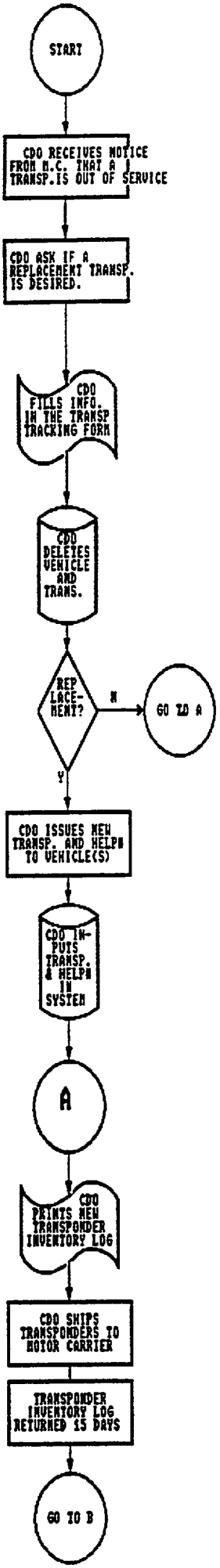
REV. 8/92

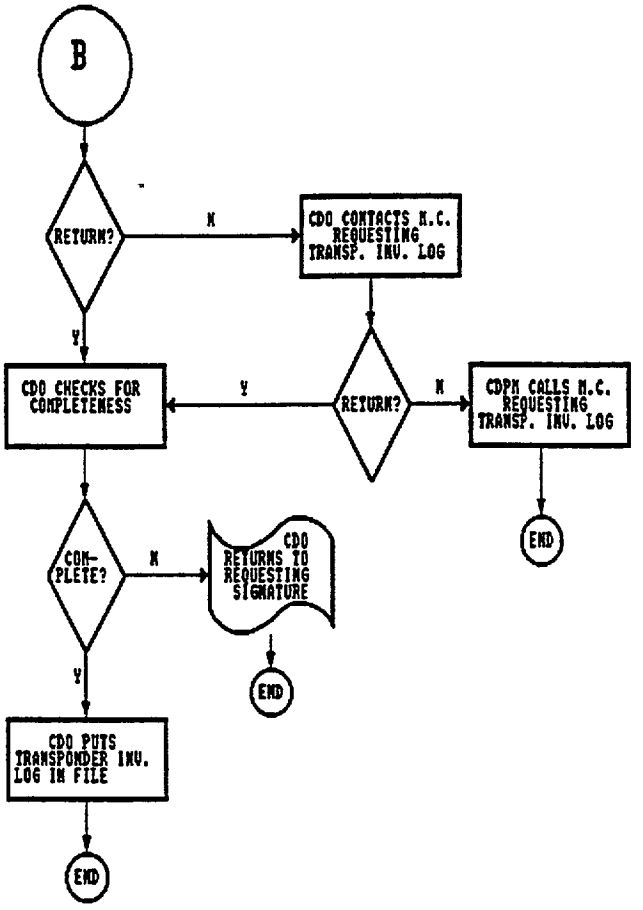
FLOW #6

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR

CDPM = CRESCENT DEMONSTRATION PROJECT MANAGER





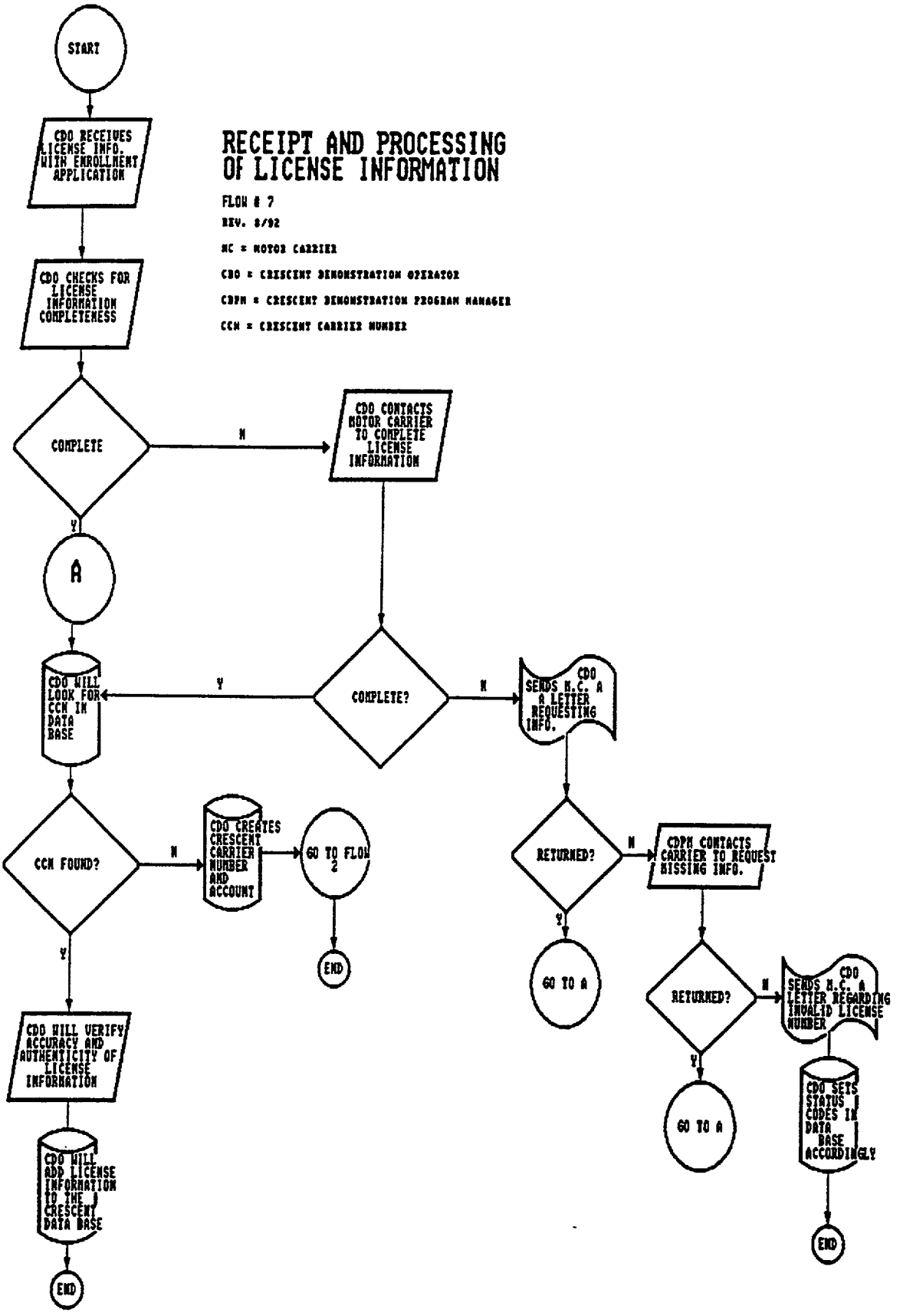
CREDENTIALS ENTRY ASSESSMENT

The evaluation team noted that although the procedures are documented and in place, the data in the system is often not current or complete. Under the current operating procedures, the information flow of registration and permit data must be initiated by the motor carrier. The process flow diagram for these procedures are displayed on the following pages.

In a number of cases, registration data is not being kept up to date by the motor carrier and requires prompting by the CDO. To the credit of the CDO, it is trying to keep this information as up to date as possible by contacting those carriers whose data needs to be updated. Permit data is virtually nonexistent in the system -- again, the responsibility for providing this data rests with the motor carrier. However, there was little incentive since there was no application utility provided for this data in the demonstration.

The evaluation team recommends that the CDO keep the documentation and procedures updated as the processes change over time. These changes are likely to occur as special conditions occur and as the process becomes more automated. One special condition, for example, is the process for validating Oregon data on the Crescent data base. This process is completely different than the one followed for the other five states.

Another recommendation is that automated interfaces be established between the Crescent Computer System and various state agency computers. These interfaces would permit downloading of accurate and timely registration and permit data for enrolled carriers and vehicles. Although these interfaces will be difficult to achieve -- primarily for institutional reasons -- they provide the only means of maintaining an acceptably accurate data base for CVO functions such as roadside compliance checking and weigh station pre-clearance and bypass.



RECEIPT AND PROCESSING OF LICENSE INFORMATION

FLOW # 7

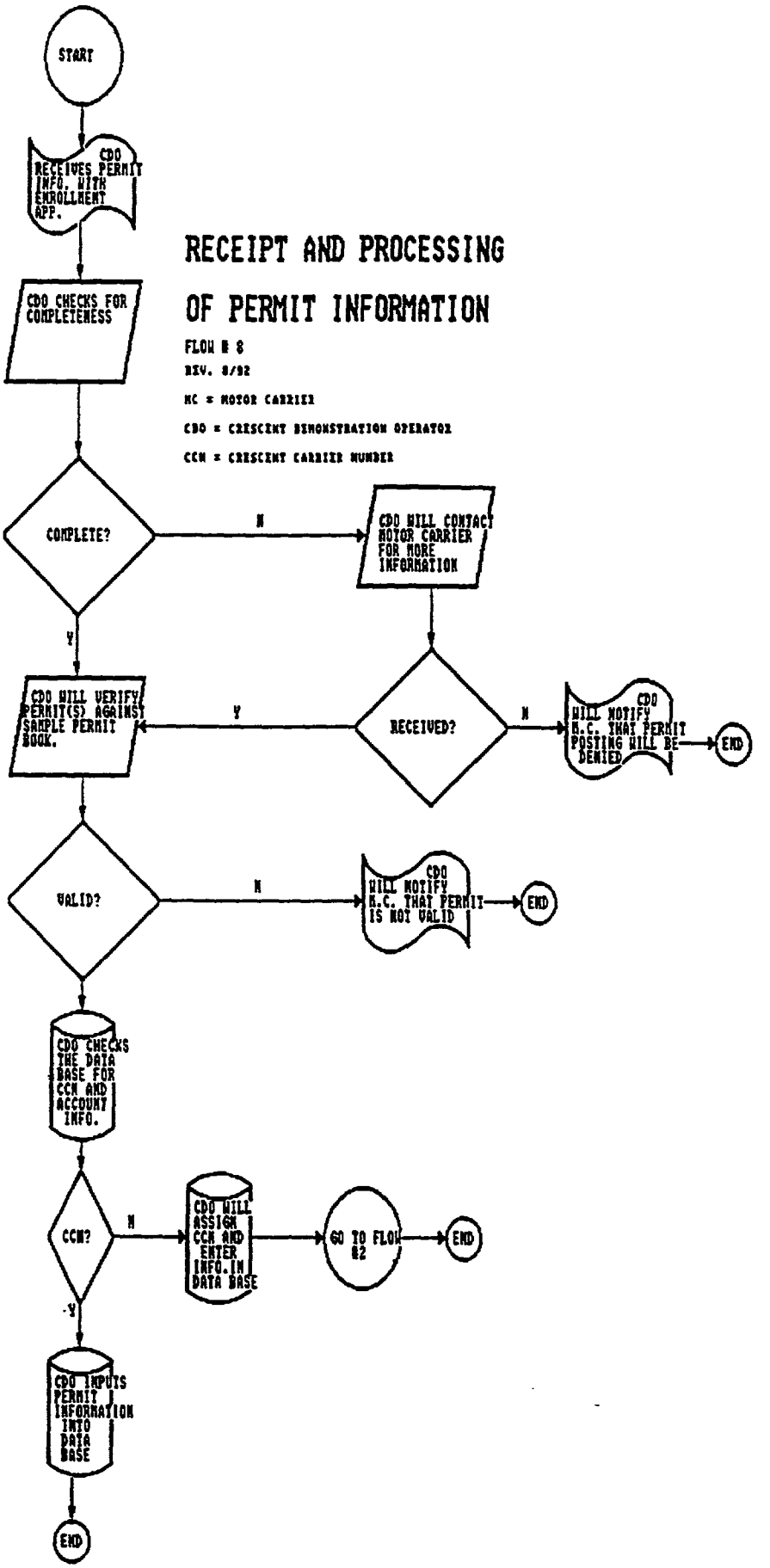
REV. 8/92

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR

CDPM = CRESCENT DEMONSTRATION PROGRAM MANAGER

CCN = CRESCENT CARRIER NUMBER


START
CDO RECEIVES PERMIT INFO. WITH ENROLLMENT APP.
CDO CHECKS FOR COMPLETENESS
COMPLETE?
N
CDO WILL CONTACT MOTOR CARRIER FOR MORE INFORMATION
Y
CDO WILL VERIFY PERMIT(S) AGAINST SAMPLE PERMIT BOOK.
Y
RECEIVED?
N
CDO WILL NOTIFY M.C. THAT PERMIT POSTING WILL BE DENIED
END
VALID?
N
CDO WILL NOTIFY M.C. THAT PERMIT IS NOT VALID
END
CDO CHECKS THE DATA BASE FOR CCN AND ACCOUNT INFO.
CCN?
N
CDO WILL ASSIGN CCN AND ENTER INFO. IN DATA BASE
GO TO FLOW #2
END
Y
CDO INPUTS PERMIT INFORMATION INTO DATA BASE
END
RECEIPT AND PROCESSING
OF PERMIT INFORMATION
FLOW # 8
REV. 8/92
MC = MOTOR CARRIER
CDO = CRESCENT DEMONSTRATION OPERATOR
CCN = CRESCENT CARRIER NUMBER

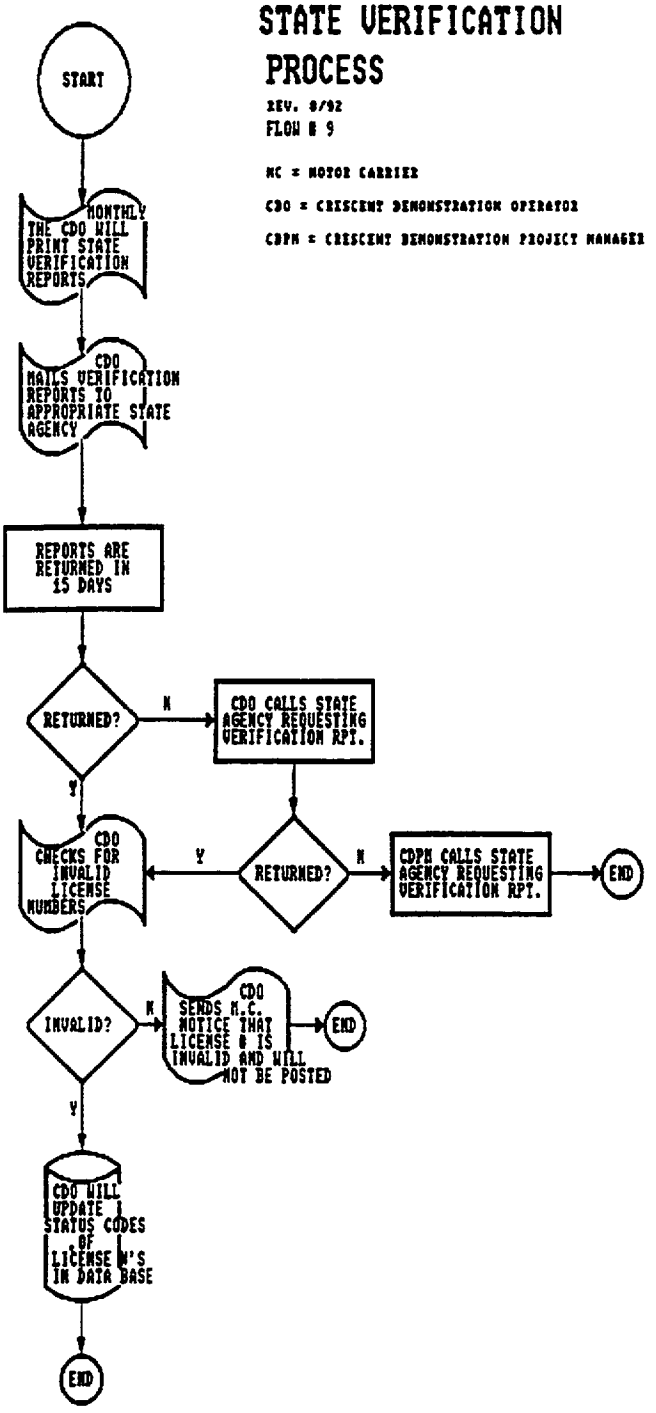
STATE VERIFICATION PROCESS

REV. 8/92
FLOW # 9

MC = MOTOR CARRIER

CDO = CRESCENT DEMONSTRATION OPERATOR

CDPM = CRESCENT DEMONSTRATION PROJECT MANAGER



CREDENTIALS DOWNLOAD ASSESSMENT

None of the weigh stations evaluated during the HELP/Crescent on-site testing currently utilize HELP/Crescent equipment to verify the credentials of AVI-equipped trucks. A number of reasons have been specified by site personnel for this lack of equipment usage. These reasons include:

- HELP equipment is not functional;
- too few trucks are AVI equipped;
- lack of training on the system; and
- utilization of different systems for credentials verification.

The most often expressed reason for the lack of use of HELP/Crescent equipment for credentials verification was that the equipment was not operational. Down-time and lack of consistently accurate data were cited by the majority of site personnel interviewed. As a result of the down-time, site personnel lost interest in the system and the knowledge gained during training sessions quickly diminished.

In a follow-up survey, site personnel from each of the weigh stations evaluated during the on-site testing were contacted and interviewed on their knowledge of the system. The majority of site personnel questioned stated that they could not remember what they were taught and that they have not received additional training during the past three years.

In addition, the site personnel stated that the percentage of AVI equipped trucks was too small to warrant a separate procedure for validating credentials for these trucks. As a result, each state surveyed currently uses the same credentials verification procedures for both AVI equipped and non-AVI equipped trucks. In Arizona, weigh station personnel use the TARGET magnetic card reader and the state data base system. Oregon weigh station personnel use the state PUC data base system. Both New Mexico and Washington weigh station personnel examine the required paper credentials. California weigh station personnel, due to the over capacity of most California weigh stations, attempt to check only a small percentage of truck credentials through spot checks of specific trucks in the weigh station traffic stream.

This lack of usage of the HELP/Crescent equipment by site personnel makes it very difficult to access the validity and consistency of credentials downloaded to the weigh station sites. The number of AVI equipped trucks passing through a weigh station during the on-site testing did not provide a significant sample that can adequately assess the downloaded credentials. In addition to obtaining information on the usage of the downloaded information, this task requires an assessment of the number of "truck not in data base" occurrences. Although site personnel stated that a number of "registration status failing" warnings have been displayed on their screens, they

were unable to provide information on the number of occurrences. During the on-site visits, no activity of this type occurred. In addition, when requested to supply this information for all sites for a sample period, Lockheed stated that this information was not stored in their files.

SITE QUERIES ASSESSMENT

Of the sites evaluated during the on-site testing, only the Woodburn, Oregon and Santa Nella, California weigh stations were identified as utilizing the HELP/Crescent equipment to any degree on a regular basis. Unfortunately, both of these sites utilized the WIM equipment for weight screening but did not use the AVI equipment for standard credentials verification.

The Woodburn, Oregon site utilizes the state PUC data base for credentials verification In Oregon's credential verification process, all trucks that are licensed to operate in Oregon are issued a PUC license plate. At the time of issue, all of the carrier's credentials, including license, permits and registration are recorded in the PUC data base. As a result, when a truck enters an Oregon weigh station, the weighmaster can key in the PUC number associated with the identified truck into the site computer and the data base displays all of the required credentials. Site personnel interviewed stated that they preferred this system to AVI because the large majority of trucks that pass through the weigh station have PUC plates while only a small percentage of trucks are AVI equipped. The large coverage of trucks is recognized as a primary reason for the overwhelming acceptance of the PUC data base procedures by Oregon weigh station personnel.

The Santa Nella, California site personnel do not currently examine the majority of truck credentials by any method. Overweight/oversize trucks and hazardous material carriers are the only exceptions. At Santa Nella, these trucks are requested to bring in all paper credentials for verification by the site operator. The HELP equipment is used only to screen truck weights.

Although neither the Woodburn, Oregon site nor the Santa Nella, California site utilize AVI for credentials verification, these are the only two sites observed during the on-site testing that had the capability to use the Crescent data base on a regular basis. As a result, the site personnel from both of these weigh stations were asked to assess the ease of querying the Crescent data base and the information displayed.

The site personnel from the Woodburn weigh station stated that the weighmasters currently use three screens to monitor truck weights. These screens include:

- Screen A, which displays the previous ten trucks which have passed over the WIM.
- Screen B, which identifies the trucks that are currently in the bypass lane at the weigh station.
- Screen C, which displays the axle weight and credentials of a specific truck selected from the trucks in screen A.

According to site personnel, screen C contains all of the credentials information needed by the weighmasters and the PUC if the truck is AVI equipped. Site personnel also stated that they perceived the system to be potentially useful if a larger percentage of trucks were AVI equipped.

The Santa Nella site personnel stated that all of the information needed to verify truck weights and credentials is displayed on a single screen, This screen is currently the only screen being used by Santa Nella site personnel. The site personnel stated that the system would greatly benefit California's credentials verification for commercial vehicles if the system was more reliable and more AVI equipped trucks were incorporated.

CARRIER SCREENS ASSESSMENT

At an early stage of the evaluation process, motor carriers were urged to establish a computer/modem link with the Crescent Database by following the procedures outlined by Lockheed. At the time, CRT viewing was the only means available to monitor the data being collected about their transponder-equipped trucks. For the most part this request fell on deaf ears.

Forty-three of the original 57 carriers initially indicated a willingness to establish a database connection. Of these, 23 are known to have followed through to obtain access authorization, However, in subsequent evaluation questioning, only 11 could be confirmed as having actually established the connection successfully. Of these, only five were identified as more than occasional users. As a result, feedback on the utility of this CDO-provided function was extremely limited.

Following is the essence of the few general comments received:

- Chevron and Texas Instruments - want the ability to download data to their own computer system.
- PLXPRESS - would like to be able to select their own time periods rather than being locked into the daily or weekly cycles available.
- Reed's Fuel - would like speed information shown on daily/weekly activity reports.
- Food Express and Wilhehn Trucking - are satisfied with the format/access the way they are.

Specific Comments

WHI provided Lockheed with a critique of the demonstration screens in April 1992. In August 1992, WHI's clearance for modem access to a "Demo" database enabled development of a crude "user's" guide to assist motor carriers. At that time, none of the April concerns had been addressed, although it is understood (though not verified) that several of the most troublesome problems have now been rectified. The reported improvements apparently resolved problems which were basically mechanical, involving the inability to either scroll within or escape from several potentially lengthy reports once initiated. What follows is an aggregation of specific recommendations compiled from earlier WHI comments and carrier suggestions offered.

System General

The database consists of two basic types of data: Credentials and Activity. Although not a "big deal," the initial entry screen could well offer that choice. The "Main Menu" currently offers four Credentials options and access to the "Activity" data via the label "AVI/WIM." Within the system, there is inconsistency regarding use of the terms "Transponder Number" and HELP I.D." between the two primary database sectors. The terms are used interchangeably with "HELP I.D."

appearing less frequently (only in the Activity sector). "Transponder Number" should be used throughout to maintain clarity and consistency.

In both segments of the database, provision must be made for motor carriers to obtain electronically either: "hard copy" reports or "downloadable" data. While a few carriers may find the current CRT-based system advantageous, others are unwilling to dedicate the time required for undocumented on-line analysis. If data timeliness is to be a consideration, other data retrieval mechanisms must be developed. Even so, the periodic "hard copy" summary reports currently provided each carrier should be continued as a default option.

Credentials Sector.

As important as they are, credentials data are of no interest or value to a carrier unless used for something -- and found erroneous. At the completion of the motor carrier's evaluation, no use had yet been made of these data and therefore no incentive was provided for a carrier to even examine the data. This was evident in several instances of transponders having been placed on the wrong trucks. These errors went undetected until the evaluation interview stimulated an attempt to verify activity records.

Among the credentials screens, only one of those populated exhibited problems. Under the "Vehicles" option, Selection 1, "Display Registered Vehicles for ALL/ONE State," would not respond to a request for a single state. Entering "CA," for example, kicks the process back to the original entry screen. Also, the advisory message on this screen deviates from that of other similar situations in every other credentials chain. When "Select State" is encountered, the typical advisory message is "(use "*" for all states)," this screen reads "(Press <ENTER> to Display Transponders In All States)" . . . not serious, but uniquely inconsistent.

+Activity Sector.

One common complaint concerning the activity reports was the inability to readily determine the direction of travel for the observations reported. Granted, the lane number is shown, but nowhere did Lockheed spell out for the carriers (or others to our knowledge) the lane numbering scheme which was finally adopted. Even so, requiring unfamiliar users to reconstruct direction of travel from a lane number is cumbersome, to say the least. It is recommended that, in every situation in which a lane number is reported, the lane number be supplemented by an alpha code related to the basic directional orientation of the route. For example, for a lane 1 observation on a North-South route, show "1-NB" (if lane 1 actually has that implication).

Another common complaint was the reporting of totally irrational data. All activity data should be subjected to some type of logic screening. How detailed this might be is open for discussion, but it is probable that most states have already developed some of this logic in conjunction with the Truck Weight Studies which they do periodically. At a minimum, acceptable criteria

should be established for speed, axle spacing, axle weight' and gross weight. Should observed data fall outside the norms established, it is recommended that the record be "tagged" and all data' other than that of the AVI occurrence, be eliminated from further processing. A periodic "tagged record" review could also then be developed to help identify systematic problems with malfunctioning site equipment.

A third general observation has to do with the entry of dates when requested. The system accepts straight numeric including leading zeros, i.e., 020592, or numeric with slashes and no leading zeroes, i.e., 2/5/92. An entry error kicks the process back to the original entry screen -- bummer! Since the prompting message, "(mm/dd/yy)," suggests slashes, it would seem reasonable to mask in the entry slashes and insert leading zeros in each sector given single digit entry. Irrespective of the convention adopted, the precise nature of the desired entry should be made explicit.

Weekly Vehicle Activity Report. Although this is a full screen as presented, carriers have requested the addition of a field for speed where monitored. Since carriers deal more frequently with their own Equipment Number, it would seem reasonable to eliminate the Transponder Number, if necessary, in order to integrate the observed speed data. If Equipment Numbers have not been assigned, Transponder Numbers should be entered as the default. Directional alpha codes should be appended to the lane numbers as noted earlier. Further, the utility of the report as presented is open to question. It would appear that a more appropriate order of presentation (and sorting) would be: Date, Equipment No., and then Time.

Individual Truck Activity Report. Carriers indicate that this report badly needs the ability to specify a date range choice to limit the extent of the search and extraction time -- the system currently presents everything on file (since day 1) for the selected unit. Also missing is the "please wait" message as displayed for other reports while the records requested are being retrieved. The base report screen has presentation room for the observed speed data which should be added.

The carriers also have interest in seeing evidence of computer-determined weight violations as tempered by the range of variability adopted for WIM data in the local jurisdiction. The base screen should display a violation indicator or flag and the specific violation(s) should be identified on the "exploded" view of the individual record. Ideally, this should be available for every WIM observation. Logic for this should be no problem since it is already built into the enforcement screening process. It is acknowledged that this involves either-a change in the way data are currently processed or an additional batch processing routine. However, the overall objective must be to generate the highest possible level of carrier interest in accessing and using the data.

Daily Vehicle Activity Report. As indicated for the Weekly Vehicle Activity report, provision should be made to include the speed observations and perhaps the violation flag as well. In this case, no change is suggested with respect to the presentation and sorting order.

Daily Site Activity Report. This presentation screen should already have adequate room to display gross weight' speed, and violation flags if reoriented. Again, the carrier's Equipment Number is more significant than the Transponder Number if space limitations require a choice.

Further, the current site selection process is extremely awkward and time consuming. A suggested improvement would have the entry screen request the two character state code of the site desired. The second screen would display sites in the selected state with page-down (rather than scroll-down) if required. Site selection would be by site number entry. (This screen should also contain for each site ***some*** message relating the current operational status of the equipment at the site.) After viewing the selected site report, the return should be back to allow selection of another site in the same state. Exit from the same state should be back to select another state with exit from the select state screen then the return to the "Activity" menu.

STATE REPRESENTATIVE SCREENS ASSESSMENT

This assessment summarizes state CVO agency representatives' perceptions of screen characteristics, ease of access, usefulness of information, user-friendliness, and reliability of the Crescent data base.

The basis of this section lies in the assessments provided by eighteen state agency representatives from five of the six states participating in the Crescent demonstration project, It is unfortunate that the CVO agencies in Arizona did not provide any response to the Crescent evaluation questionnaire that was sent out for the purpose of gathering agency screen and report perceptions. However, of the eighteen individuals who returned at least a partially filled out questionnaire, only about half actually took the opportunity to try the Crescent data base system. Many of the respondents that did use the data base only used it for the purpose of answering the survey and did not regularly sign on. In fact, only four participants in the study utilized the data base more than three times prior to the questionnaire. Therefore the results of this study are based on a very small sample of state CVO agency representatives.

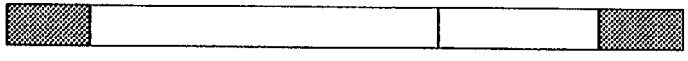
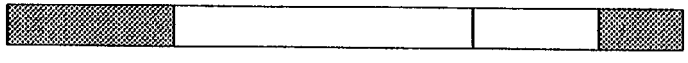
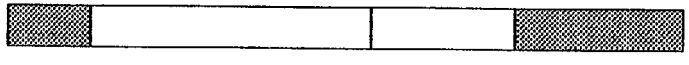
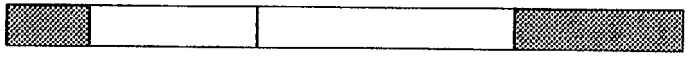
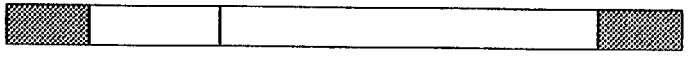
The individuals within the agencies that tried out the data base system were primarily technical support personnel and computer operators who were familiar with the operations of computer networks in general. Since these individuals were computer "experts", they did not have any significant problems understanding the instructions provided by Lockheed on using the Crescent data base network. When minor questions arose, they were easily handled by support technicians at Lockheed.

The best assessment of what the state representatives thought about the screen displays and reports can be obtained by examining the figure on the following page. This chart provides an overall rating of the seven questions on the questionnaire used to assess the screens and reports. The first three statements were perceived positively by the representatives who answered this portion of the survey. These statements basically dealt with movement between screens, the readability of the screens, and the ability of querying the specific information being sought, The fourth statement (being in the wrong menu window and not being able to get out) was rated as neutral.

The last three questions were rated more negatively. The respondents did not think that the screen display provided the right amount of information or that the form of the reports produced were satisfactory. Finally, the agency representatives clearly indicated that the reports that were produced were not very useful to their agencies.

EXHIBIT 1

SUMMARY OF SCREEN DISPLAY RATING

	ISSUES	Number of Responses	Results	Min.	Avg.	Max,
			Strongly Disagree Neutral Strongly Agree 1 2 3 4 5 6 7			
1	The on-line screen display was easy to read.	15		1	5.3	7
2	It was easy to query the specific information that you were seeking.	15		1	5.1	7
3	It was easy to move between different menus and submenus.	15		2	5.5	7
4	No difficulty was experienced iu querying the database (i.e. getting "stuck" in a particular menu window that you did not want to be in).	15		1	4.3	6
5	The typical screen display provided just the right amount of information.	14		1	3.0	6
6	The form of the reports produced under the REPORTS options was satisfactory.	9		1	2.6	7
7	The reports produced were useful to my agency.	9		1	2.2	5

In addition to asking the agencies to rate their degree of agreement with the seven statements previously displayed, the evaluation team also asked them to provide some feedback on any improvements or modifications to the screen display that they would like to see. Some of the screen display modifications mentioned include having more information on each carrier, especially those that were based in other states outside of the Crescent corridor states. Other representatives were concerned about the width of the screen display because the text characters tended to wrap around at the edge of the display. Suggested improvements were adding horizontal lines to increase readability or having a regular 80 character column screen display. A few of the respondents recommended improving the slow response time and non-typical key strokes necessary for access to the data base.

Some of the agencies mentioned that more information should be included in the data base. For example, the port of entry operators would prefer to see data on all carriers entering into their state rather than just the carriers participating in the Crescent program. Other agencies would prefer more driver and vehicle specific information than what was provided on Crescent.

One individual who assessed the network had difficulty in exiting the carrier screen until a fictitious vehicle was entered onto this screen. In addition, there was no on-line help screen provided to explain how to correct a data query or entry mistake. Some representatives also had some difficulty with the lack of function keys for displaying certain screens.

A functional assessment was included in the state agency questionnaire in order to allow the representatives to voice their opinion on how useful they believe the Crescent data base is to their particular agency. When it came to the on-line information, most of the respondents stated that the information was not any more reliable than the data that is provided currently by their own data bases. It is important to point out that many agencies felt that the verifiability of the Crescent data was difficult to measure. As one representative put it, the data base output can only be as accurate as the data input originally provided by the demonstration program participants. Another representative suggested that the data base needs to be tested on a site by site basis in order to truly test the integrity of the data.

There was a rather large range of responses to the question of the extent to which the on-line information is useful to the agencies, from no use whatsoever to very useful. Some specific information that was deemed useful by various agencies includes volume and classification data, carrier identification, number of vehicles operated by the carriers in each state, vehicle speed data, and vehicle class weight data.

Most of the agencies felt that an interface between their current data base systems and the Crescent data base was questionable at this point in time. However, many respondents did not really focus upon the interfacing capabilities of Crescent.

The agencies, however, did provide clues as to additional information they felt should be included in the data base. For example, the carrier's insurance status and change of base state was deemed of great importance to some operating authority agencies. Other agencies would like to see a comprehensive presentation of all regulatory data on every carrier such as tax status, registration status, safety inspection reports, size and weight reports, and noncompliance data. For tax purposes, some agency representatives felt that the ability to track vehicles traveling in or out of a particular state was of utmost importance. It should also be noted that some respondents claimed that they were satisfied with what Crescent currently provided and did not specify any additional requirements.

As mentioned earlier, the purpose of the questionnaire was to assess the usefulness of the information provided by the Crescent data base to the various state commercial vehicle regulatory agencies. One of the questions posed to these agencies was whether they would be willing to use the Crescent system on a regular basis in addition to, or in place of, their current data bases. As expected, most of the answers to this question were a very qualified yes. Two of the qualifications include acceptability of the Crescent data by the FHWA and availability of complete vehicle information on the data base. Most agencies stated that the Crescent data base should initially be used as a supplement to the current state networks and not completely replace these networks.

In order to become more useful, the Crescent data base would have to provide more information about more trucks. This was the underlying theme that the agency representatives mentioned in their responses as to what changes were needed before they were willing to access Crescent on a regular basis. More specifically, the data base needs to include more transpondered vehicles and more comprehensive data on each vehicle's status before it can truly be useful to the states. Because of the lack of enough detailed information in the Crescent demonstration data base, the majority of the agencies believed that Crescent does not currently enhance the performance of their commercial vehicle regulatory functions.

One positive outlook provided by the agencies is that the Crescent Demonstration Project has definitely increased, and will continue to increase, interagency and interstate trust and cooperation. In fact, many state representatives mentioned that Crescent was the key to enhancing communications between the different agencies and states. This demonstration project has come into being only after considerable organization, coordination and cooperation. The continued existence of this data base depends very heavily on the continuation of the agencies working closely together. Only then will Crescent become the data base of choice for all commercial vehicle regulatory agencies.

REPORTS ASSESSMENT

State Agency Reports

In addition to screen assessments, the state agency representatives were also asked to assess their ability to glean‘ useful information from the Crescent data base reports. Their perception of report formats and the value of the information contained within was significant.

Recall from page 21 that the respondents did not think that the form of the reports produced was satisfactory or that the reports themselves were very useful to their agencies.

The representatives brought up the need for more specific reports that they could use for their agency. Since each agency has specific functions that they perform, they wanted to see this type of data on the reports. Some examples include miles traveled within each state by all commercial vehicles; inspection status of vehicles; driver information; vehicle information defined by a state's classification system; traffic volumes, classification data and weight data in the same format as FHWA reports; and size/weight summary of all vehicles with more than five axles.

One state representative pointed out that many of the reports produced by Crescent were useless to his agency since these reports contain the same information as current state agency reports.

The question of the printed reports usefulness had a large range of responses. Examples of useful reports include the Vehicle Classification Report, and the vehicle weight and speed by class reports. AVI Daily Vehicle Record by AVI Number Report and Site Report were particularly useful to one representative since they were used to "track" a particular vehicle through two or more weigh in motion systems and could determine the consistency of the data between these systems. Since data security is a concern of motor carriers, information regarding carrier identification was not provided in some reports based on the need-to-know by various agencies.

Motor Carrier Reports.

Based on surveys and interviews with 52 Crescent demonstration carriers, the conclusion is that few carriers currently find much useful information in the Crescent data base. At the end of the evaluation period (May 1993), only one carrier was known to be accessing the data base on a regular basis. The information was being used to check driver logs for accuracy. That carrier would also have liked to use the axle load information (for example, to see if/where loads were shifting in transit) but found that the information in the data base was not accurate enough.

In terms of potential, however, two-thirds of the carriers surveyed said that they could see some use for AVI data – that is, a record of a particular truck passing a specific site at a certain time. The number of potential users increases to 71 percent given both AVI and WIM data that includes speed, axle weight, gross weight, and axle spacing.

Two qualifications must be considered for responses concerning potential use. First, no overwhelming need was expressed by the respondents for any of the information in the Crescent data base, but some data might be found useful on occasion. Second, when carriers were questioned about potential uses, they were asked to assume that all of the "bugs" in the system had been eliminated.

Current Perceptions.

The following are a series of observations on the motor carriers' perceptions about report contents and the value of the information available. All of these observations explain the reasons why the Crescent database is perceived as less valuable than it might otherwise have been.

Competing tracking/locating/communicating technologies. Some of the larger carriers (particularly TL, irregular route, long haul) have purchased, or are considering purchasing, more sophisticated tracking/communications technologies (e.g., satellite). These carriers tend to see little potential for Crescent information. Other carriers, that tended to be smaller or that tended to operate shorter and/or more regular routes, were quite often content with the existing capabilities of such things as beepers, radio phones, or cellular phones for their fleet management requirements.

Accuracy. Most carriers, even the majority that could see some potential uses in the Crescent database, complained of accuracy problems with the existing information: inaccurate weights, duplicate records, extra "ghost" axles, inexplicable measurements for axle spacings and (in a few cases) inaccurate times.

Need for weight information. A large number of carriers, those that regularly scale their trucks and/or otherwise have weight information on loads, have little interest in axle-load or GVW information.

Need for speed information. Many carriers are not interested in the "speed" aspects of the Crescent data, as they have other means of monitoring and/or governing speed: electronic logs (e.g., OBCs), electronic engines with governing capabilities, or "old fashioned" speed-o-graphs. Presumably the number of these carriers will grow in the future with the spread of electronics in truck and truck tractors and the increasing use of other tracking systems.

Timeliness. For a few carriers -- those that would like to use the Crescent data for locating, tracking, or estimating times of arrival -- there is a timeliness problem caused by the two-hour site polling frequency of mainline stations.

Coverage. Many carriers found that the geographical dispersion of Crescent sites was such that the information in the database, as it now exists, was only of marginal interest. (One carrier with 50 transponders had a grand total of seven records in the database for a four-week period.)

Whether and to what extent the information (assuming it were accurate) can be used. While many carriers see potential uses for the Crescent data, these uses presuppose changes in existing

institutional arrangements. Presumably, this will happen at some point in the future. In the meantime, there are a certain number that see the potential only when and if the information can be used authoritatively for weight-compliance matters, reporting/auditing support, or in aspects of weight-distance taxation (in Oregon). All of these uses assume that the Crescent database reliability is acceptable to state/federal agencies.

The absence of trip permit integration Although it is understood that the Crescent database has the capability of handling trip permit information, this capability was not tested during the demonstration. Again, then, the numbers shown (71% of the carriers seeing a potential for AVI/WIM information) should be qualified in the sense that though the potential of this use may be seen, whether or not the Crescent database can actually perform has not yet been demonstrated.

Crescent sites at state borders. The use, or potential use, that some carriers saw in the Crescent data required supplementing the current Crescent sites with state-line beacon sites (e.g., carriers that wanted to use the Crescent data to calculate state mileage.)

Modem access. Some of the potential uses for AVI/WIM information in the Crescent database either require or (at least) are enhanced by the ability to access the information by modem. That few carriers acquired any familiarity with this means of using Crescent data may have been a factor in the general perception of lack of value in the Crescent database.

Direction of travel. In several cases, a motor carrier's potential use of information in the Crescent database was limited by the carrier's inability to determine the direction of travel. Those familiar with the Crescent sites can generally determine the direction, but those using just the hard copy reports or the modem access often do not have this background.

"Niche" Applications.

Notwithstanding the above factors detracting from the perceived value of the Crescent database, there were two "positive" observations advanced about situations in which the Crescent database may be of use.

Tracking/Monitoring as an inexpensive alternative to other systems Some of the smaller firms, or some of the firms that have quite regular operations, find the newer, sophisticated tracking/communicating technologies (satellite, etc.) to be more than they really need. These carriers said they would find the Crescent database an inexpensive means of improving aspects of their operations. Two examples will clarify this potential. One carrier, hauling a bulk commodity, from a limited number of origins to a limited number of destinations, does not need (and, in the particular circumstances, cannot afford) satellite or other tracking services. However, Crescent data which showed when a particular truck passed a certain point might enable this carrier to sharpen its dispatching practices. Currently, the dispatching decisions -- "can truck xx get one more load from A to B before the driver hits his daily time limit?" are now all done in the

manager's head. Other carriers, particularly private carriers hauling regularly between a central depot and a series of retail locations, do not really need the more technologically sophisticated tracking systems. A simple "flag" that a truck had passed a given point is all that is needed to advise a fleet manager of the expected time of arrival.

Checking Weight Some of the larger carriers, particularly LTL carriers that operate trucks on a regular terminal-to-terminal basis, indicated that they would find aspects of the Crescent data useful for such things as: monitoring patterns of axle overloading problems, or checking, within fairly large margins, shippers' claims about shipment weights. **Unlike** truckload carriers, these firms typically do not scale their trucks regularly and do not generally have an easy way of determining the total weight of a load or its distribution over individual axles.

Reporting Enhancement.

Following from these observations, several recommendations on how the motor carrier reports could be improved are offered. The process inevitably begins with increasing the quality and/or authority of the basic data.

WIM calibration. Serious attention must be given to the capabilities of various WIM scales in producing usable weight information. If, because of the manufacturer or the technology, certain "scales" are incapable of producing reasonably accurate weights, distances, or counts of the number of axles, then the data from these units should not be included in the Crescent database.

Monitoring. Consideration should be given to a program of monitoring the consistency of data from various Crescent sites (e.g., by driving a truck of known weight and dimensions through the entire "system" on a regular basis).

Synchronization of Times. A solution should be found to the current apparent lack of synchronization in time observations entered into the database.

Polling frequency If the cost of increasing the polling frequency is not prohibitive, efforts should be made to increase these frequencies from the current two hours.

Matching transponders/credentials/vehicles. A means for ensuring that the correct transponders are attached to the correct vehicles should be developed.

Improving hard copy reports Many carriers find hard copy reports more useful than on-line modem monitoring (e.g., those that want to use the information for log checking). Efforts should be made to develop the mechanisms by which the reports and/or data can be downloaded (via modem) to better facilitate carrier use as or when needed.

Weigh Station Site Reports

Currently, **none** of the weigh stations surveyed receive Crescent data base reports with the exception of the Bow Hill, Washington weigh station which reported that a small sample of state generated reports were received in the past six months. Based on the surveys of weigh station

managers, most Crescent reports are considered unnecessary. The majority of the managers surveyed stated that the only reports that may currently be required are monthly truck volume reports. However, Oregon and California site personnel stated that additional reports on the number of violations recorded, inspections performed, and citations written were required. This information is not currently contained in the Crescent data base.

Based on weigh station manager surveys, site reports are a low priority feature of the Crescent system. Classification and weight distribution information derived from the site equipment can currently be obtained by state planning personnel by polling the state Crescent data base. It therefore recommended that little effort be expended on developing Crescent reports for weigh station personnel.

DATA SECURITY ASSESSMENT

Currently, data security is achieved using software mechanisms to restrict data access to those who either generate the data (motor carriers, sites, states) or those with a "need to know" (states using the data for planning or enforcement purposes). The current security mechanisms appear to operate correctly and there have been no known security violations within the system.

Future security of the system is likely to become more complex as new technologies are applied. For example, cellular telephone and other radio frequency approaches are susceptible to interception by other parties with relatively inexpensive equipment. Consideration of encryption and decryption schemes will be required to truly protect the data

In addition to the data access issues, there are other security issues that must be addressed in the near term. These include system redundancy (fail-safe issue), data backup and recovery procedures, and preparation and implementation of disaster recovery plans by the CDO. These have not been pressing issues up to this point However, a truly operational system requires formal addressing and resolution of these problems. The evaluation team recommends early attention to this area.

PRIOR AND FUTURE INTERFACE VALIDATION ASSESSMENT

Validation at the CDO,

As discussed in an earlier section, interfaces will be required to sustain the long-term, fully operational system envisioned under the Crescent project. Under the current technology scenario, these interfaces will likely include periodic automated dial-up facilities and prepared "scripts" to access and select data needed by the Crescent Computer System. As agencies within individual states and the region break down the institutional barriers that now prohibit "one-stop shopping" and the centralization of registration/permit data, these "scripts" will become less complicated and will naturally tend toward a standard access procedure. The ultimate interface under the current technology will center around the state/regional system controlling the data transfer based on activity affecting the Crescent Computer System. Should this occur before being overtaken by other more efficient or effective strategies, a standard data exchange format will be required. This standard format will dictate the data elements needed, their format and content, as well as the communications and update protocols required to effect the change in the Crescent data base.

Application of some of the emerging technologies will necessitate a different approach to ensuring accurate and timely data within the Crescent program. For example, if Smart Card technology is employed, it would be possible to place the carrier/vehicle "data base" on such a card to be carried in the vehicle. This would eliminate the need for a significant amount of storage, communications and processing that is currently required. Use of this approach will require standardization of the data elements and formats contained on the cards, as well as the components needed to access and process the stored data in real-time. In short, future interface requirements are directly dependent on the technology(ies) selected and must. be addressed during the design phase of any future system development.

Validation at the Weigh Stations,

The Crescent system would benefit from being integrated with the current credentials verification procedures and equipment utilized by the participating weigh stations. Site personnel stated that the small percentage of AVI equipped trucks does not currently warrant a separate procedure to validate the credentials.It is therefore recommended that each site be evaluated on an individual basis by the CDO and procedures for integration of the Crescent data base be established. As an example of a potential integration, the HELP software could be interfaced with the Oregon PUC data base. This interface would allow site personnel to examine AVI-equipped truck credentials on the PUC data base without keying in the PUC license plate. Additionally, vehicles that are allowed to be bypassed would still have their credentials monitored on the PUC data base. Interfaces with the TARGET system in Arizona and the manual tax account procedures

in New Mexico could also be established. Without integration of the Crescent system into each of the participating weigh station systems, its functional capabilities will not be fully utilized.

A single standard interface, however, will not be appropriate for integrating the Crescent system into current weigh station operations. Instead the CDO should examine each existing system utilized by weigh station personnel and seek to develop an interface between this system and Crescent. This will undoubtedly increase the utility of the system to the operators and their willingness to use it.

As an example, a standard could be developed for integrating Crescent with the state weigh station credential procedures similar to those in California. California weigh station personnel currently attempt to inspect a random sample of trucks from all the trucks entering the weigh station. Implementing this standard could allow for the inspection of only non-AVI equipped trucks and potentially draw more carrier participants into the HELP program. This would also allow a greater number of trucks to be inspected through an AVI credentials examination.

According to weigh station personnel involved in the Crescent program, the main problems are not related to the functional characteristics or capabilities of the system, but rather the lack of state and site specific integration with the Crescent data base.