Advance Warning to Avoid Railroad Delays (AWARD) Model Deployment Initiative Acceptance Test Plan

Version 1.0

SwRI Project No. 10-8684
P.O. No. 7-70030
Reg. No. 50115-7-70030

November 1997

Prepared For:

Texas Department of Transportation
TransGuide
3500 NW Loop 410
San Antonio, Texas 78229

Prepared by:

Southwest Research Institute
P.O. Drawer 28510
San Antonio, Texas 78228

Approval Page

_____	_____
AWARD Project Manager	Date
_____	_____
SwRI MDI Project Manager	Date
_____	_____
Automation Engineering Department Director	Date

Table of Contents

Acronym List

ASCII	American Standard Code for Information Interchange
ATMS	Advanced Traffic Management System
CD-ROM	Compact Disk-Read Only Memory
CPU	Central Processing Unit
CRC	Cyclic Redundancy Check
ECR	Engineering Change Request
EMI	Electromagnetic Interference
ESRI	Environmental Systems Research Institute
FCC	Federal Communications Commission
FM	Frequency Modulation
GUI	Graphical User Interface
ITS	Intelligent Transportation Systems
IVN	In-Vehicle Navigation
LAN	Local Area Network
MB	Megabyte
MDI	Model Deployment Initiative
MHz	MegaHertz
MO	MapObjects
RAM	Random Access Memory
RFO	Request for Offer
ROS	Railroad Operational Software
SDD	System Design Document
SwRI	Southwest Research Institute
TBD	To Be Determined
TCP	Transmission Control Protocol
TCP/IP	Transmission Control Protocol/Internet Protocol
TIM	Traffic Information Message
TxDOT	Texas Department of Transportation
UL	Underwriters Laboratories

1. SCOPE

This document describes the tests to be performed and the results that are required in order to verify that the Advance Warning to Avoid Railroad Delays (AWARD) system is constructed and operates in accordance with the requirements specified in the AWARD System Design Document (SDD).

1.1 Identification

The tests described in the following sections refer to the Advance Warning to Avoid Railroad Delay (AWARD) subsystem of the Model Deployment Initiative program in San Antonio, Texas. Tests are generally divided into three sections:

- The sensors physically located along the railroad track
- The railroad operational software (ROS)
- The TransGuide ATMS software as it is affected by the AWARD system

1.2 System Overview

The AWARD system is an Advanced Traveler Information Service (ATIS) implementation designed to help motorists avoid delays due to railroad operations that cross freeway access or frontage roads. It is a part of the Federal Highways Model Deployment Initiative (MDI) in San Antonio, Texas.

The system includes Doppler radar sensors placed at selected locations along the railroad track to detect the presence, speed and length of trains before they approach grade crossings. Data from the sensors is transmitted to the TransGuide Control Center where computer programs calculate the predicted time and duration that grade crossings at or near freeway exits will be blocked. This information enables TransGuide operators to control changeable message signs placed at strategic locations along the freeway to alert motorists of potential delays ahead and allow them to select alternate exits. Information on blocked grade crossings is also placed in the Area Wide Data Base for use in other MDI components such as Kiosks and In-Vehicle Navigation.

The AWARD system is part of the TransGuide MDI and operates independently of railroad signals or communications. System software has been implemented with a modular, object-oriented architecture so that additional sensors and crossings can be added easily. This also provides a method for future implementations of the AWARD system in other locations and applications including advance warning of train-related delays on arterial and city streets.

1.3 Goals and Objectives

The goal of the AWARD system is to assist the driving public and emergency service vehicles in avoiding railroad grade crossings when they are closed due to the passage of trains.

The goal of this ATP is to demonstrate the capability of the AWARD system in its operational environment and to validate that it meets the requirements specified in the design document. The test cases contained in this ATP have been directly derived from the requirements contained in the *AWARD Model Deployment System Design Document*. This "black box" testing strategy is designed to discover faults of omission by identifying which requirements have and have not been fulfilled.

1.4 Referenced Documents

- Southwest Research Institute, *Proposal for the Model Deployment Initiative System Integration*, SwRI Proposal No. 10-20342, November, 1996.
- Texas Department of Transportation, *Request for Offer (RFO) for the Model Deployment Initiative System Integration, 60115-7-70030*, Specification No. TxDOT 795-SAT-01, October, 1996.
- Southwest Research Institute, *AWARD Preliminary System Design*, February 14, 1997.
- Southwest Research Institute, *AWARD System Design*, October, 1997

2. TEST DESCRIPTIONS

The following sections describe specific tests that shall be carried out to demonstrate that the system meets required specifications. The preparation required for each test, the specific requirements to be verified, the test conditions and the expected results are described.

The specific requirements to be verified are derived from, and cross-referenced to, specific requirements listed in the AWARD Preliminary Design Document, Version 1.0, February 14, 1997. Each requirement listed in the Design Document includes a unique requirement identification (ID) label which maps the particular requirement to a subsystem within the AWARD System. The ID labels are defined as:

- RR-GEN-XX General (Programmatic) Requirements
- RR-SYS-XX System Requirements
- RR-SNS-XX Sensor Subsystem Requirement
- RR-COM-XX Communications Subsystem Requirement
- RR-MEC-XX Mechanical Subsystem Requirement
- RR-RRS-XX Railroad Software Subsystem Requirement
- RR-TGS-XX TransGuide Operational Software Subsystem Requirement

The general (GEN) programmatic requirements relate to schedule and document delivery and are not included in this test plan. The remaining requirements are discussed in three major sections as follows:

- Section 2.1 - All requirements related to sensor placement, sensor subsystem and mechanical design
- Section 2.2 - All requirements related to sensor communications and the Railroad Software Subsystem
- Section 2.3 - All requirements related to the TransGuide Operational Software Subsystem

Test cases will be implemented using one or more of the following qualification methods:

- Inspection. The visual examination of computer code documentation, hardware, etc.
- Demonstration. The operation of the system, or a part of the system, that relies on observable functional operation not requiring the use of instrumentation, special test equipment, or subsequent analysis.
- Test. The operation of the system, or a part of the system, using instrumentation or other special test equipment to collect data for later analysis.

- Analysis. The process of accumulating data obtained from other qualification methods. Examples are reduction, interpretation, or extrapolation of test results.

Problems detected during execution of the ATP will be classified by category as follows:

- Software problem. The software does not operate according to the specified requirements and the requirements are correct.
- Hardware problem. The hardware does not operate according to the specified requirements and the requirements are correct.
- Documentation problem. The software/hardware does not operate according to the specified requirements but the software/hardware operation is correct.
- Design problem. The software/hardware operates according to the specified requirements but a design deficiency exists. The design deficiency may not always result in a direct observable operational problem but possesses the potential for creating further problems.

Problems detected during execution of the ATP will be classified by priority as follows:

- Priority 1: A problem that prevents the accomplishment of an operational or essential capability.
- Priority 2: A problem that results in user/operator inconvenience or annoyance but does not affect required operational or essential capability.
- Priority 3: Any other effect.

Retesting will consist of repeating a subset of the test cases after changes have been made to correct problems found in previous testing. Retesting will be considered complete if (a) test cases that revealed problems in the previous testing have been repeated and the results have met acceptance criteria; and (b) test cases that revealed no problems during the previous testing, but which test functions that are affected by the corrections, have been repeated and the results have met acceptance criteria.

2.1 Train Speed Sensor Field Equipment

The design and installation of the Train Speed Sensor Field Equipment will be evaluated to verify that it meets specified requirements.

2.1.1 Hardware Preparation

The speed sensors will be mounted on utility poles near a railroad right-of-way. The cover will be removed from one of the train speed sensor units to allow complete inspection of the interior.

2.1.2 Software Preparation

No software preparation is required.

2.1.3 Other Preparation

Transportation will be provided to each sensor site. Suitable arrangements, such as a ladder or a bucket truck, will be provided for access to the pole mounted equipment. A radar detector, of the type normally used to detect police radar, will be used to determine the range of the sensors. Detailed maps showing the location of each sensor in relation to right-of-ways and easements will be prepared. Parts drawings, specifications of purchased parts and warranty information will be provided.

2.1.4 Test Description

Tests will consist of visual observations of sensor installation sites to verify that all requirements specified are met.

2.1.4.1 Design of Sensors

The internal layout of the sensor enclosure will be observed and evaluated to verify that it meets all requirements specified.

2.1.4.1.1 Requirements Addressed

RR-ELC-01	The field unit shall operate on standard line power. (Nominal 120 VAC)
RR-MEC-01	The equipment will be designed to operate within an ambient temperature range of 10°F to 120 °F and will not allow condensation accumulations which would intefere with its operation.
RR-MEC-02	The system enclosure shall be able to be mounted on a pole or other suitable structure.
RR-MEC-03	The system will provide an internal mechanism for accurate pointing of the sensor.

2.1.4.1.2 Test Inputs

No test inputs are required.

2.1.4.1.3 Test Results Evaluation

Test results evaluation will consist of visual inspection and observation that the specified requirements are satisfied.

2.1.4.1.4 Test Procedure

Inspectors will examine layout drawings and the construction of the sensor enclosure. They will confirm that

the enclosure is fabricated and assembled in accordance with the drawings. Specifications of purchased parts and warranty information will also be examined to verify that the purchased parts meet system requirements.

2.1.4.1.5 Assumptions and Constraints

Only one of the sensor units will be opened and examined in detail. This sensor will be representative of the other identical units which are difficult to access due to the pole mounting.

2.1.4.1.6 Test Results

The required results of the visual inspection and observation are:

- The power input will be observed to verify that operation is from standard line power (Nominal 120 VAC).
- The thermal design of the enclosure will be reviewed to verify that the design, including solar heat loading and internal heat generation, provides for operation within an ambient temperature range of 10ºF to 120ºF. The sealed enclosure will be examined to verify that ingress of moisture will not occur and there will be no condensation accumulation which would interfere with the operation.
- The location of the sensor will be observed to verify that the system enclosure can be mounted on a pole or other suitable structure.
- The mounting bracket for the radar will be examined to verify that it provides an internal mechanism for accurate pointing of the sensor.

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.1.4.2 Location of Sensors

The location of the sensors will be observed to verify that they meet the requirements specified.

2.1.4.2.1 Requirements Addressed

RR-SYS-07	The field equipment shall be mounted on a suitable structure at some location along the railroad line in advance of the crossing for which warnings are to be given.
RR-SYS-08	Field equipment shall be located in TxDOT or the City of San Antonio right-of-way.
RR-STS-09	The field equipment shall determine length and speed of trains through observation only. No connection to the railroad tracks or controlling equipment will be used.
RR-SNS-01	The train speed sensor shall have a range to allow measurement of the train speed from a location outside the railroad right-of-way. This is normally 50 feet on either side of the track center line but may vary in some locations.

2.1.4.2.2 Test Inputs

No test inputs are required.

2.1.4.2.3 Test Results Evaluation

Test results evaluation will consist of visual inspection and observation that the specified requirements are satisfied.

2.1.4.2.4 Test Procedure

Inspectors will visit each train sensor site at the following locations:

- Dreamland Drive at Old Gold Lane about 1.5 miles north of IH-410
- Dresden Drive at Olympia Drive about 1.3 miles south of IH-410
- Mariposa Drive at Warner Road about 0.5 miles east of IH-10
- San Francisco Street at Capitol Street about 0.2 miles east of IH-10
- Cincinnati Street at Kensington just east of IH-410
- West Poplar Street between San Jacinto and Brazos Streets

At each site, the location will be observed to verify that the location, connections to railroad equipment, method of mounting, etc. meet requirements.

2.1.4.2.5 Assumptions and Constraints

None.

2.1.4.2.6 Test Results

The required results of the visual inspection and observation at each sensor site are:

- Inspectors will verify that the field equipment is mounted on a suitable structure at some location along the railroad line in advance of the crossing for which warnings are to be given.
- Maps and letters from the City Engineering office will be examined to verify that field equipment is located in TxDOT or the City of San Antonio right-of-way.
- The equipment will be inspected to verify that there is no connection to the railroad tracks or controlling equipment.
- The operational range of the sensor will be determined by use of a police radar detector to verify that the unit has a range to allow measurement of the train speed from a location outside the railroad right-of-way.

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.2 AWARD RR (Rail Road) Operational Software (ROS)

The railroad operational software receives train speeds from the trains sensors via modem. The data is smoothed and filtered and train acceleration is calculated.

2.2.1 Test Descriptions

The following test cases exist for the AWARD RR Operational Software. Each test case is described in more detail in the following sections.

- Receive Sensor Data
- Determine Train Data – Calculating length and crossing data (Case #1)
- Determine Train Data – Calculating length and crossing data (Case #2)
- Determine Train Data – Calculating length and crossing data (Case #3)
- Determine Train Data – Calculating length and crossing data (Case #4)

2.2.1.1 Receive Sensor Data

The purpose of this test is to verify that the field units are communicating with the TransGuide equipment, the AWARD Master Computer, using the correct communication protocol.

2.2.1.1.1 Hardware Preparation

All train sensors will be operating and telephone lines will be connected to the modem in each sensor.

2.2.1.1.2 Software Preparation

The ROS program will run on the AWARD Master Computer in normal operation mode.

2.2.1.1.3 Other Preparation

This test will be performed when a train is moving along the tracks. Since the trains run at unscheduled times, it may be necessary for the inspectors to wait at the computer terminal for several hours before the passage of a train is recorded.

The modem documentation for the field units and the AWARD Master Computer will be necessary to verify the proper protocol is being used. An additional computer with a data modem and a commercial terminal emulator program will be used to demonstrate the data format and communication protocol.

2.2.1.1.4 Requirements Addressed

Requirement Number	Requirement Description
RR-COM-01	The field unit shall communicate to the TransGuide equipment using a non-proprietary protocol.

2.2.1.1.5 Prerequisite Conditions

No prerequisites other than those addressed in the previous preparation sections are required.

2.2.1.1.6 Test Inputs

As a train proceeds along the track, the data from each sensor will be displayed on the screen to verify that the sensors are communicating with the AWARD Master Computer.

The Practical Peripherals modem documentation stating that the modems, for the field sensors and the AWARD Master Computer, are Hayes compatible.

2.2.1.1.7 Test Results Evaluation

The results of this test will be evaluated as follows:

- As a train passes each sensor, the train speed will be displayed on the AWARD Master Computer screen. This will be verified by visual inspection.
- Page 1 of the user's manual for the MaxTech Net Pacer modem will be examined to verify that the field sensor communication uses V.34, an industry standard, non-proprietary protocol.
- Page 37 of the Installation Manual for the Practical Peripherals PCMCIA-336 modem will be reviewed to verify that the AWARD Master Computer communicates using V.34 protocol, an industry standard, non-proprietary protocol.
- The character sequences used to communicate with the field units (commands and responses) will be displayed using a terminal emulation program to verify that the data format is accessible and documented.

2.2.1.1.8 Test Procedure

The following steps of the test will be conducted:

- Start the ROS program on the AWARD Master Computer.
- View the sensor data as it scrolls onto the AWARD Master Computer screen.
- As a train passes each sensor, visually verify that the train speed is being communicated to the AWARD Master Computer.
- Read the modem documentation to verify that the modems are Hayes compatible.
- A field unit will be called using a data modem connected to the serial port of a computer. A terminal communications program (PC-Plus) will be used to communicate with the field unit. The commands and responses displayed on the screen will be verified.

2.2.1.1.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.2.1.1.10 Test Results

Test Results

❑ **PASS** ❑ **FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.2.1.2 Determine Train Data – Calculate Length and Crossing Data (Case #1)

The purpose of this test is to verify that the train length of an eastbound train is calculated correctly by the AWARD Master Computer. This test will verify that the AWARD Master Computer is calculating the Estimated Time of Arrival of the front of the train and the rear of the train. This test will verify the calculation of the expected delay time at the crossings and transmit the railroad delay data to the TransGuide ATMS system.

2.2.1.2.1 Hardware Preparation

No hardware preparation is necessary for this test. All sensor data is to be simulated.

2.2.1.2.2 Software Preparation

Copy the *test_case1.cfg* file from the AWARD RR Operational Software ATP *test_case1* directory into the $ATMS/*etc* directory. This configuration file contains the data necessary to run the ROS program in simulation mode. The ROS will obtain its data from the simulation files specified below.

Copy the simulation data files used for this test case from the AWARD RR Operational Software ATP *test_case1* directory into the directory containing the ROS executable.

2.2.1.2.3 Other Preparation

The TransGuide ATMS system and the AWARD ATMS sub-system must be operating in order to execute this test.

2.2.1.2.4 Requirements Addressed

Requirement Number	Requirement Description
RR-RRS-01	The RR-Delay Master Computer shall calculate the length of the train from measured train speed integrated over time.
RR-RRS-02	The RR-Delay Master Computer shall calculate the expected time of arrival of the first element of the train and the last element of the train at selected downrail crossings.
RR-RRS-03	The RR-Delay Master Computer shall determine expected delay times at railroad crossings. The RR-Delay Master Computer shall estimate delay time within ±30 seconds.
RR-RRS-04	The RR-Delay Master Computer shall transmit the railroad delay data to the existing TransGuide ITS system.

2.2.1.2.5 Prerequisite Conditions

No prerequisites other than those addresses in the previous preparation sections are required.

2.2.1.2.6 Test Inputs

The ROS will obtain its data from the following simulation files:

- a1.cfg
- a2.cfg
- a3.cfg
- a4.cfg
- a5.cfg
- a6.cfg

2.2.1.2.7 Test Results Evaluation

The results of this test will be evaluated as follows:

- The calculated train length displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated Estimated Time of Arrival of the front of the train and the rear of the train displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated railroad delay time displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.

- The receipt of the railroad delay information from the ROS by the TransGuide ATMS interface of the TOS will be verified using the contents of the AWARD status log. The status log will contain status messages indicating the receipt of railroad delay data by the TransGuide ATMS interface. These messages will be compared against the simulation data contained in the simulation files.

2.2.1.2.8 Test Procedure

- Verify that the TransGuide ATMS system and the AWARD ATMS sub-system are operating.
- Start the AWARD RR Software on the AWARD Master Computer.
- View the sensor data as it scrolls onto the screen.
- As a train passes each sensor, visually verify that the crossing data is being sent to the Transguide ATMS system at the correct times.
- Verify that the Transguide ATMS system received the crossing data at the correct times.

2.2.1.2.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.2.1.2.10 Test Results

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.2.1.3 Determine Train Data – Calculate Length and Crossing Data (Case #2)

The purpose of this test is to verify that the train length of another eastbound train is calculated correctly by the AWARD Master Computer. This test will verify that the AWARD Master Computer is calculating the Estimated Time of Arrival (ETA) of the front of the train and the rear of the train. This test will verify the calculation of the expected delay time at the crossings and transmit the railroad delay data to the TransGuide ATMS system. This test case will use different simulation files so that the length, duration, and ETAs of the train are different from the last test case.

2.2.1.3.1 Hardware Preparation

No hardware preparation is necessary for this test. All sensor data is to be simulated.

2.2.1.3.2 Software Preparation

Copy the *test_case2.cfg* file from the AWARD RR Operational Software ATP *test_case2* directory into the $ATMS/*etc* directory. This configuration file contains the data necessary to run the ROS program in simulation mode. The ROS will be obtaining its data from the simulation files specified below.

Copy the simulation data files used for this test case from the AWARD RR Operational Software ATP *test_case2* directory into the directory containing the ROS executable.

2.2.1.3.3 Other Preparation

The TransGuide ATMS system and the AWARD ATMS sub-system must be operating in order to execute this test.

2.2.1.3.4 Requirements Addressed

Requirement Number	Requirement Description
RR-RRS-01	The RR-Delay Master Computer shall calculate the length of the train from measured train speed integrated over time.
RR-RRS-02	The RR-Delay Master Computer shall calculate the expected time of arrival of the first element of the train and the last element of the train at selected downrail crossings.
RR-RRS-03	The RR-Delay Master Computer shall determine expected delay times at railroad crossings. The RR-Delay Master Computer shall estimate delay time within ±30 seconds.
RR-RRS-04	The RR-Delay Master Computer shall transmit the railroad delay data to the existing TransGuide ITS system.

2.2.1.3.5 Prerequisite Conditions

No prerequisites other than those addressed in the previous preparation sections are required.

2.2.1.3.6 Test Inputs

The ROS will obtain its data from the following simulation files:

- a1.cfg
- a2.cfg
- a3.cfg
- a4.cfg

- a5.cfg
- a6.cfg

2.2.1.3.7 Test Results Evaluation

The results of this test will be evaluated as follows:

- The calculated train length displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated Estimated Time of Arrival of the front of the train and the rear of the train displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated railroad delay time displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The receipt of the railroad delay information from the ROS by the TransGuide ATMS interface of the TOS will be verified using the contents of the AWARD status log. The status log will contain status messages indicating the receipt of railroad delay data by the TransGuide ATMS interface. These messages will be compared against the simulation data contained in the simulation files.

2.2.1.3.8 Test Procedure

- Verify that the TransGuide ATMS system and the AWARD ATMS sub-system are operating.
- Start the AWARD RR Software on the AWARD Master Computer.
- View the sensor data as it scrolls onto the screen.
- As a train passes each sensor, visually verify that the crossing data is being sent to the Transguide ATMS system at the correct times.
- Verify that the Transguide ATMS system received the crossing data at the correct times.

2.2.1.3.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.2.1.3.10 Test Results

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.2.1.4 Determine Train Data – Calculate Length and Crossing Data (Case #3)

The purpose of this test is to verify that the train length of a westbound train is calculated correctly by the AWARD Master Computer. This test will verify that the AWARD Master Computer is calculating the Estimated Time of Arrival of the front of the train and the rear of the train. This test will verify the calculation of the expected delay time at the crossings and transmit the railroad delay data to the TransGuide ATMS system.

2.2.1.4.1 Hardware Preparation

No hardware preparation is necessary for this test. All sensor data is to be simulated.

2.2.1.4.2 Software Preparation

Copy the *test_case3.cfg* file from the AWARD RR Operational Software ATP *test_case3* directory into the $ATMS/*etc* directory. This configuration file contains the data necessary to run the ROS program in simulation mode. The ROS will obtain its data from the simulation files specified below.

Copy the simulation data files used for this test case from the AWARD RR Operational Software ATP *test_case3* directory into the directory containing the ROS executable.

2.2.1.4.3 Other Preparation

The TransGuide ATMS system and the AWARD ATMS sub-system must be operating in order to execute this test.

2.2.1.4.4 Requirements Addressed

Requirement Number	Requirement Description
RR-RRS-01	The RR-Delay Master Computer shall calculate the length of the train from measured train speed integrated over time.
RR-RRS-02	The RR-Delay Master Computer shall calculate the expected time of arrival of the first element of the train and the last element of the train at selected downrail crossings.
RR-RRS-03	The RR-Delay Master Computer shall determine expected delay times at railroad crossings. The RR-Delay Master Computer shall estimate delay time within ±30 seconds.
RR-RRS-04	The RR-Delay Master Computer shall transmit the railroad delay data to the existing TransGuide ITS system.

2.2.1.4.5 Prerequisite Conditions

No prerequisites other than those addressed in the previous preparation sections are required.

2.2.1.4.6 Test Inputs

The ROS will obtain its data from the following simulation files:

- a1.cfg
- a2.cfg
- a3.cfg
- a4.cfg
- a5.cfg
- a6.cfg

2.2.1.4.7 Test Results Evaluation

The results of this test will be evaluated as follows:

- The calculated train length displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated Estimated Time of Arrival of the front of the train and the rear of the train displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated railroad delay time displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The receipt of the railroad delay information from the ROS by the TransGuide ATMS interface of the TOS will be verified using the contents of the AWARD status log. The status log will contain status messages indicating the receipt of railroad delay data by the TransGuide ATMS interface. These messages will be compared against the simulation data contained in the simulation files.

2.2.1.4.8 Test Procedure

- Verify that the TransGuide ATMS system and the AWARD ATMS sub-system are operating.
- Start the AWARD RR Software on the AWARD Master Computer.
- View the sensor data as it scrolls onto the screen.
- As a train passes each sensor, visually verify that the crossing data is being sent to the Transguide ATMS system at the correct times.
- Verify that the Transguide ATMS system received the crossing data at the correct times.

2.2.1.4.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.2.1.4.10 Test Results

Test Results

❑ PASS ❑ FAIL SwRI:_____ Date:_____

TxDOT:_____ Date:_____

2.2.1.5 Determine Train Data – Calculate Length and Crossing Data (Case #4)

The purpose of this test is to verify that the train length of another westbound train is calculated correctly by the AWARD Master Computer. This test will verify that the AWARD Master Computer is calculating the Estimated Time of Arrival (ETA) of the front of the train and the rear of the train. This test will verify the calculation of the expected delay time at the crossings and transmit the railroad delay data to the TransGuide ATMS system. This test case will use different simulation files so that the length, duration, and ETAs of the train are different from the last test case.

2.2.1.5.1 Hardware Preparation

No hardware preparation is necessary for this test. All sensor data is to be simulated.

2.2.1.5.2 Software Preparation

Copy the *test_case4.cfg* file from the AWARD RR Operational Software ATP*test_case4* directory into the $ATMS/*etc* directory. This configuration file contains the data necessary to run the ROS program in simulation mode. The ROS will obtain its data from the simulation files specified below.

Copy the simulation data files used for this test case from the AWARD RR Operational Software ATP *test_case4* directory into the directory containing the ROS executable.

2.2.1.5.3 Other Preparation

The TransGuide ATMS system and the AWARD ATMS sub-system must be operating in order to execute this test.

2.2.1.5.4 Requirements Addressed

Requirement Number	Requirement Description
RR-RRS-01	The RR-Delay Master Computer shall calculate the length of the train from measured train speed integrated over time.
RR-RRS-02	The RR-Delay Master Computer shall calculate the expected time of arrival of the first element of the train and the last element of the train at selected downrail crossings.
RR-RRS-03	The RR-Delay Master Computer shall determine expected delay times at railroad crossings. The RR-Delay Master Computer shall estimate delay time within ±30 seconds.
RR-RRS-04	The RR-Delay Master Computer shall transmit the railroad delay data to the existing TransGuide ITS system.

2.2.1.5.5 Prerequisite Conditions

No prerequisites other than those addressed in the previous preparation sections are required.

2.2.1.5.6 Test Inputs

The ROS will obtain its data from the following simulation files:

- a1.cfg
- a2.cfg
- a3.cfg
- a4.cfg
- a5.cfg
- a6.cfg

2.2.1.5.7 Test Results Evaluation

The results of this test will be evaluated as follows:

- The calculated train length displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated Estimated Time of Arrival of the front of the train and the rear of the train displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.
- The calculated railroad delay time displayed on the AWARD Master Computer screen will be compared against the simulation data contained in the simulation files.

- The receipt of the railroad delay information from the ROS by the TransGuide ATMS interface of the TOS will be verified using the contents of the AWARD status log. The status log will contain status messages indicating the receipt of railroad delay data by the TransGuide ATMS interface. These messages will be compared against the simulation data contained in the simulation files.

2.2.1.5.8 Test Procedure

- Verify that the TransGuide ATMS system and the AWARD ATMS sub-system are operating.
- Start the AWARD RR Software on the AWARD Master Computer.
- View the sensor data as it scrolls onto the screen.
- As a train passes each sensor, visually verify that the crossing data is being sent to the Transguide ATMS system at the correct times.
- Verify that the Transguide ATMS system received the crossing data at the correct times.

2.2.1.5.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.2.1.5.10 Test Results

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.3 TransGuide ATMS Software

2.3.1 Test Descriptions

The following test cases exist for the TransGuide ATMS Software. Each test case is described in more detail in the following sections.

- Communications between the TransGuide Operational Software (TOS) and the Railroad Operational Software (ROS).
- TransGuide Alarm Notification of a Railroad Crossing Delay.
- TransGuide Scenario Search of a Railroad Crossing Delay
- Railroad Crossing Delay Alarm Updates

2.3.1.1 Communications Between the TransGuide Operational Software and the Railroad Operational

Software

The purpose of this test is to verify the communication interface between the TransGuide Operational Software and the Railroad Operational Software. Railroad delay information and sensor data are transmitted from the ROS to the TOS. Sensor data is transmitted at each poll cycle and railroad delay information is transmitted when a train is detected within the monitored section of railway.

2.3.1.1.1 Hardware Preparation

No hardware preparation is necessary for this test. All sensor data is to be simulated.

2.3.1.1.2 Software Preparation

Copy the *award_master.cfg* file from the AWARD TransGuide ATMS ATP directory into the $ATMS*ėtc* directory. This configuration file contains the data necessary to run the ROS in simulation mode. The ROS will be obtaining its data from the simulation files specified below.

Stop the External Alarm Handler on the TransGuide ATMS.

Copy the simulation data files used for this test from the AWARD ATP directory into the directory containing the ROS executable.

2.3.1.1.3 Other Preparation

No other preparation is necessary.

2.3.1.1.4 Requirements Addressed

Requirement Number	Requirement Description
RR-TGS-01	The TransGuide Operational Software shall interface with and receive railroad delay data from the Railroad Operational Software.

2.3.1.1.5 Prerequisite Conditions

No prerequisites other than those addressed in the previous preparation sections are required.

2.3.1.1.6 Test Inputs

The ROS will obtain its data from the following simulation files:

- a1.cfg
- a2.cfg
- a3.cfg
- a4.cfg
- a5.cfg
- a6.cfg

2.3.1.1.7 Test Results Evaluation

The results of this test will be evaluated as follows:

- The receipt of the railroad delay information from the ROS by the data server interface of the TOS will be verified using the detailed status GUI. The values displayed in the detailed status GUI will be compared against the simulation data contained in the simulation files.
- The receipt of the railroad delay information from the ROS by the TransGuide ATMS interface of the TOS will be verified using the contents of the AWARD status log. The status log will contain status messages indicating the receipt of railroad delay data by the TransGuide ATMS interface (award_tgif). These messages will be compared against the simulation data contained in the simulation files.

2.3.1.1.8 Test Procedure

- Start the AWARD detailed status GUI.
- Start the AWARD subsystem. The ROS should be executing in simulation mode and the TOS should be operational.
- View the contents of the detailed status GUI and note the changes in the display.
- Let the simulation run to completion.
- Stop the AWARD subsystem.
- Verify the receipt of the railroad delay information by viewing the contents of the status log using a text editor.

2.3.1.1.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.3.1.1.10 Test Results

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.3.1.2 TransGuide Alarm Notification of a Railroad Crossing Delay

The purpose of this test is to verify the receipt of railroad crossing alarms by the TransGuide ATMS from the AWARD Master Computer and the display of these alarms to the assignment plan manager. The alarm incident screen contents will display the railroad crossing information. The existing alarm incident screen functionality has not been modified (eg. assignment of alarms, cancelling of alarms, obtaining help). Verification of the existence of these buttons is done in this test.

2.3.1.2.1 Hardware Preparation

No hardware preparation is necessary for this test. All crossing delay messages are simulated for this test.

2.3.1.2.2 Software Preparation

Copy the award_master.cfg file from the AWARD TransGuide ATMS ATP directory into the $ATMS*/etc* directory. The AWARD master process uses this configuration file to start all processes within the AWARD subsystem except the ROS.

The AWARD ROS message simulation program must be running on the AWARD Master Computer. This program is used to simulate messages sent from the ROS to the AWARD TransGuide Interface process. The AWARD TransGuide Interface process receives the message and forwards it to the External Alarm Handler on the TransGuide ATMS.

2.3.1.2.3 Other Preparation

The TransGuide ATMS must be operational and there must be a manager in the assignment plan.

2.3.1.2.4 Requirements Addressed

Requirement Number	Requirement Description
RR-TGS-02	The TransGuide Operational Software shall transmit expected delay information to TransGuide operators as an alarm.
RR-TGS-02.01	The AIH shall accept a RR delay alarm from the RSS.
RR-TGS-02.03	The AIH shall create a new AIH RR incident if the RR delay alarm is not related to a current RR delay incident.
RR-TGS-02.04	The AIH RR incident shall contain data from the railroad delay information contained in the RR delay alarm.
RR-TGS-02.05	The AIH shall build the AIH RR incident screen for new RR delay alarms.
RR-TGS-02.06	The AIH shall display the AIH RR incident screen, as an icon, on the workstation of the manager responsible for the sector containing the RR incident.
RR-TGS-02.07	The AIH shall generate an audio notification of new RR incident alarms at the workstation of the manager responsible for the sector containing the RR incident.
RR-TGS-02.09	The AIH RR incident screen shall provide the same actions currently provided by the AIH-NewIncidentScreen.

2.3.1.2.5 Prerequisite Conditions

No railroad crossing delay alarms should be present in the TransGuide ATMS.

2.3.1.2.6 Test Inputs

The AWARD ROS message simulation program will be used to generate simulated test inputs for this test. Each test procedure step will indicate the data to be entered into the simulation program, if required.

2.3.1.2.7 Test Results Evaluation

The results of this test will be visually inspected to verify the associated requirements have been satisfied.

2.3.1.2.8 Test Procedure

- Use the AWARD ROS message simulation program to send a simulated crossing delay message to the AWARD TransGuide Inteface process. The following data should be entered for the simulated message:
    - ◊ Crossing Address: RRC-0010W-567.001
    - ◊ Delay Condition: Crossing Delay
    - ◊ ETA Front: 10:30:00
    - ◊ ETA Rear: 10:40:00
    - ◊ Length: 2000
    - ◊ Duration: 6000
- Verify a new alarm icon has appeared at the ATMS workstation of the manager in the assignment plan. (RR-TGS-02, RR-TGS-02.01, RR-TGS-02.03, RR-TGS-02.05, RR-TGS-02.06)
- Verify audio notification has occurred at the ATMS workstation of the manager in the assignment plan. (RR-TGS-02.07)
- Double-click on the alarm icon.
- Verify the alarm screen is displayed and contains the railroad crossing delay information entered in the AWARD ROS Message Simulation program. (RR-TGS-02.04)
- Verify the alarm incident screen contains buttons for assigning the alarm, canceling the alarm, and obtaining help. (RR-TGS-02.09)

2.3.1.2.9 Assumptions and Constraints

There are no assumptions or constraints associated with this test.

2.3.1.2.10 Test Results

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.3.1.3 TransGuide Scenario Search of a Railroad Crossing Delay

The purpose of this test is to verify a TransGuide operator will be capable of performing scenario searches for railroad crossing delay incidents. This test should be run immediately after running the TransGuide Alarm Notification of a Railroad Crossing Delay test described in section TransGuide Alarm Notification of a Railroad Crossing Delay.

2.3.1.3.1 Hardware Preparation

No hardware preparation is necessary for this test. All crossing delay messages are simulated for this test.

2.3.1.3.2 Software Preparation

No software preparation is necessary since this test should be run immediately after running the TransGuide Alarm Notification of a Railroad Crossing Delay described in the section "TransGuide Alarm Notification of a Railroad Crossing Delay."

2.3.1.3.3 Other Preparation

An operator other than the manager in the assignment plan must be logged on to the TransGuide ATMS.

2.3.1.3.4 Requirements Addressed

Requirement Number	Requirement Description
RR-TGS-03	The TransGuide Operational Software shall be capable of performing a scenario search for a RR delay incident.
RR-TGS-03.01	The SCM-ScenarioSearchScreen shall contain the RR incident type for selection by a TransGuide operator.

2.3.1.3.5 Prerequisite Conditions

The test described in the section "TransGuide Alarm Notification of a Railroad Crossing Delay" must be run immediately prior to running this test.

2.3.1.3.6 Test Inputs

This test is to be run immediately following the test described in the section "TransGuide Alarm Notification of a Railroad Crossing Delay," therefore there are no additional test inputs required.

2.3.1.3.7 Test Results Evaluation

The results of this test will be visually inspected to verify the associated requirements have been satisfied.

2.3.1.3.8 Test Procedure

- Assign the alarm generated from the test described in the section "TransGuide Alarm Notification of a Railroad Crossing Delay."
- Verify that a new incident icon appears at the ATMS workstation of the operator assigned to the alarm.
- Log on to the incident.
- Verify that the scenario search screen appears with the Railroad Crossing Delay incident type selected and that the scenario search string is already entered. (RR-TGS-03.01)
- Perform a scenario search and verify that the scenario returned is the appropriate scenario for the railroad crossing delay incident.
- Cancel the scenario search.

2.3.1.3.9 Assumptions and Constraints

It is assumed that prior to this test the railroad crossing delay scenarios have been entered into the scenario database by TransGuide Operations personnel.

2.3.1.3.10 Test Results

Test Results

❑ PASS **❑ FAIL** **SwRI:_____ Date:_____**

TxDOT:_____ Date:_____

2.3.1.4 Railroad Crossing Delay Alarm Updates

The purpose of this test is to verify that railroad crossing delay alarms associated with existing railroad crossing incidents are handled as updates to the existing incidents and not as new alarms within the TransGuide ATMS. This test should be run immediately after running the TransGuide Scenario Search of a Railroad Crossing Delay test described in the section "TransGuide Scenario Search of a Railroad Crossing Delay."

2.3.1.4.1 Hardware Preparation

No hardware preparation is necessary for this test. All crossing delay messages are simulated for this test.

2.3.1.4.2 Software Preparation

No software preparation is necessary since this test should be run immediately after running the TransGuide Scenario Search of a Railroad Crossing Delay described in the section "TransGuide Scenario Search of a Railroad Crossing Delay."

2.3.1.4.3 Other Preparation

No other preparation is necessary for this test.

2.3.1.4.4 Requirements Addressed

RR-TGS-02.02	The AIH shall indicate the RR delay alarm as an update alarm if the RR delay alarm is related to a current RR delay incident.
RR-TGS-02.08	The AIH shall update the railroad delay information for an existing incident using the railroad delay information contained in the associated RR delay update alarm.

2.3.1.4.5 Prerequisite Conditions

The test described in the section "TransGuide Scenario Search of a Railroad Crossing Delay" must be run immediately prior to running this test.

2.3.1.4.6 Test Inputs

The AWARD ROS message simulation program will be used to generate all simulated test inputs for this test. Each test procedure step will indicate the data to be entered into the simulation program, if required.

2.3.1.4.7 Test Results Evaluation

The results of this test will be visually inspected to verify the associated requirements have been satisfied.

2.3.1.4.8 Test Procedure

- Use the AWARD ROS message simulation program to send a simulated crossing delay message to the AWARD TransGuide Inteface process. The following data should be entered for the simulated message:
    - ◊ Crossing Address: RRC-0010W-567.001

- ◊ Delay Condition: Stop at Crossing
- ◊ ETA Front: 10:30:00
- ◊ ETA Rear: 10:40:00
- ◊ Length: 2000
- ◊ Duration: 6000

- Verify the existing railroad crossing incident screen has been updated to indicate the train will be stopping at the crossing. The ETA Rear will be UNKNOWN and the Duration will be UNKNOWN. (RR-TGS-02.02, RR-TGS-02.08)
- Use the AWARD ROS message simulation program to send a simulated crossing delay message to the AWARD TransGuide Inteface process. The following data should be entered for the simulated message:
  - ◊ Crossing Address: RRC-0010W-567.001
  - ◊ Delay Condition: Crossing Clear
  - ◊ ETA Front: 0
  - ◊ ETA Rear: 0
  - ◊ Length: 0
  - ◊ Duration: 0
- Verify the existing railroad crossing incident screen has been updated to indicate the crossing is now clear. The ETA Front, ETA Rear, Length, and Duration will all be N/A. (RR-TGS-02.02, RR-TGS-02.08)
- Cancel the railroad crossing delay incident.

2.3.1.4.9 Assumptions and Constraints

No other assumptions or constraints are associated with this test.

2.3.1.4.10 Test Results

Test Results

❑ PASS ❑ FAIL SwRI:_____ Date:_____

TxDOT:_____ Date:_____

APPENDIX A

REQUIREMENTS TRACEABILITY

APPENDIX B

NOTES

NOTES