



W E L C O M E



U.S. Department of Transportation
Office of the Assistant Secretary for
Research and Technology

Welcome



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A screenshot of the website for the ITS Professional Capacity Building Program. The page features a blue header with the United States Department of Transportation logo and navigation links. Below the header is a search bar and a main navigation menu. The central content area includes a large image of people in a classroom setting, a 'Welcome to ITS Professional Capacity Building' section, a 'FREE TRAINING' section with a list of courses, and a 'WHAT'S NEW' section with several news items.

United States Department of Transportation
OFFICE OF THE ASSISTANT SECRETARY FOR RESEARCH AND TECHNOLOGY
Intelligent Transportation Systems
Joint Program Office

ITS Professional Capacity Building Program / Advancing ITS Education

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Welcome to ITS Professional Capacity Building
The ITS PCB Program is the U.S. Department of Transportation's leading program for delivering ITS training and learning resources to the nation's ITS workforce.

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The ITS PCB Program and partners offer many free ITS training courses.

- Web and Blended Courses from CITE
- ITS Standards Training
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WHAT'S NEW

New Web-Based Training from ITS Joint Program Office

- Connected Vehicle Reference Implementation Architecture Training now available

New NHI Course

- Systems Engineering for Signal Systems Including Adaptive Control (NHI-133123)

New ITS Case Study Available

- National ITS Architecture

Added to T3 Archive

- Learn from the Experts: Open Data Policy Guidelines for Transit - Maximizing Real Time and Schedule Data-Legalities, Evolutions, Customer Perspectives, Challenges, and Economic Opportunities - Part II Presented on August 7, 2014
- Saving Lives and Keeping Traffic Moving: Quantifying the Outcomes of Traffic Incident Management (TIM) Programs Presented on July 31, 2014

www.pcb.its.dot.gov

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**T204 Part 1 of 2:
How to Develop Test Procedures for an ITS
Standards-Based Test Plan**

Instructor



Dave Miller,

Chair: NEMA / AASHTO / ITE

Joint Committee on ATC

Chair: 3TS Technical Committee

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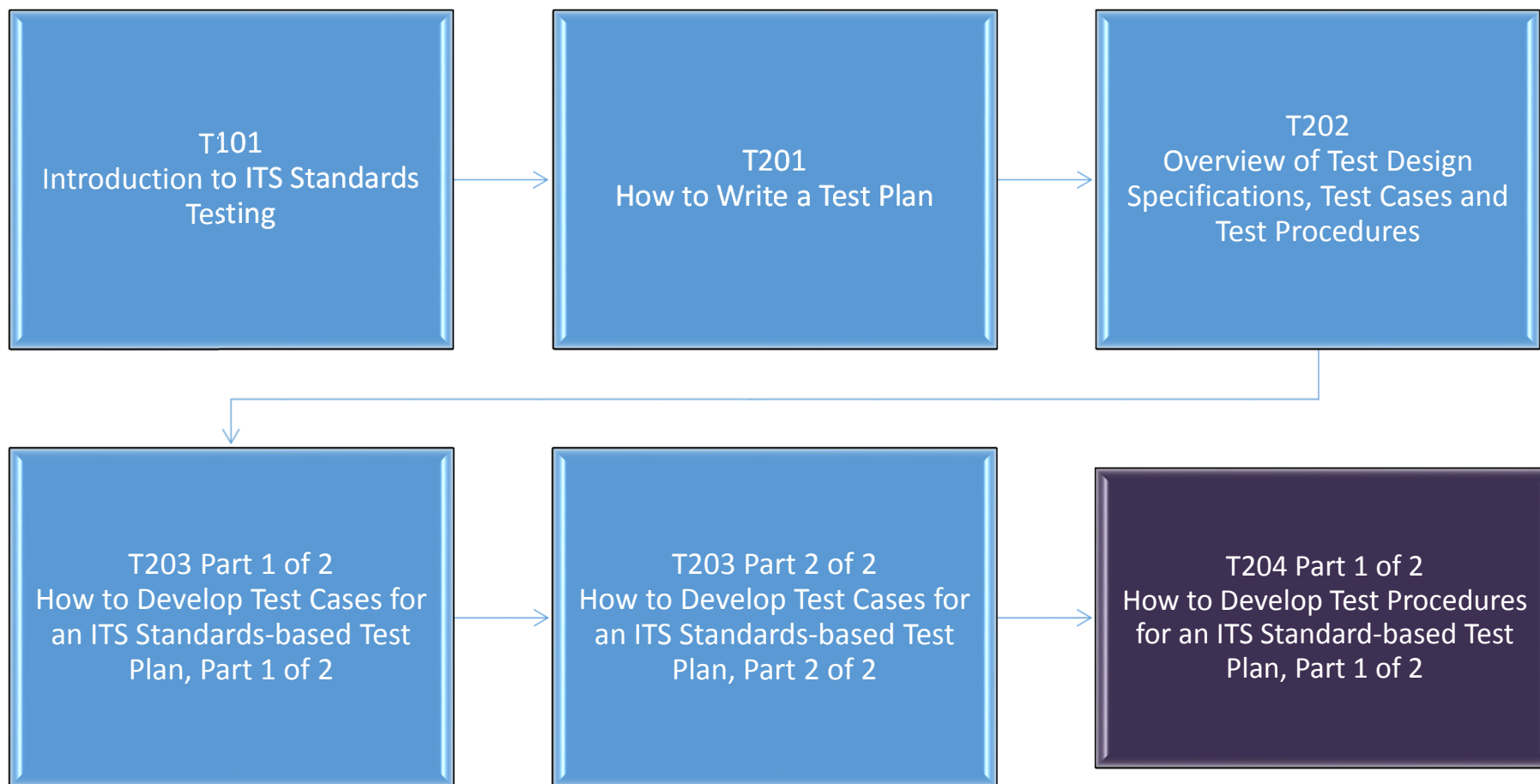
Target Audience

- Traffic management and engineering staff
- Maintenance Staff
- System developers
- Test personnel
- Private and public sector users including manufacturers

Recommended Prerequisite(s)

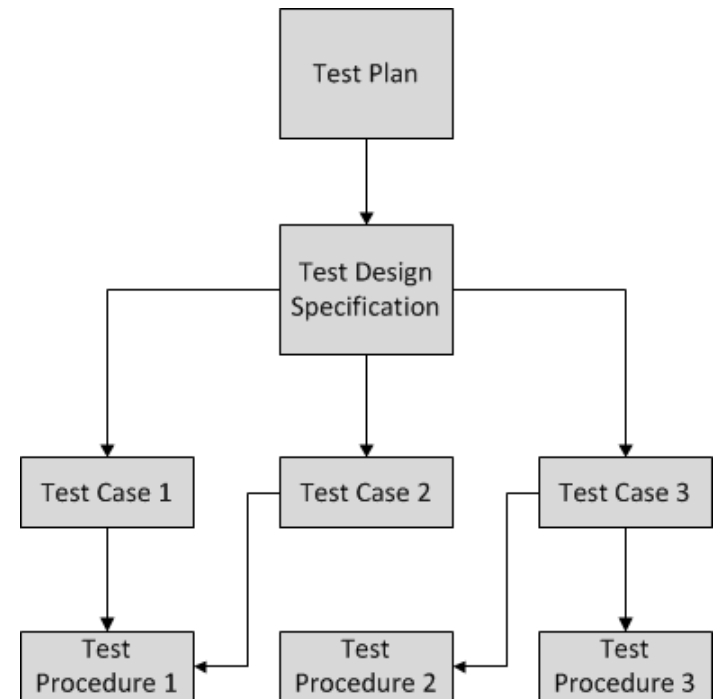
- T101: Introduction to ITS Standards Testing
- T201: How to Write a Test Plan
- T202: Overview of Test Design Specifications, Test Case Specifications and Test Procedures
- T203 Part 1 of 2: How to Develop Test Cases for an ITS Standard-based Test Plan, Part 1 of 2
- T203 Part 2 of 2: How to Develop Test Cases for an ITS Standard-based Test Plan, Part 2 of 2

Curriculum Path



Acronyms and Terminology Used

- TP Test Plan
- TDS Test Design Specification
- TPS Test Procedure Specification
- TPG Test Plan Generator
- TCS Test Case Specification
- DMS Dynamic Message Sign
- TMDD Traffic Management Data Dictionary
- RTM Requirements Traceability Matrix
- RTCM Requirements to Test Case Matrix



See Student Supplement for Details

Learning Objectives

Part 1 of 2

1. Recognize the purpose and structure of a test procedure
2. Identify the role of a Test Procedure Specification (TPS) within a test plan and the overall testing process
3. Synchronize the test procedure specification to the contract terms and conditions for successful contract execution
4. Write the reports produced at the end of testing and understand their relationship to successful procurement contracts
5. Use tools to develop the test procedures for a sample TPS structure

Part 2 of 2

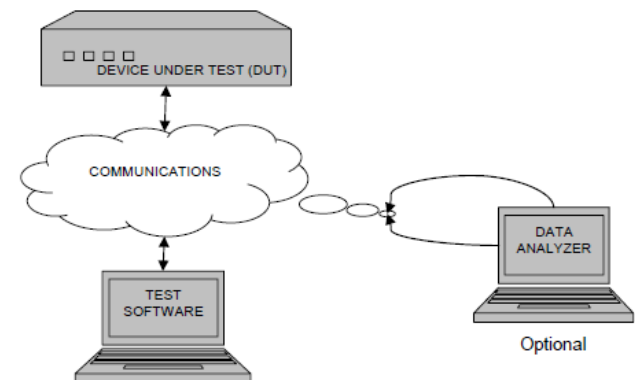
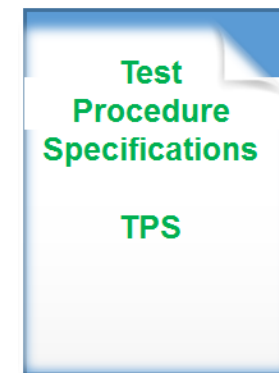
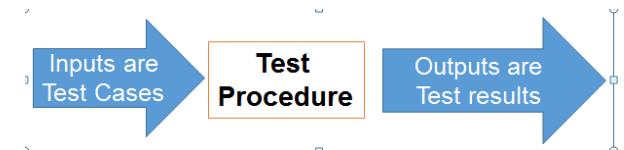
6. Use the Test Plan Generator (TPG) to generate test procedures for a variety of equipment
7. Adapt the generated test procedures to procurement contract terms and conditions for successful project conclusion
8. Develop complex test procedures that pull together NTCIP elements using the TPG

Learning Objective #1: Recognize the Purpose and Structure of a Test Procedure Specification

- Explain structure of a Test Procedure Specification (TPS)
- Discuss inputs and expected outputs from a test procedure
- Explain special needs from a test procedure stand point

Definitions

- A **test procedure** provides detailed instructions for the setup, execution, and evaluation of results for a given test case (IEEE Std 829)
- **Test Procedure Specification (TPS)** is a document that defines the steps to execute a test and relates to test cases
- TPS is used in ITS project as part of a test plan prepared for a system acceptance



Purpose and Structure of a Test Procedure

Purpose of Test Procedure

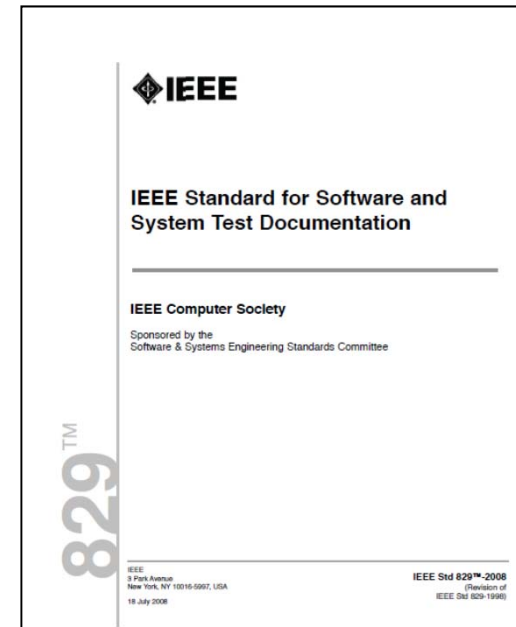
- A standardized test procedure provides meaningful results (outputs) to a user for evaluating the system:

Did we build the system as intended by the project specification (user)?

- In the previous Module, T203, we learned how to develop test cases for DMS and TMDD-based ITS projects
- Continuing further, in this module we will learn how to develop TPS using IEEE Std 829 format and definitions

What does IEEE Std 829 Provide?

- Guidance and formats for preparing testing documentation:
 - Test Plan
 - Test Design Specification
 - Test Case Specification
 - **Test Procedure Specification (TPS)**
 - Test Reports
 - Test Logs
 - Test Anomaly Report
 - Test Report
- Testing professionals across ITS are familiar with these definitions and the sequence of the testing workflow



Purpose and Structure of a Test Procedure (cont.)

Structure of a Test Procedure (IEEE Standard 829)

1. Introduction

- Document identifier
- Scope
- References
- Relationship to other procedures

2. Details

- Inputs, outputs, and special requirements
- Ordered description of the steps to be taken to execute the test cases

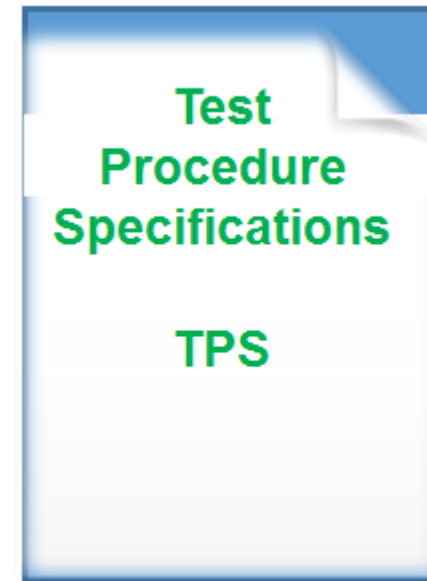
3. General

- Glossary
- Document change procedures and history

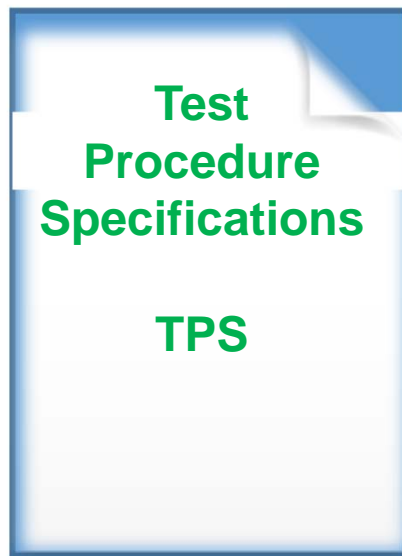
Purpose and Structure of a Test Procedure (cont.)

Related Details

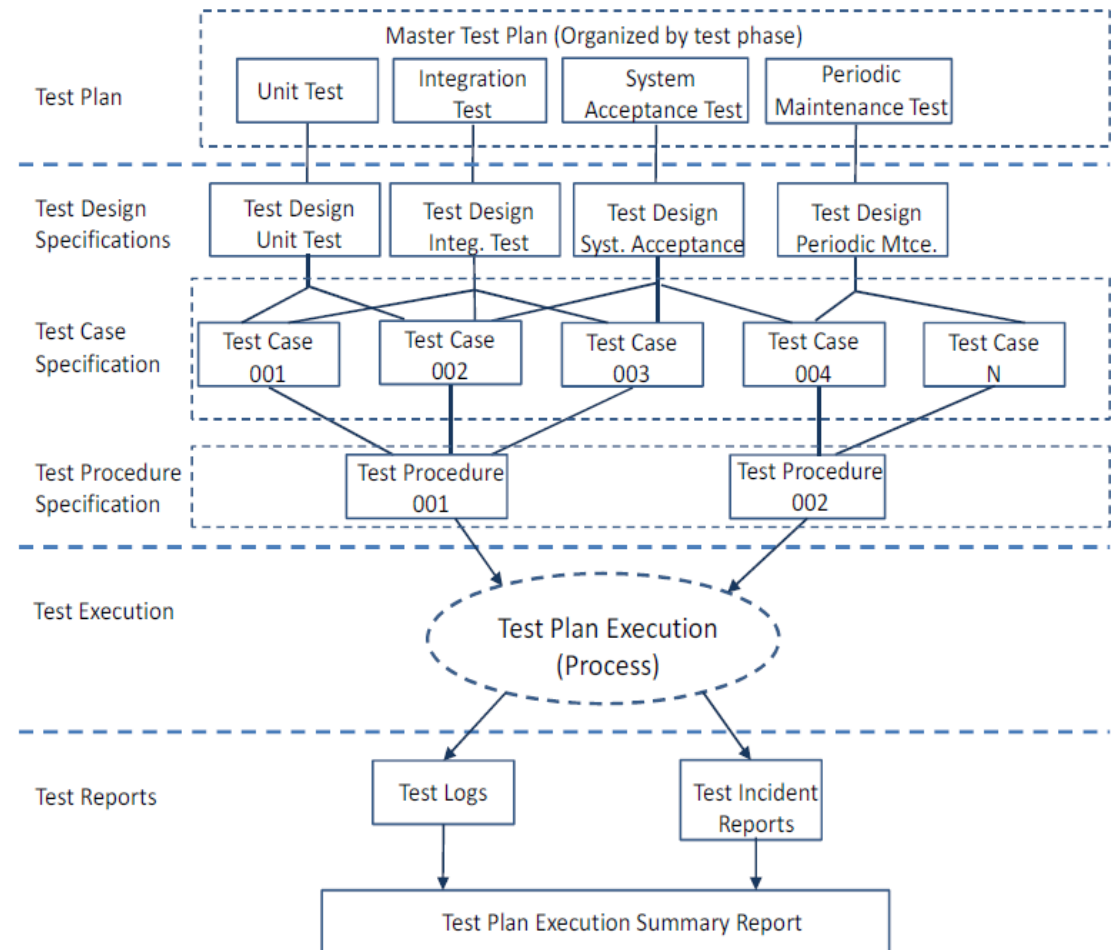
- Test resources
- Test schedule
- Items to be tested
- Features to be tested
- Test tasks to be performed
- Test personnel required to conduct tests
- Test risks



Where does TPS Fit in Documentation Structure?



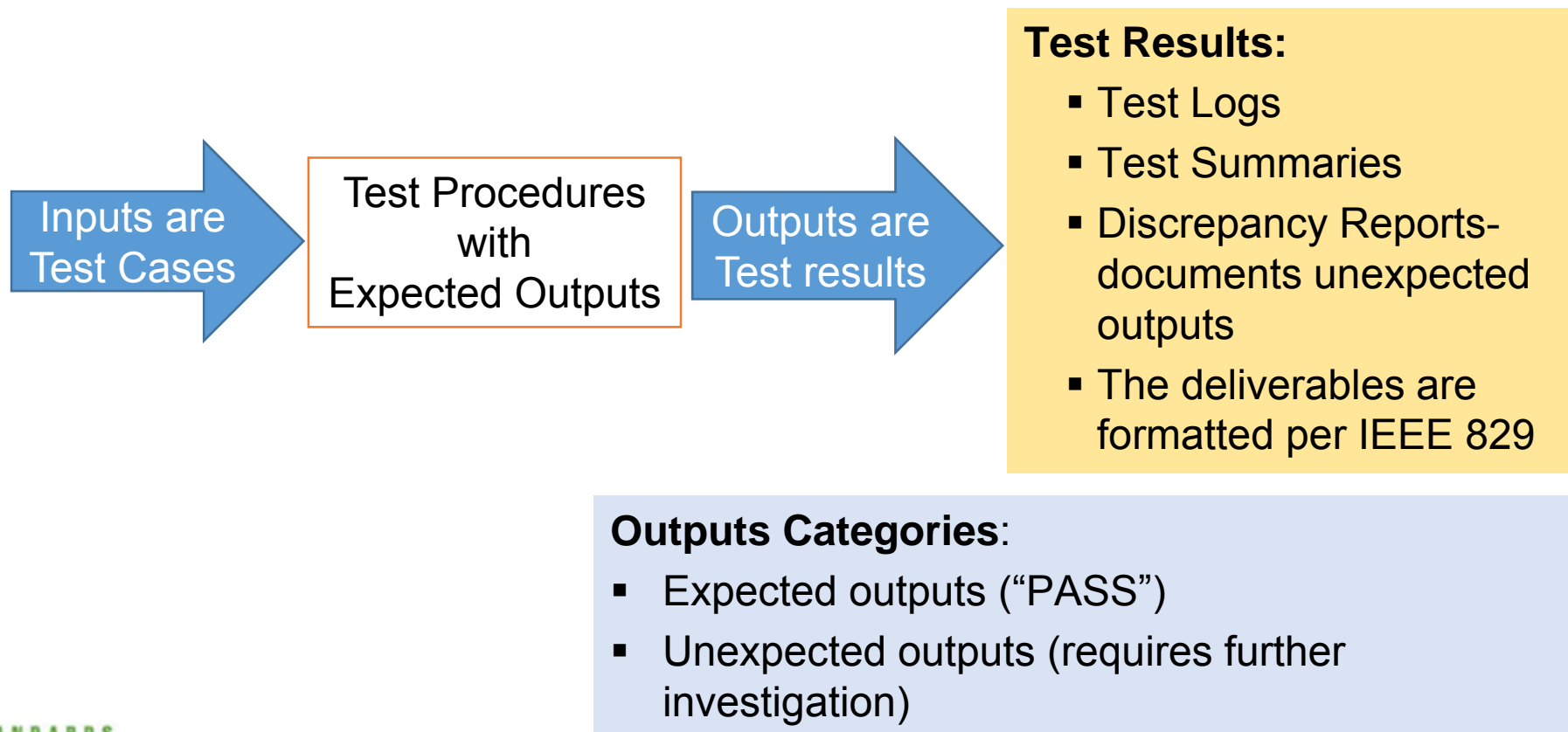
TPS defines the steps to execute a test and relates to test cases.



Source: PCB Module-IEEE 829-1998

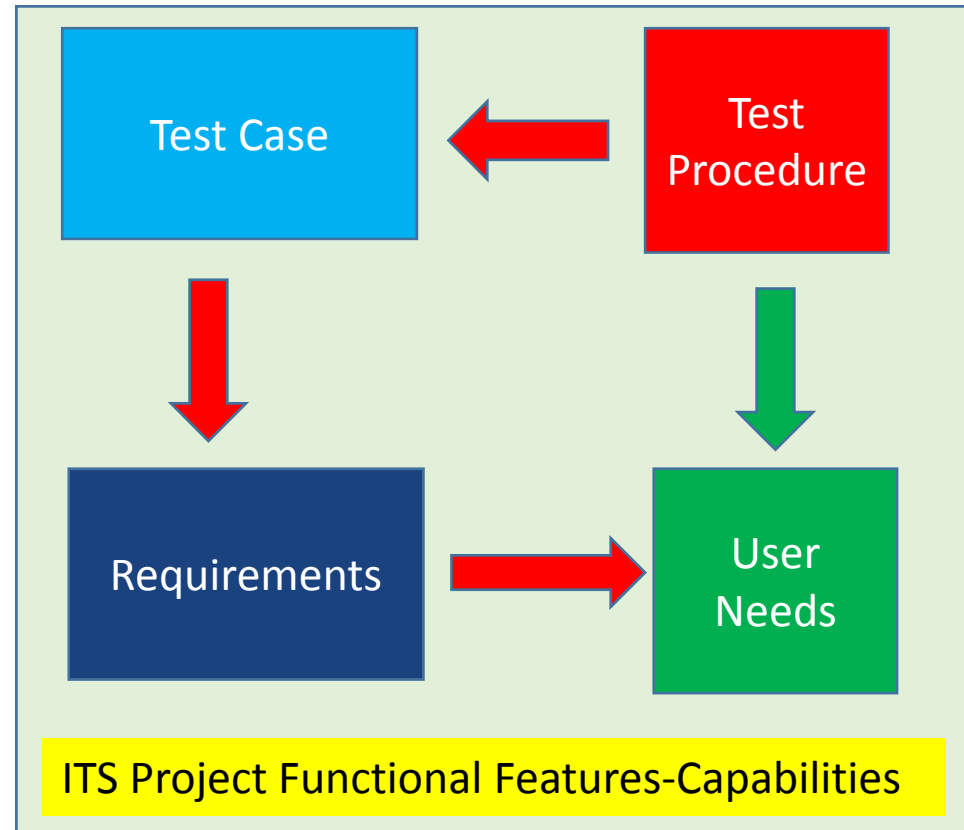
Inputs and Expected Outputs

A Test Procedure is Conducted on Test Inputs to Produce Test Outputs



Role of Test Procedures

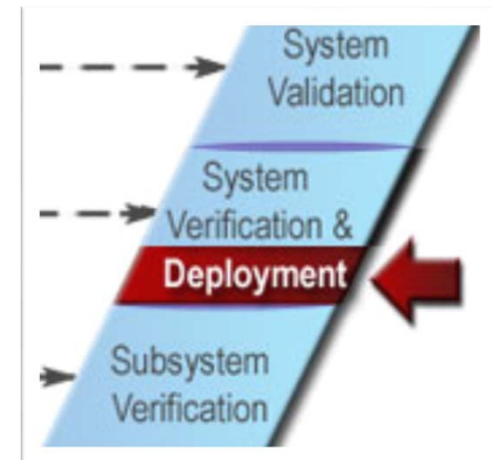
- Test procedure ultimately traces back to the user needs—a starting point in a SE life cycle of an ITS project:
 - Test procedure traces back to test cases
 - Test cases trace back to requirements
 - Requirements trace back to user needs



Role of Test Procedures (cont.)

Test Procedure Insures the System is Built Correctly as Expected by the User

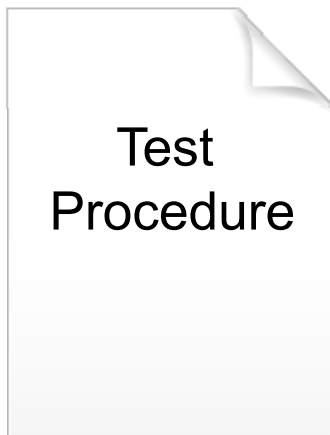
- Verifying that we built the system correctly:
 - Design used standard objects and dialogs correctly
 - Design implemented special contract provisions (if any) correctly
 - The system performs as expected by the user



Source: FHWA

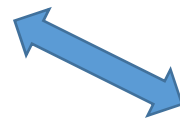
***Did we build the system as intended by a project specification?
-users, owners, developers, vendors***

Special Needs from a Test Procedure Standpoint



Special Needs Outside of the Standards

- Special security measures
- Special access rights (permission) to data bases
- Documentation control for archiving deliverables
- Configuration management to reproduce the same results
- Records of any automated test tools
- Special skill sets required of test operators



Special contract provisions (if any):

- Special needs do not show up for the first time in the TPS
- Special Needs of contracts move through TDS and TCS

IEEE 829 Level Test Procedure Steps

LEVEL TEST PROCEDURE # ID	
LOG:	Logging tools and methods List ...
SETUP:	Sequence of actions to prepare for testing List ...
START:	Actions to begin test execution List ...
MEASUREMENT:	Describe how measurements are to be made List ...
SHUT DOWN:	Actions to suspend testing for unscheduled events List ...
RESTART:	Procedure to restart testing from shutdown List ...
STOP:	Procedure for orderly halt to testing List ...
WRAP UP:	Actions after execution has been completed List ...
CONTINGENCIES:	Actions necessary to deal with anomalies List ...

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Which of the following is a FALSE statement?

Answer Choices

- a) ITS standards define objects and dialogs to be tested
- b) ITS standards provide format and steps for test procedures
- c) Test procedures can merge with test cases
- d) Test cases trace to requirements

Review of Answers



- a) ITS standards define objects and dialogs to be tested

Incorrect. Objects defined in the ITS standards. The most recent version of several NTCIP standards include dialogs



- b) ITS standards provide format and steps for test procedures

Correct! ITS standards do not provide formats and steps for TPS, ONLY IEEE 829 does.



- c) Test procedures can merge with test cases

Incorrect. Std 829 links test cases as inputs to a test procedure.



- d) Test cases trace to requirements

Incorrect. A test cases traces to requirements.

Summary of Learning Objective #1

Recognize the Purpose and Structure of a Test Procedure

- Discussed the purpose and structure of a TPS based on IEEE 829 format and definitions
- Reviewed the inputs and expected outputs in a test procedure
- Reviewed special needs that arise from outside of ITS standards and contractual requirements

Learning Objective #2: Identify the Role of a Test Procedure Specification Within a Test Plan and the Overall Testing Process

- Briefly review the role of Test Design Specification (TDS)
- Briefly review the role of Test Case Specification (TCS)
- Discuss test procedure steps

Brief Review of Test Design Specification (TDS)

TDS Details What a Test is to Demonstrate

- TDS is a document that:
 - Specifies the details of the test approach
 - Specifies what is to be verified
 - Identifies the associated tests

- Each test identified in the TDS may identify and detail:
 - A test of a single requirement
 - A test of a combination of multiple requirements

Example of TDS

TDS Outlines Requirements to Be Tested

NTCIP 1203 Protocol Requirements List (PRL)

USER NEED SECTION NUMBER	USER NEED	FR SECTION NUMBER	FUNCTIONAL REQUIREMENT	CONFORMANCE	SUPPORT / PROJECT REQUIREMENT	ADDITIONAL PROJECT REQUIREMENTS
2.3.2.3	DMS Display Matrix Configuration			M	Yes	The DMS shall be 9,000 millimeters wide (0..65535) and 2,700 millimeters high (0..65535), inclusive of borders. The Sign's Border shall be at least 400 millimeters wide (0..65535) and 400 millimeters high (0..65535).
2.3.2.3.1	Non-Matrix			O.2 (1)	Yes / <input type="checkbox"/> No	
2.3.2.3.2 (Matrix)	Matrix			O.2 (1)	<input checked="" type="checkbox"/> Yes / No	The pitch between pixels shall be at least 66 millimeters (0..255).
2.3.2.3.2.1	Full Matrix			O.3 (1)	Yes / <input type="checkbox"/> No	The sign shall be ___ pixels wide (0..65535) and ___ pixels high (0..65535).
2.3.2.3.2.2	Line Matrix			O.3 (1)	Yes / <input type="checkbox"/> No	The sign shall have ___ lines with each line being ___ pixels wide and ___ pixels high.
2.3.2.3.2.3	Character Matrix			O.3 (1)	<input checked="" type="checkbox"/> Yes / No	The sign shall be 18 characters wide and 3 characters high with each character being 5 pixels wide (0..255), 7 pixels high (0..255).

Source: NTCIP 1203 DMS

Brief Review of Test Case Specification (TCS)

TCS Specifies Conditions and Sequence of Verification

- TCS is a document that specifies:
 - The inputs to the test
 - The outputs of the test – the predicted results
 - A set of execution conditions for the test
- Section 1: Introduction
 - Document identifier
 - References to other documents
 - Context required outside of the TCS document
 - Notation description, such as numbering systems

Brief Review of TCS (continued)

TCS Specifies Purpose of Verification

- Section 2: Test Case Details
 - Test case identifier, unique to each
 - Test objective and focus
 - Inputs required to execute the test
 - Expected outcomes and behaviors
 - Environmental needs for setup, execution and recording the results
 - Special procedures
 - Interdependencies to other test cases
- Section 3: General
 - Glossary
 - Document change procedure and change history

Role of TPS within Test Plan & Testing Process

TPS Defines the Steps to Perform the Test

- TSP is a document that:
 - Specifies a sequence of actions (steps) for the execution of a test
 - TPS based on TDS and TCS
 - In general, TPS specifies the steps of the verification such as inspection, demonstration, analysis and a test procedure

Role of TPS within Test Plan & Testing Process

Requirements to Test Case Matrix (RTCM) : Example from NTCIP 1204 ESS v03, C.2.2

ANNEX C TEST PROCEDURES [NORMATIVE] 152

- C.1 Purpose..... 152
 - C.1.1 Scope 152
 - C.1.2 Keywords..... 152
 - C.1.3 Rules for Following Test Procedures 153
- C.2 Testing Requirements..... 153
 - C.2.1 Field Device Test Environment 153
 - C.2.2 Traceability Table 153**
 - C.2.3 Test Procedures..... 161

Table 30 Requirements to Test Case Traceability Table

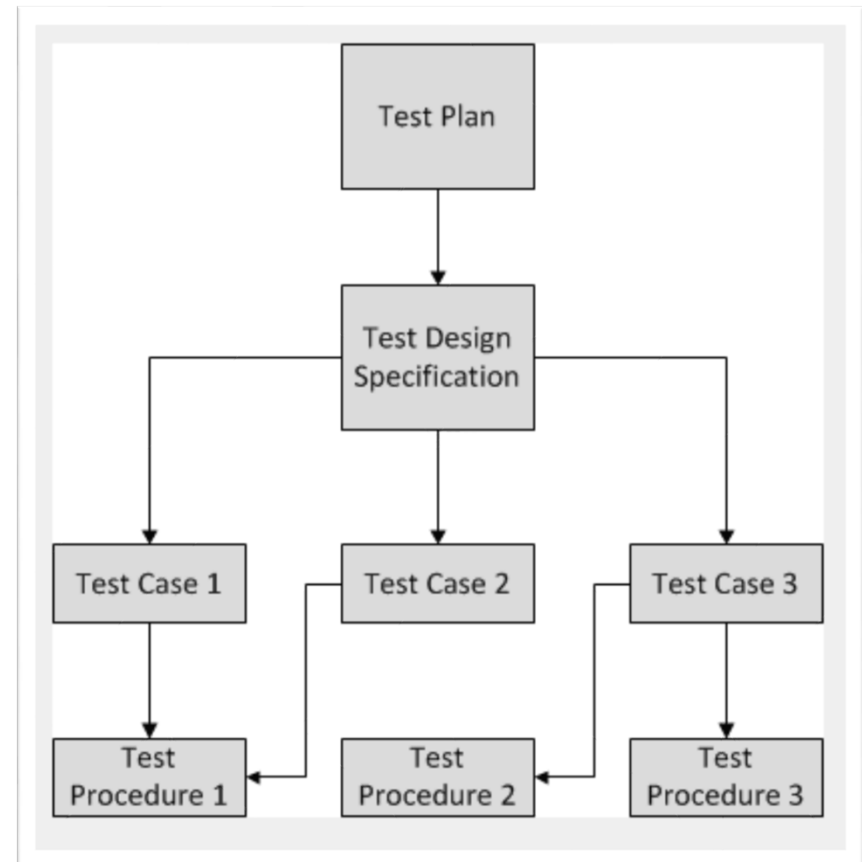
Requirement		Test Case	
ID	Title	ID	Title
3.5	Data Exchange Requirements		
3.5.1	ESS Manager Requirements		
3.5.1.1	ESS Configuration Requirements		
3.5.1.1.1	Retrieve ESS Characteristics		
		C.2.3.1.1	ESS Characteristics

Source: NTCIP 1204 ESS v03

Role of TPS within Test Plan & Testing Process

Test Workflow: Continued from Module T202

- **Test Workflow Steps:**
 - Overall Test Plan
 - Test Design Specification
 - Multiple Test Cases per TDS
 - Multiple Test Procedures
 - Each test procedure may cover one independent test case
 - Each test procedure may cover multiple dependent test cases



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In addition to inputs, outputs, and execution conditions, test case specification includes:

Answer Choices

- a) Test objective to provide guidance to the test operator
- b) Test environment hardware and software
- c) Special procedures, such as automated tools
- d) All of the above

Review of Answers



a) Test objective to provide guidance to the test operator

All are true.



b) Test environment hardware and software

All are true.



c) Special procedures, such as automated tools

All are true.



d) All of the above

Correct! All are true.

Summary of Learning Objective #2

Role of Test Procedure Specification within a Test Plan and Overall Testing Process

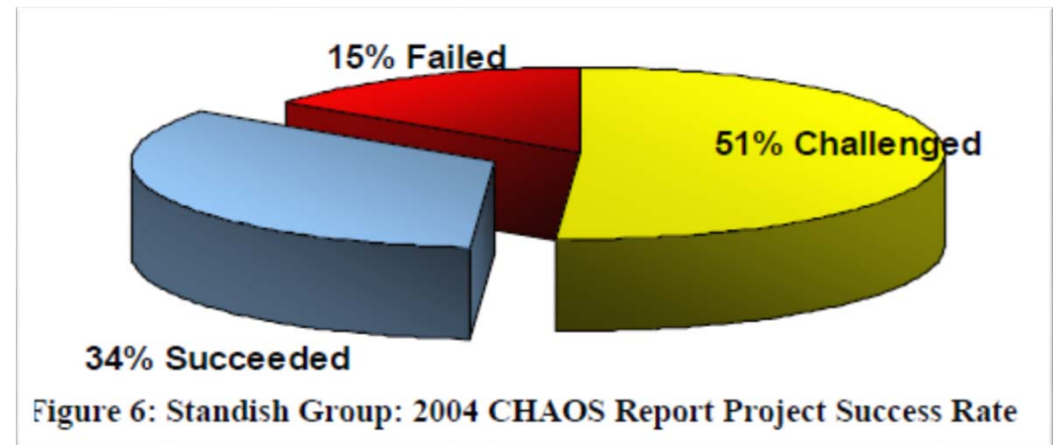
- Briefly reviewed the role of Test Design Specification (TDS) as per Standard IEEE 829
- Briefly reviewed the role of Test Case Specification (TCS) as per Standard IEEE 829
- Discussed test procedure steps and overall role within a test plan and testing process

Learning Objective #3: Synchronize the Test Procedure Specification to the Contract Terms and Conditions for Successful Contract Execution

- Discuss ITS project background
- Discuss how to structure contract terms and conditions from viewpoint of project end successfully

ITS Projects Background (cont.)

- Study has shown that of 280,000 Information Technology projects surveyed, 142,000 were late or over budget; 42,000 failed and were canceled



- Factors contributing to failures:
 - Lack of user involvement
 - Few limits on project scope
 - Lack of firm requirements
 - No consensus of project success at project kickoff

Source: FHWA SE Handbook, 2007
See student supplement for reference

Synchronizing the TPS to the Contract Terms and Conditions

Start the Project with an Eye on the Finish Line

- In the beginning: What constitutes success at the end?
- For project acceptance at the end, project terms and conditions should include:
 - Design specifications
 - Test case specifications
 - Test procedures
 - Testing of interfaces by suppliers before integration

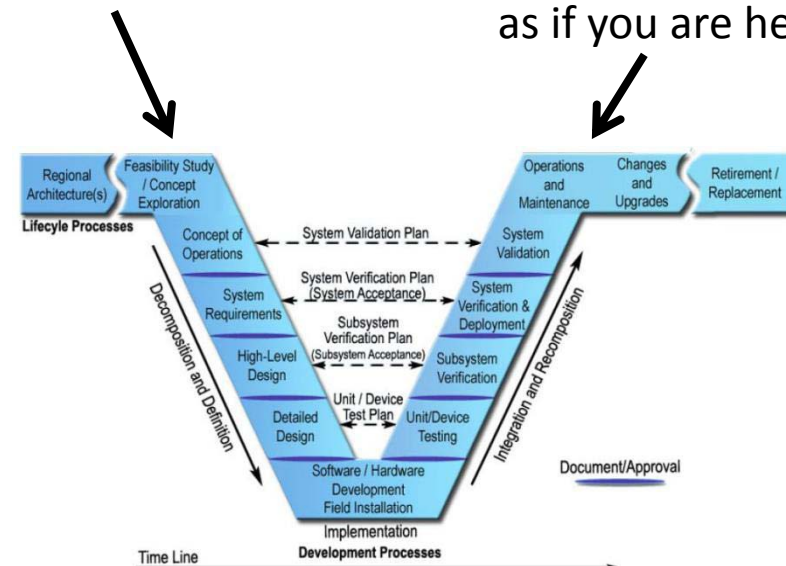
Synchronizing the TPS to the Contract Terms and Conditions (cont.)

- Expect systems engineering and planning effort to consume over 15% of the project budget to avoid ambiguities and system defects at project end
- Good planning includes test documentation

Synchronizing the TPS to the Contract Terms and Conditions (cont.)

- Terms and conditions should include IEEE 829 elements:
 - Test plan
 - Test design specification
 - Test case specification
 - Test procedures with “fill-in-the-blank” fields for test outputs

Write Terms and Conditions here...
as if you are here.



Synchronizing the TPS to the Contract Terms and Conditions (cont.)

Additional Concerns to be Aware Of

- Terms and conditions could also specify:
 - Third party test equipment model-requirements
 - Test scripts as deliverables
 - Test procedure for common test equipment and test scripts
 - Example: Type of ASC, ATC, 2070, etc.

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The TPS should be synchronized to the contract terms and conditions...

Answer Choices

- a) Project ending without unexpected issues
- b) Minimizing the project planning costs and time
- c) Replicating the wording of a similar prior project
- d) Enforcement after the project is late and over budget

Review of Answers



- a) Project ending without unexpected issues

Correct! Contract terms including the tests allow the suppliers to test deliverables throughout the project, eliminating unexpected results.



- b) Minimizing the project planning costs and time

Incorrect. Studies of IT project show that investing 15% or more of the total project cost in planning will save more than 15% in cost overruns.



- c) Replicating the wording of a similar prior project

Incorrect. Replication of “boilerplate” acceptance wording does not provide clear acceptance criteria for differing equipment and software.



- d) Enforcement after the project is late and over budget

Incorrect. Enforcing design changes for unexpected results is more expensive than planning the final acceptance before the project begins.

Summary of Learning Objective #3

Synchronize the TPS to the Contract Terms and Conditions for Successful Contract Execution

- Discussed ITS project background, how they present challenges
- Discussed how to structure contract terms and conditions from the viewpoint of project end successfully

Learning Objective #4: Write the Reports Produced at the End of the Testing and Understand Their Relationship to Successful Procurement Contracts

- Logs, including data, information, files, and needs that are captured during the test
- Incident report, including a failure description and the investigation process
- Summary report, providing a measure of success compared to the stated goals and scope of the test plan

Reports Produced at the End of Testing and Their Relationship to Successful Procurement

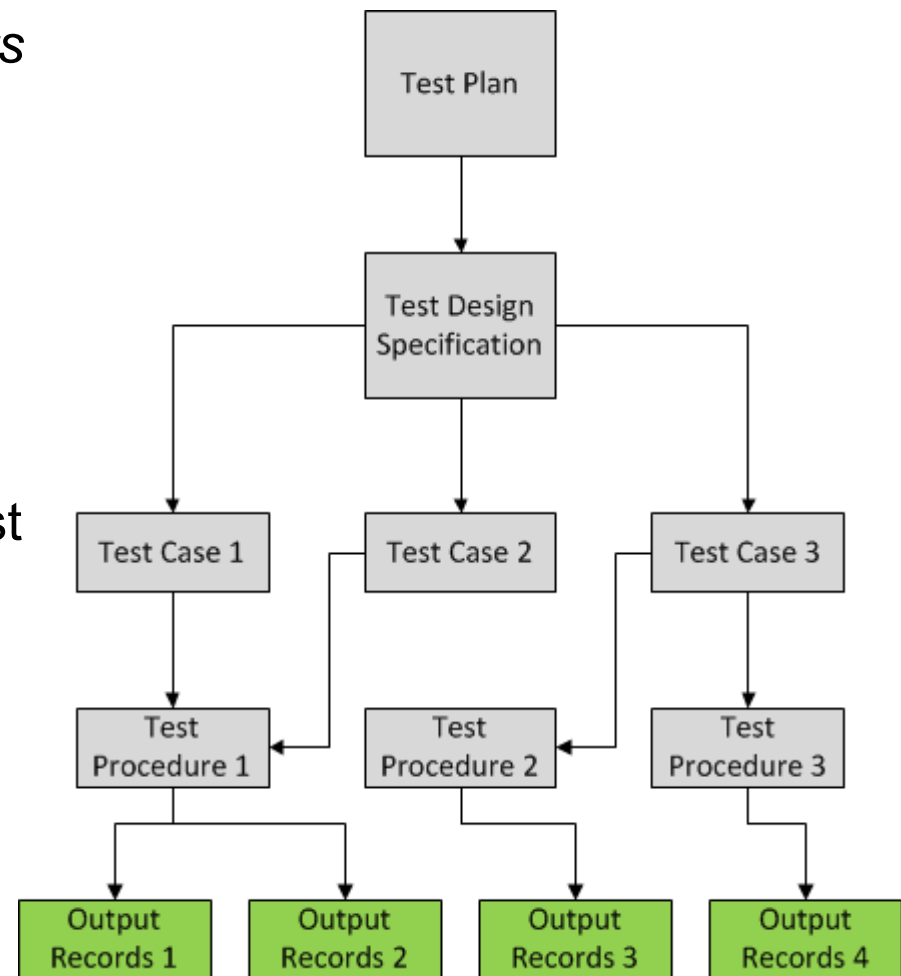
Logs, Including the Data, Information, Files and Fulfilled Requirements That are Captured During the Test

- Outputs captured during the test
 - Test Logs
 - Test Data
 - Test Information
 - Test Files
- Output documentation is tailored to each test procedure from the formats available in IEEE 829
- We will demonstrate how the outputs are populated during a test procedure that includes more than one test case

Reports Produced at the End of Testing and Their Relationship to Successful Procurement

Workflow: Test Procedure Outputs

- We have created (gray):
 - Test Plan
 - Test Specification
 - Test Cases
 - Test Procedures
- Using test cases as inputs, test procedures will create output records (green):
 - Test Logs
 - Test Data
 - Test Information
 - Test Files



Reports Produced at the End of Testing and Their Relationship to Successful Procurement

Anomaly Report, Including a Failure Description and the Investigation Process

- Discovery of anomalies:
 - Evaluate the test procedure outputs
 - Identify data that is out-of-bounds of the expected result
 - Out-of-bounds data is unexpected and requires investigation
 - AKA “incidences”, “errors”, “problems”, “defects”, “issues”
- Anomaly report includes:
 - Unexpected results in the test procedure outputs
 - A description of each unexpected result
 - Investigation plan as the next step for disposition of each anomaly

Anomaly Report: IEEE Standard 829 Format

1. Introduction

1.1. Document identifier

1.2. Scope

1.3. References

2. Details

2.1. Summary

2.2. Date anomaly discovered

2.3. Context

2.4. Description of anomaly

2.5. Impact

2.6. Originator's assessment of urgency (see IEEE 1044-1993 [B13])

2.7. Description of the corrective action

2.8. Status of the anomaly

2.9. Conclusions and recommendations

3. General

3.1 Document change procedures and history

Anomaly Report: IEEE Standard 829 Format

- Introduction
 - Document identifier
 - Scope of testing
 - References, such as standards documents
- Details
 - Summary: What was found to be out of bounds?
 - Date, context, description: When, Where, What?
 - Impact and urgency: Major or minor impact to project cost & schedule?
 - Action: Stop and fix or investigate further?
 - Status: Open, investigating, or resolved and closed? Who decides?
 - Conclusions and Recommendations: Next steps for stakeholders
- General: Document control numbers, versions, history

Anomaly Report: IEEE Standard 829 Format

- Description
 - Test inputs used
 - Expected outputs from the plan
 - Actual results observed
 - Gap between expected and actual
 - Test procedure step
 - Test environment
 - Attempts to repeat the test
 - Test operators, who conducted the test?
 - Observers

Level Test Reports Produced at the End of Testing

Level Test Report, Providing a Measure of Success Compared to the Stated Goals and Scope of the Test Plan

- Level test report:
 - Measure of success
 - Identify gap between current situation and stated goals
 - Clear objective metrics based on anomaly report and remaining disposition of open issues
- Clear conclusions and recommendations:
 - Ready for deployment
 - Ready with minor modifications
 - Not ready

Level Test Report: IEEE Standard 829 Format

- For each level of integration test
- Introduction
 - Document ID
 - Scope of testing
 - References, if any
- Details
 - Overview of test results
 - Detailed test results
 - Rational
 - Recommendations
- General: Document control

1. Introduction

- 1.1. Document identifier
- 1.2. Scope
- 1.3. References

2. Details

- 2.1. Overview of test results
- 2.2. Detailed test results
- 2.3. Rationale for decisions
- 2.4. Conclusions and recommendations

3. General

- 3.1. Glossary
- 3.2. Document change procedures and history

Example of a Level Test Report

- For ASC Timing
- Introduction
 - Document ID
 - Scope of testing
 - References, if any
- Details
 - Overview of test results
 - Detailed test results
 - Rational
 - Recommendations
- General: Document control

Master Test Report Produced at the End of Testing

- For all levels of integration test
- Introduction
 - Document ID
 - Scope of testing
 - References, if any
- Details
 - Overview of test results
 - Detailed test results
 - Rational
 - Recommendations
- General: Document control

1. Introduction

- 1.1. Document identifier
- 1.2. Scope
- 1.3. References

2. Details of the Master Test Report

- 2.1. Overview of all aggregate test results
- 2.2. Rationale for decisions
- 2.3. Conclusions and recommendations

3. General

- 3.1. Glossary
- 3.2. Document change procedures and history

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Which of the following statements is FALSE?

Answer Choices

- a) Only one test case used as input to each test procedure
- b) A test procedure can use multiple test cases as inputs

Review of Answers



- a) Only one test case used as input to each test procedure

Correct! This statement is false. Test cases that are independent of each other will likely be the single input to a test procedure. However, several dependent test cases are often used as multiple inputs to one test procedure.



- b) A test procedure can use multiple test cases as inputs

Incorrect. This statement is true. Test cases that require similar equipment with related functions can be tested with one procedure.

Summary of Learning Objective #4

Reports Produced at the End of Testing and Their Relationship to Successful Procurement

- Learned the format and content of logs, including data, information, files, and needs that are captured during the test
- Learned the format and content of an incident report, including a failure description and the investigation process, and an anomaly report
- Learned the format and content of the level test report and summary report, providing a measure of success compared to the stated goals and scope of the test plan

Learning Objective #5: Using the Test Procedure Generator (TPG) to Develop the Test Procedures for a Sample TPS Structure

- Test Procedure Generator (TPG) Tool
 - Purpose of TPG
 - How to obtain a copy of the TPG
 - Show a quick overview of installation
 - Explain each step and the results
 - Learn how to how handle an error in a sample TPS structure
- Understand pre and postconditions, and different types of steps

Using a Tool to Develop the Test Procedures

Test Procedure Generator (TPG) for a Sample TPS Structure

- TPG is a software tool developed by USDOT
- Guides the development of uniform test procedures:
 - NTCIP standards that can typically use the TPG have:
 - Management Information Base (MIB)
 - With standardized dialogs
 - Requirements Traceability Matrix (RTM) defining performance
- Creates XML scripts
 - Consistent interpretation among stakeholders
 - Eliminates errors of manual creation of scripts
 - Can be used on any automated test equipment

Using TPG to Develop the Test Procedures

Test Procedure Generator (TPG)

- TPG is used to develop test procedures from NTCIP standards with:
 - Management Information Base (MIB)
 - Data exchange dialogs
 - Requirements Traceability Matrix (RTM)
- Advantages of using the TPG:
 - Creates scripts in commonly-understood XML format
 - Creates uniform scripts for use in multiple projects
 - Creates uniform scripts for each stakeholder within a project
 - Eliminates syntax errors and manual entry errors

Using a Tool to Develop the Test Procedures

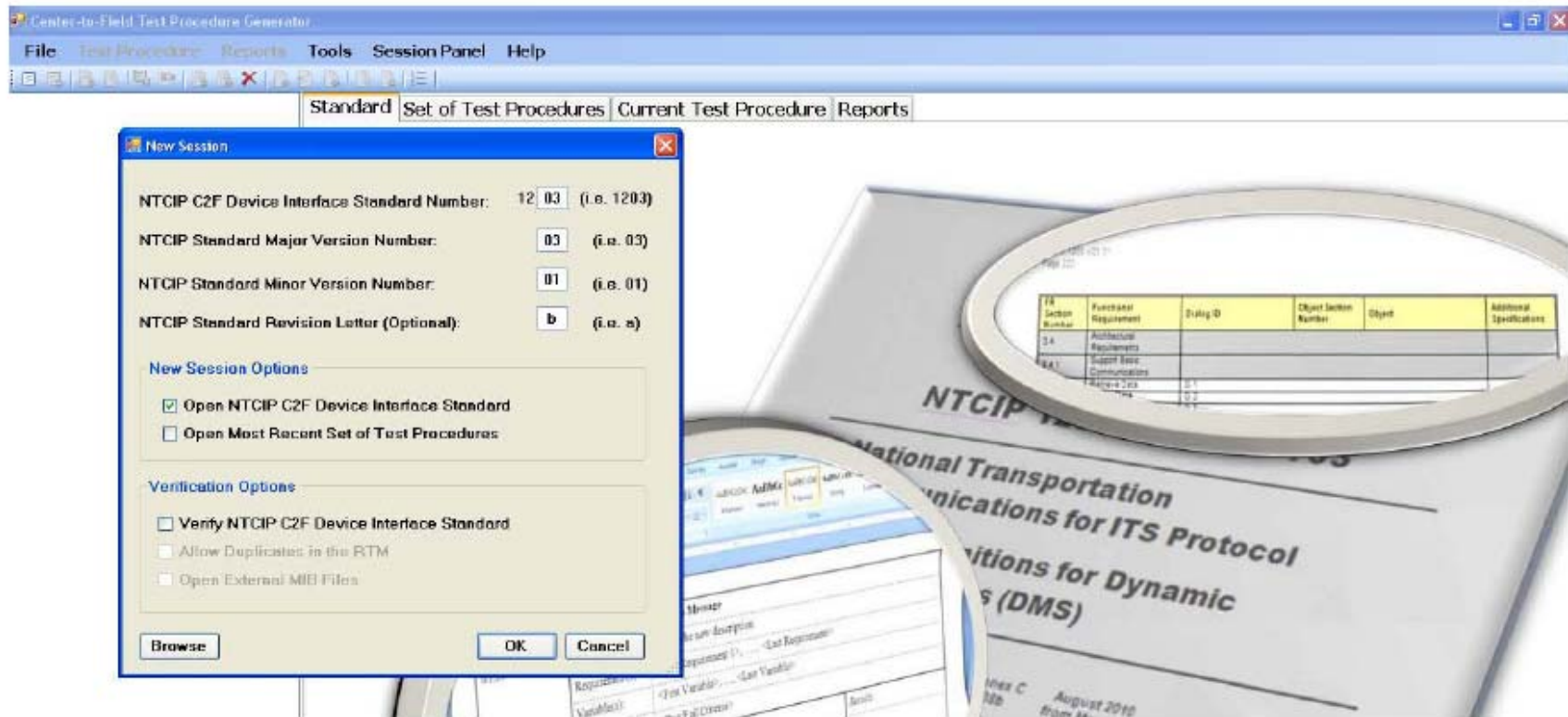
Test Procedure Generator (TPG)

- Will be able to request a copy of TPG to be added to distribution list
- Will be able to download the TPG, including:
 - TPG executables
 - TPG installation procedure
 - TPG instruction manual



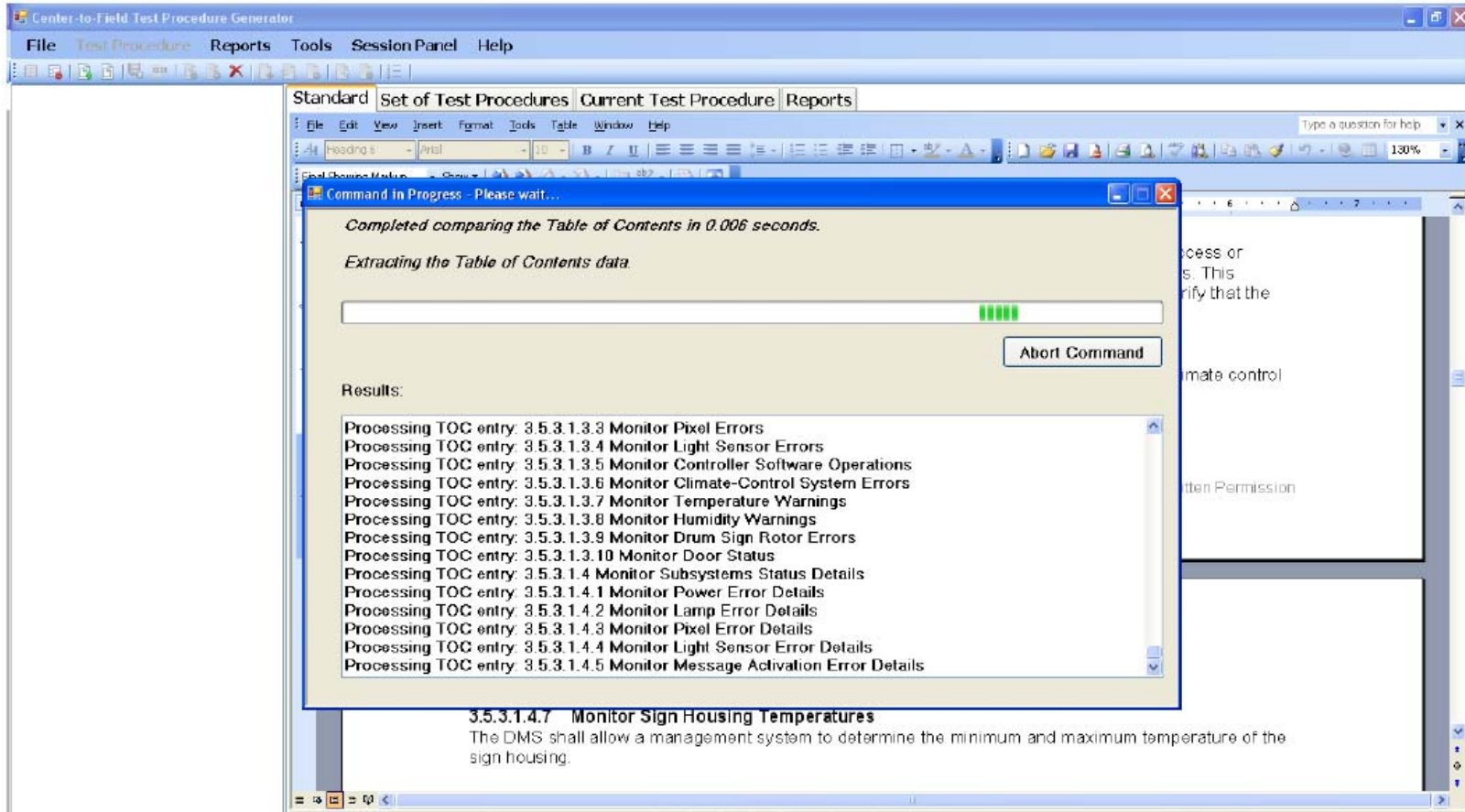
How to Use TPG (cont.)

Opening a New TPG Session



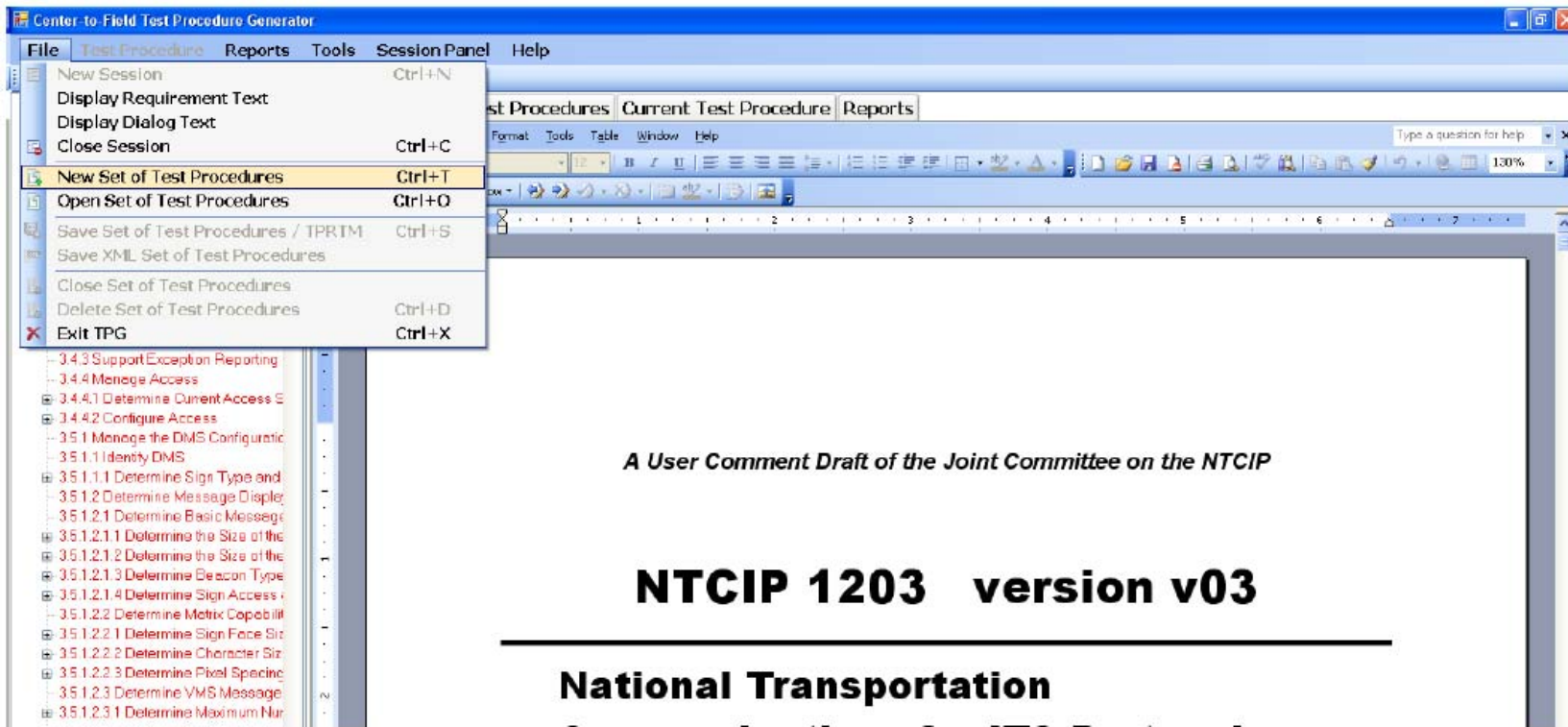
How to Use TPG (cont.)

Opening a Standard



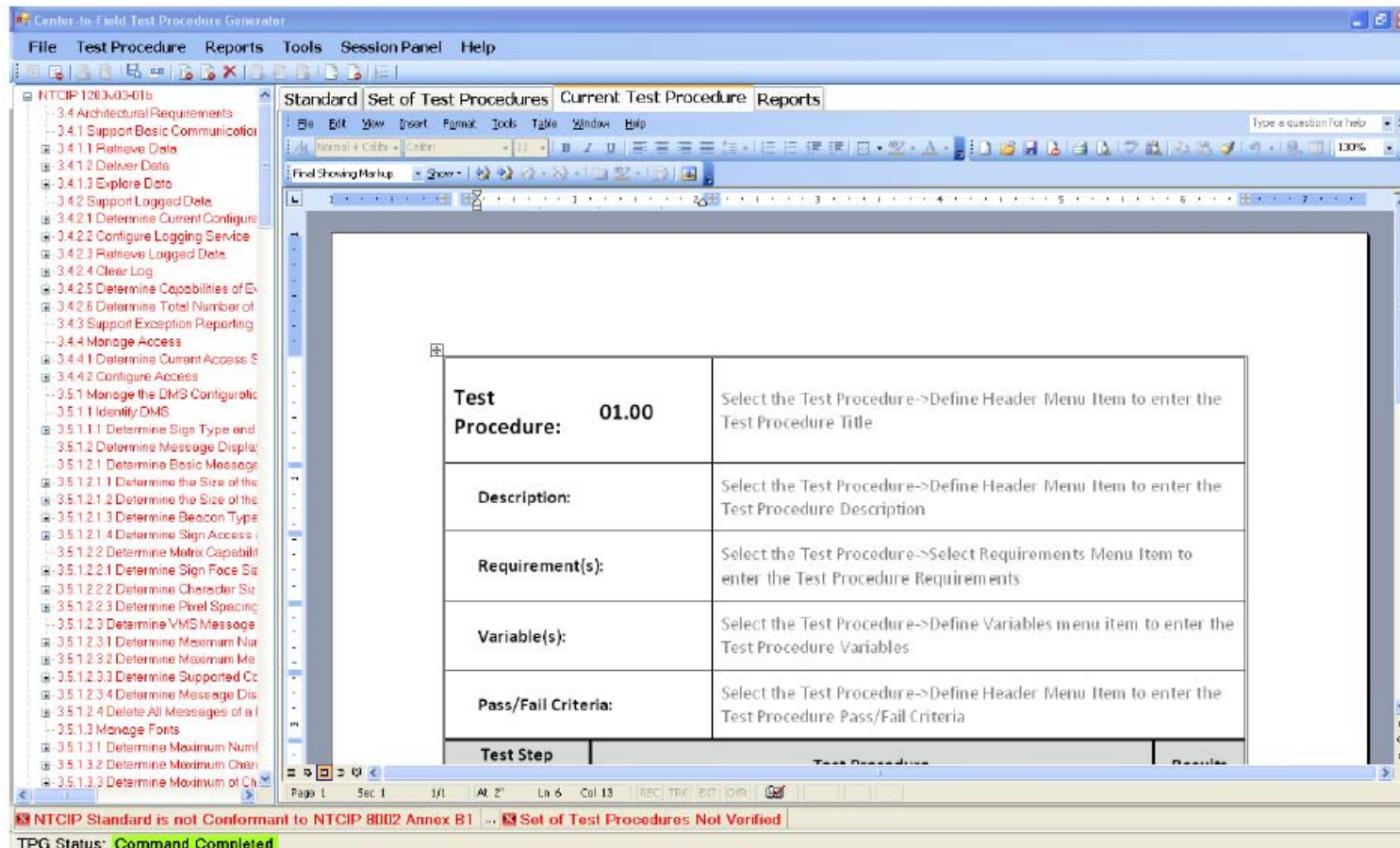
How to Use TPG (cont.)

Create a New set of Test Procedures



How to Use TPG (cont.)

Test Procedure 01.00



How to Use TPG (cont.)

Define the Test Procedure Header

Test Procedure:	01.00	Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Title
Description:		Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Description
Requirement(s):		Select the Test Procedure->Select Requirements Menu Item to enter the Test Procedure Requirements
Variable(s):		Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables
Pass/Fail Criteria:		Select the Test Procedure->Define Header Menu Item to enter the Test Procedure Pass/Fail Criteria

How to Use TPG (cont.)

Test Procedure Header Window Defined

Test Procedure:	01.00	Determine Sign Type and Technology
Description:	This test case verifies that the DMS indicates that it is the sign type and uses the technology as required by the specification.	
Requirement(s):	Select the Test Procedure->Select Requirements Menu Item to enter the Test Procedure Requirements	
Variable(s):	Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables	
Pass/Fail Criteria:	The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case.	
Test Step Number	Test Procedure	Results
Test Procedure Results		
Tested By:	Date Tested:	Pass/Fail

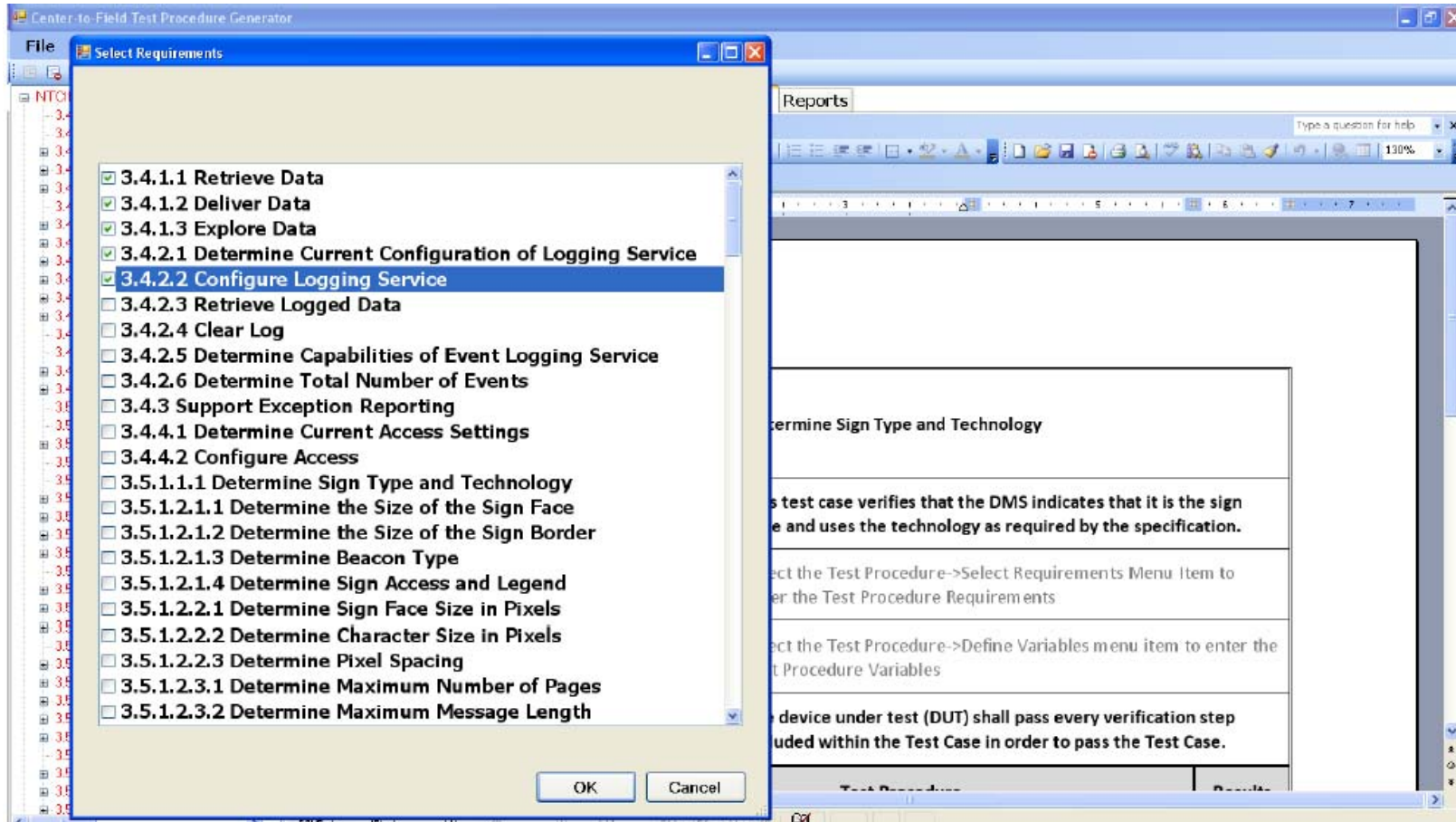
How to Use TPG (cont.)

Select a Requirement

Test Procedure:	01.00	Determine Sign Type and Technology
Description:		This test case verifies that the DMS indicates that it is the sign type and uses the technology as required by the specification.
Requirement(s):		Select the Test Procedure->Select Requirements Menu Item to enter the Test Procedure Requirements
Variable(s):		Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables
Pass/Fail Criteria:		The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case.

How to Use TPG (cont.)

Select a Requirement From Window



How to Use TPG (cont.)

Requirements Populated

How to Use TPG (cont.)

Define Variables

The screenshot shows the 'Center-to-Field Test Procedure Generator' application. The 'Test Procedure' menu is open, and the 'Define Variables' option is selected. The main window displays a table with the following content:

Test Procedure:	01.00	Determine Sign Type and Technology
Description:		This test case verifies that the DMS indicates that it is the sign type and uses the technology as required by the specification.
Requirement(s):		3.4.1.1 Retrieve Data 3.4.1.2 Deliver Data 3.4.1.3 Explore Data 3.4.2.1 Determine Current Configuration of Logging Service 3.4.2.2 Configure Logging Service
Variable(s):		Select the Test Procedure->Define Variables menu item to enter the Test Procedure Variables
Pass/Fail Criteria:		The device under test (DUT) shall pass every verification step included within the Test Case in order to pass the Test Case

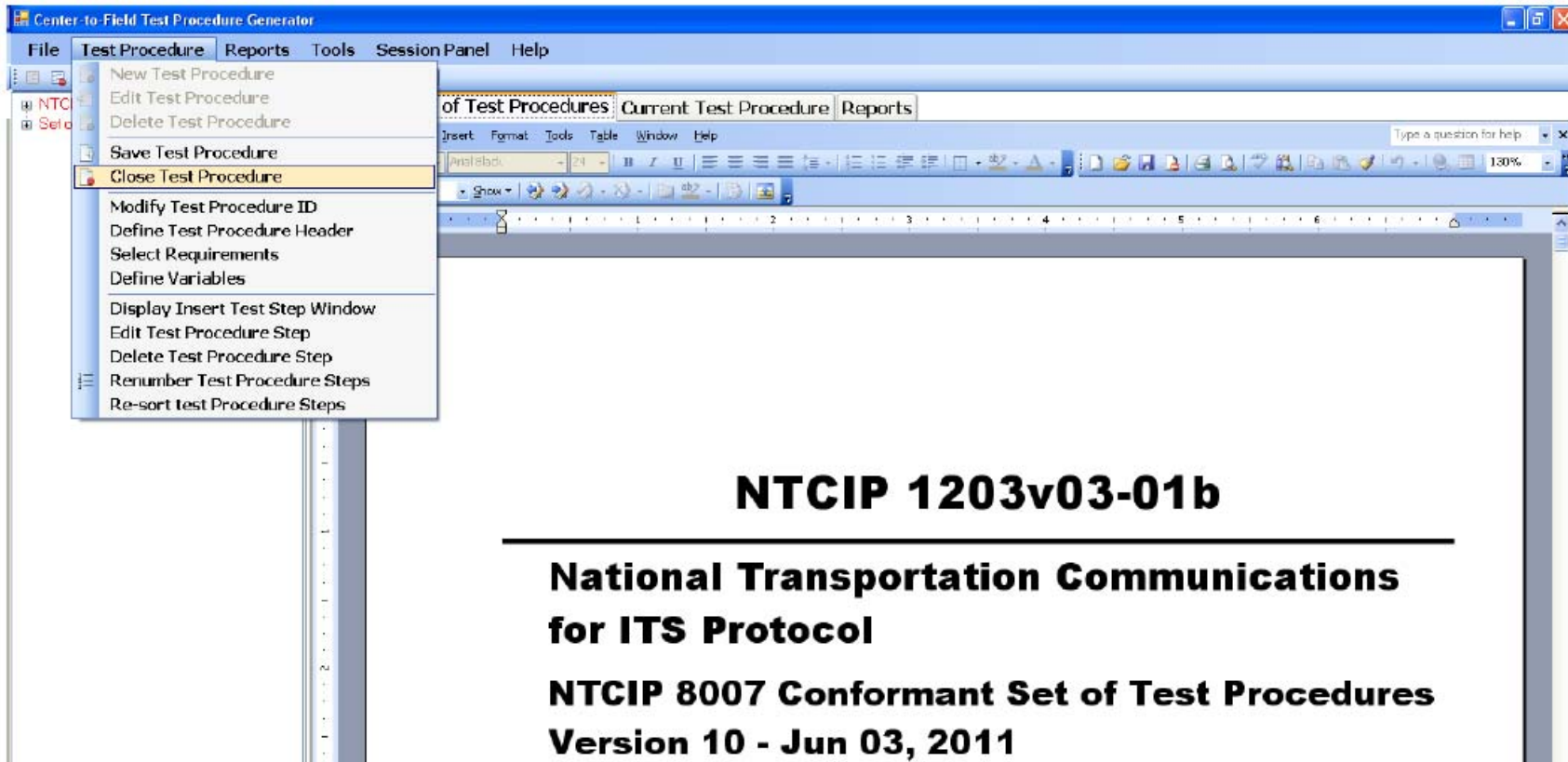
How to Use TPG (cont.)

Saving a Test Procedure

Test Step Number	Test Procedure	Results
01.00	GET the following object(s): » 1201 v02 A2.11 - 2.5.1.1 eventClassNumber.0 » 1201 v02 A2.11 - 2.5.1.2 eventClassLimit.0 » 1201 v02 A2.11 - 2.5.1.4 eventClassDescription.0 » 1201 v02 A2.11 - 2.5.1.3 eventClassClearTime.0 » 1201 v02 A2.11 - 2.5.4.1 eventConfigID.0 » 1201 v02 A2.11 - 2.5.4.2 eventConfigClass.0 » 1201 v02 A2.11 - 2.5.4.3 eventConfigMode.0 » 1201 v02 A2.11 - 2.5.4.4 eventConfigCompareValue.0 » 1201 v02 A2.11 - 2.5.4.5 eventConfigCompareValue2.0 » 1201 v02 A2.11 - 2.5.4.6 eventConfigCompareOID.0 » 1201 v02 A2.11 - 2.5.4.7 eventConfigLogOID.0 » 1201 v02 A2.11 - 2.5.4.8 eventConfigAction.0 » 1201 v02 A2.11 - 2.5.4.9 eventConfigStatus.0 [Pass/Fail]	Pass/Fail
02.00	GET the following object(s): » 1201 v02 A2.11 - 2.5.1.1 eventClassNumber.0 » 1201 v02 A2.11 - 2.5.1.4 eventClassDescription.0 » 1201 v02 A2.11 - 2.5.1.2 eventClassLimit.0 » 1201 v02 A2.11 - 2.5.1.3 eventClassClearTime.0 » 1201 v02 A2.11 - 2.5.4.1 eventConfigID.0	Pass/Fail

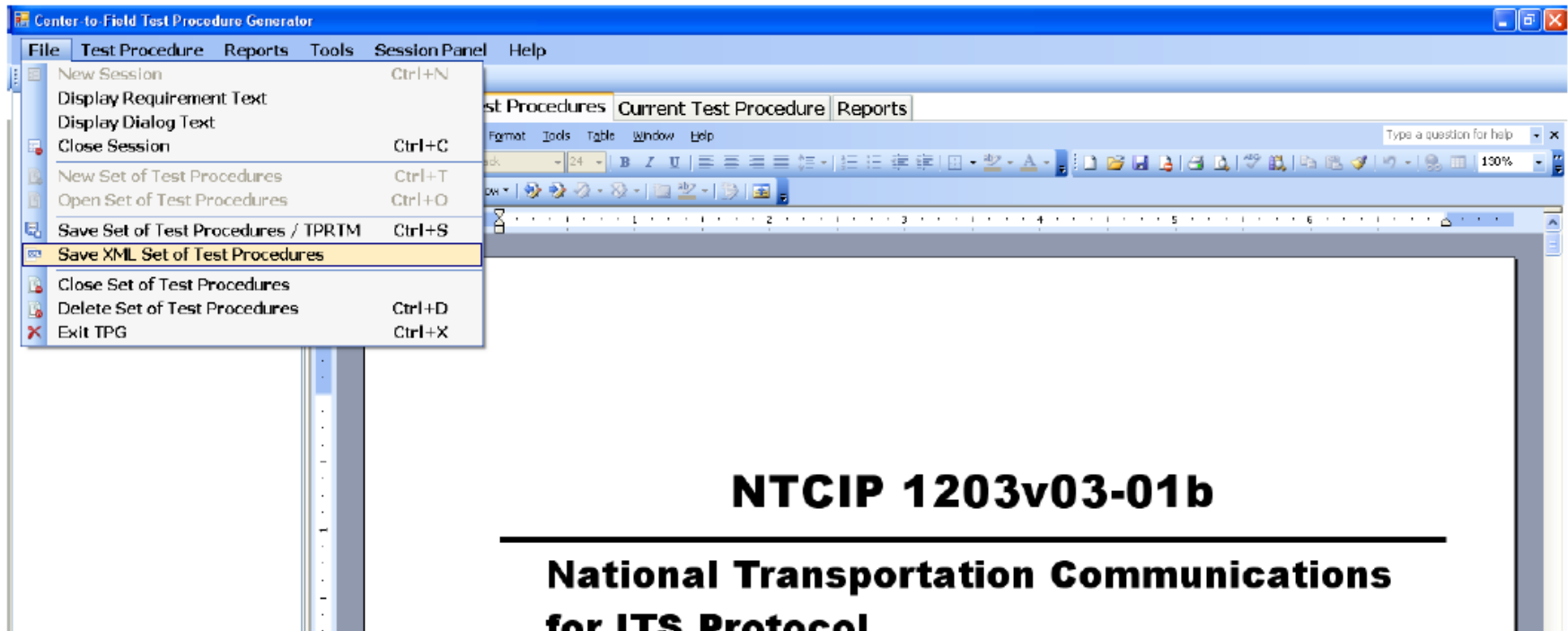
How to Use TPG (cont.)

Closing a Test Procedure



How to Use TPG (cont.)

Save XML Set of Test Procedures



How to Use TPG (cont.)

XML Representation

Center-to-Field Test Procedure Generator

File Test Procedure Reports Tools Session Panel Help

Standard Set of Test Procedures Current Test Procedure Reports

File Edit View Insert Format Tools Table Window Help

Normal+Left Times New Roman 12 B I U

Final Showing Markup Show

NTCIP 1203v03-01b
Set of Test Procedures

NTCIP C2F Device Interface Standard
XML Encoded Set of Test Procedures
Standard: 1203v03-01b.doc

```

<Set_of_Test_Procedures>
  <TPG_Version>0.3.4.0</TPG_Version>
  <Standard_ID>1203</Standard_ID>
  <Standard_Major_ID>03</Standard_Major_ID>
  <Standard_Minor_ID>01</Standard_Minor_ID>
  <Standard_Major_Revision>1</Standard_Major_Revision>
  <Test_Procedure>
    <ID>11.02</ID>
    <Title>This is the Internal AT test No. 1 Note that the instructions did not ask to have any misspelled words. However, the tester inserted a few in this section to see if the TPG will check for these since step 2.2 says the TPG will check for misspelled words. Tester also checked for lines
  
```

How to Use TPG (cont.)

Other TPG Functionality

- Delete a test procedure step
- Resort test procedure steps
- Renumber test procedure steps
- Modify test procedure identification
- Edit a test procedure
- Print a test procedure

Understanding Pre and Postcondition and Different Types of Steps

- Preconditions and Postconditions:
 - Constructed of key words
 - Key words are consistent with the common understanding of the ITS standards
 - Key words entered are validated, creating consistent test procedures that are interoperable among manufacturers

ACTIVITY



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Which statement is TRUE? The TPG...

Answer Choices

- a) Takes test cases directly as inputs
- b) Guides test procedures having MIBs, Dialogs, and RTM
- c) Creates outputs in commonly understood XLS files
- d) Executes test procedures automatically

Review of Answers



a) Takes test cases directly as inputs

Incorrect. The TPG does not read in test cases. It pulls information from various sections of the standard and reads non-TPG created test procedures.



b) Guides test procedures having MIBs, Dialogs and RTM

Correct! The TPG is used to develop test procedure with uniform key words, dialogs and requirements traceability matrix to eliminate manual entry errors and to enable test procedures to be reused.



c) Creates outputs in commonly-understood XLS files

Incorrect. The TPG creates outputs in commonly-understood XML scripts.



d) Executes test procedures automatically

Incorrect. The TPG does not execute test procedures. TPG XML scripts can be used as inputs to automated test equipment.

Summary of Learning Objective #5

How to Use Tools to Develop the Test Procedures for a Sample TSP Structure

- Introduced Test Procedure Generator (TPG) Tool and showed how to use it to produce test procedures
- Discussed pre and postconditions, and different types of steps

What We Have Learned in Part 1

- 1) Test Procedure Specification (TSP) inputs are test cases used to create outputs of expected results and anomaly reports of unexpected results in IEEE 829 standard format.
- 2) A test design specification details what a test is to demonstrate, a test case specification is a specific example that assigns values, while a test procedure defines the steps to perform the test.
- 3) Contract Terms and Conditions should be viewed from the project's end including test case specifications and test procedures.
- 4) A master test report measures project success to stated goals.
- 5) Test Procedure Generator (TPG) is an automated tool that generates XML scripts using consistent key words for interoperability.

Resources

- IEEE 829: IEEE Standard for Software and System Test Documentation
<http://standards.ieee.org/findstds/standard/829-2008.html>
- NTCIP 1204 v03 ESS, www.ntcip.org
- PCB Website: Module T201, T202 Available
http://www.pcb.its.dot.gov/stds_training.aspx
- Systems Engineering for Intelligent Transportation Systems, USDOT, January 2007
<http://ops.fhwa.dot.gov/publications/seitsguide/seguide.pdf>
- Center to Field Test Procedure Generator User Manual, v1.7, Federal Highway Administration, October 18, 2012

Next Course Module

Module T204 Part 2 of 2:

How to Develop Test Procedures for ITS Standards-based Test Plan

Part 2 of 2

(We will cover Learning Objectives 6, 7, and 8)

Next Course Module

Homework between T204 Part 1 and T204 Part 2

- Request a copy of the Test Procedure Generator at the address:
 - blake.christie@noblis.org
- Register at the same link to receive updates
- Download and install the TPG on a computer
- Create a simple Test Procedure to become familiar with the TPG before we begin T204 Part 2
- Have the TPG up and running when we begin Part 2

QUESTIONS?



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