

Chapter 11: Test and Evaluation Safety

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11.0 TEST AND EVALUATION SAFETY

11.1 Introduction

Verification testing will be required at some point in the life cycle of a system and the component(s) of a system. Tests may be conducted at many hierarchical levels and involve materials, hardware, software, interfaces, processes, and procedures or combinations of these. These tests determine whether requirements have been met by the design, compatibility of personnel with equipment and operating conditions, and adequacy of design and procedures. There are two broad types of testing which may be of benefit to safety, which are discussed below.

11.2 Tests Conducted Specifically For Safety

Testing can be conducted to determine the existence of hazards, effectiveness of hazard mitigation, or whether the hazard analysis is correct. This includes safe levels of stress in mechanical systems or components, severity of damage resulting from an uncontrolled hazard, or suitability and/or effectiveness of safety equipment. Examples include testing such materials as plastics, lubricants, or solvents for flammability; testing of fire extinguisher materials for effectiveness; testing the effectiveness of personnel protective equipment; testing the radiation characteristics of RF emitters.

11.3 Tests Conducted For Purposes Other Than Safety

Testing is normally conducted to verify performance, i.e. verify that the system meets design requirements. The data from these tests can also be used for safety purposes. Examples include, determination of part failure rates which can be used to predict the probability of failure; testing the strength or compatibility of new materials which can be used to identify possible hazards; determination of interface problems between integrated assemblies which can also define hazards; and quality control tests performed by vendors of subcontractors. Tests performed for purposes other than safety can generate data useful to the safety process only if the proper data is collected and documented. It is the job of safety engineering to clearly define the safety program objectives so that test planners will be aware of the data which will be useful to safety.

11.4 Test Safety Analysis

It is also important to consider the safety of the test itself. Safety engineers need to work closely with test planners to ensure that the proper precautions are observed during the testing to prevent personnel injury or equipment damage. Each proposed test needs to be analyzed by safety personnel to identify hazards inherent in the test and to ensure that hazard control measures are incorporated into test procedures. It is during the process of test safety analysis that safety personnel have an opportunity to identify other data that may be useful to safety and can be produced by the test with little or no additional cost or schedule impact.

11.4.1 Test And Evaluation Safety Tasks

A comprehensive test and evaluation safety program will involve the following activities:

- Coordinate with test planning to determine testing milestones in order to ensure that safety activities are completed in time to support testing.
- Schedule safety analysis, evaluation and approval of test plans and other documents to ensure that safety is covered during all testing.
- Prepare safety inputs to operating and test procedures.
- Analyze test equipment, installation of test equipment and instrumentation prior to the start of testing.
- Identify any hazards unique to the test environment.
- Identify hazard control measures for hazards of testing.
- Identify test data that will be of use to safety.
- Review test documentation to ensure incorporation of safety requirements, warnings, and cautions.
- Review test results to determine if safety goals have been met or if any new hazards have been introduced by the test conditions.
- Collect data on the effectiveness of operating procedures and any safety components or controls of the system.
- Compile safety-related test data.
- Make a determination about the safety of the system. Determine if the safety features have been controlled as expected and if identified hazards have been controlled to an acceptable level of risk.
- Evaluate compatibility with existing or planned systems or equipment.
- Identify deficiencies and needs for modifications.
- Evaluate lessons-learned from previous tests of new or modified systems or tests of comparable systems to identify possible hazards or restrictions on test conditions.
- Document and track all identified hazards to ensure resolution.

11.4.2 Test And Evaluation Safety Results

A comprehensive test and evaluation safety program will produce the following products:

- Hazard analysis reports.
- Test safety analysis reports.
- Hazard tracking and risk resolution system.
- Safety analysis schedules.
- List of identified hazards.
- List of hazard control measures.
- List of required safety data.
- List of warnings and cautions.
- Reports of procedure and test plan reviews.
- Safety inputs to test planning reviews.
- Safety inputs to training materials.
- Safety inputs to operations manuals.

11.5 Other Test And Evaluation Safety Considerations

11.5.1 A system whose safe operation depends upon trained personnel should not be tested without appropriately trained personnel.

The test personnel should undergo a training program consistent with the anticipated operator training program. Testing a system in the operational environment using design engineering personnel provides limited validation data. A successful OT&E program includes training in normal operation, support, and emergency procedures. Most systems have some residual risk (i.e., high voltages, RF energy, hot surfaces, and toxic materials) that must be reflected in the training program. Personnel must receive training in how to handle the residual hazards. Also, emergency procedures are developed to minimize the impact of system failures. Personnel must be trained in these procedures. Safety must review all operations and emergency procedures to ensure the adequacy of the procedures and training.

11.5.2 Adequate documentation is required for correct operation and support of a system.

Personnel must rely on manuals to supplement their training. These manuals must be accurate and include comprehensive information on safe operation and support of the system. Manuals must be reviewed prior to the start of the test to ensure that safety portions are complete and provide adequate instructions, cautions, and warnings to protect personnel and equipment.