M&S for LFT&E - Examples

Example 1 – M&S for Ship LFT&E

3.5.2. Modeling & Simulation

3.5.2.1 M&S for Test Planning and Prediction. For the tests of surrogate ships, the Internal Blast (INBLAST) model and the Blast Damage Assessment Model (BDAM) will be used for pretest predictions of blast pressure loading and ship structural response to the loading, and SVM will be used for fragment penetration predictions. The Consolidated Model of Fire Growth and Smoke Transport (CFAST) will be used for fire growth curve development in the post-shot analyses for the CG 19 testing, and for the pretest fire spread predictions and post-test data analyses for the ex-*Maui* test. The Advanced Survivability Assessment Program (ASAP) will be used for primary damage pretest predictions and post-test analyses for the DD 930 test. ASAP, BDAM, CFAST, and the Fire and Smoke Simulator (FSSIM) will used for the ex-*Larson* Autonomic Fire Suppression System (AFSS) Weapons Effects Test (WET).

3.5.2.2 Reliance on M&S for Evaluation. M&S is a primary method of executing the alternative LFT&E program. The Shock Trial, TSST, component shock testing, surrogate testing, combat incidents, and peacetime accidents supplement the M&S and serve in part to validate the modeling that is performed. Realistic tests of surrogates will address the most significant areas of uncertainty, e.g., fire spread and the ability to extrapolate shock trial results to realistic encounter conditions for proximity underwater bursts. One of the primary objectives of both the Advanced Threat Weapons Effects tests is to obtain data that could be used to improve or validate damage algorithms used in ship vulnerability models.

Susceptibility analyses will be performed to determine likely hit points for the threats to be assessed in the Final Vulnerability Assessment Report. The M&S tools that will be used to generate hit points included CRUISE_MISSILES, Total Mine Simulation System (TMSS), and the Technology Requirements Model (TRM).

A full ship DYSMAS finite element model is being used to predict the structural damage and equipment shock environments with greater fidelity. Deactivation diagrams for the prediction of secondary damage will replace the Integrated Recovery Module (IRM). Since deactivation diagrams do not enable the generation of recoverability time lines, recoverability will be addressed through other means.

The program office VV&A process relies heavily on data from legacy models, and will use test data to assist in the validation of new model functionality. ASAP was accredited with limitations for the Initial Vulnerability Assessment Report. The Program Manager is funding a project to improve the fidelity blast projections in the ASAP model.

Example 2 – M&S for Aircraft LFT&E

3.5.2. Modeling & Simulation

3.5.2.1 M&S for Test Planning and Prediction. Susceptibility and vulnerability issues will be examined with modeling and simulation. M&S will be used to scope the ballistic series of

tests and the specific tests within each series. Pre-test predictions are being made for all tests, with the intent of using test results to identify M&S improvements.

A Modular UNIX-based Vulnerability Estimation Suite (MUVES-S2) vulnerability assessment model will be employed to support the overall aircraft vulnerability assessment. It will be used to select shotlines for testing and to generate pre-shot predictions.

3.5.2.2 Reliance on M&S for Evaluation. System-level survivability will be assessed using the aircraft signatures and known threat weapon system accuracies to evaluate the susceptibility and the vulnerability analysis results. Aircraft signatures will be measured in flight testing and used in models to predict countermeasure effectiveness. Infrared signatures will be used in Hardware-in-the-Loop (HITL) simulations to determine realistic impact locations on the aircraft for man-portable air defense system (MANPADS) threats and to evaluate the ability of aircraft survivability equipment to detect and counter MANPADS threats. The vulnerability analysis will use a 26-view average to determine vulnerable area and probability of kill given a hit for fragments and non-bursting projectiles.

A hierarchy of M&S will be used to analyze aircraft survivability and effectiveness. Engineering-level analyses will be used to assess vulnerability aspects such as structural response to hydrodynamic ram, fire and explosion, and vulnerable area. Higher level M&S will be used to assess one-on-one encounters, mission effectiveness, and force effectiveness. The models include:

- FPM – Fire Prediction Model
- ARAM – Advanced Ram Model
- FASTGEN – target description and Fast Shotline Generator model
- COVART – Computation of Vulnerable Area Tool model
- SHAZAM – missile warhead endgame model
- ESAMS – Enhanced Surface-to-Air Missile Simulation
- Brawler – air-to-air combat model
- JIMM – Joint Interim Mission Model
- Thunder – Force effectiveness model.

Since model improvements are always being made, model versions are not listed.