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OPERATIONAL REQUIREMENTS DOCUMENT

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NATIONAL AIR AND SPACE (WARFARE) MODEL (NASM)

ACAT LEVEL III/IV

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**National Air and Space (Warfare) Model (NASM)
Operational Requirements Document (ORD)**

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National Air and Space (Warfare) Model (NASM) Operational Requirements Document (ORD)

1. General Description of Operational Capability

This Operational Requirement supports the mission need identified in Air Force Mission Need Statement USAF 009-93. The Mission Needs Statement for the Air Force National Air and Space (Warfare) Model (NASM) analyzed deficiencies associated with the current Air Force Air Warfare Simulation (AWSIM) used for battlestaff training and determined that a new system was required to correct these deficiencies and to interface with the next generation of Department of Defense models being developed as a part of the Joint Simulation System (JSIMS). NASM will be designed to overcome the current limitations in AWSIM and provide a modern foundation upon which to base the further evolution of training exercises in the foreseeable future.

NASM will provide an operationally realistic simulated mission space with force and behavioral representations for aerospace roles and missions across the range of military operations. The NASM domain will include the full spectrum of AFM 1-1 mission areas: Counterair and Counterspace, Strategic Attack, Interdiction, Close Air Support, Airlift, Air Refueling, Spacelift, Electronic Combat, Surveillance and Reconnaissance, Special Operations, Base Operability and Defense, Logistics, Combat Support, On-Orbit Support, Intelligence, and Information Warfare. NASM will model underlying environmental factors and processes such as weather, terrain, infrastructure, navigation, and command and control. NASM will be flexible and extensible enough to address future operational needs and missions, and to incorporate additional aerospace functions for support of other services' needs within the JSIMS confederation of models.

The NASM synthetic training environment will be used as an exercise driver for Air Force, joint, and combined training audiences at all echelons from the theater commander down to wing level, to include staff training activities and educational wargames. NASM will also function as a decision support tool to assist in the formulation, assessment, and evaluation of operational plans, development and evaluation of doctrine and tactics, and Operational Test and Evaluation (OT&E).

NASM will interface with real world Command, Control, Communications, Computers, and Intelligence (C⁴I) systems to provide realistic training in the places these operations would normally be conducted. NASM will be interoperable (through included external support modules) with C4I systems such as the Global Command and Control System (GCCS)/Global Combat Support System (GCSS), Contingency Theater Automated Planning System (CTAPS), Combat Intelligence System (CIS), and other systems (theater and national) that support theater operations.

NASM will be a distributed simulation system with the capability to interact with geographically separated training audiences, external live simulations, virtual simulators, and other constructive models. It will use portable, interoperable, and reusable modular components within a flexible common framework supporting multiple levels of resolution, using centralized deconfliction. The scope of NASM training will include capabilities for distributed collaborative planning and scenario development (pre-exercise), simulation execution (exercise), and analysis of results (exercise and post-exercise).

NASM will be developed, deployed, operated, and maintained in a cost-effective and efficient manner. To provide a more maintainable system with a longer life-cycle, NASM will be developed using modern computer technologies, software engineering, and programming techniques, with open system interfaces. Where practical NASM will use off-the-shelf hardware, software, validated algorithms, and existing databases.

Development of NASM will occur concurrently with development of the Joint Simulation System (JSIMS), which includes development of a JSIMS core structure and a new family of training models by Joint agencies and the other Services. The Air Force is the executive agent for development of the aerospace model within JSIMS, and NASM satisfies this requirement. Compliance with JSIMS standards and High Level Architecture (HLA) protocols will significantly improve the prospects for interoperability and serve to eliminate duplication of effort.

Attachment 1 contains the Requirements Correlation Matrix (RCM), Parts I and II.

2. Threat

The USAF recognizes the exponential increase in information technologies and the resulting vulnerabilities for all C4I systems. Adversary techniques that corrupt, deny, exploit or destroy information through a variety of means must be considered. Although this system (NASM) is intended to be a training aid, its connectivity to wartime systems such as CTAPS/CIS and other intelligence systems (theater and national) could make NASM a potential target for information attack.

Threats to this initiative include physical threats (i.e. sabotage, espionage, etc.), information collection threats (internal and external), data denial or manipulation threats (introduction of malicious codes or viruses), and reactive threats (identification of system capabilities or dependence could increase the possibilities of countermeasures). Connectivity to telecommunications networks in multiple distributed locations and the incorporation of commercial technologies also have inherent threat implications to this system. Additional information concerning the threat can be found in DST-2660F-210-94 "Command, Control, Communications, Computers and Intelligence (C4I) Systems and Networks, Telecommunications Networks, and Automated Information Systems (AIS) Threat Environment Description (TED)" (U) 15 Jan 94, and in the Draft Information Warfare to Automated Information System TED.

3. Shortcomings of Existing Systems

The Air Warfare Simulation (AWSIM) model was created and first used at the Warrior Preparation Center in the early 1980's and was an adaptation and expansion of a model originally developed for the Navy in the early 1970's. AWSIM has a number of functional, maintenance, and fidelity limitations. The scope of these limitations, coupled with significant advances that have evolved in software technologies and hardware capabilities, have brought the Air Force to a point where it is no longer practical or efficient to attempt the significant enhancements that are now required. In addition, the Air Force requirements for training, analysis, and OT&E have grown significantly in scope and complexity.

a. Model Representations

- (1) AWSIM does not allow for more than two sides to play in a scenario. The models are not flexible enough to allow for neutrals to become combatants nor allies to switch sides in scenarios.

- (2) AWSIM does not adequately model logistics, to include air/ground mobility and re-supply, maintenance, personnel, and non-weapon consumption rates.
- (3) AWSIM does not adequately model visual, radar, or infra-red (IR) detections, to include terrain, atmospheric and electromagnetic environmental effects, and low-observability concepts.
- (4) AWSIM does not adequately model air-to-air engagements, including visual range combat, modern weapons and cockpit factors, low altitude operations, and flight dynamics.
- (5) AWSIM does not adequately model air-to-ground engagements, to include delivery platform capabilities, targeting and weaponeering, weapons effects, ground threat effects, terrain and weather factors, and damage assessment.
- (6) AWSIM does not adequately model surface-to-air engagements, to include salvo rate, launcher capacity, reload time, site configuration and mobility factors, missile time of flight, guidance modes, terrain, electronic combat effects, or command and control factors.
- (7) AWSIM does not model space-based systems, to include launch vehicles, on-orbit support, platforms, sensors, and communications..
- (8) AWSIM does not model fratricide and does not adequately address track identification problems.
- (9) AWSIM has no capability to represent Information Warfare (IW). AWSIM does not adequately model friendly or enemy C4I, which is the digital battlefield for Information Warfare.
- (10) AWSIM depends on external models to show effects of electronic combat, intelligence collection/reporting, and space-based warning systems
- (11) AWSIM has no provisions for considering social, economic, or political factors across the full range of military operations.

b. Simulation System Support

- (1) The scenario generation capability does not provide for validation of scenarios, and does not allow for an audit trail capability for tracking changes made to the scenario.
- (2) Exercise preparation is resource intensive and requires extensive manpower for supporting both stand-alone Air Force missions and missions that require interaction with other confederation models.

(3) AWSIM was not developed with the capability to interface with or represent real-world C⁴I systems. To date, only limited work-arounds have been successfully developed and those are difficult to maintain.

(4) The system lacks capabilities to provide error handling and error recording for the purpose of determining the cause of problems. This deficiency occurs during both exercise execution and system maintenance.

4. Capabilities Required

The primary objective of NASM is to provide a synthetic training environment in which battlestaffs (from the theater commander level down to wing level) can practice decision-making, and see the results of those decisions played out convincingly through simulation. The measures of NASM effectiveness relate to the quantity and quality of those decision-making opportunities, and the accuracy of modeled events in comparison to real-world expectations.

a. System Performance

NASM will consist of: (1) a hardware and software environment in which to host the simulation (model execution, interfaces to other models, player input/output, controller functions); (2) simulated mission space that represents the real-world environment in which air and space missions occur (terrain, weather); (3) model representations of physical entities (bases, aircraft, spacecraft, weapons, sensors, targets); (4) behavioral models that govern the interaction between the entities (navigation, detection, communications, combat engagements, damage assessment, logistics); and (5) support modules (scenario and database preparation, aggregation of results and de-aggregation of orders, translators for interfacing results to real world C⁴I systems, familiarization training).

(1) Simulation Environment: The following capabilities and specifications are needed to "set the stage" for the NASM synthetic training environment:

(a) Core Structure (Common Framework): The NASM core structure must comply with the overall JSIMS architecture, to ensure interoperability with the other Joint and Service models and simulations. The NASM core structure must also support operations in a stand-alone mode (without interfaces to other models) when other services/models are not participating in a training event.

(b) Interfaces: NASM will be compliant with the DOD High Level Architecture (HLA), and must have the ability to interface (link) with live, virtual, and constructive simulations including those outside of the JSIMS confederation.

(c) Data Deconfliction: To support distributed training over extended geographical distances, NASM must maintain consistent representations of the data for participants of the exercise at all sites. NASM must ensure unambiguous interchange of data among system modules and between the system and external sources such as other Service models and simulations, virtual simulations, and C⁴I systems. Model outcomes for each discrete event must be determined in a manner that ensures consistent results are reported to

the training audience at all levels of participation and at all locations. This may require centralized deconfliction in some configurations, especially where portions of the scenario are isolated and distributed to other models for resolution and the outcomes must then be returned within the constraints of time-synchronized interfaces.

(d) Multiple Force Sides: NASM must support multiple player "sides" including multiple services from multiple nations in multiple coalitions, neutral forces (which may convert to active participants), suspect or unknown forces, and opposing forces. The number of sides should be set by the scenario database, and not be constrained by software limits. Units and bases must be able to transfer sides during the exercise (for example, if a base is overrun or forces are politically realigned).

(e) Transparency: NASM will provide trainees the ability to train in their respective command and control centers. NASM will support a distributed system so that trainees can be at the same locations from which they will fight a war or execute a mission. In addition, the trainees must be able to use the same C⁴I systems that they would normally use, gather information via wartime channels, and issue the same commands and tasking as in wartime. NASM must not require trainees to use artificial means to input or receive data, nor can the system provide or require means of communication that would not ordinarily be available. At the same time, NASM must not adversely impact any real-world C4I systems.

(f) Levels of Resolution/Aggregation: NASM must be able to generate data for each training audience consistent with the volume, format, level of detail, and quality received during real-world operations. NASM will be able to portray variable levels of fidelity, dictated by the scenario and training audience being supported. Resolution will increase as requirements for training lower echelon units are incorporated. For example if lower-echelon logistics play is an exercise objective the model needs to represent logistics flows and constraints in detail, but if not an objective the exercise controllers should be able to selectively turn off logistics constraints and/or detailed reports. For higher level activities (where only senior staffs are involved, or in educational seminar-level settings) the system will provide aggregated data as required to present results to the players in a realistic format, and de-aggregate higher-level decisions into mission orders appropriate for entity-level execution in NASM. (See "Support Modules".)

(g) Warfighter-In-The-loop (WITL) Capability: The primary NASM training audience is intended to be battlestaffs at and above the level that produce an Air Tasking Order (ATO) to be executed in the model. Below this level tasks will be simulated in the model itself, or via support modules (to handle such tasks as mission planning to translate the ATO into individual flight orders). However NASM will allow for the WITL at lower levels within the simulation (such as mission planning cells at the wing level or air defense battle management cells), and the ability to isolate entities in the model and "drill down" or link to detailed external simulations (such as virtual simulator

missions to resolve small scale engagements). NASM will provide for WITL Semi-Automated Forces (SAFORs) and fully automated Computer Generated Forces (CGFs) to represent friendly, neutral, and opposing forces at all applicable levels. NASM will provide the ability to combine and switch between WITL and SAFORs/CGFs.

(h) Simulation Time: NASM will have the ability to run at rates ranging from slower than real time, to real time, to faster than real time. NASM will be able to jump time backward for replay or restart of a simulation. NASM will also be able to jump time further into a scenario. Time compression factors (run rates) should be selectable within a range from 1/10th to 1000 times real-time. NASM must be able run faster than real time (at least 2:1) while supporting a multiple Major Regional Contingency (MRC) scenario with maximum levels of resolution and full participation of training audiences down to the wing level. With semi-automated forces (SAFOR), NASM must be able to run a multi-MRC scenario at a speed of 10:1, and with fully automated Computer-Generated Forces (CGF) and only high-level inputs at a speed of 100:1 (12 days in about 3 hours). The maximum speed of 1000:1 is envisioned for analytical purposes where high speeds will allow focusing on a narrow area of interest (such as multiple runs of a single mission package), or for educational uses where maximum detail is not required. In addition to the time ratio, the time-step interval must also be variable. To keep the time-step interval inside decision cycles for short-response actions such as missile launch decisions under high rates of closure, a nominal time-step of 6 seconds (for high-resolution theater-size scenarios) must be achieved, but settings between 1 and 60 seconds should be available. A nominal time-step of 3 seconds is desired as a long-range goal for large high-resolution scenarios. When the time-step interval is varied, there must be no measurable change in event outcomes (such as survivability, threat lethality, firing opportunities, and consumption rates). Update rates for information displays should be controlled separately from the time-step interval

(i) Player Input/Output: Where real-world C4I systems are not used as the primary tools for player interaction with the model (for example in stand-alone sessions and academic seminar settings), NASM must provide a simple "organic" computer interface. As a minimum, this would include a visual display of the perceived air picture, access to status boards in table or database form, and the ability to input mission orders. Combining these functions under a single easy-to-learn graphic user interface with intuitive menus and context-sensitive help is essential. Maximum training time for these NASM-specific interfaces should be less than 2 hours for player familiarity, less than 6 hours for player proficiency, and less than 12 hours for controller proficiency. Additionally NASM must incorporate thorough error-checking for syntax and context in player inputs, with the capability to challenge illogical commands and "catch" mistakes that would not happen in real-world situations (such as launching aircraft without weapons loads, or crashing while attempting to fly without fuel).

(j) Model Technical Control: Technical control functions are required to ensure the simulation operates within design parameters. The number of

technical controllers may vary depending on the exercise and training activity complexity, but simulation operation should not exceed 5 technical controllers per exercise node during execution. As the model matures and further efficiencies are realized, the goal is to operate with no more than 3 technical controllers per exercise node. Technical controllers must be able to start, freeze, stop, or restart the model, save all or selected portions of data, vary game speed, override event outcomes, and manage system configuration.

(k) Wargame Controller Privileges: The wargame controllers will operate in exercise control and response cells to serve as a buffer between exercise participants (trainees) and the simulation, to ensure that the exercise meets training objectives. At the exercise director level, controllers will have access to unfiltered "ground truth" data, and will have the ability to start or freeze the model, save data, vary game speed, and override event outcomes. Controllers must also have the ability to modify target lists, inventory levels, object characteristics, and order-of-battle databases while the model is running. Varying levels of controller privileges should be established, as appropriate for each location. At the response cell level controllers may be limited to "perceived truth" data, and will supervise semi-automated force (SAFOR) control, role-play as wing level operations centers or air defense cells, and interpret trainee responses and commands for input to the simulation. They will provide feedback to exercise participants via established exercise communications links.

(l) Player Privileges: The NASM players (training audience and/or response cells) need to be able to inject a new order or modify existing orders for their assigned forces commensurate with the training concepts, practices, and exercise objectives. The players will only see and control what the technical controllers have defined for each location. There will be a direct relationship between what the player can see and what the player can control. For example, players will not have knowledge of situations beyond their scenario-driven ability to collect or access data, and will not be able to give orders to forces under someone else's control.

(2) Mission-Space Environment: The "playing field" of the NASM simulation includes the natural and man-made environment, which influences interactions between modeled entities.

(a) Coordinate Systems: The locations of NASM objects should be defined by accepted spherical coordinate system conventions (latitude, longitude, altitude). For purposes of order inputs and visual displays, other common coordinate systems (such as UTM grid) should be accepted and translated automatically. Although exercise scenarios may focus on a single theater of operations, NASM must be able to track objects in any location worldwide (including space).

(b) Terrain: NASM will use Defense Mapping Agency (DMA) data to maintain a representation of natural and man-made terrain features. Due to the volume of terrain data that could potentially be involved in a large-scale

exercise, terrain resolution should be tailored to the area and scope of the scenario. For example in a European scenario it would be necessary to accurately model terrain in the areas where outcomes of detections and combat engagements are critical, yet it would be unnecessary for rear areas such as the continental United States (CONUS) where the only activity might be launch and recovery of airlift aircraft or spacecraft under benign conditions. As a minimum, NASM terrain data should include elevation, type of terrain (water, woods, desert, urban, mountainous, etc.), and man-made features such as political boundaries. Where DMA data is not available, other approved terrain databases may be used. If a synthetic terrain layout is desired for a training scenario, NASM must be able to accept substitute artificial terrain data. As available terrain databases improve, NASM should be able to grow in capability to take advantage of greater fidelity and level of detail. Modeled terrain should be available for display at variable levels of resolution, from simple overhead views of geopolitical outlines in adjustable scale (threshold requirement), to "birds-eye" or cockpit view of terrain and model entities from selectable angle, elevation, and range (when technically feasible).

(c) Weather: NASM must be able to represent weather and the effects of actual and forecast weather on all surface, air, and space operations. Weather conditions must be represented by linking to real-world data, replaying "snapshots" of historical data, or presenting credible artificial weather systems as an exercise driver. Atmospheric conditions such as rain, snow, wind, smoke, dust, haze, fog, winds, and clouds should be represented. NASM will differentiate between actual ("reported") and forecast ("predicted") weather states. While both the actual and forecast weather can affect operational planning, only actual scenario weather at the time of mission execution will be used to determine the outcome of modeled operations such as aircraft sortie generation/launch/recovery, reconnaissance and surveillance, aerial refueling, and target acquisition. Upper atmospheric conditions and electromagnetic effects (such as solar flares, which effect communications) will be included. NASM will provide actual and forecast weather in formats normally available through operational communications, sensing, and forecast systems, including satellites which provide imagery. The Air Force has been designated as executive agent for DOD modeling and simulation of the air and space natural environment; NASM representations of weather will be used by other models including those in the JSIMS confederation.

(3) Model Entity Representations: The "playing pieces" of the NASM simulation are physical entities (such as airbases, aircraft, spacecraft, missiles, weapons, sensors, and communications nodes) which will be represented as data objects with specific characteristics that determine their behavior and capabilities, and against which status can be reported throughout the exercise.

(a) Data Classes: NASM will model data classes for all types of airbases, launch sites, aircraft, spacecraft, missiles, munitions, sensors, and communication devices. Separate classes may be required to differentiate between objects with significantly different behavior. For example aircraft objects might need to be split into classes for helicopters, prop aircraft, and jets.

Missiles might be split into surface-to-air, tactical air-to-surface, air-launched cruise missiles, ground-launched cruise missiles, theater ballistic missiles, and intercontinental ballistic missiles. In a stand-alone mode additional classes to model ground and naval forces must also be described, to permit joint play. Object characteristics in each class should include sufficient detail to accurately model significant behavior and differentiate capabilities/vulnerabilities. For example aircraft characteristics might need to include parameters such as speeds (max, min, best cruise, preferred tactical low level), weapons/sensor/cargo compatibility, fuel capacity and load options, fuel consumption as a function of speed/load/altitude, radar cross-section as a function of aspect, and maintenance/support requirements.

(b) Aggregation and Inheritance: NASM will model higher-level objects (such as airbases) with characteristics of their own (such as location and operability status), characteristics and capabilities inherited from subordinate objects (such as runways, shelters, air defense sites, communications facilities, and maintenance facilities), and inventories of subordinate objects (aircraft, munitions, fuel, personnel). This object-oriented approach is necessary in order to comply with JSIMS architecture conventions.

(c) Growth: NASM must be capable of providing air and space data objects for other Service models within the JSIMS confederation, and will be able to incorporate data objects to model new and potential weapons systems when defined (such as directed energy weapons).

(4) Behavioral Models: The heart of the NASM training environment is the set of "rules" by which objects interact with the natural environment and with each other. To support the exercise of theater-level decision-making, NASM must credibly represent all AFM 1-1 missions plus air and space missions of the other services. For each of these missions to be successfully exercised in the synthetic battlespace, NASM must provide a credible representation of the target or vulnerable process, a means to attack or influence that target or process, and observable outcomes by which to judge the effectiveness of the action. The typical Air Force missions of air and space power include Counterair and Counterspace (offensive and defensive), Strategic Attack, Interdiction, Close Air Support, Airlift, Air Refueling, Spacelift, Electronic Combat, Surveillance and Reconnaissance, Special Operations, Base Operability and Defense, Logistics, Combat Support, On-Orbit Support, Intelligence, and Information Warfare.

(a) Movement and Navigation: The movement of aircraft, spacecraft, missiles, and surface traffic must conform to accepted laws of motion and constraints in weather, terrain, routing, trafficability, availability of navigation aids, and system performance (including speed, altitude, payload, fuel, and configuration). NASM speed, range, and payload calculations for aircraft and missiles must fall within 10 percent (preferably within 5 percent) of values calculated via detailed planning using current operational system-specific performance data for friendly systems, and best available data for threat systems (such as Defense Intelligence Agency [DIA] estimates or approved OSD/PA&E modeling and simulation [M&S] databases).

(b) Detection: Detection (including surveillance/reconnaissance) of objects within the simulation battle space must be dependent upon having a sensor in position, tasked to detect, and with the ability to detect a target given variables including sensor capabilities, range, weather, time of day, line-of-sight constraints, target observability factors (radar, visual, infra-red), and electromagnetic environmental effects such as jamming. Sensor objects may be placed on entities such as aircraft, missiles, munitions, missile sites, airbases, and ships. NASM detection determinations must fall within 10 percent (preferably within 5 percent) of values calculated by Air Force or OSD-accredited analytical/engineering-level models (such as the JMASS family of models), and validated by real-world results where available. Players in the training audience will only have access to information gained by sensors with the capability, tasking, and communications connectivity to report detections. At the most detailed levels, this includes limitations such as an imaging optical sensor on an air-to-surface missile being constrained by terrain, clouds, haze, or light levels. At higher levels, this includes limitations such as development of a cohesive air picture being constrained by connectivity to surveillance platforms such as AWACS and ground-based radars, and the rate at which down-linked data can be transmitted.

(c) Combat Identification and Rules of Engagement (ROE): NASM must include a capability to simulate results of combat identification using ground-based or aircraft systems to determine the status of detected tracks as friendly, enemy, or unknown. Aircraft should be modeled to include realistic use of Identification Friend or Foe (IFF) squawks. Additionally, NASM must include the ability to recognize ROE orders and translate them into behavior rules such as criteria for engagement by aircraft or ground-based weapons systems. A controllable degree of uncertainty in identification is appropriate, depending on the system used for identification (visual, radar, IFF, or other), and uncertainty scaling parameters should be set by the exercise controller. Misidentification should result in the potential for fratricide.

(d) Targeting: A critical part of battlestaff decision-making is the selection of targets for offensive counter-air, strategic attack, and interdiction missions. Targets are often designated using theater-specific database conventions which may specify a Desired Mean Point of Impact (DMPI) by target number, sometimes with additional level of detail. In most cases these targets will not have a one-to-one correlation with NASM objects, so NASM must incorporate a means to relate target numbers with target systems that are represented in the model. For example, attacking a DMPI that corresponds to fuel storage tanks centrally located between two nearby airbases may not result in immediate damage to either airbase, but should (over time) result in degradation of sortie generation capability if both bases were dependent upon that source of fuel and no alternatives are available. In a theater of operations where there are thousands of target numbers and the target database is under constant revision, this correlation between target number and NASM representation could potentially require a prohibitive investment in exercise preparation time unless some tasks can be automated via support modules. (See "Support Modules".) The desired capability is to allow battlestaffs to target by DMPI or target

number, and see results in the model consistent with real-world expectations. Similarly targets such as ground or naval forces, which will reside primarily in other JSIMS models, must be observable within NASM (even when operating in stand-alone mode).

(e) Damage Assessment: Regardless of whether targets are specified by DMPI using target numbers, or directly using NASM objects or subsets, or indirectly against objects in other linked models, the result of air-to-ground attack must be assessed and reported at two levels. At the lowest level, results should be expressed in terms of physical damage consistent with the capabilities of the delivery platform, type of delivery, type of weapon, terrain, weather, and target characteristics. These results should correlate within 10 percent (preferably within 5 percent) to Joint Munitions Effectiveness Manual (JMEM) data, with a realistic distribution of game results ranging from gross errors (no damage) to higher-than-expected damage. At higher levels, as stated above under "Targeting", the impact of damage on a specific point must be translated into measurable and observable results on a target system. For example, cutting a runway surface should translate into a change in maximum launch and recovery rates, dependent upon availability of alternative takeoff / landing surfaces and rapid runway repair capability. Similarly, an attack on maintenance facilities or fuel or munitions stockpiles should be reflected in a change of sortie generation capability, and an attack on aircraft shelters might result in destruction of sheltered aircraft and/or degradation in sortie generation. Battlestuffs will need to know both that a mission was successful ("runway cratered"), and that some impact was reflected in model operations ("airfield closed and estimate 8-12 hours to repair runways"). To credibly represent the effects of strategic attack, national infrastructure (transportation, communications, fuel, electricity, logistics, social services, national command authority) must be modeled for all scenario "sides" either as a part of NASM or in another JSIMS model that will always be available to NASM. These target system effects should take into account repair capability and adaptive behavior. The measure of performance for credible damage effects on complex target systems would probably depend on a user "calibration conference" and other analytical models, as part of the verification and validation process. Ultimately, target damage should be reported in the same detail that would be available using real-world systems such as overhead imagery, to include graphical computer-generated simulations of physical damage.

(f) Communications: NASM must model communications nodes, communication paths, communications equipment, and the data itself as items which can be targeted by the training audience (or adversary). Communications networks are the battlefield for Electronic Combat and Information Warfare, to include Counter Info, Command and Control (C2) Attack, and Information Operations. C2 links should influence the effectiveness of NASM entities that depend on orders or information. For example, surface-to-air missile (SAM) sites that are cut off from air defense warning nets and command nets by jamming or direct attack might be forced into autonomous modes of operations with potentially decreased effectiveness due to late warning, lack of identification, or sub-optimal target selection. As with other targeting

considerations described above, the ability to designate C4I targets and observe realistic effects is essential. Performance of modeled communications capabilities, and impacts of lethal and non-lethal attack on communications systems, must be within 10 percent (preferably within 5 percent) of expected values derived from actual operational data or detailed analytical models.

(g) Logistics: NASM should include sufficient logistics detail and enough logistics-related events to train Logistics Readiness Center (LRC) and Air Operations Center (AOC) personnel, adding logistics-based realism to the exercise. To train these battlestaff personnel, NASM must be logistically constrained and must generate logistics training challenges such as execution of Time-Phased Force and Deployment Data (TPFDD) schedules, deployment force beddown, prepositioned stock management, resupply, re-leveling in-theater resources, redirecting incoming resources, and resetting supply and transportation priorities. Resupply and evacuation should be modeled to include transportation routes and modes (air, waterborne, rail, road, pipeline, and sea). The functions and capabilities of critical transportation nodes should also be modeled, to include enroute stopover facilities and trans-shipment points, aerial and sea ports of embarkation and debarkation, road/rail/air terminals, and fuel holding/transfer facilities. Plus, it should realistically replicate logistical impacts resulting from attacks on these facilities. Properly modeling transportation nodes and routes will give more realism in monitoring and managing the flow of resources into and out of the theater. Critical CONUS repair and supply functions should also be modeled for further realism and to provide a basis for analyses of reparable parts flow and sustainment of critical consumables. Combat operations in NASM (and other JSIMS models) should generate casualties that can be tracked in NASM and used to drive requirements for patient evacuation.

(h) Airlift: NASM will model airlift-specific capabilities, to include specialized delivery profiles such as airdrop, combat offload, and engine-running offload. Airlift aircraft capacity will be constrained by factors such as max gross weight, cargo type, max cargo weight, max cargo size, pallet limits, and max passenger seating. Cargo throughput will be constrained by aircraft and crew availability/use rates, ramp space, material-handling equipment, fueling capability, load/offload times, and effects of airfield attacks (runway/taxiway closures, POL availability, decreased runway/taxiway length/width/load-bearing capacity, etc.). For example, the training audience should be constrained by availability and capacity of airlift aircraft, forcing realistic decision-making on resource allocation and scheduling.

(i) Air Refueling: NASM will model air refueling-specific capabilities, to include schedule control (routing, rendezvous times, and track/anchor locations), offload capacity, offload rates, and boom/drogue combinations. For example, the training audience should be constrained by availability of tanker aircraft to support deployments and force packaging, forcing resource allocation decisions in all phases of a scenario.

(j) Space Operations: NASM will model space operations functionality, to include Global Positioning System (GPS) platforms, communications platforms, missile warning, reconnaissance/surveillance and intelligence collection, environmental monitoring, on-orbit support, space system control, and message/information distribution. These should be subject to spacelift constraints such as availability of booster and platform, weather, and time-to-orbit. For example reconnaissance or surveillance by overhead platforms should depend on the assets being properly positioned, creating a decision-making opportunity for the training audience in managing spacelift and orbit positioning in order to support the collection requirement. NASM must be expandable to integrate new space systems such as the Space Based Infrared System (SBIRS) and the Global Broadcast Service (GBS) as those become operational.

(k) Special Operations: NASM will include the capability to represent Special Operations activities, to include direct action by air or surface on critical targets, insertion or extraction of personnel, strategic reconnaissance, unconventional warfare, combating terrorism, psychological operations, and foreign internal defense. The objective is to allow the training audience to task these missions, observe their execution, and see realistic results reported by the model. For example, insertion of a ground reconnaissance team should result in availability to collect information (sensors) that would not otherwise exist.

(l) OOTW: NASM will be capable of simulating conditions of OOTW, such as arms control, combating terrorism, counterdrug operations, enforcement of sanctions/maritime intercept operations, enforcing exclusion zones, ensuring freedom of navigation and overflight, humanitarian assistance, military support to civil authorities, nation assistance/support to counterinsurgency, noncombatant evacuation operations, peace operations, protection of shipping, recovery operations, show of force operations, strikes and raids, and support to insurgency. This will normally require the portrayal of non-aligned forces, non-combatant groups, and forces unidentified or changing alliances. The NASM representations of these combat and non-combat operations will focus on the specific missions employed in each such as airlift, air refueling, and surveillance/reconnaissance which can be tasked and directly observed by the training audience.

(m) Human Factors: Scaling factors must be included for each side at both the national and unit levels to reflect human factors which influence object behavior, to take into account variables such as level of training, morale, fatigue, national resolve, political influences, social and religious factors, and chemical or biological attack. These scaling factors should be under the control of the exercise director, but NASM should include a mechanism for directly influencing the scaling factors to represent the cumulative effects of a bombing campaign on the enemy's ability to wage war. Human factors should have measurable and observable impact in the model, through behavior such as sortie generation rates or aircraft and missile launch response times.

(n) Simulated Mistakes and Uncertainty: NASM will be able to cause simulated entities to "make mistakes" based on human factors such as level of

training and variables in combat effectiveness. There will be two categories of errors: mistakes in actions taken (execution) and mistakes in actions reported (uncertainty). Mistakes in actions taken affect the ground truth of the simulation because they differ from the what was expected to occur. Mistakes in actions reported will be in the form of incomplete data or data which is different from ground truth. Mistakes in reporting will not impact the ground truth. The simulation must have the ability to provide the correct information if challenged for confirmation.

(5) Support Modules: Many of the important functions associated with the NASM synthetic training environment do not have to be conducted within the simulation process itself. The success of NASM in providing an effective training opportunity will depend largely on the ability of supporting modules to facilitate scenario and database preparation, to translate real-world orders into model-specific orders at the necessary level of detail, to aggregate results into meaningful information in the formats necessary for use at the battlestaff level, and to translate model data into formats that can be used by external or modeled C4I systems.

(a) Scenario Preparation: The NASM suite of simulation and support modules must include automated tools to facilitate distributed/collaborative exercise planning. Using graphical user interface tools, exercise planners must be able to tap into existing terrain, environmental, target, and order-of-battle databases, translate the information into model-specific inputs, and then tailor the information to create a scenario that meets training objectives. For example, by using a graphical interface workstation, scenario builders should be able to display SAM sites and C2 nodes, then designate command networks in a "point-and-click" environment. An important goal is to keep these database preparation aids as simple and intuitive as possible, taking advantage of the latest technological advancements and commercially accepted techniques.

(b) Aggregation: To provide meaningful information to higher-level training audiences when lower-level response cells are not present, NASM must be able to aggregate results and report summary data that would normally be fused by battlestaffs based on tasked collection and reporting. These summary reports should not present full ground truth, but should filter data to provide a product consistent with what a typical battlestaff might provide. Aggregation tasks include reporting on friendly operations as well as on enemy operations (intelligence fusion). Intelligence fusion may also be handled by a separate intel model, if interfaced and available. When aggregating reports and de-aggregating orders for higher-level training audiences, it is important not to penalize or reward the players for automated decisions beyond their control.

(c) De-aggregation: To realize the full potential for training efficiencies, NASM must provide the means to translate a highly aggregated player input order, consisting primarily of the elements of a campaign plan, into the necessary commands in order to execute at the weapon system level. Realistically, this is a two-step process. First, a campaign plan or Master Attack Plan (MAP) must be translated into the equivalent of an Air Tasking Order (ATO) if the training audience does not include battlestaff elements responsible

for that product. If targets are not specified in detail, de-aggregation at this stage must include automated selection of target subsets which will result in taskings consistent with the intent of the attack plan. Second, the ATO needs to be translated through a mission planning process into model-specific mission orders at the level of detail equivalent to a flight plan that incorporates knowledge-based route planning, threat avoidance, range and fuel calculations, and weaponeering if necessary. The time required for this two-step orders translation must be minimized, optimally under two hours. The input will also include plan execution options, desired courses of action based upon the options taken, and move-decision points which when reached will terminate the move and allow the player to adjust his campaign plan. During execution, NASM-provided Semi Automated Forces (SAFOR) and Computer Generated Forces (CGF) must be capable of credible battle management tasks in compliance with high-level aggregated orders such as Rules of Engagement (ROE) and general air defense plans. The level of sophistication for these knowledge-based force management "laws" should evolve with available technology and through experience gained with model prototypes. A formalized system to identify "system experts" to train these "expert systems" may be necessary, to include automated data/behavior collection functions integrated in real-world weapons systems and/or mission training devices.

(d) Displays and Reports Generation: NASM will export situation displays and standardized reports to the controllers and players before, during, and after an exercise. The situation displays will include track data equivalent to those fed by real-world systems. The standard reports set will include but not be limited to mission results, target damage, weapons expended, aircraft losses, and kills claimed. In addition, status reports must be available for bases, units, radar sites, SAM/SHORAD sites, space assets, C4I infrastructure, and logistics/maintenance status. NASM will also provide the training audience with the ability to design and modify user-defined reports, and to automatically generate these reports based on simulation results, events, or time.

NASM must also translate model-specific data into formats that can be exported directly into real-world C4I systems and other simulations. This includes TADIL links for track data, USMTF format for standardized Joint message traffic, and NATO 80-50 message format. Intelligence reports commonly required include TACREP and TACELINT, HUMINT, MASINT, RECCEXREP, and MISREP.

Inter-simulation interfaces include all JSIMS models plus NATSIM, a high-fidelity model of national intelligence collection assets which operates against scenario ground truth to generate intelligence reports which can be transmitted over standard tactical communications channels. Interfaces to real-world C4I should include the following current/projected systems, plus future systems (TBD):

Air Force Mission Support System (AFMSS)
AMC Deployment Analysis System
Battlefield Situation Display (BSD)

Combat Integration Capability (CIC)
 Combat Intelligence System (CIS)
 Combined Mating and Rating Planning System (CMARPS)
 Command and Control Information Processing System (C2IPS)
 Contingency Theater Automated Planning System (CTAPS)
 Deliberate and Crisis Action Planning and Execution System (DCAPES)
 Global Command and Control System (GCCS)
 Global Decision Support System (GDSS)
 JFACC Planning Tool (JPT)
 Joint Engineering Estimation Planning System (JEEPS)
 Joint Collection Management Tool (JCMT)
 Joint Deployable Intelligence Support System (JDISS)
 Special Ops Forces Mission Planning and Rehearsal System (SOFPARS)
 Stand-Alone Tactical Ops Message Processing System (STOMPS)
 Tactical Elint Processor (TEP)
 Tactical Data Information Links (TADIL) - [e.g. A,B,C,J, links16, 22]
 Tactical Information Broadcast System (TIBS)
 Tactical Reconnaissance Applications (TRAP)
 Wing Command and Control System (WCCS)

(e) After Action Review (AAR): NASM will provide the ability to perform on-site AARs in order to assess and improve the effectiveness of the exercise, and to conduct post-exercise analysis. NASM will be able to record user-specified events and data, to respond to specific analysis requirements during and after an exercise. The formats include, but are not limited to, three dimensional graphical displays on a portable screen (visible by a group of 25 people), printouts and overhead viewgraphs of data (overlaid on maps when applicable), statistical graphs of resource consumption, and tabular outputs of data as well as text messages. During the AAR process, NASM will provide the ability to track special or high interest information, provide automatic detection of events based upon common errors, perform evaluative/analytic functions, and compare "ground truth" information from the simulation databases with each players "perceived truth" and other data. The AAR capability must allow the operator to modify existing output formats or build new displays to support the analysis and review of AAR data.

b. Logistics and Readiness

(1) Reliability and Maintainability (R&M): NASM will be capable of operating 24 hours a day, 7 days a week. NASM will be required to support training exercises whose durations range from 1 to 30 days, 24 hours per day. Overall NASM system availability during an exercise of 1 to 30 days should be at least 99% (down-time less than 1 hour every 4 days). The system should be capable of restarting no more than one hour after correction of a full system failure, with a confidence factor of 95%, and without data loss of more than 15 minutes scenario time.

(2) Maintenance: NASM software will be comprised of portable, reusable component modules developed in a modern supportable programming language using

modern programming techniques. NASM must maximize the use of Commercial Off-the-Shelf (COTS) and Non-Developmental Items (NDI), in order to reduce manpower and other support requirements, and to permit ready technological upgrades. Configuration control of software and data components that are shared by the models at local and remote sites will be centrally managed.

(3) Degraded System Performance: NASM must provide the ability for the system to run in a limited-operations (limop) mode when communications links or the computer environment are degraded. Limop modes may include slower speeds, lack of desired interfaces with other models, or decreased level of detail.

c. Critical System Characteristics

(1) Flexibility: The NASM architecture will be open, robust, scaleable, extensible, and flexible to provide for the development of the system that will be maintainable and can evolve as the NASM operational needs change. NASM will be developed to allow for the incorporation of advances in hardware and software technologies. NASM will have the ability to modify the training environment in three areas: system dependencies (changing system parameters, allowing for multiple level resolution and varying levels of fidelity, adding and deleting workstations, resource allocation and management of exercise components, and reconfiguring workstation configuration), models and simulations (manipulating scenarios, adding or replacing models and simulations, controlling an exercise), and operations (changing doctrine). NASM will be compatible with existing network and interface systems to facilitate implementation. NASM will allow new simulation assets to be integrated into the system on a temporary or permanent basis. Standard interfaces will be used and documented to promote readily configurable system composition capability.

(2) Distributed Capability: NASM will provide a distributed simulation mission space that allows exercise participants to receive, process, and transmit commands and information across geographically dispersed locations. In addition, NASM will support the training of mobile command posts and/or units and must accommodate the movement of command posts and/or units during training exercises. NASM will not require physical collocation of participants involved in a training exercise. To support a variety of exercise configurations NASM will provide a modular simulation capability to permit operation, either separately, as a stand-alone system, or in combination with other existing or future models. NASM will be capable of operating in either a centralized (single site/node) or remote/distributed (multiple site/node) configurations. Specifically, for education of the technical controllers prior to an exercise, the system must be able to run on a single node.

(3) Computer System Support: Lack of specialized hardware at any location will not preclude active participation, even if such participation is restricted and requires operator interpretation. NASM will also possess the ability to migrate to improved hardware platforms as they become available, or to equivalent theater-owned equipment. NASM will allow remote system management and system technical control to support distributed exercise environment.

(4) Security : Sufficient operational and systematic safeguards will be inserted at all interfaces between NASM components and real-world C4I systems to prevent inadvertent insertion of simulation information into the on-line, real-world information. The system must meet all security requirements for interoperability with theater and national command and control systems, and must be able to interchange data with these systems. NASM shall not prohibit operation in a TEMPEST-controlled environment. However, necessary security measures are external to the NASM system and shall be provided by the respective simulation centers and users, as appropriate. The NASM architecture must also be capable of incorporating multi-level/compartimented security solutions, when available. NASM will require protection from INFOSEC threats as defined by the designated approval authority at each anticipated deployment site.

5. Integrated Logistics Support (ILS)

a. Maintenance Planning

Maintenance planning includes all activities for the life cycle support IAW AFI 10-602 "Determining Logistics Support and Readiness Requirements". There will be two levels of maintenance: organizational and depot. On-equipment and off-equipment maintenance will be conducted using existing technical orders, procedures, and best commercial practices. These require that maintenance be planned and accomplished to ensure optimum effectiveness with minimum maintenance costs.

(1) Organizational Maintenance: Maintenance at the organizational level will be performed by military, civilian, or contractor technicians. The contractor's repair level analysis will differentiate between software and hardware failures, and determine the appropriate action/repair location. On-equipment maintenance conducted at the organizational level includes fault isolation and troubleshooting, repair of prime mission equipment (generally limited to removal and replacement of faulty Line Replaceable Units [LRUs]), preventive/scheduled maintenance and testing, and resident or loaded software diagnostic systems.

(2) Depot Maintenance: Off-equipment maintenance will be accomplished at the site repair facility, software support facility, CONUS depot, or contractor facility. Off-equipment maintenance performed at the depot includes technical assistance and active maintenance beyond the responsibility and capability of organizational maintainers, bench check/repair/overhaul of unserviceable components, service engineering of modifications, repair and calibration of specialized test equipment, modifications that require additional man hours, facilities, or equipment not available at the organizational level, software diagnostic systems, and emergency on-site support.

b. Support Equipment

Support equipment for maintenance will be kept to a minimum and the system will be designed to be maintained by standard test equipment and will include fault isolation capabilities to diagnose failures at a level commensurate with the final support concept. Types of support equipment will include standard items, preferred items, items in Government inventory or being developed under a Government contract, commercially available items that meet technical and

logistics requirements, modification of any of the above, and newly developed items. All support equipment, both expendable and non expendable, that has been approved for use with the system will be identified by an assigned National Stock Number, and will be on site prior to fielding the equipment.

c. Human Systems Integration

(1) Human Computer Interface (HCI): NASM will include: tutorials, on-line references, manuals, and context sensitive "help screens," to include all system configuration operations and operator maintenance. HCI will be in accordance with the TAFIM, Volume 8, DOD HCI *Style Guide*.

(2) Manpower Support: The user will determine operations and maintenance manpower requirements, with the goal of no increase in manpower authorizations or skill levels. At a minimum, NASM is to allow fielding within the current manpower constraints.

(3) Training and Training Support: For each phase of the program, Type I (contractor) operations and maintenance training for the initial cadre of instructors and acceptance testing participants, as well as Type I software maintenance and training for software support personnel will be provided. As part of this training, tutorials, manuals, and "help screens" to include all system configuration operations and operator maintenance will be provided. Sites will identify any unsatisfied Type I follow-on training requirements. Training will be provided for the system controllers. Training will cover the interaction with the system and role-playing techniques. It is assumed that students shall have the basic operational knowledge of the position that they are to portray in an exercise.

d. Computer Resources

(1) Open System Architecture and Standards: NASM will be developed under the Advanced Distributed Simulation (ADS) architecture concept and the DOD High Level Simulation Architecture (HLA) developed by the DOD-wide Architecture Management Group (AMG), allowing direct interaction with JSIMS and other Service models. Existing documented, maintainable, portable, GOTS, or COTS software packages will be used to the maximum extent possible to satisfy identified requirements before dedicating resources to developing major system enhancements or new application components.

(2) Software: The system design should be developed according to the practices delineated by the Software Engineering Institute (SEI). NASM will be comprised of portable, reusable component modules developed in a modern supportable programming language using modern programming techniques. Existing DOD and commercial off-the-shelf (COTS) products and non development items (NDIs), as appropriate, will be used to the maximum extent possible within the constraints of the life cycle maintenance to reduce manpower and other support resource and permit ready technological upgrades. Quality, non proprietary software documentation and source code that facilitates software maintenance will be developed and delivered.

Developed software will be modular so that the software can be changed and improved with minimal effect on the design and implementation of other modules. The system will be developed with growth in mind. The software will employ error management aids and permit users to obtain on-line guidance by requesting help screens. Following the output of an error message, users should be permitted to request additional information at levels of increasing detail.

NASM will be designed such that all data (i.e., parameters of the models, rules for expert systems, addresses for network nodes) are not hard-coded into the software. NASM will provide the flexibility to change system parameters, rules, network configuration during run-time without disruption to an exercise.

e. Other Logistic Considerations

(1) Storage Areas: Permanent, environmentally controlled facilities for fixed site equipment must also include storage areas for the simulation support system. The simulation support systems must be designed to operate out of temporary facilities that may or may not be environmentally controlled. Selected facilities must be capable of supporting exercises in a secure mode.

(2) Supply Support: Spares and support will be provided from IOC through FOC. After FOC, it will become the responsibility of each user to provide the necessary spares for NASM life-cycle support. Delivery of initial spares should arrive concurrent with, or prior to, equipment installation. Follow-on spares support will be determined in accordance with the support concept selected.

(3) Technical Data: Technical Orders, users manuals, analysts manuals (to include detailed descriptions of model algorithms), and vendor documentation for each level of operation and repair will include illustrated parts breakdowns, parts listings, cabling diagrams and cable pin-outs, theory of operation, and maintenance and troubleshooting guides. The technical orders and/or vendor documentation must be formally verified, validated, and approved by the appropriate agencies. The system will provide in the required format any system unique documentation required to operate, troubleshoot and maintain the system.

(4) Engineering and Data Rights: Engineering data and data rights requirements include acquisition of commercial data and unrestricted data rights on software developed for NASM. Existing commercial manuals recommended for use will be evaluated for adequacy in accordance with standards jointly approved by the users and AFMC.

(5) Facilities and Land: NASM will be installed within existing facilities/sites. The requirements for the Software Support Facility will be determined by ESC in coordination with USAF/XOM and other appropriate facilities.

(6) Maintenance Data Collection: Logically centralized mechanisms will be used to ensure the configuration management of software, data, etc. Maintenance data collection (MDC) and equipment status reporting (ESR) procedures will consist of data collection and analysis methods that will be used after the fielding of the NASM equipment.

6. Infrastructure Support and Interoperability

a. Command, Control, Communications, Computers, and Intelligence

NASM will interface with existing and planned C⁴I systems.

b. Transportation and Basing

NASM hardware (such as workstations) will be capable of operating in a stand-alone cluster mode as well as in a wide distributed mode. No equipment item will exceed the two-man lift requirements.

c. Standardization, Interoperability, and Commonality

All NASM components will be compliant with DOD and Air Force requirements for standardization and interoperability. All NASM interfaces with Air Force C4I systems will meet the Air Force requirements for interoperability certification. All NASM interfaces with joint C4I systems will meet the requirements of joint interoperability certification. NASM will make use of best commercial practices to the maximum extent possible, and will consider standardization and interoperability, where possible, with NATO and other allies. To the extent possible, NASM will use standard external interfaces. All interfaces will be in accordance with the DOD Technical Architecture Framework for Information Management (TAFIM), Air Force Technical Reference Codes (TRCs), and other approved C4I interoperability guidance and standards.

d. Mapping, Charting, and Geodesy (MC&G) Support

MC&G requirements for NASM will be determined in accordance with AFI 14-205 "Identifying Requirements for Obtaining and Using Cartographic and Geodetic Products and Services", and NASM will use standard digital products, software, and services. World Geodetic System 1984 Datum will be used

e. Environmental Support

NASM will require environmental support in terms of realistic feed of accurate environmental (meteorological, oceanographic, space, terrain) data for use during exercise scenarios. Appropriate interfaces to environmental dissemination systems will be necessary to ensure accurate and timely flow of data to NASM users.

7. Force Structure

NASM will be fielded at locations to include:

- a. USAFBTS: Training of Air Component Commanders and their staff.
- b. WPC: Training of Air Component Commanders and their staff.
- c. JWFC (Ft. Monroe): Training of Air Component Commanders and their staff.

- d. JTASC (USACOM): Training of Joint Commanders and their staff.
- e. Osan Simulation Center, 11AF, and another location in PACAF (site to be determined). NASM capability and data must be releasable at these sites to coalition partners on a case-by-case basis.
- f. SSF: Responsible for life-cycle maintenance of the NASM software.
- g. HQ/USAF: Support the requirements, analysis/acquisition communities as well as assisting in refining requirements.
- h. Air University (CADRE/Air Force Wargaming Institute): Supporting the requirements for joint professional military education and training for Joint Task Force and Air Component Commanders and their staffs.
- i. ESC/AVM: Core capability to assist in the refinement of system requirements and conduct of enhancements.
- j. Space Warfare Center and National Test Facility: Training Air Component Commanders and their staff.
- k. Det 4, 505 CCEG (TACCSF): Training Air Component Commanders and their staff.
- l. HQ AMWC: Training DIRMBOFOR's AME Staff.
- m. HQ AMC: support mobility analyses and validation requirements.
- n. Space and Missile Systems Center.
- o. HQ USAF Modeling and Simulation Support Facility (FOA, TBD at Orlando FL).

8. Schedule Considerations

NASM IOC is defined as the employment of one NASM system that satisfies the operational, performance, and security requirements defined within the NASM ORD. The NASM IOC system may operate as a stand-alone model or tightly coupled with JSIMS. At a minimum, the NASM IOC system will provide the correct presentation of air and space doctrine required to support JTF wartime and MOOTW training exercises. It is anticipated that NASM IOC system will be available in 1999.

The NASM FOC system will be required to fully interface and interoperate with the external systems outlined in this ORD. The NASM FOC system will fully satisfy the Air Force wartime and OOTW training objectives and will consist of the previously described configuration. The NASM FOC system may operate as a stand-alone system or tightly coupled with JSIMS. The NASM FOC system must be able to operate by adequately trained military personnel. FOC will be considered complete after full delivery of the NASM system. It is anticipated that FOC will be in 2003.

ATTACHMENT I

REQUIREMENTS CORRELATION MATRIX (RCM)

PART I

As of 21 May 96

SYSTEM CAPABILITIES AND CHARACTERISTICS <i>* = Key Performance Parameter</i>	THRESHOLDS	OBJECTIVES
1. Core structure and configuration. Para 4a(1)(a) *	Compliant with JSIMS architecture and able to run in stand-alone mode.	
2. Model interfaces. Para 4a(1)(b)	Ability to link to live, virtual, and constructive simulations including those outside JSIMS.	
3. Data deconfliction. Para 4a(1)(c)	Consistent data at all sites regardless of where outcome is initially resolved.	
4. Force sides. Para 4a(1)(d) *	Friendly, neutral, unknown, and opposing sides represented and can be changed during play.	
5. Transparency. Para 4a(1)(e)	Primary training audience able to operate from wartime facilities without model-specific equipment or communications.	
6. Resolution. Para 4a(1)(f)	Levels of detail and fidelity selectable to suit training audience.	
7. Warfighter-In-The-Loop (WITL) capability. Para 4a(1)(g)	Able to insert WITL at any level of simulation.	

SYSTEM CAPABILITIES AND CHARACTERISTICS <i>* = Key Performance Parameter</i>	THRESHOLDS	OBJECTIVES
8. Selectable time compression from 1/10 to 1000 times real time. Para 4a(1)(h)	At least 2:1 under max load with WITL at wing level; 10:1 with SAFOR; 100:1 with fully automated CGF; 1000:1 max speed (limited scale)	1000:1 fully automated, in larger scenarios for analytical and decision-support functions.
9. Selectable time step. Para 4a(1)(h) *	Variable from 1 to 60 sec without effecting outcomes (nominal 6 sec)	Variable from 1 to 60 sec without effecting outcomes (nominal 3 sec)
10. NASM-specific graphic user interfaces available. Para 4a(1)(i)	Train players to familiarity level within 2 hours, proficiency in 6 hours; controllers in 12 hours.	
11. Technical controller requirements. Para 4a(1)(j)	Not to exceed 5 tech controllers per exercise node.	Not to exceed 3 tech controllers per exercise node.
12. Controller privileges. Para 4a(1)(k)	Exercise controllers provided with full "ground truth" data, response cell controller permissions limited to "own" forces and "perceived" data.	
13. Player privileges. Para 4a(1)(l)	Control and information limited to "own" forces and "perceived" situation.	Control and information limited to "own" forces and "perceived" situation.
14. Coordinate systems. Para 4a(2)(a)	Track objects worldwide by lat/lon and altitude, accept UTM.	Track objects worldwide by lat/lon and altitude, accept UTM.

SYSTEM CAPABILITIES AND CHARACTERISTICS <i>* = Key Performance Parameter</i>	THRESHOLDS	OBJECTIVES
15. Terrain. Para 4a(2)(b)	DMA data represented at selectable levels of resolution, and factored into detection and engagement models. Overhead map views available.	Detailed terrain views available for display from any angle/elevation/range or cockpit perspective, and at increased levels of detail when available.
16. Weather (air and space natural environment). Para 4a(2)(c)	Factored into detection, communications, and engagement models.	
17. Model entities defined with characteristics and capabilities, tracked and reported throughout exercise. Para 4a(3) *	Define airbases, aircraft, spacecraft, space launch systems, missiles, launch sites, munitions, sensors, comm sites/ devices for NASM and other JSIMS models; add future systems when defined.	
18. Movement and navigation, constrained by weather, terrain, routing, payload, performance. Para 4a(4)(a)	Speed/range/payload within 10% of detailed operational performance planning guides.	Speed/range/payload within 5% of detailed operational performance planning guides.
19. Detections, constrained by weather, terrain, sensor capabilities, target. Para 4a(4)(b)	Within 10% of actual performance data or detailed analytical models.	Within 5% of actual performance data or detailed analytical models.
20. Combat identification. Para 4a(4)(c)	Engagements comply with ROE; mis-identification and fratricide possible and controllable.	
21. Targeting of NASM entities and shared objects from other models. Para 4a(4)(d)	Target by model name, or by DMPI/target #.	

SYSTEM CAPABILITIES AND CHARACTERISTICS <i>* = Key Performance Parameter</i>	THRESHOLDS	OBJECTIVES
22. Damage assessment. Para 4a(4)(e) *	First-order effects within 10% of JMEM data; data dependent upon ability and tasking to collect and report; long range and infrastructure effects modeled.	First-order effects within 5% of JMEM data; infrastructure effects validated; simulated BDA imagery available.
23. Communications systems, nodes, and links. Para 4a(4)(f)	Targetable by direct attack, jamming, or IW; effects within 10% of analytical models.	Effects within 5% of analytical models.
24. Logistics. Para 4a(4)(g)	All operations logistically constrained, logistics functions represented.	
25. Airlift and air refueling operations. Para 4a(4)(h) and 4a(4)(i)	Represent cargo, pax, and refueling operations/ constraints.	
26. Space operations. Para 4a(4)(j)	Represent launch ops, satellite ops, recon / surveillance and tactical warning, navigation, communication, environment monitoring, prompt strike, space surveillance, counter space, and missile defense.	
27. Special Operations activities. Para 4a(4)(k)	Represent direct action, special reconnaissance, unconventional warfare, foreign internal defense, psyops, and counter-terrorism.	
28. Military Operations Other Than War (MOOTW) Para 4a(4)(l)	Represent all types of MOOTW as listed.	

SYSTEM CAPABILITIES AND CHARACTERISTICS <i>* = Key Performance Parameter</i>	THRESHOLDS	OBJECTIVES
29. Human factors. Para 4a(4)(m)	Performance scaling factors incorporated at all levels; both controller- and model-driven.	
30. Simulated mistakes and uncertainty. Para 4a(4)(n)	Controllable levels of execution and reporting errors.	
31. Scenario preparation support modules. Para 4a(5)(a)	Automated database and GUI tools available to facilitate scenario preparation.	Take advantage of future innovations to improve GUI interface and database access, make systems more user-friendly.
32. Data aggregation and de-aggregation support modules. (Knowledge-based tools to add detail to higher-level orders and summarize data into fused reports.) Para 4a(5)(b) and 4a(5)(c)	Translate MAP into ATO and mission plan to entity-level orders within 2 hours; automate basic battle management tasks.	Expand knowledge-based planning tools, to include "intelligent" CGF capable of planning and directing forces in "hands-off" mode.
33. Reports generation support module. Para 4a(5)(d)	Generate standardized reports; create and modify user-defined reports; deliver via real-world C4I systems. [See list para 4a(5)(d)]	Include future systems TBD.
34. After-Action Review (AAR) support module. Para 4a(5)(e)	Provide standardized and user-defined AAR aids including summaries, charts, and motion replays.	
35. Reliability and maintainability. Para 4b(1)	24-hour ops for up to 30 days; down-time less than 1 hour every four days; recover after full system failure within 1 hour with 95% confidence; max data loss 15 minutes.	

SYSTEM CAPABILITIES AND CHARACTERISTICS <i>* = Key Performance Parameter</i>	THRESHOLDS	OBJECTIVES
36. Security. Para 4c(4)	Meet security and TEMPEST requirements for interface with theater and national systems, and operate in TEMPEST-controlled environment.	Incorporate multi-level security solutions, when available.
37. Manpower. Para 5c(4)	No increase in manpower requirements over current system and level-of-effort.	

ATTACHMENT 1

REQUIREMENTS CORRELATION MATRIX (RCM)

PART II

(Supporting Rationale for System Characteristics and Capabilities)

As Of: 21 May 96

General Comments: The air power simulation currently being used to support Air Force, joint and combined training exercises and other training programs is the Air Warfare Simulation (AWSIM). AWSIM has significant shortcomings in its ability to realistically portray the full range of aerospace missions and capabilities. AWSIM also has many functional, maintenance and enhancement limitations associated with archaic hardware and software and inability to interoperate with the simulations systems of the other Services. These shortcomings have been identified by operations and support staffs for many years and, coupled with significant advances that have evolved in software technologies and hardware, have brought the Air Force to a point where it is no longer practical or efficient to attempt the significant enhancements that are now required. In addition, AWSIM shortcomings are magnified when supporting distributed exercises since it requires excessive numbers of control staff personnel to operate and maintain. Despite increasing costs associated with maintaining and improving this outdated simulation, its basic design precludes the possibility of reaching a satisfactory level of performance. NASM will overcome these deficiencies by integrating the full range of air and space missions within a common framework, using modern simulation technologies. NASM will interoperate with real world C4I systems and other constructive, virtual and live simulation systems.

References:

- (1) Air Force Modeling and Simulation Master Plan, HQ USAF/XOM, 24 Aug 95 (Draft).
- (2) Department of Defense Modeling and Simulation Master Plan (DOD 5000.59-Paa), 26 Jun 95 (Draft).
- (3) Joint Simulation System (JSIMS) Master Plan, JSIMS Joint Program Office, 7 Nov 94.
- (4) National Air and Space (Warfare) Model (NASM), Mission Needs Statement, HQ USAF 009-93, 8 Aug 94.

Parameter 1 -- Core Structure. NASM must be designed from the outset to operate as part of the JSIMS architecture. NASM will provide air and space objects as well as the air and space natural environment for the other Services' models within the JSIMS confederation. NASM must also be able to stand alone for limited-scale Air Force-specific training and decision-support needs.

Parameter 2 -- Model Interfaces. The ability to link to live, virtual, and other constructive models is the centerpiece of the Air Force vision for Modeling and Simulation, as the means to create a seamless synthetic training environment in support of warfighters from the unit level to theater CINCs.

Parameter 3 -- Data Deconfliction. Although a major technological challenge, it is imperative that outcomes of discrete events be decided in one and only one place. Those outcomes must be consistently communicated to all distributed locations, without interrupting or delaying time-synchronized interfaces.

Parameter 4 -- Force Sides. A significant limitation of many current-generation simulations is the bi-modal mindset and restriction to just two "sides" in a conflict -- friendly or enemy. The nature of modern conflict is oriented towards joint and combined (coalition) warfare and Military Operations Other Than War (MOOTW), where the affiliation of participants can differ in subtle or drastic ways and can change quickly. Engagement ROE is also highly dependent on classification as friendly, hostile, unknown, or neutral.

Parameter 5 -- Transparency. A primary requirement for NASM is the ability to train battlestaffs in their wartime locations using the equipment they would normally have available, instead of forcing them to learn model-specific equipment or relying on exercise-specific communications. In this sense the wargame must be "transparent" to the primary training audience.

Parameter 6 -- Resolution. NASM will be focused as an entity-level simulation, but the level of detail in the model and in the reported data should be selectable based on the data available and on the exercise training objectives. For example, if wing-level logistics training is an exercise objective then the model would be asked to generate inventory and/or consumption rates for fuel, weapons, spare parts, engines, and personnel (by skill codes). If this level of detail is not available for database inputs, or if lower-level logistics play is not required, there is no need to ask the model to calculate or report this data.

Parameter 7 -- Warfighter-In-The Loop (WITL). NASM must support training audiences that range from unit level to theater CINCs. When lower-echelon participants are involved, the model must be able to insert human decision-making into model activities, and/or "drill down" to high-fidelity models (such as virtual combat simulators) to resolve outcomes and return the results.

Parameter 8 -- Time Compression. Training and analysis requirements dictate the need to slow the simulation down for close scrutiny of complex operations or to speed the simulation up in order to cover campaign-length scenarios in a matter of days or hours. This requires the ability to specify run rates as a technical control function, as well as the capacity to process vast amounts of data during large scenarios with many participants and a high level of activity. A compression factor of 2:1 is appropriate to allow the model to "catch up" to real time after delays or failures, or to allow playing 24 hours of simulated operations in a 12-hour duty day. A ratio of 10:1 would be appropriate for playing 2 scenario days in a discuss-play-discuss-play seminar setting. A ratio of 100:1 would be useful for analytical purposes or to generate overviews of mission packaging or rehearsal drills. 1000:1 represents essentially an unbounded technical control setting for small-scale analytical purposes.

Parameter 9 -- Time Step. Current-generation models were designed to run on a fixed time-step interval, typically one minute. This does not generate data updates on the order of real-world systems, and is insufficient to accurately resolve engagements where high closure rates are involved (such as supersonic head-to-head engagements or theater ballistic missiles). Databases and algorithms have been tailored to this fixed-step methodology, a limitation which must be overcome. A nominal time-step of 6 seconds is reasonable as a threshold value because it is close to update/sweep rates of modern radar surveillance systems. During head-to-head air engagements closure is on the order of a mile every three seconds, so 6 seconds (2 miles) can take aircraft from beyond visual range (BVR) to close combat. Performance data for air-to-air missiles needs to differentiate significant capability shift with as little as 2

miles difference in maximum range. For these same reasons, a 3 second time-step would add greater fidelity, though it would approximately double computational load.

Parameter 10 -- Graphic User Interfaces. Current player and controller interfaces include many model-specific tasks that are labor-intensive and difficult to learn. In cases where the training audience will not be using their native C4I systems as the sole model interface, such as in response cells or control cells, the NASM "organic" interfaces need to be simple, efficient, intuitive, and easy-to-learn in order to keep manpower costs and training time to a minimum. User acceptance ultimately depends on developing a friendly interface. A player train-up time of 2 hours to the familiarity level is appropriate for seminar settings, and 6 hours is essentially a duty day plus administrative overhead for full-scale exercises. 12 hours is essentially 2 duty days with overhead for training exercise controllers.

Parameter 11 -- Technical Controller Requirements. Current requirements for technical controllers are driven by the large number of manual tasks, inefficient human interfaces, and the unreliable systems needed to interface a confederation of models not originally designed to work together. NASM needs to overcome this obstacle through intentional design, with efficient architecture and equipment.

Parameter 12 -- Controller Privileges. Exercise controllers and response cell controllers act as buffers between the training audience and the model, and require varying levels of authority for tasks such as overriding model outcomes and "editing" player inputs to ensure realistic play in the wargame.

Parameter 13 -- Player Privileges. NASM exercise participants and control cells should be restricted to control of their own forces. Access to information should be limited to that which they would realistically be able to obtain given the capabilities of reconnaissance / surveillance / intelligence systems, collection tasking, and communications connectivity.

Parameter 14 -- Coordinate Systems. NASM representations of air and space missions should not be restricted by geographical limits such as "designated playbox". NASM objects should be able to move anywhere worldwide, using latitude/longitude/altitude as the primary coordinate system. Other coordinate systems should be accommodated via automatic translation, such as when ground targets are passed using UTM coordinates.

Parameter 15 -- Terrain. Current air model representations are based on a "flat but curved earth", ignoring critical factors such as line-of-sight restrictions to detections, navigation, target acquisition, and engagement outcomes. With the availability of DMA databases and modern modeling techniques, terrain data can and should be included throughout the NASM model to add realism.

Parameter 16 -- Weather. The current air model does not adequately model the natural air and space environment, or its effects on the ability to conduct operations or the outcome of attempted detections, communications, navigation, target acquisition, or combat engagements. The Air Force is designated as the executive agent for modeling the air and space natural environment for all Service models within the JSIMS confederation of models.

Parameter 17 -- Model Entities. The most visible parts of any air model are the "playing pieces" that can be tracked, displayed, and reported on throughout an exercise. Accurate modeling of the capabilities and characteristics of each entity (as a data object) is essential. NASM will provide air and space objects for all other models within the JSIMS confederation.

Parameter 18 -- Movement and Navigation. Current model entities are not constrained in movement. For example SAM sites are permitted to travel by surface in straight lines over water and through mountains, aircraft range is not dependent upon configuration (payload, drag, external fuel), and all navigation is 100% accurate. To be credible, NASM must place realistic constraints on movement and navigation, and speed/range/payload capabilities of modeled aircraft/missiles must be brought closer to real-world figures. Experience with current wargaming systems shows that accuracy within 10 percent is approximately the level of acceptable credibility for operational-level wargaming, and accuracy to within 5 percent will generally stand up to close scrutiny and is more defensible.

Parameter 19 -- Detections. Current model detection calculations are not dependent upon terrain or weather, and modeling of sensor capabilities and target observability factors is poor. Target detection/acquisition is a critical step in simulation of surveillance and engagements of all types, and must be modeled accurately.

Parameter 20 -- Combat Identification. Current detection and engagement routines do not model the identification process or Rules of Engagement (ROE), do not take into account identification capabilities or constraints, and do not allow for the possibility of fratricide. ROE balances the risk of friendly losses against the need to engage the enemy efficiently and at maximum range. The potential for fratricide is an important consideration for battlestuffs in developing or refining theater ROE. Strict compliance with ROE is required to reduce or eliminate fratricide and ensure positive hostile identification. Compliance with ROE, identification processes, and fratricide potential must be represented in NASM.

Parameter 21 -- Targeting. Real-world battlestuffs conduct campaign planning in terms of strategy, objectives, and/or phasing. Target systems and associated targets are identified and prioritized by the order in which they are attacked, the desired results, and/or the weight of effort required to achieve desired results. Air-to-surface mission tasks are assigned in terms of individual targets or responsibility for areas of coverage. In current models, there is rarely a one-to-one correlation between a model entity (target system) and an individually tasked or assigned target. To provide useful training for battlestuffs, NASM must be able to accommodate targeting by real-world conventions, and successfully translate those orders into actions that will be represented and observable in the model. NASM must also be able to represent as targets those entities which are shared with or provided by other models, such as ground or naval forces.

Parameter 22 -- Damage Assessment. One of the primary functions of any air and space model is to provide feedback to the training audience on the results of operations they direct. At the most basic and immediate level, specific mission results should be available and consistent with JMEM data considering the weapon and delivery used, target characteristics, terrain and threat environment, and weather. Results should include credible random distribution (from gross error/misfire to "lucky hit"). Experience with current wargaming systems shows that damage assessment accuracy within 10 percent is approximately the level of acceptable credibility for operational-level wargaming, and accuracy to within 5 percent will generally stand up to close scrutiny and is more defensible. Although information such as "mission successful, bombs on target, hangar damaged" is useful and desired, what the training audience needs and what NASM must deliver is a realistic and observable change in modeled status, capability, or behavior. For example the mission objective is rarely just to put a bomb on target, but rather to change the ability of an airfield to generate sorties or launch/recover aircraft. NASM must provide some means to show the effects of damage to complex target systems such as airfields, transportation networks, and command and control networks. Availability of this data to the players should be dependent upon having appropriate means of collection/reporting available and tasked.

Parameter 23 -- Communications. Communications networks, processes, capabilities, constraints, and vulnerabilities are only marginally modeled in the current air warfare model. NASM must overcome these shortfalls and show realistic effects of direct attack on communications nodes, jamming of communications links, and information warfare activities.

Parameter 24 -- Logistics. Current models are not subject to realistic logistic constraints, and do not adequately generate logistics challenges and decision-making opportunities for the training audience. NASM must provide sufficient logistic detail to represent activities such as deployment and beddown, resupply, repair, and inventory management.

Parameter 25 -- Airlift and Air Refueling. After-action reviews of all recent exercises consistently criticize the lack of explicit modeling for mobility activities. NASM must represent airlift and tanker operations with the ability to show realistically constrained movement of cargo and passengers, air refueling operations, and competition for resources both in transit to and in the theater of operations..

Parameter 26 -- Space Operations. Simulation of space support to theater operations is essential and must be part of the threshold capability in any new model.

Parameter 27 -- Special Operations. Simulating the full range of special operations as a threshold capability is essential to train AOC personnel in the unique capabilities of special operations forces and to make the impact of special operations more realistic during future wargames.

Parameter 28 -- Military Operations Other Than War (MOOTW). MOOTW is a relatively new but high-interest challenge for modeling and simulation. Although MOOTW and war may often seem similar in action, MOOTW focus on deterring war and promoting peace while war encompasses large-scale, sustained combat operations to achieve national objective or to promote national interests. MOOTW are more sensitive to political considerations and often the military may not be the primary player. More restrictive rules of engagement and a hierarchy of national objectives are followed. Therefore, NASM must provide some means to show the effects of the 16 types of MOOTW.

Parameter 29 -- Human Factors. Human factors such as morale, training, fatigue, and national resolve should be represented as a part of all behavior models, and should be controllable at both the unit level and for each "side" by exercise directors.

Parameter 30 -- Mistakes and Uncertainty. Simulating mistakes in execution and reporting is another link to realism and will improve training programs to the degree that we are technically capable of simulating human performance and other "fog-of-war" factors.

Parameter 31 -- Scenario Preparation. The volume of information and level of detail required to prepare scenarios for large-scale exercises requires automated tools in order to keep time and manpower requirements down to an affordable level.

Parameter 32 -- Aggregation and De-aggregation. Since NASM will simulate operations at the entity level, player inputs such as the ATO must be broken down and detail added in order to generate model-specific mission orders. The tasks of creating detail where none exists, and of summarizing results into coherent assessment reports, requires automated knowledge-based processing tools. This is a threshold capability required to run exercises in real time while keeping response-cell manning requirements to an affordable level, or to run any scenario faster than real time.

Parameter 33 -- Reports Generation. A primary objective of the NASM and JSIMS training environment is to allow the training audiences to work from their normal operational locations, using real-world C4I systems as their primary interface to simulations. NASM must include support modules that can translate model results into standardized formats that are compatible with and can be delivered to real-world systems.

Parameter 34 -- After-Action Review. A regular critique item for computer-assisted exercises is the inadequacy of computer-assisted debriefing tools. NASM must include support modules to automate exercise analysis and review, providing the training audience with immediate and understandable assessments of what happened and why it happened.

Parameter 35 -- Reliability and Maintainability. Current-generation models are unable to demonstrate the reliability needed for large-scale distributed theater-level exercises. NASM must be capable of 24-hour operations with all interfaces intact, and the ability to recover quickly from any overall system failure with minimal loss of data. Large scale exercises are enormously expensive, and the training audiences cannot afford extended down-time which reduces scenario progress and therefore training opportunities. Extended down-time also degrades overall credibility of the simulation, especially when the "game clock" cannot be made to match real-world time. A one-hour lapse every four days was identified by user groups as a needed level of reliability for training purposes.

Parameter 36 -- Security. To bring the NASM training environment to wartime battlestaff locations via real-world systems, sufficient operational and systematic security safeguards must be inserted at all interfaces. Scenario and database access must be appropriately restricted, even when non-US forces are part of the training audience and both theater/coalition and national systems are used. Multi-level security technology is not currently available.

Parameter 37 -- Manpower. One of the most significant shortfalls of the current system is the high full-time manpower overhead need for technical control, exercise scenario preparation, and software maintenance. An important requirement for NASM is the ability to provide a better training environment without an increase in manpower requirements, at a given level of effort.

ATTACHMENT 2

GLOSSARY

As Of: 21 May 96

Aggregate - To create an aggregated entity from individual entities.

Aggregation: The ability to group entities while preserving the effects of entity behavior and interaction while grouped.

Constructive Simulations - Consist of traditional wargames, models, and analytical tools. The simulations are usually run on computers with humans interacting external to the simulation. The performance of entities in the simulation is derived from random outcomes based on input probability distributions rather than from human interaction. The level of detail in constructive simulations can vary greatly from a highly aggregated one, where the basic entities in the model are for example divisions or battalions, to one that describes the behavior of an individual weapon system by representing its individual components.

Live Simulation - Simulation operations are performed with real equipment in the field.

Mission Space - Mission space refers to the entities, actions, and interaction that must be represented to produce credible simulations of the specific mission area being addressed. Mission space includes all elements which support the simulation and which are required to achieve the desired goals and objectives.

Model - (1) A representation (executable or not) of real things or events, (e.g. terrain, air, space land, sea) (2). A physical, mathematical, or otherwise logical representation of a system, entity, phenomenon, or process.

Models - a group or combination of the models (e.g., synthetic environment)

Scenario - (1) Description of an exercise (initial condition in military terms). It is part of the session database which configures the units and platforms and places them in specific locations with specific missions. (2) An initial set of conditions and time lines for significant events imposed on trainees or systems to achieve exercise objectives.

Simulation - (1) A model that behaves or operates like a given system when provided a set of controlled inputs. (2) The process of developing or using a model as in (1). (3) An element of a special kind of model that represents at least some key internal elements of a system and describes how those elements interact over time.

Simulation Entity: An element of the synthetic environment that is created and controlled by a simulation application. It is possible that a simulation application may be controlling more than one simulation entity.

Simulation Exercise - (1) Consists of one or more interacting simulation applications. Simulations participating utilize correlated representation of the synthetic environment in which they operate.

Simulation System - A group of simulations packaged with ancillary functions (i.e., terrain database, threat database, engagement database) that may interface to external systems (e.g., NASM).

Simulator- (1) A special case of virtual simulation that provides an encapsulated virtual environment for interfacing with the simulation system. (2) A device, computer program, or system that performs simulations. (3) For training a device which duplicates the essential features of a task simulation and provides for direct practice. (4) A physical model or simulation of a weapon system, set of weapon systems, or a piece of equipment which represent some major aspects of the equipment's operation. (5) A training device that permits development and practice of the necessary skills for accomplishing flight operational tasks, to a prescribed standard of airman competency, in a specific aircraft and duty position.

Virtual Simulation - A simulation involving real people operating simulated systems. Virtual simulations inject human-in-the-loop (HITL) in a central role by exercising motor control skills, decision skills, or communication skills. Form of a simulation in which entities exist in effect or in essence, although not in actual form.

ATTACHMENT 3

ACRONYMS

As Of: 21 May 96

AAR	After Action Review
ADANS	AMC Deployment Analysis System
ADS	Advanced Distributed Simulation
AETC	Air Education and Training Command
AFI	Air Force Instruction
AFM	Air Force Manual
AFMC	Air Force Materiel Command
AFR	Air Force Regulation
AMC	Air Mobility Command
AME	Air Mobility Element
AMG	Architecture Management Group
AMRAAM	Advanced Medium-Range Air-to-Air Missile
AMWC	Air Mobility Warfare Center
AOC	Air Operations Center
ARCT	Air Refueling Control Time
ATO	Air Tasking Order
AWACS	Airborne Warning and Control System
AWSIM	Air Warfare Simulation
BIT	Built-in Test
BITE	Built-in Test Equipment
BTS	Battlestaff Training School
BVR	Beyond Visual Range
C ²	Command and Control
C2IPS	Command and Control Information Processing System
C ³ I	Command, Control, Communications, and Intelligence
C ⁴ I	Command, Control, Communications, Computers, and Intelligence
CAS	Close Air Support
CCB	Configuration Control Board
CGF	Computer Generated Forces
CIS	Combat Intelligent System
CMARPS	Combined Mating and Ranging Planning System
COTS	Commercial Off-The-Shelf
CTAPS	Contingency Theater Automated Planning System
DCA	Defensive Counterair
DIRMOBFOR	Director of Mobility Forces
DIS	Distributed Interactive Simulation
DMA	Defense Mapping Agency
DMPI	Desired Mean Point of Impact
DMS	Digital Mapping System
DOD	Department of Defense
ENWGS	Enhanced Naval Wargaming System
ESC	Electronic Systems Center
ESR	Equipment Status Reporting

FOC	Full Operational Capability
GBS	Global Broadcast Service
GCCS	Global Command and Control System
GCSS	Global Combat Support System
GDSS	Global Decision Support System
GOTS	Government Off-The-Shelf
GPS	Global Positioning System
HCI	Human Computer Interface
HITL	Human-In-The-Loop
HLA	High Level Architecture
HQ	Headquarters
IAW	In Accordance With
IFF	Identification Friend or Foe
ILS	Integrated Logistics Support
INFOSEC	Information Security
IOC	Initial Operational Capability
JCMT	Joint Collection Management Tool
JDISS	Joint Deployable Intelligence Support System
JFACC	Joint Force Air Component Commander
JMEM	Joint Munitions Effectiveness Manual
JPT	JFACC Planning Tool
JSIMS	Joint Simulation System
JTASC	Joint Training, Analysis, and Simulation Center
JWFC	Joint Warfighting Center
LRC	Logistics Readiness Center
LRU	Line Replaceable Unit
LSA	Logistics Support Analysis
MAJCOM	Major Command
MAP	Master Attack Plan
MASS	Mobility Analysis Support System
MDC	Maintenance Data Collection
MOOTW	Military Operations Other Than War
MTWS	Marine Air-Ground Task Force (MAGTF) Tactical Warfare Simulation
NATO	North Atlantic Treaty Organization
NASM	National Air and Space (Warfare) Model
NDI	Non-Developmental Item
NEO	Noncombatant Evacuation Operations
NOFORN	Not Releasable to Foreign Nationals
OCA	Offensive Counter Air
OPFOR	Opposing Forces
ORD	Operational Requirements Document
OT&E	Operational Test and Evaluation
PDSS	Post Deployment Software Support

POL	Petroleum, Oils, and Lubricants
R&M	Reliability and Maintainability
RCM	Requirements Correlation Matrix
ROE	Rules of Engagement
Rz	Rendezvous
SACON	Semi Automated Controller
SAFOR	Semi-Automated Forces
SAM	Surface-to-Air Missile
SBIRS	Space Based Infrared System
SEAD	Suppression of Enemy Air Defenses
SEI	Software Engineering Institute
SHORAD	Short-Range Air Defense
SOPARS	Special Operations Forces Planning and Rehearsal System
SSF	Software Support Facility
STD	Standard
STOMPS	Stand-Alone Tactical Operational Message Processing System
TACCSF	Theater Air Command and Control Simulation Facility
TADIL	Tactical Digital Information Link
TBD	To Be Determined
TED	Threat Environment Description
TELS	Transporter Erector Launcher
TEP	Tactical Elint Processor
TIBS	Tactical Information Broadcast System
TO	Technical Order
TPFDD	Time-Phased Force and Deployment Data
TRAP	Tactical and Related Applications
USAF	United States Air Force
UTM	Universal Transverse Mercator
WARSIM	Warfighter's Simulation
WCCS	Wing Command and Control System
WITL	Warfighter-In-The-Loop
WPC	Warrior Preparation Center
WRSP	War Readiness Spares Package
WWMCCS	Worldwide Military Command and Control System