

Minimum. Measures the ability to launch/transport the nuclear warhead(s) and conventional munitions within nominal performance characteristics to the minimum range possible. Minimum range required is estimated to be approximately that of current MM III and PK systems. However, the latest technologies should be incorporated whenever possible to determine minimum capabilities.

Overflight. Measures the ability to launch/transport the nuclear warhead(s) and conventional munitions within nominal performance characteristics while minimizing impact of geopolitical overflight restrictions. Overflight is a function of maximum, minimum and azimuth and as such is not measured independently.

All-azimuth. Measures the ability to launch/transport the nuclear warhead(s) and conventional munitions within nominal performance characteristics worldwide with respect to launch/target azimuth. Weapon system must be all-azimuth capable within all ranges specified.

Time-of-Flight. Measures the ability to control missile time-of-flight to include, but not limited to, the ability to coordinate near simultaneous/non-simultaneous time on target from co-located/non-co-located Launcher Locations (LL). Time-of-flight is a function of booster type, reentry vehicles utilized (Normal, MIRV, TSV and cLBSD), target location and LL. Weapon system must be capable of supporting all RV types and missions.

MOP 12: Command, Control, Communications, Computer (C4) Systems..

PLC to LL. Communications from Primary Launch Center (PLC) to Launcher Location (LL). Measures the flexibility, accuracy and timeliness to transmit targeting changes, positive control execution orders and routine commands from the PLC to the LL. Also measures the ability to monitor the day-to-day health/status of the weapon system. This should at least be equal to current MM III or PK system and should look to incorporate new technologies to increase speed, reliability, and survivability.

ALS to LL. Communications from an Alternate Launch System to Launcher Location (LL). (May or may not be similar to the current Airborne Launch Control System aboard the Navy's E-6A/B TACAMO aircraft). Measures timeliness to transmit targeting changes, positive control execution orders and routine commands from the ALS to the LL. Also measures the ability to monitor select day-to-day health/status reports from the weapon system. This should at least equal current Airborne Launch Control System (ALCS) capabilities for both MM III and PK

systems and should look to incorporate new technologies to increase speed, reliability, and survivability.

ALS to PLC. Communications from ALS to PLC. Measurement of ALS ability to contact PLC in stressed environments. Measures the flexibility, accuracy and timeliness to transmit (and retransmit) targeting changes and positive control execution orders from the ALS to the PLC. This should at least equal current ALCS capabilities for both MM III and PK systems and should look to incorporate new technologies to increase speed, reliability, and survivability.

In-flight. Does not apply to nuclear weapon systems. Measures the ability to maintain C2 of the conventional weapon system in-flight to include, but not limited to, the ability to retarget or terminate the weapon system in-flight without compromise to any threat systems or forces. A communications capability facilitating C2 for the weapon system in-flight is envisioned. Retargeting and termination of execution orders would be primary capabilities for a conventional LBSD C2 of in-flight weapons systems would require an achievable capability distance range that has yet to be defined.

MOE 1.4: Security. Security information provided is for nuclear and conventional weapon systems. Nuclear security information will be provided through the Mighty Guardian Exercises, Nuclear Surety Inspections, combat readiness evaluations, historical modeling and simulation results, analysis of the Integrated Base Defense Security System, and Air Force Force Protection concept when considering alternative basing concepts. Any designed LBSD security system should consider the following for both nuclear and conventional weapon systems:

Designed Security. Measures the performance-based integrated security approach to design in security technology for trusted entry and access control and to meet nuclear surety and safety requirements through all phases of maintenance and operations.

Designed Denial. Evaluates the ability of the system to prevent any unauthorized access to, damage, theft or sabotage of the critical components of the weapon system (inclusive of unauthorized use and unauthorized launch). Theft includes "theft" of a warhead and can be a motivation by other than terrorists (i.e., third party sell-to-terrorist group or other nation).

Security Effectiveness. Measures the overall effectiveness of supporting security systems to deter, detect, delay and deny adversary access to critical components of the weapon system.

An integrated security approach should include these capabilities: wide area intrusion detection and tracking; long-range assessment; integrated command and control; wireless secure communications; identification friend or foe; robotics; rapid positive base access; and remotely operated weapons for final denial fire.

Common terminology/definitions applicable to security are:

Anticipate. Anticipation allows friendly forces to see and understand the adversary's use of space and means to attack.

Assess. The defense effect can be analyzed through the leverage of intelligence or other information.

Deceive. Deception will distort the adversary's view and mislead his course of action.

Delay. Delaying tactics slow the adversary without the need for a massive response at the outset of an engagement and allow friendly forces more time to react.

Deny. Denial prevents adversary's use of space and means to attack.

Deploy. The ability to rapidly mass a reaction force and attain positional advantage by early and sensible deployment.

Destroy. To render unusable or ineffective when applied to an adversary's assets or capabilities.

Detect. Detection allows friendly forces to see all potential attacks.

Deter. Deterrence can discourage adversary's action by making the consequences of that action clear and unpalatable.

Disrupt. The ability to disorder or interrupt a course of tasks or actions.

Exclusion Area. The area that immediately surrounds a nuclear weapon or nuclear weapon system and associated command and control systems.

Mitigate. Mitigation minimizes the effects of an adversary's success.

Neutralize. Neutralization renders the adversary ineffective.

Response. Security force element(s) capable of interrupting and neutralizing an adversary prior to the completion of a malevolent act.

MOE 2: Probability of Target Destruction (PD). The probability an arriving weapon with a given yield, circular error probable, height of burst and displacement from a target or set of targets will achieve at least the specified degree of damage to the target. The target is characterized by type, size and vulnerability to weapon effects. The probability a target will achieve a desired level of damage (i.e., severe, moderate, light) from a given weapon system in a given hostile/threat environment. MOE 2 is broken into (3) sub-MOEs: MOE 2.1, Hard/Fixed Targets (Surface); MOE 2.2, Soft/fixed Targets (Surface, SRTs and High Altitude); and MOE 2.3, Hard/Deeply Buried Targets (Sub-surface).

MOE 2.1: Hard/Fixed Targets (Surface). Weapon accuracy (nuclear and conventional) must be sufficient to ensure a high PD against a hard/fixed target. As a minimum, nuclear weapon accuracy must equal the accuracy of the latest ICBM or SLBM system (whichever is better). Nuclear and conventional munitions' accuracy (i.e., CEP) must be the best technology can provide.

MOE 2.2: Soft/Fixed Targets (Surface, SRTs and High Altitude). Weapon accuracy (nuclear and conventional) must be sufficient to ensure a high PD against a soft/fixed target. Nuclear weapons must also be capable of a High Altitude Burst. As a minimum, nuclear weapon accuracy must equal the accuracy of the latest ICBM or SLBM system (whichever is better). Nuclear and conventional munitions' accuracy (i.e., CEP) must be the best technology can provide.

MOE 2.3: Hard & Deeply Buried Targets (Sub-surface). Weapon accuracy (nuclear and conventional) must be sufficient to ensure a high PD against a hard/buried target. As a minimum, nuclear weapon accuracy must equal the accuracy of the latest ICBM or SLBM system (whichever is better). Nuclear and conventional munitions' accuracy (i.e., CEP) must be the best technology can provide.

Note: The MOPs that follow apply to MOEs 2.1, 2.2 and 2.3.

MOP 13: PD Characteristics.

Yield. Yield represents the destructive power of a given weapon. The Department of Energy defines yield as the approved blast/physics rating of the energy released by a nuclear device. The blast comparison of a nuclear device to the effects of TNT where 1 kiloton is equivalent to the energy released by 1000 tons of TNT. Conventional munitions are measured in pounds.

Kiloton. Kiloton – Weapons must be designed to support nuclear blasts in the 50 – 999 kiloton range.

Conventional munitions. Weapons must be designed to support conventional munitions in the 1000 pound-class.

Circular Error Probable (CEP). The radius of a circle centered on the desired ground zero with which 50 percent of the reentry vehicles or weapons are expected to be located at detonation.

Height of Burst (Aim point). The height (planned or actual), above or below a target, where a nuclear or conventional device will detonate.

HAB. The aim point(s) in the exoatmosphere for a nuclear munitions. The system must be capable of supporting variable high altitude heights of bursts.

Air Burst. The aim point(s), in various altitudes, above the target for nuclear munitions. The system must be capable of supporting variable altitude requirements for an air burst.

Surface Burst. The aim point(s) of various surface bursts at varying altitudes, depending upon target altitude. The system must be capable of supporting a surface burst at any target altitude.

Sub-surface Burst (Earth Penetrator). The aim point(s) in various feet below the surface of the ground. The system needs to support various sub-surface aim points in order to effect damage on hardened/buried targets.

Offset. The translational distance from the center point of the target to the planned aim point. Nuclear weapon system must be able to take into account offset.

MOP 14: Fusing Options.

HAB. High Altitude Burst – Fusing for nuclear munitions must be capable of supporting a high altitude burst in the exoatmosphere (various heights).

Air. Fusing for nuclear munitions must be capable of supporting an air burst at multiple altitudes (various heights).

Surface. Fusing must be capable of supporting a surface burst at any altitude.

Sub-surface (Earth Penetrator). Fusing must be capable of supporting an earth penetrator weapon at various depths below the surface in various ground compositions, voids, and sensing regimes.

5.3 Working Taxonomy Definitions

Measures of Effectiveness (MOEs): Quantify directly how well the system meets the mission objectives. An MOE can be defined as a measure of operational success that must be related to the objective mission or operation being evaluated.

Measures of Performance (MOPs): An MOP can be defined as a measure of how the system performs its functions in a given environment. It is closely related to inherent physical and structural parameters, but measures attributes of system behavior.

Capable: The capacity to be used, treated or developed for a particular purpose; ability.

Command and Control (C2): The exercise of authority and direction by a properly designated commander over assigned and attached forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in the planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission.

Command, Control, Communications, and Computer (C4) Systems: Integrated systems of doctrine, procedures, organizational structures, personnel, equipment, facilities, communications, and computer software and hardware designed to support a commander's exercise of command and control across the range of military operations. C3 (Command, Control, Communications) includes use of all communications means with the intent of conveying information of any kind from one person or place to another in support of a commander's exercise of command and control.

Flexible: Capability to adapt to new, different or changing requirements.

Interoperability: The ability of systems, units, or forces to provide services to and accept services from other systems, units, or forces and to use the services so exchanged to enable them to operate effectively together. For DOD only: the condition achieved among communications-electronics systems or items of communications-electronics equipment when information or services can be exchanged directly and satisfactorily between them and/or their users. The degree of interoperability should be defined when referring to specific cases.

Lethality: The ability of munitions or directed energy weapons to cause damage that will cause the loss or degradation in the ability of a target system to complete its designated missions(s).

Operable: Fit, possible, or desirable to use; practicable.

Reliable: Suitable or fit to be relied on, dependable; giving the same result on successive trials. Measure of the ability of a weapon system to operate as advertised in the absence of a threat environment--the probability the weapon system will attain nominal performance characteristics.

Responsive: Giving response, answering; quick to respond or react appropriately.

Survivability: The capability of a system and crew to avoid or withstand a man-made hostile environment without suffering an abortive impairment of its ability to accomplish its designated mission. Survivability consists of susceptibility, vulnerability and recoverability.

Susceptibility: The degree to which a weapon system is open to effective attack due to one or more inherent weaknesses. (Susceptibility is a function of operational tactics, countermeasures, probability of enemy fielding a threat, etc.). Susceptibility is considered a subset of survivability.

Vulnerability: The characteristic of a system that causes it to suffer a definite degradation (loss or reduction of capability to perform its designated mission) as a result of having been subjected to a certain (defined) level of effects in an unnatural (man-made) hostile environment. Vulnerability is considered a subset of survivability.

Recoverability: Following combat damage, the ability to take emergency action to prevent loss of the system, to reduce personnel casualties, or to regain weapon system combat mission capabilities.

Characteristic: A distinguishing attribute or element.

5.4 Assumptions and Constraints

The following constraints and assumptions will bound the AoA Effectiveness Analysis. Many of the constraints and assumptions are consistent with the LBSD AoA Study Plan Chapter Three constraints and assumptions. Additional assumptions and constraints may be added in the future as required.

Assumptions:

Analysis Level. The analysis performed for the nuclear weapon system will be conducted at the Campaign level. The analysis performed for the conventional weapon systems will be conducted no higher than the Engagement level.

Basing. Basing will be confined to Continental United States.

Collateral Damage. Meeting the desired destruction goals of the target will always be a primary goal of planning; however, the collateral damage associated with these strikes remains a very important part of any weapon system application. The effects of a weapon on surrounding infrastructure, buildings and/or population are a vital part of the weapons application process. Increased accuracy, flexible fusing options, etc., all combine to minimize collateral damage and will be considered during the AoA.

C4. It is assumed the current C4 weapon system infrastructures, consisting of launch facilities, launch control system, the airborne launch control system, and communications and computer infrastructure will not necessarily be utilized for command and control. It is also assumed that future C4 systems may utilize emerging technologies for in-flight C2 of weapon systems (e.g., trajectory shaping vehicles or multiple independent reentry vehicles).

Conventional Attack. It is assumed that adversaries to the US will have conventional weapons capable of destroying US weapon systems unless active measures are taken. These potential systems will be capable of interfering with the system by jamming, laser, microwave and electro-magnetic interference.

Conventional Weapons. It is assumed all conventional weapons will not exceed 1000 lbs and be a variety of configurations (to include Standard, MIRV, TSV, and CAV).. Conventional weapons will be utilized for penetrator and surface bursts.

Damage Expectancy. It is assumed that damage expectancy is a product of pre and post-launch survivability, weapon system reliability, weapon system responsiveness, security and probability of target destruction to a given target.

Fusing. It is assumed fusing for nuclear weapons will be developed consistent with mission (penetrator, surface, air and high altitude burst). It is assumed fusing for conventional weapons will be developed consistent with mission (penetrator and surface burst).

Multiple Independently Retargetable Vehicles. It is currently assumed that MIRVed vehicles may be deployed with nuclear and conventional weapon systems.

Nuclear Weapons. It is assumed all nuclear weapons will detonate in the 5--999 kiloton range. Nuclear weapons will be utilized for penetrator, surface, air and high altitude burst.

Postulated Threat. The official baseline threat definition, identifying the type and capabilities of the threat to US nuclear weapons. The integrated security system must be capable of thwarting the postulated threat as found in DOD 5210.41M (Secret) for nuclear and AFI 31-101 for non-nuclear resources.

Probability of Target Destruction. It is assumed that probability of damage is a function of weapon system yield, circular-error probability, height of burst, offset and target hardness.

Range. It is assumed that range of the weapon system is a function of the boost vehicle and type of reentry system. A global range of targets required to be attacked will be assumed. A minimum range of equal to the current ICBM systems (MM III and PK) will be assumed. Permission of overflight by foreign countries will be assumed along with an all-azimuth capability. Range requirements may differ depending upon whether nuclear or conventional weapons are executed.

Retargeting. It is assumed that all retargeting actions by crewmembers will be as fast as or faster than the current system performs. It is further assumed that system alignment will be faster than current system parameters and that an all-azimuth retargeting capability will be developed.

Retargeting: In-flight. It is assumed that in-flight retargeting of sorties carrying nuclear weapons will not be accomplished. In-flight retargeting of sorties carrying conventional weapons may be accomplished. In-flight retargeting is different than updating guidance information that would lead to increased accuracy against a given target. Updating guidance information will be considered for both nuclear and conventional sorties.

Standard Reentry Vehicles. It is assumed that nuclear and conventional weapons may be employed aboard ballistic RVs.

Target Sets. It is assumed that target sets will consist of hard/fixed, soft/fixed (includes strategic relocatable targets), and hard/buried targets. Nuclear and conventional weapons will be utilized against these target sets. Nuclear weapon types developed to attack these targets will be penetrator, airburst, ground burst and high altitude burst. Conventional weapon types developed to attack these targets will be penetrator and ground burst. Target sets are defined as follows:

Hard/Fixed – A hardened target with any part of the target either exposed to the surface or not buried more than 100 feet in depth. Examples to be considered would be some launch facilities or C4 facilities. A normal

surface burst, or in some cases an air burst by a nuclear weapon would achieve desired damage expectancy. A conventional weapon may attack this target with either a surface burst or earth penetrator, depending upon the hardness/depth of the target.

Soft/Fixed - A soft target with any part of the target exposed to the surface. Also, high altitude target coordinates are considered a soft/fixed target. Examples to be considered would be airfields, factories or a set of coordinates in the exoatmosphere. A normal surface burst or an air/exoatmosphere burst by a nuclear weapon would achieve desired damage expectancy. A conventional weapon may attack this target with a surface burst.

Strategic Relocatable - A soft target that is capable of relocation in a timely manner (timely manner not defined). Examples to be considered would be mobile C4 facilities and relocatable weapon systems (nuclear and conventional). A normal surface burst or air burst by a nuclear weapon or surface burst by a conventional weapon should achieve desired damage expectancy.

Hard/Deeply Buried - A hardened target buried deeper than 100 feet below the ground surface. Examples to be considered would be hardened, buried C4 facilities; hardened, buried weapons of mass destruction facility; or hardened, buried regular storage facilities. Normally an earth-penetrating weapon would be required to achieve desired damage expectancy.

Timeliness of Execution Orders. It is assumed that both human processing of emergency action messages and weapon system reaction times to these orders will, as a minimum, be as capable as currently experienced in the MM III and PK ICBM weapons systems.

Trajectory-Shaping Vehicles. It is assumed trajectory-shaping vehicles (TSVs) may be developed for nuclear and conventional weapons.

Weapons of Mass Destruction (WMD) - Survivability. It is assumed that Launcher Locations, Primary Launch Centers, the Alternate Launch System, C4 systems and facilities, critical support systems and personnel may be potential targets of US adversaries using nuclear, biological and chemical weapons. The standard minimums for weapon system hardness against WMD must at least equal current MMIII or PK and should look to incorporate new technologies to increase survivability.

WMD - Lethality. It is assumed the Land-Based Strategic Deterrent weapon system will attack potential high value, nuclear, chemical and biological targets.

Attack of these targets may be accomplished utilizing nuclear or conventional weapons.

Weaponry. It is assumed that nuclear weapons will be employed singularly or MIRVed aboard a single boost vehicle. Nuclear weapons that may be employed are a standard reentry vehicle, a MIRVed vehicle and trajectory-shaping vehicle. In addition, conventional weapons may be employed aboard a CAV. Nuclear and conventional weapon systems may contain defensive counter-measures such as chaff or other means not yet developed.

Constraints:

Arms Control. All systems must comply with US international obligations and be designed for compatibility with future arms control regimes, to the extent predictable.

C4ISR. All new or modified hardware and software affecting Command, Control, Communications, Computer (C4), Intelligence, Surveillance, Reconnaissance System (ISR) interfaces must be developed to enhance interoperability and survivability in accordance with the standards specified in the DoD Joint Technical Architecture, Air Force Infostructure Technical Reference Model, DOD Architecture Framework, and the Air Force Enterprise Architecture Framework. All new or modified C4 systems will interoperate with the DOD Global Information Grid and Transformational Communications. In addition, all installed communications-electronics equipment/systems including any commercial or non-developed item (NDI) subsystems shall comply with all DoD, National and International spectrum management policies and regulations.

Commonality. Programs should apply common technologies and components wherever possible. Commonality between the USAF and Navy Strategic Systems is necessary to obtain synergy and prevent duplication of effort, but should guard against a single fault jeopardizing the viability of the nuclear ICBM and SLBM legs of the triad.

Environment, Safety and Health. Systems shall comply with all federal, state and local environmental laws, regulations and executive orders regarding safety, health, pollution, and waste minimization. Actions will be taken to minimize the use of hazardous/environmental impact materials and manufacturing processes. Environmental analysis of weapon system acquisition, testing, operations and disposal must ensure impacts are identified and minimized whenever possible.

Information Assurance. Information Assurance (IA) shall be an integral part of all system design, implementation and interoperability efforts thus allowing appropriate security measures to protect mission data and system resources. This includes protection of information facilities and equipment from all known threats. The system must incorporate defensive IA capabilities that provide the availability, integrity, authentication, confidentiality and non-repudiation of the

information exchanged and used. This includes characteristics needed for restoration through protection, detection and reaction capabilities.

Joint Potential Designator. Joint Interest.

Logistics. The design of all life extension efforts and modifications must be inherently reliable and maintainable in order to minimize maintenance actions. All efforts, including new technology, must equal or exceed current reliability, maintainability and performance standards.

Manpower. Programs must be devised and implemented with due attention to manning constraints in operations, maintenance, support and security forces. Innovative concepts to reduce manpower must be explored.

Nuclear Surety. The changing threat environment intensifies the need to ensure safe handling of nuclear weapons; avoidance of unauthorized, accidental, or inadvertent launch; and physical security of nuclear weapons facilities. System modifications must not degrade nuclear surety and should enhance it whenever possible.

Operating Environment. The system must be able to perform all missions while operating in the most hostile environments, up to and including the conditions created by a nuclear exchange. The weapon systems/equipment and C4 infrastructure shall be electro-magnetically compatible both internally and with other systems in its operational environment, such that system operational performance requirements are met.

Operations and Maintenance Costs. All programs must endeavor to reduce operations and maintenance costs in line with the AF's weapon system cost reduction process.

Political Acceptability. Systems and employment concepts must be flexible, capable and consistent with US national policies regarding strategic force employment.

Stability. The system must contribute to enhancing the stability of deterrence. The system must have the composite qualitative and quantitative force characteristics that are instrumental to robust deterrence.

Security. Program protection must be applied throughout the system's life cycle. System security measures must be applied to insure the integrity, availability and integration of facilities and equipment and must continue to meet or exceed DoD security requirements.

Treaties. All treaties other than arms control (such as SALT, START, and SORT) that affect weapons in or through space such as the Outer Space Treaty will be applied.