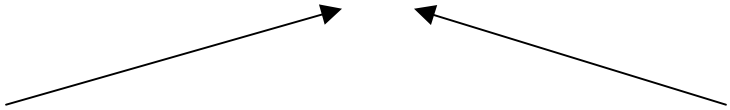
Table 5-1 Military Utility (MU) = Damage Expectancy (DE)

DE = f (PA, PD)

*PA= PLS (MOE1.1) * WSR (MOE1.2) assuming adequate Responsiveness (MOE1.3) and Security (MOE 1.4)

MT 1: *Deter aggression.

Dissuasion	Denial	Retaliation	Pre-emptive Capabilities.



MOE 1 Probability of Arrival (PA)	MOE 2 Probability of Target Destruction (PD)
MOE 1.1 Survivability (Pre and Post Launch) (PLC, ALS and LL) MOP 1 Weapons of Mass Destruction Attack MOP 2 Conventional Attack – pre/post-launch MOP 3 Intercept Attack MOP 4 Natural Disasters MOE 1.2 Weapon System Reliability MOP 5 Launch reliability MOP 6 In-flight reliability MOP 7 Re-entry Vehicle reliability MOE 1.3 Responsiveness #MOP 8 Execution Orders #MOP 9 Rapid In-flight Retargeting MOP 10 Rapid In-silo Retargeting MOP 11 Range #MOP 12 Command, Control, Communications & Computer (C4) Systems MOE 1.4 Security #Note 1: MOP 8, 9 and 12 will be incorporated into the WSR inputs.	MOE 2.1 Hard Targets (Surface) MOE 2.2 Soft Targets (Surface and High Altitude) MOE 2.3 Hard & Deeply Buried Targets (Sub-surface) * The MOPs that follow apply to MOEs 2.1, 2.2 and 2.3 MOP 13 PD Characteristics MOP 14 Fusing Options

5.2 Working Military Utility Taxonomy Descriptions

MT 1: Deter aggression. (*Implies dissuasion, denial, retaliation and pre-emptive capabilities).

MOE 1: Probability of Arrival (PA). P (Arrival) = PLS (MOE 1.1) * WSR (MOE 1.2) assuming adequate Responsiveness (MOE 1.3) and Security (MOE 1.4). The Probability of Arrival (PA) is equal to Pre/Post Launch Survivability (PLS, a probability) times the Weapon System Reliability (WSR, a probability) assuming adequate Responsiveness (R - measured by various methods including time, distance and azimuths) and Security (S, determined by weapon system basing and techniques employed).

MOE 1.1: Survivability (Pre and Post Launch) (Primary Launch Center, Alternate Launch System and Launcher Location).
(DoD 5000.2-R). The probability 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.

MOP 1: Weapons of Mass Destruction Attack. Expected survival rate varies by type of WMD.

Nuclear. Must be able to operate through a nuclear attack and still be executable. Measures susceptibility to damage/degradation from blast, radiation (gamma, x-ray, etc.), thermal and other attacks. Survivability of LL, PLC, ALS, C4 infrastructure, critical support equipment and personnel is directly proportional to lethality of attacking system and hardness of employed system. Attacking system lethality will have to be determined based on most likely weapon system to be used by an adversary, as determined by intelligence methods. Survivability is the measure of the weapon system hardness/susceptibility to damage from physical, blast, radiation and thermal attack in all phases of its employment. The baseline for the new system must, as a minimum, achieve current survivability capabilities of MM III or PK ICBM (whichever is more survivable) and should incorporate the latest technologies to ensure the highest possible level of survivability to a nuclear attack.

Chemical. Must be able to operate through a chemical attack and still be executable. Measures susceptibility to damage/degradation from chemical attacks. Survivability of LL, PLC, ALS, C4 infrastructure, critical support equipment and personnel is directly proportional to lethality of attacking system and hardness of employed system. Attacking system lethality will

have to be determined based on most likely weapon system to be used by an adversary, as determined by intelligence methods. The baseline for the new system must, as a minimum, achieve current survivability capabilities of MM III or PK ICBM (whichever is more survivable) and should incorporate the latest technologies to ensure the highest possible level of survivability to a chemical attack.

— **Biological.** Must be able to operate through a biological attack and still be executable. Measures susceptibility to damage/degradation from biological attacks. Survivability of LL, PLC, ALS, C4 infrastructure, critical support equipment and personnel is directly proportional to lethality of attacking system and hardness of employed system. Attacking system lethality will have to be determined based on most likely weapon system to be used by an adversary, as determined by intelligence methods. The baseline for the new system must, as a minimum, achieve current survivability capabilities of MM III or PK ICBM (whichever is more survivable) and should incorporate the latest technologies to ensure the highest possible level of survivability to a biological attack.

MOP 2: Conventional Attack (pre/post launch). Expected survival rate from all conventional attacks should be as a minimum at least equal to the current PK or MM III system (whichever survival rate is greater) and should take advantage of increasing survivability through emerging technologies. The following conventional attack methods are not necessarily the only conventional types of attacks the weapon system could encounter, but are provided as a baseline.

Jamming. Must be able to survive attack by conventional means. The weapon system and supporting C3 infrastructure needs to be able to operate correctly despite jamming to include PLC to LL, ALS to LL, ALS to PLC and potential commands to weapon system while in flight (during all phases of flight except terminal reentry). All weapon system commands in the aforementioned modes need to be addressed. This includes normal operating system commands to emergency war order procedural commands. The weapon system should operate in a day-to-day anti-jamming mode without degradation.

Laser. Must be able to survive laser attack to include an attack on the PLC, LL, ALS and the weapon system during all phases of flight. Also, any "critically" designated ground support systems, including supporting C4 infrastructure, must be protected. The weapon system should operate in a day-to-day laser denial mode without degradation.

Microwave. Must be able to survive microwave attack to include an attack on the PLC, LL, ALS, weapon system and supporting C4 infrastructure during all phases of flight. Also, any "critically" designated

ground support systems must be protected. The weapon system should operate in a day-to-day microwave denial mode without degradation.

Electro-Magnetic Interference (EMI). Must be able to survive EMI attack to include an attack on the PLC, LL, ALS, weapon system and C4 infrastructure during all phases of flight. Also, any "critically" designated ground support systems must be protected. This would include any platform for the ALS, to include support equipment for the platform. Weapon system should be protected from EMI in day-to-day operations without degradation.

MOP 3: Intercept Attack. Expected survival rate from all intercept attacks should at least equal current PK, MM III system or Submarine-Launched Ballistic Missile (SLBM) (whichever survival rate is greater) and should take advantage of increasing survivability through emerging technologies.

Boost Phase. Must be able to survive boost phase attack. Measures susceptibility to damage/degradation from blast, radiation, thermal and other attacks (see Conventional Attack requirements above) during boost phase of the missile launch, both for physical damage as well as communication and/or sensor degradation.

In-flight. Must be able to survive in-flight intercept. Measures susceptibility to damage/degradation from blast, radiation, thermal, kinetic and other attacks (see Conventional Attack requirements above) during in-flight phase, both for physical damage as well as communication and/or sensor degradation. This includes the ballistic environment produced by direct attack by missile defense/Anti-Ballistic Missile (ABM) systems.

Terminal. Must be able to survive terminal intercept attack of the reentry system (RS) or reentry vehicle (RV). Terminal Penetrator--Measures susceptibility to damage/degradation from blast, radiation, thermal and other attacks during the terminal/penetration phase of the weapon. This shall include expected engagements with missile and air defense systems. RV types will be considered for all target types. All weapons must ensure an acceptable PD (see MOE 2.1-2.3) against a nominal target set within weapon system capabilities. Weapon systems must have variable altitude delivery presets as well as independent altitude setting capability.

> **Standard (normal single RV straight-in) (SRV).** Surface – Measures the weapon system's capability to deliver a nuclear warhead intact utilizing a surface burst within nominal performance characteristics. Air – Measures the weapon system's capability to deliver a nuclear warhead intact utilizing an airburst to within nominal performance characteristics. High Altitude Burst (HAB) – Measures the weapon system's capability to deliver

a nuclear warhead intact utilizing a high altitude burst within nominal performance characteristics. Penetrator--Measures the penetrator's capability to deliver a nuclear warhead intact within nominal performance characteristics; the probability the penetrator will deliver the warhead intact to provide nominal warhead/ground coupling performance.

No Penetration Aids. Self-explanatory.

Penetration Aids. All types of penetration aids technologically achievable must be examined. This could include, but is not limited to, chaff, stealth technology, etc.

Multiple Independently Retargetable Vehicle (MIRV). Surface–Measures the weapon system's capability to deliver a nuclear warhead intact utilizing a surface burst within nominal performance characteristics. Air – Measures the weapon system's capability to deliver a nuclear warhead intact utilizing an air burst within nominal performance characteristics. HAB – Measures the weapon system's capability to deliver a nuclear warhead intact utilizing a high altitude burst within nominal performance characteristics. Penetrator--asures the penetrator's capability to deliver a nuclear warhead intact within nominal performance characteristics; the probability the penetrator will deliver the warhead intact to provide nominal warhead/ground coupling performance.

No Penetration Aids. Self-explanatory.

Penetration Aids. All types of penetration aids technologically achievable must be examined. This could include, but is not limited to, chaff, stealth technology, etc.

Trajectory Shaping Vehicle (TSV). Surface – Measures the weapon system's capability to deliver a nuclear warhead intact utilizing a ground burst within nominal performance characteristics. Air – Measures the weapon system's capability to deliver a nuclear warhead intact utilizing an air burst within nominal performance characteristics. Penetrator--Measures the penetrator's capability to deliver a nuclear warhead intact within nominal performance characteristics; the probability the penetrator will deliver the warhead intact to provide nominal warhead/ground coupling performance.

No Penetration Aids. Self-explanatory.

Penetration Aids. All types of penetration aids technologically achievable must be examined. This could include, but is not limited to, chaff, stealth technology, etc.

Conventional Land-Based Strategic Deterrent (cLBSD). Surface – Measures the weapon system's capability to deliver conventional munitions intact utilizing a ground burst with nominal performance characteristics. Penetrator--Measures the penetrator's capability to deliver conventional munitions intact within nominal performance characteristics; the probability the penetrator will deliver the conventional munitions intact to provide nominal warhead/ground coupling performance. Standard, MIRV, TSV, and CAV capabilities should be considered for cLBSD.

No Penetration Aids. Self-explanatory.

Penetration Aids. All types of penetration aids technologically achievable must be examined. This could include, but is not limited to, chaff, stealth technology, etc.

MOP 4: Natural Disasters. The only natural disaster considered is weather. Extreme temperature ranges could range from minus 100(F) to plus 120(F). High winds can damage ground equipment and affect launch safety. Deep snow and ice can damage ground equipment, communications, et cetera. Heavy rains and associated downdrafts can prevent successful fly-out during launch and damage support equipment and communications. Lightning can temporarily interrupt ground equipment and possibly disrupt Aerospace Vehicle Equipment (AVE) and even cause catastrophic failure of the boost vehicle during launch. Lightning can also can affect ALS/node operations and connectivity. As weather extremes are not anticipated to differ in the future from what has been experienced in the past 30 years, the capability to survive weather extremes should be at least equal to the current MM III or PK systems (whichever system's weather survivability is greater) and should incorporate the latest technologies to ensure the highest possible level of survivability.

MOE 1.2: Weapon System Reliability (WSR). The probability of a scheduled weapon arriving in the target area and detonating as planned excluding the effects of enemy action. Measures 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. Minimum reliability standards, as envisioned by HQ AFSPC/XON for all components together (launch, in-flight and re-entry) should be no less than 93%. Acceptable standard for all components is 95%. Ideal standard would be 98%.

MOP 5: Launch Reliability. The probability of a scheduled weapon system surviving launch (actually launching).

MOP 6: In-flight Reliability. The probability of a scheduled weapon system surviving in-flight (completing in-flight phase).

MOP 7: RV Reliability. The probability of a scheduled weapon system RV surviving (arriving) and striking its intended target.

MOE 1.3: Responsive. Responsive–giving response, constituting a response, answering; quick to respond or react appropriately or sympathetically, sensitive. Responsive is defined in terms of the LBSD AoA to reflect both human (C2) and weapon system responsiveness in a rapid, timely manner reflected in minutes and seconds (not hours or days); distance; and azimuth.

MOP 8: Execution Orders.

Human Processing. Human processing (C2)–Timelines associated with human processing of an execution order. Includes copying, decoding and weapon system operations required to launch weapons. Baselines for current MM III and PK ICBM systems are acceptable minimum standards for new system (as defined in CJCSI 6811.01A, Nuclear Technical Performance Criteria); however, the latest technologies should be incorporated whenever possible.

Weapon System Timeliness. Timeliness associated with physical weapon system processing commands. Includes human commands and weapon system responsiveness to commands. Baseline launch execution timelines for current MM III and PK ICBM systems are acceptable minimum standards for new system, however, the latest technologies should be incorporated whenever possible.

MOP 9: Rapid In-flight Retargeting. Conventional weapons may be retargeted in-flight.

Strategic Relocatable Targets (SRT). SRTs are typed as a Soft Target. SRTs will be treated as an emerging soft target for nuclear weapons. Conventional weapons may be retargeted in-flight. The following information measures the ability of the a conventional weapon to receive/process retargeting data from various sources to effect retargeting of the conventional weapons in-flight.

Search zone. Measures the ability of a conventional weapon to receive and process retargeting data in the loiter or terminal phase. The conventional LBSD (cLBSD) should be able to search an area equal to 200 miles by 500 miles (notional only--exact area would

be classified, but needs to be determined). Area could vary widely depending upon capabilities of a cLBSD.

Kill Zone. Measures the ability of the cLBSD to receive/process retargeting data in the kill zone. The cLBSD should be able to successfully engage a given target/target type anywhere in the search zone upon successfully receiving/processing retargeting data. Search zone and kill zone area dimensions should be equal.

Identification. Measures the probability of the cLBSD to successfully collect/classify a specific target/target type within its search zone. The cLBSD should be able to achieve a probability of identification of at least 90% of a given target in its search/kill zone.

Emerging Fixed Targets. Measures the ability of the conventional weapon system to receive/process retargeting data in-flight and successfully strike an emerging fixed target. An SRT is also considered as an emerging fixed target. A nuclear weapon may be targeted against an emerging fixed target whose targeting coordinates are known prior to launch.

MOP 10: Rapid In-silo Retargeting. In-silo retargeting timing should at least equal current MM III or PK timelines (whichever is fastest) and should take advantage of new technology available to increase speed.

System Alignment. Weapon system must be capable of rapid retargeting. Weapon system must not experience any significant delays when directed to realign to different target coordinates, regardless of what the new coordinates may be.

Rapid Input of Data. Retarget timing. Measures the time required to transmit retargeting updates of various complexities to the weapon system both in-silo and in-flight.

All Azimuth Capability. Measures the weapon system's capability to encompass all azimuth requirements and associated parameters. Weapon system must be capable of 360-degree azimuth launch settings per guidance of HQ AFSPC/XON.

MOP 11: Range.

Maximum. Measures the ability to launch/transport the nuclear warhead(s) and conventional munitions within nominal performance characteristics to the maximum range possible. Currently, HQ AFSPC/DRM estimates maximum range requirement to be global.

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 that 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.