CHAPTER 2

NUCLEAR WEAPONS EMPLOYMENT POLICY, PLANNING, AND NC3

OVERVIEW

Planning for the potential employment of U.S. nuclear forces goes through a deliberate and methodical process. This process includes elements such as identification of objectives and guidance, target development, weaponeering, force planning, force execution, and battle damage assessment (BDA). In order to meet policy and planning objectives, U.S. Strategic Command (USSTRATCOM) and geographic combatant commands nominate, vet, and select adversary strategic facilities and capabilities as targets. This process cannot succeed without command and control, and U.S. policy states that the nuclear deterrent is only as effective as the command and control network that enables it to function. The United States ensures this effectiveness through the Nuclear Command and Control System (NCCS), a combination of capabilities necessary to: ensure the authorized employment and termination of nuclear weapon operations under all threats and scenarios; secure against the accidental, inadvertent, or unauthorized access to U.S. nuclear weapons; and prevent the loss of control, theft, or unauthorized use of U.S. nuclear weapons. The NCCS is broken into two main components: nuclear command, control, and communications (NC3) and nuclear weapons safety, security, and incident response. NC3 is the focus of this chapter.

NUCLEAR WEAPONS EMPLOYMENT POLICY AND PLANNING[1]

OBJECTIVES AND GUIDANCE

Planning for the potential employment of U.S. nuclear forces goes through a deliberate and methodical process, as depicted in Figure 2.1. The first step in the planning process is the issuance of nuclear employment policy and planning guidance to meet national security objectives. Planning for the employment of nuclear

[1] See JP 3-72, *Nuclear Operations*, for more information about this topic.

systems is consistent with national policy and strategic guidance, which is articulated in a number of documents. These include:

- *Presidential guidance* – issued through directives and memoranda, addresses planning, posture, and strategic objectives regarding nuclear employment.
- *Departmental guidance* – issued by the Secretary of Defense, implements the President's guidance and contains amplifying planning and policy guidance consistent with Presidential direction.
- *Military guidance* – from the Chairman of the Joint Chiefs of Staff (CJCS) to Combatant Commanders (CCDRs), provides guidance on the development and coordination of nuclear operations plans.
- *Other strategy and posture documents* – such as the National Security Strategy, the National Defense Strategy, and the Nuclear Posture Review, which together describe U.S. nuclear policy, strategy, capabilities, and force posture.

Figure 2.1 Nuclear Planning Process

TARGET DEVELOPMENT

In order to meet policy and planning objectives, USSTRATCOM and geographic combatant commands nominate, vet, and select adversary strategic assets, facilities, and capabilities as targets. This process is based on analysis of the strategic environment as well as the identification of adversary weaknesses that, if exploited, would help achieve U.S. military goals and objectives. Facilities and capabilities can be nominated as they are discovered or in response to changing priorities, guidance, or objectives. Once selected, the Defense Intelligence Agency (DIA) performs a physical vulnerability assessment to evaluate a target's susceptibility to the effects of a nuclear weapon.

Using engineering best practices and target intelligence information, structural engineers develop detailed models of targets with an emphasis on design aspects, and the construction practice and materials relevant to a comprehensive vulnerability analysis. Simplifying assumptions are made about the behavior of a structure and a numerical engineering model is developed to evaluate the target's response to nuclear weapon effects. The applied modeling techniques span the spectrum of numerical methods, from simple single-degree of freedom models to high fidelity codes. Factors determining the type of method used include required structural details, damage mechanism, and strategic importance of the target. Whether very simple or very complex, the model must allow an estimate of the actual behavior of the structure with reasonable accuracy.

A target's response to a nuclear detonation is determined for a wide range of weapon yields and results in a vulnerability number. Vulnerability numbers for targets are stored in the DIA target database, the national-level repository for the general military intelligence available to the entire DoD intelligence information system community.

WEAPONEERING ASSESSMENT

Nuclear planning or "weaponeering" is the process of delivering and applying weapons to targets in order to meet national and military objectives. Nuclear weaponeering assessments consider the characteristics of nuclear systems (e.g., yield and accuracy) against the characteristics of targets (e.g., vulnerability, size, defenses) and seek to identify applications of weapons on targets that would succeed in delaying, disrupting, disabling, or destroying critical enemy forces or resources. Other considerations include the adversary ability to reconstitute or regenerate, avoidance of collateral damage, and environmental conditions in the target vicinity.

Another aspect of nuclear planning is the construction of the intended location of a weapon detonation, known as the Desired Ground Zero (DGZ). The goal of DGZ construction is to identify weapon aim points to achieve the stated damage criteria. Whenever possible, a single weapon may be planned for use to cause damage to multiple targets.

FORCE PLANNING

Force planning brings together target development and weaponeering analysis with available forces. It marks a shift in the overall process from analysis to operational planning. Planning for the employment of nuclear weapons is based on a number of factors, to include: the number, yields, and types of nuclear weapons available; the operational availability of weapon delivery platforms; the characteristics and limitations of the forces available; and the status and disposition of friendly forces at the time nuclear weapons are to be employed.

Each nuclear delivery system and weapon has unique planning and employment considerations, including alert levels and generation times (time required for the weapon or system to become available for employment), overflight considerations, and flight times. As such, there may be adjustments to targeting recommendations as planners develop force packages, assign primary and supporting assets to carry out the mission, and deconflict other operational considerations (e.g., timing, sequencing). This is a dynamic stage in the overall process, whereby operations and intelligence staffs work closely together to determine the optimal execution of nuclear-capable forces and supporting assets to engage a target and achieve a particular objective.

DECISION CONFERENCING

The decision to employ nuclear weapons requires the explicit authorization of the President of the United States. In a crisis, the President will be briefed on the likelihood of achieving national or military objectives using nuclear weapons as well as the diplomatic, strategic, operational, and legal implications of such use. The President bases this decision on many factors and will consider the advice and recommendations of senior advisors, to include the Secretary of Defense, the CJCS, and CCDRs. Depending on the crisis situation, the President may consult with U.S. allies during the decision-making process. The Nuclear Command and Control System plays a critical role in enabling decision-making conferencing and, if determined, receiving presidential orders to conduct a nuclear strike.

FORCE EXECUTION/BATTLE DAMAGE ASSESSMENT

The execution of nuclear operations must seek to optimize both the survivability and combat effectiveness of the forces, while mitigating casualties to the extent possible while still achieving objectives. As a whole, U.S. nuclear forces are diverse, flexible, effective, survivable, enduring, and responsive in order to prevail against a range of threats and across a spectrum of environmental conditions. During the pre- and post-employment of nuclear forces, planners, operators, and intelligence staffs will conduct a battle damage assessment. This entails measuring the physical and functional effects of target engagement, assessing the extent of collateral damage, and examining the overall impact on adversary military activities. This includes examining direct, indirect, cumulative, cascading, and unintended effects of nuclear weapon use, which are further described in *Chapter 13: Basic Nuclear Physics and Weapons Effects*.

NUCLEAR WEAPONS TARGETING TERMINOLOGY

Damage Criteria

Damage criteria are standards identifying specific levels of destruction or material damage required for a particular target category. These criteria vary by the intensity of the damage and by the particular target category, class, or type, and are based on the nature of the target, including its size, hardness, and mobility, as well as the target proximity to military or non-military assets. These criteria provide a means by which to determine how best to strike particular targets and, following the attack, evaluate whether the target or target sets were sufficiently damaged to meet operational objectives.

Radius of Damage

Radius of damage (RD) is the distance from the nuclear weapon burst at which the target elements have a 50 percent probability of receiving at least the specified (severe or moderate) degree of damage. In strategic targeting, this has been called the weapon radius. Because some target elements inside the RD will escape the specified degree of damage while some outside the RD are damaged, response variability results. The RD depends on the type of target, the yield of the weapon, the damage criteria, and height of burst (HOB) of the nuclear weapon.

Circular Error Probable

Circular error probable (CEP) is a measurement of the delivery accuracy of a weapon system and is used as a factor in determining probable damage to a target. The CEP is the radius of a circle within which half of the weapons are expected to fall. A weapon has a 50 percent probability of landing within one CEP of an aimpoint.

Probability of Damage

Probability of damage (PD) is the prospect of achieving at least the specified level of damage, assuming the weapon arrives and detonates on target. It is expressed as fractional coverage for an area target and probability of damage for a point target. The PD is a function of nuclear weapons effects and weapons system delivery data including yield, RD, CEP, and HOB.

Probability of Arrival

Probability of arrival (PA) is the likelihood the weapon arrives and detonates in the target area, calculated as a product of weapon system reliability (WSR), prelaunch survivability (PLS), and probability to penetrate (PTP). The equation for planners is WSR x PLS x PTP = PA.

- *WSR* – compounded reliability based on test data for each warhead-type and each delivery system type.
- *PLS* – probability the weapon system will survive a strike by the enemy.
- *PTP* – probability the weapon system survives enemy air-defense measures and reaches the target.

Damage Expectancy

Damage expectancy (DE) is calculated as the product of the PD and the PA, shown in the formula PA x PD = DE. DE accounts for both weapons effects and the probability of arrival in determining the probability of achieving at least the specified level of damage.

Nuclear Collateral Damage

Nuclear collateral damage is undesired damage or casualties produced by the effects of nuclear weapons. Such damage includes danger to friendly forces, civilians, and non-military-related facilities as well as the creation of obstacles and residual nuclear radiation contamination. Because the avoidance of casualties among friendly forces and non-combatants is a prime consideration when planning either strategic or theater nuclear operations, preclusion analyses must be performed to identify and limit the proximity of a nuclear strike to civilians and friendly forces. Specific techniques for reducing collateral damage include:

- *Reducing weapon yield* – the yield of the weapon needed to achieve the desired damage is weighed against the associated risks in the target area;
- *Improving accuracy* – accurate delivery systems are more likely to strike closer to the aimpoint, reducing the required yield and the potential collateral damage;
- *Employing multiple weapons* – collateral damage can be reduced by dividing one large target into two or more smaller targets and by using more than one lower-yield weapon rather than one high-yield weapon;
- *Adjusting the height of burst* – HOB adjustments, including the use of air bursts to preclude any significant fallout, can help to minimize collateral damage; and
- *Offsetting the desired ground zero* – moving the DGZ away from target center may achieve the desired effects while avoiding or minimizing collateral damage.

Counterforce Targeting

Counterforce targeting plans to destroy the military capabilities of an enemy force. Typical counterforce targets include bomber bases, ballistic missile submarine bases, intercontinental ballistic missiles (ICBM) silos, air-defense installations, command and control centers, and weapons of mass destruction storage facilities. Because these types of targets may be hardened, buried, masked, mobile, and defended, the forces required to implement this strategy need to be diverse, numerous, and accurate.

Countervalue Targeting

Countervalue targeting plans the destruction or neutralization of selected enemy military and military-related targets such as industries, resources, and/or institutions contributing to the enemy's war effort. As these targets tend to be softer and less protected, weapons required for this strategy need not be as numerous or accurate as those required to implement a counterforce targeting strategy.

Layering

Layering is a technique that plans to use more than one weapon against a target. This method is used to either increase the probability of target destruction or improve the probability a weapon arrives and detonates on target to achieve a specific level of damage, particularly against defended targets.

Cross-Targeting

Cross-targeting incorporates the concept of "layering" and uses different delivery platforms for employment against one target to increase the probability of at least one weapon arriving at that target. Using different delivery platforms, such as ICBMs, SLBMs, or aircraft-delivered weapons, increases the probability of achieving the desired damage or target coverage, particularly against hardened, buried, masked, mobile, and defended targets.

NUCLEAR COMMAND, CONTROL, AND COMMUNICATIONS

U.S. command, control, and communications is necessary to ensure the authorized employment and/or termination of nuclear weapons operations, to secure against accidental, inadvertent, or unauthorized access, and to prevent the loss of control, theft, or unauthorized use of U.S. nuclear weapons. The President's ability to exercise authorities is ensured by NC3.

NUCLEAR COMMAND AND CONTROL

In order to understand NC3, it is important to define and understand the components. Nuclear command and control (NC2) is the exercise of authority and direction, through established command lines, over nuclear weapon operations by the President as the chief executive and head of state. The fundamental requirements of NC2 are that it must be assured, timely, secure, survivable, and enduring in providing the information and communications for the President to make and communicate critical decisions throughout the crisis spectrum.

EXERCISING PRESIDENTIAL AUTHORITY

NC3 assures the integrity of transmitted information and must be survivable to reliably overcome the effects of a nuclear attack. NC3 performs fivecritical functions:

- situation monitoring;

- planning;
- decision-making;
- force direction; and
- force management.

The elements detailed below comprise the NC3 infrastructure that supports the President, through his military commanders, in exercising presidential authority over U.S. nuclear weapons operations, all of which need to function before and during a nuclear attack or nuclear war.

Personnel

Because of the policy implications, military importance, destructive power, and the political consequences of an accident or an unauthorized act, it is DoD policy that only those individuals who are appropriately trained, cleared, experienced, and demonstrate reliability are authorized to perform NC3 duties. NC3 personnel include operators, security personnel, and those who maintain facilities, equipment, communications, weapons, and delivery systems.

Procedures and Processes

NC3 requires rigorous procedures and processes to support the President and the Secretary of Defense in exercising command authorities in the areas of situation monitoring, decision-making, force direction, force management, and planning to direct the actions of the people who operate nuclear systems.

Facilities

Facilities include the National Military Command Center (NMCC), the Global Operations Center (GOC), the E-4B National Airborne Operations Center (NAOC), and the E-6B Take Charge and Move Out (TACAMO)/ Airborne Command Post.

The primary facility is the NMCC located within the Pentagon. The NMCC provides daily support to the President, the Secretary of Defense, and the CJCS, allowing for the monitoring of nuclear forces and ongoing conventional military operations.

Another command center resides within USSTRATCOM Headquarters at Offutt Air Force Base in Nebraska. The USSTRATCOM GOC enables the Commander of USSTRATCOM to conduct command and control while also enabling the day-to-day management of forces and the monitoring of world events.

If fixed command centers are destroyed or incapacitated, several survivable alternatives exist to which NC2 operations can transfer, including the E-4B NAOC and the E-6B TACAMO/Airborne Command Post (Figures 2.2 and 2.3). A NAOC aircraft is continuously ready to launch within minutes from random basing locations, thus enhancing the survivability of the aircraft and the mission.

Figure 2.2 E-4B NAOC

Figure 2.3 E-6B TACAMO/Airborne Command Post

NC3, managed by the Military Departments, nuclear force commanders, and the defense agencies, provides the President with the means to authorize the use of nuclear weapons in a crisis.[2]

The E-6B serves as an airborne command post. In this capacity, the E-6B is an airborne backup of the GOC. As a result of this role, the E-6B performs two additional key missions. First, as the Airborne Launch Control System, the aircraft has the ability to launch Minuteman III ICBMs as backup to the land-based launch control facilities. Second, in its TACAMO role, it can relay presidential nuclear control orders to Navy nuclear submarines and Air Force nuclear missile control centers and bombers.

Equipment

Equipment includes information protection (cryptological) devices, and the sensors (radars and infrared satellites, fixed, mobile and processing systems) of the Integrated Tactical Warning/Attack Assessment (ITW/AA) System.

[2] NC3 can also prove critical for U.S. response to other significant national events, such as a terrorist attack or natural disaster, where there is a need for continuity and the means to ensure the performance of essential government functions during a wide range of emergencies. Nuclear crisis is the worst-case scenario.

The ITW/AA includes rigorously tested and certified systems that provide unambiguous, reliable, accurate, timely, survivable, and enduring warning information of ballistic missile, space, and air attacks on North America. In general, the ITW/AA process includes four steps to support the decision-making process:

1. *Surveillance* – detection, collection, identification, processing, and reporting of ballistic missile, atmospheric, and space events by means of a worldwide network of ground- and space-based sensors.

2. *Correlation* – collection, integration, analysis, and interpretation of surveillance data along with intelligence information on all potentially hostile events.

3. *Warning* – process that uses automated displays of missile, atmospheric, and space events, confirmed by voice conferences to sensor sites, to assess the validity of warning information. Intelligence information can further corroborate sensor data.

4. *Assessment* – evaluates the likelihood that an air, missile, and/or space attack is in progress against North America or an ally. Missile or air attack assessment is based on a combination of sensor information and the judgment of the Commander, North American Aerospace Defense Command (NORAD) of its validity. The Commander, USSTRATCOM validates missile and space warning information for areas outside North America and provides an assessment of potential attacks on U.S. and allied space assets.

To assist in ITW/AA decisions, two independent information sources using different physical principles, such as radar and infrared satellite sensors associated with the same event, help clarify the operational situation and ensure the highest possible assessment credibility. Regardless of the type of event, assessments are passed over an emergency communications conference to the President, the Secretary of Defense, and the CJCS. The assessment details whether an attack is occurring against North America or U.S. assets or allies.

COMMUNICATIONS

NC2 is supported by a survivable network of communications and warning systems that ensure dedicated connectivity from the President to all nuclear-capable forces. NC3 relies on terrestrial (e.g., land-based secure and non-secure phone linesand undersea cables), airborne relay (e.g., E-4B and E-6B), and satellite (military and commercial) sensors to transmit and receive voice, video, or data. The ability to move trusted data and advice from sensors to correlation centers, from presidential advisors to the President, from the President to the NMCC, and from the NMCC to the nuclear weapons delivery platforms depends on NC3 (Figure 2.4). These encompass a myriad of terrestrial, airborne, and satellite- based systems ranging in sophistication from the simple telephone, to radio frequency systems, to government and non-government satellites. Some of these systems are expected to be able to operate through nuclear effects, while others are expected to be subject to nuclear effect disruption for periods ranging from minutes to hours.[3]

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[3] As with other critical elements of NC3, even communications systems whose frequency spectrum is expected to be available in a nuclear-affected environment are susceptible to physical effects. This includes burnout or temporary disruption due to the effects of a nuclear detonation on their electronic components if these components are not hardened against such effects.

NC3 REQUIREMENTS

NC3, managed by the Military Departments, nuclear force commanders, and the defense agencies, provides the President with the means to authorize the use of nuclear weapons in a crisis. Presidential guidance, via presidential policy directives, is the authoritative source for NC3 requirements. The requirements support nuclear force planning, situation monitoring including an ITW/AA of bomber threats and missile launches, senior leader decision-making, dissemination of presidential force-direction orders, and management of geographically dispersed forces.

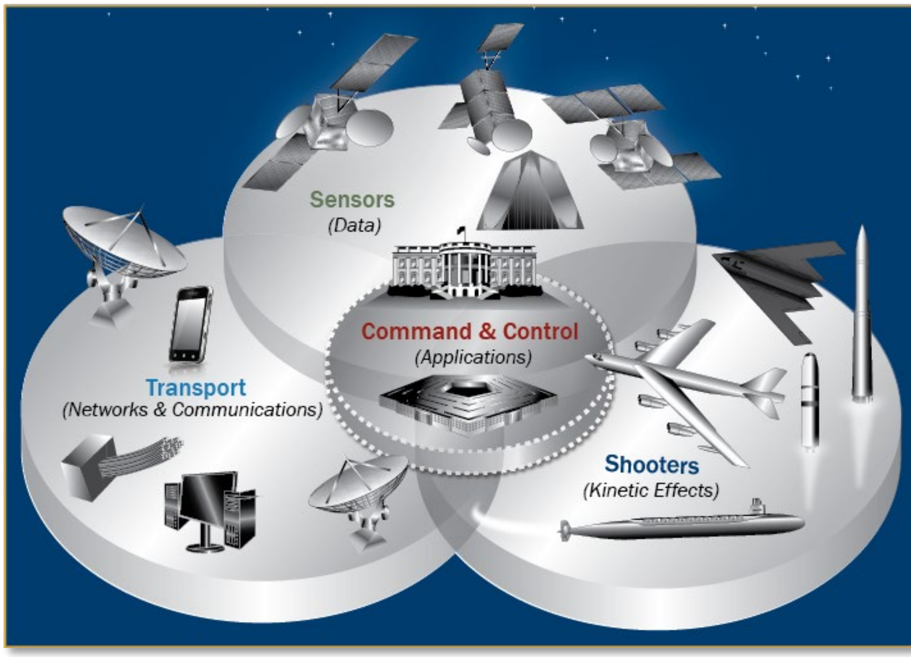

Figure 2.4 Nuclear Command, Control, and Communications

Many NC3 requirements are set forth in national and DoD policy; among these are the requirements that NC3 must be assured, reliable, and resilient. These requirements have been translated into specific, measurable, and testable criteria to evaluate the performance of NC3 elements through exercise, testing, and analysis.

Mission-critical facilities and equipment must be built to resist the effects of a nuclear explosion, especially electromagnetic pulse (EMP), which can interrupt or destroy sensitive electronics. See *Chapter 9: Nuclear Survivability and Effects Testing* and *Chapter 13: Basic Nuclear Physics and Weapons Effects* for more information about nuclear effects.

Additionally, modern systems must be capable of operating on internet-like networks to provide survivable, reliable support for senior U.S. government officials, the U.S. military, and U.S. allies, as appropriate. While the implications and applicability of this policy can introduce increased vulnerability, it is still necessary to protect critical information and information systems against cyberattack or network intrusion.

CURRENT NC3 ARCHITECTURE

The present U.S. NC3 architecture is described in two layers. The first layer is the day-to-day architecture which includes a variety of facilities and communications to provide robust command and control over nuclear and supporting government operations.

The second layer provides the survivable, secure, and enduring architecture known as the "thin-line." The thin-line responds to policy that requires assured, unbroken, redundant, survivable, secure, and enduring connectivity to and among the President, the Secretary of Defense, the CJCS, and designated commanders through all threat environments to perform all necessary command and control functions. The thin-line NC3 architecture must be sustained and supported during any modernization effort to ensure presidential requirements can be met.

EVOLVING THREATS

The threat to NC3 is evolving as more nations and non-state actors recognize the benefits and seek their own space or counterspace capabilities as well as cyber, electronic warfare, and advanced conventional capabilities. As the modernization of NC3 evolves, the United States is faced with new opportunities and new challenges in the NC3 domain.

Space

Current policy states, "Space is no longer a sanctuary and orbital space is increasingly congested, competitive, and contested."[4] Strategic competitors, such as Russia and China, have developed counterspace capabilities to provide a military advantage. These capabilities threaten critical U.S. NC3 assets. Next-generation NC3 will have to mitigate or "fight through" a degraded environment.

Cyber

Legacy NC3 had minimal vulnerability to cyber effects due to its isolation from the global internet network. As NC3 modernization occurs and continues to integrate nuclear and non-nuclear command and control, new cyber vulnerabilities will be identified and must be mitigated.

Cyber risks will accelerate as nuclear modernization proceeds and systems are migrated to internet protocols. The new generation of nuclear forces, the Columbia-class SSBNs, ground-based strategic deterrent (GBSD), ICBMs, B-21, long-range standoff (LRSO) cruise missiles, and F-35 will be designed to modern cyber standards. It will be critical for designers of future NC3 to adopt cyber defense to mitigate threats from adversary offensive cyber action against these systems. Cyber threat mitigation will address the network vulnerabilities to ensure U.S. NC3 remains an assured, effective, and resilient network.

Nuclear Environment

Original NC3 was designed to counter a massive nuclear attack from Russia. As the nuclear environment changed through the addition of nuclear capable adversaries, NC3 has also been modified to meet this change. In the future, with potential new adversaries with new nuclear weapons tactics, the U.S. NC3 must be able to

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[4] *2018 Nuclear Posture Review*.

counter an adversary's limited nuclear strike. Additionally, U.S. leadership must be able to communicate across nuclear and non-nuclear command and control.

MODERNIZING NC3

Current national policy outlines a series of initiatives to ensure NC3 remains survivable and effective in crisis and conflict, and is strengthened to address future needs and challenges. The United States will:

- strengthen protection against space-based threats;
- strengthen protection against cyber threats;
- enhance integrated tactical warning and attack assessment;
- improve command posts and communications links;
- advance decision support technology;
- integrate planning and operations; and
- reform governance of overall NC3.

In July 2018, the Secretary of Defense and the Chairman of the Joint Chiefs of Staff formally appointed the USSTRATCOM Commander to be "the NC3 enterprise lead, with increased responsibilities for operations, requirements, and systems engineering and integration." USSTRATCOM has created an NC3 Enterprise Center inside the command's headquarters at Offutt Air Force Base, Nebraska. On November 5, 2018, Commander, USSTRATCOM stated, "It is imperative that the U.S. government modernize its three-decade old NC3 in a manner that accounts for current and future threats to its functionality and vulnerabilities." The NC3 Enterprise Center is developing and evaluating NC3 architectures and approaches for modernization.

The Under Secretary of Defense for Acquisition and Sustainment created an NC3 Enterprise Capability Portfolio Manager organization to: provide NC3 policy guidance to the heads of other DoD components; conduct analyses (including but not limited to NC3 planning, programming, budgeting, and execution activities); make recommendations; and monitor the implementation and performance of approved NC3 programs.

To meet NC3 modernization initiatives, specific activities include:

- *Survivable airborne operations center (SAOC)* – A new aircraft(s) will replace the E-4B Boeing 747-model national airborne operations center (NAOC) and the new Boeing 707-model E-6B Mercury;
- *Very low frequency receivers (VLF)* – The common VLF receiver program will provide new terminals to command and control aircraft, bombers, tankers (to refuel bombers), ICBM launch control centers, and other command posts. These receivers will allow the reliable and secure transmission of emergency action messages on the VLF band over very long distances and through nuclear detonation interference; and

- *Satellite terminals* – The Advanced Extremely High Frequency (AEHF) satellite constellation is designed to operate through EMP and nuclear scintillation. It is jam resistant. Satellite replacement receive-transmit terminals include the Family of Advanced Beyond Line-of-Sight Terminals (FAB-T), Global Aircrew Strategic Network Terminal (Global ASNT), the Minuteman Minimum Essential Emergency Communications Network Program Upgrade (MMPU), and Presidential and National Voice Conferencing (PNVC).