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March 1999

Los Alamos National Laboratory

Nuclear Weapons Stockpile Systems

Military Applications Group

The US Nuclear Stockpile:
Looking Ahead
Drivers of, and Limits to, Change in a Test-Constrained Nuclear Stockpile (U)

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Classifier: Thomas K. Scheber, Project Leader, NWT

Derived From: LA-4000, Rev. 7, 9/94

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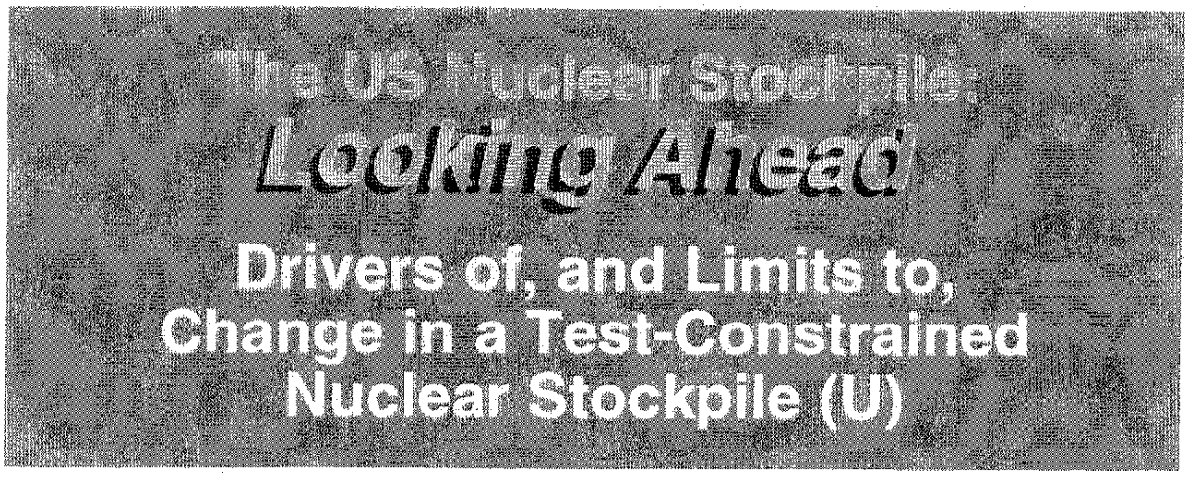

As the United States implements its policies and treaties to enhance global nuclear security, these initiatives have been accompanied by "hedges" to ensure that the nation would be able to respond should world events turn hostile to US interests. For example, the July 1994 Presidential Decision Directive identified the requirement for a plan to compensate for the absence of nuclear testing and "safeguards" that provide the framework for a Stockpile Stewardship Program (SSP). The September 1994 Nuclear Posture Review by the Department of Defense (DoD), endorsed by the President, found no requirement for new stockpile designs at that time but required that the Department of Energy (DOE) maintain the capability to design, develop, and produce new warhead designs.

The President and the Secretary of Defense have clearly articulated the continuing importance of the nuclear deterrent (e.g., the President's May 1997 National Security Strategy and the Secretary of Defense's 1998 annual report).

It will be important for the nation to maintain the nuclear deterrent and safeguards in a way that is nonprovocative to other countries whose national interests differ from our own. Continuing to reduce the global nuclear threat and develop a more stable security environment while hedging against an uncertain future will be a major challenge for the nation.

This briefing is intended to stimulate thoughtful debate about how best to incorporate into US nuclear force planning the capability to respond to uncertain futures. The underlying assumptions for this briefing include the strict compliance with a Comprehensive Test Ban Treaty (CTBT) and a fiscally constrained budget for the DOE Stockpile Stewardship Program. The briefing will identify potential strategies for managing the composition of the nuclear stockpile in the future and will identify key tradeoffs, which must be made within a fixed budget for the SSP.

CIC-1/99-0666

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ALDNW Military Applications Group

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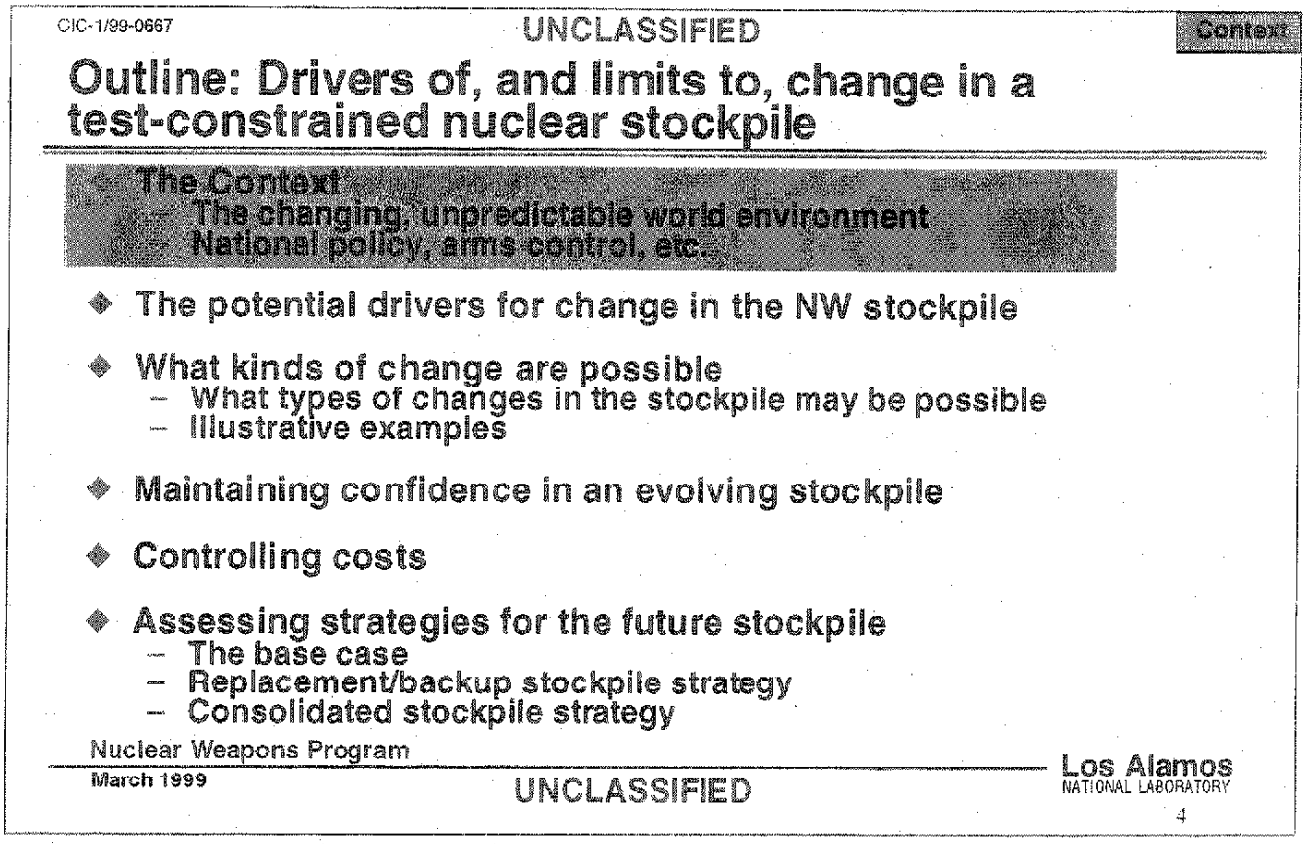
This briefing was developed by the Los Alamos National Laboratory's Military Applications Group (MAG), which reports to the Associate Laboratory Director for Nuclear Weapons (ALDNW), Dr. Stephen Younger. The MAG members have backgrounds in strategic force planning, policy, nuclear weapons physics, nuclear weapons engineering, systems analysis, and arms control issues.



This briefing is divided into six parts:

1. The changing context of nuclear weapons (NW) in the transition from post–cold war to uncertain world environment. What strategic forces will be required in the future?

2. The drivers for change within this context. This topic includes issues such as DoD delivery system acquisition programs, sunset technologies, maintenance strategies, and potential new DoD requirements.

3. What kinds of change are possible? This is a broad look at current US stockpile assets and modifications that might be possible under a Comprehensive Test Ban Treaty (CTBT).

4. Maintaining confidence in an evolving stockpile. We discuss the basis for certification, the issues to be addressed, and broadly define the constraints imposed by the test ban environment.

5. Cost will be a significant driver in the consideration of any evolution in the nuclear arsenal. A framework for costs for the nuclear stockpile is developed and fundamental cost tradeoffs in a fixed DOE budget are identified.

6. Three possible strategies for the future stockpile are explored: (1) an extension of the present stockpile; (2) a strategy which requires a more diverse stockpile; and (3) a strategy where the stockpile is consolidated to the fewest types required.

Drivers of, and limits to, change in a test-constrained nuclear stockpile --The context

- A nuclear deterrent will be required for the foreseeable future as a critical element of the US National Strategy
- The required military characteristics for the nuclear deterrent of the future may require forces different from the current suite of nuclear forces
- We cannot fully define those future requirements at this time, but we can make reasonable estimates
- The quantitative and qualitative nature of change in strategic nuclear forces will be constrained by arms control agreements
- We should identify the elements of the nuclear deterrent forces that contribute to flexibility in the future

The Context includes the following:

There will be drivers of, and limits to, change in the nuclear stockpile. An obvious driver is the life extension/acquisition cycle of the DoD strategic nuclear delivery vehicles (SNDVs). A limit is the absence of nuclear testing mandated by the CTBT.

As the SNDVs age and/or the threats change, we expect the required military characteristics (MCs) and the stockpile-to-target sequence (STS), which defines the operating environment for nuclear weapons, to evolve as well. The question is, how much can the stockpile evolve in the absence of nuclear testing while sustaining confidence in the warhead performance.

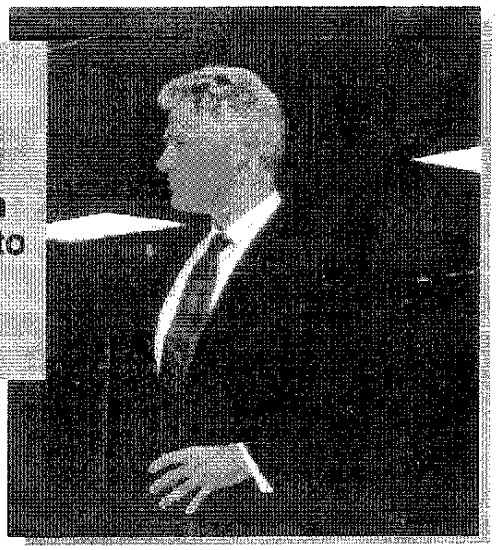
Within these constraints, we need to identify and plan to maintain those elements that can best provide flexibility for the future.

A nuclear deterrent will be required ....

- "The United States must continue to maintain a robust triad of strategic forces sufficient to deter any hostile foreign leadership with access to any nuclear forces and to convince it that seeking a nuclear advantage would be futile."

President Clinton
May 1997

A National Security Strategy for a New Century, May 1997



The President and other senior leaders continue to endorse a nuclear deterrent for the nation. In addition to the quotation shown on this slide, the President, in remarks at Los Alamos National Laboratory on February 3, 1998, made the following statement:

"Our national security requires that we maintain a nuclear arsenal strong enough to deter any adversary and safe enough to retain the confidence of our military leaders, our political leaders, and the American people."

However, most studies and policy statements on this subject are focused on the near term, and few try to address the potential for change over the long term. What *might* be required to maintain our nuclear deterrent?

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Context

Nuclear policy and force posture requirements for the future – "US Nuclear Policy in the 21st Century"*

- Nuclear Weapons will continue to play an indispensable role in US security policy
- Nuclear Weapons will continue to be part of the global security setting
- Even if the US were to divest itself of its nuclear arsenal, other states would be unlikely to follow suit
- In the changing security setting, the nuclear weapons infrastructure–broadly defined to include both operational and the development/production capabilities–takes on a heightened strategic prominence

*NDU/LLNL study published July 1998

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The recent study conducted jointly by the National Defense University (NDU) and Lawrence Livermore National Laboratory addressed "The US Nuclear Policy in the 21st Century" and developed these findings.

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Context

Impact of CTBT

The Comprehensive Test Ban Treaty (CTBT) bans any nuclear weapon explosion or other nuclear explosions

- Constrains the development of new-design weapons
  - Will result in some loss of confidence in the nuclear weapons stockpile
- The ability of the US to live with a ban on nuclear testing depends on having a vigorous Stockpile Stewardship Program (SSP).
  - Guard against aging-related problems
- The SSP is designed to:
  - Provide the capability to survey and assess the stockpile for problems
  - Replace weapons components as needed
  - Certify the rebuilt weapons

(CTBT) has reduced our flexibility and options to meet future nuclear deterrent requirements

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The CTBT prohibits nuclear explosions. In the past, the nation relied on full-scale integral nuclear testing to ensure the safety, reliability, and performance of our weapons. Furthermore, we relied on nuclear testing to ensure that our systems continued working as they aged.

The CTBT will constrain treaty-compliant nations from making significant advances in nuclear weapons.

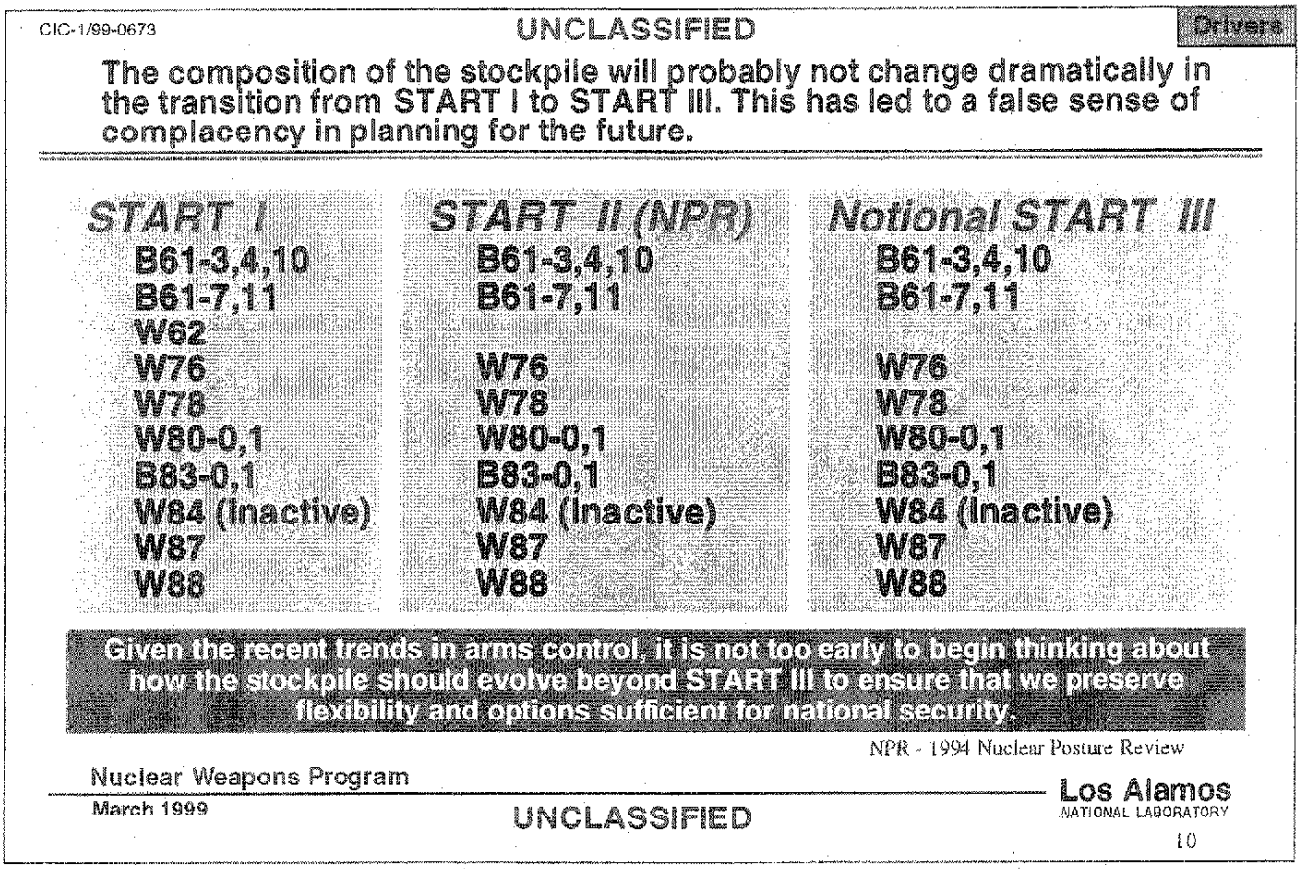
Our ability to certify modifications, such as a life extension refurbishment of the enduring stockpile, depends on the success of the Stockpile Stewardship Program (SSP). The success of SSP, in turn, depends on a competent and motivated cadre of nuclear weapons experts, the accelerated strategic computing initiative (ASCI), new experimental facilities, infrastructure improvements, archiving, and funding.

Outline: Drivers of, and limits to, change in a test-constrained nuclear stockpile

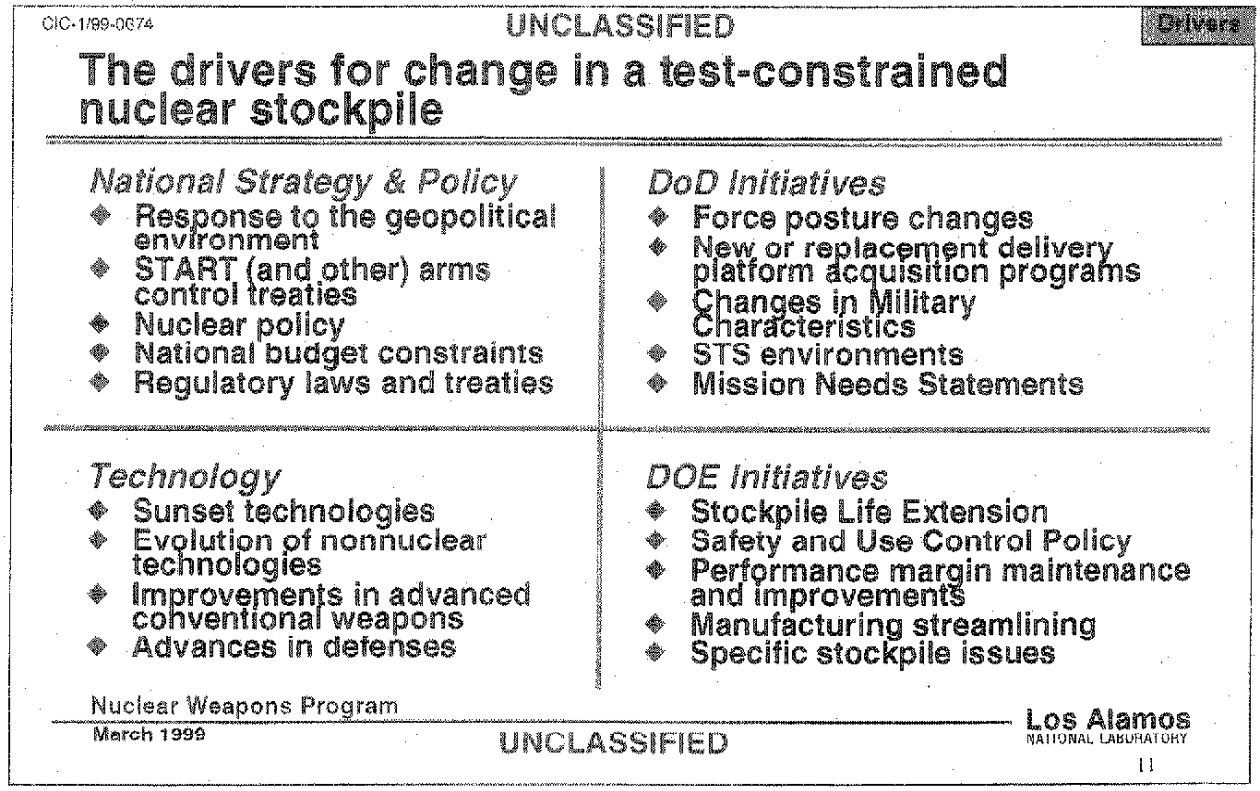
- The Context
  - The changing, unpredictable world environment
  - National policy, arms control, etc.

The potential drivers for change in the NW stockpile

- What kinds of change are possible
  - What types of changes in the stockpile may be possible
  - Illustrative examples
- Maintaining confidence in an evolving stockpile
- Controlling costs
- Assessing strategies for the future stockpile
  - The base case
  - Replacement/backup stockpile strategy
  - Consolidated stockpile strategy



Moving from START I to a potential START III stockpile, the composition of the stockpile, in types of warheads, does not change dramatically. While the number of each type of warhead is reduced to comply with arms control limits on force structure, the strategy has been to incrementally reduce the force structure and the required warheads. At some point, with a lower number of warheads, a more dramatic reshaping of the nuclear deterrent is likely to be required.



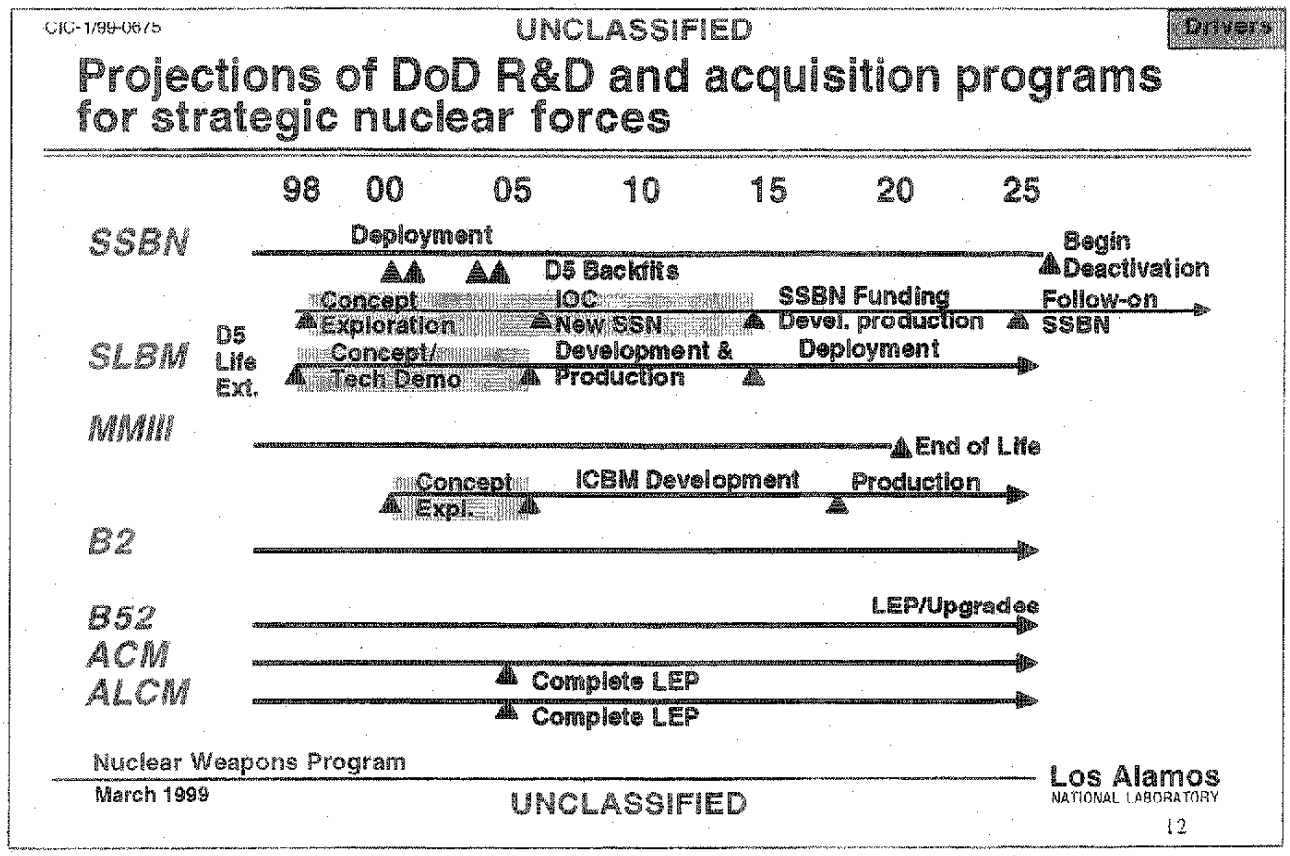
The four major drivers for change are as follows:

1. National strategy and policy. The United States will adjust its security strategy and policy as the world changes. Treaties, such as START, will likely force changes in the deterrent structure. National nuclear policy will continue to evolve. There will likely be budget constraints on both DOE and DoD. In addition, laws and treaties, particularly in the environmental area, make components extremely expensive or impossible to replace as they were originally designed.

2. DoD initiatives. As many of the DoD delivery platforms reach the end of their lifetime, they will need to be replaced. This presents an opportunity to reevaluate the required military characteristics in light of the post – cold war era. The evolution of technology will probably lead to changes in the defined stockpile-to-target sequence (STS), thus placing new requirements on warhead designs. In addition, new mission needs statements could force changes in both the military characteristics (MCs) and STSs.

3. DOE initiatives. As existing warheads reach the end of design life, we will rebuild the warheads through the stockpile life extension programs (SLEPs). DOE must ensure the systems meet the MCs and STSs, but some of the components will be different. We have seen an evolution in surety standards in the past, and as the terrorist threat evolves, we should expect to see some further evolution in these requirements. DOE is responsible for the safety, surety, and performance of US nuclear weapons. Our confidence rests primarily on our nuclear test history. If we find reason to believe that we do not have enough performance margin in some systems, we may need to make a change. The manufacturing infrastructure is being sized and configured for a post–cold war era, but it will produce some components that are different from those originally manufactured; maintaining confidence will be a challenge. We may also find something in our surveillance program that could force change.

4. Technology. Sunset technologies, such as we have seen in the electronics industry, will force change. There are components and materials that are no longer available on the market; the W76 mount material and [redacted] are examples. The evolution in the nonnuclear technologies can affect delivery system capabilities. Improved advanced conventional weapons may replace nuclear weapons in some areas. Finally, changes in the defense systems may force changes in the US force posture.



One possible catalyst for a national debate on the future strategic force posture is the need to replace or modernize the current inventory of strategic nuclear forces.

This chart shows the important milestones that are currently being considered in the development of acquisition strategies for strategic forces. Highlighted in yellow are the timeframes in which the DoD will likely have to begin funding concept development for follow-on systems. It is conceivable that this funding requirement will fuel an intense debate over the affordability of a triad after the current strategic nuclear forces reach the end of useful life and must be replaced or modernized.

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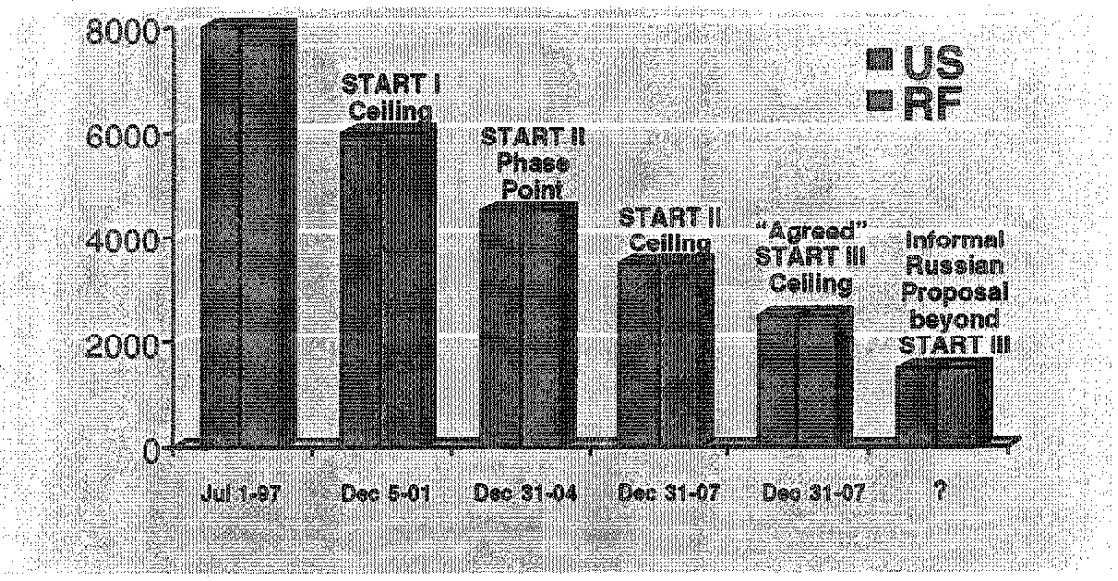
Drivers

Strategic Arms Reduction Treaties



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This chart depicts the evolution in the number of accountable strategic nuclear warheads, assuming that START II and START III enter into force. Although it is generally accepted that a triad will be maintained through START III, arms reductions beyond START III would likely reopen the debate on the affordability of a triad for such low levels of strategic nuclear forces.

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Classifier: Thomas K. Scheber, Project Leader, NWT
Derived from: LA-4000, Rev. 7, 9/94

Drivers

USSTRATCOM is engaged in a detailed study of future stockpile configurations

[redacted]

Would the notional START III stockpile be too dependent on a few systems?

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SECRET FRD

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DOD
DOE
b(3)

The chart shows an early proposal by the US Strategic Command (USSTRATCOM) for warhead requirements, both active and inactive, for a notional START III force posture.

DOD
DOE
b(3)

[redacted] This issue will be discussed further in the presentation.

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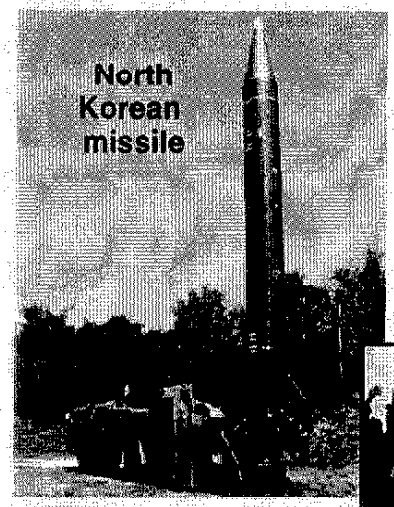
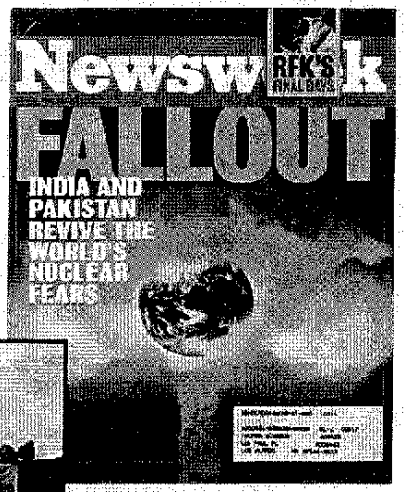
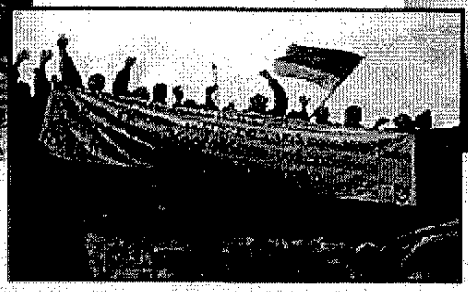
Drivers

We should prepare to be surprised in the future... by the application of technology and by political events



Newsweek report of India and Pakistani Nuclear tests





Opening of the Berlin wall November 1989

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The nation has been surprised in the past by technological developments, as well as by political events around the world. We should expect that future surprises will require adjustments in the nation's force posture.

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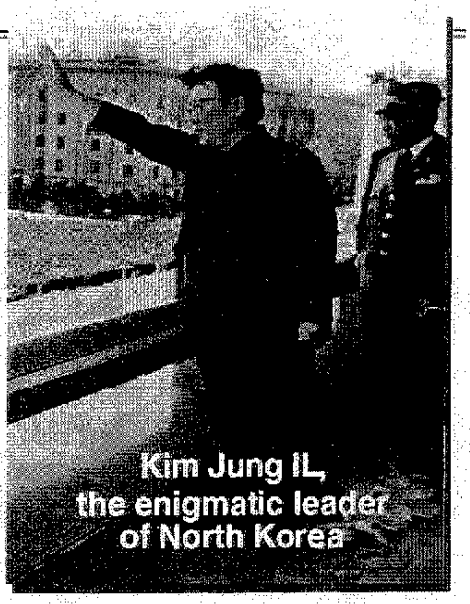
Drivers

Although no peer competitor to the US is envisioned for at least the next decade, the world may evolve into dangerous and unforeseeable environments.

- *Russia:* Will Russia maintain control of its many factions? Will it be able to transfer power peacefully?
- *China:* How will China assert its growing economic and political strength?
- *Mid East:* How will future conflicts be resolved?
- *Korea:* Will reunification take place peacefully or with a major conflict? To what end?
- *South Central Asia:* How will Indian and Pakistani nuclear capabilities affect the stability of the region?
- *Terrorist threats* (state-sponsored or transnational): Can these threats be deterred?



Kim Jung IL, the enigmatic leader of North Korea

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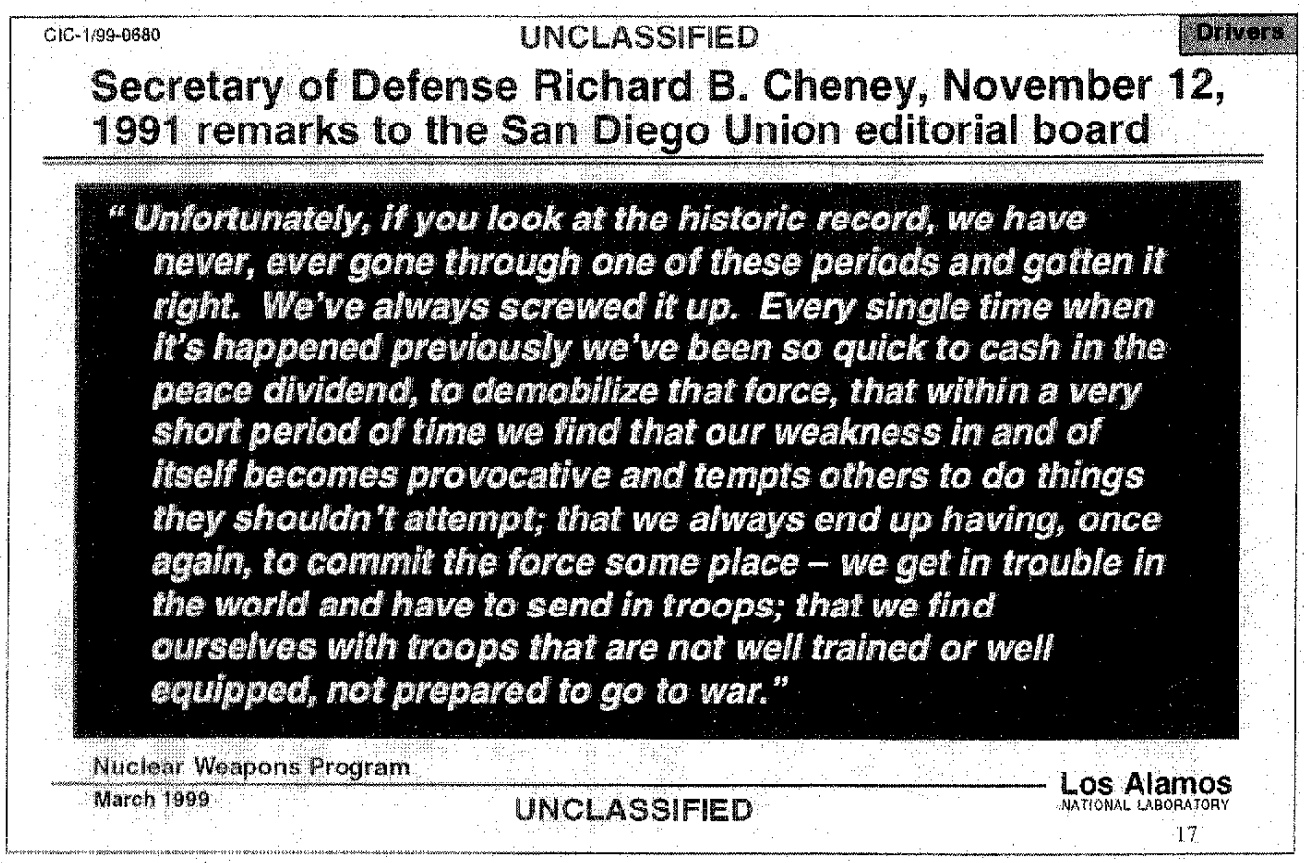
The evolving world situation may require that the United States modify its nuclear policies and forces to provide a credible deterrent to a wide range of potential enemies that might choose to threaten the US, its allies, or its interests.



This quotation from former Secretary of Defense Cheney articulates the difficulty of preserving force capability and flexibility for the future.

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Drivers

The stockpile and our capabilities must be sufficiently agile to accommodate the drivers for change

- In the past, DOE has optimized warheads for DoD weapon platforms
- In the future, DoD weapon platforms may have to be designed around existing warheads, with *some modifications*

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As the national security requirements for a nuclear deterrent change over time, the warheads in the current arsenal will provide the basis for options for future nuclear deterrent forces. Compliance with a comprehensive test ban treaty (CTBT) will preclude the development of new, significantly different warheads. We need to develop a strategy to downsize our arsenal in a way that preserves flexibility for the future.

One aspect of change in the future is clear. In the past, the DOE optimized warheads as part of the overall weapons system development for the DoD. We will not have that range of freedom in the future. Although the DOE has some freedom to modify warheads, the DoD may have to design its delivery platforms around the capabilities of existing warheads with perhaps some warhead modifications.

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Change

Outline: Drivers of, and limits to, change in a test-constrained nuclear stockpile

- The Context
  - The changing, unpredictable world environment
  - National policy, arms control, etc.
- The potential drivers for change in the NW stockpile
- What kinds of change are possible
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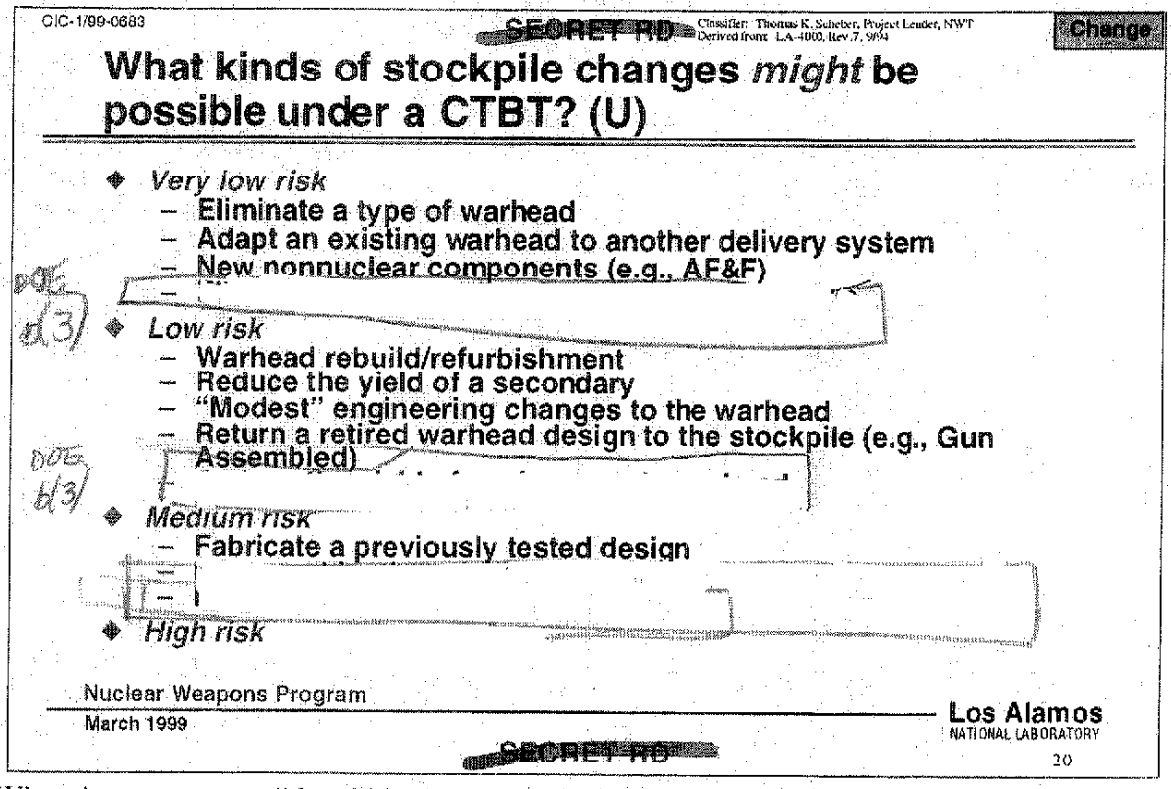


What changes are possible within the constraint of a comprehensive test ban treaty (CTBT)? The risks are divided into four categories*: very low, low, medium, and high.

1. Very low risk. A system can be eliminated from the stockpile, thus changing the nature of the deterrent force. An existing warhead can be adapted to a new delivery vehicle, assuming the DoD conserves the mapping of the hydrodynamic characteristics into the new system. Nonnuclear components can be changed, such as the arming, fusing, and firing (AF&F) system, which can be tested.

2. Low risk. A system can be rebuilt and refurbished as planned for the stockpile life extension program (SLEP). For components where we can duplicate every aspect of the original manufacturing processes, there would be no more risk than the original build, but there may be a low risk for new materials and/or new manufacturing processes. In many cases the yield of a secondary could be reduced. Some systems were tested, but not manufactured, with lower yields to comply with the 150-kt limit imposed by the threshold test ban treaty (TTBT). Modest engineering changes can be made. Retired warhead design could be returned to the stockpile, although not all parts would use the original manufacturing processes.

3. Medium risk. Designs that were previously tested but never produced could be manufactured.

4. High risk. Changes are possible, but they would have to be evaluated on a case-by-case basis.

* Each change will have to be evaluated on a case-by-case basis.

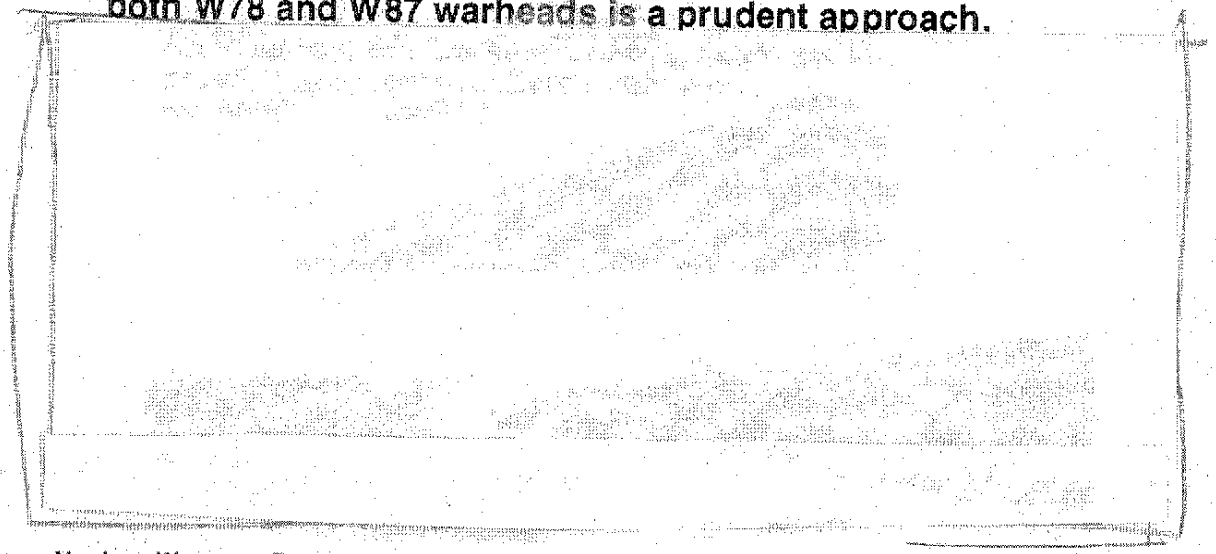
CIC-1/99-0684

Classifier: Thomas K. Scheber, Project Leader, NWT
Derived from: LA-4000, Rev.7, 9/94

Change

Guard against failure of ICBM warheads (U)

- The Air Force plan to employ a MMIII START II force with both W78 and W87 warheads is a prudent approach.



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DOD DOE b(3)

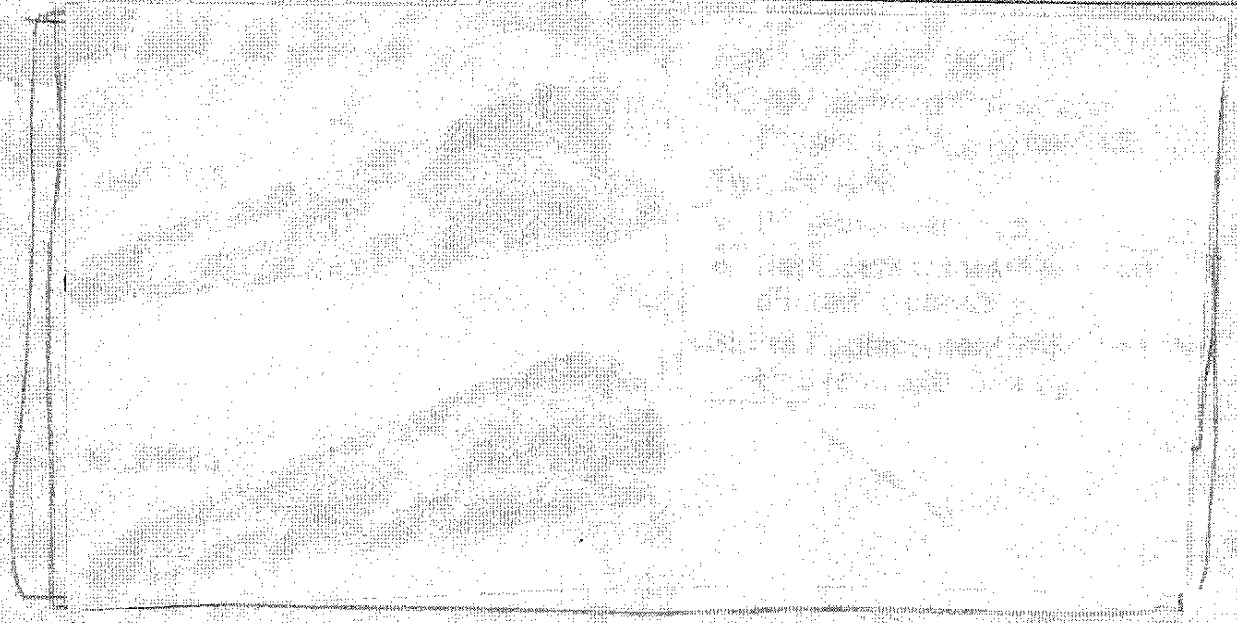
Under START II, the Air Force plans to deploy both the W78, currently on the Minuteman III (MMIII), and the W87, currently on the Peacekeeper, on the MMIII intercontinental ballistic missile (ICBM) force. However, the Air Force plan provides a prudent approach to ensure a backup warhead capability. The Air Force estimates that it will cost approximately $350 million to adapt the W87 warhead to the MMIII delivery system.

DOE DOE b(3)

CIC-1/99-0685

Change

Guard against failure of SLBM warheads (U)



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The W76 and W88 are currently deployed on the submarine-launched ballistic missile (SLBM) force.

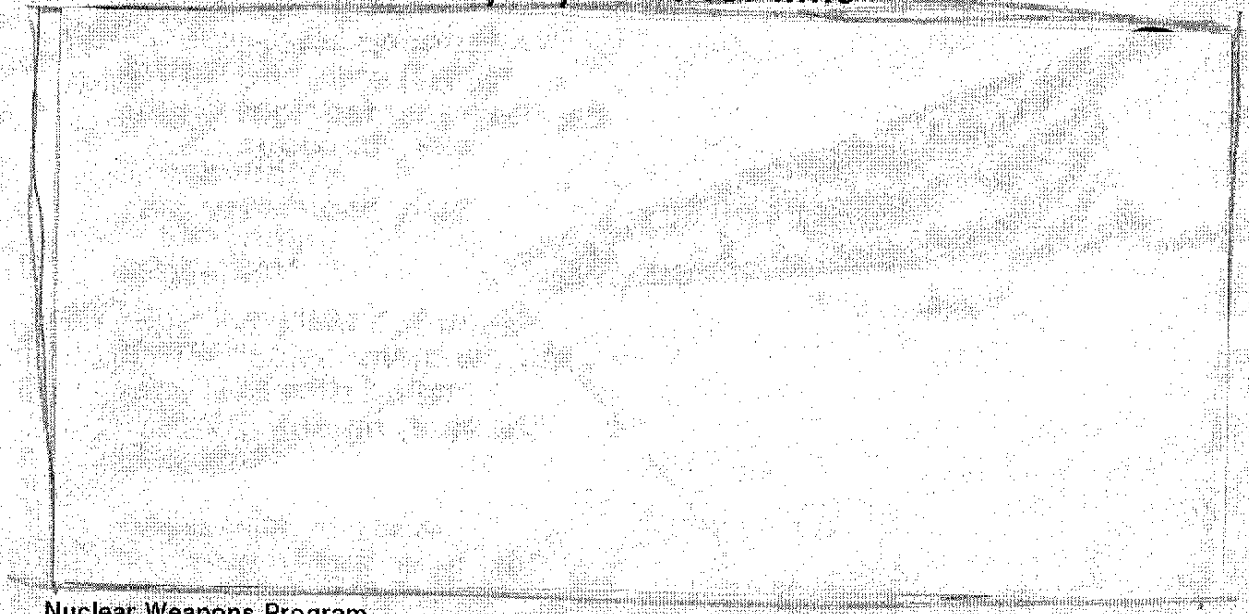
The Navy requested that the DOE initiate the SLBM Warhead Protection Program (SWPP) as backup to the W76 and W88 warheads.

CIC-1/99-0686

Change

Guard against failure of SLBM warheads, but the range of potential warhead replacement options is much broader (U)

Backup Options for Mk5



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The range of options for potential replacement warheads for SLBM applications is broader than the SWPP alone. For example,

1. It might be desirable to build additional W88s after the Los Alamos pit production capability is on line.
2. Other options include the W78.

This option has an advantage: if the W78 was adapted for the SLBM role, it would still be available to be deployed on either ICBMs or SLBMs.

3. Other candidates have been proposed, such as the W84 (and probably the B61-10 and W80).

CIC-1/99-0687

Classifier: Thomas K. Scheber, Project Leader, NWT
Derived from: LA 1000, Rev. 7, 3/94

Change

Additional options to enhance the flexibility of both ICBM and SLBM forces (U)

[redacted]

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DOD DOE b(3)

Furthermore, the flexibility of the ballistic missile force could be enhanced by providing additional yield options for deployment on the current systems.

[redacted]

DOD DOE b(3)

Either of the SWPP warheads could also be considered as a backup for the ICBM role.

[redacted]

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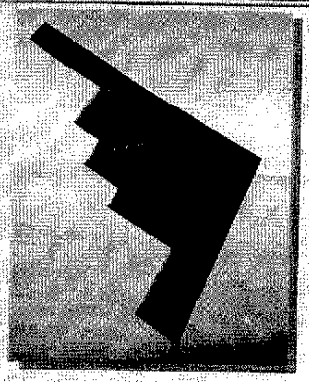
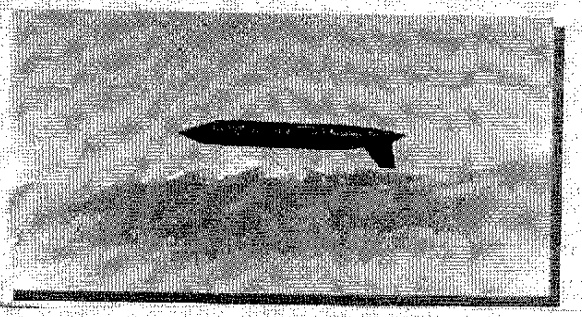
Change

Guard against failure of strategic bomber force warheads (U)





B61-7 bomb

B61-11

B83 bomb

W80-1 for
ALCM & ACM

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The strategic bomber force carries both bombs and cruise missiles.

Bombs.

Cruise missiles. The W80 is the only active cruise missile warhead.

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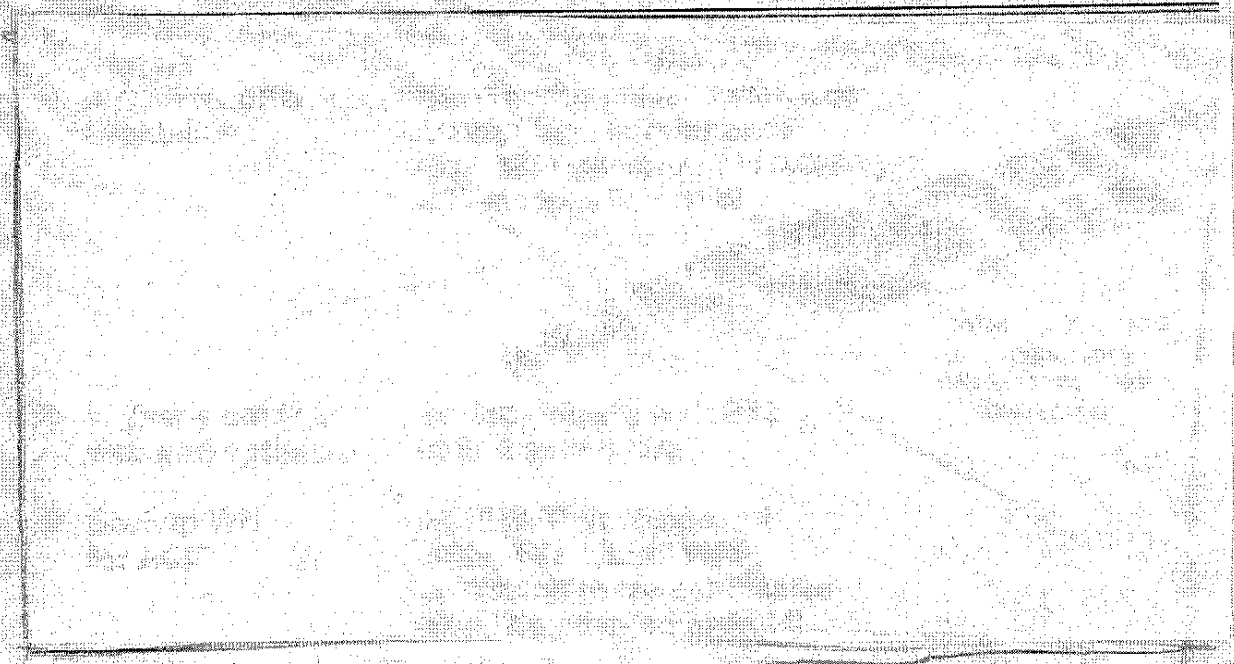
CIC-1/99-0689 SECRET RD Classifier: Thomas K. Scheber, Project Leader, NWT Derived from: LA-4000, Rev.7, 99-1 Change

Warhead options for strategic bomber force (U)



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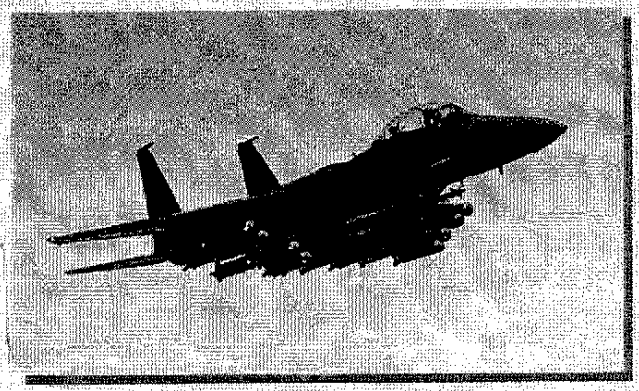
CIC-1/99-0690 SECRET NSI Classifier: Thomas K. Scheber, Project Leader, NWT Derived from: LA-4000, Rev.7, 9/94 Change

US Nonstrategic Nuclear Forces (NSNF) capabilities are spread extremely thin (U)

- Only 2 systems remain
  - Air Force F15 and F16 DCA with gravity bombs
    - Provide last vestiges of "nuclear burden-sharing" with NATO
  - Navy attack submarines with TLAM/N
    - TLAM/N missile maintenance and testing is a funding issue for the Navy



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The F15 and F16 are the only tactical aircraft currently certified to carry nuclear weapons.

CIC-1/00-0601

Change

What would be the role of NSNF in the future?

- Regional deterrence (for nuclear, chemical, and biological weapons)
- Symbolic deployments to threatened regions
- Reassurance for threatened allies
- Operational considerations: Strategic nuclear weapons from CONUS are less suited for regional deterrence
  - Avoiding overflights of neutral countries
  - Limiting collateral damage
  - Yield options and special effects

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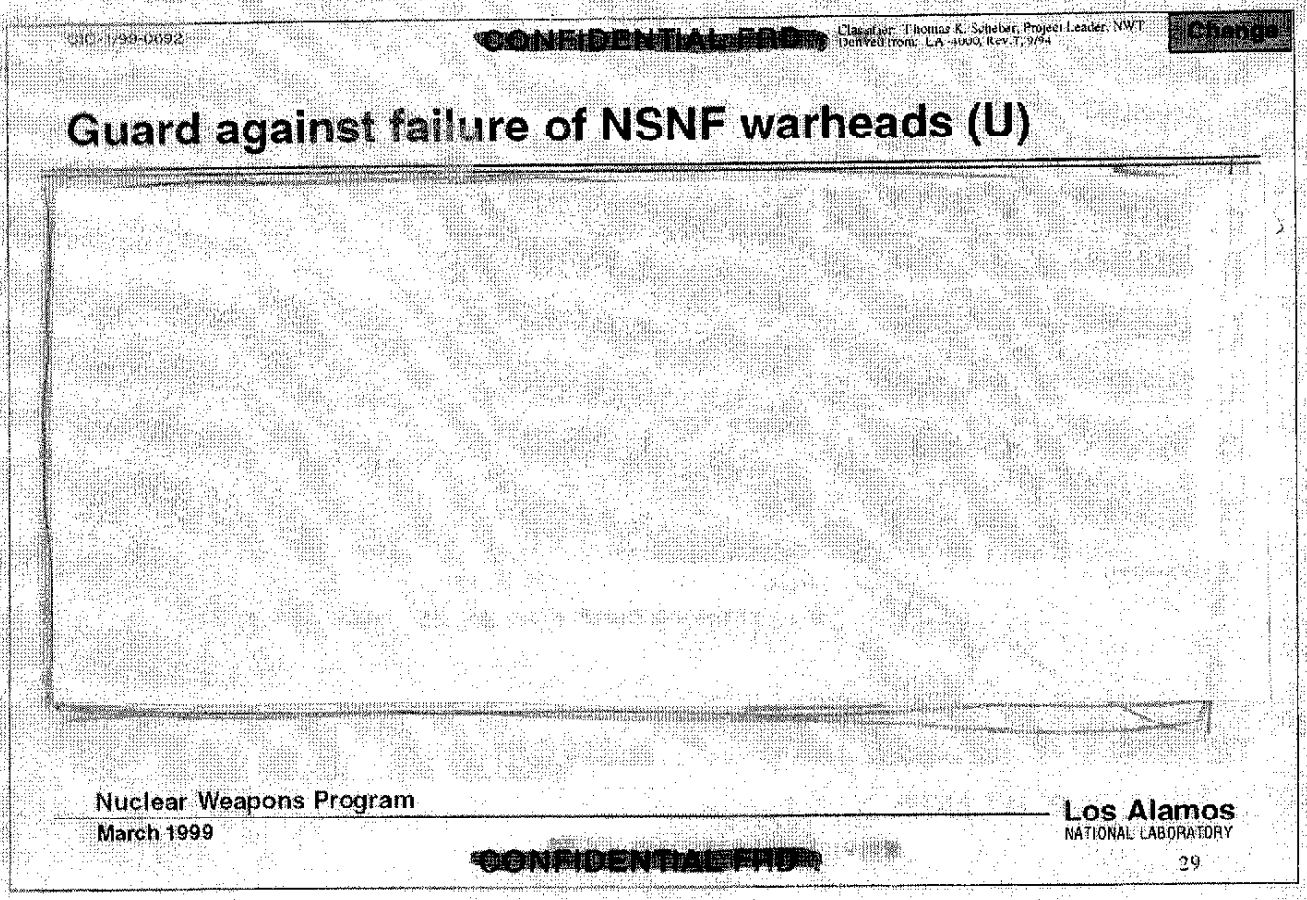
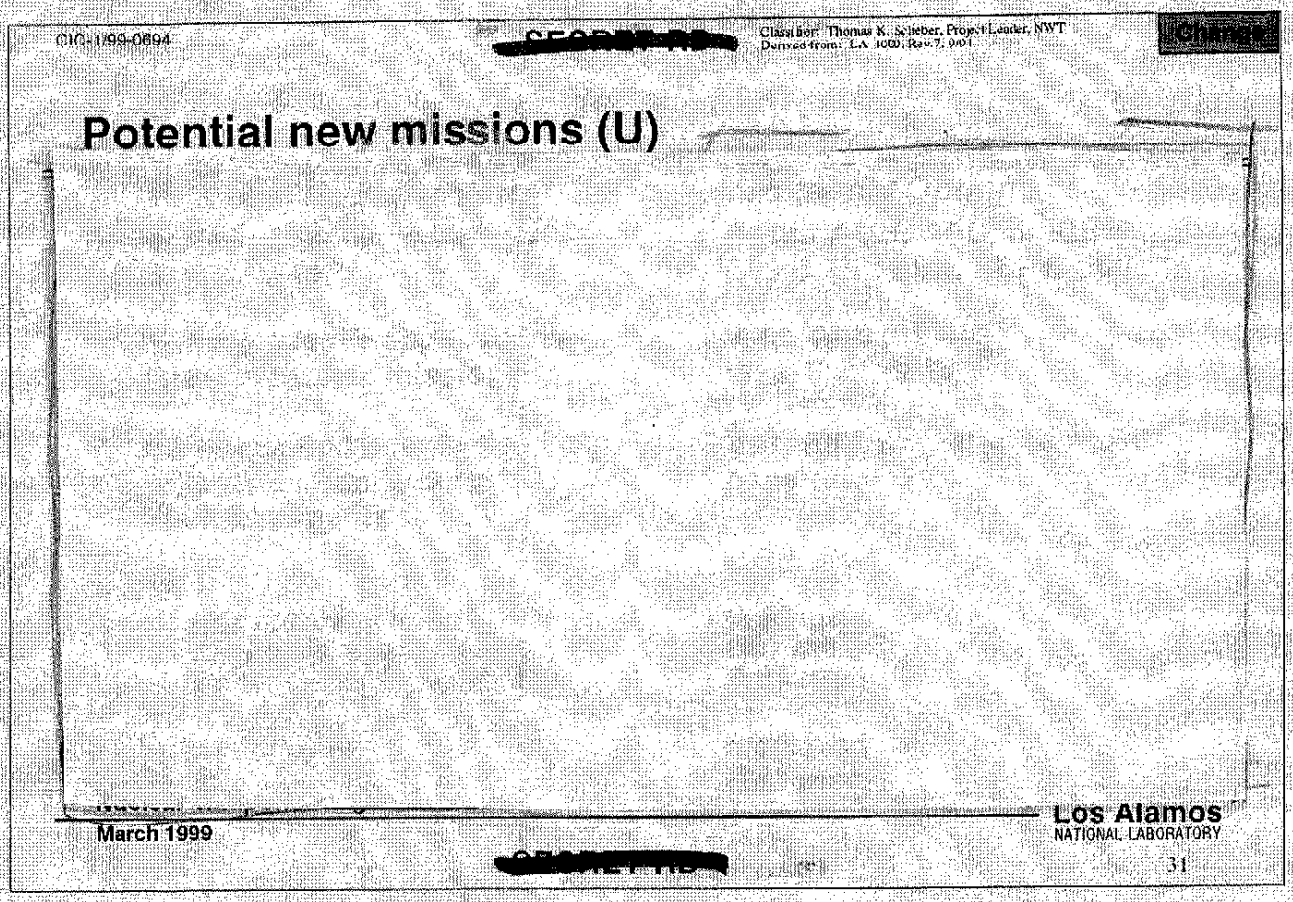
Although the current force posture for US nonstrategic nuclear forces (NSNF) is not nearly as robust as in the past, there seems to be a compelling case for retaining some NSNF capability for future contingencies.



This chart shows the current NSNF warheads and the limited existing backup options, as well as the potential for development of more robust backup capabilities.

If development of new weapon platforms to replace existing nonstrategic nuclear delivery forces proves unaffordable or impractical, adapting other delivery platforms to carry nuclear payloads may provide affordable alternatives

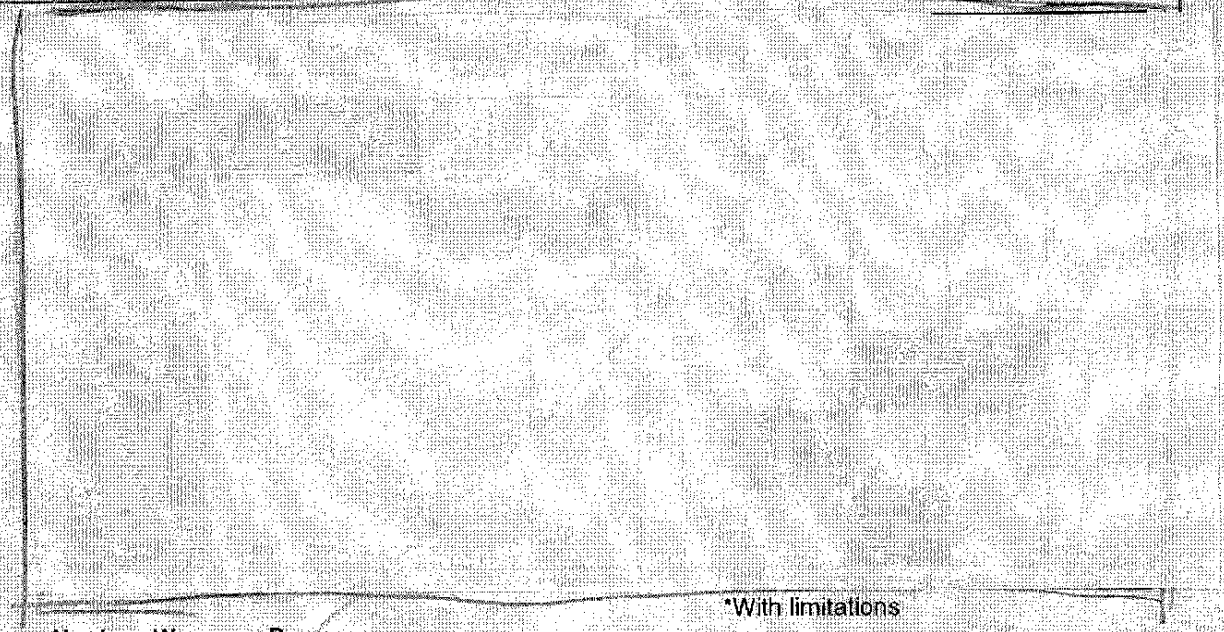


In addition to considering warhead options for reliability backup roles, the DoD may require that the DOE support new mission requirements that are different from those of today. This chart lists the potential future requirements that the study team recorded in its interactions with the DoD. Modifications to the existing stockpile would provide some improved capability for each of the listed missions.

UNCLASSIFIED [redacted]

CIC-1/99-0695 [redacted] Classifier: Thomas K. Scheber, Project Leader, NWT Derived from: LA-4000, Rev. 7, 9/91

Enduring stockpile with planned backups (U)



*With limitations

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[redacted]

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This summary shows the planned inventory of nuclear warheads for START II. The current DoD systems on which each warhead type is carried is depicted with a black dot in the matrix. Existing or planned backup warheads are listed in the matrix. An asterisk after a backup warhead notes that some significant limitation is attached to the consideration of that backup option. The limitation may be in a different or insufficient yield, inadequate hardening for the backup mission, or in the necessity of modifications to the warhead and/or delivery vehicle.

Several charts that follow will build on this matrix to produce a more complete list of options from which a future force posture might be developed.

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[redacted]

CIC 1/99 0696

[redacted]

Classified: Thomas K. Scheber, Project Leader, NWT
Derived from: LA-1000, Rev. 7, 9/81

Enduring stockpile with more diverse backup options (U)

"With limitations

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[redacted]

Here the additional warhead replacement options are added to the "planned backups."

CIC-1/99-0697 [redacted] Classifier: Thomas R. Scheber, Project Leader, NWT Derived from: LA-10000, Rev.7, 0993

Enduring stockpile and options for potential new missions (U)

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[redacted] 34

Now the potential new mission requirements are added to the left column of the matrix. The types of warhead, modified as indicated, that might be considered to meet each potential future requirement are also added to the matrix.

As the DoD considers potential new missions, a number of enduring warheads could be modified to accomplish each mission. Where enduring systems may not be sufficient to meet the mission requirement, we will need to consider other options, including designs based on older warheads or warheads that were tested but never stockpiled.

CIC-1/99-0698

[redacted] Classifier: Thomas R. Scheber, Project Leader, NWT
Derived from: LA-4000, Rev. 7, 9-94

Enduring stockpile with backup options and potential new mission options (U)

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[redacted]

This summary matrix now lists all of the options discussed in the presentation and depicts the inherent flexibility of the existing stockpile. As the US considers any further downsizing of the stockpile, we should consider not only the role currently being filled by each warhead type but the potential for application to future roles.

CIC-1/99-0699

The stockpile can evolve

- The stockpile can adapt in response to changing DoD requirements
- Treaties and policies will constrain the evolution
- Confidence must be maintained
- Cost will be a driver

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To summarize, the nation has significant flexibility within the existing stockpile to support a wide range of potential options for the future. As treaties and policies force changes in, and constrain evolution of the stockpile, preserving flexibility for the future should be considered in the range of options.

However, preserving flexibility comes with a price. We will now discuss the constraints and tradeoffs; primarily how confidence is maintained and how costs could be managed in a fixed budget.

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Outline: Drivers of, and limits to, change in a test-constrained nuclear stockpile

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  - What types of changes in the stockpile may be possible
  - Illustrative examples
- Controlling costs
- Assessing strategies for the future stockpile
  - The base case
  - Replacement/backup stockpile strategy
  - Consolidated stockpile strategy

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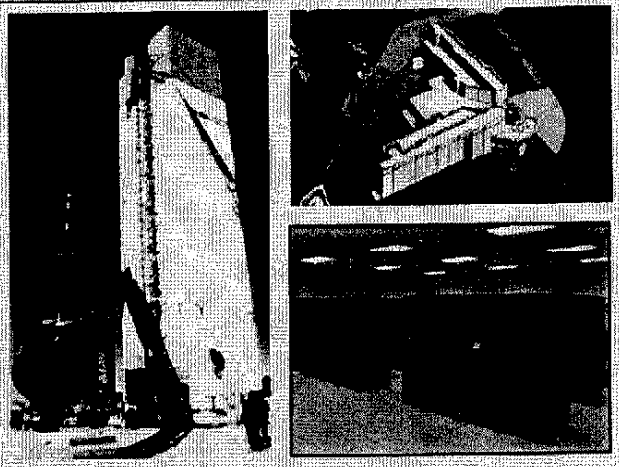
Confidence in an evolving stockpile can be maintained through:

- Understanding initial certification and production
- Ongoing certification through the Stockpile Stewardship Program
  - Surveillance (ongoing + enhanced)
  - Assessment (ASCI + test facilities + tests)
  - Respond (SLEP + plant infrastructure)
- A formal certification process for incremental changes



Maintaining confidence will be imperative to any future stockpile strategy

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Confidence in the evolving stockpile has three main elements. The first is ensuring that we have a thorough understanding of the initial certification and production processes that were used for each warhead type in the stockpile. The second is managing the continuing certification process through the SSP in the absence of nuclear testing. With the addition of the enhanced surveillance capabilities, the success of the advanced strategic computing initiative (ASCI), the addition of new experimental facilities, and an ability to respond both at the labs and the plants, we will be able to certify an evolving stockpile. The third element is implementing a new formal certification process to manage changes for each warhead type.

CIC-1/99-0702

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Initial certification basis

- *DoD Requirements*
  - MCs
  - STS
- *Physics Performance*
  - Computer models
  - NTS tests
  - Physical models
- *Manufacturing Quality*
  - Meets strict QA
  - Process qualification
  - Process prove in (PPI)
- *Engineering Performance*
  - Computer simulations
  - Shake/rattle/roll tests
  - Material properties
  - Safety
- *Issues*
  - The experience base for the certification process must be preserved
    - Archiving
    - Well-trained staff

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The military characteristics (MCs) and stockpile-to-target sequence (STS) provide the criteria for the initial certification. The physics and engineering performance basis is documented in the Final Development Report. The physics basis generally rests on the nuclear test data, with understanding and insight provided by computer models and expert judgement. The computer models integrate various physical models, geometry, and material equations of state. We also depend on the manufacturing quality processes and the surveillance program to ensure that every system in the stockpile is within the performance bands acceptable for nuclear performance—as manufactured and throughout its life. The engineering performance is validated with understanding developed through material properties integrated with geometry, assembly processes, and computer codes. Engineering performance is finally certified through development testing. Nuclear explosive safety, both one-point and plutonium dispersal, is also ensured through nonnuclear testing and computer modeling.

A major issue is maintaining the certification-related experience base of our people. The need is to archive the data that support the documents mentioned above and to develop a well-trained staff that has access to, and knows how to use, the data.

CIC-1/99-0703

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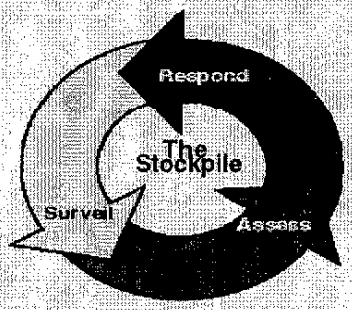
Ongoing certification in the absence of nuclear testing requires:

- ***Surveillance***
  - New material lab tests
  - New material flight tests
  - Shelf-life tests, etc.
  - Enhanced surveillance program
- ***Assessment***
  - ASCI-level computer models
  - Improved test facilities
  - Improved hydro and subcritical test base
- ***Response***
  - Phase 6.2A completed
  - SLEP in place
  - Plant processes in place
  - Plant infrastructure ready



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Core activities within the Stockpile Stewardship Program are surveillance, assessment, and response.

The surveillance program of the past had two main goals: (1) ensuring that a system would last to its end of life, normally 20 years, and (2) providing data to improve the next system in the evolution. We now expect our current systems to remain well past the end of their design life. Therefore, the surveillance program of the future will need a different focus. We will need to identify small changes much earlier for two reasons: (1) the systems are expected to remain in service indefinitely, and (2) we need to plan refurbishments and life extension programs far enough in the future to compensate for the limited production capacity of the downsized complex. The traditional surveillance program and new technologies from the enhanced surveillance program are critical for the success of the SSP.

In the past, the assessment program was primarily dependent on nuclear testing. To comply with the comprehensive test ban treaty (CTBT), we have developed a new strategy. The new strategy has three major components: (1) Hydrodynamic testing—The purpose of hydrotesting in the past was primarily to minimize the possibility of an expensive surprise at the Nevada Test Site (NTS). In the future, the hydrotesting program will play a large role in ensuring that we have not changed the implosion performance of a primary as the stockpile evolves. (2) Facilities—New test facilities are critical for determining the effects of incremental physics and engineering changes on portions of the weapon explosion sequence. (3) Computing—The ASCI initiative will integrate the incremental physical models together to predict performance.

Finite-life components must be maintained for a safe, secure, and reliable stockpile through remanufacture and replacement. In addition, it is prudent to have a demonstration program in place at each plant for each component by "building a few" each year. This readiness program would ensure that the material specifications and pipelines are understood, that training programs are effective, and that the resulting products and quality programs are working. The readiness program would also allow additional surveillance sampling as needed for the extended life requirements.

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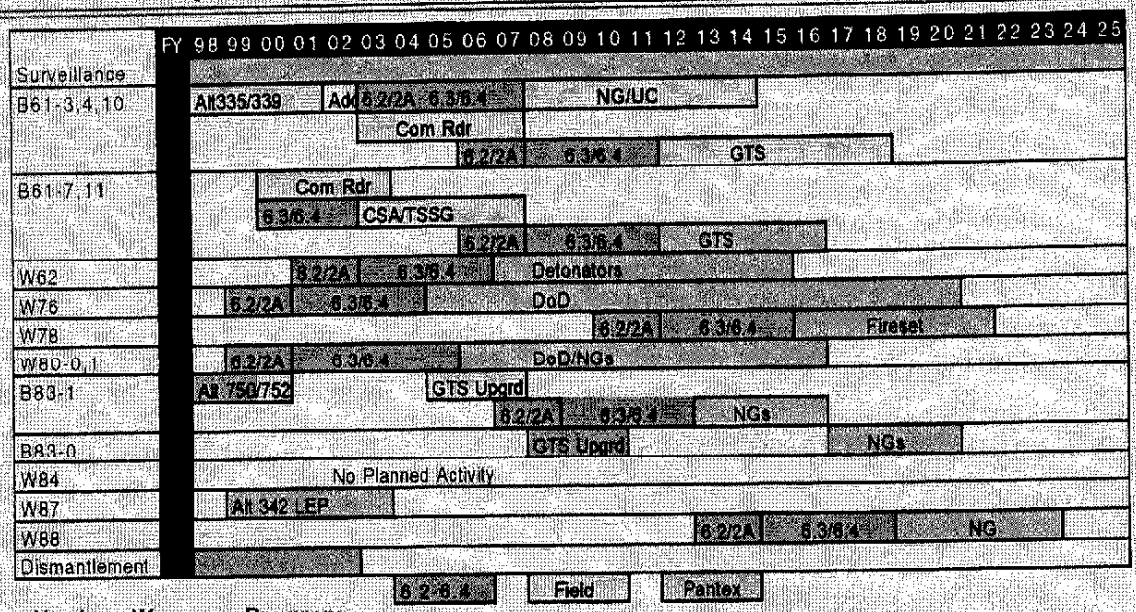
Confidence in the base case stockpile depends on the SSP and a comprehensive stockpile life extension plan



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The most recent schedule for the implementation of stockpile life extension program (SLEP) activities is shown here. Note the extensive planning studies and preparation required before a SLEP of each type of warhead.

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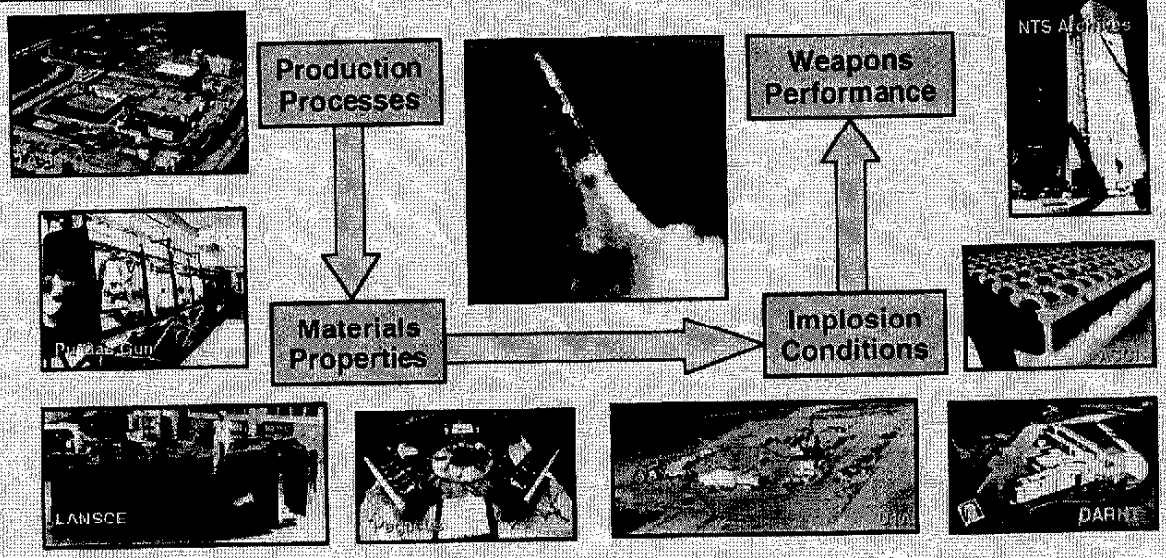
Tools that have been developed for stockpile stewardship will enable us to evaluate future changes in the stockpile



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The final piece of confidence for incremental change rests on a formal change certification process. To accomplish this will require (1) a substantial improvement in computational capability (e.g., ASCI); (2) improved resolution of fundamental physics data obtained at improved experimental facilities; (3) scaled integrating experiments such as the national ignition facility (NIF) and the Los Alamos Neutron Science Center (LANSCE); (4) a careful use of archived nuclear data; and (5) a well-trained staff.

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Outline: Drivers of, and limits to, change in a test-constrained nuclear stockpile

- The Context
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  - National policy, arms control, etc.
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  - Illustrative examples
- Maintaining confidence in an evolving stockpile
- Assessing strategies for the future stockpile
  - The base case
  - Replacement/backup stockpile strategy
  - Consolidated stockpile strategy

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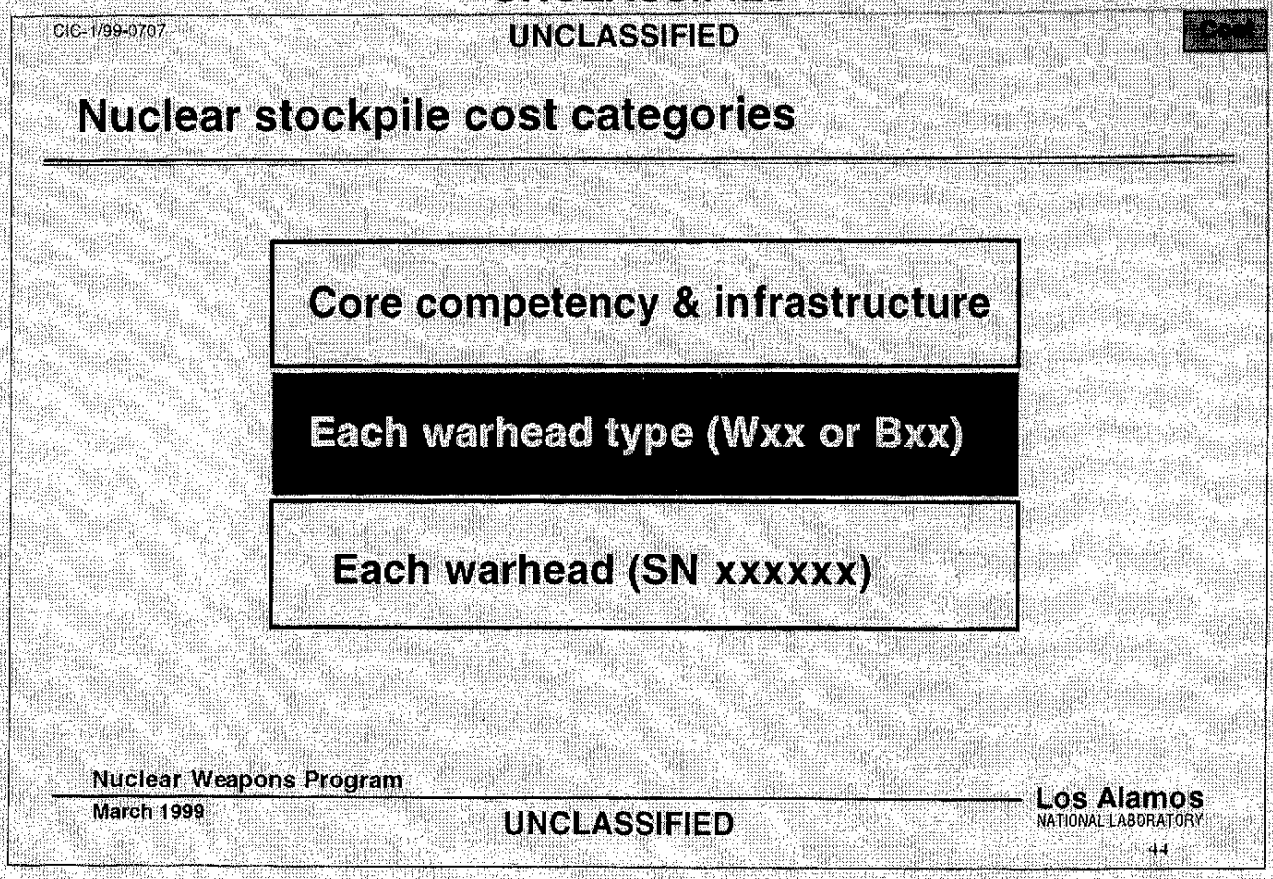
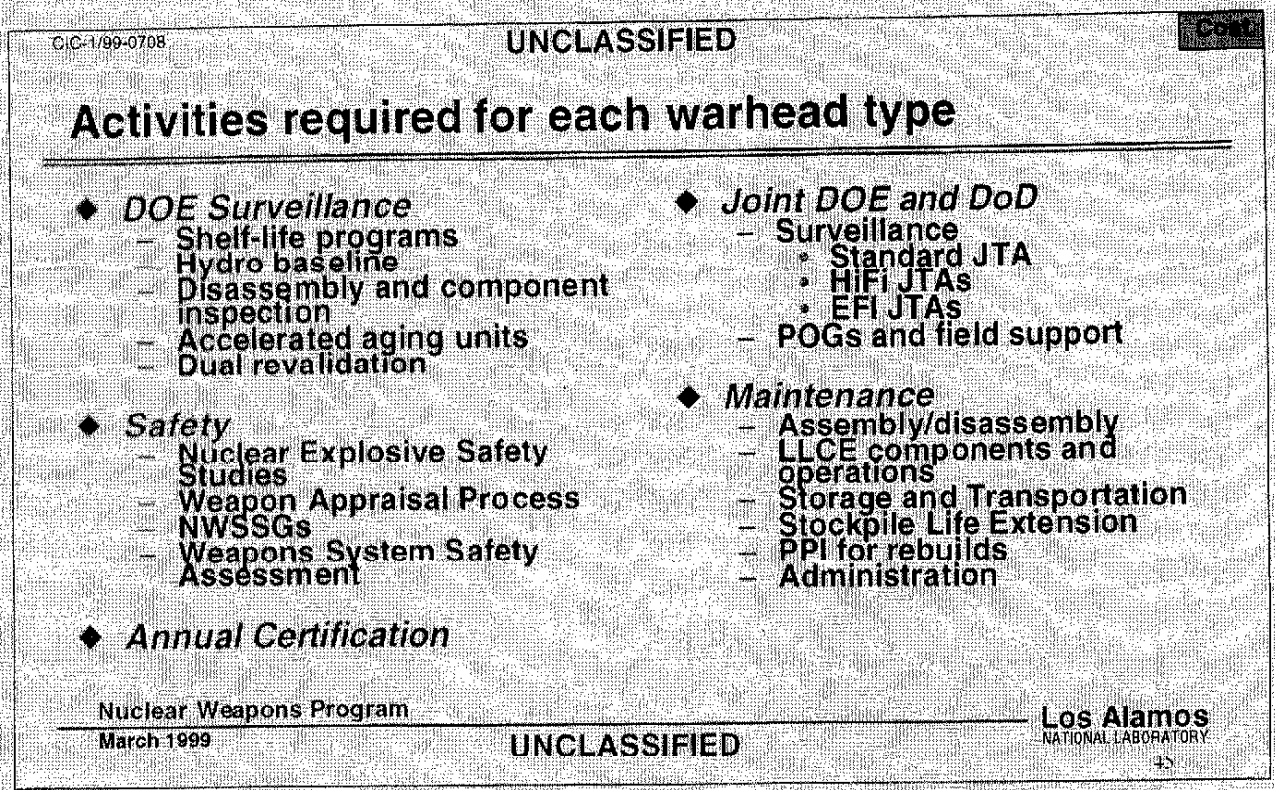


The DOE Defense Program budget required to maintain a nuclear deterrent was divided into three categories for the purpose of this assessment.

The first area includes those activities and infrastructure required for the United States to be a nuclear power. They include such items as computational capabilities, experimental facilities, and manufacturing and surveillance infrastructure. These activities are required regardless of how many weapons or how many types of weapons the country retains.

The second category includes all the activities that are required to keep each of a given type of warhead in the stockpile. The next viewgraph lists examples of these activities.

The third category includes those activities that depend on the number of warheads, regardless of the type, in the stockpile. This cost category is dominated primarily by capacity requirements for the manufacturing infrastructure and includes tritium requirements.



Substantial effort is applied to keeping a warhead type in the stockpile. This effort is required whether there are 10 warheads of a given type or 1000 warheads of that type.

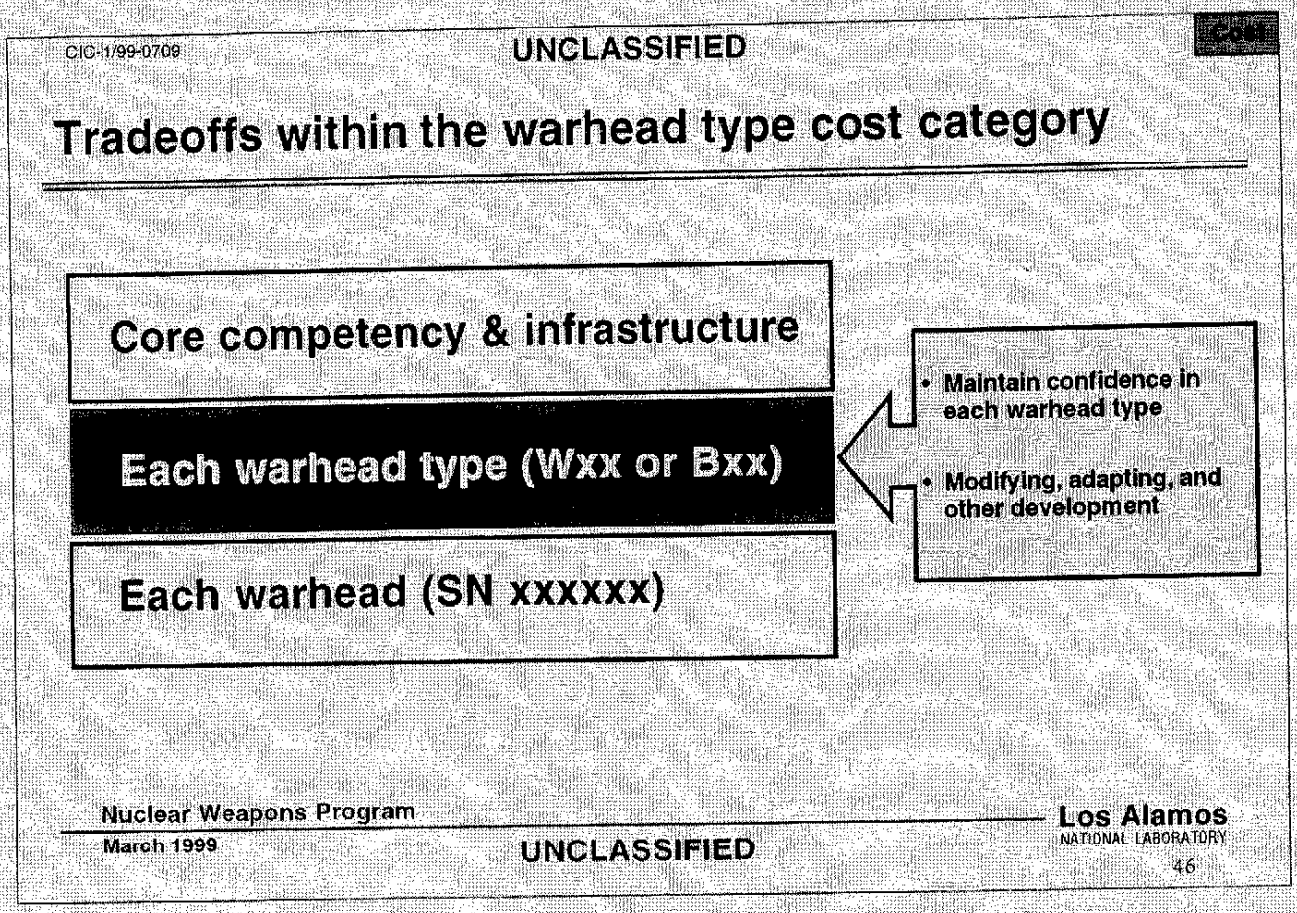
A DOE surveillance program is required to ensure that we understand the current stockpile and can plan the SLEPs. To accomplish this, we have several shelf-life programs, which give us ready access to aging phenomena as well as a known base (temperature history, mechanical history, etc.) to compare the stockpile against. To certify future stockpile changes, we will need to compare the performance of new components (e.g., W76 mount) against a known base line. A hydrodynamics test base line must be developed for each system. The conventional surveillance program requires system disassembly, inspection, and in some cases reassembly of a number of systems each year. If we are going to plan SLEP time tables with reasonable accuracy, we need better long-term data (accelerated-aging unit tests). These tests accelerate the chemical aging of systems to allow us to better predict system lifetimes.

Because of the potential severity of an accident with nuclear weapons, very high safety standards are maintained. An up-to-date Nuclear Explosive Safety Study (NESS) is required to perform any operation on a given type of weapon. The Weapon Appraisal Process (WAP) is another periodic study and document that must be maintained. There are other joint DOE/DoD studies, such as that done by the Nuclear Weapons Safety Study Group (NWSSG), that require periodic review and updating.

The annual certification process requires an in-depth evaluation and report of each weapon type.

The DoD and DOE jointly carry out major surveillance efforts. The Joint Test Assembly (JTA) test program requires DOE to build several assemblies that look and behave like nuclear weapons but that do not have the materials necessary to produce nuclear yield. There are several types of JTAs. Some are very simple from the DOE point of view; they mostly contain electronics replacing the physics package to diagnose the performance of DoD hardware. The DOE also constructs more "lifelike" JTAs that allow better diagnoses of the performance of the physics package during real environments. In addition, both DoD and DOE support the Project Officers Group (POG) process.

Finally, a number of periodic activities are necessary to keep a warhead in the stockpile.



Recently, it was suggested that confidence in an overall delivery system may be increased by adding additional "reliability backup" warhead types. If we decide to add or modify additional weapons types, the trade space for costs is within the "warhead type" cost categories as defined for this assessment.

This fundamental tradeoff will be explored further on the next slide.

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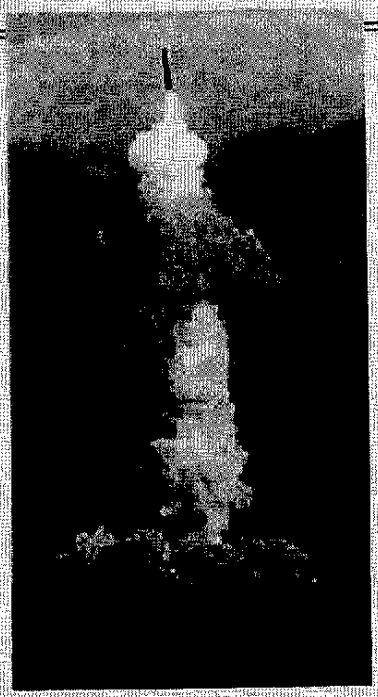
The diversity vs confidence tradeoff

More warhead backup options would require:

- **Adapting and certifying an existing warhead to a delivery system**
  - Develop and engineer interfaces (e.g., mechanical, electrical) and assess warhead performance to meet new MCs
  - STS environments (structural, thermal, vibration, etc.) must be evaluated
  - Weapon surety standards must be met
- **Some loss of system performance would be expected**

Fewer warhead types could result in:

- **Increased investment in confidence-building measures for the remaining stockpile**
  - Increase hydrotests, surveillance flights, etc.
  - More in-depth understanding of STS environments
  - Fewer components for the labs to design and certify and for the plants to produce and qualify
- **Some loss of flexibility for DoD would be expected**



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Within a fixed budget for the stockpile stewardship program (SSP), this assessment found an important tradeoff in developing a strategy for the future. That tradeoff is whether to pursue a more diverse stockpile, to provide a range of reliability backups, to consolidate to a less diverse stockpile, or to devote more resources on maintaining confidence in a smaller number of warhead types.

The key issues associated with this fundamental tradeoff are outlined on this slide.

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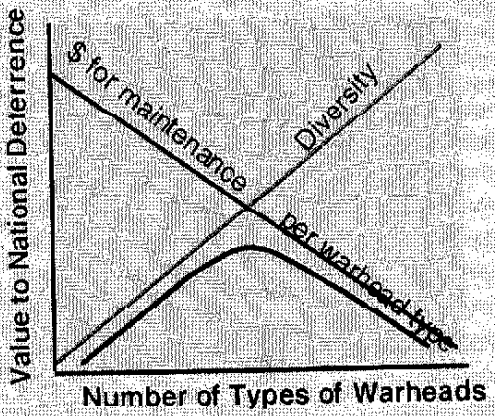
If constrained by a fixed DOE budget, more warhead types and numerous backup options may not be the best strategy

- Too many backup warhead options may result in decreased confidence for the overall stockpile
  - Confidence-building measures for the stockpile would have to be reduced to fund the development of backup options
  - Additional DoD flight assets must be dedicated to the development programs
- Sustainment and confidence-building measures for each of the warhead types would likely be constrained by a fixed budget



In planning a strategy for the future, the level of diversity in the stockpile will be a key factor

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The diagram on the right side of this slide illustrates an application of the diversity versus confidence tradeoff.

The horizontal axis is labeled "Number of Types of Warheads." As the number of different types of warheads in the stockpile is increased, depicted by the line labeled "diversity," our targeting flexibility and utility should increase. At the same time, in a fixed budget environment, the amount of funding and effort to maintain confidence in each warhead type decreases as more warheads are added to the stockpile, as depicted by the line labeled "dollars for maintenance per warhead type."

Both of these factors, stockpile diversity and confidence, must be considered when choosing the number of warhead types for the future. The blue line is a notional depiction of our assessment that at some point adding more warhead types to the stockpile without additional funding could result in decreased confidence in the overall stockpile and therefore in less total value to the nation.

Los Alamos alone will not be able to judge whether the US stockpile should be increased or decreased in the number of types of warheads. That assessment should be left to a joint study conducted by the DoD and DOE. We will, however, discuss how this factor, "diversity" in the stockpile, could be considered in developing a strategy for deploying a nuclear stockpile on the next generation of nuclear-capable weapon systems. The time frame for such a transition would probably occur in the period from 2015 to 2025, when the current generation of nuclear-capable delivery systems reaches the end-of-service life and replacement systems are developed and deployed.

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- Controlling costs

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In developing a strategy for the future stockpile, our objectives should be clear

- Maintain confidence in the stockpile warheads
- Guard against the failure of any leg of the triad and NSNF
- Provide flexibility for future nuclear force requirements
- Manage warhead and weapon system tasks within constrained budgets for the DoD and DOE

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Our objectives in developing a stockpile strategy should be clear. We need to

1. Maintain confidence in the stockpile warheads.
2. Guard against the failure of any leg of the triad and nonstrategic nuclear forces (NSNF).
3. Provide flexibility for future requirements.
4. Manage assets to maximize the deterrent value to the nation.

In addition, we should identify any initiatives or tasks that are required in the near term to preserve the capability to respond to new requirements over the long term.

CIC-1/99-0714

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Strategy

Three stockpile strategies for the future

- **The base case**
  - The current plan for the enduring stockpile
- **The replacement/backup case**
  - A stockpile that is more diverse than the base case
- **The consolidated case**
  - A stockpile that is less diverse than the base case

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We will examine three cases for the future.

The base case is the path that represents duplicating the deployment scheme of the current force posture as the nation plans for follow-on forces.

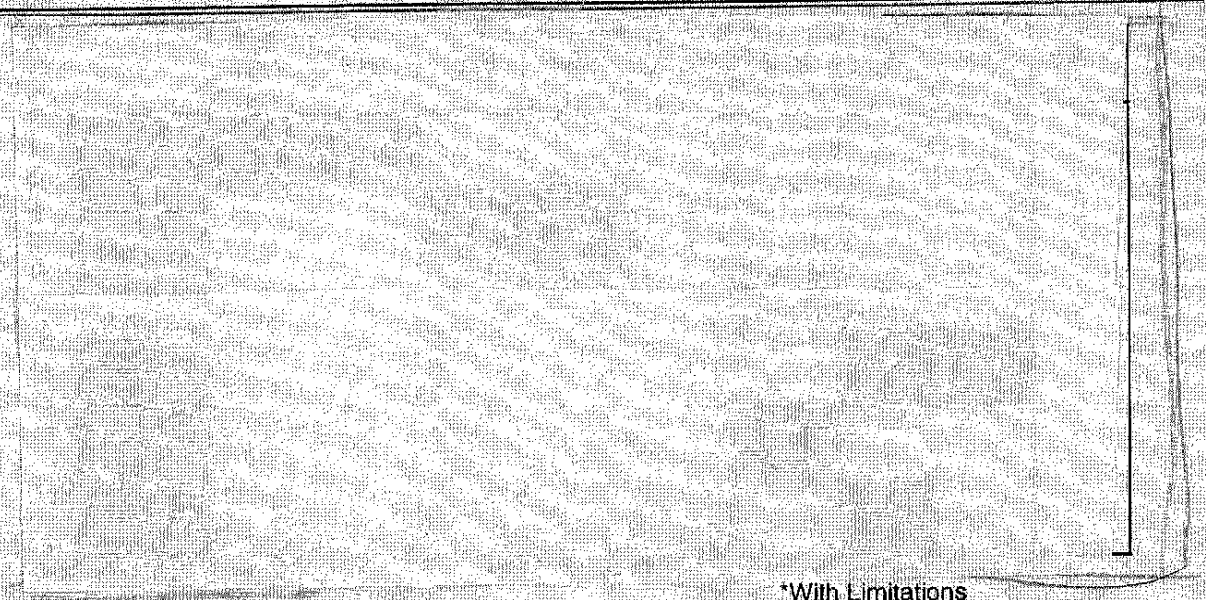
The replacement case adds to the base case some options, proposed earlier in the briefing, to deploy additional backup warhead capabilities for each delivery system.

The consolidated case proposes a less diverse stockpile by minimizing the number of warhead types and increasing the level of effort to maintain confidence in a core set of warhead types.

UNCLASSIFIED [redacted]

CIC-1/99-07/15 [redacted] Classifier: Thomas K. Sutherland, Project Leader, NWT. Derived from: LA 4000, Rev. 7, 9/91 [redacted]

Base case: Our current approach (U)



*With Limitations

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[redacted]

The base case is defined by the current deployment scheme shown here. In this case the warheads currently deployed on each nuclear delivery system would be adapted to the next-generation, replacement weapon system.

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[redacted]

CIC-1/99-0716

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Strategic

The replacement/backup case

The motivation for this case rests on the premise that confidence is enhanced by

- **A more comprehensive range of backup/replacement options than in the base case**
- **Modifications to the primary and backup warheads to provide flexibility for changing mission requirements**

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The motivation for the replacement case, "more diverse" stockpile option, is that confidence would be enhanced by (1) a more comprehensive range of backup/replacement options, and (2) more warhead types in the stockpile, which would provide more choices of warhead types that could be modified in response to changing mission requirements.

[redacted]

CIC-1/99-0717

[redacted]

Classifier: Thomas K. Scheller, Program Liaison, NWT
Derived from: DA-1000, Rev.7, 9/99

Strategy

Enduring stockpile with more diverse case (U)

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[redacted]

A more diverse stockpile could be developed using many of the options discussed earlier in the briefing and summarized on this matrix.

[redacted]

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The consolidated stockpile case

The motivation for this case rests on the premise that confidence is enhanced by

- Concentrating surveillance, assessment, and manufacturing efforts on a consolidated set of warhead types.
- Modifying the consolidated warhead types to provide the flexibility for changing mission requirements.
- As required by DoD, developing small lots of special purpose warheads.

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The motivation for the consolidated case is that confidence would be enhanced by (1) concentrating surveillance, assessment, and manufacturing efforts on a smaller set of core warhead types, and (2) selecting the core set of warhead types to provide high leverage for changing mission requirements.

In addition, for this case, it may be desirable to develop a "small-lot" philosophy for the production or modification of small numbers of warheads that is not as rigorous as that used for the consolidated warhead types. This will be further discussed on the next slide.

CIC-1/99-0719

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Strategy

The future stockpile may consist of two populations

- ***The consolidated stockpile will be supported with a robust infrastructure for***
  - Surveillance,
  - Assessment, and
  - Response (SLEP and production capability)
- ***A "small-lot" program could provide flexibility***
  - Limited surveillance program–rebuild every *n* years
  - Much less formality in production processes
  - Few or no process prove-in lots–inspection
  - No "protected-period" unit production–fewer builds
  - Evolve as the world changes

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Under the consolidated scenario, if a small number of special purpose warheads is required, the future stockpile could consist of two populations.

The core warheads in the consolidated stockpile would consist of those warhead types in the stockpile in relatively large numbers. The core warhead types would be supported by a robust SSP program as described earlier.

The "small-lot" warheads, if required, would be those for which the number of special purpose warheads is relatively small (e.g., 20 to 50). For those warhead types, we may adopt a different support strategy in order to preserve the benefits of the consolidation strategy. These warhead types would be rebuilt periodically instead of relying on a more comprehensive surveillance structure. Some of the elements that might be considered for a small-lot strategy are listed on the slide.

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Consolidated case + small lots (U)

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The matrix shown here could be used to develop a strategy for the consolidated stockpile case.

The core set of warhead types would be selected from those warheads currently deployed. This selection would consider the inherent flexibility in the stockpile to respond to new mission requirements such as those shown at the bottom half of this slide.

The consolidation would meld with DoD plans (U)

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For the consolidated stockpile case a notional stockpile down-select schedule is shown here as an illustrative example. The time frame for some of the down-select decisions was assumed to be five years before the deployment of the replacement delivery system. For example, if the MMIII is to be replaced by a follow-on intercontinental ballistic missile (ICBM) in 2020, a decision on a single warhead to be deployed on that system might be required by 2015.

Reliability backups would be inherent in this strategy also. For example, a reliability backup for the ICBM system could be provided by qualifying and adapting the submarine-launched ballistic missile (SLBM) warhead during the ICBM development.

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Comparison of future stockpile strategies for a *fixed budget* for DOE Defense Programs

	Flexibility (to meet changing requirements)	Confidence (in the performance of each WH type)	Cost (for DoD)
Diverse Backup Case			
Base Case			
Consolidated Case			
Consolidated Case with Small lots			

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This slide summarizes the strategies in terms of relative numbers of warhead types.

The diverse case has the greatest inherent flexibility since it has the most warhead types, which could be modified. It provides the lowest confidence in each warhead type since, in a fixed budget environment, it has the least amount of funding allocated to maintain each warhead type. It is also the most costly for the DoD, because a flight qualification program will be required for each warhead type for each delivery system.

The base case has moderate inherent flexibility. Planning to date has not identified major shortcomings. Confidence in each system is also moderate.

The consolidated case has the least flexibility because it has the fewest warhead types available for future modifications. The confidence in each warhead type is maximized as more effort is dedicated to each warhead and system. The costs to the DoD for future flight qualification programs are the lowest of the three cases.

An excursion to the consolidated case is the consolidated case with small lots, if required.

The consolidated with small-lot case restores the flexibility of at least the base case. It provides higher confidence than the base case does because more efforts are devoted to the smaller number of consolidated warhead types. Compared with the base case, the costs to the DoD for future flight qualification programs and maintenance could be lower, depending on small-lot rules.

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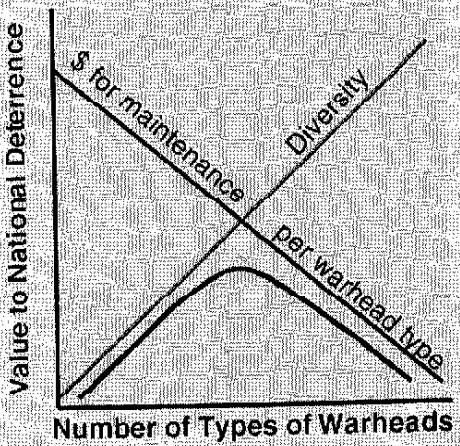
Summary

- No new warhead requirements and no nuclear testing has led to the perception of a static stockpile
- Several drivers will force change to the stockpile in the future
- There is an identified set of possible changes to the stockpile, even under a CTBT
- Maintaining confidence in an evolving stockpile is a major task for the SSP
- Within the SSP budget, costs can be controlled by managing the number of warhead types



Conclusions

- It will be possible to support the DoD with flexible and effective warhead options to meet future force requirements
- The stockpile should be managed to balance diversity, confidence, flexibility, and cost

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Summary points and conclusions are shown on this slide. This briefing has not endorsed a single strategy nor the warheads that should make up the stockpile of the future. That task should be conducted by a joint DoD and DOE study team.

The briefing has highlighted the considerable flexibility inherent in the current stockpile and has outlined some of the fundamental tradeoffs and strategies that should be considered in developing a strategy for the future nuclear stockpile.