Confidence in nuclear weapons as numbers decrease and time since testing increases

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Outline

- Preview of bottom line
- My relevant experience
- Stockpile stewardship today
  - *The NW complex and today's stockpile*
  - *Today's challenges*
- U.S. objectives and policies
- Tomorrow's challenges
- Summary

Sustained commitment is essential for maintaining the deterrent as numbers decrease.

- **Nuclear Posture Review:**

  "… as long as nuclear weapons exist, the United States will maintain a safe, secure, and effective arsenal …"

- **This is challenging today, and the challenges may increase as numbers decrease and the testing moratorium continues.**

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My opinion:
The technical challenges c*an* be met,
but only with a sustained national commitment.

I am a semi-outsider with a long history of interactions with the weapons program.

- 5.5 years (1986-1992): code developer in weapons design division, Lawrence Livermore National Laboratory (LLNL)
- Current or past chair of review & advisory bodies:
  - *Weapons Science Capability, Los Alamos National Lab (LANL)*
  - *X-Division (weapons design), LANL*
  - *Predictive Science Panel, LLNL and LANL*

  and member of many others.
- Co-chair of in-depth studies:
  - *U.S. NW Surety (safety and security), 2010*
  - *Life extension options for the U.S. NW stockpile, 2009*

  and participant in many others.

The opinions expressed in this talk are mine.
I am not representing any organization, committee, or study group!

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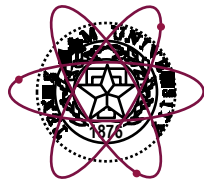

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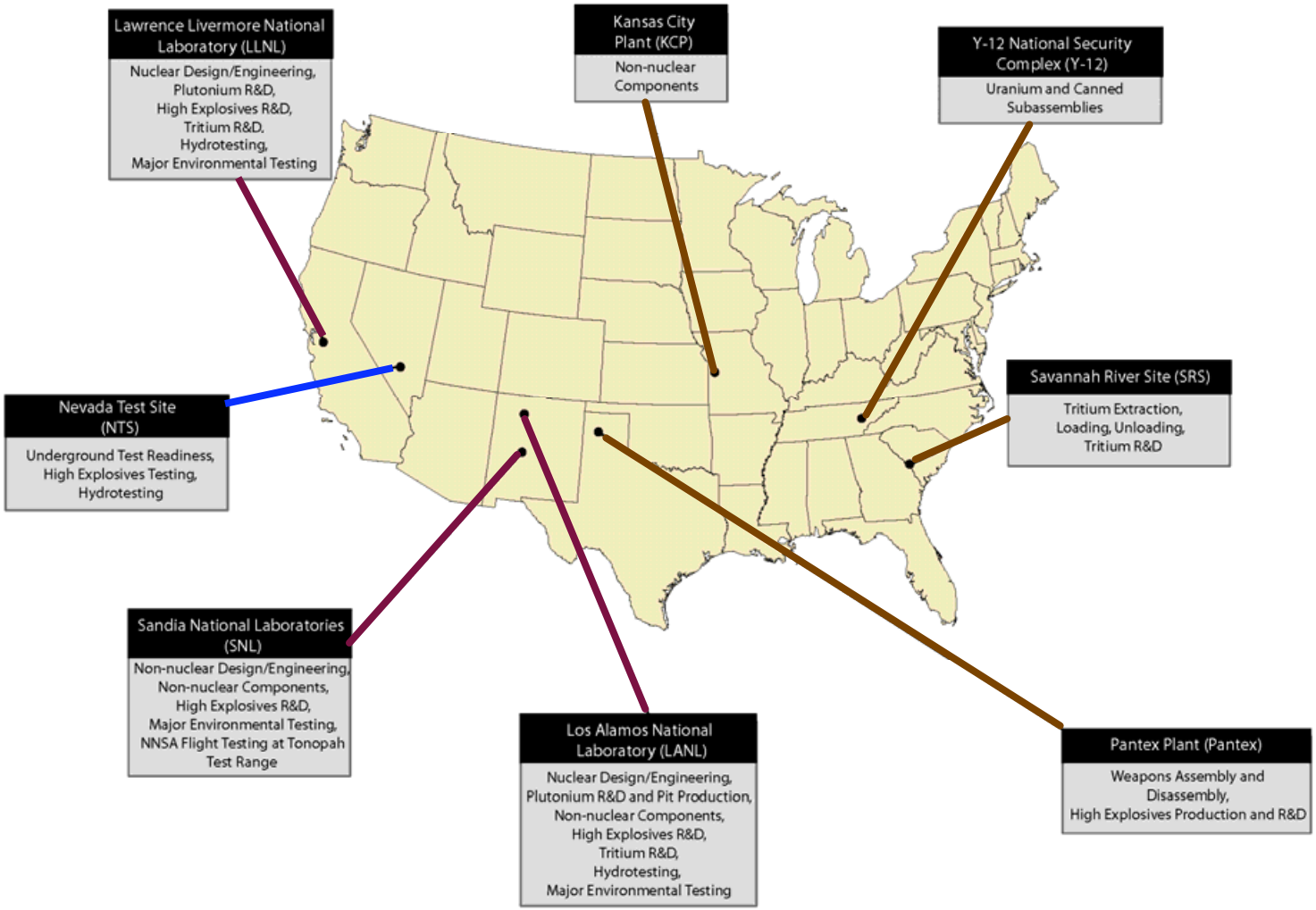
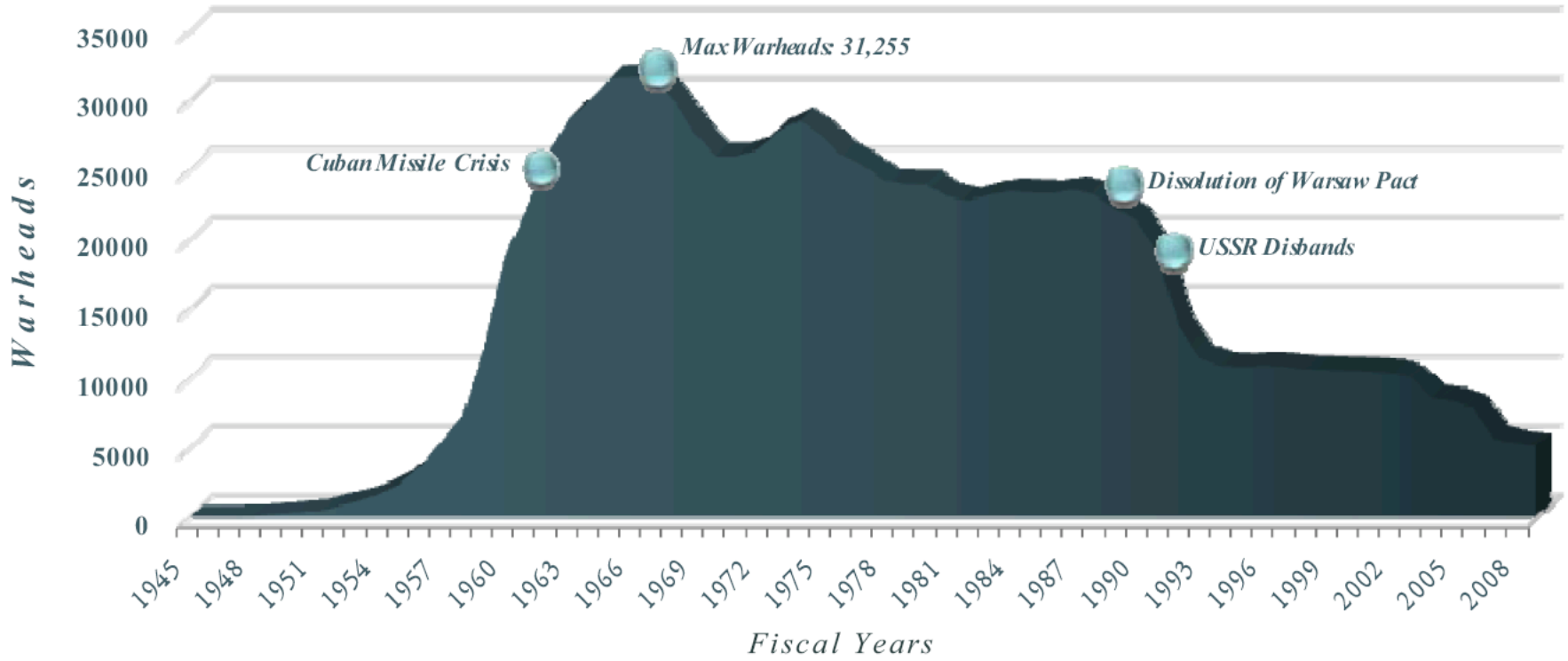
The NW complex includes 3 laboratories, 4 production sites, and 1 test site.

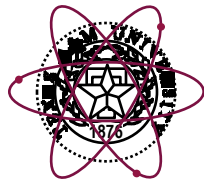


US NW stockpile numbers have dropped (from a peak of >30,000).



- **Today's deployed stockpile has 7 designs (one with variants)**
  - ***Two SLBM warheads: W76 and W88***
  - ***Two ICBM warheads: W78 and W87***
  - ***Two bombs: B61 (several mods) and B83***
  - ***One cruise-missile warhead: W80***

Weapons are changing, but we are not testing.

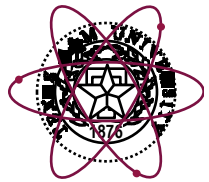


- **Kinds of changes:**
  1. ***Age-induced** changes (from chemical & nuclear reactions, e.g.)*
  2. *Changes in our **understanding** of as-designed performance*
  3. ***As-built changes** from design (manufacturing errors)*
  4. ***Deliberate** physical modifications*

- **Every weapon faces eventual retirement or life extension.**

- **Life extension involves deliberate physical changes. Reasons:**
  - *To **address detrimental changes** of kinds 1-3 above*
  - *To **improve safety and security** as threats evolve*
  - *To **meet evolving stockpile requirements** (reduced yield, inter-operability, increased confidence?, …)*

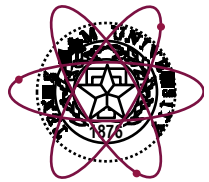
Changes introduce challenges.



- **Life-Extension Program (LEP) options include:**
  - ***Refurbishment** (components have same form, fit, and function)*
  - ***Reuse** (some components taken from other systems)*
  - ***Replacement** (some components have new design)*
- **Even "refurbishment" involves design and/or manufacturing changes.**
- **It is technically challenging to assess the effects of these changes in absence of yield-producing tests. Assessments rest on:**
  - *Linkage to data from previous nuclear-explosive testing*
  - *Other past and ongoing experiments*
  - *Scientific understanding*

Expert judgment is required to evaluate relevance of each factor.

Stockpile stewardship has been working... … so far.



- We have not performed nuclear-explosive tests since 1992.
- Responsible authorities (3 lab directors, STRATCOM, Secretaries of Energy and Defense) have stated each year that

  the deterrent remains sound and we do not need to test.

- However, these and many other knowledgeable people and groups have expressed concerns about
  - *Adequacy of surveillance*
  - *Ability to recruit & retain excellent workforce*
  - *Decrepit production facilities*
  - *Adequacy of weapons-science effort*
  - *Technical foundations for assessment of certain kinds of changes*

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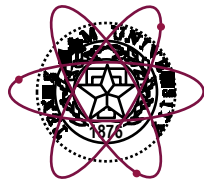

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US NW objectives were outlined in the Nuclear Posture Review Report (2010)

- **Five "key objectives"**
  1. *Preventing nuclear proliferation and nuclear terrorism;*
  2. *Reducing role of U.S. nuclear weapons in U.S. national security strategy;*
  3. *Maintaining strategic deterrence & stability at reduced nuclear force levels;*
  4. *Strengthening regional deterrence and reassuring U.S. allies and partners*
  5. *Sustaining a safe, secure, and effective nuclear arsenal.*

- **The US will not:**
  - *conduct nuclear testing.*
  - *develop new nuclear warheads.*

- **Life Extension Programs (LEPs)**
  - *Will use only nuclear components based on previously tested designs*
  - *Will not support new military missions or provide new military capabilities*
  - *Will consider the full range of options (3 R's)*
    - **But the US will give strong preference to refurbishment or reuse**

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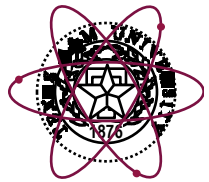
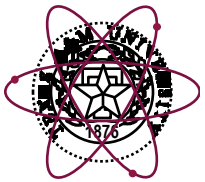
US NW objectives and policies may drive further changes in designs.



- **Safe and secure + prevent terrorism**
  - *May require new safety and security features*
- **Reduced nuclear force levels**
  - *May imply need for higher confidence and/or reliability*
  - *May imply need for interoperability*
- **Consider full range of LEP options**
  - *Opens door for more extensive changes than with refurbishment only*

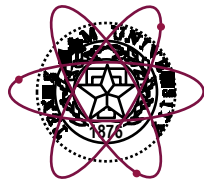
Changes bring challenges.

What will it take to meet the challenges into the future?



- Outstanding workforce with deep expertise in nuclear weapons
- Continued advances in understanding
  - *Robust program of ongoing experiments*
  - *Improved computational capability and capacity (hardware and software)*
  - *Humility in the face of nature*
- Robust surveillance of existing weapons
  - *Cannot assess issues if we don't find them*
- Adequate production capability

What does it take to meet the challenges?



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These exist today.

But they are fragile.

Open questions threaten stockpile stewardship into the future.

- **Can we attract and retain an outstanding workforce?**
  - *Many groups have expressed concern.*
  - *I share the concern.*
- **Will we maintain and exercise a robust experimental program?**
  - *Facilities are expensive*
  - *Many are under-utilized, which makes each experiment cost more, which …*
  - *The easy questions have been answered; can we answer the difficult ones?*
- **Will we give sufficient priority to surveillance?**
  - *If you don't look for problems, you don't know when you have them*
  - *Surveillance has historically been vulnerable*
- **Will we renew the production complex?**
  - *Spiraling costs threaten this and the other components*

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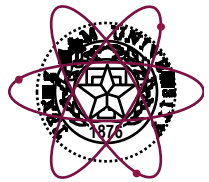

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