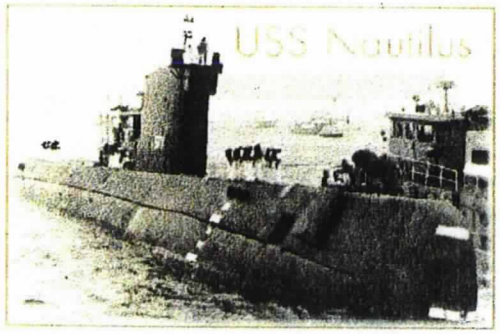
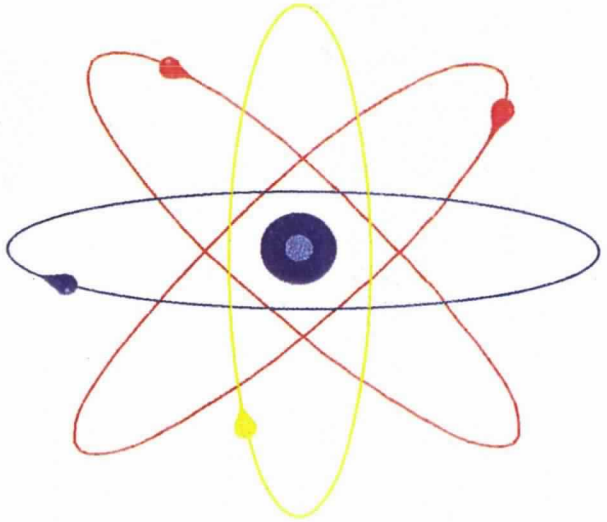
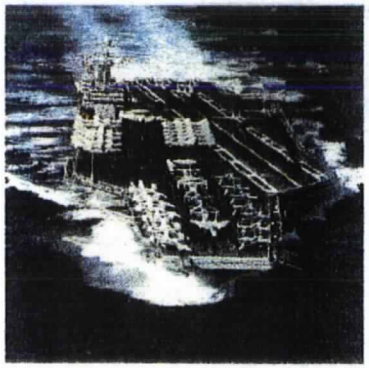
The United States Naval Nuclear Propulsion Program

Over 112 Million Miles

Safely Steamed on Nuclear Power







CVN 69
USS Dwight D. Eisenhower

NAVAL NUCLEAR PROPULSION

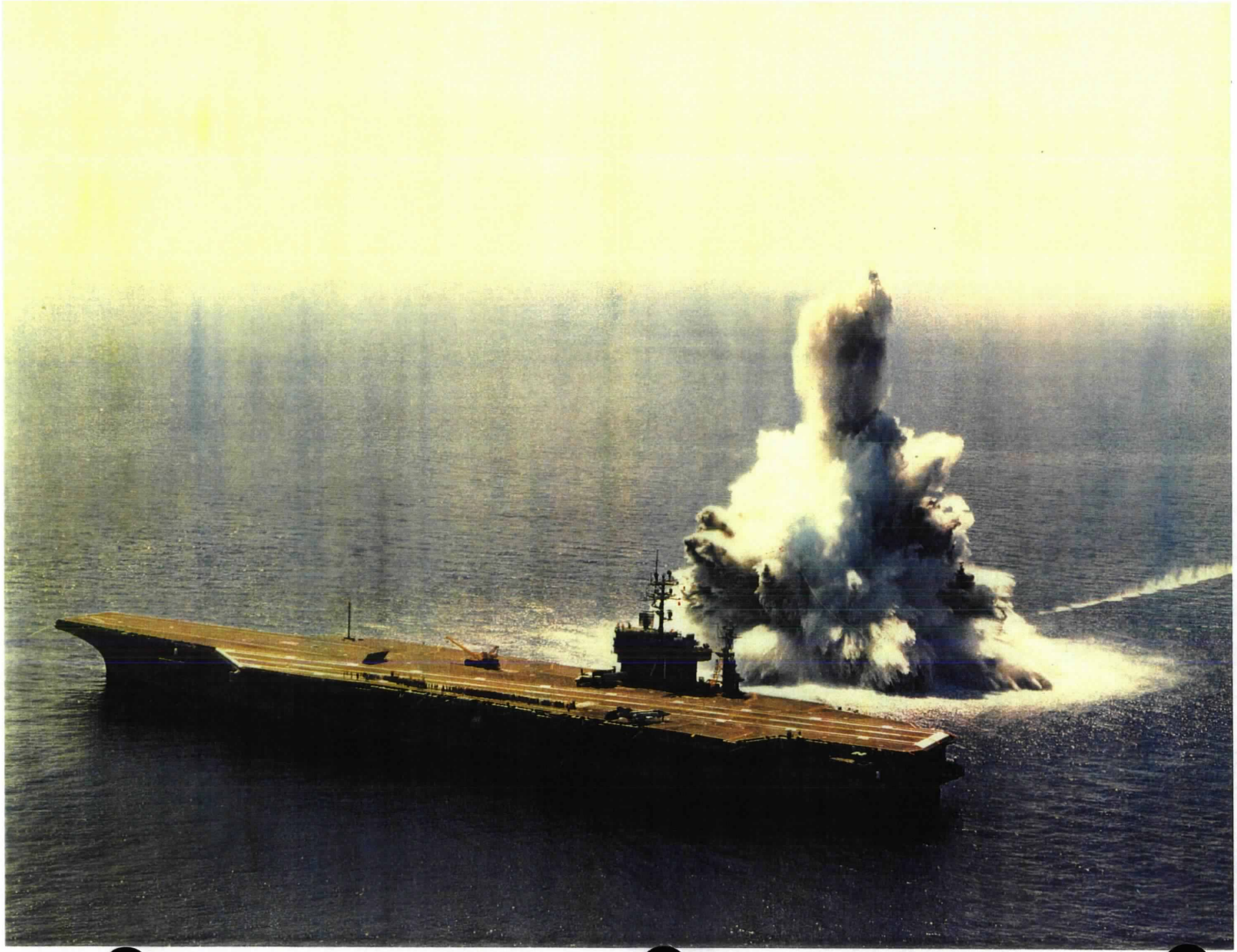
- Key to Navy's national defense mission
  - CNN is telling the story
- Over 40 percent of Navy's principal combatants nuclear powered
  - 8 of 12 aircraft carriers (2 more under construction)
  - 85 submarines
  - 2 guided missile cruisers
- Commitment to safety and environmental protection
  - over 112 million miles steamed
  - over 4,800 reactor-years without a reactor accident
  - Nuclear powered warships visit over 150 ports in over 50 countries

NAVAL NUCLEAR PROPULSION PROGRAM EXPERIENCE

- Over 45 years design and operating experience
- First core taken critical in 1953 (S1W Prototype)
- 488 cores operated
- 39 different core types
- 116 cores currently operating
- A total of 209 ships commissioned

NAVAL SPENT FUEL CHARACTERISTICS

- Solid metallic form - not flammable, not explosive, not RCRA hazardous
- Built for combat - battle shock
  - well over 50 g's
- Contains fully all long-lived radioactivity (fission products)
- Operates over 20 years
  - Thus safe to store shut-down for far longer periods
- Safe to operate in close proximity to sailors on warships during combat
  - Thus exceptionally well-suited for safe transport, storage, disposal



KNOWLEDGE OF THE FUEL

- Control of the manufacturing process
- Core certification process
- Detailed acceptance and lifetime testing
- Follow/reporting throughout core lifetime
- Development of accurate calculational models
- Non-destructive examination at INEEL after removal
  - Every used reactor core
- Selected destructive examinations
  - samples and dissolutions
- Failure modes well understood from in-reactor testing

NAVAL SPENT FUEL CYCLE

- Upon refueling/defueling, all naval spent fuel transported to INEEL for examination to:
  - ensure maximum performance of current fuel
  - enable design of new fuel with longer lifetimes
- For comparison:
  - NAUTILUS fuel operated 2 years
  - Current generation submarine fuel ("SEAWOLF") to operate life of ship (30 years)

NAVAL SPENT FUEL CYCLE (CONTINUED)

- Before 1992, INEEL reprocessed naval spent fuel after examination to recover unused U^{235}
- In 1992, decision made to cease reprocessing
  - naval spent fuel now temporarily stored at INEEL after examination
  - dry storage at INEEL planned for future
- Ultimate plan: Interim storage, or permanent disposal in a geologic repository, outside Idaho

NAVAL SPENT FUEL AND THE GEOLOGIC REPOSITORY

- Naval fuel will be canisterized
- Dry storage at INEEL will be the responsibility of Naval Reactors
- Transportation from INEEL will be the responsibility of Naval Reactors
- Final Container System EIS published November 1996
- Record of Decision issued December 1996 - selected Dual Purpose Canister (DPC) system
- Second ROD issued April 1997 - all naval spent fuel will be loaded into DPCs at NRF, and temporarily stored at NRF
- DPC system is currently being designed
- Goal is that fuel will not need to be handled at the repository, only the canister

AMOUNT OF NAVAL SPENT FUEL

- Small reactors, infrequent refuelings
  - very small amount of naval spent fuel
- Current inventories:
  - approximately 14 MTHM naval spent fuel at INEEL
  - 2,600 MTHM non-naval DOE spent fuel throughout U.S.
  - 30,000 MTHM commercial spent fuel throughout U.S.
- 2035 projected inventories:
  - 65 MTHM naval spent fuel
  - over 2,700 MTHM non-naval DOE spent fuel throughout U.S.
  - over 80,000 MTHM commercial spent fuel throughout U.S.

NAVAL SPENT FUEL AND THE GEOLOGIC REPOSITORY

- Total year 2035 repository load from naval reactors:
  - 65 MTHM
  - About 5,000 cubic meters volume (about 900 cubic meters fuel volume)
  - About 13,000 metric tons weight (about 4,400 metric tons fuel weight)
- About 300 canisters
  - Heaviest loaded canister - about 44 metric tons (about 13-18 metric tons fuel weight)
  - Canister - about 66 in. diameter - about 212 in. long - fabricated of 300 series stainless steel

NAVAL SPENT FUEL AND THE GEOLOGIC REPOSITORY

- Calculational Results -- 1
  - Best estimate prediction is that cladding will not be penetrated by corrosion in 1 million years for any fuel element.
    - By then radioactivity has decreased more than four orders of magnitude
  - Fuel Assembly Geometric integrity maintained for more than 1 million years
  - Isotopes released from naval spent fuel will not contribute significantly to overall repository dose rate
    - only expected releases to the drift are from crud layer and impurities and activations of cladding and control rods
    - peak release rate of 0.01 Ci/yr from carbon-14 at approximately 10,000 years

NAVAL SPENT FUEL AND THE GEOLOGIC REPOSITORY

- Calculational Results -- 2
  - Hypothetical fuel release cases evaluated for perspective
    - mechanical damage of 1,000 fuel elements (e.g., due to rock fall)
      - less than 10 grams U^{-235} released
    - accelerated corrosion beyond 99.98 percentile
      - 225 elements corrode through cladding
      - less than 200 grams U^{-235} released

NAVAL SPENT FUEL AND THE GEOLOGIC REPOSITORY

- Calculational Results -- 3
  - Although naval spent fuel uses highly enriched uranium, the amount of U-235 per container will be comparable to that for commercial spent fuel
  - Will design the system to ensure ample shutdown margin under worst-case moderation/fuel spacing/reflection conditions using permanently attached control rods and affixed poison, as necessary.

NAVAL SPENT FUEL AND THE GEOLOGIC REPOSITORY

- Calculational Results -- 4
  - Decay heat:
    - naval spent fuel decay heat per container will be about half that for commercial spent fuel container
    - peak repository heat load for naval spent fuel is 700 kW total

INTERACTIONS WITH OCRWM

- Contributing analysis information on naval spent fuel to YMSCO for Yucca Mountain EIS
- Working with OCRWM on a memorandum of understanding
- Have been involved in the commenting and comment resolution on OCRWM baseline documents.
- Will provide analyses of naval spent fuel in support of application for NRC license for geologic repository.
- Our prime contractor, Bettis Laboratory, has a field office in the YMSCO/M&O facilities in Las Vegas.
- Other numerous, miscellaneous interactions; we are a recognized participant in the repository planning process.

NAVAL SPENT FUEL -- DEFENSE IN DEPTH

- Overall knowledge of fuel from cradle to grave
- Structural strength of naval spent fuel assemblies
  - built to withstand battle shock
- Corrosion resistance of cladding
- Corrosion resistance persists even after cladding is breached
- Hafnium material integral to fuel assembly - affixed with zircaloy
- The releases of fission products and U-235 from naval fuel will not be a significant contributor to overall repository dose rate.