Introduction

- **Sandia's role in US nuclear weapon transportation**
  - **Design of US DOE transportation assets for over 50 years**
  - **Design and evaluation safety and security subsystems**
  - **Safety and security assessments in support DOE and DoD programs**

- **Role in US-Russian Cooperative Programs**
  - **Support to US DTRA CTR Program**
    - **Design and implementation of VG-124A railcar upgrades**
    - **RF MOD railcar maintenance program**
    - **Technical advisors**
  - **Initial lead DOE laboratory for US DOE MPC&A program efforts to upgrade Minatom railcars**

An Abbreviated History of the Rail Transport of U.S. Nuclear Weapons (1948 – 1986)

John Franklin

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Periods of Interest

- **From an historical perspective, there are four distinct periods of interest:**
  - **1946 – 1958**
  - **1959 – 1968**
  - **1969 – 1977**
  - **1978 – 1986**

- **Each period represents a different approach regarding:**
  - **Transportation safety measures**
  - **Transportation security measures**

- **Evolution in practices and equipment primarily driven by changes in external factors**

Earliest Period (1948 – 1958)

- **Rail was primary method of transport for weapons and some types of weapon production material**
  - **US system of highways not yet highly developed**
  - **Transport by road considered unsafe for transporting weapons**

- **Weapon assemblies shipped separately from nuclear components**

- **Weapon and weapon material shipped by regular railroad freight service**
  - **Use of regular freight railcars adapted for weapons**

- **Protection of weapon shipments**
  - **4 to 5 guards would accompany in separate coach**
  - **No special training for guards in tactics**
  - **No means of constant communications**

Safety Concerns (1959 – 1968)

- **Development of "sealed pit" weapons**
  - **Increased safety concerns**
    - **Scattering of radioactive material in an accident**
    - **Detonation of weapons in adjacent railcars**

- **Weapons now transported only by "special trains"**
  - **Not transported with regular freight shipments**
  - **Locomotives and train crews provided by commercial carrier**
  - **Train speed restricted to 56 km per hour (35 mph)**

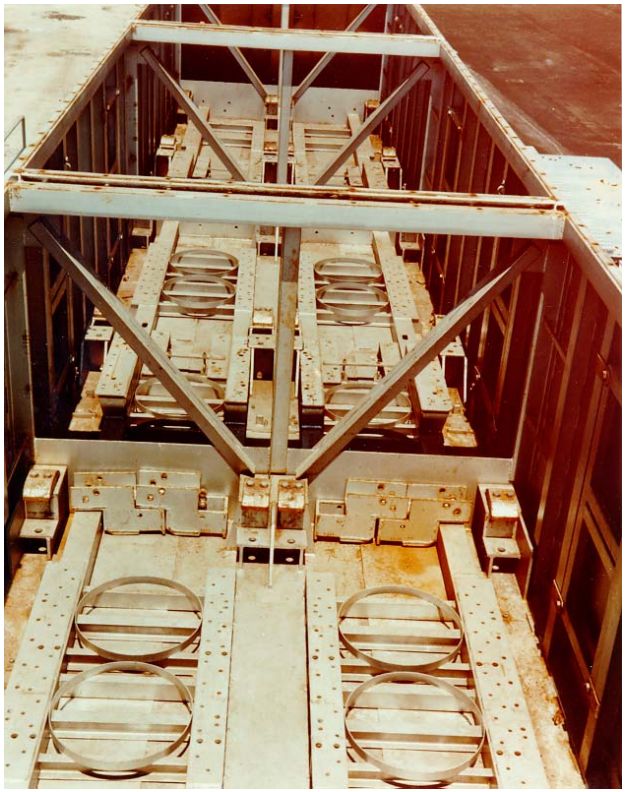
- **No significant enhancements to transportation security**

- **Design of new special rail car to safely transport nuclear weapons**
  - **ATMX railcar**

Safety Features of ATMX Rail Car

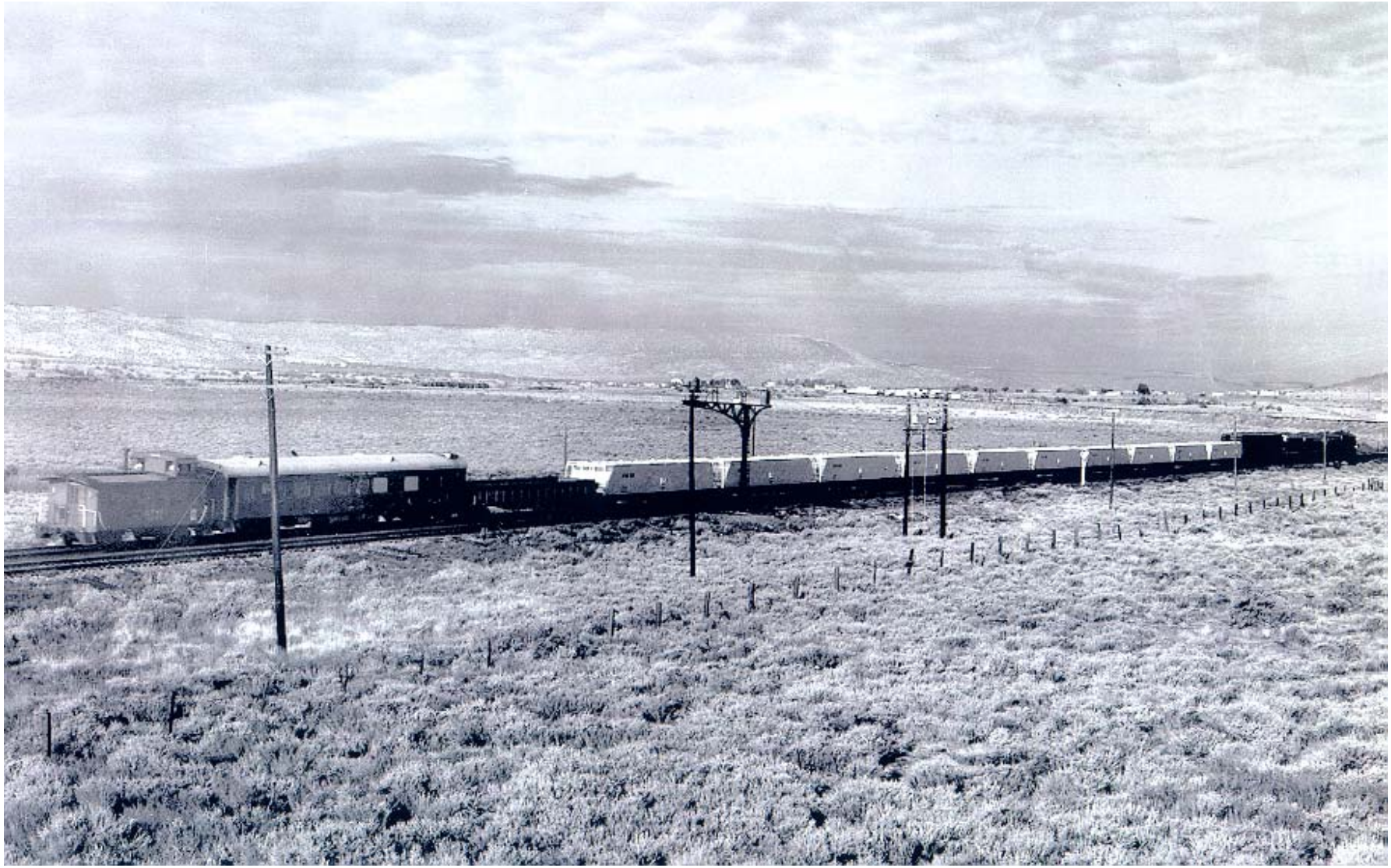
- All-steel construction (fire-proof interior)
- Heavy cast-steel undercarriage to resist twisting and buckling
- Sloped ends to deflect projectiles from explosion in adjacent car
- Superstructure resistant to crush if car rolled over in accident
- Trucks permanently attached to railcar
  - Unlike normal railcars, did not separate if car was elevated
- Use of passenger car couplers
  - To prevent railcars from uncoupling in the event of an accident
- Roller bearings for wheel axle assemblies
  - For reliability and safety
- Weapon containers bolted directly to railcar carriage
  - More secure in event of an accident

Internal View of Railcar



Removal of top hatch in preparation for loading

External View of Railcar



Typical Train Configuration During the 1960s

Security Concerns: Late 1960s – Early 1970s

- **Late 1960's and early 1970's – a time of civil and political unrest**
  - **In US and elsewhere**
  - **Airplane hijackings**
  - **Domestic anti-war protests and violence**
  - **International terrorist incidents**
  - **Massacre at Munich Olympics (1972)**

- **Grave concern regarding security of nuclear weapons and weapon materials**

- **Joint Department of Defense & Atomic Energy Commission (AEC) Study of Transportation Security – 1969**
  - **Recognized transport environments as the <u>most vulnerable</u> from a security perspective**
  - **Recognized transport safeguard measures at that time were inadequate against contemporary threats**
  - **Recommended specific improvements in transportation security**

Conclusions from Joint DoD/AEC Report

- ***…it is impractical to provide enough guards/couriers to guarantee against seizure in transit. Any reasonable increase in guard strength could be countered by any group determined to seize a shipment.***

- ***(SNM) moving by highway and rail offer the greatest exposure to diversion.***

- ***…establish as the ultimate objective the requirement to provide radio telephone, transponder system, or some other equally effective means of ensuring continuous position and surveillance of vehicles and rail cars.***

1969 - 1978

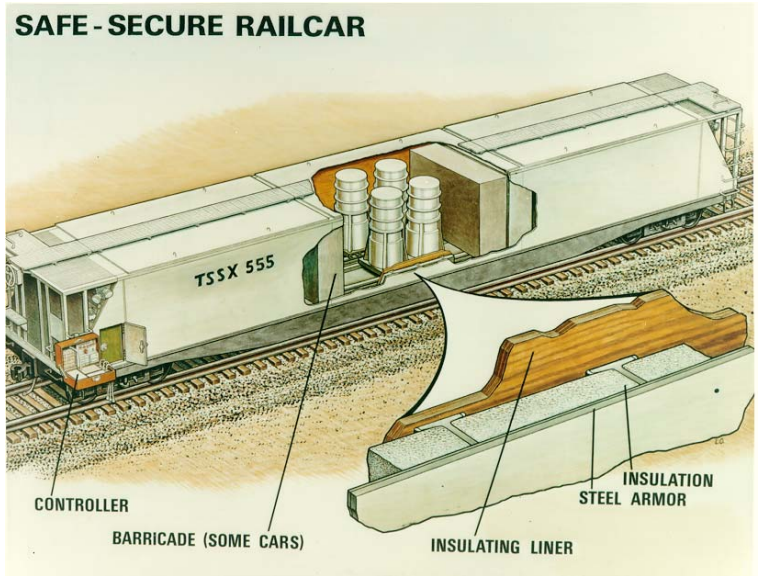
- **Partial measures to address new security concerns**
  - **Constrained, in part, by existing types of railcars**
- **Increase in security forces accompanying shipments**
  - **Two guard coaches typically accompanied each rail shipment**
  - **Number of guard personnel increased**
- **Addition of long-distance communications capability**
  - **HF radio network capable of reaching any point in U.S.**
- **Construction and use of Safe-Secure Transport (SST) for shipment on roads**

Typical Train Configuration During the 1970s with Two Guard Coaches

Safe-Secure Railcar (SSR) Program

- **Safe-Secure Railcar (SSR) program begun in 1975**
  - **Significant modification of ATMX cargo railcars**
  - **Development of specialized armored guard coaches**
  - **Placed into service beginning 1979**

- **Major enhancements to security**
  - **Special tactics training for guard personnel**
  - **'Force-on-force' exercises and simulations to develop and improve tactics**
  - **Emphasis on survivability and dispersal of guard personnel**
  - **Improved communications**



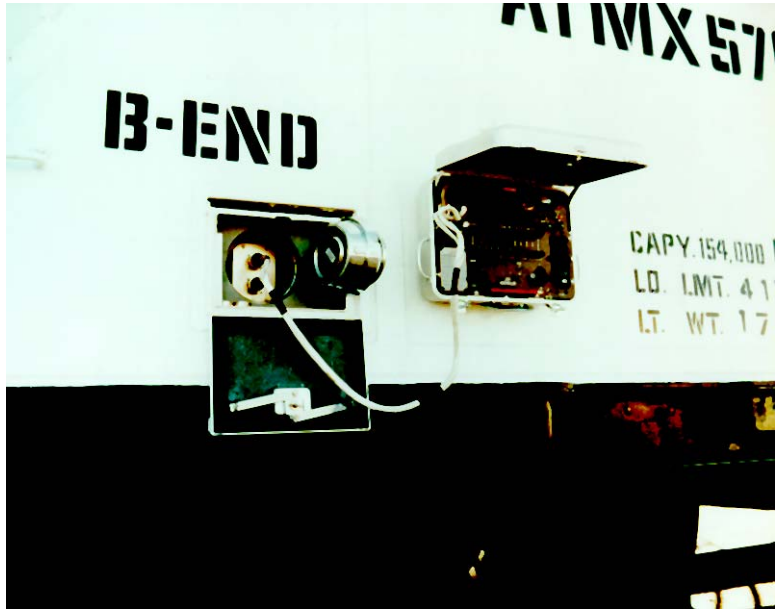
Escort Coaches

- Ballistic armor protection
- Enhanced radio communications
- Elevated cupola for enhanced visibility
- Emergency escape hatches
- Remote control from coach of:
  - Generators
  - Floodlights on each cargo railcar
  - Loudspeaker on each cargo railcar

Safe Secure Railcar

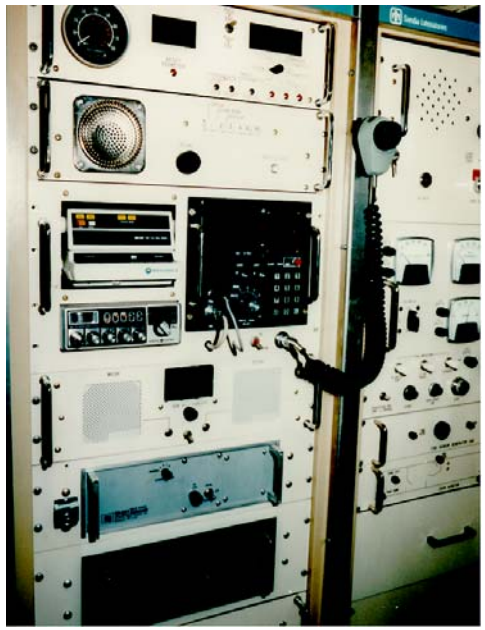
- Modification of ATMX railcar
- Ballistic armor protection
- Thermal insulation from fire
- Active and passive delay features
- Protective locking system
- Upgraded trucks and running gear
- Loudspeakers
- Floodlights

Observation Cupola in Guard Coach



Secure Locking System for Cargo Car

Lighting and Loudspeakers Controlled from Guard Coach



Radio Systems in Guard Coach

Typical Train Configuration During the 1980s with Three Guard Coaches

Problems with Anti-nuclear Protesters

- **In early 1980's, large protests against trains**
  - **Protestors would track and follow trains**
  - **Acts of civil disobedience, blocking of tracks**
  - **Concerns that protests might evolve into sabotage and violence**

- **Measures taken to minimize interference by protestors**
  - **Increased speed of train**
  - **Minimize delays and number of stops**
  - **Cars painted different colors to resemble regular commercial freight**
  - **Use of alternate rail routes**
  - **Prior coordination with local law enforcement agencies**
  - **Measures were generally ineffective against <u>organized</u> opposition**

Decision to Stop Train Shipments (1986)

- All weapon shipments by train were stopped in 1986
  - A 'temporary' measure that became permanent

- Reasons:
  - Security concerns:
    - Fear of escalating protests and potential violence
    - Cost of additional railroad and local law enforcement
    - Excessive publicity by television and press
  - Cost:
    - Deregulation of US railroads (1980) resulted in high tariffs
  - Adequate means of alternate and less costly transport available
    - Extensive inter-state highway system well developed by the 1980s
    - Development of 'Safe-Secure Transporter' trucks

Security Lessons Learned Over 50 Years

- **Security during transportation: *significant differences in security of fixed storage sites***
  - **Detection times are significantly shorter**
  - **More constraints on implementing physical delay and denial**
  - **Cannot rely on secondary (off-train) response force to arrive in time**

- **Significant emphasis must be placed on primary (on-train) security force**
  - **Numbers must be adequate to engage and interrupt attackers**
  - **Must be dispersed to preclude neutralization in early phase of attack**
  - **Require special training and tactics for transportation environments**
  - **Training and tactics validated through simulation and realistic exercises**

- **Physical delay and denial systems must be sufficient to allow time for primary security force to respond and interdict attackers**