Nuclear Security and Safety Challenges:
The Challenge of Non-State Actors

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CATALYTIC NUCLEAR ATTACK

Metaphor: catalyst increases rate of chemical reaction without catalyst
Being destroyed; tiny amounts often suffice

In 1950s, concern about n-country, that small nuclear weapons states (“China” could start nuclear war between US and FSU on theory that a catalytic state would be least damaged at end, and could increase its relative power by starting a war between other nuclear armed states.

Classic essay: Kobe derived suspicion, retaliation, destruction, catalytic war utility, and casualty matrices for each country that defined outcomes for each state in a “catalytic nuclear war”

However, the ability of US and FSU to overwhelmingly retaliate and damage the catalytic state soon allayed this concern, but it motivated superpowers to strive for nuclear non-proliferation

Main concern was state-sponsored nuclear terrorism

ARGUMENT: CATALYTIC NUCLEAR TERRORISM IS A SERIOUS POLICY CONCERN?

THREE NESTED ARGUMENTS:

1. Inadvertent nuclear war is possible, probability > 0
2. Nuclear terrorism: valid: one or more of three threshold events are conceivable, and probability >0
3. Threshold nuclear terrorism can trigger inadvertent nuclear war

- Credible Threats
- Hostage Taking
  - Steal, Smuggle, Acquire Footloose Fissile Material
    - Dirty Bomb
    - Attack Reactors
    - Attack Spent Fuel
  - Simultaneous Cyber Attacks Disable Critical Infrastructure
  - Acquire Nuclear Weapon; Detonate Nuclear Weapon

Least Damage

Most Damage
COMPLEXITY 21ST CENTURY STATE-BASED NUCLEAR THREAT SYSTEM

Tier 1: United States
Tier 2: Russia, China
Global triangle
Tier 3: UK, France, NATO allies + nuclear umbrella allies
Tier 4: India, Pakistan, Israel, DPRK
no shared rules of the road, more unpredictable and unstable (true effect)

Tier 5: Non-State Nuclear Actors
But these two nuclear worlds—a non-state actor nuclear attack and a catastrophic interstate nuclear exchange—are not necessarily separable. It is just possible that some sort of terrorist attack, and especially an act of nuclear terrorism, could precipitate a chain of events leading to a massive exchange of nuclear weapons between two or more of the states that possess them.


How might this link happen?
NUCLEAR TERRORISM POST-COLD WAR: TRIGGER FOR INADVERTENT NUCLEAR WAR?

Multiple Pathways

• EW failure “trips” launch-on-warning
• Accidental detonation
• Strategic miscalculation in crisis, show of force
• Decision making failure (irrational, misperception, bias, degraded, group, compressed decision making)
• Allied or enemy choices (revenge, exploit nuclear risk, desperation)
• Organizational cybernetics, NC3 system itself, including meta-NC3 system
• Synchronous and coincident combinations of above

6. Current NC3 Stresses:

- Russia
- China
- SSBNs
- North Korea
- False alarms-social media triggering of EW systems
- Non-State Catalytic attack
- Disruptive AI, Q-Tech, Autonomous Vehicles
Emerging Interaction 2: North Korea NC3I

- In April 2012, North Korea reportedly upgraded its Missile Guidance Bureau to become a Strategic Rocket Force, apparently separate from the KPA’s Army, Navy and Air Force. Its Commander, Lt. Gen. Kim Rak Gyom was elected to the Korean Worker’s Party Central Military Committee, underscoring the commitment to developing a deliverable strategic nuclear weapon.

- For such a centralized and personalized command structure as North Korea, this question of control is critically important. KJU is in command.

- Moreover, the peculiarly North Korean pyramid of power presents the possibility of instant propagation of error and possible inadvertent escalation for a military command structure prone to constant probing by and interaction with devolved US and ROK military forces at the “hard edges” of the DMZ and the Northern Limit Line.

- Cybernetic errors may creep into the DPRK nuclear command and control system.

- Kim’s nuclear command-and-control system may be susceptible to the Byzantine (traitorous) General subversion problem should war come at a time of disorder and near collapse in the DPRK itself.

- DPRK NC3I simple but very tightly coupled with DPRK conventional and nuclear forces.

- Preplanned STRATCOM target sets likely obsolete by time war breaks out. Improvised targeting combined with delayed delivery time by strategic bombers generates real risk of useless nuclear attack.

- DPRK communications are fiber optic underground, and opaque to SIGINT, making EW difficult.

- US-ROK inclination is to strike early and possibly first in revised OPLAN 2015, but attacking CPs and leadership, not just weapons and missiles, may lead to DPRK nuclear first-use.

- North Korean strategic retreat may lead to KJU-KPA taking Pyongyang hostage with nuclear weapons.

- What then?

- Coincident risks? Taiwan Sts crisis? Terrorist attack? ROK irrational move?
Emerging Interaction 3:
Nuclear Terrorism as Trigger Event: Key Questions Non-State Actor NC3I

➢ Would nuclear-armed non-state actor eg terrorist group, have centralized single commander or adopt decentralized and delegative contingent authority? How do non-statea NC3I systems differ from state-based NC3I systems?
➢ Would decapitation attack on network leader prompt non-state actor nuclear use?
➢ What precedents exist eg Aum Shinrikyo, Al Qaeda, what formal, informal, or tacit rules and behaviors of non-state actor C3I
➢ Mumbai attack is archetype for self-organizing attack with centralized C2 with prior reconn, real-time situational awareness via social media, trans-border
➢ Does time compression of decision-making drive delegation for non-state actors as with states?
➢ Would non-state actors mimic launch-under-attack or launch-under-warning of attack state policies?
➢ What geographic depth, ability to preposition nuclear weapons, and other factors affect non-state actors propensity and ability to use nuclear weapons, and related NC3I systems?
➢ How does organizational structure (eg star, daisy-chain, all-channel network) affect possible nuclear threat-attack strategies?
➢ How do motivational goals, eg political-ideological orientation and aspiration to proto-statehood versus religious-apocalyptic orientation, affect resources, partnerships, stamina, operational procedures and strategies, targeting for nuclear threat or attack?
➢ How would non-state actor implement transnational C3I demands; use of non-state NCI leads to sigint, targeting, strikes, even if use encrypted communications? (including non-state cyber-attacks eg Anonymous against Islamic State
➢ How would non-state acquisition, threat, or use of nuclear weapons interact with n-state NC3I systems in various combinations and scenarios?

Sources:
Daniel Byman, “Why ISIS might regret the decision to go global,” Brookings blog, November 16, 2015
Factors Affecting Terrorist Nuclear Command-and-Control

### Procedural and Technical Measures to Control Nuclear Weapons

#### Positively (ensure authorized use)
- Delayed retaliation posture
- Adopt de-alert posture, NFU or LUA
- Two-person rule, PRP, etc.
- Restricted access to launch codes
- Separation of warheads & vehicles
- Separation of warhead components
- Personnel Reliability Programs, etc.

#### Negatively (ensure never used without authority)
- Airborne alert status
- Launch on Warning (LOW) posture
- Pre-delegation of launch authority
- Final assembly of warhead
- Mating warhead with delivery vehicle
- Other

#### “Always-Never Paradox”

### Controls

<table>
<thead>
<tr>
<th>Negative Controls (-)</th>
<th>Positive Controls (+)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Delayed retaliation posture</td>
<td>Airborne alert status</td>
</tr>
<tr>
<td>Adopt de-alert posture, NFU or LUA</td>
<td>Launch on Warning (LOW) posture</td>
</tr>
<tr>
<td>Two-person rule, PRP, etc.</td>
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<td>Final assembly of warhead</td>
</tr>
<tr>
<td>Separation of warheads &amp; vehicles</td>
<td>Mating warhead with delivery vehicle</td>
</tr>
<tr>
<td>Separation of warhead components</td>
<td>Other</td>
</tr>
</tbody>
</table>

### Figure 1. Example Technical and Procedural Negative and Positive Controls


RISK OF NUCLEAR TERRORISM
Northeast Asia Regional Experience

- Low-level individual terrorist violence with nuclear materials, against nuclear facilities, is real
- Nuclear material diversion risk is real
- Insider “sleeper” threat is real
- Insider corruption is real
- Extortion threat over insider is real
- Cult threat and attempt to build, buy nuclear weapons is real
- Cyber-terrorism against nuclear reactors is real (although ambiguous as to attribution)
- Stand-off ballistic and drone threat is real
- Non-state actors adopt new technology very fast, eg drones
- Risk of loss of control of nuclear weapons only in North Korea, China, Russia, and on US deployed submarines. None in South Korea or Japan to worry about.
- Extreme ethno-and xenophobic nationalism emerging in China, Korea, Japan
STUDY COMPLEX ENGINEERING PROJECTS BY FIVE VIOLENT NON-STATE ACTORS
CONDITIONS FOR SUCCESS

- Substantial resources
- Safe Haven
- Technical Expertise, Own, Procured
- Culture of Learning from Failure

Requires strategic commitment due to goal or change in environment, not tactical
Long-term planning, rational choice (up to 10 years)

<table>
<thead>
<tr>
<th>Complex Engineering Effort</th>
<th>PIRA</th>
<th>Aum Shinrikyo</th>
<th>FARC</th>
<th>Zetas</th>
<th>HAMAS</th>
<th>AQ Khan Network&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sophisticated mortar systems</td>
<td>Chemical weapons; Nuclear Weapons</td>
<td>&quot;Narco-sub&quot;</td>
<td>Encrypted countrywide radio network</td>
<td>Operational tunnel network into Israel</td>
<td>Illicit transfer of nuclear equipment and designs</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Overall Outcome</th>
<th>Successful</th>
<th>Successful</th>
<th>Successful</th>
<th>Successful</th>
<th>Successful</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Type of Organization</th>
<th>Terrorist</th>
<th>Terrorist / Cult</th>
<th>Terrorist / TCO</th>
<th>TCO</th>
<th>Terrorist</th>
</tr>
</thead>
<tbody>
<tr>
<td>General Motive</td>
<td>Ethnonationalist</td>
<td>Apocalyptic-Millenarian</td>
<td>Marxist; Financial gain</td>
<td>Financial gain</td>
<td>Ethnonationalist; Islamist</td>
</tr>
<tr>
<td>Regional Context</td>
<td>Western Europe</td>
<td>Asia</td>
<td>South America</td>
<td>North America</td>
<td>Middle East</td>
</tr>
</tbody>
</table>

PAST IS NOT PROLOGUE

Past and Present Supply Non-State Terrorist Actors

- Politico-ideological
- Apocalyptic-millenarian
- Politico-Religious
- Nationalist-separatist
- Ecological
- Insurgency

- Criminal-military (profit based)
- Criminal-scientists (profit based)
- Psycho-pathological mass killers
- Lone Wolf
- Copy Cats

Future Supply:

- Independent cities (theocratic, corporate, green)
- Non-states (Taiwan, micro-states, failed state, ungoverned territory, province in dissociating, failing state)
- Convergent global terrorist-criminal networks gatekeepers of flow through coastal megacities, supplanting highlands
NUCLEAR WEAPONS -CAPABLE NON-STATE TERRORIST ORGANIZATIONS

Practical constraints
- Expense, hard to steal, risk of discovery
- Hard to make
- Hard to conceal

Strategic constraints (CB ratio)
- Delegitimate NSA if genocidal
- Political-ideological objectives
- Lead to elimination, own
- Opportunity cost, easier alternatives
- Failure, discovery

REGIONAL PATHWAYS TO NUCLEAR WAR

1. **US-DPRK conflict** (including with it, US allies in the region Japan, South Korea and Australia; and all sixteen [check] UNC command allies in Korea. Many permutations possible ranging from non-violent collapse to implosion and civil war, inter-Korean war, slow humanitarian crisis. Of these implosion-civil war likely most dangerous.

2. **China-Taiwan conflict**, whereby China may use nuclear weapons to overcome US forces operating in the West Pacific, either at sea, or based on US (Guam, Alaska) or US allied territory in the ROK, Japan, the Philippines, or Australia); or US uses nuclear weapons in response to Chinese attack on Taiwan.

3. **China-Japan conflict** escalates via attacks on early warning systems, eg SOSUS (Ayson-Ball, 2011).

4. **China-Russia conflict**, possibly in context of loss-of-control of Chinese nuclear forces in a regional conflict involving Taiwan or North Korea.

5. **Russia-US conflict**, involving horizontal escalation from a head-on collision with Russian nuclear forces in Europe or the Middle East; or somehow starts at sea (mostly likely seems ASW)

6. **Simultaneous conflict combinations across 1-5, or other** unanticipated nuclear-prone conflict axes erupt (such as Russia-Japan)

Figure Seven: **State nuclear weapons control biases by NC3 type**

Note: according to dominant characteristic shown in orange circle; also, real states may exhibit more than one characteristic


THRESHOLD TERRORIST NUCLEAR ATTACKS

Three types terrorist nuclear attacks may affect nuclear weapons decisions of states due to scale, perpetrator ambiguity, precursor signal

1. **Credible threat** of either nuclear detonation or radiological attack with possible massive damages

2. Actual or sub-critical **nuclear detonation**

3. Actual **spent fuel or reactor attack** with substantial radiological release
VULNERABILITY TO TERRORISM OF NUCLEAR SPENT FUEL: THE SOUTH KOREAN CASE

Figure 6. Contamination levels after the hypothetical fire of Kori-3 pool using weather data on Jan 1, 2015

Figure 7. Contamination levels after the hypothetical fire of Kori-3 pool using weather data on Apr. 1, 2015

Table 5. Summarized results of the Kori-3 SFPF accident

<table>
<thead>
<tr>
<th>Country</th>
<th>Contaminated area (km²)</th>
<th>Evacuated people</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Max</td>
</tr>
<tr>
<td>ROK</td>
<td>Evacuated area</td>
<td>9,000</td>
</tr>
<tr>
<td></td>
<td>Evacuated area for more than 30 years</td>
<td>5,400,000</td>
</tr>
<tr>
<td>DPRK</td>
<td>Evacuated area</td>
<td>5,000</td>
</tr>
<tr>
<td></td>
<td>Evacuated area for more than 30 years</td>
<td>1,100,000</td>
</tr>
<tr>
<td>Japan</td>
<td>Evacuated area</td>
<td>27,000</td>
</tr>
<tr>
<td></td>
<td>Evacuated area for more than 30 years</td>
<td>7,900,000</td>
</tr>
<tr>
<td>China</td>
<td>Evacuated area</td>
<td>2,000</td>
</tr>
<tr>
<td></td>
<td>Evacuated area for more than 30 years</td>
<td>700,000</td>
</tr>
</tbody>
</table>

Figure 8: Impact of a Terrorist Nuclear Threat or Attack on Interstate Nuclear Use Control
CREDIBLE THREAT OF ACTUAL OR SUB-CRITICAL NUCLEAR DETONATION 1

Event In: Nuclear Weapons States

• Two possibilities for conflict linkage: Insider sourced perpetrator, none if determined
• Outsider sourced perpetrator—suspicion matrix activated [x country], connects to potential escalation pathways to interstate nuclear war.

Possible NUDET sites and [suspected perpetrator]:
China NC3 Bias Impact [US, North Korea, Russia]
Russian Far East NC3 Bias Impact [US, China]
North Korea NC3 Bias Impact [US]
NUCLEAR COMMAND-AND-CONTROL IN THE QUANTUM ERA

Q-NC3 communications
Q-NC3 encryption: secrecy and past data files, eg PRP, procedures
Q-NCE Solving Computationally Massive Problems
Q- Rendering Visible Nuclear Weapons and Delivery Systems—and Command Centers
Q- Quantum Monitoring and Verification

Peter Hayes, "NUCLEAR COMMAND-AND-CONTROL IN THE QUANTUM ERA",
Blue Peter NAPSNet, March 29, 2018,
FALSE ALARMS, FALSE NEGATIVES AND POSITIVES, FAKE PEACE, FAKE WAR

- Seoul Facebook non combatant evacuation Feb 2017
- Guam false alarm July 2017
- Hawaii false alarm September 2017
- Tokyo false alarm September 2017
- Minuteman/Trident missile launch, Dec 6 2017


See also:
Stanley Foundation, Three Tweets to Midnight: Nuclear Crisis Stability and the Information Ecosystem, Policy Dialogue Brief, February 2018 at:


Possible Antidotes

- Resolve nuclear prone conflicts
- Multilateral Data Exchange & Independent Early Warning Networks
- Global NC3 Code of Conduct
- Command Discipline, military tradition and honor
- Laws of War, humanitarian international law—NWPT assert jurisdiction to hold nuclear weapons personnel accountable and create tribunals for trials for nuclear aggression and starting nuclear wars
- Support nuclear refuseniks, provide sanctuary in NWPT states
- Trade warheads for NC3 upgrade
- Reduce warheads, fissile material, vulnerable fuel cycle sites!
- NWPT: supply sanctuary for nuclear refuseniks, make nuclear weapons targeting transparent, accountability tribunals
Trump: Deal or create Adam
Antidotes for Relative EW Deficit-Remedies 1

Joint Data Exchange Center (JDEC)

Provisions
The Memorandum Of Agreement Between The Government Of The United States and Government Of The Russian Federation On The Establishment Of A Joint Center For The Exchange Of Data From Early Warning Systems And Notifications Of Missile Launches established a Joint Data Exchange Center (JDEC) in Moscow for the exchange of information derived from each side's missile launch warning systems on the launches of ballistic missiles and space launch vehicles. The JDEC is also intended to serve as the repository for the notifications to be provided as part of an agreed system for exchanging pre-launch notifications on the launches of ballistic missiles and space launch vehicles.

Background: President Clinton and President Yeltsin issued a joint statement 02 September 1998 announcing that they had reached agreement on a cooperative initiative between the United States and Russia regarding the exchange of information on missile launches and early warning, and the potential establishment of a multilateral notification system for the launch of ballistic missiles. President Clinton and President Putin signed the Memorandum Of Agreement in Moscow on 04 June 2000. The JDEC will builds upon the successful establishment and operation during the millennium rollover of the temporary joint center for Y2K Strategic Stability in Colorado Springs. The system is to be set up in phases, and by the end of the third phase, it will include information on ballistic missile and space launches of third parties.

2015...DOA...moribund?

New Concept: Replace JDEC with Mulilateral Data Exchange Network

- Revive as multilateral mechanism based on multiple levels of reciprocal, bilateral data exchange between nuclear weapons states, and including data from non-nuclear states?
- Devolved, self-implementing networked data exchange on bilateral basis (NOTAMs-ICAO system)
- Include nuclear and non-nuclear weapons states
- Parallel civil society based early warning-surveillance system, especially cities
GLOBAL NC3 CODE OF CONDUCT

// to 2002 Hague Code of Conduct against Ballistic Missile Proliferation

CODIFICATION OF NORMS AND STATES PRACTICES, EG

“DO NOT TARGET THE NATIONAL HIGH COMMAND OF A NUCLEAR WEAPONS OR NUCLEAR ARMED STATE;“

“DO NOT CO-LOCATE NUCLEAR WEAPONS WITH ONE'S OWN HIGH COMMAND POST OR EARLY WARNING INTERPRETATION SITES OR SENSORS;”

“DO NOT MIX/FUSE/SHARE NUCLEAR AND CONVENTIONAL COMMUNICATIONS SYSTEMS;”

“WHEREVER POSSIBLE, USE DEDICATED NUCLEAR COMMUNICATIONS SYSTEMS;”

“DO NOT ATTACK OR INTERFERE WITH A NUCLEAR WEAPONS STATE'S NATIONAL TECHNICAL MEANS,” INCLUDING BY IMPLICATION,

“DO NOT ATTACK THE UNDERLYING COMMUNICATIONS AND COMPUTER SYSTEMS ON WHICH NTM RELY FOR NC3 OPERATION;”

“DO NOT TAKE NC3 COUNTER-MEASURES THAT REDUCE DECISION TIME AND INCREASE IMMEDIACY OF NUCLEAR DECISIONS UNDER INTERNATIONAL LAW.”

“DESIGNATE A LEGITIMATE AND ACCOUNTABLE NATIONAL COMMAND AUTHORITY FOR ALL NUCLEAR FORCES.”

“INSTITUTE A TWO-PERSON RULE FOR ALL LAUNCH DECISIONS AND IMPLEMENTATION STEPS IN NC3 OPERATIONS.”
Trident submarine-launched ballistic missile fired on November 7 from offshore Los Angeles
Social Media Storm
Aliens?
Armageddon?
Nuclear attack?
Early warning for CH, RF, DPRK?
Already in play


Briefing image in submarine from: https://www.flickr.com/photos/usstratcom/sets/72157658690516614
Kimball Nebraska missile silo at: 41°21’46.0″N 103°39’38.0″W
Antidotes-Remedies 2

Kimball Nebraska missile silo at: 41°21′46.0″N 103°39′38.0″W
Antidotes-Remedies 2

Kimball Nebraska missile silo at: 41°21’46.0″N 103°39’38.0″W
Antidotes for NC3 system failure 3: Duty to Disobey and NC3 Refuseniks?

October 28, 1962: ~ 12.30 am Air Force Capt. William Bassett unit in Okinawa received authenticated launch order to fire Mace missiles *at China* and Russia in spite of Defcon2 not 1 status. He challenged the order, even after it was resent, and took measures to ensure no missiles would be fired, until stand-down order received.

~ 6 hours later in real time

October 27, 1962, ~ 5pm Vasili Arkhipov, political officer on Russian sub B-59 and in command of Russian sub flotilla, voted against firing nuclear torpedo at US aircraft carrier, 1 of 3 votes, after an argument.

September 26, 1983: Stanislav Petrov, lieutenant colonel in the Soviet Air Defense Forces, was the officer on duty at the Serpukhov-15 bunker near Moscow which housed the command center of the Soviet early warning system. Dismissed multiple warnings of incoming US missile attack as errors. Later alarm determined due to rare alignment of sunlight on high-altitude clouds and satellite orbits.

1968 Michael Roach, ADM officer, Korea
1975, Major Harold Hering

What norms, standards, principles, if any, justify refusal by military personnel at receiving end of NC3 system to refuse to fire nuclear weapons?

*Humanitarian law: “manifestly illegal”
• Necessary
• Proportional
• Civilian-military principle*

Antidote 4
Trade smaller arsenals for upgraded NC3 force multiplier (reducer)