Nuclear Use Scenarios on the Korean Peninsula

by
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Nuclear Use Scenarios on the Korean Peninsula

- Recent Changes in U.S. Nuclear Policy;
- Potential Targets for U.S. Earth-Penetrating Nuclear Weapons in North Korea;
- Nuclear Weapons Effects Simulation and Modeling
U.S. Nuclear Posture Review
(December 2001)

• "More than 70 countries now use underground facilities (UGFs) for military purposes. In June 1998, the Defense Science Board Task force on Underground Facilities that there are over 10,000 UGFs worldwide. Approximately 1,100 UGFS were known or suspected strategic (WMD, ballistic missile basing, leadership or top echelon command and control) sites. Updated estimates from DIA reveal this number has now grown to over 1,400. A majority of the strategic facilities are deep underground facilities. These facilities are generally the most difficult to defeat because of the depth of the facility and the uncertainty of the exact location. At present the United States lacks adequate means to deal with these strategic facilities."

• “The United States currently has a very limited ground penetration capability with its only earth penetrating nuclear weapon, the B61 Mod 11 gravity bomb. This single-yield, non-precision weapon cannot survive penetration into many types of terrain in which hardened underground facilities are located. Given these limitations, the targeting of a number of hardened, underground facilities is limited to an attack against surface features, which does not provide a high probability of defeat of these important targets."
Nuclear weapons are needed that produce much lower collateral damage (great precision, deep penetration, greatly reduced radioactivity): have robust performance margins: are devised for ease of manufacture and maintenance: and produce special effects (e.g., enhanced EMP, enhanced neutron flux, reduced fission yield).

The Task Force recommends that research be initiated on weapons that meet this new vision.”
Proposed candidates for the Robust Nuclear Earth Penetrator (RNEP)

- DOD asked for a study to determine if an existing warhead can be adapted, without nuclear testing, to destroy hardened, deeply buried targets.

- B61-11 – a 400 kiloton, fixed yield bomb weighing ~545 kg – approximately 50 were converted in mid-1990s from the B61-7 nuclear bomb. LLNL design

- B-83 – selectable yield, to 1.2 megatons weighing 1090 kg, LLNL design

- For FY 2005 administration requested $27.5 million to continue feasibility and cost studies. The five year budget request (FY2005-2009) was $484.7

Technical Limits of Earth-Penetrating Nuclear Weapons

- Limited penetration – in soil, concrete or rock, maximum 10-15 meters
- Cannot penetrate deeply enough to contain the nuclear explosion
- 1 kt at 20 foot depth – eject 1 million cubic feet of radioactive debris, crater size of ground zero at World Trade Center
- Higher yield = more fallout

www.nrdoc.org/nuclear/bush/abb.pdf
Explosion Depth Required to Substantially Contain Radioactive Fallout

Maximum feasible penetration depth = 15 meters in "dry rock soil"
Radioactive Fallout Area as a Function of Depth of Burial for 0.3-kt, 1-kt and 10-kt Earth Penetrator Nuclear Weapons

www.nrdc.org/nuclear/bush/abb.pdf
Finding Likely Targets for Earth-Penetrating Nuclear Weapons: NRDC’s geo-spatial database of North Korea

- High resolution commercial satellite imagery – first available to non-governmental researchers in 1999
- Ikonos (Space Imaging) – sun-synchronous, 98-minute orbit – produces a color photo at one-meter resolution
- QuickBird (DigitalGlobe) – can achieve 61-centimeter resolution under some conditions.
- Today’s commercially available imagery is comparable to U.S. intelligence community of early 1970s
- Computing power – current laptops have speed and memory comparable to the Cray II that went to LLNL in 1985
- New research can refine military estimates, provide additional verification by the public
Democratic Peoples Republic of Korea

Basic Facts

- Occupies 120,000 sq km – slightly smaller than Mississippi or Fujian province
- Population 22,700,000
- Coastline – 2,495 km
- Borders - Russia (19 km), China (1,416 km), ROK (238 km DMZ)
- DMZ – extends 2 km on either side of a military demarcation line for 238 km from the Yellow Sea to the Sea of Japan

LandSat7 Image of the DPRK Capitol, P’yongyang, built along the Taedong River.
DPRK Military Facts
Most militaristic state in the world…

• 23% of GDP for military ($5.2 billion in 2002) (ROK 4%)
• 40 of 1,000 are in uniform (ROK 14 of 1,000)
• 1,200,000 active forces, 5,000,000 reserve, 4th largest in the world
• Army, Air Force, Navy and Special Operations Force (SOF)
• Military strategy – 1) reunify Korean Peninsula under North Korean control within 30 days of the beginning of hostilities 2) defend North Korea
• Most important facilities underground
• DPRK Steadily Building a Nuclear Weapons Capability

DPRK: an Underground Nation and Military

After the Korean War experience, Kim Il Sung said: “The entire nation must be made into a fortress.”

- The degree to which the DPRK military is based underground is unique in the world – takes advantage of mountainous topography;
- Virtually everything of military significance is underground – several hundred large facilities, more than 10,000 smaller facilities;
- It is reported that thousands of artillery pieces are at underground sites; four tunnels have been discovered under the DMZ;
- Concealment of their military infrastructure from satellites and aerial reconnaissance make it an intelligence challenge;
- A verification nightmare for agreements limiting nuclear or other military developments in the DPRK.

Red: Airbases where NRDC has Observed Underground Hangers in Satphotos
Blue: Navy Bases where NRDC has Observed Waterfront Caves/Tunnels in Satphotos
# Underground Air Force

Nineteen air bases that have associated underground aircraft hangers

<table>
<thead>
<tr>
<th>Airfield Name</th>
<th>Coordinates</th>
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<tbody>
<tr>
<td>Changjin-up Air Base</td>
<td>40 21 51.9 127 15 50.1</td>
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<tr>
<td>Hwangju Air Base</td>
<td>38 39 13.3 125 47 17.3</td>
</tr>
<tr>
<td>Hwangsuwon Air Base</td>
<td>40 40 56.0 128 08 55.5</td>
</tr>
<tr>
<td>Hyon-ri Air Base</td>
<td>38 36 47.8 127 27 04.5</td>
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<tr>
<td>Iwon Air Base</td>
<td>40 21 37.9 128 43 08.4</td>
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<tr>
<td>Koksan Air Base</td>
<td>38 41 19.5 126 36 08.4</td>
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<tr>
<td>Kuum-ni Air Base</td>
<td>38 51 55.1 127 54 12.6</td>
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<tr>
<td>Kwail Air Base</td>
<td>38 25 32.2 125 01 09.4</td>
</tr>
<tr>
<td>Nuchon-ni Air Base</td>
<td>38 14 16.7 126 07 13.4</td>
</tr>
<tr>
<td>Onch'on Air Base</td>
<td>38 53 14.0 125 16 49.9</td>
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<tr>
<td>Orang Air Base</td>
<td>41 25 45.3 129 38 52.7</td>
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<tr>
<td>Panghyon Air Base</td>
<td>39 55 38.4 125 12 28.1</td>
</tr>
<tr>
<td>Pukch’ang Air Base</td>
<td>39 30 16.5 125 57 52.9</td>
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<tr>
<td>Sunan Air Base/International Airport</td>
<td>39 12 25.7 125 40 09.8</td>
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<tr>
<td>Sunch’on Air Base</td>
<td>39 24 41.8 125 53 27.5</td>
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<tr>
<td>Taet'an Air Base</td>
<td>38 07 50.4 125 14 43.1</td>
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<tr>
<td>Toksan Air Base</td>
<td>39 59 47.8 127 36 43.3</td>
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<tr>
<td>U'iju Air Base</td>
<td>40 09 00.4 124 29 50.9</td>
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<tr>
<td>Wonsan Air Base</td>
<td>39 09 56.4 127 29 06.9</td>
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</table>
## Underground Navy
Navy Bases with Submarine Caves

<table>
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<tr>
<th>Location</th>
<th>Entrance (1)</th>
<th>Entrance (2)</th>
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<tbody>
<tr>
<td>Ch'aho-nodongjagu Navy Base</td>
<td>40° 12' 15&quot;N 128° 39' 00&quot;E</td>
<td>40° 12' 06&quot;N 128° 39' 03&quot;E</td>
</tr>
<tr>
<td>Kosong Naval Facility</td>
<td>38° 44' 04&quot;N 128° 12' 45&quot;E</td>
<td>38° 44' 00&quot;N 128° 12' 44&quot;E</td>
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<tr>
<td>Namae-ri Navy Base</td>
<td>38° 48' 12&quot;N 128° 08' 17&quot;E</td>
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<tr>
<td>Puam-dong Navy Base</td>
<td>41° 19' 18&quot;N 129° 46' 05&quot;E</td>
<td>41° 19' 30&quot;N 129° 46' 12&quot;E</td>
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<tr>
<td>Songjin pando Navy Base</td>
<td>39° 22' 18&quot;N 127° 26' 18&quot;E</td>
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<tr>
<td>Yoho’ri Naval Facility</td>
<td>39° 52' 33&quot;N 127° 47' 39&quot;E</td>
<td>39° 52' 39&quot;N 128° 47' 17&quot;E</td>
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</tbody>
</table>
Other Underground Facilities
(Purpose Unknown)

- Haqap 40 04 54N; 126 11 22E

- Kumchang-ni 40 06 43N; 125 07 47E (under construction)

- Other suspect underground facilities, whose locations are not publicly known, are cited in the literature
Wharf Area

Red: Visible Submarines (14)

Entrance to Cave (1)

Entrance to Cave (2)

Ch'aho-nodongjagu Navy Base

Image Source: DigitalGlobe
Photographed June 29, 2002

Shore Facilities
I.

50

100

Meters

Borneo (or Whiskey Class Submarines)

Ch'aho-nodongjagu Navy Base

Image Source: DigitalGlobe
Photographed June 29, 2002

Romeo (or Whiskey) Class Submarines

Entrance to Cave (2)

Romeo (or Whiskey) Class Submarine
Casualty Calculations from a Hypothetical Nuclear Attack on the Pukch’ang Air Base
Hypothetical Nuclear Attack on Pukch’ang Air Base: 5 kt EPNW

Potential Casualties: 6,000
Hypothetical Nuclear Attack on Pukch’ang Air Base: 100 kt EPNW

Potential Casualties: 100,000
Hypothetical Nuclear Attack on Pukch’ang Air Base: 400 kt EPNW

Potential Casualties: 400,000
Hypothetical Nuclear Attack on Pukch’ang Air Base: 1.2 Mt EPNW

Potential Casualties: 1,100,000
Casualty Calculations from a Hypothetical Nuclear Attack on the Ch’aho Navy Base

Casualties

- Ch’aho, 5 kt
- Ch’aho, 100 kt
- Ch’aho, 400 kt
- Ch’aho, 1.2 Mt

- January
- April
- July
- October
Hypothetical Nuclear Attack on Ch’aho Navy Base: 5 kt EPNW
Hypothetical Nuclear Attack on Ch’aho Navy Base: 100 kt EPNW
Hypothetical Nuclear Attack on Ch’aho Navy Base: 400 kt EPNW
Hypothetical Nuclear Attack on Ch’aho Navy Base: 1.2 Mt EPNW
Ch’aho and Pukch’ang: Discussion

• Casualty estimates—primarily from fallout—will vary greatly depending on target location (potentially controllable) and ambient wind speed and direction (probably not controllable) …we illustrated this for two specific targets;

• While fallout is reduced with reduced yield, a 5 kt EPNW at 20 meters depth of burial still produces a lot of fallout!
Calculating a Hypothetical Nuclear Attack on Seoul: 
Reviewing the Data from Hiroshima and Nagasaki
Calculating a Hypothetical Nuclear Attack on Seoul: Reviewing the Data from Hiroshima and Nagasaki

<table>
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<th>Distance from hypocenter (km)</th>
<th>0</th>
<th>1</th>
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<td><strong>Outdoors (unshielded)</strong></td>
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<td>radiation injury</td>
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<td><strong>Inside (wooden house)</strong></td>
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<td><strong>Inside (concrete building)</strong></td>
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</table>
Seoul

Attacking Nuclear Weapon: 15 kt
Height of Burst: Ground Burst
Potential Casualties: 1.25 Million
Seoul

Attacking Nuclear Weapon: 15 kt

Height of Burst: 100 Meters

Potential Casualties: 840,000
Seoul

Attacking Nuclear Weapon: 15 kt

Height of Burst: 500 Meters

Potential Casualties: 620,000
Calculating a Hypothetical Nuclear Attack on Seoul:

**HPAC Casualty Calculations**
Seoul: Discussion

• Because of the higher population density of Seoul (2004) versus Hiroshima and Nagasaki (1945), predicted casualties for the same kind of nuclear attack (air burst) are as much as six times worse;

• If the attacking nuclear weapon were a ground burst producing fallout, predicted casualties could be more than ten times worse and damage to South Korea would include widespread contamination.
Conclusions

• Development of nuclear weapons by North Korea and development of EPNW by the United States are destabilizing, dangerous and could lead to their use.

• While not demonstrated here, it would appear that underground aircraft parking areas and navy caves can be defeated by conventional means.

• These potential targets could also be defeated using existing surface burst nuclear weapons. The casualties from earth penetrator weapons will be greater than surface burst weapons of the same yield.

• The only sensible alternative is a diplomatic resolution of the nuclear crisis on the Korean peninsula.