

## SESSION 2: PATHWAYS AND PITFALLS TO NEA CONVENTIONAL DETERRENCE

### **How Conducive is the Military Environment to a Korea Japan Nuclear Weapon Free Zone? Observations, Derivations and Postulations**

This paper starts by characterizing the present military balance as stable. But there are many political leadership changes between now and the end of 2012. There is an opportunity for a fresh set of eyes on the problem set. However, there is an increased risk of miscalculation as new leaders are tested. Elections and leadership changes are also normally characterized by relative inflexibility leading up to the change. Next we look at some of the possible costs if things don't go well. There is almost no way DPRK can hope to achieve its goals via military means and specifically in an artillery attack on Seoul, a chemical attack on Seoul and a nuclear strike on Busan. So what alternatives are available to the KJI and the other three main actors in DPRK if none of those scenarios leads ROK to fold? There are forces and actors within what had been perceived as a monolithic DPRK political scene. Rather than being viewed as cracks or seams to exploit, they may be viewed as signs of a dynamism with the potential for DPRK to evolve. We also look at possible roles China may play. Finally we conclude with some possible activities to provide opportunities for the Koreans to talk to each other in responsible, reasonable, and acceptable ways. Having responsible dialogue increases the chances of having a discussion of KJNWFZ beyond merely exchanging talking points. This paper also has five annexes containing detailed looks and methodologies supporting the analysis.

This paper will attempt to cover several different topics but ultimately with one goal: Answering the question, how conducive is the military environment on the Korean peninsula to a Korea Japan Nuclear Weapons Free Zone (KJNWFZ)?

#### **Major Assertions:**

- The military environment is conducive to a KJNWFZ, but is insufficient to justify a KJNWFZ by itself. However, if the military environment were not conducive, it would be almost impossible to proceed any further.
- ROK Armed Forces alone are almost certainly able to defeat a KPA conventional, chemical and even nuclear attack.
  - o Using a set of scenarios escalating from conventional attack to limited DPRK chemical use to a DPRK ground burst nuclear device, ROK can absorb and defeat these KPA attacks (albeit costly in human lives, economics, destruction, etc) without having to resort to nuclear weapons.
  - o Once U.S. Forces are factored in, DPRK's only hope of non-defeat is a diplomatically negotiated settlement or Great Power intervention.
  - o These findings are consistent with several other U.S. findings over time since at least early 2000.
- A Long Range Artillery (LRA) attack on Seoul would not result in a "Sea of Fire".
  - o LRA surprise attack aimed mostly at ROK barracks would likely kill less than 3,000 people immediately if people were home or in an office space.
  - o However, those casualty rates alone would not cause a military defeat. Most fatalities would likely occur in the first few hours of an LRA attack.

- As soon as LRA moves from its caves, it will likely start to be destroyed at a likely rate of 1%/hour through the effects of direct, indirect and counter-battery fire.
- Within 3 hours, most of Seoul's population can be out of LRA effects by moving into subways and other shelters in Seoul designed to hold 20 million people.
- If DPRK were to escalate using chemical weapons, they could cause 356,000 deaths or more assuming some worst case conditions, but the majority would be civilian.
  - The fatalities would likely include about 9,500 foreigners.
  - Given that Seoul is an international city and Chinese-Korean nationals and Chinese nationals make up almost 77% of Seoul's foreign population, of the 9,500 foreign nationals, about 7,300 would likely be Chinese citizens or Chinese-Korean living in and around Seoul assuming people die in numbers related to their representation in the 2010 Korean census.
  - Foreigners in Seoul tend to be diplomats, senior management at international companies or students. Hence, the majority of foreigners killed would have a disproportionately large adverse economic and political impact in present terms and in future lost earnings terms.
  - It is unclear how devastatingly ROK, the U.S. or others might respond. This number is toward the low range of many other studies and reports and assumes a winter attack with a stable atmosphere.
  - Militarily, a chemical attack would degrade ROK fighting strength, but would also likely strengthen ROK resolve.
  - Escalating to chemical weapons would also likely threaten more than USD 470 billion in trade exports from the region, causing wide spread unemployment and social instability for countries near Korea.
- KPA would likely move use cyber and special operations forces immediately after attacking and quite possibly before attacking. DPRK likely does not consider these attacks as escalatory.
- KPA capabilities have stagnated since the late 1990s while ROK forces have increased in quality. ROK also closed the quantitative gap to a modest degree.
  - ROK retains a vibrant diverse economy and thus has an industrial base which can rapidly expand to "grow" innovative armaments.
  - DPRK's economy remains much more modest and likely does not have several of the specialties or expertise required to "grow" more armaments (e.g. metallurgical engineers, industrial engineers, electrical plant operators, etc)
- Despite KPA being about 10 years behind ROK technologically, it is unclear how DPRK would translate new technology into a Juche society in a decentralized way. Mass Army hierarchical thinking and decentralized execution are very difficult contradictions to reconcile along the spectrum from theoretical standpoint to practical doctrinal exercise.
- However, there are fairly clear signs that since at least 2006, DPRK has pursued strategically asynchronous goals via three distinct institutional actors: . This could indicate openness to some changes "with Juche characteristics".
- DPRK logistics are likely the weakest link.

- In order to succeed, DPRK would have to move most of the world's 4<sup>th</sup> largest military along 3 well-defined corridors with mountains on both sides and use approximately 8 months of normal fuel usage.
- KPA would likely have to shuttle ~2,500 thin skinned vehicles every other day simply to keep from running out of gas or bullets.
- DPRK's nascent nuclear systems have a low probability of success in exploding a nuclear weapon under anything other than laboratory like controlled conditions, low number of weapons and an ROK overwhelming conventional force leaves a strong opportunity to hold at risk key DPRK capabilities, hard targets and deeply buried facilities.
- China would almost certainly become involved in any conflict on the peninsula.
  - As a great power, China must do something. As a neighbor, China is worried about instability and a liberal democracy on its border.
  - A newspaper reports Chinese forces are already in DPRK. China vehemently denies sending forces to DPRK.
  - China does allow for stationing troops abroad under UN mandate or if invited by the country.
- If Japan and Korea were to develop nuclear weapons, Taiwan would likely feel significant domestic pressure to develop nuclear weapons despite Beijing including Taiwan development of nuclear weapons a "Red Line"
- A possible way to address the great amount of distrust is some fairly basic and benign Confidence Building Measures which first do no harm.

### **Characteristics of the Present Military Balance: Stable**

The military environment in Korea can be characterized by a stable conventional stasis which presently serves the interest of all Six Parties. A KJNWFZ is a vehicle to continue down the road of continued stasis and is likely in the interest of a DPRK seeking more time to look for more favorable military conditions to reunify the peninsula as well as ensure an orderly dynastic socialist transfer of power. A KJNWFZ could also provide DPRK with a real security agreement in exchange for a real disarmament. Such conditions increase the range of options available to DPRK leaders. A tangible security agreement provides DPRK leaders time and space to consider other options such as co-existence, co-evolution, rapprochement and does not preclude reunification. Should DPRK attack South Korea and use chemical, biological or nuclear weapons, the conventional forces resident in ROK are likely sufficient to restore the present borders. If one includes conventional forces from the U.S., there are unquestionably sufficient and credible forces to restore the ROK border. A way to even further demonstrate to DPRK the ability to hold the regime at risk is to undertake studies of improving conventional means of destroying nascent nuclear capabilities.<sup>1,2</sup> The hardest and likely the most valuable targets will be buried fairly deep. Testing a modified B83 to determine its ability and effectiveness to penetrate granite may provide a fairly quick solution to demonstrate the ability to severely damage targets 300 meters below granite when coupling nuclear explosion and ground shock.<sup>3</sup> Alternatively, 140 one ton bombs with a CEP of 10 meters would likely ( $P_k = 0.95$ ) destroy any airfield remotely possible of supporting a nascent nuclear weapons system. As few as 10 bombs would destroy an aircraft bunker or shelter. Only one would hold the entire nuclear weapon at risk if delivered where the bomb was being transported. Five or less would destroy any interim or final assembly facilities.<sup>4</sup> This is a far cheaper and safer alternative than sitting and

waiting for an attack. Aside from a psychological desire to retaliate or send a message to others who might conceive of using nuclear weapons, there is likely no MILITARY need to resort to nuclear weapons to restore ROK borders in the event of an all-out KPA attack.

ROK Armed Forces alone present an overwhelming credible deterrent to a KPA attack. ROK, U.S., CFC forces provide an overwhelming conventional and credible deterrent. Yet DPRK claims to develop a nuclear weapon against what it perceives as a threat of nuclear attack from the U.S. – not to prevent a conventional imbalance. However, DPRK actions are more consistent with compellence than deterrence.

If ROK and Japan were also to develop nuclear weapons, DPRK would certainly claim nuclear weapons are needed to protect itself against ROK and Japan weapons which were developed to counter DPRK weapons. Moreover, if Korea and Japan developed a nuclear weapons program, they would complicate every aspect of their already very complicated relationships with each other, with their neighbors and others. Their planning scenarios across the spectrum of diplomatic, information, economic, financial and legal aspects would become incredibly burdensome.

In this particular case, more nuclear weapons means more INsecurity for all, not more security. There is the possibility of another chain reaction. A particularly thorny issue would arise if Taiwan expressed a desire to acquire nuclear weapons. A Taiwan desire to acquire nuclear weapons would challenge Chinese leadership and set back positive strides in relationships across the Taiwan Strait. China is already supportive of Nuclear Weapons Free Zones in concept and in the Middle East, in particular.<sup>5,6</sup>

### **Condition Stable. For now...**

Why explore these concepts now? Miyamoto Musashi had a particularly apropos observation so long ago, and still relevant today, timing is everything, “All things entail rising and falling timing. You must be able to discern this. In strategy there are various timing considerations.<sup>7</sup> Many governments will likely be receptive to these topics between now and 2013 since there will be several major elections and governmental changes in 2012. Chronologically:<sup>8</sup>

- Taiwan, Presidential and entire legislature January 14
- Russia, Presidential March 4
- Republic of Korea, Parliamentary April
- Hong Kong, Legislative September 12 (has the potential to distract Beijing or reduce their flexibility)
- PRC 18<sup>th</sup> Party Congress (not an election in the normal sense, but a leadership transition and dynamics approaching that of an election and also decreases the amount of flexibility) October<sup>9</sup>
- United States of America, Presidential, legislative November 6
- Republic of Korea, Presidential, December

Now is when incumbents and prospective candidates are formulating ideas and possible policies. Add to this mix, U.S. Secretary of State recent plan for American foreign policy in Asia. She stated U.S. diplomatic work to realize the “Pacific Century” “...will proceed along six key lines of action: strengthening bilateral security alliances; deepening our

working relationships with emerging powers, including with China; engaging with regional multilateral institutions; expanding trade and investment; forging a broad-based military presence; and advancing democracy and human rights.”<sup>10</sup> In short, there will be some extremely complex domestic issues to complicate and likely dilute this particular issue and provide fertile ground for miscalculation. During and shortly after election/leadership transition season there is an increased possibility of miscalculation due to domestic concerns/processes and possibly due to a desire to test leadership or demonstrate leadership. DPRK is not listed as a government which will change leadership.

### **Some costs of instability**

If DPRK were to attack (not just a limited attack), it would be far more likely for DPRK to act out of desperation (and indicative of tremendous internal DPRK stress) than miscalculation. Regardless of the genesis, the KPA does not presently possess the military capability to resolve the central contradiction of a split peninsula through military force. KPA can kill many people in Seoul and inflict severe damage upon Seoul in relatively short order, but cannot reduce it to a “Sea of Fire” in hours using conventional weapons. For KPA to even drop one conventional shell on Seoul also demonstrates an act of DPRK desperation. Seoul has numerous conventional and credible “rungs” of escalation to respond.

Should DPRK choose to escalate from there, DPRK would certainly have to answer to Beijing why DPRK was wrecking Beijing’s 4<sup>th</sup> largest trading partner and risking up to USD 473 billion of China’s export markets (aggregating Chinese exports to U.S., Japan and ROK).<sup>11</sup> In 2009, PRC-DPRK trade stood at USD 640 million.<sup>12</sup> Security is not always denominated in Won or Yen, but trading 700 Renminbi to earn 1 RMB is not in the self-interest of any country seeking social stability and harmony. Therefore, a KJNWFZ provides some much needed time to DPRK to seek better conditions for reunifying the peninsula militarily and ensuring a more orderly dynastic socialist transition. Engaging in responsible dialogue also provides DPRK with a rare opportunity to mollify the neighbors. Even though DPRK and its leader are often characterized as crazy, there is much to suggest they act rationally toward the goal of achieving what they believe is in DPRK interest – even if most of the world does not agree with the characterization of “DPRK interest”.

DPRK major interests are likely: resolving the central contradiction of a split peninsula and ensuring a dynastic socialist transition from Kim Jong Il to Kim Jong Eun. Secondary issues include feeding its people and growing the economy.

### **Peeking in the “Red Box”: Alternative Explanations**

However, let us consider at least three other alternatives: 1) Some elements in DPRK might seek something like co-existence; 2) Some elements might seek something like Chinese style economic reforms and opening up; and 3) some seek an evolution from a one person authoritarian pluralist rule to a “Prima inter pares” leader of a small group. Given a DPRK which presently has three main political institutions: the Korean Workers Party (“the party”), the Cabinet (“the government”), and the Korean Peoples Army (“the military”)<sup>13</sup>, what would each institution lose from an attack. What might each institution gain from a KJNWFZ?

In an all-out attack and war which DPRK will lose, all three institutions would likely cease to exist. However, the Party might believe even if it fails to exist, it would be acquitted well in history books. The military may be subject to War Crimes trials and so might parts of the Cabinet. They clearly have an interest in avoiding that outcome.

It is likely difficult for Koreans inside the “Red Box” of government to discern exactly what the other institutional actors want, let alone an outsider, but there are some consistencies in the institutional positions over time.

The party, as the “authoritative interpreter” of ideology, judges by the morality of a proposed action.<sup>14</sup> Their practical curve is inflexible. Unless this group develops a broader or different interpretation of ideology based on changed conditions, there will likely be a great deal of tension inside the DPRK system which will likely manifest itself in prickliness outside the system. The party can only change from inside.

Cabinet Premier Hong in early (March and April 2001) provides a classic example of how the cabinet, as an institution, can flexibly adapt a concept to conditions in a way that works towards a practical goal. In the particular example raised, he was advocating that Juche demanded good relations with ALL countries. He did not specify the U.S. but given the context of the time and statement, he was holding out a possibility. During that time, he was also presenting his economic vision which entailed change “In keeping with a changed environment...”.<sup>15</sup> The cabinet can change from within and impose a certain amount of change on the state. However, other actors often act at cross purposes in order to diminish government power or to increase their own – and they are sometimes comfortable expressing those differences to a foreigner.<sup>16</sup>

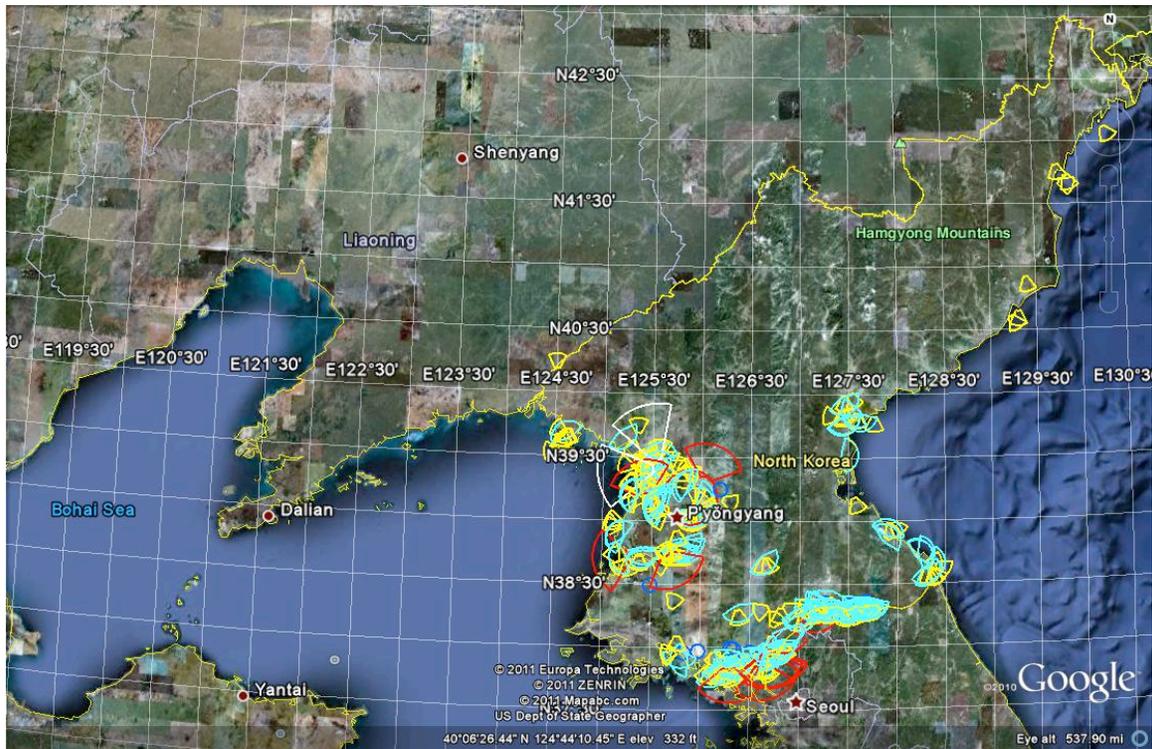
The KPA almost invariably bares its teeth, puffs its fur and postures like a cornered animal. It must weigh heavily on KPA that ROK and its ally exercise frequently while DPRK and its neighboring ally don’t exercise. From a KPA point of view, they likely do feel cornered. Until a new interpretation of “Military First” is imposed upon the KPA, it is extremely unlikely there will be any change.

And so the system moves in fits and start with DPRK seeking asynchronous strategic goals such as economics and juche ideology. But at least there is some movement and some desire for movement. And even though there are words indicating movement toward a military solution, the reality is that an all-out DPRK invasion of ROK would likely end in another stalemate, at best, and more likely in a complete military defeat for DPRK. There are three studies in particular, spread out over a time sequence from 1995<sup>17</sup> to 2001<sup>18</sup> to 2009<sup>19</sup>, which also consistently rate ROK forces as stronger than DPRK forces.

A North Korean all-out attack would likely fail for at least two extremely important reasons despite brave and loyal DPRK soldiers: 1) insufficient logistics, 2) a mass army in an era of high tech conditions.<sup>20</sup>

**Figure 1: Selected DPRK Forces Needing to Move South**

DPRK has to move almost everything south of Pyongyang on this map to Busan – in 30 days in order to succeed. Not depicted: ~4,000 tanks; ~2,500 armored personnel carriers; ~8,000 light and medium wheeled vehicles



A war on the Korean peninsula would be an operational-level war with strategic consequences. Operational-level wars depend on battle campaigns and battle campaigns depend on logistics.

Korean peninsula geography is characterized by very defined north-south corridors between mountain ranges. Almost everything that is flat in Korea is a city, a village or agriculture. KPA cannot simply bypass built up areas. Built up areas favor the defender by a great margin meaning an attacker would like to outnumber the defender by a ratio of 3:1. ROK has had 50 years to prepare a labyrinthine series of bunkers, positions, weapons and ranges. DPRK has also had as long. So as soon as either country moves from their own positions, they are exposed. In order for the KPA to achieve their objective, they would have to move from their positions to capture Seoul and surround Busan. Those two cities, combined, have a population equal to half of all of DPRK's population. DPRK will also have to move the world's second largest military in the world and move about 2/3 of the world's fourth largest military some 500 km in a month.<sup>21</sup> Moving that sheer volume of equipment through that distance takes an incredible amount of energy. In this case, DPRK would have to deliver about 8 months of their normal energy consumption in one month.<sup>22</sup>

This a task which they have not performed in at least 50 years. And as far I can tell they have not even practiced anything of a similar scale (moving 2/3 of Army within DPRK in a month's time) in at least as long.

Delivering that energy and moving that many people and things along three defined geographic corridors seems ideal for a mass armed force with the majority of its forces positioned far forward. And it was until technology enabled others to immediately sense (see, hear, feel) enemy preparations and know when the military moves. Technology also enables detection and destruction on an unprecedented scale. Given a battlefield air interdiction rate approaching 0.5<sup>23</sup> and that ROK has 467 aircraft,<sup>24</sup> ROK alone can destroy approximately 230 targets per sortie. ROK would likely get one to two sorties before DPRK attempts to shut down ROK airfields by conventional means or by escalating to chemical or biological weapons.

However, the cost to DPRK of resorting to chemicals or biological weapons is extremely high. Moreover, in the end, it will not significantly impact the military outcome, even though it would certainly impact the political outcome. The vast majority of U.S. aircraft are not on the Korean peninsula and are out of DPRK range. If the U.S. were to commit only half of the Air Force fighter and bomber fleet<sup>25</sup> to bear, DPRK would likely lose another 500-700 targets per day in addition to those lost to direct, indirect and counter-battery-fire and various other reasons. And even assuming the forces are successful, they will likely run out of fuel and ammunition in one to two weeks unless DPRK leaves ROK stores intact and scavenges ROK fuel supplies. These calculations exclude Naval and Marine aircraft as well as TLAMs. DPRK would likely lose 20% of their tanks and artillery per day which is consistent with Operations DESERT SHIELD and DESERT STORM. In particular, DPRK would suffer the majority of the damage in the first week, starting as soon as they leave their covered positions.

The following table summarizes the kind of military damage DPRK can inflict upon their fellow Koreans in the short run. These numbers are not just numbers, but people: fathers, mothers, children, etc. But in order to demonstrate a credible conventional deterrent exists, we will look at them as numerical abstractions. Appendices A-E contain all the details and methodologies. I realize everyone will find some part of the analyses they disagree with. I welcome your feedback and willingness to contribute to furthering the discussion. This is also one of the major recommendations: Increase the public analysis and amount of data available via scholarship on the subject. Based on in-depth, albeit not exhaustive, analysis of openly available material, it is likely that ROK can absorb and defeat a full-fledged DPRK conventional attack at the strategic, operational and tactical levels – however, ROK would be extremely weakened after such an attack and DPRK would likely not have a capacity for self-defense after being defeated. In short, there would be a large vacuum. Just before that vacuum reaches full strength is likely one of the biggest inflection points to escalate or not, to what degree and by what means, to achieve what goal?

Table 1  
Summary of Effects

IMPORTANT CAVEATS:

- 1) No indications there are plans for these events;
- 2) Assumes people are at home or in an office

Scenario	Possible Casualties	Weapons
Surprise Volley (Primarily counter-force)	~2,881 initial volley; mainly soldiers	240 MM MRL 170 MM KOKSAN
Surprise Volley (Countervalue and astrategic)	~29,661 Civilian; likely ~790 Foreign nationals ~605 Chinese	240 MM MRL 170 MM KOKSAN
DPRK chemical (non persistent Nerve agent) 10°F Stable atmosphere	~356,000 Civilian ~9,500 Foreign nationals ~7,300 Chinese	Single volley of 2200 rounds from 240MM M1991
EXTREMELY UNLIKELY <sup>26</sup> Nuclear strike on Busan NOTE: only a scenario to think through certain concepts.	~50,000 within 12 weeks Mostly civilian	10 Kt ground burst, North Harbor.  Effectively turns this into a Korean-against-Korean fight.
Very few 240 MM or 170 MM KOKSAN would exist after 1 week.	Expect DPRK to lose these weapons at 1%/hour	467 ROK aircraft; Possibly 1,200 U.S. aircraft 2,660 Main Battle tanks 1,538 Multiple Rocket Launchers
KPA would likely run out of fuel/ammunition within two weeks. NOTE: another study projects KPA can last up to two months. The point is, once started there is very finite amount of fuel and therefore time left.	DPRK would need to drive approximately 2,500 vehicles per day to supply a southward invasion in order to sustain themselves – or spare ROK fuel stores and scavenge from ROK	

Because a conventional conflict would likely end in DPRK defeat, DPRK and all those countries desiring stability in Korea, have strong incentives to seek alternative means of resolving or postponing resolution of its twin dialectic conflicts: a split peninsula and ensuring a third dynastic socialistic transition. Some likely unconventional means to move toward those goals short of full-fledged conflict include: limited strikes, cyber warfare<sup>27</sup> and Special Operations Forces.<sup>28</sup> A Korea Japan Nuclear Weapon Free Zone would likely be viewed as another form of legal warfare available to DPRK with no real cost and a tangible benefit of buying time. Establishing a KJNWFZ would engage Northeast Asia in debate and provide DPRK some much needed time to find or create a more advantageous set of international conditions which might be more favorable to finally resolving its conflicts. Finally, China would almost certainly become involved in any conflict on the peninsula. A

KJNWFZ provides a means for shaping what will eventually happen when stasis on the peninsula changes. In fact, a KJNWFZ provides some opportunities to provide basic outlines or principles to address a future change in the status quo. As an example, a reunified peninsula would have to turn over any nuclear weapons to a nuclear power.

### **Conventional Balance**

As we look at the conventional balance on the Korean peninsula, it is fairly clear that the conventional forces of Combined Forces Command, which is the ROK Armed Forces and U.S. Forces Korea, have sufficient conventional strength to prevent KPA from achieving a unified peninsula under DPRK rule via a conventional military attack. However, even if DPRK were to prevent additional U.S. forces from coming onto the peninsula, KPA would likely STILL FAIL to successfully unify the Korean peninsula via a conventional military attack. In other words, the conventional strength currently resident in ROK alone is likely sufficient to absorb and stop a DPRK conventional military attack. Existing ROK conventional deterrence on the peninsula is strong enough and “not incredible” (in a Herman Kahn sense of the words) enough to frustrate a DPRK plan to reunify the peninsula. Existing ROK conventional strength is likely not enough to reunify the peninsula under ROK rule. Hence, the peninsula remains divided. DPRK conventional military capability has remained fairly static since the 80s while ROK military capability has increased in key capabilities and continues to increase. DPRK continues to maintain a numbers advantage; however, they fall well short of the desired 3:1 ratio for attacking a defense. ROK has decreased the gap in numbers to a moderate degree, and it has greatly increased its capabilities lead over DPRK. Moreover, ROK has an industrial base and relatively robust economy to support continued increases while DPRK economy has a modest economy and a corresponding modest industrial infrastructure should DPRK desire to increase its conventional strength. That means DPRK will have trouble adding new, resource intensive conventional capabilities while ROK retains that future capacity. Therefore DPRK has sought asymmetric means which are less resource intensive yet still yield large dividends such as nuclear weapons, cyberwarfare and special operations forces. We will only look in detail at the nuclear weapons aspect.

Aside from psychological reasons such as a desire to punish DPRK or send a message to the rest of the world that using nuclear weapons is an unacceptable norm and will end in regime change, there is likely no military need to resort to nuclear weapons in order to achieve the military goal of stopping a KPA military attack from unifying the peninsula. Introducing nuclear weapons from any party onto the peninsula complicates pre-conflict, conflict and post-conflict planning across the spectrum of Diplomatic, Information, Military, Economic, Financial, Intelligence and Legal considerations.

DPRK might have performed similar calculations. While searching for information from English language sources and even some Chinese language sources on the internet, it was extremely difficult to find reliable information on DPRK. It is unclear the degree to which DPRK has performed similar calculations, if at all. However, with DPRK's strong links to military traditions from both China and Russia, both of which have honorable and very competent academies of military science it is very likely has conducted such an analysis. They have likely arrived at the same conclusion – a favorable outcome for DPRK is sufficiently in doubt (or perhaps extremely clear) and the stakes so high they have decided to

wait for a better set of conditions. If DPRK thought it would be successful in attacking, it likely would have done so by now.

As alternatives to direct military attack they often engage in relatively low levels of activity such as berating the ROK-U.S. alliance. In an ironic twist DPRK verbal attacks as well as existential threats to the alliance structures between the U.S., ROK and Japan have led to a closer U.S.-ROK alliance as well as a stronger U.S.-Japan alliance and even increased the strength of the bond between ROK and Japan.

### **What role might China play?**

Of course many people ask if China would become involved. However, the real question is how much more will China become involved in a Korean contingency? There are numerous historical examples of China involving itself in Korean affairs.<sup>29</sup> Most recently, From 1950 through 1953, China was involved via the People's Volunteer Army. China was directly party to the final armistice talks and maintained its role until 1994. Perhaps as a signal, perhaps by design, maybe both, China transferred control of its border with DPRK from the Border Guards to the PLA in 2003 during a state of relatively high tension.<sup>30</sup> According to an Iranian report, China moved or is planning to move PLA into Najin-Sonbong<sup>1</sup> Special Economic Area to protect Chinese interests in January 2011.<sup>31</sup> An anonymous Chinese defense official vehemently denied that China sent troops.<sup>32</sup> Two observations: 1) The headline denies sending troops to Pyongyang, but only much later in the article does it mention Najin; and 2) a Chinese official also restated China's position that it could send troops in to DPRK if authorized by UN mandate, thus leaving open the option in the future. It was never clarified from what threats PLA was protecting Chinese interests. Presumably, there were no credible threats of DPRK taking over Chinese interests in any part of the DPRK. China has facilities and Chinese citizens in the well-guarded compounds at Najin-Sonbong so it would be natural for any government to want to protect its citizens abroad. Militarily, there are several advantages to having forces at a place like Najin: a port on the East Sea (Sea of Japan); a post from which to effectively seal one part of a very long border if needed; a central location to set up a refugee camp on the Northeast Coast. China is also improving the approximately 100 km road network<sup>33</sup> between Hunchun city in Jilin province and Najin. By using this one location, there are likely several messages: to DPRK China wants to expand business and help improve the lot of the average Chinese and North Korean citizen via trade. Also, if the average DPRK citizen wants to leave, they should walk south instead of north.

We cannot know for certain what China intends nor what Russia perceives, but some likely perceptions are: Russia may understand that China is placing itself in a blocking position. By choosing a location so close to the Russian border, there is likely another message: Russian help/intervention is neither required nor desired. Russia may also sense an undertone of latent threat since the Russian border at that point is almost as far away as one can get from Moscow and there are extremely few Russian citizens let alone Russian troops in that area. All maritime powers in the area immediately understand China now has access to another port. Although the kinds of ships that can come to Sonbong (the northern of the

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<sup>1</sup> Note: Najin and Rajin are the same place, but are sometimes Romanized differently. Both of them refer to 라진 /羅津 in North Korea. They are also sometimes combined into "Rason"

two piers) are limited to a draft (depth) of 6.1 meters at high tide.<sup>34</sup> The port at Najin (the southern of the two piers) allows for ships with a draft of 7.6 m to berth. An even more substantive difference is that Najin has anchorage for a ship over 500 feet long and a draft of 23.2 meters.<sup>35</sup> ADMIRAL KUZNETSOV class aircraft carriers, as an example have a draft of 9.1 meters.<sup>36</sup> There is even a domestic message: China is working to improve standards of living; it is cheaper to ship coal from Jilin province to China's south than overland.<sup>37</sup> In short, a Chinese presence at Rason via a Special Economic Zone and at Dandong via the same method means there are important Chinese economic interests and Chinese citizens in those locations. As border locations, it is also consonant with having a future capability to seal the border and makes great sense for any country desiring stability.

Possibly related to those planning considerations and certainly related to stated economic considerations China has made major infrastructure improvements in Liaoning province in the vicinity of DPRK border. China has increased the numbers of highways, the quality of the roads and is also funding a USD 258 million dollar four lane bridge to connect the border cities of Dandong and Sinuiju since they are also a new Special Economic Zone<sup>38</sup>. Chinese press claims this development is to support increased cross border business. Supporting business is almost certainly one of the main goals. At present, the vast majority of PRC-DPRK trade is via road<sup>39</sup> and an increasingly robust road network makes sense in this context. Infrastructure construction is also labor and resource intensive. And it is a well-known way to increase employment which leads to greater social stability.

### **Economics is part of the plan, but not all of the plan**

There have also been newspaper reports that China has a “병아리/小鸡 (鷄)/Chick plan” (as in a hen's baby chickens) to move into DPRK in a contingency such as major DPRK instability or military defeat.<sup>40</sup> In this particular plan, according to the article, the PLA would deploy along the Taedong river and as far south as Nampo. If China were to deploy forces south of Pyongyang, it would be an unmistakable sign that China is placing itself quite literally between Seoul and Pyongyang and will determine the future of the Korean peninsula. It is difficult to imagine the Armed Forces of any country continuing to move north beyond any PLA positions. A PLA deployment along a Taedong river trace almost certainly ensures a buffer zone – and a forever split peninsula.

DPRK is likely a rational actor and also aware that there are potential costs each time it tries to execute a plan. However, DPRK has shown they have a relatively high threshold for risk. Not crazy, just higher threshold. As a more recent example of course there is the attack on the CHEONAN, an artillery barrage on Yeonpyong do, and three assassins who were caught in ROK.<sup>41, 42</sup> That ROK was able to detect and capture three assassins in relatively rapid succession has at least three likely explanations: 1) vastly improved ROK detection methods, 2) someone very high in DPRK who has changed loyalties, or 3) a test run to determine procedures. Notice – they are not mutually exclusive. That grey area in determining which one is predominant or in determining what other factors may exist is where high potential for miscalculation exists.

It is unclear how Pyongyang would explain to PRC why Pyongyang just devastated PRC 4<sup>th</sup> largest trading partner. ROK is PRC's 4<sup>th</sup> largest trading partner with total volume

of trade valued at USD 207.2 billion in 2010<sup>43</sup>. It's a simple economic fact that a war would negatively impact the economies of U.S., Japan and ROK to buy imported goods.

In each of the scenarios, from conventional to chemical to nuclear, the ROK suffered more losses than in the preceding scenario, with the exception of the chemical attack. However despite painful and devastating outcomes, in all cases, ROK can credibly and unilaterally defeat a DPRK invasion. Once CFC and other Air and Naval forces from outside the peninsula are factored into the fight, there is virtually no possibility, from a military force standpoint only, that DPRK can succeed. The only possibility for a DPRK victory comes from diplomatic compellence. Even a Great Power intervention would likely only buy DPRK mere existence and not a unified peninsula.

### **Possible ways to build positive expectations**

Mutual trust, mutual respect and most other mutual terms are ambiguous and leave an incredible amount of “wobble room” as well as a propensity for the aggrieved party to always blame the other side for the lack of mutuality or reciprocity. But is possible to develop positive patterns of behavior and manage expectations in a manner where both parties generally know what to expect of the other party. We'll use the normally accepted concept called Confidence Building Measures as a means to move toward positive expectations.

General Guidelines and Specific recommendations for Confidence Building Measures:

- First, do no harm. Do not engage in activities which would make the situation worse such as increasing military capability or activities which deliberately target any of the Six Parties.
- Manage expectations. ROK should go to the DPRK first. DPRK hosting first allows DPRK to manage expectations and pace. Since DPRK will be the first to host, ROK will know what and how to reciprocate the event. Also, there will likely be few political cancellations for ROK going to DPRK. By DPRK hosting first, DPRK has some extra time to ensure internal political approval to travel.
- Agree to fewer but better activities. Better to agree to and actually perform fewer exchanges than agree to too much and not do everything. Consistently carrying out exchanges which both sides agreed to helps build trust that each side will do what it say it will do. When one side agrees to an event and then cancels that event, it can lead to distrust. An alternative argument holds that it is better to have more events and reserve a few events to cancel, if necessary, to signal displeasure. These few events serve as a pressure release valve. By cancelling a few events, the overall relationship is preserved even though a few events were sacrificed. This second argument makes sense at the Senior Leader level. However, for the mid and lower levels, cancelling events appears to be a bad faith effort to the second and third generations of leaders.
- Frame exchanges and activities as mutually beneficial. Casting events in a “zero-sum” or “hand out” light almost guarantees failure. Mutually beneficial does not mean

exact reciprocity, but lack of reciprocity will quickly kill the political viability of any future exchanges.

Possible Ideas for Exchanges: These are provided in a spirit of increasing future discussion and interaction. They should obviously be adjusted to fit the specific conditions existing at the time.

**Disaster response exchange:** Since this involves a neutral and common enemy, “natural forces”. Each side picks a domestic disaster to which they had to respond. They then explain how civil and military authorities identified the most salient issues in the disaster, and the process involved in developing, disseminating, executing and monitoring the plan. If a party feels uncomfortable with this the first time, they can describe an ideal or hypothetical plan for disaster relief. Typhoons and floods commonly afflict the Korean Peninsula. For example, one party might present a hypothetical tornado (Korea rarely experiences tornados) then both parties would go through the paces of reacting to the tornado. It is probably too early and too resource intensive to examine conducting joint Disaster Mitigation efforts abroad. DPRK is probably not ready to deploy disaster help abroad. And all help sent abroad from DPRK is that much less help available at home.

**Acupuncture or Pain Management or Preventative Health Care exchange:** DPRK has done an amazing job of maintaining public health with a minimum of resources. Preventive health care via acupuncture may be a low-cost model for others to emulate. Managing pain with acupuncture has the potential to save other countries much money. Several countries are experiencing abuse of prescribed medication. Preventing dependency of prescribed medicines therefore has great potential to alleviate some societal ills.

**Public Health exchange:** DPRK has done a good job of preventing and controlling the spread of infectious disease. ROK was the only major country in NEA not affected by SARS. There is great potential in exchanging lessons. Some possible goals down the line include joint disease spread monitoring.

**Joint Study of German Military Reunification:** Selected scholars from South and North study West and East German military experiences’ after German unification. They should research some of the major issues and innovative solutions Germans used. There should also be a focus on jobs programs for demobilized East German soldiers. South researches East Germany and North Korea researches West Germany.

**Reforestation Experience Exchange:** Conservancy groups from both sides exchange experiences and history of rapid reforestation efforts after the Korean War. Should also include some experts on genomic experts of rice, corn, maize and the beloved sweet potato.

**Theoretical basis for NCO development exchange:** ROK Armed Forces were able to assimilate successfully the concept of empowering NCOs to lead and train soldiers. Since the military is completely trusted in DPRK, they alone have the possibility to experiment with NCO leadership exchanges. The exchange should involve school commandants and personnel officers, but not actual NCO’s. As a function of expectation

management, trying to exchange NCOs will likely end in disappointment on both sides as one side sends NCOs and one side sends intelligence officers.

**Cook exchanges:** This exchange involves cooking demonstrations and Koreans' affinity for enjoying delicious cuisine. ROK cooks prepare meals in DPRK and DPRK cooks share and prepare their favorite recipes in the ROK. ROK provides food for both sets, DPRK provides cooking and kitchen utensils for both sets.

**Cultural / Dance troupe exchanges:** Since both sides share a common Korean language, music, and culture, they should exchange dance or cultural troupe performances. Cultural exchanges in general are a great soft power tool with the chance to change the perceptions of a large number of people at the same time. An initial first step might be a performance broadcast live from both countries simultaneously. A DPRK troupe performs on live TV which is broadcast on KCTV and/or Mansudae station as well as South Korean stations. A third variation is a pre-recorded radio program featuring symphonies from both sides playing Korean classical music and broadcast nationally to both sides.

**Military News Reporters / Combat Camera / Propaganda Department exchanges:** This exchange should focus on exchanging experiences of keeping soldiers informed and entertained. South Korean soap operas are sweeping the international market. There is likely a way to capitalize on the cultural phenomenon which is sweeping across borders.

**Sports Team Exchanges:** Stay away from these. They are almost directly analogous to combat. Losing teams and individuals will likely face severe shame and worse upon return. They will eat much bitterness for a long time preparing for these events. Don't set them up for failure or long grueling hours of practice and preparation. However, if there is a desire to go down this path here are some suggested areas to help channel aggression to relatively manageable levels try to turn these into exhibitions instead of competitions.

- Tae Kwon Do: of course
- Basketball: three games in DPRK, three games in ROK, two games in a third country.
- Survivor Soldier Skills Challenge – ROK and DPRK soldiers are well-known for their physical and mental toughness. Put teams of ROK and DPRK soldiers through various military events. Half the events in ROK, half the events in DPRK.

**Retired Officers Exchanges:** O-10 lead with one O-10 through O-7 and five O-6. Discuss how military lessons learned can be applied to civilian careers after the military. This can also serve a secondary purpose as another reliable conduit for information.

**Oral History Project Exchange:** Fewer and fewer Koreans remember a unified peninsula. Teams composed of ROK and DPRK historians/anthropologists travel simultaneously north and south to capture quickly fading memories and also aid in future efforts to identify split families. So for instance a ROK and a DPRK historian interview a DPRK citizen in DPRK who was alive when there was one Korea. Simultaneously, a ROK and a DPRK historian interview a ROK citizen who was alive when there was one Korea. May also expand to include Russians to interview citizens who assisted Russia or participated

in Russian units. Same for Chinese who may want to interview those DPRK citizens who fought with Chinese People's Volunteer Army.

**Astronomic Observatory program:** DPRK has many sites ideally suited for a small to mid-size observatory. There are low levels of ambient light pollution as well as low levels of atmospheric pollution. Observatory sights are always fairly isolated so DPRK won't expose many people to outside influences. However, if there is a desire to boost tourism, it can be located near a major city or port similar to the DaeJeon observatory in the south. Likely too expensive (USD 100 million or more)

**True Military Moves** – Since there are an estimated 100 KOKSAN and 200 tubes of 240 MM MRL, move a percentage away from the DMZ. As an alternative, move some pieces of artillery away from the DMZ. This is a verifiable gesture which DPRK can reverse. Agree to pre-notify of any moves within 20 km of DMZ or of a certain weapon system or any basic common denominator. Look at Figure A-CCC, surely moving a few pieces will not create a mission critical failure. But it would send an extremely positive signal to all other parties and has a ratcheting down effect. If the level of tension is permanently high, the state, like any other organism accustoms itself to the new level as an equilibrium point. After a while, there are only bad and worse options – the land of potential miscalculation – to increase tension. See Figures A-9 and A-10 in Appendix A.

**Higher End:** These activities involve armed forces conducting “joint operations” or even conducting activities in roughly the same place at about the same time at the low end of the scale.

**Anti-terrorism:** At the very highest end, DPRK and ROK jointly pursuing terrorists who may have had contact with either side. DPRK conducts anti and counter terrorism drills in DPRK territory. ROK and DPRK forces (squad sized) conduct anti and counter terrorism drills in ROK territory. An easy first step involves researchers or theoreticians discussing anti and counter terrorism theory at the respective NDUs.

**Counter-piracy:** Both sides patrol areas like the Mekong river in order to ensure safe passage of riverine traffic. Neither Thailand nor Burma would fear a ROK/DPRK river patrol and all countries would benefit from added security to this key riverine artery for SE Asia.

**Joint Maritime Patrols:** Both sides jointly enforce EEZs against other countries attempting to use Korean EEZs for economic gain. Or renting those waters out and enforcing the standards of rent. This likely better led by the Coast Guard. ROK Navy is likely still too raw from DPRK sinking of CHEONAN to make a willing partner right now.

**Study of Korean Security in the early 80s:** ROK was in a time of transition and faced several possible paths. ROK and DPRK civil governance experts can research ROK's possible pathways at that critical juncture as well as study the effects of policy choices from the early 60's.

**Martial Justice system:** Military lawyers from both sides can discuss the legal theories they consider most crucial to ensuring good order and discipline in the ranks.

## Conclusion

There are many reasons to be very guardedly optimistic as opposed to the recent past of absolute despair. There are several signs pointing to increased dialog and decreased violent action. Of course the potential still exists.

A Korea Japan Nuclear Weapon Free Zone can be a viable pathway for DPRK to receive a tangible security improvement, allows senior leaders a spectrum of options as opposed to only one option of reunification, provides a more stable environment conducive to foreign direct investment and for the doctrinaire, it is a convenient tool to stall for more time allowing for a transition in DPRK government at a scale, scope and pace of DPRK's choosing. A KJNWFZ does no harm, is a step in the right direction of establishing normative behavior in Northeast Asia, is extremely low cost and promotes responsible dialogue. There likely are numerous viable paths away from conflict on the peninsula, even if they do not immediately lead to reunification, if all parties manage expectations, they can fall into patterns of positive expectation. A KJNWFZ provides verifiable trust for all sides.

## Appendix A: Geographic Context

Figure A-1

### Seoul Metropolitan Area and DMZ Trace

Seoul is famously and dangerously close to the DMZ. The city proper has about 10 million residents. However, approximately 24 million Koreans call Greater Seoul Metropolitan home.

There are plenty of detailed statistics in Annex B



Maps created from Google Earth.

All data on the following maps is from Planeman.

Planeman is a pseudonym for an avid Google Earth user who also enjoys putting together his love of drawing and analysis to compile list of equipment and places.

This particular dataset is available at:

[http://bbs.keyhole.com/ubb/ubbthreads.php?ubb=download&Number=809291&filename=DPRK\\_file.kmz](http://bbs.keyhole.com/ubb/ubbthreads.php?ubb=download&Number=809291&filename=DPRK_file.kmz)

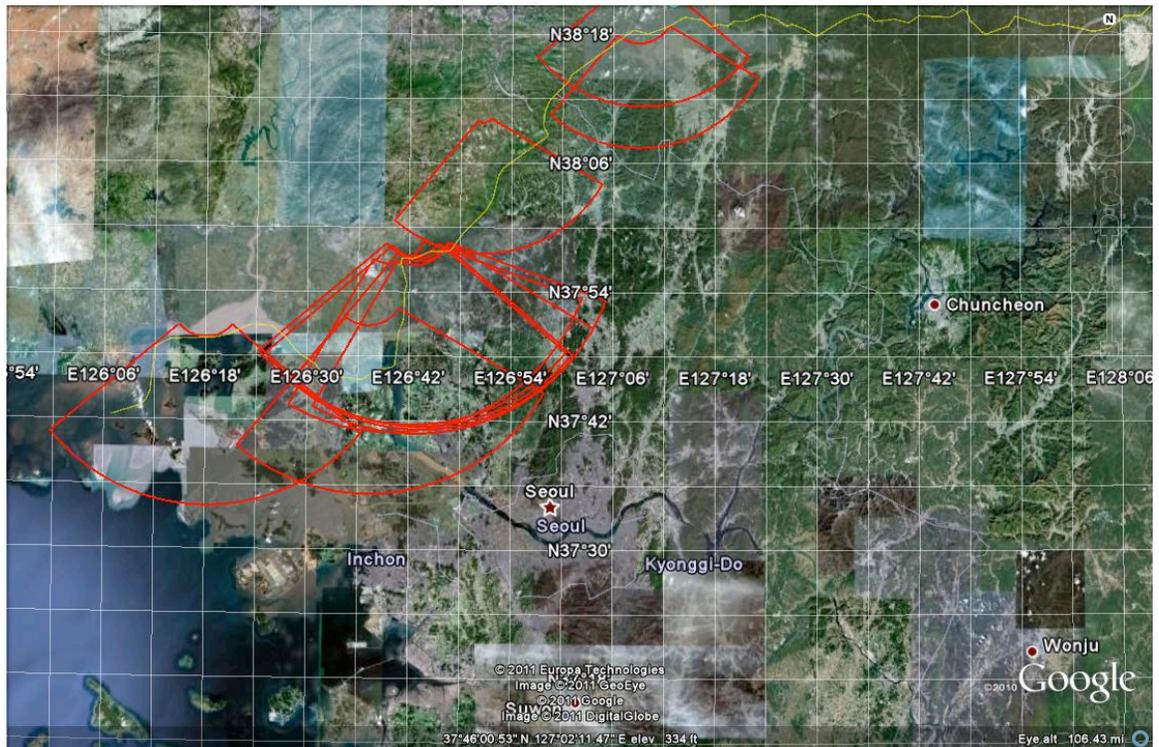
All the maps seem to show something when zoomed into the highest magnification. I personally am not an artist or scientist in these matters, but I do believe, this visually represents most of the data resident in the analytics of my paper. In the particular case of this appendix, one picture is worth approximately three thousand words.

**Figure A-2**

**Likely M240 and 170 KOKSAN Range Fans**

If one scours these areas looking for tell-tale signs of M240 and KOKSAN guns, these are likely positions for them. The range fans do not include artillery shadows and therefore encompass a larger area than can actually be struck based on physics. However, even given these range fans, it's clear the majority of Seoul is OUT of range. The parts of Seoul metropolitan which are in range are much less populated than Seoul proper.

Attack corridors are also fairly visible. They are the lighter fingers extending North through Uijeongbu and North-Northwest up the Cheorwon valley.



**Figure A-3**

**Likely Avenues of Approach to Seoul.**

All roads in the area lead to Seoul.

Even at their very widest, these corridors are only about 15 km<sup>44</sup> wide but narrow in many places to about 3km wide. There are even some places as narrow as 1 km wide. In a traditional defense, those narrow bottlenecks are extremely heavily defended. The kinds of defense are limited by the imagination but usually include small arms fire, crew-served weapons, artillery, manmade obstacles such as roadblocks, chunks of concrete that are too large for a tank to bypass, and minefields.

Panheuristics provides an excellent analysis of possible throughput of those corridors in terms of divisions per day. They assess that each corridor can hold about 2 ¼ DPRK divisions assuming the divisions maintain doctrinal distances and frontage. They would also clear out of the corridor and into Seoul at a rate of ¾ of a division per day.<sup>45</sup> Those divisions are extremely vulnerable to direct, indirect and aerial fires while they are in the corridors. Even though the discussion of divisions occurs in an atomic context, given precision weapons and improved anti-personnel artillery, one can achieve similar effects.

However, if the defender makes the area too impregnable, the defender will also find himself with limited mobility in that direction in the future. In effect, a defender can proscribe ground counterattack mobility if not careful.

Both sides have had fifty years to think through these issues.



**Figure A-4**

**Selected 240 MRL and 170 KOKSAN Hardened Artillery Sites (HARTs)**

There are several HARTs near the area. Because of the KOKSANS size, there are relatively few HARTs able to handle the gun. Here is a representative sample of the kinds of places from which and to which the guns can move.

HARTs can only be situated in certain areas to be effective. Generally they must provide protection, be oriented in the right direction, allow clearance for the artillery to come into and out of, cannot exceed certain gradient of slopes and other requirements. However, Korea has been blessed with numerous locations which meet all the criteria. If the slope is too steep, the gun will not be able to depress or raise in order to fire at certain ranges. Also if the slope is too steep there is the very real possibility of sliding off as anyone who has experienced a Korean winter knows.

The 240 MRL needs a certain blast radius cleared behind it or can kill the operators and anyone else who happens to be in the way. The 240 is likely going to have to come out of the HARTs in order to fire, unlike other systems which can fire from an almost completely protected area with only the tube sticking out. The total exposure time for a 240 MRL is around 15 minutes from exiting the HART, stabilizing the platform, erecting the launcher, raising the pads, retracting the launcher, moving and reloading.

Even the HARTs which appear to be close usually involve descending a steep hill and then ascending an equally steep hill. The lateral distance may not be that great, but total distance will usually be four to five times as much because of the ascent and descent.





**Figure A-6**

**Selected Likely Observation Posts in the Area**

The guns almost certainly have a dizzying array of pre-planned targets. The artillerists will simply plug in all the information which they have had 50 years to pre-calculate and fire.

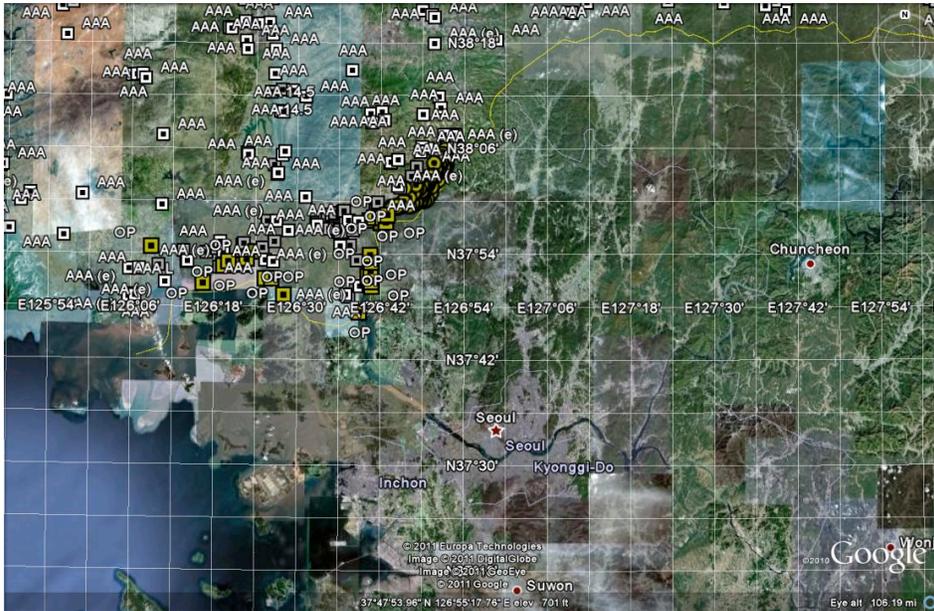
However, in order to adjust to current conditions or engage moving targets, the artillerists need an Observation Post or place for someone to observe the effects of the fire and provide corrections to the artillery. KPA has set up a series of Observation Posts throughout the country and especially around the DMZ. These observation posts are extremely vulnerable to all kinds of fire. KPA observers generally have a more modest technical means of observation, relying on their eyes and binoculars. That means their effectiveness can be drastically cut by using simple smoke to obscure vision. And of course, any counterbattery fire landing nearby rattles ones nerves and has a local obscuring effect.



Figure A-7

### Selected Anti-Aircraft Artillery Sites and Range Rings

Given that KPA has much artillery on the ground, they would like to protect what they have by dissuading aircraft from flying toward DPRK. If an aircraft does fly toward DPRK, KPA wants to make sure they have some capability to shoot it down. Here is a representative sample of sites KPA has developed to protect against air attack.



The figure below illustrates how the sites translate into air coverage rings.



Figure A-8

### Likely Tunnels, Bunkers and Road Blocks in the Area

If a corridor is too constrictive, and one is too exposed to the air, go underground. Here are some known and suspected tunnels in the DMZ area.

However, there are also many smaller tunnels far away from the DMZ which may lead to barracks, equipment, fuel, ammunition, etc. There are also bunkers and trenches which may indicate a target KPA really wants to protect. Command and control facilities and communications areas normally require high levels of protection.

Just as there are numerous road blocks in the south, there are numerous road blocks in the north. Clearly, someone in DPRK is worried about possible ground movement North. An alternative explanation is that as soon as KPA moves south, those who remain behind close off any possibility of those troops coming home. This is very similar to the Chinese saying “Breaking the clay pots and sinking the boats” in other words, the only way out is victory.

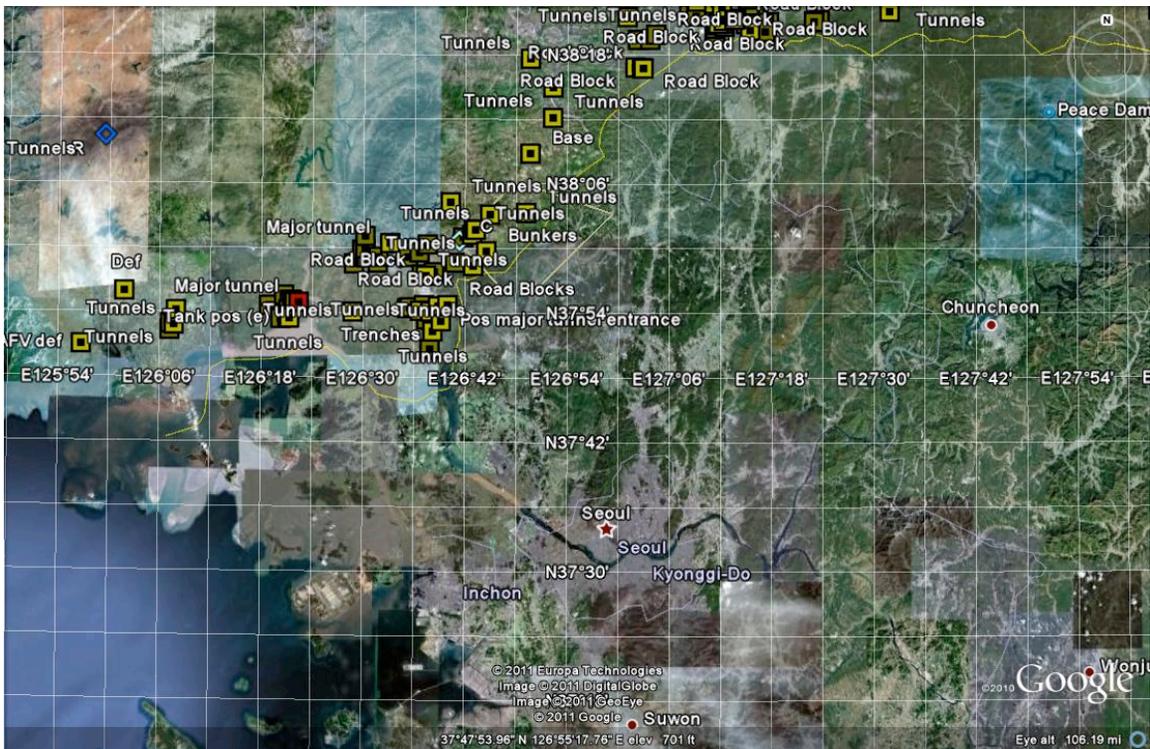




Figure A – 10

### KPA Artillery Range Fans in the rest of DPRK

Of course DPRK must protect other areas of its country or those become weak points. What stands out is the almost complete lack of artillery on the Chinese and Russian borders. DPRK displays their trust in their neighbors here.

It is also noteworthy that the only other places we are likely to see 240 MRL and 170 KOKSAN is near Pyongyang. The KPA places high value upon its ability to threaten Seoul and protect Pyongyang. This dynamic is strategically asynchronous with DPRK stated desire to have better relations with ROK and U.S. It is difficult to have a positive relationship with someone pointing many weapons at you.

As a positive gesture, DPRK could move at least some percentage or even some number of all those range fans directly across Seoul. Surely a few pieces won't determine the outcome and the rewards can be great. It is up to the Koreans to decide.

As a reminder of the significant logistical challenges, they have to move almost everything south of Pyongyang, even further south to Busan. That is a tough challenge for any military.

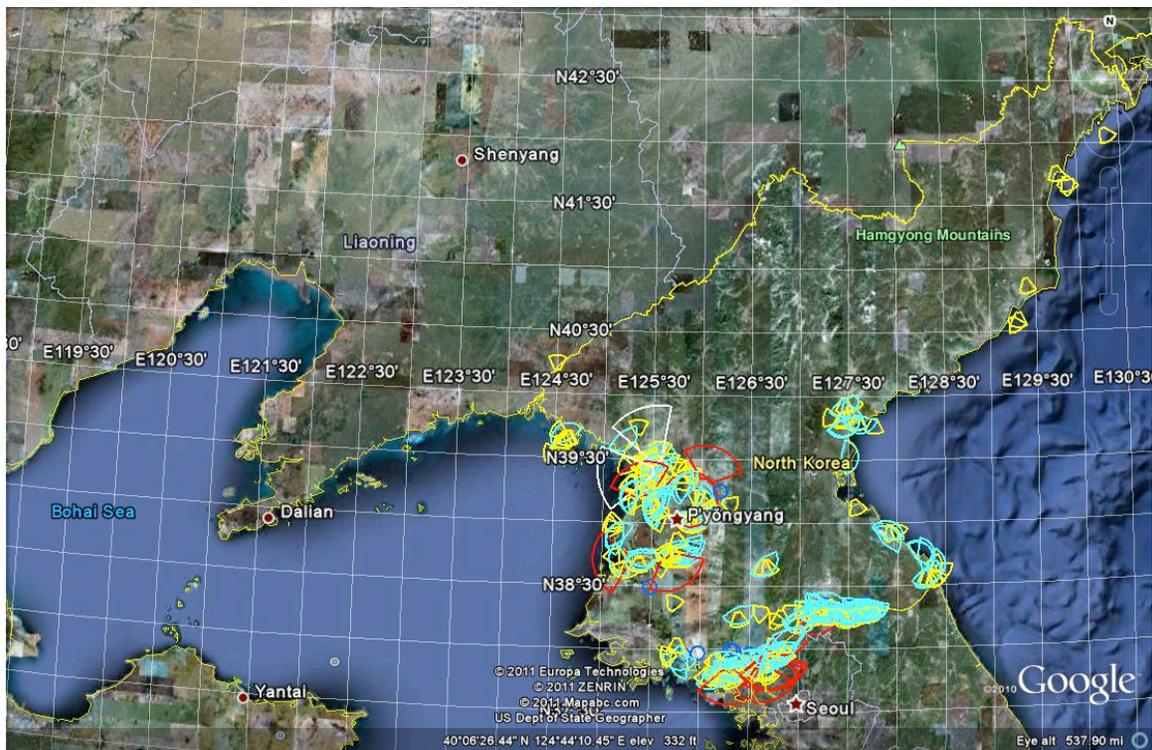


Figure A – 11

**KPA Air Defense Rings in the rest of DPRK**

An Air Defense Plan like this definitely emphasizes protecting Pyongyang.

Perhaps KPA assumes its troops in the south will be too close to the ROK for effective air support. Whatever the reason, KPA troops in the south have a very light air defense cover.

Presumably the air defense range rings next to China and Russia are a fence to ensure no KPA aircraft exit the country. However, they are immediately obvious and likely to be further explored since they may be protecting something else DPRK holds dear.

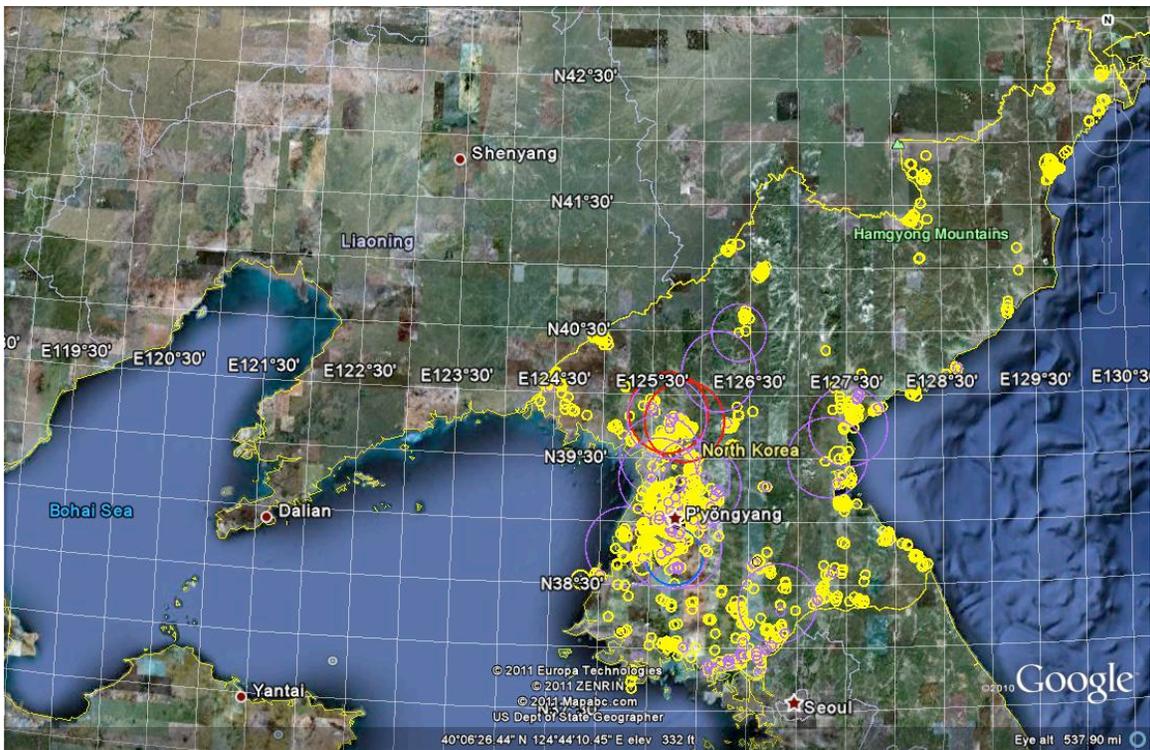
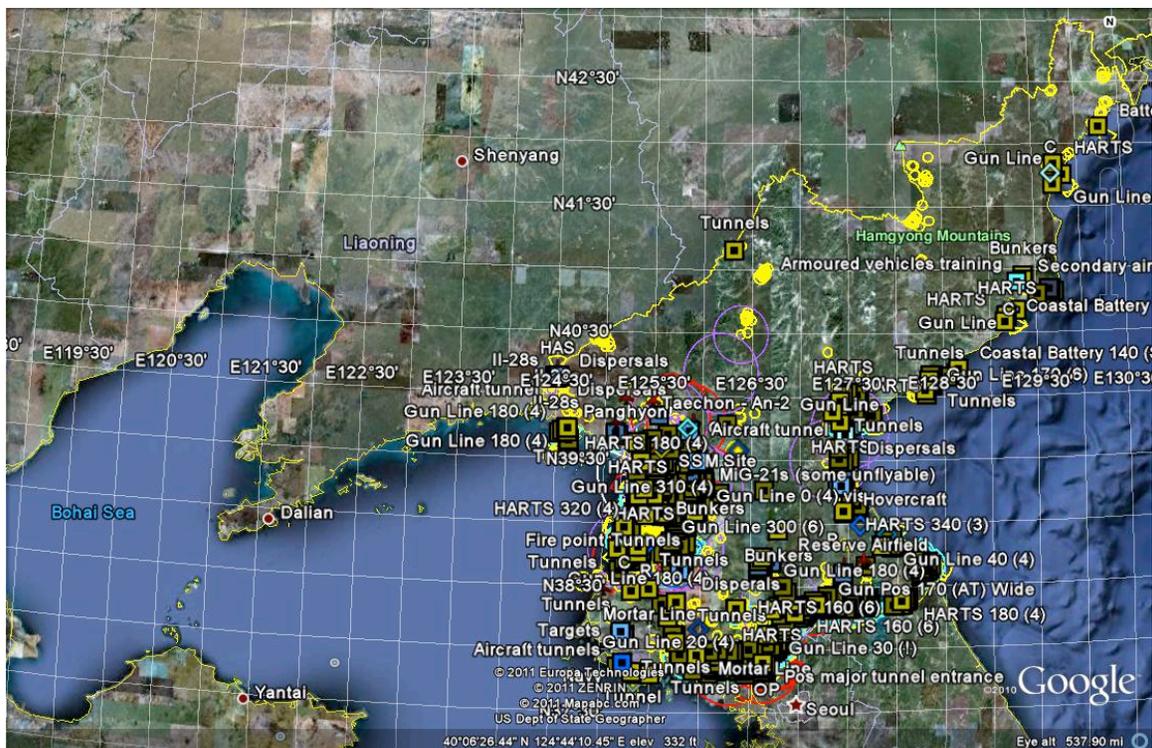


Figure A – 12

### KPA Air Defense Rings in the rest of DPRK

What stands out is the amount of preparation, work and effort which went into creating this national fortress.

This is a country that feels extremely unsafe in the world despite having two nuclear armed countries for neighbors. They likely feel the entire world is against them.



## APPENDIX B: Where did those horrible numbers come from?

### Conventional Artillery Attack of Seoul

Here is the summarized table of results and what follows below the table is a more detailed description of deriving these numbers.

**Table B-1: Conventional Artillery Attack**

Scenario	Possible Casualties	Artillery
KPA primarily counter-force	<p>~ 2,811 fatalities initial volley.</p> <p>~ 64,000 first day (majority in first three hours)</p> <p>~ 80,000 one week. Very few KOKSAN and 240 MM MRL last more than one week</p>	<p>2/3 of batteries firing max rate for 5 minutes from likely positions between 5 and 10 km north of DMZ and then sustained rate for 1/2 of batteries for 24 hours. Batteries destroyed by direct, indirect and counter-battery fire at about 1%/hour.</p> <p>Unrealistic assumption of unlimited ammunition and 100% maintenance rate.</p>
KPA counter-value Likely indicates KPA desperation	<p>~29,661 fatalities initial volley.</p> <p>Within the range of a previous study by Bennet, Bruce<sup>46</sup></p>	<p>2/3 of batteries firing indiscriminately into Seoul from DMZ trace. Most residents at home or office.</p>
DPRK Chemical attack Nerve agent non-persistent 10°F Stable atmosphere	~356,000 (if pure countervalue)	<p>Single volley of 2200 rounds from 240mm M1991.</p> <p>Represents crossing an escalation threshold.</p>
DPRK Chemical attack Nerve agent non-persistent 68°F Stable atmosphere	~1,200,000 (if pure countervalue)	<p>Single volley of 2200 rounds from 240mm M1991.</p> <p>Represents crossing an escalation threshold.</p>
Nuclear Strike on Busan NOTE: Extremely unlikely and only a scenario to think through certain concepts	<p>~5,000 (within 2 days)</p> <p>~35,000 (within 6 weeks)</p> <p>~50,000 (in 12 weeks)</p>	<p>NOTE: Extremely unlikely and only a scenario to think through certain concepts.</p> <p>10 kt ground burst centered in Busan North Harbor.</p> <p>Represents crossing an international escalation threshold.</p>

		Effectively slows U.S. heavy forces deployment onto Korean peninsula but invites an unpredictable response.
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According to the Korea Statistics, Korea’s central government organization for statistics, Korea’s total population in 2010 was approximately 48,219,000. The city of Seoul officially counted 9,708,00 residents which was about a 1% decline from 2005. However, the Seoul Metropolitan area population was assessed as 23,616,000. The proportion of Seoul’s population relative to Korean population has grown from 46.3% to 49% the past decade.<sup>47</sup> Some may consider this as common indicators that people do not believe there is an immediate existential threat from North Korea. Korea’s population overwhelmingly lives in cities with an urbanization rate of 82.1 %.<sup>48</sup> This simple fact has great military significance in that DPRK forces will have to engage in urban warfare almost the whole length of the Korean peninsula if they seek to unify the peninsula by force. There are simply almost no blank spaces where KPA can bypass ROK forces.

Every war is different, but given so much of it, there are some fairly consistent ratios of horrible events which allow us to create some morbid hypotheticals of various kinds of attacks. For example, we know typical weather patterns over South Korea and roughly how humans are negatively affected (i.e. die) when hit with certain chemical agents or conventional artillery in war. The numbers are ghastly since each number as not an abstraction but a person. However, for this paper, we will try to treat the numbers as only numbers in order to demonstrate methodology, promote conversation and provide the basis for exploring the value (or lack thereof) of nuclear weapons.

First, a conventional artillery attack on Seoul. It is often said that DPRK can hold Seoul hostage and “kill millions” in a sudden artillery barrage. The numbers just don’t support that assertion unless chemicals or multiple nuclear weapons are involved. Here’s an analytical look at the numbers in five scenarios:

- KPA relatively close to doctrine conventional artillery attack, mainly counter-force
- KPA conventional artillery attack mainly counter-force
- DPRK summer chemical attack
- DPRK winter chemical attack
- (an extremely unlikely) DPRK nuclear strike on a southern ROK port. Even though the probability of DPRK successfully assembling, transporting, arming, commanding and firing a nuclear device in ROK is assessed to be so extremely low as to be negligible, this allows for an absolute worst case scenario to think through certain concepts.<sup>49</sup>

These numbers start out as ABSOLUTE WORST CASE. Everything works in DPRK favor and then we progress the sequence to what’s more likely to happen. I have not found another study which walks through a surprise volley even though all the numbers are publically available. The other numbers for a sustained barrage and a chemical barrage are within the ranges outlined in some previous studies. I did

not find a previous analysis of a nuclear strike on Busan, and it wouldn't likely matter anyway since this look is for a very specific scenario.

If DPRK were to begin and sustain a conventional artillery barrage, DPRK would begin with some 20,500 artillery pieces. Sounds overwhelming, but if we go down another level, it's believed DPRK has 5,100 Multiple Rocket Launchers (MRL); 4,400 Self-propelled artillery and 7,500 mortars but not all 20,500 pieces can range Seoul<sup>50</sup>. Going down one more level of detail, initially, we need only be concerned with two systems: Multiple Rocket Launcher 240mm (MRL 240) rocket launchers with a range of 35 km and the KOKSAN 170mm with a 60km range if using Rocket Assisted Projectiles (RAP). Digging just a little deeper, some assess 500 KOKSAN pieces and 200 each 240 mm systems that can range parts of Seoul. The following paragraphs provide a brief overview of the systems.<sup>51</sup>

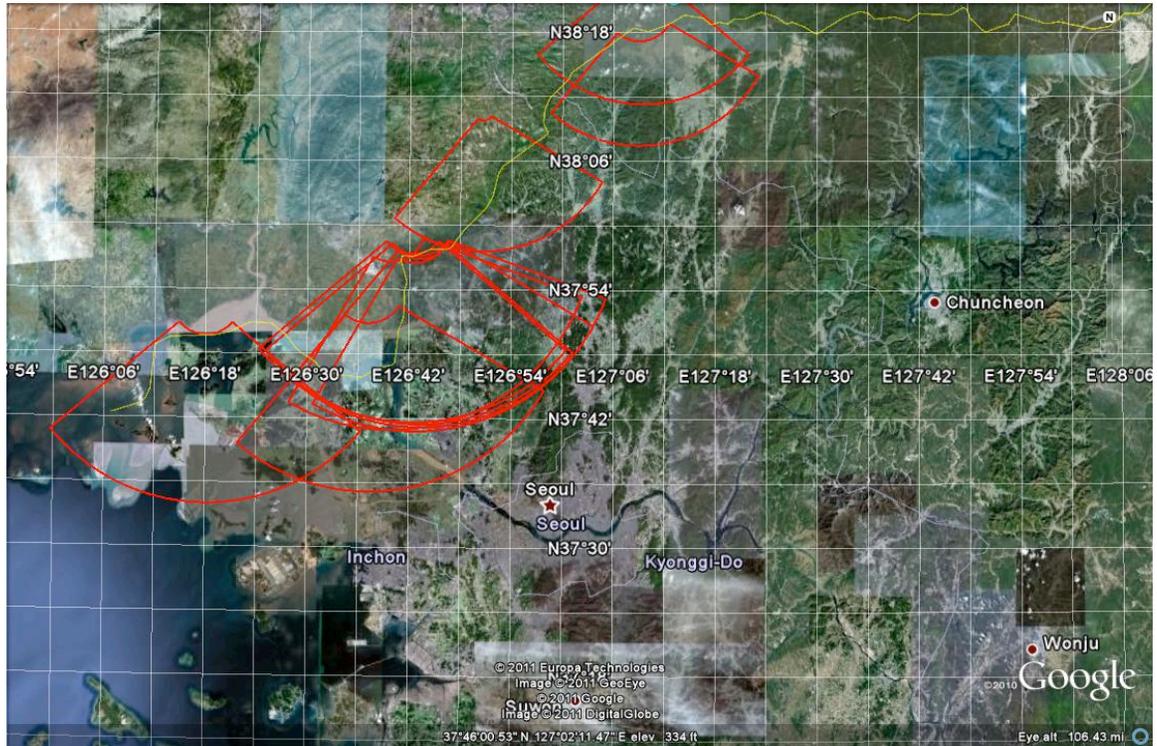
The MRL 240 rocket launcher has two main variants: M1985 and M1991. The M1985 fires 12 rockets in a single salvo while the M1991 can fire 22 rockets in a salvo. Both can fire their entire salvo within 45 seconds. They then need approximately two minutes to lower the firing pack and raise the stabilizing pads before they can move. Adding another minute to move back into a hardened artillery site (HARTS)<sup>52</sup> there is a total exposure time of roughly four minutes. It is unclear how long it takes to reload the firing pack, but we'll assume a 10 minute reload time – about the time it takes to reload a roughly similar BM-21 Multiple Rocket Launcher. MRL 240 rockets are basically unguided and are meant to destroy large areas with little regard for accuracy. DPRK use of these weapons against heavily populated areas might indicate DPRK intends to cause a great deal of casualties. If DPRK only meant to harass or send a warning, they could use the more precise KOKSAN to fire into unpopulated areas such as a park.

There are also two different types of KOKSAN 170 mm: M1978 and M1989 each with the same range, 60 km with Rocket Assisted Projectile (RAP). The main difference is that the M1978 is usually mounted on some other chassis such as a T54, Chinese T59 or T62 and has no organic ammunition storage capability. That means in order to re-locate, it has to either move to a site where more ammunition has been pre-positioned or have vehicle transport ammunition for it and then both vehicles have to stop and cross-load the ammunition. The M1989 variant has a 12 round storage capacity or enough to fire an initial burst of 4 rounds in 1 minute and then shoot at a sustained rate of 1 round every 3 minutes giving it about 24 minutes of firing time, if firing constantly, until it has to re-load.

In a worst case scenario, there are 700 artillery pieces capable of ranging most of Seoul. Not all the rockets or shells will explode. The most recent dud rate available from any DPRK artillery piece comes from DPRK attack on Yeonpyong Do and yields a dud rate of 25%<sup>53</sup>. The source of such a large dud rate is unclear at this time, but again it is the only recent indicator available.

Figure B-1

Likely M240 and 170 KOKSAN Range Fans near Seoul



In all cases, standard practice would be to only fire about 2/3 of artillery at any time. Some artillery must be kept on standby as a reserve, some kept on standby since one would not want to give away every position immediately. And of course some must be ready to counter-counterfire in an artillery duel. Again, the latest incident at Yeonpyeong do indicates that KPA will likely receive counter-fire within 15 minutes of firing the first shot<sup>54</sup>.

Even assuming a worst case with all DPRK artillery firing an opening burst, again this is not doctrinal and only about 2/3 would fire, but for calculation purposes, we'll assume every piece fires. This would be indicative of a completely countervalue tactic and does not make military sense at all.

We can represent it as:  $\sum$ Worst countervalue  $K+M+ M_2$   
 $K = 500 * KOKSAN * 4 \text{ rds/min} = 2,000 \text{ rounds}$   
 $M = 100 * M1985 * 12 \text{ rds/min} = 1,200 \text{ rounds}$   
 $M_2 = 100 * M1991 * 22 \text{ rds/min} = 2,200 \text{ rounds}$

Opening barrage Worst Countervalue =  $\sum$ Worst Countervalue  $K+M+ M_2 = 5,400$  rounds – 1350 rounds (representing dud rate of 25%) = 4,050 rounds with total projected fatalities in the range of 82,392 people assuming each round is evenly distributed across Seoul and the entire population of the Seoul metropolitan area is also evenly distributed across Seoul and standing outside in the open. Truly, a hardly likely scenario, but even with these worst case assumptions, there is nowhere near the “tens of thousands of shells turning Seoul into a sea of fire”.

Here is how we derived projected casualties:

□ (lethal blast radius in meters)<sup>2</sup> \* (# rds) \* (pop density /km<sup>2</sup>) \* (convert km<sup>2</sup> to m<sup>2</sup> by 1 km<sup>2</sup>/1,000,000 m<sup>2</sup>).

Substituting in the scenario numbers and we have: 3.1416(12m\*12m)(4050 rds) (16,188.9 people/ km<sup>2</sup>) (1 km<sup>2</sup>/1,000,000 m<sup>2</sup>) = 29,661 fatalities or just over one-tenth of one percent of Seoul Metropolitan's population.

However, if we make one assumption change, that most people are either at home or an office, in other words most people are NOT outside standing in the open, then the casualties, while still horrendous, change drastically to a projected 252,000 fatalities in an initial barrage. The major difference is the protection offered by being in a prone position, i.e. asleep and the protection offered by being in a covered position, a standard concrete apartment.

And even this is way more than would normally happen for three very important reasons: 1) DPRK would likely only open fire with no more than 2/3 of their artillery in order to keep some in reserve, not give away all their firing positions at once and in order to prepare for counter-counter battery. We can immediately reduce the numbers of systems firing by at least a third; 2) not all DPRK pieces are likely on a DMZ trace. Much of the terrain along a northern DMZ trace does not offer the right angle of fire and clearances needed. For example, the slopes may be too steep or face a direction which would leave them open to easy and direct strikes from the south. Also, a northern trace of the DMZ is generally within South Korean artillery range. Standard military doctrine would argue for DPRK using "stand off" or being out of range of ROK artillery, but still being able to use KPA artillery range to hit targets in the south. 3) MRLS can only fire 35 km which means they can only range the northern parts of Seoul and in particular Paju county, Yeoncheon, Dongducheon and Uijeongbu which have population densities ranging between 957.7 and 5,146 people /km<sup>2</sup>. However, there are also a fairly large number of foreign citizens living in Seoul. In 2010, there were 281,780 foreigners. Of those, 216,532 were Chinese or Korean-Chinese.<sup>55</sup> They are mainly concentrated in the Incheon and Goyang areas. There is another important factor here and that is these areas and the small cities in these areas are characterized by numerous mountains and hills meaning there will be significant artillery "shadows" which can only be struck by mortars and some howitzers since those are the only weapons with the trajectories to eliminate most of those "shadows". Howitzers and mortars can't range Seoul from a DMZ trace.

A blended average population around 3,000 people /km<sup>2</sup> is closer to representative of the northern areas. ROK forces and bases in the DMZ and north are relatively isolated from nearby populated areas meaning if KPA artillery hit civilian targets while aiming at a ROK base there would three likely reasons in what I think are descending order: 1) KPA is intentionally engaging in counter-value targeting; 2) KPA had faulty data on their aimpoints since 1953; or 3) they are extraordinarily incompetent due to lack of training or disintegrating infrastructure.<sup>56</sup>

In this case, a more realistic result would be represented by:  $\sum$ likely countervalue K+M+ M<sub>2</sub>  
K = (2/3)500 \* KOKSAN \* 4 rds/min \* 25% dud rate = 1,001 rounds  
M = (2/3)100 \* M1985 \* 12 rds/min \* 25% dud rate = 600 rounds

$$M_2 = (2/3)100 * M1991 * 22 \text{ rds/min} * 25\% \text{ dud rate} = 1,100 \text{ rounds}$$

Substituting back into the formula:  $\square$  (lethal blast radius in meters)<sup>2</sup> \* (# rds) \* (pop density /km<sup>2</sup>) \* (convert km<sup>2</sup> to m<sup>2</sup> by 1 km<sup>2</sup>/1,000,000 m<sup>2</sup>) provides a still horrible, but eminently survivable figure since we have accounted for the much less densely populated area within range of artillery, a likelihood that most people are either at home or in the office, that the majority of ROK bases are away from high population concentrations, only a certain percentage of KPA artillery will open fire immediately, the dud rate remains consistent with what was observed at Yeonpyong do, and that KPA uses a weapons stand off which is to their advantage.

$\square$  (12)<sup>2</sup> \* (2701rds) \* (3,000 people /km<sup>2</sup>) \* (1 km<sup>2</sup>/1,000,000 m<sup>2</sup>) = 2,811 fatalities. I think this is a bit overstated and really depends on the degree to which KPA actually targets the ROK armed forces versus how much it targets the civilian population.

As a backward historical example, let's look at Yeonpyeong-do. Approximately 1,700 civilians and 1,000 military on 7 square kilometers using 170 rounds of a 120 mm shell (which has a smaller lethal blast radius). Using our standard formula yields:  $\square$  (8)<sup>2</sup> \* (170rds) \* (2,700 people /7km<sup>2</sup>) \* (1 km<sup>2</sup>/1,000,000 m<sup>2</sup>) which yields an expected 13 fatalities. As tragic as it was that 4 people died on Yeonpyeong do, we would have expected more. Perhaps it was a function of the numerous bunkers and people immediately diving for cover(which dramatically and quickly reduced the population density), or perhaps there was diminished effectiveness of the explosive charges. It is impossible at this stage to definitively explain the discrepancy.

However, after the initial barrage all the systems will have to move into a sustained firing rate which is much lower. Also, assuming that DPRK is actually going to invade after actively shelling Seoul, they are going to have to start displacing their systems south. Some systems will have to stay in place, some in reserve as stated above and some leapfrogging south. This means only about half their systems are able to fire.

$$\begin{aligned} K_s &= (1/2)500 * KOKSAN * 24 \text{ rds/hr} * 25\% \text{ dud rate} = 4,500 \text{ rds/hr} * 24 \text{ hrs} \\ M_s &= (1/2)100 * M1985 * 48 \text{ rds/hr} * 25\% \text{ dud rate} = 1,800 \text{ rds/hr} * 24 \text{ hrs} \\ M_{2s} &= (1/2)100 * M1991 * 88 \text{ rds/hr} * 25\% \text{ dud rate} = 3,300 \text{ rds/hr} * 24 \text{ hrs} \end{aligned}$$

Sustained barrage =  $\sum_s K_s + M_s + M_{2s} = 24,064$  rds/hr for a 24 hour max rate of 230,400 + 5,076 or 233,101 rounds in a 24 hour period assuming DPRK has unlimited rounds, fires as rapidly as it can, moves south and suffers absolutely no losses, not even for maintenance, in short this is an artificial worst case.

$\square$  (12)<sup>2</sup> \* (233,101rds) \* (3,000 people /km<sup>2</sup>) \* (1 km<sup>2</sup>/1,000,000 m<sup>2</sup>) = 316,358 potential fatalities in a 24 hour period.

Again, let's apply a little bit of reality in two specific areas: 1) percentage of equipment DPRK will likely lose to destruction from the effects of direct, indirect and counter-battery fire based on past statistics, as well as various other reasons; and 2) how rapidly Seoul and other areas can change their population densities. It is extremely

understandable that most people will seek cover from fire in Seoul's shelters with space for 20 million.

A rough historical analog includes OPERATIONS DESERT STORM and DESERT SHIELD (ODS/S). I realize there are many flaws with this assumption, but it is the closest thing we have to the equipment match readily available. Present day KPA equipment is broadly based on former Soviet equipment.

During OPERATION DESERT SHIELD/STORM, coalition forces destroyed approximately 86% of Iraqi Main Battle Tanks (T-72s) over 83% of other armored vehicles and 83% of Iraq's 3,110 Artillery tubes. All that destruction took place over 42 days, but the statistics do not cover destruction per day. If the numbers were a consistent percentage every day, it would be right at 2% per day. However, it was almost certainly a great deal at the beginning and then a smaller amount later. In particular, most fighting was done in four days which leads to a daily loss rate of about 20%<sup>57</sup>. This is also more consistent with 50 years of studying the terrain with every sense available. No one can be surprised that almost every square meter of the Korean peninsula has been studied. The basic assumption is that while the pieces are in the north, they have decent protection from airpower. However, as the pieces move from their HARTS toward the south, they move out from under their Air Defense Artillery cap and become extremely vulnerable as ROK, U.S. and other Air Forces have air superiority from roughly the DMZ south. Counterfire battery has historically taken another immediate 2% or so per day. There is also the matter any military would face and that is trying to keep every mission critical piece functioning. The gun systems are at least 33 years old gun system and the associated transport system upon which the gun rides is 57 year old. Altogether a daily loss rate at the outset of 20-25% is likely. It is entirely possible for the numbers of Precision Guided Munitions to become the limiting factor. Understandably, there are no reliable numbers of Precision Guided Munitions publicly available.

DPRK (and all militaries) will suffer a personnel casualty rate of between 2 and 6% under fluid modern warfare conditions due to non battle injuries. Militaries have a lot of cold, hard steel equipment which is folds, spindles and mutilates any flesh and bone in the way of its normal functioning. And people still contract normal flu and other diseases in war.<sup>58</sup>

In a temperate climate, all armed forces suffer a normal amount of attrition due to heat or cold depending on the season. This will further decrement DPRK fighting strength by a small but consistent and persistent percentage depending on the time of year and ranging from a high of 0.3%/day in winter to 0.15% in early summer.<sup>59</sup> If DPRK is wearing chemical protective gear, despite training often in such gear, they will likely experience 2% or so heat casualties per day. That rate will only increase the longer they stay in chemical protective gear.

Very few DPRK weapons systems have modern night vision capability and even fewer personnel possess the equipment. The weapons systems which do have night vision usually have an older infrared (IR) system which require active illumination. Any active IR will be very quickly destroyed. Also, the older IR systems are blinded by many types of

smoke, while most ROK night vision equipment has much greater resolution and is generally less degraded by smoke.

Another factor is that it is extremely unlikely every person in Seoul will be outside in the open and remain that way for 24 hours. Major roads into and out of Seoul will almost immediately fall under military control, but there will be an inexorable flight of people and vehicles south. There will also be a large number of people moving into Seoul's 3,919 underground shelters designed to hold at least 20 million people<sup>60</sup>. It is very possible to reduce Seoul's exposed population density by about one half in a relatively short time. On any given business day 4 million people take the subway<sup>61</sup>. Many will be motivated to avoid the artillery so it is possible to double the number of people in subway stations to 8 million and within 12 hours to basically have everyone out of range or in a shelter, thus greatly reducing Seoul's surface population. It is also unlikely that as KPA guns move toward Seoul they would engage in randomly targeting the ancient capital of Korea and its associated priceless Korean artifacts, history and palaces. DPRK will likely not want to increase damage to its historical legacy and be forever known as the regime responsible for destroying a large part of Korea's historical artifacts.

Running the numbers one more time, but with reasonable decrements, we see a dramatic improvement in Seoulites' survivability. While still horrific, painful and extremely costly in terms of human lives, destroyed infrastructure, reduced and economic productivity such an attack is imminently survivable for Seoul, the Republic of Korea and almost certainly dooms any DPRK hope of achieving strategic or operational success since DPRK's bluff will have been called.

Here are the changes made to the calculations: First, we decrement the numbers of systems and rounds by 1% per hour to account for a 20-25% loss per day. After 3 hours over 1/2 of the surface population is in shelters which reduces the population density to ~ 1,000 people per square kilometer. A shell would need to land extremely close to and almost directly on a shelter in order to produce fatalities. Finally, after about 12 hours, even though the shells keep falling and the numbers of systems steadily decreases, virtually everyone has some sort of shelter thus reducing the surface population and the survivability of those who do come under fire. At that point, it is almost exclusively soldiers and those unfortunate civilians who happen to be at the wrong place at the wrong time who are susceptible to the effects of fire. This gives a daily fatality rate around 65,000 the first day. Assuming, the long range artillery continues decrementing, in a week the guns could claim up to 80,000 before themselves being decimated. It is well beyond the scope of this paper to attempt to quantify the amount of psychological casualty rates. However, it is within the scope to look at a chemical attack.

## APPENDIX C: Chemical Attack background

### Chemical Artillery Attack of Seoul

Again, this is a grisly and macabre, but instructive exercise since it is something being threatened we have to rationally calculate what might reasonably result from miscalculation and a spirit of “sobak ham” or spontaneity without any consideration for the costs. It is far more likely that DPRK would use chemicals on exclusively military targets and especially airfields or harbors in order to slow down air interdiction and prevent outside forces from coming to the Korean peninsula.

Unfortunately, there is a terrifying array of many kinds of chemicals and biological agents to permit look at all possible permutations. But to give a rough order of magnitude, we'll look at two representative cases, a non-persistent chemical strike using a nerve agent on Seoul in summer and one in winter. A look at two different seasons demonstrates the wide variances and because these are two broad windows when an attack would make more military sense. One is in summer; when the monsoon rains are hitting and cloud ceilings are relatively low which Close Air Support and Battlefield Air Interdiction more difficult. The other broad window is in mid-winter when some of the rivers freeze over and provide natural fords and facilitate movement from north to south. Even then, unless there is a particularly harsh freeze the larger rivers like the Han and Imjin will not support moving extremely heavy military equipment.<sup>62, 63</sup>

Summer weather is generally characterized by high humidity, meaning chemicals will generally last longer than in low humidity, but this tendency is also tempered by relatively warmer temperatures which hastens chemical degradation and increases the relative strength of chemicals. Surface winds will generally blow from north to south and especially in the Seoul area, they will blow from north to south through the Munsan corridor and through the Cheorwon valley from the DMZ toward Seoul. However, they will usually be around 3 knots. Speeds below 3 knots are considered stable conditions and create maximum casualties. The Incheon area should see a very slight westerly breeze in the morning shifting to a more brisk easterly breeze in the late afternoon. The atmosphere around Incheon (and other ports such as Busan) would likely have enough of a breeze in the late afternoon to dilute some effects of the chemicals.

Winds aloft during the summer are generally westerly (away from China and toward the Sea of Japan) and fairly strong. Militarily, it would affect nuclear fallout since that is the only kind of blast to make it into the upper atmosphere. Almost no chemicals will make it to that altitude.

Winter weather is marked by generally clear skies and excellent visibility. Surface winds are generally north. However, in the early mornings, especially in the valleys, there will be the famous “Morning Calm”. Chemicals will stick around and some of them will even freeze during this time. Upper winds are generally to the West Northwest.

Given these general conditions, we'll look at a specific instance of only 100 240mm 1991 variants firing all chemical rounds one time. One salvo would lob 2,200 shells into Seoul of GB Nerve agent, a non-persistent chemical in the evening when atmospheric

conditions are stable and most people are at home. Because the atmosphere is basically stable at this time, the cloud would spread and place people as far away as 50 km in danger. Each round would likely cause casualties at a rate of 10% per 0.1m<sup>2</sup> if they were to fall on a cold winter's night with a temperature of 10 degrees Fahrenheit. Assuming each round was evenly spaced and Seoul's population were evenly distributed across the entire metropolitan area this could yield a staggering 356,156 casualties<sup>64</sup>.

Now given the same 2,200 shells of non-persistent GB Nerve agent and increasing the temperature to 68 degrees, it is entirely possible to expect an almost unimaginable 1,175,314 casualties simply based on the effect of the temperature change<sup>65</sup>.

As devastating as the casualties are, if this is the only chemical attack, it will not result in a ROK military defeat by itself. If there are a series of chemical attacks, then some questions develop. Political considerations will likely become the primary determining factor before an attack reaches the point of putting the military decision at risk.

The bottom line is that if DPRK uses chemicals, there will be staggering casualties and such an international outcry and hue, DPRK as we know it will likely cease to exist. DPRK suddenly becomes painful, but mostly irrelevant as the only negotiations would likely be between the U.S and China on principles for a unified peninsula as well as basic rules for the genocide trial for surviving members of the DPRK regime.

## APPENDIX D: Calculating the Incalculable: A nuclear strike on Busan?

Even though it is extremely unlikely DPRK can explode a nuclear device under any condition other than completely controlled testing laboratory-like conditions, for the purposes of this gedankenexperiment, we'll look at DPRK exploding a nuclear device in Busan harbor. Why Busan harbor?

If DPRK were to explode a device in Busan harbor, they would achieve several operational and tactical goals, but at the cost of losing their strategic goal which is to unify the peninsula. The most immediate operational goal, and object of this gedankenexperiment, is to effectively shut down Busan harbor which would drastically slow receiving any foreign military help which might arrive to assist the ROK Armed Forces. This will be a Korean to Korean fight.

Destroying Busan harbor means both south and north will have to fight with what is presently on peninsula at the time which is the true objective of this horrible scenario. As shown earlier, even in this most drastic and unrealistic scenario, ROK armed forces can prevent KPA from militarily achieving their goal of unifying the peninsula under DPRK rule.

For the purposes of this paper, we will assume by whatever means, DPRK was able to surreptitiously insert a functional 10 kiloton (Kt) device into Busan harbor. We'll assume that Busan harbor pilot met the ship about 8 km away from the harbor as they usually do and piloted the ship through the passageway into the harbor where it detonates in the middle of the harbor.

Many websites offer potential casualty rates resulting from a nuclear explosion. They are accurate enough and provide a good thumbnail sketch of what happens when one thinks the unthinkable. This appendix provides a more detailed and specific methodology to arrive at those numbers. The full formulas for each calculation are from the 1977 version of *Effects of Nuclear Weapons*<sup>66</sup> and were performed on the Nuclear Bomb Effects Computer.

Nuclear weapons produce four distinct effects<sup>67</sup>:

- Blast and Shock e.g. shockwave and overpressure
- Thermal Radiation e.g. light and heat
- Initial Nuclear Radiation e.g. highly penetrating and damaging rays
- Residual Nuclear Radiation

We will use a depth of 10 meters of the North Harbor for the purposes of this scenario which means that the fireball would touch the ground and greatly increase the radioactivity of the fallout<sup>68</sup>. However, because of the presence of a great deal of water, we would expect an abbreviated time for radioactivity to remain in the atmosphere since the water vapor would fairly quickly re-condense and fall as rain droplets. We would expect a cloud radius of 5000 feet at a top height of about 20,000 feet. During the summer, the winds aloft will generally blow. However, the water in the harbor would help limit the radioactivity a bit. Assuming a weapon yield of 10 kilotons even though the October 2006 test was assessed around 2 kilotons and the May 2009 test was assessed somewhere between

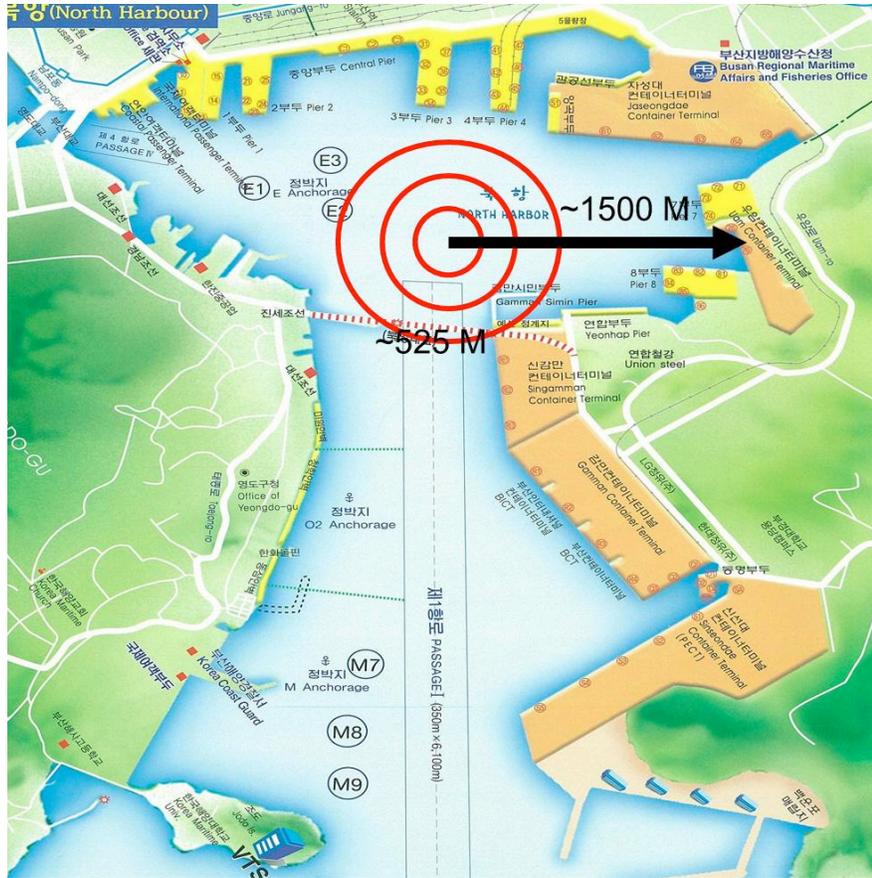
2 and 7 kilotons<sup>69</sup>For a 10 kiloton surface burst at sea level, theoretically one would expect the following parameters at approximately ~ 0.4 miles (~650 meters) from ground zero. 650 meters is about the distance from the center of the harbor to some of the berthing piers. The areas a few hundred meters beyond the piers, especially in the Jung-gu and Nam-gu districts are where the majority of apartments, housing and offices are located. It is extremely unlikely anyone within this radius will survive more than 2 days, even with medical intervention.

**Table D-1: Effects 650 meters from Ground Zero**

Max Overpressure	10 psi / 68.95 kpa (pounds per square inch / kilopascals)	Will destroy all buildings and cranes in the pier area. Will destroy ships berthed in the pier. Will severely damage most of the rail cars in the pier area. Will likely destroy the train tracks in the harbor area.
Max Dynamic Pressure	~2.2 psi / ~15.17 kpa	
Max Wind	~290 mph / ~467 kph	Will create a large number of secondary missiles
Fireball Radius	~0.14 miles / ~225 meters	Most things incinerated
Max translational velocity = 13 feet per second / 4.57 meters per second. A person weighing 165 lbs / 75 Kg mass experiences translational velocity, by being moved by the forces of the shockwave.	~0.55 miles / ~890 meters	Around 13 fps/4.57 mps is a rough threshold where most will suffer broken legs and some will concussions or skull fractures. Damage results when a person abruptly stops by hitting a nearby stationary object
Total Casualties in the area	~5,000 dockworkers/sailors in harbor and people at passenger terminal	The majority of the area inside this radius is harbor and lightly populated. However, it is unlikely anyone in the pier area will survive more than 2 days.

Figure D-1

525 M Circle from Ground Zero of Busan Port



**Table D-2: 3 km meters from Ground Zero**

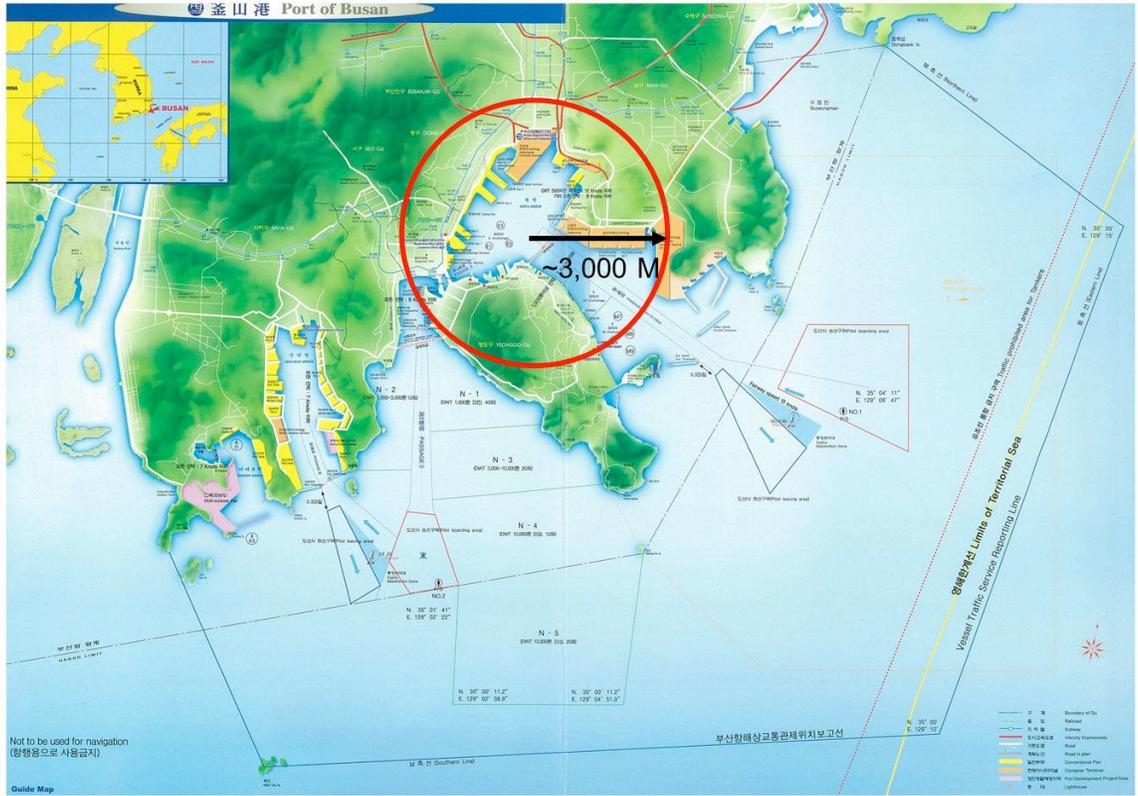
Max Overpressure	0.73 psi	Most glass blown out. Most concrete buildings suffer light damage, but remain functional. Most vehicle windows blown out
Max Dynamic Pressure	.014 psi	
Max Wind	27 mph	
Thermal radiation	6 cal/cm <sup>2</sup>	Most people will experience 1 <sup>st</sup> degree burns on exposed skin, some may receive 2 <sup>nd</sup> degree burns. All will experience a “hot flash”. Some newspaper and paper products will combust.
Initial Nuclear Ionizing radiation Exposure	Less than 1 rad	Most people will experience no ill effects from radiation.
Total Casualties in a 3 km circle are “relatively” low: 1) Ground burst (not scaled height of burst) 2) Large open area around Ground Zero 3) Better attenuation from concrete apartments, and other buildings.	~50,000 total ~ 5,000 within two days ~35,000 within six weeks	The majority of people within 0.9miles/ ~1045 meters will suffer an initial radiation dose so high, even with medical care about 90% of the population will die within 6 weeks. Those just another 0.1miles /~160 meters further will likely suffer few radiation-related injuries if they keep themselves from being exposed to more radiation.

Given population densities of Seo-gu is 9,155 people /km<sup>270</sup> Dong-gu at 11,247 people /km<sup>271</sup> Yeoungdo-gu at 10,539 people /km<sup>272</sup> Nam-gu with 11,582 people /km<sup>273</sup> and Jung gu at 17,922 people /km<sup>274</sup> and a total area of 66.78 square kilometers we have a blended average of 10,943 people /km<sup>2</sup>. Simply by virtue of a surface burst and not a scaled height of burst, it immediately limits some of the maximum damage which could occur. And also since ground zero is in the harbor, the first truly built up civilian population centers are insulated by between 500 and 1500 meters of water, ships, light infrastructure and open ground. Since max psi drops rapidly over distance, this one factor will “save” a several tens of thousands of lives that would otherwise be lost if the nuclear device were detonated at scaled height of burst in the maximum populated areas – i.e in a pure countervalue fashion.

Destroying the pier effectively limits outside ground forces from intervening – the point of the analysis.

Figure D-2

3 Km Circle from Ground Zero of Busan Port



**APPENDIX E:  
A Tale of the Tape<sup>75</sup>: Analysis of the fuels required**

If we do a cursory analysis of KPA equipment, distances that equipment must travel and how much fuel they'll likely require, it becomes rapidly apparent the KPA will likely run out of fuel in a relatively short time. They will have extended supply lines which are easily interdicted by conventional means. They will also likely run into a problem based on the sheer volume of fuel they'll consume although this is much tougher to confirm since it is unknown how much fuel KPA has stored and where. On the other hand, they'll likely have fewer platforms to support as soon as they move from their HARTS and away from protective cover.

Assuming a straight line distance from just north of the DMZ, KPA must cover about 415 km, however they cannot travel across mountains, they will have to stick to certain mobility corridors since the majority of mountain ranges in Korea run generally North-South with very few East-West corridors. And all of them are relatively narrow. KPA forces travelling from just north of Seoul will have to cover about 500 km to make it to Busan. A rough order of magnitude of KPA military usage is 50 petajoules/year which is about 35 million gallons of diesel a year<sup>76</sup>. However, if we dive one more data layer deeper, we find that over half of the usage is in coal, biomass and electricity. One can't throw a hunk of coal into a T54 engine and expect it to function the same. So KPA realistically consumes 25 petajoules or roughly 17.5 million gallons of refined petroleum products a year in its "wartime readiness" peace state.

Summing up a rough estimate of the amount of fuel required to move DPRK's equipment listed in the Military Balance 500 kilometers, would conservatively take 12 million gallons of refined petroleum products – assuming little to no resistance, that is they merely hop on the highway and drive down the highway to Busan. 12 million gallons equals about 8 months of normal usage levels. During Operation DESERT STORM, the U.S. military consumed almost 18 million gallons a DAY. DPRK would have to move more people and things south than the U.S. had to move into Iraq at that time. The major difference is that DPRK will likely not fly anywhere near as much as the U.S. had to fly. Also, it is likely a major assumptive error DPRK will only require 12 million gallons of petroleum. Even when vehicles idle, they burn a great deal of fuel. DPRK vehicles are generally a little more efficient in idle since they have less electronic equipment and therefore less generator power required. However, DPRK forces would likely need to fill up every other day during actively engaged combat operations. But we'll assume they only fill up once en route to Busan.

**Table E-1: U.S. Petroleum Products Consumed, Jan 17 – Feb 28 1991**

Service <sup>77</sup>	Millions of Gallons Used (Jan 17 – Feb28)
Army	105
Air Force	452
- Air Refueling <sup>78</sup>	110 (already counted inside 452)
Marines	44
Military Sealift Command	6
Navy	165
TOTAL	772 (or almost 18 million gallons per day)

In order to logistically supply Operation DESERT SHIELD/STORM with fuel, the Department of Defense had access to approximately 1.68 million gallons of various fuels.<sup>79</sup> Therein lies a second issue: not all fuels are equal and not all fuels can be used for the same thing. Given DPRK current equipment inventory, they likely require at least five broad fuel types: ship diesel, vehicle diesel, various kerosene blends for aircraft, gasoline and heating oils<sup>80</sup>. But given that DPRK likely only has had refining capacity of 4.5 million gallons PER YEAR since at least 1990, it is unlikely DPRK has continuously re-adjusted the amount of product which comes out of that refinery<sup>81</sup>. Oil products are always negative sum. A gallon of oil can only be refined into a fraction of a gallon of diesel and a fraction of a gallon of jet fuel. And the sum of the products is always less than the one gallon which went into the refining process.

If DPRK had any petroleum product shortfalls, it is extremely unlikely they would be able to buy the difference on world spot market and have it delivered in time. They will have to rely on pre-existing reserves and deliver it along a relatively exposed resupply route. Even if DPRK were able to get oil, some assess that DPRK only has one working refinery with a capacity of 4.5 million gallons PER YEAR. South Korea had 2.6 million gallon/day refinery capacity PER DAY in 2009<sup>82</sup>. In other words, ROK can refine more fuel in 3 days than DPRK can refine in a year. In 2011, China was projected to have strategic reserves of 281 million barrels or 11,802,000,000 gallons of oil.<sup>83</sup> If China wanted to provide fuel to DPRK, there are enough stocks. Whether the will exists is solely a Chinese determination.

In order for any military to move that fuel from where it is, be it a hollowed out mountain or a gas station, the military has to load it onto something and transport the fuel. In the case of the U.S. military during DESERT SHIELD, it was an entire infrastructure of more than 450 vehicles, 490 temporary storage drums and tanks and set up some 24 “filling stations”<sup>84</sup>.

From a military standpoint, there seems little to argue that KPA has a feasible logistical plan to support a militarily viable plan to make it all the way south. Most KPA equipment has a range of about 200-300 km which means they might move as far south as Taegu without needing refueling. However, even when the systems are idling, they are still burning quite a bit of fuel. Left idling, most of the systems will run out of fuel in about 30 hours. That means DPRK will have to provide some 13.5 million liters (3.5 million gallons) every day and a half to simply keep from running out of gas. Assuming KPA uses a 9,000 liter (2,378 gallons) refueling vehicles that means approximately 1,470 - or more – thin skinned (i.e. not armored) trucks moving along very defined and exposed corridors. While exact numbers are extremely difficult to find, according to one source, DPRK has approximately 8,000 logistic vehicles of all kinds<sup>85</sup>. Add to this burden, the requirement for most of the forces to resupply with ammunition almost every day and that adds another approximately 1,500 vehicles on the road. Having 3,000 vehicles on ROK highways is a relatively insubstantial number – if there is no other traffic on the road. ROK has experience via peacetime experience at home as well as direct observation how to control traffic in war and conditions other than war. DPRK roads are famously light of traffic so they will have difficulty managing the flow of traffic. This usually results in even more vehicles on the road in order to try to achieve the same delivery results. The farther south, the more tenuous and the more exposed the KPA logistics line.

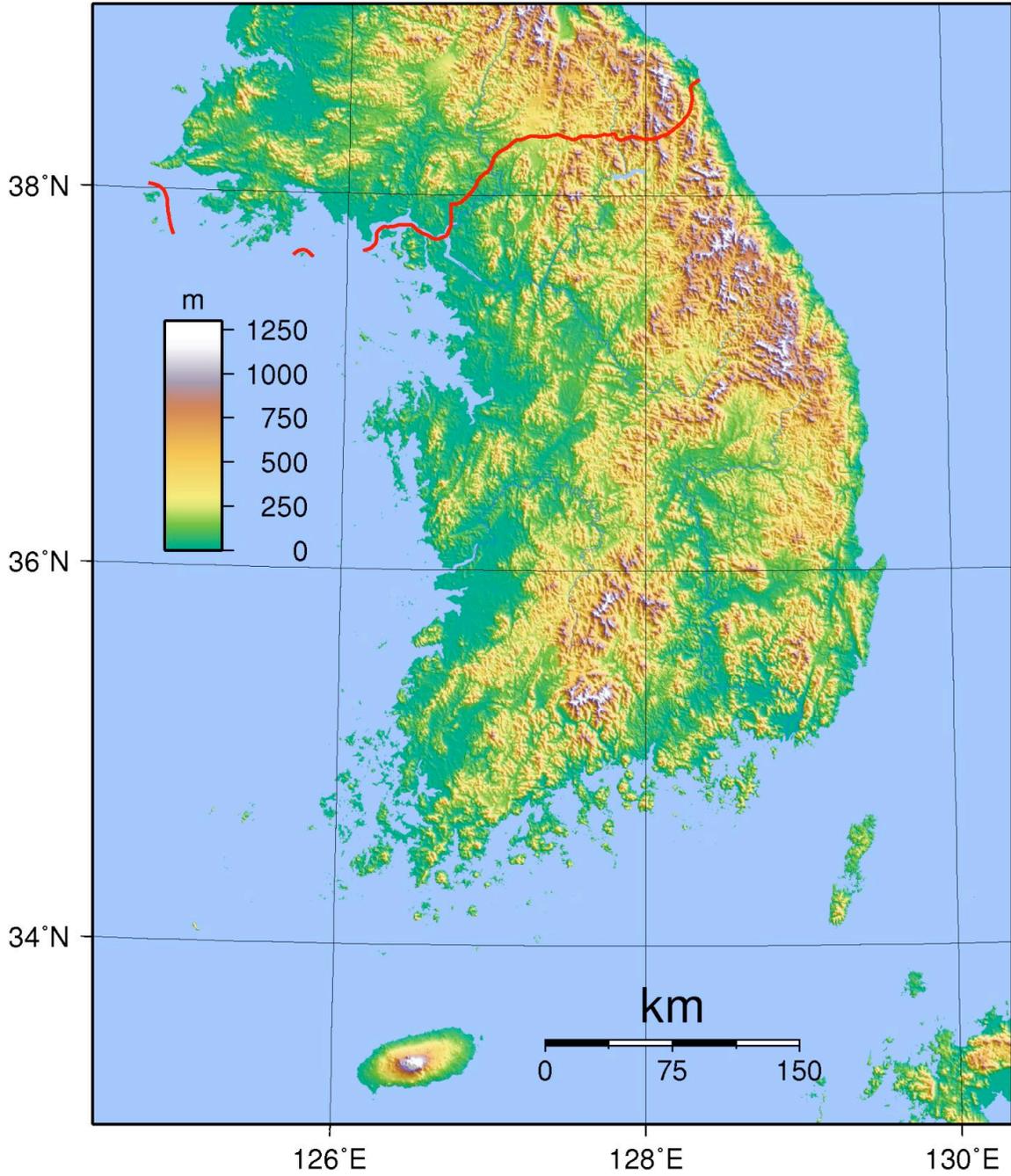
Some say that KPA might target ROK refineries and oil stores in order to start huge fires. Sun Tzu observes "...one bushel of the enemy's provision is equivalent to twenty of one's own...". A military that will almost certainly have to rely upon its existing stores and whatever strategic reservoirs may exist and whatever strategic reserves they might get from a third party should consider scavenging whatever they can find and be very selective about destroying others stores since they might be able to use them later.

Map 1: Asia





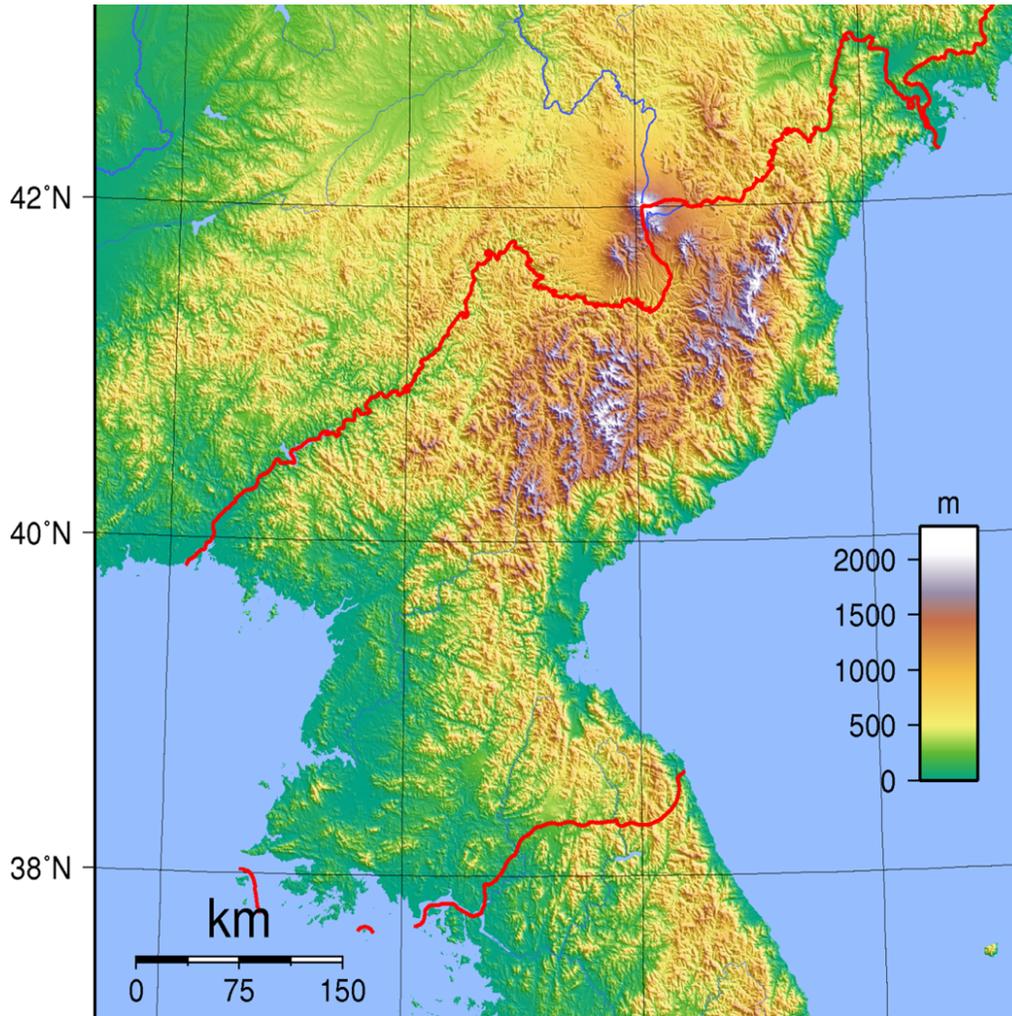
Map 3: South Korea Topography



Map 4: DPRK



Map 5: DPRK Topography



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- <sup>2</sup> Lewis, Jeffrey and Elbridge Colby, “How to Worry Kim Jong Il”, The Diplomat (September 23, 2011) <http://the-diplomat.com/2011/09/23/how-to-worry-kim-jong-il/2/>(searched date: 20 October 2011)
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- <sup>5</sup> PRC Ministry of Foreign Affairs Website, Nuclear Weapon Free Zones, <http://www.fmprc.gov.cn/eng/wjb/zjzg/jks/kjlc/hwt/t410744.htm> (searched date: 14 October 2011)
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- <sup>11</sup> U.S.-China Business Council, <https://www.uschina.org/statistics/tradetable.html> (searched date: 14 October 2011)
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- <sup>14</sup> McEachern, “Inside the Red Box” (2009), pg 119
- <sup>15</sup> McEachern, “Inside the Red Box” (2009), pg 120-121
- <sup>16</sup> McEachern, “Inside the Red Box” (2009), pg 121
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<sup>46</sup> Bennet, Bruce, “The Prospects for Conventional Conflict on the Korean Peninsula”, *Korean Journal of Defense Analyses*, (Summer 1995, updated March 30, 2009), Table 5, pg 23 NOTE: differing assumptions of numbers of rounds and population densities. However, the methodologies are similar.

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<sup>51</sup> All information about 240mm and KOKSAN come from [www.globalsecurity.org](http://www.globalsecurity.org) (searched date: 14 October 2011)

<sup>52</sup> A Hardened Artillery Site (HARTS) provides cover and concealment of personnel and equipment by basically being dug into a cave. Such sites usually have water, food, ammunition, communications equipment like a camp or small fort. However, these are exceptionally well hidden and protected by a mountain. However, in order to attack, a force must leave its HARTS. That is when a force is most vulnerable.

<sup>53</sup> Bermudez, Joseph, “Special Report 11-1” (January 2011) *38 North* “<http://38north.org/2011/01/the-yeonpyeong-island-incident/> , pg 10 (searched date: 14 October 2011)

<sup>54</sup> OP CIT, pg 6-7 for an excellent timeline on the specific details.

<sup>55</sup> Korea Times Online “Korean Chinese account for 70% of Foreigners in Seoul” *Korea Times* (September 11, 2011) at: [http://koreatimes.co.kr/www/news/nation/2011/09/117\\_94610.html](http://koreatimes.co.kr/www/news/nation/2011/09/117_94610.html) (searched date: 14 October 2011)

<sup>56</sup> Paju – si City Government website,

[http://en.paju.go.kr/en/en\\_paju/en\\_info/en\\_paju\\_general/en\\_paju\\_general.cms](http://en.paju.go.kr/en/en_paju/en_info/en_paju_general/en_paju_general.cms) (searched date: 14 October 2011)

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<sup>58</sup> OP CIT table B

<sup>59</sup> OP CIT, pg 92

<sup>60</sup> Bae Ji-sook, “Seoul Not Safe from Artillery Attack,” *Korea Times*, (November 26, 2010) at:

[http://www.koreatimes.co.kr/www/news/nation/2010/11/177\\_77036.html](http://www.koreatimes.co.kr/www/news/nation/2010/11/177_77036.html) (searched date: 14 October 2011)

<sup>61</sup> Seoul Metro website <http://www.seoulmetro.co.kr/eng/page.jsp?code=A02000400000> (searched date: 14 October 2011)

<sup>62</sup> All weather characterizations are from Walters, Kenneth R and Traxler, Maj Kathleen M, in *North Korea – A Climatological Study*, August 1994, USAF Environmental Technical Applications Center, 859 Buchanan Street, Scott AFB, IL pg 4-1 to 4-4 and 6-1 to 6-4

<sup>63</sup> All chemical characterizations and effects come from Field Manual 3-6/Air Force Manual 105-7 / Fleet Marine Force Manual 7-11H, Headquarters, Departments of the Army , Air Force and United States Marine Corps 3 November 1986, pg 1-10 and 3-2

<sup>64</sup> Casualty rates and temperature correlations from Field Manual 3-7 Headquarters, Department of the Army Washington, D.C. 29 September 1994, pg1-7

<sup>65</sup> OP CIT, pg 1-7

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<sup>67</sup> Glasstone, Samuel and Dolan, Philip J editors. “The Effects of Nuclear Weapons” Third Edition. 1977 pg 3 Figure 1-02 and pgs 1 to 2.

<sup>68</sup> Ports.com website, <http://ports.com/south-korea/port-of-busan-pusan/> (searched date: 14 October 2011)

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- <sup>75</sup> In American English, “Tale of the Tape” is a common way to measure boxers. The boxer with the longer reach and greater height usually has an advantage. Therefore the title is an analogue. We will consider the objective measure of the tape, that is, the objective statistics of past match ups.
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