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THE STRATEGIC PERFORMANCE OF

DEFENSIVE BARRIERS

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This monograph was prepared by the US Army Engineer Studies Center for the Combined Forces Command of the Republic of Korea and the United States. It reviews the strategic performance of barrier and fortification systems built by a variety of countries in the 19th and 20th centuries for lessons applicable to the design of a future Korea Barrier System. Those systems built in peacetime for the purposes of deterring invasion or stopping an initial attack during the beginning of a war were found to be most comparable to the nature of the Korea Barrier System. The barrier/fortifications systems reviewed include those of France (the Sere de Rivieres and the Maginot Lines), Germany (the Siegfried Line), the Low Countries (Eben Emael in Belgium, the water barriers in the Netherlands), Great Britain (Gibraltar and Singapore), Finland (the Mannerheim Line), and Israel (the Bar-Lev Line). (L-2)

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CONTENTS

EXECUTIVE SUMMARY

This monograph was prepared by the US Army Engineer Studies Center for the Combined Forces Command (CFC) of the Republic of Korea and the United States (ROK/US). It reviews the strategic performance of barrier and fortification systems built by a variety of countries in the 19th and 20th centuries for lessons applicable to the design of a future Korea Barrier System.

In considering which historical barrier/fortifications systems are most relevant to the Korea Barrier System, the most important criteria are those concerning the purpose and timing of the barrier systems. Those systems built in peacetime for the purposes of deterring invasion or stopping an initial attack during the beginning of a war were found to be most comparable to the nature of the Korea Barrier System. For comparative analysis, these criteria were found to be more relevant than using conditions of similar terrain, required length of protective construction, or balance of opposing forces. The barrier/fortifications systems reviewed include those of France (the Sere de Rivieres and the Maginot Lines), Germany (the Siegfried Line), the Low Countries, (Eben Emael in Belgium, the water barriers in The Netherlands), Great Britain (Gibraltar and Singapore), Finland (the Mannerheim Line), and Israel (the Bar-Lev Line).

The existence of these barrier/fortifications systems did have strategic impacts in all cases, and in most cases provided major tactical benefits to the defenders. However, if deterrence was the fundamental strategic purpose for those barriers, as the various national leaders at the time maintained, then the only systems which were strategically successful were those of the Siegfried Line and of Gibraltar, neither of which was attacked.

The conclusions reached in the analysis for this monograph are:

* Peacetime Barriers Deter Attacks But Do Not Defeat Them.

  Once a peacetime barrier has been attacked, it has probably already failed strategically.

* Peacetime Barriers Quickly Decay and Become Obsolete.

  More than most other military systems, peacetime barriers are unlikely to be in proper condition and up-to-date on the outbreak of war.

* Peacetime Barriers Are Poorly Understood.

  Political and military decision makers at the strategic level understand the capabilities of peacetime barriers less than they do most other components of military strength.

The following recommendations are made:

* Enhance Deterrent Value.

  The Korea Barrier System should be effective tactically, and, for the sake of strategic deterrence, it should appear to north Korea to be even more formidable than it is.

* Provide for and Require Continual Feedback.

  The historical barrier/fortifications systems examined in this paper show it is all too easy to let a barrier system deteriorate over time. The Korea Barrier System should be designed for the maximum practical degree of continual feedback on its true combat status.

* Design for Maximum Flexibility and Responsiveness.

  It is important to design the Korea Barrier System so that it can be modified over time to adapt to changing conditions. Fixed investments in unchangeable obstacle components should be held at a practical minimum.

* Ensure Adequate Understanding of the Capabilities of the Barrier System.

  While it is desirable to make north Korean planners overestimate the effectiveness of the barrier system, it is equally important that CFC have a realistic understanding of the barrier system's capabilities and limitations. The Korea Barrier System should be understood better by CFC and other ROK/US decision makers than it is by their north Korean opponents.

LIST OF ABBREVIATIONS AND ACRONYMS

CFC.....Combined Forces Command

DMZ.....demilitarized zone

ESC.....US Army Engineer Studies Center

IDF.....Israel Defense Force

nK.....north Korea

ROK/US.....Republic of Korea and the United States

THE STRATEGIC PERFORMANCE OF BARRIER DEFENSES

I. INTRODUCTION

1. Purpose. This monograph highlights lessons which may be drawn from the effectiveness of selected military barrier systems. Such lessons should be useful to the design of future barrier systems in Korea, as well as to an appreciation of the probable value of the current barrier system.

2. Background. This report is the first of several planned monographs being prepared as part of the US Army Engineer Studies Center's (ESC's) Korea Barrier System Alternatives Study. This study was requested by the Combined Forces Command (CFC) on 17 June 1987.

3. Scope. This report examines several barrier systems around the world. Although references are made to other barriers, it emphasizes those involved in conflicts between first-class military powers (or equipped with first class weaponry) which have been built (in peacetime) and tested (in combat) during the 19th and 20th centuries. It also emphasizes barriers and fortifications constructed in peacetime for the purposes of war deterrence, and of effectively stopping attacks and invasions that initiate hostilities. It uses secondary resources dealing with the purposes, construction, and effectiveness of these barriers. This report does not attempt to assess the tactical performance of these barriers, except in passing. The significant tactical benefits provided by even simple defensive works have been well documented in a variety of studies.

4. Assumptions. This analysis assumes that experiences of earlier wars and other locales can be beneficial in assessing current barrier system alternatives for Korea.

5. Study Approach. This study reviewed prominent examples of military barrier systems, selected those most suitable for this analysis, examined secondary sources dealing with those barriers, and analyzed the available information for potentially applicable lessons to contemporary Korea.

II. FINDINGS

6. The Selection of Relevant Barriers. There are many examples of well-known barriers, defensive lines, and fortresses being constructed for and tested in the world's numerous 19th- and 20th-century conflicts. These include such famous names from the European portion of World War II as the Maginot Line (French) and the Siegfried Line (German). They also include lesser known barriers like that designed by the Sere de Rivieres (French), the Gothic and Gustav Lines and the Atlantic Wall (German), and the Bar-Lev Line (Israeli). Finally, certain "fortresses" such as Verdun, Eben Emael, Gibraltar, and Singapore also provide lessons useful for the planners of defensive positions.

a. Clearly, the nature and effectiveness of a defensive system is influenced by conditions of terrain, climate, and the balance of opposing forces. The most important factor in determining a barrier system's performance, however, is the relationship between the length of time an attacker has had to prepare to breach or circumvent it, and the length of time since the defender has critically reviewed the adequacy of his barrier system for any needed redesign or updating. This latter factor also has a direct bearing on the defender's degree of complacency and understanding concerning his barrier system.

b. Emphasis in this study will, however, focus on an examination of those barriers and defensive systems which, like the Korea Barrier System, were designed and built during a period of peace, and which were not tested in hostilities until several years or decades later. The examples chosen for discussion here include: from France, the Sere de Rivieres Line (1870-1914), with special discussion of Verdun (1916) and of the Maginot Line (1929-1940); from Germany, the Siegfried Line (1936-1944); from Great Britain, the "fortresses" of Gibraltar (1704-1943) and Singapore (1921-1942); from the Low Countries (Belgium and the Netherlands), their fortress defenses and their water barrier system, respectively (as tested in 1940); from Israel, the Bar-Lev Line (1968-1973); and from Finland, the Mannerheim Line (1922-1940).

7. French Barrier Experiences. From the time of Vauban (1633-1707) until the Second World War (1939-1945), France has had the reputation of producing the best fortifications and the best defensive systems in Europe.

During this period, the long shared border between France and Germany had been crossed by hostile armies many times as the two nations contested for the continental mastery of Western Europe. In most cases, these fortifications and barriers have not proven themselves equal to the hopes of their builders or of their owners during periods of actual combat. Despite this, as in the case of other fortifications to be discussed throughout this report, the existence of such barriers has often served as an unquantifiable deterrent against the initiation of hostilities, and as a strategic factor which altered the attacker's plans.

a. The Franco-Prussian War of 1870-71 was an unmitigated defeat for France and the French Army. One striking feature of this short war was the failed French defense of the major fortress of Metz, located near the Franco-Prussian border. The rapid German capture of this forward position with its large, but isolated, defending force impressed itself deeply on the French military. One result of this French defeat was the plan for, and construction of, a defensive barrier to protect France against its more powerful German neighbor. This barrier was named after its primary designer, Sere de Rivieres, an engineer general. The official objectives of this barrier, as stated by General de Rivieres in 1874, could well serve with minor modifications as the ideal statement of objectives for most such barriers.

> "[it is] to create a barrier stretching from Calais to Nice, and behind it a general defensive scheme in depth as far as Paris... for the purpose of providing a cover during the mobilization, concentration and formation of troops in battle order, of controlling the invasion routes and of providing strong defensive points behind the barrier which would increase the strategic possibilities of the area without impairing freedom of operations."[1]

b. As noted earlier, the French had long been masters of fortifications. The difference between earlier French defenses and that designed by Sere de Rivieres was the difference between isolated fortresses and a continuous barrier composed of mutually supporting strongpoints. This system of Sere de Rivieres was designed as two continuous lines of sunken forts, with

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[1]Rowe, Vivian. *The Great Wall of France: The Triumph of the Maginot Line*, G.P. Putnam's Sons, New York, 1959, p. 21.

the lines separated by a preplanned 40-mile gap. Other portions of the French borders which were not fortified included those facing neutral nations like Switzerland and Belgium, plus those areas with terrain considered impassable, such as the Argonne and Ardennes regions. The 40-mile gap between Epinal and Toul was designed to entice and channel any German attack into a desired corridor where it could be destroyed by the waiting French forces. It is unclear how well this planned breach in the French barrier would have performed, since Germany never obliged by attacking according to the French plan. In any event, in 1914, the Germans avoided these defenses entirely by attacking across neutral Belgium and invading France through an unfortified region.

c. Strategically, then, this barrier had the effect of influencing the Germans to first invade Belgium in the process of attacking France. The execution of the German "Schlieffen Plan" almost achieved a rapid and decisive defeat of France. Most observers believe it would have succeeded if it had, in fact, been executed according to the original plan. Since it did not work, however, the related strategic effect of the barrier system and the diversion of the German attack through Belgium was to bring Great Britain into the war against Germany. This created a balance of forces which led to prolonged stalemate and eventual German defeat.

d. Tactically, the sunken and mutually supporting fortifications performed very well when they were seriously defended and had been maintained properly. Verdun, for example, the strongest of the individual fortress complexes, withstood the German attack in 1914 and provided a strongpoint on which the defending French forces could rely firmly. The subsequent French defense of Verdun in 1916 was to prove one of the costliest episodes of the entire First World War for both the French and the Germans. This defense, successful only in a Pyrrhic sense, was made possible only because of the strength of the defensive positions. However, it was also severely jeopardized because of the neglect of those positions.

e. Long before the outbreak of World War I in 1914, the French had already begun to ignore defensive strategy. Thus, the magnificent system designed by Sere de Rivieres in response to the experience of 1870 was allowed to deteriorate. Prior to 1900, the French Army had become enamored with the need for an all-out offensive spirit. Thus, it was natural for France to neglect its defenses and favor investments in offensive forces. Along the

Western Front, World War I, of course, was to show overwhelmingly the dominance of the defense over the offense, and the errors in a total reliance on offensive strategy and tactics. Even after the war was well underway, however, and confirming daily the effectiveness of defensive weapons and defensive positions, the French military leadership demonstrated little capability to modify their offensive-oriented views. In battle after battle, this repeatedly caused unnecessarily high casualty rates for the French troops. More particularly for the purposes of this analysis, this offensive overemphasis was also manifested in the mindless weakening of the defenses at Verdun, the pride of the Sere de Rivieres Line.

f. Verdun had been carefully designed to take advantage of its neighboring good defensive terrain with a series of some 60 greater and lesser mutually self-supporting strongpoints. Before the German attack on it in 1916, it was in theory and to all outside appearances, one of the world's strongest fortresses. In practice, however, it was one of the weakest, due to the actions of the French Army's leadership. These leaders, who still believed in the power of the offensive and thoroughly failed to understand the value and utility of strong defensive positions, wanted to strengthen the forces committed to an upcoming French offensive. They therefore decided to relieve an artillery shortage by removing large amounts of weaponry from Verdun and its associated complex of strongpoints. In so doing, they essentially stripped Verdun's forts, particularly the flanking blockhouses, of their critical artillery defenses.

g. By October 1915, about 43 heavy and 11 field-gun batteries, and more than 100,000 rounds of ammunition had been removed from these sites. Inevitably, the defenders of Verdun and the French Army as a whole were to pay dearly for this deliberate weakening of their defenses when the German attack on the Verdun complex came in 1916. The residual strength of the Verdun positions, and an all-out French effort to reinforce and hold Verdun, did enable France to repel the German attack. They did so, however, only at such a cost in human lives that the French Army was ruined as an offensive force, not only through the rest of World War I but also into the Second World War.

h. The losses sustained by France at Verdun and elsewhere along the Western Front in World War I critically influenced French thinking and French reserves of demographic and psychological strength. In response, France

reacted totally against its previous offensive philosophy and adopted a wholly passive and defense-only orientation. One tangible result of this response was that most famous 20th-century symbol of false reliance on fixed defenses, the Maginot Line.

i. The first French Army staff work on a design for what became the Maginot Line began in 1919, with World War I scarcely over. The designs were in an advanced stage by 1926, but the first funds for construction were not available until 1928. By 1930, construction and the propaganda campaign accompanying the Line were in full swing.

j. Well thought-out and strongly constructed, it was in many ways like the defensive system designed by Sere de Rivieres. Like its predecessor, it was a limited defensive system extending only along certain portions of the French border, even though this was directly contrary to the beliefs of the general public in France and other allied countries. Like its predecessor, it too was destined to be outflanked. Also like its 19th century predecessor, the strongpoints of the Maginot Line were often sunken fortresses with mutually self-supporting fire. In addition to the underground strongpoints, its integrated design included minefields, barricades, and prepared fields of fire. It did differ significantly from the line of Sere de Rivieres in its design location, since its position was determined more by political than military considerations. It was a forward defense line sited to defend the very border of France and its adjacent industrial resources from a frontal German assault.

k. The problems in designing and constructing a defensive line in peacetime for use at some uncertain date in the future afflicted the Maginot Line just as that of Sere de Rivieres, which had suffered neglect and abuse in the years subsequent to its initial construction. The Maginot Line, which was started in 1928 according to a plan initiated in 1919, was not actually tested until 1940, when several technical transformations in the art of war had greatly altered its value. During the period 1935 to 1939, when the ever more threatening actions of Germany came at an increasing tempo, a series of alerts for France and the defenders of the Maginot Line did provide it with some trial periods which revealed some of the weaknesses of the initial construction. Many of these defects in lighting, heating, etc., were rectified by the time actual war broke out in 1939. Other defects in environmental conditions remained until the time of the French surrender.

l. More significantly, the little-used or tested offensive systems within the Maginot Line fortresses, their artillery, exhibited some major problems when the time came for their actual use in combat. At the beginning of the "Phony War," in September 1939, only one of the 75-mm French guns situated in one of the Maginot Line's forward positions at Hochwald-Est could reach German territory with its fire. This gun jammed and became unusable after firing only a few rounds. Investigation revealed that the old, stored ammunition was defective. Similarly, during the winter of 1939 to 1940, two-thirds of the rounds fired from the larger 135-mm guns had defective fuses. As a result, when they hit the frozen ground, they failed to explode, and instead would simply skid for hundreds of yards until their forward momentum was expended.

m. Despite these problems, the fortresses of the Maginot Line performed quite well in a tactical sense during the 1940 campaign in France. They were intended to withstand a German attack for up to 3 weeks to permit time for French mobilization. By the time the rest of the French forces had collapsed and a surrender negotiated, more than 7 weeks had passed, and none of the major Maginot forts had been captured by the Germans. The defenders within those fortresses surrendered only under the strongest of orders from their new governmental and military leadership, as the Maginot Line positions they occupied were virtually unscathed and their morale high. Their survival was partly due to the inherent strength of the well-designed positions, and partly due to the nature of the German attack, which was pointed especially at rendering this great defensive work nearly irrelevant to the course of the war.

8. <u>German Barrier Experiences</u>. The opposite side of the Franco-German border was occupied by the dominant European military power of the mid-19th through the mid-20th centuries. As a dominant power, Germany had less need of peacetime barriers than France, and gave much less attention to them. The Germans did, however, perform an excellent job of building effective tactical defenses during wartime, just as they mastered many other aspects of modern warfare. The first-class defensive system along the Somme in World War I, for example, helped the Germans to totally repel the massive Allied attack on that front in 1916, with enormous losses to the attackers. Indeed, the German defenses built up along the Western Front during the course of the war fully

served their tactical purposes, as they helped prevent the Allied forces from entering German territory. On the Western Front, the entire war was fought on French and Belgian territory. During World War II, the German Army possessed a well-developed, integrated strategic philosophy of barrier construction and use.

a. Despite its frequent tactical success with defensive systems in both World Wars, however, Germany only created one peacetime barrier in the last century selected for the current analysis. This was the Siegfried Line or West Wall, constructed along the German border with France during the late 1930's. Work officially began on it in 1936, but the effort only reached serious proportions in 1938, when it absorbed one-third of Germany's total cement production for a time. It paralleled the Maginot Line, but was constructed of about 3,000 supporting pillboxes spaced about 10 per mile, instead of the Maginot Line's much smaller number of "superfortress" complexes. It was never intended to block an invasion but merely to delay it while a mobile German reserve force launched counterattacks. Partly because of this fact, historical accounts are full of the reminiscences of German generals who were convinced the French could easily have penetrated the Siegfried Line even as late as September 1939, thus severely threatening Germany at the time when German forces were attacking Poland to the east.

b. The Siegfried Line's critical strength, in fact, existed mostly in the minds of the French. It was one of many bluffs which Hitler successfully executed against both his domestic and his foreign opponents. It achieved its mission of protecting Germany's western borders against attack, not only in September of 1939, but also during earlier periods of tension preceding the outbreak of war. It did so by never being tested. Its successful deterrence of an attack was, of course, partly due to the lack of any offensive intentions on the part of the passive French.

c. Later, in 1944, the Siegfried Line was actually tested and successfully breached by the Allied armies who then pressed on into Germany. Although it did provide significant assistance to the weakened German defenders of 1944, like the Bar-Lev Line (see below), it is another example of how barriers are often neglected, poorly maintained, and obsolescent even after only a few years. Like the British soldiers pulling back down the Malayan Peninsula in 1942, the German soldiers retreating toward the Siegfried

Line in 1944 were dismayed with the conditions of the defensive system, which came nowhere near the level of their expectations. In 1944, these German soldiers discovered a barrier with poorly functioning telephone and electric systems (the result of neglect), and more interestingly, one with its enclosures already too small to mount the new larger weapons which had displaced those current in the 1930's (the result of obsolescence).

9. British Barrier Experiences. The primary British barrier system, which has now functioned successfully for more than 900 years against land attack, is the English Channel, supplemented by an effective navy. As an insular power, with most of its continental interests represented in its overseas territories, Great Britain in the 19th and 20th centuries has had relatively little occasion to construct peacetime barriers against first-class foes, although, like all other major powers, it has often used tactical wartime barrier systems. Two of the overseas British "fortresses," Gibraltar and Singapore, both located on peninsulas and supportable by naval power, were selected for consideration in this analysis, particularly for their performance during World War II.

a. **Gibraltar.**

(1) Great Britain has held Gibraltar (the Rock) since first taking it, in an assault from the sea, in 1704. With its sheer rock walls rising abruptly from the water and from the low and flat peninsula connecting it with the Spanish mainland, Gibraltar has long been considered an incomparable natural fortress. Internally, its primary vulnerabilities lie in its shortage of water and arable land. Because of this, a garrison at Gibraltar undergoing a long siege from a mainland attacker would require resupply by sea, or alternatively, in the 20th century, by air. The British, with their traditional command of the sea, have managed to perform this maritime resupply as necessary. During the major siege of Gibraltar from 1779 to 1783, at the time of the American Revolution, there were two major successful resupply efforts in which the British Navy temporarily broke the combined French and Spanish blockade. These successful efforts at resupply by sea were critical to the survival of the defenders, who would have had to surrender eventually due to lack of supplies, even if their fortress could not be taken by storm.

(2) Based on the long-term strength of the British Navy, the dominant power position of Great Britain versus Spain in the 19th and 20th

centuries, and the natural defensive strength of the position, there have been few serious or even potential threats to the British hold on Gibraltar since 1783, either from Spain or from more powerful British foes. The most serious potential threat in recent times came during the Second World War when Spain, considered to be a quasi-ally of Germany and Italy, was under German pressure to assault Gibraltar by itself or to permit the passage of German troops through its territory for such a purpose.

(3) Franco, the cautious Fascist leader of Spain, never chose to accept either option, and thus Gibraltar was never faced with a land assault during the war. Although Spaniards have wished to reclaim Gibraltar for more than two centuries, Franco's prudent desire to keep Spain out of the war must have been reinforced by Gibraltar's reputation as an impregnable position. The success of Gibraltar's defenses in this instance, however, was, in fact, due more to the deterrent value of its reputation than to its true strength.

(4) Throughout the early part of World War II, when Allied fortunes were at their lowest ebb, the British were greatly worried that their weak position at Gibraltar would fall to any reasonable attack force. They realized it was clearly vulnerable to any potential German attack, particularly the exposed airfield, a 20th century addition to Gibraltar's more level reaches, which assumed importance as a military target for the first time in the long history of the Rock. Even if the Rock itself had been able to withstand a long siege, it would have been without much value for the British. Gibraltar's value by the time of World War II came as much or more from its character as a base for aircraft patrolling the western Mediterranean and nearby Atlantic waters, as from its character as a naval base for refit and resupply. Artillery located on the adjacent Spanish mainland could easily have rendered the Gibraltar airfield unusable without the necessity of ever capturing the Rock itself.

(5) In his memoirs of the Second World War, Great Britain's Prime Minister Winston Churchill relates a very telling illustration of the uncertain reliabilities of untested defenses, reliabilities which often cannot be verified until an attack occurs. When Churchill visited Gibraltar in 1943 in the company of US General George C. Marshall, the governor of Gibraltar proudly displayed the most recent and most impressively protected British

artillery positions, which had been arduously excavated into the north (landward) facing side of Gibraltar. After this convincing demonstration of relative invulnerability which had suitably impressed Churchill, Marshall rather diffidently commented that the Japanese had quickly succeeded in neutralizing a similar American defensive design at Corregidor by shelling the rock face above the positions and burying the sites in fallen debris.

b. **Singapore.**

(1) At the beginning of the Second World War, Singapore was widely considered to be an impregnable fortress in the same class as Gibraltar, though with much less history and far less rationale. Gibraltar, as noted above, had been held by the British as a fortress since early in the 18th century, had withstood a number of attacks, and had only been captured by the British originally after a hard fought seaborne assault. It possessed enormous defensive natural advantages of terrain which could be effectively employed against any land or sea attack. Singapore, by contrast, although in British possession for many decades, had only received the beginnings of a significant defensive system subsequent to the First World War. Furthermore, it possessed none of the natural defensive qualities of Gibraltar, and, as was to be seen, fell quickly to Japanese attack in 1942.

(2) Actually, it was absurd to refer to Singapore as a "fortress." According to one of its defenders, General Percival, it was much more accurately described as "a large defended and inhabited area." The island of Singapore itself was an area of about 200 square miles, mostly consisting of mangrove swamps and rubber plantations without significant commanding heights. Additionally, the Johore Strait, which separated Singapore from the Malayan Peninsula, was little more than a wide, shallow moat. The impregnability of Singapore existed far more in the minds of its publicists and willfully gullible, or simply ignorant, individuals than in reality.

(3) Although it had been in British hands since the early 19th century, Singapore had not appeared to need significant defensive preparations until Japan was perceived as a potential threat by the British at the time of the First World War. Formal decisions to improve the defenses of Singapore were taken by the British government as early as 1921, and work began on them at a slow pace during the 1920's. Such work was accelerated after the Japanese move into Manchuria in 1931, and by 1937 the defenses were considered nearly completed.

(4) Unfortunately for the future British defenders, Singapore was assumed to need defense only from a naval assault. British planners did not believe a landward campaign down the length of Malaya was of concern and therefore did not make any serious preparations for defending either the peninsula or the island of Singapore itself from an attack by land forces. The powerful shore artillery, with its armor-piercing ammunition and flat trajectory fire, was designed for anti-ship action and was nearly useless as a defense against land attacks by tanks or infantry. It was, in any case, intended to defend only Singapore's naval base and not the entire island.

(5) In their swift, decisive campaign against Singapore the Japanese moved efficiently down the length of the Malayan Peninsula, against all British expectations, and captured the great "fortress" after a 70-day campaign. The actual taking of Singapore was militarily anti-climactic by the time the Japanese forces had reached the northern shore of the Johore Strait, since the island's long low northern coastline was essentially indefensible without control of the opposing shoreline.

(6) Although militarily a foregone conclusion once the Japanese had captured the Malayan Peninsula, the sudden fall of Singapore was nevertheless an enormous shock to Great Britain, its empire, and its allies. This shock was due to the image of Singapore, rather than to its reality. Just as in the case of the Maginot Line, press reports of the "invulnerability" of Singapore and public belief in its strength greatly exaggerated the true state of affairs, or, for the Maginot Line, its extent and strategic effectiveness. In both cases, these misleading impressions were partly for the purpose of impressing potential foes and deterring any attacks on the positions, by Germany or by Japan, respectively.

(7) Again, as in the case of the Maginot Line, this propaganda campaign for Singapore had much more of an effect in deluding its defenders than in deterring the attackers. The Japanese conducted a careful reconnaissance of Singapore in the period prior to the outbreak of war and correctly concluded that the island would fall easily if it could be subjected to a land-based attack. Although the Japanese knew this, and British commanders on the scene certainly knew it as well, the mistaken perception of Singapore's strength extended not only through most of the world but to the very top of the British government. No less a personage than Sir Winston Churchill was

utterly devastated when he was apprised of Singapore's true status, and again when the island was actually surrendered to the Japanese after what seemed like an incredibly weak defensive performance. He, like many others, had unquestioningly believed in the myth of Singapore as an invulnerable fortress.

10. Barriers in the Low Countries (Belgium and the Netherlands). The low, flat terrain in northwest Europe has rendered countries like Belgium and the Netherlands particularly susceptible to invasion. Like their French neighbors, their geographic situation has stimulated them to devote considerable attention over the centuries to the problems of designing fortifications and barriers. In the World War II combat examples briefly examined here, Germany employed the then-new methods of warfare to overcome, bypass, or ignore these obstacles so effectively that both Belgium and the Netherlands were forced into almost immediate surrender (less than 2 weeks in the case of Belgium, and only 5 days for the Netherlands).

a. Belgium's border defenses primarily consisted of more or less independent fortresses which, like barriers in many other countries, were nominally intended only to delay an attacker until reinforcements could arrive. In Belgium's case, the planned-for reinforcements were from France and Great Britain rather than only from its own mobilized reserves, but the principles for defense were the same as for a country depending on internal mobilization. The most spectacular failure of this Belgian fortress system in World War II, and the most spectacular demonstration of the dominance of the offensive forces, was seen in May 1940 with the 1-day German capture of Eben Emael, possibly the strongest single fort in the world at the time.

b. Having methodically evaluated the strengths and weaknesses of Eben Emael, and convinced of the need to quickly subdue it, the German planners decided to assault it with their new and most mobile weapons, aerial bombing and strafing, and paratroop landings. When this planned assault was executed, the 1,200 men defending Eben Emael were totally surprised and demoralized by this rapid and unexpected means of attack. They quickly surrendered, even though they did not suffer significant casualties.

c. The Netherlands, with an extensive network of canals and much of its land actually located below sea level, has long depended on defensive plans adapted to its unique conditions. These plans called for releasing impounded waters to flood its territories, meanwhile destroying key bridges

and other transportation links to slow and bog down an attacker's progress. The final, fallback Dutch position, just as it had been for more than 300 years, was to retreat to Holland and its neighboring states, those closest to the North Sea and the Zuider Zee and lowest in elevation. This "fortress Holland" could readily be surrounded by a continuous belt of submerged territory.

d. Against the Dutch, just as in Belgium, the Germans relied on air attacks, paratroop assaults, and other special force maneuvers to render the proposed water barriers useless. By seizing key bridges and other sites through air drops, small-scale crossings by rubber boats, and rapid mechanized ground advances, the Germans both bypassed the water barriers and captured the pre-planned demolition points before the emplaced explosives could be triggered by the slower-reacting Dutch defenders. Once again, a fixed, static defensive system designed in earlier times for earlier conditions was quickly overcome by a well-executed attack mounted by up-to-date forces.

11. The Finnish Barrier Experience. The Mannerheim Line, a defensive position emplaced by Finland to defend itself against invasion from the Soviet Union, stands in great contrast to the other defensive systems discussed in this report. It represents both the lowest level of investment of any of the barriers here reviewed and the highest level of strategic success, as manifested by its performance in the Russo-Finnish "Winter" War of 1939-1940.

a. The beginnings of what came to be called the Mannerheim Line arose from the aftermath of World War I, when portions of the Russian Empire, including Finland, broke away from Russian control after the revolution of 1917 and the Russian collapse under German military pressure. In the early 1920's, the resurgent Bolsheviks attempted to regain control of former fringe provinces in Europe and in Asia, and in some cases were successful in doing so. Newly independent Finland sought to prevent such reabsorption into the new Soviet Empire by maintaining effective, if small, armed forces and by supplementing them with defensive obstacles placed at key chokepoints in the difficult Finnish terrain of lakes, forests, tundra, and swamps. The worldwide tensions of the late 1930's affected Russo-Finnish relations as well, and Russians threats, demands, and ultimata prompted the Finns to refurbish these defenses prior to the actual Russian attack in 1939.

b. The Russian invasion was, in general, poorly prepared and poorly executed. Although the Soviet border with Finland was nearly 1,000 miles in length, and the Soviets frittered away much of their logistic resources in worthless attacks against much of this long border with its nearly impassable and unpopulated areas, the one key region lay near the Gulf of Finland where the important Soviet city of Leningrad and the Finnish capital of Helsinki were separated from each other by only 150 miles. The relatively narrow isthmus between Lake Ladoga and the Gulf of Finland was the only feasible corridor for a land attack on Finland; it was the area where the Finns placed their greatest defensive effort; and it was where the Soviets concentrated their major assaults.

c. The Mannerheim Line was a relatively small scale effort consisting of simple tactical obstacles designed to slow a Soviet attack, protect Finnish defenders, and cause increased Soviet casualties. Because Finnish resources were so small in comparison to that of the Soviet Union, with a population ratio of 1:50 versus their eastern neighbors, the Finns could not, and did not, delude themselves into believing that any barrier they could construct would either deter the Soviets from attacking or would stop a Soviet attack once launched. Finnish hopes for deterrence or survival rested more strongly on the overall balance of power between the Soviet Union and other countries than on their own resources.

d. Ironically, however, this defensive system, constructed for tactical reasons and used as a tactical resource, did achieve the greatest strategic success of any of the barriers here considered. The many thousands of casualties and months of delays suffered by the Soviets in the assaults on the Finnish positions, coupled with other international developments, were so great that the Soviets scaled back their war aims significantly, allowing Finland to survive as a viable country with most of its territory still intact. The energetic Finnish defense of a relatively meager defensive line, strengthened by easily defensible terrain, achieved results far in excess of other barriers, incomparably more expensive but less effectively utilized.

12. Israeli Barrier Experience. The modern state of Israel, created in 1948 as a result of a United Nations resolution, is a classic case of a country which possesses no strategic depth, no space with which to trade for time. From the moment of its inception, Israel was under attack by

neighboring forces from all sides. For the two decades prior to the Six-Day War in 1967, much of Israeli territory, including its urban and political centers, was subject to artillery fire from the territory of its hostile neighbors. In some places, the distance from one side of the country to the other was only a few miles.

a. Based on its strictly limited geographic extent and the vulnerability of its critical centers, Israel was a classic example of a country which could have benefited from a reliable and effective, forward-positioned barrier. Yet for several reasons, including economics, the length of its threatened borders, and the general political and psychological situation in the Middle East, the Israel Defense Force (IDF) has always relied primarily on an effective reserve and mobilization system for a mobile counterattack force, on an effective Air Force, and when expedient, on pre-emptive strikes.

b. Only once in its 40-year existence has Israel invested significantly in a major barrier fortification system. This was the Bar-Lev Line, established along the eastern bank of the Suez Canal beginning in 1968. Ironically, this was also both the only time when the Israelis were in possession of a significant buffer space in which they could trade space for time (the wastes of the Sinai Peninsula), and the only time when they suffered a strategic surprise.

c. Like most of the other barrier systems examined for this analysis, the performance of the Bar-Lev Line, once it was attacked, was far below that hoped for by either its designers, its builders, or the political authorities who governed its use. During their several wars with their Arab neighbors beginning in 1948, the Israelis had themselves frequently overcome a variety of most formidable-appearing defensive fortifications in the Sinai, along the Gaza Strip, and in the Golan Heights. They thus should have been less surprised then they were in 1973 when the Egyptian forces readily crossed the Suez Canal in a surprise attack, basically uninhibited by the existence of the expensive Israeli defensive barrier. Like so many other countries, even the militarily effective and efficient Israelis had been lulled into complacency by their previous successes and the existence of their new "barrier."

d. During the striking Israeli victory in the Six-Day War of 1967, Israel occupied all of the Sinai Peninsula up to the banks of the Red Sea and the Suez Canal. As has been the case in all of the Arab-Israeli conflicts,

however, military victories by the Israelis did not reconcile their Arab foes to the long-term defeat of their aims. The Egyptians, in particular, learned the bitter lessons of their defeats in 1967. They rearmed rapidly and began a long-term plan to harass the Israelis in a war of attrition through artillery shelling, minor raids, and continued political pressures. At the same time, the Egyptians began thorough preparations leading to a planned eventual attack across the Suez Canal and the reconquest of the Sinai.

e. One major Israeli response to this war of attrition, and to the recognized threat of a future Egyptian invasion across the Suez Canal, was the design and construction of what came to be known as the Bar-Lev Line, named after General Bar-Lev, the Israeli Chief of Staff at the time of its creation. Although it was never completed according to original designs, it still became the single largest engineering project ever undertaken by Israel. Like many other defensive systems, however, its purpose became blurred over time and its construction proved a mixed blessing.

f. The proximate cause for the creation of the Bar-Lev Line was the protection of the Israeli observers on the east bank of the Suez Canal who were suffering casualties from Egyptian artillery shelling. The fortifications eventually built were designed to provide nearly complete personnel protection from direct hits. The engineering and construction on these strongpoints was properly done and they performed this sheltering function well, both before and during the 1973 Yom Kippur War. Their prospective and actual strategic value was another story, however, and has been the subject of considerable debate, debate which began even before the construction of the Bar-Lev Line.

g. The Bar-Lev strongpoints, primarily forward observation posts, were spaced at 7-mile intervals along the line of the Canal, with good visibility for both human and electronic means of observation. They were planned for a garrison of 15 men and were to function partially as a warning (trip-wire) outpost line, as well as to provide observation of Egyptian activities. They were to be supported by mobile armored forces held further back from the Canal for the purpose of counterattacking any Egyptian incursions.

h. Opposition to the construction of any such line was expressed by Generals Ariel Sharon and Israel Tal at the time of its creation. They believed that the fixed posts only provided permanent targets for the

Egyptians. They instead felt the defense of the Canal should be maintained by armored maneuver units alone, in keeping with the previously successful IDF tradition of emphasizing mobility and rapid responses to hostile action.

i. Surprisingly, even though the period between the beginning of the Bar-Lev Line in 1968 and its wartime test in 1973 was only 5 years, the Bar-Lev Line suffered the same kind of neglect and changes in policy over its utilization that have afflicted numerous other peacetime barriers through their lifetimes. Nearly half (14 of 30) of the fortifications constructed by the Israelis had been closed up and were unmanned at the time of the Egyptian attack in 1973. The planned armor, artillery, and air support was also not at hand when the attack took place. This was partly because the Egyptian surprise was nearly total, despite the massive and visible nature of their preparations.

j. Before the detailed planning of their cross-canal attack, the Egyptians created a counter to the construction of the Israeli defensive line which was representative of the typical fate of a static defensive system. In order to pinpoint and conduct counter-observation on the Bar-Lev observation posts, the Egyptians elevated the rampart on the western side of the Canal to 130 feet, so they could overlook the opposing, but lower, Israeli rampart. This simple and direct expedient enabled the Egyptian observers to receive a clear view of Israeli positions and activities. This Egyptian maneuver was not noted by the higher Israeli commanders until the newly appointed Israeli commanding general spotted it on his initial inspection tour shortly before the outbreak of the 1973 war. He promptly ordered construction of counter-vailing 230-foot high observation towers, but this response came too late and the Egyptian attack took place before the towers were built.

k. When the Egyptians launched their attack in October 1973, it took place along the full length of the Canal. Even though the still-active Israeli outposts only contained 15 men, and were not equipped with the artillery which would have made them true strongpoints, the Egyptians took pains to make their crossings in the totally undefended intervals between the manned front-line Israeli positions. When the Egyptians did attack the Israeli positions as part of their continuing offensive, the defenders gave a good account of themselves but were unable to significantly hinder the Egyptian advance. The Israeli outposts provided no useful warning of the

Egyptian attack, nor did they succeed in slowing it or channelling the Egyptian offensive in paths advantageous to the Israelis. In the words of one eminent Israeli observer, Chaim Herzog

> "...the fortifications proved to be a liability. Over the years, they had become a compromise - between strongpoints designed to hold the Canal against Egyptian attack, and warning and observation outposts. As the former they were too weak and dispersed; as the latter they were too strongly manned."[2]

1. Due to the small size of the Israeli population and the ethos of the IDF, the 436 Israelis pinned down in the static defensive positions along the Canal represented important resources to Israel, forcing rescue efforts to recover those soldiers who could be brought back behind Israeli lines in the Sinai. Although the Israelis eventually recovered and went on to mount an effective counterattack into Egypt itself, the successful initial stages of the Egyptian attack in the Yom Kippur War represented the most significant Israeli defeat in the extended series of 20th-century Arab-Israeli conflicts. Israel suffered significant personnel and materiel losses, and major damage was done to the professional futures of those military and political leaders deemed responsible for the atypical lack of Israeli preparedness.

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[2]Herzog, Chaim, *The Arab-Israeli Wars: War and Peace in the Middle East* (Random House, New York, 1982) p. 246.

II. THE KOREA BARRIER SYSTEM AND HISTORICAL BARRIERS

13. Comparative Parameters. Among the relevant parameters for comparing different barrier systems are their geographic length, their lifespan, their style of construction, the terrain in which they are placed, the degree of tension along the barrier, and the importance of the barrier to the defending country (see **Figure 1** for a tabular summary of the historical barriers discussed in this report, and of their strategic performance). These parameters, physical and political, are reviewed here to help place the Korea Barrier System of the 1980's in the perspective of the barrier systems of the past.

a. The length of the Korea Barrier System, running about 150 miles in a path roughly parallel to the Demilitarized Zone (DMZ), makes it approximately equivalent in geographic extent to that of the other major defensive lines discussed in this report. Since its origins in the frontline positions existing at the end of the Korean War in 1953, it has now been performing its defensive role for more than 30 years, a duration exceeded only by the Sere de Rivieres Line, among those examined here. In company with other defensive systems designed and built during the 20th century, the Korea Barrier System does not contain huge fortress complexes equivalent to the Belgian Eben Emael and the French Verdun. Like other more recent barriers, it depends instead on a large number and variety of obstacles composed of minefields, antitank ditches, barbed wire, and many other countermobility defenses. The mountainous terrain in which the Korean Barrier System lies, and its placement across the full width of the Korean Peninsula, which makes it essentially impossible to outflank through a land-only attack, together constitute the greatest physical difference between the Korean defenses and the other peacetime barriers. Based solely on these terrain and geographic considerations, the Korean Barrier System should have a greater potential for performing effectively than any of the referenced barriers.

b. Despite its nonviolent name, the Korean DMZ is the focus of perhaps the most concentrated military presence of any border in the world (excluding the active combat zone between Iran and Iraq). The frequency of cross-border incursions and other hostile activities by north Korea (nK) has served to maintain tensions at a high level, which should have the effect of

BARRIER PERFORMANCE SUMMARY

Name	Date	Status at Time of Combat	Tactical Performance	Strategic Performance
Sere de Rivieres Line	1914	Neglected	Individual fortifications performed adequately when defended.	Outflanked, almost irrelevant to outcome of attack, defending country survived.
Verdun	1916	Neglected, stripped of artillery	Adequate when defended.	Positions held at great cost.
Maginot Line	1940	Strong, fairly well-maintained	Fully successful, all major forts still uncaptured at time of French surrender.	Outflanked, fully irrelevant to outcome of attack, defender surrendered in seven weeks.
Siegfried Line	1939	Moderately weak, not protected by planned mobile reserve	Untested by any actual attack in 1939.	Fully successful through deterrence. Did well tactically in 1944.
Gibraltar	1940-1943	Weak, unprepared	Untested.	Untested
Singapore	1942	Defenses essentially nonexistent	Rapid surrender.	Complete collapse, almost immediate surrender of defender regionally.
Eben Emael	1940	Nominally strong and well-maintained defenses	Surrender in 25 hours.	Complete collapse, surrender of defending country in two weeks.
Dutch water barrier	1940	Nominally well-maintained	Overrun in hours and days.	Complete collapse, surrender of defending country in five days.
Mannerheim Line	1939-1940	Weak, but refurbished	Superb, caused heavy Russian casualties.	Helped force compromise on otherwise dominant attacking power.
Bar-Lev Line	1973	Weak, neglected	Individual positions stubbornly defended when attacked, often bypassed.	Costly and severe, but temporary, setback to defending country.

Figure 1

promoting continued attention to the status and readiness of the Korean Barrier System. Only the Egyptian-Israeli border fronted by the Bar-Lev Line displayed a similar level of ongoing low-level hostilities. Finally, the degree of importance of the Korea Barrier System to its host country considerably exceeds that for any of the other peacetime barriers noted in this report. The proximity of Seoul to the DMZ, and the relative importance of Seoul to the ROK, are major factors which should enhance the profile of the Korea Barrier System in the minds of the highest level ROK/US decision makers.

14. Comparison Summary. The length, cost, lifespan, general purposes, and the overall importance of the Korea Barrier System to its host country are comparable, but not identical, to many of the barriers examined in this report. The most important differences lie in the nature of the terrain and the continuing high degree of tension in the contemporary Korean scene. The similarities, however, are such that lessons drawn should have applicability to Korea, with due regard for the recognized significant differences.

II. CONCLUSIONS

15. Peacetime Barriers Deter Attacks But Do Not Defeat Them. History has shown a variety of means by which a supposedly unassailable fortress or unbreachable barrier can be overcome in war. These include treachery, starvation, and the finding of some hidden vulnerability or "chink in the armor." In the examples analyzed here, all of the defenses which were attacked were quickly overcome by the offensive forces which exploited some weakness or technological change ignored or unperceived by the defenders.

a. **Deterrence.** Doubtless all of the barriers here cited gave their possessors a certain degree of deterrence against attack, which delayed the assaults by months, years, or decades, and which forced the attackers to devise new and effective strategies for dealing with the barriers in some fashion. Similarly, the presence of defensive barriers must have prevented many potential attacks from ever being carried out because the existence of those barriers rendered the potential costs of an attack too expensive to risk.

b. **Wartime Performance.** Aside from those attacks and wars which were successfully deterred, however, the existence of barriers appears simply to bring forth sufficient creative abilities on the part of the attackers to overcome the barriers, of whatever type. A pre-built peacetime barrier should be expected to hinder an attacker and cause him some additional casualties and effort, thereby providing tactical advantages to the defender. However, it is dangerous for the defender to rely on the barrier to determine the outcome of the conflict. Once they were attacked, all of the barriers discussed in this monograph did, in fact, provide tactical advantages to the defenders using them, but, except for the Mannerheim Line, none of them were as successful as the defenders had hoped or anticipated. All of them were quickly penetrated or bypassed in some fashion, to the great detriment of those countries which relied upon them to some degree for their security. This frequency of failure in wartime performance is caused by the life cycle of a static barrier system. Often in place for years, it is subject to the best efforts of an aggressor's war planners for as long as it takes them to develop countervailing strategies. Thus, when the attacker commits to the offensive, which is at his discretion and initiative, it is usually because he has rationally calculated a way of overcoming the known obstacles, including the pre-built opposing barrier

system. By its very nature, therefore, a peacetime barrier is unlikely to be fully successful in an actual war, and most national leaders, inadequately informed on the true capabilities and limitations of their barriers, have held unrealistic expectations for them. **Thus, once a peacetime barrier has been attacked, it has probably already failed strategically.**

16. Peacetime Barriers Quickly Decay and Become Obsolete. The period of the 19th and 20th centuries has been one of rapid technological change. This change has had particularly profound impacts on military conflicts. Nations armed with obsolete weapons and strategies have suffered severely. A fixed barrier represents a certain type of major weapons system, one in which there is usually a major financial investment. Unlike more mobile weapons systems such as ships and aircraft, neither the decay nor the obsolescence of a fixed barrier may become very visible. It is, of course, also possible to delude oneself as to the strength of one's active air force, army, or navy, but such mobile units are more readily evaluated than the conventional barrier system.

a. **Decay.** Barriers, by contrast, can consist of fortresses guarded by passive shielding, of permanently mounted artillery which may be seldom if ever fired prior to the opening of hostilities, of minefields with explosives buried underground and untested (and virtually untestable) for years or decades, and of other relatively static devices which may never be checked for performability until needed in the heat of combat. The decay which afflicts all human creations can generally proceed unseen much easier in barriers than is the case with other weapon systems. In the case of the barriers examined here, both of the French barriers, including the 40-year-old Sere de Rivieres Line and the much shorter-lived Maginot Line, suffered from such decay. Strikingly, even the 8-year-old Siegfried Line, and the still younger Bar-Lev Line had also been allowed to atrophy significantly by the time they were needed, in 1944 and 1973, respectively. The reasons for such decay lie not only in ignorance and lack of attention to maintenance needs, but also in changing concepts of operations which seem to render the existing barrier systems less relevant to current plans. Because of their offensive orientation prior to World War I, the French, for example, effectively discarded many of the major tactical advantages which they could have preserved if they had kept the defenses of the Sere de Rivieres Line in proper condition. As a result,

they suffered significant losses in territory and human casualties which could have been prevented with a more balanced attention to the very real benefits of well-prepared defensive positions, even in a war of movement.

b. **Obsolescence.** The effects of the understandable and scarcely avoidable neglect -- which allows unused systems to decay -- are accentuated by changes in external conditions which render the plans of previous years or decades relatively worthless. The mobility provided by tanks and planes completely overrode the World War I concepts of defense which were employed in the design of the Maginot Line. The same mobility and striking power provided by modern weapons allowed the Japanese to conduct an effective and speedy campaign down the Malayan Peninsula to assault Singapore unexpectedly from the landward side. Other major weapons systems can also be overtaken by the pace of technological change. In the 20th century, examples abound, from horse cavalry to trench warfare. All armies and their weapons suffer from a lack of meaningful feedback during peacetime. Fixed barriers, however, are especially subject to obsolescence because they are not readily tested, their rather significant financial investment turns them into projects which may take decades to move from conception to completion, and their technology is perhaps the least likely to receive emphasis and the least likely to be changed significantly over time. **More than most other military systems, peacetime barriers are unlikely to be in proper condition and up-to-date on the outbreak of war.**

17. Peacetime Barriers Are Poorly Understood. By their very nature, fixed barrier systems tend to be located at the peripheries of a nation's power and influence, far from the areas likely to be frequented by top political, or even military leaders. The barriers themselves are most often underground or built into the landscape, and can usually do little more than remain motionless during inspection. Thus, there is little occasion for most decision makers to learn much about the operating details of a necessarily passive peacetime barrier. Beyond this, the very physical size of a barrier, which often alters the appearance of the landscape and may be extremely high, deep, wide, or solid in appearance (or all at the same time) can easily impart a false sense of security in its durability when viewed in the absence of hostile offensive capabilities, and thus contribute to strategic misconceptions. Basically, all of the top decision makers utilizing the barriers discussed in this analysis failed completely to understand the true military value of their respective barriers

(with the possible exception of Hitler and his masterful psychological use of the Siegfried Line). The French leaders of both world wars considered fortresses, like Verdun and those of the Maginot Line, to provide fully sufficient strategic protection and reaction time against German invasions. During World War II, even as experienced and knowledgeable a leader as Churchill was shocked by the vulnerability of the two outlying British "fortresses" of Gibraltar and Singapore. Similarly, as recently as 1973, none of the Israeli leaders seemed to have a clear idea of the purpose or capabilities of the Bar-Lev Line prior to the Egyptian attack. This ignorance of the true state of their defenses must have contributed to the unusual Israeli failure to be fully ready at the outbreak of the Yom Kippur War. The fortifications engineers and military planners who designed and built the barrier systems examined here did so with an eye to the tactical advantages their work could provide their defending forces. In most cases, they did their work well and the defenses did provide tactical benefits to the defenders. Unfortunately, the national leaders who treated those defenses as strategic assets failed to comprehend the limitations of their barrier systems. **Strategic political and military decision makers understand the capabilities of peacetime barriers less than they do most other components of military strength.**

V. RECOMMENDATIONS

18. Enhance Deterrent Value. The primary security benefit of the barriers examined in this analysis was the deterrence of attack. Thus, design of the Korea Barrier System should place strong emphasis on its deterrent characteristics. The barrier system should obviously be designed to work as well as possible at aiding CFC defenders and injuring nK attackers during actual combat. It should also be designed to impress nK with the difficulty of overcoming the barrier. Without neglecting its potential combat performance, it should be a system which is conspicuously and publicly forbidding to an nK attack. Thus, in addition to its actual strength, capacities for bluff and exaggeration which cannot be easily disproved by nK should also be designed into the system. **The Korea Barrier System should be tactically effective and it should appear to nK to be even more effective than it is.**

19. Provide for and Require Continual Feedback. For long-term effectiveness, the Korea Barrier System should be designed to allow for frequent and adequate testing of its effectiveness. For example, mines and other explosive objects held in storage for rapid emplacement should have an appropriate mandated test and rotation frequency to ensure their reliability. Pre-emplaced minefields should be neither designed nor relied upon without provisions for continual testing of the minefields as they lay. Similarly, despite the short-term costs, selected sample testing of all other prepositioned obstacles, including side drops, road craters, and related barriers, should be performed under conditions as closely reproducing wartime conditions as possible. In other words, the Korea Barrier System and its operating personnel should be tested, trained, and exercised just as much as the CFC maneuver forces they support. **The Korea Barrier System should be designed for the maximum practical degree of continual feedback on its true combat status.**

20. Design for Maximum Flexibility and Responsiveness. Because a fixed and static barrier system can be viewed as a puzzle contrived for the prospective attacker to solve, the Korea Barrier System should be designed to complicate that puzzle as much as possible and to let it respond rapidly to changes in nK attack plans and capabilities. Thus, in addition to a variety of different types of obstacles, as much emphasis as possible should be placed on those obstacles which can be employed where and when they are needed.

Allowances should be made for continued improvements in barrier components. Fixed investments in unchangeable obstacle components should be held at a practical minimum.

21. Ensure Adequate Understanding of the Capabilities of the Barrier System. Those who design, select, and operate the Korea Barrier System should fully understand its changing capabilities and its known weaknesses, and communicate those facts about the barrier system to all relevant military and political decision makers. These decision makers should not be misled by the physical appearance of the barrier system, by a nominal but unrealized readiness status, or by descriptive material designed for public distribution. The Korea Barrier System should be understood better by CFC and other ROK/US decision makers than it is by their nK opponents.

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