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**BATTLEFIELD NUCLEAR WEAPONS AND
TACTICAL GRIDLOCK IN EUROPE**

**A Monograph
by
Major Michael W. Cannon
Armor**



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Abstract

This paper addresses the issue of whether the use of tactical nuclear weapons in a war in Europe will bring about a tactical stalemate or "gridlock." The TRADOC Common Teaching Scenario is used for a guide as to the area, forces employed, general situation, and nuclear weapons available to commanders on both sides. With these considerations, two iterations of a wargame were run and the areas contaminated and rough levels of casualties calculated. An analysis of how this may affect battlefield maneuver is made and other issues which may affect the use of battlefield nuclear weapons are presented. The paper concludes with a discussion of areas that require additional research to further develop the answer to the research question. (KR)



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I. The Historical Background

The years following World War II (WWII) presented the United States with a situation it was ill-prepared for. A traditionally isolationist and non-militaristic society was thrust onto a global stage and called upon to play a leading role in reestablishing the world order following history's most destructive war. One of the most troublesome issues for American decision makers centered around the type and size of military force structure that would be required to support proposed policies. After the Korean War, however, Massive Retaliation became the nation's military strategy with its centerpiece being the atomic bomb. Many viewed this weapon as not only a budgetary panacea, but a military one as well. Even such a distinguished theorist as Bernard Brodie wrote that "we should probably need to use nuclear weapons tactically in order to redress what is otherwise a hopelessly inferior position for the defense of Western Europe."¹

During the course of the 1950s, the Army began to integrate the rapidly increasing stock of nuclear weaponry into its arsenal. Changes in organization and doctrine to support this integration were needed on a large scale. Validations of the shifts from the Army's WWII organization were required as well and were carried on throughout the 1950s in field tests and command post exercises held in service schools and doctrinal development agencies. One of the best known field exercises was held in November of 1955 and was called SAGEBRUSH.

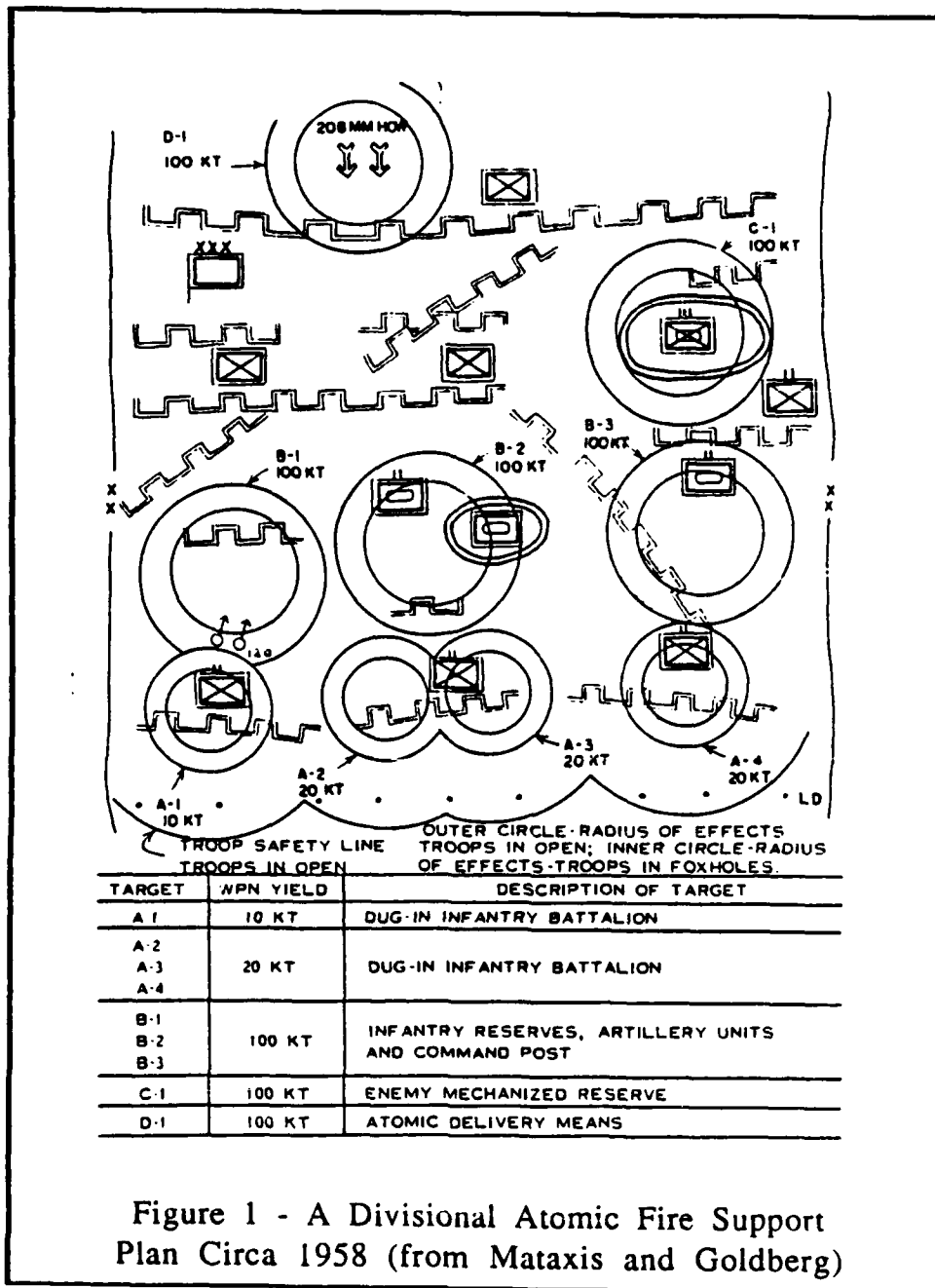
Held in the maneuver area around Ft. Polk, La., SAGEBRUSH was designed to provide an "extended test" of the atomic age army's capabilities on the nuclear battlefield. Over 100,000 troops from four divisions conducted maneuvers in a "nuclear" environment for a little over two weeks.

The scale of nuclear use... was considerably greater than in the earlier exercises. Simulated nuclear strikes totalling over 19,000 kilotons were delivered against both sides by Army and Air Force weapons. Army delivered weapons ranged from 2-kiloton atomic demolition munitions to 200 kiloton Corporal warheads, while Air Force weapons ranged up to 500 kilotons. Damage assessed in the maneuver area included 20,000 casualties and 2,700 vehicles destroyed.²

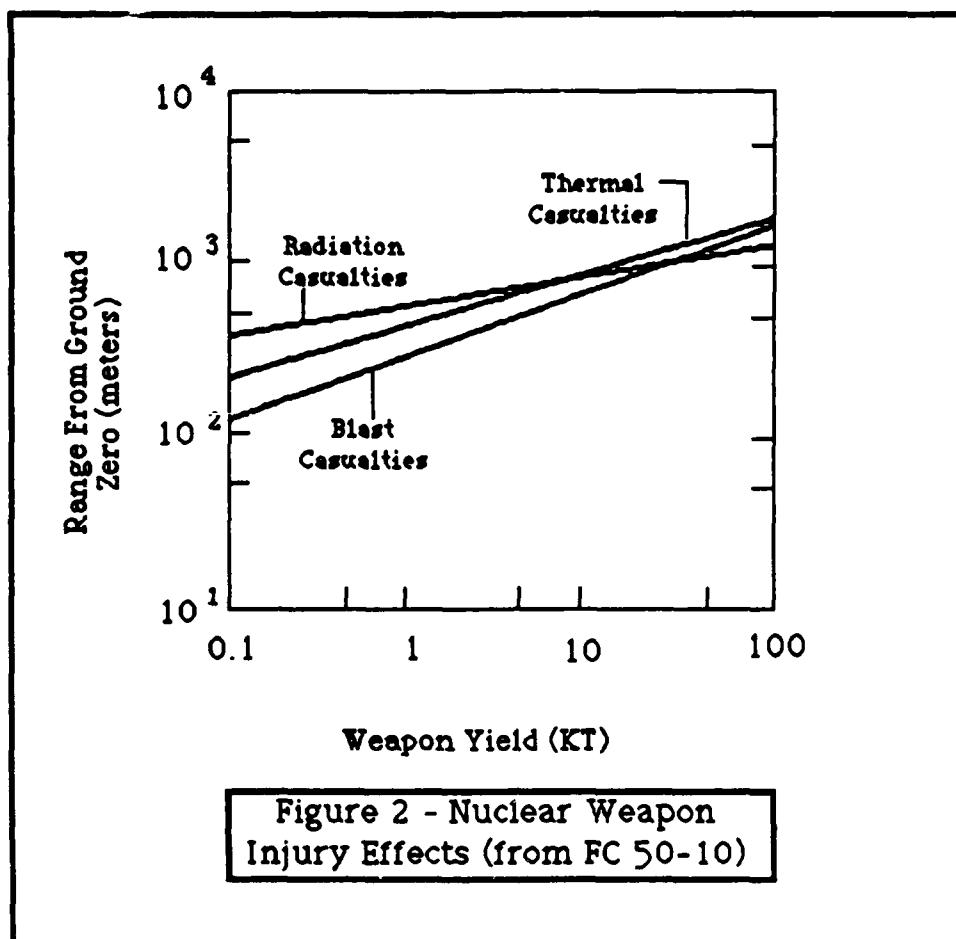
Unhappily for the Army, and anyone who would have been living in the Ft. Polk area, the results of SAGEBRUSH indicated that the "large-scale use of nuclear weapons could make maneuver impossible."³ The destructive power provided by the inclusion of nuclear weapons was orders of magnitude greater than that available to commanders in Korea and WWII. The Army Chief of Staff, General Maxwell D. Taylor, commented on the "tremendous fire power and terrible destructiveness of modern weapons" and postulated that "if Sage Brush had been a war instead of a maneuver, with about half a hundred nuclear weapons used against the ground forces, within a few days of combat it is unlikely that the Army - as we know it today - could have continued to fight as a coherent, integrated combat force."⁴

Other studies confirmed the unprecedented destructiveness of a nuclear war. In the early 1960s, at a meeting of NATO military commanders, a summary was presented of the results of a number of wargames that had included nuclear weapons. In the view of one of the presenters, "the numbers of nuclear weapons that would be fired in a battle on, say, a corps front would cause so much physical damage (regardless of the numbers of actual military casualties) as to render the idea of mobile or any other form of warfare meaningless. The damage in the battlefield area would be as great as would occur in an exchange of strategic nuclear weapons." Furthermore, the "picture that emerged... was fairly consistent. In a nuclear battle on NATO territory, between 200 and 250 nuclear 'strikes' of average yield 20 kt would be exploded in the space of a few days in an area no more than 50 by 30 miles.... The effect would have been indescribable, and meaningless from the point of view of any continuing battle between opposing armies."⁵ Rather than allowing sweeping battles of maneuver, therefore, nuclear weapons were bringing untold destruction and "gridlock" to the battlefield.

In many of the exercises of the period, the 20 kiloton bomb was used as the basis for discussion.⁶ Approximately half of the destructive energy from this weapon went into blast effects, one-quarter into thermal effects, and around five percent into radiation. At greater orders of magnitude, the



percentage of blast and thermal effects would increase at a rate far greater than that of radiation.⁷ These larger weapons were also integrated into examples given for instruction in many of the texts of the day. A "typical division" could expect to see



around 600 kilotons of weapons used in its sector with the largest yield in the vicinity of 100 kilotons (see Figure 1). "None of them were so large, however, as to cause problems of cratering and fallout."⁸ The risk associated with residual radiation after the blast in the form of fallout was also considered to be nonexistent as it was assumed that the majority of the strikes would be airbursts and not surface bursts.⁹ Yet these were the weapons and assumptions that formed the basis of the exercises that discovered maneuver was impossible.

It was in the mid-1950s that American technology appeared to promise an answer with the development of "fractional" or sub-kiloton atomic weapons.¹⁰ With the introduction of these weapons, "the emphasis shifted from blast to radiation, that is, to killing or disabling enemy troops, including tank crews, primarily by short-lived radiation from high bursts of low-yield weapons."¹¹ As can be seen in Figure 2, the crossover line between blast and thermal effects versus radiation as the main killer is around 3 kilotons.¹² The potential tactical benefits were significant. The area of neutron-induced gamma activity (NIGA - the area irradiated in the vicinity of ground zero by the weapon) was much smaller. The fallout hazard was also less as the area that would be affected by the blast was much smaller. These are the type of weapons that are now available for use by battlefield commanders.

In actuality, however, the benefits of the shift to smaller weapons at the tactical and operational level are still being hotly debated. The German Max Planck Institute conducted a large-scale survey in 1971 that looked at the effects a nuclear war would have on Germany. Their conclusions were not encouraging. The study group determined that if only 10 percent of NATO's battlefield nuclear weapons (BNW)¹³ were employed only in the area of operations (with densely populated areas being spared) heavy damage would result. Over 10 million people could be expected to die and a radioactive belt would be established along Germany's eastern

boundary that would measure 1000 rads.¹⁴ Additional areas would be contaminated with doses of over 100 rads. What is most discouraging is that Soviet weapons were not considered. When these were used on an equal scale, the study group concluded that the "political annihilation" of the Federal Republic of Germany would result.¹⁵ Based on the results of studies such as these, many now believe that "there has been a fundamental change on how nuclear weapons are viewed. Increasingly they are seen by both the Soviet and American militaries as political devices that have very little war-fighting utility."¹⁶ Others, however, disagree. As an example, Majors John Rose and Calvin Buzzell argue that "nuclear weapons will tend to limit density rather than suppress maneuver" in an article in Military Review.¹⁷ These authors contend that nuclear weapons can be used as warfighting implements if certain doctrinal changes are made.

A major difficulty with the arguments on both sides is that they are backed more by intuition than by cold, hard analysis. There is no disagreement that nuclear warfare should be discussed. As Colin Gray has stated, "nuclear war is not a controversial topic. Everybody agrees on its horrors.... However, the threat of nuclear war is so crucial to U.S. national security policy, that policymakers and the general public are duty-bound to be interested in defense postures that limit their society's liability while strengthening the stability of deterrence."¹⁸

The military, unfortunately, has shown little inclination to study tactical nuclear warfare on a large scale. In the 1950s, "the atomic battlefield attracted widespread interest." The staff college at Leavenworth devoted "half its curriculum" to this topic.¹⁹ Contrast this with my recent experience as a student at the Command and General Staff College (CGSC) where in the course of the school year we never discussed nuclear weapons or their influence on operational and tactical matters.

One of the reasons for this lack of study is the sheer amount of material that needs to be covered in a one year course. Another, and perhaps more plausible, reason is that "what is absolutely clear is that to engage in nuclear war... would be to enter the realm of the unknown and unknowable...."²⁰ The problem faced by the tactician or practitioner of the operational art, however, is that "use of tactical nuclear weapons is likely to alter ground war in ways that are by no means easy to predict."²¹ More importantly, the "first time that nuclear weapons were used both sides would feel that an important new dimension had been introduced into the war. Neither would be clear as to what its implications were."²²

As it stands at the current time, it appears that the military is making little effort towards overcoming this lack of information in the public domain. The overarching issue, therefore, is that the "services need to revitalize interest in tactical nuclear doctrine..."²³ for as Sir Michael Howard wrote, it is "the business of the strategist to think what to do if

deterrence fails, and if Soviet strategists are doing their job, and those in the West are not, it is not for us to complain about them."²⁴

A suitable starting place would be answering the question as to whether the new generation of fractional nuclear weapons will bring about tactical "gridlock" on the battlefield as they seemed to do in exercises in the 1950s and 1960s. The thrust of this manuscript will be towards developing a solution using the Training and Doctrine Command (TRADOC) Common Teaching Scenario (TCTS) as a guide. The TCTS is the basis for exercises conducted at CGSC and revolves around actions undertaken by the fictitious U.S. 10th Corps in the American area of responsibility in Germany.²⁵ Prior to launching into a wargame of this corps problem, however, the assumptions underlying its conduct need to be laid out. A brief review of the major aspects of U.S. and Soviet doctrine that pertain to this situation shall be presented and the assumptions drawn from them. The problem will then be analyzed using a combination of the "avenue-in-depth" and "box" wargaming methods with particular emphasis given to the likely areas of nuclear weapons use.²⁶ An analysis of losses and, more importantly, contaminated areas will then be conducted to determine if the use of nuclear weapons hinders or promotes maneuver. Other issues that may have an impact on U.S. doctrine will then be discussed.

II. Assumptions

Two of the most critical assumptions are perhaps the weakest parts of the analysis: the numbers of nuclear weapons systems that would be employed in a corps area and their relative yields (to include weapons effects data). Although more than likely available in classified documents, I have purposely avoided them in order to provide a non-classified study. Total numbers of BNW in Europe are difficult to pin down, yet according to one source, the NATO Council decided in 1983 to reduce the stockpile of weapons to 4600.²⁷ Another source claims that this can be further broken down into around 1400 artillery shells, 400 Lance warheads, and 700 to 800 tactical bombs. Altogether, given limits on the sizes of bombs that can be employed at the Forward Edge of the Battle Area (FEBA) and the use of a number of these weapons in the deep battle, "NATO could probably deliver considerably fewer than 2,000 nuclear munitions on or near battlefields in Central Europe."²⁸ Assuming a strength of 100 NATO divisions, this works out to be roughly twenty weapons per divisional sector. Current doctrine precludes such a neat marshaling of weaponry, however.²⁹

U.S. doctrine centers around the concept of "packages" of nuclear weapons. A "package" is a request for BNW submitted by a Corps commander that is defined using four parameters:

1. a specified number of weapons by yield, or yield and delivery system,

2. the purpose for which the package will be employed (such as "support OPLAN 10" or "prevention of a threat breakthrough within the corps sector by 'x' number of threat divisions"),
3. a time for employment,
4. and a specific area.³⁰

Once approved, refinements that can be made to the package are limited and pertain only to certain aspects such as adjusting aimpoints (where the rounds will detonate) within the area specified, exchanging weapons on a one-for-one basis for smaller yields, adjusting times and schedules of fires to yield the best tactical effects, or coordinating non-nuclear fires to be delivered in conjunction with the nuclear "pulse."³¹

The result is that each "package" is highly situation dependent. Shown in Figure 3 are the "packages" provided in the TCTS for a divisional unit and one developed for a corps sized unit.³² As another example, a corps "package" was developed for use in CGSC instruction in 1973 that included approximately 200 BNW.³³ Numbers, therefore, can vary widely. For this study, the "package" developed for the Pre-Command Course³⁴ will be used (see Package Red in Figure 3).

Numbers and yields for Soviet forces are even more difficult to develop from unclassified sources. Yields for a "typical" threat weapon range from 10KT to 50KT.³⁵ One source even suggests that a "reasonable rule of thumb would assume a 100-kiloton standard and vary it up or down depending on current battlefield intelligence."³⁶ What is evident is that "Pact ability to fight a truly limited nuclear battle appears to be slight. Public data do not show a short

Weapon System	Yield(KT)	Corps PNL ¹	Package Darby	Package Smurf	Package Bingo
155mm	.2	63	-	6	5
	1	155	7	2	4
203mm	1	-	1	-	-
	2	70	-	7	6
	8	95	4	2	3
Lance	5	-	-	-	-
	10	54	3	-	1
ADM	1	-	-	-	-
TACAIR	2	-	-	-	-
	10	-	2	2	4
Total Yields =>		1607.6 KT	90KT	53.2KT	91KT

PCC Corps PNL ²			Package Red		
WPN	KT	Nos.	Corps	23AD	52MECH
155	2.5	60	10	10	7
203	1	16	8		
	2	18	10		
	8	22	15		
Lance	10	15	10		
	100	5	2		
Bombs	20	0	9		
	100	0	2		
Total Yield in Corps Package is 895.5 KT					

¹ PNL is the Prescribed Nuclear Load - the nuclear basic load

² PCC is the Pre-Command Course

Figure 3 - Types of Corps "Packages"
Extracted from FM 101-31-3, TCTS, and the PCC Extract

**Figure 4 - Nuclear Delivery
Systems in a Corps Area**

US			
Weapons	Nos.	Yields	Ranges
155mm How.	240	sub-KT to 2	18.1 KM to 23.5(RAP)*
8-inch How.	96	1-10KT	22.9 to 30 KM (RAP)
Lance Missile	18	1-100 KT	115 (nuclear rounds) 83 (non-nuclear)
US air assets vary - see Figure 3 for examples			

Soviet			
Weapons	Nos.	Yields	Ranges
FROG-7	15 Bns 60 Wpns	50-300KT	70 KM
2S3 (M1973) 152mm How	14 Bns (252- 336 Wpns)	1 KT(?)	27 KM
SCUD-B (SS1C)	11 Bns (132- 264 Wpns)	100-500KT	300 KM
SS12	3 Bns 12 Wpns	200KT to 1MT	900KM
M240 Mortars	2 Bns (24 Wpns)	2-8KT	.8 to 9.2 KM

* RAP is Rocket-Assisted Projectile

range, low yield capability comparable with NATO's."³⁷ Moreover, open-source literature "indicates that threat delivery systems have inherently large delivery/accuracy errors."³⁸ Soviet yields would therefore have to be larger than NATO's for comparatively similar missions.

A related issue concerns the type of systems the Soviets have available to deliver nuclear weapons. Soviet forces undergo organizational changes as do NATO and U.S. forces, resulting in disparities between desired and actual tables of organization. A common assumption within this framework is to treat any Soviet weapon of 152mm or greater as having a nuclear capability.³⁹ My method has been to use the TCTS organization and tables in FM 100-2-3 to produce the number of weapon systems and range of weapon yields shown in Figure 4. The weapon effects data will be drawn from FM 3-3 and FM 3-100.⁴⁰ Yields to be used will be based on the type of targets to be engaged.

Another set of assumptions deals with how nuclear weapons will be employed by both sides. There are marked differences in viewpoint between the U.S. and Soviet Union about the nature of nuclear weapons that cause their approach to be dissimilar. The West views BNW as political tools and not exclusively combat weaponry. There appears to be four aspects to the NATO-accepted policy concerning the use of BNWs:

1. deliberate escalation with rising but controlled conflict intensity,
2. controlled escalation to convey limited objectives and the possibility of conflict termination,
3. escalation linkage, or coupling BNW to all Western nuclear assets, and

4. consultation with Allies, time and circumstances permitting.⁴¹

The political objective of using nuclear weapons would be "to achieve early termination of the conflict at the lowest level of violence on terms acceptable to the United States."⁴² The introduction of nuclear weapons has been described as being either a "powerful signal of the West's determination" to stop a Soviet advance or a "monumental gamble" aimed at terrifying the Soviets into halting by "raising the specter of uncontrollable escalation leading to inestimable costs." In both cases, "deliberate escalation would be [valuable] less for the military effects such a move would produce than for its impact on the will of the Soviet leadership to continue fighting."⁴³

What is most important about this philosophy is that it assumes that BNW will not be used until "after the corps' conventional defenses had been severely tested and were in danger of failing"⁴⁴ or unless "the enemy uses them first...."⁴⁵ U.S. doctrine does not, however, preclude first use. Moreover, the "employment of [BNW] between ground forces... will probably involve restrained use on both sides."⁴⁶ Three "questionable assumptions," therefore, underlay current NATO doctrine: the idea of a transition period between the conventional and nuclear phases of a war, a relatively short period of nuclear use, and the ability (and desire) of the enemy to read restraint into the selective use of nuclear weapons.⁴⁷

Since the release of BNW cannot be predicted, BNW must be continuously integrated into existing maneuver schemes and

plans of fire support. From a Western standpoint, there is "nothing magically decisive about nuclear weapons at the operational and tactical levels of warfare unless they are integrated with other fires and maneuver. *Their employment alone does not guarantee decisive results.*"⁴⁸ No targets are specifically reserved for nuclear strikes. If they are "the best means to defeat the target, and are available" then they are used. If, however, the target "can be readily defeated by maneuver forces or conventional fire" then those means will be employed first.⁴⁹

Units in contact (in the close battle at the Forward Edge of the Battle Area) will more than likely find that combat remains conventional. Nuclear fires will be used "to attack reserves, stop advancing armor formations, and protect the flank of maneuvering forces."⁵⁰ Targets that are engaged which are close to friendly forces will be "targeted with low-yield, artillery weapons for safety...."⁵¹

Responsibility for directing this tightly-controlled, discrete use of firepower resides at corps level.

Corps will determine the degree of autonomy divisions can exercise in the employment of subpackages. Once corps has selected the time of the package, divisions will be responsible for employing their designated subpackages within the employment constraints, package parameters, and fire support coordination measures. Maneuver brigade commanders and their FSCOORD determine the effects a given nuclear aim point will have on the brigade scheme of maneuver. He will inform

the division commander of the consequence of the parameters of the subpackage.⁵²

Moreover, because "of the possible loss of command and control elements, the authority to employ these weapons may be decentralized to brigade level."⁵³ This is a good compromise as "enough staff and communications exist there to support the use of nuclear weapons." It also coincides with current doctrine on chemical weapons release which recommends decentralization of release authority to division and brigade level to enhance responsiveness.⁵⁴

U.S. doctrine, then, holds that nuclear weapons are to be used only when necessary, in the lowest yield possible to do the job, and in a surge or "pulse," to demonstrate to the enemy that we are determined to meet our commitments. This is all the more critical since BNW "are available only in limited quantities" and are to be employed judiciously.⁵⁵ The result is a doctrine that builds from the battlefield outward.

The question as to whether or not the Soviets would resort to the use of nuclear weapons in a European conflict is a real one with protagonists on both sides of the argument. Army doctrinal literature states that the "use of nuclear weapons is a fundamental part of the threat warfighting capability, not simply an adjunct to their conventional forces."⁵⁶ Recent trends indicate that the Soviets are moving away from a nuclear force orientation in Europe, however, as "Soviet military spokesmen... expect that in a nuclear war they could obtain, at best, a pyrrhic victory."⁵⁷ Yet "no amount of

argument or evidence to the contrary will convince a large number of sincere, well-informed, highly intelligent and now very influential people that the Soviet Union is not an implacably aggressive power quite prepared to use nuclear weapons as an instrument of policy."⁵⁸ Even with this understanding, though, the point to be made is that the Soviets have thought a great deal about how a nuclear war in Europe would be conducted.

In the 1970s, the Soviets were not very optimistic about the chances of keeping a war in Europe conventional. The following quotes from a series of lectures at the Voroshilov Academy are illuminating:

War employing conventional weapons can be initiated simultaneously in all TSMAs [Theaters of Strategic Military Action]. Such a war will not last very long, and is expected to develop into a nuclear war at a crucial stage. The duration of the conventional phase of the war in Europe will be much shorter, lasting several days.

* * * * *

Conducting military actions with limited employment of nuclear weapons in Europe and in other vital areas would not last very long, and the use of all nuclear weapons, similar to initial nuclear strikes, would soon be initiated.⁵⁹

If a war in Europe went nuclear, the chances of it staying limited to this specific region were perceived as being slight.⁶⁰ The Soviet dismissal of the idea of a nuclear war being limited to Europe was "an explicit rejection of the notion that U.S. territory will be spared the ravages of nuclear war."⁶¹ From a

Soviet perspective, limited nuclear war refers to "concepts of protracted nuclear conflict involving selective targeting against strategic and operational targets."⁶² The most important "threshold" for Soviet leadership is the decision to go to war.⁶³ The "true firebreak" recognized by the Soviets, however, "if one is recognized at all - is the conventional-to-nuclear firebreak."⁶⁴ The concept of graduated escalation does not play a role in the Soviet approach as it does in NATO's. What "one finds in contemporary Soviet military writings... is not... concern about escalation control... but concern about battle management."⁶⁵

NATO may, therefore, not initiate the use of nuclear weapons. It is not clear that the Soviets' conventional abilities to achieve a quick victory "match the demands made upon that strategy under contemporary conditions. It may well be the case that the USSR... would face the requirement to introduce nuclear weapons in the early stages of conflict."⁶⁶ To some extent, this idea is supported by the Soviet view on nuclear weapons.

Soviet military planners point out that the task of anticipating the enemy is not so much one of 'beating the enemy to the draw' as it is being the first to employ forces in a decisive way.... What will be important... is that the subsequent use of Soviet TNW [Theater Nuclear Weapons] should be decisive, seizing the initiative through pre-emptive nuclear strikes against enemy TNW and other targets. In other words, *it is not the first nuclear use per se that is of concern to Soviet military planners, so*

*much as the first decisive use of nuclear weapons in the theatre.*⁶⁷

The danger of Soviet preemption is very real.⁶⁸

Moreover, studies have shown "that where there is careful and discrete first use of nuclear weapons, the side that initiated the nuclear attack is overwhelmed by a sudden and massive enemy nuclear response."⁶⁹ Indications are that this strike would be far different than those conducted by NATO as the Soviets would start with strategic and operational targets. Soviet target groups suggest that:

battlefield nuclear strikes would come either simultaneously with, or much more likely after, strategic nuclear strikes against major sectors of the operational and strategic rear areas in the European theatre, but certainly not before. *In this respect, Soviet military strategy calls for jumping several rungs of the escalation ladder, then climbing down.*⁷⁰

Concentration of strikes will be against high priority targets. As one Soviet officer has written:

Use of nuclear weapons against insignificant, secondary objectives contradicts the very nature of this weapon. The selection of targets should be approached with special care and nuclear weapons should not be thrown around like hand grenades.⁷¹

Massed nuclear strikes will also be made "along axes of attack and against the most important objectives."⁷² If targets require more than one weapon, coverage will be overlapping.⁷³

Yet another option apparently exists. Howard's earlier contention is supported by other authors who contend that the

Soviets are not interested using nuclear weapons at all. If the Soviets are meeting with success in the conventional realm, there may be the chance that they will merely "ride out" NATO's use of BNW and employ antinuclear maneuver. These are tactics that stress dispersion and contact with NATO forces (also referred to as "hugging.")⁷⁴

These then, are the options available to the Soviets: make the decision to use nuclear weapons first and on a large scale in order to preempt NATO use, employ BNW in a decisive strike after NATO has attempted to demonstrate "resolve" with a limited series of strikes, or "ride out" NATO's use and attempt to achieve success conventionally. In this study the first and last options will be used as they appear to be the most likely and provide extremes at either end of the spectrum of nuclear use.

A final assumption concerns the ability of any force to operate in the confusion that would be inherent in a nuclear conflict. Current U.S. Army doctrinal publications stress that "a nuclear environment exists on the battlefield at all times, whether or not either side has used nuclear weapons."⁷⁵ In recent years, Western forces have made great strides towards improving their ability to operate in an environment where nuclear, biological, and chemical weapons are employed. Many authors feel that the Soviets have an advantage, however, in that they have developed "new doctrinal and tactical concepts... as suited to nuclear as to conventional warfare."⁷⁶ A commonly held assumption about Soviet forces is that they "are

conditioned to regard [such] an... environment not as a disastrous situation, but one in which well-trained and skillful troops can survive and which they can use to their advantage."⁷⁷ Due to intensive training and appropriate doctrine "the Soviet commander does not have to make a complex transition from nonnuclear to nuclear warfighting modes, since the nonnuclear mode is already adapted to an overall nuclear posture."⁷⁸

The ability of any force to be adequately trained for such an intense and thoroughly nasty type of conflict should be in question, however. FM101-31-1 offers a partial description of what warfare under these circumstances would be like:

Warsaw Pact Countries will likely employ chemical weapons simultaneously or sequentially with nuclear weapons to take advantage of whatever operational or physiological interaction might occur. For example, in a chemical environment vomiting induced by ionized radiation will very probably force wearers to remove protective masks, thereby increasing vulnerability to chemicals. Further, damage to either the chemical protective garment or to skin by nuclear weapons effects will provide entries for chemical warfare agents to get at sensitive tissues.⁷⁹

Just the basics of survival will be difficult. Although for the purpose of this study it is necessary to assume that military units will be able to function in this environment, it would be worthwhile to bear in mind the contention of William Kaufmann that:

Force versatility is... difficult to achieve... [as] even small units with a great deal of experience have difficulty adapting rapidly to new conditions and the demands of specific missions. It is no disparagement to say that large military units are like elephants in a ballet company. Their repertoires are bound to be limited and they are not very adept at rapid change.⁸⁰

III. Analysis

In the TCTS the U.S. 10th Corps is a part of the Central Army Group(CENTAG) in NATO and is defending the area known to generations of American soldiers as the "Fulda Gap." The corps consists of one each mechanized and armored division, a cavalry regiment, a separate mechanized brigade, three field artillery brigades, a combat aviation brigade, and the appropriate support elements. It is faced by the 2nd Western Front which is attacking in the sector of the 10th Corps with the 8th Combined Arms Army(8CAA) and the 1st Guards Tank Army(1GTA), possessing between them a total of 5 motorized rifle divisions and 5 tank divisions with supporting assets. Map 1 shows the initial dispositions of both sides. The CENTAG operations order comments that threat forces may use nuclear or chemical weapons, but in the TCTS, no additional dispersion of units is made to account for this threat. The corps "package" is based on OPLAN Darby which has the corps reserve (the 313th Mechanized Brigade) attacking from an assembly area to the west of Fulda to destroy the second echelon divisions of the 8th CAA.⁸¹

Although this exercise focuses on the effects of nuclear weaponry, it needs to be pointed out that in this type of environment, chemical usage will be just as prolific. The chemical basic load for the corps (given in rounds) is as follows:

	Agent	52nd Mech	23rd AD	208th	313th	Corps
155mm How	GB	366	250	65	65	1,392
	VX	170	100	40	40	1,550
203mm How	GB					1,925
	VX					685

This is roughly enough in the way of munitions to cover a 12.5 KM area. Soviet capabilities are not listed but are certainly far greater.⁸²

In the first scenario, the battle developed along the lines shown in Maps 1 to 4. A Soviet theater wide nuclear offensive struck targets throughout the width and depth of the corps area. One of the most striking aspects of this portion of the exercise was the range disadvantage that the corps commander was at. The SCUD missile allowed the Soviets to strike with impunity at depths that the U.S. could not reach except with aircraft (which at this time would be on theater counterair missions). In the initial strikes, 5 - 50KT and 9 - 100KT landed in the corps area with 4 and 1, respectively, landing forward of the division rear boundaries. It was assumed that, based on the Soviet first use, NATO nuclear release would be more readily forthcoming and that available munitions could then be used beginning around H+12 by U.S. forces.⁸³ The situation as it ended at H+24 is shown in Map 4, with the Soviet forces poised to make a breakthrough in the center.

The second scenario was run in the same manner yet the use of nuclear weapons was delayed until H+24. The strikes then

Figure 5 - Residual Radiation By Weapon

From FM 3-3, pg. L-1		Extrapolations For This Study		
Yield (KT)	Radius (meters)	Yield (KT)	Radius (meters)	Area in Sq. KM*
.1	200	2.5	800	2(1.4x1.4)
1	700	8	950	2.8(1.7x1.7)
10	1000	10	1000	3.1(1.8x1.8)
100	1600	50	1200	4.5(2.1x2.1)
1000	2000	100	1600	8(2.8x2.8)
		200	1650	8.54(2.9x2.9)
		1000	2000	12.6(3.5x3.5)

*The figure in parenthesis is a rectangular area approximately equal to the circular contamination. When working with a rectangular grid on a map this was easier to use.

Figure 6 - Areas Contaminated By Fallout (Approximate By Weapon)

Yield (KT)	Zone I (Sq. KM)	Zone II (Sq. KM)	Total Area (Sq. KM)
2.5	30	60	90
8	75	150	225
10	100	220	320
50	435	870	1305
100	880	1760	2640
200	1288	2576	3854
1000	5880	11,760	17,640

Wind Speed = 16 KPH

carried out by U.S. forces halted the Soviets on a line essentially along the FEBA but both sides had suffered heavy losses. The Soviets retained an advantage in both scenarios in that the second echelon Soviet army had not been committed.

The numbers used to determine radioactive contamination based on the projected nuclear strikes are provided in Figures 5 and 6. The areas of residual radiation, NIGA, were arrived at by the procedure presented in FM 3-3 that essentially involves extrapolation from a table. The yields used for Soviet and U.S. weapons were limited to those in Figure 6 as this corresponded with Package Red.⁸⁴ The target-oriented method was chosen to plot where rounds would land as opposed to the preclusion method.⁸⁵

IV. Conclusions

Figure 7 summarizes the data gleaned from the first and second scenarios.⁸⁶ The tables highlight what may be the crux of the argument concerning whether or not gridlock will occur - the issue of air versus surface bursts. The areas of residual contamination shown will be present whether or not there is militarily significant fallout.⁸⁷ In these two scenarios, the ground contaminated through NIGA represented only 1.8 and 3.5 per cent of a corps area of roughly 22,400 square kilometers (based on the TCTS). Although these contaminated areas were located along major avenues of approach and supply routes, this type of radioactivity is expected to last only from 24 to 96 hours. Routine occupancy is possible after two to five days with periodic monitoring.⁸⁸ Chemical contamination is also expected to be a transitory obstacle with the contamination within the area of attack becoming minimal after 2-4 days and the surrounding areas seeing relief even sooner.⁸⁹ Based purely on the use of airbursts, then, the employment of BNW does not seem to pose a problem for maneuver.

The difference comes when fallout is factored into the problem. FM 100-31-3 states that the "large area contaminated by fallout from large surface bursts poses an operational problem of great importance. Fallout may extend to greater distances from GZ [ground zero] than any other nuclear weapon effect. It may influence the battlefield for

Figure 7 - Contaminated Areas Based on Weapons Usage			
Scenario Number 1			
Yields (KT)	Numbers Detonated	Contaminated Areas (Sq. KM - Approximate)	
		NIGA	Fallout
2.5	76	152	6840
10	15	46.5	4800
50	11	49.5	14,355
100	19	152	50,160
Totals =>		400	76,155
Scenario Number 2			
Yields (KT)	Numbers Detonated	Contaminated Areas (Sq. KM - Approximate)	
		NIGA	Fallout
2.5	27	54	2430
8	10	28	2250
10	10	31	3200
Totals =>		113	7880
<ul style="list-style-type: none"> • In Scenario 1, approximately 100 sq. KM were hit with persistent agents. In Scenario 2, the usage was greater. • The Corps area is approximately 22, 400 sq. KM. 			

a considerable time after a detonation."⁹⁰ In these two cases, if all weapons were detonated as surface bursts, the areas of fallout would amount to three times the corps area in the first scenario and 35 per cent of the corps area in the second.⁹¹ Although overlap of the fallout areas was not computed, the overlap generally involved smaller weapons. Moreover, larger

weapons were employed throughout the battle area with smaller weapons being concentrated around battalion and regimental-sized engagements. The projected areas of fallout, therefore, would not be substantially smaller.

The main issue centers around delivery system reliability. If 100 per cent reliability is achieved, the damage to the combat area will not be much more than will be caused by conventional combat. If the Clausewitzian concept of friction, or its American cousin, Murphy, raise their ugly heads and the weapons fail to match technical specifications, things will be far different. Even 25 per cent of the weapons causing fallout will irradiate the corps area if both sides use weapons or affect up to 10 per cent if only the U.S. does (in scenario one). With the associated tree blowdown and collateral damage to buildings that will result, maneuver will be difficult at best or done at a cost in radiation casualties that will be prohibitive.

Two factors exist that pull in different directions along the scale of nuclear use which can affect the results of any study on this topic: control problems and the nature of war itself. Under ideal conditions such as the ones under consideration here, the release and control procedures work. Indications are, however, that "current target selection procedures are too slow to permit using nuclear weapons against troop units... aircraft can strike only relatively immobile targets. Even cannon and Lance missiles can take an hour or more to prepare and fire, precluding their use against moving targets."⁹² Yet efficient utilization of a limited supply

of weapons and the need to "apply incrementally increasing pressure on the enemy" necessitates centralized control.⁹³ Based upon the exercises that I have been involved in, the higher the level, the more difficult it is to strike moving targets, particularly those close to the FEBA. These considerations may, therefore, reduce the scale of nuclear use along the line of contact. In one of the paradoxes of the nuclear age, it may be safer nearer the FEBA on the nuclear battlefield than in the rear areas.

Other issues that make control difficult, and thus the use of BNW on a large scale less likely, are those of the electromagnetic pulse (EMP) and communications blackouts. The actual interference that will be caused "will depend on how many nuclear bursts occur in what period of time, at what altitudes, and over what areas."⁹⁴ When this is coupled with the possibility of preinitiation of rounds, resulting in lower yields, there may only be a certain level to which the use of BNW can proceed tactically before the system collapses on its own and they can no longer be employed.

On the other hand, both Western and Soviet writers have noticed a tendency of war to escalate even if political and military leaders strive to keep it under control. William Kaufmann wrote that war "is a process so dynamic that it positively invites the resort to increasingly destructive influences."⁹⁵ Even more pessimistic are Soviet statements:

Once the military movements on land and sea have been started, they are no longer subject to the

desires and plans of diplomacy, but rather to their own laws, which cannot be violated without endangering the entire expedition.⁹⁶

It is quite possible that a field commander would "tend to use more and more weapons if it became apparent that a previous weight of attack was not having the desired effect.... Once the weapons he used included nuclear warheads, the likelihood is that more would be used."⁹⁷ Leon Sigal writes, in a sobering thought, that "in some cases there are no physical impediments to keep division commanders from deciding on their own to use the nuclear artillery at their disposal."⁹⁸ The tendency to use more rather than less, BNWs, is a likely aspect of any nuclear conflict yet falls into the category of the unquantifiable and imponderable.

Unfortunately, this study raises more questions than it answers. It does, however, suggest numerous areas that are open for further research. A controversial topic, yet one that should be addressed if BNW are to be used as warfighting implements is where the best level to place authority to expend nuclear munitions is. Another centers around what tactics to use at division and corps level. The doctrinal solution for fighting on a nuclear battlefield is to increase unit frontages to enhance dispersion. In the TCTS, the 10th Corps was responsible for a frontage that varied in width from 55 to 80 kilometers. According to FC 50-20, this frontage could have been increased to 160 to 200 kilometers.⁹⁹ The area assigned to the 10th Corps in this scenario appeared, however, to be

consistent with its environment and the assigned mission. More width was not needed, but given the coordination problems mentioned above, would increased depth be the answer to a more efficient targeting of attacking forces? Finally, are today's officers equipped to handle the technical details that arise from the resort to nuclear war? The more one gets into the employment considerations and technical intricacies associated with BNWs, the more it feels like one is studying the arcane rites of an obscure priesthood. Is either side technically proficient enough to employ BNW in a manner consistent with doctrinal dictates?

Although Bernard Brodie wrote that "history suggests... Europe is not a good place to have a war if one wants to keep it reasonably manageable"¹⁰⁰ it remains a distinct possibility. It could very easily go nuclear as well, posing "the greatest challenge US forces have ever faced. To do less than have the best minds available attempting to anticipate and solve its formidable problems invites disaster and defeat."¹⁰¹ If the overwhelmingly destructive means available in such a war are not carefully tailored to its ends, such a war "might or might not achieve its object," as Michael Howard wrote, "but I doubt whether the survivors on either side would very greatly care."¹⁰² Yet as long as nuclear weapons form the foundation of the defense of Western Europe, we must consider the whys and hows of nuclear weapons use or invite an Armageddon.

ENDNOTES

- 1 Brodie, Bernard, "Nuclear Weapons: Strategic or Tactical?," Foreign Affairs, Vol. 32, No.2, Jan 1954, p. 224.
- 2 Midgely, John. Deadly Illusion (Boulder: Westview Press, 1986), p. 51.
- 3 Ibid., p. 63.
- 4 Baldwin, Hanson W., "The New Face of War," Bulletin of the Atomic Scientists, Vol XII, No. 5, May 1956, p. 154.
- 5 Zuckerman, Solly, Nuclear Illusion and Reality (New York: Vintage Books, 1983), pp. x-xi and 62-5. Hereafter referred to as Zuckerman.
- 6 Referred to as the "nominal 20-KT" in a number of sources. References are also made to 100 KT weapons as a "standard." Reinhardt, G.C. and W.R. Kintner. Atomic Weapons in Land Combat (Harrisburg, PA: The Military Service Publishing Company, 1954), p. 12.
- 7 Ibid, p. 13.
- 8 Ibid, pp. 200-1.
- 9 Fallout from the detonation of a nuclear weapon is caused by the fireball, the "luminous sphere of hot gases which forms a few millionths of a second after a nuclear (or atomic) explosion," touching the ground. FC 50-10 Soldier Dimensions on the Nuclear Battlefield (Ft. Leavenworth, KS: US Army Combined Arms Combat Developments Activity (CACDA), Nuclear and Chemical Directorate, 1 January 1986), p. B-3. Hereafter referred to as FC 50-10. FM 101-31-1 Nuclear Weapons Employment Doctrine and Procedures (Washington, D.C.: Department of the Army, Jan. 1986), pp. 99-100, states that a low airburst takes place at that vertical distance from the earth's surface which gives a 99 per cent assurance of no militarily significant fallout. A near-surface burst is one that occurs "in the atmosphere but low enough so that the fireball contacts the surface" and so will cause fallout. Hereafter referred to as FM 101-31-1. In this paper, a surface burst is used to describe any detonation that will cause fallout. The term airburst will refer to non-fallout producing detonations.
- 10 Taylor, Maxwell. Swords and Plowshares (New York: W.W. Norton, 1972), p. 167.

11 Garrett, James, "Nuclear Weapons for the Battlefield: Deterrent or Fantasy?" The Journal of Strategic Studies, Vol. 10, No. 2, June 1987, p. 173. Hereafter referred to as Garrett.

12 The curves in the figure illustrate "the ranges over which radiation (immediate transient incapacitation from 3000 cGys prompt exposure), thermal (second degree burns under chemical protective overgarment), and blast (bodily injury from decelerative tumbling) casualties occur depending upon tactical weapon yield. Adapted from FC 50-10, p. 4-3. FM 101-31-3 Nuclear Weapons Employment Effects Data (Washington, D.C.: Department of the Army, Jan. 1986, p. 1-5 defines immediate transient ineffectiveness as that level of radiation where "personnel become ineffective for any task within 3 minutes of exposure and remain so for approximately 7 minutes...." Personnel will remain ineffective or severely performance degraded until death occurs in 5-6 days. Hereafter referred to as FM 101-31-3.

13 FM 100-30, p. Glossary-10, defines tactical nuclear weapons by area, yield, and weapons system. They are "for battlefield use (against military targets), with deployment, ranges, and yields consistent with such use and confined to the immediate zone of military operations in a localized conflict (term applies to strikes against military forces in and around the forward edge of the battlefield).... Primarily sub-kiloton nuclear weapons but could go as high as 10 kt.... Artillery fired atomic projectile... tactical air plus other systems that can fire within above area and yield constraints." Based on these considerations, the weapons involved in this study are not necessarily tactical. They are being used at the tactical level by a tactical level commander however. This may indicate a problem with the definition of the term. An argument has also been made that any nuclear weapon that is used on Allied soil would be considered strategic by the unfortunate ally. I will, therefore, use the term battlefield nuclear weapons (BNW) to refer to the weapons in this study. This manual will hereafter be referred to as FM 100-30.

14 The term "rad" is a shorthand method of saying "radiation absorbed dose." It is used to measure accumulated exposure to radiation. An exposure to 1000 rads will cause severe and prolonged nausea, vomiting, and fever within one-half to one hour and deaths within 14 days to all who have received this amount of exposure. RB 100-34 Operations on the Integrated Battlefield (Ft. Leavenworth, KS: USACGSC, March, 1981), pp. 2-2 and E-4 and FM 3-100 NBC Operations (Washington, D.C.: Department of the Army, 17 Sept 1985), Glossary, p.12.

FC 50-10 gives the following data for comparison -

<u>Dose</u>	<u>Symptoms</u>	<u>Results</u>
0-75	slight vomiting in up to 5% of personnel	combat effective - no deaths
75-150	same as above but in 5-30% of personnel	same as above

150-300	mild to moderate nausea and vomiting in 20-70% of personnel	death may occur in up to 10% of personnel
300-530	moderate nausea and vomiting in 50-90% of personnel	10-50% deaths after 4 weeks
530-830	moderate to severe nausea and vomiting in 80-100% of personnel	50-99% deaths after 3 weeks
830-1500	moderate to severe symptoms, disorientation in 100% of personnel	if more than 1000 cGys then death will result in 1 to 3 weeks
1500-3000	severe symptoms, fluid loss, headache in 100%	if more than 2500cGys, death occurs in 5-12 days
3000-8000	incapacitation in 100% for 15 minutes	if more than 4500 cGys, 100% deaths in 2-3 days

15 Reinhardt, Klaus, "Problems of Employing Nuclear Weapons Considering the Special Situation of the Federal Republic of Germany," RB 101-31 (Ft. Leavenworth, KS: April 1980), pp. 7-7 to 7-8.

16 From comments made by Admiral Stansfield Turner in a speech to the Naval War College as reported by COL (ret.) Harry G. Summers in "Military advice for new president [sic]," The Kansas City Times, September 17, 1988, p. A21.

17 Buzzell, Calvin and John Rose, "New Concept for Battlefield Employment of Nuclear Weapons," Military Review, 61, August, 1981, p. 69.

18 Gray, Colin, "Nuclear Strategy: A Regrettable Necessity," S AIS Review, reproduced in Readings in Theater Operations: Strategic Nuclear Warfare (Ft. Leavenworth, KS: USACGSC, AY 1884-5), pp. 14-5.

19 Sollinger, Jerry. Improving US Theater Nuclear Doctrine: A Critical Analysis (Washington, D.C.: NDU Press, 1983), p. 21. This is not substantiated in the text, however. The latitude that whoever made this judgement had could have been substantial and exaggeration is most certainly present. Hereafter referred to as Sollinger.

20 Howard, Sir Michael, "On Fighting a Nuclear War," International Security, Spring 1981, Vol. 5, No. 4, p. 14. Hereafter referred to as Howard.

21 Halperin, Morton. Limited War in the Nuclear Age (Westport, CT: Greenwood Press, Publishers, 1963), p. 59.

22 Ibid, p. 64.

33 Reed, p. 43.

34 The Pre-Command Course is a short block of instruction given at Ft. Leavenworth, Kansas, to newly-selected battalion and brigade commanders to acquaint them with the latest doctrines and administrative procedures in the Army.

35 FC 50-10, p. 2-5, states that the "50 kiloton yield was chosen [in a particular example] as being representative of a 'typical' threat weapon." FC 50-20 Nuclear Considerations for Operations on the Air Land Battlefield (Ft. Leavenworth, KS: CACDA, Nuclear and Chemical Directorate, 1 February 1984), p. 1-11, uses a 10 KT weapon in the attack of an artillery battalion. Stephen Meyer claims that Soviet studies "suggest that a 20-kiloton (KT) weapon is sufficient to render an infantry battalion useless. (Two such weapons are required if the battalion is in column formation.)" A 50-division force would require between 18 and 25 megatons. "Of course, poor accuracy would drive warhead yields up and low reliability and survivability would call for a greater number of delivery vehicles and warheads..." in Soviet Theater Nuclear Forces Part I: Development of Doctrine and Objectives (London: The International Institute for Strategic Studies, 1983), p. 37.

36 Sollinger, p. 15.

37 Garrett, p. 180.

38 ST 3-1, p. 5-47.

39 Arkin, William, and Richard Fieldhouse. Nuclear Battlefields (Cambridge, Mass.: Ballinger Publishing Co., 1985), p. 61. The authors state that "it was not until 1981 that the Soviet's widespread adoption of nuclear artillery was confirmed.... DOD has concluded that the 152mm, 180mm, 203mm, and 240mm calibers are nuclear capable.... Nuclear-capable self-propelled 152mm artillery guns are now assigned to Soviet divisions."

40 Numbers and yields are drawn from FM 100-2-3, FC 101-5-2, Meyer's article, and ST 100-3. Soviet numbers include all weapons belonging to the 2 Western Front which is attacking two separate corps areas. Approximately 2/3 of these weapons will face 10th Corps if the 1st Guards Tank Army in the second echelon is committed in support of the 8th Combined Arms Army (the first echelon).

41 Kelleher, p. 70.

42 Reed, p. 41.

23 Sollinger, p. 21.

24 Michael Howard quoted in Zuckerman, p. 76.

25 TRADOC Common Teaching Scenario, revised October 1985 (Ft. Leavenworth, KS: USACGSC). Page I-1 states that the TCTS "was designed to teach military operations applying AirLand Battle doctrine." However, the "material is designed solely for use in TRADOC instruction. It does not purport to reflect the plans, intentions, or policies of the United States of America or its Allies."

26 There are three wargaming techniques. The "avenue-in-depth" method focuses on one avenue of approach at a time with emphasis on the main avenue. The "belt" technique divides the battlefield into sectors along its width. The gamer then analyzes actions sequentially along its depth to determine possible actions and counteractions of opposing forces. The "box" technique is a "microanalysis of a few critical areas" and focuses in on the most critical areas in a more detailed analysis. ST 100-9 The Command Estimate. (Ft. Leavenworth, KS: USCGSC, July 1988), pp. 4-3 to 4-4. I attempted to have the agencies on post that run computer simulations run these scenarios. None of the computer models that involve the use of nuclear weapons consider the effects of fallout or residual radiation, however.

27 Kelleher, Catherine. "Managing NATO's Tactical Nuclear Operations," Survival, International Institute for Strategic Studies, Jan/Feb, 1988, p. 61. ADMs have apparently been removed and the nuclear weapons stockpile is at its lowest level in 25 years. Significant cuts have also been made in short and medium range systems. Hereafter referred to as Kelleher.

28 Garrett, p. 169 (figures and quote).

29 One author writes that the "significant feature is not numbers of delivery vehicles but numbers of deliverable nuclear explosives." Garrett, p. 169.

30 ST 3-1 Fundamentals of NBC Operations (Ft. Leavenworth, KS: USACGSC, July 1987), p. 5-49. Hereafter referred to as ST 3-1.

31 Ibid, p. 5-51. A "pulse" is the firing of a "package" in the shortest time possible to obtain the shock effect desired and convey to an enemy that nuclear weapons are being used in a limited manner." Reed, Jean D. NATO's Theater Nuclear Forces: A Coherent Strategy for the 1980's (Washington, D.C.: NDU Press, 1984), p. 42. Hereafter referred to as Reed.

32 This example of a corps "package" was developed by Mr. Dick Wright in the Nuclear and Chemical Directorate, CACDA.

- 43 Thies, Wallace, "On NATO Strategy: Escalation and the Nuclear Allergy," Parameters, Vol.XVIII, No. 3, September, 1988, p. 20.
- 44 Reed, p. 41.
- 45 RB 100-30 Volume #1: Tactical Nuclear Operations - Doctrine (Ft. Leavenworth, KS.: USCGSC, April 1980), p. 2-1.
- 46 Ibid, p. 3-2.
- 47 Reed, p. 9.
- 48 FM 100-30, emphasis added. Perhaps the understatement of the nuclear age is in CGSC 50-25 Nuclear Operations in Support of the AirLand Battle (Ft. Leavenworth, KS: USACGSC, June 1986), p. ii. "There is no doubt that the use of nuclear weapons by the U.S. will make a political statement." Hereafter referred to as CGSC 50-25.
- 49 FC 50-20 Nuclear Considerations for Operations on the Air Land Battlefield (Ft. Leavenworth, KS: CACDA, Nuclear and Chemical Directorate, 1 February 1984.), p. 2-4. Hereafter referred to as FC 50-20.
- 50 CGSC 50-25, pp. 2-5 to 2-6.
- 51 RB 100-30, p. 2-3.
- 52 FM 100-30 Nuclear Operations in Support of AirLand Battle (Final draft being submitted to TRADOC for approval), U.S. Army Combined Arms Combat Developments Activity, Dec. 1987, p. A-B-2. Hereafter referred to as FM 100-30.
- 53 FC 50-20, p. 1-3. FM 100-30 has apparently modified this somewhat as the brigade commander and his fire support coordination officer will "determine the effects a given nuclear aim point will have on the brigade scheme of maneuver. He will then inform the division commander of the consequences of the parameters of the subpackage." (p. A-B-2)
- 54 Reed, p. 13.
- 55 FM 101-31-1, p. 2.
- 56 FM 100-30, p. 1-2.
- 57 Arnett, Robert, "Soviet Views on Nuclear War," in Kincaide, William H. and Jeffrey D. Porro, Negotiating Security (Washington, D.C.: The Carnegie Endowment for International Peace, 1985), p. 120.

- 58 Howard, p. 7.
- 59 From the draft manuscript of a forth-coming book to be published by the National Defense University Press that contains a series of lectures from the Voroshilov Military Academy (provided by the Soviet Army Studies Office at Ft Leavenworth).
- 60 Douglass, J. "Soviet Strategy for Nuclear War," in Readings in Theater Operations: Strategic Nuclear Warfare (Ft. Leavenworth, KS: USACGSC, AY 1884-5), p. 42.
- 61 Meyer, Stephen. Soviet Theater Nuclear Forces Part I: Development of Doctrine and Objectives (London: The International Institute for Strategic Studies, 1983), p. 24.
- 62 Ibid. These targets include command and control facilities, airbases, ICBM silos, and so on.
- 63 Cimbala, Stephen, "Soviet 'Blitzkrieg' in Europe: The Abiding Nuclear Dimension," Strategic Review, Vol XIV, No. 3, Summer 1986, p. 69. Hereafter referred to as Cimbala.
- 64 Meyer, p. 25.
- 65 Ibid, p. 32.
- 66 Cimbala, p. 68.
- 67 Meyer, p. 28. Emphasis in the original.
- 68 Sigal, Leon. Nuclear Forces in Europe: Enduring Dilemmas, Present Prospects (Washington, D.C.: The Brookings Institution, 1983), p. 157. Hereafter referred to as Sigal. Record, Jeffrey, "U.S. Tactical Nuclear Weapons in Europe: 7000 Warheads in Search of a Rationale." Kincaide, W. and Jeffrey D. Porro, eds. Negotiating Security. Washington, D.C.: Carnegie Endowment for International Peace, 1979. p. 126.
- 69 Collins, Arthur S., "Neutron Weapons: A Military Perspective." Kincaide, W. and Jeffrey D. Porro, eds. Negotiating Security. Washington, D.C.: Carnegie Endowment for International Peace, 1979. p. 136.
- 70 Meyer, p. 30.
- 71 Ibid, p. 31.
- 72 Ibid, p. 47, footnote 121.

73 FC 50-20, p. 1-5.

74 From an interview with Dr. Jake Kipp, Soviet Army Studies Office, on 1 November 1988

75 FM 100-30, p. 2-10.

76 Cimbala, p. 73.

77 FM 100-2-1 The Soviet Army: Operations and Tactics. (Washington, D.C.: Department of the Army, 16 July 1984), p. 16-1.

78 Ibid, p. 2-9.

79 FM 101-31-1, p. 89.

80 Kaufmann, William, Planning Conventional Forces, 1950-80 (Washington, D.C.: The Brookings Institution, 1982), p. 22.

81 This information is drawn from various places in the TCTS. The U.S. forces are fully modernized and equipped with M1s and M2s. Although air units are not played in this study's scenarios, over 600 Warsaw Pact sorties are expected per day in the corps area until D+2 when sortie rates are expected to drop off. A number of these aircraft are expected to be nuclear capable.

82 TCTS, p. XXIV-35.

83 This is, admittedly, an optimistic figure. Kelleher states that the estimate of 24 hours from time of request to release is "obviously dependent upon the situation. Other estimates suggest perhaps as many as 60 hours would be required even under the most favourable conditions; the only known available exercise evidence - the command post NATO exercises known as *Wintex* - seems to support this contention." Kelleher, p. 65.

84 I have chosen to use the 2.5 yield for the U.S. and Soviet low-yield artillery weapons as the numbers were not very different in terms of contamination and made the computations simpler. Fallout Zone I is an area of "immediate operational concern." Units in this area can expect to receive up to 150 cGys (Centigrays - the metric equivalent of rads) in less than four hours. "Major disruptions of unit operations within portions" of this area are expected. Personnel in Zone II can continue critical missions for up to four hours if they have not been previously exposed. If the cumulative dosage has been up to 150 cGys, then serious disruption of the unit's mission and casualty producing doses can be expected. FM 3-3, pp. D-1 and D-2.

85 The preclusion method of targeting involves looking for areas that you want to limit damage to and adjusting aimpoints or weapons yields from there. The target oriented method involves looking for the best aimpoint and yield to give you maximum damage to the target. Also, nuclear weapons were targeted at military facilities and units, not utilized for denial operations.

86 The "Totals" column represents total Zone I and II contamination by weapon. This does not occur in bands across the battlefield but as a series of "hot spots" where a number of rounds have detonated and are surrounded in some places by fallout zones. The pattern is otherwise random.

87 FM 3-3, p. 1-2.

88 Ibid. Unless monitoring is done, long-term casualties can result from accumulated radiation at lower dose rates. The rate of decay of the areas contaminated by fallout depends on many factors. Some of these are the type of weapon (fission versus fusion), type of active materials, type and amount of material sucked into the fireball, "salting" the weapon to slow the decay, and overlapping areas of fallout. It cannot be predicted until a series of dose-rate readings are taken after fallout has stopped arriving. FM 3-3, p. 3-2 and K-2. It may drop off fairly quickly or stay in the area as a significant obstacle for several days, weeks, or months.

89 Ibid, p. N-9.

90 FM 101-31-3, p. 79. The following is derived from FM 3-3. NIGA is expected to be the quickest type of residual radiation to decay. Soil composition is the most important factor in predicting the decay rate as the per cent by weight of materials is the prime determinant. Up to 30 minutes after detonation, aluminum is the principal radioactive element. After 10 to 20 hours, sodium becomes the chief cause of NIGA. Soils have been classified into four types for use in calculating decay. Using Type II, that with the slowest decay rate, the following chart can be developed for an initial contamination of 150 cGys:

Time (Hours)	Rate (cGys)
H+0	150
H+24	34
H+48	11
H+96	1

Fallout calculations are more difficult. "Meaningful dose rate and total dose calculations cannot be performed until the decay rate is known.... Accurate determination must wait until several sets of directed NBC-4

[contamination] reports are available." Decay rates are determined using the Kaufmann equation $R_1 T_1^n = R_2 T_2^n$ where R=dose rate at a location, T=time in hours after H-hour, n=decay exponent, and 1 and 2 represent different times after H-Hour. Variations of n are expected to be from .2(slowest) to 2 (quickest) with the standard rate being 1.2. The following chart illustrates the wide variation in rates of decay and the unpredictable nature of fallout.

Rates in cGys		
Time	n=1.2	n=.2
H+0	150	150
H+24	3.5	80
H+48	1.5	75
H+96	less than 1	62
H+250 (10 1/2 days)		50

91 I used a simplified fallout prediction to develop these numbers. The prediction of fallout is inherently inaccurate, and so "these methods can be used only to identify suspect areas for early monitoring and survey or to plan the movement of units. They are not to be used as a sole basis for executing operational moves." FM 101-31-1, p. 11. They do, however, indicate the scale of projected "hot spots" on the battlefield. It is not clear who fallout will hamper the most. Although the ability of Soviet forces to maneuver may be restricted the most near the FLOT, due to Soviet use of nuclear weapons in rear areas, the movement of NATO brigade and higher reserve formations or logistical units may be severely constrained.

92 Garrett, p. 175.

93 Ibid.

94 FM 101-31-3, p. 8.

95 Kaufmann, William, "Limited Warfare." Military Policy and National Security (Princeton: Princeton University Press, 1956), p. 112.

96 From Douglass, p. 49, a quote from Engels in The People, The Army, The Commander.

97 Zuckerman, p. 68

98 Sigal, P. 161.

99 FC 50-20, p. 2-1.

100 Brodie, Bernard, "Unlimited Weapons and Limited Wars," The Reporter, November 18, 1954, p. 20.

101 Sollinger, p. 55.

102 Howard, p. 17.

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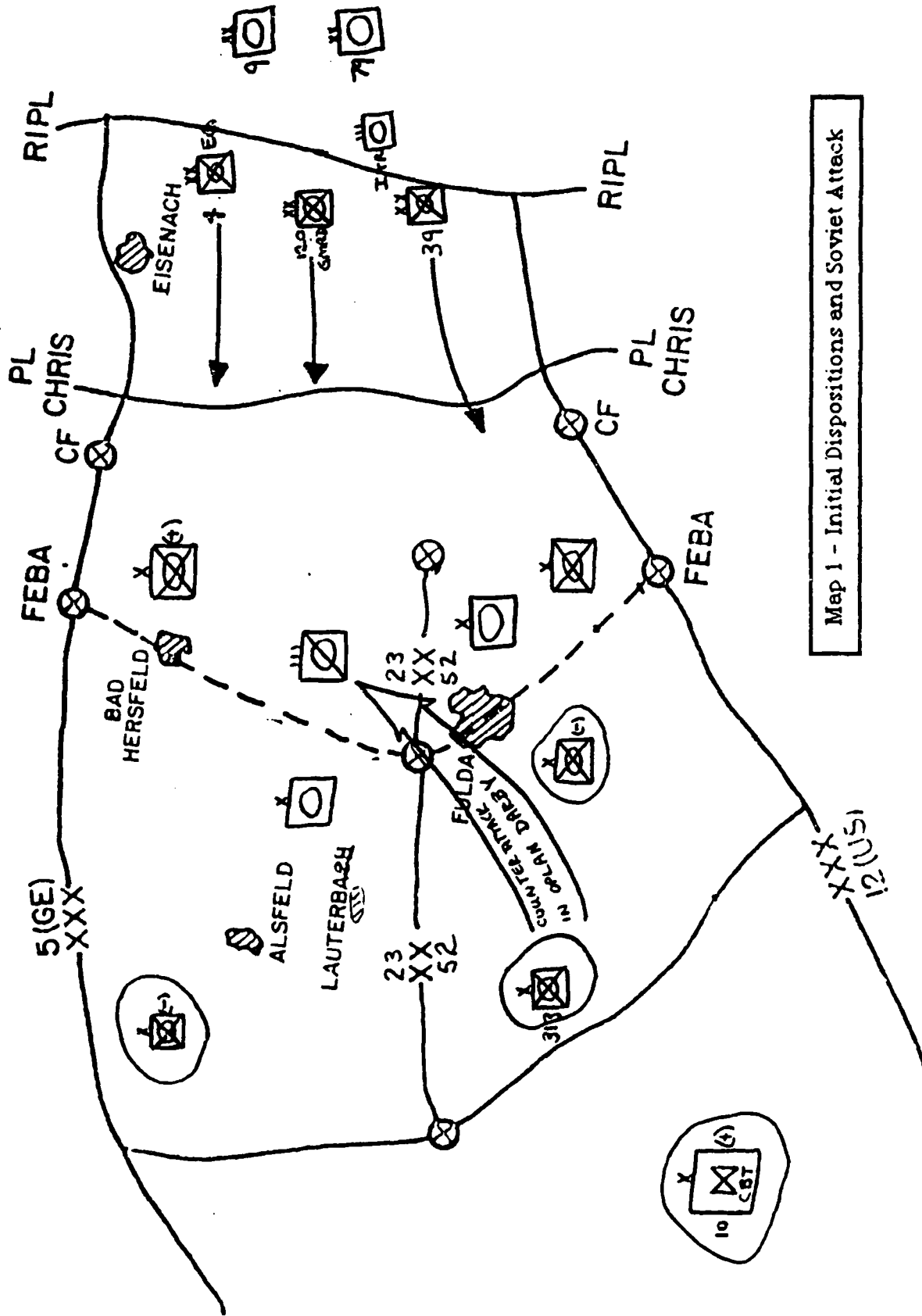
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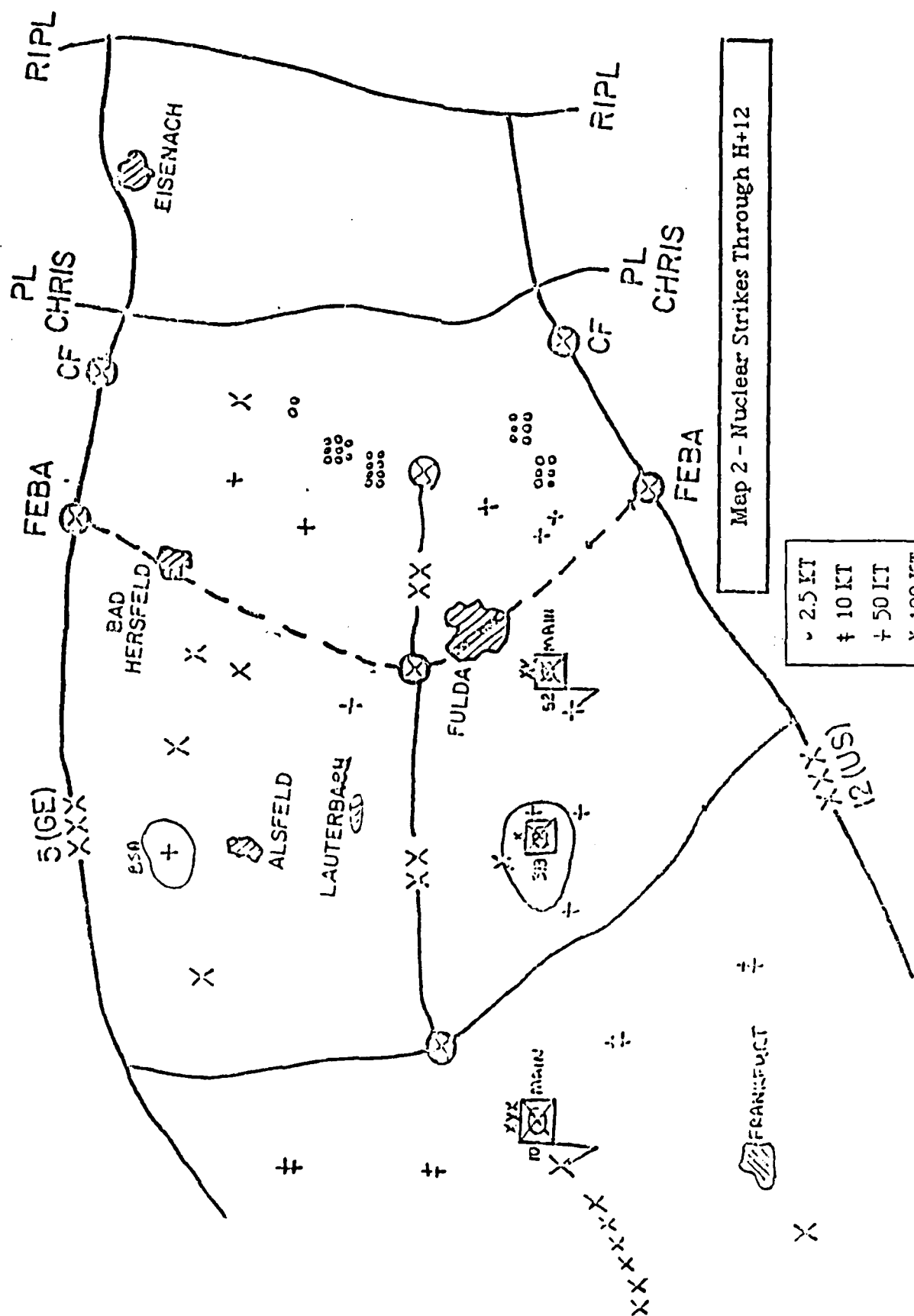
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Map 1 - Initial Dispositions and Soviet Attack



Map 2 - Nuclear Strikes Through H+12

o	2.5 KT
+	50 KT
X	100 KT

FRANKFURT

X

12 (US)

RIPL

PL CHRIS
CF

FEBA

5 (GE)
XXX

BAD HERSFELD

BSA

ALSFELD

LAUTERBAH

EISENACH

FULDA

SIB

10 main

S2 main

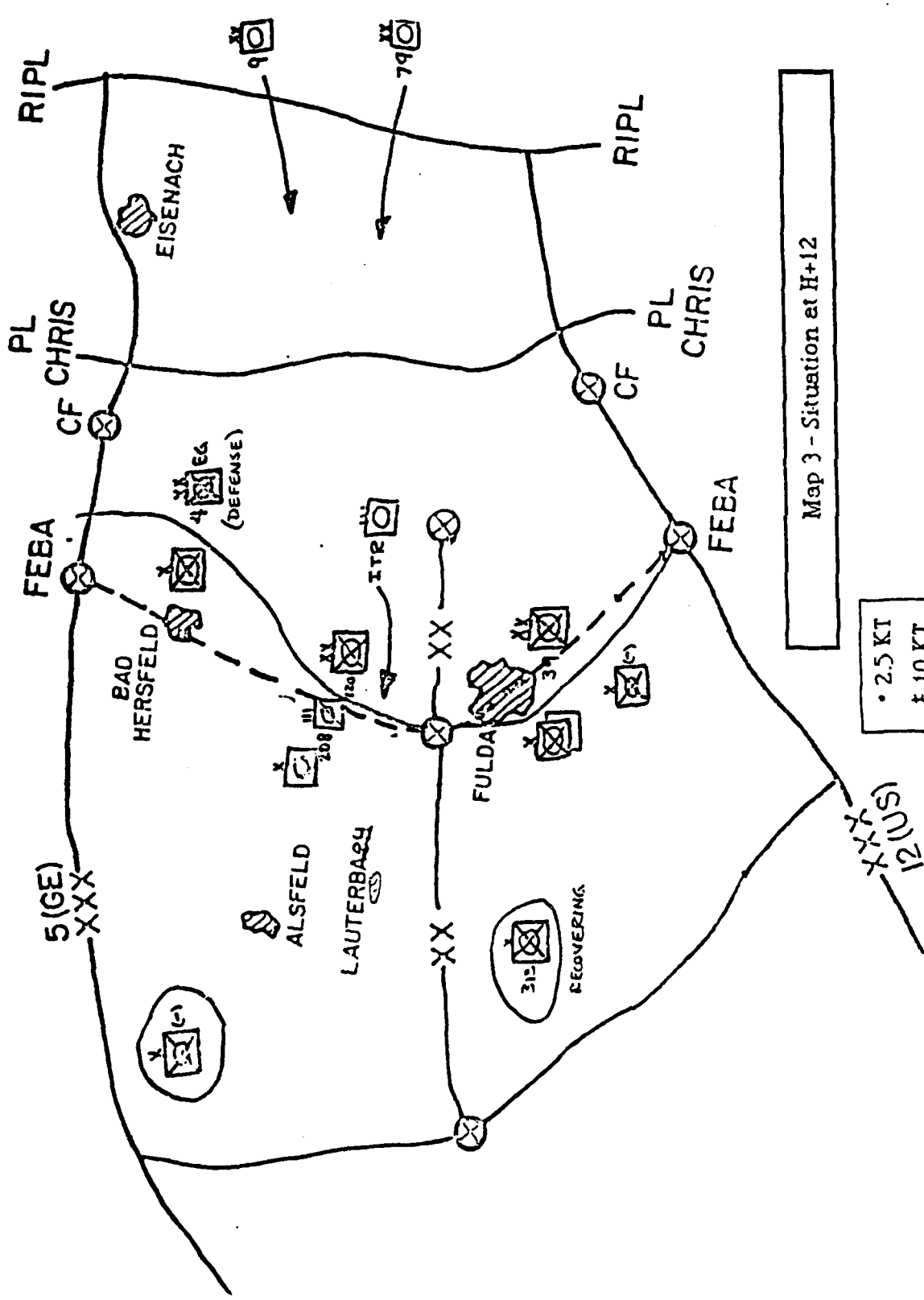
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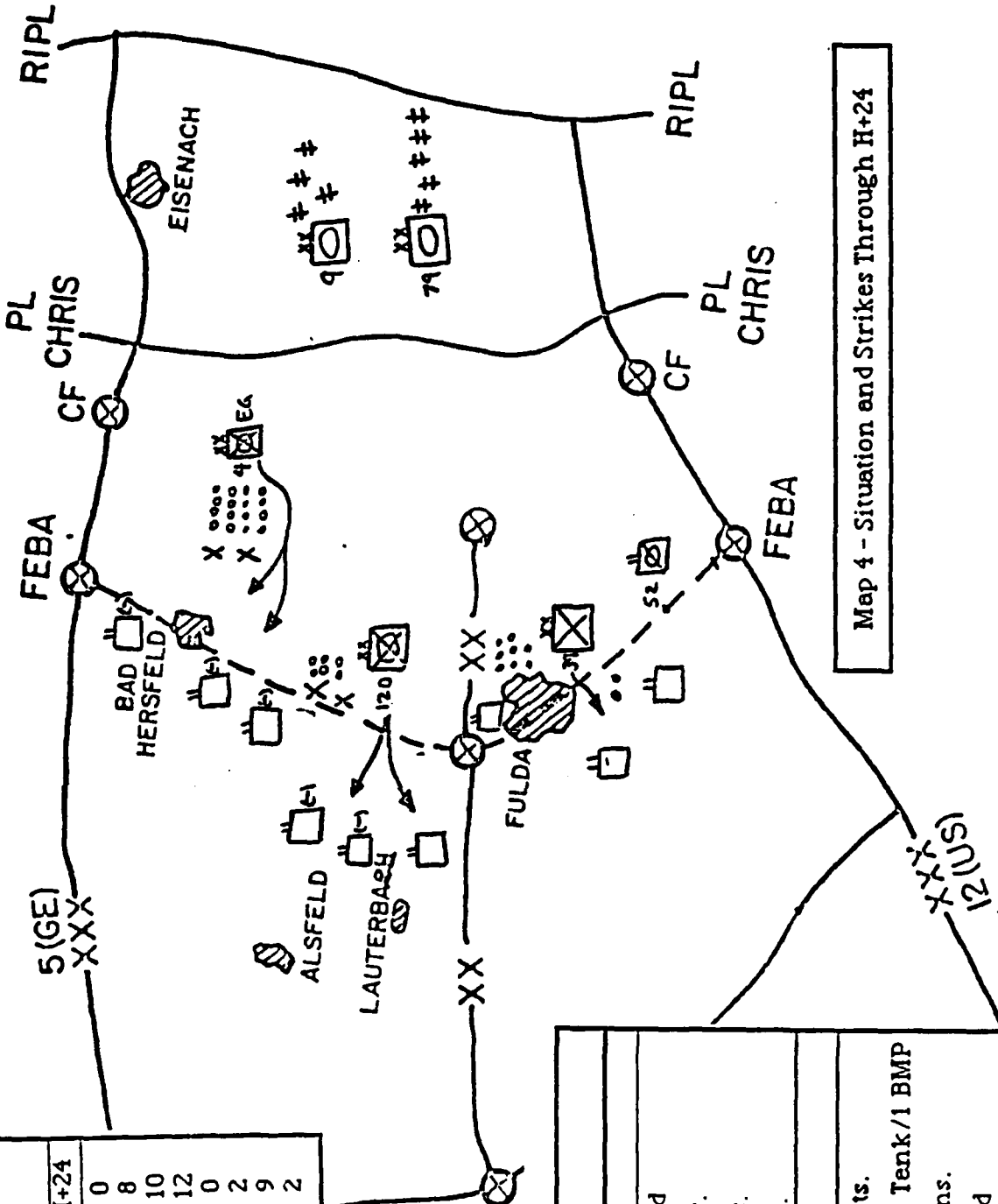
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Map 3 - Situation at H+12

•	2.5 KT
F	10 KT
+	50 KT
X	100 KT

US Nuclear		
Type	Rounds Remaining	
	H+0	H+24
155	27	0
203	8	8
	10	10
	15	12
Lance	10	0
	2	2
	9	9
Bombs	2	2



Map 4 - Situation and Strikes Through H+24

Forces at H+24	
US	Destroyed
208 ACR	4 1/2 Bns.
52 Mech	5 1/2 Bns.
23 AD	1 1/2 Bns.
313 Sep Bde	
Soviet	
4 EG	1 1/2 Regts.
120 GMRD	2 Regts. 1 Tank/1 BMP
39 MRD	2 Tank Bns.
ITR	Destroyed
79 TD	3 Regts.
9 TD	3 Regts.