

# NAVAL POSTGRADUATE SCHOOL MONTEREY, CALIFORNIA



## THESIS

### **THE ROLE OF SPECIAL OPERATIONS FORCES IN OPERATIONS AGAINST THEATER MISSILES**

by

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March, 1996

Thesis Advisor:

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**THE ROLE OF SPECIAL OPERATIONS FORCES IN OPERATIONS  
AGAINST THEATER MISSILES**

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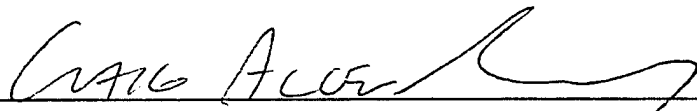
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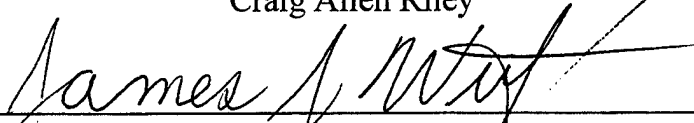
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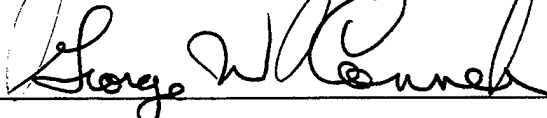
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## **ABSTRACT**

From World War II until the present, the U.S. military has not been able to defeat theater missiles attacks. Post-war analysis of attack efforts during World War II and the Persian Gulf War could not identify a single instance when either a German V weapon or an Iraqi SCUD was destroyed before launch. During the Cuban Missile Crisis, the best estimate that the Air Force could provide the National Command Authority was that ninety percent of the Soviet missiles in Cuba would be destroyed by an airstrike.

To correct this deficiency, the military developed joint theater missile defense (JTMD) doctrine. This doctrine attempts to integrate synergistically all U.S. military assets and capabilities. However, this doctrine does not fully integrate special operations forces (SOF) into attack operations against theater missiles. Additionally, the joint tactics, techniques, and procedures needed to implement this doctrine have not been developed. The integration of SOF's capability to conduct pre-strike and post-strike reconnaissance, critical material recovery operations and target acquisition tasks can immediately improve JTMD capabilities.



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## EXECUTIVE SUMMARY

Since the first use of V-1 flying bombs and V-2 rockets by Germany in World War II, to the use of the SCUDs by Iraq in the Persian Gulf War, the U. S. military has not been able to defeat enemy theater missile (TM) attacks. Within the U.S. military, each service conducts TM defense and/or interdiction operations. These separate operations have been poorly coordinated and produced only limited success despite the superiority of U.S. air and land power. The Air Force attempts to destroy TMs, their transporter-erector-launchers (TELs), and supporting infrastructure. Meanwhile, special operations forces (SOF) also conduct special operations (SO) to destroy TMs, their TELs, and supporting infrastructure. If separate Air Force and SOF efforts fail to stop TM launches, Army air defense assets attempt to destroy the TMs in their terminal stage of flight. Singly, none of these operations can guarantee destruction of the enemy TMs. Meanwhile, civilians, usually the intended enemy targets, have been left to hide in their basements or bomb shelters.

This thesis defines TMs as ballistic, cruise, and air-to-surface missiles with ranges over 260 kilometers that carry payloads over 300 kilograms, but whose targets are within a given theater of operations. This definition combines the Joint Staff definition of TM, the Missile Technology Control Regime's missile definition, and considers the area of influence and the range of maneuver and fire support assets under the command of an Army ground commander.



Since the Persian Gulf Conflict, the U.S. military is working to develop a coherent joint theater missile defense (JTMD) doctrine and the joint tactics, techniques, and procedures (JTTPs) to implement it. The JTTPs are the "how to" actions and methods that implement joint doctrine. There is a weakness in current JTMD doctrine and JTTPs. The unique capabilities of SOF are not integrated into attack operations against TMs. This weakness is critical. Some form of "eyes on target" is needed at one or more phases of an attack operation to ensure success in destroying TMs aimed at politically or militarily significant targets. Special operations forces can provide those eyes.

The integration of SOF into JTMD doctrine and JTTPs can immediately improve JTMD attack operations capabilities. Improving JTMD attack operations capabilities increases the probability of success for the other elements of JTMD doctrine. Prior to a strike, SOF can assist in the detection, identification, and acquisition of TMs, its TELs, or supporting infrastructure. If necessary, SOF can assist Air Force assets strike TM targets by using terminal guidance or beacon capabilities. If immediate confirmation of destruction of a TM target is critical, SOF can conduct post-strike reconnaissance/battle damage assessment and determine the extent of the damage to the TM target. If necessary, SOF can coordinate follow-on strikes to ensure destruction of the TM target. Finally, if recovery of TM components is critical for military, intelligence, political or environmental value, SOF has that capability as well.

This thesis examines the question: What is the role of SOF in operations against TMs? It uses a comparative case analysis of three historical cases involving U.S. and Allied/Coalition attempts to destroy or interdict TMs. The first is Allied efforts to stop German V weapons' attacks during World War II. The second is U.S. and Coalition attempts to stop Iraqi SCUD attacks during the Persian Gulf War. The final case examines U.S. military planning efforts to destroy Soviet missiles in Cuba during the Cuban Missile Crisis. All three cases demonstrate the difficulty of destroying TMs without some form of "eyes on target" at one or more phases of an attack operation.



## I. DEFENDING AGAINST MISSILE ATTACKS

The U. S. military is unable to defeat enemy theater missile (TM) attacks. There are three internal reasons for this inability. First, our military lacks effective joint theater missile defense doctrine (JTMD).<sup>1</sup> Second, our military lacks the joint tactics, techniques, and procedures (JTTPs) to implement effective JTMD doctrine. Third, the lack of effective JTMD doctrine and JTTPs prevents special operations forces (SOF) from being integrated into operations against TMs. The solution requires the United States military to do three things. First, it must develop comprehensive JTMD doctrine that overcomes the existing competing and incompatible service oriented concepts that plague current JTMD doctrinal efforts. Second, our military must develop effective JTTPs that implement this JTMD doctrine. Third, our military must ensure that SOF is incorporated into the improved JTMD doctrine and the JTTPs that implement it.

Since the first use of V-1 flying bombs and V-2 rockets by the Germans in World War II, missile attacks have been difficult to defend against. Within the U.S. military, each service conducts defense and/or interdiction operations against enemy missiles.<sup>2</sup> These separate operations have been poorly

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<sup>1</sup>Doctrine is the fundamental principles that guide the actions of military forces. It is authoritative but requires judgment in application. Joint indicates that all of the services use the same doctrine. (Office of the Chairman, Joint Pub. 1-02, 1994, pp. 120 and 200)

<sup>2</sup>Operations are combat or other military actions to achieve specific objectives (Office of the Chairman, Joint Pub 1-02, 1994, p. 275). Operations are larger in scale and refer to general types to activities or capabilities. Missions refer to a specific military task that clearly indicates the actions to be taken and the reason therefor. Missions generally referred to a duty assigned to a specific unit (Office of the Chairman, Joint Pub 1-02, 1994, p.

coordinated and produced only limited success despite the superiority of U.S. air and land power.<sup>3</sup> The Air Force attempts to destroy enemy TMs, their transporter-erector-launchers (TELs), and supporting research, manufacturing, and transportation infrastructure. Meanwhile, SOF also conducts special operations (SO) to destroy enemy TMs, TELs, and supporting infrastructure.<sup>4</sup> If Air Force and SOF efforts fail to prevent enemy TMs from being launched, Army air defense assets attempt to destroy the TMs in their terminal stage of flight. Singly, none of these operations can guarantee destruction of enemy TMs. Meanwhile, civilians, usually the intended enemy targets, have been left to hide in their basements or bomb shelters.

#### **A. THE DEFINITION OF THE THEATER MISSILE**

This thesis defines TMs as ballistic, cruise, and air-to-surface missiles with ranges over 260 kilometers that carry payloads over 300 kilograms, but whose targets are within the same theater of operations. This definition combines the Joint Staff definition of TM, the Missile Technology Control Regime's (MTCR) missile definition, and considers the area of influence of an Army ground commander.

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245).

<sup>3</sup>During the Persian Gulf War, initial reports indicated that conventional and SOF strikes against TMs, their TELs, and infrastructure were successful. Further analysis revealed the inaccuracy of the initial reports. (Miller, 1992, p. A-24; Powell, April 1992, pp. 48-53; Powell, October 1992, pp. 32-35; Schneider and Fink, 1991, pp. 12-13)

<sup>4</sup>Special operations are conducted by SOF to achieve military, political, economic, or psychological objectives by unconventional military means in hostile, denied, or politically sensitive areas. Special operations differ from conventional operations in the degree of physical and political risk, operational techniques, mode of employment, independence from friendly support, and dependence on detailed operational intelligence. (Office of the Chairman, Joint Pub 3-05, 1992, p. GL-20)

The Joint Staff defines TMs as:

ballistic, cruise, and air to surface missiles whose targets are within a given theater of operations. Short range, non-nuclear, direct fire missiles, bombs, and rockets such as Maverick or wire-guided missiles are not considered TMs. (Office of the Chairman, Joint Pub. 3-01.5, p. I-2)<sup>5</sup>

The phrase, "within a given theater of operations," excludes intercontinental ballistic missiles (ICBMs) capable of reaching the United States as a TM threat.<sup>6</sup> The term theater missile is used because the U.S. military's war fighting strategy delegated the theater commander in chief (CINC) to fight wars.<sup>7</sup> This thesis builds on the Joint Staff definition of TM. It considers current related academic literature and applicable U.S. military doctrine.

Current academic literature calls TMs theater ballistic missiles (TBMs), tactical missiles, or short-range missiles. One definition of TBM is "a missile with a range of 600-3000 kilometers." Tactical or short-range missiles have been defined as "missiles with a range between 0-600 kilometers." (Yarymovych, 1995, p. 1)

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<sup>5</sup>A laser guided bomb (LGB) has a range of up to seven miles. A maverick air to ground missile has a range of up to fifteen miles. The standoff land attack missile (SLAM) has a range of over fifty miles. (Department of Defense, 1992, pp. 775, 777, and 782)

<sup>6</sup>Intercontinental ballistic missiles have a range of 4000 miles or more (Smart, 1969, p. 2).

<sup>7</sup>A theater is defined as a geographic area outside the continental U.S. for which a combatant commander command has been assigned responsibility. Examples of U.S. theater commands include European Command (EUCOM), Central Command (CENTCOM), Pacific Command (PACOM), etc.. The combatant commander is also called the unified commander or theater commander in chief (CINC). The theater CINC's command authority is established by Title 10 U.S. Code. He has authority to organize forces, assign tasks, designate objectives, and give authoritative direction over all aspects of military operations including joint and combined operations. (Office of the Chairman, Joint Pub, 1-02, 1994, pp. 385 and 74) This thesis will use the term theater CINC exclusively.

A better definition of TM can be found within the MTCR. The MTCR is a voluntary regime designed to limit the export of missile technology capable of delivering weapons of mass destruction (WMDs).<sup>8</sup> The MTCR places two limits on the export of missiles and missile technology. The first limit restricts the transfer of technology that would enable a state to build a missile with a range of greater than 300 kilometers. The second limit restricts the payload of the same missile to less than 300 kilograms. (Spector, McDonough, with Medeiros, 1995, pp. 185-187) These limits restrict the possibility that a missile could carry a WMD any significant distance.

Military doctrine defines an area of interest as "a geographic area in which a commander is directly capable of influencing operations by maneuvering forces or employing fire support assets normally under that commander's command or control" (Office of the Chairman, Joint Pub 1-02, 1994, p. 33). This thesis uses 260 kilometers as the maximum depth of the ground commander's area of interest. It is used because 260 kilometers is the combat radius of the AH-64 Apache attack helicopter (Department of Defense, 1992, p. 669). This is the longest range weapon that an Army ground commander has under his command or control to conduct deep attack operations.

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<sup>8</sup>Weapons of mass destruction are weapons capable of a high order of destruction. They can be nuclear, chemical, biological, or radiological weapons. Radiological weapons employ radiological materials or radiation producing devices to cause casualties or restrict the use of terrain. This definition excludes the means of transporting or propelling the weapons where such means is a separate or divisible part of the weapon. (Office of the Chairman, Joint Pub 1-02, 1994, p. 412)

## **B. THEATER MISSILE THREAT SCENARIOS**

If an aggressor state does not possess TMs, then there is no TM threat. If an aggressor state possesses TMs, then there are three possible scenarios for the use of TMs. In the first scenario, an aggressor state has TMs armed only with conventional warheads. World War II and the Persian Gulf War are two examples of this type of scenario.<sup>9</sup> In the second scenario, an aggressor state has a small number of TMs possibly armed with WMDs. The Cuban Missile Crisis is an example of this scenario.<sup>10</sup> The third scenario involves a state that has a TM force armed with sufficient WMDs to have a credible second-strike retaliatory capability. Once an aggressor state deploys more than a small force level of TMs armed with WMDs, that state might then possess a credible second-strike retaliatory capability. The Cold War period after the Cuban Missile Crisis, between the United States and the Soviet Union, and the current Post-Cold War period, between the United States and Russia, are examples of this scenario.

This thesis examines the first two scenarios described above. Attack operations against conventionally armed TMs or against a small number of TMs armed with WMDs can only be successful in these two types of scenarios. A

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<sup>9</sup>Despite initial United States concerns about the possible use of chemical warheads on SCUD missiles by Iraq, military planning indicates that these weapons were soon considered militarily insignificant by the CINC and his staff.

<sup>10</sup>This thesis takes the stance that the Soviets risked placing nuclear armed missiles in Cuba to overcome the eighteen to one advantage in nuclear weapons the United States had over the Soviets. With that great disparity, the Soviets would not risk a nuclear war with the United States. As long as the United States only used conventional air and ground forces in Cuba, the Soviets only option was horizontal expansion of conflict on some other front, such as Berlin.



small force level of WMDs is not numerically defined in this thesis. It is not defined because the particular geopolitical circumstances, U.S. military capabilities, and U.S. domestic political concerns will impact on the National Command Authority's (NCA) determination of what number of TMs, possibly armed with WMDs, constitutes a credible second-strike capability.<sup>11</sup>

### **C. THE THEATER MISSILE PROBLEM**

There are four factors, outside the control of the U.S. military, which prevent current U.S. doctrine from enabling our forces to defend against TMs. These four external factors make up the TM problem. First, TMs produce a political impact beyond all proportion to their military significance. The significant political impact stems from the practice of using TMs against civilian population centers.<sup>12</sup> The political impact forces the military commander to make last minute changes to his plan of operation in response to unanticipated political pressure. These last minute changes may reduce the effectiveness of United States military capabilities.

Second, three TM characteristics and four TM employment techniques limit the capability of the United States military to defend against TMs. These TM characteristics are mobility, ease of concealment, and ease of maintenance

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<sup>11</sup>The NCA consists of the President and the Secretary of Defense together or their duly deputized alternates or successors. The term NCA is used to signify constitutional authority to direct Armed Forces in their execution of military actions. (National Defense University, 1993, p. 2-2)

<sup>12</sup> Besides the extensive use of TMs in World War II and the Persian Gulf Conflict, both Iran and Iraq used SCUD missiles extensively against each other's cities from 1982-1988 (McNaugher, 1990, p. 9).

and resupply.<sup>13</sup> The employment techniques include the use of deception, decoys, dispersion, and using civilians as shields. These characteristics and employment techniques compound an already difficult problem of detection, identification, continuous tracking and acquisition of targeting information, allocation of forces to strike, and finally striking to neutralize or destroy TMs.<sup>14</sup>

Third, TMs, both state of the art and simple systems, have proliferated throughout the world. This enables poor states to threaten U.S. national interests. Finally, if a TM is possibly armed with a WMD, any operation to destroy or neutralize it must be successful. Failure could be catastrophic.

#### **D. A PARTIAL SOLUTION - JOINT THEATER MISSILE DEFENSE**

Since the Persian Gulf Conflict, the U.S. military has been working to develop a coherent theater missile defense strategy. It is called joint theater missile defense (JTMD) doctrine. Joint theater missile defense:

applies to the identification, integration, and employment of forces supported by theater and national capabilities, to detect, identify, allocate, track, minimize the effects of, and/or destroy enemy TMs.  
(Office of the Chairman, Joint Pub 3-01.5, p. I-2)

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<sup>13</sup>During the Persian Gulf Conflict, many Iraqi modified SCUD missiles were fired from fixed, surveyed sights. Even these permanent sites were not completely destroyed or continuously monitored (Powell, October 1992, p. 33).

<sup>14</sup>Destruction is damaging a target until it is unusable and can not be repaired (Office of the Chairman, Joint Pub 1-02, 1994, p. 261). Neutralization, on the other hand, is a lower level of damage that renders a target ineffective or unusable. The target can still be dangerous and repairable (Office of the Chairman, Joint Pub 1-02, 1994, p. 378).

The term "joint" connotes activities, operations, etc., involving forces from more than one U.S. military service (Office of the Chairman, Joint Pub 1-02, 1994, p. 200). The need to integrate synergistically the different military services of the United States became apparent after the invasion of Grenada in 1983. Since Grenada, the U.S. military has attempted to integrate synergistically all U.S. Military Services and their capabilities. Joint doctrine is also supposed to integrate special operations forces and capabilities.

In 1986, Congress, through the Goldwater Nichols Act, decided to help the U.S. military with its efforts to become joint.<sup>15</sup> Prior to 1986, each military service was primarily responsible for developing its own strategy, doctrine, tactics, training, weapons, and equipment. Since 1986, the Chairman of the Joint Chiefs of Staff has been given the authority, responsibility, and assets to implement jointness.

Additionally, to ensure that SOF was effectively integrated into joint service doctrine, Congress established the United States Special Operations Command (USSOCOM). United States Special Operations Command is a unified command. It exercises command over all Army, Navy, and Air Force SOF units located in the continental United States. Part of USSOCOM's mission is to prepare assigned forces to carry out SO. Its functions include developing strategy, doctrine, tactics, and training for all SOF (United States

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<sup>15</sup>For further information see Di Rita, L.T., "Evolution of Jointness: The Color Purple," *Proceedings*, May 1995, p. 104.

Special Operations Command, 1988, pp. Intro-4 and 2-6). This mission is nearly identical to the missions of each of the individual military services.

Special Operations Forces (SOF) are military units of the Army, Navy, and Air Force designated for special operations (SO). They are organized, trained, and equipped specifically to conduct SO (Office of the Chairman, Joint Pub. 3-05, 1992, p. GL-20). This thesis focuses on Army SOF, specifically Special Forces (SF), Rangers, and Special Mission Units (SMUs).

There are three weaknesses in current JTMD doctrine. First, the doctrine has been under development or revision for over four years. Because of the lack of guidance and the changing nature of the JTMD doctrine, the separate Military Services have concentrated on their own separate theater missile defense (TMD) missions. Second, each Service's concentration on its own TMD mission has hindered the development of Joint Tactics, Techniques, and Procedures (JTTPs) for attack operations against TMs. Joint tactics, techniques, and procedures are actions and methods which implement joint doctrine and describe how forces will be employed in joint operations (Office of the Chariman, Joint Pub. 1-02, 1994, p. 207). Third, the lack of JTTPs for attack operations against TMs has prevented the successful integration of SOF's unique capabilities into attack operations against TMs.<sup>16</sup> This weakness is

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<sup>16</sup>Attack operations are not missions in themselves, but a way of characterizing offensive strikes against launch platforms and their supporting infrastructure, including logistics (Office of the Chairman, Joint Pub 3-01.5, 1994, p. III-12). Strike operations are attacks intended to inflict damage on, seize, or destroy an object. Counterforce operations employ strategic air and missile forces in an effort to destroy, or render impotent, selected military capabilities of an enemy force (Office of the Chairman, Joint Pub 1-02, 1004, p. 114 and 96). Academic literature defines counterforce operations against TMs as operations that attack TMs before they are launched from TELs or silos or while they still are in stockpiles. (Lennox, 1991, p. 302)

critical. Some form of "eyes on target" may be needed at one or more phases of an attack operation to ensure success in destroying TMs aimed at politically sensitive or militarily significant targets. Today, Special Operations Forces can provide those eyes.

#### **E. A BETTER SOLUTION**

The development of improved JTMD doctrine and the integration of SOF into that doctrine and the JTTPs that implement it can enhance JTMD attack operations capabilities. This, in turn, enhances overall JTMD capabilities. Prior to a strike, SOF can assist in the detection, identification, and acquisition of the TM, its TEL, or supporting infrastructure. If necessary, SOF can assist in the strike using terminal guidance or beacon capabilities. If immediate confirmation of destruction of a TM site is critical, SOF can conduct post-strike reconnaissance and determine the extent of battle damage to the TM target. If necessary, SOF can assist in coordinating follow on strikes.<sup>17</sup> Finally, if recovery of missile components from the TM site is critical for military, intelligence, environmental, or political purposes, SOF can perform this mission as well.<sup>18</sup>

Special operations forces involvement in operations against TMs will normally be deep inside enemy controlled territory. Special operations forces

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<sup>17</sup>For information on SOF Special reconnaissance (SR) mission capabilities see Office of the Chairman, Joint Pub 3-05, 1992, p. II-8.

<sup>18</sup>For information on SOF Direct Action(DA) mission capabilities see Office of the Chairman, Joint Pub 3-05, 1992, p. II-5.

operate beyond the range of conventional ground force reconnaissance and strike capabilities (Office of the Chairman, Joint Pub 3-05, 1992, pp. II-5 and II-7). To be effective, deep penetration SO against TMs may require additional joint service capabilities. Joint service operations have more difficult command, control, and communication issues. These issues go right to the heart of current JTMD doctrine issues. To eliminate these difficult joint issues, effective JTTPs must be developed, tested, and implemented.

Single service operations are much simpler and easier to execute. Exercise *Roving Sands 95* demonstrated that if attack operations against TMs fall within an Army Corp's area of interest, it is a single service operation under one commander with a short, effective target mission decision-making cycle.<sup>19</sup> During *Roving Sands 95*, SOF reconnaissance elements identified numerous TM threats to an Army Corp Headquarters. The TMs were within range of the Corp weapon systems. The Corp Commander quickly engaged the TMs with his own strike assets.<sup>20</sup>

During the same exercise, other SOF reconnaissance elements located TMs for a Joint Headquarters. The Joint Headquarters did attack the TMs, however, their response time was significantly longer than that of the Corp

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<sup>19</sup>The target mission cycle is the decision making process used by commanders to employ forces. It is a six step process. The steps are detection, identification, location (and tracking), decision, execution, and assessment (Office of the Chairman, Joint Pub 1-02, 1994, p. 245 parentheses added).

<sup>20</sup>The Apache attack helicopter and the Army tactical missile system (ATACMS) are the two weapons systems that a Corp Commander has under his command that would most likely be used in a strike operation against TMs. For additional information on these two weapons systems see Association of the U. S. Army, *Army Green Book 1995-96* Vol 45 No 10, October 1995, pp. 290 and 278 and Department of Defense, 1992, pp. 699 and 752.

Headquarters. It was longer because additional coordination, liaison officers (LNOs), and layers of command were involved in the operation.

## **F. PURPOSE AND SCOPE OF THIS STUDY**

This thesis examines the question: What is the role of SOF in operations against TMs? Chapter II examines current and proposed JTMD doctrine. Current JTMD doctrine, and the four layers that compose it are identified. The impact that attack operations, one layer of current JTMD doctrine, have on the other elements of JTMD is examined. Three reasons why current JTMD doctrine is unable to defend against TMs are discussed. Ongoing attempts to improve JTMD doctrine are identified. Finally, the possibility of improving JTMD attack operations by incorporating Navy anti-submarine warfare (ASW) philosophy into JTMD doctrine is examined.

Chapter III identifies the TM problem. It examines four external factors which prevent current JTMD doctrine from effectively defending against TMs. First, TM political impact verses TM military significance is addressed. Second, TM characteristics and employment techniques are discussed. Third, the proliferation of TMs is addressed. Finally, the issue of TMs and WMDs is examined.

Chapter IV examines Allied attempts to destroy and disrupt German V weapon attacks during World War II. It is an Allied attempt to destroy or disrupt TMs armed with conventional weapons. Chapter V examines U.S. led Coalition attempts to stop Iraqi SCUDs from striking Israel during the Persian

Gulf War. This case includes SOF involvement in operations against TMs armed with conventional weapons, their TELs, and infrastructure. Chapter VI examines Air Force planning efforts to destroy Soviet nuclear missiles in Cuban during the Cuban Missile Crisis. This case incorporates the problems involved when TMs are armed with WMDs. All three cases demonstrate the difficulty in destroying TMs without some form of 'eyes on target' at one or more phases of an attack operation.

Chapter VII examines a recent multi-service theater missile defense (TMD) exercise called *Roving Sands 95*. It was the first attempt by the Army and Air Force to test their individual service TMD capabilities. Chapter VIII offers an assessment of the case studies. United States military doctrinal weaknesses and strengths are examined. The TM problem is discussed. The benefits and limitations of JTMD doctrine are discussed along with the unique capabilities that SOF can bring to JTMD operations. This thesis supports the development of JTTPs that integrate SOF and enhance JTMD capabilities.

Five assumptions underlie this thesis. First, it does not address U.S. policy concerns involved in authorizing an attack operation against an identified TM threat to U.S. forces or national interests. Such an attack operation may or may not be preemptive. The specific circumstances of the TM threat and whether the United States and the potential aggressor state are involved in peacetime competition, conflict, or war will determine if an



operation is preemptive.<sup>21</sup> The U.S. military must plan for a worst case scenario and be prepared to execute an attack operation against hostile TMs if ordered by the NCA.

Second, intelligence issues, requirements and shortfalls are not addressed. This thesis assumes that accurate and reliable intelligence will exist and enable the execution of attack operations with a high probability of success. The development of JTTPs for attack operations against TMs will help define the intelligence requirements for these operations to be successful. Without accurate and reliable intelligence, an attack operation cannot be executed.

Third, the use of nuclear weapons by the U.S. against hostile TMs is not considered. Joint theater missile defense doctrine addresses only non-nuclear responses.<sup>22</sup> Policy concerns involved in the preemptive or retaliatory use of nuclear weapons involve different strategic and policy considerations. Non-nuclear options must be adequately addressed before nuclear options are considered.

Fourth, the issue that using force, even non-nuclear force, against another state's nuclear weapons capabilities, and other WMD capabilities by

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<sup>21</sup>The terms peacetime competition, conflict, and war are used in the National Security Strategy of Engagement and Enlargement. These terms are not specifically defined there. The DOD definitions for these terms appear to be similar and are used in this thesis. Peacetime (competition) is the period when the U.S. influences world events through actions that routinely occur between states. Conflict is a period characterized by confrontation and the need to engage in hostilities other than to secure strategic objectives. War is a state of open and declared armed conflict between states. War can be limited or general. (Headquarters, Department of the Army, *FM 100-5 Operations*, 1993, pp. GL-7, GL-2, and GL-9)

<sup>22</sup>For information on nuclear options for targeting mobile missiles see Westbrook, K. L., *U.S. Options for Targeting Soviet ICBMs*, (Newport: Naval War College, 1990), pp. 3-12 and Schneider and Fink, 1991, pp. 12-14.

extension, can be viewed by the targeted state as the initiation of nuclear war by the United States.<sup>23</sup> This U.S. policy consideration must be examined based on the particular circumstances surrounding the potential conflict.

Finally, JTMD doctrine is oriented to defend against other states that have, are developing, or will develop TM capabilities. This thesis does not consider transnational threats or substate groups as potential TM threats.<sup>24</sup> These definitions overlap and are often used interchangeably. The term substate group will be used in this thesis. To date, there is not yet an effective defense against the employment of conventional weapons and WMDs by substate groups. An example of unconventional aerial employment by a substate group is the use of small manned or unmanned aerial vehicle to carrying conventional high explosives or WMDs to a target. An effective JTMD capability can defend against TMs. A JTMD capability could provide some marginal protection against unconventional aerial employment where none exists today.

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<sup>23</sup>For information on this issue see Wirtz, James J., *Counterproliferation, Counterforce, and Nuclear War*, pp. 10-12, Naval Postgraduate School, 12 March, 1995.

<sup>24</sup>Transnational threats spread beyond state borders and combating them generally relies beyond the reach of any single state government. Terrorism is an example of a transnational phenomenon. (Office of the Chairman, *The National Military Strategy of the United States of America*, 1995, p. 31) Substate groups are defined as movements or organizations that consider themselves outside the domain of any state. They can also spread across state borders. A terrorist organization is an example of a substate group. (Dror, 1980, p. 30)



## II. THEATER MISSILE DEFENSE

The President is responsible for the development of the National Security Strategy. The *National Security Strategy of Engagement and Enlargement* advances the President's perception of the U.S. international role. It also presents the President's strategy to fulfill that role and advance U.S. interests abroad.

The Chairman of the Joint Chiefs of Staff is responsible for developing the *National Military Strategy of Flexible and Selective Engagement*. The National Military Strategy is developed from the President's National Security Strategy. The National Military Strategy identifies regional instability and WMDs as two of the four principal dangers that our military must address. Overseas presence and power projection are strategic concepts that support this strategy. The requirement for strong alliances is also an important component of the strategy. (Office of the Chairman, *The National Military Strategy of the United States*, 1995, pp. i, 2, 6, 7, and 10)

The proliferation of TMs represents a significant challenge to U.S. security. Whether armed with conventional warheads or WMDs, TMs can threaten regional stability. Theater missiles can be a threat to American and Allied forces overseas. Theater missiles can be used to target civilian populations. Endangering Allies' cities with TMs can weaken or destroy alliances that are critical to U.S. national security.

*The Report to Congress on Nonproliferation and Counterproliferation Activities and Programs* identifies prompt mobile target kill capabilities as a counterproliferation area needing improvement. The report also says that prompt mobile target kills are an adequately funded area (Office of the Deputy Secretary of Defense, 1994, p. ES-2). Despite adequate funding for future requirements, new TM attack and defense systems are years away from fielding.<sup>25</sup> Meanwhile, the Persian Gulf War demonstrated that the U.S. military and our allies are vulnerable to TMs now.<sup>26</sup>

#### **A. CURRENT JOINT THEATER MISSILE DEFENSE DOCTRINE**

Theater missiles can appear across the entire military environment. The threat can span military operations other than war (MOOTW) through mid- and high-intensity conflicts/wars. Because the scope of the threat is so large, the doctrine to defend against it must be comprehensive.

Current JTMD doctrine is composed of four operational elements. These elements are interconnected defenses that, together, have the potential to form an effective missile defense. The elements or layers are: passive defense; active defense; attack operations; and command, control, communication, computers, and intelligence (C4I). Passive defense includes individual and unit defensive

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<sup>25</sup>For information on USAF attack operations and active defense initiatives see Snodgrass, 1993, pp. 21-36 and 43-63. For information on the Army Theater High Altitude Area Defense (THAAD) system see Association of the U. S. Army, October 1995, p. 238. For information on the equivalent Navy Aegis Vertical Launch System also known as the Endo- and Extro-atmospheric Interceptor see Yarymovych, 1995, pp. 3-4.

<sup>26</sup>See Miller, 1992, p. A-24; Powell, April 1992, pp. 48-53; Powell, October 1992, pp. 32-35; and Schneider and Fink, 1991, pp. 12-13.

measures, also called collective measures, to reduce the effects of a TM attack. Active defense includes measures to intercept, destroy, or negate the effects of TMs in flight after launch. Attack operations are actions to neutralize, destroy, and/or negate an adversary's ability to produce, deploy, and employ TMs before launch. The responsibility of C4I is to allow the joint/combined commander to synergistically coordinate and integrate the other three JTMD capabilities across all military forces, both joint and combined, within a theater. (Office of the Chairman, Joint Pub 3-01.5, 1994, p. iv)

#### **1. Passive Defense**

Passive defensive measures provide individual and collective protection for friendly forces, population centers, and critical assets. Principal passive defensive measures include tactical warning, reducing targeting effectiveness, reducing vulnerability, recovery, and C4I. Tactical warning is important because it triggers other passive defensive actions, both civilian and military. (Office of the Chairman, Joint Pub 3-01.5, 1994, pp. III-4 and III-5)

#### **2. Active Defense**

Active defense consists of a defense in depth against TMs during their entire flight profile when TM destruction prior to launch was not possible or not successful. Active defensive measures include multiple engagement opportunities with different systems to increase the chances of successful interception. Multiple defense and interdiction systems, Patriot, THAAD, etc., decrease the possibility that an enemy can successfully counter our active

defense capabilities. Active defense capabilities include boost phase intercept, mid-course intercept, and terminal phase intercept. (Office of the Chairman, Joint Pub 3-01.5, 1994, pp. III-8 and III-9)

Boost phase intercept requires destruction of the incoming missile immediately after launch. It requires the integration of near-real-time strategic and operational launch intelligence capabilities with the immediate targeting and delivery of destructive capabilities. Rapid damage assessment is also required to determine if additional engagements of the same target are required (Office of the Chairman, Joint Pub 3-01.5, 1994, p. III-8 and III-9). This capability does not yet exist.<sup>27</sup>

Mid-course intercept is the second level of active defense. It allows additional time for the integration of near-real-time launch information, target identification and tracking, and extra-atmospheric interception (Office of the Chairman, Joint Pub 3-01.5, 1994, p. III-9). This capability also does not exist.<sup>28</sup>

Boost phase and mid-course interception provide the best opportunities to intercept TMs after launch and limit collateral damage to friendly facilities and populations. Mid-course intercept allows a second opportunity to engage TMs. Limiting collateral damage is especially important if there is a possibility that TMs are armed with WMDs. When these capabilities are developed, they will significantly enhance JTMD capabilities.

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<sup>27</sup>For information see Snodgrass, 1992, pp. 26-35.

<sup>28</sup>For information see Olson, 1991, pp. 5-10.

Terminal phase interception involves intercepting a TM after reentry into the atmosphere in its final phase of trajectory. Interception is primarily by surface-to-air missile (Office of the Chairman, Joint Pub 3-01.5, 1994, p. III-9). Although the Patriot was not originally designed for TM defense, it was modified. The new Patriot PAC-3 system is currently the only mobile anti-missile system in the world. Despite initial reports, the effectiveness of the system and its recent improvements has yet to be determined.

### **3. Attack Operations**

Attack operations are characterized by offensive actions intended to destroy and disrupt enemy TM capabilities before, during, and after launch. The object is to prevent TM launches by attacking each element in the TM target system.<sup>29</sup> The preferred method is to attack and destroy TMs prior to launch. Attack operations also attempt to deny or disrupt the employment of additional TMs that may be available to the enemy. Attack operations are not isolated missions. They are operations that involve the execution of mutually supporting and synergistic tasks across all operational elements against TMs and their launch platforms, supporting infrastructure, and logistics (Office of the Chairman, Joint Pub 3-01.5, 1994, III-13). The overall political and military circumstances surrounding a potential conflict will determine if prelaunch

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<sup>29</sup>A target system is a group of interrelated targets where the destruction of a target system component or critical node will destroy or degrade the capabilities of the entire system. A target system component consists of one or more basic elements required for a target weapon system to function. Components can include manufacturing, transportation, support infrastructure, etc.. (Office of the Chairman, Joint Pub. 1-02, 1192, pp. 378-381). A TM weapon system is an example of a target system. Its components would include the manufacturing facilities; communication networks; transportation means, i.e., modified rail or truck carriers, etc.; missile storage and supply facilities; presurveyed launch facilities; and TEL hide sites. See also, Footnote 31.



strikes are possible. The issue of preemptive attacks is not considered in this paper, only the requirement that the military must be able conduct them if ordered.

Current JTMD doctrine emphasizes passive defense, active defense, and C4I. There have been limited efforts devoted to attack operations by conventional precision guided munitions. Efforts to improve attack operations are centered on technological improvements in precision guided munitions and aerial assets. Yet, immediate improvements in attack operations can be achieved by integrating SOF and their capabilities into attack operations against TMs.

Successful attack operations require rapid detection, identification, acquisition, and the application of firepower on target before a TM is launched. Because prelaunch intercept has never been accomplished, preventing the launch of additional missiles by the same TEL has been selected as the next best measure of success.

#### **4. Command, Control, Communications, Computers, and Intelligence**

Command, control, communications, computers, and intelligence (C4I) is an integrated system that includes doctrine, procedures, organizational structures, facilities, communications, and supporting intelligence. It includes missile warning and cuing of defensive systems by missile warning sensors. It provides commanders at all levels the timely and accurate data and to plan, monitor, direct, control, and report TM operations (Office of the Chairman,

Joint Pub 3-01.5, 1994, p. I-4). Command, control, communication, computers, and intelligence allows the military commander to synergistically coordinate and integrate all of the military forces and their combat power in a theater.

## **B. ATTACK OPERATIONS AND JOINT THEATER MISSILE DEFENSE**

Attack operations are the most critical element of JTMD. The success or failure of attack operations contributes directly to the success or failure of the second most critical element of JTMD, active defense. To understand the interdependence of these two elements, two concepts must be understood: "the Theater Missile Transporter-Erector-Launcher Cycle" and "the Flaming Datum Approach."<sup>30</sup> (Conner, Ehlers, and Marshall, 1993, p. 6)

### **1. The Theater Missile Transporter-Erector-Launcher Cycle**

While the TM actually causes death and destruction, the TEL is the critical damage point or critical node of the TM system.<sup>31</sup> Without TELs, TMs cannot be launched. The TM TEL Cycle describes the employment cycle of the TEL from its secure base facility, to its forward staging area, to its launch site, and back again.

During peacetime, TELs spend a significant amount of time at centralized base facilities or in storage. By consolidating TM assets at centralized

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<sup>30</sup>For additional information, also see, Hair, T.W., *The Application of Search Theory to the Timely Location of Tactical Ballistic Missiles*, Thesis, Naval Postgraduate School, March 1993.

<sup>31</sup>The target critical damage point or critical node is the point of a target component that is most vital. (Office of the Chairman, Joint Pub. 1-02, 1994, p. 379) See also, Footnote 29.

locations, their security and maintenance is improved. Periodically, the TEL units will deploy into the field to conduct proficiency training. They return to the centralized facility for security and routine maintenance operations. (Conner, Ehlers, and Marshall, 1993, p. 6)

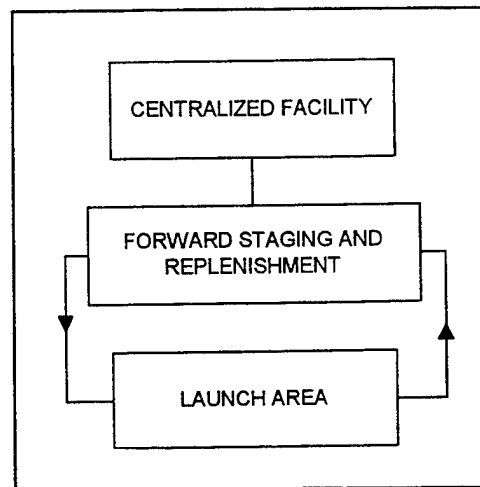
During crises, the TELs deploy from their centralized facilities. The TELs move into smaller forward operating bases. These bases still provide a reasonable level of physical security, maintenance and support for the TELs. By increasing the number of secure forward operating bases, a state increases its security against preemptive attacks. At the same time, a state can still maintain the capability to command, control, maintain, and service the TELs. Movement to the forward operating bases is the first step of the TM TEL circulation model. (Conner, Ehlers, and Marshall, 1993, p. 6)

Should tensions continue to rise, the TELs would be ordered to move into launch positions at the first sign of hostilities. The dispersal of the TELs is an effective defense against preemptive strikes. Dispersing TELs to their launch positions is the second step of the TM TEL circulation model. Once a TEL has launched its missile, it normally must return to the forward operating base to load another missile, and begin the cycle again.<sup>32</sup> This final step completes one

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<sup>32</sup>Three other means of employing TELs include augmenting a TEL with an additional missile(s), positioning additional missiles at alternate launch points to wait the TELs arrival, or have a transporter meet a TEL and transload missiles. These techniques require at least one vehicle large enough to transport and transload additional missiles. The hinderance in employing TMs has been the limited number of TELs available, not the number of missiles. Since World War II, no state has used its resources to develop only a transporter when it could produce a TEL with only a minor increase in resources and effort. Additionally, these techniques increase the amount of vehicle traffic in and near the launch area. This increased signature reduces the survivability of the TELs and missiles.

cycle of the TM TEL circulation model. (Conner, Ehlers, and Marshall, 1993, p. 6)



**Figure 1.** TM TEL Circulation Model (Conner, Ehlers, and Marshall, 1993, p. 7)

The major limitation in the TM TEL circulation model is how long a TEL and its crew can remain deployed and operational without outside resupply or maintenance. Once resupply or maintenance is necessary, the TEL becomes more vulnerable. It must move to the forward staging area, or supplies and/or a maintenance crew must travel to it. This additional traffic endangers the TEL and its crew.

## **2. The Flaming Datum Approach to Attack Operations Against Theater Missiles**

The post-launch interdiction of TELs prevents them from rearming and launching additional TMs. This approach has been described as "the flaming datum approach" (Conner, Ehlers, and Marshall, 1993, p. 3). This tactic is part

of the Air Force's emphasis on conducting attritional attack operations against TELs after launch, rather than dedicating significant assets to conduct pre-launch attack operations.<sup>33</sup> This approach depends on two capabilities, the capability to rapidly destroy the TELs after launch. The second is the capability to conduct a successful in depth, multi-layered defense that destroys the TMs after launch.<sup>34</sup> Neither capability presently exists.<sup>35</sup>

To destroy a TEL after launch, the flaming datum approach emphasizes using national and theater intelligence collection assets to cue off the tremendous TM launch signature. Then there are three possible means of striking the TELs. First, dedicated air assets on station in the suspected TEL launch area are immediately directed into the TEL target area. Second, dedicated air assets on strip alert are launched into the TEL target area. Finally, any aircraft in or near the TEL target area on any other mission is diverted to locate and attack the TEL. All these tactics were tried without success during the Persian Gulf War.

To destroy a TM after launch, a multi-layered defense capability must exist. The technology necessary to field an integrated multi-layered active defense does not yet exist. Neither the Army's Patriot Advanced Capability-3 (PAC-3) nor the Theater High-Altitude Area Defense (THAAD) system is

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<sup>33</sup>Based on experience in the Cold War attempting to locate and destroy mobile Soviet ICBM missiles, the Central Command Air Force (CENTAF) chose to concentrate on interdicting the SCUD missile infrastructure not individual launchers. (Keaney and Cohen, 1993, p. 43)

<sup>34</sup>For additional information see Snodgrass, 1992, pp. 28-36.

<sup>35</sup>For additional information see Olson, 1991, p. 5-10; Glashow, J., "Hite Pushes Army Priorities," *Army Times*, 4 September, 1995, p. 24; and Association of the United States Army, 1995, pp. 238 and 290.

operational. The Navy's Aegis system is not operational. The Air Force's Boost Phase Intercept concept is still in its developmental phases.

### **3. The Impact of Attack Operations on Joint Theater Missile Defense**

This thesis defines an attack operation as successful if it destroys a TEL before it can launch its TM. This success has two parts. First, the attack absolutely prevents a missile from being launched at U.S. or Coalition assets. Second, the destruction of the TEL also reduces the number of possible missiles that could be launched by that TEL in the future.

A partial success occurs if a TEL is destroyed after it launches its TM. It is a partial victory because the destruction of the TEL reduces the number of possible missiles that the destroyed TEL could have launched in the future. Destruction of the TEL after its missile is launched is a partial failure because the active defense assets may or may not intercept and destroy the TM.

Every missile destroyed before launch prevents casualties and reduces the amount of destruction to U.S. and Coalition assets. It also reduces the number of inbound missiles that active missile defense assets must defend against. If the TEL is destroyed after it has launched its TM, the active missile defenses must still intercept the inbound TM. They will not have to

intercept additional missiles that could have been launched from the destroyed TEL in the future.

### **C.     RETHINKING JOINT THEATER MISSILE DEFENSE DOCTRINE**

Current JTMD doctrine emphasizes attritional warfare. This type of warfare is effective if the war lasts a long time and one side can afford to wear the other side down. Recent conflicts, however, have demonstrated the limited effectiveness of attrition and the lack of time to carry it out. The nature of warfare has changed in two important ways. First, the U.S., its Allies, and enemies now prepare to fight and win wars quickly and decisively. As Vietnam demonstrated, modern warfare has become too costly to prolong purposely. Second, WMDs change the calculations of interests and costs of modern warfare (The White House, 1995, p. 13). States can no longer allow themselves to be vulnerable to weapons capable of delivering WMDs. The implications of these two changes indicate current JTMD doctrine is not suited for the problem of TMs armed with WMDs. Two case studies in Chapters IV and V demonstrate it is ineffective to waste air assets conducting a strategic bombing campaign against an enemy's TM factories, storage facilities, and logistics facilities when the enemy's TMs and TELs have already moved into individual launch sites and are aimed at U.S. forces and/or national interests.

## **D. IMPROVING JOINT THEATER MISSILE DEFENSE CAPABILITIES**

There are three separate players in the joint doctrine development process. These players are the military services, the theater CINCs, and USSOCOM.

### **1. The Military Services**

Currently, the Joint Staff designates individual services to lead the development of joint doctrine. This method of developing joint doctrine has produced "a compendium of competing and sometimes incompatible concepts" (Department of Defense, Commission on the Roles and Missions of the Armed Forces, 1995, pp. 2-3). The main weakness in the process is the possibility that an individual service will put its own interests over the interests of the U. S. military.

### **2. The Theater Commanders in Chief**

The Goldwater-Nichols Act strengthens the role of the theater CINCs in the joint doctrinal development process. Theater CINCs are the nation's war fighters. Before the act, the military services developed the doctrine, tactics, training, weapons, and equipment used by the CINCs. The CINCs had little if any input. They were expected to follow the different services' doctrine whether it applied to combat in their individual theaters.

Each theater CINC is responsible for developing their theater's strategic concept. The strategic concept is the CINC's course of action



(COA) and is based on his estimate of the strategic situation. The concept must be flexible enough to permit its use in framing the military, diplomatic, economic, psychological, and other measures (Office of the Chairman, Joint Pub. 1-02, p.363). From the strategic concept, operations plans (OPLANS) are developed. They are plans for the conduct of joint operations. They can be used as a basis for developing a complete operations order (OPORD). Operation plans identify the forces and supplies required to execute the CINC's strategic concept. It also includes a movement schedule of those resources to the theater of operations. A contingency plan (CONPLAN) is an abbreviated OPLAN. It requires considerable expansion or alteration to convert it to an OPORD.

Today, the different theater CINCs develop their strategic concepts, OPORDs, OPLANS, and CONPLANS based on existing doctrine and their own theater requirements. After review by the Chairman of the Joint Chiefs of Staff, if current doctrine, tactics, or forces do not support the implementation of the CINC's strategy, the services must prepare, train, and equip the forces necessary to support the CINCs.

### **3. The United States Special Operations Command**

The United States Special Operations Command (USSOCOM) was created within the Department of Defense "in response to deep-rooted Congressional concerns" regarding the capability of the different services' to

prepare SOF and conduct SO (United States Special Operations Command, 1988, p. Intro-5). The United States Special Operations Command is unique. It was the first truly integrated and joint command and combined all continental SOF units from the Army, Navy, and Air Force under its command.

For USSOCOM and its units to maintain a high degree of autonomy from their parent services, they were given their own budget authority. This was necessary because different service SOF unit funding requirements were significantly different from their parent service requirements. This difference resulted in SOF and SO capabilities being consistently underfunded. Along with the funding authority came the requirement for USSOCOM to develop all SOF strategy, doctrine, tactics, training, equipment, and weapons requirements. These are functions that the military services normally perform.

Besides its service-like responsibilities, USSOCOM was directed by the Secretary of Defense to take the lead in developing SOF counterproliferation (CP) doctrine (Secretary of Defense Memorandum, 5 May 1995). Special operations force operations against TMs should fall under this CP directive. This requirement should force USSOCOM to become a significant player in the development of JTMD doctrine and JTTPs.

## **E. THE DEVELOPMENT OF JOINT THEATER MISSILE DEFENSE DOCTRINE**

The joint publication for JTMD was first published in 1994. The Army was tasked by the Joint Staff to be the lead Service in developing this doctrine. The Army did a decent job in developing current JTMD doctrine from scratch. Next, the Joint Staff tasked the Air Force with improving on current JTMD doctrine. The Air Force submitted a draft proposal to change JTMD doctrine and make it a subset of counter-air operations (Department of the Army Memorandum, 14 July 1995, p. 1). Counter-air operations are operations dominated by the Air Force. Upon reviewing the Air Force's proposed changes to current JTMD doctrine, the Army advised the Air Force that their proposed doctrine was flawed and "does not conform to current joint doctrine as established in Joint Publications 3-0 and 3-1.5.3." The Army did agree that there were areas where theater counter-air doctrine and JTMD doctrine overlapped. The two doctrines, however, were separate and distinct from each other (Department of the Army Memorandum, 14 July 1995, p. 1). This is an unfortunate example of the doctrinal development processes described by the Commission on the Roles and Missions of the Armed Forces.

Some elements of existing joint doctrine and JTTPs fit directly into existing JTMD doctrine. Two examples are laser target designation (LTD)

and radar beacon operations.<sup>36</sup> These two SOF capabilities represent only a small portion of the capability that SOF can bring to operations against TMs. The current disagreement between the Army and Air Force over JTMD doctrine has delayed further development and implementation of additional JTMD JTTPs. This delay also interferes with USSOCOM's efforts to integrate SOF capabilities with conventional force capabilities. These delays continue to leave the United States unable to effectively defend against TM attacks.

#### **F. THEATER MISSILES AND ANTI-SUBMARINE WARFARE**

An unorganized and uncoordinated search operation for either a TM TEL located somewhere within a country, or a submarine located somewhere at sea, has been characterized as 'looking for a needle in a field of haystacks.' This helps explain why the U.S. military's poorly organized and coordinated efforts to locate TM TELs has never been effective.

Professors and researchers at the Naval Postgraduate School have compared the target acquisition and destruction of TM TELs to the Navy's doctrine of anti-submarine warfare (ASW). Submarine and TM TEL operations are similar. Operations to destroy both have similarities (Wirtz, 1995, pp. 4-7). Both weapon systems require an extensive support

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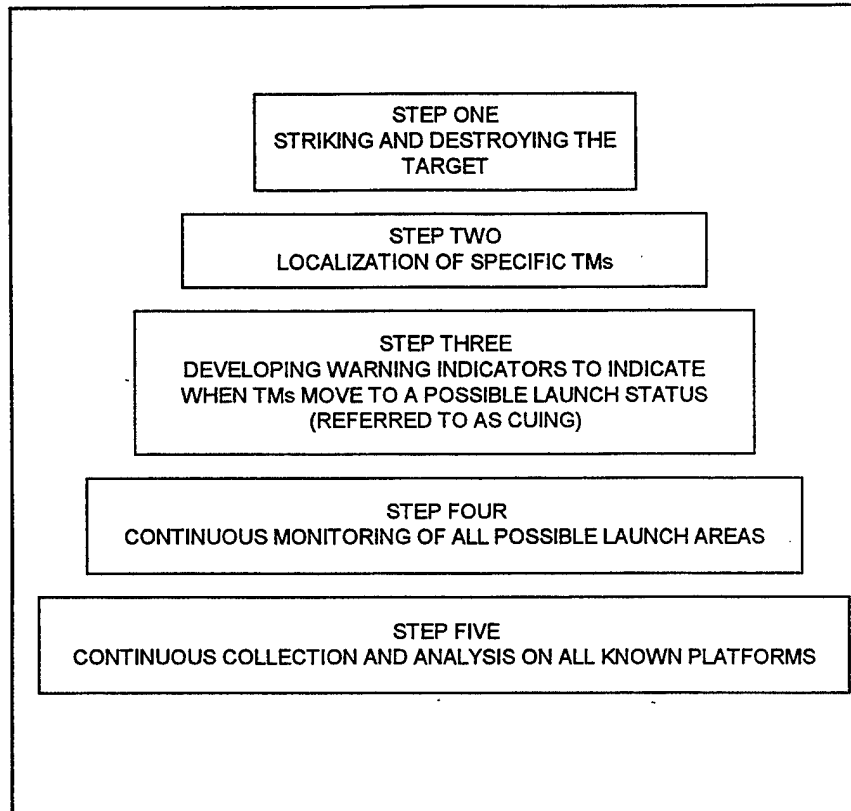
<sup>36</sup>For additional information on laser target designation operations, see Joint Pub. 3-09.1, Joint Laser Designation Procedures, U.S. Government Print Office, 1991. For information on radar beacon operations, see Joint Pub. 3-09.2, JTTP for Radar Beacon Operations (J-Beacon), U.S. Government Printing Office, 1993.

infrastructure, beginning with the necessary research, development, and testing facilities and continuing through the manufacturing and fielding of the two weapon systems. Both weapons require high degrees of complex maintenance and tight security precautions. Due to of these requirements, both weapon systems are concentrated at a few secure bases or ports when not deployed for training or alert. Both weapons regularly depart from their bases or ports for training. Both move into their operational areas, train, and then return to their base or port. Finally, if properly organized and trained, the United States has the national and theater intelligence capabilities to track and destroy both weapons.

The Navy's ASW operations have two immediate advantages over JTMD operations. First, ASW operations are strictly Navy operations and no other services are involved. While air, surface, and subsurface forces are involved, they are all Navy forces that are organized and trained together. Second, ASW operations are conducted in international waters. The initial stages of operations could be accomplished without violating an aggressor state's territorial boundaries. At some point, those boundaries must be violated and a state's air defenses become a threat as well.

There are five phases to ASW doctrine. Phase One is "the continuous collection and analysis of intelligence on all known platforms." Phase Two is the "continuous monitoring of all probable launch areas." Phase Three is

the "generation of cuing (warning) when specific platforms move to a launch status."



**Figure 2.** The Five-Step ASW Pyramid

Phase Four is "the localization of specific systems." Phase Five is "attack." (Wirtz, 1995, pp. 4-5)

Employing ASW doctrine resembles a pyramid. Completing each phase of the ASW doctrine pyramid builds on the success of the other phases and brings the operation one step closer to success, the destruction of the target. Figure 2 shows the five-step pyramid.

Success at the first step reduces the area that intelligence collection assets must cover. This process of focusing intelligence assets on smaller target areas increases the probability of success up through the other steps of the pyramid. (Wirtz, 1995, p. 5)

Step One identifies a potential aggressor's capabilities. It indicates the type, characteristics, and numbers of an aggressor's TMs. Success in this step narrows down the size of an aggressor state's potential TM operating area. This allows U.S. intelligence assets to be more effectively employed and concentrate on suspected or known TM training and operational areas in Step Two (Wirtz, 1995, pp. 5-6). These first two steps require gathering large amounts of information and intelligence from all states that develop, produce, or acquire TMs, including friendly states. This is necessary because even the U.S. and other friendly states sell arms to other states that have the potential to become aggressor states (*i.e.*, Iraq).

Cuing, the third step, begins the intensive process of tracking each potential TM. The NCA or the theater CINCs would determine what potentially aggressive states this resource intensive and methodical process would be focused on. Additionally, if tensions in a particular theater began to rise, additional resources could be added to enable that CINC to effectively monitor the TM situation.

Step Four, localizing, would require a significant and noticeable increase in military and intelligence collection activities. To be successful,

overflights of another state's territory might be required. The NCA would normally be closely monitoring any situation where the tensions had risen to such a degree that this step was required.<sup>37</sup>

Step Five is the actual strike. The theater CINC, and his assigned forces, would be responsible for executing the actual attack operations. A closer examination of the Navy's ASW doctrine could help the development of JTTPs that better integrate all the different Service capabilities and SOF's unique capabilities.

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<sup>37</sup>This thesis is only concerned with ensuring the military has the necessary capability to execute attack operations when and where ordered by the NCA. The NCA, not the military, determines what action, either military, diplomatic, or a combination of both, is necessary.





### **III. THE THEATER MISSILE PROBLEM**

There are four factors, outside the control of the U.S. military, which make up the TM problem. First, the political impact of TM strikes, usually against civilian populations, outweighs their military significance. Second, TM characteristics and employment techniques make them difficult weapons to defend against. Third, the widespread proliferation of TMs makes the problem more difficult to defend against. Finally, if WMDs are inserted into the TM equation, mission success becomes important. The elimination of TMs armed with a WMD becomes virtually impossible without some form of "eyes on target." Failure could be catastrophic.

#### **A. POLITICAL IMPACT VERSUS MILITARY SIGNIFICANCE**

Theater missiles can produce a political impact beyond all proportion to their military effectiveness. The first V-1 attacks against the United Kingdom occurred on June 13, 1944 at Swanscombe:

Within 10 weeks . . . over a million individuals moved to the country at their own expense in addition to the more than a quarter of a million who travelled free of charge under government schemes for voluntary withdrawal of school children and of younger children and their mothers. (Collier, 1964, p. 12)

Political necessity then forces the military to divert assets from other targets of military value to solve the TM problem. This reallocation process has been implemented twice in conflicts involving the United States. The first occurred in World War II when the Allies were forced to reallocate air sorties and target German rocket launching sites:

General Eisenhower diverted thirty percent of Allied bomber sorties away from targets inside Germany to attack V-1 launch sites. He did this while the battle for Normandy was still raging. (Snodgrass, 1993, p. 79)

When strategic and tactical bombing raids proved ineffective at stopping the rockets, the Allies were forced to change the priority of the ground campaign against the Germans. One of Operation Market-Garden's goals was to capture V-2s along the Dutch coast. (Ryan, 1974, pp. 84-88)

The second example occurred during the recent Persian Gulf War. Again, political necessity forced the Coalition to divert air assets from high priority military missions to locating and destroying Iraqi modified SCUD missiles, their TELs, and infrastructure. The SCUDs were fired at Israel to force that country to retaliate against Iraq and cause the Coalition to split along Arab ethnic lines (Wirtz, 1995, p. 2). Some SOF elements also attempted to locate and assist in the destruction of the SCUDs. Lacking

previously established joint doctrine or JTTPs, the effectiveness of the separate efforts was minimal.<sup>38</sup>

## **B. DIFFICULTIES TARGETING MOBILE THEATER MISSILES**

As demonstrated in World War II, the Cuban Missile Crisis, and the Persian Gulf War, the U.S. military has been unable to target or destroy TMs fired from fixed sites.<sup>39</sup> The United States was not successful defending against or attacking Iraq's SCUDs. The SCUDs were designed in 1962. Our military has no experience attacking newer, more accurate, and highly mobile TM systems.<sup>40</sup>

There are two groups of attributes that make TMs difficult to locate and destroy. Those attributes are TM characteristics and TM employment techniques. Theater missile characteristics include mobility, ease of concealment, and ease of maintenance and resupply. Theater missile employment techniques include the use of deception, decoys, dispersion, and using civilians as shields. When combined TM characteristics and

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<sup>38</sup>See Miller, 1992, p. A-24; Powell, April 1992, pp. 48-53; Powell, October 1992, pp. 32-35; and Schneider and Fink, 1991, pp. 12-13.

<sup>39</sup>Target acquisition is the detection, identification, and tracking of a target in sufficient detail to permit the effective employment of weapons (Office of the Chairman, Joint Pub 1-02, 1994, p. 365). Detection is the process of perceiving a possibly military significant target (Office of the Chairman, Joint Pub 1-02, 1994, p. 115). Identification is discriminating between detected objects as friendly or enemy, or the name that belongs to a particular object as a member or a class of items. For example, identifying a object as an Iraqi TM (Office of the Chairman, Joint Pub 1-02, 1994, p. 177). Tracking is the precise and continuous position-finding of targets by radar, optical, or other means (Office of the Chairman, Joint Pub 1-02, 1994, p. 392).

<sup>40</sup>With the exception of German V-1 flying bombs and the Soviet SS-5 intermediate range ballistic missile (IRBM), mobility has been an important design feature in TM systems. Mobility enhances survivability. To improve the accuracy of older TM systems, TMs have been fired from fixed or presurveyed firing points. This was the case in the Persian Gulf War and in the Iran-Iraq War.

employment techniques make it difficult for the military to defend against TM attacks.

## **1. Characteristics of Theater Missiles**

Three characteristics of TMs make them difficult to target and destroy: mobility; ease of concealment; and ease of maintenance and resupply. First, modern TMs are highly mobile. The mobility of TELs allows them to travel on average highways and traverse most bridges, tunnels, and underpasses. They can also be transported over regular railroad systems. This degree of flexibility significantly reduces a TM's signature. Add in a limited off road capability and attempting to gather intelligence, locate, target, and destroy TMs becomes significantly more difficult.

Second, TMs are easy to conceal.<sup>41</sup> Materials such as a portable camouflage net system can provide protection against most national and theater level intelligence collection assets. Another concealment technique used by Germany and Iraq was to hide their missiles or TELs in caves or tunnels. If intelligence and strike assets cannot locate TELs, they cannot be destroyed.

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<sup>41</sup>Camouflage involves the use of natural or manmade material on people, objects, or tactical positions to confuse, mislead, or evade an enemy. Concealment is protection from observation or surveillance. (Office of the Chairman, Joint Pub 1-02, 1994, pp. 59 and 85.) Camouflage is one means of providing concealment.

Third, TMs have become easy to maintain and resupply. Modern TMs have become self-contained modular type systems. Missiles, similar in design to the Patriot or ATACMS, are now stored, transported and fired from sealed containers. If a missile is fired or just needs replacing, the modular container is removed and a new one put on.

One way of tracking a TM is by its maintenance and logistics signature. This signature includes radio communications and personnel and vehicular movement. Reducing that signature increases the survivability of the individual TELs dramatically. However, modular systems are simple to resupply. They no longer need two or three different trucks to load the different fuel components into the rocket immediately prior to launch. The modernization of TMs significantly reduces the maintenance and logistics support.

## **2. Employment Techniques of Theater Missiles**

Combining the use of deception, decoys, dispersal, and using civilians as shields makes locating, targeting, and destroying TMs difficult. If a potential aggressor state is good at using deception, it is extremely difficult to gather intelligence about that state's potential TM capabilities. Proper use of deception, combined with disinformation, can interfere or prevent U.S. intelligence analysts from determining the existence of TMs in a state, the capabilities of those TMs, or number of TELs and TMs. If a theater CINC

does not know or cannot rely on the accuracy of his critical intelligence, he cannot defend against TM threats. The Germans, the Iraqis, and, to a lesser extent, the Soviets all practiced good techniques of deception.

The successful use of decoys depends directly on the success of a state's deception campaign. Decoys are easier and cheaper to build than real TELs and TMs. Decoys force the United States to waste intelligence and strike assets. Besides wasting limited strike assets, the personnel that will attack the decoys could be killed for no reason other than that our intelligence was not good enough. Lacking intelligence on a state's TM capability means that all potential TM targets, including inexpensive decoy TELs, will have to be eliminated. Meanwhile, real TELs located away from the decoys are launching real TMs at U.S. and Coalition assets. The use of deception and decoys can confuse intelligence and command capabilities. Decoys overextend strike capabilities and forces precious strike assets to be wasted on inexpensive decoys.

Dispersing TELs, TMs, storage and maintenance facilities also increases the intelligence assets necessary to gather information on a state's TM capabilities. It overextends and wastes valuable reconnaissance. More potential targets spread over a wider area means that more intelligence assets are required to locate concealed targets and make sure that they are not decoys. The military commander must then destroy those targets, which

can be spread over an entire country, before the missiles can launch or relocate.

Positioning TMs near or within populated areas increases the risks of accidentally injuring noncombatants. Potential aggressor states know that the United States is more concerned about collateral damage than the potential aggressor is worried about its own people. This U.S. concern raises the political stakes for our political and military leaders when they consider conducting attack operations, especially possible preemptive operations, against TMs.

The combination of these TM characteristics and methods of employment makes it difficult for U.S. planners to employ reconnaissance and strike assets to target and destroy TMs. With today's shrinking military, the virtually unlimited strike assets that were available to the military commanders during the Persian Gulf War are no longer available.

### **C. THE PROLIFERATION OF THEATER MISSILES**

There are at least twenty-five emerging states that possess TMs.<sup>42</sup> To date, TMs were used by four countries in three major interstate conflicts. The first significant use was by Germany in World War II. Iran and Iraq

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<sup>42</sup>The countries are Afghanistan, Algeria, Argentina, Brazil, Burma, Cuba, Egypt, Ethiopia, India, Indonesia, Iran, Iraq, Israel, Kuwait, Libya, North Korea, South Korea, Pakistan, Saudi Arabia, South Africa, Syria, Taiwan, Thailand, Vietnam, and Yemen (Fetter, 1991, p. 14).



used TMs in their 1980-1988 war. Iraq and the United States used TMs in the Persian Gulf Conflict.<sup>43</sup>

Efforts to control the proliferation of missiles capable of carrying WMDs have slowed their spread. In 1987, Canada, France, Germany, Italy, Japan, the United Kingdom, and the United States established an informal agreement known as the Missile Technology Control Regime (MTCR). This informal arrangement is not a treaty and has no enforcement or compliance mechanisms. (Spector, McDonough, with Medeiros, 1995, p. 185)

The MTCR was designed to prevent the spread of missiles capable of carrying a payload of 500 kilograms to a range greater than 300 kilometers. This 500 kilogram weight was estimated as the minimum weight required for a basic nuclear warhead. This payload weight has since been amended to 300 kilograms. This new weight is designed to limit the potential use of a chemical or biological warheads on missiles. (Spector, McDonough, with Medeiros, 1995, p. 185)

There are twenty-five members of the MTCR. Six other states are considered unilateral adherents to the regime. China claims to control missiles according to the original MTCR standards, however, China has been

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<sup>43</sup>Five other less significant uses of TMs have occurred. First during the 1973 Arab-Israeli War, Egypt and Syria attempted to launch, without effect, several missiles at Israeli troop concentrations. Second in 1986, Libya launched two SCUD missiles, without effect, at a U.S. LORAN facility on an island off the coast of Sicily. Third, the Soviet sponsored Communist government of Afghanistan used SCUD missiles against the Mujahideen in 1988-89 (Carus, 1990, p. 1). Finally, since the end of the Persian Gulf War, the U.S. has launched cruise missiles at targets Iraq and Bosnian Serb controlled territory. These attacks continued through 1991. (O'Ballance, 1993, pp. 180-183)

the subject of U.S. missile sanctions because of transfers of missile components. (Spector, McDonough, with Medeiros, 1995, pp. 185-186)

#### **D. THEATER MISSILES AND WEAPONS OF MASS DESTRUCTION**

The National Security Strategy identifies, as a critical requirement, the need to stem the proliferation of WMDs and their means of delivery (The White House, 1995, pp. 13-15). The proliferation of nuclear, chemical, biological, and radiological WMDs compounds the difficulties of targeting TMs possibly armed with WMDs. However, if it is in America's vital interest, we would be forced to take whatever actions necessary to ensure the destruction of WMD capable TMs:<sup>44</sup>

We will do whatever it takes to defend these interests, including the unilateral and decisive use of military power. In all cases the cost and risks of U.S. military involvement must be commensurate with the stakes involved. (The White House, 1995, p. 13)

Strong action would be necessary, because the survival of the U. S. forces or Allies was at stake. The risk of failure, of an attack operation against a limited number of TMs possibly armed with WMDs that were being prepared for use against vital U.S. interests, is small when compared to the

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<sup>44</sup>"America's vital interests are those of broad, overriding importance to the survival, security, and vitality of our national entity - the defense of U.S. territory, citizens, allies, and economic well-being." (The White House, 1995, p. 12)

outcome if those TMs were used. This section briefly examines the threat posed by each type of WMD.

### **1. The Lethality of Weapons of Mass Destruction**

Weapons of mass destruction are a status symbol and an instrument of political and military power (National Defense University, 1995, p. 116). Three factors must be considered when facing the threat posed by TMs armed with WMDs. The first is the level of destruction that the different types of WMDs can cause. The second is the degree of difficulty involved in developing, testing, and fielding the different types of WMDs. The third is the difficulty involved in detecting the presence of a WMD program in a state that is potentially hostile to the United States. States that wish to possess WMDs generally do not limit their research and development programs to just one type of WMD. Certain states are involved in multiple WMD acquisition programs.

The most significant threat to U.S. vital interests overseas is a limited WMD strike delivered by either aircraft or TMs. Our vulnerability to aircraft delivered WMDs is low because our military has a highly developed counter-air capability. Our vulnerability to TMs is high because current JTMD doctrine and capabilities are in their infancy. Because of the high order of destruction, suspected or potential nuclear proliferators already possessing TMs present the greatest threat to U.S. vital interests overseas. An effective

JTMD doctrine is needed to enhance the U.S. military's capability to defend against this threat.

## **2. Nuclear Weapons of Mass Destruction**

While not the first WMD to be used, nuclear weapons were the first truly destructive weapons. Virtually everything at ground zero is destroyed. Because of the infrastructure needed to create nuclear weapons, they are the most difficult weapons for a state to produce. They are also the easiest WMD programs to detect.

At least twenty countries have, or are seeking, the capability to deliver nuclear weapons (Institute for National Strategic Studies, 1995, p. 116). There are eight countries that have declared they possess nuclear weapons.<sup>45</sup> Undeclared countries include India, Israel, and Pakistan. Iran, Libya, and North Korea have active or suspected nuclear weapon programs. It is believed that Iraq's nuclear weapons program has been dismantled. Iraq is subject to U.N. mandated long-term monitoring of its WMD programs (Spector, McDonough with Medeiros, 1995, p. 9).

Five countries have voluntarily renounced or abandoned nuclear weapon programs and opened their nuclear facilities for international

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<sup>45</sup>They are the five permanent members of the UN Security Council, China, France Russia, the United Kingdom, and the United States. Also included are the three Soviet successor states, Belarus, Kazakhstan, and Ukraine, that inherited them.

inspections.<sup>46</sup> Approximately eighteen industrialized countries have the potential to become nuclear proliferators but are abstaining from developing nuclear weapon programs. These countries possess the technical capability to produce nuclear weapons, have commercial nuclear power generation capability, and may also have significant quantities of weapons-usable nuclear material. Any of these states could join the nuclear club very quickly.

### **3. Radiological Weapons of Mass Destruction**

Radiological weapons employ nuclear materials and/or radiation producing devices to create casualties or restrict the use of terrain/areas. They are terror weapons, not high order mass-casualty producing weapons like nuclear WMDs. Radiological WMDs are easy to produce and hard to detect. Threatening to use a radiological WMD on a neighboring country could have major psychological and economic impact.<sup>47</sup>

Worldwide, there are over 531 commercial nuclear power generation facilities operating, under construction, or in the planning stages. Each year, over 4,000 kilograms of enriched commercial nuclear material is in

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<sup>46</sup> These countries are Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Finland, Germany, Hungary, Ireland, Italy, Japan, Netherlands, Norway, Poland, Slovakia, South Korea and Spain. (Spector, McDonough with Medeiros, 1995, p. 9).

<sup>47</sup>One hypothetical example of the use of a radiological WMD is the World Trade Center bombing. If a few pounds of radiological material had been added to the bomb, the impact would have been significantly greater. More deaths and a significant number of radiation sickness cases and a few deaths would have occurred. The economic impact would have been the difficulty in isolating and decontaminating the large area of downtown New York City surrounding the Trade Center.

continuous circulation among these facilities (Leventhal and Alexander, 1986, pp. 56-65). With minor modifications, any state possessing nuclear material and TMs can develop TMs armed with radiological WMDs.

#### **4. Chemical Weapons of Mass Destruction**

Chemical weapons have the second lowest lethality capability of WMDs. If used properly, chemical protective equipment, clothing, and antidotes can defend against chemical agents. Chemical agents are easy to produce. As with nuclear weapons, the manufacturing infrastructure needed to develop chemical weapons is easy to detect.

Most countries with facilities capable of producing pesticides or flame retardants can convert these facilities into chemical weapon's production in a matter of weeks or months. The globalization of the chemical trade, the availability of chemical know-how, and the availability of production equipment has given over 100 countries the capability to produce chemical weapons. (U.S. Office of Technical Assessment, 1993, p. 16)

Like radiological WMDs, chemical WMDs are terror weapons rather than high order mass-casualty producing weapons.<sup>48</sup> Even minimal protective equipment can significantly reduce casualties:

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<sup>48</sup>For information on chemical weapons see Bailey, K. C., *Doomsday Weapons in the Hands of Many: The Arms Control Challenge of the 90's*, University of Illinois Press, 1991.

On average, chemical weapons used in World War I produced from 1.6 to 5 times as many immediate casualties as a similar amount of high explosive weapons . . . Averages are misleading, however, in that they tended to be driven up by high casualty rates incurred when gas was used against unprotected troops. Properly trained and protected troops took much lower casualties. (Clark, 1959, pp. 99-100)

The rate of death per casualty was two to four times higher for fire wounds than chemical weapons (Clark, 1959, p. 1). A man wounded by gas had about twelve times the chance to live than a soldier suffering the effects of a traditional explosive wound (Waite, 1942, p. 5).

Iraq's threatened use of SCUD missiles filled with chemical agents against Israeli cities demonstrated that chemical weapons have a significant psychological impact. A successful prelaunch attack operation against those missiles would be the best defense. Extra-atmospheric interception would be the next best defense. The potential for chemical agents to rain down on a city exists if a TM is intercepted in the lower atmosphere by a Patriot type TMD system.

## **5. Biological Weapons of Mass Destruction**

Biological weapons possess a combination of characteristics that make them one of the most effective WMDs. They produce a high order of casualties, second only to nuclear weapons. Like chemical WMDs, they are easy to produce, however, it is harder to detect a biological WMD program than it is other WMD programs.

Biological and toxin warfare involves the use of diseases and natural poisons to incapacitate or kill (U.S. Office of Technical Assessment, 1993, p. 71). They also can be targeted against livestock and domestic agriculture.<sup>49</sup> Unlike radiological and chemical weapons, biological weapons are the true "the poor man's atomic bomb." A militarily significant quantity of a biological agent could be produced in a matter of days in a small, easily concealed, clandestine facility (U.S. Office of Technical Assessment, 1993, pp. 72-73).

#### **6. A Theater Missile Weapon of Mass Destruction Solution**

Army SOF units are better suited to deal with TMs than conventional military forces. Because of their specialized training and focus, SMUs are potentially the most qualified to deal with TMs armed with WMDs. These units have the highest probability of success in conducting attack operations against a limited number of TMs armed with WMDs.<sup>50</sup> Even SMUs may require support and assistance from other SOF or conventional military units.

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<sup>49</sup>For additional information on biological agents see the U.S. Office of Technical Assessment, 1993, p. 71.

<sup>50</sup>Special mission unit is a generic term used to represent a group of operations and support personnel from designated organization that are task organized to perform a specific mission (Office of the Chairman, Joint Pub 3-05, 1992, p. GL-20).



## **E. UNITED STATES THEATER MISSILE RECONNAISSANCE AND STRIKE CAPABILITIES**

This section discusses the theater targeting processes used by the theater CINC staff. By developing joint doctrine and JTTPs that maximize the strengths of both conventional and SOF reconnaissance and strike capabilities, the theater CINC's capability to conduct attack operations against TMs is greatly improved.

### **1. United States Theater Target Planning Procedures**

The difficulty in targeting and destroying TMs rests with the targeting process and the C4 process. To better employ all U.S. deep-strike assets within a theater of operations, the theater targeting board and related procedures were developed. Targeting boards "ensure the effective employment of theater level deep surveillance, attack, and support resources." (Roach, 1989, p. 2)

The theater level intelligence collection assets available during the Persian Gulf War included the E-3 Airborne Warning and Control System (AWACS) aircraft, the Joint Surveillance and Target Attack Radar System (JSTARS), Unmanned Aerial Vehicles (UAVs), and high performance aircraft fitted with intelligence collection equipment. (Department of Defense, 1992, pp. 684 and 709)

The deep-strike assets available during the Persian Gulf War included the F-15E Eagle, F-16 Fighting Falcon Multi-Role Aircraft, F/A-18 Hornet

Strike Fighter, F-111 Aardvark Strike Fighter, F-117A Night Hawk Stealth Fighter, and the B-52 Stratofortress Bomber. (Department of Defense, 1992, pp. 694, 696, 704, 699, 702, and 674).

Targeting boards are oriented toward wartime mission accomplishment. In peacetime, they are required to identify potential critical targets, collect the necessary intelligence, and assign those targets to forces for destruction should a war occur. The forces assigned targets may be actual forces under control of the CINC. In other circumstances, the forces may only be identified for deployment to the theater in time of crisis.

The problem faced by the targeting board is threefold. First, a targeting board's peacetime guidance is not specific and rests on numerous assumptions about future conflicts and their most likely aggressors. Second, the targeting board is forced to rely on intelligence that is readily available. This intelligence is inadequate to cover mobile targets like TMs. Finally, the target board is oriented to support the preponderance of the military reconnaissance and strike assets. These assets capabilities are significantly different from SOF reconnaissance and strike capabilities.

The CINC develops his strategic concept, operation plans (OPLANs), and concept plans (CONPLANs) in peacetime. As the threats change the strategic concept must be reevaluated. Changes in the strategic concept cause changes to the existing OPLANs and CONPLANs. The OPLANs assume that the forces identified for deployment into theater will be

available. Any critical target list developed is based on these assumptions. These assumptions force targeting boards to work under the unwritten philosophy that the larger the database of targets, the more likely it is that they will have the required information on critical targets. (Roach, 1989, p. 6)

Once the relations between the United States and a potential aggressor shift from peacetime competition to conflict, the theater CINC can modify his strategic concept, OPLANs, and CONPLANs. This new information allows the military planners to develop a prioritized critical target list. The target board then scrubs its laundry list of targets to match the critical target list. Intelligence is gathered for any critical targets not previously identified. These new critical targets are placed on the critical target list and forces are assigned for their destruction or neutralization.

Because the entire targeting and intelligence process is focused on assets designed to destroy large, fixed targets, it takes significant external political pressure to focus assets on small, highly mobile, easily camouflaged targets. A massive missile attack against civilians of a democratic state or the possible designation of a United States led coalition are two historical examples of external pressure. Short of this type of external pressure, the military will follow its targeting procedures.

The targeting board is forced to rely on available intelligence. This intelligence consists mainly of imagery intelligence (IMINT) and

photographic intelligence (PHOTINT). Overhead imagery is ideally suited for monitoring large, fixed installations. Small, mobile, easily camouflaged targets, like TMs, are too difficult to monitor in peacetime based on current OPLANs and CONPLANs and available intelligence assets and capabilities. As a result, the board targets only fixed installations.

Finally, the preponderance of deep reconnaissance, strike, and support assets is Air Force aircraft. Army attack helicopters and ATACMS make up the remainder of the conventional deep strike assets. These conventional weapon platforms have similar employment characteristics, strengths, and weaknesses, however, special operations forces have entirely different employment characteristics, strengths, and weaknesses.

## **2. Military Reconnaissance and Strike Asset Capabilities**

The targeting board, which is composed of personnel that understand confidential military reconnaissance and strike capabilities, view potential targets with these capabilities and limitations in mind. Military reconnaissance and strike asset strengths are: high speed; an ability to cover a large area; an ability to carry numerous types of equipment or munitions; and their immunity from most enemy defenses. Military reconnaissance and strike assets depend on speed for security and protection and cover large distances quickly. These conventional reconnaissance and strike assets can employ numerous types of intelligence

collection equipment or strike munitions. The different types of collection allow reconnaissance assets to collect imagery intelligence (IMINT), signal intelligence (SIGINT), and measurement and signature intelligence (MASINT).<sup>51</sup> Strike assets can carry an assortment of precision strike or non-precision or dumb munitions. Conventional reconnaissance and strike assets are immune from most enemy defenses. General purpose forces and civilians are not normally threats to them. Only anti-aircraft defenses are threats.

Strike asset capabilities also can deliver large quantities of explosives, (*i.e.*, firepower) on target. They are effective against large, fixed targets visible from great distances or high altitudes. Strike assets are accurate, especially when using precision guided munitions. To be employed, they require limited intelligence, primarily overhead imagery. Except for ATACMS, once launched on a mission, the target can be switched in flight if the aircraft or helicopter is carrying munitions suitable for the new target. (Roach, 1989, pp. 9-10)

Strike assets weaknesses include the possibility of inflicting significant collateral damage. This is caused by using warheads that are too powerful. Most aircraft ordnance is also not precision guided. The lack of precision

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<sup>51</sup>For information on intelligence and collection see Office of the Chairman, Joint Pub 2-0, Joint Doctrine for Intelligence Support to Operations, U. S. Government Printing Office, 1993.

guidance increases the circular error of probability (CEP).<sup>52</sup> If targets are small and well camouflaged, high performance aircraft traveling at high speeds and high altitudes have difficulty acquiring targets. (Roach, 1989, pp. 9-10)

### **3. Army Special Operations Force's Reconnaissance and Strike Assets**

Army SOF assets available to the theater CINCs include the Special Forces (SF) Groups, the Ranger Regiment, and the Special Mission Units (SMUs). Each of these forces has different strengths and weaknesses. It is their different capabilities that make each of them an important asset in JTMD attack operations.

#### ***a. Army Special Forces***

The first asset available to each of the theater CINCs are Army Special Forces.

(1) Strengths. Each CINC has their own dedicated, area oriented SF Group. Several CINCs, including European Command (EUCOM), Pacific Command (PACOM), and Southern Command (SOUTHCOM), have forward deployed SF battalions in their theaters. The other CINCs, and the remainder of the SF Groups oriented to the EUCOM,

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<sup>52</sup>A CEP is an indicator of the delivery accuracy of a weapon system. It is used as a factor in determining probable damage to a target. It is the radius of a circle within which half of a missile's projectiles are expected to fall. (Office of the Chairman, Joint Pub. 1-02, 1994, p. 67)

PACOM, and SOUTHCOM theaters, are based in the continental United States. Each SF Group is oriented to one theater.

A twelve-man SF operational detachment (ODA) is ideally suited to conduct small unit Special Reconnaissance (SR) tasks of pre-strike reconnaissance, target acquisition, and post-strike reconnaissance. If necessary, the detachment can split into smaller, highly mobile, easily concealed TM assets or infrastructure in a scenario where TMs are armed with conventional weapons. Their small size also gives them a limited Direct Action (DA) strike capability. The SF ODA also has a limited capability to recover items of high value intelligence, military, and political importance.

(2) Weaknesses. While the small size of an SF ODA make it ideally suited for SR missions, it significantly limits its DA capability. An SF ODA does have a limited standoff or long-range strike capability. That capability, however, is a capability of last resort, to be used when all other means have failed.

(3) Conclusion. An SF ODA's specialized training, small size and area orientation make them an ideal asset for pre-strike reconnaissance, target acquisition, post-strike reconnaissance, and a limited high value item recovery capability.

***b. The Ranger Regiment***

The Ranger Regiment is another force available to the theater CINCs. The Ranger Regiment's size and mission focus give it a completely different capability from an SF unit.

(1) Strengths. The Ranger Regiment is better suited to execute strike operations. Ranger strike operations would be operations against larger TM infrastructure or TM security forces. Doctrine established by USSOCOM limits the Ranger's missions. The preferred target is multi-company to multi-battalion sized.<sup>53</sup> This strike capability would give the CINC the capability to eliminate virtually any TM infrastructure. The Ranger's large size would also make it easier to recover high value items.

(2) Weaknesses. The Rangers main limitation is they only conduct large-scale strike operations. Rangers are not oriented and trained for small scale independent operations like SR. A second limitation is the Rangers are not area oriented. They train to operate worldwide. Finally, the theater CINCs do not have dedicated Ranger units. They must be requested and their deployment authorized by the Secretary of Defense. If there were possible conflicts developing in two theaters nearly simultaneously, it is possible that one CINC's request would be denied.

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<sup>53</sup>A regiment consists of three battalions. Battalions consist of four companies, three rifle companies and one headquarters/support company. Each rifle company consists of three rifle platoons and a weapons platoon.



(3) Conclusion. The Ranger Regiment's specialized training and larger size make them an ideal asset in strike operations against TM infrastructure or heavily guarded facilities. They have the manpower available to recover high value items. The Rangers are not designed to conduct small scale SR operations.

*c. Special Mission Units*

The SMUs are the third SOF asset available to the CINCs. These specially trained units would be the ideal force for use in a limited TM WMD scenario. They could be one of the nation's first lines of defense against TMs armed with WMDs. While SMUs are national level assets, any theater with a potential TM WMD threat would get these assets. As in the Persian Gulf War, SMUs can also operate in a conventionally armed TM scenario. If SMU assets need augmentation, either SF, Ranger, or conventional elements would be selected. The capabilities required would determine which force was selected.

**4. Army Special Operations Force Reconnaissance and Strike Capabilities**

Army SOF SR and DA capabilities can immediately enhance JTMD attack operation capabilities. Special Reconnaissance missions include conducting pre-strike reconnaissance, target acquisition tasks in support of conventional strike forces, and post-strike reconnaissance, also called Battle Damage Assessment (BDA) to determine the success of a strike.

Direct Action missions include strikes against TMs, TELs and infrastructure, and/or recovery of designated personnel or material (Office of the Chairman, Joint Pub. 3-05, 1992, p. II-7). Material recovery operations could also be conducted following a conventional strike against TM targets.

Special operations forces small size, stealthy reconnaissance, and precision destructive capabilities can be enhanced when combined with conventional weapons platforms. Special operations forces strengths can make up for the weaknesses of conventional strike assets. In many circumstances, combining both forces in attack operations against TMs can enhance mission success, while limiting the possibility of collateral damage.

## **5. A Theater Missile Targeting Solution**

The combination of SOF and conventional reconnaissance and strike capabilities creates a virtually unbeatable combination. Special operations forces have the capability to locate, identify, and designate targets for high performance strike aircraft. This SOF capability increases bombing accuracy and survivability of the aircraft and the survivability of the SOF element. Work has been done to develop JTTPs to enhance this target designation capability.<sup>54</sup>

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<sup>54</sup>For additional information on Laser Target Designation Operations, see Joint Pub. 3-09.1, Joint Laser Designation Procedures, U.S. Government Printing Office, 1991. For information on Radar Beacon Operations, see Joint Pub. 3-09.2, JTTP for Radar Beacon Operations, U.S. Government Printing Office, 1993.

The peacetime implementation of JTTPs that integrate SOF into attack operations against TMs is required. Joint tactics, techniques, and procedures provide the necessary framework for SOF to train, eliminating many problems in planning and executing strategic operations on very short notice. Joint tactics, techniques, and procedures also allow different SOF and conventional units to train together and develop high confidence in their combined abilities to execute difficult operations.

During times of conflict, SOF and conventional units can combine and incorporate the necessary intelligence and support quickly. This is possible because the specific intelligence and support requirements have already been established by previous exercises that incorporated JTTPs. Even if the SOF and conventional units have not worked together, if they have participated in exercises or practiced JTTPs with other units, any mission training that is required will be reduced. This commonality of training of JTTPs makes them critical. Since each element knows and understands the JTTPs, the probability of mission success significantly increases.

#### **IV. OPERATIONS AGAINST GERMAN V WEAPONS**

Despite the best efforts of the Allied Air Forces, they were unable to stop the launching of V-1s and V-2s against Great Britain and the Continent. Neither the strategic bombing attacks against the manufacturing and transportation infrastructure nor the tactical bombing of storage facilities and launch sites could stop the V weapon launches. The V weapon attacks against British cities continued until Allied ground forces overran the weapon launch sites and forced the firing units to withdraw out of range.

##### **A. DEVELOPMENT OF THE V WEAPONS**

The Treaty of Versailles limited the amount of artillery the Germans were allowed to possess. In 1931 in an apparent effort to overcome legally this restriction, the German Army adopted an idea to bombard distant objectives with remote controlled pilotless aircraft. The Army ultimately decided to use rockets for long-range bombardment. Meanwhile, the Luftwaffe began conducting research on rocket powered aircraft. In 1936, the German War Office and Air Ministry agreed to share costs of developing a test site on a German island located on the edge of the Baltic Sea (Collier, 1964, pp. 153-155). The facilities were called Peenemunde, after the small village located on the island (Kennedy, 1983, p.12).

Early in the development of both weapons, disagreement emerged regarding how to employ the weapons. At Peenemunde, there were two

schools of thought. The scientists, engineers, and technicians, wanted to fire the missiles from massive bunkers. These facilities could contain storage, testing, and servicing facilities. They believed that would make servicing, storage, and launch of the weapons easier, enhancing the effectiveness of both weapons. Army and Luftwaffe officers, were more interested in the combat survivability of the weapons. They wanted mobile field batteries. The military officers believed this was the only way to ensure the survivability and effectiveness of the weapons. A compromise between the two positions was worked out. Each V weapon was deployed using two battalion sized units of field launchers and one battalion operating from hardened bunker facilities. (Kennedy, 1983, p. 30)

While the Army rocket program continued, the Luftwaffe developed a prototype of an unmanned photo reconnaissance aircraft. At the beginning of World War II, the Luftwaffe prepared plans to employ a pilotless flying bomb with a range of 350 miles. These plans were not put into action until 1942. In that year, the British began the practice of fire bombing German cities. These attacks incensed Hitler. He ordered terror attacks of a retaliatory nature must be directed against British cities. (Collier, 1964, p. 15)

This order resurrected the Luftwaffe's project and helped the Army continue its development program. The Luftwaffe's weapons became known as the Vengeance Weapon-1.<sup>55</sup> The Army's weapon became Vengeance

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<sup>55</sup>The most accurate description of the V-1 is a flying bomb. It is neither a rocket or missile.

Weapon-2.<sup>56</sup> (Kennedy, 1983, p. 5) Because of Hitler's new emphasis, the Luftwaffe could now divert a small amount of its resources into developing the V-1 (Collier, 1964, p. 14). This was accomplished without adversely affecting production of conventional aircraft. The Army's V-2 project, which had been plagued with numerous failures throughout its development, also benefited from its increased national priority. Because of resource constraints, until May 1943, both programs were competing against each other. Then a committee of high ranking government officials, Luftwaffe officers, and Army officers determined that the two weapons were complimentary and not mutually exclusive. Each weapon's strengths and weaknesses offset the other weapon's strengths and weaknesses (Kennedy, 1983, pp. 19-20).

Despite their attempt to overcome legally the Treaty of Versailles, the Germans maintained a high level of security around the V weapon programs. It was not until November 1939 that British intelligence became aware of the development of rockets at Peenemunde. Little intelligence effort was devoted to rockets and Peenemunde until 1942. Then, new information of unknown reliability again mentioned that rocket research and testing was being conducted around Peenemunde. Intelligence collected in 1942 and early 1943 was confusing and contradictory for two reasons (Collier, 1964, pp. 158-159). First, the Allies were not aware that they were getting information on two

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<sup>56</sup>Different sources describe the V-2 as a rocket or a missile. The DOD Dictionary, Joint Pub. 2-01, does not define either term. Webster's Dictionary defines a rocket primarily as a propulsion device. It defines a missile as a type of weapon used to strike at something at a distance. Because of the variety and age of the sources used, this thesis will use the terms rocket and missile interchangeably to describe a weapon designed to attack distant targets.

different types of weapons. Second, no one was initially responsible for collecting and analyzing the available intelligence on the V weapons.

By April 1943 photo reconnaissance around Peenemunde began to reveal unusual structures. In June photo reconnaissance showed the presence of V-1 unmanned aircraft and V-2 rockets. In early August, new information finally made it clear that there were two distinct weapons programs (Collier, 1964, pp. 158-159). Even with the new intelligence and photographs, numerous high ranking Allied government and military leaders refused to believe that these new weapons were a threat.

Ultimately, the decision to bomb Peenemunde was ordered for two reasons. First, something was going on there. Second, one bomber raid was not a significant diversion of Allied air assets. (Kennedy, 1983, p. 21) The British Bomber Command conducted the attack on August 17, 1943. The attack was declared a success despite the loss of forty aircraft. That amount represented about seven percent of the total aircraft involved in the operation. The facilities at Peenemunde were severely damaged and two important scientists are killed (Collier, 1964, pp. 158-159).

The bombing forced the Germans to change tactics. The deception techniques that had been used up till then were increased. Reconstruction at Peenemunde began in secret. It was well concealed by camouflage. The bomb damage was left unrepaired. Within six weeks the facilities were operational again. Work there continued unmolested for almost nine months (Kennedy, 1983, p. 23). The air attack on Peenemunde ultimately had little impact on

testing and development of the V-1. Renewed attacks on Peenemunde began at roughly the same time that the V-1 attacks against Great Britain commenced.

About the same time that Peenemunde was attacked, several proposed production facilities in other parts of Germany were also bombed. While the attacks were unrelated, the German's inability to protect a large portion of its manufacturing base from air attacks caused them to consolidate most V weapon production. The V weapons manufacturing was done at an underground factory, at Niedersachswerfen, in the Harz Mountains (Military Analysis Division, 1947, p. 35). Using underground production facilities deep inside Germany prevented the Allies from attacking them.

The air attack on Peenemunde also caused the Germans to disperse the design and testing of the V weapon programs. The testing and design of the V-2 were moved to Blizna, Poland. Since Blizna was beyond the range of Allied bombers, V-2 testing and development were protected (Collier, 1964, pp. 33-34). Additionally, some parts for the V-2s were subcontracted out to other factories that were also out of range of Allied bombers. The advance of the Russians on the Eastern Front ultimately forced all construction to be consolidated at the Harz facilities. The Russian advance also closed the test facility at Blizna (Kennedy, 1983, pp. 29 and 34).

By 27 August 1943, construction was underway on the first hardened V-2 site. By October, construction was underway on most of the original V-1 ski ramp sites (Collier, 1964, p. 36). Security at the construction sights was practically nonexistent. French contractors and laborers were used in the



construction of the original launch sights. In December 1943, a seasoned artillery Commander, Lieutenant General (LTG) Erich Heinemann, assumed overriding responsibility for the V-1 and V-2 programs. Because of the unique design and construction of the V-1 ski ramp sites and the lack of security employed during construction, the Allies began harassment bombing on the V-1 ski sites. General Heinemann realized that the existing launch facilities under construction were useless. He allowed construction on them to continue as a decoy while simpler, less distinctive, underground facilities were prepared (Collier, 1964, p. 22). Heinemann's decision was the end of the controversy over the best means of employing both V weapons.

On June 13, 1944, the Germans introduced a new type of terror weapon for wartime use against civilian populations. The first use of the V-1 was less than spectacular. It exploded in the village of Swanscombe, England without causing any casualties. By the last attack on March 29, 1945, about 10,500 V-1s were launched at Great Britain. About 8,892 V-1s were launched from ramps in German occupied territory. About 1,600 V-1s were launched from German aircraft. (Collier, 1964, p. 180)

## **B. THE V-1 FLYING BOMB**

The V-1's strengths were its simple design and low manufacturing costs. Its few logistics requirements, including the required to use low-grade aviation fuel was also an advantage. Its weaknesses were its slow, straight, and level flight profile and its need for fixed launch ramps. (Kennedy, 1983, p. 19)

The V-1 was a pilotless aircraft with a single mid-wing and a wingspan of sixteen feet. Its overall length was twenty-five feet. The V-1 weighted over two tons. Its fuel weighted just over one half a ton. The warhead weighed just less than one half ton. Its initial range was about 160 miles. It was increased to about 250 miles. The V-1s were primarily fired from ramps using auxiliary launching devices that gave the V-1 its initial burst of propulsion at launch. Once clear of the ramp, the V-1's jet pulse engine took over. Because of the short distance to London, approximately 100 miles from the original launching facilities, simple and inexpensive jet-pulse engines were used. These engines only had a working life of between one half and one hour (Collier, 1964, pp. 169-170). The V-1 flew at a constant speed, about 360 miles per hour, on a constant heading, at low altitude (Kennedy, 1983, p. 19).

#### **1. Launch Site Characteristics**

Originally, the German's planned to launch the V-1s from ninety-six fixed launch sites and two large hardened sites. The large sites were envisioned by the scientists and technologists as a combination service, storage, and launch site. Construction began on both the ninety-six ski sites and the two large bomb proof launch sites. The two large sites were supposed to be hardened with reinforced concrete to withstand even the heaviest Allied bombing attacks and continue launch operations. The significant construction effort involved in building the two large sites made them stand out as potential targets for Allied

bombing. The bombing was effective and neither of the two large hardened sites ever launched a V-1.

The initial design of the ski ramp launch sites included a ramp, one square building with one open side, and a number of tunnel like buildings. The square building with the open side was where the magnet compass, used to guide the V-1, was set. The long tunnel like buildings were designed to store the missiles and wings before final assembly. The other distinctive characteristic of the ski ramp site was their orientation. The ski ramps were constructed on a direct magnetic azimuth with their intended targets. The open side of the square building was also constructed on a magnet azimuth with the target (Collier, 1964, p. 20). The unique design and blast construction of the ski ramp facilities made them easy to identify and attack from the air once the Allies knew what to look for.

Modified launch sites were designed and constructed to be much more survivable. They consisted of concrete foundations and floors for the square building and an easily assembled launch rail/ramp. Prefabricated building components were positioned very near their concrete floors. No long storage buildings were constructed. The V-1 components were dispersed around the launch site. This practice was identical to dispersing and camouflaging aircraft around their airfields. The launch rails were not fixed in place until the day before launches began. (Collier, 1964, pp. 47 and 69) Additionally, a large number of anti-aircraft guns were emplaced to protect the modified sites.

Seventy to eighty modified sites were in various stages of construction. When ordered to begin attacking with the V-1s on June 6, 1944, fifty to sixty of the completed sites were manned. Simultaneously, 873 bombs were moved by rail from the depots to the sites. Initial difficulties plagued the first launch attempts. Only four of the first ten missiles reached Great Britain. On 15 June, the V-1 bombardment begins. Within fourteen hours, 244 missiles hit the London area. (Collier, 1964, pp. 69 and 163 -164)

## **2. Ease of Concealment**

The original ski sites were not concealed. This contributed to their abandonment. The modified launch sites were constructed using better techniques of security and camouflage. After construction, the concrete foundations and floors were camouflaged. When the prefabricated buildings were erected, they were also camouflaged. The components of the V-1s were dispersed around the launch site and camouflaged. This practice was identical to dispersing and camouflaging aircraft around airfields. Finally, the launch rails were not fixed in place until the day before launches began. (Collier, 1964, pp. 47 and 69)

## **3. Ease of Maintenance and Resupply**

The V-1's design made it easy to maintain and resupply. The use of low grade aviation fuel also simplified the logistics requirements. Launch crews could complete final assembly and preparations of the flying bombs at the modified ski sites. Assembly included attaching the wings and adjusting the

magnetic guidance mechanism. All that was then left was to fuel, mount the V-1 and booster on the ramp, and launch it. These tasks were accomplished despite continued attempts to interdict launch operations by air attack.

The logistics network originally designed for the V-1 supported two large sites and ninety-six ski ramp sites. It consisted of eight storage depots. The same lack of security precautions that plagued the launch sites plagued the construction of these original eight depots. General Heinemann also abandoned these facilities. Three new storage depots were established. Two in large limestone caves and one in a railway tunnel (Collier, 1964, p. 78). These facilities remained operational until they were captured, still containing V-1s, by advancing Allied ground forces. The original supply sites also served as effective decoys and absorbed tons of Allied bombs.

### **C. V-1 EMPLOYMENT TECHNIQUES**

The employment techniques of deception, decoys, dispersal, and using civilians as shields are examined.

#### **1. Deception**

Initial attempts to maintain the secrecy of the development and employment of the V-1 was successful. Allied intelligence was aware that something was going on. However, it took a considerable amount of time and effort before they could identify the V-1 and its capabilities. The operational security of the hardened launch sites, the original ski sites, and their supply

sites was compromised. This compromise wasted a considerable amount of German effort and expense. However, those sites became effective decoys.

## **2. Decoys**

The Allies began bombing the two hardened sites, the original ninety-six ski sites, and the eight storage sites, in December 1944. Because their security was compromised and the Allies were consistently bombing them, all of the sites were abandoned. The facilities, however, became perfect decoys. While the Germans began building modified ski sites, the Allies continued to bomb the other decoy sites.

German deception was so good that it helped delay the bombing of the modified sites until days after the V-1s were being launched at Great Britain from those sites. While the Allies had been aware of the presence on the new modified sites, they chose to not bomb them for two reasons. First, the German deception had worked so well that the Allies could not be sure where the V-1s were being launched from. Second, the modified sites were so well camouflaged and constructed, the Allies decided the sites were too difficult to attack until there was proof that V-1s were being launched from them. However, after the deadly attack on the chapel at Wellington Barracks on 18 June killed or wounded 189 civilians and service members, all V-1 launch sights, ski and modified, became top priority targets. (Collier, 1964, p. 69 and 163 -164)

### **3. Dispersal of facilities**

The range and flight characteristics of the V-1 limited the German's ability to widely disperse their launch sites. Within these limitations however, German dispersal efforts were successful. Originally, two methods of launching V-1 had been planned, from hardened facilities and from individual ski ramps. While the plan to use the hardened launch facilities failed miserably, the large number of individually dispersed launch ramps, both decoy ski and modified sites, proved to be successful. The number and dispersal of both type of sites inhibited the Allies attempts to destroy the launchers.

The Luftwaffe developed another effective technique launch technique for the V-1, by aircraft. This launch technique incorporated both employment techniques of mobility and dispersal. The range of the aircraft increased the range that V-1 launch facilities, now airfields, could be established from Great Britain. This increased dispersal increased the survivability of the V-1s, their launch aircraft, and other supporting infrastructure. Aircraft launched V-1s proved to be the only means of attack left to the Luftwaffe until after modifications to increase the range of the V-1 were completed.

### **4. Using Civilians as Shields**

There was no direct attempt to use civilians as shields to protect the V-1 launch sites from Allied air attack.

#### **D. V-1 PHASES OF EMPLOYMENT**

The employment of V-1 weapons can be broken into four phases. Phase One lasted about three months. It began on 13 June and lasted until the middle of September 1944. This phase involved the heaviest attacks against Great Britain. Phase Two lasted for about four months. It began on 23 September 1944 and lasted until 20 January 1945. This phase consisted of attacks against Great Britain by aircraft launched V-1s. Phase Three lasted six months. It began in October 1944 and continued until March 1945. It consisted of a heavy bombardment campaign against targets on the European continent. Phase Four lasted about one month. It began on 1 March 1944 and ended on 29 March 1945. Phase Four consisted of renewed attacks on Great Britain by modified longer range V-1s.



	MAIN TARGET	ESTIMATED LAUNCHES	APPROACHED OR REACHED THE COAST
PHASE ONE 13 July to Mid- September 1944	GREAT BRITAIN	7408	6743
PHASE TWO 23 September 1944 to 20 January 1945	GREAT BRITAIN	701	638
PHASE FOUR 1- 29 March 1945	GREAT BRITAIN	137	125
PHASE THREE October 1944 to March 1945	EUROPE	7,821	6,518

Table 1. V-1 Phases of Employment (Military Analysis Division, 1947, p. 15)

## E. THE V-1's EFFECTIVENESS

London was the main V-1 target in Great Britain. It received most of the strikes. Antwerp, Belgium received the majority, eighty-eight percent, of all continental strikes. Because of the shorter range, attacks against Antwerp were more concentrated and accurate. Attacks slowed the clearing of the port and the unloading of supplies. This slightly diminished the usefulness of Antwerp to the Allied Armies. (Military Analysis Division, 1947, pp. 14-15)

Two factors limited the effectiveness of the V-1. First, the accuracy of the weapon prevented it from being used on point targets, including critical military facilities, in Great Britain. The accuracy and reliability required that many missiles had to be fired to achieve a significant effect. This required the

production, transportation, and maintenance of large stocks of V-1s to sustain a useful rate of fire (Collier, 1964, p. 139). Additionally, the low, slow, and straight flight path from Northern France enabled the British to establish an effective defense plan.

#### **F. DEFENSES AGAINST THE V-1**

A series of anti-aircraft defense measures was established. They proved to be highly successful against the V-1s. These measures included the use of radar, anti-aircraft guns, balloons, and attacks by fighter aircraft (Military Analysis Division, 1947, p. 17). Radar was useful because it gave the other defensive measures and the civilians warning and time to prepare for the attacks. This was possible because of the slow speed of an approaching V-1. Radar also helped vector fighter aircraft in on the V-1s.

In December 1943, the British began to prepare an initial air defense plan, called Overlord Diver, for use against the V-1. In part, the plan called for the employment of 1,332 anti-aircraft guns to be deployed. In February 1944, the British adopted an air defense plan that emphasized the protection of the military forces that were massing for the invasion. Five hundred seventy guns were authorized for defense against the V-1s until the invasion. After the invasion, the plan was to reduce the number of guns devoted to V-1 defense to three hundred eighty-four. (Collier, pp. 159-163)

On the morning of 13 June 1944 after the first few V-1s struck Great Britain, the Chiefs of Staff Committee, composed of senior Allied Officers that

represented their commands, decided to not implement Overlord Diver yet. By 15 June, however, the British were hurriedly implementing and attempting to improve Overlord Diver. Anti-aircraft guns increased to over 900. Balloons, which trailed cables that damaged V-1s, were increased from 400 to 1,000. And fighters were formed into three separate belts with the first one starting in the middle of the English Channel. (Saunders, 1954, pp. 157-158)

By late June 1944, the defensive measures were beginning to eliminate many incoming V-1s. As the bombardment continued into the fall and winter of 1944, the defenders refined their capabilities. In some cases, they destroyed as many as ninety percent of the incoming V-1s. In all, a total of 3,957 V-1s were destroyed by British defenses. Aircraft accounted for 1,847 destroyed. Anti-aircraft guns accounted for 1,866 destroyed. Balloons, cables hanging from them, intercepted 232 V-1s. (Saunders, 1954, p. 169) Besides the active defensive measures employed by the British, they still had a significant civil defense organization and capability in place.

#### **G. THE V-2 ROCKET**

The V-2 rocket's strengths were its mobility, flight trajectory, and speed. The V-2's trajectory and speed made it immune from all known air defense countermeasures. The mobility of the V-2 came from its ability to be fired by mobile field launchers. These mobile launchers made it impossible to attack the V-2 before it was launched. The mobile launchers could fire a missile and move before being detected and attacked by Allied air reconnaissance and

strike assets (Kennedy, 1983, p. 19). The V-2s weaknesses included its overall complexity and need for special propellants.

The V-2 was an Army program and originally designated as the A-4. It was a gyroscopically-stabilized finned rocket forty-six feet long. Without fuel, but with a one-ton warhead containing 1,650 lbs. of explosives, the V-2 weighted just under four tons. The diameter of the body at its widest point was nearly five-and-a-half feet. At the fins, the V-2's diameter was close on twelve feet. The missile carried roughly four tons of a three-to-one mixture of ethyl alcohol and water and about five tons of liquid oxygen. Its total weight at takeoff was nearly thirteen tons. The maximum range of the V-2 in its standard configuration was two hundred to two hundred and twenty miles. The missile reached a height of fifty to sixty miles at peak trajectory. The V-2's speed reached a maximum of 3,600 miles per hour. Its speed fell to between 2,200 to 2,500 miles per hour immediately before impact (Collier, 1964, pp. 180-181). The length and fin span of the V-2 was based on the largest size object that could be transported through railroad tunnels and small villages (Kennedy, 1983, p. 9).

#### **1. Launch Site Characteristics**

At first, as with the V-1, the Germans attempted to construct two large hardened bombproof bunker facilities for launching V-2s. The first, near Watten, was designed to store 108 missiles, a three-day supply of fuel, and a liquid oxygen plant. Allied bomber attacks destroyed the bunkers while they

were under construction. (Kennedy, 1983, p.31) There is no evidence that V-2s were launched from bunkers.

The V-2 was launched from mobile launchers. It was launched in an upright position from a portable stand resting on a concrete or other hard surface. It was launched from prepared hard sites for two reasons. First, early rockets were test fired without some form of hard stand underneath. One test launch crashed after takeoff because one of the launcher's legs had sunk into the dirt and mud and canted the rocket too far for it to correct its trajectory after launch. General Heinemann, who was partially responsible for V-2s launching from mobile launchers, ordered that they be fired only from concrete platforms (Kennedy, 1983, p. 32). The second reason it was practical to fire the V-2 from some form of prepared site was because the rocket generated twenty-five tons of initial thrust at launch. Some form of hard stand was also required for the attendant vehicles. There were forty-five launch points prepared. They consisted of groups of concrete platforms for the V-2 and its supporting vehicles. (Collier, 1964, pp. 16, 67, and 180-182)

## **2. Ease of Concealment**

After abandoning the idea of launching V-2s from hardened facilities, concealment became paramount in all aspects on V-2 transportation and operations. Concealment began at the underground factory where railroad transporters were camouflaged with special covers to conceal the V-2s. After being off loaded from the railroad cars, the missiles were transported to the

final preparation area and then to their launch sites by special wheeled trailers that had special camouflaged covers. (Kennedy, 1983, pp. 43-44)

To conceal the launch sites, pine forests were preferred. They made aerial detection difficult and provided a wind screen for the V-2s in their upright position. Final preparation areas were selected with concealment in mind. This was necessary because the preparation sites contained numerous large tents and parking areas. They were also selected for their proximity to the launch sites. Launch sites were also picked based on their proximity to the railroad and the quantity and type of roads nearby. (Kennedy, 1983, pp. 43-44) Additionally, the less time the V-2s spent in vulnerable forward preparation and firing positions, the fewer their chances of their being detected and interdicted by Allied air assets.

### **3. Ease of Maintenance and Supply**

The missile storage facilities constructed to support the V-2s included seven main depots, four field storage depots, and six transit depots. Rocket fuel component liquids were also stored at separate locations. There were two main storage sites for liquid oxygen. There were two main depots and eight field depots to store alcohol. (Collier, 1964, p. 67)

During initial testing and use, the Germans learned that the longer a V-2 was stored, the greater the chance for a misfire. This caused the Germans to abandon their missile storage sites. Instead, they developed the technique of rapid rail transport directly from the underground factory to the firing units and

launch sites. These missile trains carried all of the necessary missile components, except the fuel and transporter-erectors. The trains carried twenty missiles and their components, including warheads packed in shipping containers, jet vanes, and fuses. (Kennedy, 1989, p. 45)

The V-2 was a very complex weapon. It also required three different rocket fuel components and an igniter. Because of the complexity of V-2, the handling and launching of the missiles demanded more specialized training and organization of the personnel involved. A V-2 Launch Battery was organized into four troops. A Headquarters Troop, a Fuel and Rocket Troop, a Technical Troop, and a Launch Troop. Each troop was subdivided into platoons and sections as necessary to execute their missions. The Headquarters Troop was responsible for the Launch Battery. The Fuel and Rocket Troop was responsible for transporting the missile from the railhead to the Technical Troop's final preparation area and fueling the rocket. They used specially camouflaged, wheeled trailers. The Fuel and Rocket Troop also transported the rocket fuel components, liquid oxygen, alcohol, hydrogen peroxide, to the launch site. Sodium permanganate, the final component needed to initiate the launch, was packaged at the factory and shipped with the missiles. (Kennedy, 1983, p. 44)

The Technical Troop was responsible for off loading missiles at the railhead. At the final preparation area, the Technical Troop inspected, conducted minor repairs, and mounted the warheads on the V-2s. Special rubber protection cases were put on the V-2 to protect it on the final leg of its trip. The V-2 was then placed on a Meilerwagen, a combination wheeled

transporter and missile erector, for final transport to the launch site. (Kennedy, 1983, pp. 44-46)

The Launch Troop transported the V-2 to the launch site. The site was normally set up with a fire control vehicle, portable launch pad, and electrical cables prior to the V-2's arrival. If camouflage was insufficient, overhead camouflage was also setup around the launch site. The V-2 was positioned on the concrete firing pad and erected onto the portable launch pad using the hydraulic lift on the Meilerwagen. The Launch Troop removed the protective shipping covers and conducted final checks and inspections. A platoon within the Fuel and Rocket Troop was responsible for fueling the V-2 while the final checks were being conducted. Three different fuel trucks, one for each separate fuel component, were required to fuel the V-2. First, the alcohol was loaded. Second, the liquid oxygen was loaded. Third, the hydrogen peroxide was loaded. Finally, the sodium permanganate was added. Arming the warhead was the final requirement before firing. (Kennedy, 1983, pp. 45-46)

## **H. V-2 EMPLOYMENT TECHNIQUES**

The employment techniques of deception, decoys, dispersal, and using civilians as shields are examined.

### **1. Deception**

As with the V-1, the Germans employed an effective campaign of deception against the Allies. It began after the 1931 decision to develop rockets



and lasted until V-2 attacks against the Great Britain began. Despite some limited successes, Allied attempts to gather intelligence on the V-2 were unsuccessful. The British air attack against Peenemunde also had very little negative effect on the development and testing of the V-2. In fact, the air attack caused the German's to move V-2 test and production out of range of Allied bombers.

## **2.     Decoys**

Allied bomber attacks against the hardened V-2 launch sites convinced the Germans to abandon efforts to launch the V-2 from those facilities. The Germans then decided to only use mobile launchers. As with the V-1 hardened sites, the V-2 hardened sites served as effective decoys for Allied air strikes.

## **3.     Dispersal of Facilities**

The longer range of the V-2 made it less of a factor in the dispersal of the forty-five prepared V-2 launch sites. The mobility of the V-2s and its logistic infrastructure, enhanced the German's capability to disperse them. The Allies never destroyed a V-2 rocket that was being prepared for launch.

Bombing of V-2 related production facilities caused the Germans to consolidate most of V-2 production into one underground site. This is an example where the survivability of a weapon's production facility was improved by consolidating its components at one location. This was effective for two reasons. First, the Germans could not stop the Allied air attacks. Second, the underground facility was also out of range of Allied bombers.

#### **4. Using Civilians as Shields**

From September 1944 until March 1945, the Germans launched V-2s from around the Hague in Holland (Collier, 1964, pp. 172-173). The German's use of Dutch civilians as shields limited the Allies' willingness to bomb possible launch sites. Initially, the Allies attempted to only attack V-2 targets that were at least 250 yards from the nearest building known to house Dutch civilians (Collier, 1964, p. 129). The Allies even attempted to get permission from the Dutch government in exile in Great Britain to bomb launch facilities in and near populated areas. The Dutch government never responded to the Allied request. Instead, the Dutch government agreed not to object to "well chosen" attacks (Collier, 1964, p. 129).

#### **I. THE V-2's EFFECTIVENESS**

The V-2s were employed as terror weapons to seek revenge against the British civilian population. In this capacity they were effective. From 6 September 1944 until 27 March 1945, 1,115 V-2s reach Great Britain. Of those, 518 hit London or its suburbs. There were 2,754 deaths and 6,523 serious injuries in London alone. (Kennedy, 1983, p. 40)

The V-2 was also used as a bombardment weapon against high value military targets on the continent. Against closer range targets, they were more effective. As a bombardment weapon against military targets, the V-2 was primarily used against the Allied resupply facilities at the port of Antwerp, Belgium. The first V-2 was fired against a continental target on the 13

September 1944. On 12 October 1944, Hitler decided that Antwerp was the primary continental target. On the continent, V-2s killed 5,400 persons, wounded 22,000 people, and destroyed 90,000 houses (Kennedy, 1983, p. 51). This secondary mission was necessary because by this point of the war, the Germans had no other way to bombard Allied military facilities.

#### **J. DEFENSE AGAINST THE V-2**

Because of its steep trajectory and high speed, no effective defense against the V-2 was developed. One plan developed in December 1943 involved concentrating a high volume of anti-aircraft flack on the radar predicted trajectory of the falling missile (Collier, 1964, p. 174). There is no evidence that a V-2 was ever shot down (Military Analysis Division, 1947, p. 17).

The speed of the V-2 also did not allow sufficient time for the civil defenses to respond. By the time a launch was identified and the civil defense sirens activated, the V-2 was already exploding on its target. Civilians were unable to take passive defensive measures with so little warning.

#### **K. THE V WEAPONS' EFFECTIVENESS**

At their maximum ranges, the V weapons were not accurate enough to strike militarily targets. Both the V-1, and later the V-2, were extremely as terror weapons against the British civilian population.

The attacks caused widespread damage, many casualties, and a considerable reduction of industrial efficiency. . . They had, however, little or no military effect. (Military Analysis Division, 1947, p. 16)

Twice, the Allies were forced to refocus their air and ground offensive operations in attempts to capture and overrun areas of the continent where the V weapons were fired from.

Even if the V-1 had little direct military effect, it had an impact on the civilian population and leaders of Great Britain. After the bombardment began on June 15 and the first mass casualties were received on 18 June, air support for the invasion, except in emergency circumstances, lost its high priority. Prior to June 18, the government officials trusted the military's judgement and were satisfied with the low priority the V-1 facilities had received. The attacks on the civilian population caused British politicians to apply pressure on General Eisenhower to reprioritize Allied military efforts. General Eisenhower was forced to shift significant air assets from covering the invasion beachhead to destroy and suppress V-1 launch sites. This major effort by the Allies against the V-1s lasted until the first phase of the V-1 attacks against Great Britain were stopped. The V-1 attacks stopped only when Allied ground forces threatened to overrun V-1 launching sites in Northern France. This forced the V-1 launch units to withdraw. The Germans then had to depend on aircraft launched V-1s to strike Great Britain. This method of employing the V-1s was less effective and it reduced the pressure on the British civilians.

Just when the Allied warning and air defenses against the V-1 attacks were beginning to enjoy successes, the swift and deadly V-2s attacks began. The V-2s reapplied pressure on the British population. In turn, the civilians reapplied pressure on their elected representatives. This pressure forced General Eisenhower to again redirect Allied efforts. Allied ground efforts were redirected further northeast into the low countries in an attempt to overrun all of the potential V-1 and V-2 launching sights. This was one reason that General Montgomery's Operation Market Garden was approved. (Ryan, 1974, pp. 84-88)

The success of V-1s attacks compared to V-2 attacks is debatable. Basil Collier, who wrote about both V-1s and V-2s, contends the V-1s were more effective than the V-2s. The low flight profile and loud engine noise made the V-1 attacks noticeable to the public. The final glide before detonation increased the amount of secondary damage to structures. British factory production information taken during the height of the V-1 attacks indicates the attacks reduced total factory output. These facts combined to make the V-1 an effective terror weapon against the British population. The average V-1 flying bomb that landed in Great Britain killed or seriously injured between six and seven personnel. (Collier, 1964, p. 125)

Gregory Kennedy, who wrote about the V-2, disagreed. He believed the engine cutoff and final glide of the V-1 served as a warning to personnel within earshot. This warning was supposed to be enough to allow people to seek last second protection behind any available bunker. Kennedy gives the example of people diving into street gutters and using the curbs to protect themselves. The

warheads on both weapons were nearly identical. The primary and secondary damage zones, which measured the degree of damage caused by the explosions, of both weapons were nearly identical. Kennedy believed that the swiftness and lack of warning of the V-2 attacks made them more effective terror weapons. The V-2 was more effective and spectacular because of a greater number of incidents with in excess of one hundred casualties per warhead. Kennedy uses average deaths in London as his measure of weapon effectiveness. There, the V-1 is credited with 2.2 deaths per round. The V-2 caused 5.3 deaths per round. (Kennedy, 1989, p. 39)

No matter which V weapon was the most effective, both weapons were effective. Both weapons caused the British population to pressure the British politicians. The British politicians pressured the Supreme Allied Commander to make every attempt to stop the attacks.

#### **L. ALLIED INTERDICTION EFFORTS**

General Eisenhower was forced to redirect military assets in response to pressure from British politicians. Allied military efforts to reduce and ultimately eliminate the V weapon threat can be divided into four phases of operations. The first phase involved strategic and tactical reconnaissance and preemptive bomber strikes against V-1 and V-2 infrastructure and static launch facilities. The second phase involved increased strategic and tactical reconnaissance and bomber strikes against V-1 infrastructure and active launch sites. The third phase involved redirecting ground forces into northeastern

France to overrun V-1 launching sites. It also included redirecting ground force operations into the low countries in a similar effort to overrun V-2 launching sites. Only by pushing the V weapons out of range of Great Britain, could the Allies eliminate the V weapon threat to the British population. The fourth phase involved human resource intelligence (HUMINT) operations to gather information on the V weapons.<sup>57</sup> The intelligence operations got off to a slow start in 1939. However, they continued after the war ended. (Kennedy, 1989, pp. 53-56)

#### **1. Attack Operations Against the V Weapons' Infrastructure**

The first series of attack operations against V weapons involved strategic and tactical reconnaissance and bomber strikes against V-1 and V-2 infrastructure and static launch facilities. Strategic reconnaissance and bombing of infrastructure included the initial attack on the research and development (R&D) facilities at Peenemunde, Germany and related manufacturing facilities at Fallersleben and Stettin, Germany. The bomber attack against Peenemunde, Germany was a daring operation. It was located deeper inside Germany than Berlin. Unfortunately, these attacks caused the Germans to disperse their R&D facilities, camouflage all of their V weapon facilities better, and ultimately manufacture them underground. German passive defensive measures prevented the Allied strategic bombing effort from

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<sup>57</sup>Human resource intelligence (HUMINT) uses human beings as both the source and collector. The human being is the primary collection instrument. (Office of the Chairman, Joint Pub 1-02, 1994, p. 174)

significantly effecting V weapon operations. At best, V-1 employment was delayed two months. (Military Analysis Division, 1947, p. 5)

Tactical reconnaissance and preemptive bombing focused mainly on the large hardened launch sites, the original ski launch sites, and original storage sites. All three eventually became decoy sites. Additionally, the transportation infrastructure in northern France was targeted. Beginning in October 1943, the Allies began bombing the hardened V weapon launch facilities under construction. In December 1943, the Allies also begin bombing ninety-five of the ninety-six ski ramp sites. By May 1944, photo reconnaissance revealed many modified underground sites under construction. It was surmised that they were for the V-1s. Allied fighter-bombers make one experimental attack on a modified site in May 1944. The attack did not effect the site. Because of emphasis on the invasion, there were no further air attacks on the modified sites. After the start of the invasion, the Allied Expeditionary Air Force Air Staff estimated that it would be weeks before the modified sites were operational. (Collier, 1964, pp. 161-162)

Allied bombing of the large hardened facilities and ski launch sites did prevent their use. Unfortunately for the Allies, the attacks begin about when LTG Heinemann decided that the sights must become decoys. These operations dropped over 23,000 tons of bombs on the decoy facilities (Collier, 1964, p. 76). Allied bombing convinced the Germans the best way to employ V weapons was from modified sites and mobile launchers.



## **2. Attack Operations Against V Weapons' Launch Sites**

This series of operations included strategic and tactical reconnaissance and bomber strikes against V-1 launch and storage facilities and other related infrastructure. These operations enjoyed a high priority and continued until significant V-1 launches against Great Britain from northern France ended.

After the first V-1s started striking Great Britain, the Chiefs of Staff Committee, decided to not modify their employment of air assets against German military targets. Their priority remained with the invasion forces (Saunders, 1954, p. 157). The Committee did allocate a very small portion, 1,000 sorties, of their available air forces against the decoy ski ramps and the decoy supply depots. No serious thought was given to attacking the modified sites, which were launching the V-1s. Only after a V-1 attack on the Wellington Barracks Chapel killed or seriously injured 189 civilians, did General Eisenhower direct that the V-1 targets take precedence over all other targets except the urgent requirements in Normandy (Saunders, 1954, pp. 157 and 158).

Despite Allied air efforts, neither the original ninety-six decoy ski ramps nor their decoy supply facilities were destroyed. Neither were the actual modified launching sites and their underground supply depots destroyed. Increased daylight air attacks against the V-1 launching facilities did apparently cause the Germans to begin conducting some of their attacks at night. The Germans were moving their supplies primarily at night (Collier, 1964, pp. 132-135). Additionally, two V-1 supply sites located in the Oise valley were

apparently damaged for a short time after being attacked on 6 July. This is because there was a sharp drop in the number of V-1 launches immediately after the attack (Military Analysis Division, 1947, p. 20). Despite the continued air attacks against the V-1 sites, their supporting infrastructure, and transportation network, V-1 storage facilities captured in northern France still contained V-1s. From August 1943 until March 1945, the Allied air effort against the V weapons was 68,913 sorties and 122,133 long tons of bombs.<sup>58</sup> Despite air interdiction efforts, there is no evidence that a V-1 was destroyed during pre-launch or launch operations. There also is no evidence that a V-2 launch platform ever received a direct hit (Collier, 1964, p. 139).

### **3. Ground Operations Against V Weapon Launch Sites**

To stop the launch of V-1s from northern France, ground forces were redirected into northeastern France to force V-1 launch units to withdraw. Until this time, Allied intelligence indicated that occupying this area could also prevent Germany from employing its, as yet, unused V-2 rocket against Great Britain. This information proved to be incorrect. After V-2 attacks began, ground forces were again redirected northeast into the Low Countries to overrun V-2 launching sites or push them out of range of Great Britain. Only

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<sup>58</sup>This information is incomplete and may under represent the actual number of missions and tons of bombs dropped. Early in the bomber operations, many V weapon related targets were classified and sorties and tons of bombs dropped were not accurately recorded for security reasons. Additionally, the Strategic Bombing Survey does not give much credit to tactical fighter harassment operations conducted against known or suspected V weapon launch sites.

by having ground combat forces physically occupy the launch areas could the Allies prevent V weapon attacks against Great Britain.

#### **4. Special Operations Force Operations**

World War II saw the development of modern SOF forces. Modern SOF developed directly from the American Office of Strategic Services (OSS) and the British Special Operations Executive (SOE). In World War II, these forces were not involved in DA strike operations against V weapons and their infrastructure. They were involved in HUMINT collection operations. These operations began in 1939 included gathering and passing information collected from indigenous underground resistance movements located in occupied countries. Human intelligence successes included first identifying Peenemunde as the V weapon R&D facility (Persico, 1979, p. 57). Information and recovered material provided by the Polish underground provided important information about the V-2 rocket. Information and recovered material from contacts in Sweden also provided important information about the V-2 rocket. (Collier, 1964, p. 166)

After testing began in Blizna, Poland, the Polish underground reported information on missile launches to London. The underground even captured a rocket that crashed in a swampy area. After hiding it, they located some technical experts and dismantled and examined the rocket. A 4,000-word final report, eighty photographs, twelve drawings and eight pieces were flown out of Poland by a C-47 Dakota in July 1944. (Collier, 1964, p. 167)

## M. CONCLUSION

Despite their best efforts, U.S. and Allied Air Forces were not able to destroy or interdict V weapons before they were launched at civilian and military targets in Great Britain and on the continent. Military leaders misjudged the significance of the V weapon attacks on the civilian population and elected leadership of great Britain. Only the V weapons' limitations and Germany's inability to produce and deploy them earlier in greater numbers prevented them from having a greater impact.

After the war, the U.S. military conducted a strategic bombing survey. Strategic and tactical bombing efforts failed to stop the development, testing, production, transportation, and employment of the V weapons, the survey determined that air interdiction efforts were successful. To make this claim, a low standard of success was developed. The low standard was defined as delaying employment and production of the V weapons and degrading their launch capabilities. This standard was developed by taking the unrealistically high production plans of the Germans and saying that since the production figures were not met, bombing efforts must have been the cause. Bombing efforts deserve some credit, but not all of the credit that they claimed. This low standard of success was accepted and became part of the doctrine for later U.S. Air Force operations. This low standard appears again during the Persian Gulf War against the SCUD. Accepting this low standard leaves the U.S. military,

and our Allies that depend on us, dangerously vulnerable in times of crisis and conflict.

## **V. OPERATIONS AGAINST IRAQI SCUD MISSILES**

Despite the best efforts of the Coalition air and SOF assets, they could not stop the launch of Iraqi SCUDs at Israel and Saudi Arabia. Those attacks only ended when Iraq agreed to a cease fire. It took U.N. inspectors in Iraq after the war to locate and destroy Iraqi SCUDs.

Two incidents prior to the Persian Gulf War demonstrate the importance that Iraq placed on its SCUD missile program. First, Iraq used SCUD missiles against Iran to help bring an end to the 1980-88 Iran/Iraq War. Second, Iraq threatened to use chemical weapons, employed from modified SCUD missiles, against Israel.

### **A. THE EFFECT OF MODIFIED SCUD MISSILES ON IRAN**

From 1980-1988, Iraq and Iran were at war. Over 600 SCUD B and modified SCUDs were fired by both sides from 1982-88 during that war. Iran fired about 270 SCUD B missiles at Iraq (Lennox, 1991, p. 301). Iraq had a more robust SCUD missile capability and fired the first SCUD B missile at Iraq.<sup>59</sup> On 27 October 1982, a single SCUD B exploded in Dezful, Iran. It killed twenty-one civilians and wounded over one hundred others. On 19 December 1982, two more SCUD Bs were fired at Dezful. This time there were 349 casualties. Iraqi SCUD B missile use against Iranian cities within range of

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<sup>59</sup>Iraq fired fifty-four Soviet Frog-7A Artillery rockets at Iranian cities in 1980-81. (Zaloga, 1988, p. 1423) Because of their short range, seventy kilometers, they are not theater missiles.

their SCUD B missiles continued unopposed until 1985 when Iran was able to obtain and employ its own SCUD B missiles. Because of Baghdad's proximity to the Iranian border, Iran's SCUD Bs were able to hit Baghdad, but Iraq's SCUD Bs could not hit Tehran. This forced Iraq to develop modified SCUDs capable of hitting Tehran. (Zaloga, 1988, p. 1424)

During the War of the Cities, the term used to describe the intense missile attacks against the two countries' cities in 1987-88, Iraqi modified SCUDs had a significant impact (Eisenstadt, 1990, p. 17). Iraq fired seventy SCUD B missiles at various Iranian cities. More important, Iraq could now directly attack Tehran with missiles. Iraq fired 150 Al Hussein SCUD variants at Tehran (Lennox, 1991, p. 301). Despite the Al Hussein's small warhead, its strikes at Tehran were credited with causing panic and contributing to a decline in Iranian civilian morale. These attacks were credited with bringing Iran to the negotiating table (McNaugher, 1990, p. 5).

## **B. IRAQ, ISRAEL, CHEMICAL WEAPONS AND THEATER MISSILES**

The United States has a significant level of interest in Middle Eastern politics. This is especially true where Israel is concerned. Domestic concerns help explain the White House's reaction to a speech delivered by Saddam Hussein on 1 April 1990. Before a public gathering that included large numbers of military, Saddam Hussein threatened to burn half of Israel with chemical weapons, if Israel attacked Iraq. In response, the White House issued a statement on 3 April that called the remarks "particularly deplorable and

irresponsible." The United States continued to talk tough to Saddam Hussein later in the same year when Iraqi SCUD missiles were moved closer to Israel. (Woodward, 1991, pp. 179 and 191)

Saddam Hussein used unofficial channels to tell the United States that he did not mean his remarks to be offensive and inflammatory. He just meant to remind Israel he had a retaliatory capability to use against them if attacked. (Woodward, 1991, p. 179) Hussein he was referring to the 1981 Israeli preemptive air strike against the Osirak nuclear research facility south of Baghdad. At that time, Iraq had no means to retaliate. Hussein did not want to chance another strike against his rebuilt nuclear, or any other special weapons, programs. The preemptive attack against Osirak was somewhat successful because it set the Iraqi nuclear program back at least three to four years (Feldman, 1982, p. 141).

Yet, the attack on Osirak taught Iraq an important lesson. That lesson was a reminder for Iraq not to put all of its nuclear eggs in one basket. Following Osirak, Iraq began an effective clandestine program for research, development, and fielding of WMDs and TMs. Iraq's clandestine approach included the used techniques of deception and dispersal. Deception limited the west's, including the United States', information about both programs. Dispersal prevented Israel, or anyone else, from attacking one site and destroying Iraq's weapons technologies. Iraq's SCUD acquisition, modification, and deployment of modified SCUDs employed these simple but effective techniques.



### **C. UNITED STATES CONCERNS AFTER THE INVASION OF KUWAIT**

During the early stages of Operation Desert Shield, the NCA was concerned about Iraqi use of SCUD missiles. Initially, General Schwarzkopf, the theater CINC responsible for the Middle East theater of operations known as Central Command (CENTCOM), also worried about SCUDs. However, those initial concerns soon vanished.

As early as 4 August 1990, President Bush expressed his concerns about the use of Iraqi SCUDs against the Israelis during a briefing at the White House (Reynolds, 1994, p. 11). Intelligence estimates concerning the number of modified SCUD missiles that Iraq possessed ranged from 800-1000 (Woodward, 1991, p. 268). General Schwarzkopf was present at the White House briefing. On 8 August, General Schwarzkopf was attempting to develop an effective air response option. The air response option was his only available option until ground forces were deployed into the area. One of General Schwarzkopf's concerns was the need to respond immediately if Iraq employed SCUD missiles armed with chemical warheads. Yet, by 17 August 1990, Iraqi SCUDs possibly aimed at Israel or Riyadh, Saudi Arabia were no longer considered a threat by General Schwarzkopf. (Reynolds, 1994, pp. 24 and 107)

Meanwhile, the NCA was still worried about Iraqi SCUDs. In mid-October, General Schwarzkopf and his staff were busy trying to develop a ground offensive campaign. The Secretary of Defense, Richard Cheney, was not happy with the original plan put together by General Schwarzkopf's staff.

As an alternative, Cheney suggested a ground offensive sweep 300-400 miles west of Kuwait's border. Besides being unexpected, a deep flanking attack that far west would allow direct ground attack against fixed SCUD sites threatening Israel. (Woodward, 1991, p. 294)

The differing opinions between the NCA and senior military planners at CENTCOM would go unnoticed until after Iraqi began launching modified Scud missiles at Israel. When Israeli retaliation threatened to break apart the Coalition, General Schwarzkopf was forced to alter his plans and divert air assets to keep Israel from retaliating against Iraq.

#### **D. DEVELOPMENT OF THE IRAQI SCUD MISSILE PROGRAM**

Intelligence on Iraq's SCUD acquisition and modification program is sketchy. Possible suppliers include the USSR, the original developers of the missile, Libya, North Korea, or even possible internal manufacturing within Iraq. In 1987, Iraq announced it had test fired a new missile called the Al Hussein. Iraq originally claimed that it was a new design, but it soon became evident that it was only a modified SCUD B missile (Lennox, 1991, p. 301). Apparently, the Iraqis produced their modified SCUDs by cannibalizing parts from other SCUD Bs and reducing the warhead weight (Zaloga, 1988, p. 1425). The combination of these two actions increased the range of the Iraqi modified SCUDs to between 500 and 650 kilometers. This enhanced range allowed Iraq to strike at Tehran and Israel.

## **E. CHARACTERISTICS OF SOVIET SCUD MISSILES**

The original SCUD missile was designed by the Soviets shortly after World War II. It was based on the German V-2 plans and some original German engineers and scientists were involved in its development. The R-11, also known as the SS-1b or SCUD A, entered service in 1955. Its TEL was a converted tank chassis. It had a circular error of probability (CEP) of four kilometers. This inaccuracy was overcome by arming the SCUD A with a fifty kiloton tactical nuclear warhead. (Lennox, 1991, p. 301) The SCUD A's range was 180 kilometers. (Zaloga, 1988, p. 1426)

An improved R-17 or SS-1c SCUD B, still using the original TEL, entered service in 1962. It used different propellant and had a more efficient propulsion system. Its improved guidance system included three gyroscopic devices that steered the graphite rocket vanes. The missile's weight was 5.9 tons. The fuel weighed 3.7 tons. The warhead weight was increased to one ton. The rocket itself weighed 1.2 tons. The Soviet version was designed to carry conventional warheads and WMDs. (Lennox, 1991, p. 301)

Another important improvement in the SCUD B was the introduction of a warhead that separated from the missile during flight. This separation occurred during the missile's terminal phase of flight over the target. It was introduced to improve the accuracy of the missile. Accuracy was improved by preventing axial sway which is caused by the lack of weight in the empty fuel tanks after all the fuel has been used. This weight imbalance causes the missile

to wobble during the terminal phase of its trajectory. The degree of sway was unpredictable and reduced the missile's accuracy. Eliminating the sway decreased the CEP. The CEP for the SCUD A was four kilometers at the maximum range of 180 kilometers. The SCUD B CEP was one kilometer at its maximum range of 300 kilometers. (Zaloga, 1988, p. 1426)

In 1965, a new R-17 SCUD B TEL entered service. It was based on a modified MAZ-543 8x8 heavy truck. The new TEL had better reliability and lower operating costs. Despite using wheels instead of tracks, there was only a small reduction in cross-country performance. (Zaloga, 1988, p. 1426)

#### **F. CHARACTERISTICS OF IRAQ'S SCUD MISSILES**

To produce the Al Hussein and the Al Abbas missiles, Iraqi modified Soviet SCUD Bs. Soviet SCUDs were cannibalized two ways. First, sections of the missile and fuel tanks were taken from one SCUD B and added to another SCUD B. The second technique was to reduce the weight of the payload/warhead that the missiles carried. Both techniques increased the range of the Iraqi modified SCUD missiles.

##### **1. The Al Hussein Modified SCUD Missile**

To produce the Al Hussein, Iraqi modified the SCUD B by lengthening its fuel tanks and by using a smaller warhead. The Al Hussein is about 12.2 meters long and has a diameter of .88 meters. It weighs 7,000 kilograms at launch. The warhead was reduced to 500 kilograms. The range increased to

650 kilometers. The Al Hussein probably still uses the SCUD B guidance system. Using the original guidance system, at the increased range, makes the missile less accurate. The conventional high explosive (HE) warhead in the Al Hussein carries about 227 kilograms of HE. (Lennox, 1991, pp. 301-302)

## **2. The Al Abbas Modified SCUD Missile**

The second modified SCUD developed by Iraq was known as the Al Abbas. It is about 13.75 meters long and .88 meters in diameter. It weighs about 8,000 kilograms at launch. Its fuel tanks were also increased and the warhead reduced even more. The warhead weighs about 350 kilograms. The Al Abbas has an estimated range of 900 kilometers. Its CEP is even greater than the Al Hussein, probably 1,500 meters. To hold these new missiles, Iraq developed a new TEL. It is called the Al Waleed. It is a converted articulating vehicle (Lennox, 1991, p. 301). An articulating vehicle has a hinge in the middle of the vehicle that allows it to bend.

## **3. Iraqi SCUD Missile Characteristics**

Three employment techniques enhanced the survivability of Iraqi SCUDs: mobility, ease of concealment, and ease of maintenance and resupply.

### ***a. Mobility***

The first reason that Iraqi TELs were so difficult for the Air Force to destroy was their on and offroad mobility. Iraqi SCUDs are transported on, and fired from, modified eight-wheeled Al Waleed TELs. A command vehicle, similar to four wheel drive off road vehicles, accompanied each TEL. The

commander and/or surveyor travels in the command vehicle. There are two drivers/operators in the front of the TEL. There are other operators in the missile command post/launch facility located in the center of the TEL. The command post is protected against blast effects from the launch of the missile. Soldiers can be dispatched to provide security around the missile prior to launch. (McNab, 1993, pp. 33-34)

The surveyor takes about an hour to prepare to launch a SCUD from an unsurveyed site. The surveyor is responsible for accurately surveying the site, radar tracking of balloons in the upper atmosphere, and calculating the angle of deflection for the missile. While this is occurring, the propellants are pumped into the missile. (McNab, 1993, p. 34)

***b. Ease of Concealment***

One lesson Iraq learned from Osirak was the need to conceal its military capabilities, including SCUD capabilities. Basic concealment techniques were incorporated into the Iraqi SCUD modification and employment program from the beginning. These techniques included camouflaging pre-surveyed missile launch points, missile storage facilities, and numerous short duration TEL hide sites. These hide sites were located between the storage facilities and launch sites. Other SCUD related infrastructure, including land line and radio communications links and anti-aircraft defenses, was also camouflaged.

Iraq used highway culverts, underpasses, and desert ravines to camouflage its TELs. (Department of Defense, 1992, p. 167) Iraqi concealment techniques were so effective that U.S. national and theater intelligence collection capabilities were unable to locate TELs and their associated launch storage sites.

*c. Ease of Maintenance and Resupply*

The SCUDs that Iraq modified were first deployed by the Soviets in 1962. By today's standards, they are difficult to maintain and resupply. Based on intelligence gathered on Soviet SCUD operations during the Cold War, U.S. military planners made three assumptions about Iraqi maintenance and resupply operations. First, it would "require several hours to prepare to launch a missile. Second, the TEL would produce distinctive prelaunch signatures (Keaney and Cohen, 1993, p. 43). One of these signatures was the missile fueling process. Third, after launch, the TEL would have to remain in place for up to thirty minutes. However, to protect the TELs and their crews, the Iraqis reconfigured their TELs so they could move within minutes after launching their missile (Department of Defense, 1992, p. 167). If these assumptions had been accurate, they would have allowed reconnaissance and strike assets to engage the TELs. Unfortunately, the planning assumptions were wrong.

## **G. IRAQI MODIFIED SCUD MISSILE EMPLOYMENT TECHNIQUES**

Iraqi SCUD missile employment techniques included the use of deception, decoys, dispersal, and using civilians as shields. These techniques enhanced the survivability of Iraqi SCUD TELs.

### **1. Deception**

Deception measures were incorporated into all aspects of Iraq's SCUD program, from initial development to fielding. Electronic and other communication signals were protected from foreign intercept. This included radar signatures and routine military communications. Additionally, because the SCUD's design was so old, no missile telemetry data was transmitted during test flights.

After the invasion of Kuwait, Iraq redeployed and limited the use of their radars. Limiting their routine military communications signals also reduced the United States and the Coalition's ability to gather intelligence necessary to target SCUD missiles and their infrastructure. During the air war, the telephone system was identified as a strategic target. It was surgically attacked with precision guided bombs. Yet, Iraq still maintained land-line communications with its military forces, including SCUD facilities and units (Lennox, 1991, p. 301). Iraqi deception measures required U. S. and Coalition air forces to expend large amounts of resources locating and attacking SCUDs, TELs, and their infrastructure.



Deception measures also included restricting the outflow of information about the SCUD missile modification program, especially from the civilian scientists and technicians working on the program. The deception helped Iraq to procure an unknown number of SCUD Bs from unknown sources. The effectiveness of Iraq's deception program became evident when Iraq announced the existence of the missile modification program. (Lennox, 1991, p. 301) Until then, the existence or the extent of the program was not widely known. At the start of the Persian Gulf War, intelligence estimates on the number of SCUDs Iraq possessed ranged from 400 to 1,000. Planners used 600 SCUD missiles including variants, thirty-six TELs, and twenty-eight fixed launchers for target planning. (Department of Defense, 1992, p. 97)

## **2.     Decoys**

Iraqis deployed decoy TELs and decoy missiles. This technique was so effective that five years after the war, the exact number of Iraqi modified SCUDs actually destroyed is still debated.<sup>60</sup> There are two reasons that Iraq's decoys were so effective. First, before the surprise invasion of Kuwait, Iraq was not considered a significant threat to U.S. national interests. For this reason, U. S. national intelligence collection assets were not focused on Iraq. Without these assets, there was little intelligence available on Iraqi capabilities, especially SCUD capabilities.

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<sup>60</sup>For different totals see Miller, 1992, p. A-24; Schemmer, 1991, p. 36; Powell, April 1992, pp. 48-53; Powell, October 1992, pp. 32-35.

Second, after the invasion, the Iraqis restricted the ability of U.S. national intelligence assets to monitor SCUD missile activities. These actions limited U.S. intelligence analysts' capabilities to determine decoy TELs and missiles from real TELs and missiles. This intelligence shortfall required U.S. and Coalitions assets to destroy every SCUD target, real and decoy. This wasted valuable military assets and needlessly placed U.S. and Coalition personnel at risk.

### **3. Dispersal**

Dispersal was accomplished by constructing multiple launch and storage facilities in the eastern and western portions of Iraq. There were up to five separate SCUD complexes in western Iraq. There were also training launchers in eastern Iraq (Department of Defense, 1992, p. 97). By dispersing the facilities throughout the country, targeting and destroying them becomes more difficult. In western Iraq within range of Israel, there were at least two main missile facilities. The complexes in eastern Iraq were within range of targets in Iran. Those same eastern facilities were also within range of targets in Saudi Arabia. Each of these facilities serviced multiple TELs. Each TEL could operate from multiple launch sites and hide sites near the facilities. These launch sites include surveyed and unsurveyed launch points.

### **4. Using Civilians as Shields**

During Operation Desert Shield, Iraq used foreign hostages as human shields. Iraq deliberately placed SCUD infrastructure and facilities near their

own civilian population centers. Their plan was to use their own civilians as a shield against Coalition air strikes. By increasing the possibility of civilian casualties, Iraq hoped to limit U.S. and Coalition air attacks on their SCUD facilities.

#### **H. IRAQI SCUD MISSILE EFFECTIVENESS**

From a military standpoint, the Al Hussein and the Al Abbas missiles were inaccurate and ineffective. They were modified by Iraq for use as a terror weapon against civilian targets. The two tons of missile and warhead falling on a city at 3,000 miles per hour is terrifying and lethal to the civilian population (Lennox, 1991, p. 302). Iraqi missile modifications increased the range of the SCUDs to enable them to target cities. These modifications, however, further reduced the accuracy of the modified SCUDs. Their accuracy was reduced because the guidance systems were not improved to compensate for the extended range.

Iraq modified its SCUDs to use as terror weapons against cities. During the Iran-Iraq War, Iranian troop concentrations and other militarily targets were within the range of Iraqi SCUD Bs. If Iraq wanted to attack military targets with its SCUD Bs, modifications to the guidance system to reduce the CEP would have given Iraq that capability. (Ficken, 1992, pp. 4-5) Instead, it chose to increase the missile's range to be able to strike Tehran, a militarily insignificant target.

Additionally, Iraq was the only Middle Eastern country that had a credible long- range aerial strike capability. Iraqi planes routinely bombed civilian population centers and infrastructure instead of concentrating on military targets. These civilian targets included transportation, petroleum production and refining, and industrial facilities. (Eisenstadt, 1990, p. 24)

Approximately eighty-eight total SCUDs were launched. Fifty-five were launched at Israel. Thirty-three were launched at Saudi Arabia. (Lennox, 1991, p. 302)

DATES	# DAYS	SAUDI ARABIA	ISRAEL	TOTAL
18-25 January	8	26	24	50
26 January - 6 February	10	2	25	27
7 - 15 February	10	5	6	11
TOTALS	28	33	55	88

Table 2. Iraqi SCUD Launches (Lennox, 1991, p. 302)

In Israel, 10,476 apartments were damaged. There were 283 people injured and one death. The greatest single loss of life occurred in Saudi Arabia when a SCUD hit a warehouse used by the U.S. military as a barracks (Schneider and Fink, 1991, p. 13). Twenty-eight U.S. soldiers were killed and almost 100 were injured by a SCUD attack (Department of Defense, 1992, p. 168). Despite the attempted interception by a Patriot missile battery, this attack caused the single greatest U.S. military loss of life during the entire war. While

the damage inflicted from the attacks was not great, they did cause civilians to flee the cities by the thousands (McNab, 1993, p. 23). However, the greatest fear of both the Israeli and Saudi populations never came to pass. Iraq did not employ chemical weapons against them.

## **I. DEFENSES AGAINST SCUD MISSILES**

United States and Coalition active defense measures were limited to the deployment of Patriot air defense systems. The effectiveness of the systems was highly publicized during the war, possibly to calm the fears of Israel's and Saudi Arabia's threatened civilian populations. However, post-war reviews were less favorable of the systems performance.<sup>61</sup> The main reason the Patriot did not perform well against Iraqi SCUDs was it was not designed as an area anti-missile defense weapon. It was designed as a point anti-aircraft defense system to protect small militarily significant targets, not large cities. Its range, speed, altitude, and warhead were all designed to defeat high performance aircraft, not an incoming TM. Last minute modifications provided the Patriot some anti-missile capabilities. However, when a Patriot missile battery attempted to intercept an incoming SCUD, the SCUD separated during flight to increase accuracy. This separation produced two targets for the Patriot to intercept per missile. This two for one ratio assumes the SCUD body remains intact after warhead separation. The Patriots limited range and fragmentation

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<sup>61</sup>For additional information see Postol, T., "Lessons of the Gulf War Experience with Patriot," *International Security*, Vol 16 No 3, Winter 1991/92 pp. 119-171.

warhead could not destroy all incoming missile component fragments, including the warhead.

Instead, Patriot missile detonations probably increased the diameter of the area where missile debris fell. Its own destruction could also increase the amount of debris that fell onto an area. This, in all likelihood, increased the amount of damage caused by the missiles. Reexamining Israeli damage figures demonstrates this. Approximately one half of the Iraqi SCUD missiles impacted before the Patriots were employed in Israel. The remaining half of the missile impacts occurred after the Patriots were operational. Before the Patriots became operational, the damage caused by incoming SCUDs was 2,698 apartments damaged and 115 people injured. After the Patriots were operational, the damage caused by incoming missiles was, 7,778 apartments damaged, 168 people injured, and one death. (Hughes in Fink, 1992, p. 12)

	# MISSILE IMPACTS	APARTMENTS DAMAGED	INJURIES	DEATHS
BEFORE OPERATIONA L	13	2,698	115	0
AFTER OPERATIONA L	11	7,778	168	1

Table 3. Patriot Effectiveness. (Hughes in Fink, 1992, p. 12)

Passive defensive measures included attempts at timely missile launch warnings to military and civilian personnel. These attempts demonstrate the

difficulty integrating and disseminating U. S. national warning capabilities into a theater of operations to military units and cities. Civil defense measures and procedures were implemented and followed. Fear of chemical weapons may have helped in civil defense implementation. Passive defensive measures are a fundamental part of military training and preparedness. However, even those measures are not effective against direct hits.

## **J. COALITION INTERDICTION EFFORTS**

Looking back, it is apparent a shortfall occurred during Exercise *Internal Look 90*. That exercise was conducted in July 1990. It was the first exercise conducted in which the Persian Gulf aggressor state was Iraq and not Iran. While changing the exercise aggressor proved invaluable while executing *Operation Desert Shield*, it did not help the Central Command Air Force Component (CENTAF) planners prepare CONPLANS for targeting SCUDs and nuclear, biological, and chemical (NBC) facilities (Keaney and Cohen, 1993, p. 31-32). Ultimately, two separate, but somewhat coordinated, campaigns were employed against the Iraqi SCUDs. The first was the air campaign with all its extensive planning and preparations. The second was a SOF campaign. After a shaky start, efforts were made to coordinate and integrate the two campaigns.

## 1. The Coalition Air Campaign

The CENTAF and CINC planning shortfall occurred despite four important factors.<sup>62</sup> First, Iraq had extensively used SCUDs against civilian targets in Iran to affect the outcome of that war. Second, prior to the invasion of Kuwait, the White House made public statements directed at Iraq after it had moved SCUDs into positions capable of striking Israel. Third, the theater CINC heard the President express concerns about the use of SCUDs against Israel. General Schwarzkopf had been present at that briefing. Finally, since 1973 all uses of TMs, both in interstate and internal conflicts, had occurred in the Middle East or North Africa.

This initial failure was not corrected during the months of planning before the air campaign began. This failure to anticipate the use of SCUDs against Israel forced General Schwarzkopf to reprioritize the air war against Iraq. Had the air forces not been able to gain immediate air superiority and divert a significant portion of air assets against the SCUD threat, the spectacular victory with minimal losses might not have been achieved.

According to Keaney and Cohen:

The planners in the Black Hole, like CENTCOM's leaders, regarded Iraqi ballistic missiles (even with chemical warheads) chiefly as nuisance weapons that might cause political difficulties for the alliance (particularly if Israel were to retaliate against Iraqis). They viewed the missiles as posing little tactical or operational threat to the Coalition and intended to reduce the

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<sup>62</sup>The Central Command Air Force Component (CENTAF) created a secret planning cell known as the Black Hole. It consisted primarily of USAF officers. Later, it was expanded to include representatives from the other U.S. services and British and Saudi representatives as well. (Keaney and Cohen, 1993, p. 31)



offensive threat they represented by attacking fixed launch sites, support bases, production facilities, potential hide sites, and support facilities for mobile launchers, but not the launchers themselves. (Keaney and Cohen, 1993, p. 43, parentheses added)

The first night of the air war, the Black Hole did plan for and implement air strikes against fixed SCUD missile infrastructure. Unfortunately, their concentration on fixed strategic facilities did not degrade Iraq's ability to launch SCUD missiles. Again according to Kennedy and Cohen:

When Desert Storm began, Coalition planners appear to have assumed that the Iraqis would launch their ballistic missiles initially from fixed or known launch sites, giving Coalition air power a reasonable chance of eliminating the SCUD threat-or most of it-in the opening hours of the war. If the Iraqis did shift to mobile operations under attack, Coalition planners assumed that their setup and launch procedures would resemble those utilized by Soviet SCUD units in Europe. More specifically, the mobile launchers would not only require several hours to launch a missile but, in the process, provide distinctive signatures that Coalition forces could exploit to locate and attack them. Planners also assumed that decoys and other "background noise" would not greatly complicate the problem of dealing with Iraqi SCUD units. (Keaney and Cohen, 1993, p. 43)

In all fairness to the Black Hole, they had identified SCUDs as one of eight strategic core target categories. These eight categories contained 295 targets attacked on 15 January 1995. Of those at least thirteen targets were SCUD related. Fixed Iraqi SCUD facilities were attacked beginning on the first night of the war. These eight target categories were allocated fifteen percent of all Coalition air strikes. Those fifteen percent of the allocated air strikes employed a disproportionate thirty percent of all precision guided munitions

expended. (Keaney and Cohen, 1993, pp. 12, 42 and 64-65) Had the political stakes not been so great, had Iraq not had a history of strategic employment of SCUDs, had Iraq not recently maneuvered its SCUDs into threatening positions against Israel, and had the Middle East not had a history of missile use, the Black Hole's planning assumptions could have seemed appropriate.

The campaign against the SCUDs had many facets. Satellites detected missile launches and sent six minute warnings to civilians and military units in the theater of operations. From intelligence, SCUD boxes were identified to narrow down the area that aircraft had to search for the mobile missiles. Strategic bombing attacks were targeted against production and storage facilities and other related infrastructure. At the tactical level, A-10 Thunderbolt II attack aircraft, F-15E Eagle dual role fighters, and F-16 Fighting Falcon multi-role aircraft conducted attack operations against SCUDs. (Powell, April 1992, p. 50)

The A-10 is the USAF's primary close air support (CAS) aircraft. It was designed as a low altitude tank killer. Their slow speed and long loiter time over their target area made them exceptionally suited for counter SCUD hunter operations in daytime. The F-15E Eagle dual role fighters were equipped with Low-Altitude Navigation and Targeting Infrared for Night (LANTIRN). This navigation and target designation equipment made the F-15E the most effective night capable ground attack aircraft. The F-16 Fighting Falcon multi-role aircraft was also used in counter SCUD operations. Modifications for the F-16s use of LANTIRN equipment were not completed before the start of the war.

This limited the F-16's nighttime effectiveness against SCUDs. (Department of Defense, 1992, pp. 664, 665, and 694-698)

In an attempt to limit the effectiveness of U.S. reconnaissance and strike aircraft, Iraq installed and camouflaged anti-aircraft weapons and radars in the areas surrounding SCUD launch sites. By eliminating Soviet peacetime safety procedures, the Iraqi TELs could depart the launch site minutes after launch (Department of Defense, April 1992, p. 167). To limit the effectiveness of Iraq's defenses, aircraft attempting to interdict SCUD launches were required to fly at high altitudes. The high altitudes limited the aircraft's ability to detect small, well-camouflaged SCUD TELs. An aircraft must find its target before it can destroy it.

Another means of detecting SCUDs involved employing a prototype aircraft. Two E-8A Joint Surveillance and Target Attack Radar System (J-STARS) aircraft were rushed from development testing into combat employment during the war. These aircraft, with powerful side-looking ground surveillance radar, were supposed to be able to locate targets on the ground. (Powell, April 1992, p. 50) Because there were only two aircraft available, the J-STARS aircraft could not provide the continuous twenty-four-hour theater wide coverage necessary. They were used in counter SCUD operations. Their mission was to detect mobile SCUDs and direct attack aircraft onto the target. The J-STARS aircraft did detect vehicular movement in western Iraq. It was able to assist aircraft in attacking those vehicles. However, J-STARS could not identify types of vehicles, only their movement. Unless detailed TEL signatures

can be developed prior to the start of hostilities, a J-STARS aircraft may be better suited for post-launch detection and tracking of TELs.

A third interdiction technique involved aircraft deploying area denial mines on suspected launch areas. (Department of Defense, 1992, p. 168) The intent behind this tactic was to restrict the number of possible SCUD launch sights.<sup>63</sup> Reducing the mobility of the TEL decreased the size of the search area. Reducing the size of SCUD boxes increased the concentration of Coalition assets and increased the chances of detecting SCUDs.

After only planning for approximately 295 SCUD related targets, 1,460 strikes were directed against SCUDs. Despite this massive air effort, there have been no confirmed SCUDs or TELs destroyed (Department of Defense, 1992, p. 168). All reported SCUD kills were either a misidentified vehicle or they were Iraqi SCUD TEL decoys.

Because of their failure to destroy SCUD TELs, the USAF decided to use a less demeaning measure of success. They decided to do what they did in World War II when they could not stop V-1 and V-2 launches. The Air Force determined that interdiction, the possible decreased number of SCUD launching, was an acceptable measure of success. (Powell, April 1992, p. 51)

Despite the Coalition's inability to stop SCUD launches their efforts did keep Israel out of the war. Publicity behind the apparently successful Patriot

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<sup>63</sup>The CBU-89 area denial mines have time delayed self-destruct mechanisms built into them. After a preset time, they automatically explode. This significantly reduces the possibility that civilians will be hurt by the mines after hostilities cease.

interdictions and SCUD hunting operations demonstrated to the civilian population that all available efforts were being used to protect them.

## **2. The Special Operations Force Ground Campaign**

Most information on U.S. SOF operations against SCUDs is classified. However, U.S. and British SOF units were involved in counter SCUD operations. General Schwarzkopf mentions that special operations teams went deep into Iraq to watch the roads and report sightings of mobile launchers (Schwarzkopf, 1992, p. 418). There is one mention of U.S. SOF involvement in operations against SCUD missiles in the 824 page Department of Defense Report on the Conduct of the Persian Gulf War. It states that a key element in the counter SCUD effort was small SOF elements on the ground who provided vital information about SCUDs (Department of Defense, 1992, p. 168).

Several techniques were used by Coalition forces to hunt SCUD TELs. One technique involved establishing a "fusion cell" of A-10 Thunderbolts, Delta Force and British Special Air Service (SAS) commandos to paint mobile launchers with laser target designators and call in air strikes" (Olson, 1991, p. 4). A second technique involved using the best intelligence available to narrow down the search area into SCUD boxes. Coalition air assets were concentrated into these boxes (Department of Defense, 1992, p. 168). It would be reasonable to expect that Coalition SOF were deployed into these boxes as well to assist in locating, target acquisition, and interdiction of SCUD TELs.

At least one British Special Air Service (SAS) patrol received a two-part counter SCUD mission. First, the team's mission was to locate and destroy landlines, including fiber optic lines, believed to be carrying information from Baghdad to the SCUD units. Second, the team was to find and destroy SCUDs. This mission was planned and executed after the Iraqi had begun launching SCUDs at Israel. (McNab, 1993, pp. 24, 5, and 23) This mission was part of the effort to prevent Israel from retaliating against Iraq and endangering the U.S. backed Coalition.

In preparing for their mission, the small SAS team evaluated three means of infiltration into the western desert area of the Iraqi desert. The means of infiltration included driving hundreds of miles overland into their area of operation (AO), inserting by helicopter near their AO and walking the rest of the way in, or inserting directly into their AO. The team also evaluated two means of operating in the desert. One means of operation involved using vehicles. The second means was to operate on foot (McNab, 1993, pp. 28-33). Ultimately, the way the team chose to operate dictated their means of infiltration.

The advantage of operating by vehicle was they would have more speed and firepower in an emergency. The disadvantage was the terrain in their AO. It would require continued hiding the vehicles every time the team came close to a potential target. Hiding the vehicles also meant leaving someone from their already small team behind with the vehicles to secure them. The long overland infiltration, overland exfiltration, and extended duration of their

mission also concerned the team. The team worried about carrying sufficient fuel to operate the vehicles the entire time.

Operating by foot had the advantage of making concealment in the flat, barren desert easier for the eight man team. Infiltrating by helicopter into or near the AO was quicker. The faster means of infiltration could possibly put the team into position to execute their mission days earlier. The disadvantage was the slow rate of movement, limited firepower, and enormous weight of equipment each man had to initially carry. These restrictions would seriously reduce the team's chances of survival if detected. The team decided to go in on foot.

The team determined they had two means of attacking and destroying a SCUD. First, they could call in an air strike. The team's concern was that they could be located by radio direction finding equipment if they called in aircraft. They decided that if they located a concentration of SCUD missiles and launchers, they would take the risk of compromise. Otherwise, they would attack an isolated SCUD TEL themselves.

To prevent a SCUD from being launched, the team had three options. First, it could eliminate the launch crew. The advantage of a stand off precision sniper attack is that it would prevent the launch with minimum risk to the team. The disadvantage is that the missile and TEL might still be operational. Because of the volatility of the fuel, attacking the missile itself could produce catastrophic detonation, explosion of the missile fuel and warhead. If it was a chemical warhead, its detonation would endanger the team. The explosion

would also alert any enemy forces within a wide radius. The third alternative was to destroy or disable the TEL. This could be done by infiltrating up to the TEL, quietly eliminating the crew, and planting a small booby trapped time delayed explosive in the command center located in the middle of the TEL. Because the command center was shielded to protect the launch crew, the team determined that the explosion was unlikely to cause damage to the missile. Destroying the TEL prevented it from launching any other missiles. The time delay allowed the team to leave the area before the small detonation could alert any enemy forces.

This SAS team decided to insert into the AO by helicopter and travel on foot. They were compromised and unable to complete either part of their mission. How other British and American SOF forces preformed is unknown. There is no information available to confirm any SCUDs were destroyed by SOF forces.

#### **K. THE UNITED NATIONS SPECIAL COMMITTEE**

Accurate information was not available on Iraq's SCUD program until after the war. The United Nations Special Committee (UNSCOM) sent inspectors to investigate Iraq's WMD and missile programs. Besides collecting information, the UNSCOM inspectors located and destroyed Iraqi SCUDs (McCarthy, 1995). The missiles destroyed by the U.N. inspectors are the only ones that can be confirmed.



## L. CONCLUSION

The Soviet strategy of Maskirovka, deception and disinformation, was at the heart of Iraqi SCUD missile employment techniques. Despite the best efforts of U.S. and Coalition air and SOF assets, there is no confirmation of a single SCUD or TEL destroyed during the entire war (Department of Defense, 1992, p. 168). It took the deployment of UNSCOM inspectors on the ground in Iraq after the war to track down and destroy the Iraqi SCUDs. Coalition interdiction efforts did appear to have some effect on the Iraqi employment of SCUD missiles. However, it was primarily the limited number of SCUD TELs available and the accuracy of the modified SCUD missiles that limited the effectiveness of the Iraqi missiles.

After the Persian Gulf War, the Department of Defense completed a major report to Congress. The U.S. Air Force also conducted another Air Power Report similar to the Strategic Bombing Survey it completed for World War II. Despite the failure of strategic and tactical bombing efforts of the U.S. and Coalition Air Forces, the survey again determined that air interdiction efforts were successful. This standard of success was again defined as delaying employment of and degrading the launch capabilities of Iraqi SCUDs. This was the same low standard of success developed to validate the concept of strategic and tactical air bombing against German V weapons in World War II.

Accepting this low standard of success prevents the U.S. military from learning from its past mistakes and moving forward with joint service efforts

to conduct effective, coordinated attacks against TMs. The creation of the "fusion cell" by CENTCOM clearly indicates there was a lack of joint doctrine and JTTPs in existence during the Persian Gulf War to combat SCUDs. Since then, some progress has been made in developing JTMD doctrine. Little progress has been made developing JTMD JTTPs.



## VI. THE CUBAN MISSILE CRISIS

The U.S. Air Force planned a 500-sortie air strike against Soviet TMs, bombers, and their supporting infrastructure located in Cuba (Garthoff, 1989, pp.50, 53, and 150). The Air Force repositioned nearly a thousand aircraft within striking distance of Cuba (Blight and Welch, 1989, p. 3). However, because of uncertainties with Air Force bombing capabilities and possible intelligence shortfalls, a massive air attack could not provide a one hundred percent guarantee that Soviet TM launchers, missiles, and short-range bombers positioned in Cuba would be destroyed. To ensure destruction of the Soviet weapons, it was determined that a ground force would have to invade and occupy the Soviet facilities. Only an invasion and occupation of the launch sites and storage sites could ensure the destruction of the missiles and prevent other missiles from being emplaced there in the future.

This section analyzes the 1962 Soviet employment of medium-range ballistic missiles (MRBMs) and intermediate range ballistic missiles (IRBMs) in Cuba. United States defense efforts against the Soviet missiles are examined. This is the only case available that involves the employment of TMs possibly armed with WMDs that threatened U.S. vital interests.<sup>64</sup> It is the best documented case where the United States planned attack operations against TMs possibly armed with WMDs. Despite the U.S. Air Force claim of being

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<sup>64</sup>The Soviet missiles fall within the range limits of this thesis' definition of TM. The MRBMs had a range of 1,000 miles. The IRBMs had a range of 2,500 miles. Neither was designed to strike targets in the United States.

capable of conducting precision bombing strikes, they were unable to guarantee success in eliminating Soviet TM launch sites in Cuba. The success of the Air Force plan was uncertain, even though Soviet forces in Cuba failed to camouflage their missile emplacements.

#### **A. DEPLOYMENT OF SOVIET MISSILES IN CUBA**

Beginning as early as 2 January 1961, Khrushchev denounced personally any idea that the Soviet Union would put missile bases in Cuba. After the Bay of Pigs incident in April 1962, Khrushchev sent a note to President Kennedy saying the Soviets would not put missiles into Cuba (Abel, 1966, pp. 15-16). Additionally, until the Cuban Missile Crisis, it had been Soviet policy to not deploy nuclear missiles outside the borders of their country (Allison, 1970, p. 14). The Kennedy Administration was aware of this policy.<sup>65</sup> Except for the Director of the Central Intelligence Agency, no high-level Executive Official believed Soviet missiles in Cuba was even a remote possibility. (Abel, 1966, p. 18)

In July 1962, Khrushchev met in Moscow with Castro's brother Raul, the Cuban Defense Minister. Shortly afterwards, the Soviets significantly increased the number of ships carrying military supplies to Cuba from the Baltic and Black Seas. Several of the ships off loading in Cuba were designed to carry

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<sup>65</sup>One reason the Soviets never deployed nuclear missiles outside their own borders was for their own security. If Soviet missiles placed in any European satellite country fell under the control of anti-Soviet factions, Moscow and other major Soviet cities could be threatened with their own missiles. If MRBMs and IRBMs missiles were placed in Cuba, the Soviet Union could not be placed in danger if they lost control of their own missiles. The missiles did not have the capability to reach targets in the Soviet Union. (Abel, 1966, p. 18)

large bulky items. The ships had oversized hatches suitable for shipping large oversized items. These ships also rode high in the water, as though they were loaded with lightweight, bulky items. Despite the increase in shipments of military supplies to Cuba, the White House remained unconcerned. The Soviet doctrine of Maskirovka, deception and disinformation, was successfully employed by senior Soviet leaders against U.S. policy makers.

Fortunately, for the United States, Soviet military forces in Cuba failed to employ Maskirovka. Basic concealment and security measures were not used. It was reported to the CIA that Cubans living near the deep water port of Mariel had been forced to evacuate their homes. Russians were now guarding the port. Russians were unloading cargo from ships coming from the Soviet Union. The CIA also began to receive multiple reports of large rocket components being transported from Mariel by road. (Abel, 1966, pp. 21-25)

Reconnaissance flights along the coast of Cuba showed evidence of surface to air missile (SAM) site construction. The Soviets made no attempt to camouflage the sites. At first, it was believed that the construction was just for Cuban defense. Then it was noticed that the trapezoidal employment pattern of the SAMs was the same as the trapezoidal employment pattern of SAMs around missile emplacements inside the Soviet Union. Because of these observations, aerial surveillance near the town of San Cristobal was conducted. The next day the United States had photographic evidence of Soviet missile launchers and infrastructure construction in Cuba. (Abel, 1966, pp. 26-29)

## **B. SOVIET MISSILE CHARACTERISTICS**

While Soviet MRBMs and IRBMs had different maximum ranges, permanent launch sites were being constructed in Cuba for both types of missiles. This case study emphasizes the MRBMs because they were the only missiles that could have become operational during the crisis.

### **1. Soviet Medium-Range Ballistic Missiles**

The Soviet SS-4 MRBM was a liquid-fueled rocket with a range of 1,000 miles. It could strike targets on the Gulf and Atlantic Coasts, including Washington, D.C. (Abel, 1966, p. 59). The SS-4 was a 'mobile' missile system. It was as mobile in the same way as a house being lifted off its foundation and moved by truck is mobile. The SS-4 launcher normally deployed with two missiles. It could be reloaded and a second missile launched from the same launcher (Schlesinger, 1965, p. 796). The SS-4's weakness was its unstable fuel. Because of the fuel's instability, the rocket could only be placed on alert for a maximum of five hours. After that, the fuel had to be removed (Blight and Welch, 1989, pp. 210-211).

United States intelligence agencies determined that the SS-4 was an effective first strike weapon, but that it was incapable of surviving a preemptive counter attack (Allison, 1970, p. 29). There were three possible reasons for the missile's vulnerability. First, because of the fueling process, warhead mating process and countdown, the fastest estimated launch time was eight hours (Blight and Welch, 1989, pp. 210-211). Second, the SS-4 required

approximately twenty men to be fired (Jane's Weapons Systems 1987-88 in Blight and Welch, 1989, p. 350). It is reasonable to assume that minor servicing, including the cleaning or flushing of the fuel tanks, would be required before new fuel could be reloaded into a missile and it could go back on alert. Finally, while the SS-4's mobility made U.S. Air Force targeting efforts more difficult, the Soviet's initial failure to camouflage the SS-4's launch sites gave U.S. intelligence agencies and the Air Force the opportunity to overcome this advantage.

## **2. Soviet Intermediate-Range Ballistic Missiles**

The Soviet SS-5 IRBM had a range of 2,500 miles. To achieve this range, the SS-5 was large, complicated, and required too much support to be mobile. The SS-5 was designed for firing from permanent launch sites (Blight and Welch, 1989, pp. 210-211). The SS-5 could strike targets as far west as Wyoming and Montana (Abel, 1966, p. 59).

## **3. Mobility**

Mobility was not designed into Soviet MRBMs and IRBMs. While the SS-4 had limited mobility, it could not be transported and launched from a TEL like modern SS-24 and SS-25 ICBMs. There was no indication that more than one launch site was prepared for each SS-4 launcher. Mobility was not a critical design factor for their MRBMs and IRBMs. Soviet doctrine did not include the deployment of MRBMs and IRBMs outside the borders of the Soviet Union. The limited mobility of the SS-4, however, did cause significant



concerns for U.S. policy makers. They were concerned that the Soviets would attempt to reposition the SS-4s during the crisis. Repositioning would have made the missiles more difficult to destroy.

#### **4. Ease of Concealment**

The Soviets concealed their missiles during transport. However, Soviet military forces in Cuba failed to camouflage the missile launch site and infrastructure construction and missiles. During the crisis, the Soviets did start to camouflage their sites. This also concerned U.S. policy makers because it could make the sites more difficult to destroy (Graham, 1970, p. 33). The crisis was resolved before camouflaging was completed.

The Soviets made two errors concerning the use of camouflage while employing missiles in Cuba. First, they did not camouflage their SAM emplacements. The Soviets should have been aware of U.S. photo reconnaissance capabilities.<sup>66</sup> The error in failing to camouflage the SAMs was compounded by employing the SAMs in the same trapezoidal configuration as was used in employing SAMs around missile sites inside the Soviet Union.

Second, and even worse, was the Soviet military's failure to camouflage the MRBMs and IRBMs, their launch sites, and supporting infrastructure. Had it not been for the lack of camouflage at the air defense and TM construction

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<sup>66</sup>There are two possible reasons for not camouflaging the sites. First, by not camouflaging the SAM sights, the U.S. might overlook any reports of missile activity on Cuba if they were aware that SAMs were being emplaced. Second, the Soviets may have underestimated U.S. aerial reconnaissance capabilities. Reconnaissance aircraft had already been shot down over the Soviet Union and China. Also, the U.S. was not directly over flying Cuba prior to the introduction of the missiles by the Soviets. The U-2s were flying off the coast at an altitude of fourteen miles. Their cameras were looking inland. This flight pattern and weather conditions over the island significantly limited the U-2's photo reconnaissance capability. (Abel, 1966, p. 26)

sites, the United States might not have confirmed the presence of Soviet missiles in Cuba until the SS-4s were operational.

#### **5. Ease of Maintenance and Resupply**

By today's standards, the Soviet MRBM and IRBM missiles placed in Cuba were not easy to maintain and resupply. During the crisis, the eight-hour prelaunch preparation time and five hour maximum alert time limited the SS-4's effectiveness. Because of the SS-5's increased maintenance and support requirements, they were at least a month away from becoming operational.

### **C. SOVIET MISSILE EMPLOYMENT TECHNIQUES**

The Soviet doctrine of Maskirovoka required the missile facilities in Cuba be established by using deception and disinformation. At the strategic level, Soviet efforts were successful. At the tactical level, their efforts failed.

#### **1. Deception**

The Soviet leadership used deception at the strategic level. They were successful in maintaining the secrecy and security of their TMs during shipment. The sudden surge in the shipment of materials to Cuba did not go unnoticed by the U.S. intelligence agencies. However, the missile shipments went not detected. The efforts of senior Soviet government officials and their pattern of not deploying nuclear missiles outside the Soviet Union, mislead U.S. policymakers. The reconnaissance flight, which discovered the MRBM sites, was

not initiated because of the increase in the volume of supplies coming into Cuba. It was initiated because of the detection of SAM sites.

To ensure security, the Soviets attempted to limit the Cuban's knowledge of the missiles. Soviet military personnel were used to transport missiles and construct the launch sites and supporting infrastructure. Limiting the Cuban military's knowledge and access to the missiles turned out to be unnecessary and counterproductive. It was unnecessary because the reports that the CIA received from Cubans were considered unreliable until confirmed by other means. It was counterproductive to not involve the Cubans in missile construction operations because the assistance of the Cubans with construction and deception operations could have helped keep the presence of the Soviet missiles a secret. (Blight and Welch, 1989, pp. 297-299)

## **2. Decoys**

There is no evidence that the Soviets employed decoys in Cuba during the crisis. The continued construction of the SS-5 launch sites is the closest the Soviets came to employing decoys. Although intelligence estimates indicated that the SS-5s would not be operational for at least a month, the continued construction of these sites caused the Air Force to target them also, rather than concentrate their firepower on the SS-4 sites.

## **3. Dispersal**

The Soviets dispersed their missiles in four separate launch areas. There were:

eight to ten bases located in areas around Guanajay, Remedios, San Cristobal, and Sagua la Grande, each base having about four launchers . . . Reports from all intelligence sources confirm that at least thirty missiles and more than twenty IL - 28 light jet bombers are present in Cuba. (A. Sylvester in Abel, 1966, p. 153)

By dispersing the launch sites, the number of combat sorties necessary to attack the missile, launch sites, and infrastructure had to be increased. Attacking multiple targets simultaneously also increases command, control, and communications (C3) problems.

#### **4. Using Civilians as Shields**

By dispersing the launch sites as they did, the Soviets used Cuban civilians as shields. One civilian casualty figure used by Robert Kennedy in a speech in 1964 indicated that as many as 25,000 civilians could have been killed if the missile launch sites and SAM sites had been attacked by air (Abel, 1966, p. 64).<sup>67</sup> American policy makers were concerned about the domestic and international impact resulting from Cuban civilian casualties resulting from a preemptive U.S. air strike on Soviet missiles in Cuba. A large number of civilian casualties would have had a negative impact.

#### **D. SOVIET MISSILE EMPLOYMENT EFFECTIVENESS**

Despite their lack of tactical camouflage, the Soviets still deployed their SAMs and missiles. Only forty-two of the SS-4 MRBMs were deployed into

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<sup>67</sup>Without further information on how the casualty figures were determined, it is possible that an unusually high casualty figure was used for purely political reasons.

Cuba. They were emplaced in six sites, four sites at San Cristobal and two sites at Sagua la Grande. There were four launchers at each site. This meant that there were twenty-four primary targets, the missile launchers, for the U.S. Air Force. The Soviets normally deployed two missiles per launcher.<sup>68</sup> During the crisis, the construction and preparations around the SS-4 sites indicated they were rapidly becoming operational (Blight and Welch, 1989, pp. 210 and 350). As early as 18 October, intelligence reports indicated the SS-4s could be ready for launch within eighteen hours (Abel, 1966, p. 71).

The Soviet SS-5 IRBMs were not even close to becoming operational during the crisis.<sup>69</sup> Because of their larger size and increased range, the SS-5s required larger, permanent launch site facilities. Sixteen IRBM launch sites were identified (Schlesinger, 1965, p. 796). Even at the height of the crisis, intelligence reports indicated that at least one month more was required before the SS-5s would be operational.

Even the attempts to camouflage the SAM and MRBM sites after discovery increased those sites chances of survival in the event of an air attack. If U.S. pilots knew the exact location of the launch sights on their maps, those sites still had to be located by the individual pilots during an attack. In the heat of battle, traveling at high speeds with SAM missiles and other anti-aircraft

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<sup>68</sup>It is believed that the last six SS-4s were on board the Soviet ships that returned to Soviet ports and did not attempt to cross the quarantine (Schlesinger, 1965, p. 796). The sixteen SS-5 IRBMs were believed to also be on board the same ships. (Blight and Welch, 1989, p. 350)

<sup>69</sup>It is believed that the SS-5 missiles were enroute to Cuba when the quarantine was announced. Several of the ships that turned back for their Soviet ports were similar in design to the ships that were believed to have transported the SS-4 MRBMs into Cuba.

weapons firing at them, the pilots would have had difficulty pinpointing and destroying each individual launcher.

#### **E. DEFENSE MEASURES**

Before the United States announced the presence of the Soviet missiles in Cuba, defensive measures were taken. Air defense facilities were stripped from places outside the range of the MRBMs positioned in Cuba and repositioned in the southeastern United States (Schlesinger, 1965, p. 803). Sixty-nine of the 850 Air Force aircraft repositioned to air bases in Florida were interceptor aircraft (Blight and Welch, 1989, p. 210). Their mission was to defend the United States from attack by Soviet aircraft positioned in Cuba. The additional interceptors augmented other interceptor units permanently based in Florida to defend the continental United States.

#### **F. INTERDICTION PLANS**

Of all the plans examined by the President and his advisors, only two involved the destruction of the missiles. All of the other diplomatic options, including the Naval quarantine, were designed to apply pressure on the Soviets and force them to withdraw their missiles. The two options for destroying the Soviet MRBM missiles in Cuba were an air strike and/or an invasion.

## **1. The Attack Operation Plan**

The USAF Tactical Air Command (TAC) had responsibility for planning the air strike. The TAC developed a plan that required 500 aircraft sorties to execute the air strike.<sup>70</sup> Even with that tremendous number of aircraft, the Air Force could not guarantee the destruction of all of the Soviet missiles. There are two reasons behind the Air Force's inability to guarantee the destruction. First, the Air Force did not have a truly precision bombing capability. Second, the Air Force believed that it could not rely on the intelligence agencies to locate and identify every missile launcher in Cuba.

General Sweeney, the commander of the TAC stated "he was certain that the air strike would be 'successful'; however even under optimal conditions, it was not likely that all of the known missiles would be destroyed." General Sweeney also said that "the known missiles are probably no more than 60% of the total missiles on the island." (Blight and Welch, 1989, p. 349)

General Maxwell Taylor, Chairman of the Joint Chiefs of Staff, stated "the best we can offer you is to destroy 90% of the known missiles" (Blight and Welch, 1989, p. 349). To understand the complicated air strike plan, one must first understand the priority of importance of the various types of targets that had to be attacked.

First, there were twenty-four primary targets, the SS-4 MRBM launchers. Guarding the sites was five SA-2 SAM sites, out of a total of twenty-four total

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<sup>70</sup>A sortie is one flight by one aircraft (Office of the Chairman, Joint Pub 1-02, 1994, p. 349). Two sorties could be flown by two aircraft, each flying one mission, or by one aircraft flying two mission back to back.

sites in Cuba. There were also three airfields with thirty-nine Soviet MIG-21 interceptors. The SS-5 IRBM launch sites under construction were also identified for attack. (Blight and Welch, 1989, p. 210) The MIG-21 aircraft posed a significant threat.

Before attacking the missile sites, the air defenses had to be suppressed or destroyed. The original plan called for eight aircraft to attack each of the five SAM sites. This required a total of forty strike aircraft. Twelve aircraft were to attack each of the three airfields where the MIG-21s were located. This required a total of thirty-six aircraft. Other aircraft were dedicated to intercept any aircraft that took off from the airfield. In total, one hundred aircraft were assigned to suppress or destroy Soviet air-defenses in Cuba. (Blight and Welch, 1989, p. 210)

To eliminate the missile threat, twenty-four MRBM sites and between eight and twelve IRBM sites were identified for attack.<sup>71</sup> The plan required six aircraft to attack each launcher. That required a total of 216 aircraft. In all, 250 aircraft were identified to attack the launchers (Blight and Welch, 1989, p. 210). This figure allows for redundancy in the event of aircraft losses due to maintenance or combat action prior to the actual attack. Finally, one hundred fifty aircraft were identified to attack the IL-28 bombers and their airfields. This brought the total requirement to 500 aircraft sorties (Blight and Welch, 1989, p. 210). The Air Force built a safety factor into their plan. There were twenty-

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<sup>71</sup>The IRBM sites identified for bombing were the sites closest to completion. However, those were at least a month from completion.



four extra aircraft in the air defense suppression portion of the plan. There were thirty-four extra in the attack on the missile sites. Finally, using one hundred fifty aircraft against the bombers indicates extra aircraft were included in that portion of the attack as well.

Besides the 500 sortie aircraft required to conduct the attack, the TAC positioned three hundred additional aircraft in Florida. This was an additional reserve equal to sixty percent of the strike force. If the attack against the IRBM sites was postponed, only 400 aircraft would have been required to execute the smaller plan. That meant that the Air Force had a one hundred percent reserve. (Blight and Welch, 1989, pp. 210-211)

Despite all of the Air Forces plans and aircraft repositioning efforts, as late as 27 October, they still required at least thirty-six hours before they could commence an attack. In addition to the time required, the President did not believe the Air Force could execute the strike with the precision the Air Force claimed (Abel, 1966, pp. 194-195). Finally, the best advice available to the President indicated that even if the air attack was successful, meaning no missiles were immediately launched at the United States, an invasion of Cuba would be necessary within five or six days to prevent any further possibility of a launch (Abel, 1966, p. 194).

## **2. The Invasion Plan**

Throughout the crisis, the President remained focused on the one reason that an invasion of Cuba was necessary. That reason was to guarantee the

elimination of the missile threat. An invasion would be necessary to ensure that no launchers could become operational and launched at the United States. Only the physical occupation of the missile launch sites and infrastructure could guarantee that. (Abel, 1966, pp. 193-195)

Toward that aim, the Army assembled more than 100,000 troops in Florida and the southeast United States (Salinger, 1966, p. 269). A previously scheduled Navy-Marines amphibious exercise in the Caribbean was reinforced. It became a 40,000 strong marine landing force. There were also 5,000 marines stationed at Naval base at Guantanamo, Cuba. Fourteen thousand reservists were recalled. Their mission was to provide air transport if an airborne operation was necessary (Schlesinger, 1965, p. 803).

## **G. CONCLUSION**

Unlike military leadership in World War II and the Persian Gulf War, the commander of the Air Force Tactical Air Command (TAC) and the Chairman of the Joint Chiefs of Staff did not misjudge the political significance of possible Soviet MRBM attacks on American cities. The TAC easily had one hundred sixty percent of the air assets necessary to execute an air strike. A slight modification to their strike plan, not bombing the IRBM sites, would have given the TAC two hundred percent of the assets necessary. Given this large number of extra aircraft, the capability of attacking each MRBM launcher with at least two waves of aircraft, and then having each wave reattack the sites after

rearming and refueling, it is amazing that the TAC commander did not guarantee the president that the Air Force could eliminate the Soviet TM threat.

Unlike World War II and the Persian Gulf War, the political and military leaders understood that an air strike alone could not guarantee the destruction of the Soviet MRBM launchers. An invasion was necessary to occupy and ensure destruction of the launchers. Additionally, the potential political impact of Soviet missiles striking U.S. cities was enough to make the Air Force cautious with their estimate of the probability of success.

## VII. EXERCISE *ROVING SANDS 95*

Exercise *Roving Sands 95* was the first exercise since the Persian Gulf to bring multi-service assets together in a TMD scenario. Participants included the Army, Air Force, and some limited Navy participation. Central Command (CENTCOM) and their Special Operations Command Central (SOCCENT) headquarters also participated. Within the Army, active defense and attack operations forces, including attack and deep penetration helicopters and ATACMS, participated. Army Special Forces also participated in all aspects of the exercise.

### A. EXERCISE OBJECTIVES

From 15 April until 10 May 1995, U.S. military forces conducted Exercise *Roving Sands 95*. This exercise was the most widely known portion of a larger exercise and evaluation effort sponsored by the Joint Chiefs of Staff (JCS), known as Joint Project/Exercise *Optic Cobra*. Besides *Roving Sands 95*, *Optic Cobra* included two other exercises: *Special Project Night Vector* (SPNV) and an *Advanced Warfighting Exercise* (AWE). *Night Victor* was an "experiment that involved linking joint and national intelligence programs" (U.S. Army Operational Evaluation Command Briefing, 11 July 1995, slide 5). It also "integrated SOF into near-real-time information dissemination capabilities" (DeRobertis Briefing, 12 May 1995, slide 7). The AWE attempted "to develop a holistic operational concept for TMD that supports joint doctrine," develop

Army specific TTPs for TMD, and determine existing shortfalls in Army TMD capabilities from 1996-2001 (Cravens, 1995, p. 20).

*Roving Sands* is an annual integrated air defense exercise. Central Command and SOCCENT participated in *Roving Sands 95*. Conventional Army reconnaissance and strike elements participated as well. These assets included attack and deep penetration helicopters and ATACMS. Special Operations Forces participated in all phases of *Optic Cobra*.

#### **B. ARMY EXERCISE ACCOMPLISHMENTS**

As a result of the *Optic Cobra* and *Roving Sands 95* exercises, "the Army was able to prosecute deep targets and targets of opportunity as part of TMD operations" (TMD AWE Briefing, 12 May 1995, slide 21). Army AH-64 attack helicopters and ATACMS were able to engage TM targets. The duration of the ATACMS mission, or some portion of it, was measured in minutes. The duration of the AH-64 mission, from aircraft launch to return, averaged about three hours. The lessons learned dictated that the Army must enhance TTPs for attack operations against TMs (DeRobertis Briefing, 12 May 1995, slides 22-25 and 41).

#### **C. ARMY SPECIAL FORCES ACCOMPLISHMENTS**

The 5th Special Forces (SF) Group, which is oriented to CENTCOM's southwest Asia theater of operations, was a principal participant in all aspects of *Optic Cobra*. The mission of the 5th SF Group was to provide support to

SOCCENT and theater CINC operations (USAJFKSWC Briefing, 1995, slides 3 and 5). During the actual field exercise, SF operational detachments (ODAs) were deployed on the ground for approximately eight days. During that time, they were credited with identifying twenty-six TELs, twenty-five supply vehicles, two decoy targets, and at least thirteen other potential targets. Special Forces ODAs were also credited with conducting target location and acquisition tasks for an Air Force F-15E Eagle and Army deep penetration strike helicopters. Both missions were credited with exercise kills of TELs (DeRobertis Briefing, 1995, slides 2 and 7).

This exercise is also credited with validating SOF's doctrinal role in TMD as sensors and decision makers, BDA (*i.e.*, post-strike reconnaissance), near-real-time reporting, and an early entry force option (SOCCENT Briefing, 1995, slides 3, 14, and 17). The exercise is also credited with helping SOCCENT develop their TMD TTPs, providing SOF SR 'eyes on target,' demonstrating a SOF capability to conduct deep DA attacks on TM targets, and demonstrating that an SF element could be introduced early into a campaign and used effectively in attack operations against TMs (SOCCENT Briefing, 1995, slide 17).

The early introduction of SOF assets into a theater during conflict is important. It is important because the Army's draft TMD doctrine does not integrate SF into attack operations against TMs early in a campaign. Instead, they focus their initial TM strike force package around conventional strike assets, field artillery assets, attack helicopters, and active defense assets (U.S.

Army, 1995, pp. 5-7). Army SF demonstrated their capability to work with those assets. Army SF also demonstrated its capability to work with Air Force assets in a TMD scenario. This capability gives both the ground commander and theater CINC additional options in conducting attack operations against TMs.

#### **D. ROVING SANDS REEXAMINED**

The results reported from this exercise differ significantly from the results from the Persian Gulf War. During that war, no TELs were confirmed destroyed prior to or during launch. One reason for this wartime shortfall was a lack of intelligence on Iraqi SCUD capabilities. The lack of intelligence forced all Coalition assets, including SOF assets, to be spread over a wide area to locate and destroy SCUD TELs. Perhaps in *Exercise Roving Sands 95*, the available intelligence was better. Better intelligence would allow all assets, including SOF, to be focused on a smaller target area. As ASW doctrine indicates, the smaller the search area, the greater the chances of locating and destroying the target.

Regardless of the exact number of targets identified and/or destroyed, this exercise indicates that the services have finally begun working together and with the theater CINCs in an attempt to improve JTMD capabilities.

## **VIII. THE ASSESSMENT OF OPERATIONS AGAINST THEATER MISSILES**

The case studies reveal that the United States has never destroyed TMs prior to or during launch operations. There are two reasons for this. One reason is joint service operations are inherently difficult to conduct. The other is the characteristics and employment techniques of the TMs make them difficult to target. Add into the attack operation equation the proliferation of TMs and WMDs and the capability to conduct operations against TMs becomes even more critical to U.S. national interests.

One way to improve U.S. capabilities to conduct attack operations against TMs is to integrate SOF into JTMD doctrine and JTTPs. Special operations forces can conduct pre-strike reconnaissance, target acquisition tasks, post-strike reconnaissance/ BDA, and recovery of material that has political, military, intelligence, or environmental value. Integrating SOF into JTMD operations can be done quickly and provide an immediate payoff in increased capabilities.

### **A. THEATER COMMANDERS AND JOINT SERVICE OPERATIONS**

Differences in the development and implementation of JTMD doctrine and JTTPs has hindered its development. Each service has the responsibility to develop doctrine, tactics, organize, train and equip forces for the use by the theater CINCs (Department of Defense Directive, 1987, p. 10). Each of the



eight theater CINCs has the responsibility for handling potential military crises, other military related requirements, and developing the strategic concepts, OPLANS, and CONPLANS for their regions. Meanwhile, USSOCOM manages its responsibility to develop doctrine, tactics, organize, train and equip all SOF elements. It must also integrate SOF into all aspects of joint doctrine, including JTMD.

All three case studies demonstrated that no single service or asset has the capability to conduct successful attack operations against TMs. In World War II, air power could not stop TM launches against Allied cities. During the Persian Gulf War, again the Air Force could not stop TM launches. Special operations forces were not able to stop TM launches either. Even together, air assets and SOF could not stop TM launches. One reason was because JTMD doctrine and JTTPs did not exist. Finally, during the Cuban Missile Crisis, the Air Force assembled nearly twice the force required to strike at Soviet launch sites in Cuba. Even with the excess capability, the Air Force could not guarantee the destruction of all Soviet launch sites.

Ground forces have been the only forces capable of stopping the launch of TMs. However, it takes ground forces much more time to accomplish this mission. In World War II, ground forces had to reorient their direction of attack and overrun V-1 and V-2 launch sites. These operations took months to complete. Meanwhile, German V weapons continued to rain down on Allied cities. During the Cuban Missile Crisis, a massive Army airborne and Army/Marine invasion force was assembled. However, it would have taken

days for the forces to capture and secure the Soviet launch sites in Cuba. During that time, the United States would have been in danger of attack from Soviet TMs, possibly armed with WMDs, launched from those sites in Cuba.

During the Persian Gulf War, an *ad hoc* effort was made to integrate Air Force and SOF elements to stop the launch of SCUDs against cities in Israel. Those efforts were unsuccessful, in part, because no doctrine or JTTPs existed for attack operations against TMs. Since the war, the services, theater CINCs, and USSOCOM have worked to develop JTMD doctrine. While the results from *Roving Sands 95* appear to be too optimistic, they are still encouraging. Army SOF is beginning to prove that they can be the "eyes on target" necessary to increase JTMD attack operations capabilities. Besides providing pre- and post-strike reconnaissance capabilities, SOF can assist in the destruction of TMs or recover critical material.

Current JTMD doctrine and capabilities cannot protect U.S. assets and interests against TM attacks. Exercise *Roving Sands 95* indicates the synergistic integration of SOF into JTMD doctrine and the development of JTTPs to implement JTMD doctrine has the capacity to improve U.S. military capabilities to defend against TMs. The TM threat cannot be ignored any longer.

## **B. THE POLITICAL IMPACT OF THEATER MISSILES**

The political impact of TMs armed with conventional warheads has been greater than their military significance. In both World War II and the Persian

Gulf War, military leaders considered TM threats as militarily insignificant. The military leaders ignored the potential impact of TM attacks against civilians. When the public and politicians demanded an end to the TM attacks, the military had to quickly change plans and reallocate assets in an attempt to stop or reduce the attacks on the cities.

The Cuban Missile Crisis and the Persian Gulf War present mixed signals concerning the military understanding of the political impact of TMs. During the Cuban Missile Crisis when U.S. cities were threatened, the military was cautious in their estimates of success in destroying Soviet missile launch sites in Cuba. During World War II and the Persian Gulf War when U.S. cities were not threatened, U.S. military leaders did not consider the political importance of TM attacks on friendly cities.

During the Cuban Missile Crisis, the military had weeks to plan and implement defense measures and prepare for an air strike. Despite having between 160 percent and 200 percent of the air strike assets needed to attack the Soviet launch sites, infrastructure, and light bombers, no strike was recommended. Two military leaders, the commander of the Tactical Air Forces that would conduct the attack, and the Chairman of the Joint Chiefs of Staff, both would only guarantee destruction of 90 percent of the targets.<sup>72</sup> In this case, the increased costs and risks calculations by the military overemphasized

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<sup>72</sup>More importantly, both military leaders were concerned that perhaps as much as 40 percent of the missile sites in Cuba had not even been discovered yet. Their concerns over potential intelligence shortfalls ultimately were unfounded. History has proved that this was one time when the intelligence was accurate and complete enough to identify all missile launch sites and storage facilities.

the political concerns and underestimated the military concerns. Militarily, the Soviet missiles in Cuba were insignificant. They would remain insignificant until they were armed, camouflaged, and in a potential alert status. That condition had not been reached. Until then, with 200 percent of the strike assets needed to conduct the air attack on hand, it would appear that a strike could have been militarily feasible.

### **C. THEATER MISSILE CHARACTERISTICS AND EMPLOYMENT TECHNIQUES**

Despite the U.S. technical superiority in intelligence collection, locating TMs is extremely difficult. The case studies demonstrate that TMs fired from fixed sites have been difficult to locate and destroy. The U.S. military has no experience locating or destroying modern, highly mobile, easily concealed, and self-contained TMs.<sup>73</sup> These TM characteristics make them difficult to locate prior to launch. Theater missile employment techniques, including the use of deception, decoys, dispersal, and using civilians as shields, also make locating and destroying TMs prior to launch difficult. As proven in the Persian Gulf War, despite their flaming datum launch signatures, the military was still unsuccessful locating, attacking, and destroying TELs after launch.

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<sup>73</sup>The design of the Iraqi SCUD missile dates back to 1962. Modern TMs are more mobile, concealable, and self-contained.

#### **D. THE PROLIFERATION OF THEATER MISSILES AND WEAPONS OF MASS DESTRUCTION**

The proliferation of TMs throughout the world means the United States must be prepared to defend its assets and vital interests around the world every time it faces a potential aggressor. Even states that would not otherwise be a threat can become so by acquiring TMs and threatening their neighbors with them. Combine the proliferation of TMs with the proliferation of WMDs, and the costs and interests calculations quickly tip in favor of an aggressor state. As long as a potential aggressor state has not yet acquired a second-strike TM WMD capability, the U.S. military could probably eliminate a limited TM WMD threat. To eliminate that threat, all U.S. military assets and capabilities must be synergistically focused on a potential aggressor state's limited TM WMD capability. For the military to do otherwise is to invite disaster.

#### **E. CONCLUSION**

The TM threat exists today. Immediate steps must be taken to improve U.S. JTMD capabilities. This thesis demonstrates that no one service or asset has the capability to singly conduct attack operations against TMs. Some form of ground force is necessary to provide "eyes on target" before, during, and after attack operations against TMs. As *Roving Sands 95* has begun to demonstrate, SOF can provide those "eyes." Without those "eyes," the chances of failure are too great. The proliferation and increased lethality of TMs makes them too

important a target to attack without using the full capabilities the U.S. military possesses.



## LIST OF REFERENCES

Abel, E., *The Missile Crisis*, J. B. Lippincott Company, 1966.

Allison, G. T., *Essence of Decision: Explaining the Cuban Missile Crisis*, Little, Brown and Company, 1971.

Association of the U. S. Army, *Army Green Book 1995-96*, Vol. 45 No. 10, October 1995.

Author(s) unknown, *The Terminal Guidance Operations (TGO) Booklet*, Publisher unknown, but probably United States Army Special Operations Command (USASOC), date unknown but published after the Persian Gulf War with limited distribution. This booklet was probably the first draft of the *Terminal Guidance Operations (TGO) Handbook*, U.S. Army John F. Kennedy Special Warfare Center and School, 22 November 1993.

Blight, J.G. and Welch, D.A., *On the Brink: Americans and Soviets Reexamine the Cuban Missile Crisis*, Hill and Wang, 1989.

Carus, W.S., *Ballistic Missiles in the Third World: Threat and Response*, The Washington Papers #146, Center for Strategic and International Studies, 1990.

Clark, D.K., "Effectiveness of Chemical Weapons in WWI, ORO-SP-88," Johns Hopkins University, 1959 in McNaugher, T. L., "Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War," *International Security*, Vol. 15 No. 2, Fall 1990.

Collier, B., *The Battle of the V Weapons 1944-45*, Hodder & Stoughton, 1964.

Conner, G.W., Ehlers, M.A., and Marshall, K.T., *Countering Short Range Ballistic Missiles*, Naval Postgraduate School NPSOR-93-009, January 1993.

Craven, W.F., and Cate, J.L. *The Army Air Forces in World War II*, vol. 3, *Europe: Argument to V-E Day*, University of Chicago Press, 1951.

Cravens, J.J., Jr., Maj. Gen., "A New Approach to Theater Missile Defense," *Army*, July 1995.

Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans, *Memorandum on Review of Joint Pub. 3-01 (Initial Draft)*, 15 March 1995, 14 July 1995.



Department of Defense Commission on Roles and Missions of the Armed Forces, *Directions for Defense: Report of the Commission on Roles and Missions of the Armed Forces*, U.S. Government Printing Office, 24 May 1995.

Department of Defense, *Functions of the Department of Defense and Its Major Components*, Directive Number 5100.1, U.S. Government Printing Office, 25 September 1987

Department of Defense, *Final Report to Congress: Conduct of the Persian Gulf War*, U.S. Government Printing Office, April 1992.

Department of the Army, Office of the Deputy Chief of Staff for Operations and Plans, Memorandum Defense, *Memorandum: Review of Joint Pub 3-01 (Initial draft)*, 15 March 1995, 14 July 1995.

DeRobertis, P., MAJ (P), Briefing, TMD-AWE '95 Assessment: *Emerging Results for General Officer Review*, United States Army Operational Evaluation Command, Air Defense Artillery Evaluation Directorate, 12 July 1995.

Dror, Y., *Crazy States*, Kraus, 1980.

Eisenstadt, M., *The Sword of the Arabs: Iraq's Strategic Weapons*, Washington Institute for Near East Policy, Paper # 21, 1990.

Feldman, S., "The Bombing of Osiraq-Revisited," *International Security*, Vol. 7 No. 2, 1982.

Fetter, S., "Ballistic Missiles and Weapons of Mass Destruction: What is the Threat? What Should Be Done?," *International Security*, 16:1, Summer 1991.

Ficken, E.I. Jr., Major, USAF, *Tactical Missile Defense: A Chink in the Armor?*, Naval War College, 19 June 1992.

Garthoff, R.L., *Reflections on the Cuban Missile Crisis*, Brookings Institute, 1989.

Hair, T.W., *The Application of Search Theory to the Timely Location of Tactical Ballistic Missiles*, Thesis, Naval Postgraduate School, March 1993.

Headquarters, Department of the Army, *FM 100-5 Operations*, U.S. Government Printing Office, 1993.

Hughes, D., "Success of Patriot System Shapes Debate on Future Antimissile Weapons," *Aviation Week & Space Technology*, 22 April 1991.

Jones, R.M., COL, Briefing, *Force XXI General Officer Review*, Theater Missile Defense-Advanced Warfighter Experiment (TMD-AWE), 12 July 1995.

Keaney, T.A., and Cohen, E.A., *Gulf War Air Power Survey Summary Report*, U.S. Government Printing Office, 1993.

Kennedy, G.P., *Vengeance Weapon 2: The V-2 Guided Missile*, Smithsonian Institution Press, 1983.

Leaventhal, P., and Alexander, Y., (eds), *Nuclear Terrorism: Defining the Threat*, Pergamon-Brassey's, 1986.

Lennox, D., "Iraq's SCUD Programme - The Tip of the Iceberg," *Jane's Defense Weekly*, 2 March 1991.

McCarthy, T., Lecture presented at the Naval Postgraduate School, 6 March 1995.

McNab, A., *Bravo Two Zero*, Bantam Press, 1993.

McNaugher, T.L., "Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War," *International Security*, Vol. 15 No. 2, Fall 1990.

Merriam-Webster Inc., *Webster's Ninth New Collegiate Dictionary*, Merriam-Webster Inc., 1986.

Military Analysis Division, *The United States Strategic Bombing Survey: V-Weapons (Crossbow) Campaign*, The Secretary of War, January 1947.

Miller, M.C., "Operation Desert Sham," *The New York Times*, 24 June 1992.

National Defense University, Armed Forces Staff College, *AFSC Pub 1 The Joint Staff Officer's Guide*, U.S. Government Printing Office, 1993.

O'Ballance, K.L., *Afghan Wars 1839-1992: What Britain Gave Up and the Soviet Union Lost*, Brassey's, 1993.

Office of the Chairman, The Joint Chiefs of Staff, *Joint Pub 1-02 Department of Defense Dictionary of Military and Associated Terms*, U.S. Government Printing Office, 1994.

Office of the Chairman, The Joint Chiefs of Staff, *Joint Pub 3-01.5 Doctrine for Joint Theater Missile Defense*, U.S. Government Printing Office, 1994.

Office of the Chairman, The Joint Chiefs of Staff, *Joint Pub 3-05 Doctrine for Joint Special Operations*, U.S. Government Printing Office, 1992.

Office of the Chairman, The Joint Chiefs of Staff, *The National Military Strategy of the United States of America: A Strategy of Flexible and Selective Engagement*, U.S. Government Printing Office, 1995.

Office of the Deputy Secretary of Defense, *Report on Nonproliferation and Counterproliferation Activities and Programs*, Government Printing Office, 1994.

Olson, P., "Winds of Change," *ADA Magazine*, July-August 1991.

Persico, J.E., *Piercing the Reich*, Viking Press, 1979.

Powell, Stewart M., "Scud War, Round Two," *Air Force Magazine*, April 1992.

Powell, Stewart M., "Scud War, Round Three," *Air Force Magazine*, October 1992.

Reynolds, R.T., COL, USAF, *Heart of the Storm: The Genesis of the Air Campaign Against Iraq*, Air University Press, January 1995.

Roach, J.S., *Joint Special Operations Targeting: An Alternate Scheme*, U.S. Army War College, 30 March 1989,

Ryan, C., *A Bridge Too Far*, Simon & Schuster, 1974.

Saunders, H.S.G., *Royal Air Force 1939-45: Volume III - The Fight is Won*, Her Majesty's Stationary Office, 1954.

Salinger, P., *With Kennedy*, Doubleday and Company, 1966.

Schlesinger, A.M., *A Thousand Days: John F. Kennedy in the White House*, Houghton Mifflin Company, 1965.

Schneider, B., and Fink, L., "A Deadly Game of Hide-and-Nuke," *Defense & Diplomacy*, Vol. 9 No. 7-8, July-August 1991.

Schwarzkopf, H.N., and Petre, P., *It Doesn't Take a Hero*, Linda Grey Bantam Books, 1992.

Secretary of Defense, *Memorandum: Special Operations Activities*, 5 May 1995

Secretary of Defense, *Memorandum: Special Operations Activities*, 5 May 1995.

Smart, I., "Advanced Strategic Missiles: A Short Guide," *Adelphi Papers*, No. 63, Institute of Strategic Studies, 1969.

Snodgrass, D.E., *Attacking the Theater Mobile Ballistic Missile Threat*, Air University, School of Advanced Airpower Studies, June 1993.

Special Operations Command Central Command (SOCCENT), *USCINCSOC Briefing*, 1995.

Spector, L.S., McDonough, M. G., with Medeiros, E.S., *Tracking Nuclear Proliferation: A Guide in Maps and Charts*, Carnegie Endowment for International Peace, 1995.

The White House, *A National Security Strategy of Engagement and Enlargement*, U.S. Government Printing Office, 1995.

United States Army Theater Missile Defense Advanced Warfighting Experiment, *U.S. Army Tactics, Techniques and Procedures for Theater Missile Defense*, U.S. Government Printing Office, 7 July 1995.

United States Army John F. Kennedy Special Warfare Center Briefing, *Force XXI: The road Ahead TMD 95 ... Optic Cobra*, SOFJCIL, 1995.

United States Office of Technical Assessment, *Technologies Underlying Weapons of Mass Destruction*, U.S. Government Printing Office, 1993

United States Special Operations Command, *USCINCSOC Operational Concept*, U.S. Government Printing Office, 19 August 1988.

Waitt, A.H., "Gas Warfare: The Chemical Weapon, Its Use, and Protection Against It," Duell, Sloan and Pearce, 1942 in McNaugher, T. L., "Ballistic Missiles and Chemical Weapons: The Legacy of the Iran-Iraq War," *International Security*, Vol. 15 No. 2, Fall 1990.

Wirtz, J.J., *Counterforce and Theater Missile Defense: Can the Army Use an ASW Approach to the Scud Hunt?*, U.S. Army War College, 27 March 1995.

Woodward, B., *The Commanders*, Pocket Star Books, 1991.

Yarymovych, Dr. Michael I., "Theater Ballistic Missile Defense in Europe," Paper presented at the Transatlantic Cooperation on Missile Defense in Europe, Paris, France 11-12 May 1995.

Zaloga, S., "Ballistic Missiles in the Third World: SCUD and Beyond,"  
*International Defense Review*, November 1988.

## BIBLIOGRAPHY

Bailey, K.C., *Doomsday Weapons in the Hands of Many: The Arms Control Challenge of the 90's*, University of Illinois Press, 1991.

DiRita, L.T., "Evolution of Jointness: The Color Purple," *Proceedings*, May 1995.

Glashow, J., "Hite Pushes Army Priorities," *Army Times*, 4 September 1995.

Hair, T.W., *The Application of Search Theory to the Timely Location of Tactical Ballistic Missiles*, Naval Postgraduate School, March 1993.

Office of the Chairman, The Joint Chiefs of Staff, *Joint Pub 3-09.1 Joint Laser Designation Procedures*, U.S. Government Printing Office, 1991.

Office of the Chairman, The Joint Chiefs of Staff, *Joint Pub 3-09.2 JTTP for Radar Beacon Operations (J-Beacon)*, U.S. Government Printing Office, 1993.

Postol, T., *Lessons of the Gulf War Experience with Patriot*, International Security Vol 16 No 3 Winter 1991/92 pp. 119-171.

Westbrook, K.L., *U.S. Options for Targeting Soviet ICBMs*, Newport, Naval War College, 1990.

Wirtz, James J., *Counterproliferation, Counterforce, and Nuclear War*, Naval Postgraduate School, 12 March, 1995.



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