VI. JOINT CAMPAIGN ANALYSIS

A. INTRODUCTION

The establishment of a Sea Base begins with a decision to conduct a particular operation. The operational viability of the Sea Base can only be judged in terms of its contribution to the success or failure of that operation. In order to determine the viability of a MEB sized force in a forcible entry scenario, the ability of that force to conduct successful large scale operations had to be determined. Clearly, if a MEB was not a sufficient sized force to perform operations in hostile territory, the Sea Base would need to be designed to deliver and support a larger force.

Additionally, the size of the initial force package that forms the Sea Base had to be quantified. In view of historical naval deployment areas and their distance from potential operating areas, the Systems Engineering and Integration team had determined that a minimum of two MEUs would be available to form the Sea Base.

An evaluation of Amphibious and Marine forces capabilities to perform future expeditionary missions was conducted in Term Projects of the OA4602 Joint Campaign Analysis and SI3900 Naval Tactical Analysis courses. Of particular interest in both projects was an assessment of capability shortfalls at the operational and tactical levels. The ability to more quickly deliver combat potential in theater, the addition of capable organic mine-sensors, enhanced self-defense for expeditionary ships, and improved organic high-altitude Intelligence, Surveillance, and Reconnaissance (ISR) UAVs are highlights from this shortfall review and will be discussed in more detail in later sections of this chapter.

B. SCENARIO

The basic scenario used in the OA4602 Joint Campaign Analysis (JCA) course was the Burma scenario. The Joint Command Authority (JCA) Burma scenario differed from the Systems Engineering and Integration (SEI) Burma scenario somewhat, but insights from the JCA force on force analysis can easily be extracted and applied to the SEI scenario discussed in Chapter 5 and used in this overall study.

1. Region

The Joint Campaign Analysis scenario occurs in Burma, whose regional orientation is shown in Figure VI-1 below.

Figure VI-1: Burma and the Southeast Asia Region

Burma's proximity to the Straits of Malacca and the large amount of oil and other goods passing through it make a destabilized Burma a threat to regional and world economic stability.

2. Situation

The following scenario was generated for use in the OA4602 Joint Campaign Analysis course. In order to maintain commonality, the SEI Burma scenario borrowed heavily from this scenario in generating the Burma scenario discussed in Chapter V; however, the desire to examine logistics flows and re-embarkation in greater detail led to the creation of a slightly different scenario for the Expeditionary Warfare Integrated Project. While the scenario was somewhat different, the differences should not change the results of the Joint Campaign Analysis performed using the scenario below or their impact on the overall study. The scenario used in the JCA course and SEI course for their projects follows.

With the Taliban's demise in 2002, Burma (Myanmar) became the world's leading illicit opium producer. In the following 11 years, increased revenue from drug activity within Burma has funded an expansion of government and military power.

In addition to reinforcing its hold on power and conducting an aggressive campaign against members of the old People's Assembly and Shan rebels, the military regime has funded a special force naval brigade capable of interdicting sea-borne traffic flow through the waterways of South-East Asia. Burma developed this capability in response to repeated demands by the United States, India, and the ASEAN countries for a more open government and cooperation in fighting the drug trade.

The Burmese special forces pose as pirates in small fast patrol craft armed with hand-launched and base-mounted missile systems. Despite international protests, they have exercised within Indonesian, Thailand, and Malaysian territorial seas. It is reported that these forces number from 30 – 50 watercraft manned with 200 – 300 specially trained personnel. In addition, the watercraft may have limited mine deployment capability. Although no evidence has yet been discovered to tie these special forces to actual pirate attacks, the rate of pirate attacks within nearby international waterways has increased over the past three years.

China is also concerned with Burmese drug trade within its own borders, but has approached the military regime in a supportive manner in an attempt to gain the regime's help in controlling the drug flow and to check what it perceives as India's expansion.

Since 1990 China has sold the regime military equipment and provided military and technical advisors. These sales first included small arms, ten *Hainan*-class coastal patrol craft, and six *Houxin*-class missile boats, that in 2007 was augmented by one *Luhai* DDG and two *Jiangwei* I FFGs. SSM missiles sales included the YJ1 and YJ2 in both shipboard and coastal missile variants. In addition to arms sales, the Chinese have assisted Burma in building and improving maritime facilities at Hainggyi, Akyab, and the Mergui Islands off Burma's isthmian coast. Intelligence also reports possible electronic stations manned by Chinese in facilities on the Cocos and Hangyi Islands in the Andaman Sea (Cole, 2001).

In 2012, the Burmese military regime bloodily repressed a popular uprising originating in the city of Bhamo (northern city near the Chinese boarder). The U.N. condemned this action and the United States called for economic sanctions—a measure defeated only by Chinese veto. The measure was supported by all other ASEAN members and, in response, pirate attacks against shipping in and around South-East Asia increased.

This year, another popular uprising occurred in Bhamo, but this time the revolutionaries established a stronghold and asked remaining members of the old People's Assembly to establish a new Burmese government in Bhamo. Coordinating a second uprising in Tavoy (southern city on the Andaman Sea Coast), the fledgling revolutionary government called for assistance from the international community.

The Burmese military regime responded by threatening to close all Southeast Asian waterways if any country intervened on the revolutionaries' behalf. In addition to mobilizing forces to defeat the revolutionaries in Bhamo and Tavoy, the Burmese military activated air defenses around Rangoon, deployed shore-launch missile systems (unlocated), deployed their naval special forces (un-located), and began regular maritime patrols with their ships.

ASEAN and the United States called for an immediate cease-fire and popular elections. China and India agreed with the cease-fire, but independently warned the United States that Burma is within their sphere of influence and they will not support any U.S. military "adventurism".

In a classified memo to PACCOM, the U.S. National Command Authority, after conferring with its ASEAN allies, outlined several strategic objectives for the current situation:

Support the revolutionary movement, permitting them time to broaden their foothold in the two cities and in the countryside with the objective to force the regime to agree to conduct elections as part of a brokered cease fire agreement. Strategic end state: Freely elected Burma government that supports international anti-drug efforts.

- Protect friendly/commercial shipping in Southeast Asian waters while the political rivalry in Burma plays out. Strategic end state: Unimpeded international trade
- Hold forces of potentially intervening powers at bay. Strategic End State: Prevent escalation of conflict as battle between India and China.

The U.S. CJCS directs PACCOM to form a Combined Joint Task Force (CJTF) to begin planning for the following possible missions:

- Counter Burmese special forces' activity in and around the critical international straits, including dealing with a possible mine threat before or after mines are in the water
- Reinforcement/resupply of revolutionary forces in Bhamo and Tavoy
- Provide air support to U.S. and Allied forces that may be introduced in Burma
- Determine requirements and timeline for a large scale invasion to defeat Burmese forces mobilizing against Tavoy and Bhamo.

Evaluate forces required to deter China and India counter-intervention and monitor their forces' locations and behavior. Be prepared to integrate these same forces if they volunteer to join allied efforts.

3. Enemy Situation

a. *Ground Forces*

The Burmese government has the following ground forces at their disposal to deal with the rebels. A number of these forces are tied down in border security operations along the Thai, Chinese, and Indian borders as depicted in Figure VI-2.

- 12 National Infantry Divisions of 12,000 troops each. These professionally manned divisions represent the best trained and equipped units in the Burmese Army

- 13 State Infantry Divisions of 12,000 troops each. These divisions, with large numbers of conscripts, possess moderate offensive capability.

- 12 Regional Infantry Divisions of 9,000 troops each. These units are composed almost entirely of conscripts and are assessed as having little offensive capability

- 3 Armor Divisions of 80 tanks each

b. *Special Forces and Air Defenses*

The Burmese government has the following Special and Air Defense Forces at their disposal for the upcoming operation: 4 highly motivated Special Forces Bureaus for Intelligence Gathering and Strategic Strike Operations and 1 Air Defense Artillery (ADA) Wing armed with SA-18 missiles, antiquated anti-aircraft cannons, and radar and communication systems from China.

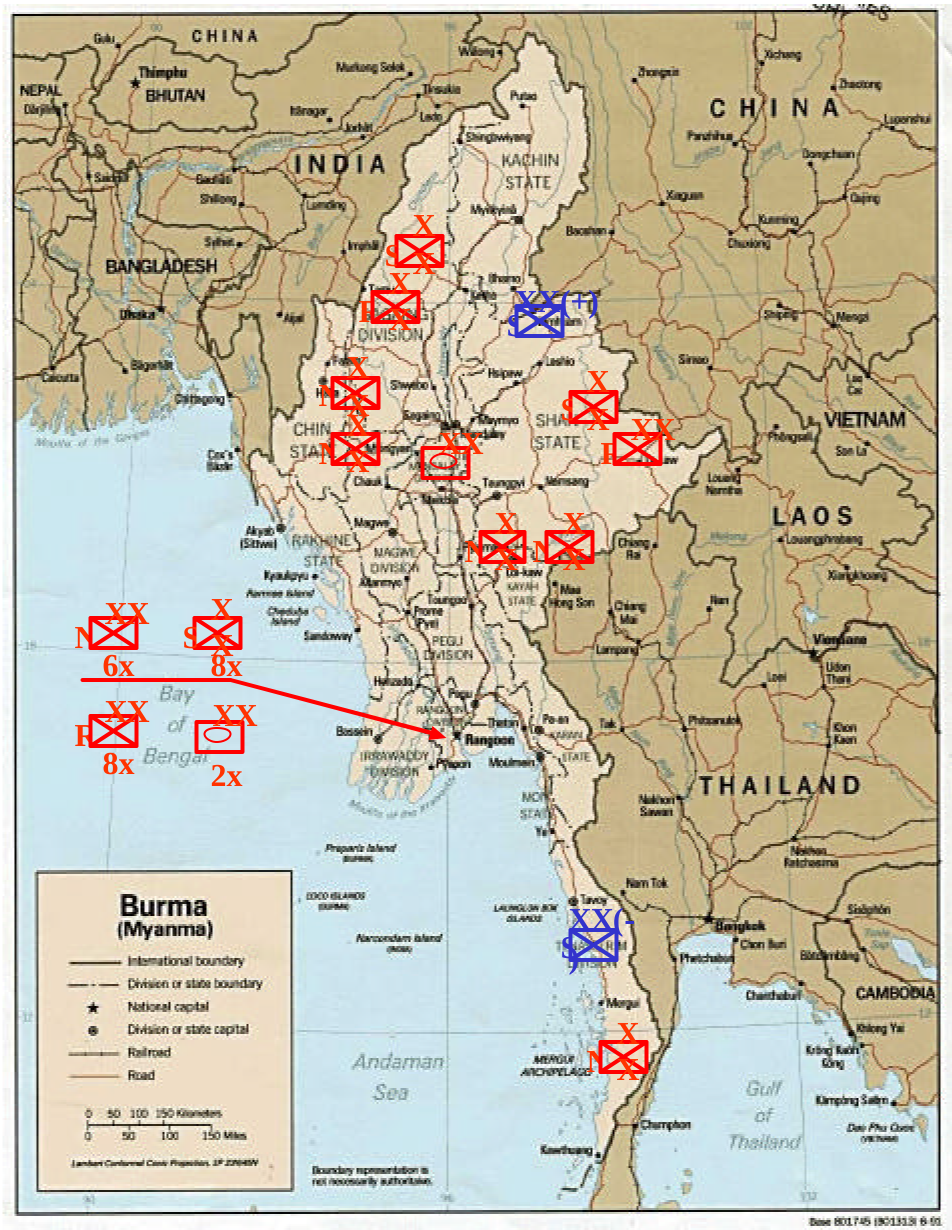


Figure VI-2: Burma Scenario Enemy Ground Force Disposition
(Source: Jensen, et al, 2002)

c. *Naval Forces*

Burmese Naval Forces are presented in Table VI-1 below. Their homeport locations throughout Burma are shown in Figure VI-3.

- 1 LUHAI DDG, 2 JIANGWEI FFGs
- 10 HAINAN-Class Coastal Patrol Craft
- 10 HOUXIN-Class Missile Boats
- 20-30 Coastal Patrol Boats
- 90 Inshore & Riverine Craft, Transports
- 2 Coastal Batteries
- 12 x mobile 200nm SSM
- 1 Coastal Battery
- 6 x mobile Rocket Cannon 120 NM, 320mm system

Table VI-1: Burma Scenario Enemy Naval Order of Battle
(Source: Jensen, et al, 2002)

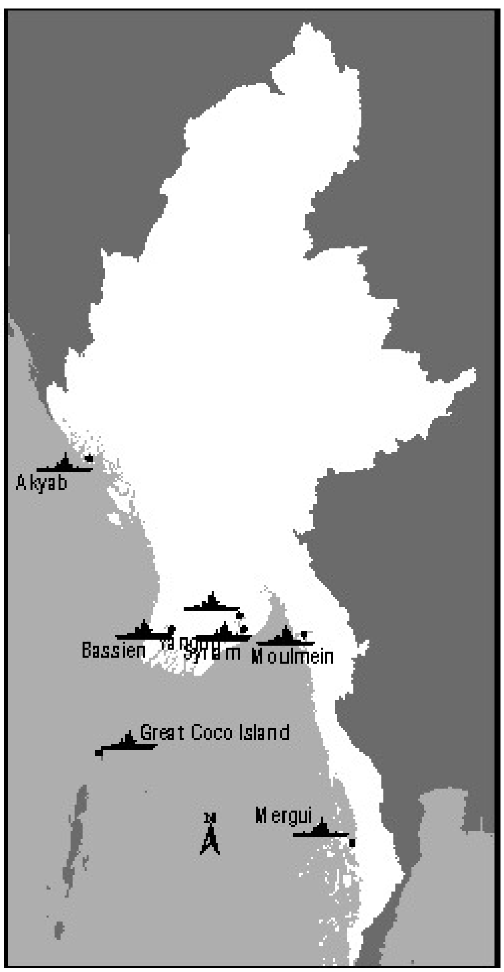


Figure VI-3: Burma Scenario Enemy Naval Force Disposition
(Source: Jensen, et al, 2002)

d. *Air Forces*

The Burmese Air Force has two air wings available to oppose the upcoming coalition operation: a fixed-wing air wing consisting of 3 intercept, 6 attack, 1 transport, and 2 surveillance squadrons, capable of striking the task force with air launched anti-ship cruise missiles (ASCM), and a rotary wing air wing consisting of 3 observation/utility and 3 modern (Bell) attack helicopter squadrons armed with Israeli ATGM. Burmese air force bases are shown in Figure VI-4 below.

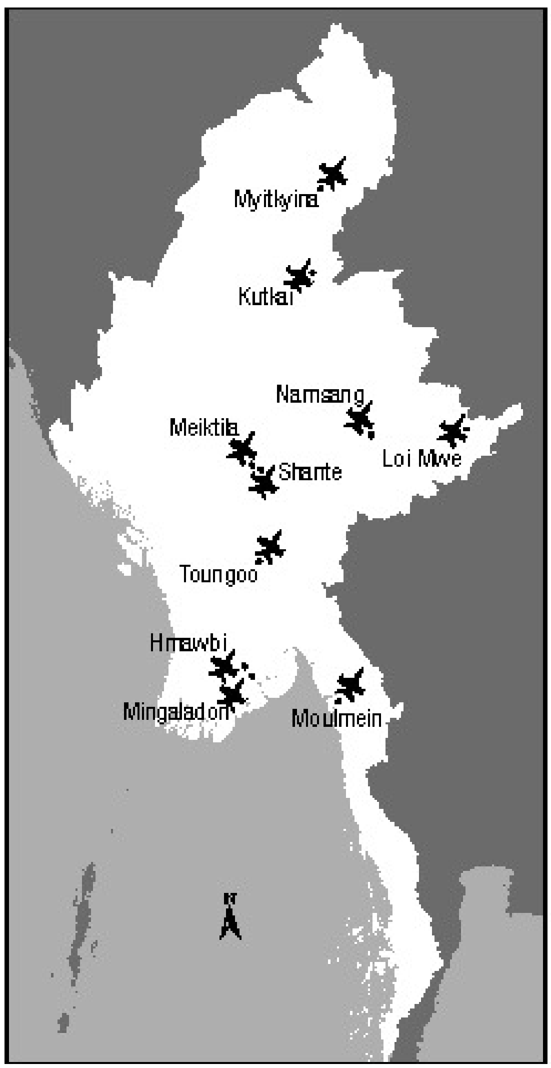


Figure VI-4: Burma Scenario Enemy Air Forces Disposition
(Source: Jensen, et al, 2002)

4. Area of Operations

The geography of the area of operation (AO) varies from heavily jungled mountains along the Thai border to low lying farmlands and rice paddies along the coast and the river. There are small towns scattered throughout the AO.

Only 15% of Burma's roads are paved. There are 3 main roads into Tavoy that can be used to move materials to and from the port.

A 102 km rail line runs north and south from Ye to Tavoy. The railway carries both passenger and freight traffic at a maximum speed of 48 km/hr

Most commercial traffic moves via waterways. There are more than 12,800 km of rivers and canals navigable by large commercial vessels, as can be clearly seen in the high altitude image of the AO contained in Figure VI-5.

There is a civilian airfield located in Tavoy; however, commercial flights are infrequent, typically less than 3 per week. The newly constructed port at Tavoy has 4 berths, as well as full port loading and unloading facilities capable of handling break bulk, conventional cargo, and containers.

Figure VI-5: High Altitude View of Tavoy Operating Area

(Source: Jensen, et al, 2002)

The transportation system in this section of Burma is heavily relied upon by China and Taiwan for trade; in fact, both nations have provided financial assistance for port construction.

C. COURSES OF ACTION

1. Mission

According to the scenario, the United States Pacific Command (PACCOM) issued the commander of the Joint Task Force the following mission:

> **Form a Combined Joint Task Force to, when directed, provide support to the revolutionary forces in order to force a cease-fire agreement with the Burmese military under conditions favorable to international anti-drug efforts, unimpeded international trade and reduced potential of participation in hostilities of neighboring countries.**

a. *Specified Tasks For The Tavoy Area Of Operations*

This overall mission was assessed to contain four specified tasks:

1. Support the revolutionary movement.
2. Reinforcement/resupply revolutionary forces in Tavoy.
3. Provide air support to U.S. and Allied forces that may be introduced into Burma.
4. Defeat Burmese forces mobilizing against Tavoy.

b. *Implied Tasks For The Tavoy Area Of Operations*

In addition to the specified tasks, the overall mission was assessed to contain five additional implied tasks:

1. Defend Tavoy against the Burmese Military.

2. Control Line of Communications (LOCs) into Tavoy.

3. Assist in gaining popular support for the uprising.

4. Provide civil-military assistance to support the uprising/revolutionary government.

5. Provide military assistance to train revolutionary forces.

c. ***Task Force Commander's Intent***

In order to plan for the mission provided them by PACCOM, the Joint Task Force Commander issued the following Commander's Intent: As part of the CJTF, I intend for the Joint Task Force to support the revolutionary forces with all necessary military resources in order to create an environment in which the current Burmese military regime is forced into a cease fire agreement with terms favorable to international anti-drug efforts and free trade.

d. ***Task Force Mission Statement***

The corresponding Joint Task Force Mission Statement was: On order, the Joint Task Force will combine with and support revolutionary forces to defend the city of Tavoy against Burmese military forces in order to allow time for the popular uprising to force a cease fire agreement favorable to the revolutionary government.

2. Assumptions

Mission planning for the operation required seven key assumptions about the situation ashore.

1. Revolutionary forces currently have control of Tavoy, including the port facility and airfield
2. By 2013, Tavoy is a major port and has a civilian airfield
3. Burmese forces are mobilizing to go on the offensive and attack the revolutionary forces in Tavoy

4. There are no Burmese forces loyal to the government currently in Tavoy
5. The waters around Tavoy are mined to an unknown extent
6. Current poor relations with bordering countries will force the Burmese military to keep a significant force along Thailand, India and China borders to provide border security
7. Units with unknown loyalties were considered enemy forces, at least for planning purposes, until their loyalties were positively determined.

3. Tavoy Mission Analysis

a. *Airlift Planning Considerations*

In order to support the Sea Base and ground element operations ashore, large amounts of supplies would need top arrive in theater. In order to plan this resupply effort, the following assumptions were made:

1. In order to maintain their neutrality, there would be no over-flight or basing permission granted by Thailand.
2. The only airfields large enough to support the operation are in Singapore, Australia, and Diego Garcia.
3. Airlift factors (time to arrive in country):
   Army forces – 24 hours
   Expeditionary Air Field (EAF) – 5 to 7 days
   MPF MEU echelon – 3 days

b. *Enemy Centers Of Gravity*

Mission analysis identified three enemy (Burmese government forces) centers of gravity:

1. Will of the individual soldier to fight.

2. Continued support of the general population.
3. Control of the avenues of approach or LOCs into Tavoy.

c. *Decisive Points*

Based on these centers of gravity, mission planners identified three decisive points the Joint Task Force would have to address, through military or other means:

1. Deny health and comfort support to the Burmese soldier (food, water, medical attention, safety).
2. Meet the basic needs of the general civilian population, especially in the vicinity of Tavoy.
3. Take control of the LOC into Tavoy at locations to be determined later in the planning process.

d. *Task Force Objectives*

In order to successfully attack these decisive points, plans were generated to attain the following military and civil affairs objectives through deterrence or application of military force:

Military Objectives:

Disrupt support to the Burmese military forces approaching Tavoy

Deny Burmese use of the Lines of Communication into Tavoy

Civil Affairs Objectives:

Win the hearts and minds of the general population around Tavoy

The only Flexible Deterrent options involve using the U.S. military presence in the Andaman Sea and Indian Ocean to prevent Burmese government forces attack on the rebels and use of SOF to provide training to revolutionary forces.

4. Candidate Courses of Action (COA)

Courses of action were generated in order to provide the Joint Task Force commander with a range of options. These options were arranged in an escalating manner from the lowest applied force option to the highest.

a. *Course of Action #1*

Insert SOF to provide training to revolutionary forces, enabling them to defeat government forces on their own, in addition to providing reconnaissance for follow on forces, if required, and to provide target acquisition, designation, and Forward Air Controller (FAC) capability if hostilities escalate.

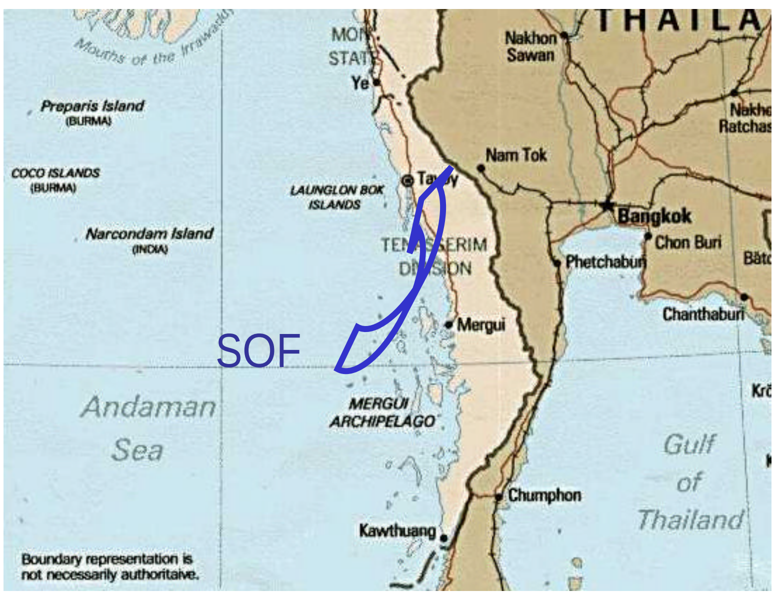


Figure VI-6: Burma Scenario Candidate Course of Action #1
(Source: Jensen, et al, 2002)

b. *Course of Action #2*

This COA utilizes SOF forces in the same manner as COA #1, but also inserts the Expeditionary Strike Group's (ESG) battalion sized Marine Expeditionary Unit (MEU) to blocking positions north of Tavoy to prevent government forces from attacking the rebels.

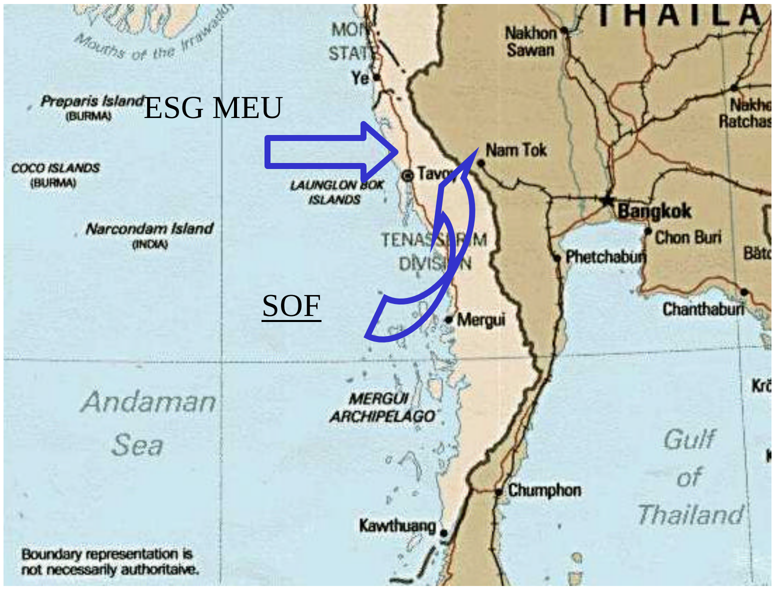


Figure VI-7: Candidate Course of Action #2
(Source: Jensen, et al, 2002)

c. *Course of Action #3*

COA #3 employs SOF and the ESG MEU in the same manner as in COA #2; however, it also calls for the arrival of MEU sized MPF assets from Diego Garcia in Tavoy along with their associated fly in troop element in order to provide a second battalion for blocking force operations north of Tavoy.

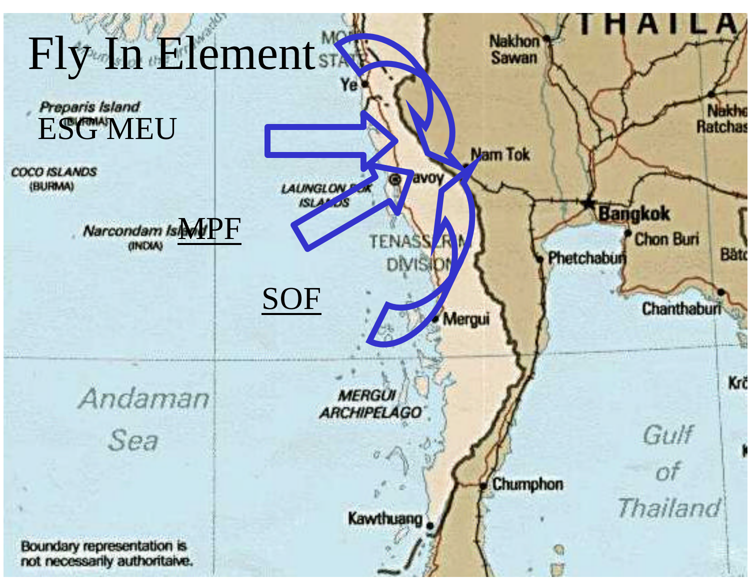


Figure VI-8: Candidate Course of Action #3
(Source: Jensen, et al, 2002)

5. Quantitative Methods of Course of Action Evaluation

a. *Circulation Model*

The simple campaign circulation model was developed by CDR Jack Hall in 1969 to illustrate statistical uncertainty in determining force effectiveness in a campaign environment where a force, aircraft, or logistics must pass through a series of independent challenges or "gates" to reach its mission objective and return to base through the same gates. A submarine campaign to interdict shipping where the submarine force must pass through anti-submarine barriers deploying to, and returning from, an operational area is an example of a circulation model. The equations used in this model will be displayed in a later section discussing resupply of Tavoy.

a. Lanchester Equations

Lanchester equations are differential equations describing the time dependence of attacker and defender strengths *A* and *D* as a function of time, with the function depending only on *A* and *D*. One partly generalized version of the Lanchester equations has the following form

$$\frac{dA}{dt} = -K_d A^r D^s \qquad \frac{dD_i}{dt} = -K_a D^t A^u$$

in which the attrition rates and exponents are time-independent parameters. Sometimes the equations are extended to include constant reinforcement-rate terms.

Most analytical work has focused on one of two special cases: the "square law" corresponds to s=u=1 and r=t=0; the "linear law" corresponds to r=s=t=u=1.

$$dA/dt = -K_d D \qquad dD/dt = -K_a A \quad \text{square law}$$

$$dA/dt = -\tilde{K}_d AD \qquad dD/dt = -\tilde{K}_a AD \quad \text{linear law}$$

The square law is typically applied to "aimed fire" (e.g., tank vs. tank) and the linear law to "unaimed fire" (e.g., artillery barraging an area without precise knowledge of target locations). The square law is also described as accounting for concentration of fire.

While the equations above are used to find analytical solutions, computer simulations may use Lanchester expressions "locally" (i.e., for attrition estimates within a given time interval), but the coefficients of those equations change from time step to time step as conditions of terrain, defender preparations, and many other factors change. The computer simulation may want to take into account the losing side may choose to break off battle and retreat rather than be annihilated. Some use a mixture of the equations in an attempt to account for the proportion of aimed and unaimed fire (i.e. tank fire vs. artillery fire) in a given engagement. Unfortunately, the more factors such as these the model attempts to take into account, the more complicated the simulation is to understand and discuss. Lanchester equations, therefore, continue to have a place in determining approximate solutions. (Davis, 1995)

c. *Salvo Equations*

A salvo model of modern missile combat is introduced by CAPT Wayne Hughes Jr., USN (Ret) to provide equations that determine the number of ships put out of action by a missile salvo exchange between two naval forces. (Hughes 2000) The two equations are:

$$\Delta A = \frac{aA - b_3 B}{b_1} \quad \text{and} \quad \Delta B = \frac{bB - a_3 A}{a_1}$$

where A and B are the number of ships in each force prior to salvo exchange; α and β are equal the striking power of each attacker in A and B respectively where striking power is the number of well-aimed and functional missile each combatant can salvo;

a3 and b3 are the defensive power of each defender in A and B respectively where defense power is the number of missiles each combatant can defend itself against without being hit; and a1 and b1 are the staying power of each defender in A and B respectively or the number of missiles a ship can absorb as a hit before it is out of action.

d. *Networks Analysis*

Network analysis converts systems into a series of nodes and connecting arcs to find optimal solutions to a range of problems including finding the shortest route through the network and determining the maximal flow through the network. Analyzing a network can also determine the number and location of nodes that must be taken down in order to prevent the network from functioning.

e. *Simulation*

A model represents and describes a real system through the use of mathematical equations or computer programs. System models are generated in order to study the behavior of military forces engaged in combat. Computer simulation is a methodology to quickly and accurately examine the results or a large variety of different behaviors and initial conditions for a given model.

f. *Cost-Benefit Analysis (CBA)*

CBA estimates and totals the equivalent value of the benefits and costs to the commander of given operations in order to establish whether they are worthwhile in attaining the objective.

One of the problems of CBA is the computation of some components of benefits and costs are intuitively obvious while intuition fails to suggest methods of measurement and calculation for others. In order to minimize these problems and ensure a consistent and meaningful solution there are several guidelines to follow when conducting a CBA: there must be a common unit of measurement to ensure apples to apples comparisons, valuations should represent valuations as revealed by their actual benefits as measured by operational choices, the double counting of benefits or costs must be avoided, and the decision criteria must be clearly understood in order to make sense of the answer.

D. FORCE REQUIREMENTS

The forces available to the JTF Commander include the USS Peleliu ESG, with its embarked aircraft and battalion landing team (BLT); the MPSRON based in Diego Garcia; a fly in Battalion Landing Team (BLT) from the continental U.S. (CONUS); and sufficient SOF for training revolutionary forces and conducting reconnaissance and raids prior to inserting the BLTs.

E. TIMELINE

The overall timeline for the Burma Operation is presented in Figure VI-9 below. These were all forces available to the Combined Joint Task force Commander to secure the international waterways, re-supply and support Bhamo, and re-supply and support Tavoy.

From this overall force structure, forces available and their arrival to support operations in and around Tavoy are separated and shown in Figure VI-10.

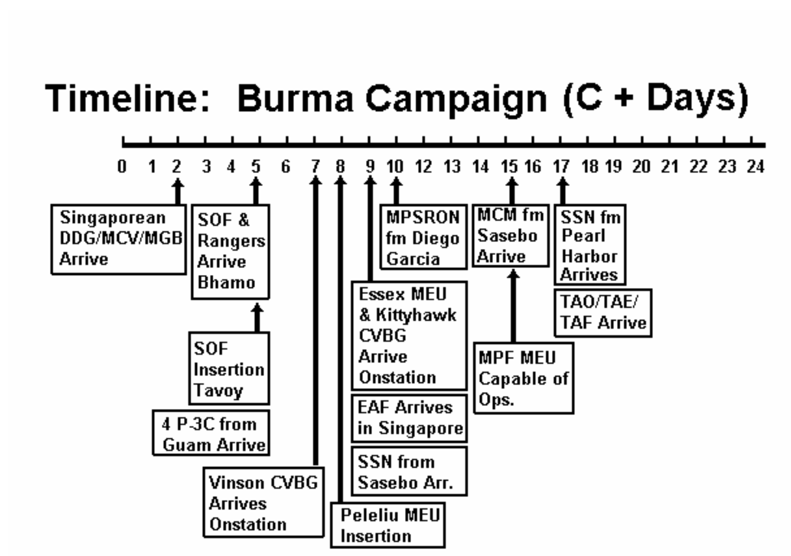


Figure VI-9: Burma Campaign Timeline (Source: Jensen, et al, 2002)

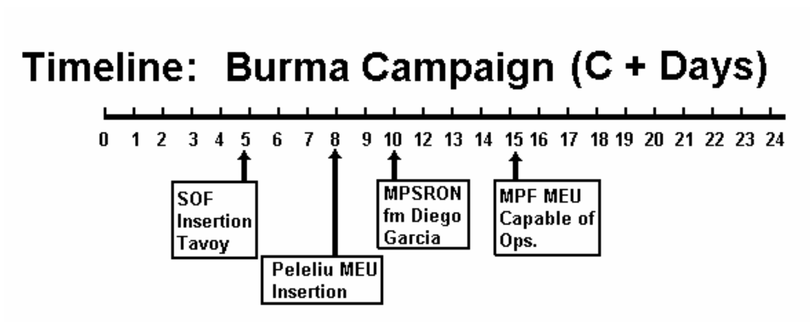


Figure VI-10: Tavoy Task Force Operational Timeline
(Source: Jensen et al 2002)

F. COURSE OF ACTION EVALUATION

Analysis from the various tools used to evaluate courses of action yielded some interesting results. The Lanchester equations imply that Allied forces can take the Burmese to their assumed breaking point only if both MEUs are in place prior to ground engagement in Tavoy. Network interdiction models show that a minimum of 4 bridges must be destroyed in order to deny the enemy use of roads and rail lines into Tavoy. A circulation model implies that local air superiority is required for the highest probability of successful re-supply flights into Tavoy.

The bottom line is: both MEUs must be in place prior to a ground engagement in Tavoy. With two MEUs in place before the ground engagement, the Allied forces can retain Tavoy even when considering the worst case assumptions. Mission success in this scenario could not be accomplished by air and maritime power alone. Local air and maritime superiority were required in order to conduct ground operations. A complete combined arms operation consisting of ground, air, and maritime forces was required to achieve the mission objectives.

1. Preparation of the Battlefield

The first step in preparing the battlefield was conducting air strikes in and around Rangoon in order to sow confusion about the focus of main effort. The air strikes should have the secondary effect of delaying the southbound movement of the most capable forces toward Tavoy and preventing some of the less capable units from moving altogether. The focus of the strike must be on destroying transportation assets before movement begins. After the Rangoon air strikes, the task force continued counter-mobility and interdiction operations along avenues of approach to Tavoy with the goal of delaying movement and the attrition of heavy weapons and additional mobility assets

2. Red Force Assumptions

The Red Force assigned to re-take Tavoy in this scenario consisted of 3 National Divisions and 1 Armored Division from Rangoon and a portion of 1 National Division from the south, around Mergui. The Red Force timeline requires approximately 48 hrs to mobilize and an additional 24 hrs to then begin movement towards Tavoy. Troop movement would be delayed by 48 hrs due to air strikes around Rangoon, meaning significant movement towards Tavoy would not begin until C+6. Red Force lead elements would begin arriving in the vicinity of Tavoy on about C+9 (48 hrs for travel plus a 24 hr delay due to interdiction operations). After arrival, each unit would require 24 hrs to consolidate for an attack on the blocking force units, making the earliest date for an attack C+10. The C+10 Lead element attack includes one National Division and all or part of the Armored Division from Rangoon and the portion of the division from the south around Mergui. After the attack, the remaining Burmese forces were joined by another National Division on C+11 and the final National Division on C+12, both from Rangoon.

Troop and armored vehicle strengths of these Burmese government units as well as the Revolutionary Force division are calculated in Tables VI-2 through VI-6 below.

12,000	**Troops**
x .75	**Trigger pullers vs. support**
9,000	
x .90	**Troops available**

8,100	
x .98	**2% lost in strike on Rangoon**
7,938	
x .90	**10% lost to interdiction, accidents, etc in**
7,144	**transit to Tavoy**

7,144 effective troops per National Division from Rangoon

Table VI-2: Strength of One National Division from Rangoon
(Source: Jensen, et al, 2002)

80	**Tanks**
x .75	**Readiness**
60	
- 5	**Strike on Rangoon**
55	
- 5	**lost in transit to Tavoy (maint)**
50	
x 5	**lost to interdiction in transit to Tavoy**
45	

45 effective tanks for the Armored Division from Rangoon

Table VI-3: Tank Strength of One Armored Division from Rangoon
(Source: Jensen, et al, 2002)

60	**APCs (400 troops with ~ 7 troops per APC)**
x .75	**Readiness**
45	
- 5	**Strike on Rangoon**
40	
- 5	**lost in transit to Tavoy (maint)**
35	

35 effective APCs for the Armored Division from Rangoon

Table VI-4: APC Strength of One Armored Division from Rangoon
(Source: Jensen, et al, 2002)

35	**APCs**
x 7	**troops/APC**
245	
+ 55	**troops transported other than APCs**
300	

300 effective infantry soldiers for the Armored Division from Rangoon

Table VI-5: Troop Strength of One Armored Division from Rangoon
(Source: Jensen, et al, 2002)

12,000	**Troops**
x .75	**Trigger pullers vs. support**
9,000	
x .25	**Troops available (75% stay on the border)**
2250	
x .50	**50% lost to interdiction, accidents, etc in**
1,125	**transit to Tavoy**

1,000 effective troops for the National Division from the South

Table VI-6: Troop Strength of the National Division to the South
(Source: Jensen, et al, 2002)

3. Strength of Allied Forces

On C+5, the allies can expect to have the services of 6,940 Revolutionary Force Division troops, including their 100 SOF trainers/advisors. The Peleliu MEU BLT can be ashore by C+8, bringing the allied troop total to 7,940. The MPF MEU BLT will not be ready for combat until C+15, augmenting the remaining troops out of the original 7,940 with a second BLT.

9,000	**Troops**
x .80	**Trigger pullers vs. support**
7,200	
x .95	**Troops available**
6,840	

6,840 effective troops for the Revolutionary Force Division

Table VI-7: Troop Strength of the Revolutionary Force Division
(Source: Jensen, et al, 2002)

4. Scenarios

The effectiveness of the allied forces in defending Tavoy was evaluated in two separate scenarios concerning the three National Infantry Divisions (NIDs) and one Armor Division from Rangoon. The first, or "Trickle Down," scenario modeled an attack by one Burmese division of infantry per day, with a pair of sub-scenarios modeling armored division employment. In the second scenario, all the Burmese forces mass for a single coordinated assault.

a. *Quantifying Forces*

Holding power was modeled differently for the different forces. For the Burmese divisions, it was assumed that they would flee if 20% of the troops were killed since they had less incentive to stay. It was further assumed that if the forces fled one day, because of the difficulties in reorganizing the forces, none of them would return to fight the next day. The freedom fighters defending Tavoy were assumed to flee if 35% of the troops were killed, and the U.S. forces were also assumed to retreat if 35% killed. While the U.S. forces had less incentive to stay in the fight than the Revolutionary forces, they were more disciplined and would remain in the fight until ordered to leave.

The following quantifying assumptions were made about the infantry forces: U.S. forces, Marines and SOF, would defeat Burmese forces in a 5:1 ratio. Freedom fighters with SOF advisors would defeat Burmese forces in a 2:1 ratio. Tavoy's defending rebels were given this higher effectiveness ratio as their will to fight would be higher and, if captured, would probably be executed by government forces. As air support increased, the exchange ratio of U.S. to Burmese forces increased to 7:1. Burmese tanks were weighted as having the equivalent firepower of 10 infantry troops, which decreased the U.S.: Burmese exchange ratio to 7:2, which was conservatively approximated as 3:1 for simplicity.

Lanchester Square Law coefficients were therefore set as Alpha = 0.01 (the rate at which Allies are killed) and Beta = 0.03 (the rate at which Burmese are killed).

Using these assumptions, the Allied forces have a total of 9,590 Combat "points" and will retreat when the total points drop below 6,233. These "points" will be used to graph and compare force on force exchanges later in this section.

These coefficients were built into a Lanchester Exchange Model implemented in a Microsoft Excel spreadsheet that produced the results discussed below.

b. *Trickle Down*

The Trickle Down scenario was considered the more likely of the two scenarios. One Burmese division would likely be ready to move toward Tavoy before the second and third divisions. As described above, the minimum time required before sufficient forces would be available for the Burmese to attack Tavoy is C+10, or the lead forces arrive ten days after an “Execute” order is given, with another division arriving on the next two subsequent days to augment the survivors from the previous day’s fighting.

The initial values for the first Trickle Down attack showed the Burmese forces totaled 1,000 infantry from south and 7,144 infantry from Rangoon combined with 300 infantry in APC’s from the armored division and 15 tanks, or approximately one third of total Burmese force. The Burmese’s Combat Points totaled 8,594 for Day 1 with a Breaking Point of 6,875.

The Trickle Down scenario was divided into two sub-scenarios. In the first, tanks were divided evenly among infantry divisions, meaning roughly one third of the tanks arrived on each day and attacked in coordination with a Burmese Infantry Division. This allows for 15 tanks per division or the equivalent size to U.S. tank company. With one MEU in place, the Burmese nearly break in this scenario; however, they become stronger each day and the Allies eventually break. With two MEU’s in place; however, the engagement is a clear victory for the Allied forces. Force remaining verses time plots for both one and two MEUs ashore in this sub-scenario are presented in Figures VI-11 and VI-12 below. The step increases in Burmese force strength are the result of the arrival of subsequent Burmese divisions at one day intervals. The sharp drop in allied force strength at Day 3.5 is the result of the force reaching its breaking point assumed in the Lanchester Exchange Model. The transition from solid to dotted lines on the plot represent the projected force strengths of both sides if combat is continued past the breaking point of either force.

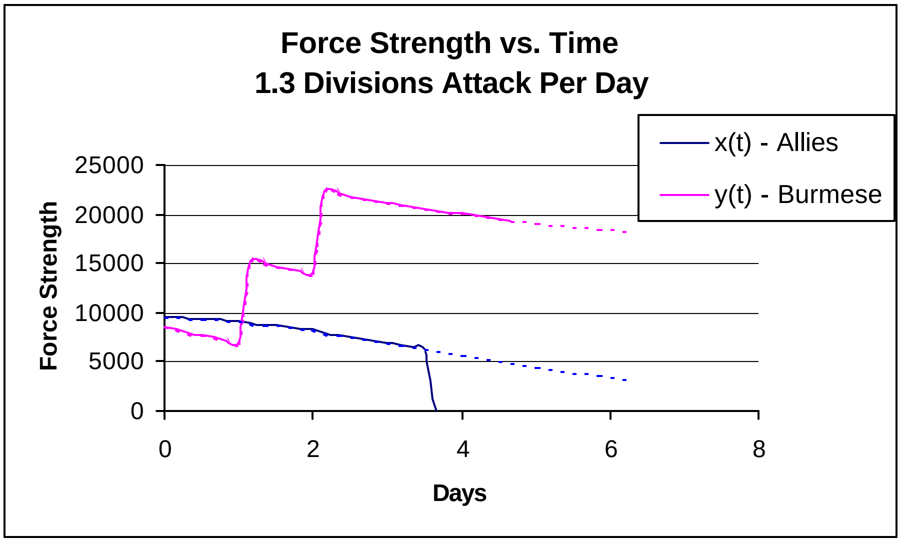


Figure VI-11: Force Strength Over Time For The "Trickle Down" Scenario With One MEU In Place Prior to The Attack [Armor Evenly Spread Among Divisions] (Source: Jensen, et al, 2002)

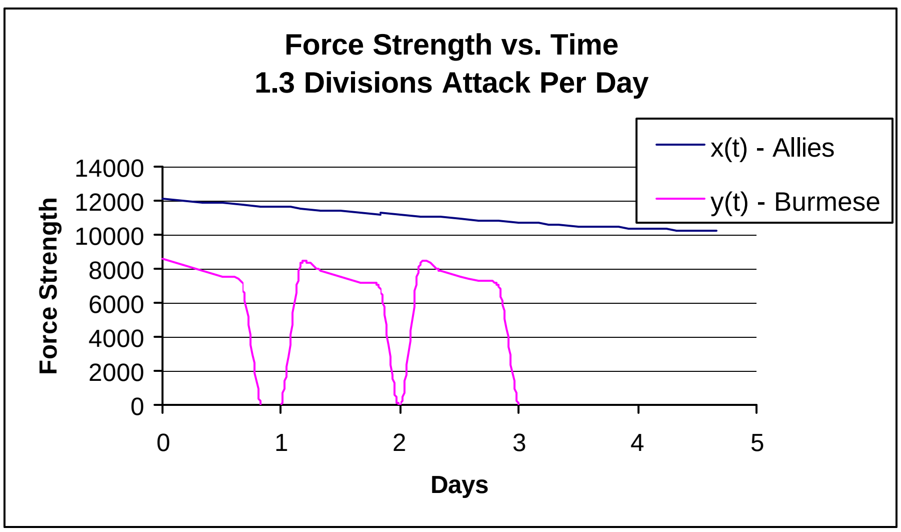


Figure VI-12: Force Strength Over Time For The "Trickle Down" Scenario With Two MEUs In Place Prior to The Attack [Armor Evenly Spread Among Divisions] (Source: Jensen, et al, 2002)

In the second sub scenario, all tanks mount out with the first Burmese division and are available to fight when first division arrives to retake Tavoy. The initial values of the second sub scenario show that Burmese forces total the same 1,000 infantry from the south and 7,144 infantry from Rangoon along with 300 infantry in APC's as in the first sub-scenario; however, now there are a total of 45 tanks, giving the Burmese a Combat Point total of 8,894 to go against the Allies 9,590 Combat Points. Victory in this scenario only occurs if the US can place two MEUs ashore and re-supply them in order to hold until Day 5. The results of engagements based on this sub-scenario with one or both MEUs inserted prior to the assault are resented in Figures VI-13 and VI-14, respectively.

As in Figures VI-11 and VI-12 above, the step increases in Burmese force strength are the result of the arrival of subsequent Burmese divisions at one day intervals. The sharp drop in Allied force strength at Day 3.5 is the result of the force reaching its breaking point assumed in the Lanchester Exchange Model. The transition from solid to dotted lines on the plot represent the projected force strengths of both sides if combat is continued past the breaking point of either force.

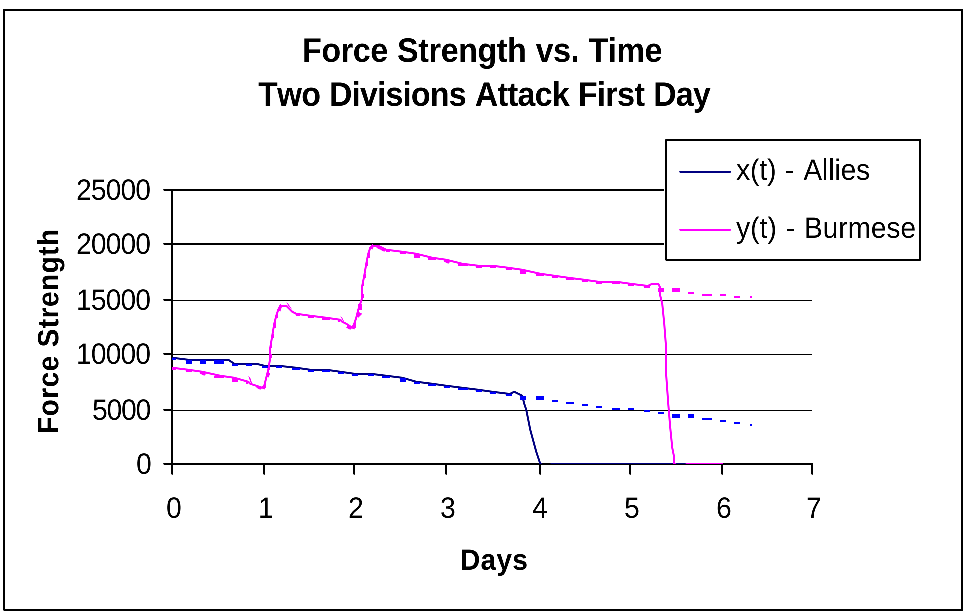


Figure VI-13: Force Strength Over Time For The "Trickle Down" Scenario With One MEU In Place Prior to The Attack [All Armor With The First Division] (Source: Jensen, et al, 2002)

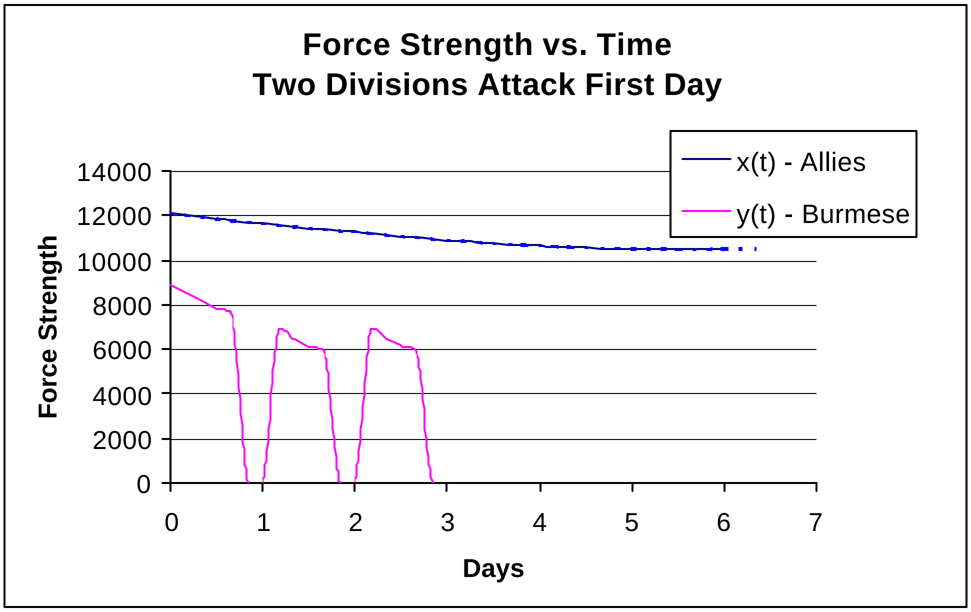


Figure VI-14: Force Strength Over Time For The "Trickle Down" Scenario With Two MEUs In Place Prior to The Attack [All Armor With The First Division] (Source: Jensen et al 2002)

c. *Mass Attack*

A mass attack is potentially the most dangerous COA for the Allied forces. All Burmese forces either leave Rangoon/Mergui and arrive at the same time in Tavoy or depart separately and wait outside Tavoy until all the forces have arrived. Unlike the Trickle Down scenario, where the MPF MEU did not make it to the fight until late, the additional time required to marshal these Burmese forces may permit the second MEU to arrive in place prior to the assault.

Burmese combat power comprised all infantry from north and south, plus the APC's and tanks of the armored division on the first day of the attack, for a Combat Point total of 23,182 and a Breaking Point of 18,545. The Allied total remains the same at 9,590 Combat Points. If the assumptions concerning breaking points are correct, the allies have a reasonable chance of prevailing if they can have two MEUs in place prior to the assault. If however, the Burmese force commander, recognizing they still have a 2:1 force advantage at the breaking point, continues to press the attack, the allied forces reach their breaking point at approximately day 3.5.

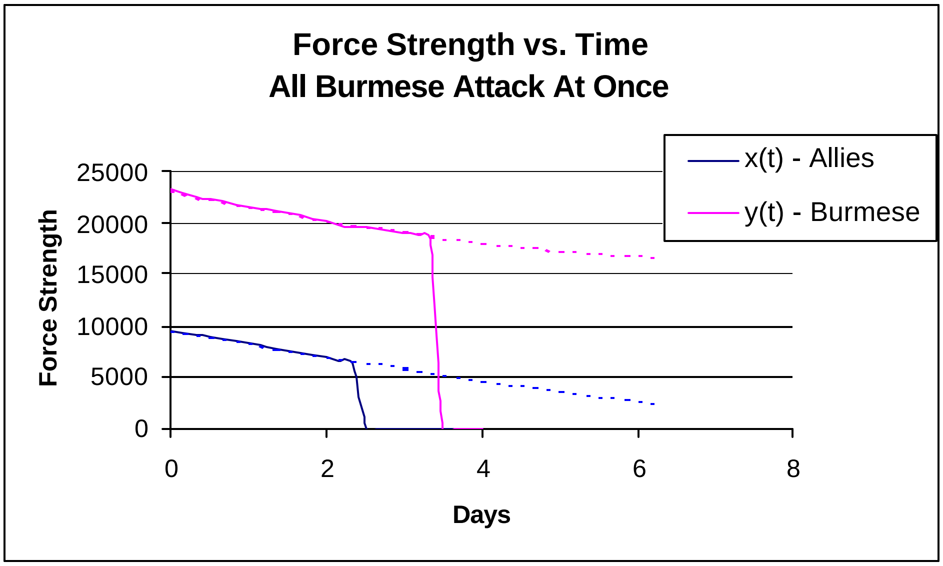


Figure VI-15: Force Strength Over Time For The "Mass Attack" Scenario With One MEU In Place Prior to The Attack
(Source: Jensen, et al, 2002)

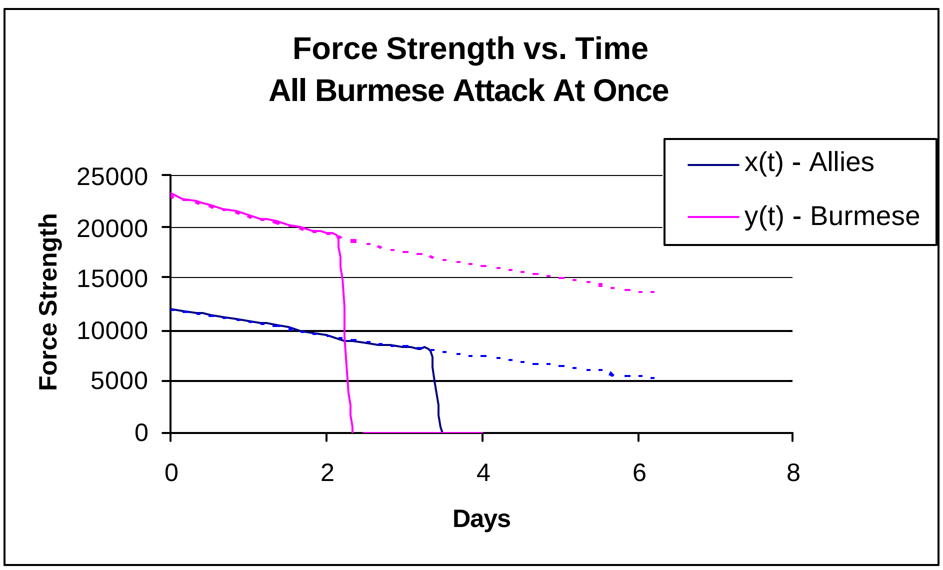


Figure VI-16: Force Strength Over Time For The "Mass Attack" Scenario With Two MEUs In Place Prior to The Attack
(Source: Jensen, et al, 2002)

5. Lanchester Conclusions

These results from the Lanchester equations demonstrate it is imperative the U.S. must have at least two MEUs in place prior to the Burmese attack, regardless of whether it is a Trickle Down or mass attack. There are two ways to ensure there is sufficient time for both MEUs to be in place prior to that attack. The task force can delay Burmese attacks until both MEU's are able to land and be ready for attack through interdiction in the areas depicted in Figure VI-17, or the deployment time for the second MEU and its prepositioned materials can be accelerated. Since the number of strike assets onboard the task force ships is limited, it is hard to see how more interdiction could be employed to further delay the arrival of Burmese forces.

Two options for accelerating the deployment of the second MEU were examined as part of the ExWar Integrated Project. One, the design of a MEU based on High Speed Vehicles (HSV), is discussed below. The second, a ship and aircraft system of systems capable of projecting an entire brigade into the Tavoy area prior to C+10 is the subject of the remainder of this report.

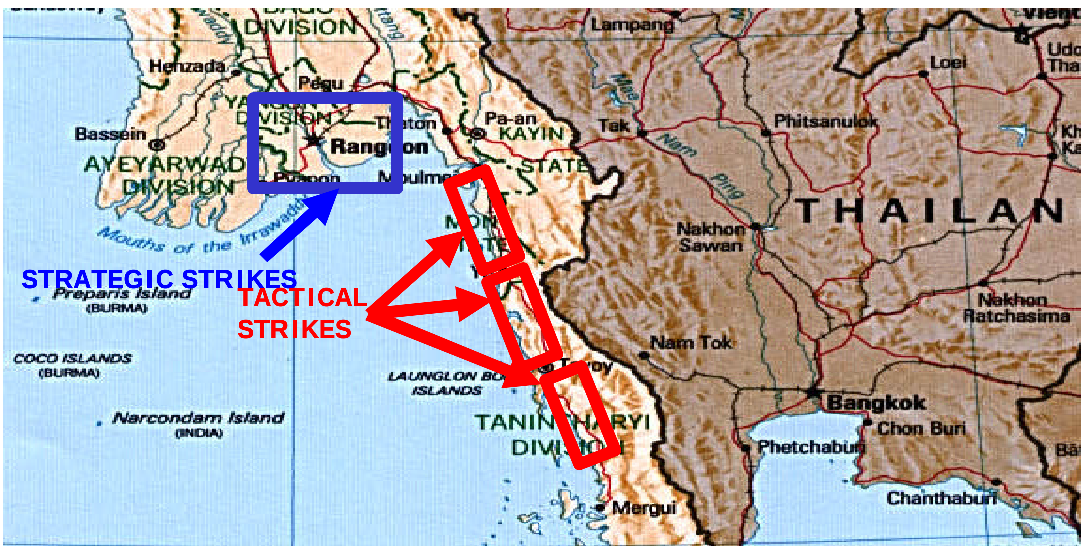


Figure VI-17: Burma Campaign Interdiction Strike Areas
(Source: Jensen, et al, 2002)

6. Transportation Network Interdiction

Network theory allows the analysis of a network, such as a system of roads and bridges, in order to determine the fastest and most effective way to destroy the network by attacking the critical nodes. Network analysis was applied to the road and rail networks running north and south out of Tavoy in order to determine the most effective way to prevent Burmese forces from arriving in time to attack the Allied forces before they reached full strength. Once possible source–terminal node (s-t) cuts are identified, SOF raids or air and cruise missile strikes are used to destroy bridges as necessary. Attacks that focused on enemy centers of gravity and cut off road and rail transportation routes into Tavoy have the highest priority. The goal is to force enemy troops to dismount and leave their equipment, ammunition, and supplies behind. Finally, Allied control of Tavoy prevents enemy use of the airfield and its facilities.

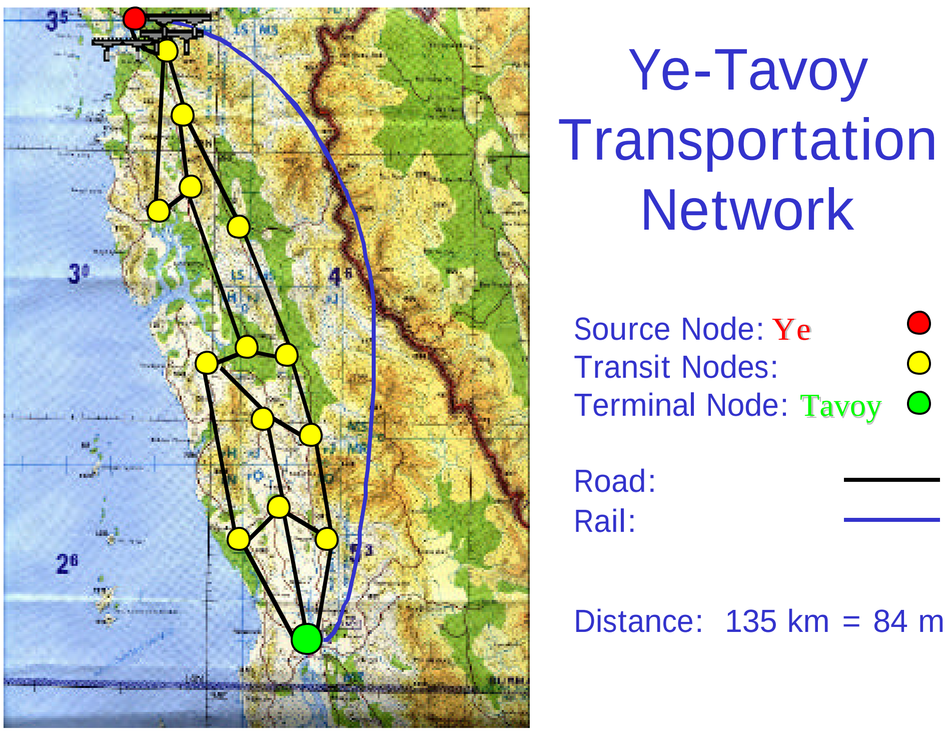


Figure VI-18: Ye-Tavoy Transportation Network (Source: Jensen, et al, 2002)

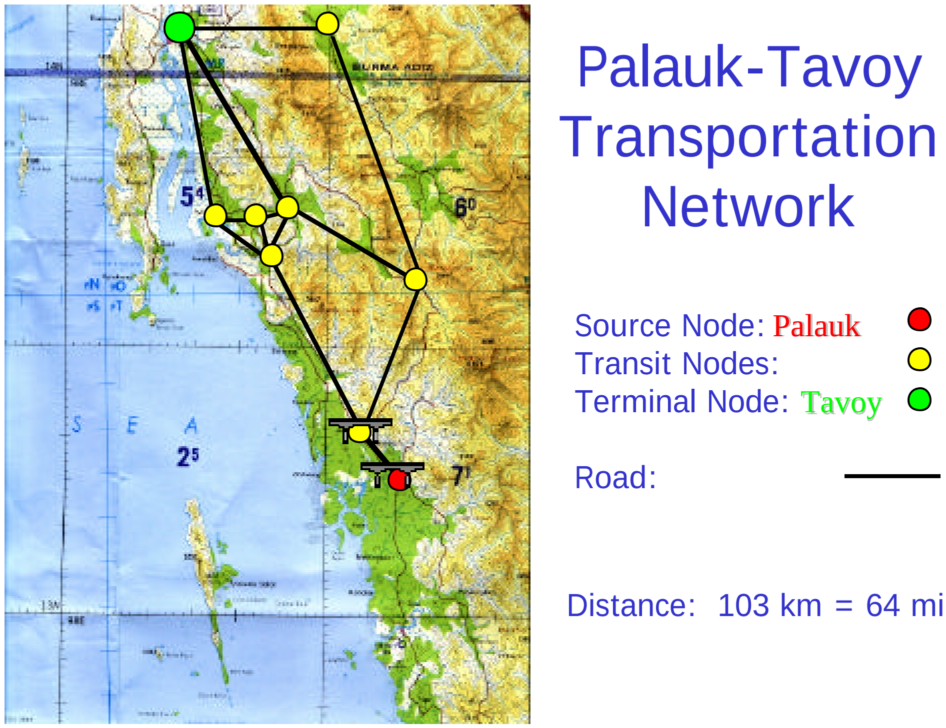


Figure VI-19: Palauk-Tavoy Transportation Network
(Source: Jensen, et al, 2002)

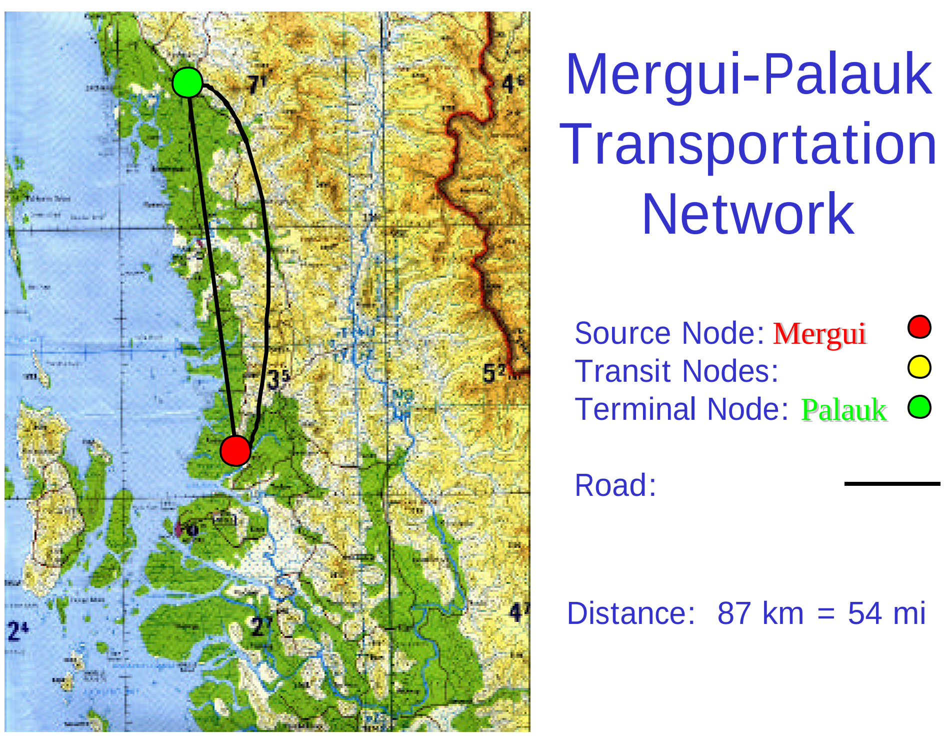


Figure VI-20: Mergui-Palauk Transportation Network
(Source: Jensen, et al, 2002)

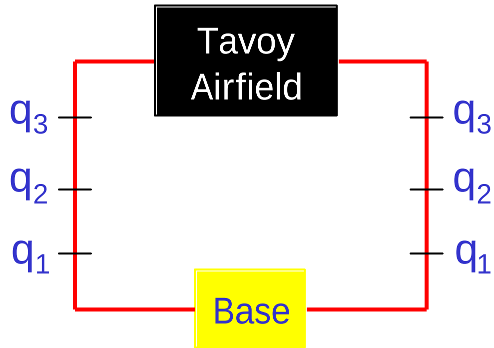
Network interdiction analysis yielded the following conclusions: a minimum of 4 bridges must be destroyed to prevent enemy use of roads/rail lines into Tavoy: 2 road bridges and 1 rail bridge in Ye, and 1 road bridge in Palauk.

Despite the fact that most material moves via the river system, it is too complex to fully eliminate enemy use of waterways throughout the region. Round the clock UAV reconnaissance missions from the battle group or ESG ships are required to monitor sea and river activity in and around Tavoy. High endurance reconnaissance assets with weapons capability like the Sea Spectrum UAV described in Chapter XVIII would be ideal for this monitoring role. The Allies must maintain costal sea superiority up to 84 miles to the north and 64 miles to the south to prevent smuggling of small units of men and equipment via coastal shipping. Plans to gain sea superiority are discussed under Advance Force operations below.

7. Circulation Model

The Joint Campaign Analysis team built a circulation model in order to examine the arrival of supplies and material at the Tavoy airfield to support the ground combat element in combating Burmese forces moving toward Tavoy. The air transport circulation model used in the analysis is presented in Figure VI-21 below.

Air Transport Circulation Model



q_1 = Probability transport sustains no mission-ending mechanical failures

q_2 = Probability transport survives Surface-to-Air missile attack

q_3 = Probability transport survives Air-to-Air missile attack

Figure VI-21: Burma Campaign Air Transport Circulation Model
(Source: Jensen, et al, 2002)

The circulation model makes four major assumptions: surface-to-air and air-to-air missile attacks are independent, one attack of each type is conducted during each half-mission, attacks are conducted with effective weapon systems (i.e. no misfires or weapons failures), and the independence of mechanical failures during each flight.

Survival probabilities were calculated for each aircraft. Individual q_i survival probabilities were set at 0.990, leading to an aggregate half-mission survival probability of:

$$q = q_1 q_2 q_3 = (.990) \times (.990) \times (.990) = 0.970$$

a full-mission survival probability of:

$$qq = q^2 = (.970) \times (.970) = 0.941$$

and a full-mission non-survival probability of:

$$p_k = 1 - q^2 = 1 - 0.941 = 0.059$$

In the model formulation, the Probability Mass Function (PMF) used was

$$\Pr\{X = n\} = q^{2n-1} (1-q^2)$$

Which leads to a Probability Distribution Function (PDF) of

$$\Pr\{X = n\} = 1\text{-}q + S\, q^{2n-1}\,(1\text{-}q^2)$$

where X is a random variable with integer value from 0 to n representing the number of successful transport flights into the Tavoy airfield.

The expected value calculations sought to find the Expected Number of Successful Transport flights into Tavoy via:

$$–E[X] = q\,(1\text{-}q^2)^{-1}$$

$$–E[X] = (.970) \times (.059)^{-1} = \mathbf{16.44}$$

where the Standard Deviation of X was:

$–s_X = (1\text{-}q^2)^{-1}\,(q^3 - q^2 + q)^{0.5}$ $–s_X = (.059)^{-1}\,(.970^3 – .970^2 + .970)^{0.5}$ = **15.96**

q1 =	0.990	q =	0.970
q2 =	0.990	q*q =	0.941
q3 =	0.990	1-qq =	0.059

n	q^(2n-1) (1-q^2)	Pr{X <= n}	Pr{X > n}
1	0.0568	0.0865	0.9135
2	0.0535	0.1399	0.8601
3	0.0503	0.1903	0.8097
4	0.0474	0.2377	0.7623
5	0.0446	0.2823	0.7177
6	0.0420	0.3243	0.6757
7	0.0395	0.3638	0.6362
8	0.0372	0.4010	0.5990
9	0.0351	0.4361	0.5639
10	0.0330	0.4691	0.5309
11	0.0311	0.5002	0.4998
12	0.0293	0.5294	0.4706
13	0.0275	0.5570	0.4430
14	0.0259	0.5829	0.4171
15	0.0244	0.6073	0.3927
16	0.0230	0.6303	0.3697

Figure VI-22: Burma Campaign Success Probabilities When E[x]=16

In order to examine the effects of increasing q_i, individual q_i survival probabilities were increased from 0.990 to 0.995, leading to a new aggregate half-mission survival probability of:

$$q = q_1 q_2 q_3 = (.995) \times (.995) \times (.995) = 0.985$$

a full-mission survival probability of:

$$qq = q^2 = (.985) \times (.985) = 0.970$$

and a full-mission non-survival probability of:

$$p_k = 1-q^2 = 1 - 0.970 = 0.030$$

As before, the expected value calculations sought to determine the Expected Number of Successful Transport flights into Tavoy via:

$$–E[X] = q\,(1-q^2)^{-1}$$

$$–E[X] = (.985) \times (.030)^{-1} = \mathbf{32.83}$$

where the Standard Deviation of X was:

$$–s_X = (1-q^2)^{-1}\,(q^3 - q^2 + q)^{0.5}$$

$$–s_X = (.030)^{-1}\,(.985^3 – .985^2 + .985)^{0.5} = \mathbf{32.35}$$

q1 =	0.995	q =	0.985
q2 =	0.995	q*q =	0.970
q3 =	0.995	1-qq =	0.030
n	q^(2n-1)	Pr{X <= n}	Pr{X > n}
1	0.0292	0.0441	0.9559
2	0.0283	0.0724	0.9276
3	0.0275	0.0999	0.9001
4	0.0267	0.1266	0.8734
5	0.0259	0.1525	0.8475
6	0.0251	0.1776	0.8224
7	0.0244	0.2019	0.7981
8	0.0236	0.2256	0.7744
9	0.0229	0.2485	0.7515
10	0.0223	0.2708	0.7292
11	0.0216	0.2924	0.7076
12	0.0210	0.3134	0.6866
13	0.0203	0.3337	0.6663
14	0.0197	0.3534	0.6466
15	0.0192	0.3726	0.6274
16	0.0186	0.3912	0.6088

Figure V ties When E[x]=32
(Source: Jensen, et al, 2002)

The circulation model led to an important conclusion: the expected value of successful missions was extremely sensitive to small increases in q_i survival probabilities; therefore, in order to ensure transport flights can safely deliver equipment, personnel and supplies into Tavoy, allied forces must achieve air superiority from Diego Garcia and/or Singapore to Tavoy as well as ground and sea superiority in and around Tavoy.

8. Strike Requirements

In order to conduct strategic interdiction strikes, the task force needs access to B-2s in addition to the organic Tomahawk Land Attack Missiles (TLAMs). Tactical strikes will also be conducted B-2s, as well as Navy Tactica Air (Tacair), TLAMs, and SOF demolitions. Strategic strikes are required in Rangoon prior to C+2, while bridges targeted through network analysis must be set for demolition by SOF prior to C+6.

Tactical strikes will then be required on the avenues of approach into Tavoy and around the obstacles created by the destroyed bridges.

Time is of the essence, ground engagements around Tavoy must be delayed until both MEUs are in place. These engagements could be delayed by performing air strikes in Rangoon, by conducting interdiction by indirect fire on advancing forces, and by conducting counter-mobility operations along the avenues of approach into Tavoy.

G. IMPACT OF HIGH SPEED VESSELS

1. Introduction

The campaign analysis examined a pair of excursions in addition to the baseline scenario. The first involved the use of HSVs for the delivery of the second MEU instead of the MPF. The second involved the employment of a small littoral combatant to enhance force protection and sea control throughout the area of operations.

2. Impact of High Speed Vessels

The introduction of HSVs for troop transport or force protection has several implications for the analysis. How could these HSVs have helped in the previously described Burma scenario? What about a small littoral combatant, like the Sea Lance discussed in Chapter XVIII? Can it contribute to Allied success against the superior Burmese forces? A review of the pertinent conclusions of the Joint Campaign Analysis is required. First, mission success cannot be accomplished by air and maritime power alone. Second, local air and maritime superiority are required to conduct successful ground operations. Third, a complete combined arms operation utilizing ground, air, and maritime forces is required for success. And finally, with two MEUs in place before any ground engagement, the Allied forces can retain Tavoy in even the worst case scenario.

In this scenario, four HSVs can carry a rifle company, weapons squad, 2 helicopters, and 3 Advanced Amphibious Assault Vehicles (AAAVs). So a total of 12 HSVs is needed to transport the 3 companies comprising the battalion. Two "aviation" HSVs carry additional aircraft to move the troops ashore. In this analysis, no artillery, artillery ammunition, nor tanks accompanied the HSV MEU. The analysis was conducted using COA #2 as described above, with the exception that the scenario now includes insertion of both MEUs, less one MEU's organic artillery and armor.

How does the availability of an HSV based MEU impact the scenario? The delay of Burmese forces is not as critical if both MEUs can be in place and operational by C+8. The primary purpose of interdiction air strikes and raids can then shift from delaying movement to attrition of enemy forces. Attrition of enemy forces becomes especially important in worse case scenario of massed force attacks. The smaller these massed forces, the higher the likelihood of Allied success.

While an HSV MEU has advantages in how fast its troops arrive at the fight, there are also some disadvantages. The deep re-supply pockets of the MPF would not be available in that scenario. All re-supply will have to be by air into Tavoy or through the ships of the Sea Base and thus potentially open to Burmese Special Forces interdiction.

3. Impact of Littoral Combatant Ships

Littoral combatant ships (LCS) were examined in the following roles: assisting allied forces in gaining river superiority just south of Ye, to assist UAVs from the battle group in monitoring sea and river activity in and around Tavoy, and to complement battle group aircraft in targeting/engaging enemy coastal and river targets, thereby increasing the survival probabilities of re-supply flights into Tavoy.

As previously concluded, a minimum of 4 bridges must be destroyed to prevent enemy use of roads and rail lines into Tavoy. This would leave open only one major transportation path for Burmese forces to move south, the local waterways. LCSs fire support and patrols would assist the allied forces in gaining river superiority just south of Ye in order to prevent internal transport of government troops across the river after destruction of the 4 bridges. Meanwhile LCSs along the coast would prevent the Burmese military from using Naval forces or commercial ferries to transporting troops, equipment and supplies.

While the river system is too complex to fully eliminate the enemy's use throughout the region, LCSs would assist UAVs from the battle group to monitor sea and river activity in and around Tavoy as well as ensuring coastal sea superiority north to Ye and south to Palauk. LCSs would complement aircraft and other strike platforms in targeting and engaging enemy coastal and river targets.The analysis confirmed the delay and attrition of Burmese forces is critical for mission, so the additional capability of the LCS to patrol close inshore and up the main rivers provided an additional capability for the Allied forces. Local air, sea, and ground superiority is required for aerial re-supply into Tavoy and re-supply to the HSVs and ships of the Sea Base. HSVs and LCSs will facilitate gaining sea superiority.

4. Revised Operational Timelines

While the overall situation remains the same, the task force composition is now composed of SOF, the Peleliu Naval Expeditionary Strike Group, and a HSV MEU. As previously discussed, final combat potential is reduced in this scenario. With the MPF MEU, the fly-in MEU operational at C+15 along with supplies and equipment for 17,500 Marines for 30 days. With the HSV MEU, the troops are there in time to defend against the government forces assault on Tavoy, but the ability to support U.S. and Revolutionary forces in Tavoy is reduced by the need to fly in additional materials and sustainment supplies.

Revised potential timelines are presented in Figures VI-24 through VI-26 below.

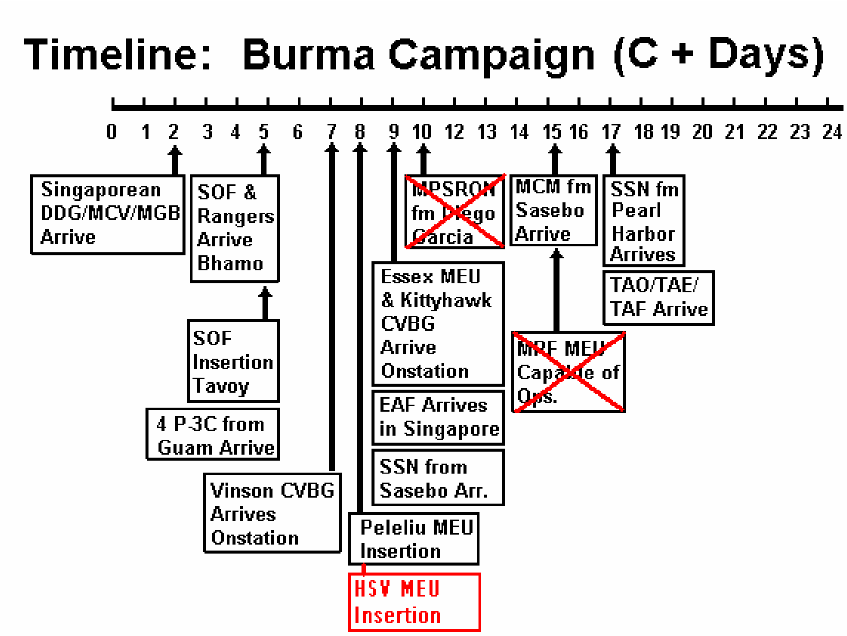


Figure VI-24: Revised Campaign Timeline for the Burma Scenario Incorporating the HSV and LCS (Source: Jensen, et al, 2002)

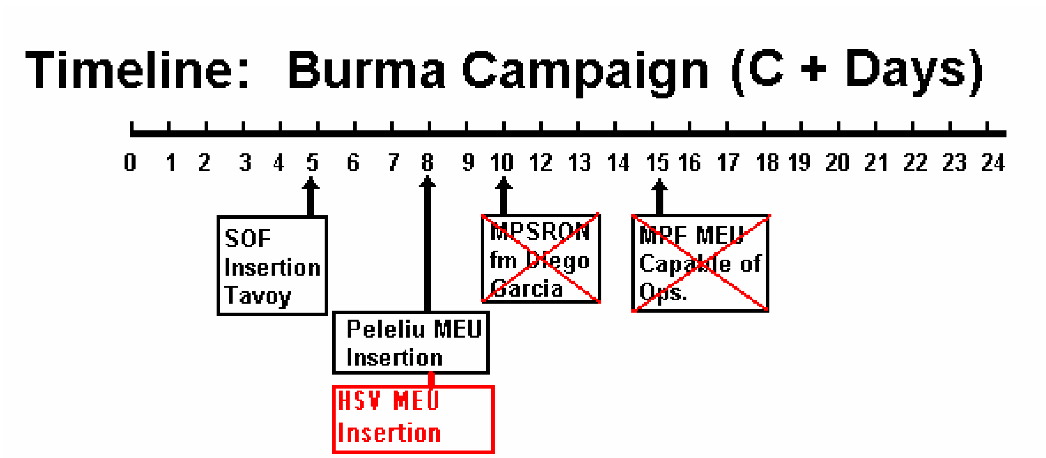


Figure VI-25: Revised Tavoy Task Force Operations Timeline for The Burma Scenario Incorporating the HSV and LCS

(Source: Jensen, et al, 2002)

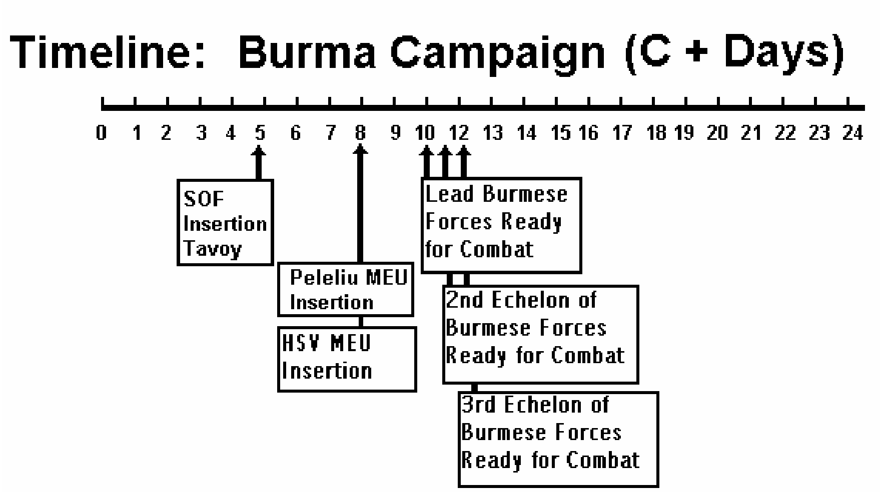


Figure VI-26: Revised Order Of Battle Availability Timeline for the Burma Scenario Incorporating the HSV and LCS
(Source: Jensen, et al, 2002)

H. ADVANCE FORCE OPERATIONS

Advance force operations for the Burma scenario were studied in greater depth in the Systems Engineering & Integration course SI3900 Topics for Systems Engineering. The study effort concentrated on the planning and execution of placement of the first MEU ashore.

1. Mission Analysis

The first step in the mission analysis was to review the tasking to determine the Superior's Mission, define the problem, and list all the tasks to be performed in order to successfully accomplish the mission. The Superior's Mission directed the Joint Task Force (JTF) to "counter Burmese special forces activity in and around the critical international straits, including dealing with a possible mine threat before or after mines are in the water." Taking this tasking in conjunction with other information in the scenario document defined the problem as "The JTF will establish a deterrent presence and, when ordered, conduct a sustained offensive sea, air, and land operations in the vicinity of Ye, in order to prevent Burmese government forces from reaching rebel forces in Tavoy." The problem statement contained five specified tasks:

1. establish a deterrent presence;

2. conduct covert recon to support MEB-size landing to locate coastal defenses, underwater obstructions (mines, obstacles), and directly support small-raids/Sea, Air , Land (SEAL) Team Ops;

3. be prepared, on order, to land the BLT as a show of force, blocking force, or entry force for follow-on MEB;

4. be prepared, on order, to conducted limited raids against rail stations, fuel depots, or other targets; and

5. be prepared to support Tactical Recovery of Aircraft and Pilots (TRAP) Ops.

The specified tasks contained three implied tasks:

1. counter Burmese special force's activity in and around critical international straits,

2. support and sustain MEU BLT during combat operations ashore,

3. integrate Allied forces into operations.

Comprehensive planning requirements led to identification of three additional tasks:

1. provide logistic support for forces,

2. provide intelligence support for forces,

3. provide force protection.

These 11 tasks defined the spectrum of operations included in operational planning.

2. Assumptions

The following assumptions were made in generating courses of action: Thailand is friendly to the U.S.; therefore Burmese forces will not be able to use Thai territory to evade a blocking force, the port itself at Tavoy is not mined (or if mined, the locations are known by the rebels) and can be used as a backup for landing heavy equipment if a suitable beach is not available in the vicinity of Ye, and the enemy has only two COAs: they can move ground forces toward Tavoy to crush the rebels or cede control.

3. Potential Courses of Action

In order to accomplish the mission with the forces available and provide for a gradual and controlled escalation of force, courses of action were developed and presented as Figure VI-27 below. As discussed above, the single MEU sized initial force was not large enough to effectively execute an effective blocking mission against a sizeable Burmese force before the arrival of additional MEUs or without rebel support. Blocking and air raids, other than on a limited scale, require the presence of a carrier battle group and its escorts to implement.

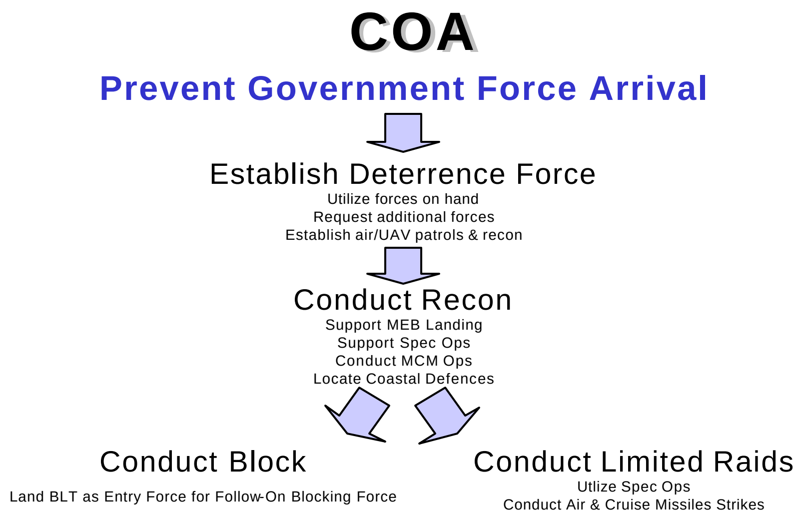


Figure VI-27: Burma Scenario Advance Force Candidate COA

In order to evaluate the effectiveness of these courses of action and aid in identifying when to transition to a higher level of force, variables and measures of effectiveness were identified for each COA. In order to provide an apples-to-apples comparison, these Measure of Effectiveness (MOE) measured identical or very similar quantities in each scenario. The overall MOE for the scenario is the number of enemy forces arriving at Tavoy and the time it takes for them to arrive. The fewer enemy forces arriving and the longer it takes them to arrive, the better. The variables are presented in Table VI-8 and the MOEs in Table VI-9 below.

Controllable	**Uncontrollable Known**	**Uncontrollable Estimable**	**Unknown Random**
Own Force Composition & Size	Southbound Routes	Southbound Routes Used	Mine Distribution
Location of Littoral Penetration Sites		Mine Distribution	Coastal Defense Deployment
Raid Targets		Coastal Defense Deployment	
Blocking Force Positions		Enemy Force Distribution between Routes	

		Weather	
		Enemy Rate of Advance	

Table VI-8: Burma Scenario Advance Force Variables

	COA	MOEs
1.	**Recon**	▪ Length of ShoreLine with Defences identified (Coastal Defences) ▪ Number of Lanes searched (MCM) ▪ Number of Southbound routes identified (PA) ▪ Number of Potential Interdiction Points identified(PA) ▪ Number of Interdiction points for raid ▪ Number of interdiction points for blocking force ▪ Number of Potential Landing Sites Identified
2.	**Deterrence**	▪ Decrease in enemy's rate of advance ▪ Time to build up to force size required
3.	**Raid**	▪ Time to conduct mission ▪ Decrease in enemy's rate of advance ▪ Reduction in enemy force level ▪ Number of southbound routes denied
4.	**Block**	▪ Time to establish forces ashore ▪ Number of enemy forces engaged ▪ Number of southbound routes blocked • Amount of time Block force can be sustained

Table VI-9: Burma Scenario Advance Force MOEs

The COAs were arranged into operational phases, escalating in use of force, which could be executed on orders from higher authority when the current phase's MOEs showed the operation was not successfully preventing Burmese forces from reaching Tavoy. The phases, in more detail, are:

1. *Deterrence*: establish air and UAV patrols to prevent southern movement of government forces (need Rules of Engagement (ROE) to implement), detect and prevent air and sea movement along 250 NM line running SW to NE intercepting the coast north of Moulmein, establish high altitude, high endurance UAV surveillance of region between Rangoon and Ye for early detection of troop movement and other enemy activity, and, finally, begin information operations to dissuade government from attacking rebels.

2. *Reconnaissance*: maintain high altitude, high endurance UAV patrol for rail and road movement of troops through Moulmein, while conducting aerial reconnaissance for raid and interdiction targets between Moulmein and Ye; conduct beach survey, Mine Countermeasures (MCM), and locate coastal defenses for potential landing sites up to 50 NM south of Ye; conduct reconnaissance of potential blocking force sites south of Ye; and contact rebel forces in Tavoy to coordinate plans to land troops and blocking strategy

3. *Raid*: raid targets (identified during reconnaissance) with air launched precision weapons and cruise missiles beginning with road and rail junctions at Moulmein and move south along the enemy's line of advance toward Ye, simultaneously conduct raids south of Ye with Special Forces, begin to move rebel forces into blocking positions south of Ye, and complete preparations for BLT landing.

4. *Block*: continue interdiction air strikes between Moulmein and Ye directed against Burmese forces moving south, implement Maritime Interdiction Zone (MIZ) along coast from Ye to Mergui to prevent reinforcement of government troops by sea, and insert BLT to their blocking positions in vicinity of Ye and link up with rebel forces moving north. If a suitable landing site cannot be found, land heavy equipment in Tavoy and drive them north.

4. Additional Forces Required

In order to accomplish these phases, the following additional forces will be required: 7 additional surface ships capable of providing force protection and implementing maritime surveillance scheme (a minimum of 5 must be SH-60R equipped), Information Operations support, 1 Advanced Seal Delivery Vehicle (ASDV) and 60 lobsters for MCM, an additional Seal Delivery Vehicle (SDV)/ASDV capable submarine to allow both assets to be employed simultaneously, an additional Seal Platoon for reconnaissance and raids, Special Forces to coordinate and advise rebel forces, JSTARS assets to supplement road surveillance, and B-52 support for 2 raids per day (Diego Garcia).

5. Advance Force Mine Countermeasures Operations

As required by the scenario, over the next 24 hours, the JTF had to covertly check for the presence of mines from very shallow water (VSW) to the 50m curve using experimental lobster unmanned underwater vehicles (UUVs) in order to allow for SEAL recon insertion or creation of AAAV landing site transit lanes.

a. *Mine Countermeasures Operations Assumptions*

Several assumptions were necessary in order to obtain a solution. First, the Operational Area (OPAREA) was converted to a 5.8 x 25 NM rectangle. This assumption was made to simplify the calculation of mine density and thus the number of mines found in individual lobster search areas. The second assumption concerned the nature of the threat. Since AAAVs are relatively small, not particularly noisy, and operate primarily in shallow water, influence mines would not be very effective in preventing a landing and thus will not be employed by Burmese government forces. The primary mine threat, therefore, comes from contact mines. The third set of assumptions concerned the mines themselves. Individual mines were 1.0m in diameter and probability of detonation given activation (touching the mine) was assumed to be 1.0, which seemed reasonable for a contact mine. Mine reliability was accounted for separately. The mine's probability of kill given a detonation was also assumed to be 1.0. The mine's lethal radius was not expressly estimated; however, it was assumed the lethal radius was less than 50 meters, or that a single mine detonation could not kill more than one AAAV. Finally, it was assumed, in accordance with current doctrine, that AAAVs would not approach a potentially hostile beach in line astern. They would instead transit in a line abreast or 45^{o} wedge with 50 – 100m between adjacent craft and have sufficient maneuverability to avoid mine locations while maintaining their station. The AAAVs also have an organic ability to breach minefields past the VSW region if they encounter them, since they are not detected by the lobsters.

b. *Mine Countermeasures Operations Variables*

The analysis variables are shown in Table VI-10 below:

Controllable:
The location and area of transit lanes
The number of lobsters assigned to search a given transit lane
Uncontrollable Estimable:
The number and disposition of enemy mines in each search area
The mine's probability of detonation given detection
The probability of kill given detonation
The mine's lethal radius
The mine's reliability
Uncontrollable Unknown:
The number and disposition of mine-like objects in the OPAREA

Table VI-10: Burmese Scenario Advance Force Mine Search Variables

c. *Mine Countermeasures Operations Measures of Effectiveness*

The analysis used four measures of effectiveness:

1. The number of mines detected per lobster search area
2. The width of transit lanes searched
3. The time to search each transit lane
4. The expected number of AAAVs lost

d. Analysis of Mine Countermeasures Operations

Since each lobster has the capability to transmit the location of only 10 mines or mine-like objects, the first step in the analysis is to calculate how many mines may be present in the OPAREA. The number of mines is heavily dependant on the enemy's strategy, which leads to four possible enemy courses of action:

Course of Action	Description	Probability of Adoption
1	No mines available to the enemy commander and therefore none present in the OPAREA	.1
2	A limited number of mines (~200-500) are available and are used to defend the approaches to the harbor in the middle of the OPAREA and adjacent beaches	.4
3	A moderate number of mines (~500-1000) are available and are used to defend a number of potential landing sites	.3
4	A large number of mines (>1000) are employed throughout the OPAREA to deny any access	.2

Table VI-11: Advance Force Mine Search Courses of Action

COA 1 was assigned the lowest probability of occurrence. COA 2 was assigned the highest probability because the harbor is the highest value target and number of assets required to defend it seem reasonable. COA 3 was assigned a slightly lower probability due to the large number of mines required (see Figure VI-28) and the increased difficulty in laying them effectively. In order to ensure 1 AAAV is killed out of a wave of 7 in line abreast requires only 17 mines per NM or 425 across the entire OPAREA, but to ensure 1 AAAV is killed in a line astern wave requires 810 mines per NM or 20,250 mines across the OPAREA. An AAAV wave size of 4 or less or an increase in the desired number of AAAVs killed per wave greatly increases the number of mines required.

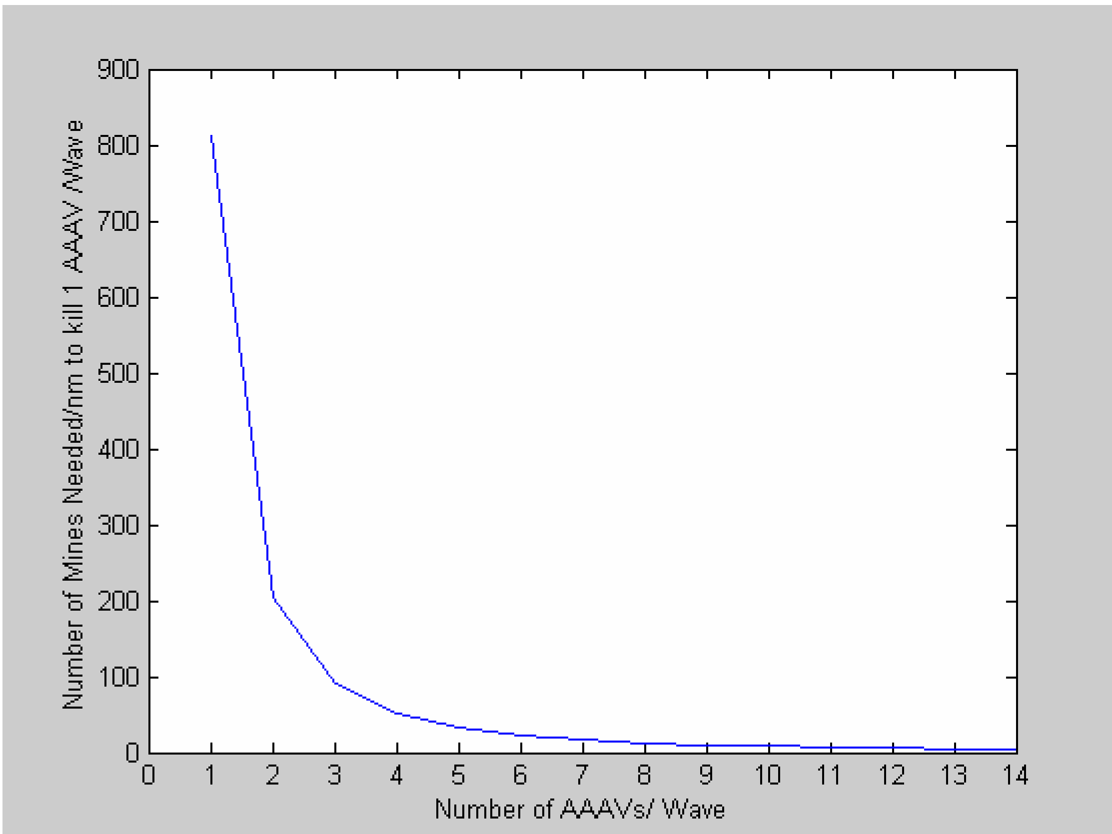


Figure VI-28: Number of Mines Needed to Implement Enemy COA 3

The figure was generated using the following equation from the detailed mine method contained in the Mine Warfare chapter of Driels, 2002

$$N_m = \frac{W_m^2 \ln(1-T)}{R W_D P_{Dmax} D_B}$$

where W_m is the width of the minefield, T is the probability of damaging a single target with the number of mines the target is expected to encounter, R is the mine's reliability (assumed here to be .95), W_D is the detection width (5.56m for AAAV and 1m mine), P_{Dmax} is the maximum probability of damage (1.0), and D_B is the distance over which the mine can cause damage (5.56m).

COA 4 was given a lower probability than either COA 2 or COA 3 because of the large numbers of mines required to saturate the overall OPAREA, the difficulty in distributing them, and the effects on civilian and commercial boat traffic. Further, high numbers of mines do not saturate the lobster's pinger capability. A total of 4,750 mines still allow a 1:1 false alarm ratio while detecting all the mines in a lobster's designated search area (Figure VI-29).

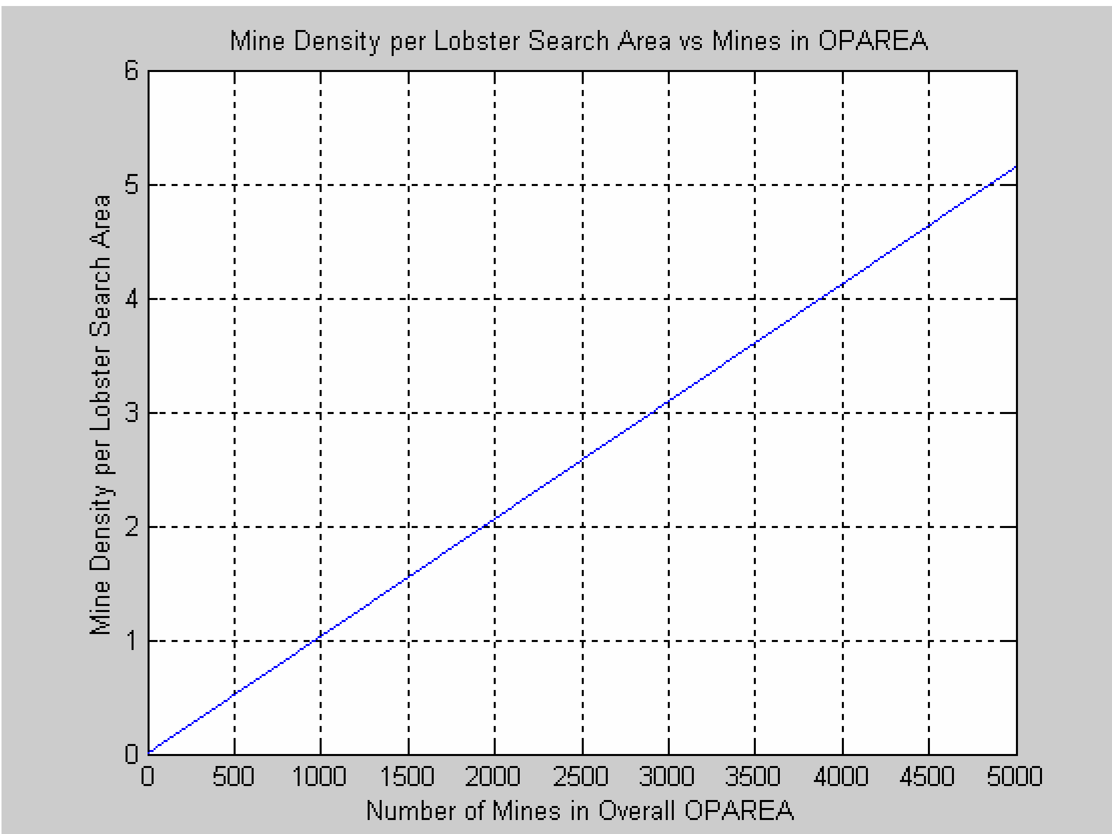


Figure VI-29: Number of Mines Expected in a Lobster's Search Area

Once the enemy's most likely COAs (2 or 3) have been determined, our own force COAs can be analyzed against them and a lobster search pattern generated. For a given speed and time, the area a lobster can search is fixed. For a UUV speed of 3 knots and a 24 hr operating time this area is .1544 NM^2. The area can be divided by the distance from the line of departure to shore to find the width of the area searched by each lobster. The width multiplied by the number of lobsters determines the width of the searched lane. The COAs are shown below.

Course of Action	Description	Probability of Adoption
1	Heli-borne insertion and sustainment	.2
2	Surface craft insertion in the vicinity of the harbor	.3
3	Surface craft insertion at other beach	.5

Table VI-12: Task Force Mine Avoidance COA

COA 1 was assigned a low probability due to the difficulty involved in transporting heavy equipment and sustaining the BLT entirely via air. COA 2 was also assigned a low probability because, while the harbor does control the best routes inland, it maximizes the likelihood of encountering high mine and mine-like object densities, since defending the harbor was the enemy's most likely COA. COA3 was given the highest probability of adoption because it combines a low likelihood of encountering both mines and mine–like objects in all three of the enemies most likely COAs.

Given, then, that COA 3 is our preferred course of action, how can the lobsters be best employed? The average distance from the line of departure in the non-harbor portions of the OPAREA is 5.8 NM. This permits the first round 10 of lobsters, starting 37m apart, to complete 12 search legs each covering a total of 370m. A second round of 10 lobsters starting 1 hr later can still cover the same area. A 370m lane can easily accommodate 5 AAAV in line abreast (318m total at 75m spacing) or 6 in a 45^o vee or echelon formation (287m total) with sufficient boundary cushion on each side of the lane. The lanes can be widened with additional lobsters from the third group, if desired. This wave size corresponds with the sharp increase in the number of mines required to kill one AAAV per wave shown in Figure 1. For a wave size larger than 5 abreast, the probability of killing at least one AAAV increases much faster than the number of mines required increases. For smaller than 5 abreast, the number of mines required increases dramatically for each AAAV killed. As can be seen from Figure VI-27, the number of mines per NM (frontal density) required would be between 25 and 75, which leads to a total of between 5 and 10 mine per lane. This permits a lobster false alarm ratio of between 10:1 and 20:1 without depleting the pingers, which should be adequate for the approaches to an undeveloped beach.

From Figure VI-29, there would only be approximately one mine in each lobster's search area, even if 1000 mines were used across the OPAREA. The reliability of a lobster's pingers is .95, making the chances of encountering an unmarked mine in each lane very low (0.095), but since the probability is non-zero, it will be rounded up and assumed one mine remains unmarked in each lane (this does not take into account the small overlap in search areas that occurs when the individual lobster legs are rounded down to the nearest complete leg, which should drive the probability of non-detection slighly lower). Using the frontal width of the AAAV and the diameter of the mines, the probability a AAAV of the 6 vehicle wave is destroyed by the unlocated mine is 0.09 per transit, and the probability a AAAV of the 5 vehicle wave is destroyed by the unlocated mine is 0.075 per transit. This conservatively estimates the loss of 1 AAAV during a 3 wave, 5 abreast each landing of the MEUs 15 AAAVs.

e. *Mine Countermeasures Operations Conclusions*

After evaluating the various known COAs against the enemy's likely COAs and the MOEs (number of mines detected per lobster search area, width of transit lanes searched, time to search each transit lane, and expected number of AAAVs lost), recommend two sets of lobsters be deployed to search two 370m transit lanes in a section of the OPAREA away from the harbor and that, once searched, AAAVs be landed in waves of 5 abreast through the transit lanes. It is expected that up to 1 AAAV may be lost. The third set of lobsters should be held in reserve to either expand the two transit lanes, as required, or re-search transit lanes if additional mine laying activity is suspected during the 24 hour search.

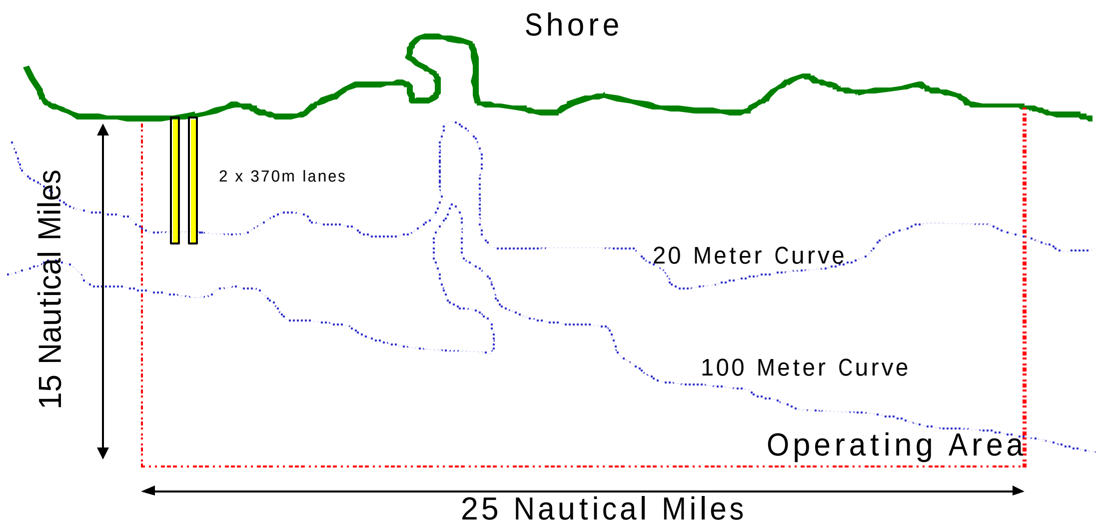


Figure VI-30: Advance Force Mine Countermeasures Area of Operations

6. Advance Force Analysis Conclusions

The phased plan was tailored to the forces known or currently planned to exist in the 2015-2020 timeframe, so the operational timeline includes the limitations of these systems. In order to eliminate these limitations and provide more flexibility, several additional technological areas need to be exploited. The biggest limitation encountered in planning this operation was the availability and speed of mine detection assets. The combination of lobsters, SDV/ASDV, and divers was not capable of searching a large area and, in fact, had difficulty clearing even a small area in less than several days. Further, these are only times to search the areas for mine-like objects, it does not include classification or sweeping of confirmed mines. A determined and capable enemy with sufficient mine assets to effectively protect likely landing beaches could have seriously disrupted the operational timeline for this mission, especially since there are only limited organic mine clearance means available, even if all the mines are located. Technology to provide covert mine search, detection, classification, and clearance for multiple landing lane areas one NM in width and up to 10 NM deep in 24 hrs or less to a reasonable level of certainty should be developed and deployed as soon as possible.

There must be a means to move a full Brigade to the operational area in less time than the one month it takes the final MEU to arrive in this scenario. As formulated, Burmese forces have almost two weeks to move troops towards Tavoy before they're opposed by anything larger than a battalion sized force. Considering the Burmese government has forces well in excess of 10,000 available to them, it's unreasonable to expect one or even two MEUs with a carrier battle group providing strike support to hold them off for a month (as confirmed by the Joint Campaign Analysis results above). Technology permitting, the rapid arrival of troops in the OPAREA could take many forms, from a Sea Base to seizure of an airfield to a high-speed means of transport from the troops base to the OPAREA; in any case, troops and their equipment in brigade strength should be available in the OPAREA one week after the start of the operation.

There is also no organic, dedicated, high endurance, wide area surveillance. This task force had the services of two Global Hawk assets, but it was not clear whether these assets were dedicated to the JTF for the duration of the mission. These low-density, high-value assets are always at risk of diversion to other missions, leaving a coverage gap. Satellite surveillance can cover wide areas, but the revisit rates are relatively low and the images are not displayed in real or near real time. Tactical UAVs have an important role, but their coverage area and sensor payloads are not designed to provide this level of coverage.

The task force does not have the capability to conduct medium or large scale air interdiction operations from MEU assets. With only 6 to 8 JSF available per MEU and limited ordnance stowage, the number of targets the JTF is able to attack each day is limited. This requires the presence of a CVBG; however, these ships often have other missions that reduce the number of aircraft available for air interdiction missions. Technological solutions could include increasing the number of JSFs per MEU, increasing the ordnance stowage, and/or reducing the size of ordnance in order to allow more weapons to be stowed in existing magazines.

Current surface assault craft have only a limited force protection capability while enroute from ship to shore. In the current CONOPS this does not pose much of a problem since the forces transit to the beach within sight of escort ships and the amphibious task force. In future operations, however, these craft will transit long distances unescorted where they will be vulnerable to attacks from special forces of the type employed by Burma in this scenario. One solution is to provide airborne escort, but with transit times up to 3 hours and only a limited number of air assets available, this may not be the best option. Small surface craft could provide force protection to assault craft and the task force as a whole, but the endurance and transport of these ships to theater could prove difficult.

The largest threat to ships of the task force in this scenario is from anti-ship cruise missiles (ASCM) launched from shore or missile patrol boats. The long pole in these attacks is targeting data, since neither shore batteries nor missile boats have onboard sensors capable of targeting the task force from long range. In order to reduce the threat, these ships already employ speed, maneuver, and deception, but with the high value of the amphibious assault ships in this scenario, more insurance is needed. An integrated system capable of denying targeting information (especially electronic), providing early detection of cruise missile launch and counter battery targeting, and a robust, organic defense (including sophisticated EW) would provide crucial extra measure of protection to amphibious task forces operating largely alone and unafraid off hostile shores.