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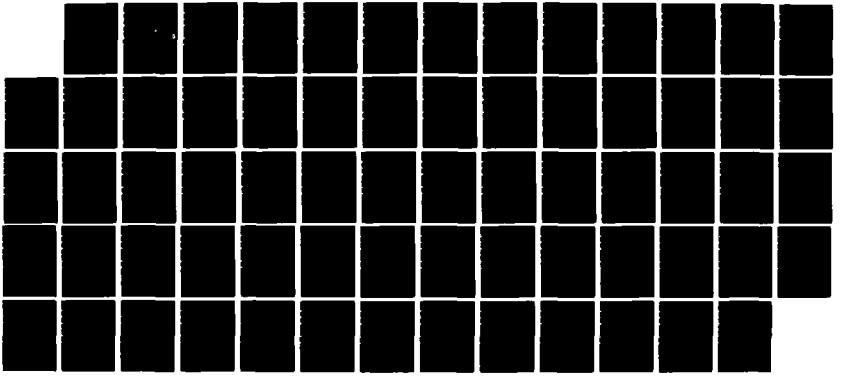

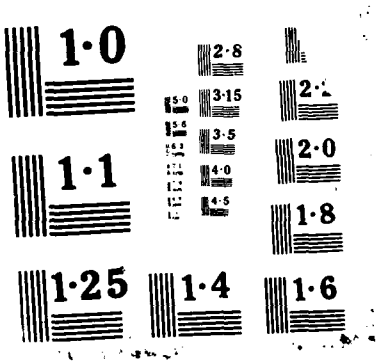
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THE RAND STRATEGY ASSESSMENT SYSTEM AT
THE NAVAL POSTGRADUATE SCHOOL

by

JAMES JOHN TRITTEN
AND
RALPH NORMAN CHANNELL

MARCH 1988

Approved for public release; distribution unlimited

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Report describes The RAND Strategy Assessment System (RSAS) installation at the Naval Postgraduate School (NPS). The RSAS attempts to combine the best features of political-military gaming and analytic modeling. The RSAS can be run in a near automatic mode with essentially two expert systems playing against each other or as an interactive game with human players. In between these extremes, the RSAS can be used as an analytic tool to support research and instruction. RSAS models are not yet completely developed to the satisfaction of Navy users. The Navy should continue to encourage development of maritime models and continued in-house expertise in the use of the system. When fully operational, the RSAS will be a unique system that will aid Navy analysts and decsion-makers who, for the first time, will have models that can represent every level and location of the political and military dimensions of warfare simultaneously.

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THE RAND STRATEGY ASSESSMENT SYSTEM AT THE NAVAL POSTGRADUATE SCHOOL

by

James John Tritten
and
Ralph Norman Channell

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EXECUTIVE SUMMARY

This report describes the RAND Strategy Assessment System (RSAS) installation at the Naval Postgraduate School (NPS). The NPS RSAS became operational in September 1987. The RSAS is a product of a multiyear effort by the RAND Corporation ("Improved Methods for Strategic Analysis") under the sponsorship of the Director, Net Assessment, in the Office of the Secretary of Defense (OSD/NA). It attempts to combine the best features of political-military wargaming and analytic modeling. The RSAS is extremely flexible: it can be run in a near automatic mode with essentially two expert systems playing against each other, or it can be run as an interactive game where all the moves are controlled by human players. In between these extremes, the RSAS can be used as an analytic tool to support strategy research and instruction.

Major models in the RSAS include Blue/Red/Green agents playing the various nations, the Force Agent for actual military operations, and the Control Agent which allows the analyst to control events, the scenario, timing, etc. National Command Level models conduct high level decision-making, and analytic war plans carry out military operations for each side. The RSAS can currently be run emphasizing strategic nuclear combat, Central European theater warfare, naval warfare to a certain degree, and secondary land/other theater engagements. The current naval model is considered evolutionary in that only basic naval play is possible.

The current software installation at NPS is RSAS release

3.0, running on a Sun microworkstation with a large hard-disk in support. Secure space and partial hardware/software support is provided by the Operations Research Department. Operating expertise is provided by the National Security Affairs Department. Future enhancements to the system include additional workstations locally networked for interactive wargaming and a large screen display for instruction and game purposes. Primary RSAS use at NPS will be in support of research sponsored by those organizations that have funded the installation. It is anticipated also that extensive use will be made of the system in support of student theses and classroom instruction.

RSAS models are not yet completely developed to the satisfaction of Navy users. Rather than precluding future support of the RSAS, the Navy should continue to encourage development of maritime models and continued in-house expertise in the use of the system. When fully operational, the RSAS will be a unique system that will aid Navy analysts and decision-makers who, for the first time, will have models that can represent every level and location of the political and military dimensions of warfare simultaneously.

CONTENTS

ACKNOWLEDGMENTS..... 1

EXECUTIVE SUMMARY..... 3

CONTENTS..... 5

I. INTRODUCTION..... 6

II. THE RSAS CONCEPT..... 9
Methodology..... 9
Models in the RSAS..... 10
Analytic War Plans..... 14
Data Base and Software Tools..... 15

III. STRATEGIC NUCLEAR AND RELATED MODELS..... 17
Strategic vs Theater..... 17
Nuclear Forces..... 17
Readiness..... 18
Operations..... 18
C3I..... 19
Targeting and BDA..... 20

IV. CENTRAL EUROPEAN THEATER MODEL..... 21

V. NAVAL WARFARE AND SUGGESTED IMPROVEMENTS..... 24
Naval Warfare..... 24
Location and Capability..... 24
Organization..... 25
Deployment..... 25
Naval Combat..... 26
Asymmetries..... 27
Improvements Needed..... 28

VI. SECONDARY LAND AND OTHER THEATER MODELS..... 34
Organization..... 34
The S-Land War..... 34
Graphics..... 35
Deep Operations..... 35
Improvements Needed..... 36

VII. INSTALLATION AND USE OF THE RSAS AT THE NPS..... 37
Installation..... 37
Use of RSAS..... 37

VIII. OPPORTUNITIES FOR RESEARCH..... 42

APPENDICES:

A. SOP for RSAS Use at NPS
B. Security and Release Procedures at NPS
C. IDSA for Maintenance, Security and Use
D. Enhancements to RSAS Installation at NPS
E. Bibliography

Part I

INTRODUCTION

The RAND Strategy Assessment System (RSAS) was developed by the RAND Corporation under a project entitled "Improved Methods for Strategic Analysis." The work is sponsored by the Director, Net Assessment, in the Office of the Secretary of Defense (OSD/NA) in cooperation with the Office of the Joint Chiefs of Staff (OJCS), each of the Service Deputy Chiefs for Plans, Policy, and Operations, the Central Intelligence Agency (CIA), National Security Agency (NSA), and Defense Intelligence Agency (DIA). Representatives of these organizations make up the RSAS Steering Group.

Current users of the RSAS include OSD/NA, the Force Structure, Resource & Assessment Directorate of the Joint Staff (J-8), the CIA Office of Soviet Affairs (SOVA), the Army Concept Analysis Agency (CAA), the National Defense University War Gaming and Simulation Center (NDU-WGSC) and the Naval Postgraduate School (NPS). The system will later be installed at: OSD Program Analysis & Evaluation (OSD/PA&E), the NSA, the DIA, the Air Force Institute of Technology (AFIT), the Air University Center for Aerospace Doctrine Research & Education/Wargaming & Technical Analysis Division (AU/CADRE/WGTA), and the U.S. Commander in Chief Pacific (USPACOM) J-55. Additional users, such as the Center for Naval Warfare Studies at the Naval War College, may be authorized by the RSAS Steering Group at a later time.

Essentially a complex political-military simulation, the RSAS will eventually have the capability to handle all forms and

phases of warfare, including intelligence and logistics, in a highly aggregated fashion. This will include the ability to play crises short of war, extended conventional war, nuclear war, conventional actions after nuclear strikes, war in space, war at sea, and all supporting political actions that supplement the armed conflict portion of war. The models are intentionally deterministic; hence plays may be repeated with the analyst making the choice of variables to be modified in order to do sensitivity analysis. All decisions are automatically logged, making transparency a major asset.

NPS was selected to be the recipient of the Navy's first RSAS as a result of a meeting of the RSAS Steering Group in Santa Monica, California on 24-25 March 1986. This decision was recorded in a memorandum from the Director of Net Assessment/OSD, dated 12 May 1986, reporting the results of the conference. Hardware was obtained by NPS using $43,227 in 1987 NPS laboratory package resources to upgrade a Sun workstation originally purchased by the Naval Ocean Systems Center (NOSC) for the NPS Wargaming Analysis & Research Laboratory (WARLAB). The RSAS software, valued at some $31M, was provided by the Rand Corporation as authorized by the RSAS Steering Group. Other support for research has been provided for by a $16,194 grant in FY-87 by the NPS Foundation Research Council and by $135,000 in FY-88 Navy Direct Research Funding. The NPS RSAS became operational in September 1987.

This report satisfies the requirements of the NPS Foundation Research Council grant and will provide a brief overview of what

the RSAS is, the types of capabilities found in strategic nuclear, European and other land theaters, and naval models, how the RSAS is set up at NPS, and opportunities for research. It is also produced as a product for the Office of the Chief of Naval Operations (OP-603) as a deliverable resulting from FY-88 Navy Direct Research Funding. Appendices will include a more detailed description of the hardware and software, the standard operating procedures for RSAS employment at NPS, specific restrictions due to security of the models, and agreements with appropriate departments regarding maintenance and security.

Part II

THE RSAS CONCEPT

1. Methodology. The RSAS is the product of a multiyear effort which is attempting to improve the ability of strategy analysts by combining the best features of political-military wargaming and analytic modeling. This approach presents certain difficulties since war games usually address the asymmetries in conflict, the roles of non-superpowers, the nuclear forces, and the operational constraints, etc. Modeling, in contrast, tends to be more rigorous, and more inclined to a "what if?" type of approach. There are two important components in the RSAS approach: The use of decision models, and the procedures for analytic modeling.

The use of decision models to replace some or even all of the human decision making involved in game play both speeds play and requires a rigorous approach to the decisions being made. It also insures that the same decisions are always made for a given set of circumstances. Analysts and game players can still play all or part of the time, depending upon the requirements of the situation, by changing variables.

The second important component, the procedures for modeling the actual warfare, is embodied in the system of models called CAMPAIGN. CAMPAIGN is essentially the force agent for the RSAS, evaluating force operations and adjudicating combat. It uses a relatively high level of aggregation for forces, geography, and targets, reflects increasingly higher asymmetries in terminology and operational concepts between Red and Blue, and captures parametrically some of the more complex military operations, such

as mobile missiles and communications sabotage. CAMPAIGN allows the user to set most major parameters into the simulation, such as the yield of a nuclear weapon, or to script the results of "off-line" analysis, such as the impact of chemical attacks on aircraft sortie rates.

In addition to permitting rapid testing of various scenarios and alternatives, the fast RSAS run time permits a "lookahead" in which the player or analyst can run a game within a game to test a plan using the entire gaming system to play against perceptions of the opponent. The "lookahead" tests the feasibility and acceptability of a specific plan, although the results may differ from subsequent runs due to misperceptions about the opponent or that the opponent simply chooses another alternative.

2. Models in the RSAS. Since there was never any intent to make the RSAS available to the general public, model architecture itself is generally classified. Although the RSAS Steering Group approved the creation of totally unclassified models, with the ability to add classified data, the resources for such a massive undertaking have not followed, and it is not expected that an UNCLASSIFIED RSAS will ever be developed. The major political agents in the RSAS are the Blue, Red, and Green representing NATO, the Warsaw Treaty Organization, and other countries, respectively. The Force Agent (CAMPAIGN), tracks military forces worldwide and assesses the results of force operations and battles. The third major agent is the Control Agent which assists the analyst in writing information displays, changing parameters, introducing exogenous events, and specifying the key events of a

desired scenario. Each of these major agents and models is covered in detail below.

Red and Blue Agents. RSAS command, control and communication (C^3) models have been developed that represent the actual organization and operation of NATO/U.S. and WTO/USSR C^3 functions. Command and Control (C^2) of forces is generally displayed in normal wartime position, i.e., there are generally no separate peacetime and wartime C^2 organizations. The functions of changing operational control from peacetime C^2 to wartime C^2, however, are generally accounted for within the RSAS. Thus, U.S. naval forces may be under the C^2 of NATO's Supreme Commander-Atlantic (SACLANT) for display purposes, but additional tableaus may show these forces as not available. Although such C^2 depiction is not absolutely correct, the emphasis on wartime functions for the RSAS did not warrant the additional expense and computer memory needed to depict correctly C^2 in both peacetime and war. Generally, the names used for NATO/U.S. Commanders-in-Chief (CINC's) correspond to reality although a general command for forces in the continental U.S. was used instead of the multiple commands that actually exist. Actual CINC boundaries were also used.

For WTO/USSR theaters of military operations (TVD) commands, actual names/boundaries are used, recognizing that in wartime these strategic directions will not necessarily follow pre-war expectations. Communications models used are classified and as accurate as possible, given the level of classification of the system. The RSAS architecture allows more accurate portrayal of C^3, to include data at extremely high levels of classification.

The Red and Blue agents for the RSAS each have a high level model termed the National Command Level (NCL) that emulates the highest authority for each agent - the National Command Authority (NCA) for Blue, and the Defense Council for Red. The NCL selects escalation guidance, objectives, and strategies for each theater based upon the type of NCL selected by the analyst and a series of rules assessing the various NCL parameters to include the threat, the type and rapidity of decisionmaking, the status of superpower relations, etc. There are currently two different Red and two different Blue agents available in the RSAS; one set being more "hawkish" than the other.

A Global Command Authority (GCL) that represents the U.S./ NATO Joint Chiefs of Staff and NATO Military Committee, and Soviet General Staff (VGK) then implements these decisions into specific plans to be run. The NCL models selected by the analyst can be modified or can be run on an automated basis. They can be used to run the game or can be studied as part of the research into national decision-making procedures.

Green Agent. The Green Agent is the RSAS model of non-superpower states which simulates national behavior in periods of superpower crises and open warfare. Countries modeled include the non-Soviet Warsaw Pact states, all NATO countries other than the U.S., as well as Japan, China, and numerous others. Green Agent is a rule based model which tests various conditions and takes actions based upon the rules of the system. Variables for each country include such items as alliance, orientation, temperament, assertiveness, opportunism, staying power, and nuclear capability. These variables can be set at the start of the game or

changed during the game run.

Control Agent. The Control Agent allows the analyst to schedule the writing out of information displays, to change selected parameters, to introduce exogenous events such as unconventional warfare, and to specify key events in the scenario, as required. The analyst can specify, for example, the day when nuclear warfare is to start, the loss of command posts to special forces action at specified times, and the degree of logging detail desired. The Control agent is extremely useful in adapting game play to the analytic or research requirements at hand. The Control Agent uses a System Monitor polling the decision models and a series of wakeup rules that are created when the analyst selects the various inputs noted above.

CAMPAIGN. CAMPAIGN is the global combat model providing a fully integrated treatment of conventional, theater-nuclear, and intercontinental nuclear warfare on a worldwide scale. CAMPAIGN is, in turn, part of the larger system that provides national level political models that deal with such issues as grand strategy, escalation, and war termination. CAMPAIGN is a time stepped model in which the length of the steps (one hour or less, up to 24 hours) are determined by the world situation, and by various wake up rules set by the players or by the system decision models. Most of CAMPAIGN is run in a "C" language program called "Camper". The remainder is coded in RAND-ABEL, and includes the S/LAND referee as well as the tactical warning decision tables part of the strategic C3I. The heart of CAMPAIGN is a collection of theater warfare, naval warfare, strategic warfare, and supporting models. These warfare models, usually

developed separately to control complexity, contain significant interactions, sometimes using the same submodel for multiple purposes, e.g., dispersal of aircraft. Also, some model substitution can take place, e.g., RAND's TacSage for the normal air battle model. It is anticipated that CAMPAIGN will be used for Central Europe and Korea, while the S/LAND models will be used for northern and southern Europe, the Middle East, Southwest Asia, and Cuba.

3. Analytic War Plans. Blue analytic war plans (AWP's) are based upon the same base year as the data bases. War plans do not derive from strategies used to support programming but rather from strategies based upon forces in hand. Historical files were used to create AWP's for earlier years. AWP architecture should support entering a wide variety of future or alternative current plans, and the architecture is generally compatible with that in current use by major CINC's. Red AWP's were developed using the best information available from national intelligence sources. Where alternative strategies are possible, a default strategy is provided. Should an analyst desire to modify AWP's to reflect alternative strategies, this is possible.

The AWP's in the RSAS are written in RAND-ABEL code, are relatively easy to read, and can be modified, although implementation of such modifications is not trivial. The AWP's are constructed in a modular fashion, using a phase, move, and order structure, together with bounds and wakeup rules for the various commands. AWP's can be controlled by the use of the Data Editor tableaux for the AWP's, although care must be taken with regard

to changing the variables.

4. Data Base and Software Tools. Data base type information is contained in the notional World Situation Data Set (WSDS), containing entries in both RAND-ABEL and in the "C" programming language. All of the decision models and a few Force models are written in RAND-ABEL for understandability and ease of modification. The analyst can interface with the system through the data editor, force displays, map tool, the logs of the various agents' actions, and the graphics Tool. These interfaces can be used to set and change inputs before and during the game, can be used to call and analyze data at any point during or after the game, and can be used to study in detail the logic and responses of the various models following each game.

Four of the software tools merit special mention:

a. Data Editor: the primary means of viewing and changing data interactively. It relies upon displays called tableaux which are arranged in sets according to function.

b. Cross Referencing Tool: for using or building rule based decision models. It can provide allowed values for variables, their locations, and comments regarding them.

c. Hierarchy Tool: depicts which entity is active at any given time during the game, permits the game to be stopped when a particular entity is active, and can permit rules to be displayed regarding a selected actor.

d. Retargeting Tool: interactive spreadsheet program that allows modifying strategic targeting.

Other interface features of RSAS 3.0 include Interpretive

RAND-ABEL which permits fast rule changes in the source code, and the numerous "help" windows and README files throughout the system.

The standard configuration for RSAS 3.0 is the Sun 3/160 color workstation operating under Berkeley UNIX, and using the "C" programming language. RSAS 3.0 has some 300,000 lines of source code, or about 600,000 equivalent lines of "C" code. Rand originally intended that the RSAS would have a standard configuration based upon a VAX 11-780, but opted in favor of the Sun workstation with its superior human interface. The feasibility of other workstation options, including those using VMS, has been approved by the RSAS Steering group and may be examined at some future time when a sponsor is willing to fund the development.

Part III

STRATEGIC NUCLEAR AND RELATED MODELS

1. Strategic vs Theater. CAMPAIGN provides extensive "strategic" nuclear models of targeting, command, control, communications, and intelligence (C^3I), force operations, and battle damage assessment (BDA). These models are integrated into the overall CAMPAIGN structure, thus, "strategic" nuclear forces may be used in the theater campaign and may be damaged by the theater nuclear or conventional campaign. "Strategic" and theater nuclear models share the same BDA models. For ease in communicating to Western readers, the more familiar use of the term "strategic" will be used in this report; i.e., intercontinental nuclear forces that are generally addressed in "strategic" arms control agreements. The reader is cautioned that this concept of "strategic" is not shared by the Soviet Union nor the Red agent in the RSAS.

2. Nuclear Forces. Nuclear capable forces can be used for strategic, operational, or tactical nuclear missions in any theater of warfare. Within CAMPAIGN, Red, Blue, or Green (British, French, or Chinese) strategic nuclear missions are currently carried out by heavy bombers, land (ICBM) and submarine-based ballistic missiles (SLBM), and cruise missiles, depending upon the types of forces assigned to that agent. All strategic nuclear forces as well as operational and tactical nuclear forces can be used for theater nuclear missions. Artillery fired atomic projectiles, tactical surface-to-surface and surface-to-air missiles, atomic demolition mines, and

nuclear capable tactical aircraft are used for battlefield nuclear missions. Tactical nuclear warfare at sea is an area that will need extensive upgrading in the future to represent fully the options available to each political-military agent.

Generally, nuclear forces are designed to execute preplanned targeting packages to handle various warfighting options that support the strategic, operational, or tactical objectives specified by the appropriate functional/area commanders. Execution of strategic forces operations is dependent upon the appropriate National Command Level (NCL) connectivity, but currently theater and battlefield models do not explicitly model the necessary C^3.

3. Readiness. Levels of readiness are as indicated by the force alert level, which is a fraction representing the combat ready percentage of submarines, aircraft, and missiles in the data base. A default alert rate is assumed but the analyst may vary these levels uniformly or by force type. CAMPAIGN provides an automatic bomber and tanker flush on warning model as an option to increase survivability.

4. Operations. Strategic nuclear forces can be alerted, dispersed, deployed, executed and damaged. These forces will execute whenever they receive the appropriate authenticated communications which are disseminated from the NCL to the functional or regional groupings of forces. ICBM's and SLBM's are moved by a common missile movement model. Missile trajectories and space based defenses will be added in a future RSAS software release. A parameterized ballistic missile defense model extracts fixed

attrition rates on incoming re-entry vehicles up to a selectable threshold.

Bombers and cruise missiles are assigned to predefined flight paths according to expected targeting plans, although the analyst may vary predefined plans. Bombers are assigned tankers as required and are subjected to the simplified air defense model that allows for a fixed attrition rate for all enemy aircraft by region. Bombers may release cruise missiles at the appropriate distances from their target. Modeling of recovery and reconstitution of bomber forces is currently extremely limited. All nuclear forces are subject to attrition during the conventional phase of a war. Provisions for land silo and naval missile reloads will have to be added in future software deliveries.

5. $\underline{C}^{3}\underline{I}$. The current nuclear C^{3} models deal primarily with the ability of the NCL to communicate with strategic nuclear forces. C^{3} decisions are made by the models of the full RSAS instead of CAMPAIGN. Once a decision has been made, the C^{3} model assesses the capability of the source command node to communicate with its destinations. The output of the C^{3} model is an estimated time for correct message receipt and the fraction of each force connected. The model conducts a path search to find the fastest available path to destination. The various alternative command posts and communications aircraft are modeled in RSAS, considering refueling, maintenance, and home base damage. Warning is partially modeled for strategic forces. Satellite detection of missile launch is modeled as are certain communications paths. Tactical warning in CAMPAIGN serves to alert the NCL, and causes

appropriate countermeasures to be taken. Strategic warning is specifically addressed by various political and military signals given by the Red, Blue, and Green agents.

6. Targeting and BDA. There are 124 distinct classes of targets in CAMPAIGN, referring not only to types of fixed facilities but also to more dynamic targets such as mobile missiles, aircraft, or troop formations. Damage from nuclear and conventional weapons is inflicted by attacking a target class and subclass within a given region. CAMPAIGN uses a generalized BDA assessment methodology (modeling only blast damage) for all conventional and nuclear weapons. C^3 facilities may be damaged by electromagnetic pulse and scripted (off-line) sabotage. Degradation in C^3 due to jamming, etc., can also be represented. The attacker currently is not allowed a real-time BDA capability.

Part IV

CENTRAL EUROPEAN THEATER MODEL

Theater warfare modeling is probably the best developed aspect of the RSAS. The model has concentrated on the land/air war on the central front, with global escalatory, naval, and strategic nuclear force operations. Logistics that could impact on the central front is to be improved later. The result is a reasonably reliable model of the central front, but an incomplete global model that needs to represent accurately these potentially significant contributions. Without these full capabilities to model areas outside of the European theater, the RSAS will be incapable of performing the types of simulations that are envisaged by the Navy.

The model follows Red divisions and Blue brigades along axes of advance/defense as specified in analytic war plans (AWP's) using a roughly rectangular grid base superimposed upon the geographic features of central Europe. The simulation/model emphasizes the overall Red/Blue theater commander's perspective rather than that of the division and corps commander. The model tracks unit characteristics in some detail to include nationality, cohesiveness, composition, and level of training. The user can vary assumptions about a fairly broad range of issues to include national fighting effectiveness, maximum combat intensity, exchange ratios from prepared defenses, the effectiveness of close air support and helicopters in imposing attrition, and the delay, defense and attacker strategies.

The model allows the attacker and defender to maneuver at

the corps level or higher. Axes for main thrusts, holding actions, follow-on attacks, and flank protection are all possible. There is also provision for the attacker to conduct a strategic level envelopment/encirclement (Red's preferred offensive) and for the defender to mount counteroffensives. The model uses phases of battle to include preparation, assault, breakthrough, exploitation and pursuit. Breakthroughs, large local one-time losses, and operational maneuver groups in the defender's rear area may all be represented. One of the major strengths of the system is that Blue players are forced to confront a Red who engages not in parallel opposing "pistons" but rather through an envelopment/encirclement method of advance.

The current model does not allow for amphibious landings, combined arms amphibious/airborne assault, defense against invasion, inshore mine warfare, or an accurate representation of the battle for the sea lines of communication. These deficiencies will need to be corrected before the RSAS can perform all the simulations of Navy interest. When the RSAS is fully developed, analysts will have a new opportunity to study the cross influences of war at sea to warfare ashore.

With regard to the air war, the model conducts operations for Blue squadrons and Red air regiments, handling sortie generation, mission planning, air-to-air combat, interdiction, and air-ground interactions to include close air support and battlefield interdiction. Air power can be used to defeat an operational maneuver group during the period of initial insertion. Carrier-based naval aviation can be used by the theater commander to supplement land-based tactical air assets in all normal air

warfare missions.

Logistics is played at a high level of aggregation by tracking days of supplies by nationality and permitting optional sharing of supplies. Movement of supplies is simulated crudely, with each geographic zone having its own lines of communication trafficability and vulnerability. Movement through the zone can be reduced by interdiction. Strategic mobility deals with combat forces and support packages separately. Sea lines of communication are not currently fully modeled, making the logistical sustainability issue a major current failing.

Part V

NAVAL WARFARE AND SUGGESTED IMPROVEMENTS

1. Naval Warfare. The naval combat model permits naval force movements including sealift, elementary antisubmarine warfare (ASW) operations, and attacks on land targets by carrier-based aviation and cruise missiles. It does not permit battle group defense, at-sea engagements, combined arms strikes against battle groups, or full representation of battles over sea lines of communication. Individual ships are represented, but operations are conducted and battle damage assessment (BDA) done at the task group level. Naval operations are conducted in accordance with rules of engagement (ROE's) prepared for Blue, Red, and Green. Combat results vary by region. Choke point engagements are handled separately.

ASW includes the employment of submarines, maritime patrol aircraft, and surface ships with emphasis on operations against nuclear powered submarines. Sea-based aviation, ASW mines, ASW nuclear weapons, space assets, and operations by diesel submarines all need to be added.

2. Location and Capability. There are 32 ocean regions, and 32 additional ocean subregions and chokepoints currently in the RSAS. These regions and subregions/chokepoints represent the lowest level of geographic detail for naval and maritime forces. All ships are located in these ocean region/subregions unless they are in port, in which case they are assigned to a land region, thus allowing a distinction between attacks on maritime

assets on the high seas and those in port or in internal waters. Deployment orders specify unit location (latitude/longitude) within an RSAS region.

Routes for naval forces consist of paths from ports to operating regions. The RSAS chooses the most direct feasible route unless specifically instructed to use intermediate regions. Each ship is assigned to a class, with all ships in a class having the same general characteristics. Data records are maintained for each ship, to include weapons capacity, ASW capability, sustainability data, and special weapons inventories.

3. Organization. Individual ships are assigned to task groups headed by a designated flagship. The task groups are subordinated to task forces and fleet commanders. The task group is the basic element for naval forces, and they are named to signify their primary mission, e.g., carrier groups, anti-carrier warfare groups, convoys, etc. Naval forces can be displayed in tabular form by individual ship or task group, by listing all forces assigned to an ocean region/chokepoint, or by listing forces assigned to a specific mission activity. Nuclear powered ballistic missile submarines are treated as strategic missile forces, and were described previously with the strategic models.

4. Deployment. Naval forces are organized and deployed in a mid-1985 force structure with Blue and Red strategies for employment paralleling those expected for the U.S./NATO and the Soviet Union/Warsaw Pact. The initial deployment of Blue forces is intended to be consistent with U.S./NATO maritime strategy. Initial Red employment emphasizes "bastion" defense. Green naval

forces are deployed and operated in accordance with expected behavior of each individual nation. The RSAS will eventually allow the employment of forces in other possible modes, e.g., "swinging" forces from one major command to another, convoy escort instead of forward operations, interdiction of the sea lines of communication instead of "bastion" defense, etc.

5. Naval Combat.

a. ASW. ASW operations in the RSAS are modeled by the interaction between submarines, surface task groups or maritime patrol aircraft and submarines. Each ocean region, subregion and chokepoint is assessed regarding the presence of submarines and ASW forces and, if combat is authorized, capabilities versus vulnerabilities are computed and damage calculated for each side on a periodic basis. All ASW capable ships and aircraft are assigned capabilities relative to a baseline unit with engagement parameters. Relative capabilities are pooled when multiple units are present, and attrition is distributed based upon relative vulnerabilities and current damage levels. Certain parameters can be changed by the analyst using "script" commands. Results can be displayed in several different ways: by region, by units, by activity.

ASW activity can be initiated by analytic war plans or by issuing force orders. Force orders can be used to deploy forces, to increase activity, to change operating areas, to assign forces to new task groups or forces, and to assign maritime patrol aircraft to an ocean area. Combat is controlled by assigning ROE's to each ocean region, subregion or chokepoint in the form

of attack, defend, withdraw, trail, and exclude.

b. Air Strikes. Fighters and attack aircraft on board aircraft carriers can be assigned to launch flights in support of theater warfare. The carriers must be within range, and sorties will continue on a daily basis until unassigned or the carrier moves out of range. To perform strikes, laydown packages of targets must be preplanned using the strike order. Nuclear strikes can be ordered from appropriate naval forces, and an inventory is maintained.

c. Surface Ship Engagements. Currently, the RSAS cannot support combined arms warfare against carriers, except by writing ad hoc rule based models in RAND-ABEL for specific problems. Surface-to-surface combat is not yet modeled, but scripted or directed ship kills can be used at any time.

6. Asymmetries. It is important to remember the very different natures of the Blue and Red navies which present different modeling problems. These asymmetries include the following areas: different objectives and style of maritime warfare such as the Red Navy's preference for sea denial and selective sea control in the maritime approaches to the homeland as opposed to the Blue Navy preference for forward deployment and long-range power projection; survivability in nuclear powered ballistic missile submarines in which Blue relies upon stealth while Red relies upon defensive "bastions"; at-sea tactical nuclear weapons capabilities; peacetime naval deployment patterns; forces and concepts of employment for naval aviation; command and control; the influence of the ground forces in the thinking and employ-

ment of navies; the differing capabilities of the allied navies; and the use of diesel submarine forces.

The RSAS has been developed with Blue/Red asymmetries in mind. The top down approach and the use of separate Red and Blue models lends itself to the development of the differing approaches characteristic of the Red and Blue sides. The RSAS also permits the use of special warfare phenomena that have been difficult to model in other systems. The global scope of the RSAS gives it a unique capability to reflect the breadth of asymmetries, described briefly above, and the abilities of navies to execute lateral excursions and escalation by fighting a more extended campaign.

7. Improvements Needed. There are several areas in the RSAS where the models are not sufficient to meet NPS and Navy requirements. All of these have been communicated to Rand and OSD/NA. Some of the more obvious improvements needed include:

a. Strategic nuclear strikes against the shore from naval ballistic and cruise missile carriers from all nations that possess or might possess such a capability, and an ability to reload launchers where appropriate.

b. Active defense of strategic nuclear assets at sea by a combined arms defense by all nations that might employ such a strategy or for all nations so that such a concept can be analyzed.

c. The full range of all current and programmed maritime nuclear capabilities.

d. Active attacks by all types of ASW forces, including at-

sea ASW aviation against naval ballistic and cruise missile carriers and attacks by the appropriate air defense forces (including naval) against the missiles. ASW forces must also be expanded to include space-based systems, communications intercept capability, and passive listening devices.

e. Strikes against the shore by Carrier Battle Group (CVBG) assets for all nations, full defense of the CVBG against a combined arms attack, recovery of assets by the CVBG, and reattacks against the shore targets.

f. Convoy operations in all ocean areas, including attacks against them from a combined arms force and full defense.

g. Improved models for strategic sealift and logistics flow for all theaters of warfare.

h. Mine warfare, including modern ASW mines, in areas where they are expected to occur and to have a major military or political impact on the course of a campaign.

i. Amphibious warfare in areas where it is expected to occur in major campaigns, and where analysts might wish to test its impact; specifically against islands in the Baltic, Norwegian and Barents Sea, along the flank areas of NATO, and the Pacific Far East.

j. Although execution of expected maritime strategies as the normal default is proper, options must include all other major possible strategies: "swing," interdiction/defense of sea lines of communication, etc.

k. Faithful representation of actual areas of responsibility for U.S./NATO and Soviet/Warsaw Pact Commanders-in-Chief (CINC's) boundaries. For the classroom, it is important that actual names

and boundaries be used vice artificial creations designed to ease modeling.

l. Major assumptions about vital strategic canals and waterways that are consistent with the assumptions made by the Joint Chiefs of Staff (JCS)/CINC's for planning purposes.

m. Political actions depicting activation of naval control of shipping world-wide and potential contributions of other nations.

n. Consideration of possible actions to be taken against Cuba in the event of a major war in Europe.

o. Strategies for a war focused on and originating in the Pacific. Global warfighting options simply must be addressed.

p. In-depth operations in the Mediterranean, Baltic, North Sea, Norwegian Sea, Barents Sea, Sea of Japan, Sea of Okhotsk, Bering Sea, Arctic, etc., in support of the appropriate theater commander's objectives for each area of responsibility. NPS desires to use these theaters to assess competitive strategies for war. In-depth bastion defense must be replicated.

q. Careful consideration of where the "sea" ends with regard to the question of escalation and control of forces. Simply put, naval forces that are attacked on the high seas will send a political signal that is different than if those same forces are attacked in territorial seas, historic/closed bays, internal waters, etc.

r. Escalation considerations must also include the asymmetries in the political sensitivities of certain areas of the world's oceans as expressed by different political actors, e.g., Red claims to ocean space and views on the right of access may

not be the same as Blue or Green. A proper depiction of escalation with regard to maritime operations must account for operations taken in varying parts of the oceans; i.e., an attack on maritime assets in Soviet Arctic "zonal" sectors is probably more escalatory than an attack on that same asset in the mid-Pacific Ocean.

s. Escalation must also represent the different values assigned to different types of maritime assets. For example, an attack on a civilian registered/owned ship may bring one type of response but an attack on a man-of-war may bring another. A fairly sophisticated accounting needs to be created listing ship ownership, crew, and registry so that actions taken against such assets involves the proper political actors.

t. Representation of drilling platforms and other such maritime assets needs to be added to allow for attacks against these. Nations are expected to respond to attacks on these types of assets.

u. Naval BDA currently spreads fractions of damage over the entire battle group. A more detailed assessment may prove too expensive and self-defeating for the overall purposes of the RSAS. Scripted battle results, however, might specify details not actually captured in the models to lend credibility, e.g., a CVBG might have its combat potential reduced in the models as the result of an attack but the displays might state CV radars out of commission, flight deck damaged, etc. In any case, defensive capability should degradate in stages, not just all at once when a ship is sunk.

v. Although the RSAS is not a tactical tool, the current

lack of geographic coordinates for naval force strike orders undermines credibility.

w. ROE's must vary by oceanic/land region, e.g., the rules allowing attacks on enemy naval forces should not be the same if the unit is on the high seas or is in port, or, the rules may not be the same in the Pacific if the war is thus far confined to the Atlantic.

x. Surface-to-surface warfare is needed. Surface-to-air warfare needs to treat fighters as something other than just long-range surface to air missiles. Surface-to-air warfare needs to account for multiple engagements of incoming aircraft or missiles (layered defense). Short-range surface-to-air missile capability may be too ambitious.

y. Cruise missile attacks on CVBG's or convoys should not assume a uniform spread across all ships in the formation. Great efforts are made by the attacker to ensure that the high value units are hit first.

z. Timely and routine updating of data bases is essential, once the first ones are more thoroughly scrubbed. Names of ships and squadrons are less important than good numbers/ locations. Adding programmed Blue forces and projected Red/Green forces for 1995 should come as soon as possible. The current plan for a 1965, 1975, 1985, 1995 data base is supported with additional years to follow.

8. NPS intends to address this lack of depth in naval warfare by setting itself up as a center of naval strategic analytic excellence using the RSAS as a tool. NPS will take the lead on

setting up an in-government working group comprised of RSAS users interested in naval force/modeling issues. Feedback will be provided to all users, Rand, and the Steering Group. NPS also intends to use the RSAS to measure the impact of the war at sea upon the war ashore, and to demonstrate where the lack of naval models makes other forms of combat analysis fatally flawed. The Navy and NPS need a fully developed working model from Rand that covers the broad spectrum of naval warfare involving all nations around the world that have navies. Primary emphasis should first involve strategic nuclear issues and the conduct of war in Europe to include the flanks (since these models are the most developed), and all other areas of the world should come later. Navy and maritime models must be an integral part of the strategic and European war models, not simply an adjunct.

Part VI

SECONDARY LAND AND OTHER THEATER MODELS

1. Organization. Secondary Land Theaters, or S-Land is a flexible model of land and air warfare in secondary theaters of operation (outside of the central front in Europe). The model is organized as a network with key theater locations as nodes, and lines of communication (LOC) as arcs. In some cases, a point node may not have any LOC arcs, such as on islands. The secondary theaters represented in the RSAS thus far include Northern Norway, the Baltic islands of Zealand and Bornholm, Greece, and Turkey. There is also a modest model representing Southwest Asia. A limited interaction with naval forces (generally scripted) is available. S-Land depends upon the following three programs to execute: analytic war plans (AWP's) in RAND-ABEL, a referee model, also in RAND-ABEL, and a force adjudicator or "scripter" written in "C." AWP's provide instructions to the model regarding what each side is supposed to accomplish under various conditions. Ground and air forces are assigned and deployed to specific theaters and axes of operations. Naval air may be assigned for use, and deep operations may also be ordered.

2. The S-Land War. A local ground commander module assesses the situation as action progresses, and dispatches units according to need. Each LOC and node have values and the composite theater status is determined by the status of the most important LOC's and nodes. Damaged targets are repaired at a fixed rate of five per cent per day. Key and strategic events have been defined to

assist in assessing the progress of the engagements. These include the loss of a capital, the cut-off of forces along a LOC, and the loss of key nodes. Bases are considered closed when the level of damage exceeds 50%.

Combat adjudication is assessed by the referee, and results passed to the S-Land force adjudication model. Combat results are based upon results from previous studies extrapolated to fit the area being simulated. Part of this process occurs in the referee module and part in the force adjudication model, e.g., if air superiority has been gained by one side, this will have an affect on the movement rate of the forward leading edge of troops (FLOT). Seasonal modifiers built in to the modules affect FLOT movement rates, air sorties and loss rates in specific areas being simulated.

3. Graphics. The S-Land has a series of sophisticated graphics to support it. A map can be called up which depicts the theater, color coded to indicate friendly/enemy control. Windows can be called up for various LOC's/nodes indicating their status. Unfortunately forces assigned are currently not shown, a planned future improvement.

4. Deep Operations. The referee model assesses the results of deep operations and the impact that the operations have on the rest of the war. Deep operations currently include airdrop, air-reinforce, heliborne, amphibious, sea-reinforce, unconventional warfare, and chemical strikes. Several factors are assessed in determining the outcome of these operations: air control, surprise, defending forces. Missions include occupy or denial in

most cases. Battle damage assessment is a function of mission type and success. Types of targets include national capitals, airfields, ports, stockpiles, key facilities, and LOC choke-points. Each target is updated regarding degree of enemy/friendly control and the amount of damage sustained.

5. Improvements Needed. Future versions of S-Land should permit representation of all seaborne and airborne forces contained in the RSAS data base, permitting the analyst/player to change the use of these unique forces as required rather than having to preset them before the start of the war. Additional flexibility is needed in the assessment of capabilities of airfields, e.g., when battle damage is sustained. Also, a compact method of addressing all relevant S-Land parameters from a single location is planned, so that the analyst need not enter different processes to make changes. There is also no logistics representation in the current model. S-Land should include logistics at least to the extent that it is in CAMPAIGN. Connections between S-Land and the rest of the strategic portions of the RSAS need to be improved so that RSAS events will have an impact upon the S-Land. Perhaps the most important recommendation regarding S-land is that it should not be developed to support testing truly secondary land theaters (e.g. Korea) at the expense of strategic nuclear and European theater needs (including the missing naval components). The RSAS was originally conceived as a global, macro-level model. Where S-land can be shown to be necessary to represent accurately European flank campaigns, then priority should be assigned there.

INSTALLATION AND USE OF RSAS AT THE NPS

1. Installation. The Sun installation at the NPS WARLAB consists of two Sun 3/160 microworkstations with eight megabyte random access memory (RAM) and two 71 megabyte hard disks each, a 575 megabyte hard disk, a 1/2" high density tape unit, and a laser printer. Other units are on order to provide a networked system with at least three monitors for research flexibility and Red/-Blue/Control war gaming. The Sun installation is a shared arrangement with the Operations Research (OR) Department WARLAB providing the electronic and physical security as well as part of the networked system. Arrangements are in progress to provide hardware and software support for the Sun workstations and to implement the local network capability. Additional details regarding the installation and planned enhancements are contained in Appendix D.

2. Use of RSAS. It is anticipated that the RSAS will find multiple uses at NPS subject to the Standard Operating Procedures (SOP) contained in Appendix A, the security restrictions and release procedures outlined in Appendix B, and the agreements for mutual support in Appendix C. Potential users must understand that mastering the RSAS is a process which should be expected to take up to four man-weeks of concentrated training and up to six months of full-time hands on experience.

a. The National Security Affairs (NSA) Department will provide a professor who is knowledgeable about the Sun microwork-

station and the RSAS. This individual, the RSAS Administrator, will control access to the RSAS part of the microworkstations in accordance with the SOP guidance provided in Appendix A and on a not-to-interfere with sponsored research basis. The RSAS Administrator will assign passwords, file space, give machine instruction, and will act as primary liaison with Rand Corporation and the subcontractor, CACI, for all technical issues.

b. Primary RSAS use, naturally, is in support of sponsored research performed by faculty members whose research accounts have paid for the hardware and training of personnel. All other use of the system is on a not-to-interfere basis. It is expected that additional faculty and staff, including faculty from departments other than National Security Affairs, will be able to use the RSAS as a teaching aid for courses and classes in general and nuclear strategic planning, strategy, net assessment, threat assessment, gaming and simulations, and intelligence. When the RSAS is used to support instruction for any curriculum, the faculty member responsible for the specific course/class will first be given a copy of this report, a short orientation briefing at the Sun microworkstation, and will be asked to determine how RSAS use would best fit the needs of the course/class. The RSAS Administrator will then perform whatever runs are required (on a not-to-interfere basis) and the results will be returned to the students in the form of a briefing/presentation, to include charts and graphics. This would be followed by a critique, and further runs as desired by the faculty member. It is <u>not</u> anticipated that any faculty/staff members, other than those specified in sponsored research already involving the RSAS,

will be trained to operate the system due, primarily, to the lengthy training time required to master the system.

c. Student participation in the form of thesis projects which will make use of the RSAS is especially encouraged. It is not anticipated that any student will have the time to be trained as an RSAS operator for seminar or other class papers. Students who desire to use the RSAS for thesis research and their two faculty advisors will first be given a copy of this report and a short briefing/demonstration of the system. The faculty advisor and student will be asked to explain to the RSAS Administrator what use of the system they desire. The RSAS Administrator will then perform whatever runs are required (on a not-to-interfere basis), and the results would then be returned to the students in the form of a briefing/presentation, to include charts and graphics. This would be followed by a critique, and further runs as desired by the student and advisor.

d. Other faculty may be able to use the RSAS for their own research, again subject to standard restrictions, and on a not-to-interfere basis with on-going research and use of the system in support of instruction and thesis research. If adjudication is necessary, the RSAS Principal Investigator will make any necessary rulings.

e. Although the RSAS is available for student and faculty research and instruction, and such use is encouraged, it must be kept in mind that the information in the RSAS is SECRET/NOFORN/WNINTEL/NO CONTRACT overall, and that these restrictions must be carefully observed. Any reports which make use of the RSAS must be submitted through proper channels for security review. The NSA

Department, through the RSAS Administrator, will provide advice and guidance regarding classification and release. Additional details regarding security and release are contained in Appendix B.

PART VIII

OPPORTUNITIES FOR RESEARCH

Opportunities to support research at NPS are as follows: any U.S. government sponsor can provide lists of topics that it desires students or faculty to research in the future. The Office of the Chief of Naval Operations (OP-06) and the Air Force Institute of Technology (AFIT) have already done this. Student thesis topics are of the student's own choosing, as long as they meet the necessary educational skill requirements, although students are encouraged to select topics that their sponsors desire. The obvious drawback is that NPS cannot "guarantee" that a topic will be researched by students nor completed by a particular date.

Individual research desires and the ability to obtain sponsorship from any DoN, DOD, or any other sources tends to complicate the topics selected by the faculty for research. Each civilian faculty member at NPS is normally hired for ten months. The faculty member is expected to obtain sponsored research for the remaining two months or take two months off without pay. The faculty are naturally drawn into areas where a sponsor is willing to provide resources. NSA faculty have been extremely interested in the past to do Navy-relevant research but have not always been able to find a Navy sponsor who has access to study money.

The lack of study money for OP-06 and a relatively modest research budget within Naval Intelligence for research at NPS has resulted in faculty being drawn to research areas that lie outside of those areas of normal interest to these two sponsors.

When faculty research moves into one area or another, student research in the form of theses generally follows. Put another way, sponsored research generally results in additional student research at no additional cost.

During FY-88, the Navy has set up a new direct funding program for all Navy research. Under this scheme, Navy research money is not allowed to be sent from a Navy sponsor directly to NPS; these funds are provided directly to the school in the budget. The National Security Affairs (NSA) department obtained some of this block funding and has an FY-88 research program already on-going. No Navy sponsor had to send additional money to NPS under this scheme; instead money was provided by NPS to the faculty member Principal Investigator if that faculty member was able to locate a sponsor who agreed that the work ought be done. For FY-88, the Office of the Chief of Naval Operations (OP-603) agreed to sponsor RSAS work at NPS. Since there were more faculty members at NPS who desired access to study money, NPS could not fund all research proposed by the faculty. Generally, those funded were those where the sponsor not only agreed that the work needed to be done, but that the work also was of major importance to the Navy.

Letters of Intent (LOI's) to perform Navy research under a continuation of this direct funding program in FY-89 and beyond are being prepared by faculty members at time of printing. These LOI's must include a sponsor's name, rough budget page, and a brief description of what work will be performed. Finding Navy sponsors who want work done under the above conditions should be relatively easy given the current budget climate. Identifying

policy relevant projects to be done one year in advance is extremely difficult. During the last cycle, most sponsors wanted to change the terms of reference at the last minute and thus marked the original proposals sent to them as no longer of interest. Unfortunately, the net result of this was to cancel some projects for one entire year, since NPS had not yet found a mechanism to be administratively responsive to late breaking changes in sponsor desires when a proposal had already been ruled upon. Improved research administration procedures may change this.

An NSA department objective for the future is to find additional research sponsors who understand the unique opportunities for RSAS and other related research at NPS. For example, if a sponsor is interested in seeing NPS faculty perform research using the RSAS, a general proposal for work should be crafted with the understanding that upon execution (1 October 19XX), the sponsor will identify more specifically what is to be done during the next year. This will require that all officials in the sponsor's office understand why proposals are written the way they are so that they are not rejected at the last minute for being "vague."

Another vehicle to sponsor research at NPS is to transfer funds from a non-DoN activity to NPS. A Military Interdepartmental Purchase Request (MIPR) can be used, for example, to transfer money from DNA or OSD/NA to NPS. In such cases, DNA or OSD/NA will act as the official sponsor. This vehicle is the only way to sponsor additional research for FY-88 since all Navy monies have been obligated and no new Navy money can be accepted

by the NPS. This scheme might also be the one required for FY-89 if the current direct funding system is terminated at the last minute.

Potential sponsors should contact the RSAS Principal Investigator or the RSAS Administrator (the authors of this report) at AVN 878-2521 or (408) 646-2521 to discuss opportunities further. There has been some discussion of using the RSAS to support the Strategic Think Tank (STT) being formed by the Navy to be located at the Center for Naval Analyses (CNA). The terms of reference for the STT signed out by the Vice Chief of Naval Operations on 24 November 1987 included supporting work to be performed by NPS. Follow-through will have to include transfer of funds to NPS to sponsor such efforts.

Appendix A to RSAS Report

SOP FOR RSAS USE AT NPS

1. The RSAS is primarily a research and teaching tool designed to analyze planning on the broad "strategic" level. It is not a machine for evaluating specific weapons systems. The analyst must be prepared to spend a considerable amount of time to set up war plans and to learn enough about the system to be able to make changes in the data base, and even the rules of the various force structures. RAND estimates that mastering the system requires at least four man-weeks of concentrated training, and up to six months of full time hands-on experience. Naval Postgraduate School experience validates this estimate.

2. The RSAS is located in the Wargaming Analysis and Research Laboratory (WARLAB) in Ingersoll Hall. Physical security is under the control of the security specialist assigned to the WARLAB. Access to the RSAS itself is under the control of the RSAS Administrator, normally the senior RSAS analyst/lab technician assisting the Principal Investigator in the National Security Affairs (NSA) Department. Individuals desiring to use the RSAS for research, studies, thesis preparation or classroom support will initially discuss their proposal with the RSAS Administrator, and will be given a copy of this report for study and a short orientation briefing on the RSAS. The individual will then be requested to determine how RSAS use would best fit the needs of the project under investigation, and to advise the RSAS Administrator of the type of data and/or runs required. The RSAS

Administrator will then ensure that the necessary runs are performed, and will provide the results to the individual. Conflicting priorities that cannot be resolved will be referred to the RSAS Principal Investigator.

3. It is not anticipated that any faculty/staff members, other than those specified in sponsored research already involving the RSAS or hired directly to support the RSAS as a part of the NSA Department laboratory package, will be trained to operate the system, due to the time involved and the sensitivity of the information in the RSAS.

4. In the case of those individuals who have been, or are to be trained on the RSAS, the RSAS System Administrator will provide system access, checkout, and briefings as needed. Individuals requiring access to the RSAS must contact the WARLAB security specialist for the proper procedures to gain entry to the WARLAB spaces.

5. A signup sheet will be maintained in the WARLAB for the Sun workstations. A certain amount of flexibility should be maintained by all regarding use of the machines until the network of three monitors is fully installed. The RSAS Administrator will referee any problems concerning access to the RSAS, as needed, and will be available for technical assistance as much as possible.

6. The RSAS is a SECRET NOFORN WNINTEL NO CONTRACT classified operation, as covered in Appendix B for security and release. Much of the information regarding intelligence and planning is

very sensitive, warranting even closer protection. Requests for downgrading and declassification must be reviewed by the RSAS Administrator prior to forwarding via the proper channels for these purposes.

7. Individuals working on additional new research grants and requiring RSAS support will be expected to contribute in accordance with the following guidelines:

a. pay own salary and travel;

b. pay a prorated portion of the maintenance, supplies, and other consumables;

c. pay for any upgrades that might be required for their project; and

d. pay a prorated portion of the RSAS Administrator or Laboratory Technician salaries, if a significant amount of their time is involved.

8. Use of the RSAS is highly encouraged among the faculty and students. The Department of Defense has expended a significant amount of funding on this project, and it represents an elaborate system which should be used to good advantage here at the Naval Postgraduate School.

Appendix B to RSAS Report

SECURITY AND RELEASE PROCEDURES

1. The RSAS contains information extracted from the best available intelligence, and from sensitive U.S. planning procedures. It is essential that certain restrictions be observed with respect to protecting the classified material contained in the various models and data bases that are part of the system. In accordance with guidance determined by the RSAS Steering Group and promulgated by the Director of Net Assessment, in the Office of the Secretary of Defense, the RSAS runs at the SECRET NOFORN WNINTEL NO CONTRACT level. Access is currently limited to U.S. Government employees. Contractor access to the RSAS is limited to RAND and one RAND-selected subcontractor. Consultants are not exempt from these rules. Access will not be granted automatically to any individual who has the appropriate clearance; need to know must be established to the RSAS Principal Investigator's satisfaction. Students, faculty, and staff of the NPS using the RSAS for research or analytical support purposes in preparing studies, papers, theses, etc., must classify the appropriate sections. Studies that make use of the RSAS intended for open publication must be submitted to the appropriate clearance release authorities, and must be approved for release prior to unrestricted distribution.

2. The NPS RSAS Administrator will provide advice and assistance regarding any RSAS related material for which downgrading or declassification authority is desired. An appropriate request

will then be made, as necessary, through the normal chain for such matters.

3. The RSAS Administrator will maintain a list of individuals authorized access to the RSAS, and will make the necessary arrangements for access and passwords. The WARLAB provides physical and electronic security for the RSAS. Arrangements will also be made for an RSAS procedures guide and a use log. Individuals making use of the RSAS will be instructed regarding security constraints as outlined in this appendix, and in the use of the procedures guide and the use log.

4. It must be kept in mind that the RSAS is a joint strategic net assessment tool, and thus contains classified information that is within the purview of all the services and intelligence agencies. The sensitivity of the information within the system must be observed.

Appendix C to RSAS Report

IDSA for Maintenance, Security, and Use

1. The National Security Affairs (NSA) Department, the Operations Research (OR) Department, the Director of Wargaming, and the Wargaming Advisory Committee agree to the following procedures for the use, maintenance and security of the RSAS:

a. The recognized, prioritized list of operations which are conducted in the Wargaming Analysis and Research Laboratory (WARLAB) is as follows, in priority order:

(1) Classroom wargame laboratory sessions and preparation.

(2) Student and faculty research, to include resultant thesis and report preparation.

(3) General classified word processing and computation analysis (a recognized ancillary capability of the resident systems).

(4) Other DOD research and activities, to include resultant report preparation.

b. The WARLAB Technical Director will manage the provision of space on laboratory machines and floor space for peripherals to support the operation of the RSAS as a recognized project under category 1.a.(2) above. Normal SECRET level physical and electronic security will be provided by the existing plant and security procedures as currently published. Additional procedures for the RSAS to meet the specialized requirements of SECRET NOFORN WNINTEL NO CONTRACT, as directed for the system by the RSAS Steering Group and the Director of Net Assessment, Office of the Secretary of Defense (OSD/NA), will be observed through adminis-

trative arrangements between the WARLAB Technical Director and the NSA RSAS Administrator. This will include visitor control and physical access to the Sun workstation.

c. The NSA Department will provide a knowledgeable professor, normally the senior RSAS analyst, who will be designated the RSAS Administrator. The RSAS Administrator will be trained in RSAS matters and in Sun system administration, will give advice and assistance on RSAS security matters, will maintain administrative access security to the RSAS by the use of passwords and the normal UNIX security system, and will provide indoctrination and control for RSAS users. The RSAS Administrator will be eligible for and authorized access for certain SCI and compartmented clearances in order to maintain a full comprehension of all RSAS capabilities.

d. Primary access control to the space containing the Sun workstation which hosts the RSAS will be through scheduling dedicated time. At other times, when dual use of the space is required, the Sun monitors will be screened from viewing by others in the WARLAB while the RSAS is being operated.

e. Scheduled war games for classroom instructional support on any system in the WARLAB will take precedence over any other activity in the WARLAB. Whenever possible, RSAS analysts will be permitted access to the Sun workstation when such access will not interfere with the progress of a scheduled wargame. RSAS analysts will be cleared for at least Secret, so their presence should not hinder the progress of any regular lab war game. Any other priority conflicts will be handled by the Technical Director and the RSAS Administrator, with adjudication by the RSAS Principal

Investigator and the Director of Wargaming, the OR Department Chairman, and by the Naval Postgraduate School appeal process, if required.

f. The Technical Director will administratively manage the contract of the necessary Sun hardware and Sun software maintenance support. In the near term, the purchase of maintenance services may be necessary while additional experience is gained with the system. The primary concept for the future will be the establishment of self insurance through the purchase of redundant critical components to preclude costly maintenance services. The NSA Department will provide reimbursement for a proportional share of this cost, to be arranged by the Principal Investigator and the Director of Wargaming. The NSA department will provide all RSAS software support and unique RSAS hardware requirements.

g. Individuals working on additional/new research grants and requiring RSAS support will be expected to contribute on a prorated basis to RSAS costs. Additional details are as covered in the RSAS standard operating procedures (SOP) contained in Appendix A.

h. The NSA Department will make the RSAS available to the WARLAB to be used in support of WARLAB war games, subject to the coordination required through the RSAS Administrator and the Principal Investigator, as covered in the RSAS SOP contained in Appendix A.

SIGNATURES:

NSA DEPT CHAIRMAN:

OR DEPT CHAIRMAN:

WG ADV CMTE CHAIR:

DIR OF WARGAMING:

RSAS P.I.:

RSAS ADMINISTRATOR:

Appendix D to RSAS Report

ENHANCEMENTS TO RSAS INSTALLATION AT THE NAVAL POSTGRADUATE SCHOOL

1. Current Installation. The WARLAB current inventory of Sun workstations and related equipment consists of two Sun 3/160 workstations with eight megabytes of memory and two 71 megabyte SCSI disks each, color monitors, a Fujitsu "Super Eagle" 565 megabyte hard disk, a 1/2" high density 6250 bpi tape drive, a laser printer, and a Sun mounting rack. The Sun workstation pedestals and monitors are part of the WARLAB, the remaining equipment, including some of the memory augmentation, is part of the RSAS project. The workstations are not networked together as yet, but it is intended that this be accomplished in the near future. The large disk and the 1/2" tape drive are to be moved to the equipment room and installed in the newly arrived rack, using cables on order. This move will reduce the noise level around the workstation area.

2. Future Requirements. The current Sun workstation inventory is adequate only for limited individual RSAS research and elementary scripted RSAS war games. To make full use of the RSAS capabilities in the future, the NPS system will require a total of three networked workstations which will permit multiple use for analytic purposes and the ability to play two sided war games (one monitor each for Red, Blue, and Control/Green). For proper instruction, future development will require some type of large screen display device in a secure classroom. Currently, display of RSAS data is limited to a maximum of four individuals

"huddled" around one individual workstation. Consideration must also be given to the possibility that the Sun 3/160 on loan from NOSC will eventually need to be replaced. The RSAS Principal Investigator will look into using research and/or other resources to obtain these improved capabilities. Plans for the new Building "A" being prepared by the Director of the WARLAB will include full replacement for all RSAS hardware and a large screen display in a secure classroom.

3. Workstations. The WARLAB has recently received the second Sun 3/160 workstation noted in paragraph one above. The new workstation included the most recent Sun software release, which has been installed on the station operating the RSAS. The two stations will eventually be networked for a two-station system. One additional diskless workstation will give NPS the three station system required for gaming and for research flexibility. In addition, the WARLAB has two large group displays, both about 7' by 4', that could be used temporarily with the RSAS for presentations to larger groups, but these do not appear to be adequate in the long term for instructional classroom purposes.

4. Maintenance Required. RSAS software maintenance will be provided by RAND under the Director of Net Assessment in the Office of the Secretary of Defense (OSD/NA) development contracts through at least FY-88. Subsequent arrangements are the responsibility of the RSAS Principal Investigator. With regard to the Sun workstations, it is intended that the basic maintenance will be through redundant units, to lower the cost. In the initial

stages, however, and especially with certain single items, a maintenance agreement with Sun Microsystems may be required. There is currently no repair maintenance capability beyond what has been learned during installation, i.e., NPS personnel can remove and replace boards, and check basic DIP and backplane settings. There are several alternatives, but the best seems to be the telephone type maintenance, in which phone consultations can be held with Sun, and parts pulled and returned for replacement via mail. Since Sun is relatively handy (Santa Clara and Milpitas), this arrangement should not present any insurmountable problems, and is much cheaper than on-site support (about half the price). Unfortunately, due to the presence of classified information on the hard disks, the maintenance cost is higher than normal. If Sun workstations proliferate at NPS, closer support might be more cost effective in the future. Sun workstation maintenance should remain a responsibility of the NPS WARLAB, with appropriate fund support from the PI.

5. Sun Software Support. Software support for the Sun workstation is also required. The most recent Sun release is 3.5, which was included with the new workstation. The latest Rand RSAS release, 3.0, has been installed on the Sun workstation. Sun software support should be obtained to keep the Sun system current, and to permit the use of all applications, including those needed by the WARLAB, as well as the RSAS. If the Sun workstations proliferate at NPS, multiple licensing arrangements should lower the cost.

6. Networking. Cables, attachments, and a transceiver box are on

order to connect the two present workstations and the various devices together for the start of the network. For flexibility in the WARLAB, a gateway to connect the Sun network with the DEC network is required. A gateway is necessary to cut off the Sun network, as needed, to meet security requirements. Gateway hardware is currently available in the WARLAB, additional software may be required.

7. Summary of Programmed/Recommended Additions. In summary, the following hardware/software additions are recommended:

Priority:		
Sun hardware maintenance for Super Eagle hard disk *	$ 400	(apprx per mo)
4Mb Memory expansion board *	$ 2,000	
Sun 3/60-12 diskless workstation w/graphics monitor *	$ 11,300	
Transceiver box for server and client stations *	$ 1,500	
Cables and connectors *	$ 2,000	
Sun 3/180S-4 Data center server	$ 12,600	
8Mb Memory expansion board	$ 3,400	
Mid-term:		
Shutdown power supply	$ 5,000	
Sun 3/60-12 diskless workstation	$ 11,300	
Long-term:		
Sun 3 tempested remote workstation	$ 30,000	
Large screen display	$ 30,000	
Fiber optics cables	$ 4,000	
Color printer	$ 10,000	
Hardware/Software maintenance	$ 10,000	

* items currently on order.

8. Installation Summary. The current installation provides a minimum capability to conduct research and to run elementary war games on the RSAS. The addition of the equipment already on order will enhance the present installation, provide for more flexible use, and permit improved research and gaming. The purchase of the mid and long-term equipment will provide excellent flexibility in research for both students and faculty, will permit large-scale briefings and group instruction, and will support the basis for the operation of highly sophisticated war gaming.

Appendix E to RSAS Report

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