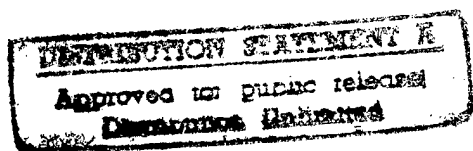




PB92-130020

NTIS
Information is our business.

FEDERAL ADVISORY COMMISSION ON CONSOLIDATION AND CONVERSION OF DEFENSE RESEARCH AND DEVELOPMENT LABORATORIES

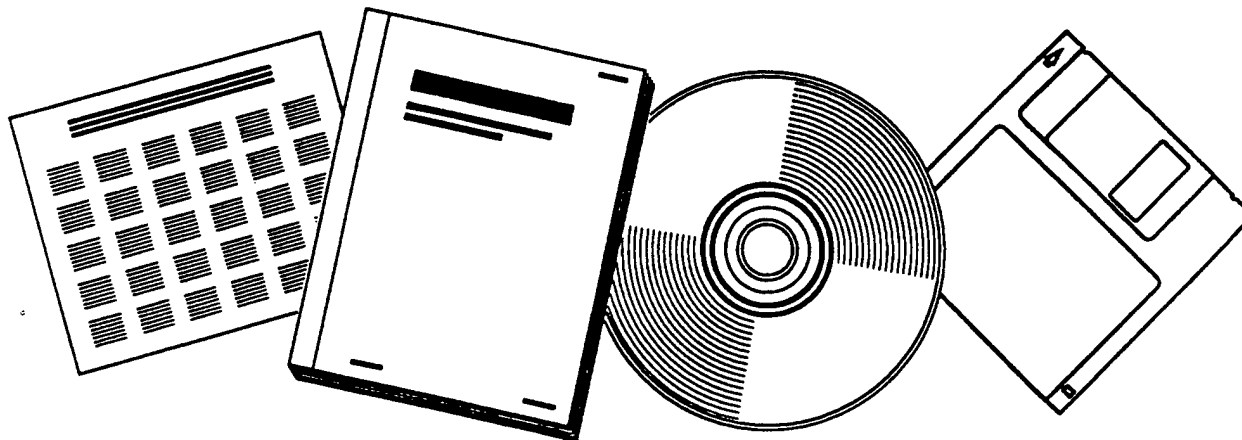


19970415 048

FEDERAL ADVISORY COMMISSION
WASHINGTON, DC

DTIC QUALITY INSPECTED 2

SEP 91



U.S. DEPARTMENT OF COMMERCE
National Technical Information Service



Federal Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories

Report to the Secretary of Defense

September 1991

REPRODUCED BY
U.S. DEPARTMENT OF COMMERCE
NATIONAL TECHNICAL
INFORMATION SERVICE
SPRINGFIELD, VA 22161

REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson De				
1	PB92-130020	2. REPORT DATE September 1991	3. REPORT TYPE AND DATES COVERED	
4. TITLE AND SUBTITLE Federal Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories			5. FUNDING NUMBERS	
6. AUTHOR(S) Charles E. Adloph, Chairman, Federal Advisory Commission				
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)			8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Directorate for Public Communication OASD(PA) Room 2E777, The Pentagon Washington, DC 20301-1400			10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES Report to the Secretary of Defense				
12a. DISTRIBUTION/AVAILABILITY STATEMENT No restriction on distribution Available from National Technical Information Service Springfield, VA 22161			12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 words) This report provides recommendations to the Secretary of Defense the feasibility and desirability of various means to improve the operation of the DoD laboratories.				
14. SUBJECT TERMS			15. NUMBER OF PAGES 75	
			16. PRICE CODE	
17. SECURITY CLASSIFICATION OF REPORT UNCLASSIFIED	18. SECURITY CLASSIFICATION OF THIS PAGE UNCLASSIFIED	19. SECURITY CLASSIFICATION OF ABSTRACT UNCLASSIFIED	20. LIMITATION OF ABSTRACT	

CHARLES E. ADOLPH, CHAIRMAN

FEDERAL ADVISORY COMMISSION
ON CONSOLIDATION AND CONVERSION OF
DEFENSE RESEARCH AND DEVELOPMENT LABORATORIES

COMMISSIONERS:
DR. SOLOMON J. BUCHSBAUM
MR. ROBERT M. HILLYER
DR. O'DEAN P. JUDD
DR. JAMES C. MCGRODDY
DR. JOHN M. PALMS
DR. FRANK D. VERDERAME

COMMISSIONERS:
DR. JAMES F. DECKER
DR. JOHN W. LYONS
DR. WILLIAM C. MCCORKLE
MR. EARLE L. MESSERE
COL. RICHARD R. PAUL
DR. VICTOR H. REIS

September 30, 1991

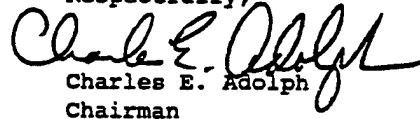
Honorable Richard Cheney
Secretary of Defense
The Pentagon
Washington, DC 20301

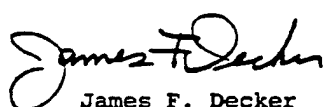
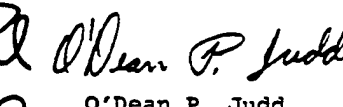
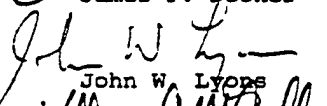
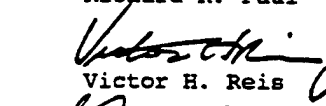
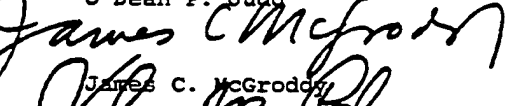
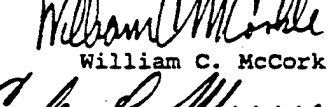
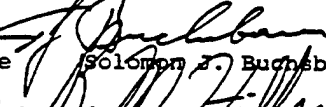
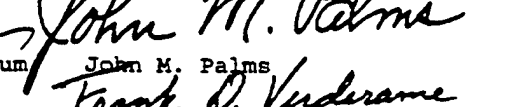
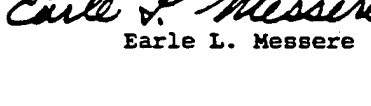
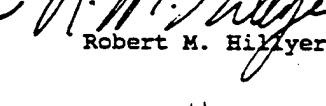
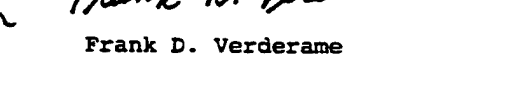
Dear Mr. Secretary,

We are pleased to submit the report of the Federal Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories. This report contains the Commission's findings and recommendations on the feasibility and desirability of various means to improve the operation and effectiveness of the DoD laboratories. To prepare this report, the Commission met for nine sessions, received extensive briefings from the Services, and reviewed previous Defense laboratory studies and other written documentation. Among the individuals who presented testimony were members of Congress and officials representing the Department of Defense, the Office of Technology Assessment, and the General Accounting Office. In addition, the Commission conducted on-site reviews at one laboratory of each of the Military Departments.

The Defense laboratories provide the technical expertise to enable the Services to be smart buyers and users of new and improved weapons systems and support capabilities. There is significant room for improvement in the operation of the laboratories, and our report contains specific recommendations to move in that direction. The Services' planned restructuring and realignment, coupled with interservice cooperation through Project Reliance and vigorous implementation of the DoD Laboratory Demonstration Program, afford a unique opportunity to improve DoD laboratory effectiveness.

Respectfully,


Charles E. Adolph
Chairman

 James F. Decker	 Richard R. Paul	 O'Dean P. Judd
 John W. Lyons	 Victor H. Reis	 James C. McGroddy
 William C. McCorkle	 Solomon J. Buchsbaum	 John M. Palms
 Earle L. Messere	 Robert M. Hillyer	 Frank D. Verderame

**FEDERAL ADVISORY COMMISSION
ON CONSOLIDATION AND CONVERSION OF
DEFENSE RESEARCH AND DEVELOPMENT LABORATORIES**

EXECUTIVE SUMMARY

Public Law 101-510 established the Federal Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories to study the Department of Defense (DoD) laboratory system and provide recommendations to the Secretary of Defense on the feasibility and desirability of various means to improve the operation of the DoD laboratories. Among the means the Commission was directed to study were: (1) conversion of some or all of the DoD laboratories to Government-Owned, Contractor-Operated laboratories, (2) mission and/or function modification of some or all of the laboratories, and (3) consolidation or closure of some or all of the laboratories.

The DoD operates a large and complex laboratory system. The DoD laboratories (42 Army, 20 Navy, and 4 Air Force) spend approximately \$6.5 billion annually and employ nearly 60,000 people, of whom over 26,000 are scientists and engineers. The DoD laboratory system has evolved over the past 150 years. Each Service's system is different and is a product of its historical origins, culture, and method of systems acquisition. Several laboratories are embedded in larger organizations. A significant number of the laboratories are relatively small and geographically isolated.

In undertaking its task, the Commission started with the fundamental issues concerning the laboratories: Why does the DoD have in-house laboratories? What are their primary functions? What is their current level of effectiveness? What are the attributes of an effective laboratory? How best can these attributes be achieved within the current environment? Is conversion to Government-Owned, Contractor-Operated necessary and/or feasible?

With a consensus on these fundamental issues, the Commission focused on the efficacy of the Services' laboratory reorganization plans and other opportunities for improving the productivity and effectiveness of DoD laboratories. Additionally, the Commission sponsored an independent assessment of the methodology and data that the Services used in evaluating the costs and savings associated with implementing their laboratory reorganization plans.

PRINCIPAL FINDINGS AND RECOMMENDATIONS

FINDINGS

1. The mission of the Defense laboratories is to provide the technical expertise to enable the Services to be smart buyers and users of new and improved weapons systems and support capabilities.

2. The functions provided by the DoD laboratories are an essential part of the acquisition process. Dedicated organizations free from commercial pressure are required to provide these functions.

3. The Services operate laboratories that span the range from those with broad research, development, and engineering responsibilities to those focused on science and technology. The Army and Navy operate both types of laboratories, while the Air Force operates the latter type. The laboratory types within each Service are a function of that Service's weapons systems acquisition structure. There is no need to force the Service laboratory systems into a single model.

4. While the Services are making progress, there is the need to improve the effectiveness of the DoD laboratories.

5. The following attributes are essential to achieving high quality and effectiveness:

- o Clear and substantive mission
- o Critical mass of assigned work
- o A highly competent and dedicated work force
- o Inspired, empowered, highly qualified leadership
- o State-of-the-art facilities and equipment
- o Effective two-way relationship with customers
- o Strong foundation in research
- o Management authority and flexibility
- o Strong linkage to universities, industry, and other Government laboratories.

6. Restructuring the in-house laboratory system is not only essential to achieve cost reductions, it also should be used as a major opportunity to improve effectiveness.

7. In general, the Services' cost and savings estimates associated with their laboratory reorganization plans are in

accordance with established procedures for base closures and are reasonable.

8. The restructuring of the laboratories, as proposed by the Services, could result in work-force turbulence, loss of key technical personnel, and disruption of critical research and development activities, therefore requiring special attention.

9. Strong advocacy on behalf of the laboratories at Service headquarters and in the Office of the Secretary of Defense is needed to ensure the effectiveness of the laboratories.

10. The effectiveness of the DoD laboratories suffers from regulatory and policy impediments to the authority and flexibility of the individual laboratory directors.

11. DoD-wide commitment to laboratory management excellence, high-level advocacy, and removal of obstacles to management authority and flexibility will provide an environment for greatly improving the productivity and effectiveness of the laboratories.

12. The Laboratory Demonstration Program and the recently enacted Federal Employees Pay Comparability Act contain many of the provisions needed to enhance organic management flexibility.

13. Conversion of some or all of the laboratories to Government-Owned, Contractor-Operated organizations could improve their effectiveness. However, fixing the problem organically is preferable to such a conversion.

14. The recently initiated interservice Project Reliance offers considerable potential for strengthening the effectiveness, productivity, and cohesiveness of DoD science and technology.

15. Many of the observations in this report have been made numerous times in the past, but have not been acted upon. The planned laboratory restructuring and realignment effort affords a unique opportunity to achieve significant improvements.

RECOMMENDATIONS

To materially improve the Defense laboratory system, the Commission recommends the following:

1. The proposed Army and Navy laboratory consolidations and realignments should begin in January 1992. The Army should delay implementation of the microelectronics function at Adelphi, Maryland, and construction of the facility to house the function until the completion of the study in recommendation 7. The Air Force should continue implementation of its laboratory consolidation plan. All service plans should be implemented so as to minimize disruption during the transition to a new structure.
2. The Secretary of Defense should direct the Services to implement all the provisions of the Laboratory Demonstration Program without delay, extend the program to all DoD laboratories, and seek legislative action required to complete the Laboratory Demonstration Program initiatives, including the personnel-related actions.
3. The Secretary of Defense should instruct the Services to delegate the authorities provided under the Federal Employees Pay Comparability Act immediately to the individual laboratory directors.
4. The Secretary of Defense should direct each Service to establish a high-level advocate who will report to the Service Assistant Secretary level and who will be accountable for the effectiveness of its laboratories.
5. The Services should strengthen the selection process for laboratory directors, emphasizing technology and technology-management qualifications. These positions should be for a minimum term of 4 years.
6. Each laboratory should establish an advisory committee of outside experts to review periodically the status of the laboratory and its work, and make recommendations to the director.
7. An independently appointed review group should assess the advantages and disadvantages of a single microelectronics research facility for all three Services. If a single facility is a viable solution, consideration should be given to a Government-Owned, Contractor-Operated laboratory.

8. The Services should continue to implement Project Reliance and the Director, Defense Research and Engineering should review the implementation of Reliance agreements periodically to ensure that there is no unwarranted duplication and that optimum resource utilization is achieved.

9. The Director, Defense Research and Engineering should ensure through periodic reviews that the recommendations contained in this report are being implemented. In addition, the Director should review the status of the individual Service laboratory consolidations and realignments at least semi-annually to ensure that they are being accomplished to maximize effectiveness and minimize disruption to personnel and ongoing technical programs.

SERVICE-SPECIFIC FINDINGS AND RECOMMENDATIONS

ARMY - FINDINGS

1. The Army's proposed laboratory consolidation and realignment should result in a more effective laboratory structure: eight streamlined Research, Development, and Engineering Centers within the commodity commands and the Combat Materiel Research Laboratory. The Commission supports this proposed consolidation.

2. Strong leadership at the Combat Materiel Research Laboratory is crucial to that laboratory's successful startup and long-term success.

3. The Combat Materiel Research Laboratory and the Research, Development, and Engineering Center technology base activities must interact with and support each other to achieve maximum effectiveness. High-level leadership must oversee and manage an active cooperative effort.

4. High-level leadership must institute active measures to maintain the connectivity between the Combat Materiel Research Laboratory and the Army user community.

5. The effectiveness of the laboratories can be improved by significantly increasing their connectivity to the acquisition process.

6. An underpinning research program within each Research, Development, and Engineering Center is important to its success.

7. The large capital investment planned for a new Army microelectronics research facility at the Combat Materiel Research Laboratory may not be warranted.

8. The Army's plan to ensure responsiveness of the Combat Materiel Research Laboratory science and technology program to the Research, Development, and Engineering Centers through a Board of Directors is sound.

9. The Army's plan to allocate a substantial part of its 6.1 budget to in-house laboratory independent research at the Research, Development, and Engineering Centers will ensure basic research programs in support of their missions.

ARMY - RECOMMENDATIONS

The Army should:

1. Appoint a strong civilian director for the Combat Materiel Research Laboratory as soon as possible. The new director must be given extensive authority to form Combat Materiel Research Laboratory divisions for maximum effectiveness and to recruit Combat Materiel Research Laboratory division leaders. This director should be a scientist or engineer with stature as a research and development leader and administrator.

2. Hold the Assistant Secretary of the Army for Research, Development, and Acquisition responsible for appointing and rating each of the Research, Development, and Engineering Center directors and the director of the Combat Materiel Research Laboratory.

3. Use all possible incentives to minimize turbulence, loss of key personnel, and disruption of critical research and development programs. These incentives include retention bonuses, relocation services and assistance, placement services, and time flexibility.

4. Defer the capital investment for an Army microelectronics research facility at the Combat Materiel Research Laboratory pending the outcome of principal recommendation 7.

5. Implement procedures for the Combat Materiel Research Laboratory and the Research, Development, and Engineering Centers to evaluate and interact with each other's programs and with the user.

6. Include all Army Research, Development, and Engineering Centers and laboratories in the Laboratory Demonstration Program.

NAVY - FINDINGS

1. The Navy's proposed laboratory consolidation and realignment will result in an organizational structure that includes a range of functions from science and technology to depot support within each of four major Naval Warfare Centers (Air, Surface, Undersea, and Command and Control), each of which has one or more research and development elements embedded within it. This overall structure provides flexibility for change in the face of uncertain future budgets and problems. The Commission supports the warfare center concept with the following reservations:

- a. There is risk that the research and development elements of the warfare centers will lose their identity as laboratories in the planned structure.
- b. A high-level official responsible for laboratory effectiveness is not identified in the plan.

2. The Navy's planned personnel relocations (approximately 4800) present a particular challenge to minimize work-force turbulence, loss of key personnel, and disruption of critical research and development programs.

NAVY - RECOMMENDATIONS

The Navy should:

1. Modify the plan to identify the research and development element or elements within each warfare center as Navy Research, Development, and Engineering Laboratories. These activities will be DoD laboratories, as will the realigned Naval Research Laboratory and the Navy medical laboratories. Each of these laboratories should be led by a scientist or

engineer with stature as a research and development technical manager.

2. Use all possible incentives to minimize turbulence, loss of key personnel, and disruption of critical research and development programs. These incentives include retention bonuses, relocation services and assistance, placement services, and time flexibility.

3. Include each Navy Research, Development, and Engineering Laboratory within each warfare center along with the Naval Research Laboratory and the Navy medical laboratories in the Laboratory Demonstration Program. Consistent with the Laboratory Demonstration Program, these laboratories, including the Naval Research Laboratory, should have their own organic support.

AIR FORCE - FINDINGS

The Commission finds:

The Air Force Laboratory Consolidation Plan will improve the overall effectiveness of the Air Force laboratory system. That plan, already partially implemented, provides for the following:

- a. Organizational consolidation of 14 laboratories into four laboratories that align with and reside in the Air Force Systems Command's four product divisions.
- b. Gradual geographical migration of the elements associated with each laboratory to that laboratory's headquarters location.
- c. A Technology Executive Officer who provides integrated science and technology investment strategy guidance to the four laboratories and serves as a dedicated Air Force laboratory system advocate.
- d. Strong emphasis on technology transition and support of the weapons systems acquisition process through direct reporting of laboratory commanders/directors to their product division commanders.

AIR FORCE - RECOMMENDATIONS

The Air Force should:

1. Continue implementation of the Air Force Laboratory Consolidation Plan.
2. Use all possible incentives to minimize turbulence, loss of key personnel, and disruption of critical research and development programs. These incentives include retention bonuses, relocation services and assistance, placement services, and time flexibility.
3. Continue to improve the connectivity between the laboratory structure and the acquisition elements of the product divisions.
4. Include all Air Force laboratories in the Laboratory Demonstration Program.

**Federal Advisory Commission
on Consolidation and Conversion of
Defense Research and Development Laboratories**

Report to the Secretary of Defense

September 1991

TABLE OF CONTENTS

EXECUTIVE SUMMARY	ES-1
I. INTRODUCTION	1
II. PURPOSE AND FUNCTIONS OF DEFENSE LABORATORIES	1
II A. MISSION OF DoD LABORATORIES	2
II B. ATTRIBUTES OF A "GOOD LABORATORY"	6
II C. RESTRUCTURING OF THE LABORATORY SYSTEM	8
III. SERVICE LABORATORY CONSOLIDATION PLANS	8
III A. THE ARMY LABORATORY SYSTEM	9
DISCUSSION	9
FINDINGS	11
RECOMMENDATIONS	12
III B. THE NAVY LABORATORY SYSTEM	13
DISCUSSION	13
FINDINGS	15
RECOMMENDATIONS	15
III C. THE AIR FORCE LABORATORY SYSTEM	16
DISCUSSION	16
FINDINGS	18
RECOMMENDATIONS	19
III D. INDEPENDENT COST AND SAVINGS ASSESSMENT	19
IV. INTERSERVICE LABORATORY COOPERATION	21
V. IMPROVED MANAGEMENT AUTHORITY AND FLEXIBILITY	23
V A. THE LABORATORY DEMONSTRATION PROGRAM	25
V B. CONVERSION TO GOVERNMENT-OWNED, CONTRACTOR-OPERATED LABORATORIES	26
VI. PRINCIPAL RECOMMENDATIONS	27
VII. APPENDICES	
A. MEMBERSHIP OF THE COMMISSION	A1
B. ENABLING LEGISLATION	B1
C. DISCUSSION OF SELECTED FUNCTIONS OF DEFENSE LABORATORIES	C1
D. "GOOD LABORATORY" ATTRIBUTES	D1
E. LABORATORY MEASURES OF EFFECTIVENESS	E1
F. GOALS AND OBJECTIVES OF DEFENSE LABORATORIES	F1
G. FEDERAL EMPLOYEES PAY COMPARABILITY ACT	G1
H. REFERENCES	H1

I. INTRODUCTION

Public Law 101-510 established the Federal Advisory Commission on Consolidation and Conversion of Defense Research and Development Laboratories to study the Department of Defense (DoD) laboratory system and provide recommendations to the Secretary of Defense on the feasibility and desirability of various means to improve the operation of the DoD laboratories.

The Commission, chaired by the Director, Defense Research and Engineering (DDR&E), consisted of 13 members of the research and development (R&D) community. Besides the chairman, there were six members from the private sector and six from the public sector. A list of the membership is provided in appendix A. As specified by the enabling legislation (appendix B), the Commission was directed to conduct a study to determine various means to improve the operation and effectiveness of DoD laboratories. Among the means the Commission was directed to study were: (1) conversion of some or all of the DoD laboratories to Government-Owned, Contractor-Operated (GOCO) laboratories, (2) mission and/or function modification of some or all of the laboratories, and (3) consolidation or closure of some or all of the laboratories. The Commission focused on developing findings and recommendations designed to improve laboratory effectiveness and productivity over the long term.

II. PURPOSE AND FUNCTIONS OF DEFENSE LABORATORIES

The DoD operates a large and complex laboratory system. The DoD laboratories (42 Army, 20 Navy, and 4 Air Force) spend approximately \$6.5 billion annually and employ nearly 60,000 people, of whom over 26,000 are scientists and engineers. The DoD laboratory system has evolved over the past 150 years. Each Service's system is different and is a product of its historical origins, culture, and method of systems acquisition. Several laboratories are embedded in larger organizations. A significant number of the laboratories are relatively small and geographically isolated.

In undertaking its task, the Commission considered the following fundamental issues concerning the laboratories:

- o Why does the DoD have in-house laboratories?
- o What are their primary functions?
- o What is their current level of effectiveness?
- o What are the attributes of an effective laboratory?

- o How best can these attributes be achieved within the current environment?
- o Is conversion to GOCO necessary and/or feasible?

These questions must be answered before one can define, in the DoD context, what is meant by laboratories. Only then is it possible to set the Defense laboratory structure on a course toward excellence in meeting future requirements.

While the origin of the Defense laboratory system dates to the 1842 establishment of the Naval Observatory, today's Defense laboratory system has its foundations in the laboratory infrastructure that grew in response to the national need during World War II. There is a continuing need to apply advanced technology to improve the performance of the fighting forces in the face of a technologically sophisticated or numerically superior enemy. Today's laboratory system, directly and indirectly, descended from an organized and purposeful restructuring of the wartime laboratories into a system of Defense laboratories designed to support the DoD in the post-war era.

Numerous studies of the Defense laboratories have been conducted since World War II. The Defense Science Board's 1987 Summer Study on Technology Base Management referenced some 87 such studies. These studies have been remarkably uniform in their findings in support of improving the Defense laboratories. While significant problems in the management of these organizations and in the environment in which they had been forced to operate have been identified, again with remarkable uniformity, no findings have challenged the need for Defense laboratories. This Commission agrees that the DoD requires a viable laboratory system today and for the foreseeable future.

II A. MISSION OF DoD LABORATORIES

The Commission finds that the *raison d'etre*--the underlying mission--for the DoD laboratories can be simply stated as follows:

The mission of the Defense laboratories is to provide the technical expertise to enable the Services to be smart buyers and users of new and improved weapons systems and support capabilities. (ExSum F1)

The necessity for a technically sophisticated government organization to perform this mission was addressed in a 1980 report by then-Under Secretary of Defense William J. Perry: "The decision-

making process leading to materiel acquisition is inherently a governmental function....[Performing the] function of selecting among technical alternatives requires internal technical capability of sufficient breadth, depth, and continuity to assure that the public interest is served. The nature of this technical capability is dictated largely by the degree of complexity and sophistication of the materiel to be acquired." Thus, the DoD laboratories are necessary to ensure the technical integrity of the DoD acquisition process.

The laboratories have performed appropriate functions in support of this mission. While defining and evaluating these functions has been the subject of the aforementioned studies, the Commission has reorganized them, added new ideas, and consolidated them into the set shown in figure 1.

1. *INFUSE THE ART OF THE POSSIBLE INTO MILITARY PLANNING*
2. *ACT AS PRINCIPAL AGENTS IN MAINTAINING THE TECHNOLOGY BASE*
3. *AVOID TECHNOLOGICAL SURPRISE AND ENSURE TECHNOLOGICAL INNOVATION*
4. *SUPPORT THE ACQUISITION PROCESS*
5. *PROVIDE SPECIAL-PURPOSE FACILITIES NOT PRACTICAL FOR THE PRIVATE SECTOR*
6. *RESPOND RAPIDLY IN TIME OF URGENT NEED OR NATIONAL CRISIS*
7. *BE A CONSTRUCTIVE ADVISER FOR DEPARTMENT DIRECTIONS AND PROGRAMS BASED ON TECHNICAL EXPERTISE*
8. *SUPPORT THE USER IN THE APPLICATION OF EMERGING TECHNOLOGY AND INTRODUCTION OF NEW SYSTEMS*
9. *TRANSLATE USER NEEDS INTO TECHNOLOGY REQUIREMENTS FOR INDUSTRY*
10. *SERVE AS A SCIENCE AND TECHNOLOGY TRAINING GROUND FOR CIVILIAN AND MILITARY ACQUISITION PERSONNEL*

Figure 1. Functions of Defense Laboratories

The functions in figure 1 are those which the Defense laboratories fulfill today and which the Commission agrees should be their functions in the future. An elaboration of some of these functions appears in appendix C.

None of these 10 functions justify the need for Defense laboratories. Rather, in concert, they are required to support the above-cited central mission of the laboratories. The Commission finds:

The functions provided by the DoD laboratories are an essential part of the acquisition process. Dedicated organizations free from commercial pressure are required to provide these functions. (ExSum F2)

Given the above-defined mission and functions for the Defense laboratories, it is possible to better define what we mean by the word "laboratory" in the context of this report. According to Webster's Ninth New Collegiate Dictionary, a laboratory is "a place equipped for experimental study in a science or for testing and analysis; broadly: a place providing opportunity for experimentation, observation, or practice in a field of study." Clearly, this definition will not suffice to describe the spectrum of organizations that the Defense community has come to call laboratories.

Simply to include all Defense organizations that conduct R&D also does not suffice. That would be too broad a definition, since many activities, especially test and evaluation, in-service engineering, and fleet and field support conduct limited R&D. Accordingly, the Commission defines a laboratory as any activity that performs at least 10 percent of total applied work-years in science and technology (S&T) (budget categories 6.1, 6.2, and 6.3A) and at least 50 percent of total applied work-years in all research, development, test, and evaluation (RDT&E) (budget categories 6.1 - 6.6).

A survey of the functions of laboratory organizations reveals that the Army and Navy operate two distinct classes of laboratories, while the Air Force operates one type of laboratory that is an organic part of the Air Force weapons systems acquisition organization. The first type, which approaches the Webster definition, focuses its effort primarily on basic research, exploratory development, and advanced-technology development in technical areas that are broadly applicable across the missions of its parent Service. This work is usually referred to as part of the technology base and is normally funded from the budget category 6.1, 6.2, or 6.3A accounts. The prototype of this class of laboratories is the Naval Research Laboratory (NRL), which has served the Navy in this role since 1923. Other laboratories of this type include the four Air Force laboratories, as recently restructured, and the Army's proposed Combat Materiel Research Laboratory (CMRL). The medical laboratories of the three Services might also be considered to be in this class, although in many ways they form a unique subset. The

second type of laboratory has as its central role the support of acquisition (development) programs. Laboratories of this type would include current Navy RDT&E Centers and Army Research, Development, and Engineering Centers (RDECs) and should be product-line oriented. With respect to laboratories within the DoD system, the Commission finds:

The Services operate laboratories that span the range from those with broad research, development, and engineering responsibilities to those focused on science and technology. The Army and Navy operate both types of laboratories, while the Air Force operates the latter type. The laboratory types within each Service are a function of that Service's weapons systems acquisition structure. There is no need to force the Service laboratory systems into a single model. (ExSum F3)

To evaluate the current state of the DoD laboratories, the Commission heard testimony from high-level Service officials and from laboratory directors, and also visited a representative laboratory for each of the Services. The picture that emerged from this evidence was unequivocal in several respects:

- o The laboratories are doing challenging work with significant results. They are justifiably proud of their contributions.
- o There is some mission overlap.
- o Laboratory directors need to be highly-qualified in technology management and to be kept in place long enough to realize full effectiveness.
- o The work-force is aging, and recruitment of highly-qualified new talent is impeded by non-competitive compensation and inconsistent hiring policies.
- o Laboratory facilities are aging faster than they are being replaced.
- o Laboratory managers believe that their effectiveness is impeded by outside control of various aspects of laboratory operations.

Based on the evidence, the Commission finds that:

While the Services are making progress, there is the need to improve the effectiveness of the DoD laboratories.
(ExSum F4)

II B. ATTRIBUTES OF A "GOOD LABORATORY"

The Commission explored and studied the attributes and characteristics essential to the health and long-term productivity and effectiveness of laboratories. Previous studies on how to improve laboratory effectiveness were reviewed. The Commission noted a commonality of identified problem areas which have, to the frustration of many of the parties involved, simply not been addressed. The following set of attributes is fundamental to the effective functioning of the laboratories and is the Commission's basis for correcting these problems in the future.

- o **A Clear and Substantive Mission** with documented responsibilities for technical performance in specific areas.
- o **A Critical Mass of Assigned Work** appropriate to a viable, separate entity that is able to conduct the full range of support functions and command recognition for its contributions.
- o **A Highly Competent and Dedicated Work Force** retained through aggressive recruitment and training, a stimulating environment, and strong leadership. This includes internationally recognized scientists and technologists and technology managers.
- o **An Inspired, Empowered, Highly-Qualified Leadership** committed to technical excellence through support for creativity, and high-risk/high-payoff initiatives.
- o **State-of-the-Art Facilities and Equipment**, including many specialized laboratory facilities appropriate to leading-edge technology applications to support operational systems.
- o **An Effective Two-Way Relationship with Customers** via frequent contact with operational

forces and their requirements, involvement with operational systems, and a shared vision.

- o **A Strong Foundation in Research** with a balance of effort in development and engineering, in keeping with the Commission's laboratory definition of minimum 10 percent S&T, 50 percent R&D work effort
- o **Management Authority and Flexibility**, including the authority to staff and direct its technical programs as well as to completely control all inherent support functions (personnel, finance, contracting, data processing, etc.).
- o **A Strong Linkage to Universities, Industry, and Other Government Laboratories**, including foreign ones, to ensure that opportunities for technology advancement are utilized most effectively.

With respect to long-term productivity and effectiveness of the laboratories, the Commission finds:

The following attributes are essential to achieving high quality and effectiveness:

- o **Clear and substantive mission**
- o **Critical mass of assigned work**
- o **A highly competent and dedicated work force**
- o **Inspired, empowered, highly qualified leadership**
- o **State-of-the-art facilities and equipment**
- o **Effective two-way relationship with customers**
- o **Strong foundation in research**
- o **Management authority and flexibility**
- o **Strong linkage to universities, industry, and other Government laboratories. (ExSum F5)**

In addition to the laboratory attributes described above, it is important that laboratories have high-level advocates to serve as spokespersons for unique laboratory needs and to minimize external interference in their operation. Such an advocate must have the authority to review the performance and effectiveness of the laboratories and the charter to represent and advocate their welfare and effectiveness at the highest levels.

II C. RESTRUCTURING OF THE LABORATORY SYSTEM

The Federal budget is very clearly being adjusted to reflect a changing world and a changing nation. As the military threat lessens, the Defense portion of the budget is being reduced accordingly. This trend will necessarily be reflected in reductions of operating forces, their logistics support base, and the DoD RDT&E complex. This is not to say that the need for the functions of the DoD laboratories is fading away. Rather, the laboratories' capabilities must be strengthened while their numbers are decreased. President Bush, in his August 1990 speech to the Aspen Institute, strongly asserted this approach: "Our task today is to shape our defense capabilities to these changing strategic circumstances. ...What we need are not merely reductions, but restructuring. ...And to prepare to meet the challenges we may face in the future, we must focus on research -- an active and inventive program of defense R&D."

The most cost-effective way of downsizing the in-house level of efforts is through restructuring of activities to improve critical mass, reduce unwarranted duplication, reduce overhead costs, and to increase work effectiveness. In general, the Commission finds:

Restructuring the in-house laboratory system is not only essential to achieve cost reductions, it also should be used as a major opportunity to improve effectiveness.
(ExSum F6)

III. SERVICE LABORATORY CONSOLIDATION PLANS

Each of the Service's consolidation plans is discussed in detail below. In general, the Services are considering major realignments that will result in a significant migration of personnel. Understanding that fact, the Commission finds:

The restructuring of the laboratories, as proposed by the Services, could result in work-force turbulence, loss of key technical personnel, and disruption of critical research and development activities, therefore requiring special attention. (ExSum F8)

III A. THE ARMY LABORATORY SYSTEM

DISCUSSION

The Army currently operates 42 laboratories, centers, and institutes that employ approximately 25,000 civilians. The Army's S&T organizations belong to five major commands: the Army Materiel Command, the Corps of Engineers, the Army Surgeon General and its Medical Research and Development Command, the Information Systems Command, and the Deputy Chief of Staff for Personnel. Policy and oversight for the Army's laboratory system is provided by the Deputy Assistant Secretary of the Army for Research and Technology DASA(R&T).

The Army Materiel Command manages about 75 percent of the Army's S&T resources through its seven corporate laboratories, eight RDECs, and its Army Research Office. The Army Surgeon General operates nine laboratories, and the Corps of Engineers operates four laboratories. The Information Systems Command and the Deputy Chief of Staff for Personnel each operate one laboratory.

The corporate laboratories of the Army Materiel Command conduct generic, longer-term R&D in support of the Army's technology base investment strategy. The emerging technologies that these corporate laboratories develop are applicable to a broad spectrum of Army weapons systems. The seven laboratories of the Laboratory Command receive significant funding from Army technology base resources; and they receive customer funding from RDECs, Army project managers, and other Government agencies.

Each RDEC conducts basic research, exploratory development, and advanced technology development. They also provide engineering support to developmental and fielded weapons systems for a specific commodity (e.g., tanks, aviation, and missiles). The RDECs are embedded into six independent commodity commands that conduct technology base activities applicable to a specific commodity. The RDECs also perform most of the advanced technology development activities in the Army. The RDECs receive significant customer funding from the Program Executive Officer (PEO) structure to support the engineering development and manufacturing of major weapons systems. RDECs also provide engineering support to fielded systems until they are phased out of operation. They are full-spectrum organizations in that they provide technical support to the weapons systems acquisition process from concept development to weapon phaseout.

Army tactics and doctrine are developed by the operational user--the Training and Doctrine Command and the Deputy Chief of staff for Operations. This community provides the principal guidance for the activities of Army S&T organizations. An active dialogue has been maintained between the user and the RDECs and the corporate laboratories. This interaction serves to focus R&D and to prioritize S&T programs that are more responsive to the user's needs.

The Army plans to consolidate its seven laboratories in the present Laboratory Command into a single Combat Materiel Research Laboratory (CMRL). The Laboratory Command would be abolished, eliminating almost 1000 civilian personnel positions. The CMRL would provide a critical mass of resources in technologies essential to Army weapons systems objectives--lethality, materiel, life sciences, modeling, simulation, and assessments, for example.

The Commission is sensitive to any planned investments in expensive laboratory facilities. The capital investment in CMRL of an expensive microelectronics research facility is questionable, given the intent and thrust of Project Reliance (see Section IV). Numerous microelectronics research efforts are ongoing within the Services and industry, and some duplication may exist. Industry is heavily involved in basic microelectronics research. It may be desirable to consolidate the research activities within DoD into one microelectronics laboratory to achieve critical mass and improve effectiveness. The Army's realignment affords an opportunity to do so.

The establishment of CMRL requires a net investment of \$177 million (in FY 91 dollars) by the Army over the next six fiscal years. Of this, approximately \$78 million is associated with the microelectronics facilities. These initial costs were recognized by the Army as a challenge in a period when significant savings are required. However, the Army leadership recognized that an opportunity existed to consolidate and improve the operation of its laboratory assets in accord with its projections of future needs.

The Army Laboratory Consolidation Plan also includes disestablishing the Letterman Army Institute of Research as part of the closure of the Presidio of San Francisco, and reassigning its functions along with other realignments under the Army Surgeon General laboratories in accordance with Project Reliance agreements. The Army's medical laboratories will be reduced from nine to six. The Corps of Engineers laboratories will remain unchanged.

The RDECs and the proposed CMRL will require strong and continuing advocacy within the Army Materiel Command and in the Assistant Secretary of the Army's office. The advocate must maintain a strong coupling among the laboratories and ensure that they continue to interact with the using commanders. This will require long-term nurturing for the fledgling CMRL and a strong commitment to basic and applied research within the RDECs and at the Army Materiel Command. Strong civilian leadership for the CMRL is essential.

FINDINGS

With respect to the Army, the Commission finds:

1. The Army's proposed laboratory consolidation and realignment should result in a more effective laboratory structure: eight streamlined Research, Development, and Engineering Centers within the commodity commands and the Combat Materiel Research Laboratory. The Commission supports this proposed consolidation. (ExSum FA1)
2. Strong leadership at the Combat Materiel Research Laboratory is crucial to that laboratory's successful startup and long-term success. (ExSum FA2)
3. The Combat Materiel Research Laboratory and the Research, Development, and Engineering Center technology base activities must interact with and support each other to achieve maximum effectiveness. High-level leadership must oversee and manage an active cooperative effort. (ExSum FA3)
4. High-level leadership must institute active measures to maintain the connectivity between the Combat Materiel Research Laboratory and the Army user community. (ExSum FA4)
5. The effectiveness of the laboratories could be improved by significantly increasing their connectivity to the acquisition process. (ExSum FA5)
6. An underpinning research program within each Research, Development, and Engineering Center is important to its success. (ExSum FA6)
7. The large capital investment planned for a new Army microelectronics research facility at the Combat Materiel Research Laboratory may not be warranted. (ExSum FA7)

8. The Army's plan to ensure responsiveness of the Combat Materiel Research Laboratory science and technology program to the Research, Development, and Engineering Centers through a Board of Directors is sound.

(ExSum FA8)

9. The Army's plan to allocate a substantial part of its 6.1 budget to in-house laboratory independent research at the Research, Development, and Engineering Centers will ensure basic research programs in support of their missions. (ExSum FA9)

RECOMMENDATIONS

The Army should:

1. Appoint a strong civilian director for the Combat Materiel Research Laboratory as soon as possible. The new director must be given extensive authority to form the Combat Materiel Research Laboratory divisions for maximum effectiveness and to recruit Combat Materiel Research Laboratory division leaders. This director should be a scientist or engineer with stature as a research and development leader and administrator. (ExSum RA1)

2. Hold the Assistant Secretary of the Army for Research, Development, and Acquisition responsible for appointing and rating each of the Research, Development, and Engineering Center directors and the director of the Combat Materiel Research Laboratory. (ExSum RA2)

3. Use all possible incentives to minimize turbulence, loss of key personnel, and disruption of critical research and development programs. These incentives include retention bonuses, relocation services and assistance, placement services, and time flexibility. (ExSum RA3)

4. Defer the capital investment for an Army microelectronics research facility at the Combat Materiel Research Laboratory pending the outcome of principal recommendation 7. (ExSum RA4)

5. Implement procedures for the Combat Materiel Research Laboratory and the Research, Development, and Engineering

Centers to evaluate and interact with each other's programs and with the user. (ExSum RA5)

6. Include all Army Research, Development, and Engineering Centers and laboratories in the Laboratory Demonstration Program. (ExSum RA6)

III B. THE NAVY LABORATORY SYSTEM

DISCUSSION

The current Navy laboratory system consists of two S&T laboratories (NRL and the Naval Oceanographic and Atmospheric Research Laboratory), seven R&D centers, eight medical laboratories, and small laboratories for civil engineering, clothing and textiles, and personnel research. The size of the major activities in terms of full-time permanent (FTP) civilian personnel and total funding (FY 90 data) is shown in table 1:

Activity	FTP	\$M
Naval Research Laboratory	3329	\$651
Naval Oceanographic and Atmospheric Research Laboratory	427	64
David Taylor Research Center	2668	404
Naval Air Development Center	2349	405
Naval Coastal Systems Center	1279	207
Naval Ocean Systems Center	3027	593
Naval Surface Warfare Center	4963	721
Naval Underwater Systems Center	3492	662
Naval Weapons Center	5148	803
Medical Laboratories (8)	710*	83
*includes military		

Table 1. Total Personnel and Funding Levels (FY 90)

The S&T laboratories report to the Chief of Naval Research, while the seven R&D centers report to the Director of Naval Laboratories, who is a Deputy Commander of the Space and Naval Warfare Systems Command. The main customers for R&D work at the centers are the Chief of Naval Research (for S&T effort) and the several systems commands and various acquisition officers (for systems development

effort). The centers maintain direct relationships with their customers. The medical laboratories are under the Navy Medical Research and Development Command.

The NRL and the seven R&D centers operate under the Navy Industrial Fund financial management system, which provides for flexible budgeting and accounting very similar to private enterprise.

The Navy Laboratory Consolidation Plan is the result of 1 1/2 years of extensive study. Its major objective is to consolidate, realign, and downsize the seven R&D centers and merge them with 29 support engineering activities and T&E centers to form four warfare centers with 10 divisions. This plan will also consolidate the two current Navy corporate laboratories into one, and will implement the Project Reliance recommendations, which eliminate three Navy medical laboratories through merger with Army and Air Force laboratories while absorbing two Army medical laboratories into Navy laboratories.

The Navy's plan is motivated primarily by the declining budget for R&D efforts, and secondarily, by the congressionally mandated 20 percent reduction in the civilian acquisition work force. The intent is to consolidate and realign along functional lines so that similar work is performed at only one location, maintaining a critical mass of capability while reducing overhead requirements and the possibility of duplicative efforts. The Navy is using the opportunity afforded by the drawdown to improve the effectiveness of its laboratory system.

This is a phased plan, intended to be completed by the end of FY 95. The pace at which the consolidation and realignment actually take place will be governed by the funding available to put the plan into effect.

In achieving this consolidation and realignment, the Navy's plan will result in the relocation of approximately 4800 positions, of which about 2800 are scientists or engineers positions, 300 of which are currently staffed by personnel with Ph.D. degrees or the equivalent.

Inherent in the Navy's plan is the establishment of a Navy Laboratory/Center Coordinating Group that will provide a mechanism for management coordination across the warfare centers and the corporate laboratory. The draft charter specifically includes annual reviews of business and investment plans and review of technical program structure for quality and balance, along with various other coordination efforts.

Another significant aspect of the Navy's plan is a Laboratory/Center Oversight Council chaired by the Assistant Secretary of the Navy for Research, Development, and Acquisition.

FINDINGS

With respect to the Navy, the Commission finds:

1. The Navy's proposed laboratory consolidation and realignment will result in an organizational structure that includes a range of functions from science and technology to depot support within each of four major Naval Warfare Centers (Air, Surface, Undersea, and Command and Control), each of which has one or more research and development elements embedded within it. This overall structure provides flexibility for change in the face of uncertain future budgets and problems. The Commission supports the warfare center concept with the following reservations:

- a. There is risk that the research and development elements of the warfare centers will lose their identity as laboratories in the planned structure.
- b. A high-level official responsible for laboratory effectiveness is not identified in the plan.
(ExSum FN1)

2. The Navy's planned personnel relocations (approximately 4800) present a particular challenge to minimize work-force turbulence, loss of key personnel, and disruption of critical research and development programs.
(ExSum FN2)

3. The Navy Industrial Fund system is judged to be a flexible financial management system, as called for under "Attributes of a Good Laboratory."

RECOMMENDATIONS

The Navy should:

- 1. Modify the plan to identify the research and development element or elements within each warfare center as Navy Research, Development, and Engineering Laboratories. These activities will be DoD laboratories, as will the

realigned Naval Research Laboratory and the Navy medical laboratories. Each of these laboratories should be led by a scientist or engineer with stature as a research and development technical manager. (ExSum RN1)

2. Use all possible incentives to minimize turbulence, loss of key personnel, and disruption of critical research and development programs. These incentives include retention bonuses, relocation services and assistance, placement services, and time flexibility.

(ExSum RN2)

3. Include each Navy Research, Development, and Engineering Laboratory within each warfare center along with the Naval Research Laboratory and the Navy medical laboratories in the Laboratory Demonstration Program. Consistent with the Laboratory Demonstration Program, these laboratories, including the Naval Research Laboratory, should have their own organic support. (ExSum RN3)

4. Retain the Navy Industrial Fund financial management system for the Naval Research Laboratory and the Navy Research, Development, and Engineering Laboratories.

III C. THE AIR FORCE LABORATORY SYSTEM

DISCUSSION

In response to DoD policy to reduce overhead and an Air Force internal decision to promote better integration of the family of technologies associated with a given end product or commodity, the Air Force began to realign and consolidate its laboratory structure in December 1990. Prior to that time, the Air Force laboratory structure consisted of 14 organizations. In December 1990, the Air Force organizationally consolidated its 14 laboratory organizations into four "super" laboratories that align with and reside in the Air Force Systems Command's (AFSC's) four product divisions: Aeronautical Systems Division, Electronic Systems Division, Space Systems Division, and Human Systems Division. The four new laboratories are the Wright Laboratory, Rome Laboratory, Phillips Laboratory, and Armstrong Laboratory. Each laboratory has unique S&T responsibilities to its parent product division as well as selected corporate research responsibilities.

Each of the four Air Force laboratories was organized internally to a uniform organizational structure. That structure consists

of a command section, technology directorates that correspond to each laboratory's specific mission, and a plans and programs directorate to provide interdisciplinary investment strategy planning and technology transition processes. Additionally, operations and support directorates and comptroller and contracting directorates were established to support the technology directorates in the execution of their responsibilities. For its assigned technology disciplines, each laboratory conducts activities in all three S&T categories: basic research, exploratory development, and advanced technology development, to enhance the flow of a given technology through all three S&T areas. The Air Force's basic research activities are centrally managed by the Air Force Office of Scientific Research located at Bolling AFB, Washington, DC.

The four realigned Air Force laboratories have a dual reporting chain: a Technology Executive Officer (TEO) chain and a product division chain. With respect to the TEO reporting chain, the Air Force has established a TEO who functions in a similar manner to a PEO. The TEO is directly responsible and accountable to the Air Force Acquisition Executive for the execution of a portfolio of S&T programs. In turn, the TEO provides integrated investment strategy guidance to the four laboratory commanders/directors and ensures that uniform processes are in place to determine the quality and relevance of research being conducted across the Air Force laboratory community. The TEO is also dual-hatted as the Deputy Chief of Staff for Technology on the AFSC staff, and reports in that capacity to the AFSC Commander. The AFSC Deputy Chief of Staff for Technology is responsible for the infrastructure (people and facilities) aspects of the four laboratories, and is concerned with such issues as personnel policies, Ph.D. recruitment, facility improvement, and professional development of all Air Force scientists and engineers.

With respect to the product division reporting chain, each of the four laboratory commanders/directors reports to his respective product division commander for purposes of efficiency reports and day-to-day accountability. While the TEO is responsible for ensuring that the laboratories are pursuing the right technologies with high-caliber research programs, the four product division commanders are responsible for ensuring that the technologies developed by their respective laboratories are transitioned to the system developers who also reside in their product divisions or to the system maintainers who reside in the Air Force's five Air Logistics Centers. The direct reporting of a laboratory commander/director to his respective product division commander ensures that the focus of each laboratory is on supporting the systems acquisition process.

The long-term vision of the Air Force is to geographically collocate the technology directorates associated with each of the four laboratories to that laboratory's headquarters location. However, the Air Force wants to be very deliberate about relocating its remote directorates in the interest of, first and foremost, preserving high-caliber scientific efforts and minimizing disruption to Air Force laboratory personnel. Accordingly, the Air Force has adopted a philosophy called "gradual migration." Under this policy, one laboratory will initially conduct detailed planning and subsequently relocate over a phased period to avoid the potential for widespread disruption to the Air Force laboratory community and to provide experience and "lessons learned" to the other three laboratories. Phillips Laboratory will begin this process by planning for the relocation of its Geophysics Directorate at Hanscom AFB, Massachusetts, and its Rocket Propulsion Directorate at Edwards AFB, California, to its headquarters site at Kirtland AFB, New Mexico.

FINDINGS

With respect to the Air Force, the Commission finds:

The Air Force Laboratory Consolidation Plan will improve the overall effectiveness of the Air Force laboratory system. That plan, already partially implemented, provides for the following:

- a. Organizational consolidation of 14 laboratories into four laboratories that align with and reside in the Air Force System Command's four product divisions.
- b. Gradual geographical migration of the elements associated with each laboratory to that laboratory's headquarters location.
- c. A Technology Executive Officer who provides integrated science and technology investment strategy guidance to the four laboratories and serves as a dedicated Air Force laboratory system advocate.
- d. Strong emphasis on technology transition and support of the weapons systems acquisition process through direct reporting of laboratory commanders/directors to their product division commanders. (ExSum FAF)

RECOMMENDATIONS

The Air Force should:

1. Continue implementation of the Air Force Laboratory Consolidation Plan. (ExSum RAF1)
2. Use all possible incentives to minimize turbulence, loss of key personnel, and disruption of critical research and development programs. These incentives include retention bonuses, relocation services and assistance, placement services, and time flexibility. (ExSum RAF2)
3. Continue to improve the connectivity between the laboratory structure and the acquisition elements of the product divisions. (ExSum RAF3)
4. Include all Air Force laboratories in the Laboratory Demonstration Program. (ExSum RAF4)

III D. INDEPENDENT COST AND SAVINGS ASSESSMENT

The Institute for Defense Analyses (IDA) assisted the Commission in the review of the cost and savings estimates submitted by the Services in support of research facilities realignment. IDA reviewed documentation provided to the Commission by the Services and by those who oppose closing/moving specific functions in the Services' consolidation plans. The general methodologies and assumptions used in preparing the cost estimates were evaluated, particularly those inherent in the Cost of Base Realignment Action (COBRA) model. Finally, IDA made detailed investigations of the costs and savings of a selected set of installations scheduled for consolidation. Specific investigations were made of the Army CMRL, the Naval Air Development Center, the Naval Underwater Systems Center-New London, the Naval Surface Weapons Center-White Oak, the David Taylor Research Center-Annapolis, and the Aircrew Training Research Facility at Williams AFB.

Based on the IDA report, the Commission finds:

In general, the Services' cost and savings estimates associated with their laboratory reorganization plans are in accordance with established procedures for base closures and are reasonable. (ExSum F7)

IDA identified several limitations in the Services' cost estimating methodology, particularly those relating to the COBRA model. However, these limitations, both individually and collectively, were not sufficient to change the final recommendations or to alter significantly the cost and savings estimates.

In reviewing one-time costs, particular attention was paid to ensure that all relevant cost elements and associated dollars were included. The validity of offsetting cost avoidances was also assessed. IDA took no significant exception to the Services' estimates. The major component of one-time costs is the cost of constructing replacement facilities at the new location. The marginal costs associated with the estimated number of personnel moving, retiring, resigning, or finding other Federal employment, etc., are not major cost drivers. Independent of the effectiveness factor, the one-time costs are generally about the same whether people move or not.

IDA evaluated the cost estimate for Navy construction by reviewing the current plant value of research facilities at the losing installation and comparing that with the replacement costs estimated with the COBRA model. The cost per square foot in the COBRA estimates and those derived from the current plant value were reasonably close and IDA concluded that the estimates were reasonable.

The Army did not use the COBRA factors because they performed a detailed analysis of construction costs for its proposed CMRL at Adelphi, Maryland, and the Aberdeen Proving Ground facilities. The cost for these specialized technical facilities was from two to five times as high as the COBRA model's estimates. This discrepancy illustrates the potential need of performing more detailed analysis for special or unique situations. The COBRA model used standard factors for average requirements. If there is a requirement that differs significantly from the average, such as a highly specialized and costly technical laboratory, the COBRA factors would have to be adjusted accordingly.

Realignment savings usually result from reducing the number of personnel authorizations, which lowers payroll costs and related overhead costs. For the specific research facilities reviewed, the personnel savings accrue mostly from a reduction in civilian positions. Overall, the savings were reasonably calculated using the standard COBRA methodology.

Opponents of some of the realignments questioned the validity of claiming as consolidation savings those personnel reductions that

were also attributable to the congressionally mandated 20 percent reduction. The Navy used savings from consolidations as a means of achieving a portion of the 20 percent mandatory reduction. However, the question of using part of the mandatory reduction in realignment is more properly a laboratory efficiency and effectiveness issue than it is a cost estimating issue. If the research activity can obtain the most favorable efficiency and effectiveness mix through consolidation and its attendant manpower reductions, then the savings are appropriate.

Some limitations were noted with the COBRA cost model. First, documentation is not current. Secondly, the data base that supports the standard factors used in the model is very limited. Third, COBRA is not designed to handle the simultaneous realignment of multiple installations. Fourth, the COBRA structure cannot be easily modified to accommodate certain types of installations - specific data in lieu of standard factors. With respect to the cost estimating methodology, the Commission recommends that:

The COBRA model should be updated to enhance its capability to support the Defense Base Closure and Realignment Commission (BCRC) 93 and BCRC 95 analyses.

IV. INTERSERVICE LABORATORY COOPERATION

The three Military Departments have formalized agreements for joint planning, collocated in-house work, or lead-service assignment of 30 technology areas and 12 areas of scientific research, which cover most of the non-Service-unique portions of the basic research, exploratory development, and advanced technology development programs. This initiative is known as Tri-Service S&T Reliance, or Project Reliance. The study phase of this effort, during which Reliance agreements were developed, was completed in March 1991. The implementation phase began in December 1990, when the overall philosophy of the Reliance process began to become clear.

The goals of Tri-Service S&T Reliance are to:

- o Enhance the quality, effectiveness, and productivity of DoD science and technology
- o Reduce the overlap of capabilities
- o Eliminate unwarranted duplication of effort

- o Increase efficiency and productivity through collocation of in-house work
- o Ensure that a critical mass of resources is applied to programs and facilities to develop world-class organizations and products
- o Maximize cooperation in program planning and execution, wherever appropriate
- o Preserve the Military Departments' mission-essential capabilities.

Breaking the technology areas into appropriate component technologies, Project Reliance produced over 200 specific agreements, 19 of which recognized Service-unique aspects of the various technologies. The agreements require varying degrees of cooperation, collocation, or Service leads in each of the specified technology areas or their component technologies. In some cases, one or more of the Services are proscribed from conducting in-house work on specific technologies in their own laboratories and instead agree to rely on the facilities and/or capabilities of another Service. Changes called for under these reliance agreements become effective in October 1991, with the start of FY 92. Joint planning has already begun, with the goal to begin joint programs in October 1992, with the start of FY 93.

Establishment of this joint planning process is perhaps even more important than the Reliance agreements. The process, which involves senior Service technology base managers, is designed to ensure a top-down focus and a coherency across the Services in terms of both utilization of in-house resources and contractual efforts.

Cognizance for overseeing the implementation of these agreements and the joint planning process was assigned to four Tri-Service oversight bodies:

- o Joint Directors of Laboratories (JDL)--combat materiel technologies and basic research
- o Armed Services Biomedical Research, Evaluation and Management (ASBREM) Committee--biomedical technology
- o Training and Personnel Systems Science and Technology Evaluation and Management Committee--manpower personnel, training technologies

- o Joint Engineers--civil engineering and environmental quality.

These bodies, in turn, have created technology panels that have been assigned responsibility for implementation of specific Reliance agreements, coordinating with technical specialists in the Office of the Director, Defense Research and Engineering, and interacting with organizations within and outside of DoD. The JDL has had the lead role for developing an overall implementation system, integrating joint Service planning with the planning processes of each of the Military Departments, which also will serve as models for the other bodies.

With respect to laboratory cooperation, the Commission finds:

The recently initiated interservice Project Reliance offers considerable potential for strengthening the effectiveness, productivity, and cohesiveness of DoD science and technology. (ExSum F14)

Substantial benefits should be expected after execution of joint programs in FY 93.

Project Reliance has opened up channels of communication in the S&T community at multiple management levels as well as the bench scientist level.

With respect to laboratory cooperation, the Commission recommends:

The Services should continue to implement Project Reliance and the Director, Defense Research and Engineering should review the implementation of Reliance agreements periodically to ensure that there is no unwarranted duplication and that optimum resource utilization is achieved. (ExSum R8)

V. IMPROVED MANAGEMENT AUTHORITY AND FLEXIBILITY

To be effective, DoD laboratory management must have adequate authority and flexibility to permit aggressive, responsive execution of the laboratory mission. In general, laboratories are required to operate under the same set of statutes, regulations, and directives that were enacted to govern the acquisition of major weapons systems. However, the nature of conducting research is fundamentally different than acquiring weapons systems for operational use.

Accordingly, there are a number of management measures tailored for the laboratory community that could improve laboratory effectiveness significantly. Those measures include, but are not limited to, the following:

- o Allow DoD laboratories to operate under standard business practices within statutory limits; delegate to laboratory directors the authority and control over resources and management functions such as contracting, purchase of technical equipment and supplies, personnel management (work force managed to budget), financial management, automated data processing, and facilities, with minimal external constraints. External reviews would ensure that laboratory management adheres to sound business practices.
- o Provide institutional discretionary laboratory-directed funding at a level based on total R&D funding, e.g., 10 percent of total R&D funding. Oversight on use of discretionary funding by laboratory directors can be provided through periodic external peer review.
- o Improve the recruitment and retention of talented professionals through full delegation of authority of the provisions of the Federal Employees Pay Comparability Act of 1990 (FEPCA) to laboratory directors. These provisions include advanced in-hire rates, interview expenses, first post-of-duty expenses, recruitment bonuses, retention allowances, and special rates. A more thorough discussion of FEPCA is provided in appendix G.
- o Make liberal allocations of senior-level technologist positions to the laboratories. Modify the definition of senior-level technologist to allow limited supervisory responsibilities in keeping with the need to lead teams in technology projects.
- o Provide sufficient Senior Executive Service (SES) positions for the responsibilities assigned to an activity.
- o Improve the efficiency of contracting procedures by substantially raising the small purchase limitation and allowing exceptions to advertising for bidders for work requiring technology specialties.

- o Raise facility construction approval thresholds to realistic levels, then index them to the inflation rate for construction costs.
- o Develop unified, DoD-wide coordination of external reviews to avoid time-consuming, overlapping reviews and audits by multiple agencies.
- o Establish clear and nonconflicting policies from the DoD level down and maintain a commitment to these policies. Continuity of direction is essential to effective RD&E activity.

With respect to laboratory management, the Commission finds:

Strong advocacy on behalf of the laboratories at Service headquarters and in the Office of the Secretary of Defense is needed to ensure the effectiveness of the laboratories. (ExSum F9)

The effectiveness of the DoD laboratories suffers from regulatory and policy impediments to the authority and flexibility of the individual laboratory directors. (ExSum F10)

DoD-wide commitment to laboratory management excellence, high-level advocacy, and removal of obstacles to management authority and flexibility will provide an environment for greatly improving the productivity and effectiveness of the laboratories. (ExSum F11)

Currently, two principal vehicles exist for implementing laboratory management improvements: (1) the DoD Laboratory Demonstration Program (LDP) and (2) conversion of some or all of the current DoD laboratories to GOCO laboratories.

V A. THE LABORATORY DEMONSTRATION PROGRAM (LDP)

In November 1989, the Deputy Secretary of Defense initiated the LDP to develop and demonstrate management initiatives that could dramatically improve the quality, productivity, and effectiveness of the DoD laboratory system. The LDP is designed to be a vehicle by which the Military Departments and Defense Agencies can evaluate innovative administrative procedures and management practices that are tailored to the laboratory mission and environment. The LDP

concentrates on making improvements in the following four functional areas: personnel management, R&D contracting, facilities modernization, and the laboratory director's authority. The goal is to increase local management authority and flexibility to approach that of a GOCO while retaining the advantages of closer customer ties enjoyed by DoD laboratories. One of the most important advantages that GOCO laboratories enjoy over DoD laboratories is in the area of personnel regulations. The recently enacted FEPCA (appendix G) addresses many of the personnel concerns. Currently, 30 laboratories and centers are "demonstration laboratories": 18 Army, 9 Navy, 2 Air Force, and 1 Defense Nuclear Agency.

With respect to the Laboratory Demonstration Program, the Commission finds:

The Laboratory Demonstration Program and the recently enacted Federal Employees Pay Comparability Act contain many of the provisions needed to enhance organic management flexibility. (ExSum F12)

V B. CONVERSION TO GOVERNMENT-OWNED, CONTRACTOR-OPERATED LABORATORIES

Another alternative to provide increased management authority and flexibility to DoD laboratories is to convert some or all of the current DoD laboratories to contractor operator status. As the name implies, GOCO laboratories are operated by contractors (e.g., universities or private firms). Examples of GOCO laboratories are the Department of Energy National Laboratories and the Air Force's Lincoln Laboratory. The key advantage of GOCOs is that they are not restricted by Federal statutes and regulations pertaining to personnel and procurement practices. For example, a GOCO laboratory can typically offer higher salaries to prospective employees and hire them much more quickly than can DoD laboratories operating under current Federal regulations. GOCO laboratories must operate within fixed budget restraints just as DoD laboratories must do. Thus, GOCO laboratories are motivated to be highly selective in their hiring practices.

While GOCO laboratories currently have more management authority and flexibility than DoD laboratories, there are some disadvantages associated with GOCO laboratories. Perhaps the most significant disadvantage is the potential for GOCOs to be less closely connected to their Government customer than DoD laboratories.

With respect to conversion to GOCO laboratories, the Commission finds:

Conversion of some or all of the laboratories to Government-Owned, Contractor-Operated organizations could improve their effectiveness. However, fixing the problem organically is preferable to such a conversion.

(ExSum F13)

VI. PRINCIPAL RECOMMENDATIONS

The proposed Army and Navy laboratory consolidations and realignments should begin in January 1992. The Army should delay implementation of the microelectronics function at Adelphi, Maryland, and construction of the facility to house the function until the completion of the study in recommendation 7. The Air Force should continue implementation of its laboratory consolidation plan. All service plans should be implemented so as to minimize disruption during the transition to a new structure.

(ExSum R1)

The Secretary of Defense should direct the Services to implement all the provisions of the Laboratory Demonstration Program without delay, extend the program to all DoD laboratories, and seek legislative action required to complete the Laboratory Demonstration Program initiatives, including the personnel-related actions.

(ExSum R2)

The Secretary of Defense should instruct the Services to delegate the authorities provided under the Federal Employees Pay Comparability Act immediately to the individual laboratory directors. (ExSum R3)

The Secretary of Defense should direct each Service to establish a high-level advocate who will report to the Service Assistant Secretary level and who will be accountable for the effectiveness of its laboratories.

(ExSum R4)

The Services should strengthen the selection process for laboratory directors, emphasizing technology and technology-management qualifications. These positions should be filled for a minimum of 4 years. (ExSum R5)

Each laboratory should establish an advisory committee of outside experts to review periodically the status of the laboratory and its work, and make recommendations to the director. (ExSum R6)

An independently appointed review group should assess the advantages and disadvantages of a single microelectronics research facility for all three Services. If a single facility is a viable solution, consideration should be given to a Government-Owned, Contractor-Operated Laboratory. (ExSum R7)

The Director, Defense Research and Engineering should ensure through periodic reviews that the recommendations contained in this report are being implemented. In addition, the Director should review the status of the individual Service laboratory consolidations and realignments at least semiannually to ensure that they are being accomplished to maximize effectiveness and minimize disruption to personnel and ongoing technical programs. (ExSum R9)

APPENDIX A

MEMBERS FEDERAL ADVISORY COMMISSION ON CONSOLIDATION AND CONVERSION OF DEFENSE RESEARCH AND DEVELOPMENT LABORATORIES

CHAIRMAN: Mr. Charles E. Adolph
Performing Duties of Director,
Defense Research and Engineering
Office of the Secretary of Defense

PRIVATE-SECTOR MEMBERS:

Dr. Solomon J. Buchsbaum
Senior Vice President
Technology Systems
AT&T Bell Laboratories

Mr. Robert M. Hillyer
Executive Vice President
ORINCON Corporation

Dr. O'Dean P. Judd
Chief Scientist
Los Alamos National Laboratory

Dr. James C. McGroddy
Vice President and Director of Research
International Business Machines Corporation

Dr. John Michael Palms
President
University of South Carolina

Dr. Frank D. Verderame
President
Verderame Associates, Inc.

PUBLIC-SECTOR MEMBERS:

Dr. James F. Decker
Deputy Director
Office of Energy Research
U.S. Department of Energy

Dr. John W. Lyons
Director
National Institute of Standards and Technology
U.S. Department of Commerce

Dr. Victor H. Reis
Director
Defense Advanced Research Projects Agency
U.S. Department of Defense

Dr. William C. McCorkle
Director
U.S. Army Missile Command Research and Development
Center

Mr. Earle L. Messere
Technical Director
U.S. Navy Naval Underwater Systems Center

Col Richard R. Paul
Commander
U.S. Air Force Wright Laboratory

EXECUTIVE DIRECTOR:

Mr. Raymond F. Siewert
Acting Deputy Director
Defense Research and Engineering
(Research and Advanced Technology)
U.S. Department of Defense

EXECUTIVE SECRETARY:

Dr. Michael A. Heeb
Staff Specialist for Laboratory Management
Office of Director
Defense Research and Engineering
U.S. Department of Defense

APPENDIX B

NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 1991

SEC. 246. ADVISORY COMMISSION ON CONSOLIDATION AND CONVERSION OF DEFENSE RESEARCH AND DEVELOPMENT LABORATORIES

(a) **ESTABLISHMENT.**--There is established a commission to be known as the "Commission on the Consolidation and Conversion of Defense Research and Development Laboratories" (hereinafter in this section referred to as the "Commission").

(b) **DUTIES.**--(1) The Commission shall conduct a study to determine the feasibility and desirability of various means to improve the operation of laboratories of the Department of Defense.

(2) In conducting the study described in this subsection, the Commission shall --

(A) consider such means as--

(i) conversion of some or all such laboratories to Government-owned, contractor-operated laboratories

(ii) modification of the missions and functions of some or all such laboratories; and

(iii) consolidation or closure of some or all such laboratories; and

(B) determine--

(i) the short-term and long-term cost savings that are likely to result from such consolidation, closure, or conversion, and

(ii) a proposed schedule for each consolidation, closure, or conversion of a laboratory considered appropriate by the Commission.

(c) COMPOSITION.--(1) The Commission shall be composed of 13 members, as follows:

(A) The Director of Defense Research and Engineering who shall be the chairman of the Commission.

(B) Six members appointed by the Secretary of Defense from among officers and employees of the Federal Government, including at least one director of a research and development laboratory of each military department.

(C) Six members appointed by the Secretary from among persons in the private sector.

(2) The Secretary of Defense shall make all appointments under subparagraphs (B) and (C) of paragraph (1) within 60 days after the date of the enactment of this Act.

(3) Members shall be appointed for the life of the Commission. Any vacancy in the commission shall not affect its powers, but shall be filled in the same manner as the original appointment.

(d) MEETINGS: QUORUM.--(1) The Commission shall convene its first meeting within 15 days after the first date on which all members if the commission have been appointed. Thereafter, the Commission shall meet at the discretion of its Chairman or at the call of a majority of its members.

(2) Seven members of the Commission shall constitute a quorum, but a lesser number may hold hearings.

(e) COMPENSATION OF MEMBERS TRAVEL EXPENSES.--(1) Each member of the Commission who is not an officer or employee of the Federal Government shall be compensated at a rate equal to the daily equivalent of the annual rate of basic pay prescribed for grade GS-18 of the General Schedule under section 5332 of title 5, United States Code, for each day (including travel time) during which such member is engaged in the performance of the duties of the Commission. All members of the Commission who are officers or employees of the United States shall serve without compensation in addition to that received for their services as officers or employees of the United States.

(2) The members of the Commission shall be allowed travel expenses, including per diem in lieu of subsistence, at rates authorized for employees of agencies under subchapter I of chapter 57 of title 5, United States Code, while away from their homes or regular places of business in the performance of services for the Commission.

(3) Any Federal Government employee may be detailed to the Commission without reimbursement, and such detail shall be without interruption or loss of civil service status or privilege.

(f) **REPORT TO SECRETARY.**--Not later than September 30, 1991, the Commission shall submit to the Secretary a report containing the Commission's recommendations regarding the matters considered and determined by the commission pursuant to subsection (b).

(g) **REPORT BY SECRETARY.**--Not later than 30 days after the date of the submission of the report pursuant to subsection (f), the Secretary shall transmit such report to each House of the Congress, together with any comments that the Secretary considers appropriate.

(h) **TERMINATION.**--The Commission shall terminate 90 days after the date on which the Commission submits its report to the Secretary pursuant to subsection (g).

- - - END - - -

APPENDIX C

DISCUSSION OF SELECTED FUNCTIONS OF DEFENSE LABORATORIES (FROM FIGURE 1. FUNCTIONS OF DEFENSE LABORATORIES)

The Second Function: ACT AS PRINCIPAL AGENTS IN MAINTAINING THE TECHNOLOGY BASE

This statement requires an elaboration of what is meant by the word maintain. The Defense laboratories do not develop all, or even a major part of, the technology applicable to DoD defense. Their role is to bring the national technology base (Government, academia, and industry) to bear on defense problems. The DoD laboratories identify areas where the base is inadequate and stimulate additional research in those areas. To do this, they collectively must have expertise in virtually all areas of science and, most important, must have in their employ experts in all areas appropriate to each laboratory's mission.

The Fourth Function: SUPPORT THE ACQUISITION PROCESS

This function is central to the underlying mission of the Defense laboratories stated above. By policy, and perhaps necessity, the nation relies primarily on the private sector for the development and production of military equipment. The laboratories provide to the acquisition agents (i.e., the Services' program managers), an in-house, technologically qualified agent to oversee or evaluate the performance of the industrial developer as required to ensure that the design is technically sound, will satisfy performance requirements, and is producible and affordable. In this role, the laboratories often serve as an integral part of the program manager's team.

The Fifth Function: PROVIDE SPECIAL-PURPOSE FACILITIES NOT PRACTICAL FOR THE PRIVATE SECTOR

This function recognizes that, while it would be possible to interest private concerns in running almost any facility, it may not be practical to do so. Typical facilities considered here include test ranges, environmental test facilities, large-scale simulation capabilities, systems integration laboratories, etc. Such facili-

ties are expensive and can consume large amounts of land, sea, or air space. They tend to be used intermittently. It is not practical or economical to have each Defense contractor maintain its own facility. The laboratories provide these facilities for the use of the Government and its contractors. They can accommodate intermittent use by sharing resources across several such facilities.

The Seventh Function: BE A CONSTRUCTIVE ADVISER FOR DEPARTMENT DIRECTIONS AND PROGRAMS BASED ON TECHNICAL EXPERTISE

The purpose of this function is to provide independent advice to the Services' and DoD's management on the efficacy, status, timeliness, and progress of acquisition programs. No other function of the laboratories is more contentious, but the complexity of these programs requires an independent voice to ensure the best systems for our fighting forces at an affordable cost.

The Eighth Function: SUPPORT THE USER IN THE APPLICATION OF EMERGING TECHNOLOGY AND INTRODUCTION OF NEW SYSTEMS

In executing this function, the laboratories rapidly insert technology advances into operational forces and assist the user in adapting technologically sophisticated equipment for the operational environment. In the process of doing this, the laboratories gain the knowledge to undertake FUNCTION NINE: TRANSLATE USER NEEDS INTO TECHNOLOGY REQUIREMENTS FOR INDUSTRY and to most effectively provide the central role of the smart buyer.

APPENDIX D

"GOOD LABORATORY" ATTRIBUTES

Section II C of the report identifies nine attributes of a healthy and effective (i.e., "good") laboratory. These attributes, as further discussed below, represent the salient points that emerged from extensive deliberations on what qualities and characteristics are essential to the health and long-term productivity of a DoD laboratory. Previous studies on improving the effectiveness of the laboratories were reviewed, including the White House Science Council Federal Laboratory Review of 1983 (the Packard Report) and, especially relevant, the 1990 report of the Research and Development Subcommittee of the House Armed Services Committee ("Challenges Confronting the DoD Laboratories"). This latter report identified six continuing major problem areas that impede the effectiveness of DoD laboratories. The Commission viewed these long-term, unresolved problems as a strong indication that there is a widespread lack of appreciation for the special nature of DoD laboratories.

The attributes of a good laboratory are indicators of the probability of success in providing needed products for the national defense effort. Products of the laboratories include technology explorations and advancements, analysis of needs and opportunities, definition of new military systems, transitions of technology to industry and into military operation, strong involvement in the acquisition process, direct support of operational systems (problem fixing, design improvements, etc.), technical documentation for the above, and all other efforts required to perform the smart buyer role. One product area requiring special emphasis for the Research, Development and Engineering Laboratories, because of its critically important role in decision making at all levels, is modeling, analysis, and simulation at the subsystem, system, and operational force levels.

To fulfill the nation's needs for creativity and excellence in R&D, the DoD laboratories must be allowed to operate as unfettered entities, in a similar fashion to the successful contractor-operated laboratories. Indeed, none of the attributes identified would be

viewed as exotic criteria for R&D laboratories in private industry. The discussion below should make this evident.

Nine major attributes of a good laboratory can be used as measures of health and productivity for DoD laboratories:

1. A Clear and Substantive Mission with documented responsibilities for technical performance in specific areas.

The first necessary condition for an effective DoD laboratory is a significant purpose with technical responsibilities. This condition is best met through a clear, substantive, relevant, and unique mission statement and augmenting statements explaining specific areas of technical responsibility. The parent organization and all customers must recognize, accept, and support this mission through consistent assignment of appropriate tasks to the laboratory.

2. A Critical Mass of Assigned Work appropriate to a viable, separate entity that is able to support the full range of support functions and command recognition for its contributions.

An effective DoD laboratory must exceed some threshold of size to be a viable, separate entity that is able to support the full range of support functions and command widespread recognition for its contributions. Since size should be a function of workload, it is necessary that the extent of the work needed from the laboratory exceed some critical mass value, probably near the 1000 work-years level.

3. A Highly Competent and Dedicated Work Force comprised of high-caliber technologists and technology managers.

The fundamental basis of any successful laboratory is the technologists and technology managers who are widely recognized for their creativity and productivity. These scientists and engineers can be either in-house or recruited. Good morale is also essential to effectiveness. In DoD laboratories, this is based on interesting work, opportunities for further education, recognition of superior achievement (monetary, public, and peer recognition), and nurturing of creativity by management.

4. An Inspired, Empowered, Highly Qualified Leadership committed to technical excellence through support for excellence, creativity, and high-risk/high-payoff initiatives.

Effective management of a DoD laboratory has much in common with effective management in private industry. There is a clear requirement that the key managers (the technical directors) meet high standards of qualification in their technical background and technology management experience. Another characteristic of good technical management is a commitment to creative work environments, where individual initiative in support of laboratory functions is encouraged and nurtured. This type of management provides opportunities for fledgling technology efforts to be reviewed and discussed with upper management. Requirements for resources (people, equipment, proposal funding, etc.) must also be addressed early and fairly.

Ensuring the success of a DoD laboratory requires a management perspective that emphasizes a long-term view of planning and accomplishment. Technological breakthroughs can take many years to mature into operational applications; the laboratory manager must make an ongoing commitment of resources, which allows that maturation to take place in an orderly fashion.

A related attribute for technical directors is the willingness to undertake technology developments that are recognized as being high risk and having high payoff potential. Even in the absence of a profit requirement, there is still the fear of failure that may dissuade managers from supporting "giant leap" projects. Since superiority in military capabilities depends on large strides in applied technology, effective management will base its go/no go decision on an objective risk/reward evaluation.

External managers in the laboratory chain of command also need to have appropriate technical qualifications and a perspective sympathetic to the long-term technology innovation functions of the laboratories. It is clearly important that they have a close working relationship with local laboratory managers; both sides must be committed to nurturing such a relationship.

5. State-of-the-Art Facilities and Equipment, including many specialized laboratory facilities appropriate to leading-edge technology applications to support operational systems.

Facilities appropriate to advancing the leading edge of relevant technologies are necessary to fully exploit the creative potential of scientists and engineers. They include laboratory facilities that are unique and highly specialized to execute the laboratory's substantive and unique mission. New technical facilities must become available at the rate for which technology advancement is desired; there is a direct cause-and-effect relationship.

6. **An Effective Two-Way Relationship with Customers**, via frequent contact with operational forces and their requirements, involvement with operational systems, and a shared vision.

In discussing the desired customer relationship for a DoD laboratory, it is necessary to distinguish between the science and technology (S&T) laboratory and the research, development, and engineering (RD&E) laboratory. (See discussion under #7 below.)

The effective RD&E laboratory, in fulfilling its smart buyer function, must have a good understanding of the operational requirements, including the operating environment, for the systems whose acquisition it is supporting. Such an understanding can only be obtained through frequent contact with the operational forces. These contacts will include training and troubleshooting assistance to the users of supported systems, tracking of operational systems' performance to identify problem areas and improvement opportunities, and regular tours of laboratory personnel in technical advisor positions with operational staffs. Frequent, purposeful user contacts ensure a smooth transition of newly developed systems into the operating forces and provide a feedback mechanism for user concerns and user satisfaction. Typically, there will also be a specific laboratory organizational element established to maintain routine liaison with the operator/customer.

Finally, frequent, high-level contacts between laboratory managers and both headquarters acquisition managers and operational force commanders are essential to developing the understanding and trust that ensure the greatest productivity of the laboratory and greatest benefit to the customer.

The appropriate customer relationships for the S&T laboratory are more variable. Contacts with the user may be limited, but not nonexistent. Higher-level contacts will be emphasized, because of the strategic (long-term) planning implications of S&T laboratory research. The parent command will have a greater role in influenc-

ing the course of S&T laboratory programs and making potential users aware of the opportunities implicit in their research products. RD&E organizations, whether in-house or a contractor, should also be considered as a user group for the technology products of the S&T laboratories.

7. A Strong Foundation in Research with a balance of effort in development and engineering.

An effective laboratory fulfills an ongoing need for laboratory-type work in R&D. The Commission has chosen the criteria of at least 10 percent of total work-years in S&T (funding categories 6.1, 6.2, and 6.3A) and at least 50 percent of total work-years in R&D (funding categories 6.1 - 6.6) as defining a laboratory. If a laboratory is unable to attract funding to support these categories of work, then its role within the Service should be reconsidered.

In practice, there are two basic types of DoD laboratory: (1) the S&T laboratory, which is focused on basic and applied research; and (2) the research and development, and engineering (RD&E) laboratory, which is involved throughout the life cycle from basic research to operational system improvement, but is focused on advanced technology applications and acquisition support.

8. Management Authority and Flexibility, including the authority to staff and direct its technical programs as well as to completely control all inherent support functions (personnel, finance, contracting, data processing, etc.).

Given a clear assignment of responsibilities, an effective laboratory has sufficient local operating authority to execute the above responsibilities in a rational, effective manner. Laboratory management must have the authority to plan, organize, staff, and direct its technical program as well as all necessary support services to ensure that the technical program is not impeded by inadequate support. The support services should be organic to the laboratory. External controls should be minimized; for example, as was noted in the Packard Report(1983), external "personnel ceilings...should not be used in addition to budgetary control." Laboratory management must also have the contracting authority to procure the goods and services needed for these efforts.

Further, management at a successful laboratory has the authority and accountability to perform its own financial and personnel management functions in accordance with good business practices and within statutory and regulatory controls. Automated data processing equipment and operations are also essential laboratory resources and should be left under laboratory management control.

It is important that the overall DoD authority structure afford the opportunity to manage in a stable environment. The need for clear and consistent external direction has been a frequent topic in DoD laboratory studies over the years. Among the perturbation factors are the rotation of senior military officials and initiatives by officials and organizations outside the chain of command. While it would be unrealistic to expect that the laboratories could be totally insulated from changing Government policies, a high-level commitment to minimizing change (including abrupt changes in funding) and maximizing continuity of policies is an unequivocal prerequisite for laboratory effectiveness. Other externally imposed burdens on local management, such as audits, need to be minimized through coordination with their source agency.

Since each laboratory is recognized as an expert activity within DoD for its mission area, it follows that the laboratory technical director is uniquely well qualified to determine S&T projects that are deserving of immediate effort. To enable the laboratory to aggressively pursue potential high-payoff projects without having to "sell" them into the budget, the technical director must have the flexibility to devote a portion of the laboratory's annual R&D budget to independent, laboratory-directed R&D programs.

The value of institutionalizing a laboratory-directed funding element has been noted many times in previous studies. For example, Recommendation 3-2 of the Packard Report states: "At least 5 percent, and up to 10 percent, of the annual funding of the Federal laboratories should be devoted to programs of independent research and development at the laboratory director's discretion."

The Commission judged that 10 percent of the laboratory's R&D (6.1-6.6) funding is an appropriate gauge for discretionary funding.

Clearly there should be periodic outside reviews of the effectiveness and excellence of a discretionary S&T program. However, it is important that such reviews address those projects that are completed, not attempt to second-guess projects that are in progress.

9. **A Strong Linkage to Universities, Industry, and Other Government Laboratories**, including foreign ones, to ensure that opportunities for technology advancement are utilized most effectively.

It is important to mission success for the DoD laboratory to cooperate with universities, other leading research institutions, and industry in advancing mission-relevant technologies. Laboratory managers must be willing to turn to the best available external consultation in dealing with identified impediments to program success.

In addition to the nine laboratory attributes described above, it is essential to have the advocacy of a high-level official to ensure respect for the laboratories and minimizing external interference in its operation. This official/advocate must be responsible for, and committed to, the laboratories' ability to succeed. Such an advocate must have the authority to review the effectiveness of the laboratories under his purview and the charter to represent and advocate in their behalf at the highest levels. The preferred method of ensuring the highest effectiveness is periodic peer reviews by teams of outside (Government, industry, universities) technical managers, who would report their findings to this senior advocate.

APPENDIX E

Laboratory Measures of Effectiveness

The Commission believes that laboratory productivity and effectiveness need improvement. Appendix D lists and defines the attributes essential to laboratory health and long-term productivity. A necessary element for continuous improvement is periodic measurement using input and output measures of effectiveness.

The Commission views the following as a representative set of measures of effectiveness suitable for internal and external reviews of DoD laboratories:

Input

1. Mission - clear, substantive, unique
2. Types and percentages of funding and applied work-years - appropriate for laboratory
3. Specific tasking/responsibilities - appropriate for laboratory
4. Workload - demonstrated need for products
5. Quality of facilities
6. Employee credentials - degrees, GPA, training

Output

1. Transitions to warfare systems
2. Reports/presentations - external/internal
3. New system concepts - proposed/successful
4. Proposals of all kinds - proposed/successful
5. System specifications developed
6. Systems analysis
7. Invention disclosures, patents
8. Peer review - qualitative
9. External awards
10. Reputation among users - commendations, surveys
11. Audits - types of problems, resolved vs. unresolved

All output measures of effectiveness may not apply to every laboratory.

APPENDIX F

**DEPARTMENT OF DEFENSE
Washington, D.C.**

**GOALS AND OBJECTIVES*
FOR
DEPARTMENT OF DEFENSE
RESEARCH AND DEVELOPMENT LABORATORIES**

The Department of Defense laboratories exist to achieve - in cooperation with universities and industry - a level of **technological leadership** that will enable the United States to develop, acquire, and maintain military capabilities needed for national security.

MISSION

- Ensure the maintenance and improvement of national competence in technology areas essential to military needs
- Avoid technological surprise and ensure technological innovation
- Maintain a continuity of effort, free from excessive commercialization pressure, directed toward the conception and evolution of advanced military materiel and support technologies
- Pursue technology initiatives through the planning, programming, and budgeting process: allocate work among private sector organizations and government elements
- Act as principal agents in maintaining the technological base of the Department of Defense
- Provide materiel acquisition and operating system support
- Have available a fast-reaction capability to solve critical, immediate technical problems that arise when unexpected operational situations are encountered
- Stimulate the use of demonstrations and prototypes to mature and exploit U.S. and allied technologies
- Carry out activities having high technological risk or requiring intensive resource investment not available

from the private sector

- Interface with the worldwide scientific community; provide support to other governmental agencies

OPERATIONS

- Respond to national defense needs by undertaking actions to:
 - Achieve timely improvements in military systems and develop techniques for increasing their effectiveness
 - Reduce manpower and skill constraints on material performance
 - Lower materiel production, operation, and support costs
 - Extend life of operational systems
- Continue intensive user-developer interfacing to:
 - Achieve greater sensitivity to potential combat requirements and operating environments
 - Integrate technological objectives with materiel readiness, modernization, and sustainability requirements.
 - Evolve effective balance between technology push and requirements pull
- Continue a vigorous partnership with industry and the academic community
- Distribute efforts appropriately across short-, mid-, and long-term horizons
- Participate actively in the overall Defense planning process

MANAGEMENT

- Provide laboratory managers with the responsibility, authority, and flexibility to manage laboratories and technical programs through use of broad guidelines and without overlapping controls
- Ensure competency of Personnel
 - Recognize clearly that the most valuable resource of the laboratories is the capability, skill, and creativity of their personnel
 - Provide for personnel stability, challenging work, and meaningful incentives

- Provide for equal opportunity for career development, training, promotion, recognition and reward
- Upgrade Facilities and Equipment
 - Remove limitations which constrain modernization of laboratories
 - Promote productivity, energy efficiency, and cost avoidance through policies which provide for modern facilities and equipment
 - Base replacement policies on practices that benefit the business venture nature of research and development activities
- Provide effective procedures for Procurement and Acquisition
 - Provide laboratories with the authority and capability to make procurement and acquisitions in a timely and efficient manner
 - Ensure technical excellence in contractor performance
- Achieve continuing Assessment and Accountability

The Office of the Secretary of Defense and the Military Departments are jointly responsible for establishing policies and procedures conducive to the continuing vitality of the laboratories. Accordingly, periodic evaluations will be conducted to assess the health of the laboratories, the quality and quantity of their contributions, and their performance against the public's legitimate expectations of efficient and effective use of personnel and financial resources.

* Extracted from DoD Directive 3201.1, March 9, 1981 and DoD Instruction 3201.3, March 31, 1981

APPENDIX G

NOTES ON FEPCA

I. FUNDAMENTAL IMPROVEMENTS IN THE GENERAL SCHEDULE

The Federal Employees Pay Comparability Act of 1990 is the most comprehensive change in the Federal White Collar Pay System since 1949, when the 18-grade General Schedule was established.

A. Regular Annual Adjustment (under 5303) - Pay will be adjusted annually to reflect the increase in the nationwide Employment Cost Index (ECI, an index maintained by the Bureau of Labor Statistics) which measures the percent increase in payroll costs from one point in time to another.

1. In January of 1992 and 1993, all General Schedule employees will receive annual raises equal to the increase in the ECI.
2. Beginning in 1994, the annual increase will equal the ECI minus one half of one percentage point.

The President retains authority to reduce the amount of these adjustments but can do so only in the following manner and only under the following circumstances, and must report both the reasons and the expected effects of such a modification to Congress.

- (a) If the adjustment for 1992 or 1993 should be 5% or less, no change may be made by the President unless there is (i) a state of war, or (ii) there are "severe economic conditions" defined as there having been 2 calendar quarters of negative growth in GNP during the 12 month period ending June 30, 1991 (for 1992) or June 30, 1992 for 1993.

If the adjustment for 1992 or 1993 should be more than 5% and there is a national emergency or serious economic conditions, the adjustment may be reduced to 5%, but if conditions (i) or (ii) exist, the adjustment may be reduced below 5%.

- (b) For subsequent years, the President may make the annual adjustment less than prescribed by this Act if there is a national emergency or if serious economic conditions exist. The GNP, the Indexes of Leading Economic Indicators, the budget deficit, the unemployment rate, the Producers Price Index, the Consumer Price Index and the ECI and other unnamed factors may be used to define serious economic conditions.

Based on the ECI for the 12 months ending September 30, 1990, the nationwide increase in January, 1992 will be 4.2% unless the prescribed conditions (war or recession) exist. In fact, we are no longer at war, and 12

we have had one quarter of negative growth in GNP. The second quarter (Apr - June) GNP must be negative to meet the recession requirement.

Under the Ethics Reform Act, the December 30, ECI was 4.0 percent, which translates into a 3.5 percent increase for the Executive Schedule, Congressional, and Judicial salaries. Presumably, SES will get the same 3.5 percent.

B. Locality-based Comparability Payment (under 5304) - Under instructions on boundaries for pay areas and jobs to be surveyed, the BLS will make pay surveys for each pay area in the contiguous states. The pay for these surveys will be aggregated across occupations. These surveys will include salaries for state and local government employees (which the ECI doesn't include.) The difference between (average) Federal and (average) non-Federal pay for comparable positions shall be referred to as a "pay disparity". Every General Schedule employee within the continental United States (as defined in sec. 5701(6)) shall be included within a pay locality.

Beginning in 1994, Federal General Schedule employees in areas where the pay disparity between the local average non-Federal salaries and Federal salaries is at least 5%, will receive an additional increase. [not automatic for VA, FS, FWS, ALJs/BCAs, SES, critical Positions, or senior level positions.]

In the first year, 1994, this locality payment will be 20% of the amount of the disparity over 5%.

The locality adjustment will be 30% of the remaining disparity over 5% in 1995, 40% of the disparity over 5% in 1996, 50% in 1997, 60% in 1998, 70% in 1999, 80% in 2000, 90% in 2001 and 100% of the remaining disparity over 5% in 2002.

All General Schedule employees in the same area will receive the same percentage locality adjustment. These comparability adjustments are part of basic pay for retirement, life insurance, and premium pay purposes. If a Federal employee is transferred to another geographic area, the employee will not retain the old geographic adjustment but will receive the General Schedule rate of pay effective for that new area.

The President has discretion to reduce locality adjustments in 1994 if the total cost in the first year exceeds \$1.8 billion.

The sum of comparability payments and the rate of basic pay may not exceed the rate of basic pay for Executive Level IV (\$108,300 in 1991). For senior-level, SES, FBI and DEA SES, ALJ, and Contract Appeals Board positions the maximum is Executive Level II (\$125,100 in 1991).

B. Senior Level Positions - (sec. 102) FEPCA establishes a new 5 U.S.C. 5376 on paysetting for senior-level positions. Supergrades, GS 16-18, and the

Executive Assignment System (EAS) are replaced with a single pay band. Pay for these positions is fixed by the agency head, subject to FPM guidelines, and shall be not less than 120% of the minimum basic rate for a GS-15 (amounts to \$73,972 in 1991) and not more than the rate for Executive Level IV (\$108,300 in 1991). The method of pay setting for the agency should be shown in written procedures which also establish how often pay may be adjusted. There continues to be a Governmentwide limit of 517 ST positions. *As of April 4, 1991 there is no legal limit on the number of SES and SL positions combined, but 5 U.S.C. 3133 still requires that OPM, in consultation with OMB, allocate a total number of SES positions to each agency on a biennial basis. SL numbers could be limited by regulation, but these have not yet been published.*

OPM also shall establish standards and procedures for classification of senior level positions. The method and speed of movement through this band has not yet been established.

II. NEW COMPENSATION TOOLS FOR RECRUITMENT AND RETENTION

Advanced In-Hire Rates - New hires may be offered starting pay which is higher than the minimum rate for any grade so long as the salary is within the range for that grade and the other requirements of section 5333(a) are met. This gives managers a range of salaries to work with when competing with other potential employers. All other restrictions remain in effect as before. The decision may not be based solely on the candidate's existing salary but must also be based on high or unique qualifications or special need of the agency. Regulations effective February 14, 1991.

Interview expenses - An individual being considered for employment by an agency may be paid for travel or transportation expenses to and from pre-employment interviews determined necessary by the agency. Regulations effective February 14, 1991.

First Post of Duty Expenses - Travel and transportation expenses may be paid for new appointees whenever the agency determines that such payment is appropriate for any position regardless of shortage category. Regulations effective February 3, 1991. Regulations effective February 14, 1991.

Recruitment Bonuses - An agency may be authorized to pay a lump-sum bonus of up to 25% of basic pay (without any comparability or other additions) in order to recruit for hard-to-fill positions from outside or inside the Government. This is not basic pay. A service agreement is required. Interim regulations issued March 28, 1991 require that (1) the agency establish a recruitment bonus plan with procedures, criteria, designation or authorized officials, requirements for service agreement, and documentation procedures; (2) the minimum service requirement is one year; (3) two levels of reviews be used; (4) each case be determined separately even if specific categories of employees were identified in the plan, and (5) an internal evaluation shall be conducted and reported to OPM. *Although we have assumed that this was not intended as a vehicle for ruling other agencies, the language of the regulations is open to interpretation on that point. It specifies, in each case, a person "newly appointed to a position ..." (emphasis added).*



Relocation Bonuses - An agency may be authorized to pay a lump-sum bonus of up to 25% of basic pay (without any comparability or other additions) in order to entice a current employee to relocate to another position in a different commuting area to fill a hard-to-fill position. This is not basic pay and a service agreement is required. Interim regulations issued March 28, 1991 allow this to apply to GS, PMRS, SES, senior level positions, LEOs, and Executive Level appointments. Requirements are similar to those for recruitment bonuses except that these apply only to current employees.

Retention Allowances - Retention allowances of up to 25% of basic pay (exclusive of any additions) may be used to entice employees with unusually high or unique qualifications or special skills needed by the agency to stay. These are paid at the same time and manner as basic pay but are not part of basic pay. Interim regulations issued March 28, 1991 include requirements similar to those for recruitment and relocation bonuses except that these are prorated over the year and paid incrementally. There is an emphasis in the regulations on the idea that these will be used when an employee is likely to leave for other employment outside government (implying, but not requiring, a specific competing offer). It may not be used to prevent going to another government agency.

Critical Positions - OMB, in consultation with OPM may designate within the Executive Branch up to 800 critical positions (those positions requiring an "extremely high level" of scientific, technical, professional, or managerial expertise, and/or those critical to the agency's mission, and for which additional compensation is necessary for recruitment or retention). At the discretion of the agency head, the critical position incumbent may be paid basic pay up to the rate in effect for Level I (\$138,900 in 1991) of the Executive Schedule unless the President gives written approval of a higher rate. See OMB Bulletin No. 91-9.

Special Rates (5305) - Higher minimum rates of basic pay may be authorized for 1 or more grades or levels in 1 or more occupations in 1 or more areas (with optional corresponding increases in all steps of the pay range) whenever recruitment or retention is impaired due to uncontrollable factors and it is believed that higher pay will help. The minimum Special Rate may not exceed the usual maximum for that grade by more than 30% [and thus the maximum special rate may be up to 60%] (\$101,300 in 1991). Such an increase is not an equivalent increase within the meaning of sec. 5335 (step increases).

The President or his designated agency may determine whether the special rate is to be paid in addition to or in place of local comparability and whether comparability pay is to be adjusted for recipients. [These special rates are intended to give the flexibility to deal with problems resulting from the fact that local comparability is based on aggregated occupations when, in fact, a few occupations may be paid at much higher rates in some areas.]

Performance Awards The head of an agency may authorize a lump-sum cash award of up to 10 percent of the rate of basic pay for an employee whose most recent performance rating was fully successful (FS) or better. Alternatively, employees may be given paid time off as an incentive award for superior accomplishment.

At the request of an agency head, the President may authorize the application of such performance-based awards to categories of employees who would not otherwise be covered.

III. IMMEDIATE RELIEF FOR THE MOST PRESSING PROBLEMS

Interim Geographic Adjustments - Before the Locality Adjustments become effective in January 1994, the President may authorize geographic adjustments of up to 8% where there are widespread recruitment and retention problems. By Executive Order 12736 of December 12, 1990, the President has authorized interim geographic adjustments of 8% of the rate of basic pay for the New York, Los Angeles, and San Francisco CMSAs, effective the first pay period beginning in 1991. IGA schedules are being published which define the rate of pay as the basic rate multiplied by 1.08 and rounded to the nearest whole cent, counting .5 cent and over as a whole cent. The IGAs are offset for local, but not nationwide or worldwide special rates. Given budget constraints, we do not expect any additional cities this calendar year.

Staffing differentials - Beginning in January, 1991, the President may establish staffing differentials of a flat 5 percent of basic pay for "GS 5 or 7 or 2-grade-interval occupations", as determined by OPM, to be paid at the same time and in the same manner as basic pay but which is not basic pay. The conceptual basis for this provision began as a means for facilitating college recruitment. There were technical problems with the language in FEPCA. In its present form this authority may not be exercised at all. However, OPM is working on a technical amendment.

These interim adjustments will be paid in the same manner as the plans for locality adjustments and will be phased-out as the latter are phased-in.

Special Occupational Pay Systems - The President's pay agent may establish for one or more special occupational pay systems for "any positions within occupations or groups of occupations that the pay agent determines should not be classified under chapter 51 or subject to subchapter III" [PL 101-509, Title I, Section 105]. The legislated procedure includes identification of occupations, consideration of alternatives, considering views of employing agencies and employee organizations, publishing a proposed plan, conducting public hearings, providing Congress with a report at least 90 days before implementation, and publishing a final plan in the Federal Register at least 30 days before implementation.

These special occupations may not waive any law or rule which could not be waived under our demonstration authority and may not set a basic pay rate greater than Executive Level V (\$101,300 in 1991).

Pay for such a special pay system may be adjusted as OPM sees fit when the annual adjustment goes into effect for the General Schedule.

IV. SPECIAL PAY SYSTEMS

There are a variety of other features affecting special groups. If you are

interested in a particular area, I can provide you with additional information or the name of someone in OPM who is working on the specific issue. Below is a brief list of features.

Special Pay Systems for:

Administrative Law Judges - (sec. 104(a) (1))

Contract Appeals Board

Senior Biomedical Research Service

Separate Law Enforcement Pay System - To be developed by January 1, 1993.

V. OTHER FEATURES FOR SPECIAL CATEGORIES

Supervisory Differential - When a GS employee supervises non-GS employees (such as FWS employees) OPM may authorize an agency head to grant a small supervisory differential if 1 or more of the subordinates would otherwise have higher pay than the supervisor.

Reemployment of retirees - OPM may authorize the reemployment of civilian or military annuitants without loss of pay or annuity when necessary during an emergency involving direct threat to life or property or when necessary to recruit qualified candidates when needed to fill particular positions which are exceptionally difficult to fill. Decisions generally are made by OPM on a case-by-case basis but categorical delegation for an agency is possible. The agency must show that the employee is critical. The candidate must be off the agency's rolls before a request is submitted and combined pay must not exceed Executive Level V and a time limit will be placed on the waiver. No reduction is necessary if the member's retired or retainer pay is based in whole or in part on combat disability. [Normally, under 5 U.S.C. 8368, the amount of a Civil Service annuity is deducted from the basic pay of a reemployed annuitant.]

Paid Time Off as an Incentive Award Given as an award to an employee for superior accomplishment.

Pay-for-Performance Labor-Management Committee - The law mandates establishing a committee to advise OPM on methods for strengthening the link between performance and pay. Systems developed should provide flexibility for adaptation to different needs in different agencies and should be ready for implementation by October 1, 1993. Committee must provide a report to the Director of OPM one year from enactment.

LIMITATIONS

Basic pay (including special rates) may not exceed Executive Level V (\$101,300 in 1991).

- Basic pay (including special rates and local comparability may not exceed Ex. Level IV (\$108,300 in 1991). For Senior-Level, SES, FBI, DEA, ALJs, and Contract Appeals Board positions, the maximum is Executive Level II (\$125,100 in 1991).
- There is no longer a legal limit on the number of SES and SL positions combined, but 5 U.S.C. 3133 still requires that OPM, in consultation with OMB, allocate a total number of SES positions to each agency on a biennial basis.
- Basic pay plus comparability payments, may not exceed Executive Level IV (\$108,300.) with the following exceptions:
 The maximum is Executive Level III (\$115,300.) for
 1. senior-level positions under sec. 5376;
 2. SES positions under sec. 3132;
 3. SES in the FBI and DEA under sec. 3151;
 4. ALJs appointed under sec. 3105;
 5. Contract Appeals Board members under sec. 5372a.
- Total aggregated pay (including bonuses, allowances, and awards) may not exceed Executive Level I (\$138,900 in 1991) except as specifically permitted (and it is not expected to be permitted).

APPENDIX H

REFERENCES

1. Cost Analysis Report, Institute for Defense Analysis, September 12, 1991
2. Testimony to Commission, Congressman Coughlin, September 12, 1991
3. Testimony to Commission (Oral only), Congressman Kostmayer, September 12, 1991
4. Project Reliance, Briefing by Joint Laboratory Directors, September 11, 1991
5. Future Army R&D Laboratories, Army Missile Command Briefing, August 31, 1991
6. Army Combat Materiel Research Laboratory Costing Process, Army Staff Briefing, August 29, 1991
7. Minimizing Turbulence, Army Staff Briefing, August 29, 1991
8. Minimizing Turbulence, Air Force Staff Briefing, August 29, 1991
9. Army Lab 21 Costing Methodology, Army Staff Briefing, August 28, 1991
10. Navy Cost Methodology, Navy Staff Briefing, August 28, 1991
11. Letter to Commission, Congresswoman Mink, August 27, 1991
12. Testimony to Commission, Congressman Gejdenson, August 27, 1991
13. Testimony to Commission, Senator Dodd, August 27, 1991
14. Testimony to Commission, Senator Lieberman, August 27, 1991
15. Testimony to Commission, Mr. Bart Whitman, August 27, 1991

16. Testimony to Commission, Congressman Machtley, August 27, 1991
17. Testimony to Commission, Congressman Pallone, August 27, 1991
18. Testimony to Commission, Dr. Robert S. Wiseman, August 27, 1991
19. Testimony to Commission, Congressman McMillen, August 27, 1991
20. Testimony to Commission, Ms. Dee Baumbeara (Representing Congresswoman Morella), August 27, 1991
21. Testimony to Commission, Mr. Tom Kesles, August 27, 1991
22. Testimony to Commission, Mr. David McGuigan, August 27, 1991
23. Testimony to Commission, Mr. Robert Fry, August 27, 1991
24. Comments by Past Deputy Technical Director, Naval Surface Weapons Center/White Oak, August 27, 1991
25. Testimony to Commission, Mr. William Koven, August 27, 1991
26. Letter to Commission, Congressman Kostmayer, August 17, 1991
27. Testimony to Commission, Congresswoman Morella, August 13, 1991
28. Tri-Service Reliance Process, DoD Staff Briefing, August 2, 1991
29. Technology Base Management, Report of Defense Science Board, 1987 Summer Study, DDR&E Staff Briefing, August 2, 1991
30. Federal Employees Pay Comparability Act of 1990, DoD Staff Briefing, August 2, 1991
31. Laboratory Demonstration Program In-Progress Review, DoD Staff Briefing, August 2, 1991
32. Laboratory Demonstration Program Implementation Status Report, DoD Staff Report, August 1, 1991

33. Lab 21 Costing Methodology, Army Missile Command Briefing, July 31, 1991
34. Department of Army Engineers and Scientists Career Program, Army Materiel Command Briefing, July 31, 1991
35. Army Research Program, Basic Research, Science and Technology Review, Army Staff Briefing, July 24, 1991
36. Overview of the Naval Research Laboratory, Navy Staff Briefing, July 18, 1991
37. Air Force Systems Command, Air Force Briefing, July 17, 1991
38. Letter to Commission, Dr. Robert Wiseman, Ref. Combat Materiel Research Laboratory, July 12, 1991
39. Letter to Chairman, Congressman Machtley, July 12, 1991
40. Letter to Executive Secretary, Congressman Gejdenson, July 10, 1991
41. Letter to Chairman, Congressman Smith, July 1, 1991
42. Defense Base Closure and Realignment Commission, Report to the President, July 1, 1991
43. Statements by Deputy Assistant Secretary of the Army (Research and Technology) to the Base Closure and Realignment Commission, June 27, 1991.
44. Letter to the Base Closure and Realignment Commission Referencing the Electronic Devices and Technology Laboratory from Congressman Pallone, June 22, 1991
45. US Office of Personnel Management, Letter to US Office of Management and Budget Commenting on DoD Proposed Legislation to Improve DoD Laboratory Management, June 21, 1991
46. Proposed Legislation: DoD Laboratory Revitalization Demonstration Act of 1991, Analysis Memorandum, June 14, 1991
47. Authority of the Commission, DoD General Counsel Memorandum, June 14, 1991

48. Navy RDT&E Engineering and Fleet Support Activities Consolidation Plans, Navy Staff Briefing, June 12, 1991
49. Site Selection Factors for the Army Combat Materiel Research Laboratory Factors, Army Staff Briefing, June 12, 1991
50. Army Lab 21, Army Staff Briefing, June 12, 1991
51. DoD In-House RDT&E Facilities and Core Competencies, DoD Staff Briefing, June 1991
52. Testimony to the Base Closure and Realignment Commission, Mr. Jerry Guarnini, May 24, 1991
53. Testimony to the Base Closure and Realignment Commission, Senator Spector, May 22, 1991
54. Testimony to the Base Closure and Realignment Commission, Reference Naval Air Development Center, Congressman Kostmayer, May 22, 1991
55. Testimony to the Base Closure and Realignment Commission, Congresswoman Morella, May 22, 1991
56. Naval Underwater Systems Center, Navy Staff Briefing, May 22, 1991
57. Army Research, Development and Engineering Centers, Army Staff Briefing, May 22, 1991
58. Air Force Wright Laboratory, Air Force Staff Briefing, May 22, 1991
59. Congressional Research Service Memorandum: Consolidation of Navy Laboratories, May 17, 1991
60. The DoD Base Closure and Realignment Recommendations Selection Process, General Accounting Office, GAO Letter, May 15, 1991
61. Military Bases, Observations on the Analysis Supporting Proposed Closures and Realignments, GAO Report, May 1991
62. Comments on Office of Technology Assessment Report "Holding the Edge", Defense Systems Management College Briefing, April 29, 1991

63. Army Lab 21, Army Staff Briefing on Army Laboratory Reorganization Plans, April 29, 1991
64. Navy RDT&E, Engineering, and Fleet Support Facilities, Navy Staff Briefing, April 29, 1991
65. Base Closure Impact on Air Force Science and Technology Programs, Air Force Staff Briefing, April 26, 1991
66. DoD Defense Management Review, Laboratory Demonstration Program Facilities Working Group, Report on Research and Development Facilities Modernization, April 25, 1991
67. DoD RDT&E Funding, DoD Staff Briefing, April 22, 1991
68. Army Support for the Science and Technology Reliance Program, US Army Laboratory Command Memorandum, April 18, 1991
69. Army Lab 21, Army Staff Briefing on Army Laboratory Reorganization Plans, March 29, 1991
70. Air Force Laboratory Reorganization Plans, Air Force Staff Briefing, March 29, 1991
71. Army Tri-Service Science and Technology Reliance Program, Army Staff Briefing, March 29, 1991
72. Office of the Secretary of Defense Base Closure and Realignment 1991, DoD Staff Briefing, March 28, 1991
73. Department of Navy Research Development, Test and Evaluation Consolidation Plans, Navy Staff Briefing, March 28, 1991
74. DoD Base Closure and Realignment: Background Information, DoD Staff Information Package, March 28, 1991
75. Defense Laboratories: Proposals for Closure and Consolidation, Congressional Research Services Report for Congress, Mr. Michael E. Davey, January 24, 1991
76. Army Materiel Command Civilian Training, Education, and Development System, Memorandum, November 20, 1990
77. Defense Management Review Decision No. 922, Consolidation of R&D Laboratories and T&E Facilities, November 18, 1990

78. Defense Management Review Alternative 1 Approach: Research, Development, Test and Evaluation Consolidation, DoD Staff Briefing to the Deputy Secretary of Defense, August 22, 1990
79. Influence of the Defense Contracting Process on R&D Productivity, OASA(FM) Independent Study, Dr. Pauline Cason, August 1990
80. Public Law 101-510, Title XXIX, Defense Base Closures and Realignments Act of 1990
81. Military Bases, an Analysis of the Commission's Realignment and Closure Recommendations, GAO Report, November 1989
82. Federal R&D Funding by Budget Function, Fiscal Year 1988-90, National Science Foundation Report, NSF 89-306, April 1989
83. Holding the Edge, Maintaining the Defense Technology Base, Report of the Office of Technology Assessment, April 1989
84. The Defense Technology Base, Introduction and Overview, Office of Technology Assessment Special Report, March 1988
85. DoD In-House Research, Development, Test and Evaluation Activities, Management Analysis Report, October 30, 1987
86. Goldwater-Nichols, Department of Defense Reorganization Act; Public Law 99-433, October 1, 1986
87. Implementing the Recommendations of the White House Science Council's Federal Laboratory Review Panel (Packard Report), Office of Science and Technology Policy Progress Report, Volume 1-Summary Report, July 1984
88. White House Science Council, Federal Laboratory Review Panel, (Packard Report), May 1983
89. Study of Scientists and Engineers in DoD Laboratories, Report of DoD Laboratory Task Force (Personnel and Manpower Working Group), September 1982
90. Director, Defense Research and Engineering Report, Required In-House Capabilities for DoD RDT&E, October 1, 1980
91. DoD Laboratory Management Task Force, DoD Report, July 1980

92. Institutional Barriers on DoD Laboratories, Ad Hoc Task Group on In-House Laboratories Report, September 1979
93. DoD Laboratory Utilization Study, Office of Director, Defense Research and Engineering, (Allen Report), April 28, 1975
94. Comments on Army Laboratories/Centers, Paper by Dr. Robert Wiseman, (Not Dated)

NTIS does not permit return of items for credit or refund. A replacement will be provided if an error is made in filling your order, if the item was received in damaged condition, or if the item is defective.

***Reproduced by NTIS
National Technical Information Service
U.S. Department of Commerce
Springfield, VA 22161***

This report was printed specifically for your order from our collection of more than 2 million technical reports.

For economy and efficiency, NTIS does not maintain stock of its vast collection of technical reports. Rather, most documents are printed for each order. Your copy is the best possible reproduction available from our master archive. If you have any questions concerning this document or any order you placed with NTIS, please call our Customer Services Department at (703) 387-4660.

Always think of NTIS when you want:

- Access to the technical, scientific, and engineering results generated by the ongoing multibillion dollar R&D program of the U.S. Government.
- R&D results from Japan, West Germany, Great Britain, and some 20 other countries, most of it reported in English.

NTIS also operates two centers that can provide you with valuable information:

- The Federal Computer Products Center - offers software and datafiles produced by Federal agencies.
- The Center for the Utilization of Federal Technology - gives you access to the best of Federal technologies and laboratory resources.

For more information about NTIS, send for our FREE NTIS Products and Services Catalog which describes how you can access this U.S. and foreign Government technology. Call (703) 487-4650 or send this sheet to NTIS, U.S. Department of Commerce, Springfield, VA 22161. Ask for catalog, PR-827.

Name _____
Address _____

Telephone _____

***- Your Source to U.S. and Foreign Government
Research and Technology***



U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Technical Information Service
Springfield, VA 22161 (703) 487-4650
