RDT&E BUDGET ITEM JUSTIFICATION SHEET (R-2 Exhibit)								DATE February 2000	
APPROPRIATION/BUDGET ACTIVITY RDT&E, Defense-Wide / BA 3				R-1 ITEM NOMENCLATURE High Performance Computing Modernization PE 0603755D8Z					
COST *(In Millions)*	FY1999	FY2000	FY2001	FY2002	FY2003	FY2004	FY2005	Cost to Complete	Total Cost
Total Program Element (PE) Cost	151.613	164.262	164.027	137.988	143.038	145.808	148.643	Continuing	Continuing
HPCM/P476	151.613	164.262	164.027	137.988	143.038	145.808	148.643	Continuing	Continuing

(U) A. Mission Description and Budget Item Justification

(U) BRIEF DESCRIPTION OF ELEMENT:

(U) The Department of Defense (DoD) High Performance Computing (HPC) Modernization Program (HPCMP) directly supports the needs of the warfighter for technological superiority and military dominance on the battlefield by providing the highest computational power available to U.S. weapons system scientists and engineers. By exploiting continuous advances in high performance computing technology, the defense research, development, test and evaluation (RDT&E) community is able to resolve critical scientific and engineering problems quicker and with more precision than any potential adversary threatening national security. The results of these efforts feed directly into the acquisition process by increasing our fundamental understanding of the battlefield environment as well as improving upon weapon system design, development, test, evaluation, deployment, operations and sustainment. As such, high performance computing (HPC) has been identified as a key enabling technology essential to achieving the objectives of the DoD's Science and Technology (S&T) and Test and Evaluation (T&E) programs.

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(U) The HPCMP has established and supports four major shared resource supercomputing centers as well as several smaller, special-purpose distributed supercomputing centers. These centers directly support the DoD S&T and T&E laboratories and centers and are accessible to local and remote scientists and engineers via high-speed network access. Providing for the adaptation of broadband, widely-used applications and algorithms to address S&T and T&E requirements, along with continued training of users as new system designs and concepts evolve, is an integral part of the program. The program pursues continuous interaction with the national HPC infrastructure, including academe, industry, and other government agencies to facilitate the sharing of knowledge, tools, and expertise.

(U) The HPCMP user base includes approximately 5,000 computational scientists and engineers and over 60 DoD laboratories and developmental test and evaluation facilities. The integrated HPCM program consists of a set of four large Major Shared Resources Centers (MSRCs) that are responsible for as large a fraction of DoD's S&T and DT&E computational workload as feasible. These MSRCs provide extensive capabilities to address user requirements for hardware, software, programming environments, and training. A limited set of smaller shared resource centers, Distributed Centers (DCs), augment the MSRCs to form the total HPCMP computational capability. Distributed Centers address critical HPC requirements that cannot be met at MSRCs, such as real-time, and near real-time computing requirements, and leverage significant HPC expertise located at the remote sites. The MSRCs and DCs are currently interconnected with all S&T and DT&E user sites via the Defense Research and Engineering Network (DREN). Additionally the Common HPC Software Support Initiative (CHSSI) develops a set of critical common DoD applications programs that run efficiently on advanced HPC systems at the MSRCs and Distributed Centers.

(U) True modernization of DoD's HPC capability and fulfillment of the program's vision and goals requires an on-going program strategy that addresses all aspects of HPC. While advancing the level of hardware performance is critical to success, the higher objective is to enable better scientific research and technology development for superior weapons, warfighting and related support systems. The goals of the HPCMP are to:

- Provide the best commercially available, state-of-the-art HPC capacity and capability to enable weapons development and more capable warfighting systems,
- Ensure development of software tools, supportive programming environments, and applications to exploit the capabilities of HPC,
- Expand and train the DoD HPC user base to more effectively use HPC,
- Link users and HPC centers through robust high speed networking (thus facilitating classified and unclassified access and the creation of collaborative work environments), and
- Engage, leverage, contribute to, and be a major participant in the national HPC infrastructure and exploit benefits for Defense R&D.

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(U) Four major contracts to support each of the MSRCs were competitively awarded during FY 1996. These contracts provide equipment for up to five years and comprehensive support services for the next five to eight years. The four MSRCs and their location are:

- Aeronautical Systems Center (ASC), Wright-Patterson Air Force Base, OH
- Army Corps of Engineers Waterways Experiment Station (CEWES), Vicksburg, MS
- Army Research Laboratory (ARL), Aberdeen Proving Ground, MD
- Naval Oceanographic Office (NAVO), Stennis Space Center, MS

(U) Nichols Research Corporation of Huntsville, AL was awarded contracts to support both the ASC and CEWES MSRCs. Grumman Data Systems of Herndon, VA was awarded the contract to support the NAVO MSRC. Finally, Raytheon E-Systems of Garland, TX was awarded the contract to support the ARL MSRC. Each of the MSRC contracts contains provisions, i.e. established contract options, to allow significant expansion of high performance computing systems and related support systems over the first five years of the contract. These contract options ensure that MSRC system expansions can take place in a timely fashion during each fiscal year.

(U) There are currently 17 distributed centers. In FY 1999, one distributed center was retired; four existing centers were upgraded; and two new centers were added. Also in FY 2000 multiple distributed center proposals will be evaluated resulting in awards to upgrade existing centers or establish new ones. Currently identified distributed centers and their locations are listed below:

- Air Armaments Center (ARC), Eglin AFB, FL
- Air Force Flight Test Center (AFFTC), Edwards AFB, CA
- Air Force Research Laboratory (AFRL-Rome), Rome, NY
- Air Force Research Laboratory, Sensors Directorate (AFRL/SN), Wright-Patterson AFB, OH
- Army High Performance Computing Research Center (AHPCRC), South Minneapolis, MN
- Arnold Engineering Development Center (AEDC), Arnold AFB, TN
- Arctic Region Supercomputing Center (ARSC), Fairbanks, AK
- Joint National Test Facility (JNTF), Schriever AFB, CO
- Maui High Performance Computing Center (MHPCC), Maui, HI
- Naval Air Warfare Center - Aircraft Division (NAWC-AD), Patuxent River NAS, MD

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- Naval Air Warfare Center - Weapons Division (NAWC-WD), China Lake, CA
- Naval Research Laboratory (NRL), Washington, DC
- Redstone Technical Test Center (RTTC), Huntsville, AL
- Space and Missile Defense Command (SMDC), Huntsville, AL
- Space and Naval Warfare Systems Center (SSCSD), San Diego, CA
- Tank-Automotive Research, Development and Engineering Center (TARDEC), Warren, MI
- White Sands Missile Range (WSMR), NM

(U) The Defense Research and Engineering Network (DREN) provides wide area network (WAN) connectivity among the Department's High Performance Computing resources (high performance computing systems and the HPC user base of scientist and engineers in the research, development test and evaluation community). The DREN is implemented through the DREN Intersite Services Contract (DISC) awarded to American Telephone and Telegraph (AT&T) in FY 1996. This contract allows the government to purchase high-speed network service to anywhere in the United States at bandwidths ranging from 3.0 megabits per second to 622 megabits per second (OC-12), with upgrade potential to 2.4 gigabits per second (OC-48) over the five year life of the contract.

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Total Program Element (PE) Cost	151.613	164.262	164.027	137.988	143.038	145.808	148.643	Continuing	Continuing
HPCM/P476	151.613	164.262	164.027	137.988	143.038	145.808	148.643	Continuing	Continuing

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(U) Project Number and Title: P476 HPCM

(U) PROGRAM ACCOMPLISHMENTS AND PLANS:

(U) FY 1999 Accomplishments:

(U) Shared Resource Centers: The program continued the modernization and sustainment of the Shared Resource Centers. Additional HPC systems, storage, and scientific visualization capabilities were acquired to populate and upgrade the established MSRCs to fulfill a substantial portion of the projected HPC requirements of the laboratories and R&D centers. Contract options were executed to upgrade performance at four MSRCs that will minimally triple their computing capability over the current two-year performance level (PL) upgrade period (FY 1999 and FY 2000). The program assessed and prioritized HPC requirements for DCs and deployed new systems at four existing DCs and established two new DCs to accomplish S&T and DT&E mission needs which cannot be met effectively or efficiently at the MSRCs. Per congressional direction, funding was provided to two DCs and 1 MSRC for next generation internet initiatives.

(U) Networking: Due to researchers taking greater advantage of their connectivity to high performance computing systems and other researchers, the bandwidth demands on DREN continued to grow and more user sites took full advantage of the DREN ATM fabric. The majority of the effort in FY 1999 was to provide services to selected sites with some increases in bandwidth. Low end users continued to be connected at 3 Mbps and mid to high range users were connected at 155 Mbps (previous plans to connect high range users at 622 Mbps were postponed due to funding reductions imposed prior to FY 1999). Due to reductions in FY 1999 Research, Development Test and Evaluation funding, 6 link upgrades were postponed and 18 partial to full link improvements were postponed. Security enhancements were implemented. Collaborative work continued with the Federal networking community and standards associations to assure DREN remains compatible with future technology changes. Formal acquisition planning for the DREN follow-on contract was begun. ($ 17.021Million)

(U) Software Applications Support: Development efforts in the CHSSI program continued to mature as some CHSSI projects were completed, and others begun. The CHSSI projects continued developing shared scalable applications supporting software to exploit scalable HPC assets. ($ 23.635 Million)

(U) MSRC Sustainment: The program sustained and supported the integration, operation and use of HPC computational resources at the four Major Shared Resource Centers. However, this support was less than originally planned due a reduction in FY 1999 Research, Development Test and Evaluation funding. Support for scientific visualization through a high performance visualization center was increased. Support for the next generation internet initiative was also provided through 1 MSRC. .
($ 87.561 Million)

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(U) **Distributed Center Sustainment:** The program supported sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center in accordance with FY 1999 Congressional language. Due to program funding limitations recognized in 1996, a decision was made to typically only support investments in HPC systems at new or existing DCs with HPCMP procurement funding. In return for the HPCMP investment, the DC organization agrees to appropriately fund the sustainment and operations of the HPCMP equipment located at the site. Only a nominal amount of funding was allocated by the HPCMP for DC program management. Special projects supporting next generation internet initiatives were supported at two DCs.
($ 23.396 Million)

(U) **FY 2000 Plans:**

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(U) **Shared Resource Centers:** The program will sustain the existing capability and continue the modernization process by acquiring additional HPC systems, storage, and scientific visualization capabilities to populate and upgrade the established MSRCs to fulfill the projected HPC requirements of the laboratories and R&D centers. Contract options will continue to be executed to meet the required performance levels at the four MSRCs, minimally tripling their computing capabilities from the previous performance levels over the two year period (FY 1999 and FY 2000). The program will continue to identify evaluate and prioritize HPC requirements for DCs and will acquire and deploy new systems or upgrades to existing systems as needed to accomplish RDT&E mission needs. Formal acquisition planning efforts will begin to assure new acquisition vehicles are in place to support FY 2001 and beyond procurements.

(U) **Networking:** As researchers take greater advantage of their connectivity to high performance computing systems and other researchers, the bandwidth demands on DREN continue to grow. As local infrastructures expand, more user sites will be able to take full advantage of the DREN ATM fabric. Thus the majority of the effort in FY 2000 will be to upgrade services to selected sites and increase bandwidth. Low end users will continue to be connected at 3 Mbps, mid and high range users will be connected at 155 Mbps and high range users will be connected at 622 Mbps. Previously planned upgrades will be accomplished. Additional security enhancements will be implemented. Collaborative work will continue with the Federal networking community and standards associations to assure DREN remains compatible with future technology changes. Formal acquisition planning for the DREN follow-on contract will continue to assure new contracts are in place in FY 2001. ($ 29.296 Million)

(U) **Software Applications Support:** Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others are begun. The CHSSI projects will continue developing shared scalable applications supporting software to exploit scalable HPC assets. ($ 21.569 Million)

(U) **MSRC Sustainment:** The program will sustain and support the integration, operation and use of HPC computational resources at the four Major Shared Resource Centers. Partial year sustainment and operations for systems purchased and deployed in FY 2000 and cost saving resulting from the retirement of older HPC systems are included in the total FY 2000 funding requested. Support for scientific visualization through a high performance visualization center is being increased. ($ 87.166 Million)

(U) **Distributed Center Sustainment:** The program will fund sustainment and operations at the Maui High Performance Computing Center and the Arctic Region Supercomputer Center for FY 2000. Support for a multi-thread-architecture system is being implemented at the program's Distributed Center at the Naval Research Laboratory. Due to program funding limitations recognized in 1996, a decision was made to typically only support investments in HPC systems at new or existing DCs with HPCMP procurement funding. In return for the HPCMP investment, the DC organization agrees to appropriately fund the sustainment and operations of the HPCMP equipment located at the site. While funding has been added in FY 2000 to sustain the ARSC and MHPCC, only a nominal amount of funding is allocated by the HPCMP for DC program management. ($ 26.231 Million)

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(U) FY 2001 Plans:

(U) Shared Resource Centers: The program will sustain the existing capability and continue the modernization process by acquiring additional HPC systems, storage, and scientific visualization capabilities to populate and upgrade the established MSRCs to fulfill the projected HPC requirements of the laboratories and R&D centers. The program will continue to identify evaluate and prioritize HPC requirements for DCs and will acquire and deploy new systems or upgrades to existing systems as needed to accomplish RDT&E mission needs.

(U) Networking: The majority of the effort in FY 2001 will be to upgrade services to all sites and increase bandwidth. Low end users will continue to be connected at 3 Mbps, mid range users will be connected at 155 Mbps and high range users will be connected at 622 Mbps. Operation of security systems and enhancements will continue. Collaborative work will continue with the Federal networking community and standards associations to assure DREN remains compatible with future technology changes. ($ 32.691 Million)

(U) Software Applications Support: Development efforts in the CHSSI program will continue to mature as some CHSSI projects are completed, and others are begun. The CHSSI projects will continue developing shared scalable applications supporting software to exploit scalable HPC assets. ($ 22.304 Million)

(U) MSRC Sustainment: The program will sustain and support the integration, operation and use of HPC computational resources at the four Major Shared Resource Centers. Partial year sustainment and operations for systems purchased and deployed in FY 2001 and cost saving resulting in the retirement of older HPC systems are included in the total FY 2001 funding requested. New contracts for sustainment support in FY2001 and beyond will be awarded. ($ 88.318 Million)

(U) Distributed Center Sustainment: Due to program funding limitations recognized in 1996, a decision was made to typically only support investments in HPC systems at new or existing DCs with HPCMP procurement funding. In return for the HPCMP investment, the DC organization agrees to appropriately fund the sustainment and operations of the HPCMP equipment located at the site. While funding has been added in FY 2001 to sustain the ARSC and MHPCC, only a nominal amount of funding is allocated by the HPCMP for DC program management. ($ 20.714 Million)

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(U) B. Program Change Summary	FY1999	FY2000	FY2001	Total Cost
Previous President's Budget	152.585	159.099	145.140	Continuing
Appropriated Value	153.927	168.099		Continuing
Adjustments to Appropriated Value				
a. Congressionally Directed undistributed reduction	0	0.000	(1.113)	
b. Rescission/Below-threshold Reprogramming, Inflation Adjustment	(.972)	(1.668)	20.000	
c. Other		(2.169)		Continuing
Current President's Budget	151.613	164.2662	164.027	Continuing

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Change Summary Explanation:

(U) **Funding:** The funding changes in FY 1999 and FY 2000 are the result of inflation savings, below threshold reprogrammings and the government wide rescission. The adjustments in FY 2001 are the result of inflation adjustments and program revisions. The adjustments in FY 2002 are the result of inflation adjustments. Sustainment funding for the ARSC and the MHPCC is included, but only for FY 2000 and FY 2001.

(U) **Schedule:** Not Applicable

(U) **Technical:** In accordance with FY 1999 congressional language, the High Performance Computing Modernization Program used additional FY 1999 RDT&E funding for operations, sustainment and upgrades at the Maui High Performance Computing Center and the Arctic Region Supercomputing Center and provided support for scientific visualization as well as next generation internet efforts. In accordance with FY 2000 congressional language, the High Performance Computing Modernization Program will use additional FY 2000 RDT&E funding to establish a multithread architecture system and support scientific visualization.

(U) **C. Other Program Funding Summary Cost**

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Procurement Line P-1 Line, PROCUREMENT, DEFENSE-WIDE (OSD High Performance Computing - Major Equipment)

($ in Millions)

FY 1999	FY 2000	FY 2001	FY 2002	FY 2003	FY 2004	FY 2005	To Complete	Total Cost
91.435	95.865	39.978	50.445	49.348	50.333	51.892	Continuing	Continuing

MILESTONE SCHEDULE:	**Fiscal Years**
Milestone II Decision Review	1Q 1996
Awards for MSRC Contracts (Performance Level 1)	2Q, 3Q, 4Q 1996
Award for DREN (DISC)	4Q 1996
MSRC Performance Level 1 Capability Installed	1Q 1997-4Q 1997
In-Process Review	3Q 1997
FY 1997 HPC Modernization Plan Updated	3Q 1997
MSRC Performance Level 2 Capability Installed	2Q 1997- 3Q 1998
DREN Initial Performance Capability	3Q 1997
FY 1998 HPC Modernization Plan Updated	2Q 1998
IDREN to DREN Transition Complete	4Q 1998
MSRC Performance Level 3 Capability Installed	2Q 1999- 3Q 2000
MSRC Follow-on Contract(s) (Recompete)	2Q 2001
DREN Follow-on Contract (Recompete)	1Q 2001

(U) D. Schedule Profile Not Applicable