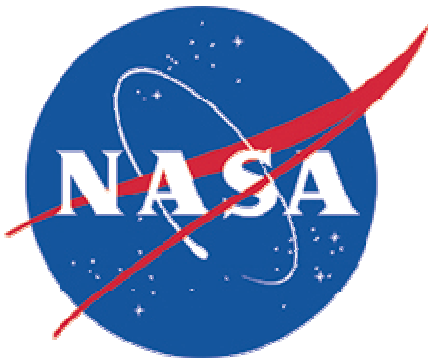

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Workforce Transition Strategy

Initial Report

Space Shuttle and Constellation Workforce Focus

March 2008

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1.0 Introduction

This report responds to direction in the Consolidated Appropriations Act of 2008 (P.L. 110-161):

> *"The Administrator of the National Aeronautics and Space Administration shall prepare a strategy for minimizing job losses when the National Aeronautics and Space Administration transitions from the Space Shuttle to a successor human-rated space transport vehicle. This strategy shall include: (1) specific initiatives that the National Aeronautics and Space Administration has undertaken, or plans to undertake, to maximize the utilization of existing civil servant and contractor workforces at each of the affected Centers; (2) efforts to equitably distribute tasks and workload between the Centers to mitigate the brunt of job losses being borne by only certain Centers; (3) new workload, tasks, initiatives, and missions being secured for the affected Centers; and (4) overall projections of future civil servant and contractor workforce levels at the affected Centers. The Administrator shall transmit this strategy to Congress not later than 90 days after the date of enactment of this Act. The Administrator shall update and transmit to Congress this strategy not less than every six months thereafter until the successor human-rated space transport vehicle is fully operational."*

The transition from Space Shuttle to Constellation over the next few years provides a rare opportunity to reinvigorate the Nation's space exploration capabilities. During that time, NASA's greatest challenge and top priority will be to safely fly out the Space Shuttle manifest, complete assembly of the International Space Station (ISS), and honor commitments to our international partners prior to retiring the Shuttle in 2010, all while developing the new Constellation space systems and preparing them for flight as soon as possible after the Shuttle's last mission.

Through this period, NASA's greatest asset will continue to be its people – the thousands of individuals across the country in both government and industry who conceive, design, build, operate, and manage an ambitious program of space exploration on behalf of the Nation. At the same time, our greatest challenge over the next several years will be managing this extremely talented, experienced, and geographically dispersed workforce as we transition from operating the Space Shuttle to utilizing the International Space Station and expanding our reach to the Moon, Mars, and beyond. This report describes NASA's strategy for meeting this challenge, integrated across programs, Centers, and our industry partners. Because this is a dynamic process, future versions of this report will provide updates to both this strategy and the underlying data which drives NASA's strategic and tactical plans.

NASA's most critical resource, and the one which will be most crucial to the success of this initiative, is the highly skilled workforce that will turn the Nation's space exploration policy into a reality. Today, a large portion of the Agency's skilled civil servant and contractor workforce is focused on the safety of ongoing mission operations. Much of the experience and expertise within this workforce is required for the Constellation program to succeed. However, the effects of the transition will not be the same for everyone. While approximately 80 percent or more of NASA's budget will continue to pay for the purchase of contractor products, goods, and services, the nature of the work being done will change. NASA's human spaceflight workforce will shift from being focused primarily on operating spacecraft to a recurring cycle of spacecraft development and operations. NASA recognizes and values the dedication of its Space Shuttle workforce and will leverage this resource, where feasible, by engaging those men and women in challenging future work that capitalizes on their unique skills and abilities to the maximum extent practical.

All data in this report are NASA's best estimates as of March 2008. The maturity of the data will improve over time and will be updated in future versions of this strategy.

2.0 Background

NASA is managing human spaceflight workforce issues within the broader context of the U.S. Space Exploration Policy and the Agency's overall transition efforts. The *NASA Human Space Flight Transition Plan* (TCB-001) describes the processes by which the Agency manages and integrates all of the strategic and tactical aspects of transition, including workforce. To augment these transition processes and ensure close cooperation and partnering between NASA and industry, a Human Capital Council, comprised of human resources directors from the prime contractors and Centers, has been formed and meets quarterly. Supporting the efforts of the Human Capital Council, NASA and its prime contractors conduct frequent formal and informal Technical Interchange Meetings including a broad range of participants.

In addition to these standing Agency transition processes, NASA also tightly integrates transition workforce planning into its acquisition and budget development activities. NASA uses a strategic acquisition approach for make/buy decision and contracting. For example, a senior-level leadership forum reviews and approves Center acquisition strategies. Criteria during these reviews include any impacts of decisions on the health of the workforce at NASA's Centers, and any new programs, major program shifts, or major new institutional initiatives are coordinated through this process. Acquisition strategy planning decision meetings will occur semi-annually, synchronized to the President's budget development, as well as when any significant new mission element or program is proposed.

The annual Planning, Programming, Budgeting, and Execution (PPBE) process involves planning, analysis, recommending requirements, and developing decision packages as part of the Agency's development of the President's budget request. Transition workforce planning across the programs, the institutions, and Headquarters has shaped the last several budget development cycles and will continue to be a critical component of the budget process.

NASA's contractor workforce is vital to success. The Agency and its Space Shuttle prime contractors have developed and implemented a range of personnel management tools to help safely manage operations through retirement. It is important to note that while NASA directly plans and controls its civil servant workforce, the Agency does not determine the personnel levels of the contractor workforce. Instead, NASA purchases the products and services they provide as part of the national human spaceflight workforce and aerospace industrial and supplier base. NASA expects that many of its contractors will apply their human spaceflight workforce to the design, development, test, and integration of new human spaceflight and support systems. At the same time, containing workforce costs for exploration is key because NASA's new systems must cost less to produce, process, launch, and operate or the Agency will not have the resources to return to the Moon.

NASA Organization and Current Workforce Distributions

The Space Operations Mission Directorate (SOMD) oversees NASA's operational space capabilities, including the Space Shuttle, International Space Station, Launch Services, Space Communications and Navigation, and Rocket Propulsion and Test programs. The 2008 Space Shuttle workforce includes approximately 15,000 contractors and 1,700 civil servants in locations across the country (Figure 1).

Figure 1: Major Space Shuttle Program Facilities

The Exploration Systems Mission Directorate (ESMD) oversees the Constellation, Human Research, Exploration Technology Development, and Lunar Precursor Robotic Programs, as well as the Commercial Orbital Transportation Services (COTS) project through the Commercial Crew and Cargo Program Office. Constellation Program work takes place across NASA's ten Centers and at prime contractor and subcontractor locations throughout the country. The Constellation Program project elements include the Orion Crew Exploration Vehicle (CEV), the Ares I crew launch vehicle, and extravehicular activity systems. NASA's first new Constellation human spaceflight capabilities will be Orion and Ares I, which will be followed by the development of the Ares V heavy-lift launch vehicle, the Altair lunar surface access module, and other systems necessary to support the exploration of the Moon, Mars, and beyond. Figures 2 and 3 highlight the Constellation Program Center work distribution.

Figure 2: NASA Center Constellation Work

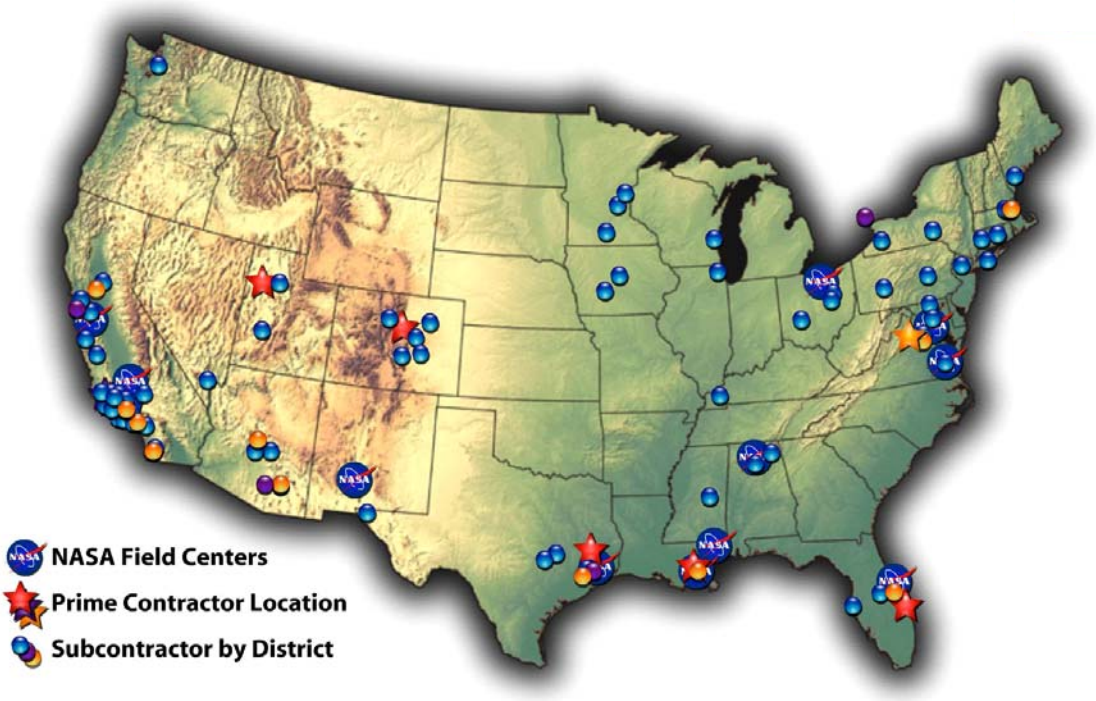


Figure 3: Constellation Work Distribution Nationwide

To manage an efficient and cost-effective transition of workforce, facilities, and contractor support from the Space Shuttle Program to the new Constellation Program, the NASA leadership team must ensure that our workforce skills are rebalanced to meet the evolved focus of the Agency, and effectively communicate our actions and goals to all of our stakeholders, most importantly our employees.

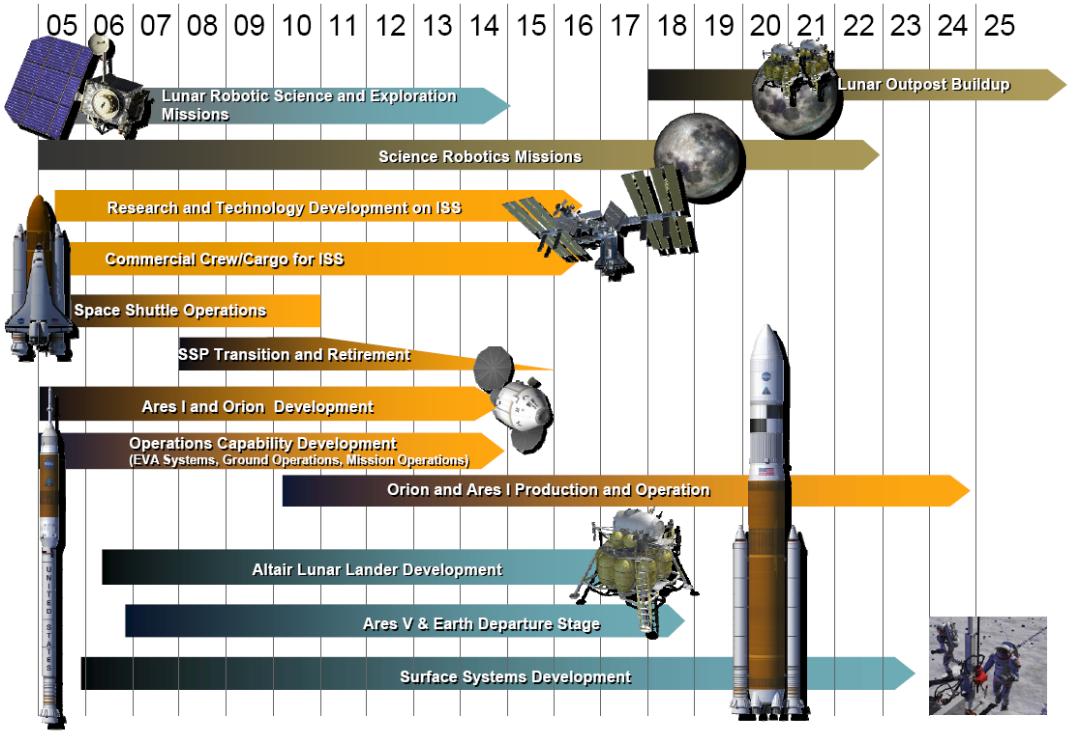


Figure 4: Space Shuttle's Legacy and Constellation's Future

While there will be a gap between flights of Shuttle and Ares I/Orion, a great deal of development activity is planned during this time, including Orion abort testing at White Sands Test Facility (WSTF), the Ares I-Y flight test at Kennedy Space Center (KSC), J-2X engine integrated development and testing at Marshall Space Flight Center (MSFC) and Stennis Space Center (SSC), and new testing and operations facility construction at SSC and KSC. NASA may schedule additional flight tests as requirements and program plans continue to mature. These and many other development and construction activities across all NASA Centers will provide the workforce with many opportunities to remain engaged with meaningful work between flights of Shuttle and Orion. Transition also provides an opportunity for NASA to forge a new line of business – to re-invent, re-invigorate, and re-vitalize the Nation's spirit and capacity for human space exploration.

Overall, NASA will spend the same amount on skilled labor as it has during the Space Shuttle era, but with a growing emphasis in the near term on the design of new vehicles to explore beyond Earth orbit. Further, NASA is committed to ensuring that all ten Centers remain fully capable of leveraging their unique resources and rich heritage by supporting Exploration work as well as NASA's scientific and research missions.

NASA's new systems must cost less to produce, process, launch, and operate or the Agency will not have the resources to further develop the vehicles and systems needed to return to the Moon. As NASA transitions, some of the workforce will move from Space Shuttle and ISS operational work to new vehicle design, development, test and evaluation (DDT&E) work. Regional workforce impacts of shifting from "vehicle processing" and "operations" to DDT&E activities are becoming clearer and will be outlined in subsequent sections of this report. Reducing the impacts to specific regions will require the assignment of specific Constellation development, test and manufacturing work to affected NASA Centers as the Space Shuttle is retired. Since upcoming Constellation contracts are competitively awarded, NASA cannot provide exact contractor workforce numbers or the location of the work performed beyond already awarded current work assignments. However, where possible, this report will provide forecast estimates for these assignments while still preserving the integrity of future acquisition activities.

As future procurements are conducted, contractors selected, and contracts awarded, a more comprehensive public assessment will become available during 2008 and 2009. For example, this past year, NASA announced the winning contractors for the Ares I Upper Stage and Ares I Instrument Unit, but the contracts for the Ares V Core Stage, Earth Departure Stage, and for Altair have not yet been completed. Selection of contractors for these efforts will greatly influence contractor employment in the locations in which the work is performed. For those contracts that were awarded recently, NASA is still working with industry to refine contract related information, such as workforce levels. Further, the systems remain under development and the workforce requirements for the ground operations and launch processing for Orion/Ares at KSC are still being determined, with the program attempting to minimize the cost of operations of the new systems. As both requirements and plans solidify during the current and future budget cycles, NASA will have more precise information on the workforce impacts in particular areas.

NASA Transition Workforce Strategy

NASA's strategic approach to ensuring that critical skills are retained is fundamentally simple: provide a clear career path to challenging and exciting follow-on work in Constellation and on other programs, maintain NASA's quality workplace by providing a collaborative and creative environment, and support career development and learning opportunities. NASA is committed to transitioning the key Space Shuttle civil servant workforce to other Agency programs as is necessary using tools such as workforce synergy, matrixing, detailing, and retraining. In addition, Centers identify opportunities for the placement of employees with needed skills in other organizations.

Three key documents form the foundation for the NASA transition workforce strategy:

- *NASA Workforce Strategy*, 2006
  http://nasapeople.nasa.gov/HCM/WorkforceStrategy.pdf

- *NASA Human Capital Plan for Mission Execution, Transition, and Retirement of the Space Shuttle Program*, 2006
  www.nasa.gov/pdf/218792main_SSP_human_capital_plan.pdf

- *NASA Human Space Flight Transition Plan* (currently being updated as the *NASA Transition Plan, 2008*).
  http://spaceoperations.nasa.gov/tran_plan.pdf),

NASA has created seven goals focused on the human spaceflight workforce:

NASA's Human Space Flight Workforce Goals

1. Enable a capable and committed workforce to fly the Shuttle as safely as possible until its retirement in 2010 and complete the ISS in a manner consistent with NASA's International Partner commitments.
2. Make available the workforce required to advance Constellation to initial operating capability, both during the period of completing the Shuttle manifest through fiscal year 2010 and the period between the last Shuttle mission and the first Constellation mission.
3. Retain critical skills through the gap between the last Shuttle mission and the first Constellation mission.
4. Use the experienced, dedicated and skilled Shuttle and ISS industry workforce to the maximum extent required to implement Constellation.
5. Maintain ten "healthy" NASA Centers.
6. Identify and manage workforce geographic dislocation.
7. Maximize workforce efficiency and knowledge transfer through workforce sharing and synergy among NASA programs.

From these goals, NASA has created three specific workforce objectives:

NASA's Human Spaceflight Workforce Objectives

1. Retain the skills for Space Shuttle operations to safely execute the remaining Space Shuttle missions;
2. Manage the transition of appropriate Space Shuttle workforce into Constellation development; and
3. Retain the skills after Shuttle retirement that are needed to safely prepare for and execute the Constellation Initial Operational Capability (IOC) in 2015 and flight operations beyond.

NASA is committed to working with the aerospace contractor community on workforce issues. The Agency's industry partners have a range of transition, retention, and staffing tools available to maintain critical skills to meet their contractual obligations required for safe Space Shuttle mission execution. Specific impacts will be unique to each contractor, depending in part on its

role in future Constellation work and its skill set. NASA is also committed to the equitable distribution of tasks and workload among the Centers, leveraging the core technical capabilities of NASA's workforce and infrastructure, and limiting the impact of workforce changes to local communities of workforce changes. In the end, though, Constellation program requirements will drive Constellation's workforce size and skills needs.

NASA has provided the Space Shuttle prime contractors with a number of opportunities to help safely manage the Shuttle operations through FY 2010 and to prepare the contractor workforce for Shuttle retirement. This includes opportunities for employees to do work on several different NASA programs, acquire skills retraining, and in selected cases, receive retention bonuses. NASA remains committed to working with its industry, supplier, and research partners to craft and implement strategies to minimize disruption, upheaval, and economic impact, while maximizing support vital for Shuttle missions and program requirements.

NASA buys products and services from industry, and does not determine contractor workforce levels. However, the Agency has made a substantial investment in training an industrial human spaceflight workforce with unique skills. NASA believes that the highly skilled, experienced, and dedicated human spaceflight workforce of the Space Shuttle and International Space Station programs will be employed by successful bidders for future Constellation development work, but the geographic distribution and quantity of each type of work continues to be determined as NASA competes and selects contractors to design and develop Constellation. As Constellation contractors further define their vehicles through successful design reviews, suppliers and vendors will be selected and the implications for the contractor workforce will become clearer.

While NASA maintains internal Government estimates for likely future contractor costs and workforce at NASA Centers for future contracts, these estimates are procurement sensitive and not released to the public. In some cases, NASA is still formulating the acquisition strategy and developing detailed procurement plans, including the division of work between civil servants and contractors and the Center at which the work will be conducted. Ultimately, Constellation program requirements will drive the workforce size and skills needs in the acquisition process. See Appendix C, "NASA Non-Sensitive Integrated Acquisition Roadmap", for more details.

3.0 Workforce Initiatives

NASA has undertaken a number of specific initiatives aimed at meeting its workforce goals. The total civil servant workforce level is expected to remain relatively constant through the transition from Space Shuttle to Constellation. NASA contractors are primarily responsible for implementing any initiatives needed to keep a skilled and robust contractor workforce in place and ready to perform its critical function of delivering products and services. NASA has been strongly engaged with its contractor partners in these activities at both the strategic and tactical levels.

Important milestones for NASA workforce planning include the design milestones for Constellation Program, the development contract start dates for Constellation, and the retirement of the Shuttle by the end of FY 2010. Constellation Design Reviews and the Space Shuttle manifest are shown on the NASA Multi-Program Integrated Milestones (MPIM) chart (Appendix D), and Constellation Procurement milestones are shown on the NASA Non-Sensitive Integrated Acquisition Roadmap (Appendix C). By completing the Constellation design reviews, NASA and its prime contractors determine in detail what work needs to be performed to develop Constellation vehicles, and by awarding the prime contracts for IOC, NASA determines who in industry is going to perform the work, where it will be performed, and what quantity of which skills are needed to deliver the products and services.

As NASA reaches the end of the Space Shuttle Program, specific Space Shuttle contract actions will be used to retain workers needed for Space Shuttle even as new Constellation work is competed with industry. NASA is assisting in the development and implementation of contract workforce retention plans for each Space Shuttle prime contractor, with a focus on communication and future work. In some cases, prime contractors are implementing monetary retention incentives. As appropriate, the contractor community is using a range of tools, such as cross-training, to demonstrate a future path for employees, as well as embedding personnel with operational experience in the design phases of Constellation's vehicles

Additional initiatives will continue to be worked as part of the current budget development process, and NASA will provide updates to the status of these items in future updates to this report.

Space Shuttle Workforce Surveys

Background: The safety and success of the Space Shuttle Program depends on a skilled, focused, and motivated workforce. As the retirement of the Space Shuttle approaches, there is a large and growing need to ensure that there are enough skilled team members to support safe operations through the conclusion of the Space Shuttle Program. Annual surveys of the Space Shuttle civil servant and contractor workforce help NASA leadership monitor trends and refine communications and incentive activities aimed at retaining these critical workforce capabilities.

Status: The confidential 2007 Shuttle Employee Survey involved over 2,800 civil servant employees at KSC, JSC, MSFC, and SSC. The survey included employees who charged time to the Space Shuttle Program from October 2006 to May 2007. The survey was web-based and conducted between June 25 and July 13, 2007. Response rates from the four Centers were quite good, ranging from about 34 to 44 percent.

General observations from 2007's survey include:

- There continues to be a great deal of goodwill toward the Space Shuttle Program.
- Sixty-five percent of employees indicated that they will stay until the end of the program.
- Employees are nervous about the future, both their own and the Agency's. They are concerned about having meaningful work now and in the future, and about job security.
- Employees are concerned about the funding stability of the Constellation program.

These observations indicate a continuing need to improve communication at the Agency, Center, and program level. At the Agency level, NASA needs to continue to share the U.S. Space Exploration Policy, plans, and vision. At the Center level, the human spaceflight Centers must address workforce issues and concerns. At the program level, the three human spaceflight programs have to provide employees the status of Space Shuttle transition and retirement activities, plus information on new contracts and program progress.

Workforce Synergy, Matrixing, Detailing, and Cross-Training

Background: NASA uses the matrix form of management (or organizational structure) to support its multiple programs. In this approach, the functional skills (such as engineering, operations, etc.) are "sourced" within a Center and the program(s) tap into the expertise as needed. For example, the structural engineering function resides within the engineering organization allowing the managers and structural engineers to support not only the Shuttle Program, but potentially the Station and Constellation Programs as well. Not only does this allow for cross-training and broader skill development, but helps supervisors manage peaks and valleys in workload.

To build crossover skills for employees, NASA has made a concerted effort to share civil servant and contractor workforce across the programs (especially between Space Shuttle, ISS, and Constellation). This workforce synergy enables the Constellation Program to make steady progress towards its development and operational goals while ensuring the continuing availability of the critical skills necessary to safely and efficiently execute the remaining Space Shuttle missions. In addition, this synergy encourages transferring lessons learned, accounting for operations needs in spacecraft systems design, and showing employees the future of human spaceflight with the Constellation Program. NASA is providing the tools, training, and time for civil servant and contractor workers to gain experience and skills on new processes that NASA will implement for Orion and Ares. This hands-on experience will increase employee familiarity with the new techniques and qualify them for future work.

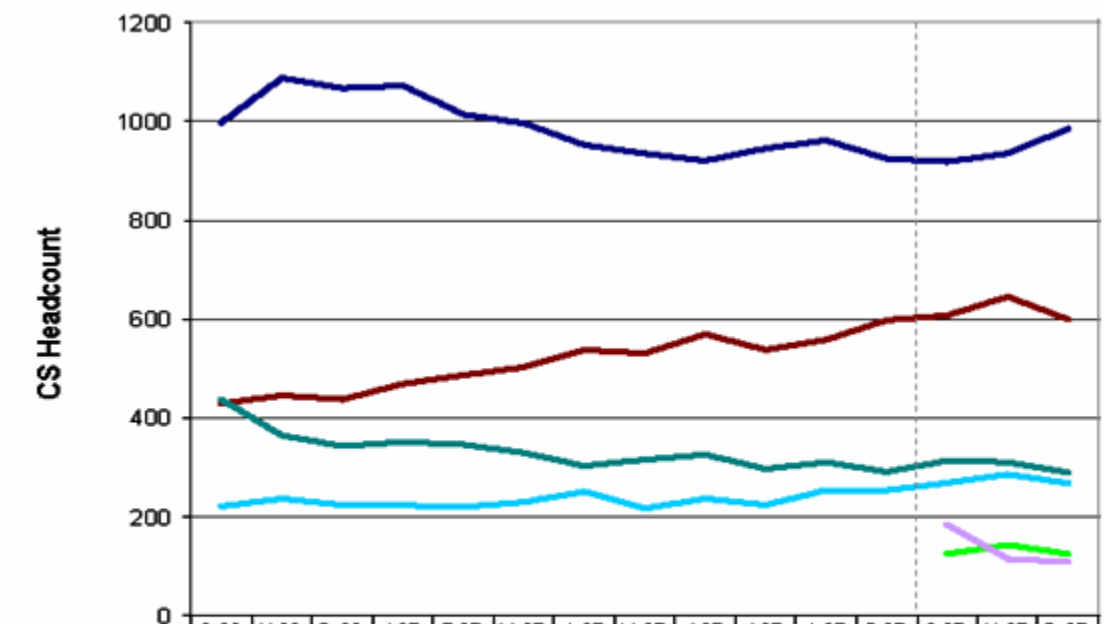
In addition, Centers are partnering with the programs to look for opportunities for retraining. For example, KSC identified several likely positions for Fuel Cell Engineers currently supporting the Shuttle Program to transition to Constellation in support of Cryogenic Systems or Environment and Crew Life Support Systems (ECLSS). Currently, the KSC training and development office is in the process of creating training plans that will identify the precise pathway for these individuals to transition to the new roles.

Status: NASA is tracking and comparing civil servant time spent on Space Shuttle, ISS, and Constellation. Based on the 2007 Shuttle Workforce Survey (the second year the survey has been taken), over 57 percent of those responding provide regular support to programs and

projects outside of the Space Shuttle Program. The following data is for civil servant employees at each of the four main human spaceflight Centers that supported more than one program in 2007. The trends are showing increasing use of this effective practice, even with the unforeseen impacts of the additional work required to repair the Space Shuttle external tank damaged during the hail storm in 2007 and the engine cut-off (ECO) sensor challenges during STS-122. The following shows the percentage of civil servant employees at each of the four main human spaceflight centers that supported more than one program (Space Shuttle, ISS, and Constellation) in December 2007:

- Kennedy Space Center (KSC) 56 percent
- Johnson Space Center (JSC) 61 percent
- Marshall Space Flight Center (MSFC) 56 percent
- Stennis Space Center (SSC) 83 percent

Figure 5 shows the number of civil servants working full-time for Space Shuttle, ISS, Constellation, Center Management and Operations (CM&O), "Other", as well as the number of employees who split their time between multiple programs. The data is current as of January 2008.



	O 06	N 06	D 06	J 07	F 07	M 07	A 07	M 07	J 07	J 07	A 07	S 07	0 07	N 07	D 07
Shuttle 100%	988	1088	1068	1073	1015	997	953	936	921	946	962	925	919	936	986
Cx/SSP	429	446	436	469	487	503	538	531	570	538	559	598	608	646	600
ISS/SSP	438	365	343	352	346	330	303	316	326	297	311	291	314	311	290
ALL 3	221	237	224	223	220	230	251	217	237	224	254	254	269	286	268
SSP/CMO													125	143	125
SSP/Other													184	115	109
Total Shuttle Employees													2419	2437	2378

Figure 5: Transition of Civil Servant Employees

Based on workforce synergy metrics, from October through June of 2007, the number of civil servants charging to both the Space Shuttle and Constellation programs increased by 33

percent, while the number charging to both the ISS and Constellation increased by 23 percent. In addition, Shuttle contractor workforce has been used for Constellation Program tasks. Examples of synergy across the programs include the following:

- On STS-118, Shuttle Orbiter *Endeavor* was powered up before its mission using a new "paperless" process as a test of future procedures for the Orion spacecraft.
- For STS-120, a single Solid Rocket Booster was stacked one segment at a time to gather engineering information for the Ares I-X launcher, which will also use segmented solid rockets stacked singly. The Space Shuttle Program has also begun demonstrating new paperless, electronic procedures for processing solid rocket motors in the Rotation, Processing, and Surge Facility (RPSF) and the Vehicle Assembly Building (VAB).
- The United Space Alliance (USA) Space Programs Operation Contract (SPOC) workforce is being used by Constellation to process the Ares I-X vehicle for the first Constellation test flight (scheduled for April 2009). The first Constellation flight of Ares will be conducted by many contractor personnel from the Space Shuttle workforce.
- Pratt & Whitney-Rocketdyne's Space Shuttle Main Engine employees across all sites spend approximately 20 percent of their time on other programs. Some examples of areas where this is occurring are combustion devices engineering, manufacturing engineering, electrical engineering, software engineering and business operations in support of J-2X development for Ares I and Ares V.
- Constellation's Orion project is defining a Relative Navigation Sensors Development Test demonstration, which would be conducted on a Space Shuttle flight in 2009 or 2010. This test would demonstrate operation of Orion navigation sensors on the Shuttle as it navigates near the ISS, similar to Orion's initial missions planned to the Station.
- To help retire the risk of Ares I first stage thrust oscillations, a Space Shuttle reusable solid rocket booster will be instrumented to simultaneously measure pressure, sound pressure level and acceleration in 2009 and 2010.

NASA has also assigned specific work tasks to Space Shuttle Government and contractor organizations to prepare their staffs for future positions, while providing work needed today for Constellation. Expanded industry workforce skills can be developed in a variety of ways under Space Shuttle contracts. In some cases, Constellation tasks are added to Shuttle contracts and Shuttle workers are able to broaden their skills applicability to Constellation work by performing actual contract tasks.

Workforce Skills Mapping

Background: The purpose of the Space-Shuttle-to-Constellation Workforce and Skills Mapping activity is to provide the requisite baseline data necessary to facilitate Agency management of personnel and skill needs across the portfolio, develop appropriate transition strategies, uncover potential problems, and test assumptions about mitigation actions.

Status: Phase I of the mapping activity, completed in the fall of 2007, focused on the civil servant workforce. In this phase, the four traditional human spaceflight centers (JSC, KSC, MSFC, and SSC) compared Constellation's project needs with Shuttle workforce becoming available after the Shuttle Program ends, and assessed how well this demand and supply matched at a skills level. The Phase I assessment was designed to help the Agency uncover issues related to migration of workforce from Shuttle to Constellation after 2010, so that Centers and programs could add or refine human capital strategies for the placement and training of civil servant workforce in time for the major transition years of 2010 and 2011.

Although Constellation workforce demand projections at each Center used in Phase I were considered preliminary (particularly the projections for fiscal years 2013 through 2015), the study nonetheless resulted in the identification of a few skill mix issues at each Center that would likely remain even as Constellation demand is further refined. Furthermore, Phase I yielded more detailed information about how the Centers were planning to migrate specific skills to the Constellation program post-2010, and identified a set of issues for each Center that required specific near-term actions or special attention during the fiscal year 2010 budget planning cycle.

Phase II, currently underway and nearly complete, focuses on contractor data for on, near, and off-site contractor personnel, and expands the scope to all ten NASA Centers from the previous four human spaceflight operations centers. The purpose of this phase is to bring more quantitative rigor and detail to contractor workforce supply and demand projections. Phase III, scheduled for the third and fourth quarter of fiscal year 2008, will refresh the Phase I civil servant data with new information available from the fiscal year 2010 planning cycle, assess the validity of initial findings, and check progress of mitigation actions undertaken as a result of Phase I. The Agency will continue to refresh both civil servant and contractor data as part of the budget planning cycle each year between now and 2011.

Communications

Background: NASA's workforce surveys have indicated that communication is the key to managing the workforce during transition. NASA and its prime contractors are engaged in a robust communications effort at all levels to ensure that the workforce is kept informed of current programs and future plans. The Agency is utilizing many tools and media options to make this possible, and the effectiveness of these tools is continually evaluated in both surveys and by monitoring various media metrics.

Status: The recent establishment of the external Space Shuttle transition website at www.nasa.gov/transition is an important step towards providing ready and open access to key NASA transition information. Additionally, a host of internal secure websites, newsletters, supervisor talking points, and monthly news articles add new elements to the NASA toolkit for

communicating with the workforce. Notable among the tools in use are *Rendezvous* magazine and other periodical publications.

In addition, a number of other communications methods and products are used, such as manager talking points, program websites, feedback groups, all-hands meetings, Transition "road shows," and quarterly program updates. Public briefings at symposia, conferences, and industry events are also frequently conducted to ensure the widest audience possible

Figure 6: Examples of NASA Publications to Communicate with Shuttle Workforce

4.0 Distribution of Workload and Tasks to Centers

Background: New work assignments from ESMD have been distributed across the various Centers to not only leverage resident capabilities and expertise, but also mitigate some of the effects of Space Shuttle retirement. Analysis of current and projected workforce needs resulted in the following considerations being viewed as primary drivers behind workforce and workload allocation:

- geographical location of the work and workforce demographics;
- acquisition approach;
- degree of heritage system or support infrastructure composition in new vehicle architecture;
- unique skill set requirements or resources available;
- dynamics in work assignments and future assignment allocations;
- Operations/Development/Sustaining Engineering definitions, budgeting and mission splits, and transition funding;
- contractor-unique workforce issues; and
- NASA's repeated cycling from predominantly operations to development work as new systems are developed and fielded.

A sound baseline of data from which to build is fundamental to the success of NASA's evolving workforce strategy, and the results of the current workforce initiatives are central to any equitable evaluation of re-distribution, tailoring, or modifications to existing or projected Agency workload. However, each NASA Center has specific and unique capabilities and resources to execute their core competency mission areas. Awarding lunar contracts as soon as possible provides evidence of emerging opportunities, reduces workforce concern about the end of the Shuttle Program, and facilitates workforce strategy development and mitigation plans.

Status: NASA has made Exploration lunar lead and support role and work assignments that leverage expertise across the NASA Centers and facilities. These work assignments are provided in the table in Appendix A.

NASA is analyzing the costs and refining the method of retiring the Space Shuttle after its last mission in 2010. Space Shuttle Transition and Retirement work plans have been approved though the end of the Space Shuttle Program in 2010, but plans and costs for the remaining work to be conducted after 2010 are still being studied and are expected to be defined at the time the President's 2010 Budget Request is submitted in Congress in February 2009.

The following Center breakdown highlights the trends and major Transition-related activities that are and will be occurring that impact workforce utilization and future projections.

Johnson Space Center

JSC continues program management and mission operations for the International Space Station after the Space Shuttle's last mission in 2010. Management of Orion development continues, as well as mission operations capability development to enable Orion's first piloted spaceflight. Design and development of the Altair Lunar Surface Access Module does not begin on a large

scale until 2011 and beyond. JSC's projected contractor workforce level is slightly lower in FY 2011 after the completion of the Space Shuttle Program.

Marshall Space Flight Center

MSFC continues management and sustaining engineering of the Space Shuttle's propulsion systems until completion of the last Space Shuttle mission in 2010. MSFC continues the design and development of the Ares I Crew Launch Vehicle from 2005 to 2015, while design and development of the Ares V Cargo Launch Vehicle will take place in 2011 and beyond. MSFC's projected contractor workforce level is approximately level over the years, due to more Ares V design work commencing right after Space Shuttle completes its last mission.

Kennedy Space Center

KSC completes Space Shuttle launch and landing work in 2010. In 2007, NASA started the construction of facilities modifications to KSC to prepare for the Ares I-X test flight in 2009, as well as for the later launch of Ares vehicles. NASA does not gather comprehensive workforce information for construction of facilities work, so not all of this work is included in Agency projections. NASA is still studying the tasks and contracts required for ground processing of the integrated Orion/Ares I vehicle, and only Government internal estimates are available for budget and workforce. A Request for Information (RFI) for Constellation Ground Processing Services was released in February 2008, which will be followed by industry brief in the late summer of 2008 and a Request for Proposals in spring 2009. Contract selections and awards are expected in 2010. Analysis of the results from this RFI and follow-on activity is expected to have a significant impact on workforce planning at KSC and will be documented in future updates to this plan. KSC's contractor workforce is expected to decrease from FY 2010 to FY 2011. Work required at KSC to retire the Space Shuttle after 2010 is still being refined and is not included in these estimates. These estimates also do not include work still under negotiation between NASA Centers or prime contractors and subcontractors which will probably be reallocated to the launch site. .

Stennis Space Center

SSC is transitioning from support of Space Shuttle Main Engine propulsion testing to propulsion test development for Constellation's new J-2X and RS-68B engines. Significant construction of facilities activities, including the A-3 Test Stand, is currently underway.

Michoud Assembly Facility

The Michoud Assembly Facility (MAF) will complete production of External Tanks for the Space Shuttle in 2010. Starting in 2008, MAF will begin preparations to start production assembly of upper stage tanks by Boeing for the Ares I launch vehicle. Lockheed Martin plans to use MAF for selected Orion Launch Abort System developments. NASA will select a new multi-program Facility Operations and Maintenance contractor in early FY 2009; NASA is still studying the scope and work required to conduct that function for all the NASA programs which will use MAF, so those estimates are not included. Production and test of the Ares V Core Stage and Ares V Earth Departure Stage begin ramping up in FY 2011; NASA is still studying the tasks and contracts for Ares V work, so these elements are not included in the estimates for MAF. NASA is considering early Ares V risk reduction and skill retention manufacturing tasks at MAF, but in 2008 these are only being evaluated for a later decision. Work required at MAF to retire the Space Shuttle External Tank production after 2010 is still under study and is not included in these estimates.

5.0 Workforce Projections

Background: NASA's projections for Center civil servant and contractor workforce levels are based on data from the Space-Shuttle-to-Constellation Workforce Mapping activity and updates to civil servant full-time equivalent (FTE) and contractor work-year equivalent (WYE) requirements from the Agency budget planning process. This is an evolving effort and will be updated accordingly as the data and information are further refined.

Status: NASA's bottom-up estimates in 2007 and early 2008 show a lower number of contractor work year equivalents in FY 2011 than in FY 2010 because:

1. Space Shuttle work, which ends in FY 2010, is well defined, with predictable contractor workforce information provided by the existing contractors based on extensive experience.

2. As a mature, operational program, Space Shuttle budget maintains a low level of annual budget reserve. The direction of budget reserve to solve problems (by paying staff overtime or surge skills) does not drive gross change in the workforce distribution between various sites.

3. Given that the Constellation Program's Ares I and Orion projects are still in their early phases, work to be conducted at the production, assembly, and launch sites is still not fully defined, nor are contractor work year equivalents fully mapped to the correct work location (see KSC estimates, below).

4. NASA is planning the work to be contracted for vehicle processing and operations. Once the planning is competed and providers selected, the industry workforce levels will be clearer. NASA's internal assessment is that less vehicle processing and operations labor will be needed to launch two Orion/Ares I missions each year to the International Space Station than that required to maintain the Space Shuttle for flight.

5. Current estimates are that several thousand fewer contractor positions may be required at KSC for that work after FY 2010, but more accurate information will not be available until vehicle processing contact work planning is better defined. These numerical estimates are based on work assigned to KSC during the FY 2009 formulation process negotiated with companies to provide these contracted products and services, these numbers will be based on internal Government estimates.

6. Because the Constellation Program is still early in development and has not yet gone through Preliminary Design Review, budget reserves in later fiscal years (starting FY 2011) are not yet allocated to specific work, as the final allocation will be based on what challenges occur during development; these will not be identified for several years.

7. The Constellation lunar work for Ares V and Altair - including early technology development for these efforts – is in the early stages of planning, so the work allocation and time phasing are still internal Government estimates until the final phasing is confirmed. This leads to less work being explicitly defined in FY 2011 and beyond than that supported by the budget; these data will be better defined over the next year.

8. NASA has not yet authorized the exact work which will be conducted to close-out and retire the Space Shuttle after FY 2010, primarily at KSC, MAF, and Shuttle Prime Contractor sites. That work will be better defined later in 2008 as part of the current budget process.

9. NASA does not uniformly gather data from contractors conducting construction of facilities projects, as these are not long-term, contracted efforts involving R&D. However, modification of facilities to support future Constellation development and operations has already started. Work will continue on construction of facilities for this through the gap in flights between Shuttle and Constellation. Some estimates are included, but these are not inclusive

10. NASA does not gather data from companies participating via Space Act Agreement in the Commercial Orbital Transportation Services (COTS) activity, nor will NASA collect data from the follow-on Commercial Cargo services for ISS, as these are purchased services. After the last Space Shuttle mission, NASA will increase the percentage of budget going to procure these services and they will likely comprise part of the overall NASA contractor figures.

Specific Workforce Information by Center/Location

Note on contractor workforce estimate numbers: In order to project probable contractor workforce levels in the future, NASA gathers information from contractors on their current work, makes internal Government estimates, and estimates allocation of future budget reserves not yet assigned to any contract. These can include NASA estimates of future budget reserves according to pro-rata distributions or technical risk assessments, as well as estimates of the percentage of funds used to design and develop new and unique products versus raw materials or purchased services. Contractor workforce projections for these years therefore may contain data which are the sum of: (a) defined, approved work on contract; (b) the Government's estimate of work not yet awarded or negotiated (i.e., procurement-sensitive information); (c) an informed estimate for budget reserves allocated to mitigate not-yet-identified future technical problems; and (d) potential work not yet assigned by the Government but under internal consideration. The details of these estimates cannot be made public, as potential bidders could use that information to determine the Government's "should cost" estimate, or existing contractors could use that information to propose work up to that level. Additionally, many of the specific contractual details are still being refined as NASA continues to develop the appropriate acquisition strategies to meet its mission objectives at best value to the Nation.

Pursuant to P.L.110-161, Table 1 provides specific annual civil servant and contractor workforce projections for the four human spaceflight Centers (as well as MAF) that are most affected by the Shuttle-to-Constellation transition, including a low and a high range based on the variability in data inputs discussed above.

Space Shuttle and Constellation Workforce Estimates - as of March 2008

NOTE CAVEATS BELOW

Category	FY08	FY09	FY08-09 Delta	FY10	FY09-10 Delta	FY11	FY10-11 Delta	FY12	FY11-12 Delta	FY13	FY12-13 Delta
Nationwide											
Shuttle + Constellation FTEs	4,700	4,400	-300	4,200	-200	4,100	-100	4,200	100	4,300	100
Shuttle + Constellation WYEs (low)	20,900	20,200	-700	18,700	-1,500	12,500	-6,200	14,100	1,600	15,100	1,000
Shuttle + Constellation WYEs (high)	21,000	20,300	-700	19,100	-1,200	13,800	-5,300	15,700	1,900	17,000	1,300
Kennedy Space Center											
Shuttle + Constellation FTEs	1,000	1,000	0	1,000	0	1,000	0	1,000	0	1,000	0
Shuttle + Constellation WYEs (low)	8,000	7,300	-700	6,400	-900	1,600	-4,800	2,200	600	2,400	200
Shuttle + Constellation WYEs (high)	8,000	7,400	-600	6,700	-700	2,300	-4,400	3,100	800	3,800	700
Johnson Space Center											
Shuttle + Constellation FTEs	1,400	1,400	0	1,400	0	1,200	-200	1,200	0	1,300	100
Shuttle + Constellation WYEs (low)	5,900	6,000	100	6,000	0	3,700	-2,300	3,800	100	3,500	-300
Shuttle + Constellation WYEs (high)	5,900	6,200	300	6,600	400	5,500	-1,100	5,700	200	5,800	100
Marshall Space Flight Center											
Shuttle + Constellation FTEs	1,200	1,200	0	1,200	0	1,200	0	1,300	100	1,300	0
Shuttle + Constellation WYEs (low)	2,700	2,900	200	2,900	0	2,800	-100	3,000	200	3,100	100
Shuttle + Constellation WYEs (high)	2,700	3,100	400	3,500	400	4,400	900	5,100	700	5,500	400
Stennis Space Center											
Shuttle + Constellation FTEs	100	100	0	100	0	100	0	100	0	100	0
Shuttle + Constellation WYEs (low)	300	300	0	300	0	200	-100	200	0	100	-100
Shuttle + Constellation WYEs (high)	300	300	0	300	0	200	-100	200	0	100	-100
Michoud Assembly Facility											
Shuttle + Constellation WYEs (low)	1,900	1,400	-500	800	-600	600	-200	600	0	600	0
Shuttle + Constellation WYEs (high)	1,900	1,400	-500	800	-600	1,100	300	1,100	0	1,100	0

Increasing Uncertainty

Caveats:

1) This table covers civil service and contractor personnel working on the Space Shuttle and Constellation programs at the Centers noted; it does not display the total Center workforce, and it does not include students involved with the programs.
2) "Nationwide" workforce estimates include personnel working on the Shuttle and Constellation programs beyond the Centers noted in the table.
3) FTE = Civil Servant Full Time Equivalent.
4) WYE = Contractor Work Year Equivalent.
5) See pages 19 - 20 of the March 2008 Workforce Transition Strategy, "Workforce Projections", for further notes on this table.

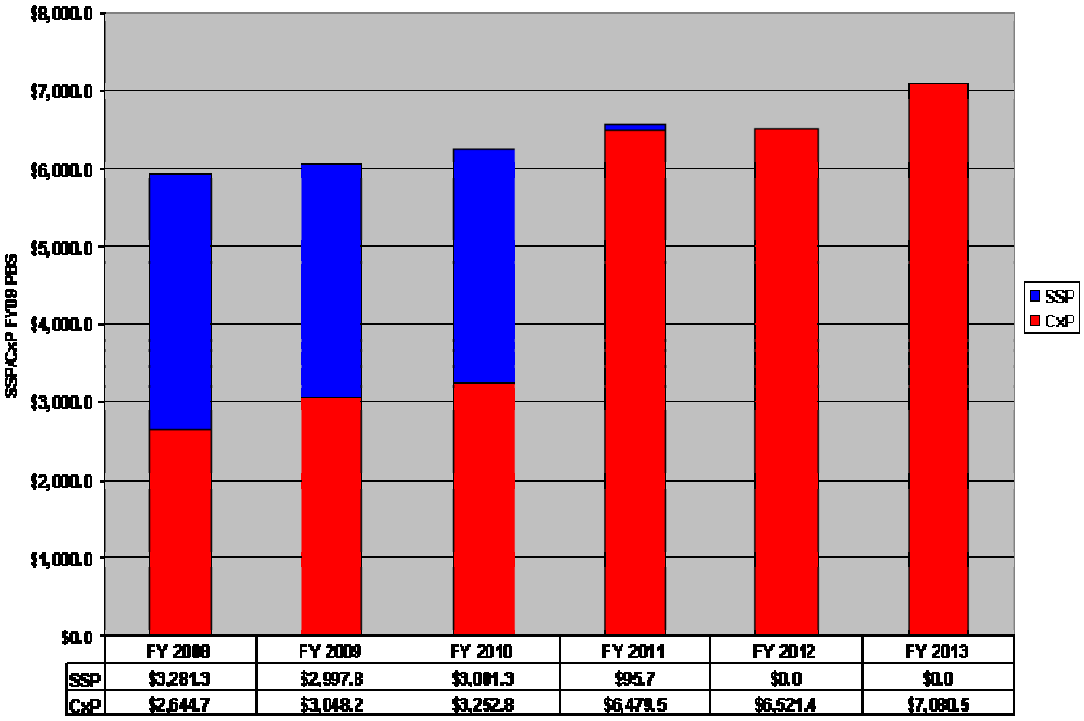
Table 1: Human Spaceflight Center Workforce Trends (Shuttle and Constellation Only) FY 2008 – FY 2013

NASA has focused its analysis to this point on the retirement of the Shuttle, which primarily affects the four human spaceflight Centers. As part of the FY 2010 budget formulation process and Shuttle-to-Constellation Workforce Mapping activity, estimates are being developed for transition impacts to other NASA Centers and future Constellation work package assignments. However, the number of civil servants and prime contractors supporting Shuttle today at the other Centers is small. While the Shuttle workforce at these Centers is declining towards zero in FY 2010, the overall impact of Shuttle retirement at these Centers will be relatively minor. For example, in FY 2008 there are approximately 25 civil servants and prime contractors that support Space Shuttle at Ames Research Center in California, 36 at Dryden Flight Research Center in California, 6 at Glenn Research Center in Ohio, 33 at Goddard Space Flight Center in Maryland, and 14 at Langley Research Center in Virginia. Though mature estimates will not be available until the FY 2010 budget formulation and Workforce Mapping activities later this year, Constellation work at these Centers is likely to exceed present Shuttle demand.

The data in Table 1 (including estimates of Constellation workforce at all ten Centers) will be continue to be updated in future versions of this strategy.

Focusing on the Shuttle and Constellation elements alone, Nation-wide, NASA plans to spend roughly the same amount of money on the purchase of products and services from its contractors as before. Presently, the budget and workforce distributions are well known for the existing Shuttle program, while the Constellation aspects are continually being refined as previously discussed. Requirements maturation, budget allocations, future contract awards,

and reserve expenditures on currently unknown future cost, schedule, technical, and safety risks will better define the precise workforce, skill, and locational needs of the projects.



	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
SSP	$3,281.3	$2,997.8	$3,091.3	$95.7	$0.0	$0.0
CxP	$2,644.7	$3,048.2	$3,252.8	$6,479.5	$6,521.4	$7,080.5

Figure 7: Space Shuttle and Constellation Budget Systems FY 2009 Budget

As the Space Shuttle Program begins to phase out, the Shuttle prime contractors project that contractor workforce will begin to be drawn down. Using these data, NASA estimates that the total contractor reductions across all NASA Centers will be between 1,000 – 2,000 people in FY 2009 and between 2,000 – 3,000 people in FY 2010. These are the same projections that were presented as part of the President's FY 2009 budget roll-out and are consistent with the original Shuttle phase-out plan.

During the same period, Constellation work requirements will increase. Contractor workforce synergy and Constellation work definition have served to lessen overall contractor workforce reductions. NASA is attempting to capture a portion of the Shuttle workforce for required Constellation work. NASA believes that many experienced Shuttle workers will be employed in the new Constellation contracts.

As of the time of this report, not all of the Constellation work content that is expected to follow Orion/Ares I initial and full operational capability has been included in the Space Shuttle Workforce Mapping effort. It is anticipated that future content will be updated in future updates to this plan at the time of the President's FY 2010 Budget Request.

While the above estimates represent progress in defining workforce requirements at NASA Centers, the requirements should be considered preliminary and subject to change as work is better defined and contracts are awarded. Though student and Co-Op employees are not

included in the FTE estimates, NASA expects that the number of student and Co-Op workers will remain relatively constant. Contractor workforce needed for Space Shuttle transition and retirement, as well as COTS launch workforce, is not included in the above projections, given the uncertainty related to the work requirements at this time and the nature of the relationship between the Agency and its COTS partners. Facility construction work is also not included in these estimates. A full list of caveats is noted on pages 19 and 20 of this report. NASA will provide Congress with civil servant and contractor workforce projections in future updates to this plan.

NASA has workforce estimates from 2007 which were used to generate the President's 2009 Budget to Congress. These were preliminary and subject to change – these estimates only portray the work assigned to NASA Centers and industry as of late 2007. NASA is analyzing updated information as the Agency prepares the Presidents 2010 Budget Request. The President's 2009 Budget Request provides a preliminary look at how workforce would change from FY 2007 to FY 2012 if NASA does not assign additional design, development, manufacturing, test, integration or operations work to be conducted at KSC or MAF.

6.0 The Road Ahead

In a short span of years, NASA has taken long strides in the formulation of strategies and programs that will take us back to the Moon and on to Mars and other destinations in the solar system. The Agency is continuing to transition from the Space Shuttle to new Exploration Systems; this transition is the largest and most daunting since the end of the Apollo Program and the beginning of the Space Shuttle Program. To implement it, NASA is focused on managing the evolution from current operations of the Space Shuttle to future operations of Constellation and emerging commercial services, in a safe, successful and smooth process. This joint effort between the Space Operations and Exploration Systems mission directorates includes the utilization and disposition of resources, including real and personal property, personnel, and processes, to leverage existing Shuttle and Space Station assets for future Exploration activities, including the Orion Ares I, and Ares V projects. Formalized Transition Boards are working to successfully achieve this outcome, and, to date, NASA has met all of its milestones and disposition targets. Acquisition, budget, and workforce planning are closely integrated and will continue to mature over the upcoming years.

The Agency will continue to keep the Congress informed of progress on Transition activities, and will provide biannual updates to this report.

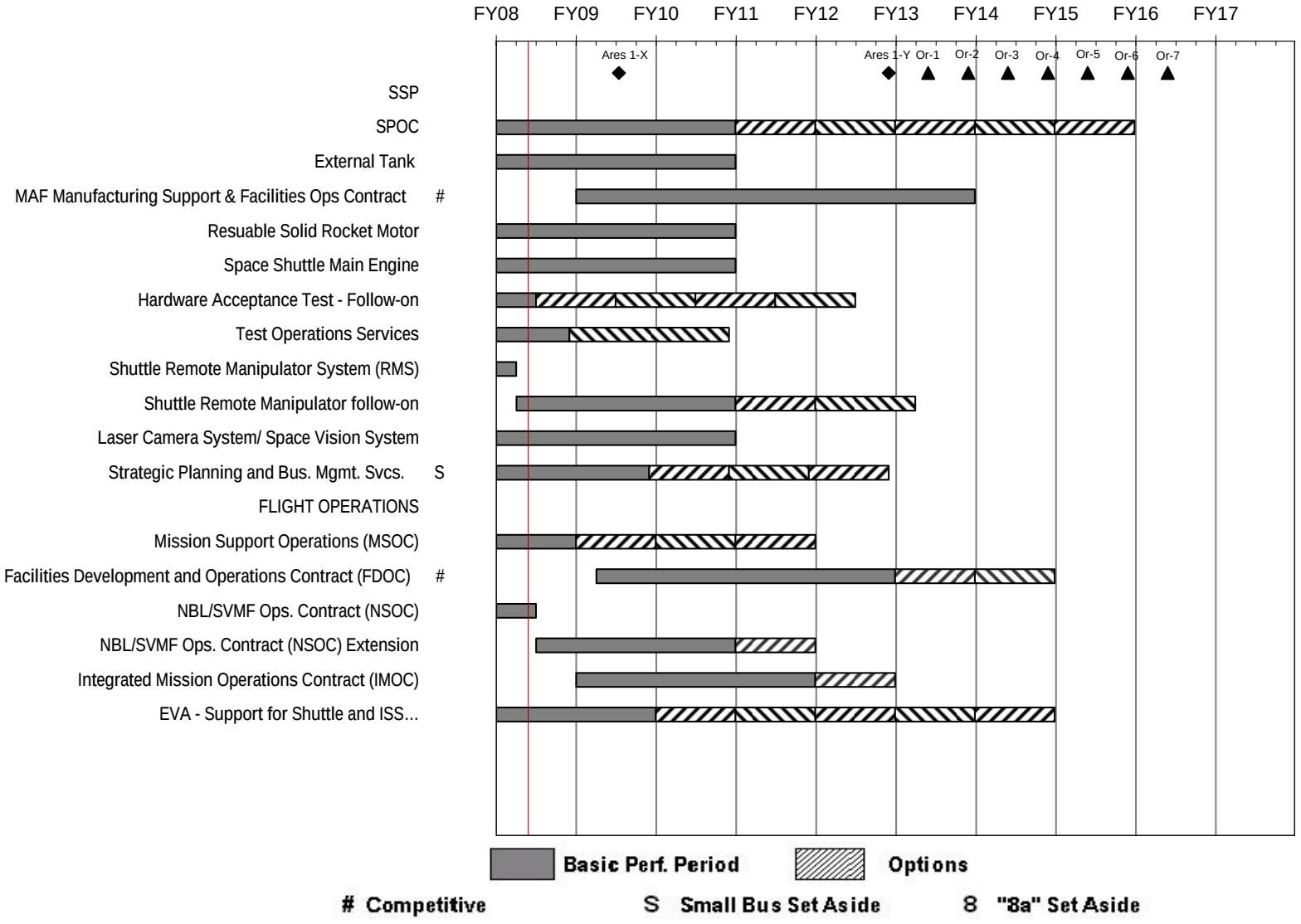
Appendix A: Constellation Work Assignments to NASA Centers

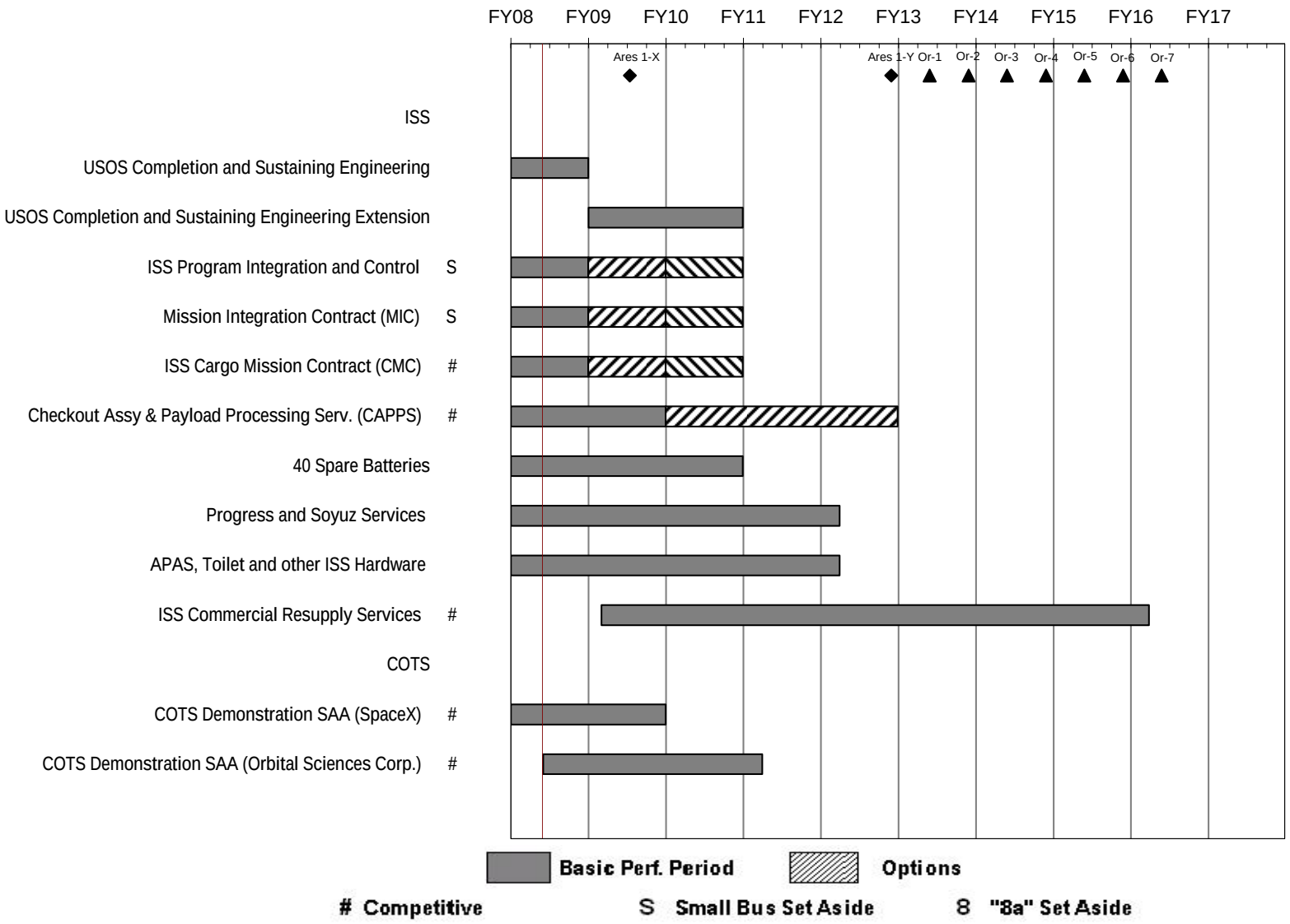
Ames Research Center, Moffett Field, California	
ESMD	Manage Lunar Crater Observation and Sensing Satellite Project; support Exploration life support; lead radiation dosimetry and medical sensor technology development; support space human factors standards; support ISS Exploration experiment development; lead piloted spacecraft handling qualities.
Constellation	In program integration, support for program planning and control including data systems support; safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
Mission Operations	Provide tools for flight controllers; develop new applications for the Constellation training program; support multiple mission operations planning and development tasks.
Orion	Lead thermal protection system advanced development; support aero/aero-thermal database development; support flight software and guidance, navigation and control.
Ares I	Lead integrated systems health management; aborts lead including blast analysis for Ares abort; lead for launch abort system software requirements, interface and verification; launch abort system flight instrumentation and health management; provide high fidelity aero/aerothermal models and analysis and simulated assisted risk assessments.
Constellation Work Announced 10-30-07	Support lunar architecture work for Constellation Program system engineer; build mission operations simulation capabilities; lead Ares V integrated health management; support Ares V payload shroud development at NASA's Glenn Research Center; subsystem lead for lunar lander and lunar surface systems integrated health management; support concepts for lunar surface extravehicular activity suit lock and concept trade studies for Moon suit; support lunar surface mobility; support lunar *in situ* resource utilization systems.
Dryden Flight Research Center, Edwards, California	
ESMD	Support NASA's Ames Research Center on piloted spacecraft handling qualities.
Constellation	In program integration, support test and evaluation.
Ground Operations	Support definition and planning for Orion ground operations including launch abort and landing and recovery tests, re-entry and landing profiles, and range safety requirements.
Orion	Lead abort flight test integration and operations; abort test booster procurement; flight test article and abort test booster integration; flight test article design, assembly, integration and test; independent analysis and oversight of flight test articles.
Constellation Work Announced 10-30-07	Support mission operations simulation capabilities; support ground and flight test operations for lunar projects.
Glenn Research Center, Cleveland, Ohio	
ESMD	Lead cryogenic fluid handling, propulsion, fission power and energy storage projects; support Exploration life support; support Exploration medical capability and exercise technologies development.
Constellation	In program integration, support for safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
EVA Systems	Manage power and communications avionics informatics subsystems for low Earth orbit and lunar extravehicular activities; support extravehicular activity systems power, avionics and software disciplines.
Orion	Lead service module and spacecraft adapter integration; produce service module and spacecraft adapter flight test articles and pathfinders; support integration analysis and system engineering and integration; vehicle environmental qualification at Plum Brook.
Ares I	Lead upper stage thrust vector control subsystem development; lead upper stage electrical power and power distribution system development; lead developmental flight instrumentation package; support upper stage system engineering and integration; J-2X thermal and vacuum testing at Plum Brook; support vehicle integrated design analysis; lead upper stage module development for Ares I-X test flight.
Constellation Work Announced 10-30-07	Support lunar architecture work for Constellation Program system engineer; lead Ares V power, thrust vector control and payload shroud development; lead Earth departure stage orbital environments testing at Plum Brook; subsystem lead for lunar lander ascent stage propulsion; and ascent and descent stage power generation, management and energy storage systems; lead lunar lander environmental testing at Plum Brook; support for lunar lander project integration and descent stage propulsion subsystems; lead lunar surface systems power generation and management, energy storage systems and element environmental testing; subsystem lead for passive thermal systems and surface element communications; support lunar surface *in situ* resource systems and surface mobility systems.

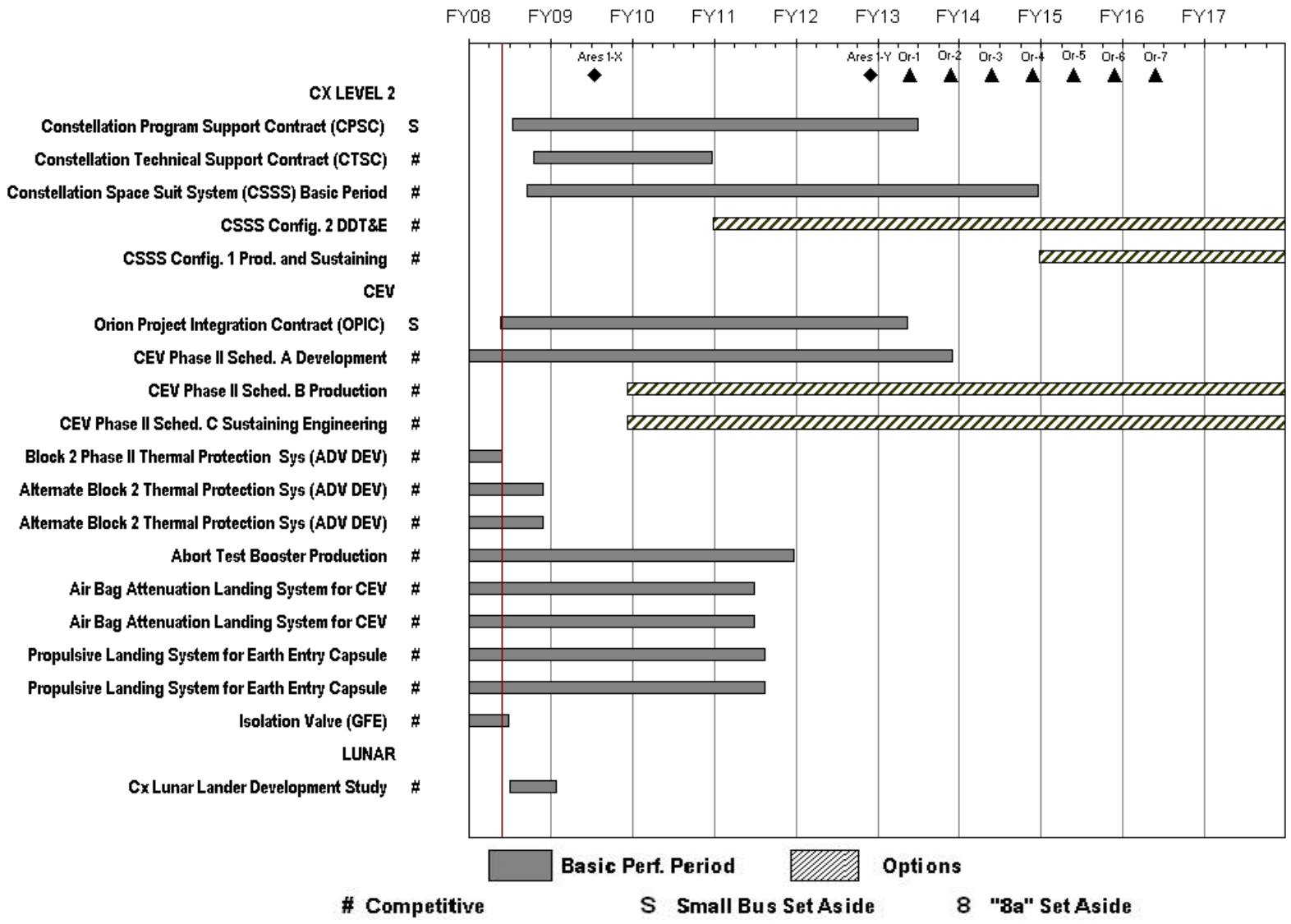
Goddard Space Flight Center, Greenbelt, Maryland	
ESMD	Lunar Reconnaissance Orbiter Project management and integration.
Constellation	In program integration, support safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
Orion	Communications and tracking support.
Constellation Work Announced 10-30-07	Lead program requirements for unpressurized cargo carriers; lead Orion unpressurized cargo carrier; support lunar architecture work for Constellation Program system engineer; subsystem lead for lunar lander avionics; support lunar surface systems avionics and surface element communications; provide extravehicular activity tools and equipment.
Jet Propulsion Laboratory, Pasadena, California	
ESMD	Navigation support for Lunar Crater Observation and Sensing Satellite; lead Advanced Environmental Monitoring and Control Project.
Constellation	In program integration, support safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
Orion	Support thermal protection system advanced development.
Constellation Work Announced 10-30-07	Support lunar architecture work for Constellation Program system engineer; lunar lander project support including spacecraft design; guidance, navigation and control; life support systems, and avionics; lead specific robotic surface mobility; support environmental monitoring and control and surface system local element communications.
Johnson Space Center, Houston, Texas	
ESMD	Human Research program management and integration; Commercial Orbital Transportation Services Project (COTS) management and integration; lead autonomous landing and hazard avoidance technology; *in situ* resource utilization; thermal, surface and extravehicular activity systems, and life support projects.
Constellation	Program management and integration; extravehicular activity systems project management and integration; extravehicular activity hardware development including suit, vehicle interface, tools and ground support equipment; manage life support, pressure garment and crew survival subsystems; mission operations project management and integration including Mission Control Center and training and mockup facilities.
Ares I and Ares V	Support program and mission operations interface.
Orion	Project management and integration; lead crew module and vehicle integration, government-provided hardware, flight test execution and parachutes.
Constellation Work Announced 10-30-07	Lunar lander and lunar surface systems project management and integration including lunar architecture work; element lead for lunar lander crew module/ascent stage; lead crew habitation and environmental control and life support subsystems; subsystem support for ascent stage propulsion, propulsion testing, and project avionics and structures; lead lunar surface crew habitation, environmental control and life support systems, and human mobility systems; support lunar surface *in situ* resource utilization systems.
Kennedy Space Center, Kennedy Space Center, Florida	
ESMD	Support Exploration experiments on the ISS.
Constellation	In program integration, support safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
Ground Operations	Project management and integration; responsible for achieving all Agency ground operations objectives allocated to the launch and landing sites; lead design, development, test and engineering and logistics activities for all ground processing, launch and recovery systems; lead ground processing, launch and landing operations planning and execution.
Orion	Ground processing including ground support equipment; launch operations; and recovery support during design, development, test and engineering; prime contractor oversight and independent analysis.
Ares I	Ground processing, launch operations, and recovery support during design, development, test and engineering; lead launch operations planning and execution for Ares I-X and other flight demonstrations.
Constellation Work Announced 10-30-07	Support lunar architecture work for Constellation program system engineer; ground operations and assembly for Orion Block 1 and Ares I low Earth orbit operations phase; Ares V ground processing, launch operations and recovery support during design, development, test and engineering; final assembly of and ground processing support for human lunar lander; lunar surface habitat management and integration; lead for lunar surface *in situ* resource utilization systems; support surface systems logistics concepts.

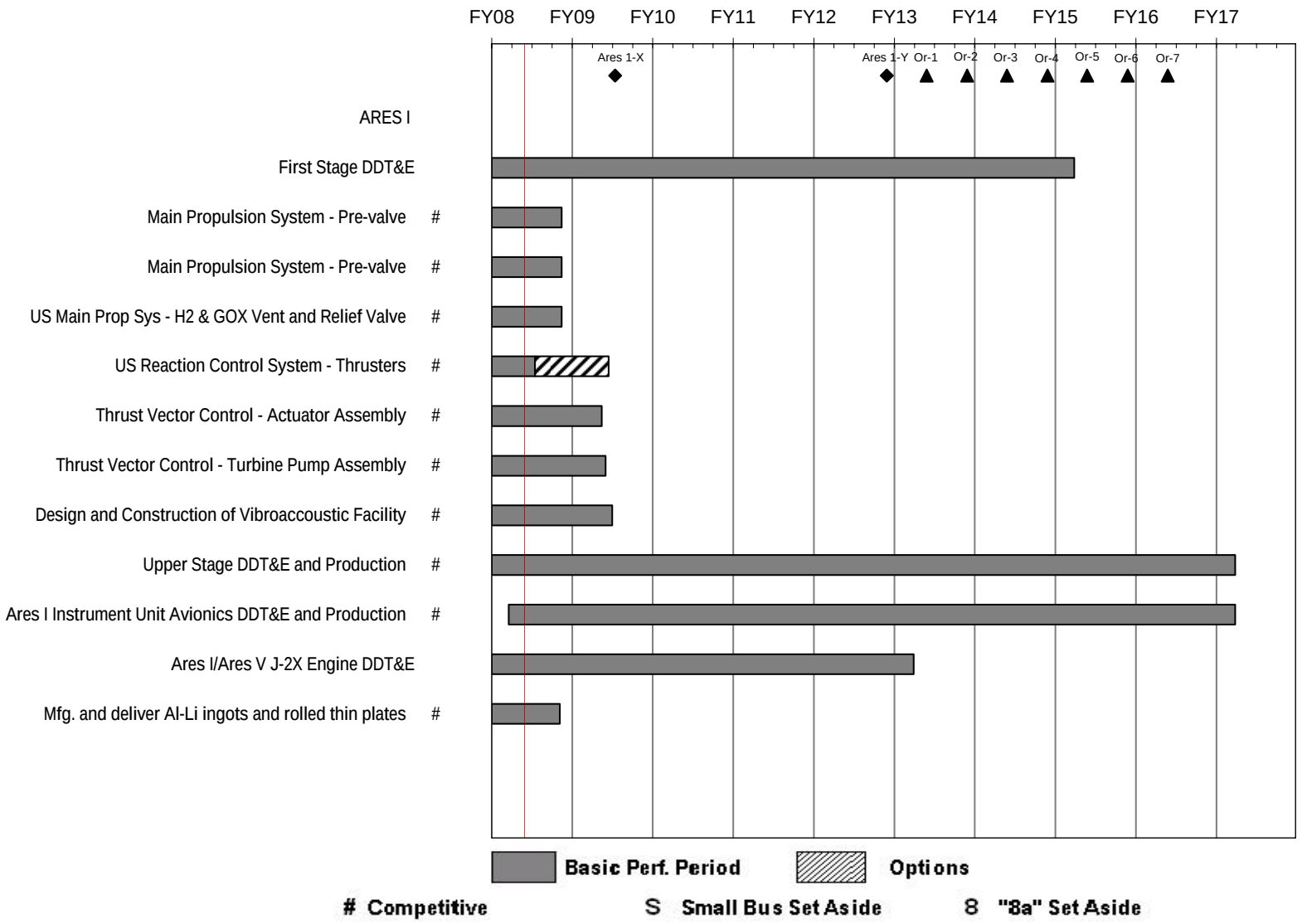
Langley Research Center, Hampton, Virginia	
ESMD	Exploration Technology Development Program management and integration; lead structures, mechanisms and materials and supportability projects; support autonomous landing and hazard avoidance technology project with lead for sensors; deputy management for radiation protection element.
Constellation	In program integration, support safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
Orion	Lead launch abort system integration and crew module landing system advanced development; produce flight test and pathfinder articles for crew module, launch abort system and separation rings; support aero/aerothermal; guidance, navigation and control; avionics software; and displays and controls; independent analysis and system engineering and integration support.
Ares I	Lead aerodynamic characterization of integrated launch vehicle stack, aerodynamic database development, and aeroelasticity test and analysis; support structural design and analysis; guidance, navigation and control development; flight mechanics and trajectory analyses; support systems engineering and upper stage design, development, test and engineering; lead vehicle integration activities and crew module and launch abort simulator design and fabrication for Ares I-X.
Constellation Work Announced 10-30-07	Support lunar architecture work for Constellation Program system engineer; lead Ares V aerodynamics; support Ares V systems engineering, structures and materials engineering, and payload shroud structures; build mission operations and simulation capabilities; subsystem lead for lunar lander structures and mechanisms including ascent and descent stages; support lunar lander project integration; support lunar lander and lunar surface systems crew habitation (radiation protection); lead lunar surface systems structures and mechanisms including support to habitat, mobility and *in situ* resource systems.
Marshall Space Flight Center, Huntsville, Alabama	
ESMD	Lunar Precursor Robotic Program management and integration.
Constellation	In program integration, support program planning and control; safety, reliability and quality assurance; system engineering and integration; and test and evaluation.
Orion	Support launch abort systems and service module; support abort test booster requirements development and validation.
Ares I and Ares V	Project office management and vehicle integration for Ares I and Ares V; Ares I first stage development and management and Ares V first stage management; Ares I upper stage design and development; J-2X engine development and management; manage upper stage production contracts at NASA's Michoud Assembly Facility; lead Ares I-X avionics, roll control system, and first stage modifications; Ares V Earth departure stage development, test and oversight; core stage development, test and oversight; core stage (RS-68) engine management.
Constellation Work Announced 10-30-07	Support lunar architecture work for Constellation Program system engineer; element lead for lunar lander descent stage; subsystem lead for lunar lander descent stage propulsion; subsystem support for lunar lander ascent stage propulsion, propulsion testing, project avionics, life support, and structures; support project integration; support lunar surface systems life support, habitat, structures and *in situ* resource systems.
Michoud Assembly Facility, New Orleans, Louisiana	
Constellation	Manufacturing of Ares I upper stage, Ares V stages, and Orion structure.
Stennis Space Center, Stennis Space Center, Mississippi	
Constellation	In program integration, support system engineering and test and evaluation.
Ground Operations	Support design, development, test and evaluation of propellant test and delivery systems; ground engine checkout facility simulation and analysis; engine and launch facility planning and development.
Ares I	Focused program management and integration for rocket propulsion testing; lead sea-level development, certification and acceptance testing for flight upper stage assembly, upper stage engine and main propulsion test article including facility modifications and test operations; lead altitude development and certification testing for upper stage engine.
Constellation Work Announced 10-30-07	Lead Ares V liquid rocket systems and stage testing at sea level and altitude; support lunar lander descent stage propulsion testing.
White Sands Test Facility, Las Cruces, New Mexico	
Constellation	Orion Abort Test Booster Test Site.

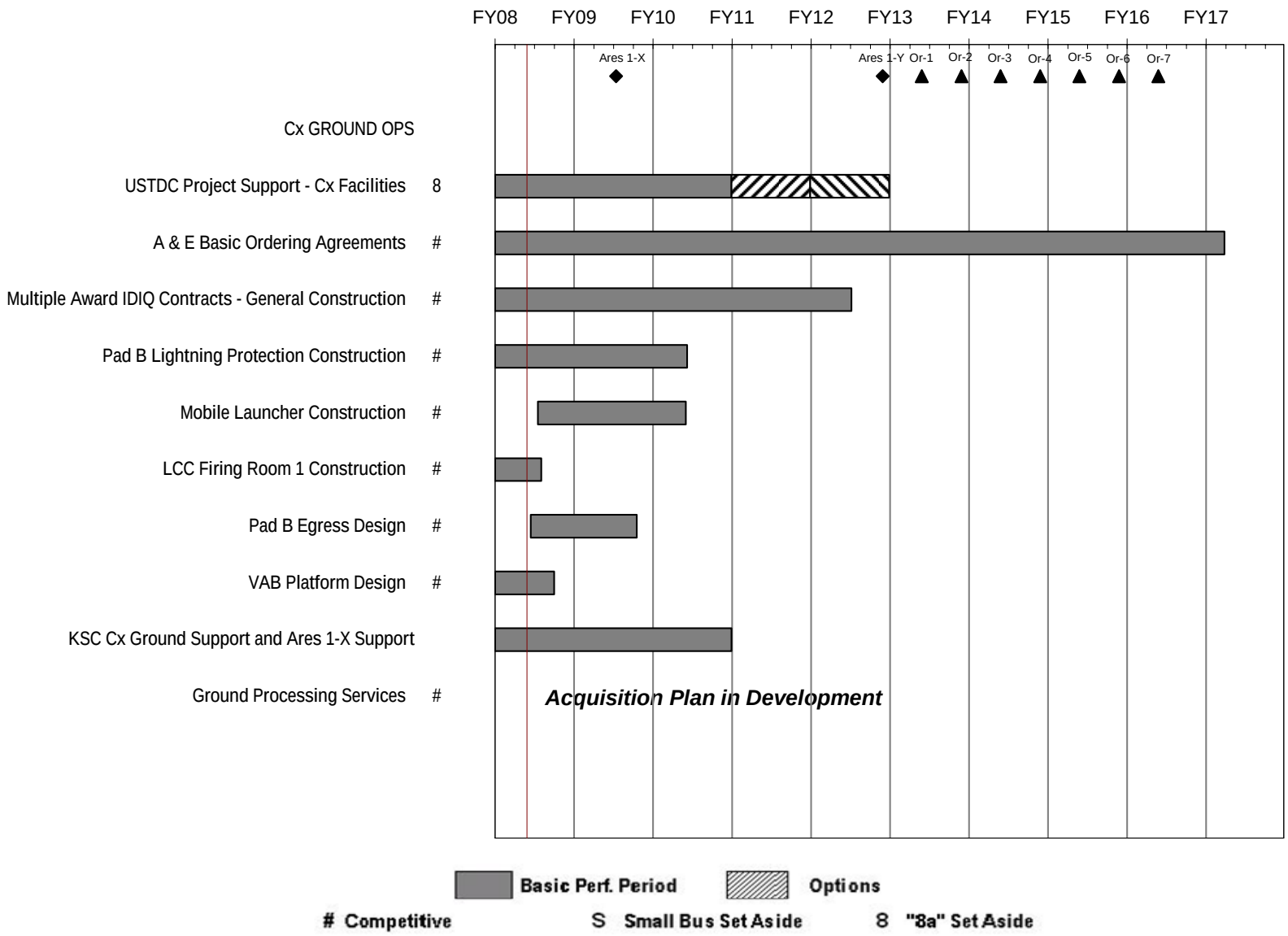
Appendix B: NASA Non-Sensitive Integrated Acquisition Roadmap




FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Ares 1-X
Ares 1-Y
Or-1
Or-2
Or-3
Or-4
Or-5
Or-6
Or-7
ISS
USOS Completion and Sustaining Engineering
USOS Completion and Sustaining Engineering Extension
ISS Program Integration and Control S
Mission Integration Contract (MIC) S
ISS Cargo Mission Contract (CMC) #
Checkout Assy & Payload Processing Serv. (CAPPS) #
40 Spare Batteries
Progress and Soyuz Services
APAS, Toilet and other ISS Hardware
ISS Commercial Resupply Services #
COTS
COTS Demonstration SAA (SpaceX) #
COTS Demonstration SAA (Orbital Sciences Corp.) #
Basic Perf. Period
Options
Competitive
S Small Bus Set Aside
8 "8a" Set Aside


FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Ares 1-X
Ares 1-Y
Or-1
Or-2
Or-3
Or-4
Or-5
Or-6
Or-7
CX LEVEL 2
Constellation Program Support Contract (CPSC) S
Constellation Technical Support Contract (CTSC) #
Constellation Space Suit System (CSSS) Basic Period #
CSSS Config. 2 DDT&E #
CSSS Config. 1 Prod. and Sustaining #
CEV
Orion Project Integration Contract (OPIC) S
CEV Phase II Sched. A Development #
CEV Phase II Sched. B Production #
CEV Phase II Sched. C Sustaining Engineering #
Block 2 Phase II Thermal Protection Sys (ADV DEV) #
Alternate Block 2 Thermal Protection Sys (ADV DEV) #
Alternate Block 2 Thermal Protection Sys (ADV DEV) #
Abort Test Booster Production #
Air Bag Attenuation Landing System for CEV #
Air Bag Attenuation Landing System for CEV #
Propulsive Landing System for Earth Entry Capsule #
Propulsive Landing System for Earth Entry Capsule #
Isolation Valve (GFE) #
LUNAR
Cx Lunar Lander Development Study #
Basic Perf. Period
Options
Competitive
S Small Bus Set Aside
8 "8a" Set Aside


FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Ares 1-X
Ares 1-Y
Or-1
Or-2
Or-3
Or-4
Or-5
Or-6
Or-7
ARES I
First Stage DDT&E
Main Propulsion System - Pre-valve #
Main Propulsion System - Pre-valve #
US Main Prop Sys - H2 & GOX Vent and Relief Valve #
US Reaction Control System - Thrusters #
Thrust Vector Control - Actuator Assembly #
Thrust Vector Control - Turbine Pump Assembly #
Design and Construction of Vibroaccoustic Facility #
Upper Stage DDT&E and Production #
Ares I Instrument Unit Avionics DDT&E and Production #
Ares I/Ares V J-2X Engine DDT&E
Mfg. and deliver Al-Li ingots and rolled thin plates #
Basic Perf. Period
Options
Competitive
S Small Bus Set Aside
8 "8a" Set Aside


FY08
FY09
FY10
FY11
FY12
FY13
FY14
FY15
FY16
FY17
Ares 1-X
Ares 1-Y
Or-1
Or-2
Or-3
Or-4
Or-5
Or-6
Or-7
Cx GROUND OPS
USTDC Project Support - Cx Facilities 8
A & E Basic Ordering Agreements #
Multiple Award IDIQ Contracts - General Construction #
Pad B Lightning Protection Construction #
Mobile Launcher Construction #
LCC Firing Room 1 Construction #
Pad B Egress Design #
VAB Platform Design #
KSC Cx Ground Support and Ares 1-X Support
Ground Processing Services #
Acquisition Plan in Development
Basic Perf. Period
Options
Competitive
S Small Bus Set Aside
8 "8a" Set Aside

Appendix C: Multi-Program Integrated Milestones (as of January 25, 2008)