



Project Status Report

High End Computing Capability Strategic Capabilities Assets Program

June 10, 2014

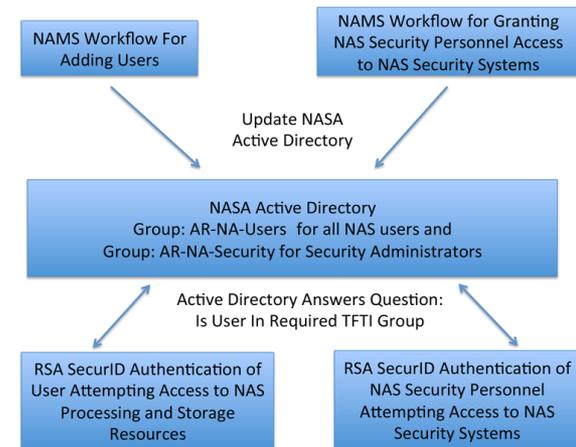
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Automation of TFTI SecurID Workflow Streamlines, Improves Account Processes



- To streamline provisioning of NASA's two-factor token infrastructure (TFTI) RSA-SecurID accounts, the HECC Security team, working through Ames personnel, modified the NASA Account Management System (NAMS) workflow to automatically assign users to the appropriate TFTI groups used for controlling access to HECC systems.
- The NAMS workflow for regular users will add them to the TFTI group AR-NA-Users.
- The Security team also created a new NAMS workflow that will add users who need access to HECC/NAS security systems to the TFTI group AR-NA-Security.
- These improvements will speed up the processing of new accounts and new access privileges, as they will occur automatically instead of being manually implemented by HECC Control Room analysts.
- Automation will also lead to higher accuracy with the elimination of the manual process.

Mission Impact: Streamlining and automating the process of adding and managing HECC user accounts improves accuracy, reduces staff workload, and ensures that the agency's TFTI RSA-SecurID requirements are met.



The improved NASA Account Management System (NAMS) workflow will update the NASA Active Directory, which is then used for access control as part of the two-factor token infrastructure (TFTI) RSA-SecurID authentication. TFTI allows users to gain general access to HECC systems and allows HECC security personnel to gain access to NASA security systems.

POCs: Thomas H. Hinke, thomas.h.hinke@nasa.gov, (650) 604-3662 and Catherine Schulbach, catherine.h.schulbach@nasa.gov, (650) 604-3180, NASA Advanced Supercomputing Division

Transition of Sybase Databases to Oracle Reduces Costs and Simplifies Processes



- The HECC Tools team completed the transition of the HECC Sybase databases to Oracle, reducing maintenance and database administration costs. The transition included converting databases for Pleiades usage accounting, downtime scheduling, asset management, operational logs, MicroStrategy reporting, and other tasks.
- Work during this transition included:
 - Development of the Oracle module for the Virtual database server to process SQL queries.
 - Development of tables, views and scripts, and the transition of data to the Oracle databases.
 - Resolution of issues caused by reserved names and rounding differences between Sybase and Oracle.
 - Development of new MicroStrategy reports to replace old reports that failed to transition accurately.
- In addition, ongoing development of database tools was simplified by the consolidation of databases under Oracle.

Mission Impact: Consolidation of HECC databases under Oracle reduces costs, eases development work when utilizing multiple databases, and simplifies database administration processes.



HECC Sybase databases were transitioned to take advantage of NASA's site license for Oracle, which provides free usage of Oracle for inward-facing databases.

POC: Mi Young Koo, mi.y.koo@nasa.gov, (650) 604-4528, NASA Advanced Supercomputing (NAS) Division, Computer Sciences Corp.

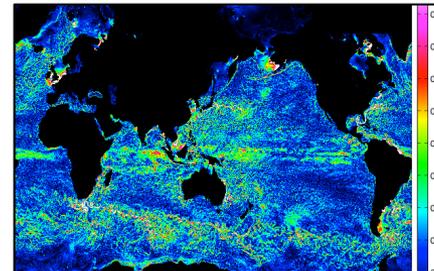
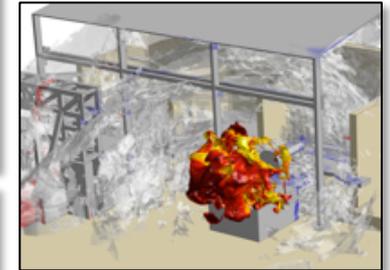
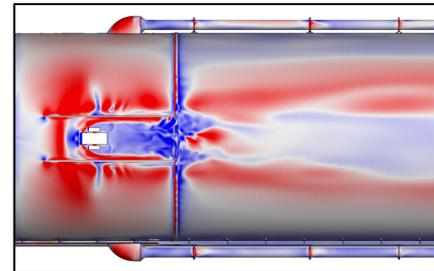
New Allocation Period Begins for NASA Mission Directorates



- May 1, 2014 marked the beginning of a new allocation period for the Human Exploration and Operations Mission Directorate (HEOMD), the NASA Engineering and Safety Center (NESC), and about half of the Science Mission Directorate (SMD).
- These organizations awarded allocations of computing time on Pleiades and Endeavour to 240 computing projects that support NASA's science and engineering activities.
- Combined awards exceeded 95 million Standard Billing Units* (SBUs)—a 70% increase over 2013.
- The new allocation period is an opportunity for each organization to assess demands for computing time and to rebalance allocations to meet computing needs for the next year.
- Continued growth of Pleiades makes it possible for HECC to provide more resources to meet growing demands.

* 1 SBU equals 1 hour of a Pleiades Westmere 12-core node

Mission Impact: NASA programs and projects periodically review the distribution of supercomputer time to assess the demand for resources and assure consistency with mission-specific goals and objectives.



Representative images from HEOMD, NESC, and SMD projects. From top left, clockwise: Visualization of a Space Launch System buffet analysis simulation (Emre Sozer & Mike Barad, NASA ARC); Detonation of gaseous hydrogen and oxygen released from a rocket nozzle (Brandon Williams, NASA MSFC); Image from a simulation showing ocean surface current speed (Christopher Henze & Bron Nelson (NASA ARC).

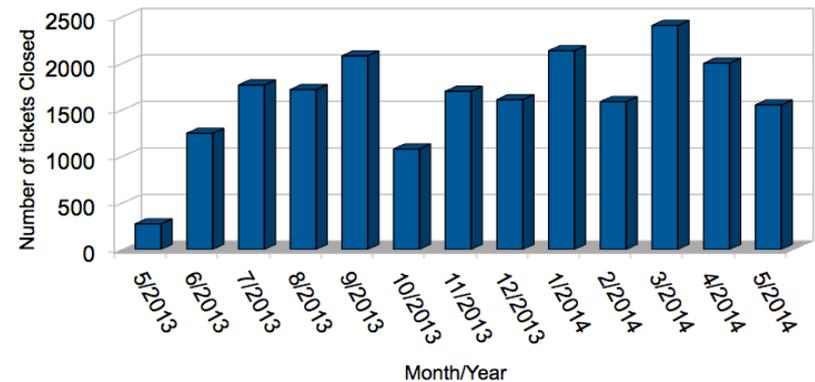
POC: Catherine Schulbach, catherine.h.schulbach@nasa.gov, (650) 604-3180, NASA Advanced Supercomputing Division

HECC Support Staff Continue Providing Excellent Support to Users



- HECC staff processed, tracked, and resolved more than 16,000 user requests over the past year, and provided 24x7 support for hundreds of users representing all mission directorates.
- Support services for the last year included:
 - Handling inquiries about accounts, allocations, jobs, and system status.
 - User application modification and optimization.
 - Improving data transfer times and solving data storage/retrieval issues.
 - Development of high-resolution visualizations of scientific and engineering results.
 - Custom, one-on-one support for the entire range of support services.
- “The support is amazing—out-of-this world. I’ve never seen it anywhere else!” said scientist Dimitris Menemenlis, NASA Jet Propulsion Laboratory. Most users agree: They ranked overall support as 4.3 out of 5 in the 2013 NAS User Survey.

Mission Impact: The high-quality, 24x7 support provided by HECC experts resolves users’ technical issues and enables them to focus on their critical mission projects.



HECC staff typically resolved between 1,000–2,500 Remedy tickets per month over the last 12 months—more than 16,000 tickets total.

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New Conference Room to Showcase Quantum Computing Project



- To complement the installation of the D-Wave quantum computer, the HECC Facilities team coordinated with NASA Ames facilities engineering services staff to build an adjacent conference room.
- The new conference room will allow researchers to meet and collaborate right next to the quantum computer, and for Ames center- and division-level management to showcase the system while discussing the exciting potential of quantum computing technologies to solve difficult optimization problems for agency missions.
- Facilities work included the installation of Smart Glass windows that can be easily switched from transparent to opaque electronically, the removal of four large air handling units, painting, carpeting installation, and electrical work.

Mission Impact: Quantum computing is of great importance to the future of computing, and there is a much interest in this exciting new technology. This conference room allows NASA to showcase its Quantum Artificial Intelligence Laboratory (QuAIL) and discuss difficult scientific problems that quantum computing may help solve.



Smart Windows installed in the quantum computing conference room, with (at left) opaque coloring switched on. With transparent view switched on (at right), the 512-qubit D-Wave Two quantum computer is visible in the background.

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HECC Resources Continue Key Role in NASA Earth Exchange Collaborations *



- Scientists working under the NASA Earth Exchange (NEX) project are running new, higher-resolution simulations on Pleiades to enable greater and more efficient use of Earth observations from space- and ground-based instruments.
- Recent applications of NEX include:
 - Completed the first annual Landsat 5 and Landsat 7 composite under the Web-Enabled Landsat Data (WELD) project.
 - Continuing experiments in high-resolution land cover classification at 1-meter spatial resolution using data from the National Agriculture Imagery Program.
 - Continuing support for the North American Forest Dynamics project in performing annual assessment of forest disturbance from 1985 to 2010 using high-resolution Landsat data.
- WELD is the first petascale project utilizing NEX, with peak data volumes reaching about 1.5 petabytes.

Mission Impact: The Pleiades supercomputer, with HECC's massive data storage capacity and high-speed networks, enables the NASA Earth Exchange (NEX) to engage diverse scientific communities and provide them with capabilities to execute modeling and data analysis on a grand scale that was not previously achievable by most scientists.



This image shows an annual climate year (December 2009 to November 2010) global Web-Enabled Landsat Data (WELD) Top of Atmosphere (TOA) true color reflectance product, made from more than 120,000 Landsat 5 Thematic Mapper and Landsat 7 Enhanced Thematic Mapper Plus Level 1T images. The WELD project utilizes NASA Earth Exchange (NEX) and Pleiades resources for its computational and data needs.

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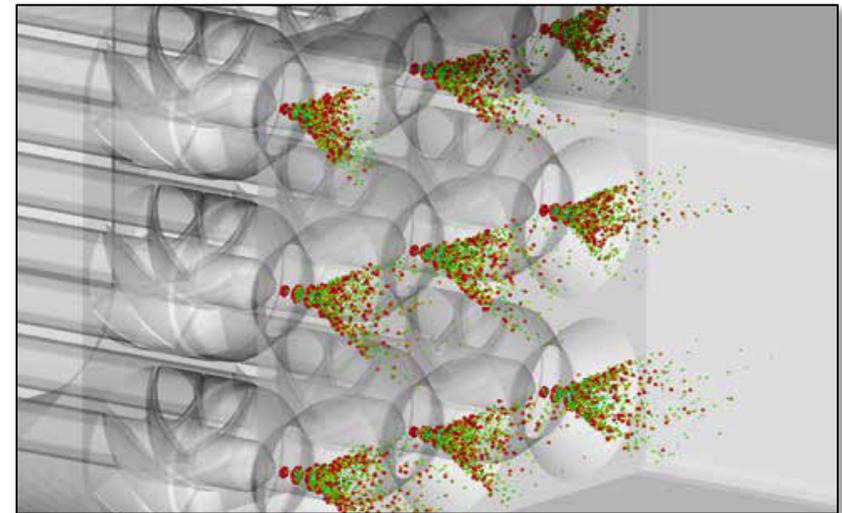
* HECC provided supercomputing resources and services in support of this work

Pleiades Enables Simulations for Design of Clean-Burning Aircraft Engines *



- Researchers at NASA Glenn are running Reynolds-Averaged Navier-Stokes (RANS) simulations on Pleiades to support the Environmentally Responsible Aviation (ERA) project goal to reduce nitric oxide and nitrogen dioxide (NOx) emissions from aircraft.
- The team uses a baseline Lean Direct Injection (LDI) concept for two air swirler configurations to improve the ability of computational fluid dynamics (CFD) models to accurately predict emissions for advanced, low-emissions combustion concepts operating on a variety of fuels.
- The simulations provided validation of pressure drop and NOx emissions against baseline (2005) LDI combustor concepts, and resulted in the development of best practices for RANS simulations of LDI combustor concepts.
- All CFD simulations were performed on Pleiades using 576 Intel Xeon Westmere processors. The simulations used 18-step chemistry and several thousand spray particles, requiring about 60 hours of wall-clock time for each case to converge.

Mission Impact: Best practices developed from simulations enabled by the Pleiades supercomputer support the design of Lean Direct Injection concepts manufactured and tested under the Environmentally Responsible Aviation (ERA) project to meet aggressive NOx emission reduction goals.



Visualization of liquid fuel (Jet-A) spray formed near each of the nine fuel injectors that make up the Lean Direct Injection (LDI) design, where each particle may represent hundreds to thousands of actual spray droplets (the smallest particles are blue and the largest are red).

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* HECC provided supercomputing resources and services in support of this work

HECC Facility Hosts Several Visitors and Tours in May 2014



- HECC hosted 10 tour groups in May; guests learned about the agency-wide missions being supported by Pleiades, and viewed scientific results on the hyperwall system. Visitors this month included:
 - Administrator Charlie Bolden and the NASA HQ Public Affairs office held a media event on the National Climate Assessment at the NAS facility, with scientific data shown on the hyperwall.
 - A large group from the NASA Office of the General Counsel, who attended an agency-wide meeting and visited the NAS facility as part of their Ames tour.
 - Congresswoman Zoe Lofgren was briefed on NASA space weather endeavors; senior researchers from NASA and Lockheed Martin Solar and Astrophysics Laboratory presented their current projects.
 - Attendees of the Probabilistic Safety Assessment Technical Interchange Meeting received a HECC overview and tour; guests were from Sierra Nevada Corp. and members of the Commercial Crew Program from NASA Johnson and NASA Kennedy.
 - Crown Prince Guillaume of Luxembourg and Luxembourg Deputy Prime Minister Etienne Schneider were briefed by Rupak Biswas and Piyush Mehrotra on HECC resources.



Crown Prince Guillaume of Luxembourg (right) and Luxembourg Deputy Prime Minister Etienne Schneider viewed scientific data on the hyperwall-2 and received an overview of the HECC project.

POC: Gina Morello, gina.f.morello@nasa.gov, (650) 604-4462, NASA Advanced Supercomputing Division

Papers and Presentations



- **“Supercomputing at NASA”**, B. Biegel, community outreach presentation at Webster House, Palo Alto, May 2 (National Space Day).
- **“Relativistic Pair Beams from TeV Blazars: A Source of Reprocessed GeV Emission Rather than Intergalactic Heating,”** L. Sironi, D. Giannios, *The Astrophysical Journal*, vol. 787, no. 1, May 2, 2014. *
<http://iopscience.iop.org/0004-637X/787/1/49>
- **“Evolution of Cold Streams and Emergence of the Hubble Sequence,”** R. Cen, arXiv:1405.0516 [astro-ph.GA], May 2, 2014. *
<http://arxiv.org/abs/1405.0516>
- **“On the Reversal of SFR-Density Relation at $z=1$: Insights from Simulators,”** S. Tonnesen, R. Cen, arXiv:1405.1049 [astro-ph.GA], May 5, 2014. *
<http://arxiv.org/abs/1405.1049>
- **“Shape Profiles and Orientation Bias for Weak and Strong Lensing Cluster Halos,”** A. M. Groener, D. M. Goldberg, arXiv:1405.2035 [astro-ph.CO], May 8, 2014. *
<http://arxiv.org/abs/1405.2035>
- **“Energy Dissipation by Whistler Turbulence: Three-Dimensional Particle-in-Cell Simulations,”** O. Chang, S. P. Gary, J. Wang, *Physics of Plasmas (1994-Present)*, vol. 21, issue 5, May 12, 2014. *
<http://scitation.aip.org/content/aip/journal/pop/21/5/10.1063/1.4875728>

* HECC provided supercomputing resources and services in support of this work

Papers and Presentations (cont.)



- **“Gravito-Turbulent Disks in 3D: Turbulent Velocities vs. Depth,”** J.-M. Shi, E. Chiang, arXiv:1405.3291 [astro-ph.EP], May 13, 2014. *
<http://arxiv.org/abs/1405.3291>
- **“Type II Migration Is Not Locked to Viscous Disk Evolution,”** P. C. Duffell, Z. Haiman, A. I. MacFadyen, D. J. D’Orazio, D. B. Farris, arXiv:1405.3711 [astro-ph.EP], May 14, 2014. *
<http://arxiv.org/abs/1405.3711>
- **“Running with BICEP2: Implications for Small-Scale Problems in CDM,”** S. Garrison-Kimmel, S. Horiuchi, K. N. Abazajian, J. S. Bullock, M. Kaplinghat, arXiv:1405.3985 [astro-ph.CO], May 15, 2014. *
<http://arxiv.org/abs/1405.3985>
- **“A Simulation of Convective Dynamo in the Solar Convective Envelope: Maintenance of the Solar-like Differential Rotation and Emerging Flux,”** Y. Fan, F. Fang, arXiv:1405.3926 [astro-ph.SR], May 15, 2014. *
<http://arxiv.org/abs/1405.3926>
- **“Abundance of Field Galaxies,”** A. Klypin, I. Karachentsev, D. Makarov, O. Nasonova, arXiv:1405.4523 [astro-ph.CO], May 18, 2014. *
<http://arxiv.org/abs/1405.4523>

** HECC provided supercomputing resources and services in support of this work*

Papers and Presentations (cont.)



- **“A Regional CO₂ Observing System Simulation Experiment for the ASCENDS Satellite Mission,”** J. S. Wang, et al., Atmospheric, Chemistry, and Physics Discussions, May 20, 2014. *
<http://www.atmos-chem-phys-discuss.net/14/12819/2014/acpd-14-12819-2014.html>
- **“Three-Fluid, Three-Dimensional Magnetohydrodynamic Solar Wind Model with Eddy Viscosity and Turbulent Resistivity,”** A. V. Usmanov, M. L. Goldstein, W. H. Matthaeus, The Astrophysical Journal, vol. 788, no. 1, May 20, 2014. *
<http://iopscience.iop.org/0004-637X/788/1/43>
- **“Magnetic Field Generation in Core-Sheath Jets via the Kinetic Kelvin-Helmholtz Instability,”** K.-I. Nishikawa, et al., arXiv:1405.5247 [astro-ph.HE], May 20, 2014. *
<http://arxiv.org/abs/1405.5247>
- **“NASA Advanced Computing Environment for Science & Engineering,”** R. Biswas, Presented at the 26th International Conference on Parallel Computational Fluid Dynamics, Trondheim, Norway, May 20-22, 2014.
- **“Combined Uncertainty and A-Posterior Error Bound Estimates for General CFD Calculations Theory,”** T. Barth, Presented at the Workshop on Uncertainty Quantification in Computational Fluid Dynamics, Pisa, Italy, May 26-27, 2014. *
- **“Drag Prediction for the Common Research Model Using CFL3D and OVERFLOW,”** A. J. Sclafani, M. A. DeHaan, J. C. Vassberg, C. L. Rumsey, T. H. Pulliam, Journal of Aircraft, May 2014. * <http://arc.aiaa.org/doi/pdf/10.2514/1.C032571>

* HECC provided supercomputing resources and services in support of this work



- **The Revolutionary Quantum Computer That May Not Be Quantum at All**, *Wired Magazine*, May 20, 2014—Wired Magazine talks about the history and science behind the D-Wave computer at NASA's Quantum Artificial Intelligence Laboratory.
<http://www.wired.com/2014/05/quantum-computing>
- **Supercomputers Help Reveal the Sun's Hidden Mysteries**, *NAS Feature Story*, May 21, 2014—Stunning new data from space-based observatories, combined with rapid advances in computing, are inspiring breakthroughs in space weather research.
http://www.nas.nasa.gov/publications/articles/feature_helio_kitiashvili.html

Phi-based Systems



- **Background:**

Two Xeon Phi-based systems are being utilized as path finding resources to determine whether the Many Integrated Core (MIC) Architecture is cost effective for NASA's computational requirements

- Maia is a 128-node SGI system with two Intel Xeon Phi accelerator cards in each node.
- Mira is a 64-node Cray system with two Intel Xeon Phi accelerator cards in each node.

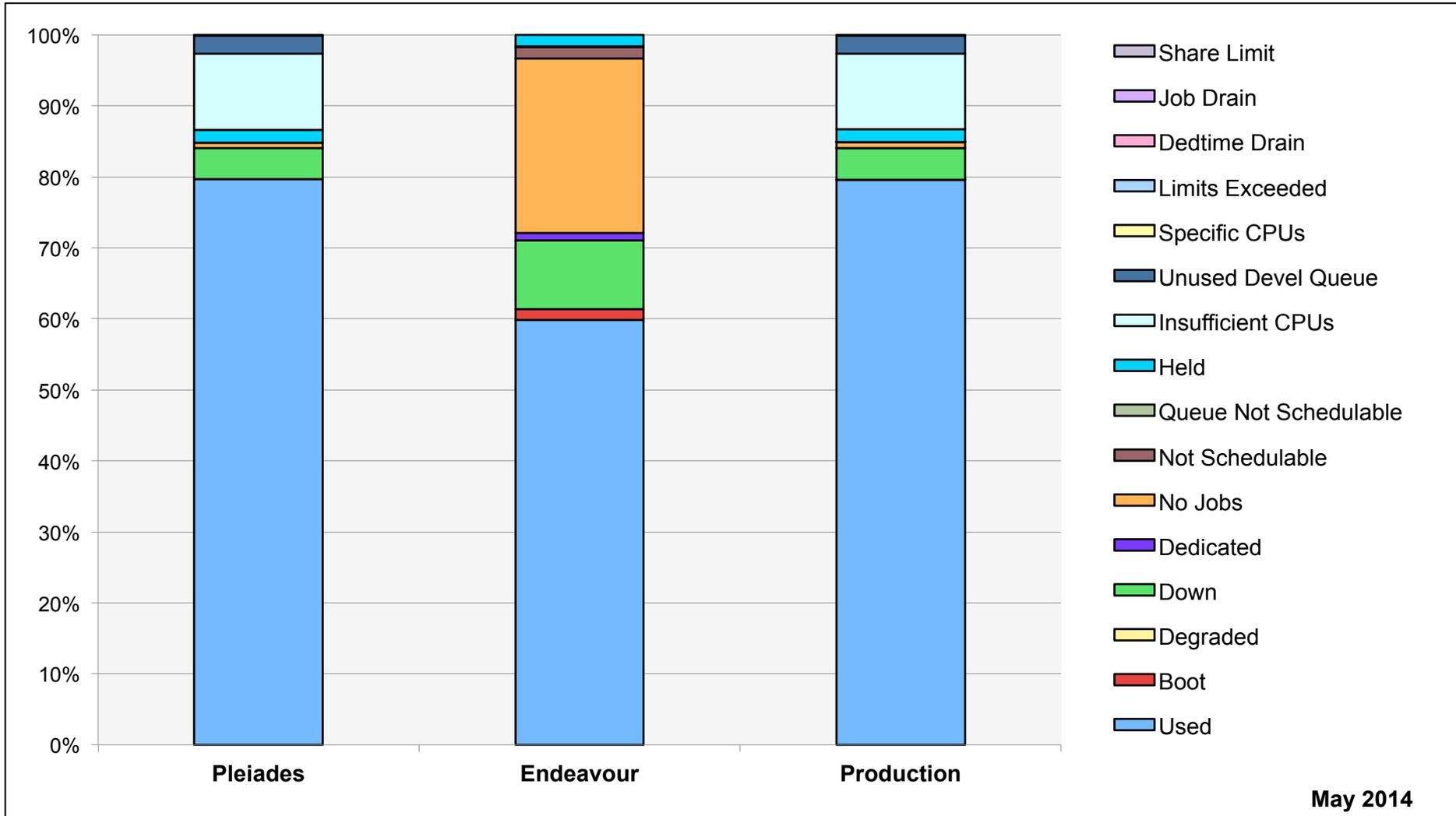
- **Status**

- Maia was shutdown starting May 16 because of a security upgrade. Users who have accounts on Maia for porting their codes to the experimental systems, did not exercise the system.
- Mira is being “NASified”. NAS engineers are working with Cray to re-install system software to comply with NASA security requirements. This is a time-consuming process.

- **Upcoming Activities for June**

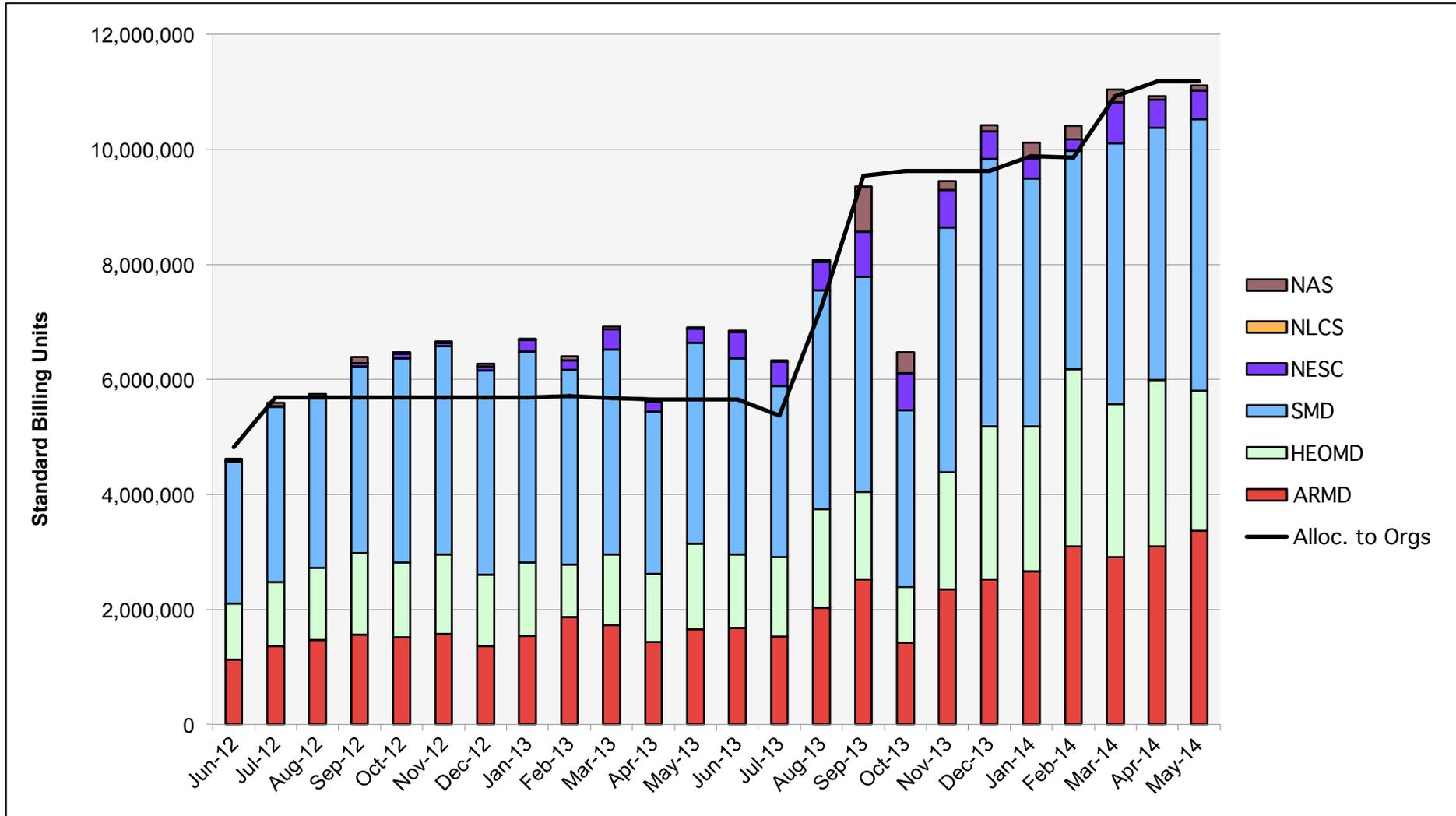
- Maia: The minor problems that surfaced after the security upgrade will be corrected and the system will be available for testing.
- Mira: The “NASification” process will most likely take all of June.

HECC Utilization

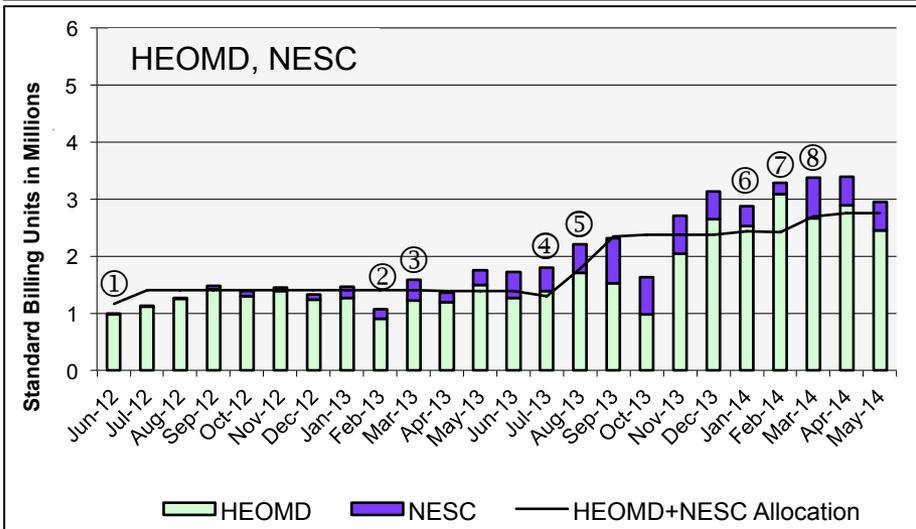
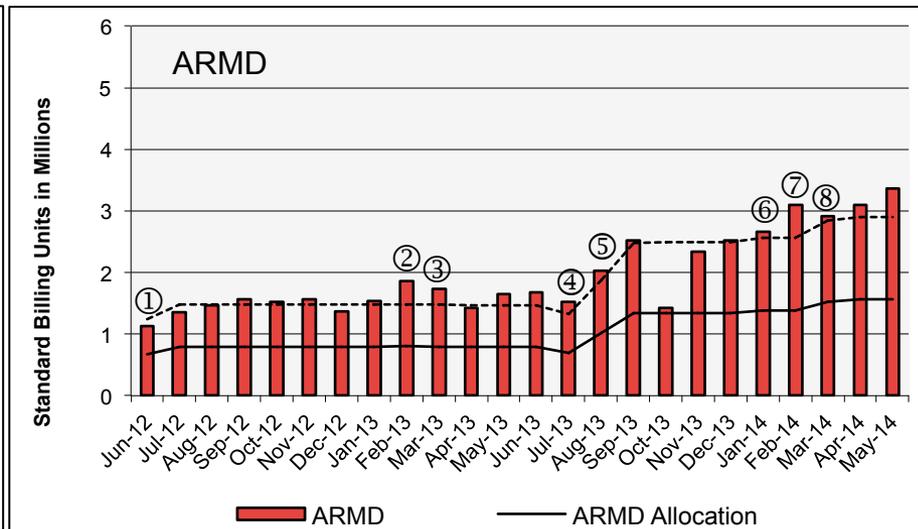
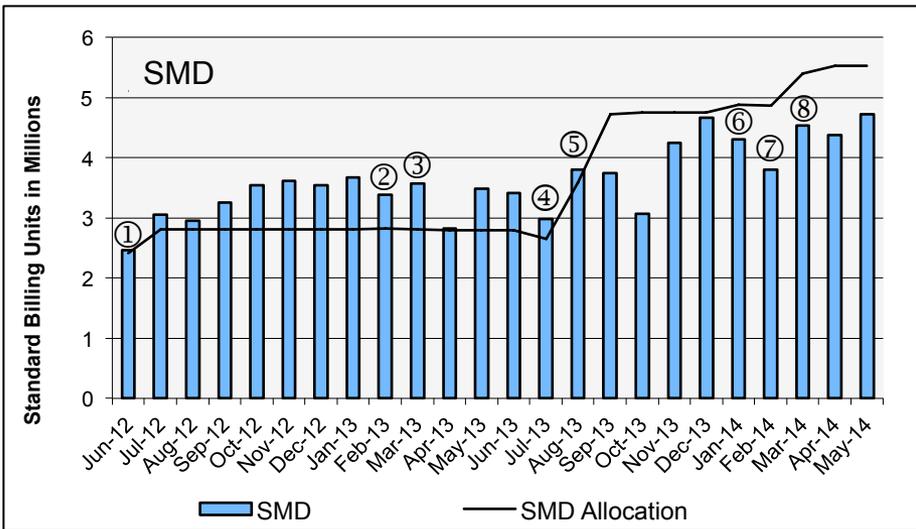


May 2014

HECC Utilization Normalized to 30-Day Month

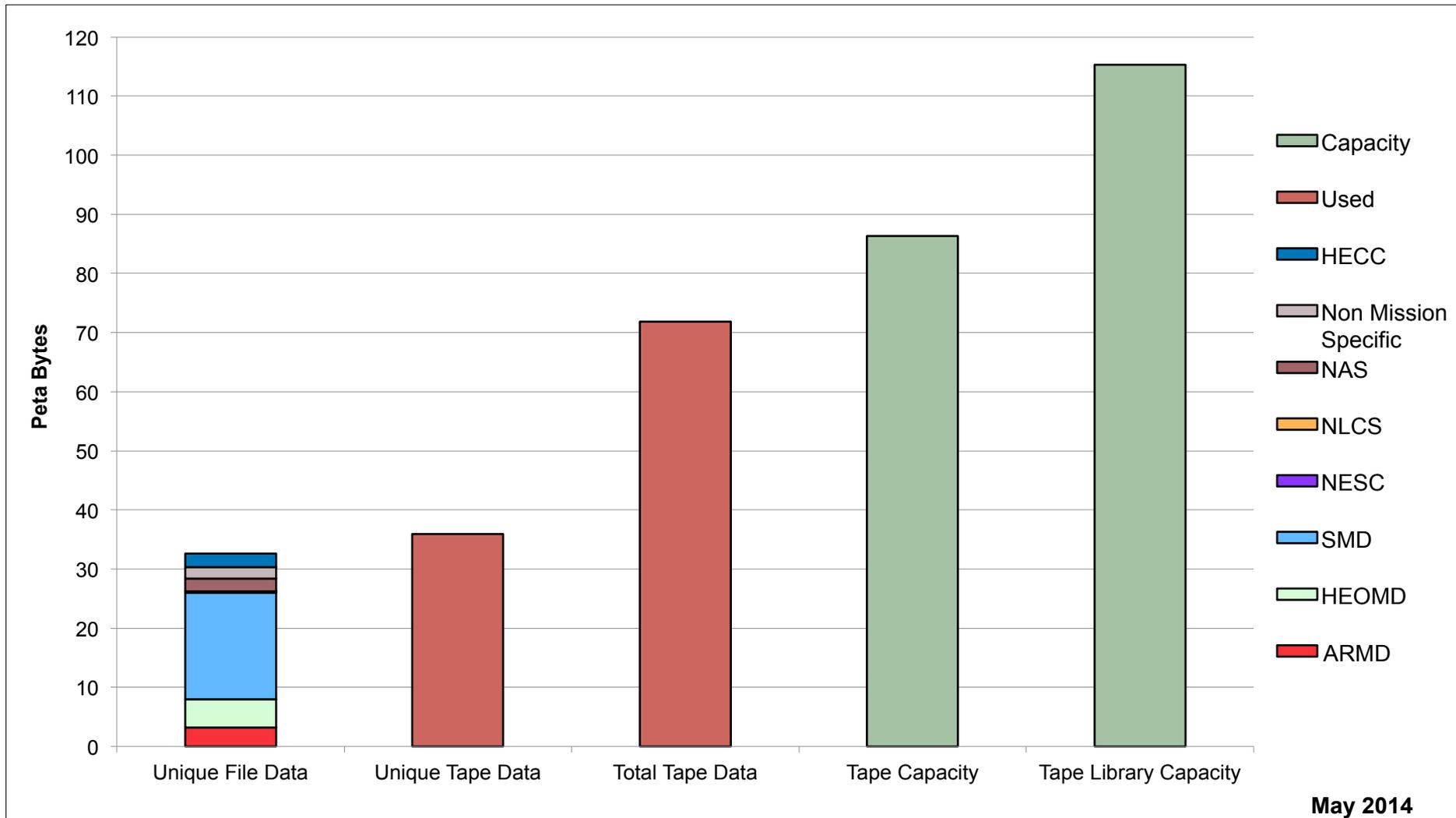


HECC Utilization Normalized to 30-Day Month

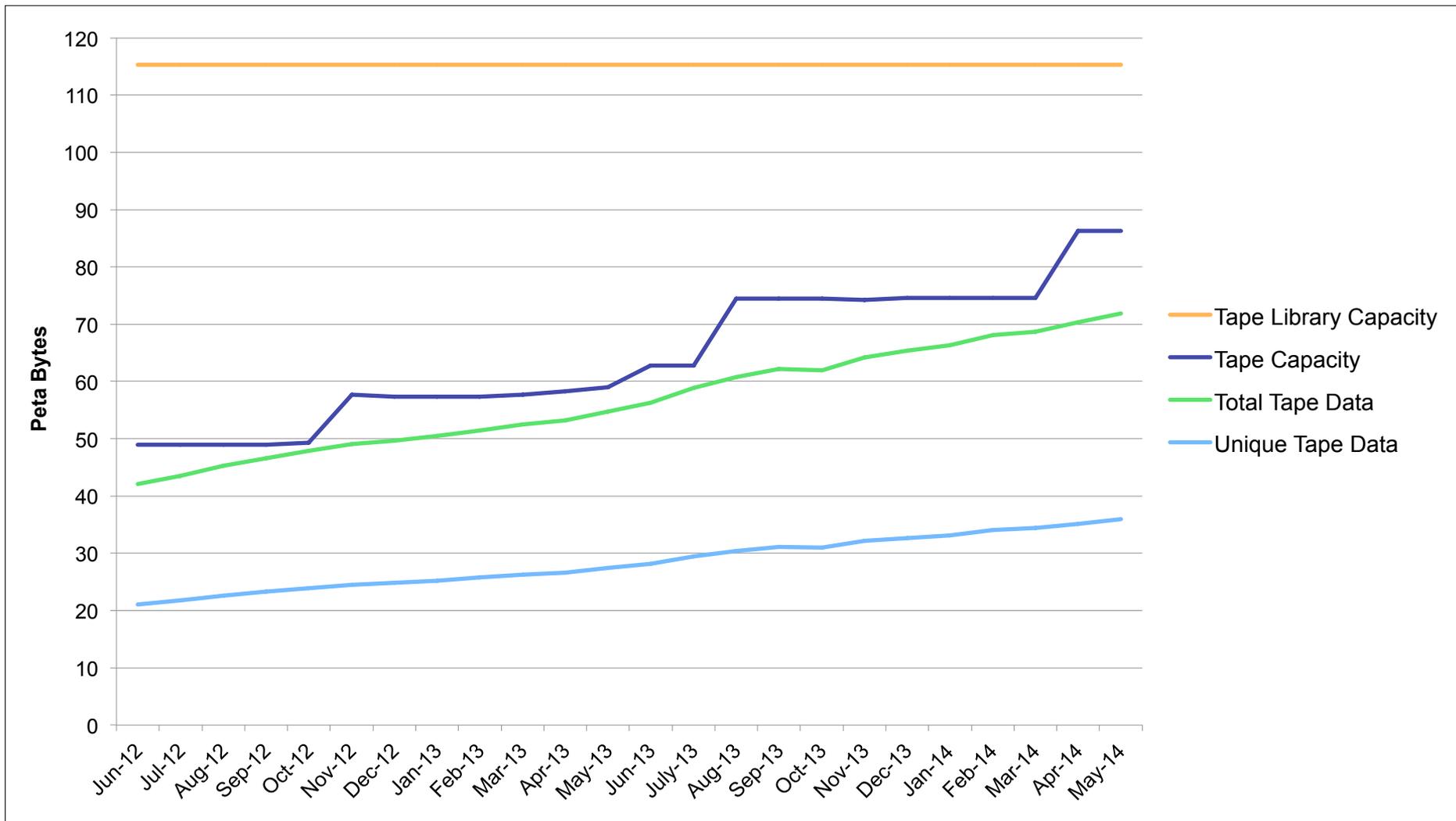


- ① 24 Sandy Bridge Racks added
- ② Columbia 21, 23, and 24 retired, Endeavour 2 added
- ③ Columbia 22 retired; Endeavour 1 added
- ④ 32 Harpertown Racks retired
- ⑤ 32 Harpertown Racks retired; 46 Ivy Bridge Racks added
- ⑥ 6 Ivy Bridge Racks added; 20 Nehalem and 12 Westmere Racks Retired
- ⑦ 8 Ivy Bridge Racks added mid-Feb; 8 additional Ivy Bridge Racks late Feb.
- ⑧ 4 Ivy Bridge Racks added mid-March

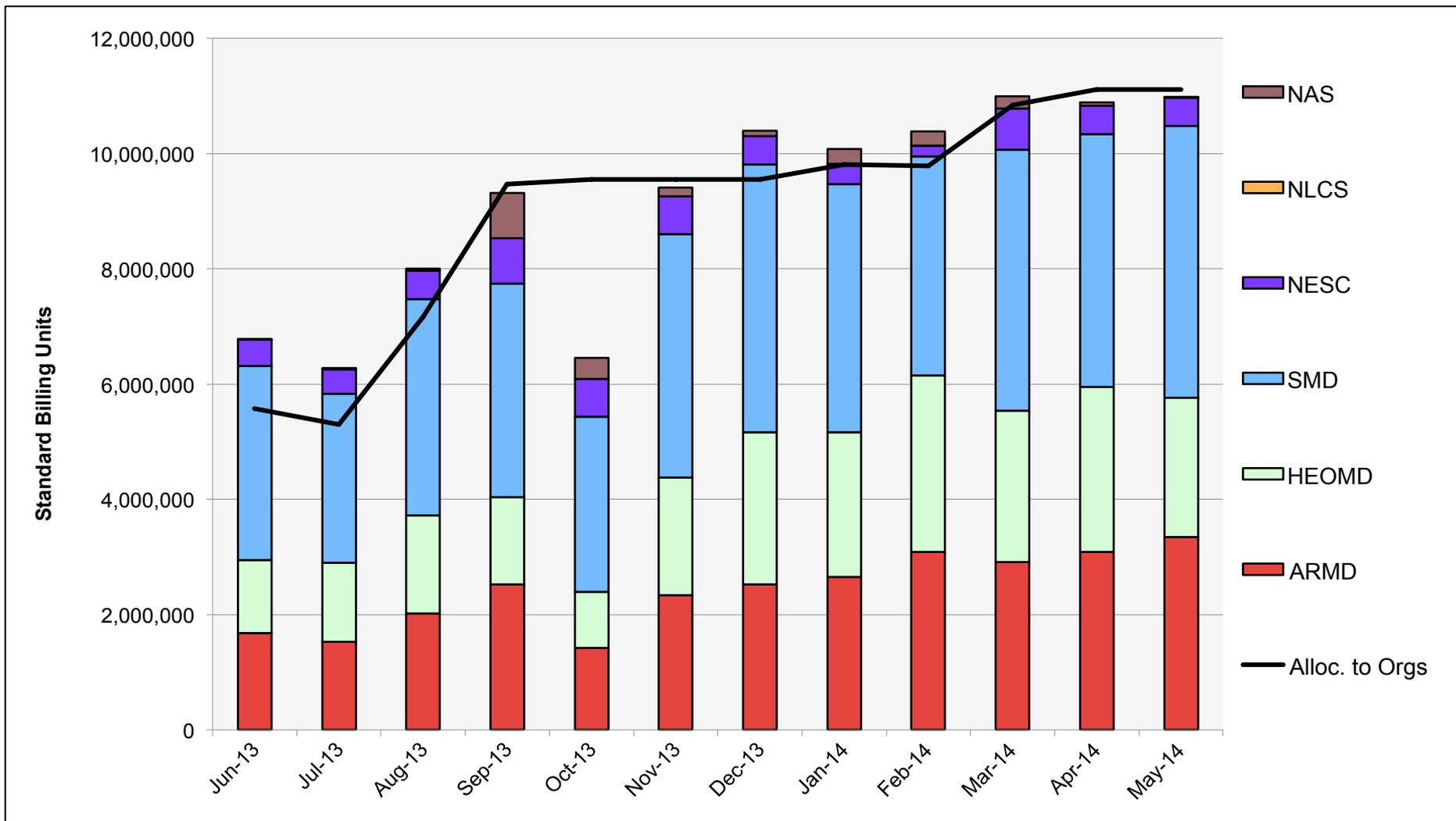
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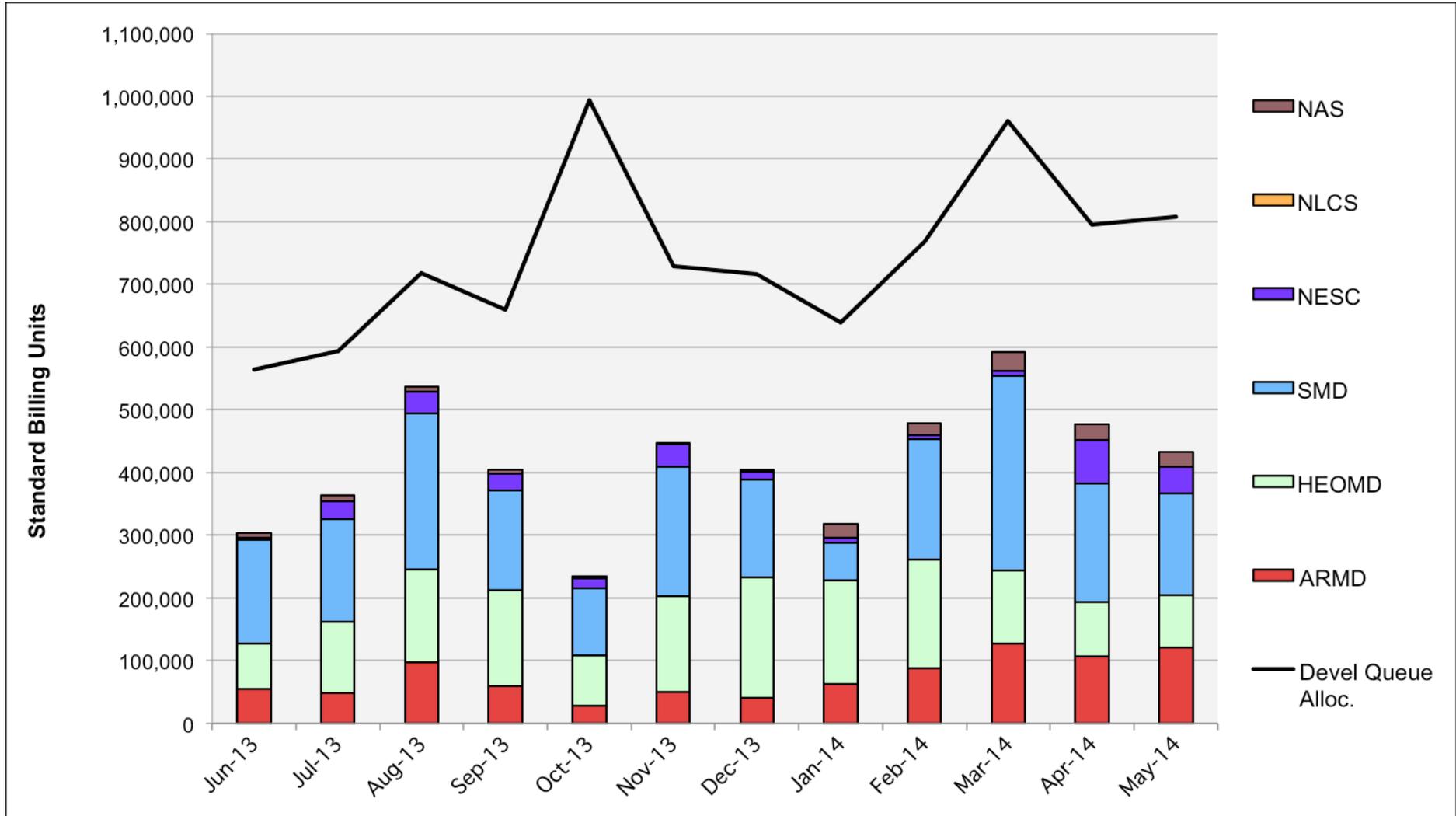
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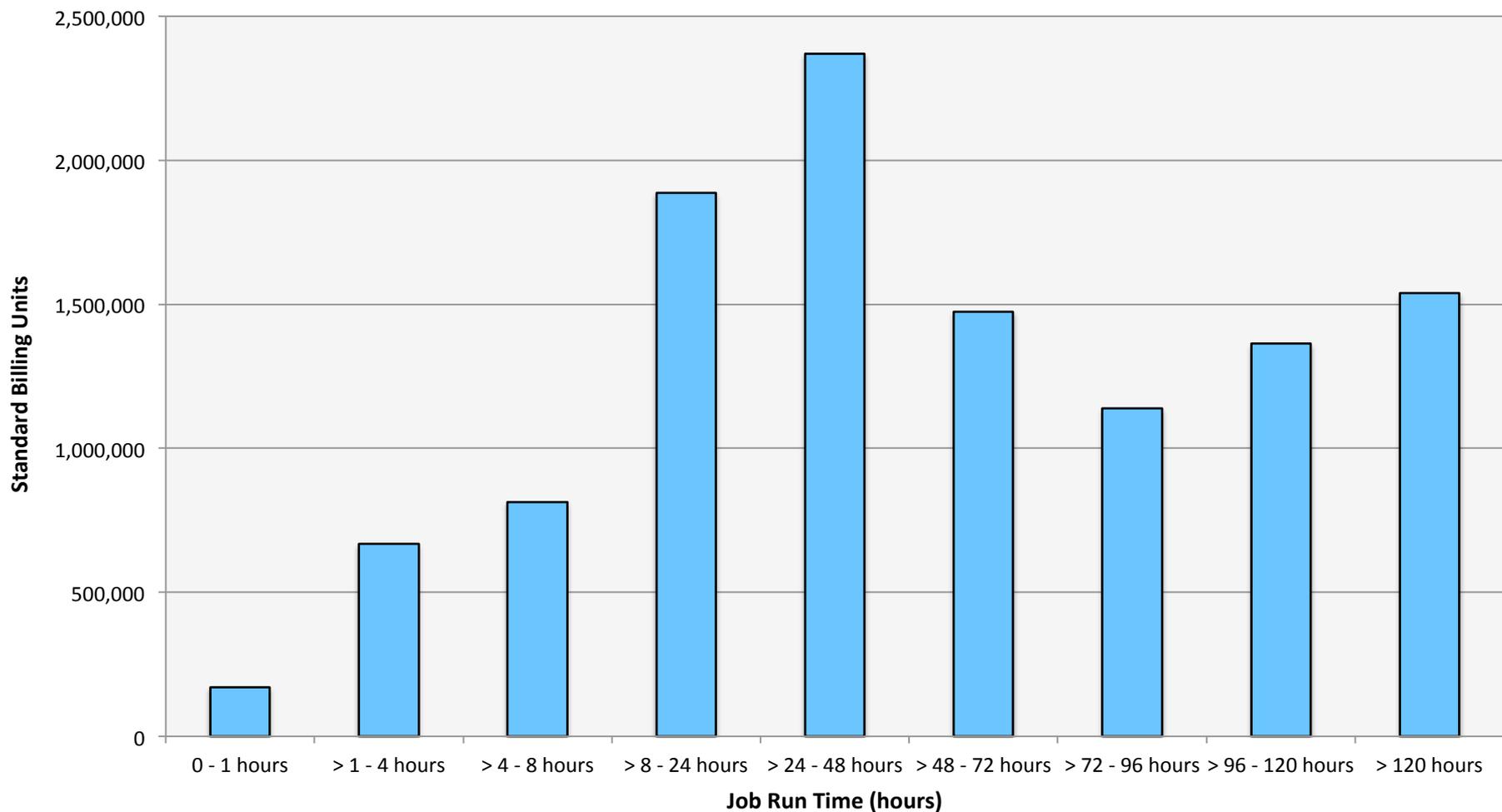
Pleiades: SBUs Reported, Normalized to 30-Day Month



Pleiades: Devel Queue Utilization

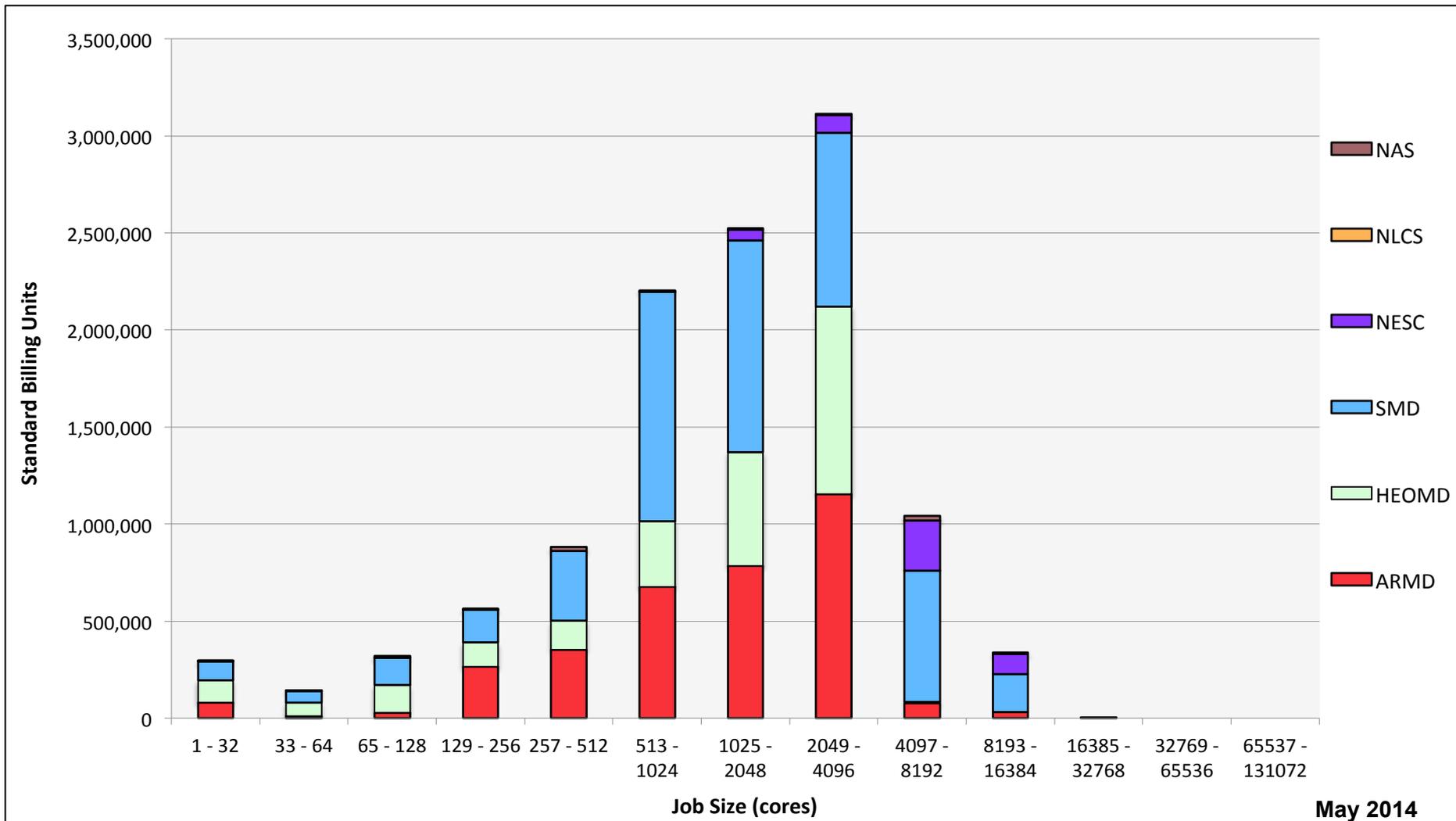


Pleiades: Monthly Utilization by Job Length



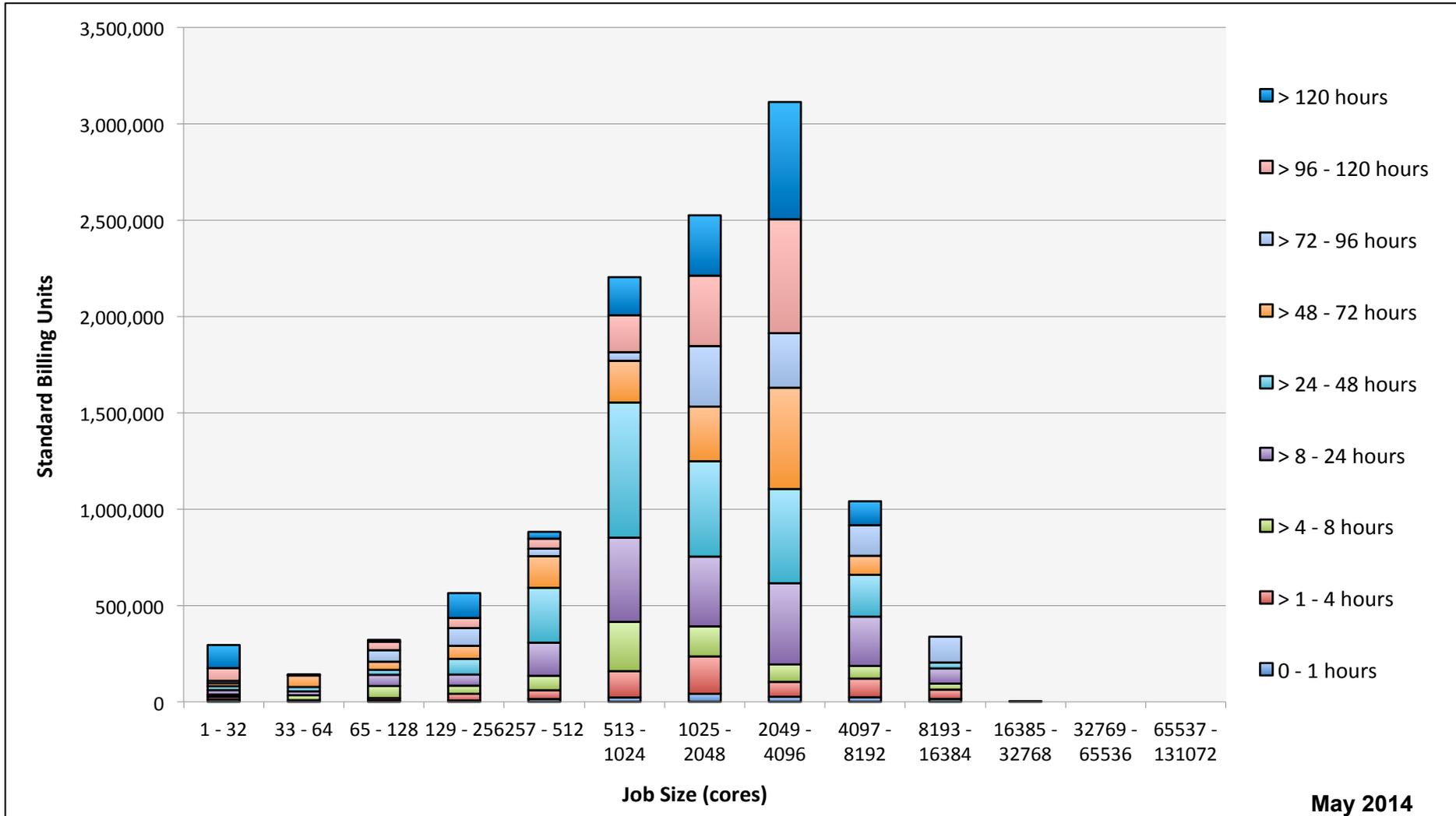
May 2014

Pleiades: Monthly Utilization by Size and Mission



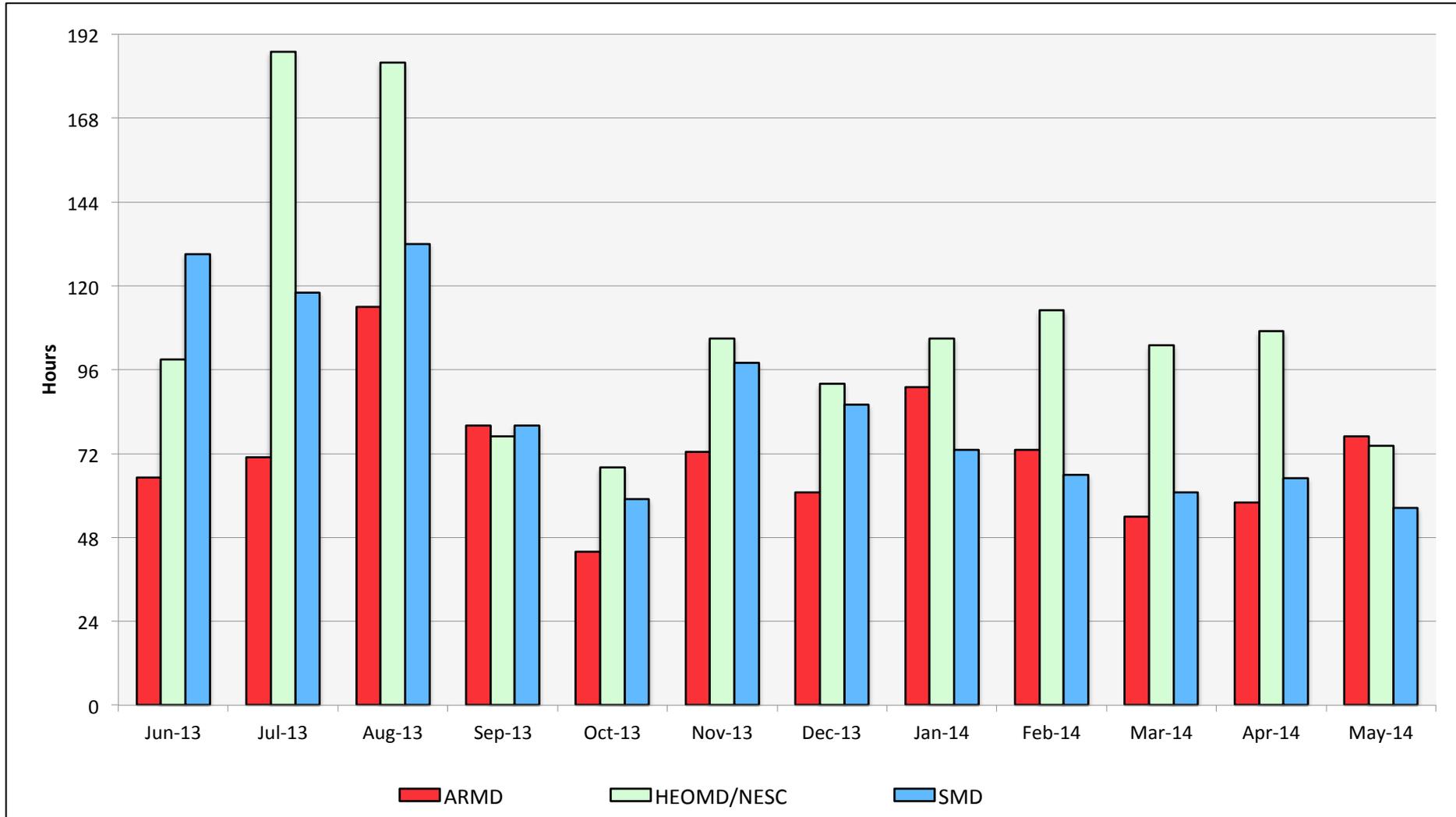
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Pleiades: Monthly Utilization by Size and Length

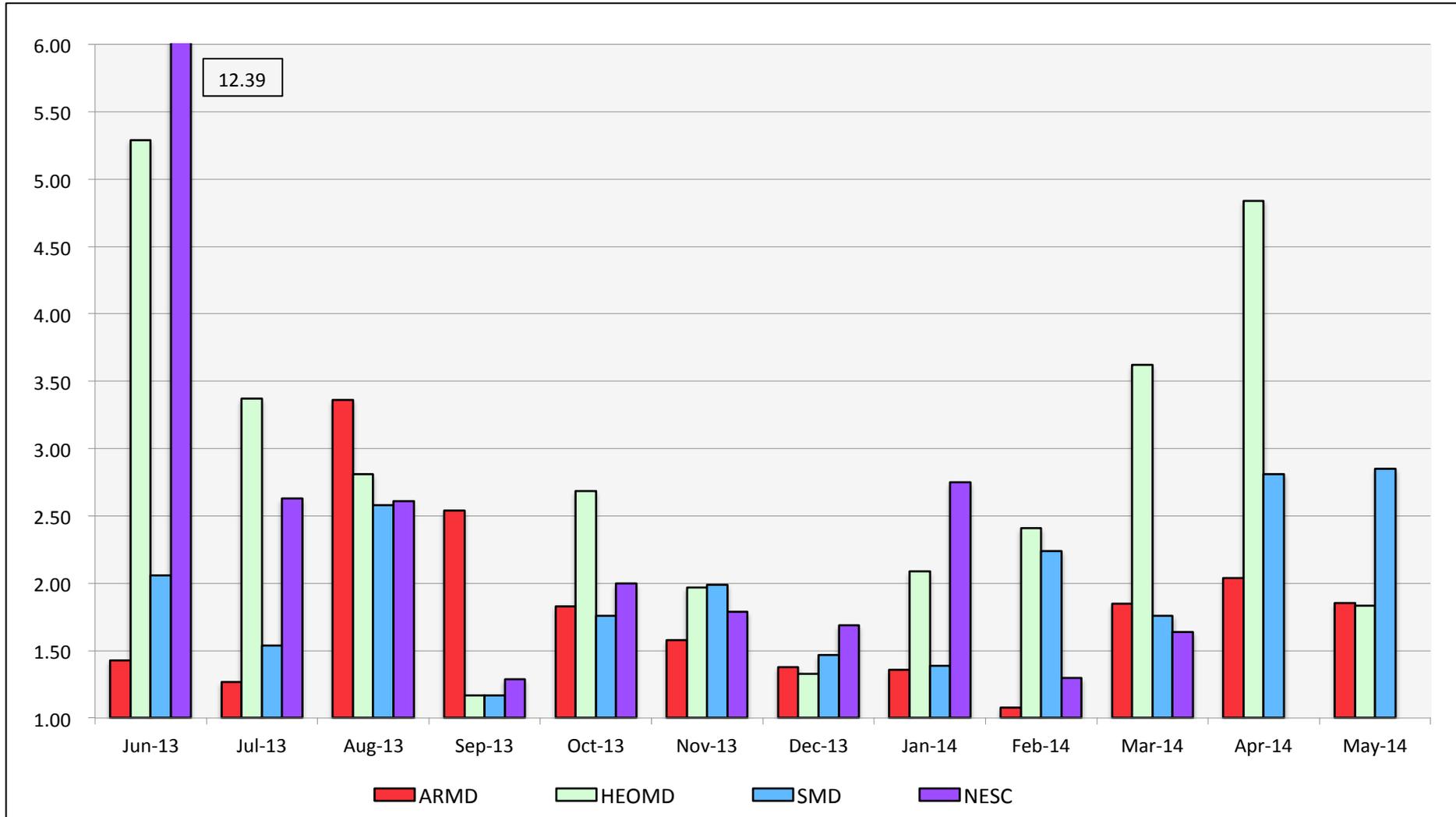


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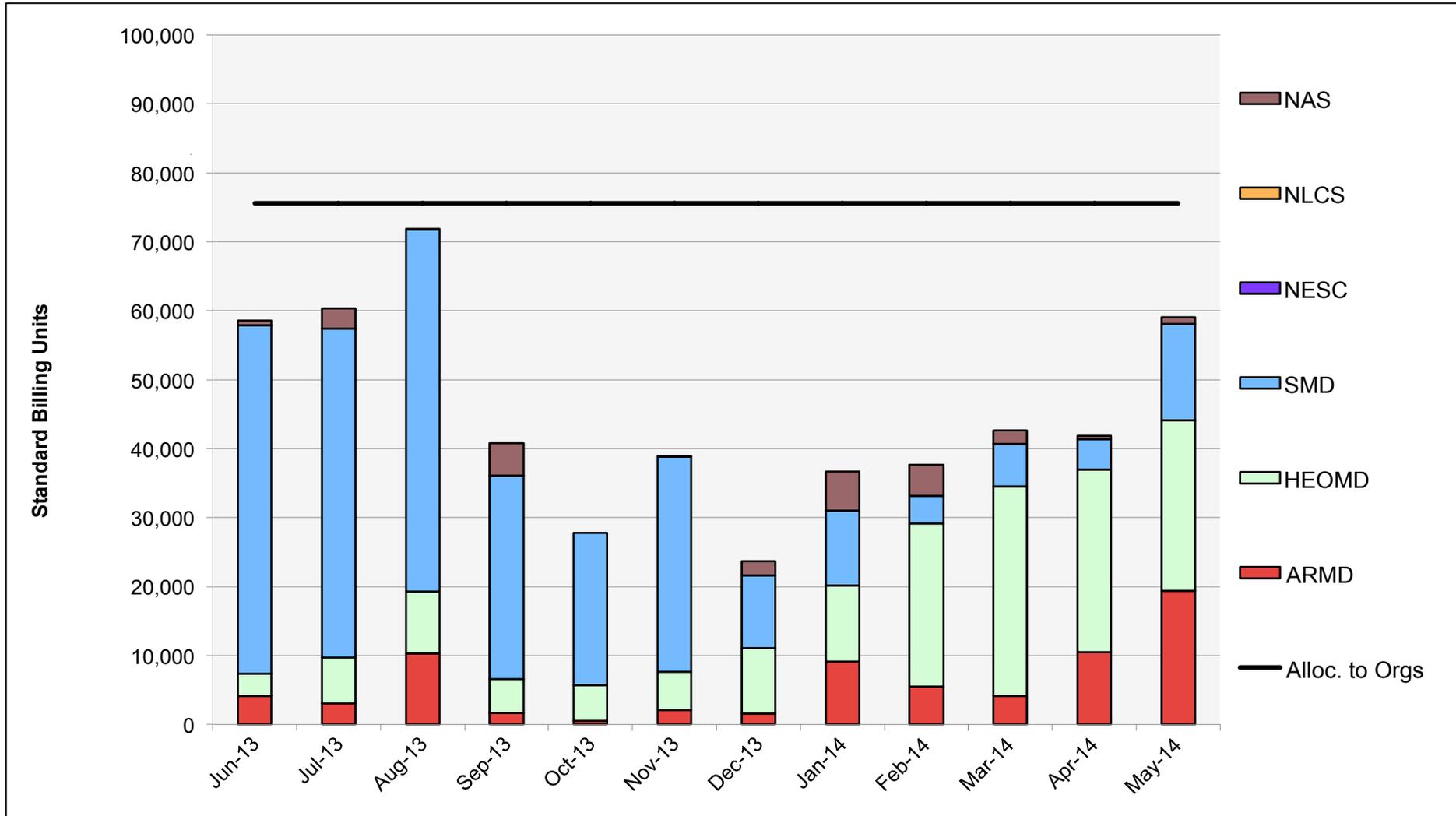
Pleiades: Average Time to Clear All Jobs



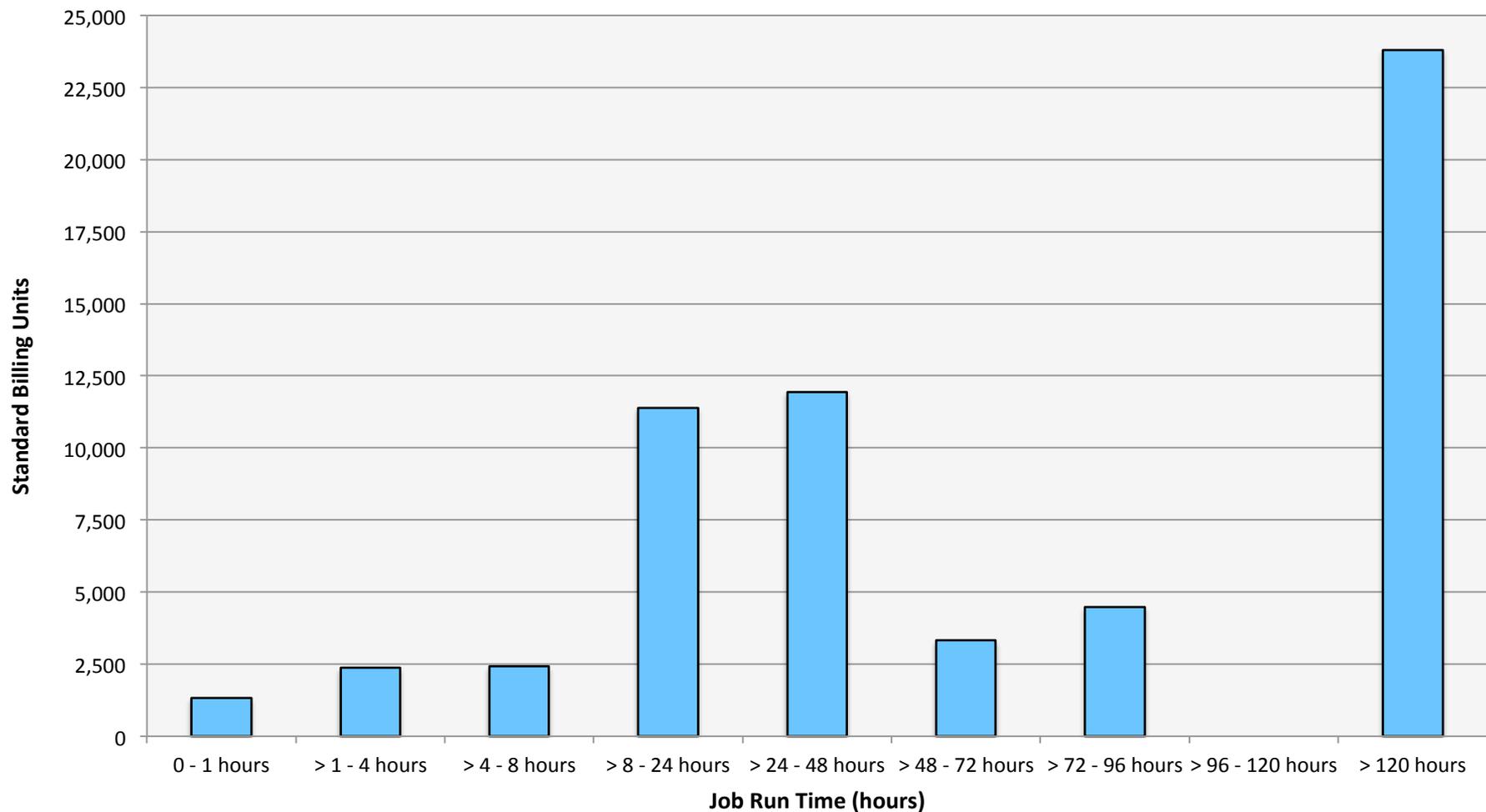
Pleiades: Average Expansion Factor



Endeavour: SBUs Reported, Normalized to 30-Day Month

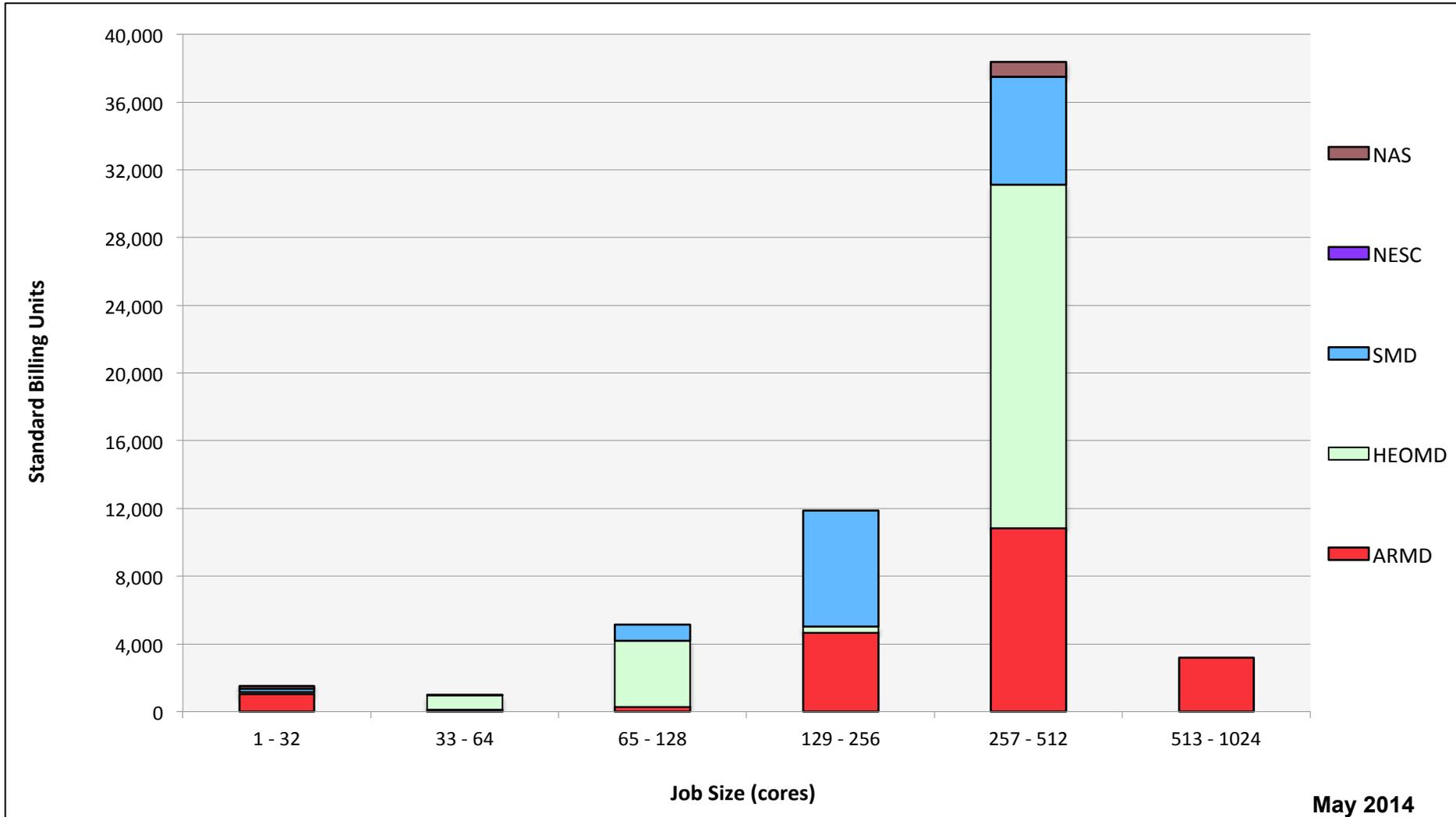


Endeavour: Monthly Utilization by Job Length



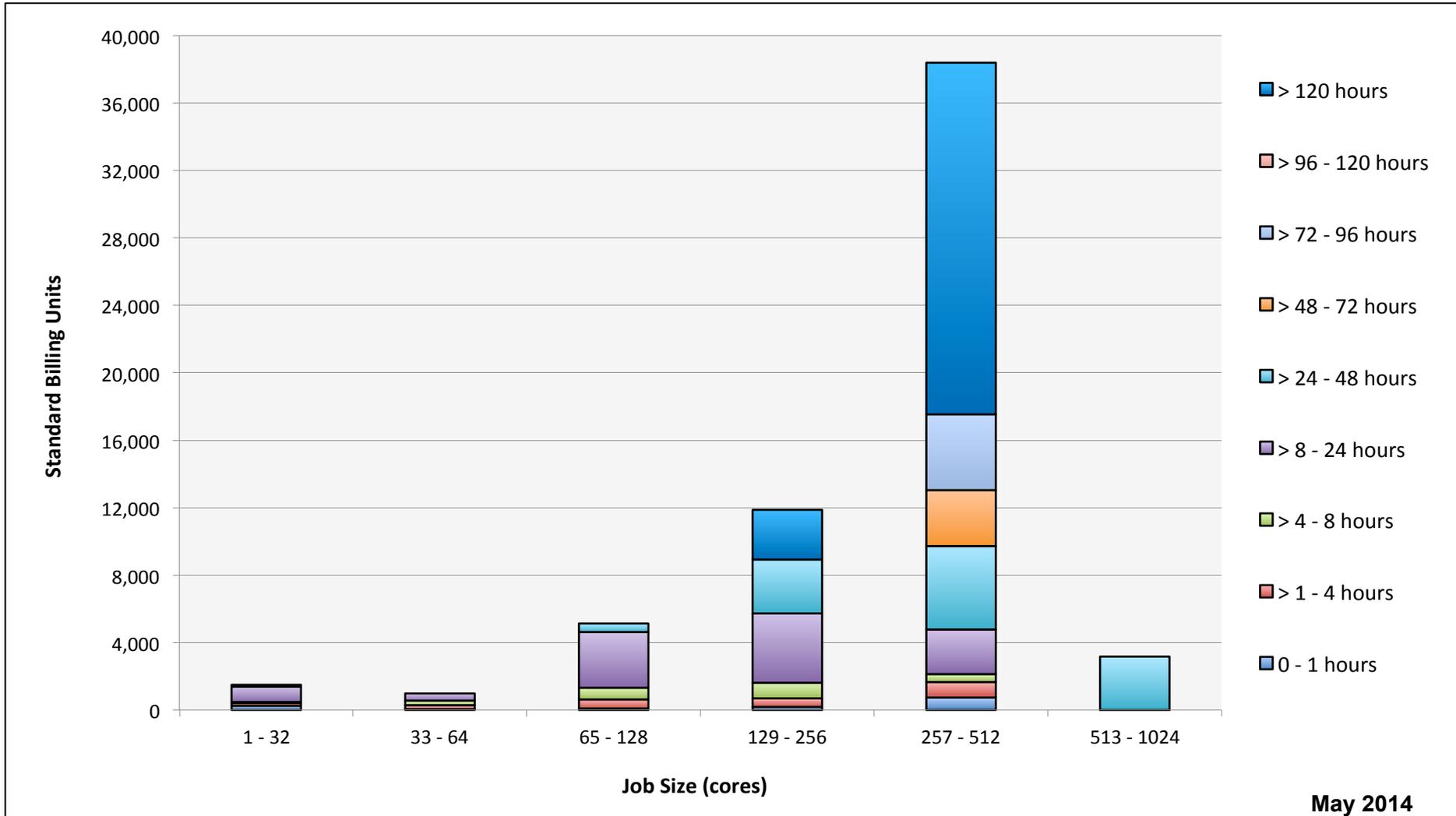
May 2014

Endeavour: Monthly Utilization by Size and Mission



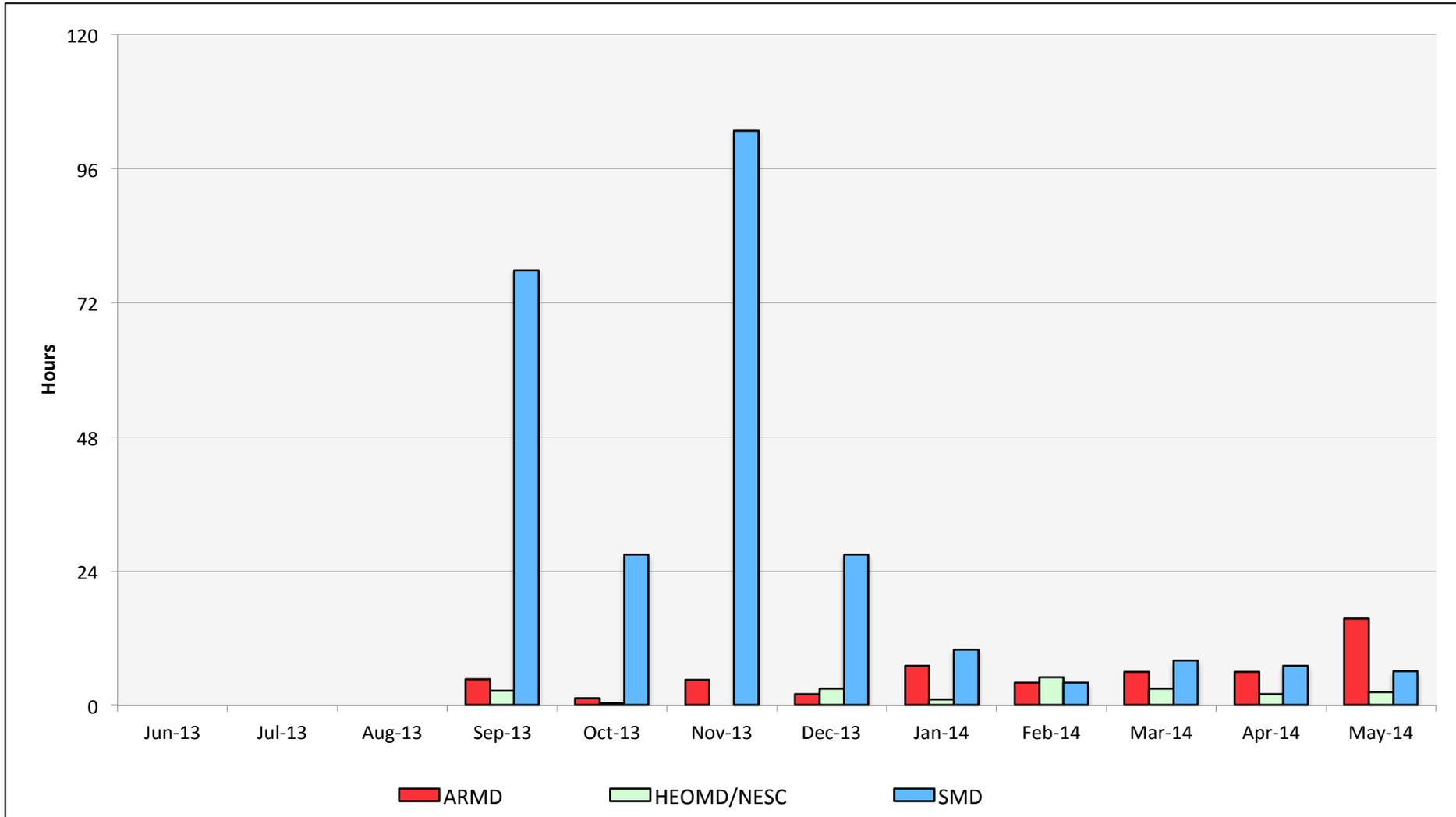
May 2014

Endeavour: Monthly Utilization by Size and Length



May 2014

Endeavour: Average Time to Clear All Jobs



Endeavour: Average Expansion Factor

