Project Status Report

High End Computing Capability

Strategic Capabilities Assets Program

December 2018 – January 2019

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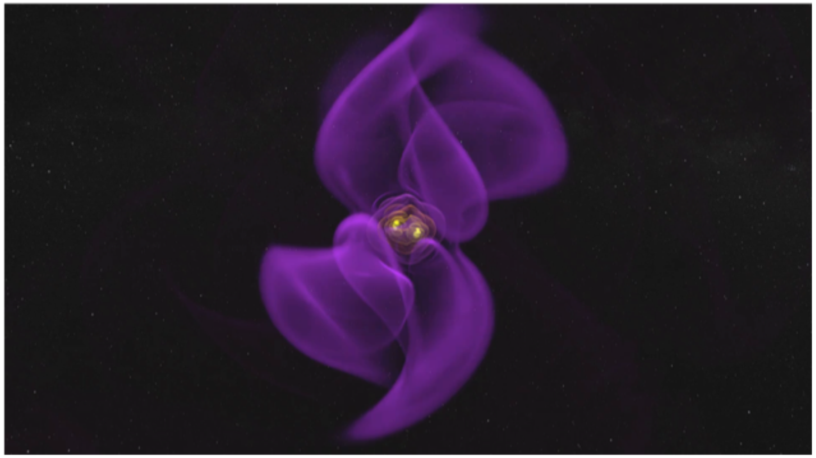
HECC Visualization Experts Showcase Black Hole Science at European Planetarium

- HECC Visualization team members were invited to submit an animation of a black hole merger, crafted for Europe's largest planetarium, at the Cité des Sciences et de l'Industrie, in Paris, France.
- The HECC visualization experts iterated with the Paris crew for more than a month to get the animation details just right, including a special "fisheye" projection, moving viewpoint, and overall timing to fit the requirements for the planetarium show.
- Previous visualization work completed for NASA Goddard scientist Bernard Kelly laid the groundwork for this new animation.
  - Kelly's work was done in response to the Laser Interferometer Gravitational-Wave Observatory (LIGO) Nobel Prize winning discovery of gravitational waves.
- Invited NASA contributors, including HECC staff, were present at the exhibit premier, which was well attended and purposefully coincided with an astronomy conference at the museum.

Mission Impact: This high-visibility showcase of NASA research, enabled by the Pleiades supercomputer and HECC visualization services, inspires thousands of students and visitors from around the world to learn about black holes and their formation and evolution.



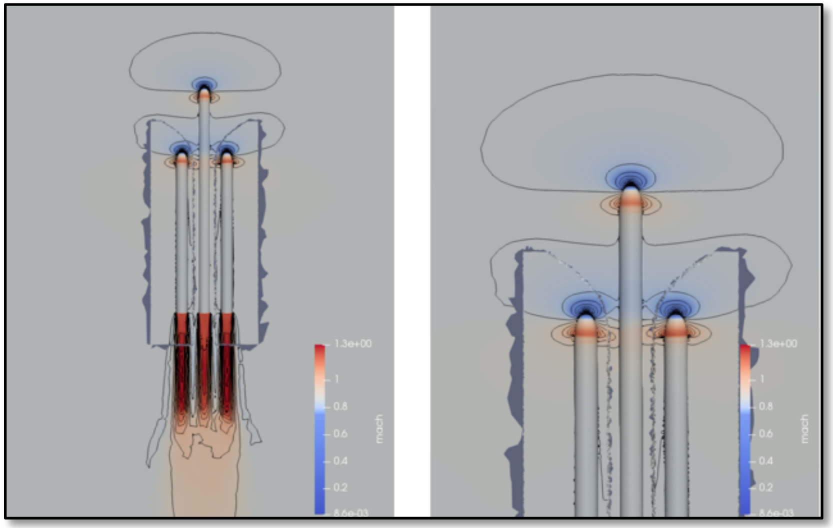
Visualization showing gravitational waves emitted by two black holes of nearly equal mass as they spiral together and merge. Orange ripples represent distortions of space-time caused by the rapidly orbiting masses. These distortions spread out and weaken, ultimately becoming gravitational waves (purple). *Bernard J. Kelly, NASA/Goddard and Univ. of Maryland Baltimore County; and Chris Henze and Tim Sandstrom, NASA/Ames*

POCs: Chris Henze, chris.henze@nasa.gov, (650) 604-3959, NASA Advanced Supercomputing (NAS) Division;
Tim Sandstrom, timothy.a.sandstrom@nasa.gov, (650) 604-1429, NAS Division, ASRC

HECC Applications Experts Help NASA Langley with CFD Vision 2030 Study Recommendations

- The Applications Performance and Productivity (APP) team improved the performance of the kernel of the HyperSolve computational fluid dynamics (CFD) solver by a factor of 2.
  - HyperSolve is part of NASA Langley's T-infinity framework, which seeks to meet a recommendation of the CFD Vision 2030 study by facilitating decentralized development of software to enable rapid CFD technology maturation. It relies heavily on templating features of C++, which often pose performance issues.
  - HyperSolve's key feature is the use of algorithmic differentiation (AD) as part of the solution process. While AD enables clean, error-free code, it was found to perform poorly compared with a handwritten implementation.
- The APP team achieved the improvements in kernel performance through compiler keywords, memory layout changes, and code simplification.
- When the Langley team applied a subset of the modifications to the full code, they saw a 3% speedup. The remaining APP modifications are more time consuming to apply and their full impact is not yet known.
- In the future, the APP team will work to improve the full code and will investigate the impact of using vector intrinsic functions.

Mission Impact: Achieving faster performance in modern software frameworks for NASA's physics-based modeling and simulation is critical to their acceptance by aerospace engineers.



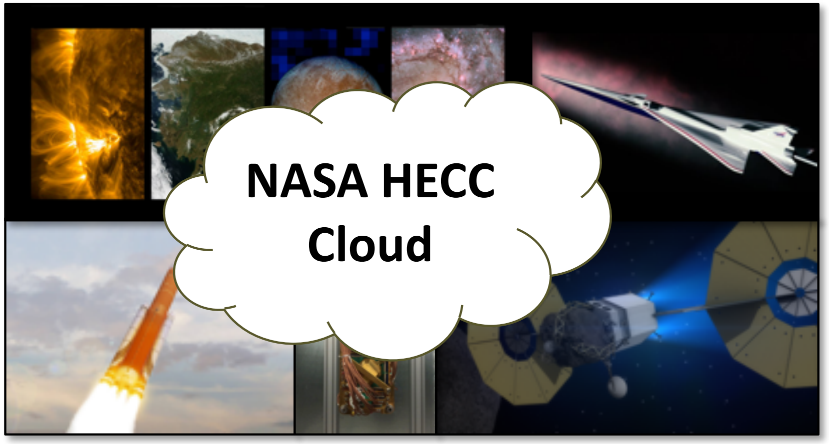
Snapshots from a HyperSolve steady overset simulation of a notional heavy-lift vehicle. The Mach contours on three domains are displayed at left. Close-up Mach contours are shown at right. *Image credit: Matthew O'Connell, Cameron Druyor, and Kyle Thompson [POC], NASA LaRC*

POCs: Gabriele Jost, gabriele.jost@nasa.gov, (650) 604-0468, NASA Advanced Supercomputing (NAS) Division, Supersmith; Daniel Kokron, daniel.s.kokron@nasa.gov, NAS Division, Redline Performance Solutions

Cloud Team Delivers Phase 2 Operational Requirements Document

- The HECC Cloud team delivered a document describing and defining requirements for a fully operational cloud environment.
- In September, the team implemented the first phase of their efforts—a pilot project that demonstrated the feasibility of cloud-bursting the batch jobs of a few early-access users from HECC servers to Amazon Web Services (AWS).
- The second phase—integrating commercial clouds as part of the offerings in the production environment for all HECC users—requires careful planning in multiple aspects of the project.
- The Cloud team finalized a set of 21 operational requirements in the categories of security, accounting, operational environment, and user support through:
  - Use of best practice concepts established by AWS in the design.
  - Collection of inputs from the NASA Enterprise Managed Cloud Computing manager and HECC staff from various groups.

Mission Impact: Having a set of well-planned requirements allows HECC staff from different groups to better coordinate efforts to bring commercial clouds into production in the HECC environment.



By the end of June 2019, HECC will incorporate commercial clouds into the HECC production environment. Amazon Web Services (AWS), the first vendor approved by NASA, will then be available to all HECC users.

POCs: Sherry Chang, sherry.chang@nasa.gov, (650) 604-1272, and Steve Heistand, steve.heistand@nasa.gov, (650) 604-4369, NASA Advanced Supercomputing Division, ASRC

NAS Facility Expansion (NFE) Concrete Pad Construction Underway

- The NASA Ames Permit Board approved the construction permit for the NFE site concrete pad on December 10.
  - A second permit to land the module and install mechanical and electrical service is expected in February 2019.
- Hewlett Packard Enterprise (HPE) and sub-contractors Schneider Electric and Tri-Technic are all under contract and mobilizing to the site.
  - Schneider Electric (module contractor) and Tri-Technic are procuring building materials to support pad construction.
  - Site surveying and markings for the concrete pad began on December 19.
- Ames personnel (from Code J, NAS, and Jacobs) associated with the primary infrastructure construction will continue to oversee HPE's construction activities.
- Schneider Electric is fabricating the module in Ohio for delivery in late February 2019 and installation in March.

Mission Impact: The NAS Facility Expansion will provide the infrastructure to support four times the capacity of existing HECC resources.

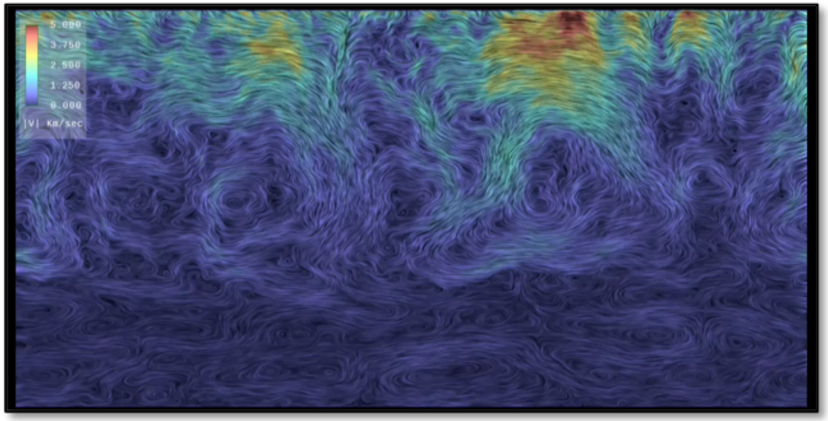
The NAS Facility Expansion site aggregate pad and power distribution is complete and ready for construction of the concrete pad.

POC: Christopher Tanner, christopher.tanner@nasa.gov, (650) 604-6754, NASA Advanced Supercomputing Division, ASRC

Stellar Simulations Help Exoplanet Hunters Separate Transit Signals from Noise Sources*

- Simulations run on Pleiades are helping researchers understand stellar noise sources that can hinder the detection of planet transits, which are used to infer the presence of planets circling other stars.
  - Because the signal from planetary transits is weak, understanding and eliminating non-planetary-transit signals (noise) in the observational data is key to the planet detection process.
  - Using measurements such as a star's spectral type, age, metallicity (amount of matter heavier than helium), rate of spin, and gross variability and activity level, researchers at NASA Ames ran simulations to quantify the various noise sources relevant to exoplanet detection and characterization.
  - Results show that granulation—spots of moving plasma at the solar surface—can have very different structures on stars with masses only slightly different than the Sun, and the brightness variation caused by granulation forms background noise in planetary transit detection.
- Simulations also provide details about highly energetic activity of some stars that could impact habitability conditions on their planets.

Mission Impact: Simulations produced using HECC resources help researchers understand the nature and magnitudes of distant stars, providing insight into the sources of stellar "noise" in observational data, which is vital to the planet detection process—the prime goal of the Kepler, K2, and Transiting Exoplanet Survey Satellite (TESS) missions.



Simulated velocity direction and magnitude for the near-surface region of a star 47% heavier than the Sun and rotating much faster than the Sun (in one day rather than 27), with brown indicating fastest and dark blue, slowest. *Irina Kitiashvili, Tim Sandstrom, NASA/Ames*

POCs: Alan Wray, alan.a.wray@nasa.gov, (650) 604-6066;
Irina Kitiashvili, irina.n.kitiashvili@nasa.gov, (650) 604-2203,
NASA Advanced Supercomputing Division

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

Advanced CFD Tools for Accurate Rotorcraft Analysis and Design*

- A goal of NASA's Revolutionary Vertical Lift Technology Project is to develop and validate advanced, high-fidelity CFD tools with improved physical realism and numerical solution accuracy that can be used in the rotorcraft design process.
- For the first time, research scientists at NASA Ames used a near-body (NB) adaptive mesh refinement (AMR) approach to refine the flow features on flexible rotor blades with embedded curvilinear meshes.
  - AMR only refines the local mesh where needed and is more computationally efficient than refining the mesh throughout the entire domain. Simulations were run on Electra; each rotor revolution required 60 wall-hours.
  - NB-AMR was applied to the challenging dynamic stall problem, where flow separation on a helicopter rotor blade causes a sudden reduction in thrust, increase in drag, and a nose-down pitching moment.
  - Dynamic stall also causes large structural vibrations and limits the maximum flight speed of the helicopter.
- Researchers are now working to further improve the NB-AMR process by reducing the computational cost and establishing best practices for engineering analysis and design.

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

Mission Impact: Advanced computational tools are enabling more realistic simulations to help engineers design safer, greener, and quieter rotorcraft in a timely, cost-effective way. HECC resources are needed for these complex, processor-intensive simulations.

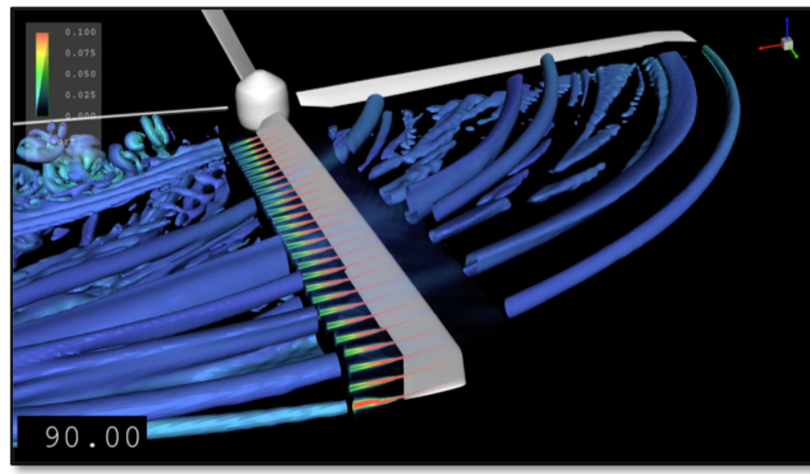


Image showing—for the first time—blade vortex interaction (BVI) causing dynamic stall on a Blackhawk helicopter rotor in forward flight. The vortex wake is visualized using isosurfaces of the Q-criterion, where red is high vorticity and blue is low vorticity. A novel visualization technique utilizes transparency to visualize the underlying separated flow near the rotor blade surface. Two dynamic stall events occur near azimuth angles of 220° to 270° and 330° to 360°. *Neal Chaderjian, Tim Sandstrom, NASA/Ames*

POC: Neal Chaderjian, neal.chaderjian@nasa.gov, (650 604-4472, NASA Advanced Supercomputing Division

HECC Facility Hosts Several Visitors and Tours in December 2018

- HECC hosted 3 tour groups in December; these guests learned about the agency-wide missions being supported by HECC assets, and also viewed the D-Wave 2000Q quantum computer system. Visitors this month included:
  - Joe Van Belleghem, Google's Senior Director for Development; along with Jeff Hosea and Jeff Holzman, Google project managers.
  - Solomon Darwin, Executive Director of the Haas Business School's Garwood Center for Corporate Innovation, made a return visit to the facility with additional members of his Smart Village Research India Team.
  - Aline McNaul, USA Legislative Representative, Institute of Electrical and Electronics Engineers, visited Ames this month.

At right: William Thigpen, HECC Deputy Project Manager, shows Google guests the Modular Supercomputing Facility during their visit to NASA Ames Research Center. In foreground: Christopher Tanner, NAS facility engineer, accompanied the tour.

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

Papers

- "**Increased Frequency of Extreme Tropical Deep Convection: AIRS Observations and Climate Model Predictions**," H. Aumann, et al., Geophysical Research Letters (prepublication), December 3, 2018. *
  https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018GL079423
- "**Efficacy of Early Stellar Feedback in Low Gas Surface Density Environments**," R. Kannan, et al., arXiv:1812.01614 [astro-ph.GA], December 4, 2018. *
  https://arxiv.org/abs/1812.01614
- "**Probabilistic Assessment of Tunguska-Scale Asteroid Impacts**," L. Wheeler, D. Mathias, Icarus (Elsevier), published online December 6, 2018. *
  https://www.sciencedirect.com/science/article/pii/S0019103518304676
- "**GEONEX: Challenges in Producing MODIS-Like Land Products from a New Generation of Geostationary Sensors**," S. Li, et al., American Geophysical Union (AGU) Fall Meeting, Washington D.C., December 10-14, 2018. *
  https://ntrs.nasa.gov/search.jsp?R=20180008583
- "**Predicting the Rossby Number in Convective Experiments**," E. Anders, et al., arXiv:1812.04518 [astro-ph.SR], December 11, 2018. *
  https://arxiv.org/abs/1812.04518
- "**Heterogeneous Changes in Western North American Glaciers Linked to Decadal Variability in Zonal Wind Strength**," B. Menounos, et al., Geophysical Research Letters (prepublication), December 13, 2018. *
  https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018GL080942

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Papers (cont.)

- "**Effects of Asteroid Property Distributions on Expected Impact Rates**," L. Wheeler, D. Mathias, Icarus, vol. 321, published online December 18, 2018. *
https://www.sciencedirect.com/science/article/pii/S0019103518305062
- "**Polygram Stars: Resonant Tidal Excitation of Fundamental Oscillation Modes in Asynchronous Stellar Coalescence**," M. MacLeod, et al., arXiv:1812.07594 [astro-ph.SR[, December 18, 2018. *
https://arxiv.org/abs/1812.07594
- "**High-Fidelity Multidisciplinary Sensitivity Analysis and Design Optimization for Rotorcraft Applications**," L. Wang, B. Diskin, R. Biedron, E. Nielsen, O. Bauchau, AIAA Journal, published online December 27, 2018*
https://arc.aiaa.org/doi/abs/10.2514/1.J056587
- "**Effects of Cross-Sheet Density and Temperature Inhomogeneities on Magnetotail Reconnection**," S. Lu, et al., Geophysical Research Letters (prepublication), December 28, 2018. *
https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018GL081420
- "**Global-Scale Dispersal and Connectivity in Mangroves**,: T. Van der Stocken, et al., Proceedings of the National Academy of Sciences, published online December 31, 2018. *
https://www.pnas.org/content/early/2018/12/26/1812470116
- "**Breezing Through the Space Environment of Barnard's Star b**," J. Alvarado-Gomez, et al., arXiv:1901.00219 [astro-ph.SR], January 1, 2019. *
https://arxiv.org/abs/1901.00219

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Papers (cont.)

- **AIAA SciTech Forum**, San Diego, CA, January, 7-11, 2019.
  - "**Effect of 3D Roughness Patch on Instability Amplification in a Supersonic Boundary Layer**," M. Choudhari, F. Li, P. Paredes, L. Duan. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0877
  - "**Numerical Investigation of a Shielded Chevron Nozzle**," B. Heberling. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0254
  - "**A Knowledge-Based Optimization Method for Aerodynamic Design**," R. Campbell, M. Lynde. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1207
  - "**Flutter Analysis of the Transonic Truss-Braced Wing Aircraft Using Transonic Correction**," N. Nguyen, J. Fugate, J. Xiong, U. Kaul. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0217
  - "**A Correction Method for Unsteady Transonic Aerodynamics**," U. Kaul, N. Nguyen. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2037
  - "**Investigation of Transitional Shock-Wave/Boundary Layer Interactions Using Direct Numerical Simulations**," B. Venkatachari, C.-L. Chang. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0093
  - "**Sidewall Effects on Exact Reynolds-Stress Budgets in an Impinging Shock Wave/Boundary Layer Interaction**," M. Vyas, D. Yoder, D. Gaitonde. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1890
  - "**Comparison of Boundary Layer Similarity Transformations for High Mach Number Flows**," N. DiGregorio, T. Drozda, C. Madnia. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1390
  - "**The Effect of Fuel Stratification on the Detonation Wave Structure**," S. Prakash, et al. *
    https://arc.aiaa.org/doi/pdfplus/10.2514/6.2019-1511

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Papers (cont.)

- **AIAA SciTech Forum** (cont.)
  - "**Preliminary Results from an Experimental Assessment of a Natural Laminar Flow Design Method**," M. Lynde, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2298
  - "**Toward a Pseudo-Time Accurate Formulation of the Adjoint and Tangent Systems**," E. Padway, D. Mavriplis. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0699
  - "**Comparison of SLS Sectional Loads from Pressure-Sensitive Paint and CFD**," J. Meeroff, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2127
  - "**Numerical Aspects for Physically Accurate Direct Numerical Simulations of Turbulent Jets**," N. Sharan, J. Bellan. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2011
  - "**Time Accurate Simulation of Nonequilibrium Flow Inside the NASA Ames Electric Arc Shock Tube**," K. Bensassi, A. Brandis. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0798
  - "**High-Fidelity Multidisciplinary Sensitivity Analysis Framework for Multipoint Rotorcraft Optimization**," L. Wang, B. Diskin, R. Biedron, E. Nielsen, V. Sonneville, O. Bauchau. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1699
  - "**Adaptive Wavelet-Based Delayed Detached Eddy Simulations of Anisothermal Channel Flows with High Transverse Temperature Gradients**," X. Ge, Y. Zhou, O. Vasilyev, M. Hussaini. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1558
  - "**The Effect of Turbulence Modeling on the Mixing Characteristics of Several Fuel Injectors at Hypervelocity Flow Conditions**," T. Drozda, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0128

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Papers (cont.)

- **AIAA SciTech Forum** (cont.)
  - "**Establishing Best Practices for X-57 Maxwell CFD Database Generation**," J. Duensing, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0274
  - "**Fluid-Structure Interactions with Geometrically Nonlinear Deformations**," J. Boustani, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1896
  - "**Development of Unsteady Pressure-Sensitive Paint Application of NASA Space Launch System**," N. Rozzeboom, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2129
  - "**Space Launch System Booster Separation Supersonic Powered Testing with Surface and Off-Body Measurements**," C. Winski, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2311
  - "**Accuracy, Scalability, and Efficiency of Mixed-Element USM3D for Benchmark Three-Dimensional Flows**," M. Pandya, D. Jespersen, B. Diskin, J. Thomas, N. Frink. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-2333
  - "**Investigation of Reduced-Order Modeling for Aircraft Stability and Control Prediction**," N. Frink, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0980
  - "**Kestrel Results at Liftoff Conditions for a Space Launch System Configuration in Proximity to the Launch Tower**," S. Krist, N. Ratnayake, F. Ghaffari. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1841
  - "**Microjet Configuration Sensitivities for Lift Enhancement in High-Lift Systems**," S. Hosseini, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-0590
  - "**Computational Fluid Dynamics Methods Used in the Development of the Space Launch System Liftoff and Transition Lineloads Databases**," N. Ratnayake, et al. *
    https://arc.aiaa.org/doi/pdf/10.2514/6.2019-1840

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Papers (cont.)

- "**Multiple Spiral Arms in the Disk Around Intermediate-Mass Binary HD 34700A**," J. Monnier, et al., arXiv:1901.02467 [astro-ph.EP], January 8, 2019. *
https://arxiv.org/abs/1901.02467
- "**MESSENGER Observations and Global Simulations of Highly Compressed Magnetosphere Events at Mercury**," X. Jia, et al., Journal of Geophysical Research: Space Physics, published online January 8, 2019. *
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018JA026166
- "**Link Between Trees of Fragmenting Granules and Deep Downflows in MHD Simulation**," T. Roudier, et al., Astronomy & Astrophysics, published online January 8, 2019. *
https://www.aanda.org/articles/aa/pdf/forth/aa34283-18.pdf
- "**CGM Properties in VELA and NIHAO Simulations; the OVI Ionization Mechanism: Dependence on Redshift, Halo Mass, and Radius**," S. Roca-Fabrega, et al., Monthly Notices of the Royal Astronomical Society, published online January 10, 2019. *
https://academic.oup.com/mnras/advance-article/doi/10.1093/mnras/stz063/5287982
- "**Circumstellar Dust Distribution in Systems with Two Planets in Resonance**," F. Marzari, et al., The Astronomical Journal, vol. 157, no. 2, January 11, 2019. *
https://iopscience.iop.org/article/10.3847/1538-3881/aaf3b6/meta
- "**Magnetized Interstellar Molecular Clouds II. The Large-Scale Structure and Dynamics of Filamentary Molecular Clouds**," P. Li, R. Klein, arXiv:1901.04593 [astro-ph.GA], January 14, 2019. *

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Papers (cont.)

- "**Ocean Dynamics of Outer Solar System Satellites**," K. Soderlund, arXiv:1901.04093 [physics.geo-ph], January 14, 2019. *
  https://arxiv.org/abs/1901.04093
- "**On the Prevalence of Super-Massive Black Holes over Cosmic Time**," J. Buchner, et al., arXiv:1901.04500 [astro-ph.CO], January 14, 2019. *
  https://arxiv.org/abs/1901.04500
- "**On the Spatial Scales to be Resolved by the Surface Water and Ocean Topography Ka-Band Radar Interferometer**," J. Wang, et al., Journal of Atmospheric and Oceanic Technology, published online January 18, 2019. *
  https://journals.ametsoc.org/doi/full/10.1175/JTECH-D-18-0119.1
- "**Modeling the Recent Changes in the Arctic Ocean CO_2 Sink (2006-2013)**," M. Manizza, et al., Global Biogeochemical Cycles, published online January 19, 2019. *
  https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018GB006070
- "**Dust Polarization Maps from TIGRESS: E/B Power Asymmetry and TE Correlation**," C.-G. Kim, S. Choi, R. Rlauger, arXiv:1901.07079 [astro-ph.GA], January 21, 2019. *
  https://arxiv.org/abs/1901.07079
- "**UV Core Dimming in Coronal Streamer Belt and the Projection Effects**," L. Abbo, S. Giordano, L. Ofman, Astronomy & Astrophysics, published online January 22, 2019. *
  https://www.aanda.org/articles/aa/pdf/forth/aa34299-18.pdf

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Papers (cont.)

- "**The Hall Electric Field in Earth's Magnetotail Thin Current Sheet**," S. Lu, et al., Journal of Geophysical Research: Space Physics, published online January 28, 2019. *
https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2018JA026202
- "**FIRE-2 Simulations: Physics versus Numerics in Galaxy Formation**," P. F. Hopkins, et al., Monthly Notice of the Royal Astronomical Society, November 11, 2018. * (not previously reported)
https://doi.org/10.1093/mnras/sty1690
- "**How to Model Supernovae in Simulations of Star and Galaxy Formation**," P. F. Hopkins, et al., Monthly Notice of the Royal Astronomical Society, last revised November 2018. * (not previously reported)
https://doi.org/10.1093/mnras/sty674

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Presentations

- **American Geophysical Union Fall Meeting**, Washington D.C., December 10-14, 2018.
  - ”**Probabilistic Assessment of Tunguska-Scale Asteroid Impacts and Frequencies**,” L. Wheeler. *https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/449249* *
  - “**Synergy of Observations and Dynamo Models to Understand and Predict Solar Activity Cycles**,” I. Kitiashvili. *https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/452012* *
  - “**Realistic 3D MDH Modeling of the Emerging Magnetic Flux and Corona**,” A. Wray, I. Kitiashvili, N. Mansour, A. Kosovichev. *https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/448537* *
  - “**Using Machine-Learning Methods and Expert Prediction Probabilities to Forecast Solar Flares**,” V. Sadykov, A. Kosovichev, I. Kitiashvili. *https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/384834* *
  - “**Inferring Bolide Pre-Entry Parameters Using Deep Neural Networks**,” D. Mathias, A. Tarano, L. Wheeler, S. Close. *https://agu.confex.com/agu/fm18/meetingapp.cgi/Paper/465674* *

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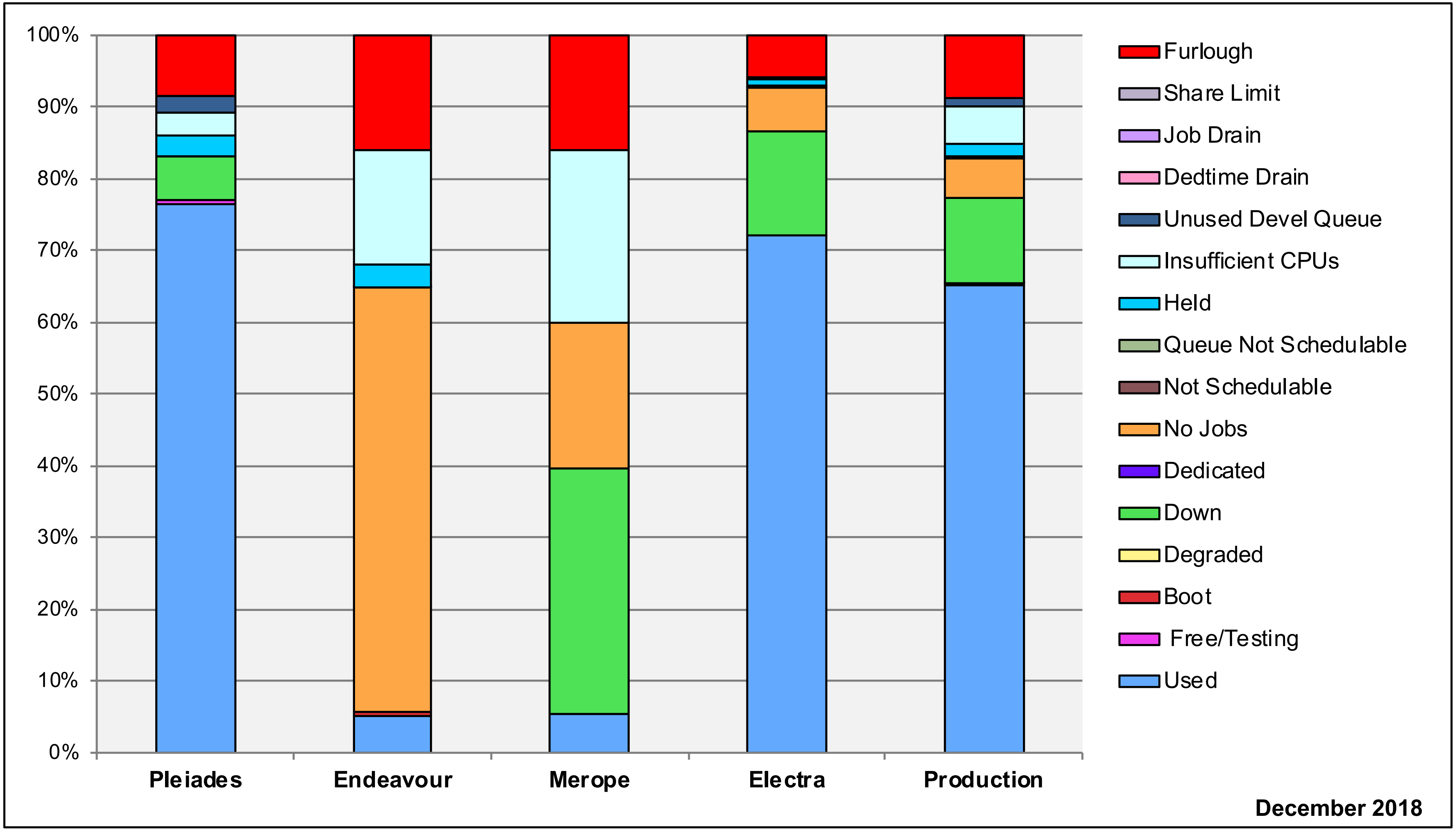
News and Events

- **Tracking Dynamo Waves Inside the Sun to Fathom the Solar Cycle**, *NAS Feature Story*, December 12, 2018—Visualizations produced from NASA solar data open a window into the Sun's interior, revealing dynamo wave patterns that help us understand the solar cycle better than ever before. *https://www.nas.nasa.gov/publications/articles/feature_sunspots_Kosovichev.html*
- **Solar Flares: From Emergence to Eruption**, *NCAR & UCAR News*, January 14, 2019—A team of scientists has, for the first time, used a single, cohesive computer model to simulate the entire life cycle of a solar flare. The model ran on supercomputers at the National Center for Atmospheric Research (NCAR) and the NASA Advanced Supercomputing (NAS) Division. *https://news.ucar.edu/132648/emergence-eruption*
  - **Video: A Comprehensive Simulation of a Solar Flare**, *insideHPC*, January 30, 2019. *https://insidehpc.com/2019/01/video-a-comprehensive-simulation-of-a-solar-flare/*
- **How to Escape a Black Hole: Simulations Provide New Clues to What's Driving Powerful Plasma Jets**, *Lawrence Berkeley National Labs*, January 24, 2019—New simulations run on supercomputers at the NASA Advanced Supercomputing Division, led by researchers working at the Department of Energy's Lawrence Berkeley National Laboratory and UC Berkeley, combined decades-old theories to provide new insight about the driving mechanisms of plasma jets that allow them to steal energy from black holes' powerful gravitational fields and propel it into space. *https://newscenter.lbl.gov/2019/01/24/how-to-escape-a-black-hole-simulations-provide-new-clues-to-whats-driving-powerful-plasma-jets/*

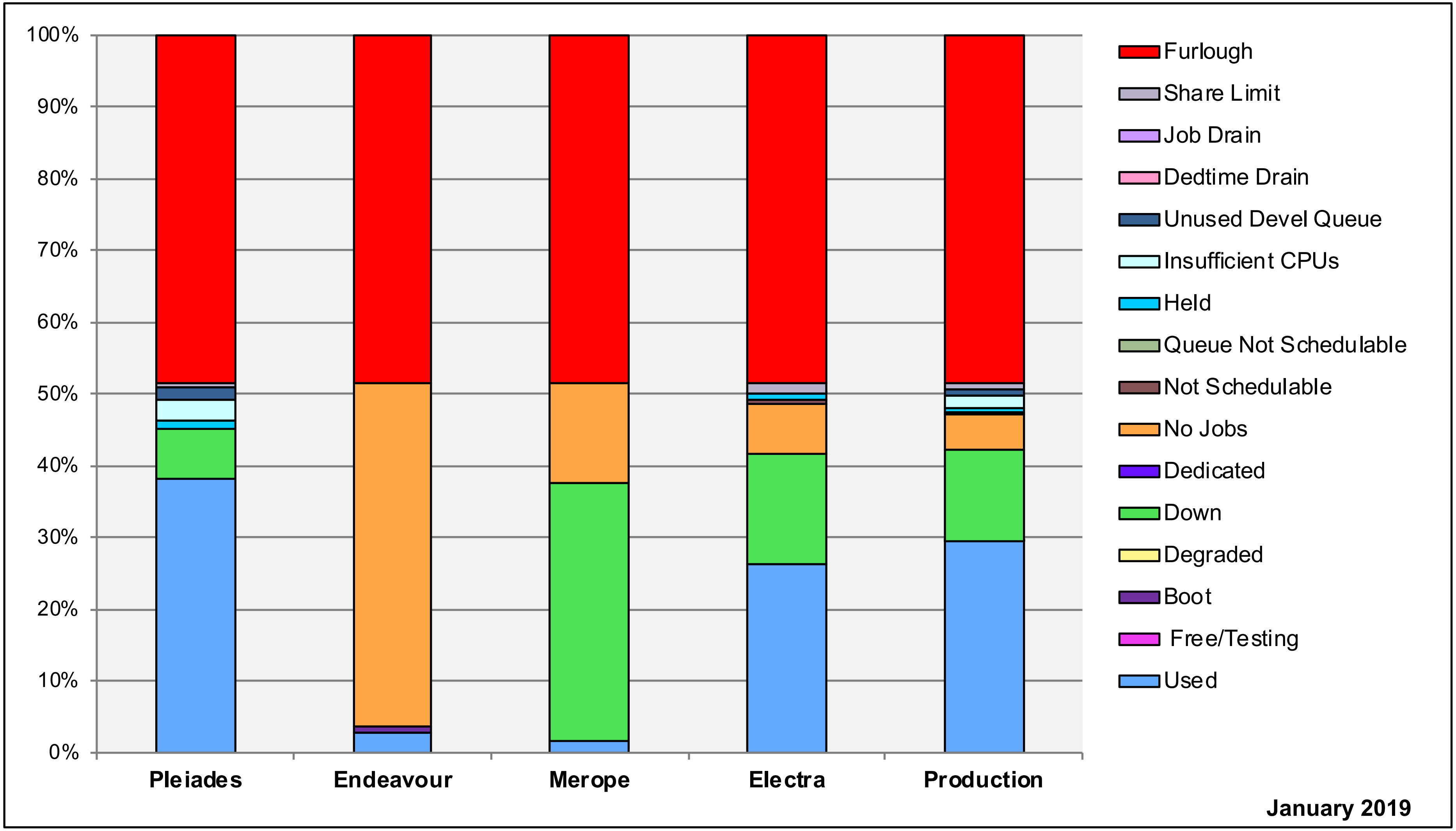
News and Events: Social Media

- **Agency Coverage of NAS Computing**
  - NASA Aeronautics Advent Calendar, featuring UAV simulations performed at NAS
    Twitter: 11 retweets, 28 likes.
  - NASA Aeronautics "Moment of the Year" vote, featuring UAV simulations performed at NAS
    Twitter: 17, likes 52.
  - NASA Planetquest (via @NASAAmes), featuring TESS data pipeline through Pleiades supercomputer
    Twitter: 9 retweets, 23 likes.
  - NASA Supercomputing (via @NASAAmes), featuring TESS data pipeline
    Facebook: 253 users reached, 13 engagements.
- **Top Posts from NAS**
  - Honoring legacy of former President George H. W. Bush
    - Twitter: 37 retweets, 277 likes
    - Facebook: 349 users reached, 39 engagements
  - Solar visualization feature story
    - Twitter: 72 retweets, 150 likes
    - Facebook: 469 users reached, 72 engagements
    - Accompanying AGU tie-in, Twitter: 13 retweets, 47 likes
  - Aeroacoustics feature from SC18, featuring work done on Pleiades, Facebook: 782 users reached, 63 engagements.
  - Solar flare simulations (news tie-in) run on NAS machines
    - Twitter: 14 retweets, 54 likes
    - Facebook: 334 users reached, 28 engagements

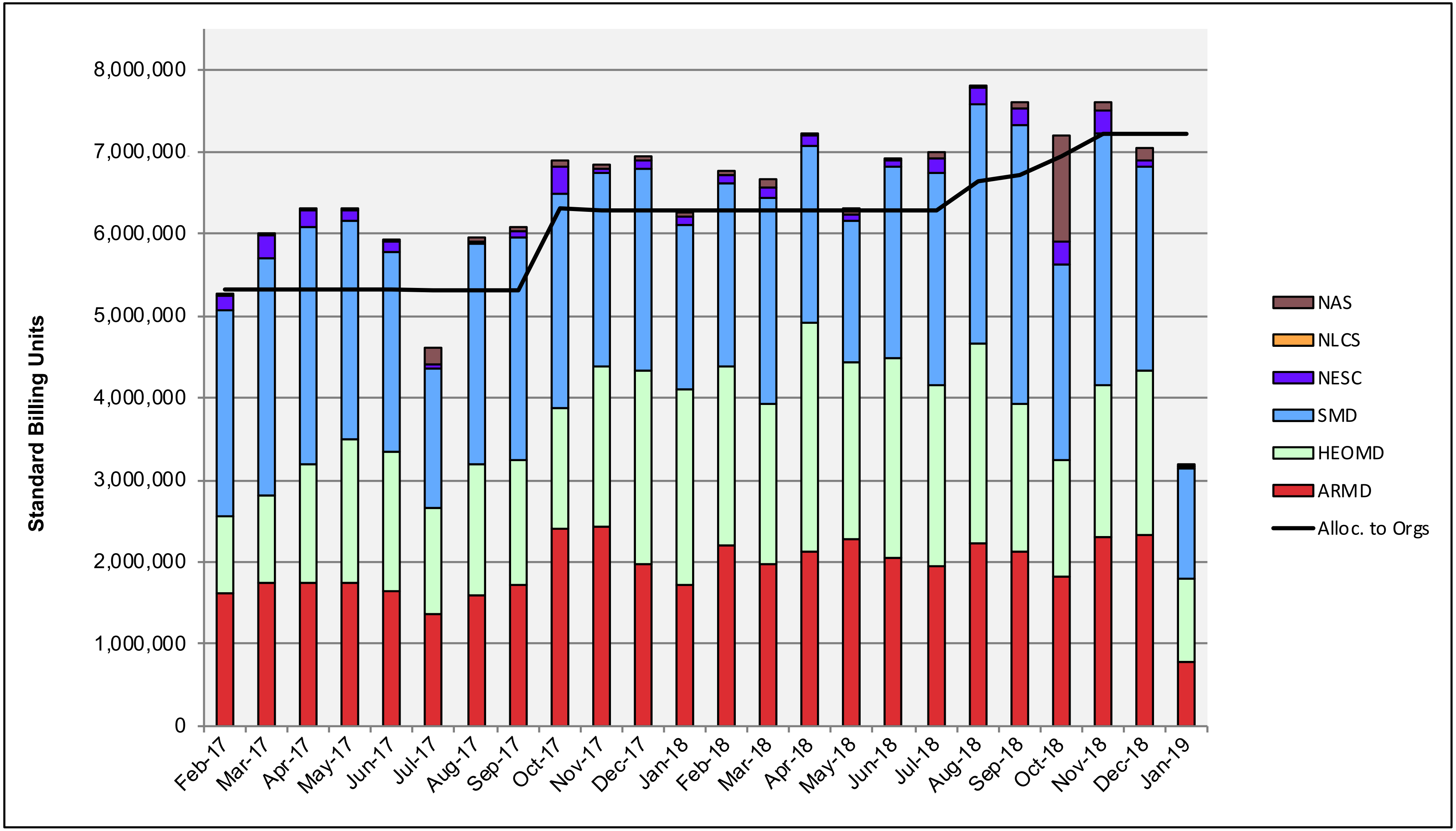
HECC Utilization



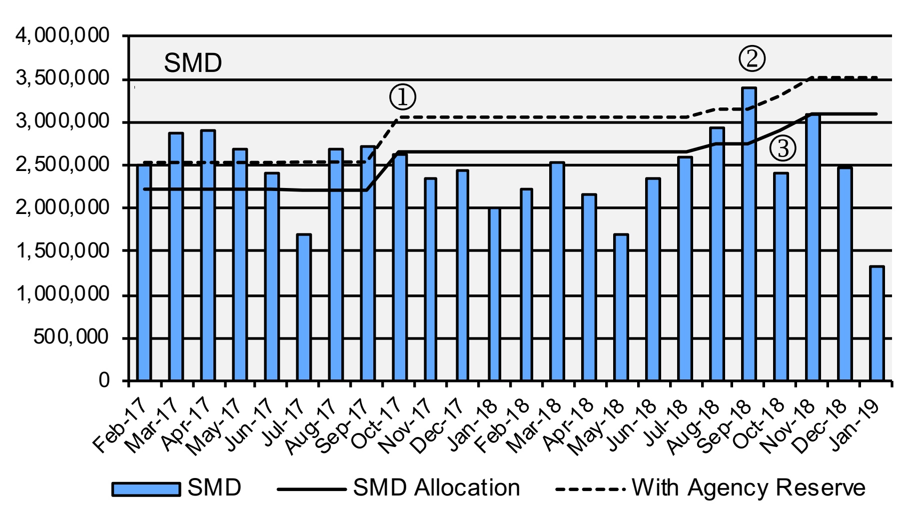
HECC Utilization

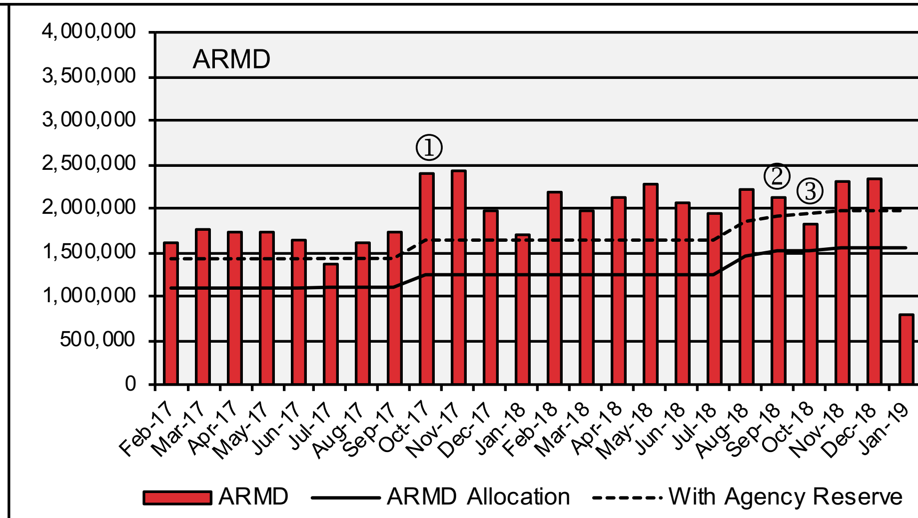


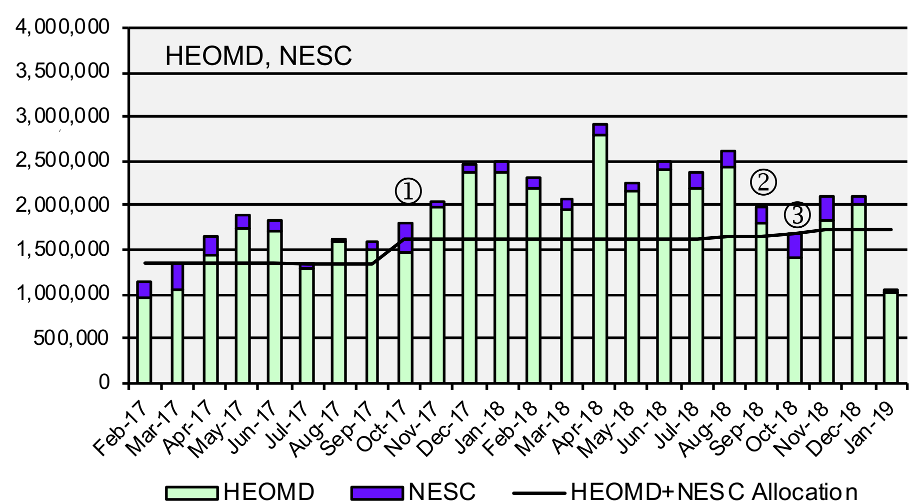
HECC Utilization Normalized to 30-Day Month



HECC Utilization Normalized to 30-Day Month





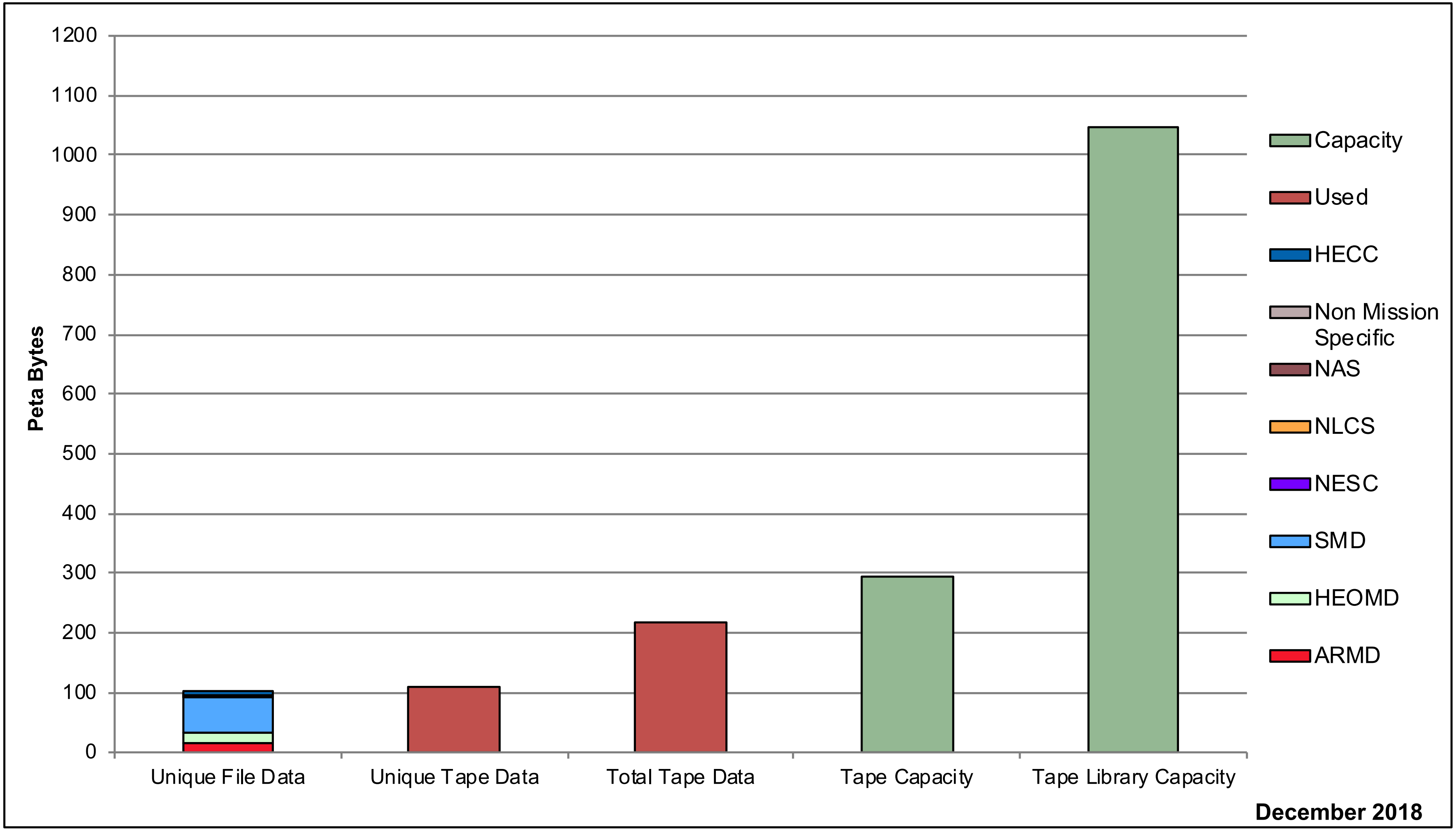


① 4 Skylake E cells (16 D Rack Equivalence) added to Electra

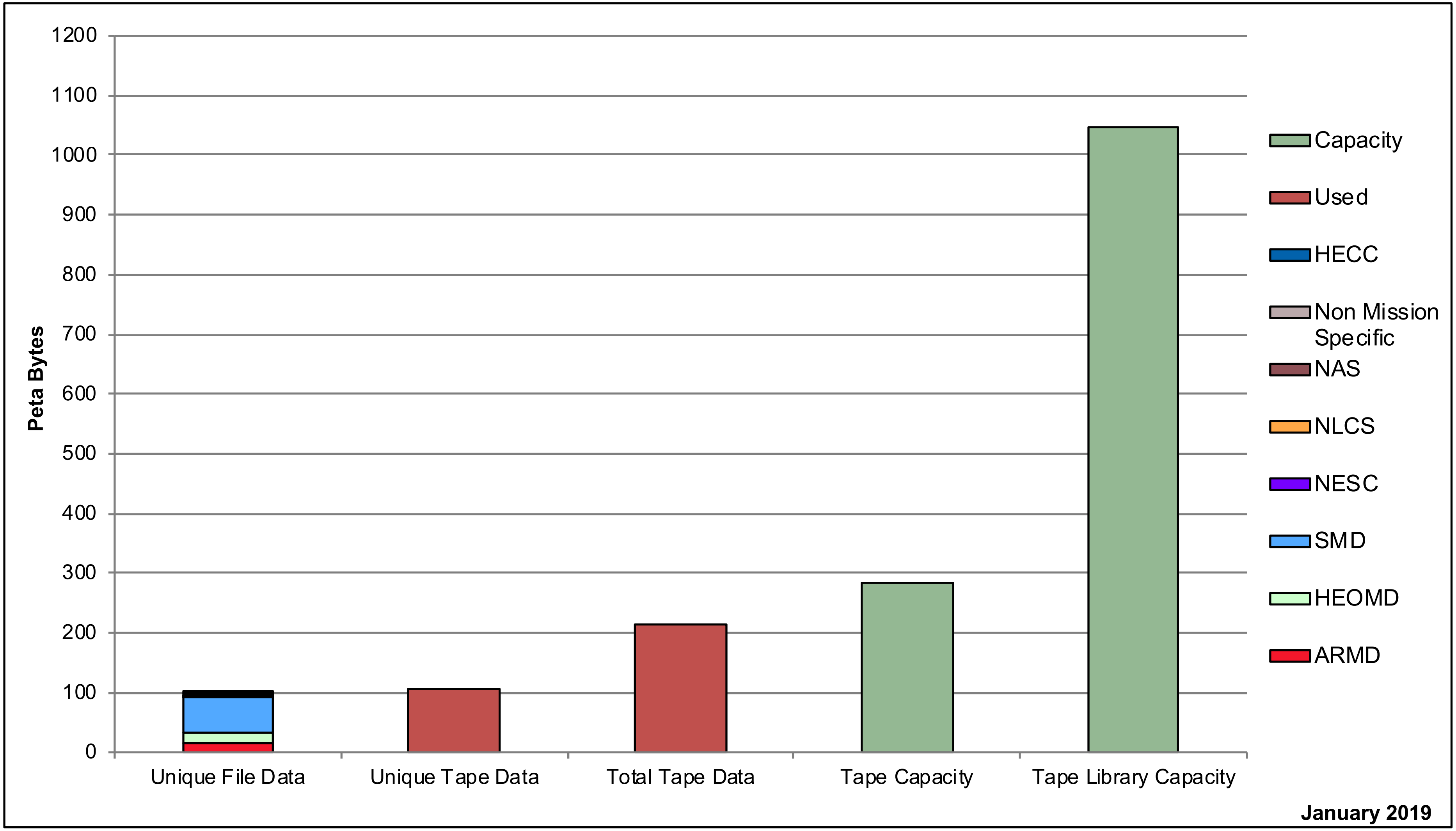
② 2 Skylake E cells (8 D Rack Equivalence) added to Electra; 1 rack is dedicated to ARMD

③ 2 Skylake E cells (8 D Rack Equivalence) added to Electra; 1 rack is dedicated to SMD

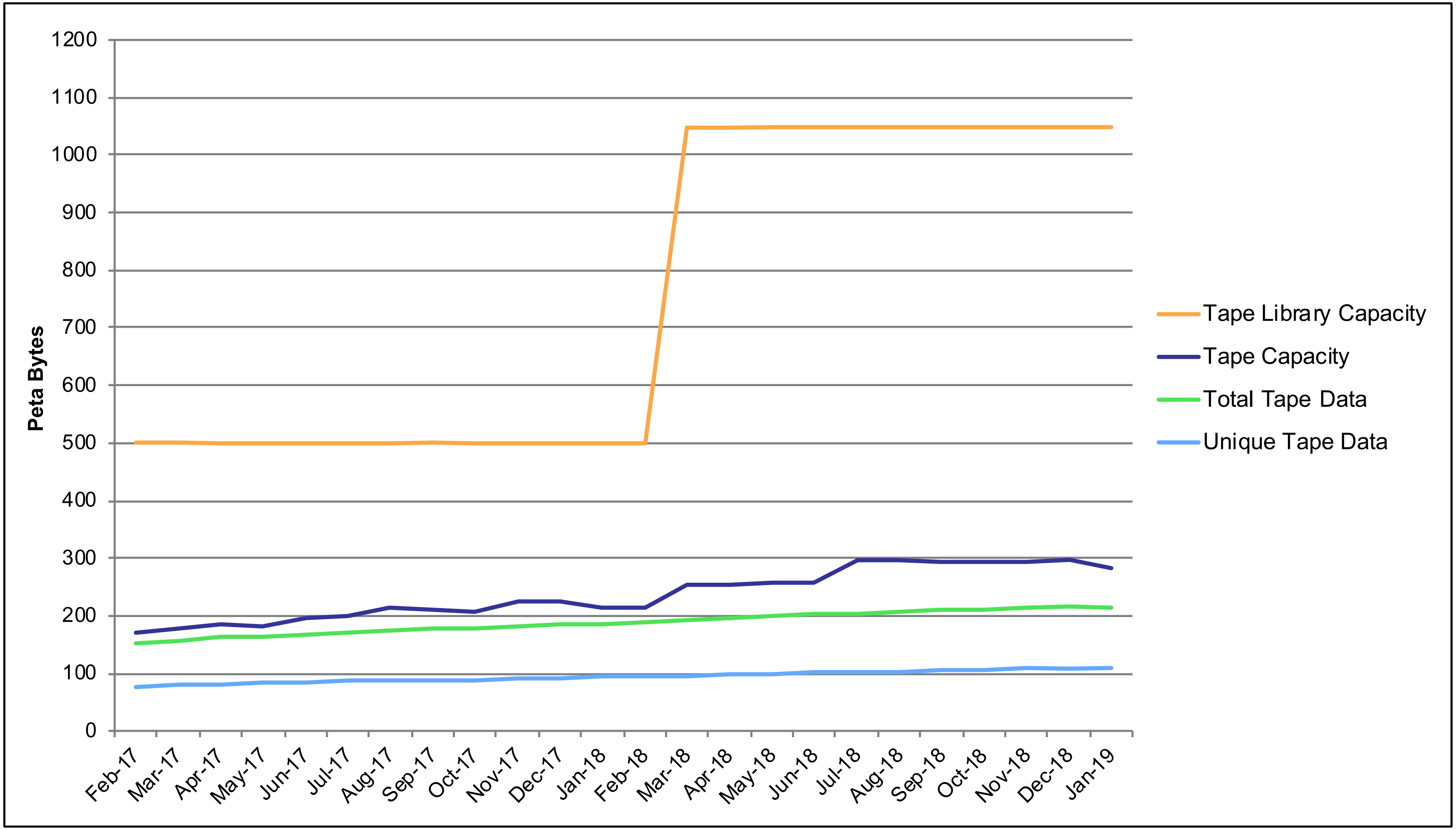
Tape Archive Status



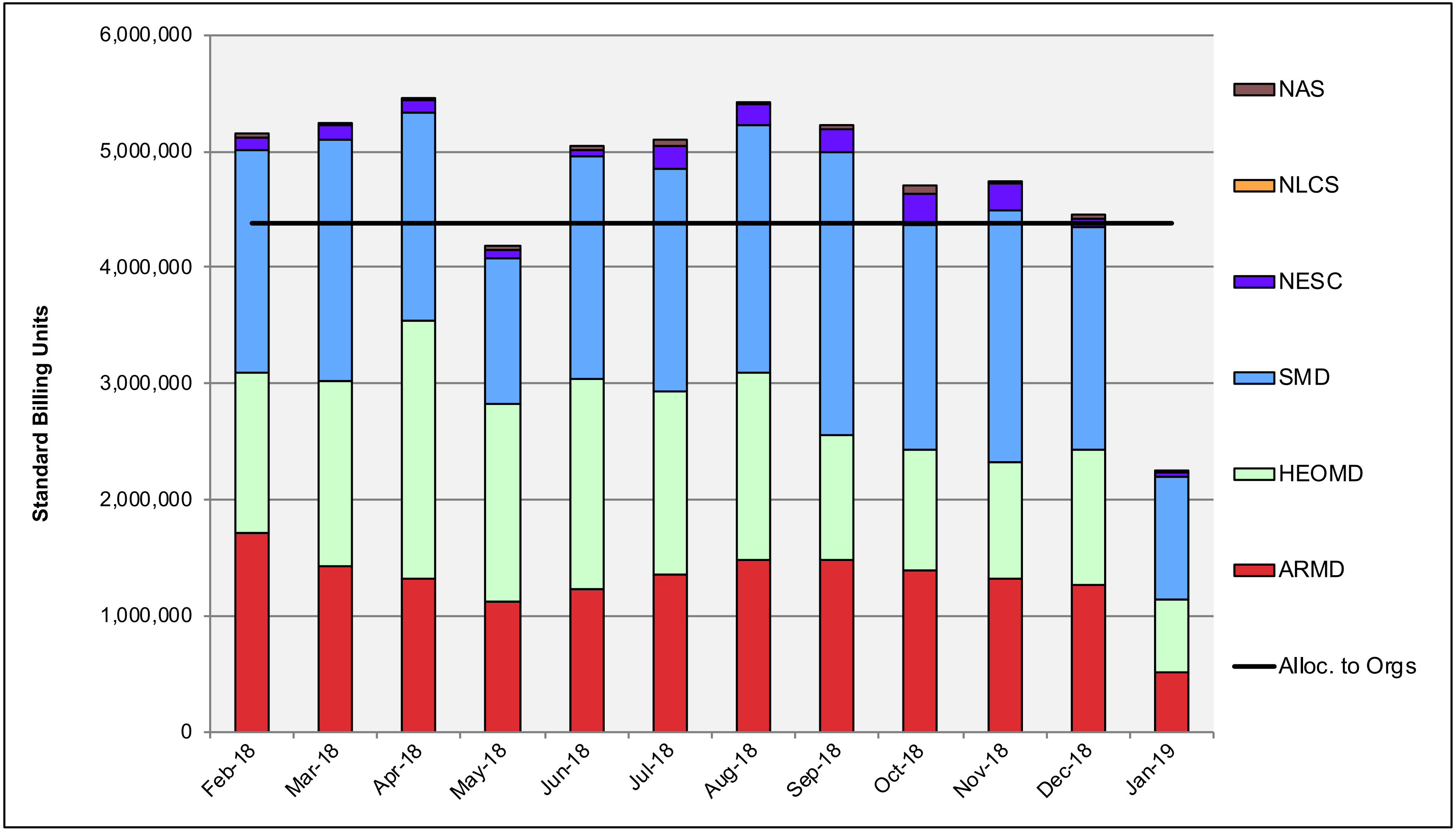
Tape Archive Status



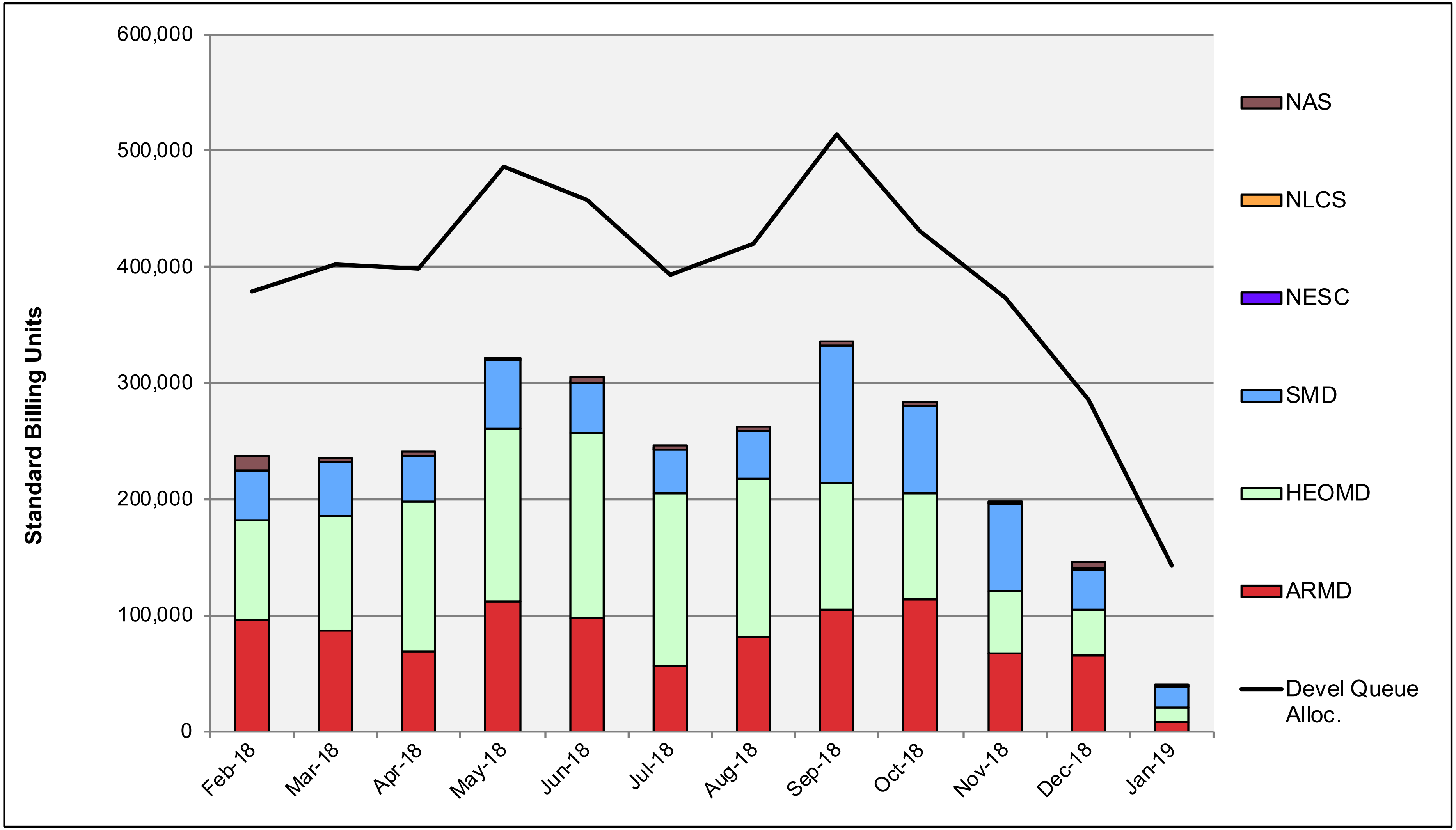
Tape Archive Status



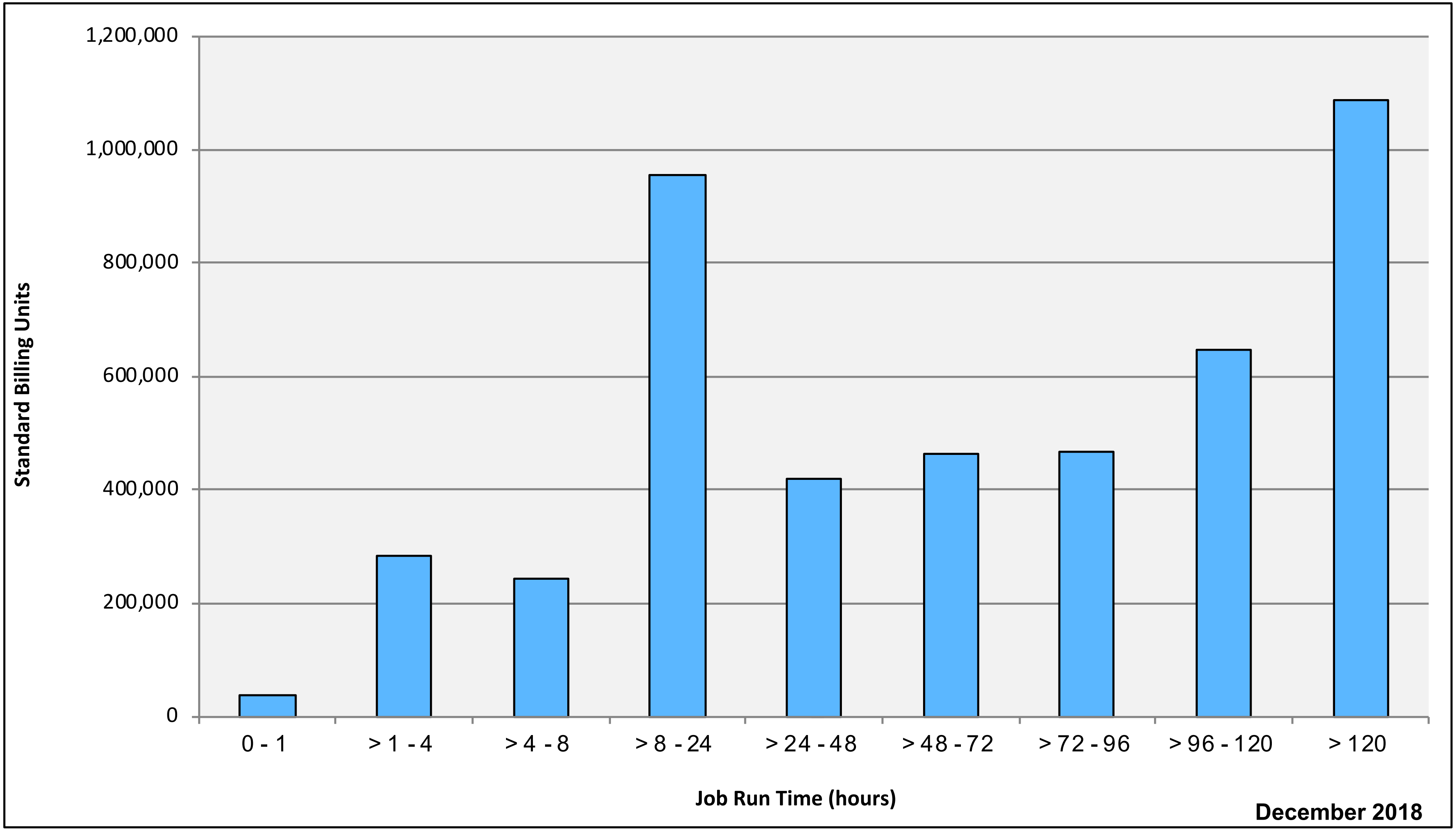
Pleiades: SBUs Reported, Normalized to 30-Day Month



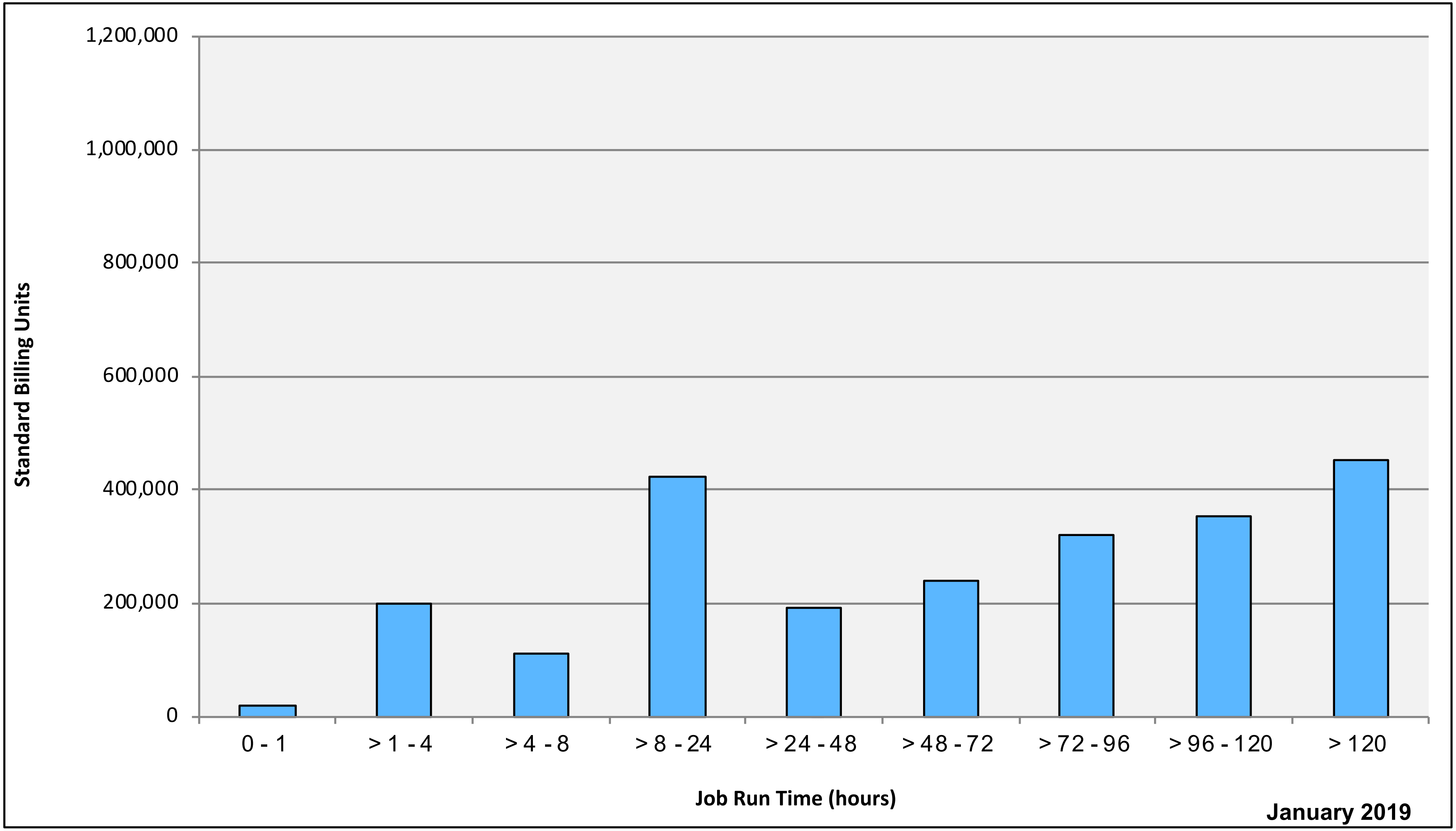
Pleiades: Devel Queue Utilization



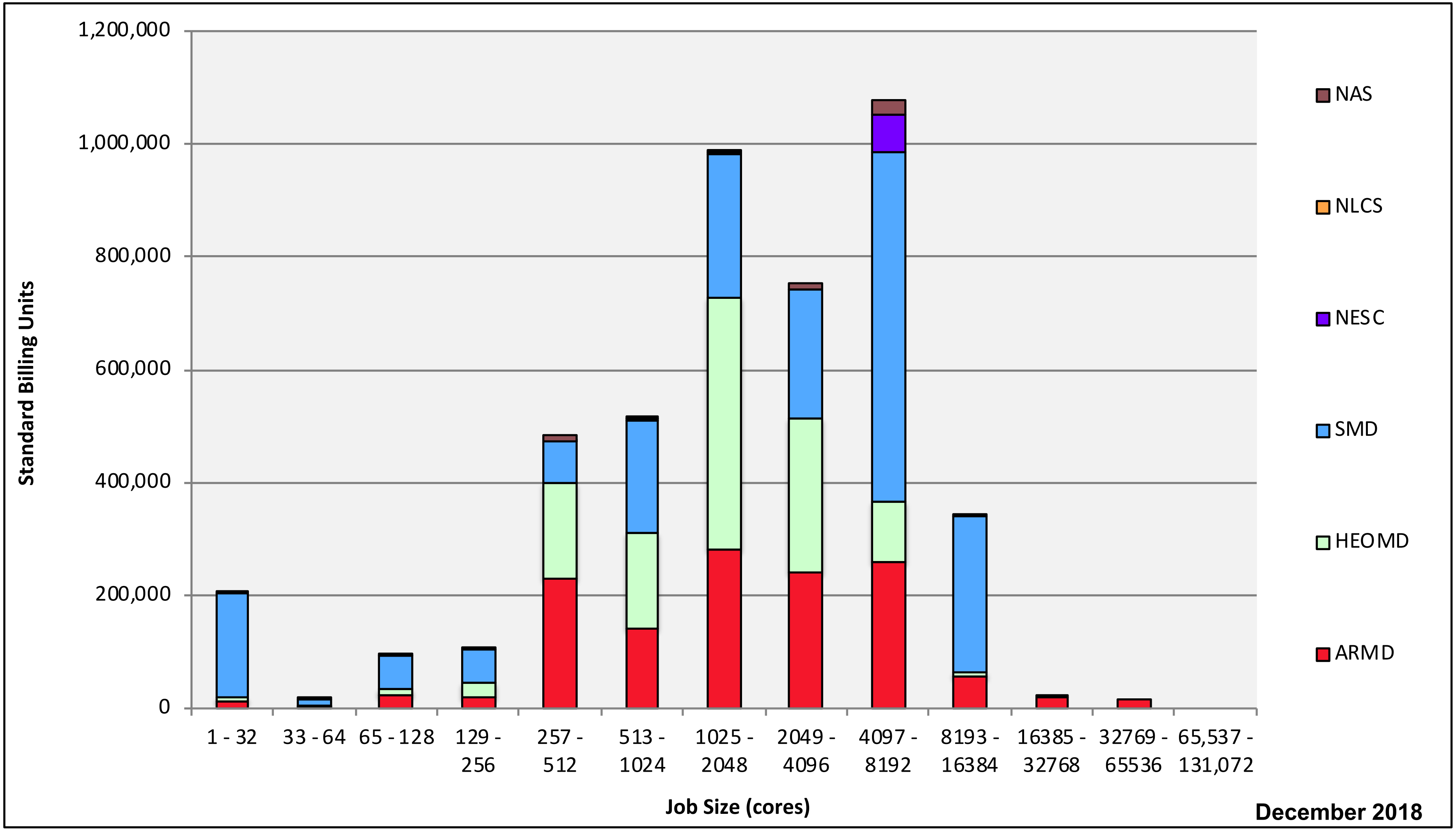
Pleiades: Monthly Utilization by Job Length



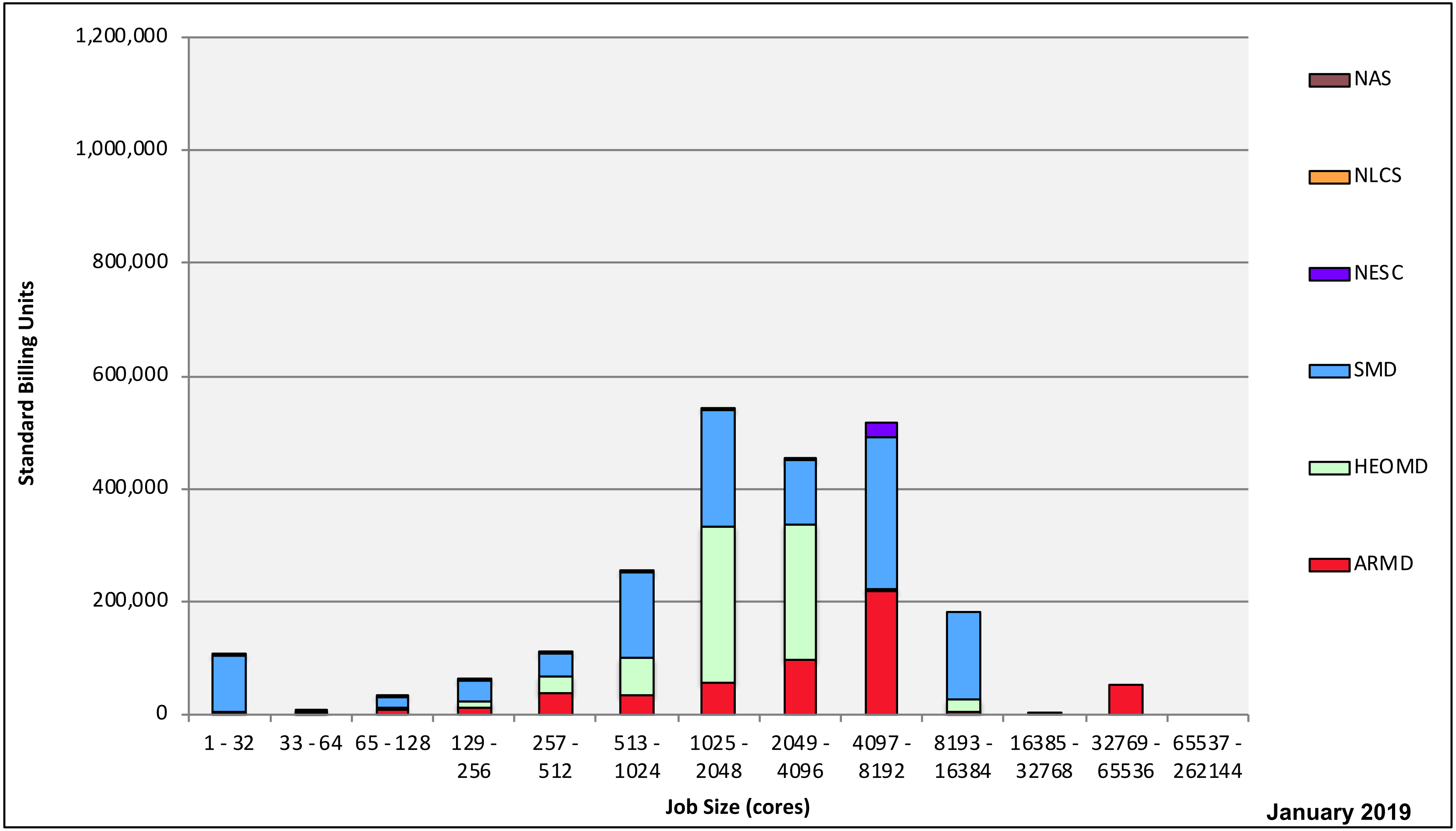
Pleiades: Monthly Utilization by Job Length



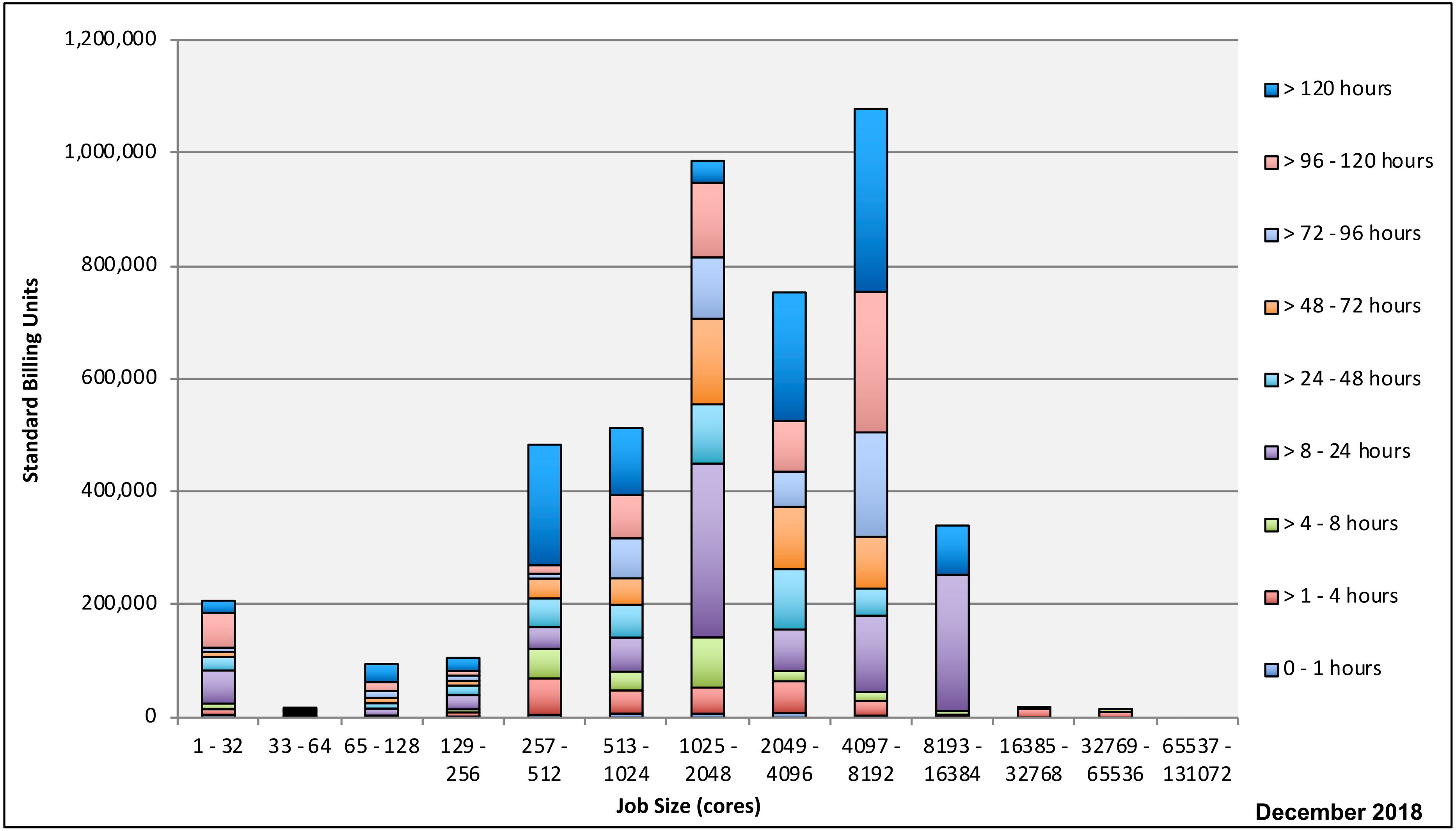
Pleiades: Monthly Utilization by Size and Mission



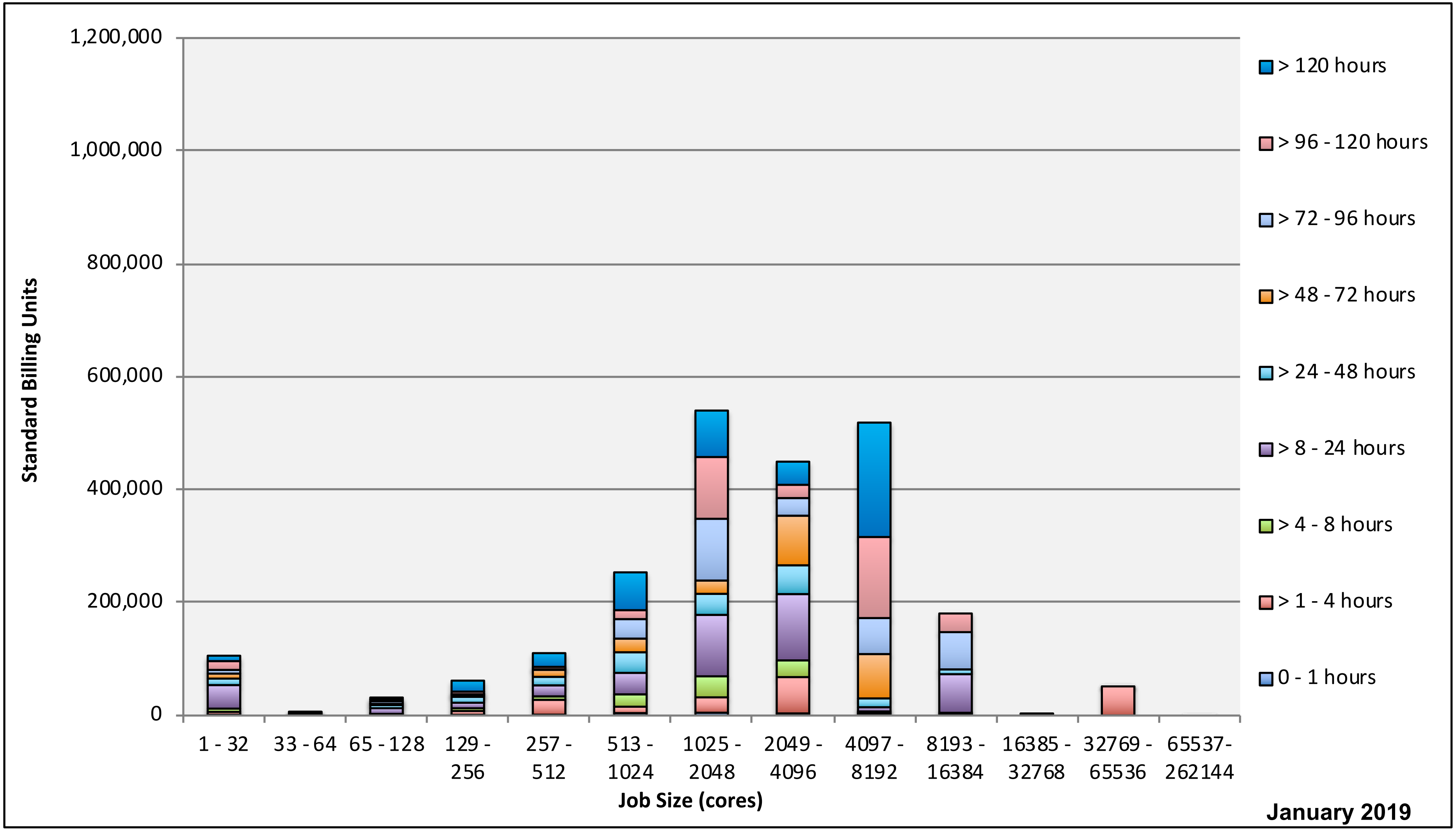
Pleiades:
Monthly Utilization by Size and Mission



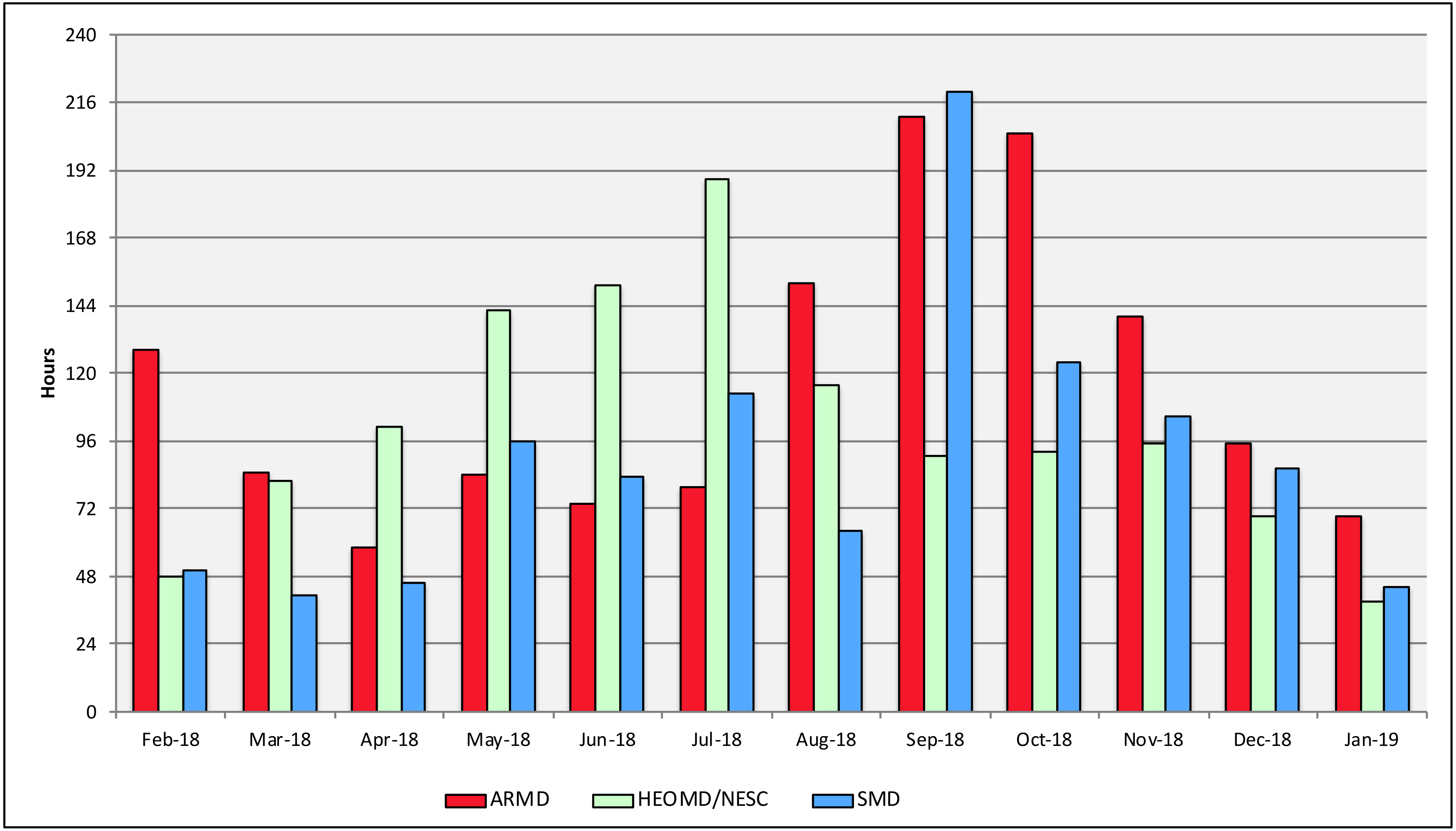
Pleiades: Monthly Utilization by Size and Length



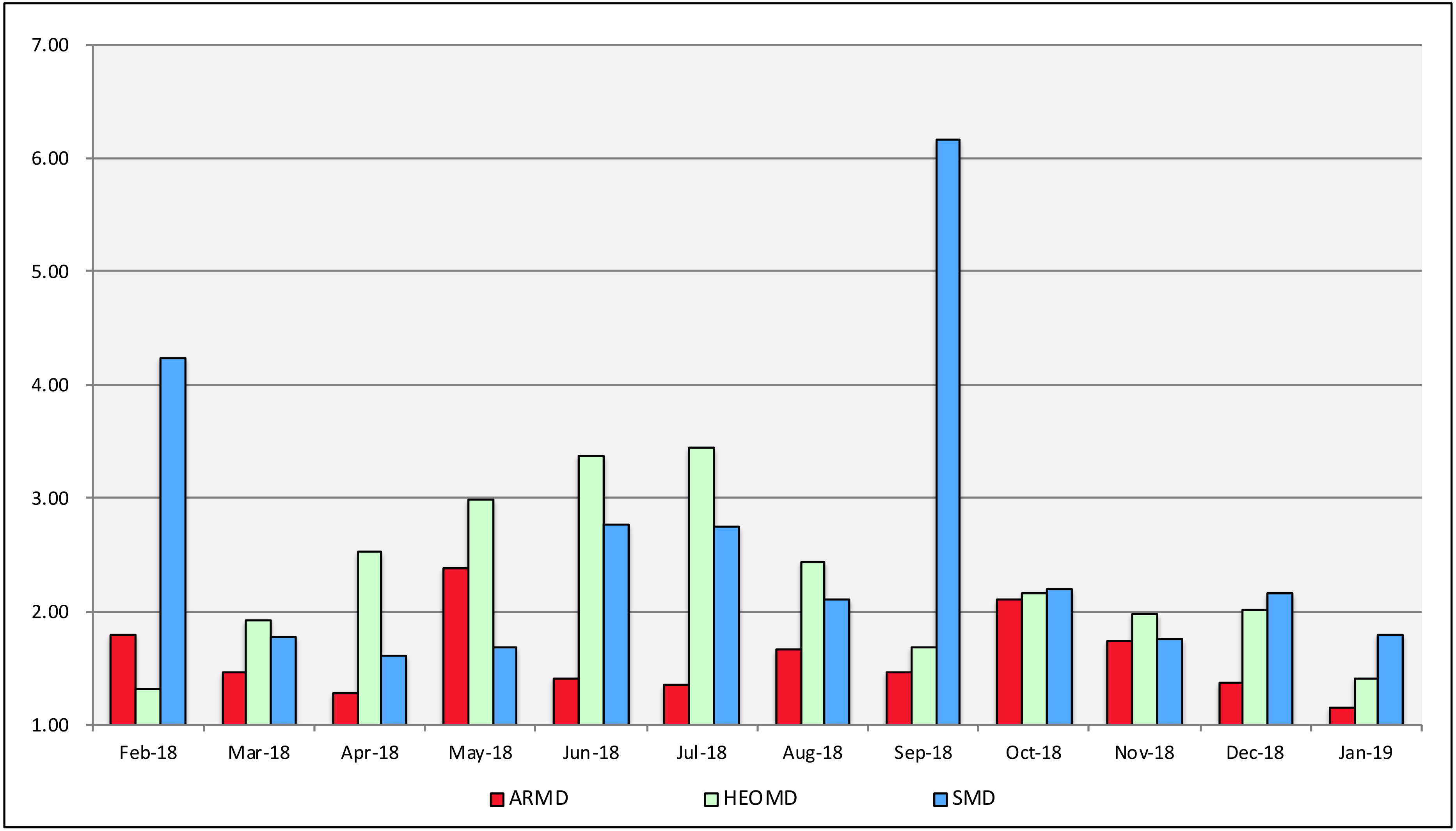
Pleiades: Monthly Utilization by Size and Length



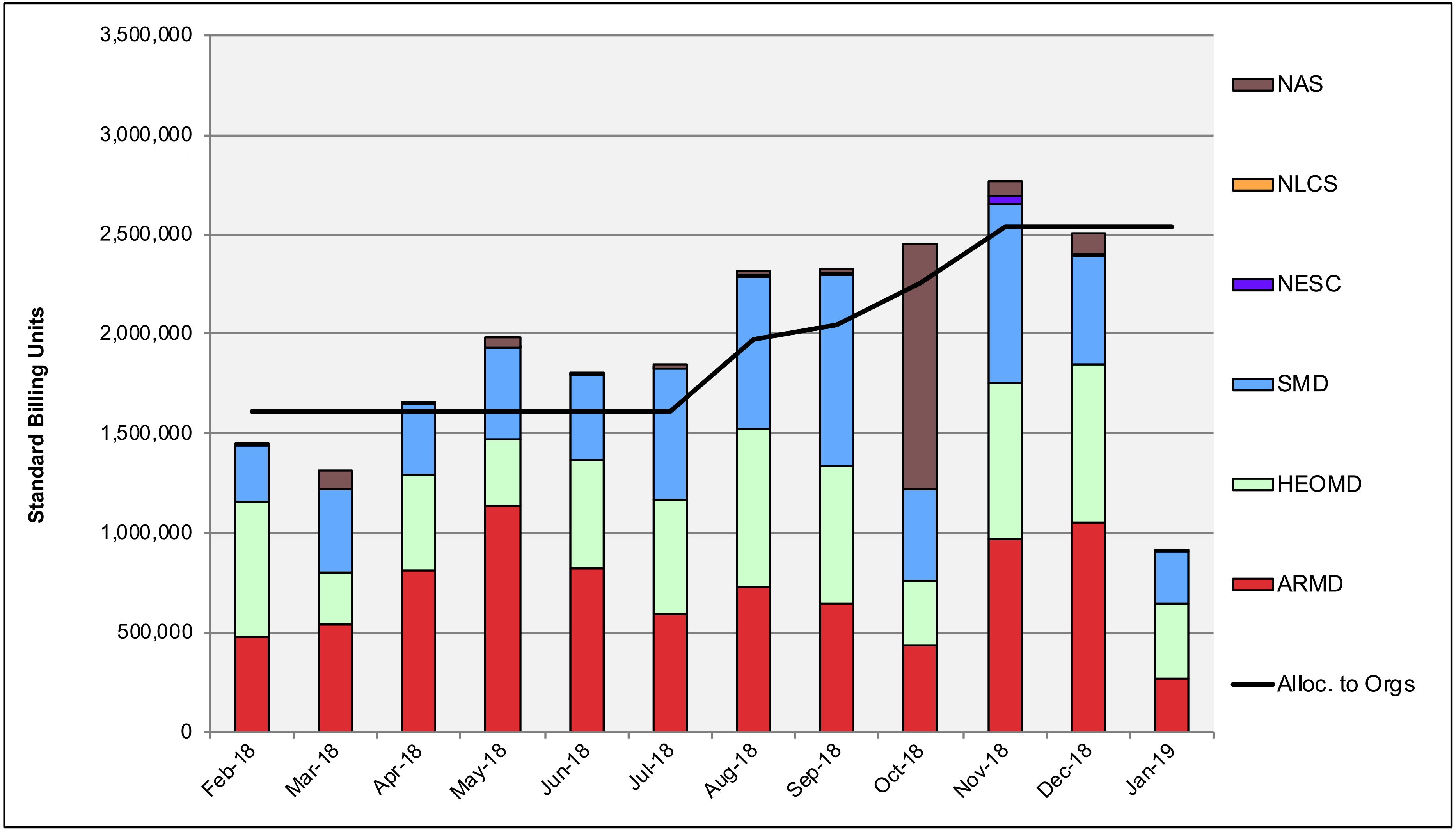
Pleiades: Average Time to Clear All Jobs



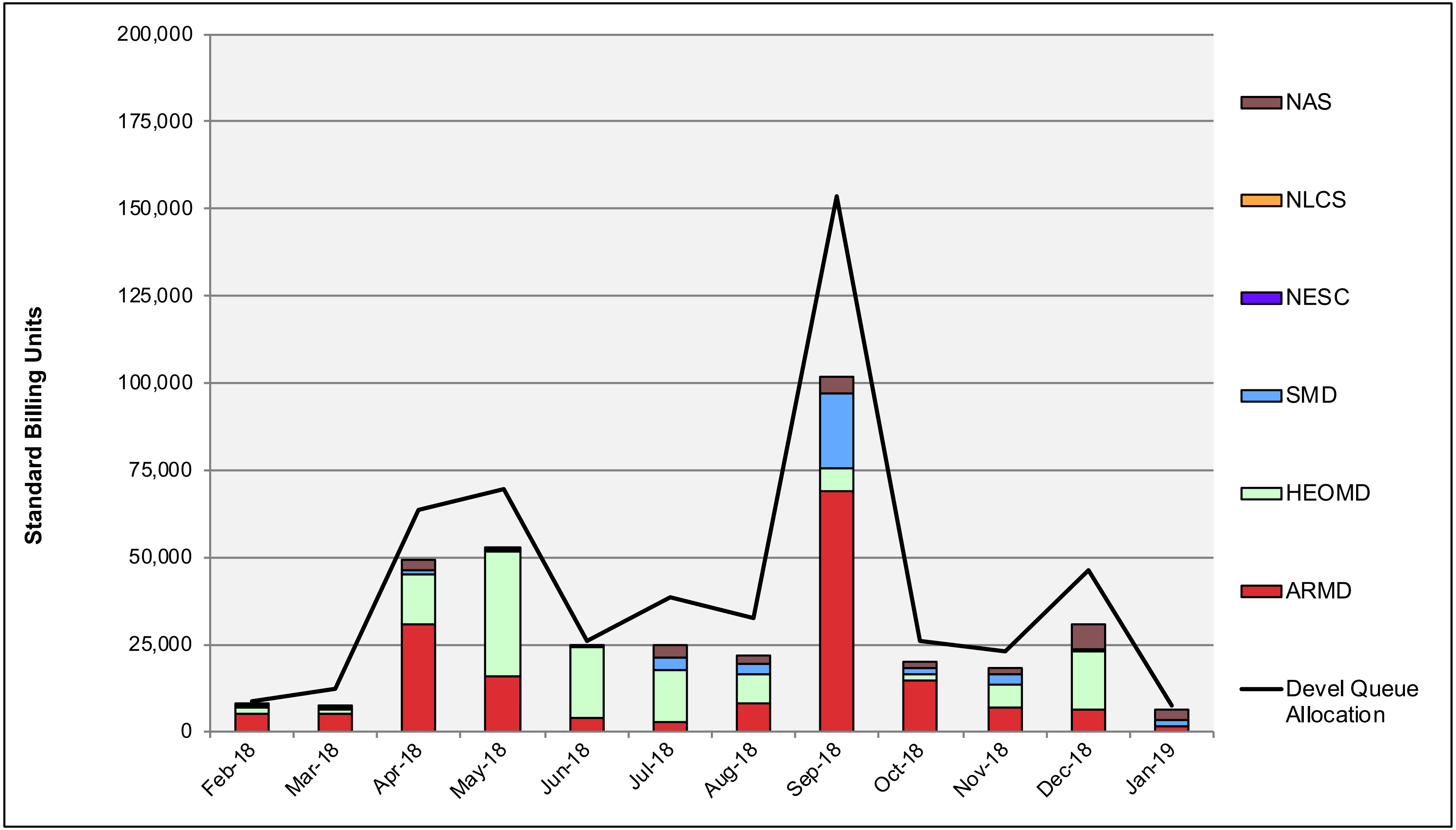
Pleiades: Average Expansion Factor



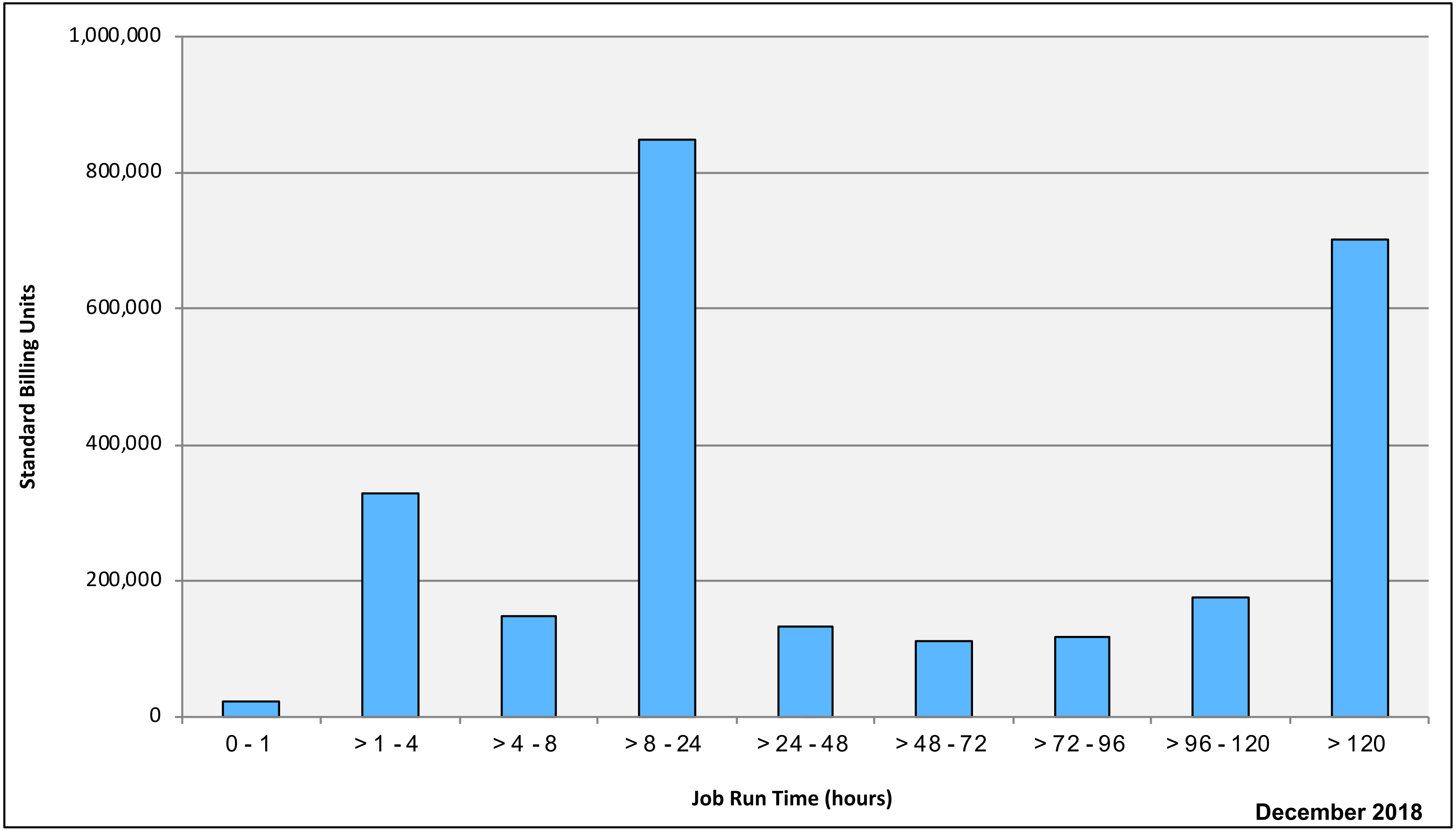
Electra: SBUs Reported, Normalized to 30-Day Month



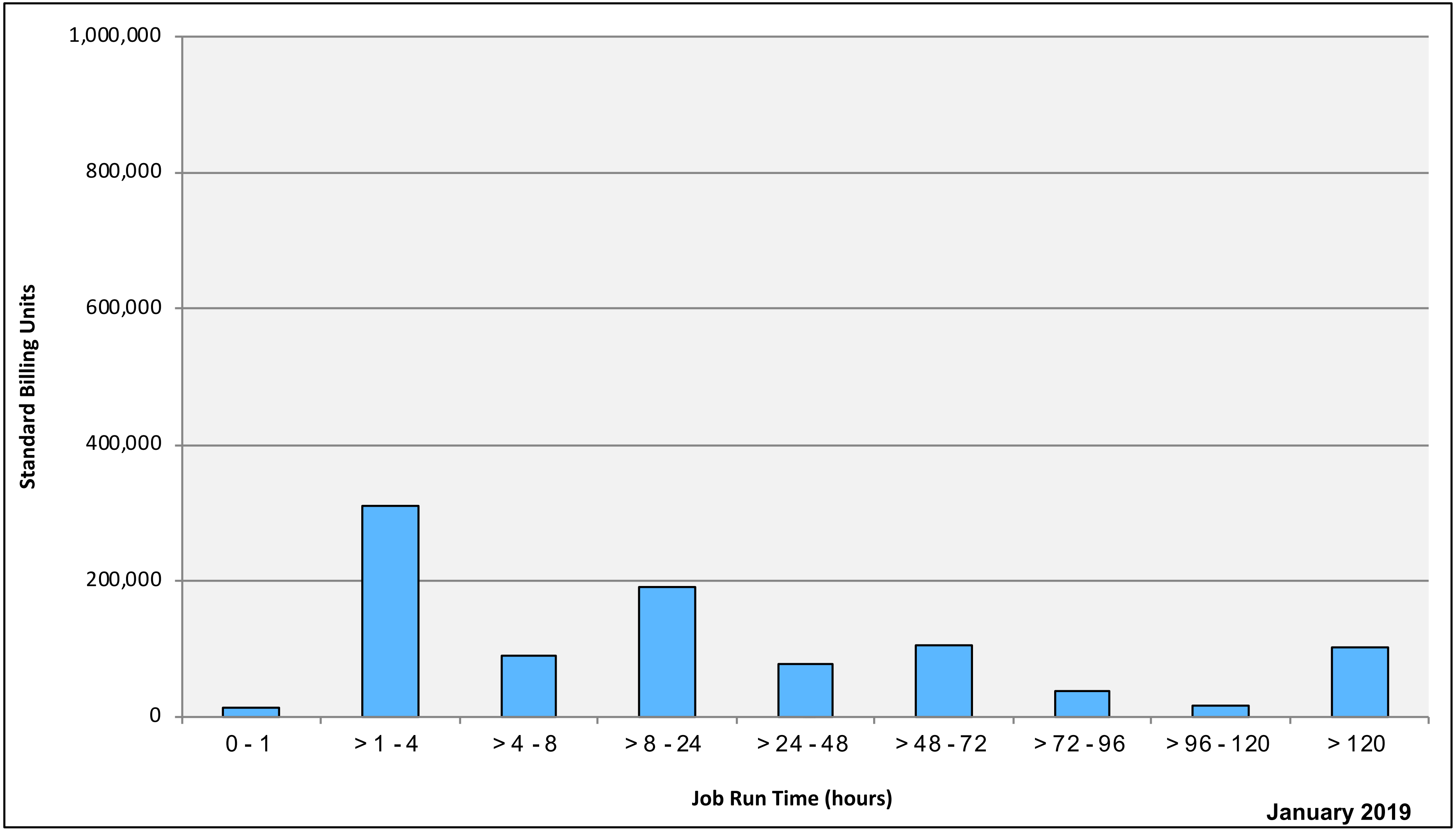
Electra:
Devel Queue Utilization



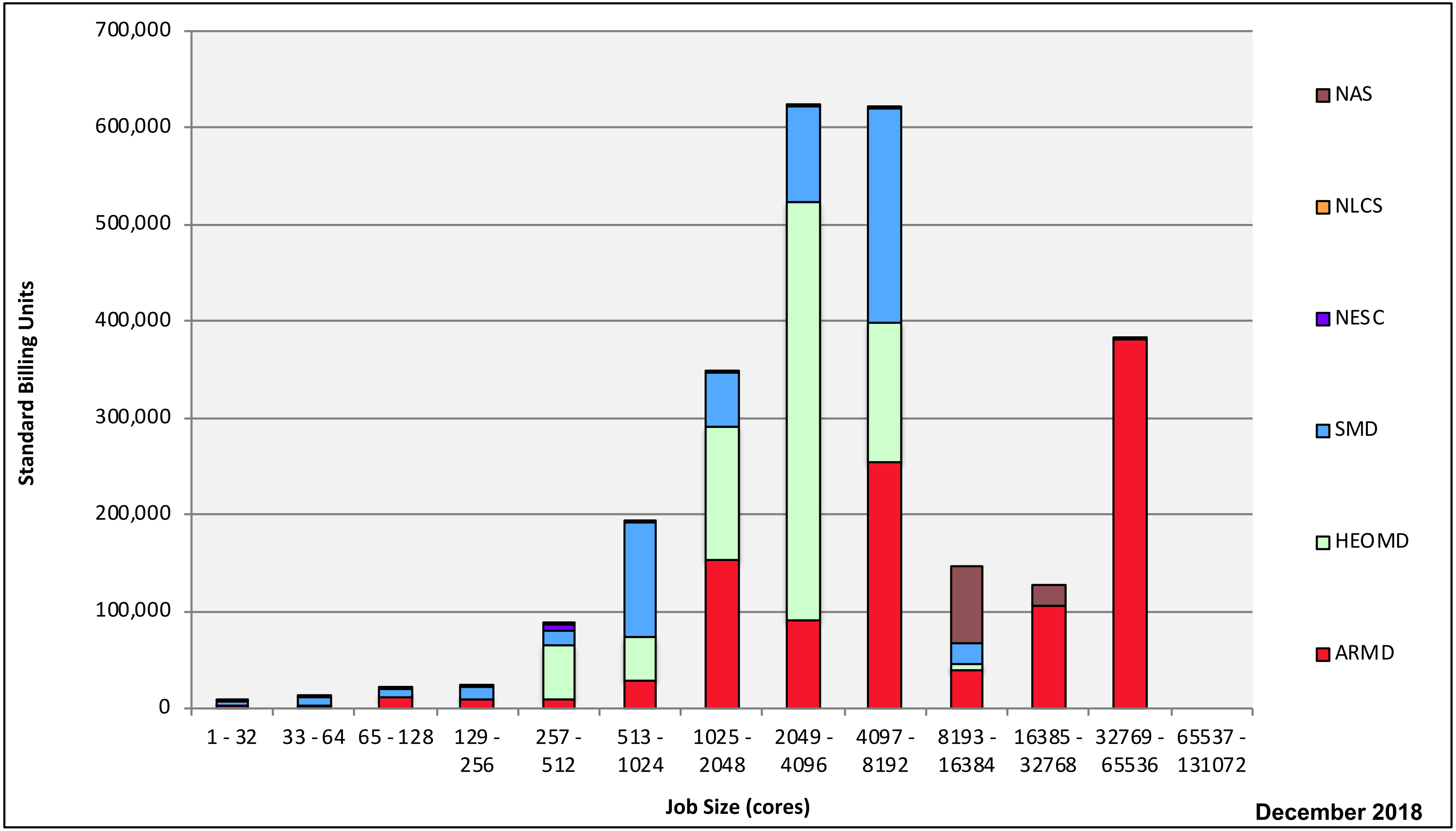
Electra:
Monthly Utilization by Job Length



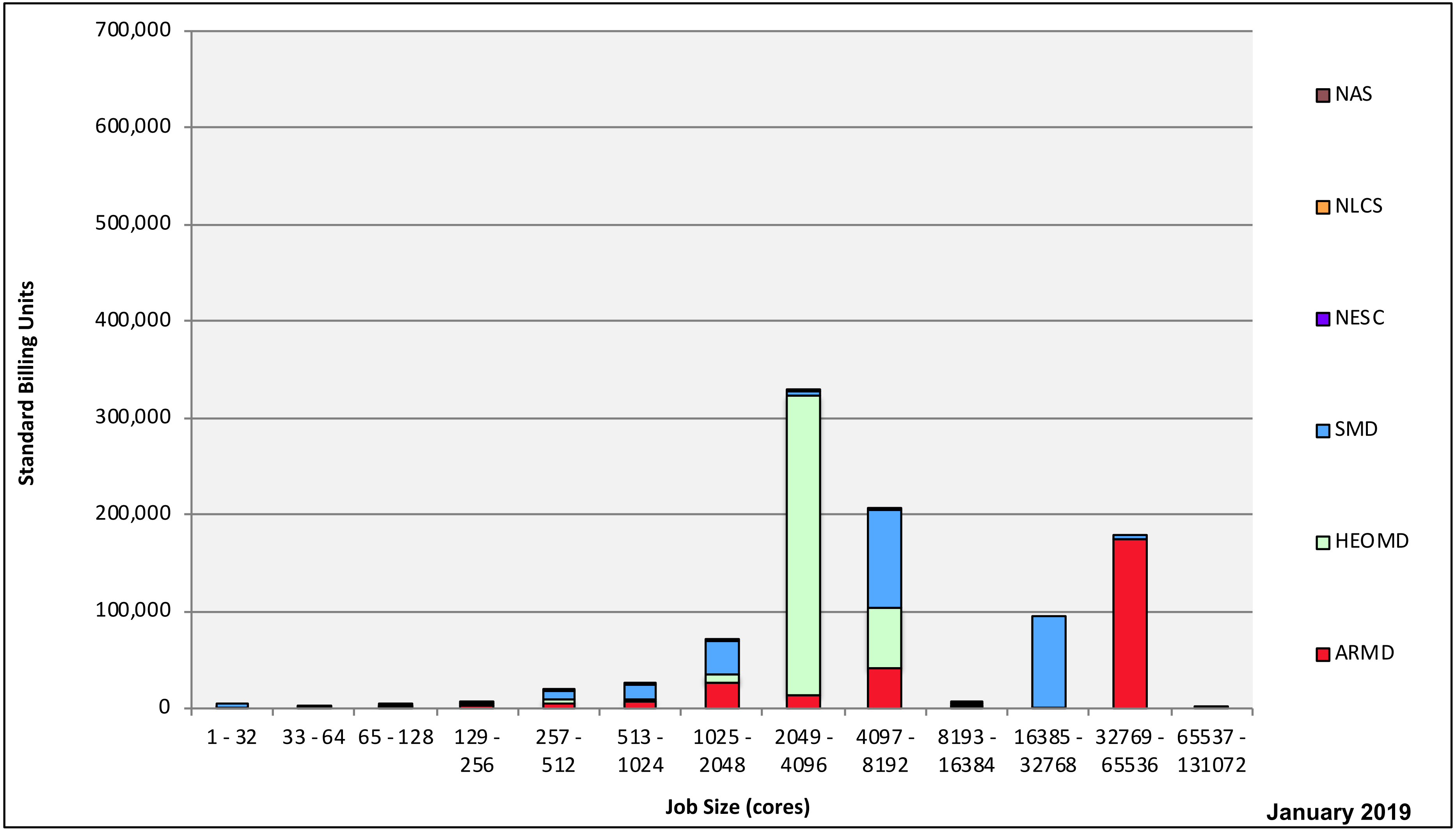
Electra: Monthly Utilization by Job Length



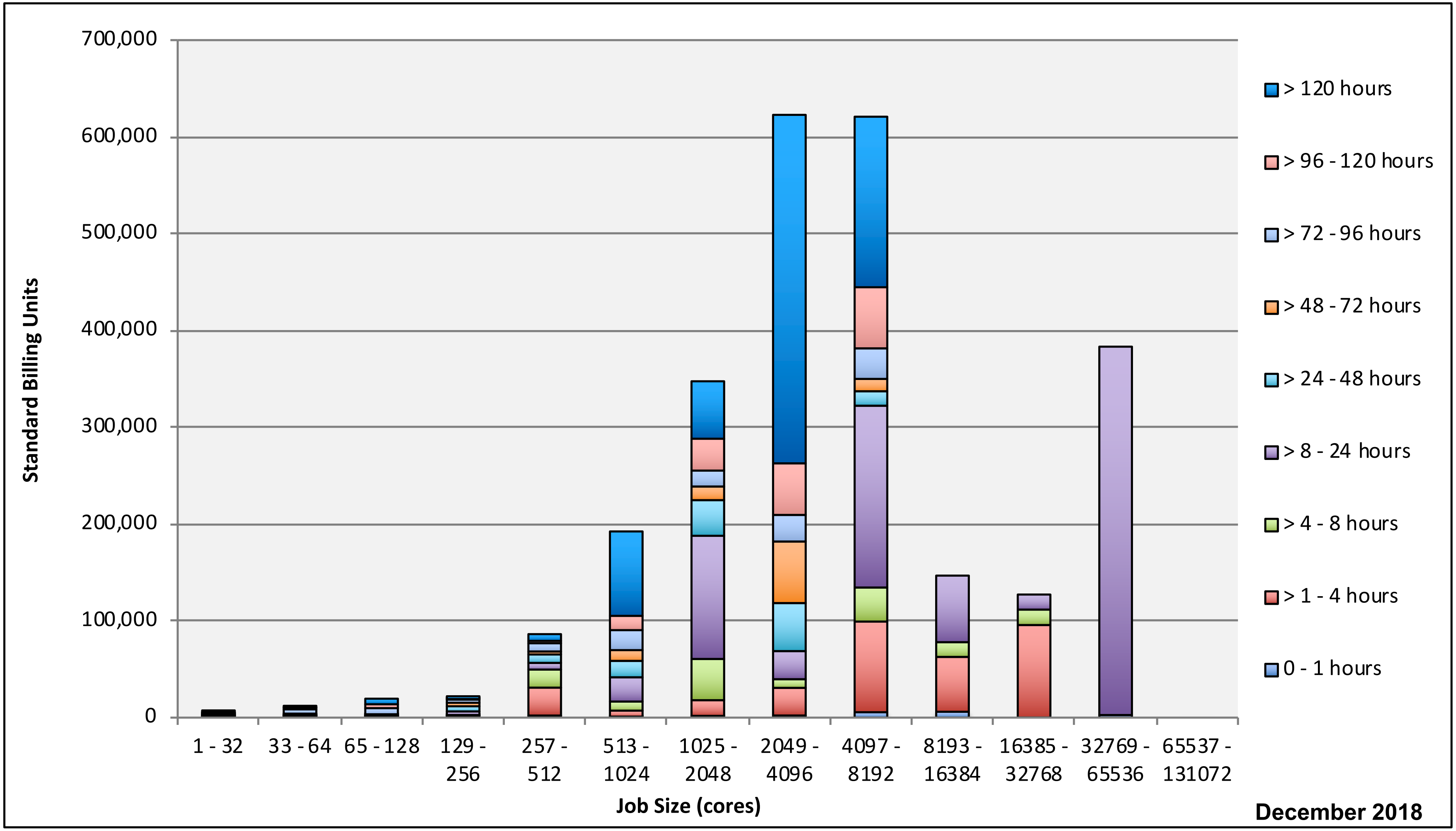
Electra:
Monthly Utilization by Size and Mission



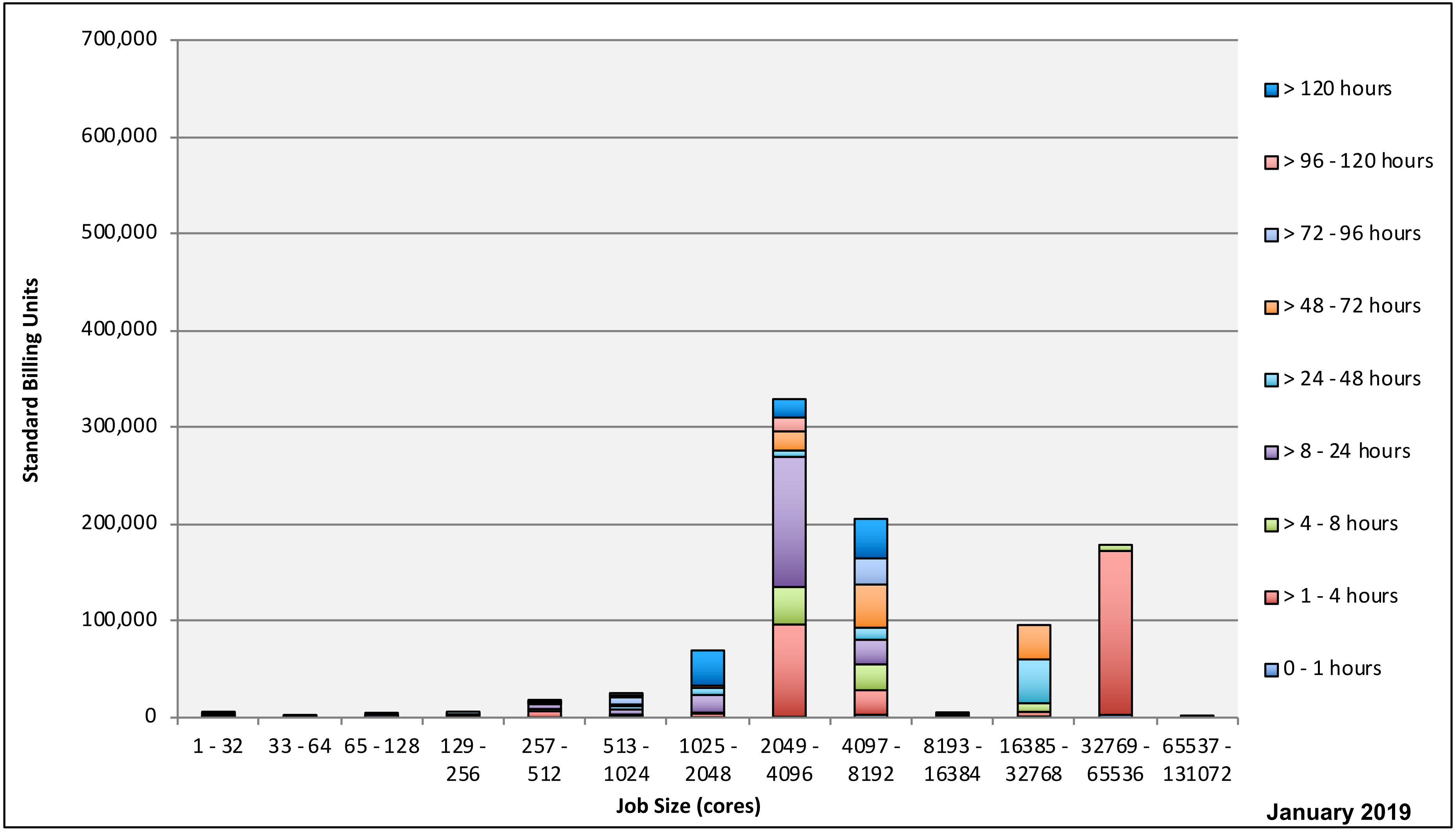
Electra: Monthly Utilization by Size and Mission



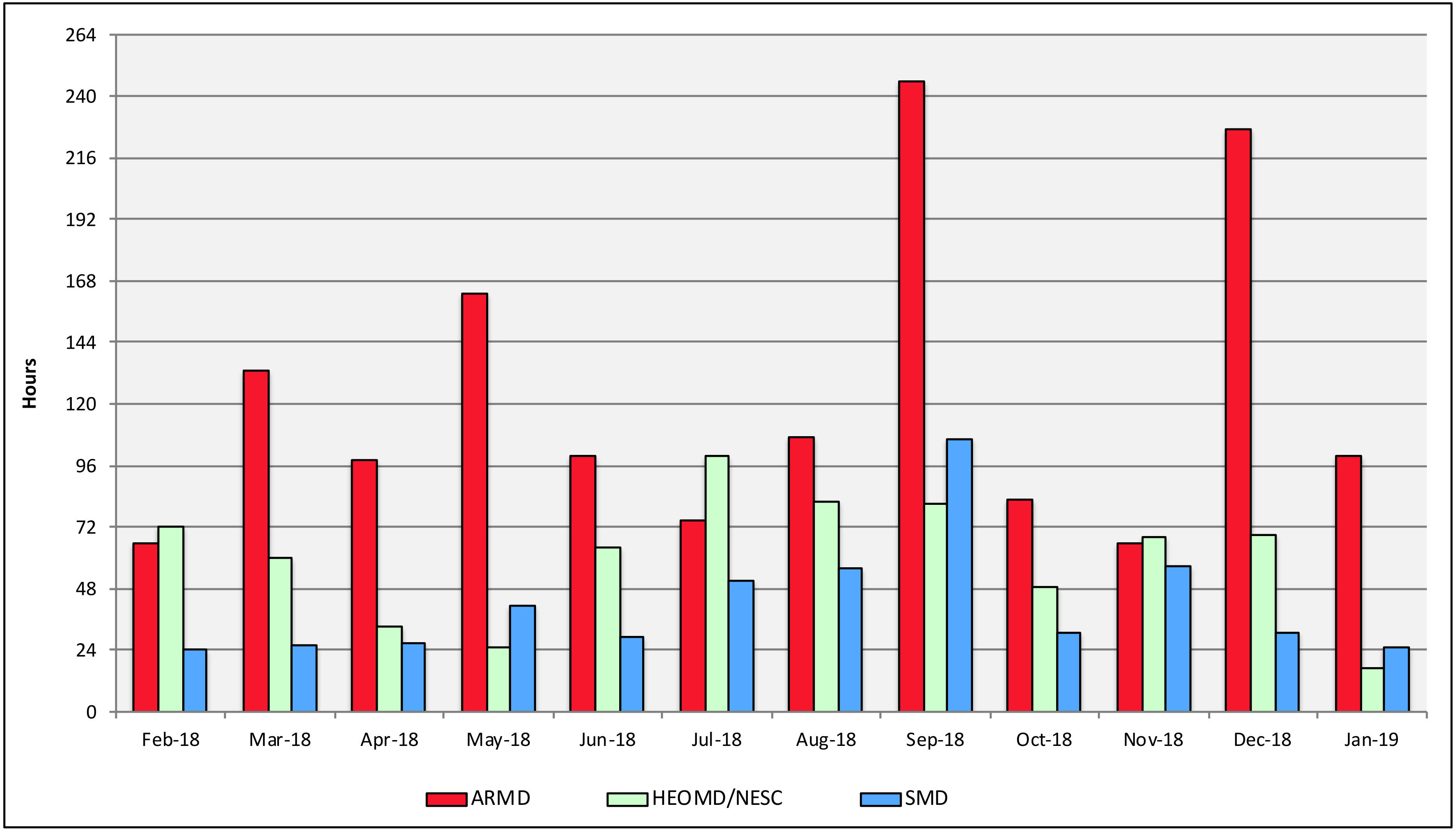
Electra: Monthly Utilization by Size and Length



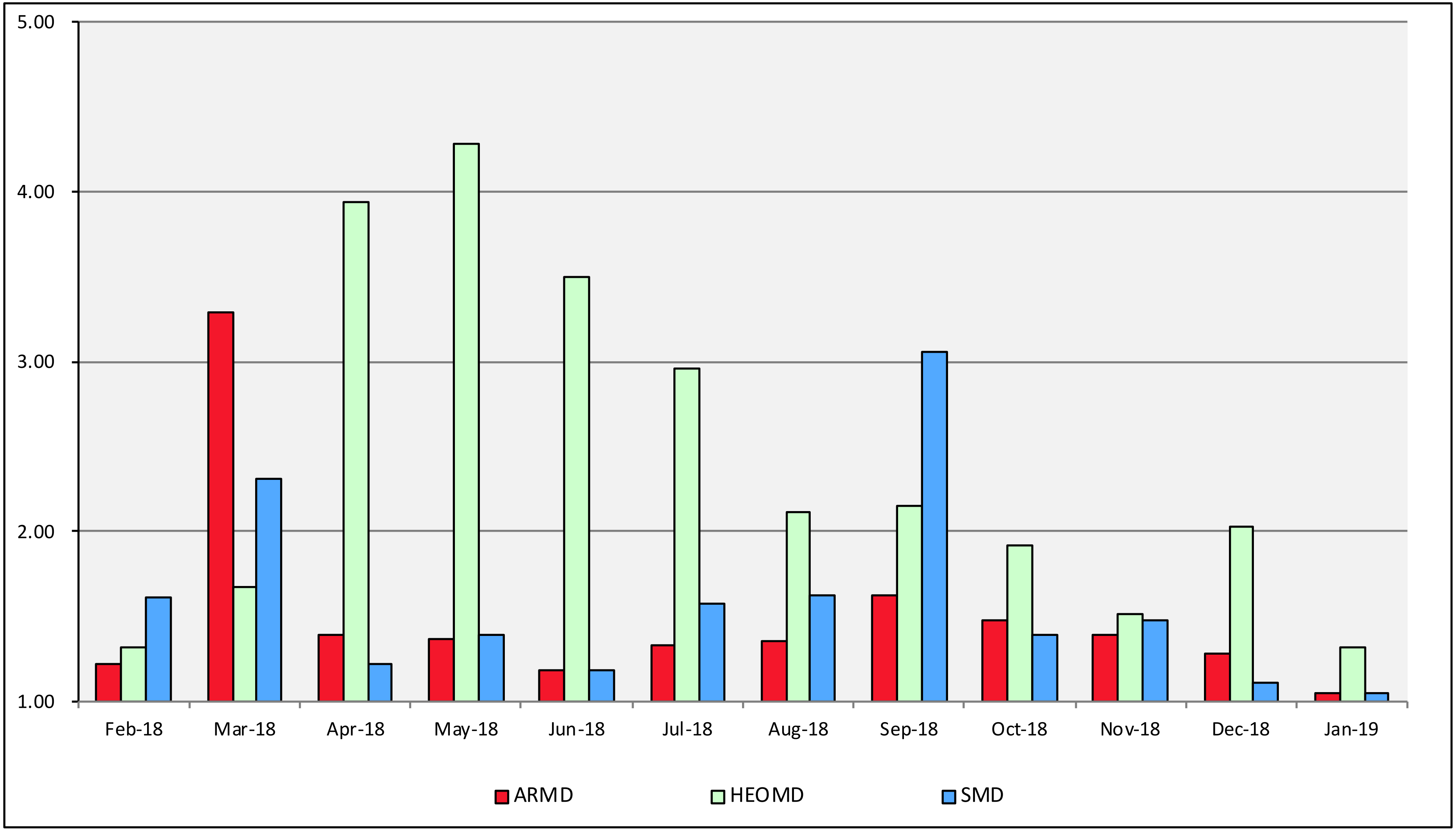
Electra: Monthly Utilization by Size and Length



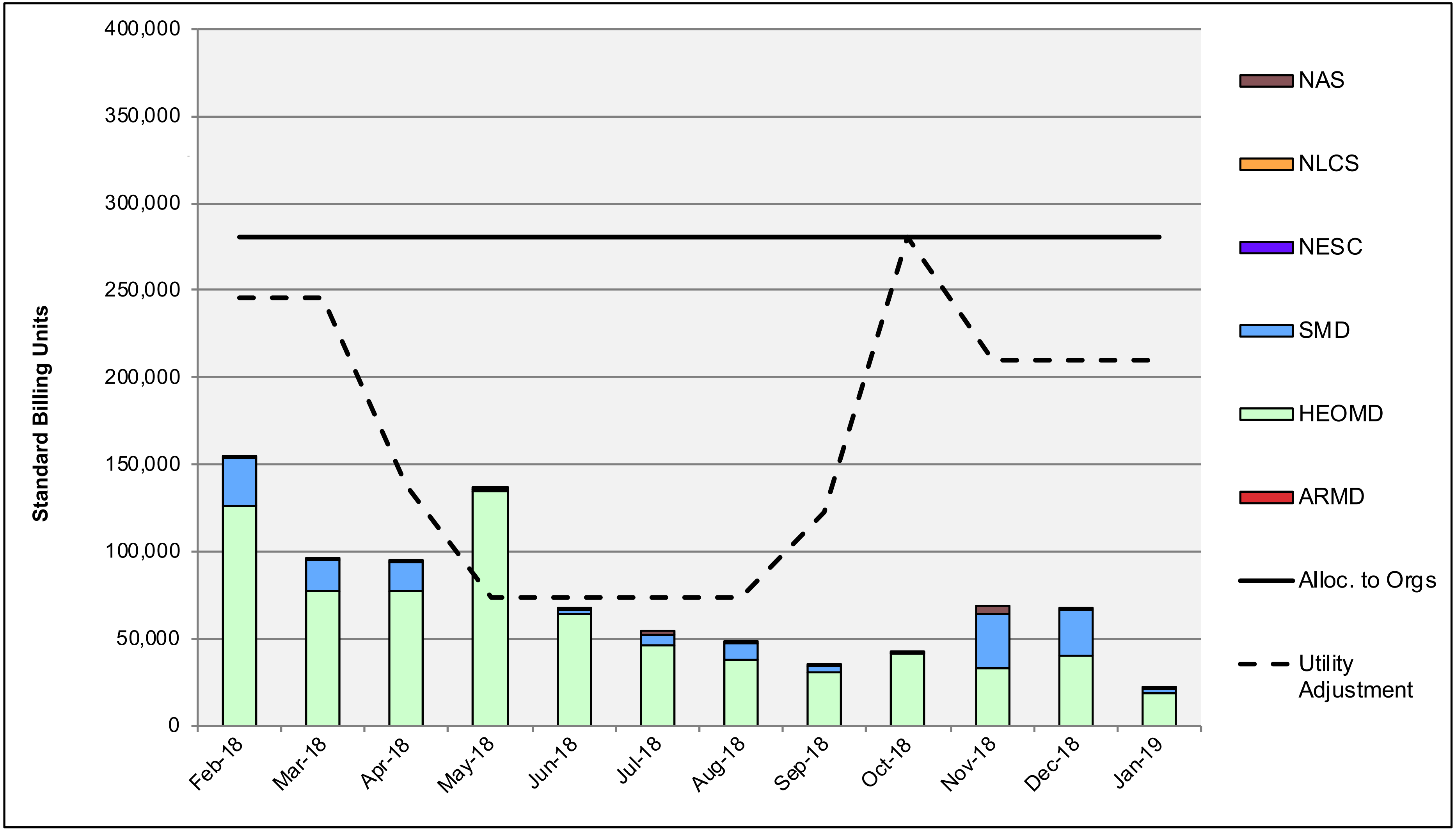
Electra: Average Time to Clear All Jobs



Electra:
Average Expansion Factor

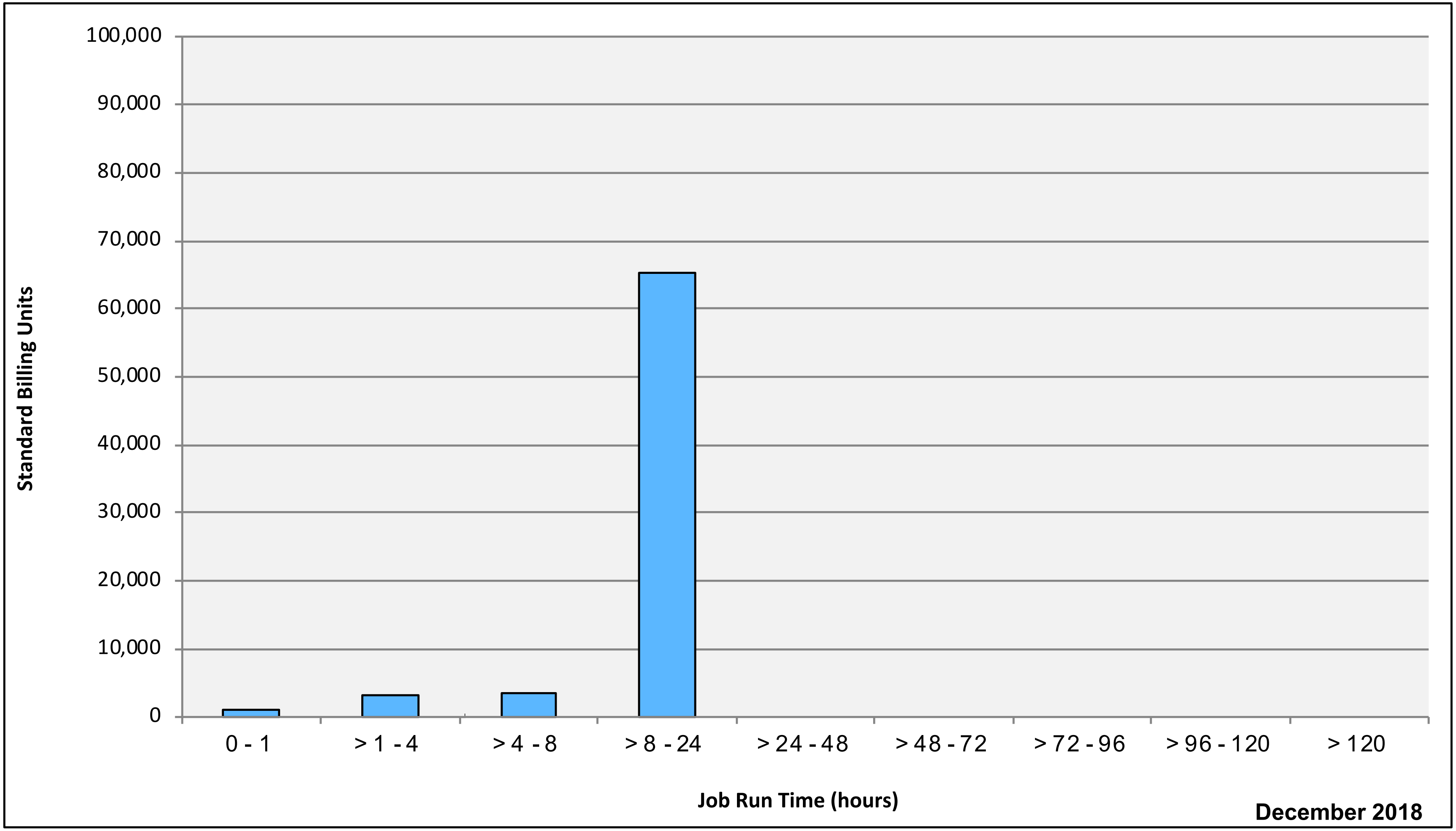


Merope:
SBUs Reported, Normalized to 30-Day Month

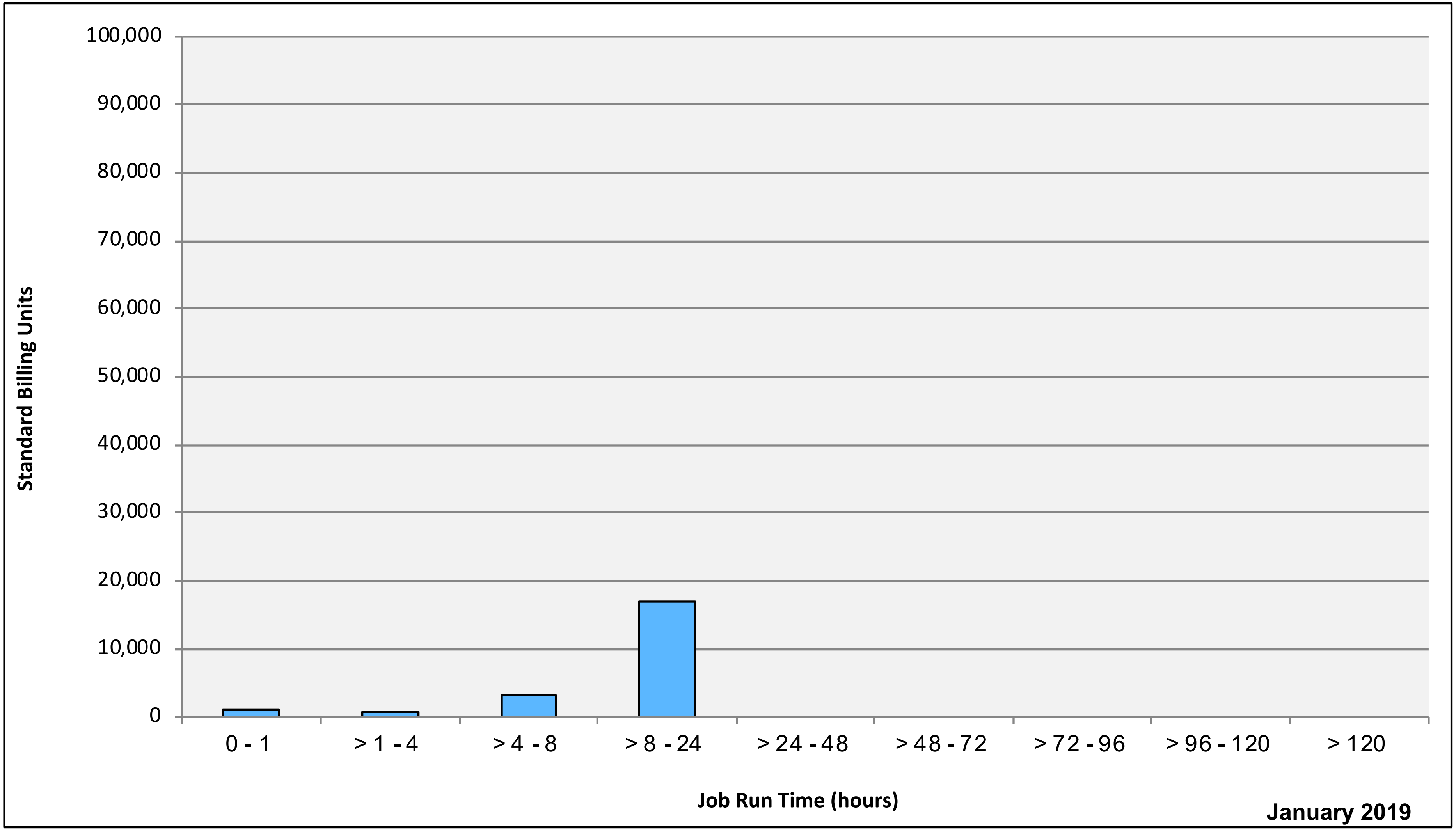


*Utility Adjustment: Multiple failures of chillers in N233A necessitated turning off a large portion of Merope

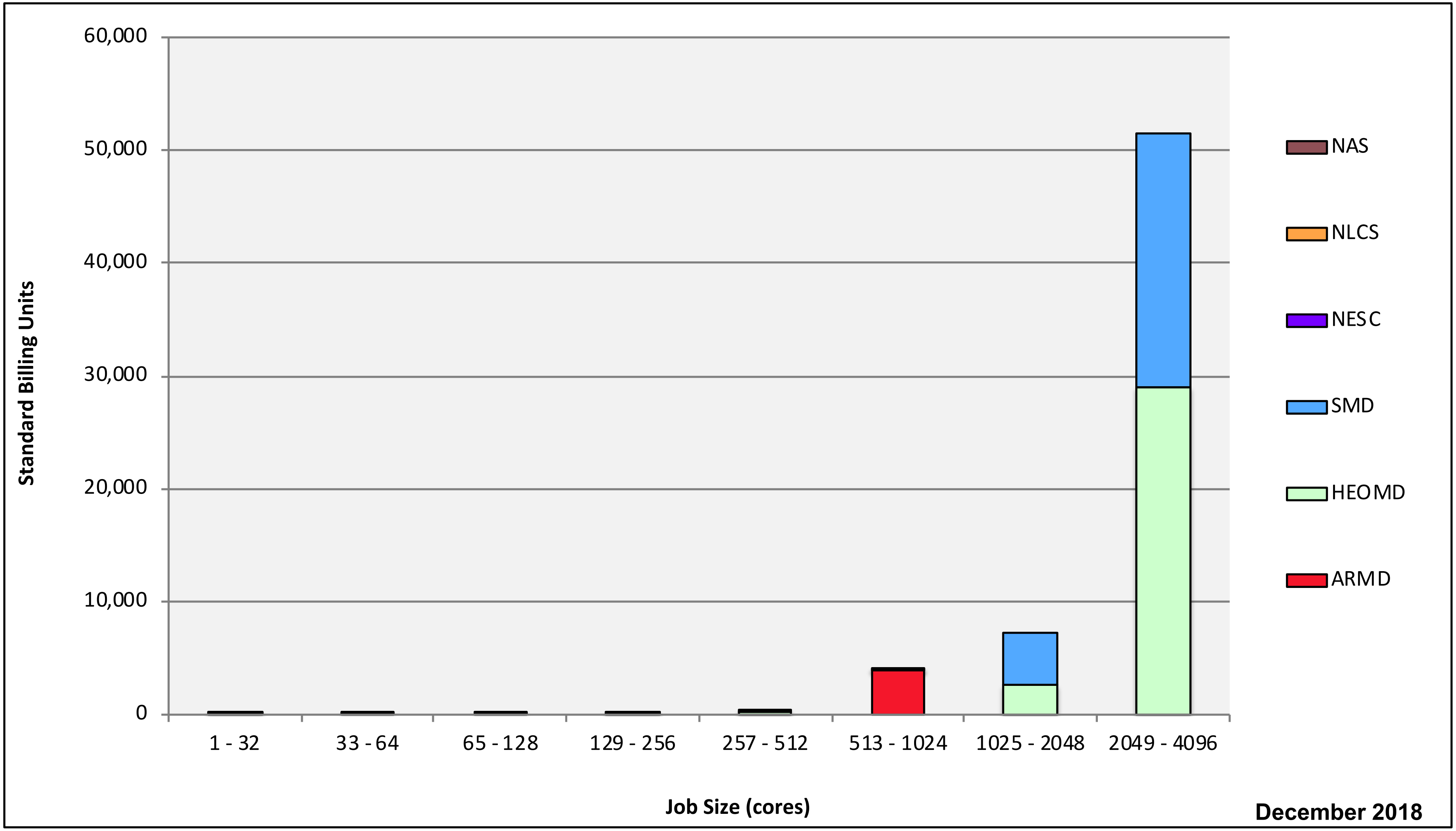
Merope: Monthly Utilization by Job Length



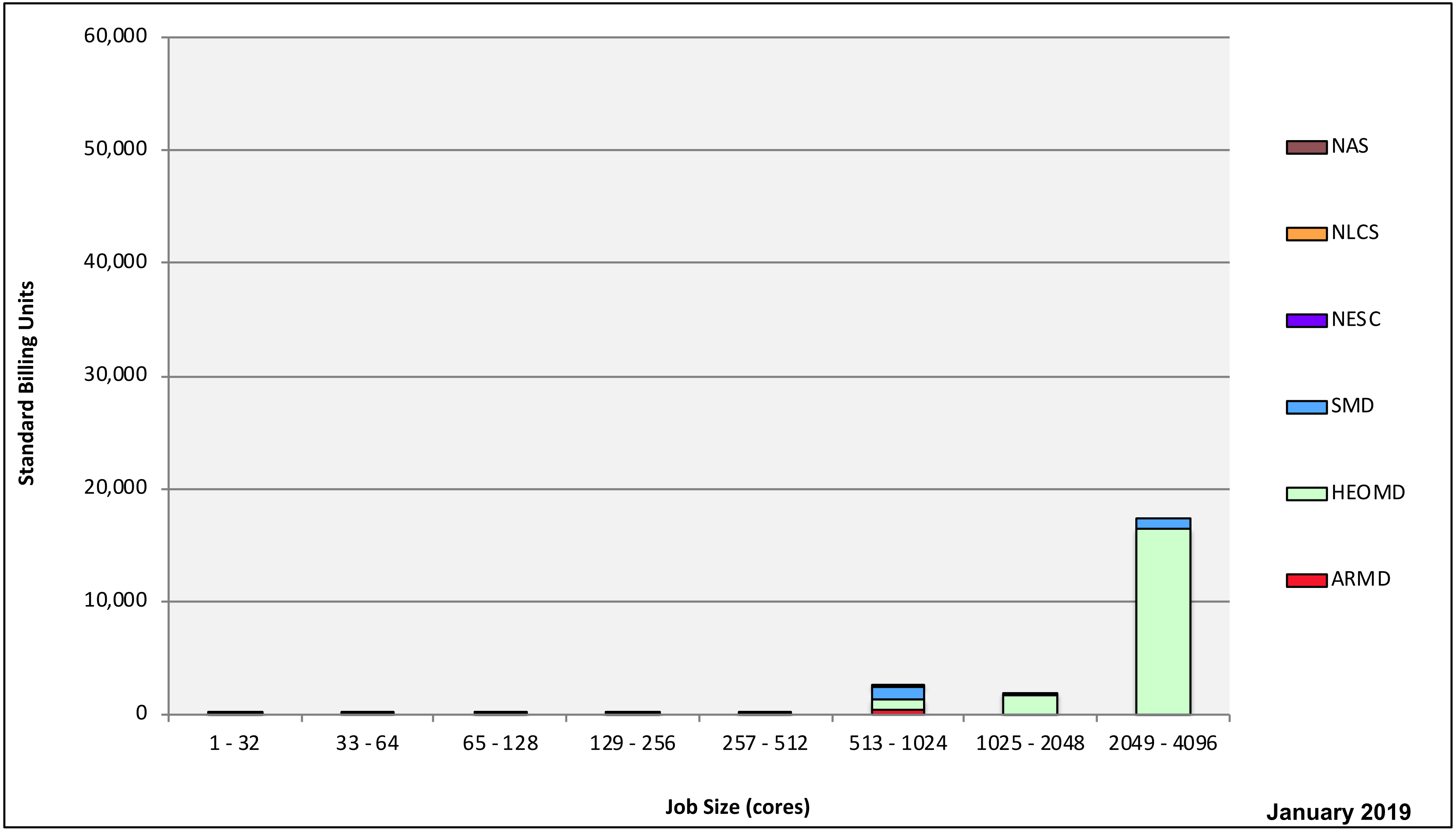
Merope:
Monthly Utilization by Job Length



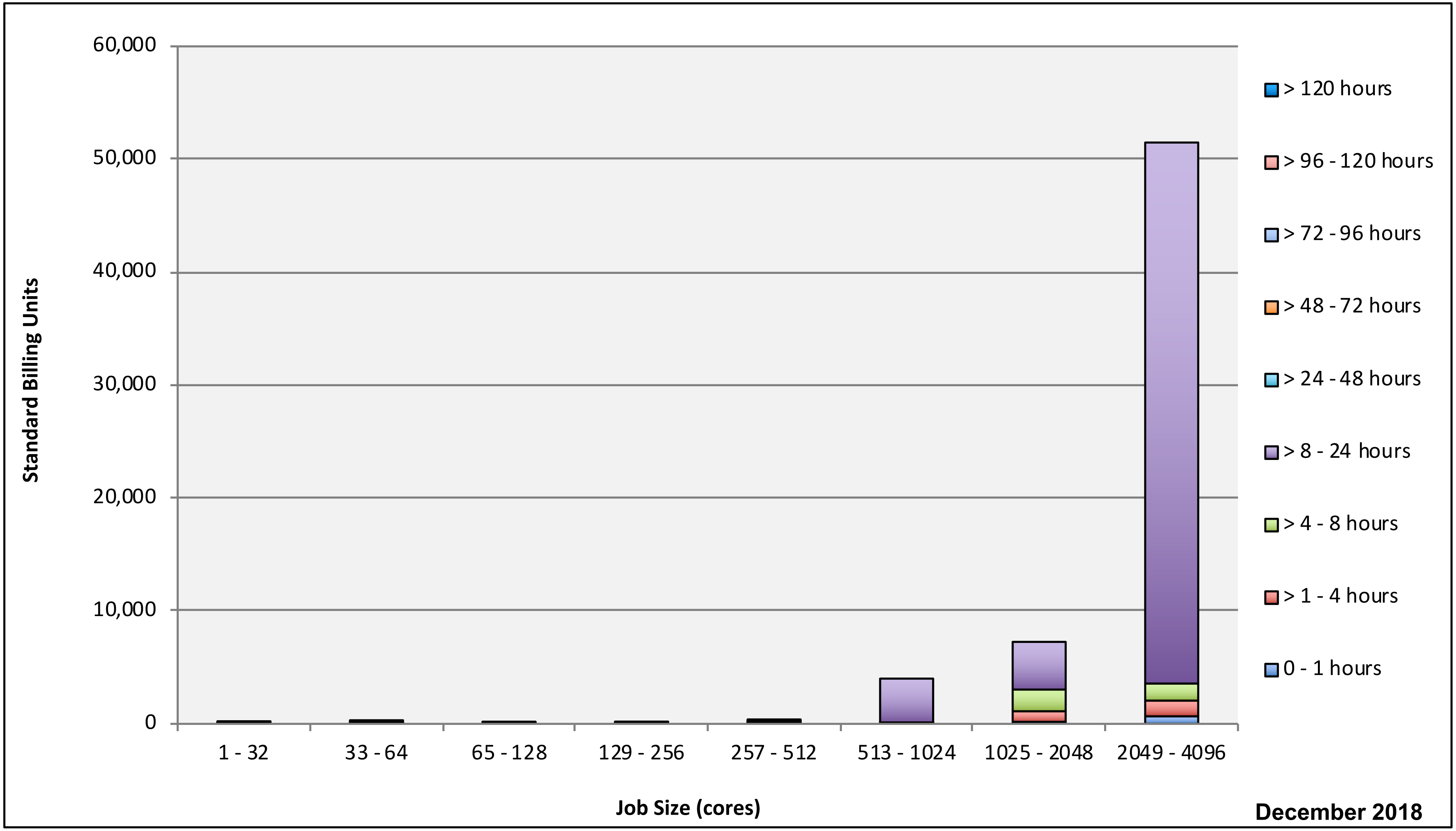
Merope:
Monthly Utilization by Size and Mission



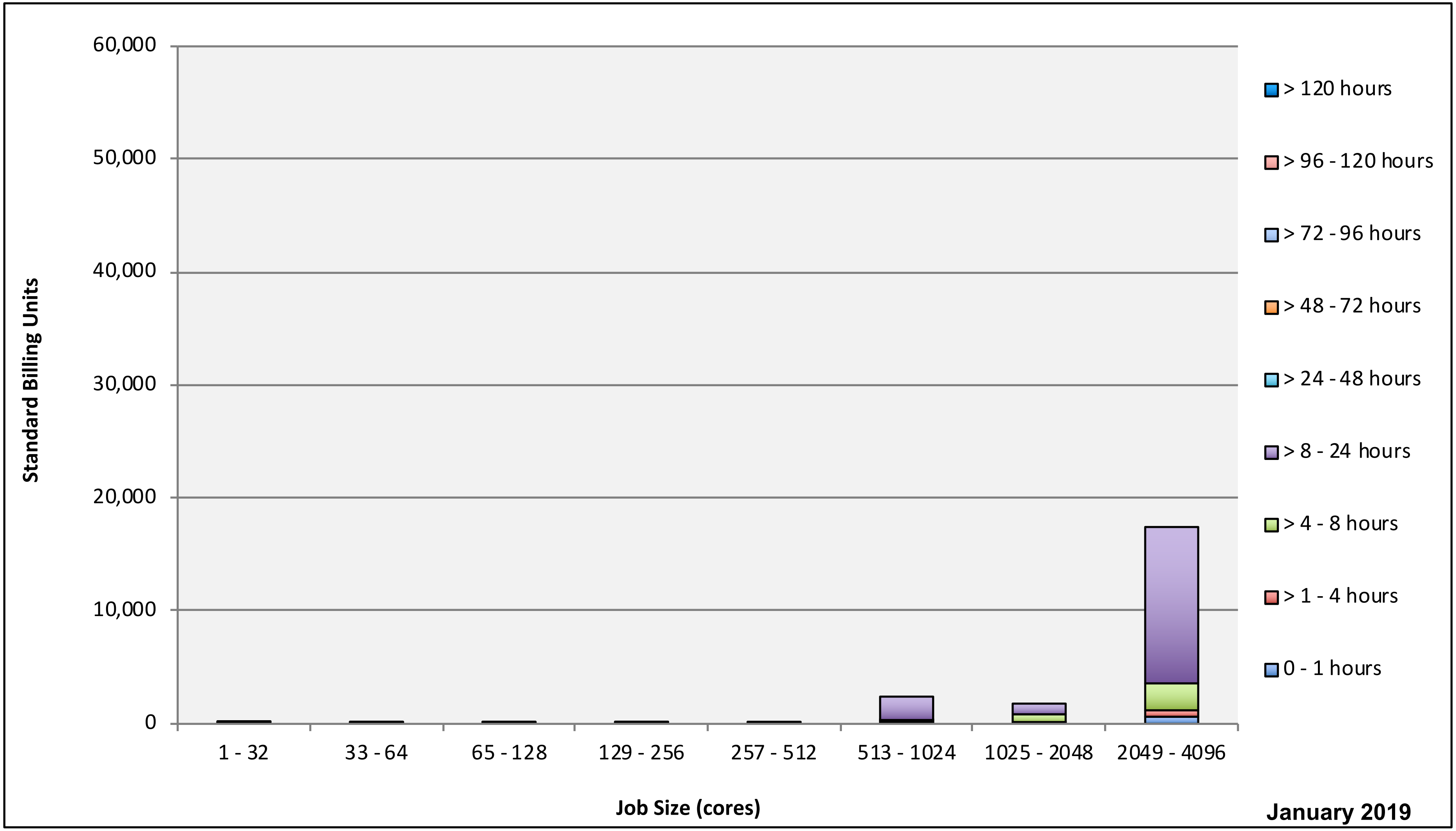
Merope:
Monthly Utilization by Size and Mission



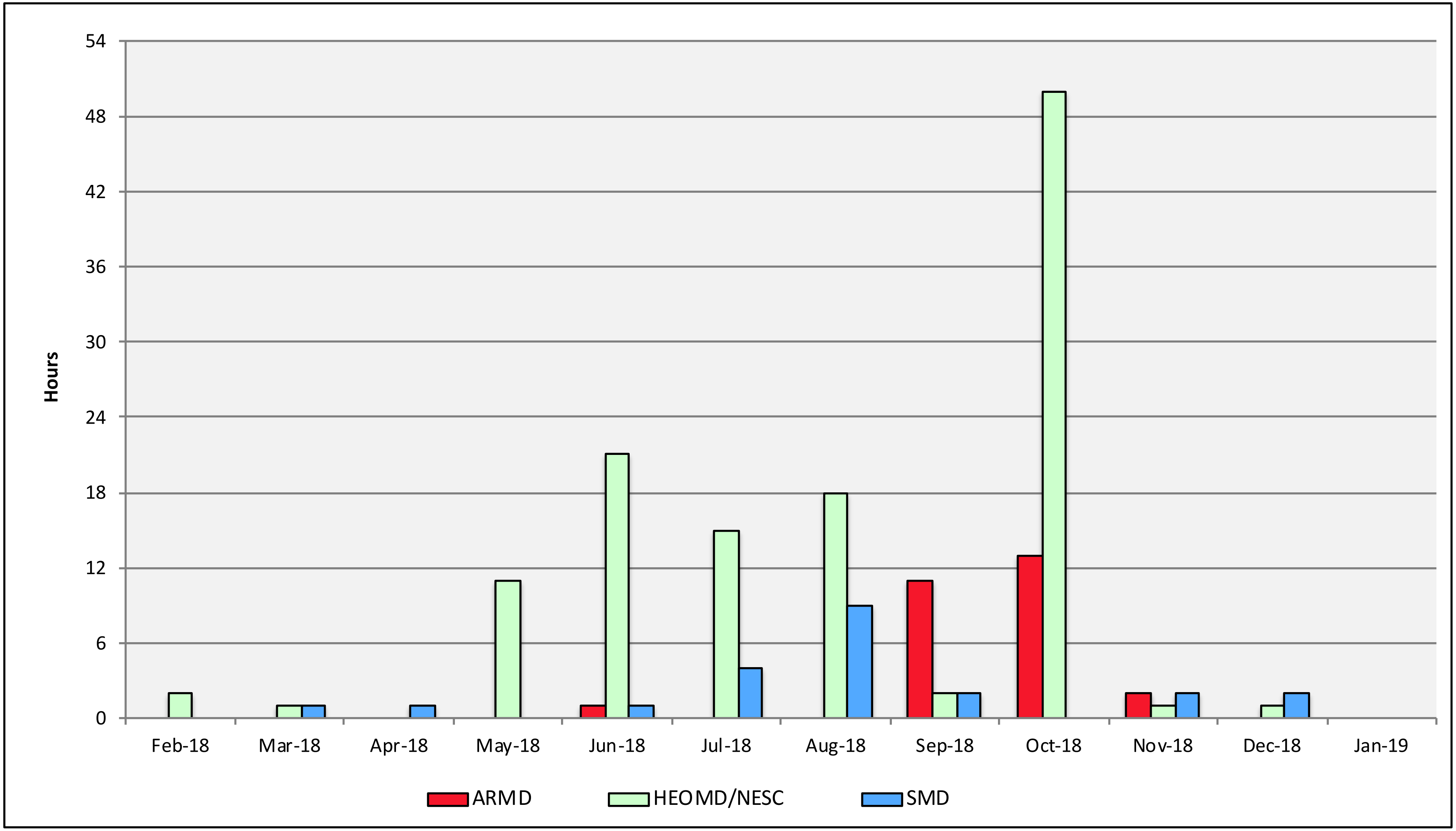
Merope:
Monthly Utilization by Size and Length



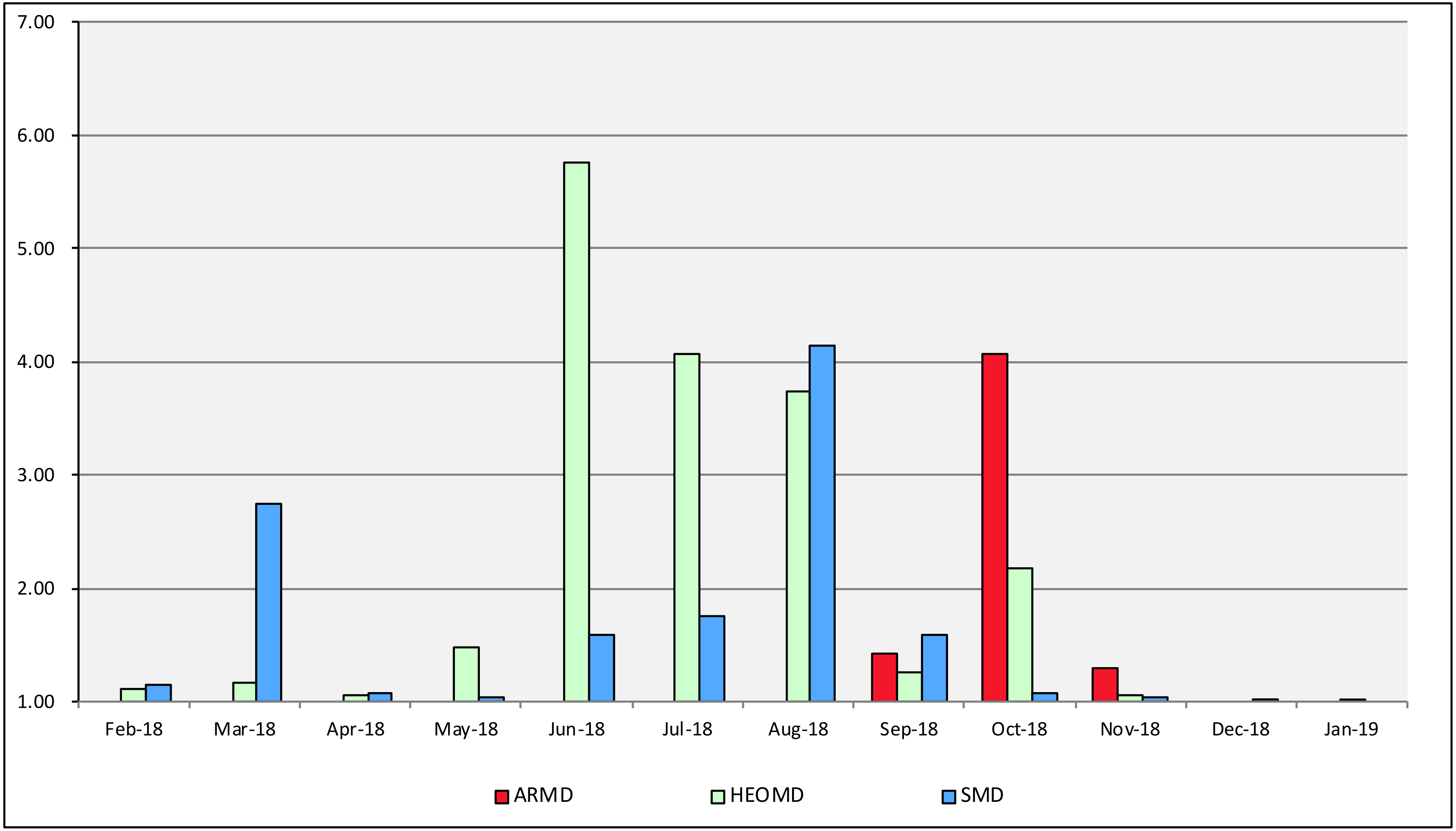
Merope: Monthly Utilization by Size and Length



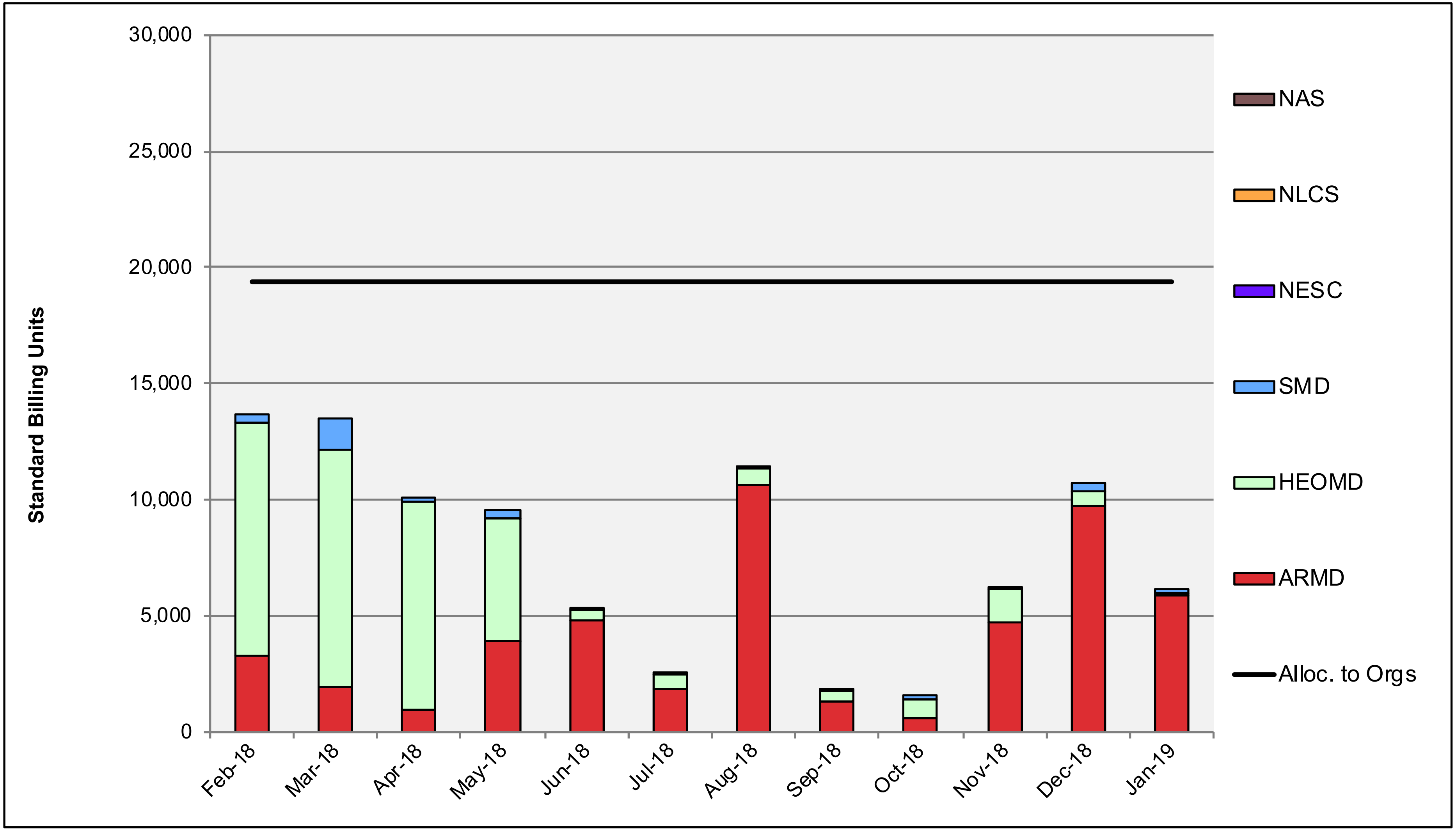
Merope: Average Time to Clear All Jobs



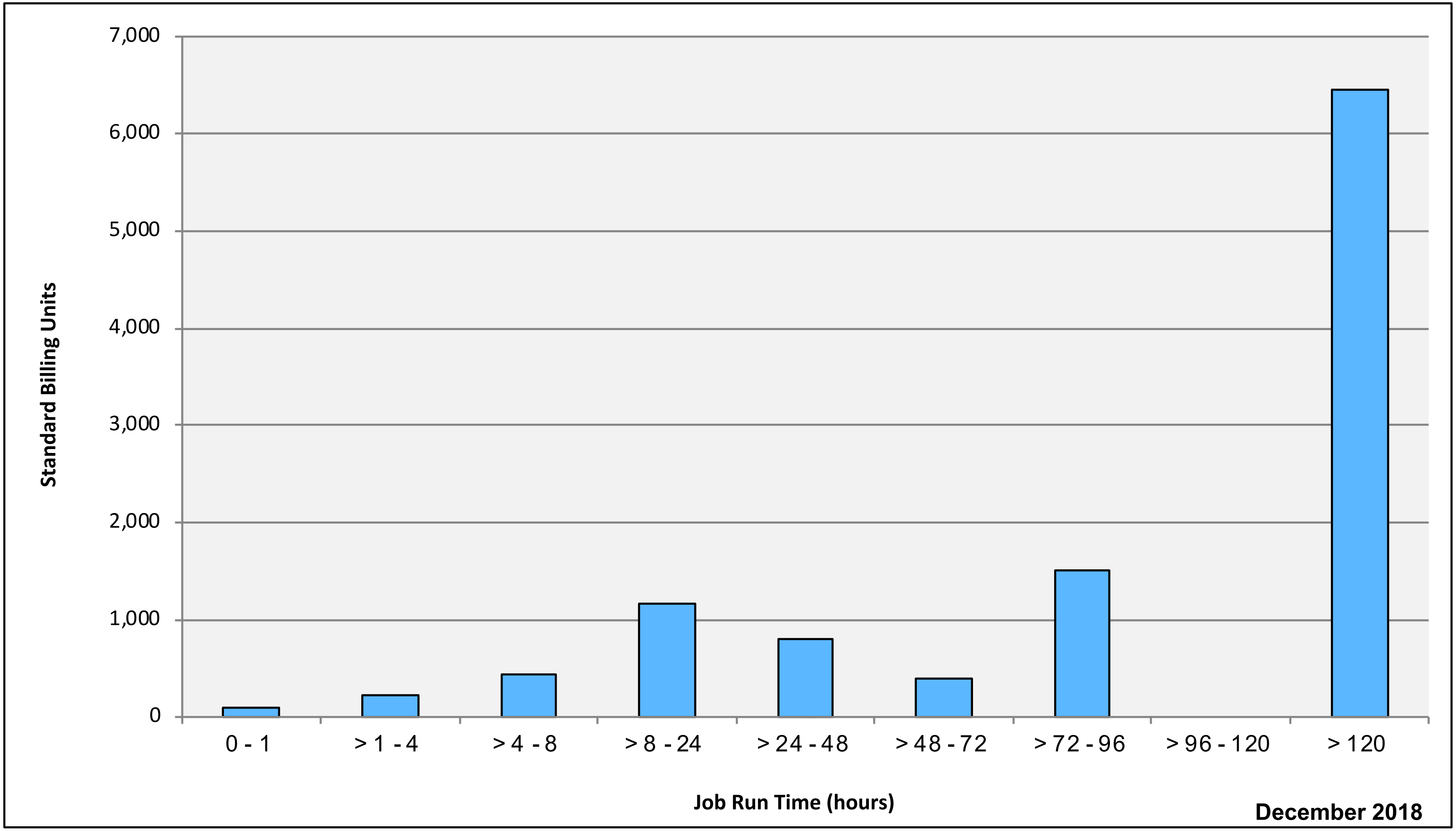
Merope: Average Expansion Factor



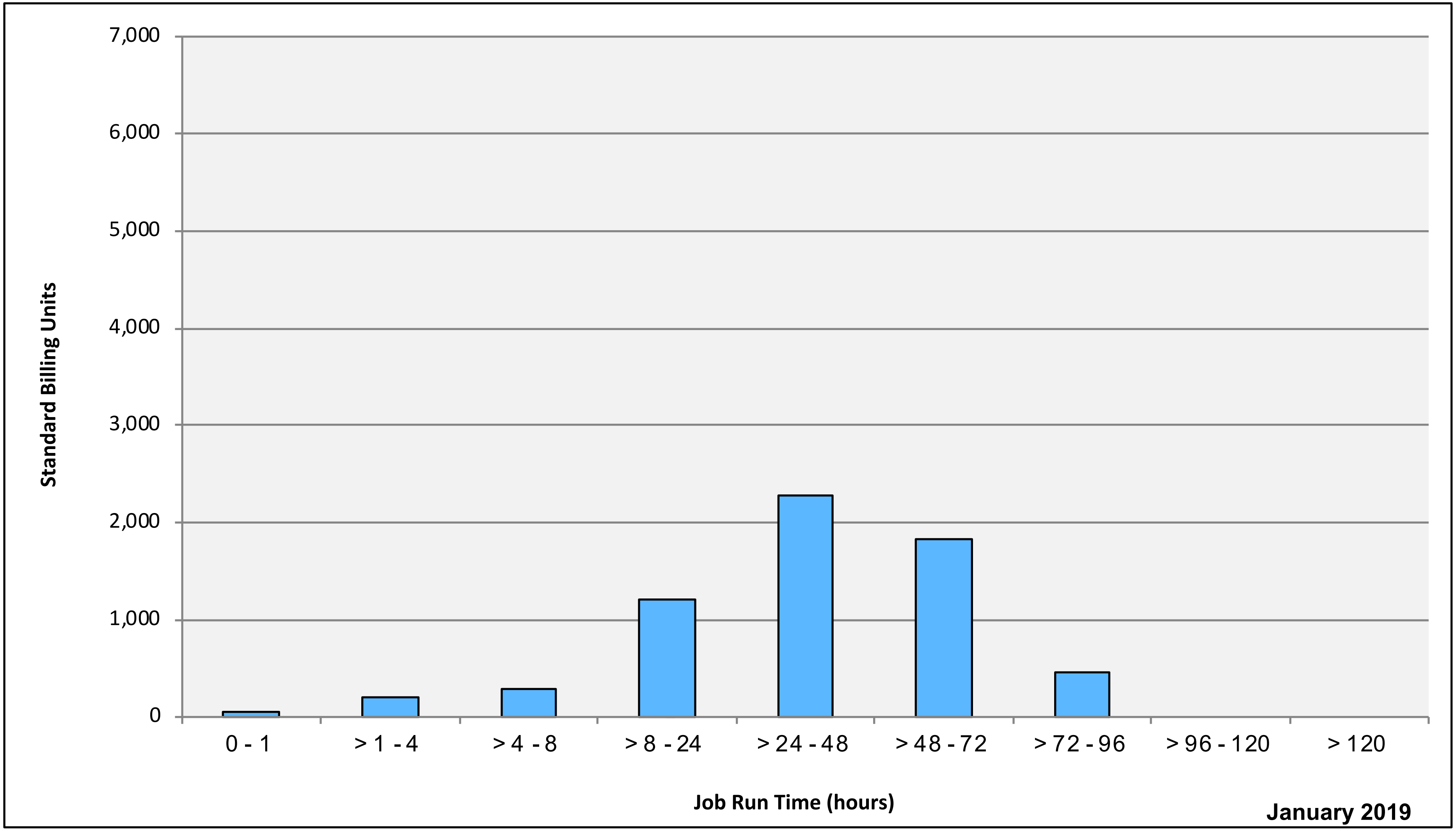
Endeavour:
SBUs Reported, Normalized to 30-Day Month



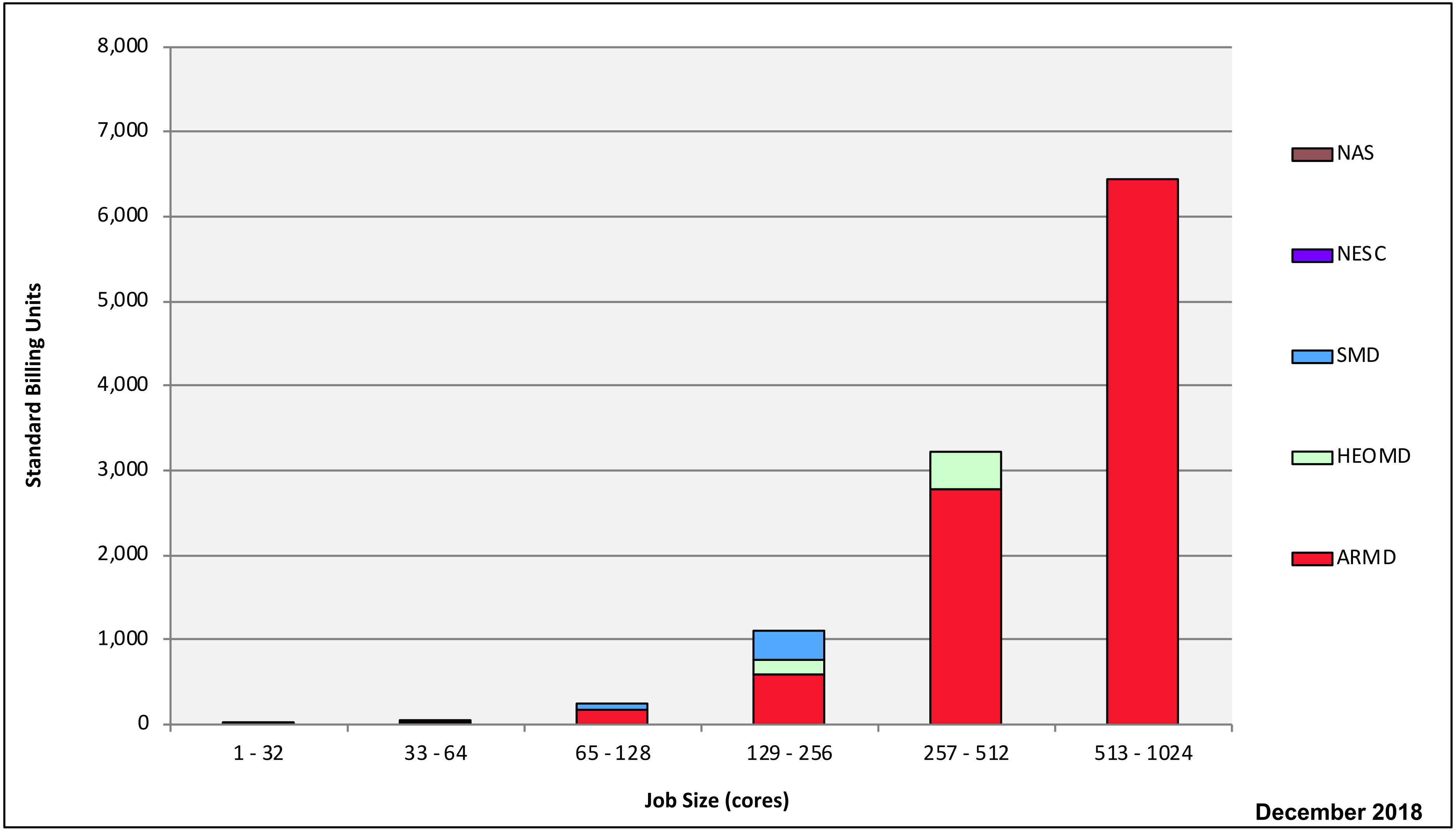
Endeavour: Monthly Utilization by Job Length



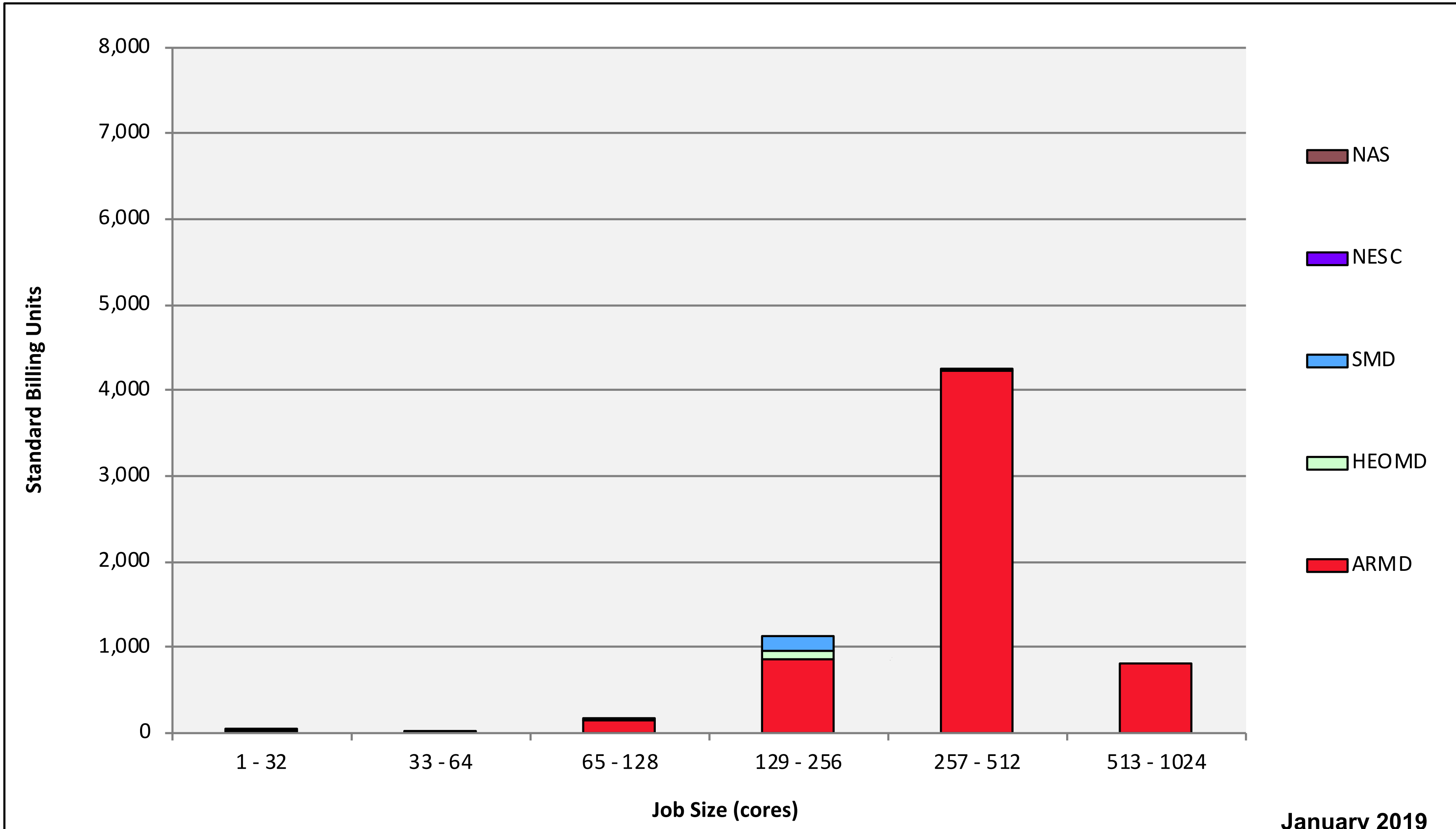
Endeavour: Monthly Utilization by Job Length



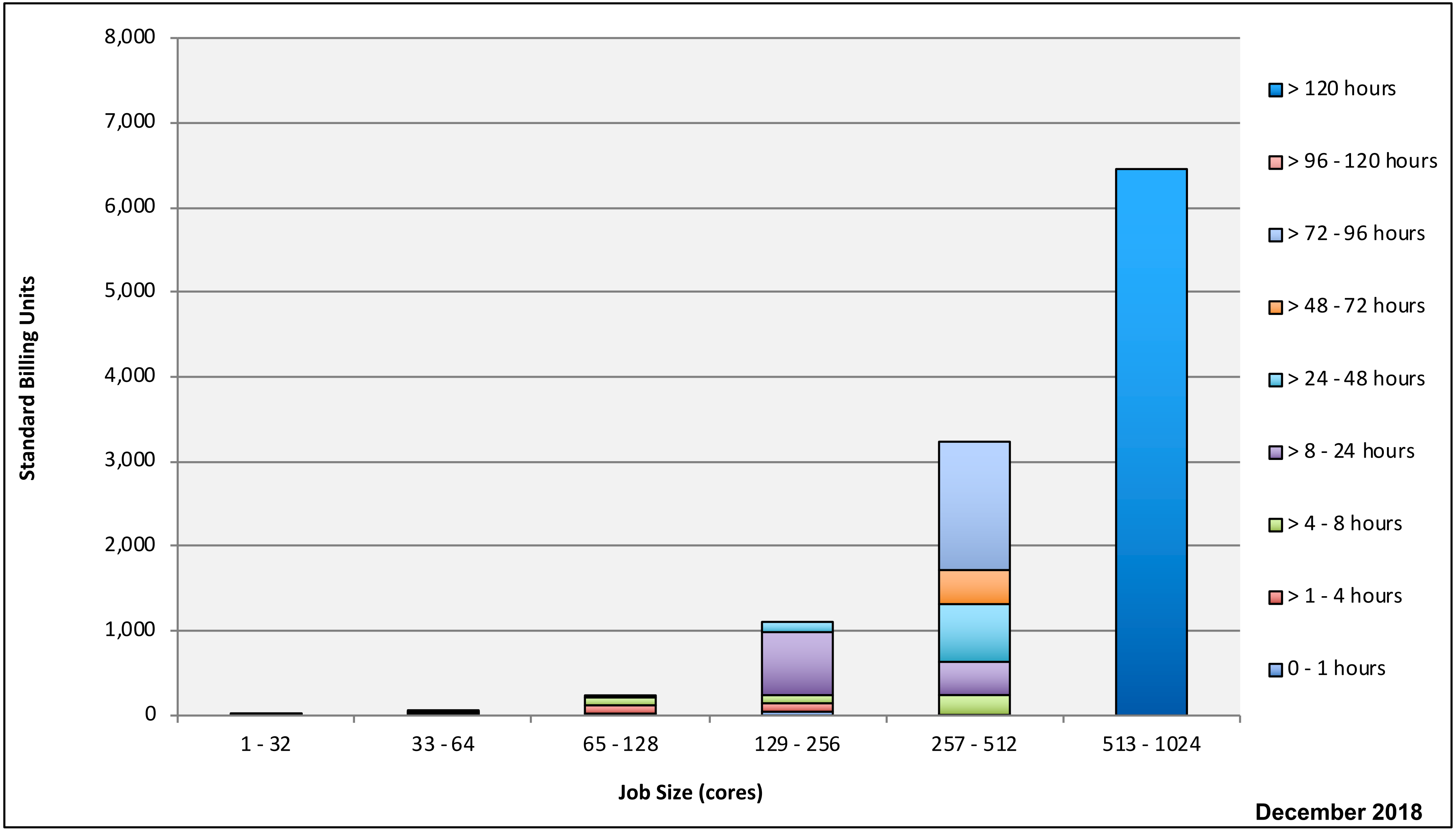
Endeavour:
Monthly Utilization by Size and Mission



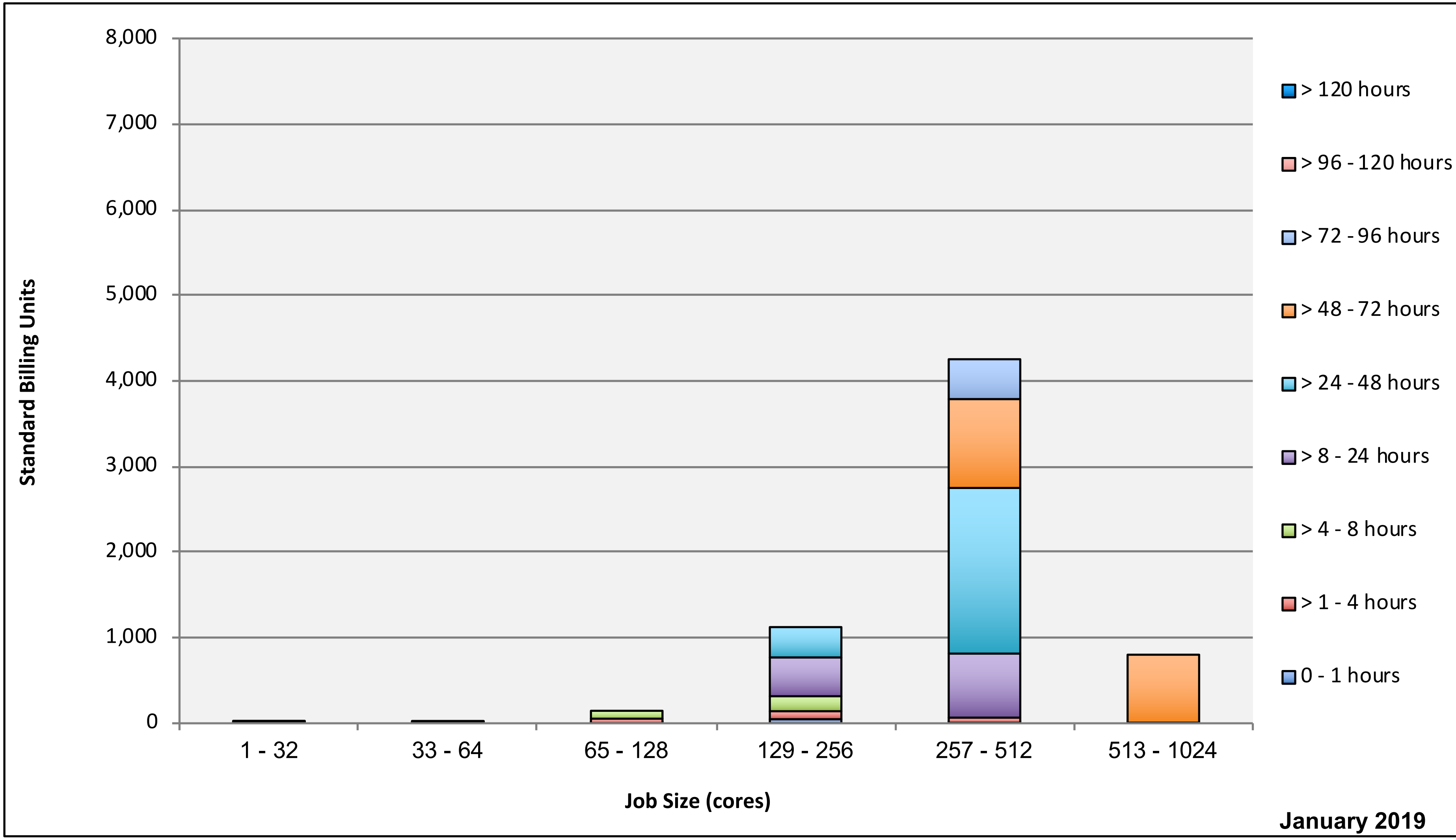
Endeavour:
Monthly Utilization by Size and Mission



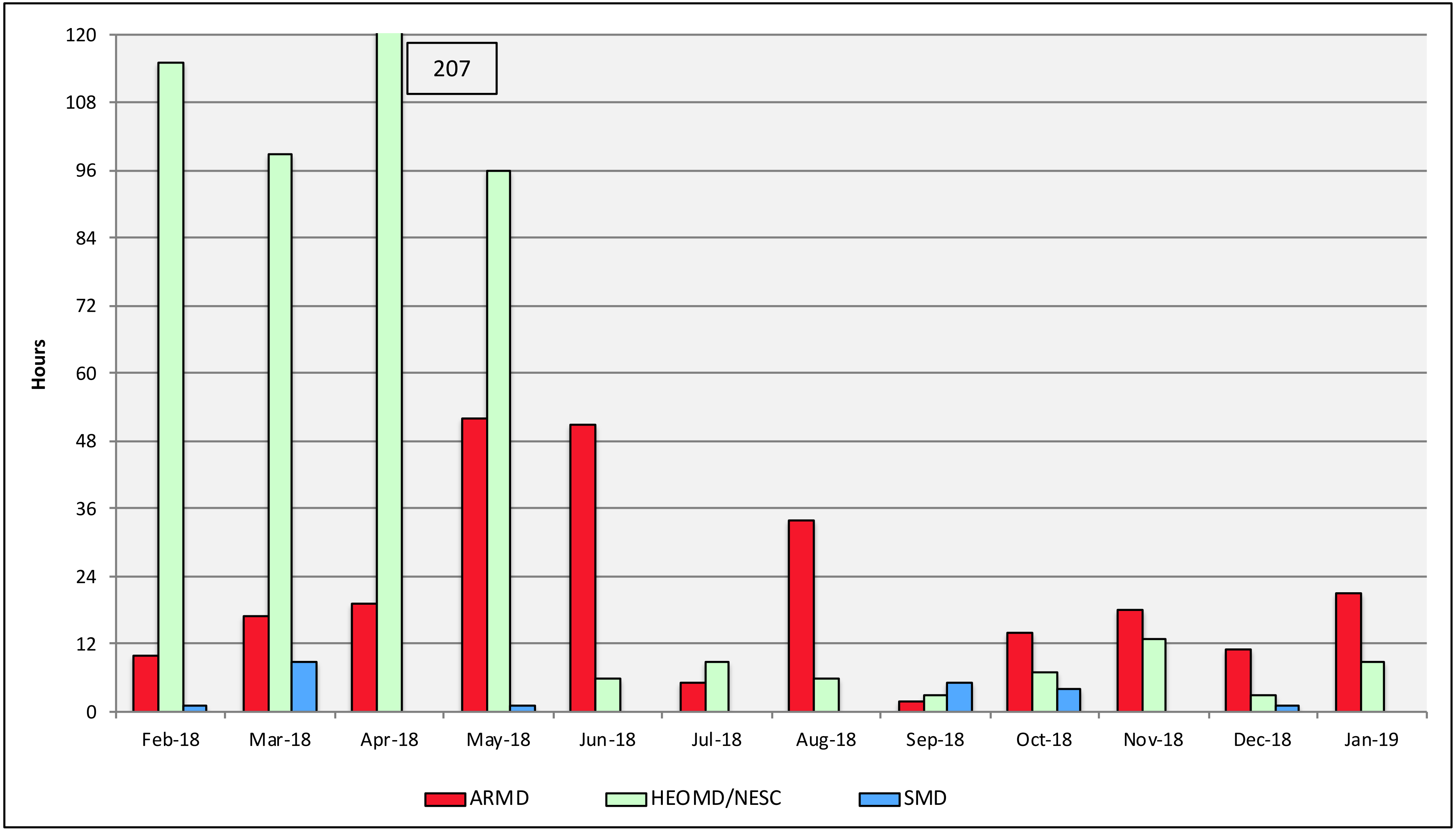
Endeavour: Monthly Utilization by Size and Length



Endeavour: Monthly Utilization by Size and Length



Endeavour:
Average Time to Clear All Jobs



Endeavour: Average Expansion Factor