STATEMENT OF CONSIDERATIONS

REQUEST BY ARM, INC. FOR AN ADVANCED WAIVER OF DOMESTIC AND FOREIGN PATENT RIGHTS TO INVENTIONS AND COPYRIGHTS MADE AS A SECOND-TIER SUBCONTRACTOR IN RELATION TO:

THE PATHFORWARD PROGRAM OF THE EXASCALE COMPUTING PROJECT

THE ABOVE-REFERENCED SYSTEM BEING DEVELOPED UNDER DOE CONTRACT NO. DE-AC52-07NA27344 AND LLNL SUBCONTRACT B620872. DOE WAIVER NO.: W(A) 2017-005.

ARM, Inc.[1] seeks an Advanced Waiver of Domestic and Foreign Patent Rights to inventions and Copyrights that may be produced under their second-tier contract relating to work that is to be initiated in accordance with the PATHFORWARD program of the Department of Energy's (DOE) *Exascale Computing Program* under Prime Contract No. DE-AC52-07NA27344 between Lawrence Livermore National Security, LLC (LLNS) and the United States Government, and subcontract No. B620872 issued under the PATHFORWARD program between Lawrence Livermore National Laboratory (LLNL) and Cray, Inc.

The provisions of Class Advance Waivers typically do not automatically apply to any foreign owned or controlled subcontractors at any contracting tier. In this instance since ARM, Inc. is owned by a foreign entity (ARM Ltd.), the provisions that are applicable to the waiver of domestic and foreign intellectual property rights as assigned to Cray, Inc. (Cray) under the PATHFORWARD program Class Advanced Waiver W(C) 2016-003 do not apply to ARM, Inc. as a foreign owned subcontractor to Cray. Therefore, in order to be considered covered under the intellectual property waiver provisions similar to those assigned to Cray under W(C) 2016-003 a designation must be made by DOE that ARM, Inc. is qualified to be covered under this Advance Rights Waiver request.

The PATHFORWARD phase of the DOE Exascale Computing Program is the DOE/Office of Science (SC)/National Nuclear Security Administration (NNSA) designated follow-up program to the FASTFORWARD and DESIGNFORWARD programs that will be ending in 2017. Focusing on hardware technological innovation, the PATHFORWARD program seeks to develop solutions that will lead to improvements in developer productivity and application performance. In particular, the scope of Cray's contract under PATHFORWARD is the advanced research of exascale node design. ARM, Inc.'s (ARM) contractual duties to Cray relate to research/work in the areas of instruction set architecture and system architecture of exascale nodes.

ARM is a major U.S. employer with over 1,100 employees located in the states of California and Texas. Much of the anticipated work to be performed under the PathForward subcontract to Cray is to be performed by ARM's U.S. personnel. The source of funding for the PATHFORWARD program are the DOE SC Advanced Scientific Computing Research (ASCR) program and the NNSA's Advanced Simulation and Computing (ASC) program via LLNS.

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[1] ARM, Inc. is a Delaware, United States incorporated subsidiary of United Kingdom based ARM Ltd. which is owned by Japanese telecommunications and Internet corporation Softbank Group Corp.

TECHNOLOGICAL BACKGROUND QUALIFICATIONS OF ARM, INC.

ARM is a market leader in semiconductor design; however ARM does not manufacture semiconductor components. Alternately, ARM's business model by design and strategy comprises the global non-exclusive licensing of its intellectual property semiconductor component designs.

ARM's fields of technology span from traditional microprocessor cores to graphics, video, on-chip interconnects, memory controllers, and system intellectual property. ARM designed energy-efficient and scalable processors are employed within a multitude of technological systems including, but not limited to, smartphones and wearable devices, enterprise infrastructure, servers and High-Performance Computing (HPC) systems, and embedded technologies for automotive and industrial applications. As reported to our office, ARM technology is licensed by over 350 partners who have presently shipped in excess of 60 billion microchips containing ARM processors since the founding of the company in 1990.

As stated above, ARM does not sell CPUs directly but instead licenses its technology and designs to technology companies industry-wide. These companies implement ARM architectures that provide the underpinning for software that is portable across a range of systems. ARM architectures not only specify the instructions that can be executed but also provide foundations such as memory types, ordering guarantees, memory translation, virtualization, multi-processing support, fault reporting, interrupt controllers, and performance counters.

Examples of ARM licensed design technologies include its system architecture ARMv8, micro-architecture Cortex-A57, on-chip interconnect technology CCN-508, GPU Mali T-684, memory controllers, and other intellectual property designs. Companies that license ARM's technologies can choose to implement some or all of ARM's product designs. Further, licensee companies are provided with the capability to combine ARM products with their own intellectual property technology in order to build market-specific semiconductors at a fraction of the cost of creating such products from their own technologies from scratch.

ARM continuously pursues the reliability of its designs and technology, this includes investing in improving the vectorization support of open-source compilers such as LLVM and GCC, and developing support for Scalable Vector Extensions (SVE) in said open source compilers. ARM has a large architecture team (located in both the U.S. and UK) working on SVE and future extensions throughout the architecture and microarchitectures that are associated with the compiler systems.

In regard to software applications, ARM has substantial investments in teams in the UK that are tasked with working on HPC applications, libraries, runtimes, and operating system improvements. ARM also has a team developing base simulation technologies that are to be utilized in PATHFORWARD research projects; these include research technologies that are related to power models, memory models, and interconnect models. Currently, over 50% of ARM's research department is either directly or indirectly working on technology projects that are relevant to HPC and exascale computing, with additional efforts underway within their product groups to transfer this research technology into commercial products.

FINANCIAL CONTRIBUTION

The total amount of the subcontract between Cray and ARM is $2,640,386. ARM is matching 100% of the contract cost thereby bringing the total cost-shared value of the contract to $5,280,772. The period of performance for the contract is from 1Q2017 through 4Q2019 (this is subject to change upon finalization of the contract). ARM has presently invested over $11,000,000 in HPC research. However, this figure may be much higher when taking into account ARM's additional investments in ARMv8 system architectures (said investments which directly support their HPC research).

ECONOMIC EFFECTS OF WAIVER

ARM anticipates the performance of substantial portions of its scope of work will be performed by its wholly-owned U.S. subsidiary, ARM, Inc., which maintains major research facilities in Austin, Texas, and San Jose, California. Any hardware and software purchased in the course of performance will be bought by and housed at one of these U.S. facilities. U.S. personnel are expected to perform the majority share of the tasks (approximately 85%) called for by ARM's statement of work as specified under the PATHFORWARD contract with Cray.

Further, ARM presently employs approximately 1,100 people in Austin, Texas, and San Jose, California, who will be developing and promoting the technologies underlying the PATHFORWARD project with an eye toward the widespread adoption of the technologies by ARM's customers in the semiconductor industry. ARM broadly licenses its technology non-exclusively within the semiconductor industry and anticipates that it will broadly license any new technologies resulting from its efforts on the PATHFORWARD contract on that same basis. ARM also envisions the possibility of a partnership with Cray (the prime contractor on its PATHFORWARD subcontract) in the event the contractual collaboration between Cray and ARM lead to the development of new patentable technology under the PATHFORWARD contract.

It is foreseen that there will be no material effect on U.S. competition or market concentration as a consequence of the granting of the requested waiver. All of ARM's U.S. competitors that bid on the PATHFORWARD contract or serve as PATHFORWARD subcontractors will enjoy precisely the same intellectual property waiver provisions as requested by ARM. Nor is there a risk that ARM will obtain a preferred or dominant position in the field of semiconductor architecture design on the basis of the approval of the requested waiver.

ARM's anticipated contributions to the PATHFORWARD project will be based on ARM's existing technologies, which were primarily developed at private expense and already are subject to ARM's intellectual property rights. Therefore, granting ARM the requested waiver as to extensions of its own proprietary technologies would not change the status quo of the industry.

CONCLUSION

As a subcontractor to the Cray agreement the Petitioner is obligated to abide by the provisions provided in attached Appendices A and B. Appendix A contains the 10 CFR 784.12 Patent Rights Waiver provisions and Appendix B contains the modified version of the FAR 52.227-14 Rights in Data provisions. The content of the appendices were included in the Alliance for Application Performance at Extreme Scale (APEX) project Class Advance Waiver W(C) 2016-002 which details the contractor patent and data rights as specified within agreements between the DOE/NNSA laboratories and their contractors in regard to first and second tier subcontracts issued under the program's projects. Therefore, as a prerequisite to the implementation of this waiver the terms of the subcontract issued by Cray to ARM should be modified in order to be in compliance with attached Appendices A and B.

In regard to the execution of this waiver the Petitioner has agreed to accept and act in accordance with the provisions of 35 U.S.C. §§ 202 and 203. Additionally, the Petitioner agrees to abide by the preference for U.S. Industry standards as presented in 35 U.S.C. § 204, the requirements of which are set forth in the U.S. Competitiveness Clause, and in doing so the Petitioner agrees to the following:

> The Petitioner agrees that any product that embodies any waived invention or produced through the use of any waived invention will be manufactured substantially in the United States, unless the Petitioner can show to the satisfaction of the DOE that it will not be commercially feasible to do so. In the event that the DOE agrees to foreign manufacture, there will be a requirement that the Government's support of the technology be recognized in an appropriate manner (e.g., the recoupment of any Government investments, etc.). Further, the Petitioner agrees to make this condition binding on all assignees or licensees of the subject matter technology. Yet further, the Petitioner will also abide by the Export Control laws and will require that all licensees do the same.

With regards to the copyrighting of ARM's software DOE agrees, in advance, to authorize ARM to assert copyright without the prior approval of the DOE Contracting Officer in software that is produced under ARM's subcontract. It must be noted that the DOE funding programs (ASC and ASCR) maintain policy requirements that all software developed under program funding is to be released as Open Source Software (OSS). This specific requirement will also apply to any original software that is developed by ARM under their Contract with Cray.

However, if the software developed under the subcontract is a derivative work of ARM's existing software that derivative work can be commercially licensed by ARM. Additionally, any original software developed by ARM under their subcontract agreement with Cray may need to be delivered to DOE's Energy Science and Technology Software Center upon any direction from the DOE Patent Counsel.

Therefore, in consideration of the Petitioner's developed and demonstrated research/work capabilities in fields related to the areas of instruction set architecture and system architecture of exascale nodes, it is concluded that the requested waiver will most likely result in the good faith

efforts of the Petitioner to develop and commercialize any intellectual property to be developed under the forthcoming research subcontract agreement.

Thus, upon the evaluation of the present Petition for Waiver in view of the objectives and considerations as set forth in 10 CFR 784, it is recommended that the requested waiver be granted.

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NNSA

Based on the foregoing Statement of Considerations and the representations of the attached Waiver Petition, it is determined that the interests of the United States and the general public will best be served by a waiver of patent rights of the scope described above and, therefore, the waiver is granted.

CONCURENCE:

[redacted]

Barbara Helland
Associate Director
Advanced Scientific Computing
Office of Science
U.S. Department of Energy

Date: 9/29/17

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Mark C. Anderson
Director
Advanced Simulation and Computing
Office of Defense Programs
NNSA

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APPROVED:

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Brian Lally
Assistant General Counsel
Technology Transfer and Intellectual Property
U.S. Department of Energy

Date: 10/3/17