



High Performance Computing Peak Shaving for Microreactor Operation

July 2024

Changing the World's Energy Future

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Nuclear Reactors and HPC Datacenters



HOME > NEWS > THE INVESTMENT & MARKETS CHANNEL

AWS acquires Talen's nuclear data center campus in Pennsylvania

Cloud company pays \$650 million – plans 960MW campus

March 04, 2024 By: Dan Swinhoe [Have your say](#)



Amazon Web Services (AWS) has acquired Talen Energy's data center campus at a nuclear power station in Pennsylvania.

Talen Energy Corporation this week announced it has sold its 960MW Cumulus data center campus in Pennsylvania to a 'major cloud service provider' – listed as Amazon in a Talen [investor presentation](#). Amazon is yet to comment on the news.

Nuclear microreactors are coming! HPC are expected end-users

Developer	Name	Technology Type	Power Output [MW(electric)/MW(thermal)]	Fuel	Coolant	Moderator	Refueling Interval
Alpha Tech Research Corp.	ARC Nuclear Generator	MSR	12 MW (electric)	LEU	Fluoride salt	—	—
BWXT	BANR	HTGR	17 MW(electric)/50 MW(thermal)	TRISO	Helium	Graphite	5 years
General Atomics	GA Micro	HTGR	1 to 10 MW(electric)	—	Gas	—	—
HolosGen	HolosQuad	HTGR	13 MW(electric)	TRISO	Helium/CO ₂	—	10 years
Micro Nuclear, LLC	Micro Scale Nuclear Battery	MSR/HP	10 MW(electric)	UF ₄	FLiBe	YH	10 years
NuGen, LLC	NuGen Engine	HTGR	2 to 4 MW(electric)	TRISO	Helium	—	—
NuScale Power	NuScale Microreactor	HP	<20 MW(electric)	Metallic	Liquid metal	Liquid metal	10 years
Oklo	Aurora	SFR/HP	1.5 MW(electric)	Metallic	Sodium	—	10+ years
Radiant Nuclear	Kaleidos Battery	HTGR	1.2 MW(electric)	TRISO	Helium	Graphite	4 to 6 years
Ultra-Safe Nuclear	MicroModular Reactor	HTGR	5 MW(electric)/15 MW(thermal)	TRISO	Helium	Graphite	20 years
Westinghouse	eVINCI™	HP	1 to 5 MW(electric)	TRISO	Sodium	Graphite	3+ years
X-Energy ³³	Xe-Mobile	HTGR	7.4 MW(electric)/20 MW(thermal)	TRISO	Helium	Graphite	—
Nano Nuclear Energy Inc.	NANO Nuclear	FR	0.5 to 1 MW(electric)	—	—	—	10 years

Small size

May be mobile

Produce <10 MWe

Operate Autonomously

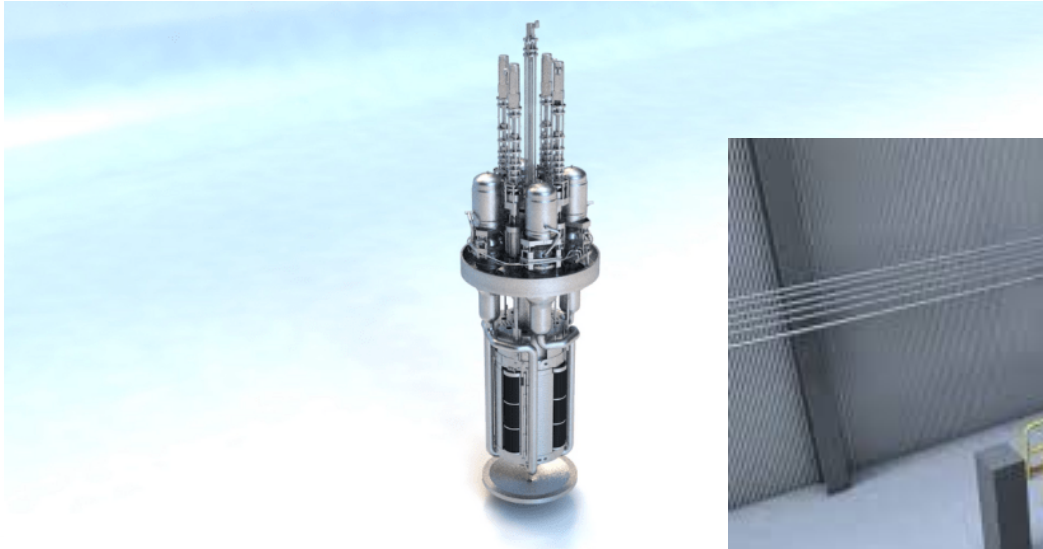
Refueling interval as much as 10 years

Load follow limited (< 10%/minute)

MARVEL is an example of a prototype microreactor

DOI: <https://doi.org/10.1080/00295450.2022.2118626S1>

Marvel Microreactor at Idaho National Laboratory



Under construction at INL
Expected output: 50 kWe
Ready ~2026

eVinci Microreactor

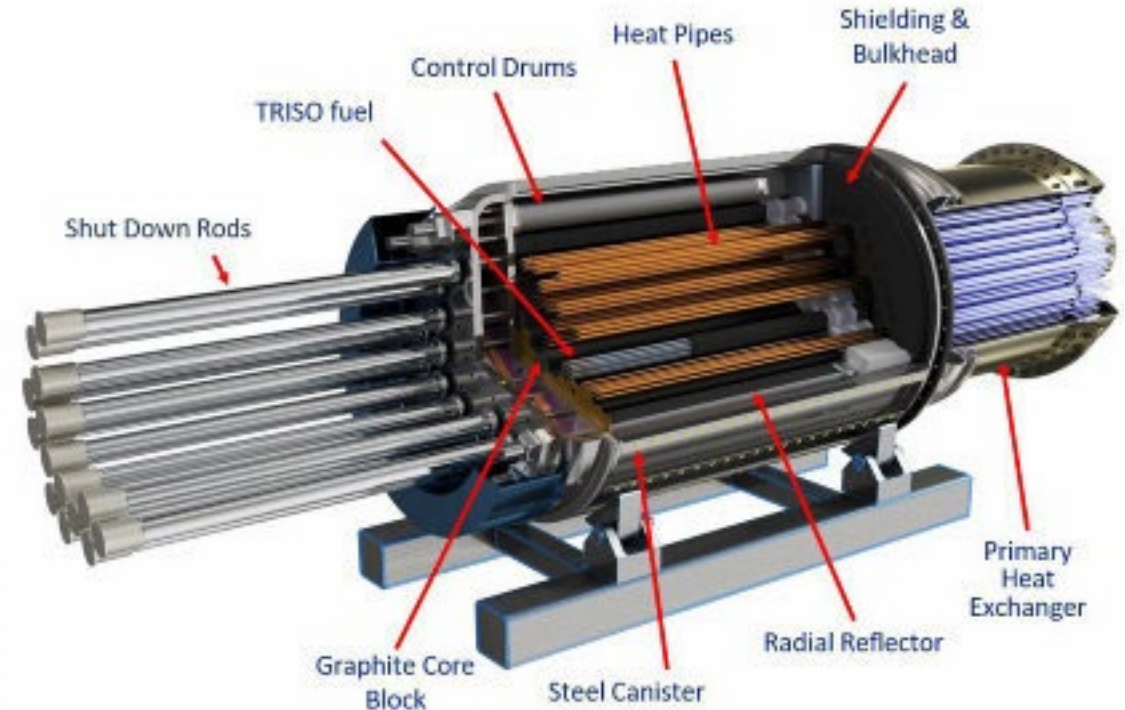
Westinghouse

5 MWe

8+ year fuel cycle

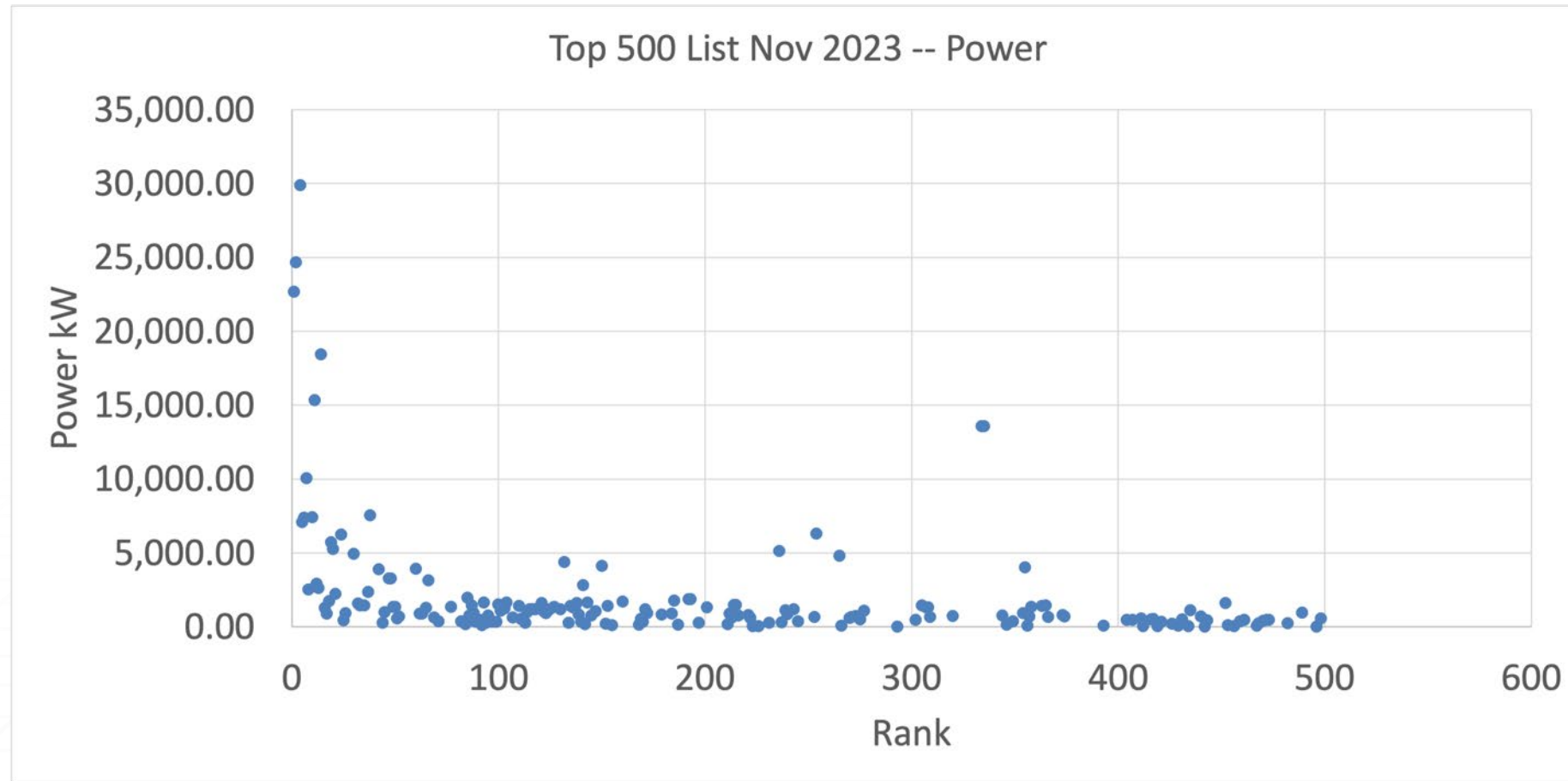
No water required for operation

Above ground installation



<https://www.westinghousenuclear.com/flysheet-directory/evinci-microreactor-the-next-generation-nuclear-research-reactor>

Top500 List Power



481 systems of the Top500 list in Nov 2023 could be powered by eVinci!

Microreactor Integration with HPC: Some Challenges

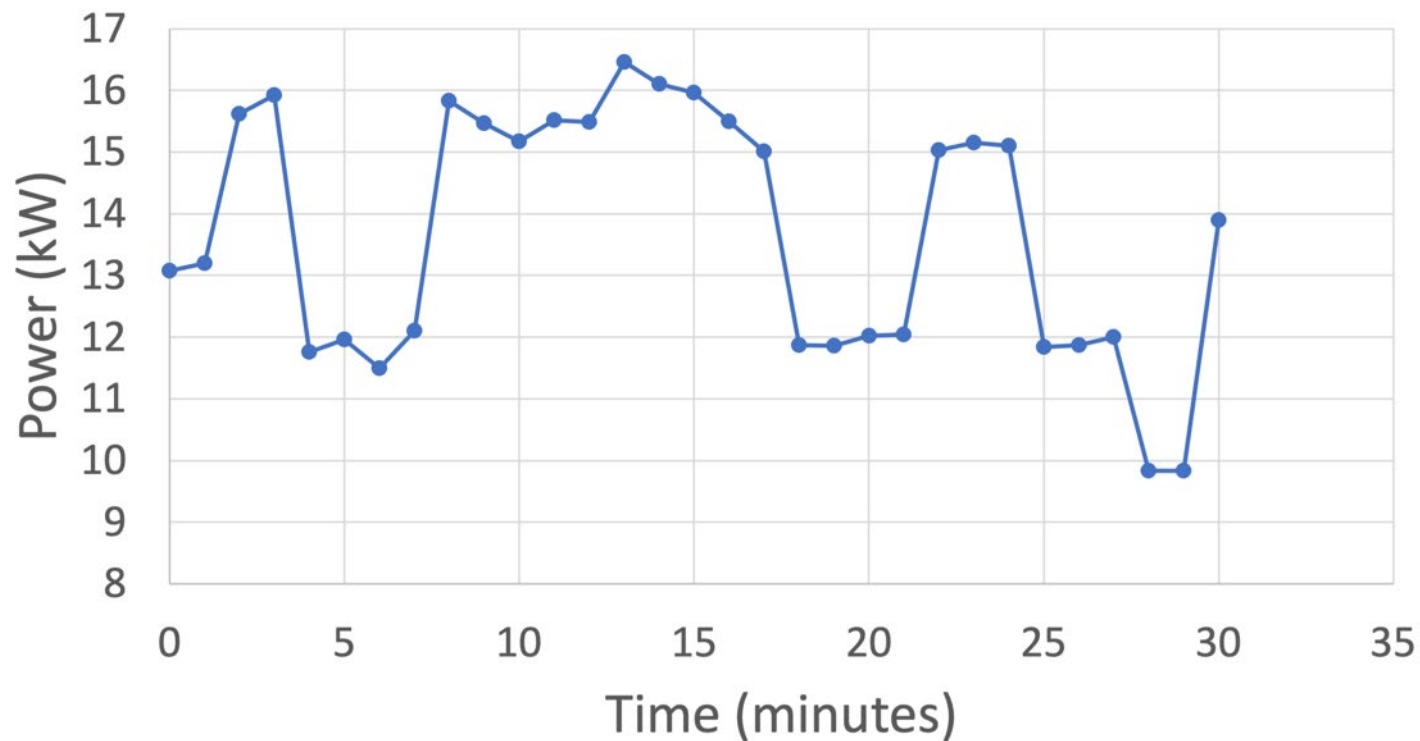
- First of a Kind Installation cost estimated \$140 - \$410/MWh
Nuclear Energy Institute, “Cost Competitiveness of Micro-Reactors for Remote Markets”
- Load-follow is limited; benchmark at 10%/minute or worse
- Load-follow for HPC datacenters is much faster than 10%/minute

Two easy options:

- Overprovision power for the HPC system and oversize the microreactor
- Peak shave the upswings in HPC power demand using an energy storage system

Load Follow for an x86 Cluster running a single application

Power for HPL run on x86 cluster



560 cores, 5 nodes, EDR Infiniband
AMD EPYC 7663 (112 cores/node)

Idle:

- 1536 Fujitsu A64FX cores
- 20 A100 GPUs, 160 AMD EPYC 7534P cores



UPS

- Most datacenters have existing energy storage systems in the form of UPS
- Can these be leveraged to reduce power variance to support a typical microreactor load-follow?

Schneider Electric
Symmetra 20K with a
capacity of 10.0kVA
and contains eight out
of 12 V66 batteries



Mobile Datacenter

Self-contained system for HPC

Bard B-410A/@36H Wall-Mount
Heat Pump with 3 Tons cooling
capacity

3 compute racks

UPS

Experimental Configuration



1536 Fujitsu A64FX cores



20 A100 GPUs, 160 AMD
EPYC 7534P cores

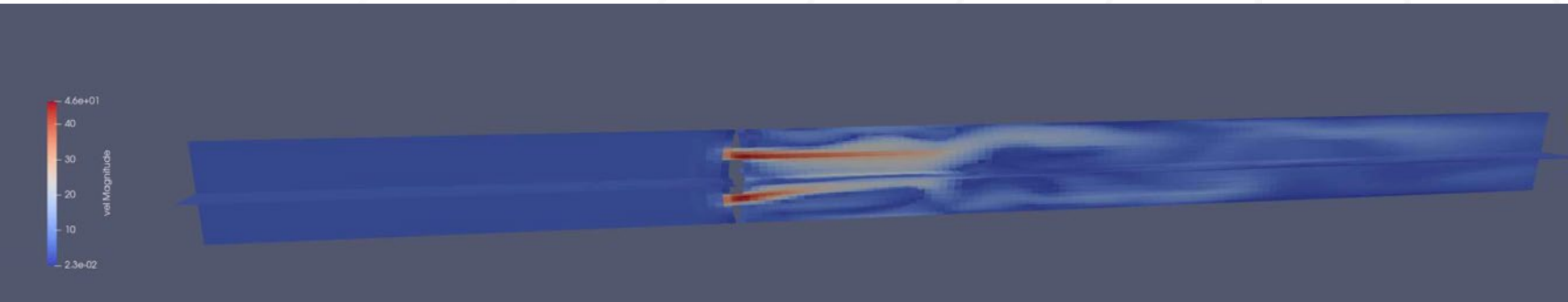
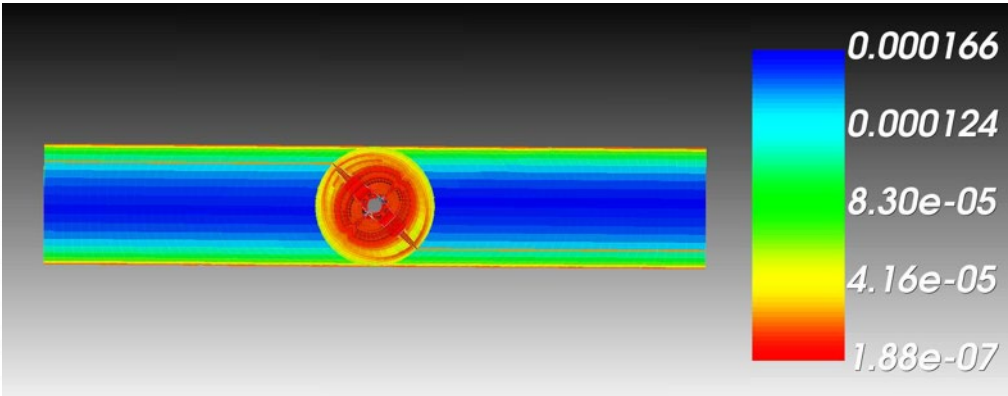


560 cores, 5 nodes, EDR Infiniband
AMD EPYC 7663 (112 cores/node)

Application Workload

x86 and ARM

MOOSE Navier-Stokes module
Mixing Length Model
Derivative size: 153
ATR Butterfly Valve

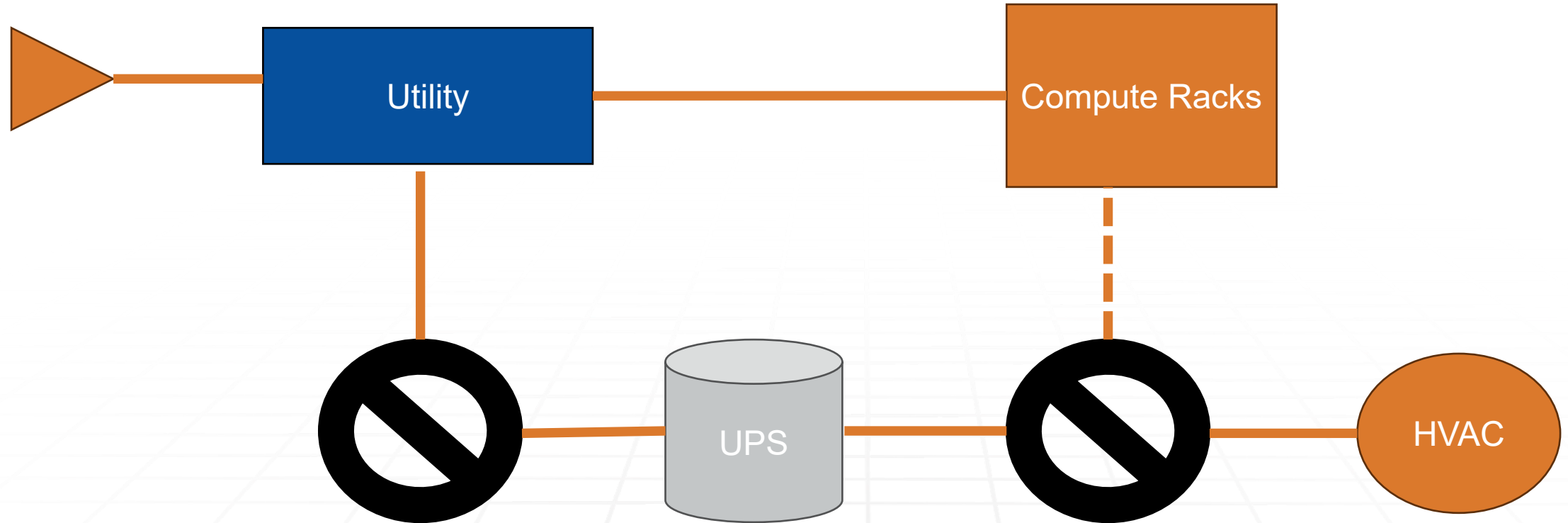


GPU

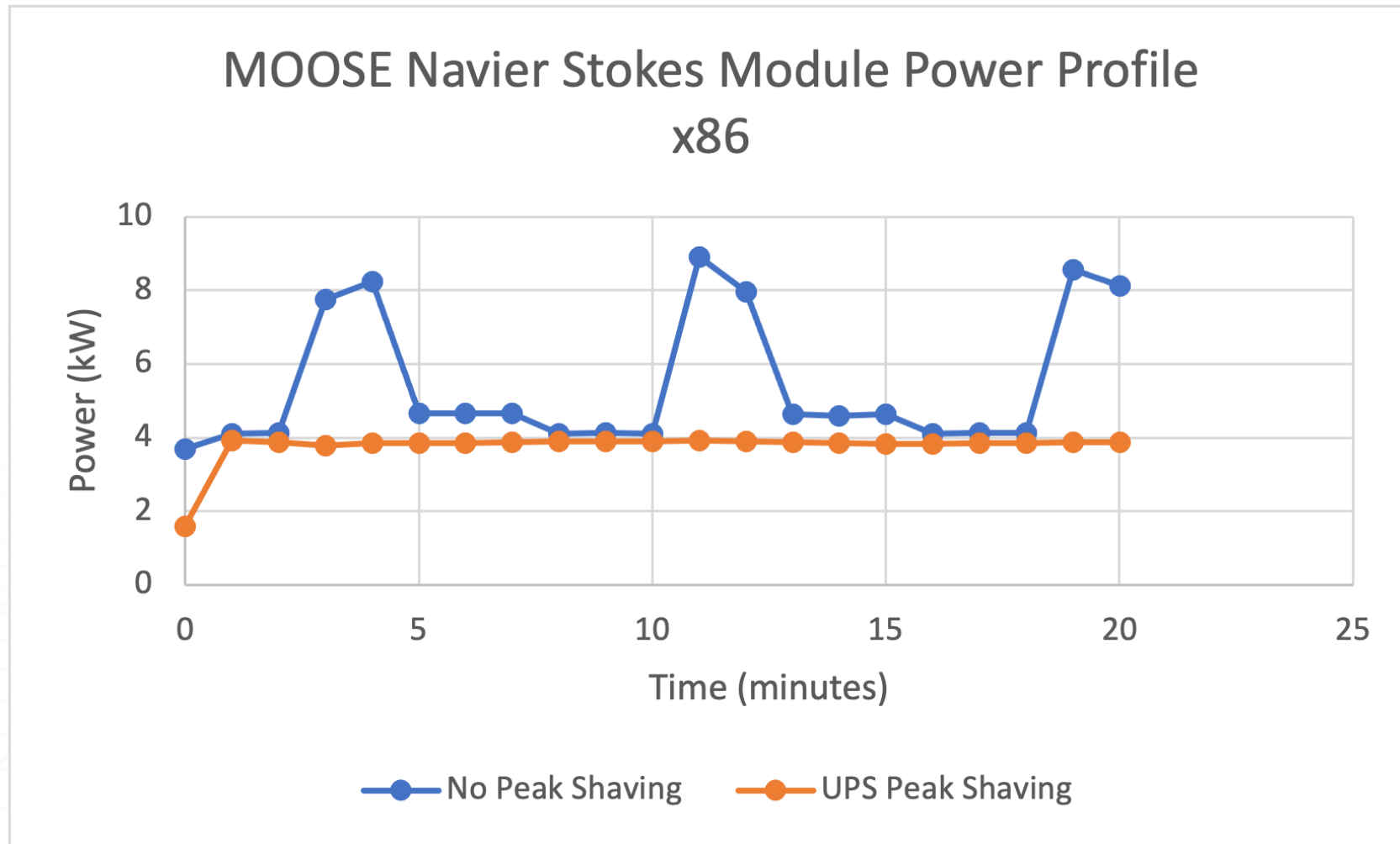
Horovod Digits Recognition Training



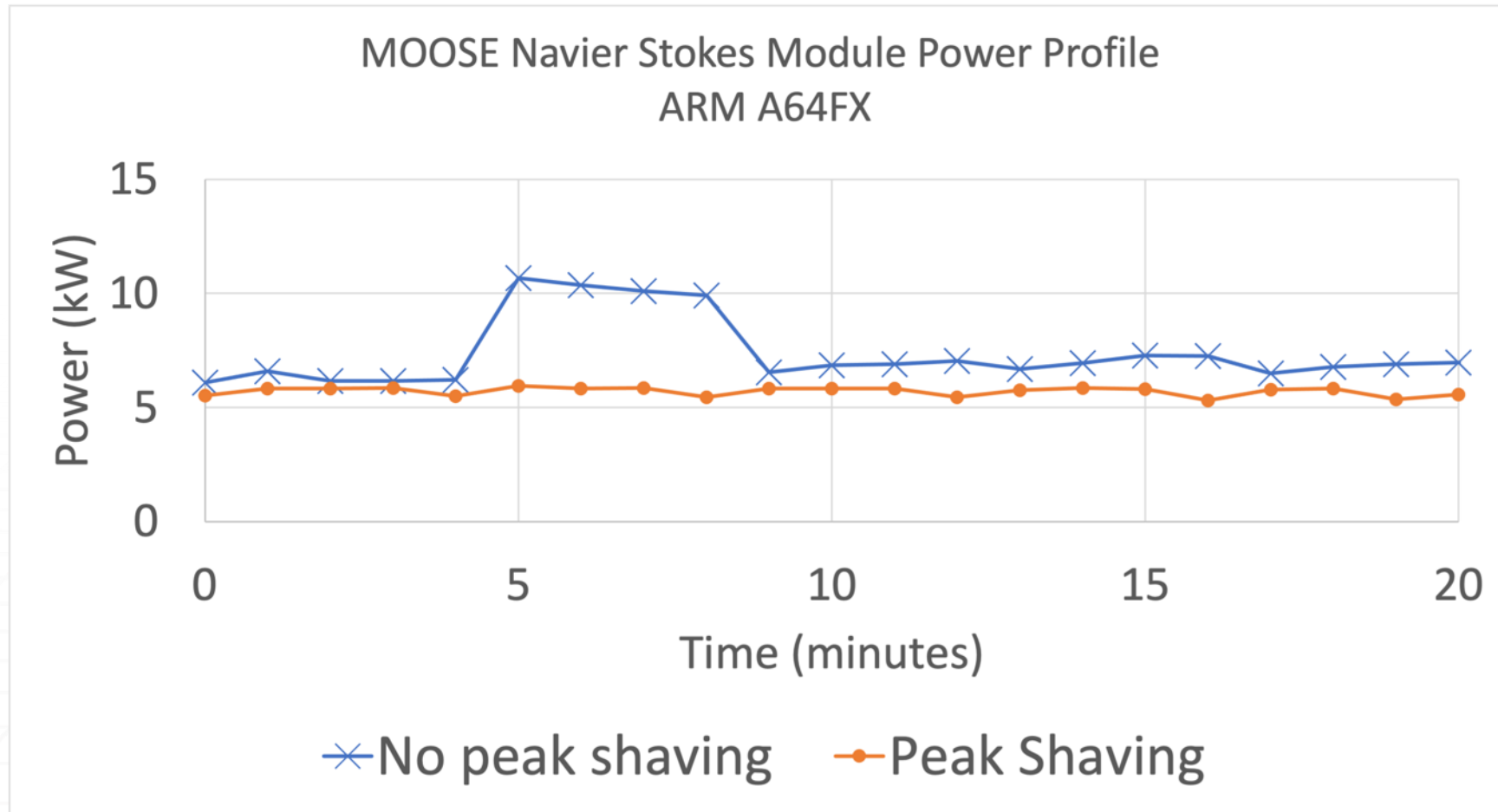
UPS Configuration



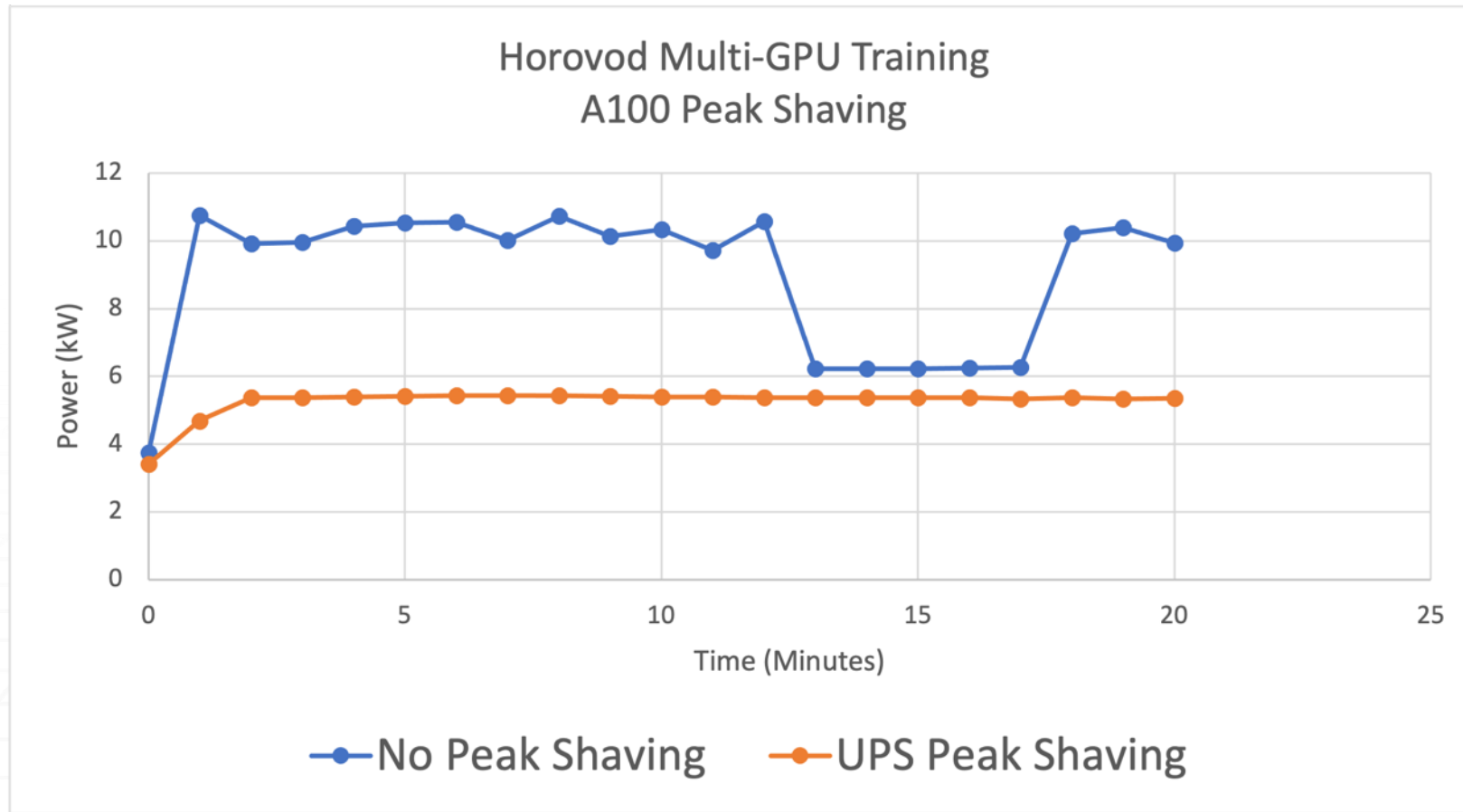
x86 Peak Shaving



ARM Peak Shaving



GPU Peak Shaving



Conclusions

- UPS can be leveraged to meet load follow requirements for microreactors
- ARM is the easiest to meet microreactor load follow requirements, followed by x86, and then GPU
- The most significant power variance observed is due to cooling requirements
- Future Work:
 - Grace-grace coming -- will revisit power numbers (more power friendly?)
 - Integrating with microgrid (no more UPS for energy storage peak shaving)