

Commissioning for AI Readiness

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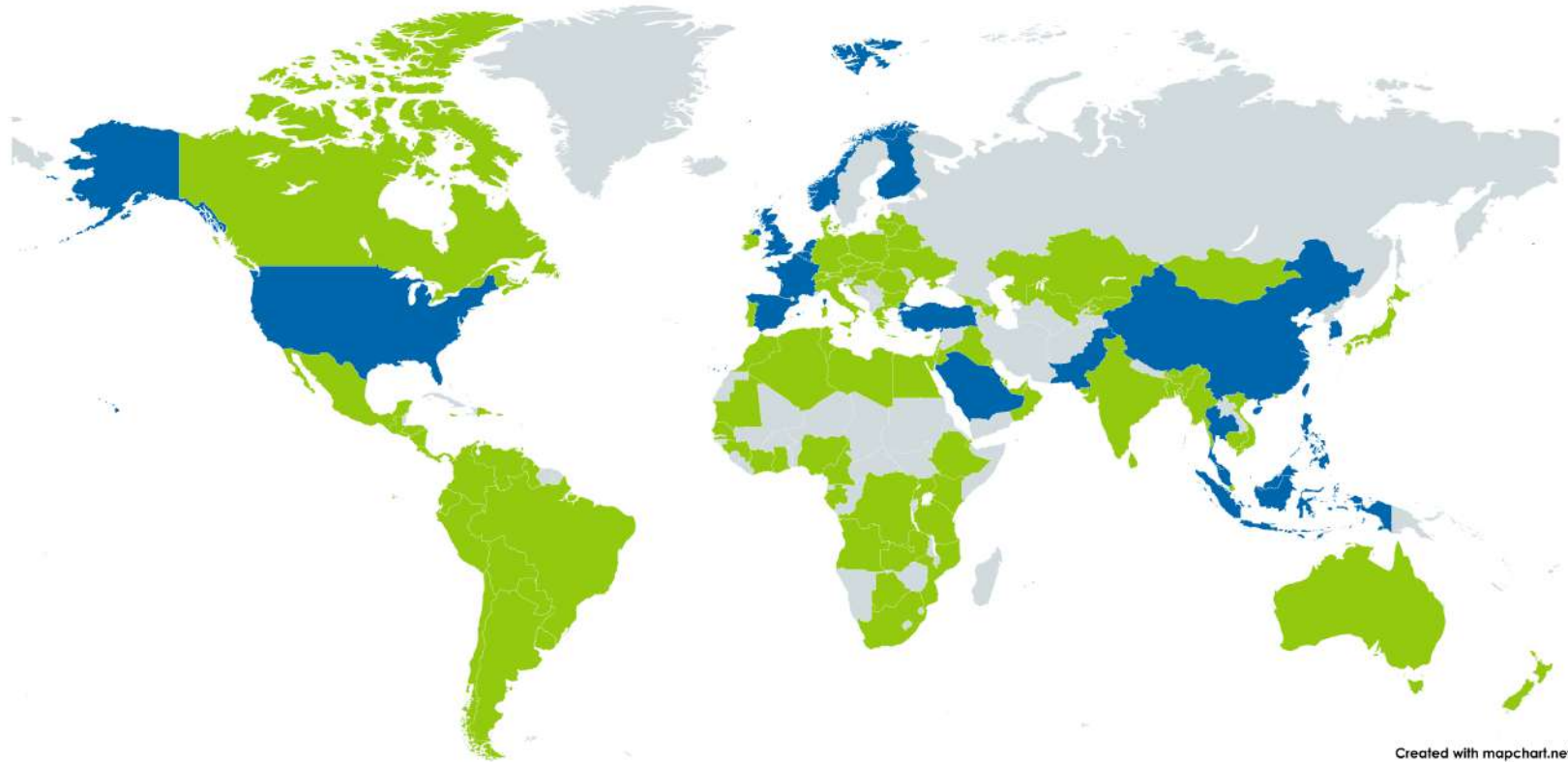
Uptime Institute Timeline

Uptime Institute Services Portfolio

Tier Topology Certification	Uptime Intelligence & Network	Educational Training	Management & Operations	Consulting	Sustainability
Design	Research	Extensive Curriculum	Infrastructure Consulting	AI Consulting	Sustainability Consulting
Constructed Facility	Global Community	Expert Instructors	Data Center Risk Assessment	IT Advisory	Sustainability Strategy Gap Analysis (SSGA)
Tier Gap Analysis	Best Practices sharing	Course offerings run through the entire career progression, from Data Center Fundamentals to the Masters Degree in Data Center Leadership Management.	Data Center Cybersecurity Assessment	Digital Resilience Assessment	Uptime Institute Sustainability Assessment
Tier-Ready/Edge	Largest Incident DB		Operational Sustainability		Accredited Sustainability Advisor & Certified Data Center Sustainability Professional Training Programs
			SCIRA-FSI for Financial Sector		
			FMO Advisory		
			DCIM Consulting		

Uptime's Unique Insight

Global Dispersion of
Tier Certification
Projects for AI Data
Centers and Network
Member Projects



Created with mapchart.net

TECHNOLOGY

AI vs Traditional Data Center

Technology



Commissioning Failure?



What Changed



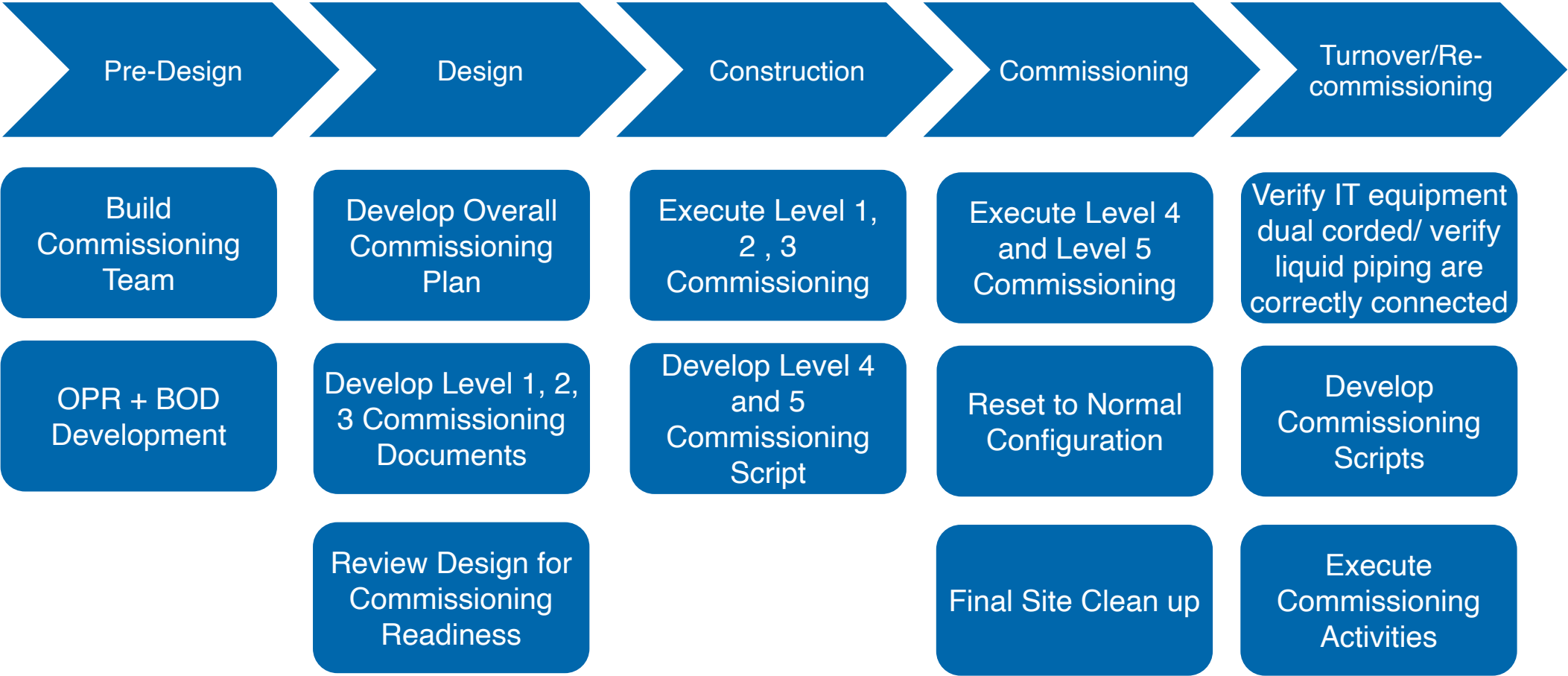
Design

- **Rack Densities:** 10-20X higher power / cooling demand per rack.
- **Space Requirements:** Space Split between White and Gray Space. Depending on rack densities this split has changed to 30-70.
- **Floor Load Capacity:** Ensure the data center floor can support the weight of liquid-cooled racks and equipment, especially for immersion cooling tanks.
- **Floor Plan:** For immersion cooling, modifications may be needed to accommodate tanks and provide appropriate access for maintenance and installation.
- **Dielectric Fluid Selection:** Choose a suitable dielectric fluid (non-conductive liquid) for immersion cooling. Consider factors like thermal conductivity, viscosity, chemical stability, cost, and environmental impact.
- **Power Profiles:** Erratic and dynamic power behavior of AI workloads are challenging power system design.
- **Leak Detection and Containment:** Implement leak detection systems and secondary containment measures to quickly identify and contain leaks, minimizing potential damage and ensuring safety.
- **Heat Exchangers and CDUs:** Design and place heat exchangers and CDUs to effectively transfer heat from the coolant to the external environment.

Commissioning Philosophy

Commissioning

9



Commissioning

Level 1: Factory Witness Testing (FWT)

Performance of equipment at the factory before it is delivered to the site. This includes testing critical components such as generators, uninterruptible power supplies (UPS), chillers, and other major systems to ensure they meet the required specifications.

Level 2: Receipt, Installation, Post-installation Checks

Site Acceptance Testing to ensure all equipment has been shipped and installed correctly.

Level 3: Functional Component Testing (FCT)

Functional testing to verifying that all individual systems (e.g., electrical, mechanical, and plumbing) are installed and functioning correctly on their own.

Level 4: Functional System Testing (FST)

Integrated operation of all systems to ensure they work together as designed.

Level 5: Integrated System Testing (IST)

Integrated System Testing is the final phase of commissioning, where we validate the complete data center infrastructure under real-world conditions.



Commissioning

AI Simulators:

AI Data Centers require specialized load banks to mimic actual power and cooling profile of the AI work loads to perform integrated system testing before handover.

COMMISSIONING CONSIDERATIONS

Commissioning Levels

Commissioning

Factory Witness Testing (FWT)

Validate dynamic load capability, not just nameplate capacity
Confirm UPS, switchgear, CDUs, chillers tolerate rapid load ramps
Review firmware, protection curves, control logic for AI behavior
Catch long-lead AI incompatibilities before shipment

Level-1

Receipt, Installation, Post-installation Checks

Verify correct delivery, installation, accessibility, safety, and compliance.
Verify sensor placement critical for liquid cooling and fast controls
Confirm piping, manifolds, and cabling support future density
Validate maintainability under high rack power
Ensure no commissioning blind spots for temporary AI test equipment

Level-2

Functional component Testing (FCT)

Test components under non-steady load conditions
Verify UPS ride-through during fast load changes
Validate CDU response to rapid heat rejection changes
TAB establishes accuracy, along with airflow

Level-3

Function System Testing (FST)

Test power systems under dynamic, partial, and oscillating loads
Validate cooling control stability at high liquid temperatures
Confirm alarms, interlocks, and sequences under AI stress
Prove systems are ready to be integrated, not just balanced

Level-4

Integrated System Testing (IST)

Power + cooling + controls tested together under AI-like loads
Failure scenarios executed at high density
Concurrent maintainability proven while AI loads remain active
Validate responses to expected and unexpected AI behavior

Level-5

COMMISSIONING CONSIDERATIONS

Level 4 and 5 Commissioning Phase Elements and Benchmarks



Commissionin

	OWNER OR OWNER'S REPRESENTATIVE	CONTRACTOR	ARCHITECTS AND ENGINEERS	OPERATIONS TEAM	COMMISSIONING AGENT
Execution of Level 4	X	X	X	X	X
Execution of Level 5	X	X	X	X	X
Final site cleanup		X			
Ensure all equipment is back in normal position		X		X	X

COMMISSIONING CONSIDERATIONS

Re-Commissioning and Future Installation-Phase Elements and Benchmarks



Commissioning
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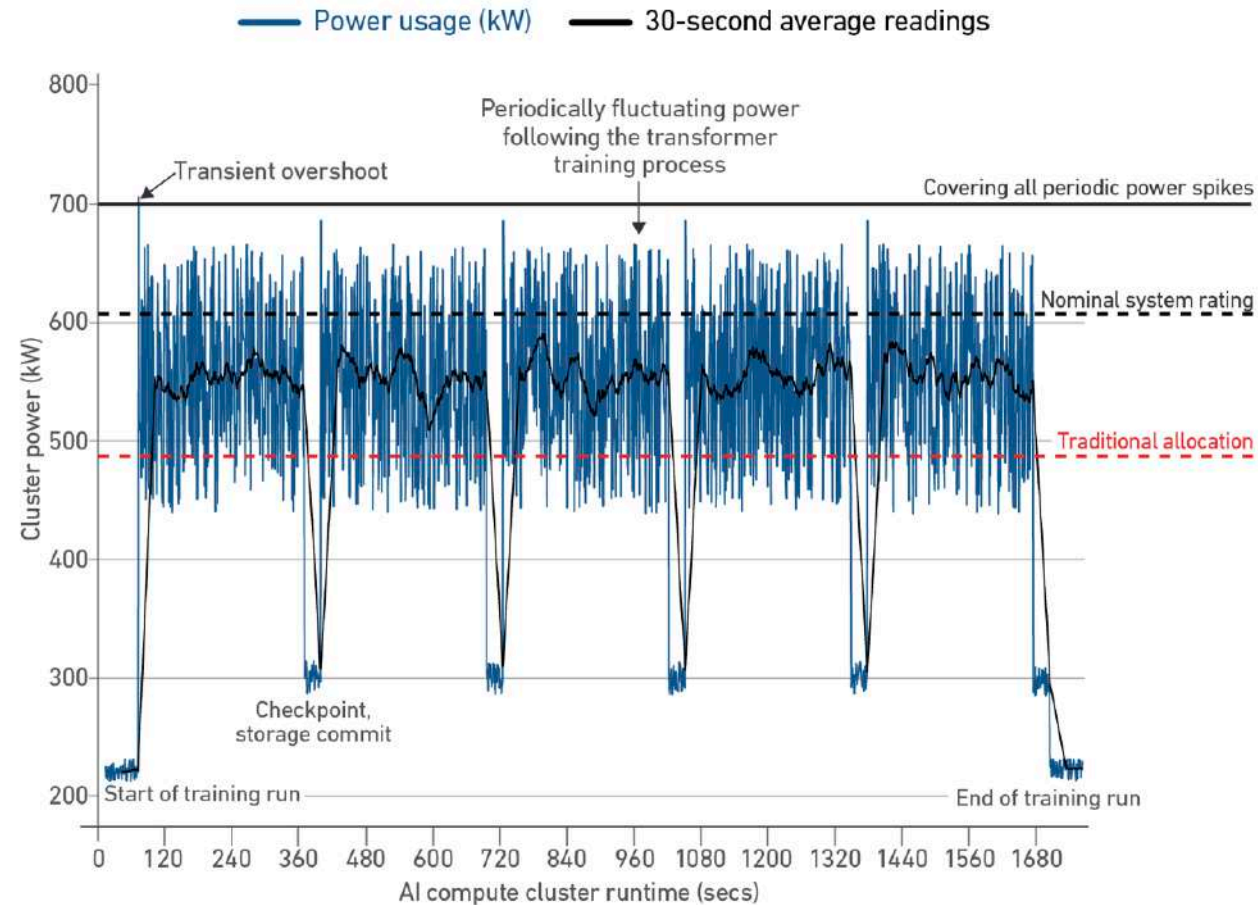
	OWNER OR OWNER'S REPRESENTATIVE	CONTRACTOR	ARCHITECTS AND ENGINEERS	OPERATIONS TEAM	COMMISSIONING AGENT
Develop detailed commissioning scripts for all levels	X			X	X
Review commissioning scripts	X	X	X	X	X
Ensure IT hardware is dual corded (as required)	X			X	
Execute commissioning	X	X	X	X	X
Update SOPs, MOPs, and EOPs	X			X	

TECHNOLOGY CONSIDERATIONS

AI Loads Power Profile

Commissioning

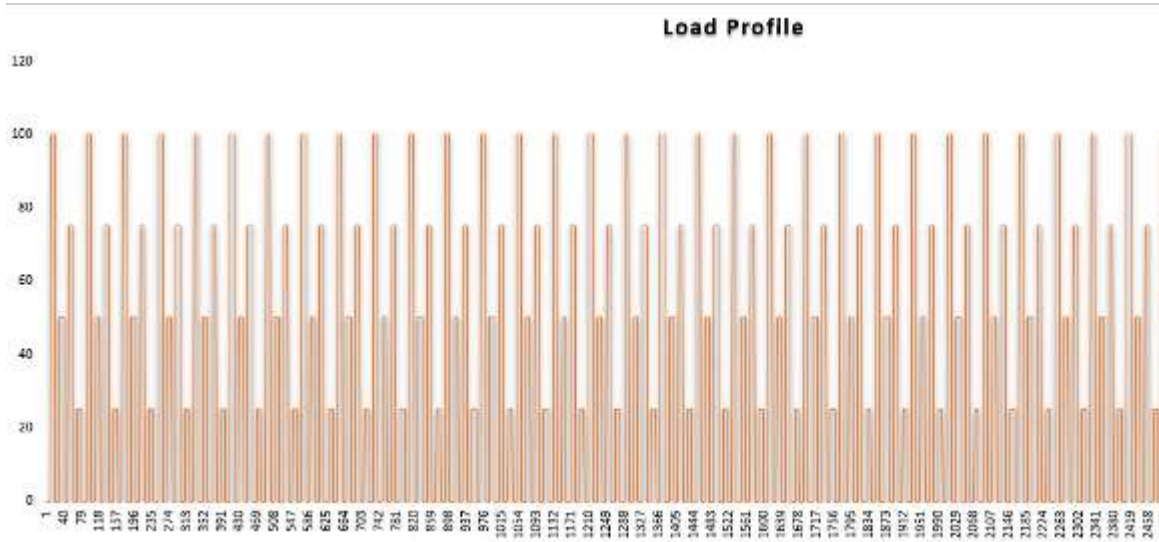
Figure 1 Power profile of a GPU-based training cluster (algorithmic not real-world data)



<https://intelligence.uptimeinstitute.com/resource/electrical-considerations-large-ai-compute>

TECHNOLOGY CONSIDERATIONS

Commissioning – AI Load Simulators



Commissioning

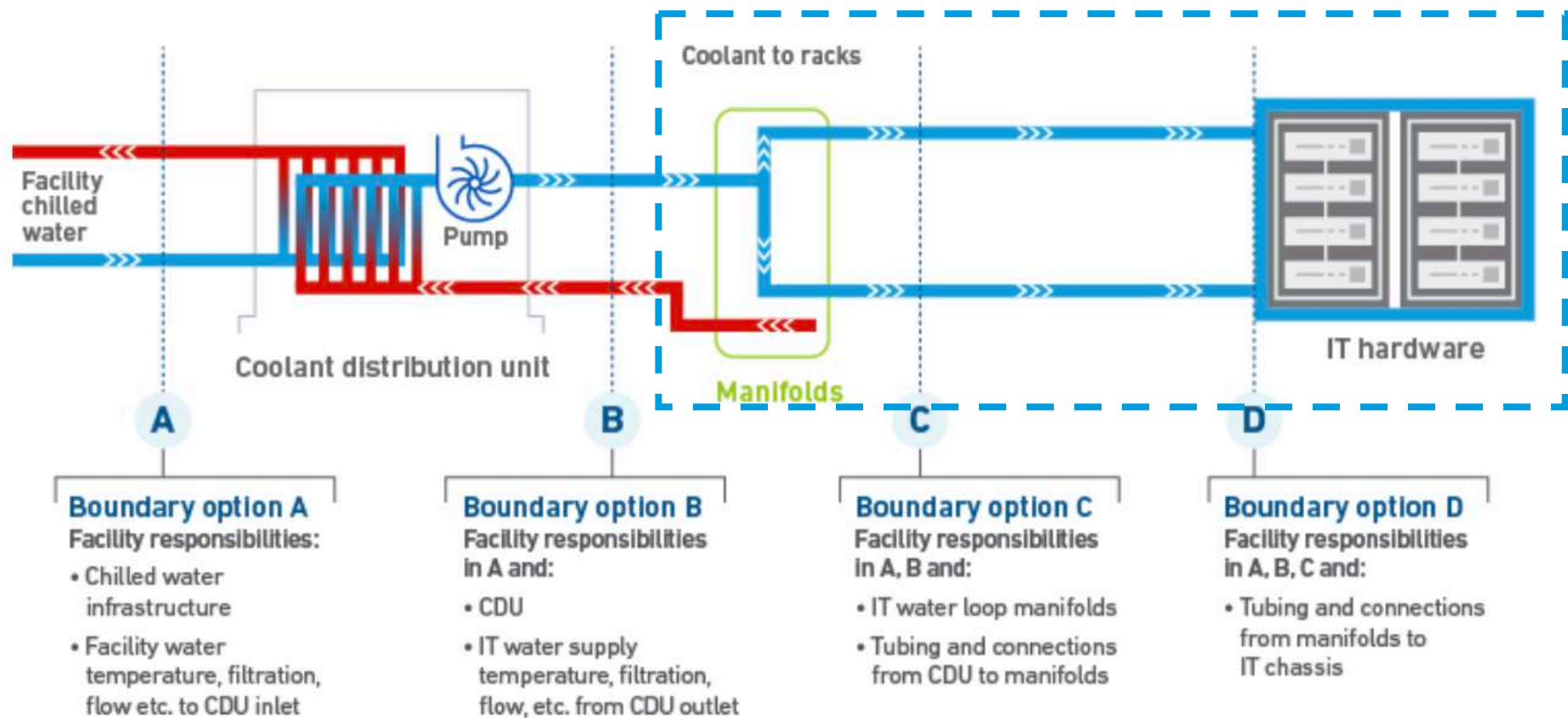
AI Simulators:

AI Data Centers require specialized load banks to mimic actual power and cooling profile of the AI work loads to perform integrated system testing before handover.

OPERATIONS CONSIDERATIONS

Operations – Demarcation Line

Operation



DELIVERY

Case Study : Data4

Knowledge

- Data4, a European colocation provider, to provide high-density capacity for deploying up to 250 MW of liquid-cooled 130 kW racks in new facilities at its PAR01 campus in Marcoussis. This campus is a 110-hectare site just south of Paris that currently hosts 23 data centers totaling 250 MW.

Company	Role
APL Data Center	Consultant, POC designer
Rentaload	Load bank supplier
Danfoss	Coolant distribution unit supplier
Apilog	Building management system software supplier
CEME	Implementation
Uptime Institute Professional Services	Test validation

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Specification	Input
Rack dimensions	600 mm (width) x 1380 mm (depth) x 2600 mm (height)
Total clear space above rack	3300 mm (high)
Clear space above the cabinet	3.8 m (minimum clearance)
Rack density	65–130 kW
Electrical supply	680 kW/row
IT coolant	PG25 (75% water, 25% propylene glycol)
IT coolant flow rate	1.5 L/min kW
IT coolant supply temperature	26°C (maximum)
IT coolant ΔT	10°C
CDU location	Technical corridor
Supply of CDU	10 rows (maximum)
CDU redundancy	N+1
IT coolant pressure drop	15 psi (103 kPa)

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DELIVERY

Lessons Learnt



Knowledge

- **Knowledge Gap:** Engineering teams often lack understanding of the operational demands and real-world behavior of AI workloads.
- **Concurrent Maintainability:** Engineers struggle to configure cooling systems that remain fully serviceable without interrupting high-density AI operations.
- **Technology Limitations:** Power systems frequently fall short in handling the highly dynamic and spiky load profiles characteristic of AI infrastructure.
- **Load Bank Availability:** Sourcing appropriately sized and capable load banks for commissioning AI-ready systems remains a significant challenge.
- **Precise Controls:** Integrated control strategies to manage dynamic AI loads are often overlooked during design, risking performance inefficiencies and operational instability.
- **Future-Proofing:** Designs often lack options and flexibility to accommodate evolving AI workloads or future technology upgrades.
- **Commission-ability:** Designs frequently overlook the requirements for commissioning equipment, including phased or staged commissioning strategies that reduce operational risk.



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