

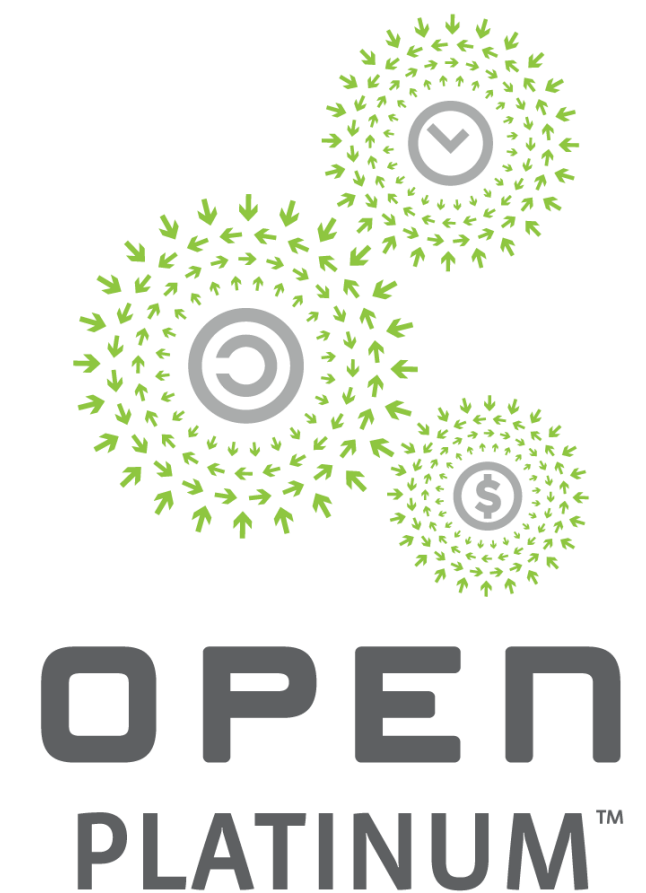
An abstract graphic on the left side of the image, composed of numerous thin, wavy green lines that swirl and curve together, creating a sense of movement and depth. The lines are more concentrated in the center and fade out towards the edges.

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OCP
SUMMIT

A large scale deployment experience using immersion cooling in datacenter



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A large scale deployment experience using immersion cooling in datacenter



ACS

With the improvement of computing performance, the power consumption is significantly increased. Increasing power consumption of server components brings enormous challenges to heat dissipation and power optimization. Immersion cooling completely breaking the air-cooling power dissipation bottleneck and also achieving extremely low PUE.

This presentation introduces the problems encountered by Alibaba in the scale deployment of immersion cooling data center, solutions and considerations.

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Case Studies



1、Today's Datacenter Challenges

2、Why immersion cooling?

3、Challenges of immersion cooling

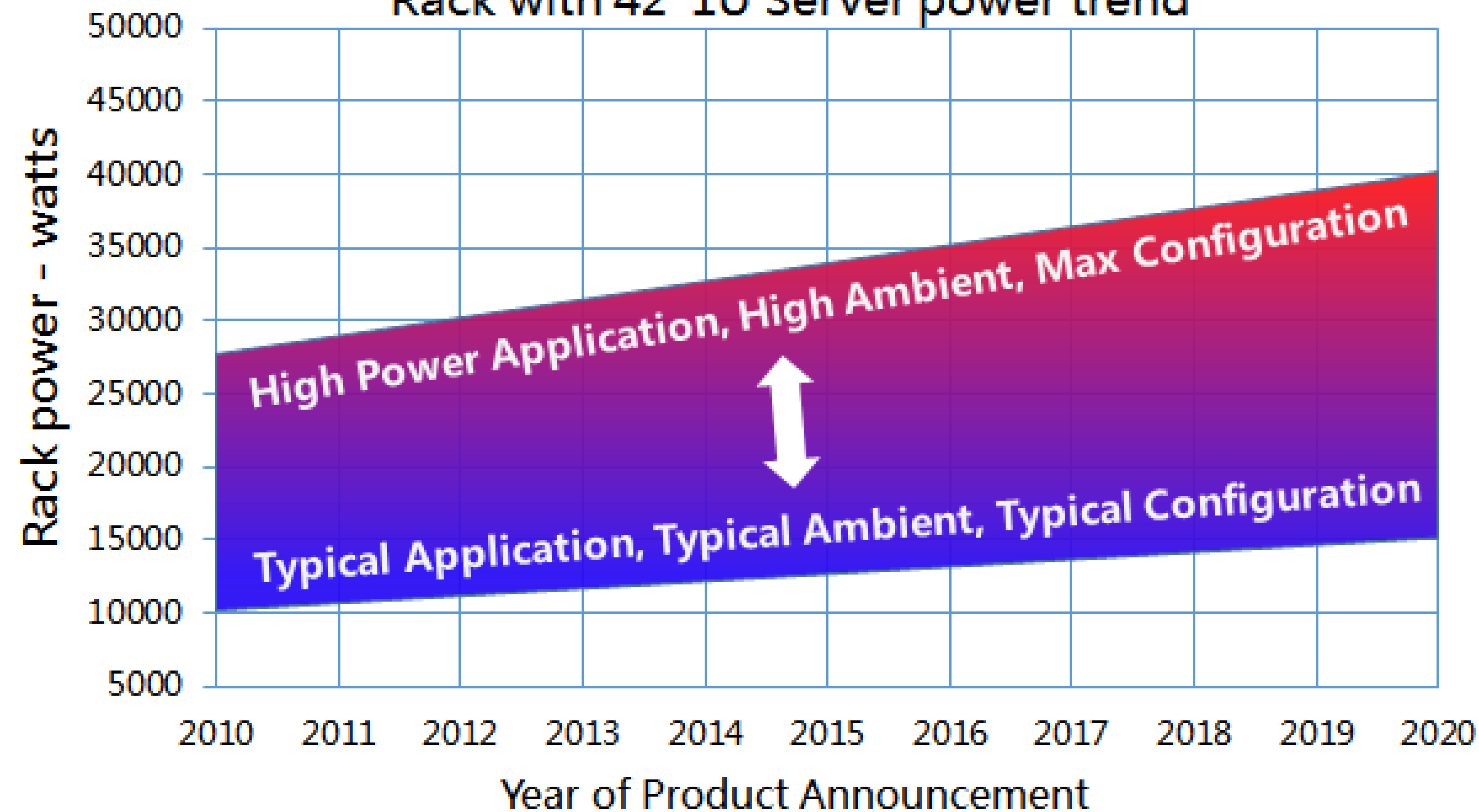
4、Practice of Alibaba

Today's Datacenter Challenges

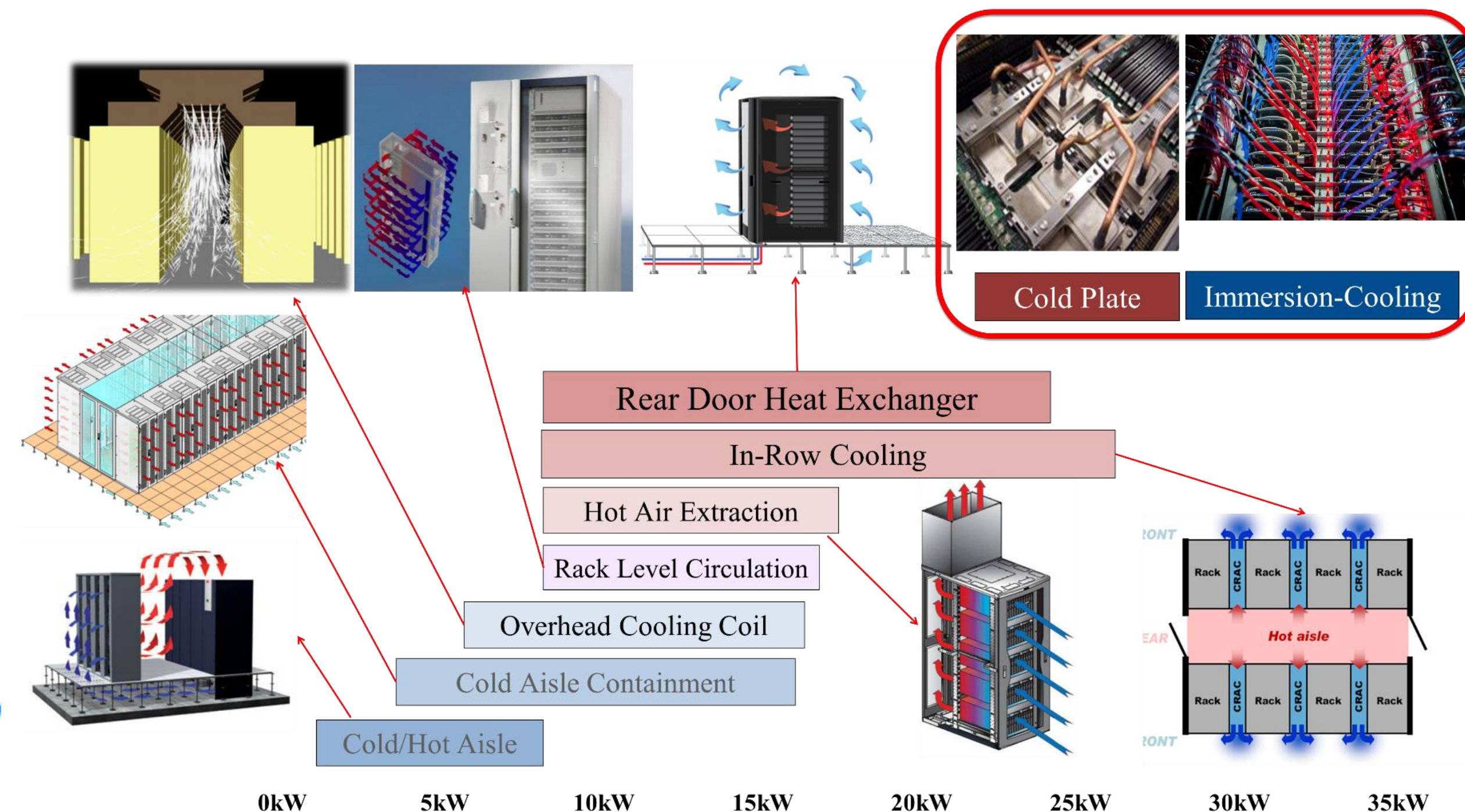
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1. high power density racks' cooling

Rack with 42*1U Server power trend



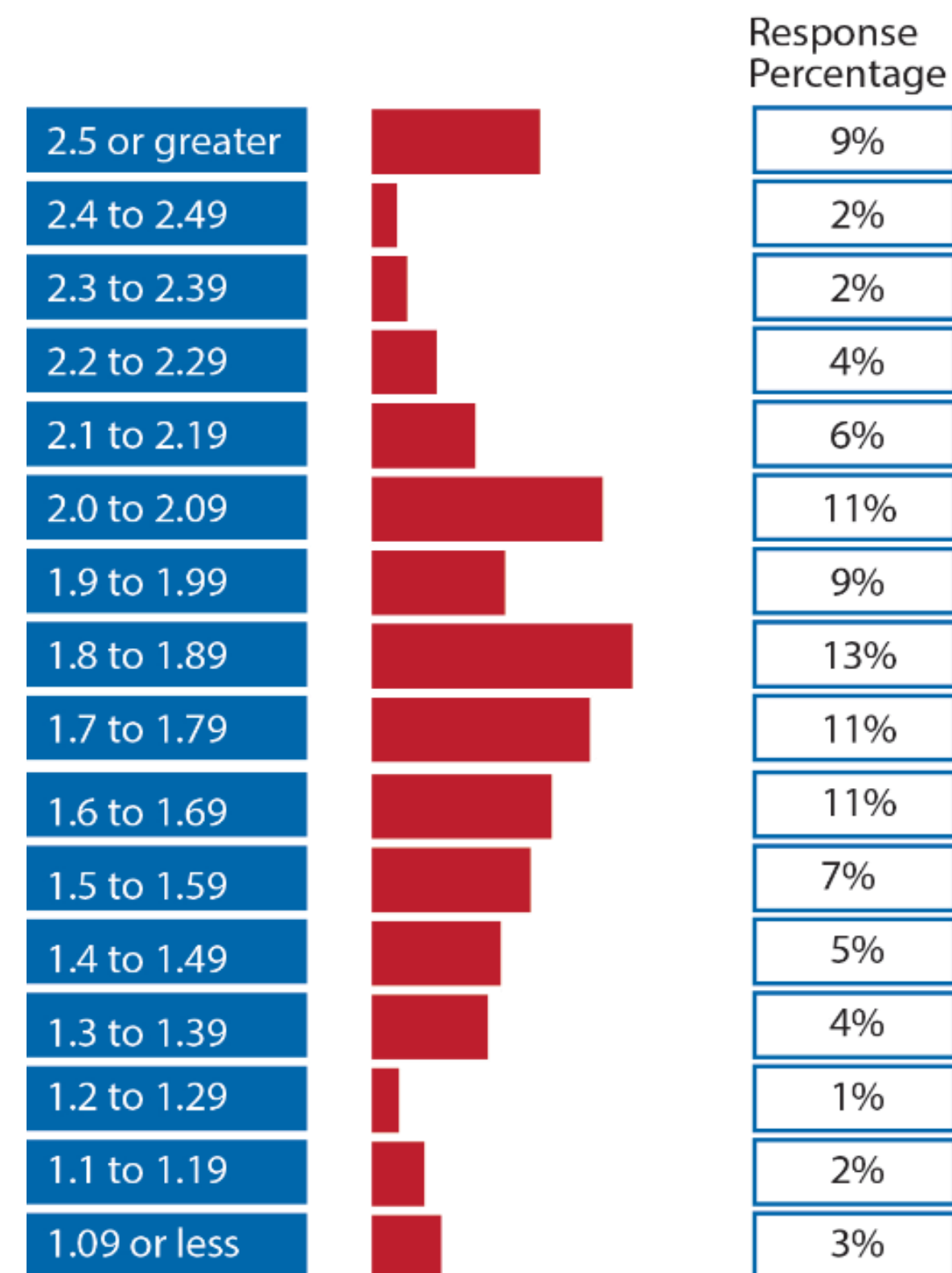
Datacom Equipment Power Trends and Cooling Applications --ASHRAE



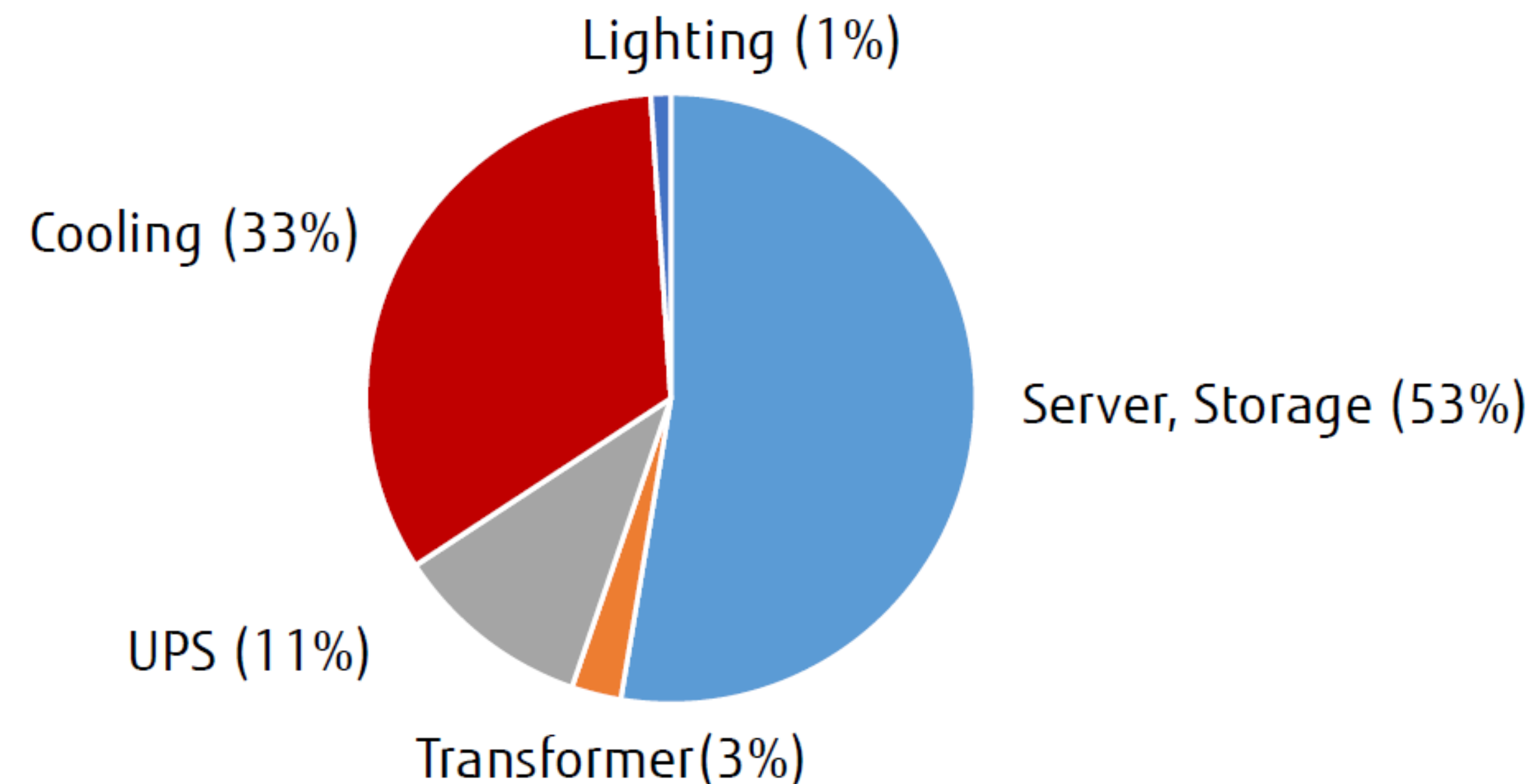
- Computing drives devices into higher power consumption. Rack power density is growing rapidly
- Air-Cooling cannot meet the heat dissipation demand any more

2. PUE/TCO

Average PUE of your largest data center:



Source : Uptime Institute
survey of over 1100 data centers



*A Shehabi: LAWRENCE BERKELEY
NATIONAL LABORATORY "United
States Data Center Energy Usage
Report", 2016.

- The energy consumption of the data center for cooling is quite large.
- How to achieve low PUE and optimized TCO? That has become a new challenge.



1、 Today's Datacenter Challenges

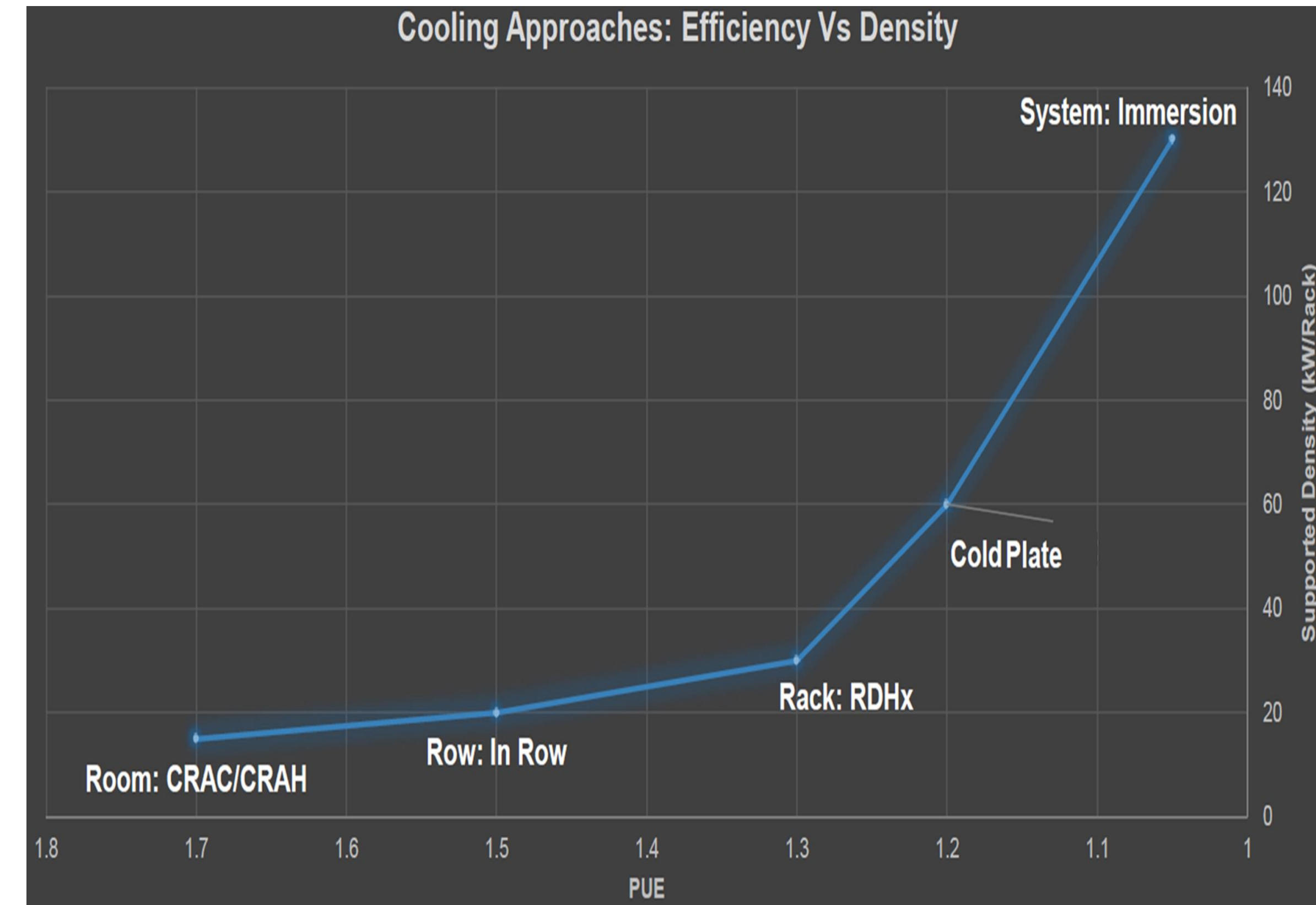
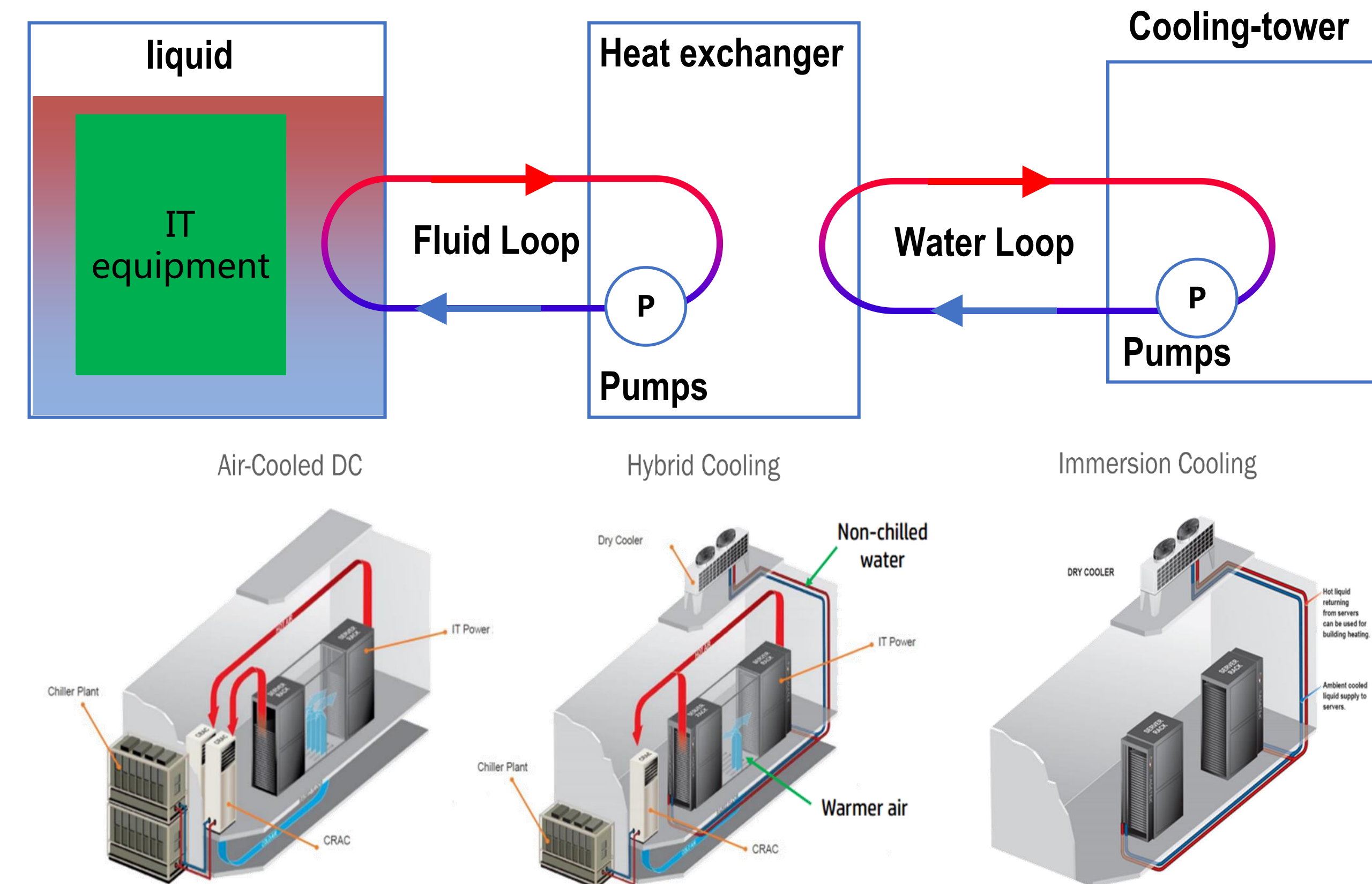
2、 **Why immersion cooling?**

3、 Challenges of immersion cooling

4、 Practice of Alibaba

Why is immersion cooling?

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- liquid has greater heat transfer capacity than air.
- No Server Fans, No CRAC, High Density Servers , low PUE 1.05-1.07

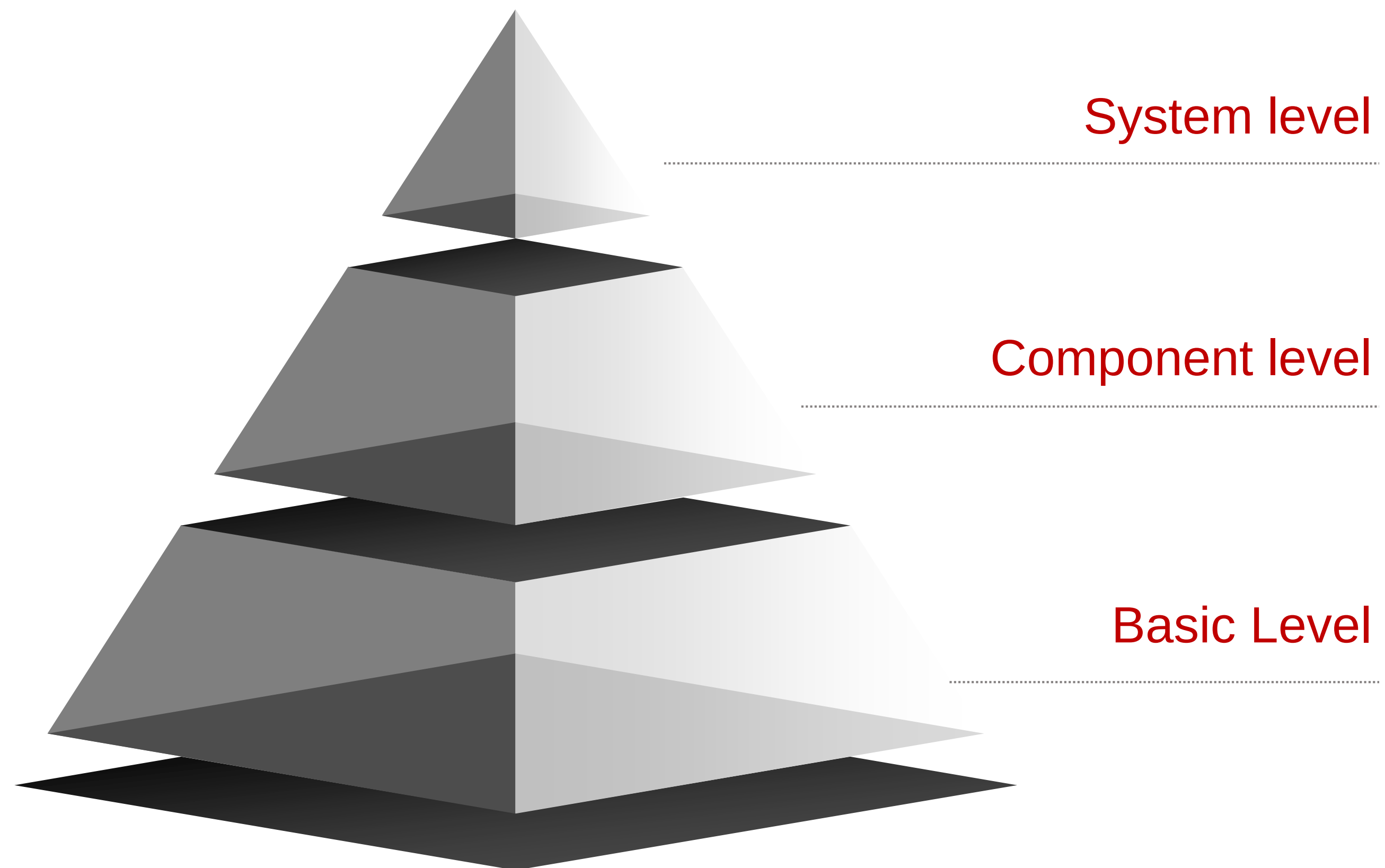


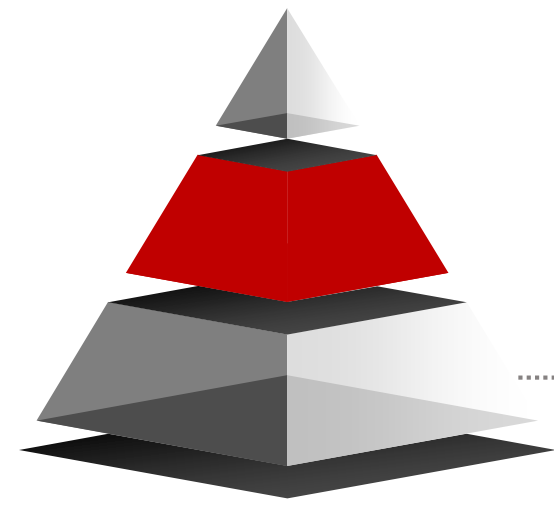
1、Today's Datacenter Challenges

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Basic Level



Liquid Selection



Material Compatibility



Signal Integrity
(PCB/ CONN)

Liquid Selection

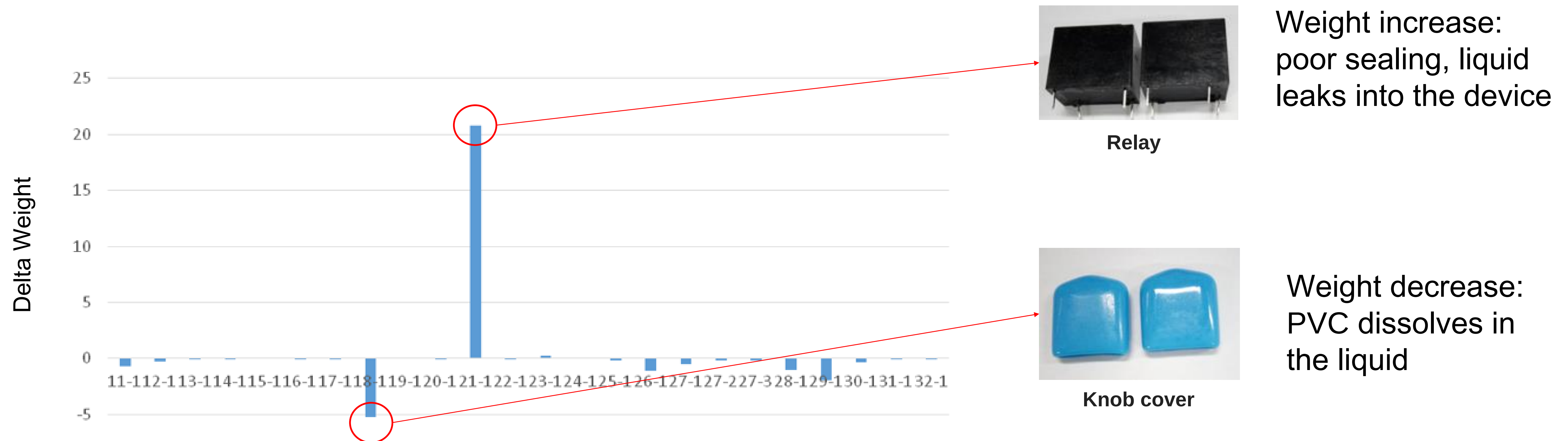
Choosing the right heat transfer fluid for immersion cooling requires a multi faceted evaluation of fluid candidates. The chart below shows the different parameters:

	Fluorocarbon	Mineral Oil	White Oil	Vegetable Oil
Heat Transfer Effectiveness	Very Good	Good	Good	Good
Electrical insulator Characteristics	Good	Good	Good	Good
Chemical stability	Very Good	Fair	Fair	Fair
Material Compatibility	Very Good	Good	Good	Fair
Oxidation Stability	Very Good	Good	Fair	Poor
Flammability	Very Good	Poor	Poor	Good
Cost	\$\$\$\$	\$	\$	\$\$

Challenges of immersion cooling

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Material Compatibility



The weight decrease in mass is due to small molecules such as PVC dissolves in the liquid.
Solutions: Replacing PVC with PTFE or other materials

The Weight increase in mass is due to liquid leaks into the device. It shows that the sealing performance of this type of relay is poor.
Solutions: Replace the relay with good sealing

Signal Integrity

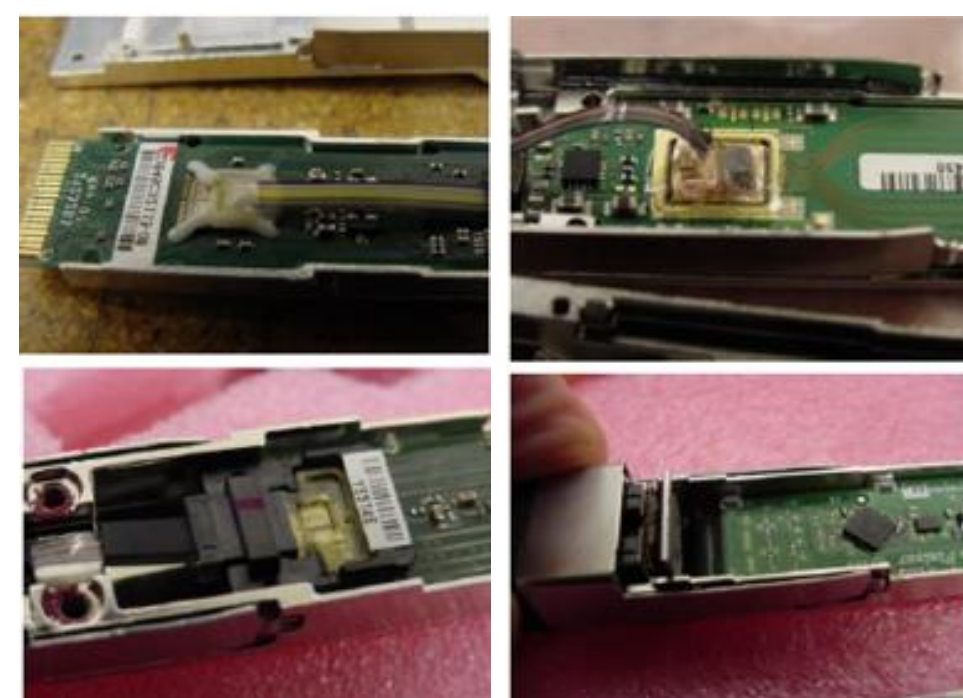
Type	Dielectric constant	6Gpbs (SAS/SATA)
A	7.52	Not meet
B	7.35	Not meet
C	1.91	Meet
D	1.9	Meet
E	1.80	Meet



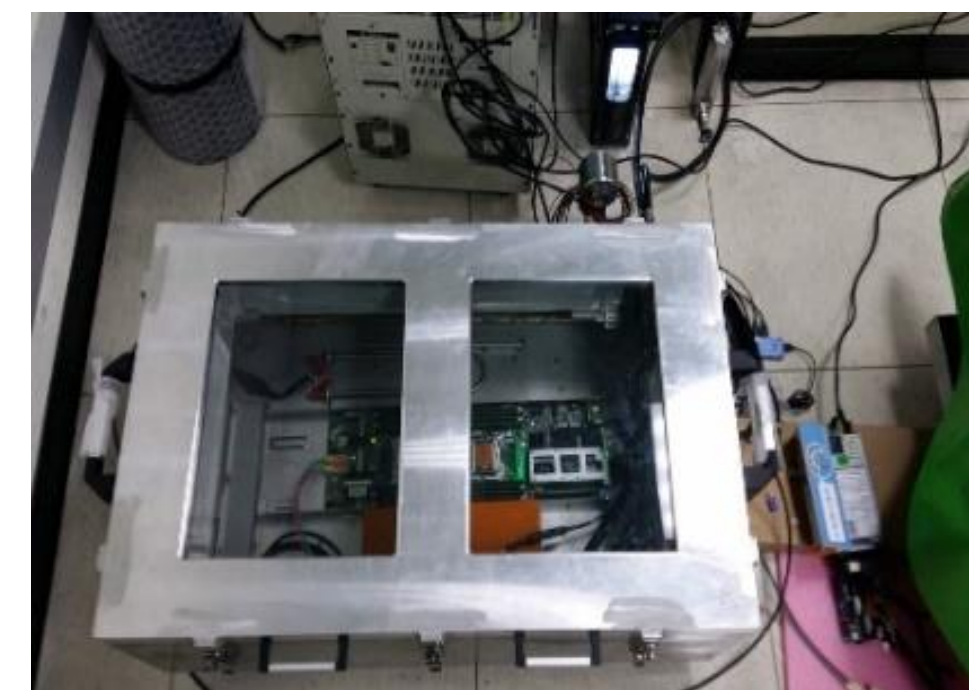
Component Level



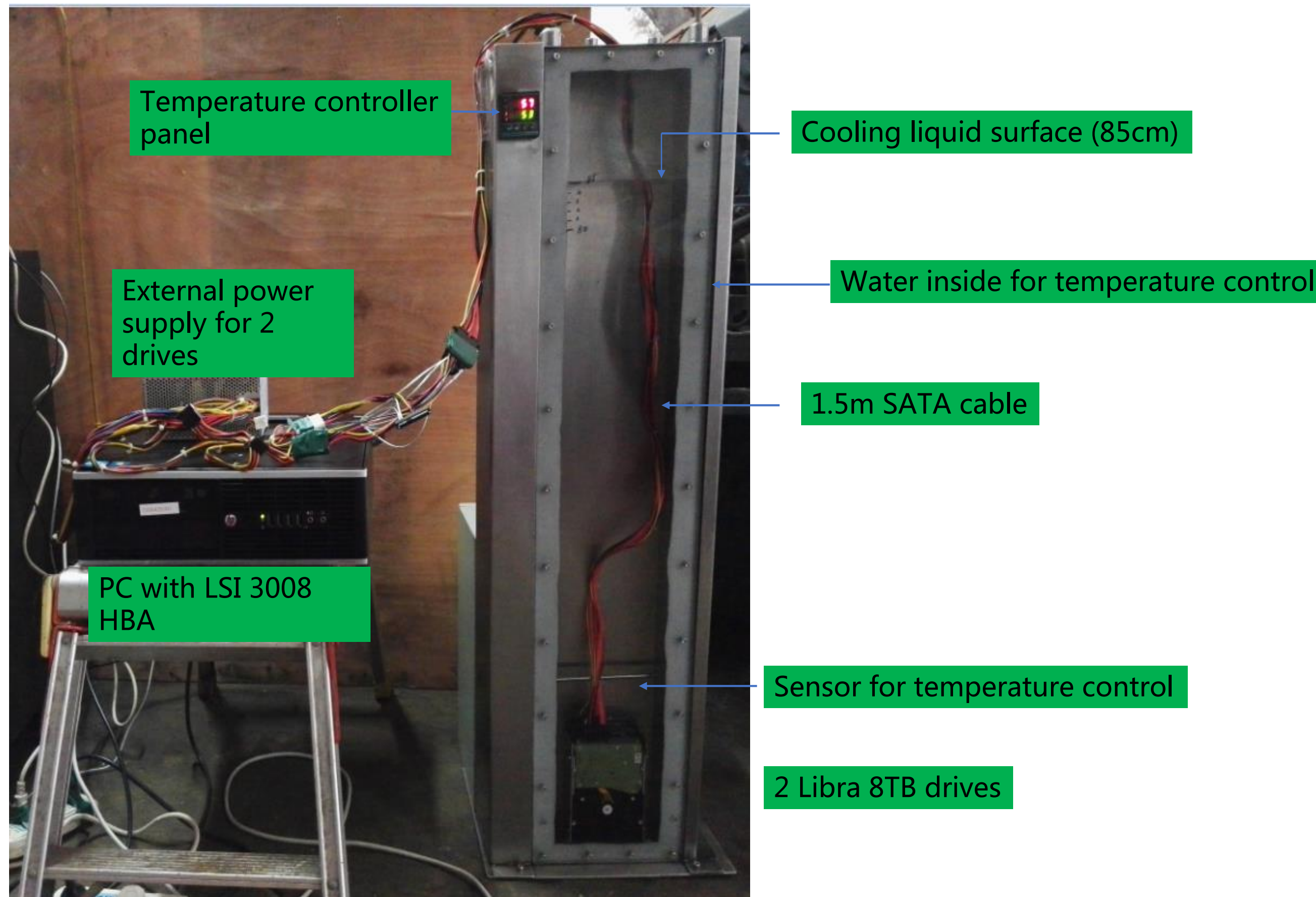
CPU, Storage, Memory,
HBA



Optical Devices



Performance, Stability,
Energy efficiency



Purpose

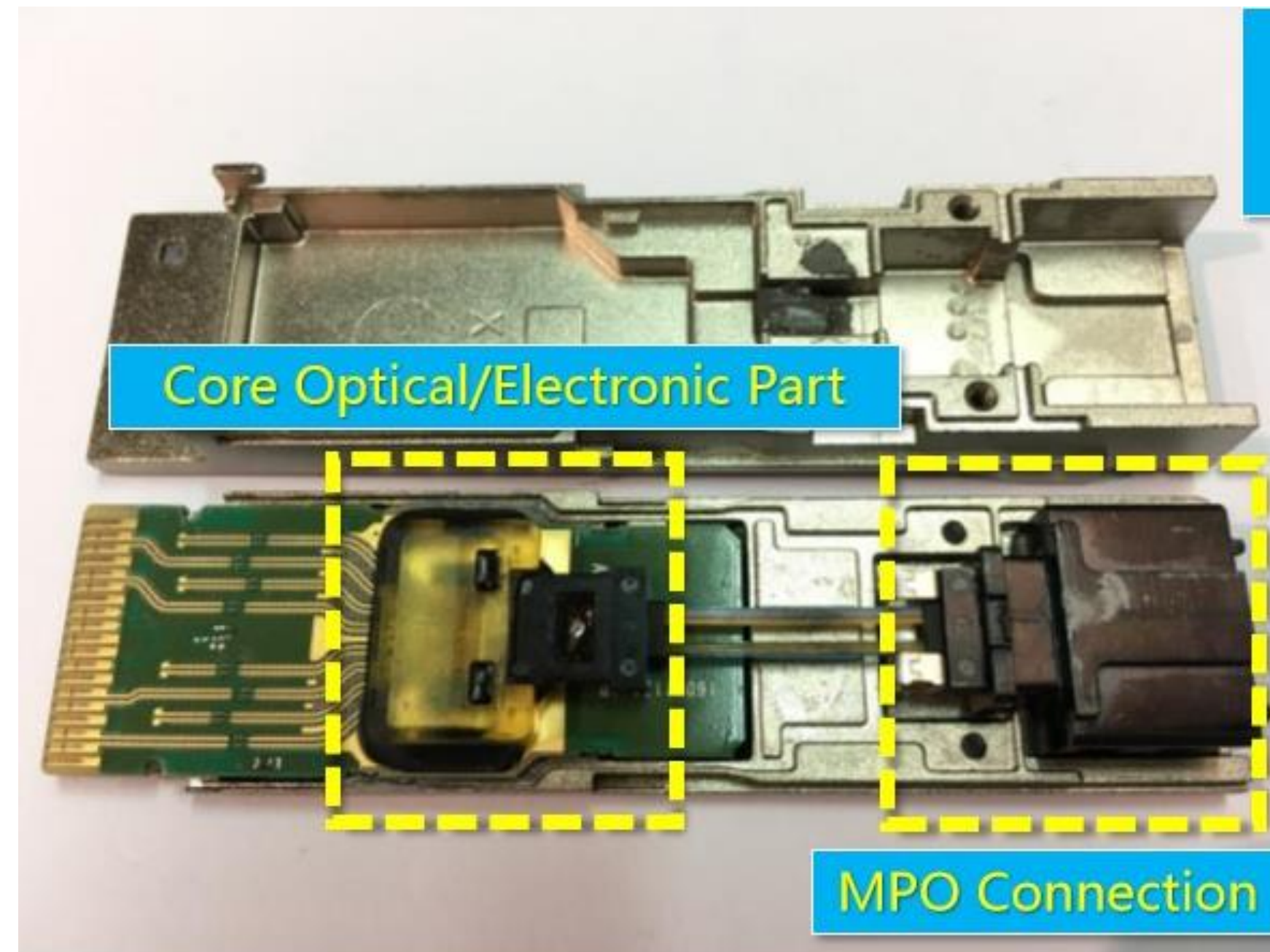
To confirm if there is a issue or degradation unique for liquid cooling in High Temperature

Condition

Drive : SATA 8TB

Condition : Soaked in the coolant (55degC 1000hrs) with running test script

Conclusion : No fatal issue and degradation were observed in 1000hrs running in 55degC liquid

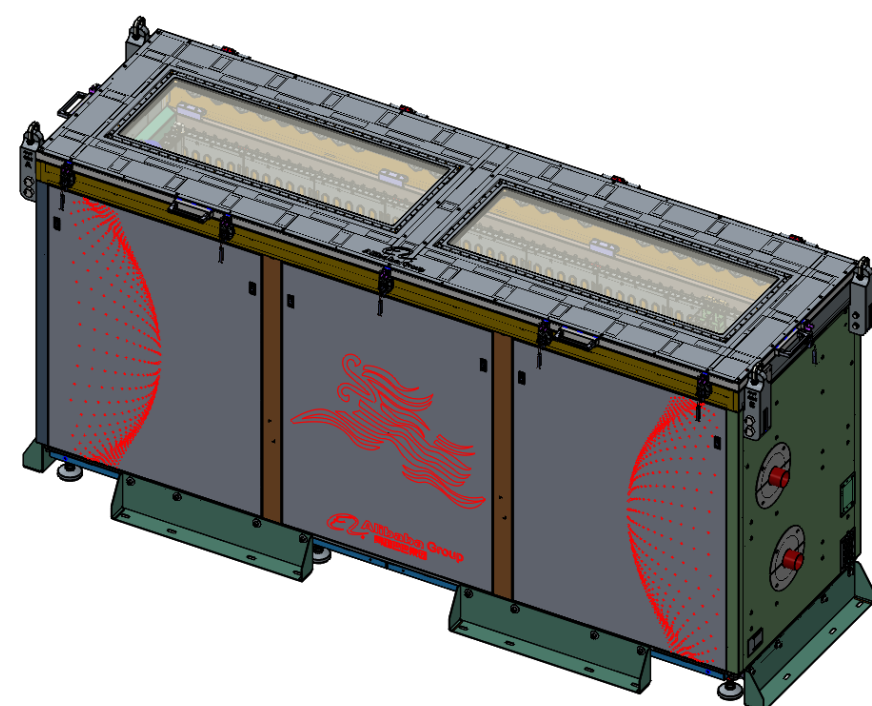
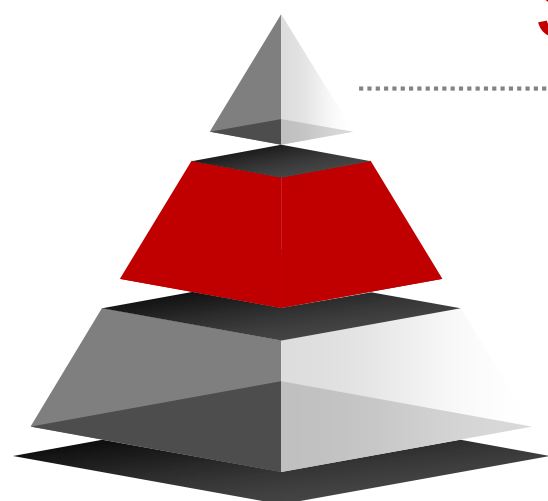


Unsealed



Sealed

System Level



Server architecture,
Tank sealing,
Maintainability,
Space utilization



Data center architecture
pipe layout

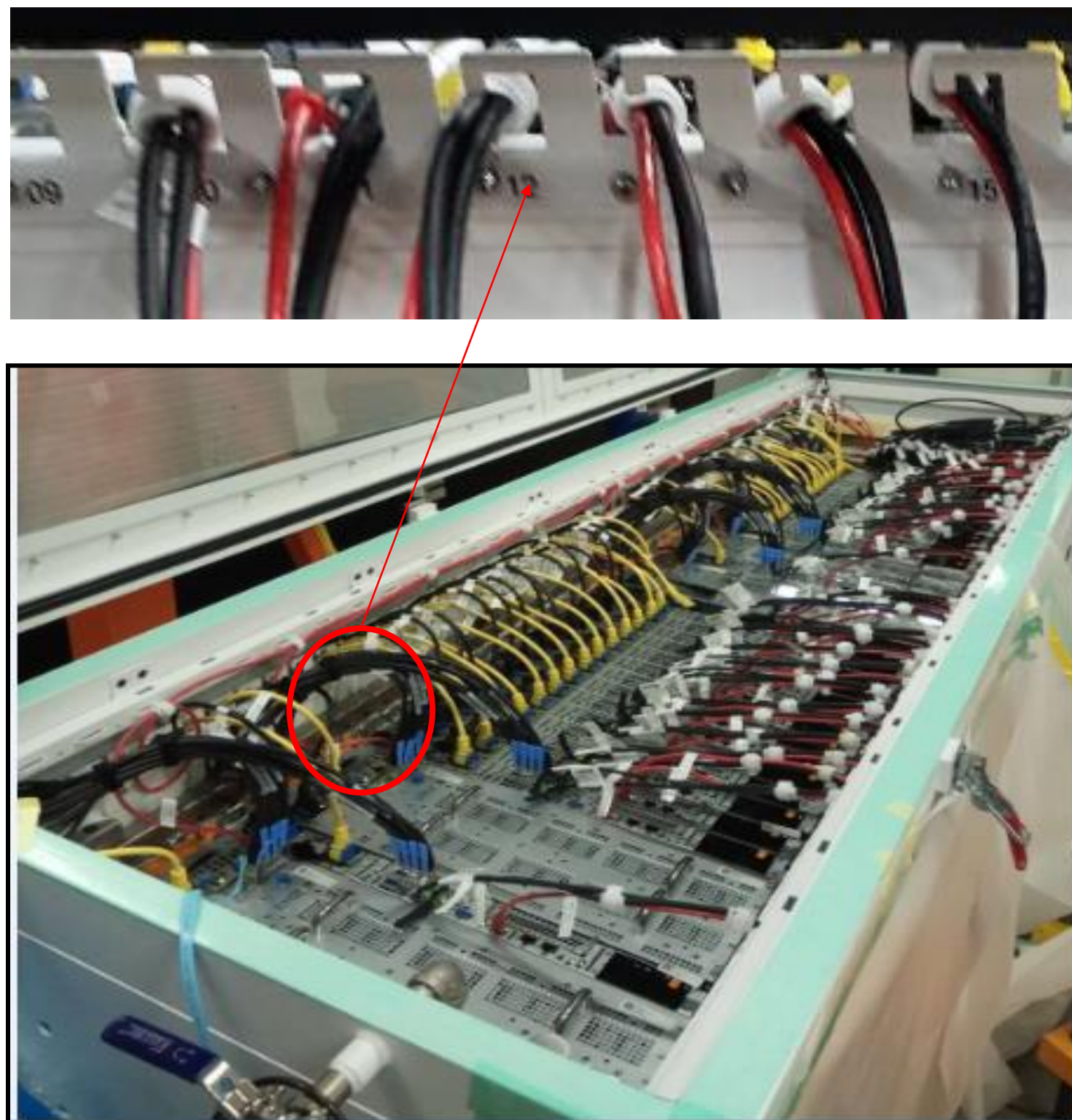


Monitoring and
Management system

Challenges of immersion cooling

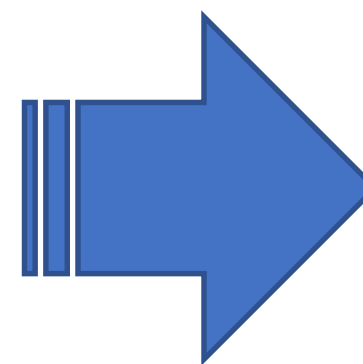
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Unsealed

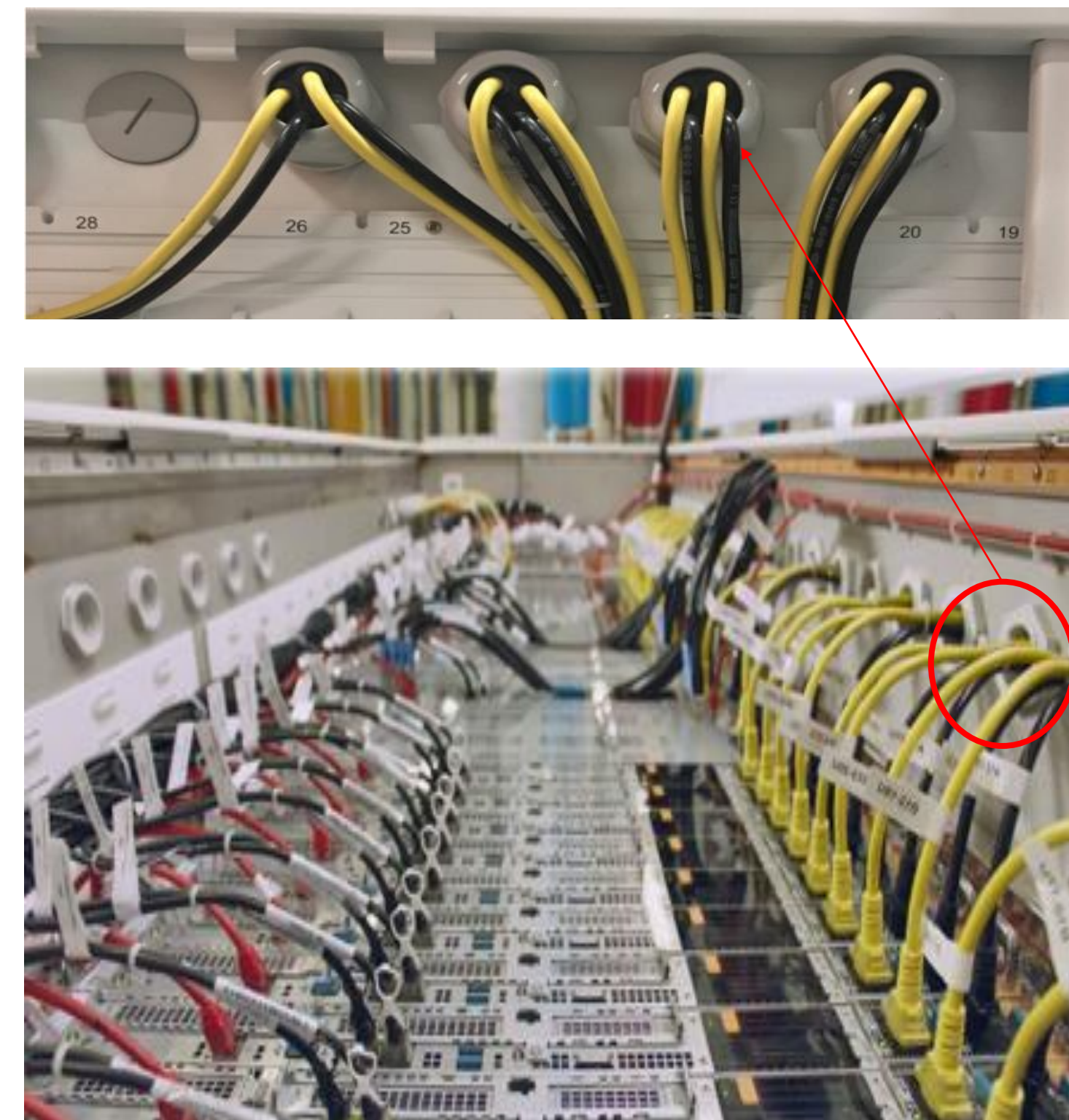


annual fluid loss ~10%

Tank sealing

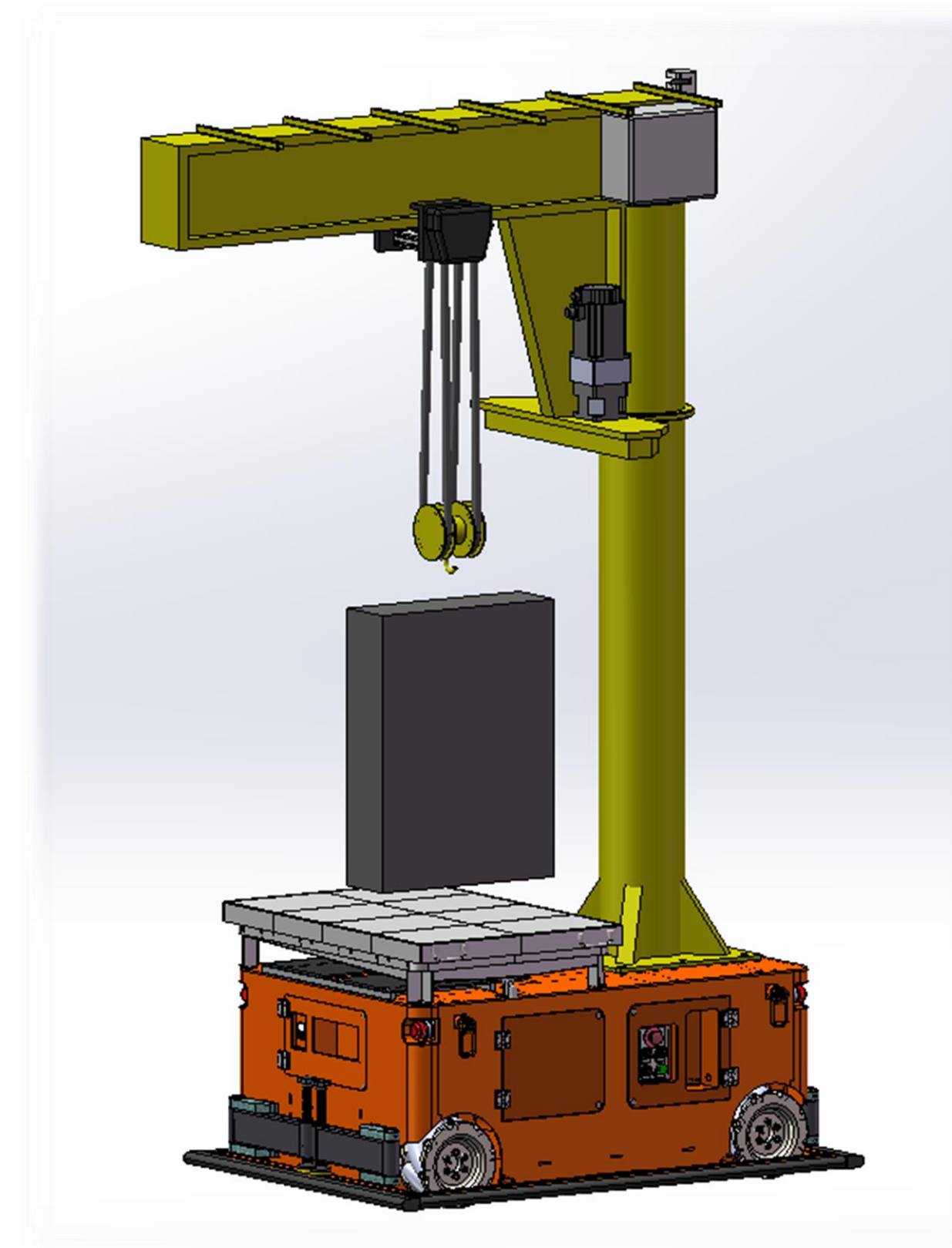
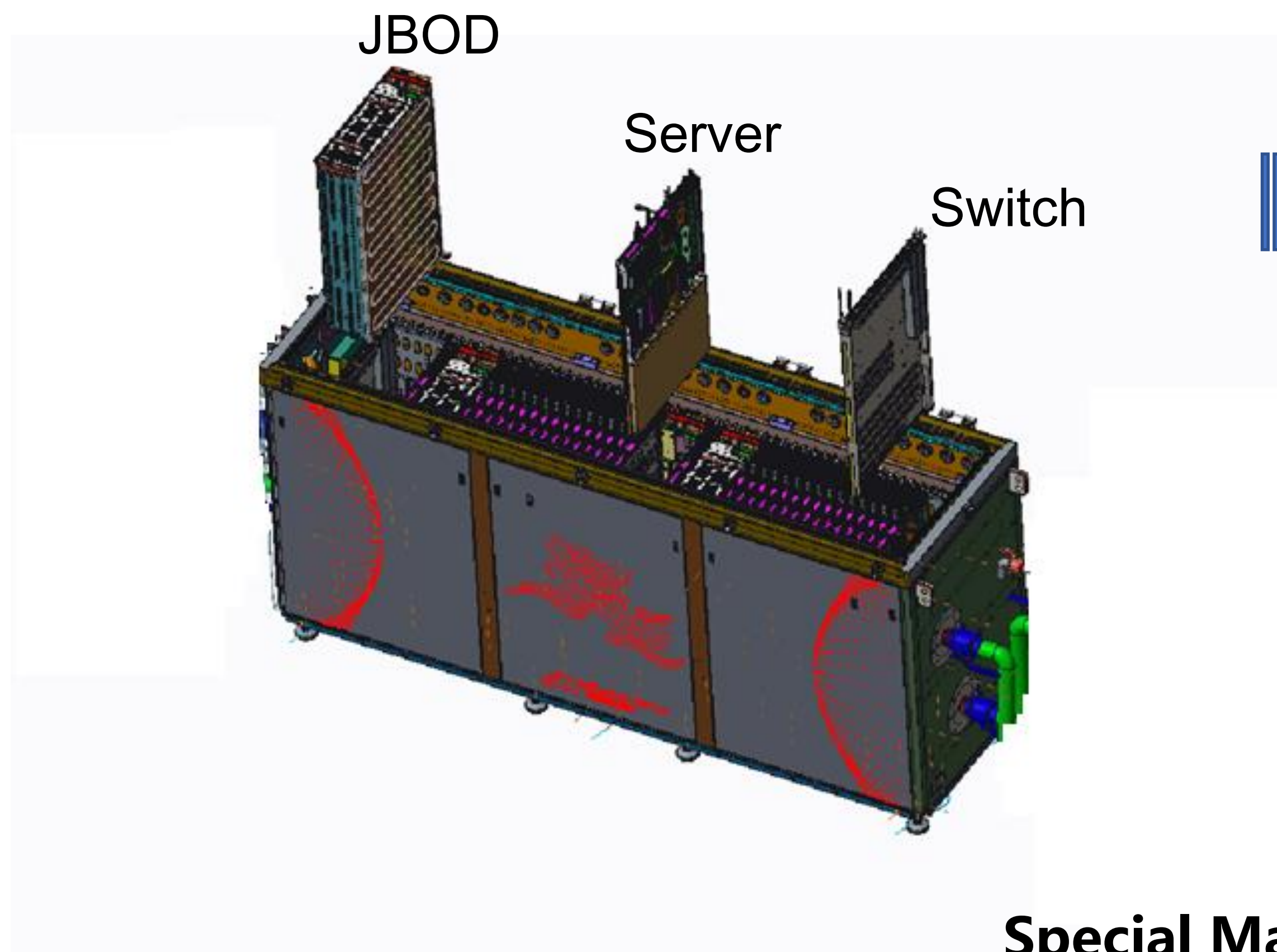


cable-sealed



annual fluid loss ~1%

Maintainability





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Practice of Alibaba

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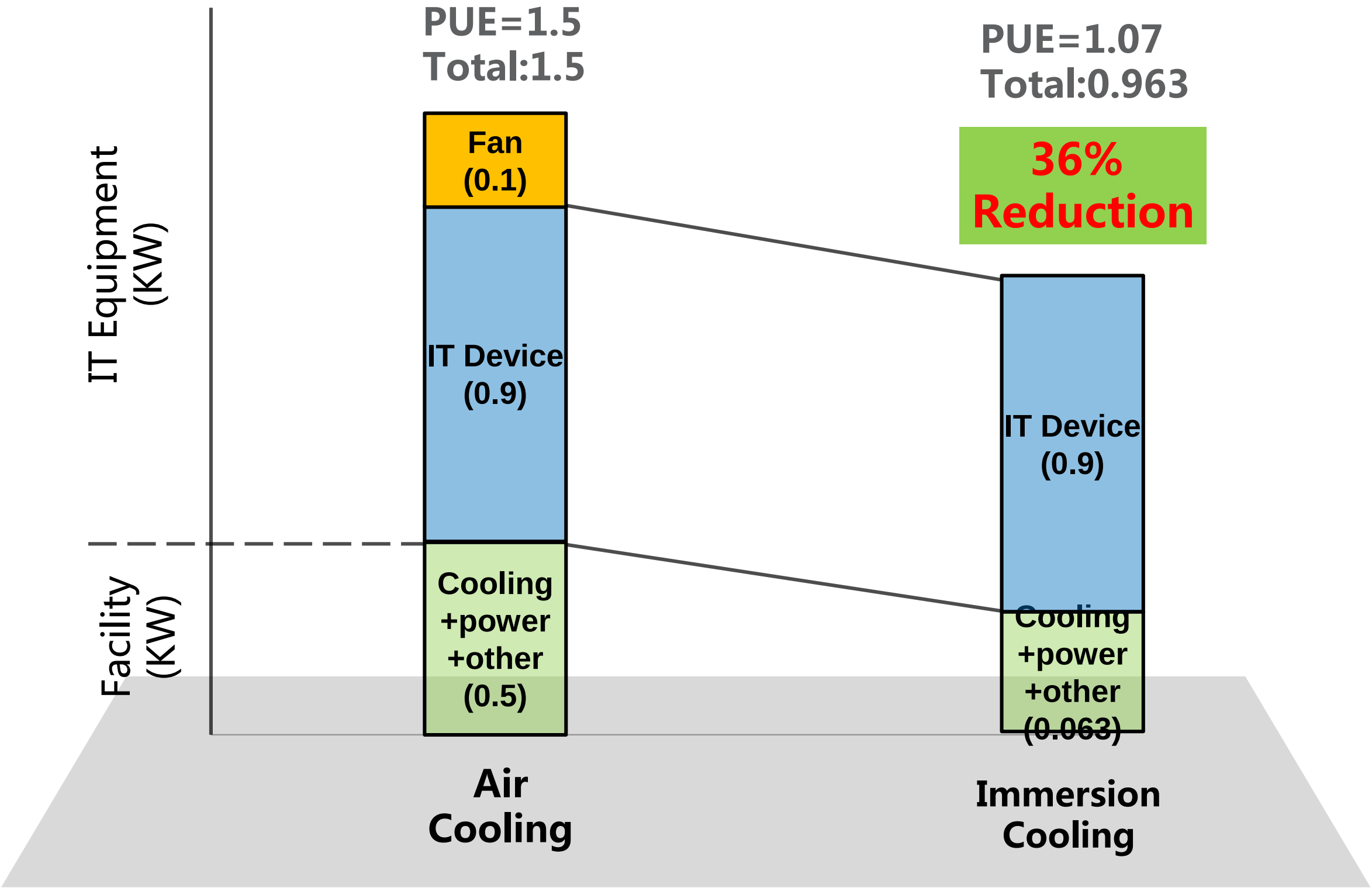


Practice of Alibaba

Less Power



Power consumption comparison
Air-cooling Vs immersion cooling

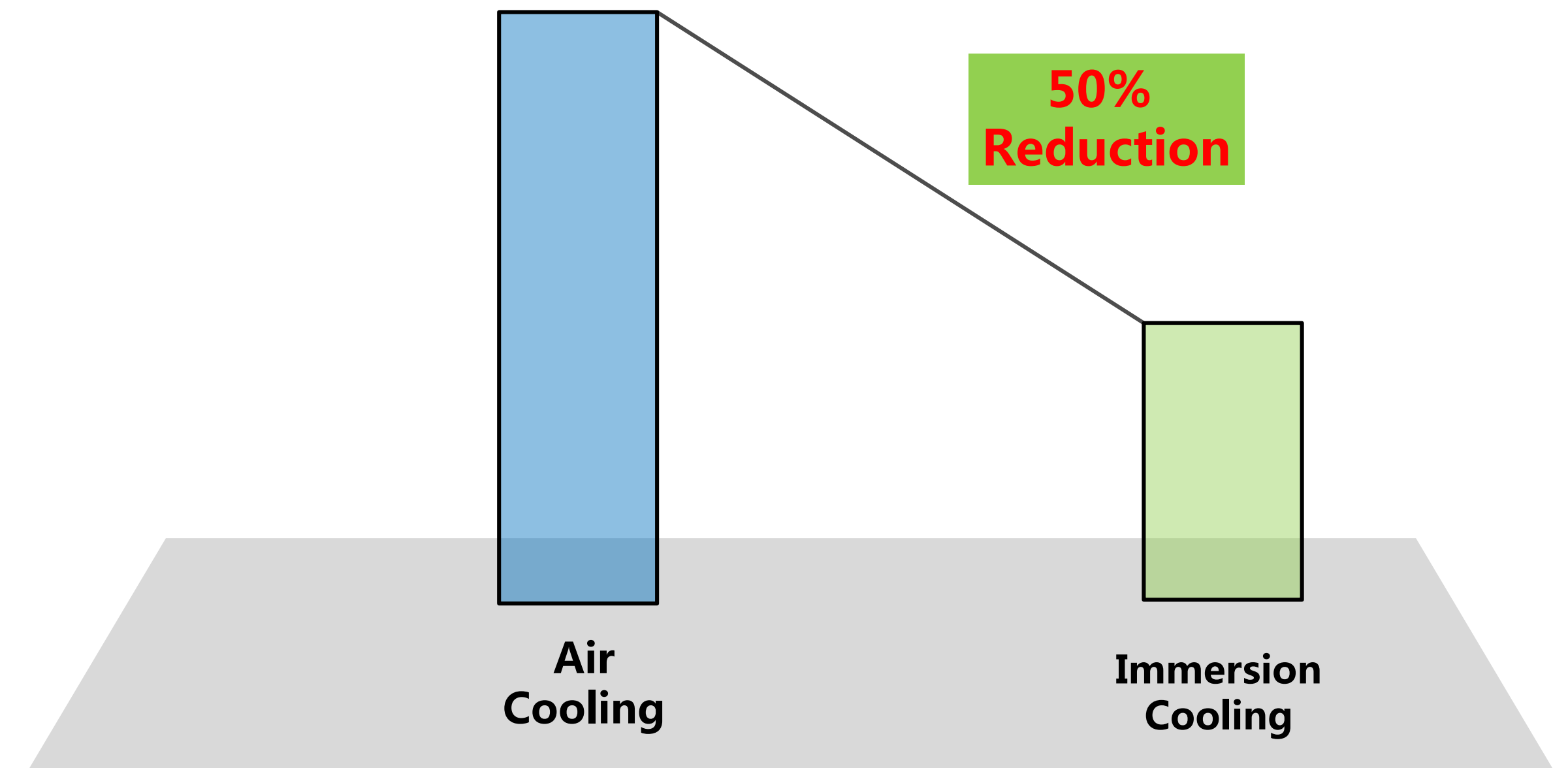


As the number of servers increases,PUE gradually stabilized from 1.13 to about 1.07.

Higher reliability



HDD Failure rate
Air-cooling Vs immersion cooling



Liquid protects IT devices from harsh environment including high temperature, humidity, vibration, dust
The failure rate of storage HDD in liquid is 50% lower than that of air-cooled environment.

Higher Stability

Thermal Inertia of a liquid bath 1000 times higher than air

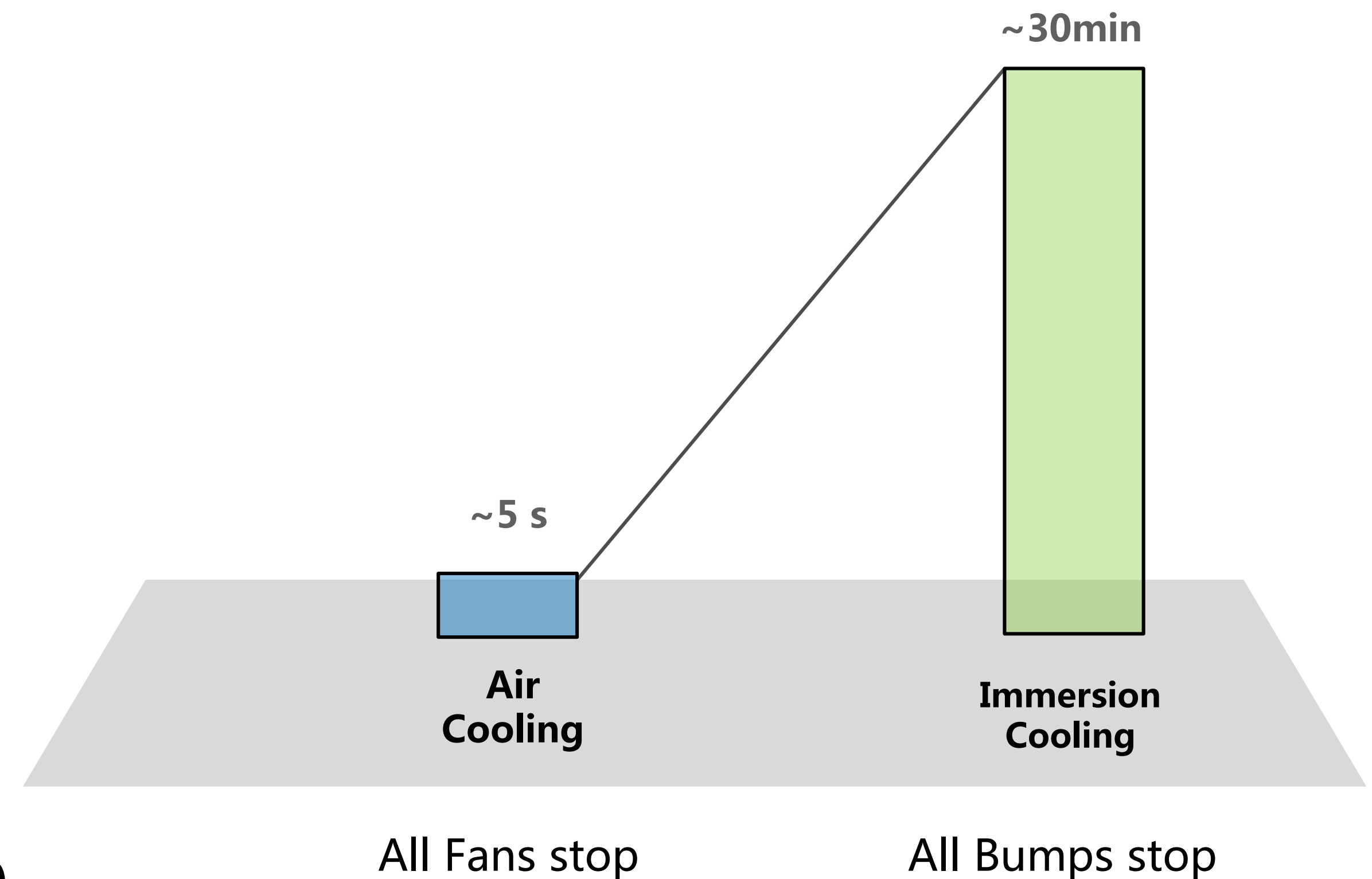
Liquid can safely absorb the heat pulses during heat exchanger units are in trouble

In case of a loss of cooling fluid

In air systems throttle and shut down in ~5 s

In immersion cooling system can run up to 30 min

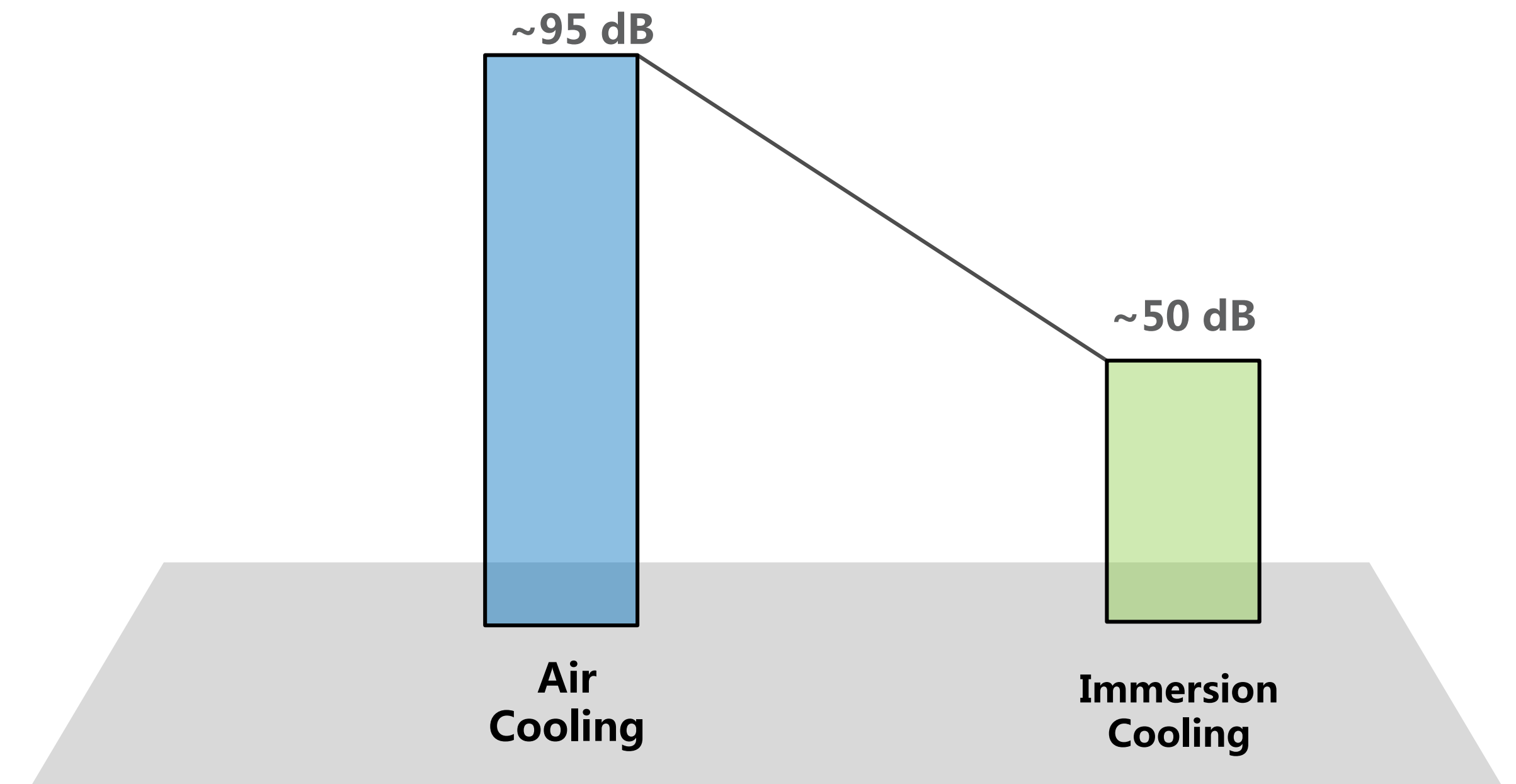
In case of a loss of cooling fluid
Air-cooling Vs immersion cooling



Lower noise

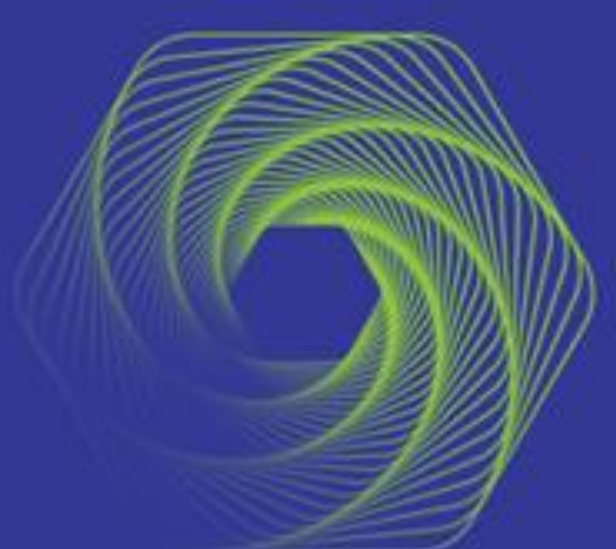


Noise Levels
Air-cooling Vs immersion cooling



In Alibaba air cooled data centers ,noise levels reach up to 95dB; In immersion cooling data center, noise levels are around 50dB

1. Immersion cooling is a better way to tackle the high power density challenges
2. Alibaba creatively bring the immersion cooling solution to its current data centers, and build out the world's first immersion cooling server cluster in internet industry. We hope to work together with industry partners to promote ecological development.



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