



# OCP SUMMIT

March 20-21  
2018  
San Jose, CA

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# **Two Phase Rack Level Liquid Cooling Solution**

Lentis Pai/Associate Director/Wiwynn

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# Agenda

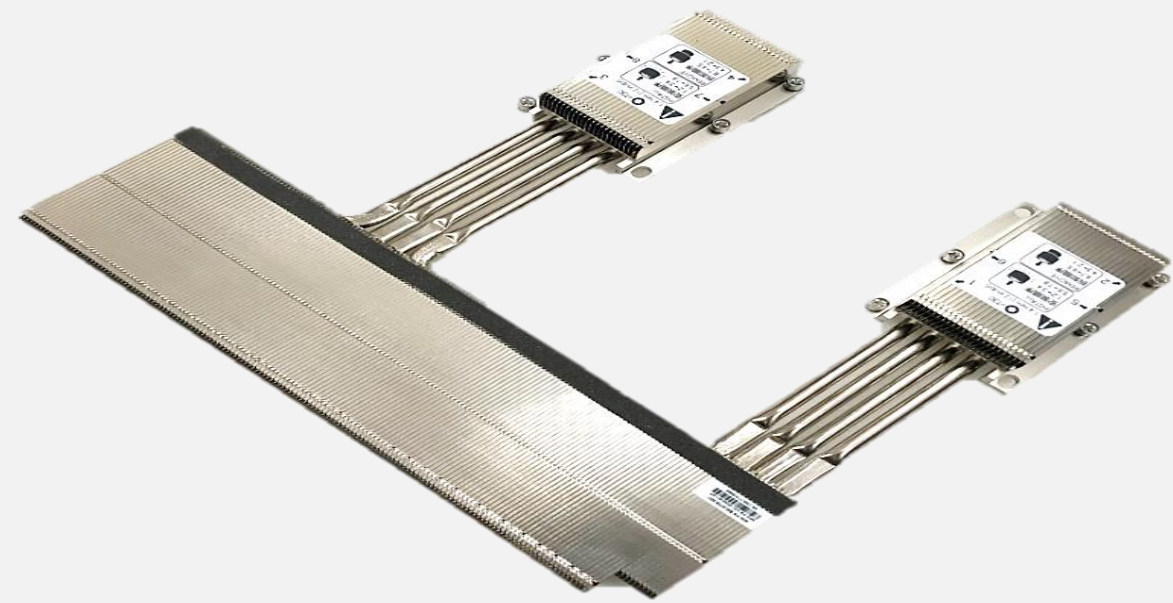
- **Existing Chassis Level Solution**
- **Wiwynn Two Phase Immersion Cooling**
- Rack Level Liquid Cooling Solution Overview
- Investigation of Single Phase & Two Phase
- Advantage
- Next Investigation
- Schedule

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# Existing Chassis Level Solution

Enhanced Volume Air Cooling



Air

Water Assisted Air Cooling



Water + Air

Flexible Solution

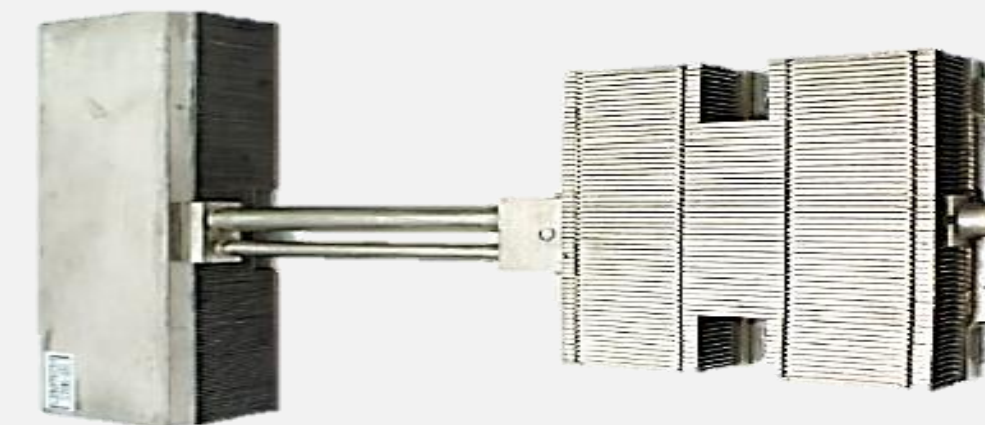
Patent

Loop Heat Pipe



Air

Thermosiphon



Air

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# Wiwynn Two Phase Immersion Cooling

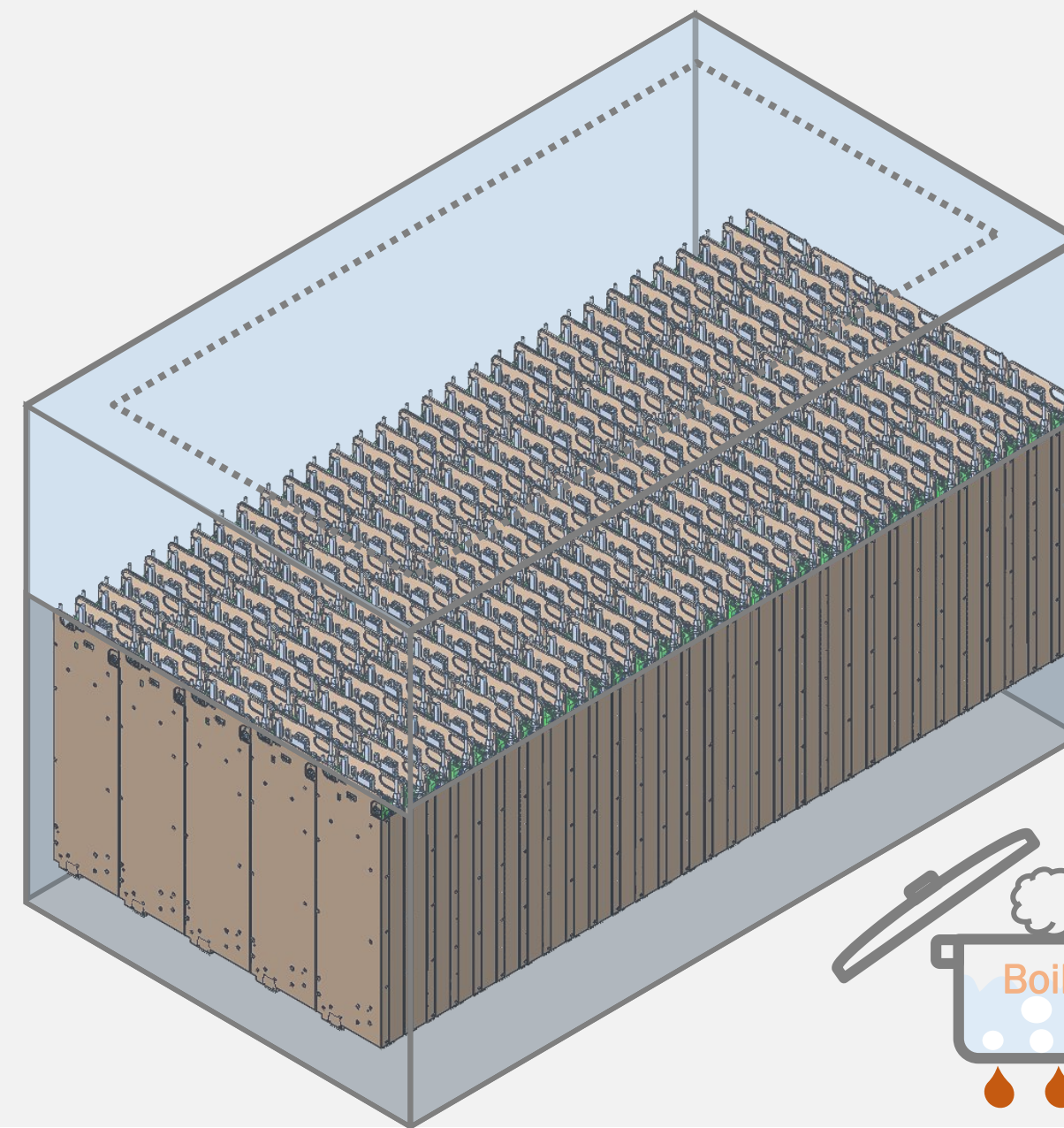
## Two Phase Immersion Cooling

- 48Vdc
- High Power Efficiency
- High Capacity Usage

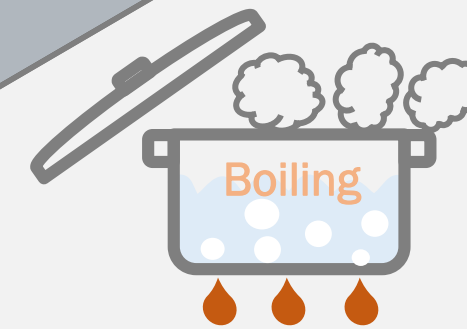
- POC Project

- White Paper

Board Matrix in Tank



Sled



# 48Vdc

### POC Schedule

~February 2018  
POC Design

April 2018  
POC Prototyping

May 2018  
POC Test

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# Current Limitation

Chassis  
Level

- High Power ASICs are in demand with **limited space**

Water  
Cooling

- **Water leakage** is concerned in rack

Immersion  
Cooling

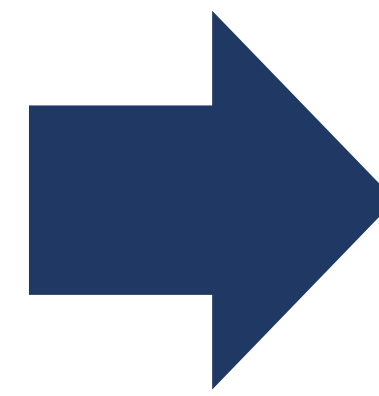
- Power dissipating ability is enhanced with **data center facility change**

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# Complementary Solution

**Chassis Level**

**Limited Space**



**Rack Level**

**More Space**

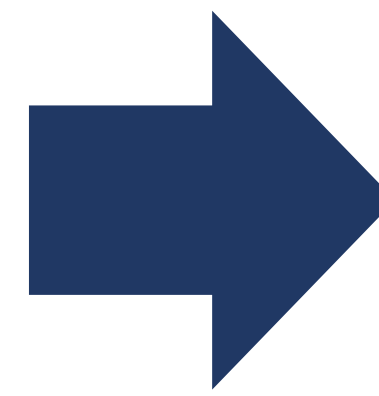
**Fan Wall**

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# Complementary Solution

**Water Cooling**

**Water Leakage  
Freeze  
Corrosion**



**Dielectric Fluid**

**Minimum Risk**

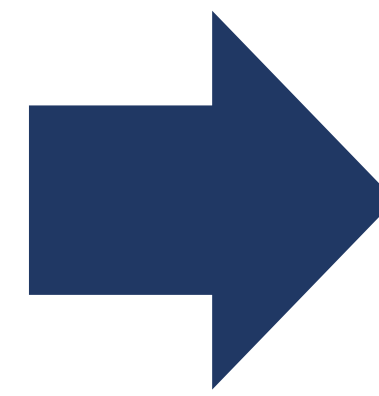
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# Complementary Solution

**Immersion Cooling**

**Facility &  
Serviceability  
Change**



**Two Phase Liquid  
Assisted Air Cooling**

**High Heat Transfer**  
**No Change**

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# Complementary Solution

## Two Phase Liquid Assisted Rack Level Air Cooling

**More space**

**No data center facility change**

**Dielectric fluid with minimum leakage concern**

**High heat transfer ability of latent heat of vaporization**

# Advantages drive us to investigate

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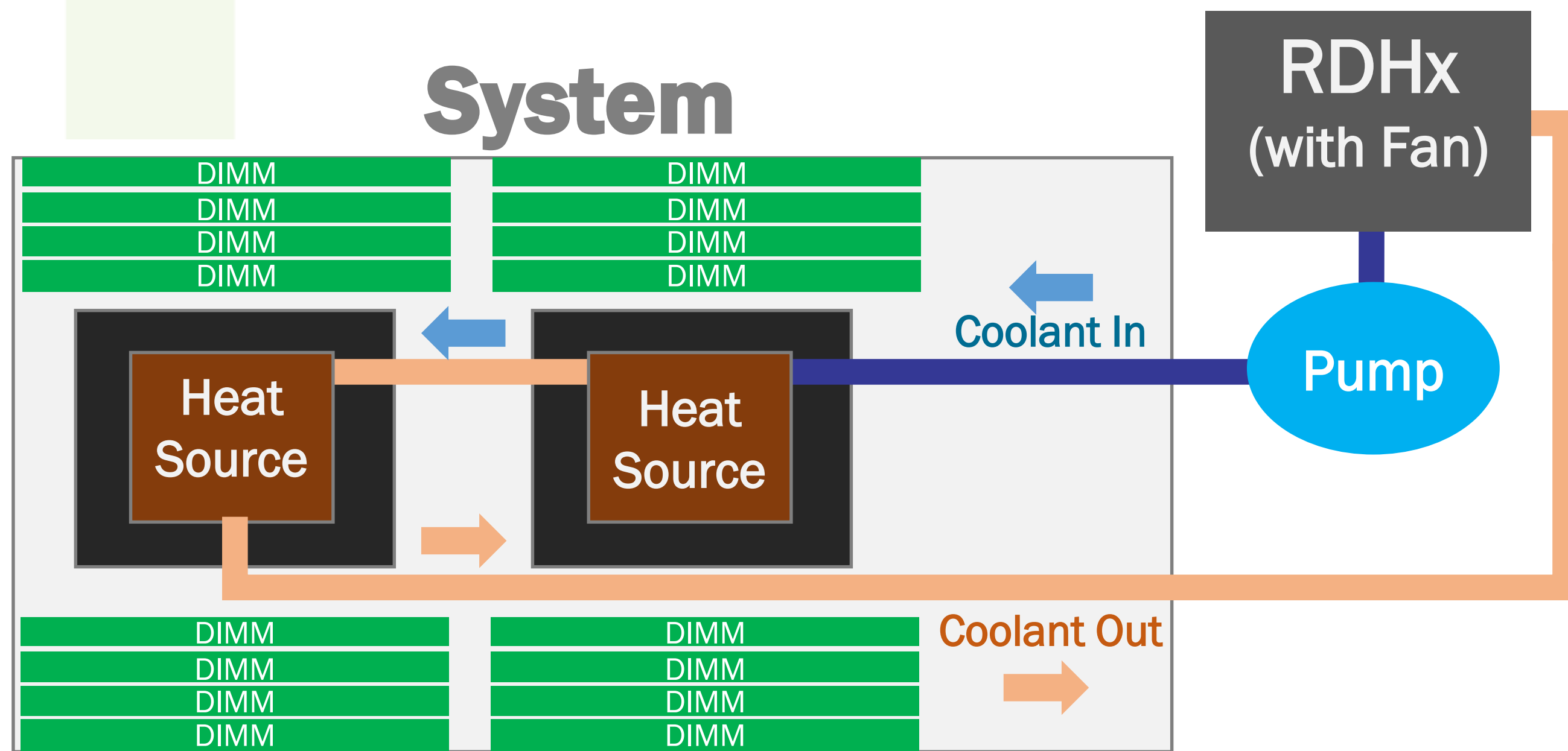
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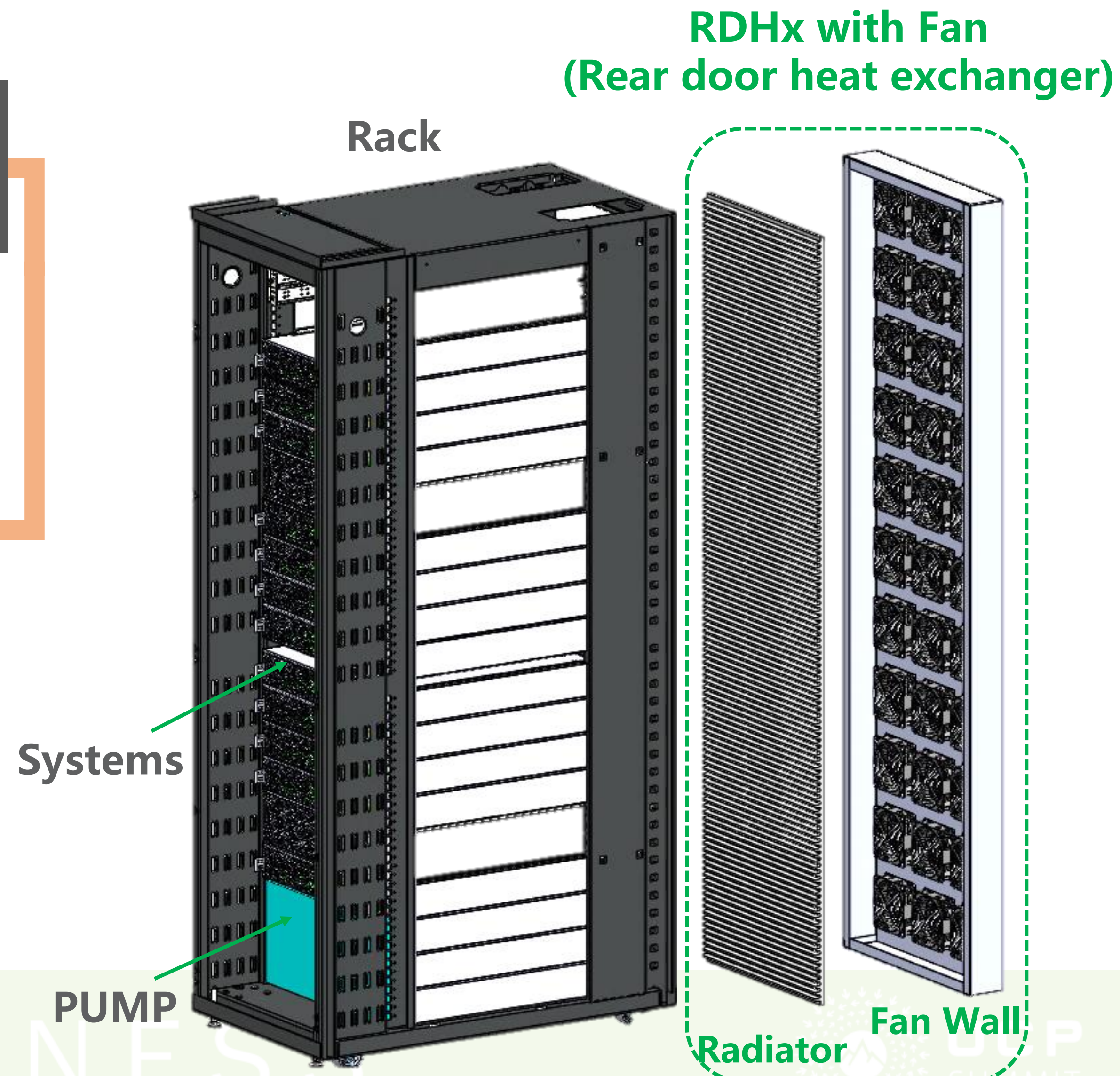
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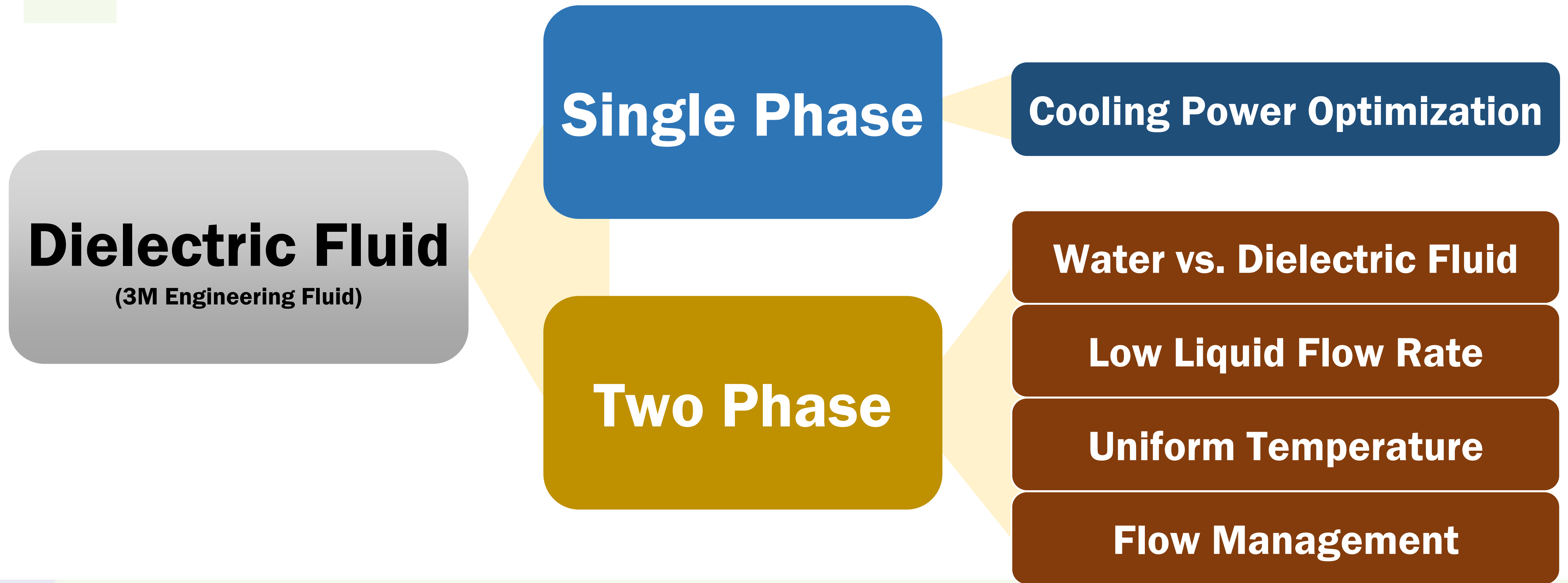
# Rack Level Liquid Cooling Overview



**Working Fluid**  
**Dielectric Liquid**  
(3M Engineering Fluid)

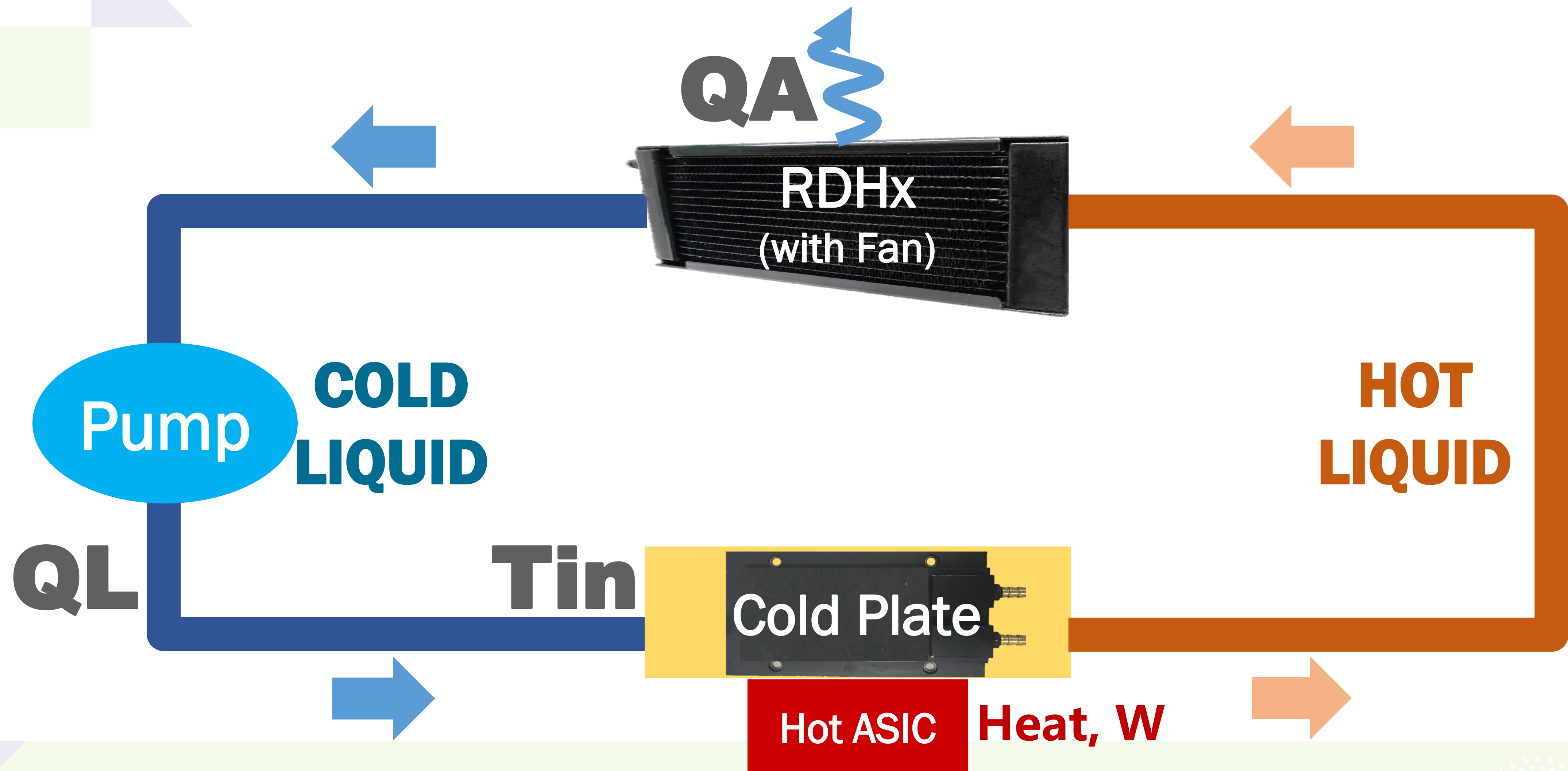


# Investigation of Single Phase and Two Phase



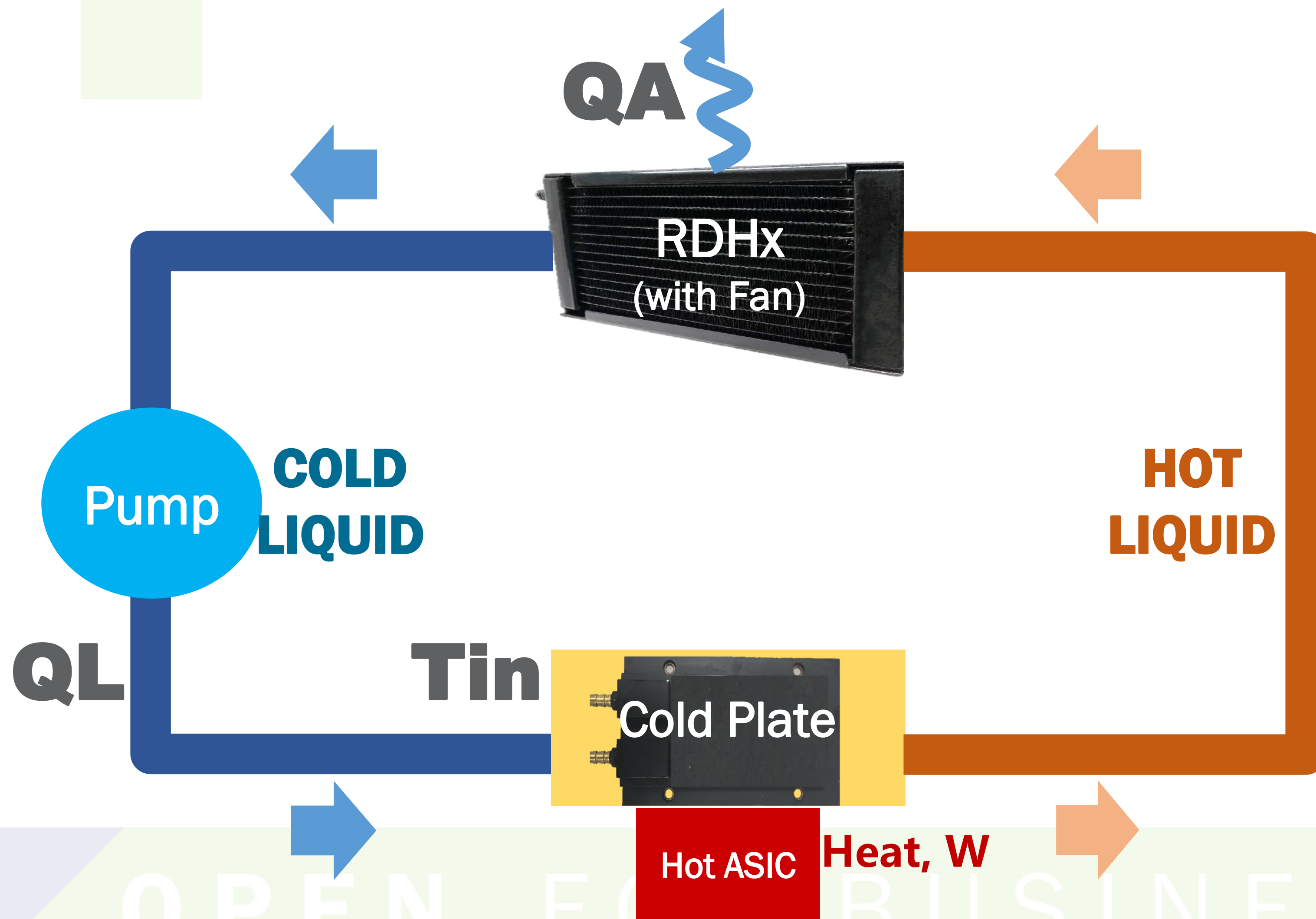
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# Liquid Cooling Loop (Single Phase)



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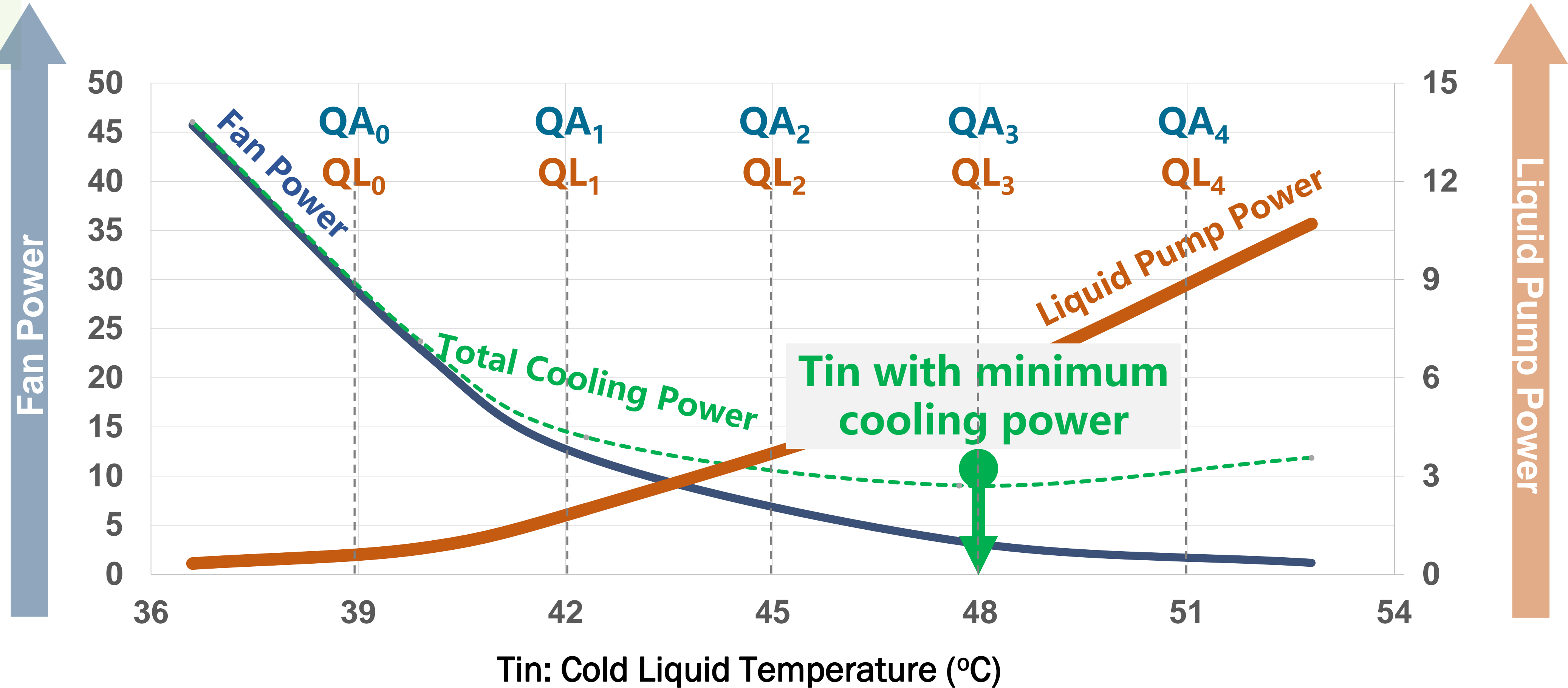
# Investigation - Cooling Power Optimization



Keep a target ASIC temperature

Optimize QA and QL by cooling power perspective

# Investigation - Cooling Power Optimization (Experiment)



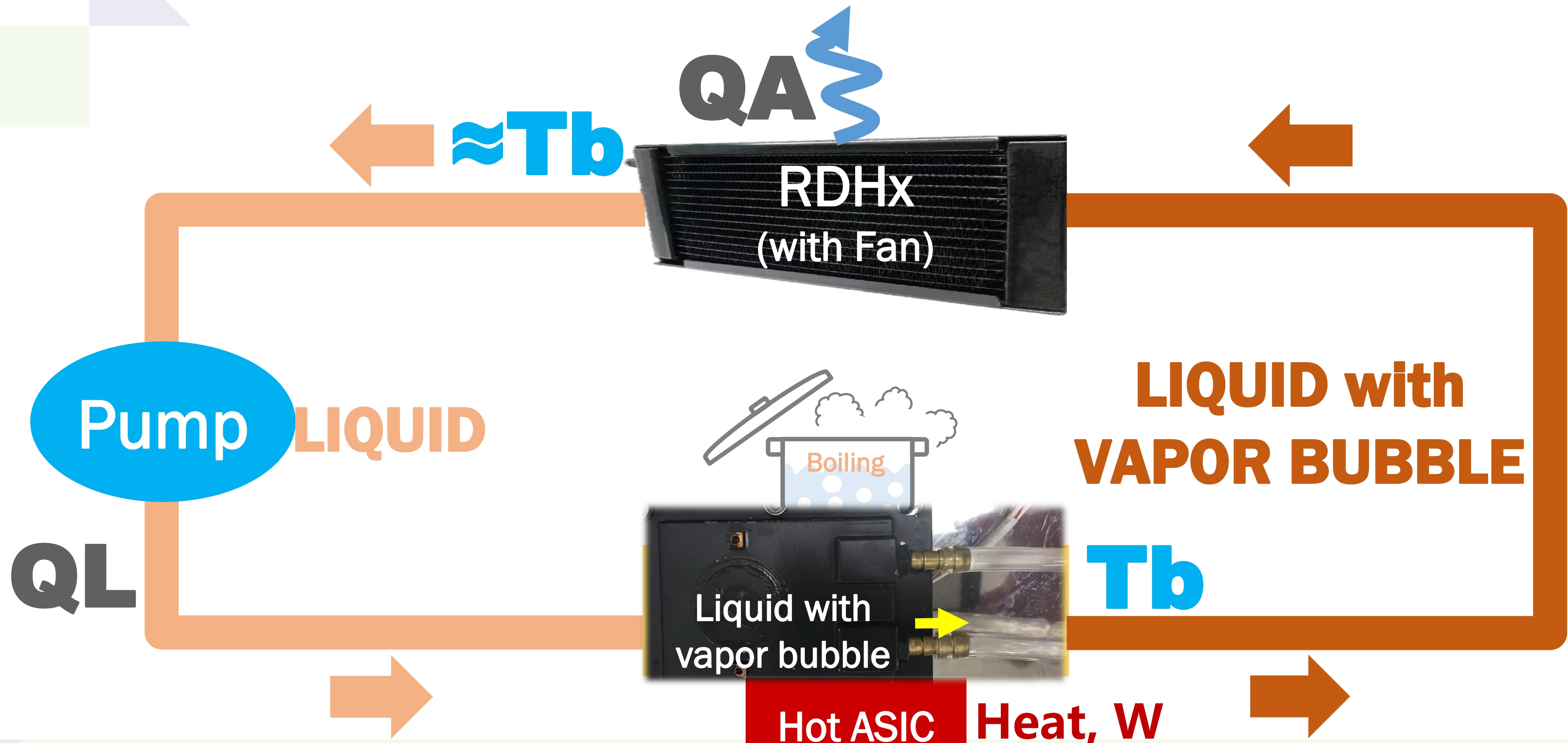
Condition: 250W Heat source at 25°C ambient temperature, target heat source case temperature = 55°C

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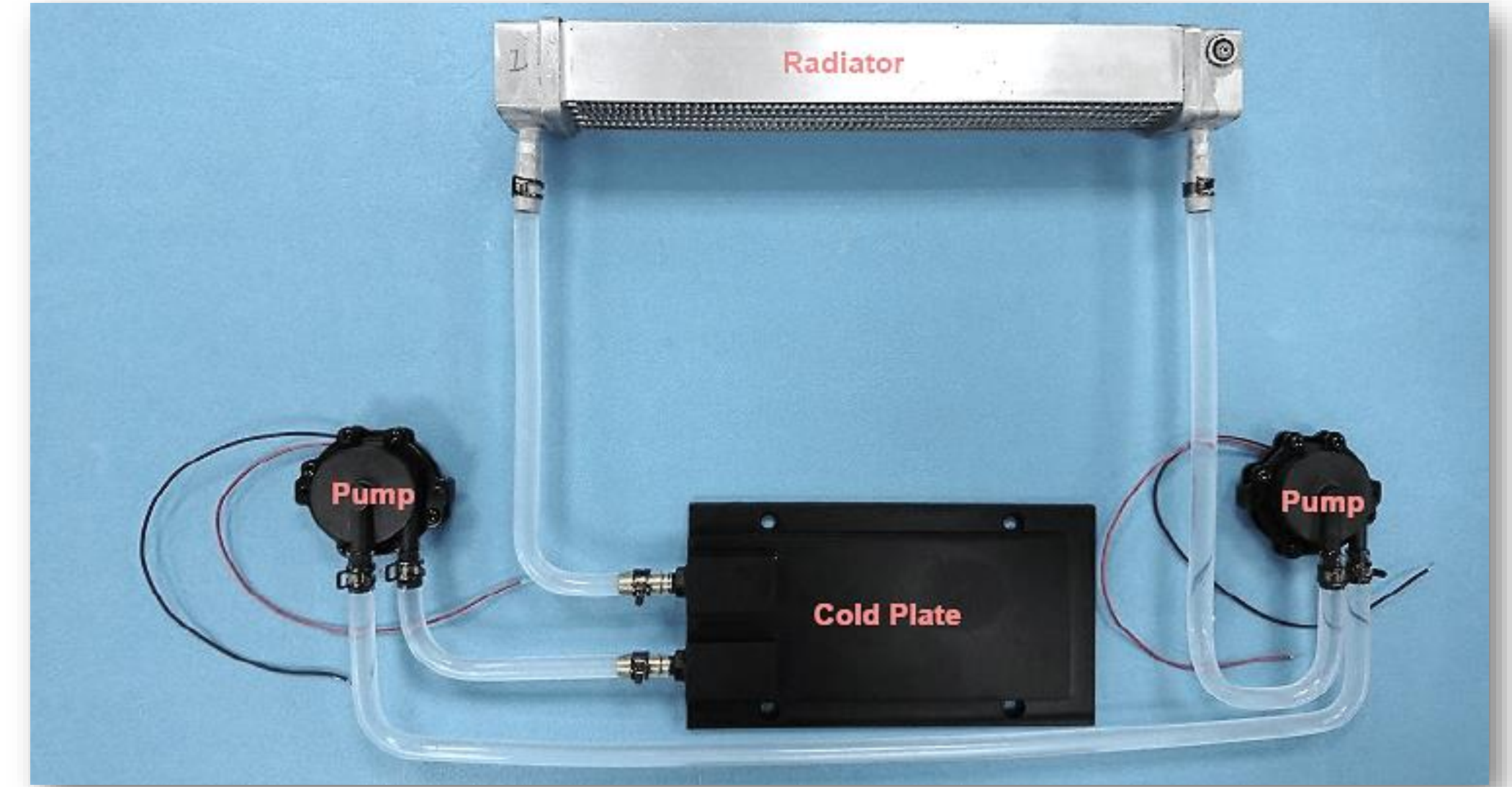
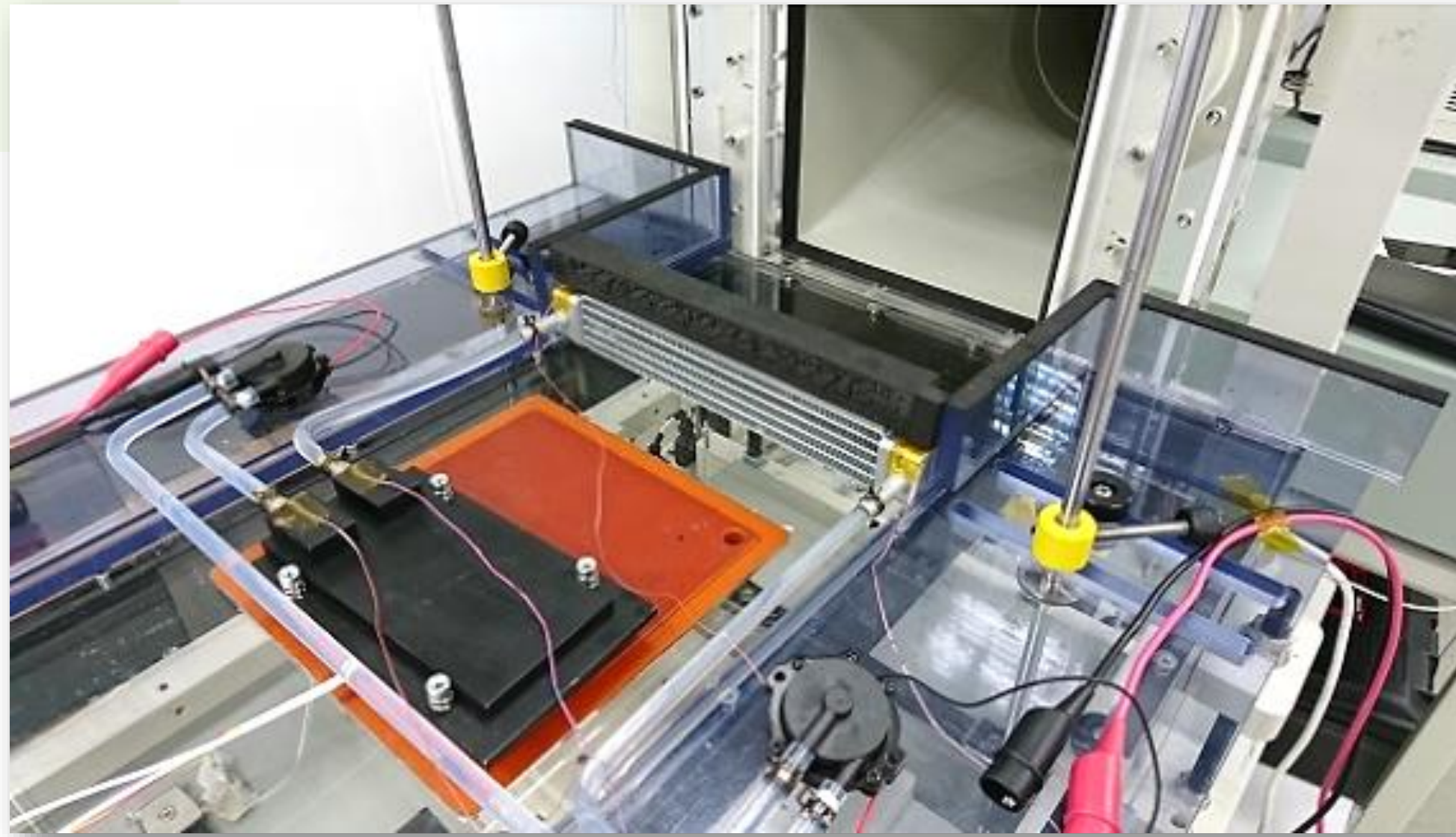


# Liquid Cooling Loop (Two Phase)



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# Investigation – Dielectric Fluid vs Water

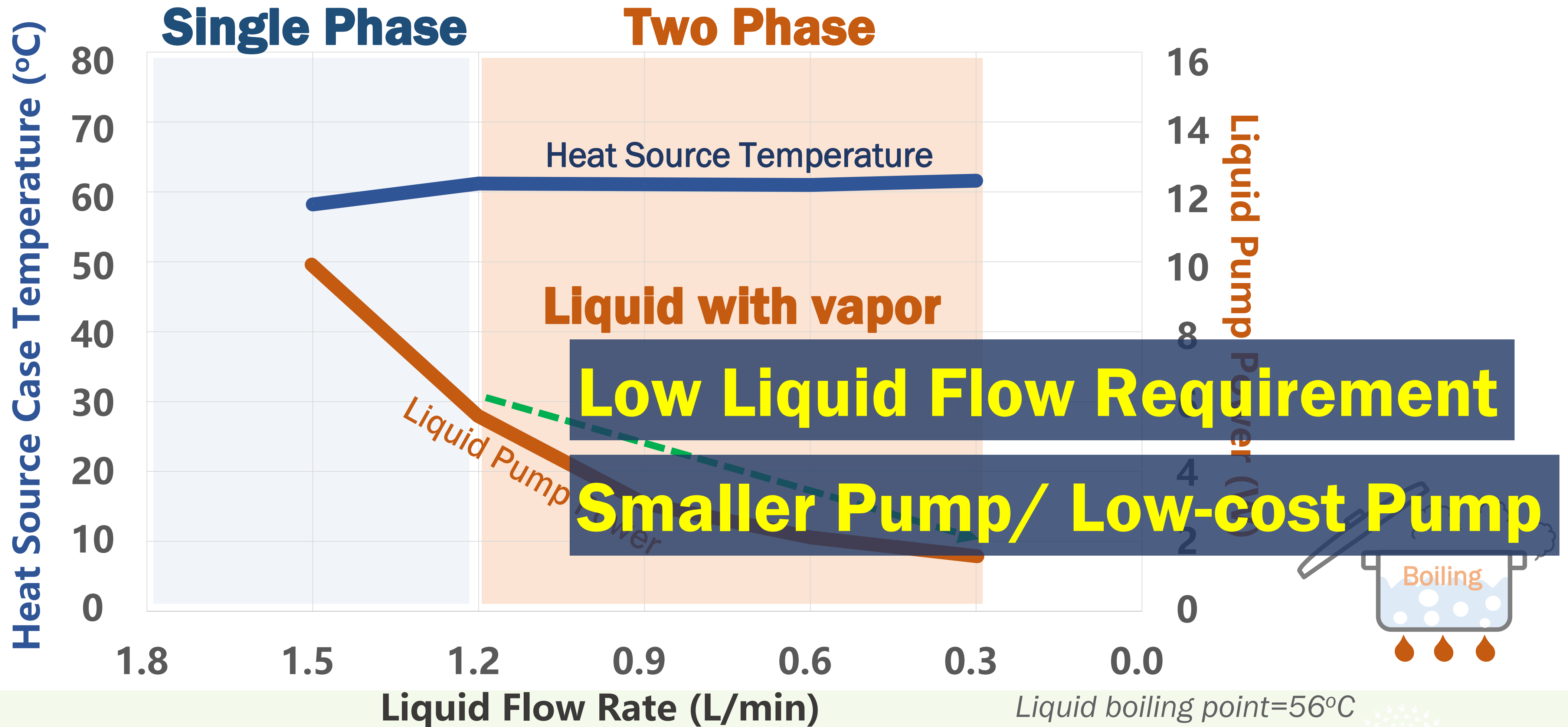


Fluid	Phase	Heat Source Power	Liquid Flow Rate	Air Flow Rate	Heat Source Case Temperature
Water	Single Phase	400W	0.3 L/min	26CFM	<b>68.2</b>
Dielectric Fluid (3M, FC-72)	Two Phase	400W	0.3 L/min	26CFM	<b>63.5</b>

Liquid boiling point=56°C

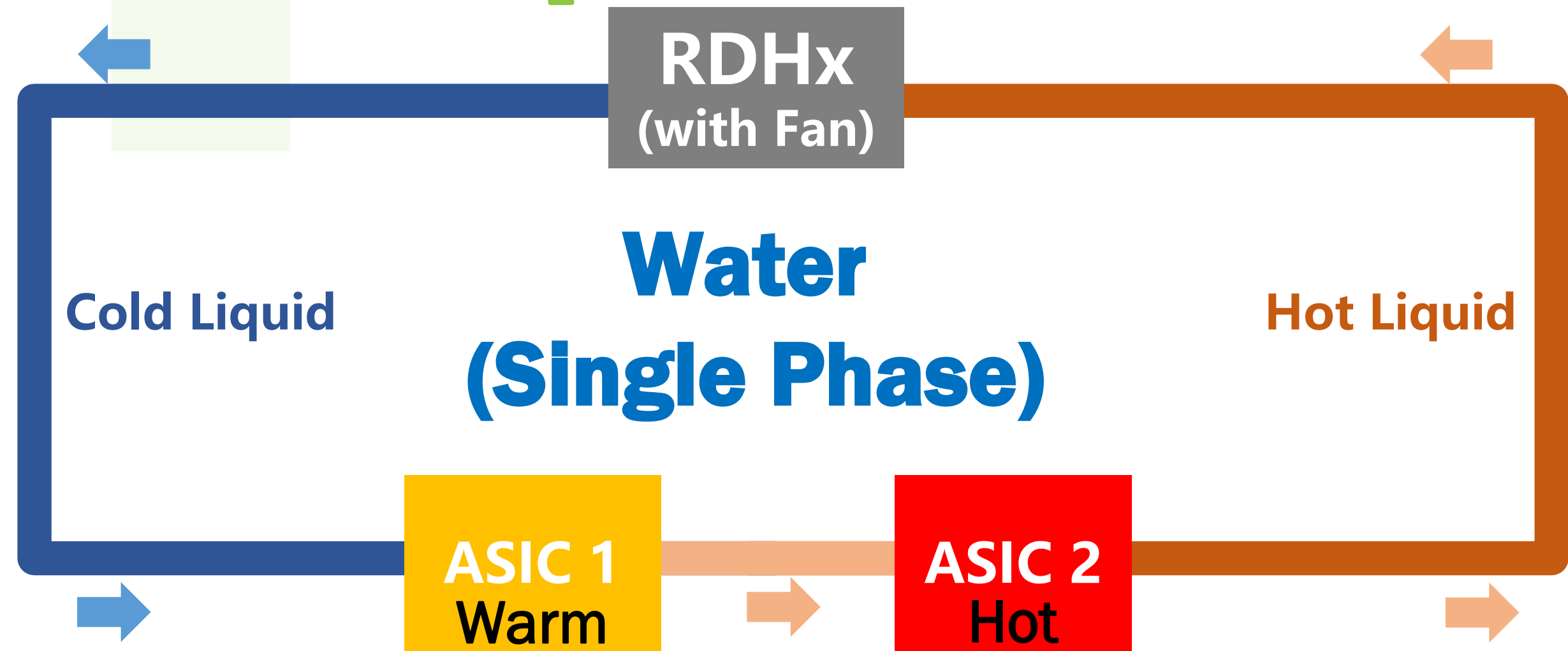
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# Investigation – Low Liquid Flow Rate

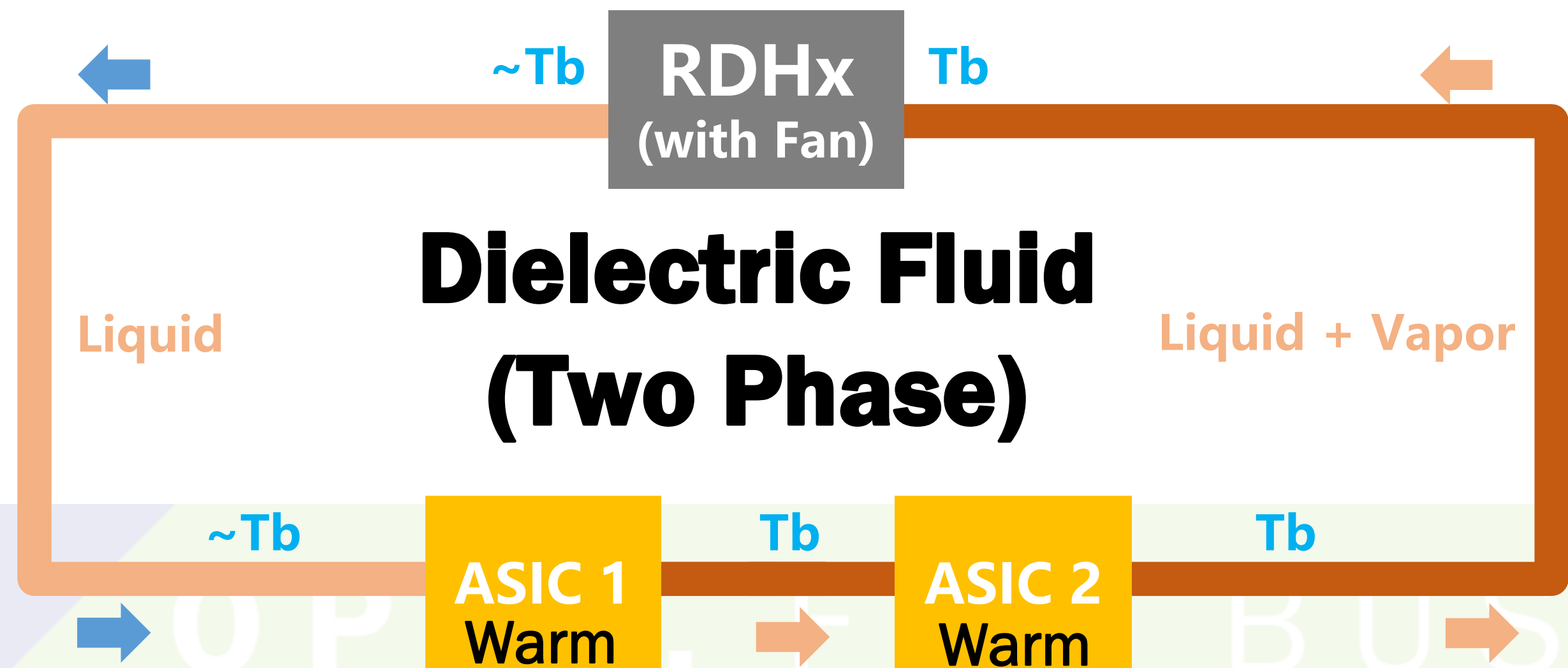


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# Investigation - Uniform Temperature



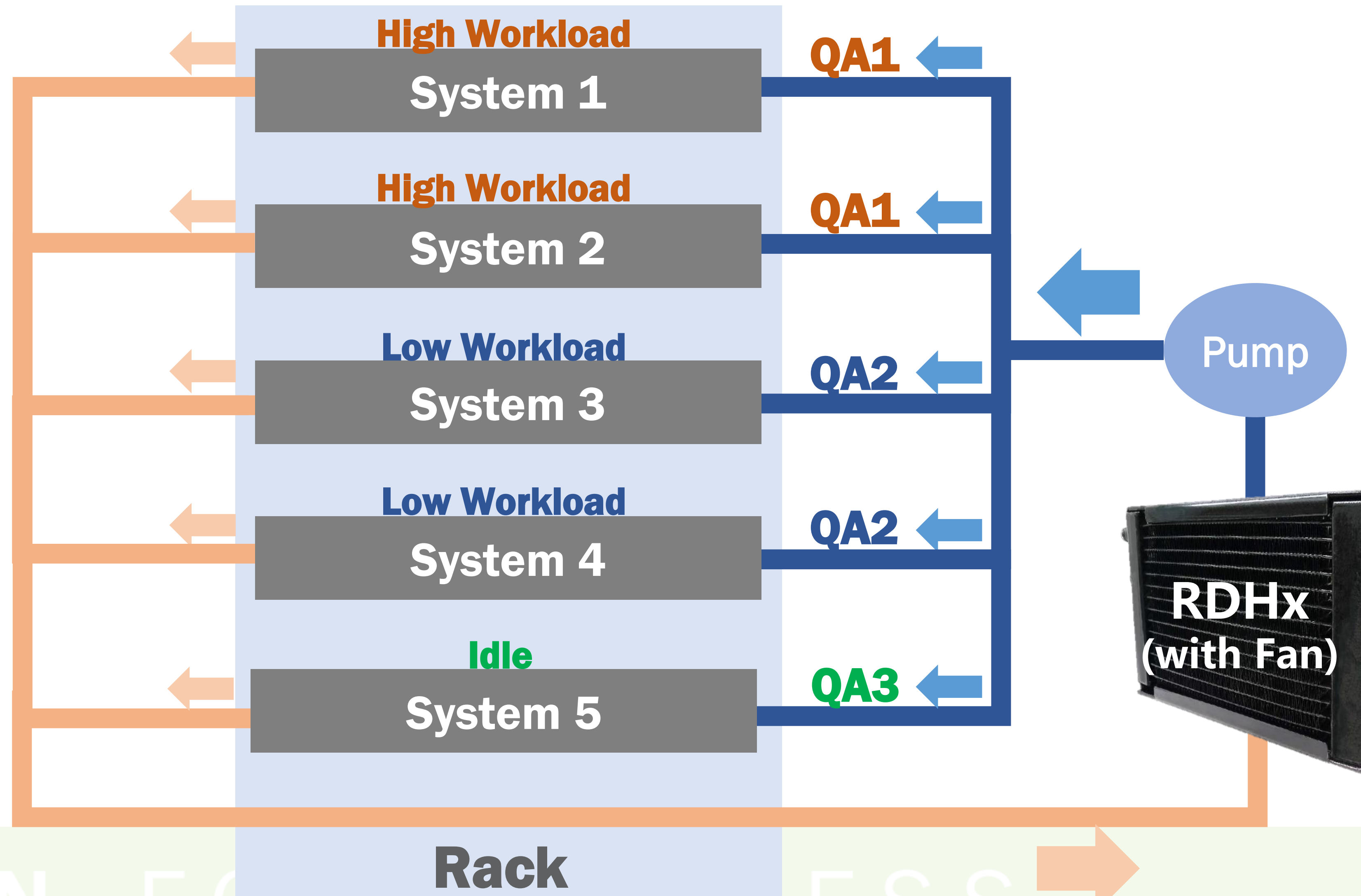
**Water (Single Phase)**  
**ASIC 1 < ASIC 2**



**Dielectric Fluid (Two Phase)**  
**ASIC 1  $\approx$  ASIC 2**

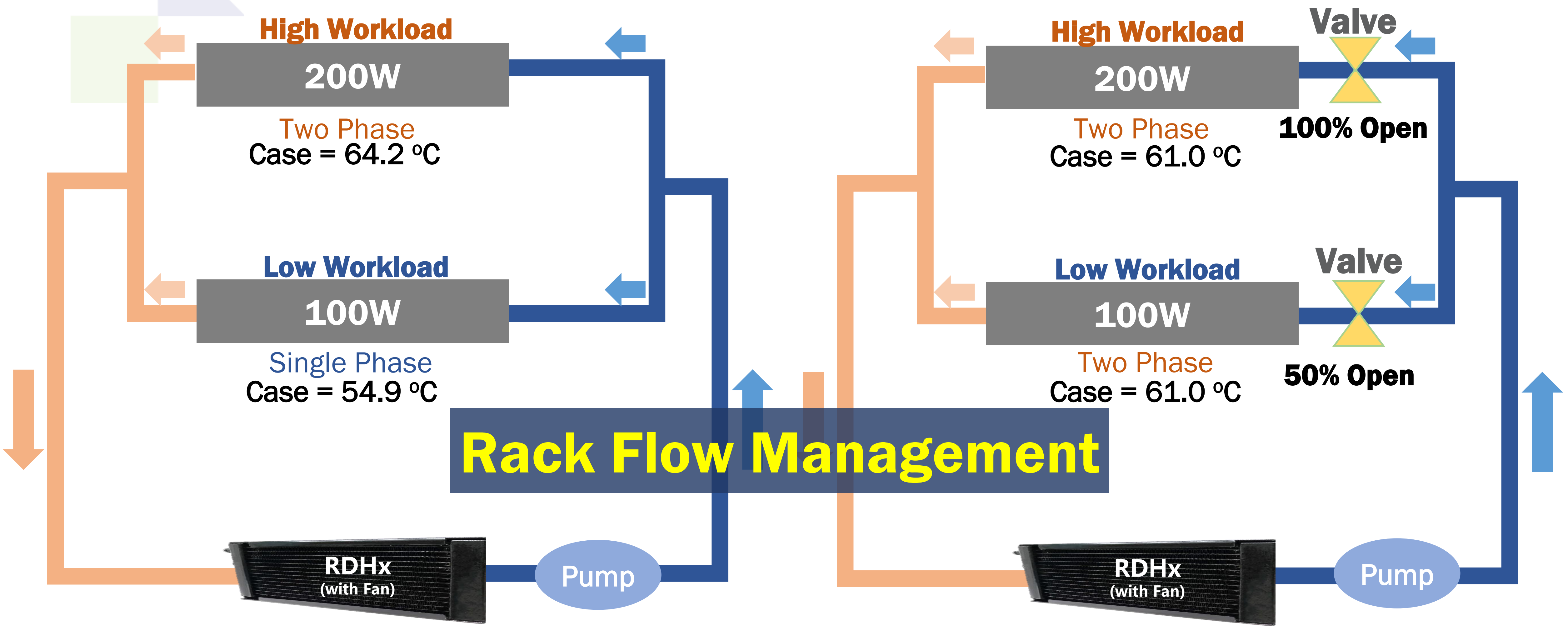
**More Uniform Temperature**

# Rack Flow Management



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# Investigation - Flow Management



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# Advantage

**Minimum  
Leakage Concern**

**No  
Facility Change**

**Two Phase Rack Level  
Liquid Cooling**

**High  
Heat Transfer**

**Uniform  
Temperature**

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# Investigations

## Two Phase Cold Plate

- Boiling Enhancement

## Pressure Control

- Low Loop Pressure

## Cost Reduction

- Commercialization

## Flow Management

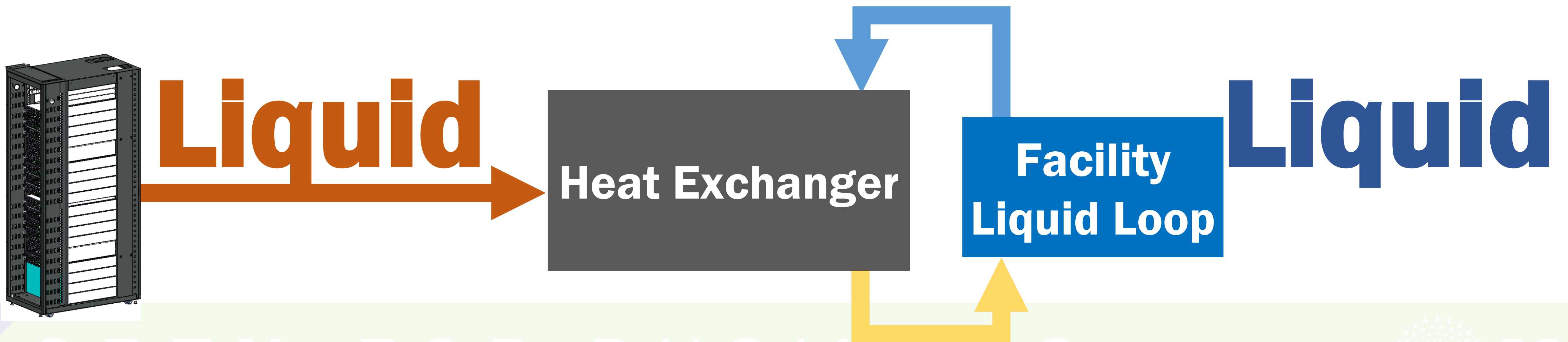
- Efficiency Optimization

## Blind Mate Tube

- Easy Connection

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# Flexible Heat Transfer



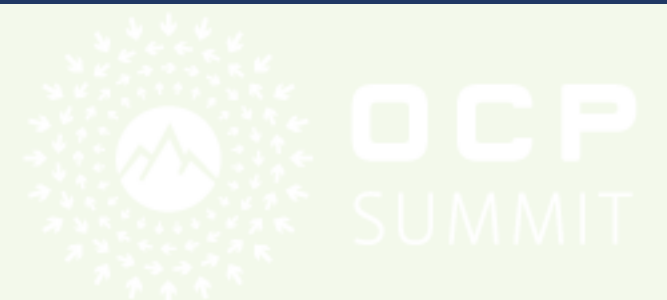
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# Conclusion

**Wiwynn**

**Two Phase Rack Level  
Liquid Cooling Solution**

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# Schedule

**Q2 2018**

**White Paper Publishing**

**~Q3 2018**

**Rack Prototyping**

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