LIQUID COOLING REFERENCE DESIGNS

ADVANCED COOLING FACILITIES

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ADVANCED COOLING FACILITIES

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ACF, Co-Lead
Solutions Architect - Vertiv

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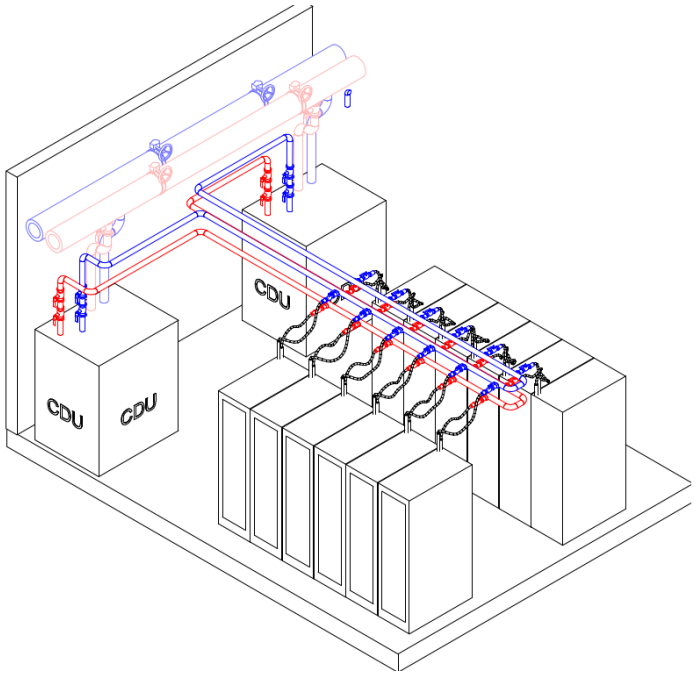
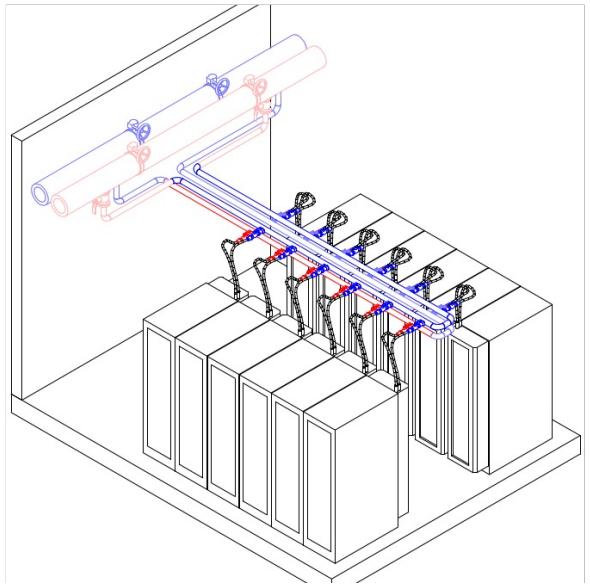
OCP - ACF Mission: Develop global best practices; collaboration, common guidelines for adding liquid cooled ITE into data centers

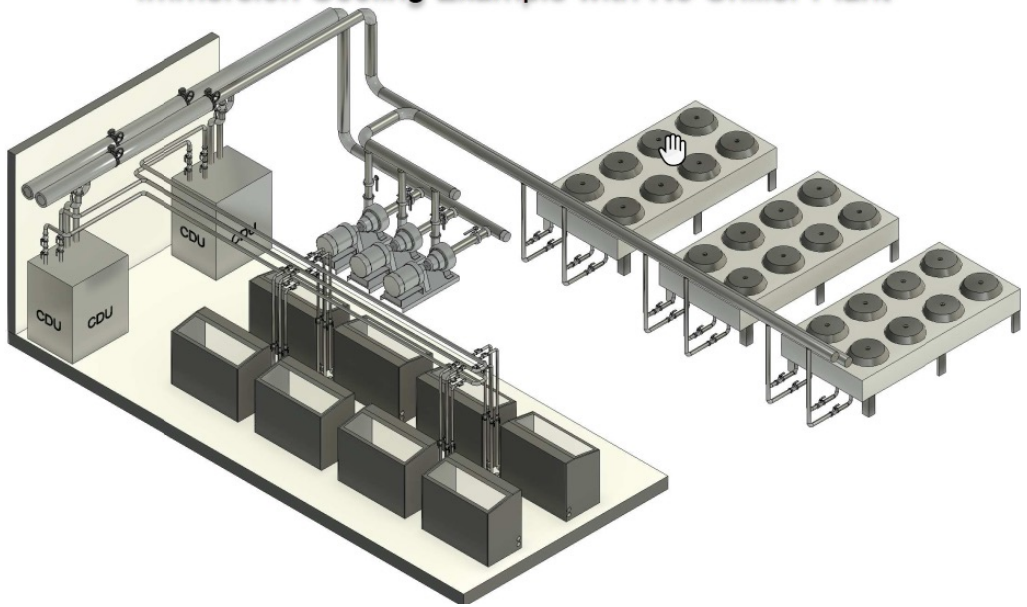
Concept Design 1 - Coldplate Addition w/CDU



Concept Design 1A Existing FWS:
Rear Door HX, No CDU



Concept Design 2 - Elevated temperature loop
Immersion Cooling Example with No Chiller Plant



SUSTAINABILITY IMPACT

Sustainability Factor	ColdPlate	Immersion	DoorHX
Efficiency			
Device	Improves efficiency of CPUs	Improves efficiency of servers	
Facility	Improves efficiency of data center	Improves efficiency of data center	Improves efficiency of data center
Metric paradox	PUE goes up	PUE goes up	PUE ↑↓ (depend on measurement location)
Performance			
Chip performance	Chip performance improves	Chip performance improves	
hard drive performance		HD Performance improves	
Economizer Performance/WUE	Greater economizer use, less water use	Global operation - no refrigeration, water use	Greater economizer use, less water use
Heat Reuse			
W32	Seasonal heat reuse applications	Seasonal heat reuse applications	Seasonal heat reuse applications
W45, W45+	Advanced heat reuse applications	Advanced heat reuse applications	Advanced heat reuse applications

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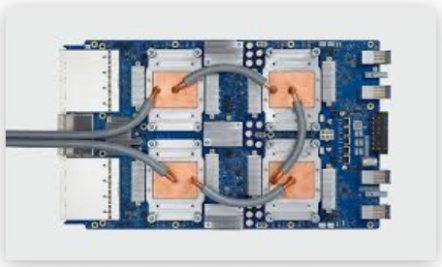
REAL WORLD DEPLOYMENTS



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REAL WORLD DEPLOYMENTS

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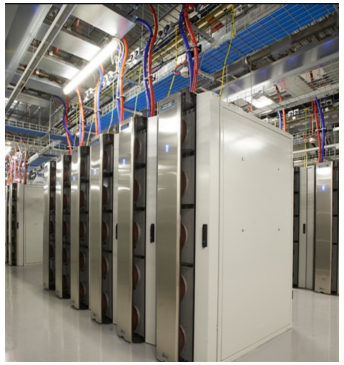

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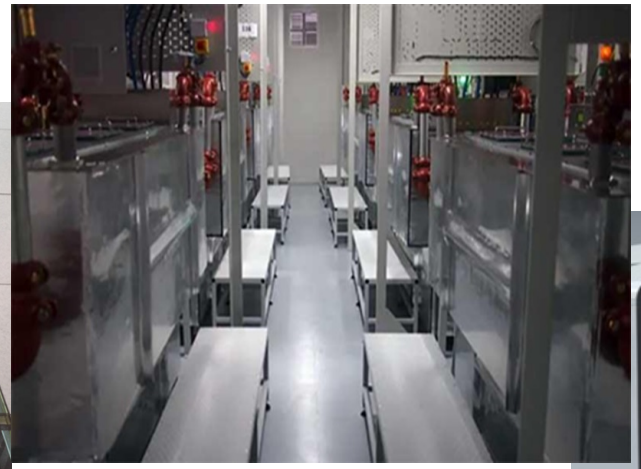
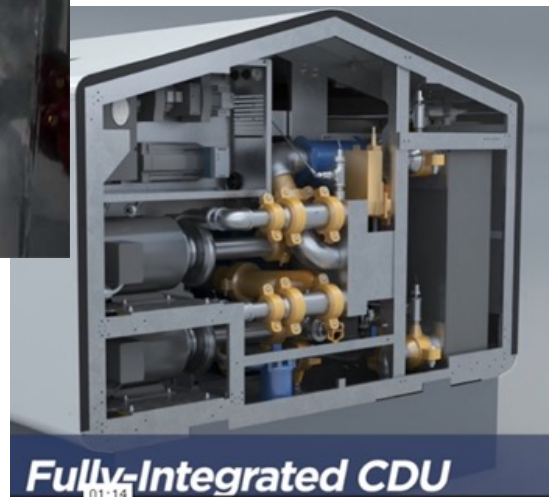
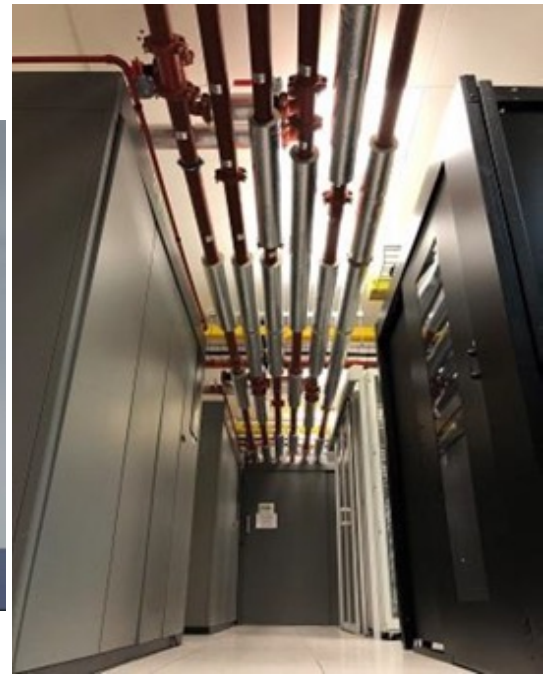


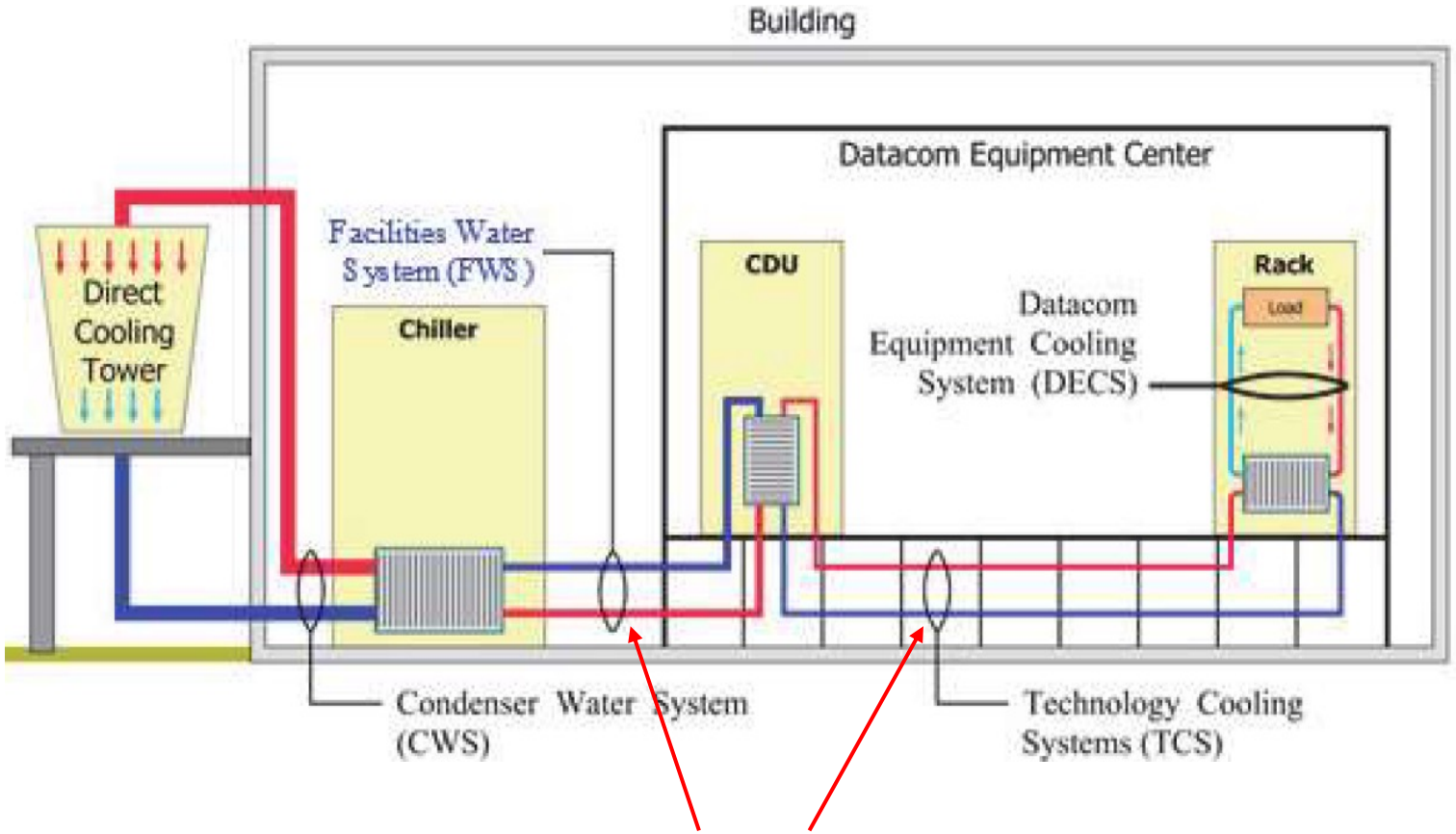




ACF/ACS BOUNDARIES

ACF Focus: Facility Water System

- Line of demarcation with ACS is critical
- ACS Reference Designs feed into ACF Workstream for ACF Guidance.
- Physical location of demarcation is dependent on ACS solution.



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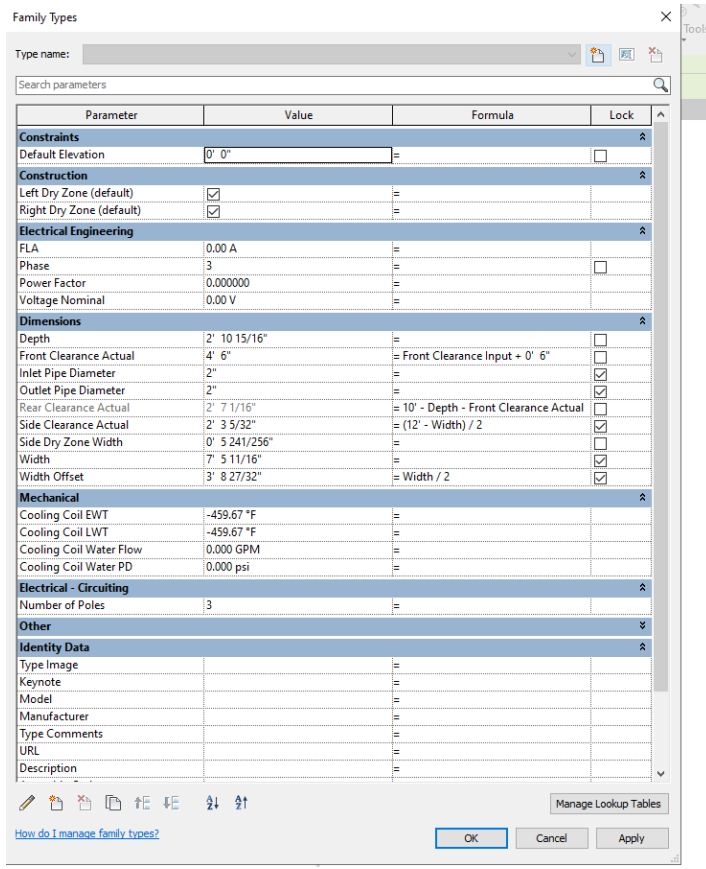
BIM CONTENT FOR PRODUCTS

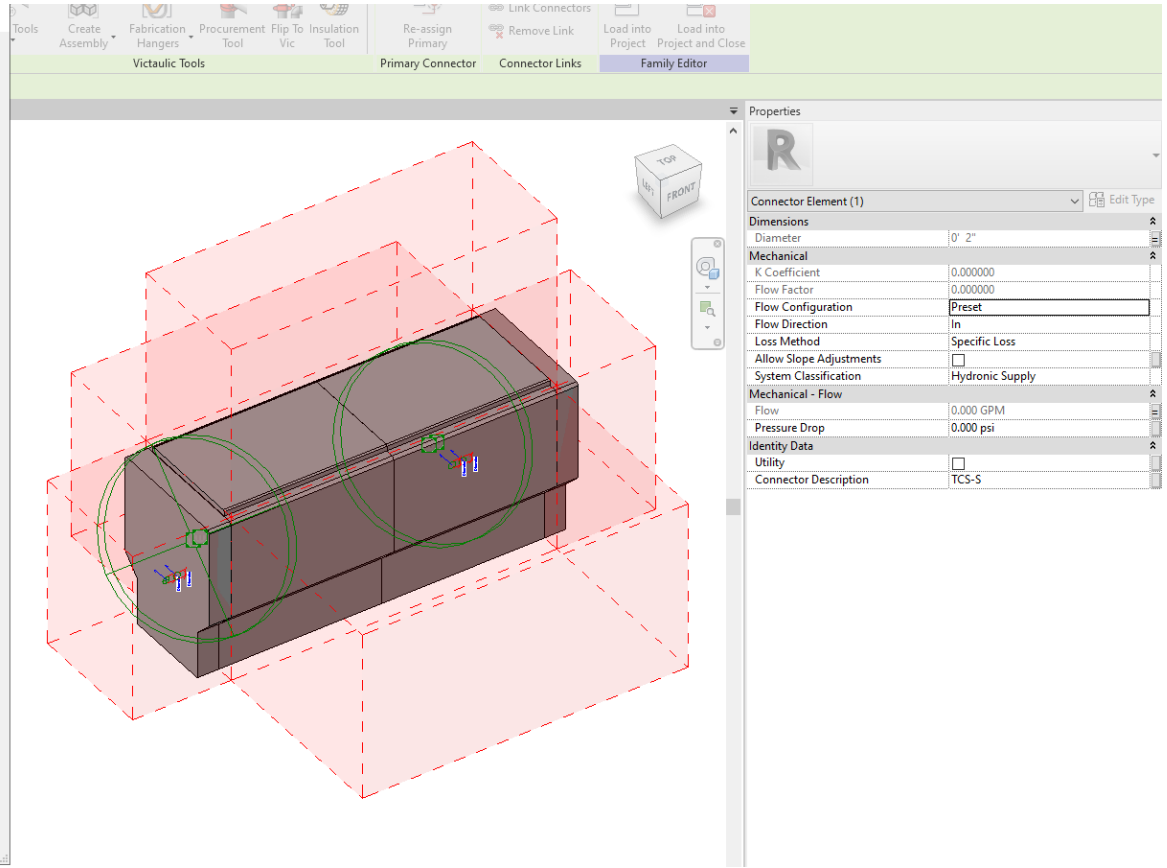
Exterior Shape and Dimension without Detail (no perforations, bolts, etc)

Physical Attributes including clearances (able to be toggled off)

Mechanical Properties:
Connection Size
Flow
Pressure Loss
Inlet/Outlet Temperature

Electrical Properties:
Voltage
Ampacity
Phase
Power Factor





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ITE VENDORS – SHOW US YOUR MEGAWATT

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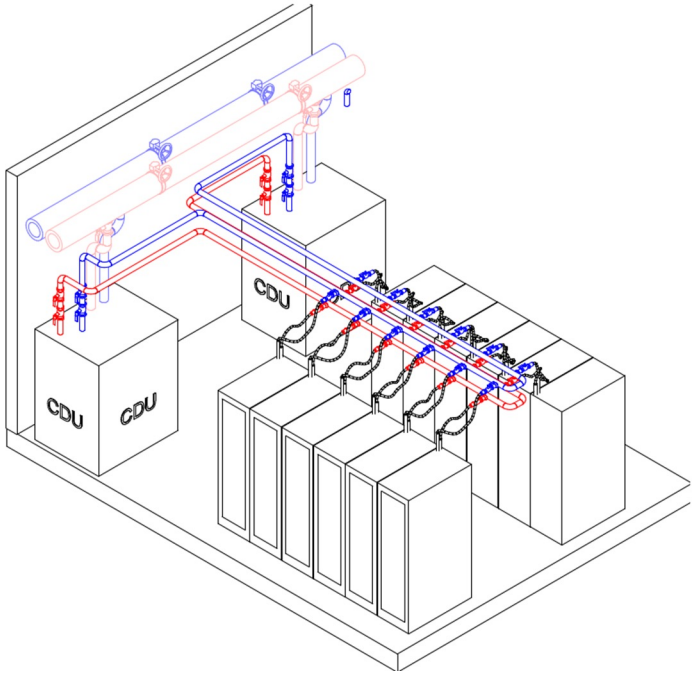

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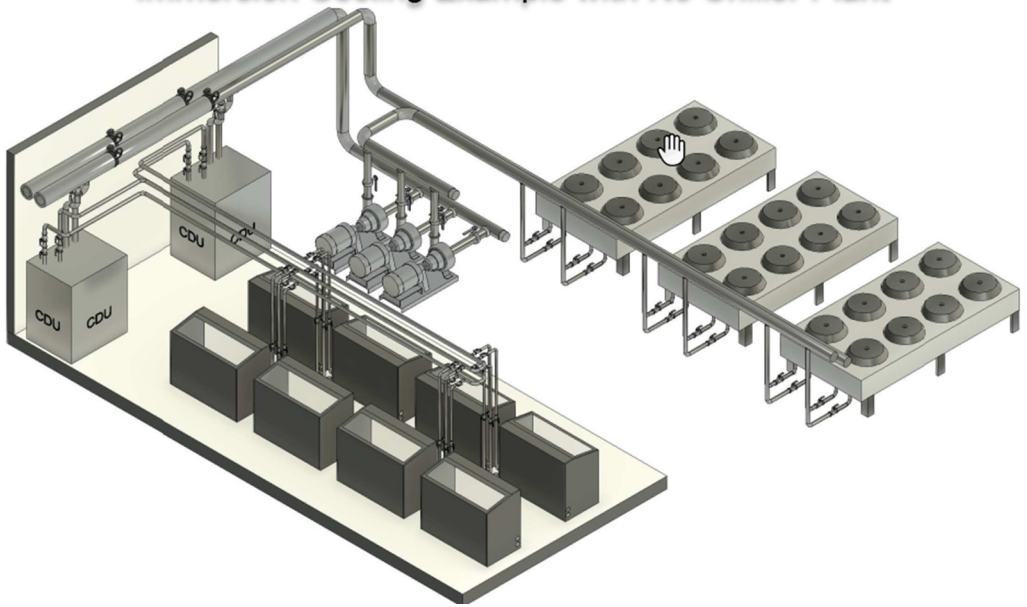

PIPE SIZING AND CAPACITY

Pipe Size		ASHRAE 90.1-2019 Table 6.5.4.6		Equiv Velocity		ΔT				
						4	6	8	10	C
						7.2	10.8	14.4	18	F
DIN	in	l/s	GPM	m/s	ft/s *	Max kW				
50	2	4.95	78	2.3	7.5	83	124	166	207	
65	2-1/2	6.94	110	2.2	7.4	116	174	232	290	
80	3	10.73	170	2.2	7.4	180	269	359	449	
100	4	20.19	320	2.5	8.1	338	507	676	845	
150	6	42.90	680	2.3	7.6	718	1077	1436	1795	
200	8	69.40	1100	2.1	7.1	1162	1742	2323	2904	
250	10	100.94	1600	2.0	6.5	1690	2534	3379	4224	
300	12	145.11	2300	2.0	6.5	2429	3643	4858	6072	

Based on flow rates per ASHRAE 90.1-2019 Table 6.5.4.6 for Variable Flow

* - Values are based on standard weight carbon steel pipe dimensions, ASTM A53

Represents typical design dT for chiller-based systems

Represents dT lower than typical design/operation of FWS systems

SLA CONSIDERATIONS – DEWPOINT

ASHRAE TC 9.9 Table 3.1 2021 Thermal Guidelines for Liquid Cooling				
Liquid Cooling Class	Typical Infrastructure Design			Facility Water Supply Temperature, °C (°F)a
		Primary Facilities	Secondary/ Supplemental Facilities	
W17	}	Chiller/cooling tower	Water-side economizer	17 (62.6)
W27	}	Chiller/cooling tower	Water-side economizer	27 (80.6)
W32	}	Cooling tower	Chiller or district heating	32 (89.6)
W40	}	Cooling tower	Chiller or district heating	40 (104)
W45	}	Cooling tower	District heating system	45 (113)
W+	}	Cooling tower	District heating system	>45 (>113)

ASHRAE TC 9.9 – Stay 2 degrees C above dewpoint in ITE space

Table 2: Dewpoint Limits Per ASHRAE		
ASHRAE Class	Max Inlet Temp °C	Max Dewpoint Temp °C
A1-A4 Recommended	27	15
Allowable Limits		
A1	32	17
A2	35	21
A3	40	24
A4	45	24
B	35	28
C	40	28
ASHRAE TC 9.9 © 2015		

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- Call to Action:
- Get in Involved!

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- OpenCompute Cooling Environments Project
  https://www.opencompute.org/projects/cooling-environments
  - Advanced Cooling Facilities
  - https://www.opencompute.org/projects/advanced-cooling-facilities