Open for All.

OCP
GLOBAL
SUMMIT

DATA CENTER
FACILITIES

ADVANCED
COOLING
SOLUTIONS

Managing Barbeques in Data Centers
Agenda

High Density Data Center Facility Challenges

Liquid Cooling Opportunities

- Types of Liquid Cooling
- Energy Opportunities
  - Optimizing PUE
  - Energy ReUse

Simplifying Liquid Installation, Reliability

ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

How Many Barbeques Fit In A Data Center?

Avg IT Loads = < 10KW/rack

(note - one barbeque = 10KW of heat)

AI / HPC Applications = > 40KW/Rack

Crypto-Currency => 200KW/tank

Data Centers =

- **30 yr Buildings, 3 year Vision**
- **Adapt or Perish**

Image Source: Weber Barbeque, Weber.com

ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

“Liquid Cooling” (ASHRAE TC9.9)

ASHRAE TC 9.9 Liquid Cooling Guidelines for Datacom Equipment Centers (©2014)

Liquid Cooling Types–

- Liquid Cooled Rack (Rear Door, etc)
- Liquid Cooled IT (Chassis cooling, Cooled Plate…)
- Liquid Cooled Electronics (immersion cooling)
  - Single phase
  - Dual phase

Sources

- Facility Water – i.e. CW system
- Condenser Water
- DiElectric with HX to Facility, Condenser, or external

Chilled-Water Cooling to Row & Rack

Inrow

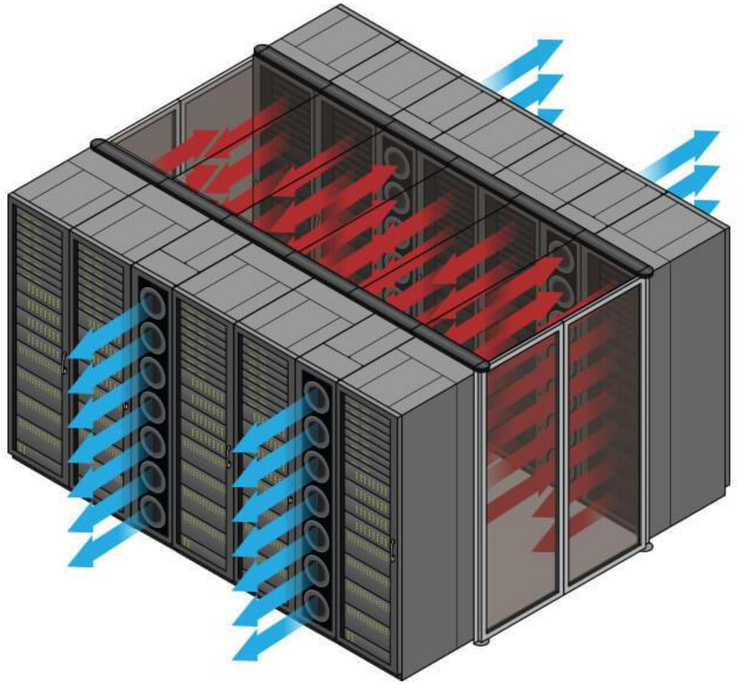


Image Source – Schneider Electric

RearDoor

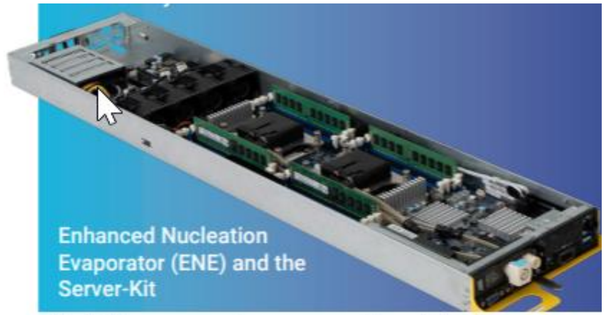
Motivair Chilled Do

OptiCool Cool Door System

Liquid Cooling to server, immersion

Server

Immersion



2 Phase - Image fm Zutacore

Single Phase - Image fm CoolIT

Single Phase Example (GRC)

Dual Phase Example Allied Control)

ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

Optimizing Energy Usage Via Liquid Cooling

Optimizing PUE

- **Minimum PUE as Density and Diversity Increase**
- **Cascade Cooling** – (Optimizing PUE)
  - rejection temperature from CRAH units provides supply temp for cold plate, immersion cooling

Energy ReUse – ReUse waste heat from data center for building, district or agriculture applications

Facility Water Requirements (ASHRAE TC9.9)

Table 5.1 ASHRAE Liquid Cooling Guidelines

Liquid Cooling Class	Typical Infrastructure Design		Facility Water Supply Temperature
	Primary Facilities Cooling Equipment	Secondary/Supplemental Cooling Equipment	
W1	Chiller / Cooling Tower	Water Side Economizer (with Dry Cooler or Cooling Tower)	2°C – 17°C
W2			2°C – 27°C
W3	Cooling Tower	Chiller	2°C – 32°C
W4	Water Side Economizer (with Dry Cooler or Cooling Tower	N/A	2°C– 45°C
W5	Building Heating System	Cooling Tower or Dry Cooler	> 45°C

Facility Water Requirements (ASHRAE TC9.9)

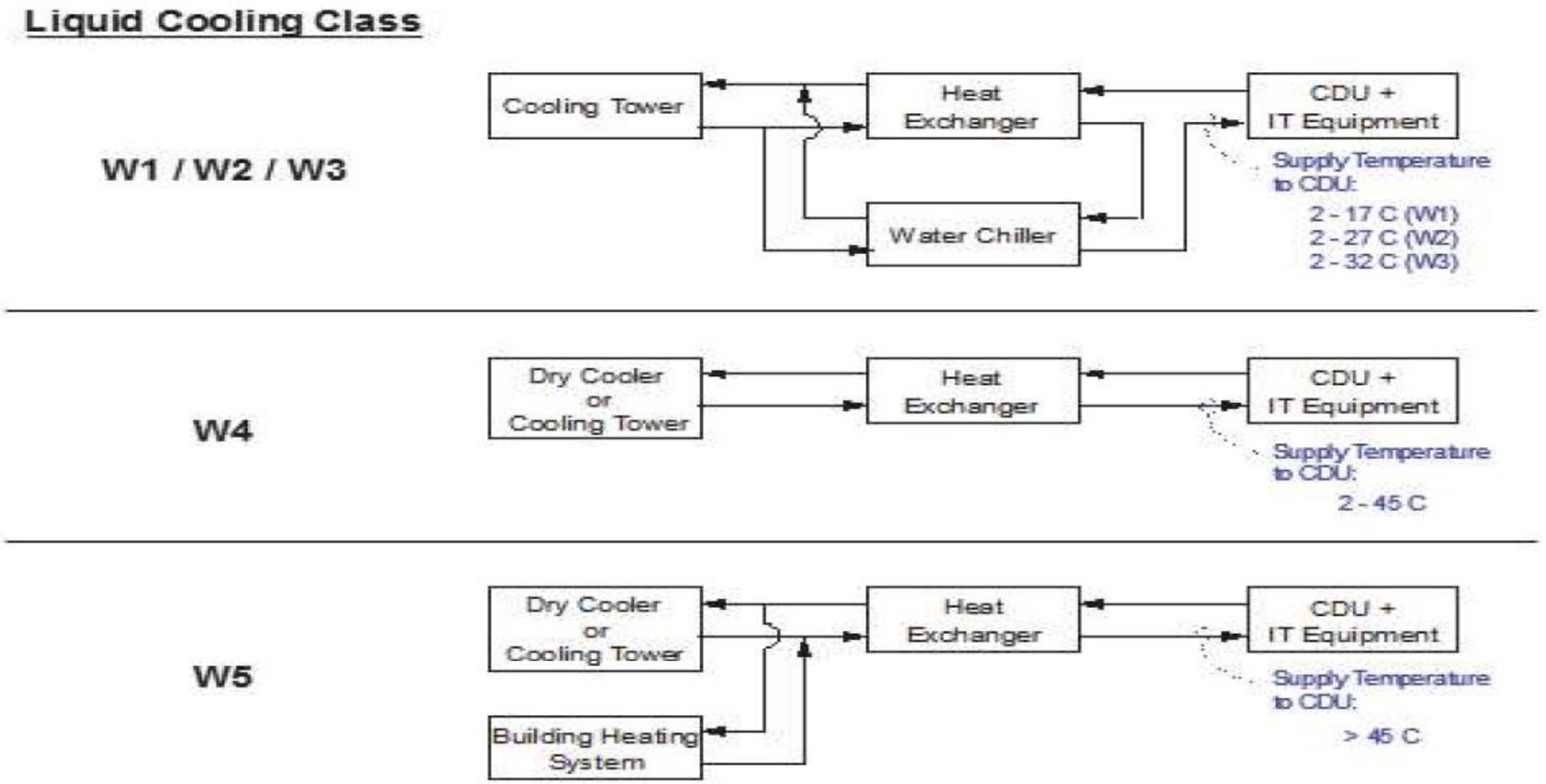


Figure 5.3 ASHRAE liquid cooling classification, typical infrastructure design schematics.

OCP GLOBAL SUMMIT

High Density + Reuse Simplified

No chiller required
Incoming "cool" fluid can be as high as 45°C

Redundant Pumps

Option 1:
Direct External Heat Removal

Heat Exchanger

Fluid 2

Fluid 2

LiquidCool Server Racks

Option 2:
Heat Recovery for Building Heating

Drawing supplied by LiquidCool Solutions, Cloud9 Edge Technologies LLC. Noel Wideberg

Creative Energy Options - “Cascade Cooling”

Chilled-Water Temperatures, Rack Door

- **Supply** (**20-25 C**) (TC9.9 W1, W2)
- **Return** (**30-35 C**)

2 Phase - Image fm Zutacore

Liquid Temperatures, Cold Plate

- **Supply** (**25-35 C**) (TC9.9 W2, W3)
- **Return** (**35-45 C**)

Single Phase - Image fm CoolIT

Liquid Temperatures, Immersion Cooling

- **Supply** (**30-60 C**) (TC9.9 W3, W4, W5)
- **Return** (**45-70 C**)

Energy Reuse Application

ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

PUE Vs ERE

- **PUE** (Power Usage Effectiveness)

  "Perfect" PUE= 1.00

$$PUE = \frac{Total\ Energy}{IT\ Energy}$$

- **ERF** (Energy Reuse Factor)

  "Perfect" ERF = 100%

$$ERF = \frac{Reuse\ Energy}{Total\ Energy}$$

- **ERE** (Energy Reuse Effectiveness)

$$ERE = (1\text{-}ERF) \times PUE$$

Increased focus on IT industry energy usage drives need for energy reuse metric

Enabling Liquid Distribution Success

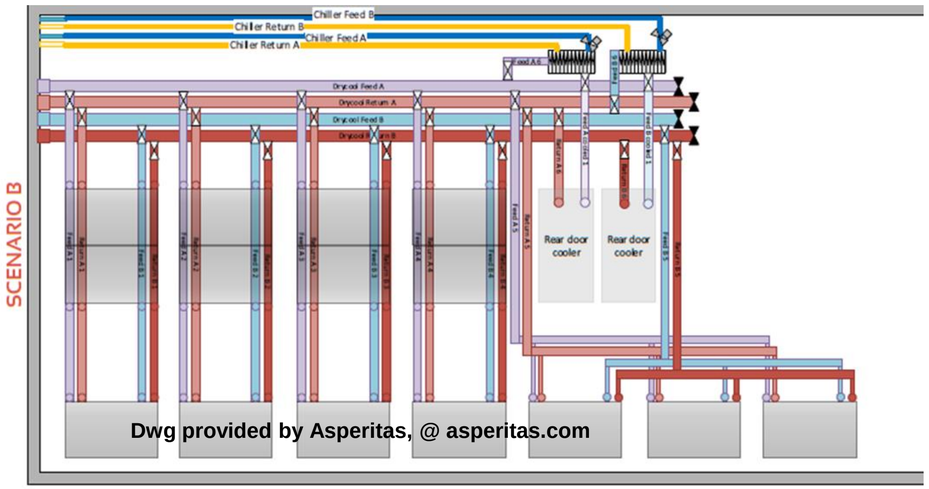
Pipe Solution Needs

- Adaptable
- Rapid Deployment, Simplistic Alignment
- BIM Precision, Reference Designs
- Mission Critical Performance

OCP GLOBAL SUMMIT

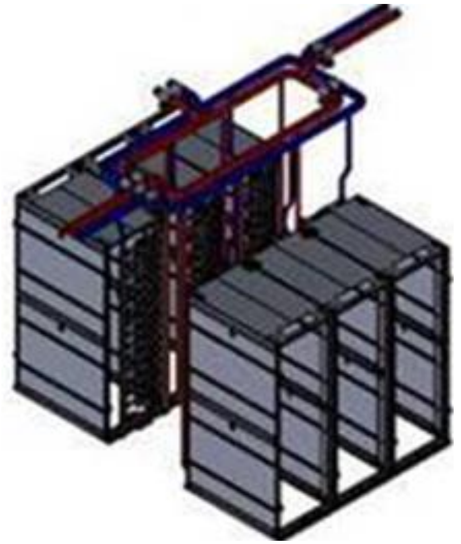
Simplify – Concept to Construction
Advancements in BIM Tools + Adaptability

Reference Design



Dwg provided by Asperitas, @ asperitas.com

VDC / Detail design / Cut length



Lean Installation

A-BOM / BOQ and list of pipe lenghts

Coordination in an early stage
with warehousing and allocation of the material

Project Name : Equinix
Project number : 74877_AAF (based on DRW 74877_AAF)
System : Cooling
Note : Pump Room B **CONSTRUCTION BOM**

Area	Quantity	Article Code	Description
Rucklauf chillers	16	C0W070457000002	457.0 mm/18 Style W07 AGS Rigid Cplg Orange FlushSeal EPDM Gskt
Rucklauf chillers	6	F0W100457000002	457.0 mm/18 No W10 90° AGS Elbow Orange
Rucklauf chillers	1	F0W200457000002	457.0 mm/18 No W20 AGS Tee Orange
Rucklauf chillers	2	VW7610457000004	457 mm/18 AGS Vic-300 MasterSeal Butterfly Valve Black EPDM Gear Op Dew Block
Rucklauf chillers	1	F0W000813000001	813 mm x 457 mm / 32" x 18" Reducer flanged (PN6) - grooved (AGS)
Rucklauf cracks	10	C0W070355000002	355.6 mm/14 Style W07 AGS Rigid Cplg Orange FlushSeal EPDM Gskt
Rucklauf cracks	12	C0W070457000002	457.0 mm/18 Style W07 AGS Rigid Cplg Orange FlushSeal

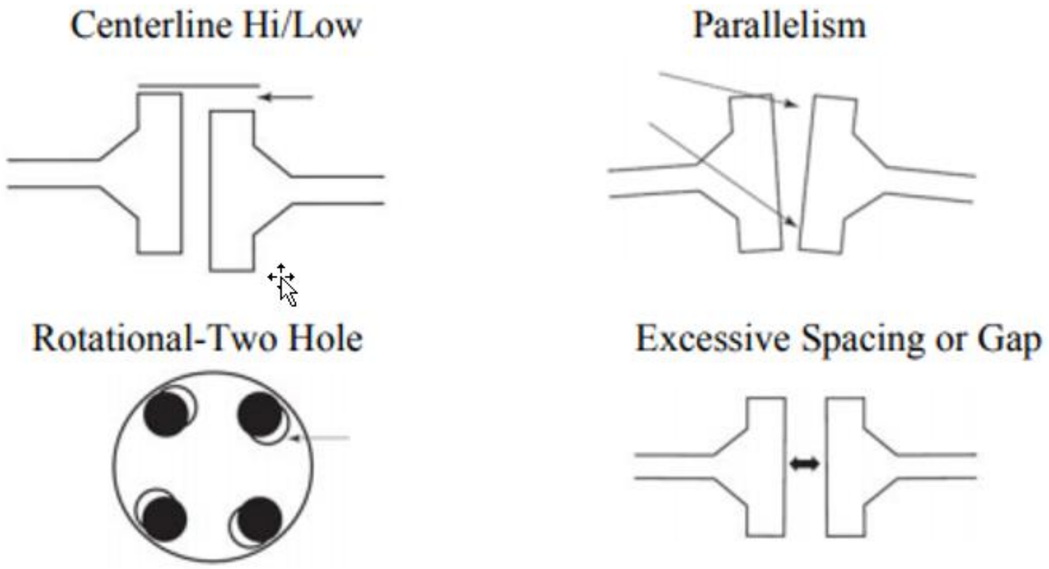
ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

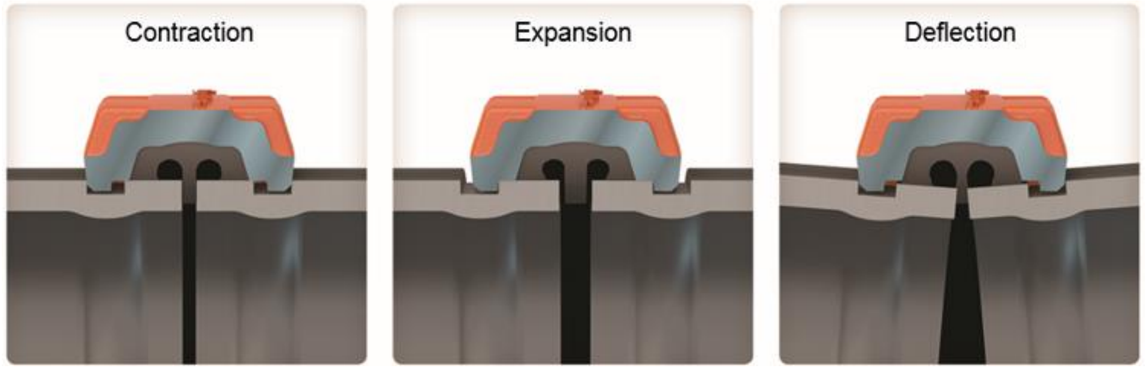
OCP GLOBAL SUMMIT

Simplicity in Alignment is Key Challenge

The Flange Challenge



The Coupling Solution



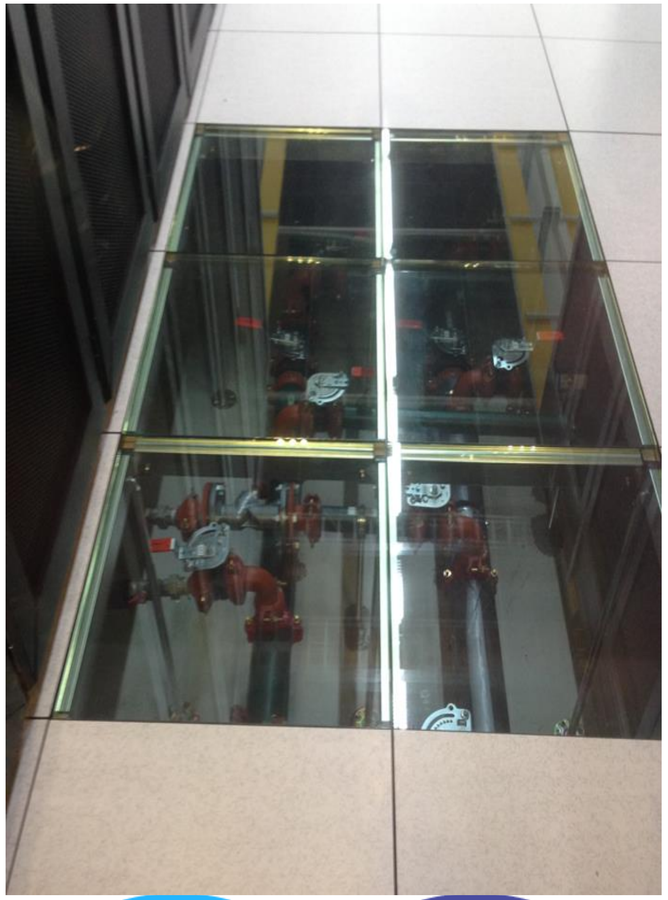
Eliminate alignment issues – rotational, angularity, pipe movement

ADVANCED COOLING SOLUTIONS

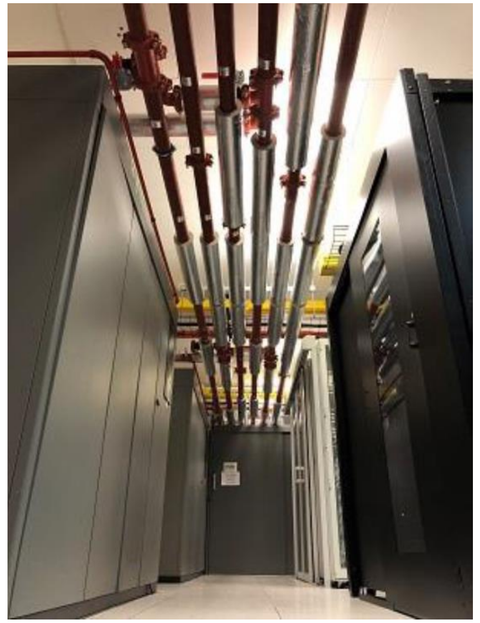
DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

Adaptable, Reliable Liquid Distribution



- Precision Design (BIM LoD 400)
- Fast
- Low Risk, No Hot-work
- Low Labor
- Extended Warranties Available – 30 years
- Mission Critical Compliant

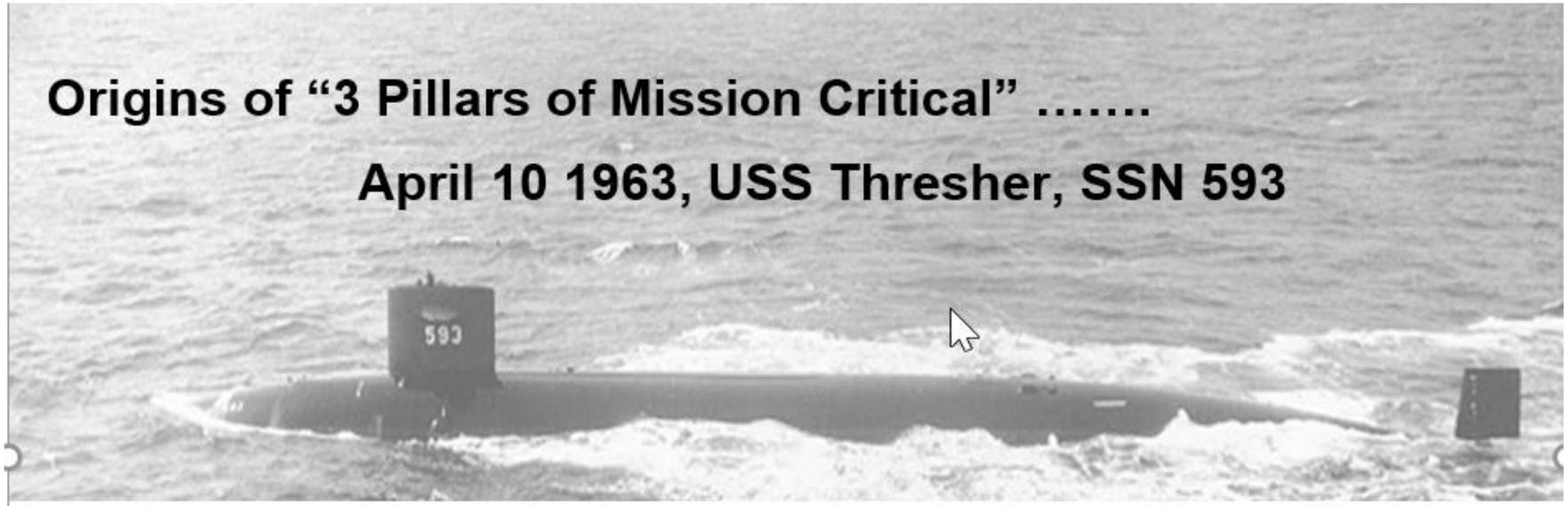


ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

Call to Action – Defining Mission Critical Pipe Solution



“the loss of the Thresher should not be viewed solely as the result of failure of a specific braze, weld, system or component, but rather should be considered ***a consequence of philosophy of design, construction and inspection”***

Admiral Rickover

ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

Defining Mission Critical Grade Pipe Solutions

Three Pillar Mission Critical Performance Summary

Pillar 1: Holistic Engineered Design	o **Coupling Design**	"installation ready" for direct stab installation without field disassmbly
	o **Seismic performance –**	Performance data verified for seismic movement
	o **Expansion/Contraction Performance**	Performance data for thermal, building movement
	o **Vibration response, reduction analysis**	Performance data verified for vibration mitigation
	o **Temperature, pressure, liquid types**	Gasket material performance data for liquid type, temperature and pressure
Pillar 2: Vertically integrated Quality Control	o **Single manufacturer of product solution**	Couplings & gaskets from same manufacturer
	o **Quality/performance testing, traceability**	Gaskets and housings traceable from installation back to manufacture date, location, test date
	o **Revit Design Support**	Content libraries accurate to +/- 0.01 inch to enable construction grade design accuracy
	o **Global Access and Quality Control**	Certification of all production sources globally to ISO9001 standards
Pillar 3: Certified Inspection & Installation	o **Simplified Installation Process**	Simplified installation without disassembly. Factory training/certification program
	o **Visual Inspection Process**	Verification of proper installation and performance via visual inspection
	o **Certification of installation inspectors**	manufacturers shall provide installation certification training to all installers.

Call to Action

Recommended Actions and Timelines–

- DCF - Define “mission critical grade” standards for liquid distribution – June 2020
- DCF - Integrate energy reuse into OCP goals - Dec 2020

Links:

- https://www.cooldc.co.uk
- https://www.victaulic.com
- https://www.opencompute.org/projects/data-center-facility
- TheGreenGrid – http://thegreengrid.org
- ASHRAE TC9.9 - http://tc0909.ashraetcs.org/

Additional thanks to input from GRC, LiquidCool, Asperitas, Motivair, Submer, Iceotope, Allied Control, 3M, Dell, HP, Schneider, Vertiv, Stulz, Engineered Fluids, Lenovo, Qcooling, Asetek for public concepts and images.

ADVANCED COOLING SOLUTIONS

DATA CENTER FACILITIES

OCP GLOBAL SUMMIT

Open for All.

OCP
GLOBAL
SUMMIT

MARCH 4 & 5, 2020 | SAN JOSE, CA