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Immersion Requirements rev2

Immersion Requirements rev2

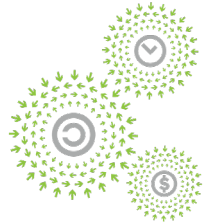ADVANCED COOLING SOLUTIONS

Rolf Brink, Asperitas

OCP Immersion Project lead

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Original publication: May 20, 2019

Authors	Company	Revisions
Author		
Rolf Brink	Asperitas	Original, Rev 1, Rev 2
Co-authors		
Jessica Gullbrand	Intel	Rev 1, Rev 2
John Bean	Schneider Electric	Rev 1
Nigel Gore	Iceotope	Rev 1
Rick Payne	Flex	Rev 1

Rev 2 publication: December 2021

Authors	Company	Revisions
Author		
Rolf Brink	Asperitas	Original, Rev 1, Rev 2
Co-authors		
Jessica Gullbrand	Intel	Rev 1, Rev 2
John Bean	Schneider Electric	Rev 1
Nigel Gore	Iceotope	Rev 1
Rick Payne	Flex	Rev 1
Jimil Shah/ Rick Margerison	TMGcore Inc	Rev 2
Kevin Wirtz	Cargill	Rev 2
John Bean	GRC	Rev 2
Andy Young	Asperitas	Rev 2
Ashley Hessin/ Nigel Gore	Vertiv	Rev 2
Eduardo de Azevedo/ Volker Null	Shell	Rev 2
Eleanor Jones/ Sayan Sengupta	M&I Materials	Rev 2
Peter Cooper/ Raul Alvarez/David Montes	Submer	Rev 2

ADVANCED COOLING SOLUTIONS

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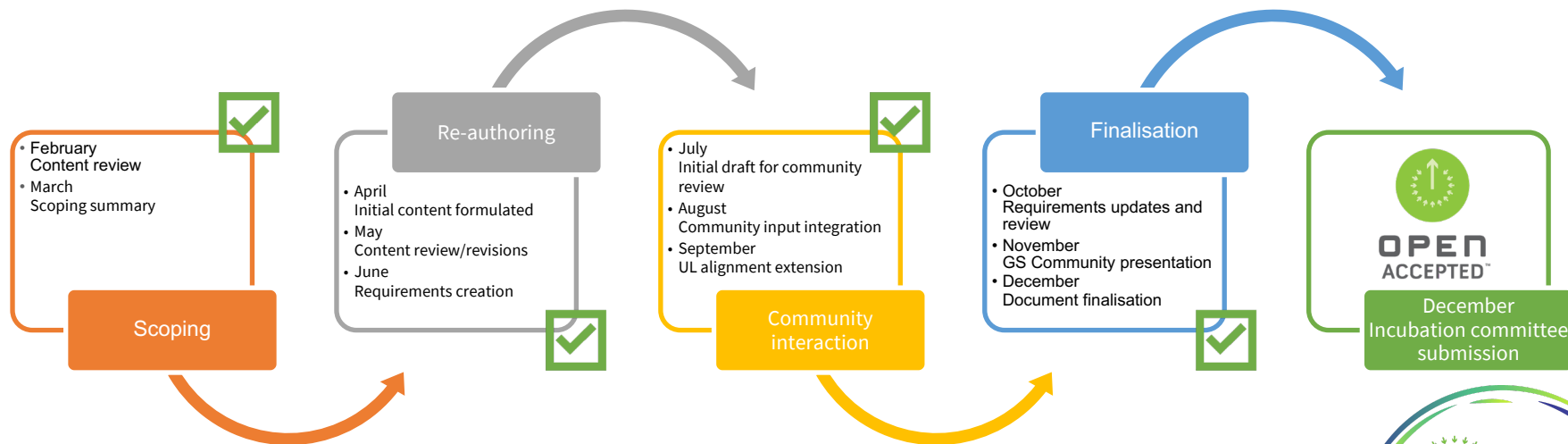# Full year of community work

- 2 plenary meetings per month
- 7 break-out non-plenary focus groups with subject matter experts

Scoping
- February
  Content review
- March
  Scoping summary

Re-authoring
- April
  Initial content formulated
- May
  Content review/revisions
- June
  Requirements creation

Community interaction
- July
  Initial draft for community review
- August
  Community input integration
- September
  UL alignment extension

Finalisation
- October
  Requirements updates and review
- November
  GS Community presentation
- December
  Document finalisation

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December
Incubation committee submission

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Purpose of Immersion Requirements

- Establish common terminology
- Facilitate immersion specific measures and with parameters of importance
- Compliancy requirements for specifications and immersion solutions

- Ensure quality solutions in the OCP domain
- Ensure accurate and factual technology positioning
- Weed-out marketing vs engineering (OCP is engineering focused)

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When is qualification necessary?

- OCP immersion spec submission
- OCP Logo accreditation for immersion solutions (accepted/inspired)
- OCP solution branding
- OCP Marketplace positioning
- OCP Solution building

Qualification process

Check out immersion wiki for detailed process

Submit request for qualification:
- Rolf.Brink@ocproject.net
- John.Bean@ocproject.net

Complete Immersion Requirements Checklist
- Provided by PL's
- Sample here

Present your qualification to the community (Public)
- Why and how a solution qualifies against Immersion Requirements

Verify your qualification during an interactive peer review (Non-Public)
- One-off panel of volunteer experts, selected by PL's (authors, reviewers, active community members)
- Overseen by Immersion PL's

Approve, Decline or provisionally with follow-up items

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CH 1: Requirements

Requirements format: SR 1.1-1 :
- {SR/OR/CR}: Requirement type
- {#.#}: Paragraph number which contains the requirement
- {-#}: Requirement number

Requirement types
- **SR:** *Specification Requirements shall be met by the immersion solution vendor.*
- **OR:** *Optional Requirements may be met to enable recognition of special functionality of features.*
- **CR:** *Customer Requirements shall be met by owners, operators, or end users of the solution. Sufficient effort shall be made and demonstrated by the solution vendor to accommodate compliancy.*

CH2: Technology definitions

Explanatory text on technology types and terminology
- TCS or Technology Cooling System
- FWS or Facility Water System
- Single vs Two-phase
- Enclosed Chassis
- Open Bath
- Hybrid

CH3: Quality and Safety requirements

Regulatory compliance

- UL, FCC, CE, etc
- SR 3.1-1 to 3.1-2

Mechanical safety

- Emergency procedures, usability by skilled IT personnel
- Electrical safety (Horizontal busbars, electrical assemblies, grounding)
- Fluid/fumes/gas containment
- SR 3.2-1 to SR 3.2-11

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CH3: Quality and Safety requirements

Facility side liquid management

- Ventilation, prevention of sewage discharge, disposal, containment, spill management, HSE practices and documentation, training
- CR 3.3-1 to 3.3-9

Solution side liquid management

- Pressure release, volatile liquids compliancy, evaporative losses containment
- SR 3.3-1 to 3.3-3

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CH4: Immersion Fluids

- Extended and more meaningful fluid specification requirements
- SR 4.1-1

MSDS/TDS documentation

Reporting requirement only

Specification	Test method(s)	Format
Dielectric strength, 1 mm (May be estimated based on 2,5 mm)	ASTM D 1816 (IEC 60156)	kV/mm (kV, est. kV/mm)
Dielectric Constant (Relative permittivity) *Measured at:* *5 VAC* *20 GHz and 40 GHz* *20°C and 70°C*	*There is no prescribed method at this point. IEC 60247 may or may not provide a basis for this testing procedure* **The high temperature test can be lowered in line with evaporation temperatures of 2-phase fluids*	#,## @# GHz and #°C
Loss tangent	*Data must be associated with tests conducted for Dielectric Constant with the referenced properties*	#,#### @# GHz and #°C
Flash point COC	ASTM D 92 / ISO 2592	°C
Fire point	ASTM D 92 / 2592	°C
Auto ignition point	DIN 51794/ ASTM E659	°C
Pour point	ASTM D 97 / ISO 3016	°C
Odor	n/a	{TDS spec}
Color	ASTM D 156 / ISO 2211	{MSDS spec}
Sulphur content	ISO 14596	ppm
Specific heat capacity	ASTM E 1269	kJ/kg*K @ 40°C
Thermal conductivity	ASTM D 7896	W/m*K @40°C
Density at any °C	ISO 12185	kg/m3 @ #°C
Volumetric expansion	ASTM D 1903	/°C

Kinematic viscosity curve (or list following)	ASTM D7042	Graph
0°C		mm2/s (cSt)
20°C		mm2/s (cSt)
40°C		mm2/s (cSt)
60°C		mm2/s (cSt)
NSF Nonfood Compounds certification	NSF certificate	Yes/No
Acidity	IEC 62021-2 / IEC 62021-1	mgKOH/g
Hazard statements	GHS Classification[1]	SDS{MSDS spec}
STOT - single exposure	Safety Data Sheet	SDS{MSDS spec}
STOT - repeated exposure	Safety Data Sheet	SDS{MSDS spec}
Global warming potential (GWP)	IPCC 2007	
Biodegradability	OECD 301	{MSDS spec}
Vapour Pressure at 60°C	ASTM D2879	mbar
Maximum moisture content for dielectric breakdown	(100% Water saturation point, ASTM D1533-20)	ppm
Oxidation Stability	IEC 61125	Values per method
Ozone Depletion Potential	Reference to ASHRAE Standard 34/CFC11?	Yes/No

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CH4: Fluids minimum requirements

- Essential properties to maintain (warranty recommendation)
- SR 4.2-1

Property	Unused fluid minimum requirements	Lifetime fluid minimum requirements
Dielectric strength	>15 kV	>15 kV
Resistivity	>2 GΩm	<0.2 GΩm
Flash point (COC)	>150 °C	>150 °C
Auto ignition point	>250 °C	>250 °C
Sulphur content	<10 ppm	-
Acidity: hydrocarbons natural esters synthetic esters fluorocarbons?	≤0.01 mg KOH/g ≤0.06 mg KOH/g ≤0.03 mg KOH/g ??	-
Odor (unsealed solutions only)	≤Slight	≤Slight

CH4: Fluid quality management

Single phase fluids

- Single phase fluids limited to synthetic oils and esters, processed natural esters and fluorochemical fluids.
- Quality management requirements
- SR 4.3-1 to 4.3-4

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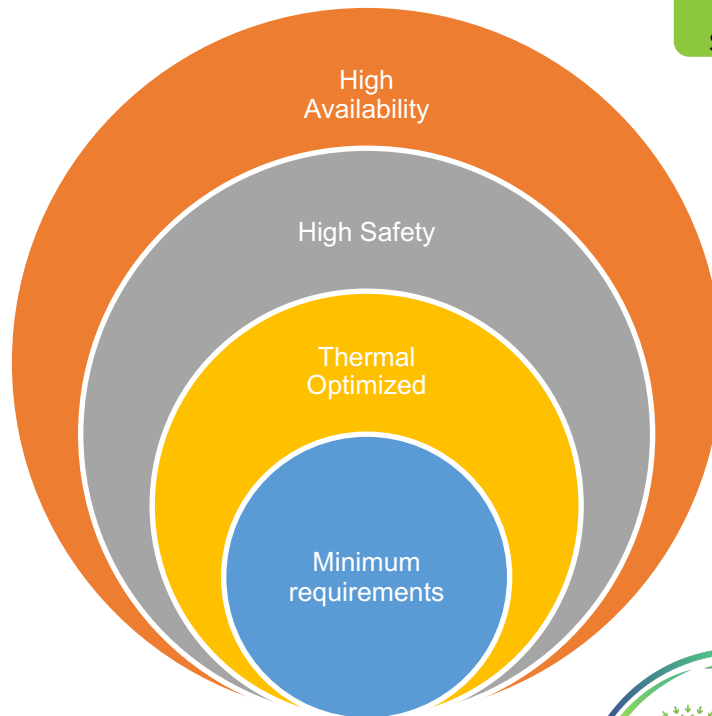
CH5: Feature classifications

Minimum requirements

Amended with optional classifications

Stacked features enable higher classification

High Availability

High Safety

Thermal Optimized

Minimum requirements

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CH5: Feature classifications

Minimum requirements
- Dielectric In/output temperatures, overheat protection, pump status, redfish compliance.
- SR 5.1-1

Thermal optimized
- Power monitoring, FWS interface thermal monitoring, flowrate monitoring & control, controlled TCS variable pump.
- OR 5.2-1
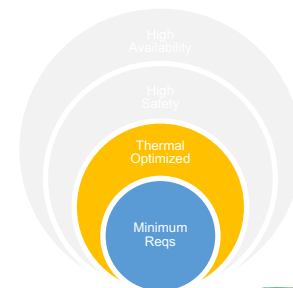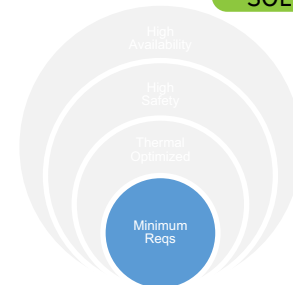
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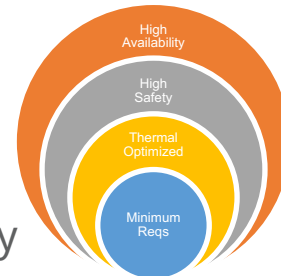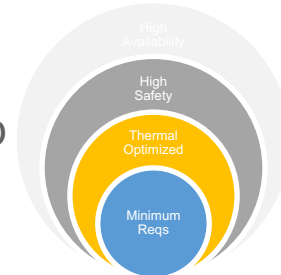
CH5: Feature classifications

High safety

- compliance with "Thermal Optimized"
- Reporting&logging of all sensors, controls of shut-off valves, pump and electrical input, fault reporting, automated safety responses and fault handling
- OR 5.3-1

High availability

- Compliance with Thermal Optimized and High Safety
- Concurrent critical component maintainability without IT downtime, Dual power and selectivity, N+1 or 2N cooling capability
- OR 5.4-1

High Availability
High Safety
Thermal Optimized
Minimum Reqs

High Availability
High Safety
Thermal Optimized
Minimum Reqs

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CH6: General standards
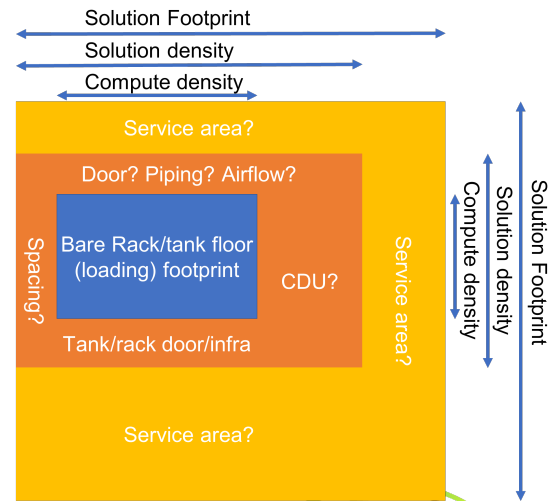
Measurement units

- SI units, mandatory metrics to report, required documentations
- SR 6.1-1 to 6.3-1

Harmonised data definitions:

- Compute density, Solution density and Solution footprint
- Power per volume of liquid
- Static load for bare, full and IT solution
- Height clearance
- Non-IT power data per kW IT and per m2
- Thermal losses
- More…

CH7: Datacenter interface

Input/output differentiation, FWS compatibility

- Colour coding & flow direction indicators, material compatibility of components, pressures and coolant mixtures
- SR 7.1-1 to 7.2-2
- CR 7.2-1

Extensive FWS descriptive information referring water quality, wetted materials, galvanic properties and DCIM.

Immersion related uptime factors

Descriptive content on following topics:

- Ride through (dielectric, partial dielectric and FWS)
- Thermal defsign
- Cooling infrastructure
- Oxidation and moisture
- IT compatibility

Reference collections

Requirements catalogue
- Full collection of all requirements grouped by requirement type

Glossary
- Used terms and explanation of meaning

References
- Listing of all referenced documents, studies or used sources

Call to Action

- Join and contribute in the immersion community

- Submit your technology for qualification against Immersion Requirements rev2

- Contribute to other immersion related projects

More information:

- About Asperitas and the work we do in OCP: Rolf.Brink@asperitas.com

- About the OCP activities, community work, projects: Rolf.Brink@ocproject.net

Immersion project participation:

- Check out the project Wiki with all essential information:
  https://www.opencompute.org/wiki/Rack_%26_Power/Advanced_Cooling_Solutions_Immersion_Cooling

- Join the mailing list and receive all community call invitations:
  http://lists.opencompute.org/mailman/listinfo/opencompute-acsimmersion

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Thank you!

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