

Immersion Reliability Community Update

Community Leadership

Samantha Yates - *Intel*

Brian Kinkade - *Fuchs*

Workstream Leadership

Bobby Glidwell - *Magnalytix*

Punith Shivaprasad - *Shell*

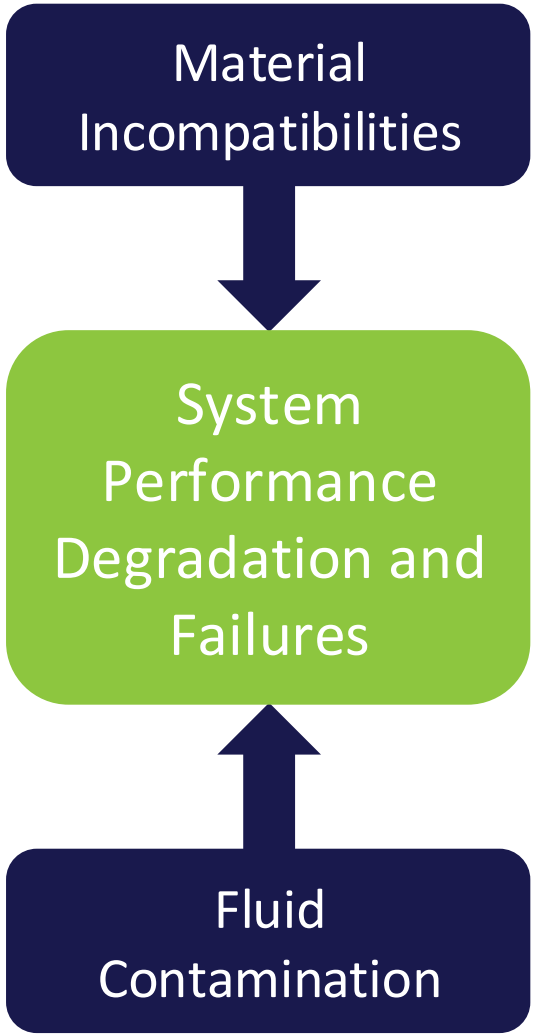
Betsy Cossette - *ExxonMobil*

Beau Van Vaerenbergh - *Oleon*

Thermochemical Quality and Reliability

Thermochemical Quality

Detection of material incompatibilities between the fluid and hardware that degrade capability and performance.



Thermochemical Reliability

Detection of hardware performance degradation due to deleterious reactions with fluid during the service lifetime.

Immersion Reliability Workstreams

Material Compatibility

Leads:

Bobby Glidwell
(Magnalytix)
Punith Shivaprasad
(Shell)

Meeting Time:

Each 3rd Tuesday
8:00-9:00am PT
10:00-11:00am CT
17.00-18.00 CET

Component Compatibility

Leads:

Beau VanVaerenbergh
(Oleon)
Brian Kinkade
(Fuchs)

Meeting Time:

Each 1st Tuesday
8:00-9:00am PT
10:00-11:00am CT
17.00-18.00 CET

Thermochemical Reliability

Leads:

Samantha Yates
(Intel)
Betsy Cossette
(ExxonMobil)

Meeting Time:

Each 2nd Tuesday
8:00-9:00am PT
10:00-11:00am CT
17.00-18.00 CET

Material Compatibility Workstream Scope

Workstream Leads

Bobby Glidwell
Director of Technology
Magnalytix
bobby.glidwell@ocproject.net

Punith Shivaprasad
Global Technical Lead: Liquid Cooling
Shell
punith.shivaprasad@ocproject.net

Workstream Objectives

- Evaluate material compatibility across fluid classes
- Standardize testing methodologies for consistency
- Provide comparative reference tools for decision-making
- Investigate post-aging compatibility testing

Whitepaper in Development:
Material Compatibility in Immersion Cooling Rev 2.0

Updating the guidelines and creating clearer templates and guidance for every participant in the compatibility process.

01

GUIDELINES v2.0

Clarify the core document

- Simplify structure, definitions, and test-method guidance
- Incorporate v1.x lessons and community feedback
- Expand practical coverage across materials and fluids
- Make compatibility decisions clearer and more consistent

02

TOOLS UNDER DEVELOPMENT

Create role-based templates

- Fluid manufacturers: report properties and compatibility data consistently
- Materials manufacturers: document composition, test results, and limits
- End users: capture use conditions, materials, fluids, and observations
- Common fields and examples make inputs easier to compare and reuse

03

GUIDANCE + NEXT STEPS

Turn inputs into action

- Develop clear guidance for completing and using each template
- Consolidate document and template changes into the v2.0 draft
- Review usability and remaining gaps with the community
- Contribute examples, feedback, test results, or review expertise

GOAL

Version 2.0 should be easier to apply, better supported by data, and more directly tied to real immersion-system risk.

Now Live: Material Compatibility Database

Compatibility answers, now easier to find.

Live access to OCP wetted-material interaction data for single and two-phase immersion cooling.

Search • Compare • Advise • Export • Contribute

570
compatibility observations

95
component profiles

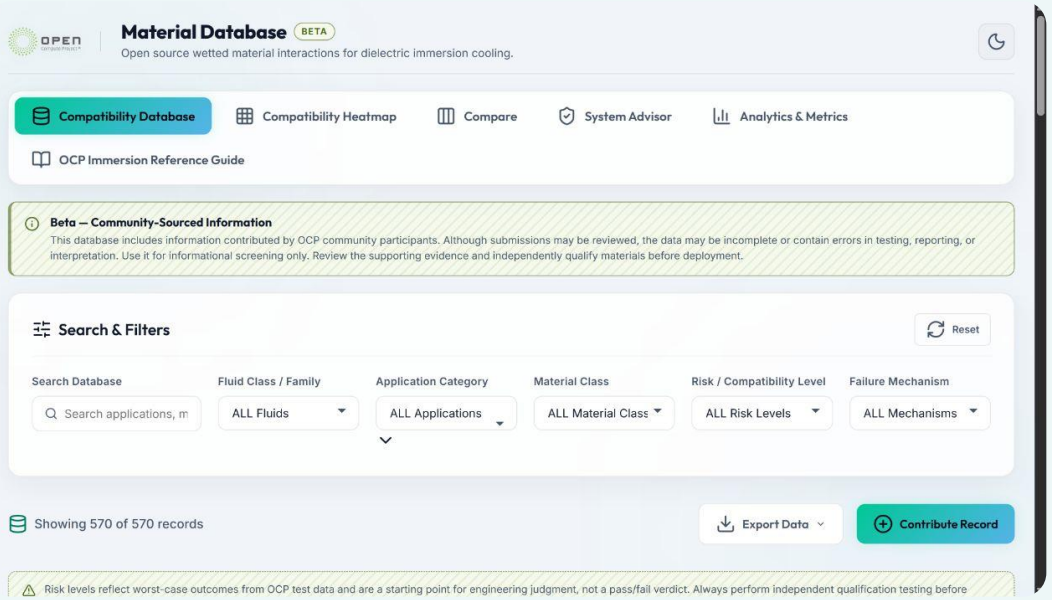
6
fluid families

SCAN TO OPEN THE TOOL

Official OCP URL: [add when available]

Maintained by the OCP Material Compatibility Workstream

THE LIVE EXPERIENCE



Use the database. Compare candidates. Contribute evidence.

Community-sourced screening information. Independent qualification remains essential.

Material Compatibility Database: OCP Resource

The roadmap focuses on reviewed contributions, versioned releases, and alignment with Material Compatibility in Immersion Cooling 2.0 guidance.

NOW

Open the public tool

Search, filter, compare, export, system advice and reference guidance in one browser experience.

NEXT

Grow community evidence

Structured submissions, OCP review and versioned releases keep contributions traceable and useful.

TOWARD V2.0

Align with the workstream

Refine application taxonomy, classifications, test conditions and mechanism tags as Version 2.0 guidance evolves.

Community-sourced screening information • Independent qualification remains essential

Component Compatibility Workstream Scope

Workstream Leads

Beau Van Vaerenbergh
Principal R&D Engineer
Oleon
beau.vanvaerenbergh@ocproject.net

Brian Kinkade
Market Development Manager
FUCHS SE
brian.kinkade@ocproject.net



Workstream Objectives

- To identify the server component and base-fluid combinations where performance of either is **not outside** of acceptance specifications
- To identify fluid contaminants values which are extracted from server components when exposed to base-fluids used for immersion cooling.

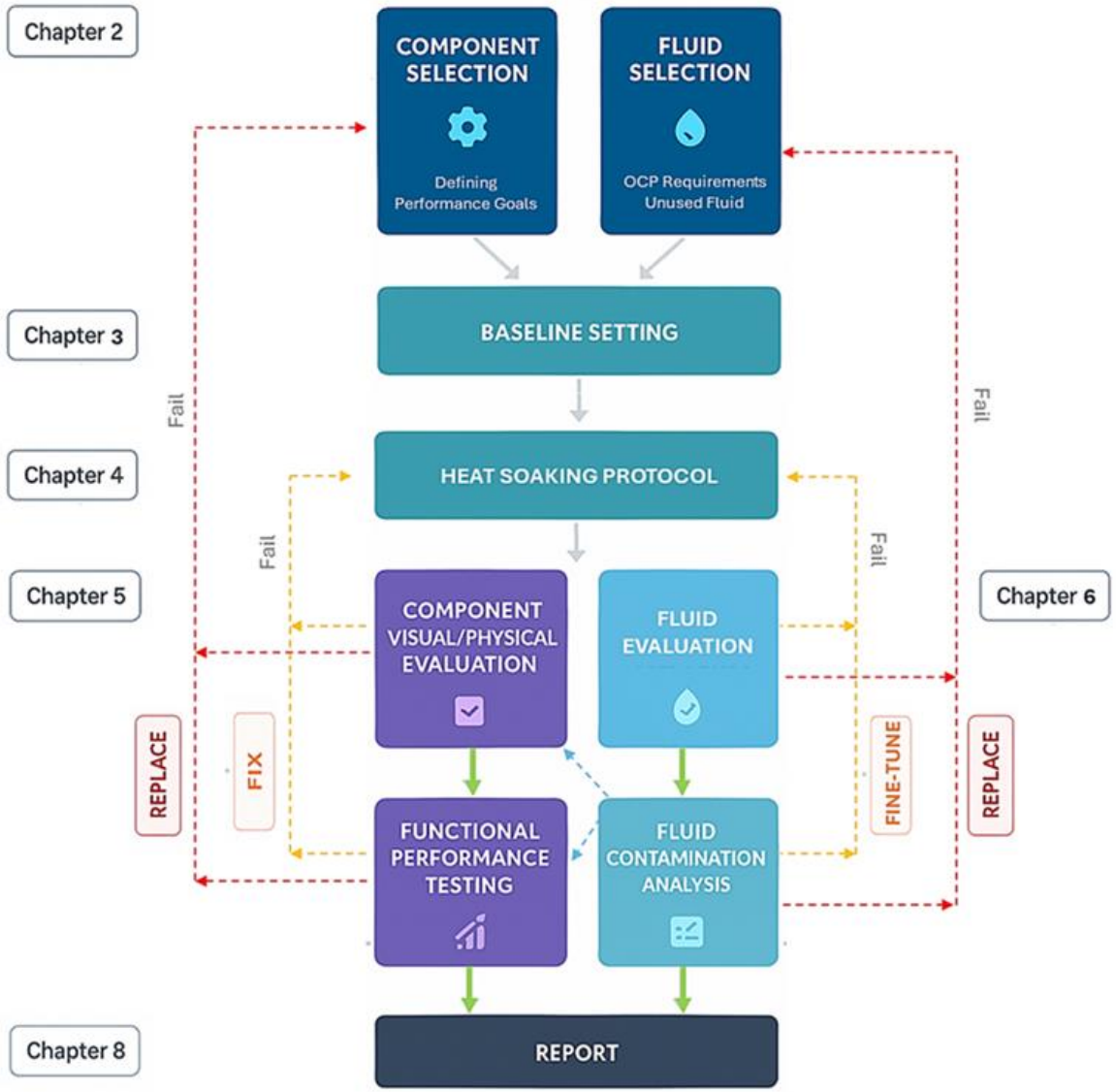
Whitepaper Published!

Objectives

- To standardize the material compatibility testing of functional server components to identify server component/base-fluid combinations where performance of the server component is not outside of vendor production acceptance specifications.
- To identify fluid contaminants extracted from server components during component material compatibility testing.

Key Elements

- A risk-based component prioritization framework
- Standardized soak conditions for single- and two-phase immersion cooling fluids
- An integrated root cause analysis linking component failures to fluid contamination.
- The methodology is applied to test cases such as cable assemblies and optical transceivers.



What's Next?



- Component & fluid selection
- Test conditions
- Qualitative risk assessment: low - medium - high

- Compile component & fluid characteristics.
- Compile component performance goals.
- Define low, medium and high-risk criteria and solicit feedback.

Goal: Create a practical, standardized, and trusted data form that enables meaningful compatibility data sharing while respecting confidentiality and supporting informed decision-making.

Thermochemical Reliability Workstream Scope

Workstream Leads

Samantha Yates
Principal Engineer: Platform QnR
Intel Corporation
samantha.yates@ocproject.net

Betsy Cossette
Immersion Cooling Market Development
ExxonMobil
betsy.cossette@ocproject.net

Workstream Objectives

- Develop standardized thermochemical reliability test methodologies for IT hardware.
- Aggregate thermochemical reliability test data and failure modes from the OCP community
- Provide recommendations on immersion requirements

Whitepaper in Development: Thermochemical Reliability of Server Hardware

Will IT hardware maintain reliable performance throughout its intended immersion service life?

White paper provides a framework to:

- Identify immersion-relevant failure modes
- Develop equivalent service lifetime acceleration models
- Execute immersion reliability testing
- Characterize hardware and fluid degradation
- Assess reliability risk over the intended service life

Experts Needed:

- Component and Reliability Engineers
- ODM System Designers/Engineers
- Chemists

Preview:

Thermochemical Reliability Failure Modes

Mode*	Mechanism	Hardware Detection Tests	Fluid tests	Mitigation Strategies
Electrical shorts	Corrosion deposits, conductive films, dendrites, insulation degradation	SIR, ECM, SEM/EDS, Insulation resistance	ICP-MS, electrical conductivity, water content, Dielectric breakdown voltage, particle count	minimize polar contaminants & moisture ingress; corrosion-resistant materials/coatings

*Extract from white paper

Equivalent Service Lifetime

How to build an acceleration model → Apply to reliability testing → Assess reliability risk

SIR: surface insulation resistance
ECM: electrochemical migration
SEM: scanning electron microscopy

EDS: energy dispersive spectroscopy
ICP-MS: Inductively Coupled Plasma Mass Spectrometry

Industry-Academia Collaboration to Advance Immersion Cooling Thermochemical Reliability

Copper Corrosion Contaminant Thresholds
- First threshold dataset to the community
- Sulfur, Halide and TAN contaminants study

Environmentally Induced Degradation
- Contaminant and corrosion by-product effects on PCB electrical reliability, with Magnalytix



Thermal Performance Impact due to Contaminant
- Thermal resistance changes due to contaminants induced copper corrosion

Signal Integrity at System Level
- DDR5 and, plus fluid service lifetime models

Milestone data released to the OCP community at each marker

Beyond Cooling: Engineering for Reliability and Longevity

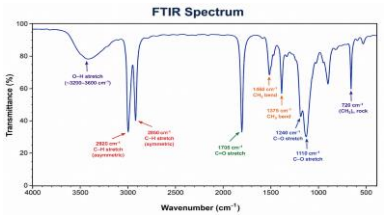
Contamination Thresholds



Copper coupons aging with sulfur, acid and halide contaminants to establish critical concentrations threshold

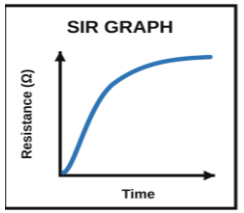
Different chemistries, three fluid Collaborators

Analytical Characterization



Surface analysis via XPS and chemical characterization using FTIR, ICP-OES,GCMS to **identify and quantify corrosion by-products**

Functional Reliability Testing



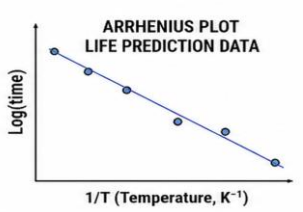
Evaluate **Environmentally Induced Degradation** by measuring changes in PCB electrical resistance and leakage current caused by corrosion by-products and contaminant-driven losses in surface insulation

Signal Integrity Testing



DDR5 rank margin variation vs contamination level and **dielectric shift impact** on high speed signaling

Fluid Service Lifetime Assessment



Corrosion threshold curves, acceleration models, lifetime estimators, and safe operating windows

Call to Action – Contributors Needed!

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Thank You!

