CHARTER: HTS-WORKSTREAM IN FUTURE TECHNOLOGY INITIATIVE

Author (s):

Peter Abrell, Vision Electric Super Conductors GmbH

Shrikanth Venkateshappa , Rittal GmbH Co & KG

Date: XXXX, 2XXXX

Table of Contents

1. Introduction and Workstream Goal

AI data centers are entering a new phase of electrical infrastructure demand. As accelerator rack power increases toward hundreds of kilowatts and potentially megawatt-class deployments, conventional power-distribution systems may face growing challenges in current density, space, losses, heat, material usage, protection, and maintainability.

High-temperature superconducting power infrastructure may offer an alternative architecture for selected high-power data-center use cases. Its relevance must therefore be evaluated in a neutral, technology-agnostic, and OCP-aligned manner.

The goal of this workstream is to evaluate whether, where, and under what conditions HTS-based electrical infrastructure could become relevant for future AI data centers.

The goal of this workstream is to:

- Evaluate whether HTS is relevant for future AI data-center power infrastructure.
- Identify where HTS may provide value versus conventional systems.
- Define suitable use cases from grid interface to whitespace and rack-level distribution.
- Develop initial candidate reference architectures.
- Create a path toward validation, standardization, and future OCP contributions.

2. Compliance with Open Compute Project Tenets

This workstream will follow OCP principles by evaluating HTS power infrastructure through open collaboration, transparent comparison, and practical applicability to future AI data-center needs.

2.1. Openness

The workstream will be open to participation from operators, suppliers, researchers, and standards contributors. Outputs will focus on open use cases, reference architectures, interface points, and evaluation criteria rather than proprietary vendor solutions.

2.2. Efficiency

The workstream will assess whether HTS power infrastructure can improve electrical, spatial, thermal, and material efficiency in high-density data centers. Efficiency claims will be evaluated against conventional copper and aluminium systems.

2.3. Impact

The workstream will focus on power-distribution challenges that may become critical for future AI data centers, especially at high rack and facility power levels. The intended impact is to identify where HTS could meaningfully improve data-center design, operation, and scalability.

2.4. Scale

The workstream will evaluate how HTS architectures may scale across row, hall, building, and campus-level power distribution. Particular attention will be given to power density, repeatability, modularity, and integration with data-center construction practices.

2.5. Sustainability

The workstream will assess the potential sustainability benefits and trade-offs of HTS infrastructure, including electrical losses, material usage, cooling demand, embodied carbon, lifecycle impact, and end-of-life considerations.

3. Workstream Objectives

The primary objective of the workstream is to develop an OCP-aligned reference architecture for HTS power infrastructure in future high-density AI data centers.

The reference architecture will define how HTS-based power infrastructure could be integrated from grid interface to data-center whitespace, row, rack, and selected server-interface concepts.

The workstream will:

- Create a grid-to-rack HTS reference architecture.
- Define key electrical interfaces and system boundaries.
- Map applicable HTS use cases within the data center.
- Compare the reference architecture with copper and aluminium alternatives.
- Identify technical and economic break-even points.
- Define cryogenic, protection, safety, reliability, and maintainability requirements.
- Identify standards gaps and OCP alignment points.
- Assess supply-chain and deployment-readiness requirements.
- Create a roadmap toward validation, pilots, and future OCP contributions.

4. Scope of Workstream

The scope of the workstream is to define the system boundaries, interfaces, and technical building blocks required for an OCP-aligned HTS power-infrastructure reference architecture for future high-density AI data centers.

In Scope

- Grid-to-data-center electrical interface for HTS integration.
- Medium-voltage to low-voltage HTS interface concepts.
- HTS power distribution from electrical rooms to whitespace.
- Row-level, rack-level, and selected server-interface concepts.
- HTS tap-off and connection concepts.
- Cryogenic infrastructure, monitoring, redundancy, and maintainability.
- Protection philosophy, fault behavior, and HTS fault-current limiting.
- Fire interaction, emergency response, and hazard mitigation.
- Technical standards, code applicability, and OCP interface points.
- Comparison with copper and aluminium alternatives.
- Techno-economic, space, material, and energy-loss assessment.
- Supply-chain maturity and commercial deployment readiness.
- SMES as an adjacent HTS-enabled use case, where relevant to data-center power architecture.

Out of Scope

- Superconducting electronics.
- Quantum-computing infrastructure.
- Chip-level superconducting interconnects.
- Vendor-specific proprietary product design.
- Certification of any individual vendor solution.
- Room-temperature-superconductor concepts unless commercially validated.

5. Key Participants

Co-leads:

- Peter Abrell, Vision Electric Super Conductors
- Shrikanth Venkateshappa, Rittal GmbH Co & KG