Oak Ridge AI Supercomputing Campus

(ORNL / TVA-Aligned)

Executive Implementation Summary

Planning-Only, RFI-Aligned, Non-Binding Concept

Planning Disclaimer and Scope Anchor

This executive summary overlays the Oak Ridge AI Supercomputing Campus concept and is strictly bounded by the March 2025 DOE "AI Infrastructure on DOE Lands" Request for Information (RFI) and associated public DOE descriptions. All elements are planning-grade and proxy-based; no operational control, construction authorization, procurement activity, or deployment commitment is implied. Energy integration, compute integration, and infrastructure interactions are modeled exclusively through conceptual abstractions, not physical or operational systems.

This summary supports internal planning, comparative site evaluation, and governance design. Any progression to engineering, construction, or operations would require separate DOE approvals, detailed studies, and formal authorization processes.

Strategic Positioning and Acceleration Signal

The Oak Ridge AI Supercomputing Campus frames Oak Ridge National Laboratory (ORNL) as a high-readiness planning candidate for AI infrastructure evaluation within DOE's portfolio, leveraging ORNL's established leadership in high-performance computing (HPC), scientific research, and secure federal environments. It frames Oak Ridge as a strategic convergence for AI-HPC adjacency in planning models, subject to future decisions, site constraints, and governance approvals.

Planning-level acceleration is signaled through modular templates, phased readiness gates, and proxy workloads with synthetic datasets, enabling rapid iteration in modeling without physical deployment. This signal is fully reversible, focusing on efficient planning cycles rather than execution timelines or milestones.

Program Purpose and RFI Anchor

The Oak Ridge AI Supercomputing Campus concept provides a planning framework for a sovereign AI enclave adjacent to advanced supercomputing on DOE-managed lands, aligned with the RFI's opportunity space. It explores AI workloads, HPC adjacency, and abstract energy representations in proxy models to inform infrastructure planning and governance.

This concept does not authorize site development, facility modification, grid interconnection, or system integration. It serves solely as a structured tool for DOE to compare Oak Ridge against other sites within public information boundaries.

Implementation Architecture Overview

The architecture is structured around three planning templates mirroring a phased maturity model:

1. Initial Template: Models a compact AI enclave adjacent to existing supercomputing, using synthetic workloads to validate governance, cybersecurity, orchestration, and data models in planning space.

2. Intermediate Template: Explores federated AI nodes across zones, assessing scaling, partitioning, and governance complexity without physical expansion assumptions.

3. Long-Horizon Template: Evaluates phased growth paths, cumulative governance, and evolving interactions over extended horizons, with each phase reversible and gated. All three templates are planning constructs only and are explicitly designed to be reversible and modifiable as DOE priorities, environmental data, or mission constraints evolve.

Energy interactions are abstracted as couplings between workloads and power signals; no grid integration or control is implied.

Phase Roadmap

- Phase Zero: Refine architecture, define proxy workloads, mature governance, and align cybersecurity using synthetic data in unclassified settings. Harden concepts for internal coherence.

- Phase One: Conduct cross-template comparisons, stress scenarios, and scalability testing. Maintain abstractions bounded by public data.

- Phase Two: Support decision analysis on warranting site-specific studies. Outputs are non-binding and assess planning viability.

- Phase Three: If authorized, transition to formal environmental, engineering, and realty studies under DOE oversight. No construction or procurement is assumed. Entry into Phase Three itself is not assumed or requested by this guide; it would depend on separate DOE decisions and additional analyses.

Risk Register (Planning-Level)

- Technical Risk: Uncertainty in AI-HPC scaling without unintended coupling. Mitigated via modular proxies and separation.
- Cybersecurity Risk: Evolving threats to sovereign environments. Addressed through layered governance and federal framework alignment.
- Regulatory/Environmental Risk: Land use, permitting, and stewardship constraints. Treated as planning boundaries.
- Programmatic Risk: Misinterpretation of plans as commitments. Mitigated by disclaimers, gating, and authority separation.

All risks are preliminary and subject to refinement in authorized phases. The intent is to surface and structure these risks at the planning stage so that any future DOE decision to advance Oak Ridge would face fewer unknowns and clearer mitigation options.

Governance Framework (Target Construct)

The governance framework described here is a proposed target state for any future Oak Ridge AI campus concept; it does not reflect current authorities or organizational decisions. A multi-layer model ensures conservative authority, transparency, and reversibility:

- Executive Steering: Oversees scope, pacing, and termination.
- Technical Board: Manages modeling integrity, cybersecurity, data standards, and boundaries.
- Risk Review: Provides independent challenge and traceability.

These are target planning assumptions, not existing authorities.

Metrics Framework

Planning-oriented metrics include architectural coherence, governance maturity, cybersecurity readiness, proxy stability, and reversibility. Used for evaluation and gating, not operational guarantees. Metrics are used for internal planning gates and comparative evaluation only; they do not constitute performance guarantees or readiness certifications.

Readiness Gates

- Gate One: Validate completeness, discipline, and coherence.
- Gate Two: Assess scalability, alignment, and risk under scenarios.
- Gate Three: Determine confidence for deeper studies without execution commitment.

Each gate preserves pause, redirect, or termination options.

Compliance Mapping

Designed for alignment with federal cybersecurity standards, DOE orders, environmental policies, and data governance, as planning constraints—not certifications.

Expected Strategic Objectives (Planning Targets)

Objectives inform prioritization: The concept is modeled to explore how it could support scientific workflows, enhance sovereign AI in research, provide insights into AI-HPC interaction models, and refine infrastructure governance. These are targets, not commitments.

Investment Discipline

Structured for incremental planning, gated authority, and reversibility. No irreversible funding, contracting, or site actions assumed.

Initial Decision Request

Request authorization only for continued planning, modeling, governance, and analysis. Future authorities require separate processes.

No-Fabrication and Sourcing Note

Derived from public DOE descriptions of ORNL and the March 2025 RFI. No new capacities, ratings, volumes, counts, or timelines introduced. Undefined elements remain unspecified. All concepts are planning-only and proxy-based.

Instruction for future edits: Maintain this document's planning-only, RFI-bounded posture; do not add tables, new site facts, capacities, or commitments in subsequent revisions.

Problem Statement and Opportunity

AI workloads are central to DOE's scientific, energy, and security missions, often partnering with HPC systems. ORNL, on the Oak Ridge Reservation in Tennessee, hosts leading computing infrastructure and national research programs [DOE RFI, Mar 2025]. All site descriptions and role characterizations are drawn from the March 2025 'AI Infrastructure on DOE Lands' RFI and public DOE/ORNL materials; no additional site facts are introduced.

The RFI identifies Oak Ridge as a candidate site but lacks an integrated AI-HPC concept [DOE RFI, Mar 2025]. The gap: No unified vision showing how an AI campus could complement ORNL missions, interact with the TVA-served grid in models, and respect constraints.

The opportunity: Develop an ORNL/TVA-aligned concept that treats AI and HPC as reinforcing, uses the RFI as factual boundary, and provides DOE a disciplined comparison basis before solicitations.

Scope and Non-Scope

Scope

- Define architecture templates for AI campus on DOE lands near ORNL, emphasizing AI-HPC adjacency, grid-aware models, and mission alignment.
- Develop tool-agnostic proxy modeling for AI loads, power interactions, cooling, and constraints under scenarios.
- Describe planning-level governance, security zoning, and data handling, protecting ORNL missions.
- Identify gaps and readiness criteria for DOE pre-solicitation.

Non-Scope (Explicit)

- No operational control of TVA or grid assets.
- No reactor or nuclear interfacing.
- No real-time actuation, dispatch, or control.
- No build, procure, solicit, or deploy commitments.
- No vendor, technology, or software endorsements.
- No numerical claims on power, lines, water, land, or budgets unless RFI-specified; otherwise, “Not specified in the RFI” [DOE RFI, Mar 2025].
- No classified networks or secure programs references.

RFI Alignment Narrative (Categories 1–10)

This concept aligns explicitly with the RFI and Oak Ridge appendix [DOE RFI, Mar 2025].

- **Category 1 – Interest in Solicitation**: Expresses interest in Oak Ridge for AI+HPC planning, citing ORNL missions, facilities, and energy access, without presuming outcomes [DOE RFI, Mar 2025].

- **Category 2 – Site Information and Data Center Design**: Describes AI campus purposes (AI-assisted science, analytics) and considerations (HPC adjacency, climate-compatible cooling, zoning). No non-RFI numerics [DOE RFI, Mar 2025].

- **Category 3 – On-Site Energy Development**: Allows generic firm resources in models; at Oak Ridge, grid-primary in planning models with co-located technology information needs identified for any future studies, and no deployment assumed [DOE RFI, Mar 2025].

- **Category 4 – Off-Site Energy and Transmission Capacity**: Represents the conceptual campus as a large modeled load interacting with abstract TVA-served transmission signals, without asserting actual interconnection or capacity; flags substation/line info needs, unspecified in RFI [DOE RFI, Mar 2025].

- **Category 5 – Financial and Contractual Considerations**: Acknowledges long-term land arrangements and tariffs per RFI; no specific terms proposed [DOE RFI, Mar 2025].

- **Category 6 – Benefits and Collaboration Opportunities**: Outlines qualitative enhancements to ORNL domains, grid research, universities/industry, per RFI [DOE RFI, Mar 2025].

- **Category 7 – Economic Opportunities and Considerations**: Notes regional workforce/economic contributions; flags local contexts, no projections [DOE RFI, Mar 2025].

- **Category 8 – Environmental Documentation**: Assumes baseline data/permits central; screens areas via reviews [DOE RFI, Mar 2025].

- **Category 9 – Challenges and Additional Information**: Identifies uncertainties (demand, grid, cooling, missions); calls for site/grid data [DOE RFI, Mar 2025].

- **Category 10 – Engagement Strategy with Communities and Tribes**: Frames engagement with locals, governments, Tribes as core requirement [DOE RFI, Mar 2025].

Site Context

Per RFI: ORNL is a DOE science lab with advanced computing; DOE manages suitable land subject to reviews; access to energy/transmission (ratings unspecified); water/parcel details unspecified; sensitivities/operations guide development [DOE RFI, Mar 2025]. Undefined elements: “Not specified in the RFI.” No additional site-specific details beyond those in the RFI and public DOE/ORNL materials are introduced.

Concept of Operations (CONOPS)

The campus is modeled as a multi-zone facility co-located with ORNL computing. Co-location here refers to conceptual adjacency in planning constructs, not any commitment to modify existing ORNL facilities:

- **Zones and Workloads**:
    - HPC-adjacent: AI for simulation processing.
    - Research AI: Broad unclassified workloads.
    - Mission-aligned: Dedicated analytics with restrictive zoning.
- **Load and Operation**: Zones with varying profiles (training/inference/scheduling); flexible portions for grid-aware simulations.
- **Power and Cooling**: Modeled as TVA-served grid supply with optional generic on-site resources in planning scenarios; no actual interconnection, capacity, or plant configuration is assumed. Cooling classes climate-consistent, volumes unspecified.
- **Integration with Missions**: Is intended in planning to support adjacent AI capabilities alongside ORNL HPC for science/energy/national research.

Proxy Modeling Plan

All modeling is unclassified and relies on synthetic, public, or proxy datasets; no operational ORNL or TVA data is assumed. Use tool-agnostic proxies to simulate:

- AI loads: Time-varying profiles.
- Energy: Abstract grid signals, no actuation.
- Cooling/Environment: Constraint models.
- Scenarios: Baseline, stress, growth.

Governance and Security

Governance and security constructs in this section are planning-only target states and do not reflect existing authorities or controls.

- **Zoning**: Segmented for protection.
- **Data Handling**: Stewardship models.
- **Cybersecurity**: Federal-aligned postures.

Readiness Criteria and Gaps

- Gaps: Detailed grid capacities, water, parcels.
- Criteria: Complete models, reviews passed before advancement.

Engagement and Next Steps

Engage stakeholders per RFI expectations at the planning level; next steps focus on refining proxy models and comparative analysis only. No siting, construction, or deployment commitments are implied.

Marketing Paragraph for Website Card:
Review the planning concept for an Oak Ridge AI Supercomputing Campus, which explores how AI innovation could be aligned with ORNL's high-performance computing capabilities to support DOE missions. This RFI-bounded framework offers a disciplined way to evaluate secure, grid-aware AI infrastructure on federal lands, without implying deployment or commitment.

View Implementation Guide (Planning) (Manual link: https://ucdpforge.com/pdfs/NLIG/ORNL_AI_Campus_Impl_Guide.pdf)