Session 002-004 — Design

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Course: High-Containment Laboratory Design

Purpose of the document:

This lecture map is designed to help participants navigate the content of Lecture 002-004. It identifies the main conceptual sections, structural inflection points, and logical transitions of the session. It functions as an orientation and study tool and does not replace the lecture.

SECTION 1 — Design does not begin with a blank page

Main focus: Reframe the design phase as a process of verification and consolidation rather than creative initiation.

Key points:

- Design inherits decisions from planning.
- Assumptions must be explicit before drawing begins.
- Silent re-decisions create downstream risk
- Design validates whether prior decisions are technically coherent.

Rhetorical questions / Attention signals:

- What exactly are we designing?
- What happens if we begin drawing without verifying inherited decisions?

Orientation signal: Establishes the conceptual boundary between planning (002-003) and design (002-004).

SECTION 2 — The critical transition from planning to design

Main focus: Define the formal handoff required before entering schematic design.

Key points:

- Inherited decisions must be documented.
- Unresolved constraints must be identified.
- The project must be demonstrably designable.
- Verification is a structural checkpoint, not administrative formality.

Rhetorical questions / Attention signals:

- Are we sure what has already been decided?
- What is still ambiguous but assumed to be fixed?

Orientation signal: Marks the inflection point where the project becomes structurally constrained.

SECTION 3 — Integrated Design Process (IDP) as decision architecture

Main focus: Introduce IDP as a coordinated and sequenced decision framework.

Key points:

- Architecture, engineering, and biosecurity must align early.
- Effort shifts forward in time.
- The order of decisions reduces later conflict.
- Sequential fragmentation increases redesign risk.

Rhetorical questions / Attention signals:

- What happens when each discipline works independently?
- When do costs actually become fixed?

Orientation signal: Positions integration as a structural necessity, not a management preference.

SECTION 4 — Decision timing and cost impact

Main focus: Establish the relationship between decision timing and lifecycle consequences.

Key points:

- Early decisions are inexpensive to adjust
- Late changes multiply cost and operational disruption.
- Between schematic and anteproyecto, most structural logic must be resolved.
- Executive documentation does not redesign the project.

Rhetorical questions / Attention signals:

- When is a change still affordable?
- What happens if layout shifts during executive phase?

Orientation signal: Connects decision sequencing with lifecycle cost and risk control.

SECTION 5 — Schematic design as freeze point

Main focus: Define schematic design as the structural locking of layout and flow logic.

Key points:

- Layout freeze defines spatial hierarchy.
- Flow paths become architectural constraints.
- HVAC and pressure cascades depend on geometry.
- Flexibility decreases after freeze.

Rhetorical questions / Attention signals:

- What becomes irreversible after schematic design?
- What does it mean to “change a wall” in BSL-3?

Orientation signal: Prepares the transition from layout logic to system coupling.

SECTION 6 — Operational flows as the first security system

Main focus: Establish flows as the foundational safety mechanism.

Key points:

- Personnel flow.
- Material flow
- Waste flow.
- Layered zoning (campus → building → lab → BSL-3).

Minimization of cross-traffic.

Rhetorical questions / Attention signals:

- Can mechanical systems compensate for poor flow logic?
- Where does safety actually begin?

Orientation signal: Reorients containment from mechanical systems to spatial behavior.

SECTION 7 — Containment as airflow behavior

Main focus: Define BSL-3 containment in behavioral rather than numeric terms.

Key points:

- Directional airflow stability.
- Controlled leakage
- Influence of door geometry and openings.
- Pressure differential as robustness, not origin.

Rhetorical questions / Attention signals:

- Does a pressure number create containment?
- What determines airflow direction in practice?

Orientation signal: Links spatial geometry with mechanical logic.

SECTION 8 — Redundancy (N+1) and resilience

Main focus: Introduce redundancy as architectural resilience.

Key points:

- Avoidance of single points of failure.
- Application to exhaust, supply, electrical, and control systems.
- Resilience under malfunction.
- Continuity of containment.

Rhetorical questions / Attention signals:

What happens when one fan fails?

- Is redundancy optional or structural?
- Orientation signal: Connects system architecture with operational continuity.

SECTION 9 — Barrier equipment as system decisions

Main focus: Treat autoclaves, EDS, and HEPA components as integrated design decisions.

Key points:

- Equipment location affects flow and envelope.
- Maintenance access affects exposure risk.
- Equipment placement influences lifecycle cost.

Rhetorical questions / Attention signals:

- Is equipment selection just a procurement task?
- Where should maintenance occur relative to containment?

Orientation signal: Reinforces system thinking beyond product choice.

SECTION 10 — Anteproyecto as full technical resolution

Main focus: Define anteproyecto as the stage of complete technical consolidation.

Key points:

- System dimensioning finalized.
- Pressure cascades validated.
- Interdisciplinary conflicts resolved.
- Redundancy confirmed.

Rhetorical questions / Attention signals:

- What must be fully resolved before executive documentation begins?
- What risks arise if systems remain undefined?

Orientation signal: Transitions from schematic logic to full system definition.

SECTION 11 — Basis of Design (BOD) as technical memory

Main focus: Present BOD as the document that anchors decision continuity.

Key points:

- Records validated requirements.
- Defines system architecture and redundancy logic.
- Captures airflow and containment strategy.
- Guides executive documentation and commissioning.

Rhetorical questions / Attention signals:

- What prevents reinterpretation during construction?
- Where are core decisions preserved?

Orientation signal: Positions documentation as structural control, not paperwork.

SECTION 12 — BIM precision and early LOD requirements

Main focus: Explain why high-containment design requires early modeling precision.

Key points:

- Critical systems require LOD 350–400.
- Clash-free coordination is safety-critical.
- Progressive ambiguity is unacceptable.
- Model precision supports regulatory validation.

Rhetorical questions / Attention signals:

- Can containment tolerate "approximate" duct routing
- When must coordination be final?

Orientation signal: Closes the lecture by reinforcing that design in high containment is a process of disciplined decision closure, not incremental refinement.

How to use this lecture map

When reviewing the session:
Distinguish verification logic from creative design logic.
– Identify freeze points and irreversible decisions.
– Relate layout directly to airflow behavior.
– Treat redundancy as architectural resilience.
– Understand anteproyecto as full technical resolution.
– Recognize BOD as structural continuity.
– Avoid reducing containment to numeric compliance.