Section 002-001 — Foundations of High-Containment Laboratory Design

Instructor: Luis Linares

Course: High-Containment Laboratory Design

Purpose of the document:

This lecture map is designed to help participants navigate the content of Section 002-001. It identifies the main conceptual sections, key ideas, and logical transitions of the session. It functions as an orientation and study tool and does not replace the lecture.

Section 1 — Introduction: the laboratory as a living system

Main focus: Establish the foundational idea that a high-containment laboratory is not merely a building, but a living system shaped by design, systems, procedures, and human behavior.

Key points:

- A containment laboratory depends as much on human behavior as on technical systems.
- Physical barriers, equipment, procedures, and safety culture work together as a single system.
- Failure in any one element weakens the entire system.
- The session sets the conceptual foundations for understanding containment as integrated protection.

Rhetorical questions / Attention signals:

- What truly makes a laboratory safe?
- Is safety defined by infrastructure, equipment, or culture?

Orientation signal: Introduces the central question that will accompany the entire course.

Section 2 — Scope and objectives of the course

Main focus: Clarify the purpose, structure, and pedagogical approach of the course.

Key points:

- The course offers an integrated view of high-containment laboratory design, particularly BSL-3.
- Biological safety principles are translated into design decisions.
- The content is framed within Latin American institutional and operational contexts.
- The course emphasizes not only what to do, but why decisions are made.

Rhetorical questions / Attention signals:

- How do biosafety principles become design choices?
- Why must design adapt to local contexts?

Orientation signal: Aligns participant expectations with the technical and conceptual goals of the course.

Section 3 — Structure of the course and thematic blocks

Main focus: Present the internal organization of the course and the progression of topics.

Key points:

- The course is divided into two main parts.
- Part 1 addresses historical context, technical foundations, materials, and engineering controls.
- Part 2 addresses human-centered design, regulatory balance, operational continuity, and sustainability.
- Each block builds toward an integrated understanding of containment.

Rhetorical questions / Attention signals:

- Why is containment discussed from history to sustainability?
- How do these topics connect?

Orientation signal: Provides a roadmap for how concepts will accumulate across sessions.

Section 4 — Historical context and origin of biological containment

Main focus: Explain why biological containment emerged and how it evolved historically.

Key points:

- Early containment laboratories originated in the United States during the 1940s and 1950s.
- Facilities such as Fort Detrick and Plum Island shaped early containment strategies.
- Containment initially served defense programs before shifting to public health and research.

- Epidemic outbreaks reinforced the need for safer laboratories.

Rhetorical questions / Attention signals:

- Why were the first containment laboratories created?
- How did historical events shape today's laboratories?

Orientation signal: Connects present-day containment design to its historical roots.

Section 5 — From technical systems to integrated protection

Main focus: Reinforce containment as an integrated system rather than a collection of technical components.

Key points:

- Containment is not achieved through a single system or device.
- Design decisions span materials, spatial organization, and personnel training.
- All decisions align with a guiding principle of comprehensive protection.
- Protection extends to people, animals, the environment, and research integrity.

Rhetorical questions / Attention signals:

- Can equipment alone ensure containment?
- How do design and training interact?

Orientation signal: Transitions from historical context to systemic thinking.

Section 6 — Planning as the foundation of containment

Main focus: Introduce planning as the most critical factor in laboratory safety and performance.

Key points:

- Laboratory planning defines access control and spatial hierarchy.
- The "box-in-a-box" concept isolates the laboratory from external environments.
- Planning supports both energy efficiency and biosafety.
- Design must anticipate operational needs and risks.

Rhetorical questions / Attention signals:

- Why must containment be planned before technical design?
- What happens when planning is insufficient?

Orientation signal: Positions planning as the basis for all subsequent decisions.

Section 7 — Influence of SOPs on design and containment

Main focus: Explain how Standard Operating Procedures directly shape laboratory design.

Key points:

- SOPs determine primary containment measures such as biosafety cabinets.
- Workflows influence spatial layout and equipment placement.
- Aerosol-generating activities require specific containment strategies.
- SOPs guide personal protective equipment requirements.

Rhetorical questions / Attention signals:

- How does work practice influence spatial design?
- Can SOPs be separated from architecture?

Orientation signal: Links operational behavior to physical design requirements.

Section 8 — Secondary barriers, airflow, and pressure zoning

Main focus: Describe how SOPs influence secondary containment systems.

Key points:

- Pressure differentials organize clean, less clean, and potentially contaminated zones.
- Personnel and material flows must align with negative pressure zoning.
- HVAC systems respond to procedural needs.
- Airflow direction reflects biological risk.

Rhetorical questions / Attention signals:

- What happens when airflow contradicts workflow?
- How does zoning protect containment?

Orientation signal: Bridges procedures with mechanical systems.

Section 9 — Decontamination and waste management as design drivers

Main focus: Present decontamination requirements as determinants of laboratory design.

Key points:

- SOPs may require autoclaving or chemical disinfection before material exit.
- Design may include pass-through autoclaves and effluent treatment systems.
- Whole-room decontamination requires hermetic sealing and injection ports.
- Finishes must resist chemical exposure.

Rhetorical questions / Attention signals:

- What design changes are required by VHP decontamination?
- Why must hermeticity be planned early?

Orientation signal: Shows how operational requirements fix physical design decisions.

Section 10 — Hermeticity and verification of containment

Main focus: Explain the importance of laboratory airtightness and its verification.

Key points:

- Hermetic laboratories are safer and more energy efficient.
- Airtightness stabilizes pressure differentials and airflow.
- Laboratories must be isolated from atmospheric pressure fluctuations.
- Pressure decay testing verifies containment performance.

Rhetorical questions / Attention signals:

- How do we know a laboratory is truly airtight?
- Why is verification as important as design?

Orientation signal: Introduces validation as a measurable requirement.

Section 11 — Sustainability and energy considerations

Main focus: Address sustainability within the constraints of high-containment laboratories.

Key points:

- BSL-3 laboratories renew 100% of air and cannot rely on recirculation.
- Energy efficiency is possible when addressed through planning and design.
- Containment integrity must always take precedence.
- Sustainability begins with airtightness and system optimization.

Rhetorical questions / Attention signals:

- Can a high-containment laboratory be sustainable?
- Where do efficiency gains come from?

Orientation signal: Prepares the transition from fundamentals to advanced system design.

Section 12 — Closing reflection: containment as shared responsibility

Main focus: Conclude the session by reinforcing containment as a shared technical and human responsibility.

Key points:

- Safety emerges from the interaction of systems, people, and culture.
- Design decisions carry long-term consequences.
- Containment is maintained through continuous attention and discipline.
- The guiding question remains central throughout the course.

Rhetorical questions / Attention signals:

- Who is responsible for containment over time?
- How do decisions made today affect future safety?

Orientation signal: Closes the session by reinforcing the foundational principles that support all subsequent lectures.

Lecture 002-002 — In-Depth Design: Critical Systems and Infrastructure

Instructor: Luis Linares
Course: High-Containment Laboratory Design

Purpose of the document:

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

SECTION 1 — The laboratory as a living system

Main focus: Introduce the laboratory as a dynamic, living system rather than a static collection of walls, equipment, or specifications.

Key points:

- The course is grounded in accumulated experience from high-containment projects across Latin America.
- The laboratory is not defined only by walls, filters, or ventilation.
- Containment, comfort, and efficiency depend on how systems interact over time.
- The laboratory must be understood as a system that evolves during operation.

Rhetorical questions / Attention signals:

- Is a laboratory just a collection of components?
- What happens when one part of the system changes?

Orientation signal: Establishes systems thinking as the foundational lens for the entire lecture.

SECTION 2 — Design in depth as a performance-based approach

Main focus: Define what “design in depth” means in the context of high-containment laboratories.

Key points:

- Design in depth goes beyond drawings and equipment catalogs.
- It requires anticipating laboratory behavior over 10, 15, or 20 years.
- Decisions affect hermeticity, system response to failure, energy use, and personnel safety.
- Each component exists for a reason within a broader balance.

Rhetorical questions / Attention signals:

- How will this laboratory behave years after commissioning?
- What happens when one component is altered?

Orientation signal: Frames design as a long-term performance question, not a short-term construction task.

SECTION 3 — Layers of containment design

Main focus: Present containment as a layered system composed of multiple interacting elements.

Key points:

- The lecture introduces physical barriers as one layer of containment.
- Critical engineering systems support containment.
- Energy management is integrated into containment performance.
- The lecture will culminate in a real integrated case study.

Rhetorical questions / Attention signals:

- Where does containment actually reside?
- Can a single system ensure containment on its own?

Orientation signal: Prepares participants to see containment as a system, not an isolated feature.

SECTION 4 — Critical systems as containment elements

Main focus: Position critical systems as integral components of containment, not auxiliary infrastructure.

Key points:

- HVAC systems are not just comfort systems.

- Airflow behavior directly affects containment stability.
- Directional airflow and pressure gradients are containment mechanisms.
- System balance is essential; altering one element affects all others.

Rhetorical questions / Attention signals:

- What happens if airflow balance is modified without coordination?
- Can containment exist without stable airflow control?

Orientation signal: Transitions from conceptual containment to mechanical and operational realities.

SECTION 5 — Directional airflow and pressure control

Main focus: Explain the logic of directional airflow and differential pressure in BSL-3 laboratories.

Key points:

- A BSL-3 laboratory is not fully sealed.
- The secondary barrier is directional airflow.
- Controlled leakage is intentional and managed.
- Pressure differentials between rooms maintain containment.

Rhetorical questions / Attention signals:

- Where do we want leaks to occur?
- What happens when doors open?

Orientation signal: Clarifies common misconceptions about sealing and containment.

SECTION 6 — Airflow control devices as critical containment components

Main focus: Describe airflow control devices as critical containment elements.

Key points:

- Airflow control devices are not generic HVAC components.
- Venturi valves and dampers control directionality and stability.
- These devices determine recovery after dynamic events.
- They must meet both aerodynamic and containment integrity criteria.

Rhetorical questions / Attention signals:

- What defines a containment-grade air valve?
- How does recovery time affect safety?

Orientation signal: Links mechanical design decisions directly to biosafety outcomes.

SECTION 7 — Measurement, monitoring, and system stability

Main focus: Emphasize measurement and monitoring as the foundation of containment control.

Key points:

- Containment depends on reliable measurement.
- Without data, the system is blind.
- Differential pressure sensors must be strategically located.
- Calibration is essential to avoid instability and excess energy use.

Rhetorical questions / Attention signals:

- What happens when sensors are inaccurate?
- Can containment be trusted without verification?

Orientation signal: Introduces verification as a continuous operational requirement.

SECTION 8 — HVAC systems and energy demand in BSL-3 laboratories

Main focus: Explain why HVAC systems dominate energy consumption in high-containment laboratories.

Key points:

- Air is the main energy consumer in BSL-3 laboratories.
- Single-pass air and continuous operation drive demand.
- Air must be fully conditioned before entering the laboratory.
- HVAC design choices directly affect energy and containment.

Rhetorical questions / Attention signals:

- Why do BSL-3 laboratories consume 10–20 times more energy?
- Where can efficiency be introduced without risk?

Orientation signal: Sets the stage for integrating sustainability with containment.

SECTION 9 — Sustainability as a containment strategy

Main focus: Present sustainability as an integral part of biosafety, not a separate objective.

Key points:

- Sustainability does not mean reducing energy at any cost.
- Efficiency must not compromise containment.

- Technical improvements can also be environmental improvements.
- Sustainability is a way of thinking, not a decorative option.

Rhetorical questions / Attention signals:

- Can a safer laboratory also be more efficient?
- What happens when sustainability is considered late?

Orientation signal: Reframes sustainability as a safety and resilience issue.

SECTION 10 — The hierarchy of energy strategies

Main focus: Introduce the priority sequence for energy decision-making.

Key points:

- First: reduce demand.
- Second: optimize systems.
- Third: recover energy.
- Fourth: generate renewable energy.
- Renewable generation only makes sense after demand is defined.

Rhetorical questions / Attention signals:

- Why does photovoltaic sizing come last?
- What happens when generation compensates inefficiency?

Orientation signal: Establishes order and discipline in energy decision-making.

SECTION 11 — Integrated case study: SAG Lo Aguirre

Main focus: Apply the lecture concepts to a real high-containment laboratory project.

Key points:

- The SAG Lo Aguirre BSL-3+ laboratory in Chile is presented.
- Design decisions led to a carbon-neutral building.
- Certified under CES and ISO 50001.
- Demonstrates that containment and sustainability are compatible.

Rhetorical questions / Attention signals:

- How do these decisions translate into real buildings?
- What trade-offs were required?

Orientation signal: Demonstrates integration of theory and practice.

SECTION 12 — Life-cycle cost and ethical responsibility

Main focus: Close the lecture by linking design decisions to life-cycle cost and responsibility.

Key points:

- Construction is only a fraction of total life-cycle cost.
- Operation and maintenance dominate long-term costs.
- Continuous training and recommissioning are essential.
- Planning is an ethical responsibility, not just a technical exercise.

Rhetorical questions / Attention signals:

- What defines success if a laboratory cannot be sustained?
- Who bears the consequences of poor planning?

Orientation signal: Closes the lecture by reinforcing long-term responsibility and accountability.

Session 002-003 — Planning

Instructor: Luis Linares

Course: High-Containment Laboratory Design

Purpose of the document:

This lecture map is designed to help participants navigate the content of Lecture 002-003. It identifies the main conceptual sections, decisional points, and logical transitions of the course. It functions as an orientation and study tool and does not replace the lecture.

SECTION 1 — The laboratory as a life-cycle system

Main focus: Introduce the high-containment laboratory as a living installation governed by a full life cycle, and establish planning as the fundamental framework of the course.

Key points:

- The high-containment laboratory is not a conventional construction project.
- It is conceived as a repetitive cycle of evaluation, validation, training, and operation.
- The typical analysis horizon is 20 to 25 years.
- Operation and maintenance constitute the longest and most costly phase of the cycle.

Rhetorical questions / Attention signals:

- Why can a laboratory not be understood as a straight line of design and construction?
- What does it mean to plan for decades rather than only for inauguration?

Orientation signal: Establishes the temporal and conceptual framework from which all subsequent decisions will be evaluated.

SECTION 2 — Planning failures as the origin of problems in high containment

Main focus: Dismantle the idea that problems in BSL-3 laboratories are primarily technical failures.

Key points:

- Most problems are not errors in calculation or equipment selection.
- Failures arise when critical decisions are made too early, too late, or without sufficient information.
- Planning errors propagate into design, construction, operation, and maintenance.

Rhetorical questions / Attention signals:

- When a BSL-3 does not work, what actually failed?
- Why are early errors difficult to correct later?

Orientation signal: Introduces the central thesis of the course: planning is deciding, and poor decisions have irreversible consequences.

SECTION 3 — Viability as the central objective of the lecture

Main focus: Clearly define what kind of lecture this is and what kind of lecture it is not.

Key points:

- It is not a lecture on architectural design.
- It is not a normative or regulatory compliance lecture.
- It is not a technology selection lecture.
- It is a lecture about viability.

Emphasis:

- Assessing whether a laboratory can be built, operated, and maintained safely and sustainably.
- Viability precedes design.

Rhetorical questions / Attention signals:

- Can this project be sustained technically, operationally, and financially for 20–25 years?
- Orientation signal: Defines the scope of the lecture and aligns participant expectations.

SECTION 4 — Budget as a result, not as a starting point

Main focus: Reorder the traditional logic used to initiate laboratory projects.

Key points:

- The budget cannot be the starting point.
- It is the explicit result of the planning process.

- Early numbers are hypotheses, not commitments.
- Many costly decisions are fixed early without being recognized as financial decisions.

Rhetorical questions / Attention signals:

- Why does asking for numbers before decisions generate structural errors?
- Which decisions fix costs without us realizing it?

Orientation signal: Connects planning with long-term financial consequences.

SECTION 5 — Sequential chain of decisions in planning

Main focus: Present the lecture's logic as a structured sequence of decisions.

Key points:

- Each step reduces uncertainty.
- Each step fixes technical and financial decisions.
- Real options close progressively.
- The order of steps matters.

Rhetorical questions / Attention signals:

- What happens when this order is reversed?
- Which decisions cannot be undone later?

Orientation signal: Introduces the logical diagram of the lecture and prepares the transition to client inputs.

SECTION 6 — Initial client inputs: value and limits

Main focus: Distinguish between preliminary inputs and validated technical requirements.

Key points:

- Proposed scientific program.
- Preliminary pathogen list.
- Available site.
- Target budget.
- Institutional timeline.

Central concept:

- These inputs are not wrong, but they are not sufficient.
- At this stage, they are hypotheses, not requirements.

Rhetorical questions / Attention signals:

- What happens when we treat hypotheses as requirements?

- What information is still missing?

Orientation signal: Prepares the transition toward validation and biological risk analysis.

SECTION 7 — Validating is not questioning: translating intentions into consequences

Main focus: Explain what validation means during planning.

Key points:

- Validating is not stopping the project or questioning client authority.
- It is translating intentions into technical consequences.
- Biology → space → systems → costs.
- Failing to validate pushes consequences forward, where they are more expensive.

Rhetorical questions / Attention signals:

- What does “we want to work with influenza” really mean?
- What does operating 24/7 imply in practical terms?

Orientation signal: Closes the input phase and opens the path to biological risk.

SECTION 8 — Biological risk assessment as a decisional event

Main focus: Present biological risk analysis as the project’s inflection point.

Key points:

- It is not an administrative requirement.
- It is the most important decisional event of the project.
- It transforms institutional intention into technical obligation.
- Biology ceases to be abstract and begins to impose physical conditions.

Rhetorical questions / Attention signals:

- What changes after risk analysis?
- What happens if this step is superficial?

Orientation signal: Marks the moment when the project becomes biological.

SECTION 9 — Activity-based risk, not pathogen-based risk alone

Main focus: Dismantle automatic classification by pathogen or BSL level.

Key points:

- The same pathogen can imply different risks.
- Risk depends on activities, frequency, personnel, and context.

- Evaluating only the pathogen is a common cause of failure.

Rhetorical questions / Attention signals:

- What happens when we evaluate the pathogen but not the activity?
- How does risk change between culture, animal work, or diagnostics?

Orientation signal: Introduces the direct relationship between risk and spatial design.

SECTION 10 — From risk to space, flows, and containment

Main focus: Show how risk fixes irreversible spatial decisions.

Key points:

- Laboratory size is not defined by the budget.
- It is defined by flows, separations, and SOPs.
- Risk changes the budget, not the other way around.
- Space imposes a containment strategy.

Rhetorical questions / Attention signals:

- What happens when risk requires showers, airlocks, and decontamination?
- Why must the building still remain abstract at this stage?

Orientation signal: Leads into the definition of containment as an integrated system.

SECTION 11 — Containment as an integrated system

Main focus: Define containment beyond a single isolated element.

Key points:

- Physical barriers.
- Mechanical systems.
- Operational procedures.
- Human behavior.
- If one fails, the entire system fails.

Rhetorical questions / Attention signals:

- Where does the containment barrier really exist?
- Can a procedure correct poor geometry?

Orientation signal: Prepares the transition toward envelope, HVAC, and performance.

SECTION 12 — Integrated design and early decision-making

Main focus: Introduce the Integrated Design Process (IDP).

Key points:

- Multidisciplinary teams from the outset.
- The greatest cost impact occurs during planning and schematic design.
- Oversizing is paid for over decades.
- Planning decides which risks are accepted.

Rhetorical questions / Attention signals:

- What happens when disciplines work sequentially?
- Why must the building absorb human errors?

Orientation signal: Closes the lecture by establishing planning as a strategic decision, not a design exercise.

Session 002-004 — Design

Instructor: Luis Linares

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.