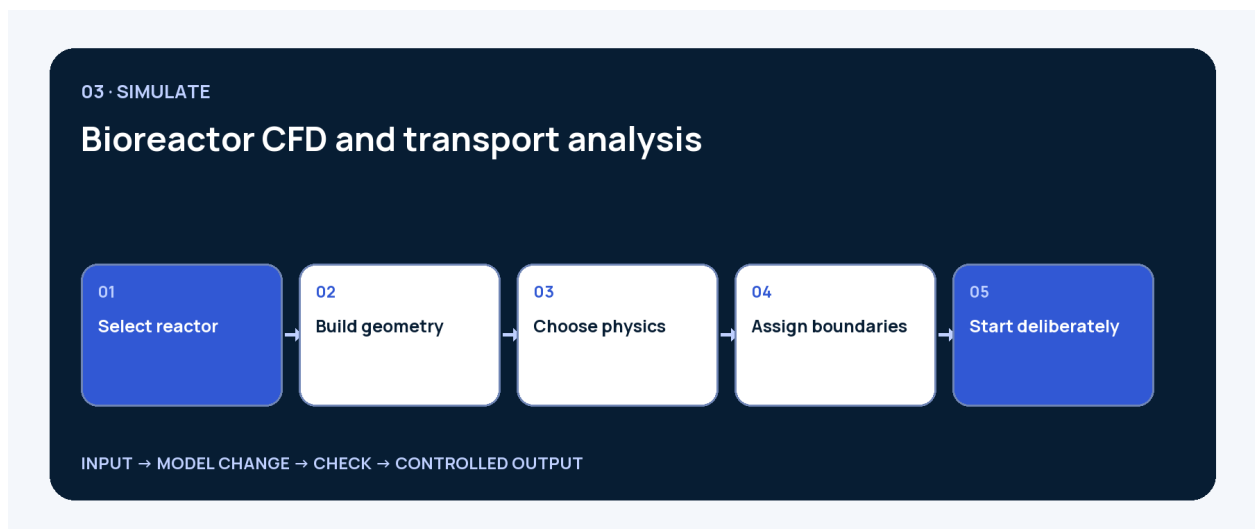




Axion

Bioreactor CFD and transport analysis

Set up geometry, boundary conditions, transport physics and validation under control



EDITION 2.6 · 19 AUGUST 2026 · MODULE MANUAL · 03 · SIMULATE

Axion · Bioprocess engineering software



At a glance

Engineering decision	Path in Axion
Where do mixing, oxygen, nutrient, shear or heat-transfer risks arise inside the reactor?	Simulate → Bioreactor CFD

Primary users	Permitted maturity
Bioreactor Engineering, CFD, Scale-up, Process Development	Browser run = engineering screening; validated 3D CFD requires an external solver, mesh and validation evidence

DECISION RULE

The CFD area leads from real reactor geometry and boundary conditions to a transport-physics assessment. It calculates only after an explicit start and separates screening from a qualified external 3D run.



Prepare the model

Input	Why it is required	Ready when
Geometry	Defines tank, fill height, baffles, shaft, impellers and internals.	Dimensions, coordinates and CAD/sketch source are reviewed.
Rheology and phases	Defines momentum, bubbles and species transport.	Density, viscosity, model and temperature basis exist.
gas_inlet	Defines gas holdup, plume and oxygen source at the ring sparger.	alpha.gas, U.gas, C_O2 and sparger basis are set.
feed_inlet	Defines nutrient addition and local feed-risk zones.	C_N/glucose/glutamine, rate, port and profile are set.
walls_baffles	Creates no-slip and possible near-wall dead zones.	U.liquid = noSlip and wall treatment are documented.
top_headspace	Represents pressure outlet and gas disengagement.	p_rgh/alpha.gas and foam/headspace basis are set.
impeller_zone	Defines MRF/momentum source and mixing energy.	Axis, rpm, direction, diameter and zone are reviewed.
cell_uptake	Consumes oxygen and nutrients as volumetric sinks.	S_O2/S_N, biomass field and time basis are defined.

Preflight check

- Confirm the correct project, branch and controlled version
- Verify units, provenance and permissions
- Save a restore point before a decision-relevant change
- Keep blocking gaps visible

APPLICABILITY LIMIT

The browser view is a screening and setup tool. Valid 3D claims require a real solver, mesh study, verification and experimental validation.



Workflow

1. Select reactor

1. Open the equipment tag and reconcile nominal and working volume.

VISIBLE RESULT

The CFD case is linked to one model version.

2. Build geometry

2. Parameterise tank, baffles, impellers, sparger, feed and headspace.

VISIBLE RESULT

The section matches real hardware.

3. Choose physics

3. Select turbulence, multiphase, species, heat and reaction models.

VISIBLE RESULT

Active equations and assumptions are visible.

4. Assign boundaries

4. Configure gas, feed, walls, headspace, impeller and uptake zones.

VISIBLE RESULT

Every boundary has a field, unit and physical meaning.

5. Start deliberately

5. Confirm preflight and only then press Start.

VISIBLE RESULT

Run ID, time progress, residuals and field time appear.

6. Interpret fields

6. Review velocity, holdup, DO, nutrient, shear, mixing and hotspots over time.

VISIBLE RESULT

Risk zones are spatially and quantitatively documented.



7. Validate externally

7. Export a 3D case and compare with PIV, tracer, kLa, DO or mixing data.

VISIBLE RESULT

Solver and experimental evidence are linked to the version.



Review the result

Review criterion	Pass condition	If it fails
Scope and structure	The documented criterion is satisfied and supported by traceable evidence.	Correct the model or keep the output Not decision-ready.
Units and balances	The documented criterion is satisfied and supported by traceable evidence.	Correct the model or keep the output Not decision-ready.
Evidence and uncertainty	The documented criterion is satisfied and supported by traceable evidence.	Correct the model or keep the output Not decision-ready.
Reproducibility	The documented criterion is satisfied and supported by traceable evidence.	Correct the model or keep the output Not decision-ready.
Review state	The documented criterion is satisfied and supported by traceable evidence.	Correct the model or keep the output Not decision-ready.

DECISION RULE

The browser view is a screening and setup tool. Valid 3D claims require a real solver, mesh study, verification and experimental validation.



Troubleshooting

Observation	Likely cause	Correction
The result looks plausible but cannot be explained	Inputs, units, model version or evidence are missing.	Open the relevant register, restore traceability and rerun.
A change affects unexpected outputs	Dependencies or imported mappings were not reviewed.	Inspect the change plan and before/after diff; undo if required.
The module appears complete but readiness is low	Required industrial evidence is still missing.	Assign the visible gaps and keep maturity at Screening or Not decision-ready.



Handover and next steps

Artifact	Recipient	Must contain
Module result package	Engineering reviewer	Inputs, calculations, results, units, intervals, maturity
Readiness register	Model owner	Gap, required work, owner, due date, intended use
Controlled version	Project team	Branch, version, change note, reviewer and restore point

Completion check

- The active project, branch, version and intended use are visible.
- All inputs have units, provenance, review state and uncertainty where relevant.
- Blocking model, physical, numerical and evidence gaps are closed or assigned.
- The result maturity matches the available evidence.
- A controlled output package opens correctly and includes limitations.

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