



AF 9700

Sustainable Aerospace & Lifecycle Management

Space / Aviation / Defense

FIRST EDITION

Document identity and authority

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Use of this publication

AF 9700 connects environmental performance to the complete lifecycle of aerospace products, services, facilities and missions. It addresses the basis of comparisons, trustworthy quantities, responsible design and operation, circular treatment, continuing obligations and truthful claims. Programme-specific values, methods, permissions and authorities are completed for the actual application.

The supporting set provides original implementation models, technical profiles, examination checklists and blank controlled records. It does not supply fabricated results, signatures, approvals or recognition.

Informative calculations and cases use synthetic values. They explain assumptions, reproducible methods and decision boundaries; they are not mandatory defaults or evidence from actual activities.

Reader route and decision boundaries

1 Define scope, responsibility and study purpose

Use Clauses 0-9 and Annexes A-D for applicability, obligations, significance, functional units, data, allocation and robust comparison.

2 Establish carbon, energy and environmental evidence

Use Clauses 10-18 and Annexes E-F for inventories, fuels, propulsion, atmospheric effects, pollution, water, land and biodiversity.

3 Design, procure and operate responsibly

Use Clauses 19-27 and Annexes G-I for materials, ecodesign, supply, manufacturing, aviation, space and restricted activities.

4 Preserve useful life and verify final fate

Use Clauses 28-31 and Annex J for maintenance, technical eligibility, circular use, retirement and actual treatment outcomes.

5 Plan resilience, cost and reliable information

Use Clauses 32-35 and Annexes K-L for adaptation, information systems, investment, monitoring and demonstrated benefits.

6 Review decisions and maintain honest claims

Use Clauses 36-40 and Annexes L-N for disclosure, instruments, assurance, correction, change, continuing duties and adoption.

Decision boundary: A carbon result, circularity indicator, financial return or reviewed disclosure does not itself establish overall sustainability, technical acceptance, operating permission or completion of a continuing obligation.

Contents - clauses and annexes

Entries and PDF bookmarks locate the controlled clauses and annexes. Page references apply to this file.

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0 Purpose and normative interpretation

0.1 Intended outcome

AF 9700 establishes requirements for identifying, reducing and managing the environmental and lifecycle consequences of aerospace activities. The adopting organization shall connect each sustainability decision to a defined product, service, site, fleet, programme or mission, its actual lifecycle and accountable owners. A favourable indicator shall not establish that an entire activity is sustainable.

0.2 Requirement language

Shall identifies a requirement; should identifies guidance; may identifies permission within the stated conditions. Clauses 0-40 and Annexes A-N form the proposed normative text. Annexes O-T are informative. Examples, blank forms and worked values shall not be treated as approved operational limits, actual results or assigned authorities.

0.3 Separate decisions

Environmental accounting, environmental performance, product qualification, safety acceptance, operational permission and public claims shall remain separate decisions. An environmental benefit shall not waive a safety, security, labour, community or environmental obligation. An authorized operation shall not by itself demonstrate an environmental improvement.

0.4 Evidence states

Each applicable requirement shall be recorded as PASS, FAIL, HOLD or approved N/A. PASS requires the complete stated condition; HOLD means that the decision cannot yet be supported. N/A requires an absent activity or responsibility with an approved rationale. Uncertainty and missing data shall remain visible through review and disclosure.

Required evidence: Defined object, adopted requirement baseline, decision-state definitions and accountable approval route.

Decision control: Do not replace an unresolved essential condition with a weighted sustainability score or an unsupported global claim.

1 Scope and lifecycle responsibilities

1.1 Covered activities

The organization shall identify its aerospace design, procurement, production, testing, logistics, aviation, space, defense, infrastructure, maintenance and end-of-life activities. Coverage shall include contractors, leased assets and shared services where the organization controls, specifies, purchases, operates or makes claims about the activity. Influence and control shall be distinguished.

1.2 Lifecycle coverage

The assessment shall consider raw-material supply, development, facilities, manufacturing, transport, use, servicing, replacement, retirement and subsequent treatment. Capital equipment, test campaigns and supporting digital infrastructure shall be screened for relevance. A short contract or a transfer of ownership shall not erase consequences from the lifecycle being assessed.

1.3 Organizational interfaces

The organization shall assign responsibilities at interfaces among asset owner, operator, design authority, supplier, service provider, waste holder and receiving organization. Contracts shall identify data delivery, environmental conditions, continuing duties, access to evidence and escalation. Responsibilities retained after outsourcing shall be documented.

1.4 Boundaries of application

A claim of conformity shall identify the included activities, locations, configurations, dates and lifecycle stages. Partial studies shall carry a prominent boundary statement. Applying this standard to an organization shall not imply that every product or mission has been evaluated, and evaluating one product shall not cover the organization as a whole.

Required evidence: Activity inventory, lifecycle map, interface responsibilities and explicit claimed scope.

Decision control: An excluded activity shall have a justified boundary treatment; exclusion shall not be inferred from unavailable data or lack of ownership.

2 Applicability, obligations and local parameters

2.1 Applicability determination

The organization shall evaluate each clause and annex against its actual activities and responsibilities. It shall identify applicable requirements, approved N/A decisions, shared duties and implementation records. A supplier-only or service-only organization may have a narrower activity scope but shall still control the claims, data and lifecycle decisions it produces.

2.2 Obligations register

Applicable legal, permit, contractual, property, worker and community obligations shall be identified by competent personnel for each jurisdiction and activity. The register shall retain the authoritative source, applicability reason, owner, deadline and evidence of fulfillment. Changes and conflicts shall be escalated before the affected activity proceeds.

2.3 Programme-specific parameters

The organization shall complete the P01-P44 parameter baseline in Annex B. Values shall identify units, basis, applicability, authority, uncertainty and change triggers. Parameters may refer to controlled specifications. A blank value shall be a blocked dependency wherever a decision requires it; no universal threshold is supplied by this publication.

2.4 Tailoring and conflicts

Tailoring shall document the technical reason, affected requirement and equivalent evidence where permitted. It shall not remove an applicable obligation, conceal an impact or transfer a safety decision to a sustainability reviewer. Conflicting requirements shall be resolved by the eligible authorities and retained with the decision record.

Required evidence: Clause applicability matrix, obligations register, complete parameter baseline and approved tailoring decisions.

Decision control: Neither a completed template nor a target completion date authorizes operation outside an applicable obligation.

3 Terms and accounting distinctions

3.1 Lifecycle and functional equivalence

A lifecycle is the linked sequence of stages needed to provide and finally dispose of the assessed function. A functional unit states the quantified service and its performance, duration and conditions. A declared unit states a quantity without claiming complete functional equivalence. Reference flows are the quantities needed to deliver the chosen unit.

3.2 Environmental results

An inventory records inputs, outputs, emissions and removals within a boundary. Impact assessment translates selected flows through stated models into impact indicators. A measured flow, a modelled impact and a forecast outcome shall not be described as the same type of result. An impact category omitted by a model is not proven absent.

3.3 Circularity and destination

Reuse retains an item for another permitted use; repair restores defined function; remanufacture follows a controlled process to an approved condition. Recycling reprocesses material. Energy recovery, disposal and temporary storage are distinct destinations. Recyclability describes a supported possibility; actual recycling requires evidence of the receiving process and material output.

3.4 Environmental claims

A reduction is a comparable change within a declared boundary and period. Avoided impact compares against an explicit counterfactual. An attribute instrument transfers a specified environmental entitlement; an offset or removal instrument addresses a separately identified project or removal. These concepts shall not be interchanged or silently deducted from a physical inventory.

Required evidence: Controlled terminology, indicator definitions, units and declared treatment of instruments and counterfactuals.

Decision control: An ambiguous term such as green, circular or zero impact shall not be used as a substitute for a bounded, evidenced statement.

4 Governance, competence and affected people

4.1 Accountable ownership

An accountable executive shall assign lifecycle objectives, resources, technical ownership, review authority and escalation routes. Owners shall cover data, engineering changes, operations, supply chains, environmental releases, retirement and public claims. Authority to approve a claim shall not imply authority to accept a technical or operational risk.

4.2 Competence and independent challenge

Personnel shall demonstrate competence for their assigned measurement, modelling, inspection, accounting and decision tasks. Review independence shall reflect consequence, complexity and conflicts of interest. Those who benefit from an outcome shall disclose their interest and shall not be the sole reviewer of a consequential public comparison.

4.3 Workers and communities

Planning shall identify affected workers, contractors, neighbouring communities and other legitimate interests. The organization shall provide accessible reporting routes, address credible complaints and protect reporters from retaliation. Consultation shall document issues and responses; participation shall not be represented as consent where separate consent or permission is required.

4.4 Resources and continuity

The organization shall fund monitoring, remediation, retirement and record preservation throughout the relevant lifecycle. Responsibilities shall remain assigned during restructuring, transfer and programme closure. A financial provision shall identify its assumptions and custodianship; it shall not be treated as evidence that a physical obligation has been completed.

Required evidence: Responsibility matrix, competence records, conflict controls, engagement records and funded continuing duties.

Decision control: A conflict of interest or a missing eligible authority shall block the affected approval until resolved.

5 Environmental significance and improvement planning

5.1 Impact and dependency screening

The organization shall screen climate, energy, air quality, water, land, biodiversity, materials, substances, waste, noise, light and orbital-environment effects. It shall consider normal activity, abnormal events, accidents, cumulative effects and dependencies on environmental conditions. Significance criteria shall include severity, extent, duration, reversibility, exposure and uncertainty.

5.2 Priorities and constraints

Priorities shall reflect the assessment purpose, affected receptors and actual decision options. Carbon shall not automatically dominate other categories. The organization shall identify non-negotiable constraints and escalation thresholds before ranking alternatives. A trade-off shall name the increased impact, affected party, decision owner and justification.

5.3 Objectives and targets

Each target shall state boundary, base period, absolute or intensity metric, denominator, target year, milestones and owner. Targets shall distinguish committed actions from contingent technologies and external dependencies. Growth, utilization, outsourcing and asset transfers shall be considered so that an intensity improvement does not conceal rising total burdens.

5.4 Improvement programme

The programme shall prioritize prevention and reduction at source, then responsible reuse and recovery where appropriate. It shall include implementation resources, measurable effects, safety and operational constraints, verification and review triggers. Changes shall be reassessed for rebound, burden shifting and displaced consequences outside the immediate site.

Required evidence: Significance register, approved criteria, target definitions, action programme and explicit trade-offs.

Decision control: Achievement of one target shall not close another unmet obligation or justify concealing an adverse effect.

6 Study purpose, functional basis and boundaries

6.1 Decision question

Before modelling, the study owner shall specify the decision, audience, assessed object, geography, period, technology and intended comparison. An attributional inventory and a consequential scenario shall be distinguished. The selected method shall be appropriate to the question; results from different approaches shall not be combined without a defensible reconciliation.

6.2 Functional unit and reference flow

The functional unit shall include useful output, service quality, availability, load, operating environment and lifetime where relevant. Passenger distance, payload delivery, observation service, equipment availability and mission success are different functions. Reference flows shall include replacements and support needed to deliver the function, with assumptions traceable to evidence.

6.3 System boundary and exclusions

The boundary shall identify included stages, processes, infrastructure, research and development, shared assets and downstream treatment. Cut-off rules shall consider environmental significance as well as mass or cost. Excluded flows shall be listed with estimates, rationale and possible decision effect; low mass alone shall not justify excluding a toxic substance.

6.4 Comparative basis

Alternatives shall be evaluated using equivalent service, boundary, data quality, allocation, impact methods and scenario assumptions. Differences that cannot be harmonized shall be disclosed and tested. A gate-to-gate study may support a process decision but shall not be presented as a complete lifecycle superiority claim.

Required evidence: Study plan, functional unit, reference flows, process boundary map and comparison rules.

Decision control: Do not rank alternatives where a material difference in function or boundary remains unexplained.

7 Data provenance, measurement and quality

7.1 Source inventory

Every material input and result shall trace to source, owner, location, period, technology, unit, collection method and version. Primary measurements, supplier data, estimates and proxy datasets shall be distinguishable. Rights to use and disclose data shall be established without suppressing the limitations needed to interpret the result.

7.2 Measurement controls

Metering and sampling shall define range, calibration, resolution, frequency, sampling location, missing-data treatment and uncertainty. Shared utilities shall be reconciled to site totals. Unit conversions, density, moisture, pressure and temperature bases shall be explicit when they affect quantities. Monitoring changes shall preserve comparability.

7.3 Quality assessment

Data shall be evaluated for temporal, geographical and technological representativeness, completeness, precision and consistency. The owner shall prioritize improved data for influential flows and high-risk claims. A supplier declaration shall be checked against its scope, source and plausibility; a certificate alone shall not replace the required quantity or boundary.

7.4 Gaps and correction

Missing or suspect data shall receive a documented estimate, range, conservative treatment or HOLD decision appropriate to the intended use. Estimates shall not be labelled measured. Corrections shall identify affected models, inventories, targets, disclosures and decisions; the original and corrected values shall remain traceable.

Required evidence: Data catalogue, measurement plan, quality ratings, reconciliation and gap-resolution history.

Decision control: Unknown quantities shall not be entered as zero solely to complete a calculation.

8 Modelling, allocation and circular flows

8.1 Reproducible model

The model shall preserve input versions, process links, formulae, units, factors, assumptions and calculation outputs. Mass, energy and attribute balances shall be checked where applicable. Double counting between supplied datasets and separately modelled processes shall be prevented. Model changes shall be tested before release.

8.2 Shared processes and co-products

Where feasible, the organization shall separate processes or obtain causal data before allocating shared burdens. Any allocation shall state its physical or other justified basis, total denominator and treatment of co-products. Alternative reasonable methods shall be tested where the choice can change a decision. A favourable result alone shall not justify the allocation.

8.3 Recycled and reused inputs

The model shall state which lifecycle carries collection, sorting, transport, reprocessing and disposal burdens and any substitution benefit. Recycled content, recovery yield and displaced virgin production shall be separate quantities. The same recycling benefit shall not be assigned in full to both the supplying and receiving product without an explicit consistent accounting system.

8.4 Time and uncertain futures

Service life, replacement frequency, grid change, utilization and end-of-life scenarios shall be bounded and versioned. Forecast improvements shall not be reported as observed reductions. Delayed emissions, temporary storage and removals shall retain their timing and accounting treatment; a financial discount rate shall not be applied to physical emissions by default.

Required evidence: Executable calculation trail, allocation decisions, circular-flow rules and scenario sensitivity results.

Decision control: A failed balance or inconsistent allocation shall block the affected result and claim until reconciled.

9 Impact assessment, uncertainty and comparison

9.1 Impact categories and methods

The study shall select relevant impact categories, methods, characterization factors, units, time horizons and geographic resolution. Climate, water scarcity, toxicity, resource use, land and other selected results shall remain distinguishable. Where a robust model is unavailable, the underlying flow, exposure concern and limitation shall be reported separately.

9.2 Uncertainty and sensitivity

The organization shall identify measurement, model, parameter and scenario uncertainty. Quantitative analysis shall state distributions, correlations and sampling assumptions; qualitative analysis shall explain direction and importance. Sensitivity shall address influential parameters and competing plausible choices. Narrow numerical precision shall not imply confidence unsupported by the evidence.

9.3 Interpretation and robustness

Interpretation shall reconcile completeness, consistency, hotspots and uncertainty with the original decision question. A ranking shall be labelled conditional if it reverses under plausible assumptions. Unresolved trade-offs shall remain explicit. Aggregation or weighting shall disclose the value choices and shall not obscure a failing constraint or an unassessed category.

9.4 Comparative review

A consequential external comparison shall undergo competent review independent of its authors and commercial beneficiaries to an extent justified by the claim. Review shall examine equivalent function, exclusions, allocation, data quality, uncertainty and disclosure wording. Review findings shall be closed or the claim restricted before publication.

Required evidence: Impact-method record, uncertainty model, sensitivity results, interpretation and comparative review.

Decision control: A smaller point estimate alone does not demonstrate a robust or universally preferable alternative.

10 Organizational greenhouse-gas inventory

10.1 Organizational boundary

The organization shall define the consolidation approach and apply it consistently to owned, controlled, leased, joint and outsourced activities. Changes in ownership or structure shall be tracked. Reporting shall distinguish direct emissions, purchased-energy emissions and other value-chain emissions with a complete category screening and explicit exclusions.

10.2 Quantification

Activity data shall be multiplied by applicable factors using consistent units and declared gas-specific warming factors and time horizon. Direct measurement may be used with validated methods. Combustion, process emissions, refrigerant leakage and relevant removals shall be distinguished. Biogenic carbon shall have an explicit source, destination and accounting treatment.

10.3 Base period and changes

The inventory shall identify its reporting period and base-period recalculation policy. Structural changes, major errors and method changes shall be assessed against predeclared significance criteria. Actual performance changes shall remain distinguishable from boundary and method effects. Recalculated and originally disclosed results shall remain traceable.

10.4 Reconciliation and reporting

The inventory shall reconcile fuel, energy, purchase and operational records and explain transfers between categories. Gross emissions shall be shown before separately reported instruments or removals. Organizational and product totals shall not be added without resolving overlap. Method, coverage, exclusions, factors and uncertainty shall accompany the result.

Required evidence: Consolidation register, activity/factor ledger, category screening, reconciliations and base-period bridge.

Decision control: Outsourcing, certificate purchase or a boundary change shall not be reported as a physical reduction without a supported explanation.

11 Product, service and mission carbon footprints

11.1 Object and service basis

A footprint shall identify the product configuration, service or mission and the functional or declared unit. It shall state included development, production, delivery, use, maintenance and final-treatment stages. A mission footprint shall include the supporting ground segment and allocated launch services where relevant, not only the deployed hardware.

11.2 Use and lifetime scenarios

Use-phase assumptions shall identify duty cycles, utilization, payload or occupancy, geography, energy sources, degradation, maintenance and replacements. Expected lifetime shall be justified and bounded. Results shall distinguish observed operation from projections; an optimistic lifetime shall not dilute production impacts without evidence supporting that service duration.

11.3 Carbon sources and instruments

The footprint shall distinguish fossil, biogenic and other relevant carbon flows, their accounting treatment and any removals. Fuel and electricity attributes shall follow the declared accounting rules and custody evidence. Avoided emissions, offsets and separate contributions shall not be silently subtracted from the gross lifecycle result.

11.4 Update and communication

Footprints shall be updated when configuration, factor, supplier, operating scenario or material evidence changes sufficiently to affect the intended decision. Communication shall state the boundary, period, unit, method, uncertainty and limitations. A product-level result shall not be represented as a complete organizational inventory or proof of overall sustainability.

Required evidence: Product or mission model, use scenario, carbon-flow ledger, versioned result and disclosure statement.

Decision control: Comparisons require equivalent service and compatible accounting; dissimilar labels alone do not establish a reduction.

12 Energy management and electricity attributes

12.1 Energy baseline

The organization shall map energy carriers, consuming processes, peak demands, idle loads, losses and shared utilities. Baselines shall be normalized only with justified drivers such as output, weather or operating hours. Both absolute consumption and selected intensity shall be retained. Changes in production mix shall be explained.

12.2 Efficiency and electrification

Energy projects shall evaluate actual demand reduction, displaced energy, upstream supply, infrastructure and service performance. Electrification shall consider the delivered electricity mix, losses, charging patterns, storage and peak capacity. Commissioning shall verify the resulting duty cycle; equipment nameplate efficiency shall not be accepted as whole-system performance.

12.3 Purchased electricity claims

Electricity reporting shall distinguish physical grid-supply estimates from contractual attribute accounting. Instruments shall identify eligible market, generation period, quantity, ownership, cancellation and associated emission factors. Unmatched electricity and residual supply shall receive the declared appropriate treatment. An instrument shall not prove that a particular device physically operated on renewable power.

12.4 Renewable generation and storage

On-site generation, export, storage losses and attribute transfers shall be reconciled. Exported attributes shall not also support retained renewable-use claims. Storage shall carry the documented charging mix and losses; it shall not create new renewable generation. Continuity requirements shall remain satisfied under adverse supply conditions.

Required evidence: Energy balance, normalized baseline, project verification and reconciled electricity-attribute ledger.

Decision control: Do not assign zero lifecycle impact solely because electricity is renewable or purchased with an attribute instrument.

13 Aviation fuels and feedstock integrity

13.1 Fuel pathway definition

Each alternative aviation-fuel assessment shall identify feedstock, origin, conversion route, processing energy, transport, blending and delivered energy basis. Technical fuel suitability and environmental eligibility shall be separate determinations. A fuel name or blend percentage shall not substitute for a pathway-specific lifecycle assessment.

13.2 Upstream consequences

Assessment shall address land conversion, displaced production, water, biodiversity, chemicals, waste and competing uses where relevant. Waste or residue status shall be supported by provenance and applicable definitions. Carbon capture source, electricity and hydrogen inputs shall be explicit for synthetic pathways. Uncertain indirect effects shall not be assumed absent without justification.

13.3 Custody and environmental attributes

The organization shall declare whether custody is segregated, mass-balanced or based on a separate attribute-transfer arrangement. It shall reconcile eligible inputs, outputs, conversion losses, inventories and transfers within the approved boundary and period. Attribute ownership, cancellation and competing claims shall be controlled separately from physical fuel delivery.

13.4 Fuel-use claims

Comparisons shall use consistent lifecycle boundaries and energy units, identify the reference fuel and quantify the actual attributed quantity. Combustion emissions and non-CO₂ effects shall remain visible. Claim wording shall distinguish physically supplied fuel, attributed procurement and a separately funded contribution; technical use permission shall remain independently controlled.

Required evidence: Pathway dossier, feedstock due diligence, chain-of-custody reconciliation and quantity-specific claim record.

Decision control: Missing origin, invalid custody or duplicate attribute use shall suspend the affected sustainability claim.

14 Electric, hydrogen and other propulsion systems

14.1 Complete propulsion system

Comparison shall include energy production, conversion, distribution, storage, propulsion, infrastructure and relevant replacements. Batteries, tanks, thermal management and additional mass shall be included where material. The delivered mission shall remain equivalent; a shorter range or reduced payload shall not be ignored when comparing energy pathways.

14.2 Battery lifecycle

Battery assessment shall identify chemistry, critical materials, manufacturing energy, usable capacity, degradation, cycle life, replacement and final treatment. Charging efficiency, reserve requirements and temperature effects shall be represented in the operating scenario. Second-life assumptions shall require evidence of condition, feasible use and allocation rather than an assumed automatic credit.

14.3 Hydrogen and other energy carriers

The model shall identify production route, electricity and feedstock sources, compression or liquefaction, storage, transport and leakage. Relevant indirect climate effects shall be assessed with a declared method or reported as an explicit gap. A point-of-use absence of carbon dioxide shall not be presented as zero lifecycle impact.

14.4 Introduction and operation

New propulsion options shall have separate technical qualification, maintenance, infrastructure and emergency arrangements. Environmental decisions shall assess actual service, supply resilience, workforce capability and treatment routes. Demonstrator results shall not be extrapolated to a fleet without a justified scaling model and stated uncertainty.

Required evidence: Equivalent-service comparison, energy-chain model, degradation/replacement basis and introduction decision.

Decision control: Environmental preference does not authorize an unqualified energy carrier, installation, handling process or operating mode.

15 Aviation non-CO2 effects, noise and local exposure

15.1 Effect identification

Aviation assessment shall consider relevant nitrogen oxides, water vapour, particles, sulphur compounds, contrail-related effects and local air-quality consequences. It shall distinguish emissions from resulting atmospheric effects and health or ecological exposure. Fuel, engine, flight profile, meteorology and location dependencies shall be identified.

15.2 Modelling and uncertainty

The organization shall state the selected model, inputs, spatial and temporal resolution, metric and time horizon. Non-CO2 indicators shall be reported separately where aggregation with carbon dioxide is not sufficiently supported. An unsupported universal multiplier shall not be used to create a precise total climate claim.

15.3 Operational mitigation

Proposed changes to routing, altitude, schedule or propulsion settings shall consider additional fuel, airspace constraints, safety, workload and actual atmospheric conditions. Environmental benefit shall be evaluated over the complete affected operation. Predictions shall be checked against available observations, and uncertain benefits shall be described as conditional.

15.4 Noise, light and disturbance

Noise, vibration, lighting and disturbance shall be evaluated at relevant receptors, periods and event frequencies. Average indicators shall not conceal peaks, night exposure or sensitive locations. Mitigation shall be verified in the affected context, and complaints shall be investigated alongside technical measurements.

Required evidence: Effect screening, model limitations, operational trade-off assessment and receptor-specific monitoring.

Decision control: A claimed carbon improvement shall not imply reduced non-CO2 effects, noise or local exposure without separate evidence.

16 Pollution prevention and hazardous releases

16.1 Source and pathway register

Facilities and activities shall identify pollutants, hazardous substances, storage, transfer points, drains, receiving environments and potential release pathways. Routine, intermittent and accidental releases shall be addressed. Particular attention shall be given to persistent substances, cleaning agents, coatings, propellants, fuels, refrigerants and process residues where present.

16.2 Prevention and substitution

The organization shall evaluate elimination, substitution, process containment and recovery before relying on downstream treatment alone. Substitution shall assess technical qualification, worker exposure, lifecycle impacts and new hazards. A lower quantity of a more persistent or toxic substance shall not automatically qualify as an improvement.

16.3 Operational controls

Handling shall use compatible containment, identification, inspection, maintenance and competent personnel. Release limits and monitoring shall follow the applicable site and activity basis. Abatement performance shall be verified over representative loading and abnormal conditions. Collected contaminants shall be tracked into their subsequent treatment route.

16.4 Incidents and remediation

Credible releases shall have detection, protective action, notification, sampling and recovery arrangements. Incident records shall preserve chronology, quantities, affected receptors and uncertainty. Remediation shall have defined objectives, verification and continuing monitoring. A cleaned visible surface shall not establish that the underlying environmental impact has been resolved.

Required evidence: Substance/pathway register, control plan, release measurements, incident records and remediation verification.

Decision control: An uncontrolled release or unavailable essential control shall trigger the approved protective response and restrict affected activity.

17 Water stewardship and catchment context

17.1 Water balance

The organization shall identify withdrawals by source, internal recirculation, consumption, discharges, storage changes and losses. Definitions shall be consistent across sites. Recirculated water shall not be repeatedly counted as new withdrawal savings. Balance discrepancies shall be investigated against the approved measurement uncertainty.

17.2 Local availability and quality

Water assessment shall consider catchment, season, scarcity, ecological needs, water quality and other legitimate users. Equal volumes at different sites shall not be assumed equivalent in impact. Stress and quality factors shall have an identified source, date, geographic resolution and uncertainty appropriate to the decision.

17.3 Efficiency and reuse

Water-saving measures shall examine treatment energy, chemicals, concentrate disposal, reliability and intended water quality. Reuse shall be authorized for the actual purpose, with cross-connection and contamination controls. Reductions in withdrawal, consumption and pollutant load shall be reported separately.

17.4 Discharge and contingency

Discharge shall identify destination, quantity, timing, temperature and relevant contaminants. Concentration alone shall not establish total pollutant burden where flow changes. Drought, supply interruption and treatment failure shall have response arrangements that protect people, essential services and receiving environments.

Required evidence: Site water balance, catchment assessment, reuse qualification, discharge record and contingency plan.

Decision control: A favourable global water total shall not conceal an unresolved local scarcity, quality or discharge condition.

18 Land, biodiversity and community interfaces

18.1 Baseline and receptors

Sites, infrastructure corridors, launch ranges and supply activities shall identify affected habitats, species, ecosystem services, land uses and communities. Baselines shall state season, survey coverage, expertise and uncertainty. Sensitive or protected areas and legitimate access or land-use rights shall be addressed before the relevant decision.

18.2 Avoidance and impact reduction

The organization shall first consider avoiding adverse locations or activities, then minimizing unavoidable disturbance and restoring affected functions where feasible. Residual impacts and any proposed compensatory measures shall be separately justified. A biodiversity score shall not imply that unlike habitats or irreplaceable features are interchangeable.

18.3 Cumulative and indirect effects

Assessment shall include relevant fragmentation, invasive species, wildlife attraction, collision risk, noise, lighting and indirect land change. Airport wildlife management and habitat measures shall be coordinated with aviation safety. Supply-chain land effects shall not be ignored solely because they occur outside the organization's property.

18.4 Restoration and engagement

Restoration shall define ecological objectives, ownership, time horizon, indicators, maintenance and failure response. Communities shall have accessible information and grievance routes appropriate to their context. Physical completion of planting or earthworks shall not be reported as demonstrated ecosystem recovery without monitoring.

Required evidence: Receptor baseline, alternatives assessment, engagement record and monitored restoration plan.

Decision control: Do not claim no net loss or a nature-positive outcome without a defined baseline, boundary, method, time horizon and evidence of the stated result.

19 Materials, substances and resource security

19.1 Material identity

The organization shall identify material grades, composition, critical or scarce inputs, restricted substances and traceability requirements for the assessed product and process. Confidential composition may be controlled through eligible access arrangements, but an unresolved substance risk shall not be recorded as absent.

19.2 Material selection

Selection shall consider required performance, durability, mass, production losses, availability, toxicity, repairability and end-of-life routes. Substitution shall include validation of the actual aerospace application. A low-carbon material shall not be selected through a comparison that omits shortened life, additional protection or increased maintenance.

19.3 Resource efficiency and origin

Material yield, scrap, recycled input and recovered output shall have defined denominators and measurement boundaries. Critical-material risks shall include concentration of supply, responsible extraction, processing constraints and loss of technical capability. Supplier origin and custody evidence shall support material claims to the required depth.

19.4 Obsolescence and continuity

Lifecycle plans shall address material obsolescence, prohibited-substance transitions, spares and disposal capability. Stockpiling shall consider shelf life, storage conditions and eventual waste. Replacement materials shall remain subject to technical approval and environmental reassessment; continuity pressure shall not erase those controls.

Required evidence: Material/substance inventory, selection trade-offs, yield/custody records and continuity plan.

Decision control: Recycled content or an environmental declaration does not establish material suitability, authenticity or aerospace qualification.

20 Ecodesign and circular architecture

20.1 Early design decisions

Environmental requirements shall enter concept and architecture decisions while meaningful alternatives remain available. The design team shall establish service performance, lifecycle hotspots and environmental constraints before selecting a preferred concept. Objectives shall be allocated to product features and supporting processes with traceable verification methods.

20.2 Design for useful life

Design shall consider durability, inspectability, maintenance access, modular replacement, software support, repair and safe disassembly. Increased life shall be evaluated against efficiency degradation, spare production and continued operation. Planned repairability shall be demonstrated through access, tools, information and qualified processes.

20.3 Circular options and trade-offs

Reuse, remanufacture and recycling options shall identify feasible receiving processes, material purity, joining methods, contamination and transport. Circularity potential shall not be scored as actual recovery. Mass reduction, recyclability and longer life shall be evaluated together so that improvement in one feature does not hide a material disadvantage elsewhere.

20.4 Design gates and handover

Each gate shall review current lifecycle results, unresolved impacts, safety and qualification dependencies and the evidence maturity of promised benefits. Released designs shall include the information needed by manufacturers, operators, maintainers and end-of-life parties. Significant changes shall reopen affected environmental and technical decisions.

Required evidence: Allocated environmental requirements, alternatives record, circular-design demonstrations and lifecycle handover data.

Decision control: An unverified future recovery route shall remain a scenario, not a guaranteed design benefit.

21 Responsible procurement and chain of custody

21.1 Procurement requirements

Purchase specifications shall identify technical needs, environmental data, material origin, substance restrictions, custody method and end-of-life responsibilities. Required evidence shall match the claimed attribute and consequence. Procurement shall distinguish supplier capability, delivered-product conformity and environmental performance of the actual supplied quantity.

21.2 Risk-based due diligence

Supplier evaluation shall address environmental and labour risks, sourcing geography, intermediaries, contradictory evidence and subcontracting. The organization shall assess credible concerns and request proportionate corrective evidence. A supplier score or declaration shall not close a substantiated serious concern without investigation and an eligible disposition.

21.3 Custody balances

Traceability shall link eligible inputs, transformations, outputs, losses, stocks and transfers through the selected custody system. Quantity, period and boundary rules shall prevent over-allocation and duplicate sale of attributes. Physical segregation, mass balance and attribute-only transactions shall be labelled accurately and shall not be presented as interchangeable.

21.4 Contract change and escalation

Contracts shall define evidence access, change notification, retention, audit rights and action for invalid claims or interrupted supply. Supplier substitution shall trigger review of affected models, material qualifications and claims. Commercial urgency shall not authorize an unsupported sustainability designation.

Required evidence: Procurement specification, due-diligence file, reconciled custody ledger and supplier-change decisions.

Decision control: Unsupported or contradictory provenance shall restrict the affected claim and delivery decision to the extent required by its consequence.

22 Manufacturing, testing and facility performance

22.1 Process mapping

Facilities shall map material and energy inputs, yield, rework, scrap, releases, water and waste by meaningful process boundaries. Shared utilities, cleanrooms, thermal equipment and test infrastructure shall be included where relevant. Development articles and failed tests shall remain in the declared accounting boundary rather than disappear from production metrics.

22.2 Process improvement

Improvement projects shall compare equivalent qualified output and actual operating conditions. Yield improvement shall consider upstream input, rework burden and final scrap destination. Additive, subtractive and composite processes shall include supports, consumables, post-processing, quality losses and useful powder or material reuse limits.

22.3 Test planning

Test campaigns shall minimize unnecessary resource use while preserving required evidence, representativeness and independence. Simulation or combined testing shall replace physical activity only where technically justified. Reduced test energy shall not justify omitting required qualification, reliability or safety demonstration.

22.4 Facility operation

Environmental control settings shall be linked to actual process requirements, occupancy and standby states. Maintenance shall preserve metering, containment and abatement performance. Improvement verification shall account for weather, throughput and changed product mix; a quieter production period shall not be misreported as an efficiency intervention.

Required evidence: Process balances, qualified-output baseline, test resource plan and verified facility-improvement record.

Decision control: Environmental optimization shall not invalidate process control or required product and test evidence.

23 Logistics, packaging and infrastructure

23.1 Logistics boundary

Logistics assessment shall include modes, distances, load factors, empty returns, temperature control, storage and damage where relevant. Transport work shall use consistent mass-distance or service units. Consolidation benefits shall be assessed against delay, inventory, handling and failure risks of the actual aerospace supply chain.

23.2 Packaging performance

Packaging shall protect the product and meet cleanliness, electrostatic, moisture, shock and other applicable conditions. Reusable packaging shall have a realistic cycle count, cleaning burden, return transport and loss rate. A lighter package shall not be preferred where greater product damage increases lifecycle burden or creates safety risk.

23.3 Buildings and infrastructure

New and modified infrastructure shall consider embodied materials, construction, land disturbance, operational energy, maintenance, resilience and final treatment. Long service periods shall use bounded scenarios for utilization and environmental conditions. Shared infrastructure shall be allocated transparently to the assessed functions.

23.4 Contractor and transfer controls

Transport and infrastructure contractors shall receive applicable environmental requirements and incident routes. Handover shall preserve item identity, hazardous-material information and required conditions. Delivery confirmation shall not be treated as evidence of lawful waste treatment or successful recycling.

Required evidence: Logistics model, packaging qualification, infrastructure lifecycle assessment and controlled handover records.

Decision control: A transport or packaging change shall not proceed where essential product protection or hazardous-material controls remain unresolved.

24 Aviation operations, airports and ground services

24.1 Operational baseline

Operators shall define fleet, routes, mission types, payload, occupancy, flight stages and ground support within the claimed boundary. Fuel and electricity use shall reconcile to actual operations. Passenger, freight and mixed-service allocation shall be explicit; incompatible intensity measures shall not be compared without conversion and qualification.

24.2 Operational improvement

Measures involving weight, taxi, flight planning, turnaround, ground equipment or maintenance shall be evaluated against safety, service reliability and complete environmental effects. Avoided delay and reduced fuel shall be supported by representative operation and a credible comparison. Capacity growth and rebound shall be disclosed where they affect total impact.

24.3 Airport and service interfaces

Airport, airline and ground-service inventories shall define control and shared responsibilities for terminal energy, auxiliary power, vehicles, deicing, drainage, waste and tenant activity. Overlap shall be reconciled before aggregation. Tenant exclusion shall be explicit and shall not imply that the excluded activity has no airport-related impact.

24.4 Verification and local effects

Monitoring shall include relevant noise, air quality, water, wildlife and community effects. Operational trials shall define stopping conditions, responsible controllers and evidence collection. Successful performance at one airport, season or fleet configuration shall not authorize unsupported extrapolation to another.

Required evidence: Operational boundary and allocation, improvement trial, interface matrix and receptor monitoring.

Decision control: Environmental planning shall remain subordinate to valid operational permissions and shall not conceal adverse local effects.

25 Space missions, launch and ground segments

25.1 Mission lifecycle

Space programmes shall assess development, low-volume manufacturing, test campaigns, launch preparation, transport, launch, operation, servicing and end-of-mission. Ground stations, computing, buildings and support operations shall be included where relevant. Failed or replacement hardware and contingency missions shall receive explicit scenario treatment.

25.2 Launch and atmospheric effects

Assessment shall identify propellants, exhaust species, trajectory, release altitude, launch frequency and local range effects. Upstream propellant production and launch infrastructure shall be distinguished from direct emissions. Uncertain upper-atmosphere effects shall be disclosed; the absence of an agreed impact factor shall not justify recording no emission or concern.

25.3 Shared and reusable systems

Shared launch allocation shall use a justified service basis and test plausible alternatives where material. Reusable systems shall include refurbishment, recovery operations, attrition and demonstrated or bounded reuse counts. Payload mass alone shall not be assumed to capture every causal relationship in a multi-mission service.

25.4 Service and mission extension

Mission comparisons shall address delivered quality, coverage, availability and duration. Benefits claimed from Earth observation, communication or other services shall be evaluated as separate counterfactual outcomes. Extension shall consider degradation, collision exposure, resource reserves and end-of-mission capability before any environmental preference is accepted.

Required evidence: Mission lifecycle model, launch-effect inventory, shared-service allocation and extension assessment.

Decision control: A beneficial mission purpose does not cancel the mission's own environmental burdens or continuing disposal duties.

26 Orbital stewardship and atmospheric return

26.1 Lifecycle responsibility

The programme shall assign responsibility for tracking, conjunction response, fragmentation prevention, end-of-mission action and post-mission observation. Requirements shall be defined for the actual orbit, object, mission and applicable permissions. A terrestrial carbon result shall not be used as a proxy for orbital stewardship.

26.2 Prevention and operational capability

Design and operation shall address debris release, stored energy, loss of control, collision exposure, maneuver capability and information exchange. Necessary capabilities and reserves shall be verified and monitored. Failure modes affecting end-of-mission action shall be considered during design and operations rather than deferred to retirement.

26.3 End-of-mission assessment

The disposal plan shall identify target conditions, success criteria, uncertainty, failure response, responsible authority and evidence of achieved state. Atmospheric return shall consider relevant ground, airspace, maritime and atmospheric consequences with competent assessment. This standard supplies no trajectory, universal disposal time or permission to conduct a return operation.

26.4 Continuing evidence

Actual end-of-mission performance shall be distinguished from an intention, command or prediction. Unresolved object status and residual risks shall remain assigned after service cessation. Changes to mission duration or configuration shall reopen the disposal and environmental assessment where they affect capability or exposure.

Required evidence: Stewardship plan, capability/reserve evidence, end-of-mission decision and confirmed or explicitly uncertain final status.

Decision control: A disposal command or administrative programme closure does not prove disposal success or end continuing responsibility.

27 Defense and other restricted aerospace activities

27.1 Complete internal assessment

Restricted missions and facilities shall retain an internally complete environmental and lifecycle assessment at the eligible access level. Security-related disclosure limits shall be distinguished from exclusions in the underlying model. The organization shall identify the actual mission function and shall not compare unlike civil and defense services as equivalent outputs.

27.2 Controlled external disclosure

Public reporting shall disclose the scope and effect of withheld information without revealing protected details. Authorized reviewers shall have access sufficient to evaluate the retained claim. Aggregation or redaction shall preserve methodological honesty; a protected-data gap shall not be represented as verified zero impact.

27.3 Materials and residues

Assessment shall address relevant fuels, propellants, energetic or hazardous residues, contaminated assets, test ranges and decommissioning interfaces. Handling, demilitarization and hazardous treatment shall be performed only by appropriately authorized competent parties. Environmental objectives shall not authorize unsafe recovery or disclosure of protected design information.

27.4 Decision and continuity

Mission necessity, environmental acceptance, security release and technical permission shall be separately assigned. Exceptions shall state the exact scope, reason, duration, protections and continuing obligations. Transfers between organizations shall preserve accountable custody, treatment evidence and residual liabilities.

Required evidence: Controlled assessment, access/disclosure decision, authorized treatment route and continuing-responsibility record.

Decision control: Confidentiality may restrict access; it shall not be used to fabricate completeness or remove a retained environmental duty.

28 Maintenance, repair and life extension

28.1 Condition and remaining service

Maintenance decisions shall use actual configuration, usage, inspections, degradation and approved life limits. An environmental case for continued use shall identify remaining service and uncertainties. Sustainability objectives shall not extend a life limit or override a design or maintenance authority's required action.

28.2 Repair-versus-replace assessment

Comparison shall include repair materials, energy, transport, expected success, future maintenance, performance degradation and replacement alternatives. Equivalent future service shall be used. Historical burdens may be treated according to the stated decision model, but shall not be inconsistently removed from one option and retained in another.

28.3 Maintenance operations

Maintenance facilities shall control solvents, coatings, cleaning, water, waste and energy alongside product cleanliness and technical requirements. Removed items shall retain identity and condition until an eligible disposition. Environmental records shall link to work orders and actual quantities rather than rely only on generic facility averages.

28.4 Extension review

Life extension shall require authorized technical evidence and an updated lifecycle scenario. The decision shall examine obsolescence, support, efficiency, parts availability and eventual treatment. Continuing monitoring and withdrawal conditions shall be set; a projected environmental saving shall not be reported as already realized.

Required evidence: Condition record, equivalent-service comparison, maintenance quantities and authorized extension decision.

Decision control: A favourable environmental calculation shall not authorize use of a life-expired, unserviceable or unsupported item.

29 Reuse, refurbishment and remanufacture

29.1 Candidate identification

Candidates shall have traceable identity, ownership, configuration, service history and condition to the depth needed for their intended use. Counterfeit, unapproved or unknown-condition items shall be segregated. The organization shall distinguish reuse in the original aerospace function from a different, separately qualified application.

29.2 Controlled restoration

Processes shall specify inspection, disassembly, cleaning, restoration, replacement, testing and acceptance. Relevant design data and permissions shall be available. Environmental benefit shall include rejected candidates and process losses. A circular-economy objective shall not justify substituting visual appearance for demonstrated condition.

29.3 Release and claims

An eligible authority shall determine technical release for the exact intended use. Reused or remanufactured status, remaining limits and provenance shall be communicated accurately. Environmental attributes shall state the lifecycle allocation and service basis; the same saved virgin production shall not be counted repeatedly across transactions.

29.4 Receiving-use responsibility

Transfer shall include installation limitations, support, monitoring and eventual treatment requirements. A second-life battery, electronic system or material shall have a demonstrated receiving function and safety basis. Export or sale shall not close waste or product obligations merely by changing the commercial label.

Required evidence: Candidate history, restoration process/results, technical release and environmental allocation record.

Decision control: Unknown eligibility or an incomplete receiving-use basis shall block release and the associated reuse claim.

30 Decommissioning, disassembly and hazardous waste

30.1 Retirement planning

Retirement plans shall begin before the operational exit and identify asset inventory, hazardous contents, ownership, permissions, funding and eligible contractors. Plans shall address stored energy, pressure, contamination, sensitive data and access constraints. A schedule shall reflect prerequisites and dependencies, not merely a target completion date.

30.2 Safe preparation and segregation

Authorized personnel shall verify the required safe state before disassembly or transfer. Materials and components shall be segregated by identity, hazard, contamination and intended destination. Potentially serviceable items shall retain condition control; prohibited items shall be prevented from re-entering use through uncontrolled salvage.

30.3 Waste determination and movement

Waste classification and movement requirements shall be established for origin, transit and destination. Records shall link quantity, composition, carrier, receiving facility and permitted treatment. Product, by-product and waste status shall have an evidenced basis; commercial value alone shall not determine the classification.

30.4 Closure evidence

Closure shall reconcile the initial inventory with reused items, recovered materials, treated residues, disposal, losses and remaining stocks. Contractor receipts shall be checked against actual downstream evidence and unresolved discrepancies. Site remediation and post-closure monitoring shall remain separately tracked until their stated conditions are met.

Required evidence: Retirement plan, verified safe-state record, movement chain and reconciled closure inventory.

Decision control: Collection, shipment or payment does not prove final treatment or discharge a continuing environmental responsibility.

31 Recycling, recovery and final fate

31.1 Destination hierarchy

The organization shall evaluate prevention, continued permitted use, repair, reuse, material recycling, other recovery and disposal in the actual context. The preferred route shall consider safety, contamination, technical feasibility, environmental burden and legitimate receiving capacity. A hierarchy label shall not replace analysis of the real process.

31.2 Quantities and yields

Reports shall distinguish collected, sent, accepted, processed and recovered quantities. Recycling rates shall state numerator, denominator, moisture basis, period and treatment of residues. Process yield and actual usable output shall be evidenced. Stored material and energy recovery shall not be counted as material recycling.

31.3 Quality and substitution

Recovered material shall have a defined quality and feasible receiving application. Any claimed displacement of primary material shall identify the substitution ratio, market or technical constraints and allocation method. A theoretical maximum recovery rate shall not be presented as an achieved closed loop.

31.4 Downstream verification

The organization shall verify downstream facilities and intermediaries to a depth justified by risk and claim. Evidence shall address final residues and disposal, including cross-border transfers. Unconfirmed destinations shall remain unresolved and shall not be included in a verified diversion or recycling result.

Required evidence: Destination assessment, quantity/yield ledger, recovered-material quality and downstream final-fate evidence.

Decision control: A recycler's acceptance certificate alone does not prove the claimed recovered output or final fate of every fraction.

32 Climate adaptation and environmental resilience

32.1 Exposure assessment

Assets and operations shall assess relevant heat, flood, drought, wildfire, storm, sea-level, precipitation and environmental-supply changes over their planned service life. Assessment shall use appropriate scenarios, locations, time horizons and uncertainty. Historical averages alone shall not justify long-lived design assumptions where conditions may change.

32.2 Vulnerability and dependencies

The organization shall examine thresholds, failure modes, critical suppliers, utilities, transport access and workforce exposure. Compound and cascading events shall be considered. Environmental and safety dependencies shall be mapped so that a resilience measure does not move unacceptable risk to another site or community.

32.3 Adaptation options

Options shall be assessed for effectiveness, lifecycle cost, environmental burdens, feasibility and residual risk. Robust or staged measures shall be considered where projections differ. Trigger points shall identify when design, capacity, operating limits or relocation decisions must be revisited.

32.4 Exercises and recovery

Continuity plans shall define protective actions, responsibilities, communications and recovery conditions. Exercises shall use credible scenarios and test essential interfaces. Restoration shall verify environmental controls and actual asset condition; a return of power or access shall not by itself establish readiness.

Required evidence: Scenario/exposure assessment, dependency map, adaptation decision and exercise/recovery evidence.

Decision control: An untested resilience assumption shall remain an explicit dependency and shall not support an unconditional continuity claim.

33 Environmental information and digital traceability

33.1 Controlled data architecture

Information systems shall preserve stable object identifiers, configurations, units, boundaries, periods, methods and source references. Organizational, product, supplier and site records shall be linked without collapsing their different accounting purposes. Access, retention and change permissions shall be proportionate to sensitivity and consequence.

33.2 Exchange and interoperability

Data exchanges shall define field meaning, units, reference periods, geographic scope, factor versions, allocation, uncertainty and unknown-value rules. Receiving systems shall validate these meanings before combining results. A common file format shall not establish methodological compatibility or prevent duplicate counting.

33.3 Calculation and automation controls

Spreadsheets, software, automated estimates and digital models shall be verified for the intended use, including unit conversion, missing data, aggregation, rounding and change behavior. Automated or AI-generated estimates shall retain source and limitations. A tool output shall not create approval authority or remove the need for competent review.

33.4 Integrity and recovery

Records shall support traceable correction, version history, access review and recovery after failure. Restored data shall be reconciled with transactions, instruments, disclosures and current asset state. Backup restoration alone shall not prove that the complete environmental ledger is current and consistent.

Required evidence: Data dictionary, exchange validation, calculation tests and verified recovery/reconciliation records.

Decision control: Incompatible boundaries, missing units or duplicate records shall block aggregation until resolved.

34 Lifecycle cost and transition investment

34.1 Cost boundary

Lifecycle costing shall define currency, price year, real or nominal basis, discount rate, horizon and included development, acquisition, operation, maintenance and retirement costs. Environmental costs, provisions and monetized impacts shall be distinguished from direct cash flows. Transfers or subsidies shall not be presented as physical environmental reductions.

34.2 Alternatives and uncertainty

Investment comparisons shall use equivalent service and consistent assumptions for lifetime, utilization, energy price, maintenance, failure and residual value. Sensitivity shall identify parameters that change the decision. Financial discounting shall apply to stated cash flows; physical impacts shall remain separately reported unless a distinct approved valuation model is explicitly used.

34.3 Transition feasibility

Plans shall identify technology maturity, qualification, infrastructure, supplier capacity, workforce, capital and timing dependencies. Committed actions shall be separated from speculative options. Interim milestones shall state measurable outcomes, accountable owners and fallback decisions if dependencies fail.

34.4 Retirement and remediation funding

Funding assumptions shall include treatment, restoration, long-term monitoring and unresolved liabilities. Provisions shall be periodically reviewed against actual condition and cost evidence. A cheaper disposal offer shall be challenged where the receiving capability or downstream obligation is unclear.

Required evidence: Cost model, sensitivity analysis, funded transition plan and continuing-obligation provisions.

Decision control: A positive financial return does not establish an acceptable environmental or technical outcome.

35 Monitoring, indicators and demonstrated improvement

35.1 Indicator definition

Each indicator shall specify object, boundary, numerator, denominator, units, source, frequency, owner and decision use. Leading activities and actual outcomes shall be distinguished. Training hours, purchased instruments and planned projects shall not substitute for measured environmental results.

35.2 Baseline and comparability

Monitoring shall track changes in throughput, utilization, weather, mix, scope and methods. Both absolute and intensity results shall be retained where relevant. The organization shall provide a bridge between periods and separate physical improvement from recalculation, structural change and data correction.

35.3 Trigger and response

The programme shall define action thresholds and escalation for abnormal use, releases, declining data quality, missed targets and invalid assumptions. Thresholds shall be justified locally and linked to timely protective or corrective action. Missing monitoring shall trigger a defined response rather than be interpreted as normal performance.

35.4 Verification of benefits

Implemented measures shall be checked against their stated comparison and actual operating conditions. Rebound, displacement, maintenance effects and unintended burdens shall be investigated. Benefits shall be reported with evidence maturity and uncertainty; projected savings shall remain separate from realized change.

Required evidence: Indicator dictionary, baseline bridge, monitoring records and verified project-benefit assessment.

Decision control: A change in denominator or reporting boundary shall not be represented as an operational reduction without explanation.

36 Claims, disclosures and environmental instruments

36.1 Claim specification

Every public or contractual claim shall identify object, boundary, quantity, period, method, evidence, limitations and owner. Wording shall distinguish measured, estimated, projected and independently reviewed results. Broad terms implying comprehensive sustainability shall require evidence for their full reasonable meaning, not a selected favourable indicator.

36.2 Reduction and comparison claims

Reduction statements shall identify the comparable baseline, function, counterfactual where relevant and calculation. Avoided impacts shall be disclosed separately from the organization's or product's gross inventory. A reduction in one stage or category shall not imply a whole-lifecycle or all-impact reduction without supporting assessment.

36.3 Instruments, removals and neutralization

Instruments shall have identifiable ownership, quantity, vintage, eligibility, cancellation and protection against duplicate use. Removal or offset claims shall address additionality, duration, reversal, leakage and verification under the selected method. Gross emissions, internal reductions, removals, offsets and other contributions shall remain separately visible; cancellation shall not be described as physical elimination of the organization's emissions.

36.4 Approval and withdrawal

An eligible reviewer shall verify claim wording against the exact evidence and intended audience before release. Claims shall have a review date and change triggers. Invalid, expired or overstated claims shall be corrected or withdrawn through affected channels, with a traceable explanation and notification proportionate to consequence.

Required evidence: Claim dossier, baseline/comparison record, instrument ledger and approved communication history.

Decision control: No claim shall imply AF recognition, official publication approval or operating permission merely because a form is completed or this standard is used.

37 Assurance and independent review

37.1 Review scope and competence

The assurance plan shall define the subject, criteria, boundary, period, evidence access, reviewer competence and independence. It shall distinguish model review, data verification, site examination and claim assurance. The intended confidence and limitations shall be explicit; an assurance label shall not imply examination outside its scope.

37.2 Risk-based examination

Review shall examine influential data, allocation, custody, exclusions, uncertainty, adverse impacts and controls against duplicate claims. Sampling shall state population, selection basis and limitations. High-risk or contradictory evidence shall receive targeted challenge. A sample result shall not be generalized beyond its supported basis.

37.3 Findings and decisions

Findings shall identify criterion, evidence, affected object, consequence and required action. The reviewer shall distinguish failure from insufficient evidence. Conclusions shall state exact scope, unresolved items and restrictions. Management responses shall not replace independent technical resolution of a material finding.

37.4 Continuing reliance

Reliance on an assurance conclusion shall be reviewed after material changes, corrections, new evidence or invalidated instruments. The organization shall preserve the reviewed baseline and notification route. A past clean conclusion shall not automatically extend to a changed configuration, period, supplier or claim.

Required evidence: Assurance plan, reviewer eligibility, sampling/evidence trail and reasoned bounded conclusion.

Decision control: A material unresolved finding shall prevent an unqualified positive conclusion about the affected subject.

38 Nonconformity, incidents and corrective action

38.1 Intake and protection

The organization shall capture environmental incidents, data errors, custody discrepancies, complaints and misleading claims through accessible routes. Records shall preserve chronology, sources and affected objects. Immediate protective action shall be distinct from root-cause correction and long-term remediation.

38.2 Extent and cause

Investigation shall examine causes, contributing conditions and the extent across sites, products, periods and disclosures. Repeated errors shall be assessed as a possible system failure. An individual mistake shall not be accepted as the sole cause where workflow, incentives, data design or supervision contributed.

38.3 Correction and remedy

Actions shall address actual harm, incorrect records, affected decisions and recurrence. Responsibilities, due basis, evidence and blocked activities shall be assigned. Public or customer-facing errors shall trigger proportionate correction and notification. Closing an internal ticket shall not substitute for communicating a material corrected claim.

38.4 Effectiveness and closure

Closure shall require verification that the correction is accurate, the cause is controlled and required remedies are completed or transparently continuing. Effectiveness shall be assessed under representative conditions. Unresolved long-term monitoring shall remain assigned even when the immediate incident phase is closed.

Required evidence: Issue record, extent/cause analysis, remedy implementation and effectiveness verification.

Decision control: A planned action, elapsed deadline or management acceptance of an explanation does not prove effective correction.

39 Change, transfer and post-closure continuity

39.1 Change assessment

Changes to design, supplier, method, factor, location, utilization, ownership or lifecycle route shall identify affected requirements, results and claims. The old and new baselines shall be retained. Significant changes shall trigger technical and environmental review before dependent decisions continue.

39.2 Transition and acceptance

Transition shall define data migration, inventory reconciliation, new controls, training, contractor readiness and verification. Temporary arrangements shall have explicit scope and expiry or exit conditions. A new reporting system shall not silently reset unresolved findings or previously disclosed obligations.

39.3 Transfer of duties

Sale, lease return, merger or programme handover shall identify continuing environmental responsibilities, evidence custody, financial arrangements and eligible receiving parties. Contractual transfer shall be checked against actual obligations. A transferred asset shall retain the information needed for safe use, treatment and accurate lifecycle accounting.

39.4 Post-closure evidence

Monitoring, remediation, instrument reversals, disposal uncertainty and record retention shall remain governed after operational closure. The responsible organization shall maintain reachable contacts and access to evidence. Completion shall be based on the defined physical and administrative conditions, not on cessation of revenue or staff departure.

Required evidence: Change impact record, transition acceptance, duty-transfer agreement and continuing-obligation register.

Decision control: Administrative closure shall not erase an uncompleted physical obligation or an unresolved public claim.

40 Adoption, publication and continuing improvement

40.1 Local adoption

An adopting organization shall identify its scope, accountable authority, applicable clauses, completed parameters, procedures and evidence routes. It shall assess competence and readiness before making local conformity claims. Adoption shall be authenticated through the organization's valid approval system and shall state effective conditions.

40.2 Publication control

This FIRST EDITION manuscript is prepared for Aerospace Federation review. Publisher approval and effective date are not assigned. Any official release shall record the eligible decision, exact publication identity and effective conditions. Administrative publication shall remain separate from validation of a particular product, site, mission or claim.

40.3 Interpretation and feedback

Technical questions, ambiguities, implementation experience and proposed changes shall be recorded and evaluated through controlled review. An interpretation shall not silently weaken a requirement or assign an absent technical limit. Affected users shall receive traceable clarification where a material misunderstanding is identified.

40.4 Management review

Management shall review performance, obligations, data quality, findings, resources, target progress and continuing liabilities at approved intervals and after material triggers. Decisions shall assign actions and verify their effects. Improvement shall address actual environmental and lifecycle outcomes, as well as the reliability of evidence and claims.

Required evidence: Local adoption record, publication-state control, interpretation log and management-review decisions.

Decision control: Use of this document does not itself grant accreditation, recognition, certification, technical acceptance or permission to operate.

Annex A - Applicability and responsibility dossier

Status: Normative within the proposed AF 9700 requirement set.

A.1 Activity selection

The dossier shall list actual activities, lifecycle stages, sites, configurations, contracts, relevant jurisdictions and retained responsibilities. It shall identify controlled, influenced and purchased activities separately. Each applicable clause shall have an implementation owner and evidence route; an absent template shall not justify an absent control.

Table A-1. Activity routes and required emphasis

Activity or responsibility	Primary clauses	Required emphasis
Designers and programme owners	4-9, 11, 19-20, 25-29, 34	Equivalent service, options, allocated requirements and downstream information
Manufacturers and test providers	7-12, 16-17, 19, 21-23	Process balances, qualified output, releases and supply evidence
Aviation, airports and ground services	10-18, 23-24, 28, 32	Operational quantities, shared boundaries and local receptors
Space and launch organizations	6-9, 19-20, 25-27, 32	Mission/ground lifecycle, launch effects and continuing orbital duties
Maintenance and circular-service providers	19, 21, 28-31	Condition, technical eligibility, custody and actual final fate
Data, assurance and claims functions	6-13, 33-40	Reproducibility, review, instrument integrity and bounded disclosure

A.2 Applicability decisions

For every clause, the record shall state applicable, shared or proposed N/A, with rationale, supporting facts, eligible reviewer and review trigger. Excluded stages and unquantified impacts shall be listed separately from N/A requirements. An unmeasured but relevant flow is a data issue, not an absent activity.

A.3 Responsibility and handover

Interface records shall identify the sending and receiving parties, retained obligations, required data, acceptance conditions, escalation and continuing evidence access. Scope shall be reassessed after acquisition, outsourcing, transfer or change of mission. The declared conformity scope shall match this dossier.

Annex B - Controlled local parameter baseline

Status: Normative within the proposed AF 9700 requirement set.

B.1 Common parameter payload

Every applicable P01-P44 entry shall identify value or controlled specification, unit, scope, source, owner, approval authority, effective conditions, uncertainty and change trigger. Where no numerical value is appropriate, a defined method or decision rule shall be recorded. Dependencies shall remain HOLD until approved; an unsupported default shall not be invented.

Table B-1. Required local parameters and decisions

ID	Parameter or decision	Minimum controlled content
P01	Adoption scope	Objects, sites, activities, dates and retained duties
P02	Obligations	Jurisdiction, permit/contract basis, owner and timing
P03	Authorities	Technical, environmental, operational and claim decisions
P04	Competence and independence	Task eligibility, conflicts and review depth
P05	Significance criteria	Receptors, severity, extent, uncertainty and escalation
P06	Targets and baseline	Absolute/intensity measures, base period and milestones
P07	Study question and audience	Decision use and permissible interpretation
P08	Functional or declared unit	Service, quality, duration, conditions and reference flows
P09	Lifecycle boundaries	Stages, shared services, geography and time
P10	Cut-off and exclusions	Significance basis, estimates and disclosure
P11	Data quality	Representativeness, completeness and acceptance rules
P12	Measurement and gaps	Sampling, calibration, uncertainty and missing-data rules
P13	Allocation	Shared processes, co-products and sensitivity
P14	Circular-flow accounting	Recycling burdens, substitution and benefit ownership
P15	Impact methods	Categories, factors, units, geography and time horizons

ID	Parameter or decision	Minimum controlled content
P16	Uncertainty and comparison	Distributions, dependencies and robustness decision
P17	Organizational inventory	Consolidation, categories and reporting period
P18	Factors and recalculation	Factor versions, gas treatment and base-period triggers
P19	Use-phase scenarios	Duty, load, lifetime, degradation and replacements
P20	Energy baseline	Carriers, drivers, losses and project verification
P21	Electricity attributes	Eligibility, matching, residual treatment and cancellation
P22	Fuel pathways	Feedstock, production, transport and lifecycle energy basis
P23	Custody system	Boundary, period, conversion yield, quantity and ownership
P24	Alternative propulsion	Full energy chain, storage, losses and qualification interfaces
P25	Non-CO2 and local effects	Models, metrics, receptors and uncertainty
P26	Pollution control	Sources, release limits, monitoring and protective action
P27	Water stewardship	Sources, catchment/season, balance and discharge rules
P28	Land and biodiversity	Baselines, sensitive receptors and restoration criteria
P29	Material/substance control	Identity, restrictions, origin and qualification
P30	Ecodesign gates	Options, lifecycle requirements and handover criteria
P31	Supplier due diligence	Risk depth, evidence, changes and escalation
P32	Process/test controls	Qualified-output baseline, resources and release controls
P33	Logistics/infrastructure	Load, return cycles, protection and service assumptions
P34	Aviation operations	Fleet/service allocation, trials and shared interfaces

ID	Parameter or decision	Minimum controlled content
P35	Space/launch assessment	Mission/ground boundary, reuse and atmospheric effects
P36	Orbital/end-mission duties	Capability, criteria, permissions and continuing status
P37	Restricted information	Eligible access, complete internal record and disclosure limits
P38	Repair/reuse eligibility	Condition, remaining life, approval and receiving use
P39	Retirement/final fate	Hazard control, destinations, yields and closure evidence
P40	Resilience	Scenarios, thresholds, dependencies and recovery criteria
P41	Information systems	Identity, units, versions, access, exchange and recovery
P42	Lifecycle cost/transition	Currency, discounting, scenarios, funding and dependencies
P43	Monitoring and claims	Indicators, wording, instruments and withdrawal triggers
P44	Assurance and continuity	Review, correction, change, retention and post-closure duties

B.2 Consistency checks

The reviewer shall verify that boundaries, units, periods, methods, technical limits and claim quantities agree across profiles. A parameter may be shared only where its applicability is demonstrated. A stricter permit or technical condition shall not be weakened by a generic environmental target.

B.3 Parameter change

Each change shall identify the old and new basis, affected studies, records, activities and disclosures. The eligible owner shall decide recalculation, requalification, correction or withdrawal. Superseded values shall remain accessible for reconstructing historical decisions.

Annex C - Governance, significance and planning dossier

Status: Normative within the proposed AF 9700 requirement set.

C.1 Governance payload

The dossier shall identify executive accountability, technical and environmental authorities, competence, independence, conflicts and escalation. It shall include obligations, affected-party engagement, complaint routes and resources for continuing duties. Delegation shall state scope and limits without obscuring the accountable owner.

C.2 Significance record

Each issue shall identify source activity, lifecycle stage, receptor, normal/abnormal scenario, potential effect, data quality and significance rationale. The record shall distinguish environmental impact from dependence on environmental conditions. Cumulative effects and low-probability severe consequences shall receive an explicit disposition.

C.3 Target and action record

Each target shall state baseline, metric, denominator, scope, timeframe, owner, actions, resources and verification. Trade-offs, constraints, growth and external dependencies shall remain explicit. Management shall record the reason for selecting an action and the response if the expected benefit fails to occur.

Annex D - Lifecycle study and data dossier

Status: Normative within the proposed AF 9700 requirement set.

D.1 Study specification

The dossier shall include decision question, audience, object identity, functional unit, reference flows, system map, exclusions and intended comparison. Each stage shall have data sources and an accountable provider. Prospective scenarios shall identify their time horizon and shall not be labelled observed performance.

D.2 Inventory and model payload

The inventory shall record quantity, unit, period, geography, technology, source, uncertainty, quality and model destination. The calculation trail shall preserve conversions, factors, allocation, circular-flow rules, replacements and balancing checks. Repeated use of a dataset shall not silently duplicate the same physical flow.

D.3 Interpretation and review

Results shall retain category-specific indicators, hotspots, uncertainty, sensitivity and excluded effects. The interpretation shall address the original question and state where conclusions are conditional. Comparative review shall retain findings, resolution, independence and the approved boundary of communication.

Annex E - Carbon, energy and fuel dossier

Status: Normative within the proposed AF 9700 requirement set.

E.1 Inventory and footprint payload

Organizational records shall identify consolidation, category coverage, period, activity/factor ledger and base-period recalculation. Product and mission records shall identify function, lifecycle stages and use scenarios. Their relationship and overlaps shall be explained before aggregation or cross-use of results.

E.2 Energy and propulsion payload

The dossier shall include energy balances, normalization drivers, losses, electricity accounting, alternative-propulsion chains, degradation and replacements. Physical delivery, contractual attributes and modelled supply shall remain distinguishable. Technical suitability and environmental preference shall have separate decision references.

E.3 Fuel and attribute payload

Fuel records shall identify pathway, feedstock origin, conversion inputs, land effects, delivered energy and reference pathway. Custody records shall reconcile opening stock, eligible additions, transformations, transfers, losses and closing stock. Attribute claims shall identify ownership, cancellation, allocation and safeguards against duplicate use.

E.4 Atmospheric effects

The dossier shall retain direct emissions, non-CO2 models, atmospheric context, time horizon and uncertainty. Where no suitable characterization method is available, the inventory and limitation shall remain visible. Carbon savings shall not be generalized to every atmospheric or local effect.

Annex F - Pollution, water and nature dossier

Status: Normative within the proposed AF 9700 requirement set.

F.1 Source and receptor payload

Records shall identify substances, release pathways, environmental receptors, obligations, controls and monitoring. Abnormal conditions shall include credible loss of containment, treatment failure and emergency response. The evidence shall cover downstream residues from abatement as well as the immediate site release.

F.2 Water and land payload

Water records shall reconcile withdrawal, consumption, discharge, storage and recirculation by source and catchment. Land and biodiversity records shall identify baseline, season, sensitive features, alternatives, mitigation and restoration objectives. Local adverse effects shall not be hidden by global aggregation.

F.3 Event and restoration payload

Incidents and restoration shall retain chronology, quantities, uncertainty, notifications, protective actions and verification. Completion criteria shall distinguish immediate containment, remediation and longer-term ecological recovery. Remaining monitoring duties shall stay assigned through transfer or site closure.

Annex G - Materials, ecodesign and procurement dossier

Status: Normative within the proposed AF 9700 requirement set.

G.1 Material and design payload

The dossier shall identify grades, substances, critical resources, technical requirements, mass/yield and environmental characteristics. Design alternatives shall show equivalent service, durability, repair, disassembly and actual treatment feasibility. Safety and qualification dependencies shall be explicit in the gate decision.

G.2 Supply and custody payload

Supplier records shall contain sourcing risk, required evidence, origin, custody method, quantity reconciliation, subcontractor controls and change obligations. Concerns shall have investigation and disposition. Supplier approval shall not be treated as blanket verification of every future delivered attribute.

G.3 Handover payload

Released designs and purchases shall carry information needed for production, operation, maintenance and end-of-life decisions. Receiving parties shall verify identity, intended use, restrictions and evidence access. Unresolved composition, origin or technical eligibility shall remain a visible blocked dependency.

Annex H - Production, logistics and aviation dossier

Status: Normative within the proposed AF 9700 requirement set.

H.1 Process and facility payload

The dossier shall record qualified output, input quantities, losses, rework, utilities, releases and final waste routes. Test campaigns shall identify resource needs and the technical basis for any reduced or combined testing. Improvements shall reconcile throughput, product mix, weather and standby conditions with the comparison baseline.

H.2 Logistics and infrastructure payload

Records shall identify transport mode, distance, payload, empty movements, packaging cycles, losses and protection requirements. Infrastructure models shall include relevant construction, operation, maintenance, resilience and final treatment. Shared burdens shall have a traceable allocation and a stated uncertainty.

H.3 Aviation and airport payload

Operational records shall identify aircraft/service configuration, actual fuel and energy, route and load basis, shared ground duties and local effects. Environmental trials shall have approved technical conditions, representative measurement and stopping rules. Reported improvements shall remain bounded to supported fleet, site and operating conditions.

Annex I - Space, orbital and restricted-activity dossier

Status: Normative within the proposed AF 9700 requirement set.

I.1 Mission and launch payload

The dossier shall include development, manufacture, tests, transport, launch, ground operation, mission use and end-of-mission. It shall state delivered service, shared-launch allocation, reuse/attrition assumptions, propellant chain and emission altitude. Uncharacterized effects shall be disclosed as limitations alongside known inventory flows.

I.2 Orbital and return payload

Records shall identify object, orbit/mission scope, responsible parties, permissions, prevention controls, reserves, end-of-mission criteria and failure response. Actual status shall be supported by observations or explicitly bounded uncertainty. Mission extension shall include renewed assessment of disposal capability and continuing exposure.

I.3 Restricted-data payload

The complete assessment shall remain available to eligible reviewers under controlled access. External records shall identify withheld scope and resulting assurance limits. Classified or otherwise protected details shall not be disclosed through environmental reporting; withholding shall not manufacture a claim of complete verification.

Annex J - Maintenance, circular use and final-fate dossier

Status: Normative within the proposed AF 9700 requirement set.

J.1 Condition and technical eligibility

Records shall identify item, configuration, ownership, history, inspection, remaining limits and intended receiving use. Repair, life extension and remanufacture shall have authorized technical criteria and results. Environmental comparisons shall use equivalent future service and include unsuccessful candidates, process losses and replacements.

J.2 Retirement and movement

The dossier shall record asset inventory, hazardous contents, verified safe state, segregation, waste determination and authorized transport/receiving parties. Each transfer shall preserve identity, quantity, conditions, destination and retained duties. Sale or collection shall not be treated as proof of lawful final treatment.

J.3 Recovery and closure

Final-fate records shall reconcile input with reused items, recovered material, energy recovery, disposal, process losses and stocks. Recovery yields shall identify actual usable output and quality. Closure shall identify residual contamination, monitoring, uncertain destinations and the responsible party for each continuing obligation.

Annex K - Resilience, cost and transition dossier

Status: Normative within the proposed AF 9700 requirement set.

K.1 Resilience payload

The dossier shall identify asset life, location, climate/environment scenarios, critical thresholds, dependencies and compound-event assumptions. Options shall show effectiveness, environmental consequences and residual risk. Adaptation triggers and recovery verification shall be assigned to eligible owners.

K.2 Cost payload

The cost model shall retain currency, price year, real/nominal convention, discount rate, horizon, cash-flow timing and residual values. Costs of maintenance, replacement, retirement and remediation shall be included where relevant. Physical environmental indicators shall be presented separately from monetized impact values.

K.3 Transition payload

The plan shall distinguish funded commitments, conditional projects and speculative options. Each action shall identify technology readiness, qualification, infrastructure, supply, workforce, funding and schedule dependencies. Failure of a dependency shall trigger an explicit reconsideration rather than automatic continuation of the original benefit forecast.

Annex L - Digital information, monitoring and claims dossier

Status: Normative within the proposed AF 9700 requirement set.

L.1 Digital and measurement payload

Records shall preserve object identity, unit, boundary, period, method, factor version, quality and source. Exchange contracts shall define unknown values and compatible aggregation. Calculation checks, access control, correction history and recovery reconciliation shall support the intended decision use.

L.2 Indicator and benefit payload

Every indicator shall retain numerator, denominator, absolute result, data basis and interpretation. Period-to-period bridges shall separate operational change from scope, method and correction effects. Project benefits shall identify the comparison, actual operating conditions, rebound and evidence maturity.

L.3 Claim and instrument payload

The claim dossier shall contain exact wording, audience, object, period, boundary, method, quantities, limitations, evidence and approval. Instrument records shall include identity, ownership, vintage, eligibility, transfer and cancellation. Gross inventory, internal reduction, avoided impact, removal and offset shall remain distinguishable.

L.4 Correction and withdrawal

The dossier shall identify review dates, invalidation triggers and affected publication channels. Corrections shall preserve the former statement, corrected statement, reason, scope and notification. Withdrawal shall not erase underlying evidence or continuing physical obligations.

Annex M - Assurance, correction and change dossier

Status: Normative within the proposed AF 9700 requirement set.

M.1 Review payload

The assurance record shall identify subject, criteria, scope, period, reviewer competence/independence, evidence access and sampling. Findings shall link the criterion, actual evidence, consequence and decision state. The conclusion shall state limits and shall not imply review of unexamined subjects.

M.2 Issue and remedy payload

Issue records shall preserve intake, chronology, protection, extent, causes, corrective action and affected claims. Closure shall include effectiveness evidence and any continuing remediation. Complaints and conflicting evidence shall remain visible until a reasoned disposition is recorded.

M.3 Change and transfer payload

Changes shall identify old/new baselines, affected requirements, data, activities and claims, plus recalculation and requalification needs. Transfers shall specify retained duties and evidence custody. Post-closure records shall maintain owners for unresolved physical conditions, monitoring and public statements.

Annex N - Adoption and decision dossier

Status: Normative within the proposed AF 9700 requirement set.

N.1 Readiness and local adoption

The dossier shall identify organization, scope, applicable clauses, P01-P44 baseline, responsible roles, adopted procedures, competence and unresolved dependencies. Local adoption shall state its eligible authority and effective conditions. A missing technical parameter shall not be supplied by the act of signing an adoption record.

N.2 Decision and evidence states

Each consequential decision shall identify object, baseline, purpose, criteria, evidence, uncertainty, findings, authority and conditions. PASS, FAIL, HOLD and approved N/A shall be used consistently. The decision shall distinguish environmental acceptance, technical release, operating permission, publication and recognition where relevant.

Table N-1. Minimum decision record

Element	Required content
Object	Identity, configuration, activity, site and period
Criteria	Complete applicable requirements and parameter baseline
Evidence	Sources, versions, methods, uncertainty and accepted use
Findings	Failures, gaps, exclusions and unresolved dependencies
Authority	Eligible decision owner, review and authentication reference
Outcome	Exact scope, state, conditions, restrictions and review triggers

N.3 Publication and continuing review

Official publication shall require its own eligible approval and exact released identity. Management review shall consider performance, obligations, resources, assurance findings and continuing liabilities. Interpretations shall retain their basis and affected requirements; feedback shall not silently amend the adopted text.

Annex O - Reproducible calculations and decision examples

Status: Informative. All values are synthetic and are not mandatory thresholds, actual project results or approved operating parameters. Each example states assumptions and the limits of its conclusion.

O.1 Absolute and intensity performance

A facility reports 1,000 t CO₂e while producing 100,000 equivalent units in its base period. A later period reports 1,080 t CO₂e and 120,000 equivalent units with unchanged boundaries and equivalent product mix.

Base intensity = $1,000,000 / 100,000 = 10 \text{ kg CO}_2\text{e/unit}$

Later intensity = $1,080,000 / 120,000 = 9 \text{ kg CO}_2\text{e/unit}$

Intensity change = $(9 - 10) / 10 = -10\%$

Absolute change = $(1,080 - 1,000) / 1,000 = +8\%$

The facility improved intensity while increasing total emissions. Both results shall remain visible. This calculation cannot attribute the change to a particular intervention without additional evidence.

O.2 Lifecycle fuel blend on an energy basis

Assume two compatible pathways evaluated on the same lifecycle boundary: reference fuel 90 g CO₂e/MJ and alternative fuel 30 g CO₂e/MJ. The delivered energy is 100,000 MJ, with 20% attributed to the alternative pathway. Technical eligibility and valid custody are separate prerequisites.

Blend intensity = $0.80 \times 90 + 0.20 \times 30 = 78 \text{ g CO}_2\text{e/MJ}$

Blend result = $100,000 \times 78 / 1,000,000 = 7.8 \text{ t CO}_2\text{e}$

Reference result = $100,000 \times 90 / 1,000,000 = 9.0 \text{ t CO}_2\text{e}$

Difference = $1.2 \text{ t CO}_2\text{e}$; relative reduction = 13.3333%

A 20% blend does not imply a 20% lifecycle reduction. The example does not establish zero combustion emissions or quantify non-CO₂ effects. A mass or volume blend shall first be converted using valid energy properties.

O.3 Electricity accounts and unmatched consumption

A site consumes 1,000 MWh. Its physical grid-average estimate is 400 kg CO₂e/MWh. In a separate contractual account, 600 MWh has eligible cancelled attributes with an illustrative generation factor of zero; 400 MWh uses an appropriate unmatched factor of 500 kg CO₂e/MWh.

Physical grid estimate = $1,000 \times 400 / 1,000 = 400 \text{ t CO}_2\text{e}$

Contractual account = $(600 \times 0 + 400 \times 500) / 1,000$

Contractual account = $200 \text{ t CO}_2\text{e}$

These are different accounting views, not additive emissions and not proof of a 200 t physical reduction. Upstream lifecycle burdens are not automatically zero and must be included where the declared footprint requires them.

O.4 Co-product allocation sensitivity

A shared process has 1,000 kg CO₂e of burden and produces 80 kg of product A and 20 kg of product B. Mass allocation is selected for the base model. A sensitivity case uses economic outputs of 160 currency units for A and 240 for B, with no change in total process burden.

Mass allocation to A = $1,000 \times 80 / 100 = 800 \text{ kg CO}_2\text{e}$

Mass intensity A = $800 / 80 = 10 \text{ kg CO}_2\text{e/kg}$

Economic allocation to A = $1,000 \times 160 / 400 = 400 \text{ kg CO}_2\text{e}$

Economic intensity $A = 400 / 80 = 5 \text{ kg CO}_2\text{e/kg}$

The result halves solely because of the allocation choice. The study shall justify its chosen causal or other basis and disclose material sensitivity; selecting the more favourable number is not an environmental improvement.

0.5 Material yield and actual recycling

A process takes 1,000 kg of material and produces 700 kg of qualified product. It generates 250 kg of collected scrap and 50 kg of other losses. The recycler recovers 80% of the scrap as usable secondary material; its remaining 20% is documented residue.

Product yield = $700 / 1,000 = 70\%$

Recovered material = $250 \times 0.80 = 200 \text{ kg}$

Recycler residue = $250 - 200 = 50 \text{ kg}$

Balance = $700 + 200 + 50 + 50 = 1,000 \text{ kg}$

The collected scrap rate is 25% of input; actual recovered material is 20% of input. Neither is the recycled content of the manufactured product. Residue destinations and losses still require evidence.

0.6 Water balance and concentration versus load

A site withdraws 1,000 m³, discharges 650 m³, consumes 300 m³ and increases stored water by 50 m³. Internal recirculation is measured separately. A treatment change reduces discharge from 100 to 50 m³/day while concentration increases from 10 to 15 mg/L.

Water balance = $650 + 300 + 50 = 1,000 \text{ m}^3$

Initial load = $100 \times 1,000 \times 10 / 1,000,000 = 1 \text{ kg/day}$

Later load = $50 \times 1,000 \times 15 / 1,000,000 = 0.75 \text{ kg/day}$

Pollutant load falls by 25% while concentration rises by 50%. Neither result alone establishes compliant discharge or acceptable receiving-water conditions; the applicable concentration, load and receptor criteria still apply.

0.7 Repair-versus-replace break-even

For equivalent future service, a replacement requires 500 kg CO₂e upfront and then 1 kg CO₂e per service hour. Repair requires 100 kg upfront but the repaired asset uses 1.2 kg per service hour. Both options are technically eligible for the assessed service; past common burdens are excluded consistently from this decision model.

Replacement = $500 + 1.0 \times H$

Repair = $100 + 1.2 \times H$

Equal burden: $500 - 100 = (1.2 - 1.0) \times H$

Break-even $H = 400 / 0.2 = 2,000 \text{ hours}$

At 1,000 hours, repair is 1,300 kg and replacement is 1,500 kg. At 3,000 hours, repair is 3,700 kg and replacement is 3,500 kg. Actual remaining life, maintenance and performance determine which scenario is credible.

0.8 Reusable packaging with loss-adjusted use

A reusable container has 40 kg CO₂e production burden and 0.8 kg per completed cycle for return transport and cleaning. A single-use package has 3 kg per delivery. Ignore final treatment only for this explicitly limited example and assume every counted cycle provides equivalent protection.

Reusable burden per cycle = $40 / N + 0.8$

Break-even $N = 40 / (3 - 0.8) = 18.1818 \text{ cycles}$

At 20 completed cycles: $40 / 20 + 0.8 = 2.8 \text{ kg/cycle}$

At 10 completed cycles: $40 / 10 + 0.8 = 4.8 \text{ kg/cycle}$

At least 19 complete cycles are needed to beat 3 kg in this model. Claimed design life cannot replace realized or justified expected cycles. Loss, damage and final treatment may change the result.

0.9 Dependent uncertainty in a total

Two independent estimated contributions are 100 and 200 t CO₂e with standard uncertainties of 10 and 20 t. A separate scenario assumes correlation 0.5 because both use a shared uncertain factor. Normality is assumed only to illustrate approximate expanded intervals.

Total = 100 + 200 = 300 t CO₂e

Independent u = $\sqrt{10^2 + 20^2}$ = 22.3607 t

Correlated u = $\sqrt{10^2 + 20^2 + 2 \times 0.5 \times 10 \times 20}$

Correlated u = $\sqrt{700}$ = 26.4575 t

Approximate k=2 expanded uncertainty = 52.9150 t

Ignoring positive dependence understates uncertainty. The approximate interval is not a guaranteed bound, and model or scenario gaps may not be represented by these standard uncertainties.

0.10 Shared launch service allocation

An illustrative shared launch lifecycle has 100 t CO₂e and carries two payloads of 200 and 300 kg. A mass-based allocation is used for this stated study purpose. The first payload delivers 1,000 qualified service units with an additional 15 t CO₂e from manufacture, ground operation and final treatment.

Payload A share = $100 \times 200 / 500$ = 40 t CO₂e

Payload A lifecycle = 40 + 15 = 55 t CO₂e

Service intensity = $55,000 / 1,000$ = 55 kg CO₂e/unit

This does not demonstrate causal marginal launch emissions, equivalent payload functions or acceptable orbital effects. Another justified allocation or a different service duration may materially change the result.

0.11 Lifecycle cost with separate physical impacts

Option A costs 100,000 currency units now, then 10,000 at the end of each of three years, and 5,000 at the end of year three for retirement. A real annual discount rate of 5% is assumed and all cash flows use the same real price basis.

PV = $100,000 + 10,000/1.05 + 10,000/1.05^2$

+ $15,000/1.05^3$ = 131,551.6683 currency units

The retirement cost is included once, alongside the third operating payment. Inflation must not be mixed into this real-price model without reconciliation. Physical emissions and waste quantities remain undiscounted inventory results unless a separate explicitly justified impact method says otherwise.

0.12 Attribute inventory reconciliation

A custody account opens with 100 eligible units, adds 500 eligible units, transfers 450 units to another owner and cancels 80 units for the reporting entity's own bounded claim. No conversion or loss occurs in this simplified account.

Closing eligible balance = $100 + 500 - 450 - 80$ = 70 units

Accounted quantity = $450 + 80 + 70$ = 600 units

Only 80 units are cancelled for this entity's claim; the transferred 450 cannot also support its retained use claim. A positive balance does not by itself prove eligibility, physical delivery, project quality or an emissions reduction.

Annex P - Integrated application cases

Status: Informative. These cases and identifiers are synthetic. They illustrate evidence and decision boundaries, not actual project results or universal acceptance conditions.

P.1 A lighter part with a shorter life

A design team proposes a lighter composite part. Use-phase fuel improves, but the part has a shorter verified life, greater production scrap and a less established treatment route. The comparison includes replacements and repair capability. The reviewer permits a bounded carbon statement only if the equivalent-service result remains supported; recyclability and technical release remain separate decisions.

P.2 A lower-carbon fuel with incomplete custody

A fuel supplier provides a favourable pathway intensity but cannot reconcile the quantity transferred through an intermediary. The calculation may remain an illustrative scenario. The actual procurement claim is placed on HOLD until the origin, conversion quantities, ownership and cancellation are verified. Technical suitability of the delivered fuel does not cure the custody gap.

P.3 A renewable electricity claim after attribute sale

An airport generates electricity on site and exports the associated attributes. Its physical energy balance records the generation, but its retained renewable-consumption claim cannot reuse the exported entitlement. The contractual account applies the declared unmatched treatment. The site corrects the wording rather than describing the same units as renewable use by both parties.

P.4 A water-saving process in a stressed catchment

A coating facility reduces withdrawal but produces a more concentrated residue and uses additional treatment energy. The decision examines consumption, local scarcity, pollutant load, discharge limits and final residue treatment. A verified water-volume saving is reported with its boundary; it is not expanded into an unsupported claim that every environmental effect improved.

P.5 A repair decision with a service threshold

A maintenance team uses the synthetic model in O.7. The repaired equipment is technically eligible for 1,000 additional service hours under the stated conditions. Repair produces 1,300 kg CO₂e versus 1,500 kg for replacement over that service. The decision remains conditional on the repair result and actual future duty; it does not grant an extension beyond the approved life.

Table P-1. Populated synthetic decision record for P.5

Record field	Illustrative entry
Object	Test support unit TS-42; controlled configuration C2
Decision question	Repair or replace for 1,000 equivalent future service hours
Evidence basis	O.7 synthetic model; eligibility and service assumed for teaching only
Compared result	Repair 1,300 kg CO ₂ e; replacement 1,500 kg CO ₂ e
Difference	200 kg CO ₂ e lower for repair over the stated future service
Remaining conditions	Actual repair acceptance, valid remaining life, duty and maintenance evidence
Decision boundary	Environmental example only; no technical release or real approval

P.6 Collected scrap reported as recycled material

A manufacturer reports all 250 kg sent to a recycler as recycled. Downstream evidence shows 200 kg usable output and 50 kg residue. The organization corrects the reported quantity and confirms residue disposal. The product's recycled-input content remains a separate measure, even though the scrap came from the same facility.

P.7 A reusable launch system with uncertain cycle count

An early design assumes many launches per vehicle, substantially lowering production burden per mission. Evidence currently supports fewer cycles and uncertain refurbishment demand. The study reports bounded scenarios and sensitivity. It does not present the best design-life scenario as demonstrated fleet performance or omit recovery and attrition.

P.8 A completed mission with an uncertain final orbit

A spacecraft stops its service after a commanded end-of-mission maneuver. Observation has not yet confirmed the intended state. The service record closes, but the disposal requirement remains HOLD with an assigned owner and observation plan. Administrative closure and expenditure completion do not convert the command into verified disposal.

P.9 A defense programme with protected data

A restricted programme maintains a complete internal lifecycle model and supplies eligible reviewers with controlled access. Its public statement discloses the boundary and the limited assurance scope without revealing protected details. Withheld quantities are not labelled zero, and the statement does not imply that unreviewed operations were independently assured.

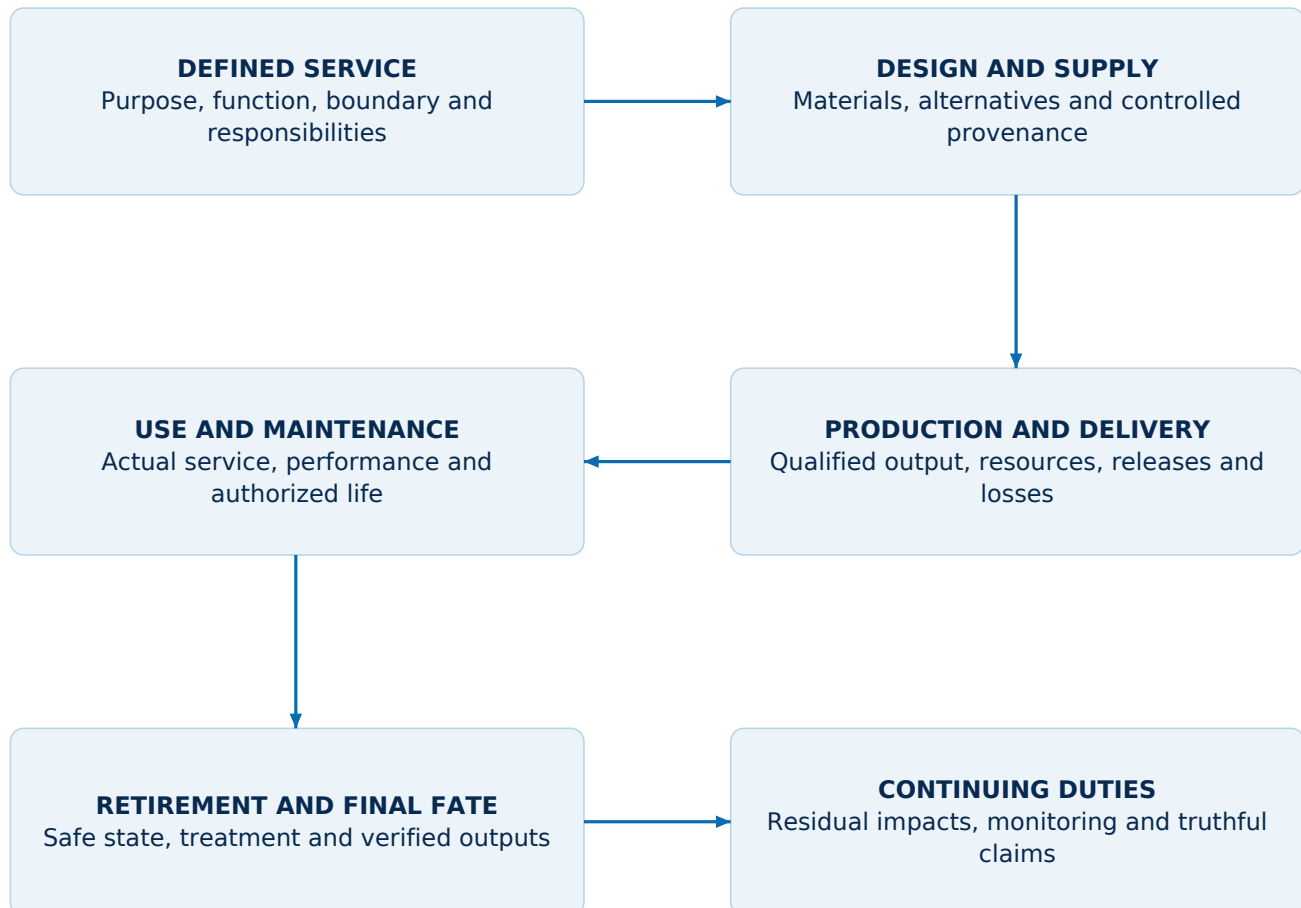
P.10 A target met through a changed denominator

A service provider increases utilization and reports lower emissions per service unit, while total emissions rise. Both values are correct within the unchanged boundary. Management retains the intensity achievement, discloses the absolute rise and revisits its total-impact target. The reporting team does not rename an intensity improvement as an absolute reduction.

Annex Q - Lifecycle and decision diagrams

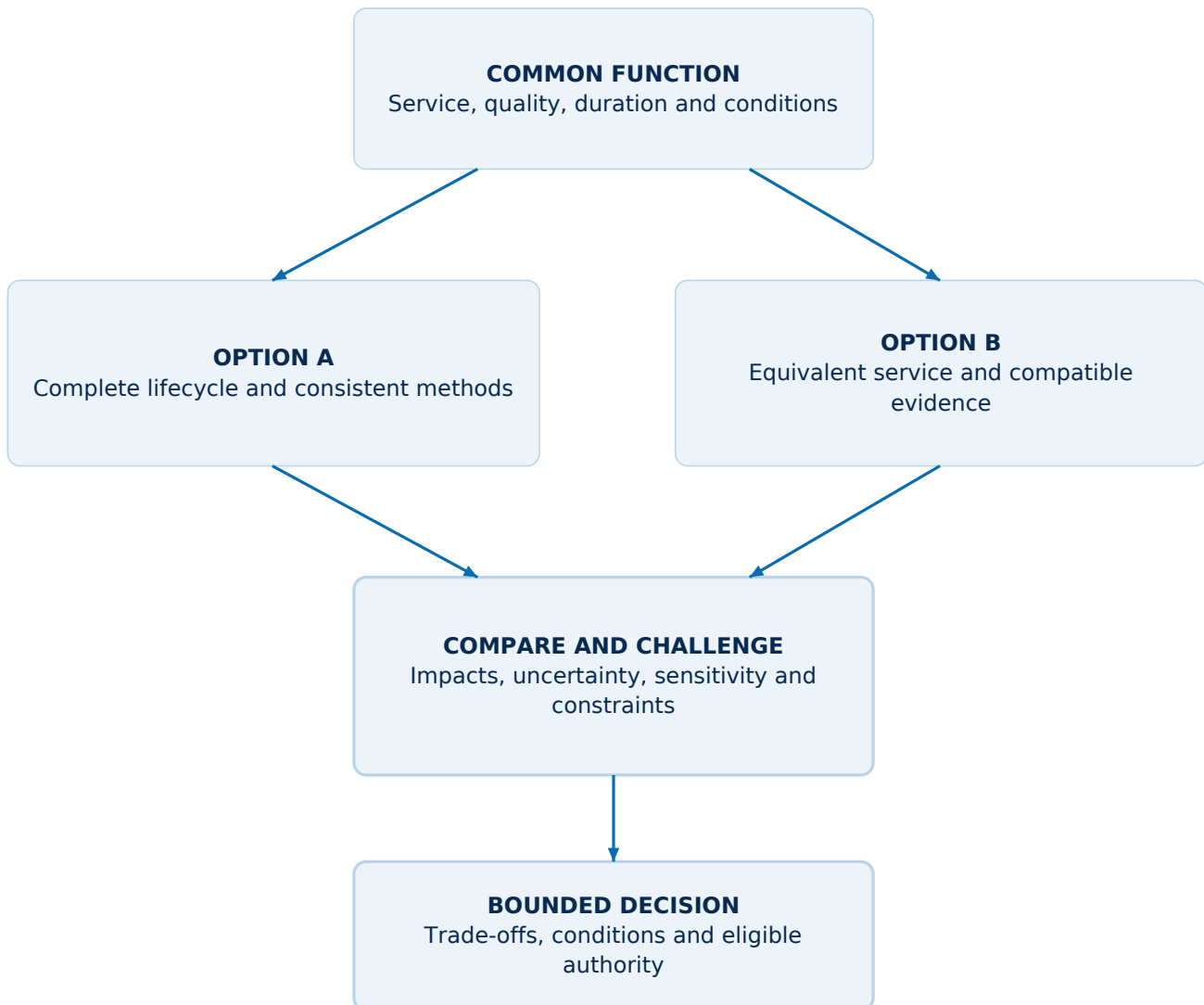
Status: Informative. The diagrams summarize requirement relationships and do not replace the complete clauses or local parameters.

Q.1 Lifecycle evidence and continuing responsibility



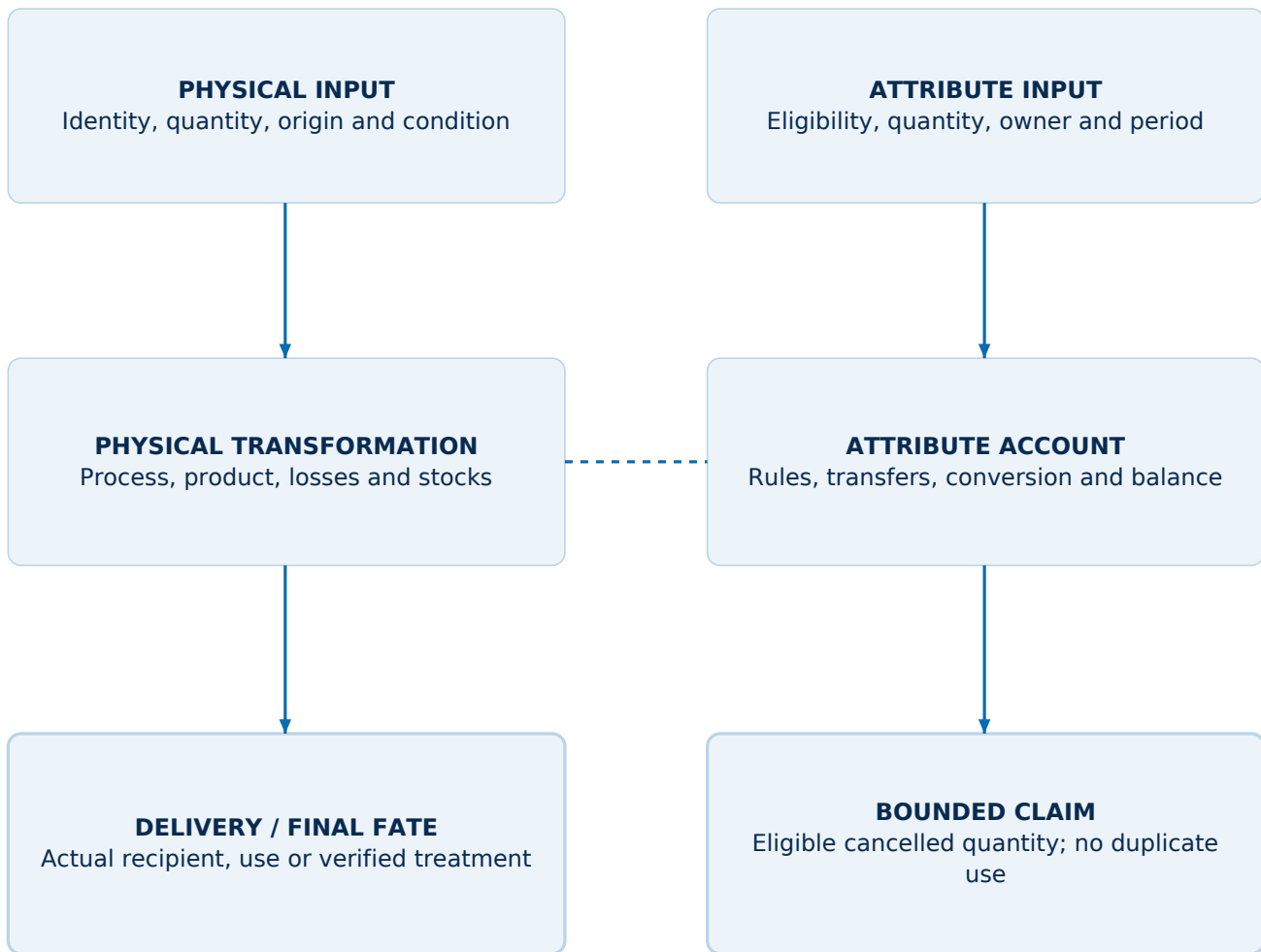
The evidence chain begins with a defined service and continues through use, final fate and residual obligations. A transfer or administrative closure does not remove an uncompleted responsibility.

Q.2 Equivalent-service comparison



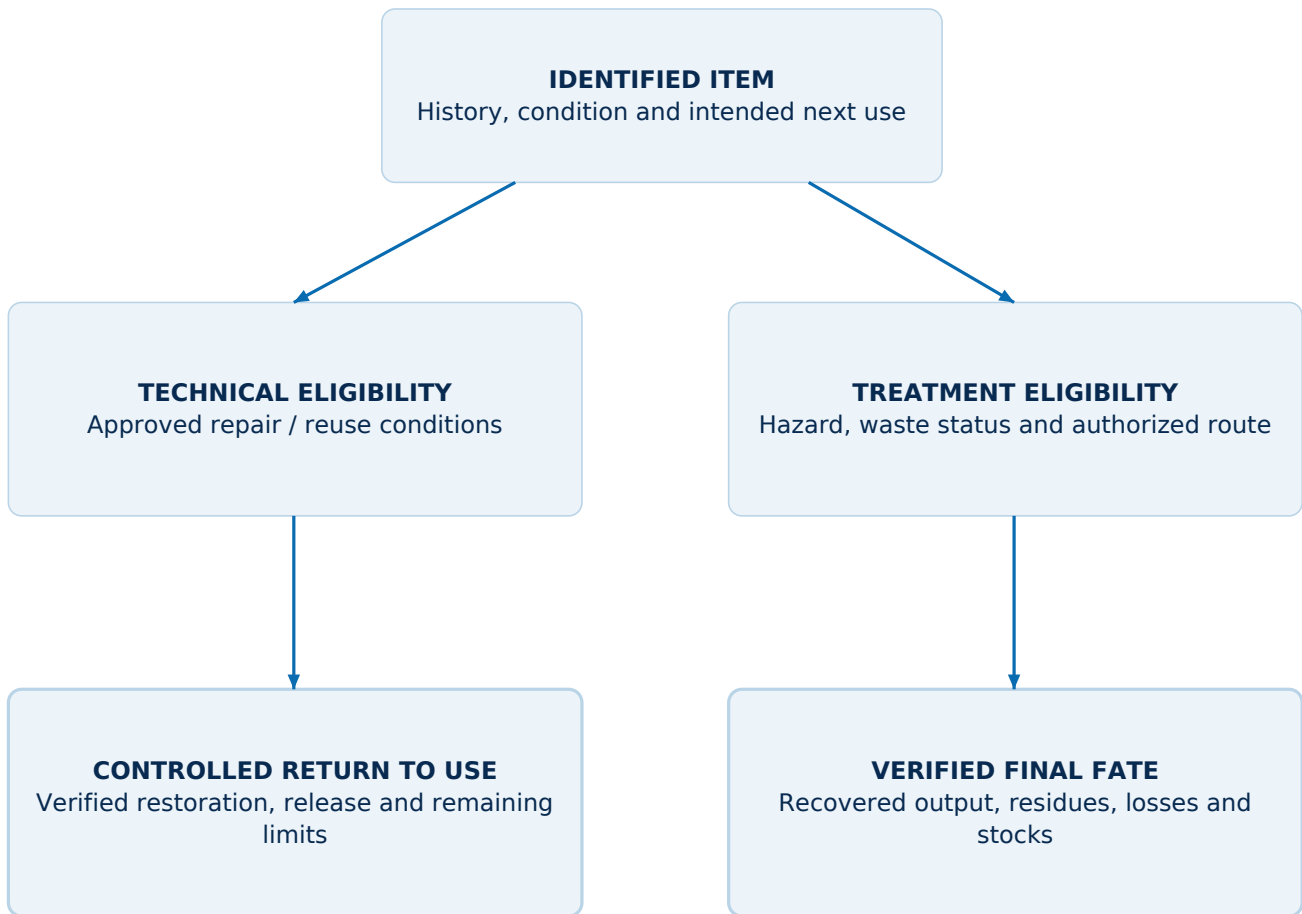
A comparison requires a shared function and consistent methods. Safety and environmental constraints remain gates; a weighted score cannot conceal an unmet constraint.

Q.3 Physical flow and environmental attribute



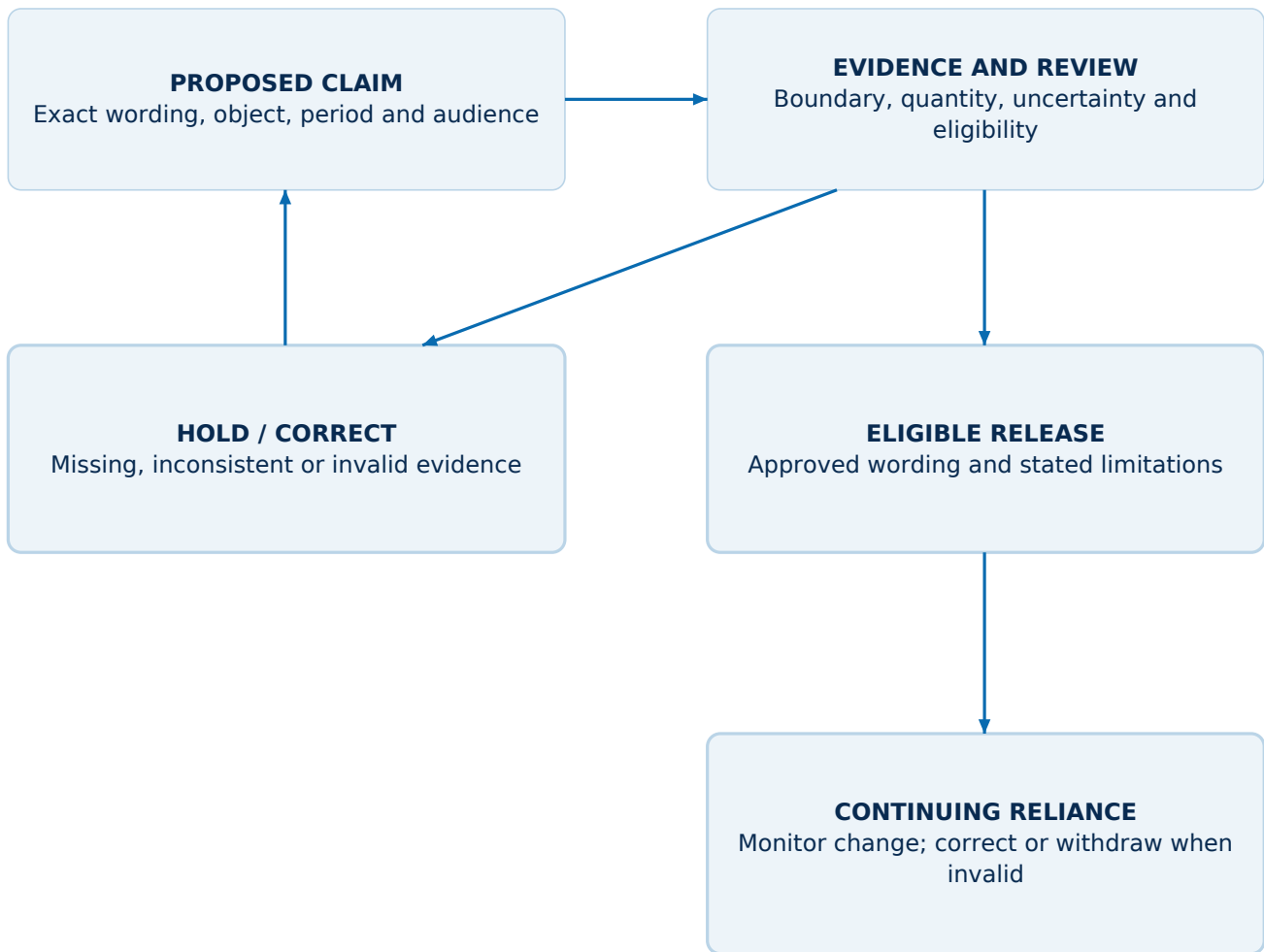
The physical material and its environmental attributes may follow different permitted accounting routes. Each route needs its own quantity, identity, boundary and claim controls.

Q.4 Circular treatment and verified final fate



Technical eligibility is required before returning an item to service. Material recycling requires evidence of actual usable output and residue treatment; sending material is an intermediate event.

Q.5 Claim review, correction and continuing reliance



A claim remains linked to the exact evidence, boundary and period. Changed or invalid evidence triggers reassessment, correction or withdrawal through the affected communication channels.

Annex R - Activity-based implementation routes

Status: Informative. These routes simplify navigation; all applicable retained responsibilities still apply.

R.1 Design and programme owner

Begin with 0-9, 19-20 and 34. Define the service, lifecycle and non-negotiable constraints before comparing concepts. Add 11-15 and the relevant operation clauses. Use Annexes C-E and G for design gates and evidence handover.

R.2 Manufacturer and test provider

Apply 7-12, 16-17 and 19-23 to qualified-output balances, supply, utilities and releases. Preserve the required technical test evidence. Use Annexes D-H and complete the site, material and process profiles.

R.3 Airline, airport and ground-service operator

Apply 10-18, 23-24, 28 and 32. Define shared boundaries and actual service denominators, then verify operating improvements and local effects. Use the aviation, energy, water and resilience profiles together.

R.4 Space, launch and ground-segment organization

Apply 6-9, 11, 19-20 and 25-27. Include development/testing, launch, ground support, actual service and continuing end-of-mission duties. Keep carbon and orbital evidence distinct in Annex I.

R.5 Maintenance and life-extension provider

Apply 19, 21 and 28-29. Establish identity, condition and authorized remaining service before an environmental repair-versus-replace comparison. Preserve technical release and environmental conclusions as separate records in Annex J.

R.6 Retirement and recovery provider

Apply 16, 19, 21 and 29-31. Verify safe state, classification, custody and actual downstream outputs. Reconcile every fraction and retain unresolved final fate, remediation and continuing duties.

R.7 Supplier and environmental-data provider

Apply 6-13, 19, 21 and 33. State the exact boundary, method, quantity and permitted use of supplied data or attributes. Prevent duplicated benefits and notify recipients of corrections and invalidation.

R.8 Corporate sustainability and investment team

Apply 4-10, 12, 32 and 34-40. Maintain absolute and intensity targets, funded transition dependencies, honest claims and continuing liabilities. Keep financial valuation separate from physical inventory results.

R.9 Reviewer and assurance provider

Apply 2-9 and 33-40 plus the technical clauses relevant to the subject. Verify competence, independence, source evidence, quantities and limitations. State what was actually examined and preserve material unresolved findings.

Annex S - Interpretation questions and boundary examples

Status: Informative. Answers clarify recurring distinctions; they do not waive requirements or assign missing local parameters.

S.1 Does a carbon footprint establish sustainability?

No. A carbon footprint addresses a defined climate-accounting question. Water, pollution, biodiversity, materials, safety and other relevant effects require their own assessment.

S.2 Is alternative aviation fuel zero-emission fuel?

No. The pathway, delivered energy, combustion and other lifecycle effects must be assessed. A lower lifecycle carbon result does not establish zero combustion or non-CO2 impact.

S.3 Does renewable electricity have zero lifecycle impact?

No. Generation infrastructure, supply chains, losses and the declared boundary remain relevant. Attribute accounting also requires valid ownership and cancellation.

S.4 Can collected material be reported as recycled?

Only to the extent supported by actual treatment and recovered-output evidence. Collection, storage, shipment, recycling and energy recovery are different states.

S.5 Does recycled content prove aerospace suitability?

No. Composition, identity, condition, qualification and the intended use require separate technical evidence and approval.

S.6 Is longer life always environmentally preferable?

No. Repair, degradation, future energy use, support and replacement burdens must be compared over equivalent service within valid technical limits.

S.7 Can offsets be deducted silently from the inventory?

No. Gross inventory, internal reductions, removals, offsets and other contributions must remain identifiable under the declared accounting method.

S.8 Is a lower intensity an absolute reduction?

No. Total impact may rise while impact per service unit falls. Report both where relevant and explain changes in the denominator and boundary.

S.9 Does a disposal command complete a space duty?

No. Achieved state, uncertainty, failure response and continuing responsibility require evidence. A command is not proof of its intended result.

S.10 Does confidentiality remove assessment duties?

No. It changes eligible access and public disclosure. The internal assessment and the limits of external assurance must remain honest and traceable.

S.11 Does independent review validate every use?

No. The conclusion applies only to its stated subject, boundary, period, criteria and examined evidence. Changes can invalidate continued reliance.

S.12 Does completing the set confer recognition?

No. Publication, local adoption, technical acceptance, operating permission and any AF recognition remain separate eligible decisions.

Annex T - Requirement families and implementation crosswalk

Status: Informative. The supporting master list and coverage matrix provide the complete working-document routes.

T.1 Requirement families

Table T-1. Core navigation map

Requirement family	Clauses	Main normative annexes
Scope, governance and planning	0-5	A-C, N
Lifecycle studies and data	6-9	D
Carbon, energy, fuels and propulsion	10-15	E
Pollution, water and nature	16-18	F
Materials, design and supply	19-21	G
Production, logistics and aviation	22-24	H
Space, orbital and restricted activities	25-27	I
Maintenance, circular use and final fate	28-31	J
Resilience, cost and transition	32, 34	K
Information, monitoring and claims	33, 35-36	L
Assurance, correction and continuity	37-39	M
Adoption and publication	40	N

T.2 Implementation sequence

Select an actual activity, define scope and functional basis, complete the local parameters, establish evidence and identify blocked dependencies. Implement the applicable procedures and profiles, record real results, conduct competent review and retain the exact authorized decision. Use monitoring and change controls to preserve continuing validity.

T.3 Completeness questions

Can an eligible reviewer reconstruct the object, service, quantities, sources, methods, uncertainty, impacts, custody, findings and authority? Can the organization explain every exclusion, unresolved final fate and published claim? Are physical obligations still assigned after transfer or closure? If not, the relevant evidence route remains incomplete.