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REFERENCE DOCUMENT

# ODDC Scenarios

Conformance Scenario Library

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Version v2.0 · February 2026 · PUBLIC DOCUMENT

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SENTINEL AUTHORITY — ODD Conformance Determination

ODDC Scenarios

Industry Applications

Version 2.0 — February 2026 — Non-Normative Examples

This document presents representative scenarios illustrating how ODDC with ENVELO-compliant three-tier enforcement applies across industries. Each scenario shows the declared ODD boundaries, the Minimum Risk Condition, and how all three enforcement tiers operate. These examples are illustrative and non-normative. Actual conformance requirements are determined through scope assessment.

## 1. Data Centers & Hyperscale Computing

Operational Context

Autonomous systems allocate power, optimize cooling, place workloads, and orchestrate AI-on-AI stacks.

Real-time decisions affect facility safety, equipment longevity, and operational continuity.

Representative ODD Boundaries

- Power draw: Per-rack limits, row limits, facility aggregate
- Thermal envelope: Inlet temperature ranges, delta-T limits
- Workload density: Compute density per zone, memory utilization ceilings
- AI recursion: Maximum depth for AI systems managing other AI systems

Declared MRC:

Automated workload shedding to base power; cooling override to maximum

Tier 1 — Self-Correction

Power draw approaching facility aggregate limit. System pauses new workload placement and begins thermal rebalancing.

#### Tier 2 — Minimum Risk Condition

Thermal envelope breached on rack row. ENVELO forces MRC: shed non-critical workloads, override cooling to maximum, halt new placements.

#### Tier 3 — Hard Halt

Cascading thermal exceedance across multiple rows. ENVELO halts: emergency power-down of affected racks, transfer critical workloads to unaffected zones.

## 2. Healthcare & Clinical AI

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#### Operational Context

Clinical decision support systems and autonomous diagnostic tools operate in high-stakes environments where bounded operation is essential for patient safety.

#### Representative ODD Boundaries

- Scope limitations: Specific conditions, patient populations, imaging modalities
- Confidence thresholds: Minimum certainty before automated recommendations
- Escalation triggers: Conditions requiring human review
- Formulary boundaries: Medication recommendations constrained to approved formulary

#### Declared MRC:

Defer to human clinician with full context provided

#### Tier 1 — Self-Correction

Confidence score approaching minimum threshold. System flags uncertainty, increases sampling, alerts clinician of reduced confidence.

#### Tier 2 — Minimum Risk Condition

Confidence below threshold or out-of-scope presentation. ENVELO forces MRC: recommendation withheld, case escalated to human clinician with full context.

#### Tier 3 — Hard Halt

Data integrity failure or unrecognized input modality. ENVELO halts: no output generated, system offline

pending integrity verification.

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### 3. Financial Services

Operational Context

Algorithmic trading systems, automated underwriting, and fraud detection require demonstrable operational boundaries for regulatory compliance and systemic risk management.

Representative ODD Boundaries

- Position limits: Maximum exposure per asset, sector, counterparty
- Velocity limits: Maximum transactions per time period
- Drawdown limits: Maximum loss before enforcement
- Market impact bounds: Maximum participation rate in any single security

Declared MRC:

Unwind positions to risk-neutral; cancel all pending orders

Tier 1 — Self-Correction

Position approaching limit for sector exposure. System reduces position sizing, increases hedging, slows order rate.

Tier 2 — Minimum Risk Condition

Drawdown threshold breached. ENVELO forces MRC: automatic position unwinding to risk-neutral, cancellation of all pending orders.

Tier 3 — Hard Halt

Flash crash conditions or system integrity error. ENVELO halts: all trading ceased, positions frozen, full human escalation required.

### 4. Aerospace & Aviation

Autonomous and semi-autonomous systems including UAS/drones, autonomous air traffic management, and satellite constellation management in regulated airspace.

- Geospatial boundaries: Maximum altitude, horizontal geofence, prohibited airspace
- Performance envelope: Maximum airspeed, bank angle, rate of climb/descent
- Communication requirements: Maximum time without ground station contact

- Weather minimums: Wind speed limits, visibility minimums, icing restrictions

Enter holding pattern at safe altitude; initiate return-to-base

Approaching geofence boundary. System adjusts heading to maintain safe distance, alerts ground station.

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Tier 2 — Minimum Risk Condition

Geofence breached or communication timeout exceeded. ENVELO forces MRC: enter holding pattern, reduce altitude, initiate autonomous return-to-base.

Tier 3 — Hard Halt

Critical navigation failure or total communication loss. ENVELO halts: automated emergency landing at nearest safe point.

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## 5. Manufacturing & Industrial Automation

Operational Context

Autonomous manufacturing systems control robotic assembly, quality inspection, predictive maintenance, and material handling with human proximity concerns.

Representative ODD Boundaries

- Force/torque limits: Per-actuator maximums
- Workspace boundaries: Permitted operating zones per robot
- Temperature thresholds: Tool and workpiece limits
- Human proximity: Collaborative zone safety distances

Declared MRC:

Speed reduction to collaborative limits; retract to home position

Tier 1 — Self-Correction

Approaching workspace boundary or force limit. System reduces speed, increases sensor polling rate.

Tier 2 — Minimum Risk Condition

Human presence detected in active zone or force limit exceeded. ENVELO forces MRC: speed reduction, retract to safe position.

### Tier 3 — Hard Halt

Unplanned contact detected or sensor failure. ENVELO halts: all motion stopped, brakes engaged, lockout until manual reset.

## 6. Energy & Grid Management

Autonomous grid management systems balance generation, transmission, and distribution across interconnected power networks.

- Frequency bounds: Acceptable Hz range
- Load limits: Maximum draw per segment
- Voltage ranges: Per-node acceptable bands
- Reserve margins: Minimum spinning reserve requirements

Shed non-critical load by priority matrix; protect critical categories

Frequency drifting toward limit. System adjusts generation dispatch, activates spinning reserves.

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Frequency or voltage out of declared bounds. ENVELO forces MRC: load shedding by priority matrix, protect critical infrastructure.

### Tier 3 — Hard Halt

Cascade failure or control system error. ENVELO halts: island affected segments, transfer to manual control.

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## 7. Autonomous Vehicles

Operational Context

Self-driving vehicles operating on public roads with declared operational domains covering speed, weather, geography, and sensor conditions.

Representative ODD Boundaries

- Speed limits: Posted and environmental maximums
- Lane boundaries: Declared roadway types
- Weather conditions: Visibility, precipitation, road surface

- Sensor ranges: LiDAR, radar, camera operational bounds

Declared MRC:

Pull to nearest safe shoulder at minimum speed; activate hazard lights

Tier 1 — Self-Correction

Approaching speed limit or lane boundary. Internal systems reduce speed, adjust steering to maintain center-lane.

Tier 2 — Minimum Risk Condition

Sensor degradation below threshold (e.g., fog)\nactivate hazard indicators.

Tier 3 — Hard Halt

Total sensor failure at highway speed. ENVELO halts: controlled emergency stop, parking brake engaged.

## 8. Pharmaceutical AI

AI systems in pharmaceutical applications manage dosage optimization, drug interaction screening, and formulary recommendations.

- Dosage ranges: Per-drug, per-patient maximums
- Drug interactions: Known interaction database scope
- Patient contraindications: Condition and allergy profiles
- Regulatory scope: Approved indications only

Withhold recommendation; alert pharmacist with full context

Dosage approaching upper limit for patient profile. System flags for pharmacist review.

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Drug interaction detected or dosage exceeds range. ENVELO forces MRC: recommendation withheld, pharmacist alerted with clinical context.

Tier 3 — Hard Halt

Unknown compound or system integrity error. ENVELO halts: no output, full escalation to clinical team.

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## 9. Autonomous Maritime

Operational Context

Autonomous vessel navigation, port operations, and fleet management in complex maritime environments.

Representative ODD Boundaries

- Sea state limits: Maximum wave height and period
- Traffic density: Maximum vessel proximity
- Channel boundaries: Navigable waterway limits
- Cargo stability: Load and trim parameters

Declared MRC:

Reduce to steerage way; alert bridge crew

Tier 1 — Self-Correction

Sea state approaching declared limit. System reduces speed, adjusts heading for optimal stability.

Tier 2 — Minimum Risk Condition

Exceeded sea state or channel boundary approach. ENVELO forces MRC: reduce to steerage way, alert bridge crew.

Tier 3 — Hard Halt

Navigation failure or critical weather exceedance. ENVELO halts: all-stop, deploy stabilization, transfer to manual helm.

## 10. Surgical Robotics

Robotic-assisted surgical systems performing precise procedures under direct or supervisory surgeon control.

- Force/torque limits: Per-instrument maximums
- Instrument positions: Permitted workspace within patient
- Tissue boundaries: Declared safe margins
- Patient movement: Maximum acceptable deviation

Retract instruments to safe position; hold; yield to surgeon

Approaching force limit on actuator. System reduces speed, increases compliance, alerts surgeon.

Force limit exceeded or tissue boundary approach. ENVELO forces MRC: retract instruments, hold position, alert surgeon for manual takeover.



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Tier 3 — Hard Halt

Unrecoverable deviation or sensor failure. ENVELO halts: actuators locked in current position, immediate yield to surgeon manual control.

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