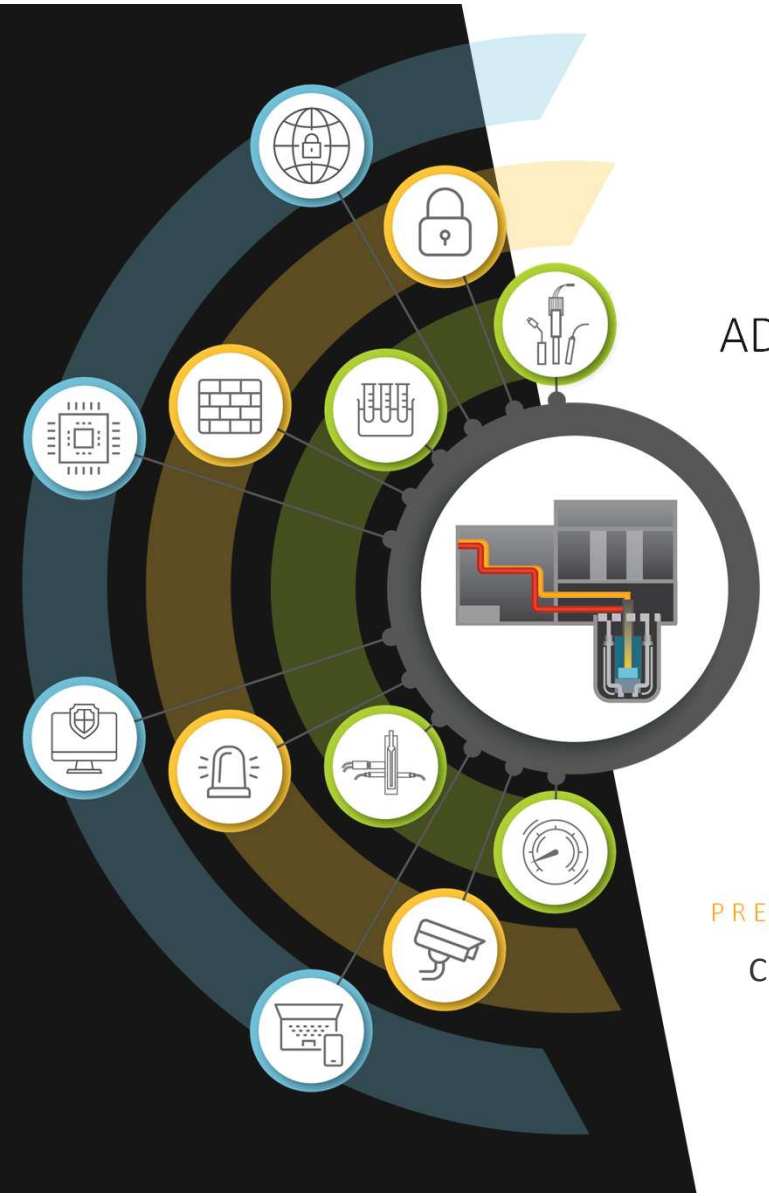


ADVANCED REACTOR SAFEGUARDS & SECURITY

Project: Glasshouse

Red Teaming To Analyze Observability and Control Pathways in A/SMR Remote Access

PRESENTED BY

Charles Nickerson

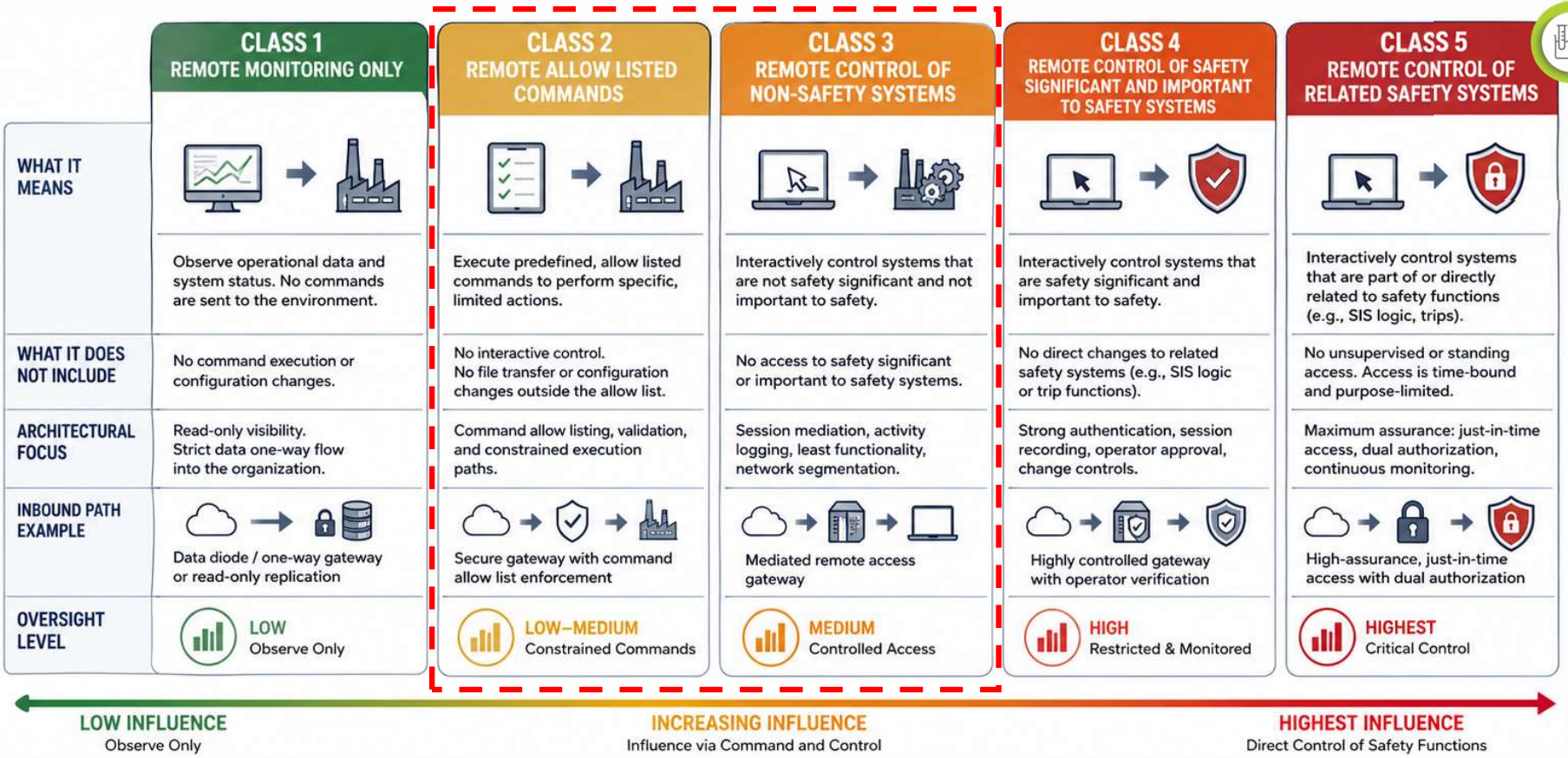
04/30/2026

INL/MIS-26-92179

INL Idaho National Laboratory | U.S. DEPARTMENT OF ENERGY

Red Team: Where can I convert access into control?

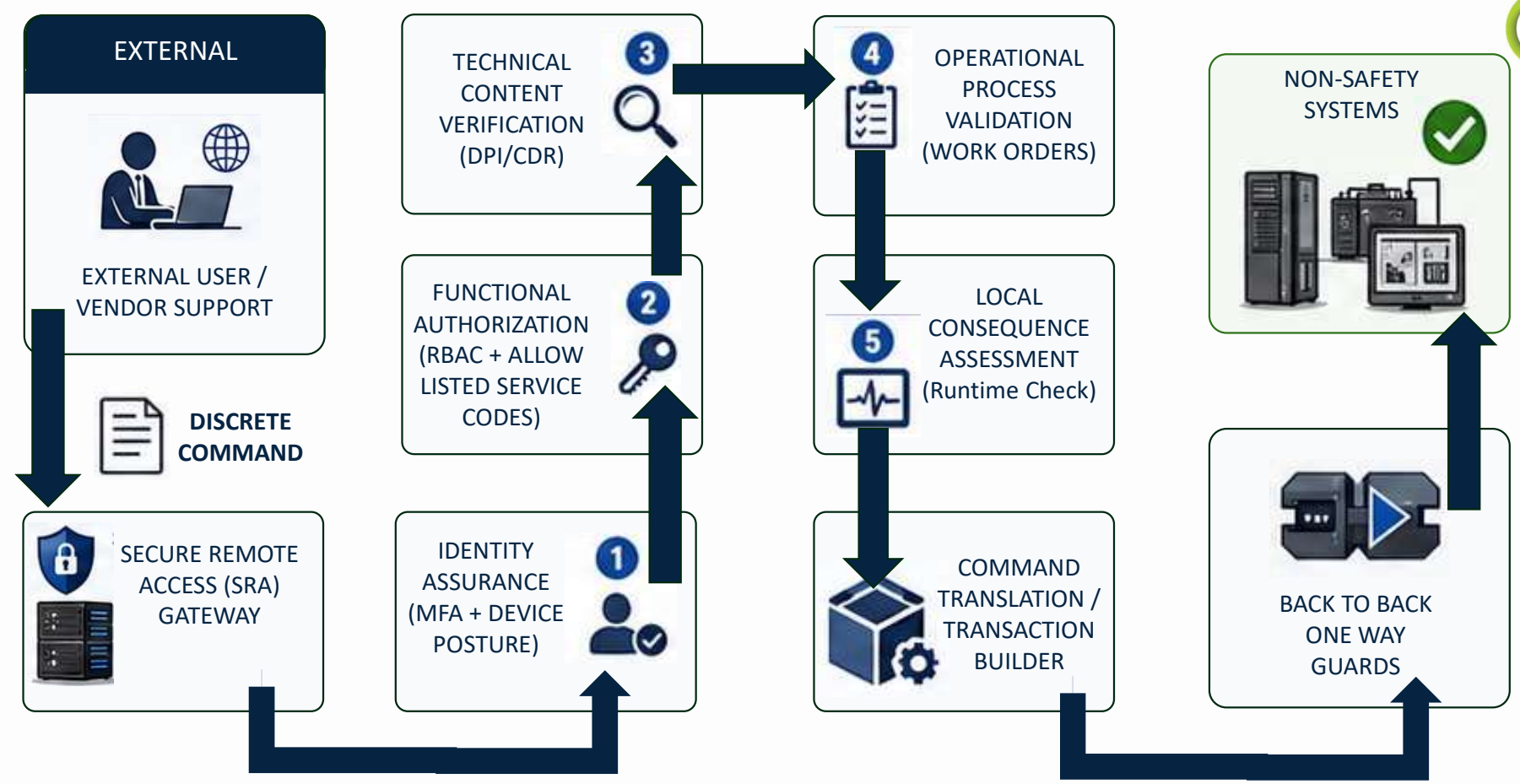
Remote access enables control escalation



As the potential impact increases, so do the architectural controls, session governance, and oversight requirements.

Red Team: What Does Class 2 Architecture Look Like?

Constrained logic becomes exploitable design

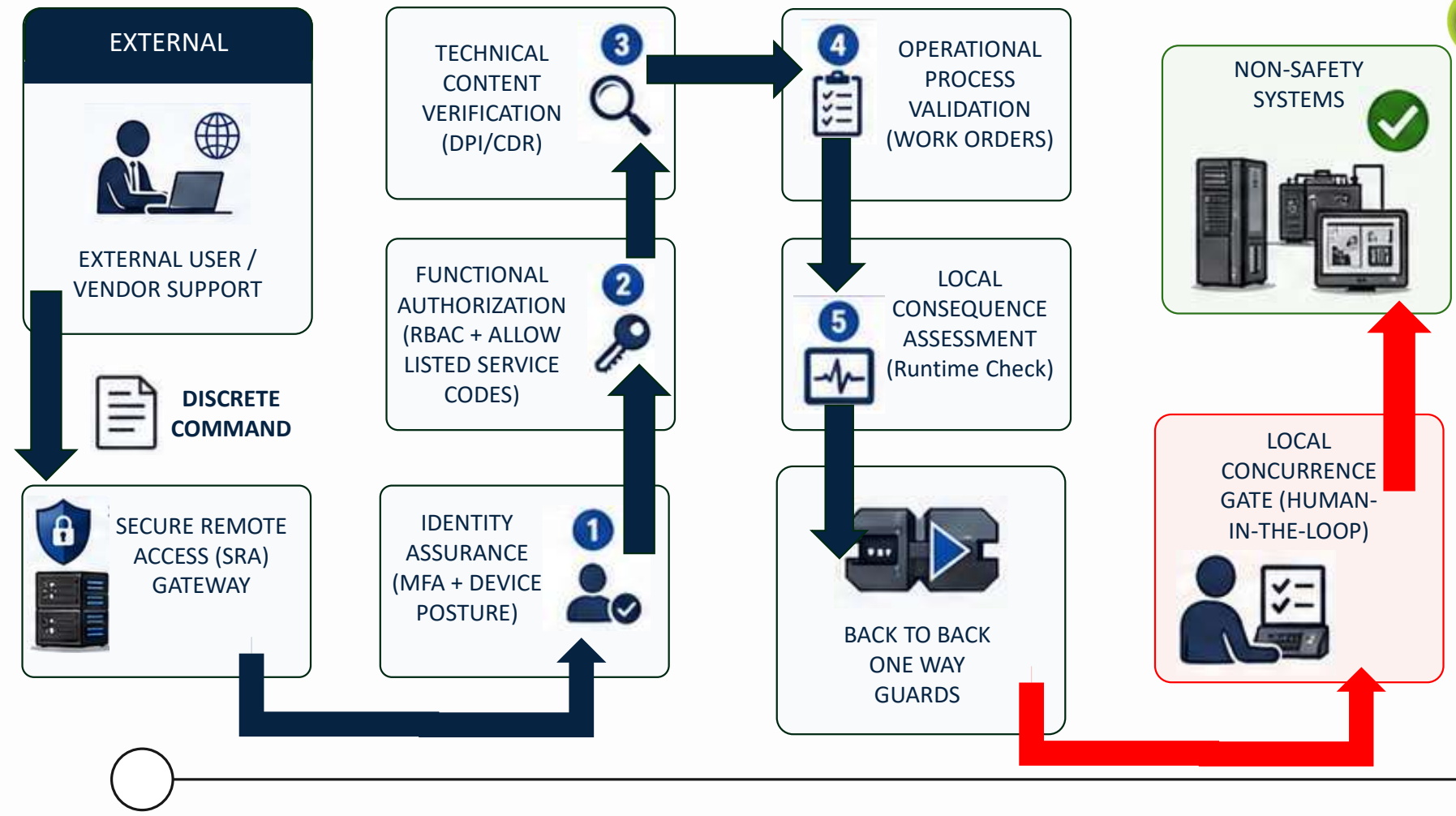


ADVANCED REACTOR SAFEGUARDS & SECURITY

- ONLY PRE-APPROVED SINGLE COMMANDS EXECUTE.
- NO INTERACTIVE SESSIONS

Red Team: What Does Class 3 Architecture Look Like?

A Complex Pathway To Trigger Allow-Listed Commands

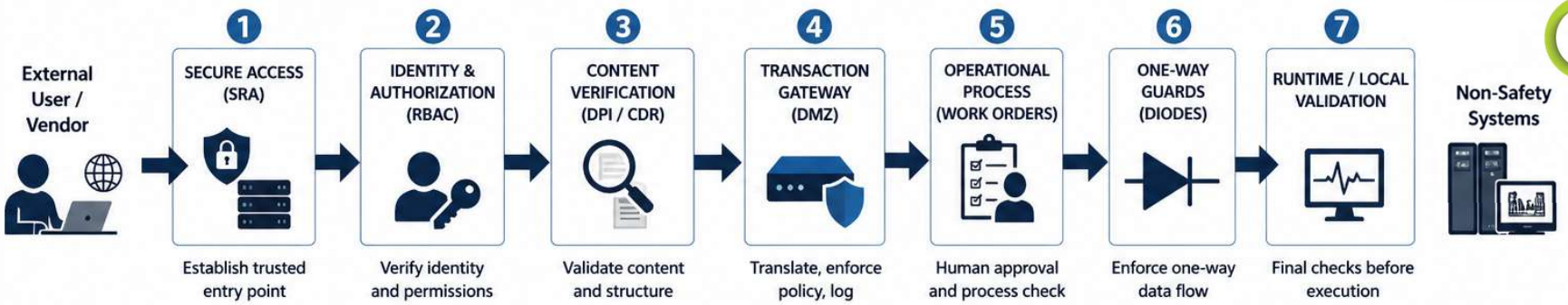


ADVANCED REACTOR SAFEGUARDS & SECURITY

- CONSTRAINED REAL-TIME CONTROL OF NON SAFETY SYSTEMS ONLY.
- LOCAL AUTHORITY RETAINED

Red Team: How do I move through the Architecture?

Layered Controls Become Sequential Opportunities



ATTACKER PERSPECTIVE – OPPORTUNITIES TO MOVE FORWARD

1. The architecture is a sequence of control decisions rather than a single barrier. Each layer evaluates and password forward only what meets defined criteria creating a path rather than a wall.
2. Trust is established at access and propagated through downstream controls. Systems rely on prior validation of identity, device, and role, so approved trust carries forward.
3. Constraints (RBAC, allow-lists, technical controls) define and enforce allowable behavior. This reduces risk but also creates predictable operating space to work within.

DEFENSIVE FOCUS – HOW WE STRENGTHEN THE PIPELINE

1. Continuously validate trust across layers, not just at the point of entry. Reassess identity, device posture, and behavior throughout the pipeline to detect drift or misuse (maloperations).
2. Evaluate commands and actions in context rather than just for correctness or compliance. Consider operational impact, asset criticality, and system state before allowing execution.
3. Incorporate cumulative, cross-system, and time-based effects into monitoring controls. Detect patterns and sequences that are invisible when analyzing individual events in isolation.

Red Team: How do I manipulate the defender's view?

Looking for observability and detection gaps

1. **Selective Visibility (Exploit What Isn't Measured) |** Operate outside the defender's field of view.
2. **Log Shaping (Control The Narrative of Events) |** Attacker goal is to make recorded history incomplete or misleading.
3. **Telemetry Manipulation (Break Reality <-> Data Alignment |** Attacker goal is to create mismatch between physical and reported states.
4. **Threshold Gaming (Live Inside "Normal" |** Attacker goal is to avoid triggering detection logic.
5. **Noise Engineering (Hide Signal in Volume) |** Reduce analyst attention and bury malicious activity
6. **Context Manipulation (Influence Human Interpretation) |** Shape how the Human-In-The-Loop interpret data.
7. **Process Exploitation (Abuse Trusted Workflows) |** Hide inside legitimate procedures.
8. **Trust Anchor Subversion |** Undermine what defenders inherently trust.