

Independent Digital Systems Assessment of RIIO-3 Licence Modifications Advanced Control, Data Architecture, and Algorithmic Assurance Perspective

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<https://www.ofgem.gov.uk/consultation/modifications-riio-3-licences-and-associated-documents>

Executive Summary

This paper provides an original, expert-level digital systems assessment of the proposed RIIO-3 licence modifications. It evaluates whether the licence drafting is compatible with modern digital control architectures, algorithmic decision-making, and data-centric assurance frameworks increasingly required to operate complex, low-carbon energy systems.

The analysis identifies structural digital limitations embedded in the current drafting—specifically where licence conditions implicitly assume manual judgement, static reporting, or non-deterministic interpretation. These limitations materially affect the feasibility of deploying advanced digital twins, AI-assisted optimisation, and automated compliance systems during RIIO-3.

Targeted, technology-agnostic drafting recommendations are proposed to ensure that RIIO-3 enables—not constrains—high-impact digital innovation, while strengthening auditability, system resilience, and regulatory confidence.

1. Author Positioning and Independence

This response is submitted in an independent expert capacity by a UK-based Electrical, Instrumentation & Control engineer specialising in digital-first system design for regulated energy infrastructure.

My professional work focuses on:

- defining digital control architectures under regulatory constraints
- translating regulatory obligations into machine-verifiable system logic
- reducing innovation risk through model-based and data-driven assurance

I am not affiliated with any RIIO-regulated licensee. The views expressed are technical, evidence-led, and reflect independent professional judgement.

2. Original Technical Lens: Licences as Digital System Constraints

This submission applies a digital systems and control engineering lens to the proposed RIIIO-3 licence modifications. While licence conditions are traditionally interpreted as legal or regulatory instruments, in modern energy systems they increasingly operate as **technical constraints** that directly shape how systems are designed, controlled, optimised, and assured.

As energy networks transition toward digitally mediated operation—characterised by automation, advanced analytics, and algorithmic decision support—licence conditions implicitly define the permissible structure and behaviour of underlying digital systems. In this context, regulatory drafting no longer sits outside the system boundary; it becomes an integral part of the system’s operational logic.

This perspective is largely absent from the consultation documentation, which focuses primarily on legal enforceability and policy intent rather than downstream digital system behaviour.

2.1 Licence Conditions as Control-System Boundary Conditions

From an Electrical, Instrumentation & Control (I&C) and digital-systems perspective, licence conditions function as **boundary conditions** on multiple layers of system operation, including:

- closed-loop control systems governing network operation
- optimisation algorithms used for planning, dispatch, and asset utilisation
- data pipelines supporting monitoring, reporting, and assurance
- digital assurance mechanisms used to demonstrate compliance and performance

In control engineering terms, licence conditions influence both the **constraints** and the **objective functions** under which systems operate. Where these constraints are clearly defined, measurable, and deterministic, they can be reliably encoded into automated or semi-automated systems. Where they are ambiguous or qualitative, they introduce uncertainty directly into the control architecture.

Qualitative constructs such as discretionary judgement, broadly defined endeavour standards, or loosely specified performance expectations cannot be represented unambiguously within algorithmic or model-based frameworks. As a result, digital systems must defer to human interpretation at critical points, breaking closed control loops and introducing manual override layers that reduce efficiency, predictability, and scalability.

This manifests in practice as:

- non-deterministic control behaviour under otherwise identical system states
- increased reliance on post-hoc human assessment rather than real-time verification
- reduced suitability for automation, optimisation, and predictive control

In data-driven environments, such ambiguity also propagates into reporting and assurance processes. Where licence obligations do not clearly specify what constitutes verifiable evidence, digital assurance mechanisms must rely on narrative justification rather than reproducible, machine-verifiable logic.

Importantly, these effects are **not policy failures** but **system-level consequences** of how regulatory language interacts with modern digital architectures. Without explicit consideration of this interaction, well-intended licence drafting may unintentionally constrain the deployment of advanced digital tools, including model-based optimisation, automated compliance validation, and digital-twin-enabled performance assurance.

This interpretation—treating licence conditions as operational constraints within digital control systems—is not addressed explicitly in the consultation documents and constitutes an original technical contribution to the RIIIO-3 regulatory discussion.

3. Key Digital and Innovation Risks Identified

3.1 Algorithmic Non-Determinism Risk

Several proposed RIIIO-3 licence obligations rely on qualitative constructs such as *reasonable endeavours*, *best endeavours*, or discretionary assessment of outcomes. While these constructs are well established in legal and regulatory contexts, they present inherent challenges when translated into digital and algorithmic operating environments.

Specifically, such constructs:

- cannot be encoded deterministically within algorithms or optimisation routines
- prevent the formation of fully closed-loop digital control and optimisation processes
- require human interpretation and intervention at critical decision points

In digitally operated networks, this introduces non-deterministic system behaviour under otherwise identical operating conditions. The resulting reliance on manual override layers increases operational friction, reduces scalability, and limits the effectiveness of advanced optimisation and automation strategies. Over the RIIIO-3 period, this creates a persistent source of systemic inefficiency rather than an isolated compliance issue.

3.2 Digital Assurance and Auditability Gap

Certain licence conditions require demonstration of performance or compliance outcomes without defining minimum technical characteristics for the supporting evidence. In particular, expectations around:

- data provenance
- temporal resolution
- model and logic traceability

are not consistently specified.

In the absence of such definitions, compliance risks shifting from **ex-ante, system-embedded assurance** toward **ex-post narrative justification**, reconstructed after operational decisions have already been made. This weakens both regulatory confidence and operational learning.

This gap materially limits the practical deployment of:

- digital twins for forward-looking performance assurance
- simulation-based stress testing under uncertainty
- automated or semi-automated compliance validation

All of these techniques are central to achieving cost-effective, resilient delivery of RIIO-3 objectives in increasingly complex and data-intensive networks.

3.3 Innovation Disincentive Through Drafting Assumptions

Although not explicit, aspects of the current licence drafting implicitly assume manual, document-based, or human-centred compliance processes. When embedded in licence conditions, such assumptions can unintentionally influence organisational investment decisions.

In practice, this may discourage or delay adoption of:

- AI-assisted operational planning and decision support
- real-time or near-real-time system visibility platforms
- predictive and anticipatory performance optimisation tools

This effect does not arise from market failure or lack of technological capability, but from **structural signals embedded in regulatory drafting**. Over time, these signals can bias delivery models toward legacy processes, even where more efficient digital alternatives exist.

This constitutes a structural barrier to innovation that can be addressed through clearer, technology-neutral licence language rather than through additional incentives or policy intervention.

4. High-Impact, Technology-Neutral Recommendations

The following recommendations are intentionally limited to clarifications in licence drafting rather than changes to policy intent. Their purpose is to ensure that RIIIO-3 licence conditions remain implementable, auditable, and compatible with modern digital operating environments throughout the price control period.

4.1 Explicit Recognition of Digital Assurance Methods

Licence drafting should explicitly recognise that compliance and performance demonstration may be achieved through **digital and model-based assurance methods**, provided that regulatory requirements for transparency, traceability, and auditability are satisfied.

In practice, this includes—but should not be limited to—the use of:

- algorithmic evaluation of performance against licence obligations
- model-based verification frameworks used to test compliance under defined scenarios
- digital-twin-enabled simulation for forward-looking assurance and stress testing
- automated and controlled data pipelines supporting continuous monitoring and reporting

The absence of explicit recognition of such methods does not prevent their use, but it introduces uncertainty regarding regulatory acceptability. This uncertainty can discourage investment in advanced digital assurance capabilities and bias delivery toward manual or document-centric approaches.

A clear, technology-neutral acknowledgement within licence drafting would remove this ambiguity. It would enable innovation while maintaining regulatory oversight, as digital assurance methods can, when properly designed, enhance reproducibility, auditability, and evidential robustness relative to purely manual processes.

Importantly, such clarification strengthens—not weakens—regulatory control by shifting assurance from narrative interpretation toward verifiable system behaviour.

4.2 Shift from Process Assumptions to Verifiable Outcomes

Where licence obligations are framed in outcome-based terms, drafting should focus on defining **verifiable outcomes** rather than implying specific processes by which those outcomes are achieved.

In particular, licence conditions should prioritise clarity around:

- what must be demonstrated to evidence compliance
- what aspects of performance must be reproducible under scrutiny
- what data, logic, or models must be auditable by the regulator

Avoiding implicit assumptions about manual, document-based, or human-centric processes allows organisations to select the most efficient and reliable means of delivery, including digital and automated approaches.

This shift is critical for alignment with future digital operating models, where performance assurance is increasingly embedded within systems rather than reconstructed after the fact. By focusing on outcomes rather than processes, RIIIO-3 licence conditions can remain robust as technologies evolve, without requiring ongoing regulatory revision.

4.3 Alignment with Real-Time and Near-Real-Time Operation

Modern energy systems increasingly depend on **near-real-time data, feedback, and decision-making**, particularly as networks become more complex, interconnected, and dynamic.

Licence drafting should therefore avoid constructs that inadvertently force:

- annualised or heavily delayed judgement for decisions that are operational in nature
- validation timelines incompatible with automated or semi-automated control systems

unless such delays are explicitly intended for policy reasons.

Where obligations interact with operational control, optimisation, or system responsiveness, drafting should remain compatible with digital feedback cycles measured in minutes, hours, or days rather than months. Failure to do so risks creating structural misalignment between regulatory expectations and practical system operation.

Explicit consideration of timing and feedback characteristics within licence drafting would improve consistency between regulatory oversight and real-world digital system behaviour, reducing the need for manual workarounds and post-hoc justification.

These recommendations are deliberately narrow in scope yet high in impact. They preserve regulatory intent while ensuring that RIIO-3 licence conditions can support efficient, resilient, and innovation-enabled delivery across the full duration of the price control.

5. Strategic Importance for RIIO-3 Delivery

From a systems engineering and digital-technology perspective, licence drafting that is coherent with modern digital operating models is a critical enabler of successful RIIO-3 delivery. As regulatory requirements increasingly interact with automated systems, data-driven decision processes, and complex control architectures, the structure and clarity of licence conditions directly influence delivery risk, cost efficiency, and system resilience.

Digitally coherent licence drafting reduces delivery risk by enabling regulatory obligations to be embedded directly into system logic rather than being managed through parallel, manual compliance processes. Where licence conditions are precise, measurable, and compatible with algorithmic interpretation, they can be integrated into control systems, monitoring platforms, and assurance frameworks. This reduces the likelihood of misinterpretation, inconsistent application, and late-stage regulatory disputes, all of which introduce avoidable delivery risk.

Such drafting also lowers long-term cost by enabling greater use of automation across planning, operation, and assurance functions. Automated data collection, model-based evaluation, and continuous performance monitoring reduce reliance on labour-intensive, document-driven compliance activities. Over the duration of RIIO-3, these efficiencies accumulate, delivering sustained cost reductions that are difficult to achieve through isolated process improvements.

Regulatory transparency is similarly enhanced. Digital-first assurance mechanisms produce evidence that is traceable, reproducible, and auditable, allowing both regulated entities and the regulator to interrogate system behaviour with greater confidence. This transparency supports more constructive regulatory engagement, reduces the burden of explanation and clarification, and improves the overall quality of regulatory oversight.

Finally, digitally coherent licence drafting strengthens system resilience under uncertainty. Model-based and data-driven approaches allow networks to test performance under a wide range of scenarios, including those not explicitly anticipated at the time of licence drafting. This capability is increasingly important in the context of rapid technological change, evolving system demand, and heightened operational uncertainty.

These benefits are not discrete or one-off. They are cumulative and compound over the RIIO-3 period, amplifying the value of early clarity in licence drafting and reinforcing the strategic importance of aligning regulatory instruments with modern digital system realities.

6. Potential Contribution to UK Energy Regulation and Market Delivery

This paper is intended to contribute constructively to the development and implementation of RIIO-3 by providing a digital-systems and control-engineering perspective on licence drafting and regulatory design. As the UK energy system becomes increasingly data-driven, automated, and interconnected, the effectiveness of regulation depends not only on policy intent but also on how regulatory instruments interact with real-world system architectures.

By interpreting licence conditions as operational constraints within digital control, optimisation, and assurance frameworks, this submission highlights areas where regulatory drafting may unintentionally introduce implementation risk, inefficiency, or barriers to innovation. Addressing these issues at the drafting stage can reduce the need for subsequent clarification, guidance, or dispute resolution, thereby improving regulatory predictability for both the regulator and regulated entities.

The recommendations set out in this paper support a shift toward more transparent, reproducible, and machine-verifiable forms of compliance and performance assurance. Such an approach is increasingly necessary as regulatory oversight relies on larger volumes of operational data and more complex system behaviour. By enabling digital-first assurance mechanisms within a technology-neutral regulatory framework, RIIO-3 can strengthen auditability while reducing reliance on ex-post narrative justification.

From a market-delivery perspective, clearer alignment between licence drafting and modern digital operating models has the potential to lower long-term costs, reduce delivery risk, and improve system resilience. Automation, model-based analysis, and real-time visibility can only be fully realised where regulatory requirements are compatible with these approaches. Over the RIIO-3 period, the benefits of such alignment are cumulative and can materially enhance value for consumers.

More broadly, this contribution is intended to support the evolution of UK energy regulation toward a framework that is resilient to technological change. By focusing on verifiable outcomes rather than prescribed processes, and by recognising the role of digital assurance in modern system operation, the regulatory framework can remain robust as technologies, system complexity, and operational practices continue to evolve.

This paper is offered in the spirit of constructive technical engagement, with the objective of supporting effective, future-proof delivery of RIIO-3 and subsequent regulatory frameworks.

Declaration

This response is submitted independently and reflects the author's professional technical judgement as a digital technology specialist working within the UK energy sector.