

ICOLD2026 Guadalajara, Mexico, International Symposium
Theme | Water, Energy, and Society: The Evolving Role of Dams in a Changing World
ABSTRACT TEMPLATE

PAPER TITLE (Capitalize the first letter of all major words)

Dependable Dams: A Framework for Reliability, Resilience, and Robustness in Changing Conditions

Relevant Topic: (Highlight Selected Topic in Bold font)

- *Water Planning, Water Management, and Climate Resilience*
- ***Dam Safety Policy and Governance***
- *Dam Construction and Rehabilitation: Innovation and Lifecycle Extension*
- *Dam Performance Monitoring*
- *Flood Resiliency in Developed and Developing Countries*
- *Sedimentation Management and Reservoir Longevity*
- *Fish Passage, Biodiversity & Environmental Integration*
- *Community Engagement in Dam Development*
- *Tailings Dam Safety*
- *Dam Decommissioning & Removal*

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ABSTRACT: Abstract shall be no more than 300 words and cannot include figures, tables, drawings, references, or equations. Abstracts should provide a brief overview of the paper, highlighting relevance to the selected topic, key findings/conclusions, and significance to the industry. Provide Spanish translation of abstract in the provided space to aid in review and selection.

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ENGLISH VERSION OF ABSTRACT:

Hydropower dams are facing increasing challenges arising from changing conditions, shifting climatic patterns, operational setup, evolving energy markets, and more complex reservoir management requirements. At the same time, maintenance strategies must adapt to aging infrastructure, digitalization, and updated regulatory demands. Traditionally, dam safety assessments have concentrated on structural integrity and flood safety. However, experience indicates that this perspective alone is no longer sufficient. Modern hydropower systems must not only be safe, but also dependable—that is, reliable, resilient, and robust under a wide range of operating scenarios.

To address this, Vattenfall has developed a structured dependability framework that extends beyond conventional safety evaluations. It integrates system engineering methods, risk-informed decision support, and systematic implementation of lessons learned from past incidents. The framework explicitly considers operational flexibility, market-driven operations control, and climate-related stressors, while ensuring that organizational and technical measures remain aligned with long-term sustainability and safety goals.

This paper presents the methodology, outlines its foundations, and demonstrates its application in dam safety and hydropower operation contexts. By combining established safety assurance with modern dependability principles, the approach supports confidence in dam performance and strengthens the sector's ability to meet future challenges.

Keywords: Dependability, Reliability, Resilience, Robustness, Risk Management

SPANISH TRANSLATION OF ABSTRACT:

Las represas hidroeléctricas enfrentan crecientes desafíos derivados de las condiciones operativas cambiantes, los patrones climáticos en transformación, los mercados energéticos en evolución y los requisitos cada vez más complejos de gestión de embalses. Al mismo tiempo, las estrategias de mantenimiento deben adaptarse a una infraestructura envejecida, la digitalización y las nuevas exigencias regulatorias. Tradicionalmente, las evaluaciones de seguridad de presas se han concentrado en la integridad estructural y la seguridad frente a inundaciones. Sin embargo, la experiencia indica que esta perspectiva por sí sola ya no es suficiente. Los sistemas hidroeléctricos modernos no solo deben ser seguros, sino también fiables; es decir, con alta fiabilidad, resiliencia y robustez bajo una amplia gama de escenarios operativos.

Para abordar esta necesidad, Vattenfall ha desarrollado un marco estructurado de fiabilidad y dependabilidad que va más allá de las evaluaciones de seguridad convencionales. Integra métodos de ingeniería de sistemas, apoyo a la toma de decisiones basado en riesgos e implementación sistemática de lecciones aprendidas de incidentes pasados. El marco considera explícitamente la flexibilidad operativa, el control de operaciones orientado al mercado y los factores de estrés relacionados con el clima, garantizando al mismo tiempo que las medidas organizativas y técnicas se mantengan alineadas con los objetivos de sostenibilidad y seguridad a largo plazo.

Este artículo presenta la metodología, describe sus fundamentos y demuestra su aplicación en contextos de seguridad de presas y operación hidroeléctrica. Al combinar la garantía de seguridad establecida con los principios modernos de fiabilidad, resiliencia y robustez, el enfoque refuerza la confianza en el desempeño de las presas y fortalece la capacidad del sector para enfrentar los desafíos futuros.

Palabras clave: Fiabilidad, Resiliencia, Robustez, Gestión del Riesgo, Dependabilidad