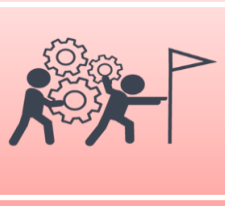
Digital transformation - the role of regulator?

Director Jussi Heinonen

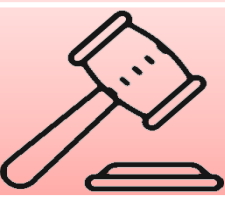
Twitter @jsheinonen

Regulator's role in digital transformation



Enable development

Enhance regulatory effectiveness



Enforce operators to apply modern technologies (if necessary)

Radiation Safe Finland

Happiest civil servants

Best government agency

Most satisfied customers

Resource targets
- Better wellbeing at work
- Enhancing holistic know how
- Cost awareness

Effectiveness targets
- Risk informed oversight
- Modern effective ways of working
- Effective safety research
- Digital customer-oriented services

Societal targets
- Highlighting Licensee responsibility
- Enhancing understanding of radiation risks
- Society resilient against disturbances

OUR VALUES:

EXPERTISE

OPENNESS

COURAGE

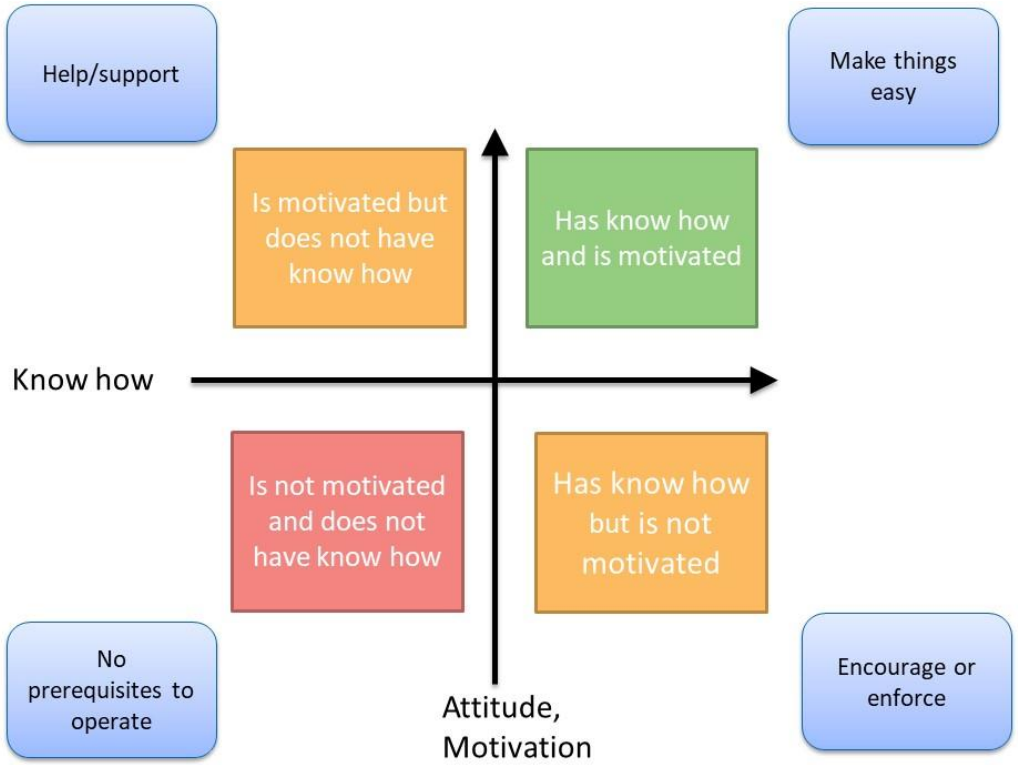
CO-OPERATION

Risk Informed and Enabling Regulations

Oversight tools and interactions endorsing licensee's responsibility

Data management enabling performance and risk informed oversight

Digital customer oriented applications and services



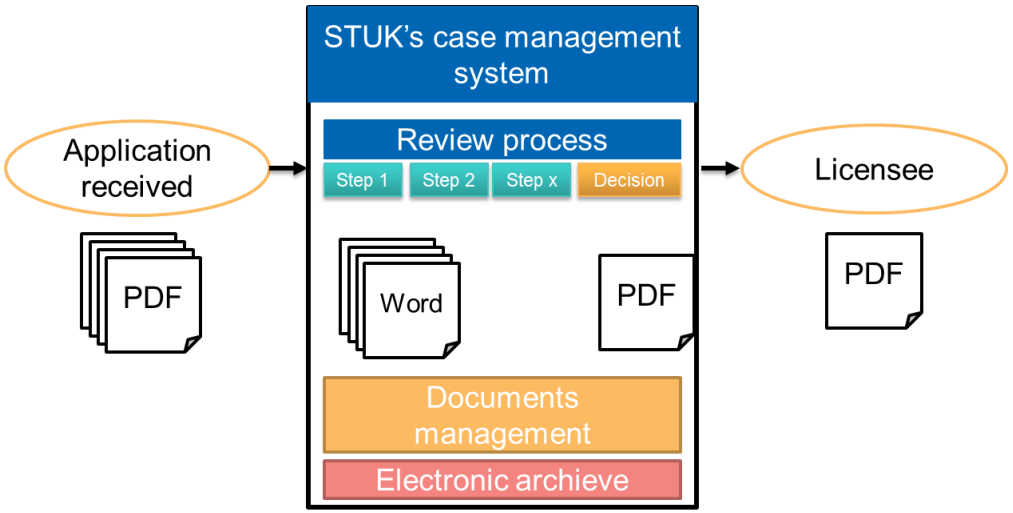
Regulatory co-operation utilizing common ecosystems

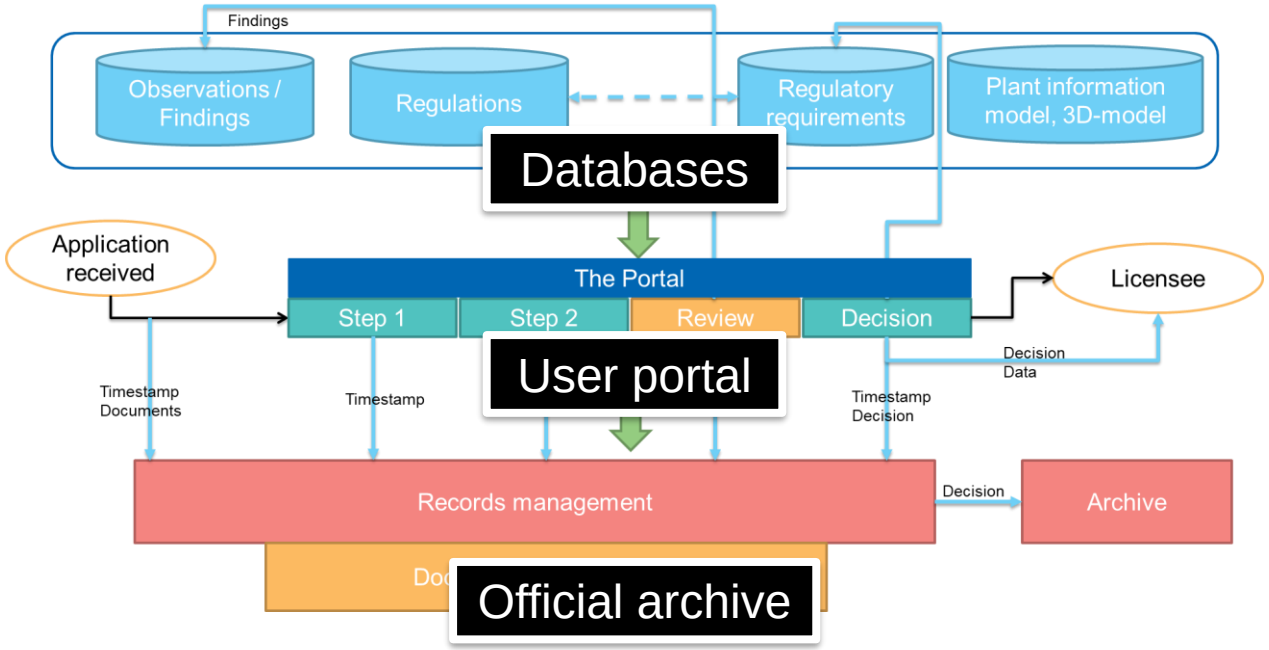
- → **Licensees in the green area, and**
  - – **More effective oversight**
  - – **Shorter review times**
  - – **Less costs**
- → **Better customer experience**
- → **Happiest civil servants**
- → **Radiation safe Finland**

stuk
SÄTEILYTURVAKESKUS
STRÅLSÄKERHETSCENTRALEN
RADIATION AND NUCLEAR SAFETY AUTHORITY

Where are we in STUK?

- We have **digitalized** our services and internal processes
- We have vision and targets for **digital transformation**





Case example: KELPO-project
Objectives and result expectations

- Enable use of high-quality industrial-standard serially manufactured equipment and ensure their availability.
- Improve effectiveness and implementation of Graded Approach through joint procedures.
- Ensure a comprehensive supplier network.
- Increase co-operation between license holders – in Finland, Nordics and Europe.
- Result
  - Ensure viability of modernization and new-build projects.
  - Secure the feasible operation of nuclear power also in the future.
  - Ensure and enable continuous development of nuclear safety.

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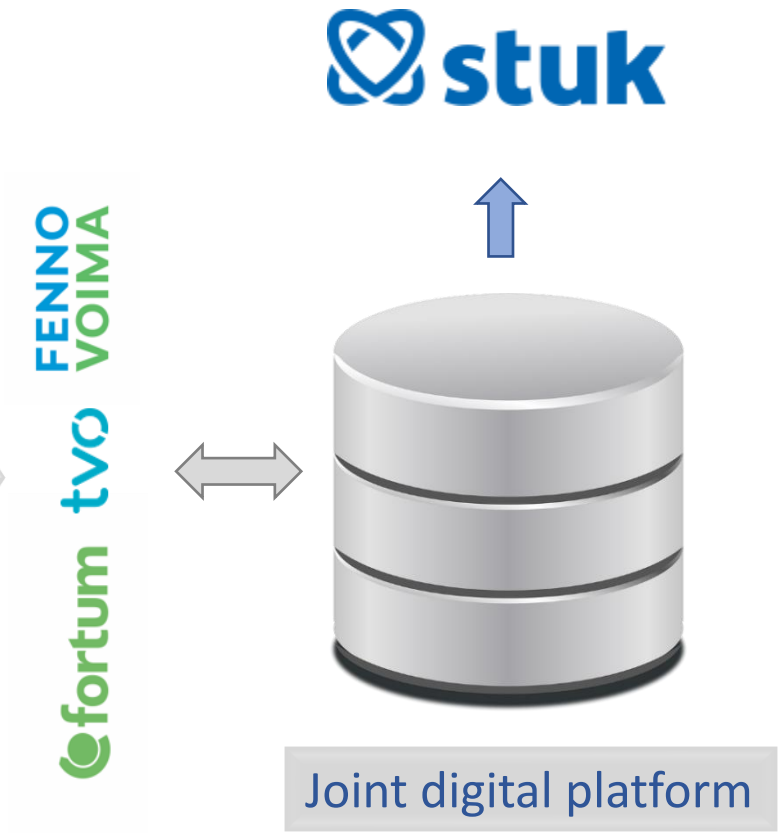
KELPO joint process and digital platform

- Use of **joint generic requirements** for all license holders
- Use of **joint supplier approval**
- Use of **joint procedures**, forms etc. in interaction with the supply chain and the regulator (STUK).
- **Common approval applications**.



- **Safety** is the **ultimate priority**. The license holder continues to have full and unshared responsibility for safety and use of high-quality industrial grade items
- High-quality industrial grade items used in the ”KELPO frame” will have the **same or higher quality and reliability** as required in the original design
- Items with nuclear specific requirements outside the industrial standard item characteristic continue to be manufactured **according to nuclear codes and standards**
- Continue using license holder specific requirements based on equipment location

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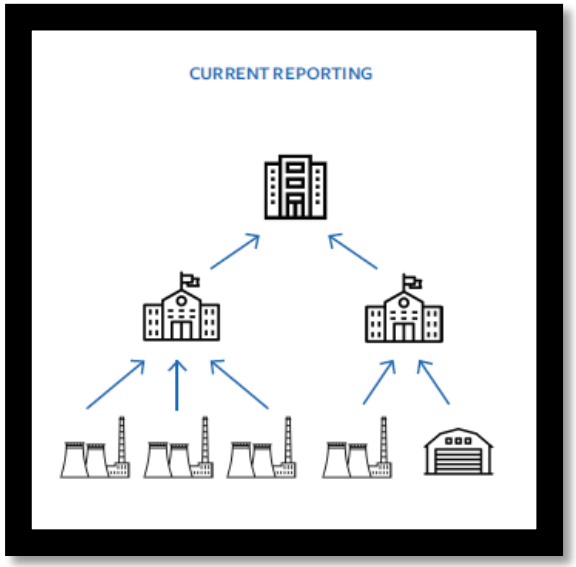
Case example: Blockchain and nuclear material safeguards

Distributed Ledger Technology (DLT) has the potential

- to streamline and strengthen safeguards by facilitating the traceability of data,
- verifying transactions and real-time detection of unauthorized access and diversion.

As industry and governments are becoming fully digitized, DLT offers

- a novel technological solution for sharing online transmissions in a secure and immutable manner.



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ICAO

NO COUNTRY LEFT BEHIND

Digital Transformation
Time for Aviation 4.0

Marco Merens
Chief Implementation Support
Air Navigation Bureau
ICAO

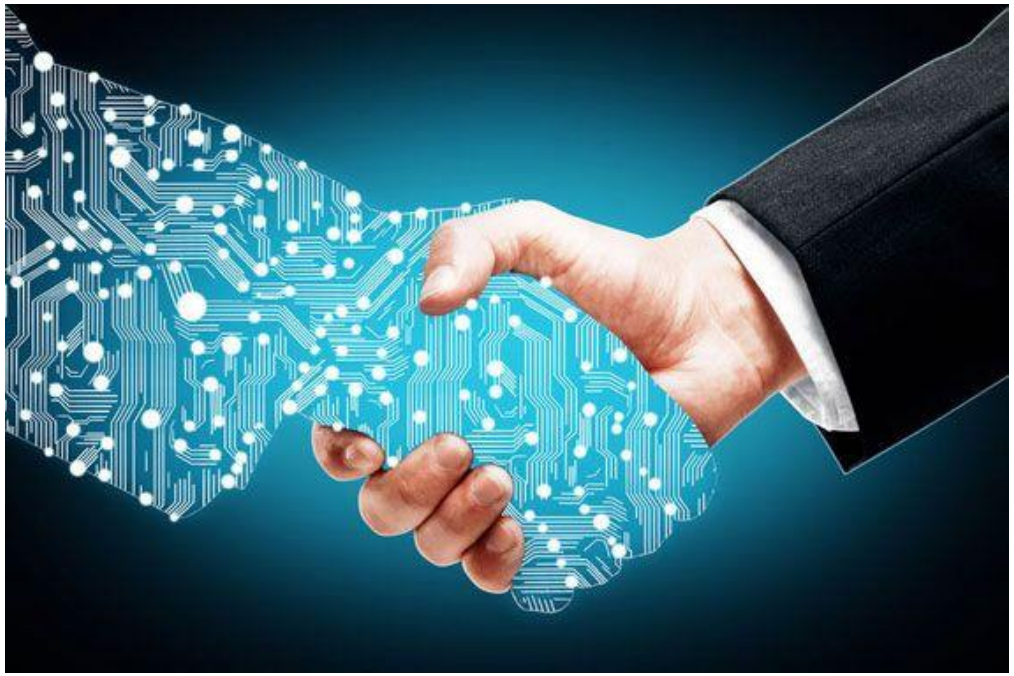
May 2021

What is Web 4.0

Web 4.0 is also known as symbiotic web.

The dream behind the symbiotic web is interaction between humans and machines in symbiosis.

Everything is Digital. No Paper. Automation is the norm. Constant drive for efficiency.



What do we need for Aviation 4.0?

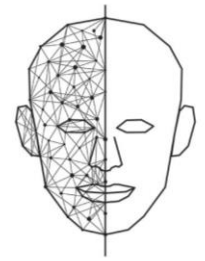
ICAO

Digital Transformation in Aviation

NO COUNTRY LEFT BEHIND

BLOCKCHAIN

DIGITAL IDENTITY



ARTIFICIAL intelligence

IOT Internet of Things

Big Data

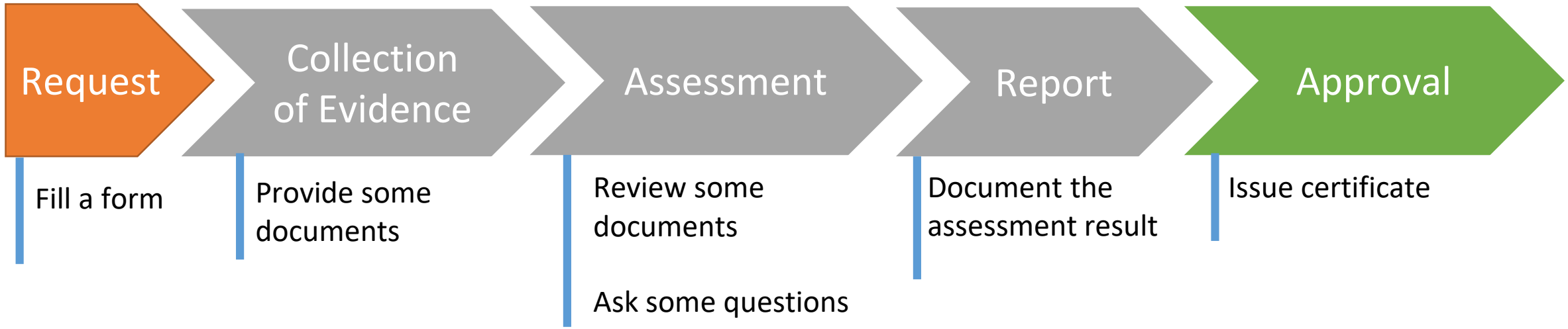
CLOUD TECHNOLOGY

Aviation and Certification

- Aviation is primarily a compliance-based industry
- Certification is the corner-stone of the aviation system
- During certification, compliance to requirements is demonstrated to a certifying authority
- If satisfactory evidence is provided, a certificate is delivered
- Certificates generally need to be renewed

Certification Process

Simplified



Signing

Request

- Fill a WORD/PDF Form
- Send by email
- Print and send by mail

Sign

Collection of Evidence

- Send PDF Documents by email
- Send printed copies by mail and file
- Provide access to binders on-site

File

Identify

Assessment

- Print Documents
- Read documents printed or online
- Read documents onsite

Authenticate

Report

- Write a report with findings
- Send report in PDF
- Print and mail
- File

File

Approval

- Write Certificate or Letter
- Sign letter
- Send by mail
- Send by email

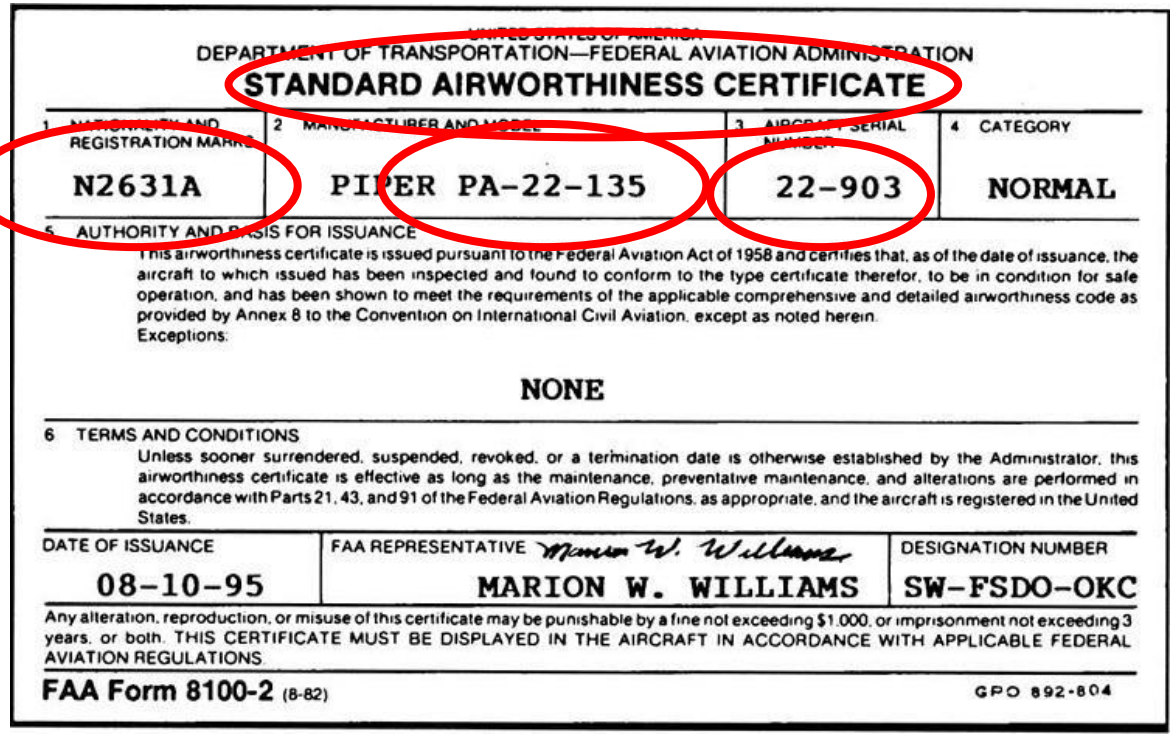
Sign

AI and Verification

- Verification generally consists of checking the content of a document against another source
- It often involves looking at an image or listening to speech
- Artificial Intelligence is a program designed to categorize and associate text, speech and images
- AI can be used to analyse and verify images

Example: Checking Airworthiness Certificate

NO COUNTRY LEFT BEHIND



DEPARTMENT OF TRANSPORTATION—FEDERAL AVIATION ADMINISTRATION

STANDARD AIRWORTHINESS CERTIFICATE

1 NATIONALITY AND REGISTRATION MARK	2 MANUFACTURER AND MODEL	3 AIRCRAFT SERIAL NUMBER	4 CATEGORY
N2631A	PIPER PA-22-135	22-903	NORMAL

5 AUTHORITY AND BASIS FOR ISSUANCE

This airworthiness certificate is issued pursuant to the Federal Aviation Act of 1958 and certifies that, as of the date of issuance, the aircraft to which issued has been inspected and found to conform to the type certificate therefor, to be in condition for safe operation, and has been shown to meet the requirements of the applicable comprehensive and detailed airworthiness code as provided by Annex 8 to the Convention on International Civil Aviation, except as noted herein.

Exceptions:

NONE

6 TERMS AND CONDITIONS

Unless sooner surrendered, suspended, revoked, or a termination date is otherwise established by the Administrator, this airworthiness certificate is effective as long as the maintenance, preventative maintenance, and alterations are performed in accordance with Parts 21, 43, and 91 of the Federal Aviation Regulations, as appropriate, and the aircraft is registered in the United States.

DATE OF ISSUANCE	FAA REPRESENTATIVE	DESIGNATION NUMBER
08-10-95	MARION W. WILLIAMS	SW-FSDO-OKC

Any alteration, reproduction, or misuse of this certificate may be punishable by a fine not exceeding $1,000, or imprisonment not exceeding 3 years, or both. THIS CERTIFICATE MUST BE DISPLAYED IN THE AIRCRAFT IN ACCORDANCE WITH APPLICABLE FEDERAL AVIATION REGULATIONS.

FAA Form 8100-2 (8-82) GPO 892-804

Tesseract OCR

AI Model

ninawzmcrvmusmwvAvloNJznanun mmeu Ammumm
STANDARD AmwonmlNEss CERTIFICAYE
N2631A 91m: **PA—227135 22403** Mom).

Request

What is this supposed to be:

- An airworthiness certificate
- For a Piper PA – 22 – 135
- Registered N2631A
- Serial 22-903

90%

Traditional Program

OCR = Optical Character Recognition

AI for Monitoring and Reporting

OpenCV

YOLO

AI Model

- Reporting and monitoring is a key activity in assessing the continued validity of a certificate
- Sensor devices (cameras, microphones, satellites etc.) can be used to collect raw data
- AI models can use such raw data to identify, categorize, count and report on objects detected

13 Ground Equipment
4 Persons

Identification

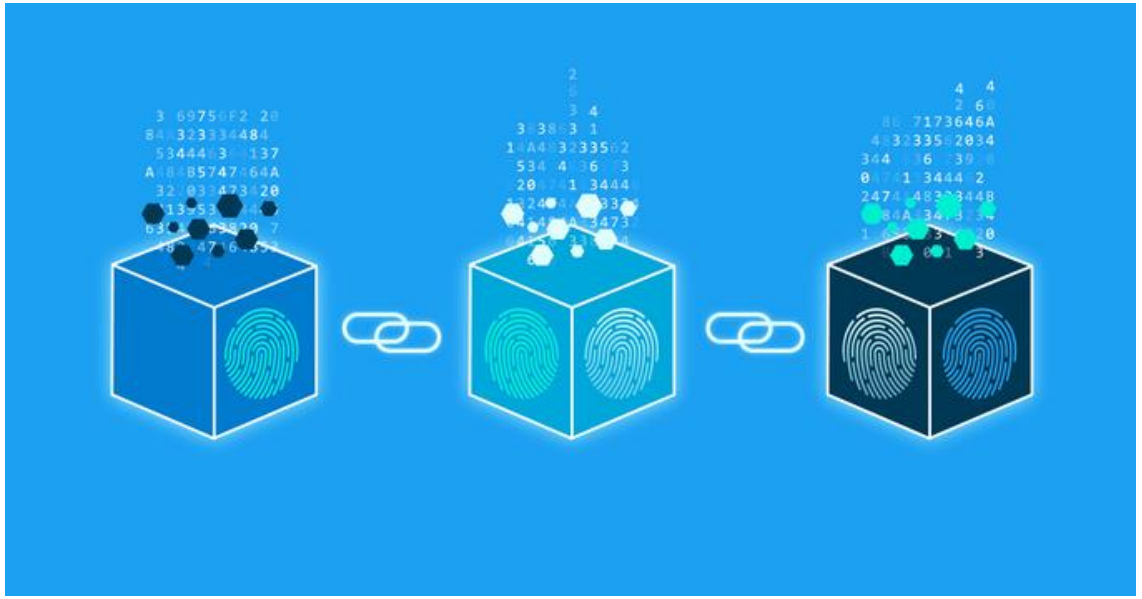
- **Identification** is central to the certification process
- Every certified entity is assigned a **unique** identifier issued by a **system** (national, regional or global)
- All documentation is **traced** and **tracked** against this number
- It allows the link between the **physical asset and the digital twin**
- **Digital Object Architecture (DOA)** should be set up to define the digital objects

How to make sure …

- Digital twin is up-to-date
- The changes are correct
- Digital twin is not corrupted

Block Chain

- Traditionally, all data is stored in a file or database and updated as required
- Block chain, in simplified terms, is a list (ledger) tracing all changes (transactions) made to a data element (block)
- Data is encrypted at all times and past changes are immutable
- Changes to blocks are automatically checked and validated by algorithms (smart contracts)



Block chains can be used to manage certificates and licenses

Challenges and Opportunities

- Digital transformation is strongly based on IT technologies which are not available equally around the world
- New skills are needed for all staff
- Cyber security is key

- Modernization of IT infrastructure
- Gain efficiency
- Engage with customers using modern communication tools

Becoming fully digital will impact everybody

ICAO

North American Central American and Caribbean (NACC) Office
Mexico City

South American (SAM) Office
Lima

ICAO Headquarters
Montréal

Western and Central African (WACAF) Office
Dakar

European and North Atlantic (EUR/NAT) Office
Paris

Middle East (MID) Office
Cairo

Eastern and Southern African (ESAF) Office
Nairobi

Asia and Pacific (APAC) Sub-office
Beijing

Asia and Pacific (APAC) Office
Bangkok

THANK YOU

Canadian Nuclear Safety Commission | Commission canadienne de sûreté nucléaire

Canada

NEA Workshop on Digital Transformation

Role of the Regulator

Michael Rinker
Director General, Directorate of Assessment and Analysis
Canadian Nuclear Safety Commission

NEA Workshop on Digital Transformation: Opportunities and Challenges for the Nuclear Sector; 27-28 May 2021

nuclearsafety.gc.ca

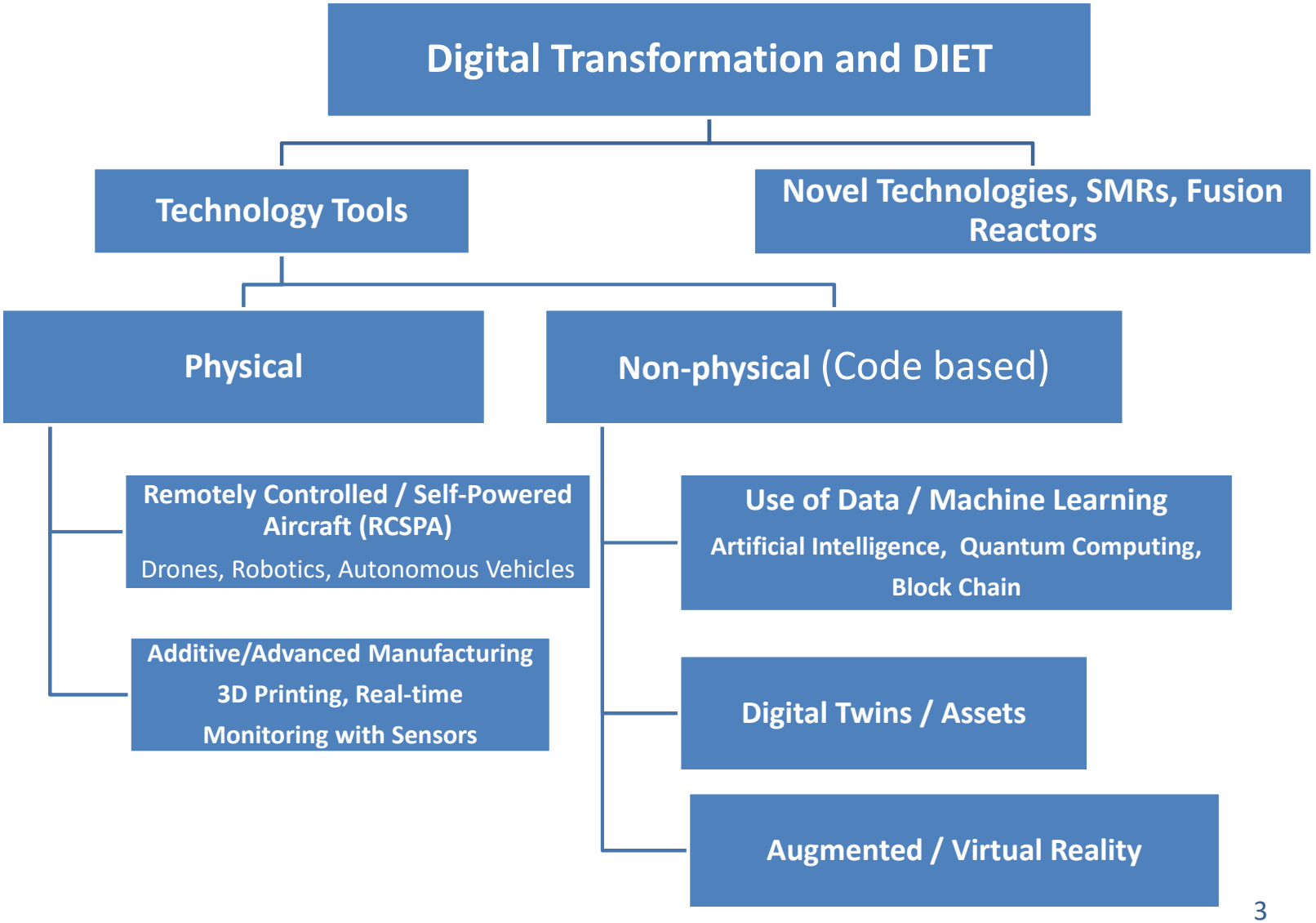
Canada

Presentation Outline

- Challenges are vast
- Case 1: Artificial Intelligence and Machine Learning
- Case 2: Computational Power allowing for novel approaches
- Concluding Remarks

Key Challenges

Digital Transformation and Disruptive, Innovative and Emerging Technologies (DIET)



Artificial Intelligence and Machine Learning

- Artificial Intelligence (AI) and Machine Learning can be used in preventive maintenance (PM) programs:
  - Advanced Pattern Recognition (APR) to detect anomalies in safety-related systems and components
  - Preventative Maintenance: a shift from clearly defined and accepted frequencies to a model where the frequencies are constantly changing based on the results

Regulatory Implications - AI

- Regulatory implications of relying on AI in Preventative Maintenance programs include:
  - A deviation from licensing and mandatory preventative maintenance activities which have been assigned to relative stable frequencies
  - Currently, human involvement in decision making (frequencies can be adjusted if technical justification and approval)

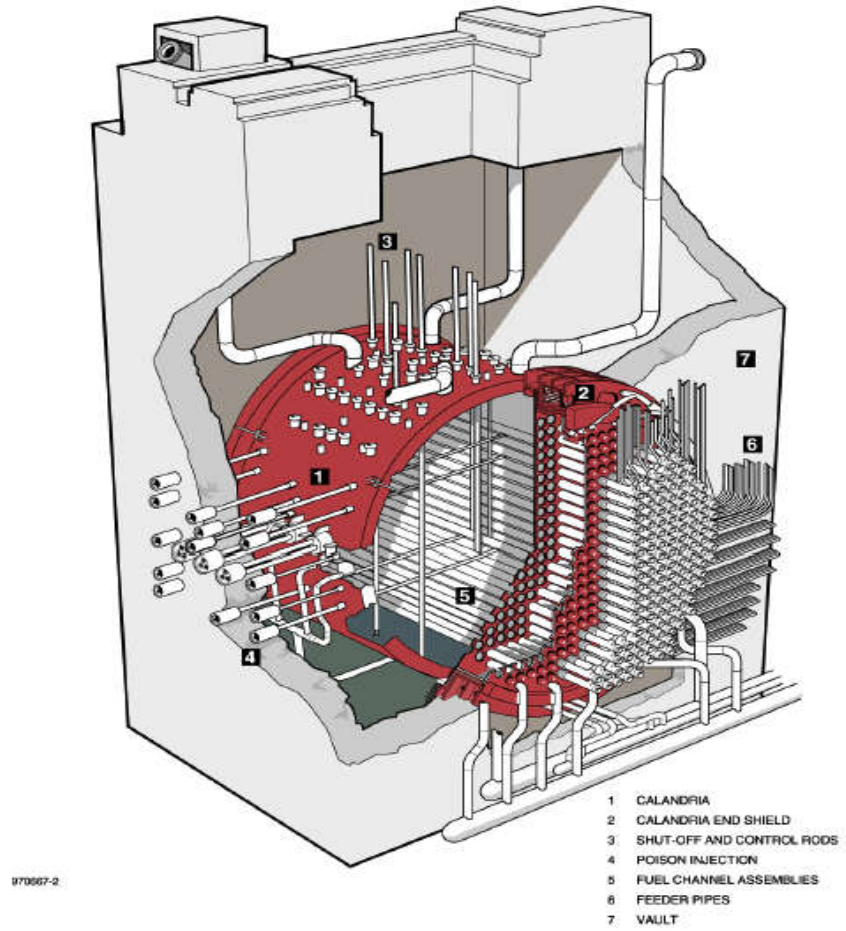
Future Challenge: Can A.I. be relied upon to adjust preventative maintenance schedules in the absence of human intervention?

Challenges Regulating AI

- Future Regulatory challenges include:
  - reliability of an AI model that is not analytically explainable by experts
  - continued validity of the AI model since the model may drift and result in less accurate predictions over time
  - maintenance of the AI model including periodic re-training of the AI system
  - human performance for the experts monitoring the machine learning system and the experts making determinations based on the AI model's prediction

Increased Computational Power

- Availability of data, and enhanced computational power allow for novel approaches to traditional analysis
- Shift to probabilistic assessment methods for fracture protection and to evaluate uninspected population of pressure tubes
- Regulatory acceptance of new approaches is challenging but has advantages



Concluding Remarks

- Innovation is influencing industries around the world including the Canadian nuclear industry
- Human technical experts play a critical role in the success of AI applications
- Early communication in a *neutral* environment is necessary to fully understand the development and deployment of innovative / digital approaches

Canadian Nuclear Safety Commission
Commission canadienne de sûreté nucléaire

Questions?

Thank You!

Canada

Regulatory Views on Digital Transformation

Becoming a Modern Risk-Informed Regulator

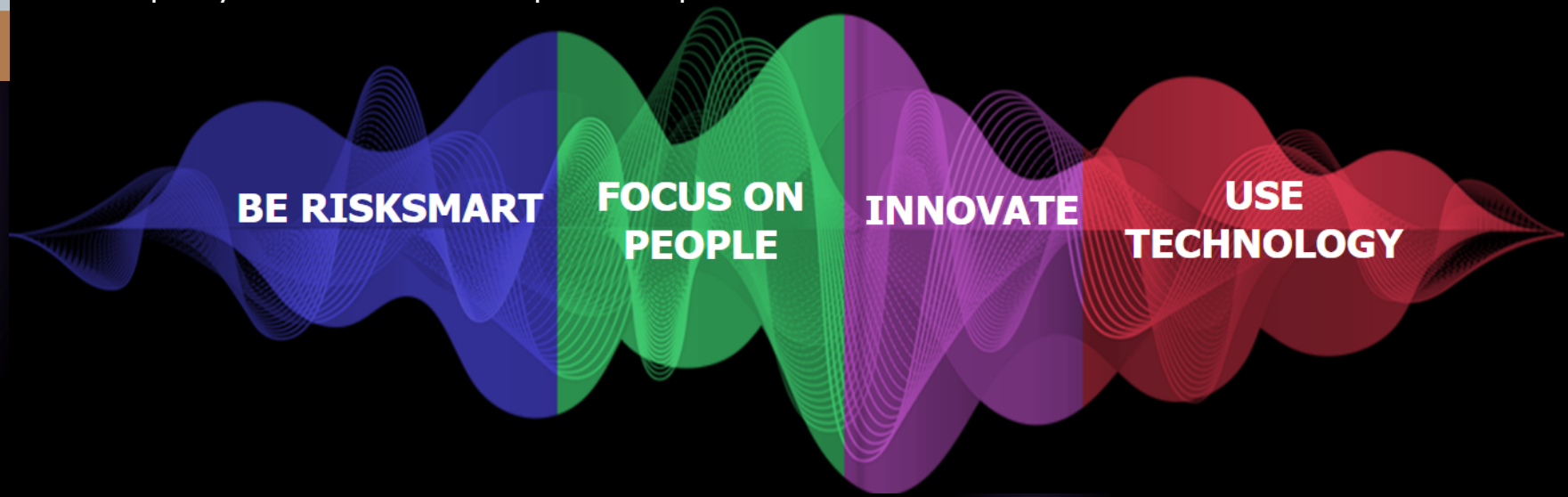
Vision for Digital Instrumentation and Controls (I&C)

Examples of success

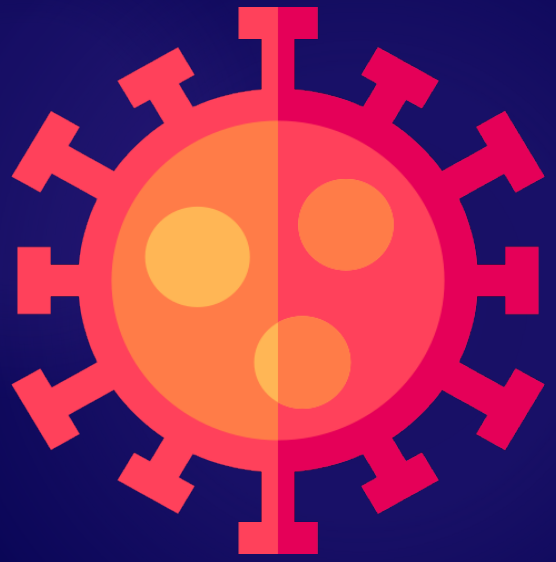
Looking Forward

Becoming a Modern Risk-Informed Regulator

- Using data analytics for regulatory enhancements
- Increasing transparency with licensees and the public
- Relying on technology during the COVID-19 public health emergency
- Modernizing regulatory infrastructure for digital technology deployed at nuclear power plants



Public Health Emergency COVID-19



- Web-based audits and meetings to support licensing actions
- Remote Inspections (Skype/tablets)
- Increased online capabilities for licensee submission and tracking
- Utilizing data analytics to improve internal decision making

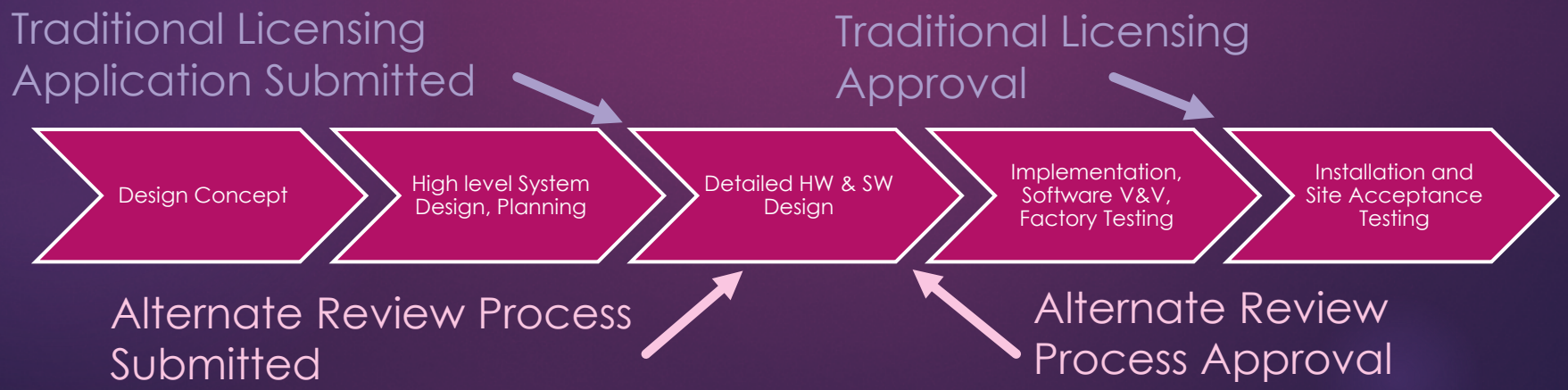
NRC Vision for Digital I&C in Nuclear Power Plants

"to develop and implement a **clear regulatory structure** with reduced regulatory uncertainty that **enables the expanded safe use** of digital I&C in nuclear reactors while continuing to ensure safety and security. "

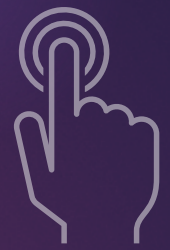
– SECY-20-0100 "Annual Update on the Integrated Strategy to Modernize the U.S. Nuclear Regulatory Commission's Digital Instrumentation and Control Regulatory Infrastructure"

Alternate Review Process for Large Scale Digital Modernization

- In 2018, the NRC defined an Alternate Review Process as an option for licensing major digital modernization projects.
  - Flexibility to approve a design earlier in the lifecycle phase compared to the traditional licensing approach
  - Currently using this process for the first time (Waterford)– expect two large scale applications (Turkey Point 2021, Limerick 2022)



NRC's Modernization Strategy for Digital I&C



Commercial Grade Dedication	Updated Guidance for Digital Mods (10 CFR 50.59)	Addressing Common Cause Failures	Continue Improvements to Regulatory Guidance
• International standard – Safety Integrity Level Certification process • Potential to expand the ability for licensees to procure and accept commercial grade digital equipment	• More clear regulatory process for licensees to pursue upgrades that do not require NRC prior approval • RIS 2002-22 Supplement 1 • RG 1.187 Rev 3	• Issued Rev 8 to BTP 7-19, to adopt a graded approach for the level of review needed for different upgrades • Additional engagement on reviewing new alternate approaches	• Ensure guidance work cohesively together • Leverage industry consensus standards

Looking Forward

- What can regulators do? **Be Ready**
  - Prepare for new digital technologies from industry (e.g. wireless)
  - Prepare for new analytical techniques from industry (e.g. digital twins)
  - Gain additional regulatory efficiencies
- Early Engagement is Key
  - Goal is the same – path to get there may be different
  - Identity technical/policy barriers and solutions