

EPRI
*Challenges Associated with
Implementing New
Technologies*

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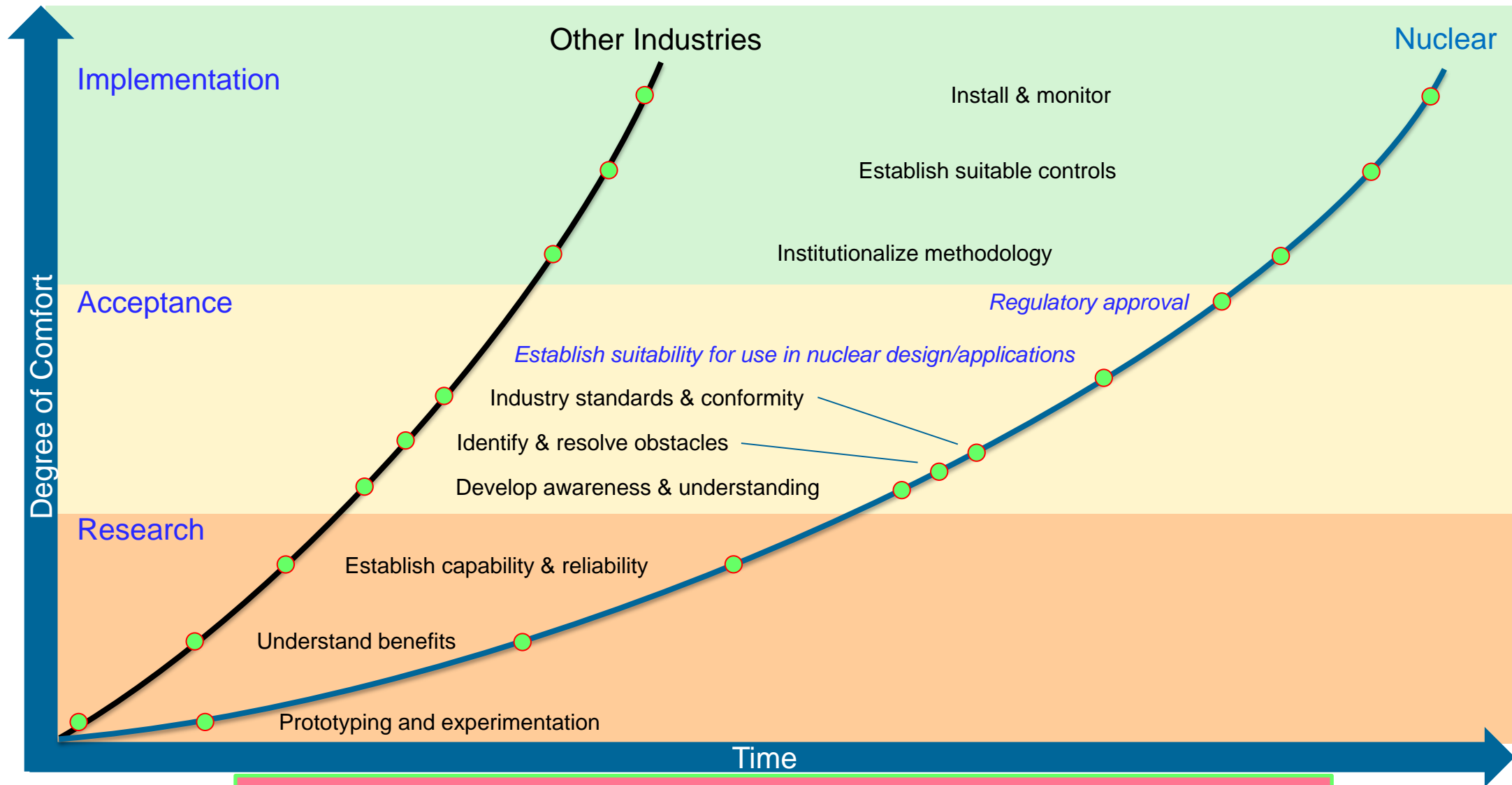
Session 5
OECD NEA CNRA VICWG
Workshop on Supply Chain Management
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“Any sufficiently advanced technology is indistinguishable from magic.”

Sir Arthur Charles Clarke, “Prophet of the Space Age”
Co-writer of screenplay for *2001: A Space Odyssey*

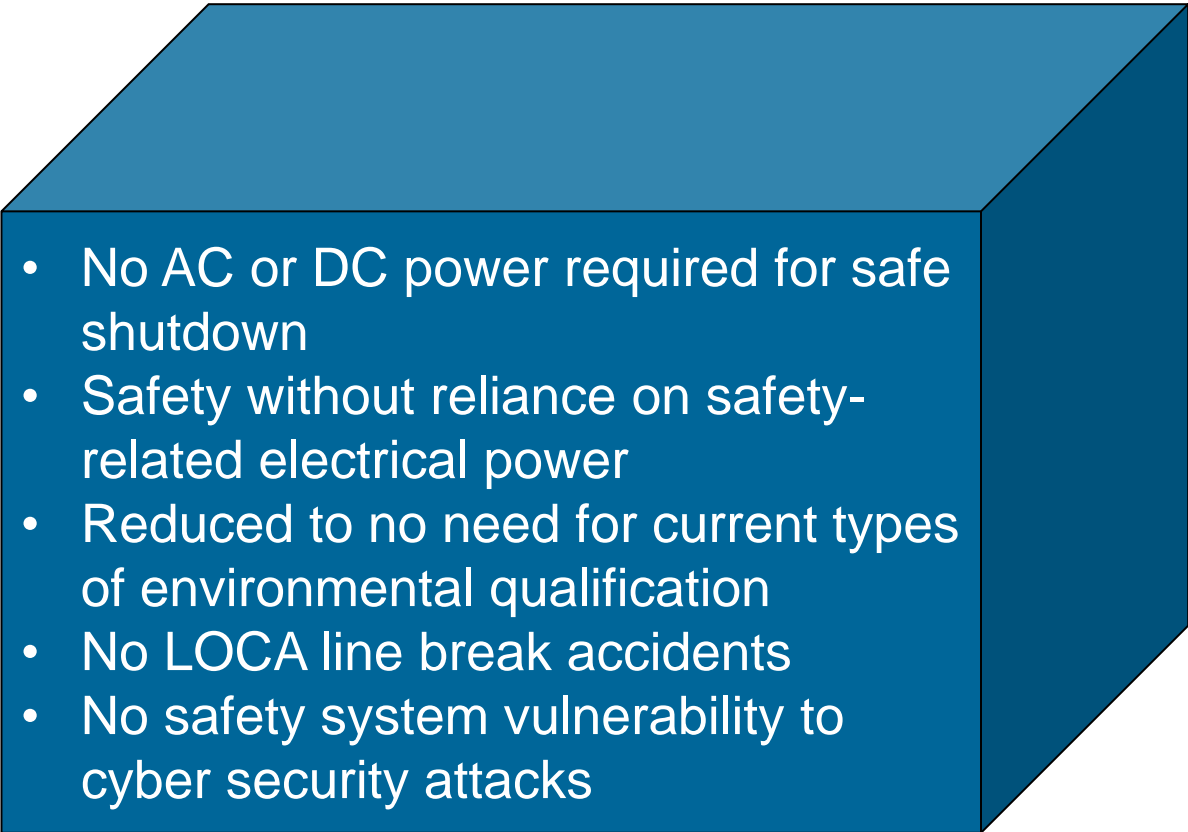
When is new technology distinguishable from magic?




Nuclear must modernize in order to survive and thrive

Innovative Reactor Technology / Designs

- Can new design result in the need to re-shape the certain approaches to adequate assurance of safety?

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- No AC or DC power required for safe shutdown
 - Safety without reliance on safety-related electrical power
 - Reduced to no need for current types of environmental qualification
 - No LOCA line break accidents
 - No safety system vulnerability to cyber security attacks

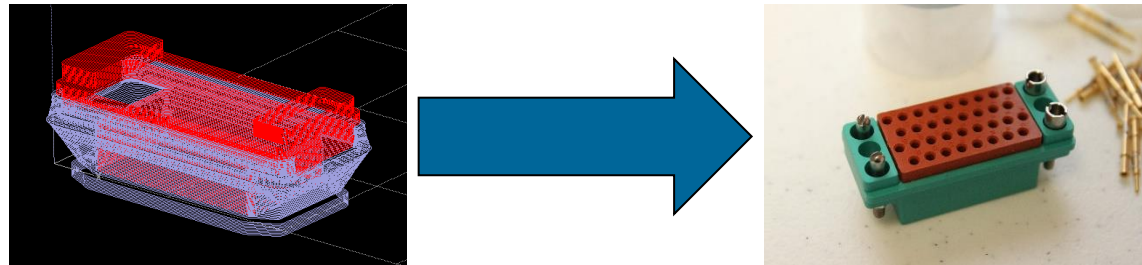
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- Existing guidance, parameters and regulations
 - Existing expectations
 - Comfort with past practices
 - Possible elimination of need to address some vulnerabilities and/or begin to address others

Smart (Advanced) Manufacturing

- Advanced manufacturing and digital technologies combined to produce customized products faster, more accurately, and less expensively
 - Digital process controls and highly accurate measurement technologies
- Powder Metallurgy Hot Isostatic Processing (PMHIP)
- Additive Manufacturing with Metals (3D) / ASTM F42 Committee
 - Powder bed (laser, fusion, electron beam melting)
 - Sheet lamination
 - Directed energy deposition
 - Binder jetting

Smart (Advanced) Manufacturing

- Additive manufacturing with thermoplastics
 - Stereolithography (SLA) Laser polymerizes a resin
 - Selective Laser Sintering (SLS) – Laser selectively fuses materials in a granular bed
 - Fused Deposition Modeling (FDM) – Polymer is heated and extruded through a nozzle
- Instead of building *“to meet”* a design, smart manufacturing technologies can build *“from”* a design
 - Certain aspects of conformance with design may be inherent in the processes themselves



Additive Manufacturing Supply Chain

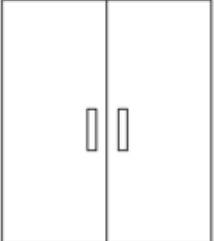
- Spares may not be manufactured concurrent with original product
 - No need to keep replacements in inventory
 - Aging and obsolete design information are made available for customer use
- “Replacement Item Centers”
 - Access available OEM “files”
 - Prototype, copy, and print replacement items

TechNext Printo's *Parts*

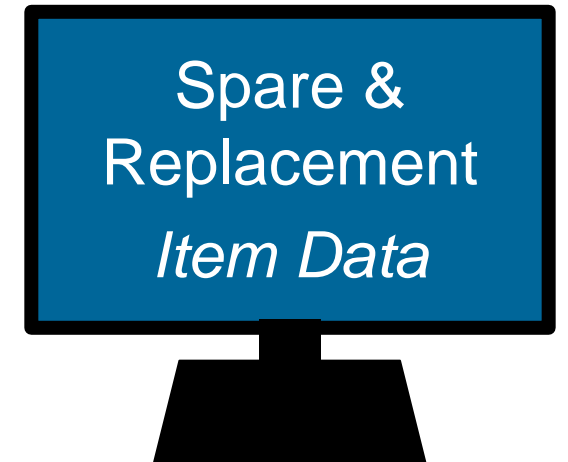
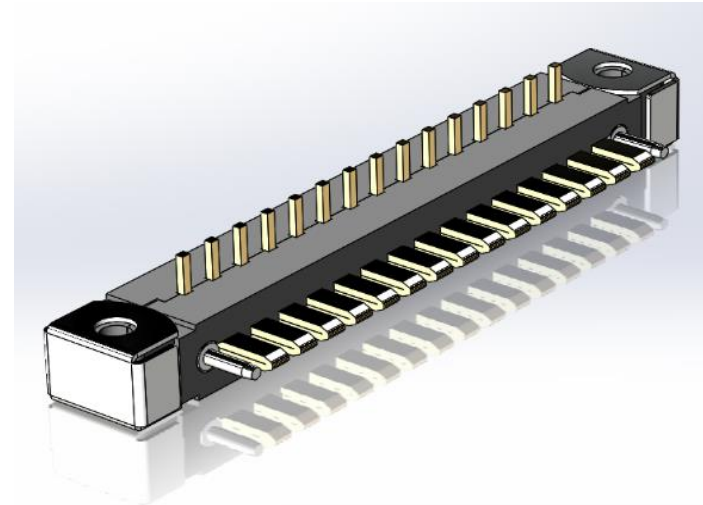
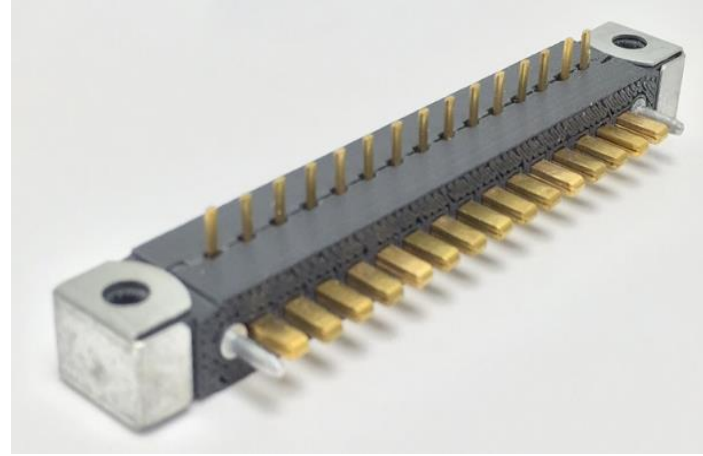
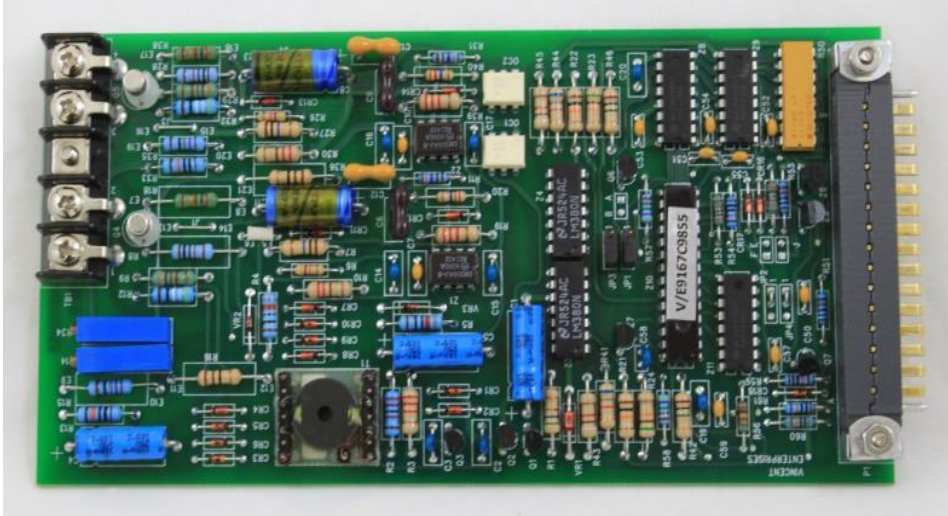
Printing and Copying in:

- Black & White
- Color
- Stainless Steel
- Ceramic
- Thermoplastic

Made to order

A diagram of a cabinet with two doors and a starburst graphic. The cabinet is represented by a simple line drawing with two vertical doors. To the right of the cabinet is a blue starburst graphic with the text "Made to order" inside it.

Additive Manufacturing Supply Chain



Digital Equipment

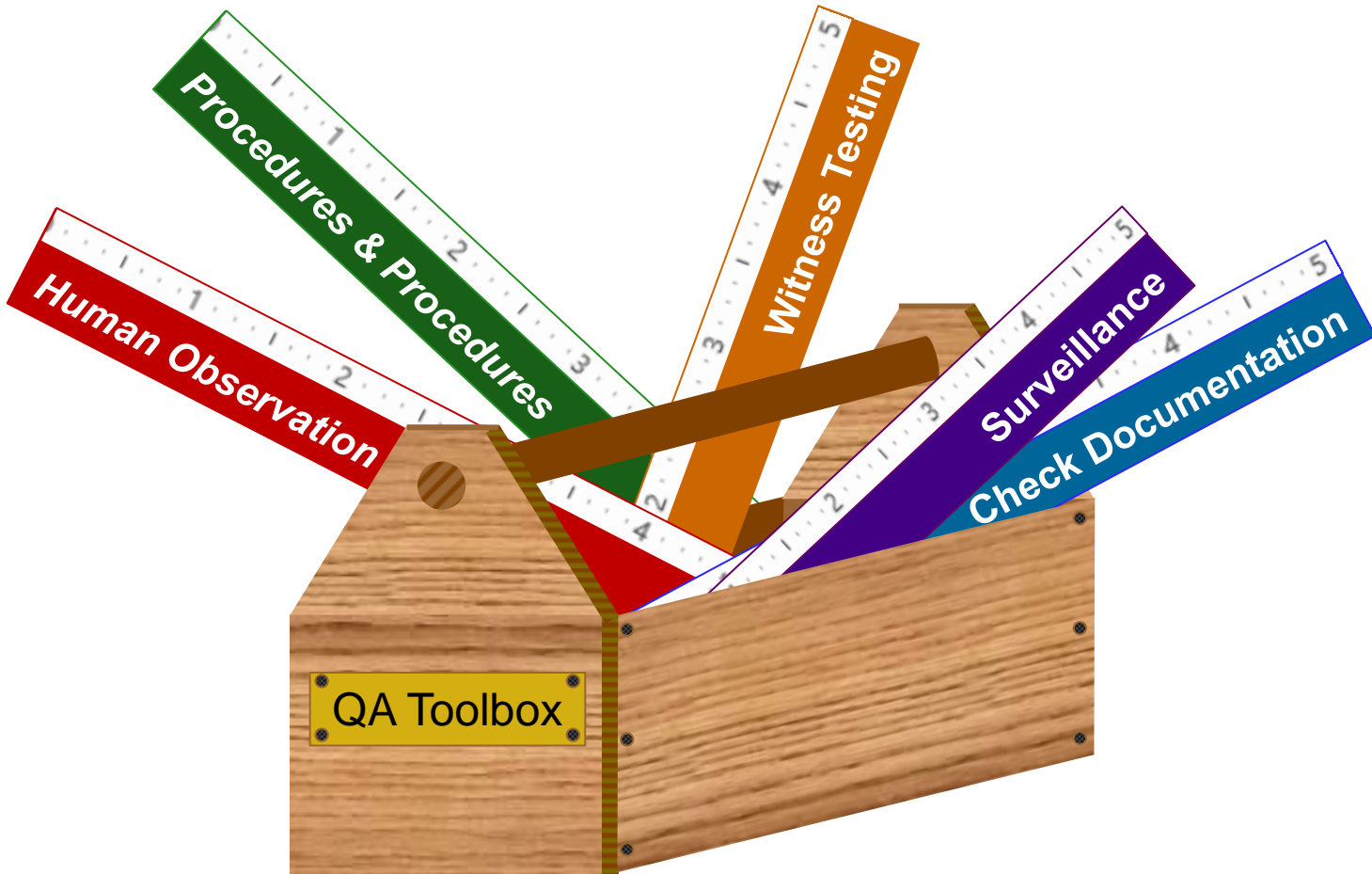
- Adopting digital is challenging for nuclear, even though:
 - Accuracy and repeatability of manufacturing processes far exceeds that of other items
 - Certification processes such as safety integrity level (SIL) provide adequate confidence in the ability of digital devices to perform their design functions
- Do methods for obtaining objective evidence of quality need to be revisited / reimaged?
 - Use of SIL certified devices in designs for nuclear applications could facilitate adoption of digital and provide objective evidence of quality and reliability



Quality Assurance Techniques

- 10CFR Appendix B and similar regulations are incredibly well written
 - Level of detail allows for significant flexibility and innovation
- Nuclear norms such as verbatim compliance, effective time-tested methods and heavy reliance on existing documented processes and procedures might inadvertently impede innovating quality assurance tools
- Many current approaches to nuclear quality are based upon manufacturing methods and technology from the 1970's
- Could QA techniques and tools used by other industries be adapted for use in nuclear . . .
 - or could nuclear adapt enough to accept their use?

Can the “QA Toolbox” be modernized?”



Risk-Informed Focus ?

Ability to share accepted digital platforms ?



OEM's structured end-user reliability and failure data ?

Standardized acceptance of alternative QA Programs ?

Remote monitoring of automated processes ?



**The Commission's mandate is to provide
*“reasonable assurance of adequate
protection, not absolute assurance of perfect
protection. . . When they change the law to
require absolute assurance of perfect
protection, there won't be a lot of nuclear
reactors in this country. Also, there won't be a
lot of cars or McDonalds.”***

**NRC Commissioner Edward McGaffigan, Jr.
The longest-serving NRC Commissioner**



Together...Shaping the Future of Electricity