



The Need for Wireless Sensor Technology for Commercial Nuclear Applications

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• Nuclear Power Industry.



• IEEE Safety Standards



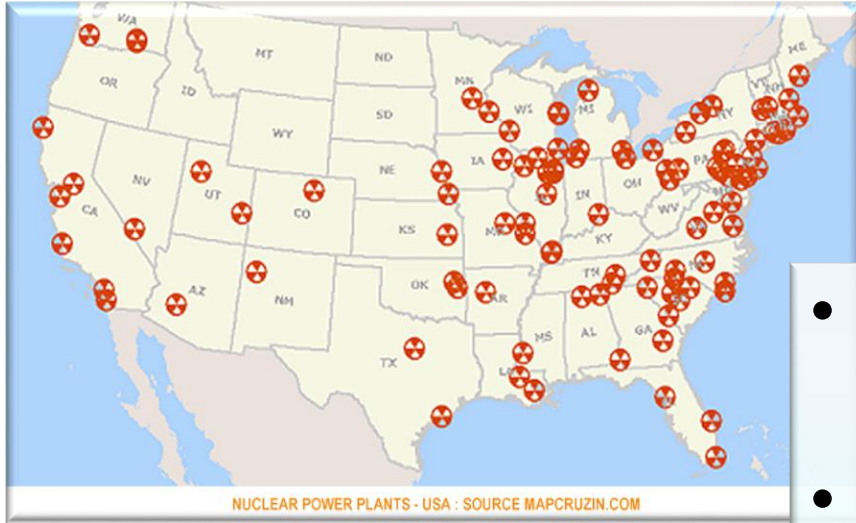
• Wireless Challenges



• MR Wireless Application Advantages



MR Instrumentation Opportunities

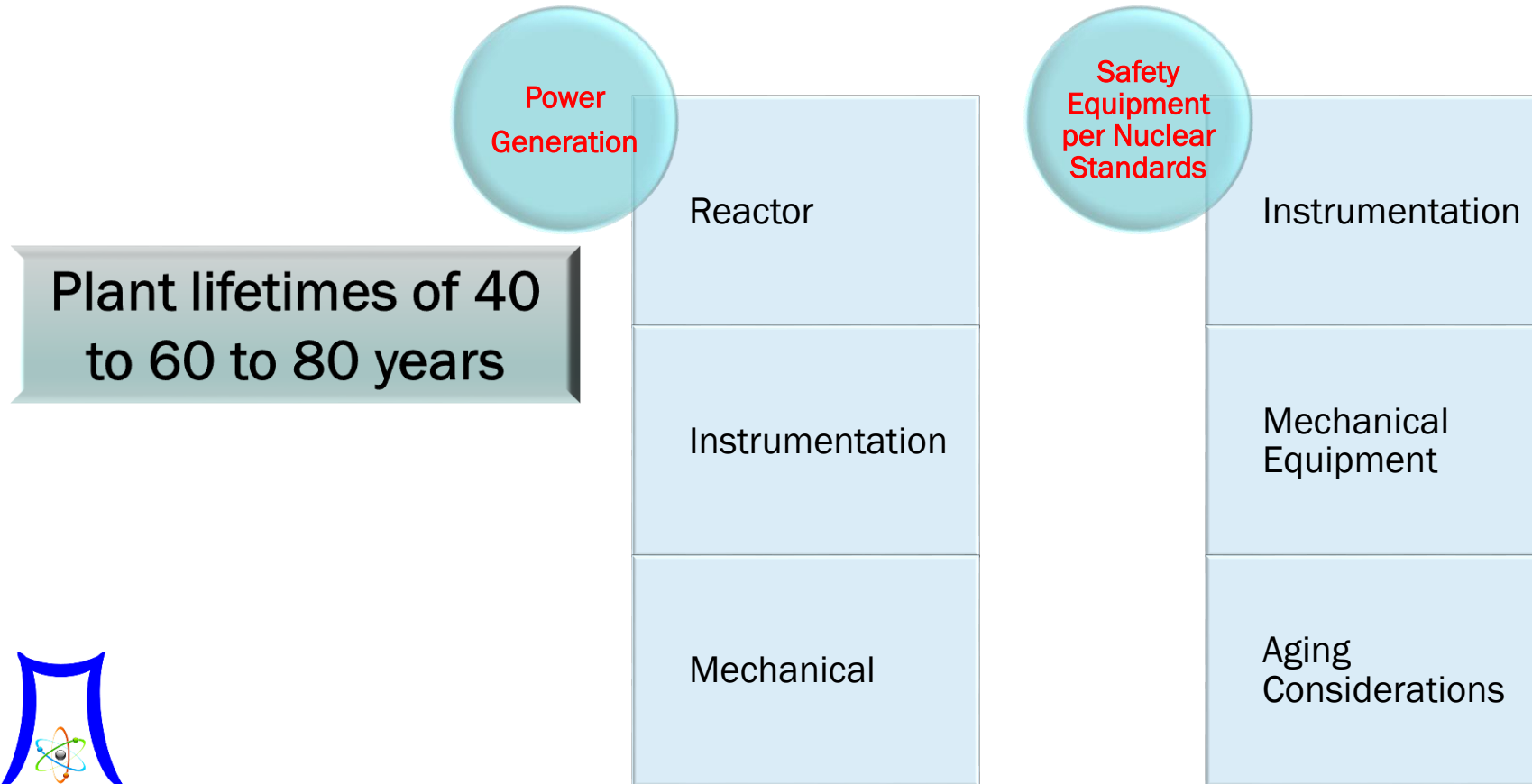


Nuclear Power Industry

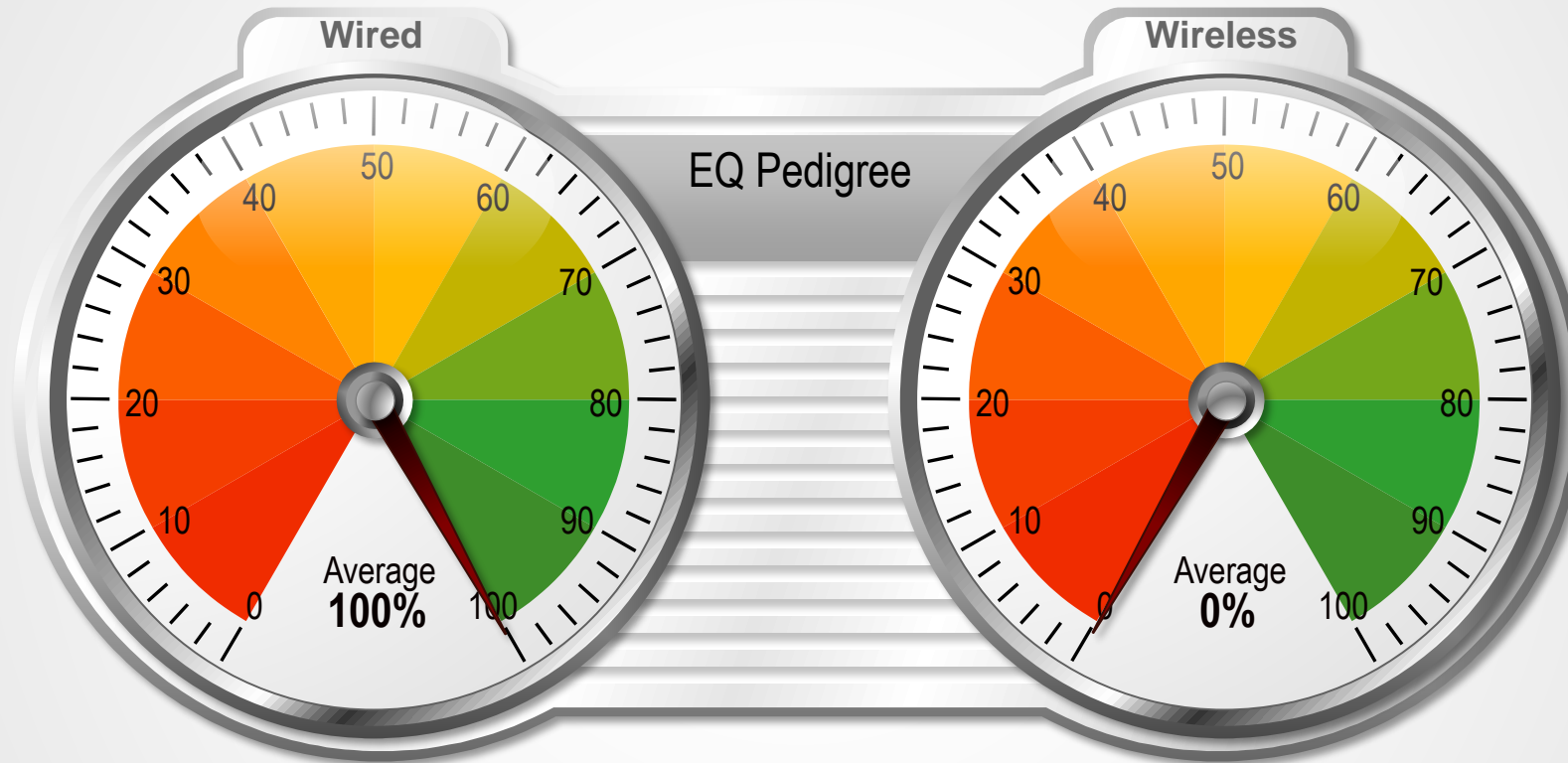
- United States has 99 commercial reactors and 2 under construction
- World wide 454 commercial reactors and 54 under construction
- Most Nuclear Plants were built in 1970's to 1980's
- There are plans for over 30 new Nuclear Plants in USA

Equipment in Nuclear Plants

Highly Regulated industry with International Nuclear Safety Standards and Nuclear Quality Assurance Programs



Wired and Wireless Qualified Instrumentation



Instrumentation has to be qualified for Severe Environmental conditions
Temperature, Pressure, Radiation, Steam and survive 40 to 80 years of operation.



Application of Wireless Technologies in Nuclear Power Plant Instrumentation and Control Systems

- **Wireless technology** provides excellent solutions to the problem of the high cost of industrial wiring and also provides a convenient and fast way to the installation of temporary instrumentation to monitor the health of selected plant equipment.
- **But Regulators and Operators highly skeptical of Wireless technology** based on trial experiences and safety first mentality

Challenges of Wireless Technologies in Nuclear Power Plant Instrumentation and Control Systems

- Resolving problems with the operation of wireless systems in the **electrically noisy environment**
- Heavy physical structures in an NPP are characterized by high reverberant radio frequency (RF) environments, which cause **multi-path interference in RF signals**.
- Wireless devices using RF are subjected to **many sources of electromagnetic interference** in the NPPs.

Challenges of Wireless Technologies in Nuclear Power Plant Instrumentation and Control Systems

- Electromagnetic interference, and a negative environment for wireless communication
 - Large motors, motor controllers, electric devices, process controllers, digital equipment, and radio communication devices
- Wireless technology also brings **problems of security and privacy** to industrial networks
- **Long continuous operating times of 2 years** between shutting the reactor down for maintenance
- **Lithium Batteries potential failure mechanism** of overheating is major fire threat

Intrinsically smart sensors with M-FIT™



- No Batteries

- No Electronics in Sensors

- Cyber Secure

- Fault and Damage Tolerant



- No Cables in Sensors

- No Life Limitations

- Severe Environment Capacity:
Temperature, Pressure, Steam,
Radiation

- Interrogated by Remote mounted
Magnetic Resonance Antenna

GLSEQ M-FI™ Wireless

M-FI™ is derived from NASA SansEC technology licensed to GLSEQ

- Wireless magnetic resonance technology
- Sensors have **no batteries or active electronics**
- **Cyber Secure**

Unlike other sensors, a SansEC sensor can be designed for measurements unrelated to each other

- Like temperature and fluid level
- Can easily switch from one to another or do both simultaneously.
- The sensors have no conventional electrical connections, **No power consumption, highly resilient to damage and excessive environments.**
- Operates as a **unattended, unobtrusive component**
- Weighs less, lower cost, fewer materials, less time and labor, produces less waste, and has a wide range of **commercial and military applications.**



Intrinsically Smart Severe Accident Instrumentation Line™

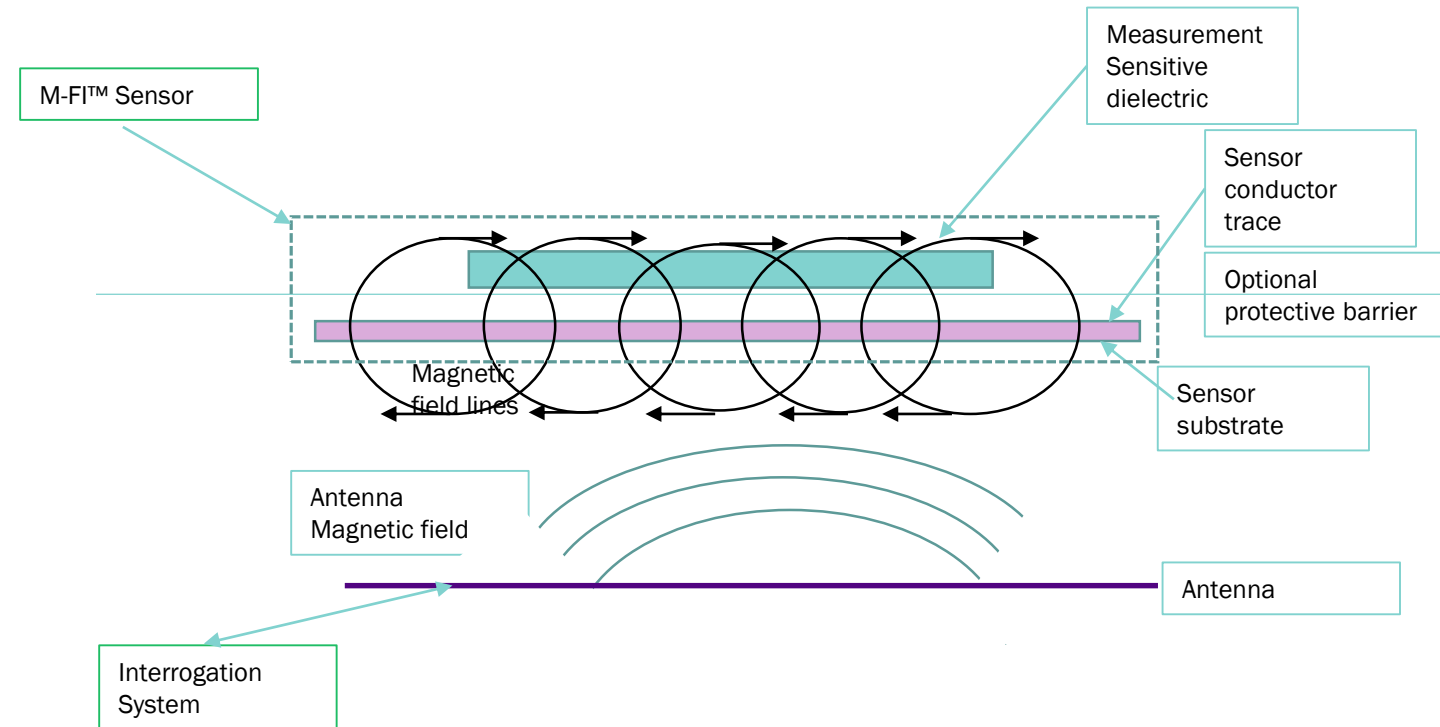
- Intrinsically Smart Severe Accident Instrumentation Line™
 - Utilize basic chemical reactions or physics to sense an important parameter
 - Environmental capable High Temperature up to 700°C (1300°F)
 - Radiation > 2 MGy
 - Pressure > 130 psig
 - Steam
 - Long life



IS-SAIL™ and M-FI™ Registered trademarks of GLSEQ LLC

**Magnetic Resonance
Antenna
Interrogates each
M-FI™ Sensor
of the Measurement
Sensitive Dielectric
Such as
Flow
Level
Temperature
Pressure
Radiation
Vibration
Chemical
Gases**

UNIQUE GLSEQ,LLC M-FI™ SOLUTION



Evolution: Wired to Wireless M-FI*

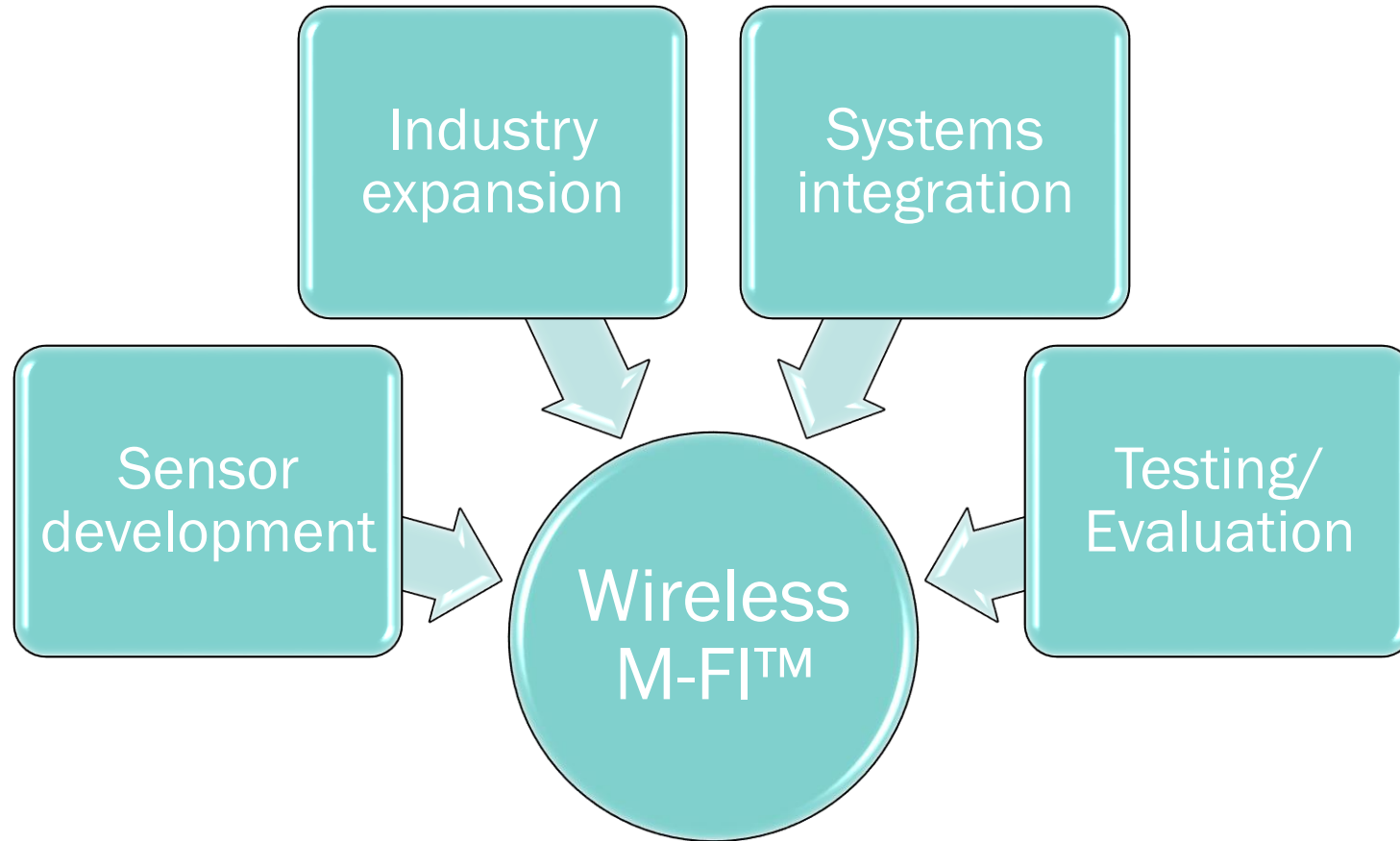


Benefits with M-FI™

Passive Monitoring

- Passive Environment Monitoring
- Fault Tolerant
- Cyber Secure
- Unobtrusive
- Stealthy

Opportunities





GLSEQ Nuclear Power Equipment Qualification Seminar Outline

- History of Equipment Qualification (EQ) and Regulations
 - 10 CFR 50.49 Equipment Qualification for nuclear power reactors.
 - IEEE 323™
 - IEC 60780 / IEEE 323
- Fukushima Accidents
 - Advanced I&C R&D
- Changes to Standards : Type F Variables
 - IEEE 497™-2016
- Equipment Qualification Process
- Wireless Application Opportunities



Thank You!

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