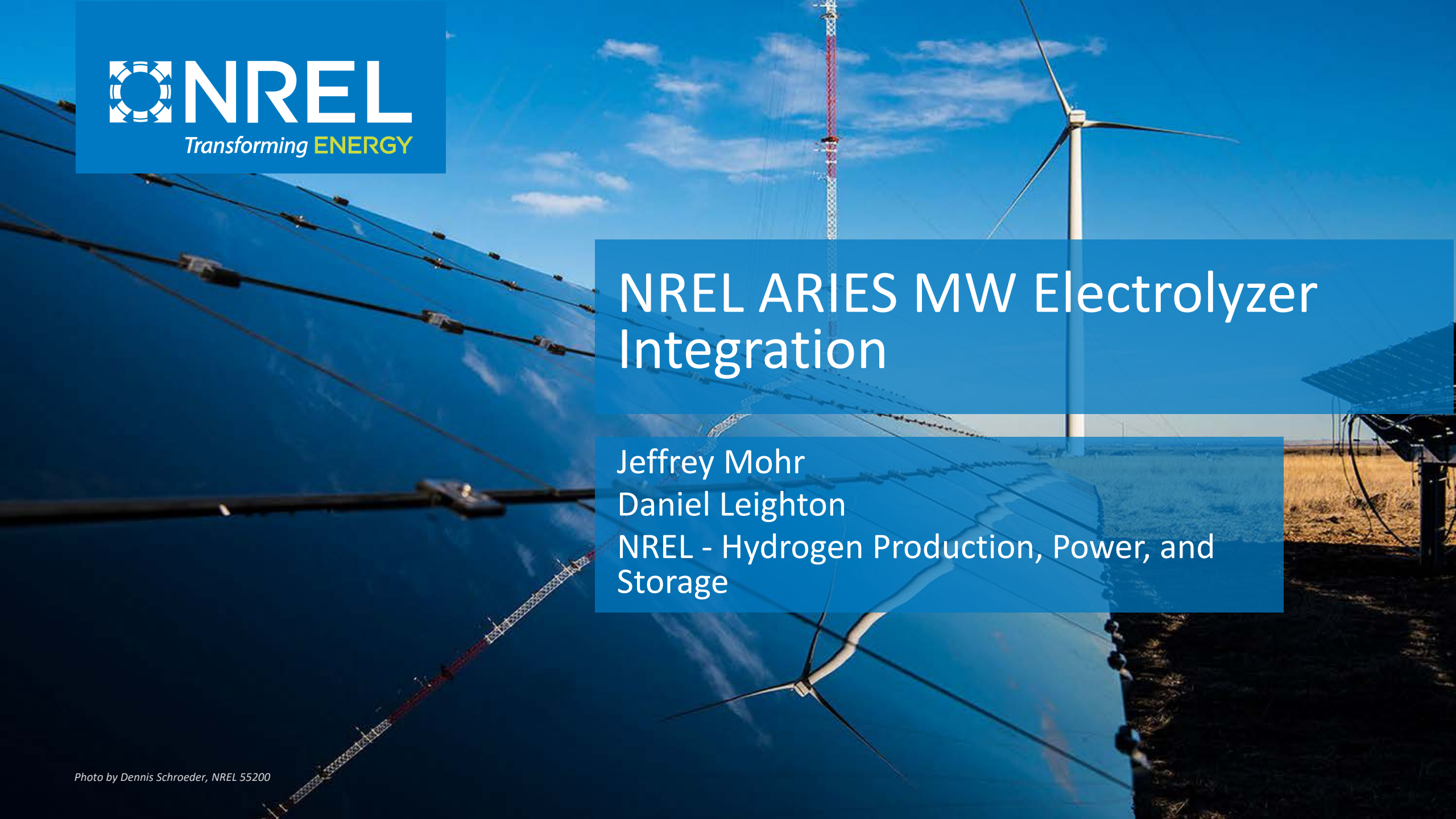
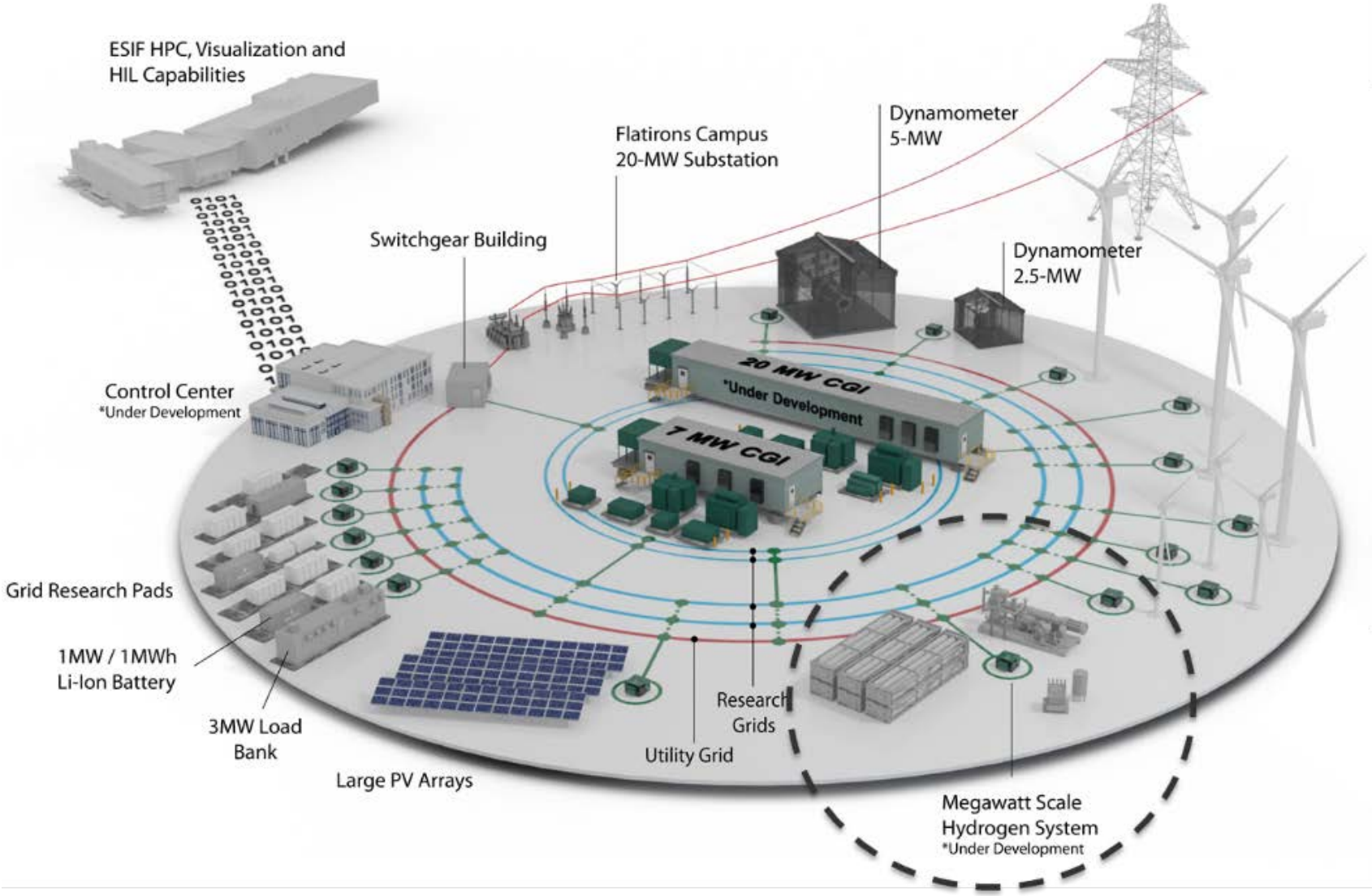


NREL ARIES MW Electrolyzer Integration

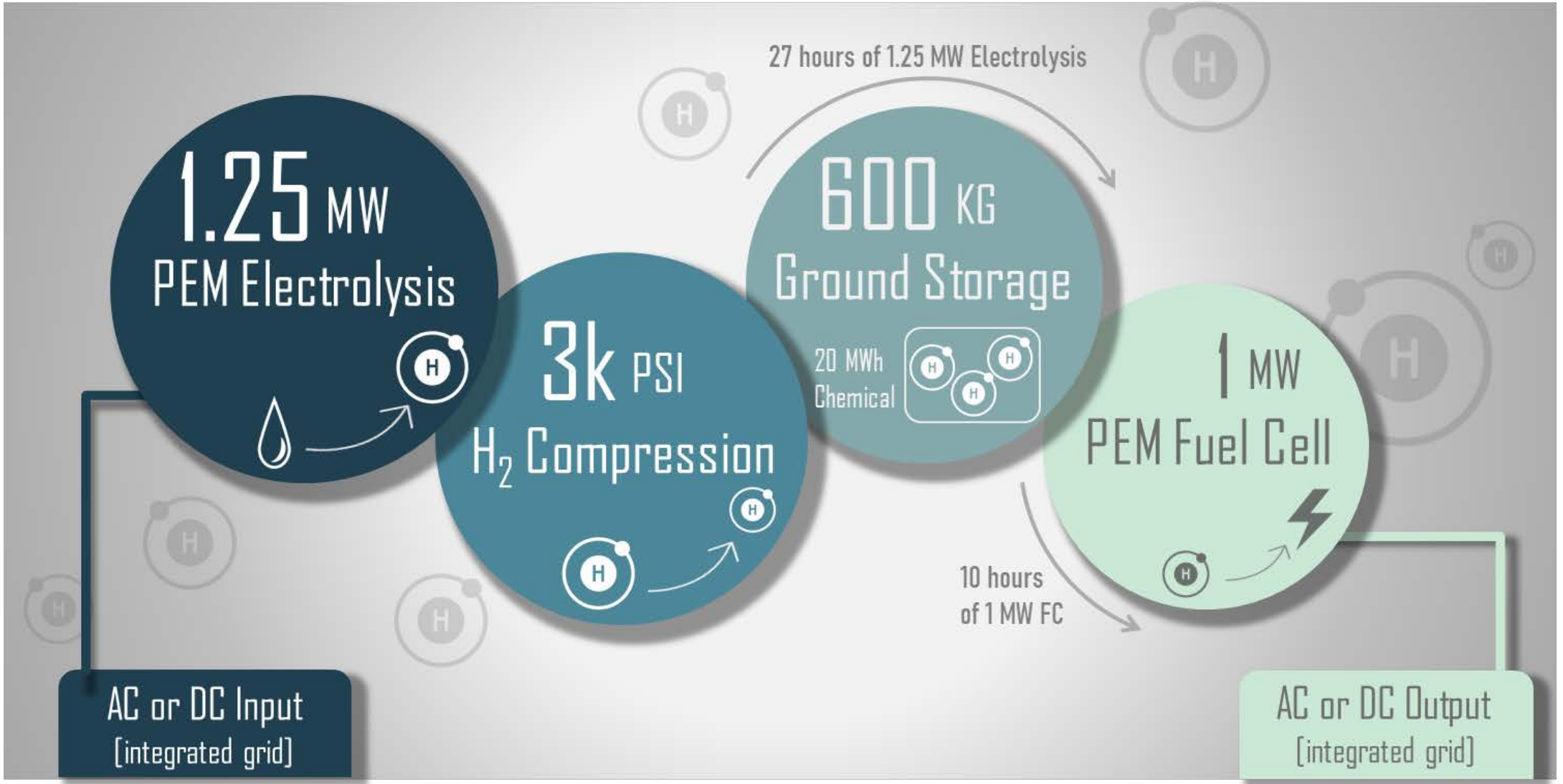
Jeffrey Mohr
Daniel Leighton
NREL - Hydrogen Production, Power, and Storage

Photo by Dennis Schroeder, NREL 55200

ARIES Flatirons Campus Grid Equipment



Approach: Hydrogen System



NREL System

Hydrogen System Interconnections

Hydrogen System Interconnections

Hydrogen System Interconnections

Hydrogen System Interconnections

Hydrogen System Interconnections

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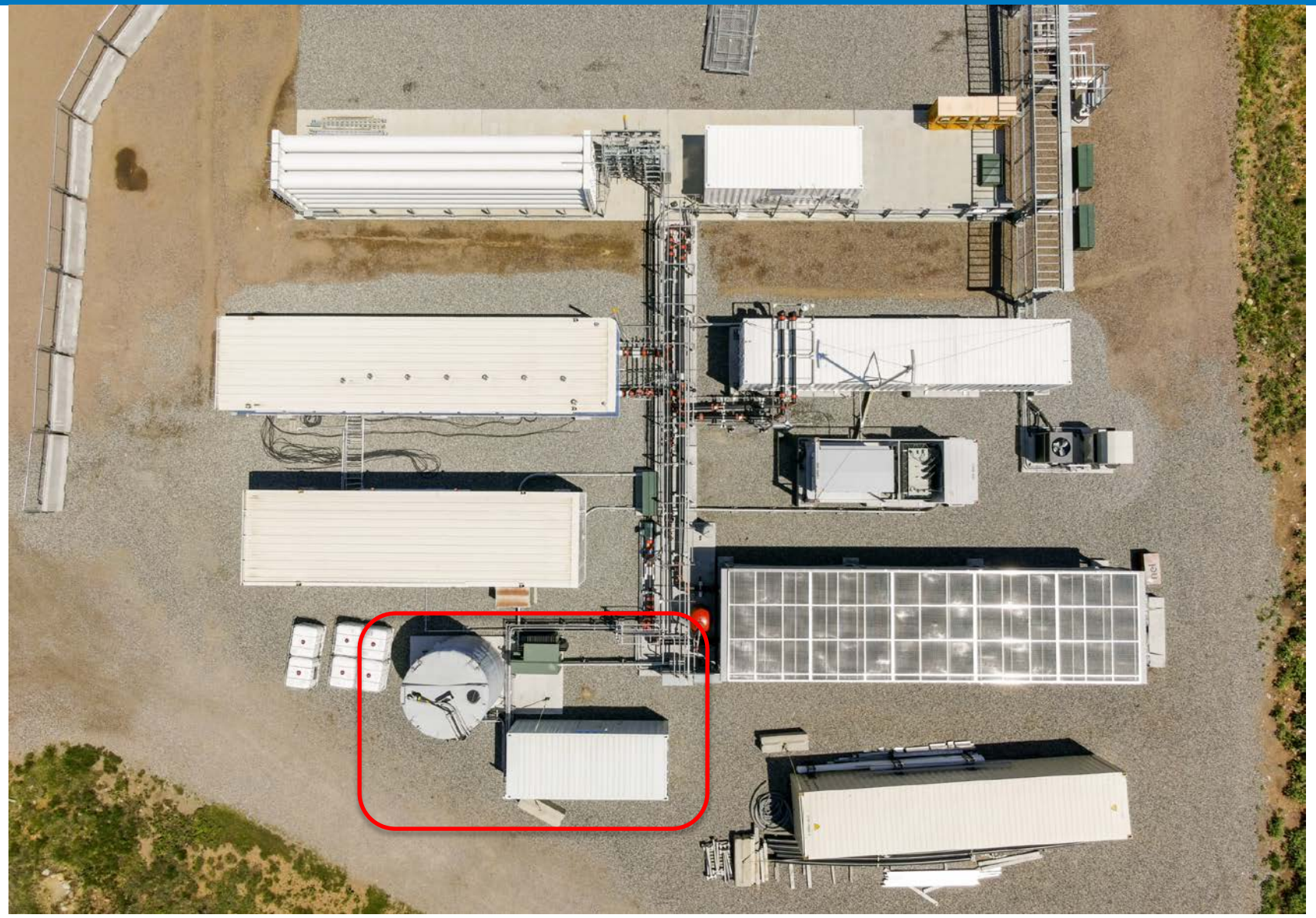
Hydrogen System Interconnections



Electrolyzer Integration

Electrolyzer Integration

Lessons Learned: Integration

- Drain/blow out water from the system yourself when it arrives at the site!
- Supply chain issues abound, down to the smallest components
- Shipping damage occurred many times, causing delays and extra work

Manufacturers have mixed code compliance experience, and will only focus on their equipment – it is up to the site owner to comply with code and double check the suppliers

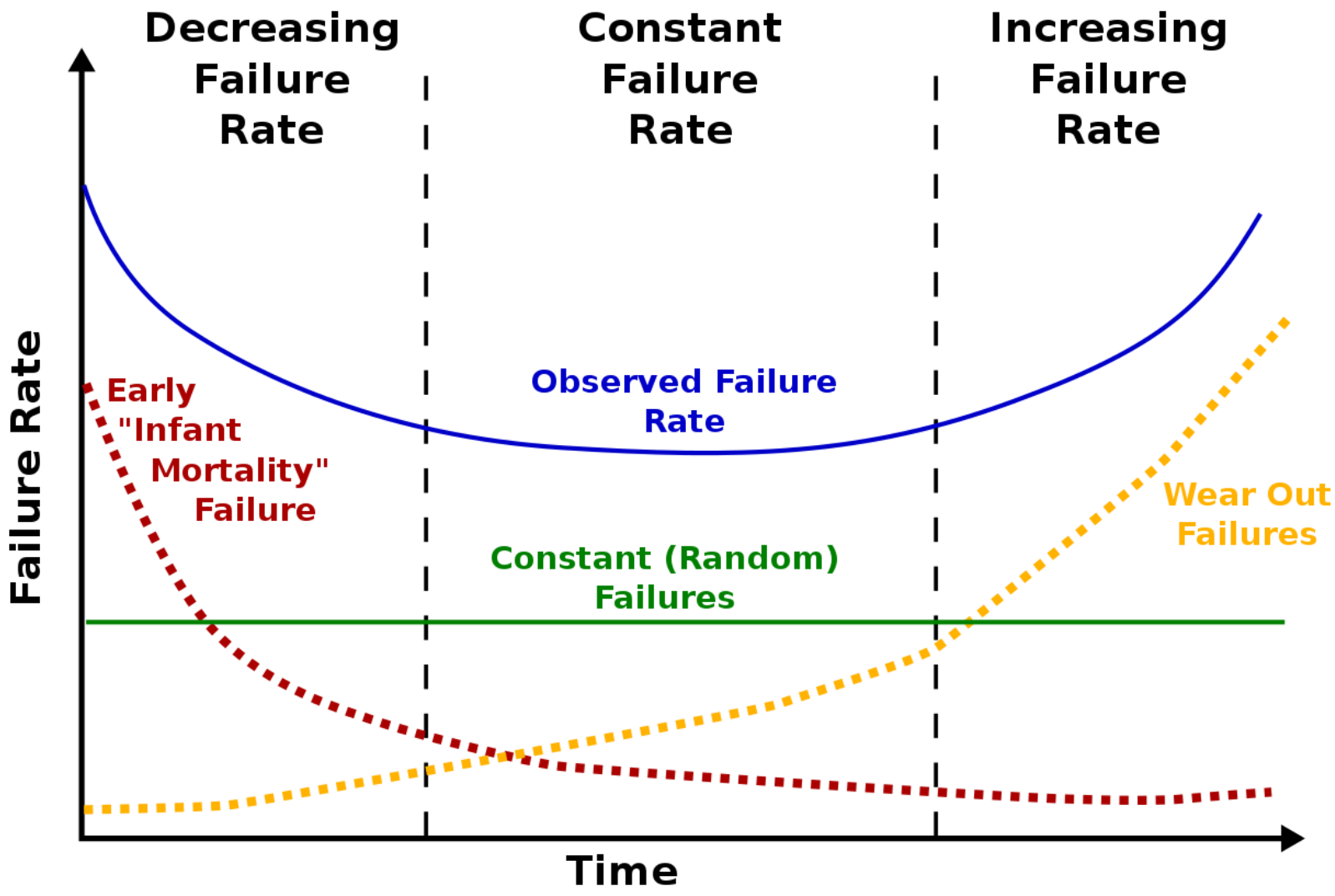
- Work with the Fire Marshal/AHJ early – education is key (resources available)
- Decide on fire panel architecture and reporting requirements ahead of time

Lessons Learned: Integration

- Perform as-built P&ID and parts specification QC, including hydrogen material compatibility
  - Several digit part numbers are easy to transpose or type incorrectly

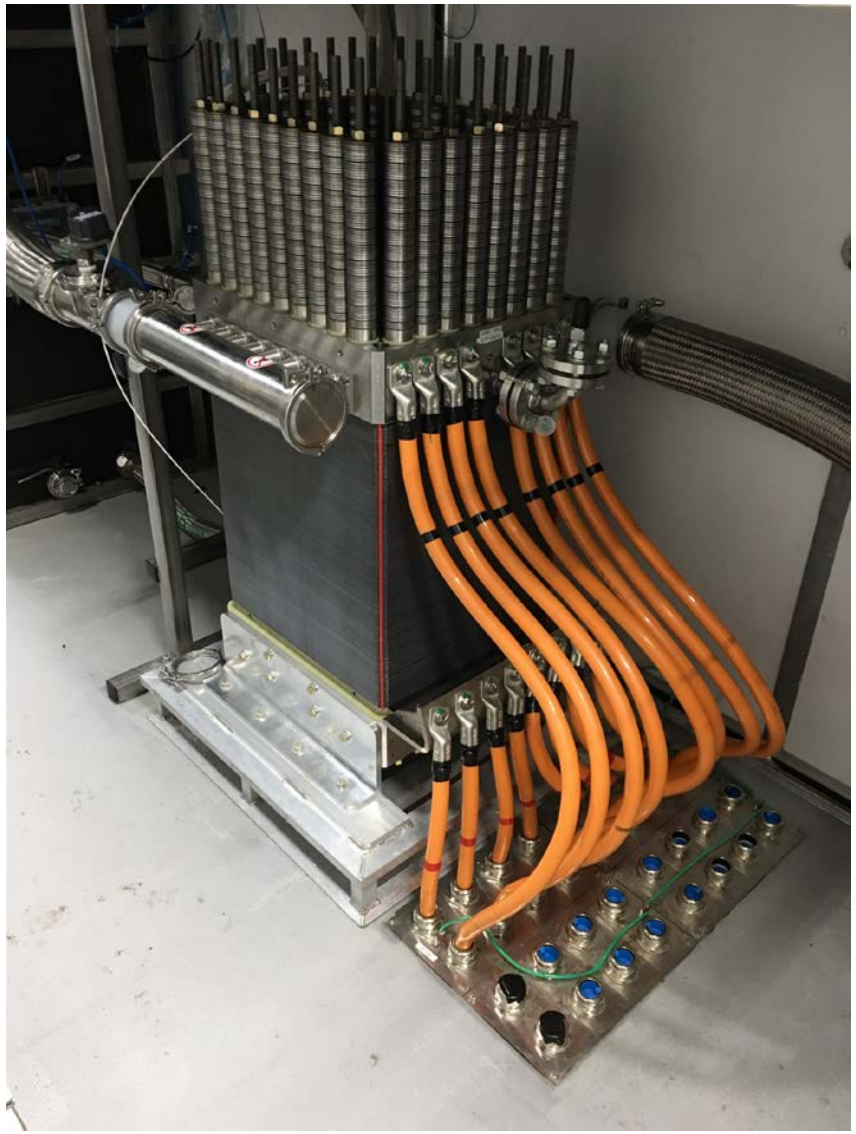
- Electrical code compliance issues seen in every sub-system especially for hazardous locations/HEE's – (NREL requirements are strict)

Lessons Learned: Operation



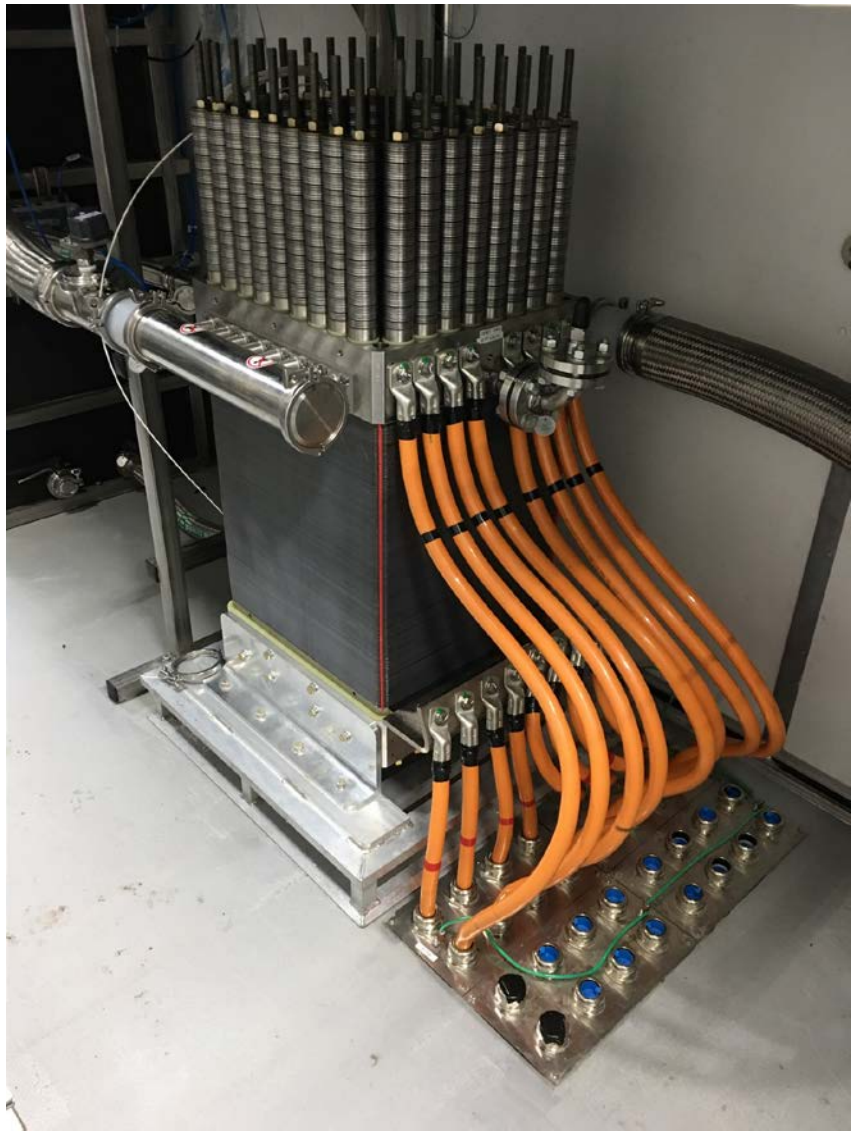
https://en.wikipedia.org/wiki/Bathtub_curve#/media/File:Bathtub_curve.svg

Lessons Learned: Operation



- Plan for project needs – what is hydrogen end use? Purity requirements?
- PEM Stacks are Reliable
- Stack BOP have 100s of parts and a single part failure can shutdown an entire subsystem
  - Early production models may undergo field design revisions and modification. NREL facilitates testing of early production products (NREL unit was second MC250/MC500 NEL produced)
    - Oxygen system leaks
    - Dryer system leaks, alarms, code bugs during commissioning
    - Issues with dewpoint sensor and H2 in O2 gas sampling issues
- Decide on options and level of support needed from manufacturer
  - NREL has enough expertise to need bare minimum support/maintenance

Lessons Learned: Operation



- NREL purchased a BoP with room for growth
  - Sized for 2.5 MW of Electrolysis currently running 1.25 MW stack
- Temperature swing absorption (TSA) dryer is a complex sub-system
  - Start/stop is not seamless (best to idle 10% minimum)
  - Requires a few hours of higher flow every few days to regenerate
  - Proved problematic during commissioning
- PEM electrolyzer stacks have inherently fast time response times, but commercial system slow down for BoP controls reasons
  - Area of research with NREL
  - Communicate with manufacture on specific needs – tune BoP to end use
- After commissioning issues were worked out unit does deliver reliable/stable dry hydrogen

Summary

- Communicate with manufacture on specific needs
  - Hydrogen end use
  - Purity requirements
  - Rate change requirements
- Tune BoP for hydrogen use requirements
- Involve Fire/Electrical AHJ's early
  - Code review is a significant portion of project planning
- Expect delays due to:
  - Part availability
  - Part damage during shipping
  - As built compatibility/code compliance
- Electrolysis is inherently coupled to water systems (design for local environmental conditions)

Thank You

www.nrel.gov

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