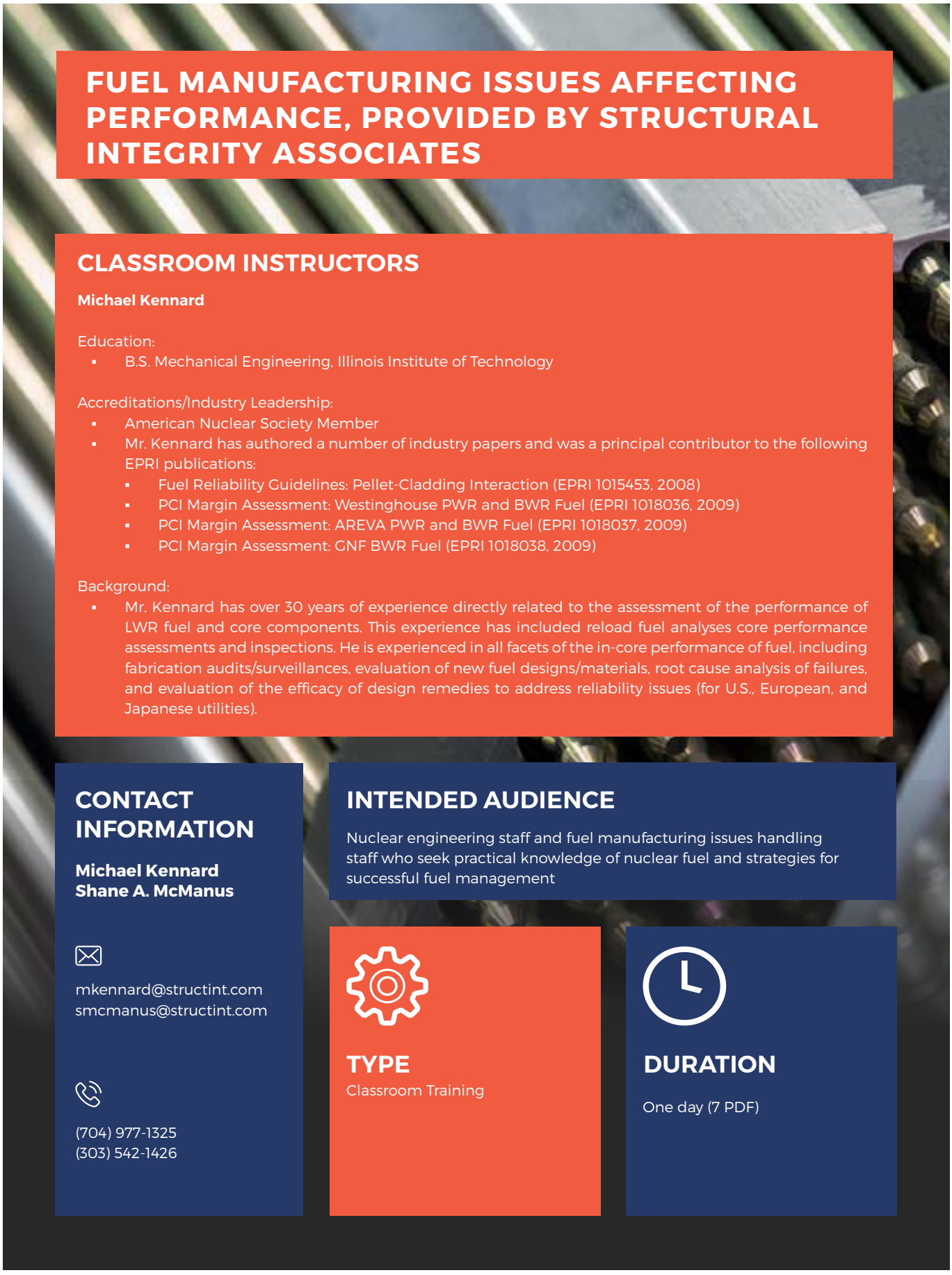

FUEL MANUFACTURING ISSUES AFFECTING PERFORMANCE, PROVIDED BY STRUCTURAL INTEGRITY ASSOCIATES

CLASSROOM INSTRUCTORS

Michael Kennard

Education:

- B.S. Mechanical Engineering, Illinois Institute of Technology

Accreditations/Industry Leadership:

- American Nuclear Society Member
- Mr. Kennard has authored a number of industry papers and was a principal contributor to the following EPRI publications:
  - Fuel Reliability Guidelines: Pellet-Cladding Interaction (EPRI 1015453, 2008)
  - PCI Margin Assessment: Westinghouse PWR and BWR Fuel (EPRI 1018036, 2009)
  - PCI Margin Assessment: AREVA PWR and BWR Fuel (EPRI 1018037, 2009)
  - PCI Margin Assessment: GNF BWR Fuel (EPRI 1018038, 2009)

Background:

- Mr. Kennard has over 30 years of experience directly related to the assessment of the performance of LWR fuel and core components. This experience has included reload fuel analyses core performance assessments and inspections. He is experienced in all facets of the in-core performance of fuel, including fabrication audits/surveillances, evaluation of new fuel designs/materials, root cause analysis of failures, and evaluation of the efficacy of design remedies to address reliability issues (for U.S., European, and Japanese utilities).

CONTACT INFORMATION

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INTENDED AUDIENCE

Nuclear engineering staff and fuel manufacturing issues handling staff who seek practical knowledge of nuclear fuel and strategies for successful fuel management

TYPE

Classroom Training

DURATION

One day (7 PDF)

LEARNING OBJECTIVES

The manufacturing of nuclear fuel is a very well-controlled process. Manufacturing is highly proceduralized, special processes are qualified and controlled, and the process operators and inspectors are highly trained. Further, process steps are subjected to rigorous inspection and oversight and processed components are subjected to in-process testing. In spite of these controls, a number of issues have occurred to in-core fuel, resulting in fuel clad failures and reduced fuel reliability.

This training course examines the critical processing steps in the fabrication of nuclear fuel in relation to the potential for manufacturing upsets that adversely affect in-core performance. The course provides the trainee with an overview of fuel pellet, rod and assembly fabrication processes. We identify critical stages of the manufacture of nuclear fuel where upsets could lead to reduced performance. We also address industry-related issues that have likely fabrication-related causal factors, and identify good practices that minimize the potential for performance loss.

The independent review of proposed fuel and component design changes is critical to ensure that the components will meet the supplier's performance goals and the utility's expectations without introducing new performance issues. This course provides the students with key insights to prevent fuel manufacturing issues.

Topics Covered:

- Pellet defects that increase cladding local stresses, thereby reducing margin to pellet-to-cladding interaction (PCI) type failures
- Hydrogenous materials internal to the fabricated fuel rod leading to primary hydriding failure
- Cladding flaws that reduce mechanical capabilities of the cladding
- Fasteners that fail during operation, resulting in foreign materials within the fuel assemblies that have the potential to cause debris fretting failures
- End plug and weld defects that challenge the integrity of the fuel rod

KEY INDUSTRY DOCUMENTS

1. 10 Code of Federal Regulations Part 50 Appendix B, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants
2. Regulatory Guide 1.70, Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)
3. NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition
4. Byron/Braidwood Updated FSAR, Chapter 4.0 – Reactor, Revision 15 (and Similar)
5. MUAP-07008-NP-A (R2), Mitsubishi Fuel Design Criteria and Methodology (and Similar)