

TRAINING CATALOGUE









LANEY BISBEE Ibisbee@structint.com

For well over 30 years, you have relied on Structural Integrity for our knowledge and expertise to solve difficult problems, provide integrated solutions, and deliver specialized engineering training. The energy industry is continually experiencing dramatic change in its workforce. Ongoing retirements coupled with hiring gaps over the past 10 years will leave a huge loss of knowledge in the industry and will need to be quickly backfilled.

- The Nuclear Energy Institute estimates that starting in 2014, 39 percent of the nuclear workforce will have been eligible for retirement by the end of 2018, which means the industry will need to hire approximately 20,000 new workers over the next four years to replace those retiring workers.
- In addition, about 40 percent of the work force at America's electric and natural gas utilities will be eligible for retirement over the next several years.

Our industry recognized technical experts are available to help you address this challenge. From new workers entering the industry, to seasoned experts taking on new roles and responsibilities, to workers wanting to become the next generation of leaders, our Training Program offers a broad spectrum of courses at varying levels with credit for Professional Development Hours (PDHs).

You decide the timing and we can provide our training conveniently at your location. We look forward to helping you and your company in Linking Theory and Practice[™] as you prepare for the challenges ahead.

Sincerely

President/CEO



Our Training Approach: Linking Theory and Practice

Structural Integrity's training courses focus on Linking Theory and Practice. You'll get more in-depth education on specific topics for industry applications. We know people learn in different ways and have differing needs, so we're Linking Theory and Practice to provide the following advantages to our clients:

- are taught in a way that lets you start turning theory into practice.
- required by regulators and other stakeholders.
- More time generating and transmitting energy, and less lost revenue.

Our training courses can be customized to your employees' needs. And we're happy to help.

Build Knowledge – We build our training courses with one goal – to equip you with the knowledge to solve more of your complex problems. All of our courses are designed to improve your understanding of a highly technical topic and

Reduce Risk – Challenges occur regularly at any facility. With the right expertise, you can solve them, before small issues become significant threats. You'll also be able to take the uncertainty out of your ability to review and analyze externally-generated, specialized reports. You can be assured you're providing the proper oversight

Save Money – Our courses help you identify issues and resolve them faster. We provide a framework you can put into practice to reduce outage critical path time and limit any reduction in capacity factors. The end result?

Practical Application of Theory

We believe that advanced education shouldn't stop at theory. We go further, using theory to build practical solutions for uncommon problems.

Our Instructors

Our instructors are at the forefront of their fields: many hold leadership roles and are active members on Codes and Standards Committees. Their expertise and commitment to our clients have earned Structural Integrity a reputation for world-class service.

Venues

You choose the location that best suits your plant/facility needs. We can provide training on site at your location and during a time frame that is convenient.

Earn PDH's

Structural Integrity's courses have all the necessary components (objectives, lesson plans, presentation materials, and evaluations) to meet the requirements INPO has established for accredited engineering training and that would qualify for Professional Engineering continuing education credit in most states.

What Clients Are Saying

- Structural Integrity's long-standing reputation for high quality training is recognized and appreciated by our clients. Here's what our clients have to say about Structural Integrity training.
- "Structural Integrity's technical capabilities and expertise are well-known in the industry. In comparison to other vendors, they have an edge on technical issues and solutions."
- "Taking this course better prepared me for my new position and helped me not only understand the theory but also apply it to real world problems."
- "Great training, the instructor used relevant examples and the in-class activities were engaging and interesting."
- "The instructors spent additional time after hours helping me understand some of the concepts. Additionally, having the equipment (NDE for Engineers and Managers course) available for the students to use was extremely beneficial and increased my understanding."



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SECTION VIII - High Pressure Vessel Design by Analysis

This course provides an overview of the design by analysis methodology and philosophy of ASME Section VIII which incorporates an overview of the analysis methods used, including the application of finite element analysis, to meet the requirements of the Code and how it can be applied to practical equipment design. The focus of this course will be to emphasize the more modern and advanced analytical techniques found in ASME Section VIII Division 3 while contrasting the differences within Section VIII Division 2. An overview of philosophical differences in the high pressure piping code, ASME B31.3 Chapter IX will also be discussed.

Examples of practical applications for many of the techniques are discussed to demonstrate the philosophy of the Code criteria. This includes an overview of the problems presented in ASME example problem manuals for ASME Section VIII. Detailed scenarios are examined to illustrate how the analytical techniques are applied, and their respective limitations. An overview of key elements of the materials and fabrication sections, a review of special construction techniques, and an overview of fatigue calculations and life assessment are also included in the discussion.

Topics Covered:

- ASME Code Overview
- Vessel Design
- Materials
- Fabrication
- Examination
- Testing

Who Should Attend:

This course is intended for pressure equipment engineers working for owner-users, manufacturing, or engineering and design firms in the high pressure industry. This may include refining, petrochemical, powdered metal, or upstream petroleum industries, who either directly use or refer to ASME Section VIII Division 3.

Location: On-site or customized training available upon request.

Duration: 2 days

Credits: 15 PDH

Pricing: Contact Us





DANIEL T. PETERS, P.E. dpeters@structint.com

Education:

M.S. Mechanical Engineering, Gannon University B.S. Mechanical Engineering,

Pennsylvania State University

Accreditations / Industry Leadership:

- ASME Honorary Fellow
- Pressure Vessels and Piping Division - Division Chairman and Member of Executive Committee ASME Codes and Standards Development -Chair Subgroup on

High Pressure Vessels – Member 10 years

Authored and Co-Authored more than 20 papers since 2001.

Background:

Mr. Peters' activities over the last 20 years has focused on the design and analysis of high-pressure equipment, including the application of fracture mechanics to the design and analysis of pressure vessels for evaluation of the life of the equipment.

Design by Analysis has become mainstream utilizing the most advanced features of finite element analysis (FEA), cyclic life assessment, and fracture mechanics.

This course will give an overview of the ASME philosophy of using ASME Section VIII Division 2 and 3 in design of pressure vessels and pressure equipment. This will include a discussion of the interrelationship between design, inspection and long term asset management of equipment.

SECTION XI - In-Service Inspection

In the early 1970's, the industry resolved to develop an in-service inspection code for nuclear plants. Section XI of the ASME Boiler and Pressure Vessel Code addresses inspection, flaw evaluations, and repair and replacement. Understanding the bases of the Code and how to apply the Code in practical ways are key to ensuring successful plant operation.

This course provides an overview of the ASME Section XI Code as well as an overview of some of the NDE technologies and how these can be used to meet your inspection requirements. Additionally, this course will identify how risk-informed alternatives to Section XI can reduce inspection requirements. Our ASME Code Section XI course can be complemented by attending the ASME Code Section III and Flaw Evaluations training courses.

Topics Covered:

- ASME Code overview
- Inspection requirements
- Flaw characterization
- Elaw evaluation
- Repair and Replacement

Who Should Attend:

Nuclear plant program engineers, design engineers, system engineers and regulators who desire a practical knowledge of analysis, monitoring, and risk-informed programs, NRC regulations and best industry practices.

Location: On-site or customized training available upon request.

Duration: 2 Days

Credits: 15 PDH

Pricing: Contact Us



RISK-BASED PROGRAMS

Risk-informed In-Service Inspection (RI-ISI) is a cost-effective alternative to ASME Code, Section XI inspection requirements. Structural Integrity played a key role in the development of EPRI's NRC-approved RI-ISI and RIS_B (Risk-Informed Safety-Based) methodologies. To date, we have supported ASME Code Case N-560, N-578 and N-716 evaluations using the EPRI RI-ISI methodology at 61 nuclear units.

Students will gain insights into realworld applications of Section XI code requirements, inspections and riskinformed alternatives.

Faculty Spotlight



MICHAEL LASHLEY mlashley@structint.com

Education:

B.S. Mechanical Engineering, University of Texas

Accreditations / Industry Leadership:

ASME Member of:

- Section XI Task Group on High Strength Nickel Alloy Issues
- Section III Subcommittee Materials, Fabrication, and Examination
- Section III Special Working Group HDPE Stakeholders
- Section III Task Group HDPE Materials, Fabrication, and Examination
- Chair of Joint Task Group (Section III, V, XI) on HDPE NDE
- Nonmetallic Pressure Piping Systems Subcommittee on Thermoplastic Piping (NM-1); Chair of NM-1 Subgroup on Inspection. Examination and Testing

Background:

Mr. Lashley has over 30 years of experience in providing engineering, failure and degradation analysis as well as NDE services to the utility industry. Mr. Lashley has managed and participated in the development and implementation of new and novel inspection protocols to support Repair Replacement Activities and In-Service Inspection including time of flight diffraction techniques and phased array techniques. He is actively involved in multiple ASME B&PV Code committees and has experience in risk-informed applications.



FLAW EVALUATIONS -ASME Code Case N-513

Evaluating, analyzing, and dispositioning flaws can be difficult and requires an in-depth knowledge of NRC Regulatory Guide 1.147, ASME Section XI and ASME Code Case N-513 (Evaluation Criteria for Temporary Acceptance of Flaws in Moderate Energy Class 2 or 3 Piping).

This course offers a practical application of flaw evaluation methodologies that meet NRC requirements. Students will gain an understanding of the basic flowchart for ASME Section XI flaw evaluations and will be able to describe linear-elastic, elasticplastic, and limit load evaluation techniques. The course also provides examples that illustrate management of degraded and leaking piping and how to properly implement ASME Code Case N-513 and other evaluation alternatives.

Topics Covered:

- Key definitions
- Flaw characterization
- Evaluation vs. repair
- Class 2 and Class 3 planar flaw evaluation
- Class 2 and Class 3 non-planar flaw evaluation

Who Should Attend:

Nuclear mechanical design engineers, program engineers, mechanical system engineers and project engineers who seek practical knowledge related to Code-compliant flaw evaluation alternatives and lifecycle management of components.

Location: On-site or customized training available upon request.

Duration: 2 Days

Credits: 15 PDH

Pricing: Contact Us

Faculty Spotlight



ERIC HOUSTON, P.E. ehouston@structint.com

Education:

B.S. Mechanical Engineering, University of Texas

Accreditations / Industry Leadership:

ASME Member of Working Group on Pipe Flaw Evaluation

Background:

Mr. Houston has more then 10 years experience with structural analyses of reactor pressure vessel boundary and system piping and is an active member of the Section XI Working Group on Pipe Flaw Evaluation. He has performed numerous operability assessments of through-wall or near throughwall flaws, design-by-rule and design-by-analysis of piping and components, and cyclic operation analysis.

CORROSION AND CORROSION CONTROL IN LIGHT WATER REACTORS

Corrosion is a significant concern for many components on nuclear power generation facilities. Left unresolved, corrosion can cause serious damage that can be difficult to resolve.

This course focuses on fundamentals, causes, and control of corrosion in light water reactors (LWRs). LWR corrosion degradation mechanisms covered include general/ uniform corrosion, galvanic corrosion, de-alloying corrosion, crevice corrosion, pitting corrosion, intergranular attack (IGA), corrosion fatigue/environmentally assisted fatigue (EAF), intergranular stress corrosion cracking (IGSCC), primary water stress corrosion cracking (PWSCC) and irradiation assisted stress corrosion cracking (IASCC).

Topics Covered:

- Fundamentals of corrosion, including Evans and Pourbaix diagrams
- Corrosion mechanisms and their effect on components and systems
- Mitigation of corrosion in light water reactor systems
- Case studies

Who Should Attend:

Nuclear program engineers, chemists, designers, maintenance engineers, inspectors, and regulators who desire a practical knowledge of LWR corrosion degradation mechanisms and their mitigation.

Location: On-site or customized training available upon request.

Duration: $4\frac{1}{2}$ days

Credits: 32 PDH

Pricing: Contact Us



ASME CODE CASE N-513

Whether preparing acceptance criteria in support of planned inspections or evaluating an existing flaw in a safety-related system, you have a wide range of options.

Learning from our experience, this course discusses the advantages and disadvantages of each option, at a sufficient depth to be able to perform the required actions. Students are challenged throughout the course to apply the course material to real life examples.



CORROSION AND CORROSION CONTROL IN LIGHT WATER REACTORS

This course provides the technical background necessary to understand the nature of corrosion phenomena and its implications for reactor safety. What makes this course unique is that it identifies real-world applications, relates the relevance to the NRC's surveillance requirements, as well as covers case histories of each type of degradation.

Faculty Spotlight



BARRY GORDON, P.E.

bgordon@structint.com

Education:

M.S. and B.S., FNACE Metallurgy and Material Science, Carnegie Mellon University

Accreditations / Industry Leadership:

- Fellow and Corrosion Specialist in the National Association of Corrosion Engineers (NACE)
- Certified LWR corrosion instructor for California, ASME, the US NRC and International Atomic Energy Agency
- Developed and qualified hydrogen water chemistry (HWC) and co-patented zinc injection for stress corrosion cracking mitigation in BWRs Holder of four patents related to
- corrosion mitigation in BWRs

Backaround:

Mr. Gordon has over 45 years of experience and expertise in materials' corrosion behavior in nuclear power plant environments. He has authored/co-authored numerous EPRI, MRP and BWRVIP reports, as well as over 75 publications, including coauthoring three books on LWR corrosion phenomena.



MICROBIOLOGICALLY INFLUENCED & OTHER RAW WATER CORROSION

Corrosion can occur in almost every raw water cooling component at power generation and industrial facilities. Facilities that use rivers or lakes for cooling water can introduce microfilms that can lead to microbiologically influenced corrosion (MIC) which can be very aggressive and attack piping welds and heat exchangers. Left unresolved, corrosion can cause serious damage to piping systems and components that are difficult to identify and resolve.

This course focuses on raw water corrosion fundamentals and on identification, monitoring, and mitigation of cooling water system corrosion. This course is a practical starting point for more-specialized courses on corrosion.

Topics Covered:

- Fundamentals of corrosion
- Differences between general corrosion, pitting corrosion, under-deposit corrosion and MIC
- Corrosion mechanisms and their effect on components and systems
- Appropriate techniques to identify and mitigate corrosion in raw water systems
- Case studies
- Corrosion monitoring

Who Should Attend:

Mechanical design engineers, system engineers, chemistry staff and project engineers who seek a foundational understanding of corrosion and MIC.

Location: On-site or customized training available upon request.

Duration: 2 Days

Credits: 15 PDH

Pricing: Contact Us



CAN OCCUR CORROSION **ANYWHERE:**

Microbiologically-influenced corrosion (MIC) is an ever-present threat to nuclear plant service water systems. This course will provide the student with practical application of corrosion theory and how to monitor for, and mitigate the effects of MIC.

Faculty Spotlight





Education:

B.S. Metallurgical Engineering, University of Illinois

Accreditations / Industry Leadership:

Mr. Licina is widely published and has been an author and major contributor for numerous EPRI Sourcebooks related to corrosion:

- "Sourcebook for Microbiologically Influenced Corrosion in Nuclear Power Plants" (EPRI NP-5580, 1988) EPRI Corrosion/Deposition Sourcebook for Nuclear Plant Service Water Systems (TR-103403, 1993)
- Service Water Piping Guideline (EPRI 1010059, 2005) – Contributor
- Life Cycle Management Sourcebook for Nuclear Plant Service Water Systems (EPRI 1008282, 2005)
- <u>Computer</u> Based Training Course for MIC for EPRI (2007)
- Co-authored EPRI's Buried Pipe Reference Document (EPRI 1021470, 2010)
- Guidelines for Replacement Materials for Service Water Systems (EPRI 1025275)
- Guideline for Preventing Galvanic Corrosion in Above-Ground Dissimilar Metal Piping Systems (EPRI 3002003191)

Background:

Mr. Licina has over 40 years of experience in evaluating environmental degradation of materials in power plant and other industrial environments, including all forms of corrosion and stress corrosion cracking in aqueous environments. He is a co-founder of the Blo-GEORGETM Corrosion Monitoring and Prevention System, which provides real-time detection of microbiological elements.

FRACTURE MECHANICS

When a flaw is found in a reactor pressure vessel, piping, or other nuclear plant component, fracture mechanics calculations are used to analyze and predict flaw behavior, including crack growth rates and critical crack sizes.

This course will cover the fundamentals of fracture mechanics (FM) and common applications of fracture mechanics in the nuclear power industry. Topics will include linear-elastic and elastic-plastic fracture mechanics, methods for computation of stress intensity factors, fatigue life, and stress corrosion life. Selected applications of the ASME Code and an introduction to probabilistic fracture mechanics (PFM) will also be provided.

Topics Covered:

- Fundamentals of fracture mechanics
- Examples of fracture mechanics applications
- Limitations of fracture mechanics
- Critical crack size calculations
- Life calculations under fatigue or stress-corrosion cracking
- Selected applications of the ASME Code
- Limit-load analyses and their nuclear applications
- Introduction to the pc-CRACK[™] FM computer program

Who Should Attend:

Engineers who seek to better understand the use of fracture mechanics to analyze and predict flaw behavior. This course will be of special interest to those working with equipment design, failure analysis and material testing.

Location: On-site or customized training available upon request.

Duration: 2 Days

Credits: 15 PDH

Pricing: Contact Us

FRACTURE MECHANICS ANALYSIS AND RISK ASSESSMENT

Faculty Spotlight



DR. DILIP DEDHIA ddedhia@structint.com

Education

Ph.D. Materials Science, Oregon Graduate Center

Accreditations / Industry Leadership:

- Co-developer of EPRI BLESS code for headers and pipes Co-developer of EPRI TULIP for
- high temperature tubing Developed Structural Integrity's pc-CRACK™ 4.0 for general
- purpose fracture mechanics analysis

Background:

Dr. Dedhia has over 40 years of experience in deterministic and probabilistic fracture mechanics analyses. He also has extensive experience in fracture mechanics methods including high-temperature creep fatigue crack growth. Dr. Dedhia has been a key contributer to the EPRI MRP extremely low probability of rupture (xLPR) program.

Structural Integrity is an industry leader in applying deterministic and probabilistic fracture mechanics techniques, including finite element analysis, to disposition flaws in a variety of materials, geometries, and applied stress fields.

Using Structural Integrity's practical experience, this course goes beyond an introduction to the theory and formulas of fracture mechanics. It will provide students with real-world practical applications and methods. The course will also cover the use of pc-CRACKTM, a specialized program we developed and often employ for ASME Code Section XI flaw evaluations and weld overlay design.



FATIGUE MANAGEMENT

Fatigue management resulting from nuclear plant cyclic stresses and strains is a life limiting concern for nuclear plant components. Plants are required by federal law to manage the fatigue of systems, structures and components in the scope of license renewal. In order to produce acceptable results when considering the additional detrimental effects of a reactor water environment, a significant decrease in conservatisms is typically required in fatigue calculations. As a result, a robust fatigue management program must be established to meet regulatory expectations.

This course provides an in-depth review of the approaches and strategies used to evaluate, monitor and manage fatigue and environmentally-assisted fatigue (EAF) of pressure vessel and piping components.

Topics Covered:

- Fatigue fundamentals
- Failure mechanisms
- Regulatory compliance
- Fatigue management
- Fatigue/cycle monitoring

Who Should Attend:

Nuclear plant design engineers, program engineers and system engineers who desire a practical knowledge of environmentally-assisted fatigue analysis, fatigue monitoring, and lifecycle management of components based on ASME Code design rules, NRC regulations and best industry practices.

Location: On-site or customized training available upon request. Call for dates and locations.

Duration: 2 Days

Credits: 15 PDH

Pricing: Contact Us



FATIGUE MANAGEMENT **EVALUATIONS**

Structural Integrity was a key contributor to the EPRI Fatigue Management Handbook as well as to FatiguePro, a widely used, real-time thermal fatigue monitoring system that automatically tracks fatique transients and usage. Based on our extensive experience, this course will provide a practical understanding of fatigue identification of potential damage locations, fatigue management options and modifications, and vibration fatigue management.

Faculty Spotlight



TIM GILMAN tgilman@structint.com

Education:

- M.S. Civil Engineering, University of California at Berkeley
- B.S. Civil Engineering, California Polytechnic State University

Accreditations / Industry Leadership:

- ASME Working Group on Environmental Fatigue Evaluation Methods – member Chaired and co-chaired ASME PVP conference related to
- fatigue monitoring Authored EPRI's Creep Fatigue software for monitoring fatigue
- and creep damage in fossil power plants Authored and co-authored
- numerous EPRI papers, including "Characterization of U.S. Pressurized Water Reactor (PWR) Fleet Operational Transients" (MRP-393)

Background:

Mr. Gilman has over 20 years of experience in the nuclear industry and has been involved in a majority of the PWR license renewal applications to date. He is an expert in ASME Section III fatigue and environmentallyassisted fatigue analysis and fatigue monitoring of vessel and piping components in nuclear power plants.

NONDESTRUCTIVE EXAMINATION FOR ENGINEERS AND MANAGERS Nondestructive examination (NDE) is an important tool for aging

management of plant components.

In this course, NDE methods are reviewed on an industry-specific basis and a general introduction and review of the most common NDE methods is presented. A more focused review of frequently used NDE technologies and techniques is provided, including multiple hands-on technology demonstrations. Structural Health Monitoring (SHM) concepts and technologies are also reviewed. A general process for matching inspection needs with NDE methods, technologies, and techniques is also provided. Participants will learn basic quality control measures, recommended reporting requirements, planning and strategies for the effective utilization of NDE results.

Topics Covered:

- Process Technology
- Intro to NDE Methods
- NDE Method Selection
- NDE Personnel, Codes, & Standards

Who Should Attend:

Engineers and managers who seek a better understanding of modern methods for NDE of pressure vessels and piping as well as strategies for effective use of NDE results. This course may be of special interest to those involved with integrity management, buried piping programs, inservice inspections, aging management programs, ILI verification assessments, road crossing examinations, External Corrosion Direct Assessment (ECDA) and Internal Corrosion Direct Assessment (ICDA).

Location: On-site or customized training available upon request.

Duration: 3 Days

Credits: 22 PDH

Pricing: Contact Us

SYNTHESIZING NDE DATA INTO ENGINEERING DECISIONS

Nondestructive Evaluation (NDE) is utilized throughout the energy industry to assess the condition of critical components. An understanding of NDE principles, as well as their capabilities and limitations, is paramount to making engineering decisions based on NDE data.



This course is unique because it will enable engineers to understand the bases for appropriate NDE technology selection as well as the capabilities and limitations of each NDE technology. Additionally, attendees will learn NDE terminology and the basics of data analysis and interpretation, facilitating informed and intelligent engineering decisions based on NDE data.

Planning NDE Activities

NDE Reporting

SHM vs. NDE

Faculty Spotlight



LARRY NOTTINGHAM

Inottingham@structint.com

Education:

B.S. Mechanical Engineering, University of Pittsburgh

Accreditations / Industry Leadership:

- Level III NDE Certifications in Ultrasonics, Liquid Dye Penetrant and Magnetic Particle Testing methods
- Published more than 70 technical papers, reports and articles
- Presenter at numerous conferences, workshops, and seminars on NDE, including being a guest lecturer at the United States Naval Academy

Background:

Mr. Nottingham has over 40 years of experience in NDE and condition assessment of a wide variety of power plant equipment and components. He has extensive experience in the development and delivery of advanced NDE systems and procedures for numerous power plant applications, both fossil and nuclear.



OWEN MALINOWSKI

omalinowski@structint.com

Education:

- M.S. Engineering Mechanics,
- Pennsylvania State University
- B.S. Éngineering Science, Pennsylvania State University

Accreditations / Industry Leadership:

- Co-inventor and co-developer of Structural Integrity's SIPEC™, a dynamic Pulsed Eddy Current NDE technology
- Authored journal publications and patents

Background:

Mr. Malinowski is in the Research, Development, & Integration Group at Structural Integrity Associates, Inc. He is an expert in the theory and practice of bulk wave ultrasonic, guided wave ultrasonic, and electromagnetic NDE.



FUEL MANUFACTURING ISSUES AFFECTING PERFORMANCE

The manufacturing of nuclear fuel is a very well-controlled process. Manufacturing is highly proceduralized, special processes are gualified 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.

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

Who Should Attend:

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

Location: On-site or customized training **Pricing:** Contact Us available upon request.

Duration: 1 day

Credits: 7 PDH



DESIGN ANALYSES OF NUCLEAR FUEL AND COMPONENTS

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.

Faculty Spotlight





Education:

- M.S. Engineering Management, University of Kansas
- B.S. Nuclear Engineering, Texas A&M University

Accreditations / Industry Leadership:

- P.E. Nuclear
- Management SRO Certification at Wolf Creek
- Member of the industry "Zero-By-2010" committee to eliminate fuel failures in the U.S. nuclear industry
- An industry peer reviewer for two INPO site evaluations.

Background:

Mr. Sparks has over 26 years of experience at nuclear power plants in the areas of core thermal-hydraulic analysis and reactor engineering. At the San Onofre Nuclear Generating Station (SONGS), he was the Supervisor of the Reload Design Group responsible for core design, reload analysis, criticality analysis, fuel design and manufacturing oversight, fuel rod performance analysis, fuel reliability and dry cask storage analysis. He was the project manager for the effort to license a second fuel vendor, including alternate core reload analysis methodologies, for SONGS. This project involved implementing a second fuel vendor's design into the licensed reload analysis methodology for SONGS. Mr. Sparks had lead engineer responsibility for core thermal-hydraulic analysis (utilizing the VIPRE and TORC computer codes), fuel reliability and inspections, and manufacturing oversight of fuel vendors.

PELLET CLAD INTERACTION

An important performance issue for nuclear fuel is power operation without incurring fuel failures from Pellet Clad Interaction (PCI). While classical PCI failures were not particularly unusual through the 1980s, the industry response consisting of improved fuel designs and power ramping guidelines for startups and restarts has proven effective. However, in the 2003 to 2006 time period, the industry was surprised by the occurrence of multiple failures in several PWRs - the failure mechanism was determined through hot cell examination to be PCI-type failure in the presence of large missing pellet surface defects.

This training course enhances awareness of PCI-type failures and effective mitigation strategies. As such, the course addresses the PCI-type failure mechanism, including contributory local fuel and cladding phenomena.

Topics Covered:

- Impacts of improper core and fuel management
- Impacts of local effects such as rod cluster control assembly withdrawal
- Classical and missing pellet surface failure mechanisms
- Power ramping programs to establish proper guidelines

Who Should Attend:

Licensed Senior Reactor Operators, fuel handling personnel, outage managers, nuclear engineering staff and probabilistic risk assessment staff that desire a deeper understanding of key factors affecting nuclear fuel reliability and strategies for improving fuel rod performance.

Location: On-site or Pricing: Contact Us customized training available upon request.

Duration: 1 day

Credits: 7 PDH



In support of the nuclear industry's initiative to eliminate fuel failures, our fuel experts worked with the Electric Power Research Institute (EPRI) to develop multiple fuel reliability guidelines for use by utility personnel and industry oversight organizations: Fuel surveillance and inspection programs to identify and assess trends in key fuel

This overview course will provide practical application to enable students to successfully manage your fuel and PCI failure.

NUCLEAR FUELS

Faculty Spotlight

MICHAEL KENNARD mkennard@structint.com



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 (ÉPRI 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).

DEVELOPMENT OF INDUSTRY FUEL RELIABILITY GUIDELINES

performance characteristics for currently operating reactors following changes PCI failure mitigation in BWR and PWR fuel designs through the development of improved power maneuvering procedures

 Grid-to-rod fretting fuel failure recommendations to eliminate failures through improvements in debris mitigation features in fuel designs, core design modifications and fuel spacer grid design improvement



FUEL ROD PERFORMANCE MODELING

Several key factors in nuclear fuel performance have come into prominence recently as a result of the trend toward increased fuel utilization. This demonstrates the need for a robust computational capability for both steadystate and transient fuel rod analysis.

This course will review a number of issues facing the industry. Topics addressed include how burnup-induced pellet changes and increased hydrogen uptake (as a byproduct of corrosion) occurring at higher burnups, impact both steadystate operation and licensing issues such as postulated Reactivity Initiated Accidents (RIA), Loss-Of-Coolant Accidents (LOCA), as well as spent fuel storage and transportation. This course will also identify why utilities have a need for an accurate and effective predictive fuel performance computational capability to provide guidance for both reactor operation, as well as feedback to the fuel design process.

Topics covered:

- Relevant fuel performance phenomena
- Theoretical approach required to develop the computational tools and capabilities to analyze these phenomena under a variety of operational conditions
- Analysis examples of several fuel performance issues based on fuel rod experiments and commercial operational data

Who Should Attend:

Licensed Senior Reactor Operators and nuclear engineering staff who seek a better understanding of fuel rod/cladding damage mechanisms and effective evaluation of spent fuel integrity related to transportation accident conditions as described in NRC regulations.

Location: On-site or customized training available upon request.

Duration: 1 day

Credits: 7 PDH

Pricing: Contact Us



FUEL BEHAVIOR MODELING AND ANALYSIS

Structural Integrity, with the addition of ANATECH, has unique experience in developing material constitutive models and integral behavior codes for nuclear fuel and irradiated materials. Under EPRI sponsorship, we developed the Falcon code for the analysis of fuel rod behavior during normal operation, maneuvers, transients and postulated accidents. As a finite-element based code, Falcon has versatile 2-D geometric representation capabilities that can be used to model a full-length fuel rod or a local region of the fuel and cladding material. The Falcon code considers all aspects of nuclear fuel performance, including thermal, mechanical, chemical, and irradiation effects.

This class will provide real-world examples and approaches to improve fuel rod performance through the use of tools like Falcon. Discussions include fuel rod failure assessments during power maneuvers, postulated Reactivity Insertion Accidents and LOCAs, and fuel design verification.

Faculty Spotlight





Education:

M.S. and B.S. Nuclear Engineering, Texas A&M University

Accreditations / Industry Leadership:

- P.E. Nuclear
- Has over 75 open literature publications and technical reports, and has published and/or presented papers at conferences in the United States, Europe, China and Japan.

Background:

Mr. Lyon has over 25 years of experience focusing on computational software development and coding, nuclear fuels and materials modeling, experimental design and analysis, and fuel performance design and analysis. He has worked with Los Alamos National Laboratory and the Advanced Thermal and Structural Technology Section of the Jet Propulsion Laboratory. Mr. Lyon previously was an Advanced Engineer in the Space and Defense Power Group at Westinghouse Hanford Company supporting the SP-100 space reactor development program as well as the FFTF and EBR-II nuclear fuel and materials experimental programs.

SPENT FUEL INTEGRITY ANALYSIS IN **TRANSPORTATION CASKS**

Cladding failures, with the potential for reconfiguration of the cask's fuel contents to a critical geometry, in combination with water in-leakage to optimum-moderation levels has raised the specter of criticality for spent fuel transportation.

Spent fuel casks must comply with NRC's licensing requirements of 10 CFR Part 71 for transportation and handling, which are governed by two drop events: a 9-meter drop of a cask protected by impact limiters and a 0.3-meter drop of a bare cask onto a flat, essentially unyielding, horizontal surface where the cask strikes the surface in a position for which maximum damage is expected.

This course focuses on the evaluation of spent fuel conditions under long-term dry storage and hypothetical transportation accidents. Topics include the evaluation of fuel rods/ cladding damage mechanisms and damage states during dry storage, and use of these damage states as initial conditions for detailed dynamic impact analysis and failure evaluation of cask/fuel rods under the transportation conditions.

Topics covered:

- Regulatory requirements for spent fuel casks
- Impact of water ingress

Who Should Attend:

Licensed Senior Reactor Operators, nuclear engineering staff, fuel handling staff and individuals involved with spent fuel storage who seek better understanding of spent fuel storage integrity issues.

Location: On-site or customized training **Pricina:** Contact Us available upon request.

Duration: 1 day

Credits: 7 PDH



these challenges.

NUCLEAR FUELS

Concepts in drop analysis with regards to the cask and the fuel contained in the casks

SPENT FUEL STORAGE AND TRANSPORTATION

The behavior of high-burnup spent fuel during long-term dry storage and subsequent transportation has been the subject of research and evaluation at EPRI for many years. We have played a significant role in supporting these R&D efforts. Through this course, participants will gain an improved understanding of potential challenges to the integrity of spent fuel stored in transportation casks as well as the evaluation methods that are used to address

Faculty Spotlight



DR. JOE RASHID, P.E. jrashid@structint.com

Education:

Ph.D, M.S., and B.S. Engineering Mechanics, University of California, Berkeley

Accreditations / Industry Leadership:

- Society membership: ASME Fellow, ANS, ASTM Committee 26.13, and MRS
- P.E. Nuclear
- Received ASME Service Award in 1990
- Appointed by the NRC to serve on the Expert Elicitation Panel for NUREG-1150

Backaround:

Dr. Rashid has over 45 years of experience in the fields of computational mechanics, nuclear fuel technology, and materials behavioral modeling and failure analysis. He has authored over 100 journal articles and conference papers in these fields. His work includes modeling and simulation of LWR fuel behavior under normal operations and design basis accidents, spent fuel dry storage and transportation evaluations, and safety analysis of nuclear power plant structures under beyond-design-basis loading, including aircraft impact. He has served on a number of expert panels and peer review committees dealing with severe reactor accidents and aging and degradation of nuclear plant structures.



PLANT VIBRATION FUNDAMENTALS AND SOLUTION DEVELOPMENT

Resolution of problems related to vibration and other forms of high-cycle loading can be extremely challenging. Issues can appear without warning, often in unexpected places, and require immediate response. Problems can originate due to acute changes, such as varied operating states, system alignment(s), and component replacement(s), or on account of occasional exposure to atypical yet damage-inducing conditions. The mechanisms which drive vibration failures are not always well understood and are not covered within standard engineering academic curricula or in typical rotating equipment vibration training courses.

Structural Integrity can help by offering plant employees an introduction to vibration solutions through this course. Training is provided in an interactive, hands-on manner, using actual case studies and live demonstrations to reinforce basic vibration principles and encourage retention of advanced concepts. This course ties in concepts of structural dynamics, stress analysis, applied mechanics/materials, and instrumentation and testing to develop a comprehensive understanding of vibration mechanisms and equip students to solve vibration problems in the field.

Design engineers, system engineers, maintenance engineers, project engineers and predictive

maintenance personnel who seek a comprehensive understanding of vibration principles and prac-

Topics Covered:

Basic vibration theory and fundamentals Common vibration problems

Diagnostics for piping system and

Vibration problem resolution process

tical knowledge for solving vibration-related failures in the field.

Location: On-site or customized training available upon request.

rotating equipment vibration

Principles and best practices of

vibration testing

Who Should Attend:

- Analysis and interpretation of test data Incorporating analytical modeling and
- other engineering analysis Applicable industry and regulatory guidance
 - Common mitigation strategies

Faculty Spotlight



MARK JAEGER, P.E. mjaeger@structint.com

Education:

B.S. Mechanical Engineering, South Dakota School of Mines and Technology

Accreditations / Industry Leadership:

Authored and co-authored multiple technical papers for EPRI and ASME Pressure Vessels and Piping conferences

Background:

Mr. Jaeger more then 10 years of experience assessing and mitigating issues related to vibration and other forms of cyclic loading. He is an expert at applying state-of-the-art instrumentation and analysis techniques to resolve a variety of challenging problems, such as flow-induced vibration (FIV) of piping, valve chattering, pump/ motor/structure resonance, and branch line failures. He routinely supports customers with highlyvisible, time-sensitive projects, ranging from operability evaluations to litigation support.

Duration: 2 ¹/₂ Days

Credits: 18 PDH

Pricing: Contact Us



Structural Integrity's vibration engineers have years of experience marrying instrumentation and testing services to core engineering capabilities such as structural dynamics, stress analysis of piping and components, and applied mechanics/materials science. We work on projects ranging from singlecomponent failures (bearings, branch lines, etc.), to general vibration assessment (T-G sets, fans, piping systems, etc.), to large-scale, distributed monitoring applications with hundreds of sensors spread across the plant.

This course provides the student with an integrated approach to solving realworld problems.

WELDING & MATERIALS

Welding is integral to construction, maintenance, and repair of power plants and components. Nuclear plants are required by federal law to control special processes such as welding and nuclear welding programs are the cornerstone for compliance with this requirement. The interaction among various organizations at nuclear facilities is necessary to plan, implement, and inspect welding activities. A fundamental knowledge of welding processes and welding programs is essential for individuals interacting with welding activities to ensure first time quality is achieved. Further, a broader understanding of welding will increase effective communication among site welding and non-welding personnel.

This course provides an in-depth review of welding at nuclear power plants, including welding process fundamentals, materials and metallurgy, and relevant Codes and Standards.

Topics Covered:

- Fundamentals of welding processes
- Weld joint configuration
- Welding materials and metallurgy
- Heat treatment
- Temper bead welding
- Welding programs

Who Should Attend:

Design engineers, program engineers, component engineers, maintenance engineers, system engineers and regulators who desire a practical knowledge of welding processes, welding metallurgy and associated heat treatments, and best industry practices.

Location: On-site or customized training available upon request.

Duration: 2 Days

Credits: 15 PDH

Pricing: Contact Us

WELDING ENGINEERING

Appropriate weld design, welding procedures, and welder qualification are vitally important in the energy industry. Structural Integrity offers comprehensive welding engineering services, including development and review of welding programs, selection and development of welding processes for critical applications, review and evaluation of procedure qualification records, and review and evaluation of weld failures. Our instructors bring many years of experience and practical applications that incorporate industry best practices to this class.



Faculty Spotlight



DR. RICHARD SMITH

rsmith@structint.com

Education:

- Ph.D. Materials Engineering Science, Virginia Polytechnic Institute
- M.S. and B.S. Metallurgical Engineering, Virginia Polytechnic Institute

Accreditations / Industry Leadership:

- American Welding Society Fellow
- ASME Section XI Working Group member and ad hoc member on welding repairs and special processes
- ASME Section IX Task Group presenter

Background:

Dr. Smith's 45-year career has focused primarily on electric power industry issues involving metallurgy, corrosion, and welding. During his tenure at Structural Integrity, he has worked with utility and industrial clients on issues involving materials selection and design, welding, corrosion, program planning, root cause evaluations, licensing support, oversight, and training.







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