Environmentally-Assisted Fatigue Analysis, Monitoring and Management of Nuclear Plant Components

A Practical, Case Study-based Training Program
Led by:

Timothy Gilman

15 Hours • 1.5 CEUs • 15 PDHs

About this Master Class *(MC118)*

Nuclear plants in the United States were originally licensed by the Nuclear Regulatory Commission (NRC) for 40 years of operation. Most utilities either have or are currently submitting applications to the NRC in order to renew the license and extend operation to 60 years. Plants are required by federal law to manage the aging effects, including 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 the fatigue calculations, and a robust fatigue management program must be established to meet regulatory expectations.

This two-day MasterClass provides an in-depth review of the approaches and strategies used in the industry to evaluate, monitor and manage fatigue and environmentally-assisted fatigue (EAF) of vessel and piping components in nuclear power plants.

For more information and to register, visit
go.asme.org/mc118

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ASME MasterClass Series

The ASME MasterClass Series focuses on applications and case studies of a particular topic. Each Master Class is led by an ASME Master, an expert in his professional discipline, who brings a wealth of knowledge and practical examples to the forum. Participants are expected to have prior knowledge of the topic area to gain the most from this interactive environment.

Sessions are focused on real world examples and case studies, with active class discussion and analysis.

About this MasterClass

Environmentally-Assisted Fatigue (EAF) analysis and management of nuclear plant components is one of the most technically challenging aspects related to meeting NRC expectations for new nuclear plant design or license renewal. Both the scientific knowledge and the regulatory requirements related to EAF have evolved relatively rapidly in recent years. This two-day MasterClass is designed to focus on the evaluation, monitoring and programmatic approaches and strategies that have been used by licensees to successfully meet regulatory expectations.

The procedures for ASME Section III fatigue and EAF analyses are provided, along with example calculations. Several Case Studies are presented and discussed in detail regarding approaches and strategies to successfully evaluate typical high fatigue locations, using NRC approved analysis methodologies. In summary, this MasterClass provides an in-depth and practical overview of real life solutions to managing fatigue in nuclear vessel and piping components.

Participants are encouraged to bring examples of particularly challenging issues encountered on the job for in-class discussion.

Upon completion, attendees will be able to

- Evaluate design requirements and regulatory expectations related to fatigue of nuclear plant components.
- Perform basic calculations related to fatigue and EAF using Design by Analysis approach.
- Define the elements and process for developing a fatigue management and monitoring program.
- Evaluate the basis of successful approaches and strategies to resolve high fatigue/challenging locations.

About this ASME Master

Timothy Gilman is an expert in ASME Section III fatigue and environmentally-assisted fatigue analyses, and fatigue monitoring of vessel and piping components in nuclear power plants. He 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. Mr. Gilman is currently with Structural Integrity Associates and for the past 7 years has managed the Fatigue Monitoring & Environmental Fatigue engineering group and is a key contributor to the development of SI's fatigue monitoring systems, installed at over 100 nuclear units worldwide. He also authored EPRI's Creep Fatigue software for monitoring fatigue and creep damage in fossil power plants.

Mr. Gilman earned his degree in Civil Engineering from California Polytechnic State University in 1993 and his Master's degree in Civil/Structural Engineering from the University of California at Berkeley in 1994.

Who Should Attend

This Master Class is intended for nuclear power plant staff engineers, designers, analysts, and regulators who desire a practical knowledge of environmentally-assisted fatigue analysis/monitoring and lifecycle management of components, based on the ASME Code design rules, NRC regulations, and best industry practices.

MasterClass Requirements

This MasterClass is structured on the assumption that participants have a basic knowledge of ASME Nuclear Codes & Standards.

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AGENDA

The contents are presented in several case studies, tentatively organized as shown below. The two-day schedule allows for ample discussion and interaction with attendees. The instructors reserve the right to modify the content to address the audience's needs and preferences.

Day One: 8:00am – 5:00pm

Introduction to Fatigue Crack nucleation and propagation, fatigue testing and basis for S-N curve, environmentally-assisted fatigue behavior, and the debate about what a fatigue usage of 1.0 means.	8:00 – 9:00
Regulatory Issues and Requirements Requirements for new plant design, operating plants, and license renewal.	9:00 - 10:00
BREAK	10:00 – 10:15
Environmentally-Assisted Fatigue Analysis Procedures and Techniques An overview with practical example calculations: Design/loading specifications; stress analysis techniques; fatigue analysis using multiaxial stresses; conservatisms between Code editions; environmentally-assisted fatigue analysis; advanced non-linear analysis.	10:15 – 12:00
LUNCH	12:00 – 1:00
Environmentally-Assisted Fatigue Analysis Procedures and Techniques (continued)	1:00 – 2:00
Case Study 1: Bettis Pipe Tests Comparison of analytical results versus experimental observations.	2:00 – 3:00
BREAK	3:00 – 3:15
Elements of a Fatigue Management Program Needs for monitoring; screening of locations to evaluate; types of monitoring (cycle counting, cycle-based fatigue, stress-based fatigue, fatigue crack growth); actual versus design numbers of cycles and their severity. Challenges for 60 and 80 years of operation.	3:15 – 5:00

End of Day 1

Day Two: 8:00am – 5:00pm

Case Study 2: Thermal Stratified PWR Feedwater Nozzle Overview of causes of cracking of nozzles with original designs. Strategies used to evaluate, monitor and mitigate fatigue cracking.	8:00 – 9:00
Case Study 3: BWR Feedwater Nozzle Overview of causes of cracking earlier in life and steps taken to repair and prevent reoccurrence. Approaches and example calculations used to manage environmental fatigue over plant life for license renewal.	9:00 – 10:00
BREAK	10:00 – 10:15
Case Study 4: PWR Charging Nozzle with High Thermal Gradients Approaches and example calculations used to manage environmental fatigue over plant life for license renewal.	10:15 – 11:00
Case Study 5: PWR Surge Line and Pressurizer with Thermal Stratification Approaches and example calculations used to manage environmental fatigue over plant life for license renewal.	11:00 – 12:00
LUNCH	12:00 – 1:00
Case Study 6: Stratification Cycling in Normally Stagnant Branch Lines Overview of thermal fatigue cracking and leakage in stagnant lines attached to RCS piping and process used to manage locations.	1:00 - 2:00
Case Study 7: Fatigue Analysis of Weld Overlaid Components Impact of weld overlays on existing fatigue analyses; strategies used to evaluate weld overlaid components.	2:00 – 3:00
BREAK	3:00 – 3:15
Case Study 8: Postulating High Energy Line Break Locations Overview of process used to postulate high energy line break locations based on fatigue usage factors, and issues plants may need to address for long term operation.	3:15 – 3:45
Case Study 9: Flaw Tolerance Analysis of Surge Line – An Industry First Inspection and flaw tolerance analysis in lieu of meeting environmental fatigue analysis acceptance criterion. Example calculations and results for the first such analysis reviewed and accepted by the NRC for license renewal.	3:45 - 4:45
Summary and Wrap-up	4:45 – 5:00