Corrosion and its Mitigation in Light Water Reactors (LWRs)

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

Barry Gordon, P.E.

15 Hours • 1.5 CEUs • 15 PDHs

About this Master Class *(MC119)*

A nuclear plant's primary operational objective is to maximize the service life from existing equipment without sacrificing structural integrity. Unfortunately, corrosion, and especially environmentally-assisted cracking is responsible for a significant amount of lost plant availability and, in some cases, a complete termination of plant operation. This two-day MasterClass provides an in-depth review of the various forms of corrosion that affect light water reactors (LWRs). It is a practical review of corrosion problems in LWRs including BWR piping and internals, PWR steam generators, PWR control rod drive mechanisms and internals, boric acid corrosion, etc. The MasterClass is based on a series of LWR case studies of corrosion problems by each form of corrosion involved, how to identify their cause and how to mitigate the corrosion mechanism involved with the component's structural degradation.

For more information and to register, visit
go.asme.org/mc119

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ASME MasterClass Series

The ASME Master Class 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

Corrosion problems in the LWR industry are so critical and costly that they sometimes hit the front pages of The New York Times (e.g., Davis-Besse twice, Oyster Creek). This two-day MasterClass is designed to focus on the causes and, more importantly, the control of corrosion in Light Water Reactors (LWRs). It is a practical review of corrosion problems in LWRs, including BWR piping and internals, PWR steam generators, PWR control rod drive mechanisms and internals, PWR boric acid corrosion, etc.

The fundamentals of corrosion are briefly reviewed, including why metals corrode, the definition of electrode potential, basic corrosion cell, etc. Case Studies are presented and discussed in detail for each form of corrosion in LWRs, how to diagnose the mechanism involved and methods to mitigate its detrimental effects. In summary, this MasterClass provides an in-depth introduction of the various forms of corrosion degradation that affect LWR structural integrity and the mitigation of the problem.

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 the huge economic impact of corrosion degradation in the nuclear power industry
- Identify and diagnose the mechanisms of the various forms of corrosion and how they affect LWRs
- Describe the most critical corrosion phenomena currently affecting the LWR industry, such as stress corrosion cracking
- Identify and apply the appropriate techniques to mitigate corrosion in LWRs

About this ASME Master

Barry Gordon, P.E., is a Fellow and Corrosion Specialist in the National Association of Corrosion Engineers (NACE) as recognized for his expertise in LWR corrosion phenomenon. He was the Chairman of NACE committees on Nuclear Systems and Energy Technology. Mr. Gordon has over 50 years of experience and expertise in materials' corrosion behavior in nuclear power plant environments, has over 75 publications including co-authoring three books on LWR corrosion phenomena and has served as an expert witness testifying for utilities before the U. S. Nuclear Regulatory Commission's (NRC's) Advisory Committee on Reactor Safeguards and Atomic Safety Licensing Board.

Mr. Gordon is a certified LWR corrosion instructor for both the US NRC and International Atomic Energy Agency and is author/co-author of numerous EPRI®, MRP and BWRVIP programs and reports.

MasterClass Requirements

Prior to the event, attendees will be given the opportunity to submit questions or examples of real-life scenarios they have experienced or are experiencing for class discussion.

This MasterClass is structured on the assumption that participants have a basic knowledge of LWR structural materials and LWR water chemistry.

Who Should Attend

This MasterClass is intended for nuclear power plant staff engineers, designers, maintenance engineers, inspectors, and regulators who desire a practical knowledge of LWR corrosion degradation mechanisms and their mitigation.

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AGENDA

The contents are presented in several corrosion mechanism 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.

Thursday, January 29, 8:00am – 5:00pm

Costs of Corrosion in LWRs and brief review of Corrosion Fundamentals	8:00 – 9:00
Case Study 1: General Corrosion of LWR Containments and Boric Acid Corrosion in PWRs Mechanism of general corrosion and its impact on the structural integrity of carbon steel LWR containments. Boric acid corrosion of carbon steel and low alloy steel in PWRs. Methods for mitigation.	9:00 - 10:00
BREAK	10:00 – 10:15
Case Study 2: LWR Balance of Plant Galvanic Corrosion and Dealloying Corrosion Galvanic corrosion on a macro scale (e.g., condensers) and micro scale sensitization. Dealloying corrosion of copper alloys and cast irons. Methods for mitigation.	10:15 – 11:00
Case Study 3: Effects of Flow on LWR Components Erosion corrosion, flow-accelerated corrosion of carbon steel in LWRs, cavitation/impingement damage of LWR components. Methods for mitigation.	11:00 – 12:00
LUNCH	12:00 – 1:00
Case Study 4: Crevice Corrosion, Pitting Corrosion and Intergranular Attack (IGA) in LWR Components Mechanisms, differences between crevices in BWRs and PWRs, statistics of pitting corrosion, IGA and its measurement. Methods for mitigation.	1:00 – 3:00
BREAK	3:00 – 3:15
Case Study 5: Environmentally-Assisted Cracking (EAC) in LWRs Mechanism of corrosion fatigue/environmentally-assisted fatigue in LWRs and an introduction to stress corrosion cracking (SCC).	3:15 – 5:00

End of Day 1

Friday, January 30, 8:00am – 5:00pm

Case Study 6: Intergranular Stress Corrosion Cracking (IGSCC) in BWRs History of IGSCC and mechanism of IGSCC in BWR piping, Alloy 600 safe end IGSCC, microstructural and compositional effects and effects of cold work on IGSCC.	8:00 – 10:00
BREAK	10:00 – 10:15
Case Study 6 (continued): IGSCC in BWRs Effect of water chemistry on IGSCC, crack growth rate modeling and mitigation of IGSCC in BWR stainless steel piping.	10:15 – 12:00
LUNCH	12:00 – 1:00
Case Study 7: Primary Water Stress Corrosion Cracking in PWRs History of PWSCC in PWRs, control rod drive mechanism and bottom mounted instrument nozzle PWSCC, PWSCC mechanism.	1:00 – 3:00
BREAK	3:00 – 3:15
Case Study 7 (continued): PWSCC in PWRs PWSCC mitigation, PWR steam generator corrosion and mitigation, SCC of stainless steels in PWRs.	3:15 - 4:00
Case Study 8: Irradiation Assisted Stress Corrosion Cracking of LWR Internals Definitions, IASCC field observations, IASCC mechanism, BWR component cracking, PWR baffle bolt IASCC, mitigation of IASCC.	4:00 - 4:50
Summary and Wrap-up	4:50 – 5:00