A.N.T. International Academy
ONLINE EDUCATION

BWR Fuel Advanced

COURSE DESCRIPTION

This course gives an overview of topics relevant to BWR fuel engineers and technical managers. The overview provides background information necessary to understand fuel and material behaviour as related to practical design, operational, reliability and safety issues. The course involves reading technical reports, watching lectures and participating in online assessments (tests).

The course material, including the online content, can be accessed at times convenient for practicing engineers and managers. Assessments are done online, with an understanding of the current material (i.e., 70% required correct answers) needed to proceed to the next part of the course. After passing the final online test, a certificate will be issued to the student.

The course comprises three technical areas: Structural material degradation, coolant chemistry and fuel materials. The principal focus of this course, fuel materials, covers the entire lifespan of fuel assemblies from design and manufacturing through operation and post-irradiation interim storage.

Background information is provided on coolant chemistry and the degradation of plant materials because the primary coolant chemistry affects fuel performance, but is generally targeted towards minimising corrosion of structural materials and minimising the buildup of plant activity.

The content is described more in the *Appendix*.

COURSE MATERIAL

The course material was developed by A.N.T. International and consists of earlier recorded A.N.T. International Seminars and associated Reports published by A.N.T. International.

Parts of the following Reports are being used in this course:	
• Environmentally-Assisted Degradation of Structural Materials in Water Cooled Nuclear Reactors — An Introduction (SMDR)	*Sample*
• Introduction to Boiling Water Reactor Chemistry — Volume I (LCC7 STR)	*Sample*
• Introduction to Boiling Water Reactor Chemistry — Volume II (LCC8 STR)	*Sample*
• Fuel Design Review Handbook (FDRH)	*Sample*
• Fuel Fabrication Process Handbook Rev 1 (FFPH)	*Sample*
• Fuel Material Technology Report (FMTR — Volume I)	*Sample*
• Fuel Material Technology Report (FMTR — Volume II)	*Sample*
• Control Assembly Technology Report (FMTR — Volume III)	*Sample*
• Fuel Material Technology Report (FMTR — Volume IV)	*Sample*

AUTHORS/LECTURERS

The lecturers, World Class Experts in their fields, are as follows:

Structural Material Degradation:
Peter Ford, Peter Scott and **Pierre Combrade.**

Coolant Chemistry and Corrosion:
Samson Hettiarachchi, Robert Cowan and **Wilfried Rühle.**

Fuel Material:
Alfred Strasser, Richard Collingham, Charles Patterson, Friedrich Garzarolli, Ron Adamson and **Peter Rudling.**

Read more about the Experts

COURSE DURATION

- Total time: around 200 hours (approx. 5 weeks of full-time studies)
- Literature: 130 h
- Lectures: 60 h
- 6 Exams: 6 h

More time may be needed to digest the information provided in this course.

CERTIFICATE

You will automatically receive an email with your certificate that you can print or share on social media. If you need a printed certificate, please don't hesitate to contact us and we can send it to you via regular mail. You reach us at *support@antinternational.com*.

CONTACT

For more information and/or an offer welcome to contact us at *sales@antinternational.com*

Please also visit our website for the latest updated information, *www.antinternational.com*

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Appendix: Course outline and topics covered

1) STRUCTURAL MATERIAL DEGRADATION

1.1 Introduction and background to material degradation
1.2 Physical metallurgy of structural alloys
1.3 Corrosion basics
1.4 Water chemistry in nuclear plants
1.5 Uniform, accelerated and localised corrosion
1.6 Environmentally-assisted cracking of carbon/low alloy steels, austenitic and Ni-base alloys

2) BWR PRIMARY COOLANT CHEMISTRY AND CORROSION

2.1 Materials and design selection
2.2 Influence of coolant chemistry on fuel performance
2.3 Plant radiochemistry
2.4 Reactor coolant system chemistry

3) FUEL MATERIAL

Fuel Design

3.1 The fuel suppliers and their design offices
3.2 Structure and components of the fuel assembly
3.3 Mechanical design
3.4 Thermal hydraulic design
3.5 Nuclear design

Fuel Fabrication

3.6 Structure and components of the fuel assembly
3.7 Fuel and fuel pellet fabrication
3.8 Zirconium alloy component fabrication

Fuel Material Performance During Normal Operation and Anticipated Operational Occurrence

3.9 Performance of Zr alloys
3.10 Overview of fuel reliability and consequences of fuel failures, methods to detect fuel failures during operation and outage (poolside and hot cell)
3.11 Secondary degradation of failed fuel
3.12 Performance of UO_2 and MOX
3.13 Performance of stainless steel and nickel-base alloy fuel assembly components
3.14 Fuel performance codes, margins, treatment of uncertainties

4) BWR PRIMARY COOLANT CHEMISTRY AND CORROSION

4.1 Fuel performance during accident conditions, LOCA and RIA
4.2 Fuel performance during interim dry storage
4.3 Design, performance and management of BWR control rods

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