



# A.N.T. International Academy

---

## ONLINE EDUCATION

## Zirconium Alloy Manufacturing

### COURSE DESCRIPTION

---

The purpose of this course is to provide insight how the manufacturing of Zirconium alloy fuel assembly components impact the following:

- Pellet Cladding Interaction (PCI) Pellet Cladding Mechanical Interaction (PCMI) corrosion and hydriding properties that, in turn, are dependent upon:
  1. Chemical composition
  2. Crystallographic texture and cladding microstructure.
  3. Clad strength/ductility/fracture toughness
- Re-opening of the pellet-cladding gap, lift-off, which is partly related to the fuel clad creep properties.
- Excessive dimensional changes (resulting in e.g. excessive Fuel Assembly (FA) bowing) of fuel components that are a function of creep (including oxide induced and residual stress relaxation creep), irradiation growth, and hydrogen pickup in the components.
- Loss of Coolant Accident (LOCA) performance that is related to hydrogen pickup both during the base irradiation, before the LOCA event, as well as during the high temperature LOCA oxidation.



The lectures can be accessed at times convenient for practicing engineers and managers. Assessment are done online, with an understanding of the current material (i.e., 70% required correct answers). After passing the test, a certificate will be issued to the student.

The content is described more in the [Appendix](#).

### COURSE MATERIAL

---

The course material was developed by A.N.T. International and consists of modified/edited earlier recorded A.N.T. International Seminar.

---

## AUTHORS/LECTURERS

---

The authors/lecturers of the reports and lectures, World Class Experts in their fields, are as follows:

Friedrich Garzarolli, and Peter Rudling.

[\*Read more about the Experts\*](#)

---

## COURSE DURATION

---

- Total time: About 12 hours
- Lectures: 8 hours

The listed time for the lectures is the actual running time. 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\*](mailto:support@antinternational.com).

---

## CONTACT

---

For more information and/or an offer welcome to contact us at [\*sales@antinternational.com\*](mailto:sales@antinternational.com)

Please also visit our website for the latest updated information, [\*www.antinternational.com\*](http://www.antinternational.com)



### **TRY THIS COURSE FOR FREE!**

All of our currently available courses have selected content you can access completely free of charge. Click the button to the right, select the course you would like to try out and sign up!

**CLICK HERE TO SIGN UP**

# Appendix: Course outline and topics covered

## ZIRCONIUM ALLOY MANUFACTURING

- » Reactor Characteristics and Fuel Design
- » Irradiation Effects
- » Microstructure, Sponge and Ingot Fabrication
- » Effect of Impurities and Alloying Elements part 1
- » Effect of Impurities and Alloying Elements part 2
- » Secondary Degradation
- » Tube, Sheet Bar Manufacturing part 1
- » Tube, Sheet Bar Manufacturing part 2
- » Microstructure and Texture Consequences on Performance part 1
- » Microstructure and Texture Consequences on Performance part 2



A.N.T. INTERNATIONAL®

Advanced Nuclear Technology International

✉ [info@antinternational.com](mailto:info@antinternational.com) [www.antinternational.com](http://www.antinternational.com)