

Outline:

General
Metallurgy

Superalloys

Heat Treatment

Degeneration

Coating

Stripping/Cleaning

Welding

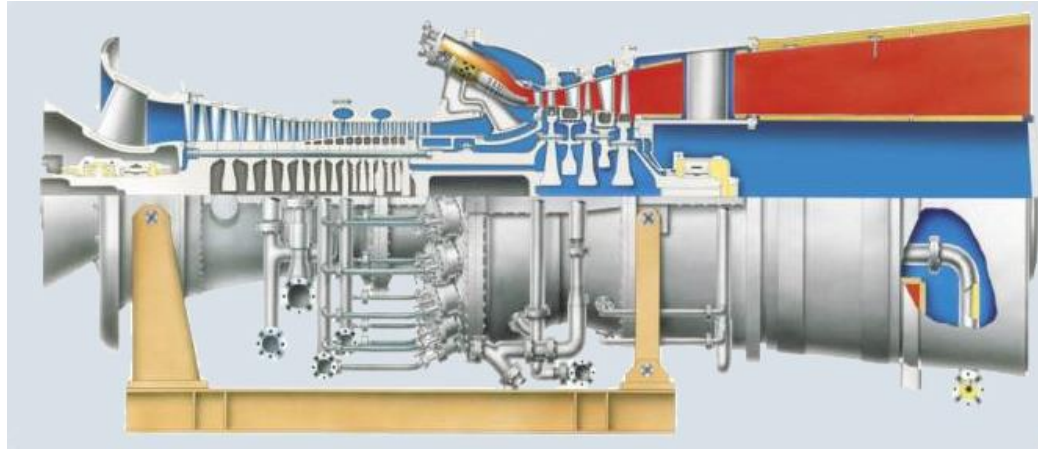
Brazing

Inspection NDT

With Case Studies

After this training, the participants should be able to:

- Recognize degeneration of IGT gas turbine components.
- Select the proper repair and coating technology to reverse this effect.
- Create an action plan to refurbish (repair and coat) these components, with proper heat treatments and in the right sequence.



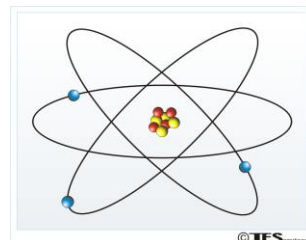
- The intention of this course is to provide technical background so the participants can make, metallurgical, sound decisions concerning the repair and coating of IGT components. This course is focused on employees of IGT refurbishment facilities who make sales, technical and production decisions, as well as give directions to refurbishment technicians. For end-users and their employees who get involved in repair of IGT components for purchasing, technical, maintenance and operational decisions, this course will be beneficial. It will enable them to understand the jargon of the refurbishment companies, make sound repair and coating decisions, create work scopes and request for quotes, review these quotes to select the best vendor, and follow the repair, coating, and inspection. The training format has been proven suitable for degreed engineers, technicians, and non-technicians.
- A full colored training manual, covering about 1000 slides is included, which will become an important information source.
- TEServices can provide training at your facility world-wide, meeting your agenda. Please contact hvanesch@TEServices.com for more information.
- The next training course will be January 11, 12 and 13, 2022 Spring Hill Suites By Marriott, 2120 Nasa Parkway, Seabrook, TX 77586. Register and pay before December 12, 2021 and receive \$300 discount.
- The 3-day training course, including manual, certificate and lunches, is \$1775 per participant.

First Day

Introduction **8:00 AM**

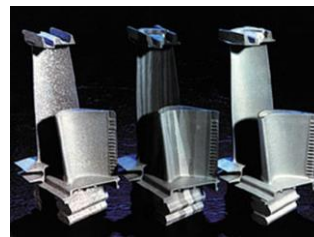
Materials fundamentals **8:30 AM**

From the atom, atom structure, metal and its alloys, solidification and phases are introduced and explained. This forms the basis of the superalloys, heat treatment and other sessions. Next are the important mechanical properties described such as: Stress and strain, yield and tensile strength, ductility, elastic modulus, creep, and hardness. This is followed by strength mechanism of the metal structure: Strain hardening, reduce grain size, solution strengthening and precipitation hardening.



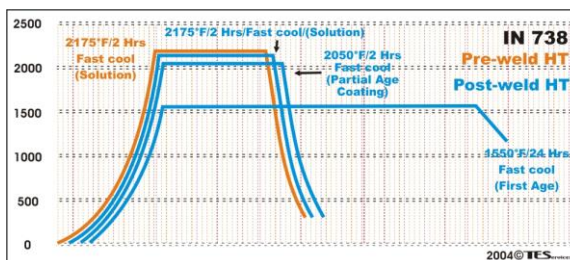
Superalloys **10:30 AM**

After a historic overview, a short refreshment of the strengthen mechanism, explained in sessions 1, is given. The difference between Fe, Ni and Co base superalloys is explained and their application in the IGT reviewed. The effect of strength and other mechanical properties of carbides, TCP phases, gamma prime, solution strengthening and grain size, will be explained and placed in superalloy context. The effect of Al and Cr is explained in the last chapter.



Heat-treatment **1:00 PM**

The different furnaces used for IGT components repair with their advantages and limitations will be discussed. Next, the quality issues related to heat treatment will be reviewed. The effect of heat treatment on weldability and serviceability will be explained for steel, cobalt, and nickel base superalloys. Attention will be given to the differences between solution strengthening and precipitation hardening nickel base superalloys.



Case Studies **3:00 PM**

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With Case Studies

Second Day

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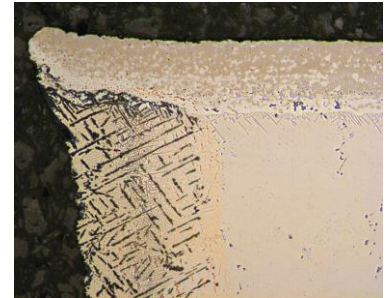
Inspection NDT

With Case Studies

IGT Component Degeneration

After introduction of the industrial gas turbine, the operation condition of the IGT components and its degeneration are discussed. Base materials and coatings of the IGT components are reviewed in the eye of the environment that they are operated in. Further samples of degeneration are given.

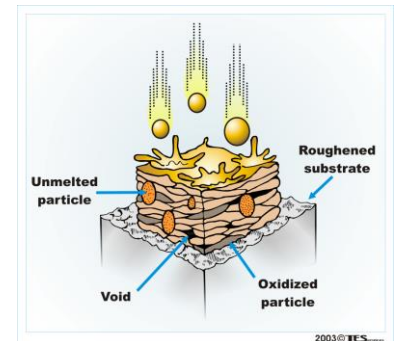
8:00 AM



Coatings

All the coating processes, such as LPPS, HVOF, EB-PVD and CVD, which are used for protecting IGT components, are described. The application of these different coating processes for different environment in the IGT are given with the advantages and disadvantages of them.

10:00 AM



Stripping and Cleaning

The different chemical, thermal chemical, mechanical and other stripping, and cleaning methods will be reviewed. Some of these methods are hydrogen and fluoride ion cleaning, water jet, salt batch and coat and strip methods. This session will be concluded with the different inspection methods, such as heat tint, macro-etch and metallurgical evaluation.

1:00 PM



Case Studies

3:00 PM

Third Day

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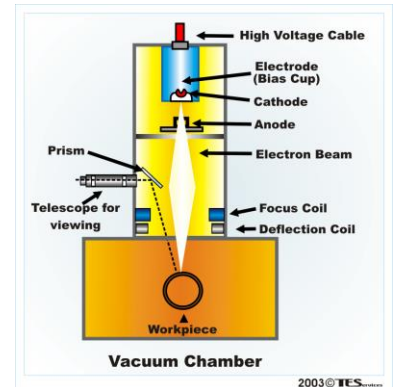
Inspection NDT

With Case Studies

Welding

The different welding processes which are used for IGT component repairs are described, and their characteristics given. For the different base materials, a typical weld scope, advantages, and disadvantages of the different weld methods as well as samples of repairs are given. The difficulties of welding precipitation strengthening superalloys and how to overcome these get special attention.

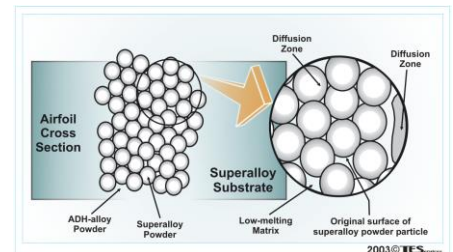
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Brazing

The different brazing processes which are used for IGT component repairs are described, and their characteristics given. The cleaning methods for the different base materials are revisited again and the advantages and disadvantages of brazing versus welding are discussed.

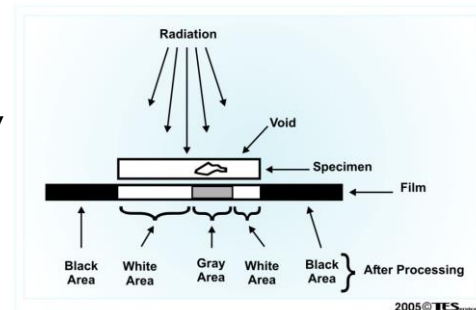
10:00 AM



Inspection: NDT

Explanation of the different Non-Destructive Testing methods used for inspection of the IGT components, such as Magnetic Particle Testing (MT), Liquid Penetrant Testing (PT), Radiographic Testing (RT), Eddy Current Testing (ET) and Ultrasonic Testing (UT) and application of the NDE technologies to inspect IGT components are given.

1:00 PM



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3:00 PM

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Instructor: Hans van Esch

With senior level technical expertise in turbine refurbishment, Hans van Esch is a metallurgical authority. His career at Hickham Industries, USA and Elbar, Netherlands (both now a part of Sulzer Turbo Services), and Chromalloy have enhanced his long career in process development for gas turbine repairs.

His specialty repair process knowledge includes heat treatment, HIPing, chemical cleaning and stripping, inspection, welding, high temperature brazing, and coating. Hans is a member of ASM, ASME, and AWS, and is supporting EPRI with creating repair specifications, international workshops and managing research and development projects.



**Registration form: Spring Hill Suites by Marriott
2120 Nasa Parkway
Seabrook, TX 77586 - Tel: 281 474 3456
January 11, 12 and 13, 2022**

Name: _____ Title: _____

Email address: _____ Phone: _____

Company: _____

Address: _____

City: _____ State: _____ ZIP: _____

_____ I have enclosed check or PO to TEServices, Inc.

_____ I will pay through PayPal.

- For more information contact Hans van Esch, TEServices phone 281 867 1500 or email to: hvanesch@TEServices.com .
- Please scan and email to hvanesch@TEServices.com, fax form to 281 867 1501 or mail to TEServices, P.O. Box 58781, Houston TX 77258.
- The 3-day training course, including manual, certificate and lunches, is \$1,775 per participant.
- Register and pay before December 12, 2021 and receive \$300 discount.
- Cancellation fee after December 12, 2021 will be \$500.

Turbine End-user Services, Inc (TEServices) in Houston specializes in the following Gas Turbine related services:

Audits

Technical and Quality Audits

To ensure that your suppliers have the technical expertise, resources, and quality system in place.



Verification

Intensive Vendor Verifications

To ensure that your components are manufactured and refurbished to your specifications and expectations.



Metallurgy

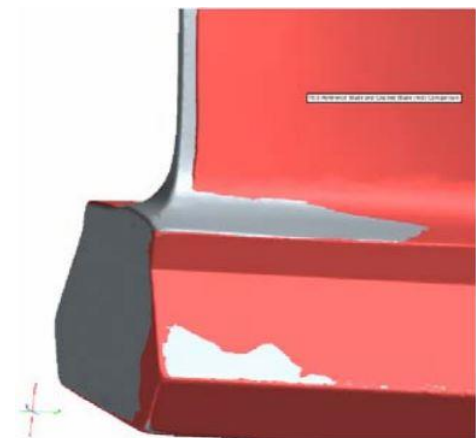
Metallurgical Evaluations

To assess the initial, work in progress, and refurbished condition of your gas turbine components.

Training

Comprehensive Training Courses

To increase your knowledge concerning gas turbine component manufacturing and refurbishment.



Other

Resolving Technical Issues

To evaluate your needs, and create your repair and bid specifications, as well as to assist resolving overhaul, maintenance, repair, coating, and inspection issues.

Let **TEServices** help you resolve your gas turbine component problems