RADIATION ENGINEERING TRAINING

- Space radiation environment & introduction to OMERE software
- Effects on components
- Materials

Specific Training in radiation engineering

We can **adapt the program to your needs**: in your company using your equipment, on our premises, or by videoconference, for one or multiple days.

FOR WHAT?

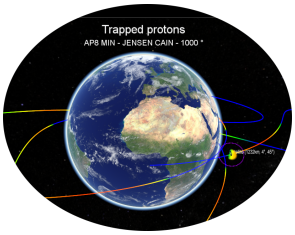
- To **understand and manage calculations** related to radiation effects on components, systems and materials
- To react proactively and integrate solutions during the design phase
- To **accurately analyse the performance of your system** in harsh environments
- To understand your client's specifications related to the qualification of their systems

FOR WHOM?

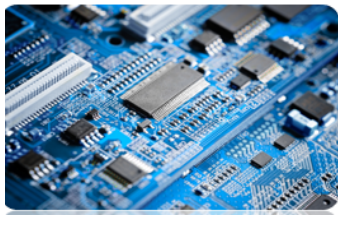
- OEMs/System designers and manufacturers
- Satellite Integrators
- Space Agencies
- Component Manufacturers

And in general, all professionals in the space domain concerned by radiation effects

TRAINING TOPICS



Space radiation environment and OMERE software



Radiation effects on electronic components

Radiation effects on materials

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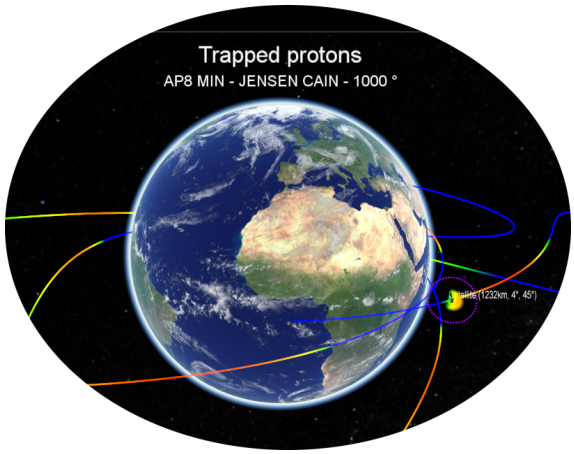
Space radiation environment & OMERE software



Taking into account radiation effects on space systems first implies the determination of precise environmental constraints. During space missions, satellites are exposed to an environment dense in charged particles from different sources (radiation belts, sun, cosmic rays).

The OMERE software - developped by TRAD with the support of the French Space Agency, the 'CNES' - allows users to quickly estimate the space radiation environment for any kind of mission.

The engineer can then define this environment in terms of Dose (TID), Displacement Damage (TNID) and Single Event Effects (SEE) with the calculation methodologies recognised by the space community and available in the OMERE freeware.

TRAINING CONTENT

1 Day*

- Radiation sources in the space environment
- Engineering models & standards
- Environment calculations
- Dose depth curve calculation
- SEE rate calculation
- Practical exercises using OMERE

PARTICIPANT PROFILE

Engineer level or equivalent

- Quality assurance
- System engineering
- Component/Material Engineering
- Equipment design and embedded instruments
- Research and development
- Project managers

Non-exhaustive list, ***we adapt the training content according to your knowledge and needs.***

**Average duration*

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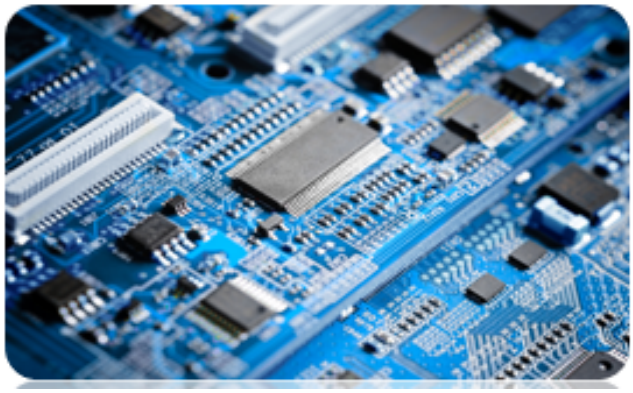
Characterisation of radiation effects on electronic components

Radiation qualification of embedded electronic equipment requires a good knowledge of:

- Types of radiation effects on electronics
- Sensitivities related to component technology
- Procedures of experimental characterisation (radiation tests)



The purpose of this training is to provide engineers with tools and methods necessary to carry out all stages of radiation qualification for components. This training will address both the microscopic aspects of radiation effects on matter, as well as the "system" aspects with the components' electrical parameters drift and its impact on systems. European specifications with regards to qualification will also be presented.

TRAINING CONTENT

1 Single Events Effects

- Physical phenomena and SEE types
- Elements for mitigation of SET, SEU, etc.
- Experimental characterisation

2 Dose & Displacement Damage

- Effects related to specific technologies
- Dose computation methodologies
- Total dose testing

1 to 2 Days*

3 Radiation Hardness Assurance

- Space standards & industrial approach
- Component qualification systems
- Radiation analyses

PARTICIPANT PROFILE

Engineer level or equivalent

- Quality assurance
- Systems Engineering
- Component/Reliability Engineer
- Equipment Design & Embedded Instruments
- Research & Development

Non-exhaustive list, ***we adapt the training content according to your knowledge and needs.***

Note: This training requires a good understanding of space radiation, space environment and the OMERE software. The 'Space radiation Environment' and 'Introduction to Omere' session can be combined.

**Average duration*

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Characterisation of radiation effects on materials

Taking into account radiation effects on materials is a distinct subject in the field of Radiation Hardness Assurance (RHA). Compared to electronic component aspects (see our training *'Characterisation of radiation effects on electronic components'*), determining dose levels in orbit and the reproduction of these constraints on earth requires a methodology and experimental means adapted to this problem.

These points are discussed in detail during the training to enable engineers to understand the physical mechanisms of material degradation and to identify key parameters for their characterisation.

TRAINING CONTENT

1 **Space radiation environment applied to materials**

2 **Effects on materials**

- Particle-matter interaction
- Effects depending on material types

Half Day*

3 **Radiation characterisation of materials**

- Experimental test sequence calculation
- Characterisation means

PARTICIPANT PROFILE

Engineer level or equivalent

- Quality assurance
- Materials Engineer
- Equipment Design and Embedded Instruments
- Research and Development

Non-exhaustive list, ***we adapt the training content according to your knowledge and needs.***

Note: This training is usually combined with the *'Characterisation of radiation effects on electronic components'* session.

**Average duration*

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Atmospheric radiation environment and its effect on electronic components

Applications evolving in a neutron-rich environment may face reliability issues related to radiation effects. This topic is becoming critical for a large number of fields (such as avionics, automotive, and nuclear research and industry) and requires specific measures for component characterization and related calculations.

The purpose of this training is to provide engineers with tools and methods to better understand and quantify the neutron-rich radiation environments and their effect on electronic components. The characterization of device sensitivity operating in a neutron environment will be addressed and the standards related to radiation governing this activity will also be covered.

TRAINING CONTENT

1 Day*

1. **Introduction to Neutron environments**
2. **Basic Neutron-matter interaction mechanisms**
3. **Single Event Effects types and definitions**
4. **Specifics of Neutron testing**
5. **Standards applied to Neutron characterization and analysis**

- **Note**: If combined with the 'Characterisation of radiation effects on electronic components' session the duration can be adapted.

*Typical duration

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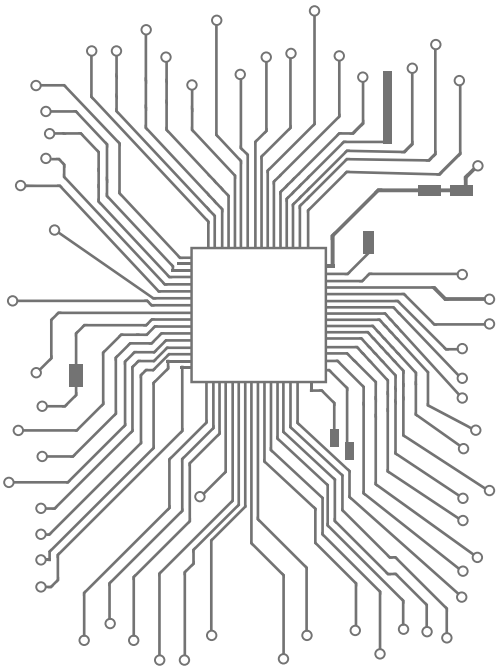
X-Ray inspections and dosimetry



X-ray inspections are part of the usual process for PCB assembly in the industry (verification of soldering; identification of defects, ...etc.). However, X-rays may generate some cumulated dose on electronic components which can have a impact on their functionality and lifetime.

The purpose of this training is to provide a general background on X-rays and their impact on electronic components, as well as discussing good practices to minimize the impact of dose when performing the inspections. General notions about dosimetry will also be presented.

TRAINING CONTENT

1 Day*

1. **X-rays origin and interaction with matter**
2. **Total ionizing dose effects on electronics devices**
3. **Notions on dosimetry, dose measurement and units**
4. **How to minimize the dose on X-ray machine**
5. **Examples of spectrum simulations with typical filters (using RayXpert® Software)**

- **Note**: If combined with the 'Characterisation of radiation effects on electronic components' session the duration can be adapted.

**Typical duration*

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TRAD
Tests & radiations

☐ **Pre-registration form**

☐ **Request for information**

Participant(s):

Forename: *Surname:*

Email: *Phone:*

Company and function(s):

Training desired:

- ☐ Space radiation environment and OMERE software
- ☐ Characterisation of radiation effects on electronic components
- ☐ Characterisation of radiation effects on materials

Location of training:

- ☐ TRAD
- ☐ In my company
- ☐ By videoconference

Dates requested:

Your needs/ Other request: