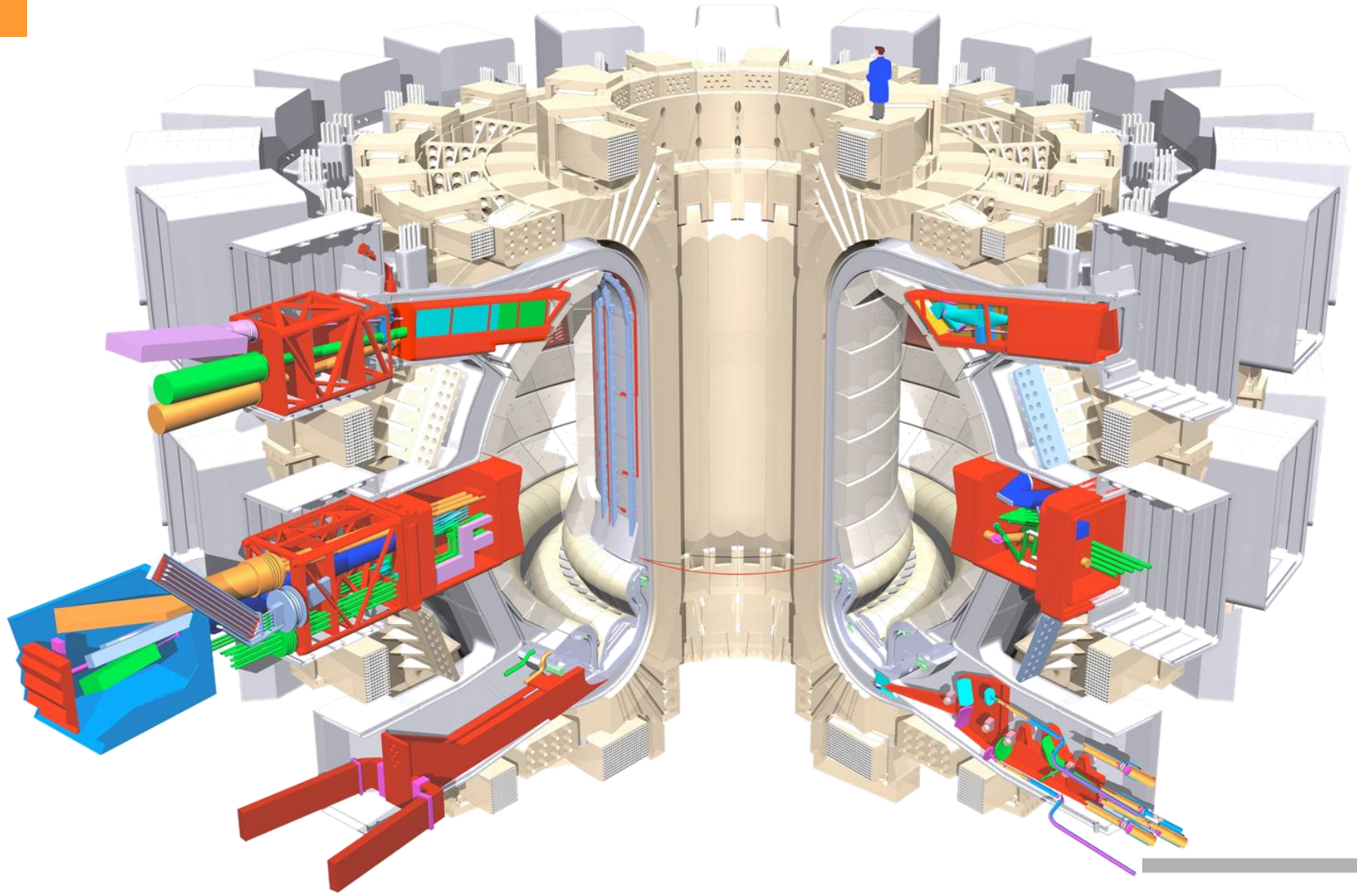
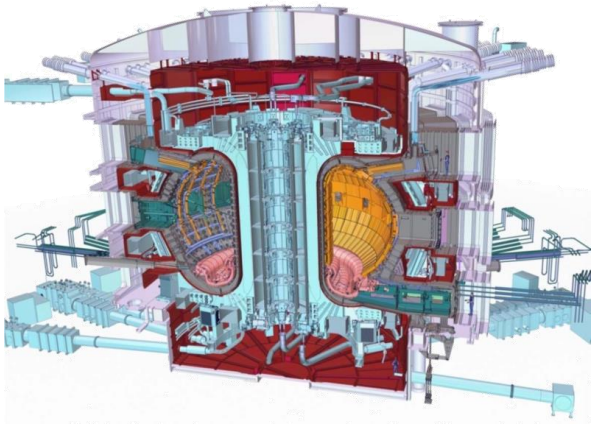
Jornada **BTEC/F4E** Diagnósticos



NATEC's engineering for ITER:

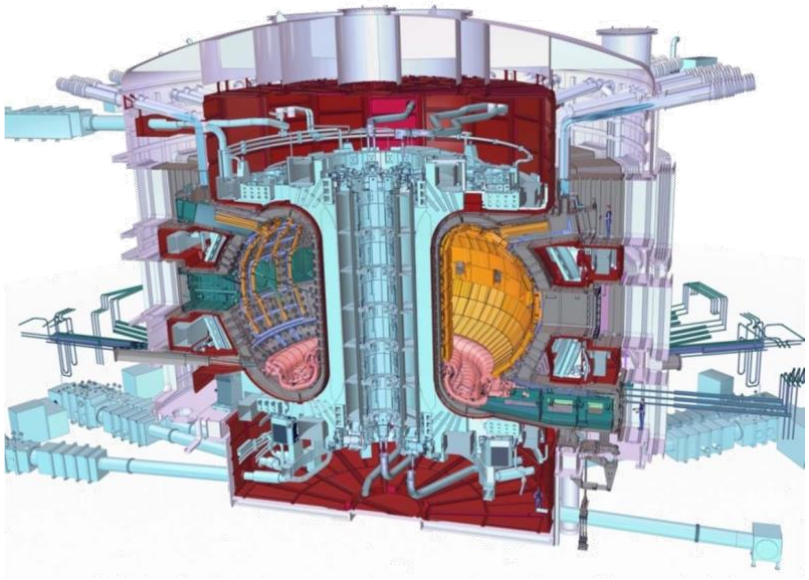
- DIAGNOSTIC PORT PLUGS DESIGN
- ENGINEERING ANALYSIS
  - THERMO HYDRAULIC
  - THERMO MECHANICAL
  - NEUTRONIC
  - STRUCTURAL INTEGRITY
  - ELECTROMAGNETIC
  - WELD DISTORTION PREDICTION
- NUCLEAR CODES AND STANDARDS



Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

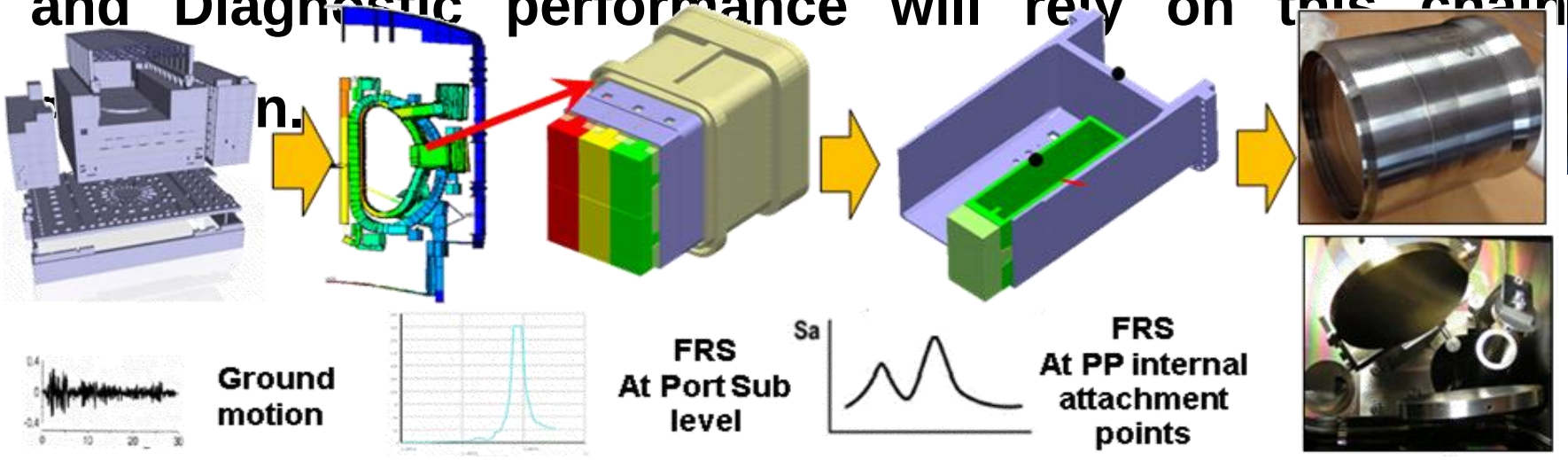
- DIAGNOSTIC PORT PLUG DESIGN

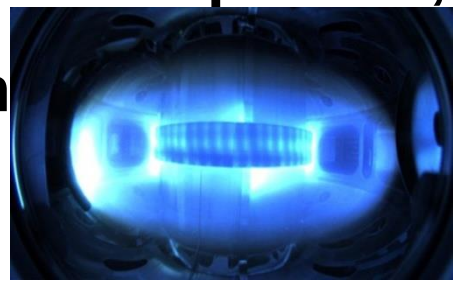


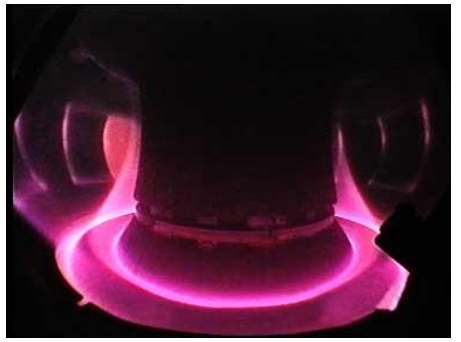
DIAGNOSTIC PORT PLUG DESIGN

Plasma Diagnostic Systems will allow SCIENCE to be done at ITER Machine.

Looking at a wide frame, they lay on top of a chain of machine components and structures built up literally from ground to plasma; and Diagnostic performance will rely on this chain



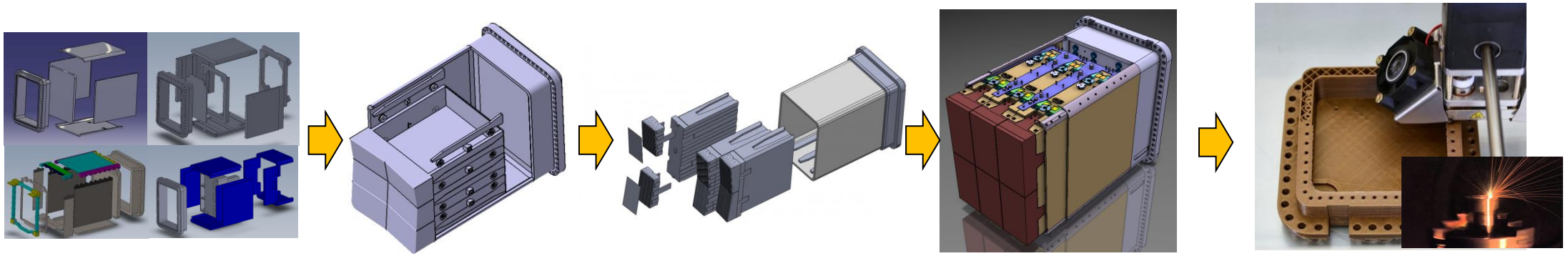




Jornada
BTEC/F4E
Diagnósticos

DIAGNOSTIC PORT PLUG DESIGN

Port plugs and Diagnostic / Shielding modules are the containers for most Diagnostic Systems. Over the last decade, our team has performed design, analysis and specification activities related to ITER Port Plugs; from earliest stages of Port Plug Design, through Conceptual, Preliminary and Final design reviews and up to Procurement and Manufacturing Specifications.



PREVIOUS DESIGNS < 2008

CONCEPTUAL DESIGN 2010

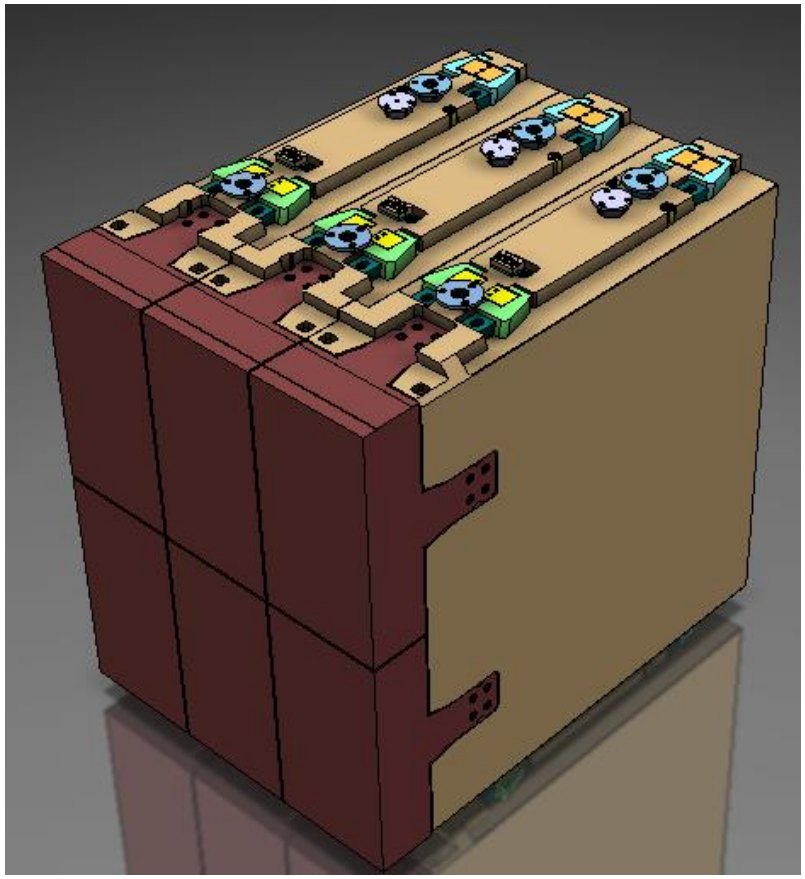
PRELIMINARY DESIGN 2011

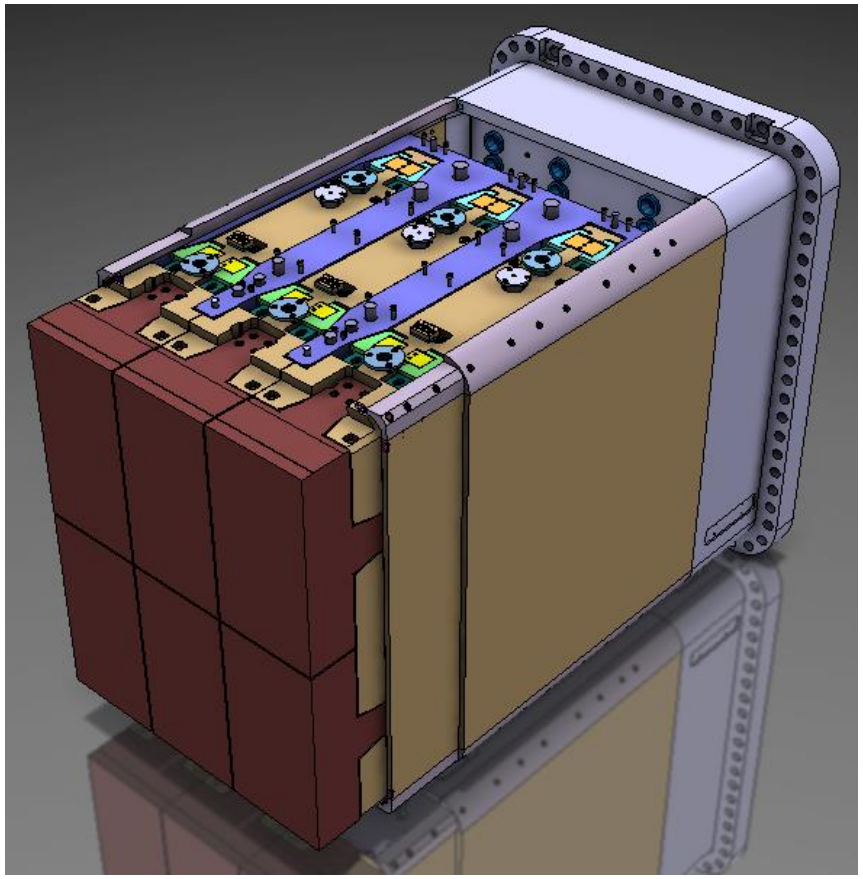
FINAL DESIGN 2013

PROCUREMENT & MANUFACTURING SPECIFICATIONS 2015

DIAGNOSTIC PORT PLUG DESIGN

A mature Final Design has been reached, with major challenges found in the attachment and assembly concepts.





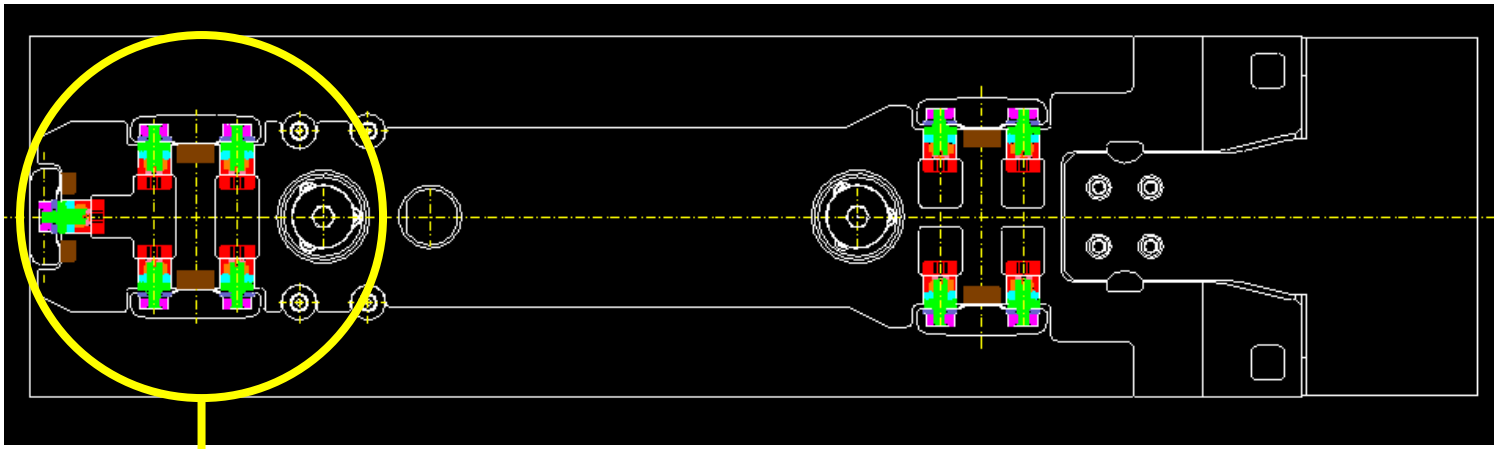
DIAGNOSTIC PORT PLUG DESIGN

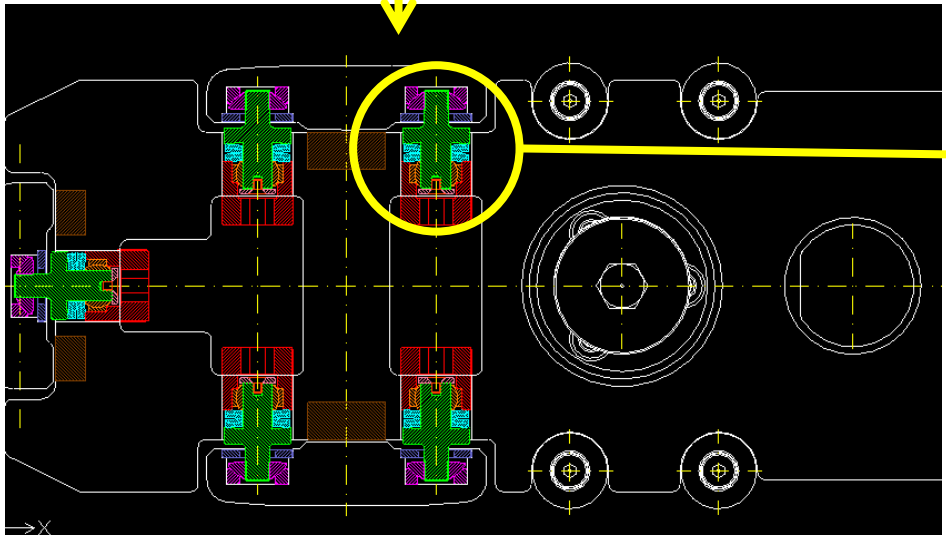
A relevant aspect of the design developed by NATEC, affecting most ITER diagnostic components has been the "*spring-damper attachment*" between Diagnostic Shielding Modules and Port Plug box structure. This is a critical design feature in order to:

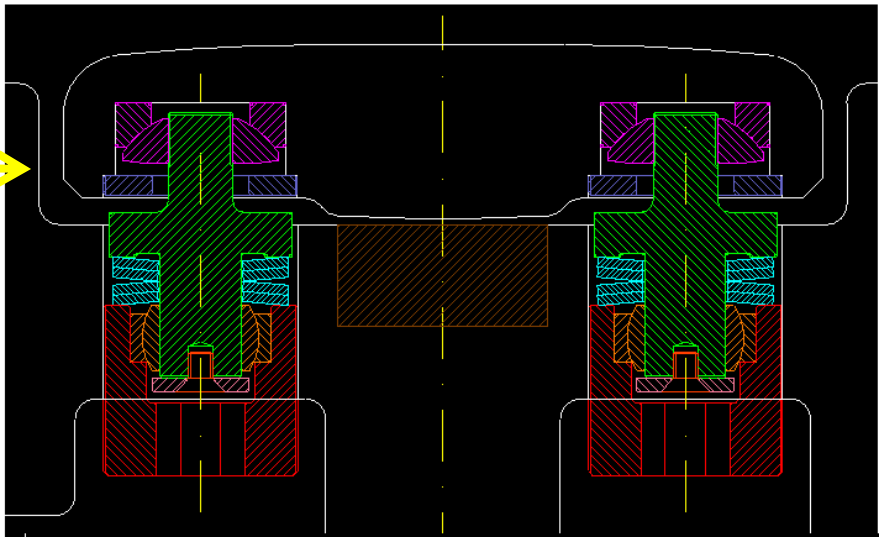
- **avoid rattling and excessive accelerations to be transmitted to Diagnostic components during Plasma disruption events.**
- **provide a cost efficient & robust design for PP and DSM manufacturing and assembly within achievable tolerances.**

DIAGNOSTIC PORT PLUG DESIGN

SPRING DAMPER ATTACHMENT SYSTEM



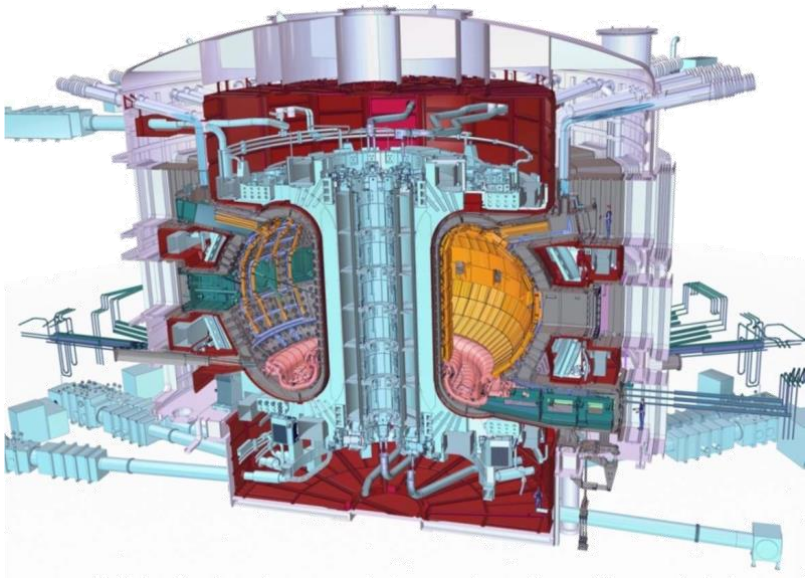




Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

- ENGINEERING ANALYSIS



ENGINEERING ANALYSIS

With over a decade of experience in Finite Element field using ANSYS, the Analysis and Engineering Support to F4E and ITER Diagnostic Section have been NATEC's main contribution to the project.

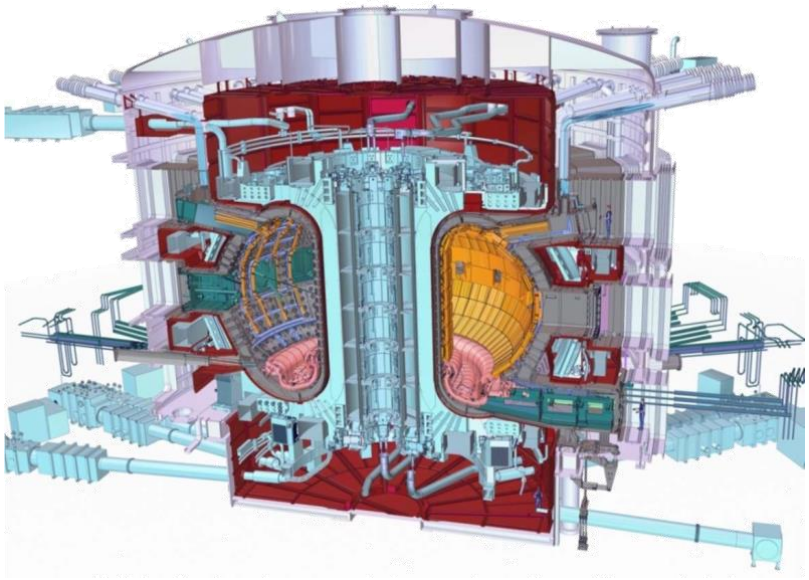
Multiple fields have been covered, making reality the transition from the *concepts*, the operation performance, and the structural integrity assessment *to* the *real component* manufacturing, predicting weld distortions and assessing the fabrication strategies.

Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

- ENGINEERING ANALYSIS:

  THERMO HYDRAULIC

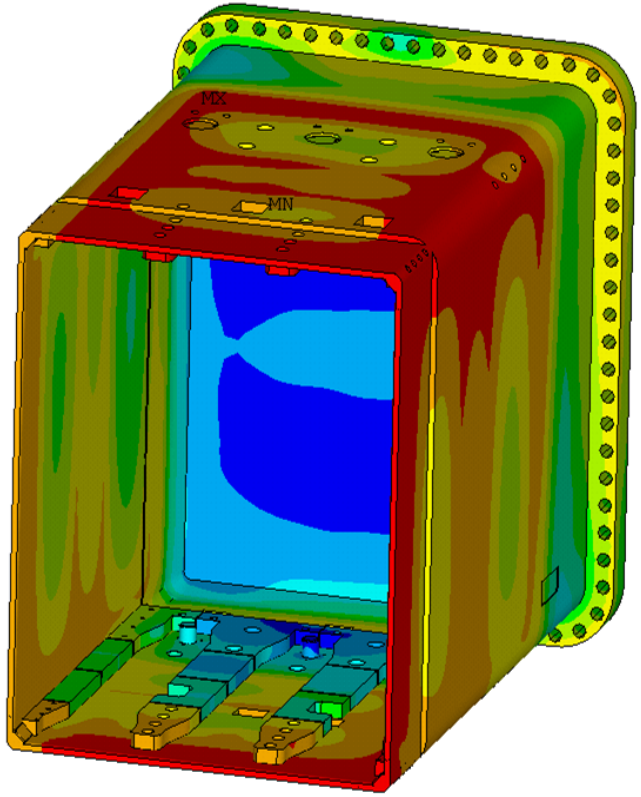


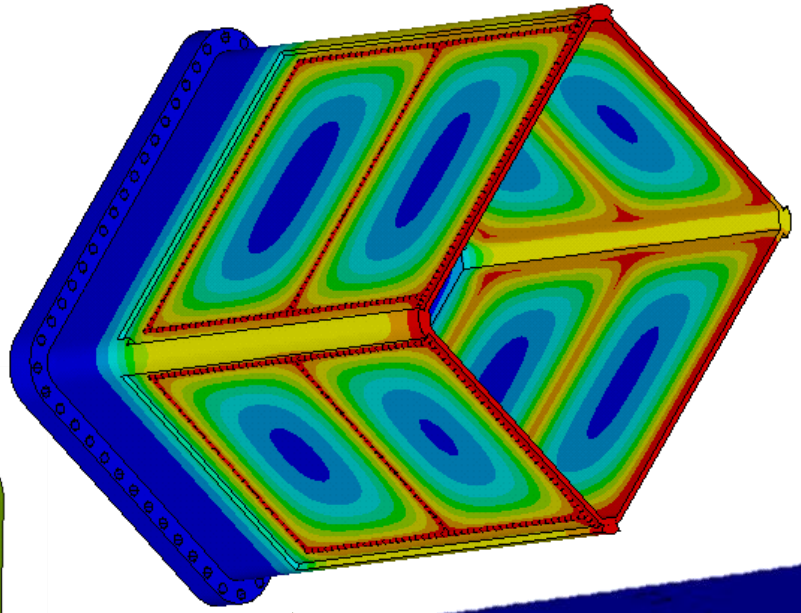
Jornada
BTEC/F4E
Diagnósticos

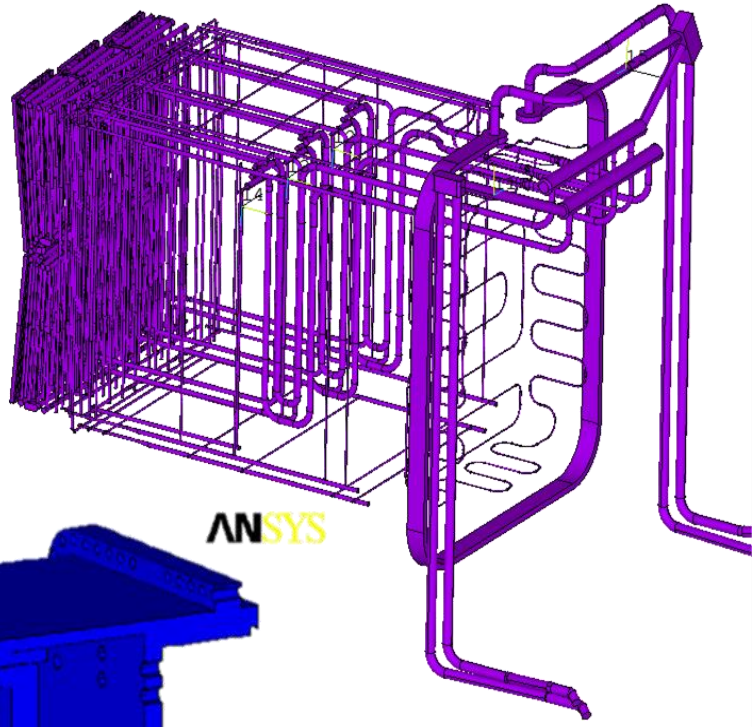
NATEC INGENIEROS

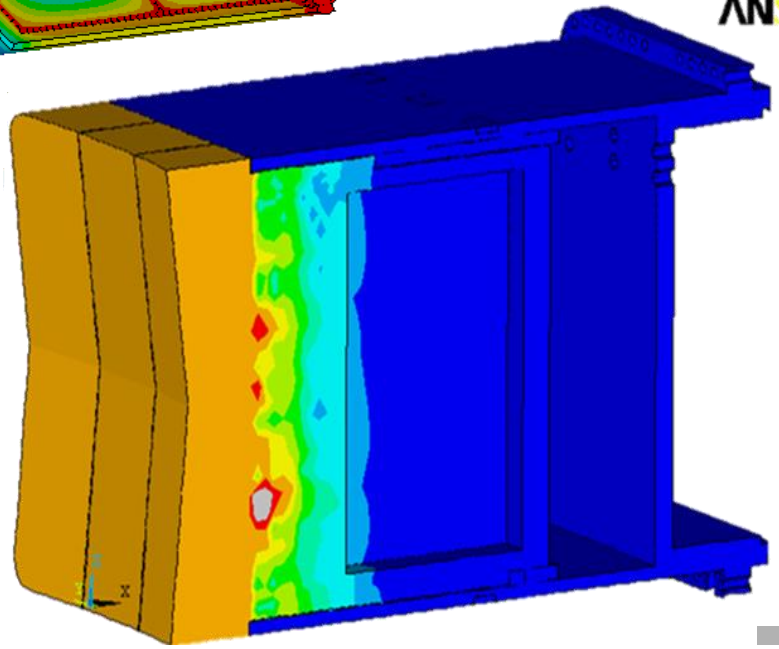
ENGINEERING ANALYSIS: THERMO HYDRAULIC

EQUATORIAL PORT PLUG STRUCTURE AND DIAGNOSTIC SHIELDING MODULES







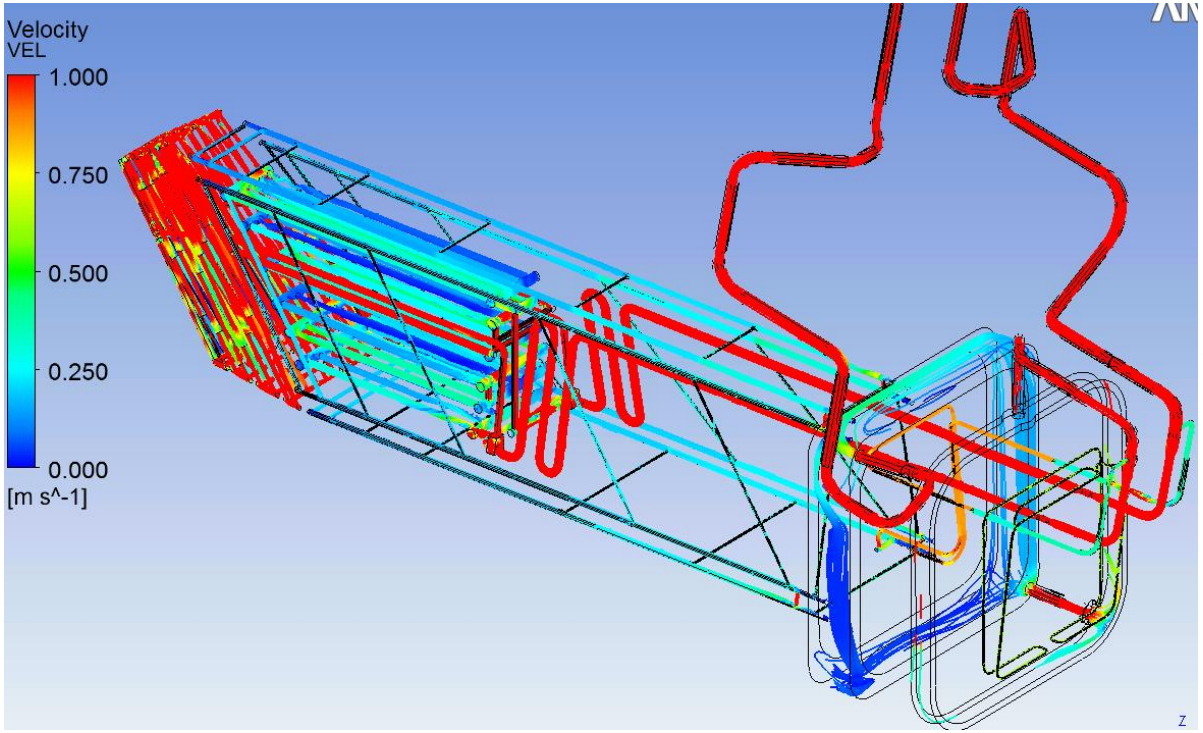


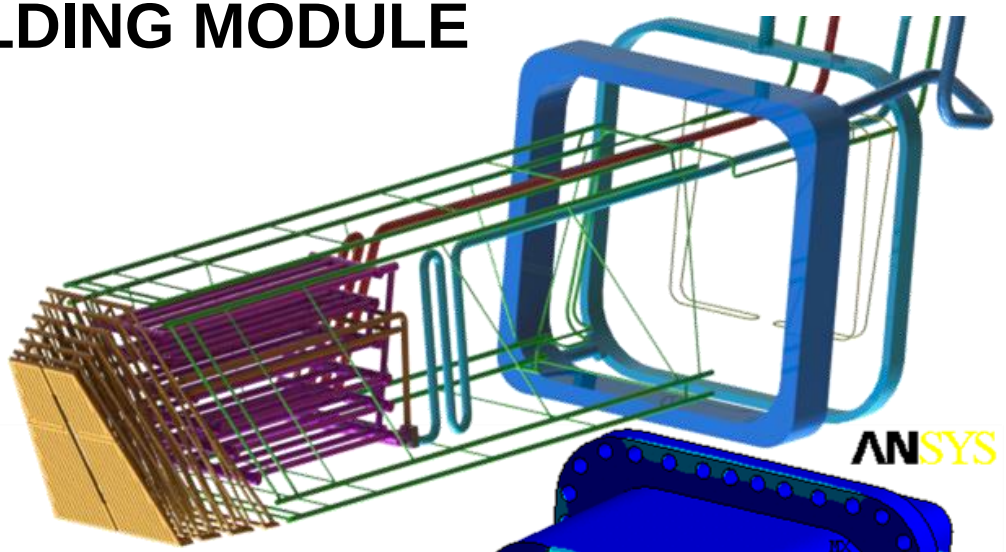
Jornada
BTEC/F4E
Diagnósticos

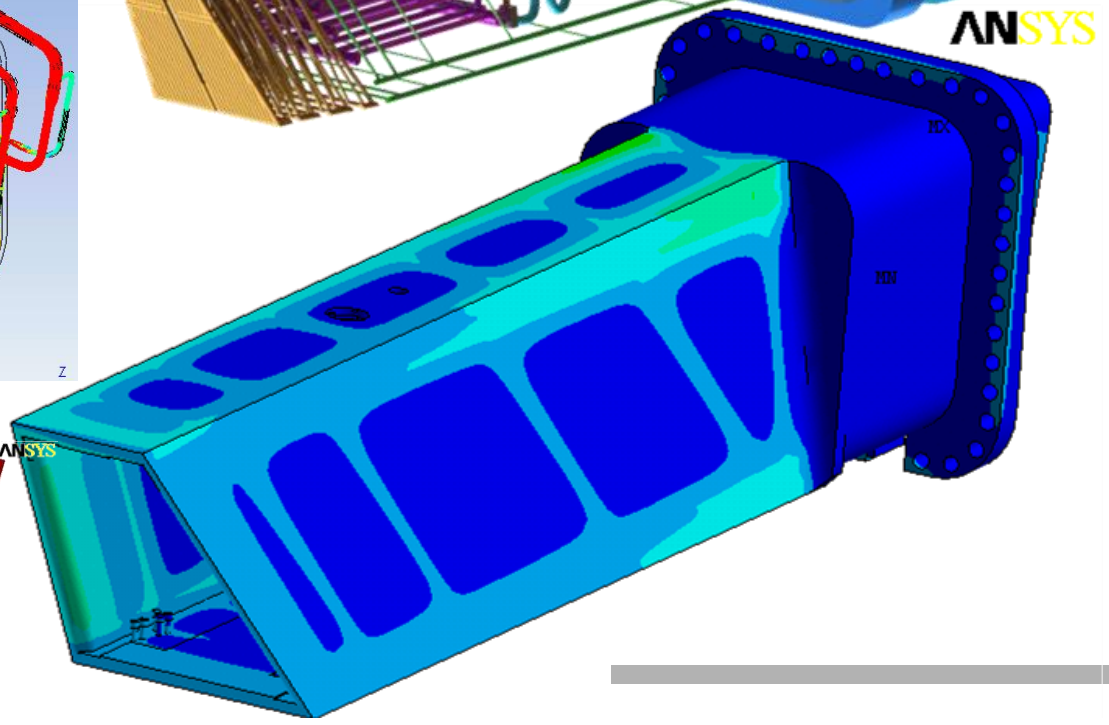
NATEC INGENIEROS

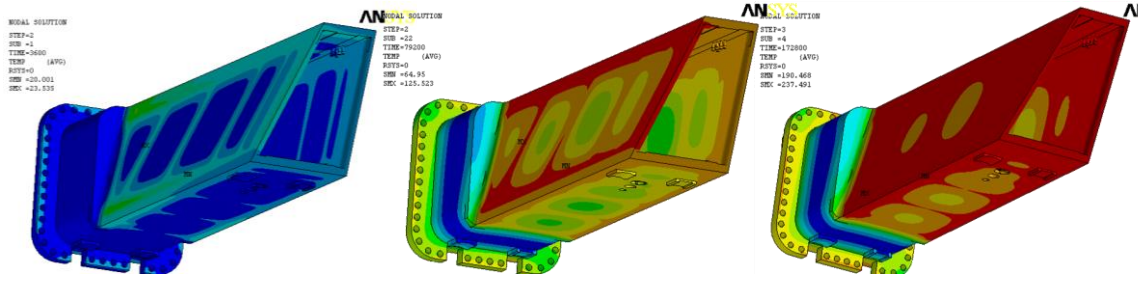
ENGINEERING ANALYSIS: THERMO HYDRAULIC

UPPER PORT PLUG STRUCTURE AND DIAGNOSTIC SHIELDING MODULE





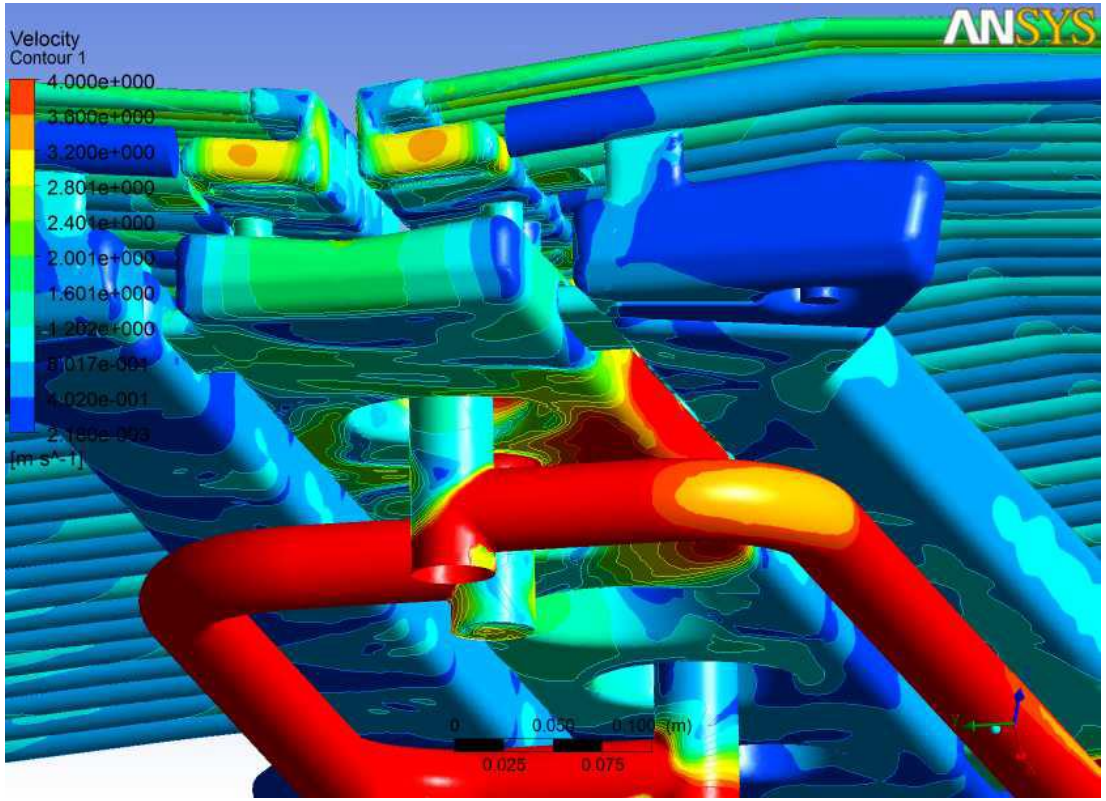


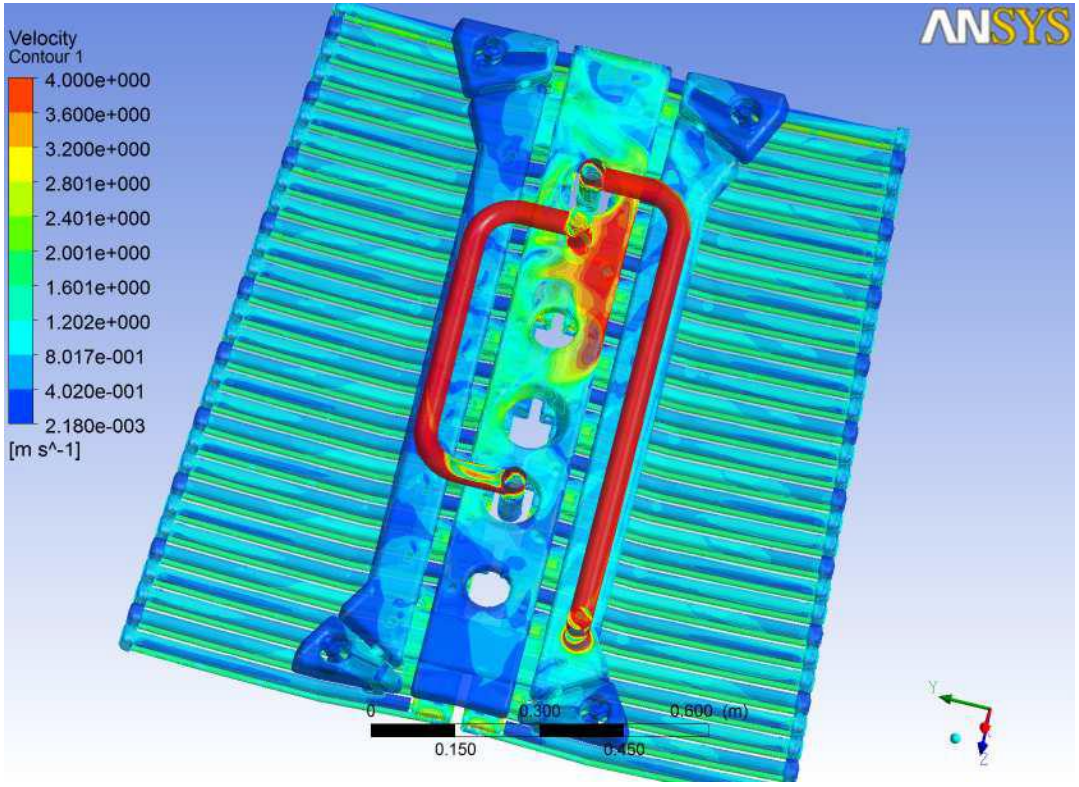


Jornada
BTEC/F4E
Diagnósticos

ENGINEERING ANALYSIS: THERMO HYDRAULIC

FIRST WALL #18

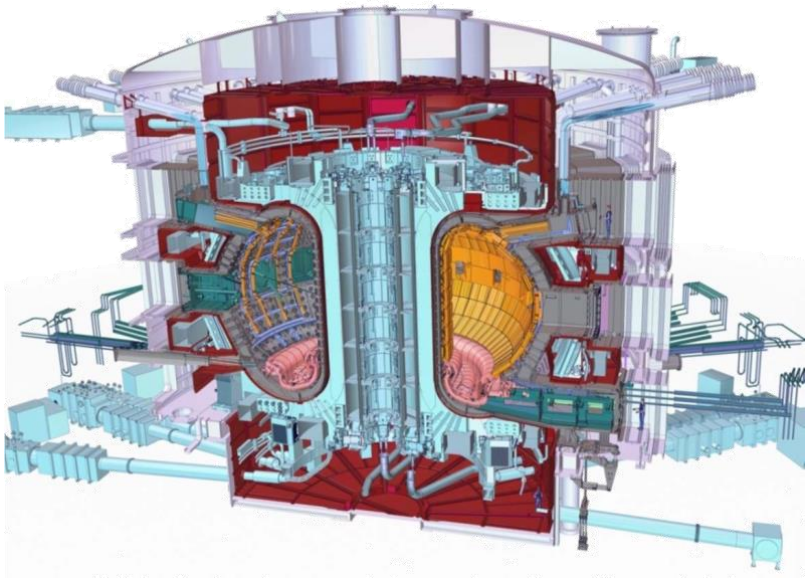




NATEC's participation in ITER project:

- ENGINEERING ANALYSIS:

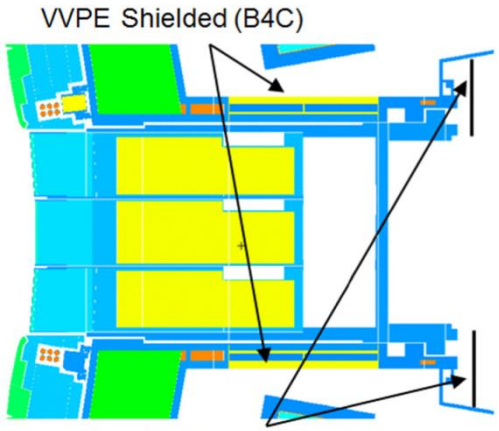
  NEUTRONIC

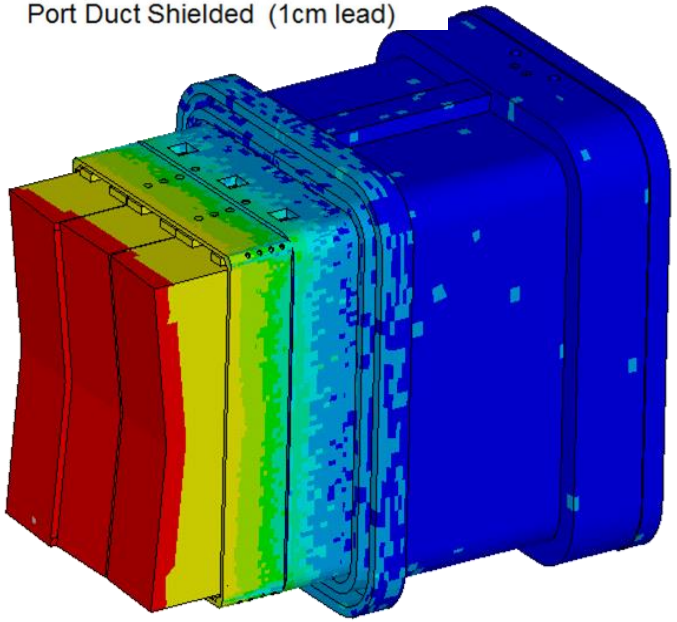


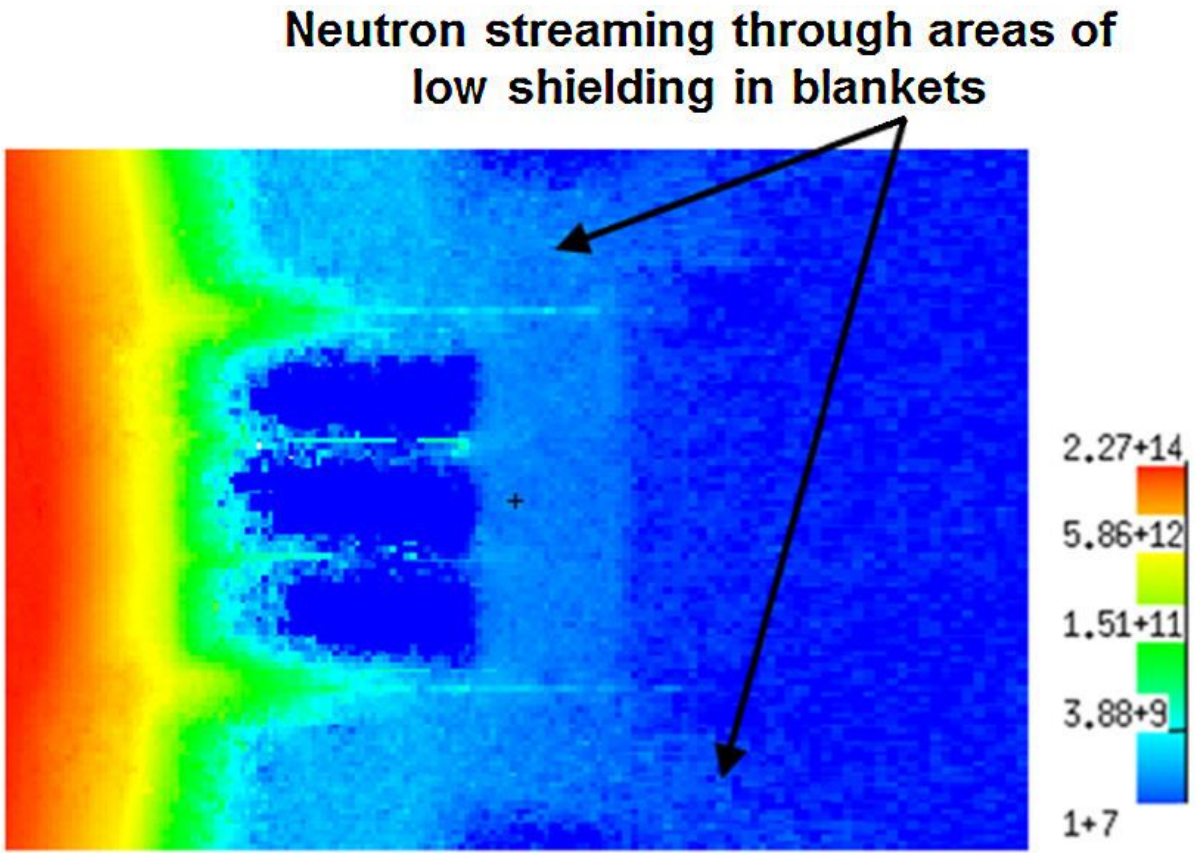
Jornada
BTEC/F4E
Diagnósticos

ENGINEERING ANALYSIS: NEUTRONICS

STUDY TO MITIGATE THE ITER SHUTDOWN DOSE RATE IN PORT INTERSPACE



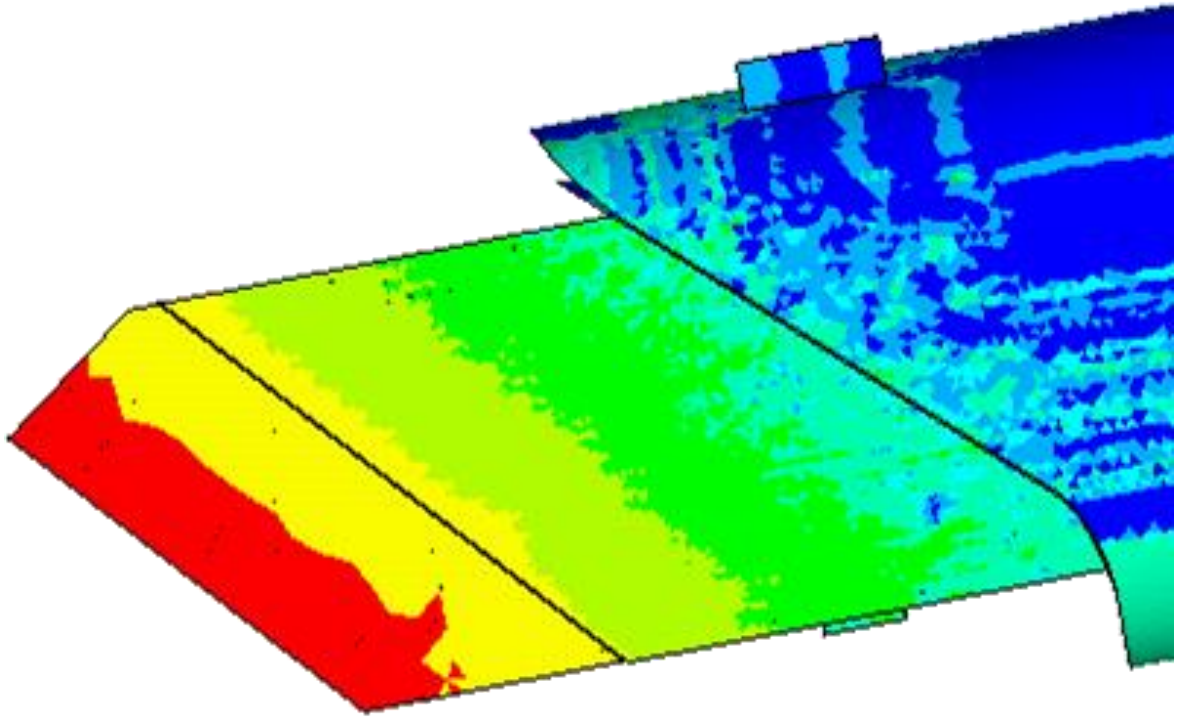


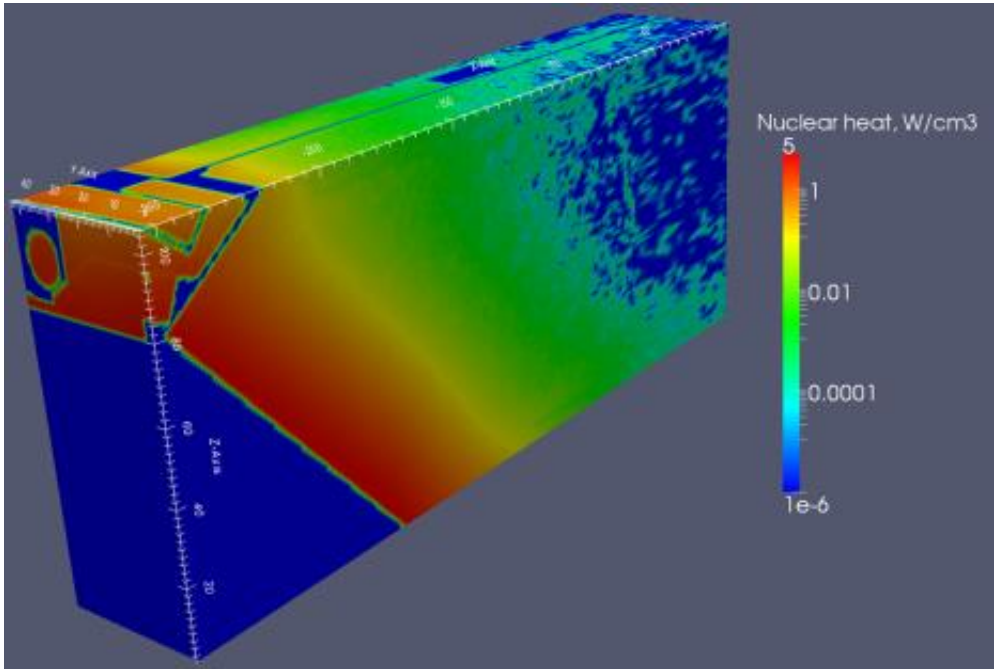


Jornada
BTEC/F4E
Diagnósticos

ENGINEERING ANALYSIS: NEUTRONICS

NEUTRON AND PHOTON HEATING AT EQUATORIAL AND UPPER PORT PLUGS





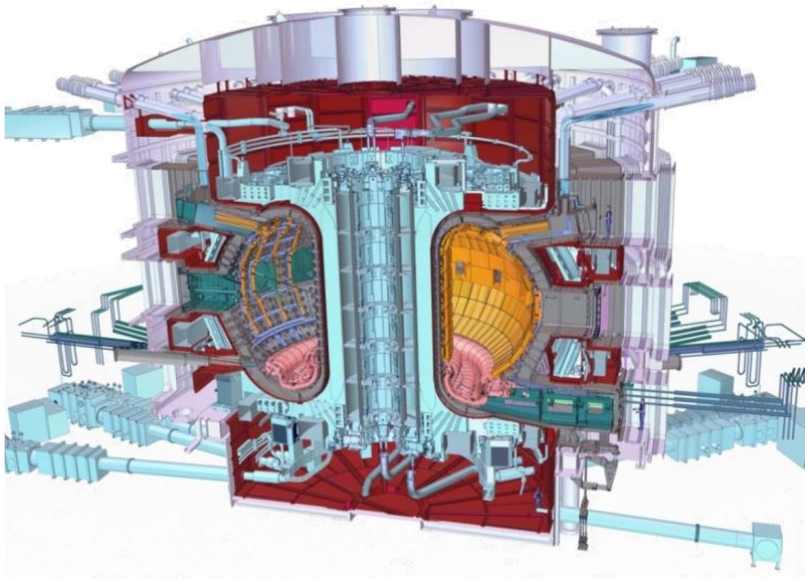
Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

- ENGINEERING ANALYSIS:

  THERMO MECHANICAL &

  STRUCTURAL INTEGRITY ASSESMENT



ENGINEERING ANALYSIS: STRUCTURAL INTEGRITY

Structural integrity of the designs for Equatorial and Upper Port Plugs and DSM's covers the full range of operative conditions and load combinations on these components .

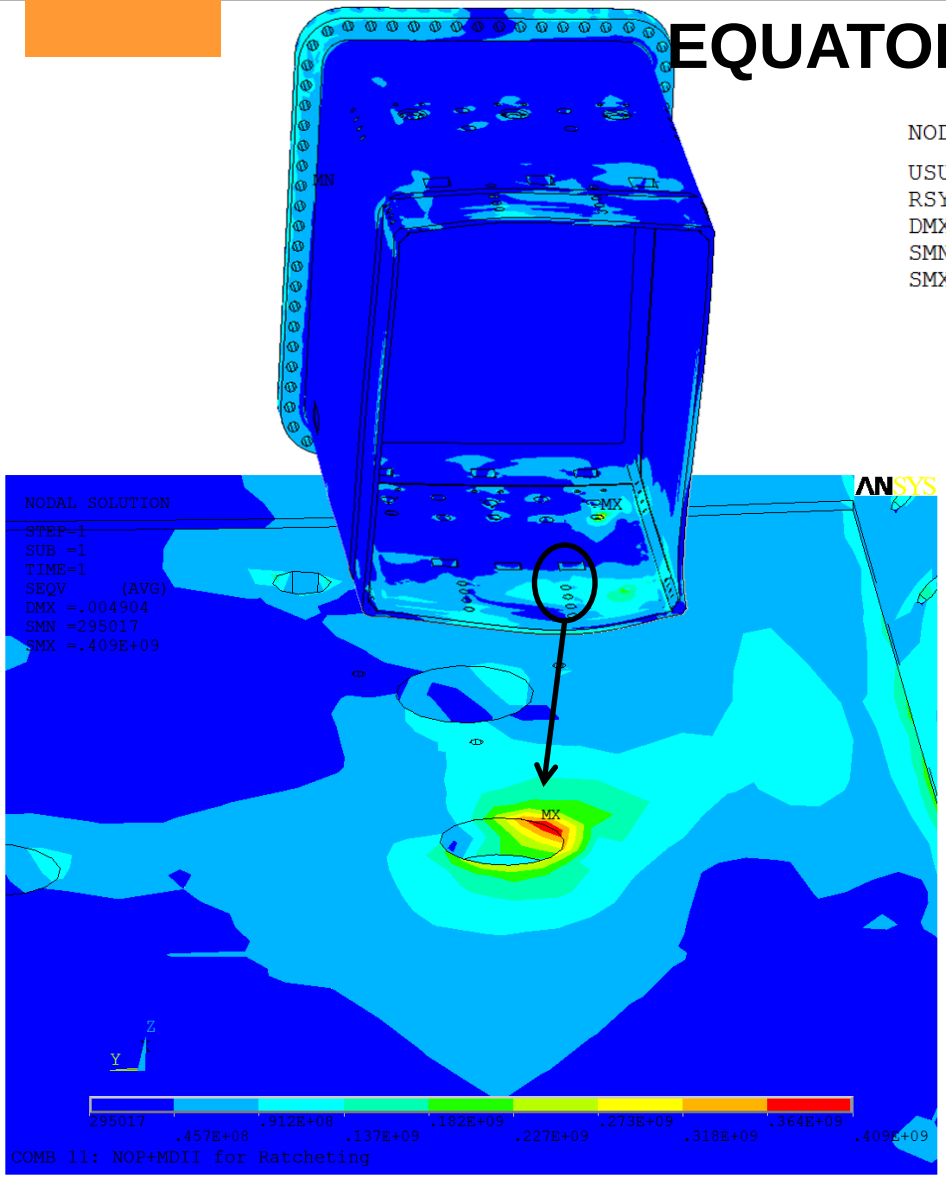
Their validated designs establish the specific basis for the following steps of Diagnostic Component assessment and Final Designs.

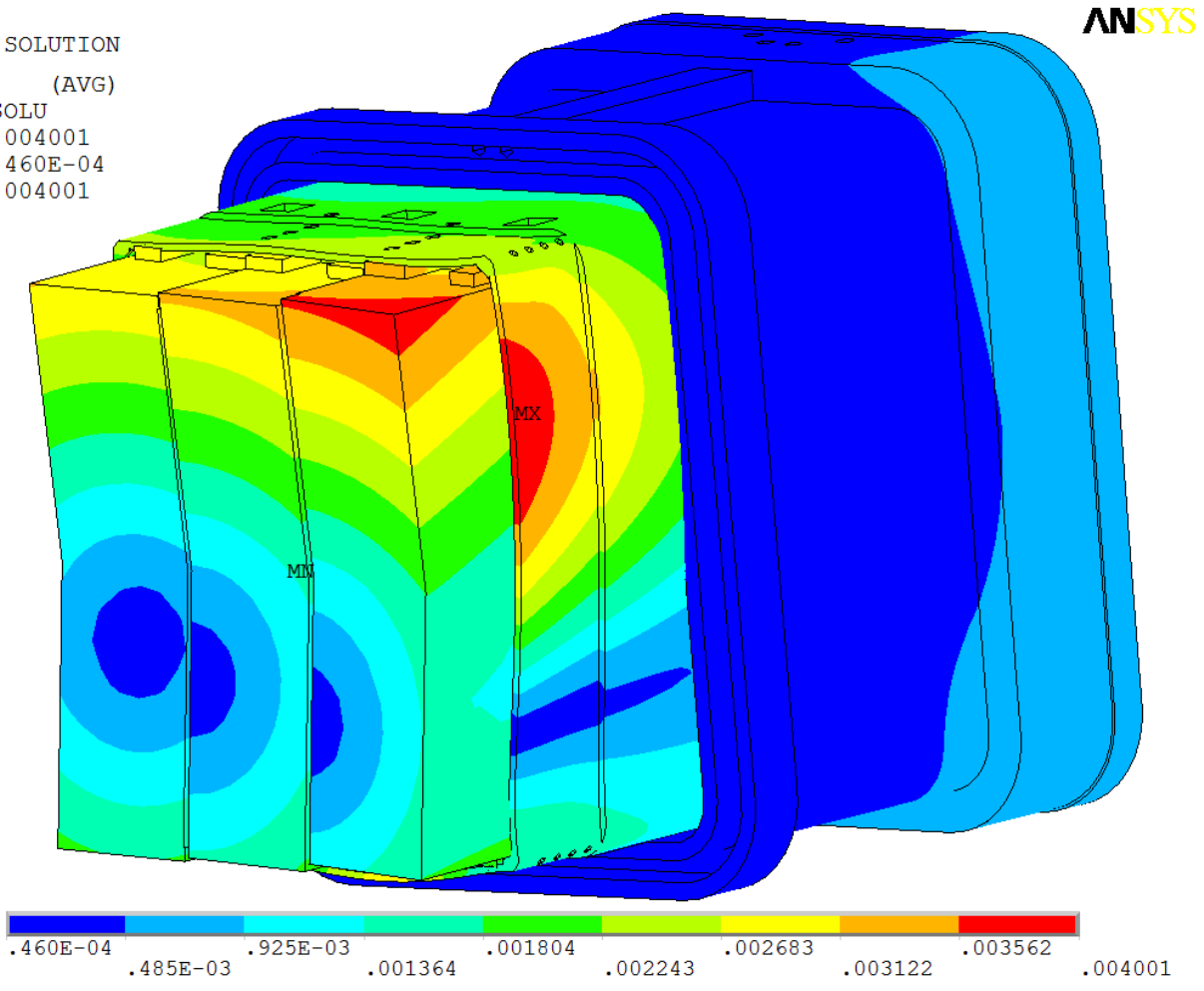
Jornada
BTEC/F4E
Diagnósticos

NATEC INGENIEROS

ENGINEERING ANALYSIS: STRUCTURAL INTEGRITY

EQUATORIAL PORT PLUG / DSM

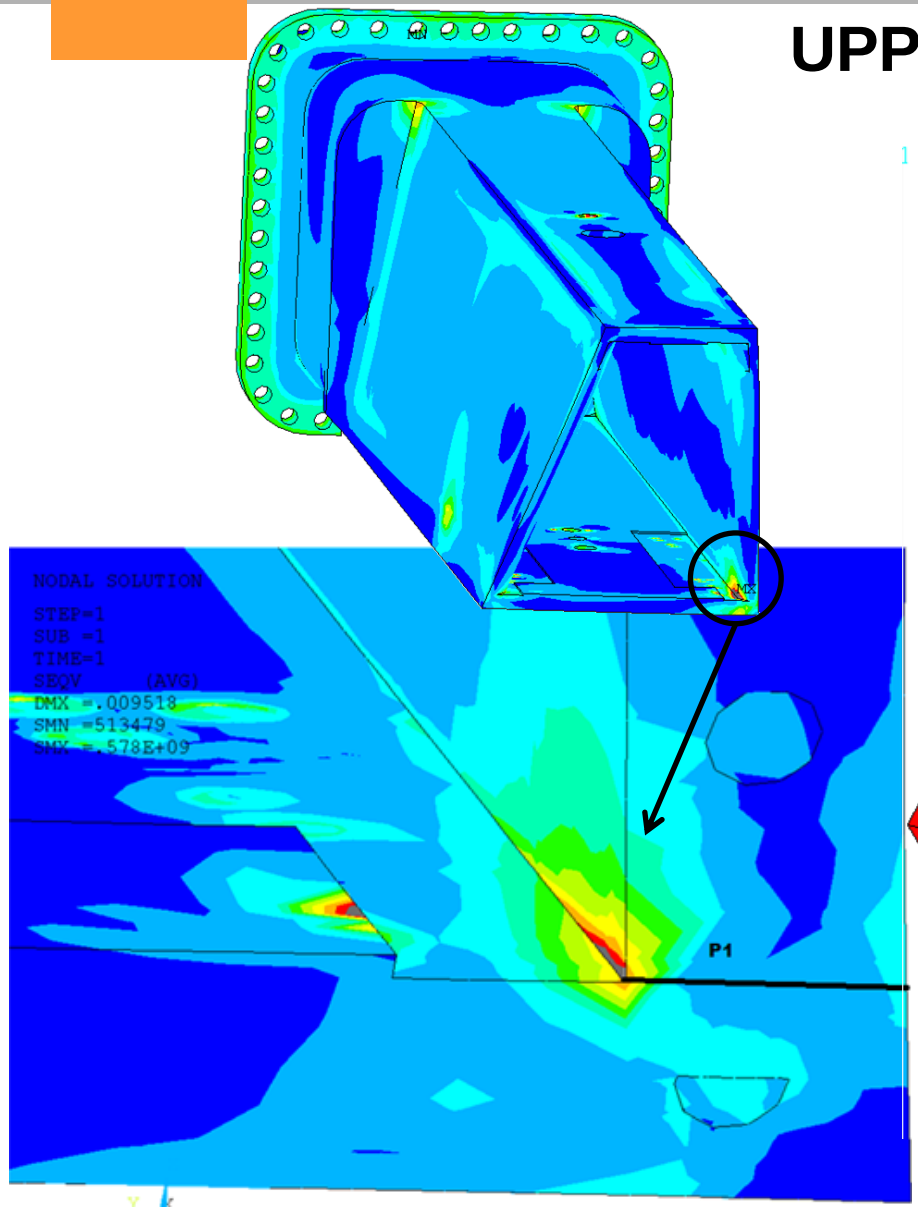


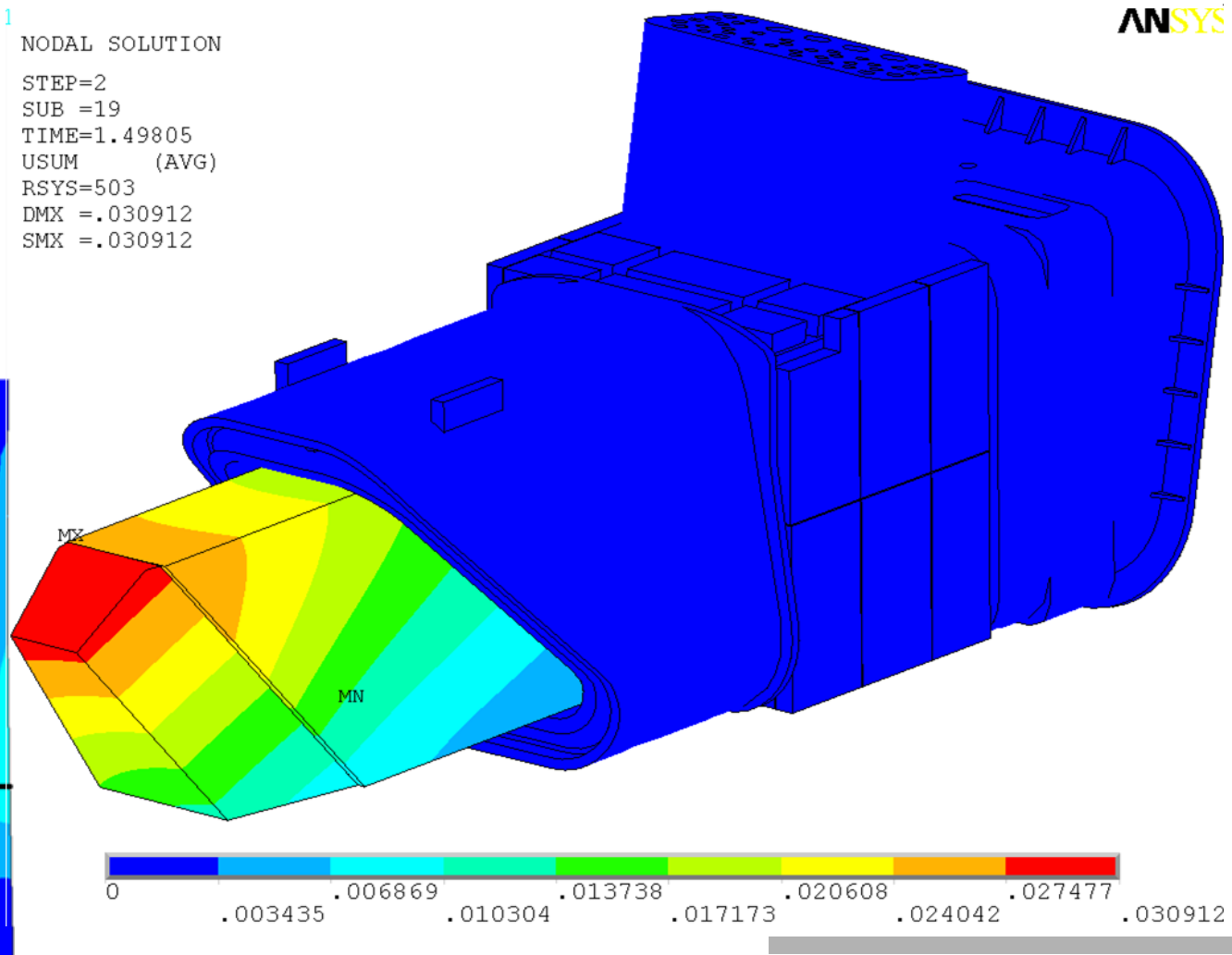


Jornada
BTEC/F4E
Diagnósticos

ENGINEERING ANALYSIS: STRUCTURAL INTEGRITY

UPPER PORT PLUG / DSM



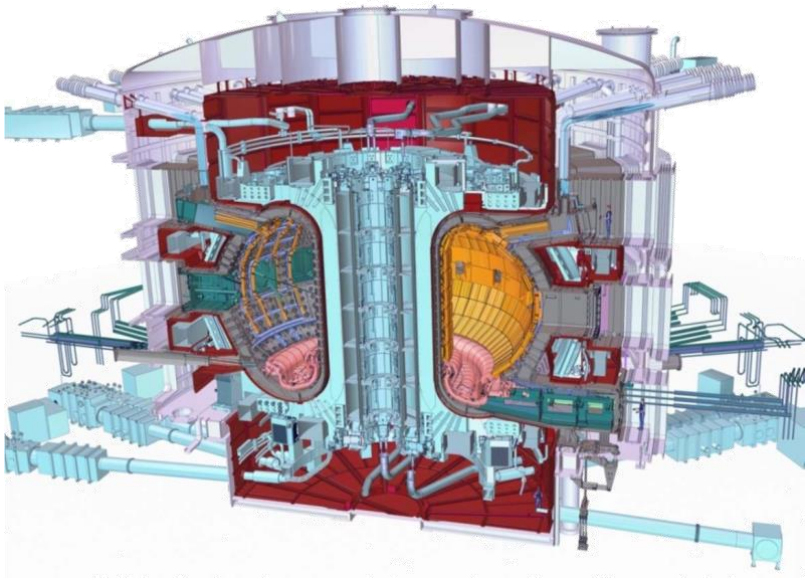


Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

- ENGINEERING ANALYSIS:

  ELECTROMAGNETIC

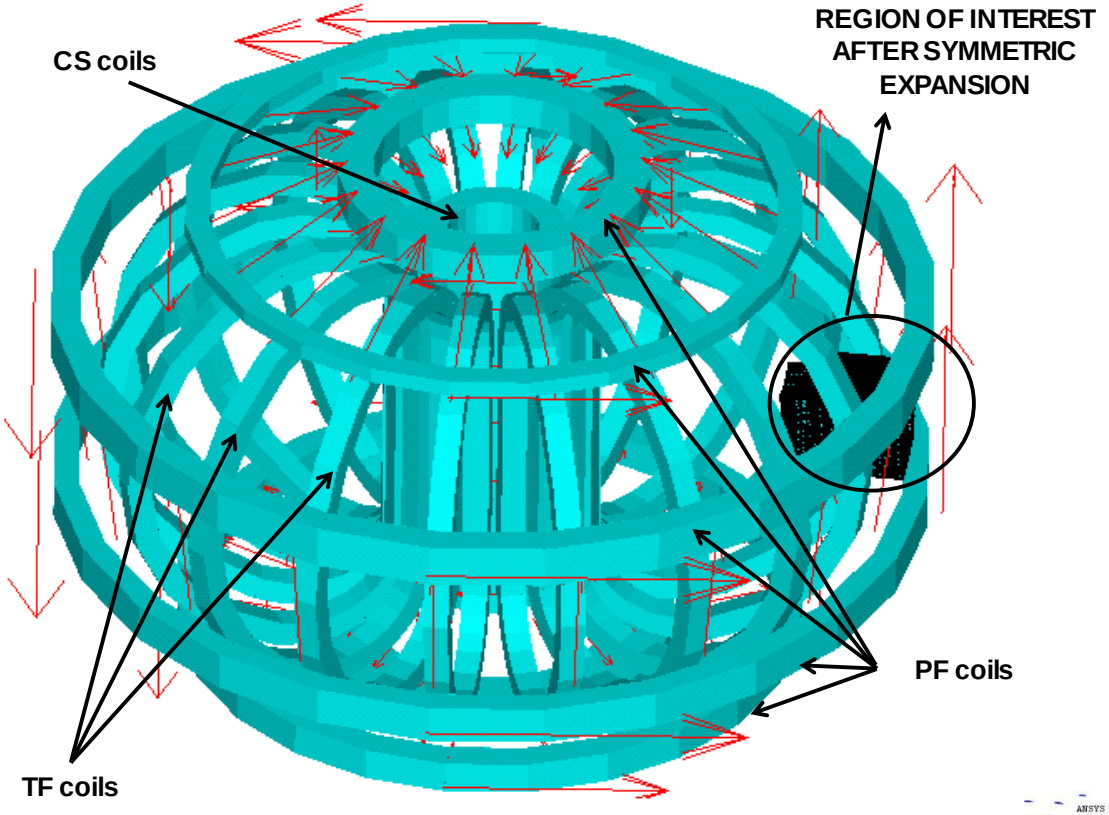


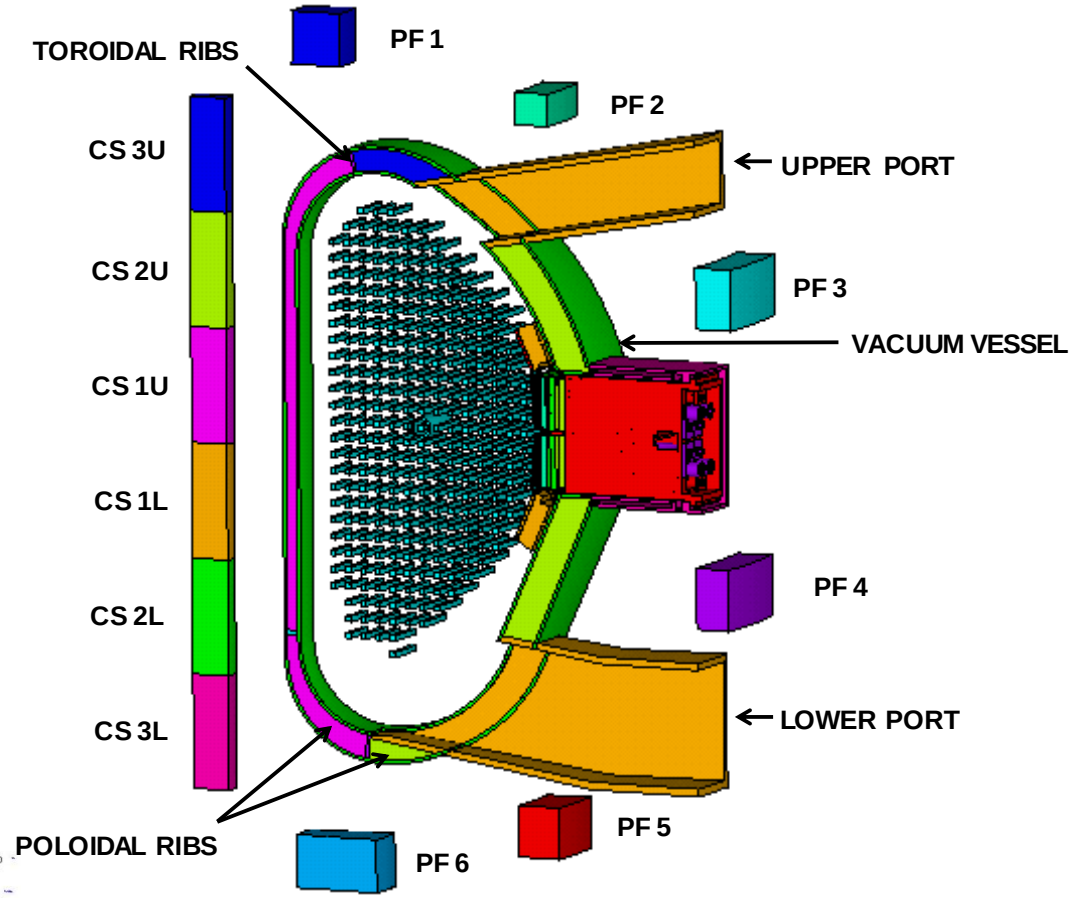
ENGINEERING ANALYSIS: ELECTROMAGNETIC

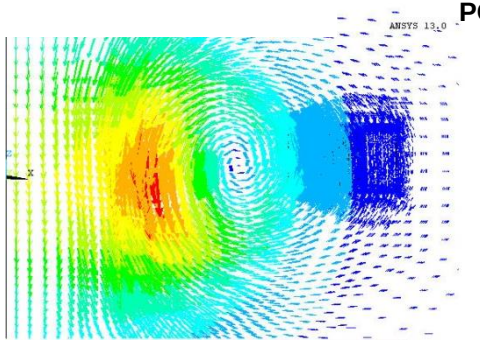
Design driving loads for many ITER components are originated by Plasma disruption Events.

Electromagnetic analysis have been performed by NATEC for several components such as Embedded Window Assemblies for plasma diagnostics, Test Blanket Modules, ICRH Antenna and First Wall #18

ENGINEERING ANALYSIS: ELECTROMAGNETIC

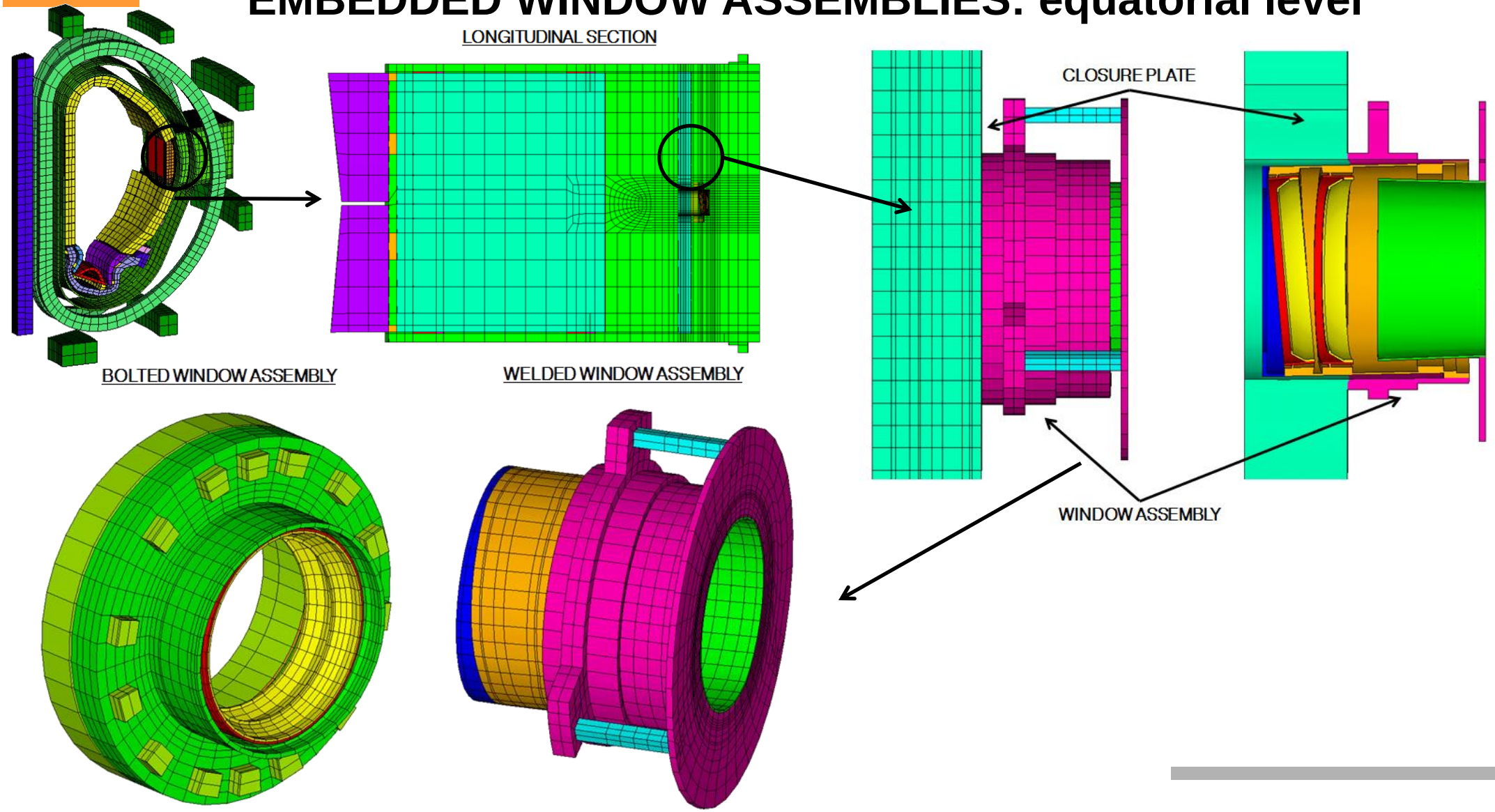






ENGINEERING ANALYSIS: ELECTROMAGNETIC

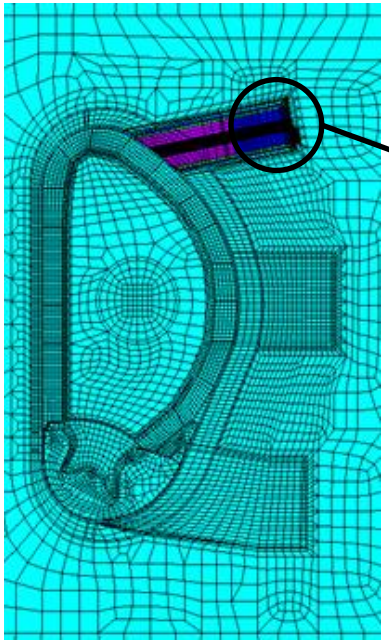
EMBEDDED WINDOW ASSEMBLIES: equatorial level

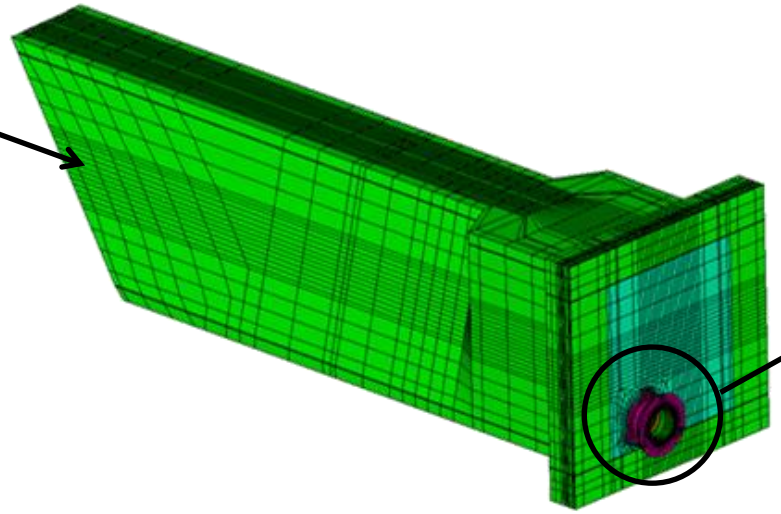


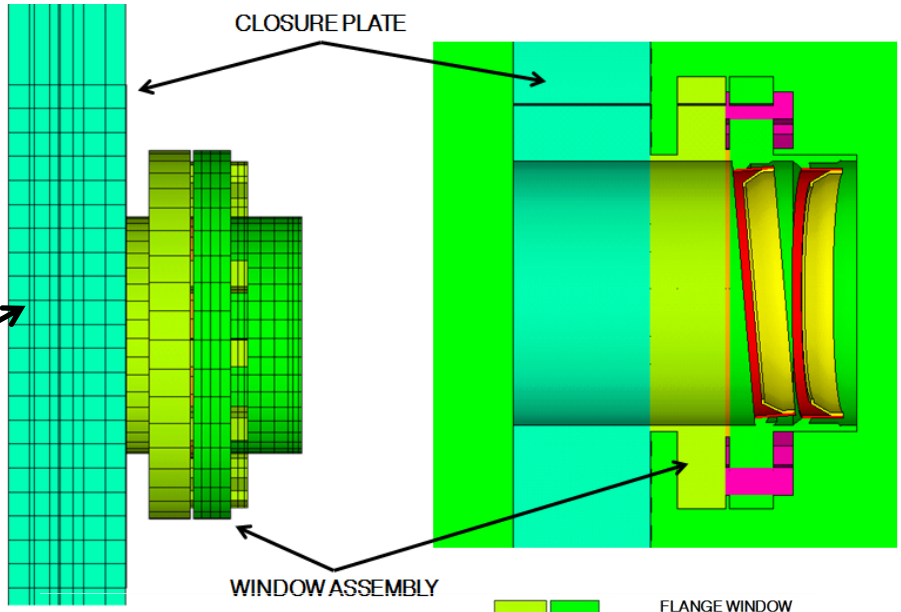
Jornada
BTEC/F4E
Diagnósticos

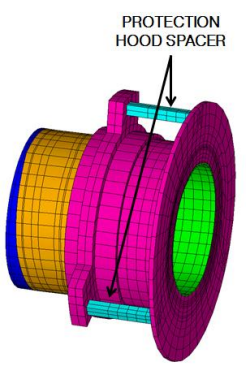
ENGINEERING ANALYSIS: ELECTROMAGNETIC

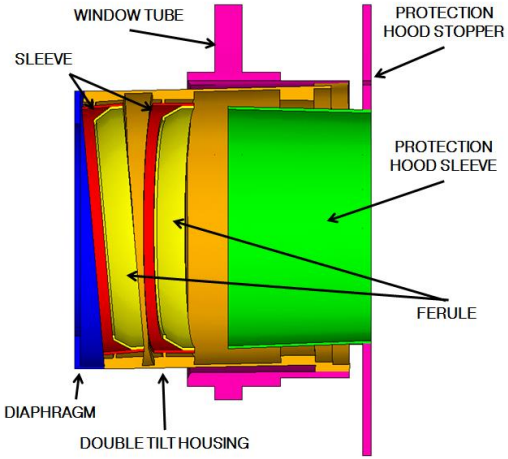
EMBEDDED WINDOW ASSEMBLIES: upper level

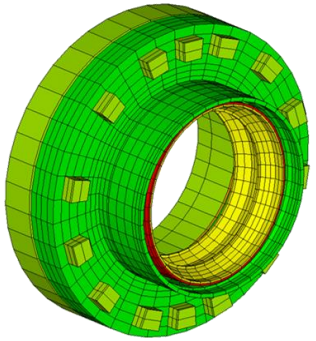


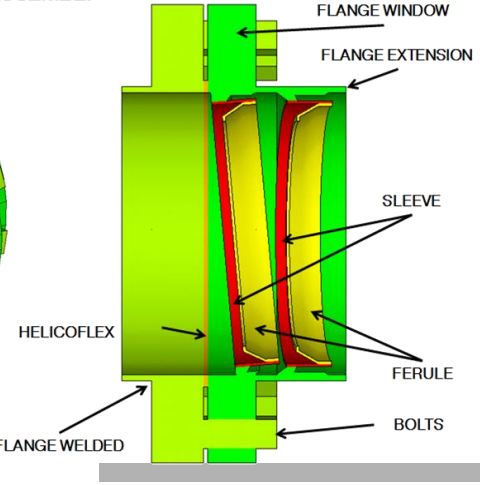








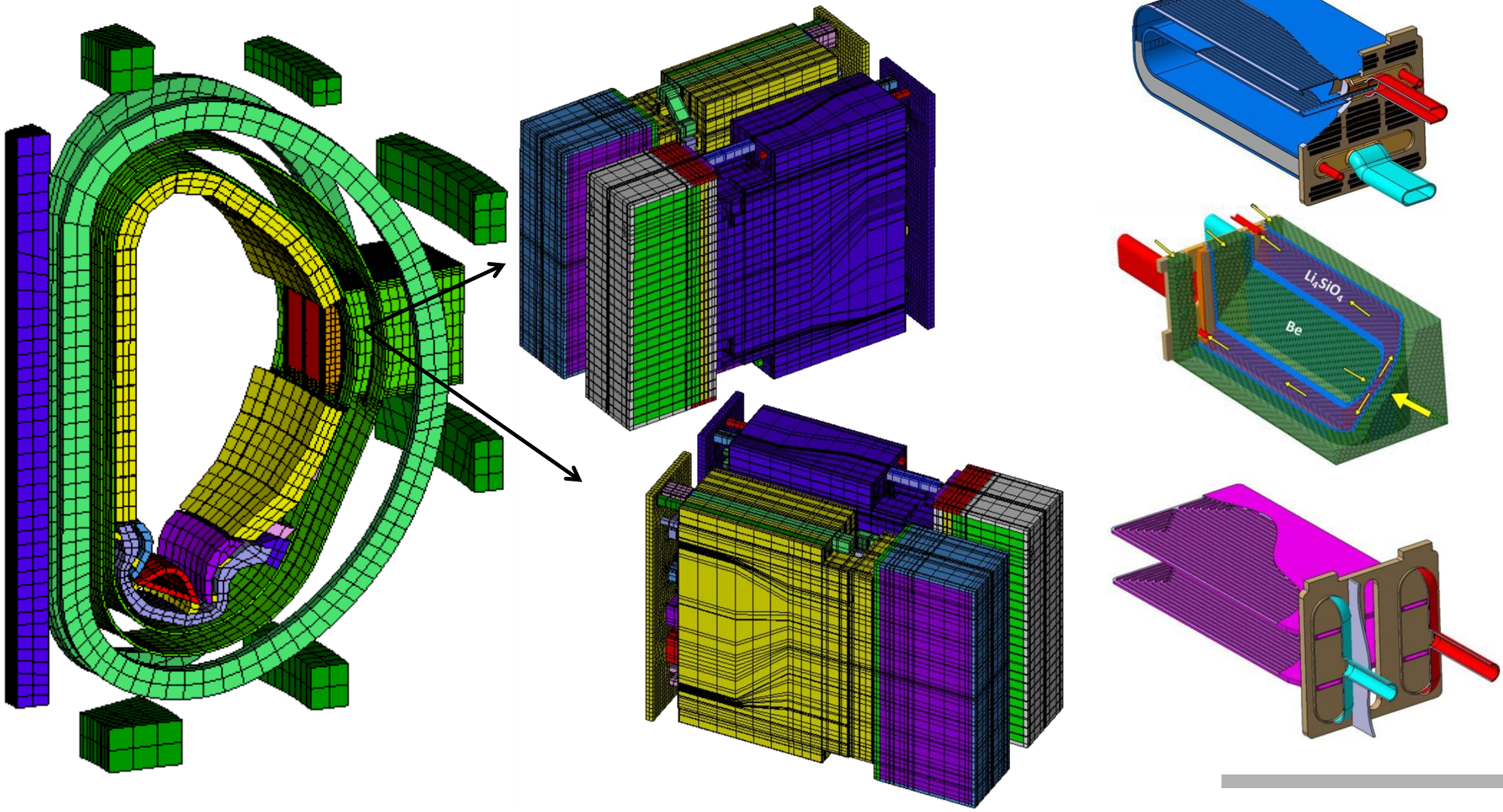




Jornada
BTEC/F4E
Diagnósticos

ENGINEERING ANALYSIS: ELECTROMAGNETIC

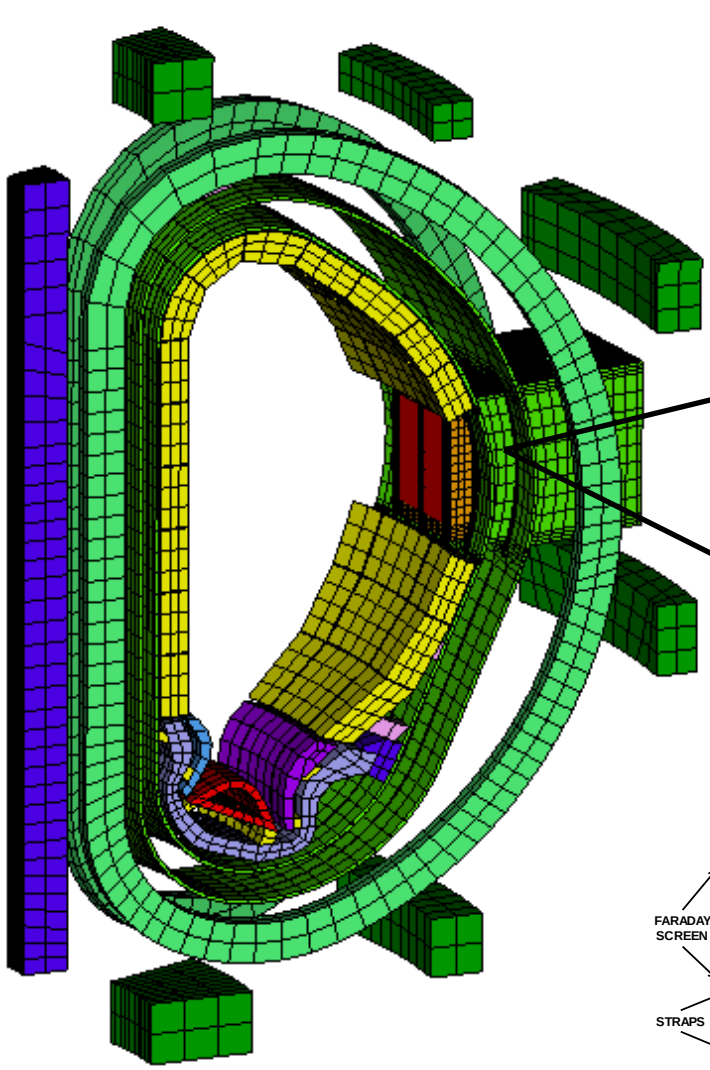
TEST BLANKET MODULES

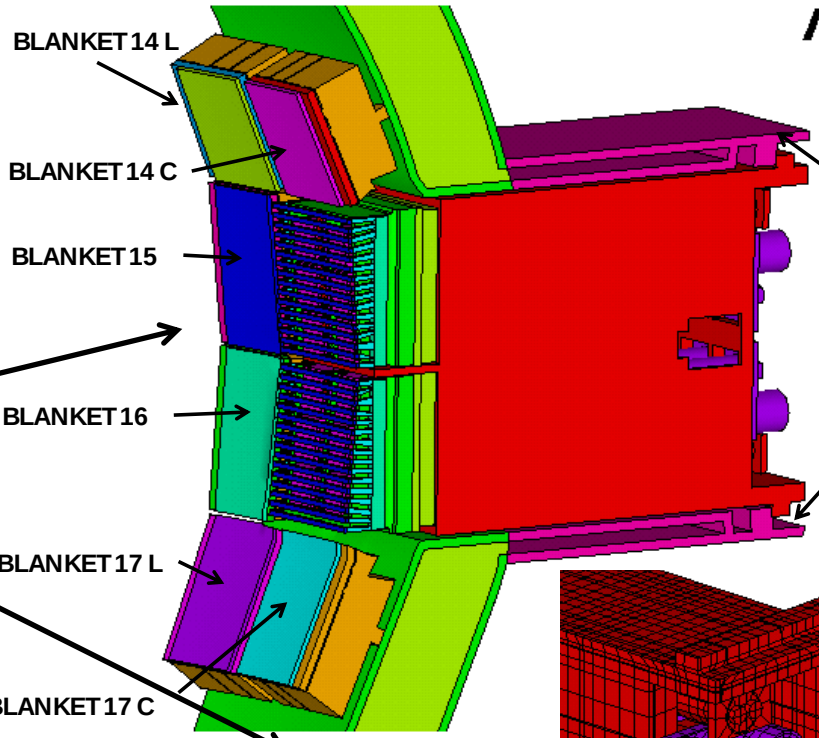


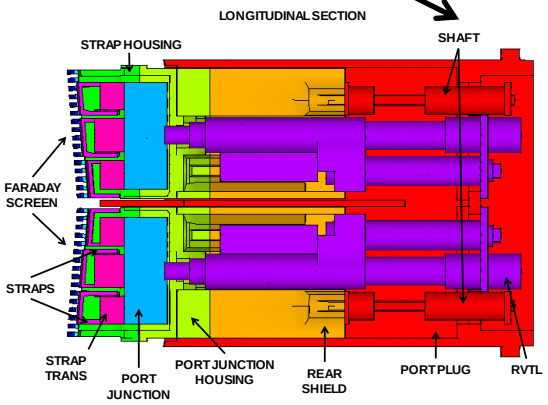
Jornada
BTEC/F4E
Diagnósticos

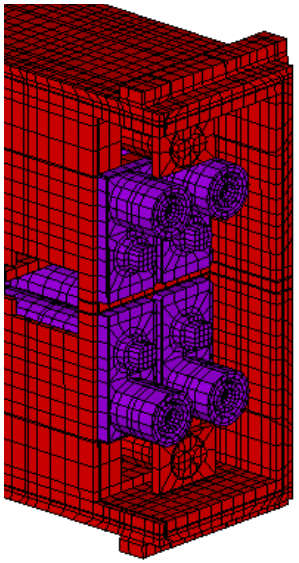
ENGINEERING ANALYSIS: ELECTROMAGNETIC

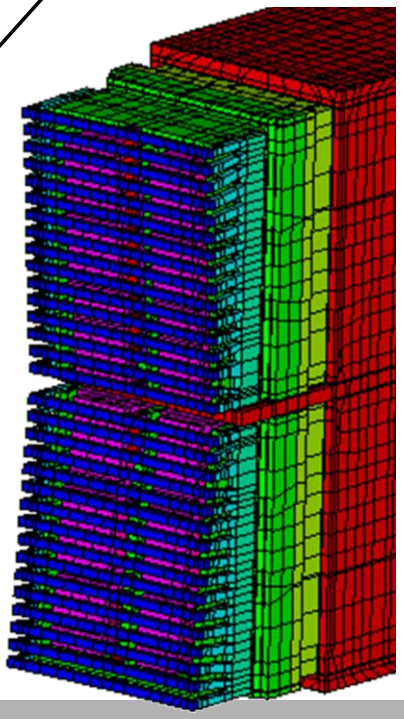
ICRH ANTENNA





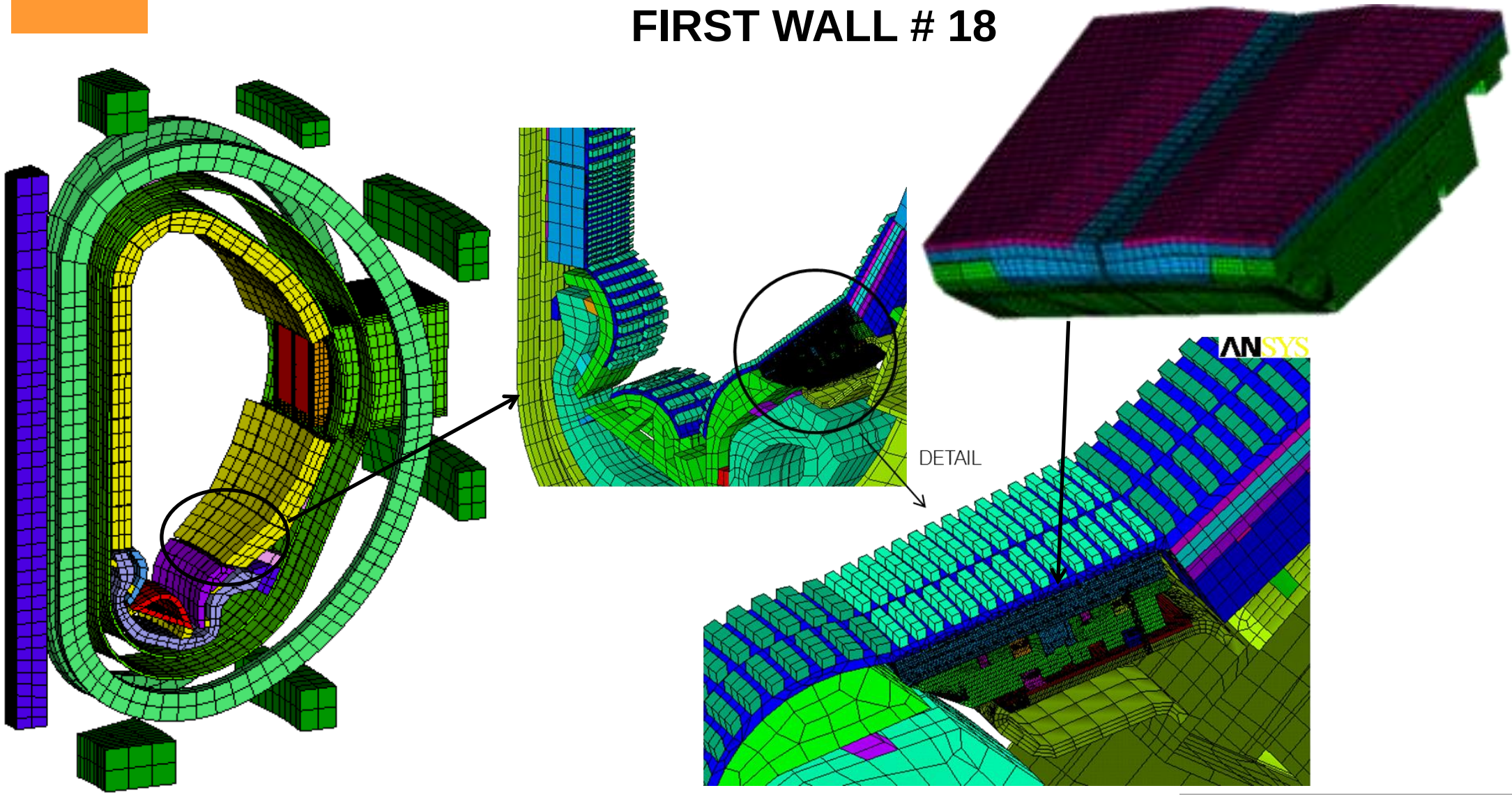






ENGINEERING ANALYSIS: ELECTROMAGNETIC

FIRST WALL # 18

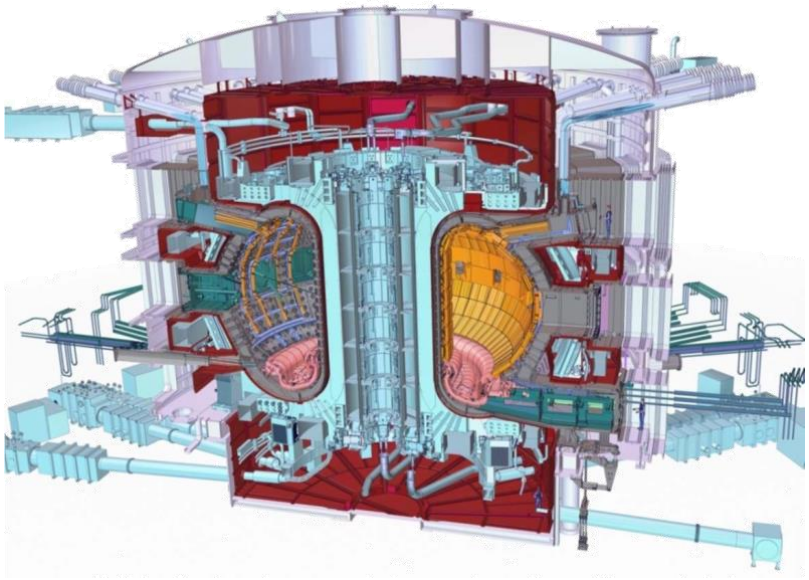


Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

- ENGINEERING ANALYSIS:

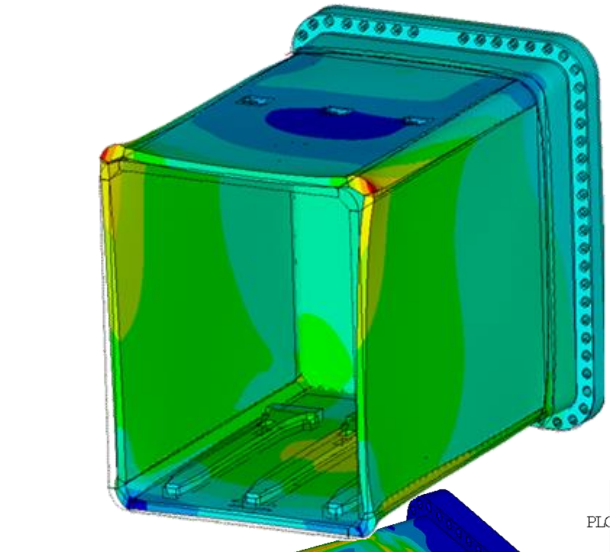
  WELD DISTORTION PREDICTION

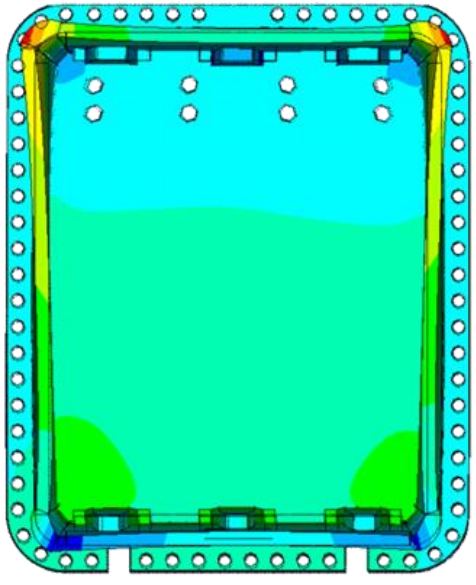


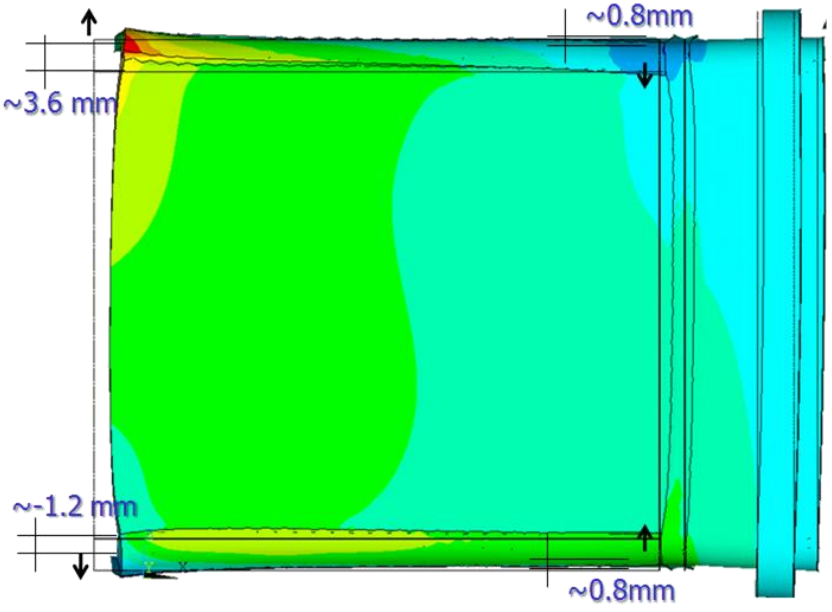
Jornada
BTEC/F4E
Diagnósticos

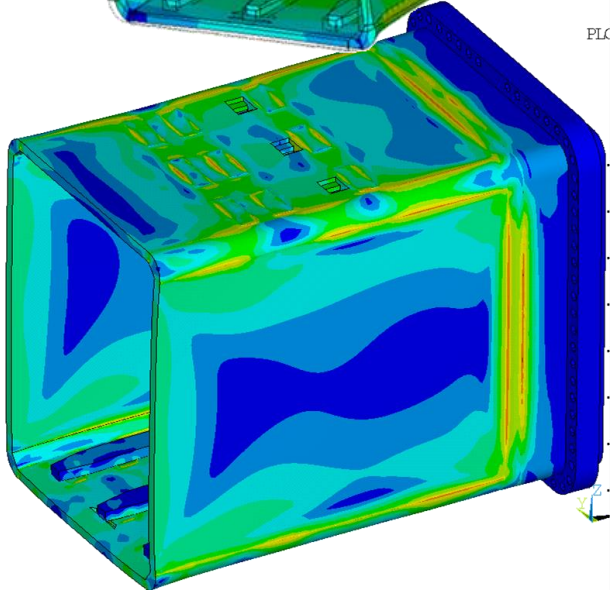
ENGINEERING ANALYSIS: WELD DISTORTION

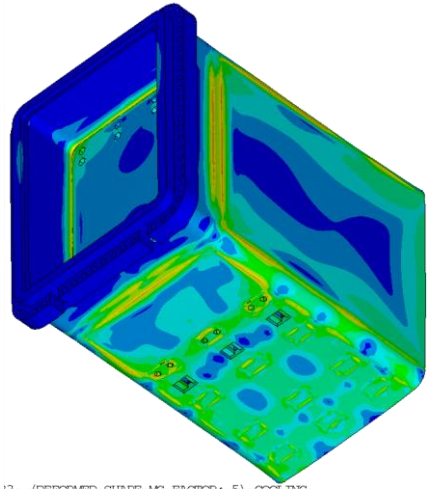
EQUATORIAL PORT PLUG

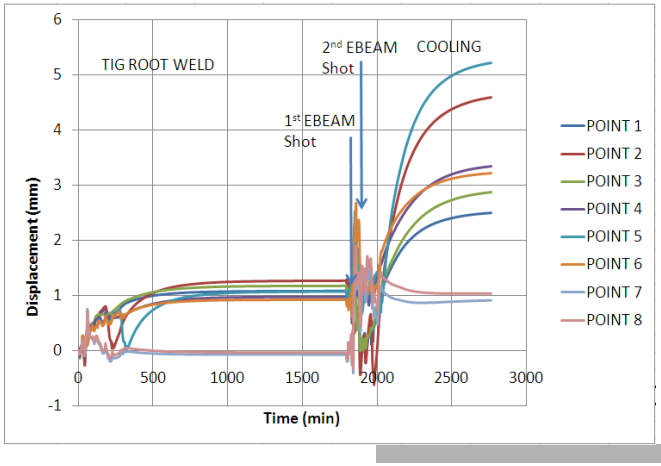








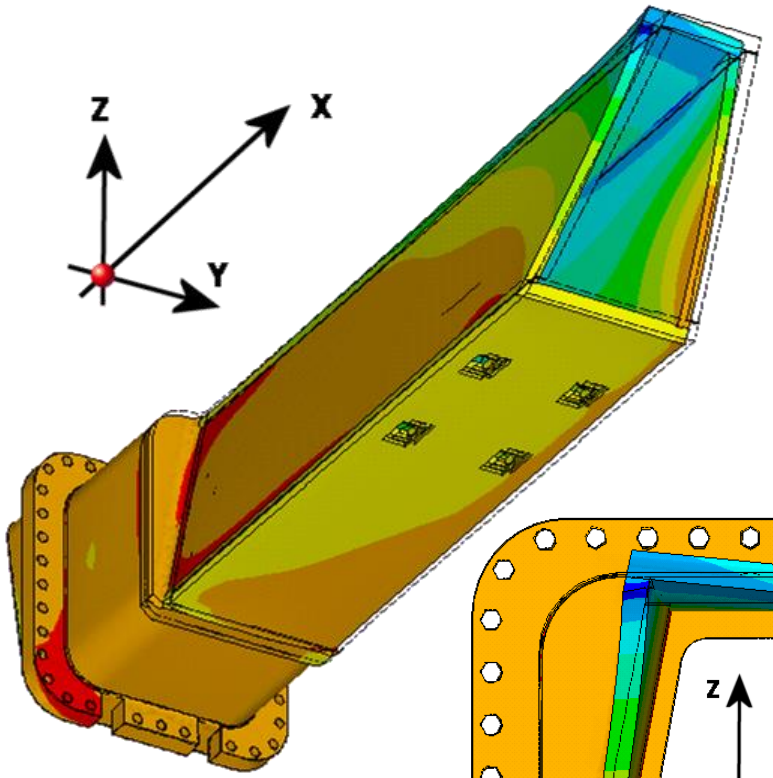


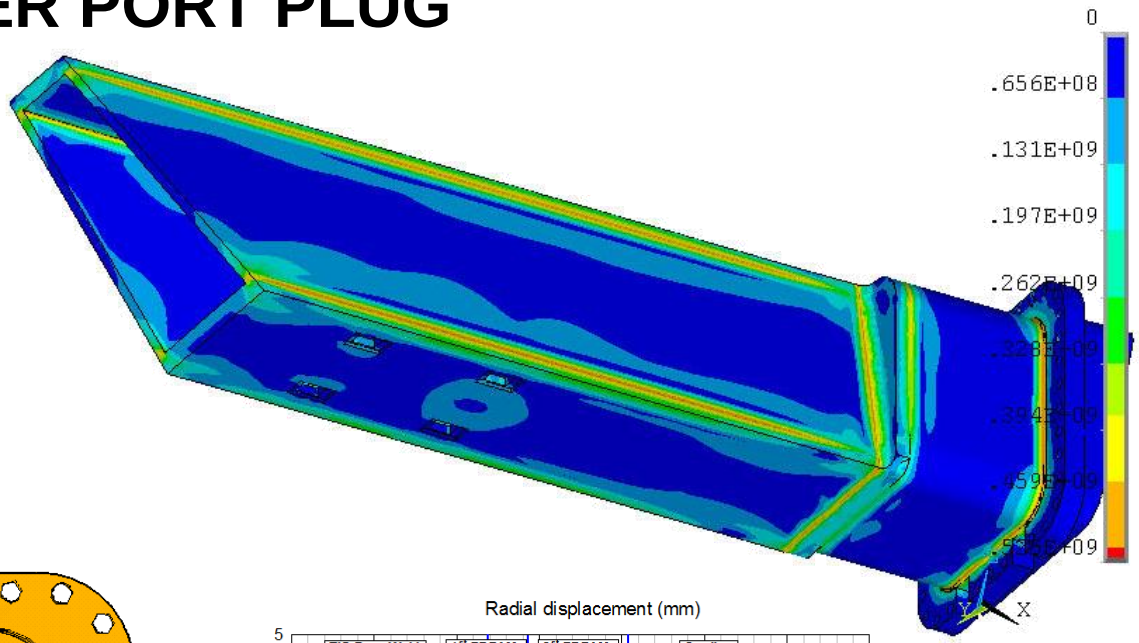


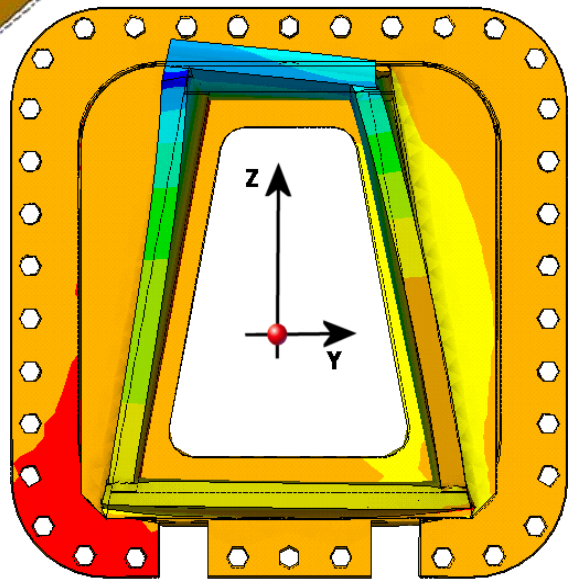
Jornada
BTEC/F4E
Diagnósticos

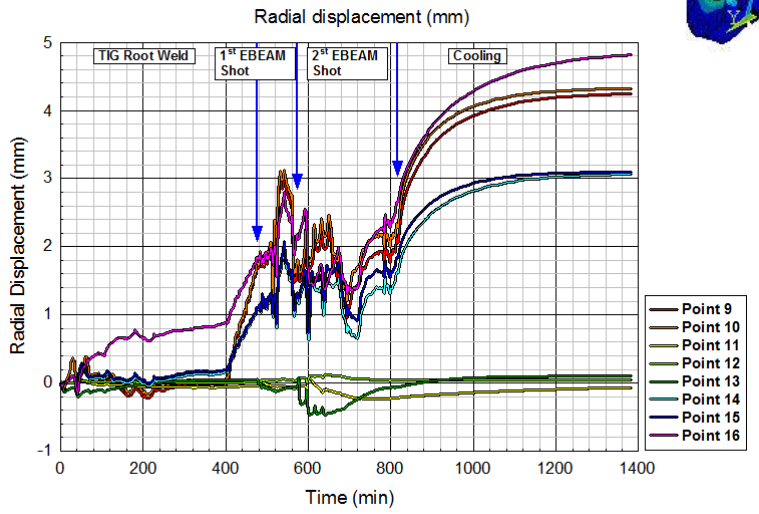
ENGINEERING ANALYSIS: WELD DISTORTION

UPPER PORT PLUG







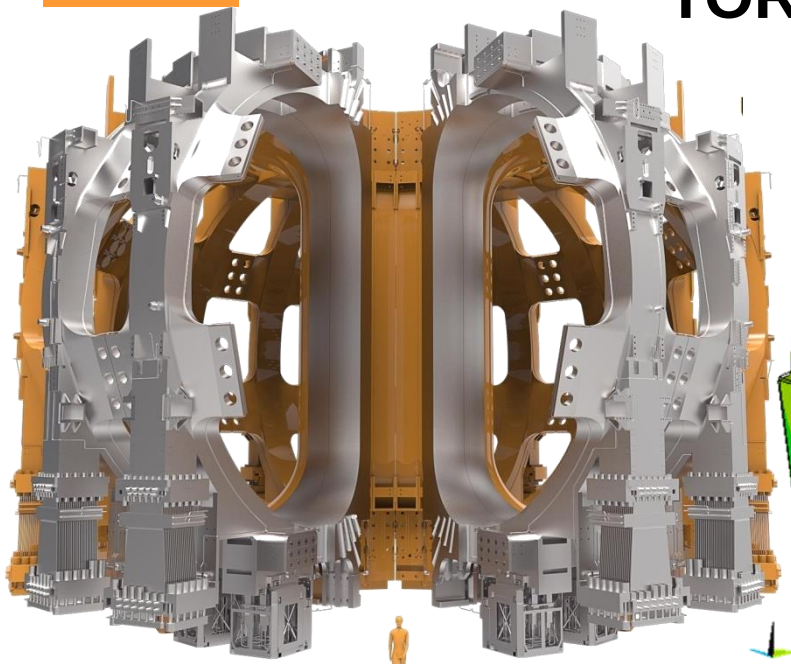


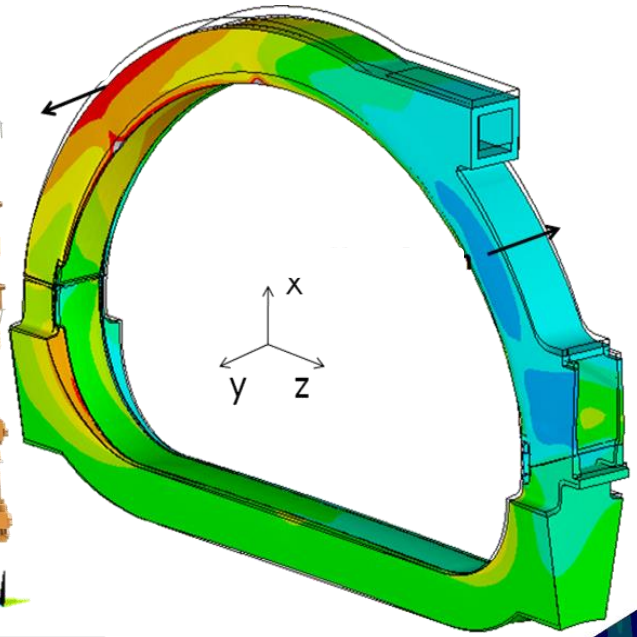
Jornada
BTEC/F4E
Diagnósticos

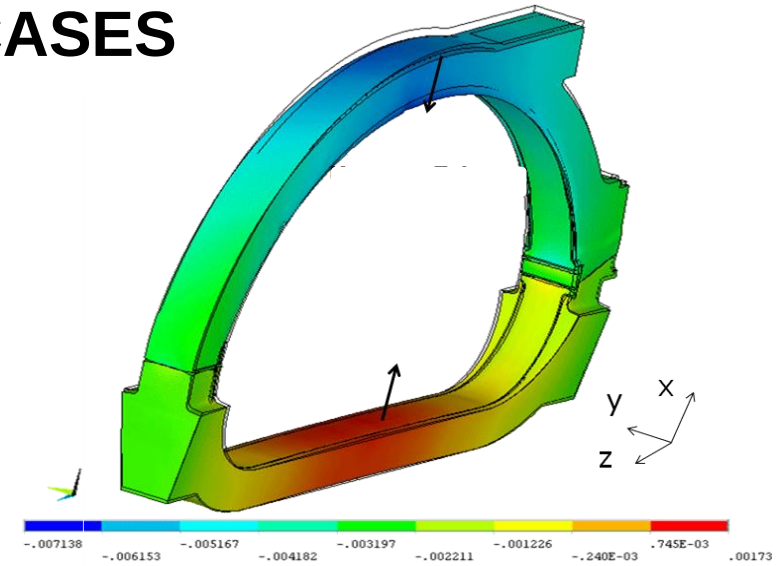
NATEC INGENIEROS

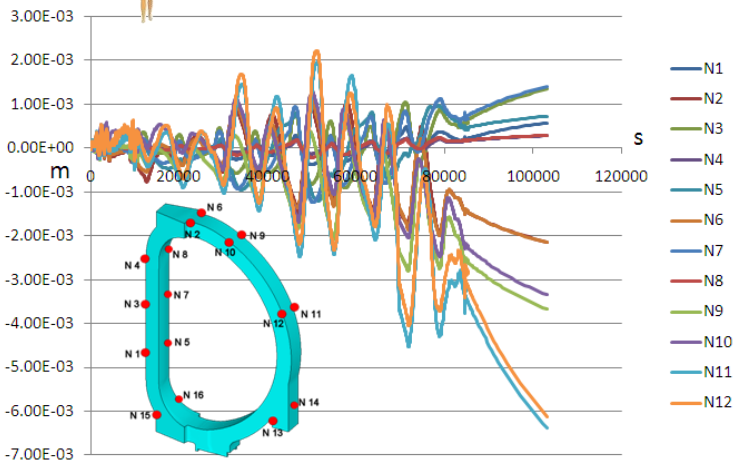
ENGINEERING ANALYSIS: WELD DISTORTION

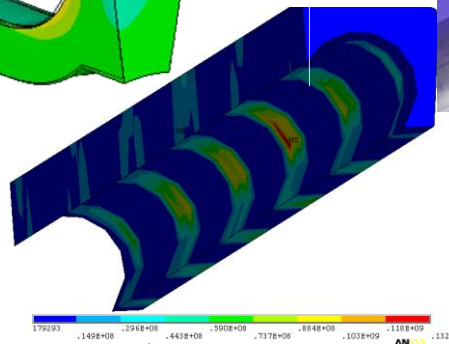
TOROIDAL FIELD COIL CASES

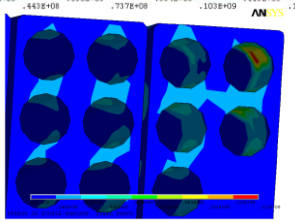


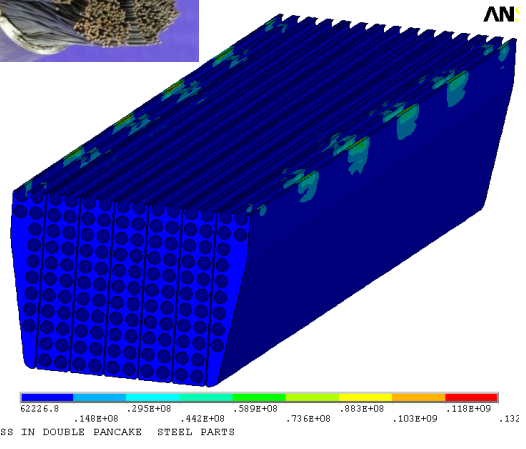








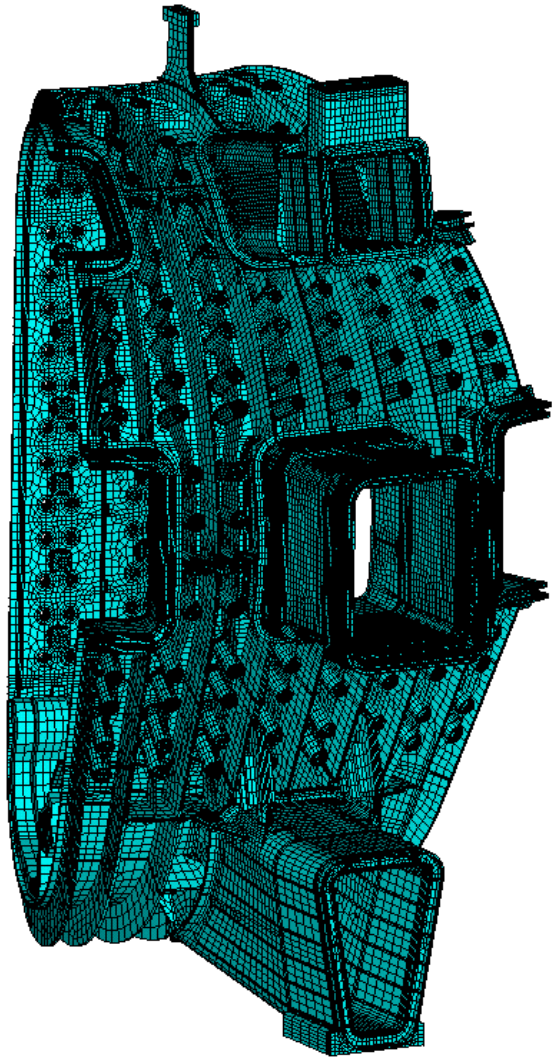


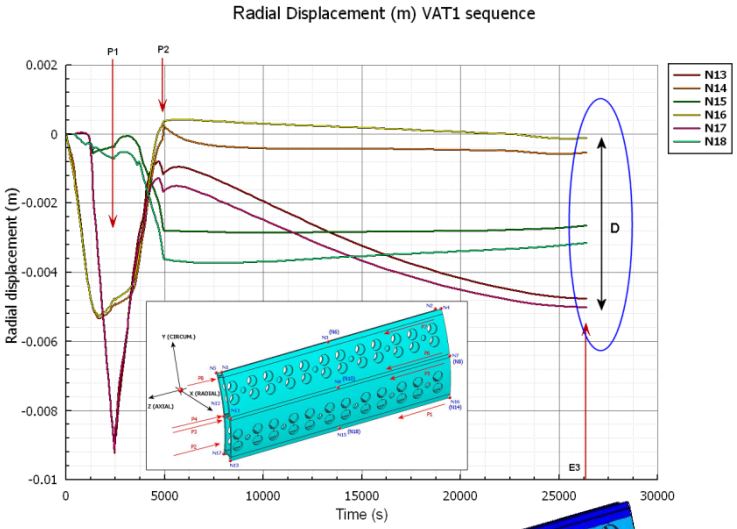


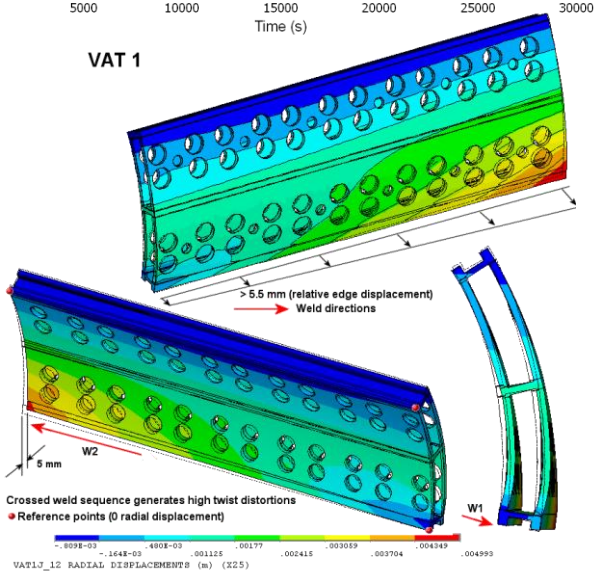
Jornada
BTEC/F4E
Diagnósticos

ENGINEERING ANALYSIS: WELD DISTORTION

VACUUM VESSEL



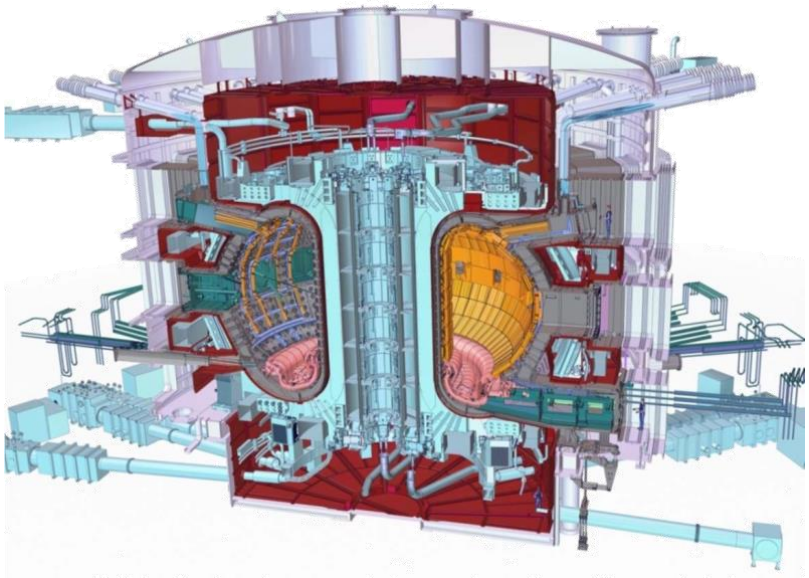




Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

- NUCLEAR CODES DEVELOPEMENT



NUCLEAR CODES DEVELOPMENT

UPDATE OF THE STRUCTURAL DESIGN CRITERIA FOR IN VESSEL COMPONENTS (SDC-IC). ED 2012

The ITER In-vessel Components are subjected to special working and environment conditions (neutron radiation, high heat fluxes, electromagnetic forces, etc.). These conditions are different from conditions in fission reactors and create challenging issues related to justification of the design of these components.

For that reason special criteria (Structural Design Criteria for in-vessel components [SDC-IC] for the design have been developed.

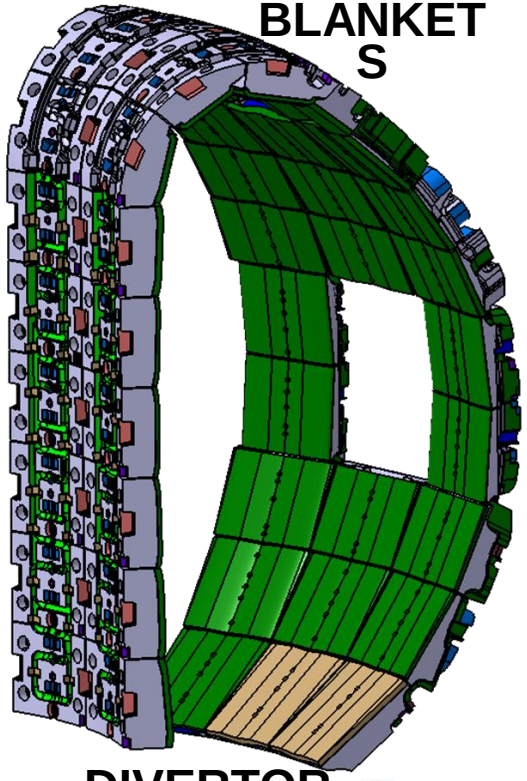
Jornada
BTEC/F4E
Diagnósticos

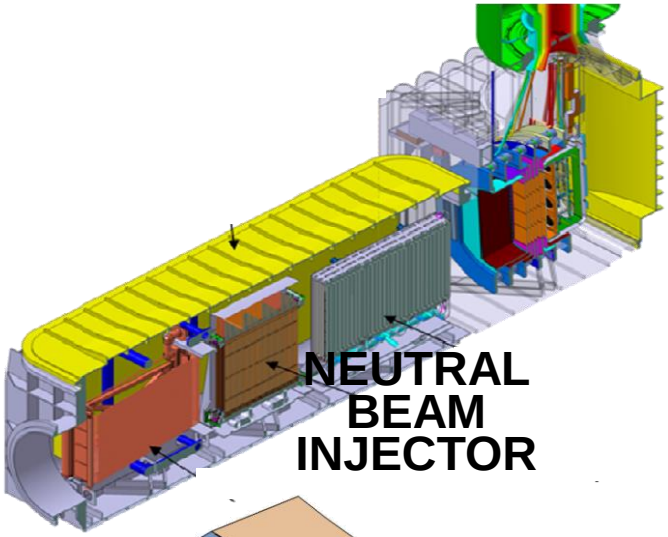
NATEC INGENIEROS

NUCLEAR CODES DEVELOPMENT

IN VESSEL COMPONENTS

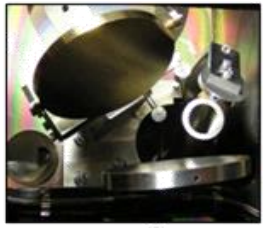
BLANKETS

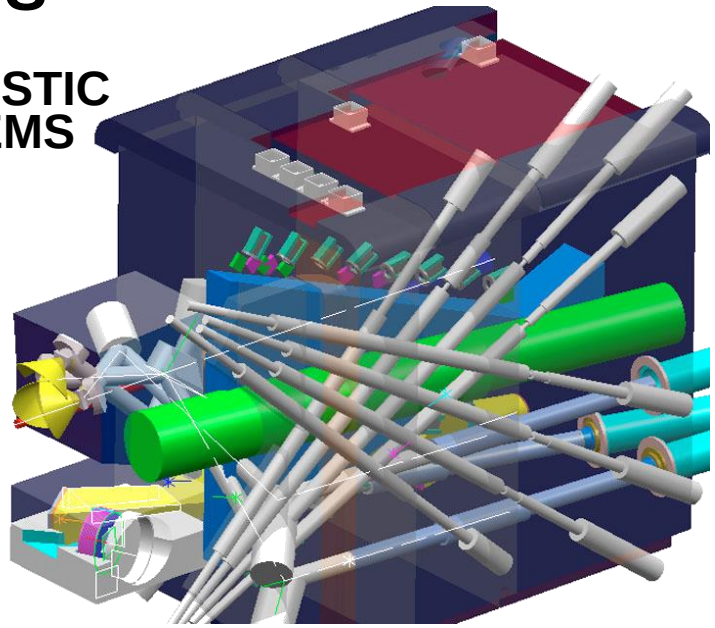




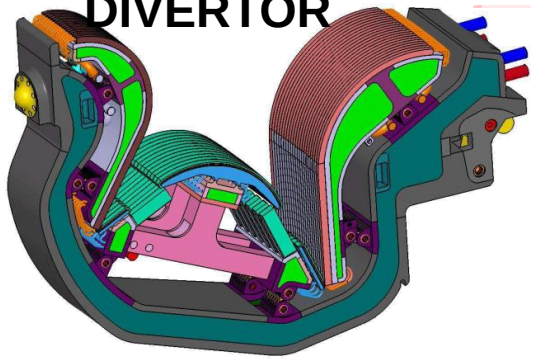
NEUTRAL BEAM INJECTOR

DIAGNOSTIC SYSTEMS

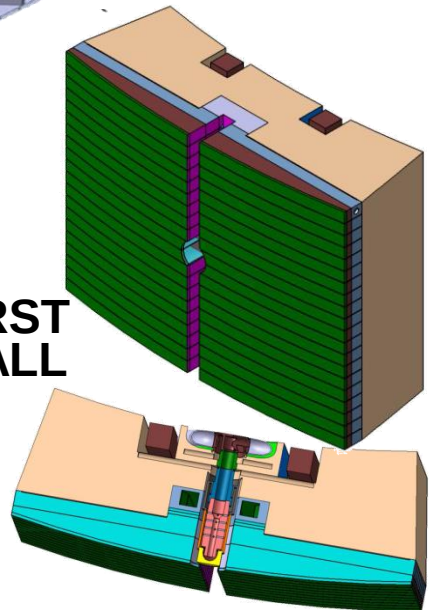




DIVERTOR



FIRST WALL



IN-VESSEL COILS

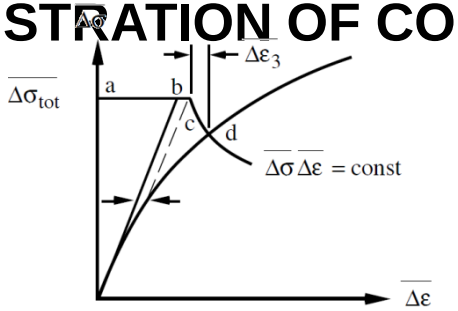
Jornada
BTEC/F4E
Diagnósticos

NUCLEAR CODES DEVELOPMENT

UPDATE OF THE STRUCTURAL DESIGN CRITERIA FOR IN VESSEL COMPONENTS (SDC-IC). ED 2012

NATEC (engineering firm), in consortium with IDESA (vessel manufacturing company), carried out in 2012 the SDC-IC update through:

- **INCORPORATION OF RCC-MX and RCC-MR LATEST MODIFICATIONS**
- **INCORPORATION OF MANUFACTURING RULES**
- **DEMONSTRATION OF COMPLIANCE WITH PED AND ESPN**



$$\text{Max}\left(\overline{P_L + P_b}\right) + \Delta\left[\overline{P} + \overline{Q}\right]_{max} \leq \overline{3S_m}$$

NUCLEAR CODES DEVELOPMENT

ITER STRUCTURAL DESIGN CRITERIA FOR IN-VESSEL COMPONENTS (SDC-IC)

FOREWORD (EDITION JULY 2012)

The Structural Design Criteria for ITER In-vessel Components (SDC-IC) contains rules for the structural design of the in-vessel components: first wall, shield blanket, divertor, in-vessel coils, diagnostic components located inside of vacuum vessel and components inside of neutral beam injector system. These components are classified as Non-Safety Important, but they are Quality Class 1 in accordance with ITER classification.

The scope of SDC-IC was originally limited to design. Applicable mandatory documents, Detailed Design Documents (DDD) for each in-vessel component, Vacuum Handbook and other ITER documents should address regulatory and manufacturing requirements. For these reasons, informative Appendixes A, B, C, D, E1, E2, F1 and G have been modified and created to address consistency of SDC-IC with materials data, manufacturing rules, design by experiment for plasma facing components, possible relationship with PED/ESPN and design of in-vessel coils.

Jornada
BTEC/F4E
Diagnósticos

NATEC's participation in ITER project:

Summary

- **For more than 8 years of working for ITER we have contributed to the design and analysis of ITER diagnostic systems**

- **Our specialists have unique experience in solving a wide range of engineering problems of ITER diagnostic devices: from design to analysis and structural assessment.**

- **We do our best applying our skills to the successful development and realization of the ITER project.**

THANK YOU FOR YOUR ATTENTION

pensando en futuro

the way to new energy

china eu india japan korea russia usa