ACCELERATOR AND MAGNET INFRASTRUCTURE FOR COOPERATION AND INNOVATION IN CIEMAT

Centro de Investigaciones Energéticas Medioambientales y Tecnológicas,
CIEMAT- Madrid

June 2022

Index

Figure index

1. INTRODUCTION

Technology infrastructure can be defined as technology services, software, equipment, facilities, and structures upon which the capabilities of communities and organizations are built. In this document we describe the technology infrastructures related to particle accelerators in CIEMAT.

2. SUPERCONDUCTING MAGNETS LAB

Name of the infrastructure	Superconducting magnets lab
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://www.ciemat.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	Cryogenic tests of SC magnets. NC magnets testing. Magnetic measurements of NC & SC magnets. Fabrication of SC magnets. Especial magnet design & Fabrication
General description of the infrastructure	This facility is composed by the following infrastructures and / or activities: **1. Test stations for superconducting magnets:** Superconductivity laboratory for testing magnets up to 2000 A and other superconducting devices. It includes power supplies, 3 helium cryostats, instrumentation, and a dry cryostat cooled with cryocooler. **2. Magnetic measurement facilities:** - Magnetic measurements instrumentation. - High precision mechanical 3D system with a Hall sensor for measurement of large magnetic devices. - Rotating coil system for the measurement of dipole, quadrupole and sextupole field quality. **3. Test stations for thermal and electrical testing (at cryogenic temperatures):** - Sumitomo RDK 415D Cryocooler. Leybold cryocooler. Autonomous liquefactor for liquid helium production, Cryogenic Supply System, CSS **4. Platforms for manufacturing treatments and test of magnet components for accelerator:** - Assembly Hall for the fabrication and mounting of accelerators components. It includes 3 winding tables, mechanical measurements instrumentation, etc...
Already existing or planned	Facility in user operation since 2007
Unique features	Ideal facility for testing small superconducting magnets. Many of the LHC small prototypes have been tested here.
Present situation/future changes/expected lifetime	In operation for several years. An additional Cryocooler will be added
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Infrastructure dedicated to R&D and projects
Main user community	SC magnets NC magnets, including current leads and other components
Number of users	Large accelerator-based facilities like XFEL, LHC, HL-LHC, IFMIF, ILC, FCC projects and R&D
Open for external users	Yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	Support will be provided by CIEMAT, at a cost: manpower for preparing the tests, assembly, running of the installation, fluids and electricity… In any case, the presence of some users will be requested at some points
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contacting the Accelerator Unit leader at CIEMAT
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed, a priori around 30 %
Number of FTEs operating the infrastructure	3
Contact details (name, Institute, email,)	Fernando Toral Head of Accelerator Unit Avenida Complutense, 40 28040, Madrid Fernando.toral@ciemat.es Tel.: +34 91 496 2557

if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

Fig. 2 Testing Cryostat

Fig. 3. Winding of MCBX Prototype for the HL-LHC

Fig. 1. Test of Autonomous cryogenic supply system of AMIT Cyclotron

3. ION SOURCE TEST FACILITY

Name of the infrastructure	Ion Source test facility
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://www.ciemat.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	Ion source, H- source, cyclotron, vacuum, instrumentation, and diagnostics. Medical accelerators, cathode.
General description of the infrastructure	This facility is composed by the following infrastructures and / or activities: 1.Test station for P.I.G. ion souces: DC and RF extraction. Measurement of beam current with Faraday cups. Plasma density and temperature can be estimated with optical emission spectroscopy and Langmuir probes. 2. NC dipole magnet: 0,85 T 3. Cold Cathode P.I.G. Ion source 4. Beam diagnostics and instrumentation 4. H- gas handling control 5. Vacuum chamber and vacuum system.
Already existing or planned	Existing. Improvement plan: adaptation for measurement of RF ion sources. RF extraction to avoid high voltage.
Present situation/future changes/expected lifetime	No large change presently planned. Expected lifetime: more than 10 years
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Medical Cyclotrons users and R&D Institutes
Main user community	P.I.G. sources for accelerators
Open for external users	yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	The equipment is under the responsibility of the CIEMAT, which are in charge of the operation, maintenance and safety issues. CIEMAT agrees to provide the personnel to ensure these functions.
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contacting the responsible
Can the infrastructure be made available?	yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed.
Contact details (name, Institute, email,)	Daniel Gavela Accelerator Unit Avenida Complutense, 40 28040, Madrid daniel.gavela@ciemat.es Tel.: +34 91 496 2573
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

Fig. 4. Ion source test facility

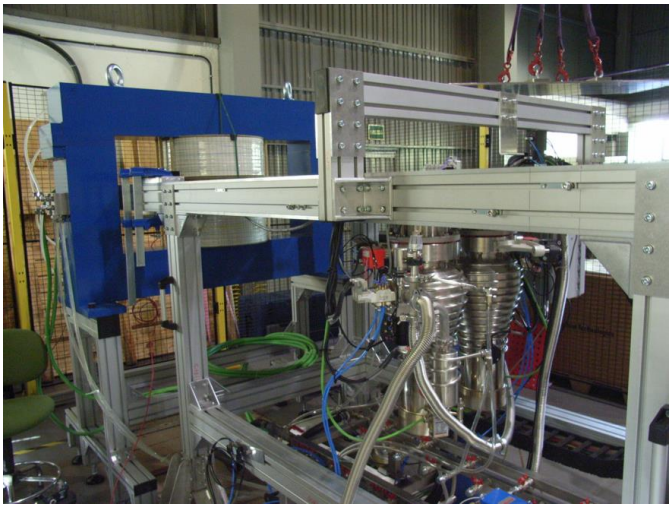

Fig. 5. Overview of the test bench with the mechanical structure, the magnet, the vacuum system, and the refrigeration water distribution system

Fig. 6. A top view inside the vacuum chamber, showing the electrical shielded box, the ion source and the magnet

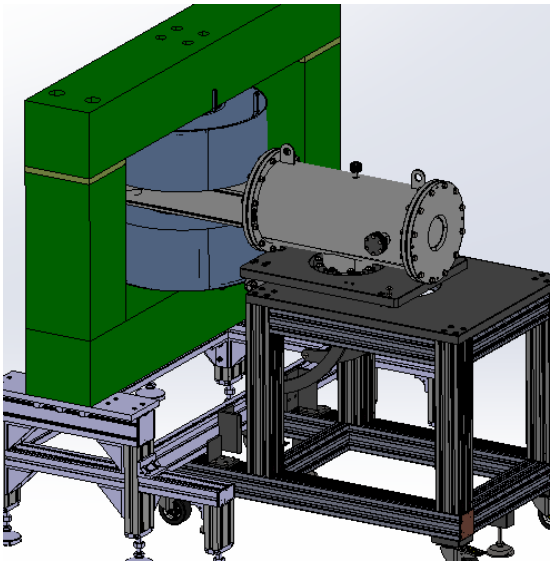

Fig. 7. New Ion source facility with RF extraction

4. LOW POWER RF FACILITY

Name of the infrastructure	Ion Source test facility
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://www.ciemat.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	RF structures
General description of the infrastructure	Facility for low power measurement, characterization and tuning RF structures This facility is composed by the following infrastructures and / or activities: 1. High frequency VNA for S-parameters masurements 2. Bread pull measurements test bench including stepper motor, pulley system and toolings for adaptation for different structures 3. Specifically developed software for the contol of the test and porst-processing of the data. 4, Characterization and tuning of RF structures for medical linear accelerators.
Already existing or planned	Existing. Improvement plan: adaptation for measurement of longer structures for linacs (RFQs, IH cavities, etc…) in horizontal position.
Present situation/future changes/expected lifetime	No large change presently planned. Expected lifetime: more than 10 years
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Facility dedicated to low power RF
Main user community	RF systems
Open for external users	yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	The equipment is under the responsibility of the CIEMAT, which are in charge of the operation, maintenance and safety issues. They agree to provide the personnel to ensure these functions.
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, european or else
How to apply	By contacting the responsible
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed.
Contact details (name, Institute, email,)	Daniel Gavela Accelerator Unit Avenida Complutense, 40 28040, Madrid daniel.gavela@ciemat.es Tel.: +34 91 496 2573

Pictures

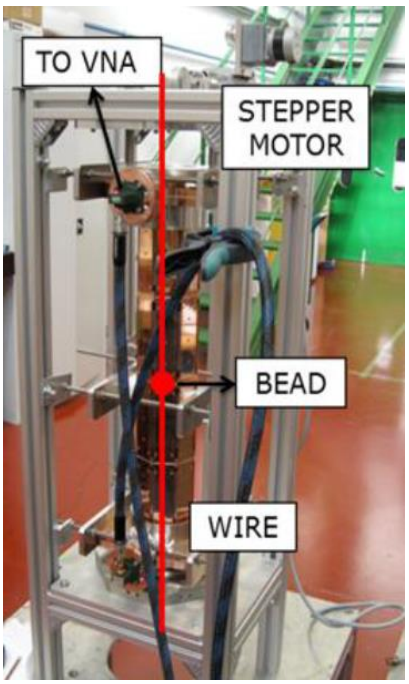

Fig. 8. Bead pull test bench

5. 400 KW 750 MHZ 0.2% D.C. SSPA

Name of the infrastructure	400 kW 750 MHz 0,2% d.c. SSPA
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://www.ciemat.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	RF structures, medical accelerators
General description of the infrastructure	The objective of this infrastructure is to contribute to the technological development in high frequency RF structures with special interest in future applications in the high energies and medical fields. The frequency of 750 MHz is especially interesting in the field of linear accelerators, especially for medical applications, with some low-beta accelerating structures being developed or proposed nowadays. This facility is composed by the following infrastructures and / or activities: 1. Set of amplifiers for providing up to 400 kW RF power at 750 MHz frequency using solid state technology.
Already existing or planned	In progress
Unique features	400 kW 750MHz 0,2% d.c SSPA
Present situation/future changes/expected lifetime	No large change presently planned. Expected lifetime: more than 10 years
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Yes
Main user community	R&D institutes, linear accelerators users, medical accelerators
Open for external users	yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contacting the responsible
Can the infrastructure be made available?	yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed.
Contact details (name, Institute, email,)	Daniel Gavela Accelerator Unit Avenida Complutense, 40 28040, Madrid daniel.gavela@ciemat.es Tel.: +34 91 496 2573
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

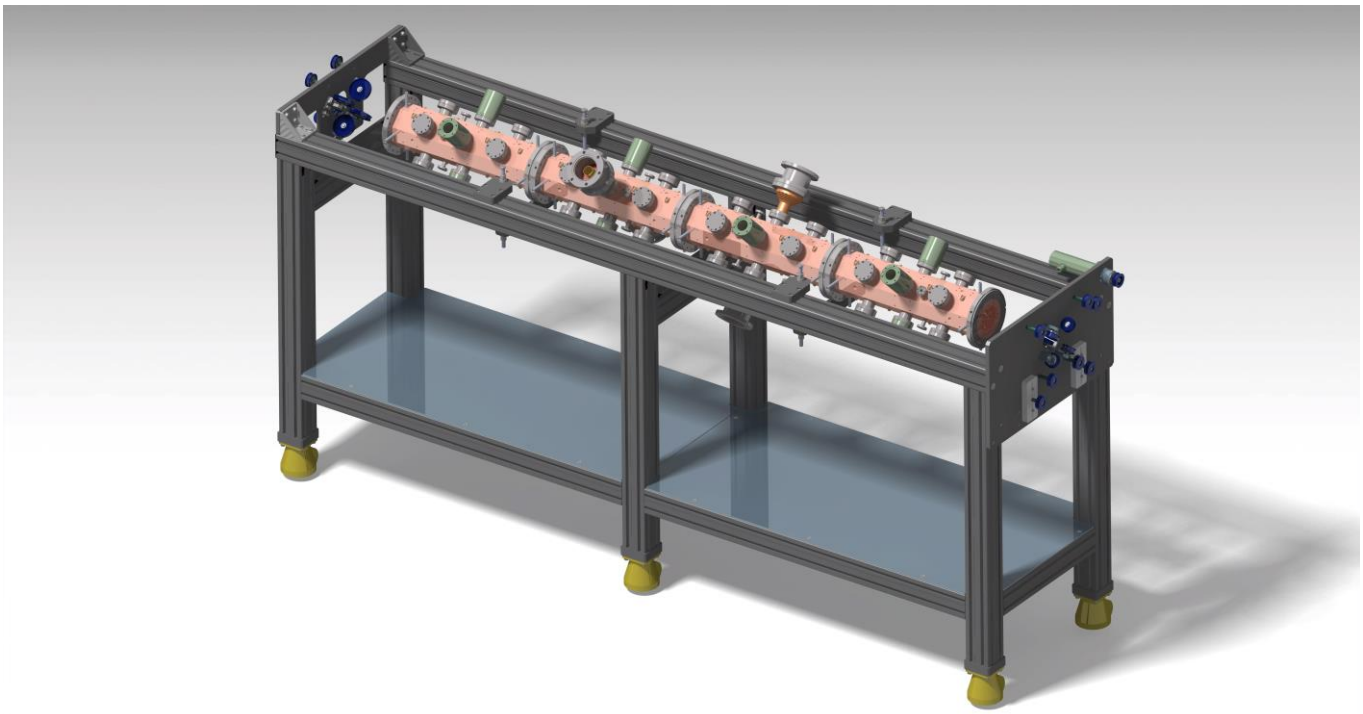

Fig. 9. Low power RF test bench

6. ELECTRON VAN DE GRAFF ACCELERATOR FACILITY

Name of the infrastructure	Electron Van de Graff accelerator facility
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://www.fusion.ciemat.es/competitive-access-to-facilities/electron-accelerator/
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	Van de Graff, material irradiation
General description of the infrastructure	This facility is composed by the following beam characteristics: - Irradiation by electron beam or by Bremsstrahlung - Energy: 0,25 to 2,0 MeV and current 10 pA to 150mA - Samples from 3 mm^2 to about 20x20 cm^2 - At target area unfocussed beam is ~1 cm diameter - Beam can be focussed up to ~1 mm diameter (for small samples) - Beam can be defocussed up to ~3 cm diameter - Beam can be scanned over 20x20 cm^2 (for large samples)
Already existing or planned	Existing
Unique features	Electron irradiation at controlled temperature from 25 C up to 900 C within high vacuum or any gas atmosphere
Present situation/future changes/expected lifetime	Fully operative.
Accelerator infrastructure or component test infrastructure	Homemade special sample holders and irradiation chambers. Measurement in situ of Radioluminescence, Radiation Induced Conductivity and Radiation Induced hydrogen permeation.
Shared facility/infrastructure	Infrastructure dedicated to R&D and service
Main user community	60% in home users; 40% external users form R&D institutions
Number of users	10 different users per year.
Open for external users	Yes
If open to external users: Modality of access to the infrastructure (access unit)	Competitive access
Number of access units available for external users	NA
If open to external users: Support offered by the organization operating the infrastructure	Operation of accelerator, Fully equipped experimental stations (detectors, sample holders, vacuum systems, electronics, etc).Expertise on radiation damage also provided to user
Review procedure for requested access	External evaluation committee
How to apply	Web application via http://www.fusion.ciemat.es/competitive-access-to-facilities/electron-accelerator/
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Negotiable
Number of FTEs operating the infrastructure	1FTE +3 technicians for infrastructure support
Contact details (name, Institute, email,)	Alejandro Moroño Tecnología de Fusión Division Avenida Complutense, 40 28040, Madrid alejandro.morono@ciemat.es Tel.: +34 91 346 6372
Annual operating costs (excl. Investment costs) of the infrastructure	1M€
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.
Estimated investment cost (replacement value)	12M€

7. HIGH POWER RF LABORATORY

Name of the infrastructure	High Power RF Laboratory
Location of infrastructure (town, country)	Leganés, Spain
Web site address	http://www.ciemat.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	RF power systems for accelerators, high power RF conditioning and testing of RF components for accelerators
General description of the infrastructure	The CIEMAT High Power Radiofrequency Laboratory (HPRF Lab) is used for the characterization, measurement, and high-power validation tests of different prototypes and RF components. Apart from basic RF and microwave laboratory test instrumentation and measurement equipment, a high-power RF source is available, which is composed of the following parts: - RF module: 200 kW CW @175 MHz RF tetrode-based amplifier + fully digital LLRF - High Voltage Power Supply. - Test bench for RF couplers conditioning. - Auxiliary RF components. - Water cooling system. - Air cooling system. - Electrical Supply System.
Already existing or planned	Already existing
Unique features	Unique 200 kW CW @175 MHz RF source in Spain, possibly Europe
Present situation/future changes/expected lifetime	Operative at least until 2025
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	No
Main user community	70% in home users; 30% external users (industry collaborators)
Number of users	CIEMAT for EUROfusion activities and several industrial partners for technology R&D
Open for external users	Yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	The equipment is under the responsibility of the CIEMAT, which are in charge of the operation, maintenance and safety issues. CIEMAT agrees to provide the personnel to ensure these functions.
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contacting the responsible
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Negotiable
Contact details (name, Institute, email,)	Cristina de la Morena / David Regidor Fusion Technology Division Avenida Complutense, 40 28040, Madrid cristina.delamorena@ciemat.es / david.regidor@ciemat.es Tel.: +34 91 496 2600/ +34 91 346 6434
Annual operating costs (excl. Investment costs) of the infrastructure	50 k€
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.
Estimated investment cost (replacement value)	3 M€

Pictures

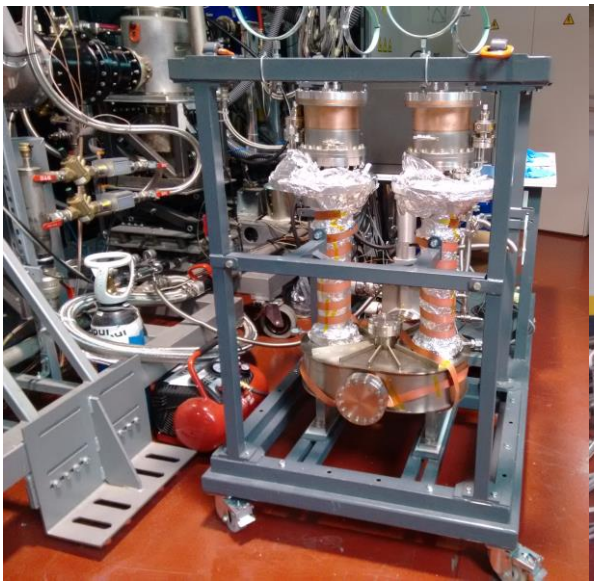

Fig. 10. RF couplers vacuum baking

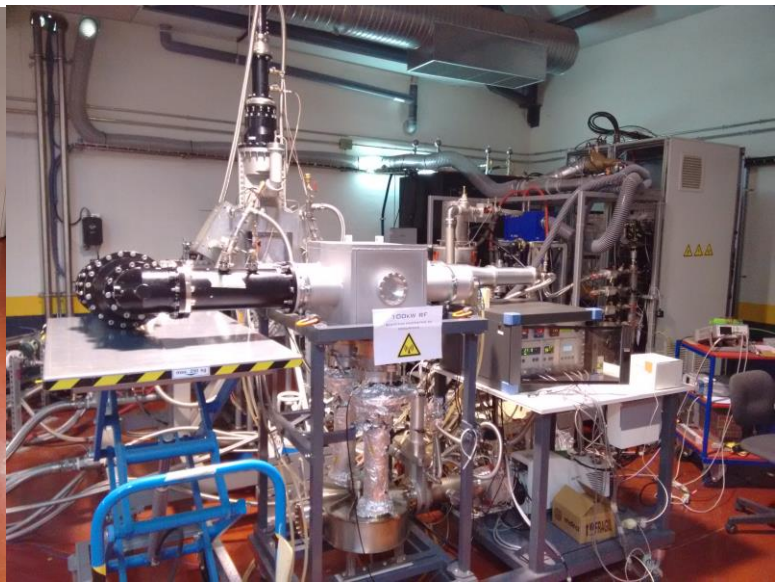

Fig. 11. Test bench for RF couplers conditioning

Fig. 12. High power RF source of the CIEMAT High Power RF Laboratory

8. IFMIF-DONES RF LABORATORY

Name of the infrastructure	IFMIF-DONES RF Laboratory
Location of infrastructure (town, country)	Escúzar, Granada, Spain
Web site address	http://www.ciemat.es https://ifmif-dones.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas IFMIF-DONES España
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	RF power systems for accelerators, accelerator components RF conditioning, high power testing of RF components
General description of the infrastructure	Radiofrequency Laboratory for the IFMIF-DONES facility in Granada, Spain
Already existing or planned	Planned
Unique features	Fully integrated RF Laboratory for test and advanced conditioning of RF components for accelerators: two high efficiency solid state 200 kW CW @ 175 MHz RF sources and auxiliaries, clean room, x-ray shielding, etc.
Present situation/future changes/expected lifetime	Expected lifetime: full IFMIF-DONES facility operation (30 years)
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	No
Main user community	RF power systems for accelerators, high power RF conditioning and testing
Open for external users	Yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
If open to external users: Support offered by the organization operating the infrastructure	The equipment is under the responsibility of the CIEMAT, which are in charge of the operation, maintenance and safety issues. CIEMAT agrees to provide the personnel to ensure these functions.
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contacting the responsible
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed.
Contact details (name, Institute, email,)	Cristina de la Morena / David Regidor Fusion Technology Division Avenida Complutense, 40 28040, Madrid cristina.delamorena@ciemat.es / david.regidor@ciemat.es Tel.: +34 91 496 2600 / +34 91 346 6434
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

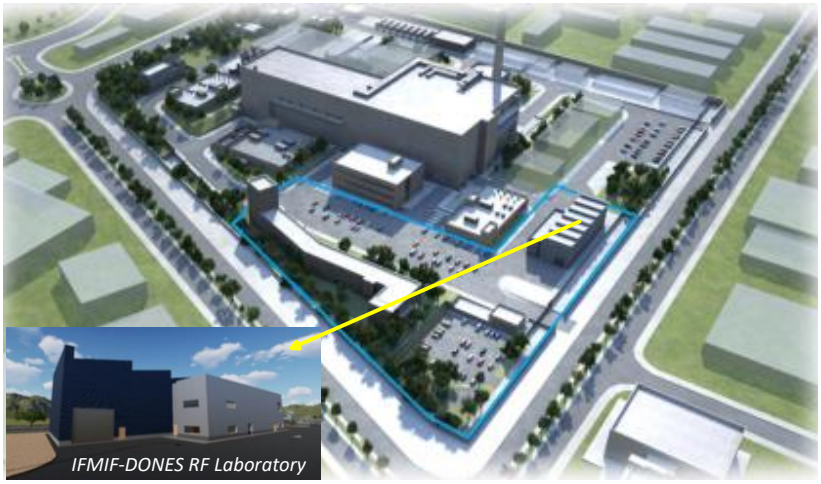

Fig. 13. Location of the RF laboratory in the IFMIF-DONES facility

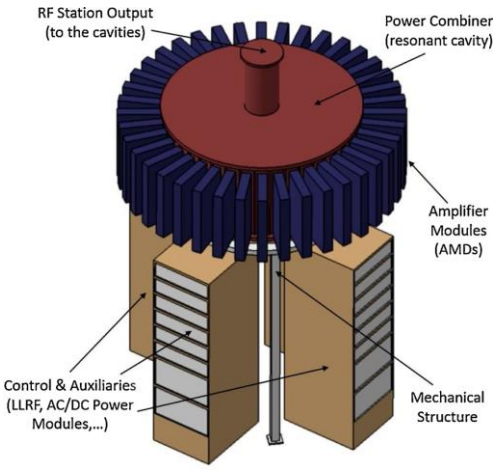

Fig. 14. Solid state 200 kW CW @175 MHz RF Station for the IFMIF-DONES RF Laboratory

9. 200 KW 175MHZ CW SSPA + CAVITY COMBINER + LLRF

Name of the infrastructure	200 kW 175 MHz CW SSPA + cavity combiner + LLRF
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://www.ciemat.es
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	RF power systems for accelerators, accelerator components RF conditioning, high power testing of RF components
General description of the infrastructure	Solid-state high efficiency demonstrator for the IFMIF-DONES RF Power System
Already existing or planned	Planned
Unique features	Solid state technology using high efficiency cavity combiner
Present situation/future changes/expected lifetime	Under design and development
Accelerator infrastructure or component test infrastructure	Accelerator infrastructure (RF source prototype)
Shared facility/infrastructure	Yes
Main user community	RF systems for accelerators
Open for external users	yes
If open to external users: Modality of access to the infrastructure (access unit)	There are different modalities to access the facility like a “Service Contract” or a “Collaboration Agreement” among others
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	The equipment is under the responsibility of the CIEMAT, which are in charge of the operation, maintenance and safety issues. CIEMAT agrees to provide the personnel to ensure these functions.
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contacting the responsible
Can the infrastructure be made available?	yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed.
Contact details (name, Institute, email,)	Cristina de la Morena / David Regidor Fusion Technology Division Avenida Complutense, 40 28040, Madrid cristina.delamorena@ciemat.es / david.regidor@ciemat.es Tel.: +34 91 496 2600/ +34 91 346 6434
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.
Estimated investment cost (replacement value)	2 M€

Pictures

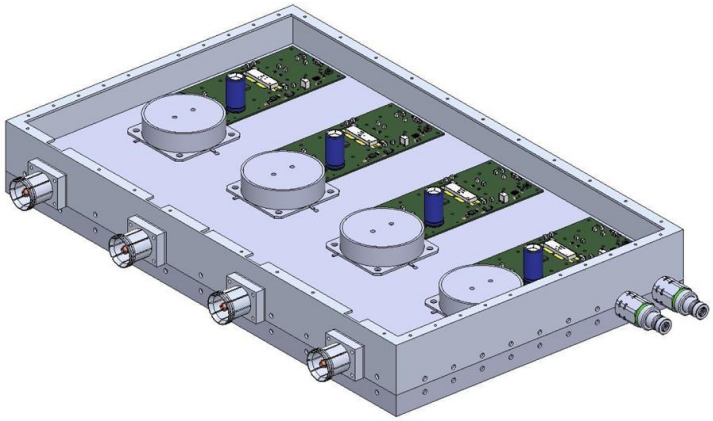

Fig. 15. Solid state Amplifier Module

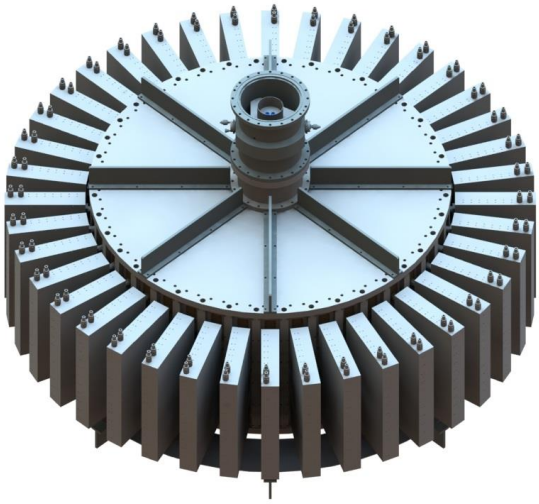

Fig. 16. Solid state Amplifier Modules and single-step cavity combiner

Fig. 17. Cavity combiner prototype in the CIEMAT High Power RF Laboratory

10. MECHANICAL PROPERTIES LABORATORY

Name of the infrastructure	Mechanical properties laboratory
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://rdgroups.ciemat.es/web/materiales/mechanical-properties-laboratory
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	creep, tensile, small punch, charpy, hardness, fatigue, toughness
General description of the infrastructure	This facility is composed by the following infrastructures: **1: Creep test:** - The creep test is performed using a tensile specimen to which a constant stress and temperature are applied. The test is recorded on a graph of deformation as a function of time. **2: Tensile test, toughness, fatigue crack growth, etc…:** - The Laboratory consists of two MTS-810 servo-hydraulic machines for carrying out tensile, toughness, crack growth, etc. tests. by using standard and miniature specimens according to ASTM & ISO test standards. **3, Small punch test:** - Use of small punch test as a screening method. - EN10371:2021: Metallic materials - Small punch test method. - Temperature range from -180 ° C to 500 ° C. **4, Small punch creep test:** - Use of small punch test as a screening method. - EN10371:2021: Metallic materials - Small punch test method. - The ovens have a temperature of up to 900 ° C. **5, Impact test:** - Two pendulums (Wolpert Impact test 300 J and 25 J) for carrying out impact tests with a standard specimen and an undersized specimen (KLST). **6, Durometer:** - Hardness machine (Akashi Seisakusho AVK-All) is used to perform Vickers hardness test according with the standard ASTM E-92. **7, Nanoindentation test:** - The MTS XP Nanoindenter is an accurate instrument for nanomechanical testing. Electromagnetic actuation allows unparalleled dynamic range in force and displacement and measurement of deformation over six orders of magnitude (from nanometers to millimetres). **8, Radiactive facility:** - Mechanical characterization of irradiated steels (tensile, toughness, impact tests, etc.). **9, Metrology laboratory:** - Profiles projector - Roughness Gauge and Profilometer - Balances - Thermobalance - Dimensional control tools: dial gauges, gauges, micrometres, rulers, etc.
Already existing or planned	Facility in user operation since 1970
Unique features	Facility for mechanical properties testing in radioactive installation.
Present situation/future changes/expected lifetime	In operation for several years. No large change presently planned.
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Infrastructure dedicated to R&D and projects
Main user community	Nuclear Materials and Metallic Materials for Energy Sector.
Open for external users	Yes
If open to external users: **Modality of access to the infrastructure (access unit)**	Contracts or agreements for services (research and development and innovation activities)
Number of access units available for external users	Depending on the availability of the part of the installation needed

If open to external users: **Support offered by the organization operating the infrastructure**	Support will be provided by CIEMAT, at a cost: manpower for preparing the tests, assembly, running of the installation, fluids and electricity… In any case, the presence of some users will be requested at some points
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contracting the Division leader at CIEMAT
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed, a priori around 20 %
Number of FTEs operating the infrastructure	3
Contact details (name, Institute, email,)	Marta Serrano García Head of Materials for Energy Interest Division Avenida Complutense, 40 28040, Madrid marta.serrano@ciemat.es Tel.: +34 91 346 6030
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

Fig. 18. Creep tests under aggressive environment

Fig. 19. Crack growth rate measurements under creep-fatigue conditions

11. MICROSTRUCTURE LABORATORY

Name of the infrastructure	Microstructure Laboratory
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://rdgroups.ciemat.es/web/materiales/microstructure-laboratory
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	Surface characterization, SEM, TEM, XPS, Auger Spectroscopy
General description of the infrastructure	This facility is composed by the following infrastructures: **1: Scanning electron microscopy (SEM):** - The scanning electron microscope (SEM) allows the obtention of high-resolution images by means of an electron beam focused on the sample to be studied, scanning its surface. **2. Scanning electron microscopy (FEGSTEM-EDX, BSE, EBDS):** - Schottky Field Emission Gun (FEG) - Accelerating voltage up until 30 kV - Magnification: 10x-100000x - Resolution with Se: 1.2 nm - Resolution with BSE: 3.5 nm **3. Scanning Auger microprobe:** - Scanning Auger Microprobe, including in-situ fracture studies, one by impact (cooling of the specimen at liquid nitrogen temperature) and the other by tension. **4, X-ray photoelectron spectroscopy (XPS/ESCA):** **5. Transmission electron microscope (TEM) JEOL JEM 2010:** - Transmission electron microscopy is a powerful technique that uses an electron beam that is transmitted through a solid (an ultra-fine sample, about 100 nm) to form an image. This technique gives information about the microstructure and morphology of the samples studied. **6. TEM sample preparation laboratory:** - Sample preparation is an important aspect of TEM analysis, as a TEM sample must be fine enough for electrons to pass through it and form an image. - The samples go through several processes of cutting, smoothing, and polishing to achieve electronic transparency.
Already existing or planned	Facility in user operation since 1980
Unique features	Facility for microstructural characterization and microanalysis (surface analysis) in radioactive installation.
Present situation/future changes/expected lifetime	In operation for several years. No large change presently planned.
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Infrastructure dedicated to R&D and projects
Main user community	Nuclear Materials and Metallic Materials for Energy Sector.
Open for external users	Yes
If open to external users: **Modality of access to the infrastructure (access unit)**	Contracts or agreements for services (research and development and innovation activities)
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: **Support offered by the organization operating the infrastructure**	Support will be provided by CIEMAT, at a cost: manpower for preparing the tests, assembly, running of the installation, fluids, and electricity… In any case, the presence of some users will be requested at some points
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contracting the Division leader at CIEMAT
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed, a priori around 20 %
Number of FTEs operating the infrastructure	3

Contact details (name, Institute, email,)	Gonzalo de Diego Velasco Head of Microstructural Characterization and Microanalysis Unit Avenida Complutense, 40 28040, Madrid g.diego@ciemat.es Tel.: +34 91 346 6618
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

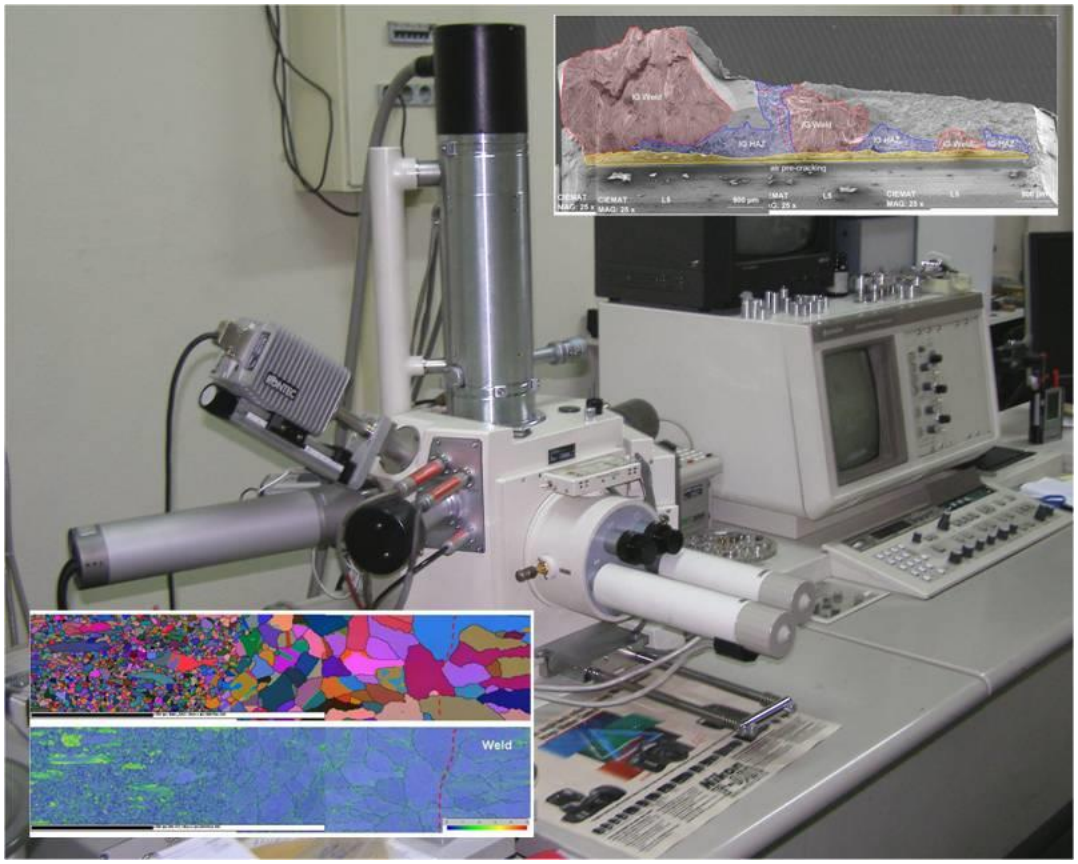

Fig. 20. Scanning electron microscopy (FEGSTEM-EDX, BSE, EBDS)

12. CORROSION LABORATORY

Name of the infrastructure	Corrosion Laboratory
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://rdgroups.ciemat.es/web/materiales/corrosion-laboratory
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	static autoclaves, molten salts, CERT, constant load, SCC.
General description of the infrastructure	This facility is composed by the following infrastructures: **1. Molten salt facility:** - Eight static autoclaves for high temperature immersion tests in molten salts up to 700º C with controlled gas atmosphere **2. Liquid metals facility:** - Devices for static tests on Pb and Pb-Bi with controlled atmospheres up to temperatures of 700º C **3. SCC test facility in light water reactor (LWR) conditions:** - Eight circuits to work at 3600C and 200 kg / cm2, with the water chemistry of the primary circuit of PWR reactors. - Performance of SCC tests in a dynamic regime, crack initiation and propagation, with a potential drop system that allows obtaining the crack length measurement in real time. **4. Static autoclaves for aggressive environments:** Six static autoclaves for corrosion and crack initiation tests in aggressive media with acidic or basic pH at high pressure and temperature **5. SCC and CL testing facilities in BRW reactor conditions with irradiated material:** - Two circuits in dynamic regime designed to work at 290 ° C and 90 kg / cm² with load systems for conducting constant expansion rate (CERT) tests inside a lead cell with previously irradiated material. **6. Low voltage corrosion installations in supercritical water for generation IV reactors:** - Dynamic regime circuit designed to work at 550 ° C and 350 kg / cm2. - It allows for uniform corrosion tests and has four load axes for CERT and crack propagation tests.
Already existing or planned	Facility in user operation since 1980
Unique features	Facility for corrosion tests in static and dynamic autoclave for high temperature in water chemistry of PWR, molten salts, liquid metals (Pb-B), supercritical water. SCC test with irradiated samples.
Present situation/future changes/expected lifetime	In operation for several years. No large change presently planned.
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Infrastructure dedicated to R&D and projects
Main user community	Nuclear Materials and Metallic Materials for Energy Sector.
Open for external users	Yes
If open to external users: **Modality of access to the infrastructure (access unit)**	Contracts or agreements for services (research and development and innovation activities)
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: **Support offered by the organization operating the infrastructure**	Support will be provided by CIEMAT, at a cost: manpower for preparing the tests, assembly, running of the installation, fluids and electricity… In any case, the presence of some users will be requested at some points
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, European or else
How to apply	By contracting the Division leader at CIEMAT
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed, a priori around 20 %
Number of FTEs operating the infrastructure	3

Contact details (name, Institute, email,)	Marta Navas Rumayor Head of Corrosion Unit Avenida Complutense, 40 28040, Madrid m.navas@ciemat.es Tel.: +34 91 346 6633
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

Fig. 21. Oxidation under controlled atmosphere

Fig. 22. Stress corrosion cracking in water

Fig. 23. Static autoclaves for high temperature immersion test in n molten salts

13. RADIACTIVE LABORATORY FOR MATERIAL TESTING

Name of the infrastructure	Radiactive facilities
Location of infrastructure (town, country)	Madrid, Spain
Web site address	http://rdgroups.ciemat.es/web/materiales/radioactive-laboratory
Legal name of organization operating the infrastructure	CIEMAT, Centro de Investigaciones Energéticas Mediambientales y Tecnológicas
Location of organization (town, country)	Madrid, Spain
Key Accelerator Research Area(s)	Radioactive laboratory for Material Testing
General description of the infrastructure	This facility is composed by the following infrastructures: **1. NAYADE facility:Pool type installation providing sufficient biological shielding for 100,000 Ci of Cobalt-60.** - Animal and plant genetics, in food preservation and microbiological sterilization. - Activation of chemical reactions such as polymerization in wood or chemical synthesis. - Irradiation of gemological materials such as the creation and modification of color centers or the differentiation of gemological materials. - Nuclear Industry for the accelerated aging of materials, equipment and components used in the nuclear industry (motors, electric cables, ...) to simulate the deterioration that they would experience under normal operating conditions, that is, management of the remaining life. - Space Industry, in which, through the use of irradiation devices at low dose rates, in simulation of cosmic radiation, the qualification of highly reliable components used in this industry is carried out. **2. Radioactive facility: Mechanical Properties and microstructural characterization for irradiated samples** - Mechanical characterization of irradiated steels (tensile, toughness, impact tests, etc.) and microstructural analysis (FEGSEM, TEM, XPS, Auger). **3. HALDEN facility:** SCC testing facilities in BRW reactor conditions with irradiated material.
Already existing or planned	Facility in user operation since 1970
Unique features	Facility for corrosion tersts in static and dinamic autoclave for high temperature in water chemistry of PWR, molten salts, liquid metals (Pb-B), supercritical water. SCC test with irradiated samples.
Present situation/future changes/expected lifetime	In operation for several years. No large change presently planned.
Accelerator infrastructure or component test infrastructure	Component test infrastructure
Shared facility/infrastructure	Infrastructure dedicated to R&D and projects
Main user community	Nuclear Materials and Metallic Materials for Energy Sector.
Open for external users	Yes
If open to external users: Modality of access to the infrastructure (access unit)	Contracts or agreements for services (research and development and innovation activities)
Number of access units available for external users	Depending on the availability of the part of the installation needed
If open to external users: Support offered by the organization operating the infrastructure	Support will be provided by CIEMAT, at a cost: manpower for preparing the tests, assembly, running of the installation, fluids and electricitty… In any case, the presence of some users will be requested at some points
Review procedure for requested access	Either after discussion with CIEMAT, or in the frame of an international contract, european or else
How to apply	By contracting the Division leader at CIEMAT
Can the infrastructure be made available?	Yes
If YES, fraction of time that could be made available (%)	Depending on the internal projects going on, and on the facility needed, a priori around 20 %

Number of FTEs operating the infrastructure	3
Contact details (name, Institute, email,)	Marta Serrano García Head of Materials for Energy Interest Division Avenida Complutense, 40 28040, Madrid marta.serrano@ciemat.es Tel.: +34 91 346 6030
if available: costing model (how is the annual operating cost calculated)	If service is delivered to internal CIEMAT clients, costs are calculated on a basis of an all-in fee package. Special conditions may be applicable for tests performed in the frame of approved official cooperation agreements.

Pictures

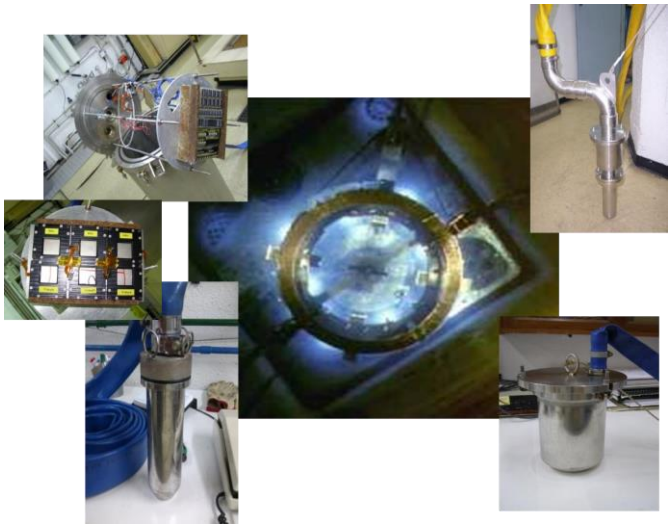

Fig. 24. NAYADE facility: Pool type installation providing sufficient biological shielding for 100,000 Ci of Cobalt-60

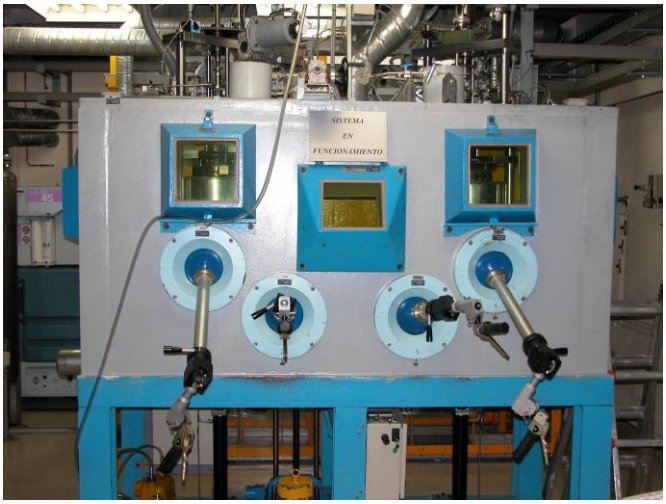

Fig. 25. HALDEN facility: SCC testing facilities in BRW reactor conditions with irradiated material

Fig. 26. Radioactive facility for mechanical characterization. Outside

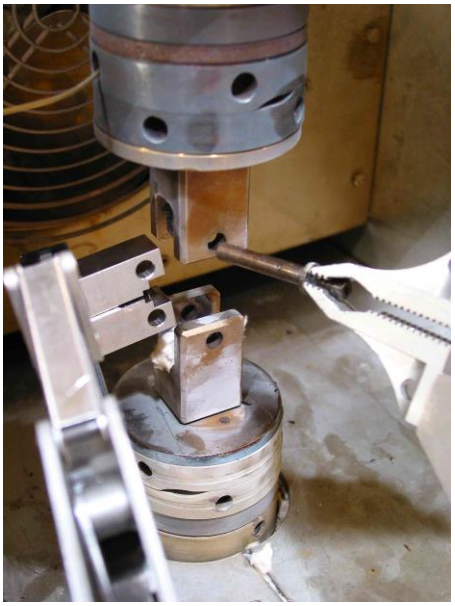

Fig. 27. Radioactive facility for mechanical characterization. Inside