
Activity of the Department of
Engineering and Technical Services
【DETS】
Hiromi.Hayashi

Outline

1. Overview of the DETS

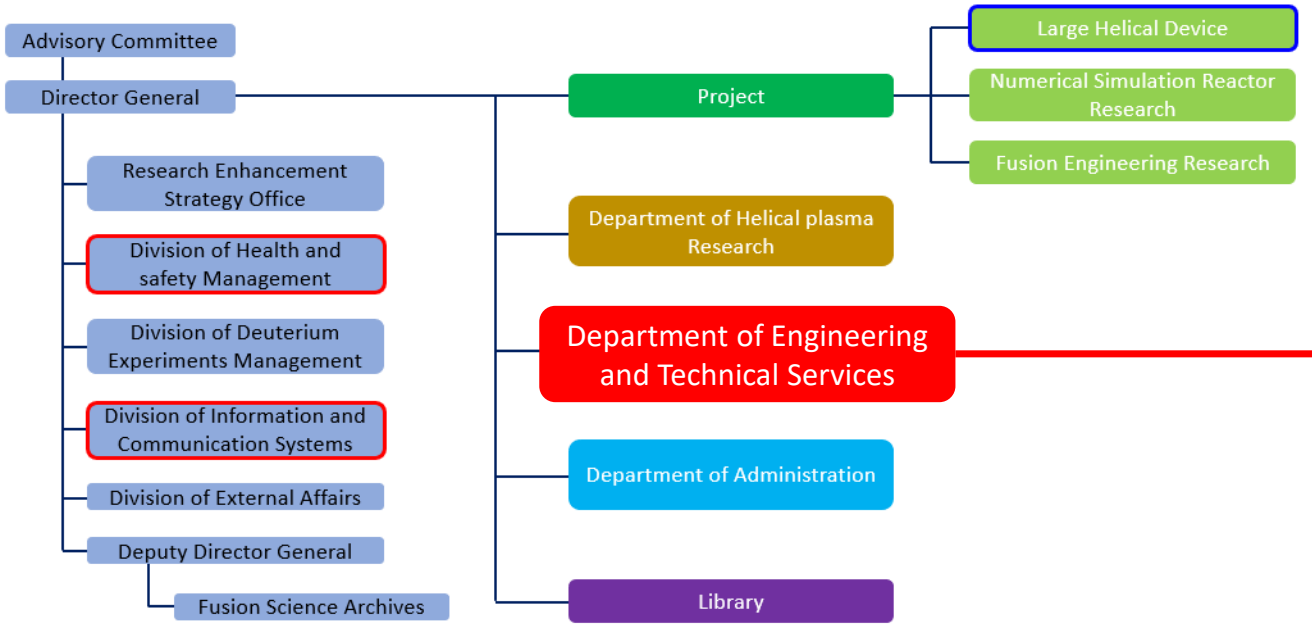
2. Evaluation Perspectives on "DETS

3. Activities of "DETS

4. Summary

Organization of DETS

NIFS Organization



- As for the research activities in NIFS, there are three research projects, that is, LHD project, numerical simulation reactor project and fusion engineering research project.
- DETS is allocated directly under the leadership of director-general.
- DETS supports the 3 research projects with 5 divisions and 20 sections, with 58 staff members.
- DETS also supports the health and safety management division and information and communication systems division, but main contribution is to the LHD project.

Fabrication Technology Division
- Parts and Material Section
- Electronic Engineering Section
- Mechanical Engineering Section
- Machinery Maintenance Engineering Section

Device Technology Division
- Device System Engineering Section
- Power supply Engineering Section
- Vacuum Engineering Section
- Experimental Application Engineering Section

Plasma Heating Technology Division
- Heating System Engineering Section
- Particle Heating Engineering Section
- Electron Heating Engineering Section
- Ion Heating Engineering Section

Diagnostics Technology Division
- Radiation Measurement Engineering Section
- Experimental Radiation Measurement Engineering Section
- Environmental Radiation Measurement Engineering Section
- Radiation Measurement Instrumentation Control Engineering section

Control Technology Division
- Integrated Control Engineering Section
- Control Information Engineering Section
- Cryogenic Control Engineering Section
- Information Infrastructure Engineering Section

DETS Organization

5 Divisions (Manage)
20 sections(chief)
Technical Staff :total 58 members

Evaluation Perspectives on "DETS

1) Has the DETS contributed to the preparation and implementation of the deuterium experiment (plasma performance improvement) in the LHD?

2). Has the DETS contributed to the maintenance and utilization of the research platform in NIFS?

3). Are safety and health initiatives sufficient?

4). As an Inter-University Research Institution, has the DETS conducted technical collaboration, exchange, and cooperation with universities and research institutes?

5). Has the DETS utilized its technical experience and knowledge accumulated so far, for industry-academia collaboration activities?

6). Is there an environment that supports the autonomy of individual technical staff members, together with a systematic effort to improve and to pass on techniques?

Evaluation Perspective（1）

(1) Has the DETS contributed to the preparation and implementation of the deuterium experiment (plasma performance improvement) in the LHD?

LHD and peripheral equipment DETS is involved in

Environmental Radiation Monitoring System

- LHD central control system
- LHD-LAN
- Super-conducting coil power supply
- Cryogenic system

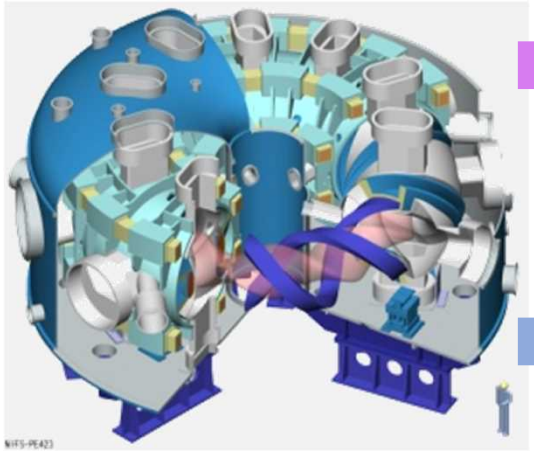
- Water cooling system (LHD system)
- Plasma vacuum vessel

Fuelling system

Gas paff, pellet injector

Plasma heating system

- NBI, ECH, ICH
- Water cooling/heating system
- Motor Generator



LHD（Large Helical Device）

Plasma Diagnostics

- Radiation
- Electron Density, temperature
- Ion Temperature
- etc.

Evacuation system

Vacuum Pump

Detritiation System

Data acquisition system

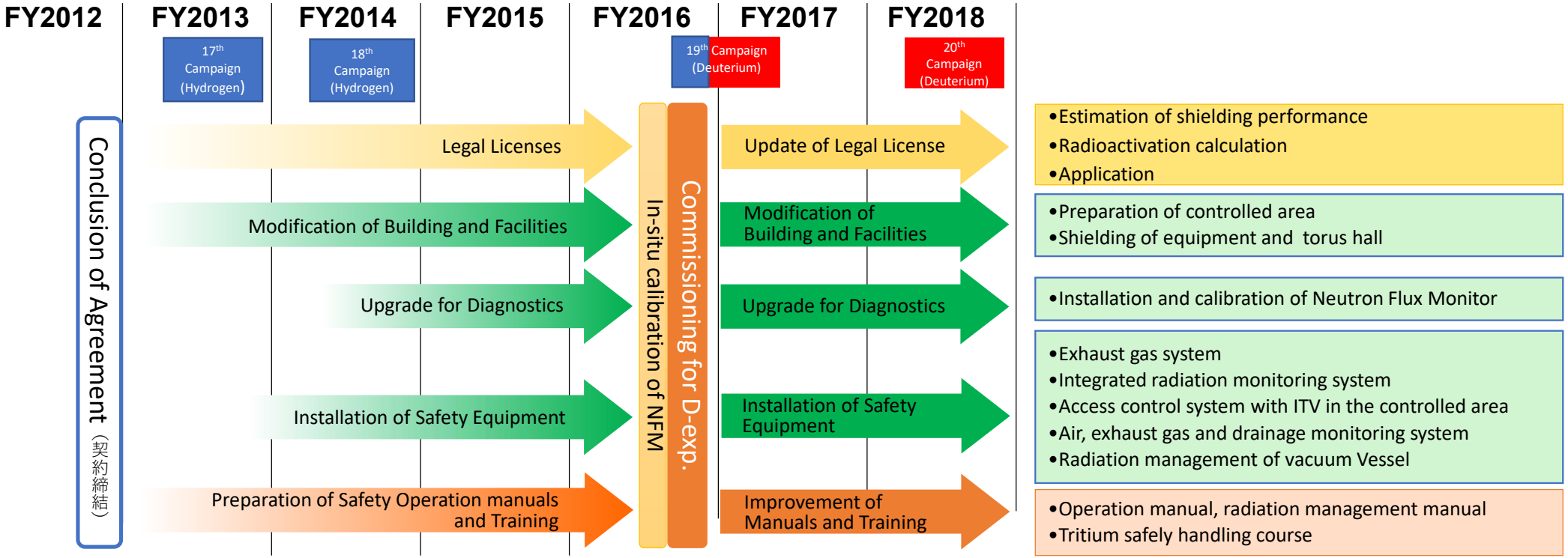
- ADC
- storage
- web portal

Radiation control system

- Radiation control
- Radiation monitoring system

From gas fuelling to exhaust, and from the plasma production, heating, diagnostics to data acquisition and storage. Another important task is the environmental and experimental radiation control. We also operate the detritiation system.

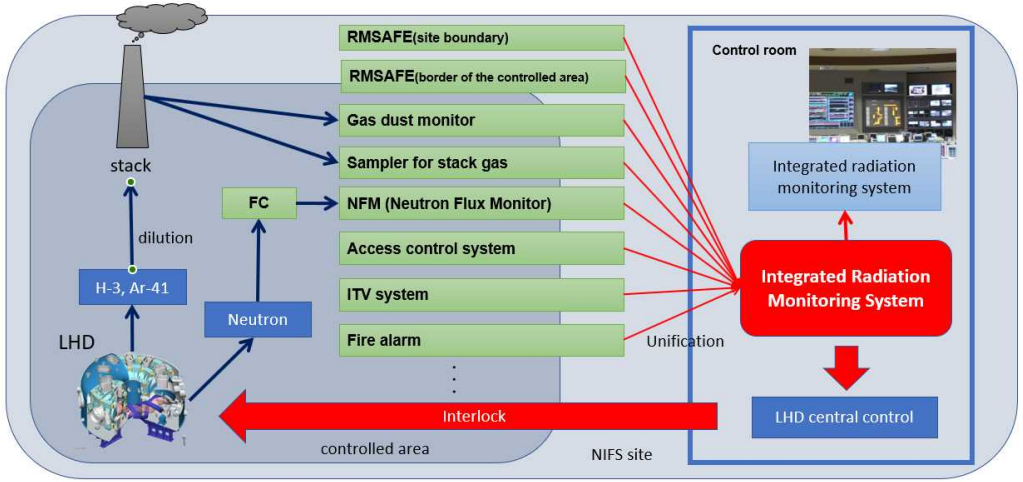
Preparation and implementation of the deuterium experiment in the LHD



- Deuterium experiments aiming for higher plasma performance started in March 2017 (19th Campaign).
- Preparation for deuterium experiments started in 2012.
- We prepared Legal licenses, Modification of Building and Facilities, Update Diagnostics, Installation of Safety Equipment and Preparation of Safety Operation manuals and Training.

Preparation for the deuterium experiment(1)

1. Integrated Radiation Monitoring System



2. Installation of Safety control Equipment

Outdoor detector

^{3}H sampler for stack gas

Stack gas monitor

Hand-foot-clothing monitors

Air monitors for torus hall

Drainage monitor

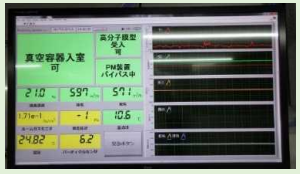
Drainage tanks

3,Access Gates with Security QR Code authentication

SQRC seal are affixed on personal dosimeters. Then, no one can enter the controlled area without personal dosimeter.

4,Access control of vacuum Vessel (VV)

VV access control system

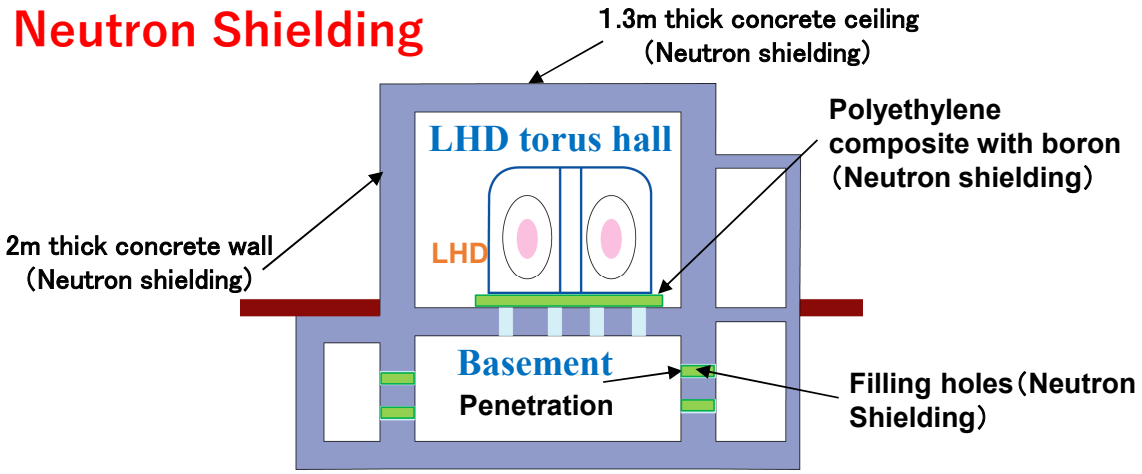


VV environment monitoring system

- 1. Integrated radiation monitoring system. This system monitors all devices related to radiation control.
- 2. Safety control equipment diagnostics.
- 3. Access gates toward the radiation controlled area.
- 4. Access control to the vacuum.

Preparation for the deuterium experiment(2)

Neutron Shielding



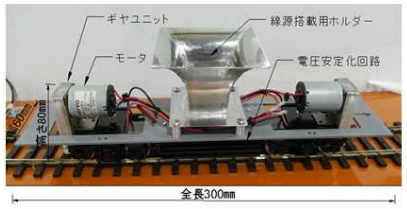
Holes on the wall in torus hall were filled with polyethylene blocks and pellets

Electronic device

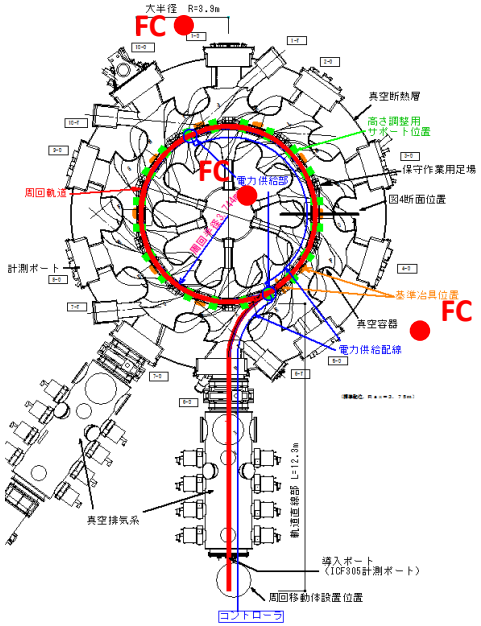
Polyethylene-boron composite panels, and Lead plates

In-situ neutron yield monitor calibration

Rails in VV



Mobile body

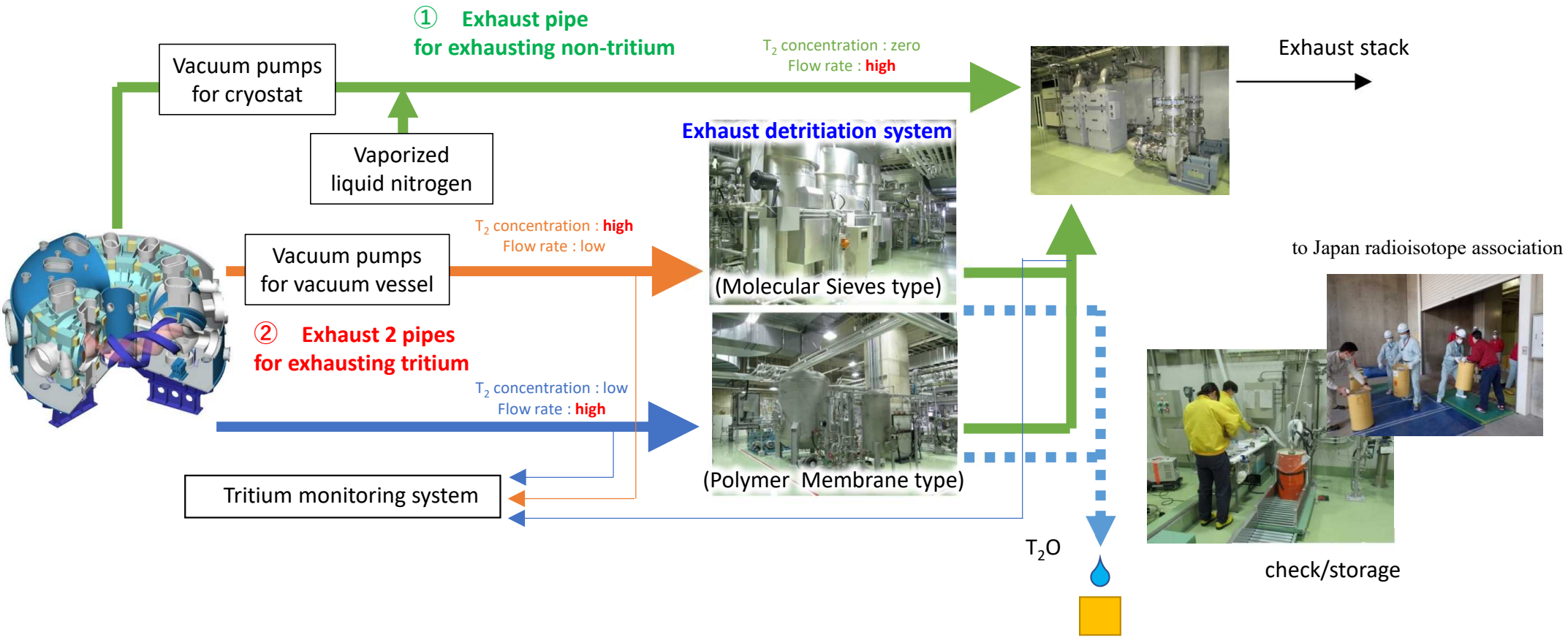


Vacuum Vessel(VV) of LHD

- **Neutron Shielding:** We filled the holes in the walls with polyethylene blocks and pellets, and shielded the electronics
- **In-situ Neutron yield monitor calibration:** We assisted in situ neutron yield monitor calibration, installing rails for mockup train to carry neutron source along the torus in the vacuum vessel. The train could be kept moving for 72 hours.

Preparation for the deuterium experiment(3)

Exhaust system of LHD



- Exhaust detritiation system is installed to reduce the tritium concentration in the exhaust gas.
- Tritium is liquefied as T_2O, and disposed of by the Japan radioisotope association.

Tritium handling training

Lecture

Facility tour

Practice

Practice

Practice

Completion certificate award

Training at the Hydrogen Isotope Research Center in Toyama University

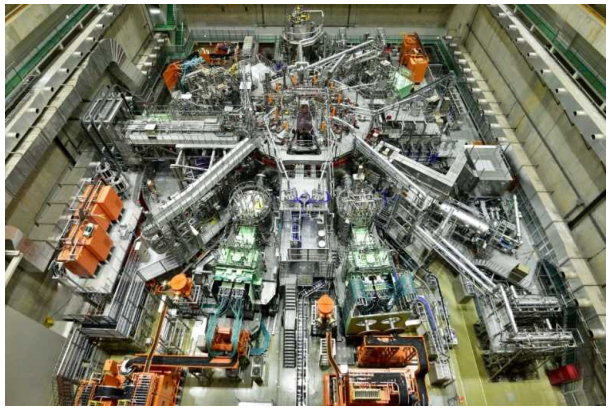
- In the tritium handling training in the radiation controlled area, **DETS staff** played the role of the instructor
- **17 training** sessions were held until February 2020, and **92 staff** members completed the training

(2) Has the DETS contributed to the maintenance and utilization of the research platform in NIFS?

Research platforms in NIFS

Approx. 34 platforms

Large Helical Device(LHD)



Engineering Research facilities

Supercomputer

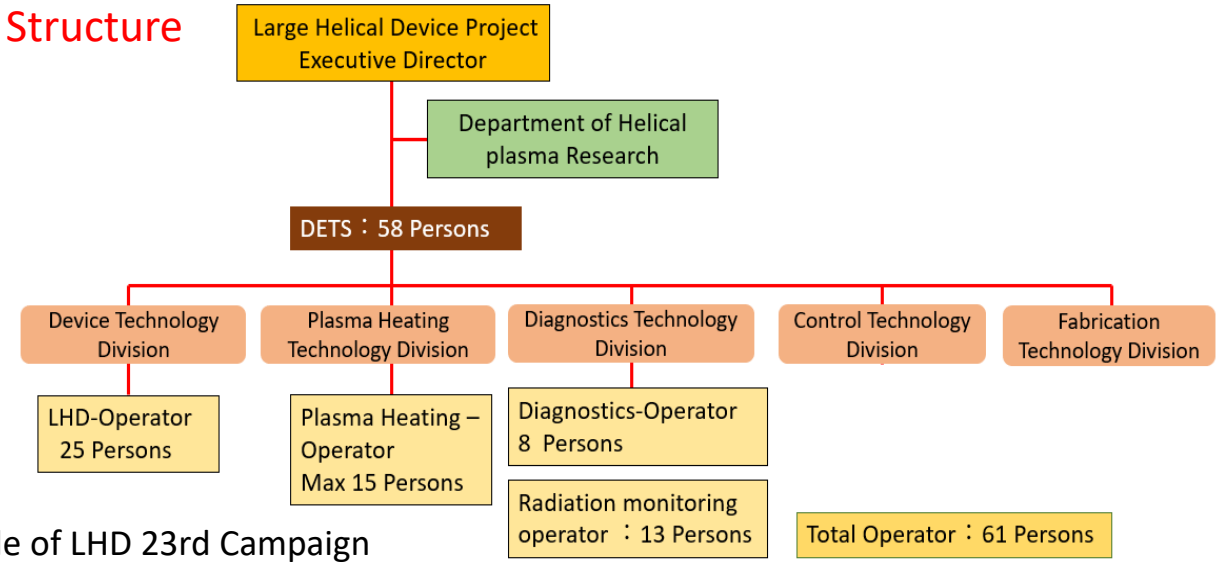
Plasma simulator（RAIJIN）

Workshop | **Parts Shop** | **NIFS-LAN** | **Web Systems Development** | **Control Systems Development**

- NIFS has three research platforms, which are LHD, engineering research facilities, and the Supercomputer
- In addition, DETS also provides technical support to these research platforms, which are workshop, parts shop, NIFS-LAN, web development, and control system development.

Contribution to the LHD project

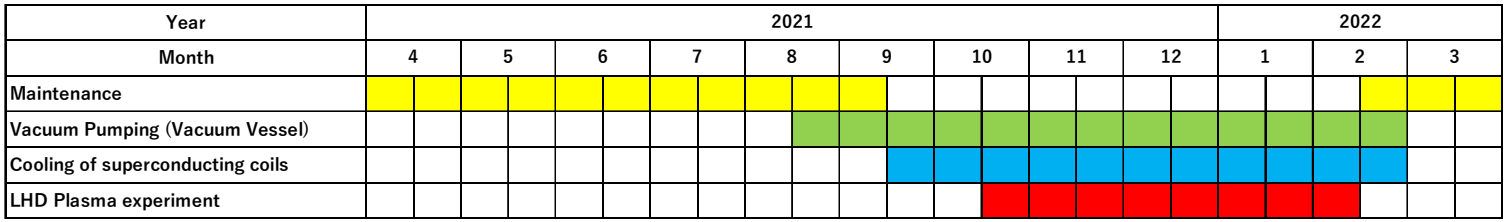
LHD Operating Structure



Operation rate
Since 1998: 86.4%
Deuterium experiment (since 2017):92.1%

Year	LHD Experimental Campaign	Plasma experiment operation rate	Number of shot
1998	1	75.50%	1888
1998	2	75.80%	5244
1999	3	90.00%	10179
2000	4	88.00%	8896
2001	5	75.10%	9024
2002	6	61.50%	6081
2003	7	86.30%	7510
2004	8	85.10%	7398
2005	9	95.40%	9833
2006	10	95.10%	9598
2007	11	93.00%	9217
2008	12	95.40%	6933
2009	13	86.80%	6229
2010	14	84.60%	6793
2011	15	91.10%	7284
2012	16	67.20%	5135
2013	17	96.40%	7384
2014	18	83.70%	6441
2017	19	88.90%	13037
2018	20	94.70%	9262
2019	21	81.50%	7801
2020	22	96.70%	8849
2021	23	98.60%	9257
		Total shots	179273

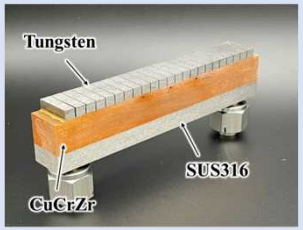
Experimental Schedule of LHD 23rd Campaign



- DETS has contributed to the maintenance and utilization of LHD.
- 58 DETS staff and 61 operators from private sectors are involved in the LHD operation.
- The experimental campaign starts in mid-August and ends in February.
- The averaged operation rate of LHD is 86.4 %, and 92.1 %, especially in deuterium experiment.

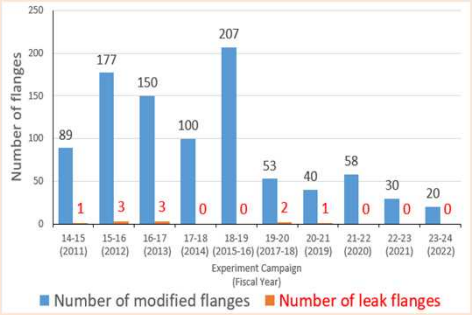
Fuelling, evacuation and in- vessel components

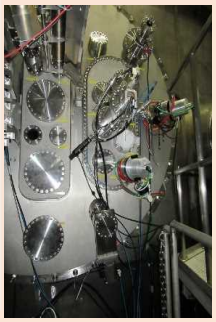
In-vessel components



Development of divertor module and its installation

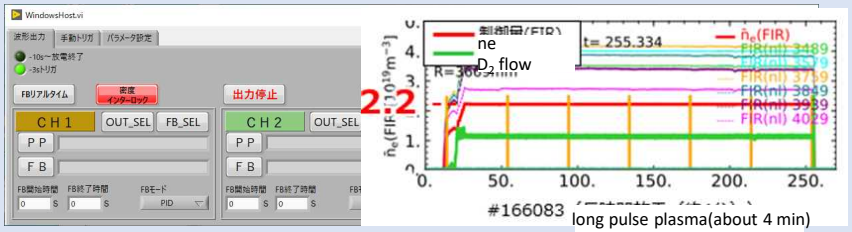
Management of vacuum





Occurrence **of vacuum leak is minimized** by managing every open-close process with up to 400 flanges.

Gas puff system



long pulse plasma(about 4 min)

Development of high-speed gas puff feedback system with **FPGA**

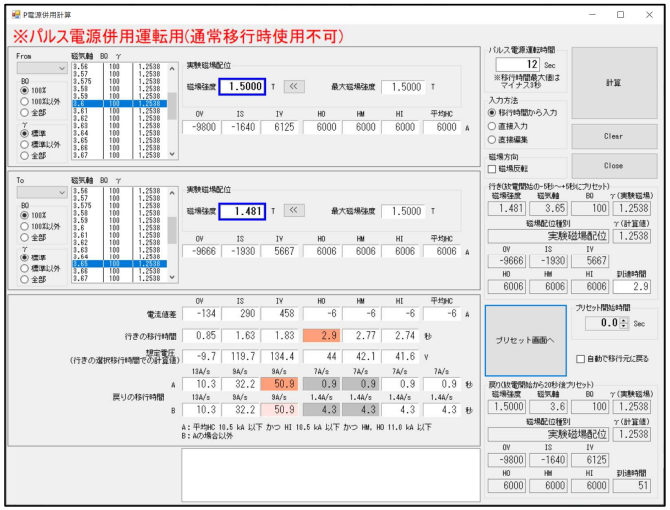
Vacuum pumping system

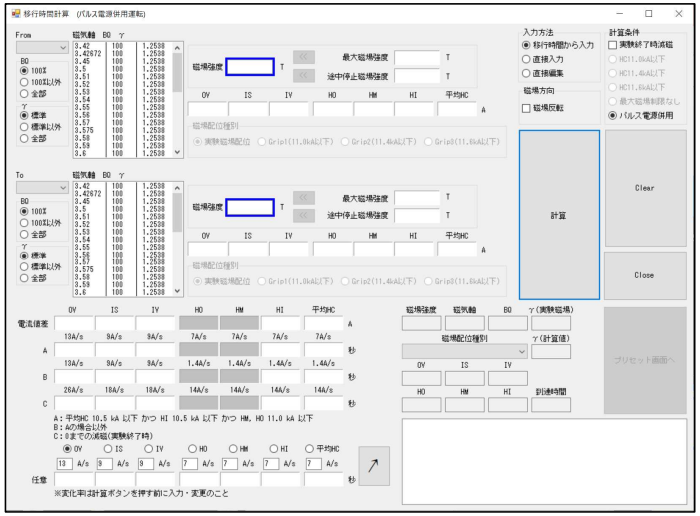
Maintenance of the **scroll-pumps**

- DETS manages vacuum performance, maintaining fuelling system, pumping system, in-vessel components.
- We also develop in-vessel components and control system.
- Few (almost zero) air leakage has been detected in recent 10 years, which is due to full inspection for each flange after closure.
- Holds high vacuum conditions for six months.

Central Control System

LHD Coil Power Supply Control System





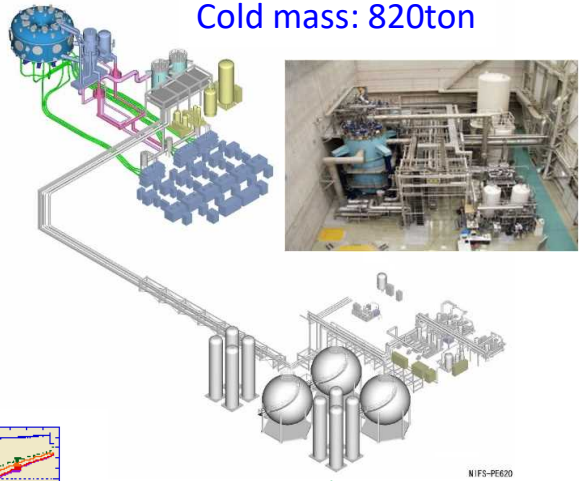
- DETS are responsible for operation and maintenance of the Central Control System and coil power supply control system

Cryogenic system

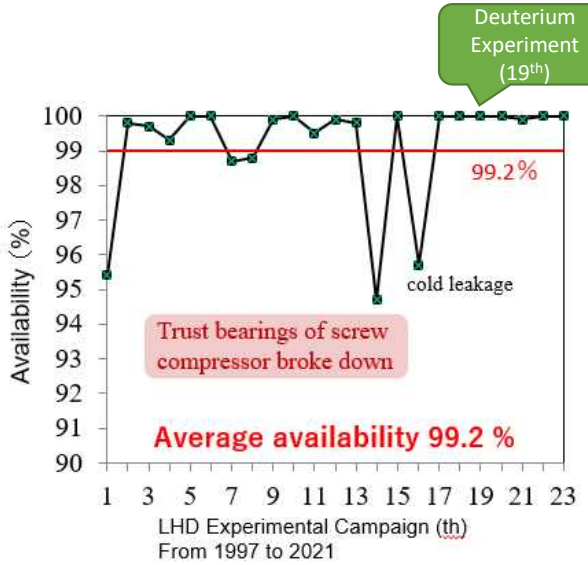
Reliable long-term operation

- Annual inspection as required by law
- Management of Automated operation procedure
- Daily inspections on about 400 items, especially for mechanical components
- Redundant system for safe and reliable operation, e.g., CPU, LAN, and I/O

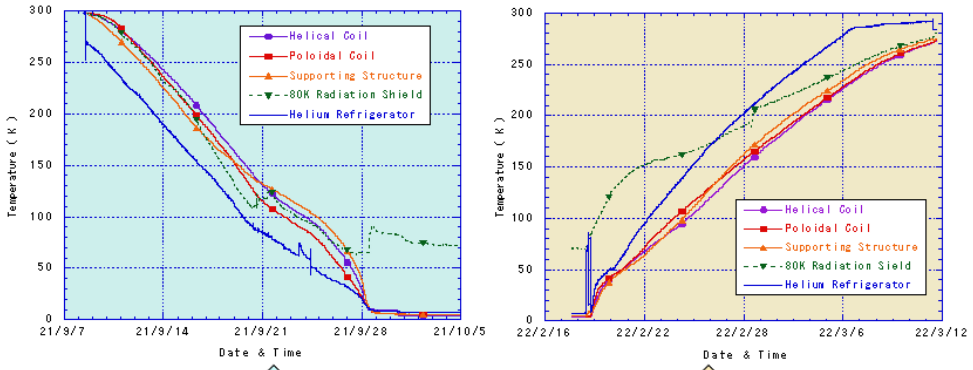
Cold mass: 820ton

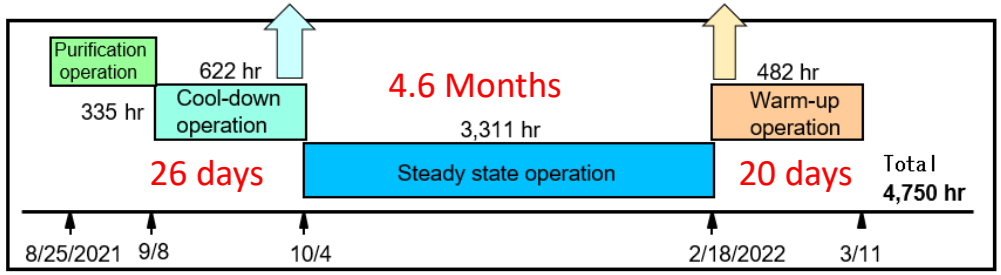


LHD Cryogenic System



23 Experimental Campaign

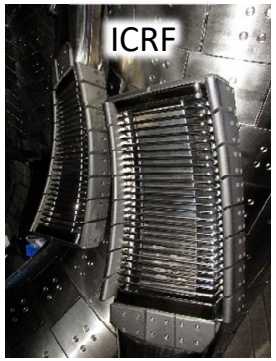


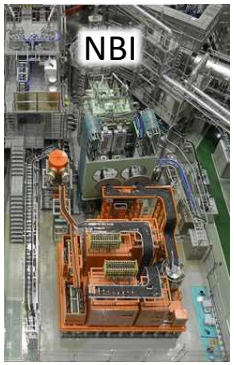


- This system cools 820 tons of superconducting coils and supporting structures down to 4.4K in about 1 month, and keeps the cryogenic condition stable for about 4.6 months. It takes three weeks for warming-up.
- The LHD cryogenic system has a high operating rate of 99.2%.

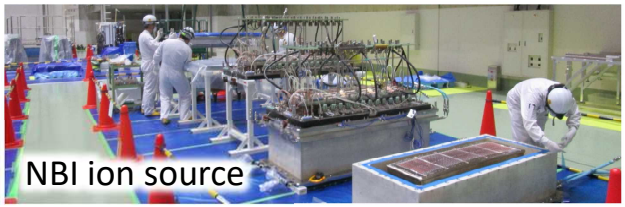
Plasma Heating Devices

Plasma heating Devices

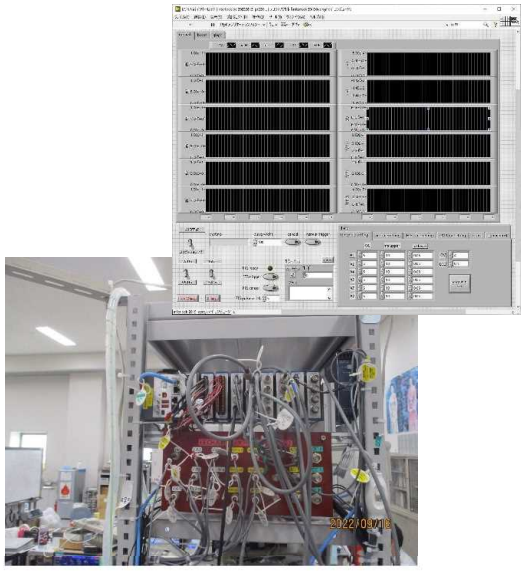




Maintenance



Development



ECH Injection Interlock System

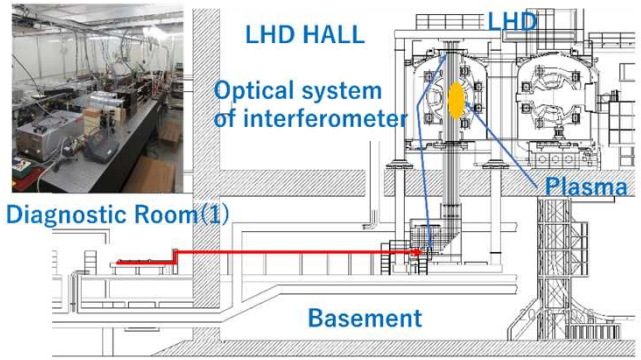
Operation

Parameter Input Screen

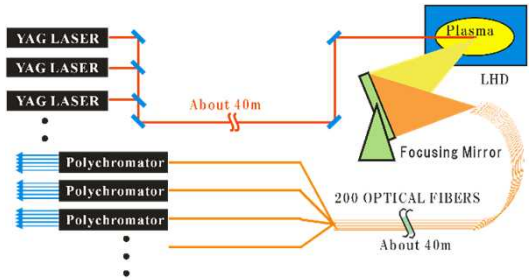
- DETS operates, maintains, and manages ECH, ICRF, and NBI including ion source.
- In addition, we maintain the cooling water system and high voltage power supply system.
- Interlock systems are also developed

Plasma diagnostics

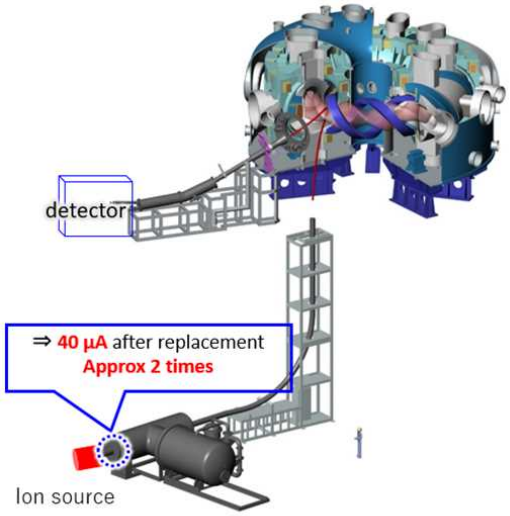
FIR laser interferometer



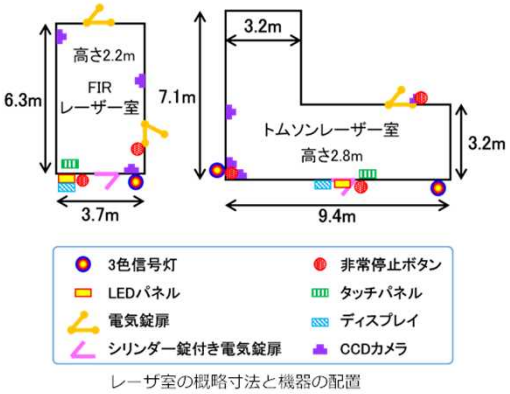
Thomson Scattering System



HIBP （Heavy Ion Beam Probe）



Development of ion-source for HIBP



レーザ室の概略寸法と機器の配置

レーザ発振中を示すパネル（OFF時とON時）

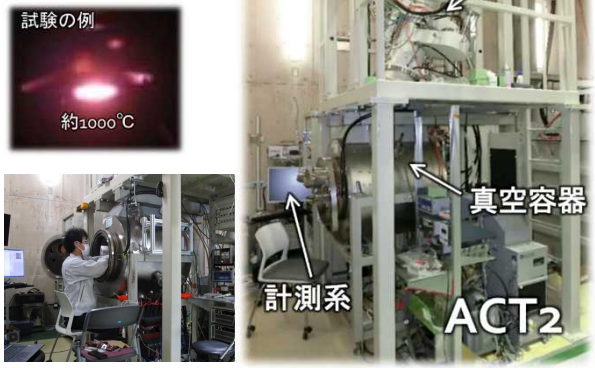
入退管理システム設置機器の様子

Access control system for the laser room

DETS operates, maintains and develops most of diagnostics in LHD.

- We have contributed to the improvement of the diagnostics for accurate signals.
- To ensure the safety in the laser room, we installed an access control.

Engineering Research Facilities



Electron beam heat load test device
（超高熱負荷試験装置）

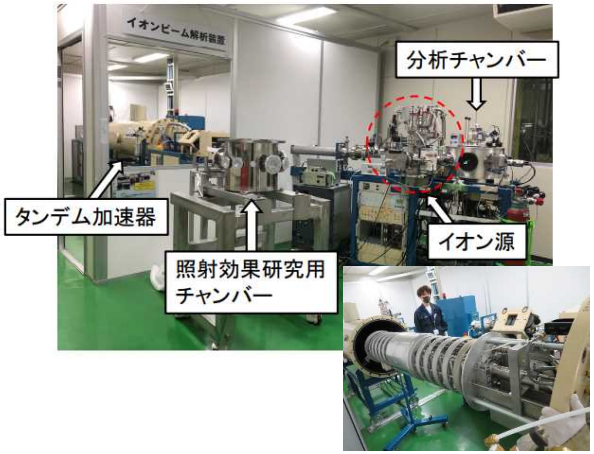
Engineering Research Facilities

- Liquid blanket experiment collaboration platform
- Creep Testing Machine
- Hot Isostatic Pressing(HIP)
- Active Cooling Test-stand 2 (Electron beam heat load test device)
- Ion Bram accelerator
- Field Emission Scanning Electron Microscopy(FE-SEM)
- Transmission Electron Microscope(TEM)
- Focused Ion Beam/ Scanning Electron Microscope (FIB-SEM)
- Development of large-current HTS conductors for fusion device
- Test Plasma by Direct current discharge(TPD-2)
- Neutral Beam Injection Test-stand

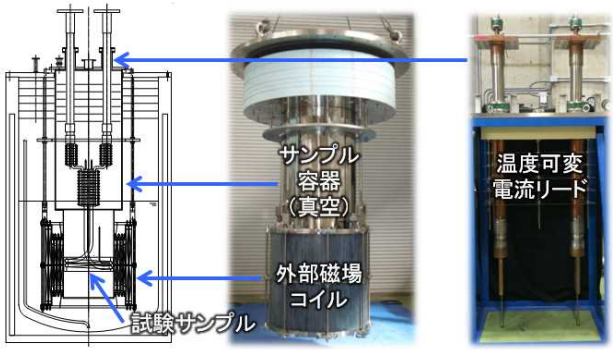
etc.

透過型電子顕微鏡
（TEM）

集束イオンビーム／
電子ビーム加工観察装置（FIB-SEM）



Ion Beam accelerator for Analysis
（イオンビーム解析装置）



Development of large-current HTS conductors for fusion device
（核融合用大電流高温超伝導導体開発）

DETS operates and maintains engineering research facilities, which are utilized to develop high heat flux components, materials, superconducting coils for future fusion devices

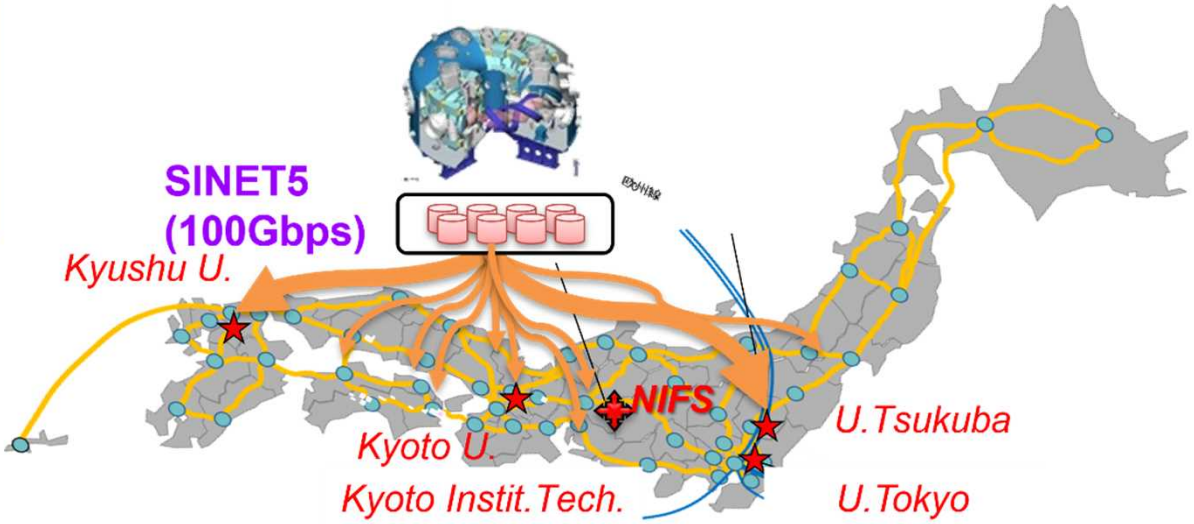
Supercomputer and data facilities

- Supercomputer (Plasma simulator, RAIJIN)
- LHD Data Acquisition System
- Analyzed Data Server
- Numerical Atomic and Molecular Database
- SINET
- Virtual Reality System

Plasma simulator（RAIJIN）

Large HDD storage system

LHD Data Acquisition System



DETS manages Supercomputer and data facilities

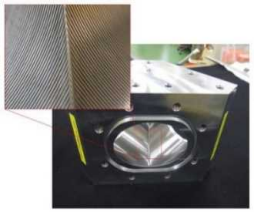
- system technical support
- User management
- Data acquisition system of university experiments are also supported by NIFS.
- Acquired data are store in NIFS and can be used with the same manner.

Workshop （Mechanical fabrication/Electronic fabrication）

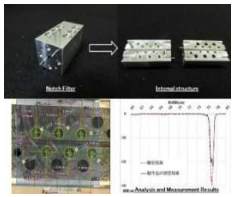
Workshop

- Ordered by NIFS staff and university collaborators
- **inexpensive, quick delivery, special request available**
- Accept 100 requests per year.

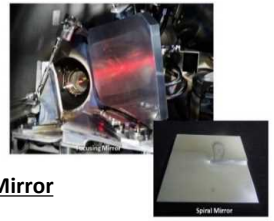
Machining parts



Miter bend for microwave transmission

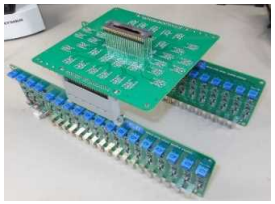


Notch Filter



Focusing Mirror

Electronic circuit module and equipment



35ch PN-Photo Diode Array Amplifier

Microwave power amplifier controller

DC Offset Canceller

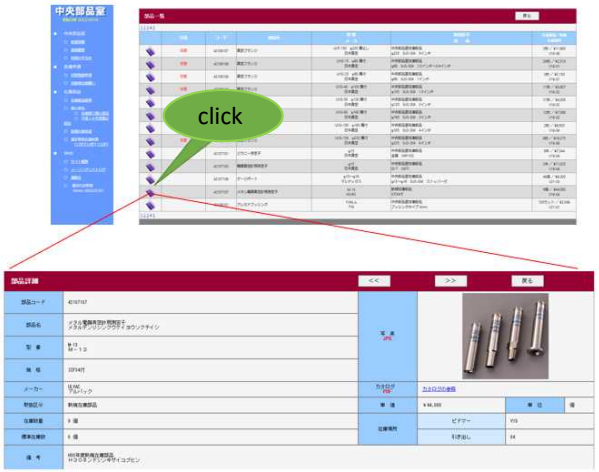
		F.Y 2020		F.Y 2021	
		Request	Number of parts	Request	Number of parts
Machining	LHD	74	279	43	121
	Universities	27	182	26	77
	etc.	15	21	7	7
	Total	116	482	76	205
Electronics	LHD	13	23	14	23
	Universities	4	23	0	0
	etc.	0	0	1	1
	Total	17	46	15	24
Total		133	528	91	229

Production parts total number (FY.2020 FY.2021)

Central Parts Shop

Central Parts Shop

Parts data book



Electronic data book

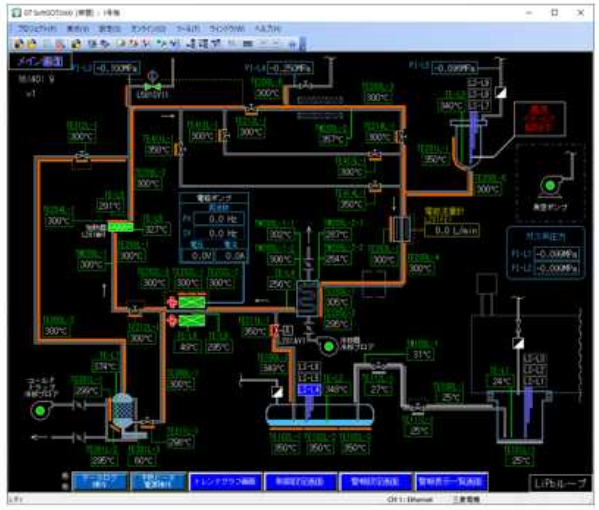
年度　F.Y	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
出庫点数	23620	19928	21314	12711	19888	12321	13660	10541	13526	8813

Number of deliveries by year

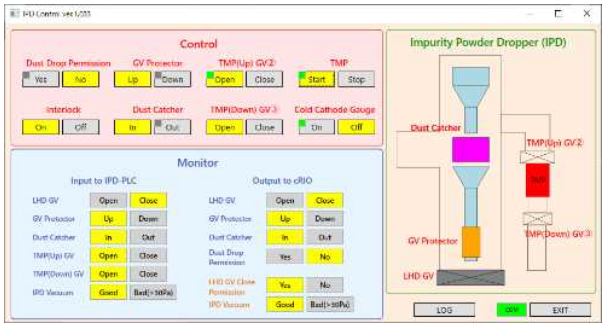
- Central Parts Shop can promptly provide about 1400 kinds of parts.
- All Inventory control, accounting, specification data book is electronic.

Development of control system

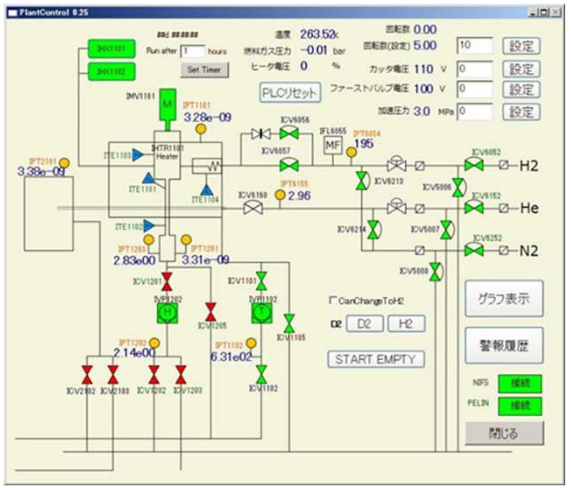
DETS has developed control systems for each device on each platform.



Liquid blanket experiment collaboration platform
熱・物質流動ループ装置



IPD（Impurity powder Dropper）
不純物ダストドロッパー

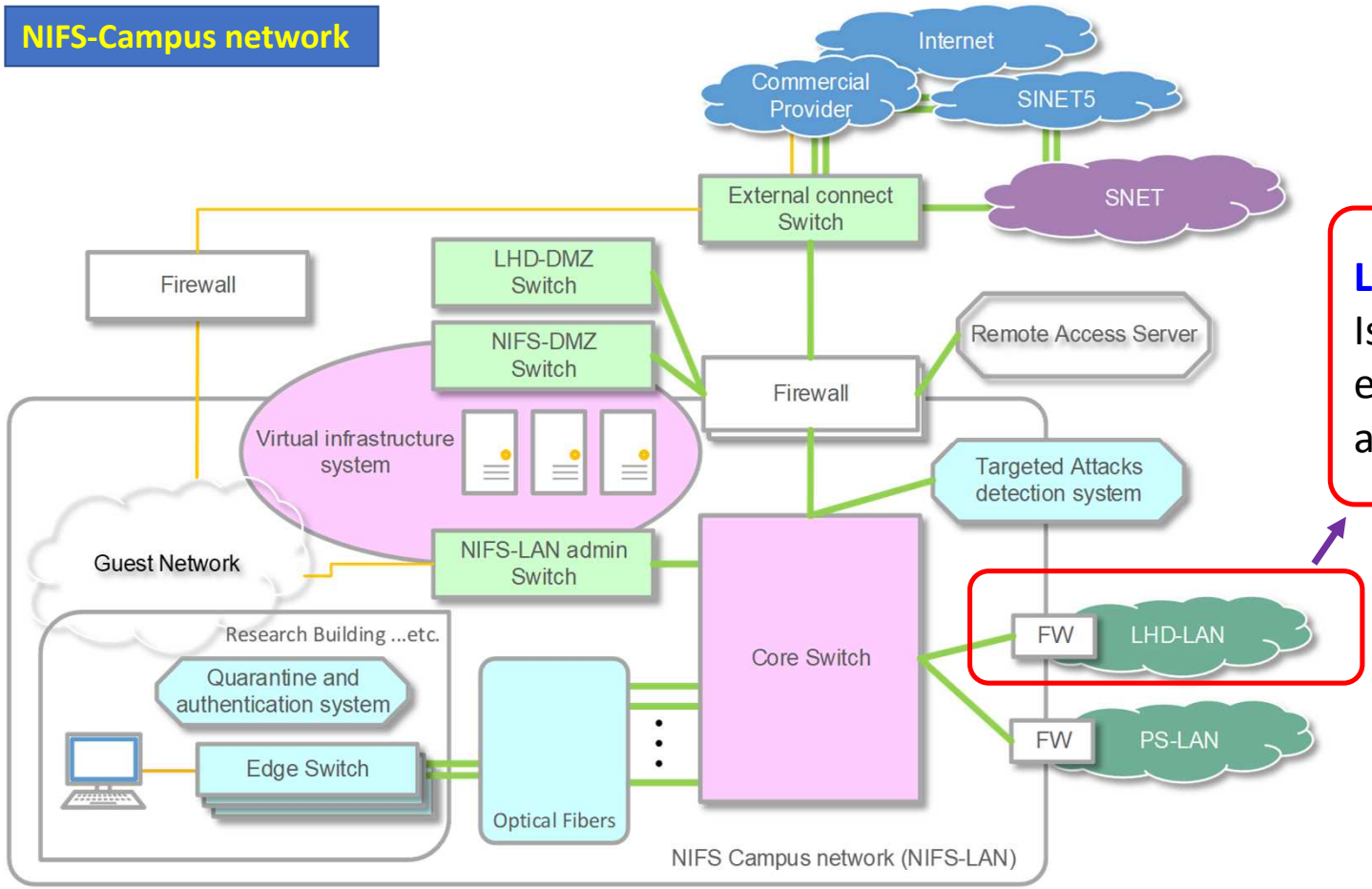


PELLET（ICE pellet injector）
固体水素ペレット入射装置

- Controllers: PLC, FPGA, Card Readers, etc.
- Language: Visual Basic, C/C++, HDL, Ladder diagram

NIFS-LAN

NIFS-Campus network



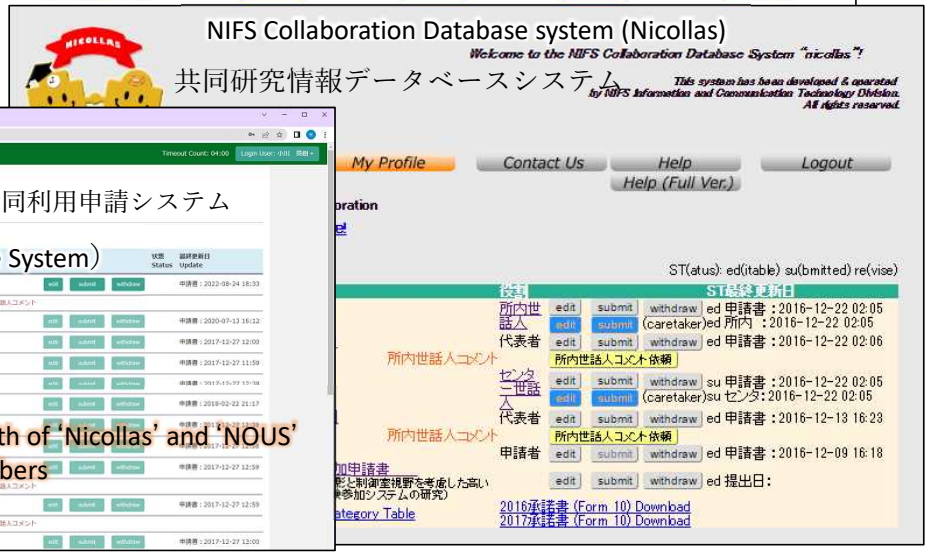
LHD-LAN
Isolated network for LHD experiment to keep safe operation and experimental data.

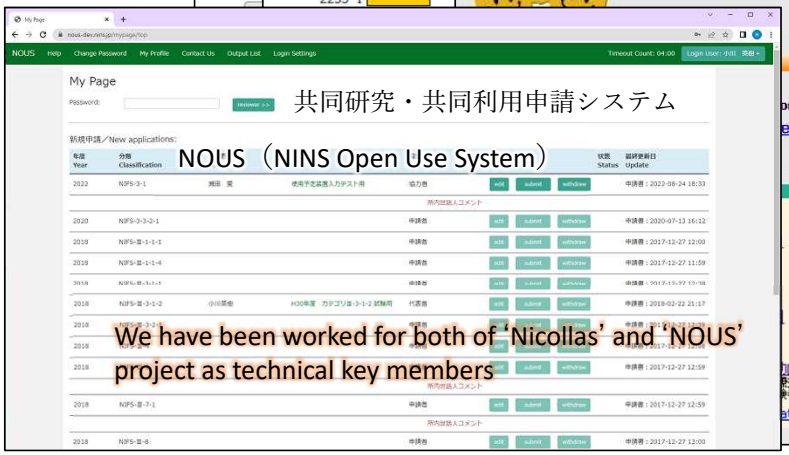
- DETS operates and maintains the network infrastructure, responds to security incidents, and provides user support to the NIFS staff and collaborators.

Web system development

NAIS (NIFS Article Information System)

論文情報システム





We have been worked for both of 'Nicollas' and 'NOUS' project as technical key members

System Development: Role and Skills

System Name	Role	Environment
NIFS Collaboration Database system (Nicollas)	Design, Implementation, Development Team management, Technical Support	OS: **Linux** Framework: **Play Framework** Language: **Scala, HTML, CSS, Javascript, Perl** Database: **PostgreSQL** Project Management: **Redmine**
"Workshop" hosting support service (Workshop)	Design, Implementation, Technical Support	OS: Linux Web Server: **Apache** Language: PHP、 HTML, CSS, **jQuery** Database: **My SQL**
Whereabouts Management System	General Development task using IC Card Reader	OS: **Windows** Language: PHP, HTML, CSS, jQuery Database: **SQL Server**
Plant operation and Monitoring systems	General Development task using controllers, such as, PLC, FPGA, Card Readers, etc.	OS: **Windows**, Linux Language: **Visual Basic, C/C++, HDL, Ladder diagram** Protocol: FINS/TCP, MC protocol, etc.

- DETS has developed many web systems by utilizing our advanced technical capabilities in information processing and web development technologies.
- NAIS (NIFS Article Information System) and NOUS (NINS Open Use System) are highly regarded.

(3) Safety and health care initiatives sufficient?

Contributions to Safety

Involvement in Division of Health and Safety Management

57 DETS members belong to Division of health and Safety Promotion, and 3 heads of 10 offices are from DETS.

- Machinery and Equipment Management Office
- Hazardous Substances Control Office
- Radiation Safety Control Room

Technical staff of DTES : Total 57

Green : Office chief = Technical staff of DTES

Safety Management at LHD

- LHD fire extinguishing drills are conducted twice before the start of the experiment.
- DETS members act effectively in an emergency with designated roles, especially some of them contributing to the activity as the group leader.

LHD fire extinguishing drills

Information Exchange on Occupational Safety and Health meeting

- institute are reported
  - Activities at universities and institutes ,
    - firefighting team
    - safety and health patrol
    - working environment management
    - chemical substance management

Meeting number	DATE	Number of Participants	Number of Presenteres
1	2005/1/27-28	50	10
2	2006/2/2-3	62	13
3	2007/2/8-9	64	11
4	2008/3/12	61	14
5	2010/2/4-5	44	11
6	2011/2/9-10	47	10
7	2012/2/9-10	57	13
8	2013/2/7-8	51	14
9	2014/2/6-7	57	12
10	2015/2/5-6	48	11
11	2016/2/4-5	59	13
12	2017/1/12-13	42	13
13	2018/2/1-2	50	13
14	2019/1/31-2/1	60	12
15	2020/2/6-2/7	51	12
16	2021/2/4	70	8
17	2022/2/3	79	9

Meeting history

- DETS annually holds "Information Exchange on Occupational Safety and Health Meeting”.
- Initiatives, activities and issues in occupational health and safety in each institute are reported.
- Participated from universities and research institutes, e.g., technical staff, administration staff, research staff, health consultant, etc.
- A forum to exchange opinions is extremely valuable.

(4) As an Inter-University Research Institution, has the DETS conducted technical collaboration, exchange, and cooperation with universities and research institutes?

Technical Exchange Program

DETS hosts and manages Technical Exchange program

- purpose of this exchange is to share and improve techniques each other, through design, products and computer programs developed by engineers from universities and research institutes.
- They come to NIFS for training, equipment development, technical consultation, and technical presentations.

F.Y	Number of exchanges	Number of participants (Outside the Institute)
2012	2	61
2013	1	34
2014	4	30
2015	4	39
2016	2	51
2017	4	40
2018	2	51
2019	3	43
2020	2	69
2021	2	84

10 Technical Exchange Items.

1, NC machining technology
2, Electronic circuit technology
3, Numerical simulation technology by finite element analysis software "ANSYS
4, Vacuum technology
5, Mechatronics technology
6, Radiation measurement and environmental radiation monitoring technology
7, Cryogenic technology
8, Computer-aided measurement and control technology
9, Safety and Health Management
10, Organization of technical staff

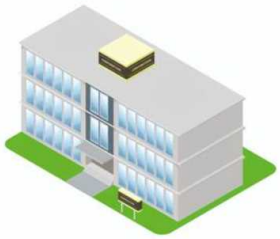
Organization of technical staff

NC machining technology

3D-PRINTOR

University

NIFS



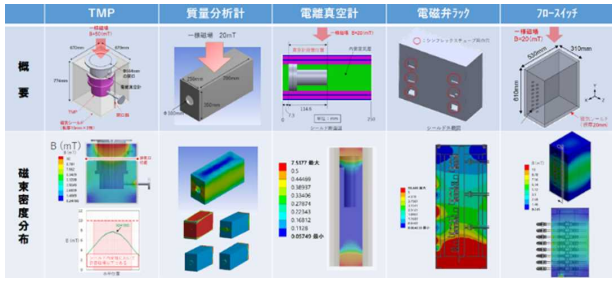
Research Institut

Technical Exchange Program

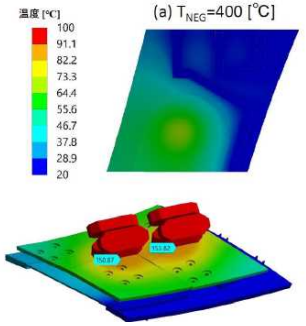
Numerical simulation technique with finite element analysis software "ANSYS

- Further improving numerical analysis technique

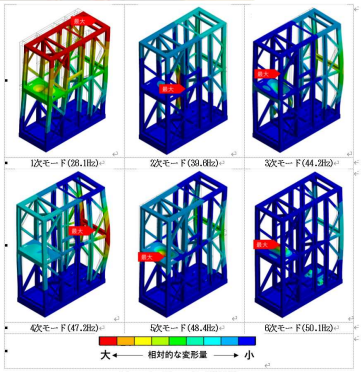
F.Y	Number of Oral presentations	Number of participants
2017	5	170(Technical Workshop)
2018	7	33
2019	8	28
2020	7	40
2021	7	45



Magnetic shielding analysis



First wall thermal analysis
(Vacuum vessel of LHD)



Control cabinet
modal analysis

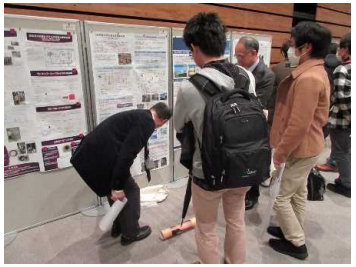
Wide range of technical fields

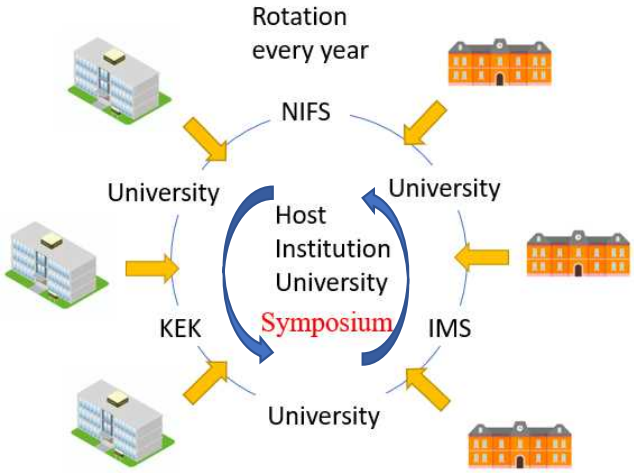
Environmental
Air conditioning
Electrical
Electronic equipment
Energy plants
Nanotechnology
Semiconductors
Fuel cells
Chemical processes

- Through discussion, they improve their analysis techniques.
- This program is not limited to the field of fusion, but to wide range of technical fields
- Wide range of the field: structural, thermal, fluid, electromagnetic, and modal analyses.

Symposium on Technology in Laboratory

- This is a symposium where technical staff from universities, research institutes, and technical colleges in Japan make presentations on development, maintenance, improvement, and upgrading of experimental facilities and equipment, as well as a wide range of technical activities.
- As an Inter-University Research Institution, NIFS hosts it every few years.
- DETS presents about 10 papers every year



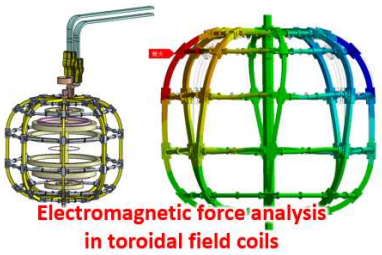


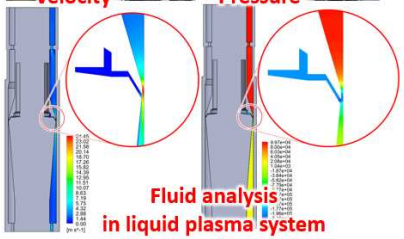
IMS : Institute for Molecular Science
KEK : High Energy Accelerator Research Organization

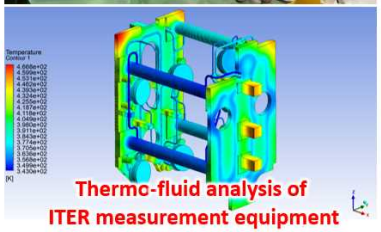
Host Year	Presentations	Presentations (Oral Poster)
1991/3/19-20	285	79
1994/3/23-24	273	78
1997/9/11-12	284	78
2002/3/14-15	407	131
2008/3/10-11	287	97
2014/3/13-14	268	92
2018/3/1-2	170	71
2022/3/10-11	253	35

Symposium held in NIFS

Technical Cooperation to Universities and Research Institutes



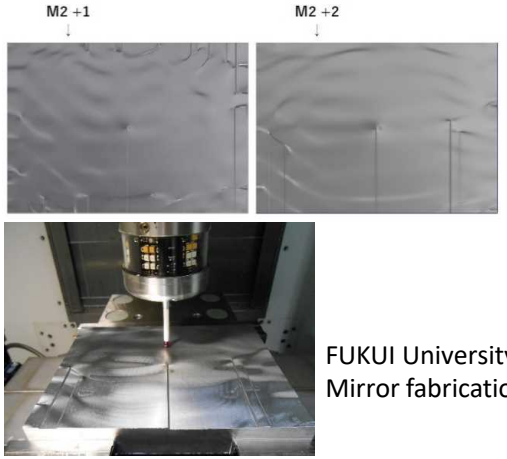




Year	Number of technical cooperation
2013	6
2014	7
2015	9
2016	10
2017	5
2018	1
2019	11
2020	9
2021	10
2022	9

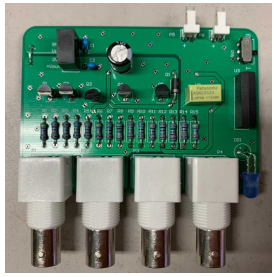
Number of technical cooperation

Contribution to plasma experimental devices at universities by utilizing numerical analysis technique in NIFS



FUKUI University
Mirror fabrication

KYOTO INSTITUTE OF TECHNOLOGY
Machining of coils for RELAX



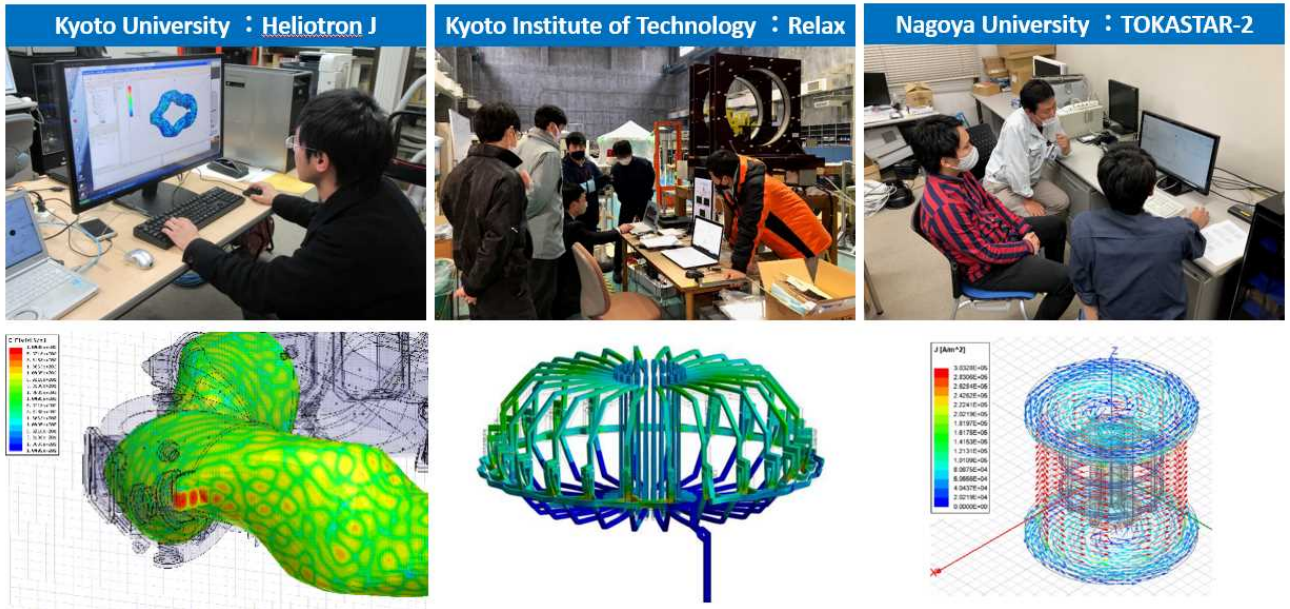
TSUKUBA University
Circuit Fabrication

- DETS has provided its accumulated technical experience and knowledge so far, to universities and research institutes as technical cooperation (joint research).
- DETS contributed to the development of plasma experimental devices in universities by utilizing numerical analysis techniques, mechanical machining, and circuit machining.

Technical Cooperation to Universities and Research Institutes

Educational activities

- DETS provides a wide range of technical support to researchers, engineers, and students in universities and research institutes, including fabrication techniques, vacuum techniques, and techniques related to cryogenic technology.
- DETS has also provided accumulated technical experience and knowledge for education.



Numerical Analysis Technology to universities

Safety patrol and safety lecture (Kyushu University)
Vacuum pump overhaul and vacuum lecture (Tokyo University)

International Technical Cooperation

Technical support for CFQS project

✓ Confirmed that the stress value and the time constant are within acceptable ranges.
✓ Provided conceptual design of power supply.

➢ **Stress analysis for CFQS vacuum vessel**

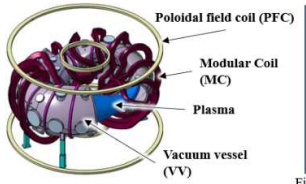


Fig. 1 Schematic view of CFQS main components

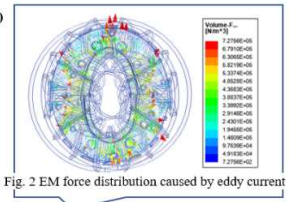


Fig. 2 EM force distribution caused by eddy current

Thermal load (130 °C) + atmospheric pressure (0.1 MPa)

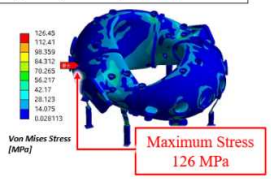


Fig. 3 Stress distribution during evacuation and baking

EM force + atmospheric pressure (0.1 MPa)

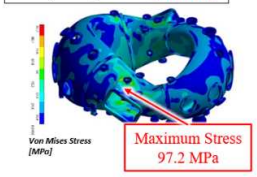


Fig. 4 Stress distribution caused by EM force

➢ **Estimation of eddy current time constant**

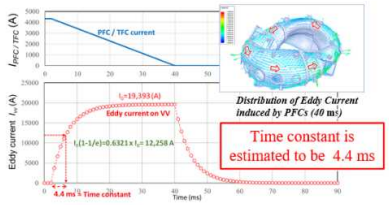


Fig. 5 Time Evolution of a Current and an Eddy Current on Vacuum Vessel

➢ **Design of power supply**

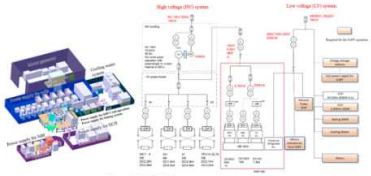
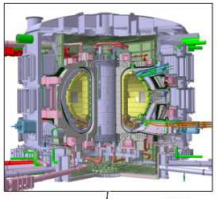
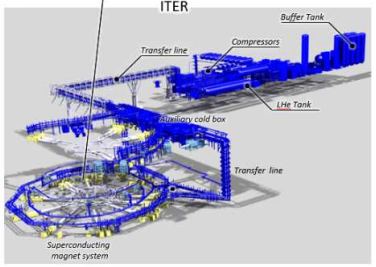


Fig. 6 CFQS power system

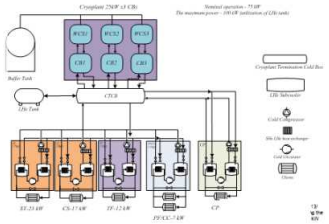
Dynamic simulation of superconducting magnet system of ITER tokamak

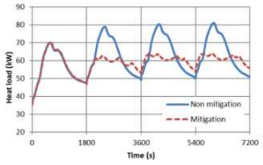


- Development of simulation model for the magnet system
- Investigate the impact on cryogenic system by the large pulse heat load due to DT palasma experiment
- Study the process control of mitigation of the pulse heatload



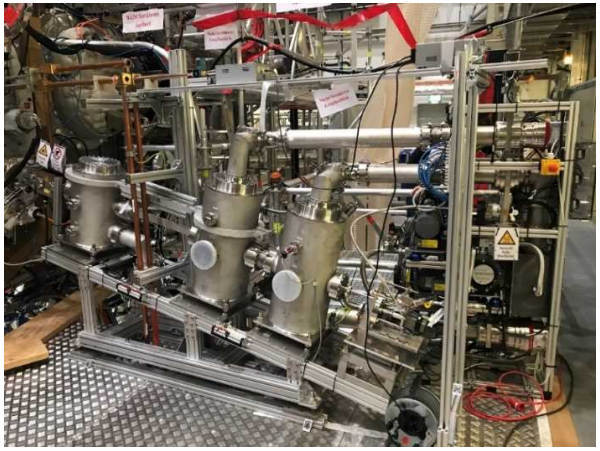
ITER Cryogenic System


Simplified process flow diagram



Mitigation result of return heat load to refrigerator

- NIFS and Southwest Jiao tong University of China started design studies in 2017 on the CFQS, which will be the world's first quasi-axisymmetric helical experimental device. The DETS has provided technical cooperation in device design, power system design, etc. The project has improved the technical skills of young staff in both sides.
- DTES has been developing a simulation model of the superconducting magnet cooling system under a technical agreement with ITER Organization in 2011, based on the experience of LHD cryogenic system operation and its dynamic simulation.
- DETS had provided a TESPEL injector for Wendelstein 7-X device in Germany.


TESPEL injector
German magnetic fusion experiment device, Wendelstein 7-X

NIFS operates lending service, supported by DETS

Researchers
Universities
Research Institutes

→ Apply for borrowing

NIFS
Department of
Administration

→ Request to send

NIFS-DETS
Technical Staff

About 23 Items

High Speed Camera

Thermography

Application HP

Network Analyzer

Quadrupole mass analyzer

Damage of wire　　Dirt of ion source(Lower)

Repair of Quadrupole mass analyzer by Technical Staff

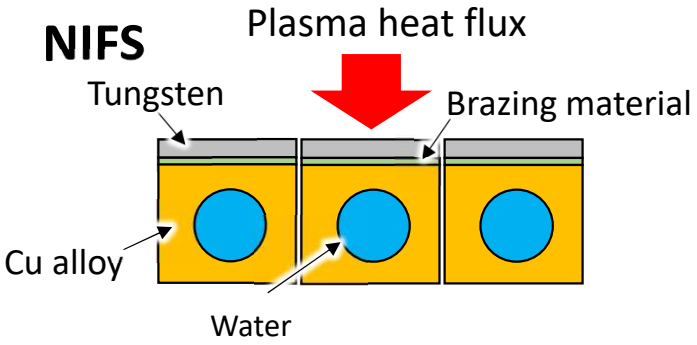
- DETS lends diagnostics to universities and research institutes.
- DETS staff checks, stores, inspects, replaces consumables, and repairs the equipment.

(5) Has the DETS utilized its technical experience and knowledge accumulated so far, for industry-academia collaboration activities?

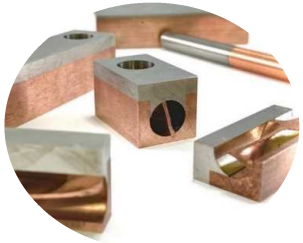
Industry-Academia Collaboration

Dissimilar Metal Bonding Technique

NIFS



Application to fusion devices



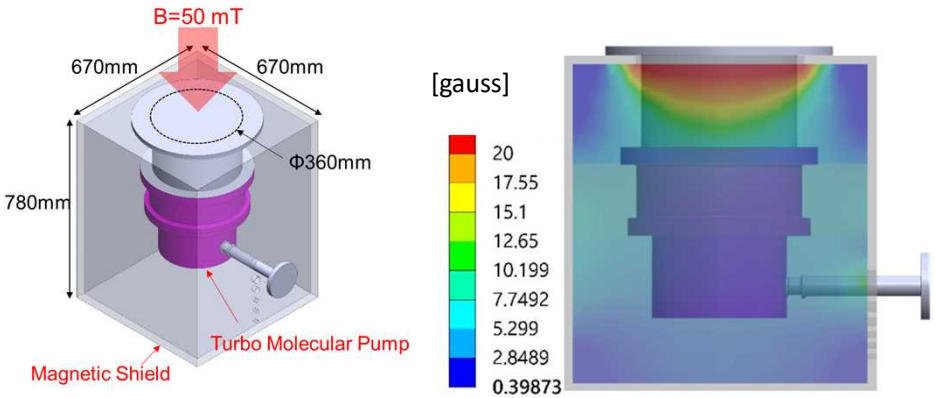
Toho Kinzoku Co., Ltd

Application to industrial devices

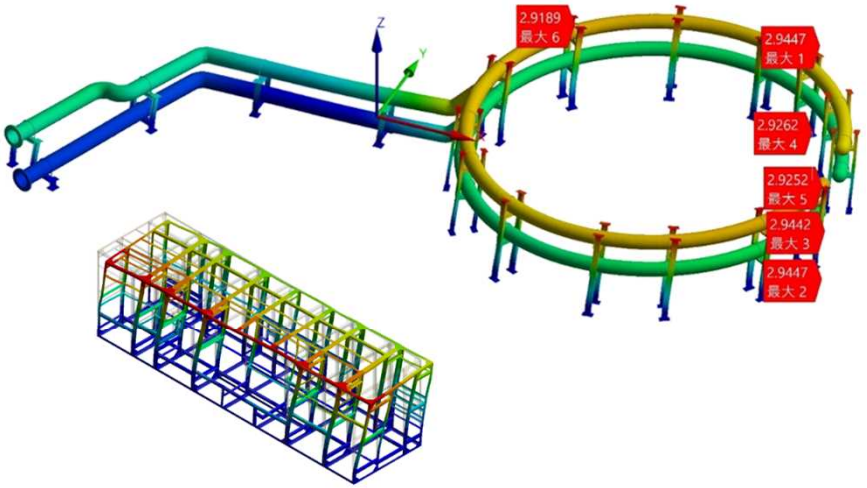
DETS has utilized knowledges, accumulated in fusion research, for social implementation, through industry-academia collaboration

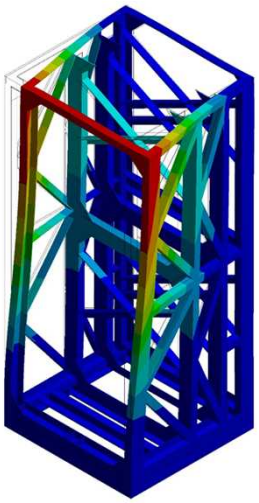
Commissioned research with private sector

Shielding performance analysis of magnetic shields



Seismic performance analysis of cooling system and control panels





Year/Month	Title of commissioned research
2018_4	**Shielding performance analysis of magnetic shields**
2018_11	Shielding performance analysis of magnetic shield
2019_11	**Seismic performance analysis of cooling system**
2020_3	Seismic performance analysis of power supply panel
2021_3	Seismic performance analysis of power supply panel
2021_9	**Seismic performance analysis of control panels**

- DETS has responded to requests for technical assistance from the private sector with our accumulated know-how.
- These numerical simulations are technologies that the DETS has been analyzing since the construction of the LHD.
- We obtained external funding and used it to improve the technical skills of technical staff, introduce the latest hardware, and provide training for application software.

（6）Is there an environment that supports the autonomy of individual technical staff members, together with a systematic effort to improve and to pass on techniques?

Human Resource Development and Technology pass and Improvement

- **Human resources are needed to design and develop next-generation reactor.**
- **Need personnel who can work in a wide range of technical fields**

Specific Activities

1 .Conduct technical (software and hardware) training in NIFS.
2 .Participate in technical training outside NIFS to introduce new techniques.
3 .Encourage the acquisition of qualifications
4 .Actively participate in joint research and international conferences to present activities


ANSYS・3DCAD Training Sessions


LabVIEW Training Sessions

Environment that supports the autonomy of individual technical staff members

The Project by NINS "Mission Realization Strategy Project"

Unutilized biomass　　Biomass activated carbon

We aim to create biomass activated carbon and implement it in society by generalizing the advanced technologies developed from fusion science research.

To ITER from NIFS

ECH：Microwave Technician

PM 育成・活躍推進プログラム

JST:科学技術振興機構
Program Managers (PM)

Training personnel who can conceive of advanced technological development.
One employee was selected for the "PM Development and Promotion Program"

- DETS staff conducted research on the development of activated carbon.
- One of staff member of DETS is selected for the "PM Development and Promotion Program".
- ECH operation technician transferred to the ITER Organization with the skills he developed at NIFS.
- **DETS is supporting the autonomy of the technical staff.**

Summary

- DETS has contributed to the progress of LHD research and the realization of the high availability of LHD. This is the result of the performance of the DETS as a technical professionals working on a single goal.
- For the preparation and implementation of the deuterium experiment, personnel for radiation-related work were properly reallocated with a long-term vision.
- Deuterium experiment started as scheduled and subsequent experiments were also conducted smoothly, which produced significant research results.
- The framework of technical exchange and technical cooperation was utilized to participate in interactive joint research with universities and research institutes, contributing to the activation of fusion research.
- The LHD project will end in FY2022; DETS will continue to support the platform to develop research activities.
- Transferring accumulated techniques have successfully been performed by internal education and trainings

24th LHD experiment campaign **180,000th shot**

October 6, 2022