National Institute of Natural Sciences

National Institute for Fusion Science

NIFS Peer Review Reports in FY2020

March, 2021

National Institute for Fusion Science

Advisory Committee External Peer Review Committee

Contents

Documents

1. Presentation material: Recent Activities of NIFS
2. Presentation material: Division of Health and Safety Promotion
3. Presentation material: Division of Information and Communication Systems
4. Presentation material: Division of External Affairs

References

1. Table of Evaluation Results for the 2020 External Peer Review

Chapter 1 Background

The National Institute for Fusion Science (below as NIFS) was established in 1989 as an inter-university research institute, and utilizes the Large Helical Device (below as LHD) as the principal device to advance fusion research in universities in Japan.

The LHD, which was planned by bearing the support and the expectations of the fusion community, has the special characteristic of producing the heliotron-type magnetic field, which is an idea unique to Japan. In addition to generating high-performance helical-type plasma through high-power heating, NIFS is advancing with experimental research that aims to clarify physical and technological issues for realizing the toroidal magnetic field confinement fusion reactor. On the other hand, parallel with this, in analyses of fusion plasmas having fundamental complexities, theoretical research that uses large-scale simulations are essential. For that reason, a supercomputer for exclusive use was introduced at NIFS. We are advancing with leading-edge research by making this supercomputer at NIFS available for use to fusion theory researchers in Japan through collaborative research. Moreover, since 2010, in order to further strengthen the centripetal power of NIFS as a Center of Excellence (below as COE) in the field of plasma and fusion research we have organized three research projects, these being LHD, theory and simulation, and reactor engineering. Looking forward toward achieving the fusion reactor, initiated research programs will integrate these research results.

In addition to having revised the research structure within NIFS and having placed all research staff in one research department, by establishing a research system that enables participation by free will in research projects and has enabled easier cooperation in the three projects of LHD, theory and simulation, and reactor engineering than in the past, we are increasingly able to respond resourcefully to new topics.

In this period, there have been changes to the structure of the domestic academic research system. Since 2004, NIFS has been a research institute under the Inter-University Research Institute Corporation National Institutes of Natural Sciences (below as NINS) for enhancing further the domestic research collaboration. Upon becoming an inter-university research corporation, a system for mid-term goals and mid-term planning spanning six years was introduced, and a system of annual evaluations regarding the progress, too, was introduced. This annual evaluation focuses primarily upon administrative management. However, at NIFS it has been determined that receiving external evaluations of research results is important. Under the NIFS Advisory Committee, each year an External Peer Review Committee is organized, and the members evaluate the research. The topics of evaluation are determined by the Advisory Committee. The evaluation is undertaken by the members of the External Peer Review Committee, which is composed of experts who are external members of the Advisory Committee and external experts who are appropriate for evaluating the topics. The External Evaluation Committee submits its evaluation results to the Advisory Committee. Then, NIFS,

together with making the results public by uploading that information to the NIFS homepage, utilizes this information to improve research activities in the following years.

The topics for evaluation for the External Peer Review Committee are discussed and decided upon by the Advisory Committee, and those topics for evaluation differ each year. Most recently, in 2017 the Reactor Engineering Research Project, in 2018 the Large Helical Device Project, and in 2019 the Numerical Simulation Reactor Research Project were topics evaluated by external reviewers. This year, 2020, the "Division of Health and Safety Promotion", the "Division of Information and Communication Systems", and the "Division of External Affairs" were selected and reviewed by the external examiners.

As external members of the External Peer Review Committee there were ten external members from the Advisory Committee and three members from foreign countries. Further, there were three experts from outside NIFS. Thus was the External Peer Review Committee composed, and thereby the evaluation was undertaken.

The first meeting of the External Peer Review Committee including the Experts' Committee was convened on October 2, 2020. The Committee discussed the process for moving forward with this fiscal year's external peer review, and decided upon the perspective of the evaluation. On November 24, 2020, the second meeting of the External Peer Review Committee and Experts' Committee was held. From NIFS was provided a detailed explanation that utilized documents from the material of viewgraphs and reports based on the perspectives (see the documents section). A question-and-answer session also was held. Subsequently, the third meeting of the External Peer Review Committee and the Experts' Committee was held on January 26, 2021. Together with holding another question and answer session with NIFS, evaluation work based on the topics of the evaluation and the coordination of the evaluation work were undertaken. We compiled the external peer review report (draft) based upon the discussions to this point, and further discussions were held by electronic mail. Upon confirmation and examination by the External Peer Review Committee and the Experts' Committee, we compiled the final report on March 2021.

Moreover, in the external evaluation regarding NIFS's "Division of Health and Safety Promotion", the "Division of Information and Communication Systems", and the "Division of External Affairs" which were implemented this fiscal year, the perspectives for the evaluation were determined as follows. The perspectives for the evaluation consist of all the aspects that are indispensable in evaluating the performance of NIFS's "Division of Health and Safety Promotion," the "Division of Information and Communication Systems," and the "Division of External Affairs."

Evaluation items in FY2020 External Peer Review

1. Division of Health and Safety Promotion

(1) Are the organizations and systems for safety and health management properly constructed and operated in compliance with relevant laws and regulations?

(2) Are the safety management equipment / facilities, experimental equipment, etc., for maintaining and managing safety taken into account for the characteristics and circumstances peculiar to fusion research?

(3) Are manuals and rules such as operation manuals, radiation control manuals, and emergency manuals properly formulated and operated?

(4) As the Inter-University Research Institute, do you properly provide safety management and education to staff and collaborators?

(5) Is the training of leaders to carry out safety management properly planned and implemented?

2. Division of Information and Communication Systems

(1) Is the information and communication system as a research platform properly constructed and operated?

(2) Is the division of information and communication systems properly responding to requests for information system development from inside and outside the institute?

(3) Is the organization of the division of information and communication systems functionally constructed and operated?

3. Division of External Affairs

(1) Do you provide information and have a dialogue on the importance and the safety of fusion research for the development of a sustainable society to a wide range of people?

(2) Do you carry out community interaction activities appropriately to gain their trust and understanding of fusion research through communication with local residents?

(3) Do you contribute to the science education of children, students, and society through various workshops and events?

Chapter 2 Summary of the Evaluation, and Recommendation

We summarize the key points of the evaluation, and report in writing the recommendation regarding promotion of NIFS's "Division of Health and Safety Promotion", the "Division of Information and Communication Systems", and the "Division of External Affairs".

[1] Summary of the Evaluation

1. Division of Health and Safety Promotion

(1) Are the organizations and systems for safety and health management properly constructed and operated in compliance with relevant laws and regulations?

- At the National Institute for Fusion Science, many large-scale equipment such as LHD, liquefied helium-related equipment, and high-power power supply equipment must be operated at the same time, and the radiation control system including tritium must be operated with an emphasis on safety. The Division of Health and Safety Promotion has 10 rooms consisting of administrative staff, technical staff, and research staff, and has created a close cooperation system in charge of specialized fields. You comply with many safety-related legal compliance operations and are working with a high level of awareness to create a safe environment.
- It is important to continue efforts such as collecting and disclosing cases of hiyari-hatto (near miss accident), preparing disaster prevention manuals, compiling and revising safety handbooks, safety seminars, and safety patrols. We hope that the current activities that maintain high motivation for health and safety will continue to be developed.
- Although the management and operation system has been properly established under the Division Director of health and Safety Promotion, we expect that we will strive for continuous safety and health management, such as taking measures such as strengthening support as necessary.

(2) Are the safety management equipment / facilities, experimental equipment, etc., for maintaining and managing safety taken into account for the characteristics and circumstances peculiar to fusion research?

- As a fusion research device, safety management and operation related to radiation handling are emphasized in LHD-related fields. After the deuterium experiment is started, management and operation at an extremely high level is required, such as activation of equipment due to neutron generation and prevention of environmental exposure of tritium. Under the Division

of Health and Safety Promotion, radiation level monitoring and necessary management equipment are being developed, and it can be judged that this is a sufficient response, including on-site gate management within the laboratory.

- Regarding radiation control, a third-party committee has been set up to measure radiation regularly. The transparency of information is guaranteed outside the laboratory. Environmental radiation in the surrounding area is measured regularly and reported to the area. In addition, the number of people who have acquired qualifications related to radiation control is increasing, and you are actively conducting educational activities within the facility. These things can be highly evaluated.
- In safety management of high power, high voltage, cryogenic temperature, high pressure gas, heavy objects, etc. required for fusion research as well as tritium and neutrons, the characteristics and circumstances are fully considered and appropriate measures are taken. It can be highly evaluated.

(3) Are manuals and rules such as operation manuals, radiation control manuals, and emergency manuals properly formulated and operated?

- Safety-related rules and response manuals for disasters have been properly formulated. It is operated with guarantee of continuity, such as not being able to participate in experiments and equipment installation without taking a seminar every year. Considering the actual use of the manuals, the minimum required items are summarized on pages 1-2, which can be referred to on the Web, etc. In addition, there are some ingenuities in terms of operation so that it is always checked in daily driving. From these things, it can be highly evaluated.
- As the Inter-University Research Institute, outside researchers including foreigners also have the opportunity to handle the equipment. The maintenance of these manuals is indispensable for building a safe experimental environment, and you are properly formulated and operated. From these things, it can be highly evaluated.
- Foreigners are also considered for the route display signs of emergency evacuation routes, and sufficient measures are taken against emergencies.

(4) As the Inter-University Research Institute, do you properly provide safety management and education to staff and collaborators?

- Not only faculty and staff inside the institute, but also many people such as collaborators outside the institute and employees of related companies are participating in the operation of the equipment managed by the National Institute for Fusion Science. In order to build a safe and secure working environment for the entire site, it is indispensable to build a safety and health management system and safety education. In addition to an appropriate health and

safety management system, you also give consideration to safety education not only for staff but also for collaborators and those who belong to companies involved in equipment installation and operation. From these things, it can be highly evaluated.

- We expect continuous improvement, such as reflecting the opinions of staff and collaborators and responding to the increase in foreign researchers. It is also worth considering imposing a simple test on the participants of the seminar.

(5) Is the training of leaders to carry out safety management properly planned and implemented?

- In order to properly comply with the law and operate the safety management system, it is necessary to train leaders who have qualifications in accordance with the law, such as radiation protection supervisor. Continued support to staff, encouraging the acquisition of national qualifications such as 27 first-class radiation protection supervisor's license holders, 50 license holders related to high-pressure gas handling, and 25 first-class health officer's license holders. The training of instructors who carry out safety management is systematically implemented and can be highly evaluated. We hope that you will continue to strive to develop human resources involved in health and safety management.
- Human resource development requires a long-term strategy, and we look forward to future measures such as conducting regular checks and reviews on scenarios for training and securing the necessary personnel in the future.

2. Division of Information and Communication Systems

(1) Is the information and communication system as a research platform properly constructed and operated?

- It is extremely commendable that the information and communication system and information network (NIFS-LAN), which form the basis of the institute's activities, have been appropriately constructed and are being safely managed and operated. In particular, three types of networks (NIFS-LAN, LHD-LAN, and PS-LAN) have been constructed and are being operated with special attention to security, and appropriate responses to incidents have been taken. In addition, it is highly evaluated that the institute has established a system to support research activities as a major research institute in the field of fusion science in Japan, including the establishment of an information system for joint researchers and a teleconference system.

(2) Is the division of information and communication systems properly responding to requests for information system development from inside and outside the institute?

- It is highly evaluated that the division of information and communication systems is responding appropriately to the development of information systems in response to requests from both inside and outside the institute, including support for the storage and management of large-scale experimental data, development of data transfer technology, software license management, and development and operation of various information processing systems such as the international conference participation registration system. On the other hand, this is a position that requires specialization, and organization needs to continue to take measures to ensure that the workload in not too unevenly distributed among some staff members.

(3) Is the organization of the division of information and communication systems functionally constructed and operated?

- Within the division of information and communication systems, task groups and operation teams have been organized and are operating appropriately. In addition to providing a single point of contact for system development, the task groups enable the exchange of technical information and cross-checking between tasks, which is highly evaluated as a way to enhance service response. On the other hand, considering the high level of expertise and responsibility in the business, it is expected that the institute will continue to manage labor appropriately by allocating personnel appropriately.

3. Division of External Affairs

(1) Do you provide information and have a dialogue on the importance and the safety of fusion research for the development of a sustainable society to a wide range of people?

- In addition to conducting facility tours, open campus, public academic lectures, Fusion Festa, public explanatory meetings, small group training sessions for SSH-designated schools, and other outreach activities for a wide range of people, the NIFS continues to disseminate information on the importance and safety of fusion research through the Web, newsletters, SNS, and press releases. This is highly commendable. Further continuation and development of online activities, which will become more important in the future, is expected.

(2) Do you carry out community interaction activities appropriately to gain their trust and understanding of fusion research through communication with local residents?

- Through the implementation of public explanatory meetings (341 times over 15 years), participation in local events, publication of PR magazines, etc., the Institute has maintained communication with local communities and residents, and has vigorously engaged in community exchange activities to gain the understanding of local residents. It is highly commendable that the NIFS has gained a better understanding of activities of the institute

from the local community. Activities aimed at further building trust are expected while maintaining communication with citizens.

(3) Do you contribute to the science education of children, students, and society through various workshops and events?

- It is highly commendable that science education activities in a broad sense, not limited to nuclear fusion and plasma, are being conducted for a wide range of citizens, from preschoolers to elementary school students, junior high school students, high school students, and adults, utilizing various forms such as science handicraft workshops, delivery classes, work experience, internships, and public academic lectures according to age groups. In the future, it is expected to promote communication activities with an overseas perspective, while responding to the shift to online activities, such as the enhancement of video content.

[2] Recommendations

In the present evaluation, we discussed NIFS's "Division of Health and Safety Promotion", the "Division of Information and Communication Systems", and the "Division of External Affairs". Based upon the contents of the discussion, we describe the recommendations regarding the future plan of these three divisions below.

1. Division of Health and Safety Promotion

(1) You will continue to maintain a safety management system for operating a large number of large devices at the same time and an organizational system for safely operating radiation control including tritium, and establish a close cooperation system between departments in charge of specialized fields. While taking this, we hope that we will continue to strengthen the appropriate support system.

(2) We expect that the safety and disaster response manuals will be reviewed regularly, and that human resources involved in the safety and health system and management will be continuously developed.

(3) To carry out continuously safety education for not only staff but also collaborators including foreigners, those involved in research institute activities. To report to the community such as radiation measurement results. To consider measures for safety that are expected when nuclear fusion is implemented in society in the future. To study continuously safety and health in fusion research in general. We expect these things.

2. Division of Information and Communication Systems

(1) It is hoped that the institute will continue to maintain a system that supports various collaborative research activities as a major research institute in the field of fusion science in Japan, taking into consideration network security as well as the information and communication systems that form the basis of the institute's activities.

(2) In the operation of information and communication systems, it is expected that the government strengthens its ability to respond to diverse services by training appropriate human resources and continuing flexible organizational management.

3. Division of External Affairs

(1) It is expected that information on the importance and safety of nuclear fusion research will continue to be disseminated to a wide age range, from children to adults.

(2) It is expected that implement activities to enhance trust with the local community and residents will continue to be conducted through various community exchange activities.

(3) It is expected to develop science education activities in a broad sense, not limited to nuclear fusion and plasma, and to promote communication activities with an overseas perspective, while adopting various PR methods such as web and video distribution.

Chapter 3 In Closing

Since 2010, in order to further strengthen the centripetal power of NIFS as a COE in the field of plasma and fusion research we have organized three research projects, these being LHD, theory and simulation, and reactor engineering. Looking forward toward achieving the fusion reactor, NIFS has initiated research programs that will integrate these research results. Moreover, the research structure at NIFS was reorganized and all academic researchers have now been placed in one research department. They may now participate in any or all of the three research projects by their choice. Due to this, we anticipate the promotion of links with LHD, theory and simulation, and fusion engineering, and we anticipate being able to respond resourcefully to new topics.

In the NIFS External Peer Review Committee review, in 2017 the Reactor Engineering Research Project, in 2018 the LHD Project, and in 2019 the Numerical Simulation Reactor Research Project were evaluated. Thus, in this current year of 2020 the Advisory Committee undertook an external evaluation that focused on NIFS's "Division of Health and Safety Promotion", the "Division of Information and Communication Systems", and the "Division of External Affairs". The External Peer Review Committee was composed of ten members of the Advisory Committee outside of NIFS and three members from abroad, and, as the experts, three members outside of NIFS.

Evaluation items in FY2020 External Peer Review

1. Division of Health and Safety Promotion

(1) Are the organizations and systems for safety and health management properly constructed and operated in compliance with relevant laws and regulations?

(2) Are the safety management equipment / facilities, experimental equipment, etc., for maintaining and managing safety taken into account for the characteristics and circumstances peculiar to fusion research?

(3) Are manuals and rules such as operation manuals, radiation control manuals, and emergency manuals properly formulated and operated?

(4) As the Inter-University Research Institute, do you properly provide safety management and education to staff and collaborators?

(5) Is the training of leaders to carry out safety management properly planned and implemented?

2. Division of Information and Communication Systems

(1) Is the information and communication system as a research platform properly constructed and operated?

(2) Is the division of information and communication systems properly responding to requests for information system development from inside and outside the institute?

(3) Is the organization of the division of information and communication systems functionally constructed and operated?

3. Division of External Affairs

(1) Do you provide information and have a dialogue on the importance and the safety of fusion research for the development of a sustainable society to a wide range of people?

(2) Do you carry out community interaction activities appropriately to gain their trust and understanding of fusion research through communication with local residents?

(3) Do you contribute to the science education of children, students, and society through various workshops and events?

The External Peer Review Committee was convened four times from October 2020 through March 2021 including the e-mail discussion committee. Detailed explanations of the evaluation topics were provided from NIFS and active discussions were held. The External Peer Review Committee members summarize evaluation results based on discussion at the committee and submit this report.

As the result of the external evaluation of the NIFS's "Division of Health and Safety Promotion", the "Division of Information and Communication Systems", and the "Division of External Affairs", a recommendation of a high evaluation are received for the above evaluation points.

In conclusion, we suggest the following recommendations regarding the future plan of these three divisions.

Recommendations

1. Division of Health and Safety Promotion

(1) You will continue to maintain a safety management system for operating a large number of large devices at the same time and an organizational system for safely operating radiation control including tritium, and establish a close cooperation system between departments in charge of specialized fields. While taking this, we hope that we will continue to strengthen the appropriate support system.

(2) We expect that the safety and disaster response manuals will be reviewed regularly, and that human resources involved in the safety and health system and management will be continuously developed.

(3) To carry out continuously safety education for not only staff but also collaborators including foreigners, those involved in research institute activities. To report to the community such as radiation measurement results. To consider measures for safety that are expected when nuclear

fusion is implemented in society in the future. To study continuously safety and health in fusion research in general. We expect these things.

2. Division of Information and Communication Systems

(1) It is hoped that the institute will continue to maintain a system that supports various collaborative research activities as a major research institute in the field of fusion science in Japan, taking into consideration network security as well as the information and communication systems that form the basis of the institute's activities.

(2) In the operation of information and communication systems, it is expected that the government strengthens its ability to respond to diverse services by training appropriate human resources and continuing flexible organizational management.

3. Division of External Affairs

(1) It is expected that information on the importance and safety of nuclear fusion research will continue to be disseminated to a wide age range, from children to adults.

(2) It is expected that implement activities to enhance trust with the local community and residents will continue to be conducted through various community exchange activities.

(3) It is expected to develop science education activities in a broad sense, not limited to nuclear fusion and plasma, and to promote communication activities with an overseas perspective, while adopting various PR methods such as web and video distribution.

Documents

1. Presentation material: Recent Activities of NIFS

2. Presentation material: Division of Health and Safety Promotion

3. Presentation material: Division of Information and Communication Systems

4. Presentation material: Division of External Affairs

NIFS External Review Committee meeting
NIFS, 24 Nov. 2020

Recent Activities of NIFS

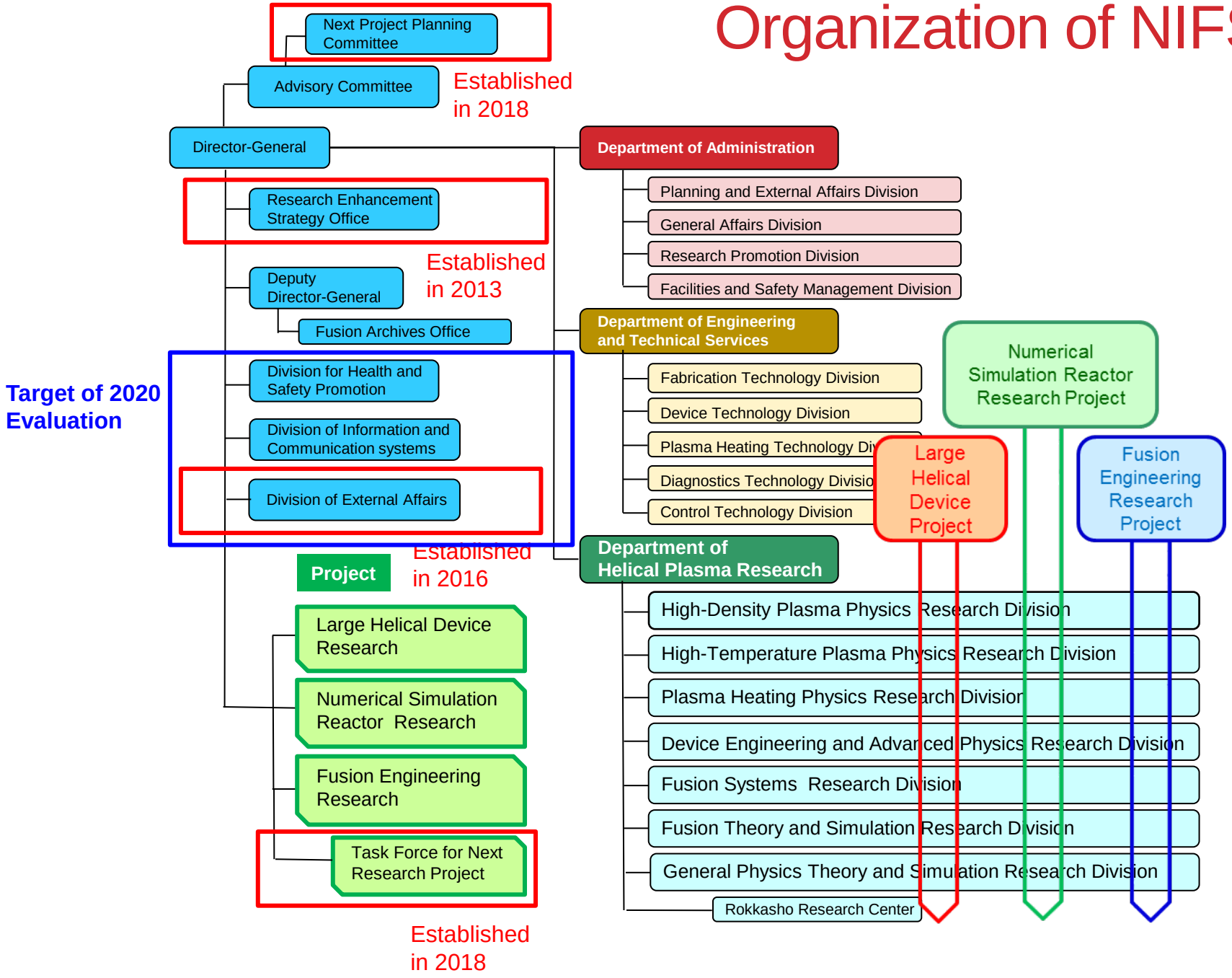
Takeo Muroga

Director, Department of Helical Plasma Research

STATUS OF NIFS IN 2020

- **Organization structure**
  - 125 researchers, 46 engineers & technicians, 43 administration staff
  - 68 graduate students
  - about 100 of contract employees
- **Research organization**
  - One department consisting of seven divisions
  - Three research projects; LHD, Numerical Simulation Reactor Research, Fusion Engineering Research projects
- **Budgetary condition**
  - 8,376million yen (1.0% less than that of FY2019) which includes salary, operational costs of LHD, Supercomputer and other facilities
  - As for operation of LHD, it is 4,053million yen which is the same as the previous year.
- **Collaboration programs**
  - 532 subjects have been approved as collaborative researches in four collaboration programs; General(395), LHD Project(25), Bidirectional Collaborations(105), and DEMO Reactor R&D(7)(started in 2019)

Organization of NIFS



Fusion Research Activities in Japan

for FY 2020

Kyoto Univ.
Heliotron J Helical System

National Institute for Quantum and Radiological Science and Technology (QST) Naka-site
JT-60SA Tokamak

Hokkaido Region
4 Institutes including
・Hokkaido Univ.

National Institute for Quantum and Radiological Science and Technology (QST) Rokkasho-site

IFMIF-EVEDA, IFERC

Tohoku Region
11 Institutes including
・Iwate Univ.
・Tohoku Univ.

Univ. of Tsukuba
GAMMA 10 Mirror

Hokuriku Region
6 Institutes including
・Toyama Univ.
・Kanazawa Univ.
・Fukui Univ.

Chugoku, Shikoku Region
16 Institutes including
・Okayama Univ.
・Yamaguchi Univ.

Kanto, Koshinetsu Region
63 Institutes including
・Univ. of Tsukuba
・The Univ. of Tokyo
・SOKENDAI
・Tokai Univ.
・National Astronomical Observatory of Japan
・JAMSTEC
・JAEA

NIFS LHD

Kyushu Region
20 Institutes including
・Kyushu Univ.
・Saga Univ.
・Kyushu Tokai Univ.

Kinki Region
23 Institutes including
・Kyoto Univ.
・Osaka Univ.

Tokai Region
19 Institutes including
・Nagoya Univ.
・Chubu Univ.

Kyushu Univ.
QUEST ST

Osaka Univ.
GEKKO-XII Laser

Total numbers of universities and research institutes under collaboration with NIFS: 162

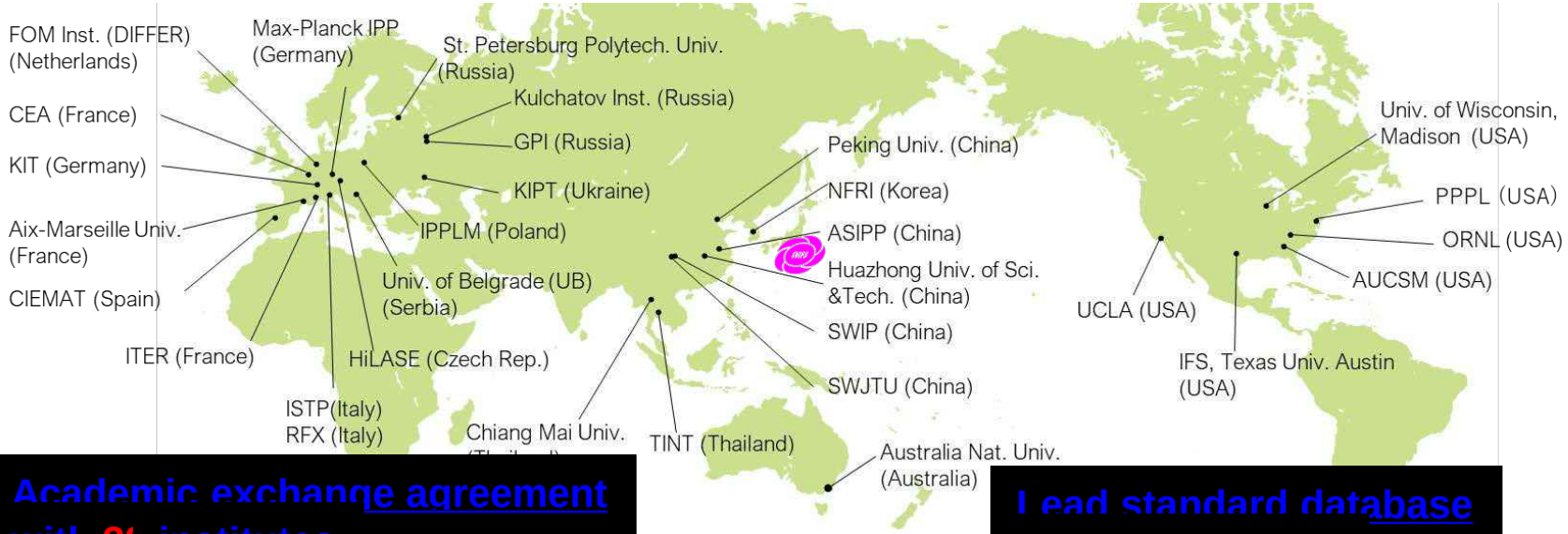
International collaborations

Agreements representing the Japanese government

- 6 bilateral agreements (with Australia, China, EU, Korea, Russia, USA)
- 3 multilateral agreements (IEA-Technology Collaboration Programmes)

Human exchange by leading programs in 2019

	J/US		J/China		J/Korea		Int. Base	
	man	Day	man	day	man	day	man	day
to NIFS/Japan	55	301	65	734	23	46	10	107
from NIFS/Japan	57	867	17	100	30	126	31	223



Academic exchange agreement with 3[illegible] institutes

- Promotion of collaboration and joint work
- Exchange of data and materials
- Human resource development/education

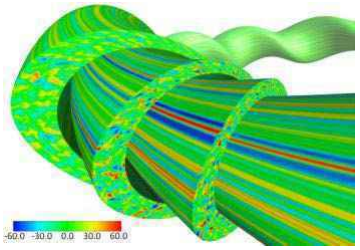
Lead standard database in fusion science

- Confinement physics database
- Atomi molecular database

NIFS carries out three projects by promoting collaboration with universities

- Large Helical Device Project pursuits to achieve the high performance plasma in the 3rd deuterium experiment
  - Enhancement of plasma parameters toward reactor relevant regime
  - Confinement and transport study of energetic particles
  - Surface modifications on plasma facing components

- Numerical Simulation Reactor Research Project develops numerical simulation methods that will be the basis of numerical helical reactor
  - Understanding and systemizing physical mechanisms in fusion plasmas
  - Development of theoretical models for plasma behaviors and their validation
  - Integration of predictive models in a whole machine range

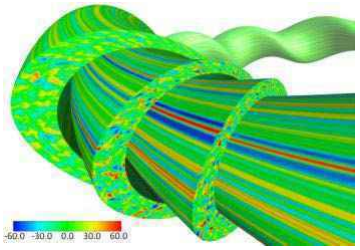


- Fusion Engineering Research Project proceeds fusion engineering research to solve key issues of the helical fusion reactor
  - Development of superconducting magnet, blanket, low activation materials, divertor / plasma facing components, and tritium control system
  - Design studies of helical fusion reactor

NIFS carries out three projects by promoting collaboration with universities

- Large Helical Device Project pursuits to achieve the high performance plasma in the 3rd deuterium experiment
  - Enhancement of plasma parameters toward reactor relevant regime
  - Confinement and transport study of energetic particles
  - Surface modifications on plasma facing components

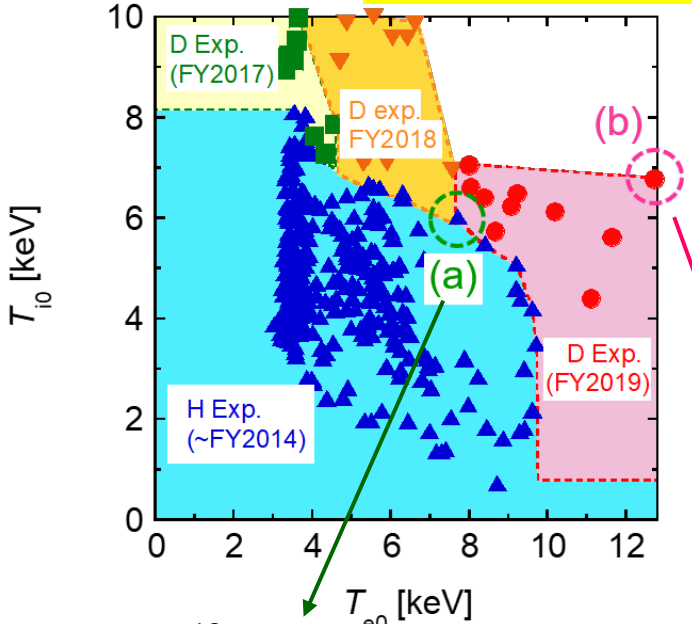
- Numerical Simulation Reactor Research Project develops numerical simulation methods that will be the basis of numerical helical reactor
  - Understanding and systemizing physical mechanisms in fusion plasmas
  - Development of theoretical models for plasma behaviors and their validation
  - Integration of predictive models in a whole machine range



- Fusion Engineering Research Project proceeds fusion engineering research to solve key issues of the helical fusion reactor
  - Development of superconducting magnet, blanket, low activation materials, divertor / plasma facing components, and tritium control system
  - Design studies of helical fusion reactor

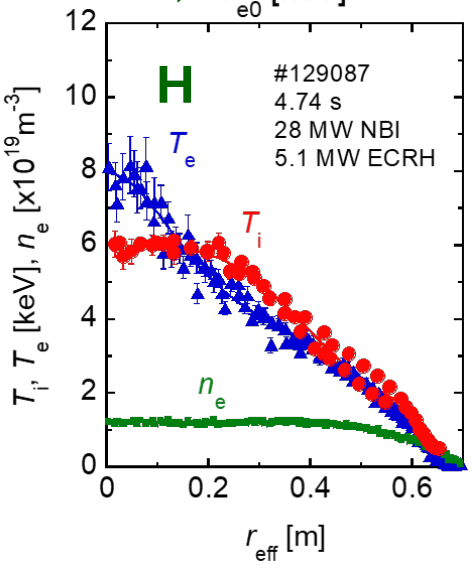
Extension of operational regime

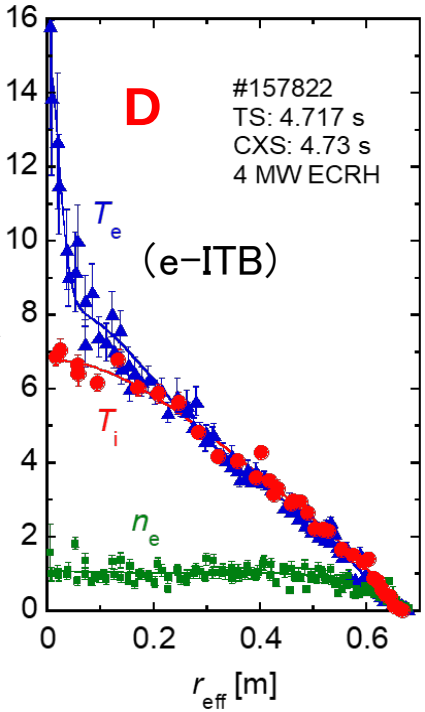
Operational regime expands to higher T_e regime



*T*e increased from 7.5 keV to 13 keV with relatively high T_i of 7 keV, which is because

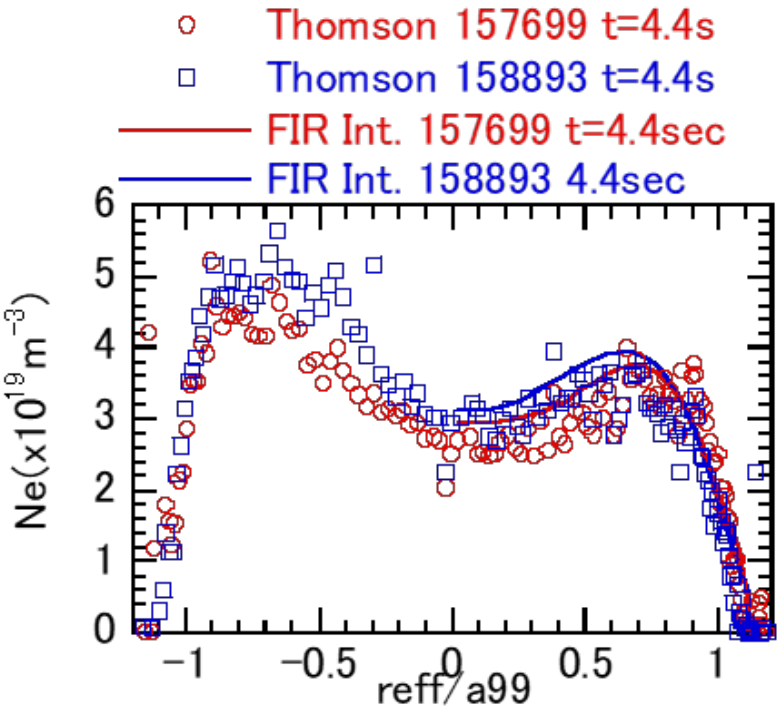
- ICH discharge cleaning by recently re-installed RF antennas
- ECH perpendicular injection to resonant surface

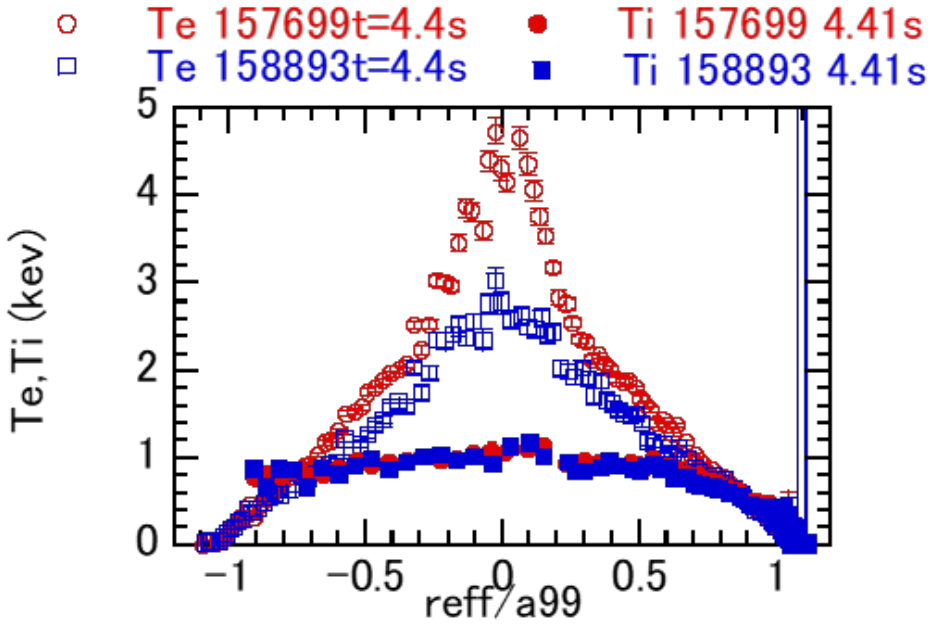




Improved confinement in EC heated D plasma

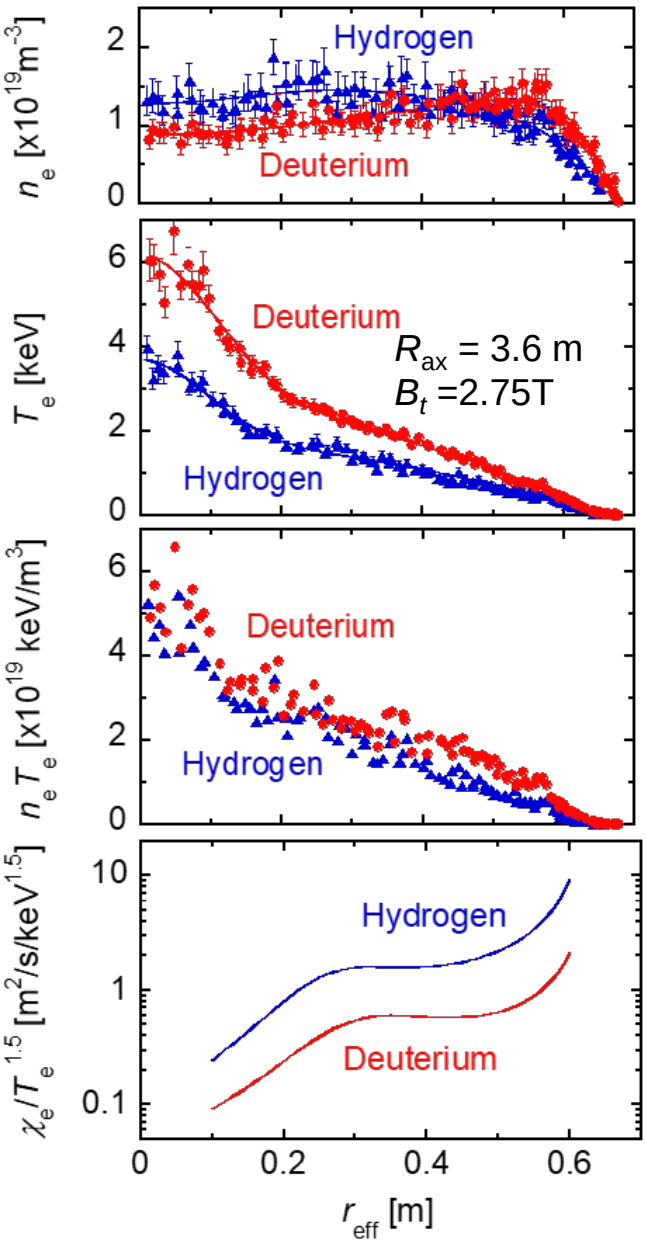
e-ITB could be formed with lower ECH power in D plasma than in H plasma



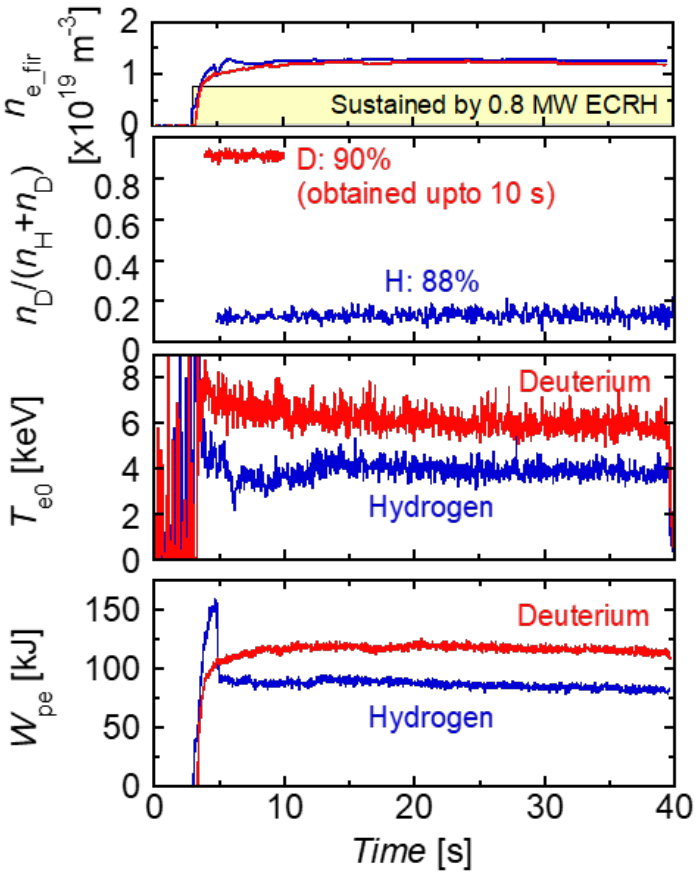


- Two discharges (H, D) with same ECH power (154 GHz, 2 MW)
- In D plasma, e-ITB was formed even in relatively high n_e region ($n_{e\ bar} \sim 3.5 \times 10^{19} m^{-3}$)
- Not formed in H plasma (isotope effect)

Long sustainment of high performance plasma



High T_e plasma (~ 6 keV) with e-ITB could be sustained for ~ 30 sec

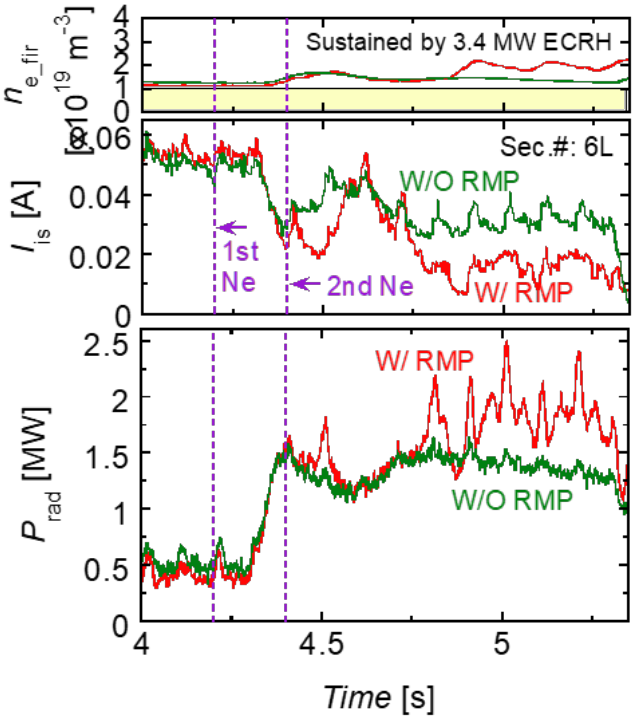


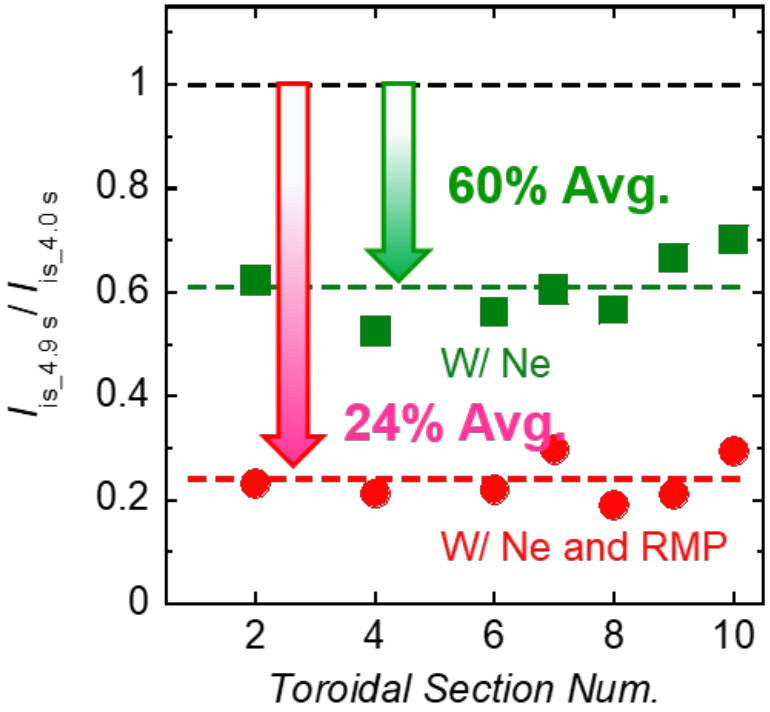
- Two discharges (H, D) with same conditions
- Higher T_e and lower energy transport coefficient were obtained in D

Simultaneous achievement of e-ITB and radiative divertor

Combination of Ne injection and RMP (m/n=1/1) application realized divertor flux mitigation during high performance discharge with e-ITB

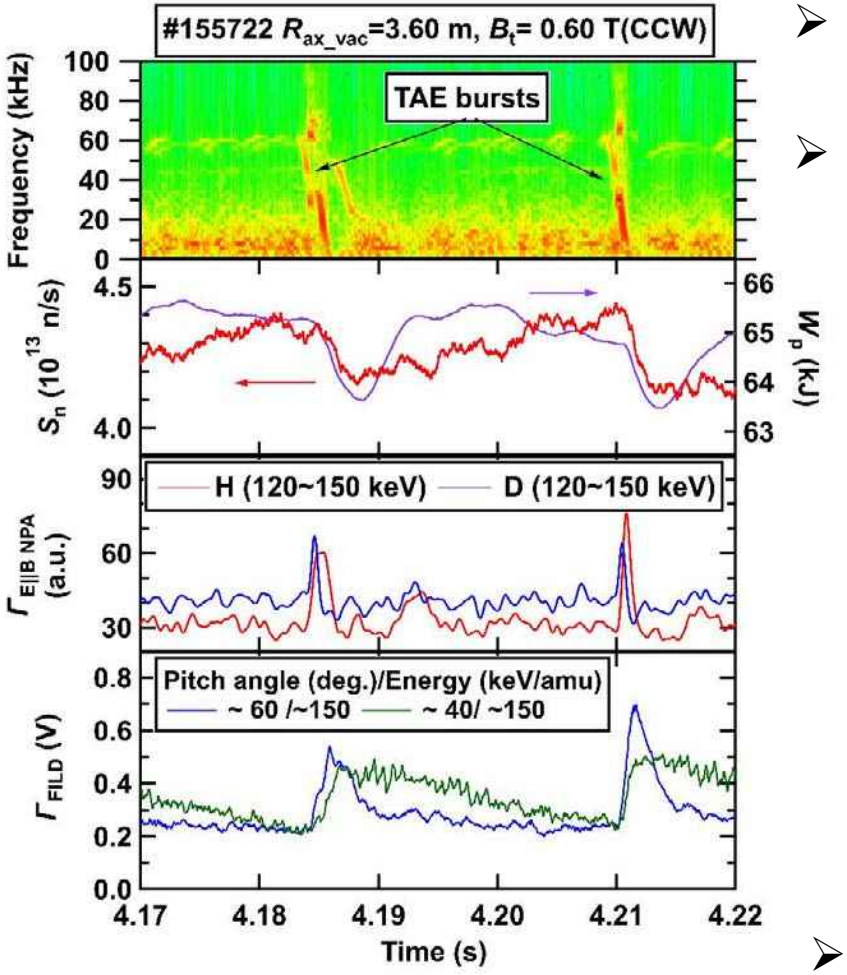
- P_{rad} increased 3 times by Ne, and 4 times by Ne + RMP
- I_{is} decreased down to 60% with Ne, and to 24% with Ne + RMP
- e-ITB existed after Ne injection and RMP application
- low T_e region increased by RMP.



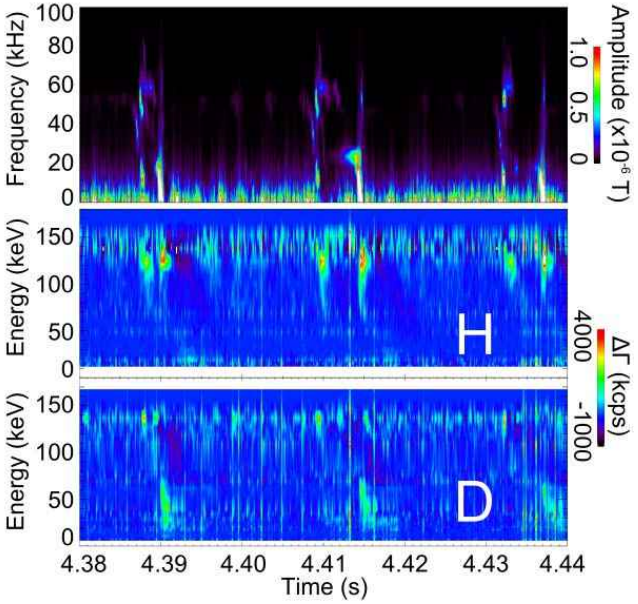


Transport study of energetic particles (EPs)

EPs lost by toroidal Alfven Eigenmode (TAE) induced MHD instability in D plasma was estimated to be about 5 %



- Low B_t (~0.6T) plasma start-up was available by tentatively changing NB#3 injection with H
- From stored energy W_p and neutron rate S_n signals, it was found that ~ 5% of EPs were lost by single TAE burst

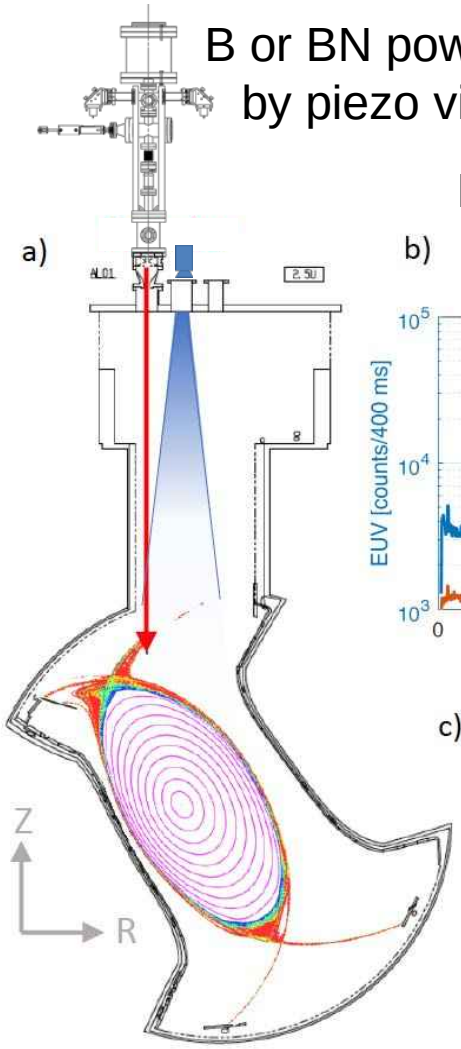


- In H/D mixture plasma, H and D EPs were simultaneously observed with E//B NPA

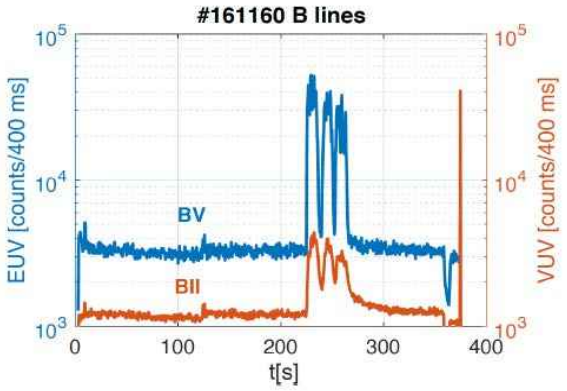
Boron powder drop experiment

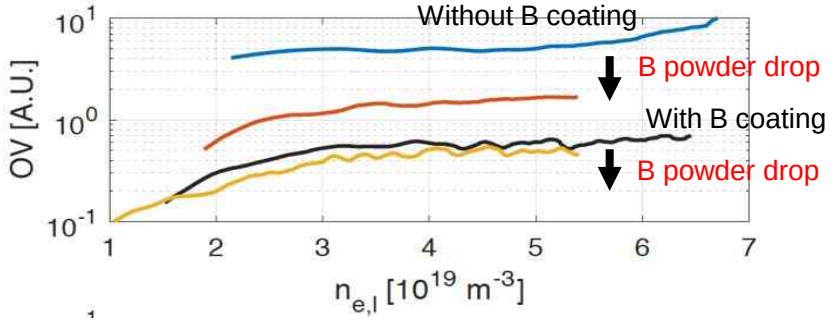
Boron powder drop and discharges made clear effects on vacuum vessel wall and edge plasma properties (collaboration with PPPL)

B or BN powder is dropped by piezo vibrator

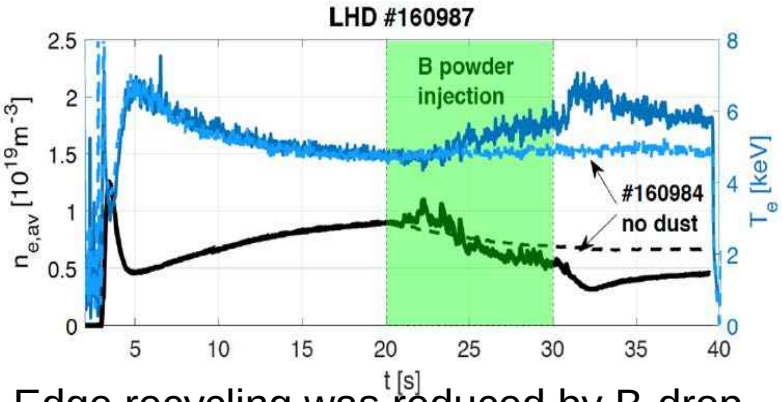


B emissions from edge region





- O drastically decreased after B-powder drop (blue => red)
- B-power drop was effective even after conventional B_2O_6 coating (yellow)

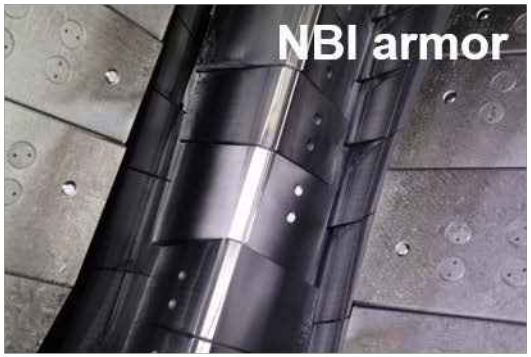


- Edge recycling was reduced by B-drop (ne: decrease, Te: increase)

Partial installation of W-coated divertor tiles

C deposition or flakes near W-coated tiles were drastically decreased

- 10 μm W-layer was coated on C tiles of one of ten helical divertor sections
- Considerable W erosion was found at the striking point due to the sputtering with C

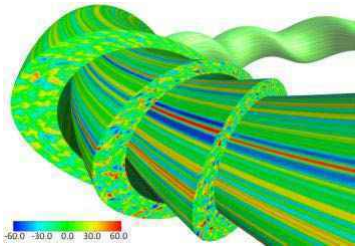


- No sputtering effect was found on NBI armor because ion energy is high

NIFS carries out three projects by promoting collaboration with universities

- Large Helical Device Project pursuits to achieve the high performance plasma in the 3rd deuterium experiment
  - Enhancement of plasma parameters toward reactor relevant regime
  - Confinement and transport study of energetic particles
  - Surface modifications on plasma facing components

- Numerical Simulation Reactor Research Project develops numerical simulation methods that will be the basis of numerical helical reactor
  - Understanding and systemizing physical mechanisms in fusion plasmas
  - Development of theoretical models for plasma behaviors and their validation
  - Integration of predictive models in a whole machine range

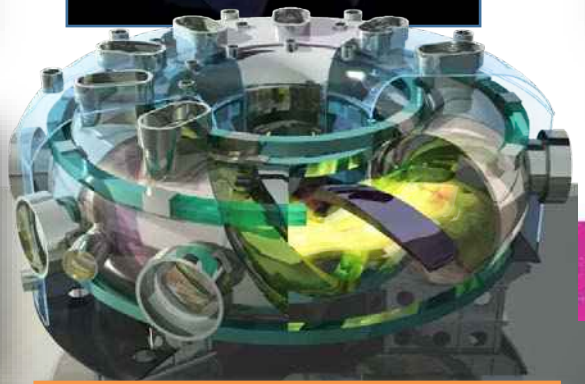


- Fusion Engineering Research Project proceeds fusion engineering research to solve key issues of the helical fusion reactor
  - Development of superconducting magnet, blanket, low activation materials, divertor / plasma facing components, and tritium control system
  - Design studies of helical fusion reactor

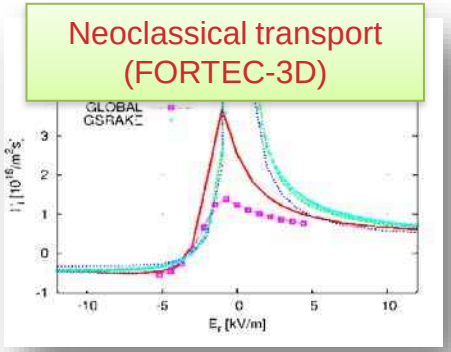
Extensive simulation code developments and comparisons between simulation and experiments towards numerical helical reactor

Turbulent transport (GKV-X)

Edge plasma (EMC3-EIRENE)

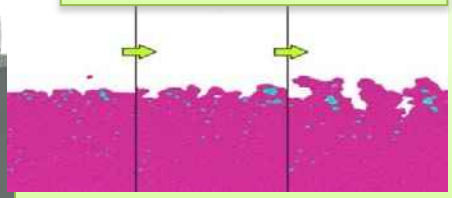


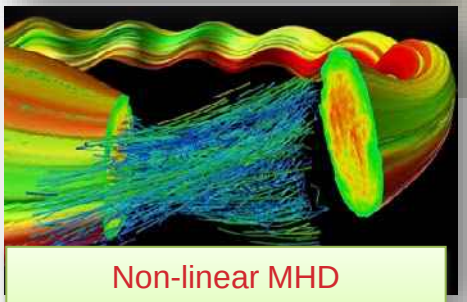
Neoclassical transport (FORTEC-3D)



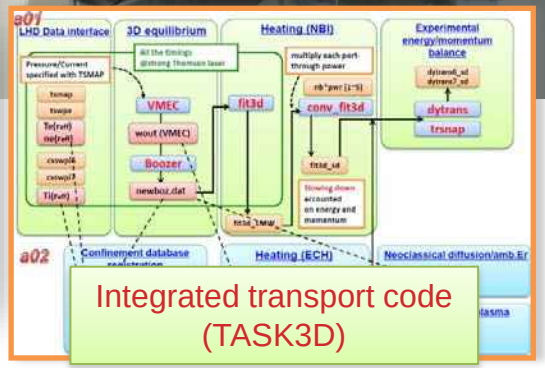
High energy particle (MEGA)

Plasma-wall interaction (MD-MC)

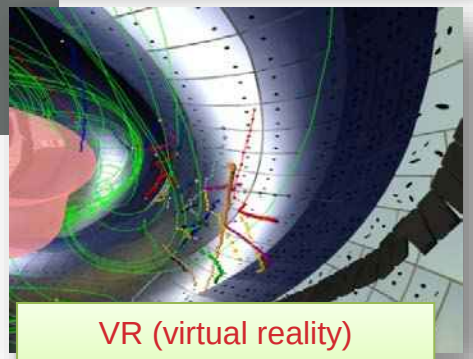




Non-linear MHD (MINOS,MIPS,NORM)



Integrated transport code (TASK3D)



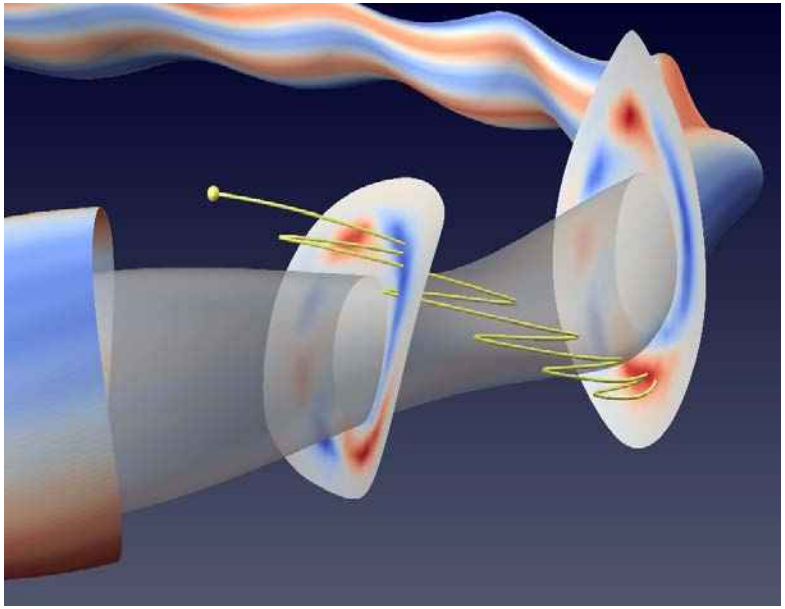
VR (virtual reality) visualization

Recent research activities of NSRP (1)

MHD simulation codes are extended to more accurately reproduce stability of LHD plasmas.

Kinetic effects of thermal ions are included.

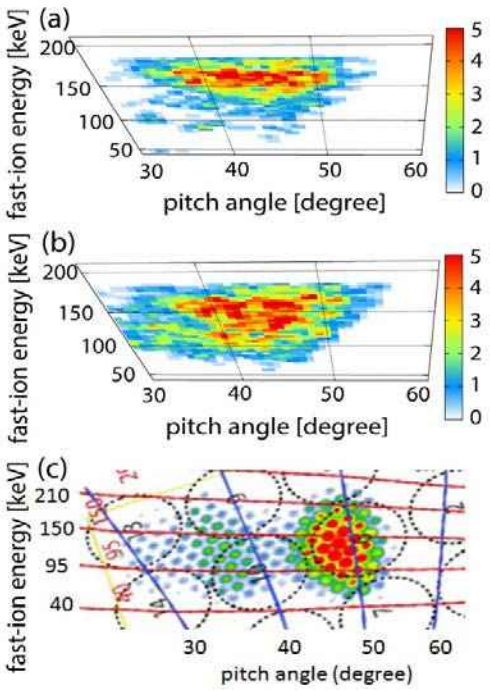
Stabilization of interchange modes and sustainment of a high beta plasma in LHD are shown by kinetic MHD simulation in which thermal ions are treated kinetically.

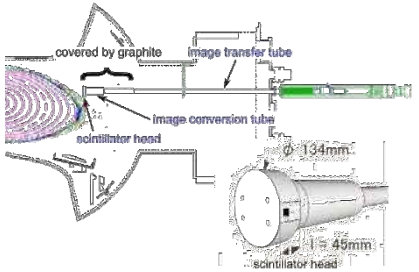


Interchange modes and trapped ion orbit

Simulation studies of high energy particle driven instabilities are advanced.

- **Efficiency of ion heating by EGAM**
- **Effects of high energy electrons on Alfven Eigenmodes**
- **Comparison of MEGA simulation and FILD**





Direct comparison between simulation results of the MEGA simulation and measurements by Fast Ion Loss Detector (FILD) in LHD shows a reasonable agreement on energy and pitch angle distribution of lost fast ions.

Recent research activities of NSRP (2)

Global neoclassical transport simulations for multi-ion-species plasmas are performed to study impurity hole phenomena in LHD.

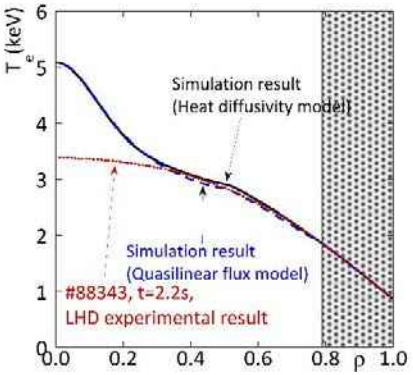
TEM/ITG instability analyses are made to investigate isotope mixture in LHD hydrogen-deuterium plasma experiments.

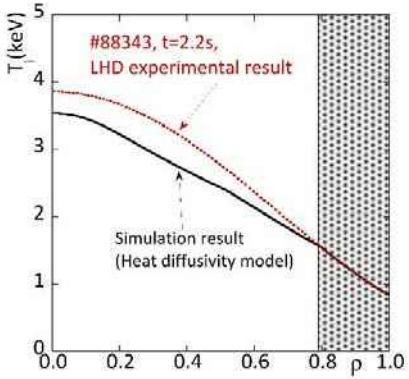
Electron and ion thermal transport models are constructed based on gyrokinetic simulation analyses.

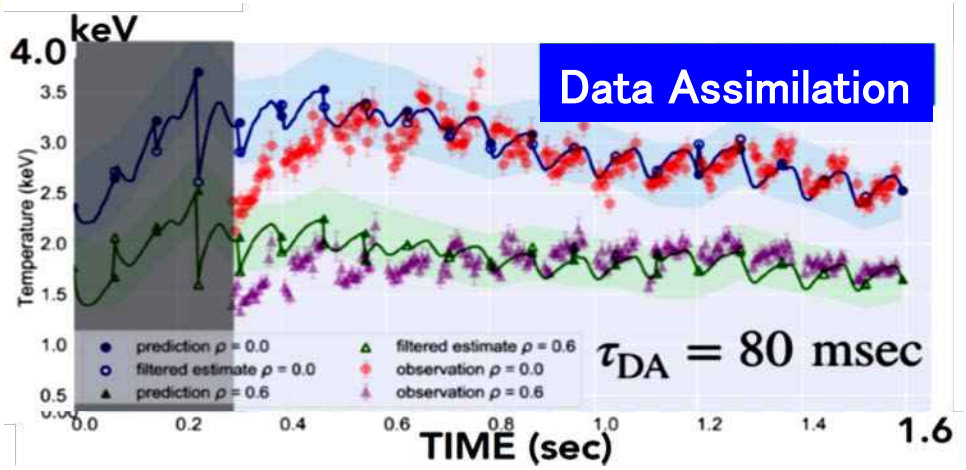
Integrated transport code (TASK3D-a) is applied to analyses of LHD deuterium experiments.

Data Assimilation approach is implemented to TASK3D (collaboration with Kyoto U and The Institute of Statistical Mathematics).

Time evolution of T_i at ρ = 0.0 and 0.6 in LHD







T_e and T_i profiles in LHD are obtained by the integrated transport code (TASK3D) using the gyrokinetic transport model.

Thermal transport model optimized by Data Assimilation successfully reproduces T_i in LHD.

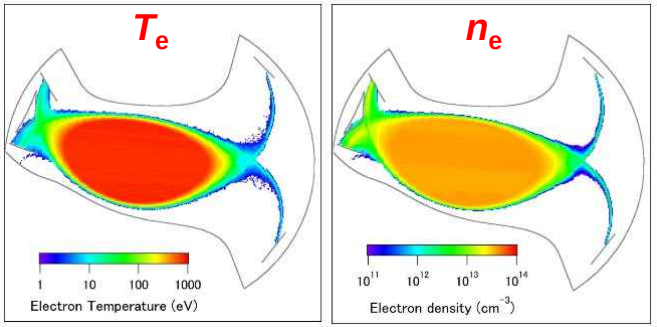
Recent research activities of NSRP (3)

Simulation analysis of peripheral plasmas

- **Impurity radiation in LHD**
- **JT-60SA with RMP fields**
- **MHD instability in the peripheral region of LHD induced by pellet injection**

Simulation models and codes for core and peripheral regions and plasma-wall interaction are developed and extended.

Code integration of neutral transport code, charged particle code (EMC3-EIRENE) and the recycling model (MD) is successfully performed.

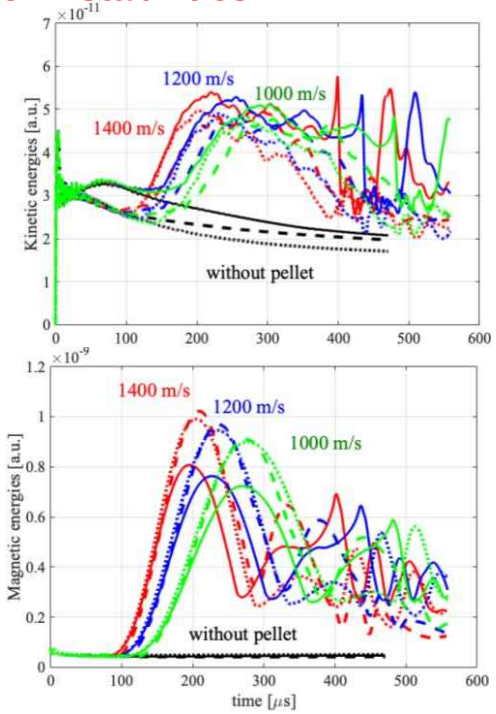


EMC3-EIRENE code

Nonlinear MHD simulation of pellet injection to LHD shows pellets with higher injection speed drive larger instabilities.

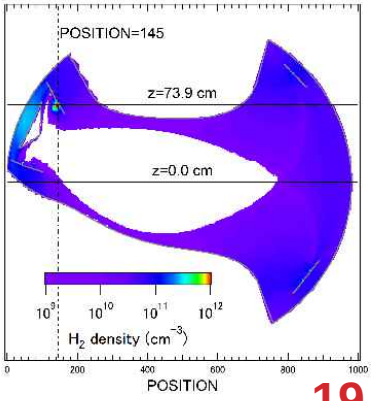
Kinetic energies

Magnetic energies



Neutral-Transport code

H_2 density

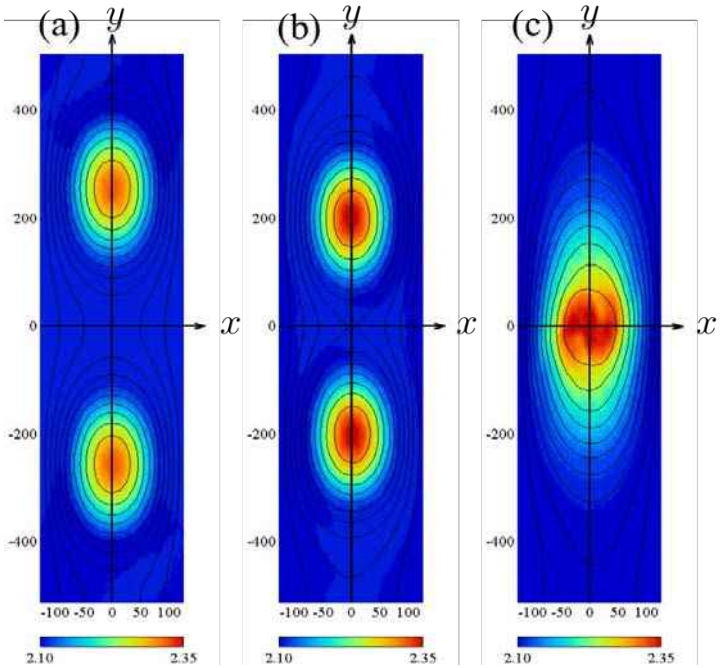


H_2 density distribution is calculated using Neutral-Transport code with H and H_2 data released from Divertor plate, which are simulated by MD-simulation.

Recent research activities of NSRP (4)

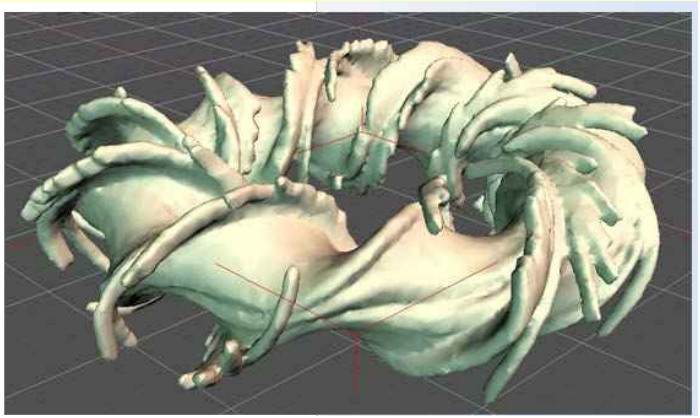
Simulation studies of magnetized plasmas and basic physics are advanced.

- **PIC simulation of radial transport dynamics in detached divertor plasma**
- **PIC simulation of heating mechanism of spherical tokamak (ST) plasmas**



PIC simulation of ST plasma merging

Advanced visualization techniques are applied to researches in plasma physics and fusion engineering.

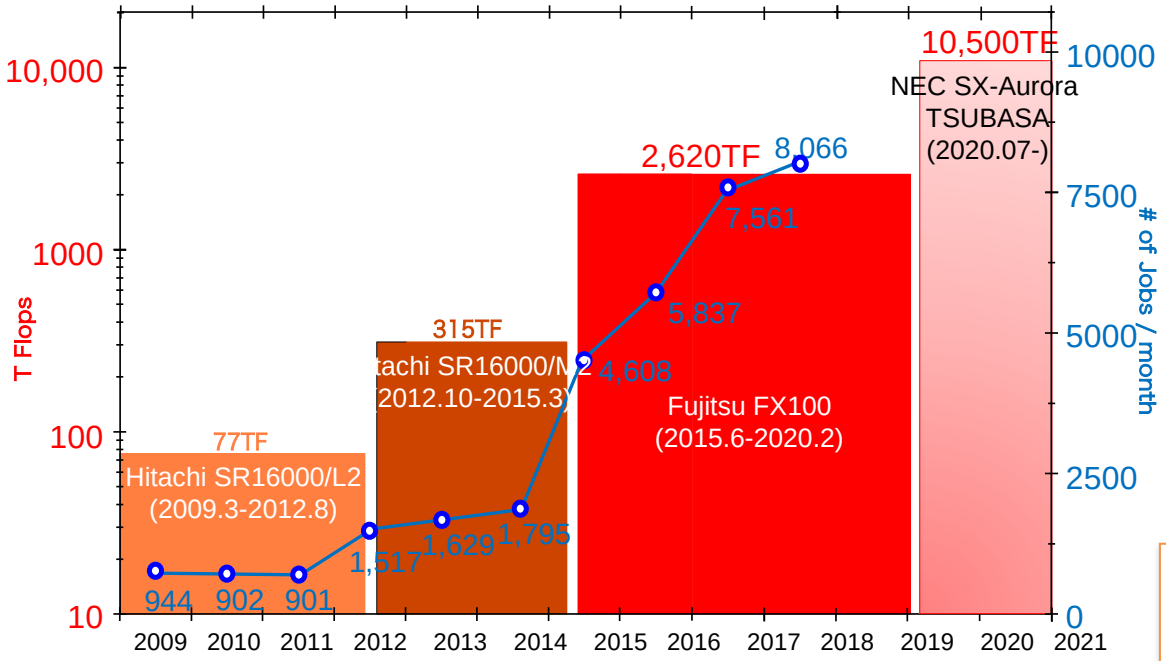


Visualization of magnetic field line structure and plasma region

Application of VR and CAD to examination of installing divertor plates in LHD

PLASMA SIMULATOR

Supercomputer system for numerical simulation research at NIFS ("**Plasma Simulator**") was replaced from Fujitsu PRIMEHPC FX100 (peak performance about 2.62 PF, and the total main memory about 81TB) to **NEC SX-Aurora TSUBASA (10.5 PF, 202 TB) in 2020**.



Peak performances of plasma simulator and numbers of submitted jobs per month

Plasma Simulator Raijin (雷神)
NEC SX-Aurora TSUBASA
Peak performance: 10.5 PF
Total main memory: 202TB
From July 2020 to June 2025

Plasma Simulator ‘Raijin (雷神)’ started operation

The operation of Plasma Simulator ‘Raijin (**雷神**)’ started on July 1, 2020, and the celebration event was held on Aug.29, 2020 with participation of guests including MEXT Deputy Minister, Diet members, Mayor of Toki City.

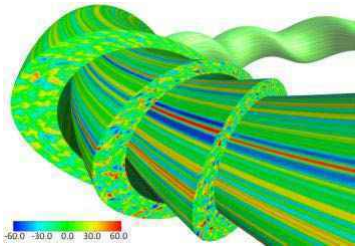
‘Raijin (**雷神**)’
= a god of thunder

A tour to Plasma Simulator ‘Raijin (**雷神**)’

NIFS carries out three projects by promoting collaboration with universities

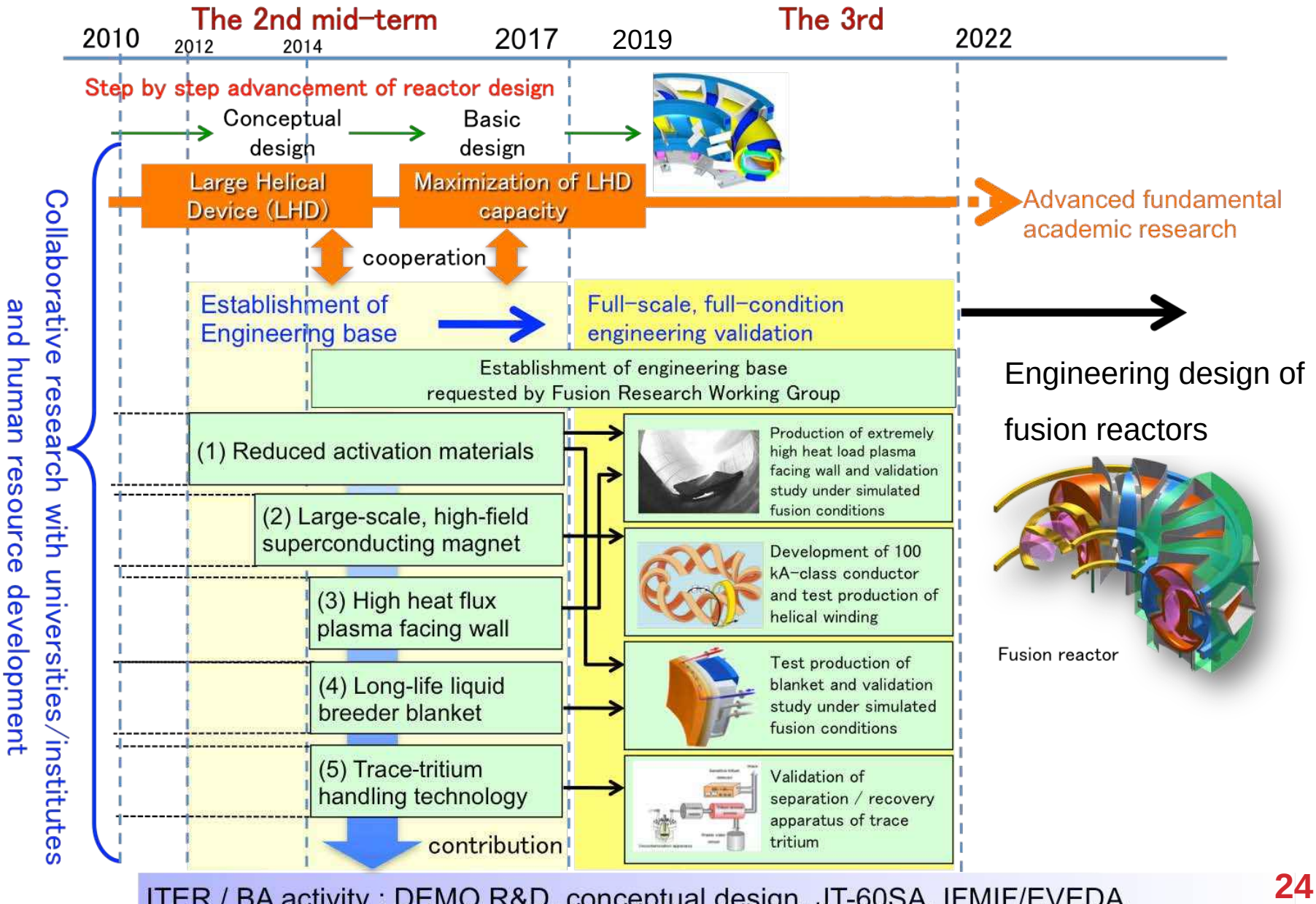
- Large Helical Device Project pursuits to achieve the high performance plasma in the 3rd deuterium experiment
  - Enhancement of plasma parameters toward reactor relevant regime
  - Confinement and transport study of energetic particles
  - Surface modifications on plasma facing components

- Numerical Simulation Reactor Research Project develops numerical simulation methods that will be the basis of numerical helical reactor
  - Understanding and systemizing physical mechanisms in fusion plasmas
  - Development of theoretical models for plasma behaviors and their validation
  - Integration of predictive models in a whole machine range



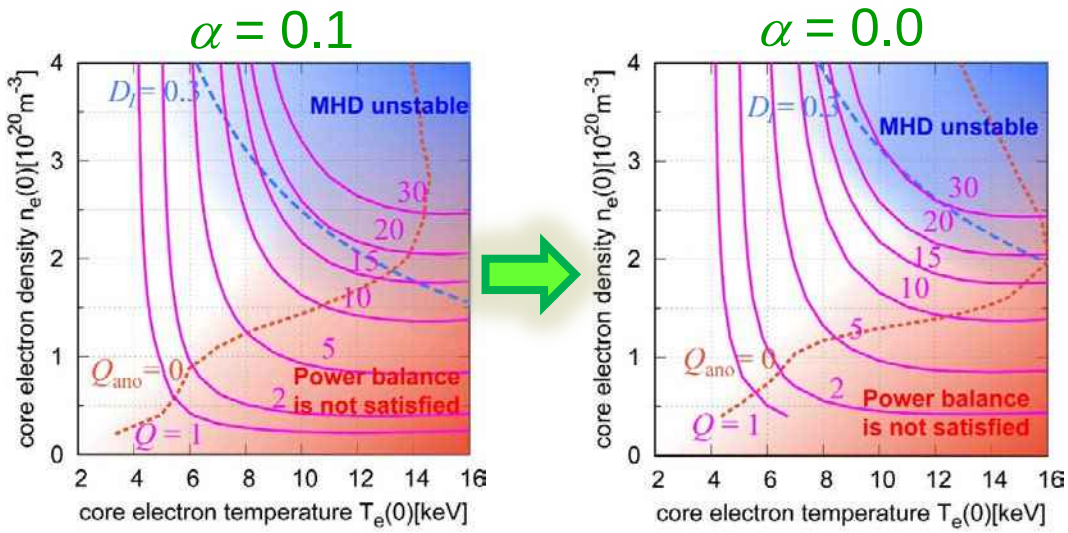
- Fusion Engineering Research Project proceeds fusion engineering research to solve key issues of the helical fusion reactor
  - Development of superconducting magnet, blanket, low activation materials, divertor / plasma facing components, and tritium control system
  - Design studies of helical fusion reactor

Research Roadmap of FERP

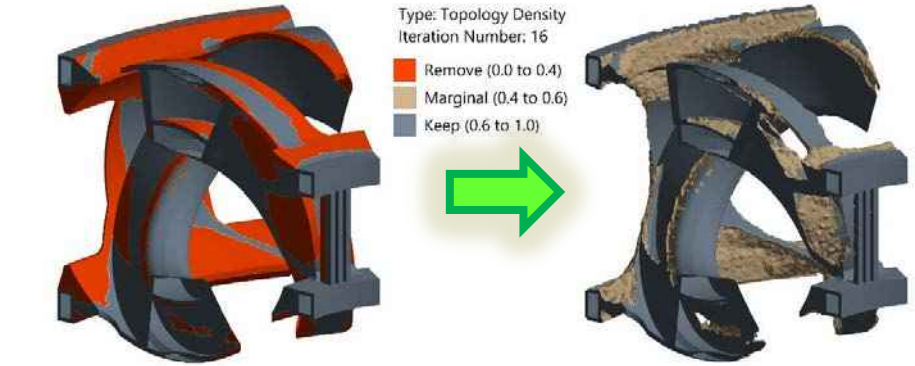


Helical Reactor FFHR Design Integration

Optimization of helical coil configuration for better plasma performance

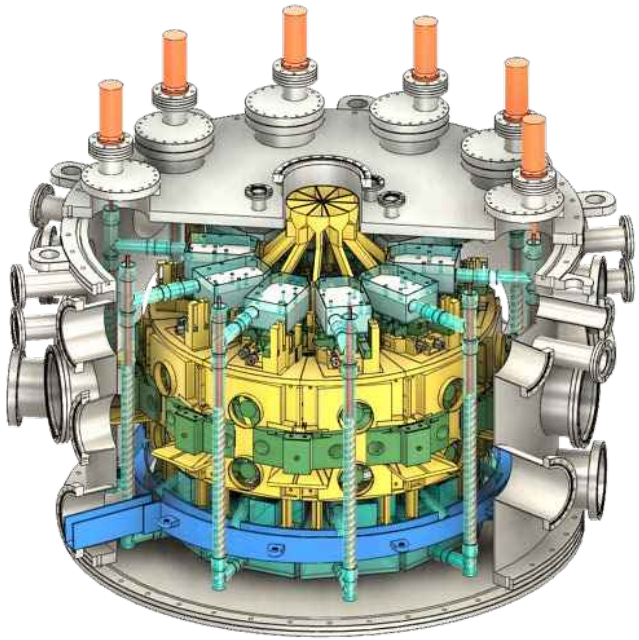


Pitch modulation parameter (α) dependence of plasma parameters and fusion gain



Topology optimization reduces weight of magnet supporting structure by >25%

Examination of enhanced maintainability by adopting advanced divertor and blanket concepts



Cartridge type blanket CARDISTRY-B2

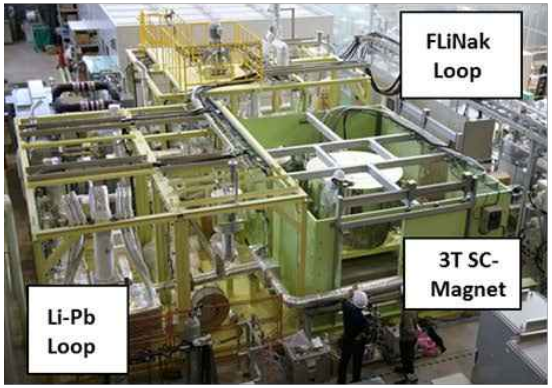
Pebble divertor REVOLVER-D2

Remote-handling replacement of breeding blankets is examined

Facilities Installed for Collaboration

13 T, ϕ700 mm Solenoid Coil

Temperature Variable Refrigerator



Li-Pb/FLiNaK Twin Loops with 3 T Superconducting Magnet (Oroshhi-2)

Ion Beam Surface Analysis

High T, High Vacuum Creep Test Facilities

Hot Isostatic Press (HIP)

High Heat Flux Test (ACT2)

Installed in Radiation Control Area of LHD

FETEM-EDS

FIB

Imaging Plate

GD-OES

Thermal Desorption Spectrometer

These devices are used to perform characterizations of specimens exposed to D-D plasmas of LHD

Research Highlight (1) High-Tc Superconductors

Superconductor Testing Facilities

- Large-bore high-field magnet facility (ϕ700 mm, 13 T, 50 kA)
- Temperature variable refrigerator supplies 4-50 K liquid & gas helium

Critical current measurement
- in liquid nitrogen (77 K) and 0 T ➔ in progress
- in gas helium (20 K) and 9 T ➔ tested soon

Large-current High-Temp. Superconducting (HTS) conductors (3-types) are being development

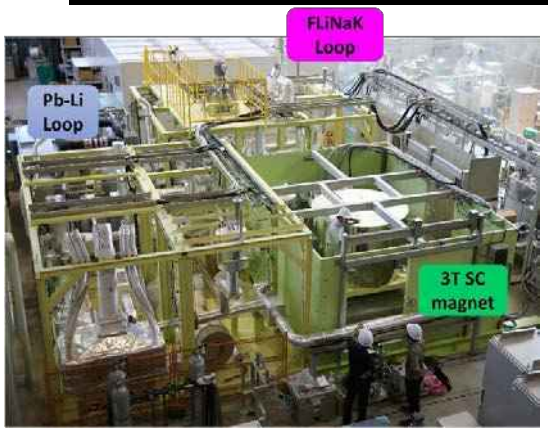
STARS

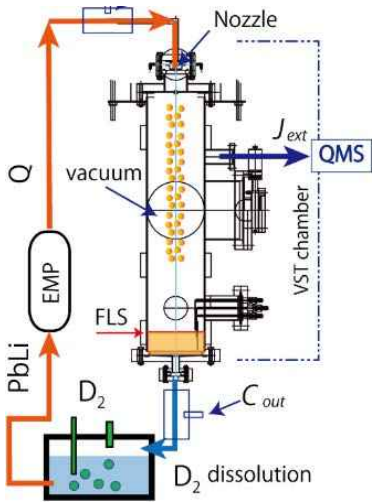
FAIR

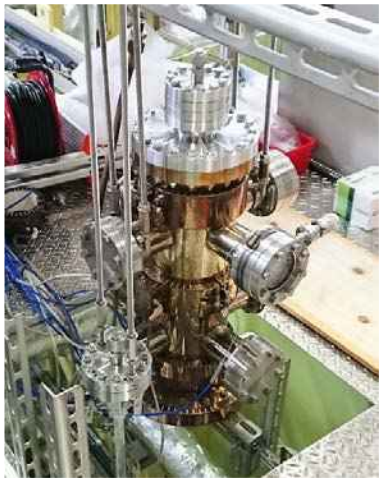
WISE

Research Highlight (2) Blanket Loop Test

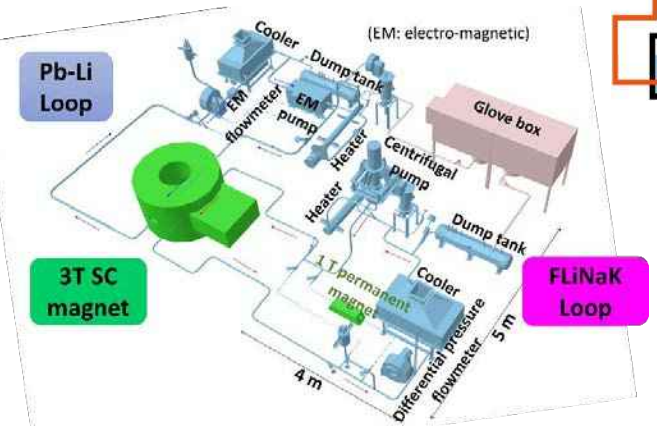
Blanket Testing Facility : Flinak / LiPb Twin-loop “Oroshhi-2”



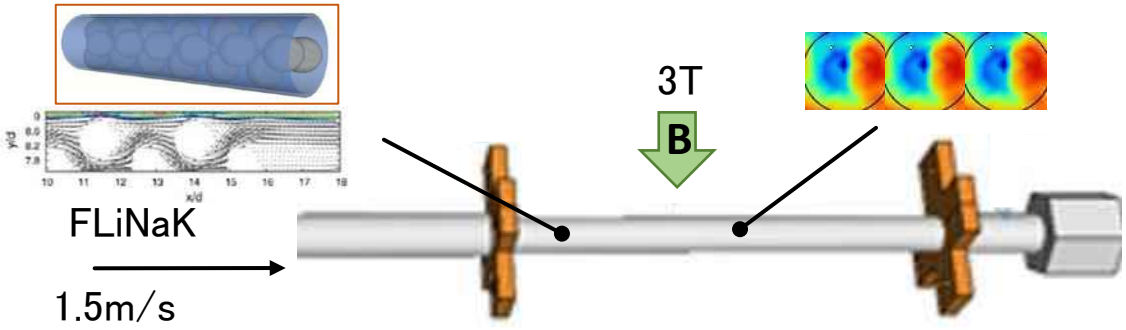




Installed at the top of Oroshhi-2



Hydrogen recovery from Li-Pb
(Collaboration with Kyoto U.)

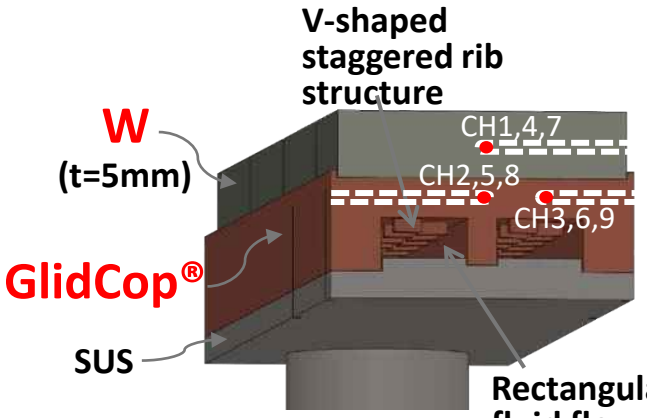


Heat recovery from FLiNaK with pebble-packed pipes
(Collaboration with Tohoku U.)

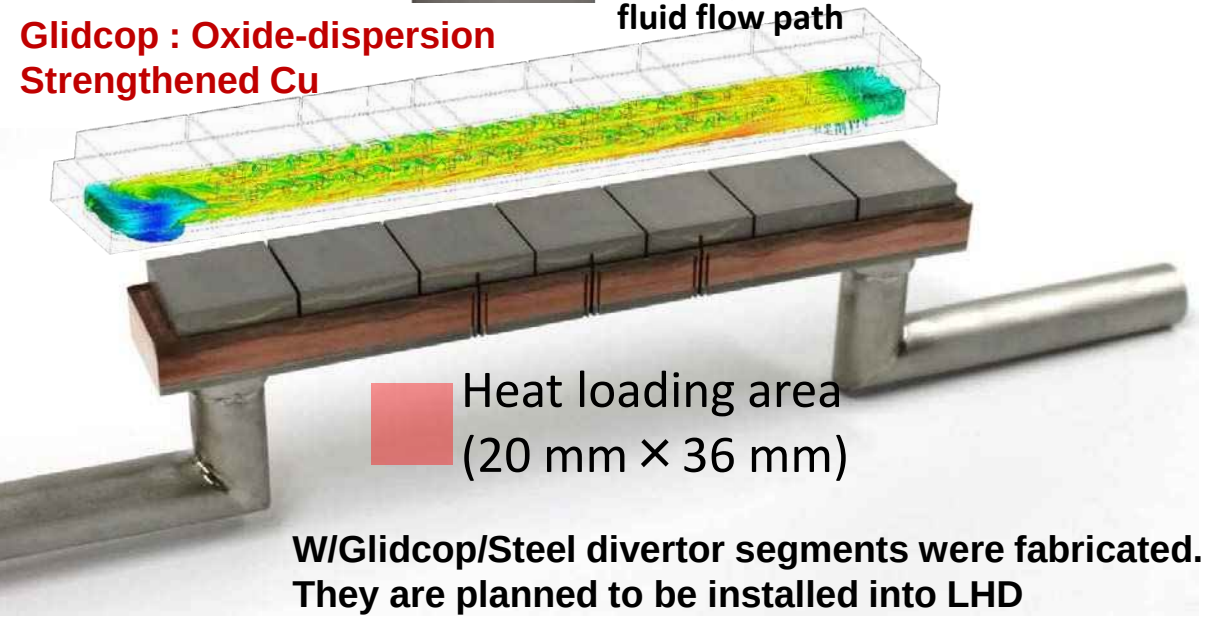
Experiment will be carried out soon

Research Highlight (3) Divertor Mock-up Fabrication

Divertor test sample fabricated by Advanced Multi-Step Brazing (AMSB) technique (for joining tungsten and ODS-copper) has shown >30 MW/m² of heat removal capability

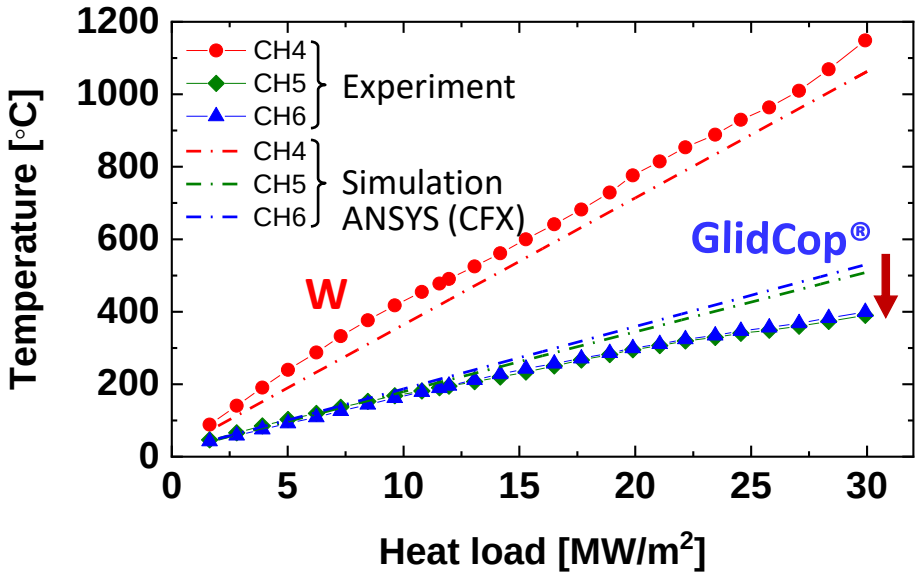


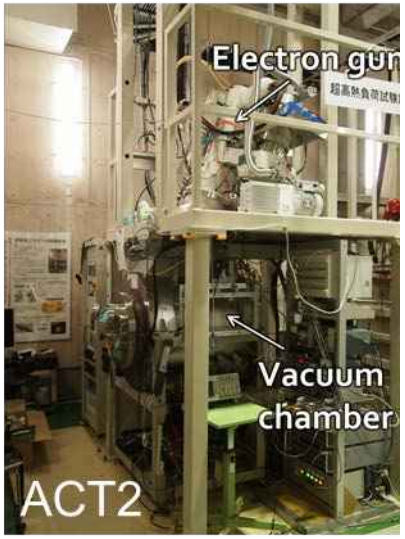
Glidcop : Oxide-dispersion Strengthened Cu



W/Glidcop/Steel divertor segments were fabricated. They are planned to be installed into LHD

"ACT- 2" 300 kW Electron Beam for Divertor Testing





Task Force for Next Research Project

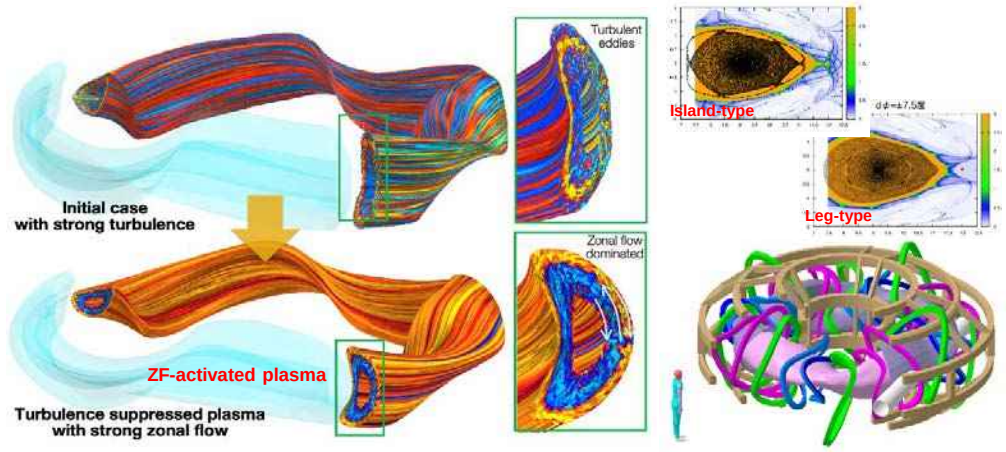
Under the Task Force, research is being enhanced targeting designing and proposing post-LHD project. The activity is guided by NIFS Next Project Planning Committee under NIFS Advisory Committee. The project plan has been presented as a proposal from NIFS for discussion in the plasma fusion community.

1. **Supporting the inter-university liaison conference in which the foremost research themes to be addressed by academia is being discussed in the framework of the NIFS general collaboration research**
2. **Investigating the next research project for creating the next generation magnetic configuration with enhanced zonal flows and turbulence suppression, leading to a new discovery of innovative confinement**

Physics and Conceptual Design Studies

❖ **Explorations towards a ZF-activated plasma**

- Nonlinear gyrokinetics based modeling of turbulence & zonal flows towards a novel stellarator/heliotron optimizations
- Showing much capabilities of establishing a 3-D magnetic configuration with turbulence transport suppressions by the activated zonal flows
- Investigation for flexible controls of field structures: divertor configurations (leg type & island type)
- The device feasibility is evaluated by preparatory studies on the engineering design of coils, VV, and support structures

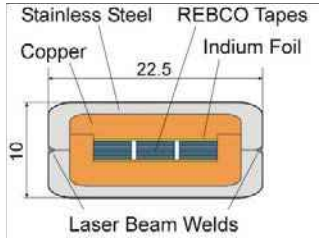


The first target of the submission of the proposal will be in early 2022 for "Master plan 2023"

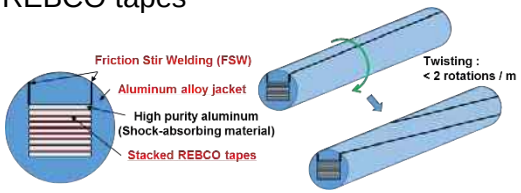
Development of HTS Conductor

Three types of advanced High Temperature Super-conductor are being fabricated and tested. After C&R, applicability to the next project will be assessed.

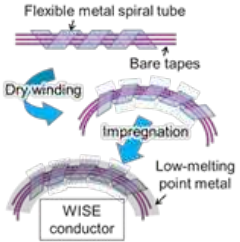
- **STARS** means "Stacked Tapes Assembled in Rigid Structure"
- Design of 18 kA conductor
- Current carrying tests of a 3-m-long prototype in liquid nitrogen
- Bending and thermal cycling effects were minimal



- **FAIR** means "Friction stir welding, an Aluminum alloy jacket, Indirect cooling, REBCO tapes"
- Current carrying tests of 1-m-long prototype conductors in liquid nitrogen
- Optimization of production methods



- **WISE** means "Wound and Impregnated Stacked Elastic tapes"
- Current carrying tests of Non-Insulation (NI) coils in liquid nitrogen



SUMMARY

- D-D experiments of LHD successfully extended the high temperature domains for Ti and Te, and proved the confinement improvement. Studies on EC heated D plasma forming e-ITB, energetic particle confinement, and surface modifications of plasma facing components were enhanced.
- A series of simulation codes have been developed, improved and utilized. Operation of Plasma Simulator Raijin started to enhance the simulation research activity.
- Helical reactor design studies have progressed by adopting innovative concepts. R&Ds on basic technologies have proceeded using research facilities installed in NIFS including domestic and international collaborations.
- Technical investigation for the post-LHD project is progressing in NIFS and discussion by the community is being enhanced.

Evaluation viewpoint

the Division of Health and Safety Promotion

(1) Are the organizations and systems for safety and health management properly constructed and operated in compliance with relevant laws and regulations?

関連法令を遵守し、安全衛生管理のための組織、体制等を適切に構築し運用しているか。

(2) Are the safety management equipment / facilities, experimental equipment etc. for maintaining and managing safety taken into account for the characteristics and circumstances peculiar to fusion research?

安全を維持管理するための安全管理機器・設備、実験機器等は、核融合研究ならではの特徴・事情を考慮されたもとなっているか。

(3) Are manuals and rules such as operation manuals, radiation control manuals, and emergency manuals properly formulated and operated?

運転マニュアル、放射線管理マニュアル、緊急時マニュアル等のマニュアル類や規則類は、適切に策定され、運用されているか。

(4) As the Inter-University Research Institute, do you properly provide safety management and education to staff and collaborators?

大学共同利用機関として、所員及び共同研究者に対する安全管理・教育を適切に行っているか。

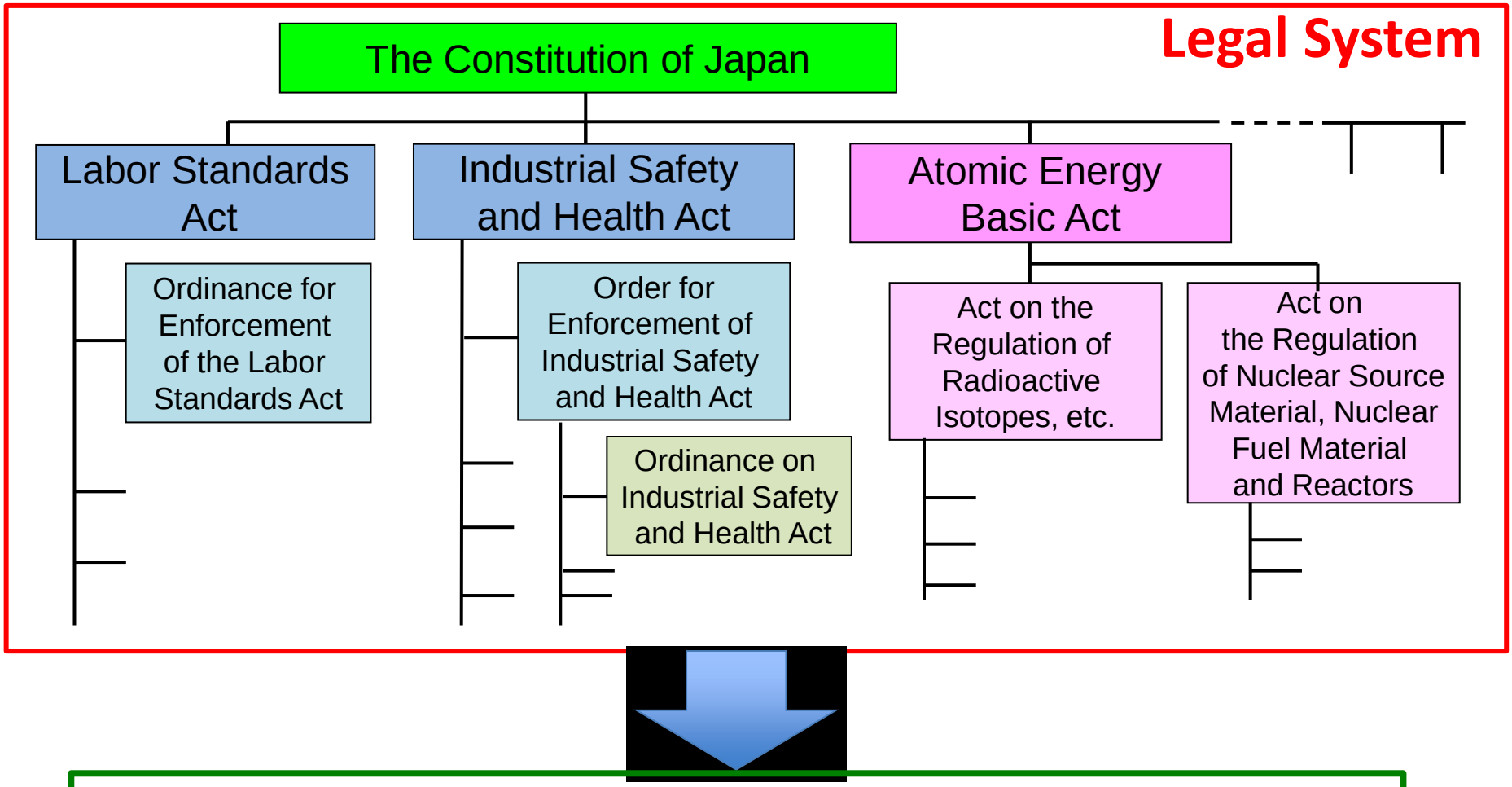
(5) Is the training of leaders to carry out safety management properly planned and implemented?

安全管理を遂行するための指導者の養成は適切に計画・実行されているか。

(1) Are the organizations and systems for safety and health management properly constructed and operated in compliance with relevant laws and regulations?

関連法令を遵守し、安全衛生管理のための組織、体制等を適切に構築し運用しているか。

Positioning of safety and health management



NIFS Regulations, Rules, Manuals

- Rules for Deuterium Experiment -

Act → **Ordinance** → **NIFS Regulation** → **NIFS Internal Rules** → **Manual etc.**

We establish internal rules and manuals before starting Deuterium experiment.

Applicable laws and regulations 1

- 労働基準法
  Labor Standards Act
- 労働基準法施行規則
  Ordinance for Enforcement of the Labor Standards Act
- 労働安全衛生法
  Industrial Safety and Health Act
- 労働安全衛生法施行令
  Order for Enforcement of Industrial Safety and Health Act
- 労働安全衛生規則
  Ordinance on Industrial Safety and Health

Applicable laws and regulations 2

・原子力基本法
　Atomic Energy Basic Act
・放射性同位元素等の規制に関する法律（ＲＩ規制法）
　Act on the Regulation of Radioactive Isotopes, etc.
・電離放射線障害防止規則（電離則）
　Regulation on Prevention of Ionizing Radiation Hazards
・核原料物質，核燃料物質及び原子炉の規制に関する法律
　Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors

・消防法
　Fire Service Act
・電気事業法
　Electricity Business Act
・クレーン等安全規則（クレーン則）
　Safety Ordinance for Cranes
・高圧ガス保安法
　High Pressure Gas Safety Act

Applicable laws and regulations 3

- 特定設備検査規則
- ボイラー及び圧力容器安全規則（ボイラー則）
- ゴンドラ安全規則
- 有機溶剤中毒予防規則（有機則）
- 鉛中毒予防規則（鉛則）
- 四アルキル鉛中毒予防規則
- 特定化学物質障害予防規則（特化則）
- 高気圧作業安全衛生規則
- 酸素欠乏症等防止規則
- 国際規制物資の使用等に関する規則
- 一般高圧ガス保安規則
- 特定設備検査規則
- 冷凍保安規則
- 危険物の規制に関する政令

Internal rules related to safety

○核融合科学研究所防災規則
NIFS Disaster Prevention Regulations
○核融合科学研究所電気保安規則
NIFS Electrical Safety Regulations
○核融合科学研究所安全衛生管理規則
NIFS Safety and Health Regulation
○核融合科学研究所放射線障害予防規程
NIFS Regulation on Prevention of Radiation Hazards
○核融合科学研究所イオンビーム解析装置の維持管理細則
NIFS Detailed Regulation on the Ion Beam Analyzer
○核融合科学研究所エックス線装置の維持管理細則
NIFS Detailed Regulation on the X-rays Device
○核融合科学研究所微量密封放射性同位元素等取扱細則
NIFS Detailed Handling Regulation on very small amount Sealed Radioisotope
○核融合科学研究所計量管理規定
NIFS Accounting Provisions
○核融合科学研究所放射線教育訓練実施細則
NIFS Detailed rules for Radiation Education and Training

Internal rules related to safety

○核融合科学研究所高圧ガス（一般）危害予防規則
○核融合科学研究所高圧ガス（冷凍）危害予防規則
○核融合科学研究所高圧ガス（冷凍）製造施設運用基準（冷暖房設備）
○核融合科学研究所高圧ガス（冷凍）製造施設運用基準（大型ヘリカル装置低温設備）

Internal rules related to safety

○核融合科学研究所危険物質管理規則

NIFS Hazardous Substance Management Regulation

○核融合科学研究所における廃液取扱いに関する規則

NIFS Regulation on Waste Liquid Handling

○核融合科学研究所大型ヘリカル装置真空維持管理規則

NIFS Regulation on the Vacuum Maintenance on LHD

○核融合科学研究所クレーン使用要項

NIFS Crane Usage Guidelines

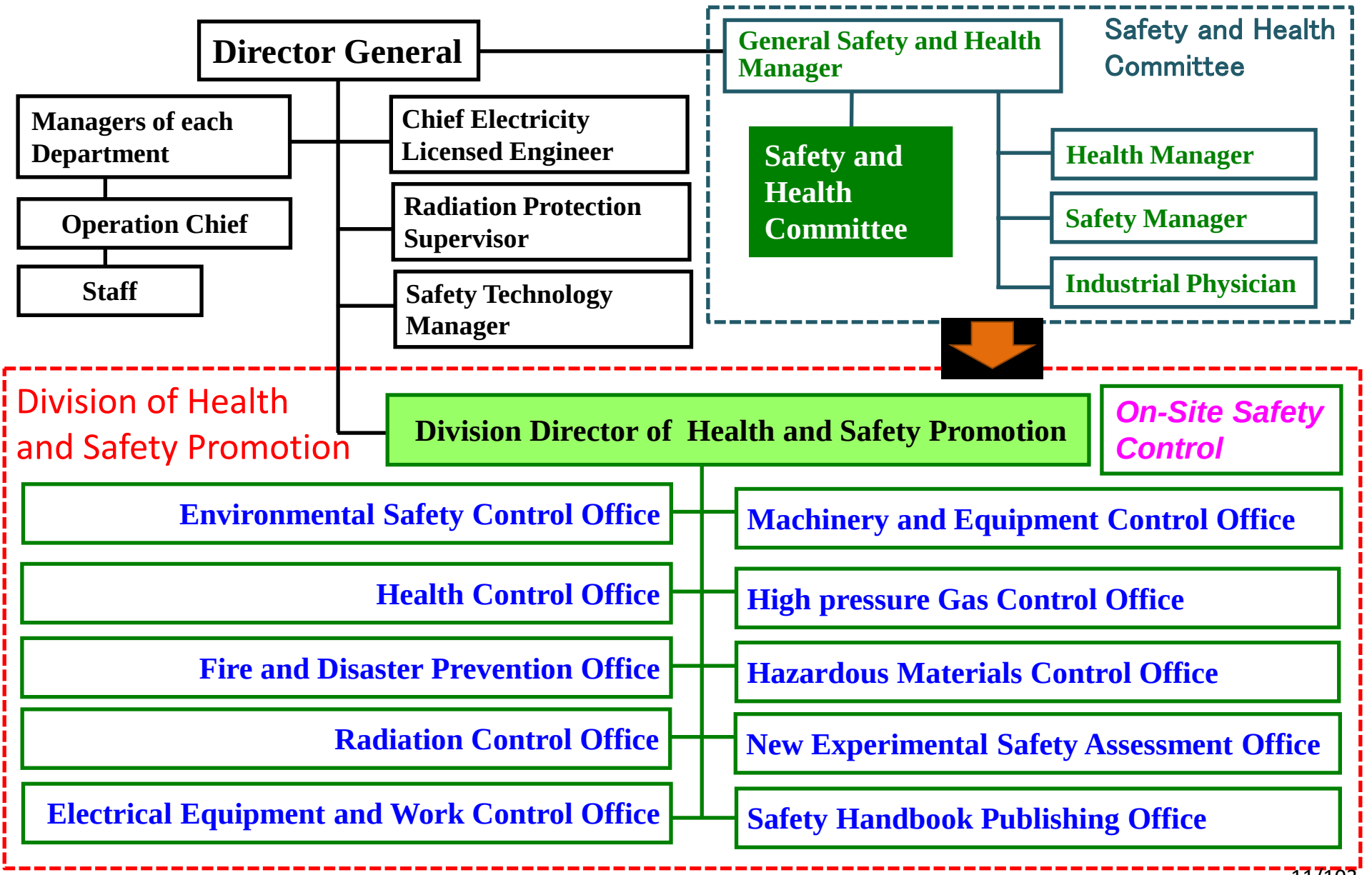
○核融合科学研究所実験装置等の維持管理細則

NIFS Detailed Regulation on the Vacuum Maintenance on LHD

○核融合科学研究所大型ヘリカル装置等の維持管理細則

NIFS Detailed Regulation on LHD and other Experimental Devices

- Structure of NIFS Safety Promoting Organization -



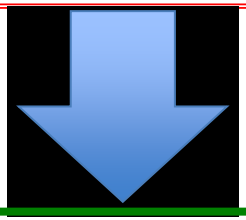
the Organization and the System for Safety Promotion

NIFS Safety Promoting Organization

- The National Institute for Fusion Science(NIFS) was re-established as a research institute of the National Institute of Natural Sciences(NINS) in April 2004.
- Director General organizes the Safety and Health Committee as a general safety and health manager based on the “Labor Standards Act“ and the “Industrial Safety and Health Act“.
- Committee Meeting is held once in a month and things about safety and health are discussed.
- The “Division of Health and Safety Promotion " was established as a department to solve various problems related to safety and health.

Purpose of activities of the Division of Health and Safety Promotion

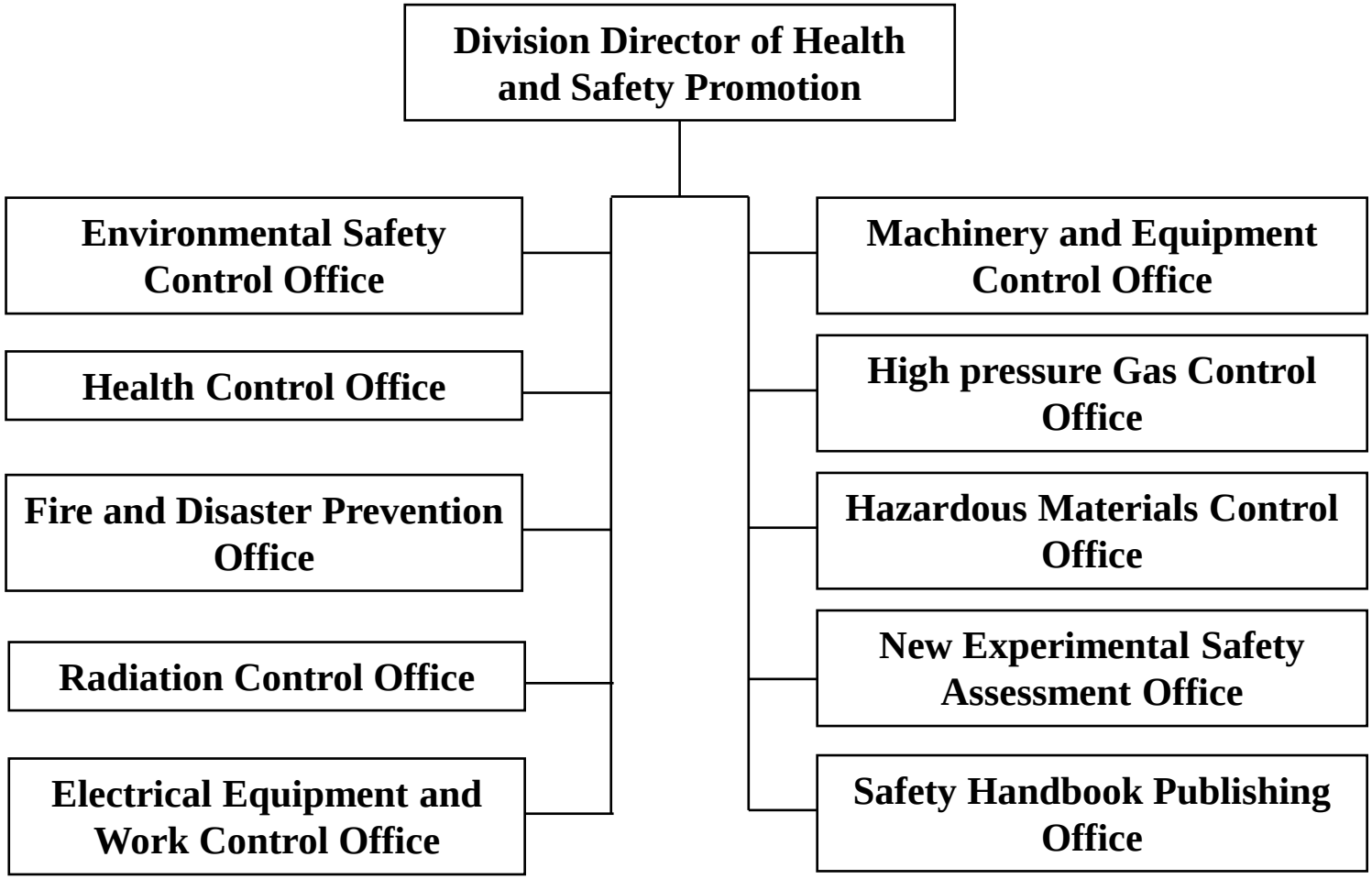
- ○ Prevention of occupational accidents
- ○ Proper equipment operation and maintenance
- ○ Ensuring the safety of staff and improving their health
- ○ Creating a comfortable working environment



There are 10 offices under the division director.
Each room is led by the chief.

Division for
Health and Safety Promotion

Division of Health and Safety Promotion



Main Activities

Routine works :

RI management,
environmental radiation measurement,
wastewater monitoring,
safety education and seminars,
issuance of safety handbooks,
disaster prevention drills,
safety patrols in working area.

Request from the Health and Safety Committee or individual experiment group :

Improvement of the indicated matter.

Member :

The members of each room are selected from the Research Department, Engineering Department, and Administration Department, who are appropriate for the work in each office.

Annual safety and health management plan

令和2年度　安全衛生管理計画

最終更新：2020/3/5

			責任者	2020/4月	5月	6月	7月	8月	9月	10月	11月	12月	2021/1月	2月	3月
全国行事				全国交通安全運動 (4/6-15)	禁煙週間 (5/31-6/6)	危険物安全週間 (6/7-13)	全国安全週間 (7/1-7)	防災週間 (8/30-9/5)	全国交通安全運動 (9/21-30)	全国労働衛生週間 (10/1-7)	火災予防運動 (11/9-15)	年末年始無災害運動 (12/15-1/15)		生活習慣病予防月間 (2/1-28)	全国火災予防運動 (3/1-7)
							上記準備期間 (6/1-30)	電気使用安全月間(8/1-31)	防災の日 (9/1)	上記準備期間 (9/1-30)					
							NIFS高圧ガス保安検査(7/6)		クレーンの日 (9/30)	高圧ガス保安活動促進週間(10/23-29)		プラズマ実験			
LHD実験期間(予定)										⇔		⇔		⇔	
委員会等			竹入	・安全衛生委員会(1回/月)											
			西村	・安全衛生推進部連絡会議(1回/月)											
安全・衛生管理	定期巡視		佐竹,田村,長谷川,曽我,近藤	・衛生管理者(1回/週)		*原則毎週金曜日13:30-とする。									
			水野	・産業医(1回/月)											
			関	・安全管理者(1回/月)					*原則毎月第4金曜日15:00-17:00とする。						
				改善確認巡視(適宜)											
	環境測定・講習等		西村	騒音等適時測定，安全講習会適時開催											
						東海・北陸地区国立大学法人等安全衛生担当者連絡会(6/一)								労働安全衛生に関する情報交換会(2月初旬)	
	廃棄物処理・回収	危険物	野村	一般廃棄物一般廃棄物は可燃：2回/週　不燃：1回/月											
				産業廃棄物産業廃棄物は1回/3ヶ月　(その他必要に応じ)											
	防災対策	防火・防災	白髭						普通救命講習会 全体防災訓練				LHD関係消火訓練	普通救命講習会 消防立入検査	
教育	講習	電気設備	宮田		低圧安全教育		高圧安全教育		低圧安全教育	高圧安全教育			高圧安全教育		
		機械設備	土伏	クレーン安全衛生教育(愛知,岐阜クレーン教習所)　数名											
		KYT講習等	成嶋	KYTトレーナー(適宜)											
		安全講習会	佐瀬		第1回(4/24),第2回(5/14),第3回(5/22),その他必要に応じて数回開催予定										
		放射線	林(浩)	放射線新規教育・・1回/月(但し,受講者があれば適時実施)											
				放射線更新教育・・2回/年(但し,未受講者には適時実施)										第1回	第2回
		高圧ガス関係	三戸	保安係員講習会・・・年2回(法定講習)			第1次,第2次,第3次(高圧ガス保安協会)4名						第1次,第2次(高圧ガス保安協会)		
				保安教育講習会　講習会(一)						一般高圧ガス,冷凍機械(岐阜県庁)					
				定期検査・点検要項の教育											岐阜県庁
	資格取得	機械設備	土伏	床上操作式クレーン運転技能講習　(岐阜クレーン教習所,半田クレーン教習所,多治見大原自動車学校)数名　数回／年											
				玉掛技能講習(岐阜クレーン教習所,半田クレーン教習所,多治見大原自動車学校)　数名　数回／年											
				クレーン運転免許(岐阜クレーン教習所,半田クレーン教習所,多治見大原自動車学校)数名　数回/年											
		放射線(取扱主任者)	林(浩)		ラジオアイソトープ安全取扱講習会(未定)			試験(8月下旬)		第1種放射線取扱主任者講習　数名　12回/年					
		環境安全	成嶋	酸素欠乏・硫化水素危険作業主任者技能講習等　毎月開催											
		冷凍機械(第1種)	三戸	講習会(年1回)及び法令試験(年1回)											
				講習会	検定						法令試験				
		一般高圧ガス(乙種　機械・化学)	三戸	講習会(年2回)及び法令試験(年1回)	冷凍機械講習会第1，第2，第3									講習会機械・化学(2月頃)	
					乙種機械講習会						法令試験				
		特定高圧ガス		講習会(年3回)	講習会			講習			講習				
		第一種衛生管理者	西村	第一種衛生管理者試験　毎月開催　数名											
保健衛生	健康診断	健康管理室	西尾(尚)	(一般定期健診)	学生(5/21)・中途採用者(随時)						職員(11/24,25)				
				(特定特殊健診)	職員・学生(5/20,21)・中途採用者(随時)						職員・学生(11/24,25)				
	保健指導	健康管理室(産業医)	水野	健康診断結果に基づく指導(随時)											
	メンタルヘルス	健康管理室(産業医)	西尾(尚)	産業医による健康相談(1回/月),メンタルヘルスカウンセリング(2回/月)・Web相談,電話相談(随時)											
						健康づくり講演会							メンタルヘルス講習会		

1. Environmental Safety Control Office

Roles

This office has the responsibility to maintain a safe work space and environment. Although the other nine offices of the division of health and safety promotion cover most of the risks that exist in the institute, some problems fall wide of them. The role of this office is to cope with such problems. Therefore, this office has a broad range of tasks.

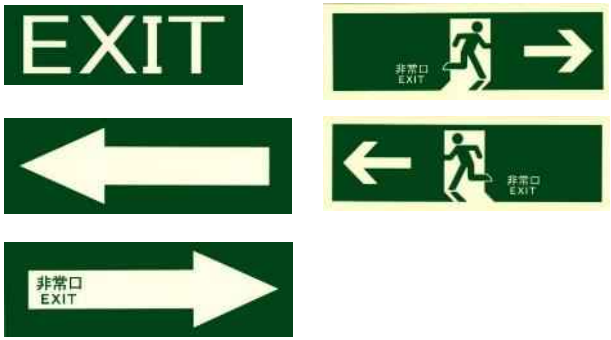
Main roles of this office are as follows;

- Management to solve the problems pointed out by the safety and health committee.
- Maintenance of the card-key system for the gateways of controlled areas.
- Maintenance and management of the vehicle gate at the entrance of the experimental zone.
- Maintenance of the fluorescent signs of the evacuation routes and the caution marks.
- Management of sewage drainage from the NIFS.
- Accompany the inspections by the Safety Manager.
- Other matters related to general safety and health.

1. Environmental Safety Control Office

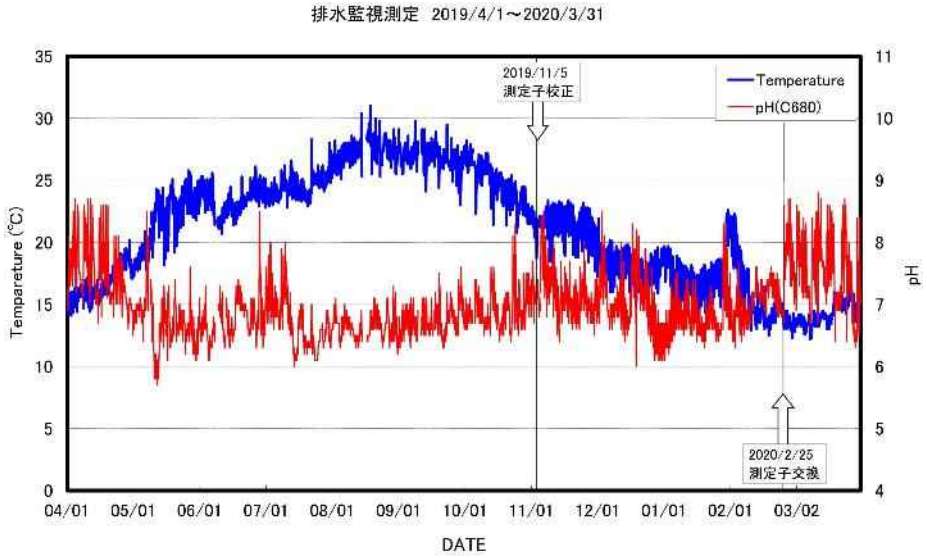
Examples of activities

Light charged Leading Plate



Caution marks

Data on sewage drainage



Component analysis table of sewage wastewater

採取場所：汚水排水槽
採取日時：令和2年1月28日
採取分析：藤吉工業(株)

基準値*：下水法(特定事業所)
＊H14年3月現在

分析項目	単位	測定結果	定量下限値	基準値
温度	℃	19.0		45
pH		7.1		5.0-9.0
生物化学的酸素要求量(BOD)	mg/l	57	0.5	600
浮遊物質量SS	mg/l	14	1	600
ヘキサン抽出物質動植物油脂	mg/l	1	1	30
鉱物油	mg/l	1未満	1	5
フェノール類	mg/l	0.025未満	0.025	5
銅およびその化合物	mg/l	0.01未満	0.01	3
亜鉛およびその化合物	mg/l	0.27	0.01	5
溶解性鉄およびその化合物	mg/l	0.1未満	0.1	10
溶解性マンガンおよびその化合	mg/l	0.1未満	0.1	10
クロムおよびその化合物	mg/l	0.04未満	0.04	2
フッ素化合物	mg/l	0.1	0.1	8
全水銀	mg/l	0.0005未満	0.0005	0.005
カドミウム及びその化合物	mg/l	0.003未満	0.003	0.1
シアン化合物	mg/l	0.1未満	0.1	1
有機リン化合物	mg/l	0.1未満	0.1	1
鉛及びその化合物	mg/l	0.01未満	0.01	0.1
六価クロム化合物	mg/l	0.04未満	0.04	0.5
砒素及びその化合物	mg/l	0.01未満	0.01	0.1
アルキル水銀	mg/l	検出されず	0.0005	検出されず
PCB	mg/l	0.0005未満	0.0005	0.003
全窒素	mg/l	24	0.1	240
全リン	mg/l	2.2	0.01	32
沃素消費量	mg/l	11	0.5	220
トリクロロエチレン	mg/l	0.001未満	0.001	0.3
テトラクロロエチレン	mg/l	0.001未満	0.001	0.1
ジクロロメタン	mg/l	0.002未満	0.002	0.2
四塩化炭素	mg/l	0.0002未満	0.0002	0.02
1,2-ジクロロエタン	mg/l	0.0004未満	0.0004	0.04
1,1-ジクロロエチレン	mg/l	0.002未満	0.002	0.2
シス-1,2-ジクロロエチレン	mg/l	0.004未満	0.004	0.4
1,1,1-トリクロロエタン	mg/l	0.001未満	0.001	3
1,1,2-トリクロロエタン	mg/l	0.0006未満	0.0006	0.06
1,3-ジクロロプロペン	mg/l	0.0002未満	0.0002	0.02
ベンゼン	mg/l	0.001未満	0.001	0.1
シマジン	mg/l	0.0003未満	0.0003	0.03
チオベンカルブ	mg/l	0.002未満	0.0002	0.2
チウラム	mg/l	0.0006未満	0.0006	0.06
セレン及びその化合物	mg/l	0.01未満	0.01	0.1
ほう素およびその化合物	mg/l	1未満	1	10
アンモニア化合物、硝酸・亜硝酸性窒素	mg/l	8.1		125
1,4-ジオキサン	mg/l	0.005未満	0.005	0.5
ダイオキシン 注1)	pg/l			10

1. Environmental Safety Control Office

Hiyari-Hatto (near miss accident)
Report Page on WEB

場　　所	ど ん な 内 容	考えられる対策
本体室	フランジ作業　ヘルメットをぬいだ、Lポート 頭をLIDコイルサポートにぶつけた。	どんなときもヘルメット、つばの小さいヘルメットを買う
本体棟	Lぽーとでせまかったのでヘルメットを脱いだ、LIDコイルサポートに 頭をぶつけた。けがはなかった。	ヘルメットをぬがない、つばの小さいヘルメットを買う
管理棟3Fから研究棟3Fへの廊下（管理部長室？の前）	コーナー部が2か所連続であり、対向者とぶつかりそうになったことがある。	カーブミラーの設置で、対向者を予測できるようにすることが効果的と思います。
計測機器室（2）	本体棟1Fの計測機器室（2）への入出口のドアは、防火対策のため、常時、閉である。そのため、ドアの反対側にいる人に気づくことができない。しばしば、両側から同時にドアにアクセスすることがあり、突き指しそうになる。	現在のドアに小窓をつけてもらいたい。見学者のルートでもあるため、東側(液化器室)と西側(本体室側)の両方に対策してもらいたい。

2. Health Control Office

Roles

The main role of this office is to keep the workers in the institute healthy, including co-researchers and students.

Main roles of this office are as follows;

- Medical checkups both for general and special purposes and immunization for influenza.
- Accompany the inspections by the Industrial Physician.
- Maintenance of AEDs.
- Alerts and response to the COVID-19.
- Conduct the online stress check.
- Conduct various lectures for physical and mental health..

* *Special medical checkups are provided to visiting co-researchers and graduate students when necessary.*

3. Fire and Disaster Prevention Office

Roles

To prevent or minimize damages caused by various disasters including earthquakes, storms, fires and accidents, as well as of providing restoration work after such damages.

Main roles of this office are as follows;

- Making self-defense plans for fires and disasters, and implementation of various training.
- Promotion of first-aid workshops and the AED class.
- Maintenance of fire-defense facilities and attending on-site inspections by a local fire department.
- Review and update disaster prevention rules and disaster prevention manuals.
- Attending at on-site inspections by a local fire department once a year.
- Maintaining fire-defense facilities twice a year.
- Improvement of the surrounding environment such as weeds and fallen trees.

3. Fire and Disaster Prevention Office

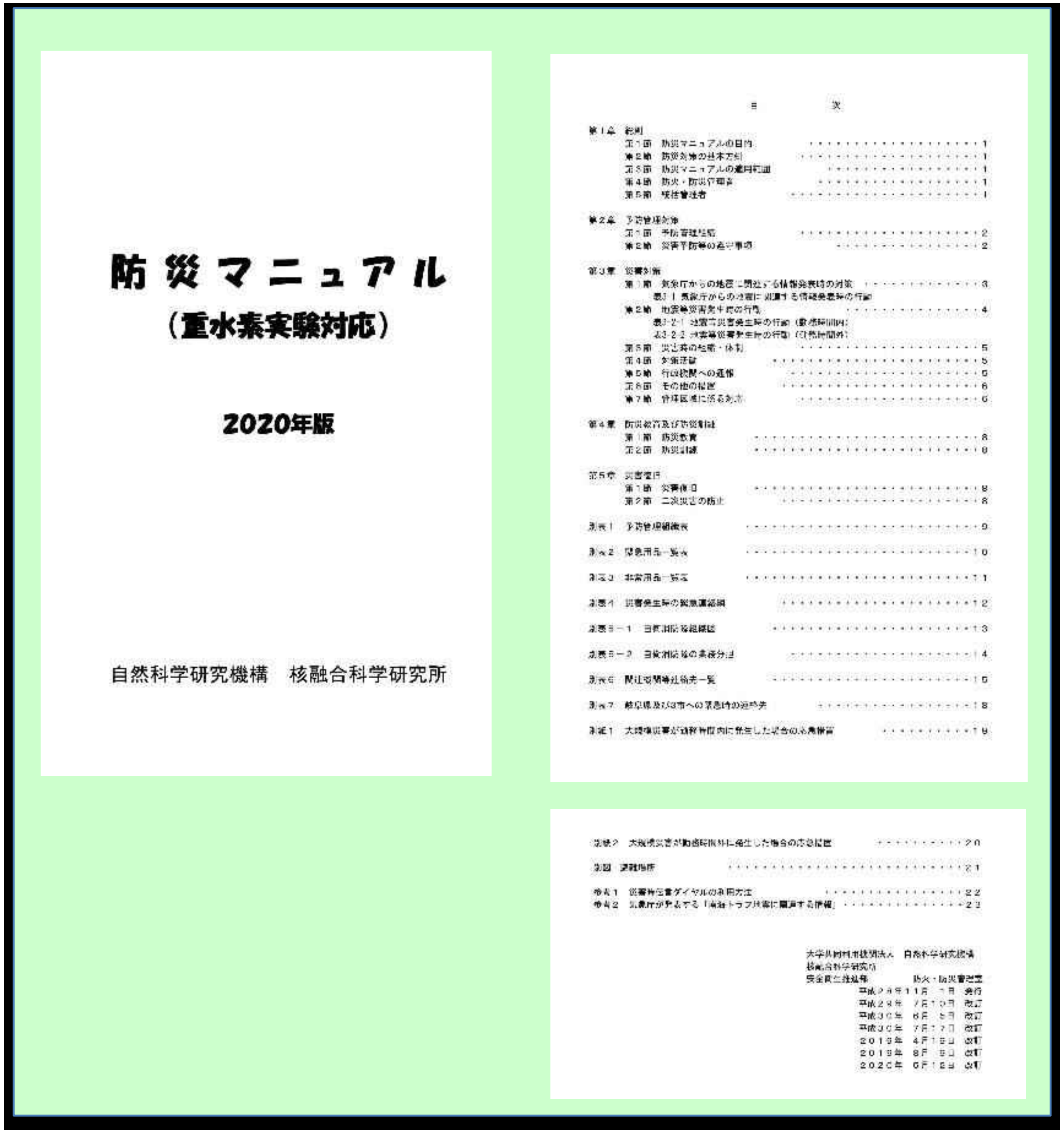
Examples of activities

General emergency drill

Pivotal work at the disaster prevention center.

Fire extinguisher training.

3. Fire and Disaster Prevention Office



緊急連絡先（Emergency Contact）

■防災センター（Disaster Control Center）
内線（Extension）：1111
外線（Outside Call）：0572−58−2070

■門衛所（Guard Station）
内線（Extension）：2071

■制御室（Control Room）
内線（Extension）：2445

■消防署（Fire Department）
外線（Outside Call）：119

Emergency Contact Information

4. Radiation Control Office

Roles

The main role of this office is to maintain radiation safety for researchers and the environment. Legal procedures for radiation safety and regular education for the radiation area workers are also important roles of this office.

Main roles of this office are as follows;

- Maintain radiation safety for the workers.
- Registration and dose control of radiation area workers.
- Radiation monitoring in the radiation controlled area and the peripheral area.
- Maintenance of the radiation monitor.
- Applications for radiation equipment to the national agencies and the local governments.
- Always review existing rules and revise them if necessary.
- Held the educational lectures for all workers including the co-researchers and students.

* Non-Japanese workers can be educated and trained in English.

4. Radiation Control Office

Educational lecture

The educational lecture was held on February 21, 2020.

* Until last year, three educational lectures in a year were held at the big meeting room.

For those who have not attended this lecture, it is possible to view the DVD of the lecture and submit a report.

Non-Japanese workers can be educated and trained in English.

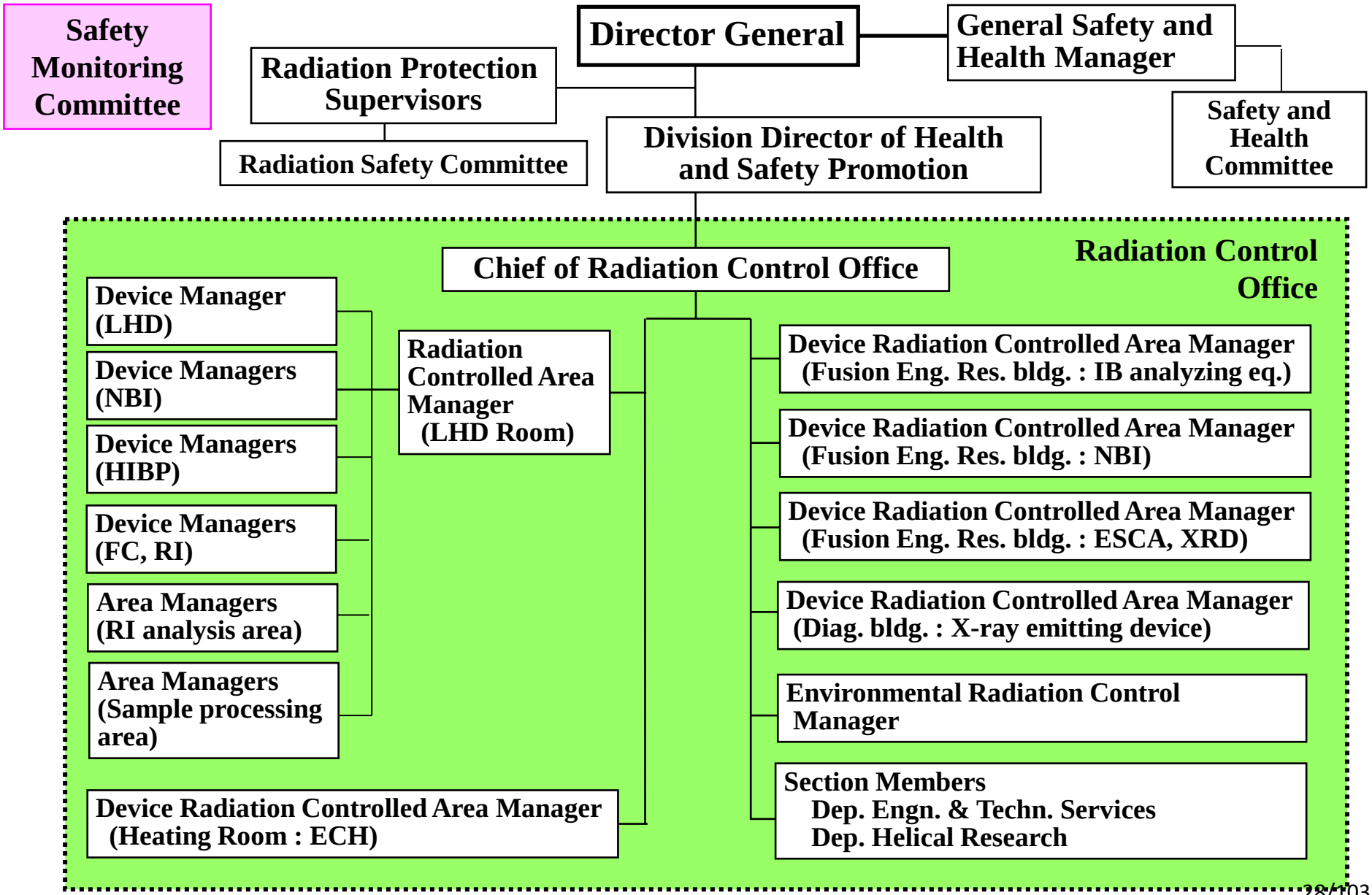
NIFS Radiation Safety System

Radiation Control office was expanded to deal with the deuterium experiment performs the administrative.

The Safety Monitoring Committee is organized by the local government as a third party organization independent of NIFS, and performs monitoring about the security of the deuterium experiment.

After the deuterium experiment begins, **the Monitoring of various apparatuses, facilities is performed for 24 hours** in a whole year.

- Radiation Control Organization -



Radiation Worker Registration

Number of NIFS Radiation Worker

Fiscal year	NIFS	non-NIFS	Total (non-Japanese)
2015	166	84	250 (11)
2016	174	132	306 (18)
2017	164	180	344 (15)
2018	177	204	381 (15)
2019	172	213	385 (13)

Registration Procedure

Submit a registration form → Get a medical check → Education and Training

From FY-2009 non-NIFS worker without registration as radiation worker in his university can get a medical check in NIFS.

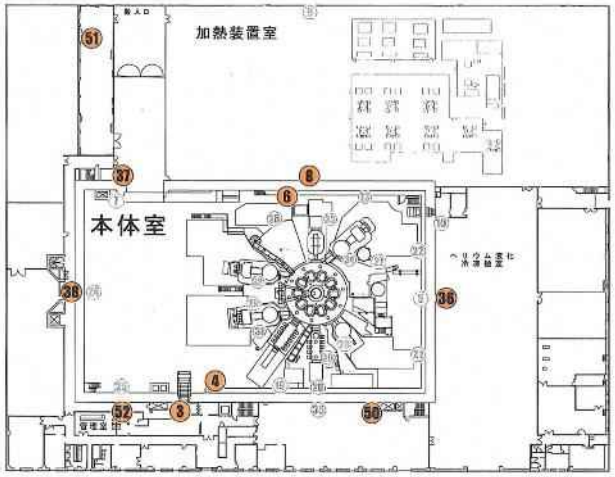
For new non-Japanese worker can be educated and trained in English.

For renewal registration, worker can be educated with using the DVD-video source.

→ Send a Permission

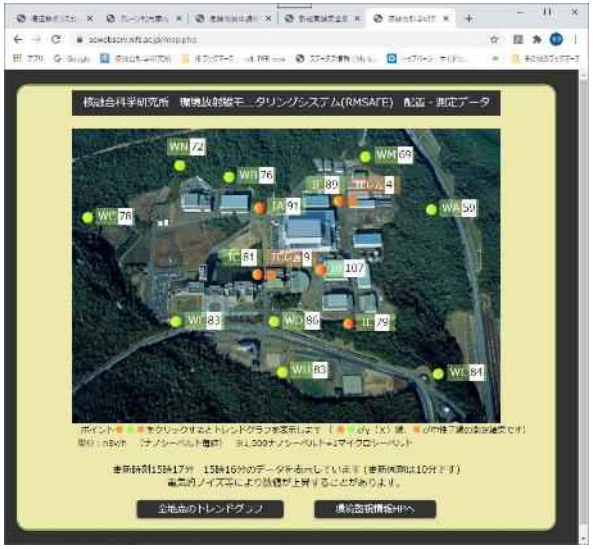
Receive a Lumines Badge

Measurements of Environmental Radiation Dose



No	測定場所	No	測定場所	No	測定場所	No	測定場所
1	屋上	16	本体室地下南	42	地下1F搬出入室 西	50	計測機器室（2）
3	本体室入口正面	18	計測機器室2F北	43	地下加熱トレンチ	51	試料加工室
4	本体室入口内側	36	本体室外側 東	44	貯蔵室（2）	52	入退管理室
6	ヤットウォーク北壁中	37	大型搬入口西 外側	45	コイル電源室（2）	53	貯蔵室（1）
8	加熱装置室南	38	本体室外側 西	46	空調機械室（1）	54	排水積置場
11	コイル電源室（1）南	39	計測器調整室	47	測定室（3）	55	保管廃棄室（2）
12	コイル電源室（1）北	40	カマック室	48	共同溝	56	線源保管エリア
14	本体室地下北	41	保管廃棄室（1）	49	計測機器室（1）		

Example of the data sheet of radiation measurement points around the LHD. Measurement is done once a week.



Continuous measurement around the NIFS site by RMSAFE system

Every three months measurement in and around the NIFS site.

Environmental radiation dose have been measured by the Electrical Dosimeter and the Radio-photo Luminescence Dosimeter.

5. Electric Equipment and Work Control Office

Roles

The main role of this office is to maintain electrical safety for researchers, technical staff members and students.

Main roles of this office are as follows;

- Check and control the electrical facilities according to the technical standards.
- Accompany the inspections by the Safety Manager.
- Safety lecture for researchers and workers.
- Annual check of electrical equipment with blackout.
- Discussion with commercial electric power supplier.

6. Machinery and Equipment Control Office

Roles

The main role of this office is to maintain the safe operation of cranes.
Main roles of this office are as follows;

- Inspection and maintenance of cranes.
- Management of the crane license holders and safety lectures for the crane users.
- Schedule management of crane operations.
- Safety lecture for researchers and workers.

6. Machinery and Equipment Control Office

Number of crane in NIFS　Total:34

Cab operation type :8（>3ton）→ (Wireless operation :3)

Floor operation type（>3ton）:　5

Floor operation type（<3ton）:20

Number of NIFS crane license holder

Crane pilot	44
Floor-operated crane pilot	59
Slinger	100

7. High Pressure Gas Control Office

Roles

This office has a very important role in NIFS, because the main experimental machine, LHD, is the superconducting machine which requires cooling by liquid helium. And many other machines have cryogenic pumping systems which require cooling down.

Main roles of this office are as follows;

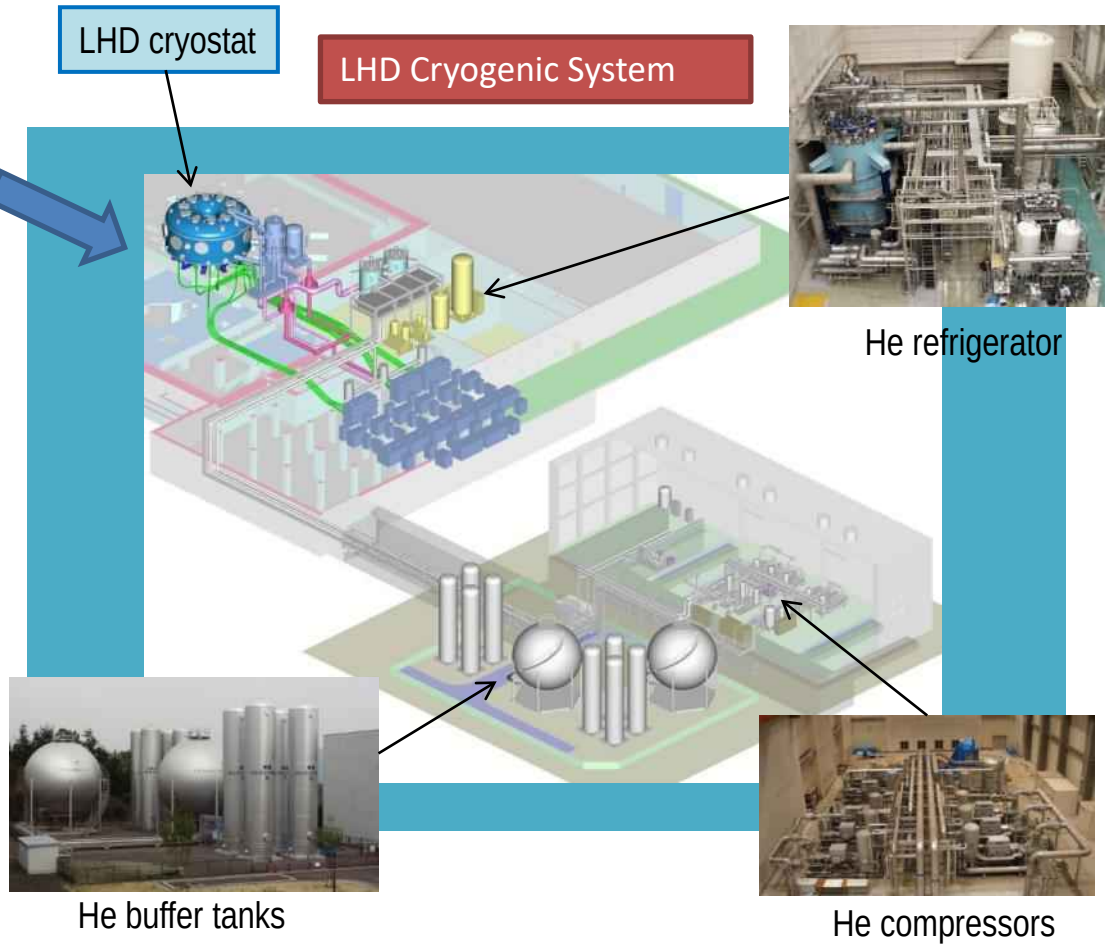
- Safety operation and maintenance of high-pressure gas handling facilities (LHD cryogenic system, diborane gas supply facility, etc.) in NIFS.
- Daily operation, maintenance, system improvement, and safety education according to the law.
- Safety lectures for researchers and workers.

Safety training

The security staff must take the security staff training in accordance with the law. (Usually once every 5 years)

7. High Pressure Gas Control Office

- High pressure gas control office
  - Cryogenic facilities for LHD superconducting system
  - Diborane gas supply facility
  - LN_2 storage /supply facility for LHD NBI system
  - Cryogenic facility for superconducting magnet research laboratory
  - LN_2 storage/supply facility for plasma diagnostic laboratory
  - LN_2 storage /supply facility for fusion engineering research laboratory
  - Refrigeration facility for fusion engineering research laboratory



High pressure gas safety Inspection

Year	2016	2017	2018	2019	2020
Date	July-20	July-7/ Nov.-10	July-20	July-20	Aug.-17

8. Hazard Materials Control Office

Roles

The main role of this office is the management of the safe treatment of hazardous materials and maintaining safety for researchers against hazardous events.

- Research the requests for hazardous materials and the storage status.
- Management to ensure safe storage of the waste.
- Monitoring of cooling drainage to prevent water pollution.
- Implementation of chemical substance risk assessment.
- Perform procedures to outsource the treatment of waste and waste liquid to a contractor.

Number of hazardous substances handled

Fiscal Year	Number of Obtain Request	Number of Disposal Request	Number of Spent	Waste liquid treatment amount (kg)
2015	277	127	100	-
2016	199	77	203	-
2017	246	146	414	1605.1
2018	339	99	247	1492.8
2019	281	76	218	1024.6

8. Hazard Materials Control Office

User

Obtain

Disposal

Request to Obtain

Tag

Use

Request to Stock

(Waste Oil & Waste Water)

Hazardous substances storage area supervisor

Hazardous substances storage area

When the stored quantities are large
When there is concern over safety in storage

Disposal

Move

Request to Move

Hazardous substances storage area

Hazardous materials storage

Storage

Waste Oil & Waste Water

Waste management Special trader

9. New Experimental Safety Assessment Office

Roles

The main role of this office is to check the safety of experimental devices other than LHD. For this purpose, researchers who want to setup new experimental apparatus must apply for the safety review. Two reviewers are assigned from members of this office and other specialists. They check the safety of these devices.

- Examine new experiments for safety problems and advise on safety measures.
  * New experiments in LHD are reviewed by the LHD Experiment Group.
- Improve safety in each experiment and reinforce the safety culture at NIFS by annual reviews by users. Therefore, each device needs to be applied for (updated) every year.

9. New Experimental Safety Assessment Office

Inspection of New applications:

- Researchers who want to setup new experimental apparatus apply for the safety review.
- Two reviewers are assigned from members of the Office and other specialists.
- The safety review is done with the applicant. Decisions are made in meetings of the Office.
- If the equipment is judged to be safe, a registration certificate is issued to the applicant and his division director.

** If he wishes to experiment with deuterium, dosimetry by the Radiation Control Office is required.*

Update of applications:

- The Office requests the researchers to check the safety of their existing experimental apparatus.
- The judgment is made at the Office meeting. If the check sheet does not pass the safety review, the applicant is notified and a new application will be required.
- If the update is approved, a registration certificate is issued to the applicant.

9. New Experimental Safety Assessment Office

連番	登録番号	実験装置名	実験場所	初回登録日	更新終了日	重水素
2	開発-005	電子－イオン衝突実験装置（ACE-IT II）	開発実験棟 1階実験室(1)北側	20041029	20200611	
3	開発-006	NICE実験装置（多価イオン－原子衝突実験装置	開発実験棟 1階実験室(1)北側	20041029	20200611	
5	開発-012	表面改質試験装置（SUT）	開発実験棟 2階実験室(3)	20041029	20200619	重水素
7	開発-014	重イオンビームプローブ用テストスタンド	開発実験棟 2階実験室(5) E6・206	20041029	20200612	
17	計測-004	化学形別大気中水素成分捕集装置	計測実験棟 2階環境物質測定室	20041029	20200612	
18	計測-006	HIBPタリウムイオンテストスタンド	計測実験棟 HIBP計測実験室	20041029	20200612	
19	計測-007	HIBP 100 kV加速器	計測実験棟 HIBP計測実験室	20041029	20200612	
25	超伝-007	中型導体試験装置	超伝導マグネット研究棟 主実験室	20041029	20200601	
27	超伝-009	直流電源装置	超伝導マグネット研究棟 主実験室	20041029	20200601	
29	超伝-011	9T磁場発生装置	超伝導マグネット研究棟 主実験室	20041029	20200601	
32	超伝-014	パルス管冷凍機実験装置	超伝導マグネット研究棟 主実験室	20041029	20200612	
33	超伝-015	超伝導コイル試験装置（大型超伝導導体試験装	超伝導マグネット研究棟 主実験室	20041029	20200612	
37	超伝-020	汎用小型低温実験装置	超伝導マグネット研究棟 主実験室,	20041029	20200601	
39	超伝-022	[illegible]	[illegible] 研究棟 精密試験	20041029	[illegible]	
66	総合-039	イオンビーム加速器	総合工学実験棟	20141017	20200615	重水素
67	総合-040	ACT2	総合工学実験棟	20150109	20200615	重水素
13	開発-028	電気対流乱流実験用回転ステージ2号機	開発実験棟 2階実験室(3)	20150717	20200525	
69	総合-042	クリープ試験機	総合工学実験棟	20150717	20200615	
70	総合-043	イメージ炉	総合工学実験棟	20150717	20200619	
76	本体-002	昇温脱離ガス分析装置	大型ヘリカル実験棟 試料加工室	20150717	20200615	重水素
71	総合-044	熱・物質流動ループ Orohhi-2	総合工学実験棟	20150915	20200617	重水素
14	開発-029	低融点金属循環装置	開発実験棟 1階実験室(2)	20171115	20200611	
15	開発-030	汎用真空実験チャンバ	開発実験棟 1階実験室(2)	20171115	20200611	
72	総合-045	HF腐食実験装置	総合工学実験棟	20180220	20200617	
78	工務-002	放出ガス測定装置	工務棟 ガラス工作室	20180831	20200611	
79	計測-019	学生教育実験用プラズマ発生装置	計測実験棟 大実験室	20181002	20200612	
80	開発-031	イオン源試験用真空チャンバー	開発実験棟 第5実験室西側エリア	20190123	20200525	
81	総合-047	多目的高温炉（ハイマルチ5000）	総合工学実験棟 大実験室	20190307	20200612	
82	計測-020	ヘルムホルツコイル磁気遮蔽試験装置	計測実験棟 1階第実験室	20190313	20200612	
85	総合-049	液体金属及び溶融塩腐食試験装置	総合工学実験棟 試料作製室	20200213	20200615	
86	総合-050	Orosshi-2強磁場下FLiNaK伝熱特性試験部	総合工学実験棟 大実験室	20200325	20200617	

9. New Experimental Safety Assessment Office

連番	登録番号	実験装置名	実験場所	初回登録日	更新終了日	重水素
2	開発-005	電子－イオン衝突実験装置（ACE-IT II）	開発実験棟 1階実験室(1)北側	20041029	20200611	
3	開発-006	NICE実験装置（多価イオン－原子衝突実験装置	開発実験棟 1階実験室(1)北側	20041029	20200611	
5	開発-012	表面改質試験装置（SUT）	開発実験棟 2階実験室(3)	20041029	20200619	重水素
7	開発-014	重イオンビームプローブ用テストスタンド	開発実験棟 2階実験室(5) E6・206	20041029	20200612	
17	計測-004	化学形別大気中水素成分捕集装置	計測実験棟 2階環境物質測定室	20041029	20200612	
18	計測-006	HIBPタリウムイオンテストスタンド	計測実験棟 HIBP計測実験室	20041029	20200612	
19	計測-007	HIBP 100 kV加速器	計測実験棟 HIBP計測実験室	20041029	20200612	
25	超伝-007	中型導体試験装置	超伝導マグネット研究棟 主実験室	20041029	20200601	
27	超伝-009	直流電源装置	超伝導マグネット研究棟 主実験室	20041029	20200601	
29	超伝-011	9T磁場発生装置	超伝導マグネット研究棟 主実験室	20041029	20200601	
32	超伝-014	パルス管冷凍機実験装置	超伝導マグネット研究棟 主実験室	20041029	20200612	
33	超伝-015	超伝導コイル試験装置（大型超伝導導体試験装	超伝導マグネット研究棟 主実験室	20041029	20200612	
37	超伝-020	汎用小型低温実験装置	超伝導マグネット研究棟 主実験室,	20041029	20200601	
39	超伝-022	[illegible]	[illegible] 研究棟 精密試験	20041029	[illegible]	
66	総合-039	イオンビーム加速器	総合工学実験棟	20141017	20200615	重水素
67	総合-040	ACT2	総合工学実験棟	20150109	20200615	重水素
13	開発-028	電気対流乱流実験用回転ステージ2号機	開発実験棟 2階実験室(3)	20150717	20200525	
69	総合-042	クリープ試験機	総合工学実験棟	20150717	20200615	
70	総合-043	イメージ炉	総合工学実験棟	20150717	20200619	
76	本体-002	昇温脱離ガス分析装置	大型ヘリカル実験棟 試料加工室	20150717	20200615	重水素
71	総合-044	熱・物質流動ループ Orohhi-2	総合工学実験棟	20150915	20200617	重水素
14	開発-029	低融点金属循環装置	開発実験棟 1階実験室(2)	20171115	20200611	
15	開発-030	汎用真空実験チャンバ	開発実験棟 1階実験室(2)	20171115	20200611	
72	総合-045	HF腐食実験装置	総合工学実験棟	20180220	20200617	
78	工務-002	放出ガス測定装置	工務棟 ガラス工作室	20180831	20200611	
79	計測-019	学生教育実験用プラズマ発生装置	計測実験棟 大実験室	20181002	20200612	
80	開発-031	イオン源試験用真空チャンバー	開発実験棟 第5実験室西側エリア	20190123	20200525	
81	総合-047	多目的高温炉（ハイマルチ5000）	総合工学実験棟 大実験室	20190307	20200612	
82	計測-020	ヘルムホルツコイル磁気遮蔽試験装置	計測実験棟 1階第実験室	20190313	20200612	
85	総合-049	液体金属及び溶融塩腐食試験装置	総合工学実験棟 試料作製室	20200213	20200615	
86	総合-050	Orosshi-2強磁場下FLiNaK伝熱特性試験部	総合工学実験棟 大実験室	20200325	20200617	

10. Safety Handbook Publishing Office

Roles

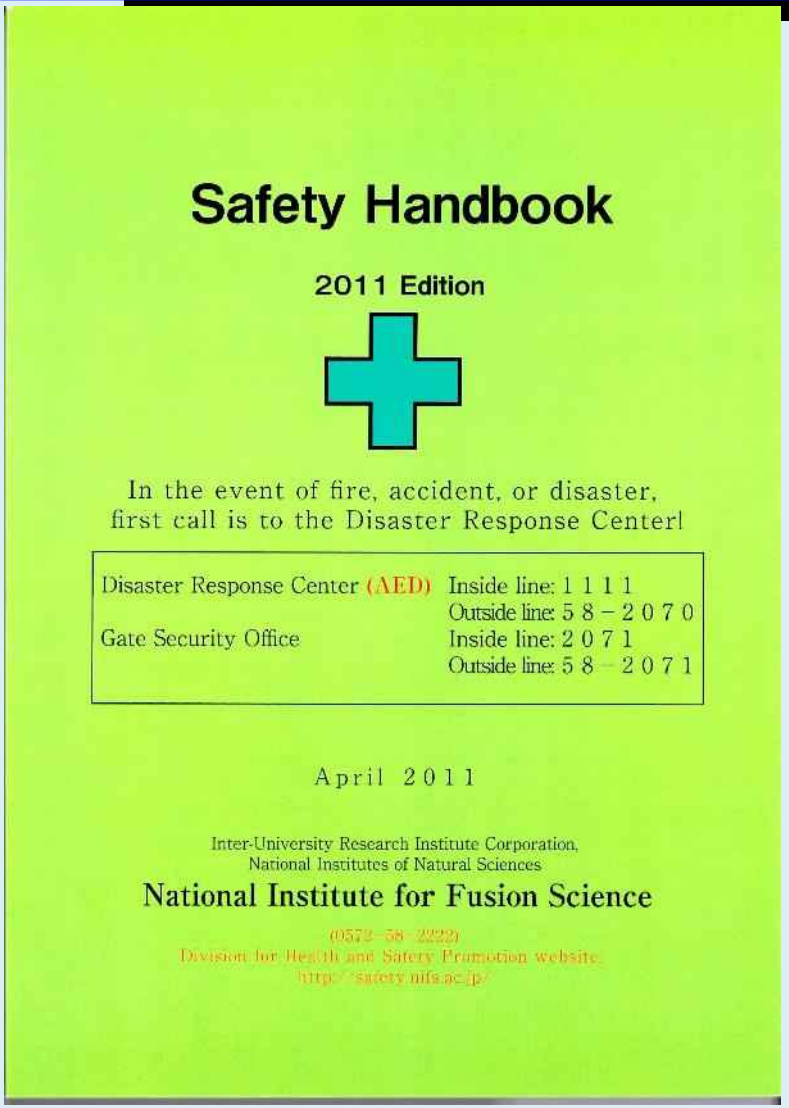
The tasks of this office are publication of the Safety Handbook in Japanese and in English and to update them as necessary.
Main roles of this office are as follows;

- Publication of the Safety Handbook in Japanese and in English and to update them as necessary.
- Held the safety lecture for all workers including the co-researchers and students.

Safety Lecture

The regular safety lectures were held on May 4, 2020 .
As an alternative course for those who have not attended this lecture, we offer viewing the lecture DVD and submitting a report.

10. Safety Handbook Publishing Office



Safety Handbook

2011 Edition

In the event of fire, accident, or disaster,
first call is to the Disaster Response Center!

Disaster Response Center (AED)	Inside line: 1111 Outside line: 58-2070
Gate Security Office	Inside line: 2071 Outside line: 58-2071

April 2011

Inter-University Research Institute Corporation,
National Institutes of Natural Sciences

National Institute for Fusion Science

(0572-58-2222)
Division for Health and Safety Promotion website:
http://safety.nifs.ac.jp/

安全ハンドブック

重水素実験対応
第３版
（所外配布版）

火災・事故・災害などの連絡は、まず防災センターへ！

防災センター	内線　1111 外線　0572-58-2070
門　衛　所	内線　2071 外線　0572-58-2071

大学共同利用機関法人 自然科学研究機構
核融合科学研究所

安全衛生推進部ホームページ：http://safety2.nifs.ac.jp/（所内限定）

http://safety2.nifs.ac.jp/handbook/handbook_out_20200611.pdf

Contents of Safety Handbook (English version)

1 Emergency Response
①Fires, ②Earthquakes, ③NIFS Disaster Response Team , ④Emergencies, ⑤Hospital Phone Numbers, ⑥Emergency Contact Network,

2 Safety Maintenance General Principles
①General Principles, ②Division for Health and Safety Promotion, ③NIFS Laboratories and Contractor Work Responsibilities, ④Where to Obtain NIFS Work Procedures and Applications, ⑤Other Data Pertaining to Safety and Qualifications

3 Radiation
①Controlled Areas, ②Restricted Areas, ③NIFS Precinct Boundary, ④Radiation Worker Registration, ⑤Individual Exposure Control, ⑥Warning Lights, ⑦Entering and Exiting Controlled Areas, ⑧Preventing External Exposure, ⑨Contacting the Radiation Safety Control Office Director, ⑩Medical Examinations, ⑪Education and Training

4 Managing Access to Main Laboratories
①Access Control to Buildings by Card Key, ②Large Helical Device Building, ③Fusion Engineering Research Laboratory, ④Diagnostic Laboratory

5 Work Environment
①Office Work (VDT work), ②Signals and Warning Lights, ③Protective Equipment, ④Oxygen Deficiency, ⑤Delivery, ⑥ Crane Work, ⑦Work in High Places, ⑧Working in Confined Spaces, ⑨Welding, ⑩Work Information, ⑪Emergency Situations, ⑫Preventing Accidents

6 Electricity
①General electricity, ②Electrical appliances, ③Wiring, ④Testing instruments, ⑤High voltage or large current equipment, ⑥Experimental board, ⑦Reports and notifications, ⑧Laws and regulations concerning electrical construction work

7 High-pressure gas and liquefied gas
①Handling high-pressure gas containers (cylinders), ②Handling liquefied gases, ③Handling combustible gases, ④Very high-pressure gases

8 Lasers, electromagnetic radiation and strong magnetic field
①Lasers, ②Electromagnetic radiation and strong magnetic fields

9 Hazardous materials, chemicals and harmful substances
①Overview and precautions, ②Cautions in the handling of hazardous substances, ③Other

10 Machine tools
①Cautions concerning the use of machine tools, ②Lessons learned from past accidents

11 Work procedures

12 Disaster prevention

13 Safety Management Organization

14 New Experiment Safety Review
①Summary, ②Purpose of the Safety Review Office, ③Application standards, ④Review method, ⑤What to do after use of the equipment is finished, ⑥Other

15 Work Safety Education Text

16 Laws and Regulations Related to Safety Management

10. Safety Handbook Publishing Office

List of Safety Lectures

FY	1st	2nd	3rd
2005	4/26	5/19	
2006	5/12	5/30	
2007	6/7	6/19	
2008	5/22	6/12	
2009	4/16	5/13	
2010	4/22	5/26	
2011	4/28	5/19	
2012	4/19	5/25	
2013	4/24	5/23	
2014	4/23	5/22	
2015	4/22	6/5	
2016	4/27	5/20	
2017	5/12	△ 8/8	△ 9/15
2018	5/10	△ 5/22	△ 6/1
2019	5/9	△ 5/22	△ 5/24
2020	▲ 5/14		

△ : watching DVD projection in the hall

▲ : on WEB

Held the safety lecture for all workers including the co-researchers and students.

○ The 2nd and 3rd lectures in 2017, 2018, and 2019 were projections of the 1st lecture.

○ The lecture in 2020 was held on the WEB.

＊ For those who have not attended any of the lectures are asked to view the DVD of the lecture and submit a report.

(2) Are the safety management equipment / facilities, experimental equipment etc. for maintaining and managing safety taken into account for the characteristics and circumstances peculiar to fusion research?

安全を維持管理するための安全管理機器・設備、実験機器等は、核融合研究ならではの特徴・事情を考慮されたもとなっているか。

Characteristics and Circumstances Peculiar to Fusion Research

○ D Plasma (D-D reaction and D-T reaction)

generation of X-ray, neutron, tritium and γ-ray

→ Management of neutron generation

Radiation shielding

Safe handling of tritium

Safe handling of radioactive substances

Management of Environmental Radiation

○ Large Experiment Machine (LHD)

Installation/removal of measuring devices, heating devices, etc.

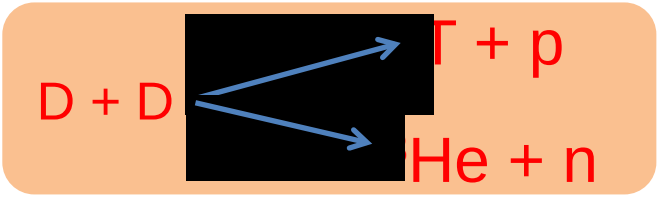
→ Safe Equipment handling work

Safe Crane work

○ Electromagnetic Waves, Magnetic Field

→ shielding

Neutron and tritium measure and control



Number of Tritium
= Number of Neutron

To manage these safely, it is necessary to grasp quantity of the neutron production precisely

The fission chamber detectors are used to grasp quantity of neutron precisely.

1. Neutron, γ-ray protection
2. Provision for tritium **(One of the most important issue)**
3. Management of Exhaust, drain water, RI and RA-waste
4. Radiation Controlled Area & Security
5. Integrated Radiation Monitoring System

- NIFS management level 1 –

- Controlled Area (Working area)
  - 1 mSv/week (100 mSv/5years)
  - 40 Bq/cm^2
- Boundary of Controlled Area
  - 1.3 mSv/3month
  - 4 Bq/cm^2
- Site Boundary
  - 50 μSv/year
- Tritium production
  - 37 GBq /year (former 6 years)
  - 55.5 GBq/year (later 3 years)
- Maximum Tritium release into environment
  - 3.7 GBq/year

- NIFS management level 2 –

○ Tritium Concentration in Working Environment (Law)

Types of Radioisotopes		Limit in Working environment
Isotope	Chemical form	(Bq/cm^3)
^3H	Gaseous tritium	1×10^{4}
^3H	triated water or vapor	8×10^{-1}

○ Tritium Concentration in Exhaust (NIFS management level)

Types of Radioisotopes		Limit in Air or Exhaust	Limit in Drainare or Waste water
Isotope	Chemical form	(Bq/cm^3)	(Bq/cm^3)
^3H	Gaseous tritium	7×10^{1}	
^3H	triated water or vapor	2×10^{-4}	6×10^{-1}
		(5×10^{-3})	(6×10^{1})

( ) : Concentration Limit in Law

- Radiation Monitoring Equipment -

Purpose of use	Installation location	Target	Frequency	Instrument	Detection method	Sampling time	Detection lower limit	NIFS management value	Remarks
Neutron measurement	LHD building	neutron	linked to plasma experiment	fission camber	Ionization chamber	real time		1-6y：2.1E19/y 9-y：3.2E19/y	
Exhaust measurement	Exhaust stack	tritium	continuous	gas monitor	ventilated ionization chamber	５分～	5E-3 Bq/cm^3	5E-3Bq/cm^3 （by law）	Outlier detected
			accumulation	tritium collector	collecte with molecular sieve after oxidation	1 week	< 2E-5 Bq/cm^3	total amount、3.7E+9 Bq/y（0.1Ci） 3mon ave. 2E-4 Bq/cm^3	Total amount & concentration control
		radiated air (Ar-41)	continuous	gas monitor	ventilated ionization chamber		5E-4 Bq/cm^3	5E-4 Bq/cm^3 （by law）	check with neutron generation rate
		dust（α,βray）	continuous	dust monitor	accumulated on filter paper				
Emission calculation	Vacuum exhaust gas treatment system	tritium	continuous	gas monitor	ventilated ionization chamber	２～３ min.	0.1 Bq/cm^3	35 Bq/cm^3 （*１）	
	VV ventilation treatment system	tritium	continuous	gas monitor	ventilated ionization chamber	２～３ min.	5E-3 Bq/cm^3	5E-3 Bq/cm^3	Below the exhaust control level
Drainage measurement	Water tank	tritium C-14	continuous	βray monitor	Liq.scintillation counter	10 min.	0.3 Bq/cm^3 water	0.6 Bq/cm^3 water	
			water sampling	LowB Liq.scintillation counter	Liq.scintillation counter	～3 hrs	1E-3 Bq/cm^3 water		
		Radiant	continuous	γray monitor	NaI detector	10 min.	1E-2Bq/cm^3 water	legal regulation value for each RI	
			water sampling	LowB semiconductor detector	Ge detector				check nuclide
	Tritium treated water	tritium	water sampling	LowB Liq.scintillation counter	Liq.scintillation counter	～3 hrs	1E-3 Bq/cm^3 water		confirmation of delivery quantity
Radiation measurement	Site boundary	X（γ）ray	continuous	Ionization chamber	Ar pressurized chaber	almost real time		50 μSv/y	
			accumulation	dosimeter	glass dosimeter	1 week/3 mon.			
		neutron	continuous	proportional counter	He-3 counter	almost real time			
			accumulation	dosimeter	electronic dosimeter	1 week/3 mon.			

*1 Maximum outlet concentration when tritium recovery rate is 95%

Monitoring of NIFS controlled values

Monitoring of Legal values

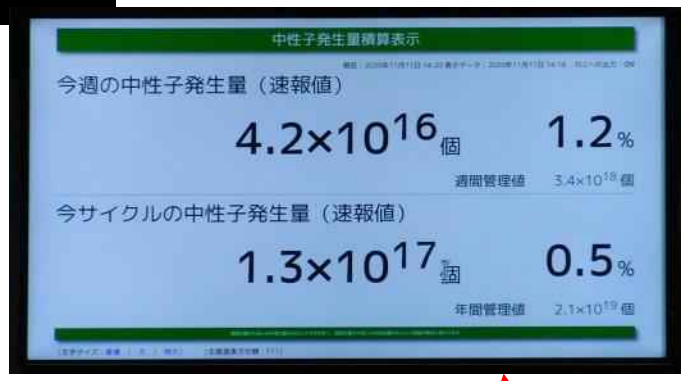
Neutron measurements

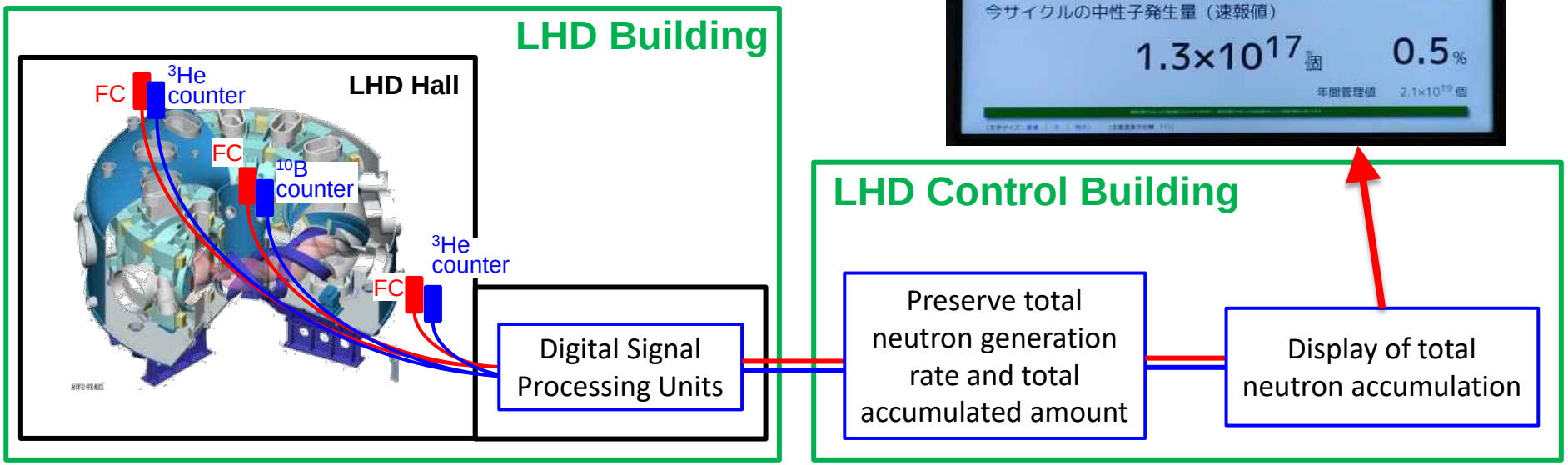
Purpose	NIFS control value	Installation Place	Measuring equipment
(1) Neutron Generation Management	2.1×10^{19} n/y (former 6y) 3.2×10^{19} n/y (later 3y)	LHD hall (controlled area)	○ *LHD plasma* • Fission chamber : 3 • ^{3}He counter : 2 • ^{10}B counter : 1 ○ *NBI (gas cell & beam dumper)* • ^{3}He counter : 5
(2) Working environment monitoring		Out side the LHD hall (Peripheral restricted area)	• Rem counter : 4 • ^{3}He counter : 2
(3) On site & at site boundaries monitoring	At site boundary : 50 μSv/y	On site & at site boundaries	• Rem counter : 2 • ^{3}He counter : 10

: *RMSAFE*

In addition to the above, as a research target, the indoor dose distribution is measured with a badge-type integrated neutron dosimeter.

Neutron measurements





- Since the amount of neutrons generated and the amount of tritium generated are the same, the amount of tritium generated can be known.

- The measurement is performed for 24 hours, and the total neutron integration amount is updated every 1/20 second.

Neutron and γ ray Protection

Reduction of radio-activation by neutron ⇨ **one of the important safety issue**

- **Concrete under the LHD machine will be strongly radio-activated.**
- **To reduce the radio-activation of concrete, we covered the concrete with 5 cm thick borated polyethylene (PE).**

PE plate

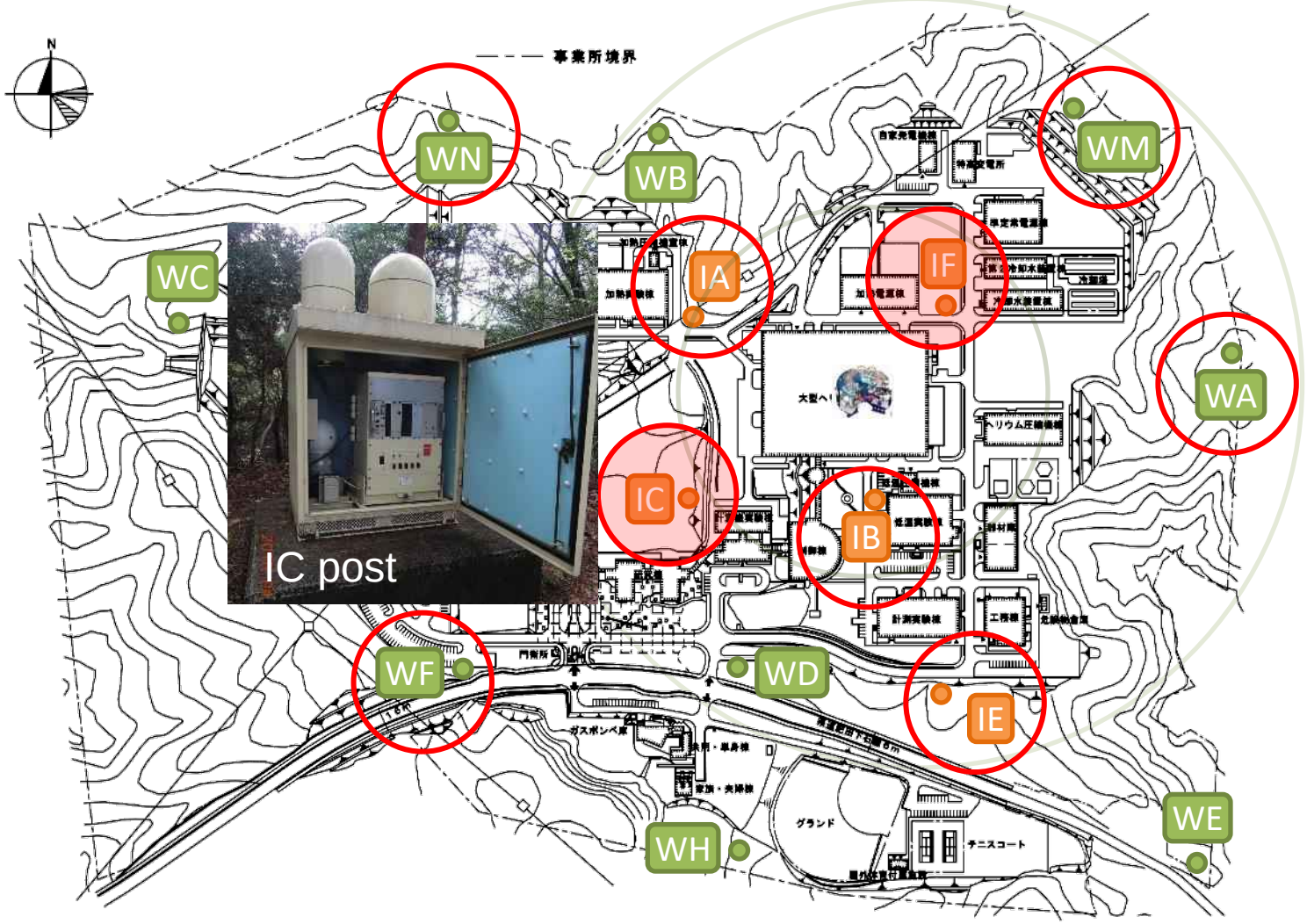
- **To reduce the effects of neutron irradiation, install PE block around the electronics.**

PE brock

Neutron monitoring on site and at site boundaries with RMSAFE

- ^{3}He counter & REM counter
- ^{3}He counter

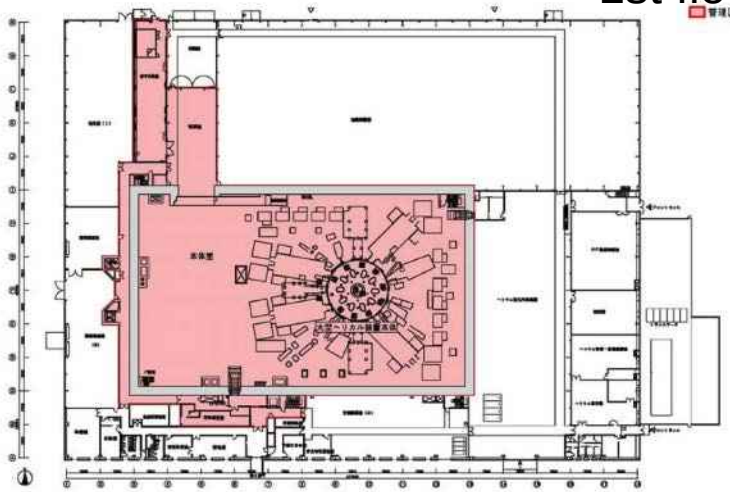
} With burst detection function
Continuous measurement



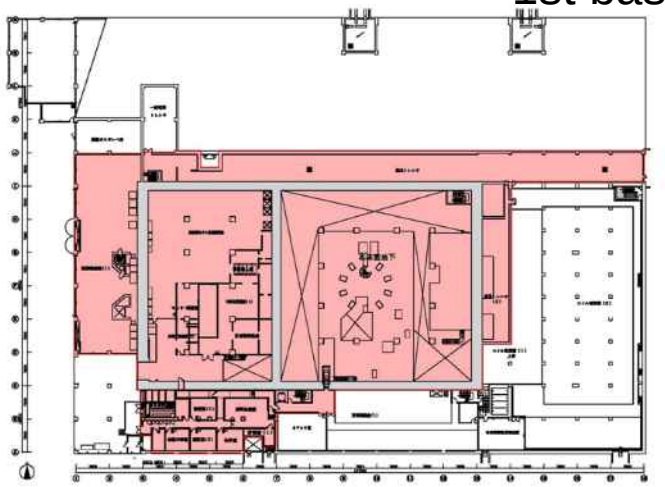
4. Controlled Area & Security

- Controlled Area -

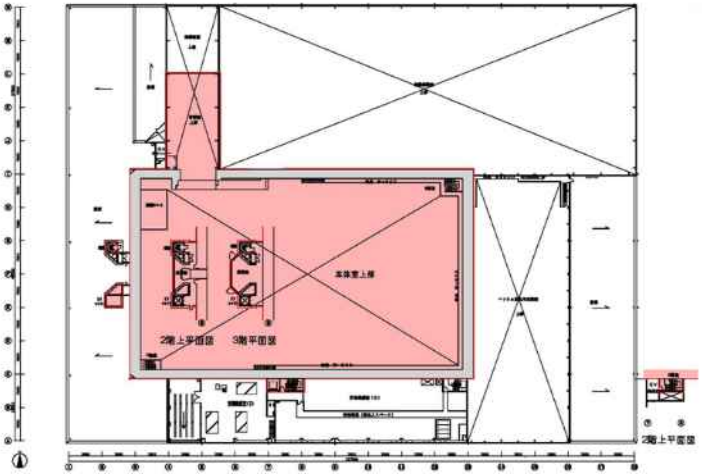
1st floor



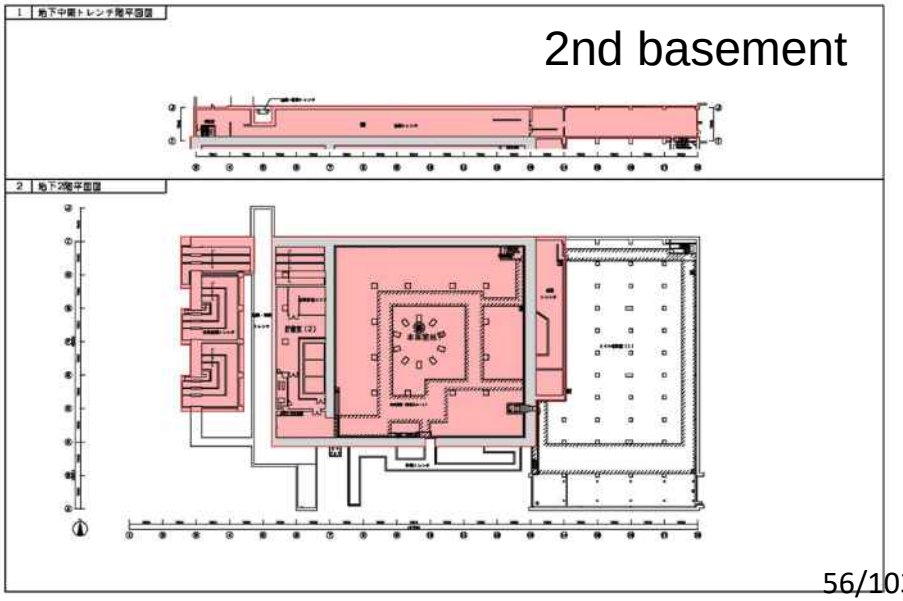
1st basement



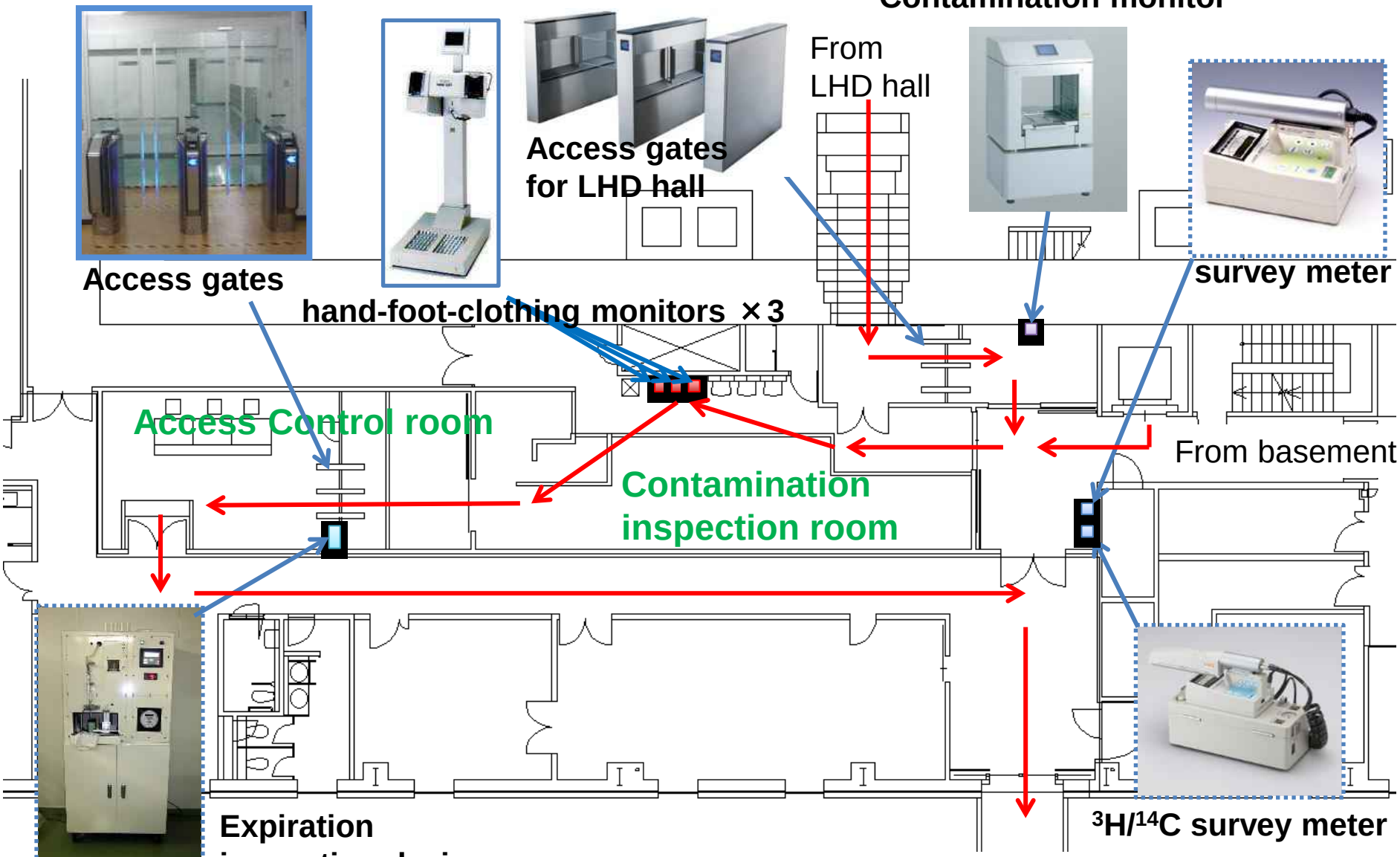
2nd floor



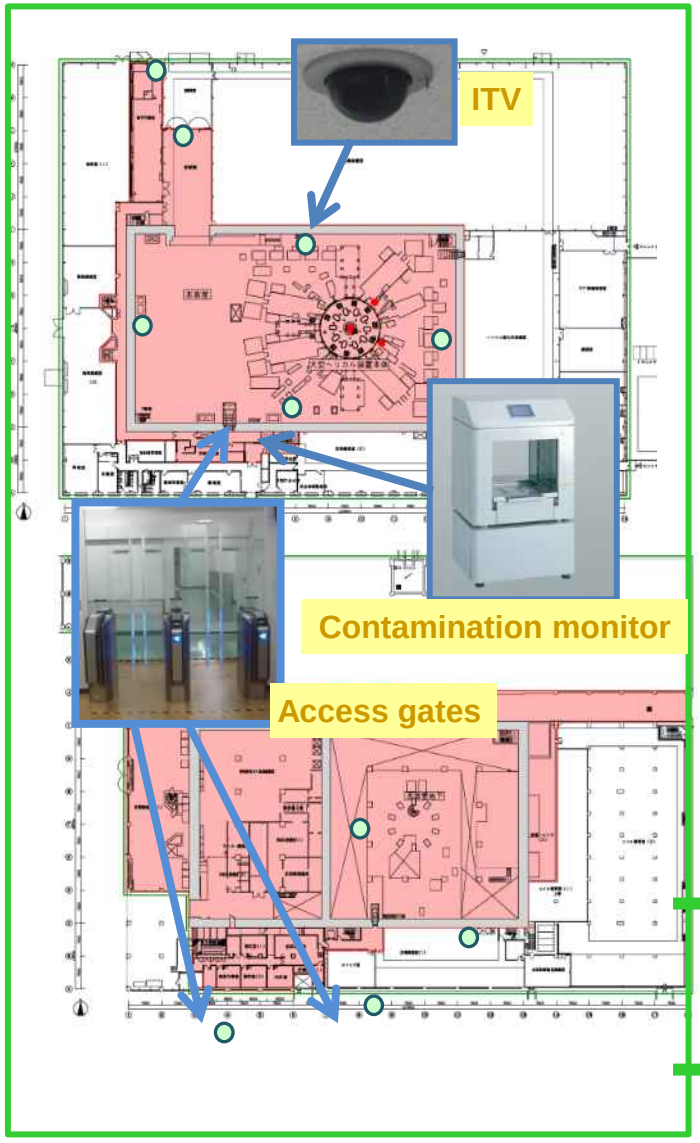
2nd basement



- Exit Flow and Contamination Test Apparatus -



5. Integrated Radiation Monitoring System

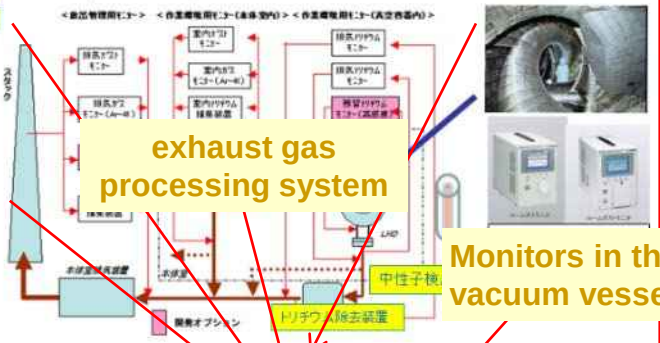


exhaust gas monitor

gas and dust monitor

drainage monitor

exhaust gas processing system



Monitors in the vacuum vessel

environmental monitors

unification

①interlock

②integrated radiation monitoring system

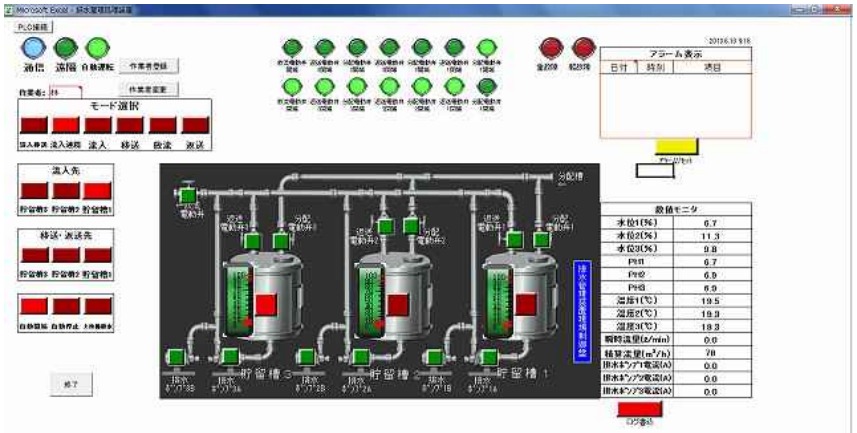
LHD central control

Control room

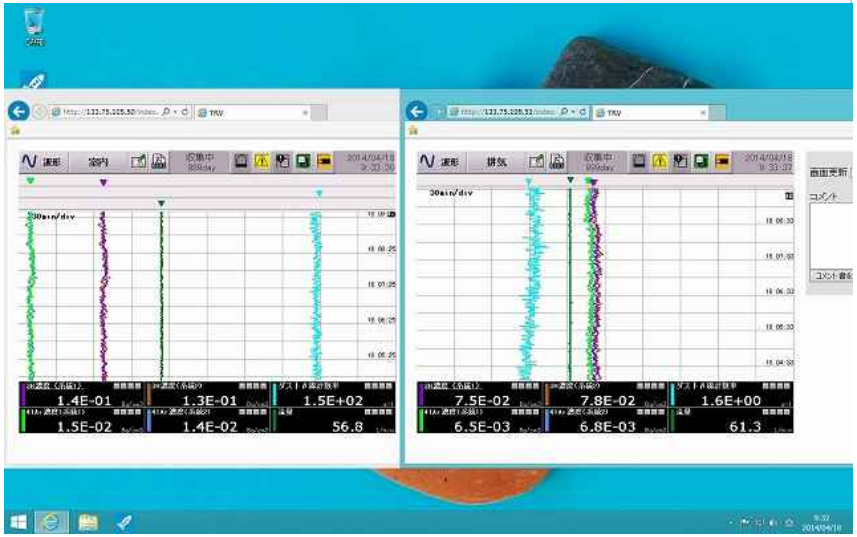
③ Enhancement of monitoring system of LHD building

Example of Monitoring Displays

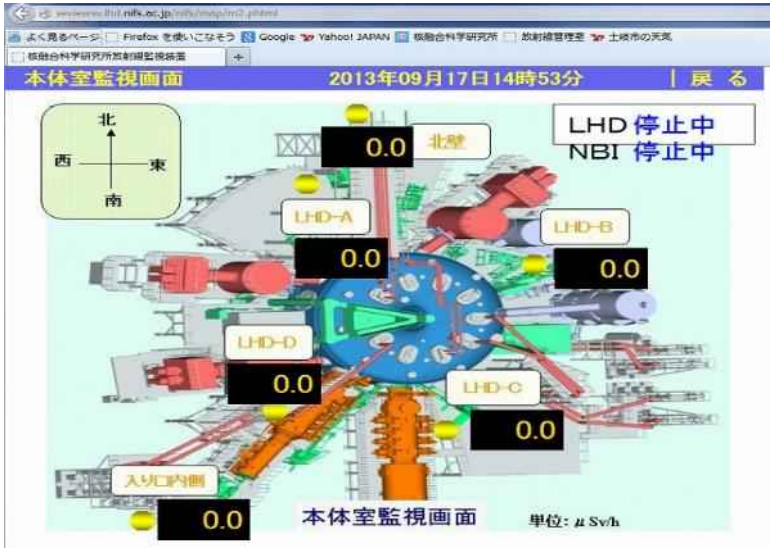
DRAINAGE CONTROL SYSTEM



RMSAFE (SITE BOUNDARY)



STACK and LHD HALL GAS MONITOR



RMSAFE(LHD HALL)

Measuring Instruments (1)

Measuring equipment

- prepared and started operations to get BG data

Stack gas monitors

^{3}H sampler for stack gas

Low background Liquid scintillation counters(LSC-LB7)

Drainage tanks

Drainage monitor

Ultra Low Level Liquid Scintillation Spectrometer (1220 QUANTULUS)

Auto Well Gamma System (AccuFLEX 7000)

Measuring Instruments (2)

Air monitors for the LHD hall

Monitoring post of RMSAFE

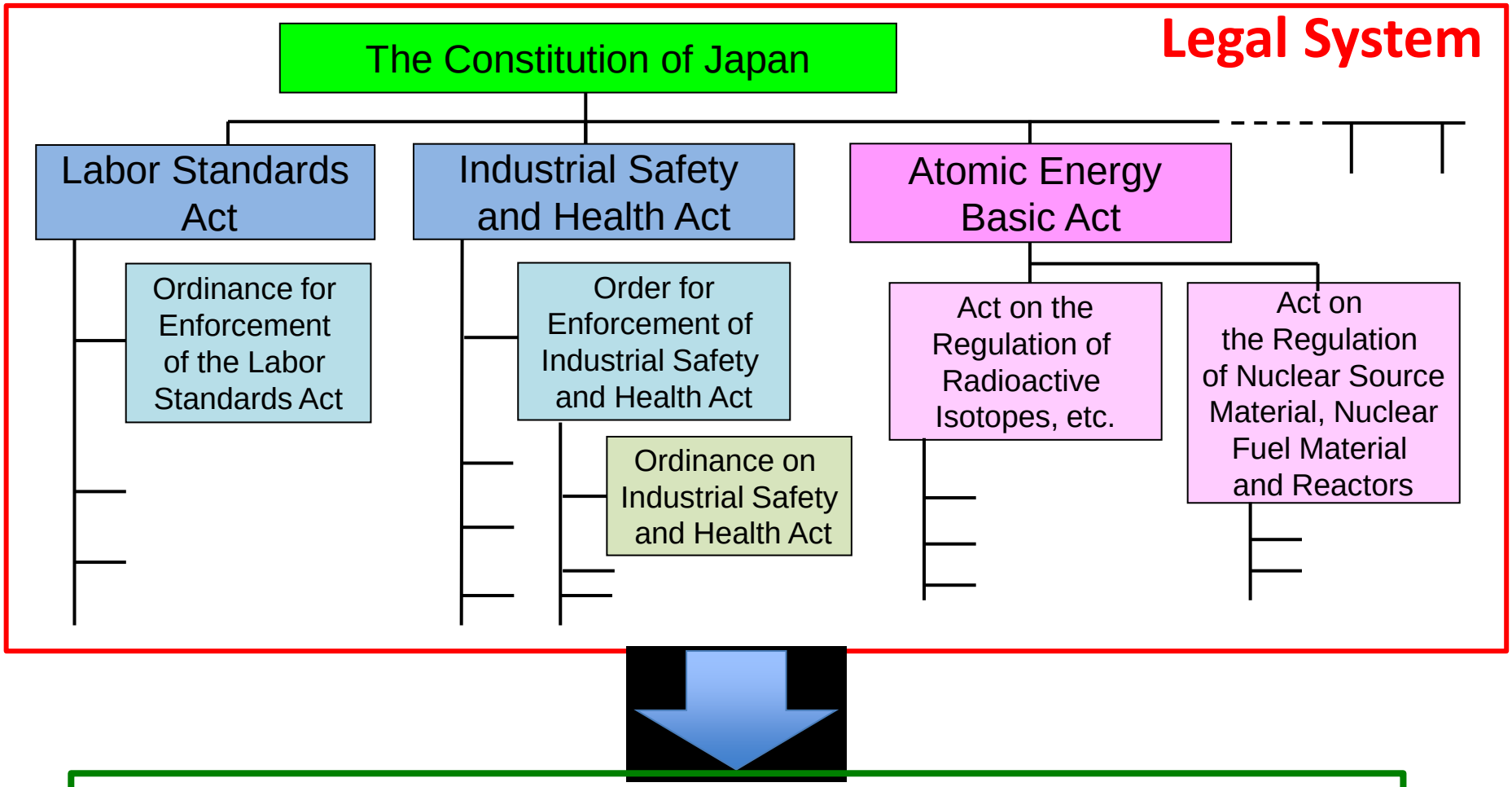
hand-foot-clothing monitors

Survey meters

(3) Are manuals and rules such as operation manuals, radiation control manuals, and emergency manuals properly formulated and operated?

運転マニュアル、放射線管理マニュアル、緊急時マニュアル等のマニュアル類や規則類は、適切に策定され、運用されているか。

Positioning of safety and health management



NIFS Regulations, Rules, Manuals

- Rules for Deuterium Experiment -

Act → **Ordinance** → **NIFS Regulation** → **NIFS Internal Rules** → **Manual etc.**

原子力基本法

放射線障害防止法	放射線障害防止法施行規則		核融合科学研究所 放射線障害予防規程	装置維持管理細則	運転マニュアル他
第21条 放射線障害予防規程 許可届出使用者は放射線障害を防止するため文部科学省令で定めるところにより放射性同位元素若しくは放射線発生装置の使用を開始する前に、放射線障害防止規程を作成し、文部科学大臣に届け出なければならない。		第21条 放射線障害予防規程 放射線障害予防規程は、次の事項について定める	第5条 所長は、法及びこの規程に定める事項の実施に関し、装置の維持・管理に関する取扱及び運用基準等を、維持管理細則として別に定めるものとする。	・大型ヘリカル装置係る通報連絡に関する細則 ・大型ヘリカル装置維持管理細則 ・重イオンビームプローブ維持管理細則 ・校正用(252-Cf)密封線源維持管理細則 ・核分裂計数管維持管理細則 ・イオンビーム解析装置維持管理細則 ・核融合科学研究所における実験装置等の維持管理細則 ・エックス線装置の維持管理細則 ・微量密封放射性同位元素取扱細則	・通報・連絡マニュアル ・放射線管理マニュアル 1-1 運転監視マニュアル 1-2 入退管理マニュアル 1-3 真空容器内作業マニュアル 1-4 ポート作業マニュアル 1-5 真空系取扱マニュアル 1-6 本体室作業マニュアル 1-7 トリチウム回収マニュアル 1-8 加熱運転マニュアル 1-9 物品搬出入マニュアル 1-10 試料取扱マニュアル 1-11 分析エリア作業マニュアル
		(1) 取扱に従事する者に関する職務及び組織に関すること	第7条～第18条		
放射線取扱主任者(第34条)	放射線取扱主任者の選任他(第30条～第32条)	(1)の2 放射線取扱主任者及び安全管理に従事する者の職務及び組織に関すること	第7条～第13条		・LHD運転マニュアル 2-1 本体運転マニュアル 2-2 本体冷却マニュアル 2-3 加熱機器運転マニュアル 2-4 計測機器運転マニュアル 2-5 入退管理装置運転マニュアル 2-6 放射線総合監視システム運転マニュアル 2-7 トリチウム除去装置運転マニュアル 2-8 分析機器運転マニュアル
放射線取扱主任者の代理者(第37条)	放射線取扱主任者の代理者(第33条)	(1)の3 放射線取扱主任者の代理者の選任に関すること	第14条		
使用の許可の基準(第6条)	使用施設の基準(第14条の7) 貯蔵施設の基準(第14条の9) 廃棄施設の基準(第14条の11)	(1)の4 放射線施設の維持及び管理に関すること	第21条～第23条		
		(1)の5 放射線施設の点検に関すること	第22条～第23条		
使用の基準(第15条)	使用の基準(第15条)	(2) 放射性同位元素及び放射線発生装置の使用に関すること。	第24条、第24－3条～第24－9条		
保管の基準(第16条) 運搬の基準(第17条) 廃棄の基準(第18条)	保管の基準(第17条) 運搬の基準(第18条) 廃棄の基準(第19条)	(3) 放射性同位元素等の受入れ、払出し、保管、運搬又は廃棄に関すること	第24－1条、第24－2条、第24－10条		
測定(第20条)	測定(第20条)	(4) 放射線の量及び放射性同位元素による汚染の状況の測定並びにその測定の結果について実施すべき措置に関すること	第27条～第30条		・放射線・装置管理区域関連マニュアル 3-1 重イオンビームプローブ運転マニュアル 3-2 252-Cf使用マニュアル 3-3 核分裂計数管使用マニュアル 3-4 イオンビーム解析装置運転マニュアル 3-5 ECH運転マニュアル 3-6 NBI運転マニュアル 3-7 校正用X線源運転マニュアル 3-8 ESCA・XRD運転マニュアル 3-9 微量密封線源取扱マニュアル
教育訓練(第22条)	教育訓練(第21条の2)	(5) 放射線障害防止するために必要な教育及び訓練に関すること	第31条		
健康診断(第23条)	健康診断(第22条)	(6) 健康診断に関すること	第32条		
放射線障害を受けた者又は受けたおそれのある者に対する措置(第24条)	放射線障害を受けた者又は受けたおそれのある者に対する措置(第23条)	(7) 放射線障害を受けた者又は受けたおそれのある者に対する保健上必要な措置に関すること	第33条		
記帳義務(第25条)	記帳(第24条)	(8) 法律第25条に規定する記帳及び保存に関すること	第34条～第41条		
事故届(第32条) 危険時の措置(第33条)	危険時の措置(第29条) 報告徴収(第39条第1項)	(9) 地震、火災その他の災害が起こった時の措置に関すること	第42条～第43条		
		(10) 危険時の措置に関すること	第44条		
報告徴収(第42条)	第39条第3項	(11) 放射線管理の状況の報告に関すること	第45条		
		(12) 省略			
		(13) その他放射線障害の防止に関し必要な事項	第47条		
原子炉等規制法 計量管理規定(第61条の八)	**核燃料物質の使用等に関する規則**		**核融合科学研究所 計量管理規定**	**装置維持管理細則** ・核分裂計数管維持管理細則	**運転マニュアル他** 3-3 核分裂計数管使用マニュアル

We establish internal rules and manuals before starting Deuterium experiment

Applicable laws and regulations 1

- 労働安全衛生法
  Industrial Safety and Health Act
- 消防法
  Fire Service Act
- 電気事業法
  Electricity Business Act
- 放射性同位元素等の規制に関する法律（ＲＩ規制法）
  Act on the Regulation of Radioactive Isotopes, etc.
- 核原料物質，核燃料物質及び原子炉の規制に関する法律
  Act on the Regulation of Nuclear Source Material, Nuclear Fuel Material and Reactors
- 電離放射線障害防止規則（電離則）
  Regulation on Prevention of Ionizing Radiation Hazards
- クレーン等安全規則（クレーン則）
  Safety Ordinance for Cranes
- 高圧ガス保安法
  High Pressure Gas Safety Act

Applicable laws and regulations 2

- 特定設備検査規則
- ボイラー及び圧力容器安全規則（ボイラー則）
- ゴンドラ安全規則
- 有機溶剤中毒予防規則（有機則）
- 鉛中毒予防規則（鉛則）
- 四アルキル鉛中毒予防規則
- 特定化学物質障害予防規則（特化則）
- 高気圧作業安全衛生規則
- 酸素欠乏症等防止規則
- 国際規制物資の使用等に関する規則
- 一般高圧ガス保安規則
- 特定設備検査規則
- 冷凍保安規則
- 危険物の規制に関する政令

Internal rules related to safety

○核融合科学研究所防災規則
NIFS Disaster Prevention Regulations
○核融合科学研究所電気保安規則
NIFS Electrical Safety Regulations
○核融合科学研究所安全衛生管理規則
NIFS Safety and Health Regulation
○核融合科学研究所放射線障害予防規程
NIFS Regulation on Prevention of Radiation Hazards
○核融合科学研究所イオンビーム解析装置の維持管理細則
NIFS Detailed Regulation on the Ion Beam Analyzer
○核融合科学研究所エックス線装置の維持管理細則
NIFS Detailed Regulation on the X-rays Device
○核融合科学研究所微量密封放射性同位元素等取扱細則
NIFS Detailed Handling Regulation on very small amount Sealed Radioisotope
○核融合科学研究所計量管理規定
NIFS Accounting Provisions
○核融合科学研究所放射線教育訓練実施細則
NIFS Detailed rules for Radiation Education and Training

Internal rules related to safety

○核融合科学研究所高圧ガス（一般）危害予防規則
○核融合科学研究所高圧ガス（冷凍）危害予防規則
○核融合科学研究所高圧ガス（冷凍）製造施設運用基準（冷暖房設備）
○核融合科学研究所高圧ガス（冷凍）製造施設運用基準（大型ヘリカル装置低温設備）

Internal rules related to safety

○核融合科学研究所危険物質管理規則

NIFS Hazardous Substance Management Regulation

○核融合科学研究所における廃液取扱いに関する規則

NIFS Regulation on Waste Liquid Handling

○核融合科学研究所大型ヘリカル装置真空維持管理規則

NIFS Regulation on the Vacuum Maintenance on LHD

○核融合科学研究所クレーン使用要項

NIFS Crane Usage Guidelines

○核融合科学研究所実験装置等の維持管理細則

NIFS Detailed Regulation on the Vacuum Maintenance on LHD

○核融合科学研究所大型ヘリカル装置等の維持管理細則

NIFS Detailed Regulation on LHD and other Experimental Devices

Disaster and Abnormal Response Manuals 1

○防災マニュアル（重水素実験対応版）

Disaster Prevention Manual (Deuterium experiment version)

○不法侵入・不審物・盗難等対応マニュアル

Manual for dealing with trespassing, suspicious objects, theft, etc.

○通報・連絡マニュアル

Report / contact manual

○衛星電話が不通の場合の職員の派遣マニュアル

Staff dispatch manual when satellite phone is not available

○宿日直マニュアル

Night shift manual

Disaster and Abnormal Response Manuals 2

○安全ハンドブック
Safety Handbook

○放射線関係対応マニュアル
Radiation-related manual
○漏水対応マニュアル
Leakage handling manual
○ＮＢＩ異常時対応マニュアル
NBI Abnormal Response Manual
○ＬＨＤ真空異常時対応マニュアル
LHD vacuum abnormality response manual
○トリチウム除去装置異常時対応マニュアル
Manual for dealing with abnormalities in the tritium removal device
○夜間・休日等におけるＥＣＨ冷却水漏水時対応マニュアル
Manual for handling ECH cooling water leaks at night and on holidays

○コロナウイルスに関するマニュアル類
Manuals for COVID-19

- Examples of NIFS Regulation –

NIFS Regulation of Prevention of Radiation Hazards

核融合科学研究所放射線障害予防規程

制　　定　平成１６年４月２０日　規則第５号
最終改正　平成３１年２月１９日

目次

第１章　総則

（目的）

第１条　この規程は，核融合科学研究所（以下「研究所」という。）における放射線の発生を伴う装置及び放射性物質等の取扱い並びに管理に関する事項を定め，放射線障害の発生を防止し，あわせて公共の安全を確保することを目的とする。

２　放射線障害の防止に関しては，放射性同位元素等による放射線障害の防止に関する法律（昭和３２年法律第１６７号。以下「法」という。），及び労働安全衛生法（昭和４７年法律第５７号），電離放射線障害防止規則（昭和４７年労働省令第４１号。以下「電離則」という。）等の関係法令に定めるもののほか，この規程の定めるところによる。

（適用範囲）

第２条　本規程は，研究所の放射線施設に立ち入るすべての者及び管理区域外での下限数量（法第２条第２項及び法施行令（昭和３５年政令第２５９号）第１条に定める数量。）を超えない密封されていない放射性同位元素（以下「下限数量以下の非密封放射性同位元素」という。）の取扱等業務に従事する者に適用する。

（用語の定義）

第３条　この規程において，次の各号に掲げる用語の定義は，それぞれ当該各号に定めるところによる。

(1)　「装置」とは次に掲げるものをいう。

イ　法第２条第４項に規定する放射線発生装置

ロ　イに掲げるもののほか，電離則第１５条第１項に規定する放射線を発生する装置又は機器及び所長の指定するものをいう。

(2)　「放射性同位元素」とは，法第２条第２項に規定するものをいう。

(3)　「放射化物」とは，法施行規則（昭和３５年総理府令第５６号。以下「施行規則」

という。）第１４条の７第１項第７の２号に規定するものをいう。

(4)　「放射性物質等」とは，放射性同位元素，放射化物及び放射性同位元素又は放射化物で汚染された物をいう。

(5)　「放射線施設」とは，法第３条第２項第５号から第７号までに規定する使用施設，貯蔵施設及び廃棄施設並びに附属設備をいう。

(6)　「管理区域」とは，放射線管理の便のために設けられる区域であって，施行規則第１条第１項第１号に規定する管理区域をいう。

(7)　「放射性廃棄物」とは，放射性物質等であって廃棄しようとするものをいう。

(8)　「放射線業務」とは，装置並びに放射性物質等を取り扱う業務をいう。

(9)　「業務従事者」とは，装置又は放射性物質等の使用，管理並びにこれに付随する業務に従事するため，管理区域に立ち入る者で，所長が放射線業務従事者に指定した者をいう。

(10)　「一時立入者」とは，見学等の目的で，一時的に管理区域に立ち入る者で管理区域責任者の許可を得た者をいう。

（他の規程との関連）

第４条　装置又は放射性物質等の取扱いに係る保安については，本規程に定めるもののほか，次の各号に掲げる規則その他保安に関する規程等の定めによる。

(1)　核融合科学研究所安全衛生管理規則　（平成１６年規則第３号）
(2)　核融合科学研究所電気保安規則　（平成２年規則第４号）
(3)　核融合科学研究所高圧ガス（一般）危害予防規則　（平成３年規則第１号）
(4)　核融合科学研究所高圧ガス（冷凍）危害予防規則　（平成４年規則第１号）
(5)　核融合科学研究所防災規則　（平成１７年規則第６号）
(6)　核融合科学研究所安全衛生委員会規則　（平成１６年規則第４号）
(7)　安全衛生推進部規則　（平成１６年規則第６号）
(8)　核融合科学研究所リスクマネジメント規則（平成２７年規則第１号）

（細則等の制定）

第５条　所長は，法及びこの規程に定める事項の実施に関し，装置又は放射性物質等の維持・管理に関する取扱い及び運用基準等を，次の各号に掲げる維持管理細則又はマニュアル等として別に定めるものとする。

(1)　核融合科学研究所大型ヘリカル装置等の維持管理細則
(2)　核融合科学研究所イオンビーム解析装置の維持管理細則
(3)　核融合科学研究所におけるニックス線装置等の維持管理細則
(4)　核融合科学研究所における実験装置等の維持管理細則
(5)　核融合科学研究所における放射線教育訓練実施細則
(6)　災害及び異常時対応マニュアル／通報・連絡マニュアル
(7)　核融合科学研究所放射線安全委員会要項

（遵守等の義務）

第６条　業務従事者及び管理区域に一時的に立ち入る者は，放射線取扱主任者が放射線障害防止のために行う指示を遵守し，その指示に従わなければならない。

第２章　組織及び職務

（管理組織）

第７条　研究所における放射線業務に従事する者及びこれらの安全管理に従事する者の組織は，別表第１のとおりとする。

- Examples of NIFS Regulation –

NIFS Detailed Handling Regulation of very small amount Sealed Radioisotope

核融合科学研究所微量密封放射性同位元素等取扱細則

制　定　平成１３年１２月１８日　所長裁定
最終改正　平成２７年１０月　１　日

（目的）

第１条　この細則は、核融合科学研究所放射線障害予防規程（平成１６年度規則第５号）第５条の規定に基づき、核融合科学研究所における微量密封放射性同位元素等（以下「微量ＲＩ等」という。）に起因する障害等の予防及び安全な取扱い方法、維持及び管理に関し、必要な事項を定めることを目的とする。

（定義）

第２条　この細則において「微量ＲＩ等」とは、下を指す。

１．放射線を放出する同位元素及びその化合物並びにこれらの含有物（機器に装備されているこれらのものを含む。）で、放射線を放出する元素の数量及び濃度がその種類ごとに原子力規制委員会が定める数量（以下「下限数量」という。）及び濃度以下のもの。

２．放射性同位元素等による放射線障害の防止に関する法律の第十二条の五第二項で規定される表示付認証機器。

（管理）

第３条　前条に規定する微量ＲＩ等は、放射線管理室が管理するものとする。ただし、放射線管理室長（以下「室長」という）及び放射線取扱主任者（以下「主任者」という）が特に指定した微量ＲＩ等については、その使用者が管理することができる。

２　放射線管理室は、微量ＲＩ等を払出し、出入庫管理を行う。

３　室長は、微量ＲＩ等の管理状況について主任者及び安全衛生推進部長（以下「部長」という）を経由して、少なくとも年１回は核融合科学研究所長に報告しなければならない。

（使用者）

第４条　微量ＲＩ等を使用できるのは、核融合研究所放射線障害予防規程で定められた手続きにより使用を許可された者とする。

（使用届）

第５条　微量ＲＩ等を所内で使用する場合は、原則使用する１０日以上前に、使用責任者は別に定める微量密封放射性同位元素使用届を放射線管理室に提出するものとする。

２　放射線管理室は、前項の使用届を許可したときは、別に定める微量密封放射性同位元素使用許可書を交付する。

３　所外から一時的に微量ＲＩ等を持ち込み使用する場合も二項とする。

（払出と返却）

第６条　微量ＲＩ等の貸出を希望する者は、別に定める微量密封放射性同位元素借用書を放射線管理室に提出し、微量ＲＩ等を借用する。

２　使用責任者は、使用が終わったら直ちに微量ＲＩ等を放射線管理室へ返却する。

３　他の事業所へ貸し出す場合は、当該事業所の放射線安全管理責任者に貸し出すものとする。

（使用の制限）

第７条　使用責任者は、使用期間中であっても、室長又は主任者から使用の中止を求められたときは、微量ＲＩ等の使用を中止しなければならない。また、それが貸し出された微量ＲＩ等の場合、返却しなければならない。

（使用責任者の義務）

第８条　使用責任者は、次に掲げる諸事項を実施する義務を負う。

（１）微量ＲＩ等の安全かつ確実な保管

（２）微量ＲＩ等の安全かつ確実な使用のために必要な実験環境又は作業環境の整備

（３）微量ＲＩ等を使用者が安全かつ確実に使用するために必要な指導と監督

（４）使用中若しくは保管中の微量ＲＩ等に事故又は異常が発生した場合の本処理員の実施と放射線管理室への速やかな報告

（５）その他の安全確保に必要な措置

（新規入手）

第９条　微量ＲＩ等を新規入手する場合は、室長及び主任者の承認を得なければならない。

２　微量ＲＩ等を新規入手した者は、入手後、速やかに入手した微量ＲＩ等に、検定書の写し及び別に定める微量密封放射性同位元素入手届を添えて室長に提出しなければならない。

（譲受け、譲渡し）

第１０条　微量ＲＩ等の譲受け及び譲渡しは、室長及び主任者並びに譲受け又は譲渡す事業所の放射線安全管理責任者との間で事前に合意に達したときにのみ承認する。

２　譲受け又は譲渡する者は、その行為の完了後、速やかに内容を室長及び主任者に報告しなければならない。

（廃棄）

第１１条　微量ＲＩ等の廃棄手続きは、室長及び主任者の承認を得て、放射線管理室が行う。

２　廃棄にあたっては、法令等を遵守し、手続きを進める。

（非常時等の措置）

第１２条　地震、火災及びその他の災害等により、使用中若しくは保管中の微量ＲＩ等に現在下回、その他の異常が発生した場合又は発生するおそれのある場合は、これを発見した者は、直ちに使用責任者に通報しなければならない。

２　前項の通報を受けた使用責任者は、直ちに応急の措置を講じ、経由して、主任者及び核融合科学研究所長に報告しなければならない。

附　則

この細則は、平成１３年１２月１８日から実施する。

附　則（平成１４年１１月２５日）

この細則は、平成１４年１１月２５日から実施する。

附　則（平成１６年７月１５日）

この細則は、平成１６年７月１５日から実施し、平成１６年４月１日から適用する。

附　則（平成１８年５月１９日）

この細則は、平成１８年５月１９日から実施する。

附　則

１　この細則は、平成２７年３月１日から実施する

２　平成１９年３月３１日までに製造された３．７ＭＢｑ以下の封入された放射性同位元素のうち放射線を放出する同位元素の数量及び濃度がその種類ごとに原子力規制委員会が定める数量（以下「下限数量」という。）及び濃度を超えるものは、本細則を適用するものとする。

附　則

この細則は、平成２７年１０月１日から実施する

The operation manual, the radiation management manual, and the emergency

We are preparing the following three manuals.

- ○ Facility Operation Manual
- ○ Radiation Management Manual for Facility
- ○ Emergency Manual

＊ As a general rule, these manuals should contain the minimum necessary content on pages 1-2 so that even observers at night or on holidays can respond.

- These manuals will be revised in a timely manner when revisions are required.
- Manuals will be added as needed when necessary items arise.

- Manuals on WEB site 1 -

重水素実験における基準及び各種マニュアル

章	節	マニュアル名
基準		0_1_1_1 放射線管理基準
		0_1_1_2 空調メンテナンス時の対応について
		0_1_2_1 プラズマ実験開始時のRMSAFE運転基準
		0_1_2_2 インターロック管理値
		0_1_3 呼気検査の管理基準
		0_1_4_1 放射線障害のおそれに係る基準
		0_1_4_2 業務従事者被ばく線量の管理目標値
		0_1_4_3 真空容器内作業における被ばく線量の管理目標値
		0_1_5 教育訓練実施基準
		0_1_6 大型ヘリカル実験棟管理区域設備点検について
		0_1_7 保守点検等従事者が新型コロナウイルスに感染したことが確認された場合の対応基準
		0_2_1 研究所における放射線を用いた非破壊検査の実施について（お願い）
		0_2_2 大型ヘリカル実験棟本体室北側遮蔽扉（1A）の開閉制限について
		0_3 対処フロー図
1_放射線管理マニュアル	1_1_LHD運転監視マニュアル	1_1_1_LHD運転監視マニュアル
	1_2_入退管理マニュアル	1_2_1_入退管理マニュアル
	1_3_真空容器管理出入り口使用マニュアル	1_3_1_真空容器管理出入り口使用マニュアル
	1_4_真空容器内作業マニュアル	1_4_1_真空容器内作業マニュアル
	1_5_ポート作業マニュアル	1_5_1_ポート作業マニュアル
	1_6_真空系取扱マニュアル	1_6_1_真空系取扱マニュアル
	1_7_本体室作業マニュアル	1_7_1_本体室作業マニュアル
		1_7_2_ガス供給システム保守点検作業マニュアル
		1_7_3_グロー放電洗浄装置保守点検作業マニュアル
		1_7_4_ゲートバルブ制御装置保守点検作業マニュアル
		1_7_5_圧空システム・GN2供給装置点検作業マニュアル
		1_7_6_真空排気装置保守点検作業安全マニュアル
		1_7_7_真空容器・ダイバータ加熱冷却装置保守点検作業マニュアル
		1_7_8_閉構造ダイバータ排気装置保守点検作業マニュアル
		1_7_9_補助排気装置保守点検作業マニュアル
		1_7_10_本体冷却水システム保守点検作業マニュアル
	1_8_トリチウム含有水回収マニュアル	1_8_1_トリチウム含有水回収マニュアル
	1_9_252-Cf取扱マニュアル	1_9_1_2522?Cf取扱マニュアル
	1_10_フィッシュンチェンバー取扱マニュアル	1_10_1_フィッシュンチェンバー取扱マニュアル
	1_11_NBI取扱マニュアル	1_11_1_NBI安全管理マニュアル
		1_11_2_NBI真空容器内作業マニュアル
	1_12_物品搬出入マニュアル	1_12_1_物品搬出入マニュアル

- Manuals on WEB site 2 -

	1_13_試料取扱マニュアル	1_13_1_試料取扱マニュアル
		1_13_2_試料駆動装置試料交換手順マニュアル
		1_13_3_ＬＨＤ照射後試料の取扱マニュアル
	1_14_保守作業室・試料加工室作業マニュアル	1_14_1_保守作業室作業マニュアル
		1_14_2_試料加工室作業マニュアル
	1_15_分析エリア作業マニュアル	1_15_1_分析エリア作業マニュアル
		1_15_2_測定室（1）使用マニュアル
		1_15_3_測定室（2）使用マニュアル
		1_15_4_測定室（3）使用マニュアル
		1_15_5_貯蔵室（1）使用マニュアル
		1_15_6_微細構造解析室使用マニュアル
		1_15_7_分析室作業マニュアル
		1_15_8_保管廃棄室使用マニュアル
	1_16_管理区域設備点検マニュアル	1_16_1_管理区域設備点検マニュアル
	1_17_室外排気配管からの水抜き作業マニュアル	1_17_1_室外排気配管からの水抜き作業マニュアル
	1_18_ＲＩ廃棄物処理マニュアル	1_18_1_RI廃棄物処理マニュアル
	1_19_本体室及び本体室地下において大気中にガス放出を伴う真空引きマニュアル	1_19_1_本体室及び本体室地下において大気中にガス放出を伴う真空引きマニュアル
	1_20_本体室及び本体室地下において採取した水の分析方法	1_20_1_本体室及び本体室地下において採取した水の分析方法
	1_21_低温トレンチ作業マニュアル	1_21_1_低温トレンチ作業マニュアル
2_LHD運転マニュアル	2_1_本体運転マニュアル	2_1_1_本体ユーティリティー（本体系冷却水システム）運転マニュアル
		2_1_2_真空容器・ダイバータ加熱冷却装置運転マニュアル
		2_1_3_本体ユーティリティー（圧空システム・GN2供給装置）運転マニュアル
		2_1_4_真空排気装置運転マニュアル
		2_1_5_補助排気装置運転マニュアル
		2_1_6_ガス供給システム運転マニュアル
		2_1_7_コイル電源運転マニュアル
		2_1_8_ＬＩＤコイル用電源運転マニュアル
		2_1_9_グロー放電洗浄装置運転マニュアル
		2_1_10_ゲートバルブ制御装置運転マニュアル
		2_1_11_閉ダイバータ排気装置運転マニュアル
		2_1_12_ボロニゼイション運転マニュアル
		2_1_13_真空容器換気システム運転マニュアル
	2_2_本体冷却マニュアル	2_2_1_本体冷却運転マニュアル
	2_3_NBI運転マニュアル	2_3_1_ＮＢＩ運転マニュアル
	2_4_ECH運転マニュアル	2_4_1_ＥＣＨ運転マニュアル
	2_5_ICH運転マニュアル	2_5_1_ＩＣＨ運転マニュアル
	2_6_計測器運転マニュアル	2_6_1_ダイバータ分光計測運転マニュアル
		2_6_2_高速イオンゲージ運転マニュアル

- Manuals on WEB site 3 -

2 6 3 本体ペレット入射装置運転マニュアル
2 6 4 電子銃・試料駆動装置運転マニュアル
2 6 5 ダイバータ静電プローブ運転マニュアル
2 6 6 高速掃引静電プローブ運転マニュアル
2 6 7 マイクロ波反射計運転マニュアル
2 6 8 ミリ波干渉計運転マニュアル
2 6 9 磁束ループ運転マニュアル
2 6 10 ダイバータ熱電対運転マニュアル
2 6 11 ヘリウムビームプローブ運転マニュアル
2 6 12 3m直入斜分光器運転マニュアル
2 6 13 イメージング結晶分光器運転マニュアル
2 6 14 不純物ペレット入射装置運転マニュアル
2 6 15 不純物モニター運転マニュアル
2 6 16 トロイダル結晶分光器運転マニュアル
2 6 17 ディスパーション干渉計運転マニュアル
2 6 18 ＦＩＲレーザー干渉計運転マニュアル
2 6 19 ＲＦスペクトロメータ運転マニュアル
2 6 20 ダイバータ干渉計運転マニュアル
2 6 21 重イオンビームプローブ装置運転マニュアル
2 6 22 高速度ＨＡアレイ装置運転マニュアル
2 6 23 損失高速イオンプローブ運転マニュアル
2 6 24 ＣＮＰＡ運転マニュアル
2 6 25 可視分光計測装置運転マニュアル
2 6 26 磁気計測運転マニュアル
2 6 27 ＶＵＶ分光器運転マニュアル
2 6 28 ＳＯＸＭＯＳ装置運転マニュアル
2 6 29 ＣＯ２レーザー計測運転マニュアル
2 6 30 ＡＸＵＶＤ運転マニュアル
2 6 31 ＴＥＳＰＥＬ・ＴＥＣＰＥＬ入射装置運転マニュアル
2 6 32 ＬＨＤ計測データ集録システム運転マニュアル
2 6 33 本体真空計運転マニュアル
2 6 34 ペニング真空計分光運転マニュアル
2 6 36 トムソン散乱計測装置運転マニュアル
2 6 37 ビーム強度分布計測運転マニュアル
2 6 38 Ｅ／／Ｂ?ＮＰＡ運転マニュアル
2 6 39 磁気プローブ運転マニュアル
2 6 40 複合型方向性プローブ運転マニュアル
2 6 41 ダスト検出器運転マニュアル

- Manuals on WEB site 4 -

	2_6_42_６０真空計運転マニュアル
	2_6_43_ＳＸシンチレータアレイ運転マニュアル
	2_6_44_第一壁プローブ運転マニュアル
	2_6_45_プラズマ監視カメラ・高速カメラ運転マニュアル
	2_6_46_中性子フラックスモニタシステム運転マニュアル
	2_6_47_中性子放射化箔システム運転マニュアル
	2_6_48_中性子プロファイルモニタ運転マニュアル
	2_6_49_ＩＲボロメータ運転マニュアル
	2_6_50_荷電交換分光計測、ビーム発光分光計測、モーショナルシュタルク効果分光計測運転マニュアル
	2_6_51_協同トムソン散乱装置運転マニュアル
	2_6_52_マイクロ波吸収体型漏洩波モニタ運転マニュアル
	2_6_53_14MeV中性子検出器運転マニュアル
	2_6_54_中性子揺動検出器運転マニュアル
	2_6_55_赤外線カメラ運転マニュアル
	2_6_56_ミリ波散乱計測器運転マニュアル
	2_6_57_真空容器内長期設置試料運転マニュアル
	2_6_58_ＤＮＰＡ運転マニュアル
	2_6_59_ＣＶＤダイヤモンド検出器運転マニュアル
	2_6_60_中性子スペクトロメータ運転マニュアル
	2_6_61_キャビラリープレート中性子検出器運転マニュアル
	2_6_62_ICHアンテナ監視カメラ運転マニュアル
	2_6_63_コンパクト中性子スペクトロメータ運転マニュアル
	2_6_64_ECHビームモニター用モリブデン保護板運転マニュアル
	2_6_65_揺動計測用高速カメラ運転マニュアル
	2_6_66_抵抗性ボロメータ運転マニュアル
	2_6_67_不純物粒子ドロッパー装置運転マニュアル
	2_6_68_駆動型ダイバータ試験装置運転マニュアル
	2_6_69_9OECE計測器_運転マニュアル
2_7_入退管理装置運転マニュアル	2_7_1_入退管理装置運転マニュアル
2_8_放射線総合監視システム運転マニュアル	2_8_1_放射線総合監視システム運転マニュアル
	2_8_2_ＲＭＳＡＦＥ運転マニュアル
	2_8_3_ＲＭＳＡＦＥ点検マニュアル
	2_8_4_排気塔トリチウム捕集装置運転マニュアル
	2_8_5_本体室ガスモニタ運転マニュアル
	2_8_6_排気塔ガスモニタ運転マニュアル
	2_8_7_排水・ドレン水取扱いマニュアル
2_9_トリチウム除去装置運転マニュアル	2_9_1_トリチウム除去装置運転マニュアル

- Manuals on WEB site 5 -

	2_10_分析機器運転マニュアル	2_10_1_分析機器運転マニュアル
3_管理区域関連マニュアル	3_1_イオンビーム解析装置運転マニュアル	3_1_1_イオンビーム解析装置運転マニュアル
		3_1_2_イオンビーム解析装置放射線管理マニュアル
	3_2_ECH運転マニュアル	3_2_1_ＥＣＨ運転マニュアル
	3_3_NBI運転マニュアル	3_3_1_ＮＢＩ運転マニュアル
	3_4_校正用X線源マニュアル	3_4_1_校正用Ｘ線源運転マニュアル
	3_5_ESCA・XRD運転マニュアル	3_5_1_Ｘ線光電子分光分析装置（ＥＳＣＡ）運転マニュアル
		3_5_2_Ｘ線回折装置（ＸＲＤ）運転マニュアル
		3_5_3_Ｘ線光電子分光分析装置（ＥＳＣＡ）放射線管理マニュアル
		3_5_4_Ｘ線回折装置（ＸＲＤ）放射線管理マニュアル
	3_6_微量密封線源取扱マニュアル	3_6_1_微量密封線源取扱マニュアル
4_災害及び異常時対応マニュアル	4_1_通報・連絡マニュアル	4_1_1_通報・連絡マニュアル
	4_2_地元自治体への緊急通報時に衛星電話が不通の場合の職員の派遣マニュアル	4_2_1_地元自治体への緊急通報時に衛星電話が不通の場合の職員の派遣マニュアル
	4_3_宿日直マニュアル	4_3_1_宿日直マニュアル
	4_4_防災マニュアル4_4_1_防災マニュアル	
	4_5_不法侵入・不審物・盗難等対応マニュアル	4_5_1_不法侵入・不審物・盗難等対応マニュアル
	4_6_放射線関係対応マニュアル	4_6_1_放射線関係対応マニュアル
	4_7_漏水対応マニュアル	4_7_1_漏水対応マニュアル
	4_8_ＮＢＩ異常時対応マニュアル	4_8_1_ＮＢＩ異常時対応マニュアル
	4_9_LHD真空異常時対応マニュアル4_9_1_ＬＨＤ真空異常時対応マニュアル	
	4_10_トリチウム除去装置（排気ガス処理システム）異常時対応マニュアル	4_10_1_トリチウム除去装置（排気ガス処理システム）異常時対応マニュアル
	4_11_夜間・休日等におけるECH冷却水漏水時対応マニュアル	4_11_1_夜間・休日等におけるECH冷却水漏水時対応マニュアル
	4_12_保守点検等作業時の新型コロナウイルス感染予防対策マニュアル（研究所職員・学生・協力会社社員向け）	4_12_1_保守点検等作業時の新型コロナウイルス感染予防対策マニュアル（研究所職員・学生・協力会社社員向け）
	4_13_保守点検等作業時の新型コロナウイルス感染予防対策マニュアル（請負業者向け）	4_13_1_保守点検等作業時の新型コロナウイルス感染予防対策マニュアル（請負業者向け）
	4_14_保守点検等の作業に従事する者が新型コロナウイルスに感染したことが確認された場合の対応マニュアル（研究所職員・学生・協力会社社員向け）	4_14_1_保守点検等の作業に従事する者が新型コロナウイルスに感染したことが確認された場合の対応マニュアル（研究所職員・学生・協力会社社員向け）
	4_15_保守点検等の作業に従事する者が新型コロナウイルスに感染したことが確認された場合の対応マニュアル（請負業者向け）	4_15_1_保守点検等の作業に従事する者が新型コロナウイルスに感染したことが確認された場合の対応マニュアル（請負業者向け）

- Facility Operation Manual -

- Preparing the Operation Manual for the Facilities which will be used in the Deuterium Experiment.
- This manual is prepared as one of materials which we decide whether this facility should remove before deuterium experiment or not.
- Each facility is checked its rating, usefulness and the resistivity against neutron exposure.
- Facility which is not submitted these materials and not cleared check is removed before the Deuterium Experiment.

- Operation Manual for Vacuum Evacuation System

LHD運転マニュアル／本体運転マニュアル／

真空排気装置運転マニュアル

2016年4月27日

1. 概要

このマニュアルは、真空排気装置を安全に運転するため、必要な事項を定めるものとする。真空排気装置は主として以下の3系統で構成される。

① 真空容器排気系
② ベルジャー排気系
③ プラズマ放電排気系

2. 装置の使用について

装置の使用者は、放射線業務従事者として登録された者でなければならない。 □

3. 運転・監視体制について

研究教育職員を装置責任者として技術職員が運転・監視に当たる。 □

・大気圧からの排気運転、大気開放運転については、実験統括主幹の指示の下、装置の使用者が運転操作を行うこと。 □

・プラズマ実験時における運転は、実験責任者の指示の下、装置の使用者が運転操作を行うこと。□

・その他の運転に関しては、装置責任者の判断の下、装置の使用者が運転操作を行うこと。 □

4. 定期点検について

定期点検は以下の様に分類される。

① 週間点検
② 月間点検
③ 年次点検

このうち①、②の項目については別途設ける点検リストに従って点検を行うものとする。 □

年次点検はポンプの運転時間やバルブの開閉回数等を考慮し、装置責任者の判断の下、行うものとする。 □

5. 運転開始の手順について

運転開始前に以下の項目について点検、確認を行う。詳細は別途設ける点検リストに従うものとする。

① 電源供給の確認 □
② 停止状態における各機器の健全性確認 □
③ 排気ガス処理装置が正常運転していることの確認 □
④ 圧縮空気装置、GN2供給装置から規定圧力のガスが供給されていることの確認 □
⑤ 規定流量の冷却水が流れていることの確認 □

6. 運転時について

・真空排気装置の運転モードは大きく以下の様に分類される。

① 大気圧からの排気
② 超高真空状態での定常排気
③ 大気開放
④ クライオポンプ再生・冷却
⑤ 放電洗浄・ベーキング対応
⑥ プラズマ実験時

各モードにおける運転の詳細は別途設ける運転手順書に従うものとする。 □

・運転中は遠隔操作端末により本装置の真空ポンプ等各機器の運転状況の監視及び警報監視を行う。 □

7. 異常時の対応について

火災・災害等の発見者は、直ちに防災センター及び消防署に通報すること。火災・災害等が発生した場合、装置の使用者は、防災マニュアルに従って行動すると共に必要な処置を施すこと。

大型ヘリカル装置実験を安全に遂行する上で前兆や不具合となる事象を発見した場合には、発見者は、管理区域責任者、実験責任者（メンテナンス期間中はデイリーミーティングの安全担当）、放射線管理室、及び放射線取扱主任者に直ちに連絡すること。また、作業中に万一事故が起きた場合には、作業者は、同様に管理区域責任者他へ直ちに連絡を行うとともに、別途定める災害及び異常時対応マニュアルに従って必要な処置を施すこと。

想定される不具合の例を以下に挙げる。

① 冷却水停止
② 故障等による真空ポンプの停止

以上

- Operation Manual for Coil Power Supply System

LHD運転マニュアル／本体運転マニュアル／

コイル電源運転マニュアル

2016年4月27日

1. 概要

このマニュアルは、コイル電源を安全に運転するため、必要な事項を定めるものとする。

2. 装置の使用について

装置の使用者は、放射線業務従事者として登録された者でなければならない。 □

3. 運転・監視体制について

研究教育職員を装置責任者として技術職員が運転・監視に当たる。装置の運転監視及び日常点検作業は運転員が行う。 □

4. 定期点検について

大型ヘリカル装置等の維持管理細則に定める項目に従い、定期点検を実施すること。 □

5. 運転開始の手順について

5-1. 始業点検

1. 運転が許可されていることを確認する。 □
2. 定期点検が終了していることを確認する。 □
3. コイルが通電条件を満たしているか確認する。 □

5-2. 電源の立ち上げ

1. 電源立ち上げ手順書に従って立ち上げること。 □

6. 運転時について

実験期間中は、装置の使用者は、点検で機器の健全性の確認に努めること。装置の異常・計器に異常な変化があった場合は、実験を停止し故障の原因及びその修理を優先すること。 □

1. コイルの励磁運転に、通電操作手順書に従って通電すること。 □
・LHD真空容器内の真空度及びX線キラーリミターの挿入を確認のこと。 □
2. プラズマ実験における定常運転
・通電中は、電圧・電流を遠隔にて監視のこと。 □
3. コイルの減磁運転に、通電操作手順書に従って通電すること。 □
・LHD真空容器の真空度及びX線キラーリミターの挿入を確認のこと。 □

7. 運転終了の手順について

1. 実験終了後電源を立ち下げ手順書に従って立ち下げること。 □

2. 損傷が見つかった場合は、装置責任者へ連絡する。 □

8. 異常時の対応について

火災・災害等の発見者は、直ちに防災センター及び消防署に通報すること。火災・災害等が発生した場合、装置の使用者は、防災マニュアルに従って行動すると共に必要な処置を施すこと。

大型ヘリカル装置実験を安全に遂行する上で問題や不具合となる事象を発見した場合には、発見者は、管理区域責任者、実験責任者（メンテナンス期間中はデイリーメーテナンスの安全担当）、放射線管理室、及び放射線取扱主任者に直ちに連絡すること。また、作業中にガー事故が起きた場合には、作業者は、同様に管理区域責任者他へ直ちに連絡を行うとともに、別途定める災害及び異常時対応マニュアルに従って必要な処置を施すこと。

以上

- Radiation Management Manual for Facility -

○ Deuterium Experiment : We have to keep the NIFS management level for an exhaust, drainage and dose level at the site boundary.

○ Port related Work : We have to minimize the tritium leakage into the environment.

In addition to the Facility Operation Manual, we push forward the preparation of the Radiation Management Manual in the viewpoint of the radiation management every apparatus.

- NIFS management level 1 –

- Controlled Area (Working area)
  - 1 mSv/week (100 mSv/5years)
  - 40 Bq/cm^2
- Boundary of Controlled Area
  - 1.3 mSv/3month
  - 4 Bq/cm^2
- Site Boundary
  - 50 μSv/year
- Tritium production
  - 37 GBq /year (former 6 years)
  - 55.5 GBq/year (later 3 years)
- Maximum Tritium release into environment
  - 3.7 GBq/year

- NIFS management level 2 –

○ Tritium Concentration in Working Environment (Law)

Types of Radioisotopes		Limit in Working environment
Isotope	Chemical form	(Bq/cm^3)
^3H	Gaseous tritium	1×10^{4}
^3H	triated water or vapor	8×10^{-1}

○ Tritium Concentration in Exhaust (NIFS management level)

Types of Radioisotopes		Limit in Air or Exhaust	Limit in Drainare or Waste water
Isotope	Chemical form	(Bq/cm^3)	(Bq/cm^3)
^3H	Gaseous tritium	7×10^{1}	
^3H	triated water or vapor	2×10^{-4}	6×10^{-1}
		(5×10^{-3})	(6×10^{1})

( ) : Concentration Limit in Law

- Radiation Management Manual for Entrance of Controlled Area

放射線管理マニュアル／入退管理マニュアル

1. 概要

2. 管理区域

3. 入域者登録

4. 個人線量計

5. 管理区域への入域

6. 管理区域からの退域

7. 一時立入

8. 緊急時の対応

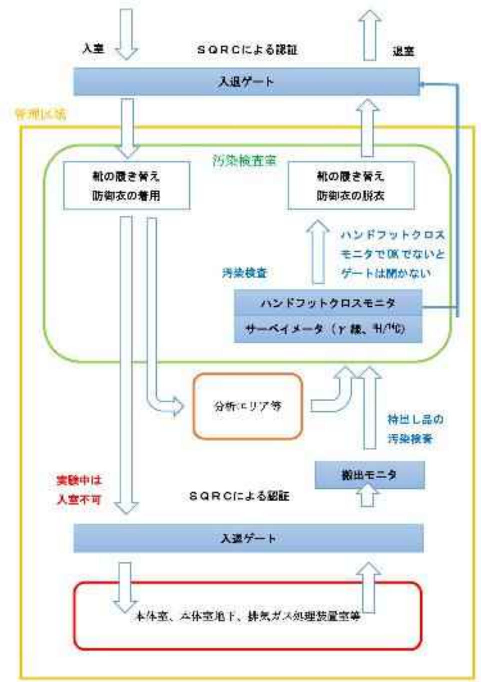


図3 管理区域への入退フロー図

- Radiation Management Manual for Port Work

放射線管理マニュアル／ポート作業マニュアル

2016年4月14日
改訂2019年3月22日
改訂2019年9月1日

1. 概要

本マニュアルは、大型ヘリカル実験装置本体室においてポート作業を行う際の安全上の注意事項に関する指針である。ポート作業を行う者（以下、ポート作業者という）は本マニュアルを必ず読んでおかなければならない。

本マニュアルの内容を変更する必要が生じた場合には、管理区域責任者を中心として変更案を作成し、放射線取扱主任者の承認を得るものとする。改定時にはポート作業者に再周知しなければならない。

2. ポート作業の定義

本マニュアルで扱うポート作業とは、メンテナンス時における、LHD本体真空容器ポート、LHDの本体真空領域と直接または各種バルブ等を介して接続する加熱機器及び計測機器等の真空容器ポートにおいて、真空回復と稼動するフランジ等の取り付け、取り外しを伴う作業のことを指す。

3. 責任体制

ポート作業を行う場合は、責任者を置け、その指示に従うこと。また、放射線の測定、管理、報告に関する適用上の責任は管理区域責任者が負う。 □

4. ポート作業者について

ポート作業の責任者は、富山大学研究推進機構水素同位体科学研究センターにおけるトリチウム安全取扱い研修を受講・修了した放射線業務従事者でなければならない。ポート作業者は、研究所が行うトリチウム安全取扱い研修を受講・修了した放射線業務従事者でなければならない。 □

5. マンホールフランジ開放作業

実験サイクルが終了し、プラズマ真空容器及びNBI真空容器を大気開放後最初にマンホールフランジを取り外す作業にあたっては、本体室への立ち入りについて事前に放射線取扱主任者と協議し、その指示に従うこと。 □

6. 作業の手順

ポート作業の手順を以下に示す。なお、各手順において放射線管理室の職員から指示があった場合は、その指示に従わなければならない。 □

6-1. 作業準備

①ポート作業の責任者は作業前に放射線作業届及びLHD周辺機器改造に関するチェックリスト（真空チェックリスト）」を放射線管理室に提出し、管理区域責任者と放射線管理室長の同意を得ること。

1/5/1

□
②本体室入室前に、汚染検査室においてポート作業専用の作業着、靴、手袋を着用すること。 □
③本体室入室時は、放射線総合監視システムが正常に動作していることを確認すること。また、別途定める放射線管理マニュアル／入退管理マニュアルに従うこと。 □

6-2. 機器設置および取り外し手順

作業時はトリチウムの本体室内流出を最小限にするよう配慮すること。ポート作業のフローチャートを図1に示す。

（1）機器ゲートバルブが閉状態の場合

①トリチウムモニタにより機器内部の残留トリチウムを計測すること。 □
②残留トリチウムが検出された場合は除去を行い、再度残留トリチウムを計測すること。 □
③トリチウムが除去できない場合は作業を中止するか、簡易作業室／ケースを設置し作業を行うこと。 □
④残留トリチウムが検出されない場合、ポート周囲に非酸ビニルシート等を用い適切な養生を行い、トリチウム濃度を計測しながら作業を行うこと。 □

（2）機器ゲートバルブが開状態もしくはゲートバルブが

①ポート周囲に非酸ビニルシート等を用い適切な養生を
行うこと
②①でトリチウムが検出された場合は速やかに作業を
するよう必要な措置を講ずること
③②の場合で引き続き作業が必要な場合は、簡易作業室

（3）簡易作業室／ケース作業

①トリチウム除去装置に繋がる空気吸い込み口を設け
②簡易作業室内での作業にあたっては、真空容器内作
ること。また、入室にあたり、換気がなされている
③機器からのトリチウム曝露を最小限にするため、取
と。作業終了後、取り外した機器のトリチウム除去を
④簡易作業室退室にあたっては、使用した作業着、靴、
により汚染の有無を確認すること。汚染がある場合は
処置をとること。

6-3. 機器設置および取り外し後

①開放したポート内その主な放置せず、作業終了後は速
②本体室退室時は、放射線総合監視システムが正常に動
定める放射線管理マニュアル／入退管理マニュアルに

1/5/1

7. 異常時の対応

火災・異常等の発見者は、直ちに防災センター及び消防署に通報すること。火災・異常等が発生した場合、装置の使用者は、防災マニュアルに従って行動するとともに必要な処置を施すこと。

大型ヘリカル装置実験を安全に遂行する上で問題や不具合となる事象を発見した場合には、発見者は、管理区域責任者、実験責任者（メンテナンス期間中はデイリーミーティングの安全担当）、放射線管理室、及び放射線取扱主任者に直ちに連絡すること。また、作業中に万一事故が起きた場合には、作業者は、同様に管理区域責任者他へ直ちに連絡を行うとともに、別途定める異常及び異常時対応マニュアルに従って必要な処置を施すこと。

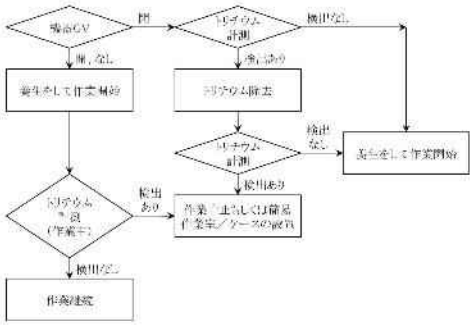


図1 ポート作業のフローチャート

以上

- Emergency Manual -

We are preparing the Emergency Manual during the Deuterium Experiment to keep the consistency with the conventional disaster prevention manual.

○ Basic way of thinking to an emergency and a disaster

In the event of a disaster or accident, we have to pay attention to neutrons and tritium, which can affect the environment.

Followings are basic way of thinking to the deuterium experiment safety at an emergency and a disaster.

1) Minimize the quantity of occurring tritium.

2) Limit the quantity of tritium remaining in a VV which does not exceed the management level, even if a gross quantity is released.

3) Keep the management level of the radiological generations, such as Ar-41, which have a possibility to give influence on the environment.

4) Pay attention severely to a leak of the recovered water.

- Emergency Manual - Report & Contact

災害及び異常時対応マニュアル／通報・連絡マニュアル

2020年4月1日

1. 概要

2. 連絡先

3. 連絡手段

4. 連絡体制

5. 通報・連絡事項

5-1. 緊急通報事項

5-2. 遅滞なく連絡すべき重要事項

5-3. 通報の基準を下回る災害発生時の報告事項

5-4. その他連絡すべき事項

6. その他

別紙2

○岐阜県及び3市への緊急時の連絡先

連絡先		連絡手段					
		時間内			時間外・休日		
		固定電話 ○	固定電話 ×	固定電話 × 衛星電話 ×	固定電話 ○	固定電話 ×	固定電話 × 衛星電話 ×
岐阜県	環境生活部環境管理課	電話及びFAX			電話又は携帯		
岐阜県	東濃県事務所環境課		衛星(電話及びFAX)	派遣		衛星(FAX)	派遣
土岐市	総務部行政経営課	電話及びFAX	衛星(電話及びFAX)	派遣	電話又は携帯	衛星(FAX)	派遣
多治見市	企画部企画防災課	電話及びFAX	衛星(電話及びFAX)	派遣	電話又は携帯	衛星(FAX)	派遣
瑞浪市	総務部企画政策課	電話及びFAX	衛星(電話及びFAX)	派遣	電話又は携帯	衛星(FAX)	派遣

時間内の固定電話によるFAXは、一斉送信により実施

時間内の衛星電話によるFAXは、回線が1回線のため電話連絡の後、順次実施

時間外・休日の電話又は携帯：県・3市担当者等の電話又は携帯

※ 固定電話が不通のときの連絡手段は、防災センター設置の衛星電話により、東濃県事務所環境課及び3市担当課に直通の衛星電話とする。

※ 固定電話・衛星電話が不通のときは、東濃県事務所及び3市担当課へ人を派遣する。

・関係自治体勤務時間中（8:30～17:00）の連絡先

岐阜県：環境生活部環境管理課
TEL：058-272-1111（2831、2836）
058-272-8232（直通）
FAX：058-278-2610

土岐市：総務部行政経営課
TEL：0572-54-1111（533）
FAX：0572-54-1127

多治見市：企画部企画防災課
TEL：0572-22-1111（1412）
0572-22-7188（直通）
FAX：0572-24-0621

瑞浪市：総務部企画政策課
TEL：0572-68-2111（333）
FAX：0572-68-8749

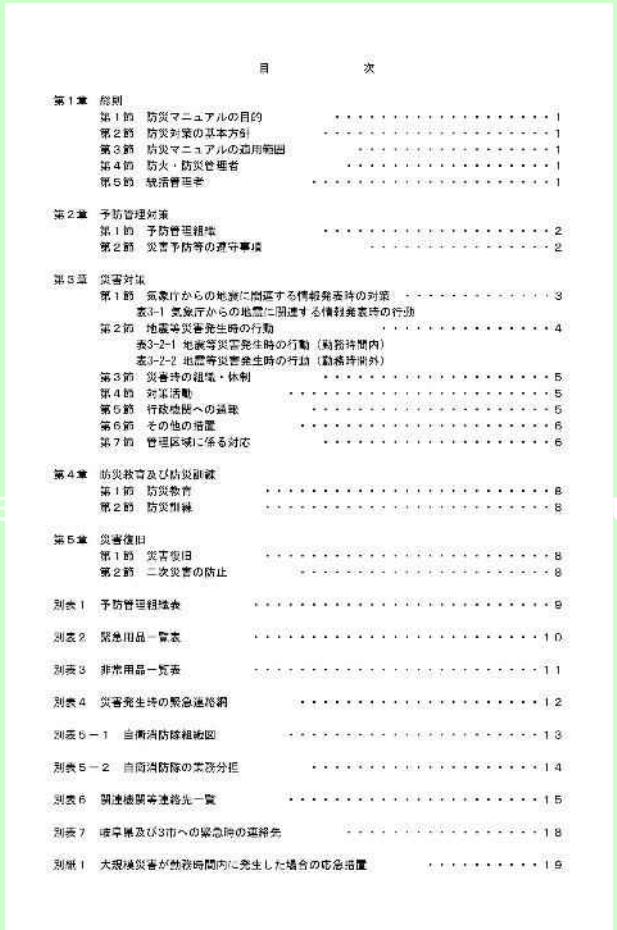
- Disaster Prevention Manual -

防災マニュアル

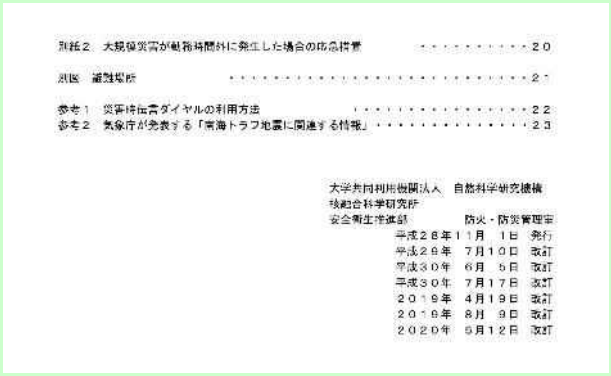
（重水素実験対応）

2020年版

自然科学研究機構　核融合科学研究所



目　　次

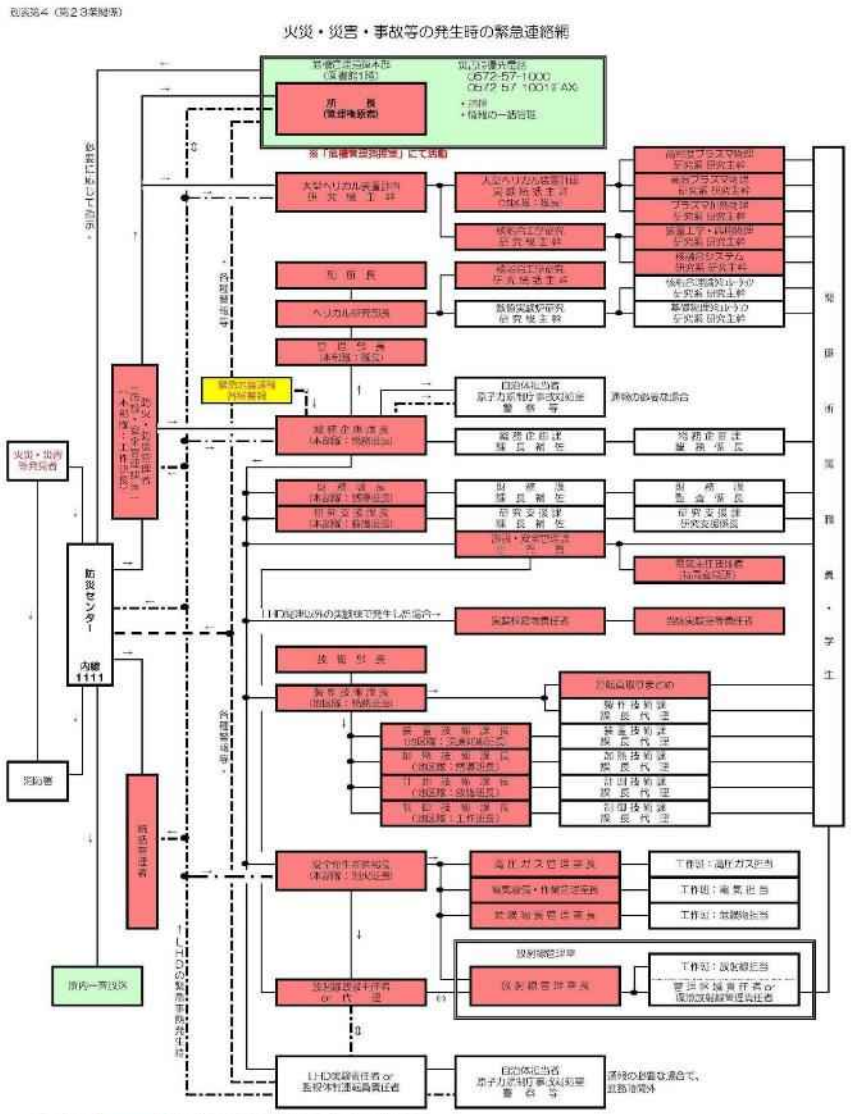


大学共同利用機関法人　自然科学研究機構
核融合科学研究所
安全衛生推進部　　防火・防災管理室
平成２８年１１月　１日　発行
平成２９年　７月１０日　改訂
平成３０年　６月　５日　改訂
平成３０年　７月１７日　改訂
２０１９年　４月１９日　改訂
２０１９年　８月　９日　改訂
２０２０年　５月１２日　改訂

http://safety2.nifs.ac.jp/bousai/rule/manual2020.pdf

- Network at Emergency -

別表４　災害発生時の緊急連絡網



緊急連絡先（Emergency Contact）

■防災センター（Disaster Control Center）
内線（Extension）　：1111
外線（Outside Call）：0572－58－2070

■門衛所（Guard Station）
内線（Extension）　：2071

■制御室（Control Room）
内線（Extension）　：2445

■消防署（Fire Department）
外線（Outside Call）：　119

Emergency Contact Information

Emergency Network

- Self Fire Brigade -

別表５－１　自衛消防隊組織図

所長	隊長	副隊長	部隊長	班	班長（統括者）	班員		
所長（管理権原者）	技術部長（統括管理者）	副所長	（本部隊）管理部長	総務班	管理部 総務企画課長	管理部 総務企画課（総務係，企画・評価係，対外協力係，専門職員，人事係，職員係）		
				消火班	安全衛生推進部長	管理部 財務課（財務課長補佐，経営係，調達係）		
				誘導班	管理部 財務課長	管理部 財務課（専門職員，経理・監査係，経理係，調達係） ヘリカル研究部（基礎物理シミュレーション研究系） 情報通信システム部		
				救護班	管理部 研究支援課長	管理部 研究支援課（研究支援課長補佐，研究支援係，国際支援係，大学院連携係，学術情報係，ビジターセンター係） ヘリカル研究部（核融合理論シミュレーション研究系）		
				工作班	管理部 施設・安全管理課長	施　設	管理部 施設・安全管理課（施設課長補佐，施設管理係）	
						電　気	電気設備・作業管理室長	管理部 施設・安全管理課（施設管理係）
		大型ヘリカル装置計画研究総主幹	（地区隊）大型ヘリカル装置計画実験統括主幹	総務班	技術部 製作技術課長	技術部 製作技術課（資材企画係，回路技術係，機械技術係，機械整備技術係） 技術部 装置技術課（装置システム技術係，電源技術係，実験応用技術係，真空技術係） 技術部 加熱技術課（加熱システム技術係，粒子加熱技術係，電子加熱技術係，イオン加熱技術） 技術部 計測技術課（放射線計測システム技術係，実験放射線計測技術係，環境放射線計測技術係，放射線計測機器制御技術係） 技術部 制御技術課（制御システム技術係，情報基盤技術係，低温制御技術課係，制御情報技術係） ヘリカル研究部（高密度プラズマ物理研究系，高温プラズマ物理研究系，プラズマ加熱物理研究系，装置工学・応用物理研究系，核融合システム研究系）		
				現場対応班	技術部 装置技術課長			
				誘導班	技術部 加熱技術課長			
				救護班	技術部 計測技術課長			
				工作班	技術部 制御技術課長	高圧ガス	保安技術管理者	保安係員，保安監督者，保安係員代理，保安監督者代理
							取扱責任者	取扱責任者代理
							冷凍保安責任者	冷凍保安責任者代理
						放射線	放射線取扱主任者	管理区域責任者，環境放射線管理責任者，放射線管理室長
						電気	電気責任者	電気装置責任者
						危険物	危険物質管理者	危険物質保管庫責任者

(4) As the Inter-University Research Institute, do you properly provide safety management and education to staff and collaborators?

大学共同利用機関として、所員及び共同研究者に対する安全管理・教育を適切に行っているか。

Education

- General Safety Lecture and Radiation Safety Lecture are held for all workers, including students and collaborators.

  Workers are required to take lectures every year.

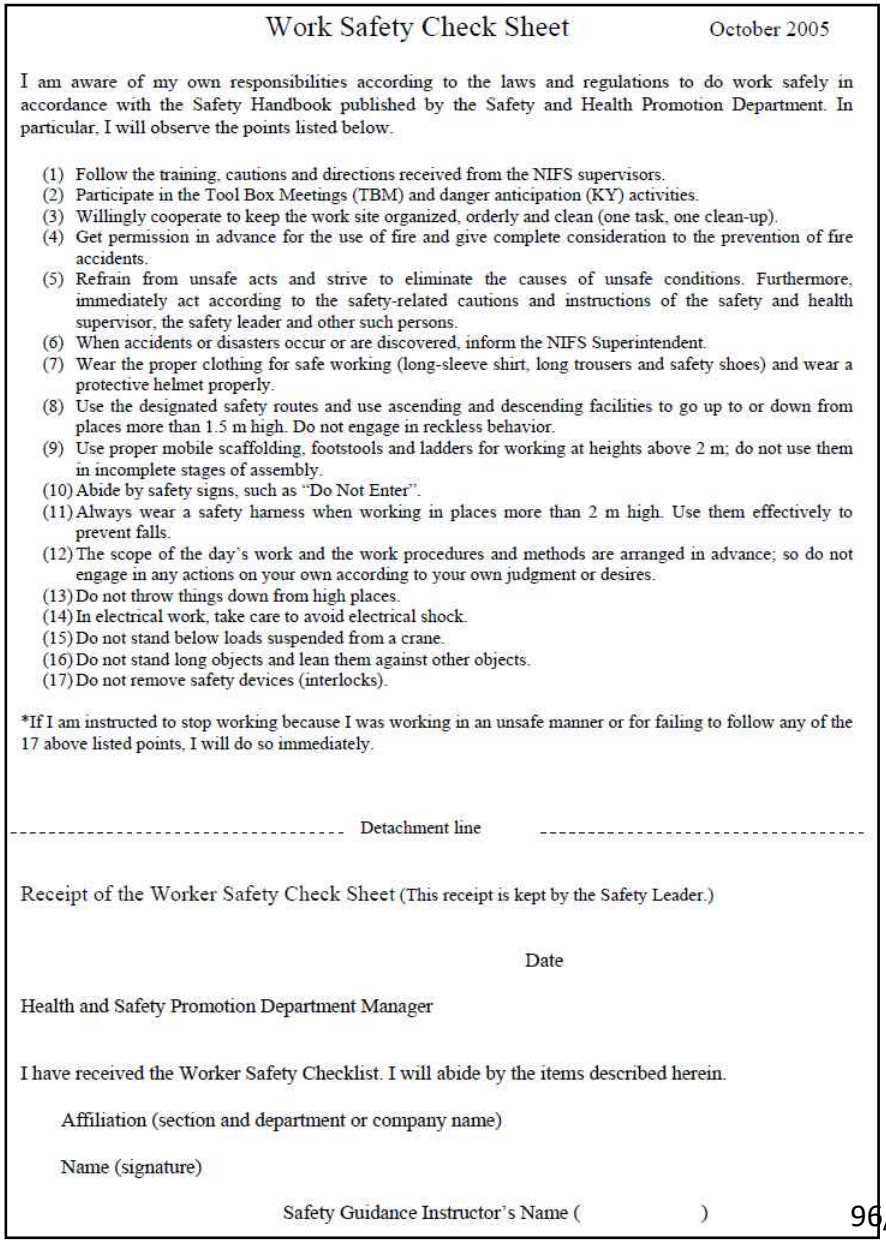
- Those who have possibility to contact with tritium during work, such as port work and work inside a vacuum vessel, require additional training for treatment of unsealed RI.

Education for the visiting co-researchers

- Safety education
  - All the co-researchers are requested to take a safety lecture and a radiation safety lecture before they start the collaboration work.
  - A guideline is presented in the “NIFS Safety Handbook”
  - A covenant should be signed after the lecture.
- Radiation safety control
  - Co-researchers who want to engage in the controlled area (ex. LHD hall) should be registered as radiation worker before they start the research
    - Registration should be carried out at their own universities
    - If their university could not go through the registration procedure, NIFS would do it instead
  - A card key to access the LHD building is issued to the co-researcher.
  - And a Lumines badge with QR code to access the controlled area are issued to the radiation worker.

Education for the foreign co-researchers

- Safety education for the foreign co-researchers is carried out in English by their caretaker
  - All the co-researchers are requested to take a safety lecture before start of their collaboration work in the controlled area.
  - A guideline is presented in the “NIFS Safety Handbook”
  - A covenant should be signed after the lecture
- Warning signs are presented in English.
- English version of NIFS Safety Handbook is available.



Work Safety Check Sheet October 2005

I am aware of my own responsibilities according to the laws and regulations to do work safely in accordance with the Safety Handbook published by the Safety and Health Promotion Department. In particular, I will observe the points listed below.

(1) Follow the training, cautions and directions received from the NIFS supervisors.
(2) Participate in the Tool Box Meetings (TBM) and danger anticipation (KY) activities.
(3) Willingly cooperate to keep the work site organized, orderly and clean (one task, one clean-up).
(4) Get permission in advance for the use of fire and give complete consideration to the prevention of fire accidents.
(5) Refrain from unsafe acts and strive to eliminate the causes of unsafe conditions. Furthermore, immediately act according to the safety-related cautions and instructions of the safety and health supervisor, the safety leader and other such persons.
(6) When accidents or disasters occur or are discovered, inform the NIFS Superintendent.
(7) Wear the proper clothing for safe working (long-sleeve shirt, long trousers and safety shoes) and wear a protective helmet properly.
(8) Use the designated safety routes and use ascending and descending facilities to go up to or down from places more than 1.5 m high. Do not engage in reckless behavior.
(9) Use proper mobile scaffolding, footstools and ladders for working at heights above 2 m; do not use them in incomplete stages of assembly.
(10) Abide by safety signs, such as “Do Not Enter”.
(11) Always wear a safety harness when working in places more than 2 m high. Use them effectively to prevent falls.
(12) The scope of the day’s work and the work procedures and methods are arranged in advance; so do not engage in any actions on your own according to your own judgment or desires.
(13) Do not throw things down from high places.
(14) In electrical work, take care to avoid electrical shock.
(15) Do not stand below loads suspended from a crane.
(16) Do not stand long objects and lean them against other objects.
(17) Do not remove safety devices (interlocks).

*If I am instructed to stop working because I was working in an unsafe manner or for failing to follow any of the 17 above listed points, I will do so immediately.

---------- Detachment line ----------

Receipt of the Worker Safety Check Sheet (This receipt is kept by the Safety Leader.)

Date

Health and Safety Promotion Department Manager

I have received the Worker Safety Checklist. I will abide by the items described herein.

Affiliation (section and department or company name)

Name (signature)

Safety Guidance Instructor’s Name ( )

Training

For a person who want to work in LHD, it is necessary to take class not only for "a vacuum work in LHD“ but also for "the tritium safely handling course" which is held in the Hydrogen Isotope Research Center in Toyama University. In this class, students learn the actual tritium handling.
The contents of the training are as follows.

- knowledge about tritium
- the lecture about the radiation preventive rule
- the tritium measurement using the tritium detecting device
- tritium decontamination
- training of safe port work

Identification of completion is conferred on a person of completion by the center.

Training and Nurturing for Safety Responsible Manager

Safety Lecture

Tritium Safely Handling Course

- Training Program of Tritium Safely Handling Course -

トリチウム安全取扱い研修日程表

	9:00	9:15	10:30	10:45	11:30	12:00	13:30		15:00	15:15	16:00	16:45
(1日目)							共同利用控室（集合）	オリエンテーション (1)センター長挨拶（松山） (2)研修について（西村） (3)教育訓練（水素研予防規程）（阿部）	休憩	講義 (1)トリチウムの基礎。(松山) (2)計測器の取扱説明(阿部)	講義・実習 (1)研修概略・注意点について(林) (2)現場にて管理区域立入に関する説明(阿部) (3)荷解き、作業準備	
(2日目)	共同利用控室（集合）	講義・実習 (1)真空装置作業説明(鈴木・林) (2)真空装置内トリチウム濃度測定(トリチウムモニタ取扱) (3)トリチウム除去（除去装置の取扱）	休憩	実習 (1)フランジ作業 (2)真空排気		昼食	実習 (1)QMASS確認 (2)リークチェック (3)チャンバー大気開放 (4)トリチウム濃度測定		休憩	実習 フランジ作業（作業者を変えて）		
(3日目)	共同利用控室（集合）	実習 片づけ、廃棄物処理、汚染検査	休憩	実習 スミア・サーベイメータ・液体シンチレーション実習	修了式 修了証授与他	昼食						

(5) Is the training of leaders to carry out safety management properly planned and implemented?

安全管理を遂行するための指導者の養成は適切に計画・実行されているか。

- Training of Leaders

the first-class Radiation Protection Supervisor qualification

- Radiation control is essential to safely carry out the LHD experiments.
- To lead radiation control, knowledge of radiation law is required.
  For this purpose, it is desirable to obtain the qualification of the first-class Radiation Protection Supervisor.
- Every year, several people from the Research Department and the Engineering Technical Department are encouraged to acquire the qualifications of the 1st class Radiation Protection Supervisor.
- Specifically, it is a support for the cost of attending a pre-examination course, taking an examination, and practicing after passing the examination.
- In addition, it is recommended that the qualification of Working Environment Measurement Expert be acquired mainly by the Radiation Protection Supervisor.

Qualification holder

- Rearcher : 18
- Engineers : 8
- Others : 1
- Radiation Protection supervisor : 5
- Working Environment Measurement Expert : 2

Training of Leaders

Qualifications related to the high-pressure gas

Production Safety Management Certificate

- Since the LHD is a device with a superconducting coil, liquid helium is used. Therefore, a qualification related to high pressure gas is required for operation.
- The low temperature group consists of the Research Department and the Engineering Technical Department members, and each of then is required to obtain a qualification related to the high-pressure gas.
- In cooperation with the experiment group, we are promoting human resource development and qualification acquisition (several per year) with an eye on generational change.

Qualification holder

- Class B Mechanical Safety Management Certificates : 34
- Class 1 Refrigeration Safety Manager Certificates : 11
- Specific High-Pressure Gases Handling chief : 5

Training of Leaders

Qualifications of Health Manager and Safety Manager

- Health managers and safety managers are indispensable for workplace safety and health management.
- NIFS has selected one safety manager and five health managers.
- Health managers are selected from the Research Department, Administration Department, and Engineering Technical Department in order to deepen the awareness of safety and health among many staff members.
- The term of office is two years, and half of them change every year.
  Therefore, every year, several people are qualified as Class-1 Health Officer's license.

Qualification holder

- Class-1 Health Officer's license

Research Department	: 12
Engineering Technical Department	: 5
Administration Department	: 8

Overview of the Division of Information and Communication Systems

Seiji Ishiguro and ICS members

Points for Evaluation

1. Is the information and communication system as a research platform properly constructed and operated ?

2. Is the division of information and communication systems properly responding to requests for information system development from inside and outside the institute?

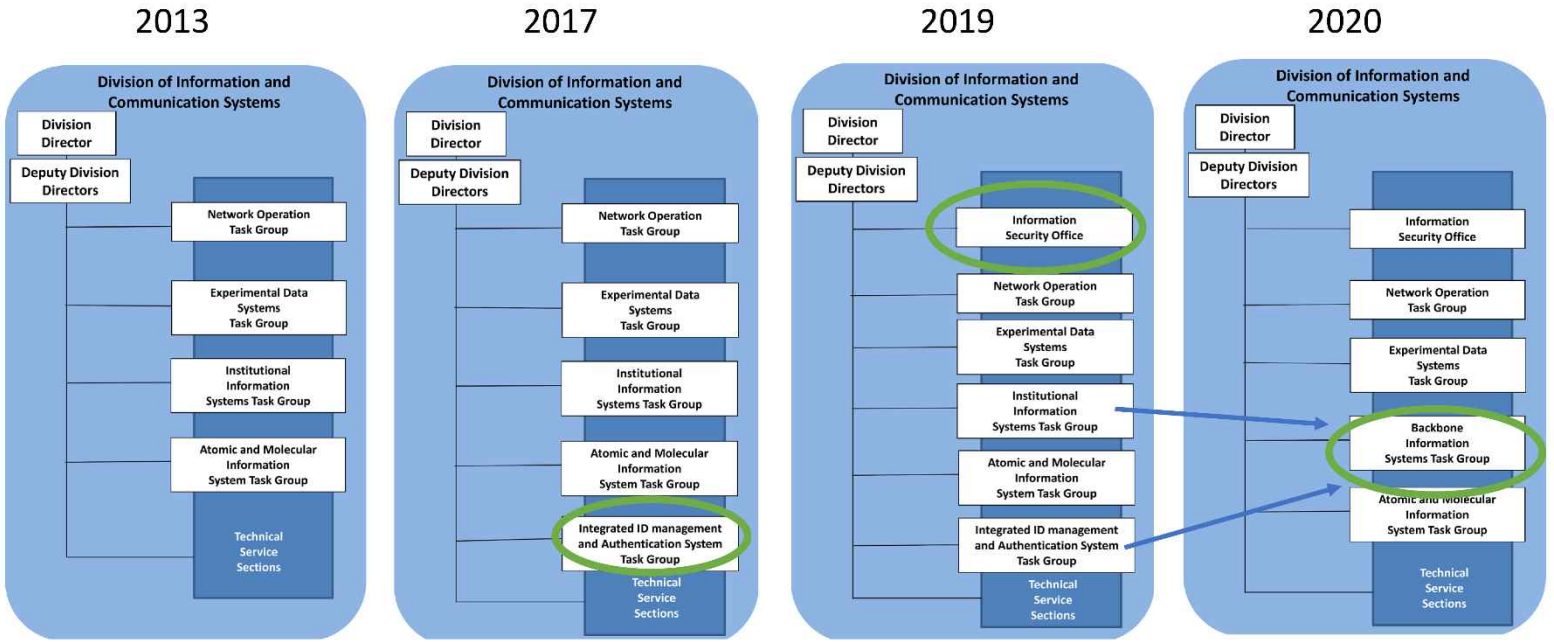
3. Is the organization of the division of information and communication systems functionally and operated ?

Outline

0. Introduction
1. Information and communication systems as a research platform
2. Response to requests for information system from inside and outside the institute
3. Organization and functionality

Introduction

- Division of Information and Communication Systems (ICS) was established in April 2013 as an organization that builds and operates information systems and information networks by consolidating the information-related organizations of the institute that were operating independently.
- The organization has changed in response to changes in the external environment, etc.



Introduction (Cont.)

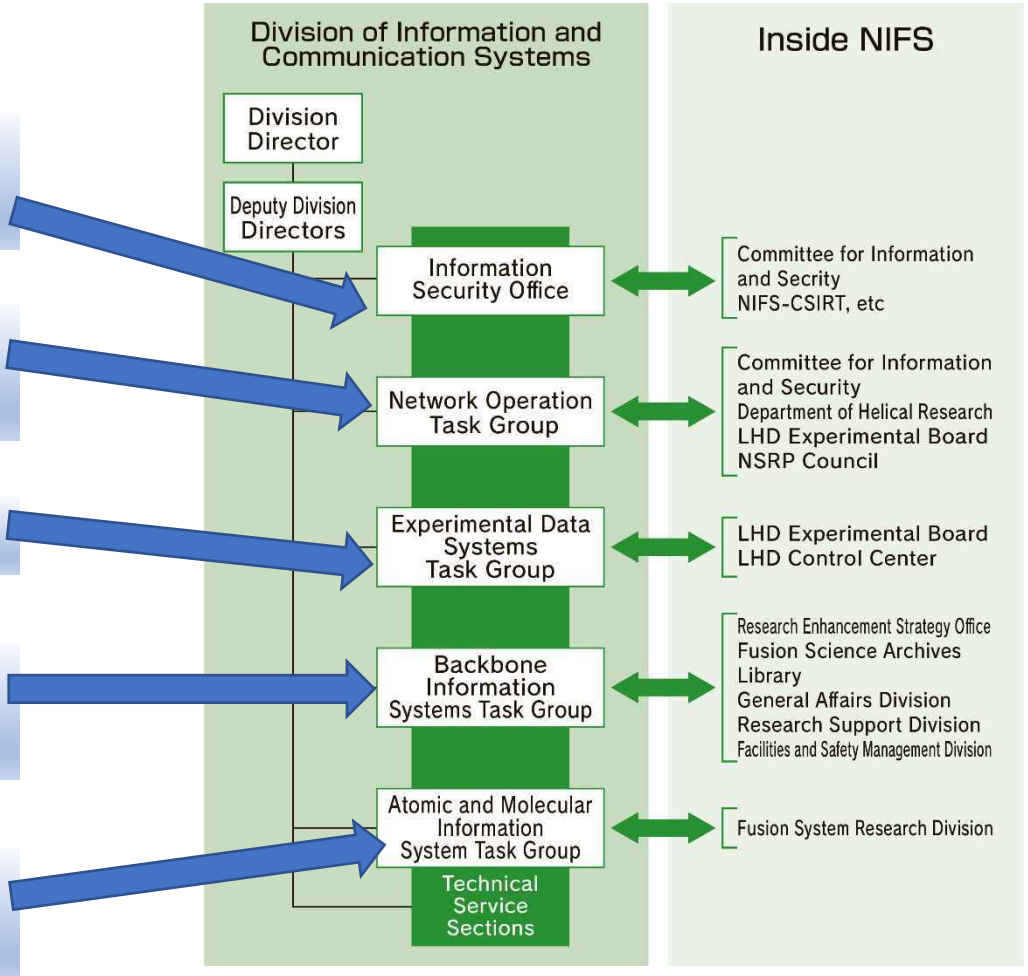
Information security survey, education

Network, mail service, security measures,

LHD experiment support

Development of backbone system, software distribution

Atomic and Molecular database management and web publishing

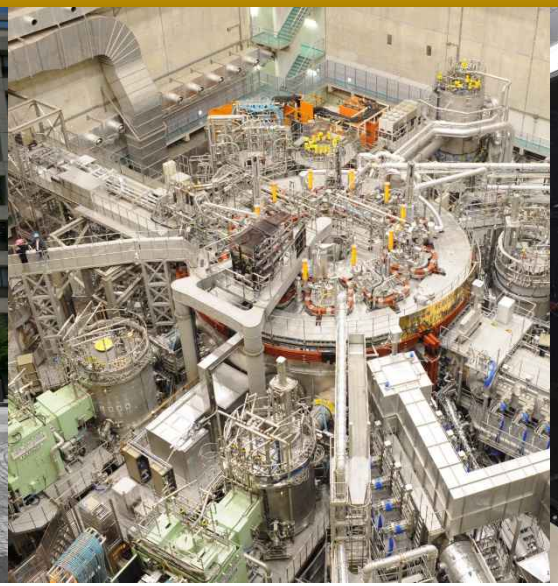


1. Information and communication systems as a research platform

・Is the information and communication system as a research platform properly constructed and operated?

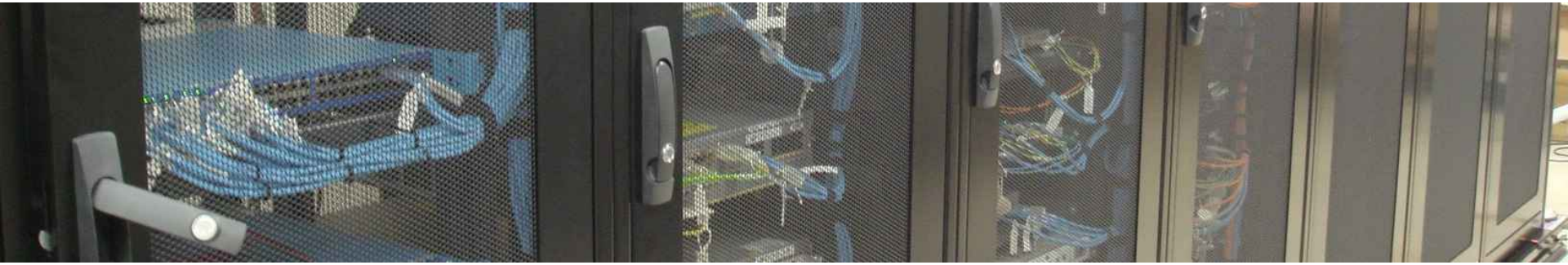
Network infrastructure

Research activities and Administration
NIFS-LAN



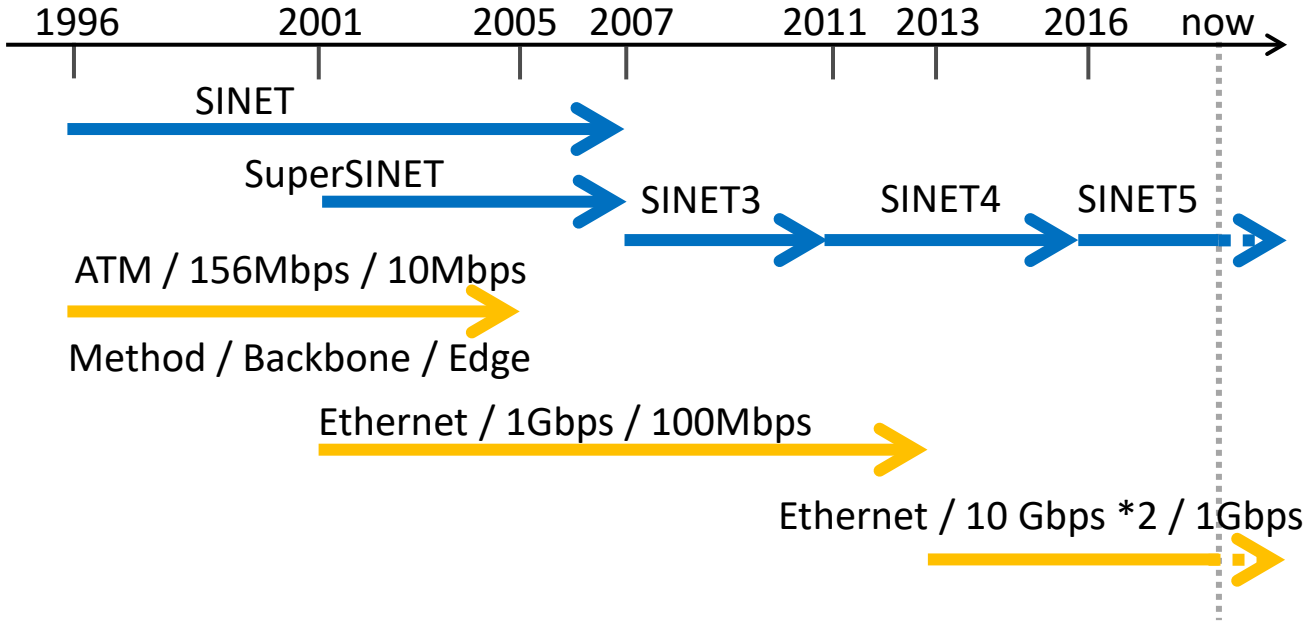
LHD experimental
LHD-LAN

Plasma Simulator
PS-LAN



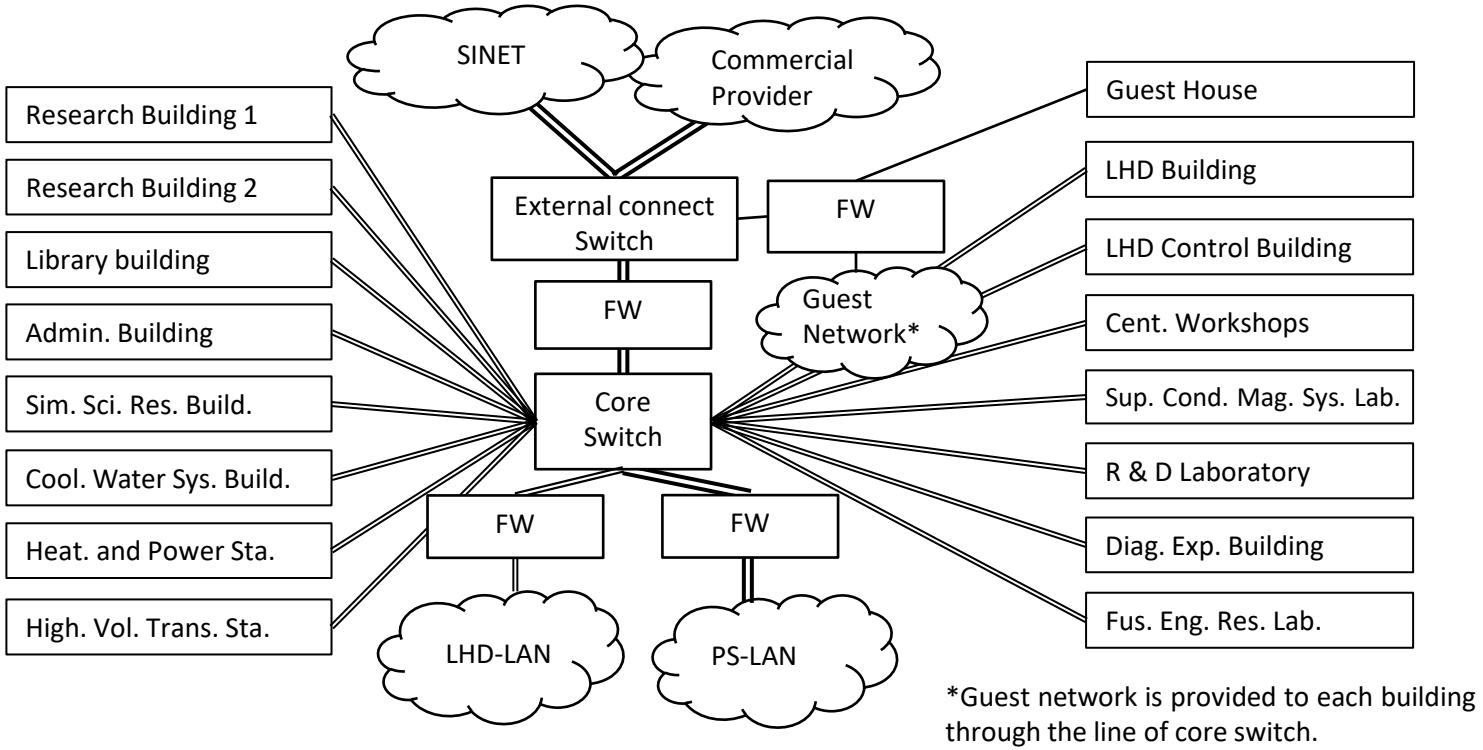
Network Operation Task Group supports research activities of NIFS by managing the network infrastructure, access-line, fiber and metal line, L2 /L3 switch, firewall, SSL-VPN server, DNS, mail, and so on. The network of NIFS consists NIFS-LAN, LHD-LAN, PS-LAN, and Guest Network.

Network Infrastructure



Progress of SINET and NIFS Campus network. SINET is an academic wide area network in Japan operated by National Institute for Informatics. The network of NIFS is connected to SINET with 10 Gbps lines via optical cables provided by Gifu information super-highway, a metro area network operated by Gifu Prefectural Gov. The internet connectivity is very important, the access line is contracted with a commercial provider that even if SINET data center is down, the internet connectivity is valid via commercial provide network.

Network Infrastructure (2)



*Guest network is provided to each building through the line of core switch.

Network connectivity map of NIFS campus network, NIFS-LAN. All of traffic of NIFS-LAN and the internet is controlled by a firewall. Network Operation TG provides the Guest Network, which is segmented by NIFS-LAN, for guest researchers to access the internet easily. Wi-Fi is serviced only on Guest Network.

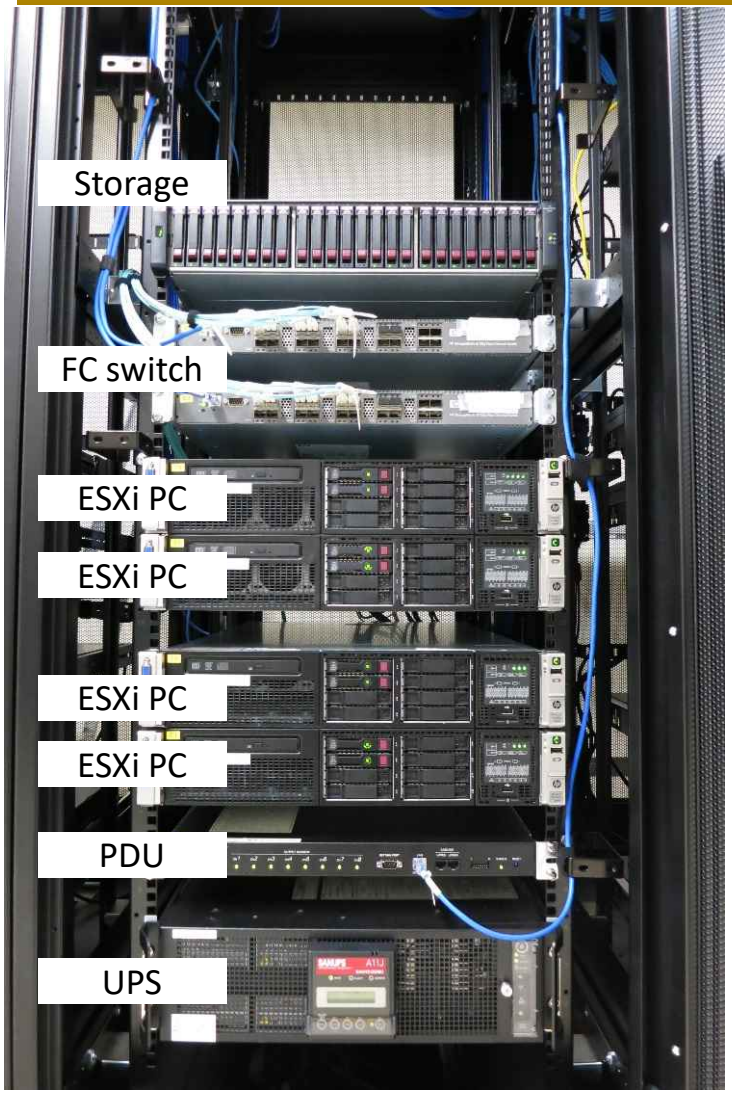
Edge switches on the building are connected to Core switch with 2 10Gbeps lines for redundancy. The single-mode optical fibers are laid between buildings. Most of the metal cable in the building is replaced from Category 5 to Category 6 to ensure the connection with 1 Gbps.

Security measure

- AntiVirus
  - is provided to the staff of NIFS from 1999.
  - is ESET Endpoint Protection standard from June 2020.
    - Monitoring servers check the PC states on NIFS-LAN and LHD-LAN.
    - Symantec Endpoint Protection had used for a long time, but the product distribution was unstable since Symantec was buyout.

- Firewall
  - connects NIFS-LAN and the internet to control the inner and outer connections.
  - distincts Web sites which staff access and block some URL for security.
  - detects the application on the connection and disconnect some application for security.

Virtual infrastructure system

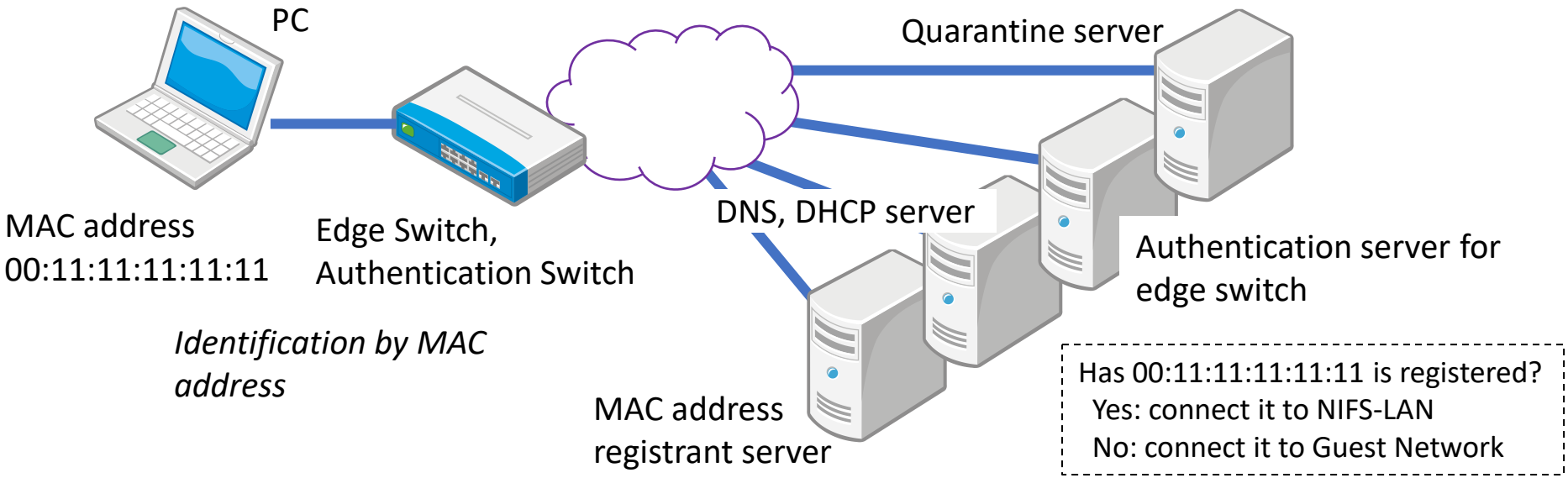


- Network Operation TG managed the virtual infrastructure system has built with servers, RAID-6 storage, and VMware ESXi to do the central management on several network services such as DNS, DHCP, Mail and so on.
- It is connected a power management system to avoid the damage by unplanned power outage.
- The virtual infrastructure system offer a common service for NIFS. For example, several public web servers managed by Division of Information and Communication Systems have moved to this system, recently. The number of servers operated in this system is 38 on Nov. 2020.
- *This system will be upgraded in FY 2020.*

PDU: Power Distribution Unit

Quarantine and authentication system

NIFS-LAN has a unique function controlling the connection of PC to prevent the connect of unauthorized PC from 2014. The information about PC and user must be registrant to the authentication system.

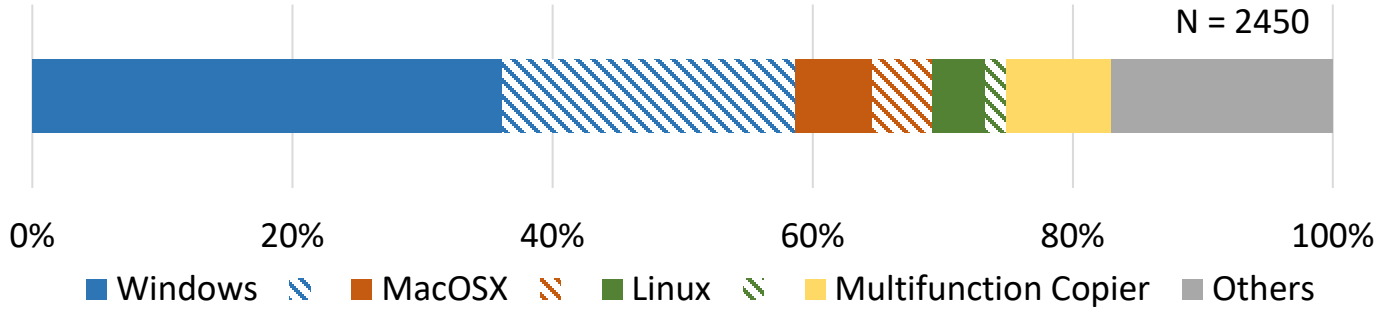


The registrant should attend the information security course held by Information Security Office each year.

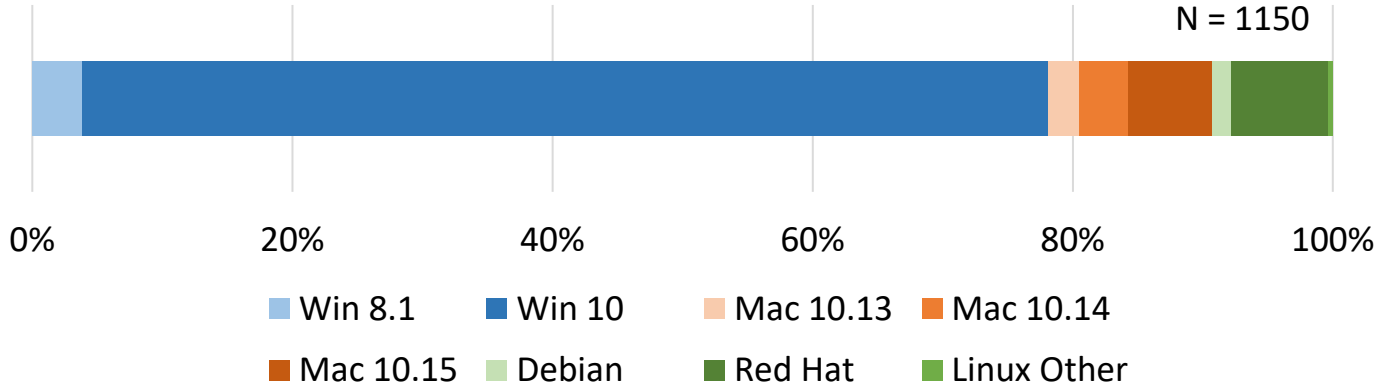
The PC is automatically checked the security requirements, OS and the virus definition file of anti-virus program is latest or not, when the user connected quarantine server and run the quarantine program. This procedure is required each 3 months to keep the online.

Quarantine and authentication system (2)

The PC with old OS, unsupported OS, cannot connect NIFS-LAN by the configurate Quarantine System to deny the old OS.



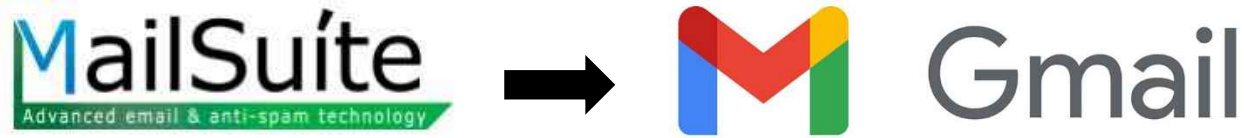
The distribution of PC registered on NIFS-LAN. The hatch shows the percentage of expired PC. Multifunction copier is not set the expire term as it cannot run the quarantine program.



The detail OS information is obtained by the quarantine program. Windows 10 is widely used on NIFS-LAN and Red Hat included CentOS and Fedora is dominant on Linux distribution.

Mail Service

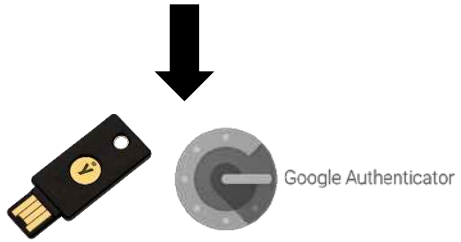
- Mail service on NIFS has migrated from MailSuite, an integrated mail software, to Google Gmail on September 1st , 2020.



- Motivations of the migration:
  - Maintenance term of MailSuite will be end at this financial year.
  - Request from staff that mail service should be up 24x7 is hard.
    - It needs to overcome the power outage due to legal inspection.
  - IP reputation of mail server is so low that sometimes the mail is not accepted as our mail server might seemed to be used by spammer.
- On the migration term, the forward configuration was setup to the mail could be received on both MailSuite and Gmail, the staff of NIFS could migrate to Gmail on the term.
- No major problem was occurred on the migration term.

Mail Service (2)

- 2-Step authentication is mandatory because of the security trend.
  - MailSuite had customized to use 2-Step authentication. Onetime passwd (OTP) cards were used.
  - YubiKey, small USB-connect authentication device, have distributed to all the staff of NIFS.
  - SMS or authentication app on smartphone is permitted to use.

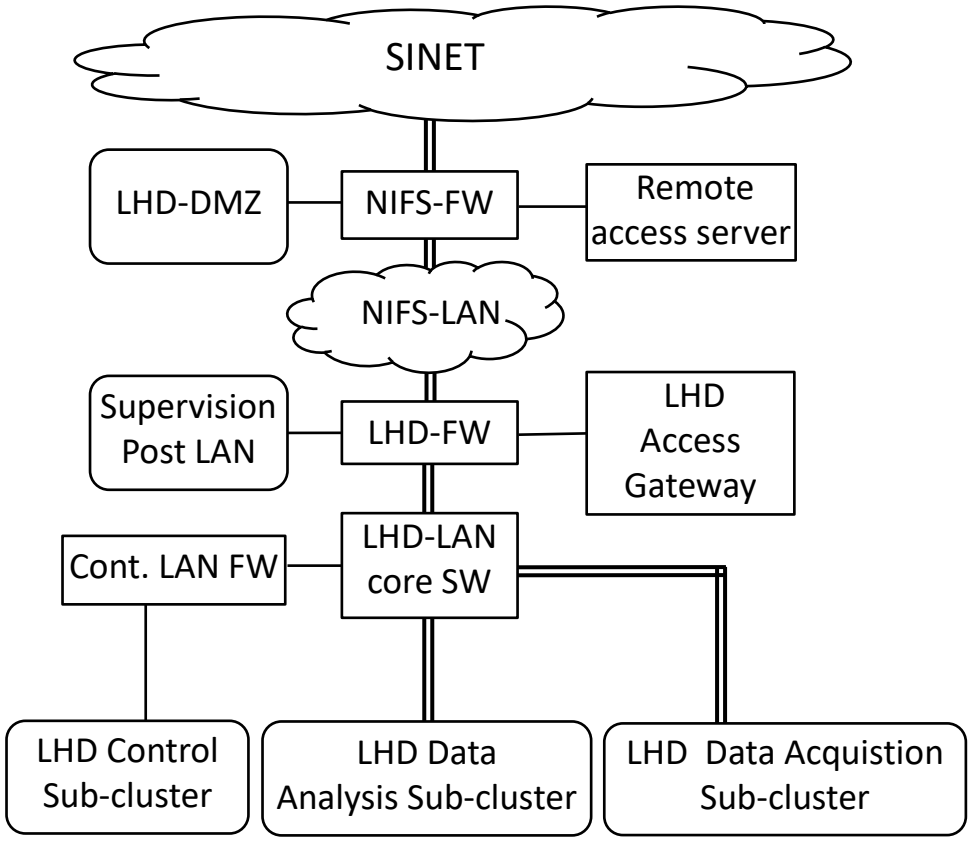


- All the migration process are done by the administrator, not user.
  - Account setting
  - Mail Spool on MailSuite
    - It takes more than a week. Number of account is about 400, and number of mail to migrate is about 4 million.
  - ML
    - ML, members of ML, and the detail configurations.
    - More than 40 configuration is there on Google Group.
    - Setting tools for Group configuration is not provided by Google, so small handmade programs written by Google Apps Script to call Admin API was used.

LHD-LAN

- LHD experimental LAN, LHD-LAN is dedicated to carry out the LHD experiment. It is separated from NIFS-LAN by FW.
- The PC on NIFS-LAN cannot directly reach LHD-LAN, an access-gateway server, which checks the security condition of PC and password authentication of user, controls whether PC can reach the LHD-LAN or not.
- LHD-LAN consists several segments, control sub cluster is separated by FW.
- Wifi is prohibit on LHD-LAN for security, Wifi on Guest Network is prepared in the control room.

LHD-LAN (2)



Supervision Post LAN is used to connect the PCs whose OS is unsupported and needed to the experimental. The connection to other PC is limited by LHD-FW.

LHD-DMZ is used to inform the LHD experimental. The servers on LHD-DMZ send general information.

Outside research collaborator can access LHD-LAN via Remote access server on NIFS-FW, SSL-VPN server, which requests 2-Step authentication and checks the terminal's security condition.

Network infrastructure development for guests/collaborators

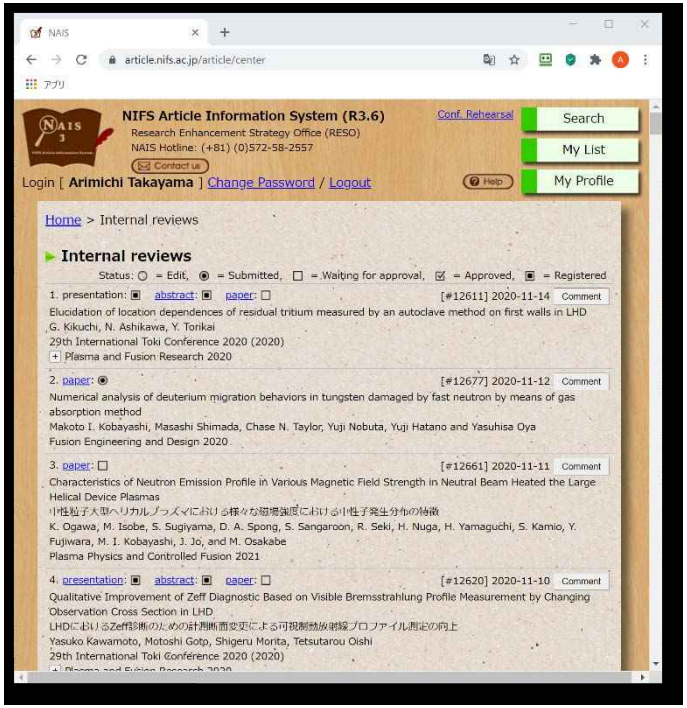
- User authentication system for remote access service
  - NIFS information network is protected from external accesses by a firewall system. In order to conduct collaborative works, we provides a remote access service by use of an SSL-VPN device. For better security, we impose multi-factor authentication.
  - The SSL-VPN device providing a remote access service was replaced in 2015. The prior system employed the RSA SecurID®. In FY 2014, the NIFS mail system has been replaced, which also impose multi-factor authentication using a one-time password (OTP) card by DAOU corp. In order to reduce the total cost of ownership, we developed an authentication system coupled with DAOU OTP authentication based on free-radius and mysql.
- Eduroam based wireless LAN service
  - A wireless LAN service for guests under Eduroam was deployed in FY 2018. The system is supported by inner and outer radius servers coupled with mysql user database, and we have distributed access points (Aps) covering common area such as a meeting room and accommodation facility. APs are managed by the centralized controller.

Institutional information systems supporting NIFS and the fusion research community

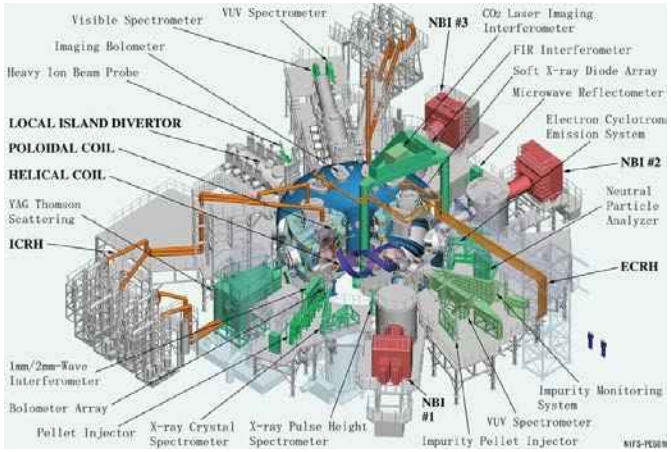
- NIFS Collaboration Database System: Nicollas
  - "Nicollas" was newly designed and developed in 2013 to be used for the online submission and judgment of the NIFS collaboration applications for FY. 2014, and had been continuously bug-fixed and functionally improved. In Nov. of 2017, this system was renewed as the NINS open use system (NOUS) in which most of the Nicollas codes have been ported with the original functionalities.
- NIFS-Repository
  - Institutional Repository (IR) is recognized as one of the most important infrastructures for universities and institutes. The first system for NIFS Repository based on "DSpace" started its operation in Mar. of 2009 by RIO. It was transferred to the institutional information systems task group (IIS-TG) in Apr. 2013 and ported into the "JAIRO Cloud" operated by National Institutes for Informatics(NII).

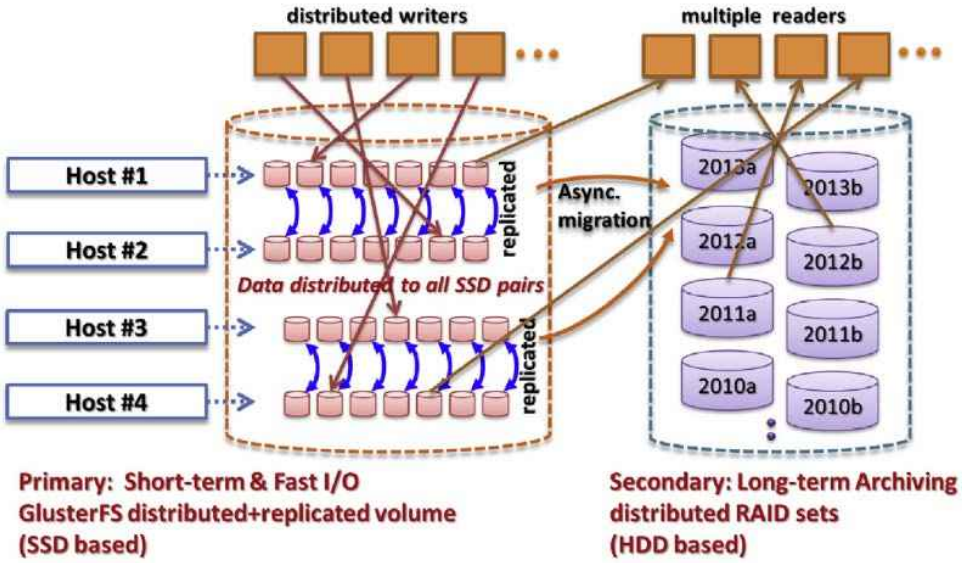
Institutional information systems supporting NIFS and the fusion research community (Contd.)

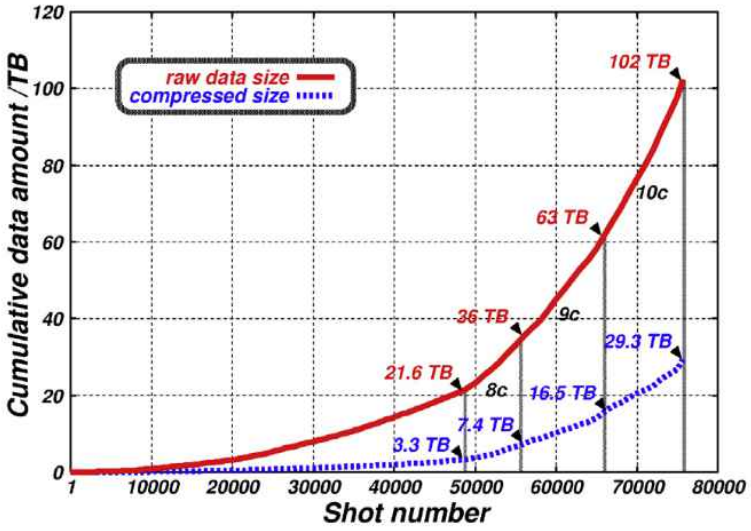
- NIFS Article Information System: NAIS
  - "NAIS" accumulates information of research achievements made by NIFS staffs and the collaborators for more than ten years. This system had been operated under Research Information Office (RIO) since April of 2006. In Apr. of 2013, it has been transferred to the institutional information systems task group (IIS-TG).
  - This system has been continuously improved under a collaboration with the Research Enhancement Strategy Office (RESO). This system is used not only for accumulating research products, but for an internal approval for publication / presentation. It becomes one of essential information systems supporting research activities in NIFS. The total number of registered records in Nov. of 2020 is about 17,000.



Distributed Data Storage System



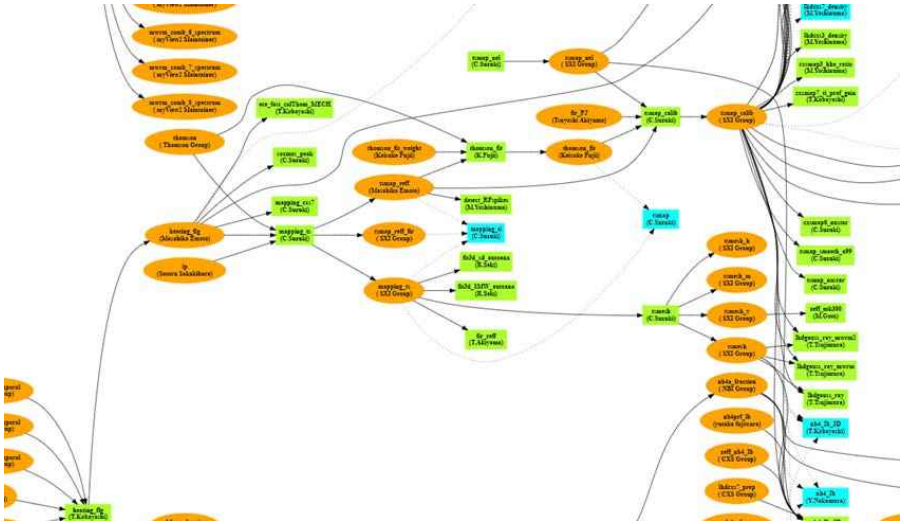




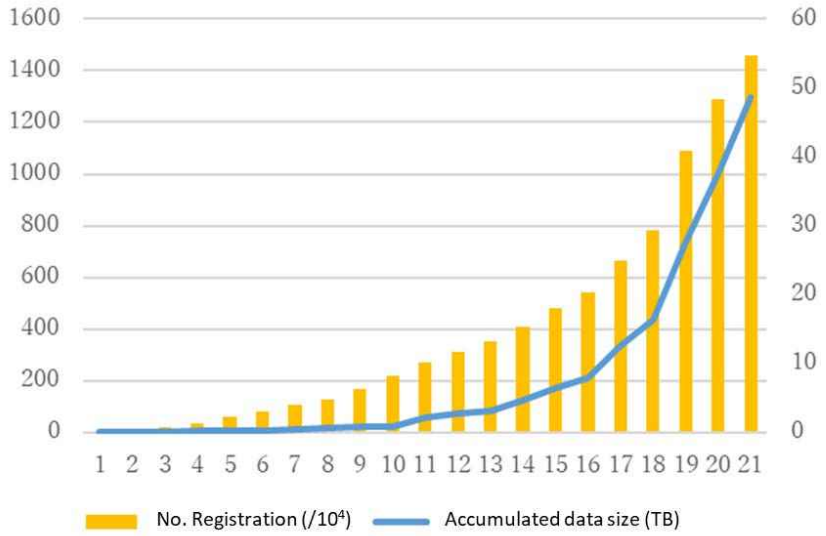
- Many advanced diagnostics are installed on LHD. Huge amount of data should be stored safely.
- GlusterFS is selected for the distributed storage system by its scalability and by the fact that recovery of the file system is much easier that the previous system.

H. Nakanishi et. al., Fusion Engineering and Design **89** (2014) 707–711

Generation of analyzed data



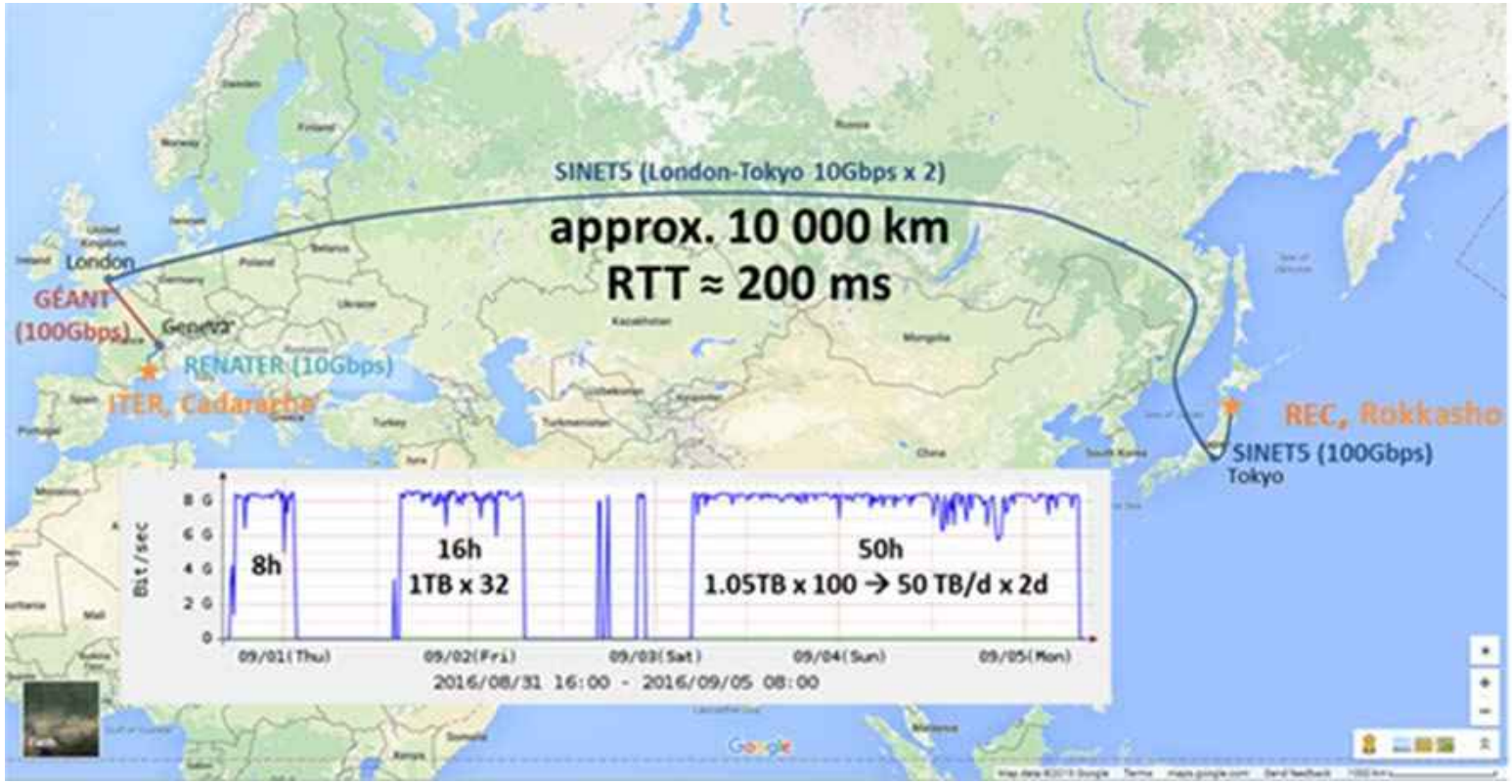
Dependence of physical parameters



- To obtain physical parameters, the AD converted binary data should be processed to the physical parameters.
- The dependence of the physical parameters is quite complicated. “AutoAna” system automatically resolves the dependency and generating analyzed data representing physical parameters.
- After developing the AutoAna system (2016), registered analyzed data increased drastically.

M. Emoto et.al., J. Plasma Fusion Res., **7** (2012), 240505

Transfer of the experimental data



- In the next generation fusion experiments, remote participance is the key developments. Technology of the high-speed transferring of the huge amount of the data has been developed.

K. Yamanaka, H. Nakanishi et. al., Fusion Engineering and Design **138** (2019) 202–209208

Operation and Maintenance of NIFS Atomic and Molecular Database

- NIFS Atomic and Molecular (AM) Numerical Databases provide AM data on elementary processes important in fusion plasmas and other various plasmas for users via internet for free.
- Data are updated regularly.
- The server has moved to DMZ from NIFS internal network for security reason in 2016.
- The database system was reconstructed in a new replaced server with using PostgreSQL and Ruby on Rails in FY2016 to be more secure system.

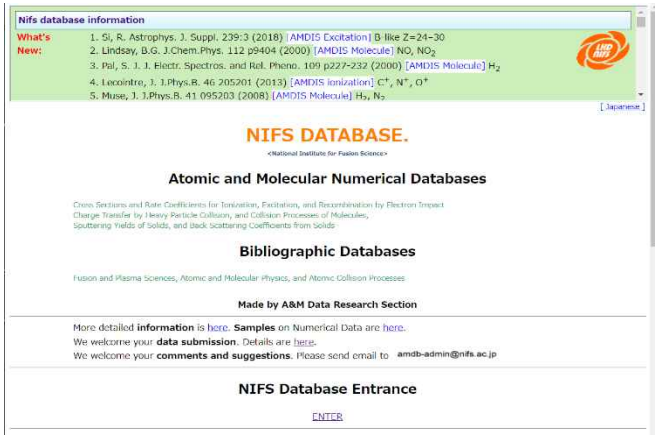
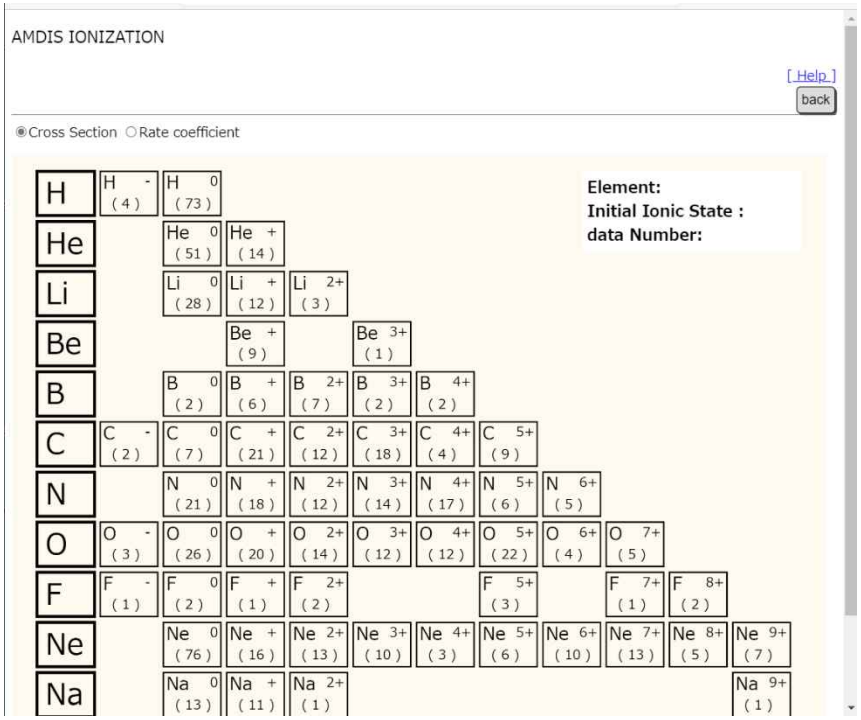


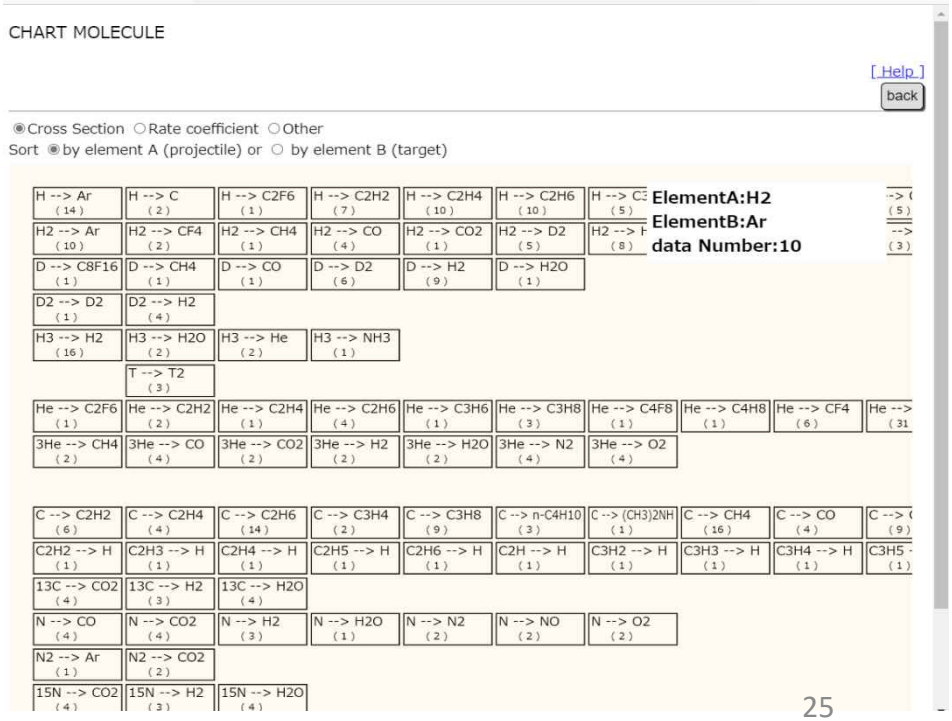
Table: List of sub-databases in NIFS Atomic and Molecular Numerical Databases (http://dbshino.nifs.ac.jp) * As of Aug 11, 2020

Name		Description	Number of data sets*
AMDIS	ION	Electron-impact ionization cross sections and rate coefficients for atoms	806,493
	EXC	Electron-impact excitation cross sections and rate coefficients for atoms	
	REC	Electron recombination rate coefficients for atoms	
	DIO	Dissociation cross sections for molecules	
CHART		Charge exchange and ionization cross sections for ion-atom collisions	7,646
MOL	AMOL	Cross sections and rate coefficients of electron-molecule collision processes	5,405
	CMOL	Cross sections and rate coefficients of atom-molecule collision processes	
SPUTY		Sputtering yields by atomic ions for solid surface	2,349
BACKS		Energy and particle back-scattering coefficients of light ions from solid surface	485

New “simple search” query system for AM database

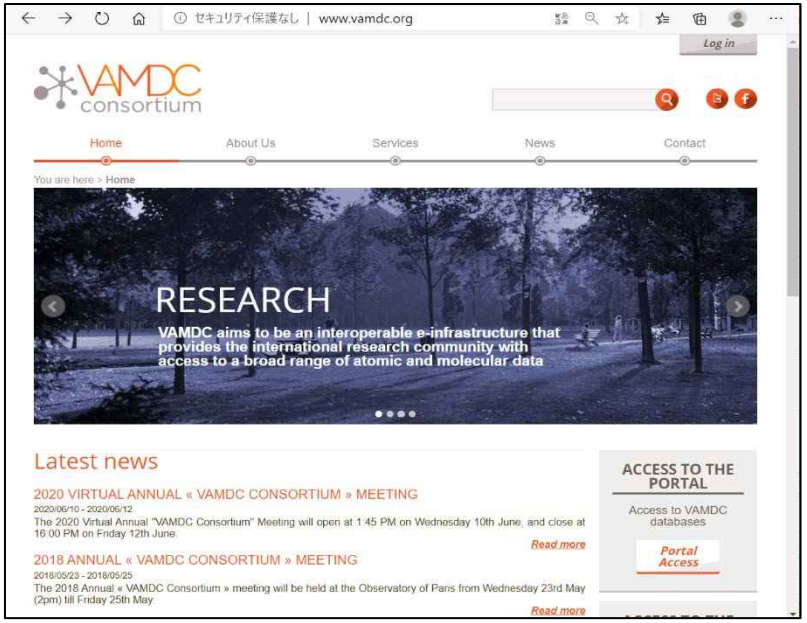
- “Simple search” system is developed for easier use in 2016. It allows users to find target processes and data more easily than before. Other problems in the older system were fixed as well.

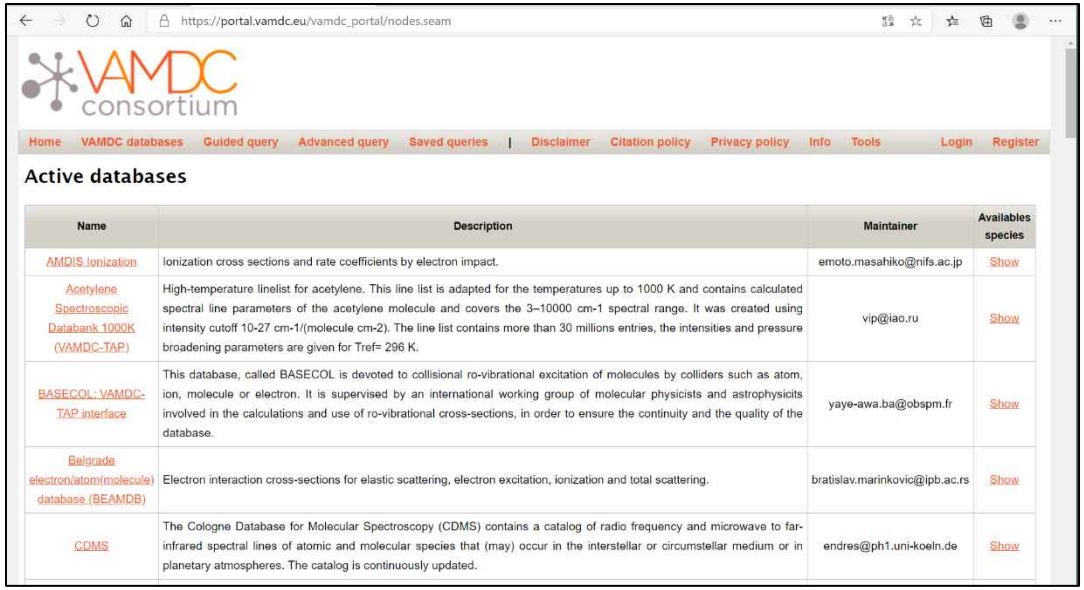




Implementation to VAMDC

- Virtual Atomic and Molecular Data Center (VAMDC) is operated by international consortium and provides web portal to access various AM database at once and to present data according to XSAMS (XML Schema for AM data). AMDIS-ION is now implemented to VAMDC since 2018. We have developed additional system and new tables to connect to VAMDC.





2. Response to requests for information system from inside and outside the institute

・Is the division of information and communication systems properly responding to requests for information system development from inside and outside the institute?

License investigation for Microsoft products

- NIFS was asked to conduct license investigation by Microsoft Corp. in Feb. of 2015. Since the number of targeted devices is about 3000, we developed a web app for inquiry and counting.
- Using the app, NIFS reported the result of license investigation to Microsoft Corp. in Jun. of 2015.
- It took about 1 month to develop the app and 2 weeks for inquiry. Total man-hour cost was 3.5 MM, which consists of 1 MM for app developing, 1.5 MM for inquiry, 1 MM for hearing investigation and reporting. NIFS recognized such an investigation as a heavy burden and decided to contract Microsoft campus license in Oct. of 2016.

Contraction of Microsoft campus license

- Since the license investigation asked by Microsoft Corp. was relatively high cost, NIFS contracted Microsoft campus license in May of 2017. As our main needs was a desktop office application and NIFS was a small institution, we chose OVS-ES plan.
- In order to conduct an adequate license management, we installed a MKS server and distribute a customized installer package for Microsoft office product via an internal web site with a user authentication.
- In May of 2020, NIFS changed the license plan from OVS-ES to EES. To adapt the EES, we established a regime for user administration under Azure Active Directory. On the ramp-up period, existing user account was exported from the email system operated by the NetTG and imported into Azure AD via a web interface and customized with use of PowerShell script.
- Now we provides a cloud-based applications such as Microsoft Teams as well as a desktop office product. A large number of NIFS members are satisfied with the situation.

Infrastructure for information disclosure to research collaborators

- ID provider for research collaborators: Colid
  - Disclosure of information required for collaborative research is important task. In order to keep proper confidentiality, an Identity and access management (IAM) is required. The NIFS Collaboration Database System “Nicollas” had provided IAM functionality. Since Nicollas stopped its operation in 2017, we became to need an alternative IAM system.
  - The Integrated ID management and Authentication System Task Group (IDMAS) built a new IAM system for research collaborators in FY 2017. We launched the identity provider for NIFS collaborators Colid in Apr. of 2018. As a base software we employed shibboleth IdP, which is widely used in the Accademic Access Management Federation in Japan (GakuNin).
  - Since collaborative research is adopted and updated every year, user account information in Colid is initialized and newly adopted research collaborators are exported from NOUS and imported into Colid. In order to establish a proper segregation of duties, this user import/export procedure is performed by the Research Support Division in the Department of Administration.
- Functional enhancement on LHD web site for collaborators

Support system for conferences/workshops

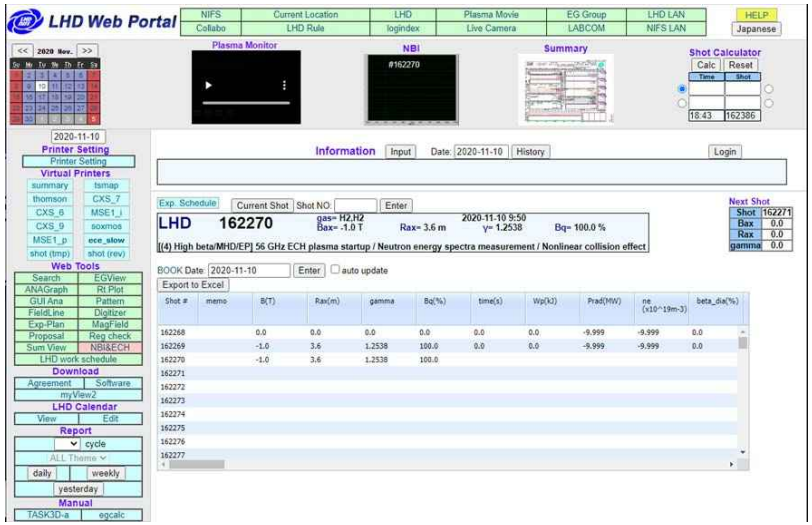
- Icarus
  - "Icarus", deployed in July of 2013, is a web-based online service for assisting various host operation to hold international conferences, which is developed on Ruby-on-Rails. It provides general functionalities required for organizing international conference, such as online registration; abstract submission, review, selection, and notification; electronic account settlement via credit card for registration fees and other optional ones; online subscription for related event participation; and so on.
  - This system is utilized in international conferences hosted by NIFS, which are held once or twice in each year. The detailed workflow may differ for each conference, we made a customization in response to the need of a conference organizer.
- Workshop
  - The "Workshop" hosting support service, deployed in June of 2015, has been developed by intensive requests from the NIFS collaboration caretakers. Answering some configuration inquiries, the workshop caretakers can automatically build their own websites with necessary online functionalities, such as participant registration. This system has been constantly used by about 10 workshops every year.

Other services operated by BIS-TG

- Providing infrastructure for internal/external web site
- Support service for internal web site
  - RMSAFE, Division of Health and Safety Promotion, the Graduate University for Advanced Studies (SOKENDAI)
    Library, public offering information of research promotion, public offering information of collaborative research
- Development and operation of various web application site
  - Fitness facility, facility tour, accommodation facility, procurement information
  - (Under construction) Joint use of measuring equipment, researcher information database, Zoom meeting
- Administration and operation of video conference system
- Administration and operation of group-ware (Cyboze)
- Attendance management system for dept. of administration
- Activities toward sophisticated/integrated ID management service

Support for LHD experiment

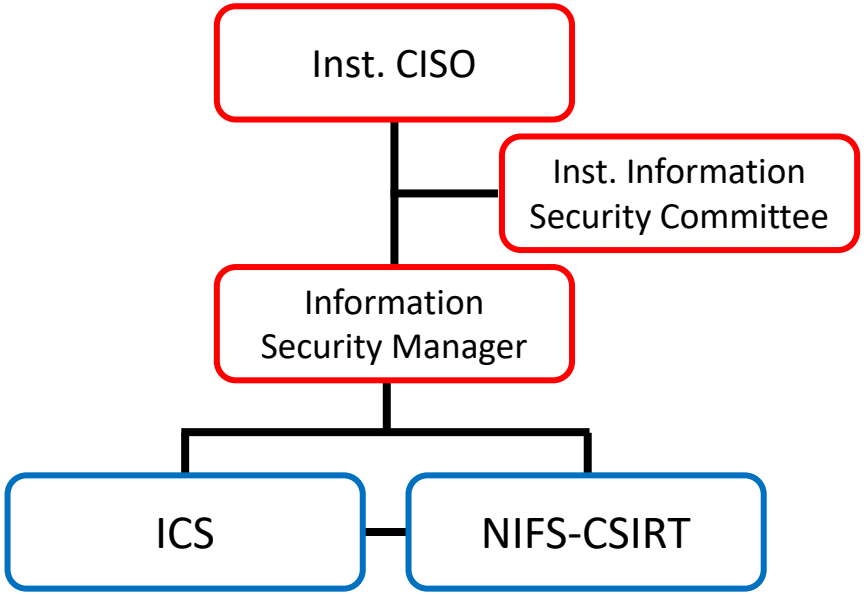
- Full-remote control of the equipment is required for the Large Helical Device experiments. Many advanced diagnostics are developed with the support of System Task Group. The number of the supported system is increasing.
- Web services to establish very large-scale experiments (~100 researchers are involved) are being developed.
- Planning, operation, and summary graphs of the experiments are well organized with our web service.
- It is quite helpful for the domestic / international collaborators



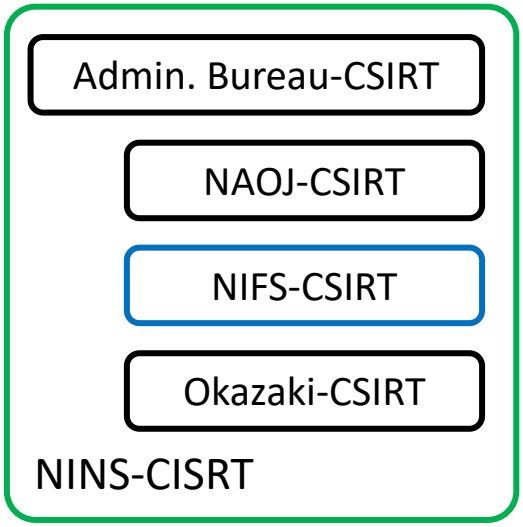
Web portal for the LHD Experiments.

Information Security Office

- controls the issues of information security of NIFS.
- provides the information about security to staff and gathers the information about a current security status of staffs and servers.
- handles the security incident as Computer Security Incident Response Team, NIFS-CSIRT.



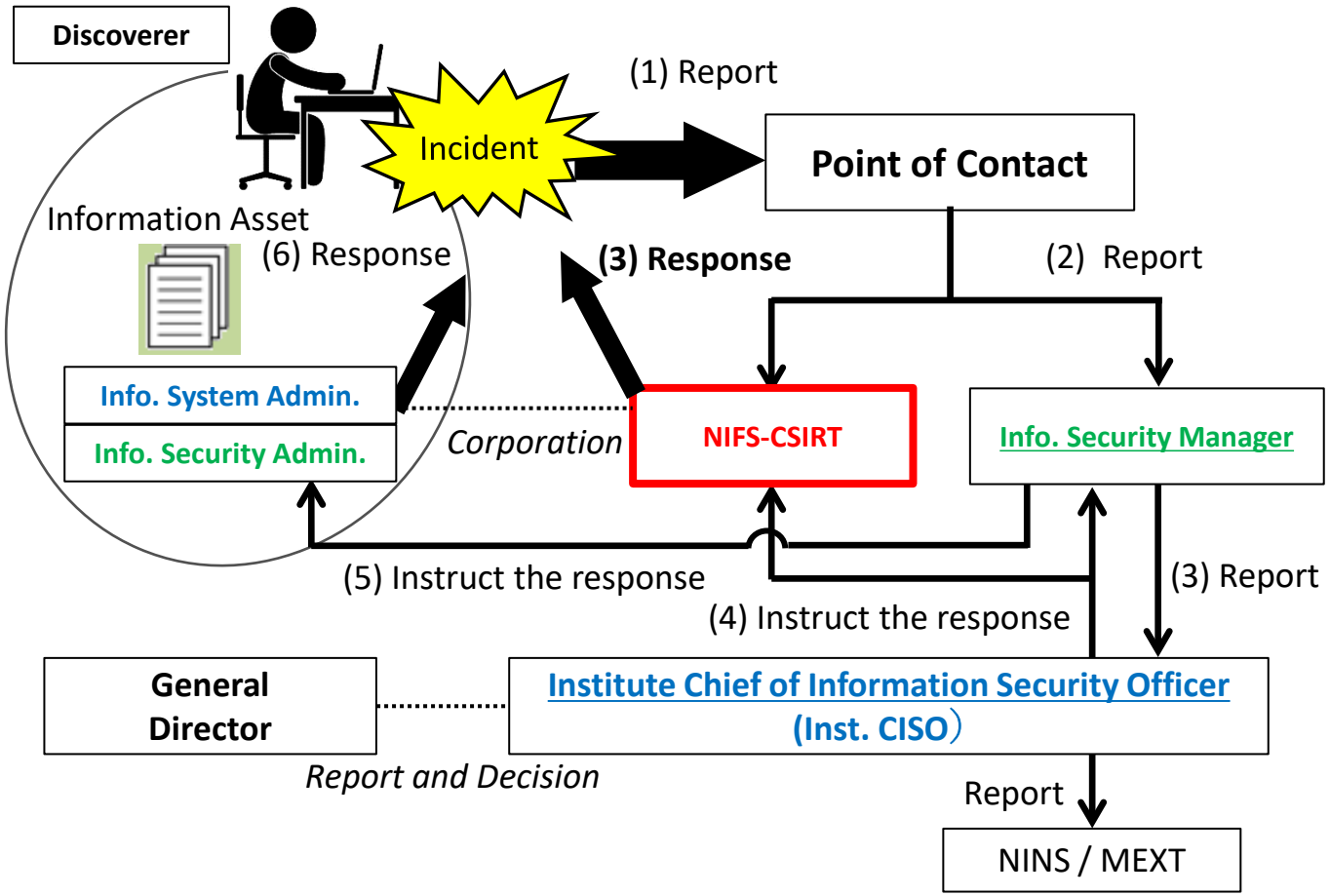
The security management diagram defined by the security policy of NIFS.



NIFS-CSIRT is a part of NINS-CSIRT and cooperate with other CSIRT. Administrative Bureau-CSIRT is a coordinating CSIRT to facilitate and coordinate the activities of institute CSIRTs.

Incident response

This handling procedure is defined by the security policy of NIFS.
NIFS-CSIRT is permitted to disconnect the network of the system to mitigate the impact of the incident.



Info. System Admin. is charged for the technical issues of the server.

Info. System Admin. is charged for the contents of the server.

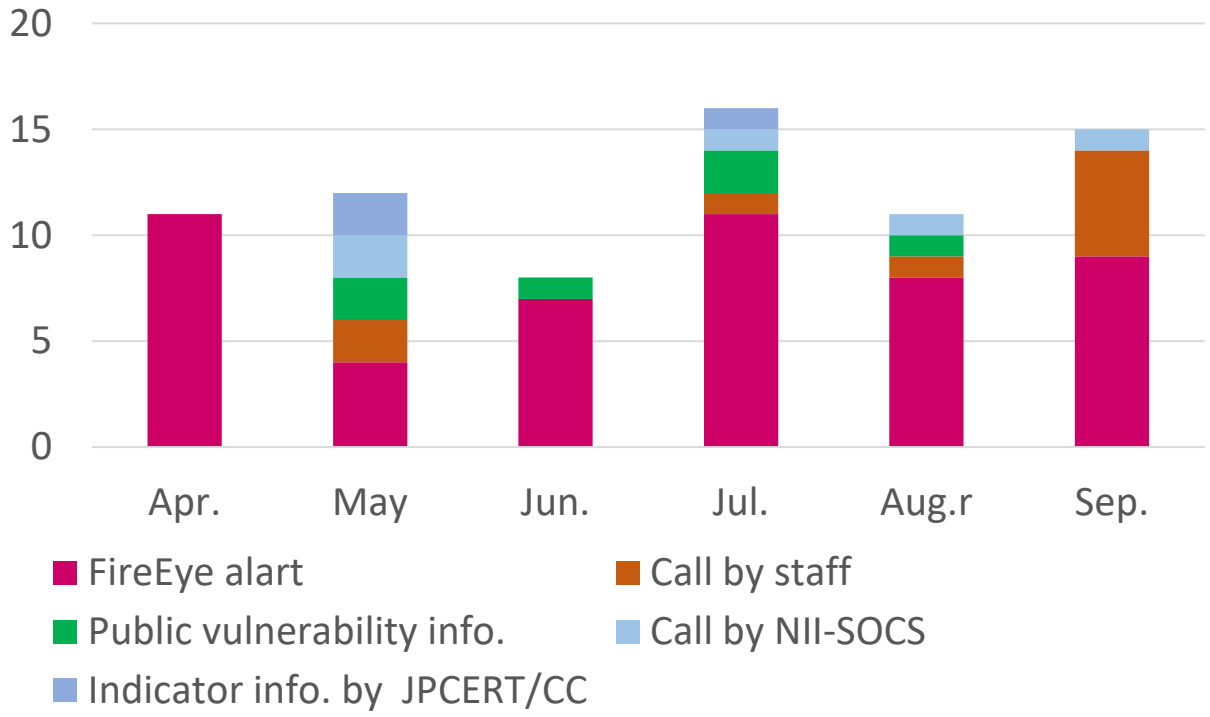
NIFS-CSIRT is charged for the incident response.

Info. Security Manager controls the incident response.

Inst. CISO decides how to response the critical issue of the incident.

Incident response (2)

NIFS-CSIRT receives many events from various source and confirms that one by one.



Number of events handled by NIFS-CSIRT in 2020

FireEye is a network security appliance detects web exploits and multi-protocol callbacks.

NII-SOC is Security Operation Center of National Institute for Informatics. We had made the agreement to notify the info. about an incident.

JPCERT/CC notifies the indicator info. base on the agreement.

Incident response (3)

NIFS-CSIRT confirms each event because a few of those might be minor, medium, or major incident.

Number of incidents handled by NIFS-CSIRT. FY 2020 is limited to April to September.

	FY 2018	FY 2019	FY 2020
Minor incident	6	6	1
Medium incident	0	0	2
Major incident	0	1	0

Major incident on FY 2019:

- A staff had unintentionally entered the account information to phishing site through the link on the phishing mail. More than 200 staff had received such a malicious mails at that time.
- An attacker had tried to login the mail server of NIFS and to send the mail, however, failed thanking for OTP authentication on the mail system.
- **NIFS-CISRT confirmed the attacker's activity** by checking the system logs and interviewing the involved people.

Event is an attack not to effect the system prevented by FW, Anti-Virus, and so on.

Minor incident is an attack which is an unwanted program starts up but not to compromise the system and not to effect the other system. It should be report to Inst. CISO. Ex. adware.

Medium incident is (a) an attack, an unwanted program starts up but not to effect the other system. (b) a status prevented the leaking the information from its possibility on the system. It should be reported to CEO of NINS.

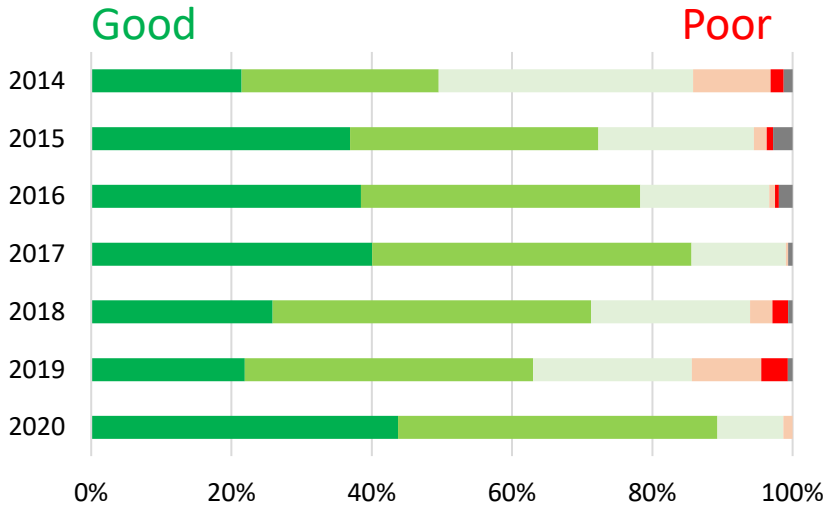
Major incident is (a) an attack to effect the other system. (b) an occurrence of the successor attacks used the leaked information. It should be report to MEXT.

Education: Information Security Course

- is held every year from FY 2004.
  - Course for beginner is also held from FY 2018.
- is mandatory for all the staff of NIFS.
  - Attendance rate is more than 99%.

Main Contents are
- security trends
- the incident occurred on NIFS / NINS
- security instructions on NIFS

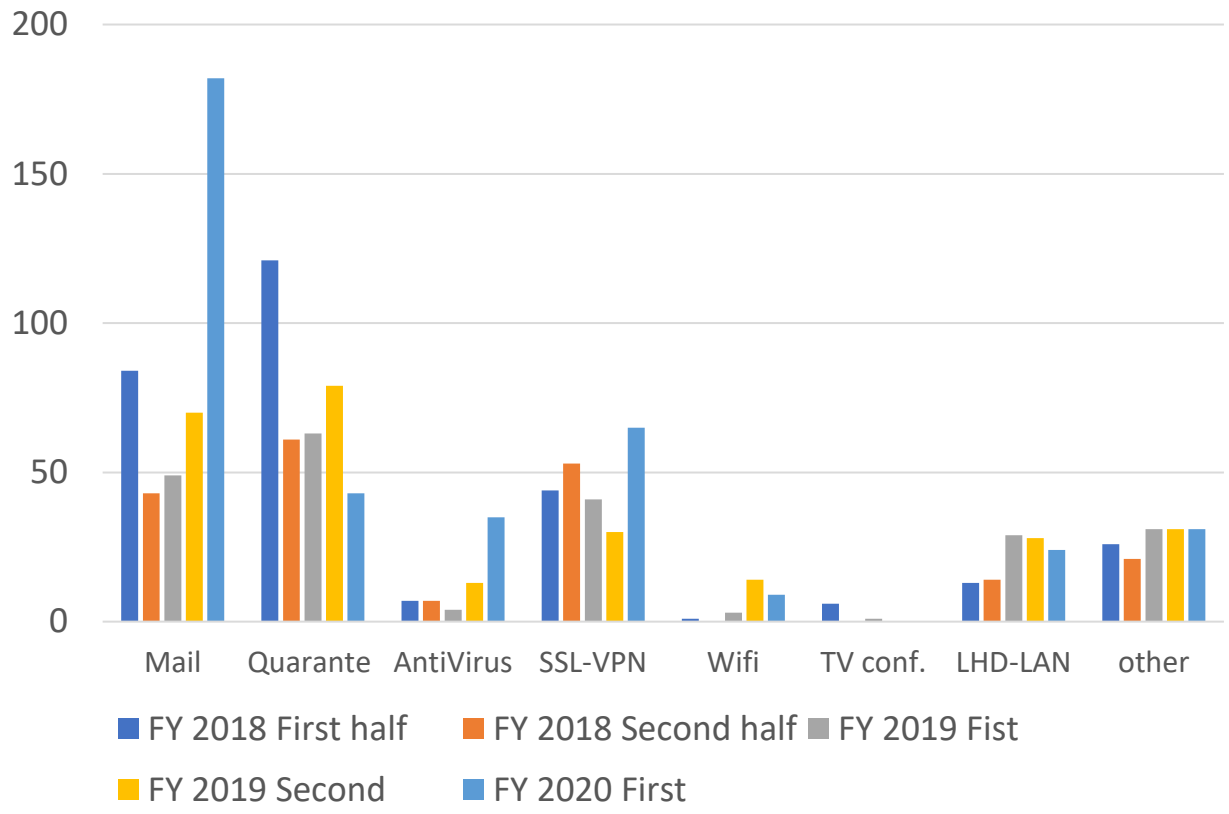
Greetings from the Director General and Inst. CISO.



Results of the questionary of the info. security course ever years. Most of the attendee are satisfied with these courses.

User support and registration work

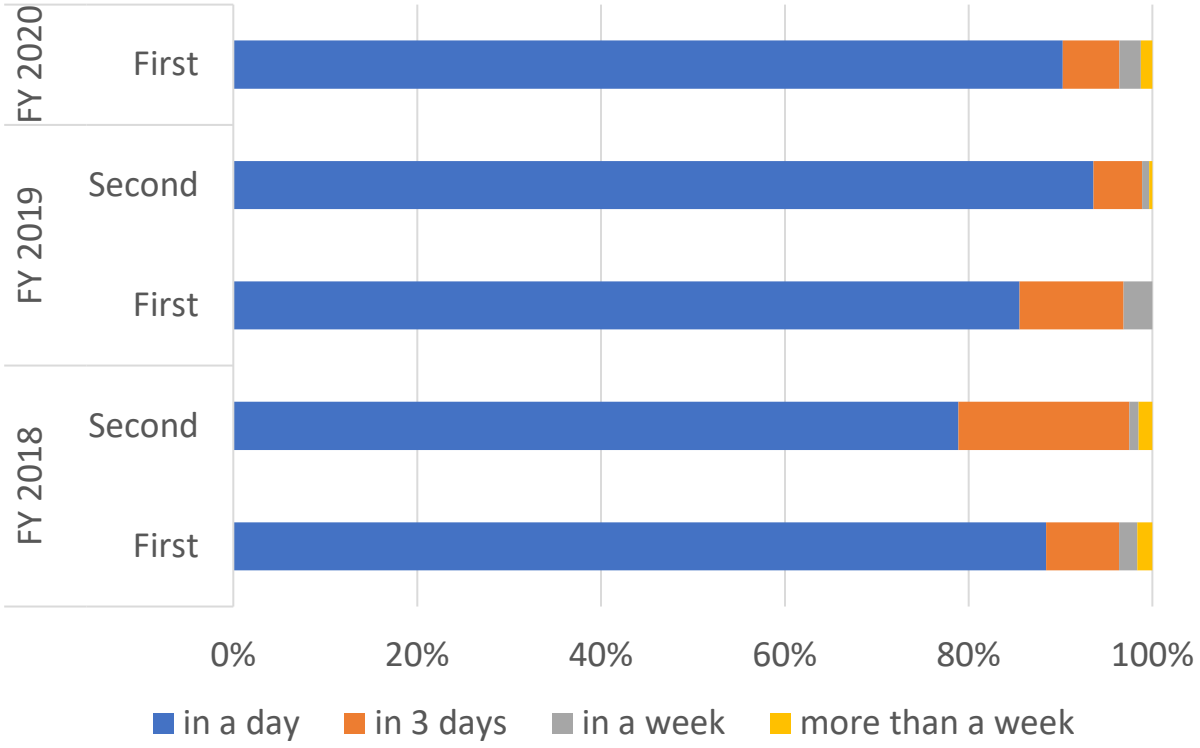
Log of user support and registration work are analyzed.



The number of question about Mail service was raised rapidly on the first half of FY 2020 because of the migration to Gmail.

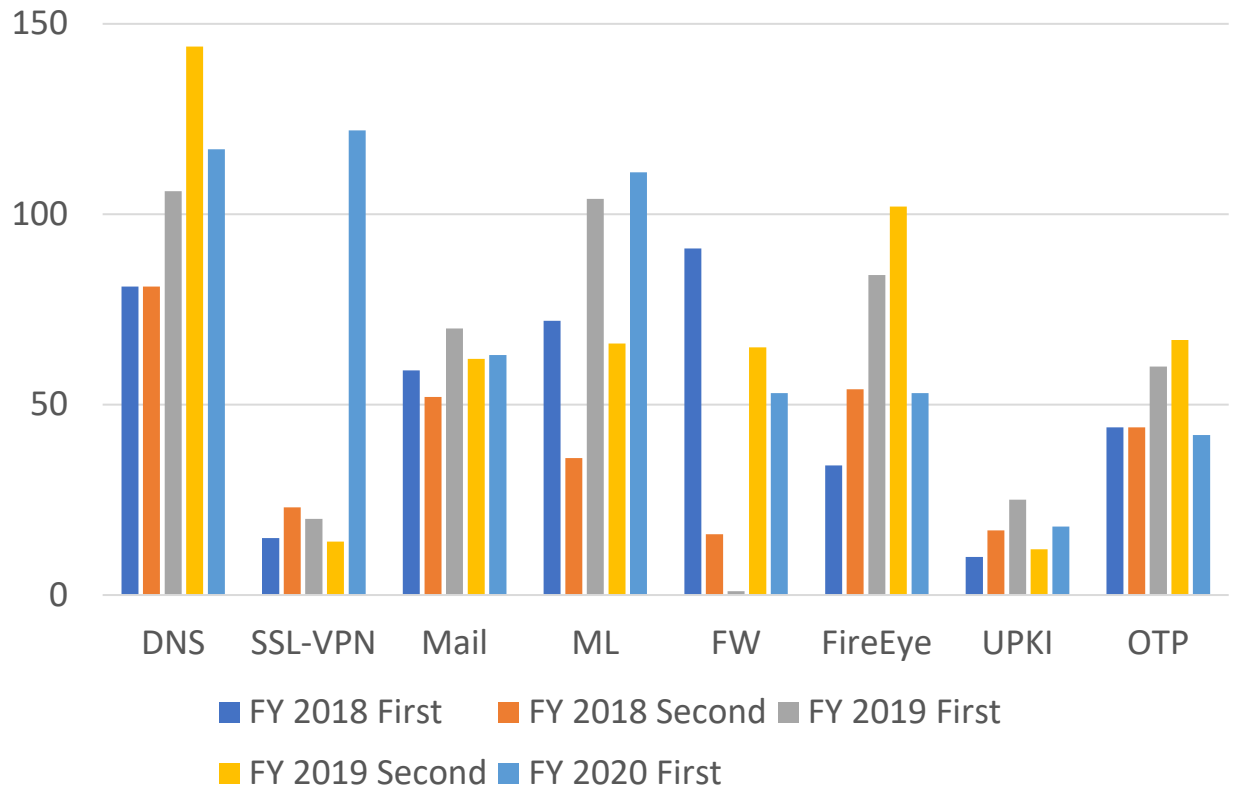
Number of questions for each area. Network Operation TG accepts more than 500 questions every year.

User support and registration work (2)



Resolve time for questions. Most of the questions (88%, average for Apr. 2018 to Sep. 2020) are resolved in a day, this is reflection of one of Network Operation TG's efforts.

User support and registration work (3)



Number of registration request for each device and service. It concludes removal and modify request. Network Operation TG accepts more than 600 request every year.

The number of request about SSL-VPN server, remote access server, was pulsed on the first half of FY 2020 because of the increment of the staff who works at home for COVID-19 prevention.

FireEye is a network security appliance detects web exploits and multi-protocol callbacks. The number shown in the graph is a count of event, not a count of alert. An event usually make multi alerts.

UPKI is an SSL certification issue service operated by National Institute for Informatics. TG is a point of contact of UPKI for NIFS.

2. Organization and functionality

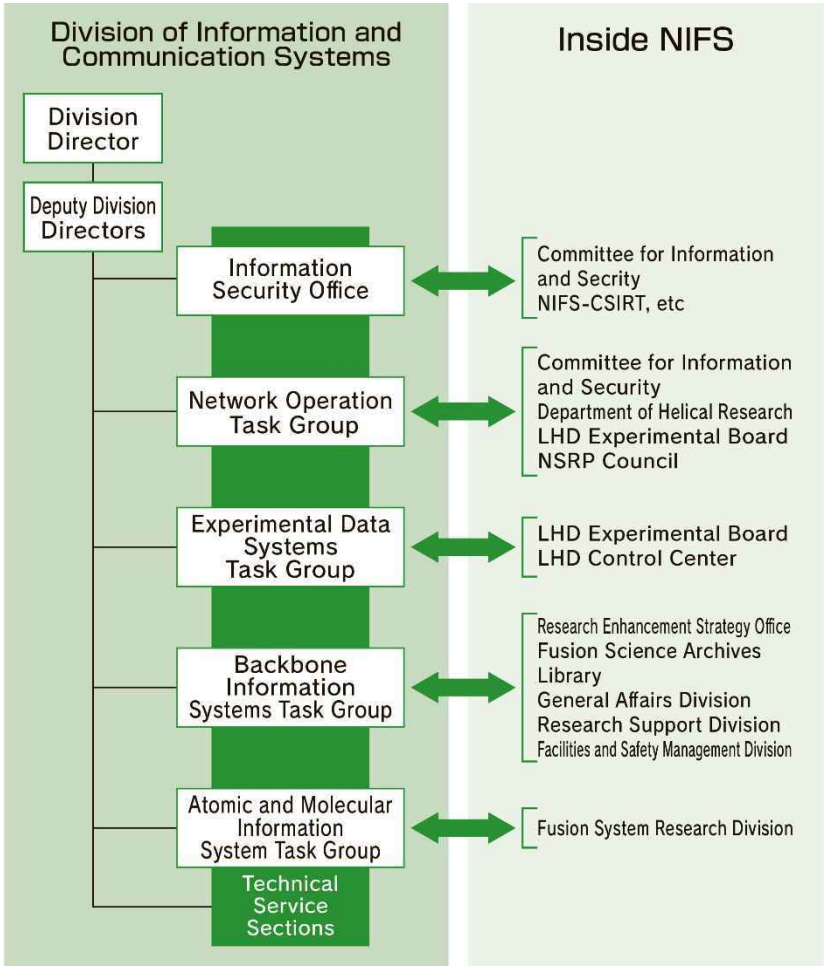
・Is the organization of the division of information and communication systems functionally constructed and operated?

Organization and Functionality

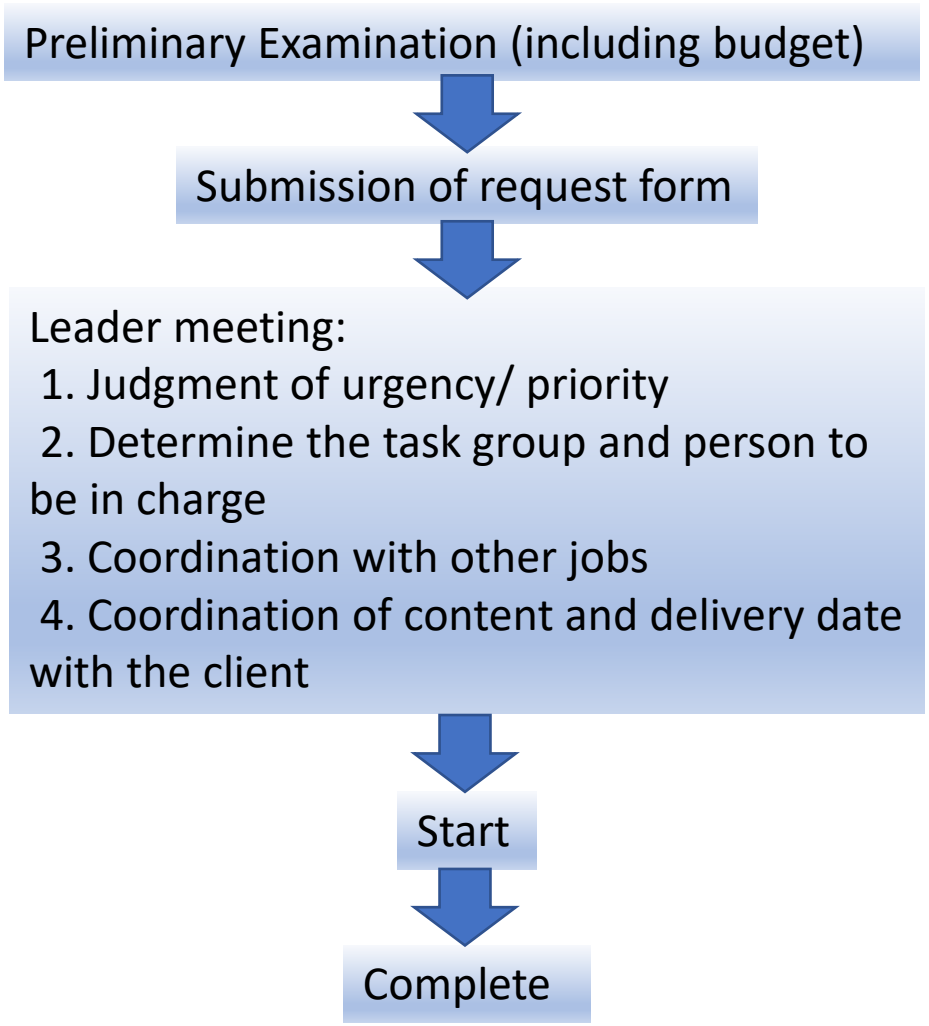
Leader Meeting
- Division Director
- Deputy Division Directors
- Task leaders, sub leaders
- Operation Team Leader

All the specialists belong to the technical service sections and arranged dynamically in task and information security office.

Staff
- Full-time 1
- Dual appointment
  - Researchers 9
  - Engineers & Technicians 11
  - Administration staff 1
- Contact Employees 4



Procedure


Preliminary Examination (including budget)
Submission of request form
Leader meeting:
1. Judgment of urgency/ priority
2. Determine the task group and person to be in charge
3. Coordination with other jobs
4. Coordination of content and delivery date with the client
Start
Complete

Effects of establishment

(a) Efficient collection and provision of experimental data
(b) Efficient response to control system development request
(c) Strengthening support for general services
(d) Development of a new system utilizing the knowledge
(e) Efficiency of new system introduction check
(f) Improving security through centralized management of information systems

Questionnaire

Outline of Questionnaire

- The questionnaire had taken to confirm the opinion of staff of NIFS to Division of Information and Communication Systems.

Respondent: Staff of NIFS include students, LHD operators, and emeritus professors.

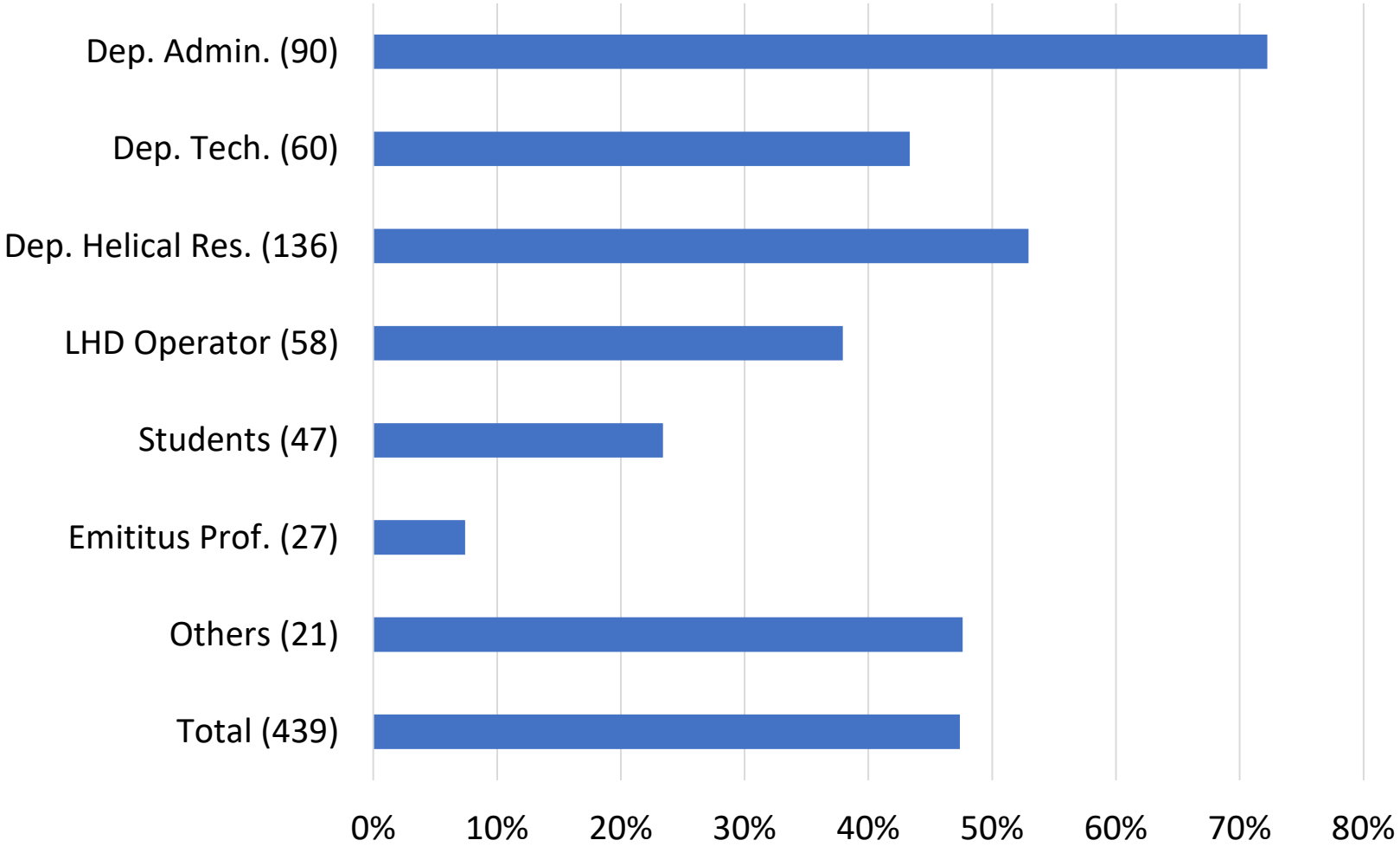
Period: October 20 to October 26, 2020.

Method: Google Form

Type: Selective answer format and free answer format

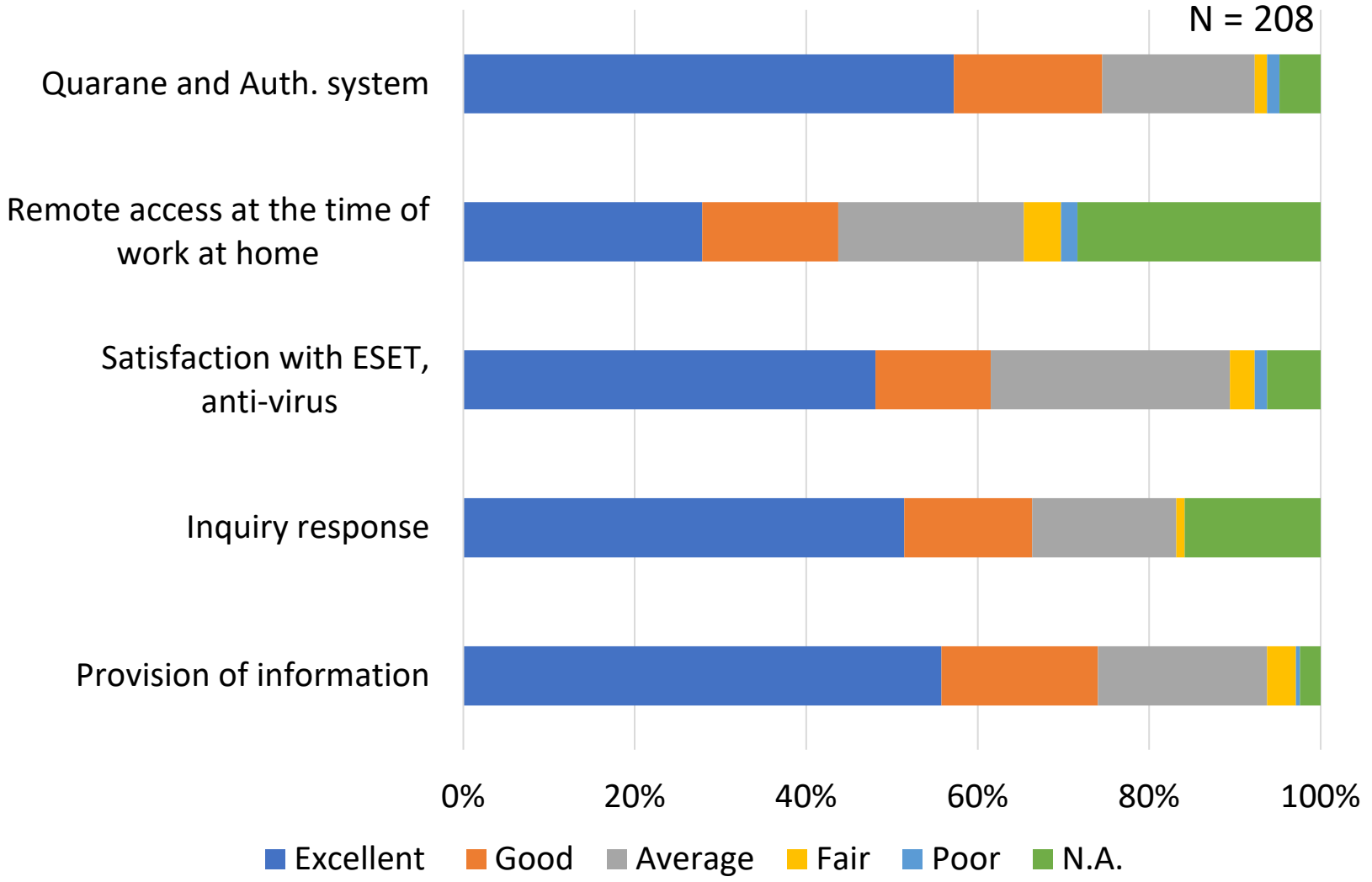
Response Rate: 47% (N = 439)

Response Rate

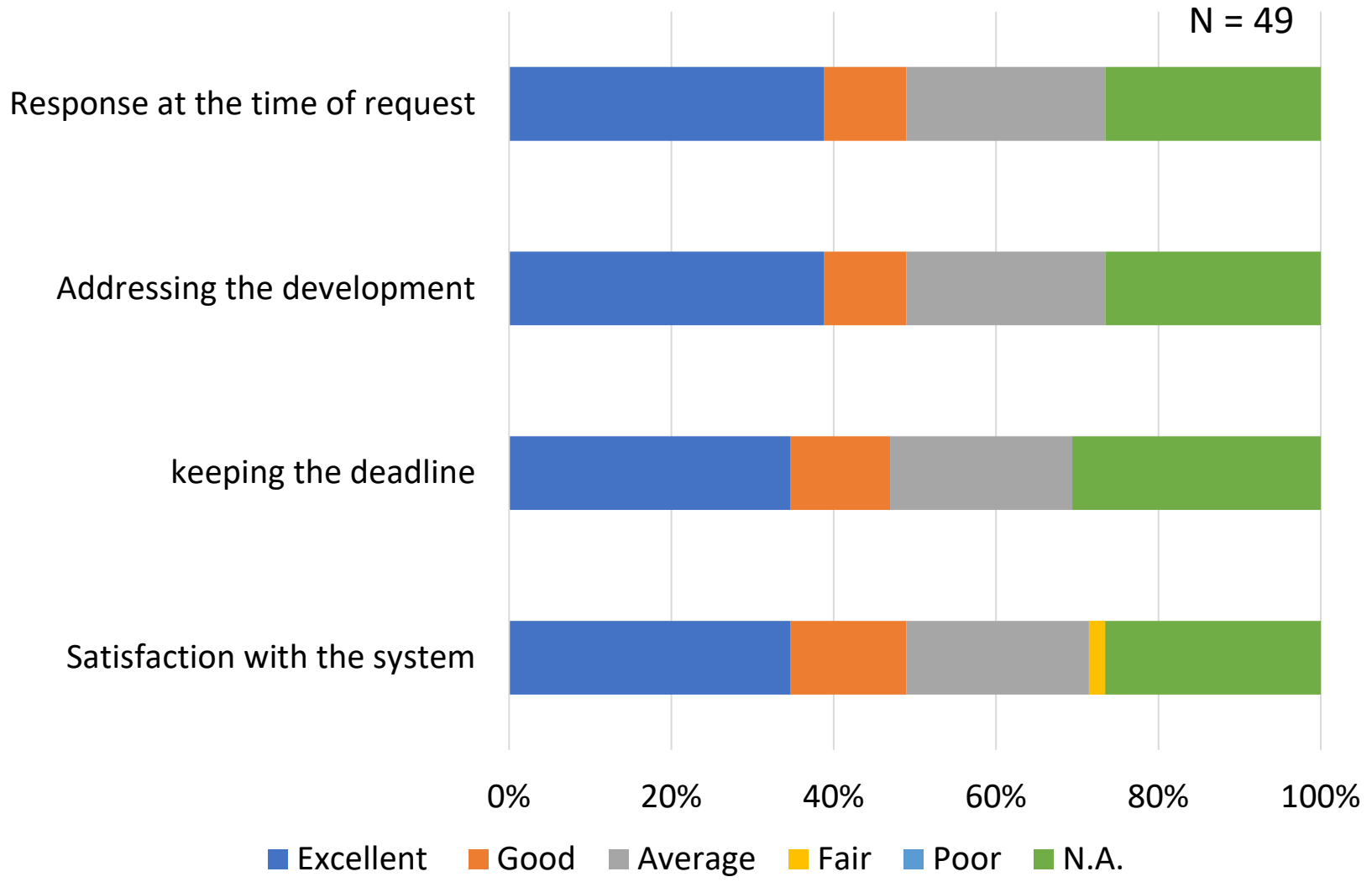


The numbers in parentheses are the number of total member.

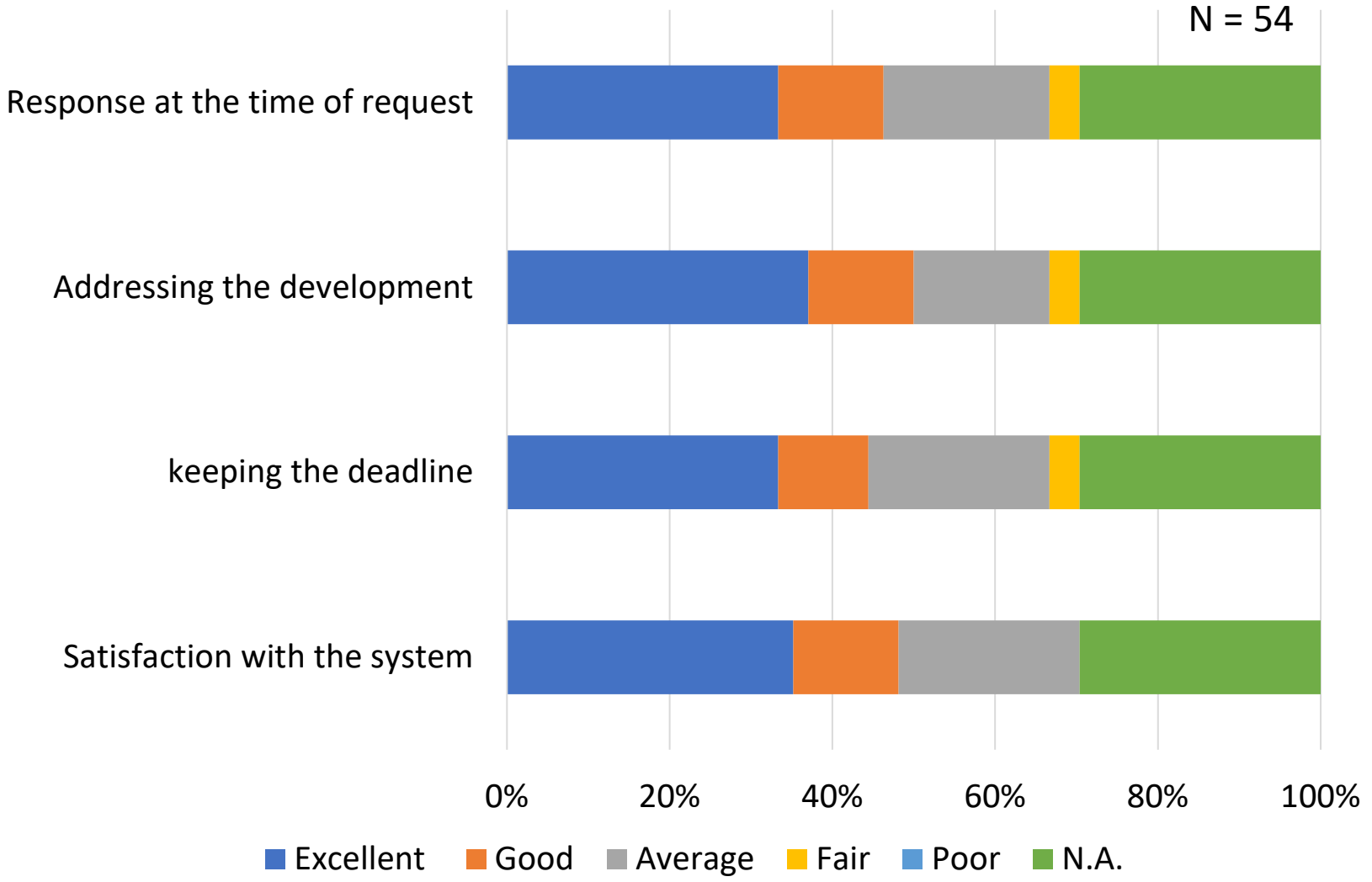
Network Operation Task Group



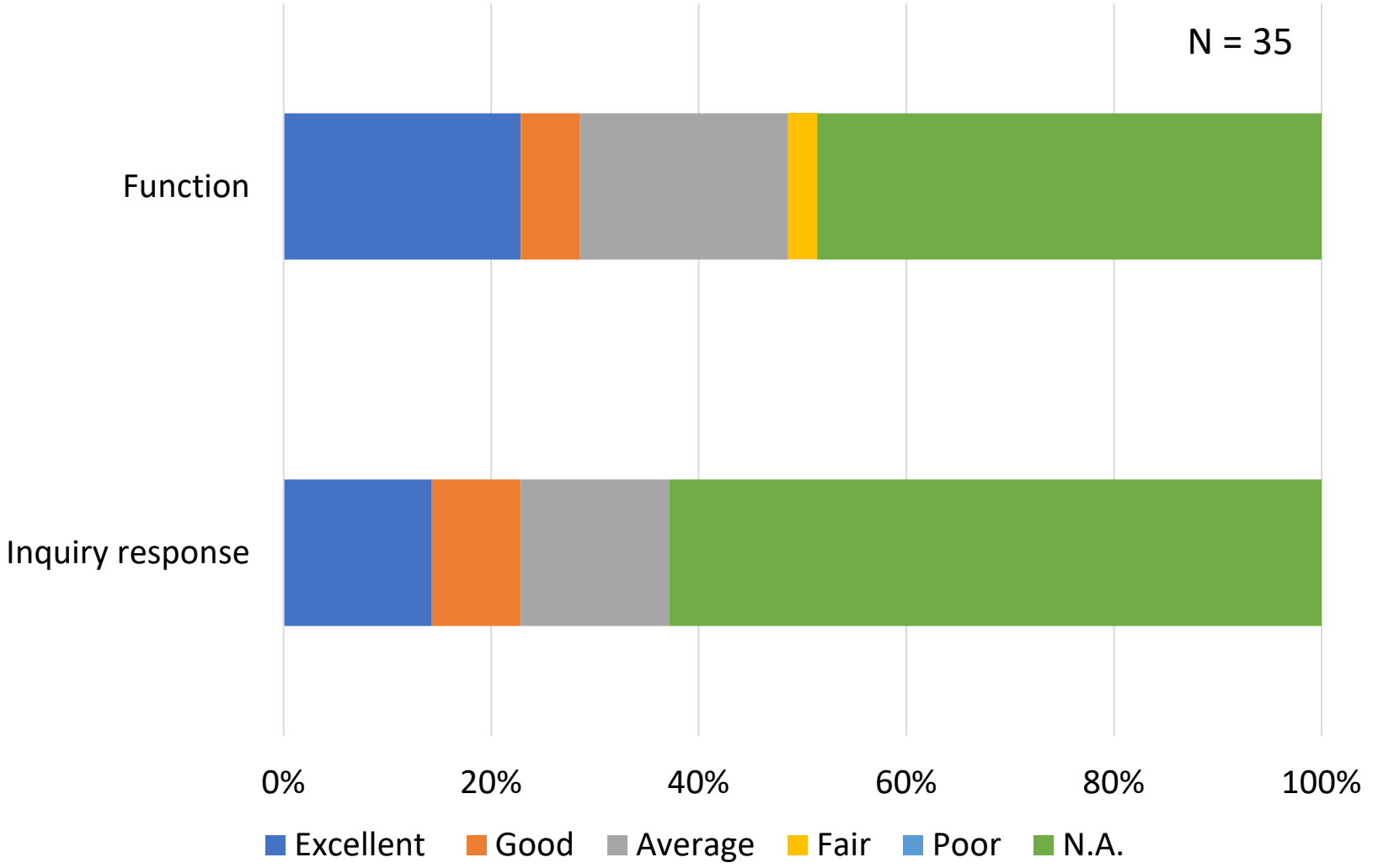
Experimental Data Systems Task Group



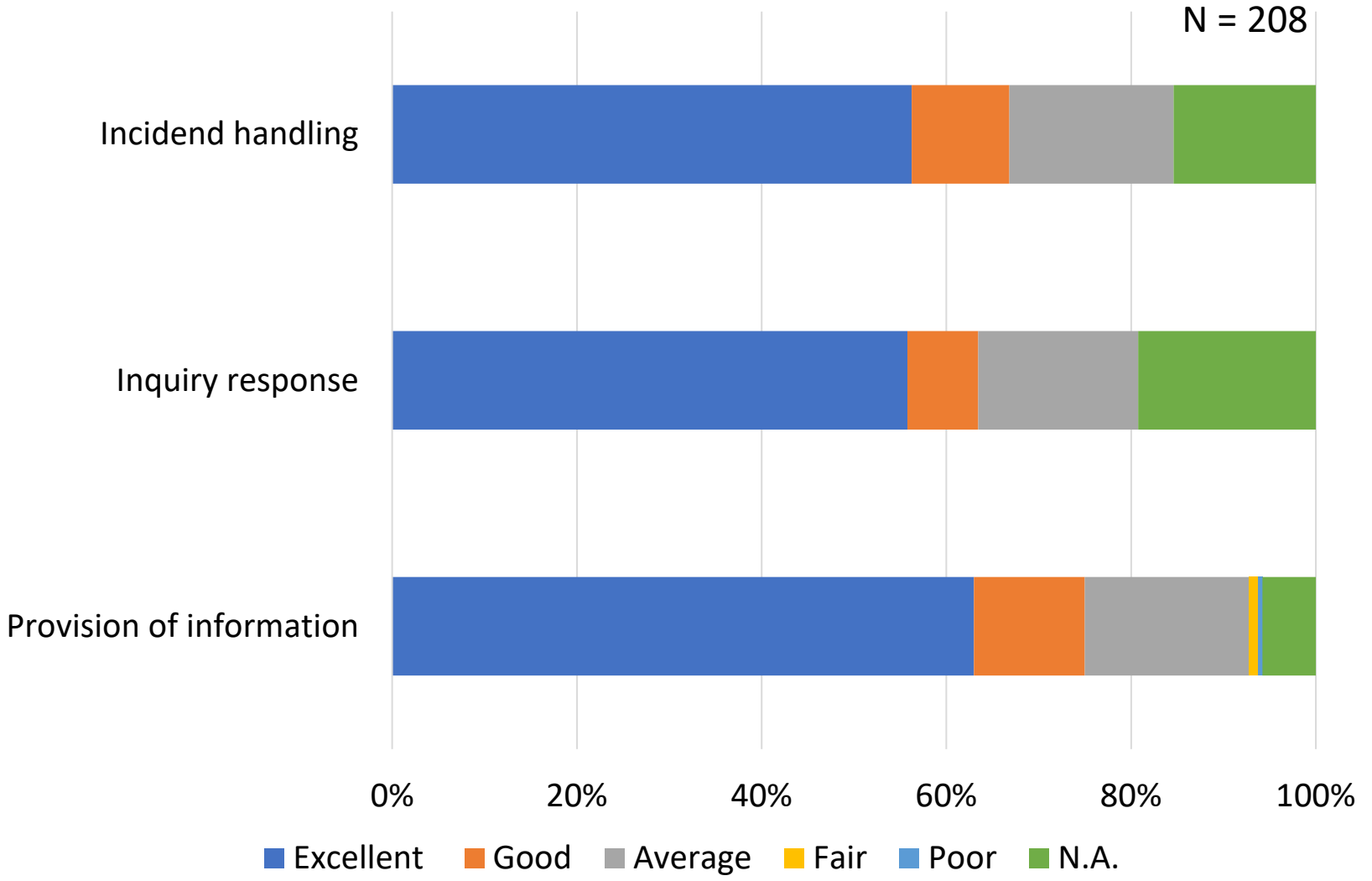
Backbone Information Systems Task Group



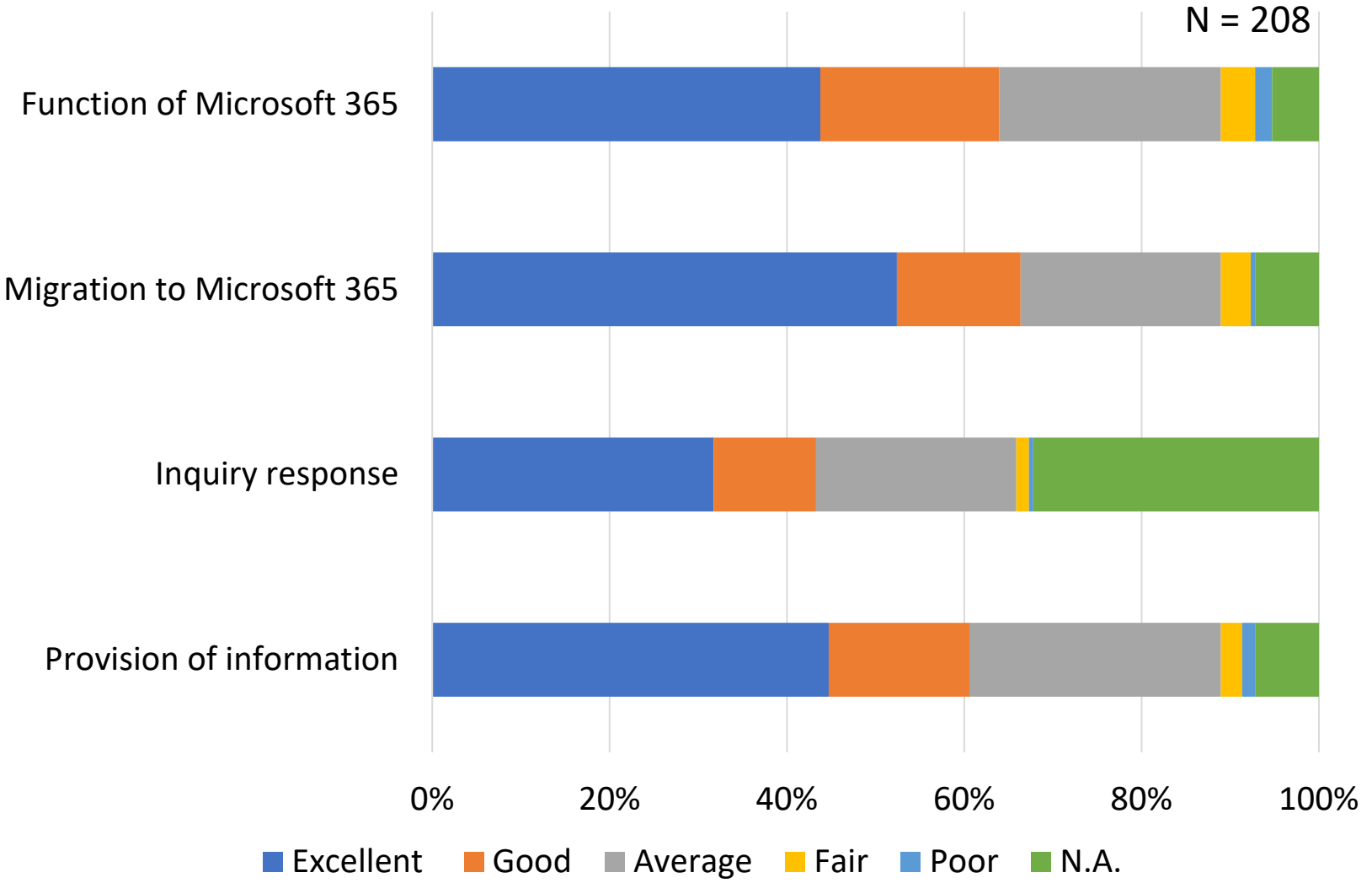
Atomic and Molecular Information System Task Group



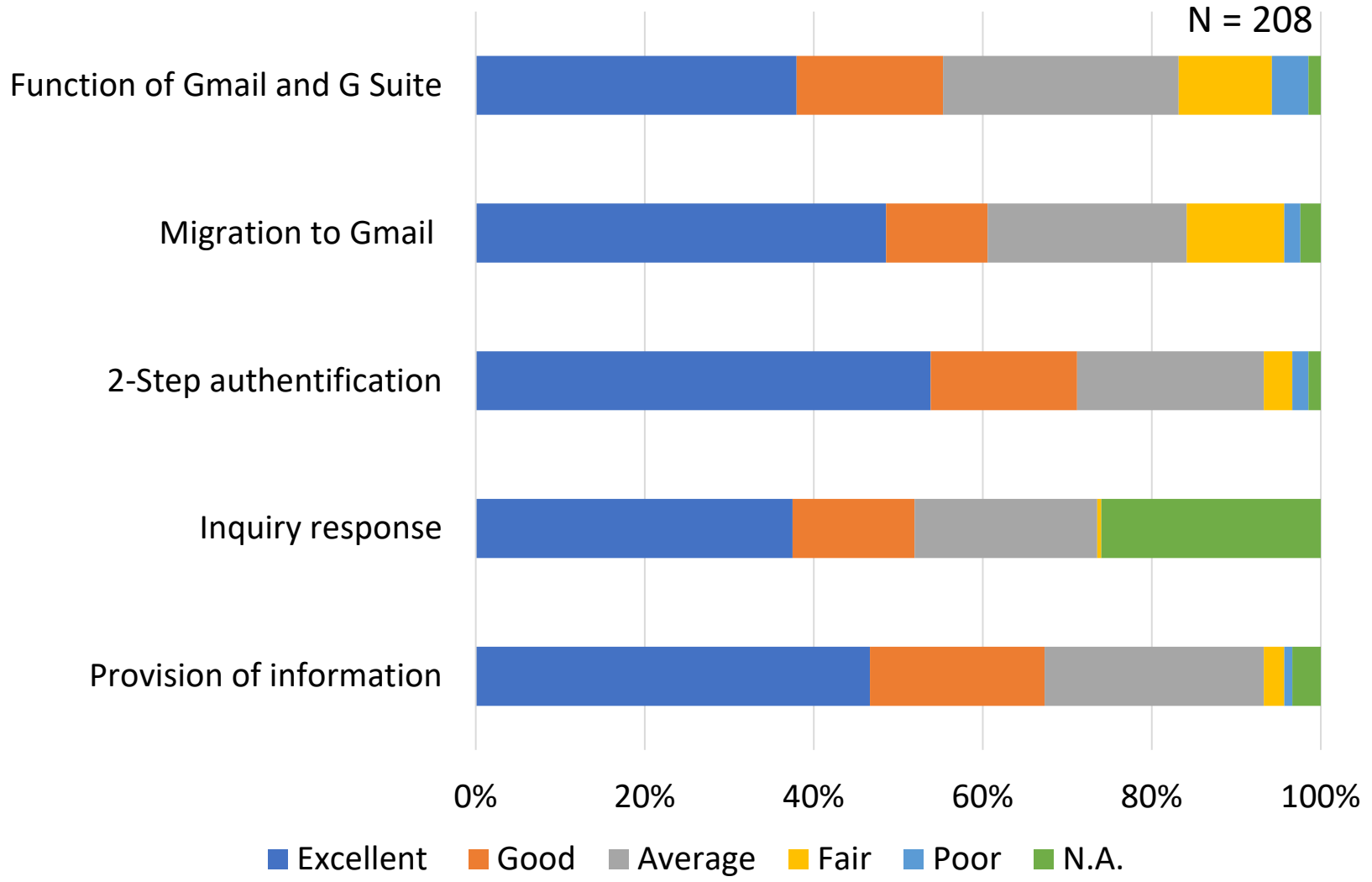
Information Security Office



Microsoft 365

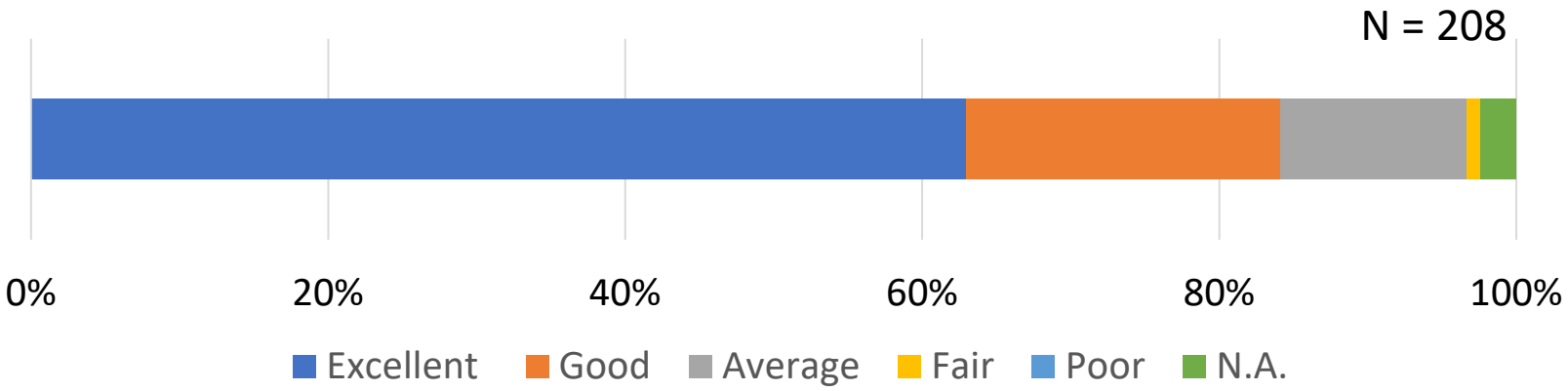


Google Gmail



Div. of Information and Communication Systems

Q. Is the Division of Information and Communication Systems doing business properly?



Overview of Division of External Affairs

Kazuya Takahata
National Institute for Fusion Science

Organization of the Division of External Affairs

Official affiliation	Dedicated staff	Dual appointment staff
Department of Administration	4	6
Department of Engineering and Technical Services	0	6
Department of Helical Plasma Research	0	36
Other (Specially Appointed Expert, etc.)	4	1

Total: 57 staffsB

udget: 12 million ¥ (including a staff cost, 3 million ¥)

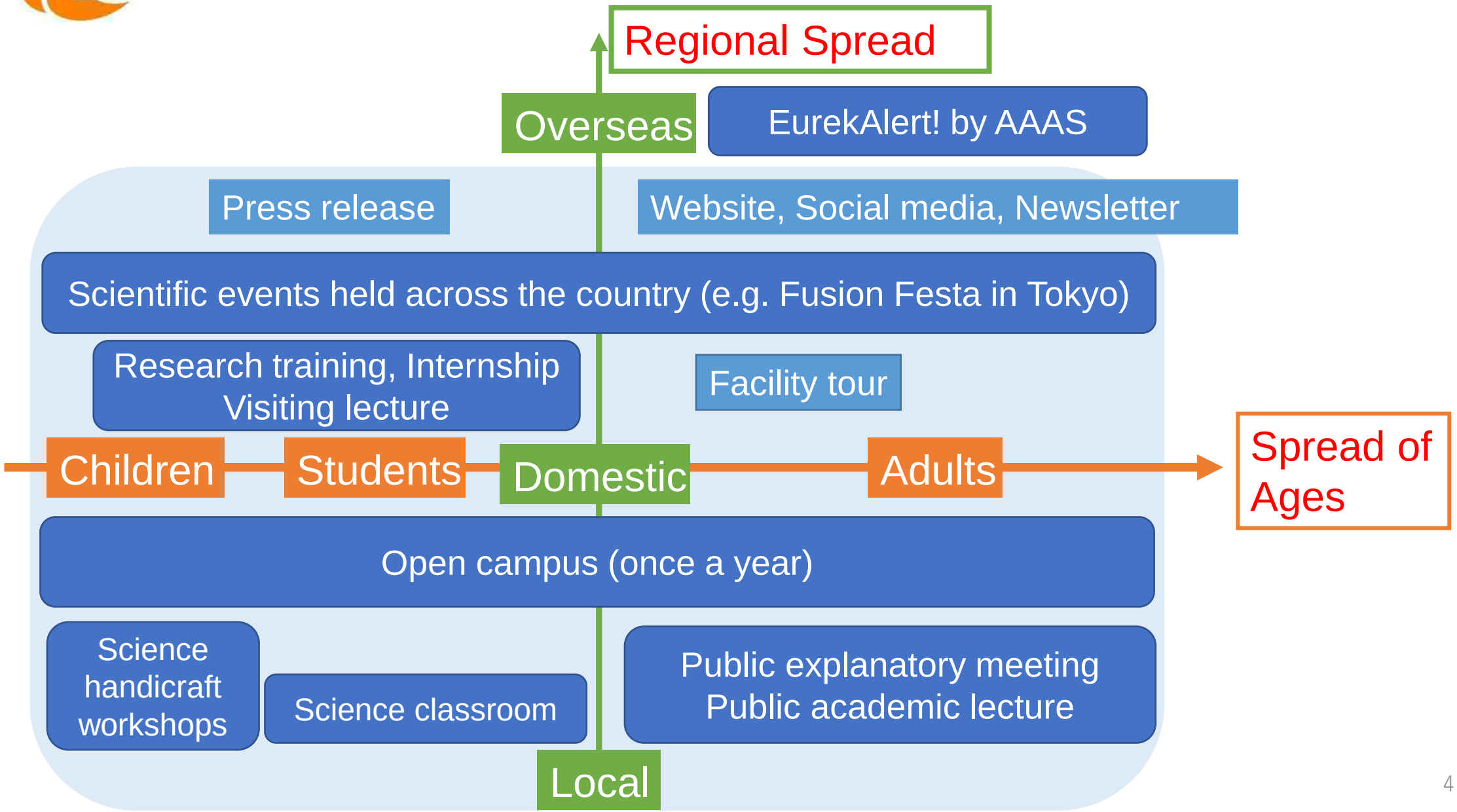
Perspective 1

Do you provide information and have a dialogue on the importance and the safety of fusion research for the development of a sustainable society to a wide range of people?

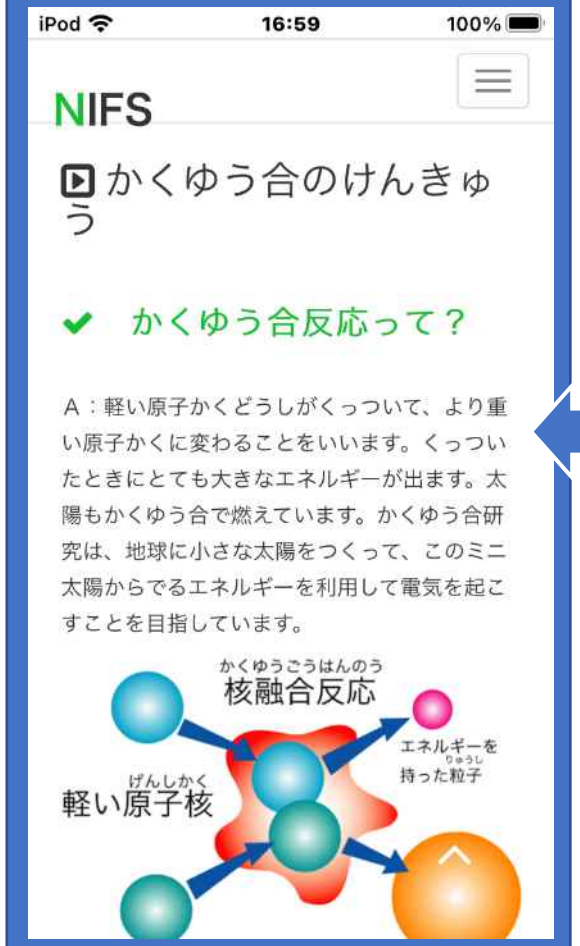
Activities

1. Website, Newsletter, Social media, Press release
2. Open Campus, Fusion Festa in Tokyo, Public explanatory meetings, Facility tours

Spread of the Division of External Affair's activities



Website to inform the importance and safety of fusion research

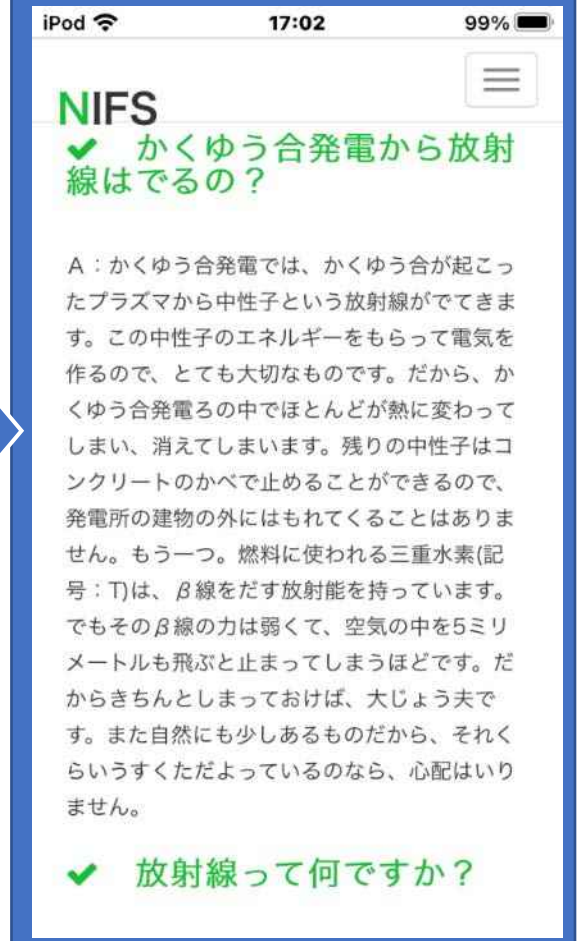


「核融合へのとびら」2006～
Introduction to Nuclear Fusion
https://www.nifs.ac.jp/ene/index.html

- Uses only the Chinese characters learned in elementary school.
- Plenty of images
- Smartphone compatibility
- Higher rankings in search engines

Keywords that show up in the top 3 Google searches

かくゆう合のけんきゅう	かくゆう合とほうしゃせん
核融合	核融合 放射線
太陽 核融合	核融合発電 原子力発電 違い
核融合とは	原子力発電 核融合
核融合反応	核融合 放射能
核融合反応 太陽	核融合 原子力
核融合反応とは	原発 核融合
水素 ヘリウム	原子力 核融合
水素 核融合	核融合炉 放射線
Importance	Safety



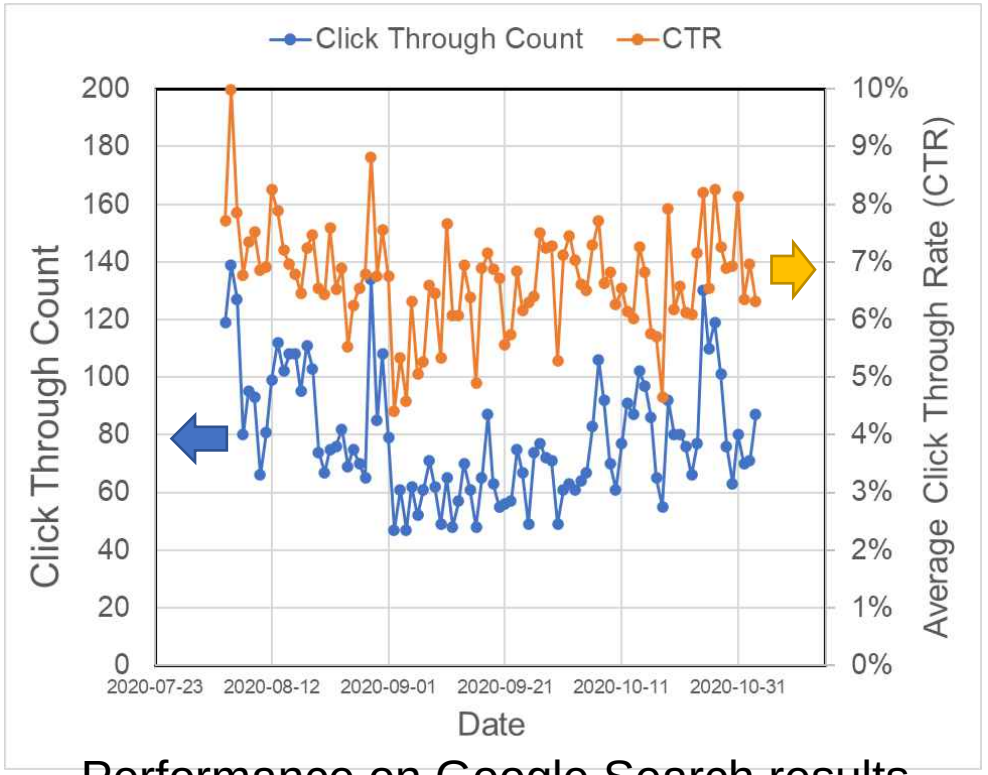
This website has become an important medium for first contact with the word “nuclear fusion.”

Website to inform the importance and safety of fusion research (cont.)

「核融合へのとびら」
Introduction to Nuclear Fusion
https://www.nifs.ac.jp/ene/index.html

This website gets a higher CTR than commercial-based sites.

Click-through rate (CTR) is the ratio of users who click on a specific link to the number of total users who view a page.



Performance on Google Search results

Average Click-Through Rate in Google Ads by Industry

Industry	Average CTR (%)
Travel	4.68
Auto	4.00
Health	3.27
E-Commerce	2.69
Finance	2.91
Technology	2.09

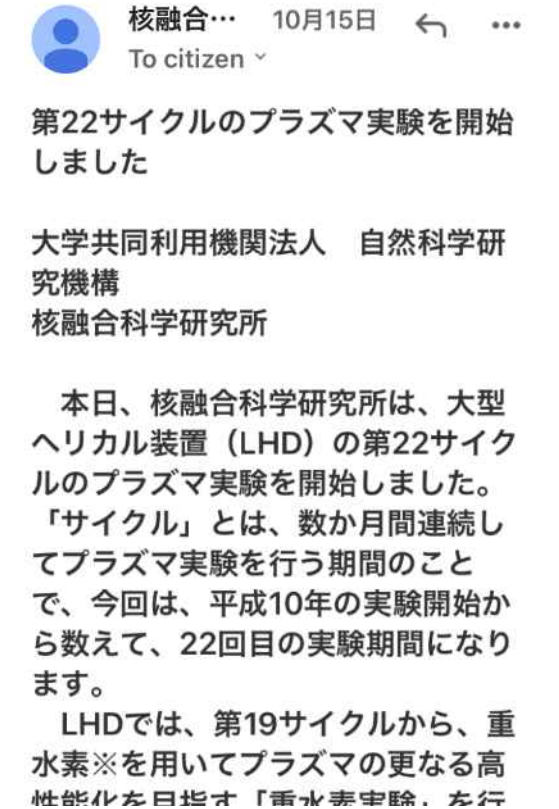
From WorldStream Website
https://www.wordstream.com/blog/ws/2016/02/29/google-adwords-industry-benchmarks

In particular, the CTR of users who searched for “fusion” and “radiation” was 55%.
We also provide information on safety without hesitating.

We use a variety of internet services to provide information

Monthly Newsletter

372 subscribers



核融合… 10月15日

To citizen

第22サイクルのプラズマ実験を開始しました

大学共同利用機関法人　自然科学研究機構
核融合科学研究所

本日、核融合科学研究所は、大型ヘリカル装置（LHD）の第22サイクルのプラズマ実験を開始しました。「サイクル」とは、数か月間連続してプラズマ実験を行う期間のことで、今回は、平成10年の実験開始から数えて、22回目の実験期間になります。

LHDでは、第19サイクルから、重水素※を用いてプラズマの更なる高

Social Media

Twitter: 1,134 followers
Facebook: 451 followers

YouTube

Starting in June 2020
12 videos

“New Plasma Simulator RAIJIN” 686 views

We distribute many press releases and spread information to the public in the form of press articles

Presenting annual research results to the press

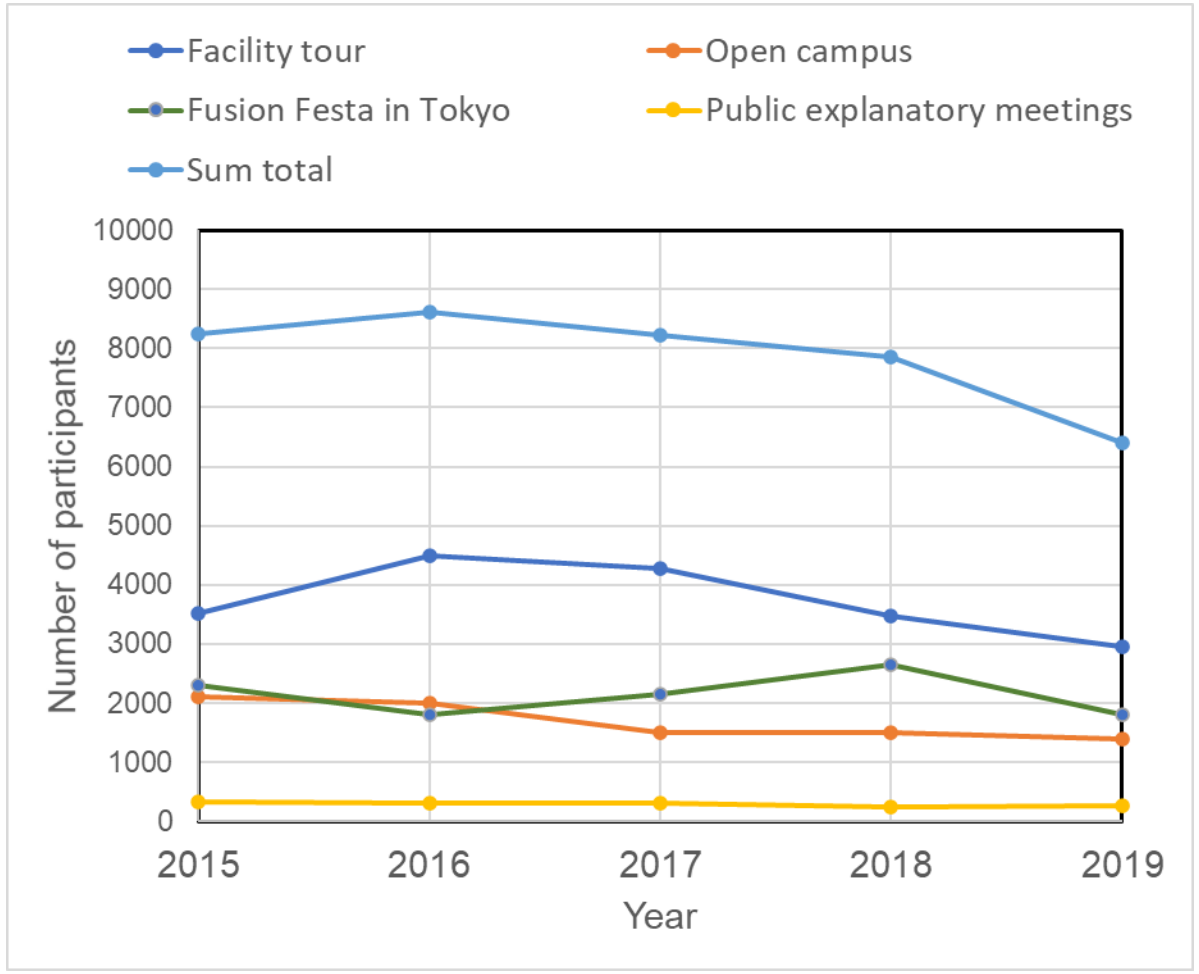
Joint press conference with a company

24 press conferences since 2015
43 press releases via websites, etc.
That resulted in 230 media reports (newspapers, online news)

We have an open dialogue on fusion research with nearly 8,000 people each year

"Fusion Festa in Tokyo"
(at Miraikan)

Open campus
(at NIFS)



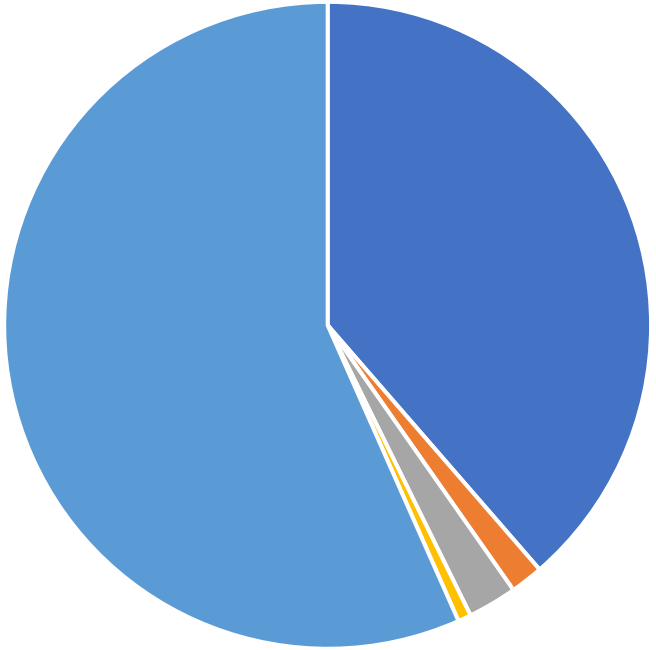
Public explanatory meetings
(In the neighborhood)

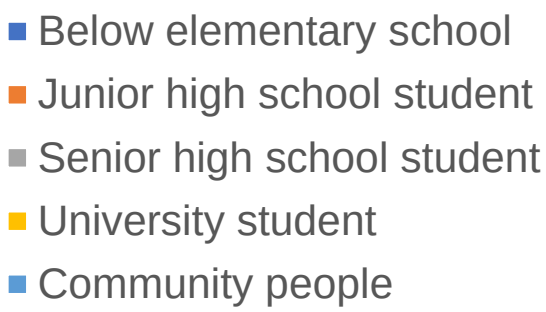
Facility tour

We also have a display booth at about 10 exhibitions each year.

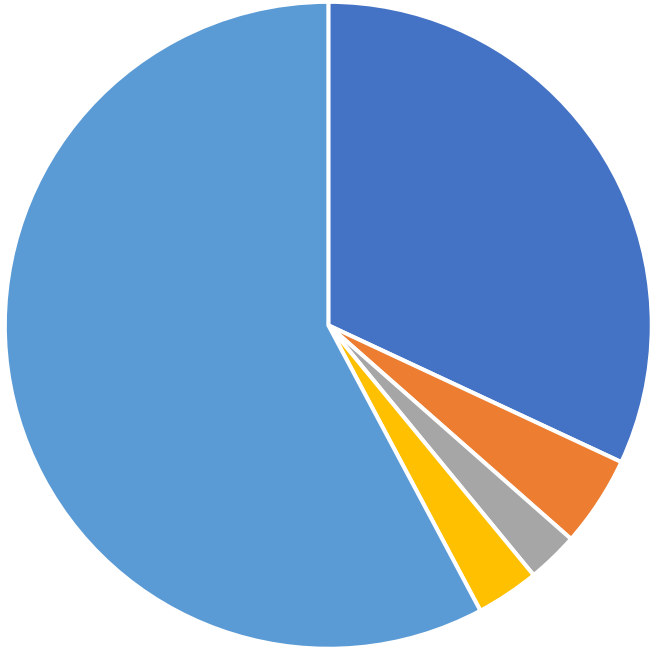
Many families with children visit the science events

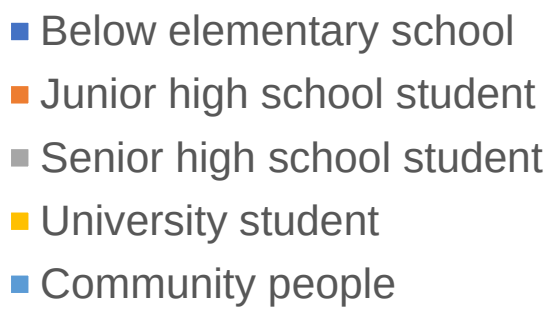
Open Campus in 2019



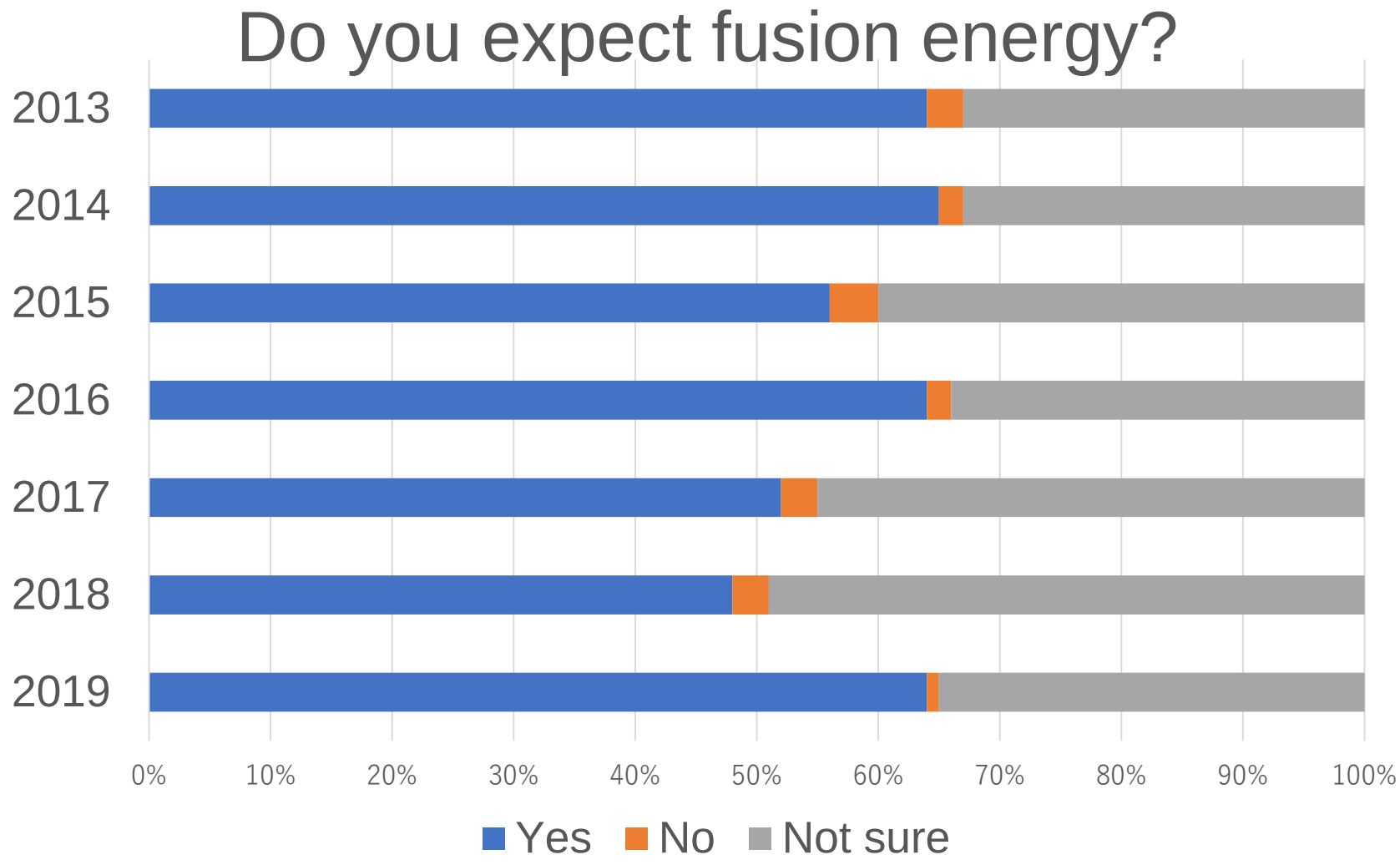


Fusion Festa in Tokyo





According to the results of the questionnaire at the Fusion Festa, more than half of the participants expect fusion energy.



At the Open Campus, we explain the importance of fusion research and have many exhibits to help children become familiar with science

children's craft class

plastic bottle rockets

Visiting the supercomputer

Superconducting maglev train

Plasma globe

Visiting the control room

In 2020, the Open Campus was held entirely online!

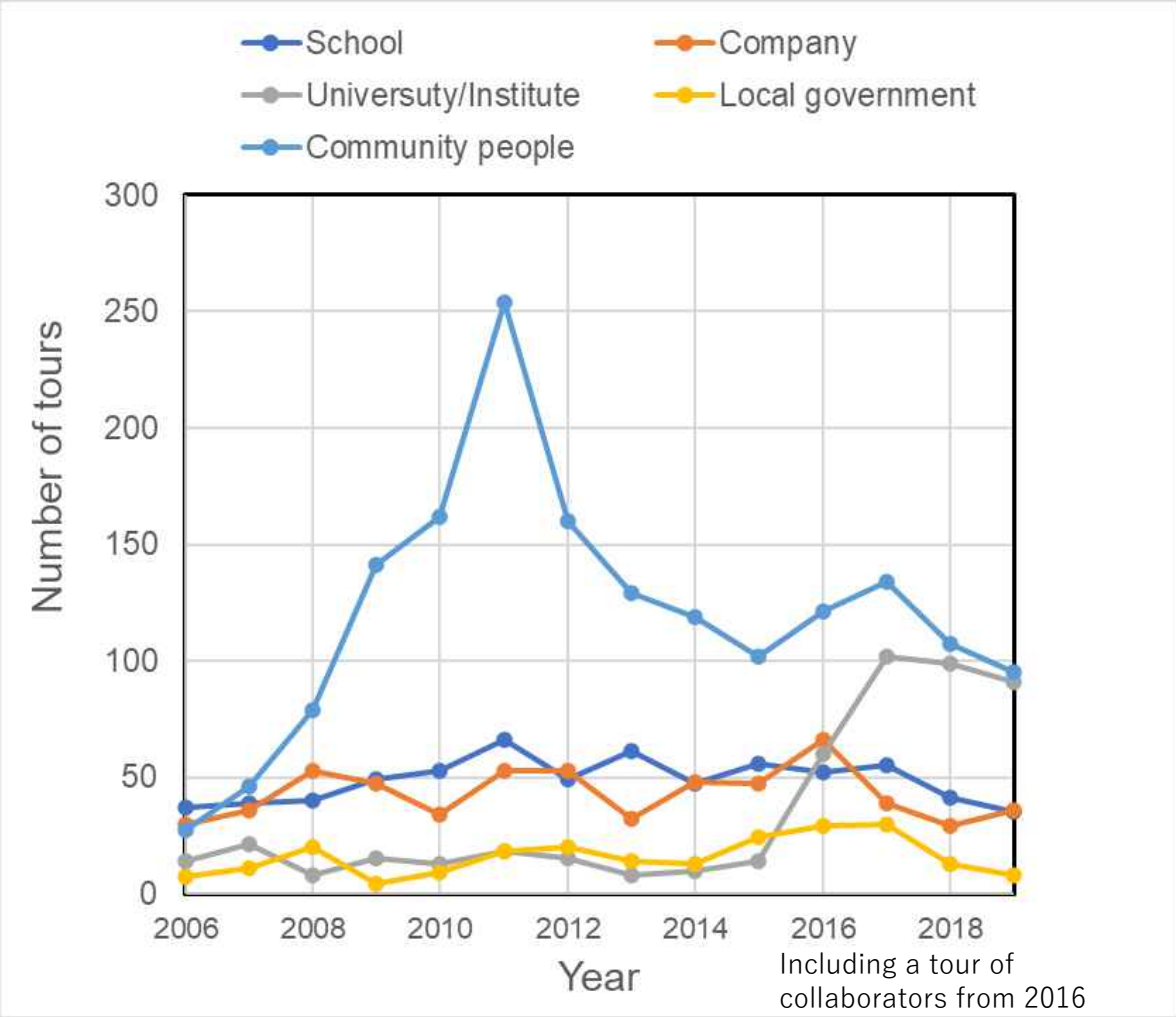
Facility tour by live streaming
(3 times, Total of 400 participants)

The ability to broadcast from places that are not usually open to visitors is one of the strengths of live streaming.

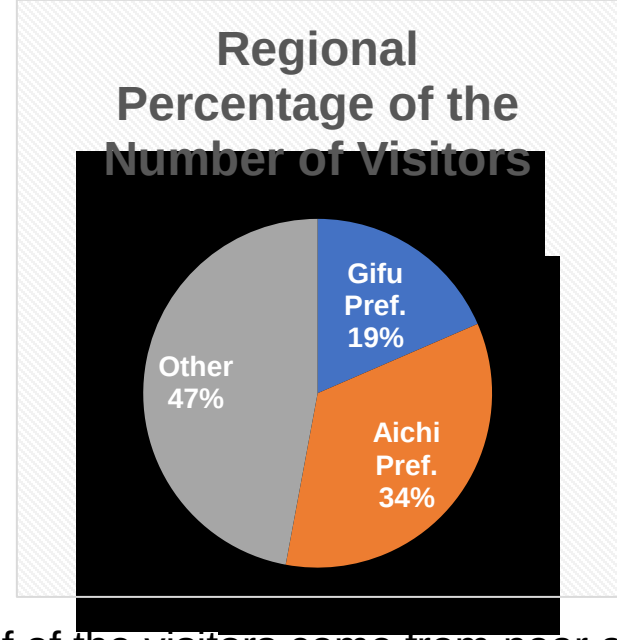
Filming of the online lecture
(Two lectures, Total of 180 participants)

Eight video contents have also been released.
“New Plasma Simulator RAIJIN”
“Fusion Research in one minute!” etc.

Many community people come to visit the facility tour



Including a tour of collaborators from 2016



Half of the visitors come from near and far.

Typical comments from visitors:

- I thought nuclear fusion was a dream, but when I saw the magnificent facility, I felt it was within our reach.

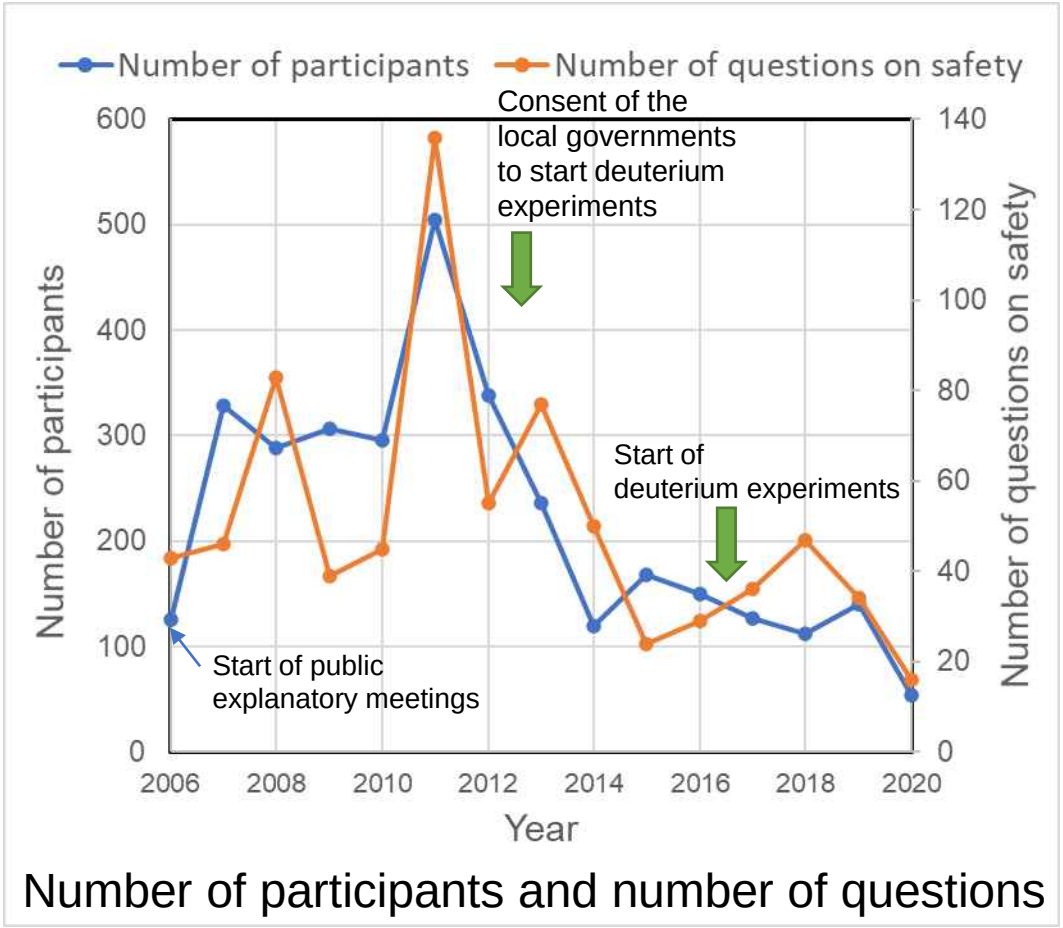
Perspective 2

Do you carry out community interaction activities appropriately to gain their trust and understanding of fusion research through communication with local residents?

Community interaction activities

1. Public explanatory meetings in the community
2. Events at the request of local communities
3. Newspaper flyers to the community

In 15 years, we have held 341 public explanatory meetings



Number of participants and number of questions on safety in the public explanatory meetings

Total 5,761 participants

Explanatory Contents:

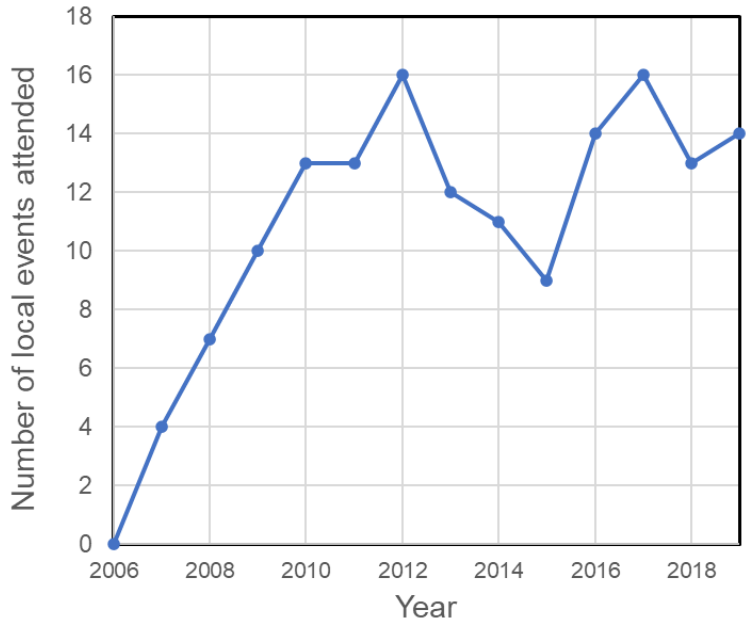
- Importance of fusion research
- Purpose of the deuterium experiment
- Radiation risk and safety management (Worst case scenario)
- Schedule

Participants' opinions gradually changed to trust in the Institute's safety management.

An example of an opinion:
“Fusion research is necessary for our children and grandchildren, so I hope that you will continue to proceed with safety and security in mind.” (September 2020)

All questions and answers can be found on the website.

We have participated in about ten community events each year at the request of local communities.



Number of local events attended

Display of scientific toys at a summer festival (Bon Dance Festival)

Providing scientific toys for a citizen participation event

This confirms the trust we have with the community.
In addition, it is an opportunity for useful dialogue.

Publishing a bi-monthly newsletter to the community

6,000 newspaper flyers are distributed in the vicinity of the institute.

Contents:

- Latest Event Information
- Status of LHD preparations and experiments
- Commentary on fusion research
- Commentary on global environmental issues
- Nature in the Institute
- Quiz

An example of feedback:
“It was interesting to learn about the necessity of fusion power by combining it with current news. I would like to read every issue from now on because I can learn about recent activities and research at the Institute.” (June 2020)

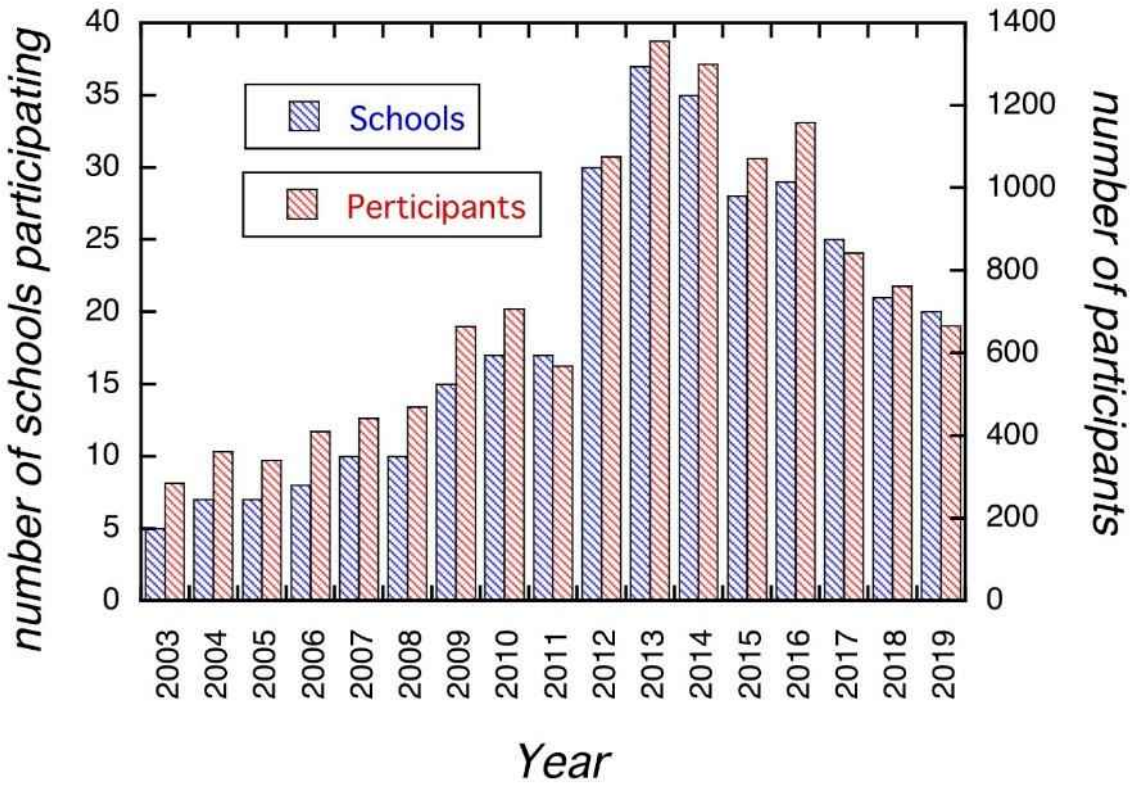
Perspective 3

Do you contribute to the science education of children, students, and society through various workshops and events?

Activities

1. Acceptance of senior high school students for a lecture, facility tour, and group training
2. Acceptance of junior and senior high school students for a few days of work experience
3. Acceptance of interns from technical colleges and universities
4. Providing craft classes for children in the community
5. Public academic lectures in the community

Contributions to science education for high school students



Number of high schools participating in the research training

- Students select one of the 13 training items (e.g. plasma, vacuum, superconductivity, simulation, electron microscope) and conduct a small group training session.
- Lecture and facility tour
- Researchers travel to their hometowns to lecture

Experiments on superconductivity

Facility tour

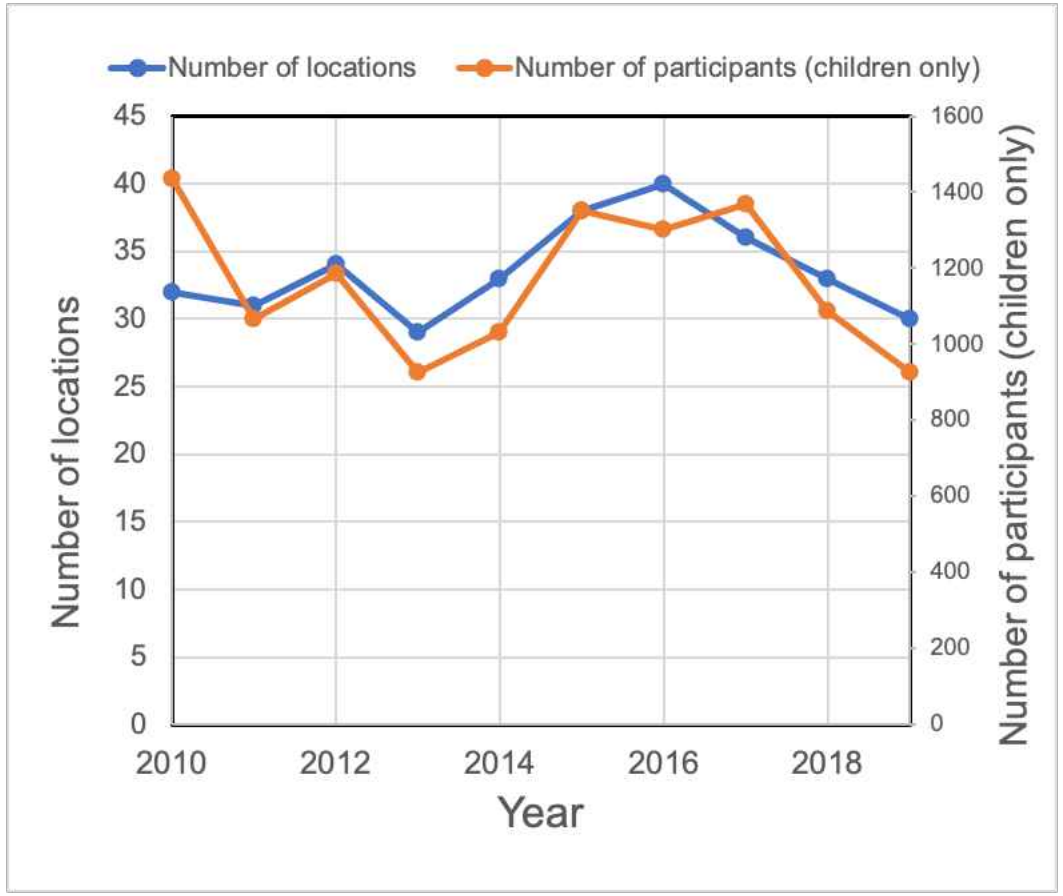
Contributions to science education for various students

Acceptance of junior and senior high school students for a few days of work experience
(Four schools, 22 students in 2019)

Acceptance of interns from technical colleges and universities
(21 students in 2019)

Contributions to science education for children

We provide science handicraft workshops to over 1,000 children every year.



Children making robots.

Completed robots. The vibration by the motors drives them forward.

Contributions to science education for society

We have biannual public academic lectures in the community.

Lecture on the HAYABUSA spacecraft
(July 2019, 660 participants)

Previous Themes:

- New mobility society
- HAYABUSA spacecraft
- Pyramids in Egypt
- Rocket development
- Biological clock
- Chimpanzees

We organize the lectures on a wide range of scientific topics.

Summary

We have provided information and had a dialogue on the importance and the safety of fusion research to a wide range of people through:

1. Website, Newsletter, Social media, Press release
2. Open Campus, Fusion Festa in Tokyo, Public explanatory meetings, Facility tours

We have carried out community interaction activities appropriately to gain their trust and understanding of fusion research through communication with local residents through:

1. Public explanatory meetings in the community
2. Events at the request of local communities
3. Newspaper flyers to the community

We have contributed to the science education of children, students, and society through:

1. Acceptance of senior high school students for a lecture, facility tour, and group training
2. Acceptance of junior and senior high school students for a few days of work experience
3. Acceptance of interns from technical colleges and universities
4. Providing craft classes for children in the community
5. Public academic lectures in the community

References

Table of Evaluation Results for the 2020 External Peer Review

Table of Evaluation Results for the 2020 External Peer Review the“Division of Health and Safety Promotion,” the “Division of Information and Communication Systems,” and the “Division of External Affairs”

Ⅰ. Points for Evaluation

1. Division of Health and Safety Promotion

(1) Are the organizations and systems for safety and health management properly constructed and operated in compliance with relevant laws and regulations?

(2) Are the safety management equipment / facilities, experimental equipment, etc., for maintaining and managing safety taken into account for the characteristics and circumstances peculiar to fusion research?

(3) Are manuals and rules such as operation manuals, radiation control manuals, and emergency manuals properly formulated and operated?

(4) As the Inter-University Research Institute, do you properly provide safety management and education to staff and collaborators?

(5) Is the training of leaders to carry out safety management properly planned and implemented?

2. Division of Information and Communication Systems

(1) Is the information and communication system as a research platform properly constructed and operated?

(2) Is the division of information and communication systems properly responding to requests for information system development from inside and outside the institute?

(3) Is the organization of the division of information and communication systems functionally constructed and operated?

3. Division of External Affairs

(1) Do you provide information and have a dialogue on the importance and the safety of fusion research for the development of a sustainable society to a wide range of people?

(2) Do you carry out community interaction activities appropriately to gain their trust and understanding of fusion research through communication with local residents?

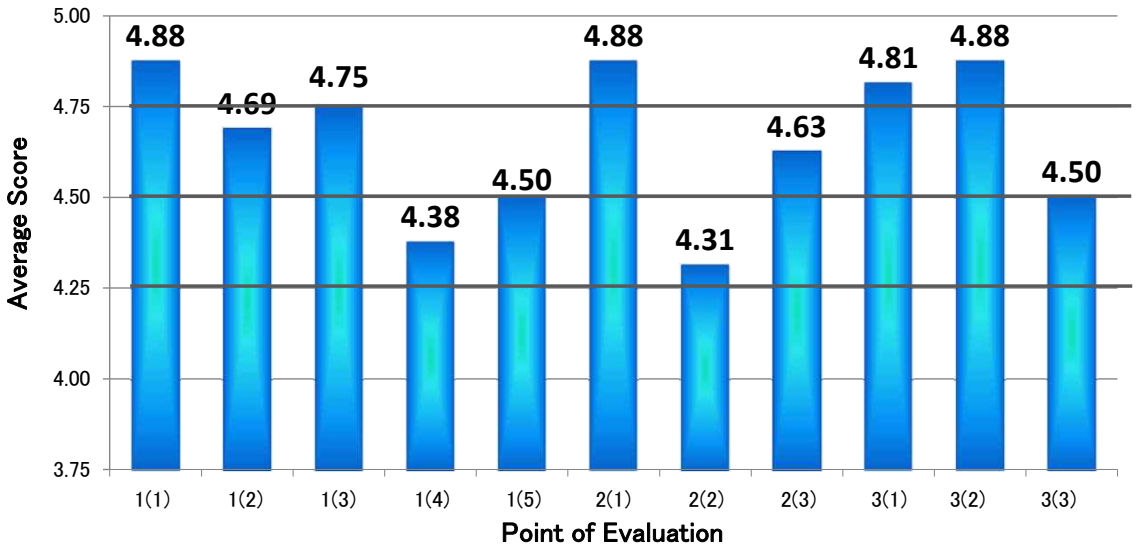
(3) Do you contribute to the science education of children, students, and society through various workshops and events?

Ⅱ. Tabele of Evaluation

Number of persons

Point of Evaluation / Score	1. Health and Safety Promotion					2. Information and Communication Systems			3. External Affairs		
	(1)	(2)	(3)	(4)	(5)	(1)	(2)	(3)	(1)	(2)	(3)
5 (Extremely highly commmendable)	14	11	12	6	8	14	5	10	14	14	8
4 (Highly commendable)	2	5	4	10	8	2	11	6	1	2	8
3 (Commendable)	0	0	0	0	0	0	0	0	1	0	0
2 (Adequate)	0	0	0	0	0	0	0	0	0	0	0
1 (Inadequate)	0	0	0	0	0	0	0	0	0	0	0
Average Score	**4.88**	**4.69**	**4.75**	**4.38**	**4.50**	**4.88**	**4.31**	**4.63**	**4.81**	**4.88**	**4.50**

※The evaluation result is a combination of the results of domestic committee members (13 persons) and foreign committee members (3 persons).



Inter-University Research Institute Corporation
National Institutes of Natural Sciences
National Institute for Fusion Science
322-6 Oroshi-cho, Toki, Gifu, 509-5292, Japan
http://www.nifs.ac.jp/