

Strategy for the International Cooperation

(Unofficial Translation)

March 2017

Japan Atomic Energy Agency

Strategy for the International Cooperation
Table of Contents

1. Adoption of the Strategy for the International Cooperation and its expected role
2. Background
 - (1) Energy situation surrounding Japan and its basic energy policy
 - (2) Recent situation surrounding nuclear energy
3. Basic concept of international cooperation
 - (1) Role of the JAEA
 - (2) Recent developments surrounding the JAEA
 - (3) Significance of international cooperation
 - (4) Basic policy for promoting international cooperation
 - (5) Points to note regarding promotion of international cooperation
4. Partners and cooperation areas to which priority is given for international cooperation
 - (1) Partners
 - (2) Cooperation areas
5. Measures for promoting international cooperation
 - (1) Increased priority of international cooperation
 - (2) Enhancement of the global orientation of the JAEA
 - (3) Enhancement of the function of the Office of International Affairs
 - (4) Acquisition of external funds for international cooperation

Attachment

1. Strategies for international cooperation with respective countries/regions, international organizations
 - (1) Europe
 - (2) Russia and CIS countries
 - (3) North and Latin American countries
 - (4) Asia Pacific Region
 - (5) Middle East
 - (6) International organizations

2. Strategies for international cooperation in respective R&D areas

- (1) R&D concerning decommissioning of Fukushima Daiichi NPP
- (2) R&D for environmental restoration
- (3) R&D for ensuring nuclear safety
- (4) Contribution to nuclear non-proliferation/nuclear security
- (5) R&D on the next-generation reactors
- (6) Basic and fundamental nuclear research
- (7) Research on the back end of nuclear fuel cycle
- (8) Support for the development of human resources in the nuclear field to other countries and development of globally-minded staff of the JAEA

1. Adoption of the Strategy for the International Cooperation and its expected role

The Atomic Energy Basic Act provides that Japan Atomic Energy Agency (hereinafter referred to as “JAEA”) shall actively make its R&D results available to international cooperation as one of the basic policies that the JAEA should follow in the execution of its mission of research and development in the field of nuclear energy (Articles 2 and 7¹). Also, in the set of objectives concerning the management of the JAEA’s operations (Medium to Long-term Objectives, April 2015, Ministry of Education, Culture, Sports, Science and Technology, Ministry of Economy, Trade and Industry and Nuclear Regulation Authority), a target to promote strategic and diversified international cooperation was indicated, and in the plan for achieving the Medium to Long-term Objectives (the Medium to Long-term Plan, April 2015, JAEA), **it is provided that the JAEA shall formulate a strategy for the international cooperation to actively promote international cooperation and enhancement of the global orientation of the JAEA. This Strategy for the International Cooperation (hereinafter referred to as “Strategy”) was developed based on the Medium to Long-term Plan as the guidelines for international cooperation which the JAEA will carry out as part of its mission. In this Strategy, “international cooperation” means making use of resources of other countries in promoting R&D, etc. (international cooperation in a narrow sense), contribution to common challenges associated with utilization of nuclear energy that the international nuclear community should tackle (international contribution), and international dissemination and outreach of R&D achievements of the JAEA (international outreach). In this Strategy, enhancement of the global orientation of the JAEA is considered as a means to promote international cooperation, and is described in the section 5.**

The Strategy will be applied during the period of the present Medium to Long-

¹ The utilization of nuclear energy shall be limited to peaceful purposes, shall aim at ensuring safety, and shall be performed independently under democratic administration, and the results obtained shall be made public so as to actively contribute to international cooperation (Article 2 of Atomic Energy Basic Act)

Activities such as the basic research and applied research on nuclear energy, the development of fast breeder reactor and necessary nuclear fuel materials for the purpose of establishing a nuclear fuel cycle, the development of technology for reprocessing, etc. of nuclear fuel materials as well as the dissemination of the results of such research and development, shall be carried out by the Japan Atomic Energy Agency in accordance with Basic Policy prescribed in Article 2 (Article 7 of Atomic Energy Basic Act)

term Plan which covers the duration until 2021. The Strategy will be revised, as appropriate, depending on the change in the situation, etc.

2. Background

(1) Energy situation surrounding Japan and its basic energy policy

Securing energy sources of Japan is inherently vulnerable as it depends on import from foreign countries of fossil fuel which accounts for the substantial part of its energy mix. To secure energy sources which are essential to the everyday life of the Japanese and their industrial activities in a stable manner has been a significant challenge for Japan.

Meanwhile, curbing greenhouse gas emissions and controlling the global warming have been increasingly regarded as common issues that humankind has to address in recent years.

Japan has worked on the utilization of nuclear energy for the purpose of improving the energy self-sufficiency. With recent requirement to increase the ratio of zero-emission energy sources, importance of such effort is being reaffirmed.

In these circumstances, Japan has adopted a policy to continue the utilization of nuclear energy, as indicated in the Strategic Energy Plan (April 2014, cabinet decision), as an important energy source substituting fossil fuel from a perspective of energy security, as well as an effective means to reduce greenhouse-gas emissions. In the Long-term Energy Supply and Demand Outlook (July 2015, METI), nuclear energy is estimated to account for 20 - 22 percent of the energy mix of Japan in 2030.

In terms of using nuclear energy, Japan has pursued a policy to promote the establishment of the nuclear fuel cycle aiming at reprocessing of spent fuel and effective utilization of recovered plutonium, etc. from the perspective of effective use of uranium resource and reduction in amount and toxicity of high-level radioactive waste, focusing on ensuring nuclear safety, nuclear non-proliferation and nuclear security as underlying premises.

(2) Recent situation surrounding nuclear energy

Due to the Great East Japan Earthquake that occurred on March 11, 2011 and the subsequent accident at TEPCO's Fukushima Daiichi Nuclear Power Plant (Fukushima Daiichi NPP), the situations surrounding nuclear energy in and outside Japan have changed profoundly. In Japan, trust of the public in nuclear safety and utility companies was severely damaged, and though a few nuclear power plants including Kyushu Electric Power Company's Sendai Nuclear Power Plants resumed

operation after passing the test of conformity to the new regulatory standards by the newly established Nuclear Regulation Authority, public's attitude to nuclear power generation is still severe. Meanwhile, as a result of the discussion within the government on the policy relating to the fast reactor, which was made based on the change in the environment surrounding the domestic fast reactor development such as the requirement of conformity with the new regulatory standards, it was decided that while prototype fast-breeder reactor Monju (hereinafter referred to as "Monju") would enter into decommissioning phase, R&D in the phase of the demonstration of fast reactors would be pursued.

Globally, on the other hand, the role of nuclear energy is being redefined from a perspective of addressing climate change. The Paris Accord was adopted in the 21st session of the Conference of the Parties (COP21) of the United Nations Framework Convention on Climate Change held in December 2015. The Accord, which set a major target of keeping the increase in temperature within two degrees compared to the pre-industrial level (within 1.5 degrees as a longer-term target), came into effect in November 2016. There is an increasing recognition that the role of nuclear power generation, power source emitting no greenhouse gases in the process of power production and enabling stable energy supply, is important for achieving this target.

When overviewing the international trend of nuclear energy after the accident at TEPCO's Fukushima Daiichi NPP, those countries that had already operated nuclear power plants will maintain nuclear power generation except for certain countries and regions such as Germany and Taiwan. China and India have implemented and been planning remarkable expansion of nuclear power generation in response to increased economic activities and growing energy demand.² While countries such as the US, Russia, France, China, India and Republic of Korea are proceeding with R&D on the next-generation reactors, some Middle Eastern countries and certain countries in Asia and Europe are launching plans to introduce nuclear power generation in terms of mitigating climate change, meeting economic needs and ensuring energy security.

In such a situation, securing nuclear safety, non-proliferation and nuclear security is becoming a major issue in promoting the utilization of nuclear energy. Also, how to secure and develop human resources in the field of nuclear energy (including in

² According to World Nuclear Association (WNA), the number of nuclear reactors under construction worldwide is 60 (27 units, accounting for 45 % of the total, are in China and India) and those at the planning phase is about 164 (60 units, or 37 % of the total, are in China and India) as of the end of 2016. The sum of the numbers of reactors under construction and at the planning phase amounts to about 50 % of the 447 reactors currently in operation (In the case of China and India, 153 % of 57 reactors currently in operation).

the area of decommissioning) is considered as a common issue for countries including those that have decided on the phase-out from nuclear power generation.

3. Basic concept of international cooperation

(1) Role of the JAEA

The major missions of the JAEA which are specified in the Atomic Energy Basic Act are as follows.

- The basic and applied research on nuclear energy
- The development of fast breeder reactors and its nuclear fuel materials aiming for establishing a nuclear fuel cycle
- The development of technology for reprocessing, etc. of nuclear fuel materials
- The dissemination of the results of the above research and development

These missions of the JAEA are required to be performed only for peaceful purposes, ensuring safety, under the principle of democracy, independence and publicity, **based on the basic policy of actively making the results available to international cooperation.**

(2) Recent developments surrounding the JAEA

The following are the recent developments surrounding the JAEA which are considered important in planning international cooperation.

1) Response to the accident at Fukushima Daiichi NPP

After the accident at the Fukushima Daiichi NPP, contributing to the restoration of confidence among the Japanese and international community in the utilization of nuclear energy of Japan is an urgent issue for the JAEA. The JAEA set up Sector of Fukushima Research and Development to focus on R&D for decommissioning of the reactors and R&D for restoration of the environment as efforts to respond to the accident. Especially, with respect to R&D toward decommissioning, R&D centers such as Naraha Remote Technology Development Center, Okuma Analysis and Research Center and Collaborative Laboratories for Advanced Decommissioning Science (CLADS) have been or are being constructed. For proceeding with R&D concerning the accident at Fukushima Daiichi NPP, expertise must be collected from both inside and outside of the country.

2) Examination and formulation of Medium to Long-term Plan of the Operation of the JAEA's facilities

Due to recent progression of aging in research facilities of the JAEA, huge cost is required for addressing the aging of such facilities, which is a major challenge, and bringing the facilities that are planned to be continuously used in conformity with the new regulatory standards. In response to such a situation, "Medium to Long-term Plan of the Operation of the JAEA's facilities" is being formulated as a plan for the period up to 2028. The Plan will promote three objectives in an integrated manner, namely, "consolidation and prioritization of facilities," "ensuring safety of facilities" and "back-end measures." A proposed Medium to Long-term Plan of the operation of the JAEA's facilities" was issued as an interim report in October 2016. From the standpoint of "consolidation and prioritization of facilities," 42 facilities among the entire 88 facilities are designated in the proposed Plan as facilities subject to decommissioning. In order to address increasing number of facilities entering a decommissioning phase, which include Monju described in the following subsection, it is important to move forward with decommissioning and associated waste management steadily, learning insight of the countries that have accumulated experience in this field. On the other hand, with regard to the facilities such as research reactors that continue to be used, early resumption of operation is important so as to be used as the core facilities of international cooperation.

3) Government's decision on the fast reactor development

It was decided in the Inter-Ministerial Council for Nuclear Power on September 21, 2016 that Japan will maintain the policy of the promotion of nuclear fuel cycle and the R&D on fast reactor development in accordance with the Strategic Energy Plan. It was also decided that the principle of R&D on fast reactor will be formulated while the future of Monju will be subject to thorough review with its decommissioning as an option. In accordance with the decision, the discussion was made in the newly established Council on Fast Reactor Development on how to move ahead with the development of fast reactor from now on. At the same time consultation on the future of Monju through the close contact among the Ministry of Education, Culture, Sports, Science and Technology and other relevant ministries and organizations was conducted. Based on such discussion and consultation, in the Inter-Ministerial Council for Nuclear Power on December 21, "Policy for Fast Reactor Development" was adopted and it was decided that the roadmap which will identify R&D efforts in the next ten years or so will be prepared around 2018.

Furthermore, in this Council meeting “Government Policy on the future of Monju” which includes the decision that the reactor will enter into decommissioning phase was also adopted. In the “Policy for Fast Reactor Development” it is considered important to rationalize development efforts through the strategic utilization of international cooperation and to explore the establishment of the international standard through the acquisition of the recent expertise.

In line with these policies of the government, the JAEA will move forward with the fast reactor development aiming at the deployment of a demonstration reactor and the decommissioning of Monju effectively using international cooperation.

(3) Significance of international cooperation

Engagement of the JAEA in the international nuclear community is broadly divided into three categories, that is, international cooperation (“international cooperation” in a narrow sense), international contribution and international outreach. They are detailed as below.

- 1) Utilization of resources of other countries (funds, human resources, expertise, R&D facilities and other infrastructures) in promoting R&D as JAEA’s missions, etc. (“international cooperation” in a narrow sense)

(Examples)

- Mutually beneficial cooperation by sharing resources (cost sharing, shared use of research facilities, etc.) with organizations of other countries in implementing large projects such as the formation of common research infrastructures for nuclear energy and development of the next-generation reactors that require large investment of money and human resources
- Utilization of expertise of such countries as the US, the UK and France with accumulated experience of its own decommissioning on the decommissioning of the JAEA’s research facilities and the treatment and disposal of radioactive waste generated from decommissioning

(Significance)

It will lead to the maximization of R&D results with limited resources through the effective use of resources of other countries for the promotion of projects which are otherwise difficult to implement due to constraint of resources and of activities in the fields on which knowledge has not been sufficiently accumulated in the JAEA.

- 2) Contribution to the common challenges that the international nuclear community

should tackle in the utilization of nuclear energy (international contribution)

(Examples)

- Contribution to the activities of international organizations such as the International Atomic Energy Agency (hereinafter referred to as “IAEA”) and the international initiatives in the fields of nuclear safety, safeguards/nuclear non-proliferation, nuclear security, etc through the dispatch of JAEA personnel to the meetings and the secretariat
- Providing expertise and human resources to the discussion and cooperation in the framework of the Organization for Economic Co-operation and Development/the Nuclear Energy Agency (hereinafter referred as to “OECD/NEA”) and Forum for Nuclear Cooperation in Asia (hereinafter referred to as “FNCA”) on the issues that the countries which use nuclear energy should address in common
- Support for the effort of other countries to develop a broad-ranging human resources, which is the basis for utilization of nuclear energy
- Promotion of the utilization of the JAEA’s facilities by other countries in the framework of international cooperation

(Significance)

The presence of the JAEA and Japan as a whole in the international nuclear community can be increased by making JAEA’s human resources, expertise and facilities available to discussion on the common issues concerning the utilization of nuclear energy and activities implemented in international organizations, etc. If contribution of Japan leads to useful results, utilization of nuclear energy in Japan also benefits from such results as common assets of the international nuclear community.

3) Dissemination and outreach of R&D results to the international community (international outreach)

(Examples)

- Dissemination of R&D results, etc. to overseas through international conference, etc.
- Leadership role on the discussion relating to establishment of international standards for the next-generation reactors
- Active implementation of international outreach of R&D results aiming at its commercialization

(Significance)

By realizing commercialization of Japanese technologies developed at the JAEA, presence of the JAEA and Japan in the international nuclear community is increased, and also it brings benefit to the international nuclear community and Japanese industry.

(4) Basic policy for promoting international cooperation

Based upon the above understanding, the JAEA will promote international cooperation in accordance with the basic policy listed below, thus contributing to the peaceful use of nuclear energy on the premise of ensuring nuclear safety and nuclear non-proliferation/nuclear security.

1) Contribution to ensuring nuclear safety

The JAEA will conduct nuclear safety research in coordination and collaboration with research institutes in other countries and widely disseminate and share the results, thus internationally contributing to securing nuclear safety.

2) Contribution to ensuring nuclear non-proliferation/nuclear security

Through collaboration with the efforts of the international organizations playing a central role in nuclear non-proliferation/ nuclear security, the JAEA will contribute to ensuring and enhancing nuclear non-proliferation/ nuclear security.

3) Maximization of R&D results

By promoting mutually beneficial cooperation allowing sharing resources with research institutes in other countries, the JAEA will create R&D results at the highest level in the world and build common research infrastructures for nuclear energy. Also, by carrying out R&D activities efficiently and effectively, it will promptly respond to the expectations and requests of the people and communities.

4) Support for developing human resources in the nuclear field in other countries and development of globally-minded personnel at the JAEA

The JAEA will support human resources development in the field of nuclear energy which is a common issue for countries using nuclear energy. By evolving its R&D sites into an international Center of Excellence, the

JAEA will create opportunities for the collaboration and the interaction and make them available to personnel both inside and outside Japan while utilize them for developing its own globally-minded staff. Moreover, it will achieve the development of leaders who represent nuclear R&D community in Japan and can lead the world.

5) Overseas dissemination and international outreach of R&D result, etc.

The JAEA will exchange experience and knowledge regarding nuclear energy with other countries and actively disseminate its R&D results to the world. Also, it aims the overseas deployment of technologies developed at the JAEA in cooperation with the industry.

(5) Points to note regarding promotion of international cooperation

For promoting international cooperation based on the above-mentioned basic policies, it is essential to recognize global trend by constantly grasping the current status of countries and relevant international organizations in terms of respective missions of the JAEA through interaction between experts at international conferences or meetings and information gathering efforts by the overseas offices of the JAEA.

Based on such recognition, the modality of international cooperation in each area must be examined and the measures to realize the cooperation must be explored proactively from the perspective that with which country and in what modality the cooperation in a certain area will maximize the R&D results of the JAEA, or that in which area and in what form of contribution to relevant international organizations will increase the presence of Japan and the JAEA in the international community and enhance the common interest of international nuclear community, considering also the relationship between Japan and the respective countries or the R&D capacity/infrastructure of the respective organizations.

Also, in addition to considering how international cooperation in respective areas should be, a perspective to grasp the cooperation between a certain country or international organization and the JAEA in a cross-sectoral and panoramic manner and to pursue optimization is important.

When there is the necessity to export nuclear materials and equipment or provide relevant technology for carrying out international cooperation, Relevant sections of JAEA are required to judge the validity of the export/provision in accordance with

the JAEA's internal export control regulation, etc., as well as follow the procedures required by applicable laws and regulations in an appropriate manner.

4. Partners and cooperation areas to which priority is given for international cooperation

The JAEA regards (1) advanced nuclear energy countries, (2) emerging nuclear energy countries and (3) nuclear-related international organizations, as priority cooperation partners in promoting international cooperation.

(1) "Advanced nuclear energy countries" means those countries that have already used nuclear power generation, and accumulated advanced knowledge in the field of nuclear energy through the experience of R&D on the next-generation reactors, R&D concerning treatment and disposal of radioactive waste, etc.

(2) "Emerging nuclear energy countries" means those countries that have limited years of experience of nuclear energy use or have a plan to introduce nuclear energy use in the future.

3) "Nuclear-related international organizations" includes the IAEA and OECD/NEA

Cooperation with countries and international organizations that are not described above might be implemented after the examination of its necessity on a case-by-case basis.

International cooperation will be implemented taking into account the respective characteristics of the following priority areas:

- R&D related to the accident at Fukushima Daiichi NPP (decommissioning, environmental restoration)
- Ensuring nuclear safety and nuclear non-proliferation/nuclear security
- R&D on the next-generation reactors
- Basic and fundamental nuclear research
- R&D on the backend of nuclear fuel cycle
- Human resources development in the nuclear field
- Decommissioning of and waste management at JAEA's nuclear facilities

Directions of international cooperation with respective countries/regions, international organizations and for R&D areas are shown in the Attachment.

(1) Partners

In promoting nuclear R&D, with the maximum use of expertise of **the advanced nuclear energy countries**, mutually beneficial cooperation in an efficient and effective manner will be promoted through sharing of resources. Bilateral commissions and other fora of cooperation established at the government level with the US, France and the UK will be effectively used to promote cooperation. Especially, R&D for addressing the accident at Fukushima Daiichi NPP will be implemented promptly in cooperation with the advanced nuclear energy countries having experience and knowledge in the areas such as accident evaluation, environmental restoration and decommissioning. While China, Russia and India are categorized as the advanced nuclear energy countries along with such countries as the US, France, the UK, cooperation with these countries has been limited or not been implemented at all until now. However, considering the potential that such cooperation will bring substantial benefit to the R&D of the JAEA, we will explore the possibility of the cooperation based on the situation of the government-level frameworks such as nuclear cooperation agreements and nuclear non-proliferation policy of Japan.

Cooperation with **the emerging nuclear energy countries** will be implemented by providing support for human resource development on basic and fundamental nuclear technology and on nuclear safety and nuclear non-proliferation/nuclear security.

In terms of cooperation with **international organizations**, the JAEA will actively participate in efforts to develop international standards and multilateral nuclear R&D activities, actively dispatching its staff to the secretariat of such organizations and meetings organized by them and play a leadership role on the development of international standards. Specifically, it will take initiative in developing international standards concerning safety requirements of the fast reactor and high temperature gas-cooled reactor, as well as make a contribution to the development of the frameworks to secure nuclear safety and nuclear non-proliferation/nuclear security, thus making proactive efforts for peaceful uses of nuclear energy.

(2) Cooperation areas

Decommissioning of Fukushima Daiichi NPP is our national priority. The JAEA, in the recognition that it is important for Japan as a country which caused the accident to share the experience and expertise acquired through the decommissioning of Fukushima Daiichi NPP with the international community, will proceed, in collaboration with the international community, with R&D for retrieving

fuel debris which is a key milestone in decommissioning and R&D for treatment and disposal of radioactive waste which is essential in decommissioning, while playing a leadership role and sharing knowledge and technology with other countries.

Also, **restoration of the environment from radioactive contamination** is a national requirement and draws international attention. The JAEA will actively implement international cooperation concerning environmental restoration (including decontamination and reduction in the amount of waste) with countries having similar issues.

Ensuring nuclear safety is the precondition for using nuclear energy and therefore a requirement of Japan and the international community. In addition to the safety research for supporting the safety regulation by the Nuclear Regulation Authority, the JAEA will be engaged in the R&D to improve nuclear safety using international cooperation on its initiative and disseminate the results domestically and globally so as to meet the expectations from inside and outside Japan.

Ensuring nuclear non-proliferation and nuclear security composes the twin pillars, together with ensuring nuclear safety, to underpin the utilization of nuclear energy, and is the most fundamental international requirement. Therefore, in addition to the implementation of accounting for and control of nuclear material and nuclear security in its own facilities in an appropriate manner, the JAEA will contribute to international efforts to enhance nuclear non-proliferation and nuclear security in cooperation with international organizations such as the IAEA.

With regard to **R&D on the next-generation reactors**, the JAEA will implement cooperation for R&D on the next-generation reactors such as the fast reactor and high temperature gas-cooled reactor in an appropriate framework of bilateral/multilateral cooperation depending on the area and items of R&D, and take initiative in the efforts to develop international criteria of safety design at the Generation IV International Forum (GIF)³ and the IAEA.

For **basic and fundamental nuclear research**, it is important to create common

³ GIF is an international forum for international cooperation, of which establishment the US called for in 1999. Generation IV is the concept of a nuclear energy system following the generation III (generation I: early reactors, generation II: light-water reactors, etc that account for a large portion of the reactors currently in operation, generation III: advanced light-water reactors, etc). Efforts are aimed at developing systems that have adequate advantage over other energy sources in view of economic efficiency, safety, sustainability (resource saving and waste minimization), proliferation resistance, etc. as a whole, and that can serve as a key energy source in 2030-2040 timeframe. The signatories of GIF are following 13 countries and one international organization: Argentina, Australia, Brazil, Canada, China, EURATOM, France, Japan, Korea, Russia, South Africa, Switzerland, the UK and the US.

infrastructures (data, code, measuring technique, etc.) through international research cooperation, as well as to promote cutting-edge R&D by forming international teams through efforts such as the evolution of advanced nuclear research facilities into international Centers of Excellence (COE). Serving as an international COE also stimulates human resources development, especially the development of globally minded experts in Japan.

With regard to **the research on the back end of nuclear fuel cycle**, cooperation will be implemented with research institutes in other countries having similar programs in the following fields: nuclear transmutation of minor actinide using the accelerator-driven system (ADS), R&D on geological disposal of high-level radioactive waste, and near-surface disposal of low-level radioactive waste.

Support for the human resources development in the nuclear field in other countries will be implemented by providing training in the fields of basic and fundamental nuclear technology, nuclear safety, and nuclear non-proliferation/nuclear security, responding to the request of the Government.

Development of globally-minded staff of the JAEA will be achieved through cooperation and exchange with overseas researchers and engineers at international research centers of the JAEA, dispatch of personnel to international organizations, etc. Especially, in respect of personnel dispatch to the secretariats of international organizations, etc., numerical targets should be set so that effort is made to meet the targets. To increase the incentive of the JAEA staff to apply for the vacant posts of international organizations, etc., the career path of the staff having experienced overseas assignment should be clarified. Such career path may include the positions within JAEA the assignees to the international organizations will occupy after the completion of their assignment and the possibility of the next dispatch for the assignment to the higher-level post of the same international organizations, etc. Collaboration with the Japan International Cooperation Agency (JICA) for safety training of nuclear energy will be strengthened. Efforts will be made to make the JAEA a major source of supply of globally minded experts in the field of nuclear energy, by **cultivating leaders of the international nuclear community** among its staff through dispatching personnel to the above international organizations, exerting the presence at important international conferences and committees meetings and building robust relationship based on mutual trust with the leaders in other countries.

Decommissioning of and waste management at JAEA's nuclear facilities is an important issue in the situation where the number of facilities entering into the

decommissioning phase, which include Tokai Reprocessing Plant and Monju, is expected to increase. Especially, knowledge of the countries which have accumulated relevant expertise such as the US, the UK and France should be used especially in the areas where the JAEA does not have enough knowledge, such as the decommissioning of reprocessing plants and fast reactors.

5. Measures for promoting international cooperation

(1) Increased priority of international cooperation

For promoting the Strategy for the International Cooperation, securing resources for the activity such as funds and staff that serve as the driving force is essential. The Management Sector, Common Mission Sector, and respective research Sectors should place a high priority on international cooperation and give special consideration to systematic implementation of the Strategy in terms of resource allocation plans, personnel distribution and budget allocation.

(2) Enhancement of the global orientation of the JAEA

As hubs for implementing the Strategy, developing and enhancing the R&D centers which serves as the core of international cooperation is effective to developing human resources inside and outside Japan including those of the JAEA. International research exchange, international joint research, international collaboration and cooperation, etc. should be organized systematically at such research centers as Advanced Science Research Center, Nuclear and Science Engineering Center, Materials Sciences Research Center, Collaborative Laboratories for Advanced Decommissioning Science (CLADS), Nuclear Human Resource Development Center, Integrated Support Center for Nuclear Nonproliferation and Nuclear Security, Nuclear Safety Research Center and Fukushima Environmental Safety Center.

Additionally, newly established facilities such as Naraha Remote Technology Development Center and Okuma Analysis and Research Center as well as J-PARC, a large R&D facility having characteristics that is unique internationally, Experimental Fast Reactor JOYO, AtheNa, a development testing facility for cooling system and components of fast reactors, High Temperature Engineering Test Reactor (HTTR), and hot laboratories at Nuclear Science Research Institute are facilities which are expected to serve as hubs of international cooperation. We will lead international collaboration and cooperation using these facilities.

The JAEA will actively organize international symposiums and workshops for

accelerating international cooperation and enhancing its presence as an internationally recognized COE, and invite excellent researchers from overseas for further improving its international research environment.

The Strategy also includes the following objectives: developing globally minded staff, improving support for researchers from other countries, considering making English an official language at international R&D centers and enhancing information transmission in English.

(3) Enhancement of the function of the Office of International Affairs

It is necessary to strengthen the function of the Office of International Affairs as an in-house think tank. Such function includes giving advice, as appropriate, to board members, relevant sectors, etc., grasping the JAEA's international cooperation in a panoramic and cross-sectional way, and following up and reviewing implementation of this Strategy. Also, the overseas offices of the JAEA should be reformed so that they can fulfill the function not only as bases for gathering information and liaison offices but also as regional centers for international collaboration and cooperation. More specifically, they will be in charge of planning and organizing symposiums and workshops on their own initiatives aiming at increasing visibility of the activities of the JAEA in the country of the office and the relevant international organizations, appealing the significance of R&D collaboration with JAEA to the audience in the respective countries/organizations, developing/broadening a network of contacts with relevant organizations, and exploring the possibility of cooperation with the countries. Meanwhile, efforts will be made to secure resources necessary to enable the enhancement of the function of the Office of International Affairs.

(4) Acquisition of external funds for international cooperation

Creation and acquisition of external funds supporting the Strategy is also an important factor. While effectively using existing grant-in-aid programs, efforts will be made to encourage relevant ministries and agencies to newly create grant-in-aid programs supporting international cooperation in the field of nuclear energy.

Directions of international cooperation with respective countries/regions, international organizations and R&D areas

1. Directions of international cooperation with respective countries/regions, international organizations

(1) Europe

The situation of progress in the utilization of nuclear energy in Europe ranges broadly. There are advanced nuclear energy countries such as the UK and France, countries utilizing nuclear energy in a stable manner, such as Sweden and Finland, and countries planning to introduce nuclear power like Poland, while Germany, Belgium, etc. are seeking to phase out the use of nuclear power. The JAEA will strategically promote mutually beneficial collaboration and cooperation based on these diversity of situation in Europe and characteristics of respective countries.

With regard to the cooperation with **France**, where nuclear power generation accounts for more than 70 percent of its energy mix and development of the demonstration fast reactor is active, cooperation on the fast reactor and nuclear fuel cycle will be promoted strategically. Especially, under the Framework Agreement with the French Alternative Energies and Atomic Energy Commission (CEA), cooperation in wide-ranging areas such as the fast reactor system, nuclear science, R&D concerning decommissioning of Fukushima Daiichi NPP and decommissioning of reprocessing plants and other nuclear fuel facilities will be further promoted. Also, cooperation will be further expanded under the general arrangement with the Institute for Radiation Protection and Nuclear Safety (IRSN) in wide-ranging areas such as fuel, thermal hydraulic including severe accidents, safety for fuel cycle facilities and waste disposal, radiation protection and nuclear emergency preparedness. Cooperation with the National Agency for Radioactive Waste Management (ANDRA) on R&D for high-level radioactive waste disposal will be promoted.

With the **UK**, where construction of reactors had been restrained until recently since the Chernobyl accident and a number of reactors have already been shut down permanently, cooperation with the Nuclear Decommissioning Authority (NDA) on treatment and disposal of radioactive waste and decommissioning of reactors and reprocessing facilities, etc. will be further promoted. R&D cooperation will be

implemented with the Science and Technology Facilities Council (STFC) on a reciprocal basis in such fields as advanced high intensity accelerators and neutron apparatus. Possibility of cooperation in other areas will also be explored based on the recent developments in the UK such as the plan of the deployment of new nuclear power plants and reactivation in nuclear energy-related R&D in the areas such as high temperature gas-cooled reactor.

Collaboration and cooperation will be actively implemented with **Finland, Sweden** and **Switzerland**, noting these countries are advanced in R&D and fundamental nuclear research in concert with the progress of the actual projects in the field of geological disposal.

In terms of the safety research and basic and fundamental nuclear research areas, the JAEA will further promote collaboration and cooperation with the countries in this region for the exchange of expertise, regardless of the nuclear energy policy of each country. For example, cooperation will be implemented with research institutes having excellent research achievements and experimental facilities such as the Karlsruhe Institute of Technology (KIT) and the GSI Helmholtz Centre of Heavy Ion Research (GSI) in **Germany**. With Belgium, cooperation will be promoted with the Belgian Nuclear Research Centre (SCK/CEN) relating to accelerator-driven nuclear transmutation technology, decommissioning, etc. As to the cooperation with **Sweden**, in coordination with the Nuclear Regulation Authority, cooperation on severe accidents research will be implemented with the KTH Royal Institute of Technology (KTH). Also, cooperation on advanced large-scale accelerator technology, neutron generators and technique for using them will be implemented at the European Spallation Source (ESS), a large-scale accelerator facility that is being constructed in Sweden with the cooperation of 17 European countries including Sweden, Denmark and Germany. Possibility of cooperation with **Poland**, which shows interest in introducing the high temperature gas-cooled reactor and cooperation with the JAEA in that area, will be explored from the perspective of international outreach of JAEA's technology for this type of reactor.

(2) Russia and other CIS countries

Russia, a resource-rich country with oil and natural gas, is developing wide-ranging nuclear technologies including conventional reactors, atomic-powered icebreakers, floating nuclear power stations and fast reactors. Taking into account that the Memorandum of Cooperation in the Peaceful Use of Nuclear Energy was signed at the ministerial level between Japan and Russia in December 2016,

cooperation with Russia will be explored for promoting innovative nuclear technology. In Russia, which has long years of experience in operating the fast breeder reactor BN-600, the BY-800 started generating electricity in December 2015. As the next step, Russia is proceeding with the development of BN-1200 with a design satisfying the requirements as a commercial reactor, aiming its start of the operation at around 2030.

Kazakhstan, which has the world's second largest uranium reserves, is strategically committed to providing resources/service relating to the nuclear fuel cycle. The JAEA will further advance cooperation with the National Nuclear Center (NNC) on the core meltdown test of the fast reactor, etc., which is difficult to perform in Japan, and explore the possibility of cooperation in the area of the high temperature gas-cooled reactor development, cooperation concerning the assessment of the environmental dynamics of radionuclide and support for the nuclear security training center set up in the Institute of Nuclear Physics (INP).

With regard to the cooperation with **Ukraine**, where nuclear accident occurred at Chernobyl NPS in 1986 at the time of former Soviet Union, cooperation with the Institute for Safety Problems of Nuclear Power Plants of Ukraine's National Academy of Sciences (ISP-NPP) including exchange of information on the accidents at Chernobyl NPS and Fukushima Daiichi NPS will be started to obtain expertise significant in R&D for removing the fuel debris and decommissioning.

(3) North and Latin American countries

The US is the most important partner of Japan in the field of nuclear energy. While paying close attention to the policy directions of the new administration that took office in January 2017, cooperation with the most advanced research institutes in the world will be continuously promoted actively in wide-ranging areas.

Cooperation on nuclear security/nuclear non-proliferation which is the precondition for peaceful use of nuclear energy will be implemented with the Department of Energy and its national laboratories under the Japan-US intergovernmental Nuclear Security Working Group (NSWG). Especially with regard to nuclear security, in line with the commitment of Japan at the Nuclear Security Summits, the JAEA will continue joint outreach activities to support human resource development in the field of nuclear non-proliferation and nuclear security at emerging nuclear energy countries in Asia and other regions, as well as actively promote cooperation on technology development relating to measurement/detection of nuclear material and nuclear forensics, etc. In terms of the nuclear energy R&D,

cooperation in the field of advanced reactors (fast reactor and high temperature gas-cooled reactor), Light Water Reactors (LWR) and nuclear fuel cycle/waste management will be implemented under the framework of the intergovernmental Civil Nuclear Energy Research and Development Working Group (CNWG). With regard to the fast reactor, the JAEA will also be engaged in consultation in order to move forward with the trilateral cooperation with the relevant organizations in France and the US. The nuclear science research cooperation will be implemented by promoting advanced nuclear science research based on the arrangement with the DOE on nuclear physics under the Japan-US Agreement on Cooperation in Research and Development in Science and Technology, as well as advancing research cooperation using research reactors, etc. based on the arrangement concerning neutron scattering.

Cooperation with the Nuclear Regulatory Commission (NRC) in the field of safety research will be promoted.

With regard to the cooperation with **Canada**, where the selection of the site for geological disposal of spent fuel is proceeding, reciprocal research cooperation to obtain the necessary data, etc. will be promoted.

With Latin American countries, especially with **Argentina**, for globalization of nuclear energy, possibility of research cooperation will be explored in the field of basic and fundamental nuclear research, such as provision of nuclear data processing technology of JAEA.

(4) Asia Pacific region

From the standpoint of the utilization of nuclear energy, countries/regions in Asia Pacific region are divided into four categories: (1)China and India, which are remarkably expanding nuclear power generation and actively being engaged in R&D on the next-generation reactors, (2)Republic of Korea, which is steadily expanding nuclear power, (3)Bangladesh and some Southeast Asian countries, which have plans to introduce nuclear power generation, and (4) Taiwan, which aims to phase out the use of nuclear power. In such a circumstance, ensuring safety of nuclear reactors is a common issue of these countries. The JAEA will contribute to enhancing nuclear safety and ensuring nuclear non-proliferation/nuclear security in those countries, by sharing lessons learned from the experience of the accident at Fukushima Daiichi NPP and being engaged in the projects for supporting human resource development entrusted by MEXT and other subsidized projects of the ministry, as well as making contributions to the efforts of the IAEA's Asia Nuclear

Safety Network, which include activities relating to nuclear disaster prevention and emergency support.

With **China**, possibility of R&D cooperation will be explored, while ensuring nuclear non-proliferation/nuclear security, noting that the country has an ambitious development plan aiming to achieve in 2020 installed capacities of 58 million kW for reactors already in operation and 30 million kW for reactors under construction and is actively promoting the development and export of indigenous reactors. For the fast reactor development, R&D cooperation will be implemented through activities of international frameworks such as the GIF and the IAEA. Cooperation with the Chinese State Nuclear Security Technology Center (SNSTC), which was established within the China Atomic Energy Authority (CAEA) in 2016 will be implemented on the human resource development in the field of nuclear non-proliferation/nuclear security.

Exporting nuclear equipment and material to **India** has been practically prohibited for long years, as it is not a member country of the Treaty on the Non-Proliferation of Nuclear Weapons (NPT) and does not accept IAEA's comprehensive safeguards. Under such a situation and from the standpoint of using tritium that is abundant in its territory, India has proceeded with a nuclear R&D plan comprising three stages of heavy-water reactor, fast breeder reactor and advanced heavy-water reactor using tritium. However, in response to the decision of the Nuclear Suppliers Group (NSG) in 2008 exempting the country from the requirements for the recipients of nuclear equipment and material, India is actively promoting the introduction of light water reactors from other countries. In line with these circumstances and the future developments on nuclear cooperation at the governmental level between Japan and India, R&D cooperation with India will be considered.

Republic of Korea is moving forward with R&D on advanced nuclear technology such as the fast reactor, the high temperature gas-cooled reactor and the pyroprocessing, while steadily expanding nuclear power generation. The JAEA will advance R&D cooperation under the comprehensive R&D cooperation arrangement with the Korea Atomic Energy Research Institute (KAERI), as well as promote the exchange of information on near-surface disposal of low- and intermediate-level radioactive waste with the Korea Radioactive Waste Agency (KORAD). Also, with the International Nuclear Nonproliferation and Security Academy (INSA) that was established within the Korea Institute of Nuclear Nonproliferation and Control (KINAC) in 2014, cooperation will be implemented to support the human resource development in the field of the nuclear non-proliferation/nuclear security.

Support type cooperation in the field of the use of radiation and the use of research and test reactors has been implemented with Southeast Asian countries such as **Thailand, Malaysia, Indonesia, Vietnam and Bangladesh**. With countries planning to introduce nuclear power generation such as Bangladesh and Indonesia, support for human resource development in the field of nuclear safety and nuclear non-proliferation/nuclear security will be implemented in coordination with the government.

Australia has not introduced nuclear power generation, while it has the world's largest uranium reserves. With the OPAL research reactor, production of medical radioisotope and research using neutron are carried out. Cooperation between J-PARC and the Australian Nuclear Science and Technology Organization (ANSTO), which owns the OPAL research reactor will be continued in the neutron science field.

The Forum for Nuclear Cooperation in Asia (FNCA) is a framework for multinational cooperation of the Asia Pacific region, where Japan plays a leadership role, and under this framework, experts of the JAEA have been engaged in the implementation of various cooperation as project leaders. JAEA will continue to be engaged in such projects as research reactor network and information exchange on safeguards/nuclear security, etc. In the research on climate change using nuclear technology that will start in FY 2017, the JAEA will be involved in efforts to form a common infrastructure of the region, by providing and distributing the JAEA-developed analysis technology.

(5) Middle East

A number of countries in Middle East have plans to introduce nuclear power generation, and inter-government bilateral agreements for the peaceful use of nuclear energy have been concluded between Japan and Jordan, United Arab Emirates and Turkey, respectively.

Taking into account the possibility of exporting nuclear power plants from Japan and based on the request from the Japanese government, the JAEA will consider the support to Middle Eastern countries through coordination between its Nuclear Human Resource Development Center and its Integrated Support Center for Nuclear Nonproliferation and Nuclear Security.

(6) International organizations

Cooperation with international organizations, including the International Atomic Energy Agency (IAEA) with diverse membership, the Organisation for Economic Co-

operation and Development/the Nuclear Energy Agency (OECD/NEA), which consists of relatively homogeneous members such as advanced countries, and the Preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organization (CTBTO), which assumes the role of the implementation of Comprehensive Nuclear-Test-Ban Treaty (CTBT) that imposes total ban on nuclear tests, cooperation will be implemented actively in accordance with their respective functions. As part of the effort in this area, the JAEA plans to increase the assignment of its personnel to international organizations.

In regard to the cooperation with the **IAEA**, in addition to the participation of the JAEA's staff in standing committees such as the Standing Advisory Group on Nuclear Energy (SAGNE) as their members, the JAEA will send a number of researchers to join experts' meetings in order to reflect the perspective of Japan in the discussion of the safety and security standards such as safety design policies for the fast reactor and high temperature gas-cooled reactor, , etc. As the contribution to safeguards effort, the JAEA will, besides dispatching staff to the IAEA, cooperate on safeguards analysis in accordance with the certification given to the Clean Laboratory for Environmental Analysis and Research (CLEAR) as one of the IAEA's Network of Analytical Laboratories. Cooperation on human resource development will be conducted jointly with the IAEA under the arrangement in the nuclear security field, to contribute to international enhancement of nuclear security. Participation in the International Project on Innovative Nuclear Reactors and Fuel Cycles (IMPRO) will be continued to gather information on the R&D situation of the participating countries and to contribute to the consideration, etc. of the scenarios for the introduction of the fast reactor, etc.

Cooperation with the **OECD/NEA** will be implemented through the participation in standing committees such as the Committee on the Safety of Nuclear Installations (CSNI) as the member, assignment of the JAEA staff to the secretariat, especially to the managerial positions based on the policy of the government, and support to the secretariat function of the GIF borne by the OECD/NEA. Participation in the joint projects such as the Data Bank project and Halden Reactor Project organized by the OECD/NEA will be continued. Especially, the JAEA will participate and cooperate actively in the new joint research projects launched by the proposal of Japan, of which objective is to reflect the lessons learnt from the accident at Fukushima Daiichi NPP and information acquired in the process of the decommissioning in the improvement of nuclear safety and decommissioning technology, while aiming to increase its international presence through this cooperation. Recently at the

OECD/NEA, new initiatives were started or proposed, including Nuclear Innovation 2050 (NI2050) which aims to fill a gap between R&D needs and the current status of technology development by international cooperation and the NEA Nuclear Education, Skills and Technology (NEST) which aims at human resource development and generational transfer of technologies through participation of young researchers and technical experts in international joint projects. The JAEA will make contributions actively through participation of its experts in such initiatives.

As cooperation with the **Preparatory Commission for the CTBTO**, the JAEA will continue the provisional operation of the radionuclide monitoring stations and samples analysis at the certified laboratory, as well as participate in the effort to improve the verification technique at experts' meetings, etc., thus contributing to the international effort toward comprehensive ban of nuclear test.

Cooperation with the **European Atomic Energy Community (EURATOM)**⁴ includes the implementation of joint research, etc. relating to nuclear measurement/detection, nuclear forensics, analysis of environmental samples for safeguards, etc. The JAEA will promote further cooperation in the field of human resource development, etc. The cooperation in this field includes joint training activities for Asian countries, etc. through the dispatch of lecturers to the training courses organized by the counterpart organization.

In regard to the cooperation with/contribution to the **International Science and Technology Center (ISTC)**⁵, for which the JAEA has been engaged in various forms of ISTC activities including regular projects (research projects initiated by governmental agencies) and partnership projects (research investment initiated by private sectors), Russian withdrawal at the end of 2015 marked a significant

⁴ The European Atomic Energy Community (EURATOM) is an international organization established in 1958 with the purpose of addressing the future shortage in energy resources. Its objectives include promotion of R&D and dissemination of information, establishment of basic research institutes necessary for utilization of nuclear energy and relevant investment, and cooperation with international organizations and countries concerned for utilization of nuclear energy. While EU member countries participate in EURATOM, respective countries have discretion on their own utilization of nuclear energy.

⁵ The International Science and Technology Center (ISTC) is an international organization established in March 1994 for the purpose of supporting R&D projects of peaceful use of nuclear energy participated by researchers/technical experts who had been engaged in R&D on weapons of mass destruction and the delivery systems in the former Soviet Union. The headquarters office was originally placed at Moscow, and transferred to Astana, the capital of Kazakhstan, in July 2015 due to the withdrawal of Russia. The signatories of the Agreement on the Continuation of the ISTC (December 2015) are Armenia, EU/EURATOM, Georgia, Japan, Kazakhstan, Republic of Korea, Kyrgyzstan, Norway, Tajikistan and the US,.

milestone. However, cooperation with CIS countries (not including Russia) on their nuclear projects will be continued in accordance with the decision of the continuance of the ISTC and relocation of its headquarters office to Astana, the capital of Kazakhstan, and taking into consideration the situation that the chairman of the Scientific Advisory Committee (SAC) and a project manager have been assigned from the JAEA. Effective use of research resources, such as the implementation of certain R&D of the JAEA as an ISTC project, will be considered in the cooperation with the ISTC.

2. Directions of international cooperation for respective R&D areas

(1) R&D concerning decommissioning of Fukushima Daiichi NPP

R&D concerning decommissioning of Fukushima Daiichi NPP and utilization of the achievements of the related R&D are the mission of paramount importance to the JAEA which was expected, requested and assigned by the Japanese people and communities inside and outside Japan.

The core issue in the efforts for accident response is decommissioning, toward which there are a mountain of challenges such as retrieval of fuel debris, treatment and disposal of radioactive waste, clarification of accident progression scenarios and basic and fundamental R&D concerning remote control technologies, etc. These challenges must be addressed with expertise gathered inside and outside of the country.

The results achieved through the R&D in this area, especially the results obtained by clarifying the accident progression scenario, will be actively communicated domestically and internationally so as to contribute to improving safety of nuclear facilities inside and outside of Japan.

In this R&D area, the JAEA will collaborate with relevant organizations such as research institutes, universities and industries inside and outside Japan using the Collaborative Laboratories for Advanced Decommissioning Science (CLADS) in order to gather expertise and experience of the advanced nuclear energy countries facing the common issues, as well as develop human resources that will be engaged in the medium- to long-term R&D and related activities, while playing a role internationally.

(2) R&D for environmental restoration

As part of the efforts to respond to the accident at Fukushima Daiichi NPP, R&D for environmental restoration that is necessary for the residents to resume lives

safely without anxiety about radiation is as significant an issue for the Japanese people and society, as the R&D for decommissioning of the nuclear power plants.

Important issues in the R&D the JAEA performs concerning environmental recovery are dose assessment of areas such as forests, rivers and coastal waters that have not been decontaminated, and environmental dynamics assessment/understanding of radioactivity such as cesium, etc. Thus, the JAEA can contribute to the formulation of reasonable safety measures, planning on recovery of agriculture, forestry, etc. and lifting of evacuation directive and residents' returning home, etc. by appropriately providing information supported by scientific evidence. Contributions to the efforts for the environmental restoration will be made through the clarification of migration mechanism of cesium and, based on such clarification, examination and proposal of rational measures for decontamination and reuse.

Capabilities/systems will be developed centering around the Fukushima Environmental Safety Center to address these issues comprehensively gathering experience and expertise of Japan and other countries.

In implementing the R&D, cooperation with the countries that face the common challenge of restoring environment will be further promoted, by sharing scientific information and experience and exchanging personnel. Such countries include the US, which is tackling nuclear waste and environmental contamination at Hanford Site, Ukraine, Belarus, and Russia, which share a problem relating to decommissioning and environmental contamination due to the Chernobyl accident, and Kazakhstan, which is working to restore environment from contamination caused by nuclear tests at Semipalatinsk. Results obtained through the evaluation, assessment, measures which will have actually been taken, etc. will be transmitted to overseas widely as a measure to prevent damage to the suffered areas caused by unfounded rumors of the accident.

The JAEA will actively participate in the discussion on the establishment of the international joint research systems so as to proceed with basic science relating to the cleanup of nuclear facilities and environmental restoration.

(3) R&D for ensuring nuclear safety

(3-1) Technical support to the nuclear regulation and relating safety research

The JAEA is required to support nuclear safety regulation and contribute to the improvement of nuclear safety and reliability of nuclear energy.

To meet the requirement, JAEA will (1)develop safety assessment methodology concerning thermal hydraulic behavior/fuel behavior in nuclear energy systems,

(2) evaluate the occurrence of severe accidents for contributing to safety evaluation of nuclear fuel cycle facilities, (3) acquire through experiment and analysis criticality characterization data of nuclear fuel material including fuel debris, (4) evaluate source term of various nuclear facilities, assess accident risk and sophisticated methods to assess impact at the time of an accident, based on the expertise gained from the Fukushima Daiichi NPP accident and (5) sophisticated safety assessment methodology concerning waste storage/disposal and decommissioning in terms of the safe management of radioactive waste, and so on.

Research cooperation and information exchanges in this research field will be further promoted with excellent research institutes, etc. of advanced nuclear energy countries, and contribution to human resource development in this field will be made through research. A broad range of technical expertise relating to nuclear safety including accident progression code, probabilistic safety assessment and regulation information will be actively made use of.

The JAEA will secure/maintain the infrastructure necessary for the above mentioned technical support and related safety research, and actively transmit the achieved results to inside and outside of the country while making technical proposals, and thus contribute to the development of scientifically highly rational regulatory standards, safety confirmation of nuclear facilities etc. in Japan and overseas.

International contribution in the field of nuclear disaster prevention will be made through the participation in the framework supporting international activities of experts concerning overseas nuclear accidents and technical support to nuclear disaster prevention in Asian countries.

The JAEA will utilize the Nuclear Safety Research Center and Nuclear Emergency Assistance and Training Center to establish the capabilities/systems to address these issues comprehensively by gathering experience and expertise from inside and outside of Japan.

(3-2) R&D concerning nuclear safety enhancement

Following the reaffirmation made after Fukushima Daiichi NPP accident that safety takes precedence over all other things under any circumstances, ceaseless efforts will be made to pursue safety at the highest level in the world.

As the sole core research institute in Japan that is devoted to R&D in the field of nuclear energy, the JAEA will promote actively and comprehensively research concerning enhancing safety of nuclear facilities. Specifically, the following activities

will be promoted: (1)R&D on fuel, material and equipment contributing to improving safety of light-water reactors and R&D for safe decommissioning technology, (2)assessment of applicability of developed technology, (3)clarification of the accident progression scenario of the accident at Fukushima Daiichi Nuclear NPP, etc.

The results obtained through research in this area will be actively communicated domestically and internationally to make contributions to safety enhancement of the nuclear facilities globally.

The JAEA will use the Nuclear Science and Engineering Center to establish capabilities/systems to address comprehensively these issues by gathering experience and expertise from inside and outside of the county.

(4) Contribution to nuclear non-proliferation/nuclear security

Together with nuclear safety, ensuring nuclear non-proliferation/nuclear security is the precondition for promoting utilization of nuclear energy. Especially, regarding nuclear security, various international initiatives have started due to the global increase of concern over nuclear terrorism after the terrorist attacks of Sept. 11, 2001. The JAEA's Integrated Support Center for Nuclear Nonproliferation and Nuclear Security was established in accordance with one of the commitments of the Japanese Government at the Nuclear Security Summits. The Center will strive to make more contribution to the enhancement of international nuclear non-proliferation/nuclear security through the support to the human resource development in emerging nuclear energy countries and technology development in cooperation with the IAEA, the US, and other international organizations and countries. Collaboration will be promoted with the Chinese and Korean centers that support development of human resources in this field in order to establish a network connecting Japan, China and Republic of Korea.

With regard to the CTBT, the JAEA will implement provisional operation of the radionuclide monitoring stations, etc. under the framework of the Preparatory Commission for the CTBTO, as well as develop technique to detect radionuclide.

(5) R&D on the next-generation reactors

The JAEA has implemented R&D associated with the construction and operation of the experimental fast reactor JOYO and prototype fast-breeder reactor Monju, as well as R&D for the establishment of the fast reactor technology at the demonstration level.

In addition to playing a leading role in international joint R&D and the efforts for

international standardization of safety design criteria in the GIF, the JAEA is engaged in activities of bilateral cooperation. While the basic design of ASTRID reactor (French demonstration fast reactor) is developed jointly with France under “Implement Arrangement on the ASTRID Program and Sodium Fast Reactor Collaboration (signed in August 2014)”, information is exchanged with the US on fast reactor material, simulation technology, advanced fuel, etc. under the framework of CNWG. Also, for developing advanced fuel fabrication technique and understanding irradiation performance of MOX fuel including minor actinides, a program is being planned to implement irradiation tests jointly with the US and France at Joyo after its restart.

The government had discussed the directions for the fast reactor development in Japan based on the various change in the situation surrounding the fast reactor development, and “Policy for Fast Reactor Development” was adopted at the Inter-Ministerial Council for Nuclear Power held on December 21, 2016. In accordance with the idea shown in this Policy that is to coordinate the entire programs for the development so that international cooperation will generate synergy with domestic projects, the JAEA will continue to be actively involved in activities for efficient acquisition of expertise and international standardization of safety design requirements for the fast reactors using bilateral and multilateral frameworks of international cooperation.

The JAEA has implemented R&D on the high temperature gas-cooled reactor through construction and operation of HTTR. Verification of the inherent safety of the high-temperature gas-cooled reactor and R&D on heat utilization technology will be implemented using HTTR in cooperation with research institutes of other countries, making use of the OECD/NEA joint test project and activities of the GIF on the Very High Temperature Reactor (VHTR). While an international joint project concerning construction of international demonstration reactor is being considered, the JAEA will take the initiative in the activities such as the efforts for technology demonstration of the high temperature gas-cooled reactor in Japan and the efforts at the IAEA for international standardization of the safety design criteria of the high temperature gas-cooled reactor. Also, the JAEA will seek to have the technology for the high temperature gas-cooled reactor and the safety design policy of Japan adopted as international standards.

(6) Basic and fundamental nuclear research

Basic and fundamental nuclear research such as nuclear engineering/reactor

engineering, fuel/material engineering, nuclear chemistry and environment/radiation science is research activities that opens a new horizon for the utilization of nuclear energy and forms its basis. The JAEA, which has great potential in broad-ranging fields of basic and fundamental research, will further promote personnel exchanges, information exchanges and mutually beneficial research cooperation with world's excellent research institutes.

Advanced nuclear science research is an activity that aims to discover new principles/phenomena, create new material and produce innovative technology, and beyond the utilization of nuclear energy, bring about innovation in society. The JAEA will seek to be internationally recognized COE through efforts such as implementation of "Reimei Research Program", to vigorously advance international cooperation, invitation of globally distinguished group leaders, adoption of research themes based on the latest R&D movements and organization of research groups in a flexible manner.

Fundamental nuclear research is an activity that builds and underpins the common infrastructure for the utilization of nuclear energy of the world by developing data code/measuring technique. International outreach of pivotal technologies in this research area will be actively implemented.

With regard to neutron application research, the JAEA will lead the advanced material science research in the world using facilities such as J-PARC, a state-of-the-art research facility, and JRR-3, a steady neutron source.

(7) Research on the back end of nuclear fuel cycle

The JAEA is the core research institute that is, based on the basic policy to promote nuclear fuel cycle of Japan, responsible for R&D of technologies that support this policy.

Accordingly, the JAEA implements the development of spent fuel reprocessing technology and fuel fabrication technology and R&D for reducing the amount and toxicity of radioactive waste. Furthermore it will pursue R&D concerning technology for high-level radioactive waste disposal and projects for near-surface disposal of low-level radioactive waste.

With regard to accelerator driven systems (ADS), which is in transition from the stage of conceptual study to that of principle demonstration, collaborations will be strengthened between the basic and fundamental nuclear research and the engineering technology development within the JAEA, and with domestic and overseas researchers belonging to the government, industry and academia in a broad

range of fields. Also the JAEA will conduct research through active international exchange of information and research cooperation in terms of effectiveness and efficiency. Specifically, research cooperation with the Belgian Nuclear Research Centre (SCK-CEN) and research cooperation with the US, etc. including test facilities utilization will be promoted.

As efforts concerning R&D for high-level radioactive waste disposal, the JAEA will obtain and provide the latest technology and expertise through technical cooperation, joint research, etc. with domestic and overseas R&D institutes, universities, etc., and thus contribute to the enhancement of technologies concerning geological disposal in Japan.

Information on near-surface disposal of low-level radioactive waste will be exchanged with the Republic of Korea.

(8) Support for the development of human resources in the nuclear field to other countries and development of globally-minded staff of the JAEA

Human resource development in the nuclear field is a common issue for the countries using nuclear energy. In accordance with the request, etc. from relevant governmental ministries, the JAEA will support human resource development in the nuclear field in emerging nuclear energy countries mainly in Asia, thus contributing to global utilization of nuclear energy. Also, in collaboration/cooperation with domestic and overseas organizations concerned, the JAEA will promote human resource network activities in this area, which include gathering, analyzing and transmitting related information.

There are the potentials in the JAEA such as nuclear facilities offered for public use at the JAEA R&D centers that can serve as the core of international cooperation, and the opportunities for collaboration and exchange between researchers inside and outside Japan. These potentials and opportunities will be used to foster researchers/technical experts having high ability of problem solving in the nuclear field of Japan. Meanwhile, as human resource development in the nuclear field through experiencing the international practice, annually about 10 staff members of the JAEA will be dispatched to international organizations, etc. with the target of sending about 50 people in total by the end of FY 2021. For those staff members who have completed the assignment term in an international organization another assignment to the higher position of the same organization will be encouraged. Resources that become available by international dispatch of staff members on a regular basis will be used to secure excellent young human resources with an

international sense. Also, for fostering international leaders, staff members who have shown excellent ability in research and management will be encouraged to increase their presence at internationally important meetings, etc. and play roles in international organizations. Organizational support will be given to their activities for building relationship based on mutual trust with the leaders in the nuclear field globally and playing role in an international arena as a representative of the JAEA and Japan as a whole.

(9) Decommissioning of and waste management at the JAEA's nuclear facilities

For decommissioning of the JAEA's research facilities and waste management, the latest technologies and expertise will be obtained/provided through cooperation with advanced nuclear energy countries such as France, the UK and the US, and through engagement in international projects of the OECD/NEA, the IAEA, etc.