The State of Affairs and Ongoing Challenges of the Fukushima Nuclear Disaster

—a Civil Society Response Towards Recovery

Citizens' Commission on Nuclear Energy (CCNE)

Our Path to a Nuclear-Free Japan

—Policy Outline for a Nuclear Phaseout

Special Edition for WCDRR 2015

Citizens' Commission on Nuclear Energy
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Preface to the WCDRR 2015 edition

We are pleased to present our report, ***The State of Affairs and Ongoing Challenges of the Fukushima Nuclear Disaster—a Civil Society Response Towards Recovery***, on the occasion of the Third UN World Conference on Disaster Risk Reduction (WCDRR 2015) in Sendai, Japan.

The report intends to answer questions such as:

- What have been the impacts of the Fukushima nuclear disaster?
- What is the current condition of the victims of the nuclear disaster?
- What is going on at the nuclear plant site and what risks still exist?
- What mistakes did authorities make in response to the nuclear disaster?
- What countermeasures are now necessary to cope with the situation?

The present report is a provisional and partial translation of the comprehensive Japanese report, ***Our Path to a Nuclear-Free Japan: Policy Outline for a Nuclear Phaseout***, published in April 2014 by the **Citizens' Commission on Nuclear Energy (CCNE)**, Tokyo. The full report comprises seven chapters, of which the first three chapters have been translated into English to meet the special interests of the WCDRR delegates as well as experts on disaster control and prevention tasks worldwide.

The translated chapters are as follows:
(also available for download from the CCNE website: www.ccnejapan.com/?p=2048)

Prologue:	Why Should We Aim for a Nuclear-Free Society?
Chapter 1:	An Overview of the Damage Caused by the Fukushima Nuclear Power Plant Accident and the "Restoration of Humanity"
Chapter 2:	The Actual State of the Fukushima Daiichi Nuclear Power Plant Reactors and Issues Surrounding the Accident Settlement

The remaining chapters deal with radioactive waste issues (Chapter 3), regulation standards, seismological issues and contingency planning (Chapter 4), financial considerations and sustainability issues (Chapter 5), and the democratic process towards the energy shift (Chapter 6). Please visit the website for a detailed table of contents. The full English edition will appear by July 2015. As such, the references to these chapters (Chapters 3 to 6) that appear within the current text have been left as they are. An executive summary in English covering all the chapters is already available for download from the website.

The Japanese Government and the organisers of WCDRR 2015 are inclined to exclude topics related to the nuclear disaster from the congress agenda. This has been criticised by delegates from international and Japanese civil society organisations (CSOs). CCNE, too, finds such avoidance quite inappropriate, unprofessional and unethical, given that the convention this time is being held in the region severely affected by the Great East Japan Earthquake of 2011, which resulted in an unprecedented complex disaster of quake, flood and radioactive fallout. Even after four years now, more than 120 thousand people are still in exile from the nuclear disaster exclusion zones. (This accounts for nearly 55% of the total number of the people still in refuge from the March 2011 disaster.) That is the reality we face, no matter what your political position is or what technological viewpoints you hold regarding the *pros* and *cons* of nuclear power. Please also be reminded that the state of nuclear emergency declared by the Japanese Government in March 2011 has not yet been lifted. The disaster is far from over and the victims need care and support.

Hopefully, our report will give you a clear idea about the actual state of affairs of the Fukushima nuclear disaster. Your comments and advice, particularly those from your expertise and experience in disaster response and prevention, are most welcome.

In the text of the report, the names of new laws and institutions we propose in our policy outline are given in “quotation marks” while existing laws and institutions are without quotes. Update information is added in [square brackets] to help readers understand more recent developments in the issues.

CCNE is an independent think tank funded by the Takagi Fund for Citizen Science (www.takagifund.org/e/about) with the support of individual donations from concerned civil society members in Japan. The original Japanese report, ***Our Path to a Nuclear-Free Japan: Policy Outline for a Nuclear Phaseout*** (2014) was prepared with contributions from some 70 professional researchers, scientists, engineers, lawyers and CSO staff, as well as comments obtained through 20 public forums held in various towns in Japan during 2013-2014.

For more information, please contact the secretariat, Citizens’ Commission on Nuclear Energy (CCNE), Tokyo, at <email@ccnejapan.com>.

11 March 2015

HOSOKAWA Komei, Secretary General, CCNE

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You are also encouraged to obtain a copy of *10 Lessons from Fukushima: Reducing risks and protecting communities from nuclear disasters*, a concise booklet prepared in 10 languages by the publication committee in partnership with the Japan CSO Coalition for 2015 WCDRR (JCC 2015). Kindly contact <fukushimabooklet@gmail.com> or visit their website (fukushimalessons.jp/en-booklet.html) for more information.

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Executive Summary

PROLOGUE: WHY SHOULD WE AIM FOR A NUCLEAR-FREE SOCIETY?

In the case of a severe accident at a nuclear power plant, the scale of damage is unimaginably large and the period for recovery is impossibly long. Moreover, severe accidents have not only happened but can certainly happen again in the future. The continuation of these high-risk conditions is not ethically acceptable. Nuclear power must be phased-out through legislation.

CHAPTER 1: AN OVERVIEW OF THE DAMAGE CAUSED BY THE FUKUSHIMA NUCLEAR POWER PLANT ACCIDENT AND THE "RESTORATION OF HUMANITY"

1. Only by following the basic principles outlined below will we be able to recover from nuclear disaster and achieve "Restoration of Humanity":
    1) Give maximum respect for fundamental human rights such as the "right to health" and the "right to avoid exposure to radiation
    2) Adopt the precautionary principle and do not underestimate risks
    3) Ensure that relevant stakeholders participate in the decision-making process
2. A new "Basic Act for Recovery from the Nuclear Disaster" should be established based on the notion of "supporting while respecting rights to personal choice" described in the Victims Protection Act. Related laws should be organised under this umbrella policy and consistent long-term measures for reconstruction and relief should also be incorporated.
3. Develop and expand medical support for preventive care from health hazards and a system for regular check-ups, as well as mobile classes for children. In order to centrally manage all of the data related to various health surveys and screenings, the national government should be responsible for establishing a permanent health support centre. To implement the operation of this centre based on scientific and ethical considerations, it should be managed by a third-party committee formed on the premise of participation by both experts and citizens (including residents of the areas affected by the nuclear disaster).
4. Support for the reconstruction of evacuees' lives should not be oriented entirely toward "early return" to the evacuated areas. Evacuation orders should not be hurriedly removed, and residents' views must be respected to the utmost. The return of evacuees should not be carried out until after the additional radiation dose falls below 1 mSv per year. Even in this case, the central government must provide compensation and support to enable evacuees to decide for themselves whether to return or remain in refuge.

CHAPTER 2: THE ACTUAL STATE OF THE FUKUSHIMA DAIICHI NUCLEAR POWER PLANT REACTORS AND ISSUES SURROUNDING THE ACCIDENT SETTLEMENT

1. Upon carrying out the liquidation of Tokyo Electric Power Company (TEPCO), the government's Nuclear Damage Compensation and Decommissioning Facilitation Corporation and TEPCO's Fukushima Daiichi Decontamination and Decommissioning Engineering Company should be combined to establish an "Agency for the Decommissioning of the Fukushima Daiichi Nuclear Power Plant (Fukushima Decommissioning Agency–FDA)" to centralise the promotion of decommissioning in one office.
2. Under the "FDA", the accident settlement of Fukushima Daiichi, the site workers' employment system, labour policies, and radiation dose management should all be radically reformed.
3. A shift from water cooling of the molten fuel debris to air cooling is proposed as a means to radically

alleviate the contaminated water problem. TEPCO's plan to remove fuel debris by the flooding method entails large risks and huge worker exposure to radiation and should therefore be suspended.

CHAPTER 3: TREATMENT AND DISPOSAL OF RADIOACTIVE WASTES

1. Abolish nuclear fuel cycle development projects (i.e. reprocessing, fast breeder reactors, uranium enrichment). Reprocessing and fast breeder reactors are projects that result in huge economic losses and involve serious drawbacks related to nuclear non-proliferation and nuclear security.
2. It is imperative to regard all nuclear materials produced in the nuclear energy production process as nuclear waste and to promote their prudent management and disposal. It has become abundantly clear that all of the following are forms of nuclear waste: high-level liquid waste, irradiated fuel, separated plutonium, recovered uranium, depleted uranium, uranium waste soil, other low-level radioactive material discharged from nuclear facilities, decommissioned nuclear facilities, the Fukushima Daiichi facility itself and all of the radioactive materials emitted as a result of the accident. Since natural and enriched uranium have some economic value, abolishing the trading of these materials will require legislation and compensation. Unnecessary and non-urgent dismantling and removal of nuclear facilities should not be carried out. Rather, it is imperative to keep these facilities under close observation to allow sufficient time for radioactivity decay.
3. Establish a new government agency, tentatively called the "Japan Nuclear Decommissioning Authority (JNDA)", to centralise the management and disposal of nuclear waste. The amount of radioactive waste generated by the abolition of nuclear power plants will be enormous, and the period required for the management and disposal will extend to the ultra-long-term. Accordingly, centralised waste management and disposal by the government is essential. However, this does not eliminate the financial liability of private corporations. It should be noted that, the "Radioactive Contamination Project" of the "Fukushima Decommissioning Agency–FDA" can, after significant progress has been made, be transferred to the "JNDA".
4. While nuclear waste management and disposal facilities will have to be located within Japan, the siting of these facilities should, to as great an extent as possible, be based on the strictest safety standards and procedures and only decided after public discussions based on the principle of "fair and equitable burden" have been held.

CHAPTER 4: TECHNICAL GROUNDS FOR KEEPING REACTORS FROM RESTARTING

1. Under the new regulatory standards, nuclear restarts must not be conducted for the following reasons:
    1) They would require turning a wilful blind eye to the "Location Regulatory Standards", the absolute conditions for protecting local residents from radiation exposure.
    2) There is always some residual risk, i.e. there can be cases in which nuclear power plants that fulfill regulatory standards cannot withstand earthquakes or tsunamis.
    3) A basic design review has not been implemented and current measures will not prevent severe accidents.
    4) Contingency plans against severe nuclear accidents are ineffective.
2. For the above reasons, the local council approvals of (existing) nuclear power plant siting should be made void. At the very least, all local authorities within a 30km radius of a nuclear power plant should initiate talks to develop a nuclear safety agreement.
3. Current works of power companies to implement severe accident prevention measures in advance of the new safety standard compliance screening should cease immediately. These measures represent

capital investments that are not necessary or effective and the costs should not be passed on to consumers.

CHAPTER 5: STEPS TO A NUCLEAR-FREE SOCIETY

1. The government's and TEPCO's responsibilities for handling the nuclear accident should be clarified and the liquidation of TEPCO should be pushed forward. In addition, based on the government's role in nuclear power development and the accident, full compensation, "restoration of humanity", and the phasing out of nuclear power should be promoted.
2. In order to realise a nuclear-free society, it is imperative to establish a "Basic Act on Nuclear Phaseout" as well as "Basic Act on Energy Shift" that will support the development of renewable energy resources. Additionally, in order to move toward a nuclear-free society, it is both imperative to abolish the institutions and government agencies that have supported the development of nuclear energy and to establish a "Nuclear Energy Phaseout Agency" in their place.
3. The Japanese government must discontinue all policies aimed at promoting the export of nuclear power. Severe accidents of nuclear stations can occur not only in Japan, which is prone to earthquakes and tsunamis, but in other parts of the world as well. We cannot allow hazardous facilities to be exported. The provision of insurance and finance for nuclear power projects by joint public-private ventures and feasibility studies in Turkey and Vietnam should be discontinued.

CHAPTER 6: DEFECTS IN THE NUCLEAR POWER COMPLEX-LED DECISION-MAKING SYSTEM AND THE PATH TO DEMOCRATIC POLICY DECISIONS

For Japanese society to take "steps for realising a nuclear-free society", it is imperative that proactive organisational approaches be taken with regard to the following issues: Electoral reform so that the will of the public is adequately reflected in legislative councils, activation of citizens' movements and deliberative democracy, strengthening of the ability of the Diet to shape policy, locally led policy initiatives, the formation of independent think tanks, and the development of critical media and the disclosure of information.

Prologue: Why Should We Aim for a Nuclear-Free Society?

INTRODUCTION

The Citizens' Commission on Nuclear Energy (CCNE) was founded in April 2014. As we had planned at the outset, we were able to publish our Japanese *Policy Outline for a Nuclear Phaseout* exactly one year later. This *Policy Outline* consists, as far as possible, of a comprehensive overview of a public policy framework that we, CCNE, believe to be necessary to achieve, in the shortest time possible, a nuclear-free society in Japan. We are confident that we have been able to cover most of the important facets of nuclear power policy. Since this document is an *Outline*, we have, on principle, avoided setting down the details of specific policies, but even so, it has turned out to be a substantial document, larger than would normally be expected for an *Outline*. This is due to the enthusiasm of the authors to produce, as far as possible, a document that is a complete statement of the issue. However, for the convenience of readers who may not have time to read the whole document, we have prepared an executive summary at the beginning of the book. Our hope is that this *Policy Outlines for a Nuclear Phaseout* will be of use as a springboard for discussion when a future Japanese government draws up a "Basic Plan for a Nuclear Phaseout" after the enactment of a "Basic Act on a Nuclear Phaseout".

We do not believe that the contents of this *Policy Outline for a Nuclear Phaseout* are perfect. In the first place, manpower and time restrictions have meant that a number of themes have not been touched upon at all. We would be delighted if readers from a wide range of viewpoints would inform us of their opinions concerning the large number of points at issue mentioned in this *Policy Outline*. CCNE also intends to hold a large number of public meetings, incorporating a two-way dialogue, on the contents of this *Policy Outline*, and we encourage everyone to participate. We welcome, of course, participation by people who are basically in favour of the standpoint of this Commission, but also look forward to engaging in dialogues with people who are opposed to or who are hesitant about the abolition of nuclear power generation, or those who, while sympathising with the direction of a future nuclear phaseout, have concerns about side effects that might accompany an immediate or early decommissioning. Intending to learn from the negative example of the government's rigid nuclear power policies, we believe that it is vital for people who hold differing views on nuclear power to engage in repeated discussion, and we wish to deepen mutual understanding while improving and bringing about a flexible evolution of the contents of the *Policy Outline*. We believe that this holds the possibility of causing the government's nuclear power policies to become more flexible.

Policy Outline for a Nuclear Phaseout consists of a Prologue, six chapters and an Epilogue. In this Prologue, firstly, we indicate our grounds for thinking why we should aim for a nuclear-free society.

In Chapter 1: *An Overview of the Damage Caused by the Fukushima Nuclear Power Plant Accident and the "Restoration of Humanity"*, we firstly give an outline of the characteristics of the suffering caused by the nuclear accident in 12 sections. We then present a multifaceted analysis and evaluation of various aspects of the suffering caused by the accident, after which we offer policy proposals for compensation and support to the victims based on the principle of "Restoration of Humanity".

In Chapter 2: *The Actual State of the Fukushima Daiichi Nuclear Power Plant Reactors and Issues Surrounding the Accident Settlement*, while placing great emphasis on the need to focus fully on investigating the progression and cause of the nuclear accident, which are still not yet well understood, we give an overview of the current on-site state of Tokyo Electric Power Company's (TEPCO's) Fukushima Daiichi Nuclear Power Plants and indicate measures to minimise the radioactive exposure of workers and

releases of radioactivity to the environment. We also propose management and disposal methods for containment of the radioactivity of the reactors.

In Chapter 3: *Treatment and Disposal of Radioactive Wastes*, while calling for the abolition of the main nuclear fuel cycle-related activities (nuclear fuel reprocessing, the fast breeder reactor, and uranium enrichment), from the standpoint of viewing all nuclear materials (including separated plutonium) deriving from nuclear power generation-related activities as "nuclear wastes," we make proposals concerning the nature of the treatment and disposal of these materials. The basic principle in doing this is "just and fair burden-sharing".

In Chapter 4: *Technical Grounds for Keeping Reactors from Restarting*, we clarify that the new safety standards formulated by the Nuclear Regulation Authority of Japan still contain serious flaws from the viewpoint of securing the safety of nuclear power facilities. Moreover, we indicate systematically, in the light of the current inadequate state of disaster control plans, that nuclear reactor restarts can never be accepted due to the difficulties of securing safety.

In Chapter 5: *Steps to a Nuclear-Free Society*, we indicate a roadmap for Japan's orderly withdrawal from nuclear power generation by the enactment of a "Basic Act for a Nuclear Phaseout", based on the national consensus formed during the 2009-2012 administration of the Democratic Party of Japan (DPJ), and along the lines of a "Basic Plan for a Nuclear Phaseout". It goes without saying that TEPCO should immediately undergo legal liquidation (bankruptcy procedures), and we indicate that this is also necessary for the post-accident cleanup and victim compensation and support.

In the Chapter 6, *Defects in the Nuclear Power Complex-Led Decision-Making System and the Path to Democratic Policy Decisions*, we highlight the fact that the established nuclear power policy decision-making mechanism has been dominated by the "nuclear power complex", and the many serious issues that this has given rise to. We then describe ethical principles and a direction for system reform toward a mechanism we believe is most appropriate for democratic decision-making. We also discuss political strategies for the realisation of a nuclear-free society. As the specific contents of these nuclear phaseout policies will have already been indicated in the previous chapters, it will not be repeated again in Chapter 6.

In the Epilogue, we, the members of the Citizens' Commission on Nuclear Energy, state the will and determination we have shared and the tasks we would like to tackle in the future.

0-1 Weaknesses in the Financial Management of Nuclear Power Generation

Nuclear power generation is a private business activity although conducted in Japan as national policy, and it is only possible for power companies to pursue this business under the premise of generous government protection. However, this entails the following economic and financial weaknesses.

(1) A severe accident would result in irreparable losses to the power company. Even the government of a major economic power would be unable to make good losses on this scale. Moreover, external factors such as large-scale natural disasters and terrorist attacks may also result in severe accidents in nuclear facilities.
(2) The treatment and disposal of nuclear wastes is an intractable problem. Downstream costs (the costs of the nuclear fuel cycle back end, and the demolition, removal and decontamination of nuclear facilities) are uncertain, and large cost overruns on the original estimates are also possible.
(3) Nuclear power generation is socially and politically vulnerable to changes in public opinion resulting

from accidents and disasters.

(4) In normal times, the cost of nuclear power generation, if capital investment costs are included, is unfavourable when compared with thermal power plants (coal thermal and natural gas thermal) and other power generation methods (oil thermal has been almost phased out in the main developed countries due to the unprecedented rise in crude oil prices since the turn of the century). With the advance of power deregulation, the financial management risk of capital investment will also be high.

(5) The wishes of an extremely large number of stakeholders have to be respected (for example, the government and local municipalities) with regards to the siting and operation of nuclear power plants, narrowly restricting the freedom of power companies to carry out strategic decision-making in their financial management operations.

Since the pioneer days in the 1950s, nuclear power has attracted high hopes from those involved. They saw it as having great potential for future development as a source of cheap and abundant electrical power, and it therefore became the target of priority investment for power companies. With the oil crisis of the early 1970s, nuclear power achieved rapid expansion under robust national policy support as a substitute energy source for oil, and the position of nuclear power was established in the 1980s as one of the major power sources in Japan.

It is clear that in the background to the expansion of nuclear power in Japan, the political motivation for a display of national prestige in diplomatic and national security aspects was strongly at work. Nuclear power technology, as a symbol of advanced technology, was a virtual *sine qua non* for the world's developed industrial countries. In addition, as a country that did not possess nuclear weapons, Japan was allowed unprecedented privileges (the right to develop and use sensitive nuclear technologies such as uranium enrichment, reprocessing and the fast breeder reactor, for which the risk of diversion to military use is high) by the United States and the international community. Thus there was an extremely strong political motivation to develop nuclear power in Japan.

However, as mentioned above, nuclear power generation has long been a high-risk business for power companies. Naturally, it has also been a high-risk business for the government. Moreover, it also became clear as time went by that the future expectations for nuclear power were greatly exaggerated. Nevertheless, over the years a vested interest group (the nuclear power complex[1]) grew up and, with the passing of time it has become more and more difficult to make choices other than to maintain the current policy line.

The Fukushima nuclear power plant accident occurred right on the extrapolation of that policy line and, as a consequence, a policy switch to a nuclear-free society has become necessary.

0-2 Problems Caused by the Fukushima Nuclear Power Plant Accident

All the nuclear power plants located along Japan's eastern Pacific coastline fell into a critical condition as a result of the Great East Japan Earthquake, which occurred at 2:46 p.m. on 11 March 2011. TEPCO's Fukushima Daiichi Nuclear Power Plant Units 1, 2 and 3 later released large amounts of radioactivity to the environment from their nuclear reactors. Unit 4 also suffered major damage to its reactor building (see Section 2-1). Large amounts of radioactivity were dispersed over a wide area of east Japan, not only

[1] The "nuclear power complex" is a collective term for the individuals and organisations that have a direct or indirect interest in promoting nuclear power, such as those belonging to industrial circles, political circles, bureaucratic circles, academic circles and media circles, and who engage in mutual co-ordination to further those interests. We have decided to use the term "nuclear power complex" to emphasise the analogy with the "military-industrial complex," but the popular term "nuclear village" (*Genshiryoku mura* in Japanese) could also be used if one wished to emphasise the feudal nature of the cultural environment. (See Section 6-1)

Fukushima Prefecture, placing at least several hundred thousand people at risk of exposure to high doses of radiation. Approximately 160,000 evacuees were forced to flee from their hometowns. Moreover, even now [as of March 2014], three years after the accident, roughly 140,000 people are still living as evacuees [Note on translation: This figure does not include those who took refuge from prefectures other than Fukushima. Nine months after the publication of this report, the figure has not changed much. As of January 2015, Fukushima prefecture officially says that 118,862 Fukushima people are still in refuge. Adding the refugees from other prefectures, the total figure would be roughly estimated around 130,000. See footnotes 9 and 10 in Chapter 1.]. The problem of releases of radioactivity has also resulted in serious international impacts. While the nuclear fission reactions of the reactors themselves have been brought under control, additional releases of radioactivity continue to occur from the nuclear reactor facilities.

This *Policy Outline* will, in principle, use the term "Fukushima nuclear accident" to express this situation, but will also use the terms "Fukushima Daiichi Nuclear Power Plant Accident"[2], "Fukushima nuclear disaster"[3], and "Fukushima seismic-nuclear disaster"[4] when necessary.

This Fukushima nuclear accident has resulted in great suffering and damage, which are still ongoing, and will continue for a long time into the future.

A detailed overall view of the damage will be given in Chapter 1, so only a simple enumeration of the characteristics of the impacts that have arisen as a result of the Fukushima nuclear accident will be given here, in order to indicate the gravity and multifaceted nature of the damage caused by the accident.

(1) A nuclear power plant earthquake disaster as a part of a complex disaster has become a reality.
(2) Multiple nuclear reactors were destroyed at one time.
(3) Large numbers of people were exposed to radiation, with the risk of subsequent health effects.
(4) Radioactive pollution to the land has brought about serious impacts.
(5) Radioactive pollution of the ocean is also severe, and the pollution is still expanding.
(6) Various kinds of social divisions and antagonisms have resulted.
(7) A large number of nuclear power plant accident-related deaths have resulted.
(8) A large number of both tangible and intangible assets that once supported the life of communities have been suddenly lost, and the dignity of human beings has been damaged.
(9) There is as yet no end to the accident in sight.
(10) Large numbers of workers, who are being exposed to high doses of radioactivity, are needed to cope with the post-accident cleanup and to bring the accident to an end.
(11) From a financial perspective alone, huge losses have resulted from the accident.

The above can be considered to be the inevitable consequences of any severe nuclear accident. In addition, the Fukushima accident has

(12) the additional characteristic that insufficient and inappropriate disaster responses by the national and prefectural governments have exacerbated the impacts, with the result that the situation remains serious to this day (see Section 1-1).

[2] A "nuclear power plant accident" refers to harm done in general to nuclear power station personnel or local residents due to abnormalities in the plant equipment or human error, etc.
[3] "Nuclear disaster" is a term used to emphasise that immense impacts have been suffered by local society and people as the result of a nuclear power plant accident.
[4] The term "seismic-nuclear disaster" is used to emphasise the point that a broad disaster-affected region suffered impacts from the earthquake and tsunami simultaneous to suffering impacts from the nuclear power plant accident as a result of the earthquake and tsunami, i.e. that the region suffered a complex disaster (see 1-1-1).

0-3 Ethical Disqualifications of Nuclear Power

The impacts of the Fukushima nuclear accident have been extremely grave, and are also of a quality that sets them apart from impacts caused by ordinary natural or human disasters. Nuclear power has long been considered an activity which would result in impacts of an overwhelming scale should a severe accident occur. Further, it has been argued that the equation "risk = scale of impact × event probability" should not be applied to such catastrophic accidents, and that such a risk should not be permitted however small the probability may be.

For example, in *Kyodai Jiko no Jidai* (The Era of Gigantic Accidents) (Kobundo, 1989) Jinzaburo Takagi stated:

> I term the total catastrophe that makes life meaningless in its wake "apocalypse", and I believe that we should absolutely not allow such an "apocalyptic" accident to happen. If we are to employ the concept of probability, then the probability of massive and catastrophic accidents occurring should be held to the minimum, but the possibility of a "downfall" accident occurring must be absolutely zero. That is, any technology that entails even the slightest potential for "downfall" is a "culture of death" of the most extreme nature, and that technology should not be selected for use. (p. 210)

The argument that technology could be banned or regulated on ethical grounds has existed for a long time. At its oldest, the record dates back to the formative period of modern society, but movements for realistic bans or regulation heightened with the coming of the 20th century. Poison gas appeared during the First World War, and atomic bombs in the Second World War, when the indiscriminate massacre of large numbers of people was carried out through strategic bombing, and experiments on the human body were performed on a large scale for medical purposes. Since the birth of the hydrogen bomb (nuclear fusion bomb) in the 1950s, it has become possible to think in real terms about the extinction of humanity itself. These ghastly experiences and the fear of final doom have led the people of the world to reach a common awareness that the use of such weapons of mass destruction, with nuclear weapons at the top of the list, is opposed to humanitarian principles. These movements can be understood as the forerunners of efforts to ban or regulate powerful technologies according to ethical judgments. The 1979 Three Mile Island and the 1986 Chernobyl nuclear accidents have given rise to the appearance of people who believe that nuclear power, despite dissimilarities in character and degree, is also a technology that is opposed to humanitarian principles. As we have now come to know through the Fukushima nuclear power plant accident, which occurred against this historical background, the possibility of a "downfall" accident is in fact a reality, and the view that nuclear power is incompatible with human society has become influential. From this viewpoint, regardless of how superior nuclear power generation may be in terms of economy or the provision of a stable power supply, its use is ruled out on ethical grounds.

On 30 May 2013, the report entitled "Germany's energy transition—A collective project for the future", was submitted to Chancellor Angela Merkel by the "Ethics Commission for a Safe Energy Supply". Precisely as suggested by the title of the Ethics Commission itself, the report incorporated an ethical viewpoint as an essential component of its argument. The basic premise of this report is that the scale of impacts from a severe nuclear accident are immeasurably large, and since the dispersed radioactive materials would also force burdens on future generations, nuclear power was therefore impermissible from an ethical point of view.

Its use should thus be permitted for the limit of a decade, until an energy transition strategy that is environmentally, economically and socially favourable can be successfully implemented. The report thus came to the conclusion that, from the perception that there was strong potential for a successful energy transition strategy in Germany, it was reasonable for all nuclear power plants to be shut down within ten years. We share this ethical position. Nonetheless, having experienced the horror of the atomic bomb, and now experiencing the ordeal of a severe nuclear accident, it is appropriate that Japan's ethical judgment on nuclear technology be even more firm and precautionary than Germany's. CCNE believes that it is Japan's historic duty to work toward the construction of a nuclear free society, and, as we shall explain below, we believe that this is achievable. This resolve would make an immeasurably great contribution to international society given the current environment in which countries in Asia and the Middle East are now planning to introduce nuclear power plants for the first time.

0-4 NUCLEAR POWER PLANT SHUTDOWN BY LEGAL MEANS

The following two policy options appear to be available for shutting down nuclear power plants: (1) removal of government protection and support policies, and (2) nuclear power plant shutdown by legal means. We believe that Japanese society should choose the policy option of (2) "nuclear power plant shutdown by legal means".

The realisation of a nuclear phaseout would also be possible, of course, if the neo-liberalistic reform of (1) "removal of the government's protection and support policies" were to be decisively carried through. What is meant by neo-liberalistic reform here is the removal, to the greatest extent possible, of laws prohibiting the free market activities of private corporations and the termination, to the minimum extent possible, of government interference in the market. Under this regime, the golden rule is liberalisation, privatisation and competition in the marketplace, and the framework of "national policy with private management", in which private corporations obey government commands, could no longer exist. All activity would take place according to the "self-determination and self-responsibility" of private corporations. Taking into account the high-risk nature of the business aspects of nuclear power generation, as already mentioned above, under such a neo-liberalistic reform, nuclear power, especially development and use of the nuclear fuel cycle, would become a huge burden for the power companies. Other than to attempt to prolong the life of existing nuclear power plants, it is difficult to imagine that there would be any incentive for power companies to pursue nuclear energy. Furthermore, if power companies were to judge the merits or demerits of nuclear power plants merely from a financial management viewpoint, there would be the danger that safety would be pushed aside for cost-cutting purposes. This is one of the reasons why (2) "nuclear power plant shutdown by legal means" should be chosen.

At present, as a reward for "national policy cooperation", nuclear power business is operated under the premise that the government will shoulder all financial risks related to nuclear power generation, and the sudden withdrawn of this support would be a nightmare scenario not only for the power companies but for all those that have had a vested interest in the promotion of the use of nuclear power. When considering the fierce struggle and ensuing confusion that is likely to occur in such an eventuality, an orderly withdrawal from nuclear power would result in far less social friction. There is also the merit for the power companies that, provided the cost burden associated with early nuclear power plant shutdown were to be alleviated by the government, they would be liberated from this unconscionably high-risk business.

0-5 Comprehensive Evaluation of Nuclear Power

Of all evaluation criteria, the greatest importance should be attached to ethical criteria. Nonetheless, if there were the danger that shutting down all nuclear power plants would cause serious energy supply problems, or bring about severe losses in terms of the economy or environment, although the construction of new nuclear power plants would not be permitted, it is possible that a judgment could be made that existing reactors should be allowed to operate to provide energy for a transition period. It is from these considerations that Germany has given nuclear power a 10-year grace period. To examine the merits and demerits of such a grace period, it is first necessary to carry out a comprehensive evaluation of nuclear power generation in comparison with other means of power generation. Without this it would be impossible to estimate the impact of shutting down nuclear power plants.

Among the various evaluation criteria, those referred to as "3E"—*E*nergy security, *E*conomy, and *E*nvironment—are considered to be especially important indices. Further, a technology will not be socially acceptable for commercial use unless a sufficient level of safety is secured. With the addition of safety to "3E", this is often referred to as "3E+S". These four criteria are applied to all energy systems, not only nuclear power. At the same time, "security" (sufficient protection against criminal or subversive activities, military attack, and so on) and "safeguards" (monitoring to ensure that nuclear materials cannot be diverted for military purposes) are special conditions for nuclear power generation. With the addition of these two conditions to safety, this is sometimes referred to as "3S". In summary, the important criteria for nuclear power generation are "3E + 3S".

0-6 The "3E" Arguments Totally Undermined

The major grounds for the expansion of nuclear power generation put forward by the government are that nuclear power has superior "3Es". That is, nuclear power generation has been thought to have advantages in stability of supply, environmental conservation and economy. Government documents conclude from this the necessity for immediate expansion of nuclear power, the realisation of which has been used to justify any and all policy measures. The Fukushima nuclear disaster has brought about a definitive denial of nuclear power generation's supposedly superior stability of supply, environmental conservation and economic efficiency.

Looking first at stability of supply, a severe power shortage was brought about for several months in the TEPCO and Tohoku Electric Power Company's regions, the disaster-affected areas, by the Fukushima nuclear power plant accident. Stability of supply effectively disappeared overnight. As it has not been possible to gain consent of the residents of host areas for the restart of halted nuclear power plants, a situation where there is only a slim margin of power supply capacity has continued for three years. When accidents, disasters and incidents occur, multiple nuclear power plants may be shut down at one time, and since restarting operations take time, this may easily lead to power supply instability. Thus the Fukushima accident has highlighted anew the vulnerabilities with respect to the stability of power supply. It is not unfair to assert that of all the main energy sources, nuclear power generation has the worst performance in terms of stability of supply.

Secondly, the advantage of nuclear power from the viewpoint of environmental conservation is that emissions of harmful chemical substances and greenhouse gasses (GHGs) per unit of energy produced are far lower than those of thermal power generation. Nuclear power, on the other hand, involves the risk of large releases of radioactivity to the environment in the case of an accident, and also produces a variety of

radioactive wastes. We can now consider that the question of which is more serious has been resolved by the Fukushima nuclear accident. The discourse of nuclear power plants being more environmentally-friendly, or green, has been transformed into a black joke. It is inevitable that the human and financial burden of the removal of radioactive pollution will be placed on the shoulders of our descendants.

Lastly, with regard to economic efficiency, estimates that purport to show the superiority of nuclear power generation have been published by the government and the power industry, but these are almost totally unreliable. They are meaningless unless they indicate the results of calculations based on actual performance data. Furthermore, the losses due to the Fukushima nuclear disaster are estimated to be at least 13 trillion yen, and this is probably set to reach several tens of trillions of yen in the long term (see Section 1-1-10). This will greatly increase the cost price of nuclear power.

Thus the Fukushima accident has totally undermined the arguments used as grounds to promote nuclear power.

0-7 THE FOUR PRINCIPLES OF SOCIAL REASONABILITY

The orthodox method of arguing the relative merits of nuclear power generation by comparison with other means of power generation is to carry out a comprehensive comparative evaluation through the use of various criteria with “3E+S” as their core. However, one meaningful alternative method to this comprehensive evaluation would be to examine whether nuclear power can be accepted from the viewpoint of social reasonability, as discussed below. Here, nuclear power is examined in the light of the four principles of “safety”, “fairness”, “justice” and “sustainability”.

(1) Safety: Avoiding health effects and environmental pollution from radioactivity should be the most important criterion when evaluating nuclear power policy. All stages of nuclear power, including the construction, operation, accident handling and decommissioning of nuclear power plants, and the management of nuclear fuels from mining of the raw materials to fuel fabrication and waste disposal, should prioritise the avoidance of exposure of both local residents and workers and pollution of the local environment. Research into the health impacts of radiation from a position other than promotion of nuclear power should also be guaranteed, and there must be evaluation and open discussion by general public and knowledgeable people from other fields.

(2) Fairness: From an ethical point of view, it is desirable to have fairness in burdens and benefits across regions and generations. In Japan, however, by shifting the environmental burden associated with the use of nuclear power to locations remote from the beneficiaries, the siting of nuclear power plants and facilities related to radioactive wastes has been pushed forward under the premise of a structure of unfair burdens across regions and generations. This has given rise to a social mechanism that promotes the use of nuclear power while playing down the “negative consequences”. We must be very prudent about the introduction, expansion and continuation of the kind of science and technology that forces certain groups of people to shoulder exceptionally large risks. For a concrete realisation of fairness in the shouldering of the burden of environmental loads, the principle should be adopted of having the people who site and operate nuclear power facilities and their beneficiaries shoulder the burdens.

(3) Justice: Justice here means that in the process of policy formulation and decision-making, all stakeholders have adequate opportunities to state their views and the power to make decisions, and that there is transparent disclosure of the information relating to decisions. Further, there must not be any information management or one-sided “PR” from a specific position that overestimates safety. In order to

achieve that, the "fair and open deliberations" should be promoted and various mechanisms should be created to reflect the "voice of the people" accurately in policy formation. In particular, it is necessary that people who may potentially suffer, or who have already suffered, the "negative consequences" of nuclear power use have sufficient right to speak and power to make decisions. The realisation of just disclosure of information and information sharing and just decision-making procedures are indispensable for securing safety, ensuring fairness in benefits and cost burdens, and avoiding distress.

(4) Sustainability: Production and consumption that is premised on a limited global environment requires moderation, and resource depletion and the accumulation of pollutants must not be foisted on future generations. If the use of the science and technology of nuclear power is continued, it will bring about huge, long-term risks for people's daily lives and the environment on the scale of several tens of thousands of years, and impose upon them the onerous burden of management of those risks. Changes that make it difficult for future generations to continue to live must not be created on Japan's soil or anywhere on the Earth. The use of nuclear power, which involves pollution, the possibility of accidents, and radioactive waste must be considered with these points in mind.

The above four principles are all ethically important and can be referred to collectively as "social reasonability".

Of these, (1) and (4) are included in "3E+S", but since the viewpoint of social reasonability differs from the viewpoint of the comprehensive comparative evaluation, there is no serious problem about having an overlap in some of the aspects to be considered.

0-8 The Problems of a Tight Power Supply-Demand Balance and Cost Increases

When evaluating the impact of decommissioning nuclear power plants, it is necessary to consider the issue of the risk of a tight power supply-demand balance. The risk of a tight power supply-demand balance is that the shutdown of all nuclear power plants could result in a critical situation for power supply stability. If this risk is seriously large, the merits of immediate shutdown of all nuclear power plants need to be reconsidered.

Looking at the actual performance during the three years following the accident, we cannot necessarily say that power supply stability itself has experienced any serious crises. The concerned increase of coal thermal did not take place, but a large-scale rise in the use of oil and natural gas was necessary to avoid power shortage in the summer and winter of 2012 (with 2 nuclear reactors in operation), the summer of 2013 (also 2 nuclear reactors in operation) and the winter of 2013 (all nuclear reactors shut down) [translation note: the 2014 summer also successfully went without any nuclear reactor in operation]. Even if all of Japan's nuclear power plants remain shut down for the next several years, there will be no power shortage provided thermal power plants are operated at a high capacity factor. A further margin of safety would be available if a number of up-to-date (i.e. high-efficiency) thermal power plants were constructed.

At the same time, as discussed in detail in Chapter 5, the cost of burning increased amounts of fossil fuels has a certain economic impact, but this cannot necessarily be said to constitute a serious macroeconomic issue. To defray the added costs associated with the shutdown of nuclear power plants, it is possible that laws could be enacted to grant state compensation to power companies and others in the case where the use of nuclear reactors and nuclear fuels, which are private assets of the power companies, were banned. It is possible that this would amount to a huge sum of money. We believe that it is appropriate to pay this

compensation to achieve the immediate closure of all nuclear power plants, but it is first crucial that a national consensus be achieved and a political decision be made to opt for a nuclear-free future. The merits and demerits of a grace period should be left to a subsequent national debate.

0-9 POLICY REFORM THAT REFLECTS THE WILL OF THE PEOPLE

To realise a nuclear-free society, it is indispensable that the will of the people exercise persistent and robust political influence. The result of the national debate in the summer of 2012, during the Democratic Party of Japan administration (2009-2012), and according to later opinion polls in the mass media and elsewhere, it appears that the majority of the people of Japan are in favour of a future nuclear phaseout. Unfortunately, the coalition administration of the Liberal Democratic Party and the Komeito Party (2012-20015+) are not formulating nuclear power policy in a manner that respects this national public sentiment. This situation could be altered if a wide range of people from all sectors of Japanese society were able to exercise powerful political influence. The way could then be opened for the enactment of a "Basic Act on Nuclear Phaseout". Several ideas for strategies to achieve this goal are discussed in the Epilogue. We hope you will find them informative and useful.

0-10 OUR VIEW ON THE NUCLEAR RESTART ISSUE

The nuclear power plant restart issue is certain to be the most serious controversy surrounding Japan's nuclear power in 2014. On this matter, we believe that restart should not be permitted even for nuclear power plants that have been judged as passing the screening for compliance with the new safety standards issued by the Nuclear Regulation Authority (NRA) (the so-called "restart screening"). Our grounds for believing this consist of the following four points.

Firstly, in their current state, the new safety standards themselves are extremely deficient. Especially important is that, since the causes of the Fukushima nuclear power plant accident have not yet been clearly determined, there is uncertainty about just where the former safety standards (regulatory criteria) went wrong, and therefore it is impossible to judge the adequacy of the new safety standards. (See Chapter 4 for a detailed discussion.)

Secondly, we find it impossible to believe that in the event of a severe accident the countermeasures will function effectively to control impacts on local residents and people throughout Japan to a minimum. (See Section 4-8 for a detailed discussion.)

Thirdly, the victims of the Fukushima accident are even now being forced to endure a very harsh daily existence. This signifies that in the event of further severe accidents, the compensation and support for the victims will remain at an exceedingly inadequate level. It is inappropriate to allow resumption of nuclear power plant in such a situation.

Fourthly, following the Fukushima nuclear power accident, it would appear that the majority of the people of Japan believe that Japan's future nuclear power generation should be phased out to zero, but political decision-making is not being carried out in line with the view of the people. To push forward towards nuclear power resumption in such a situation is to attempt to gradually enforce a reinstatement of the position of nuclear power as it existed before the Fukushima accident without first gaining a national consensus on the end state of Japan's nuclear power. We find this totally unacceptable.

0-11 Realisation of a Nuclear-Free Society is not Difficult

The proportion of Japan's energy provided by nuclear power generation was around 10% at the turn of the century, and this has greatly decreased since the Fukushima nuclear power plant accident. Provided the loss of this power supply is balanced out by other means, then a phaseout of nuclear power plants is not something that is hard to achieve.

It is thought that a natural decline in energy consumption will take place in Japan's society in the future. Among the causal factors of this are a declining population, the phasing out of highly energy-intensive manufacturing industries due to deindustrialisation, demand-side economising due to the rising prices of fossil fuels, and consumer thrift due to declines in household income (not national income), and so on. It can be estimated that within the next dozen years or so the loss in power supply caused by a nuclear phaseout will be balanced out just by this natural decline alone. At the end of the 1960s, critiques of rapid economic growth appeared in Japan, as elsewhere, and the newspapers were full of slogans such as "Get lost, GNP!" This criticism of economic growthism still holds a certain impact today, having been taken over by the ecology movement and others. These were pioneering days, but in recent years it is no longer necessary to get very worked up about energy use since the country has now entered the era of the natural decline of energy consumption, which is expected to continue for some considerable time.

Furthermore, there is still a great margin for the development of energy conservation (for example by improvements in energy conversion ratio and optimisation of energy use) and the expansion of renewable energy. It would be extremely meaningful for the whole of Japanese society to put as much effort into achieving this as possible, because it would also enable the achievement of great reductions in the consumption of fossil fuels. Seen from the citizens' side, the promotion of energy conservation and the trend towards renewable energy is helpful in building the awareness that citizens can exercise direct control over energy production and consumption. This would give citizens not only the power to change energy policy in their communities, but would also lead to citizens playing a central role in actively determining the state's energy policies. The slogan of "large-scale centralisation to small-scale decentralisation", more than just a change in the technological system, expresses a revolution in awareness of citizens who hold the sovereign power to bring about their own energy transformation.

Chapter 1 An Overview of the Damage Caused by the Fukushima Nuclear Power Plant Accident and the "Restoration of Humanity"

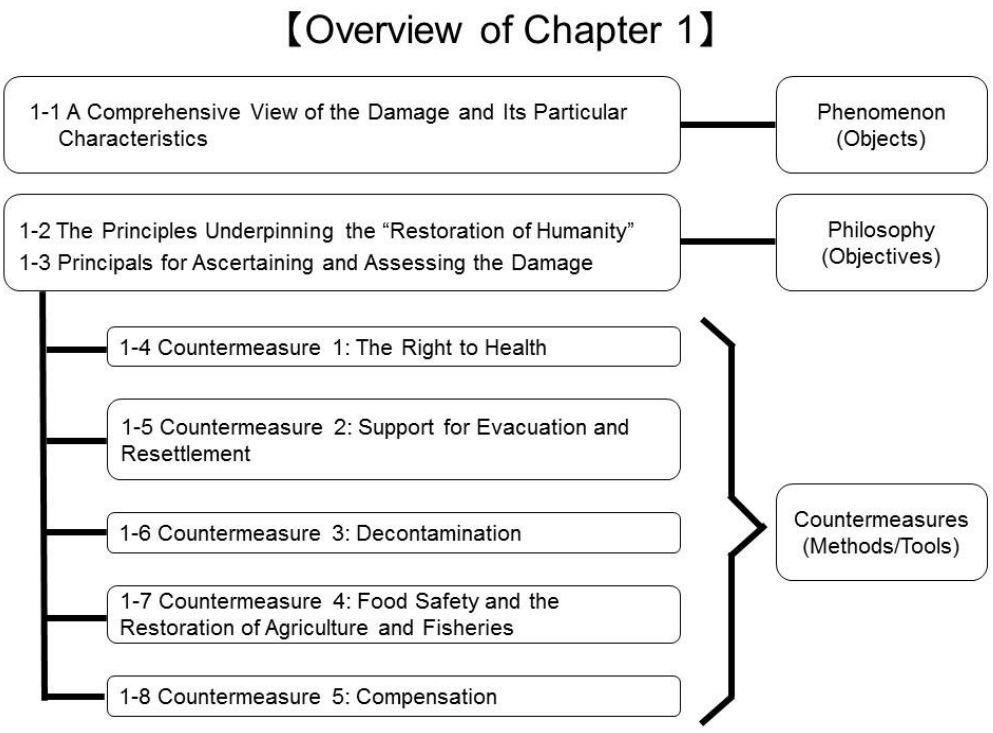
1-0 Overview and Structure of Chapter 1

This chapter sets out the principles and procedures that we believe must guide any effort to assess the damages resulting from the TEPCO Daichi Nuclear Power Plant disaster and bring relief to its victims. Since the effects of the Fukushima nuclear disaster are enormous, complex and still unfolding, grasping the full extent of this disaster presents a difficult challenge. Yet it is only by directly confronting the horrors of this disaster and the still troubling realties of its victims and affected areas that we can move further along the path to a nuclear free society.

Since the events of 11 March 2011, the central government, TEPCO, the Fukushima prefectural government and other organisations have consistently underestimated the extent of damage from the nuclear disaster and remain reluctant to aid its victims. This inadequate and delayed response has served to exacerbate the effects of the disaster. Accordingly, it is imperative that efforts to determine where fault lies for the initial disaster are accompanied by a critical investigation of the agencies responsible for the negligent response.

While support for the disaster stricken areas requires ample financial investments to rehabilitate devastated economies and promote new industries, such "infrastructural reconstruction" is but one side of the recovery process. Above all, the guiding principle of reconstruction must be to preserve people's dignity. This demands "restoration of humanity", an approach to recovery that is rooted in a deep understanding of the particulars of each local community and that takes the restoration of humane modes of inhabitation as its aim.

It is imperative that all nuclear disaster reconstruction policies are informed by the following basic points: 1) a thorough understanding of the situation, 2) guarantee of the 'right to health' as a fundamental human right, 3) establishment of new laws and institutions tailored to the exigencies of the disaster and 4) access to the decision-making process for victims. In the necessarily long-term recovery process ahead it is absolutely crucial to ensure that support for victims, disaster reconstruction policies and radiation countermeasures are all tied together at their roots by the "restoration of humanity" approach outlined here.



1-1 A COMPREHENSIVE VIEW OF THE DAMAGE AND ITS PARTICULAR CHARACTERISTICS

In section 0-2 of the Prologue, the conditions brought about by the Fukushima nuclear accident were summarised into 12 key points. While a few of these points are specific to the particularities of the Fukushima nuclear accident and local socio-environmental conditions, most of these points describe the serious and complex conditions that inevitably follow the occurrence of any severe nuclear accident.This section aims to provide a comprehensive view of the situation that we are facing and its particular characteristics through an in-depth discussion of each of these 12 points in order of their occurrence after the initial events of March 11, 2011.[5]

1-1-1 A seismic-nuclear disaster becomes a reality

The Fukushima Daiichi Nuclear Power Plant accident must be referred to as a "seismic-nuclear disaster", a complex disaster triggered by an earthquake and tsunami.[6] In addition to the earthquake and tsunami, radioactive materials emitted from the nuclear reactor spread wavelike over the disaster stricken region. Many of those who survived the earthquake and tsunami lost their lives or were severely affected by the delayed evacuation and rescue efforts caused by the ensuing nuclear accident. Additionally, not only were the nuclear reactor facilities and their various components destroyed by the earthquake and tsunami, major damage to the roads, buildings and power grid of the area created significant obstacles for the cleanup and containment effort.

The fact that the Fukushima nuclear accident was triggered by a massive tsunami that made the power station impossible to control suggests that this was, in part, a 'natural disaster'. However, the loss of the means of cooling a nuclear core due to earthquake damage to a nuclear facility was already known to be a possible scenario before the accident, as was the fact that even a relatively small tsunami could potentially result in the loss of ability to cool a nuclear core. Yet the existence of such investigative reports was concealed and proper safety measures were never implemented.[7]

Although the risks of nuclear reactors falling into crises due to an earthquake or tsunami had been previously pointed out, the proper preventative measures for safeguarding against such risks were neglected, making this a predominantly 'man-made disaster' in which the central government and TEPCO bear considerable responsibility for amplifying the scale of the disaster. The fact is that 10% of the world's earthquakes occur in Japan and an earthquake of 6 or higher on the Japan Meteorological Agency seismic intensity scale can occur at any site in the archipelago. Additionally, all of Japan's nuclear reactors are located along the coast and thus at risk from a potential tsunami. In sum, all nuclear power plants in Japan are faced with the potential for a nuclear-seismic disaster (see section 4-4).

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[5] This section contains 11 sub-sections that correspond to the 12 points listed in section 0-2 of the preface. Here, however, points 4 (terrestrial contamination) and 5 (marine contamination) have been combined into one (i.e. 1-1-3).

[6] The term "seismic-nuclear disaster" (*genpatsu shinsai* in Japanese) describes an event in which a major earthquake leads to a major nuclear accident that emits large amounts of radioactive materials, creating a catastrophe in which an the disastrous results of a natural disaster and nuclear accident are complexly combined and mutually amplified. Since the qualities of the initial earthquake are entirely transformed, standard disaster response measures become entirely inadequate. Seismologist Katsuhiko Ishibashi warned of such a disaster following the Great Hanshin Earthquake of 1995. See Ishibashi, K. (1997). "A seismic-nuclear disaster: how to avoid the destruction".[In Japanese] *Kagaku* 67(10), 720-724 http://historical.seismology.jp/ishibashi/opinion/9710kagaku.pdf and Ishibashi, K.（2012). *A seismic-nuclear disaster: traces of a disaster foretold* [In Japanese], Tokyo: Nanatsumori Shokan. The Fukushima seismic-nuclear disaster became the first such disaster in human history. Ishibashi (1997, 723) suggested that such an event may overlap with a massive tsunami to make "the relief and reconstruction of the affected areas impossible". Unfortunately that prophecy was fulfilled.

[7]Makino, J. (2013). *Nuclear accidents and scientific methods* [In Japanese], Tokyo: Iwanami Shoten. pp.27-41.

1-1-2 Multiple reactor explosions led to crisis

As with the Chernobyl nuclear disaster, the Fukushima disaster has been evaluated as an International Nuclear Event Scale (INES) Level 7, a severe accident[8] (see section 4-5). One difference between the Fukushima and Chernobyl accidents is that in Fukushima multiple reactors were brought into a crisis, lost their capacity to contain radioactivity and spread contamination over a wide area. When one nuclear reactor falls into crisis, it becomes impossible to maintain cooling operations at neighbouring reactors. This presents a situation in which other reactors, including in the case of Fukushima the nearby Fukushima Daini Nuclear Power Plant, could potentially become uncontrollable. In such a case, an even greater amount of radioactive material would be emitted, resulting, in the worst case, in an accident completely off the INES scale. If such an event had occurred in Fukushima, an evacuation of all northeastern Japan would have been a real possibility.[9]

The fact is that the destruction of each separate reactor at Fukushima Daiichi was not an independent process but rather a process that was complexly interdependent.[10] As a result of concurrent accidents at multiple reactors, cleanup and containment efforts at the site could not focus on any specific reactor but were rather scattered across multiple accident sites. As such, the Fukushima accident has exposed the difficulty of dealing with multiple simultaneous reactor accidents.[11]

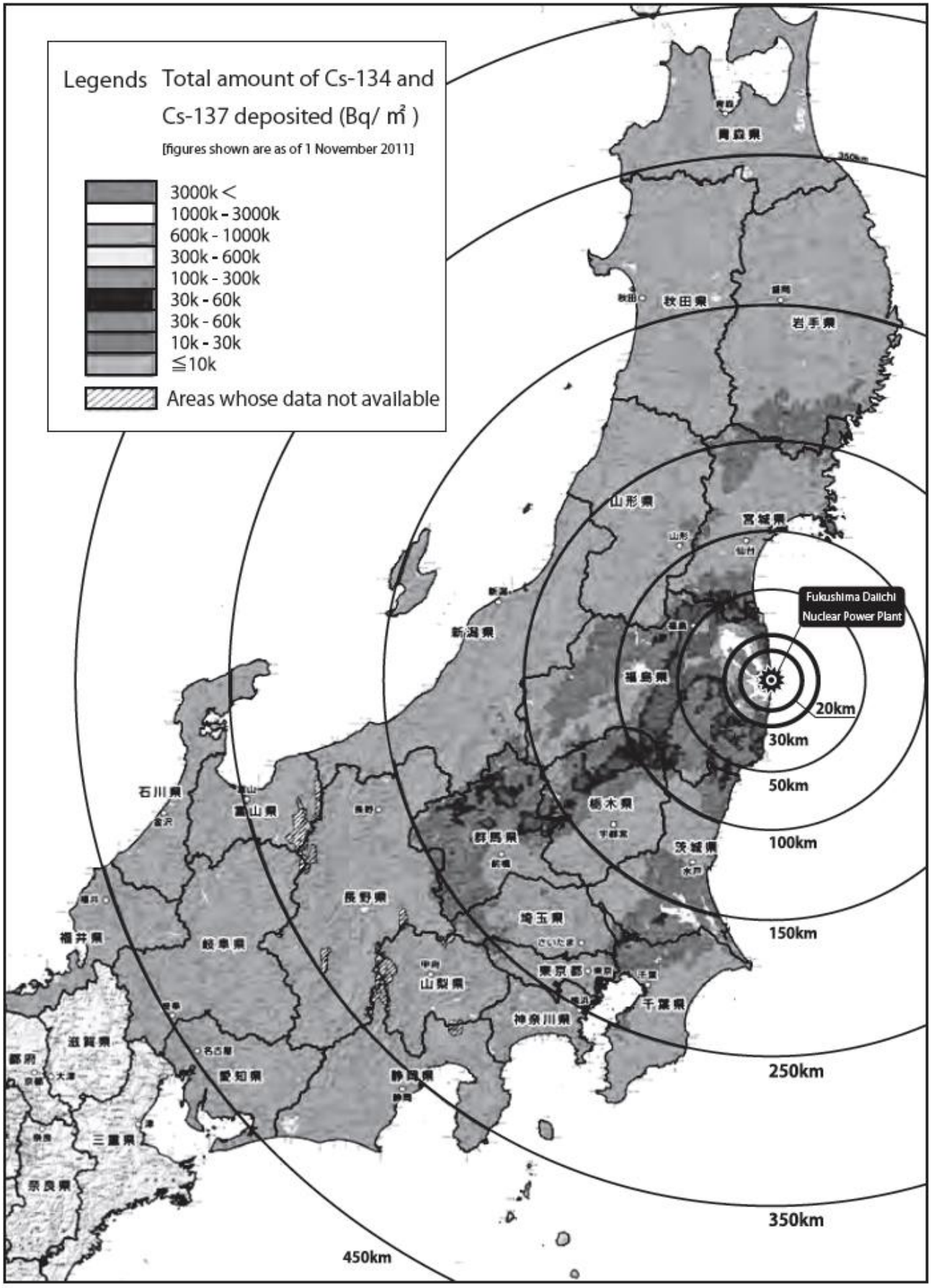
Finally, the Fukushima accident made it plainly evident and widely recognised that coolant loss accidents could occur in spent nuclear fuel pool, and that it is thus extremely dangerous to prioritise the efficiency of periodic inspections and fuel rod exchanges over safety by locating these pools above reactors.

[8] The INES is a nuclear accident evaluation scale stipulated by the International Atomic Energy Agency (IAEA) and the The Organisation for Economic Co-operation and Development's Nuclear Energy Agency (OECD/NEA). This scale comprises seven levels for evaluating nuclear events. An event in which radioactive materials are emitted on-site or cause public exposure are evaluated as a Level 3, and the numeric values proceed upward from that base level according to the scale of the event. Events reaching the maximum Level 7 include Chernobyl (1986) and Fukushima (2011). Three Mile Island (1979) and the Windscale fire (1957) were evaluated as Level 5. The Tokaimura JCO nuclear criticality accident (1999) was evaluated as a Level 4.

[9] On March 25 2011, then head of the Japanese Atomic Energy Commission, Shunsuke Kondo, gave a 15-page document to then Prime Minister Naoto Kan that gave estimates of how quickly and how far an area would be contaminated and rendered unfit for inhabitation if the Fukushima accident had fallen into the worst case scenario. According to this document, if criteria established for the Chernobyl accident were followed, then "a forced evacuation region" would have been established up to 170km from Fukushima Daiichi and a "optional evacuation if desired region" would have been established up to 250km from that site. This "worst case scenario" was initially withheld as confidential information but then later disclosed in response to a citizen's request for access to public information (Kondo Shunsuke "A Sketch of Contingency Scenarios for the Fukushima Daiichi Nuclear Power Plant" [In Japanese] http://www.asahi-net.or.jp/~pn8r-fjsk/saiakusinario.pdf)

[10] For example, Unit 2 was brought into a state of crisis because efforts to shut down the reactor were slowed as a result of damage to the lines for injecting core cooling water and those for containment vents caused by explosions at Units 1 and 3.

[11] Such 'chain reactions' were not limited to the Daiichi station site. That site is located only 12km from Fukushima Daini and, if the crisis at Daiichi had progressed further and a large amount of radiation had been emitted then it would have become difficult to continue cooling operations at the second power station, thus leading to the possibility of a chain reaction between power stations. This is suggestive of the grave risks of placing nuclear power plants in close proximity. It should also not be forgotten that the power grid of the Daini power station itself had been damaged and that cooling functions were temporarily paralysed there.



(Map created based on the press report published on 25 November 2011 by MEXT "Readings of aerial monitoring conducted by MEXT in Aichi Prefecture, Aomori Prefecture, Ishikawa Prefecture and Fukui Prefecture" available at http://radioactivity.nsr.go.jp/ja/contents/5000/4900/24/1910_1125_2.pdf)

Figure 1.1 Distribution of caesium from the Fukushima Daiichi Nuclear Power Plant Accident
Total amount of Caesium 134 and 137 deposited (Bq/m^2).
Data based on aerial monitoring in 22 prefectures conducted by MEXT from April to October 2011.

1-1-3 Widespread contamination of land and sea, many people lose their homes and communities

Large amounts of radioactive materials were dispersed through the atmosphere. Roughly 90% of these emissions were carried east by the prevailing winds and into the Pacific Ocean. The remaining 10% fell on land, contaminating a large swath of eastern Japan (see **Figure 1.1**). Additionally, groundwater intermingled with contaminated water that had been used to cool the reactors, thereby doubling the volume of the contaminated water. This contaminated water then spread even further through underground leakages and has, indeed, now even reached the sea (see sections 2-1-2 and 2-3-1). Although three years on from the accident, the natural decay of caesium 134, which has a half-life of 2 years, has reduced the amount of radioactive contamination on land, caesium 137, which has a half-life of 30 years, remains and cannot be expected to disappear by decay except in the long-term. Additionally, since caesium can be physically transferred by wind and rain, it is imperative that the formation of potential new sites of concentration is closely and carefully monitored.[12]

Table 1.1 presents data pertaining to atmospheric emissions for each of the most representative radionuclides (i.e. iodine, xenon, caesium, and strontium) as estimated by various organisations. The important point to be noted here is that these values greatly vary depending on the agency conducting measurements, with the caesium emission estimates of the central government and TEPCO standing out as markedly low.

As a result of the widespread diffusion of radioactive materials, a wide area has been rendered unsuitable for inhabitation. The livelihoods of individuals engaged in primary industries have been destroyed as a result of the contamination of their agricultural fields and kitchen gardens, the base of their productive activities, by radioactive materials. Over 200,000 people (including voluntary evacuees) were forced to temporarily evacuate their beloved towns, villages and soils. Most were forced to live as long-term evacuees or to move permanently to a new location to attempt to rebuild their lives from scratch.

At present, more than three years after the disaster began, more than 134,000 individuals from Fukushima Prefecture have sought evacuation or relocation, including 48,000 who have evacuated outside the prefecture, 86,000 who have evacuated within the prefecture, and 28,000 still residing in temporary shelters.[13] In addition to these figures from Fukushima, it is also estimated that the number of individuals from outside Fukushima Prefecture who have evacuated or relocated number in the tens of thousands.[14]

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[12] In October 2013, mushrooms over the 150Bq/kg limit for caesium 137 were discovered in Ajigasawa, Aomori Prefecture and shipments were restricted (Ministry of Health, Labour, and Welfare: http://www.mhlw.go.jp/stf/houdou/0000024859.html). Since caesium 134 was not detected, this caesium was thought not to be from the Fukushima accident but rather from atmospheric nuclear testing or Chernobyl. Caesium deposited on the slopes of sites such at Mt. Iwaki will be physically transferred over a long period of time, meaning that the formation of new hotspots is a possibility. Radioactive contamination of the soil in the regions of Kanto, Koshin and Tohoku resulting from the Fukushima nuclear accident will continue for decades. Through the various complex mechanisms of the natural environment, radioactive materials will shift into new contamination distributions, and it can be expected that high concentrations of contamination will be found in mushrooms and wild edibles. Close attention and monitoring must not be neglected.

[13] Figures based on Fukushima Prefecture "Bulletin on the Damages from the 2011 Greater East Japan Earthquake" [In Japanese]. http://www.pref.fukushima.lg.jp/sec/16025b/shinsai-higaijokyo.html (section 1157, 28 March 2014). These figures represent only cases where individuals are receiving support or have registered as evacuees. However, since there are many cases where individuals are neither receiving housing support nor have registered as evacuees, these people are not counted by the government's "evacuation figures". [See the "update at the time of translation" in 0-2 for some updated figures.]

[14] Regarding estimates for the number of people who have relocated or evacuated from outside Fukushima Prefecture, government estimates are unavailable because public housing assistance was aborted early on. Geographically, they have come from Iwate, Miyagi, Ibaraki, Tochigi, Gunma, Saitama, Chiba, Tokyo and Kanagawa. In Yamanashi, Kyoto, Osaka, Okayama, and Fukuoka, where private organisations and associates have provided relocation and evacuation assistance, it has been reported that evacuees from the Tokyo area outnumber those from Fukushima. However, it is exceedingly difficult to accurately investigate the actual numbers. See Hayao, T. (2014). The state of nuclear accident evacuees and "evacuation rights" [In Japanese]. *Impaction*, 194, 9-13.

Table 1.1 Estimation of release of radioactive materials discharged from Fukushima Daiichi into the atmosphere

Unit: petabecquerel (PBq) = 1000 trillion Becquerel (10^{15} Bq)

	Agency/published date		Iodine 131	Xenon 133	Caesium 134	Caesium 137	Strontium 89	Strontium 90
1	Nuclear and Industrial Safety Agency: NISA (estimates)	12 April 2011	130	—	—	6	—	—
2	TEPCO	24 May 2011	500	—	10	10	—	—
3	Nuclear Safety Commission: NSC	12 April 2011	150	—	—	12	—	—
4	Chino *et al.* (Japan Atomic Energy Agency: JAEA)	2011	150	—	—	13	—	—
5	Nuclear and Industrial Safety Agency: NISA (estimates)	20 October 2011	160	11,000	18	15	2	0.14
6	Institut de radioprotection et de sûreté nucléaire: IRSN [France]	22 March 2011	200	2,000	30 (both combined)		—	—
7	Aoyama M *et al.* (Meteorological Research Institute)	2012	—	—	15-20	15-20	—	—
8	Stohl A *et al.* (Norwegian Meteorological Institute)	2011	—	170	—	37	—	—
9	[cf.] Release in Chernobyl	1993	1500	4400	48	89	—	7.4
10	[cf.] Release in Hiroshima after the atomic bombing	1993	52	140	—	0.1	—	0.085

Note: "—" indicates that there were no data available in the source materials. It does not indicate that the release was zero. Figures are approximate. They are obtained from different materials where original figures indicated different effective digits. The figures are converted to PBq (e.g., $2*10^{17}$Bq > 200Bq).

1 and 3 "Application of INES (International Nuclear Events Scale) on Fukushima Daiichi Nuclear Power Plant Accident caused by the Great East Japan Earthquake" [in Japanese], News Release, METI, 12 April 2011

2 "Estimated release of radioactive materials into the atmosphere caused by the Fukushima Daiichi Nuclear Power Plant" [in Japanese], TEPCO, May 2012

4 Masamichi CHINO et al. (2011) Preliminary Estimation of Release Amounts of ^{131}I and ^{137}Cs Accidentally Discharged from the Fukushima Daiichi Nuclear Power Plant into the Atmosphere. *Journal of Nuclear Science and Technology*, 48 (7):1129–1134

5 "About the partial errors regarding the data published on release of radioactive materials" [in Japanese], METI, NISA, 20 October 2012

6 IRSN (2011) "IRSN publishes assessment of radioactivity released by the Fukushima Daiichi Nuclear Power Plant (Fukushima I) through 22 March 2011", *Information Report*, IRSN. 22 March 2011. http://www.weatheronline.co.uk/daten/weathernews/fukushima/docs/irsn_fukushima-radioactivity-released-assessment-en.pdf

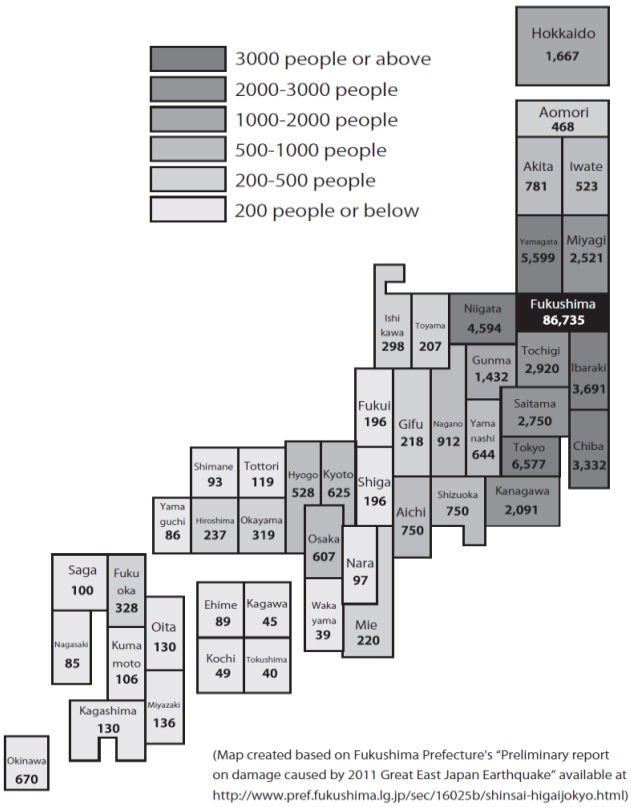
7 M. Aoyama et al. (2012) North Pacific distribution and budget of radiocesium released by the 2011 Fukushima nuclear accident, Presented at a workshop "Reconstruction of the Environmental Release and Dispersion Process of Radionuclides due to the Fukushima Daiichi Nuclear Power Plant Disaster", http://nsed.jaea.go.jp/ers/environment/envs/FukushimaWS/

8 A. Stohl et al. (2011) Xenon-133 and caesium-137 releases into the atmosphere from the Fukushima Dai-ichi nuclear power plant: determination of the source term, atmospheric dispersion, and deposition. *Atmos. Chem. Phys.*, 12, 2313–2343, http://www.atmos-chem-phys-discuss.net/11/28319/2011/acpd-11-28319-2011.html

9 and 10 SCOPE 50 (1993) Radioecology after Chernobyl - Biogeochemical Pathways of Artificial Radionuclides, http://www.scopenvironment.org/downloadpubs/scope50/

[Update at the time of translation: Please be reminded that the above figures are atmospheric emissions only. Apart from these, there are huge radioactive discharge to the sea, which was not the case in Chernobyl and constitutes one of the most serious environmental hazards of the Fukushima accident. According to the California Coastal Commission's repor (30 April 2014), the amounts of Cs-134 and Cs-137 released into the atmosphere are estimated 16.5-50 PBq and 6-50 PBq, respectively (i.e. not wildly different from the estimations given in the Figure above) whereas the amounts of direct discharge to ocean are estimated 4-40 PBq and 3.6-41 PBq, respectively. California Coastal Commission (2014) Report on the Fukushima Dai-ichi Nuclear Disaster and Radioactivity along the California Coast. http://documents.coastal.ca.gov/reports/2014/5/F10b-5-2014.pdf. Also note that there is also fallout of atmospheric emission onto the sea.]

Figure 1.2 Distribution of evacuees from Fukushima Prefecture
(as of February 2014)



(Map created based on Fukushima Prefecture's "Preliminary report on damage caused by 2011 Great East Japan Earthquake" available at http://www.pref.fukushima.lg.jp/sec/16025b/shinsai-higaijokyo.html)

Figures 1.3 Temporary housing in Iizaka Town
Kitakansen Daiichi Temporary Emergency Housing where 350 evacuees from Namie Town reside. Photo taken by Hideki Ishii on 28 March 2014.

Evacuees from Fukushima Prefecture are spread throughout every prefecture in Japan. They can be found residing in 860 municipalities[15], or over half of all the administrative districts in the country. While some local administrations initially offered evacuees generous support for housing and health care, many of these "emergency measures" were aborted after two or three years.[16]

1-1-4 Protection of residents from early-stage radiation exposure failed, many later exposed and subjected to serious health risks

While the first explosion occurred on 12 March at 3.36pm, many people went into voluntary evacuation immediately after the initial earthquake, expecting some sort of nuclear accident. Since the earthquake heavily damaged roads and bridges, movement through the area was difficult. The number of roads in these mountainous districts is highly limited and the roads that do exist are narrow and winding. It was extremely difficult for people to quickly evacuate under such conditions (see section 4-8). In the town of Namie, over half of the town's 21,000 residents sought to evacuate. Roughly 8,000-10,000 of these evacuees headed away from the Fukushima Daiichi Nuclear Power Plant towards the Tsushima District of their town. However, the radioactive plume (radioactive cloud) emitted from Fukushima Daiichi spread in a northwesterly direction, covering the Tsushima district with such high concentrations of contamination that it would eventually be designated as a "difficult-to-return zone". Since residents were not provided with appropriate information, they evacuated into an area with high levels of radiation and were heavily exposed as a result.[17]

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[15] Data obtained by Fukushima Prefecture through the Japan Anti-Tuberculosis Association (JATA). The data was provided to CCNE by courtesy of Japan Medical Association Research Institute (JMARI) on 6 February 2014 (see section 1-4-4).

[16] Volunteer evacuees are predominantly mothers and children. Such split-family living arrangements (where the husband remains in the original home) place great strain on household budgets, and while there are cases where evacuees have been forced to return there are also cases ending in divorce. There are many who, while struggling with feelings of guilt towards relatives and acquaintances left behind, feel they very strongly that they can no longer return.

[17] The local government of Namie Town received no information about evacuation. Some residents have testified that they could not hear announcements from car loudspeakers and were not provided with information about evacuation routes (from an interview with an evacuee from Namie Town living in Motomiya City conducted by Ruiko Muto on 18 February 2014).

In the Oguni District of Date City, a district where many households were later designated "Specific Spots Recommended for Evacuation" (*Tokutei Hinan Kansho Chiten* in the Ministry of Environment terminology)[18], damage from the earthquake was minimal and residents initially breathed a collective sigh of relief. However, between late March and early April 2011, residents of Oguni district began to learn that radioactive contamination levels in the area were remarkably high (see section 1-5-1). Despite the extremely intensive siting (10 nuclear reactors on the Fukushima coast), there was no system in place for emergency radiation monitoring across a wide area and analysis of the distribution of radioactive contamination after the accident was extremely delayed. Yet while the system for measuring radiation was inadequate, even the extremely valuable data that was collected was only made public after the government began to mention the possibility of meltdowns. In the disaster stricken areas, many people, including infants and children, spent long periods of time outdoors to secure gasoline and water. If the necessary information had been made public and proper measures taken, this unnecessary exposure in the days immediately after the accident could have been avoided.[19]

Government authorities had long insisted that, in the case of a nuclear accident, SPEEDI (System for Prediction of Environment Emergency Dose Information) would enable radioactive material dispersal simulations to be quickly conveyed to the public and for instructions on emergency indoor shelter and evacuation orders to be issued. Although SPEEDI began operating two hours after the earthquake and data were available to the central government and Fukushima prefectural government from an early stage, this data was not released to the public until after 23 March 2011. The fact that this systematic concealment of information led to increased radiation exposure must not be forgotten (see section 4-8-2). In the case of Iitate Village, predictions of contamination were confirmed by SPEEDI, but evacuation orders were delayed by three weeks, and it was not until July that evacuation was completed (see section 1-5-1)[20].

A press conference was held by civic groups after volunteer-based radiation monitoring initiated by residents in Fukushima City and Kawamata Town revealed shocking levels of radioactive contamination in the playgrounds of schools and day care centres. A subsequent emergency investigation conducted early the following month (i.e. April 2011) by the Fukushima Prefecture administration revealed that schools, kindergartens and other childcare facilities across a wide region outside of the designated evacuation zones were highly contaminated. However, since the Fukushima Prefectural Board of Education did not alter the school restart plan that it had decided prior to the disclosure of these results, many children were forced to return from their evacuation sites to join their classmates when schools reopened in the second week of April. Some schools even resumed regular outdoor activities as soon as the term began. At this time Shunichi Yamashita, then the Health Risk Advisor for Fukushima Prefecture, led a radio campaign proclaiming that "masks are unnecessary". This created an atmosphere in which people hesitated to wear masks from fear of drawing criticism from those around them.

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[18] Radiation levels are high even outside the designated evacuation areas, including cases where additional exposure for residents is expected to be greater than 20mSv annually. However, the specification and removal of evacuation orders (in the name of "recommended evacuation advisories") has been criticised as unilateral and arbitrary (see the columns in section 1-5-1 "The Case of Fukushima City Watari District," and "The Case of Oguni District in Date City".

[19] Arakida, T. (2012). "Reports after the Fukushima nuclear disaster" [In Japanese], *Rekishi Hyoron*, 750, 46-65. Emergency iodine supplied to the area around the nuclear power plant and Fukushima Prefecture more generally went almost completely undistributed. However, it was later ascertained that it had been distributed to staff at the Fukushima Medical University and their families. Further, the fact that even babies were present in the queues for water supplies is attributed to distribution being limited e.g. to 10 litres/person.

[20] For detailed information on the conditions of contamination and resident exposure in Iitate village, see Imanaka, T & Iitate Village early radiation exposure evaluation (2014). "Estimates of the amount of early external radiation exposure among residents of Iitate Village" [In Japanese]. *Science*, 84(3), 322-330.

Essentially, there is almost no accurate data for determining the degree of early-stage exposure suffered by residents during the days after the initial accident. The cumulative dose data collected by the Ministry of Education, Culture, Sports, Science and Technology (MEXT) for each area does not include any data for the first eight days after the accident, the period when contamination was most serious. Accordingly, identifying the amount of exposure during these early days remains a pressing task.[21] The Fukushima Health Management Survey (see section 1-4-4) has already identified 33 confirmed cases of thyroid cancer and 41 suspected cases in children under 18. [Update at the time of translation: As of February 2015, the figures increased up to 86 confirmed cases and 23 suspected cases. The survey is continuing and it is quite likely that many more thyroid cancer patients will be identified.] It is impossible to conclude that these cases are unrelated to the Fukushima nuclear accident.[22] Additionally, in Miyagi Prefecture, significant increases of patients with peptic ulcer bleeding have also been reported.[23] Furthermore, cardiovascular diseases such as stroke, heart failure, myocardial infarction and angina pectoris have also significantly increased in Miyagi Prefecture, and it has become clear that such epidemiological trends have not been reported in previous post-earthquake epidemiological studies.[24] It is also not possible to deny the potential for increases in other symptoms and diseases (see section 1-4-2).

As a result of the relaxation of the pre-accident limit of 100 Bq/kg, waste containing 8000 Bq/kg can now be burned in incineration centres, and the Minsitry of Environment is also establishing facilities for incinerating waste over 8000 Bq/kg without providing adequate explanation to local residents (see section1-6). The dispersion of caesium from these incineration facilities has not been adequately investigated or explained and residents are unable to ease their fears about additional exposure.

1-1-5 Various forms of social conflicts and divisions have arisen

Various forms of social conflicts and divisions have occurred as a result of radioactive contamination. It has become clear that "radioactive materials do not only damage cells and tissues and split DNA strands, they also cause great damage by severing human relations, wounding the fabric of local societies and threatening human dignity". [25]

The question of whether to evacuate or stay put forced family members to prioritise either their work or family life, resulting in deep conflicts and internal tensions. Likewise, individuals, neighbours and different generations held differing views on how to come to terms with and deal with the effects of radioactivity, leading to a worsening of interpersonal relations. It should be emphasised that the radioactivity safety campaigns led by so-called "experts" have served to further these conflicts and divisions. As a result of the evacuation of many mothers with young children, families have frequently been divided. Even now, three years after the accident, there are many people outside the designated evacuation zones who would like to

[21] The thorough investigation by Imanaka et al. in Iitate Village, noted above, is not only valuable as data, but also for its methodological insights. This is because it proves that this type of investigation can only be conducted with the trust of residents.
[22] While the Review Committee explains these statistics as a result of the "screening effect", after detailed and thorough investigations Toshihide Tsuda (epidemiology professor at Okayama University Graduate School of Environmental and Life Science) points out that the significant inner- and intra-prefectural differences cannot be explained by the screening effect. (Tsuda, T. (2013). "Rates of thyroid cancer according to the 12 November 2013 review committee of the Fukushima Health Management Survey" [in Japanese] *Kagaku* 83(312), 1401-1402)., Tsuda, T. (2014). "Summary of thyroid cancer screening according to the February 7 2014 review committee of the Fukushima Health Management Survey" [in Japanese] *Kagaku* 84(3), 279-283.
[23] Report of Dr Takeshi Kanno (Tohoku University Department of Gastroenterology) at the 98th Annual Meeting of the Japanese Society of Gastroenterology (JSGE) April 2014.
[24] Report of Dr Hiroaki Shimokawa (Tohoku University Department of Cardiovascular Medicine) at the 76th Annual Meeting of the Japanese Circulation Society (JCS) March 2012.
[25] Statement made by a participant at a discussion forum held by CCNE on 13 January 2014 in Koriyama city, Fukushima.

evacuate if possible[26], and there are also people in areas where evacuation orders have been lifted who still do not want to return (see section 1-5-3, footnotes 93 and 95). The conflicts and tensions continue to deepen.

While struggling to respond the disaster, dissatisfaction of local residents grew and significant tensions have formed between residents and local government. While many evacuees received a warm reception upon arrival in other prefectures, there have been cases of discrimination and inhospitality, leading to new fears and worries for the evacuees. At the same time, while continuing to live in the affected areas, many young people fear possible future stigmatisation. During the chaotic period after the initial accident, distribution channels for agricultural and industrial products from Fukushima were shut off and even now these channels have not been fully restored.[27]

The central government and local administrative bodies are encouraging residents to remain in the affected areas. Moreover, in areas that were deemed uninhabitable due to radioactive contamination after the initial accident, the government is encouraging residents to continue to plan to return to their homes after radiation levels have lowered (see 1-5-4). As planning for reconstruction of the affected areas continues, conflicts have arisen among residents and between residents and government officials over various issues, including decontamination and disposal, returning or not returning to affected areas and the amount of damages to be paid. Even amidst this tense situation, and even while residents' fears have not been dispelled, plans for returning evacuees to their homes continue to be "accelerated" (i.e. strongly promoted by the Government). Schools have resumed daily instruction at their original locations, and there are children who must commute to school by bus from their evacuation site. When evacuation orders are lifted compensation for mental stress is discontinued. However, the fact is that there are cases where evacuees' houses have been damaged by the earthquake, have become rat infested or reduced to an unliveable state. Younger generations are concerned about their children and jobs and many are acquiring homes near their evacuation destinations. With vital communal functions and services impaired in the evacuated areas, it will be impossible to re-inhabit these areas if only the elderly return. Stranded in temporary housing, unable to tend their fields, and having little option but to purchase all of their food from shops, evacuees are exhausted both mentally and physically, and the number of people falling into states of depression is increasing.

It is not only the municipal governments that are on the verge of collapse but very fabric of the local community itself. Although it is known from other cases of environmental pollution that strained social relations amplify the impacts of a disaster, in the case of a nuclear disaster a rift forms between people and their very place of residence.

[26] e.g. Asahi Shimbun survey from September 2011, Fukushima City survey from May 2012, and the Tokyo Disaster Relief Net Survey from September 2013. [Update at the time of translation: The tendency seems to continue with some decline. In the poll conducted by the Fukushima City administration in May 2014 (results published in November 2014), 23.8 % of the responding Fukushima City residents replied they would still like to evacuate if possible. The percentage was 33.7% in the city's 2012 survey.]

[27] Immediately after the nuclear accident school lunches in Fukushima were made from food products from outside the prefecture, but after two years almost all schools returned to using products from Fukushima. Some prefectural and municipal legislators have sought to dispel notions of "damage caused by harmful rumours or misinformation". Farming families struggling to continue farming and to provide safe products are caught between the reality of possible contamination and the wish to deny it. Concentrating the burden of these contradictions on agricultural producers is a serious problem (see section 1-7).

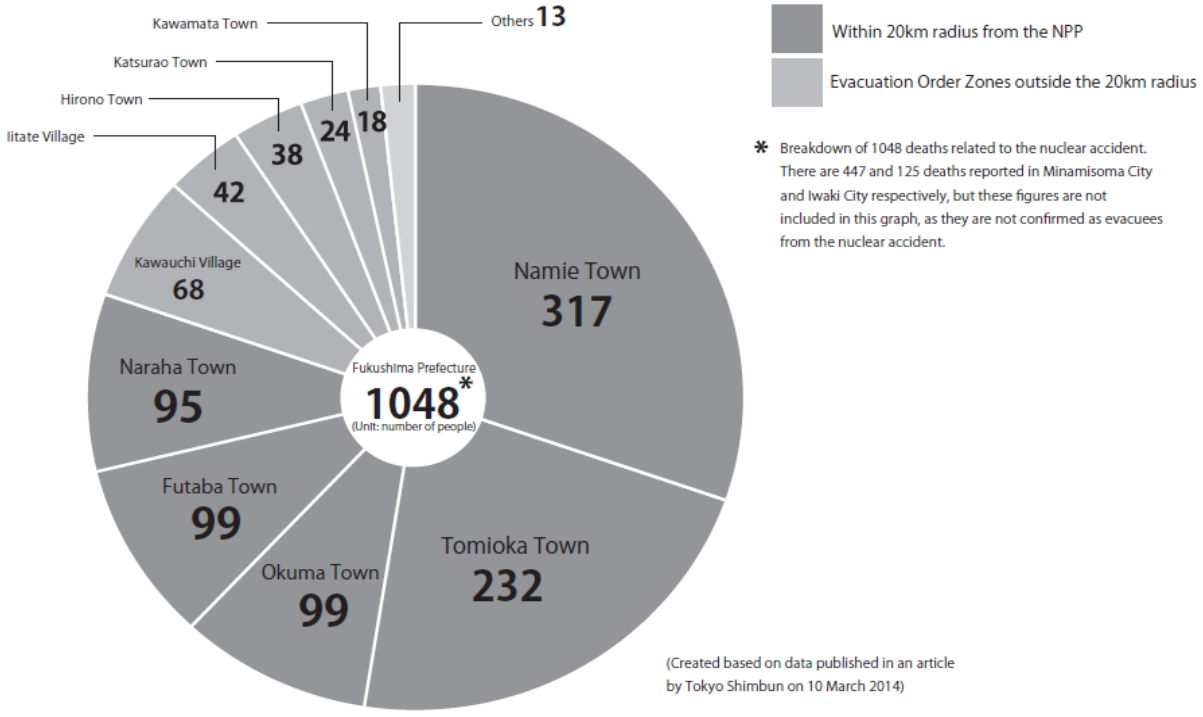


Figure 1.4 Nuclear accident-related deaths toll by municipality (Fukushima Prefecture)

1-1-6 Many nuclear accident-related deaths and suicides have occurred

The health risks brought by a nuclear disaster are extremely varied and manifest in irregular and complex ways. In addition to health risks from radiation exposure, extraordinary situations like evacuation place tremendous burdens on mind and body. The resultant sudden and forced changes in interpersonal relations and lifestyle can have negative health effects, as exemplified most painfully by the case of nuclear accident-related deaths. Although it is impossible to overstate the health risks of radiation and the need for continuing treatment, it is necessary to view and understand the health risks of a nuclear accident from a broad vantage point and to comprehensively improve health and welfare services (see section 1-4).

According to statistics from Fukushima Prefecture, as of 19 February 2014 the number of deaths recognised as resulting from evacuation and thus recognised as "earthquake-related" deaths eligible for disaster condolence money totals 1,656.[28] Around 90% of these deaths occurred in the 12 municipalities located within 30km of the Fukushima Daiichi nuclear power plant. **Figure 1.4** shows the number of the cases where the death clearly resulted from having to escape from the nuclear accident (hereafter "nuclear-accident-related deaths") in those 12 municipalities. [Update at the time of translation: As of 21 February 2015, the figure nearly doubled to 1,862 certified cases plus 46 disputed cases (Fukushima Minpo, 22 February 2015). The steep increase is largely due to the addition of Minamisoma City and Iwaki City cases that were not included in the March 2014 count (see the note in **Figure 1.4**).] Looking at **Figure 1.5** we can see that earthquake-related deaths are much higher in Fukushima, than in Miyagi or Iwate prefectures, and nuclear-accident-related deaths account for the majority of these deaths. Indeed, in Fukushima nuclear accident-related deaths outnumber the 1,607 deaths that occurred in the immediate disaster, caused mainly by earthquake and tsunami. There is also, unfortunately, no end in sight to suicides by those who have lost homes and livelihoods, and some of these cases have gone to trial. Although the number of disaster-related

[28] Nihon Keizai Shimbun February 20, 2014. On the subject of "nuclear accident-related deaths see also the Tokyo Shimbun of March 10, 2014.

suicides is decreasing in Iwate and Miyagi prefectures, the graveness of the situation in Fukushima is represented by the fact that disaster-related suicides are increasing there annually (**Figure 1.6**) (see section 1-1-7).[29] [Update at the time of translation: For the year 2014, the numbers of the disaster-related suicides were 3 in Iwate, 4 in Miyagi and 15 in Fukushima (Cabinet Office: Office for Policy of Suicide Prevention, monthly release, 10 February 2015).]

We must also not overlook the indirect effects stemming from the alterations of lifestyle and life plans. Isolation and division stemming from different perceptions of radioactivity, stress from living apart from family, stress and declining physical strength from being unable to play and exercise outdoors should be seen as very serious. Particularly enormous is the psychological blow stemming from the loss of livelihood and ancestral homelands as well as the loss of any prospect of setting plans for the future.

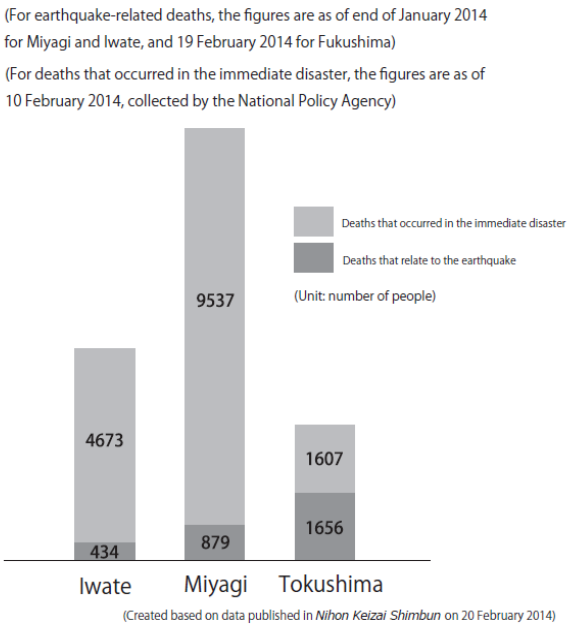


Figure 1.5
Comparison between earthquake-related deaths and deaths that occurred in the immediate disaster in three Prefectures

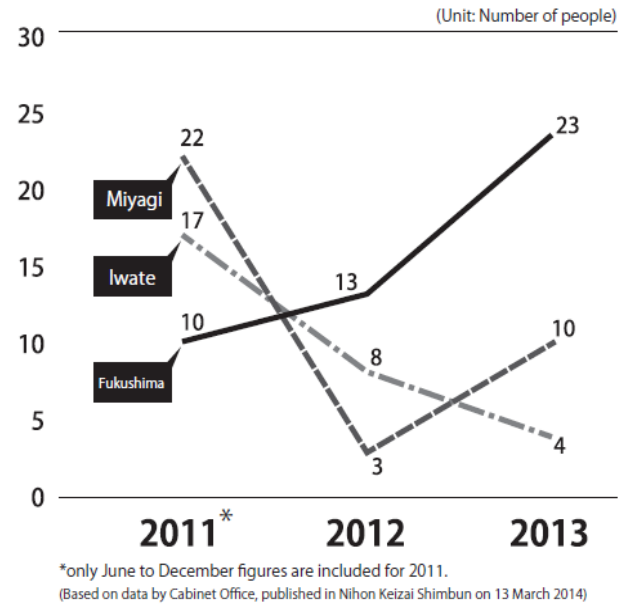


Figure 1.6 Number of disaster-related suicides in three prefectures from 2011 to 2013

1-1-7 Loss of the critical infrastructure underpinning daily life has wounded human dignity

As a result of radioactive contamination of the communities they long inhabited, people lost in one fell swoop the irreplaceable infrastructure that has underpinned daily life. Everything was radically altered as livelihoods were ripped away, essential human ties were weakened, and opportunities for work became severely limited. In some cases these alterations have stolen away the point of living and the roots that supplied the strength to live.

A man evacuated from Yamakiya district of Kawamata Town experienced the following.

> "From the day of the disaster until her suicide three and a half months later, [my wife] Hamako was not the same person she had been before the accident. Although she did not receive a medical examination, her changed state was recognised by her husband Mikio, who was always spending time with her. Hamako had always been a sociable person, and her laughing figure was a taken-for-granted presence in Yamakiya. After we evacuated her smile

[29] Nihon Keizai Shimbun (aka Nikkei), 13 March 2014.

> vanished and she lost weight. When she went shopping she would have difficulty deciding what food or clothes to purchase. She could not become accustomed to the evacuation site and became extremely self-conscious with the unfamiliar people around her. Odd behaviour and symptoms that were simply unimaginable before the accident began to appear one after another. (...)
>
> We were married for 38 years. As childhood friends who attended the same preschool, we had lived in close proximity for 60 years. We were planning to spend our old age in Yamakiya, the place where we were born and raised, but the nuclear accident destroyed it. Our happy life together as a family has been ripped away by the worst conceivable turn of events, my wife's suicide." [30]

A male nurse from Koriyama who evacuated to Aomori prefecture told of the following experiences.

> "Calling it an 'evacuation' makes it sound more smooth and easy than it has been. I had to search for housing and a job in a new place completely unfamiliar to me. For that reason, my wife and children went to Aomori City ahead of me. I remained in Koriyama City from March until August but made the trip to Aomori once a month. Leading this 'double life' greatly increased our expenditures. Then, since my wife and became less able to take each other's feelings into account, we began to frequently quarrel during our phone conversations. While preparing to evacuate, my father and I began to quarrel over whether it was the right decision or not. It wasn't that my father or myself was wrong about evacuation. But yet we sadly ended up in a dispute over it. For my father, it must have been quite saddening to see me, his eldest son, leave our family home and community behind. They were also, I think, very sad that they could not see the face of their recently born, and only, grandchild. In early May [Children's Day holiday in Japan], my parents put up koi (carp)-shaped streamers [as traditional symbols of health and power for young boys], but there was not a child in sight. The sight of that sad streamer is still burned into my eyelids. Having to evacuate was so painful that there were times when I cried in secret."[31]

1-1-8 Stabilisation of the situation is not on the horizon

What amplifies the troubles of the disaster victims is that, even three years on from the accident, stabilisation of the situation is not on the horizon and is now expected to take an exceedingly long time (see Chapter 2). A nuclear disaster entails large amounts of radioactivity being emitted, and heat and radiation being continually released over a long period. Said differently, a "nuclear fire" is a fire that cannot be easily extinguished.[32] Accordingly, if the nuclear facilities and reactors involved in an accident are not continually cooled, then there is a possibility of a meltdown reoccurring.[33] Even if radioactivity leakages from the reactor can be

[30] Fukushima Minpo March 19, 2013. "Nuclear accident-related deaths" [In Japanese] (24) [Update at the time of translation: Hamako's husband filed a compensation lawsuit against TEPCO, whose lawyer dared to claim that the suicide had resulted from Hamako's "personal weakness". In the September 2014 ruling, the court found TEPCO liable and said that Hamako had committed suicide in her agony caused by the nuclear accident.]

[31] The Complainants for Criminal Prosecution of the Fukushima Nuclear Disaster (Eds). 2013. *And still no investigation of their crimes! The statements of 50 The Complainants for Criminal Prosecution of the Fukushima Nuclear Disaster* [In Japanese]. Friday p.27-28.

[32] Takagi, J. (2012). *The principles of science and the principles of people: humans have stolen heaven's fire, but there is no life near that fire* [In Japanese]. Hojodo Shuppan. (transcript from presentation in Kanazawa City February 1991).

[33] Accident in which due to insufficient cooling of reactor core continues, or to abnormal power runup, fuel reaches its melting point and starts melting. There is a risk of such meltdown in spent fuel pools, if the cooling water is lost and the spent fuel that is stored there gets overheated. In the case of Fukushima Daiichi, the risk of meltdown is not as big as before, since it has been three years since the accident and decay heat for both debris (See Section 2-4) and spent fuel has been gradually coming down. Yet, it must be noted that strong aftershocks continue and possibility of any unpredictable occurrence cannot be cleared.

stopped, there remains a long-term risk of repeated releases of radioactivity from the reactor facilities to the surrounding environment. The accident cannot be said to have been resolved when the risk of re-criticality has become negligible, but only when the risk of further releases of radioactivity from the reactor facilities has been eradicated. The presence of this risk is one of the sources of anxiety that people in the affected areas are still fighting with and it is also one of the sources for the friction behind the issue of returning from evacuation.

1-1-9 A large number of workers are inevitably exposed to radiation

As a result of the Fukushima nuclear accident, workers at the Daiichi power station as well as disaster management personnel have been exposed to large doses of radiation, and this situation continues unabated today. As was revealed when the issue of contaminated water leakages at the power station was reported, large amounts of labour necessitating radiation exposure are required in high-radiation areas, and the need for such dangerous work will not be reduced by the current government and TEPCO's "Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Plant Units 1-4" (the so-called 'Decommissioning Roadmap')[34].

The Fukushima nuclear accident was early on declared an "exceptional case" and protective standards for workers attempting to stabilise the power station were relaxed.[35] Immediately following the accident the dose limit for workers was raised to 250 mSv. Even for those who started their work after November 2011,the dose limit for "emergency operations" of 100 mSv was applied (this special arrangement was repealed in April 2012). However, incidents occurring on the ground suggest that even these less stringent regulations are not being properly observed or complied with. Furthermore, not only is work at the crippled site subject to high levels of radiation exposure, it must also be conducted while wearing special protective clothing and full-face masks for long hours, even in the summer heat, resulting in gruelling and dangerous conditions for the workers. Cases of workers dying from heat stroke and heart failure have been reported. Decontamination work even in lower radiation level areas is a serious and long-term concern. Considering the extremely demanding and dangerous labor workers have endured, it is clear that they should, first, have the right to voluntary decide whether to engage in this work and, second, be guaranteed adequate treatment and health care. Yet these rights and services have not been afforded (see sections 1-6 and 2-6). What is of critical concern is that many such exposed workers must be continually secured to stabilise the power station over the following decades (see section 2-6).

1-1-10 Financial losses alone total hundreds of billions of dollars

Damage from the Fukushima nuclear accident (stabilisation, cleanup and reparations costs) already total at least 13 trillion yen[36], and will in the end probably amount to tens of trillions of yen. Since it is impossible

[34] If worker health and safety were to be prioritised, then a review of decommissioning schemes and the 'roadmap' is a must. These points are discussed in chapters 2 and 3.

[35] Nuclear and Industrial Safety Agency "On the Radiation Dose Limit for Radiation Exposed Labourers Engaged in Emergency Stabilisation Work" [In Japanese] March 15, 2011; Ministry of Health, Labour and Welfare "An Ordinance Amending the Ordinance Concerning the Special Exceptions Alterations to the Radiation Exposure Regulations to Respond to the Situation Caused by the Greater East Japan Earthquake of 2011" [In Japanese] 1 November, 2011.

[36] 4.9 trillion yen paid in damages, 2.7 trillion yen in accident stabilisation and decommission costs, 3.6 trillion yen in decontamination and intermediate storage costs, losses accruing from the cancellation of plans to build reactors 7 and 8 amount to .04 trillion yen, government expenses for reconstruction after the nuclear disaster (2011-2013) amount to 1.8 trillion yen, costs of dealing with water contamination amount to .5 trillion yen, giving a total of 13.1 billion yen (not including local government expenses). Based on estimates performed by Kenichi Oshima using the following sources: Committee for the Managerial and Fiscal Investigation of TEPCO "Commissioner's Report" 3 October 2011, TEPCO "Consolidated Financial Statements, March 2011", The 42nd Atomic Energy Commission materials, TEPCO securities report (2012) and Budget Reports as well as New Comprehensive

for TEPCO to cover the damages, the taxpayers of Japan are to be burdened for the very long term. The majority of these expenses will be inherited by today's youth and generations of not yet born. However, even if trillions of yen are paid for reparations and damages, this will only cover a portion of the total damages. It will probably be the case, as with Chernobyl, that the damaged reactors will not be dismantled or disposed of, but will rather be sealed off as best as possible and then subject to strict control and observation in the long term (see Section 2-5). This means that decontamination of the affected areas is likely to be insufficient. Moreover it must be noted that there is a possibility that, amidst the government's financial crisis and subsequent cost cutting measures, funding for repairs and damages will be cut off at an insufficient and halfway level. The passive stance of the government towards victims represents a foreshadowing of such a scenario.

1-1-11 Understimation of damages led to a delayed response and amplified the effects of the accident

The damage wreaked by the nuclear disaster has been enormous, and it is gradually becoming clear that the scale of the disaster is immeasurable. It will probably take decades for the full extent of the damage to become clear. However, even now, three years after the disaster, it has become painfully obvious that the breadth and depth of a nuclear accident are extraordinary.

However, the central government, TEPCO, the Fukushima prefectural government and a subset of "experts" have underestimated the damages from the accident, concealed reports suggesting the possible extent of damages, and delayed necessary measures all while hastily encouraging evacuees to return to their homes (see section 1-5). They have used the notion that information related to damages and risks would unsettle residents as justification for their omissions. However, it is the underestimation of damages, the concealment of information, and the delay of appropriate measures (including omissions), that is to say the central government's stance of "not investigating, not knowing, and not helping", that has itself caused the amplification of stress and unease for the victims of this disaster.

The developments after the Fukushima nuclear accident bring back bitter memories of the atomic bombing of Hiroshima and Nagasaki as well as the hydrogen bomb tests at Bikini Atoll. There, the perpetrators were determined to conceal information and underestimate the damages. The Fukushima disaster also brings back memories of the Minamata disease. There, analysis of what was happening and who was suffering was delayed, and the concealment of information about the difficulties that residents were experiencing resulted in amplification of the damage. Even now, the full extent of damage from the Minamata disease is not fully understood. The negligent behaviour on display at the atomic bomb sites, hydrogen bomb tests and Minamata are now being repeated at Fukushima. It is crucial that we question whether Japanese society has actually learned the lessons of these earlier examples.

It is imperative that the central government, TEPCO and experts conduct, along with scientific investigations, interviews with victims and site-based research and then release these reports to the public in the near term. Moreover these investigations must be conducted without preconceived assumptions. Regarding how the situation should be evaluated and what kind of measures should be taken, any decisions must be based on various viewpoints, public discussions involving experts and technicians from various backgrounds, as well as the opinions and viewpoints of the victims. Furthermore, it is imperative to promote resident-based evaluations of damage and policy proposals.

Special Business Plan 27 December, 2013 (there is a possibility of overlap).

COLUMN
Destruction of the five layers of the total environment: Structural damage from the nuclear power plant disaster

If you go and look at Futaba, Ohkuma, Namie and Tomioka Towns, from which all residents were forced to evacuate, you can see the vast, empty town and the collapsed buildings left just as they were after the earthquake of 11 March 2011. How, I wonder, can we grasp a situation where all these lives and livelihoods have been taken away? Let us consider, therefore, the characteristics of the damage from the nuclear power plant disaster as the collapse of the five layers of the total environment.

(1) The life system supported by the "five layers of the total environment"

In general, an individual's life is dependent on the surrounding environment, which consists of a number of layers. **Figure 1.7** shows the individual's life system made up of an environment enclosing five layers, namely the natural environment, the built environment, the economic environment, the social environment, and the cultural environment.

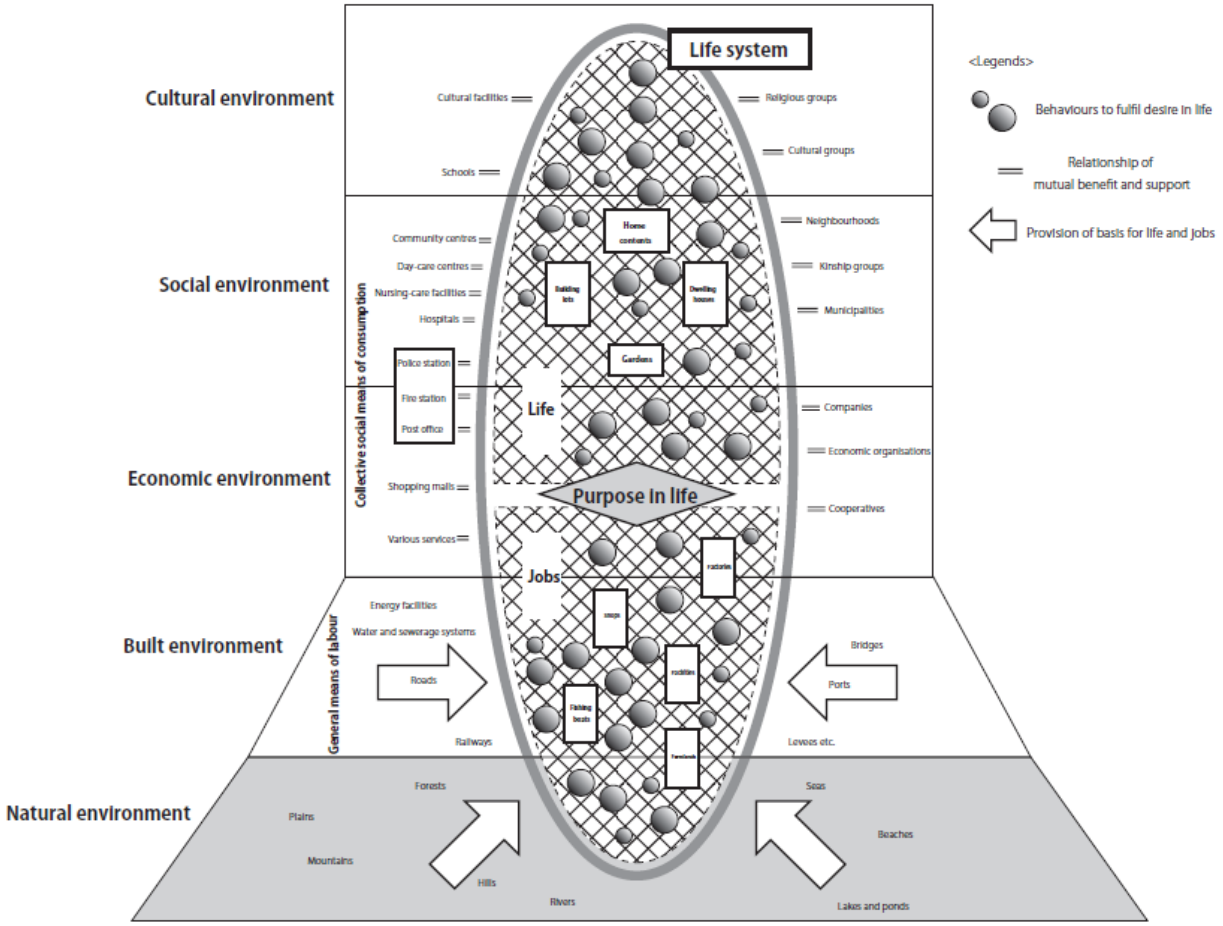
The **"natural environment"** includes all the elements that make up the natural world—mountains, plains, rivers, forests, seas, plants, animals, and so on. The natural environment forms the basis for the other four environments. The "**built environment"** is made up of all the artificially-constructed infrastructures of our collective economic and social activities—roads, bridges, railways, ports, electricity grids, and water and sewerage systems. The **"economic environment"** is constructed from facilities or organisations that allow economic activities, such as companies, cooperatives, financial institutions, shopping mall and office districts, to function. The **"social environment"** is made up of the variety of groups, organisations, and institutions that provide the basic conditions of social life. This layer consists of various groupings such as neighbourhoods, kinship groups, and groups of friends, as well as facilities such as city halls and hospitals. The post office, the police station and the fire station are parts of both the economic and social environments. The **"cultural environment"** is made up of all facilities and organisations that support cultural activities, such as education, the arts, and religion. Schools, libraries, museums, temples and churches are fundamental elements of the cultural environment.

Not only does the individual's life interact with the total environment that consists of these five layers, the former is also dependent on the latter. In other words, this five-layered environment is a *stock* (accumulated resources), from which properties and services that satisfy individuals' needs *flow*.

(2) Damage as destruction of the five layers of the total environment

The Fukushima nuclear power plant disaster contaminated a vast area with radioactive fallout, which led to the evacuation of hundreds of thousands of residents away from their home towns. The five layers of the environmental were destroyed in the Fukushima disaster zone, meaning that the system of action that met the needs of every person was completely demolished. **Figure 1.8** shows that all five layers of the human-life environment were disrupted by radioactive contamination, and that the capacity to fulfill the needs in everyday life became very weak.

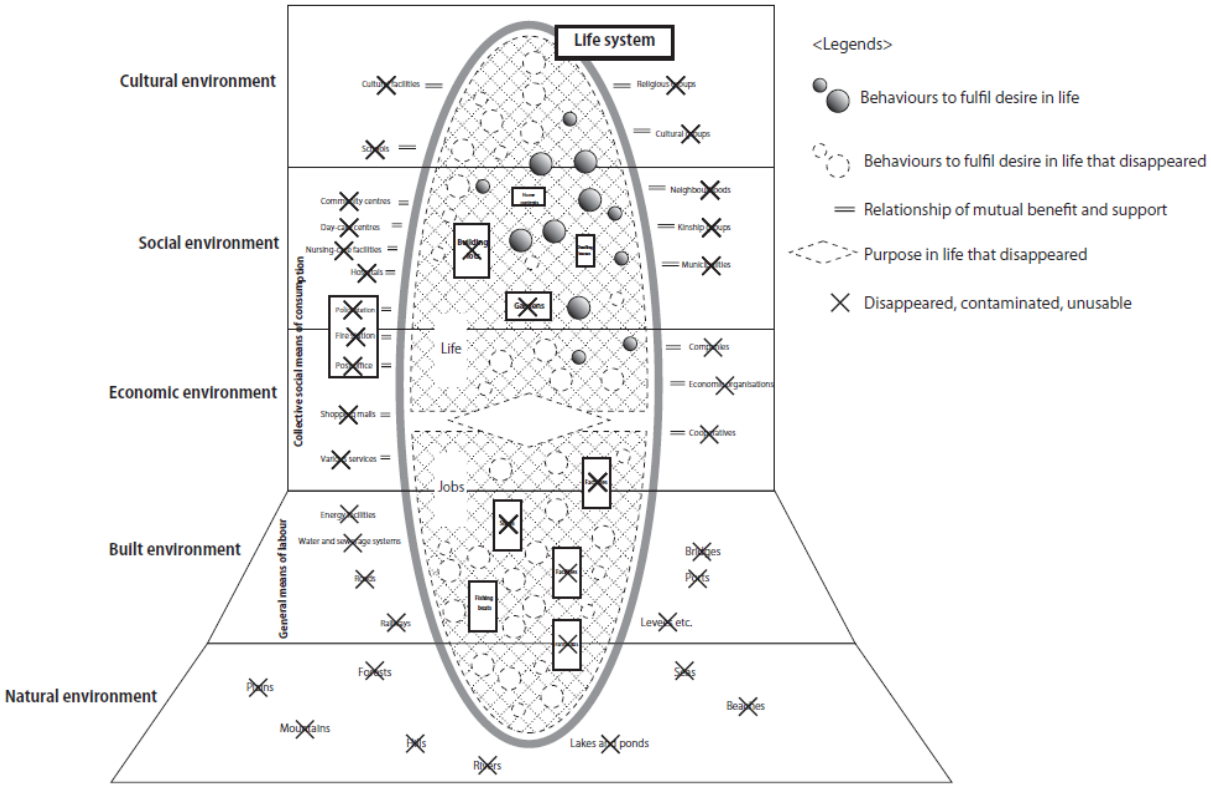
Figure1.7 Five layers of the total environment and the normal life system



What would be the significance of recognising this structural damage in assessing the appropriate compensation for such damage? Firstly, in terms of damage, at the same time as the flows of goods, services and income that had supported individual lives were cut off, it becomes apparent that the collapse of the human-life environment that forms the stock that supports these flows was also taking place. Therefore, the principle of restoring the five-layered environment is necessary as compensation for damage. Individual lives cannot be reconstructed on the basis of restoring the natural environment unless the other four overlapping layers are also restored. Secondly, the collapse of the five layers of the total environment as stock, signifies the demolition of the local community. Sociology sees society not as just a group of individuals but rather as the "emergent properties" they possess. Thus, viewed sociologically, the damage is not simply at the individual level. In the sense that if these emergent properties are removed due to the local community being demolished and ceasing to function, then the damage is present at the very level of society itself. It should be understood that damage is not only the loss of property or income at the individual level, but the demolition and dysfunction of the local community itself. Therefore, thirdly, at the same time as compensation is given at the individual level, there is a need for compensation at the community level. That is, the reproduction of the local community. For individuals, that signifies recovery of the five layers of the human-life environment. In other words, the reconstruction of individual lives and regeneration of the local community are inseparably related. These must be the premises of appropriate policy measures for damage compensation. The various actors that are responsible for the occurrence of the seismic-nuclear disaster, in particular TEPCO and the government, should bear the dual obligation of compensation to both the local community and to individuals. In addition, from time perspective, the obligation for this

compensation should continue over the long period that will be necessary for the five layers of the human-life environment to be restored.

Figure 1.8 Destruction of five layers of the total environment and dissolution of life system thereby



(FUNABASHI Harutoshi)

[Updated at the time of translation: Prof. Funabashi, the founding Chair of CCNE, passed away in August 2014.]

1-2 THE PRINCIPLES UNDERPINNING THE "RESTORATION OF HUMANITY"

The previous section identified the full extent and particular characteristics of the damages resulting from the Fukushima nuclear disaster. This section discusses nuclear disaster recovery from the perspective of the "restoration of humanity", and sets out the principles that underpin and define this approach.

1-2-1 What is the "restoration of humanity"?

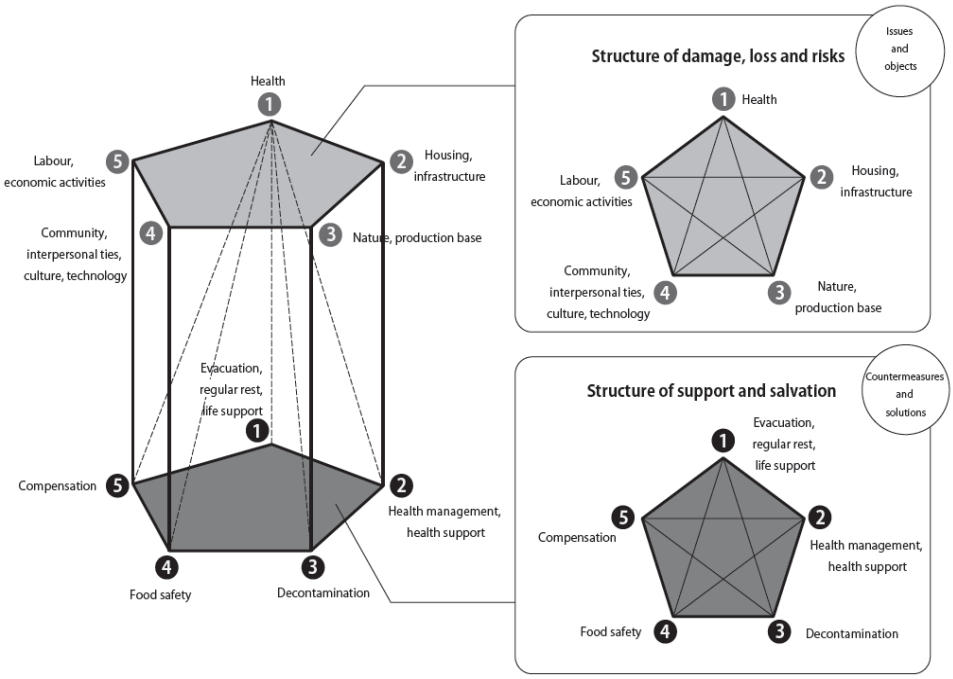
The damage, losses and risks brought by a nuclear power disaster are exceedingly severe. In fact, decades must pass before the full extent of the damage becomes clear and, ultimately, it is only from the vantage of history that a nuclear disaster can be evaluated. The damages, losses and risks from a nuclear disaster affect not only tangible and intangible "stocks" and "flows" (see column on previous page), but extend to every facet of life. Because the loss of only one social element among all those lost to a nuclear disaster makes it impossible to return to the former way of life, each element is a part of the holistic total and is therefore indispensable (**Figure 1.7**).[37]

Even more noteworthy is that the stagnation and dysfunction of support and relief efforts has increasingly

[37] For more about the multi-layered nature of a nuclear power accident (i.e. extensive radioactive contamination) described in **Figure 1.8**, see Funabashi, H. (2014a). "A nuclear disaster as 'destruction of the living environment' and the 'third way' to community revitalisation" [In Japanese]. *Kankyo to Kogai* 43(3), 62-67. Also see its revised and enlarged version: Funabashi, H. (2014b). "Damage structure of seismic-nuclear disaster and the 'third way' to reconstruction of life and community revitalisation]" [In Japanese], in H. Funabashi (ed.), Issues related to the revitalisation of areas affected by the Greater East Japan Earthquake, Hosei University Sustainability Research Laboratory, pp.1-19. The latter (Funabashi 2014b) has been made accessible on the CCNE website as a discussion paper [in Japanese] http://www.ccnejapan.com/?p=3000.

exhausted the affected people and areas, and is actually increasing the extent of damage, losses and risks. Said differently, we have to recognise that there is another side to the disaster, a "secondary human disaster" caused by the failure and stagnation of efforts to deal with the nuclear power plant accident. If these various aspects and damage are undermined, and risks from the disaster are reduced to their individual parts, then they can only be understood in a piecemeal fashion and the overall and multi-layered structure of the disaster becomes hidden from view (**Figure 1.9**). When a phrase like "disaster recovery" is uttered, it is often "infrastructural" and "industrial reconstruction" through large physical investments that are implied. While it is certainly not the case that these aspects are entirely unimportant, what is more important is that each individual victim is respected and his or her wishes for a return to a modest but satisfied life fulfilled. Following the path of the "restoration of humanity" is the only approach that can achieve that type of reconstruction.

Figure 1.9 Issues to be solved and measures towards achieving "restoration of humanity"



What must be prioritised above all by post-nuclear disaster support and relief efforts is the restoration of the health and wellbeing of victims and the technicians working to stabilise the plant. Amongst the victims are many who have not had the health and peace of their former lives restored and have not been provided with the "the minimum standards of wholesome and cultured living" that article 25 of the Japanese Constitution guarantees (see section 1-1-3). As the parties responsible for the nuclear power plant accident, the central government and TEPCO have an "obligation" to create a thorough system for realising the restoration of the health and welfare of its victims. Likewise, it is the victims fundamental "right" to demand such measures.

To reduce radiation exposure and other health risks and promote welfare, various responses are necessary: including the safe return of evacuees, emigrants and long-term evacuees, periodic respite for children to detox, decontamination, food safety policies, health and medical care enhancement and environmental restoration. Additionally, to rebuild lives fundamentally, compensation and daily life support are essential. Although the means of providing these compensation and support measures are important issues and will be discussed in section 1-4 of this chapter and after, it is essential not to lose sight of the eventual goal of restoring humanity.

For example, while the focus of efforts to return people to evacuated areas will be decontamination, infrastructural reconstruction, and job creation, it is not self-evident that implementation of such measures would actually result in the restoration that evacuees planning to return are hoping for. Many people are not seeking decontamination and infrastructural reconstruction but rather more direct for the restoration of their former ways of living. Additionally, there are also many victims who are highly concerned that completion of the restoration of the affected areas will result in the cancellation of their rights to evacuate as well as any support (see section 1-5-2). When policy makers lack clear long-term vision and fail to communicate closely with the beneficiaries, conflicts can be generated between support policies and victim's interests, and victims become alienated and divided.[38]

"Infrastructural reconstruction" and epidemiological surveys that promise results in the distant future offer warnings of the perils of turning the means for support and relief into objectives. Fundamental stance underpinning the "reconstruction of humanity" must be to listen to the voices of the victims and to implement policies that aim to mitigate the troubles of victims based on their context. To achieve the "restoration of humanity", damages, losses and risks must be appropriately evaluated. It is imperative, first, to adopt measures to restore things to their original condition to the greatest extent possible. In situations where that is not possible, victims must be given sufficient support and compensation. It is only when such measures are sufficiently in place and each and every victim has been respected by having their wishes for a return to a good life fulfilled that we can finally say that the path to the "restoration of humanity" has been lain.

The complaint statement of "The Complainants for Criminal Prosecution of the Fukushima Nuclear Disaster (*Fukushima Genpatsu Kokusodan*)" states the following.[39]

> "We are challenging a society that fails to value all who live in it, in which sacrifice is always being imposed on some members; we are coming together again, even expanding our ties after being divided and torn asunder by the accident; we who were hurt and lost in despair are reclaiming our strength and dignity. We believe that this is the way to fulfil our

[38] It has been reported that the government will establish a "Fukushima Global Medical Science Center" at Fukushima Medical University (Fukushima Minpo September 20 2011 and Fukushima Yushimbun 15 June, 2013). Advanced diagnostic equipment such as molecular imaging (i.e. equipment capable of observing and photographing molecular movements of proteins and DNA for use in cancer screening), PET, high-resolution CT, and whole body counters would be developed as well as a centre for developing cancer therapeutics in research and clinical trials in a nine-floor facility (eight floors above ground and one basement floor) that will have 250 beds. Great expectations have been pinned on this facility as a focal point for medicine in the prefecture (Fukushima International Medical Science Centre: Outline and Images December 2012). It is scheduled for completion in March 2016, and the current Radiation Medical Science Centre will be combined with the new facility. In contrast, much distrust has been attracted by the Fukushima Health Management Survey, which was supposed to contribute to health support for nuclear disaster victims, but its murky operational methods have drawn serious questions from citizens and the prefectural bar association. Resultantly, in April 2013, survey methods and the review committee were forcefully altered (see section 1-4-4). Examinees have found it difficult to receive the results of their own (or their children's) thyroid examinations, and the tests were based on the assumption that ill effects would not appear for many years after the initial exposure at the time of the accident. When patients with cancer are discovered, these are written off through a new explanation based on a "screening effect" (see section 1-4-4). Verification of the trustworthiness of evaluations is doubtful and has resulted in increased concern for victims. This case has ignored the presence of the victims, and is thus further evidence of how what were supposed to be means (i.e. facilities and surveys) are not victim-oriented. Health evaluations based on prejudicial assumptions, only invite more conflict and suspicion and the further alienation and division of the victims.

[39] The Complainants for Criminal Prosecution of the Fukushima Nuclear Disaster (Eds.) (2013). *And still no investigation of their crimes! The statements of 50 The Complainants for Criminal Prosecution of the Fukushima Nuclear Disaster*. Kinyoubi:126
The Complaints for Criminal Prosecution of the Fukushima Nuclear Disaster is a citizen's movement that has filed suit in the Fukushima District Court arguing that the Board of Directors of TEPCO and 33 members of the NISA and JNSC that have been involved in the government's regulation of nuclear power are responsible for the accident at the Fukushima Daiichi Nuclear Power Plantnju under the "Corporate Manslaughter Law" and the "Environmental Pollution Offense Law", etc. In addition to Fukushima, complaints have been lodged from 14,586 individuals from around Japan. Although the case was ruled as not valid after being sent to the Tokyo District Court, the group is appealing to the Tokyo Prosecutor's Committee (as of March 2014). Also, in regard to the leakage of contaminated water into the sea, the group has filed a case with the Fukushima Police arguing that TEPCO is in violation of the "Law for the Punishment of Environmental Pollution Crimes relating to Human Health" (October 2013).

responsibility towards children and young people."

It must be firmly stated that the divisions and alienation resulting from environmental pollution witnessed at Hiroshima, Nagasaki and Minamata have already begun to appear to a severe extent in Fukushima. How can we overcome this situation, ensure the implementation of real measures of support and construct a movement aiming for a nuclear free society? This is the task ahead for the "restoration of humanity" and it is this task that links together the various issues discussed below.

1-2-2 Four principles towards the restoration of humanity

Here we set out the principles that we must adopt to advance towards the "restoration of humanity".

PRINCIPLE 1 REMAIN FOCUSED ON THE "INDIVIDUALITY" OF THE VICTIMS AND AFFECTED AREAS AND RESPECT THEIR FUNDAMENTAL HUMAN RIGHTS AND RIGHT TO SELF-DETERMINATION

The damage, losses and risks brought by the nuclear power disaster vary according to each individual person and place, great diversity being found among the victims. These victims have been thrust into different "predicaments", they have different "interests" and they will continue to make different "choices". Even though they are victims of the same nuclear disaster they have been divided and alienated from one another (see section 1-1-5). The important reasons for this deep-rooted division and alienation are: 1) inhibition of the free choices and decision-making of individuals, 2) neglect of the difficulties and distress that individual victims experience, and 3) amplification of the conflicts of interest of victims resulting from underestimation of damages. To overcome this vicious cycle and advance towards the "restoration of humanity" it is imperative to respect victims as irreplaceable individuals and to respect their choices and fundamental human rights. Along the path to the "restoration of humanity" all victims have the right to receive adequate support and relief and the right to question the responsibilities and liabilities for the nuclear disaster.

PRINCIPLE 2 AVOID UNDERESTIMATING DAMAGES, LOSSES AND RISKS AND ADOPT THE PRECAUTIONARY PRINCIPLE

To underestimate damages to people and property as well as risks, and to wilfully avert one's eyes from human suffering, is nothing other than to ignore the fundamental human rights and right to exist of victims. It leads to the stagnation and abortion of measures that should be quickly taken and it presents the potential to further amplify the damage, losses and risks that such measures were supposed to alleviate. In the case of Minamata disease, the damage was amplified by the delayed effort to understand the situation and its causes. Moreover, the case demonstrated that even after causes are understood, if steps to resolve the problem are not advanced then the damages are likely to be amplified. This is the lesson that was learned through past environmental pollution. The same mistakes are not to be repeated.

There are cases where damage, losses and risks cannot be identified fully and uniquely. However, even if it is difficult to identify on-the-ground realities and/or causative factors, this is not grounds for cutting off or delaying support and relief. In contrast, it is precisely in cases where on-the-ground realities and causative factors are difficult to identify that hasty assumptions should not be made, the "precautionary principle" should be adopted and conscientious and comprehensive support and relief should be provided.[40]

[40] The "Precautionary Principle" is a way of thinking in which any activity that presents a threat to environment or people, even if the underlying mechanisms are not entirely understood by science, should be preceded by preventive measures. Under such conditions, the burden of proof is not on the public but rather on the party determined to take the measures (Wingspread Statement on the Precautionary Principle, 1998). The same phrase has been incorporated into important international treaties such as the Rio Declaration on Environment and Development (1992) and the Cartagena Protocol on Biosafety (1999).

PRINCIPLE 3 REALISATION OF "HEALTH" AND "WELFARE" AS A FUNDAMENTAL HUMAN RIGHT

As evidenced by the conceptualisation of health advanced by the World Health Organization (WHO), "health" is a concept that is extremely polysemic. Health does not simply indicate the absence of illness or frailty but is a multi-dimensional concept comprised by 1) physical health, 2) mental health and 3) social health.[41] Rethinking the meaning of "health" in the context of a nuclear power disaster that has forcefully transformed every facet of daily life far exceeds simply the prevention or treatment of disease. Additionally, the risks brought by a nuclear power disaster are not limited to those derived from radiation, such as external or internal exposure, but extend to the major transformations of individual and social practices and environments. Merely observing the effects of radiation is insufficient. Turning the abstract guarantee to "the minimum standards of wholesome and cultured living" into reality demands a fundamental questioning of the nature of medical treatment and welfare as well as communities and the daily lives of the people to discover how to restore the foundations of human existence.

PRINCIPLE 4 REALISATION OF RELIEF AND SUPPORT BASED ON "SOCIAL REASONABILITY"

Every measure to deal with the disaster—from evacuation, to periodic respite, decontamination, food safety policies, health care and compensation—requires planning, and it is essential that this planning is based on thorough analysis of the on-the-ground realities (see section 1-3). Such analyses are essential because they indicate the direction that appropriate support and relief measures must take and ensure that plans have rational consistency. They are also crucial in embodying social justice that is so important in meeting the suffering of victims with compassion, respecting their basic human rights and ensuring welfare and well-being. Surely, Evacuation, decontamination, food safety, compensation and all responsive measures have their limits and defects. For example, it should be clear that evacuation alone cannot solve all the issues that evacuees are confronting. If opportunities for employment or livelihood support are insufficient at evacuation destinations, then evacuees will find it difficult to rebuild their lives. The amount of radioactive materials that can be removed by decontamination is also limited, and the storage of radioactive waste at temporary facilities during the long period it takes to secure intermediate storage facilities presents its own numerous problems (see section 1-6). Additionally, while the reconstruction of the affected areas and their primary industries has been an earnest plea from many, there remains a question of which should be prioritised "individual health" or the "restoration of a locality". People should not be forced to return to the evacuated areas if the air dose does not adequately decline (see section 1-5-3), and conducting agriculture under high radiation conditions remains a complex issue in need of further investigation (see section 1-7-1). The completion of plans for lifting evacuation orders and decontamination work cannot be used as justification for cutting off "support" or "compensation" or for stealing away "evacuation rights" (see sections 1-4-1, 1-5-3).

As suggested by the discussion above, evacuation, decontamination, food safety and compensation are all strongly interrelated and it is not appropriate or reasonable to discuss one in isolation from the others. Pursuing the rationality inherent in only each individual measure increases the potential for creating negative outcomes. Questions such as how far should evacuation be conducted, decontamination pursued or compensation given demand that, alongside the acquisition of scientific data and the questioning of feasibility, that a perspective of "social reasonability" is also adopted that can ensure that the alienation and

[41] Constitution of the World Health Organization, Preface, Article 1

division of victims does not occur. To that end, support and relief for the victims and reconstruction of the affected areas should not reflect only the opinions of government, academics or business, but rather a planning and policy process that respects the opinions of victims. The concept of "social reasonability" discussed in section 0-7 of the preface is the only basis for the "restoration of humanity".

The remainder of this chapter examines the policies put in place to deal with the difficulties victims are confronting, but maintains a focus on how the principles discussed above can be put into practice for individual policies and tasks in specific situations. While the efforts of individuals and local administrations at local sites are of great importance, the tremendous damages suffered as a result of the nuclear accident make it more important for society to develop a shared conception of the principles underpinning the "restoration of humanity". In reality, decontamination, food evaluation, health checks and resident support have been handled as separate problems and addressed with separate policies and laws, while the relation of the parts of the disaster to the disaster as a whole has not been well understood or dealt with. The current "Basic Law for Reconstructing Areas Hit Hard by the Great East Japan Earthquake" is not equipped with the concepts necessary for dealing with the specific nature of a nuclear disaster, and the "Act on Special Measures Concerning Nuclear Emergency Preparedness" (i.e. the Nuclear Disaster Act) focused on addressing the emergency situation after the disaster and did not consider the possibility of a situation in which radioactive contamination would continue for a long period and on a wide scale. In order to maintain a consistent response to the diverse and serious damage resulting from the Fukushima nuclear power plant disaster it is imperative to establish a new "Nuclear Power Disaster Reconstruction Basic Law" that clearly incorporates the principles underpinning the "restoration of humanity" discussed above and allows all associated laws and policies to function in unison towards the same aims and following the same principles. This law would enable the continuation of long term relief and support for rebuilding the victims' daily lives and areas affected by the 2011 Fukushima nuclear disaster, but it would not be limited to Fukushima prefecture as the current Act on Special Measures Concerning Nuclear Emergency Preparedness is. It is advisable that a new "Agency for Fukushima Nuclear Disaster Compensation and Recovery" be established to tie together the implementation of the various laws gathered under the proposed "Basic Act for Recovery from the Nuclear Disaster", including the current Law for the Support of Children and Victims of the Nuclear Disaster (see Sections 1-4, 1-5), and placed under the proposed "Nuclear Energy Phaseout Agency" (see section 5-3-4). The main responsibilities of this agency (i.e. dealing with the continuing efforts to compensate and rebuild from the disaster) are discussed in chapter five (see section 5-3).

COLUMN
Restoration of Humanity

"Restoration of humanity," coined by the Japanese economist Tokuzo Fukuda, is a concept of reconstruction based on experiences from the Great Kanto Earthquake (1923). According to this concept, the material aspect of restoring roads, buildings and so on is merely a means to reconstruction, the original purpose of which is to reconstruct the life and work of the people after a disaster. Support for disaster victims should not only focus on "material reconstruction", the injection of massive funds to stimulate new industries, but should also be based on "restoration of humanity", in which each individual victim is treated with respect, and is able to regain and recreate hope for his or her future.

"*Reconstruction devoid of humanity*," [42] developed through discussions involving sociologists and victims of the Fukushima nuclear power plant disaster, notes that "'reconstruction for people' became 'reconstruction devoid of people' through a reversal of the means and the purpose." (p.39) "The purpose of the population return policy eventually became only to implement decontamination, rebuild infrastructure, create job opportunities and carry out urban planning rather than to resettle the people who used to live in the town." (p.39) "From the point of view of the victims, the word 'people' in 'reconstruction for the people' means themselves, and is congruent with true reconstruction in the sense of the recovery of their lifestyles and communities. However, from a different point of view, those 'people' do not necessary have to be the same residents who were living in that location before the disaster."(p.33)

(SHIMAZONO Susumu)

1-3 PRINCIPLES FOR ASCERTAINING AND ASSESSING THE DAMAGE

[OUTLINE]

1. To achieve "restoration of humanity", we must understand the actual individual injuries, damage and risk and promote their common ownership in a societal context, while respecting the individuality and diversity of the victims and the stricken localities.
2. Ascertaining and assessing the state of suffering and damage is necessary to protect the basic human rights of the victims. This is their legitimate right. It is also an important obligation of the government, which is responsible for supporting and helping the victims, and of TEPCO as the perpetrator. The ultimate objective must be to support and help the victims. The purpose should never become investigation and assessment for its own sake.
3. Assessing the suffering, damage and risks is a task highly liable to politicisation. Those who undertake it must consider all forms of damage and risk, and conduct diagnostics, investigations and monitoring openly. Assessment should not be the sole province of people in specific positions or with specialist knowledge, but must include the victims, who are themselves subjects of the assessment.
4. The victims and others affected have a right to know, and any matters that have been clarified by fact-finding and confirmation must be disclosed. This right to know must not be limited to merely being informed about the results afterwards, but must also mean citizens having the ability to proactively share information that should be known and to participate in drafting investigation plans from the planning stage.
5. The records pertaining to ascertaining and assessing the suffering, damage and risks should be gathered, analysed and preserved in as open a manner as possible. It will be necessary to establish an institution to execute this continuously and transparently.

[DETAILS]

1-3-1 Necessity of recording and assessing suffering, damage and risks with a focus on individuality and diversity

Specific measures based on the "restoration of humanity" principle stressed in section 1-2 above will be

[42] Yamashita, Y., Ichimura T., and Sato, A. (2013), *Reconstruction devoid of humanity: nuclear evacuees and "lack of understanding" by the general public*. [in Japanese] Tokyo: Akashi Shoten.

presented below in the following order: health maintenance and support (section 1-4), evacuation (section 1-5), life support (section 1-5), regional support (section 1-5), decontamination (section 1-6), food security (section 1-7), restoration of farming and fishing villages (section 1-7) and reparations (section 1-8). To promote the realisation of measures in each of these fields, it will be essential to get a thorough grasp of the real state of affairs in each specific case and assess the suffering, damage and risks while respecting the individuality and diversity of the victims and the stricken localities, and, at the same time, to reveal the overall picture and special characteristics.

The first reason for this is that the behaviour of radioactive substances in the environment and the health risks from exposure to radioactivity are issues that are still being elucidated scientifically, and there are thought to be many phenomena that remain unexplainable under the current state of knowledge. For example, directly following the accident, it was held that absorption of caesium by rice was unlikely. The governor of Fukushima Prefecture issued a declaration of safety of the rice on the basis of preliminary examinations prior to harvest, but later on, contamination in rice from some of the semi-mountainous areas was confirmed to exceed the provisional limit of 500 bq/kg. The mistake resulted from the following factors: there was poor scientific knowledge regarding the effect of the accident on rice production because there were no rice fields in the region contaminated by the Chernobyl disaster; the region in which the rice plants grew was characterised by extreme diversity of soil, water and fertilisation conditions; the event was assessed and the safety declaration issued on the basis of limited monitoring and past knowledge.

There is experience and knowledge from Hiroshima, Nagasaki and Chernobyl on the health effects of radiation, but there are many limitations to these. In addition, there are big differences in conditions between the past cases and the Fukushima accident; therefore, not a few citizens harbour doubts about predictions and assessments of health damage in Fukushima based solely on past knowledge. There are concerns that diverse illnesses and health impacts on the victims will be ignored and possible damage and risks overlooked if knowledge and theories from certain standpoints are adhered to. Rather than guessing, what is needed is an approach relying on verification of past knowledge by carefully recording what kinds of health damage were seen or not seen and using that as feedback.

The second reason is that in order to create plans and take suitable measures in keeping with on-the-ground realities in areas affected by the nuclear accident, a clear understanding of the suffering, damage and risks is needed on a case-by-case basis for each victim and each affected area. Otherwise there will be inflexible but incomplete measures from start to finish. We should be conscious of the many times abuses have occurred because measures diverged widely from the actual conditions: for example, mismatches between the supply and demand for temporary housing, and inconsistencies between needs for decontamination and execution of necessary measures.

The third reason is that if awareness and assessments of the suffering and damage caused by nuclear catastrophes are not shared with society as a whole, accidents can be underestimated, making appropriate measures impossible. If the suffering and damage from nuclear disasters are not grasped appropriately at an early stage, measures cannot be taken to alleviate suffering and damage arising in the long term. For example, there was a very poor grasp early on of radiation exposure levels, and that has led to difficulties in dealing with health damage later on. Thus, if actual damage is not appropriately understood at each stage and if this understanding is not shared with society as a whole, it will become even more difficult to share assessments at later stages, and the damage will be allowed to increase.

1-3-2 Survey and assessment with a solution-oriented model

It is said that when pollution problems such as Minamata Disease arise, the victims want to hide their injuries, or that they have no choice but to hide them. Many such people have faced discrimination or unfavourable treatment from society, and many victims have chosen to avoid having their illnesses recognised, even while suffering from symptoms. More than half a century has passed since the outbreak of Minamata Disease, but even now recognition of patients is a subject of dispute. Many patients have gone to their graves with no recognition of their status, reminding us how difficult it can be to elucidate the full picture.

We must make an effort to learn from such problems, which provide important lessons even in the case of nuclear disasters. In the Fukushima Health Management Survey, the objectives of the testing and investigation were not well known, an insufficient number of items were tested and investigated, the area investigated was inappropriate, and the results of the investigation were not shared with the victims, so a very large number of citizens harbour doubts. Changes and rearrangements in the objectives and conditions of execution also occurred in the course of the investigation, further leading to endless doubts (see 1-4-4). Radiation monitoring in farmland and testing of food products presents a similar case. Field surveys should have been conducted in order to help the victims, but in fact they have not necessarily been directly connected to improvement of the victims' lives or prevention of health problems. They have become notable examples of failure to gain the victims' trust.

Support and rescue of victims should be the first considerations in ascertaining and assessing the actual conditions. Proving or disproving the suffering and damage or gaining scientific knowledge must not become the objective in and of themselves. The professional ethics and social responsibility of those who are engaged in the support programs are called sharply into question.

1-3-3 The significance and necessity of citizens participation

If ascertaining and assessing the actual conditions requires high levels of knowledge and experience, the involvement of research institutions and researchers with expertise will be essential. A strong propensity for politicisation, however, exists when assessing suffering, damage and risks. It is important to verify that there is no bias toward specific viewpoints and specialties and to preserve relationships of mutual trust among participants, including victims and specialists in diverse fields, while remaining aware of their divergent viewpoints.

In some cases it is difficult for the victims or other citizens to take direct charge of ascertaining and assessing the actual state of damage if it requires a high degree of specialist knowledge, but it would be a mistake to have the government, TEPCO, nuclear-power related institutions or other parties with specific interests or expertise take exclusive charge of determining (1) which things to survey or (2) how to assess the survey results. Involvement of people with specific interests or expertise risks introducing bias, slanting the understanding and assessment of the real state of affairs and putting the injured and other victims at a disadvantage.

The injured and other victims have a right to know, and information must be provided to them in response to requests by the victims on matters that have come to light through fact-finding and efforts to ascertain the on-the-ground realities. This "right to know" must not be limited to being informed about the results afterwards, but must also mean citizens having the ability to proactively share information that should be

known, and participate in drafting investigation plans from the planning stage.

During the three years following the nuclear disaster, citizen initiatives have been expanding, for example, monitoring and mapping air dose rates in living areas, and measuring radioactivity levels in food and environmental samples (soil, ash, etc.). Normally, it should be possible to rely on the government, local municipalities, agricultural cooperatives and others to take such measurements and disclose the information, but in not a few cases the results were not released, or citizen trust was lost because the detection limits were set too high, or the purposes, frequency and/or density of monitoring deviated from citizens' desires or needs based on the actual state of damage. Thus citizens' initiatives began filling an important role in taking measurements (several examples are presented in columns).[43] These kinds of examples of citizens undertaking initiatives to grasp the on-the-ground realities merit special notice because not only have they complemented the existing measures, but they have also succeeded in opening new avenues for improving the situation through participatory science.

1-3-4 Verification of risks and passing down of disaster records

In 1-1-11, it was noted that insufficient assessment of suffering, damage and risks led to delays in support and aid, resulting in additional harm that increased the victims' hardships even further. The government, TEPCO, Fukushima Prefecture, local municipalities, research institutions, people of learning and experience, and others involved in recovery and reconstruction from the nuclear disaster must conduct scientific investigations and tests without prejudice, imagining all possible forms of damage and risk, and respecting the individuality and diversity of the injured and other victims. In addition, they should quickly release any information they uncover regarding the suffering and damage.

How to assess the situation and what countermeasures to take should be decided on the basis of open discussion among people with diverse standpoints and specialists and practitioners in diverse fields, and taking seriously the ideas and wishes of the persons involved.

To investigate the actual conditions of the damage and consider countermeasures, two concurrent arenas operating at different levels will be necessary: (1) an independent expert commission established by the Diet and (2) a forum in which local residents can participate to discuss the investigation and countermeasures. In the course of this, it will be necessary to gather the wisdom of people with diverse specialisations and share it with society as a whole.

From this perspective, it will be important to preserve the records and documents of the organisations involved in recovery and reconstruction from the accident in a form citizens can inspect. The intent here is, firstly, that by disclosing to the public all documentation related to programs and decision-making, omissions can be prevented, and, if mistakes occur, changes can be made quickly. Secondly, by sharing and reviewing the experiences of this complex disaster, the likes of which has never been seen anywhere in the world before, and discussing them both in Japan and abroad, knowledge can be conveyed that could prevent such a disaster from being repeated, or in the unlikely event that it is, that could minimise the damage.

[43] Of course there are also lots of issues with these citizen-led activities. Firstly, there is generally a lack of the expertise, equipment, and funding necessary to continue the activities. Vanguard activities receive donations and grants from funds and companies, but the application process is very demanding and requires a key person in order to continue activities. It is necessary for citizens' fact-finding surveys and independent assessment activities to be socially recognised, and for knowledge and economic support aimed at making them sustainable to be strengthened, at the same time as raising their level as citizen science.

COLUMN
Voluntary Measuring Activity Demonstrating Unique Significance and Meaning

The radiation contour map produced by Yukio Hayakawa, Gunma University Professor in volcanic geology, depicts the state of radioactive contamination in wide areas over eastern Japan, while showing how those areas were affected by diffusion and fallout of radioactive substances. It is plotted based on air dose rates obtained from the Internet and data obtained through his own measurements. Despite differences in accuracy and methodology compared to the aircraft monitoring measurements of the Ministry of Education, Culture, Sports, Science and Technology (**Figure 1.1**), social impact of publishing the state of contamination in eastern Japan much earlier than the Ministry's investigation and public disclosure[44] was significant. In Date City's Oguni District, which was designated as a specific spot recommended for evacuation (see 1-5-1), residents formed the "Association for Regaining Radiation-free Oguni".[45] With support from Fukushima University, they created a radioactive substances distribution map in October 2011, with a measuring density of one point per 100 square-metres. Up to now, nearly 100 citizens' radioactivity measuring stations have been established around Japan, engaged in measurement of foods and soils.[46] Consumer cooperatives and other groups have also been making efforts to meet the needs of consumers by establishing their own measuring arrangements and organising learning opportunities.

Such voluntary activities among citizens and researchers have complemented measuring activities by the state and local governments, while demonstrating unique significance as alternative initiatives, including validation of existing measuring results as well as exposure of their shortcomings and defects. Most importantly, citizens' independent measuring activities have provided opportunities for them to take the initiative in the effort to identify and assess the actual status of radiation contamination in their communities. Such processes have helped citizens to obtain deeper understanding of radioactivity-related matters and to develop the knowledge, experience and networks needed for actually solving problems inherent in a nuclear accident. In Date City's Oguni District, an extra-judicial conciliation[47] took place in response to demands for compensation for households outside of specific spots recommended for evacuation. In the course of this process, the radioactive substances distribution map created by the Association for Regaining Radiation-free Oguni functioned as significant evidence. As an additional example, a survey of soil contamination at 316 points in Iwate Prefecture, led by a citizens' radioactivity measuring station based in Aichi Prefecture, produced results[48] indicating that the iodine fallout figures reached 1.7 million Bq/m^2 in southern areas of the prefecture. Based on these results, they made a request to the Iwate Prefecture authorities to conduct a health survey among residents.

(ISHII Hideki and OHNUMA Junichi)

[44]The first edition was published on 21 April 2011 (http://blog-imgs-54-origin.fc2.com/k/i/p/kipuka/1p3BQ.gif), and the eighth edition on 1 February 2013 (http://kipuka.blog70.fc2.com/blog-entry-570.html).
[45]See the website at http://www.takagifund.org/archives2/detail.php?id=215 for more information on the Association's survey research activity funded by the Takagi Fund for Citizen Science.
[46] For more information, refer to "Radical Reform of the Food-contained Radiation Measuring System" (CCNE's website at http://www.ccnejapan.com/?page_id=1661) and "Citizens' Radiation Measurement Database (Everybody's Data Site)" (http://www.minnanods.net).
[47] A conciliation by the ADR Centre (Alternative Dispute Resolution Centre for Nuclear Damage Claims) (see 1-8-2).
[48] Refer to "Soil Survey Project, Iwate (June 2012)" on the website of Tokai No Nukes Network for Future Generations at http://tokainet.wordpress.com/advocacy/iwate/.

1-4 COUNTERMEASURE 1: THE RIGHT TO HEALTH

[OUTLINE]

1. Preventing health problems beforehand by avoiding unnecessary exposure to radiation is a right shared equally by all people, and is a basic human right guaranteed by Japan's constitution and international law.
2. In settling the nuclear accident, the status of workers engaged in controlling and decommissioning the reactors should be guaranteed, their doses properly managed and health check and support provided, with the national government taking the lead.
3. The current 20 millisievert annual additional dose (20mSv/pa) criterion for ordering evacuation and lifting the order should be reviewed, and evacuation criteria re-established that give more priority to safety. For the present, until the annual additional dose falls below 1 millisievert (1mSv/pa), the evacuees should not be forced to return, but should continue to receive compensation and livelihood support (see Sections 1-5 and 1-8). To consider new standards, the Diet should conduct expert investigations and hold intensive deliberations.
4. Regarding the area pertaining to the Nuclear Accident Victims Protection Act[49], in conformity with international advice and laws predating the Fukushima accident, which were based on the premise that radiation at low dose levels can cause health hazards, the law's operational guidelines should be revised to designate, in addition to all of the Fukushima Prefecture areas, at least the areas with annual additional dose of 1 millisievert or more since the accident, and further taking into account the estimations of initial exposures and soil contamination conditions.
5. On the basis of the Nuclear Accident Victims Protection Act, the national government should take the lead in building a long-term health management system, including the issuance of health record books, as a measure to support the residents of the area mentioned above. Health support to prevent health damage and a system providing mobile classes and periodic respite for children (i.e. detoxification opportunities) should be provided and expanded. Also, sufficient chances for administrators to hear from the designated area's residents and local councils should also be provided continuously, and improvements made regularly in the operation of the support system to keep it in accordance with the actual conditions in each location (see Section 1-5).
6. Existing systems such as medical examinations at schools should be utilised, the applicable geographic scope should be expanded and the list of items to be checked greatly increased (see 1-4-4). As a rule, the examinations must be conducted by a physician.
7. In order to manage all varieties of examination data, clinical data and health survey data in an integrated fashion, the national government should take responsibility for establishing a permanent health support centre. For the operation of this centre, an independent committee should be established on the premise of participation by medical practitioners, specialists, people of learning and experience and diverse citizens (including residents of the areas designated for support). The committee should promote research planning, data disclosure, and ways to support health on the basis of both scientific and ethical considerations.
8. In regard to the health effects of radiation at low dose levels and radiological protections, policies should be established after thorough discussions in an open forum with a mix of specialists with differing

[49] The Act on Promotion of the Measures in Order to Protect and Support the Children and Other Victims of Tokyo Electric Power Company Nuclear Power Plant Disaster (Act No. 48 of 27 June 2012), herein abbreviated as "Nuclear Accident Victims Protection Act."

opinions. For issues requiring time to resolve disputes, the precautionary principle should apply.

[DETAILS]

1-4-1 The right to avoid exposure and the significance thereof

The right to avoid unnecessary exposure to radiation in order to prevent health hazards is shared equally by all people. It is a basic human right guaranteed under both the Constitution of Japan (Preamble, Article 13 and Article 25) and the International Covenants on Human Rights (International Covenant for Economic, Social and Cultural Rights, Article 12, Item 1). All people can request their government to enforce measures to uphold this right. In order to avoid or reduce additional exposures among people who have already been exposed to considerable radiation, the government must adopt policies that provide the greatest protection possible.

(1) Exposed workers

Workers employed at nuclear facilities are allowed to receive higher doses than non-occupational people, but they are being asked to accept a risk in exchange for employment compensation. Of course, it is not that their right to avoid exposure is being denied. All kinds of measures should be taken to reduce exposure levels as far as possible, including training beforehand, securing protective equipment, good planning and management of operational procedures, follow-up inspections, etc. One cannot help but note, however, that currently the occupational exposure management system has broken down. Labour conditions and status guarantees are also inadequate. Furthermore, workers are treated as "disposable" and illegal activity is allegedly rampant. Workers engaged in decontamination face similar conditions (see Section 1-6).

On-site accident containment and reactor decommissioning operations at the Fukushima Daiichi NPP must inevitably continue for a long time into the future, so upon securing the personnel needed for these operations, ensuring strict measures to protect them from radiation is an absolute requirement. Section 2-6 explores countermeasures to the problem of workers exposure in more detail.

(2) Residents

Residents' right to avoid radiation exposure comprises the following three rights.

1. The right to decide whether or not to evacuate (and to decide the place of refuge and length of time)
2. The right to avoid exposure in daily life (or at least to reduce dose as much as possible)
3. The right to receive regular health checks and appropriate medical treatment and advice.

In order to guarantee these rights in areas that have received radioactive contamination on account of the nuclear accident, there is a need to establish evacuation zones in a step-wise manner in accordance with the degree of radioactive exposure that could occur on a daily basis, with all residents ordered to evacuate areas contaminated above a certain level, and, recognising the rights stated in 1) above, with residents in zones with intermediate levels of contamination given free, informed choice of whether or not to evacuate[50]. The government has an obligation to guarantee compensation and administrative support for the people forced to evacuate, those choosing to evacuate, those choosing to remain in or return to affected areas, and those who

[50] In the region contaminated by the Chernobyl nuclear disaster, obligatory resettlement zones (=forced evacuation zones), voluntary evacuation zones (=guaranteed transference zones, the so-called "right to evacuate" zones), and enhanced monitoring zones (=health maintenance zones) were established on a legal basis (see footnote 76). The Japan Federation of Bar Associations passed a resolution at the Civil Liberties Congress held in Hiroshima on 4 October 2013, recommending the establishment of areas under evacuation orders (annual additional exposure of 5 millisieverts or more) and elective evacuation zones (annual 1-5 millisieverts) for the areas damaged by the Fukushima nuclear accident.

have decided not to return, so that they are able to make any of those decisions[51].

In order to apply this guarantee of rights in a way that reflects the actual conditions of each area, what will be most important is not to have the government decide on measures unilaterally, but to advance measures while holding continuous detailed dialogue with the people involved at both the individual and regional level. Health management and a medical opportunities shared by all people regardless of their circumstances must also be guaranteed. In addition, it is important to ensure that there is an arena for public discussion and learning in which residents can participate, in order to realise the three basic rights listed above.

To avoid or reduce internal exposure (i.e. intake of radioactive materials), it is essential to test foods for radioactivity and take steps to reduce contamination starting from the food production stages. Specific measures are discussed in Section 1-7. The current state and problems with evacuation measures, and the inadequacy of measures to rebuild livelihoods are discussed in Section 1-5. Problems involving decontamination as a measure to reduce (mitigate) the amount of radioactivity in the total environment are considered in Section 1-6. Each of these problems involves exercising the right to avoid exposure and must be handled consistently.

(3) Recuperation measures for children

It is important for people who cannot evacuate right away for various reasons or who have chosen to stay behind to have opportunities to promote their mental and physical health with regular sojourns in environments with low levels of radiation. This should be regarded as important as a way of fulfilling rights 2) and 3) above. Especially for children, who are more sensitive to radiation, providing regular opportunities for detoxification is a responsibility of society, and a duty of the government for guaranteeing human rights.

If the existing facilities of municipalities nationwide were utilised effectively, it would be entirely possible to provide opportunities for regular, long-term recuperation to all the children of the areas affected by the nuclear accident[52], and the government should support the implementation of such plans. A “refresh budget” has previously been provided in Fukushima Prefecture with the help of the national government, but it is hoped that a good sampling of opinions of the people involved will be taken and more flexibility introduced in its employment. Remarkably, rated as a “natural living experience training” program, it was launched as a government-NPO tie-up in an attempt to utilise actual recreational programs and mobile classes[53]. It is essential that supportive policies be crafted to help this movement spread nationwide[54].

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[51] This is the principle of the Victims Protection Act (see Section 1-5) and is ranked among the basic principles of the “Basic Act for Recovery from the Nuclear Disaster” (see 1-2-2 and Section 1-5) that we have proposed as necessary.

[52] For an example of specific estimation, see J. Ohnuma’s discussion paper “Possibilities for national and municipal aid for children’s periodic respite” [in Japanese] (supplement to the CCNE Interim Report), available on-line at http://www.ccnejapan.com/?p=1661.

[53] As an example, the NPO Shalom Disaster Support Center (Fukushima City) implemented four mobile classrooms in 2013, including two in Iidate, and one each in Fukushima City and Soma (which travel to Tono, Iwate Pref.; Kawakita, Yamagata Pref.; Tome, Miyagi Pref.; and Aizubange, Fukushima Pref.). Key to its success was that the NPO that introduced the schools involved (education committees) to the areas hosting the program took charge of surveying beforehand, proposing schedules and providing living support in the host towns, reducing the burden on the school staff. The government was slow to take action, so privately led respite programmes were developed. Since April 2011, about 200 organisations nationwide have implemented a variety of programs. There are financial limitations, however, so long-term programmes of a month or more are limited. In the future, it will be necessary to increase national and municipal budgets, but even then, the key to success will be making use of the experience of NPOs, volunteer organisations, social and educational groups, etc., in each area, and promoting public-private cooperation. Also, implementing mobile classrooms among municipalities entering disaster prevention agreements together is an effort with significance.

[54] Fukushima Prefecture and the Ministry of Education, Culture, Sports, Science and Technology have also responded to a certain degree. Thus far, Fukushima Prefecture has developed programs such as the “Fukushimakko Experiential Activities Support Project” (nature camps), and “Fukushimakko Mobile Classroom Experiential Activities Support Project” (mobile classrooms for each school) and others, which, while not ostensibly mentioning “recuperation” or “reduction of exposure,” provide real refreshment. All of these, however, are conducted solely within the prefecture. The Ministry of Education, Culture, Sports, Science and Technology added a “Natural Experience and Exchange Activities Support Project for the Children of Fukushima Prefecture” to its budget in fiscal 2014

In the areas affected by the nuclear accident, circumstances have not been conducive to alleviating worries about the future, and there have been concerns about deterioration of children's mental health. Measures such as counselling have been taken, but counselling does not provide fundamental improvement in the children's level of mental health. Getting outdoors and into nature and playing to their heart's content is important after all, and there are great benefits from even a temporary break from the restrictions and limitations in children's lives necessitated by the radioactive contamination. It is necessary, however, to make allowances for children who do not want to go and parents who do not want to send them on trips with their schools or classes, and to consider how they can opt out without incurring disadvantages in studies or school life.

1-4-2 Problems regarding low-level exposure risk assessment

The Japanese government has repeatedly claimed that radioactive exposures of 100 millisieverts or less (low-level exposures) have not been proven to be dangerous, implying that they are safe. However, this strays from basic radioprotection principles and violates the basic human right to avoid unnecessary exposures. In fact, there are plenty of data from epidemiological surveys indicating health effects from low-level exposures[55]. The government and some of the experts send a message that underrates the risks from radioactivity following the Fukushima nuclear accident even more than the advice from the International Commission on Radiological Protection (ICRP) and causes confusion with regard to risk awareness among residents (see the column titled "Can attempting to imprint the populace with the notion of 'safe and secure' be worthy of the name risk communication?")

Regarding the impacts of the Chernobyl disaster, the Japanese government takes the view of UNSCEAR and the IAEA that, aside from paediatric thyroid cancer, no evidence exists of exposure to radiation resulting in any major effects on public health. International assessments of the health effects arising from the Chernobyl disaster, however, are not unanimous[56]. If observations of local physicians and other medical personnel who continuously monitored the health status of the residents living in areas notably impacted by the Chernobyl disaster are taken into account, an increase was seen not only in cancer, but in a large variety of other illnesses among people in all age groups, with ailments among children particularly numerous. Observations of various symptoms indicative of accelerated aging, increased congenital anomalies, higher stillbirth and infant mortality rates, effects on the second and third generations who had not yet been born at the time of the accident, and other complicated forms of health damage were also reported[57].

(Special Account for Recovery from the Great East Japan Earthquake). This seeks active cooperation with the private sector, which could lead to increased length of programmes and holding them outside the prefecture. The "Matsumoto Kodomo Ryūgaku" (Matsumoto Children's Study Abroad) programme of Matsumoto City, Nagano Prefecture (see http://www.kodomoryugaku-matsumoto.net), is noteworthy as a programme virtually providing a long-term refuge for children.

[55] Representative examples include "Studies of the Mortality of Atomic Bomb Survivors, Report 14, 1950-2003" (Ozasa et al., 2012), "Solid cancer incidence and low-dose rate radiation exposures in the Techa River cohort: 1956-2002" (area affected by an explosion at the Mayak Reprocessing Plant) (Krestinina et al., 2007), "The 15-Country Collaborative Study of Cancer Risk among Radiation Workers in the Nuclear Industry: Estimates of Radiation-Related Cancer Risks" (Cardis et al., 2007), a German survey finding significant increases in childhood leukaemias near nuclear power plants (Kendall et al., 2012), "Radiation exposure from CT scans in childhood and subsequent risk of leukaemia and brain tumours: a retrospective cohort study" (Pearce et al., 2012), and a large-scale epidemiological survey in Australia confirming increased cancer in children following exposure to radiation from CT scans (about 5 millisieverts) (Mathews et al., 2013). For details on each of these sources, see the Citizens' Commission on Nuclear Energy website page giving Interim Report related reference links: http://www.ccnejapan.com/?p=2258.

[56] Belarus and the Ukraine have severely criticised the UNSCEAR report, saying that UNSCEAR overlooked major reports in Russian and Ukrainian languages from those countries' scientists, or falsely represented their interpretation. Yoshida, Y. (2014) Introduction to and Interpretation of Literature on Chernobyl ~ United Nations Office for the Coordination of Humanitarian Affairs report in 2000, Chernobyl – A Continuing Catastrophe. Journal of the Citizen's Scientific Initiative Japan [In Japanese], No. 22, Jan. 2014.

[57] Yablokov, A.V., V.B. Nesterenko, A.V. Nesterenko, N.E. Preobrazhenskaya (2013) *Chosa Hokoku Chernobuiri Higai no Zenbo* [*Investigative report: a whole picture of the damage from Chernobyl*] (J. Hoshikawa and others, trans.) Tokyo: Iwanami Shoten. [This is a revised and enlarged edition of Yablokov, Nesterenko and Nesterenko (2009), *Chernobyl: consequences of the catastrophe for People and Environment*, New York: Academy of Sciences], Horishina, O.V. (2013) *Cherunobuiri no nagai kage* [*The long*

In light of these observations and experiences, it is clear that the precautionary principles should apply to the area affected by the Fukushima accident as well. It would be valid to follow an LNT model-based approach[58], which is the international standard, and create policies focused on strengthening the existing health care system so that clinical observations can be widely shared (see 1-4-4).

The idea that low-dose health effects are stochastic (i.e. probabilistic) and that there are actually very few victims makes light of the position of the people involved. Even if no future symptoms develop in their case, to the people subjected to the risk, just being exposed to a new risk is a big burden in itself. This is because having to deal with health concerns and the associated psychological burden over the long term takes an additional toll in time and money spent for prevention. One must also be aware that the probability itself of incurring illness is frequently underestimated. The permanent adoption of the 20 millisievert per year standard that was supposed to be a temporary emergency measure is a clear violation of the constitutional right to live a peaceful life. Unless these conditions are redressed no progress will be made in "restoration of humanity".

1-4-3 "Risk Communication" for encouraging repatriation and individual dose control

The Nuclear Regulation Authority of Japan compiled "A Basic Approach to Measures for Safety and Security for Repatriation" in November 2013. Based on this, 11 agencies and ministries, including the Reconstruction Agency and the Ministry of the Environment, put forward "A Package of Measures for Risk Communication on Radiation Aimed at Repatriation" and "Basic Information on Radiation Risks" in February 2014, in an attempt, as they put it, "to promote detailed risk communication to counter fears among individuals.[59]" These measures, however, are for allaying concerns about radiation, not an attempt to hold a public discussion of uncertainties regarding low-dose health effects. The content of these also constitutes systematic reinforcement of the "safety dogma" that has been the standard refrain[60].

Furthermore, within this set of measures, the government announced that it would emphasise individual exposure control for returnees over the former air dose rate method. Based on a catchphrase, "From site doses to personal doses", it was declared possible to reduce radiation exposure without necessarily having to reduce radiation levels overall on site. The returnees would be issued personal dosimeters and counselled to control their own doses. This, however, does not constitute substantial dose reduction, but only the adoption of lower dose indications (see the column titled, "Why do measurements on personal dosimeters result in lower values than measurements on air dosimeters?") Places in which dosimeters must be worn are, in the first place, radiation controlled areas. Policies encouraging pregnant women, infants, children and other residents with high sensitivity to radiation to return to such a place are themselves unethical. Individuals should not have to bear the burden of controlling their personal doses using the dosimeters individually provided.

Air dose rates, which the government renamed "site dose rates", are as important as ever in protection

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shadow of Chernobyl: the health effects of the Chernobyl catastrophe as related by on-site data]. (H. Nishiyauchi and N. Yoshikawa, trans.) Tokyo: Shinsensha.

[58] The linear non-threshold model. The linear relationship (L) has no threshold value (T); in other words, there is no safe level of radiation, with the risk of death from cancer at exposure levels of 100 mSv or less scientifically predicted to be directly proportional to the dose. A 20 mSv exposure and a 100 mSv exposure would give 20 times and 100 times the risk, respectively, of a 1 mSv exposure.

[59] http://www.reconstruction.go.jp/topics/main-cat1/sub-cat1-1/20140217175933.html For exchanges at the press conference at which these were announced also see: http://www.ourplanet-tv.org/?q=node/1729

[60] In that they inappropriately compare risks of low levels of radiation incurred through involuntary exposure as a result of a nuclear accident to those from lifestyles, habits and therapeutic irradiation, and that it failed to mention research and previously established regulations indicating effects from exposure.

against radiation, and until air rate doses are reduced, people should not be encouraged to return to those places. Anand Grover, former Special Rapporteur for the United Nations Human Rights Council, has recommended that in view of possible effects on health, evacuees should be encouraged to return home only after the annual dose falls below additional 1 millisievert, and that evacuees should continue to receive compensation and aid from the government so that it is possible for them to make their own choice on whether to return or stay[61]. Japan's government should take his recommendations seriously and take immediate measures accordingly. In fact, there should be no need for warnings from abroad, because it is considered proper to take the initiative in handling this. Maybe this is the way a government that has promoted a failed nuclear energy policy takes responsibility[62].

COLUMN

Can attempting to imprint the populace with the notion of 'safe and secure' be worthy of the name risk communication?

On 18 February 2014, the Ministry of Environment and the Reconstruction Agency announced their "A Package of Measures for Risk Communication on Radiation Aimed at Repatriation" (see 1-4-3). This package emphasises the position of UNSCEAR, taking its cue from the ICRP, that "there is no likelihood of recognition of an increase in health hazards from exposure to radiation on the general population and the many plant workers in the future."

Essentially, risk communication is a means for those who are under risk to have discussions and communicate with all of the different stakeholders to exchange information. However, risk communication has been criticised as consisting mostly of the one-sided notification of safety or security information that suits the convenience of the administration.

According to Baruch Fischoff (Carnegie Mellon University), who has done a study reflecting on the history of risk communication from the view of practitioners, indicating numbers and reporting that these are not figures to be worried about was the earliest stage of the history of the progress of risk communication. Rather, and Baruch pointed this out already 20 years ago, it is important to engage in two-way communication and work together with citizens from the start to discover what they perceive as risks, and what should be considered a social risk.[63] Giving the name "risk communication" to a one-sided proclamation of "safe" by specialist to assuage the anxiety of citizens should be recognised a fraud based on an outdated idea. According to Tetsuji Imanaka (nuclear engineer at Kyoto University Research Reactor Laboratory), the forceful communication of the notion that the situation was "secure" by the administration after the Fukushima Nuclear Disaster was an attempt at imprinting rather than risk communication.[64]

There needs to be education and proper information on scientific data on low-dose radiation, the interpretation thereof and on the differences in opinion between specialists. From this point of view,

[61] The original document can be found on the following link:
http://www.ohchr.org/Documents/HRBodies/HRCouncil/RegularSession/Session23/A-HRC-23-41-Add3_en.pdf
A tentative Japanese translation of Grover's investigative report (2013) by the international environmental NGO Friends of the Earth-Japan can be seen at: http://www.foejapan.org/energy/news/pdf/130703.pdf

[62] A detailed discussion of the various problems with the repatriation policy is given in Section 1-5.

[63] Fischhoff, B. (1995). Risk perception and communication unplugged: twenty years of process. *Risk Analysis*, 15 (2), 137-145.

[64] Imanaka, T. (2014). How to face the radioactive contamination: the question of how much exposure should be put up with. [In Japanese] *Kagaku*, 84(3), 332. [translation note: The pun here is that "imprinting" is *surikomi* in Japanese, which sounds like an anagram of *risukomi*, Japanese abbreviation of "risk communication".]

the work by Fukushima University's editors of an alternative *Reader on Radiation* are extremely important.[65]

(HOSOKAWA Komei)

COLUMN
Why do measurements on personal dosimeters result in lower values than measurements on air dosimeters?

At monitoring posts, measurements are taken in terms of the air absorbed dose rate in "gray" (Gy) and the effective dose rate is represented as an air dose rate converted on the basis of 1.0 Sv = 1 Gy. By contrast, the 2,700 real-time dose rate measuring systems which are portable installed in Fukushima Prefecture after the Fukushima Daiichi accident are treated as the survey meters, and have been calibrated based on Japanese Industrial Standards to represent the 1cm dose equivalent as the effective dose rate. As a result, air dose rate is converted on the basis of 1.2 Sv = 1 Gy.

In Fukushima prefecture, there have been many incidents such as decreases in displayed values after the replacement of fixed-type units by portable ones, as well as such cases where relocations of measuring units to sites with lower dose rates have resulted in decreases in readouts. There are numerous reports that readouts at monitoring posts or on real-time dose rate measuring systems show lower values compared to those obtained in the surrounding areas. The main causes of these phenomena are cunning practices such as embankment of soil during installation, or partial decontamination efforts just to the area directly surrounding the installed post. There were also cases where design mistake (or intentional tampering) of the system, leading to self-shielding of the unit, led to lower readouts.

A readout on an air dosimeter or personal dosimeter (cumulative dosimeter) shows the 1 cm dose equivalent rate, and it is considered as an effective dose rate. Types of personal dosimeters include a fluoroglass dosimeter (so-called glass badge), thermal luminescence dosimeter (TLD meter), OSL dosimeter (photo-stimulated dosimeter), film badge, and a semiconductor dosimeter (for example "D Shuttle" from CHIYODA TECHNOL). All of these display the "effective dose rate" converted on the basis of 1.213 Sv = 1 Gy.

As for reasons why a readout on a personal dosimeter tends to be lower than the effective dose rate (equivalent of the 1 cm dose rate) obtained on an air dosimeter, first, gamma rays irradiated from the back get attenuated due to the shielding effect of the human body when the personal dosimeter is applied on the chest or belly of the examinee. The half value layer (the thickness at which the dose rate drops to a half of the original) of water is 8.2 cm for gamma rays from Cs-137 and 8.5 cm for those from Cs-134. These facts accord with a number of reports that values obtained from personal dosimeters are about 70% of those from air dosimeters.

Secondly, this tendency occurs because of the difficulty for an average person, particularly for a child, to keep wearing a personal dosimeter 24 hours a day. As the Tokyo Shimbun (23 Dec. 2013) reported, an experiment on application of personal dosimeters conducted by Date City showed that many examinees did not wear dosimeters when they went out, leaving them in the house.

[65] Goto, S. (ed.). (2013). Radiation reader for everybody: for scientific, ethical and logical understanding of the problem. [In Japanese] Tokyo: Gōdō shuppan.

A third factor is the following equation, which assumes that an air dose rate of 0.23 μSv/h is equivalent to 1 mSv/y. In this calculation, it is assumed that the average dose from exposure to natural radiation in Japan is 0.04 μSv/h. This value is subtracted from 0.23 μSv/h to obtain 0.19 μSv/h as the basis for calculating the annual dose.

*Annual dose 1 mSv/y ≒ [air dose rate 0.19 μSv/h*8 (hours) + air dose rate 0.19 μSv/h*0.4*16 (hours)]*365 (days) = 998.64 μSv/y*

The assumptions that an average person spends 8 hours outdoors and 16 hours indoors and that the attenuation coefficient is 0.4 are imprecise. Outdoor air dose rates also vary from place to place. If the dose obtained with that equation is higher on average than the measurement on a personal dosimeter (even after subtracting contributions of the first and second factors), it means that this equation is set on the side of safety (that is, it makes people more vigilant about exposure). Given the many reasons for variation, such as differences in individual behaviour, individual difference in radiosensitivity and the difficulty in wearing dosimeters 24 hours a day, it is a fundamental principle of radiation protection to set any calculation assumptions on the side of safety. In other words, the introduction of personal dosimeters results in discarding the approach of adopting safer assumptions for exposure doses.

In the first place, it is a mistake to assume a value for the additional dose by ignoring the internal dose, which is not measured on a personal dosimeter. Personal differences in sensitivity to radiation should also be considered.

(OHNUMA Junichi)

1-4-4 Toward comprehensive medical support

1) Problems with the Fukushima Health Management Survey

In line with the principles and purpose of the Victims Protection Act, a radical reconsideration of the fundamental principles of health management surveys and the survey system is necessary[66]. In addition to construction of a health management system in which the national government bears responsibility[67], a medical care and health administration system should be created that can be implemented at the three levels of state, prefecture and local municipality[68].

The many flaws in the Fukushima Health Management Survey[69], which Fukushima Prefecture entrusted to Fukushima Medical University, included inadequate disclosure of information, causing a loss of trust among many of the victims; limiting the subjects to the registered Fukushima Prefecture residents (those who had evacuated outside the prefecture were handled belatedly); limitations in items examined (e.g. detailed blood

[66] Article 13 Item 2 of the Victims Protection Act prescribes the following. "The country shall use necessary means to provide periodic screening to the victims, and continue to investigate the potential effects of radiation on human bodies. Concurrently, the country shall implement policies in order to ensure that children who have resided in the areas with a certain level of radiation exposure (including unborn babies whose mothers apply to this condition) will receive periodic screening for their entire lifetime." In addition, Item 3 prescribes the following. "The country shall implement policies in order to reduce medical bills when children and pregnant mothers receive medical care (excluding visits regarding injury and illness that are not the result of the TEPCO nuclear disaster)." (Translation by Human Rights Now, available from http://hrn.or.jp/eng/activity/2012/08/16/Fukushima_Law.pdf)

[67] Hatanaka, T., S. Yoshida and M. Ojino (2013) Change the Fukushima Health Management Survey to Promote Nationwide Health Support Headed by the National Government! – Problems with the Nuclear Regulation Authority's Health Management Survey Studies. Japan Medical Association Research Institute (JMARI Working Paper No.280) [In Japanese] http://www.jmari.med.or.jp/research/summ_wr.php?no=507

[68] See Citizen-Expert Committee on Radiation Exposure and Health Management (2013) Problems with the Fukushima Health Management Survey and Emergency Proposals on the State of Health Management [in Japanese], Friends of the Earth-Japan, 28 February 2013 http://www.foejapan.org/energy/evt/pdf/130224_5.pdf.

[69] The name was changed in April 2014 to "Prefectural Health Management Survey".

tests limited to residents of the evacuation zones); insufficient scope of examination (e.g. little consideration given to non-cancerous diseases in thyroid examinations); insufficient explanation of examination results and provision of data to the examinees; etc.[70]

Finally, after two years had passed since the nuclear accident and various criticisms had been received, measures were taken, such as reorganising the survey's Oversight Committee[71], but the survey's implementation was still entrusted solely to Fukushima Prefecture and Fukushima Medical University, and they were not able to overcome the problems noted above. Moreover, at stages prior to entrusting health management to the prefecture, the National Institute of Radiological Sciences (NIRS) and other organisations carried out only limited measurement of internal radiation doses. What is worse, they failed to release documents on estimations of initial exposure doses to the Japanese public, and increased the public's distrust by giving the impression through international organisations such as UNSCEAR (1-4-2) that the doses were small[72].

COLUMN
Effective dose, equivalent dose and the one centimetre dose equivalent

When an object is irradiated, the absorbed energy (absorbed dose) is expressed using the unit known as the Gy (gray). Since 1 Gy = 1 Joule/kg, we can also say that 1 Gy = 0.24 cal/kg. From this, it is often explained that an absorbed dose of 1 Gy is equivalent to the energy needed to raise the temperature of 1kg of water by about 0.00024ºC. While this is not mistaken, the quantum energy of radiation is extremely large, from 1000 to 1 million electron volts (1 kev to 1 Mev), and thus radiation is able to damage the molecules that make up the bodies of living organisms. It is therefore necessary to exercise caution when given explanations about how much the temperature of water is raised, since this may lead to a misunderstanding of the true situation.

Radiation consists of α (alpha) particles, β (beta) particles, γ (gamma) rays, neutron rays, X-rays and other types of radiation, each of which differs in its potential to damage biological molecules. For this reason, a radiation weighting factor has been assigned to each type of radiation (and for different energy levels for the same dose). The absorbed dose multiplied by this radiation weighting factor is the equivalent dose, expressed in Sv (sievert).

[equivalent dose] Sv = [radiation weighting factor] × [absorbed dose] Gy

For example, the weighting factor for gamma rays and beta particles is said to be 1, and the weighting factor for alpha particles 20 times larger than that. The use of a rough but well-rounded number expresses the fact that this index is not very precise. Since the impact on each of the organs (radiation

[70] See Citizen-Expert Committee on Radiation Exposure and Health Management (2013) Problems with the Fukushima Health Management Survey and Emergency Declaration on the State of Health Management, Friends of the Earth-Japan, 28 February 2013; Japan Medical Association (2013) Proposals for Basic Policy Development for the Statute on Protection and Support for the Children and Other Victims of Tokyo Electric Power Company Nuclear Power Plant Disaster, 8 May 2013 (refer to Working Paper No. 280 in footnote 63); and United Nations Human Rights Council (2013) Special Report No. 41 at the 23rd Session of the Human Rights Council (Report of the Special Rapporteur on the right of everyone to the enjoyment of the highest attainable standard of physical and mental health, Anand Grover, Mission to Japan in November 2012), 2 May 2013.

[71] The purpose of the survey was initially to allay concerns among the prefecture's citizens, but it was reviewed after severe criticism of this point from various quarters and revised in April 2013 to a purpose of "aiming to preserve and improve the health of the prefecture's citizens into the future, through the prevention, early diagnosis and early treatment of diseases".

[72] Asahi Shimbun article of 27 May 2013, "United Nations Committee Report Says Nationwide Thyroid Exposure Doses from Fukushima Accident 1/30th Those of Chernobyl" [in Japanese]. The primary grounds for this estimated exposure was a report on the results of an internal exposure estimation based on the half-lives of iodine radionuclides at the beginning of the accident, which was submitted by the government in February 2013, but first released to the public on 8 August 2013, as a result of an information disclosure request by the NPO Information Clearinghouse Japan.

sensitivity) differs for the same equivalent dose, the equivalent dose multiplied by tissue weighting factors for each organ are combined to give the exposure dose to the whole body, defined as the effective dose. The effective dose is expressed in Sv, just as the equivalent dose is.

[effective dose] Sv = Σ ([tissue weighting factor] *i* × [equivalent dose] *i*)

In this equation, the combined tissue weighting factors are set at 1 in total.

The effective dose is thus defined as a whole body exposure index to be used as a rough guide in radiation protection, but its physical meaning is ambiguous. The calculation cannot be carried out unless the equivalent dose is given for each organ. For example, in the case where it is thought that the thyroid gland has been exposed by inhalation of iodine-131, it is not appropriate to calculate the effective dose, and the exposure should be expressed in equivalent dose. When the thyroid gland has been exposed to an equivalent dose of 1 Sv, since the tissue weighting factor of the thyroid gland is 0.04, the effective dose will be 0.04 Sv, creating the illusion that the impact of the exposure has been diluted across the whole body. As the thyroid gland has received damage amounting to 1 Sv, then the equivalent dose to the thyroid gland should be expressed as 1 Sv. We can see from this example that the effective dose can be said to be a hypothetical dose where the risk of damage to an individual organ exposed to radiation is deemed to be distributed or diluted to the whole body.

The physical quantity that air dosimeters and personal dosimeters actually measure is the Gy, but many dosimeters are calibrated in Sv. This sievert indication is the one centimetre dose equivalent. This has been defined by the International Commission on Radiation Units (ICRU) in order to associate dose measurement values from radiation monitors with effective dose. A sphere (an ICRU sphere) of 30 cm in diameter, simulating human body by consisting of the following percentages of elements, oxygen 76.2%, carbon 11.1%, hydrogen 10.1% and nitrogen 2.6%, is placed in a radiation field. This is a hypothetical model in which the dose value at a depth of 1 cm from the surface of the sphere is considered to be the effective dose. The conversion factors to the effective dose from exposure dose and air absorbed dose in Gy, which are basic physical quantities, are given in the International Commission on Radiological Protection (*ICRP) reports.* Measurement devices available on the market are calibrated based on these definitions. As such, the effective dose in Sv indicated on measurement devices is a result of this series of assumptions that have been piled up. This ambiguity should be noted.

(OHNUMA Junichi)

There were warnings from doctors at the site of the Chernobyl disaster that diseases other than thyroid cancer, such as hypothyroidism, cataracts, cardiovascular diseases, immune and endocrine dysfunction, diabetes, etc. had increased among the children there. In addition, numerous diseases or aggravation of existing health conditions were confirmed, affecting all age groups, not only children[73]. Based on the above, it would be desirable to take a stance of treating all kinds of illnesses in health management. The Fukushima Health Management Survey in its current form was designed with a narrow target in mind: thyroid cancer, psychological disorders and the like. In addition to these, a wide range of illnesses, including thyroiditis,

[73] 56th Japan Federation of Bar Associations Civil Liberties Symposium 1st Session Executive Committee, ed. (2013) Local Investigative report on Ukraine - Current Status of Chernobyl Nuclear Power Plant Damage [in Japanese], Japan Federation of Bar Associations.

hypothyroidism, leukaemia, MDS[74], anaemia, cataracts, cardiovascular diseases, decreased liver function, immune and endocrine disorders, breast cancer, diabetes, etc., should be added to the list of items being checked for, and electrocardiogram and urinalysis testing should be implemented.

Currently, testing for the purpose of preventing or treating health damage from exposure to radiation is being implemented only by Fukushima Prefecture and basically only for inhabitants of the prefecture. The radioactive contamination, however, spread far beyond the prefecture's boundaries, so reduction of or exemption from fees for health examinations and medical treatment must be achieved outside of Fukushima Prefecture as well.

Also, as was mentioned in 1-1-3, there are evacuees living outside Fukushima in 860 municipalities of 46 prefectures, and in 10 or 20 years, people who had been exposed to radiation from the Fukushima accident will be living in all parts of Japan. This needs to be taken into account when making preparations for medical support. For Fukushima people who have moved outside the prefecture, the Japan Anti-Tuberculosis Society makes medical testing rounds at the request of Fukushima Prefecture, so the number of evacuees and their distribution outside the prefecture are already known to some degree. So far the examinations have relied mostly on testing, so changes will need to be made to include consultations and diagnostic interviews with physicians[75].

2) Establishing comprehensive health check-ups and medical support

The health management and support system required for protecting the health of people, especially children, in areas that received radioactive contaminants (including areas the radioactive plumes passed through immediately following the accident) should not be for the purpose of establishing whether or not a causal relationship exists between exposure and diseases of itself. Rather, the primary purpose should be protecting health (preventing health damage). For this reason, there is a need to associate it with early clinical detection and necessary medical support. On the one hand, it will be essential to cooperate with specialists in diverse medical fields, while on the other, it will also be important to involve all local medical and health organisations and doctors in private practice. From a long-term perspective, it will be necessary to design a system that enables medical personnel nationwide to handle this. We would also like to repeat and emphasise the necessity and importance of an arena for public discussion and education in which residents can participate, as mentioned in 1-4-1. The national government should take responsibility for providing a support system that can facilitate smooth coordination of the medical system with local residents and communities.

The Science Council of Japan has proposed[76] as a useful measure issuance of health record books or disaster victim logbooks that would also serve in a health management capacity. This would need to be considered in conjunction with measures for reduction of or exemption from fees for medical care. In addition, in order to ascertain the longer-term health effects, including effects on subsequent generations, joint action should be quickly promoted with existing survey projects such as the Ministry of the Environment's *Ecochil* Survey (a nationwide survey of children's health and the environment). For operation and evaluation of a health

[74] Myelodysplastic syndrome. It appeared among atomic bomb survivors, and is also known as "refractory anaemia" or "secondary leukaemia."

[75] JMARI hearing (at the Japan Medical Association Headquarter, 6 February 2014). The Japan Medical Association submitted a request to medical associations nationwide for health checks to ascertain the situation among evacuees outside the Fukushima Prefecture.

[76] Science Council of Japan Sociology Committee Sub-committee on the Great East Japan Earthquake disaster analysis and social reconstruction (2013) Proposals for Efforts to Make and Issues to Resolve for Recovery and Reconstruction from the Nuclear Catastrophe [in Japanese], 27 June 2013 http://www.scj.go.jp/ja/info/kohyo/pdf/ kohyo-22-t174-1.pd

management system as well as centralisation and utilisation of health data, it would be necessary to have supervision and evaluation handled by a committee with transparency (disclosure), independence and fairness in composition of membership, with ethical aspects also considered. Under the Medical Practitioners Act, record cards are stored for five years, but in the case of special health checks (radiation, specified chemical substances, etc.) conducted by businesses under the Industrial Safety and Health Act, they are required to be preserved for 30 years, and for asbestos, 40 years. In the case of countermeasures to nuclear catastrophes, it is important to preserve data for 40 years or more, and that should be stipulated in law[77].

1-5 COUNTERMEASURE 2: SUPPORT FOR EVACUATION AND RESETTLEMENT

[OUTLINE]

1. To help the victims of the nuclear accident in each area, create comprehensive policies and build a system within the framework of the proposed "Basic Act for Recovery from the Nuclear Disaster" (see 1-2-2). In particular, support for resettlement, distinguished from compensation for damages and reflecting the on the actual conditions of the evacuees, should be implemented and expanded.
2. The fundamental principle of the Act on Protection and Support for the Children and Other Victims of Tokyo Power Company Nuclear Power Plant Disaster (see Section 1-4, abbreviated below as "the Victims Protection Act"), that is, the principle of respecting and supporting individual choices, should be positioned within the Basic Act mentioned above, bringing consistency to policies coming out of that law and the Victims Protection Act. In addition, the Victims Protection Act's fundamental action plan should be reconsidered on the basis of that fundamental principle.
3. In making decisions on evacuation and repatriation policies and victim support policies, ensure a forum for open discussions, getting participation from victims living in various areas under various circumstances, along with representatives of municipalities and supporting organisations and specialists with cautious approaches to the effects of low-dose radiation exposure.
4. The orientation of support for reconstruction of the evacuees' lives toward "early repatriation" should not become the sole standard. In rescinding evacuation orders, the residents' views should be respected to the greatest degree possible, and rescinding should not be done in haste. Repatriation of evacuees should be done after the additional annual radiation dose falls below 1 millisievert, and even then, compensation and livelihood support from the government should be guaranteed so that the evacuees can decide for themselves whether to return or stay.
5. The billeting system for housing based on the existing Disaster Relief Act, which presupposes emergency responses for limited terms, should be reconsidered in the proposed "Basic Act for Recovery from the Nuclear Disaster", which is based on long-term effects from nuclear accidents, so as to enable longer-term responses in accordance with the actual state of damage from the nuclear accident. A system should be considered for supporting people choosing not to return by purchasing their land and buildings at prices that would allow them to rebuild their lives in the area to which they have moved, or by

[77] In view of the necessity for a lifetime medical examination system, the current situation from a legal perspective is one of check-ups and medical examinations being implemented haphazardly by different organisations under multiple uncoordinated laws (Maternal and Child Health Act, Child Welfare Act, School Health and Safety Act, Industrial Safety and Health Act, Elder Medical Care Security Act, Health Promotion Act, Atomic Bomb Victims' Relief Act, Fukushima Reconstruction and Revival Special Measures Act, etc.). Conversely, though, even if there exists no budgetary mechanism for health checks in the Victims Protection Act itself, by coordinating it with the existing set of systems laterally, it wold be possible to implement nationwide medical support. The Japan Medical Association, which has considered these interlocking systems, indicated a need to centralise diagnostic data and requested the government to try establishing a "lifetime health project" (JMARI hearing at the Japan Medical Association Headquarter, 6 February 2014).

providing substitutions to that effect.

6. Supportive medium-to-long-term and super-long-term policies should be created for rebuilding local communities and municipalities that are separate from those for rebuilding individual lives.

[DETAILS]

1-5-1 Problems with evacuation policies

There has been a big problem with the evacuation policies and closely related compensation, in that the standard for evacuation was set at a minimum of 20 millisieverts annual cumulative radiation dose. From the designing of the evacuation standards to their implementation, the residents were unable to participate in the decision making. Because of this, there were many residents who were victims but were not paid any compensation. Problems with the government's evacuation policy thus far are listed in **Table 1.2**.

Table 1.2 Current problems with evacuation policies

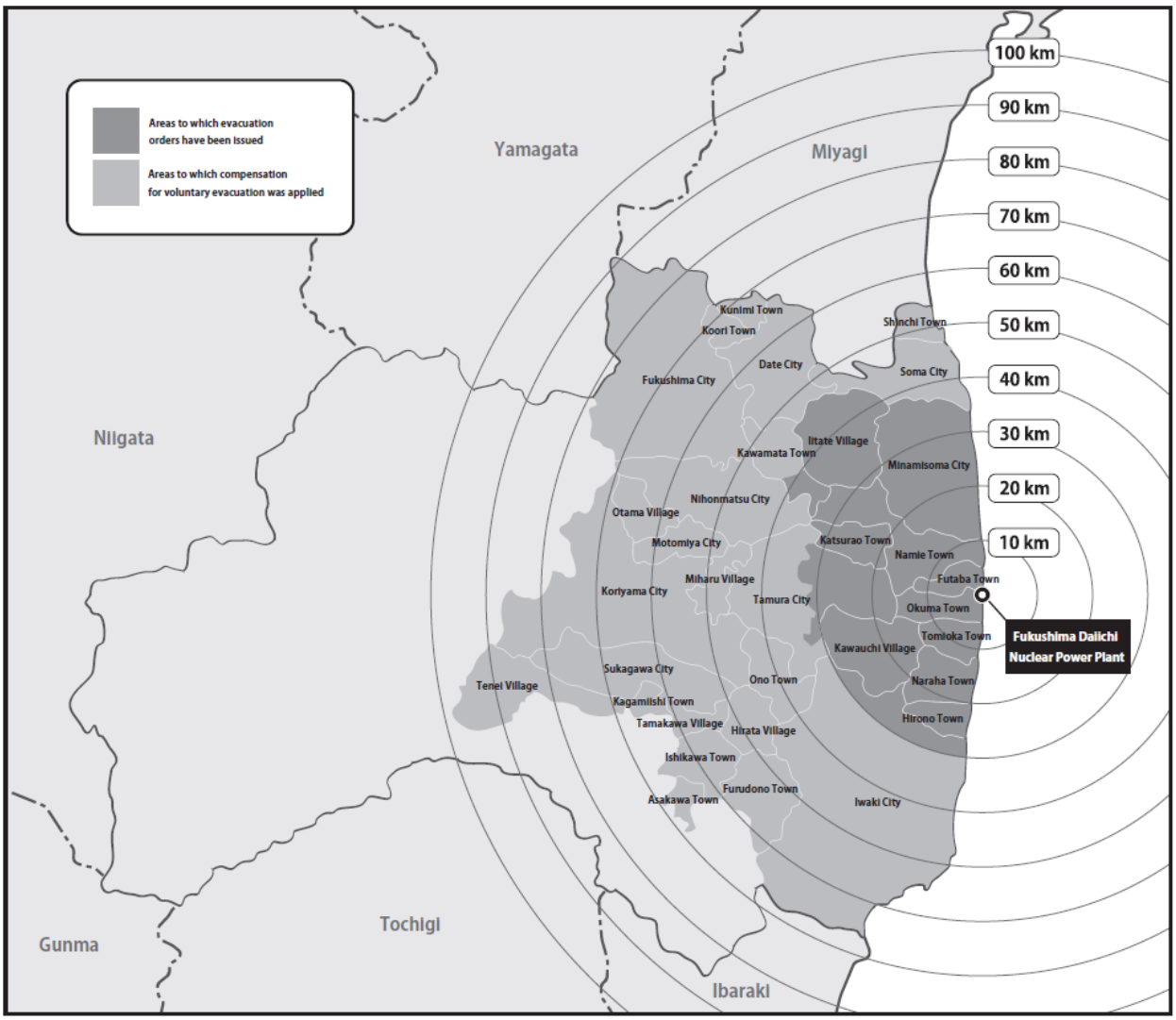
1	Annual 20 mSv standard	There are concerns that, compared to international recommendations[78], Japan's current dose limit for the general public and ordinances for protection against radiation have been set at high levels. Also, the standards apply across the board to everyone, including children and pregnant women, who have higher sensitivity to radiation.[79]
2	Lack of consensus building	Even if social consensus building is difficult under emergency conditions following an accident, after a period of several months, public hearings and discussions need to be held and consensus building undertaken on protecting against exposure and setting evacuation standards. Nonetheless, the government unilaterally decided on standards, causing a rift among the residents.
3	Unilateral designation	When the evacuation zones were designated, the residents' views were not heard. In the Oguni district of Date City and the Watari district of Fukushima City (see column), quite a few residents requested that the entire district be designated a special evacuation zone, and they negotiated with the national and local municipal governments, but their views were not accepted.
4	Almost no room for individual choice	Aside from the "specified blocks for evacuation advisory" designated for individual households, the government only established zones under evacuation orders, and there was no zoning for areas in which residents could decide whether to continue residing there or evacuate, such as "voluntary evacuation zones (=guaranteed transference zones, the so-called "right to evacuate" zones)" established in Russia, Belarus and Ukraine by the Chernobyl Act.[80]
5	Designation too late	In Iitate-mura, the Oguni district of Date City and other areas, residents were unable to evacuate for the first month after the accident, the period when radiation was at its highest levels, so they were forced to undergo needless exposure.
6	Designation too narrow in scope	Parts of areas with radiation levels that were high even under the government's standards, such as the eastern part of Fukushima City, Koriyama City (both in Fukushima Prefecture) and the southern part of Marumori City (in Miyagi Prefecture), did not receive designation.
7	Soil contamination levels not considered	Only air dose rates, which vary easily, were used and decisions were based on insufficient monitoring data. Soil contamination levels, which have an effect on longer-term exposure doses, were not considered.

[78]ICRP recommendations of 1990 (1 mSv/y standard for additional public exposure dose limit), Nuclear Reactor Regulation Act, Ordinance on Prevention of Ionizing Radiation Hazards (e.g., standard of 1 mSv/3 months for radiation controlled areas), etc.

[79]Stricter standards (2 microsieverts/hr at a height of 50 cm) were applied to households with children or pregnant women at "special evacuation points" in Minami Soma.

[80]Enacted in 1991 after the Chernobyl nuclear disaster. In the case of Ukraine, the following zones were designated based on exposure doses and soil contamination (mSv = millisievert, Bq/m2 = becquerels/sq. meter).
Obligatory resettlement zones: Estimated annual exposure dose=5 mSv or more; Caesium 137 concentration=555,000 Bq/m^2 or more
Voluntary evacuation zones: Estimated annual exposure dose=1 mSv or more; Caesium 137 concentration=185,000 Bq/m^2 or more
Enhanced monitoring zones: Estimated annual exposure dose=0.5 mSv or more; Caesium 137 concentration=37,000 Bq/m^2 or more
(Sources: UNDP, UNICEF（2002）The Human Consequences of the Chernobyl Nuclear Accident – A Strategy for Recovery: p.36 and compilation from data in a speech by Yuko Yoshida.)

Residents living outside the areas under government orders were treated as having evacuated voluntarily. They received no compensation, and they were forced into evacuation, the legitimacy of which was hard for society to recognise.[81] The interim supplementary guidelines of the Dispute Reconciliation Panel for Nuclear Damage Compensation (see Section 1-8) issued in December 2011 finally incorporated compensation for "voluntary evacuation", stipulating across-the-board sums for evacuees and residents regardless of status. This applied, however, to only limited areas (see **Figure 1.10**), and the amount of compensation awarded was completely insufficient for resettlement or supporting the lives of the evacuees.[82]



Created based on Dispute Reconciliation Committee for Nuclear Damage Compensation's "Overview of the interim supplementary guidelines (on losses related to voluntary evacuation)", available on MEXT website http://www.mext.go.jp/component/a_menu/science/detail/__icsFiles/afieldfile/2013/12/16/1329116_007.pdf)

Figure 1.10 Voluntary evacuation zones

The Victims Protection Act (June 2012) was supposed to play a big role in supporting the voluntary evacuees, but it continued to have unresolved problems with no basic action plan being drawn up, and when a basic action plan was finally decided on in October 2013, it was unsatisfactory. There were almost no new

[81]As of July 2011, compensation for voluntary evacuation had not been brought up for discussion by the Dispute Reconciliation Panel for Nuclear Damage Compensation (see 1-8-1). This brought severe criticism from evacuees facing difficulties, residents who wanted to evacuate but could not, citizens groups and others, and it became a social issue. Later, compensation policies for voluntary evacuees were seen in the committee's addendum to the interim guidelines of December 2011 and the 2nd addendum in March 2012, but they remained completely insufficient to help the victims. (see 1-1-3 and 1-8-1).

[82]Children and pregnant women residing in the Areas for Voluntary Evacuation between the time of the accident and December 2011 received 400,000 yen across the board (regardless of whether they had evacuated or stayed), and other people residing there received 80,000 yen across the board.

measures, there were limits on the areas to be supported, and it was unable to cover the broad region affected by the earthquake and nuclear disaster.[83] After the accident, air dose rates fell over time in some places but they rose in others, displaying complicated dose distributions even within the same area.

Drawing lines between areas to be or not be supported based on specific radiation doses, as the provisions of the Victims Protection Act mentioned above require, is clearly harmful. For this very reason, an additional annual dose of 1 millisievert should be the basic standard, as has been established internationally and is also the standard under various Japanese ordinances (see 1-4-2), and when there are fluctuations in dose rates within an area, every effort should be made to apply the precautionary principle to be on the safe side (i.e., strive to reduce residents' exposure), and review the designations of areas to be supported.[84]

COLUMN
The case of Fukushima City Watari district

In the Watari district of Fukushima City there are many spots with high air radiation doses, where even the government's readings are equivalent to a yearly dose of 20 mSv. Also the density of soil contamination is high. For example, Fukushima City's June 2011 measurements for Hiragamori and Oomamezuka were 3.2-3.8 microsieverts per hour. September the same year professor Tomoya Yamauchi of Kobe University reported serious soil contamination (four out of five spots measured more than 150,000 Bq/kg).[85] Although there were numerous places were the radiation was higher than the criterion set by the city there was no order or advice to evacuate, on the grounds that there was no will to do so amongst the people. A group of Watari residents approached the local and national government because they thought the whole district should be recommended for evacuation. On 8 October 2011, Fukushima City and the national government (local task force) organised a briefing for residents of the Watari district in which they communicated that the Watari district was not recommended as a "Specific Spot Recommended for Evacuation". Many residents disagreed, but they were not listened to.

(MITSUTA Kanna and ARAKIDA Takeru)

COLUMN
The case of Oguni district in Date City

Many residents of the Oguni district in Date City demanded regional designations for evacuation. Yet, in June and November 2011 "Specific Spots Recommended for Evacuation" were specified on a household basis. Thus, there were residents who faced the situation where their neighbour's house was designated but theirs not. As a result, feelings of anxiety and inequality arose between the residents and the interpersonal relations that had existed until then were broken down

In December 2012 the government's Nuclear Emergency Response Headquarters decided to lift the "Specific Spots Recommended for Evacuation", and three months later compensation payments were cut off. The Headquarters did not hold a meeting to brief the effected residents about this change. In

[83]Problems with the basic action plan were indicated by the Citizens' Commission on Nuclear Energy in its Interim Report (pp. 41-43), and further indications were presented in its discussion memorandum "Basic Action Plan of the Victims Protection Act," which can be seen at the Citizens' Commission on Nuclear Energy website (http://www.ccnejapan.com/?p=3000)
[84]As far as the Precautionary Principle is applied, regardless of the provisions of the Victims Protection Act, designation of basic administrative district units should be permitted as a realistic way to draw up action plans.
[85]Yamauchi T. (5 October 2011). Research results on the radioactive contamination: preliminary report on Watari District's soil contamination [In Japanese]. http://www.foejapan.org/energy/news/pdf/111005_houkokusyo.pdf

the Oguni district there are many places where the air dose rate is higher than 0.5 microsieverts per hour (μSv/h) and at some places it is even higher than 3 μSv/h. Despite this situation, evacuees are pressured to go home. The government is using 3.8 μSv/h as the criterion for dissolving the zones, but the scale that was used to implement the zones was 3.0-3.2 μSv/h. In other words, the limit for dissolving the zones is higher that the limit that was used to implement them and no explanation has been given about the reasoning behind this.

(MITSUTA Kanna)

1-5-2 Reorganisation of evacuation zones, lifting of orders and discontinuation of compensation

The former Emergency Evacuation Preparedness Areas, 20 to 30 km from the nuclear power plants, were lifted on 30 September 2011, and compensation was cut off in August 2012, 11 months after the lifting. About 28,000 people had evacuated from these areas just prior to the lifting.[86] As of September 2013, however, about 21,000 of the evacuees had not been able to return,[87] and they have been suffering privations living in temporary housing in various places without the benefit of compensation.

Furthermore, since 2012, the government-ordained Restricted Area (within 20 km of the plants) and the Deliberate Evacuation Area (parts of Iitate-mura and Minami Soma City beyond the 30 km perimeter) have been rearranged as "Areas to which evacuation orders are ready to be lifted", "Areas in which residents are not permitted to live" and "Areas where it is expected that residents will face difficulties in returning for a long time", as shown in **Table 1.3** (and see **Figure 1.11**).

Table 1.3 Evacuation zone categories (after the 2012 rearrangement)

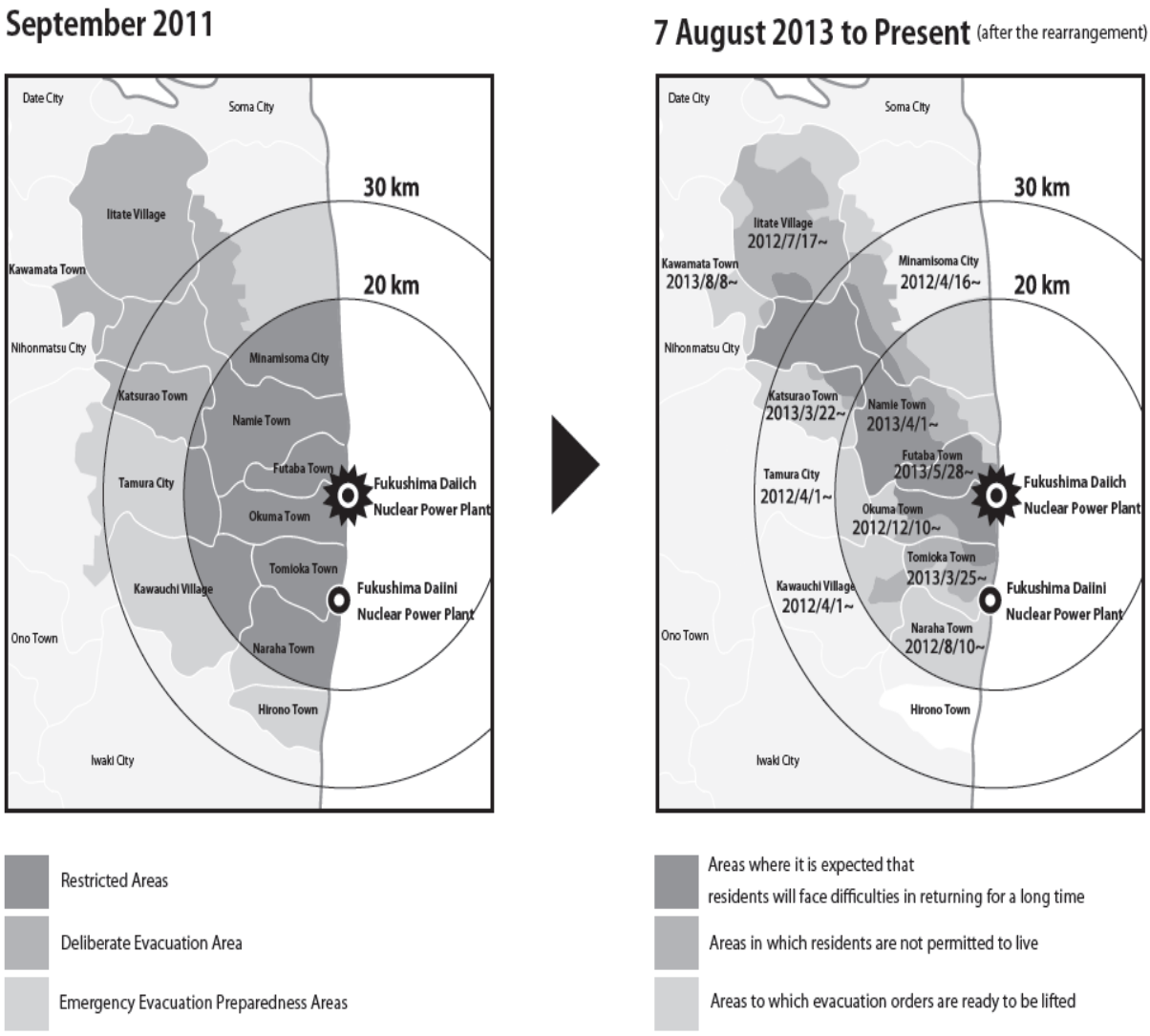
Areas to which evacuation orders are ready to be lifted ("Evacuation to be lifted zones")	Areas within the Deliberate Evacuation Area in which the annual cumulative does has been confirmed with certainty to be 20 mSv or less. Decontamination, urban infrastructure restoration, employment measures and other preparations for early return are being quickly implemented and the restrictions will be lifted sequentially once the living environment is ready.
Areas in which residents are not permitted to live ("Residence restricted zones")	Areas within the Deliberate Evacuation Area, where at the current time, the annual cumulative dose is thought to exceed 20 mSv, and from a standpoint of reducing residents' exposure doses, continued evacuation is required. Temporary visits are possible, and if decontamination succeeds at reducing radiation doses, repatriation will be possible.
Areas where it is expected that residents will face difficulties in returning for a long time ("Repatriation difficulty zones")	Areas in which over the long term (specifically after five years) it is thought that the annual cumulative dose will not fall below 20 mSv, and it currently exceeds 50 mSv. The national government is considering purchasing the real estate in these areas.

After a certain period following the lifting of the various evacuation areas, compensation is discontinued. This "certain period" in the case of the Specific Spots Recommended for Evacuation is three months after lifting, or in the case of the government-ordained Restricted Area, one year after lifting. As was clear in the example of the former Emergency Evacuation Preparedness Zones, however, not all residents are necessarily able to return even if evacuation orders are lifted. If compensation is discontinued, these residents suffer privations.[88]

[86] Support Team for Residents Affected by Nuclear Incidents, Cabinet Office (October 2013) "On reconsidering Deliberate Evacuation Areas" [In Japanese].
[87] Ibid.
[88] For more details on problems involving compensation and the rearrangement of evacuation zones, see Yokemoto, M. (2013) "'Accelerating the reconstruction' and the difficulties of municipalities evacuated due to the nuclear accident—problems with

1-5-3 Policies encouraging early repatriation not reflecting residents' views

The national government has been consistently promoting repatriation. The Early Return and Settlement Plan[89] formulated in March 2013, says "In executing this plan, rather than waiting for the evacuation orders to be lifted, the nation should move toward quick implementation of the needed policies, and further, speed up its efforts. This way, residents who are hoping to return can achieve repatriation even one day earlier" (underlines as in the original).



Created based on "On reconsidering Deliberate Evacuation Areas" prepared by Support Team for Residents Affected by Nuclear Incidents, Cabinet Office (9 October 2013). Available at http://www.meti.go.jp/earthquake/nuclear/pdf/131009/131009_02a.pdf

Figure 1.11 Rearrangement of evacuation areas

After the Fukushima Nuclear Accident, the government ordained Restricted Area (within 20 km of the plants) and Deliberate Evacuation Area (outside the 20km radius but the areas where radiation exposure was thought to exceed 20mSv/year), and evacuated the residents from these areas. Afterwards, in August 2013, the government rearranged these areas into "Areas to which evacuation orders are ready to be lifted", "Areas in which residents are not permitted to live" and "Areas where it is expected that residents will face difficulties in returning for a long time".

rearranging the restricted zones and compensation for damages" [In Japanese], *Sekai*, July 2013 issue, pp. 208-216 (available as discussion memorandum at the Citizens' Commission on Nuclear Energy web page: http://www.ccnejapan.com/?p=3000) (in Japanese).

[89]Reconstruction Agency, Fukushima Headquarters for Reconstruction and Revitalization

COLUMN

Temporary housing living conditions of evacuees from Kawauchi Village[90]

Kawauchi Village in Futaba Gun of the Fukushima Prefecture is located from 15 to 30km southeast of Fukushima Daiichi Nuclear Power Plant. After the accident, eastern part of the village area was designated as a restricted zone and the rest as an emergency evacuation preparation zone. Many of the villagers evacuated to temporary shelters in Koriyama City, approximately 50km to the west. The order for the 20 to 30km emergency evacuation preparation zone was lifted in September 2011 and the monthly payment of 100,000 yen per person in compensation for psychological distress of evacuation was terminated in August 2012. Up to the end of 2013, only about 20% of the villagers had actually returned.[91] In addition to the fact that radiation doses had not declined sufficiently, the reasons given for not returning to the village included the problems that nearby medical facilities remained closed and that it was not possible to repair the homes that had become dilapidated during the long period of evacuation. Many people are finding life very hard since the compensation was terminated. Some have found employment in decontamination operations, working from early morning to late at night. Many Kawauchi Village households own fields where the people used to grow rice and vegetables, and they are now finding that expenses for daily life, such as for food, have become a greater economic burden while living in temporary housing compared with life before evacuation. As the daily life conditions of the residents deteriorated, the residents belonging to the south temporary housing community association put out a nationwide call for "emergency rice support" before the New Year holiday. The residents are saying, "We cannot, in fact, go home even if we want to. Despite this, the evacuation zone order has been lifted and our compensation payments cut off. The situation is as if we have been simply abandoned."

(MITSUTA Kanna)

In September 2013 the Nuclear Regulation Authority formed a working group, which, after convening four discussions, compiled "Basic Ideas on Countermeasures for Safety and Security toward Repatriation" in November of that year.[92] This working group was established with the purpose of "presenting a unified view on concrete detailed protective measures in response to radiation dose levels in anticipation of lifting of evacuation orders", but because of strong opinions of participating members of the Nuclear Regulation Authority, there were lots of references to the necessity of supporting residents who chose to continue taking refuge.[93]

In December 2013, a cabinet decision "Policy for Accelerating Fukushima's Reconstruction from the Nuclear Disaster" (the so-called "Acceleration Principle")[94] was made. It called for supporting both early repatriation and new livelihoods in Fukushima, for strengthening efforts toward wrapping up the accident at the Fukushima Daiichi Nuclear Power Plant, and for accelerating the recovery of Fukushima from the

[90] Interview with Mr Atsushi Shida of the south temporary housing community association and "Left behind in the 'recovery'–The third New Year for the Kawauchi Village temporary housing residents", OurPlanet-TV, 27 December 2013.
[91] Ibid.
[92] See 1-4-3 regarding problems with the government's safety and security countermeasures.
[93] An official document stated, "regardless of whether or not the nation decides on repatriation, we must respect individuals' choices. When responding to various concerns of the evacuated residents, the nation needs to consider the measures needed overall and implement them". (Nuclear Regulation Authority of Japan (2013) "Basic Ideas on Countermeasures for Safety and Security toward Repatriation [for creating concrete protective measures against radiation dose levels]" [In Japanese], 20 November 2013, p. 1).
[94] Nuclear Disaster Management Headquarters (2013) "Policy for Accelerating Fukushima's Reconstruction from the Nuclear Disaster" [In Japanese], Cabinet decision of 20 December 2013.

nuclear disaster with the national government standing at the helm. Within it a lot was said about compensating evacuees for early repatriation.[95] While it was warm toward promoting repatriation, the support for new livelihoods consisted mostly of helping maintain residential communities from the "Repatriation difficulty zones", and even that was limited.

The current situation, however, is that there are many evacuees from the former "Emergency Evacuation Preparedness Areas" (where the orders have been lifted) and from "evacuation to be lifted zones" who do not wish to return or cannot return due to a variety of circumstances. Although the designation of the former Emergency Evacuation Preparedness Areas has been lifted and compensation discontinued, the residents were not informed about the discontinuation of compensation at the time the orders were lifted.[96] Even in the case of the "evacuation to be lifted zones", for which progress toward lifting the orders will be underway in the future, the consultations with residents cannot really be called sufficient. In the Miyakoji district of Tamura City, for which evacuation orders were lifted in April 2014, many residents thought it was too soon to return,[97] but the government's arbitrary explanatory sessions went ahead and the decision to repatriate them was made without any chance for reflecting their wishes in the decision.[98]

In a survey by the Reconstruction Agency's survey of residents' intentions, rates of responses indicating they would not return or did not want to return were lowest in Katsurao-mura at 27.1% and highest in Okuma-machi at 45.6%. For all six towns and villages, responses indicating they would not return exceeded those saying they would like to return at this time (or soon). This indicates that there are many residents who feel they would have trouble returning to their original homes.[99] The orientation of support for rebuilding the livelihoods of evacuees should not be solely toward their early repatriation. The Science Council of Japan has also criticised the standardisation of early repatriation (see footnote 72). What is required is support for the diverse intentions of the residents.

Although the degree of contamination is not evenly distributed, designations of areas were on a governmental district unit basis, so from the perspective of individual residences, there are cases in which radiation doses are higher within the limits of residences than for the "repatriation difficulty zones". In the town of Okuma, where more than 90% of the residents of the "repatriation difficulty zones" are living, and where there is a concentration of social and livelihood infrastructure, even if the evacuation orders are lifted

[95]This compensation is 900,000 yen per person and is undergoing adjustment, but it is being paid only to residents who actually returned within a few months to a year from when the evacuation was lifted, and does not apply to residents of the former "Emergency Evacuation Preparedness Areas", for which the orders have already been lifted. "Decision on Fukushima Daiichi Nuclear Accident Recovery Policy--900,000 yen per person for early returnees" [In Japanese], *Fukushima Minyū*, 21 December 2013.

[96] The "Emergency Evacuation Preparedness Areas" were lifted in September 2011, and the decision to discontinue compensation was made in March 2012 through the 2nd supplement to the Interim Report of the Dispute Reconciliation Panel for Nuclear Damage Compensation (see Section 1-8).

[97] In a survey conducted by NHK, about 60% of the area's residents responded that they would not return (NHK Special, "The Choices of 130,000 Evacuees ~ Three Years After the Fukushima Nuclear Accident", aired on 8 March 2014. In addition, when asked in a survey by Mainichi Shimbun "What would be an appropriate time to lift the orders?" the most common response, at 47%, was "after next spring", while 39% hoped for "this spring". ("Memochō no Katasumi:/27 Countries Not Doing Enough/Fukushima" [In Japanese], 27 February 2014.) Also see "Miyakoji, Fukushima Evacuation to be Lifted: Home Town Spring Joy and Fears" [In Japanese], *Mainichi Shimbun*, 24 February 2014.

[98] At a hearing with residents of Miyakoji, Tamura City, by an investigative team of the international NGO Friends of the Earth (13 March 2014).

[99] Reconstruction Agency (2013) "Fiscal Year 2012 Report on Results of Survey of the Intentions of Residents of Municipalities Damaged by the Nuclear Disaster", May 2013. In a questionnaire survey of the residents of the town of Namie (conducted in January 2013), the distribution of responses was, "I want to return" 22.3%, "I have decided not to return" 27.6%, "I have not decided yet" 29.4%, "I will continue visiting from out of town" 16.9% (Reconstruction Agency, Fukushima Pref. and the town of Namie (2013) Report on Joint survey by the Reconstruction Agency, Fukushima Prefecture and the town of Namie on the intentions of Namie Residents, June 2013.) Later, however, in a survey on the actual state of damage conducted jointly by Waseda Univ. and the town of Namie in April to May 2013 (in which 9,384 responses were received from citizens of the town of Namie of high-school age or over), rejection or hesitance toward repatriation had increased, with 33.7% saying they would not return, 16.5% saying they would, and 44.2% saying they didn't know.

for the rest of the zone, in reality they cannot make their living there. In the village of Iitate, the government proposed plans for lifting the evacuation orders in a period beginning in March 2015, but then requested that it be moved ahead by one year to March 2014. Decontamination efforts have been slow, however, and no progress has been made, so in September 2013, it was announced that decontamination work would not be completed until at least a year after the scheduled date. The government also postponed its own requested date for completion. As a result, it produced much confusion and loss of trust among the residents. The situation is that the government has grasped neither the conditions in each respective municipality, not the intentions of the residents, nor the on-the-ground reality of cleanup operations, and this is resulting in its adherence to early repatriation as the sole road to recovery (see Section 1-6).

This provision of support with no consideration of the difficult conditions faced by the evacuees and not taking their intentions seriously is the result of existing organisations and government bodies protecting the established regional community, with a stance of aiming for economic recovery and reduced costs for industry. This should be called "organisational and economic restoration" with an emphasis on organisations and money rather than people. In contrast, a "restoration of humanity" should be one that fully grasps the difficulties faced by the evacuees, and is conducted jointly with them, incorporating the evacuees' intentions. Under the existing Basic Act on Disaster Control Measures, municipalities have the authority to order and lift evacuations, but they should give maximum respect to the views of the affected residents and their decisions should be based on procedures for gaining residents' consent.[100]

1-5-4 Rebuilding local communities and municipalities

Policies currently in force restrict evacuation to a minimum and encourage repatriation. This comes in the context of concerns that the population will decline and industry will suffer in Fukushima municipalities, resulting in the breakdown of local communities. The fundamental principles of the Victims Protection Act are to recognise uncertainties with regard to the health effects of radiation and ensure freedom of choice for individuals, but these have lost their imperative due to the above-named concerns. Policies supportive of individuals are clearly needed which are separate from those for communities and rebuilding local governmental organisations (creating systems, laws and budgetary measures), but for that, ultimately, policies supportive of the original inter-personal relationships in local communities are needed, along with aid provided to the victims.

The Victims Protection Act should be fleshed out further as the basic law for supporting the victims regardless of whether they are from inside or outside the evacuation zones. However, it is necessary to pay close attention to whether or not it is appropriate to incorporate elements aiming at supporting communities. For example, preparation for lifting evacuation orders (currently when annual doses fall to 20 millisieverts) is an important issue to consider (see Section 1-4), but in this case, measures are now needed to ameliorate impacts that extend to areas without evacuation orders, while at the same time realising that individual residents' options are changing greatly. This is not the kind of problem that can be addressed within the framework of the Victims Protection Act, nor can the current Act on Special Measures for Fukushima Reconstruction and Revitalization handle it.[101]

[100]Yayoi I. (2013) Legal Issues Regarding the Lifting of Evacuation Orders—Concerning the Fukushima Nuclear Accident [In Japanese]. *Ningen to Kankyo*, 39(1), pp. 9-17.
[101]The Citizens' Commission on Nuclear Energy says that there have been too few surveys and too little discussion on how to relate support for rebuilding individual lives with that for the region and coordinate them within the Basic Act on Reconstruction from Nuclear Disasters (see 1-2-2), and that that it is an issue needing more consideration.

In addition to formulating a comprehensive linkage between the necessary evacuation policies, public housing construction and projects for creating bases for livelihood, a discussion is needed about who will play which roles in various programs therein, such as the Victims Protection Act and double residence cards systems.[102] Providing double residence cards is very difficult under the current legal system, so it will be necessary to clarify the purpose and legal basis for it within the proposed "Basic Act for Recovery from the Nuclear Disaster". For the time being, in order for them to be able to receive unrestricted information and services provided from both the villages, towns or cities where the evacuees originally lived and the municipal governments in the places to which they have evacuated, there is an urgent need to create a mechanism such as "victims certificate".[103]

1-6 COUNTERMEASURE 3: DECONTAMINATION

[OUTLINE]

1. The purposes, methods, objectives, priority and scheduling of the decontamination programmes should be reviewed according to categorical differences of respective decontamination targets (such as housing units, housing lands, streets, farming lands, grass fields, forests, holding ponds, river banks and lakesides).
2. No decontamination programmes should be used as a reason for eliminating or rejecting "the need to evacuate/relocate" or "the right to evacuate/relocate". Implementation of a decontamination programme alone should not be used as a reason for recommending "return" of residents.
3. After completing a decontamination programme, thorough measurement should be carried out for air dose rates and radioactive caesium concentrations in soils, and evaluation of the effect of the operation should include validation by a third party. For areas not showing adequate results in decontamination tests, the decontamination methods/schedules should be re-examined.
4. As for temporary deposits of decontamination wastes, situation surveys should be carried out, including surveys on air dose rates and rain runoff volumes. Actions such as enhancement of shielding measures and drainage control should then be taken as needed. For such surveys, full reference should be made to findings from preliminary surveys that residents or citizen organisations have carried out on their own.
5. For wastes from decontamination programmes, volume reduction by incineration should not be carried out without careful consideration. In principle, mixed incineration of contaminated wastes and tsunami rubble or sewage sludge should also be avoided.
6. Commitment of state agencies should also be enhanced for areas designated as "priority contamination survey zones" outside Fukushima Prefecture. Additionally, situation surveys should be urgently carried out for contamination and concentration of radioactive substances in urban areas, including municipalities not designated as "priority contamination survey zones" (in particular, the status of contamination and countermeasures for sludge and incineration ash from sewage works as well as

[102]This is recommended in the proposal by the Science Council of Japan's Sociology Committee that was mentioned earlier (see 1-4-4). For ways of thinking on "long-term evacuation and future repatriation" and support for local communities to make this possible, see Funabashi's paper (Footnote 33 in 1-2-1).

[103]At this point in time, when this kind of handbook system has yet to be established, as a measure based on the Special Act on Evacuees (Law 98 from 2011) the Ministry of Internal Affairs and Communications has sent out a nationwide notice that municipalities to which evacuees from eight cities, towns and villages of Fukushima Prefecture have moved should provide certain governmental services to them even if their residence cards have not been transferred. This special legal exception, however, did not apply to voluntary evacuees from Fukushima City, Koriyama City and other municipalities outside the evacuation zones, nor did it apply to evacuees from places outside Fukushima Prefecture. Just as with the problem of areas covered by the Victims Protection Act (see 1-5-1), the scope of applicability was too narrow. In fact, there are discrepancies in how smoothly the evacuees receive administrative services in the municipalities to which they have evacuated, and there have been cases in which evacuees from municipalities not designated in the Special Act on Evacuees have received services through administrative discretion. Under such unsteady measures, however, the needs of the evacuees and other victims of the nuclear accident cannot be fully met.

general wastes should be surveyed). Prompt countermeasures should then be taken.

7. For decontamination workers, "radiation dose logbook" should be issued according to provisions of the Nuclear Reactor Regulation Law, regardless of their working areas or zones. Full measures for exposure reduction should be taken and ongoing health follow-ups should be provided after they finish working. Also, supervision against unfair labour practices should be enhanced.
8. Management planning and facility siting for radioactive wastes from decontamination operations should be carried out through dialogue with local residents and authorities and consensus based on adequate disclosure of information. It is also necessary to encourage nation-wide discussion based on full information disclosure on how to implement a political decision to end nuclear power generation, including how various wastes from nuclear power plants should be disposed of (Sections 3-4 and 5-2). In that effort, it is important to give consideration to a viewpoint of social reasonability (Section 0-7) besides scientific and economic rationality.
9. Based on the above recommendations, a new law (the "New Decontamination Act") specifically providing for purposes, implementation arrangements and validation processes, should be enacted as one of the specific laws compliant with the "Basic Act for Recovery from the Nuclear Disaster" (See 1-2-2).

[DETAILS]

1-6-1 Drastic re-examination of how decontamination should be carried out

Given the present problems and the situation where the decontamination programmes under the basic policy of the current Decontamination Act[104] are seriously behind schedule, the methods, targets, priority and scheduling of decontamination operations should be drastically reconsidered. Unless the purposes, methods, objectives and schedules are differentiated according to the categorical differences of decontamination targets (such as housing units, housing lands, streets, farming lands, grass lands, forests, holding ponds, river banks and lakesides), effective decontamination cannot be expected.

In Ukraine and Belarus, basically no decontamination has been carried out except in the vicinity of the Chernobyl NPP. Seriously contaminated areas were blocked off, and land use in less contaminated regions depends on the contamination level. Meanwhile, it is reported that, in metropolitan areas such as Moscow and Kiev, local decontamination operations are taking place in response to re-concentration of caesium (re-formation of micro hot spots) even though nearly 30 years have passed since the Chernobyl accident.[105] Those experiences and lessons indicate that we should radically reconsider how "decontamination" should be handled in Japan.

Existing decontamination technology (methodology and chemicals to be used) is basically aimed at local decontamination within radiation controlled areas. It does not assume a situation where wide areas outside the radiation controlled areas or outside the subject facilities are contaminated. In cases such as the accident we have just experienced, where surface contamination extends over very wide areas, it is physically impossible to "decontaminate" in the conventional sense of the term (that is, to remove or collect radioactive substances to eliminate contamination virtually to a zero level). What is possible is limited to "remediation"

[104] Act on Special Measures against Environmental Contamination due to Radioactive Substances Emitted from the Nuclear Power Plant Accident in the Wake of the 11 March 2011 Great East Japan Earthquake, 2011 Law No.110 (Enacted on 1 January 2012, also referred to as "Act on Special Measures against Radioactive Contamination")

[105] This report was introduced in a lecture given by Dr A.V. Yablokov in Kyoto (on 22 May 2013).

according to the nature and contamination level of the site[106]. In areas with a high surface contamination level, local decontamination efforts would not bring about satisfactory dose reduction because radiation inflows from surrounding areas do not decrease.

Examination of the current situation of decontamination operations (most of which are remediation operations) reveals that it is frequently impossible to validate the effectiveness of the work due to inadequate prior measurement. Where appropriate specimens can be obtained, as in a farm field, evaluation should not be restricted to air dose rates (in μSv/hour). Instead, it is necessary to evaluate also by measuring caesium concentrations in soils (in Bq/kg). It is necessary to prepare check lists beforehand for judging the need for re-decontamination, considering the possibility of recontamination after decontamination (from concentration due to water flows and inflows from surrounding forests and fields). At present, national and sub-national governments have a one-shot decontamination policy. However, such a policy will fail to protect the health of local residents[107]. A framework such as monitoring for validation by third parties should be introduced to enhance transparency[108].

The greater the decontamination effort, the more contaminated wastes are accumulated, resulting in more serious exposure to radiation among workers. High-pressure flushing carried out carelessly leads to radiation concentration downstream (agricultural ponds, sewage works and rivers such as the Abukuma River). Except for cases where systems for securely collecting used water are introduced, the flushing method should not be employed. In the case of decontamination of farming lands, it is a dilemma that dose rates will not be lowered unless fertile soils are removed. This imposes a serious problem in satisfying the need for production of high-quality produce and maintenance of yields (Section 1-7).

As for so-called "forest decontamination", given the experience of Chernobyl and considering the limitations, plans should be frozen and drastically reconsidered, except for operations aimed at reduction of air dose rates in housing environments. However, this does not mean contamination should be left totally unaddressed; measures should be taken as needed, for example, to provide gutters for collecting surface rainwater. As for forests, it is also an urgent challenge to take measures against wildfire because wildfire may cause fallouts of radioactive substances leading to serious damage to surrounding areas, farming lands in particular.

On the other hand, there are cases requiring urgent action for decontamination. Even in areas where surface contamination levels (air dose rates) are controlled at around 0.2μSv/hour, certain points are prone to concentration of radioactive substances (micro hot spots) depending on conditions such as geology, drainage routes, as well as vegetation and wind conditions. For such areas, urgent decontamination is required. Existing information on hot spots outside the current "special decontamination areas" should be consolidated and confirmation surveys should be conducted as well as additional surveys in similar environments. Hot spots identified as such should be given priority for decontamination. While such surveys and decontamination operations should be conducted with enhanced direct commitment from the national government, instead of delegation to local governments, information and experiences should be shared among local governments. Collaboration between local citizens' radiation measuring centres and local

[106] Although decontamination techniques and equipment effective for paved road surfaces and wall surfaces have been developed, they cannot cope with all the radiation sources scattered here and there in a living environment.

[107] The Ministry of Environment has concluded a policy to implement "additional decontamination" as additional measures for areas where a decontamination programme has been completed, and presented it to an advisory council on 20 March 2014. It is unclear yet if this means a change of the government's policy concerning multiple-instance decontamination.

[108] As a matter that precedes verification, some have pointed out that decontamination rules are not strictly observed (that is, rules or operation manuals presented at residents' meetings are ignored). There are serious problems in two dimensions: dose reduction effect and radiation protection.

authorities is also important.

The national government should conduct surveys urgently on contamination and concentration (in particular, on the actual contamination situation concerning sludge from sewage works and resulting incineration ash, as well as incineration ash from general wastes) in urban living spheres, including municipalities not designated as "priority contamination survey zones", to secure national-level action.

1-6-2 Measures to support relocation/long-term evacuation concurrently

Decontamination itself is not the purpose, but a measure to achieve the purpose: namely, protection of residents' health. Therefore, we should proceed with decontamination processes while verifying the processes from the viewpoint of whether or not this purpose is being achieved. Particular precaution should be taken to ensure that such processes do not go against or impede the achievement of the purpose.

What is important is that any "decontamination programme" should not be used as a reason for eliminating/rejecting "the need to evacuate/relocate" or "the right to evacuate/relocate". Decontamination and relocation are measures aimed at putting people's lives back in order, not the purpose in itself[109]. It is necessary to examine the rationality (as to radiation exposure levels affecting workers and volumes of contaminated wastes to be generated) of a case where decontamination is carried out after a period of natural attenuation (ten years, for example)[110]. In that case, residents of the subject area have a right to receive assistance whichever option they choose: relocation or return after long-term evacuation. They should also be provided with adequate information on which to base their decision. In case of long-term evacuation, it may be that instead of allocating a huge budget for decontamination, spending the money on building evacuee communities and rebuilding lives would better lead to maintenance of communities and municipalities.[111] The policy exclusively focused on "decontamination and return" currently driven by the government could invite division and collapse of communities as well as imposition of health risks on residents (See 1-1-5 and 1-5-3).

What we must not forget is the fact that there are a number of areas with high caesium deposition levels outside Fukushima Prefecture where many people reside (See 1-1-3). For areas outside Fukushima, decontamination programmes have not even been planned yet. That is a negative result of the government's attitude of giving priority to decontamination in areas with high contamination levels. Normally, priority should have been given to thorough decontamination of areas with low contamination levels to secure safe living spheres. If it is clear that such an approach would be difficult or very time-consuming, serious studies must be made on alternative measures including evacuation.

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[109] Koyama, R. and Ishii, H. (2013) "Grasping the Reality Is the First Step – Creating a Framework for Decontamination and Food Measurement Based on Radioactive Substance Distribution Map" [in Japanese], in *We cacoexist with NPP,* Japan Scientists' Association (eds), Godo Shuppan, 14-20

[110] According to a report of the Ministry of Environment (issued on 7 June 2013), the gamma dose attenuation performance in decontamination model zones was 25% on average as of March 2013. Considering natural attenuation of caesium 134 and weathering (outflow by winds and rainfalls), we should recognise that human interaction hardly brought about any effect. We should also keep in mind that weathering will not eliminate radiation but only transfer radioactive substances elsewhere. However, the attenuation rate up to December 2012 was reportedly 60% (including areas outside model zones). That means the following. Although the initial action such as removal of surface soils on school grounds had dose reduction effect, further attenuation has been very difficult.

[111] For example, recommendations of Iitate-mura Radiation Ecology Study Association: "Is decontamination and return the only way for reconstruction? Assistance for 'relocation' is also required" [In Japanese], Shoji Ozawa, Tokyo Shinbun Metropolitan Edition, 30 November 2011 at http://www.ecology-archiscape.org/iitate/kouhoushien/2011/20111130/2011_11_30.jpg; "Difficulty of decontamination in forests of Iitate Call for the right to build a children's village" [In Japanese], Tokyo Shinbun Metropolitan Edition, 18 January 2012 at http://www.ecology-archiscape.org/iitate/kouhoushien/12/20120118a/2012118a.jpg

1-6-3 Necessity of a new decontamination law

"Recommendation on 'Decontamination'" by the Japan Scientists' Association[112] summarises the present situation as follows:

> […] Describing the present situation, not even the definition of decontamination and how its effect should be verified is agreed upon. Nor is the decontamination technology established or systematised. Furthermore, there is no prospect of establishing final disposal sites and interim storage facilities or relocating huge masses of wastes from decontamination operations. Thus, wastes from decontamination operations are left without destinations and "temporary disposal facilities" are scattered throughout areas where decontamination has been carried out. Moreover, social debates on the pros and cons of decontamination and its feasibility have stagnated or are blocked. In the first place, we do not have adequate specific data for discussing the above issues. Under such circumstances, it is impossible to calculate the labour, time and cost required for decontamination operations.

We at the Citizens Commission on Nuclear Energy share the above basic recognition. It is often said that the reason why decontamination does not proceed smoothly is that sites for containing wastes are not secured (See 1-6-5). Indeed, this is a great factor. However, the underlying cause lies in a structure where the purpose of decontamination is not clearly shared, there is no exchange of opinions or collaboration with local residents, and only a budget flow is secured without a framework for verifying the effect of operations. In order to solve this problem, it is essential to establish the following points that are not adequately dealt with under the current Decontamination Special Measures Act by systemising laws and regulations concerning decontamination[113]:

- Clarify the definition and attainment targets of decontamination;
- Clarify the roles and authorities of the national government, sub-national governments and decontamination operators;
- Crack down on inappropriate decontamination practices;
- Secure the status and human rights of decontamination workers, reduce exposure in workplaces and conduct thorough labour and health management;
- Set up a third-party organisation for managing planning, implementation and evaluation of decontamination operations;[114]
- Secure the right of local residents to proactively participate in planning, implementation and evaluation of decontamination operations;
- The national government should assist research and development of decontamination technologies, including adoption of expertise from overseas;
- Research and development should not be restricted to engineering-related fields, but should include viewpoints of environmental and agricultural studies, such as ecological science and hydrology.

The new law for decontamination should be positioned as one of the specialised laws compliant with the

[112] "Recommendation on Decontamination" by the Japan Scientists' Association (Decontamination Study Team), 11 February 2014 at http://www.jsa.gr.jp/03statement/20140211a.pdf

[113] These items are based, with minor changes, on the above mentioned "Recommendation on Decontamination" by the Japan Scientists' Association.

[114] The arrangements for establishing a third-party organisation will depend on the organisation responsible for decontamination—whether it will be JNDA proposed in Section 3-5, or the Agency for Fukushima Nuclear Disaster Compensation and Recovery proposed in Section 5-4. This issue requires further study.

principles of the proposed "Basic Act for Recovery from the Nuclear Disaster" covered in 1-2-2. As for its operation, an Agency for Fukushima Nuclear Disaster Compensation and Recovery (Section 5-3) should be in charge, supported by the knowledge and expertise of the Ministry of Environment, the Ministry of Agriculture, Forestry and Fisheries, the Ministry of Land, Infrastructure, Transport and Tourism, the Ministry of Health, Labour and Welfare, and the Reconstruction Agency.

1-6-4 Protecting health and rights of decontamination workers

When implementing decontamination/remediation operations, an urgently required task is to carry out all-out measures to minimise radiation exposure among workers and to enhance supervision against unfair labour practices (failure to pay wages/allowances and exploitation by intermediaries, etc.). In so doing, consideration should be given to the on the ground situation where the current system of labour administration cannot totally address the issue with the limited workforce of the labour standards supervision offices. A third-party evaluation should be urgently carried out into the employment system, prior training, on-site radiation protection, and post-operational health management, and consideration should be given to legislative measures for reform of penalties.

Unlike on-site workers operating on the premises of nuclear power plants, in most cases, off-site decontamination workers operating outdoors actually do not receive radiation dose logbook as employers are only "required to make an effort" to issue them.[115] Given the special nature of work that involves handling massive volumes of radioactive substances, even if the concentration levels are low, as well as the high risk of inhaling such substances, radiation exposure control should be carried out thoroughly by issuing radiation exposure handbooks compliant with the provisions of the Nuclear Reactor Regulation Law for both on-site and off-site workers and for those who work inside and outside of areas subject to evacuation orders. Ongoing post-operational health follow-ups should also be conducted.

Identifying how much decontamination is necessary and sufficient (1-6-1) contributes to reduction of loads on waste disposal facilities (1-6-5) at the same time as directly leading to reduced radiation exposure among workers. It should be recognised as a human rights issue for decontamination workers (Section 1-4).[116]

1-6-5 Disposal of wastes from decontamination operations

Concerning radioactive wastes (soils, sediments, wastes from weeding and pruning, sewage, sludge, waste cloth, construction materials, miscellaneous materials and equipment), final disposal methods and sites are unclear. That has led to delays in selecting interim storage facilities. Furthermore, even preparation of temporary deposit sites cannot keep up with the need, resulting in "on-site storage" in "provisional temporary storage sites" on the premises of private houses and within local communities without adequate management. Such a situation is itself illustrative of a major impasse in Japan's nuclear policy, which has been promoted without making a decision on the final disposal method for nuclear wastes.

Air dose rates around temporary deposit locations (temporary deposit sites and on-site deposits) are high, and it can hardly be said that adequate measures have been taken to prevent outflows due to rainfall. As of end of December 2013, 636 temporary deposit sites had been set up, and the number of on-site deposits in

[115] The handbook is issued to workers engaged in radiation-exposed work and is aimed at central control of exposure doses. Initially, respective operators voluntarily managed them, but since 1977, the Radiation Dose Registration Centre, managed by the Radiation Effects Association, controls radiation exposure doses.

[116] Refer to the principles for addressing radioactive waste (Chapter 3). In Chapter 2, approaches toward reactor decommissioning are discussed from a viewpoint of radiation exposure doses of workers. This is also based on the same principles (Section 2-5).

Fukushima Prefecture has reached as many as 47,433.[117] It is also a concern that flexible containers (**Figure 1.12**) used for collecting contaminated wastes have a short durable period of three to five years. It is necessary to urgently conduct situation surveys on those storage sites and take necessary measures, such as enhancement of shielding and drainage management. Local governments should be the responsible entities for conducting such surveys with assistance from the national government. Meanwhile, authorities should be prepared to address the issue by fully referring to data from numerous surveys conducted by residents on their own.

Figure 1.12: After decontamination work, resulting radioactive waste is packed into flexible containers. The containers are then stacked in layers in rice paddies, road sides and empty lands. They are also buried beneath private lands and school yards. Radiation dose in these areas is high. (Radioactive waste temporary stored in Kawauchi Village and Miyakoji District in Tamura City. Photos taken by Shinya Sato on 6 January 2016.)

Concerning radioactive wastes including surface soils, plant wastes and sludge that have been removed through decontamination operations, the Ministry of Environment has presented a policy to keep them for about three years in "temporary deposit sites" or on decontamination sites, and then to store them for about 30 years at "interim storage facilities" to be set up collectively in Futaba-chō and Okuma-chō, Fukushima Prefecture, but discussion with local authorities and residents has not been pursued adequately. While the policy has it that final disposal is to be conducted outside Fukushima Prefecture, no specific approach for establishing social consensus for selecting disposal sites has been proposed.

Regardless of such long-term planning, temporary incineration sites have already been constructed and put into operation in various communities without explanation to or agreement with local residents. It is also a concern that existing incinerators are in operation using electric dust collectors, emitting radioactive caesium as they go. Careless use of incineration for volume reduction of decontamination wastes is against the principle of protecting the health of local residents. Also, mixed incineration of decontamination wastes and tsunami-originated rubble and/or sewage sludge should be suspended until verification and third-party evaluation is conducted afresh.

The decontamination programme should be re-examined and cases where decontamination is effective distinguished from those where it is not. Attenuating dose rates over wide areas with conventional technologies would be astronomically expensive. We are caught in a dilemma where without adequate spending the attenuation effect is limited, but where money is spent to achieve satisfactory results, greater

[117] The figures are based on statistics released by Fukushima Prefecture (28 February 2014). Areas directly managed by the state are excluded. The numbers have roughly doubled compared to statistics as of the end of July 2013. Deposits on the premises of houses and offices amount to 44,531, a majority of which are located in Fukushima and Koriyama Cities. ("Doubled in Number: 48,164 temporary deposits and on-site deposits of decontamination wastes" [In Japanese], Fukushima Minpo, 1 March 2014)

quantities of contaminated wastes are produced.[118] The time has come to reconsider the volume of decontamination materials generated (that is, the capacity of storage facilities required) by reviewing priorities on the list of remediation targets.

1-7 COUNTERMEASURE 4 FOOD SAFETY AND THE RESTORATION OF AGRICULTURE AND FISHERIES

[OUTLINE]

1. As a result of the contamination of a large portion of the country by radioactive materials, the safety and reliability of food have been shaken and the health of the citizenry and the sustainability of the agriculture and fisheries of eastern Japan have been threatened.
2. To minimise the internal radiation exposure of the citizenry, and to do so in a manner compatible with realising the restoration of agricultural and fishing communities and the "restoration of humanity" of the people employed in these activities, requires sufficient attention to and protection from radiation exposure at the sites of primary production and the establishment of systems and long term policies that will synergise testing of radiation in food with measures at the stage of production.
3. Measures to guard against reputational damage, such as risk communication and information provision, are meant only to instil a sense of confidence in consumers. They do not guarantee occupational or food safety. To ensure the safety of food products and the safety of food production activities, it is necessary to conduct thorough on the ground measurements of radioactivity and to carefully manage radiation exposure levels. It is imperative that through testing radiation in food at multiple stages, the organisation of radioactivity transfer rates for each crop species into a database and measuring, mapping and zoning the radiation levels of agricultural land and surrounding environs are all conjoined and coordinated with one another.
4. It is imperative that measures for testing radiation in food and point of production management are strengthened not only for Fukushima but for Iwate, Miyagi, Ibaraki, Tochigi, Gunma and Chiba Prefectures, and that a nationwide system is established that includes the stipulation of laws and further analysis of food product distribution.
5. In regard to the safety of food products, voluntary radiation monitoring activities by citizens are being technologically improved and incorporated into networks and databases. Along with the realisation of monitoring functions through public inspection systems, it is necessary for government policies aimed at reducing internal radiation exposure to be improved through the participation of producers and consumers and for this citizen-based participation to be linked with the overall system.[119]

[DETAILS]

1-7-1 Considerations for ensuring safety from radiation in agricultural work

While careful attention must be paid to the transfer of radioactivity to agricultural products, radiation

[118] As an issue that is related but of another dimension, "a decontamination project" is also a public work project that contributes to the local economy. We should calmly analyse the implication of the mini-bubble situation among "decontamination businesses" and the civil engineering and construction industries. While bringing about temporary jobs to local communities, the fact that such operations support people's livelihoods may affect young households as they may feel that it is difficult to opt for "evacuation/relocation". Consideration should also be given to the possible impact that may be imposed on local communities by inflows of decontamination workers from outside.

[119] On the topic of linking voluntary citizen-based and government led measurement activities see the supplementary paper to CCNE's "Interim Report" available at http://www.ccnejapan.com/?p=1661 (see Ohnuma Junichi's "On the fundamental reform of the system for measuring radiation in food" [In Japanese]).

exposure during farm labour should also not be underestimated. Prolonged labour in the outdoor environments of areas affected by the nuclear disaster carries with it the possibility that radioactive materials will be inhaled or adhere to clothing. Any decision to avoid such labour (or to limit it) as a response to such concerns must be respected as fundamental to the right to avoid radiation exposure (see 1-4-1). Considering the need both to ensure food safety and to protect workers from radiation exposure, it is imperative to provide appropriate compensation in situations where people are unable to resume their previous occupations (see section 1-7-4).

1-7-2 The importance of four stage testing: linking measures from entry to exit

To minimise internal radiation exposure from food products, two things are essential: 1) exclusion of food products that exceed the limits for radiation in food by testing radiation in food and 2) pre-emptive reduction of the transfer of radioactive materials to food (including to food products below the limits) through measures at the point of production. These two have to go hand in hand and it is imperative that they are used to establish systems for food production, distribution and testing for the mid- to long-term. These systems should be tailored to the specific characteristics of agriculture (e.g. fruits, horticulture, dairy, livestock), fishing (e.g. oceanic and inland waters) and hunting and gathering (e.g. wild animals and non-timber forest products such as mushrooms and other wild edibles).

Except for rice, testing of radiation in food is primarily conducted through destructive testing. As such, it is impossible to test the actual food product to be distributed, and any testing will inevitably be "sample testing". Accordingly, the issue becomes how to prevent sampling omissions and how to ensure the precision and accuracy of "sample testing"[120]. It is also imperative to reconsider the limits for radiation in food. It seems that high intake foods such as rice and wheat should have more stringent radiation limits. However, it is not the case that merely making limits more stringent will solve all of the issues. At present, many food products (excluding some fruits, beans, and mushrooms and wild edibles and some wild marine or game animals) are often found to have contamination concentrations around the lower limit of detection (10 Bq/kg). Even if the current limit of 100 Bq/kg were changed to 30 Bq/kg, as in Belarus and Ukraine, then the majority of food would still pass inspection. Accordingly, in order to further minimise internal radiation exposure, it is important to reduce radioactive materials in food by incremental measures, and it is here that measures at the point of production become essential. More concretely, testing must be thoroughly conducted at the following four stages, and these stages must be coordinated and linked (i.e. entry and exit policies must be reinforcing and interlinked) in order to urgently construct a system capable of effectively reducing radiation contamination in food to the utmost[121].

Stage 1: Radioactive materials measurement at points of production, mapping of data and zoning based on data and maps

Stage 2: Organisation of transfer rates into a database and absorption countermeasures based on this data

Stage 3: Coordination of local government and JA Cooperative (National Federation of Agricultural

[120] The following opinion has been stated in regard to the debate over whether prevention of internal radiation exposure can be realised through improving the precision of testing. When radiation testing for food is conducted through destructive testing, the actual food products are never tested. In this there exists a contradiction between the "logic of testing" and the "logic of commerce". Even if there is a possibility that in the future non-destructive testing can be applied to foods other than grains, for now destructive testing remains contradiction-laden.

[121] Koyama, R. & Ishii, H. (2013). "Everything based on actual conditions: building decontamination and food product testing systems based on radioactive material distribution maps" [In Japanese] in The Japan Scientists' Association (Ed.), *We Cannot Coexist with Nuclear Power Plants* pp.14-20. Godo Publishing. 14-20.

Cooperative Associations) screening with national and prefectural monitoring

Stage 4: Testing by citizens at points of consumption and testing by distributors and retailers

First, based on radiation monitoring at points of production, and maps created from that data, transfer rates can be used to select crops for cultivation (stage 1), and chemical analysis of soil and water control can be used to reduce transfer to food at the stage of cultivation (stage 2). To implement effective radiation reduction measures, it is imperative that farmland be immediately measured for radioactivity and the results mapped. Government monitoring should be continuously pursued for products to be distributed (stage 3) and the results made publicly available, while for wild-harvested foods that do not reach the market or for foods subject to complex processing consumers should be provided with devices for conducting their own tests followed by government monitoring of their results (stage 4). It deserves special mention that the numerous "people's stations for radiation monitoring" established throughout the nation during the first year after the accident were established through the voluntary efforts of citizens. Through much research and by mutual verification of data, these voluntary monitoring sites have improved the accuracy of their measurements and the construction of open databases is also progressing[122]. The above examples of measurement efforts at the consumption stage can be expected to provide a feedback mechanism for monitoring at the production stage.

By using the knowledge gained from these four stages to mutually influence each other and improve methods and organisation, it becomes possible to produce positive synergistic effects and to make a more efficient and holistic system. When building such a system, government and administrators alone should not be responsible for decision-making. Rather, producers and consumers should autonomously participate in the introduction of thorough measure into localities, zoning and food testing. Also, we would like to propose that a forum be established for discussing the planning, implementation and evaluation of the above policies. In addition to enhancing the transparency of consensus building, the construction of such systems demands the systematisation of rational and effective radiation protection measures that are well adapted to local conditions.

Methods such as one-sided, indoctrinating "risk communication" or public relations campaigns meant to alleviate consumers' concerns and avoid "reputation-harming rumours" cannot alone solve the problem of reputational damage. The only true response to reputational issues, and also the basis for the "restoration of humanity" in agriculture, is to build a system that allows producers to produce with confidence and a testing system that allows consumers to trust products and ensures that safe products are supplied.

1-7-3 Systemisation of testing

While it is imperative to better link the screening tests conducted by local administrations and agricultural and fishing cooperatives with the monitoring tests conducted by the national and prefectural governments, there are a number of other issues of concern related to current food distribution, including difficulties in identifying the original sources used in processed foods, complex distribution channels that erase (or "launder") the origins of goods, and blended rice that contains rice from several locations.[123] The monitoring activities of citizens are important mechanisms for correcting these problems, but it is imperative that public forums for discussing such problems are urgently established and that consumer and producer participation is

[122] Combined Database of Independent Radioactivity Measurement Labs (Minna No Data Site) http://www.minnanods.net

[123] There is also the issue that the limit for processed foods such as dried soybeans, soy flour, rice and freeze-dried rice that were produced before the new limit of 100 Bq/kg was established was set arbitrarily by the manufacturer at the old limit of 500 Bq/kg. Consumers were completely unaware of this.

recognised as a prerequisite.

It is necessary to strengthen the terrestrial and marine monitoring of strontium 90, which is currently not being conducted to an adequate extent.[124] Strontium concentrations are particularly high in the contaminated water leaking into the ocean and monitoring of marine products is urgently needed.[125] While it is difficult to predict the transfer and accumulation of radioactive materials in marine products due to fish migration, tide and current, water convection and other factors, transfer mechanisms should be identified, and it is imperative for government and administrative agencies to link together monitoring, which is important for determining the possibility of resuming fishing operations, and to publish the data. At present the number of fish samples tested for caesium is far too small and there is a need to urgently expand these efforts. Procedures are in place for measuring caesium in marine products at the main fishing ports of the Pacific Ocean from Chiba to Hokkaido, but there is no system within MAFF or the prefectural governments for collecting the data for products under the voluntary standard of 50 Bq/kg set by fishing cooperatives. [126] Therefore, the results properly obtained are not being effectively utilised. Monitoring should not be restricted solely to determining whether products can be shipped. Rather, there is important potential to use such data to observe and identify the changes of marine product radiation contamination over the long-term. Accordingly, it is essential that a system be set in place to centralise and analyse data collected at each port (see 1-7-6).

It is important that food products for which reduction measures are possible, such as mushrooms cultivated in indoor facilities, are separated into different distribution channels from wild products. In addition, it is important that more care is placed on the contamination conditions of grasslands and on measures counteracting such conditions. It is also important to identify the transfer of radioactive materials in the circulation of biomass (e.g. forest litter, compost, manure).[127]

1-7-4 Recognition of damage: pay attention to damages to the stock

The damages caused by the nuclear disaster accrued not only to the "flows" of the affected areas (e.g. decreased sales), but also to farmlands environments, local society and social relations, or the "stock" of these areas (see 1-2-1). The loss of tangible and intangible "stock" was severe and includes: 1) complete radioactive contamination of the productive environment built up gradually over centuries 2) loss of the amenities (the sources of a comfortable life) of agricultural and fishing villages and their productive livelihoods and 3) destruction of local brand images as well as social capital (e.g. the loss of face-to-face relations between organic producers and consumers).

At present, only compensation pertaining to the amount of lost sales has been recognised. It is important first to clarify the reparations and compensation to be made by identifying the full extent of the wide range of compensation needed. To that end, detailed radiation monitoring and mapping are urgently needed, along

[124] The measurement of strontium was identified in the "Manual for Radioactivity Measurements in Food in Emergency Situations" published by the Ministry of Health, Labour and Welfare's Drug Administration Food Health Department Monitoring Safety Division in March 2002 as the nucleus for monitoring. Measurements should be implemented to accord with that.

[125] If an experimental laboratory (around the size of a high school science lab) equipped with a ventilation system were available, the isolation and purification of radioactive strontium would be possible and if hundreds of low background gas flow counters (each one costs 8 million yen) were widely deployed then tests could be conducted at 100 times current efforts.

[126] Samples that are identified as over the 50 Bq/kg limit by the NaI scintillator at each fishing port are retested by prefectural germanium semiconductor detectors. This data is collected and made public by the Ministry of Health, Labour and Welfare. However, it seems that there is no such centralisation of data for specimens under the 50 Bq/kg limit.

[127] Fukushima Prefecture had been putting effort into woody biomass (pellet stoves etc.) as a form of renewable energy, but the stock of pellets was radioactively contaminated as a result of the nuclear accident. Wood bark is highly contaminated and, at present, only the core of wood (white pellets) can be used. Additionally, large amounts of waste are emitted, and the incinerated ash is a concerning element.

with stronger efforts to conduct a comprehensive survey of how the people's life in the primary industry areas is suffering from the nuclear accident. This is the basis for the "restoration of humanity".[128]

1-7-5 Establishment of legislation, and restructuring and reinforcement of research organisation and monitoring systems

Although allowable limits for radiation in food are specified under the Food Sanitation Act, important measures such as radiation monitoring of the farmlands, mapping as well as stipulation of and responsibility for restricted shipments have no legal backing. Up till now they have been pursued in piecemeal fashion. Additionally, current environmental monitoring regulations such as the Water Pollution Prevention Act do not adequately correspond to a situation characterised by wide distribution and long-term retention of large amounts of radioactive materials. A "special measures" act must be established that will enable the strengthening of laboratory facilities, and the strengthening and extended capacity of equipment and inspection personnel.

In light of the fact that radioactive contamination is lot limited to Fukushima Prefecture but extends throughout eastern Japan, it is essential that the systematic strengthening of policies is not limited to Fukushima Prefecture but also targets Iwate, Miyagi, Ibaraki, Tochigi, Gunma and Chiba Prefectures in ways that are well adapted to local conditions in each area.

In regard to the promotion and compilation of fundamental research on radiation reduction measures and research into and supervision of its social dissemination, it is important to further the division of roles and assignment of responsibilities in existing, new and reformulated systems. It is imperative to have a fine-grained network including, for example, assignment of radiation response with associated staff training to agricultural (and marine) support centres, and also involving prefectural agricultural research stations, fisheries research stations, the National Institute for Agro-Environmental Sciences (MAFF), the National Research Institute of Fisheries Science (Fisheries Agency), and universities.

1-7-6 Inspections systems in the fishing industry and the revitalisation of fisheries

Issues related to the revitalisation of the fishing industry, including current conditions and appropriate industry responses, and approaches to trial operations and sales, are not well understood or adequately analysed. Analysis of the reality of large amounts of highly radioactive water leakage has still not been conducted. In regard to the leakage of contaminated water into the ocean, it is important to construct a consistent inspection and research system, not only for the immediate disaster, but also for the ongoing water contamination problem. Data from the Fisheries Experiment Stations and other research institutions must be centralised and coordinated, and a monitoring system that takes into account the specific conditions relating to the movement of radioactive contaminants in the marine environment into a variety of fishery products. Since the ocean is continuous in extension, the current situation where policies and decisions are made at the prefectural level is inadequate. It is important to develop inter-prefectural inspection systems, and laws and policies to back them up need to be urgently established.

The zoning of fisheries is of a completely different character than the zoning of agricultural land. Also, in regard to food product inspection, since the absorption mechanisms of agricultural and marine products are different, it is important to pay careful attention to how their distribution and mid- to long-term trends and

[128] On the topic of compensation for damages, see sections 1-8 and 5-3.

fluctuations in radiation concentrations will also differ.[129] As noted in 1-7-3, there is a great need to establish strontium measurement systems and to compile, collect and analyse the caesium measurement data from each fishing port. Since the transfer rate for freshwater species is higher than for oceanic species, freshwater fisheries must be considered separately. In addition, without consideration of the specific features of marine environments and fisheries, it is impossible to link back to actual practices and procedures.[130]

Without constructing systems for inspection based on identification of the radioactive contamination conditions of ocean environments and the transfer mechanism to marine products, as well as the resultant measures that can ensure safety at all times, then even the identification of small amounts of products over the limits for radiation in food will result in the problem of "reputational damage". Repeating the mistakes of the first year after the disaster in agricultural policy will be a serious obstacle for the revitalisation of fisheries. Scientific data, and inspection systems based on that data, as well as legal structures and policies for backing them up are the foundations of real safety and the only pathway to instilling trust in consumers.

1-8 COUNTERMEASURE 5 COMPENSATION

[OUTLINE]

1. TEPCO and the national government must adopt the principle of "restoration of humanity" and the recovery of victim's rights and sincerely listen to the voices of the victims in order to promote relief. Since the damage from the nuclear accident is still unfolding, compensation and support for victims must not be hastily aborted.
2. The government's Dispute Reconciliation Panel for Nuclear Damage Compensation (*Genbaishin* in abbreviated Japanese)[131] must listen to the voices of actual victims, squarely admit the "loss of homelands", extend compensation to evacuees from outside the designated evacuation zones and re-examine its compensation guidelines with reference to the actual realities of the damage.
3. TEPCO must recognise that the guidelines of the Dispute are minimal criteria for compensation and omissions from the guidelines must not be rationalised as grounds for denying compensation.
4. The Nuclear Damage Compensation Dispute Resolution Centre (aka 'Nuclear ADR') must be given independence from the Dispute Panel and the ADR's ruling power must be strengthened.
5. The negative prescription period of compensation claims against either TEPCO or the national government must be abolished.

It should be noted that the review of the Act on Compensation for Nuclear Damage (Nuclear Compensation Act) and problems with the Nuclear Damage Compensation Facilitation Corporation Act are closely related to problems associated with TEPCO's bankruptcy proceedings and the succession of its liabilities and, as such, will be dealt with in 5-3-1.

[129] On trends in the measurement of radiation in marine products see Ohnuma, J. "On the fundamental reform of the system for measuring radiation in food" referred to earlier in footnote 115.
[130] On the specific features of the fisheries of the affected areas see Hamada, T. (2013). *Fisheries and the Earthquake* [in Japanese]. Tokyo: Misuzu Shobo Publishers. And also Hamada, T. (2013). "Restoration of fisheries from nuclear disaster and food risks" [in Japanese], *Sekai* April, pp.133-140.
[131] In the case of any damages resulting from the operation of a nuclear power reactor, this committee is established under the 1961 Act on Compensation for Nuclear Damage (aka Nuclear Compensation Act) to mediate and achieve settlement between the victims of the accident and the operators of the plant. It falls under the jurisdiction of the Ministry of Education, Culture, Sports, Science and Technology (MEXT).

[DETAILS]

1-8-1 Reviewing the Dispute Panel guidelines

For damages subject to compensation, the Dispute Reconciliation Panel for Nuclear Damage Compensation (or "Dispute Panel" in short) produces guidelines that indicate the minimum range. Essentially, however, the Committee's guidelines do not adequately consider the actual conditions of the Fukushima nuclear disaster. Additionally, the purpose of the guidelines is to encourage settlement between perpetrator and victims, and the details have been limited only to a "modest" range acceptable to TEPCO and its financial backer, the central government.

Nevertheless, TEPCO is utilising the Dispute Panel's guidelines as if they defined the "maximum" for compensation and this has resulted in conflict regarding damages not covered or omitted from the guidelines. For example, since compensation for psychological damages (i.e. consolation money) resulting from evacuation does not adequately reflect the actual damages it has been contended in the Nuclear Damage Compensation Dispute Resolution Centre (as discussed in 1-8-2) and in lawsuits. Additionally, since evacuees from outside the official evacuation zones[132] remain almost entirely uncompensated, their treatment under the Victims Protection Act has been poor (see section 1-5), and lawsuits are constantly being pursued in many areas as a means of securing relief (to be discussed in 1-8-3).

One of the problematic points of the Dispute Panel's guidelines that can be mentioned is that the serious damage that we refer to as the "loss of homelands" has not been recognised. On 26 December 2013 the latest guidelines (fourth amendment) [133] of the Dispute Panel were established, and they stipulated that "compensation for lost homelands" should be paid to evacuees, such as those from the difficult-to-return zone. However, that payment simply extends existing evacuation consolation into the future as pre-payments and thus it is difficult to say that it has squarely admitted the "loss of homelands". [134]

1-8-2 Strengthening the authority of the Nuclear ADR

The Nuclear Damage Compensation Dispute Resolution Centre (aka Nuclear ADR)[135] is a dispute resolution agency charged with mediating settlements through reference to the Civil Code, existing laws and ordinances, as well as the guidelines of the Dispute Panel. As a result of these restrictions, it is not easy to extend compensation by going beyond the range of responses found in the Dispute Panel's guidelines. For example, as evidenced by statements such as "couldn't visit the family grave site" or "lost the home where s/he intended to live until the end of her/his life" in the negotiations of the lawyers who serve as ADR mediator, there are cases where compensation sums are added, but there are limits to the individual damages under the current ADR calculation system. Given these limitations, as noted above there is a need to both revise the Dispute Panel's guidelines to correspond with the actual conditions of damages and to to allow the ADR

[132] Evacuees from areas that have not been identified by the government for evacuation, evacuation has not been encouraged and requests for evacuation have not been received are referred to as "voluntary evacuees" (see 1-3-1 and 1-5-1).

[133] The assessment criteria for property damages questioned on p.44 of CCNE's "Interim Report" have been greatly improved for resident's compensation in this fourth amendment. However, the real test will be how TEPCO actually pursues compensation in response to this revision.

[134] For detailed accounts of how to understand "loss of homelands" see Yokemoto, M. (2013), *Questioning Nuclear Disaster Compensation: Ambiguous Responsibility, Mercy for Evacuees.* [in Japanese] Tokyo: Iwanami Shoten (Iwanami Booklet), and Yokemoto, M. (2013) "What should be done about recovery from and compensation for nuclear accident damage, primarily in relation to 'loss of homelands'?" [in Japanese] *Kankyo to Kogai* 43(2), 37-43.

[135] Also called *Genpatsu ADR* in abbreviated Japanese. [Update at the time of translation: The dispute resolution centre, also known as ADR (alternative dispute resolution), is a legal system of out-of-court arbitration by which claims can be handled more quickly and less formally than they are in court. The Nuclear Damage Compensation Dispute Resolution Centre (Nuclear ADR) is the one established in 2011 to deal with the Fukushima accident cases.]

Centre greater autonomy to make decisions beyond the Dispute Panel guidelines.

Victims of the Fukushima nuclear power plant accident have three means of claiming compensation, including direct claims, litigation and petitions to the ADR Center. While it seems the overwhelming majority have chosen to file direct claims, since private negotiations are not made public it is actually difficult to grasp the whole and precise picture. Amidst evacuation, the loss of livelihood and the continuation of damages, the decision to file suit is not easy either financially or in terms of the time required.

Petitions to the ADR Center can be filed without fees and since filing a lawsuit is not necessary and it basically focuses on interviews with the mediation committee it is easy to use. Since most cases are decided within six months, it presents a lower hurdle for victims. It has also has the advantage of maintaining privacy, unlike a lawsuit that is publicly disclosed. [136] The burden of proof is also less stringent than in compensation lawsuits.[137] Owing to these characteristics, the use of ADR Center seems rather advantageous for victims as a settlement and mediation method. It is thus very unfortunate that the system is highly restricted by the guidelines of the Dispute Panel. In light of a nuclear disaster of unprecedented scale, it seems that it is imperative to ensure the independence and strengthen the adjudicatory function of the ADR Center in order to ensure the support and relief of victims.

However, it is important to remember that the ADR Center was established in compliance with certain laws and it is thus only capable of dealing with "discussions about damages". In order to clarify "discussions about responsibility" it is necessary to go to trial.

1-8-3 Issues regarding the statue of limitations on civil compensation claims

It was originally thought that victim's right to compensation claims against TEPCO and the central government would be limited to three years by the provisions of the Civil Code.[138] However, a nuclear power plant disaster is different from a simple compensation claim in that damage conditions extend to a very long term, and damages can even expand with time. Furthermore, as a result of such things as long-term evacuation and separation of families, as well as inability to conduct business or operations, there were cases where victims are unable to find the extra time and energy to pursue compensation claims. Moreover, many people were not so fortunate as to have the assistance of bar associations or "Houterasu" (i.e. the Japan Legal Support Center) and therefore do not understand how to file claims. Amidst a situation where the nuclear power plant accident itself was not stabilised and it was impossible to set plans for the future, it was highly concerning that there are people who are unsure of whether to file claims and whose rights to compensation claims will expire because they are unaware of the legal time limits (negative prescription).

Initially, in response to this problem, the government established the "Act on Interruption of Prescription in the Nuclear ADR"[139] in May 2013 to cope with this. If a petition is made to the ADR Centre then the

[136] However, in ADR settlement cases are made public and it is thus possible to identify the tendencies regarding what kind of settlements have been reached.

[137] The above account of the advantages and disadvantages of ADR are based up several presentations and a panel discussion held at the "Is this really acceptable for compensation and relief of the damages of the Fukushima nuclear power plant accident" symposium of the Japan Federation of Bar Associations held on 8 June 2013 in Tokyo. For further information see Kojima, N. (2013) "Actual management and relief efforts at the Nuclear Damage Compensation Dispute Resolution Centre" [in Japanese], *Kankyo to Kogai* 43(2) 17-24.

[138] Article 724 of the Civil Code states "The right to demand compensation for damages in tort shall be extinguished by the operation of prescription if it is not exercised by the victim or his/her legal representative within three years from the time when he/she comes to know of the damages and the identity of the perpetrator."

[139] Act on special provision to interruption of prescription regarding use of mediation procedure by the Dispute Reconciliation Panel for Nuclear Damage Compensation for nuclear damage disputes related to the Great East Japan Earthquake (5 June 2013 Act 32)

prescription period is not applied. However, under this law the period of prescription is only extended in the following cases: 1) a petition is made to the Nuclear ADR before the prescription has expired, 2) when mediation is aborted by the Nuclear ADR and 3) when a lawsuit is filed within one month of mediation being aborted. Thus the procedures for this special law are too complicated for victims to pursue. Although it was meant to provide relief, it is highly limited in practice.

Later, partially as a result of pressure from the Japan Federation of Bar Associations, and through the bipartisan support of the ruling and opposition parties in the Diet, the prescription period was extended to ten years from December 2013. Additionally, the stipulation of "twenty years from the day of illegal actions" noted in the Civil Code was changed to "twenty years after the moment of damages" by a special exemption law. [140] The provisions of the latter guarantee that in cases where claims like ones relating to health damage that occur in the long term that the extinctive prescription will not have effect.[141]

This special act applies only to victims who file compensation claims against TEPCO, while the period of prescription for compensation claims against the central government remains three years. Three years have passed since the initial accident, and since entering into 2014, 17 plaintiff groups from around the nation (including Fukuoka, Ehime, Okayama, Kyoto, Kobe, Niigata, Gunma, Tochigi, Saitama, Yokohama, Tokyo, Sendai, Yamagata etc.) and suits from over 1,700 evacuee groups have filed suit. In particular, for voluntary evacuees living difficult lives, the psychological and physical burden of a trial is enormous. Indeed, to be rushed by the legal deadline into "last-minute appeals" is to heap further damages upon already existing damages.[142]

The provisions of the extinctive prescription in the standard Civil Code are not intended for a situation in which a nuclear power plant accident results in a large number of long-term evacuees. We must review whether the extension of limits to ten years adequately considers the characteristics of the damages or adopts the perspective of the victims dealing with the damages. In regard to claims for compensation resulting from the Fukushima Daiichi nuclear power plant accident, those will have to be reassessed in accordance with the proposed "Basic Act for Recovery from the Nuclear Disaster" (1.2.2, 1.5) and associated laws and rules.

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http://law.e-gov.go.jp/htmldata/H25/H25HO032.html

[140] Act on measures to ensure prompt and certain compensation for nuclear damages caused by the accident at the nuclear power plant associated with the Great East Japan Earthquake and special provisions to period of prescription for the right to demand compensation for such nuclear damages. (11 December 2013 Act 97) http://law.e-gov.go.jp/htmldata/H25/H25HO097.html

[141] For further information regarding these special acts see Mizukami, T. (2014) "Reasons for and legal issues of legislation of law on extension of prescription period for claims for compensation of nuclear damages caused by Fukushima Dai'ichi nuclear power plant accident" [in Japanese], *Horitsu Jiho* 1071.

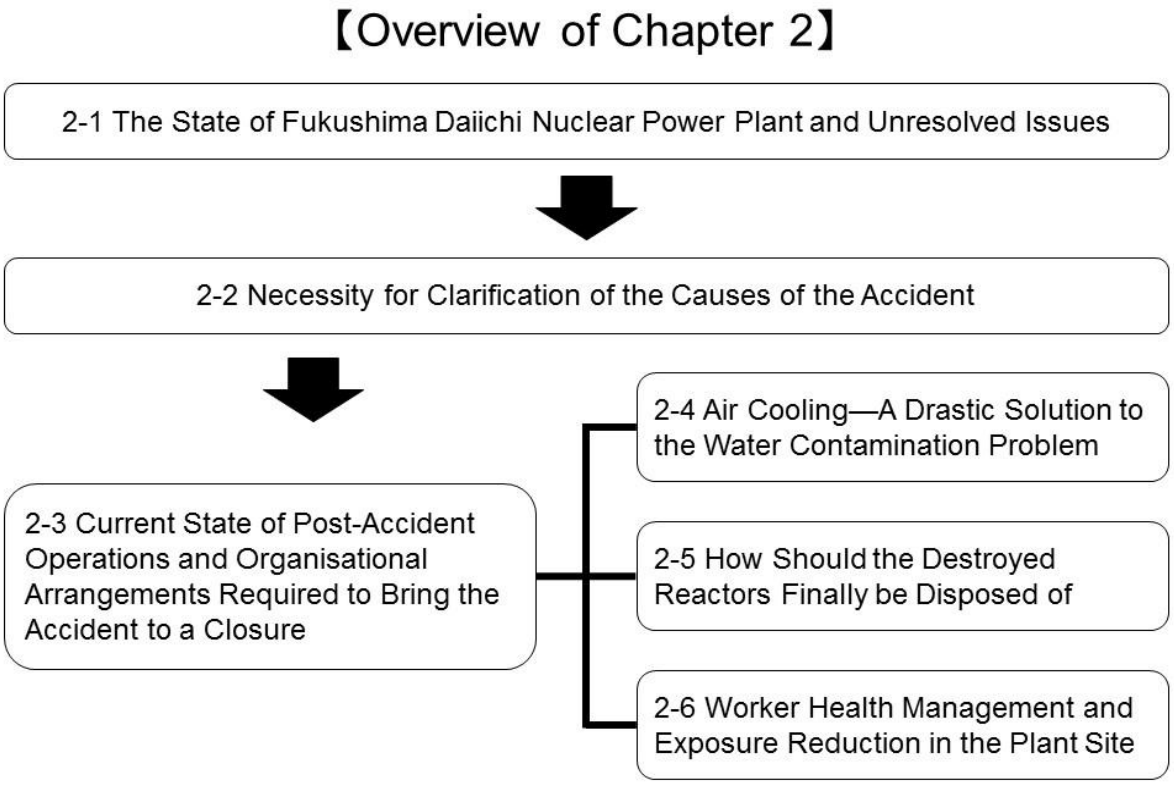
[142] Although it is separate from the negative prescription problem, it must be said that the issue of aborting of compensation following the government's "return evacuees policy" discussed in 1-5-2 is also for victims a cruel final blow.

Chapter 2
The Actual State of the Fukushima Daiichi Nuclear Power Plant Reactors and Issues Surrounding the Accident Settlement

2-0 Overview and Structure of Chapter 2

In this chapter, we firstly look chronologically at what took place inside Tokyo Electric Power Company (TEPCO)'s Fukushima Daiichi Nuclear Power Plant, from 11 March 2011 onwards, and through what process the nuclear power plant has passed to reach the current situation. What we must understand is that, even now, an accurate and detailed timeline of the accident has still not been ascertained and continued investigations are vital. The reoccurrence of nuclear power plant accidents cannot be prevented without clarification of the causes of the accident based on thoroughgoing investigations at the accident site. In addition, we analyse the causes and background to the radioactive water problem, which is becoming so complex and severe that it is now a major stumbling block to conclusion of the accident. We then summarise issues and proposals aimed at bringing the accident to an end.

We have once again been reminded of the scale of nuclear disasters, which cannot be reversed once they have occurred, and the subsequent difficulties in bringing these disasters to a close. While three years have now passed since the accident, who could have imagined beforehand that the contaminated water problem, which could be said to be a secondary consideration, is now the greatest barrier blocking the way to a permanent conclusion to the accident? One significant factor that is causing difficulties in bringing the accident to a conclusion is that the responsible organisations have become almost completely dysfunctional. An integrated implementation system in the form of an "Agency for the Decommissioning of the Fukushima Daiichi Nuclear Power Plant (Fukushima Decommissioning Agency–FDA)" should be set up on a state scale as a matter of urgency. At the same time, arrangements should be made for the liquidation of TEPCO.



According to the "Mid-and-Long-Term Roadmap"[143] for the conclusion of the accident issued by the government and TEPCO, a flooding method[144] will be used to remove the molten fuel (debris) over the next 30 to 40 years. There is a strong possibility that this will become little more than an illusory notion, and, furthermore, involve immense worker exposure. Reducing worker exposure by improving the radiation environment at the site, as well as the social and labour environment, are the most serious issues facing the continuation of work to end the accident in the long-term. In technical terms, we propose to resolve the water contamination problem by introducing air cooling of the fuel debris, and simultaneously to minimise worker exposure to radiation by constructing a sarcophagus over the stricken reactors. It would seem that there is little choice but to use this monument, consisting of the destroyed reactors and surrounding area, as a "negative heritage", a permanent reminder of humanity's error in attempting to harness the power of the atom. In any case, removal of the fuel debris by the flooding method is a dangerous choice and plans for this approach should be suspended immediately.

[143] Tokyo Electric Power Company Fukushima Daiichi Nuclear Power Plant Decommissioning Measures and Implementation Council, "Mid-and-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Plant Units 1-4", [In Japanese], 27 June 2013, http://www.tepco.co.jp/nu/fukushima-np/roadmap/images/ t130627_04-j.pdf

[144] To prevent radioactivity being dispersed into the atmosphere, the containment vessel is filled with water and the molten fuel (debris) is then removed.

Table 2.1 Fukushima Daiichi Nuclear Power Station Accident Timeline

2011	Actions by government and TEPCO	Unit 1 460MW, Online	Unit 2 784MW, Online	Unit 3 784MW, Online	Unit 4 784MW, Down for maintenance
11 Mar. 14:46	M9.0 Tohoku-Pacific Ocean Earthquake occurs				
		Automatic Reactor Scram			
		Loss of external power (Automatic activation of emergency diesel generators)			
15:37		Emergency diesel generators stop due to breakdown. Total loss of AC power. Oil tanks, etc. washed away (Arrival of tsunami)			
16:00	TEPCO notification in accordance with Art.10 of Act on Special Measures Concerning Nuclear Emergency Preparedness				
		High pressure core injection system (HPCI) failure			
		Emergency isolation cooling system (IC) malfunction	Reactor Core Isolation Cooling System (RCIC) starts up		
		Loss of cooling function			
16:45	TEPCO report in accordance with Art.10 of Act on Special Measures Concerning Nuclear Emergency Preparedness				
21:23	PM Kan orders evacuation from area within 3 km radius, and sheltering indoors from 3 km to 10 km radius.				
21:50		Radioactivity level inside building rises			
12 Mar. 00:06		Preparation for containment vent ordered			
02:30		Pressure in pressure vessel and containment rises to 8 atms. (Pressure vessel damage)			
05:44	Evacuation from area within 10 km radius ordered				
11:36				RCIC stops	
12:35				HPCI starts up	
14:30		Containment vent operation implemented			
15:36		Hydrogen explosion in reactor building			
18:25	Evacuation order altered to 20 km radius				
19:04		Seawater injection to reactor begins			
13 Mar. 02:42				HPCI stops	
				Loss of cooling function	
08:41				Containment vent operation implemented	
13:12				Seawater injection to reactor begins	
14 Mar. 04:08					Spent fuel pool (SPF) water temperature rises to 84°C
05:20				Containment vent operation implemented	
11:01				Reactor building explosion	
13:25			RCIC stops		
			Loss of cooling function		
19:54			Seawater injection to reactor begins		
15 Mar. 00:01			Containment vent operation implemented		
05:25	Government and TEPCO set up Disaster Management Centre				
06:10			Sound of severe shock heard in vicinity of pressure suppression vessel (Pressure 0 atms.)		
06:14					Explosion in vicinity of SFP
07:00	With the exception of disaster prevention personnel, about 650 workers temporarily evacuate to Fukushima Daini Nuclear Power Station.				
09:38					Fire in reactor building
11:00	Sheltering indoors ordered from 10 km to 20 km radius				
	Ministry of Health, Labour and Welfare raises permissible dose for workers to 250 mSv				
		Inability to cool reactors and SFPs continues			
18 Mar. 17:50	Nuclear and Industrial Safety Agency (NISA) announces accident to be Level 5 on the INES scale				
24 Mar.~		Radioactivity of between 10,000 and 100,000 times more concentrated reactor water detected in water accumulated in the basement of the turbine buildings, indicating that the fuel had sustained severe melting and damage and water had flowed out into the turbine building.			
		Traces of plutonium detected in soil samples taken from within the grounds of Fukushima Daiichi Nuclear Power Station on 21 and 22 March.			

25 Mar. 11:46	Voluntary evacuation requested from 20 km to 30 km radius
5 Apr.	Nuclear Safety Commission advises that the evacuation criteria be a total dose of 20 mSv.
11 Apr.	30 km radius established as planned evacuation area.
12 Apr.	NISA announces accident to be Level 7 on the INES scale
12 May.	TEPCO first admits that Unit 1 experienced meltdown.

Prepared with reference to the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), taking into account facts known later, and by revising the table published in the Citizens' Nuclear Information Center Tsushin No.442, p.6 (April 2011)

As some parts of the progression of the accident are as yet unclear, this table may be reviewed in the light of further evidence becoming available in the future.

2-1 THE STATE OF FUKUSHIMA DAIICHI NUCLEAR POWER PLANT AND UNRESOLVED ISSUES

[DETAILS]

1. The cause of the Fukushima Daiichi Nuclear Power Plant accident was failure by the government and TEPCO to make adequate provision against an accident, including prior assessments of massive earthquakes and tsunamis.[145] Further, as the disaster-prevention system almost completely failed to function after the outbreak of the accident, the number of exposed residents and the degree of exposure were unnecessarily increased.
2. This accident has made it clear that once a serious accident occurs at a nuclear power facility it cannot be controlled by human technology. The government's "declaration of a cold shutdown state" (16 December 2011) was totally unfounded in fact. The accident is still continuing to this day. Workers at the site are being forced to struggle with the cleanup operations in an exceedingly severe environment.
3. Due to the high level of radioactive contamination, it is almost impossible to carry out onsite inspections of Fukushima Daiichi Nuclear Power Plant's important equipment. This causes difficulty in assessing the state of the damage and the causes of the accident. It is therefore impossible to obtain the information and knowledge necessary for preventing reoccurrences of accidents. It is also impossible to gather basic information, such as the flow route of groundwater into and the flow route of contaminated water out of buildings, that is absolutely necessary for designing countermeasures. These are difficulties that are inescapably associated with severe nuclear power plant accidents and are symbolic of the dangers of nuclear power plants when compared with other industrial technologies, which have been improved in response to repeated accidents and other mistakes.

[DETAILS]

2-1-1 What happened in the Fukushima Daiichi Nuclear Power Plant accident?

When the M9.0 earthquake hit Fukushima Daiichi Nuclear Power Plant, Units 1, 2 and 3 were online at rated capacity, Unit 4 was under repairs to the inside of the reactor, and Units 5 and 6 were down for regular maintenance. The control rods automatically inserted in the reactors that were online, bringing the fission reaction to an emergency halt. A huge tsunami struck Fukushima Daiichi Nuclear Power Plant about 50 minutes after[146] the occurrence of the earthquake.

Although the fission chain reaction was halted in the online Units 1, 2 and 3, the fission products of uranium that had accumulated during operation continued to release large amounts of decay heat. The normal external power (AC), the emergency diesel power supply (AC), and batteries (DC power supply) had all failed due to the earthquake and tsunami, the emergency core cooling system (ECCS)[147] function had been lost, so the

[145] In 2006, the concept of "residual risk" (the potential for damage to the reactor core by an earthquake that exceeds the reference seismic movement) was introduced at the time of the revision of the Regulatory Guide for Reviewing Seismic Designs of Nuclear Power Reactor Facilities. Despite the fact that it is scientifically impossible to determine the greatest reference seismic movement and reference tsunami for use in design, nuclear power plants cannot be designed unless the reference seismic movement and reference tsunami are established for each site. Although the "residual risk" was introduced with the awareness of this contradiction, that awareness was not put to use when determining design criteria. See Section 4-1 for "safety thinking" in regulatory criteria for nuclear power facilities. See Section 4-4 for "residual risk".

[146] There are uncertain factors involved in the time of arrival of the tsunami, and these are important clues for uncovering the true causes of the accident (see the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), Section 2.2.3.4).

[147] The Unit 1 IC (isolation condenser) and the Units 2, 3 and 4 RCIC (reactor core isolation cooling system) are not classified as the ECCS.

reactor core fuel rods overheated and melted down. It is possible that in Unit 1 piping was ruptured or damaged by the earthquake and that the core meltdown was accelerated by a loss of coolant accident (LOCA). TEPCO has stated that the zirconium alloy used in the fuel rod cladding tubes and channel boxes reacted with steam to produce large amounts of hydrogen gas, which exploded inside the reactor buildings of Units 1 and 3, blowing away the walls and ceilings. TEPCO has also said that hydrogen gas exploded in the Unit 4 reactor building after flowing into Unit 4 through piping from Unit 3.[148] In Unit 2, the reactor building blowout panel had already been blown out by the shock of the explosion in Unit 1, so there was no explosion leading to a collapse of the building there.[149]

2-1-2 Continuing problems at Fukushima Daiichi Nuclear Power Plant

In the process of the series of accidents, the confinement function of the containment vessel was lost, resulting in releases of large amounts of radioactive materials into the environment.[150] Even now, although far less compared with the time of the accident, releases of radioactive materials are continuing all the time.[151] In addition, as mentioned below, far greater amounts of radioactive materials are flowing into the sea.

Cooling water is being supplied to the molten nuclear fuel in Units 1, 2 and 3 through a makeshift circulation system. The cooling water is constantly leaking out returned via a route from the reactor to the reactor containment vessel and then to the reactor building, where the accumulated contaminated water is pumped up and supplied to the reactor after removal of radioactive materials such as caesium by use of makeshift treatment equipment. The contaminated water is flowing into the turbine building as well as the reactor building, though the route is not clear. As the underground walls and floors of both buildings are constructed of reinforced concrete and are not watertight, groundwater is flowing in at the rate of around 400 tons per day. The contaminated water level in the buildings is controlled to be lower than that of the external groundwater to prevent contaminated water from leaking out. Contaminated water has also accumulated in the trenches that connect the two buildings. Since the amount of contaminated water continues to increase every day, large numbers of temporary storage tanks are being set up on the premises of the nuclear power plant, but eventually there will be no more space on which to set up new tanks. The trenches mentioned above are also not watertight and many of the temporary storage tanks, which were constructed in great haste from flanged parts held together by nuts and bolts, have become a huge problem because of frequent leakages of contaminated water. In particular, it has become clear that leaks from the trenches have continued since the occurrence of the accident, and this is developing into an international issue.

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148 Regarding the explosion in the Unit 3 reactor building, according to one theory, cooling of the spent fuel stored in the spent fuel pool on the fifth floor had stopped, and while the water in the pool was boiling the hydrogen explosion that occurred in the upper part of the of the building may have triggered a nuclear explosion. However, since too little information has been disclosed by TEPCO, such as underwater photographs of the fuel pool, there is insufficient proof of such an event. Whatever the case may be, it is thought that a hydrogen explosion occurred.

149 As the pressure in the Unit 2 pressure suppression chamber dropped rapidly at the same time as this explosion in Unit 4, it was said at first that an explosion had occurred in the vicinity of the Unit 2 pressure suppression chamber. However, later, the sound of the explosion was thought to be from Unit 4, and it has not been confirmed that an explosion occurred inside Unit 2. But as the amounts of radioactive materials released from Unit 2 are relatively high, there is a strong possibility that the containment or surrounding piping has been badly damaged.

150 There are several possibilities for the routes by which radioactive materials leaked from the buildings, including: through the vent line, opened for venting operations; through flanges and cable holes in the containment vessel, which had been damaged by high temperature and pressure; or from damaged parts such as ruptures and cracks in boundary piping. This possibility is especially strong in Unit 2, where venting failed. TEPCO claims that venting of Units 1 and 3 was successful, but since disassembling checks have not been carried out on the rupture disks (a safety valve which ruptures under high pressure), it is unclear whether they have actually ruptured or not. If the rupture disks have not ruptured, then, as with Unit 2, radioactive substances have leaked out through another route.

151 According to a TEPCO announcement in February 2014, this was 10 million Bq per hour. Releases fluctuate and are sometimes observed to become temporarily greater.

Coming into 2014, contamination consisting of strontium and other elements was detected at the highest level since the accident in a well between the turbine building and the sea, and it was confirmed that water contaminated with high levels of radiation is flowing into the sea via the groundwater. Consideration of measures to stem the flow of contaminated water into the sea is continuing. Ideas such as a frozen earth barrier method have been mooted, but the search is still on for a workable proposal.

In order to reduce the increasing volumes of contaminated water that need to be stored in the temporary storage tanks, consideration has begun on changing the method of cooling the molten nuclear fuel from the current "water-cooling method" to an "air-cooling method", but since the location, form and so on of the nuclear fuel is as yet unclear, the specific plan is still in the preparation stage (see Section 2-4).

A multi-nuclide removal system (ALPS—Advanced Liquid Processing System), which is supposed to be capable of removing all nuclides except tritium, has been installed to treat the large amount of contaminated water that has accumulated in the temporary storage tanks, but performance of the equipment in test runs has not gone well, and it is not yet officially operative.

The spent fuel pools (SFP) of each unit continue to be cooled by makeshift cooling systems. All the reactor core fuel of Unit 4 had been moved into its SFP because repairs were being carried out inside the reactor, so the pool contained 1,535 fuel assemblies (of which 204 were fresh fuel). Located in the highest part of the reactor building, which had almost collapsed, the SFP was damaged in a subsequent earthquake. Since there was the concern that huge releases of radioactive materials far exceeding those of March 2011 might occur if it became impossible to cool the fuel, the underside of the pool was fitted with steel supports. This was also an emergency measure, and operations to transfer the fuel stored in the Unit 4 SFP to an interim storage facility onsite began in November 2013. It was expected that the transfer of all the fuel would require about a year, but there were anxieties about the possibility of an accident if a large earthquake struck the site during the transfer operation. No earthquake-proofing reinforcements were carried out for Units 1, 2 and 3. [Update at the time of translation: Transfer of the fuel assemblies from Unit 4 to the common pool was completed in December 2014. The outlook is obscure as to when and how the spent fuel rods in the upper floor SFPs of Unit 1, 2 and 3 can be transferred.]

As a sufficiently high seawall has not been constructed even after the March 2011 tsunami, the Fukushima Daiichi Nuclear Power Plant site overall is still vulnerable to tsunami events. If there are strong aftershocks, perhaps causing a further tsunami to hit the site, there is the fear that the hoses and other equipment involved in the makeshift cooling water circulation could easily be damaged, or even washed away. Or if a strong aftershock were to hit the reactor buildings, where the spent fuel is stored in the SFPs, there is the fear that the pools might develop fissures from which the water would drain out, making it impossible to cool the fuel or shield the radiation from inside the pool. [Update at the time of translation: Although most of the soft hoses have since been replaced by metal or hard-plastic pipes, strong aftershocks remain grave concerns.]

In Section 2-3 we give proposals for means and measures that should be taken at the Fukushima Daiichi Nuclear Power Plant site. We also discuss the problem of radiation protection and health management of exposed workers in Section 2-6.

2-1-3 What has not been investigated about the Fukushima Daiichi Nuclear Power Plant accident

The detailed state of the interior of the buildings is almost completely unknown. This is because particularly

important aspects of the situation inside the nuclear power plant, for instance the location and state of the molten nuclear fuel (debris), the reactor pressure boundary[152], the reactor containment vessel boundary, the state of damage to the ECCS-related equipment, piping, etc., cannot be directly inspected, as excessively strong radiation precludes approach to the sites by people. The destructive forces may have included earthquakes, tsunamis, hydrogen explosions, high temperature, high pressure, sloshing (the violent movement of liquids) and so on, but it has not been clarified which of these was responsible for causing each particular kind of damage. This has therefore been an obstacle to understanding the developmental process of the accident. Determining whether the Unit 1 hydrogen explosion occurred on the 5th floor of the reactor building (as explained by TEPCO) or on the 4th floor (as speculated by the NAIIC in the course of its investigations) is extremely important information that has a bearing on whether or not main piping damage was caused by the earthquake. However, despite the fact that it is possible to visit the location, TEPCO blocked an onsite investigation by refusing to cooperate, so confirmation of the facts remains impossible. [Update at the time of translation: In February 2015, onsite inspection of the 4th floor of Unit 1 was finally conducted by a team of expert engineers commissioned by the Governor of Niigata Prefecture, which hosts another TEPCO nuclear power plant now facing the question of whether the reactors will be allowed to restart or not. Former NAIIC member Mitsuhiko Tanaka was a member of the team. The report of this investigation is yet to appear.]

Furthermore, it is still impossible to confirm exceedingly basic aspects of the urgent contaminated water issue. These include, for instance, the contaminated water leakage route from the reactor containment vessel to the below-ground section of the reactor building (i.e., the state of damage to the containment vessel); the inflow route of groundwater to the reactor building (i.e., the state of damage caused by the earthquake to the walls and floors in the below-ground section of the building); and the leakage route from the reactor building to the below-ground section of the turbine building and trenches, and the state of damage in these.

In sum, it is still not possible to obtain the necessary information to assess the true state of the accident, to clarify causes, to prevent reoccurrences, to organise countermeasures for ongoing problems, and to prepare plans for a cleanup of the accident-stricken reactors.

2-2 Necessity for Clarification of the Causes of the Accident

[Details]

1. Clarification of the causes and progression of the accident, as well as continued investigations for those purposes, are absolutely necessary. These investigations are fraught with difficulties and it is expected that they will take many years to complete, so an organisational system and upgrading of laws aimed at achieving this should be implemented without delay.
2. The authorities should carry out a thorough investigation of the criminal liability of people related to the occurrence of the accident, including executives of TEPCO.
3. It is hoped that journalism will contribute to a clarification of the causes of the accident through original research and reportage.

[152] The nuclear reactor pressure boundary consists of the reactor pressure vessel, the reactor cooling system piping, isolation valves, and so on. In a BWR, this is the boundary of the area in which a pressure of 70 atmospheres is maintained. If this collapses, it may lead to a loss of reactor coolant.

[DETAILS]

2-2-1 An organisational system and upgrading of laws are necessary to achieve a thorough investigation

The restart of nuclear reactors is out of the question unless a thorough investigation is performed, but the continuation of investigations into the accident is indispensable even if restarts are not actually implemented. Information obtained from investigations is also necessary to secure the safety of the nuclear power plants that are currently shut down. This information could also be of great use for people associated with the nuclear power business overseas, not only for nuclear power plant accident prevention but also, for example, for nuclear power policy decision-making. This would be an "international contribution" that would make good use of the "negative heritage".

It is vital to preserve the site and the evidence in order to implement this kind of objective and scientific investigation. The permanent loss of important evidence due to the rough-and-ready implementation of the "Mid-and-Long-term Roadmap" must be avoided, if at all possible. For this to happen, laws should be enacted to ensure that the current state of the accident site is not negligently altered, that documentary evidence and other related materials are not destroyed, hidden or lost, and that free access is possible to the site and related materials by empowered investigative organisations.

Both the National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC) and the government's Investigation Committee on the Accident at the Fukushima Nuclear Power Plants of Tokyo Electric Power Company emphasised the necessity for continued investigation of the causes of the accident.[153] A specialist investigative body should be established to systematically preserve the materials and testimony amassed by the accident investigation committees and others, and to continue and develop the investigation based on their outcomes.[154] Avoiding possible "conflicts of interest" in the selection of personnel for such an investigative body would also be indispensable.

Transparency is crucial in the investigation of the causes. In principle, hearings with related people should be held in public and the documentary records published at regular intervals.

An overview of Japan's accident investigation system reveals that the Ministry of Land, Infrastructure, Transport and Tourism (MLIT) has an extra-ministerial bureau, the Japan Transport Safety Board (JTSB) which oversees aircraft, ship and train accidents. The work of the JTSB is to initiate investigative activities immediately after an accident occurs, clarify the causes, make recommendations for preventing the reoccurrence of similar accidents and give opinions (Act for Establishment of the Japan Transport Safety Board, Chapter III "Investigation of Accidents", etc., and Chapter IV "Recommendations and Statement of Opinions"). In the case of fires, at the same time as carrying out fire extinguishing activities, the fire authorities are to begin investigations concerning the causes and damage (Fire Service Act, Chapter VII "Investigation of Fire"). New safety measures are then taken on the basis of the outcomes of these investigations.

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[153] National Diet of Japan Fukushima Nuclear Accident Independent Investigation Commission (NAIIC), (2012) *Report,*. [In Japanese], p.23; Investigation Committee on the Accident at the Fukushima Nuclear Power Plants of Tokyo Electric Power Company (Government Committee), (2012), *Final Report*,. [In Japanese], p.429.

[154] One proposal would be to set up a secretariat in the National Diet Library to collate and preserve documents and records, and manage these together with the materials from the Investigation Committee on the Accident at the Fukushima Nuclear Power Plants of Tokyo Electric Power Company (Government Committee) (currently managed by the Nuclear Regulation Authority (NRA)).

In the case of nuclear power plant accidents, the Law for the Regulations of Nuclear Source Material, Nuclear Fuel Material and Reactors[155] provides for Nuclear Regulation Authority (NRA) officials and others to enter and inspect the facilities and offices, to gain access to documents and so on, and recognises the right of officials to interrogate related persons (Article 68, etc. of the above-mentioned law).

It should go without saying, however, that the clarification of the causes of the Fukushima Daiichi Nuclear Power Plant accident requires the establishment of a separate and powerful body and upgrading of laws for that purpose. That is why we propose the establishment of a specialist investigative body based on the enactment of a new law.

2-2-2 Incomprehensible sluggishness on the part of the investigative authorities

If there is suspicion that an accident has been brought about knowingly or by negligence, the police and prosecuting authorities initiate an investigation. Investigators visit the site and related locations and take statements from related persons. If necessary, a criminal investigation, including searches, confiscation of documentary evidence and the arrest of suspects may be instigated on the basis of warrants (Code of Criminal Procedure, Part II, Chapter I "Inquiry and Investigation"). The purpose of the investigation is limited to building a case on the alleged facts and the establishment of the facts for prosecution, but many of the facts that are brought to light during the process from investigation to prosecution to public trial and verdict are useful for clarifying the causes of the accident.[156]

When considering a possible criminal investigation of the Fukushima Daiichi Nuclear Power Plant accident, there is an extremely strong suspicion that several acts of negligence committed by the company in question, TEPCO, and others were connected to the causes of the accident.[157] In the case of large and small accidents involving death or injury that occur in transport, construction sites or factories, it is commonplace for investigative officials to proceed immediately to the site to impound evidence and arrest suspects. For a massive accident such as that at Fukushima Daiichi Nuclear Power Plant, why the moves by investigative authorities were so abnormally sluggish is beyond comprehension. In cases such as the train derailment accident on the JR West Japan Fukuchiyama Line[158] or the accident involving death and injury of spectators at the Akashi fireworks display[159], top executives of the company or persons responsible for security were prosecuted. They were subsequently proven innocent, but the details of the cases were brought to light before the citizenry through the public trials. The pursuance of criminal liability in the Fukushima Daiichi Nuclear Power Plant accident would also be of use in eliminating moral hazards and preventing reoccurrences of accidents.

2-2-3 Social responsibility of journalism

Lastly, journalism has a crucial role if the investigation of the causes of the Fukushima nuclear power plant

[155] A law that regulates nuclear source materials, nuclear fuel materials and nuclear reactors.
[156] However, it is also very possible that clarification of the causes of an accident may be hindered by an investigation of criminal prosecution; for instance, when related persons refuse to give testimony at an accident investigation commission for reasons of possible criminal prosecution. Legislative measures are necessary to deal with such problems.
[157] For instance, NAIIC Report, Chapter 1 "Was the accident preventable?", pp. 57-125.
[158] The accident, in which 107 died and several hundred were injured, occurred on 25 April 2005. In March 2010, three successive CEOs of JR West Japan were indicted for causing death and bodily harm through professional negligence by decision of the committee for the inquest of prosecution, but a not guilty verdict was handed down by the Kobe District Court in January 2012. The not guilty verdict was affirmed when the prosecutor's office declined to appeal.
[159] The accident, in which 11 died and 247 were injured (according to the Akashi Citizens Summer Festival Accident Investigation Committee), occurred on 21 July 2001. A former Akashi Police Vice Superintendent was indicted for causing death and bodily harm through professional negligence by decision of the committee for the inquest of prosecution, but a not guilty verdict was handed down by the Kobe District Court. The appeal court decision is expected on 23 April, 2014. [Update at the time of translation: On 23 April 2014, the Osaka High Court upheld the Kobe District Court ruling. The appeal is due to be heard in the Supreme Court.]

accident is to be carried out appropriately and assist in preventing reoccurrences of nuclear power plant accidents. In order to report the important facts, it is necessary to bring pressure to bear for a removal of the veils of secrecy that surround the state and companies. There may be times when the site must be visited, despite the dangers. It is also very possible that one might be arrested and indicted on a charge of disclosure of secrets[160], face a claim for damages from a company[161] or be exposed to radiation.

There have been many excellent press reports and programmes that have cut through to the core of the issues, but at the same time there have also been tedious articles that simply pass on the explanations of the government and TEPCO uncritically. There have also been inaccurate reports, probably based on inadequate knowledge, as well as reports that did not show an adequate understanding of the intention of the informant. In the period immediately after the accident on 11 March 2011, Japanese media company journalists, with a few exceptions, avoided visiting the area around the accident site, and failed to meet the expectations of readers and viewers, merely presenting reportage based on official announcements of the government and TEPCO. Those who dared to face the dangers in the aftermath of the accident and attempted to gather material at the accident site were mainly free journalists. Nevertheless, it is well known, since it later became an issue, that when the government and TEPCO first allowed reporters into the grounds of the stricken power plant, free journalists not affiliated to the press club were shut out. We would like to reemphasise here the social responsibility of journalism.[162]

2-3 Current State of Post-Accident Operations and Organisational Arrangements Required to Bring the Accident to a Closure

[DETAILS]

1. While the contaminated water problem has been recognised as the greatest obstacle in the accident cleanup operations at Fukushima Daiichi Nuclear Power Plant over the past three years, countermeasures have all met with miserable failure. Clearly the related organisations have fallen into dysfunction and lack effective methods for getting the job done.
2. Once bankruptcy procedures for TEPCO have been carried out, the Nuclear Damage Compensation and Decommissioning Facilitation Corporation established by the government, and the Fukushima Daiichi Decontamination and Decommissioning Engineering Company, established as a subsidiary within TEPCO, should be amalgamated to form an "Agency for the Decommissioning of the Fukushima Daiichi Nuclear Power Plant (Fukushima Decommissioning Agency–FDA)" that would push forward all decommissioning work in an integrated manner as an independent entity both in terms of organisation and finances.

[160] For instance, the reporting of the secret treaty on Okinawa by the Mainichi Shimbun reporter Takichi Nishiyama. Nishiyama was arrested, indicted and pronounced not guilty in the first instance, but a guilty verdict was handed down by the Supreme Court in 1978.

[161] A so-called SLAPP (Strategic Lawsuit Against Public Participation) suit. For instance, when the Shakai Shinpo (official organ of the Social Democratic Party of Japan) reporter Minoru Tanaka wrote an article about the nuclear power interests of a security company CEO in the *Shukan Kinyobi* magazine (16 December 2011 issue) he received a claim for damages of 67 million yen. The CEO later withdrew the claim for reasons that are unclear.

[162] For treatments of reportage on the Fukushima Daiichi Nuclear Power Plant accident, see, for example, the November 2011 issue of "The Tsukuru"; [In Japanese]; the April extra issue of "Days Japan" [In Japanese], published on 9 March 2012; the June and July 2012 issues of "Journalism" [In Japanese]; the January 2013 issue of "Gakujutsu no Doko (Academic Trends)," [In Japanese], and others.

[DETAILS]

2-3-1 Current state of the Fukushima Daiichi Nuclear Power Plant accident site

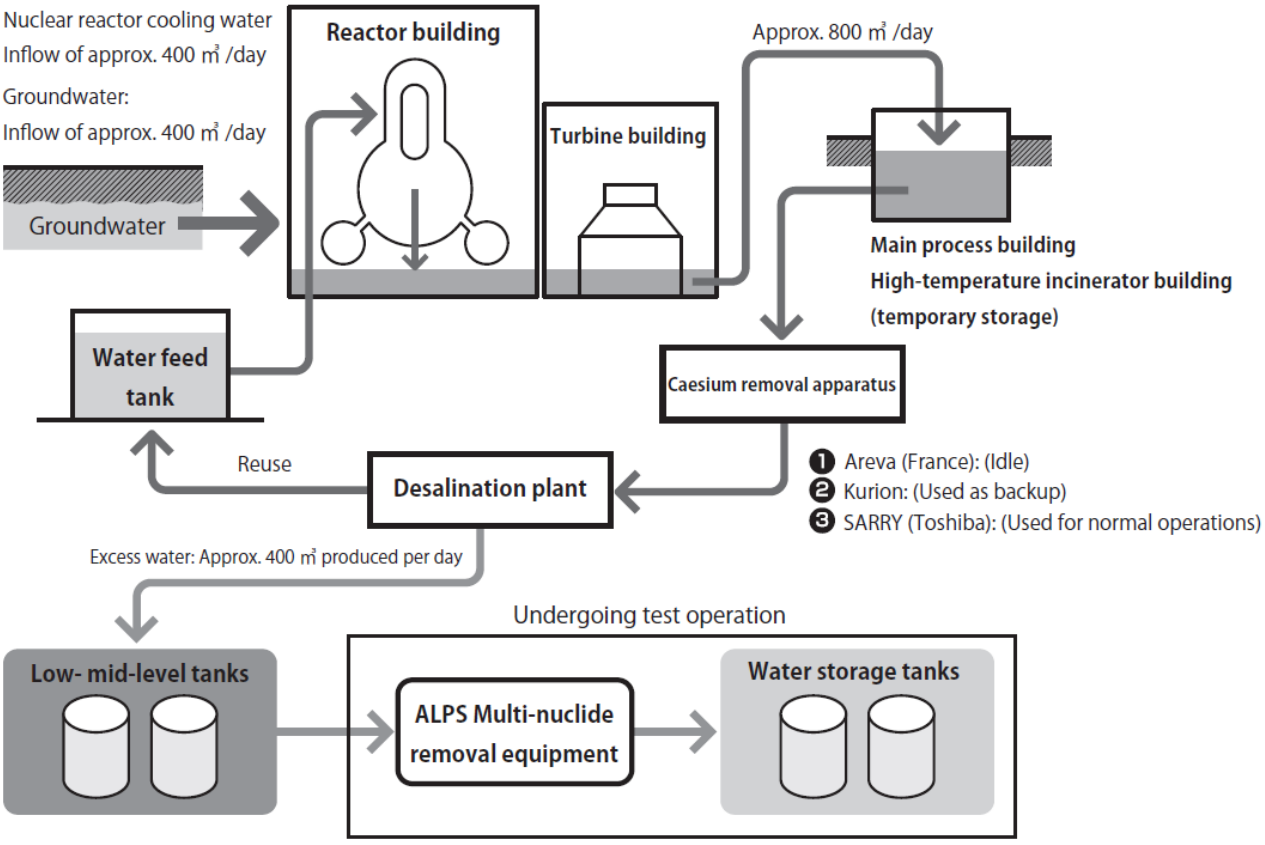
At the time of writing this *Policy Outline* (late March 2014), despite the passing of three years since the accident, releases of radioactive materials and stored contaminated water to the ocean from the Fukushima Daiichi Nuclear Power Plant site have been occurring incessantly. While releases of stored water have been substantially reduced, the outflow of radioactive materials via the groundwater is still continuing, High concentrations of caesium and strontium have been continually detected in observation wells that have been sunk in a number of locations, and incidents involving the leakage of around 300 tons of stored contaminated water in August 2013 and around 100 tons in February 2014 are still fresh in our memories. The former is the equivalent of an INES Level 3 serious incident. It must, therefore, be said that the statement by Prime Minister Abe in September 2013 during a speech inviting the Olympic Games to Tokyo that "the contaminated water is under control" showed a great lack of thoughtfulness and awareness of the current situation. [Update at the time of translation: Whereas the frequency of leakages from the water tanks is becoming somewhat lower, and bolt-fastened tanks are being replaced by welded tanks that are less vulnerable to leakage, the outflow of radioactive materials via the groundwater flow is still continuing. In February 2015, it was revealed that TEPCO had knowingly abandoned, for nearly a year without reporting to NRA, a flow of highly contaminated rainwater from the roof of the Unit 2 reactor building into the sea via a drainage channel which leads to the sea outside the power plant harbour wall. TEPCO and the government had repeatedly claimed that the outflow of contaminated water was confined to the harbour. As a matter of fact, the situation is out of control and deteriorating.]

In this situation, the existence of radioactive contaminated materials dispersed around the site—such as highly concentrated contaminated water still retained in trenches beneath the buildings and elsewhere, excess contaminated water deriving from the mixture of the reactor core cooling water and inflowing groundwater, equipment, various kinds of debris, and soil—has become the greatest obstacle to the cleanup and decommissioning project at Fukushima Daiichi Nuclear Power Plant. Nevertheless, in the three years since the accident neither the government nor TEPCO has taken any far-reaching measures to prevent contamination of the ocean, which continues to worsen. The deterioration of the contaminated water problem has been a direct result of failures by TEPCO, but more fundamentally the government has not given serious attention to the issue. This originates in a failure to establish responsible cleanup management institutions through policy means. One example is that while government-related persons were aware in the period soon after the accident of the necessity for an underground water barrier as a countermeasure to increases in contaminated water, the implementation of this measure was not demanded.[163] Rather, contrary to the slogan "government in the forefront", no effective measure was taken and the matter was simply left in the hands of TEPCO. This is one factor that has brought about the dismal state of affairs that exists today.

[163] Mabuchi S. (2013), *The Realism of Nuclear Power Plants and Politics.* [In Japanese] Tokyo: Shinchosha, p.104.

Figure 2.1 Flow of contaminated water countermeasures

(Note：Flow rates indicated are as of March 2014. Prepared from TEPCO materials.)



Since May 2011, TEPCO has announced the release to the ocean of 20 trillion Bq of caesium 137 and 10 trillion Bq of strontium.[164] With ocean contamination worsening, the resumption of fishing along the Fukushima coastline is still delayed. According to a 25 February 2014 TEPCO report, the total amount of contaminated water stored onsite at the Fukushima Daiichi Nuclear Power Plant had reached 520,000 tons, of which 90,000 tons had accumulated in the basement of the reactor and turbine buildings and 430,000 tons was stored in tanks.[165] Moreover, 400 tons of excess contaminated water continue to be generated each day (**Figure 2.1**). Even if this contaminated water is treated in the ALPS multi-nuclide removal equipment, tritium cannot be removed, so it is necessary to continue to store the water in tanks. [Update at the time of translation: As of 19 February 2015 (TEPCO press release), the total amount of contaminated water had reached 609,000 tons, only 51.6 % of which had been treated using the ALPS equipment. The total storage capacity onsite is 781,000 tons. Water accumulation in the reactor/turbine buildings of Unit 1, 2, 3 and 4 is thought to total around 63,900 tons.]

2-3-2 Factors causing deterioration of the problems and their background

Power companies are a type of process industry. The nature of their work is such that it can be formulated in detailed and standardised manuals, be they for operating the plant, purchasing equipment or construction / maintenance work. This nuclear power plant accident and the work to bring it to a conclusion, however, pose a huge and highly irregular form of work that is so extraordinary that a person might only experience something like it once in his or her lifetime. People engaged in this work always meet unknown problems

[164] TEPCO press handout material of 21August 2013 titles "Assessment of Outflow Amounts of Radioactive Materials". Further, the Japan Atomic Energy Agency (JAEA) has estimated the releases to the sea from immediately after the accident to the end of April 2011, including those occurring via the atmosphere, at 3,600 trillion Bq for caesium alone.

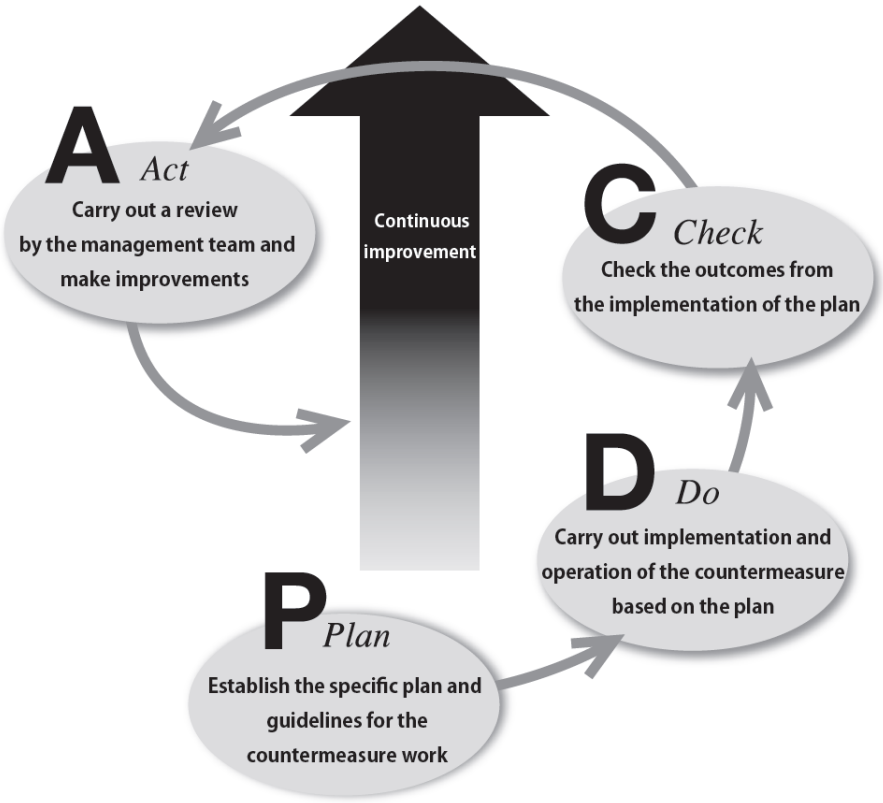
[165] TEPCO press release of 26 February 2014, titled "Storage of Accumulated Water and Treatment Situation Report No.139".

and have to make decisions about them at very short notice. This is very different from the normal pattern of work in a power company, and a kind of work that they are not good at. In addition, TEPCO is having to aim at two conflicting targets, one dealing with the accident and the other with business recovery. It may be surmised that TEPCO has fallen into a state where both the organisation and management have become unable to cope with the problems that are arising. As a result, even though the work to bring the accident to an end, including the measures against contaminated water, is defective, TEPCO is making moves to improve company performance by attempting to forcibly restart Kashiwazaki-Kariwa Nuclear Power Plant. The root of the problem lies not simply in the motivational aspects of related personnel, but in the fact that the business management target is split and the organisation has fallen into a dysfunctional state. TEPCO work sites continue to drift along without a clear vision.

Moreover, TEPCO has for some time suffered from 'big company disease' in the form of organisational fatigue, lack of transparency, a stuffy and bureaucratic atmosphere, weakness of individual decision-making power, and lack of technical ability due to an unhealthy dependency on suppliers and partner companies. As if that were not enough, in-house motivation has fallen to an exceedingly low level due to critical public opinion arising from repeated bungling and cover-ups in the accident cleanup operations.

Nevertheless, even though that may be the case, it does not entitle TEPCO to cite these problems as excuses for the expansion and failure of the contaminated water problem. In particular, TEPCO's sloppiness over the contaminated water countermeasures should be roundly criticised from the perspective of quality management (QM). For instance, with regard to the design and installation of the contaminated water tanks, the following problems were conspicuous: problems with bolt tightening that made leaking of the aging and decrepit tanks inevitable; the fact that water level indicators and alarm units were not installed on each of the tanks; insufficient height of flood prevention dikes; failure to install venting equipment; disregard for ground tilt; and so on. Furthermore, there has been little sign of improvement even after the faults were recognised, and tanks of similar design have continued to be installed. Essentially, this indicates a collapse or complete lack of a quality management system (QMS) capable of improving technical or organisational defects through the functioning of a PDCA (Plan-Do-Check-Act) cycle (see **Figure 2.2**). Reoccurrences of the problems cannot be avoided without a revival of the QMS function.

Figure 2.2 Diagram of the PDCA cycle (ISO9001)

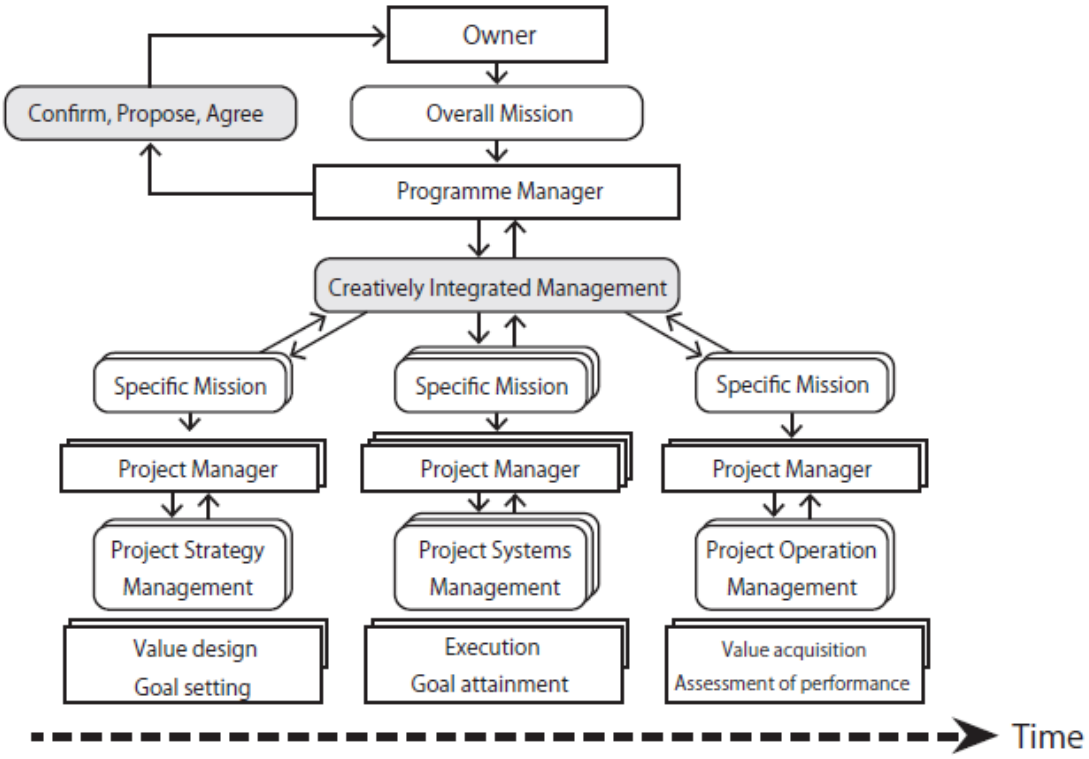


Quite belatedly, on 26 August 2013 TEPCO set up a "Contaminated Water and Tank Headquarters". Because the TEPCO CEO doubles as its head, and because it is situated beneath the board of directors, this organisation is also subject to corporate logic. It will therefore not resolve the various organisational problems mentioned above.

2-3-3 What should the organisational structure look like?

Firstly, focussing on the contaminated water countermeasures, the body that deals directly with the accident cleanup should be independent both organisationally and financially. This is a premise for agile management to optimise the plan for bringing the accident to a conclusion. In April 2014, the government established the Nuclear Damage Compensation and Decommissioning Facilitation Corporation by adding the decommissioning function to the previous organisation, and at the same time the Fukushima Daiichi Decontamination and Decommissioning Engineering Company was established as a subsidiary within TEPCO. The former is supposed to give instructions to the latter, but this is a half-baked reform with little hope of bringing about a radical resolution to the problems arising from organisational problems mentioned in the previous section. The overall premise should be to set up a "Fukushima Decommissioning Agency (FDA)" to push forward with all the work of decommissioning on an integrated basis by amalgamating the Decommissioning Facilitation Corporation and the Fukushima Daiichi Decontamination and Decommissioning Engineering Company through a fundamental review of organisational aspects, and on the premise of TEPCO bankruptcy proceedings being carried forward. In addition, massive costs are involved in the decommissioning and cleanup work and it will be necessary to request the public to bear the burden after TEPCO bankruptcy proceedings have been taken (see Section 5-4). If that is the case, it is more necessary than ever to proceed steadily with the work of bringing the accident to a conclusion while, at the same time, securing transparency and striving to minimise the cost burden.

Figure 2.3 Programme management concept



(Prepared based on the concept of P2M version 2.0 by the International Project Program Association)

Based on this premise, a Program Management Office (PMO) with the special function of bringing the accident to a close should be formed and given wide-ranging powers, including formulation and execution of a budget. Programme management is a means of integrated management that is positioned above a group of several projects, and which provides the basis for success of each project, such as through resource allocation, and so on (see **Figure 2.3**). For the realisation of the PMO, it would be necessary to rely on the dispatch of task-oriented human resources, including those with experience of overseas mega-projects, from a number of companies with a broad focus on engineering. It would be especially welcome if manufacturers and general construction technical staff that have previously had deep relations with the nuclear power industry would participate in the PMO, after having first divested themselves of vested interests and severed links with the so-called “nuclear village”. It may also be necessary to request the participation of experienced overseas engineers. Only a state-scale “Fukushima Decommissioning Agency (FDA)” would be able to perform organisation building of this nature.

2-4 Air Cooling—A Drastic Solution to the Water Contamination Problem

[Details]

1. We propose a shift from water cooling of the molten fuel debris to air cooling as a means to fundamentally resolve the contaminated water problem. This would be conditional on the decay heat decreasing to a level where it is possible to remove it by air cooling, but we anticipate that there is a strong probability that this can be achieved.
2. The following two contaminated water countermeasures should be implemented as a matter of urgency: 1) expansion of water storage capacity through the construction of large-scale 100,000-ton-class tanks;

2) construction of a barrier and appropriate use of paving or coating[166] to prevent the inflow of groundwater and surface water into the contaminated site.

[DETAILS]

2-4-1 Mechanism of the formation of contaminated water and the significance of air cooling

As stated in a previous section (2-3-1), the radioactive water problem arises when the drained cooling water, already highly contaminated through its contact with molten fuel debris, intermingles with inflowing groundwater (refer to **Figure 2.1**). Each day, 400 tons of excess water will continue to be formed unless the inflow of groundwater is suppressed. The circulating water will also continue to be contaminated with radioactivity as long as water is used to cool the fuel debris. TEPCO is currently making efforts to block or suppress groundwater inflow by constructing a barrier. However, the frozen earth barrier method that has been chosen is still at a stage where the results of repeated experiments are being reflected in the design, and there is still uncertainty about how effective it will be. It is possible that this research effort will end in failure after incurring huge costs in terms of both funds and time.

Meanwhile, an approximate calculation of debris decay heat based on injected water and temperature data as of 6 February 2014 has been published by TEPCO: [167]

Unit 1: 60 kW
Unit 2: 120 kW
Unit 3: 120 kW

We believe these values are of a calorific and temperature level at which the fuel debris itself and the steel vessels, concrete structures of the pressure vessel, containment vessel, etc. which contain the debris can be air cooled without compromising their soundness. If air cooling becomes possible, the formation of new radioactive contaminated water through contact between the debris and cooling water will be halted. Currently, to avoid the flow of high-level contaminated water into the groundwater (and thus the ocean), the water level in underground pits inside buildings is being maintained at a level somewhat lower than that of the groundwater. (This means that groundwater inevitably flows into the underground sections of the buildings.) Changing over to air cooling would mean that if the management of the water level in the pits was suspended, the water level would automatically equilibrate and the flow would cease. The formation of new excess contaminated water would almost completely cease and it would no longer be necessary to increase the number of contaminated water storage tanks.[168] Naturally, the actual application of air cooling requires more precise data concerning the location and condition of the fuel debris, whether or not there is space to install new equipment such as pipes, the radioactive environment, and so on. TEPCO should take this seriously and make maximum efforts to achieve a shift to air cooling. It should consider the possibility of undertaking joint operations with domestic and overseas organisations that have submitted proposals through the International Research Institute for Nuclear Decommissioning (IRID) to shift to air cooling.

2-4-2 Immediate technical measures

The realisation of the air cooling discussed above will require a certain amount of time, during which

[166] A construction method that prevents seepage of rainwater and cleaning water into the soil by the use of tarmac paving and so on.
[167] Fukushima Daiichi Nuclear Power Plant, Plant-related parameters, as of 5am on 6 February 2014, http://www.tepco.co.jp/nu/fukushima-np/f1/pla/2014/images/14020605_table_summary-j.pdf
[168] Sato S. (2014), "How can 1F be decommissioned?". [In Japanese] *Sekai*, January 2014 extra edition "1F Crisis", p.8.

roughly 400 ton/day of excess contaminated water will continue to be formed and the high-level contaminated water leaking from numerous locations on the site will continue to pollute the ocean. The following countermeasures must be taken as a matter of urgency in the meantime.

(1) The construction of large-scale tanks

In order to resolve the current rough-and-ready situation of contaminated water storage, the necessary number of large-scale 100,000-ton-class tanks should be constructed. Sufficiently high anti-flood dikes should be constructed around these tanks to avoid leakage to the sea even if leaks occur. This scale of tank is used in large numbers in oil refineries and as crude oil tanks in Japan's national oil stockpiling bases. Their technical reliability, including earthquake resistance, has been adequately established. The release to the ocean of tritium-containing contaminated water, due to the inability to remove tritium even after the introduction of the multi-nuclide removal equipment (ALPS), is unacceptable, and long-term storage of this water must also be carried out in the same way. Further, work to replace some 350 bolt-type sectional tanks on the site with welded tanks should be advanced in parallel with the installation of large-scale tanks, finally achieving a situation where all contaminated water is stored in large-scale tanks.

(2) Measures to prevent the inflow of groundwater and the flow of contaminated water to the sea

At present, even the groundwater flow routes have not yet been clearly defined. The preparation and execution of plans, based on geological and hydrological knowledge and an extensive survey, for the installation of a barrier and appropriate surface treatment must be implemented to prevent groundwater and surface water flowing into the contaminated site. It can be envisaged that the frozen earth barrier now being constructed to surround Units 1 to 4 will face problems arising from the inability to assess groundwater flow, the fact that a similar large-scale barrier has not yet been proven in practice, inability to withstand long-term use due to pipe corrosion, the fact that contaminated water will once again leak when the barrier is thawed out after use, and so on. There are also concerns that exposure of skilled workers during construction will cause difficulties for the completion of the barrier. For these reasons, it is imperative that a barrier that can withstand prolonged use be planned and installed. The new barrier should be one that completely surrounds the tank area and prevents the intrusion of external groundwater into the entire area that is currently contaminated (roughly 1-km square).

(3) Other measures

Improvement of the onsite environment through decontamination, removal of contaminated water from trenches, installation of a sea side barrier, prevention of dispersion of radioactive materials in the earth and sand in the harbour seabed must be implemented immediately and continually. In addition, urgent countermeasures are required to prevent the collapse of the Unit 1 and 2 exhaust stacks, parts of which have been severely damaged, and to ensure that, in the case that they do disintegrate, they do not fall on the side of the building that houses the spent fuel pool.

2-5 How Should the Destroyed Reactors be Finally Disposed Of

[Details]

1. Removal of fuel debris by the flooding method, which forms the basis of the government and TEPCO's Mid-to-Long-Term Roadmap, is nothing more than an illusion and, moreover, will entail a huge amount of radiation-exposed-labour. There is little option but to rely on air cooling of the stricken reactors while

drawing up plans to entomb them in a shelter to be passed down to future generations as humanity's "negative heritage".

2-5-1 Problems with the government and TEPCO's Roadmap

The government's Council for the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Plant finalised the formulation of its Mid-to-Long-Term Roadmap towards the Decommissioning of TEPCO's Fukushima Daiichi Nuclear Power Plant Units 1 to 4 on 27 June 2013. According to the Roadmap, the use of the flooding method to remove the molten fuel debris that remains in the pressure vessels and that has accumulated in the lower part of the containment vessels of Units 1-3 is planned to be carried out over a 30-40 year period, including a period for research and development. However, the realisation of this plan will require not only the resolution of numerous technical difficulties, but also the infusion of a gigantic budget and vast amounts of work that will entail exposure to radiation. Given the current predicament with the treatment of contaminated water, is this fuel debris removal plan really achievable?

The most troublesome hurdle facing this plan is the several hundred to 1,000 mSv/hr high-level radiation environments inside the buildings or on the operating floor of each building, which makes even accessing these areas a difficult task. Information about the location, condition and distribution of the fuel debris is based on little more than plain conjecture, and the location of damage to the containment vessels, which are scheduled for flooding, is unclear. Even the equipment and devices, including remote-controlled robots, that will be used to perform these surveys are still in their developmental stages, and should it be that there are stumbling blocks in the R&D process or the results of surveys show that the situation at the site is beyond the scope of original assumptions, implementation of the flooding method itself may then become impossible. These aspects also lead us to believe that only a very fine veneer disguises the fact that this plan may be nothing more than a gamble or simply an illusion.

Finally, there are also concerns about the soundness of the vessels themselves, since both the pressure vessels and the containment vessels have been exposed to high temperatures during the core meltdown and a corrosive environment due to the injection of seawater. At present, it is completely impossible to assess whether or not the leaks in the containment vessels of Units 1-3 can be repaired. We therefore find it hard to avoid a grave sense of doubt concerning the fact that the unilateral promotion of this mammoth project, costing several trillion yen and requiring the imposition of radiation-exposed-labour, rests on the premise that these leaks "can be repaired".

2-5-2 Current options

Is it really necessary to attempt to surmount the various difficulties mentioned above to remove the fuel debris? If, as mentioned in Section 2-4, it is possible to realise air cooling of the fuel debris, then the production of contaminated water will cease and the urgency to embark on a hazardous project premised on vast amounts of radiation-exposed-labour will recede. At the very least, the plan to remove the fuel debris should be frozen at this time, and a project to entomb the reactors in a sarcophagus, as at Chernobyl, considered while continuing to observe the attenuation of radioactivity over the coming 50-100 years.[169] There is absolutely no need to return the Fukushima Daiichi Nuclear Power Plant accident site into brownfield or greenspace (and anyway it is impossible to live there because of the contamination of the soil).

[169] Sato S. (2013). Entomb in a Sarcophagus and Consign to the Future, in Azuma Hiroki (ed.), *Plan to Turn Fukushima Daiichi Nuclear Power Plant into a Tourist Attraction,*. [In Japanese] Tokyo: Genron, p. 89.

Instead, we believe that turning the site into a monument in the form of a sarcophagus would be an appropriate way of creating a permanent memory of this catastrophic accident as an example of the "negative heritage" of the human race.

2-6 WORKER HEALTH MANAGEMENT AND EXPOSURE REDUCTION IN THE PLANT SITE

[DETAILS]

For the time being, the following special measures and policies should be applied at the exceedingly difficult and dangerous worksite of Fukushima Daiichi, where the accident settlement and decommissioning of the destroyed power plant is being carried out.

1. A nuclear plant worker recruitment division should be set up within the national-scale "Agency for the Decommissioning of the Fukushima Daiichi Nuclear Power Plant (Fukushima Decommissioning Agency–FDA)", proposed in Section 2-3, to take direct charge of recruiting workers who will be engaged in the work of bringing the accident to an end and decommissioning the destroyed reactors at Fukushima Daiichi, and despatching these workers to the companies that will perform the various tasks. FDA will supervise working conditions and manage execution of the labour contracts at the employing companies.
2. A worker education and training centre should be established by FDA, at which practical training in specialised techniques, such as the theory and practice of radiation protection, pipe fitting and electrical work under conditions of high-level radiation will be given for a period of approximately one month, after which a qualification to participate in the work will be awarded only to trainees who pass an examination. (Much can be learned from the system carried out by the Ukrainian government for the decommissioning of the Chernobyl Nuclear Power Plant.[170])
3. Workers who have exceeded the limit for exposure should either be reassigned to work that does not entail exposure or be given assistance to find other kinds of employment.
4. Workers' wages should be substantially higher than those for workers in the same category who are not working under conditions of exposure to radiation.
5. Workers should receive a regular medical check-up (for example once a month) during the time they are working at the accident site. At the end of the work contract period, each worker's work record and dose record should be registered and the registered data handed to each worker as a health management logbook to enable both parties to engage in health management.[171]
6. Regular health check-ups (for example, once every six months) should be given after retirement. The actual check-up may be commissioned to existing medical institutions, but matters such as the components of the medical examination shall be determined by FDA's recruitment division, which will be responsible for this work. An assurance system shall be set up to make free lifetime medical care available for cases in which illnesses, including diseases other than cancer, are confirmed by check-ups.

[170] Nippon TV production, NNN documentary "From Chernobyl to Fukushima: Examination paper for the future", broadcast on 27 October 2013.

[171] The 2010 proposal entitled "Unified Management of Exposure in Personnel Engaged in Work Involving Radioactivity" published by the Working Group to Consider Issues Associated with the Uses of Radiation and Radioactivity, a joint group consisting of the Basic Medicine Committee and General Engineering Committee of the Science Council of Japan, stated, "Almost 50 years have passed since the necessity for the establishment by an official body of a system for recording exposure doses to personnel engaged in work involving radioactivity was proposed by the Japan Atomic Energy Commission, among others, in the late 1960s, when commercial nuclear power generation began in Japan, but uniform management is still to be achieved." The current situation is that the Radiation Dose Registration Center for Workers that has been set up within the private organisation the Radiation Effects Association is carrying out this work, but this has become a problem due to reports of TEPCO's failure to register 1,295 workers (Tokyo Shimbun 30 June 2011) as well as neglecting to submit data for 21,000 workers (Tokyo Shimbun 28 February 2013).

7. In order to secure workers to engage in the accident cleanup and decommissioning at Fukushima Daiichi over the course of 100 years or more, in addition to the workers recruited by the mechanism noted above, a highly-skilled and public-spirited volunteer group of technical experts should be developed. At the same time, having clearly explained the dangerous and self-injurious nature of the work, a system of meritorious awards should be prepared while putting in place measures that will enable these people to work with pride in order to effect a smooth generational transition.

[DETAILS]

2-6-1 Exposure of nuclear power plant workers and human rights

Among the reasons why nuclear power plant systems are fundamentally incompatible with human rights, the most important is the problem of radiation-exposed labour. The longer a worker works the more the effects of exposure accumulate within the body, increasing the risks of cancer and other diseases. In other words, this is essentially labour that entails self-injury. Moreover, there is a great difference in exposure doses between regular power company staff and sub-contracted workers[172], and thus the burden of exposures has been unfairly placed on sub-contracted workers through the creation of a discriminatory employment structure. In the multi-layered sub-contracting structure, said to consist of seven to eight layers, sub-contracted workers are exposed to inhumane levels of intermediary exploitation. In this distressing worksite, the minimisation of exposure doses, strengthening of lifetime health management, improvements in the decency of employment, the securing of human resources, and the minimisation of discrimination should be carried forward and, through these, a system of nuclear power plant worker employment that does not run counter to the principles of the "restoration of humanity" (see Section 1-2) should be established.

2-6-2 Radiation-exposed labour at Fukushima Daiichi Nuclear Power Plant

Each day, on average, roughly 3,000 workers, more than 80% of these being sub-contracted workers, are being exposed to radiation while engaging in work to maintain the cooling system, monitoring and treatment of the contaminated water, clean-up of the site and various minor accidents that have occurred as well as preparations for decommissioning at Fukushima Daiichi.[173] [Update at the time of translation: The number of workers at the site has since more than doubled. As of January 2015, some 7,000 workers are entering the site each day.]

According to reports provided by TEPCO to the Ministry of Health, Labour and Welfare (MHLW), in the period March 2011 to the end of January 2014, 32,034 (TEPCO employees 4,102, subcontracted workers 27,932) people were engaged in work involving exposure to radiation at Fukushima Daiichi, of whom 173 received accumulated doses exceeding 100 mSv[174] and a further nine persons received doses exceeding 200 mSv. However, these figures do not include the doses for Self-Defense Forces' personnel, Fire Service rescue personnel, police officers and others who are thought to have received high exposure doses during emergency operations in the early stages of the accident. The collective effective dose (cumulative dose) to

[172] Accumulated worker exposure doses in power generating nuclear reactors (including Fugen and Monju) from FY1970 to FY2009 amounted to a total collective dose of 3,163.95 man-sieverts, which consisted of 179.2 man-sieverts for regular company staff and 2,984.75 man-sieverts for sub-contracted workers (Calculation by the Citizens' Nuclear Information Center based on data from the Ministry of Economy, Trade and Industry).

[173] The sub-contracting rate (ratio of the total number of persons) was 86.3% according to the monthly summary of January 2014, and the rate for the cumulative total from March 2011 to January 2014 was 87.2%. Calculated based on TEPCO data released on 28 February 2014. [Update at the time of translation: According to the December 2014 summary (TEPCO press release, 30 January 2015), the monthly ratio was 90.7% and the cumulative total from March 2011 to December 2014 was 89.2%.]

[174] Total of external and internal effective dose. Effective dose is the exposure dose equivalent to the whole body and differs from the thyroid gland exposure dose (equivalent dose) mentioned below.

workers, as far as we know from reports by TEPCO to MHLW, is 402.98 man-Sv[175], 74% of which has been received by sub-contracted workers. This figure amounts to a stunning 12.7% of the total cumulative dose[176] to workers in all Japan's nuclear power plants in the 40 years prior to the accident. [Update at the time of translation: The workers' collective dose continues to grow. Calculated again from TEPCO's monthly report to MHLW, workers' accumulated dose (March 2011 to December 2014) reached 493.72 man-Sv, 79.5% of which was received by sub-contracted workers. As of the end of 2014, the total number of exposed workers at the Fukushima Daiichi site was 40,569, of which 36,177 were sub-contracted workers.]

Since it is thought that during the emergency period immediately after the accident there were many workers who were not able to wear personal dosimeters due to insufficient provisioning, but who were working at the site without the accompaniment of a radiation exposure control staff[177], the full picture of worker exposure has not been elucidated. A large degree of uncertainty also surrounds the records of exposure doses to workers at the site. There is, for instance, the case of the discovery (in July 2012) of sub-contracted workers who had attempted to suppress their recorded dose rates by fitting lead covers over their personal dosimeters for fear that they would be discharged once they had reached the exposure dose limit.

Much doubt has been cast on whether the exposure doses and health management of the people working at the Fukushima nuclear power plant site have been handled appropriately. While the working conditions at the Fukushima site are far more severe than those at normal construction sites, it has been reported that even normal safety and health management practices enforced widely at construction sites are not being observed.[178]

In this situation we are far from being able to have confidence in worker exposure reduction or health management. There is a need for reform in each of the systems for worker recruitment and employment, exposure dose measurement, and health management, both during and after employment. In Germany, since exposure management is not left only to workers and employers but is also handled by a public body, workers wear two dosimeters, one of which must be submitted to the public body in its sealed state.[179] The very fact that workers themselves engage in actions such as working in high-radiation areas while hiding

[175] Calculated from the average exposure dose (effective dose) and the number of workers based on data (http://www.tepco.co.jp/cc/press/betu14_j/images/140228j0101.pdf) released by TEPCO on 28 February 2014. Further, the average exposure dose (whole body) per capita is said to be 23.61 mSv for regular company staff, 10.96 for sub-contracted workers, and 12.58 overall, with the highest individual exposure dose to a regular company staff member being 678.8 mSv and to a sub-contracted worker 238.42 mSv. These are heavily skewed toward the high dose rates associated with emergency work carried out mainly in the March to April 2011 period. More recently, the average and highest dose rates are far lower than these (looking at the external exposure dose summary of January 2011, the regular company staff member average was 0.32 mSv, the sub-contracted worker average was 1.08 mSv, the highest regular company staff individual dose being 4.15 mSv while it was 15.12 mSv for an individual sub-contracted worker). Note that regular TEPCO staff exposure doses were higher in the period immediately after the accident, but at present sub-contracted worker exposure doses are far higher than those of regular TEPCO staff. However, regular TEPCO staff are carrying out "specified high-dose tasks" (work for which the emergency exposure limit of 100 mSv is applied under the Ordinance on Prevention of Ionizing Radiation Hazards), and the above-mentioned regular TEPCO staff member, who received the 4.15 mSv individual dose was performing specified high-dose tasks. Looking at the most recent three months (November 2013 to January 2014), a total of 1,827 people were engaged in the performance of specified high-dose tasks and their collective exposure dose was 6.19 man-sieverts (also calculated based on TEPCO data released on 28 February 2014, total for internal and external exposure).

[176] See footnote 32.

[177] A manager who accompanies the workers at the worksite, and who measures workers' exposure doses, instructs workers on radiation protection, and so on.

[178] From reportage concerning excessively long 10-hour/day labour in the Tokyo Shimbun of 12 December 2013 and heat stroke in the Asahi Shimbun of 10 July 2011, and others. The Asahi Shimbun of 19 July 2013 reported that "It has been discovered at Fukushima Daiichi Nuclear Power Plant that there have been 2,000 workers, including estimates, who have received more than 100 mSv of exposure to the thyroid gland, a level at which cancer and other diseases are known to definitely increase." Figures indicated here are "equivalent doses" calculated by multiplying the "absorbed dose in Gy" by the "quality factor" for each separate organ or tissue. The effective dose mentioned above is the whole body exposure dose (the integrated "equivalent dose" for each organ after having taken the "tissue weighting factor" into account) found by addition after weights are assigned to each organ, and is a different method of assessment. These are easily confused since they use the same unit, the "millisievert" (mSv).

[179] Information from interviews conducted by Harutoshi Funabashi at the Rheinsburg Nuclear Power Plant and the Brandenburg State Ministry of Environment, Health and Consumer Protection, Germany, 24 and 25 February 2014.

their personal dosimeters in low-radiation areas because they fear discharge when they exceed their dose limit indicates that employment rules are fundamentally flawed. Workers who have exceeded their exposure limit should be treated with respect and either reassigned to work other than that involving exposure to radiation or given help to find new jobs.

2-6-3 Creating a work environment that instils workers with pride and purpose

Unbelievably sloppy mistakes are continually being made in the contaminated water treatment work. The causes of these mistakes probably stem from the shortage of skilled workers and insufficient worker training, low morale among workers, lack of experience and irresponsibility on the part of the TEPCO staff who are in overall control, and the inability to maintain normal calm common sense under conditions of high radioactivity. Reforming this dismal state of affairs would require conscientious worker education and the establishment of responsible onsite supervision, as well as the improvement of working conditions to the level where workers can feel a sense of pride and purpose in their work, but this cannot be realised simply by leaving the situation in the hands of TEPCO. To implement sufficient worker education, and to build a system for despatching workers to the companies that will perform the various tasks, it is necessary to set up a nuclear power plant worker recruitment division in a national-scale "Fukushima Decommissioning Agency (FDA)" that would directly recruit all workers to be engaged in the work to bring the Fukushima Daiichi Nuclear Power Plant accident to a conclusion and carry out decommissioning. In addition, it will also be necessary to supervise working conditions and ensure the full execution of labour contracts at the employing companies. Only by carrying through these fundamental reforms will it be possible to eliminate the intermediary exploitation caused by the inhumane multi-layered sub-contracting structure.

As there is no deterministic causal relationship between low-dose radiation exposure and health effects, this link is often difficult to prove. Many reports have shown that the health effects caused by the atomic bombing of Hiroshima and Nagasaki and the Chernobyl nuclear accident include a variety of illnesses besides cancers, but the official recognition of health damage is made difficult by the inability to show a clear causal relationship between radiation exposure and individual symptoms. This phenomenon is not limited to radiation exposure. It also occurred in the case of the organic mercury compounds that were the causal substances of Minamata disease. Of the 80,000 patients suffering from Minamata disease symptoms, a mere 5,000 were officially recognised as patients of the disease. The remainder were forced to simply accept the situation. Thus, for the radiation-exposed workers dealing with decommissioning the destroyed reactors and the contaminated premises, work which may be said to be a typical case of severe self-injurious labour, the precautionary principle should be applied to the greatest extent possible, and the assurance of lifetime medical treatment provided unconditionally. While handling these current issues in a robust manner, long-term arrangements for dealing with labour involving exposure to radiation must be completely revamped. This requires the foresight to look 100 years into the future and overlaps with the issue of securing workers who will perform the decommissioning work in the radioactive environment. Labour force shortages, especially shortages of skilled workers, are already apparent.[180] For this reason, in parallel with worker recruitment, it is necessary to begin work on the organisation of volunteer skilled workers.

[180] Happy (alias for a worker at Fukushima Daiichi) and Yujin F. (2013). "All-Japan-System Needed to Bring the Accident to a Conclusion". [In Japanese], *Sekai*, Extra edition January 2014, F1 Crisis, p.61. Happy, (2013). *Diary of the Work of Bringing the Fukushima Daiichi Nuclear Power Plant Accident to a Conclusion: 700 days from 11 March*. [In Japanese] Tokyo: Kawade Shobo Shinsha.

It should be noted that we opted to discuss the decontamination work in the municipalities contaminated by radioactive materials released by Fukushima Daiichi Nuclear Power Plant in Section 1-6-4. Few nuclear power plant workers other than those at Fukushima Daiichi Nuclear Power Plant will be needed as long as the power plants are not restarted and remain in their cold shutdown state. The exposure doses to workers at other nuclear power plants is more than a factor of ten lower[181] than to those onsite at Fukushima Daiichi Nuclear Power Plant, and the 50 mSv/year (or 100 mSv over five years), the exposure limit before the Fukushima nuclear power plant accident, can be reduced to the German level of 20 mSv/year.[182]

[181] According to the publication The Network Concerned for Radiation-Exposed Labour, ed. (2012), *The Nuclear Power Plant Accident and Exposed Labour* [in-*exposure Labour*]. [In Japanese], Tokyo: San-ichi Shobo, p.9, the total exposure dose to workers during normal operation and regular maintenance work for the 75,988 workers at the more than 50 nuclear power plants and nuclear fuel facilities in Japan in FY2009 was 93.9 man-sieverts, or 1.10 mSv per capita per annum. The total accumulated dose from 11 March 2011 to 30 March 2012 for the total personnel of 20,549 at Fukushima Daiichi Nuclear Power Plant was 247 man-sieverts, or 12.02 mSv per capita per annum.

[182] The 2010 Recommendations of the European Committee on Radiation Risks (ECRR) recommend 5 mSv/year.