Sep.11th, '20 Rev.0

The historical disaster so called 'The big disaster in East Japan' has happened at 2:46 pm on March 11th in 2011 and made the Japanese society confused extremely.

The question and answer in this paper on the radiation should be remarkable information for the foreign people staying in Japan

Question and Answer on the Low Radiation Exposure

-for Mitigation of Fear on the Radiation

Senior Network Tohoku

CONENTENS

Preface

The big disaster in the east Japan has happened on March 11 th , 2011 which seems to happen once in a thousand year. So many people apprx.20,000 were sacrificed. And also approx.16,000 people in Fukushima 1st nuclear plants site area were made evacuation with a government mandatary.

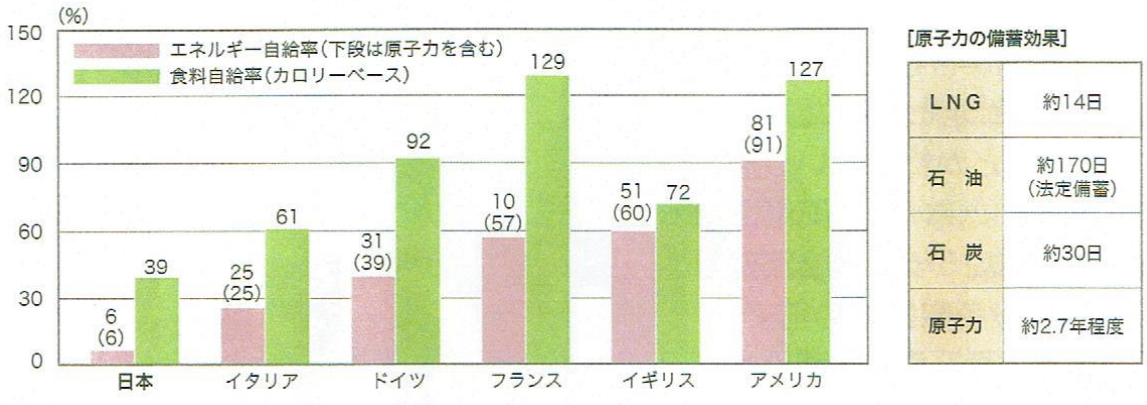
People recognized both fear of Tsunami and the nuclear accident which has happened since Chernobyl accident. After that , people were sincerely bothered with radiation and radioactivity and still have now been feared with the affection to health and the risk of cancer, and something else. Consequently the social problem of the rumor and the bully has happened.

On the other hand, most of the energy resource depends on the import from the foreign countries in Japan. So , the nuclear power must be necessary as the base load of power demand even if the Fukushima accident has happened from the improvement points of view on the energy self-supply (Fig,1)and global warming (Fig,2) respectively in the Japanese energy policy.

Therefore, Japanese government is making an effort to get public acceptance on the restart of Nuclear power generation, submitting as many information on the radiation and radioactivity as possible through the mass media and internet,

This paper is summarized those government reports concerning to the affection to health with the radiation exposure, and shall be meaningful for the people concerned to the education, foreign students , tourists in Japan and the others widely in order to mitigate and delete the fear.to radiation exposure.

Proceeding to the subject, why the nuclear in Japan shows with 2 figures as follows



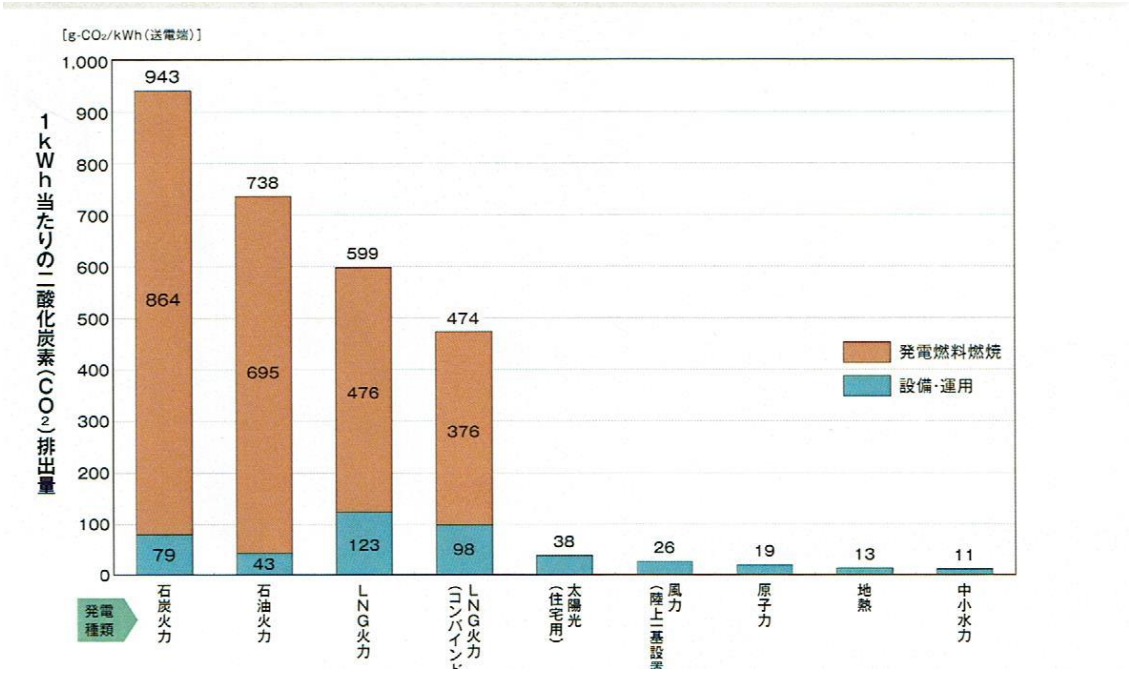
Japan Italy Germany France UK USA

Fig,1 The self-supply rate of energy and foods in each country.

*The figure shows that the rate(%) of self- supply of energy (lower number includes nuclear) and foods (calorie basis) in Japan is less than those in the other developed countries extremely.

Table shows the effective storage term of each primary energy resource. .
LNG ~14 , Oil ~ 170 ,Coal ~ 30days, Nuclear ~ 2.7 yrs.(～ ; approximately)

The longer storage term of the nuclear makes more stable supply of energy.



Coal LNG Sun light, Nuclear Micro-hydro
Oil Combined LNG, Wind mill, Geothermal ,

Fig.2 The amount of carbon di oxide exhausted to air per electric power of kilo watt hour (Kwh) with each fuel for power generation and assumed fuel for plant construction, maintenance and operation.

In the light of global warming, Nuclear has an advantage to reduce CO_2 release. to air.

Chapter 1　The origin of fear and question on the radiation and radioactivity

The first encounter to nuclear for Japanese was atomic bomb which had destroyed Hiroshima and Nagasaki entirely.　More than 200,000 were killed that the word of “radiation” and “nuclear” makes scare people and dislike, extremely.

Barack Hussein Obama ,a President of the USA visited Hiroshima with Abe, a Prime Minister of Japan on May 27 th, 2016

Dwight D. Eisenhower, a President of the USA

1.1　Utilization of Nuclear from weapon to peace use

Shinzou Abe, a Prime minister of Japan and Barak Obama, a President of the USA shook hand with deep thinking of the abandon of nuclear weapon in front of the memorial hall of Hiroshima on May 27th, 2016.

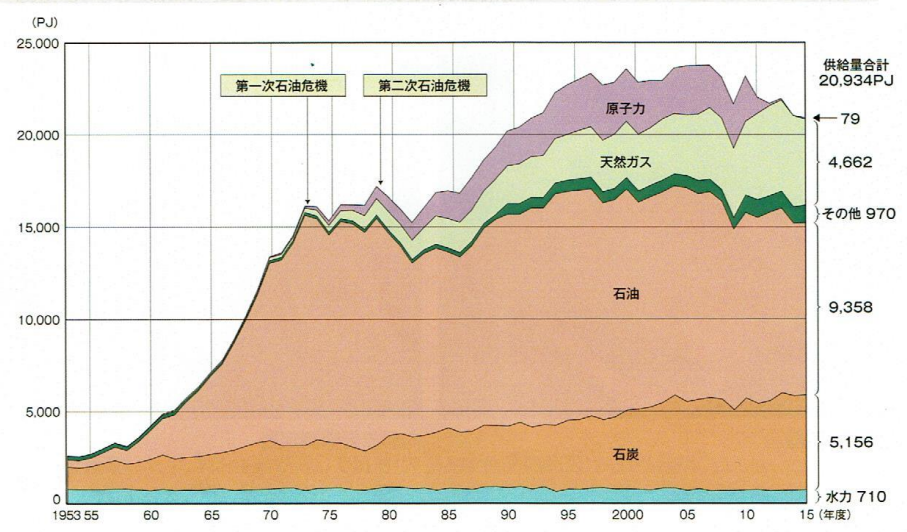
Many years ago, Dwight D. Eisenhower, a President of the USA had proposed drastically to develop the nuclear not for the weapon but for the peace use in the international conference in December, 1953.
After that, the nuclear and the radiation and radioactive materials have been developed and utilized to such several area as the power generation, the medical field, the agriculture, the process control in production and so on, rapidly in the world wide, and so ,very close to our daily life.

1.2 The extreme dependence on the Mideast Asia and the Oil crisis

Since the self supply rate of energy in Japan was very low and the extreme dependence on the Mid East Asia oil, the oil crisis in 1970' made very sever confusion of Japanese society and economical system .

In accordance with the crisis, Japanese government changed the energy policy from the fossil resource to the nuclear one which is so called artificial or technical resource and is expected relatively stable to import from its international market. .

Just before the huge disaster in 2011, approximately 30% of electrical power demand was supplied with the nuclear resource. However, the nuclear is in very small portion at this moment.



The total energy demand in 2017,Japan is 20,094PJ (1 PJ is 10^{15}J)
Primary and secondary oil crisis were in 1973 and 1979

Energy source
(up to down);

nuclear;
natural gas
the other & usable;
petroleum
coal
hydro

Fig.3 Energy supply of Japan

After the twice oil crisis in 1970's , the nuclear has been developed rapidly in Japan.

1.3 The new social problem due to the damage of Fukushima Nuclear Power Plants

As a result of the disaster of Fukushima nuclear power plants in 2011, many people in the region have not returned to their own lives yet so far.
Fishermen, farmer and the other producer and their consumer as well have been bothered with the rumor in their market.
And also the bully has happened among students in the primary school and high school,

Those malicious issue comes from short of knowledge and information on the safety which should be provided by Japanese competent authorities and the local

governments.

If the people could know accurately where, how much, and what kind of the radioactivity were there with the instruments, the emotional fear might be mitigated and removed.
So, it is important, first of all, to find if the radio activities might be dangerous level to the human health.

In a fact, since the first commercial nuclear power stations started in March, 1970, nobody has been killed with high radiation dose, so far, among the nuclear power stations. Because the instruments of the exposure as shown in Figure below and the protection system from excess exposure for each person are established in all power stations in Japan.

However, 2 of 3 workers were unfortunately killed in the nuclear fuel fabrication facility in Tokai of Ibaragi Prefecture because of the reckless nuclear reaction rash in September, 2009.

It is now said several 10 person in Fukushima area have been killed by themselves due to the extreme change of circumstances in their own daily lives. Also, many people could not resume their home because of its' high radiation level

Dose meter


Whole body counter

Chapter 2　To make sure the radiation and radioactivity circumstances in our daily life.

Q1) What are the natural and the artificial radiation and radioactivity ?

We are always exposed with both natural radiation which comes from the space and the radon on the earth.

Also,　we are exposed with the artificial radiation which comes from the nuclear power plant , the medical instruments, and the nuclear weapon test in past.

As we have the radioactivity, in every human body, of approx.7900Bq which comes from Carbon 14(C-14) of 5700yrs, and Potassium 40(K-40)of 1.3 billion yrs. defined as a half life respectively , we should be exposed internally by approx. 1mSv per year .

For instance, a passenger car which is filled with 100 people has about 800 thousand Bq there.

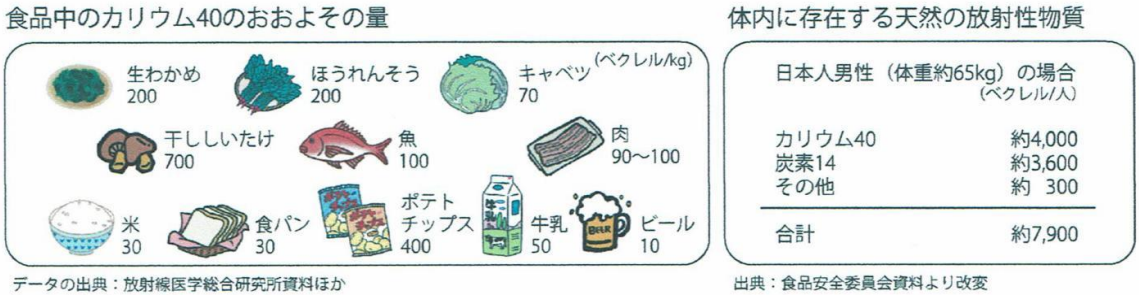
Under the usual circumstance, everybody is exposed at least less than 1 mSv per year, except medical care. When the additional exposure should be more than 1mSv per year, the national and local competent authority take action to protect the resident from radiation.

Resource of external and inner exposure

Fig. 4 Natural radiation resource

Everybody is exposed by **2.1 mSv per year** with both outer and inner exposure which comes from **Space** 0.3, **Air (mainly Rn)** 0.48 , **Earth** 0.33 and **Food** 0.98 mSv per year respectively

Potassium(K-40) in the foods and Radioactive materials in the body



Potassium(K-40) in food(Bq/kg) with approximate number	**Natural radioactive material in a body of Japanese adult 65Kg weigh,** Becquerel(Bq)/Kg in er
Sea **weed** 200, **spinach** 200, **cabbage** 70, **mushroom** 700, **fish** 100, **meat** 90=100, **rice** 30, **bread** 30, potato chips 400,**milk** 50, **beer** 10	**K-40** ~4000, **C-14** ~3600 " **Others** ~ 300 , **total~7900Bq**

Fig. 5 potassium in Food

Note

Isotope; Nuclear fission produces such isotopes as iodine -131,-133, Cesium-134,-137, Plutonium ,Strontium and so on. Here the number of 131,133 expresses the mass of nucleus which is composed of proton and neutron. Isotope is same number of proton and same chemical characteristics but different mass number (proton + neutron).

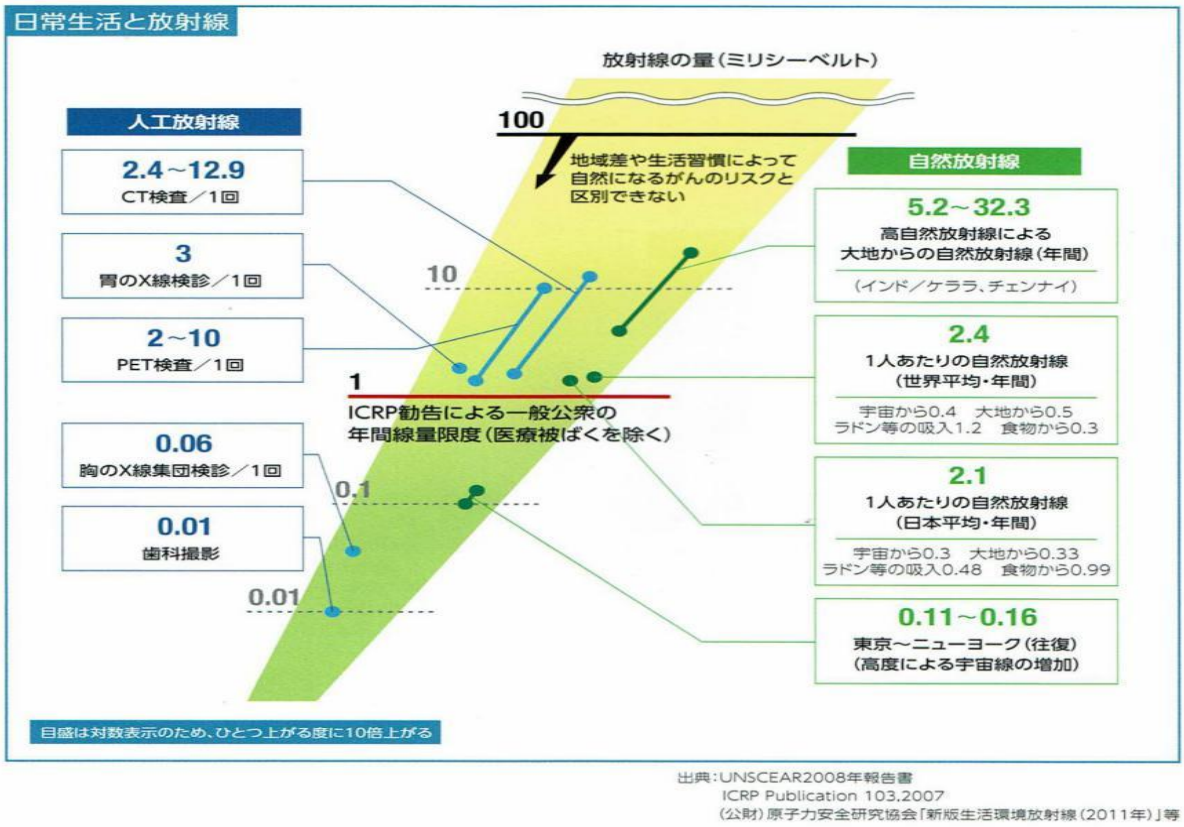
Half- life; A number of nucleus reduces with time to be 1/2 number of nucleus ,

Sievelt ; Unit to measure and evaluate the individual radiation exposure which affects to health. Milli-Sievert(mSv) is 1/1000 Sievelt

Becquerel; Number of nucleus decay per second, that is, unit of amount of radioactivity

Grey ; (in Q9,page 15) Unit to measure the absorption energy in organs (joule per Kg of organs)

Radiation exposure in our daily life (mSv)



出典：UNSCEAR2008年報告書
ICRP Publication 103,2007
（公財）原子力安全研究協会「新版生活環境放射線（2011年）」等

Artificial radiation exposure(mSv in a time)	--	Natural radiation in mSv per year
CT-exam 2.4～12.9	Less than 100 mSv. Unable to distinguish the each risk separatively	5.2～32.3 (High exp. local areas in India & others)
Stomach Xray 3 PET exam. 2～10	10 mSv	2.4 (Individual average exposure in the world) 0.4 from space 0.5 from dearth 1.2 from Rn 0.3 from foods
	1 mSv ICRP recommendation on the annual exposure limit for public except medical care	2.1 (Individual average exposure in Japan) 0.3 from space 0.33 from earth 0.48 from Rn 0.99 from food
	0.1 mSv	0.11～0.16 In a round trip New York to Tokyo
X ray on lung 0.06		
Dental X ray 0.01	0.01mSv	

Fig.6　Exposure level (in milli sievelt) in our daily life

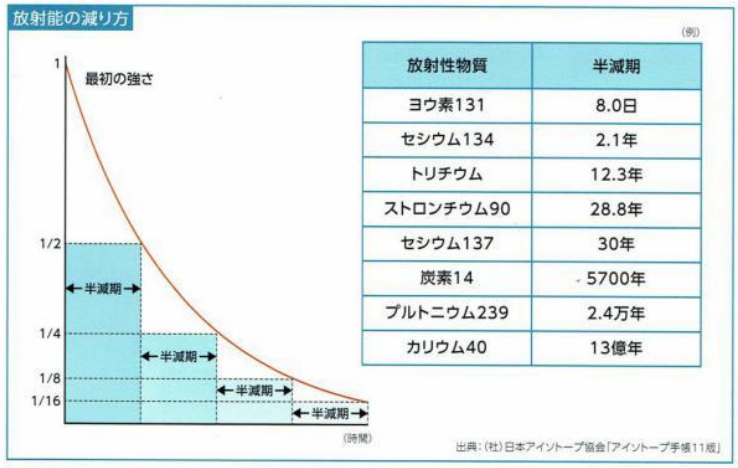
Chapter 3　To make sure the effect to human health with the radiation and radioactivity which caused by the accident of Fukushima nuclear power plants

Q2)　What are the radioactive elements which were caused by Fukushima accidents

The several kinds of radioactive materials which have scattered with the accident were iodine, cesium, tritium, strontium, carbon, plutonium, potassium and so on.

From the human health point of views, we should focus on the cesium and iodine. Cesium is very similar to potassium chemically and distributed in a whole of body. Iodine is a component of hormone in the thyroid. Both of cesium and iodine are remarakable elements from the effects to health point of view as described in 3) below .

The physical half time of the radioactive iodine is shorter than it of cesium, as shown in Fig.3 with other radioactive elements.



放射性物質	半減期
ヨウ素131	8.0日
セシウム134	2.1年
トリチウム	12.3年
ストロンチウム90	28.8年
セシウム137	30年
炭素14	5700年
プルトニウム239	2.4万年
カリウム40	13億年

I-131	8.0	days
Cs-134	2.1	yrs
T-3	12.3	yrs
Sr-90	28.8	yrs
Cs-137	30	yrs
C-14	5700	yrs
Pu-239	$24x10^3$	yrs
K-40	$1.3x10^9$	yrs

Fig.7　Physical half time of radioactive elements

3.1　To make sure the effect to human health with radiation

Q3)　Does the effect of radioactivity take in body to heath continue or many years ?

The fission of Uranium nucleus produces several nuclei including

Cesium 137and Iodine131 which are effective to human health.

The physical half-life of Cs-134 is so long as approx.30yrs and I-131 is so short as approx.8 days, the effect of I-131 is negligible as it has been a long time since the accident had occurred.

Furthermore, as Cs-137 and I-131 are removed from a body by the metabolism. the effective half-life which is combined with the physical and biological half life time in each age is shorter respectively as shown in Table 1 below.

Note; The physical half life does not change by cooking such as heating or cooling.

Effective half life of radioactive materials is as below

	Age (Years old)	Physical half life	Biological Half life	Effective half life
Iodine-131	baby 5 adult	～8 days	11 days 23 80	～5 days ～6 ～7
Cesium-137	～1 ～9 ～30 ～50	～30 years	9 days 38 70 90	～9 days ～38 ～70 ～90

Table 1 The effective half life

3.2 The examination of the thyroid by Fukushima local government

In the Chernobyl accident of 1986, many children had thyroid cancer because of milk drinking without quantitative restriction.

Q4) In the future , many children may have thyroid cancer in Fukushima ?

UNSCEAR has reported that the accident in Fukushima nuclear plants would not make the possibility of thyroid cancer increase among children, because the exposure level in Fukushima was much lower than the one in Chernobyl.

However, UNSCEAR has suspended the conclusion at this moment.

Figure 8 (quoted from Journal of Japan Atomic Society,vol.57.No4,2015.)shows the examination results of thyroid cancer to make comparison between Fukushima(left) and the other 3 combined prefectures of Aomori, Yamanashi and Nagasaki(right).

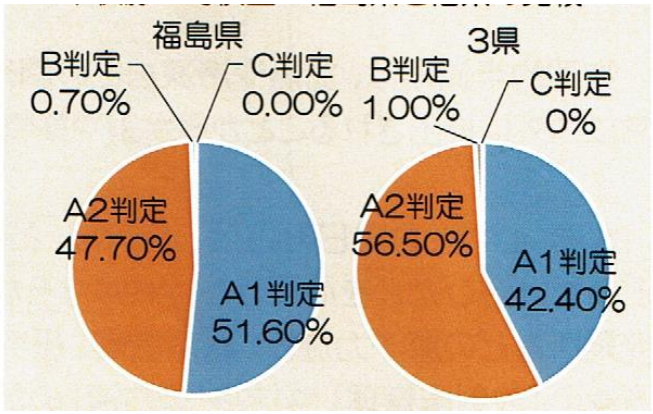


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Fig 8 Examination results in Fukushima and in the 3 combined prefectures

A1; no nodule found, A2;nodule less than 5mm in A group.
B; Secondary examination needed, B1:nodule more than 5.1mm or cyst
C; Immediate examination needed due to the thyroid status.

The number of A ,B and C were nearly equal between left and right figures.

The surgery results taken in 108 with B and C of Fukushima shew no thyroid cancer among approx. 30,000 people in Fukushima until 2016 .
The next examination will be taken on the age of 25 and 30 each person,

Q5) Are children more sensitive to radiation than adults?

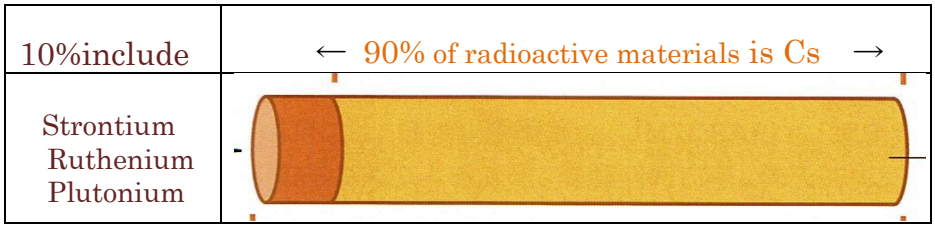
Generally, the risk of cancer occurrence in less than 100 milli sievert is so low as the natural risk among the people including children based on the investigation of the people who had been exposed by atomic bomb in Hiroshima and Nagasaki .

However, the cancer risk of child whose cell diversion is very active is seemed to be 2 to 3 times more than that of an adult.

Q6) Is it permissible not to evaluate the other radioactive materials than cesium?

In the examination of soil, the radioactive material of which half life time is more than 1 year should have been examined as a regulation.

As a result of the examination which have shown the contribution to health with strontium, ruthenium, plutonium and so on is 10 % at most, the radioactive cesium should be possible to represent a whole of radioactive materials.



About 90 percent of radioactive materials in the soil are cesium and the other 10% is Sr Ru and Pu .

It is possible to evaluate the comprehensive effects to health with monitoring cesium, because 10% of the cesium in soil transfers to foods and Strontium, Ruthenium and Plutonium are rarely found in foods.

Q7) How does the radiation effect to human health?

Human compose of 60 trillion cells and 1 % of them are replaced with new cells, every single day. Each cell has DNA with heredity information.

On the other hand, DNA is always damaged with not only radiation but also stress, tobacco, chemical materials and so on. However, everybody has a biological defense mechanism to restore the damaged cell.

If someone were exposed eventually with a lot of radiation as if more than 500 milli-Sievert (mSv), the biological defense mechanism in body could not work enough to make the damaged cell restore. Consequently, the acute disorder should appear in such active cell division organs as intestines, blood making organs, reproductive glands and skin.

The radiation effect to health depends on the exposure level in mSv and exposure time. It does not matter if you have exposed or not.

Generally, the cancer occurrence risk in less than 100 mSv is so low as natural risk level for the people including children.

It is remarkable that the exposure effects to health with 100 mSv for a life shall be different from those with 100 mSv at a time, since the former effects shall be

mitigated with the biological defense mechanism to radiation, and also the effects do not infect to the other person .

ICRP has concluded that effects with radiation are not hereditable to embryo under less than 100mSv.

Q8) How much exposure will make a cancer?

The Radiation Effects Research Foundation (which was invested by both Governments of Japan and the USA in 1975) has reported that the two people groups, one is apprx.93,000 who has been exposed in Hiroshima and Nagasaki, and, the other one of apprx.27,000 is not exposed at all, have been examined for more than 60 yrs., and ,have shown that in less than 100 mSv. the risk of the cancer by the exposure is equivalent between the two groups .

It means that the risk is so low that it is unable to distinguish the risk of radiation effect from the natural risk and is also clearly depending on the personal daily custom such as drinking , smoking and so on.

If someone is exposed eventually as if more 500mSv. the biological defense mechanism can not work enough to restore the damaged cell, and the acute disorder should appear in such active cell division organs as intestinal tract, hematopoietic organs, reproductive glands, and skin.

Note; Radiation effect should depend on how much exposed a time in mSv, but it doesn't matter if you have been exposed. If you have been exposed with 100mSv so long time as a life, the effect would be mitigated by biological defense mechanism.

Infections as if virus never occur among the people with radiation and radioactivity.

Q9) Might a fetus be affected with radiation ?

If the radiation exposure level on abdominal is less than 100 milli-grey, it is no problem to keep in pregnant. The radiation effect beyond 100 milli-grey depends on the pregnant time. For instance,

Pregnancy period of;	Risk with radiation
Less than 1 month	Abortion
1 to4 months	Malformation
in forming organs	Retardate
Beyond 4months	Birth

Note; Milli-grey is nearly equal to milli-sievert.(Ref. page 9)

In July 2013, The medical collage of Fukushima has reported that the probability of abnormal occurrence among the newborn babies was usual level, whose mothers were pregnant when the accident had happened.

In April 2014, UNSCEAR has also reported that it is not expected to occur Abortion, Pregnancy perinatal death, Innate influence, Cognitive impairment as a result of radiation exposure with the accident in Fukushima nuclear power plants.

ICRP (International Commission Radiological Protection) recommends that if an embryo were exposed less than 100 milli-grey of the threshold , it is unreasonable to abort because of exposure reason only.

Note; Milli-grey is an unit to express the absorbed energy in each cell. On the other hand, milli-sievelt is an unit which is defined especially to evaluate the radiation effect to the organs and to the health as a whole.

Note; The pregnant should consult with a doctor if she might be exposed considerably for a specified medical care .

Chapter 4　To make sure the food safety

Q10)　Are the criteria of Japan on the radioactive material contents in the food severer than that of Europe and the USA ?

The food safety commission of Japan declares that the accumulated radiation dose in a human life should be less than 100mSv, excluding natural and medical dose.

As a result of several cases depending on the age, it is found that the severest case is in the age of 13 to 18 years old who are in the most eatable on the common foods.

However, the criteria is specified to be less than 1mSv per year assuming that the exposure with water intake of 10 Bq/kg and 2 litter per day in accordance with the WHO guidance shall be 0,1mSv/yr, and, the exposure with the other common food ,baby food and milk shall be 0.9 mSv/yr.

The Japanese criteria on the radioactive material contained in the food are severer much more than that of Europe and the USA　as shown in Table2

	Japan	Codex	EU	USA
Radioactive cesium	Water 10 Milk 50 Baby Food 50 Common foods 100	Baby foods 1000 Common foods1000	water 1000 Milk product 1000 baby food 400 Common foods 1250	1200 all
Additional exposure	Less than 1 mSv	1 mSv	1 mSv	5 mSv
Radioactive Materials In food (%)	50 %	10 %	10%	30%

Codex ; Union of FAO and WHO

Table 2　The criteria on radioactivity

In fact, since the level of radioactivity in each food of markets are less than the criteria, consequently, the actual exposure levels of person are very low.

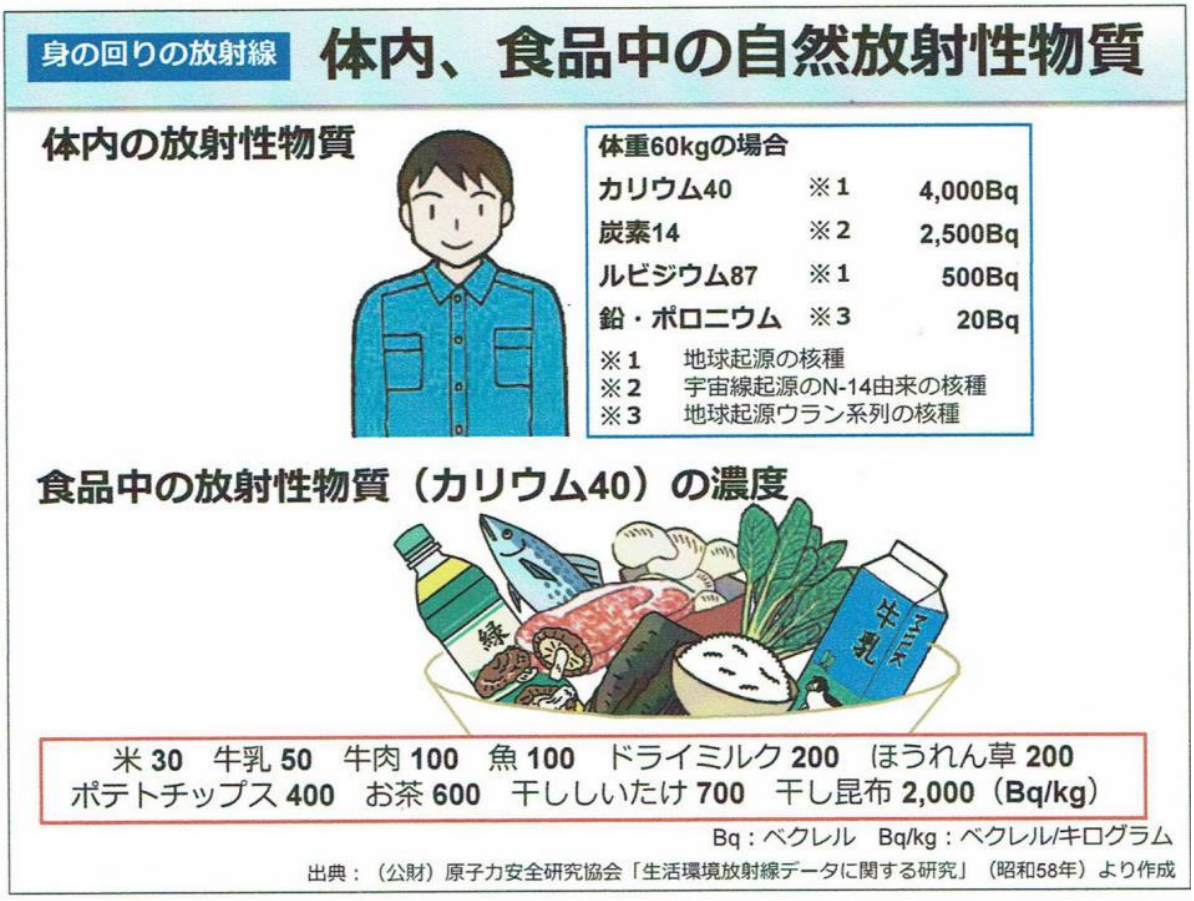
Q11)　Does the criteria on the radioactive material contained in food take into account the effects to children?

The criteria on the cesium (Bq/kg food) are itemized as water, baby food, milk and common foods.　100 Bq/kg is applied for the common food, and, 50 Bq/kg is applied to the milk and the baby food which are more taken by a child than an adult.

Criteria on the cesium contained in foods of 1kg

	Japan	USA	EU
Baby foods	50		400
milk	50	1200 all	1000
water	10		1000
Common foods	100		1250
Concept of criteria based on assumption.	Exposure should be less than **1 mSv /yr** based on an assumption that **all** of water, milk and baby food, and **50%**of common foods are contaminated with cesium	Exposure should be less than **5 mSv./yr** . **10%** of foods are contaminated with cesium	Exposure should be less than **1 mSv/yr**. **10%** of foods are contaminated with cesium.

Table 3 criteria on cesium in foods



Natural radioactivity in the food and the body.
Example in a case of adult,60kg weigh, apprx.**7000Bq** in body, which comes from **4,000Bq** for **Potassium** -40 in earth, **2,500Bq** for **Carbon -14, 500Bq** for **Rubidium-87** , 20Bq for **Lead・polonium**.

Potassium-40 in food in Bq/kg
Rice 30, Milk 50, Beef 100, Fish 200, Spinach 200, Potato chips 400, Green tea 600, Dried mushroom 700, Dried sea weed 2,000

Table 4 Natural radioactive elements

Q12) How to prevent from taking the radioactive materials into a body .

If some radioactive materials are found, it is effective to keep distance from the resource staying in a building to mitigate the outer exposure, to put a shield material and to shorten exposure time.
On the other hand, it makes sense in some degree to put a mask on face as a countermeasure to plume.

However, it is over concern not to let the children play outdoor and /or eat the vegetables to prevent from outer and inner exposure.

It is completely safe to eat the foods in the market, because those are always inspected and made sure not to be out of the criteria by national or local government.

Q13) How does the criteria apply to the raw and its processed materials?

For instance, in case of mushrooms, the inspection is taken in raw and after damping in water applying 100Bq/kg of the criteria which is shown in the table 3 as the common food.

Q14) What countermeasure by local government shall be taken if the food beyond criteria of Table 1 are found?

The condition for the restore of trade ban of foods which are out of the criteria is to make clear the inspection which is taken a time an every week of the latest one month in 3 different check points of the designated production area.

Q15) Are the food served as school lunch and sold in the supermarket safe?

All foods out of criteria in the inspection which are taken by Japanese government or the local government should be disposed or forced to remove from the market.

When cesium is found in some areas, the contaminated area shall be fixed. Based on the Japanese law , the prime minister shall ask to the local governor ,and then, the local governor shall ask to the concerned business people to restrict the ship and sales on the concerned materials and products.

Q16) What inspections are actually taken in the specified field of agriculture and fishing?

It was found that the correlation between potassium and cesium contents in soil shows the more potassium the less cesium. So, in the production of rice, beans and buck wheats' seeds the potassium content in soil is increased to avoid the

cesium tradition from soil to rice and beans.

Consequently, the rate of rice sampled by 10.33 million in 17 prefectures in Japan was 0 %.

The fishery products as well which are more than 100 Bq/ kg should not be in market with mandatory.

Q17) How do you assure the safety of milk, meat, egg against radioactivity ?

The radioactivity of milk, meat and egg has been assured to be within criteria before shipping to market. Milk, for instance, which comes from each dairy farmer has been tested in sampling basis of every cooler station.

Meat and egg also have been tested once in 3 months so far in farmers of Iwate, Miyagi, Fukushima, Tochigi and Gunma since 2011.

Q18) Is it permissible to eat the foods which are just on the criteria through a year?

The criteria are specified to keep less than 1mSv per yr., even if the foods which are just on the criteria would be eaten for a year.

If a baby with the active cell diversion eats the foods which is on the criteria, the exposure effect shall be mitigated with the metabolism as a half as lower than an adult.

In example calculation that someone eats the foods which contains 100Bq/kg of cesium-137 every day for a year, the result is 0.23 mSv.

100(Bq/kg)x0.5(kg)x0.013(μSv /Bq)=0.65μSv (0.00065mSv)

0.00065 x365=0.23mSv

	Iodine 131	Cesium 137
Baby 3month 1yr old	0.18 0.18	0.021 0.012
Child 5yrs old	0.10	0.0096
Adult	0.022	0.013

Table 5 Effective dose coefficient (μSv / Bq)

Q19) How much Cesium could be taken in body with daily foods?

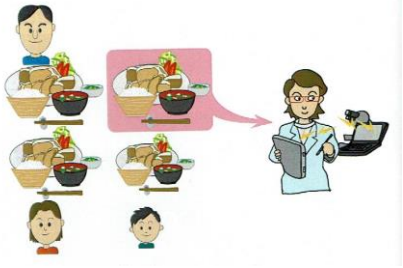
There are 2 ways to estimate how much cesium we take in body.

One is, so called "market basket" way which was investigated strictly with foods which were bought in markets and cooked at home, for Feb.～Mar., Sep.～Oct.,2012 ,and, for Feb.～Mar., Sep.～ct.,2013.

The other is so called “Hidden Table” way in which the usual homemade foods were collected and investigated on the radioactivity of cesium. In accordance with two kinds of estimation above, it has been assured that the

exposure level with the cesium contained in foods was less than 1%(0.01mSv) of acceptable exposure of 1mSv per year which is defined in Japanese law, and, is less than aprx.0.2mSv. per year of the natural exposure source with radioactive potassium.

“Market basket



“Hidden table”

Chapter 5　The safe treatment and disposal of radioactive wastes which came from Fukushima Nuclear power station

Q20)　Is it possible to treat and dispose the radioactive waste in safety?

Based on the Japanese law, the radioactive waste of more than 8,000 Bq/kg shall be disposed by Japanese government responsibility.

The deposited wastes with 8 to 100 thousand Bq/kg shall be burnt out. The gas shall be cooled in the coolant to filtrate the cesium with the high efficient filter (Bag filter) which remove the particle of cesium completely.
The filtrated residue shall be deposited in the disposal facility (Fig.9) equipped with monitors of radiation, underwater, ground slide and so on.
The radioactivity of cesium does not release to air at all.

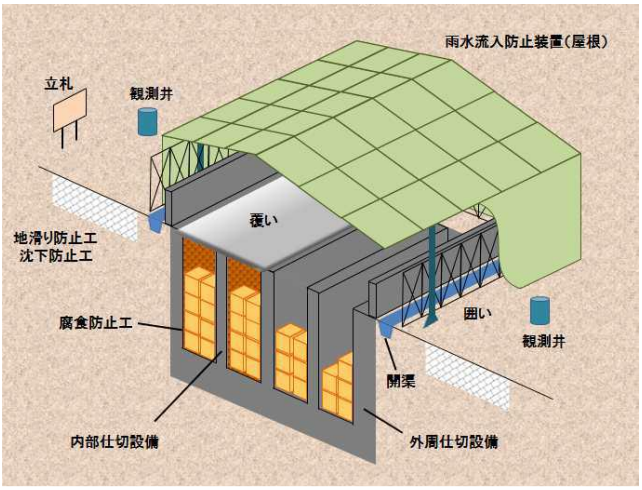


Fig.9 The deposit facility (Ref. Ministry of the environment, home page.)

Chapter 6　The active utilization of radiation in our daily life

Q21)　The utilization examples of the radiation

The radiation characteristics are very useful as follows (for examples)

Medical cares ; equipment of testing and treatment for cancer, sterilization,
Industry; improvement of automobile tire quality,
Agriculture; de-germination of potato***,** pest control, quality control,
Culture; annual ring measurement of wood, chemical analysis, research of arts,
Dairy life; the utilization of radiation to foods*****, sensor of smoke, X ray test,

*****WHO has suggested there are no change of foods quality with usual irradiation , if any change may happen, it is quite similar change with such processing as cooling, heating, drying, and so on. (Ref. The ministry of Agriculture, Forestry and Fisheries, Dec.2009)

Chapter 7　Emergency and Evacuation

Q22)　Let us know how to avoid the damages with a nuclear accident and to evacuate from it.

In the light of experience on the Fukushima nuclear power plants, if an accident occurs an integrated command headquarter (The chief officer is Prime minister of the Japanese government) should be set for the purpose of recovery on the accident and protection of resident people together with, according to the evacuation plans which are fixed by each local government.

Concerning to Precautionary Action Zone and　Urgent Protective Action Zone)

It should be declared　"a nuclear accident"　if the additional exposure level might be 1 mSv per year, that is,0.23 μ Sv/hr in air.
Evacuation shall be executed , watching over the plume there, for all residents firstly in the area within 5Km which is called PAZ ,secondarily in 30km which is called UPZ from a nuclear power plant.

Fig.10 radioactive plume

The picture above explains that small particles with radioactive materials are falling on the earth from radioactive plume and are taken in body with breathing, eating and wounded skin. （Fig.10　is provided by Miyagi prefecture office）

Chapter 8　Additional Question and Answer in the seminar

Q23)　What radiation exposure control for the each personnel who works under radiation in the nuclear facilities and the others shall be taken?

The exposure is controlled strictly for those personnel who work in the areas of medical care , nuclear facilities ,and so on, applying Japanese regulation of 100mSv for 5years , and/ or ,less than 50mSv per a year, 5 mSv for 3 months for female and 2mSv for pregnant.

The epidemiological surveys in Britain, the USA and Japan shows the mortality rate in the personnel who work in a nuclear facilities is equivalent to public as follows;

Britain; The mortal rate and the average exposure level of　33.6mSv in the 100 thousand workers　of "cancer" and "except cancer" shew 15% less than that of the average of people from 1945 to 1988.
Note; The Leukemia is so rare that one mortality makes big change in the mortal rate.

US; the risk of any type of cancer was not higher in **37** hundred workers than in people as a result of the survey for 42 years in Hanford Laboratory,
Note; It was found that the cancer of bone marrow increases relating to exposure level which was not found in Hiroshima and Nagasaki of Japan

Japan; In the statistic analysis on the 115 thousand workers with radiation exposure of 13 mSv. in average in nuclear power plants, the mortality rate of "cancer" and "except cancer" was less than that of people in Japan.

Q24)　What is the effect to human health with tritium ?

Tritium emission is beta ray and its half-life is 12.3yrs, however, the emission energy is less than it of cesium and is not transparent through the skin, that is , there are no serious affection to health .

On the other hand, the chemical characteristics of tritium is similar to hydrogen. As tritium should be taken easily out of body with sweat and urine, the affection to health with the tritium radiation of beta ray should be slight.

The exposure dose of tritium is nearly 1/1000 of cesium as shown in table below

.

Radioactive element in a body	Effective dose coefficient. mSv/Bq
Tritium	0.000000018
Cesium-134	0.000019
Cesium 137	0.000013
Iodine 131	0.000022
Strontium	0.000028

Table 6 effective dose coefficient

Q25) What is the hormesis effect?

There are some papers on the hormesis effects which might activate the several function of human body with a slight exposure.

Those papers are not referenced in the government reports, however, it is a fact that many Japanese expect a care effect of the cancer in Tamakawa , Misasa and some other hot springs.

Q26) Why do not they define the upper limit of radiation exposure for medical care?

Based on the international consensus that the merits of exposure is much more than the demerits of it, no exposure limit is set even though radiation exposure should always be as low as practicable.

Fig. 11 shows from left to right, the natural and medical exposure with radon, foods, space, earth, and medical care. The natural exposure of 2.4 mSv per year in the world average and 2.1 mSv per year for Japanese.

In fact, the medical exposure is much more in the Japanese than in the world.

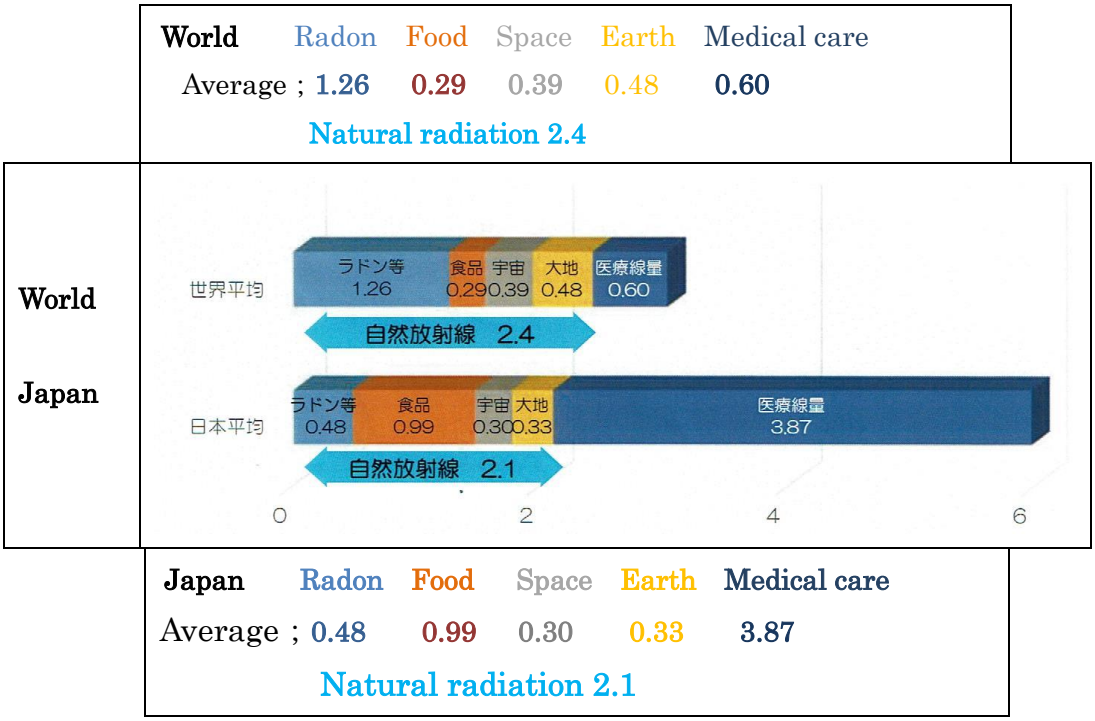


Fig. 11 Natural and Artifitual

Q27) What are still unknown and not resolved problems on the low radiation exposure ?

It has been made clear that there are no linear correlation between the exposure level and the risk of cancer less than 100 mSv..In more than 100 mSv., it is assumed a linear correlation that the cancer risk shall be 5% up with every 100mSv up, taking account to the actual observation that 300mSv exposure made 1.5% up of the risk based on Hiroshima and Nagasaki data

The fact means that much more basic data including the affection to each organ with radiation should be necessary.

Editor's subscript

This paper on the low radiation exposure is composed of Japanese government reports which are **provided and authorized sufficiently with many international research organizations.** It is, therefore, very different from the reports which are published by individual basis.

For example, more than 80 scientists in world wide who are authorized and famous have participated and reported the analysis and evaluation on the radiation effect with Fukushima accident.

The report was reviewed in the annual conference of UNSCEAR, May, 2013 by 27 countries of its member.
All participant scientists were obliged to **notify the conflict of interests.**

In fact, the evaluation way on the inner exposure effect to DNA is not agreed and under discussion at this moment among the scientists. However, you could avoid the individual disadvantages if you were confident on the government reports.
Note; The linear co-relation between the cancer risk and the exposure level was not found in the analysis.

.

However, it is pending issue among the researchers at this moment how to identify the mere effects by the low radiation exposure to health , removing the other effects which are caused by drinking, smoking, mental stress and so on ,because it takes so tremendous time and money .

Someone has suggested on TV that the most effective vaccine to prevent people from the rumor and bully should be the knowledge.
How meaning full suggestion it is!
I wish this paper could be one of effective vaccines for the people.

Terms

•ICRP(International Commission on Radiological Protection)

The commission has started in 1950 in order to recommend the basic standard and the protection criteria to the radiation which have been applied to the countries including Japan

•IAEA (International AtomicEnergy Agency)

The organization of United Nations to secure the peace use of atomic energy. The headquarters office is located in Vienna, Austria.

•UNSCEAR (United Nations Scientific Committee on the effects of Atomic)

All of the committee members are authorized scientist internationally. The report on the radiological analysis for Fukushima disaster was reviewed strictly by the participant scientists of 27countries who were obliged to file the .conflict of interest.

•**Nucleus and Isotope**

A nucleus is composed of proton and neutron. The combination of number of proton and number of neutron makes several chemical elements and isotopes, for example, iodine(I) I-131,133 ,cesium(Cs)　Cs134,137,plutonium,strontium and so on, in the fission of Uran,

•**Nucleus Decay (Radioactive decay)**

The nuclear fission of Uran produces several chemical elements, for instance , iodine(I)　I- 131,133, Cesium(Cs)　Cs- 134,137 and the others of Plutonium ,Strontium, and so on, according to the combination with the number of proton and neutron.

The radioactive material (elements) decays with a half-life ,

releasing α,ß,γ and neutron rays. For instance, potassium-40 in the human body decays and changes to calcium (Ca) Ca 40 by 89% and argon (Ar) Ar-40 by 11 %, releasing ß and ɤ rays.

Radon on the way of uranium　isotope decay exists in "the radon hot spring" so called, however, its radiation level is very low.

For instance, the radiation level in the famous hot spring of Tamakawa and Misasa in Japan is 10 micro-sievert (micro is 1/1000 milli sievert)

• **Becquerel (Bq) ;**Bq is a unit to fix the radiation level which comes from radioactive materials. 1Bq means 1 /second of isotope nucleus decays. For instance, 370 Bq of potassium means that 370/second nucleus of potassium decay and change mostly to calcium. Generally, activity of food is expressed in Bq/Kg.

Radiation of α、ß、γ、neutron, X ray, so on. has an energy which is absorbed to internal organs, eye, embryo, etc..

• **Sievert (Sv) ;**The effects to health with radiation are depending on the sorts of radiation as α、ß、γ、neutron, X ray, so on.

Sievert is a unit to control and evaluate the effects individually converting to whole body exposure. So, it is possible to evaluate the effects with artificial and natural radiation on same unit basis.

• **Grey** (Gy); Unit to evaluate the absorbed energy (joule per Kg of organs) in organs, eye and embryo with radiation.

•**Designated radioactive waste**

Under the Japanese law on the radioactive waste disposal, the designated radioactive waste of more then 8000 Bq/ kg should be disposed with Japanese government responsibility.

An address of thanks

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