Cover-up of Damages by Atomic Bombing and Severe Effects of Internal Exposure by Residual Radiation

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Present Situation of Atomic bomb Survivors and Estimation of Radiation Effects

Now, after sixty-four years of Hiroshima and Nagasaki atomic bombing, many atomic bomb survivors are still suffering aftereffect diseases. The Japanese government has provided special medical and livelihood assistance to survivors whose diseases are verified to be from the effects of the atomic bomb radiation, however, the criteria adopted by the subcommittee of Atomic Bomb Survivors Medical Care of the Ministry of Health, Labor and Welfare are very strict and far removed from the actual situation of many survivors. The numbers of legally accepted atomic bomb survivors who hold a health note book was 380 thousands in 1980 and the number of survivors who were certificated their diseases are the atomic bomb radiation effects by the Japanese government was 4 thousand and 400 at that time. After 1980, the number of certificated survivors rapidly decreased from above 4 thousands to about 2 thousands which were less than 0.8% of the total survivors of 270 thousands in 2003 reflecting only the political and financial grounds of the government. Now a collective lawsuit has been going on from 2003 in 17 local courts by 306 atomic bomb survivors against the Japanese government demanding withdrawal of rejection of application to certify atomic bomb disease. Prior to the collective lawsuit seven successive judgments including those by the Supreme Court and by two high courts had pointed out that the criteria of atomic bomb disease certification by the government is apart from actual conditions of survivors and decided to withdraw of the rejections. However, the Japanese government had introduced more severe criteria introducing probability of causation by which even the applications of survivors who got victory judicial decisions will be also rejected.

The criteria, the probability of causation, of atomic bomb disease certification has been based on the Atomic Bomb Radiation Dosimetry
System 1986 (DS86) and results of the epidemiological research that has been done at the Radiation Effect Research Foundation (RERF) which is the successor of Atomic Bomb Casualty Commission (ABCC). The epidemiological survey of RERF put emphasis only on the initial radiations (gamma rays and neutrons) which were emitted within 1 minutes after the explosion and the effects of the residual radiations had not been considered. The initial radiation had caused acute external exposure meaning irradiation from outside of human body. There are two kinds of origin for the atomic bomb residual radiations; one is from radio-activated matter induced by the initial neutron and the other is the radio-active fallout which include the fission products, neutron-induced equipments of the atomic bombs and fissile materials (uranium and/or plutonium) leaving without fission. Beyond external exposure effects, the major effects of residual radiation are chronic internal exposure due to intake of radioactive matter by respiration, ingestion and other form.

The nuclear possessed countries, in which US take a leading role, have hided the severe effects and inhuman character of internal exposure, in order to maintain their arguments that the damages of nuclear explosion can be restricted. The International Commission on Radiological Protection (ICRP), which has set international standards of radiation protection, has been influenced by the policies of governments of US and Soviet Union and especially has based on the epidemiological studies of RERF. Then the international standards of radiation protection set by ICRP have the same problems. Therefore to clarify the severe effects of internal exposure from the scientific standpoint is an important task concerning to the future of human being.

After 6 successive lost cases of the collective lawsuits the Japanese government revised their criteria of atomic bomb diseases by abolishment of the probability of causation and accepted the exposed effects by the residual radiation in March of 2008. In the memorial day of Hiroshima, 6th August of this year, after 19 successive lost cases including 5 decisions of higher courts, the prime minister signed a note of confirmation with Japan Confederation of A- and H-Bomb Sufferers Organizations, which have promoted the collective lawsuit. In the note the government made promise that the government is subjected to decision of local courts and
withdraw appeals to the higher courts.

**Cover-up Policy of US on Nuclear Damages**

Just after the beginning of Japan occupation of the Allied Forces, on 6th September 1945, a brigadier general T. Farrel, who was a commander of the research commission of the Manhattan Project made a press interview and published a statement that "In Hiroshima and Nagasaki, at present, the beginning of September, anyone for death have already died and no one does suffer from atomic radiation. "For opposition by a journalist W. Burchett who had saw the real state of Hiroshima that one hundred survivors died par a day, Farrel made a counterargument that deny the facts. "In order to remove risk by the residual radiation the bomb was exploded considerable attitude, then it is impossible to exist the radioactivity in Hiroshima at present, and if someone died at present it will not owing to residual radiation but by no mean by the effects of damage received at the time of bombing. "Farrel was in charge of research on the human effects of radiation including experiments on human body in the Manhattan Project so that he would already well known that if a few fine radioactive accumulate in lung it gives fatal effects.

On the 19th of September 1945, the General Headquarters of the Allied Forces issued the press code that control by sever inspection of press and literature concerning to atomic bomb and by demanding permission before publication of research results on the damage of atomic bombing practically forbid publication. This is the beginning of the US policy that cover-up of radiation damage, especially of the problems of internal exposure by residual radiation.

The every obtained results done by Japanese scientists just after the bombing and the results of research done by the Special Committee for Investigation and Research on Damages of Atomic Bomb established by the Japanese Academic Council were brought to America side. Late in September of 1945 the US Army and Naval surgeon group organized the Joint Commission for the Investigation of the Effects of the Atomic Bomb in Japan by making the Medical Faculty of Tokyo Imperial University as collaborator and investigated for about one year, but they carried back to US all collected materials.
**ABCC and RERF**

The US that adopted a definite world policy to govern the world in terms of nuclear weapon had driven by necessity to study, from both of offensive and defensive sides, effects on human body by use of nuclear weapon especially of the effects of initial radiation. On 26 November in 1946, President Truman ordered to establish Commission on Atomic Bomb Casualty (CAC) and the CAC decided to found Atomic Bomb Casualty Commission (ABCC). After preparatory investigations the ABCC built perpetual institutions at Hiroshima and Nagasaki in 1950 and began investigation of atomic bomb survivors. In the interview investigation of survivor the ABCC made thorough examination concerning to the exposed place (indoors or outdoors, thick or thin sheltered house, etc.) and to the posture of survivor at the instant of bombing in order to estimate exposed dose by the initial radiation of the atomic bomb. On the other hand, the ABCC did not inquire into behaviors of survivors after explosion which are necessary to estimate residual exposure for the survivor.

Due to a occupational closed character of the ABCC and frequent change of American expert staffs as well as bad feeling among citizens of Hiroshima and Nagasaki, the activities of ABCC became stagnant as the whole around 1955. Following to Francis Committees recommendation based on the examination of ABCC activities, the ABCC restarted the Adult Health Study (AHS) on about 20 thousands subject of survivors in 1958 and the Life Span Study (LSS) on about 100 thousands survivors in 1959. At long last in 1975 ABCC was closed and the RERF was started up, but the ABCCs staffs, institutions and projects were left continuously to the RERF as well as involved problems of the ABCC.

Then the epidemiological research in the RERF remains unchanged completely ignoring the effects of residual radiation.

**The Bikini-Incident and Studies on Radiation Damage**

A hydrogen bomb test Bravo Shot done at Bikini atoll of Marshall Islands on the 1st March 1954 gave Japanese people very big impact and a nationwide movement against nuclear weapon arose and the first World Conference against A & H Bombs was held in the next year August in 1955. On the basis
of this movement many scientists and experts in various fields, such as radiation physics and chemistry, radiobiology and fisheries science took part actively in investigation of damages by the Bikini nuclear tests and clarified that the damages by fallout of hydrogen bomb tests had been spread over the wide region of the Pacific Ocean. These investigations and researches by Japanese scientists pointed out that the radiation effects of fallout by these nuclear tests were very severe. Reflecting these findings the Russell-Einstein Manifesto declared in 1955 states as follow pointing out dangerous situation of radioactive fallout:
"... Such a bomb, if exploded near the ground or under water, sends radioactive particles into the upper air. They sink gradually and reach the surface of the earth in the form of a deadly dust or rain. It was this dust which infected the Japanese fishermen and their catch of fish. No one know how widely such lethal radioactive particles might be diffused, but the best authorities are unanimous in saying that a war with-bombs might quite possibly put an end to the human race. It is feared that if many H-bombs are used there will be universal death--sudden only for a minority, but for the majority a slow torture of disease and disintegration."

**Exposure of Marshall Islands People**

In the occasion of Bikini incidence not only the crew member of the 5th Lucky Dragon boat and the inhabitants of Rongelap atoll but all the people of Marshall Islands exposed simultaneously to radiation by fallout of the nuclear tests. Although the inhabitants had been received strong exposure by fallout they left unattended for a while. Moreover, in 1967 inhabitants of Rongelap atoll brought back by US army to their atoll because of absence of radioactivity. However due to frequent occurrence of injuries among inhabitants including not exposed to fallout, they departed by themselves again from their atoll in 1985. Recently it is found that the Atomic Energy Commission of US which conducted these nuclear tests had made thorough observation of radiation by fallout during these tests but did not open the observed results to the public.

Even now inhabitants of Rongelap atolls are forced to leave and pillaged their own birthplace for more than a half century. When the Marshall Islands Republic was independent in 1989, the republic had concluded the Free
Alliance Agreement with the US which includes compensation for the use of Kwajaren atoll, the largest atoll of Marshall Islands, as a military test site of missile and compensation for the damage of nuclear tests. Among the 2004 revision of this agreement the part of compensation for nuclear test damages was discontinued by the argument of US who said that there are no effects of residual radiation.

In Fig. 1 an investigation of abnormal bath among Marshallese show that rate of abnormal bath par a woman in each atoll of Marshall Islands decreases for distance from Bikini atoll and clearly indicates that effects of fallout of nuclear tests extend to the whole region of Marshall Islands (The average rate of abnormal bath par a woman among Marshall Islands before nuclear test was 0.04.) Now the people who were

![Figure 1. Abnormal birth rates among Marshallese Islanders](image)

inhabitant of the severely contaminated atolls, Enewetok, Rongelap, Utirik and Bikini atolls, set up an organization ERUB on the occasion of the 50th anniversary of the Bravo Shot and began petition for compensation to the Congress of US.

**Revision of Dosimetry System of Atomic Bomb Radiation from DS86 to DS02**

It is necessary to estimate exposed atomic bomb initial radiation dose of...
survivors for the epidemiological studies in the ABCC and the RERF. For this purpose US had made estimation of radiation dose, the T57D(Tentative Dose 1957) and the T65D(Tentative Dose 1965) on the basis of nuclear tests. The atomic bomb dosimetry system DS86 is the first computer calculated estimation of the initial radiation dose of the Hiroshima and Nagasaki atomic bombs. The DS86 put emphasis on the initial radiation reached to short distance and makes little concern or neglect of residual radiation from fallout and induced radioactive matter.

At present, the dosimetry system 2002 (DS02), a substitute of the DS86, is in preparation for publication. In the DS02 in order to dissolve an over estimate of initial radiation doses at short distances in the DS86 the height of explosion of Hiroshima bomb is changed from 580m to 600m and the yield of explosion from 15 ktTNT to 16 ktTNT. Leaving the problem of discrepancy between estimated values by the DS86 and experimentally measured values in the distant region without fundamental elucidation, the preparation of DS02 is proceeded pushed by US side argument that measurement values at distance involve background effects other than bomb radiation. The DS02 did not contain a single description concerning to the residual radiations.

Since the estimation of initial radiations (both of gamma rays and neutrons) from measurements systematically exceed the estimation of the DS86 and DS02 in the region more distant than 1.5 km from the hypocenter and the discrepancies increase with distance, the estimation of the DS86 and DS02 can not be applied to the distance beyond 1.5 km from the hypocenter of atomic bombing even confined to the initial radiation.

**Physical Consideration of Internal Exposure**

Among fallout of the atomic bomb of Hiroshima and Nagasaki (1) $3.6 \times 10^{24}$ nuclei of fission products, (2) $(2 \sim 5) \times 10^{24}$ nuclei of neutron-induced radioactive matter of bomb equipments and vessel, (3) $1 \times 10^{26}$ nuclei of uranium-235 or $2.5 \times 10^{25}$ plutonium 239 which did not participate to the chain reaction of fission were included respectively. After explosion of atomic bomb a fire ball of plasma state was formed and all radioactive nuclei listed above were included in this fireball. The fireball turned into the mushroom cloud. The central part of clouds rose breaking through the
tropopause up to 15 km or more and the other part spread along the
tropopause over a region with radius more than 15~20 km. The region
where fine particle of the fallout fell can be supposed more spread than
region covered by the mushroom. In the fallout a huge number of fine
particles were included which had contained in the fireball.
The atomic bomb survivors externally exposed by initial radiation from
outside of their bodies. This exposed dose can be estimated roughly if the
bombed place of survivor is known. Survivors and people who entered into
the regions near the hypocenter are also exposed by radiations emitted by
residual radioactive matter induced by the initial neutron beam. The doses
irradiated to survivors by the induced radioactive matter can be estimated
roughly by use of physical calculations and measurement data if their
actions or behaviors were known. It is difficult, however, to estimate the
radiation dose of fallout in terms of physical measurement long after
explosion because most of fine particles of the fallout were carried out by
the wind and the radioactive matter accumulated on the surface of the earth
or sank into the earth which had brought by so called black rains or other
form of fallout were washed away by heavy rains accompanied typhoons. It
is more difficult to estimate the effects of internal exposure by inhalation or
ingestion of radioactive matter of the fallout and/or induced matter by
physical methods.
When some radioactive matter are taken into body, if the matter are water
or oil soluble then the radioactive matter will spread out to the whole body
in the level of atom or molecule and it will occur that some radioactive
materials concentrate and/or deposit in special organs depending on the
types of chemical elements. Iodine concentrate on thyroid and phosphorus
and cobalt do on bone marrow for example. In this case amounts of
radioactive materials taken into body can be estimated from excrement
such as urine. On the contrary to this soluble case in the case that
non-soluble radioactive fine particles were taken into body there are
possibilities that the fine particles are deposited in some organ with
preserving their size and that radiations emitted from these fine particles
irradiate continuously and intensively surrounding cells. In this case it is
difficult to identify these radioactive particles from outside of body and
presumed from excrements. Effects by such radioactive fine particles
largely depend on the size of particles and also on the type of radioactive elements and type of radiation (the average life-time and alpha, beta or gamma ray). It will difficult to represent these effects in terms of simple factor such as the absorbed energy per weight, the unit of absorbed dose, Gy, or by use of the relative biological effectiveness, the unit of equivalent dose, Sv. The difference between external uniform exposure and internal exposure by a radioactive fine particle is illustrated in Fig. 2. Therefore the biological estimation of effective exposure dose which includes both external and internal ones is required on the basis of analyses of the investigation of incidence rates of the acute and clinical radiation diseases and the rate of chromosomal aberration especially appeared among distant survivors and entrant survivors who did not severely exposed by the initial radiation.

Figure 2. External and internal exposure to radiation

*Estimation of Residual Radiation in terms of Incident Rate of Acute Radiation Disease*

In order to estimate actual effects of both initial and residual radiation it will be useful to analyze examined data of acute radiation disease among survivors of atomic bombed in Hiroshima and Nagasaki. Around 1950 the ABCC obtained incidence rates for the heavy epilation (above 67 % hair loss) which appeared within 60 days after the detonation of the bomb. Preston et al. of RERF, reported separately the
incidence rates of epilation of Hiroshima and Nagasaki survivors among the LSS group. Preston et al. reported the dependence of the incidence rates of epilation of 58,500 Hiroshima survivors among the LSS on distance from the hypocenter which is shown by squares in Fig. 3 (D. L. Preston, et al. Magagine of Nagasaki Medical Society(in Japanese)). Although the initial radiation could scarcely reached to the distance beyond 2 km from the hypocenter there occurred epilation with small but non-negligible rates.
From incidence rates among the LSS Stram and Mizuno of the RERF derived a relation between absorbed dose of the acute exposure from the atomic bomb initial nuclear radiation and the incidence rates of epilation based on the assumption that epilation in the distant regions were caused by background origins other origin than radiation, such as mental effects. Obtained result by Stram and Mizuno of incidence rates among the LSS for initial radiation dose estimated by the Dosimetry System 1986 (DS86) are shown by small closed circles in Fig. 4 (Radiation Research 117, 93-113 (1989)). As shown in Fig. 4 the incidence rate rapidly increases above 1 Gy and exceeds 50 % at around 2.4 Gy. However, beyond 3 Gy the rates do not increase and even decrease as dose approaches 6 Gy. This unnatural behavior of the incidence rates in the high dose region can be explained by the fact that the LSS group contains only survivors who could survived though they had exposed near or more of a half-death-dose about 4 Gy as pointed up by Stewart et. al.(Health Phys. 58, 782-735 (1990): 64, 467-472 (1993); Int J Epidemiology, 29, 708-714 (2000)). Incidence rates of epilation shown by open circles in Fig. 4 are those
obtained by Kyoizumi et al. (Radat Res 194, 11-18 (1998); RERF Update 7(2);4-5(1995)) by means of radiation exposure to transplant-ated human head skin onto immunodeficient mice. As seen in Fig. 4 the incidence rates increase very slowly in the low exposure region compared to those given by Stram and Mizuno and increase to 95.5 % and 97 %, almost 100 % at exposure of 4.5 Gy. From experimental studies with animals it is known that most of dose dependence of incidence rates or death rates are represented by a Normal (Gaussian) distribution. The incidence rates given by Kyoizumi et. al. over the whole range of the exposure region can be fitted well by the normal distribution with an expectation value of 2.751 Gy and standard deviation 0.794 Gy and shown by a solid curve in Fig. 4. At the expectation value 50% people cause epilation. When one recognized that the results of Stram and Mizuno shown in Fig. 4 were obtained from examination data of the LSS on the basis of assumption that the epilation were caused only by the exposure to initial radiation regarding the fallout radiation as the background, there are possibility that the black circles in Fig. 4 shift toward higher dose and higher inciden- t rates direction i.e. toward the relation obtained by Kyoizumi et al. if the exposure to the fallout radiation are included. When the black circles in Fig. 4 for the initial radiation dose dependence are translated into distance dependence by use of the DS86 estimation neglecting shielding effects we obtain results which are plotted by black diamonds in Fig. 3. If the shielding effects are taken into account the diamonds shown in Fig. 3 will move to left toward hypocenter and the difference between the squares will increase. In the following it is assumed that the systematic difference between squares and diamonds shown in Fig. 3 represents exposed effects from fallout radiation. By use of the relation given by Kyoizumi et al. total exposure at 2 km from the hypocenter of Hiroshima can be obtained as follow. The incidence rate of epilation at 2 km is about 5% as seen in Fig. 3. From the relation of Kyoizumi et al. shown in Fig. 4 this rate 5% is
corresponded to exposure of 1.44 Gy. The initial radiation exposure is estimated 0.04 Gy by assuming shielding effect is 0.5. Then the exposure from fallout is estimated about 1.4 Gy. By use of similar statistical method the exposed effects from the radiation of Hiroshima atomic bomb are obtained shown in Fig. 5 from the incidence rates of epilation among the LSS Hiroshima group. The doses of total, initial nuclear radiation and fallout exposure are shown by a bold dashed curve, a thin dashed curve and a bold solid curve, respectively and the initial nuclear radiation doses estimated by DS02 are also shown by a thin solid line in Fig. 5. As seen in Fig. 5, the effects of fallout exposure increases with distance from hypocenter up to 1 km, but this has large ambiguity because the incidence rates in the region below 1 km were not employed in the present analysis. Exposure from the
initial radiation rapidly decreased with distance from the hypocenter and at about 1.2 km the fallout effects cross over that of initial nuclear radiation and beyond this distance the fallout effects become dominant. The estimated exposure from fallout radiation reaches about 1.5 Gy at around 1.45 km then decreases slowly. Beyond 4 km the exposure effect of fallout takes an almost constant value of 0.79 Gy. This result from the incidence rates of epilation, one of the actual accepted and universally agreed conditions of the bombed survivors, indicates overwhelming effects of fallout beyond about 1.5 km from the hypocenter of Hiroshima. For example at 2.25 km and 2.75 km from hypocenter the dose estimation of the initial radiation by DS02 are 0.0302 Gy and 0.0053 Gy while the incidence rates of epilation among the LSS-Hiroshima at these distances are 3.5 % and 2.1 %. The estimated fallout exposure effects from these incidence rates is 1.34 Gy and 1.16 Gy, about 44 and 219 times of the DS02 initial radiation. The maximum cumulative exposure from fallout of the Hiroshima bomb has been considered hitherto between 0.006 and 0.02 Gy in the Koi-Takasu region mentioned in the DS86 report and adapted the Japanese government as the criteria of atomic bomb diseases which are shown by cross marks in Fig.5. These absorbed doses were obtained from measurement of radiation from fallout matter retained in the soil of these regions which are located between 2 and 4 km to the west of the hypocenter where light radioactive fallout rain fell but heavy rain caused by the big whole city fire did not. As seen in Fig.5 exposure from fallout estimated from epilation incidence rates in 2 to 4 km region are 1.4 Gy to 0.85 Gy which are 40 to 230 times of physically obtained values. This large discrepancy suggests that the physically measured values are only measurements of a part of fallout and that large effects of internal exposure should be taken into account which can be deduced only by the biological methods. It will be noteworthy that the values obtained here are average exposures in the same distant regions from the hypocenter irrespective to directions. This result support understanding that fallout particles distributed in the air of very wide regions under the expanded atomic bomb. There are many examinations of incidence of epilation, for example by the Joint Commission for the Investigation of the Atomic Bomb and Tokyo Imperial University in 1945 and investigated by a medical doctor O-ho in
1957. These examinations give results almost coincide with each other indicating the reliability of all these investigations. Then from analysis of incidence rates of epilation of these examinations almost same result are obtained.

**Comparison of Fallout Exposure Estimated from Incidence Rates of Three Different Acute Diseases**
The incidence rates of epilation, purpura and diarrhea among Hiroshima survivors who were exposed indoors and did not enter the central region examined by O-ho (G. O-ho; I-Ji Shinpo, No.1746,21-25(1957)) are shown in Fig. 6. As is seen in Fig. 6 incidence rates of purpura shown by closed circles are of similar behavior to those of epilation shown by squares. Then for the incidence rate-exposure relation of purpura the same normal distribution of epilation is used. Incidence rates of diarrhea shown by triangles are very large compared to epilation or purpura in the distant regions beyond 1.5 km where the fallout exposure gave significant effects. The incidence rates of diarrhea were rather small in the short distance regions where the initial radiation exposure dominated. Therefore in the case of diarrhea, a larger expectation value for the normal distribution than those of epilation and purpura is required for external exposure from the initial nuclear radiation and smaller expectation value is required for the fallout exposure. The adapted normal distributions for relation
between incidence of diarrhea and exposed dose are with expectation value 3.026 Gy and standard deviation 0.873 Gy for the initial radiation and with expectation value 1.981 Gy and standard deviation 0.572 Gy for the fallout radiation, respectively. By use of these normal distributions the incidence rates of epilation, purpura and diarrhea in Fig. 6 are fitted and the resulting incidence rates are displayed by thin dashed, solid and chain curves for epilation, purpura and diarrhea as shown in Fig. 6.
The results of exposure doses obtained in order to reproduce these three different acute diseases are shown in Fig. 7 by bold broken lines, thin broken lines and bold full lines for total, initial and fallout radiations, respectively attached the same marks with Fig. 6. As seen in Fig. 7 incidence rates of three entirely different acute diseases are reproduced with high accuracy by almost the same exposure doses. This fact tell us that epilation and diarrhea as well as purpura occurred in the regions where the initial radiation could scarcely reach were caused by fallout radiation not by mental shock nor by poor sanitary conditions.

The fact that the expectation value of the normal distribution of diarrhea incidence is small for fallout exposure while large for the initial nuclear exposure can be explained by means of difference between external and internal exposures as follows. In the case of fallout exposure radioactive
fine particles and radio-nuclides with specific affinity for biological materials and tissues among fallout were taken into body, reached directly to intestinal wall and were retained there for a period of time. Then the emitted radiation of weak penetration power gave dense ionizations and caused heavy damages in the thin membrane and diarrhea followed. The exposure was chronic as the particulate and chemical radio-isotopic material (e.g. Sr-90, Cs-137) was retained for some time. On the other hand in the instantaneous acute initial nuclear radiation exposure case only strong penetrative radiation such as gamma ray could reach from outside of body to intestinal wall but passed away through thin membrane leaving scarcely any damage.

The present result of fallout effects shows that fallout came down over

Figure 8 Fallout rain fell in the special regions under central part of the cloud and atmosphere under cloud were filled with radioactive fine particles. very wide regions under the atomic cloud as illustrated in Fig. 8.

The epidemiological study in RERF set up as the control cohort (non exposure group) practically among the survivor group who were exposed radiation dose estimated less than 0.005 Sv on the basis of the DS86 or DS02. According to the estimation of DS86, survivors included in the control cohort were bombed in the region distant from the hypocenter more than 2.7 km, and these survivors received effects by fallout radiation equivalent to external acute exposure of gamma ray of about 1.5 Gy in the average as
shown in Figs. 5 and 7. These effects are 300 times of estimation of the initial radiation by the DS86. This will explain the reason how far the government criteria for atomic bomb diseases departs from actual states of survivors who have been suffered after effects of atomic radiation for 64 years.

**Radiation Effects for Entrants after Bombed**

The incidence rates of acute radiation disease were examined by G. O-ho (ibid) among the people who entered from that day after the bomb exploded to after 34 days into the region within 1km from the hypocenter of Hiroshima. From analysis of the incident rates exposure effects for entrant people are estimated. For the entrant on that day exploded (the 6th August) the accumulated exposed effective dose for onset of acute radiation disease is equivalent to external acute exposure of gamma ray with $1.05 \pm 0.53$ Gy. The accumulated exposed effective dose exponentially decreases and almost the half effects for the entrants who entered the central region 9 days to 10 days after the bombed day. Accumulated exposure dose received from external radiation induced by neutron can be calculated for staying at the hypocenter, and at 0.5 km and 1 km from the hypocenter. Even at the hypocenter the accumulated exposed dose from external radiation is 0.8 Gy, those at 0.5 km is 0.09 Gy and 0.0017 Gy at 1 km. The large discrepancies between exposure effects estimated from acute radiation disease among the entrants after bombing and measured external accumulated dose suggest that effects of residual radiation come from chronic internal exposure due to inhalation of radioactive matter were very large compared to those of external exposure.

As is shown by the analysis of the incident rate of the acute radiation diseases, however, for the survivors bombed in the distant region than 1.5 km it is shown that the effects of internal exposure of radio-active fallout are more severe than the effects of external exposure by the initial radiation. Therefore application of DS86 or DS02 for the estimation of exposure of distant survivors and the entrant survivors is complete mistake.

**Estimation of Residual Radiation from Chromosomal Aberrations**

When one irradiated by radiation there appear abnormalities among
chromosome in the irradiated nuclei of cell. Since this frequency of chromosomal aberration closely related to the exposed dose then the frequency of chromosomal aberration in circulating lymphocytes provides estimation of averaged absorbed dose in survivors. M. Sasaki and H. Miyata (Nature 220,1189-93,(1968)) investigated the frequency of chromosomal aberration in circulating lymphocytes of survivors bombed the Hiroshima atomic bomb and eleven non-irradiated healthy people as a control who were visiting the Japan Red Cross Central Hospital in Tokyo between April 1967 and March 1968 and found that the aberrations occurred even the initial radiation scarcely reached.

Fig. 9 shows internal dose estimated from chromosomal aberration among survivors by Sasaki and Miyata. The obtained dose beyond 2.5 km from the hypocenter of Hiroshima cannot be explained by the initial radiation. In Fig. 9, the open markers correspond to the dose obtained from frequency of chromosomal aberration of stable type and the closed ones to those obtained from unstable type of aberrations. The broken curves are obtained by chi-square fitting to the estimated exposed dose of survivors who had exposed outdoors at distances less than 2.2 km from the hypocenter (denoted by triangles) and at 2.4 km or more away (denoted by circles). The initial radiation dose given by
the T65D and DS86 are denoted by almost straight lines dashed and solid ones, respectively. The broken curves are obtained by subtraction of the contribution of the initial radiation given by DS86 from the solid curves and can be attributed to the effects by fallout contribution. The peak values 0.06 Gy and 0.3 Gy obtained from unstable and stable chromosomal aberrations exceed the initial radiation dose at 2.0 km and 1.6 km, respectively from the hypocenter. In the regions beyond these distances the effects of internal exposure by fallout superior than that of the initial radiation. It should be noted that the estimated dose based on the frequency of chromosomal
aberration in circulating lymphocytes represents the effects averaged over whole body and not include local effects by the insoluble radio-active fine particles which are considered in the case of the analysis of the incidence rates of acute diseases.

The chromosomal aberration of a larger sample of survivors had been investigated also by the study group of the RERF after 23 years of bombing and the RERF have denied the existence of chromosomal aberration in the distant region. In the RERF investigation, however, the distant survivors with dose estimation <0.01 Gy and the entrant survivors who were not in the city at the explosion time (NIC) were used as the control group. The frequency of chromosomal aberration of this control is more than 4 fold of the control used world-wide and about ten fold than used by Sasaki and Miyata.

**Problems of Epidemiological Studies in the RERF**

There are serious problems in epidemiological studies of the RERF when the results of the studies are applied to survivors. One is neglect of contribution from the residual radiation for the estimation of exposed dose of survivors. This has originated in the initial investigation of survivors interview done by the ABCC. The other serious problems is selection of non-irradiated control. The epidemiological studies in the ABCC-RERF have been adopted survivors themselves as the non-exposed control of the studies. In the recent RERF investigations the survivors who had exposed less than 0.005 Sv of the DS86 and the NIC group in which the early entered survivors are included are used as the control group. As is shown in the preceding sections these distant and entrant survivors were affected by the residual radiations estimated more than 0.5~1.5 Gy in the average which is several hundred of 0.005 Sv. Then it is evident that the ABCC-RERF studies can not be applied to the estimation of exposure for distant and entrant survivors.

The analysis of chronic diseases among the RERF control cohort by use of all Japanese as the control was made by Inge Schmitz-Feuerhake, a physics professor of Bremen University, Germany and deduced the
effects of exposure of fallout and the induced radioactive matter. Her result of the analysis is given in Fig. 10 (Health Phys. 44,693-695 (1983)). The high relative risk of both mortality and incidence of leukemia, thyroid, female breast cancer and respiratory system cancers of the control of epidemiological study of RERF (both distant and after entrant survivor) had affected by fallout and residual radiation. If the early entrants (4500 of 26,500 people entered the cities within three days after explosion ) among the NIC group of the RERF investigation are extracted then the relative risk becomes about twice the normal
rate as shown by point Early Entrants in Fig. 10. Hirose found 45 cases of leukemia among 25,798 early entrants of Hiroshima which corresponds to about 3.7 times the Japanese normal rate. These facts conclude that the epidemiological studies of the RERF have severe basic problems concerning to the adoption of the control cohorts.

Very recently T. Watanabe et al. (Environ Health Prev Med, 13:264-270(2008)) compared the mortalities of the LSS-Hiroshima group in comparison with those of entire populations of Hiroshima Prefecture and neighbouring Okayama Prefecture. They divided the LSS group by colon absorbed dose into three categories: under 0.005 Sv (very low), more than 0.005 Sv and under 0.1 Sv (low), and more than 0.1 Sv (but less than 4.0 Sv) (high), respectively. They found that there are significantly increased risks of cancer among even survivors exposed to the very low dose level. One of their results of relative mortalities of various cancer of male group of LSS vs Hiroshima Prefecture are shown in Fig. 15 against exposure by initial radiation. Assuming the relative mortality increase linearly regression lines are drawn for each cancer. If there are no excess
of relative mortalities the regression curves will cross the line with relative mortality one at zero exposure point of the initial radiation. However, the regression lines cross at negative exposure points denoted \( \times \) marks in Fig. 15. This fact means even the survivors in the very low dose initial radiation group were exposed from fallout radiation of from 0.2 Sv to 1.0 Sv.

Then the results of the ABCC-RERF should not be applied to the criteria of atomic diseases at the very least for distant and entrant survivors even though they may used to the estimation of external irradiation effects by the strong initial radiation.

**Danger of Usable Nuclear Weapon and Earth-Penetrating Nuclear Weapon**

The Bush Administration of US had decided to research and develop-ment of the earth-penetrating nuclear weapons as usable nuclear weapon. This pro-nuclear-weapon policy of US would be largely based on the ignorance or little concern on the damage of atomic bombing.

![Strong Radioactive Pyroclastic Flow as a Result of Use of Earth-Penetrating Bunker-Buster Nuclear Weapon](image)

**Figure 12** Result of Use of Earth-Penetrating Bunker-Buster Nuclear Weapon

especially negligece of the effects of residual radiation and severe effects of internal exposure. If an earth-penetrating nuclear weapon were used, a huge disaster of residual radiation which did not seen in the bombing of Hiroshima and Nagasaki, where the bombs were exploded at the height 600 and 500 m above the ground then the fallout fell after radioactivity somewhat weakened and the neutron beam largely decreased before reach
to the ground and to induce the residual radiation. On the other hand, in the
case of earth penetrating nuclear weapon it can penetrate only a few tens
meters under ground and the fire ball produced by nuclear explosion will
cause a stream of heated
rocks and ash which contains various strong radioactive matter in the fire
ball and induced by neutrons as illustrated in Fig. 12. This may cause
another the '21sts hell on the earth' instead of the 20th hell on the earth,
Hiroshima and Nagasaki.
The 1993 UNSCEAR published calculated estimation of total death by cancer
caused by fallout or down wind of nuclear tests and accidents of power
stations and nuclear factories between 1945 and 1989 as 1,116,000 on the
basis of ICPR model which had been constructed mainly by use of the results
of the RERF studies and where the effects of internal exposure are paid little
attention. If the effects by the internal exposure of residual radiation cause
cancer death is more severe than that of ICRP model by fifty times, then
total death by cancer caused by fallout becomes more than 50 millions
which is about 1% of total population of the world. Thinking of responsibility
as a scientist and as a survivor of the Hiroshima atomic bombing, if cover-up
policy of US did not enforce and scientists had clarified the severe effects of
internal exposure by the residual radiation of atomic bombing before
frequent large scale nuclear tests then the nuclear weapon tests will be
forbidden without producing great loss of human life comparable or more
than wars.
The win of the collective lawsuit of survivors, who are taking their lives, will
contributes for promotion of the movement towards nuclear weapon-free
world by pointing out that nuclear weapon should never be used by
indicating the severe and inhuman characters of internal exposure as well as
extraordinary acute damages and mass murder by the heat rays, by the
shock waves and blast and initial radiation.