SurvivalRing

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This digital document created and presented by Richard Fleetwood. He is the founder, author, producer, and webmaster of the **SurvivalRing** *(http://www.survivalring.org)* and **Civil Defense Now!** *(http://www.survivalring.org/cd-main.htm)* websites.

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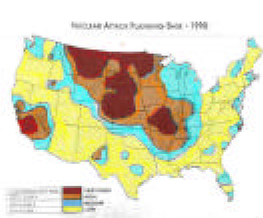

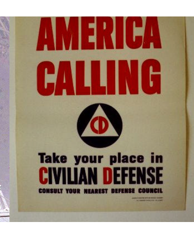

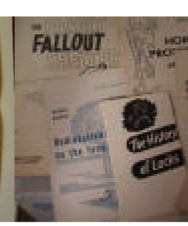


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Collective Protection against NBC Effects for Civilians

Federal Office of Civil Defence, Berne and NC Laboratory Spiez, Switzerland
by Dr. B. Brunner , 5.96

In the following presentation, I will try to respond to the changed security-policy conditions from the viewpoint of the Swiss civil defence, in particular, with regard to civil defence constructions. I will explain the reasons why we consider the constructions to be an important prerequisite for efficient protection of the population. Subsequently, I will tell you about the basic rules and requirements for the construction of civil defence shelters.

1. Switzerland's answer to the threats in a rapidly changing world

With the Report 90 on the security policy of Switzerland and the Guiding Principle of Civil Defence, the federal council has exhaustively appraised the conditions of the security policy and established the framework for the prospective measures to be taken. The valuation of the changes makes it obvious that it is too early to assess the medium and long-term repercussions of the changing threats, even with limited reliability.

In both documents, the Government has taken into account this uncertainty and decided upon a way which will take advantage of the opportunities of the changes, without disregarding the possible risks. To develop the guiding principle of civil defence, the Federal Council followed the basic rules of not abandoning whatever is now valid, not anticipating later decisions, and not missing whatever could strengthen the protection and aid the population.

Concerning shelter constructions, the Federal Council pleads for a careful adaptation to the new conditions of the security policy. For the very reason that we don't know whether armed conflicts in Europe belong to the past, we stick to the principle that protection should remain a long-term task. Civil defence cannot be abolished in times of apparent detente and be built up and trained for again in times of increasing tensions. The same rule applies explicitly to protective constructions.

The development of an efficient concept of protection is a long-term task. This is demonstrated by the fact that it has taken about 30 years to obtain the large number of shelters presently available. It is clear that you cannot stop the construction of protective facilities in times of seeming detente and within a short time, make up the difference when the threat increases.

Although shelters are primarily conceived for armed conflicts, in many cases, they are suitable for the relief of the consequences of natural and man-made disasters or emergencies. In particular, they can serve as a refuge or as emergency quarters in cases of severe disruptions of the surface infrastructure. Therefore, shelter construction also belongs to the central task of the Swiss civil defence in the future, since efficient protection of the population can only be ensured by means of protective constructions.

2. Basic rules for the construction of shelters

To prepare a solid infrastructure for the protection of the population, shelters must be built according to the following basic rules:

2.1 To be independent of any particular image of war or catastrophe

This means:

- **to provide each inhabitant of Switzerland with a place in a shelter.**

Modern weapons can hit any area and no area is safe. To counter such uncertainty, each inhabitant must have access to a shelter place.

- **to allow a preventive and gradual occupation of the shelters when political tensions reach a critical level.**

Modern weapons carriers, such as ballistic missiles, exclude the timely detection of attacks, in most cases. Normally, it is not possible to foresee such actions, as it was during the Second World War with hostile air force raids.

- **to ensure an autonomous stay in a shelter for days or even weeks.**

In order to eliminate the uncertainties of the length of such stays, shelters must be built, equipped and prepared in a way to ensure a longer stay, with the possibility to leave from time to time.

- **no evacuation**

Modern means of mass destruction and their extremely extensive effects on the surface, particularly exclude the possibilty of separating "safe" areas for evacuation. . Transportation of people into receiving areas and adequate supplies cannot be guaranteed under war operations. "No evacuation" is only feasible under the condition that each inhabitant has access to a shelter place at or near his home.

2.2 Economical aspects

Of course, restricted financial means limit the extent of protective measures. Maximum efficiency can be achieved by observing the following considerations:

- **There is no absolute protection against the effects of nuclear, biological, chemical or conventional weapons.**

However, research and tests have shown that a relatively high degree of protection can be achieved with economically bearable costs.

- **Optimal use of all protective facilities.**

Protective structures offer many possibilities for multipurpose use. Cellars, underground garages and warehouses can be combined with civil defence constructions.

- **To prevent is more efficient than to cure.**

It is not only more humane, but also more economical to provide precautionary measures first, than to conduct subsequent rescue and first aid activities.

2.3 Consideration of the physiological and psychological attributes of human beings

- **Equal chances of survival**
- **Preservation of naturally grown communities, especially families**
- **Capability of adaptation by human beings**

3. Shelter construction program

Relying on these basic rules for its conception, a comprehensive shelter program has been developed for civil defence. It includes shelters for the population, protective facilities for the civil defence organization of the communities and the medical services, as well as shelters for cultural assets.

3.1 Shelters for the population

The backbone of this system are the shelters that have been available for many years in private homes, residential buildings, office and industrial buildings. As a rule, one place in a shelter (shelter space) covers a minimum of one square meter of floor and 2.5 cubic meters of volume. Each shelter is equipped with artificial ventilation, having a primary filter and a gas filter. The ventilation may be driven either manually or by built-in electric motor.

Furthermore, there are numerous public shelters built by the communities.
These public shelters cover the so-called shelter space deficit in communal areas

- where not enough home shelters are built due to limited building activity, or
- where due to certain risks, shelters cannot be constructed (e.g. city areas in old towns, having too great a risk of fire).

Public shelters, which have been built in large numbers in recent years, have the same protective purpose as private shelters.

Whenever possible, a combination or integration within a normal construction is sought. The best example of this principle is the combination with underground parking. The normal size of these shelters is 200 to 2,000 protected places, corresponding to 10 to 100 parking lots. All of these facilities have artificial ventilation and filters, an incorporated water supply system, and, in some cases, emergency generators for electric power.

The technical requirements that the constructions must comply with, have been standardized. All shelters must have a protective scope, offering protection against the effects of nuclear, biological and chemical weapons and near-hits of conventional weapons.

3.2 Protection facilities for the civil defence organizations and medical services

Protective constructions for the civil defence organizations are the command posts for the local management and its staff, and preparation facilities for the rescue units. For medical services, first aid posts and first aid stations with protected surgery rooms are built. Fully equipped emergency hospitals are also available.

Basically these constructions comply with the same requirements as the shelters, as far as the extent and degree of protection are concerned. With regard to space requirements and technical equipment, they are somewhat better off than standard shelters.

4. Some figures, technical and operational aspects

4.1 General

In Switzerland, there has been an obligation by law since 1962 to construct shelters in practically all new buildings. At present, the total number of available shelters corresponds with the number of Swiss inhabitants. Approximately, 90 % of the population has access to a shelter space in the vicinity of his home or work, or in school buildings.

In the case of an acute threat, most of the population should go into the shelters as a precaution. Because of this, the shelters are equipped with rudimentary furniture.

People staying outside the shelters and performing urgent tasks will be equipped with protective masks. Thus, there will be no need to channel in people during or immediately after an attack.

Channeling in of people during an attack always involves certain dangers because of the infiltration of toxic gases. It also requires trained personnel and thus should be avoided whenever possible. Protection of shelterees has priority over protection of single persons outside the shelters.

4.2 Scope of Protection

a) against nuclear (and conventional) weapons effects

The shelters offer protection against blast, shock wave and radiation.

According to our concepts, shelters have to withstand airblasts of 1 bar or 3 bar, respectively. Besides adequate design of the shelter hull, doors and escape openings the shock wave has to be prevented from entering the protected rooms through air intake and outlet ducts. For this purpose every shelter disposes of so-called anti explosion valves guarding the ventilation system by immediate closure in case of an outside explosion. Mathematical modelling indicates that the air blast induced ground shock („air slap") at the 3 bar protection level will cause an underground shelter located in an average Swiss soil to be displaced 25 cm at a maximum acceleration og 16 g. With the 1 bar protection level which recently has been defined as the „basic protection level" we calculate an acceleration of 12,5 g and a displacement of about 10 cm. Not only the shelter itself but all loose and fixed equipment are subject to this impact and need to remain intact without adversely affecting the occupants.

This concept offers protection against near hits by conventional weapons, too.

The protective factor against **radiation** during the passage of a radioactive cloud emerging from a nuclear power plant is approximately 100. In the case of radioactive fallout, it may reach 500 (as shown in fig. ...).

b) against chemical and biological weapons

In the case of the presence of chemical or biological warfare agents, we consider a protection factor of 10'000 or more to be sufficient. In fact it is the same protection factor which we apply to protective masks. It can be assumed that in urban areas battelfield concentrations of chemical agents would occur very rarely if ever.

4.3 The ventilation and filtration systems

In fact both processes are essential to guarantee the required protection factor of at least 10'000 for chemical or biological warfare agents and radioactive dust.

The general layout of a shelter and that of a ventilation system are shown in fig. .. Normally, the ventilating unit is installed near the emergency exit. The latter serves as an air intake. In general, the ventilator is driven electrically. In case of an electrical breakdown, it can be operated manually.

The required volume of air depends on the number of shelter places and is

- 3 cubic meters per hour and per person when the filter is operating
- 6 cubic meters per hour and per person when the filter is not operating.

The air outlet valves are designed in such a way that in the shelter, with filter operation, a minimum overpressure of 50 Pa is maintained. The constant positive pressure which is maintained by the artificial ventilation in the interior of the shelter as well as the gas filters and air locks used for large shelters offer a good protection against the penetration of biological and chemical agents into the shelter. It even produces a locking effect which prevents the penetration of agents in case of leaks. The outlet air is used for venting the air lock.

Fig. .. shows a scheme of a ventilation system.
Please notice the blast protection valve on the intake and the pressure valve with the baffle plate on the outlet which protect the filter system. The latter valve controls the over pressure in the shelter, as well.

The filter system consists of three functional parts:

- a very crude protection against direct weather influences
- the primary filter, which protects mainly against dust and coarse particles, important in a radioactive fallout situation and
- the gas filter. It is stored outside of the air flow line, tightly closed to avoid long-term deterioration by humidity. It can easily be inserted in the flow system on demand.

Finally, it is vital to recognise that the ventilator has to be positioned at the end of the system and the filter inside of the clean room. Only under these conditions is it guaranteed that leakages within the air inlet line have no negative effects, because a small vacuum is maintained and therefore only clean air may be sucked in.

Given this layout, the protection level achieved is primarily controlled by the quality of the filter. In Switzerland there exists a series of collective filters with nominal flow capacities ranging from 20 up to 1200 m^3/h. They all have the same principal structure as shown in fig. ... and ...

The air passes first through the particle filter and then afterwards through the gas filter. The particle filter is based on a glass fibre tissue that holds back all solid and liquid particles in the air, the so called aerosols. „All" is defined here as up to the protection level of at least 10'000. Within this factor, a protection against biological agents is also assured. This is a major problem to be considered when one designs particle filters. Dust and especially soot may plug up the system leading to an increased drop in pressure.

The gas filter is normally an activated carbon bed. Activated carbon is a highly porous material manufactured from coal, peat or organic matter as wood or coco nut shells. It has an enormous inner surface on which gas molecules, and also the toxic ones, are held back by physical intermolecular forces or simply, by adsorption. The inner surface of the pores may total up to more than 1000 square meters per gram of charcoal. The system is very efficient but has important limitations, too. The capacity is limited and may strongly vary with the type of agent that has to be removed.

When air loaded with toxic substances passes through the filtration bed, first the toxin wil be adsorbed at the entrance of the bed (fig. ..). But once the maximal adsorption capa reached locally, the toxin will only be adsorbed in the deeper layer of the bed. Pract sorption front will be formed which moves with time through the bed until the end is reached. Then the filter breaks through, that means toxin is released at the end of the filter and the protection is lost.

Many parameters influence the breakthrough time, for instance the flow rate, temperature and pressure, the quality of the activated carbon and furthermore, but very important, are concentration and type of agent or the mixture of agents.

As a rough rule, agents with higher boiling points will be better adsorbed. Small molecules, such as HCN are poorly adsorbed. To remove these agents as well, the carbon has to be treated with chemicals like copper-, silver- and chromium salts. They undergo a specific chemical reaction with such agents. This necessary treatment, called impregnation of the activated carbon, reduces the physical absorption capacity and leads to negative aging behaviour in the presence of humidity.

Without going into details the choice of active carbon is always a compromise and has to be carefully adapted to the threat.

Coming back to the more general aspect of the protection by shelters, it is important to realise that our filters have first been optimised to guarantee a high protection against known warfare agents. But this system also gives, with very few exceptions, sufficient protection against industrial toxins as they could be released in the case of civil chemical disasters.

We are convinced that for civilians, collective protection offers better protection against NBC weapons effects than individual protection. This is certainly true if children and elderly people are concerned. We are aware that optimal protection is reached if preventive and gradual occupation of the shelters is possible.

5. Terrorism

In the last two to three years governments and even the public became aware of the fact that the NBC threat was no longer a matter of military confrontation, only. NBC agents appeared more and more in the civil area and it was only a matter of time, before radioactive compounds, chemical or biological agents were used by terrorists.

The attack in the Tokyo underground has shown the potential of sarin as a means for terrorists. The consequences of the sabotage were no surprise for experts on protection against chemical warfare agents. An opinion poll made some years ago showed that most of the experts expected this or even were astonished that it had never happend before on a large scale. To not encourage potential terrorists, these consequences had not been discussed earlier in public, although data concerning production of highly toxic agents is relatively available in the open scientific literature.

Will our ventilation and filtration systems give any protection against agents used by terrorists?

We know that terrorist use of chemicals has some important limitations, be it the amount of agent which can be used or the kind of location. Terrorists will not be able to poison large areas of a city, because in the open air they would need large amounts, let's say at least hundreds of liters. Furthermore agents are much less effective in the open than in rooms or partly closed areas. This means that terrorists need certain installations. Underground systems, large conference rooms, stadiums or gymnasiums may be the places of choice, as well as large office buildings with ventilation systems.

In the latter case, where it would be fairly easy to bring chemicals near the air intake of such a building, even in larger quantities, the explained ventilation and filter systems would provide good protection and make such buildings more secure. One has to be aware that such protection is technically feasible but very expensive because of the large volumes of air to be filtered. I would say that against terrorist acts a good protection is given, yet not a total protection. In fact it is conceivable that by releasing highly concentrated chemicals directly into the air intake, the filter could become saturated or even partially destroyed. There are even some compounds which can ignite a charcoal filter when adsorbed in large amounts. This is because of a large positive adsorbtion heat. Therefore, one has to conclude, that for very important shelters like command shelters, the access to the air intake should be specially guarded.

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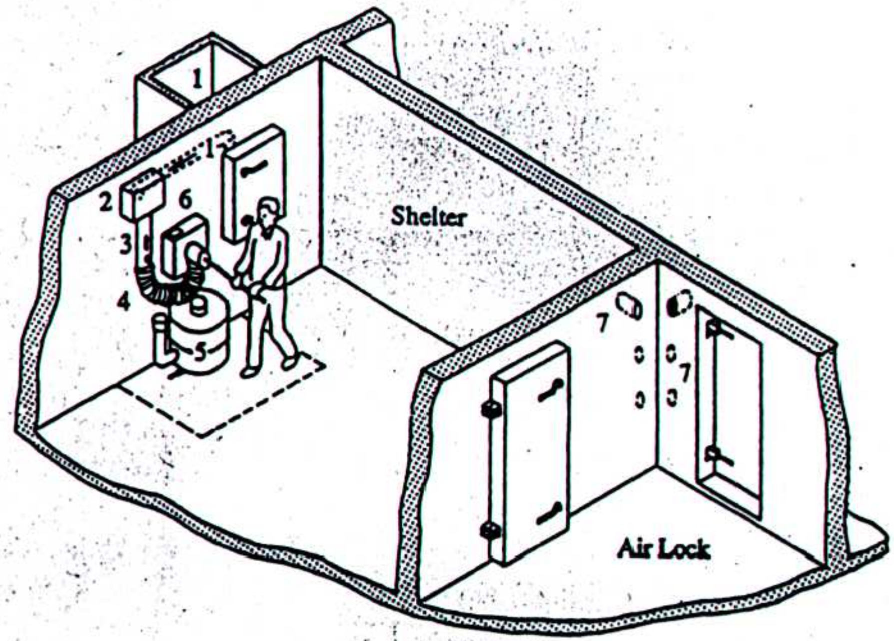


Legend :

1 Air intake
2 Blast protection valve / Primary filter
3 Ventilation rate meter
4 Flexible conduit
5 Coupling / Gas filter
6 Ventilator
7 Over pressure valve, blast protection valve

Components of Ventilation System

Fig. 1

VENTILATION SYSTEM COMPONENTS AND ARRANGEMENTS

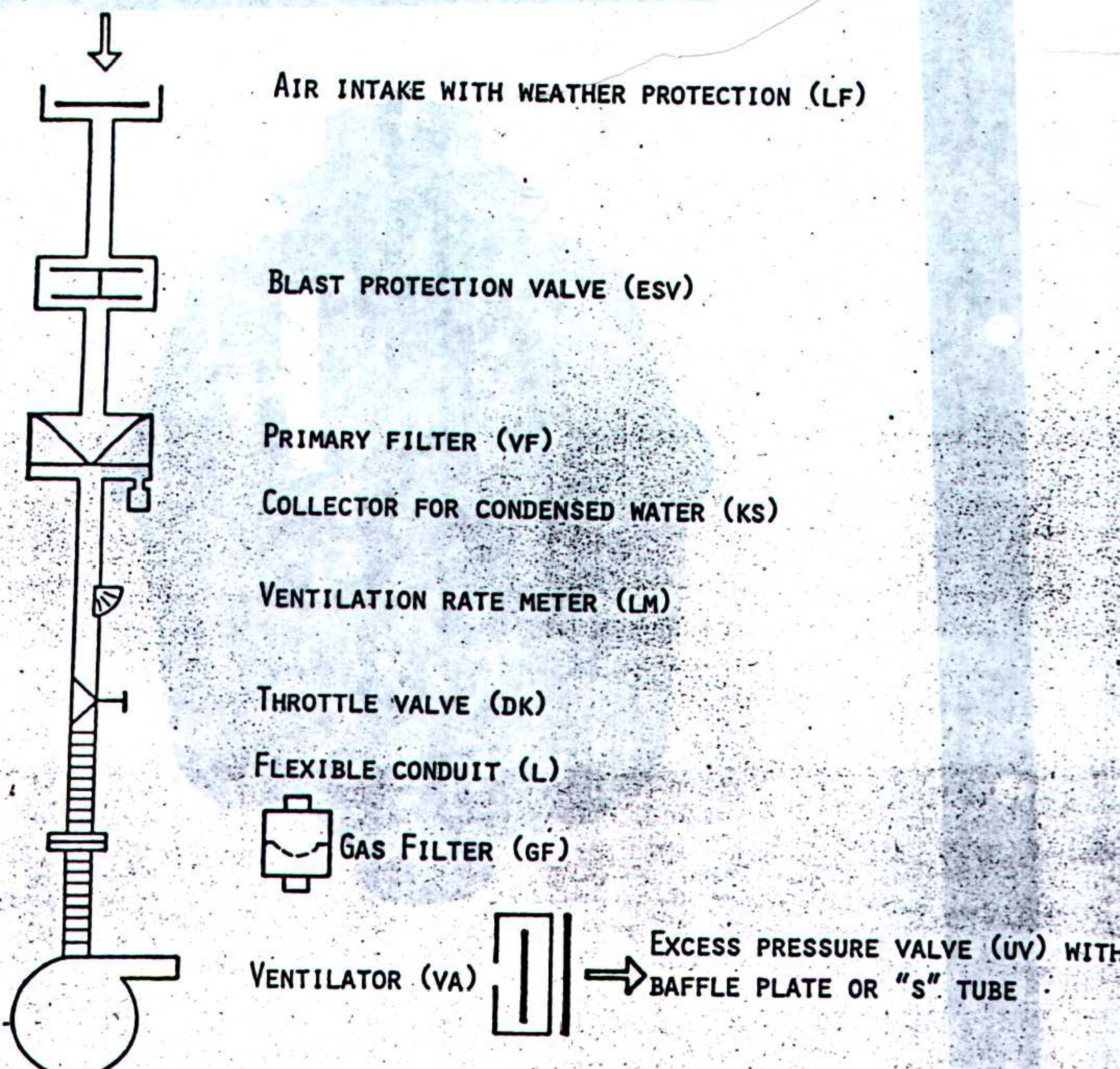
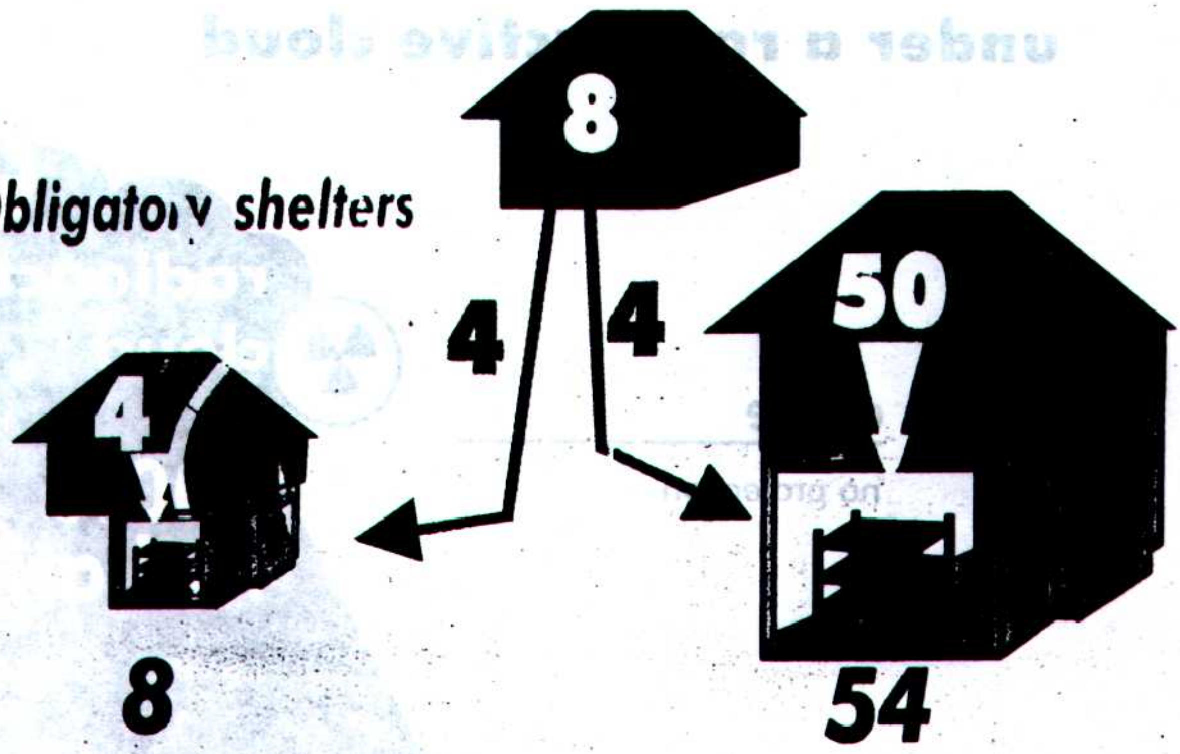


Fig. 2

Shelter Allotment (Principle)

Obligatory shelters



Public shelters (as e.g. schools)