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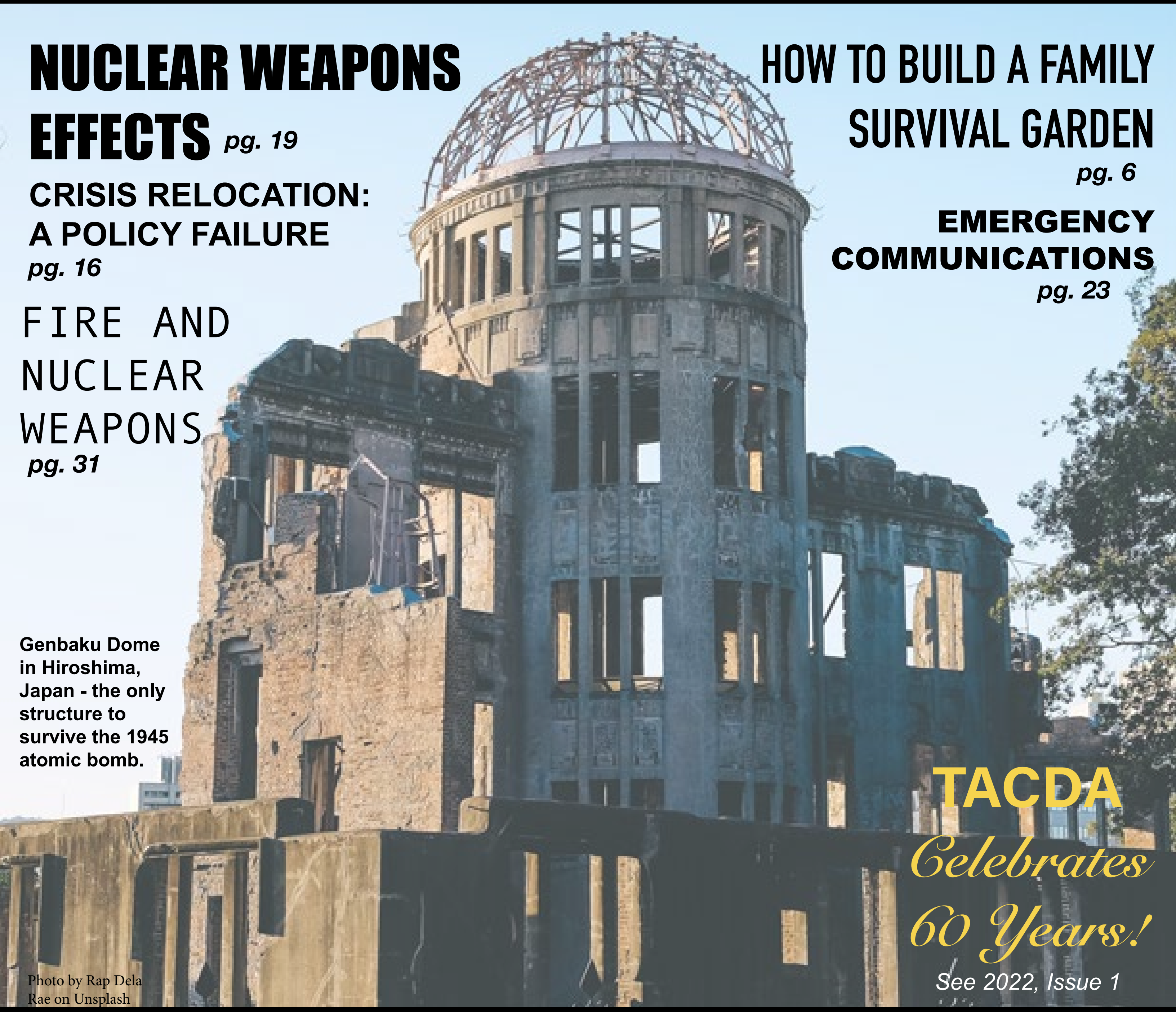

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Genbaku Dome in Hiroshima, Japan - the only structure to survive the 1945 atomic bomb.

Photo by Rap Dela Rae on Unsplash

TACDA
Celebrates 60 Years!
See 2022, Issue 1

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Donations are always appreciated.**

Together We Are Stronger. Let Your Voice Be Heard!

Contact your elected officials! Tell them your emphatic desire to have an official Civil Defense Program for our citizens, no matter the cost.

Our United States government currently:

- Has NO Department of Civil Defense
- Does NOT educate our children about the effects of nuclear weapons
- Has NO fallout shelters for the general public
- Has NO directives on how to build hardened fallout shelters
- Has NO information for post-war survival
- Has NO government directed warning systems, sirens, evacuation plans, or general preparations for nuclear attack available for the general public

Here are three easy ways to find and contact your Senators:

1. **By Email**
   Go to https://www.senate.gov/general/contacting.htm, locate your state's senators with the provided links, and email them.
2. **By Telephone**
   Call the United States Capitol Switchboard at (202) 224-3121.
3. **By Postal Mail**
   You can direct postal correspondence to your senator or to other U.S. Senate offices at the following address:

   For Correspondence to U.S. Senators:
   Office of Senator (Name)
   United States Senate
   Washington, D.C. 20510

   For Correspondence to Senate Committees:
   (Name of Committee)
   United States Senate
   Washington, D.C. 20510

TACDA has prepared pre- and post-war survival information in the **TACDA Academy**.

Click here or scan the code to purchase a copy or download for FREE!

IN THIS ISSUE

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PRESIDENT'S MESSAGE

There are many issues to be concerned about in our country and world today. There are major political disruptions, extreme weather, and societal strife. A civilization can handle many challenges if they are largely united and working together, but civilizations can and have collapsed due to a splintering of the population's views on values and principles. The larger and more complex the civilization, the more prone it is to implosion and failure.

It appears that we as a worldwide, complex civilization are at the precipice of a significant failure of the system that we rely on for our existence. There is increasing strife between governments and citizens. Leaders are embarking on striking changes without the support or concurrence of the population at large. For example, our own government has decided they want to move away from carbon-based fuels and chemical fertilizers that are necessary to support the existing population. Such actions are a recipe for disaster.

TACDA has recommended preparing ourselves for natural or man-made disasters for many years. Now that many of these disasters appear to be inevitably at our doorstep, we need to take serious steps to get prepared - now. I exhort you to use the information in the Journal of Civil Defense and prepare yourselves for potential disasters. Do not procrastinate!

I wish you well in your efforts to prepare.

Sincerely,

FROM THE EDITOR

Another Day, Another Disaster

By Roseanne Hassett, Executive Director

The news is full of reports of communities near and far suffering the effects of natural disasters such as hurricanes, floods, fire, earthquakes, and tornadoes. There are cries for help from FEMA while upset individuals wait too long for help to come and deliver life's most basic needs. Many, if not most, people don't understand that FEMA usually doesn't arrive for up to a week or more. In some cases, FEMA may be your only hope, but more often than not, suffering from want of food and water can be mitigated by preparation. Counting on last minute trips to the grocery store will most likely ensure the cupboards will be bare.

The war in Ukraine and tensions in Taiwan have made many realize that our world peace is in a delicate state. Food shortages are a devastating reality in many countries, and many fear that serious food shortages are coming down the pipeline for us in the great United States of America. We at TACDA believe these threats may very well afflict us in the near future.

We encourage you to take the time to assess your food and water supply and make the necessary adjustments for your family's comfort and survival.

The time to prepare is now. Being prepared brings peace of mind and tangible safety to you and your loved ones. So, what are you waiting for? It's time!

KEEPING AMERICA
LOCKED DOWN

By Jane M. Orient, M.D.

A 90-second New York City Public Service Announcement is going viral. Posters with its advice are showing up in New Jersey shopping malls.

"So, there's been a nuclear attack," says a smiling commentator standing on a deserted street. "OK, what do we do?" she asks in a breezy tone. Three things: Get inside—fast. Stay inside. Stay tuned for official announcements and don't come out until they tell you it's safe. "OK, you've got this!"

Why now? Nuclear weapons have been around since the 1950s. Of course, one of the nuclear powers involved in Ukraine might set off a nuke, intentionally or by accident, despite the Biden Administration's lack of concern.

But it might not be necessary to use a nuclear warhead to destroy America as a free and sovereign nation. The COVID lockdowns devastated a huge part of America's middle class. A second round to finish us off might not work because Americans might not be scared enough of monkeypox or a new COVID variant to comply.

Enter, a neutron-bomb equivalent disguised as a PSA. In case you don't remember, the neutron bomb was designed to kill people while keeping the infrastructure relatively intact.

The PSA contains none of the critical knowledge that could save millions of lives in the event of a nuclear attack. Most important, if you ever see a bright flash, drop and cover immediately. You need to be lying on the ground when the blast wave arrives a few seconds later, if possible, under cover to protect you from flying debris such as shattered glass.

There might be fallout later. If there is, you can see it. It looks like sand, ash, or grit. Its radioactivity decays rapidly falling by 90 percent in the first 7 hours, and an additional 90 percent for each sevenfold increase in time. Shelter might be needed, usually for a few days. But since Americans have long been terrorized by the false statement that there is no safe dose of radiation, they might think they need to lock down until they starve. In fact, at accumulated doses less than 200 rads, most people will have no symptoms. There could be delayed effects, but years later.

One grain of truth in the PSA is that if you need shelter, it is best to go to a basement, if there is one, or to the middle of a building. Radiation protection is increased by distance from the source or by intervening mass.

Once you are inside, what next? Will there be a radio, electricity, or a functioning cell phone tower? Where are the authorities that you are supposed to depend on, and what can they do?

Radiation, like viruses, is an invisible threat.

But it can be easily measured. During the Cold War Era, a simple radiation detector was created by the U.S. Department of Energy. This detector can be built from materials found in the average kitchen, and instructions for it would have been published in newspapers around the country. Now those instructions are on the Internet (search Kearny Fallout Meter).

Every fire truck in every town used to have radiation detectors capable of monitoring nuclear fallout. There were about 5 million of those, ready and calibrated. Now all those meters are gone along with the people who knew how to use them.

Today's emergency manager may not have meters, or anyone trained to use them. Existing meters are generally designed for Hazmat purposes. They are not capable of measuring truly dangerous levels, but give warnings that are hazardous only because fear would prevent rescue activities or essential work.

The NYC PSA seems designed only to cause panic. If you happen to be outside when "it" happens somewhere, anywhere, you are to assume you are contaminated, bag your clothing, and take a shower. (Good luck finding one.) Then stay inside indefinitely.

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Cold War civil defense experts emphasized the necessity of keeping America working—not huddled needlessly services—just as it did in World War II in London. Once people got over the fear and learned to cope with the bombing, it became far less effective.

NYC's response to the nuclear threat seems limited to this PSA. No preparation of shelters or radiation monitoring or essential public education. In this context, the PSA is like shouting "Fire!" in a crowded theater—after turning out the lights on the exit signs.

It resembles the COVID pandemic, which instilled terror, while canceling information on prevention and early home treatment.

1. Critical knowledge that could save millions of lives: (60-Second Nuclear Detonation Training for First Responders): http://www.ddponline.org/storage/card.pdf
2. Instructions for Kearney Fallout Meter: (purchase the book here) - https://tacda.org/product/nuclear-survival-skills/ (or download here) - https://oism.org/nwss/

Jane M. Orient, M.D. obtained her undergraduate degrees in chemistry and mathematics from the University of Arizona in Tucson, and her M.D. from Columbia University College of Physicians and Surgeons in 1974. She completed an internal medicine residency at Parkland Memorial Hospital and University of Arizona Affiliated Hospitals and then became an Instructor at the University of Arizona College of Medicine and a staff physician at the Tucson Veterans Administration Hospital. She has been in solo private practice since 1981 and has served as Executive Director of the Association of American Physicians and Surgeons (AAPS) since 1989. She is currently president of Doctors for Disaster Preparedness. She is the author of YOUR Doctor Is Not In: Healthy Skepticism about National Healthcare, and the second through fifth editions of Sapira's Art and Science of Bedside Diagnosis published by Wolters Kluwer. She authored books for schoolchildren, Professor Klugimkopf's Old-Fashioned English Grammar and Professor Klugimkopf's Spelling Method, published by Robinson Books, and coauthored two novels published as Kindle books, Neomorts and Moonshine. More than 100 of her papers have been published in the scientific and popular literature on a variety of subjects including risk assessment, natural and technological hazards and non-hazards, and medical economics and ethics. She is the editor of AAPS News, the Doctors for Disaster Preparedness Newsletter, and Civil Defense Perspectives, and is the managing editor of the Journal of American Physicians and Surgeons. Jane also serves on the Advisory Board for The American Civil Defense Association.

Photo by Jose Fontano on Unsplash

HOW TO BUILD A FAMILY SURVIVAL GARDEN

By Christian Wilson

Photo by Markus Spiske on Unsplash

Even decades before 2022 began, the lack of food security in the world had reached dangerous levels. Less land is used to grow crops for local populations. Only a small portion of that land is certified organic, and much of that is used for growing food that is exported outside the US.

Due to staggering demand, food handouts are becoming regular events. It doesn't have to be this way. If we are willing to grow our own food in our yard, patio, or even inside our house or apartment, it is possible to improve our food security.

With our growing population and the amount of shrinking farmland - as well as the impact of COVID-19 - the threat of food insecurity demands innovative solutions. We may soon face the harsh realities that Cuba faced in the 1990s after the Soviet Union stopped providing them with income.

Cuba offers a glaring example showing that sustainable development is not only possible but also necessary. After the fall of the Soviet Union, this small country was left in a tight corner and forced to abandon its sugar monoculture. It survived, however, thanks to organic agriculture. Until 1991, when the Soviet Union collapsed, the USSR was Cuba's main sugar market. With this gone and the tightening of trade embargos by the US, the Cuban economy was in an ultimate crisis, famously called the "special period".

With no petrol or pesticides and no cash to import food, the Cuban population was on the verge of famine. The desperate situation turned out to be a blessing in disguise as it sparked the organic agriculture revolution in Cuba.

Miguel Angel Salcines, a leading organic farmer in Cuba, was quoted in The Guardian:

"Boats had arrived from the Soviet Union full of chemicals and fertilizers, and suddenly there were no more boats from the Soviet Union, and people asked, do we need all those chemicals?"

To feed themselves, Cubans adopted a mix of old and innovative ways of doing things. Ordinary citizens started growing food plants on their balconies and home gardens. The farmers returned to traditional agriculture methods. They used oxen for plowing fields, utilized natural alternatives to pesticides, and got closer to the customers through direct sales. This is how organic agriculture gained ground in Cuba. It saved Cubans from starvation, and the country managed to reduce its dependence on imported goods.

"Organic agriculture isn't a mirage, and the closing of half of the country's sugar refineries represented the first step towards our food independence," says Fernando Funes Monzote, an Agronomy scholar. Despite all its inadequacies, Cuba's transition towards organic agriculture is an impressive example, demonstrating beyond doubt that food security and sustainable development are not only attainable but also deeply connected. Will the US and other countries be forced to follow Cuba's path, or can we take responsibility now for organic food security?

FAMILY SURVIVAL GARDEN

The Family Survival Garden is a new, socially responsible business concept focusing on the accessibility gap for wholesome food. It can grow over 512 plants within 400 square feet of space with controlled, minimal use of irrigation. The result is considerably faster and more abundant vegetable, fruit, flower, spice, and herb growth than conventional gardening can offer. It is the perfect solution for anyone who lacks resources, desires the ability to grow their own organic food, or wants an easier way to a low-cost, abundant harvest.

The mission of the Family Survival Garden is to provide a superior, portable, non-GMO and heirloom-supporting, gardening ecosystem. Using stacked pots in a greenhouse is a revolutionary self-contained garden/composting system with the potential to transform home gardening, urban gardening, and world hunger programs. The staff and followers of the Family Survival Garden are passionate about healthy food for everyone. They believe in doing everything possible as a sustainable and responsible business to help those most in need. We are working towards a more resilient and sustainable economic future for individuals and communities.

The Family Survival Garden strives to create easy availability of fresh, organic food to populations who lack either the access or the ability to grow their own food. The primary objective is to make this happen innovatively, collaboratively, and affordably.

Imagine witnessing families in your community growing their own organic food in their own yard, instead of waiting in a long line of cars for unsustainable and unhealthy food handouts that may include expired food products. What if food imports are stopped due to transportation delays, food processing plant failures, natural disasters, strikes, or an act of war?

Our project will evaluate the effectiveness of three different Food Security Greenhouse Project systems: 10' x 20', 20' x 20', and 40' x 20' sizes. We will use mostly soil systems due to the potential inaccessibility of hydroponic chemicals. We aim to compare soil, hydroponics, and aquaponics in terms of efficiency, cost, and effectiveness. Efficiency will be measured by pounds of produce per planter.

The Family Food Survival Garden Project is a uniquely viable solution for areas of the world where poor soil conditions, water scarcity, flooding, and drought contribute to

Students from BYU-Hawaii learn how to grow vertical survival gardens and take that knowledge back to homelands which suffer from food shortages.

TACDA's Executive Director, Roseanne Hassett, and her husband, Dayne, visit Christian Wilson's survival garden in Hawaii.

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chronic hunger. Further, the Project is perfect for gardeners of all sorts, especially the millions who lack access to land to start a garden, those with physical restrictions, and beginning gardeners. Anyone who is ready for a faster, easier way to grow food will love it. Absolutely no gardening experience is necessary. The design is elegant in its simplicity, and the initial setup is straightforward and easy. One doesn't have to bend down and weed the traditional way. To harvest, you can simply cut leaves or pick the fruits and vegetables with your hands.

A completed system has 16 towers. Drip and misting systems on a timer provide just enough water for 512 plants within a 20' x 20' space. Just a few benefits of the Family Survival Garden setup include the following:

- There is no weeding since the floor is covered with weed barrier fabric.
- There is no bending down since the planters are elevated on towers.
- The 40% white shade cloth prevents damage from sudden rains and hailstorms and prevents UV damage from the sun.
- The shade cloth on the sides prevents pests such as birds from eating the produce and seedlings and damage from excessive wind.
- Once all the seeds are planted, wait a few weeks. You can then harvest the produce with scissors and a bowl, easy enough for a 5-year-old child to accomplish.

The Family Survival Garden concept can thrive when planted in any community. We believe there is great need for education and community involvement in protecting ourselves from contaminants in our monolithic, over-processed, and inefficiently transported food supply. Our food system is troubled today, but much greater work can be accomplished to create a more sensible, sustainable, and healthy food system for tomorrow's needs.

It is my hope that our communities can further improve this design, in terms of expense and efficiency.

Christian Wilson loves to help people grow their own food in their yards in case there is an emergency by combining technology and permaculture practices. He thinks everyone should be creating miniature food forests that will benefit humanity for generations. Before his interest in farming, he was an Internet Marketing Professional and a Search Engine Optimization (SEO) Analyst. He has lectured at the University of Hawaii and BYU Hawaii University about SEO and has attended travel-related SEO conferences on the US mainland. He produced BYU Hawaii University's 2nd Annual SEO conference with Andy Beal as the keynote speaker. He worked as a Senior Analyst at the Polynesian Cultural Center (Hawaii's top paid attraction since 1963) for 17 years and as a marketing consultant for another 10 years. He was responsible for creating PCC's first website back in 1994. Christian is a current member of the TACDA Advisory Board.

WELCOME, CHRISTIAN!

TACDA would like to extend a warm welcome to Christian Wilson as our newest Advisory Board Member! Christian's years of experience with food sustainability, permaculture, aquaponics, and emergency preparedness will be a valuable asset to TACDA and our members. This summer, our Executive Director, Roseanne Hassett, was privileged to tour Christian's survival gardens and see first-hand the amazing 'food forest' Christian has created. The Family Survival Garden will not only benefit families, but will help communities thrive when food shortages threaten our sustainability. We encourage you to build your own Family Survival Garden, and if possible, adapt Christian's vertical growing method and reap the benefits of an efficient, care-free, ready to eat, chemical-free vegetable garden. Happy harvesting!

FAMILY SURVIVAL GARDEN ASSEMBLY INSTRUCTIONS

Click here or scan the code!

Click here for optional steps to the survival garden.

AIR PUMP AND FILTER FOR SMALL SHELTERS

By Jay Whimpey, P.E.

There is a reasonable chance that we may face a chemical or biological attack within the United States in the future. It would be wise for every family to have a sheltered area to protect them from nuclear, chemical, or biological attack. "Nuclear War Survival Skills" describes a positive-displacement air pump for fallout shelters that would work very well for nuclear war scenarios where there are no chemical or biological agents. Filters should be added to the pump to provide protection from chemical or biological agents for small shelters of various kinds.

A personal gas mask is great to address a short-term chemical or biological threat, but the individual wearing the mask cannot eat, drink, or sleep with the mask on. A small area where all those functions can occur in a safe manner is almost essential to survive the threat.

It is suggested that a filtration chamber could be added to the front end of the air pump to provide protection from chemical or biological agents. The filters and valves could be obtained from surplus gas masks and used in the pump and filter to make it easier to fabricate and more likely to be effective.

Four surplus polish gas masks were obtained at a cost of $30 each in order to complete the project. Additional gas masks were procured in order to provide extra filters and spare parts. The one-way valves for the gas masks exhaust were placed in the piston of the positive-displacement pump. They will close while the piston is being moved away from the filters to draw air through the NATO 40 mm nuclear, chemical, and biological filters and open while the piston is being moved toward the filter to let air move to the other side of the piston. The operation is repeated several times per minute to provide filtered air to the exhaust of the pump/filter.

The piston is about 14 inches square, and the stroke is roughly 18 inches. Each cycle of the piston will deliver about 2 cubic feet of air. To supply enough air for a family of four, it would require roughly six cycles per minute.

The main body of the air pump and piston is made from ¾" thick plywood. The push rod is made from 1.5" PVC schedule 40 pipe with a flange and blind flange fittings used to connect it to the piston with ½" machine bolts. Roughly half of a 4' by 8' sheet of plywood was used. A series of hole saw bits were used to make the holes for the valves and piston push rod. The air pump filter was designed to use commonly available parts and tools.

The filter could be automated by placing a CPAP machine in the chamber behind the piston and routing the output from the CPAP through one of the ports on the output of the filter and closing the other ports. The power cord for the CPAP machine would have to be routed through one of the other ports and sealed with a highly viscous sealant.

Jay Whimpey is the president of The American Civil Defense Association and the president of The Civil Defense Volunteers of Utah. He is a licensed chemical engineer with a vast amount of knowledge and experience in civil defense, developing new techniques and teaching preparedness skills. Jay received a Bachelor of Science Degree in Chemical Engineering from the University of Utah in 1982 and a professional engineering license in 1995.

SHELTER DESIGN ASPECTS FOR BOTH GAMMA AND INITIAL RADIATION

By Paul Seyfried

Photo by Vladyslav Cherkasenko on Unsplash

On January 13, 2018, a false missile alert was broadcast to citizens living in Hawaii. The message said a nuclear-armed missile was headed straight for the islands and advised people to take cover. The term "cover" is hard to define in Hawaii, since virtually no buildings have basements. The local FEMA compound on Kawaii that I visited is a very stout, all-concrete building that suggested readiness for a Category 5 hurricane. But I digress. The main point here is that citizens now facing the very real possibility that a nuclear weapon was going to explode in their area had minutes to decide how to best protect themselves.

Some made emotional phone calls to family, some ran helter-skelter for the nearest sturdy building, and some decided to lower their children into sewers (presumably storm sewers, but we can't know for sure). There were YouTube videos posted online showing this desperate attempt by loving parents to save their posterity from a horrible and wretched death (https://www.youtube.com/watch?v=x-lm9X9fYWDs). And who can blame them?

I find it appalling that the wealthiest nation in the world will not spend a dime on civil defense. One might ask how so many other countries with far smaller budgets find the money and means to effectively defend their citizens from nuclear attack.

Switzerland's civil defense program is arguably the most extensive and sophisticated in the world, yet the annual tax burden on its citizenry is a paltry $45.00 (US) each year. Residential shelters, required by Federal Building Code, are heavily subsidized; the homeowner bears about 5% of the total cost of the home's reinforced concrete shelter. Our copy of the Swiss shelter building code shows that a concrete ceiling thickness must be 30 inches (minimum), which equates to a Protection Factor (PF) of between 1000 and 2000. That means a person inside the shelter would receive 1/2000th of the outside radiation dose.

It gets more complicated when we factor in the entrances to the shelter room, as few Swiss shelters have any provision for attenuating radiation shining through the 8-inch-thick, concrete-filled, armored door. No extra shielding is afforded, such as a thick concrete wall just inside the door forming a 90-degree turn in a sort of hallway. The PF of the Swiss armored door is less than 16 if using the 2.2-inch halving thickness factor, or about 8 if using the 2.9-inch factor. I tend to embrace the 2.9-inch factor (suggested by Edwin York) because a pessimist is seldom disappointed. A lot depends on the density of the concrete used in the structure and door.

The partition wall (between the non-sheltered basement area and shelter) in the Swiss basement shelter is 24 inches thick, which provides a PF of around 500. If the home remains intact after a blast, the PF for a two-story house would be multiplied by about 10. If the house were blown away leaving just the shelter room, we're back to PF500. Fallout would settle just outside the protected area. This would provide adequate protection from gamma rays, as well as much weaker alpha and beta rays. Anyone using a shelter design without a partition wall inside the entrance should stay away from doors, as gamma rays will penetrate 8 inches of concrete with relative ease.

Prompt neutrons are present within 7,500 feet of any nuclear explosion. They turn corners far more readily than gammas and can penetrate much thicker layers of shielding. Swiss shelters are not sufficiently effective when overpressures are greater than about 18 psi with thermonuclear weapon yields of greater than roughly 300 kilotons. Weapons of lower yield pose significantly more risk to marginal shelters because they are exploded much closer to the earth's surface. This generates sufficient overpressures to assure destruction of a target, increasing the amount of prompt neutron exposure to shelterees within 1.5 miles of a surface burst. Simply put, a one-megaton weapon exploding at 8,500 feet above the ground generates far less prompt radiation to a shelter directly below than a 40-kiloton weapon exploding at an altitude of 3,000 feet.

To assure good protection for shelters installed near potential targets, the shelter should have enough shielding to defeat prompt neutrons – 6 feet of concrete in the ceiling – and a commensurate increase in the concrete walls and door partition hallway. This adds to the cost of the shelter enormously and would not be economically attainable by most of the general population.

The simplest and least expensive way to mitigate the prompt radiation issue is to increase the depth at which the shelter is buried. Since earth is about 75% as effective as concrete as a shielding material, we can use 8 feet of earth over the shelter instead of buying 6 feet (!) of concrete. Dirt is cheap.

Figure 1 shows how deep a corrugated steel pipe shelter can be buried, or at least how deep WE were installing them. Industry engineering literature states that a 10-foot diameter, 12-gauge corrugated steel pipe can be safely buried 43 feet deep and still support heavy live loads (such as a blast). Since there is no added value in going deeper than 10 feet – and since maximum blast resistance is achieved with a depth of burial one tank diameter deep – it's just wasting money and time going deeper.

Rather than buying tens of thousands of dollars in concrete for shielding, we suggest using the excellent shielding properties of earth. To calculate the PF of a shelter (not including the entrances), we can use 2.9 inches of concrete and 3.9 inches of earth as a halving thickness. That is, every 2.9 inches of concrete cuts the radiation dose in half. Let's round these factors up to 3 inches of concrete and 4 inches of compacted earth to make calculations simpler.

Figure 1

Protection Factor	Concrete	Earth
2	3"	4"
4	6"	8"
8	9"	12"
16	12"	16"
32	15"	20"
64	18"	24"
128	21"	28"
256	24"	32"
512	27"	36"
1024	30"	40"

An additional 30 inches of concrete or 40 inches of dirt will multiply these PFs by an approximate factor of 1,000. At 80 inches of cover (approximately 6 ft. 8 in.), the PF is 1,048,576 for gamma rays.

As you can see, doubling the PF for every halving thickness starts getting interesting once you reach 80 inches of earth over your shelter. Please note that these figures are for fallout gamma radiation, not prompt radiations like fast gammas and neutrons. The vastly higher PF of a deep shelter will pay off handsomely if your shelter is near a surface burst or low-altitude air burst, as you could be exposed to over 1,000,000 rads of fast gammas and neutrons. Figure 2 shows a Nuclear Bomb Effects Computer (a slide rule that came with every hard copy of "The Effects of Nuclear Weapons" by Glasstone and Dolan). The U.S. Government Printing Office sold these until President Clinton ordered the cessation of its publishing (still available online). For these photos, the calculator is adjusted to reflect the prompt effects of a 100-kiloton weapon exploding within 0.3 miles of a target. Just about every conceivable effect is noted on this handy tool: incident overpressure, dynamic overpressure, reflected overpressure, wind velocity, shock wave arrival time and duration, crater size in three types of soil/rock, and more. On the flip side (Figure 3), graphics show initial radiation in fast gammas and thermal radiation, expressed in calories per square centimeter. The calculator indicates that initial radiation will be around 10 to the sixth power or 1,000,000 REM (Roentgen Equivalent in Man), which is roughly equal to rads.

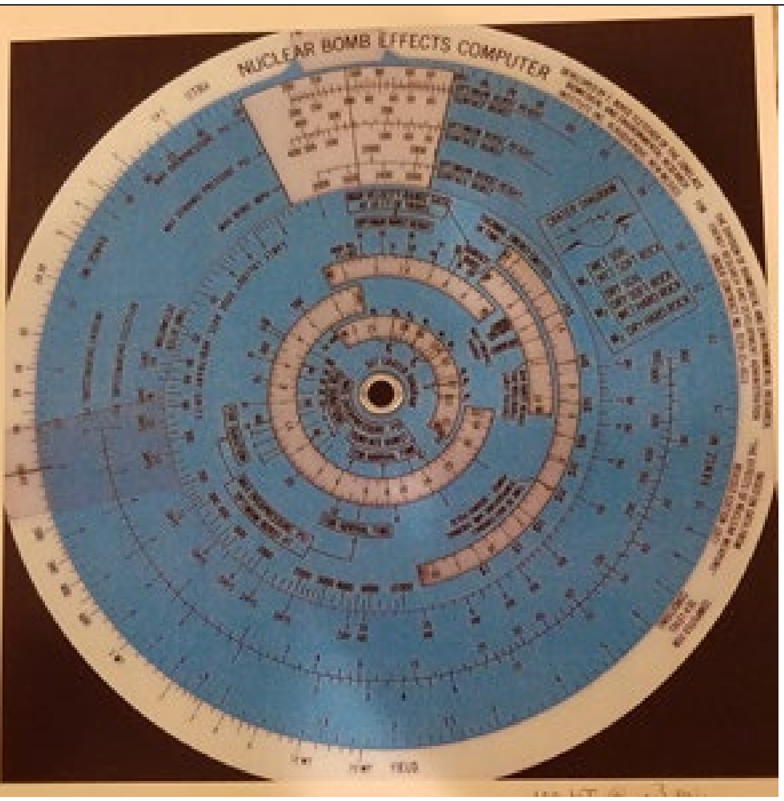

Figure 2

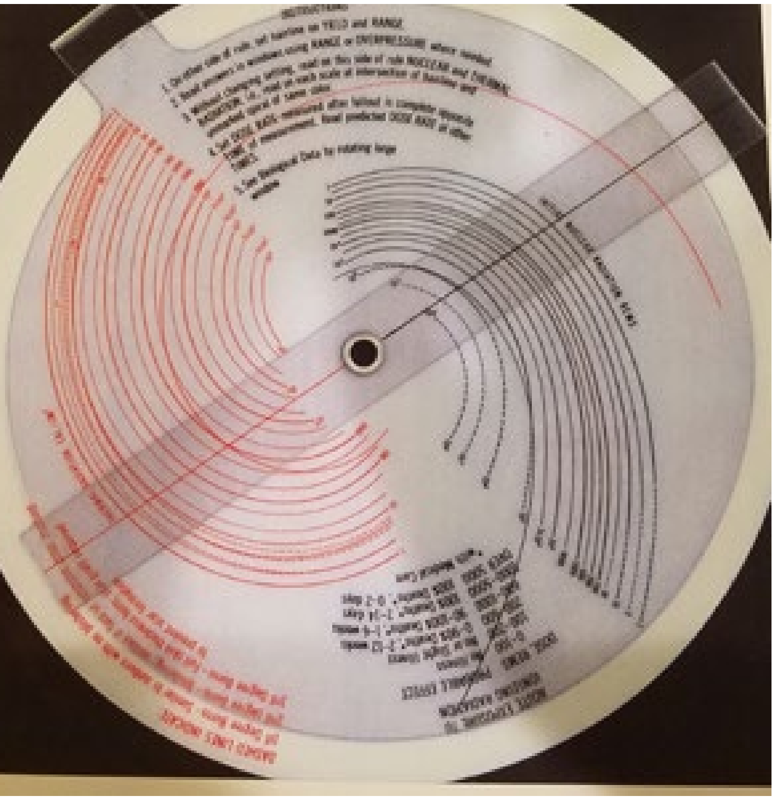

Figure 3

In another reference source, testing has shown that a shelter with 7 feet of earth cover will allow occupants to receive about 100 REM of prompt radiation exposure, which occurs in less than a second. It is the burst of radiation that is emitted from the fireball as the fuel is consumed in the reaction process. That's more radiation than I want to toy with, so while the backhoe is at the shelter site, and we're digging a big hole anyway, I'll take the shelter down another 3 feet...just to be sure. In cold or extremely hot climates, the extra cover will act as a "thermal blanket". It has been our experience that at -20^{0} F, the temperatures inside our personal shelters have not dropped below 47^{0} F, and at 100^{0} F, our shelters do not show a temperature above 67^{0} F.

Now back to the goings-on outside 0.3 miles away during the detonation. The incident overpressure will measure about 100 psi, with a dynamic wind of around 1500 mph. A Swiss concrete shelter will fail to protect occupants closer than 18 psi due to the initial radiation and will fail under blast loading at around 45 psi. The corrugated pipe shelter proved to be quite resilient at this level of insult during blast testing in Nevada. Take note that anything poking up in the air such as ventilation pipes will be sheared off cleanly at grade level, so we avoid this little problem by burying the air pipes below grade in what Edwin York described as "rock cribs". Figure 4 shows a 6-inch steel air pipe nested inside a 30-inch-diameter section of corrugated steel pipe, 48 inches long. It is open-ended so rain can pass through. Rocks the size of grapefruits are placed over and around the pipe to break up the shock wave, much like baffles in a muffler. These rocks also soften the impact on your shelter's blast valve and enable it to withstand significantly higher levels of insult.

A robust, expanded metal screen is welded over the opening of the air pipe to prevent rodent intrusion. Figure 5 shows the best way to attach expanded metal screening to the gooseneck opening. Simply cut off a 3/8 inch sliver of 6-inch schedule 40 steel pipe, lay the expanded metal over the orifice, press the 3/8-inch-thick ring over the screen, and weld in place. The result is a sturdy screen that will not be chewed through by rodents.

Figure 4

Figure 5

Shelters with generously wide and tall entrances have problems with initial radiation. Fast neutrons turn sharp corners much more efficiently than gammas do. So, while your 90-degree turn will block about 90% of gamma rays, it will only block 20% of fast neutrons. To remedy this, we use the smallest volumes we can in our entrances and fabricate long horizontal runs in them (see Figure 6). For a 48-inch-diameter, 90-degree elbow entrance, we like to have about 10 feet or more in the horizontal run so that supplemental shielding materials can be stacked inside to absorb the neutrons. On the end toward the hatch door, we want to stack 5-gallon water containers as tightly as possible for about four feet, followed by seven feet of bags of rice and grain. Sand (as in bagged sand) is not very helpful here. Grain is rich in hydrogen (as is water), and the fast neutrons will be converted to gamma energy and readily absorbed. Emergency exits can be permanently filled with water and grain so this chore will only be required to fill the main entrance in a real world scenario. I have around 1,200 pounds of rice stored in my emergency exit. The downside of this plan is that it temporarily blocks the emergency exit. We also have designs for a "trolly" type system that allows for faster entrance and egress that will be described in a later article.

In short, the more shielding material that is used, the safer the occupants will be—and remember that dirt is "dirt cheap".

Figure 6

Paul Seyfried has been interested in national security affairs since his enrollment at Missouri Military Academy and later, New Mexico Military Institute. His interest in self-help civil defense intensified during the height of the Cold War in the late 1980s. After building his first shelter with Sharon Packer he became acquainted with several nuclear weapons physicists involved with the creation of the nuclear age including Edwin York, Dr. Conrad Chester, and others who had hands-on experience in field testing of nuclear weapons and their effects upon buried shelter structures. His main interest is in the development and construction of cost-effective blast and fallout shelters within the reach of middle-class Americans. Paul builds and designs all hazard NBC shelters throughout the nation as a co-owner of Utah Shelter Systems. Paul also serves on the Advisory Board of The American Civil Defense Association.

TACDA celebrates 60 years!
1962-2022

Air Pipes and Blast Valves Q & A

QUESTION

I am planning to build a concrete shelter under my garage. I will have 10" thick concrete walls and a 12" thick ceiling. I would like to purchase a 3-bar (45 psi) blast protected ventilator and 3-bar blast valves. I would like to install three intake pipes and three exhaust pipes in case one or two become compromised. Please send your recommendations and directions for installing the ventilator and air pipes.

ANSWER

A 3-bar shelter requires 24" concrete ceilings and 12" concrete walls. If you don't have a 3-bar shelter, it's a waste of expense to purchase and install a 3-bar ventilation system. I would suggest that you use the VA150 1-bar system. The 1-bar system protects to 15 psi (0.8 miles from a 100 KT and 1.6 miles from a 1 MT nuclear ground burst). We recommend 5" or 6" schedule 40 steel air pipe for all shelters.

I would recommend the 1-bar blast valves for the current design of your concrete shelter. Drill a 5 or 6" diameter hole into the concrete and bolt the blast valve on the inside, directly to the concrete wall. This is true for both the intake pre-filter valve and the exhaust valve. A flange (with bolt holes) should be welded to the steel air pipe and bolted to the outside wall over the hole in the concrete (Figure 1).

If you are in a high-risk area for blast and want a concrete shelter, then you should build to the 3-bar standard above, with 12" walls and a 24" ceiling. The ceiling must be of solid, reinforced concrete. Please note that at 45 psi, you are at threat for initial radiation (fast neutrons and gammas). To protect against initial radiation, you will need 6' of concrete cover or 8' of dirt cover. The 3-bar system protects to 45 psi (0.4 miles from a 100 KT and 0.9 miles from a 1 MT ground burst explosion). You would then form the airpipes into the concrete wall and extend them into the shelter by about 3". You will need special plates welded to the inside end of the air pipe. These plates are about 10" square and are fabricated to match the contour of the blast

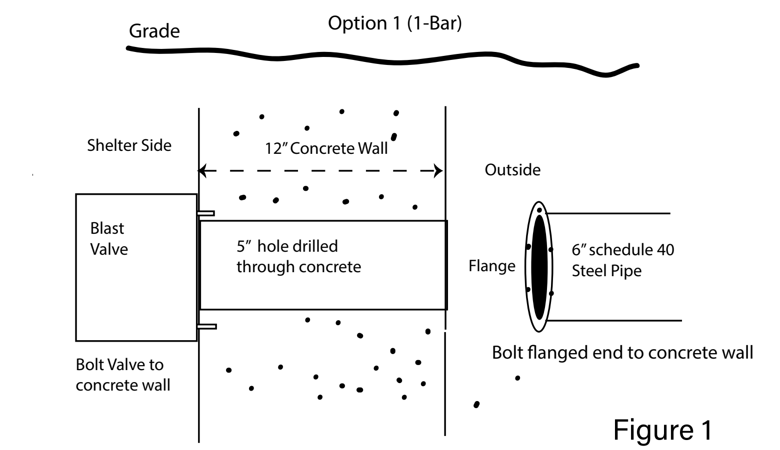

Figure 1

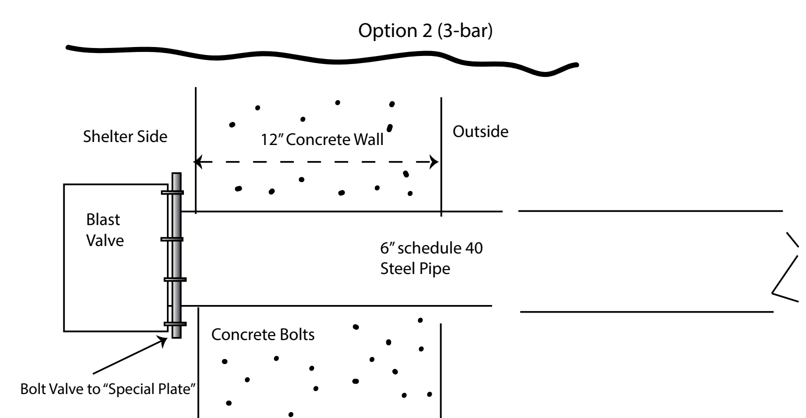

Figure 2

valves. They have bolt holes to match the holes on the blast valves and were specifically designed for this type of system. The blast valves will bolt to these plates (Figure 2). You must order these special plates with your ventilator.

You may want to consider a steel shelter. Steel shelters are usually quite a bit less expensive. Flat-topped steel shelters give very little blast protection. The 3-bar shelters are constructed from steel pipe (either corrugated steel or flat steel pipe) and require 6' or more of dirt cover for gammas and 8' of dirt cover for initial radiation. The arched ceiling and dirt cover provide the blast hardening effect. Air systems for steel shelters require the same special plates as above and these plates should be welded to the inside end of the air pipes. The air pipe should protrude about three inches into the shelter, and the blast valve is then bolted to the plate. This is true for both 1-bar and 3-bar steel shelters. The flat-topped steel shelters can have a 1-bar intake. The 1-bar intake can be bolted to the special plate, just as the 3-bar system does. They must, however, have a 3-bar exhaust valve, because the 1-bar exhaust valve cannot be bolted to the steel shelter.

If you have three intake and three exhaust pipes, you will need to find a way to close off the air from two sets of the pipes. You could then use either the 1-bar or the 3-bar ventilator, but you would need the 3-bar exhaust blast valve system described above for all of the air pipes. Bolt a solid plate over the special plate to close the air flow in the four remaining air pipes.

Best Regards,

Sharon Packer

Sharon Packer has a Bachelor's degree in Mathematics with a minor in Physics, and a Master's degree in Nuclear Engineering. She has served on the TACDA board of directors for over 20 years in several different capacities. Sharon is an expert in civil defense and in NBC shelter design.


Photo by Stanislav Kondratiev on Pexels

CRISIS RELOCATION:

A POLICY FAILURE COMPELLED BY COMPROMISE AND WISHFUL THINKING

By Nicholas Studer, M.D.,
Director, National Museum of Civil Defense

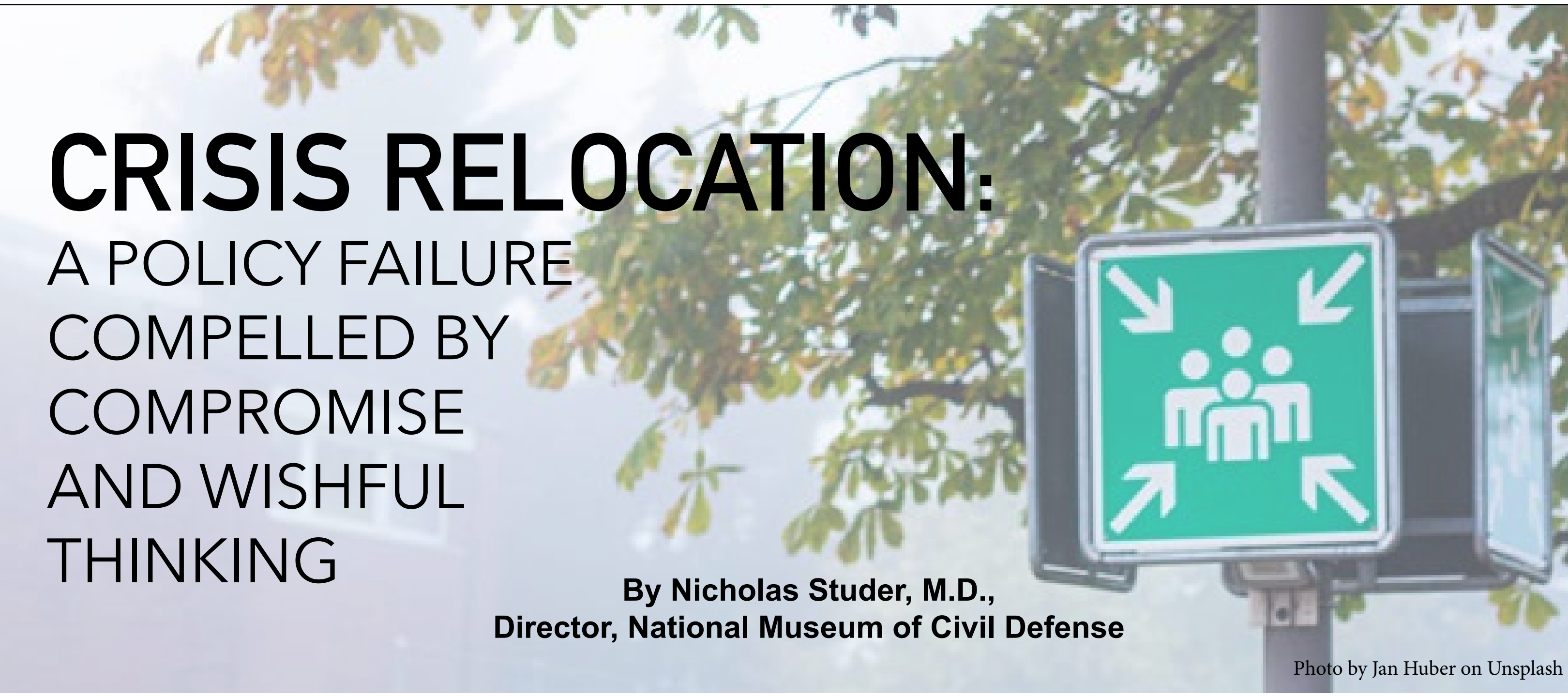

Photo by Jan Huber on Unsplash

The progression of federal civil defense policy in the United States throughout the Cold War reflects a myriad of factors ranging from developments in strategic weapons and military policy to the political inclinations of the president and congress at any given time.

1951-1976: Evacuation to Sheltering

Shortly after its founding in 1951, the Federal Civil Defense Administration (FCDA) proposed that the nation should build a system of public, blast-protective shelters to protect the civilian population from a limited number of fission bombs, coupled to a massive conventional bombing campaign like the British experience of early World War II. Without adequate radar warning capabilities, a "sneak attack" like the devastating air raid on American forces in Hawaii just 10 years before loomed large in planner's minds. Congress had no interest in this costly proposed program, with some politicians suggesting that public shelters represented socialism. As the U.S. deployed effective air raid warning capabilities, FCDA planners increasingly turned to evacuation of "Metropolitan Target Areas" to protect the public from the blast and thermal effects of fission weapons and conventional bombs.[1] FCDA encouraged a "rugged individualism" approach, but contemporary commentators would suggest only those with means and funding were able to build home shelters or quickly evacuate. Many doubted the ability of the Soviet Union to strike America, or that war would ever be likely. Apathy reigned in between brief crises, a theme that persisted throughout the Cold War. The arrival of intercontinental ballistic missiles in the late 1950s cut potential warning times from hours to only minutes. Evacuation of densely populated target areas was no longer feasible – if it ever was before. All the while, the development of fusion weapons and the Soviet acquisition of the same resulted in the threat of radioactive fallout becoming the primary threat to the population, not simply blast and heat.

Fallout consists of small, sand-like particles that form when vaporized material cools in the mushroom cloud after a nuclear detonation that occurs at or near the ground. These particles contain unstable atoms created by the nuclear fission and/or fusion reactions, emitting large amounts of gamma radiation (similar to medical x-rays, but of higher energy) for a brief period after a detonation.[2] For a period of hours to days, there is a significant hazard to personnel. In 1961, the new Department of Defense – Office of Civil Defense (OCD) seemingly learned the lessons of the previous ten years when attention had turned yet again to civil defense in the aftermath of the Berlin Crisis. The Kennedy administration recognized that a new plan was required, but massive and expensive programs did not have broad support. The National Fallout Shelter Program was both a compromise and an exercise in hope. The program hoped to find adequate shelter area by examining existing structures for adequate protection from radioactive fallout and asking building owners to volunteer the space. Original planning anticipated that personnel in areas near many ground burst detonations might need to seek shelter for several weeks, with OCD guidance suggesting two weeks as a common planning guideline. Protection from gamma radiation emitted from fallout requires both mass and distance to be placed between personnel and this particulate matter. By the 1970s, planners for what was by then termed "Nuclear Civil Protection" had recognized a contradiction of the National Fallout Shelter Program: these identified possible shelters were primarily located in dense urban areas. As the Soviet nuclear stockpile grew, it would be unlikely that fallout shelters would be spared from the nuclear blast and heat that they had never been assessed to provide protection from.

1976-1984: The Rise of Crisis Relocation

Wrestling with the need to develop a comprehensive national strategy on an ever-shrinking budget, the Defense Civil Preparedness Agency (DCPA, now the fifth incarnation of the federal civil defense agency) began proposing the concept of "Crisis Relocation Planning," more or less a companion to "Community Shelter Planning" by 1976.[3] Under the CRP model, planners suggested there would be a period of increased tensions between the U.S. and Soviet Union that might last days to weeks. Enabled by novel satellite-based intelligence gathering techniques and apparently cool-thinking politicians, level-headed civil defense personnel would order an orderly evacuation of "target areas" to lower risk "reception areas." CRP assumed that "reception areas" (generally low-density, small counties) would not only willingly accept large numbers of urban-based, "target area" residents during this crisis, but that local suburban/rural leaders would deliberately prepare to receive urban refugees. Urban areas would be tasked with the Herculean measure of evacuating millions of people, including the indigent and others without cars. With the election of Ronald Reagan to the Presidency, his administration believed in increasing funding for civil defense as well as offensive measures.[4] CRP was by then the primary defensive planning construct policy of the Federal Emergency Management Agency, which now created a seven-year plan to "revitalize" planning with what remained a mediocre budget. The stage was set for a firestorm of political controversy, as CRP proved to be highly controversial with the very civil defense personnel intended to execute it, let alone becoming a highly visible magnet for criticism from various peace and anti-nuclear activists.

The 1980s saw an increase in arguments over the benefit or futility of civil defense planning, various morality questions, and even whether civil defense was strategically destabilizing or made war more likely. However, it was CRP itself that critics zeroed in on their focus. CRP and its seeming disconnection with the political and logistical realities of such mass evacuations made FEMA appear overly optimistic at best to disingenuous and tone-deaf at worst. Feasibility of shelter planning was technically more complex, but those who saw the daily challenges in "evacuation" from downtown jobs to suburban homes each night had difficulty agreeing that even several days' notice would be adequate to entirely evacuate target areas. Even if this were to occur, many questioned the logistical requirements once evacuees reached "reception areas." Without a clear connection to a publicly obvious imminent crisis, the Reagan-era push for CRP seemed more politically related than previous "crash programs." It didn't help that it was presented to the public with an ever-escalating "Arms Race" and the Strategic Defense Initiative anti-ballistic missile program. CRP essentially invited political discourse and served as a surrogate for generalized anti-war thought as it more directly affected the public than these military programs. CRP thus resulted in the apparent first State legislative and executive rebukes of federal civil defense policy. Massachusetts Governor Dukakis issued an Executive Order in 1984 that stated:

> "Henceforth, the Commonwealth will continue to develop the concept of Comprehensive Emergency Management to deal with major disasters or emergencies in the Commonwealth, with the qualification that the Commonwealth shall not engage in crisis relocation planning in preparation for nuclear war."[5]

1984-1994: The End of Civil Defense

By the mid-1980s, CRP seems to have been de-emphasized. FEMA Director Julius Becton had originally threatened cutting all FEMA funding to States and local areas that did not participate in CRP. However, as refusals mounted, funding to states and municipalities continued despite lack of CRP support. Released in 1987, FEMA's "Preparedness Planning for a Nuclear Crisis" listed evacuation as a potential consideration if time allowed during a crisis; however, it did not mention CRP outside of an easily-missed reference within a small cartoon (Figure 1). CRP seems to have lost favor in title at least, even as FEMA re-emphasized the "Civil Defense" moniker and its traditional logo following the Government Accountability Office's 1987 scathing report on appropriate use of funds intended for nuclear preparedness. With the National Defense Authorization Act in 1994, the Federal Civil Defense Act of 1994 was terminated, and some sections

Figure 1

transferred to the Stafford Act. "Attack" was no longer a significant concern for FEMA, and while much was likely inevitable, CRP and the controversy that surrounded it helped hasten the demise of nuclear attack preparedness planning.

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Dr. Studer is a practicing Emergency Medicine physician and the founding Director of the National Museum of Civil Defense, the only 501(c)(3) nonprofit museum dedicated to the historical preservation and interpretation of the United States Civil Defense program. The terrorist attacks of 9/11 first catalyzed Dr. Studer's interest in the history of our Nation's Civil Defense program, which grew into a desire to share his research with others. He volunteered for the Brevard County (FL) Office of Emergency Management during the early 2000s, and later served at the Florida Department of Health - Bureau of Radiation Control's Radiological Instrument Maintenance & Calibration Laboratory prior to attending medical school at the University of South Florida. Dr. Studer's primary interests within Civil Defense history include the Chemical/Biological Warfare, Radiological Defense, and Packaged Disaster Hospital programs.

NUCLEAR WEAPONS EFFECTS IN SHELTERS
Part 1: Radiation

By TACDA Staff

Photo by Yosh Ginsu on Unsplash

At the instant of a nuclear explosion, a strong radiation of heat and light is emitted, lasting several seconds. Initial radiation (IR) occurs immediately, and later, the fallout bearing gamma begins. Shelters very near (within 1 ½ mi.) primary and secondary targets should consider IR as a threat and design accordingly. Initial radiation consists of fast gammas and neutrons.

Strangely, the IR for small yield weapons in the 15 and 45 psi range is expected to be greater than it would be for larger yield weapons. The reason for this is that the expected height of burst for larger yield weapons (for maximum blast effects) takes the IR level further from the ground. A 1 MT ground burst detonated at the 200 psi level would be expected to produce 1,000,000 Roentgen (R) of initial radiation. At maximum blast effects levels, however, a 1 MT burst will be detonated at a height greater than 1.5 miles, and the initial radiation level will be close to "0". A 10 KT yield ground burst at the 45 psi level (0.2 mi) will result in 70,000 R of initial radiation. A 10 KT ground burst detonated at the 15 psi level (0.4 mi.) would be expected to produce 20,000 R of initial radiation.

Ground bursts are the worst-case scenario for IR, but weapons can be detonated at any height for maximization effects for a number of scenarios and would result in little, if no, IR. Please note that IR is an instantaneous radiation level, where gamma readings are R/hr. and decay with time. Initial radiation levels (both counted in Roentgens) are counted over and above the gamma radiation levels.

GAMMA RADIATION

Most of the radiation in shelters from both gamma and IR comes through the entrances. Small-diameter entrances with a 90-degree elbow offer a great advantage for gamma radiation, but not so great an advantage for IR. The PF for gamma radiation with a 90-degree elbow can be multiplied by a factor of 10. The PF for initial radiation with a 90-degree turn can only be multiplied by a factor of 1.2.

Gamma Example 1:

Protection factors (PF) for gamma radiation in entrances are figured by the formula (where L = length and D = entrance diameter):

Let L = 16' and D = 3'

$PF = 8\ (L^2) \div D^2$

$PF = (8)(16^2) \div 3^2 = 227$

A 90-degree turn gives an additional reduction of 90% (this turning factor multiplies the PF by 10), resulting in a total PF at the entrance point of the shelter of 2,270.

Gamma Example 2:

Let L = 24' and D = 3'

$PF = 8(24^2) \div 3^2 = 512$

512 times the turning factor of 10 gives a total PF of 5,120.

As you can see, long entrance lengths and small entrance diameters decrease the gamma significantly. Divide the total radiation (R) by the protection factor to get

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the resulting radiation expected in the shelter. At 1,000 R/hr., the gamma level inside the shelter in the second example is expected to be 1,000 ÷ 5,120 = 0.2R/hr.

INITIAL RADIATION

Initial radiation protection factors in shelter entrances are decreased by the formula $2^{L/1.54D}$ where, again, L is the length of the entrance, and D is the diameter of the entrance.

IR Example 1:

Using the same example as above, L = 16 and D = 3.

$PF = 2^{16/1.54(3)} = 2^{3.46} = 11.03$

In a 90-degree configuration, there is an additional turning factor of 1.2.

Multiplying 11.03 by 1.2 results in a total initial radiation PF of 13.23.

Divide the total initial radiation at that point by the protection factor to find the resulting initial radiation in the shelter. This initial radiation PF, compared to the PF for gamma above, results in a huge attenuation difference. Add to this the fact that IR levels within the 1.5- mile range are very much greater than gamma levels. In example 1, if the IR level is 20,000 R, the total radiation felt inside the shelter will be 20,000 ÷ 13.23 = 1,512 R. This dose, as seen in the penalty chart below, is well over the lethal range. In the worst case scenario of 1,000,000 R, the total radiation inside will be over 75,500 R. It now becomes obvious that we need a further reduction of the IR in order to survive in that proximity.

IR Example 2:

Let L=24' and D=3'

$PF = 2^{24/1.54(3)} = 36.63$

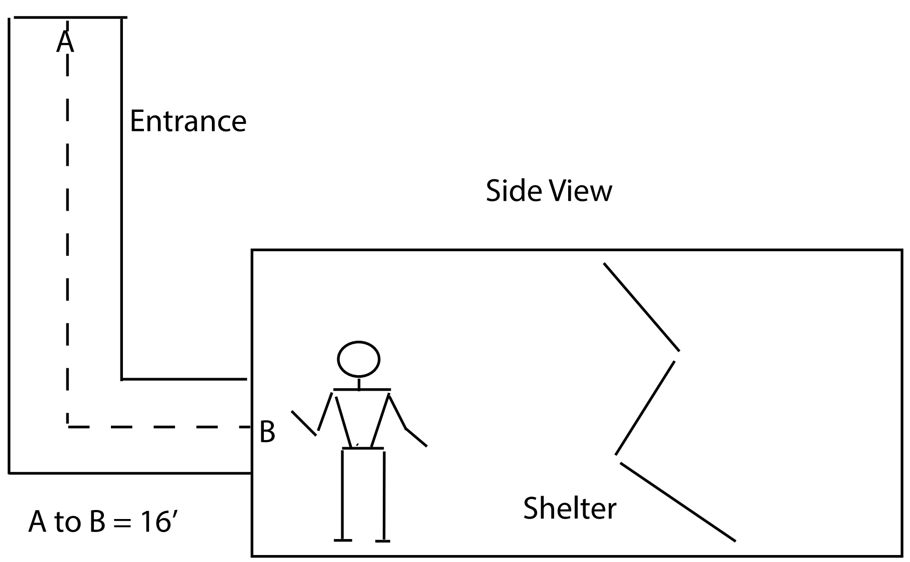
The turning factor of 1.2 times 36.63 results in a PF of 363.3.

At the 15-psi level (which is easily survivable in a good shelter) with a possible 20,000 R of initial radiation, the above example will give a PF of 363.3. 20,000 R divided by 363.3 results in a total IR level of 55 R. The penalty chart shows that 55 R is survivable with no expected medical care needed. At the 200 psi level showing a possible 1,000,000 R, however, the shelter occupants will receive 2,752 R. A further reduction must be made to survive the worst-case scenario.

SHIELDING

A good, corrugated steel shelter, if installed properly (and at the right depth), can protect the occupants from the blast effects at the 200-psi level. In the above example, however, the occupants will not survive. We have already used, to our benefit, the length and geometry of our entrances, but now we must use the "shielding" concept to get the remainder of the protection needed.

There is a different requirement for shielding against initial radiation than there is for gamma. We use heavy material like dirt, concrete, and metals to shield against gamma. The neutrons in the IR are best shielded by hydrogen, and since water contains a great deal of hydrogen, we should shield against IR with products containing larger amounts of water. If we place water bottles and rice bags in our entrances, this not only reduces the diameter, but shields from the neutrons.

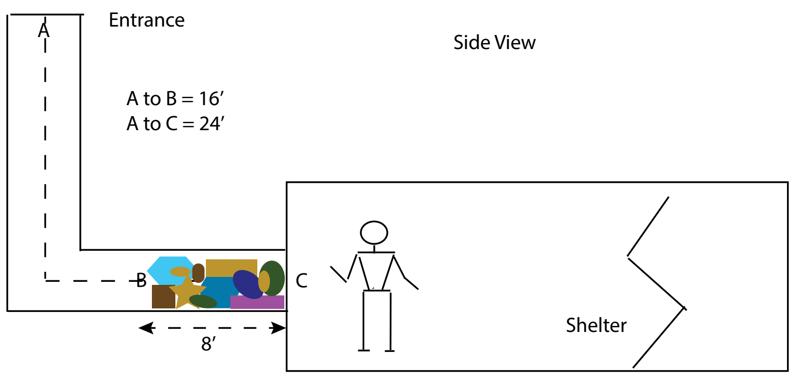


Example 3:

Use 1,000,000 R as a worst case scenario. If the length of the entrance in example 1 is increased by 8 feet to an overall length of 24 feet, and if the additional length is snugly packed with rice and water, the diameter will be reduced to 0.5 ft. As shown above, at the 16-foot level the PF is 13.23, and the resulting initial radiation level is about 75,000. Between the 16' length and the 24' length, L = 8' and D = 0.5'.

$PF = 2^{8/1.54(0.5)} = 1,342$

With the longer entrance and the addition of shielding, the level at the end of the entrance has been decreased to 75,000/1,342 = 56 R. The gamma radiation, as shown above, is negligible. The 56 R that the occupants receive is well within the survivable range on the penalty chart. Total permissible radiation in the shelter has been set by FEMA at 100 R.



RADIATION PENALTY TABLE

	Accumulated Exposure (Roentgens) 1 Week	1 Month	4 Months
Medical Care Not Needed	150	200	300
Some Need Medical Care Few if Any Deaths	250	350	500
Most Need Medical Care More than 50% Deaths	450	600	*

EXPOSURES AT 30 MILES DOWNWIND
(500 KT Surface burst, 15 mph wind)
(Roentgens)

Time	In Open	In Shelter 15 PF	In Shelter 49 PF
1 Week	3,450	230	86
1 Month	4,100	273	103
4 Months	4,500	300	113

EMERGENCY COMMUNICATIONS

Part 3: Base Stations, Antennae Gain, & Mobile Transceivers

By Dr. Randall Smith

Photo by DWilliam on Pixabay

This is the third communications article in a series of articles that will be published in the Journal of Civil Defense. If you have not studied part 1 and part 2 of this article, please refer to the 2021 fall issue, The Threat of EMP, and Components of Electronic Communication Systems in the spring issue of 2022. After we complete all six of the communication articles, the entire series will be available to you in the TACDA Academy on our TACDA web site.

BASE STATIONS

A base station is a station that is operated from a fixed geographical location. Transceivers used as base stations tend to fall into several categories. Most have what is called a "general coverage" receiver which means that they will receive all frequencies between their lower and upper limits, e.g., 500 kHz and 30 MHz. If one is a short-wave radio enthusiast who enjoys listening to international short-wave broadcasts of news and information, this is a significant plus. These transceivers will only transmit on amateur radio bands that lie between their lower and upper frequency limits. Output power is typically 100 watts. Some more expensive units produce 200 watts of output power.

Quality amateur radio transceivers can be obtained either as new or used units. If you are unsure about purchasing a used transceiver, it is strongly recommended that you ask a knowledgeable amateur radio operator to accompany you as you inspect and evaluate your intended purchase.

Major manufacturers of quality amateur radio equipment include companies such as KENWOOD, YAESU (yea'-sue), ICOM, and ALINCO. There are other companies that also manufacture quality amateur radios. Patience and due diligence are your best allies when selecting your first amateur radio transceiver and accessories.

Many newer amateur transceivers have added 50 - 54 MHz to the transceiver's transmitting and receiving capabilities. There are also base station (and portable) transceivers that are capable of transmitting on all amateur HF bands, plus VHF (50-54 MHz, 144-148 MHz) and UHF (420-450 MHz). Many of these units with expanded (V/UHF) transmit and receive frequency ranges are intended for use with amateur radio satellites.

Many amateur radio operators wish to increase the output power of their station's signals. This can be done by the addition of a "linear amplifier" which receives the signal from the station's transceiver and increases its strength. For example, with the addition of a linear amplifier, the typical 100-watt output signal from a transceiver can be increased in power up to the legal limit of 1,500 watts.

ANTENNA GAIN

Another method of increasing output power is accomplished by selecting an antenna design that, based upon its physical characteristics, provides a boost in the strength of the transmitted signal. This boost is called gain or antenna gain. In electronics, gain is measured using a logarithmic scale (as opposed to a linear scale). The gain of an antenna (or any other electronic device exhibiting signal gain such as a linear amplifier) is expressed in decibels (dB), in recognition of the contributions to the field of acoustics made by Alexander Graham Bell. Using a decibel scale, a gain of 3 dB represents a doubling of effective radiated power. That is, if a transmitter generates 100 watts of RF power and that power is fed to an antenna designed to develop a gain of 3 dB, the effective radiated power of that signal is now 200 watts. By the same token, a gain of 6 dB would produce a signal with an effective radiated power of 400 watts. In other words, each 3 dB increment doubles the applied power level.

This same principal applies to devices which reduce a signal's power level. Reduction in signal strength is called attenuation and it is accomplished by using a device called an attenuator. If a signal is reduced by one half of its original value, that decrease represents a reduction in signal strength of 3 dB. It should be noted that there are several different types of decibel scales. The decibel scale is often applied to the intensity, or the power, of audible sounds appreciated by the human ear. Neural pathways in the central nervous system conduct sound heard at the ear to sound appreciated in the central nervous system. An examination of these various logarithmic scales exceeds the boundaries of this introduction, however an awareness of the fact that there are different types of decibel scales does not.

To increase the power of a signal coming from a transceiver to its antenna, one can either insert a linear amplifier between the two or choose to build an antenna that provides gain to the incoming signal. Of course, one can also do both. At a little over one dollar per watt, choosing an antenna with the desired degree of gain is often the more economical alternative. Beam antennas, which focus a radio signal much the way a spotlight focuses and directs a light beam, are available that provide 15-20 dB of gain or more. So, considering an antenna that offers gain is usually well worth the time and effort. If your circumstances prevent you from installing a beam antenna, then a linear amplifier may be your only path to achieving greater radiated power from your transmitter.

MOBILE TRANSCEIVERS

Mobile transceivers, for the most part, are "dual band" units which transmit and receive on both the VHF (144-148 MHz) and UHF (420-450 MHz) portions of the amateur radio spectrum. Power levels are typically about 50 watts for VHF and 25 to 35 watts for UHF, although there are exceptions. There are also "quad band" mobile radios which transmit and receive in the 28-28.7 MHz, 50-54 MHz, 144-148 MHz, and 420-450 MHz amateur band allocations. Multi-band mobile antennas are plentiful. Your final decision will depend upon your preferences for size and method of mounting the antenna to your vehicle.

SCANNERS

While radio scanners lack transmission capabilities, they provide an excellent method of monitoring transmissions by local, state, and federal authorities. As Jones and Jones ("The Provident Prepper", 1984) point out, insuring access to this information is critical to surviving a natural or man-made disaster, particularly if one is confined indoors to his or her home, a shelter, or some other facility.

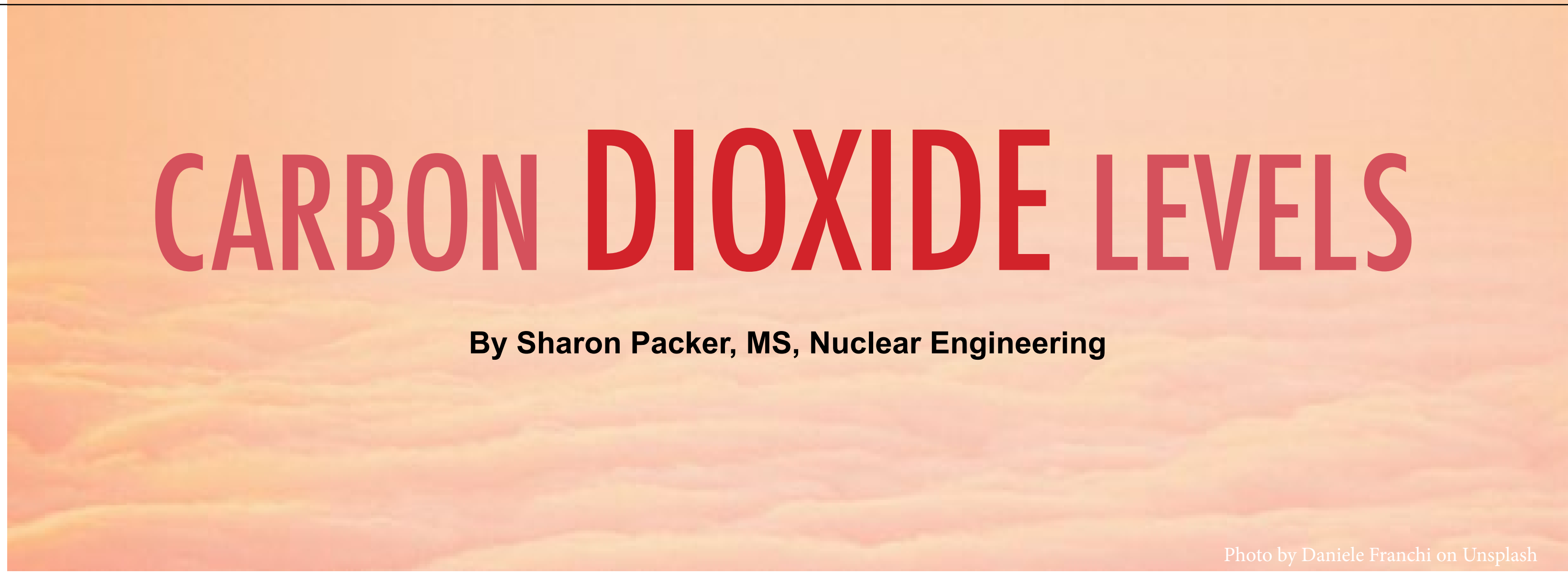
At the federal level, a relatively new Emergency Alert System (EAS) came into being on 3 October 2018. This new system replaced the Emergency Broadcast System and its much older predecessor, CONELRAD. The EAS sends alert messages to all cellular phones (which are turned on and operative). When cellular phones are turned on, this system cannot be deactivated. Jones and Jones point out that, in order to determine which radio stations you should tune to in your area, you can consult www.nws.noaa.gov/nwr/listcov.htm. Recording this information for future use is an excellent idea.

In many areas, frequencies used regularly by law enforcement, fire, EMS, and Civil Defense services can be programmed into a scanner and monitored. This leaves other communications equipment, such as V/UHF handi-talkies, amateur, and shortwave radios (especially those capable of receiving NOAA weather and related information discussed below) free to perform their primary functions. Depending upon a scanner's design and capabilities, it is possible to monitor frequencies such as the aircraft distress frequency of 121.500 MHz, the marine emergency frequency of 156.800 MHz, and an international distress frequency of 243.00 MHz. Many scanners will also monitor local Citizens Band channels which can provide a good source of local information in your area.

As with any radio, optimum performance requires an optimum antenna, and scanners are not an exception. The small, telescoping antennas that come with and attach to a scanner are very poor performers when compared to a good, outdoor antenna such as a DISCONE D-130 or comparable wide-band scanner antenna. Quality coaxial cable is also important to securing optimum operation of all antennas.

Please watch for our next journal article in the spring of 2023, where we will discuss "Power Supplies".

Dr. Randall Smith has held an FCC license since 1984. He has served as a radio operator in the U.S. Army's Military Affiliate Radio System, and with the IBM Corporation first as a field engineer, then as a systems engineer and finally as a marketing representative. He participated in the construction of the emergency communications portion of the St. Louis Civil Defense Agency's underground emergency command center.



CARBON DIOXIDE LEVELS

By Sharon Packer, MS, Nuclear Engineering

Photo by Daniele Franchi on Unsplash

Few, if any, shelter ventilation systems are designed to remove carbon monoxide or carbon dioxide from filtered air. Current Federal guidelines, under normal living conditions, require that the production of carbon dioxide (CO_2) remain below 0.1% of the volume of the structure.

FLOODED SHELTERS

Water can enter a shelter through damaged door seals, air vents, or any other type of openings. Take care that nothing is stored inside your shelter that could produce CO, CO_2, or other noxious fumes. Never store propane or gasoline inside a basement or shelter. Propane has a specific density that is heavier than air and the gas can pool in low areas. It is extremely difficult and dangerous to rid low areas of these fumes. Flood waters often contain sewage and other contaminants. Consider installing a CO_2 and CO alarm into your shelter and entrances. Never enter a flooded shelter without testing the air in the entrance with proper metering devices.

NBC SHELTERS

Immediately after a nuclear attack, smoke and radiation levels from the outside air could overcome the filtration systems. Therefore, hardened NBC shelters should have the capability to shut down for a period of 6 hours in sealed shelter operation to prevent the entrance of these contaminants. It is assumed that after 6 hours, smoke and radiation levels from outside would diminish to safe levels for continued ventilation. Carbon dioxide, which is an internal threat, builds very quickly in occupied, sealed areas. Current Swiss guidelines suggest a CO_2 level of 2.5% or less as acceptable during that 6-hour shutdown time. A concentration of CO_2 over 2.5% in the sheltered area is dangerous and, over several hours, could lead to serious oxygen deprivation resulting in permanent brain damage.

This example is for emergency "shut down time" only. The 2.5% CO_2 level may cause anxiety and an increased heart rate. If you are meeting minimum space requirements, try to keep people quiet and as immobile as possible during that 6-hour shut down period.

LET'S DO THE MATH

Each person will produce about 0.67 cubic feet/hr. of CO_2. Therefore, each person in a shelter will produce 4.02 cubic feet of CO_2 in 6 hours.

- Multiply 0.67 cubic feet per hour by 6 hours and the result is 4.02 cubic feet production of CO_2 for one person in 6 hours.
- Multiply 4.02 cubic meters by the number of people in the shelter to get total CO_2 levels.

Example:

- Eight people will produce 32.16 cubic ft. of CO_2 in a six-hour period (8 x 4.02 = 32.16).
- Your shelter must have a minimum empty volume of 1,284 cubic feet to accommodate 8 people (2.5% of 1,284 = 32.16 cubic ft.)

Note: The 1,284 cubic feet, eight-person shelter example is an impractical scenario. It should be noted that the air space for breathing must be totally "empty" space. You must add about five cubic feet to the shelter space for the mass of each person. You must also add additional space for food, water, supplies, and furniture and plan accordingly. Swiss standards require that the total minimum size of any shelter should not be less than 422 cubic feet.

Plan your shelter space to accommodate each person enough room to breathe safely for the 6-hour period. If you must shelter more people than your space can accommodate, purchase a carbon dioxide scrubber, or provide supplementation in the form of compressed air.

Note: Compressed air is not the same as pure oxygen. Oxygen tanks are extremely flammable and dangerous and should not be stored underground.

When using manual operation, always follow your ventilation requirements, so the sheltered occupants are comfortable. Carbon dioxide is not insidious, like the carbon monoxide gas that comes from a leaking gas appliance where you just go to sleep and die. If everyone is sleeping, most people will feel discomfort well before the 2.5% carbon dioxide level is reached and will be awakened. A functioning ventilator will freshen the air very quickly.

TYPES OF SHELTERS

Class 1: In a Class 1 safe room, air is drawn from outside the room, filtered, and discharged from the room at a rate sufficient to produce an internal pressure. The safe room is thus ventilated with filtered air, eliminating the constraints related to carbon dioxide accumulation. The internal pressure produced with filtered air prevents infiltration of outside air through leakage paths.

Class 2: This class also includes air filtration, but with little or no internal pressure. Without positive pressure, the safe room does not prevent the infiltration of contaminated air. A Class 2 Safe Room may be ventilated or unventilated. In an unventilated Class 2 safe room (short-term use), air is drawn from inside the safe room, filtered for CO_2, and discharged to the inside of the shelter. In a ventilated Class 2 safe room, air is drawn from outside but at a flow rate too small to create a measurable differential pressure.

Class 3: This class has no air-filtering capability and is unventilated. It is a basic safe room that derives protection only by retained clean air within its tight enclosure. Use of the Class 3 Safe Room is commonly referred to as sheltering-in-place.

Purchase a ventilation system according to the class of shelter you plan to build (see below):

- Class 1 shelters require vigorous testing by the manufacturer and should have manual function capability. The system will need pressure valves for both intake and exhaust in order to control the internal shelter pressure.
- Class 2 shelters will filter the CO_2 from the air, but if unventilated, the shelter will be depleted of oxygen after a period of time, limiting occupation time.
- Class 3 unventilated safe rooms must meet the CO_2 shutdown requirements from above.

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CO_2	
250-400ppm	Normal background concentration in outdoor ambient air.
400-1,000ppm	Concentrations typical of occupied indoor spaces with good air exchange.
1,000-2,000ppm	Complaints of drowsiness and poor air.
2,000-5,000ppm	Headaches, sleepiness, and stagnant, stale, stuffy air. Poor concentration, loss of attention, increased heart rate, and slight nausea may also be present.
5,000ppm	Workplace exposure limit (as 8-hour TWA) in most jurisdictions.
>40,000 ppm	Exposure may lead to serious oxygen deprivation resulting in permanent brain damage, coma, even death.

For more information related to this article, please click here to view FEMA's *Safe Rooms and Shelters: Protecting People Against Terrorist Attacks*

TACDA Pioneers:
Voices from the Past

Edward Teller Ph.D. and *SURVIVE* Staff

Edward Teller, Ph.D.

Edward Teller, Ph.D. was the founder of the United States Atomic Energy Commission laboratory at Livermore, California. He was one of the world's leading theoretical physicists and served on the faculties of top research institutions such as the University of Chicago and the University of California at Berkeley. Under his guidance the United States won the race to develop the first H-Bomb, thereby making this powerful weapon first available to the free world. Dr. Teller participated in the development of nuclear weapons from their beginning. From his vast knowledge in nuclear weaponry, he pointed out the likelihood that the Soviet Union had overtaken the United States in nuclear offensive capability and the effect this had on the need for civil defense. Dr. Teller's involvement with TACDA resulted in great progress with the leadership in Washington D.C. and attributed to the accelerated growth within TACDA's membership and public interest in general.

WHAT WE REALLY WANT

Edward Teller addressed the United States Civil Defense Council in Seattle on October 11, 1969. Complementing the members of the Council on their perseverance and dedication in the face of overwhelming odds he noted that Washington was now taking a new and long look at the need for a realistic civil defense program. The following is an excerpt from Dr. Teller's talk.

It has been stated that a nuclear attack may wipe out mankind. This is nonsense. The people who say such things either do not know the facts or are willfully misleading us. What has to be said is that in a nuclear attack a country like the United States will cease to exist if we are unprepared. And to be prepared means not only saving life. It means that we must be able rapidly to recover. We must be prepared to continue to exist and function under a nuclear attack.

What we really want - and this has been said often and is correct - what we really want is not to **survive** a nuclear war. What we really want is not to **have** a nuclear war. In this sense the idea of deterrence is even reasonable. I claim that the best deterrence that anyone can imagine is an effective civil defense. Missile defense is a good deterrent. The fact that we are proceeding in that direction is a sign that civil defense is not far behind. But if war should come, even if we have missile defense, even if we have civil defense, there will be very terrible destruction. We should avoid it if we possibly can. The main point is this: I doubt that anyone will ever attack us with nuclear weapons unless he is confident that he can wipe us out. If we can make sure that as a nation, we shall survive we will have abolished the incentive for the Russians, for the Chinese, for anybody to attack us."

(By Edward Teller, Ph.D.; previously published: Jan-Feb 1970)

50,000,000 AMERICANS: DEAD OR ALIVE

Note: "Survive" was the name of the TACDA journal before it was permanently changed to the Journal of Civil Defense in 1976. This study was done in 1968 when the United States had a population of 203,302,031. The population of the United States today in 2022 is 322,278,200. The number 'dead' in our day would be 80,000,000 as compared to 50,000,000 in those years.

It is shamefully tragic and obvious: fallout shelters would be robbed of value in areas subjected to significant blast in a nuclear attack. But a fallout shelter is cheaper than a blast shelter. For this reason, the Office of Civil Defense, tied fast to a mini-budget, is obliged to promote fallout shelters as the way to save the most people at the lowest cost - and to apply it to large cities where it may well not apply. It is something like substituting canoes for lifeboats on an ocean liner with the explanation that canoes are cheaper than lifeboats, therefore preferable.

The man on the street - the "big city" street - is in this way to a significant degree written off as too expensive to protect. It is impossible, they tell him, to know exactly where the bombs will fall anyway. He is advised to plan for fallout protection in anticipation that his home or his office may perchance be outside of the blast area. He is sometimes informed that those within the blast area of a nuclear weapon have little to worry about anyway, because they quickly and dramatically become "part of the problem", literally part of the explosion and part of the radioactive materials to be dropped as fallout over the countryside. The picture is somewhat inaccurate, but it is a neat way of dividing those far from the bomb who can live if they have protection from fallout, from those near the bomb who allegedly cannot live because they are within that "hopeless" blast area.

But let us look at the problem of the city dweller with an unconvinced mind. Need he really be written off? Should he be discouraged from providing himself with a blast shelter? Is his doom sealed?

The answer is that his case is not at all hopeless. The Office of Civil Defense has done a tremendous amount of blast research. Unfortunately, unlike other countries, we largely ignore the results. OCD research has classified the area around a nuclear burst into four rings or zones fanning outward from the center of the burst, from GZ (ground zero) [Figure 1]. These zones are labeled "A", "B", "C", and "D". The dimensions of the zones vary principally with the size of the weapon and the altitude at which it is detonated. At the outer edge of the "D" zone the blast

Photo by Malcolm Lightbody on Unsplash

is relatively gentle. This is a distance of 30 miles from the "GZ" of a twenty-megaton air burst. Here the 1 psi (pound per square inch) overpressure produces a wind gust of 35 miles per hour. People behind closed windows may be injured by broken glass. There will be other injuries, not too many.

Within the "C" zone 5% to 15% of the people would be killed depending upon the warning received. Over-pressures of 1.5 psi to 2.5 psi would produce winds up to about 85 miles per hour. A good fallout shelter would be effective here, although a blast shelter would be better. The "C" zone extends from 18 to 25 miles from ground zero. Damages are largely reparable.

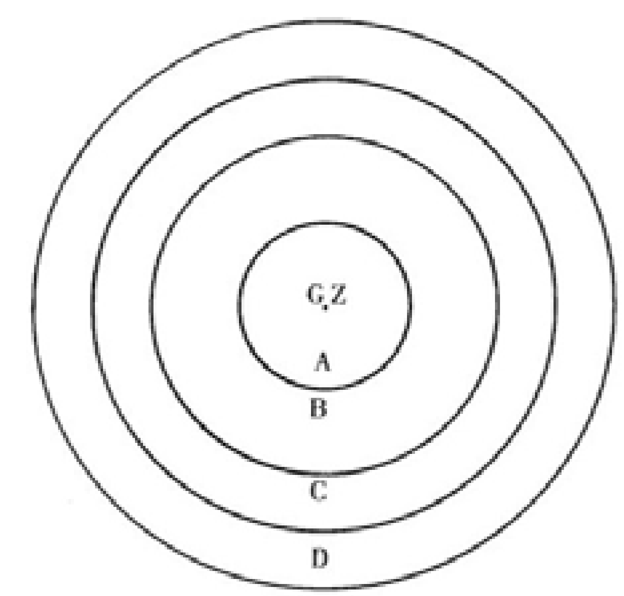


Figure 1

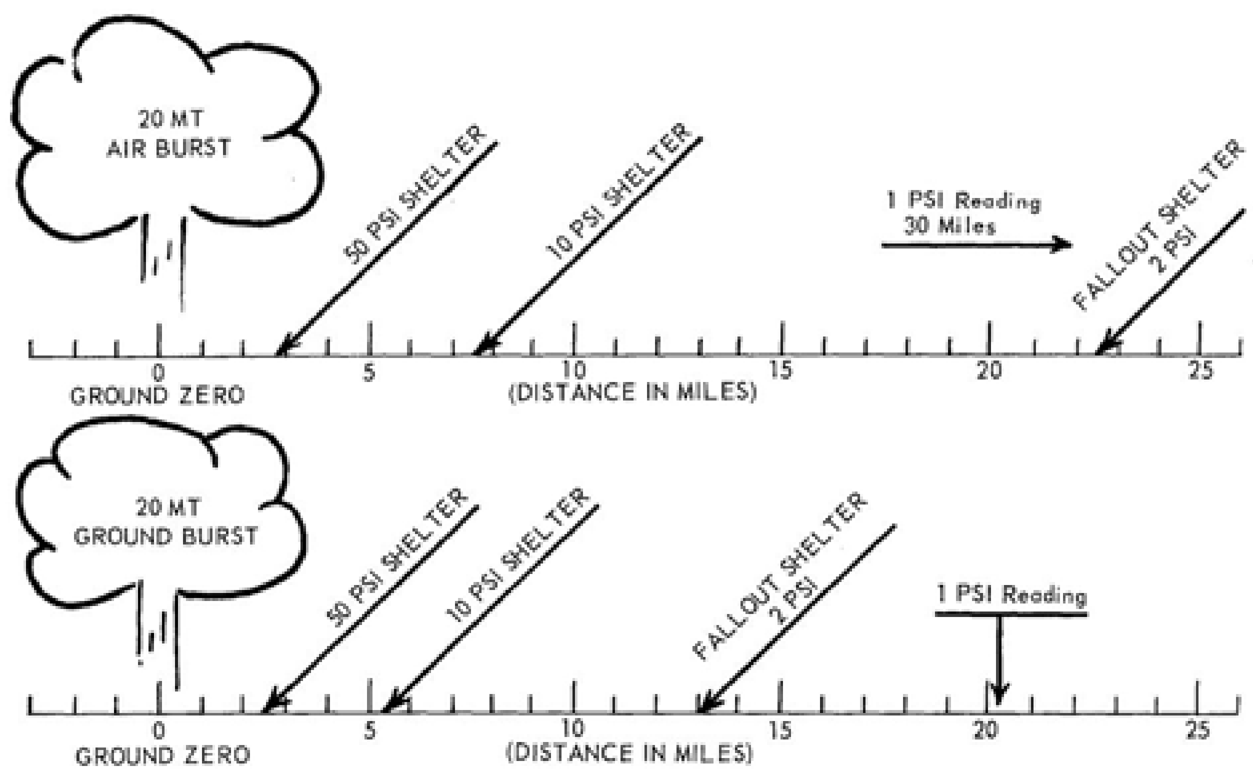
JOURNAL OF *Civil* DEFENSE

The "B" zone around a 20-megaton explosion reaches from 9 miles from the burst center at ground level to 18 miles, and overpressures vary from 7 psi down to 2.5 psi. Here the situation is somewhat rougher. Most buildings are damaged beyond repair. Eardrums are ruptured at 5 psi pressure and glass splinters and other objects hurled against people will cause other, more serious, injuries. Also, many fires could start in this region. Blast shelters, even modest ones, could, however, protect people adequately.

Devastation in the "A" zone is complete except for good blast shelter construction, which should be underground. Five miles from ground zero the wind velocity is 300 to 400 miles per hour, the overpressure 20 psi. The figures climb swiftly as we get closer to ground zero. We find winds of over 1,000 miles per hour and overpressures over 100 psi. Buildings are pulverized. 75% to 90% of those caught within this zone are killed. It is surprising, however, that 10% to 25% of the people are not killed, even without blast shelter. With good blast shelter, even here in the "A" zone, casualties could be greatly reduced. Fire, flying and falling debris, and initial radiation dangers must also be considered.

In a good blast shelter halfway between ground zero and the "A" zone boundary, for instance, occupants would survive.

The total area of blast, over 1,000 square miles, in the "A" and "B" zones is enough to cover almost any metropolitan area. But it is not an expanse where death is certain. Even under conditions of no warning, a good many people would survive. Under conditions of warning but no blast shelters, a good many more people survive. With the development of blast shelters - a protected space built into facilities serving a day-to-day need, preferably below grade - chances of survival within the blast area would be greatly enhanced. An examination of this question produces a surprising amount of hope. The claim that over 85% of the United States population could be saved in a nuclear attack begins to make a great deal of sense. The city dweller, properly prepared, has a good chance of survival - better than that of the farmer a hundred miles away who ignores protection against fallout radiation.



The above diagrams indicate approximately how close to ground zero windowless fallout shelters could be expected to afford protection from the direct effects of 20 megaton air and ground weapons. They also indicate approximately how close to ground zero blast shelters of 10 psi and 50 psi ratings could be expected to afford protection.

ZONE OF DAMAGE	MAXIMUM WINDS (mph)	MAXIMUM OVERPRESSURE (psi)	EST. KILLED (without blast shelter)	EST. KILLED (with use of blast shelter)
"A"	1,000+	100+	75-90%	10-25%
"B"	190	7	30-50%	2-4%
"C"	86	2.5	5-15%	1-2%
"D"	52	1.5	1-2%	0-1%

Where do we start for shelter against blast?

We could certainly start with what we already have: over 7,000,000 heavy basement-type spaces in cities which could be converted into blast shelter with the addition of blast doors, ventilation modifications where required, life support systems, and other necessary equipment and supplies. Much of this is already being done to support the space as fallout shelter. The cost would be comparatively minor. It would raise this "on-hand" shelter to a rating of over 20 psi, some of it over 50 psi.

Subways and urban underground railroad approaches are other existing facilities which hold promise. Properly adapted - which in some cases might mean major modifications - these would shelter another 3,000,000 people. In Russia, subways are already equipped to serve as blast shelters. In London, World War II bombing saw the "underground" successfully utilized as shelter.

New construction requirements would result in a real blast shelter bonanza. With legislative emphasis, technical support and public orientation, a firm policy of designing blast shelters into the lower levels of commercial buildings could be readily implemented. This would include commercial buildings throughout populated areas. Millions of blast shelter spaces could be added each year in this manner.

The utility tunnel system is a modern technique already practiced in a number of locations. Many more are coming. These provide excellent possibilities for blast protection, as well as the prospect of uninterrupted use of utilities. In White Plains, New York an urban renewal plan includes 7,100 feet of utility tunnels which are designed for a psi rating of 60. In Chicago underground pedestrian passageways have proved so successful that an extensive passageway network is planned for the "loop" area. These are not being designed for shelter against blast, but they could be with simple alterations.

Four and a half billion dollars-worth of subways now exist in eleven American cities. Planning for underground transit systems has already begun in thirty-two other cities. The Office of High-Speed Ground Transportation in Washington is encouraging the development of 150 mph trains that will avoid interference with congested surface transportation between major cities. Dallas is planning an urban underground truck delivery system. Disneyland in Florida will construct a city of the future with all vehicular transportation below ground. The Civil Defense Research Project of the Oak Ridge National laboratory has undertaken extensive studies to investigate the feasibility of tunnel blast shelter for metropolitan areas.

The concept of protecting urban populations is not new. It has been in effect elsewhere for many years. In America we would be pioneers only in the addition of American ingenuity to such systems.

The potential for blast shelter in American cities is a promising one - if we want it to be. The 50,000,000 Americans we let our computers write off as part of the debris in a nuclear war- need not be lost. They can for the most part be 50,000,000 live Americans.

It will take determination. It will take planning. It will take action. It will take sacrifice. It will take money.
It will take faith.

(By *SURVIVE* Staff; previously published: May-June 1968)

FIRE AND NUCLEAR WEAPONS

Exaggerated versions of the danger of fire effects of nuclear weapons have gained favor. Here the disagreeable facts are examined and brought into realistic focus. Included in the authoritative research on fire effects of nuclear weapons upon which this analysis is based is that of Dr. Abraham Broido of the U. S. Forestry Service, to whom Survive owes special thanks.

Toward the end of World War II, in 1945, two atomic bombs were dropped on the Japanese cities of Hiroshima and Nagasaki. Although the initial phases of the two explosions were quite similar, there were distinct differences in the damage inflicted on each city. In both cases, the energy of roughly 20,000 tons of exploding TNT was suddenly released in a volume with dimensions of only a few feet. The effect was similar to that of suddenly moving a chunk of the sun from its position 93 million miles away to a point above the city. Immediately a great flood of light and heat radiation poured out. Every object was bathed in an intense glare as though the sun's light had been concentrated on it by an enormous magnifying glass. Wooden walls charred and sometimes burst into flames that quickly died. But dry leaves, paper, rotten wood, and other flammable material burst into flames that did not die. This intense light passed through glass windows, igniting curtains, paper, rugs, and furniture coverings. Light colored objects fared better than dark, wool better than cotton, cotton better than rayon, but near the bomb they all ignited. As the heat radiation streamed away from the bomb it spread over a wider area and, in this manner, was "thinned out." The air itself absorbed some of its energy so that less heat was available to ignite objects farther from the bomb. Finally, at a distance of about 2/3 of a mile to one mile, the radiant energy was so degraded that it could no longer ignite flammable materials easily.

In the meantime, the hot bomb material, unable to release its vast quantity of energy rapidly enough by radiating, was violently expanding, creating an outwardly progressing crest of air called a shock wave. As this wave passed over lightly constructed homes, the fast-moving winds following the shock front ripped them from their foundations, upset stoves, and broke gas and water pipes. More strongly constructed buildings withstood this blast, but their windows and furniture became flying projectiles that still caused major damage. The upset stoves added to ignited material already present, broken gas pipes supplied fuel, and broken water pipes hampered the firefighting that would take place later. The blast wave weakened as it departed farther from the center of the explosion so that, at distances a little less than one mile, it was no longer able to add to the fire damage.

After the radiation and blast wave had passed, the flames began to spread from their points of ignition. In some cases, however, they ran out of fuel and died. In other cases, they found paper, wood, leaves, or cloth nearby. In some of these latter cases they spread until they joined, and soon whole blocks were aflame.

Here the stories of Hiroshima and Nagasaki begin to differ. The landscape of Nagasaki is chopped up with small hills, often bare on top. These hills provided some shielding from the heat radiation. Fires burned through the valleys but often stopped at the hills. A little over one square mile of the city burned in Nagasaki.

In Hiroshima, however, the terrain is flat. The fire found plenty of combustible material and coalesced until several adjacent blocks were on fire. The heated air now sought to rise as it does up a chimney. The hot air on the outer edge of this great fire mass was quickly replaced by fresh air drawn in from the outside. As the fires increased in intensity, the winds swept inward. About 20 minutes after the explosion, the "fire storm" was fully developed. After a period of 2 to 3 hours, winds reached a maximum velocity of 30 to 40 miles per hour, finally decreasing to light or moderate and becoming variable in direction after six hours. An area of 4.4 square miles was burned out by this fire storm in Hiroshima. Fortunately, the inward direction of the winds helped to prevent the spread of the fire to a larger area.

Fire storms of this nature were not new with the atomic bomb. They had occurred in large forest fires and in previous incendiary raids on German cities and on Tokyo. The Hiroshima storm was not even the biggest. A fire raid on Tokyo on March 9, 1945, for example, resulted in the destruction of 16 square miles compared to the 4.4 in Hiroshima. The dead and injured amounted to more than 80,000 and 100,000 respectively in the Tokyo raid compared to 70,000 and 70,000 respectively from all causes in the Hiroshima raid. The fire storms following incendiary raids on German cities also exceeded the size of that at Hiroshima. There was evidence of wind velocities up to 75 miles per hour on the edge of the fire storm in Leipzig.

Hiroshima Gas Company and the Atomic Bomb Dome

All persons caught in a fire storm will not be lost. It is true that persons trapped in the open have little chance to survive, but a little shelter can make a great deal of difference. An example of what shelter can do is found in the fact that 43% of the people in the Nippon building in Hiroshima survived even though the building was located only 1/5 of a mile from the exploding center, and the fire storm extended out to a distance of over one mile from this center. This is a case illustrating how a large public building can serve as an effective shelter even though no special effort has been made to design it for that purpose. Even clearer evidence is found in the official records showing that more than 85% of the 280,000 people in the fire storm area of Hamburg, Germany survived. Practically all of the more than 50,000 that sought shelter in bunkers, covered trenches and other non-basement shelters were saved. In addition, there are scores of cases of survival of experienced forest fire fighters who found shelter in tunnels, caves, or even under well-soaked blankets.

Although fears have been expressed that people would die from such things as the creation of a vacuum or the lack of oxygen, the evidence indicates clearly that no such danger occurs. There is, however, a real possibility of carbon monoxide poisoning. Since most of the burning in a given location is over in an hour or two in large mass fires, it would be wise to plan to close off the air supply of a shelter for approximately two hours. The principle danger from this step is the rise in temperature inside the shelter due to the body heat of occupants. If air is brought in by a vent, precautions should be taken in shelter construction to place the vent so that it will not be likely to be near smoldering rubble, since this rubble will generate carbon monoxide.

It is, of course, obvious that heat is of primary concern. It is interesting to note that an underground shelter with three feet of earth overhead will receive a negligible amount of heat during an hour or two of active burning overhead. As we have seen above, large buildings may also provide shelter from the fire's heat. Thus, protection provided against fallout is also effective against fires if precautions against carbon monoxide are taken.

A recent OCD report dated July 1968, Fire Aspects of Civil Defense, (TR-25) outlines steps to be taken beforehand to reduce the danger of fire in a nuclear attack. These steps include reducing the amount of ignitable material such as paper, rotten wood, cloth (particularly rayon and cotton), and dried leaves exposed to thermal radiation from the bomb. Yards should be kept clear of such material and windows can be coated to reduce radiation reaching building interiors. Tests conducted with actual nuclear explosions by the Atomic Energy Commission show the marked resistance of well-painted (preferably light colored) wood surfaces compared to rough, uncared-for surfaces. Electricity and gas should be shut off prior to an attack. Garden hoses should be connected and ready for use and sand and blankets provided for immediate smothering of fires. It is clear that quick action of a "first aid" type by many people is needed to prevent small fires from coalescing into large ones. Regular city firefighting equipment may not be able to move about because of streets littered and blocked by the blast wave.

The mass fires created in World War II were much

An overview of Hiroshima in autumn of 1945. The hypocenter and Atom Bomb Dome are visible at left center.

smaller in area than those that can be expected from large H-bombs in the megaton range. These larger weapons would emit much larger quantities of thermal radiation over greater distances. Although the mass fires would extend over larger areas, they cannot be expected to be qualitatively different than those we have discussed above. For example, the inward moving winds of a fire storm turn upward at the edge of the fire and extend only about one half a mile into the burning area. Inside of this limit, the air motion is typified by turbulent up and down drafts. According to Broide, a larger fire storm would have these same properties and should not generate winds of appreciably higher velocities than those already experienced.

Weather and smoke conditions can have considerable influence on the effectiveness of a nuclear bomb in starting fires. A cloud layer above the explosion can reflect the radiation downward and increase its intensity on the ground. On the other hand, a cloud layer beneath the bomb will shield the ground. The size of the bomb, its height above the ground, and air transparency all affect the size of the area within which such materials as newspapers can be ignited. This is shown in Table 1 [not shown] reprinted from OCD's TR-25 mentioned previously. A comparison is also made with the distance at which the blast wave falls to a strength where it does heavy damage to buildings (3 psi) and to light damage (1 psi).

If nuclear weapons are again employed in warfare, it will be necessary to combat fires as well as the other destructive effects. There is ample evidence to show that with planning and pre-attack precautions a large percentage of the people caught in a fire area surrounding an area of blast destruction can survive. Fire control continues to be an important aspect of civil defense, and the citizens of any nation determined to persevere must be prepared to fight fires effectively if attack comes.

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