

SELF-CONTAINED UNDERGROUND SHELTERS FOR PRE-POSITIONED DEPLOYMENT FOR DEFENSE AGAINST NBC WARFARE

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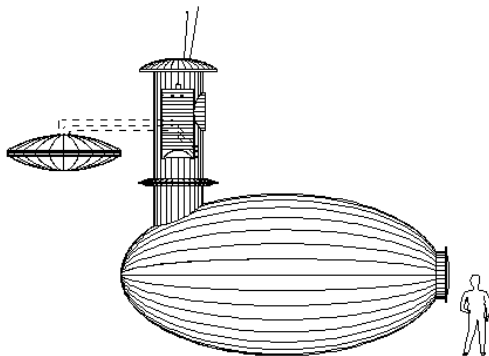
ABSTRACT

Paraboloid fiberglass self-contained underground shelters can be pre-positioned in the field to allow personnel to operate in an NBC environment. These self-contained egg-shaped shelters are almost fully assembled and equipped with a life support system including an NBC detection system, air filtration systems, light, toilet, water tank, septic system, decontamination shower, food storage, and communications systems. Unlike conventional structures, this product is stealth, corrosion free, maintenance free, and provides radiation shielding and thermal protection. Four models are available including a model for JIT (Just In Time) situations.

INTRODUCTION – CONVENTIONAL RESPONSE TO TERRORISM

To date, virtually all efforts at dealing with land-based terrorism have been based on a conventional post-response. The conventional network of physical structures, communications, and personnel protection are based on very vulnerable conventional methods. Gas masks are useful after the fact and can only be used for a few short hours. The conventional network of local and federal government along with military network are all based on a “conventionally based response” using wooden and concrete buildings, gas masks, chemical suits, local police, local search and rescue, local national guard, and conventional communications network. All are vulnerable to weapons effects; especially radiation, weather, intruder assaults, possibly from riots, and all are dependent on the local electrical power grid. *While the US Government and businesses in general attempt to provide some small protection to large populations, the Radius Engineering products are aimed at providing complete protection to the few key people to continue good management of various key teams.*

SELF-CONTAINED UNDERGROUND SHELTERS



Protection from NBC warfare can be provided by using unique lightweight self-contained fiberglass paraboloid underground shelters to allow personnel to operate during natural disasters and NBC environments without the use of cumbersome gas masks and suits. These self-contained egg-shaped shelters are fully assembled and equipped with a life support system including an NBC detection system, air filtration systems, light, toilet, water tank, septic system, decontamination shower, food storage, and communications systems. The shelters are designed by Walton McCarthy, author of PRINCIPLES OF PROTECTION, The US Handbook of NBC Weapon Fundamentals and Underground Shelter Engineering

Standards, Fifth Edition 2002. Four shelter models are available from Radius Engineering (bombshelters.com) with a 24 year history in underground shelters. One of the main advantages of these

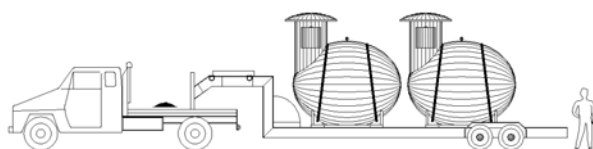
unique shelters (U.S. Patent 4,660,334, 5,115,613, 6,296,693 B1, 6,438,907, others pending) is that they can be installed in one day below the water table without concrete and can also be “dug up” and redeployed at another location. Fiberglass forms a watertight structure and the egg shape provides unprecedented strength. The shelter has no radar signature, little to no thermal signature, no metallic signature, and does not collect EMP. The hatch dome at ground level is able to resist a 2000° F fire, up to 350 mph flying debris, and meets Class IV bullet resistance under the National Institute of Justice standards. These products can be used in NBC environments for Border Patrol, Business Continuance Planning, and Emergency Treatment Centers.

Pre-positioned Underground Shelter Deployment Response To Terrorism

By using fiberglass self-contained underground shelters, the problems associated with conventionally based responses to terrorism are eliminated. The P10 and P6 underground shelter can be pre-positioned near potential terrorist’s targets and/or near tornado, hurricane, and earthquake prone areas. The P10 and P6 Underground Shelters are superior to any other shelter in the world due to the following:

1. The shelter is a structural fiberglass paraboloid resulting in extreme strength and extremely good resiliency and corrosion resistance.
2. The shelter is completely self-contained and able to operate from 30 to 200+ days, without outside electrical power.
3. The life span of structural fiberglass underground is over 150 years and maintains an almost constant pressure resistance level with virtually no maintenance.
4. The shelter is operational in all weather and in severe NBC environments.
5. The shelter is able to be installed below water table in secret locations in less than 48 hours.
6. The shelter is stealth, does not collect EMP, and provides ample radiation shielding.
7. The shelter is designed to be de-excavated and trucked to another site.
8. The shelter hatch dome at ground level has a very small visual signature and is able to resist intruder assaults.
9. The shelter has self-contained communications systems which is operational with and without satellites and does not require outside electrical power.
10. Unlike above ground shelters, the Radius shelters are below ground and therefore have small internal temperature swings and strong radiation shielding due to the mass of the earth surrounding the shelter.

These advantages allow shelterists to survive in good physical and mental condition so they are able to assist other people, coordinate first responders and rescue operations, and maintain a place of operation during and after an a disaster.



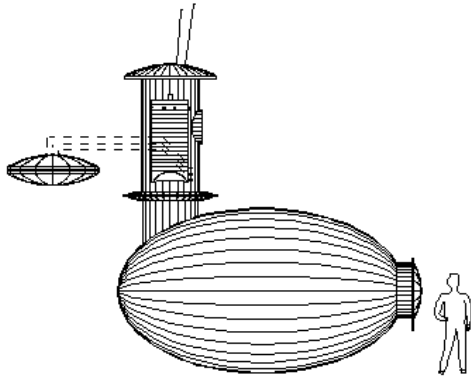
SP6

SELF-CONTAINED UNDERGROUND SHELTERS AND BORDER PATROL

For border patrol, multiple underground shelters can be placed approximately ½ mile apart so they are within visual distance of each other and a periscope built into the hatch cover can be used to

visually check border lines between shelters. This border patrol system works in all weather and has a full life support system for 6-10 people without outside electricity for 30 days. With a S.C.U.P.P. 125 the shelter has an operational duration of approximately 8 months. The smaller SP6 shelter can be used for JIT (Just In Time) applications where the shelter can be taken to a site and delivered and installed in a single day for those situations where an imminent threat is determined at the last minute.

SELF-CONTAINED UNDERGROUND SHELTERS AND BUSINESS CONTINUANCE PLANNING



P6

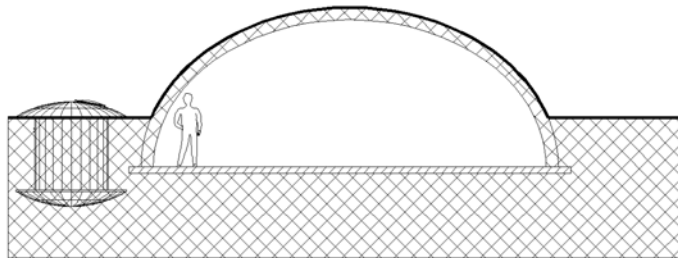
Underground shelters can be used as RTB's (Remote Tactical Bases) to continue normal business operations during times of disaster for businesses and municipalities. In the event that key facilities in various cities such as town offices, police stations, or government centers are damaged, contaminated, or at risk from riots, underground shelters allow a safe place to operate all normal business functions in an NBC environment. The location of the shelter can be kept secret. Perhaps one P10, P6, or SP6 shelter per 50,000 population could be installed at the home of a key employee. An emergency plan can be developed to allow operations from these underground shelters. Normal equipment in the

shelter would include a HAM radio and other radios to allow all community efforts to be coordinated through normal business radio channels and emergency radio channels. Backup data and hard paper copies of important data can be stored safely in the shelter.

SELF-CONTAINED UNDERGROUND SHELTERS AND EMERGENCY TREATMENT CENTERS- (ETC's)

Conventional Hospitals and NBC Casualties

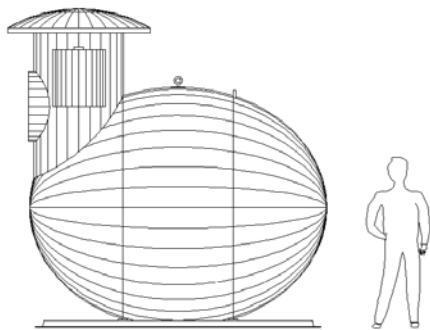
During NBC attacks, hospitals are extremely poorly equipped to deal with multiple NBC casualties. In an actual NBC disaster, hospitals will be overwhelmed with real and imaginary injuries. In this event, the hospital administrator could redirect all injured people to a certain physical address. It is expected that the hospital administrator would probably be forced to notify the public through radio, television, and newspapers, not to come to the hospital. In virtually all NBC scenarios, victims coming to the hospital is the *wrong action*. To have mass populations who may or may not be contaminated with biological or chemical agents converge on a hospital may expose non-contaminated people, including hospital personnel, to contaminated people and spread the contamination. While radiation sickness is not contagious, biological and chemical agents are contagious by air borne agents and by physical contact.



SCUUP 400 –EARTHCOM 32v

A more efficient and dependable way to deal with this problem is to install an underground Emergency Treatment Center or ETC. A protected and self-contained ETC can be developed using an earth bermed fiberglass arch called the Earthcom 32 with a Self-Contained Underground Power Plant (SCUUP). This 32 foot span fiberglass

structure could be installed at or near the local fire station or paramedic station and form a centralized location for medical help in emergency situations. The Earthcom 32 would act as an isolated underground hospital staffed by local physicians and medical personnel who may also individually own an SP6, P6 or P10 underground shelter. The ETC could be stocked with all the necessary medical supplies and equipment. Since the structure is partially below ground and earth bermed, the unoccupied temperature would be much more stable than conventional above ground structures and would be extremely resistant to flying debris from a tornado or hurricane or ground shock from an earthquake and provides a certain level of radiation shielding. This type of structure forms a complete vapor barrier and allows antibiotics and other medical supplies to be stored for approximately 5 years and has a lifespan of well over 150 years. The earth over the Earthcom 32 forms a radiation shield even when directly downwind of modern nuclear weapons. During peace time, the ETC can serve as a meeting area for firemen, search and rescue or any other community activity. This *dual use* makes the Earthcom 32 ETC effective and affordable. People can be treated in numerous ETC's as opposed to one large central hospital which is subject to



SP6

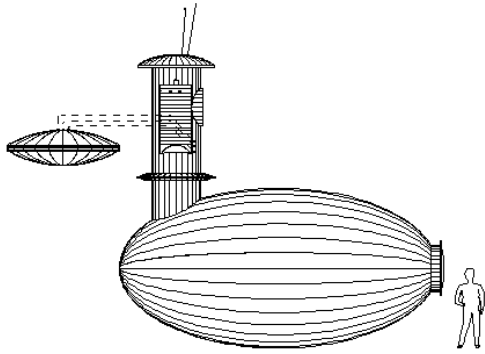
more attacks and greater complications. A “physician’s network” of ETC’s can be organized through the hospital administration. This will result in some ETCs being inside the target area and some outside the target area. In order to assure that qualified medical personnel can reach the ETC, medical personnel may have to install their own personal SP6, P6, or P10 underground shelter. The physician could pay for the shelter personally which can be recorded as medical equipment and/or security equipment for the IRS. Perhaps the hospital could pay for the delivery and installation of the shelter. In the case of the SP6 Disaster Shelter, this shelter could be paid for by my individual medical personnel and perhaps the hospital or community could pay for the upgrade to make the shelter able to

operate in a nuclear-biological-chemical disaster. All the shelters are able to operate for 14-180 days without electrical power which is a requirement since electrical power and telephones will probably not be operational.

When victims contact the hospital in person, they can be sent to an ETC and triaged. The hospital can stay in direct contact with ETCs using their standard FM radio frequencies or HAM radios which do not depend on line of sight transmission, satellites, or relay stations. The HAM radios in the shelters are “All Band-All Mode” so they are able to send and receive on all frequencies including police, fire, search and rescue, aircraft etc., except cell phone frequencies. Although HAM radios require licensing, their primary use is for emergencies in which case a license is not required. All of the Radius shelters allow air analysis for chemical agents without leaving the shelter. This information can be relayed back to the hospital or state agencies by radio on various frequencies to establish safe or danger zones.

Radio communications are critical. The communication system that the hospital has with the ETCs should be coordinated with local police, fire, and search and rescue. This will take a cooperative effort with these agencies which will also require prioritizing injuries. Who gets treated first based on what criteria, will depend on what is best overall for the general population. Medical personnel manning these ETC’s must first protect themselves so their skills are available to deal with casualties. Who gets treated after medical personnel must be decided in advance with an ETC Advisory Board consisting of representatives from these agencies and other state agencies. Once this system is in place a “mock disaster” should be practiced over a two day period.

THE P10 DISASTER SHELTER



The P10 is a totally self-contained 40-150 psi ribbed paraboloid (egg shape) underground disaster shelter designed to protect 10 adults for long periods or 20 people for short durations such as during tornadoes. The product was specifically designed and developed to protect people during and after disasters such as tornadoes, hurricanes, earthquakes, storms, forest fires, power failures, nuclear power plant accidents, nuclear/chemical terrorism, and full-scale protracted nuclear, chemical and biological war. A tremendous effort has been made to think of every conceivable incident that shelterists could face in the P10

shelter. Many geometrical shapes were experimented with before finalizing the P10. The P10 includes the fiberglass paraboloid structure, fiberglass entranceway, fiberglass/composite hatch, HEPA filter, 90 gallon fiberglass septic tank, 500 gallon fiberglass water tank, fiberglass center floor beam, fiberglass counter, fiberglass shower wall, fiberglass battery housing, aluminum carbon filter housing, toilet, floor, fourteen 12- volt deep cycle batteries, air blower, gray water tank, all wiring, all plumbing, etc.

ENTRANCEWAY

The geometry of the P10 allows the much-preferred offset entranceway. This has the same radiation geometry shielding as a 90-degree entranceway plus it provides the most efficient escape for moisture and heat. The entranceway also contains an Emergency Escape Manway (EEM) which allows a fiberglass manway cover to be removed from inside the entranceway so shelterists can dig their way 3 feet to the surface if debris falls on top of the hatch. If the shelter is located in ground subject to frost, the area around this EEM should be backfilled with crushed stone.

SHELTER CONSTRUCTION

The paraboloid shelter and entranceway are made of structural fiberglass manufactured to underground storage tank standards of Underwriters Laboratory, American Society of Testing and Materials, and shelter engineering standards of PRINCIPLES of PROTECTION. Fiberglass was chosen as the optimum material because of its extremely high resiliency and corrosion resistance plus its ability to be shaped into a compound curved structure. The 40 psi (pounds per square inch) external pressure resistance, with no earth arching, is constant over 100 years and does not have to be de-rated like steel each passing year due to corrosion. Fiberglass also forms a complete vapor barrier which provides a dry atmosphere when placed below ground, and it has proven to be sound in the underground storage tank industries. In addition, one of the greatest characteristics of fiberglass is its ability to “remain intact” if overstressed. The inside of the shelter is smooth, curved, and white to create maximum brightness with minimal light. All of these facilities function without outside electricity through the use of 12-volt, deep-cycle batteries. The inside surface is easily cleaned with common detergents and is easily repaired.

LEACHING SEPTIC TANK

Opposite the HEPA filter housing on the entranceway is the 90-gallon fiberglass leaching septic tank designed into the entranceway. The septic tank has a duration of 3-6 months depending on the

number of shelterists and diet. It is easily pumped out with an optional manual septic pump from the ground surface by removing the septic tank access cover.

SHELTER FACILITIES

The P10 contains 1337 cubic feet (10,000 gal) with headroom from 6'-8" to 8'-8". This allows for normal living and a very spacious feeling. There is ample light for reading anywhere in the shelter supplied by a 15-watt fluorescent light located on the ceiling of the shower housing. Fresh filtered air is brought into the shelter by a 12-volt 40,000-hour air blower designed to operate 24 hours per day for approximately 30 days and supplies many times the breathing volume of air required by adults. This system has the advantage of maintaining constant shelter temperature, constant shelter oxygen levels, constant shelter carbon dioxide levels, and constant shelter moisture levels, plus it prevents overheating which is common with manual air blowers in warm climates. Exhausting of hot, moist, spent air is facilitated through the entranceway which is located on the end of the shelter but very close to the highest point of the ceiling. The hot, moist, spent air rises up through the entranceway to the vent at the top of the entranceway where it exits the shelter through the hatch dome at ground level. This is the most efficient geometry for exhausting spent air, especially when resisting intruder assaults is a critical part of the hatch design. Fourteen 12-volt deep-cycle sealed batteries are stored in a fiberglass battery box under the floor. The normal loss of battery power is approximately 1.5% per month. A photovoltaic panel (solar panel) can be used to maintain the batteries if desired. A 50-foot battery charging cable can also be connected from the batteries in the shelter to the battery in a car to allow the car alternator to charge the batteries.

AIR FILTRATION

The air is purified through a three-stage filtration system. The first filter is the HEPA filter inside the aluminum HEPA housing located high inside the entranceway away from the shelterists where filter radiation emissions are shielded by earth-mass and entranceway geometry. This filter intakes air from the circular air plenum inside the hatch dome at ground level and physically removes dust and airborne contaminants including radioactive fallout and biological warfare agents. The HEPA filter system is specifically designed to operate in severe weapon effects. To change the HEPA filter requires the HEPA filter housing (40 lbs.) to be disconnected and brought to the shelter floor. The HEPA filter flat sheet material is rolled up and placed in a plastic bag and thrown out of the shelter hatch. The HEPA filter housing will accept any flat material such as a blanket, sheet, etc. in the event that actual filter material is not available. The second and third stage of air filtration takes place in the carbon filter housing located under the upper deck. In this carbon filter housing, two layers of carbon are used. Activated carbon is used to remove radioactive iodine gas and Whetlerite carbon is used to remove chemical agents. The air blower is mounted on the carbon filter housing cover and draws the air through the carbon layers. The P10 Owner's Manual details specific safe procedures for replacing contaminated HEPA filters. Both air inlet and air outlet have shut-off valves and aluminum screens accessible from inside the shelter.

STORAGE

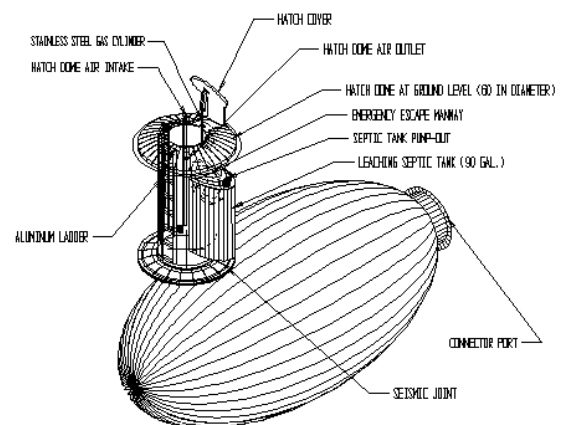
There are 137 cubic feet of storage (1000 gal.) under the floor. In addition there are 300 cubic feet of storage (2244 gal.) that allow forty-four – 5-gallon food tanks to fit under the upper deck. A 30-gallon aluminum alcohol tank is built into the aluminum counter. The 5 gallon food tanks are used to store grain, powdered milk, salt, sugar, beans, TVP, honey, etc. and hold approximately 2000 lbs. of food, forming a 1 year food supply for five people. The food supply can be extended with the purchase of more food tanks. The material and thickness of these food tanks allows the much preferred carbon dioxide packing

of food as opposed to the nitrogen packing of food. The 30-gallon aluminum methanol tank was sized to boil all the water in the 500-gallon water tank plus all the food in 44 of the 5-gallon food tanks. Storage is more easily managed with the optional *Utility Rope Line* which runs around the perimeter of the shelter at head height. This rope is connected to the shelter with stainless steel eyebolts through which a ½ inch diameter climbing rope is run. Net bags and hammocks can be hung on this line.

HATCH DOME

The S.T.A.R.D. (Stealth Terrestrial Attack Resistant Design) 60-inch diameter hatch dome at ground level is aerodynamically smooth. The 24-inch diameter manhole allows very large people with a 75-inch waist to enter the shelter quickly. The hatch dome contains the recessed hatch cover and is designed for severe impact of high speed flying debris. The angle of incidence of the hatch dome is only 20 degrees to allow flying debris to glance off. The hatch dome and hatch cover are designed to resist a non-shattering 3-inch diameter hail ball falling straight down at terminal velocity (87 mph) and impacting directly at a full 90-degree angle of incidence. The hatch dome is also designed to resist a non-shattering 3-inch diameter hail ball traveling horizontally at 150 mph. In addition, the hatch dome can resist a solid 2 x 4 wooden stud impacting the hatch dome like a battering ram or javelin at 30 to 350 mph depending on the hatch class. Some debris, depending on the size, shape, angle of incidence, and mass, may cosmetically damage the hatch dome. This can be easily repaired with fiberglass repair kits available at marine and automotive supply stores.

The hatch dome is made of a material called “*Combat Composite*” which is a structural fire-and bullet-resistant laminate developed by Radius Engineering Inc. The hatch dome is also designed to protect the shelter from a fire reaching 1700°F for one hour while maintaining its structural integrity in compliance to ASTM E119. This design and material makes the P10 very stealthy. It produces little or no thermal signature, little or no metallic signature, and little or no radar signature. When the shelter is installed, all that can be seen is the dark army-green hatch dome at ground level. This makes it almost impossible to be detected by modern target acquisition equipment. It is designed to resist 350-mph winds and more than 8.5 on the Richter scale. Although the hatch dome is not impenetrable, it is specifically designed to resist seven basic assaults from people trying to break into the shelter in compliance to P.O.P.



The hatch dome and hatch cover are manufactured according to The National Institute of Justice NIJ standards from Class 0 (standard on P10) up to Class IV to resist penetration by various threats. The material and thickness vary as the threat level increases. The classes listed below are based on resisting 90% of all of the bullet types at various velocities listed known as (V-90). The barrel length, feet per second (fps) or meters per second (mps) for the test are noted.

NIJ THREAT LEVEL	HATCH MATERIAL (V-90)	THREAT/BULLET TYPE	BARREL LENGTH (INCHES)	FPS	MPS
CLASS 0	Structural Fiberglass-self-extinguishing (standard)	Light Hammer and hatchet assaults, 3 in. dia. Hail @ 87-mph vertical, 150-mph horizontal 2 x 4 stud @ 30-mph	NA	NA	NA
CLASS I	Combat Composite self-extinguishing	.22 Cal. 40 Gr. LR .25 Cal Auto 71 Gr. FMJ .32 Cal. Auto 71 Gr. FMJ .380 Cal. Auto 88 Gr. JHP .38 Cal Special Lead 158 Gr. RN .38 Cal Special 158 Gr. SWC 2 x 4 stud @ 70-mph	6 2 4 4 6 6 --	1050 810 905 990 850 850	320 247 276 302 259 259
CLASS II	Combat Composite self-extinguishing	.41 Mag. 210 Gr. JSP .44 Mag. 240 Gr. JSP .44 Mag. 240 Gr. Lead SWC .357 Mag. 125 Gr. JHP .357 Mag. 110 Gr. JHP .357 Mag. 158 Gr. JSP .357 Mag. 158 Gr. Hornady 19mm 175 Gr. Silvertip 9mm 124 Gr. FMJ 9mm 115 Gr. Silvertip 2 x4 stud @ 100-mph	4 4 4 4 4 6 6 5 5 5 --	1300 1180 1200 1450 1550 1395 1445 1225 1175 1170	397 360 366 442 473 425 441 372 358 355
CLASS III	Combat Composite self-extinguishing	7.62 NATO Ball 150 Gr. M-80 steel Jack 7.62 NATO Ball 150 Gr. m-80 FMJ 30.06 PSP 180 Gr. .30 Carbine 110 Gr. FMJ 12-Gauge Rifled Slug .223 (5.56mm) 55 Gr. FMC 7.62 x 39 Ball 2 x4 stud @ 200-mph	28 28 24 18 18 20 22 22 22 --	2750 2750 2750 1950 1550 3075 2400	838 838 824 595 473 938 732
CLASS IV	Combat Composite self-extinguishing	30.06 A.P. M-2 7.62 mm NATO A.P. 308 Win SS 109 FN NATO .223 (5.56mm) 7.62 x 39 Russian/Chinese A.P.I. 2 x4 stud @ 350-mph	26 24 20 22 --	2850 2750 3090 2550	868 838 942 778

HATCH COVER

The hatch cover opens automatically when unlocked. The hatch will remain open even in 80 to 100 mph winds. The mechanical advantage is made possible by a gas charged stainless steel cylinder connected to a stainless steel arm on the underside of the hatch cover. The hatch cover is secured (dogged) from the inside the shelter by a stainless steel rope hoist pulley system with an 8 to 1 mechanical advantage. When inside the shelter, the hatch cover is dogged by standing on the shelter floor and pulling the ½ inch diameter rope downward with 50-100 lbs of force. The rope clutch or brake will automatically brake the rope. The maximum total uplifting force on the hatch cover during a tornado or nuclear blast is a negative 5-psi. This will place a total uplifting force of 3087 lbs on the hatch cover. To open the hatch, it is necessary to release the brake on the pulley. This is accomplished by climbing up the ladder and

pulling on the rope and lifting the rope out of the rope clutch. The rope hoist can be secondarily secured by tying off to the eye bolt on the utility line.

SHELTER DEFENSE

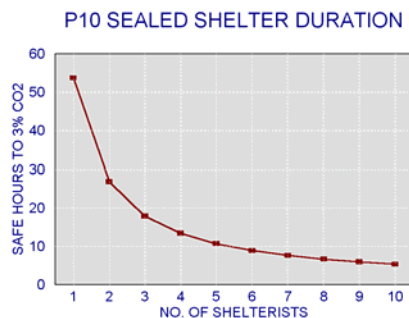
The P10 is not impenetrable but is difficult to break into while shelterists are inside.

INTRUDER ASSAULT	P10 RESISTANCE
1. Intruder trying to break into hatch using sledgehammer, hatchets, and guns.	Class 0 Hatch resists light hammer and hatchet assaults Class I -IV Hatch resists all assaults
2. Intruder trying to clog the air intake/outlet to suffocate the shelterists thus forcing them outside.	Shelterists can open up hatch and reach over to unclog air intake or wait in safety in the shelter for many hours in sealed shelter atmosphere while the intruder is exposed to the outside danger.
3. Intruder trying to suffocate shelterists by creating fire on top of the hatch thus forcing the shelterists outside.	All classes of the hatch are resistant to fire and the shelterists can breath normally inside the shelter based on sealed shelter atmosphere.
4. An intruder trying to run over the shelter or hatch with an automobile or truck.	If this vehicle becomes a threat, the Emergency Escape Manway can be used.
5. An intruder trying to drown shelterists by forcing water into the air inlet/out.	The air inlet on the hatch dome are baffled to prevent this type of assault.
6. An intruder trying to attach rope onto the hatch or air manifolds to damage or pull out of ground.	The hatch dome is a smooth design with no projections to easily attach to.
7. An intruder using a cutting torch to cut the hatch open.	The hatch is impervious to a cutting torch.
All attacks above	Release of tear gas through hatch. Details are available only to actual customers.

Storing survival supplies in a house may be a false sense of security during wartime or major natural disasters. Under the 1978 War Powers Act, the President of the U.S. can order local government officials to use limited force to commandeer necessary supplies such as generators, fuel, food, supplies, etc., from houses recorded on tax records. Even if the location of the shelter were known, it would require much more than limited force to defeat the P10.

SEISMIC JOINT

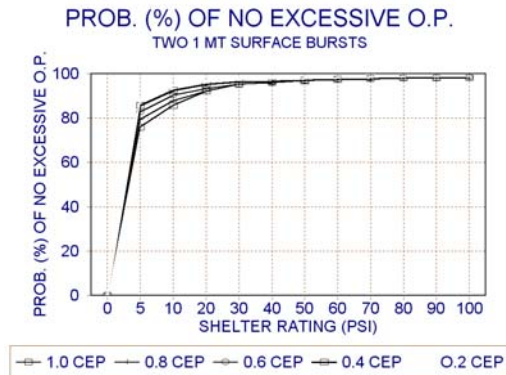
This seismic joint allows the entranceway free and independent movement from the main shelter. The entranceway is located within the frost line, while the shelter is well below the frost line. This creates tremendous stresses during winter months when the entranceway is forced up 0.5 - 1.25 inches due to frozen ground. The seismic joint removes these stresses by allowing vertical movement of the entranceway and also allows the top of the entranceway to move laterally to maintain structural integrity during rolling ground motion from severe ground shock.



SEALED SHELTER ATMOSPHERE

When ground fires are present around the hatch, the air blower should not be turned on to bring in fresh air. During this time, the shelterists must breathe in a *sealed shelter atmosphere*. The safe duration time is based on a 3% carbon dioxide limit. The time it takes for the shelter atmosphere to reach this limit is a

function of the number of shelterists, degree of physical activity of the shelterists, and the volume of the shelter above the floor. This duration is shown below for adults performing mild work.



OVERPRESSURE SURVIVAL PROBABILITY

The shelter has a given probability of not receiving overpressure above that which it was designed for. This is known as the probability of no excessive overpressure and is dependent on the Circular Error Probable (CEP) of the incoming warhead. The P10 shelter is designed to withstand 40 psi of overpressure without “earth arching” from the surrounding earth resulting in a 96% chance that it will NOT receive overpressure above 40 psi when located within a 7.1 mile radius of two 1 MT air bursts. The support from the surrounding earth will greatly increase this ability to

withstand overpressure to as high as 150 psi depending on the type of soil, moisture content, temperature of soil, etc.

PLUMBING SYSTEM

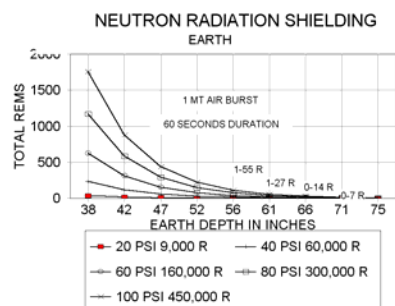
Sink – The fiberglass counter contains a stainless steel sink. A hand pump at the head of the sink brings water from the external water tank into the sink where dishes and clothes are washed. The sink drains into a 3-gallon gray water tank.

Toilet – The flush-up toilet is powered by a manual hand pump and uses water from the gray water tank. The sewage is pumped up to the leaching septic tank through an internal hose.

Shower – A shower tank is filled at the sink and hung on the bathroom wall to be used for showering. The fiberglass bathroom floor allows all water to drain into a gray water tank.

Fittings – The shelter entranceway contains three ¾ inch NPTF pipe thread outlets five feet below ground level, for connection to the water tank and seven ¾ inch NPTF threaded outlets one foot below ground level for bringing in antenna lines, a phone line, a power supply, and a 12-volt power cable from a solar panel to recharge the batteries. With the optional communications package there are two additional 1-inch diameter NPTF fittings located in the hatch dome so CB and Scanner antennas can be installed from inside the shelter. Plugs are provided to be in place when antennas are not being used.

Gas Agent Tester Housing (GATH) – This aluminum unit is installed on the outside of the shower wall on the incoming airline. It allows visual confirmation of chemical warfare agents without exiting the shelter. The GATH is also designed to collect and drain condensation from the HEPA filter housing.



RADIATION SHIELDING

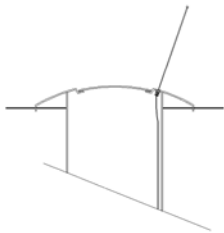
Radiation shielding from overhead in the P10 is provided by 8 feet of earth at the crown of the shelter ceiling. With a TRS (Total Rems in Shelter at the bed area) of 1 rem at 20 psi, a person would receive a maximum acute radiation dose from overhead and through the entranceway for neutron and gamma radiation equivalent to 1

mammography x-rays. This dose is based on a 500 KT air burst nuclear weapon, which produces a higher neutron radiation dose than the larger MT weapons, plus fallout doses from a 1 MT surface burst nuclear weapon to maximize the fallout gamma radiation dose.

Based on the worst cancer cases (leukemia) from the Hiroshima and Nagasaki victims, a 10-rem dose may increase the cancer rates from the current rate of 352/100,000 up to 355/100,000. It should be kept in mind that the Hiroshima victims were totally unprepared and uneducated. They were malnourished and already suffering from many diseases during a critical wartime period where food, medical supplies, and other necessities were in short supply. In addition, they were not only exposed to heavy, acute external radiation doses but also internal radiation doses from eating contaminated food and inhaling radioactive fallout. Educated shelterists can avoid such damaging effects and can determine the radiation levels with a simple radiation survey meter.

NBC PACKAGE

The P10 can provide life support in severe nuclear, biological and chemical warfare environments with the optional NBC Package. This package contains activated carbon (to remove radioactive iodine gas), Whetlerite carbon (to remove chemical warfare agents), which is manually loaded into the Carbon Filter Housing. A chemical warfare detection kit and a radiation survey meter are part of this package.



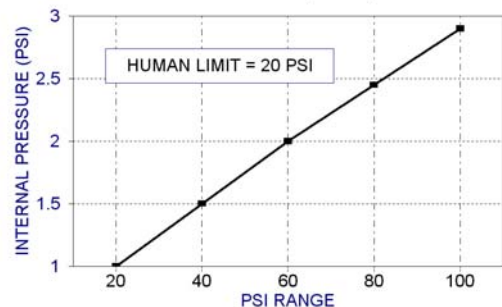
ANTENNA FITTINGS

On the inside of the hatch dome are two 1 inch NPT fitting through which the CB and scanner antenna are installed from inside the shelter. When the antennas are not installed, the brass plugs should be screwed in.

OVERPRESSURE CHOKING

The P10 does not use blast valves. Instead, it uses the “overpressure choking” which has no moving parts. The inlet air valve and outlet air valve are sized to prevent excessive pressure from developing inside the shelter. This is a combination of what is known as the Ideal Gas Law combined with Bernoulli's Law. These two theories combined state that two volumes of air (outside air volume and shelter air volume) with differing pressure will reach equilibrium or "equilibrate" over a period of time. This period of time depends on the level of overpressure, volume of the shelter, diameter and length of the air inlet and outlet pipe, resistance of air filter, and duration of the overpressure which is very short and constantly decreasing. Simply stated; the air inlet and outlet are sized so that there is not enough time for the two volumes of air to equilibrate. The outside pressure at maximum duration is simply not able to equilibrate through a 3-inch diameter air inlet and outlet within the overpressure duration.

P10 OVERPRESSURE CHOKING
2 - 3 IN DIA. INLETS (1MT AB)



LIGHTING

The shelter is equipped with a 15-watt fluorescent bulb (10,000 hour life) making it bright enough for shelterists to read anywhere in the shelter. Optional 150-hour candles can be used as a back-up. The air supply is based on 10 people in the shelter and one candle operating 24 hours/day.

OTHER RADIUS PRODUCTS FOR PRE-POSITIONED DEPLOYMENT

The P6 Underground Shelter

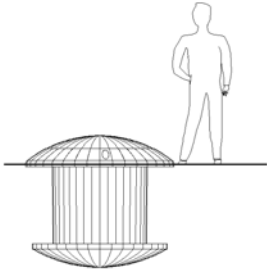
The P6 shelter is a smaller paraboloid shelter than the P10. It has the same shelter system for air filtration and mechanical systems, and provides almost the same level of blast and radiation protection.

The VP6 Underground Shelter

The VP6 is a vertical paraboloid underground shelter. It has a similar air filtration system as the P6 and P10 but is not a true *blast shelter*. It has much less storage space and a shorter shelter duration. It is delivered completely assembled and requires a 14 foot deep hole.

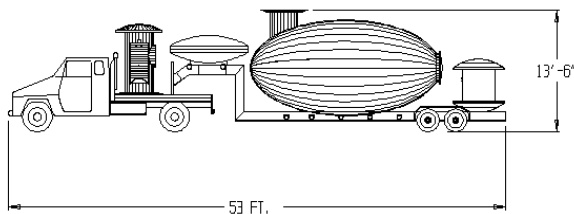
The SP6 Underground Shelter

The SP6 is short paraboloid underground shelter that can be installed extremely quickly requiring only a 10.5 ft deep hole. It has a similar air filtration system to the P6 and P10 but is not a true *blast shelter*. It is an entry level shelter that can be purchased as a storm shelter and later upgraded to an NBC shelter. It is delivered completely assembled.



S.C.U.P.P. 125

The S.C.U.P.P. 125 is a Self-Contained Underground Power Plant designed to provide life support for underground shelters and backup power for other uses. The S.C.U.P.P. 125 is composed of a double wall 125-gallon fiberglass fuel tank and housing and outfitted with a generator. Unlike conventional electric generating plants, everything is below ground and designed to work in severe climates and disaster conditions. The hatch dome and generator access cover are aerodynamically designed to resist flying debris in up to 300-mph winds from a tornado or hurricane. In addition, it can withstand an earthquake measuring 8.5 on the Richter scale with no damage and can survive 5-psi negative pressure from a tornado and 20-psi overpressure from modern weapon detonations. The S.C.U.P.P. 125 is supplied with 125-gallon double wall fuel tank and a 3000-watt gasoline generator or diesel generator. The S.C.U.P.P. 125 is shipped completely assembled and can be installed in one day. The advantages of the SCUPP 125 is that there is no danger of poisonous carbon monoxide fumes, no danger of fire in the building, no noise or vibration in shelter, complies with EPA and National Fire Code standards. The diesel equipped SCUPP 125 will provide 8 months of life support for the Radius shelters.

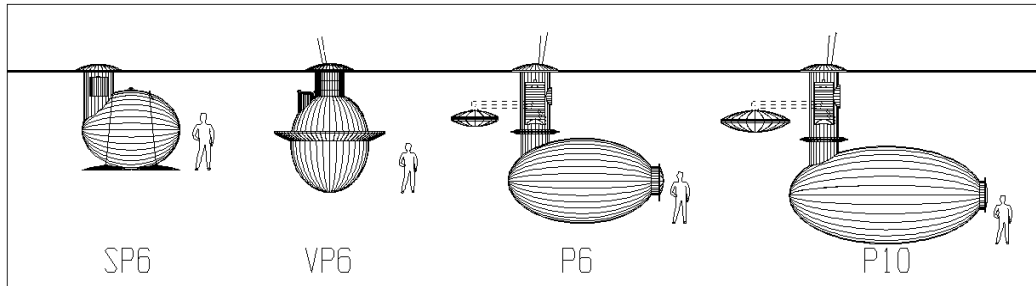


Shelter Delivery and Installation

All four shelters and S.C.U.P.P.s can be delivered by the Radius truck in all 48 states and in very congested areas. The Radius truck is radio and cell equipped to coordinate delivery smoothly. A local excavator and compactor is rented and delivered to the

site. The Radius installer operates the excavator and supervises two other people who off-load the shelter into the hole using the excavator and backfill the shelter. The earth that the shelter displaces is usually spread around the site so there is no extra earth to haul away. A building permit is usually not needed because the shelter has no foundation, no running water, and is an emergency structure which requires no construction, just assembly.

UNDERGROUND SHELTER COMPARISON



THREAT	UNITS	SP6	SP6NBC	VP6	P6	P10
Tornadoes F5 315+ mph	---	•	•	•	•	•
Chemical Warfare	---		•	•	•	•
Biological Warfare	---		•	•	•	•
Gamma Radiation-Fallout	---		•	•	•	•
Dist From GZ 1 MT	Miles	---	5	2.0	1.4	0.85
Total Rems In Shelter (28 day dose)	Rems-psi		102 w/shields	41-0	7-20	3-20
Neutron Radiation and Blast	---				•	•
Life Support-Days	Days	2	14	14	21	30
No. Of Shelterists	Adults	6	6	6	6	10
Shelter Volume/Person	Ft ³	80	80	85	133	140
Excavation Hole Depth Finished	Feet	10.5	10.5	14	16	18
Assembly Time	Hrs	0	0	0	6	6
Pressure Rating	PSI	15	15	15	20	40
Storage	Ft ³	31	31	35	142	239
Probability of No. Shelter Damage ¹	%	94	94	96+	97+	99+
Install Cost Approximate	\$	\$2500	\$2500	\$3500	\$5000	\$7000
Shelter Cost-Military Model	\$	---	\$24,125	\$33,490	\$48,750	\$63,150

- Safe for operation in this environment

Tornadoes, Hurricanes, forest fires

SP6

Tornadoes, Hurricanes, Forest Fires

SP6-NBC or VP6

Limited Nuclear, Biological, Chemical warfare
2 - 5 miles from ground zero 1 MT.

Tornadoes, Hurricanes, Forest Fires
Biological, Chemical warfare, Fallout and Blast
Protection 1.4 miles from ground zero 1 MT.

P6

Tornadoes, Hurricanes, Forest Fires
Biological, Chemical warfare, Fallout and Blast
Protection 0.85 miles from ground zero 1 MT.

P10

¹ Probability of survival without damage to shelter. The normal chance of survival in peacetime as a result of traffic accidents, homicides, cancer, suicide, general accidents, and accidents in the home is approximately 99.2%.

CONCLUSIONS

It has been shown that conventional structures and conventional mobile shelters are not able to provide the proper physical structure to provide water tightness, ground shock resistance, corrosion resistance, life support, and protection for people due to their lack of mass shielding and/or radiation shielding. The conventional structures also require significant maintenance and provide no secrecy due to their lack of stealth. The company "Radius Engineering Inc." has developed specific and unique expertise in the field of self-contained underground shelters for disaster protection which could prove extremely valuable and economical in three areas. These products are unique in the world and represent "state of the art" engineering with 24 years field experience in all 48 states.