

S.C.U.P.P. 400

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Self-Contained Underground Power Plant



- Shelter Life Support For 36 Months
- Long-Term Electric Power
- No Danger From Poisonous Carbon Monoxide Fumes
- No Danger of Fire in Building
- No Danger of Explosion in Building
- No Noise Or Vibration in Building
- Safe Underground Fuel Storage
- 10-Year Warranty

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S.C.U.P.P. 400

The S.C.U.P.P. 400 is a completely self-contained fiberglass electric power generation plant designed to provide life support for underground shelters and backup power for other uses. The S.C.U.P.P. 400 is composed of a double wall 400-gallon fuel tank and generator. Unlike conventional electric generating plants, everything is all 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. 400 is supplied with 400-gallon double wall fuel tank and an 11 Kw or 20KW slow speed diesel diesel generator. Both diesels have fuel pumps to directly fed the generator. The S.C.U.P.P. 400 is shipped completely assembled and can be installed in one day. The S.C.U.P.P. 400 is started electrically at the engine by removing the access cover and climbing down an aluminum ladder into the engine compartment or by an underground cable and remote control.

Historical Overview

Common gasoline and diesel generators pose significant health dangers. Carbon monoxide poisoning is the number one cause of accidental poisoning in the U.S. During the past decade many people were hospitalized for breathing carbon monoxide as a result of fuel-powered generators operating either in the basement or in the garage even with the garage door open. Buildings are not airtight. When the wind blows or bathroom and kitchen exhaust fans operate, negative pressure is created in the building drawing in fumes from the generator. Carbon monoxide fumes are odorless and deadly because they interfere with the human body's ability to process oxygen. Also during this time period, many people suffered injuries from fires or explosions as a result of generators operating unsafely. Power lines, solar panels, and wind generators are usually the first structures damaged during high winds, which carry flying debris and are therefore not dependable during emergency situations. It is this history that created the need to develop the S.C.U.P.P. 400. Radius Engineering Inc. has been engineering and supplying *high tech* underground and self-sufficient products for over 13 years using modern state-of-the-art computer aided drafting (CAD), computer aided engineering (CAE), and Finite Element Analysis (FEA).

Disasters

Between 1970 and 1990 presidents of the United States signed 594 major disaster declarations for territories in the United States. This has averaged more than 2.5 major disasters each month affecting millions of people. During 1989, 338,689 families qualified for disaster assistance. In 1990 more than 117 million families qualified for disaster assistance¹. Since 1990 the number and severity of disasters has risen, possibly due to reduction of the ozone layer and El Nino. The aftermath of disasters such as earthquakes, tornadoes, blackouts, fires, and hurricanes have created tremendous hardships on these people who were forced to live without electrical power for long periods of time.

¹Federal Emergency Management, Washington, D.C., 1990 computer print out, non-published data.

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Without electrical power:

- There is no running water because water pumps require electricity.
- There are no operable toilets, sinks, or showers because there is no running water.
- There is no way of using heating furnaces because they require electricity to fire burners and operate blowers. Refrigerators and freezers also will not work.
- There are no lights to allow normal living in the nighttime. Common flashlights and camping lights are only able to operate for a matter of hours.
- Driving is extremely dangerous because traffic lights may not be operating. If the roads are free of fallen debris, and it is possible to drive to a fuel station, there is no way of getting fuel out of the ground because fuel pumps require electricity. So it is not always possible to just drive over to the next town and get the necessary supplies.
- The traditional portable generator placed outside the building is not weatherproof and not designed to resist fallen or flying debris. If it survives the disaster, it is not designed to operate for more than a few hours because the fuel tank is so small. If it operates inside, it often creates severe problems due to exhaust fumes, heat, vibration, noise, and overheating.

Rebuilding after disasters has been severely hampered by lack of electrical power. The buildings where power is available, are the first to get rebuilt, simply because electrical power is available making it possible to operate construction tools and equipment.

Fuel Tank

The S.C.U.P.P. 400 contains a 400-gallon double wall fiberglass tank. This design allows the S.C.U.P.P. 400 to remain constrained in the ground in high water table areas without rising due to hydrostatic pressure (buoyancy). The S.C.U.P.P. 400 with an empty fuel tank develops 11,570 pounds of hydrostatic pressure or buoyancy. This buoyancy is resisted by 13,004 lbs of earth (@ 70 lbs/ft³) covering the gravity dish at the bottom of the unit plus the weight of the S.C.U.P.P. itself at 1000 lbs. This design meets the American National Standards Institute (ANSI A58.1) requirements for buoyancy and the Fire Codes (NFPA 30) for a tank of this size. This size fuel tank allows approximately 500 hours of operation. The fuel tank is 6 feet below the ground, which keeps the stored fuel temperature well below the outside air temperature and usually above freezing temperatures.

Air Manifolds

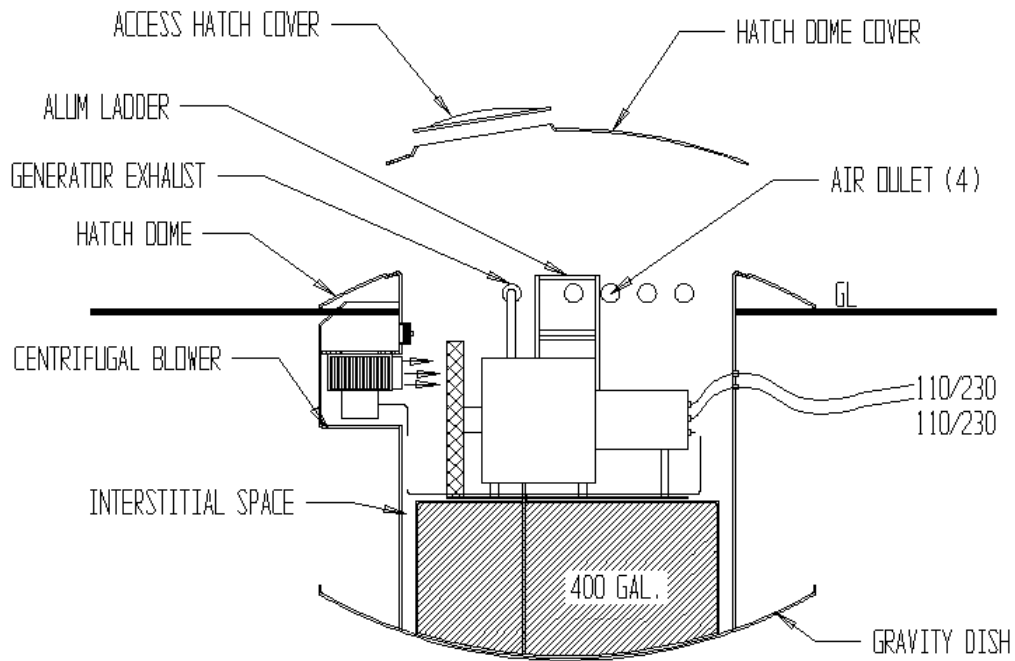
Air for combustion and cooling enters through the *air inlet* in the hatch dome and is exhausted through the *air outlet* in the hatch dome. The mechanical configuration of the air inlet system will allow rain to be sucked through the air inlet hole into the hatch dome plenum where the rain

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will drop prior to entering the air blower. The hatch access-cover is removed by unlocking two padlocks allowing the access cover to be lifted up. The generator access cover is recessed to be more aerodynamically clean to resist flying debris during high winds, hurricanes and tornadoes. The air inlet hole is large enough to allow a person's hand to enter to clear away any debris. This is particularly important in tornado and hurricane disasters where the driving wind and water result in mud being packed in every opening.

Leak Detection

The S.C.U.P.P. 400 is manufactured with a double-wall tank. The fuel tank is a separate fiberglass tank surrounded by a two-inch space. It is the customer's responsibility to monitor the fuel tank for any leaks by visually checking the space surrounding the fuel tank.



Fuel Gage

The fuel volume in the S.C.U.P.P. 400 fuel tank is determined by the supplied stick gage. The stick gage is inserted into the 2-inch pipe coupling at the top of the tank next to the manual transfer pump. The depth of the fuel in inches is related to the *available* gallons remaining in the tank.

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Gallons	Depth In.
420	28
406	27
392	26
378	25
364	24
351	23
337	22
323	21
309	20
295	19
281	18
267	17
253	16
239	15
225	14
212	13
198	12
184	11
170	10
156	9
142	8
128	7
114	6
100	5
31	4
0	3
0	2
0	1

Filling Fuel Tank

1. Extinguish all cigarettes and turn off generator.
2. Open the access cover.
3. Remove the 2-inch fill cap on the top of the fuel tank.
4. If the generator will not be operating for long enough periods to consume most of the fuel within a year, add fuel antibacterial liquid for 400 gallons of fuel. One bottle is provided with the S.C.U.P.P. 400. This should be added every year or two.
5. If the S.C.U.P.P. 400 is installed in a cold climate, No. 1 diesel should be used or No. 2 diesel with diesel antifreeze for 400 gallons of fuel. This can be purchased locally.
6. Insert the fuel nozzle into the fill port and refuel, checking visually to see where the level of fuel is. Do not completely fill the tank to allow for adding fuel biocides each year.

Generator Housing Hatch Dome and Cover

When the S.C.U.P.P. 400 is properly installed, all that can be seen on the ground is the hatch dome and access cover.



The hatch dome contains the air inlet and air outlet openings. The generator housing and tank are both vented to the hatch dome.



Operating Capacity

To determine the size generator required, add up all the running watts of all appliances that are expected to start and run at the same time. Electric motors require 2 to 3 times the name plate wattages created during the 1- to 2 second starting surge. If the S.C.U.P.P. is intended for residential use, the governing appliances are usually the well water pump, refrigerator, and furnace. The battery bank option eliminates the surge requirement.

Equipment	Running Watts	Starting Watts
Clothes Washer	1150	3450
Coffee Maker	1750	1750
Dishwasher no heat drying	700	2125
Electric Range 6 element	1500	1500
8 element	2125	2125
Furnace Blower	1/8 HP	300
	1/6 HP	500
	1/4 HP	600
	1/3 HP	700
	1/2 HP	875
Light Bulb (125W)	125	125
Oven	6000	6000
Radio	50-200	50-200
Refrigerator or freezer	800	3125
Shelter 45 Amp Bat charger	600	600
Television -color	300	300
Toaster 2 slice	1050	1050
Vacuum Cleaner	600	1800
Water Well Pump	1/3 HP	800
	1/2 HP	1050
		3200

Note: For an underground shelter using a 45-amp battery charger, each hour that the generator is operating will power the shelter life support (blower and light) for 24 hours.

Air Blower

Cooling and combustion air is supplied by a 115-volt high-pressure centrifugal blower producing 1200-2000 cfm at operating static pressure. The blower has an average life of 10,000 hours. It is activated as soon as the generator starts.

Snow

During very heavy snows, the air inlet, and air outlet holes may need to be cleared. Once the generator is operating, it will suck in blowing snow and exhaust it through the air outlet. Should either become blocked, the generator will overheat and automatically stop before damage results.

Flood

The S.C.U.P.P. 400 should be installed 2 feet above the 125-year flood plain. A local surveyor can determine this level. The generator can also be easily removed.

Generator Exhaust

The generator exhaust is connected to the air plenum under the hatch dome with a thermally broken stainless steel exhaust pipe. Combustion and cooling air exit through the hole around this exhaust connection keeping it cool.

EMP

The SCUPP 400 generator is not affected by Electromagnetic Pulse (EMP) itself. However, if it is connected to a conventional circuit breaker box connected to the local power grid, it is subject to functional damage. The overhead and underground power lines longer than one mile collect EMP which is transferred to the circuit breaker box. This EMP charge can be avoided by using a blade type throw switch to mechanically break the connection to the generator.

Automatic Off

The generator is equipped with a thermal switch, which will turn the generator off when it exceeds its maximum operating temperature. This may happen as a result of the blowers malfunctioning, low oil level, or if the air inlet/outlet manifolds becoming clogged.

Maintenance

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- Air manifolds - Make sure that the air manifolds and insect screens are clear from animal nests, bee nests, grass, snow, mud, etc.
- Fuel - Use diesel anti-gel additive (or No. 1 diesel) and anti-bacterial additive as necessary.
- Starting - Start the generator each month and run for a least 15 minutes.
- Check interstitial space of the double wall tank visually for leaks.
- Check oil level.
- Check generator air filter.
- Replace the fuel filter as required based on engines owner's manual.
- Check water level of battery.

Conforming Standards

The S.C.U.P.P. 400 conforms to the applicable portions of the following partial list of engineering standards.

NFPA 30	Flammable and Combustible Liquids Code
NFPA 30A	Automotive and Marine Service Station Code
ANSI A58.1	Minimum Design Loads for Buildings and Structures
ANSI B1	American National Standards Code for Pressure Piping
ANSI B31.4	Liquid Petroleum Transportation Piping Systems
ASTM D 256-81	Impact Resistance
ASTM D 790-81	Flexural Strength
ASTM D 543-87	Tests for Resistance of Plastics to Chemical Reagents
ASTM D 581	Chemical Resistance
ASTM D 2584	Material Composition
ASTM D 4032-1	Tank Material
U.L. 1316	Glass Fiber Reinforced Plastic Underground Storage Tanks for Petroleum Products

Shipping

The S.C.U.P.P. 400 weighs approximately 2500 pounds and can be shipped by common carrier with a double drop trailer and overwidth permits. The S.C.U.P.P. 400 is shipped stabilized on the truck floor by four fiberglass blocks which are to be returned to Radius by UPS after off-loading. The SCUPP 400 can be off-load using the same excavator that digs the hole. The excavator must be able to lift at 13.5 ft above ground to off-load the SCUPP 400.

Decontamination

The SCUPP 400 can operate in NBC (nuclear-biological-chemical) warfare environments. The inside of the S.C.U.P.P. housing and generator will become contaminated only if the generator is operating in an NBC environment. NBC contaminants do not affect the generator's performance unless an extreme amount of dust and fallout clog the air intake filter.

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Decontamination is performed in two phases.

Phase 1 In the first phase, a spray bottle with DSM-200 (Optional Decon Kit) is simply sprayed into the air inlet of the hatch dome and all over the exterior of the hatch dome and access cover while the generator is operating. It will require approximately 1 quart of this solution for this phase.

Phase 2 In the second phase, a person wearing a simple paper suit, gas mask, and rubber gloves does the following:

1. Remove the generator access cover and turn the generator off.
2. Wait 30 to 60 minutes until the generator cools down.
3. A second quart of the DSM solution is then directly sprayed onto all areas inside the S.C.U.P.P. housing and generator.
4. Remove the air blower cover and spray all parts of the air blower.
5. Replace the air blower cover.
6. Remove the air filter and spray with DSM solution. Squeeze out all the moisture in the sponge air filter.
7. After a few minutes the generator can be turned on and the hatch dome access cover should be secured back in place.
8. The generator should operate with the access cover in place for 15 to 30 minutes to dry all surfaces.

Warranty

RADIUS ENGINEERING INC. Guarantees that the fiberglass parts of the S.C.U.P.P. 400 will not leak, corrode, or structurally fail for a period of 10 years provided that 1) the S.C.U.P.P. 400 is not modified 2) the S.C.U.P.P. 400 is properly inspected, off-loaded, and installed. 3) the S.C.U.P.P. 400 is properly operated and maintained.

This warranty does not apply to the engine or generator. These items are covered by individual manufacturers. RADIUS ENGINEERING INC. reserves the right to change any specification without notice.

Our liability under this warranty shall be limited to, at our option, repair of the S.C.U.P.P. 400, or delivery of a replacement unit to the point of original delivery, or refund of the original purchase price. We shall not be liable for any indirect or consequential damages, labor, or installation costs.

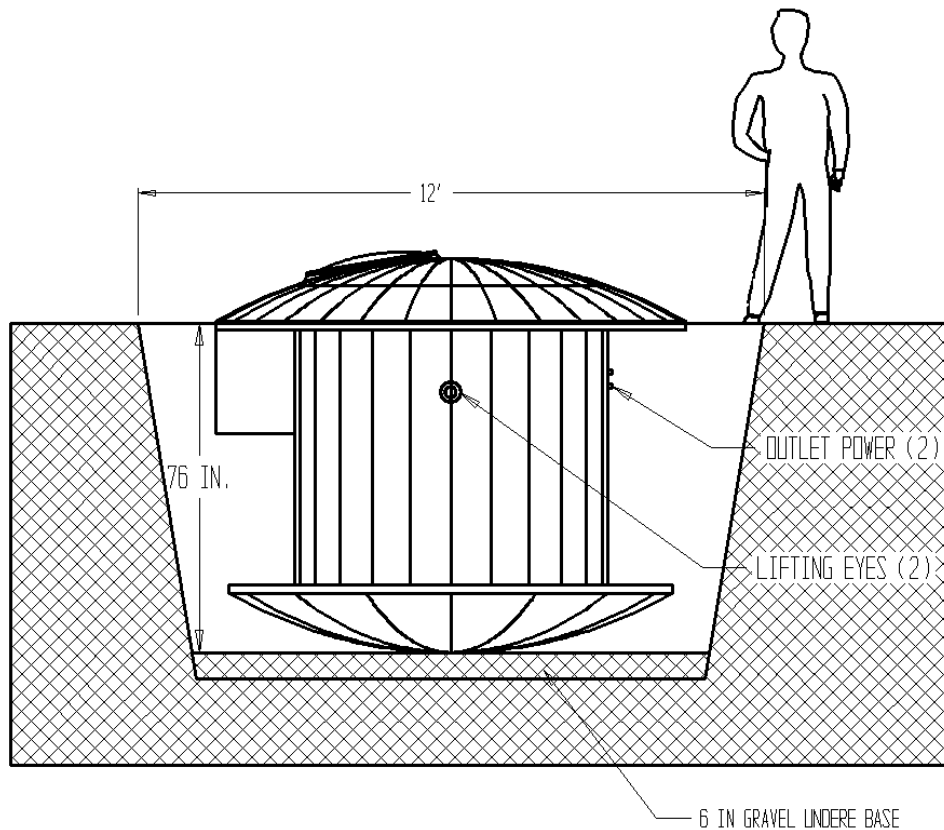
Installation Procedures

1. **Check For Damage** (Inspect the S.C.U.P.P. 400 for damage, which may have occurred during shipping. Report any indication of damage immediately to the shipper and Radius Defense and Engineering.
2. **Excavation-** (a) Stake out the corners of the hole and ditch to be excavated. The S.C.U.P.P. must be at least 10 feet away from any building. (b) Confirm the absence of power lines, gas lines, telephone lines, water pipes, sewer pipes, etc. by calling DIG SAFE. (c) Excavate a hole that is 12 feet wide by 12 feet long and 82 inches deep. This hole usually requires approximately 30 minutes to dig depending on the size of the

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excavator. (d) For the power lines from the generator, excavate a ditch that is 12 inches deep and as narrow as possible from the hole to the underground shelter and building.

- Pea Stone Bed-** (a) Build a bed of pea stone that is 6 inches deep on the floor of the excavated hole. (b) Check the height from the pea stone bed to the surface of the ground. The height should be 74-76 inches. The installation will require approximately 6 yards of pea stone including the pea stone bed.



- Off Loading Into Hole-** (a) Attach a lifting strap or chain to the lifting eyes on the side wall. DO NOT LIFT S.C.U.P.P. 400 WITH FUEL IN THE TANK. (b) Lower the S.C.U.P.P. 400 into the hole and set on gravel bed.
- Leveling-** (a) Place a level across the underside of the hatch dome. (b) Shovel stone under the base of the tank until it is stable and level. (c) Check to make sure that the hatch dome is at or above the surrounding ground level.
- Backfill Base-** Continue to shovel stone under the base of the tank in 6-inch lifts or increments all around the tank. It is very important that there be no gaps or voids under the base of the S.C.U.P.P. 400. Continue backfilling to the top of the fuel tank.
- Backfill-** (a) Continue to backfill the S.C.U.P.P. 400 with pea stone/gravel in 6-inch increments evenly around the entire S.C.U.P.P. 400 to within 6 inches of ground level. (b) Use the surrounding soil to backfill the last 6 inches and taper out so water drains away from the generator-housing ring. If gravel or sand is used or some material that is

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not self compacting, a Jumping Jack compactor must be used every 6-12 inches of backfill depth.

8. **Power Cable Connection-** The S.C.U.P.P. 400 comes with two through hull pipe couplings through which one underground electrical cable is connected to the shelter and one is connected to a house or other equipment. Employ a licensed electrician to connect the power cable to the building main electrical line using a transfer switch (not supplied). This usually requires approximately two hours.

The P6, P10, P15, CAT 15, and CAT 25 shelters have a 30 day life support duration from battery bank(s) powering the air blower, lights, water pressure system, etc. With various S.C.U.P.P.s (Self-Contained Underground Power Plants) powering the smart AC battery charger(s) in the shelters, duration times can be extended.

Altitude	Shelter Duration-Months	Generator 50% load 0.6 gph
3.5%/1000	SCUPP 225 10 KW Slow Diesel	47 hrs/30 days
Feet Above Sea Level	P6, P10	Total Days of Operation
0 - 500	8.0	16
1000	7.7	16
2000	7.4	16
3000	7.2	16
4000	6.9	16
5000	6.6	16
6000	6.3	16

Altitude	Shelter Duration-Months	Generator 50% load 0.6 gph
3.5%/1000	SCUPP 400 10 KW Slow Diesel	34 hrs/30 days
Feet Above Sea Level	P15, CAT 15, CAT 25	Total Days of Operation
0 - 500	19.7	28
1000	19.0	28
2000	18.3	28
3000	17.6	28
4000	16.9	28
5000	16.3	28
6000	15.6	28

Altitude	Shelter Duration-Months	Generator 50% load 0.6 gph
3.5%/1000	SCUPP 1000 10 KW Slow Diesel	34 hrs/30 days
Feet Above Sea Level	P6, P10	Total Days of Operation
0 - 500	49.3	70
1000	47.5	70
2000	45.8	70
3000	44.1	70
4000	42.4	70
5000	40.6	70
6000	38.9	70

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