

BUILDING A BROADBAND SEISMIC STATION

Site location

Factors affecting station location :

security → from both nature and human interference

noise →

thermal insulation →

Equipment and Materials Needed

Power

The general relationship is:

$$\text{Power (W)} = \text{Voltage (V)} \times \text{current (A)}$$

Power used by each device:

Nanometrics 120PA	centered, settled, level	2 W
	not yet settled	3 W
	start up	4.5 W

Quanterra Q330S	3 channel	0.6 W
	6 channel	0.8 W
add 1.2 W for continuous operation		

We could run in a non-continuous mode. We should then estimate the power requirement for a Q330 at 1W

Then:

Continuous operation	current is	5/12	liberal estimate
non continuous (buffer)	current is	4/12	to a very tight estimate of 3/12

In US measure battery capacity using

CCA (cold cranking amps):	Battery capacity (A-h)	CCA/7.25
RC (reserve capacity):	Battery capacity (A-h)	(RC/2)+16

Costs:

Air cell:	Cegasa 2AS10-2	1200A-h	3V	\$220 each
	need 12	total		\$2640

				v.liberal(5/12)	liberal(4/12)	tight(3/12)
				hrs (weeks)	hrs (weeks)	hrs (weeks)
Duralast Marine	type 24	RC140 (86 A-h)	\$128	206 (1.2)	258(1.5)	344(2.0)
	type 27	RC180 (106 A-h)	\$138	254 (1.5)	318(1.9)	424(2.5)
	type 29	RC210 (121 A-h)	\$148	290 (1.7)	363(2.2)	484(2.9)

Alternate Sensor

L22	passive	0 W	
Q330S	3 channel buffered	0.6 W	0.05 A

	using .05 A	using 0.08 A
1 X RC140 (86 A-h)	1720 hrs (72 days)	1075 hrs (44 days)
1 X RC180 (106 A-h)	2120 hrs (88 days)	1325 hrs (55 days)
1 X RC210 (121 A-h)	2420 hrs (100 days)	1512 hrs (63 days)

Data Logger enclosure

Install sequence and Examples

Step 1: Dig the hole.

Dig a hole for the sensor so that the sensor is about $\frac{3}{4}$ meter deep. Try to keep the sides as vertical and straight as possible. Putting the exhumed dirt on a tarp makes it much easier to replace later. If the site is on a slope (as shown in picture), dig a trench for drainage. The trench should intersect the hole about 3 or 4 inches above the bottom of the hole.



Step 2: Cement pier at bottom of hole.

Mix up some quick-setting cement and spread it on a 16" x 16" square concrete paver with the corners chipped off (so the outer barrel will not touch it). Place this in the hole with the cement down to get a good contact with the dirt. Once it is firmly in place and level, cement a 12" diameter round concrete paver on top of it. Repeat with another round concrete paver on top of that one. Spread the leftover cement into the cracks between the two round pavers. It should dry in about 5-10 minutes. If installing a drainage trench, lay the 2" PVC at this time.

Note that we use two round pavers on top of the square one so that the bottom of the outer barrel is a few inches below the connector on the sensor (depends on the sensor). This way if the vault floods and the air inside the inner barrel is compressed, the water level in the outer barrel will rise, but still be below the connector.



Step 3: Determine orientation of the pier.

Mark north and east lines on the pier. Remember to take into account the site's declination. Fill in dirt around the lower square concrete block and pack it until the dirt is flush with the top of the square block.



Step 4: Orient and level the seismometer.

Carefully orient and level the seismometer on the center of the pier. It is easier to do it before the outer barrel is installed in Step 5, but not necessary.



Step 5: Install outer barrel.

Cut off the bottom of the 50-gallon barrel so it open on both ends. Cut a 2" hole near the top to receive a short (2-3 feet) length of PVC pipe. If installing a drain, also cut a 2" hole near the bottom to receive the drainage pipe. Seal around the hole(s) with silicon caulking to avoid water leakage. Backfill the drainage trench at this time. Plug in the STS-2 power cable (orange) and pass it through the upper PVC pipe.



Step 6: Thermal insulation – if there might be serious thermal gradients

Thermal insulation is only needed when it is possible that there will exist a high thermal gradient inside the vault. This is true in areas with high temperature variations during a day-night cycle. Nest two styrafoam rose cones together, and seal any holes in them with duct tape. The cones will go into the hole with the open end down over the sensor. Cut a small notch on the bottom edge of the cones so the STS-2 cable can freely pass underneath them. Unlock the masses of the sensor and carefully place the rose cone over it. The bottom of the rose cones should rest on the square block with the two round blocks and sensor inside them.



Step 7 Install Inner barrel

Cut off about 6 inches off the top (open end) of the inner 30-gallon barrel. The barrel will go into the hole upside down with the open end down. Cut a small notch on the edge of the barrel so that the STS-2 cable can freely pass underneath it. Carefully place the barrel over the rose cones and sensor without disturbing them. Make sure it does not touch the rose cones when it is in place.



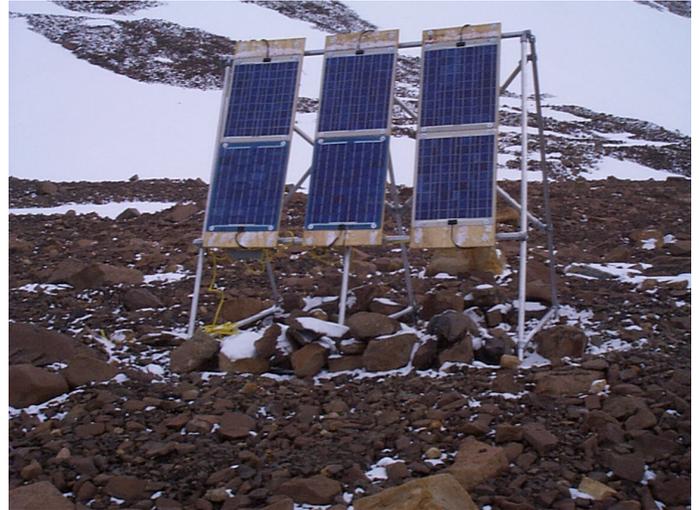
Step 8: Place weights over inner barrel.

Place five 38-lb concrete paver blocks on top of the inner barrel. It might be necessary to chip off the corners slightly to get them to fit.



Step 9: Install solar panel mount and panels

The type of solar panel mount depends on climate. Also, in high latitudes, the mount must support a steeply pitched set of solar panels, whereas in low latitude sites with benign climates a shallow and much less robust mount is fine. Many of the mounts are an “A” frame with the two legs connected along the bottom. That third side is placed in a trench and is also weighted down.



Step 10: Install Equipment Box

There are many variations of instrument boxes, depending on the requirements for battery, and data logger. Note that the cable path from the sensor to the data logger should be protected where it is close to and above the ground surface to protect from being destroyed by being chewed.



Step 11: Check to see that the sensor is working.

Before sealing the vault, it is a good idea to make sure the sensor will center and is working properly.



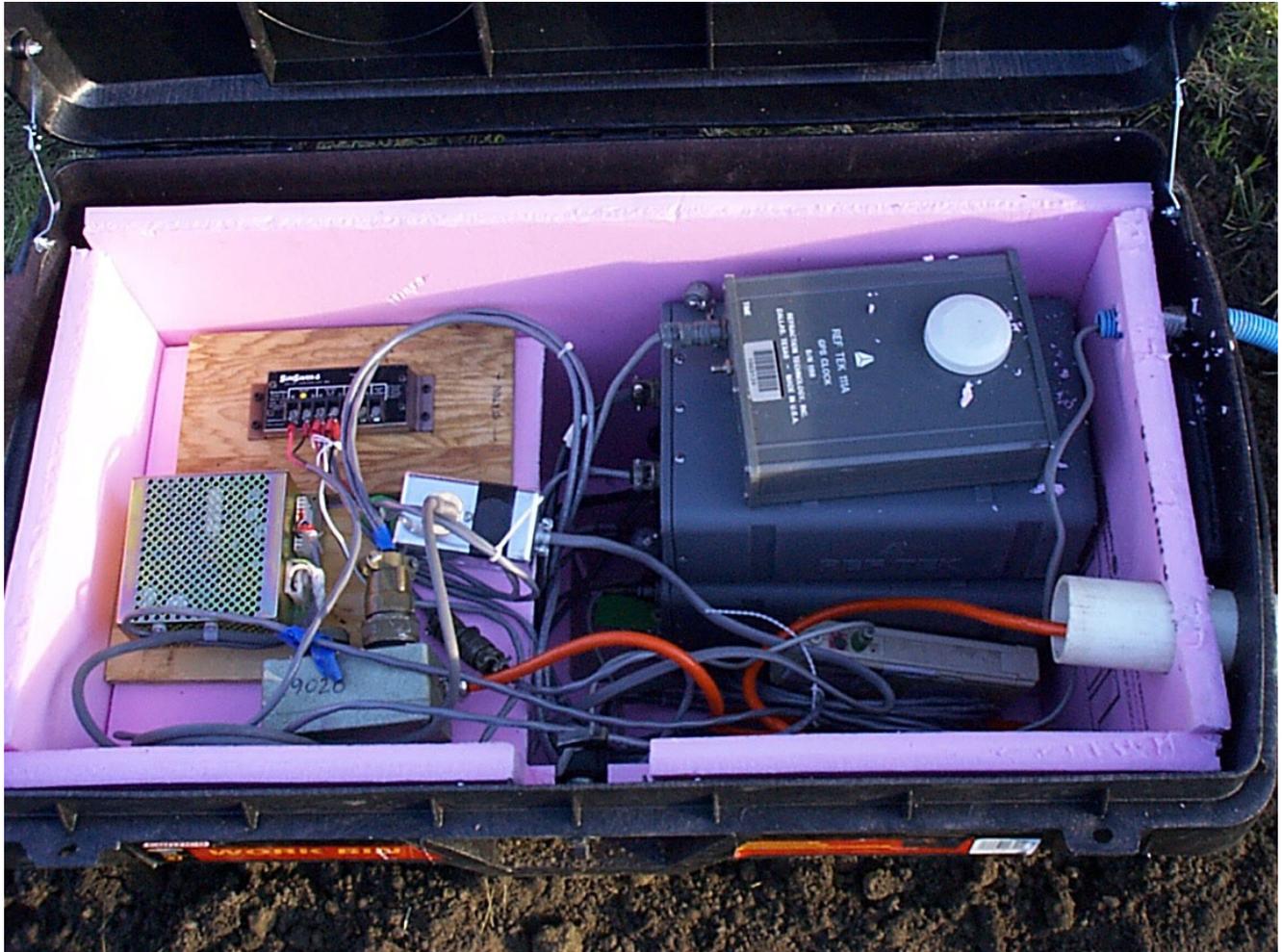
Step 12:

Put the top on the barrel and secure it tightly. Backfill around the barrel and place a folded (about 3-ft x 3ft) tarp on top. The tarp is there so that removing the dirt later will be easier. Cover the tarp/barrel with the left over dirt to create a mound. It is a good idea to place the grass pieces on the top last to act as natural erosion control (and a little extra insulation).



Step 13: View of the electronics box.

Here you can see the DAS, disk, clock, power board, host box, and kepco inside the tuff bin. The pink insulation was cut to line the box. Two 90-Amp-hr deep-cycle marine 12-volt batteries are also in the box (under the power board and kepcu). The PVC pipe on the right connects the box with the vault. A sponge was stuffed into the pipe to keep air flow from going into the vault.



Step 14: Final view of the entire site.

It is a good idea to install some type of fence around the station to deter anyone from tampering with it. A piece of wire mesh is attached to the end of the drain with a hose clamp to prevent small animals from getting into the vault.

