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Title

IRIS Procedure for Excavation and Construction of TA Seismic Vaults

May 1, 2012

This document serves as a reference for the procedures to construct a TA station, and details the responsibilities of the Construction Supervisor onsite and the responsibilities of the Excavation Contractor.

Contents

General Description of Project

The IRIS consortium (www.iris.edu) is installing seismic stations to record earthquakes occurring locally and worldwide as part of a National Science Foundation award under the project name (EarthScope-USArray). The data is used to image the Earth's interior and produce new insights into the earthquake process. The project anticipates over 2000 sites across the country on both government and private land. For more detailed information regarding this project, please visit the following web location (www.earthscope.org or www.iris.edu/USArray).

Description of Work

Overview

A seismic vault consists of a plastic HDPE tank 85" long, inserted vertically into an excavated hole so that the top end extends above grade about 1 inch. The bottom is embedded in concrete. The hole is backfilled, all soil and rock is mounded onsite. A cable conduit is trenched 20' to a 2" galvanized pole, embedded 3' into a concrete base. One or two additional poles are required at some sites to mount communication equipment-satellite dish and solar panel mounts.

A key aspect of the work is that the site locations are in remote areas, separated on average by 50 miles, with typical drive times of two hours to reach site. Materials to perform the work need to be coordinated for delivery and/or carried between sites. The work area is constantly shifting to new areas and will not generally be based from a single support location.

Proper respect for landowner property and courtesy in addressing landowner concerns are very important to the success of the project. We are guests on the property and can be asked to leave at any time for no reason, which is a great loss to the project.

The overall schedule is to construct 214 sites per year. A scheduled downtime is December 15 to January 15 each year. Scheduled maintenance breaks are negotiated with TACO Station Coordinator. The expected monthly schedule is 19 sites/month February through November and 12 sites/month December and January. Adding a second crew should schedule or favorable conditions warrant is sometimes necessary.

Safety

All OSHA safety regulations will be followed. To ensure the safety of the crew and landowner and avoid risk to equipment and property the One Call (Dig Safe) program will be used on all excavations. The Construction Contractor will have the responsibility of determining if any underground utilities exist and shall utilize the local one-call (dig safe) service prior to ground disturbance. The Construction Contractor will apply for a work radius of 300 feet around the site coordinates listed on the Recon Report. Rarely will the site be near any development. The machine operator must confirm that the One Call (Dig Safe) permits are for the same coordinates listed on the Recon Report and will have final say on safety around the machinery and around the open hole. Excavation will not commence without a valid confirmed One Call (Dig Safe) permit. Excavations will not be left open for any length of time unattended without adequate safety fence. After installation, a lid will be placed and locked over the vault.

Site Locations

Actual locations are provided in a detailed reconnaissance report for each site. A summary table of locations and communication type (for additional pole plans) and fencing requirements are prepared before each deployment. Plan for 5% of the stations to be Solar VSAT, 15% AC VSAT, and 80% Cellular sites. Substitution of different sites can be made by the TA Manager or Station Coordinator depending on weather and site permit availability.

Work will be scheduled in a region according to the seasons. Northern states will be in done in summer, southern states in winter.

Work Conditions

An IRIS representative (Construction Supervisor) will be on-site for each installation and responsible for access to the sites and communications with the landowner. IRIS is responsible for obtaining permission from the landowner to excavate on and have access to each location. The Construction Supervisor will confirm with the Construction Contractor's machine operator that the One Call (Dig Safe) permits are for the coordinates listed on the Recon Reports and are valid for the construction date. In order for the construction contractor to receive credit for payment, the IRIS representative must sign off on each installation the day that construction work is accomplished as defined in the work description above.

Work will be organized regionally where 19 or more adjacent sites can be installed in one deployment. The average distance between adjacent sites is approximately 50 miles, but because of limitations in access roads, as much as 150 miles should be anticipated per site.

Mobilization of equipment will not be expected if fewer than 10 nearby stations are ready for construction-meaning that permits and materials are in hand. IRIS will provide mobilization clearance and ask for contractor response within 7 days. The work schedule for the next 19 or more constructions will be agreed upon by the IRIS representative before the start of contract work.

To the best of our ability, most of the sites will be located in areas where excavation can be performed with a backhoe without the need for a rock hammer. Nevertheless, hard rock sites will be encountered. For the purposes of this contract, plan on the use of a hammer for 5% of sites. At these hard rock sites, the 6.5' deep hole requirement may be waived by the IRIS representative on site so that less than 1 hour of hammering will be required. Alternatively, a short (60") vault may be constructed at the IRIS representative's option.
The contractor must be licensed by any State, Local, and Federal authorities for this type of work, be fully insured and have workers compensation for each employee working on this project.

As part of negotiations with the landowner for access, occasionally a small amount (<1hour) of backhoe work is requested by the landowner, usually tasks like clearing some brush or filling a small ditch, or clearing a cattle guard. This incidental work is part of the contractor's job; we do our best to keep it reasonable. This work is coordinated by an IRIS representative.

Neither IRIS nor landowner is expected to provide toilet, water or food onsite. All waste must be removed from work site. IRIS prohibits smoking onsite due to fire hazard.

IRIS Station Coordinator Responsibilities:

1. Routine communication regarding crew schedules with excavation contractor management, construction supervisors and TA management. Weekly schedules, daily changes
2. Responsible for alerting excavation contractor management of inappropriate or unsafe work practices of the field crew. Contact for excavation contract management to report same regarding IRIS personnel.
3. Participation in Recon conference call and awareness of permit status, special construction instructions for every site.
4. Participation in Field operations conference call including responsibility for construction, installation, shipping sections of weekly summary report. Will occasionally oversee entire report and/or chair conference call.
5. Issue management of any onsite landowner concerns.
6. Scheduling and delivery of materials delivery into field depots.
7. Work area planning, including second crew, to maintain safe and efficient work with regards to weather and driving distances.
8. Send Construction Information, to Construction Supervisor, Construction Supervisor to call Landowners one week in advance for permission to construct
9. Coordinate and approve any site location moves greater than 50 feet.

IRIS Construction Supervisor Responsibilities:

1. IRIS Construction Supervisor (CS) is to maintain daily contact with the Station Coordinator in so far as possible. Preferably via phone in the morning and evening.
2. CS schedules day to day access with landowners, providing at least 24 hours notice where possible. This requires quite a bit of time and phone tag when a landowner is unavailable on the anticipated date.
3. CS is responsible for conversation with landowner to ensure they understand the work to be done, and to address any and all questions landowner may pose regarding the project.
4. CS is responsible for determining the location to dig is the staked, reconned and permitted location, or has sought appropriate clearance with landowner in the event site must be relocated. If relocated, four cardinal photos must be taken and preferably the reasons for relocation discussed with recon supervisor or station coordinator. No ad hoc relocation on federal, state or corporate lands is allowed.
5. Under no circumstances will excavation begin without a valid One Call (Dig Safe) permit for the site coordinates listed on the Recon Report.
6. Should conditions require the excavation be moved less than 50 feet from the Recon Report coordinates the CS may do so with approval from the landowner and notification of the Construction Coordinator.
7. If the site excavation must be moved more than 50 feet and less than 200 feet the CS must get prior approval from the Construction Coordinator and the landowner.
8. A new One Call (Dig Safe) permit must be applied for and permission granted if the site excavations are moved greater than 200 feet.
9. CS is responsible for deciding when access will be attempted or rescheduled due to road conditions and weather. CS should be aware that mobilizing the excavation crew when the site

is unreachable or cannot be dug incurs a fee to IRIS for the mobilization. If uncertain, check the field conditions first.

10. CS is responsible for inspecting the work performed, in particular the hole depth, tamping, concrete quality/mix. Certain photos are required for their report.
11. As available and not to interfere with above duties, CS is to help construction crew perform aspects of the construction tasks, especially if an additional hand adds a margin of safety or efficiency.
12. CS is authorized to purchase additional materials and/or to sign for materials supplied by the excavation contractor. In event the construction crew is unable to do so, the materials are to be supplied by IRIS

Excavation Contractor Responsibilities:

The contractor will be responsible for providing all the machinery, tools, dig permits, storage facilities, transport, labor and travel costs associated with the following tasks. The Construction Contractor will apply for a 300 foot work radius using the One Call (Dig Safe) program. The Construction Contractor will provide a list of One Call (Dig Safe) permitted sites to their machine operator, Construction Coordinator, and Construction Supervisor. The Construction Contractor's machine operator must confirm that there are no positive responses from utilities for the location to be excavated. See materials list in appendix.

Construction Task Detail

1. Transport HDPE vaults and lids to job site. Waste and extra material to be disposed of by contractor.

2. After One Call (Dig Safe) permits are confirmed for site coordinates listed on the Recon Report dig 7' deep hole approximately 4.5' wide. Hole must be wide enough at the bottom to fit a 42" ID HDPE vault vertically with enough space (4-6") around the outside so concrete is able to form a continuous seal. All soil and rock will be mounded on site; none is removed or brought in.

3. Mix and pour at least 6" of concrete into hole.

- Contractor to supply concrete, water, and mixer
- Quikrete mix #1101 or equivalent is used
- No rebar or other reinforcement is to be used.
- Concrete must not be poured when ambient temp is below 20F.

4. Set vault vertically into hole using 3/8" chain harness.

5. Two sections of 3/8 galvanized chain are to be connected to the vault lift eyes part-way down sidewall so that two open ends of the chain are exposed once vault is emplaced and connection links are buried once vault is backfilled. The two open ends of the chain will be used to lock the lid.

6. Add approximately 0.6 cubic yards concrete into inside of tube, on top of membrane liner to fill vault 13"-14" deep. For transport and weight estimates, estimate 35 80# bags of concrete per site.

7. Pad formed inside the bottom radius of vault will be finished off smooth and level.

The floor should be level within 5 degrees for the installation of the sensor
Under no circumstances is an open hole to be left unattended without a safety fence.

8. Auger or excavate 12" diameter hole 4' deep no further than 23' away from edge of installed vault. An 8" deep trench (minimum) connecting the solar/antenna mast hole to the vault will also be dug to set 1.5" conduit from vault to mast.

9. Using a 12" diameter SonoTube cut to length, set 2" diameter, 10' schedule 40 galvanized pipe in ground with cement. Depth of pipe in ground minimum 3 feet. Above ground end is threaded. End of steel pipe which is set into concrete will have holes drilled into it with either rods or wire mesh to add to the adhesion of pole to concrete. Contractor will supply concrete, forms, and steel pipe.

10. Install 10AWG copper ground wire between cable entry of seismic vault and mast, and install infrasound and pump hose in vault sidewall, laying tubing along conduit run.

11. Backfill around outside of vault leaving approximately 2 yards of fill dirt which will be used for final coverage of lid at a later date. Fill dirt will be ramped up to edge of vault to create adequate drainage. An opening in the mounded fill dirt will be provided for drainage.

Care will be taken at this stage to keep vault level and dirt from inside of vault.

12. Install junction boxes, conduits and fittings from instrument vault to solar/antenna mast. IRIS will supply junction boxes and fittings, contractor will supply 1.5" diameter PVC conduit, glue and couplers.

13. Hang the foam insulation within the vault

14. Install 8' per side square fence around solar panel/antenna mast.
At the owners' request, several fence types have been requested either;

- A heavy duty 5' T-post with 48" welded wire mesh (included in fixed fee)
- Aluminum panel section fencing (supplied as cost plus fee)
- Chain link fencing at school sites (supplied as cost plus fee)

Line item for installation of complex fencing is allowed.

15. Site will be smoothed out as much as possible around vault. No excess concrete or deep ruts will be left at site. This will primarily consist of smoothing un-necessary piles of dirt and budgeting enough labor and equipment hours to maneuver to avoid impacting brush and trees that cannot be disturbed. No seeding, cover or boundary fence is required.

Special care must be taken in the installation to minimize the disturbance to plants or soil around the location thus minimizing the footprint to the property. Temporary work area is defined as 50ft x 50ft, with vehicles confined to this area.

Depending on the station communications, one or two additional masts are specified. We identify the sites as using AC VSAT or Solar VSAT.

- For AC VSAT a 2" mast embedded 4' into ground and 6' above ground in a 12" SonoTube filled with concrete is required. For the site, a total of two masts are installed.
- For a Solar VSAT, in addition to the mast for AC VSAT, a 4" schedule 40 pole embedded 4-5ft in a 18" diameter SonoTube is also required. For the site, a total of three masts are installed.

Materials Transport and deliveries

IRIS is obligated to make available at a central depot for the region (e.g. Salt Lake City, Denver, etc) the bulk items: HDPE vaults with lids and Construction Kits.

Transport of Vaults and materials forward to a sub regional depot (a 19 station work area) is provided by either IRIS or the Construction Contractor. The Construction Contractor is responsible for moving material to each site.

The Construction Contractor is requested to carry 10 extra bags of concrete and 50 gallons of water to avert onsite shortages.

Materials insufficient to carry out tasks: IRIS personnel are authorized to purchase materials in the event the contractor is unable to supply them. These costs plus 10% will be deducted from contractor invoice.

Construction of a basic site consists of two components connected by conduit and a ground wire in a ditch; the two components are a vault and a solar mast. The vault contains the sensor and associated electronics and may be split into two vaults as conditions on the grounds dictate. The solar mast holds the solar cells as well as the antennas for the cell modem and GPS gear. If there is no cell coverage then site requires a VSAT component. The VSAT requires more power than the basic solar mast can supply. Therefore the VSAT site will have access to AC power or additional Solar panels as required. Fencing may be required around any or all of the various components as requested by the landowner and conditions dictate.

This following will cover the site construction component by component starting with the basic vault.

SECTION 1

Excavation

1. Contact Landowner prior to site access if required

2. Under no circumstances will excavation begin without a valid One Call (Dig Safe) permit.
3. Using a hand held GPS confirm the staked coordinates are the same as those listed on the Recon Report.
4. Should the GPS not operate or there is a discrepancy then aerial photos may be used to confirm site is within 200 feet of listed coordinates.
5. The Construction Contractor's machine operator must confirm that there are no positive responses from utilities for the excavation location coordinates.
6. Prior to excavation the Construction Contractor's machine operator and the Construction Supervisor must confirm that the One Call (Dig Safe) permit is valid for the construction date and for the coordinates listed on the Recon Report.
7. Facing North take photo of vault location showing stake, label photo "Station-code_Before" example: C12A_Before

8. Excavate vault location
    a. Depth of hole should allow vault to be 1inch above finished grade and a 6” concrete pad below vault)
    b. Should conditions warrant a short vault may be used
9. Level and Tamp bottom of hole with backhoe

10. Take photo of hole, label photo “Station-code_Hole” example: S23A_Hole

11. Dig ditch 18” wide x 18” deep x 20’ long from vault to mast location. Mast should be located in the sunniest spot and then downhill.

12. Ditch should be deeper at the mast end than the vault end
13. Mast should be nominally 20' from side of vault.
14. Dig hole 4’ deep for mast SonoTube

SECTION 2

Vault Installation

At storage area

1. Ensure construction kit and foams are inside the vault.
2. Inspect vault for damage or missing parts.
3. Load vaults onto vehicles and strap down securely.

At site

1. Confirm site is in correct location

2. Ensure photo of hole has been taken, label photo “Station-code_Hole” example: S23A_Hole

3. Place a minimum of 6” concrete in bottom of hole

4. Using a concrete vibrator level 6” concrete pad

5. Attach chains to lifting eyes using clevises
6. Attach chains to backhoe bucket and place vault in excavation.

(a) Wrap chains around outboard teeth of backhoe bucket and tie ends in a knot

(b) Leave enough slack in chain so that the vault will hang freely from bucket.

(c) Vault should be centered in hole to allow even backfill

(d) Safety Note: Hardhat required when working with Backhoe bucket above the head.

7. Vault is now ready to be placed in excavation.
8. Chains should be oriented to the sides of the vault as seen while standing in the ditch
9. Vault should be deep enough to expose only **1** inch above grade
10. Using 4' level ensure vault is level and plumb

11. Backfill around vault in 6” to 12” lifts ensuring there are no voids around vault and the vault remains level and plumb. Tamp backfill material using 2 x 4 or equivalent.

12. Lip of vault should be 1” above grade

13.Place 13” to 14” of concrete into vault
14.Record size and number of sacks of concrete used to fill vault

15.Using round end float, level and finish concrete
16.Record depth of finished concrete from top of vault near penetrations

Less than full length vault

1. If ground conditions warrant the vault can be short vault may be used.
    a. The concrete floor is 10 inches thick
    b. Note there is no Q330 shelf in a short vault

SECTION 3

Solar Mast

Required Parts:

1 ea 12”dia x 48”long Sonotube or equivalent
1 ea 2”dia x 10’long schedule 40 rigid pipe threaded on one end
1 ea 2” rigid pipe cap
1 ea 0.25” x 8” steel rod
30’ x 1.5”dia gray PVC electrical conduit
1 ea p/n 5001664 (Q330 Clock Antenna Kit)
1 ea p/n 5001268 (PVC Kit)

1. Place 12” diameter by 4’ long SonoTube in hole and back fill around SonoTube with dirt

2. Fill SonoTube with concrete
3. Cut 20’ length of 2” rigid pipe in half or use one 10’ pipe

4. If conditions dictate spray area with water to prevent fire
5. Use 2” x 10’ Schedule 40 rigid pipe, leave threaded end up
6. Install cap on threaded end
7. Drill 5/16” hole 18” from bottom of mass

8. Place 1/4” diameter x 8” steel rod in hole and using duct tape secure rod in place

9. Place bottom end of mast into center of SonoTube and ensure mast is vertical.

10. Cut 1.5” PVC conduit to length and add 90 degree sweep, Glue all PVC conduit joints

11. Glue 10' of 1.5” PVC conduit to sweep at mast end

12. Glue 10' of 1.5” PVC conduit to sweep at mast end
13. Cut added 1.5” PVC to 4’ above grade
14. Glue 1.5” x 1.5” Tee to end of 1.5” conduit, Materials in Construction kit
15. Tee should face North

16. Drill 0.25” hole in Tee for ground wire exit. Seal with small amount of sealant after completion

17. Pull power, GPS, and, Cell cables (from Step 1. (s)) from vault to Solar Mast

18. Pull 6’ of gray power cable through Tee to exit North

19. Cut a piece of 1.5” PVC to run from Tee at 4’ to the top of the 2” rigid pipe

20. Attach 1.5” PVC conduit to Mast using hose clamps

21. Install 5’ liquid tight flex over 6’ gray power cable using reducer bushing and adapter as shown

22. Coil liquid tight flex cable and secure as shown

23. Glue second 1.5” x 1.5” Tee to top end of PVC, orient Tee as shown.

24. Pull Comm cable through the North exit of Tee and install 1.5” street elbow (DO NOT Glue) orient as shown

25. Push foam plug into street elbow as shown

26. Install GPS antenna using reducer bushing and nipple

27. Attach ground wire to mast with hose clamp

28. Coil 10’ of Comm cable to top end of mast

SECTION 4

Pump Exhaust and Infrasound Gravel Pack Installation

Parts Required

1 each Pump kit
1 each Infrasound port kit
45' ¾ marine hose

2 bags Lava red rock
4 each 36"construction framing stakes

Steel Hardware cloth 1/2" x 1/2"

Procedure:

1. Use Teflon tape around threads of feed through fittings
2. Attach the 11 foot infrasound hose to the center bulkhead fitting using the ¾” barb to NPT elbow and secure with the SS hose clamp.
    a. On the inside 3/4" barb to NPT use a hose clamp to attach a 4', plugged length of 3/4" hose.
    b. This will ensure water doesn't enter the vault through it before it is connected to an infrasound sensor.
3. Attach the 23 foot pump exhaust hose to the right bulkhead fitting using the ¾” barb to NPT elbow and secure with the SS hose clamp.
    a. On the inside 3/4" barb to NPT use a hose clamp to attach a 8' length of 3/4" hose.
    b. This will be attached to the bilge pump during installation.

Be careful not to mix up the infrasound and pump hose ends.
The pump hose you can suck air from, the infrasound hose is plugged.

4. Lay both external hoses in the trench avoiding sharp or large rocks.
5. Before the trench is backfilled drive 4 each 36” long steel construction stakes 24” into the ground.

6. The first two stakes should be 5 feet from the edge of the vault and 6-8inches from excavated trench

7. The stakes should be ~12” apart in a square pattern.

8. The 36” stakes should be driven 24” into the ground leaving 12” above ground.

9. Wrap one layer of the ½” steel hardware cloth around the stakes in a cylindrical pattern.
    a. Ensure infrasound hose and diffuser are inside the cylinder
10. Attach the hardware cloth to the stakes with tie wraps.
11. Run the 11feet of ¾” infrasound hose from the center bulkhead fitting (3/4”) to the hardware cloth cylinder.
12. Install the diffuser the end of the infrasound hose using a SS hose clamp
13. Place minimum of 4-6 inches of Lava rock and pack tightly.
    a. Infrasound hose should be to one side but still inside gravel pack.
14. Place another 3 inches of lava rock inside the hardware cloth cylinder.

15. Set the infrasound diffuser in the center of the hardware cloth cylinder on the lava rock.

16. Cover the diffuser with the remainder of the lava rock.
    a. The diffuser should remain in the center of the hardware cloth/gravel cylinder while filling the cylinder
    b. The lava rock should extend ~6” above the steel stakes.

17. Fold the hardware cloth on top of the gravel pack and use tie wraps to securely fasten hardware cloth.

18. Run the 23 feet of pump exhaust hose from the right bulkhead fitting down the trench to the mast.
    a. Avoid sharp large rocks
    b. Form 180 tight bend at the end of the pump hose
    c. Attach pump exhaust hose to mast using tie wraps
19. Ensure ground wire is attached to mast and is laid in the trench.
20. The trench can now be carefully back filled

Electrical conduit Infrasound port pump exhaust

SECTION 5

Basic Vault Construction

1. Open construction kit and assemble cable feed through, infrasound feed through and pump hose feed through assemblies
    a. Cable feed through and pump feed through assemblies (typical contents may vary)
    b. Use Teflon tape around threads of feed through fittings
2. Install 1.5” flex, infrasound and pump hose and fittings in bulkhead fittings on vault (see Section 6)
3. Connect cable feed through assembly to Solar Mast using 1.5” conduit and 90 degree sweeps (see Section 3)
4. Clean, prime, and glue all PVC joints
2. Prep power, GPS, and, Cell cables and pull from vault to Solar Mast. Tape cable ends to keep them free of dirt etc. (see Section 4)
3. Pull cables through cable feed through assembly and 1.5” conduit to mast assembly

4. Run cables into vault
5. Run marine hose from bulkhead assemblies down the trench to the infrasound gravel pack and mast (see Section 4)
6. Should ground conditions require scrap 1.5” PVC conduit may be used to protect marine tubing
7. Install 8' of marine hose on inside of vault to the pump feed through assembly
8. Install a plugged 4’ length of marine hose to the infrasound feed through assembly
9. Use Teflon tape around threads of feed through fittings
10. Ensure ground wire is properly installed and placed in trench
11. Backfill trench using care not to crush hoses and conduit
12. Label Vault inside and out with Site_code ex. T33A-1

13. Backfill around feed through assemblies by hand to protect marine hose, flex conduit, and PVC conduit from damage

14. Take photo of feed through assemblies, label photo “Site-code_Feedthrough” ex P48A_Feed through

15. Install lower foam pieces in vault.

16. Coil comm, GPS, power, and ground cables inside vault

17. Install upper foam in vault.
18. Install lid with chain and locks (set locks to standard TA combination), leave lid slightly ajar to vent moisture.
    a. Place rubber latches in the up position
    b. Tape rubber lid latches to vault
19. Backfill around vault (see Section 2)

20. Take photo of vault, label photo “Site-code_Vault Height” ex P48A_Vault Height

21. Place lid on vault
    a. The lid will sit just above the vault lip and help vent moisture
    b. Chains should be installed such that the lid can be removed by unlocking one lock only.

22. Backfill around vault and mound excess dirt around vault.

a. Level out area around vault and mast
b. Ensure backfill does not cover lid

c. Take photo of Lid, label photo “Site-code_Lid” ex P48A_Lid

SECTION 6

Installation of 1.5” Flex

Construction Note: some of the following is completed at the same time as items in Section 3

Required Parts:

1each Conduit flex PVC ~3’ long
1each 1 1/2"barb to 1 1/2" male NPT PVC
1each 1 1/2"barb to 1 1/2" female slip PVC
1each Teflon Tape
2each 1 1/2" SS hose clamps

Procedure

1. Ensure 1.5” PVC conduit in trench is long enough to allow for a gentle ‘S’ bend in flex PVC conduit
    a. This will ease installation
    b. Allow for movement of vault without pulling out the threads between the bulkhead fittings and the flex conduit

2. Use Teflon tape on all threaded fittings

3. Insert barb fittings into each end of 3’ flex PVC conduit
    a. `Secure flex PVC conduit to fittings using SS hose clamps
    b. Vault end fitting is 1.5” barb to male NPT
    c. 1.5” PVC conduit end is 1.5” barb to slip

4. Take photo of 1.5” bulkhead fitting from the inside, label photo “Site-code_Connector Inside View” ex P48A_Connector Inside View

SECTION 7

Completion of Site

Fencing

1. If cattle panel is required use a minimum of 8 tee posts per installation (see appendix)

   a. 1 post on each corner
   b. 1 post located midway between corner posts
   c. Use steel tie wire to fasten fencing to posts

2. Typical finished mast fence

3. Typical infrasound fence

a. An 8’ cattle panel is either cut or bent so that each side is 2’ long
b. Use 4 each T-posts, one on each corner
c. Use steel tie wire to attach fence panels to T-posts

Final Site Prep

1. Ensure site is left in good condition
2. Remove all scrap and litter
4. Smooth out all vehicle tracks

5. Take photo of finished Solar Mast location and vault location, label photo “Site-code_After” ex P29A_After

Appendix

Changes in Construction Operating Procedures

January 2008:

1. Fencing of solar mast is 4 sides, 8 ft side with the mast pole located on the north side of fence equal distance from the E, W poles (4 ft) and 2 feet from the fence itself towards the south side. 8 posts to be use to secure fencing.
2. Solar VSAT 4 inch pole is 5 feet above ground. This is to accommodate the different type of enclosures (height) used for the VSAT electronics

January 2009:

1. Use concrete vibrator to level concrete and remove trapped water or air from under membrane

November 2010:

1. Eliminate LB Assembly
2. Add Infrasound assemblies

May 2012:

1. New infrasound gravel pack
2. Replace liquid tight flex and fittings with more flexible hose and barb fitting with more threads

Mast Requirements:

Types of masts	*Total Pole length*	*Height Above ground level*	*Pole depth*	*Fence size if required*
Std Vault Mast, 2" sched 40, threaded on top	10'	7'	3'	8'x 8'
VSAT Dish Mast, 2" sched 40	10'	6'	4'	8'x 8'
Solar VSAT mast, 4" sched 40	10'	6'	4'	8'x 16'

Site Mast:	2" Galvanized		Pole length
Standard Height	6' above grade	4' below grade	10 ft
VSAT Mast:	2" Galvanized		
Standard Height	6' above grade	4' below grade	10 ft

Solar Power Mast: 4” Galvanized Schedule 40

Standard Height	6’ above grade	4’ below grade	10 ft

628A, Solar VSAT installation at Desert height

C11, Solar VSAT snow area installation

Z13

Z13

On solar VSAT the fencing should be 16' X 8'
With the VSAT pole 6' (4"pipe) from the 8' side and VSAT Dish pole is then 6' (2" pipe) from solar pole. Desert pole would be 5' above ground level; standard site would be 6' above ground.

Mast Requirements:
Site Mast: 2" Galvanized

Standard Height	6' above grade	4' below grade
Desert Height	**NONE**	

When required, fencing of 8'x 8' square, with pole location middle of north fence line (4' from each end) and 2' from the north side towards the south

VSAT Mast: 2" Galvanized

Standard Height	6' above grade	4' below grade

When required, fencing of 8'x 8' square, with pole location in middle of area fenced

Solar Power Mast: 4" Galvanized Schedule 40

Standard Height 6’ above grade 4’ below grade

When required, Fencing of 8’x 16’ square, with 4” solar pole minimum of 5’, Maximum of 6’ from 8’side and VSAT dish pole 6’ (what the spec is now) from solar pole. Poles would be 4’ from north and south sides

Construction Check List

Photos to be sent with the construction report:
_____Site before construction, labeled StationCode_Before
_____Bottom of vault hole prior to putting in concrete, labeled StationCode_Hole
_____Feed through assemblies Teflon tape applied, labeled StationCode_Feed through
_____Lid of vault after all backfill is completed, labeled StationCode_Lid
_____Finished site after all work has been done, including mast and fencing if required, labeled StationCode_After

Guidelines for construction:
_____Construction should be planned with minimal disturbance to surrounding land.
_____When possible, the vault should be at a higher elevation than the mast to avoid leakage problems.
_____Vault hole should be clear of loose dirt and tamped.
_____With vault in place chain for lid should be oriented perpendicular to ditch
_____In placing the SonoTube, (mast Pole) the initial backfill should be by hand with the base thoroughly tamped by foot.
_____Mast pole located in open clearing, exposed to sun from east to west
_____PVC conduit should be on the North side of mast.
_____Pump hose installed in trench per specifications
_____Ground wire connected at mast pole
_____Initial backfill on the conduit should be by hand to ensure that the conduit is stable and will not move or be damaged when backfilling by machine.
_____The lid should be completely clear of any dirt on it to eliminate any unnecessary work by the installation crew.
_____On completion upper/lower foam and pump/infrasound hose left inside vault
_____Security locks set to TA lock code
_____Completed site should have final grading 360 degrees, sufficient backfill dirt should be placed around the vault. Backfill dirt should be free of large rocks and trees/shrubs roots.
_____ Crew to make a sweep of site area to remove any waste left on the ground and site is clean
_____Site area and vehicle tracks smoothed when leaving site.
_____ Any extra work performed in area
_____Record GPS location of Site
_____Record number and weight of Quikrete sacks used to fill vault
_____Record length of vault and depth to finished floor

MATERIAL LIST (PER SITE)

Materials Supplied by Contractor

- 36 80lbs bags of concrete
- 32 lf fencing (welded wire mesh) with 4 each T-posts w/steel fence ties
- 30 lf 1.5" electrical PVC conduit
- 1 each 12" X 48" sonotube
- 1 each 2" X 10' Galvanized Schedule 40 pipe with threaded cap
- 1 tube 3M 4200 caulking
- PVC glue
- 30 lf 3/8" chain
- 2 each 3/8 shackles
- ½ PVC liquid tight flex conduit 5 feet in length

when specified for AC VSAT (estimated 40% of total, or 89 sites)

- 1 each 2" X 10' Galvanized Schedule 40 pipe
- 1 each 12" X 48" Sonotube
- 4 each 80lbs bags of concrete

when specified for Solar VSAT (estimated 10% of total, or 38 sites)

- 1 each 2" X 10' Galvanized Schedule 40 pipe
- 1 each 12" X 48" Sonotube
- 1 each 4" X 10' Galvanized Schedule 40 pipe
- 1 each 24" x 48" Sonotube

Materials Supplied by IRIS

- HDPE vault with lid
- 40' solar panel cable
- 40' LMR400 RF cable
- 75' GPS antenna cable
- Misc PVC fittings to terminate conduit both ends (Construction Kit)
- Feed thru fittings for vault side
- Top foam disk
- Bottom foam halves
- Pump/infrasound tubing and fittings

The following Construction report with attached/labeled photos to be emailed each day upon completion of Site.

Recipients: Katrin Hafner, Bob Busby, Steve Welch, Don Lippert, Sandi Azevedo, Denise Elvrum

Subject line: Construction Report - Station Code

US Array Construction Report: Station Code
Form: V1.1

Date: YEAR MO DA

Site: XXXA-1

Station Code: XXXA

Tube Length = "
Distance from rim to concrete = "
Distance from rim to mast = '
Rim above grade ~: 1
Tamped hole: YES
Number of sacks of concrete to complete vault floor =
Size of concrete sack = lbs

Fencing Installed: Cattle Panel around mast/None

Elevation = M
GPS: LAT LON

Comms:

VSAT: AC/DC
Elevation = M
GPS: LAT LON

Construction crew: IRIS Construction Engineer
Coastal Tech: (Trent Hooten, Mack Maclauchlan, others)

Comments: Any notable actions or circumstances

The following Daily Construction Summary is to be emailed each day upon completion of Site(s).

Recipients: Katrin Hafner, Steve Welch, Don Lippert, Rick Stout, Anthony Gonzales

Subject line: Daily Construction Summary YRMO DA

Daily Construction Summary

Date: YRMODA

Time started: 24hr format Central

Site(s) constructed:

Site(s) plan for tomorrow:

Site(s) completed this deployment:

Location of crew:

Time reported: 24hr format Mountain

Comments: Any notable actions or circumstances

Construction Requisition Check List 10/07/2010)		QTY
5005043	Construction (box) 07/22/2010	
5000676	cable 50 ft LMR 400 N connectors	1
5009494	interface box /SP 40’	1
5001445	Master Lock	2
5008175	vault feed through kit	
5001268	PVC Kit	1
5001446	Sweep 90 degree	1
5001664	Antenna Kit	1
5001765	Pump Kit	1
5008323	flex conduit – feed through to PVC pipe kit	1
5001563	foam plug	1
5008346	Infrasound Kit	1
	42" diameter vault w/lid	1
5001692	pump hose for pump and infrasound [ft]	25
5000781	lower foam insert (2 halves) 6" thick	1
5000761	upper foam insert 4" thick	1
5006022	10awg ground wire solid bare copper [ft]	30
	1.5” SS hose clamp	1
	1.5” PVC barb to female slip	1
	1.5” PVC barb to male NPT	1
	1.5” diameter PVC flex conduit [ft]	3
5001765	Pump Kit	1
5001445	master lock	2

5001268	PVC Kit 04/11/08	
5001668	1.5” slip to 0.5” thread female PVC fitting	1
5001669	2” rigid cap	1
5001667	1.5” slip to 0.75” thread female PVC fitting	1
5001670	1.5” female slip PVC Tee fitting	2
5001671	large hose clamp	2
5006021	medium hose clamp	2
5008583	medium-small #32 hose clamp	1
5001666	PVC elbow 1 1/2 inch slip female male (street L)	1
5000668	liquid tight bulkhead connector (strain relief)	1
5001664	Q330 Clock Antenna Kit 04/11/08	
5004058	clock antenna	1
5004130	netcable LMR 50	1
5000803	0.75” by 4” gray tube PVC nipple	1
5001765	Pump Kit 04/11/08	
5006798	0.75” 90 degree reducing INS by MPT	1
5001686	1.75” washer reducer	2
5001688	0.75” 90 degree reducing INS by FPT	1
5001690	0.5” to 1.15” hose clamp	3
5001691	0.75” plastic check valve	1
5001693	0.75” ball cock washer	1
5005263	0.75” ID rubber gasket	1
5000803	0.75” by 4” gray tube PVC nipple	1

5008346	Infrasound Kit 07/22/10	
5008310	Infrasound Feed Through Kit 07/01/10	1
5008348	0.75” coupler barb x barb	1
5008349	0.75” gray plastic plug	1
5008350	0.5” mini suction strainer	1
5008310	Infrasound Feed Through Kit 07/01/10	
5001686	1.75” washer reducer	2
5001688	0.75” 90 degree reducing INS by FPT	2
5001690	0.5” to 1.15” hose clamp	4
5001693	0.75” ball cock washer	2
5001180	0.75” by 4.5” gray tube PVC nipple	1