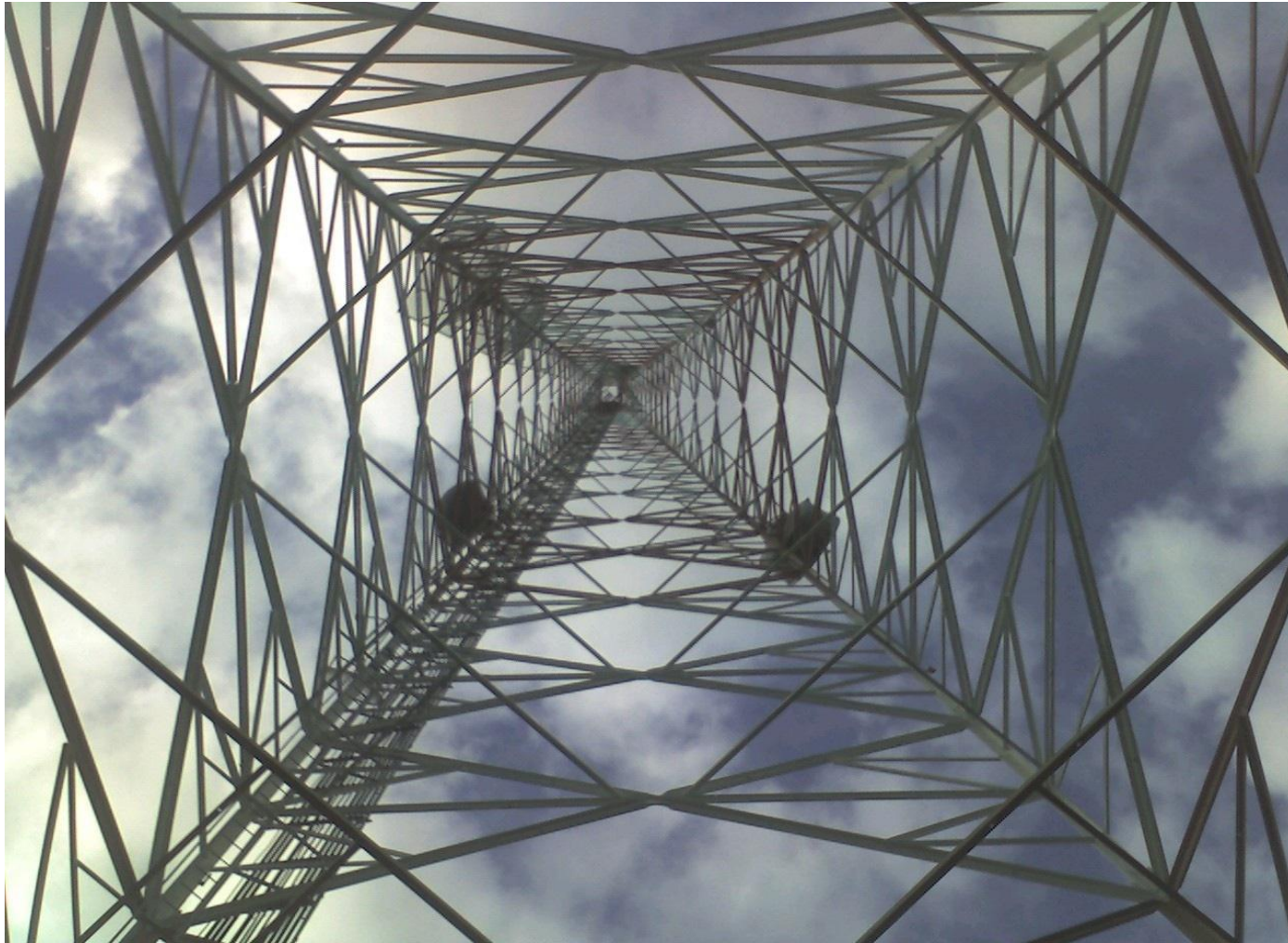
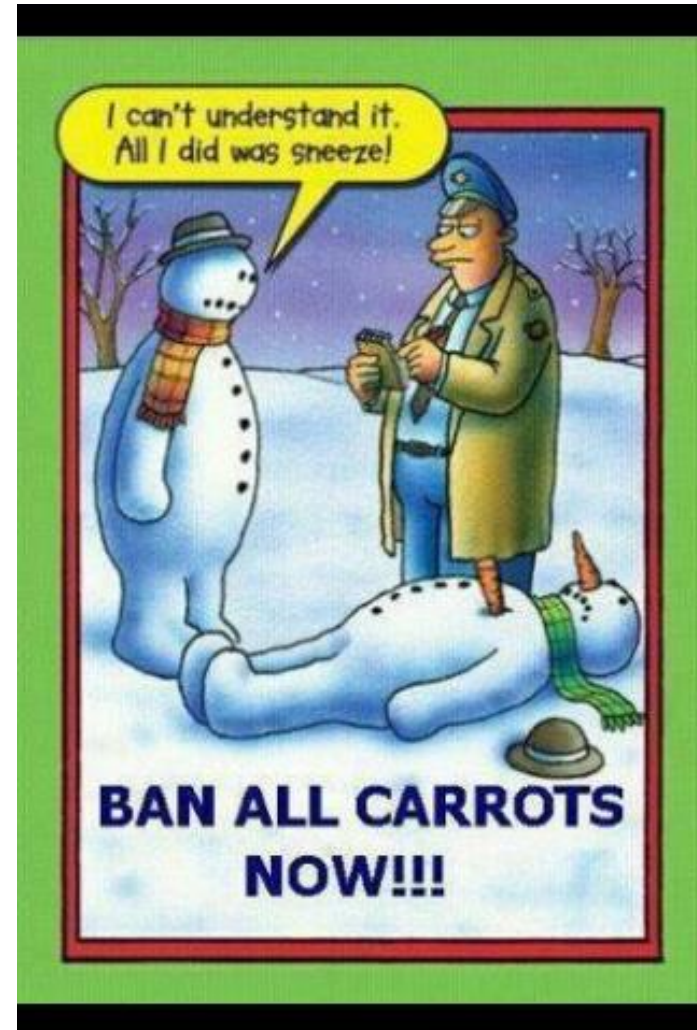


Part 2: The Continuing Challenges for the Contractor Working on Tier 1 Carrier Cell Sites: How to Ensure You Stay on the Air



QUALITY POWER, INC

- Joe Pfau
 - Associate Member IAEI
 - Associate Member IEEE
 - Licensed EC - AL/GA
 - Member NFPA



What are the Challenges - Contractor Concerns

A young graduate asked a retired engineer how he became so successful.

The engineer replied “Just Two Words Son.”

The graduate asked: “What Are They?”

The engineer replied “Correct Decisions.”

The graduate replied: “Okay. I am 21, you are retired. How Did You Know To Make Correct Decisions?”

The engineer replied: “Just One Word Son”.

The graduate replied “OK. What is That Word?”

The engineer smiled and replied “Experience.”

Feeling challenged, The Graduate Asked: “Well, How Did You Get The Experience?”

The Engineer Replied: “Just Two Words Son”.

Determined, The Graduate Asked: “What Are Those Two Words”?

To Which The Engineer Replied: Wrong Decisions.

What are the Challenges - Contractor Concerns

- Overview From 2014
 - Contractor values
 - Tier 1 Carrier values
 - Dangers of low bid
 - Dangers of undefined Scope of Work
 - What defines a healthy relationship?
- Case studies of contractor and carrier failure to define objectives and follow through
 - Is there a solution?

What are the Challenges - Contractor Concerns

Carrier Prerequisites

- **Communication**
- **Accurate (if any) drawings Standards**
 - Provided and understood
- **Ownership**
- **Training**
 - Not done!
- **Safety**
 - Realistic schedule
- **Dedicated Time & Project Oversight**
- **Execute**
- **= Values**

What are the Challenges - Contractor Concerns

Questions....

- **With price becoming the main constraint in maintaining reliable network infrastructure, how does the carrier retain qualified vendors?**
 - **Vendors are forced to reduce pricing, decrease margins**
 - **More contractors OoW, local markets reduced expense budgets**
- **How then do vendors retain qualified technicians to support the carriers?**
 - **Costs of benefits-salary-operational overhead**
- **What prevents repetitive callbacks for the same problem?**
 - **Find Personnel that want a Career vs. Job**
 - **Contractor Documented Training**
 - **Invest in people-Individual Ownership**

What are the Challenges - Contractor Concerns

Questions....

- **How do oversights by the AHJ affect projects, equipment operation, network operations?**
 - **The customer wants to know:**
 - Why the project is delayed.
 - Is it going to cost more money with change orders?
 - Why does the issue matter?
- **When the AHJ overlooks a code or standard requirement, who is responsible for making corrections?**
 - **The GC does not want to hear about it.**
 - **They may be reluctant to use a “Troublemaker”**
- **When the GC makes the statement “Who are these stupid people writing code anyway?”. Tell them “Congratulations, you are now on 2 committees.”**

What are the Challenges - Contractor Concerns

Challenges-Contractor perspective....

- **Work Scheduling**
 - **Conflicts with multiple contractors at one site-NTP**
 - Ground work delayed because of tower crew or vice-versa
- **Suppliers?**
 - **Telco provided materials**
 - Purchase Orders not processed
 - Delays in ship dates
 - Faulty equipment
 - **Contractor supplied materials**
 - Fiscal strength of contractor
- **Carrier Field Technicians**
 - **Are technicians causing problems with work?**
 - Operational Micro-management. Are techs afraid to make decisions?
 - Operational Micro-management. Do techs try to run the job?
 - Is apathy an issue? Allowing shoddy work to pass.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

1. The customer is always right, even if they are wrong.

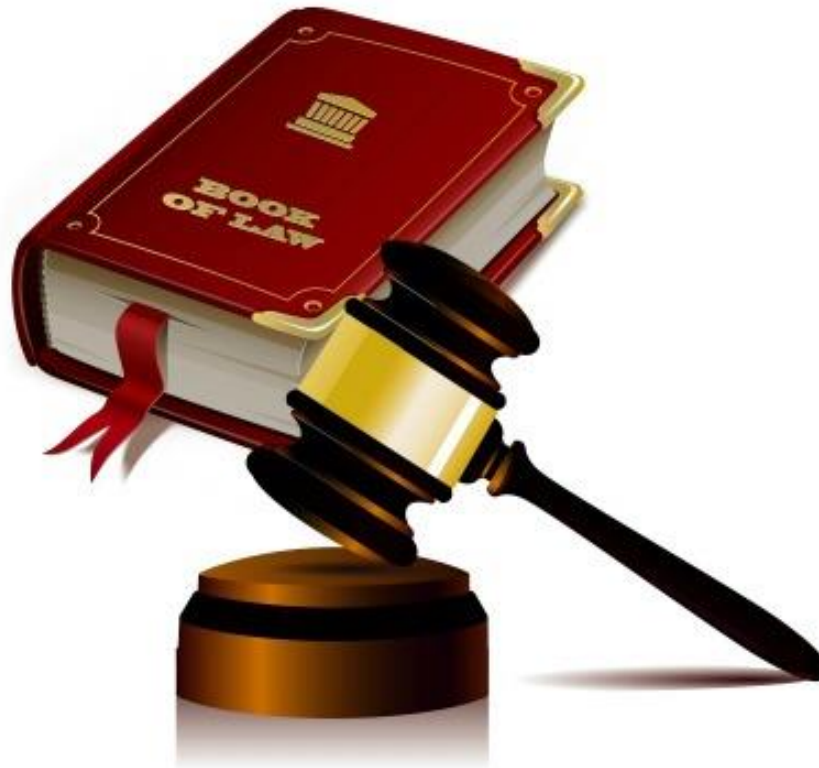


Image courtesy nirots/freedigitalphotos.net

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

2. Correct documentation (provided by Construction Engineer or Project Manager):

- At best the documentation provided to GC's is 80% accurate.
- This is primarily due to:
 - ENG/PM not properly updating files
 - Updating files within a time span.
 - Multiple ENG/PM working different projects at the same location.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

3. Standards:

- Generally there are basic nationwide standards detailing a minimum.
- Each region or area may build upon these standards.
- Contractors may become accustomed to the standards of a given region.
- Then, if they begin to do work for another region, they may encounter a tougher, more stringent enforcement of standards requiring additional manpower, time and costs.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

4. Licensing:

- Can differ from state to state or county to county.
- Issues with planning vs. inspection departments
 - Zoning required 5 sets of drawings
 - Only to find out it was not required
- Landlords
- Tower Owners-Delays in NTP
- Environmental

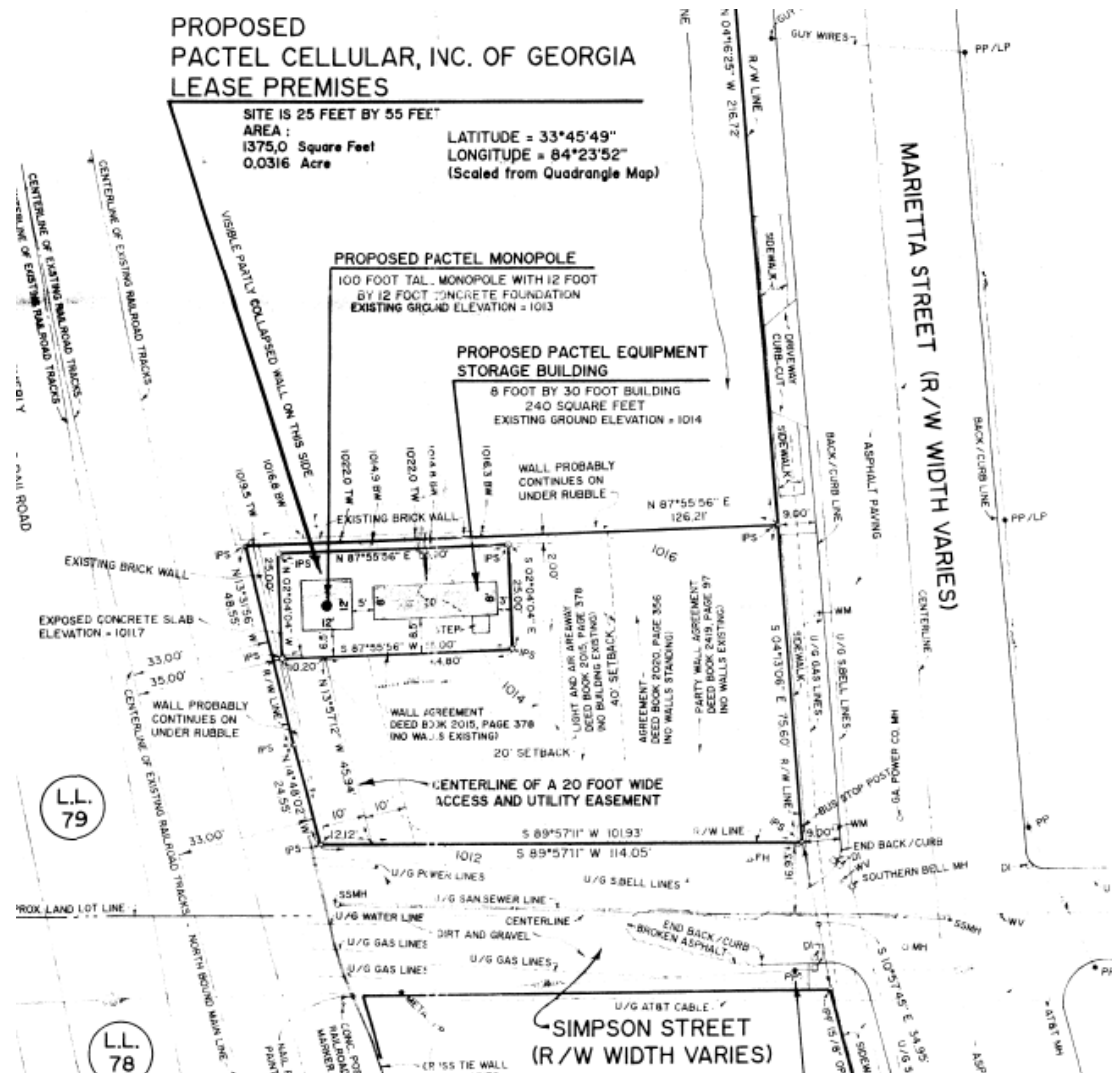
What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

4. Licensing:

– Easement:

Plans obtained from tower owner



What are the Challenges - Contractor Concerns

Challenges: Easement Delays

4. Licensing:

Easement: Real Estate said gas service was available



Date	APRIL 30, 1993
Scale	1" = 20'
Drawn	CSB
Job	924
TAX MAP REF. 14-79-9-65	

What are the Challenges - Contractor Concerns

Challenges: Easement Delays

4. Licensing:

Easement Only to find out that NG was not available



What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

5. New GC's:

- New GC's can find it very difficult to “get their foot in the door” and once inside can be highly scrutinized or put under the microscope.
- This is largely due to ENG/PM having GC's who have worked a very long time in the area and are familiar with standards and ENG/PM teams.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

6. Local GC's vs non-local GC's:

- With bidding standards and Fair Labor standards, it is hard for non-local GC's to compete financially with local GC's.

7. More GC's than a region may need:

- This is a constant problem. Everyone wants to give all a chance but can be limited by the number of GC's approved for contract.
- There may be more than a dozen different tower companies that can be sourced for project work with another dozen trying to get their foot in the door.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

8. Technology:

- Paradigm shifts occur regularly in the wireless business.
- Keeping GC's trained on new technology.
 - For example, for the past 25 years coax has generally been the standard delivery of signal to antennas mounted 200 or 300 feet up on a tower.
 - In the past year fiber has become the standard with new high-tech testing procedures.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

9. Cost of new technology:

- GC's usually provide their own test equipment (usually specified by ENG/PM) requiring high costs per test set (5-30k).
- In most cases GC's are required to have 3 or 4 different pieces of test equipment to test for 3-4 different items. If a contractor has 5-6 teams then the amount of test equipment needed increases.
- These costs are upon by the GC with no guarantee of ROI.
 - EX: We bid on tower projects in MS but lowest bid is always used. Yet we would be required to purchase and use a \$10k azimuth alignment tool.

What are the Challenges - Contractor Concerns

Contractor Challenges-Carrier Perspective

10. Fast paced:

- The wireless business moves very quickly to deliver the latest technology and latest bandwidth demand to customers.
- This requires GC's to work quickly.
- In many cases a standard AWS modification (ex: to add AWS carriers to a cell site) requires a GC to complete the project within 3-5 days, testing included.
- There is a strong temptation to take shortcuts.

What are the Challenges - Contractor Concerns

Safety-Contractor and Carrier Responsibilities

CONTRACTOR

- Not having the right tools
- Taking Shortcuts
- Safety is compromised



CARRIER

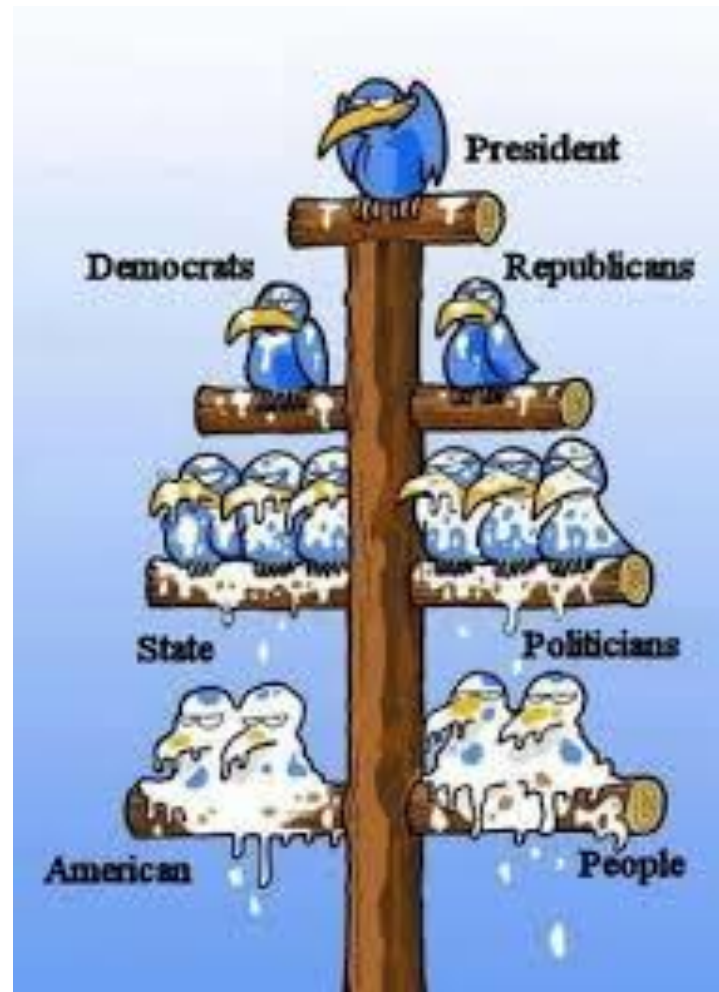
- Not maintaining infrastructure
- Equipment locations
- Safety is compromised



What are the Challenges - Contractor Concerns

Challenges: Issues Both Carrier and Contractor Faces

- First meeting the Contractor says yes to everything
- What happens when objectives from top down are not clearly defined?
- What you hear in meetings is completely different than what you see in the field (I did not know you meant that!!!)
- Sometimes it is difficult to prove the “Fault” aiding the contractor to request a change order.



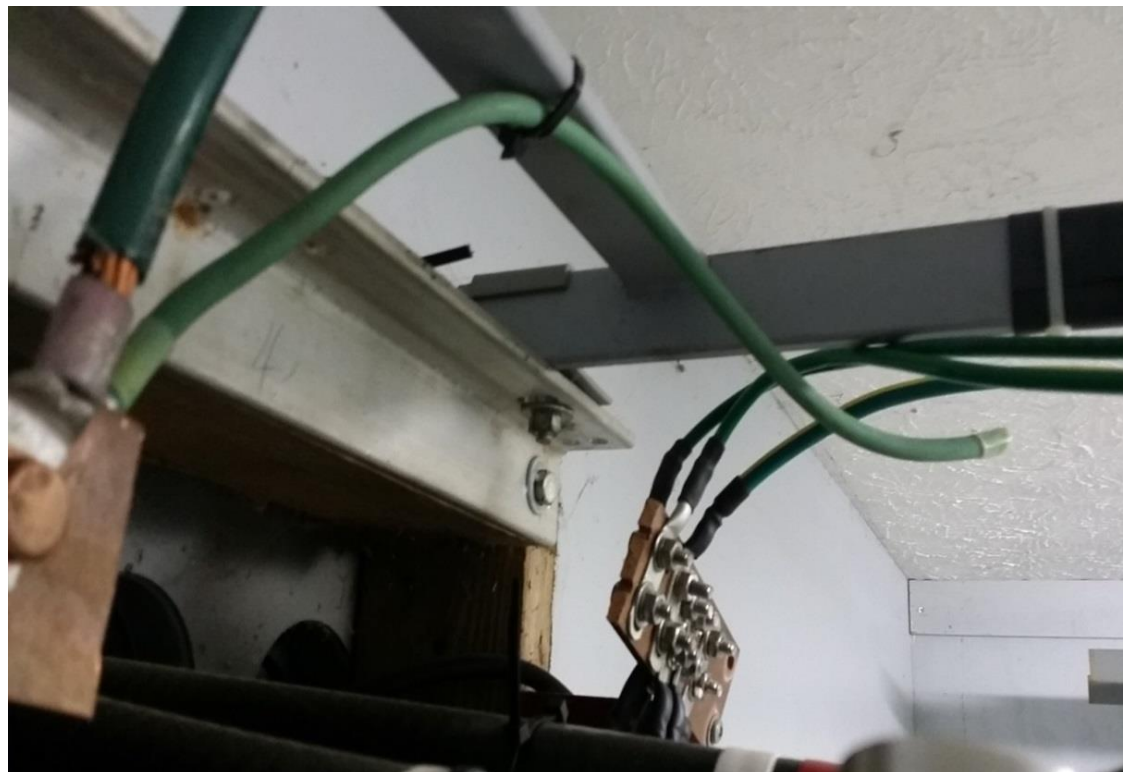
SOME CASE STUDIES

What are the Challenges - Contractor Concerns

Challenges: Contractor “Engineering”

WHAT??? **WHY???**

- How does Telco insure contractor has read and understands standards and work guidelines?
- How are field modifications reported back to Carrier?



What are the Challenges - Contractor Concerns

Challenges: Contractor Shortcuts

- How does Telco assure it's designs meet the objectives?
- An example of contractor not being prepared
- An example of a contractor not caring.
- But Hey...
- They were low bid
- Check list anyone?



What are the Challenges - Contractor Concerns

Challenges: Issues Contractor Faces

- How does the Telco ensure project has been completed properly (joint acceptance inspection)?
 - No Construction or Project Manager from Telco visited site
 - In this case, the rack makes a nice wall hanger, good luck servicing plant LV contactor



What are the Challenges - Contractor Concerns

Challenges: Issues Contractor Faces

- When equipment manufacturer does not understand its own documentation
- Manufacturer representative demanded 1.5" pipe be run from meter pressure regulator to generator regulator.
- Did not understand pressure vs. water column

TABLE 4 FUEL PIPE SIZING

Natural Gas (Table values are maximum pipe run in feet.)

kW	Pipe Size (in)						
	0.75"	1"	1.25"	1.5"	2"	2.5"	3"
7-8	55	200	820				
10	20	85	370	800			
13-14	10	50	245	545			
16-17		40	190	425			
20		20	130	305	945		
22		15	115	260	799		
25		10	95	220	739		
27			85	203	552		
30			60	147	565		
35-36			35	95	370	915	
40			25	75	315	790	
45			15	60	260	650	
48				50	230	585	
50				50	220	560	
60				25	145	390	1185
70				5	75	225	710
80					65	195	630
100					40	140	460
130						50	215
150						30	150

LP

LPG: 8.55 #/lb., 4.24 lbs./gal., 2500 btu/ft³

LPG: 36.3 ft³ = 1 gal.

Natural Gas

1 cubic foot = 1,000 BTU

1 therm = 100,000 BTU

Gas consumption = 13,000-16,000 BTU per kW/hr

Pressure

1 inch mercury = 13.61 inches water column

1 inch Water Column = 0.036 psi

5-14 inches water column = 0.18 psi to 0.50 psi

LP Vapor (LPV) (Table values are maximum pipe run in feet.)

kW	Pipe Size (in)						
	0.75"	1"	1.25"	1.5"	2"	2.5"	3"
7-8	165	570					
10	70	255	1000				

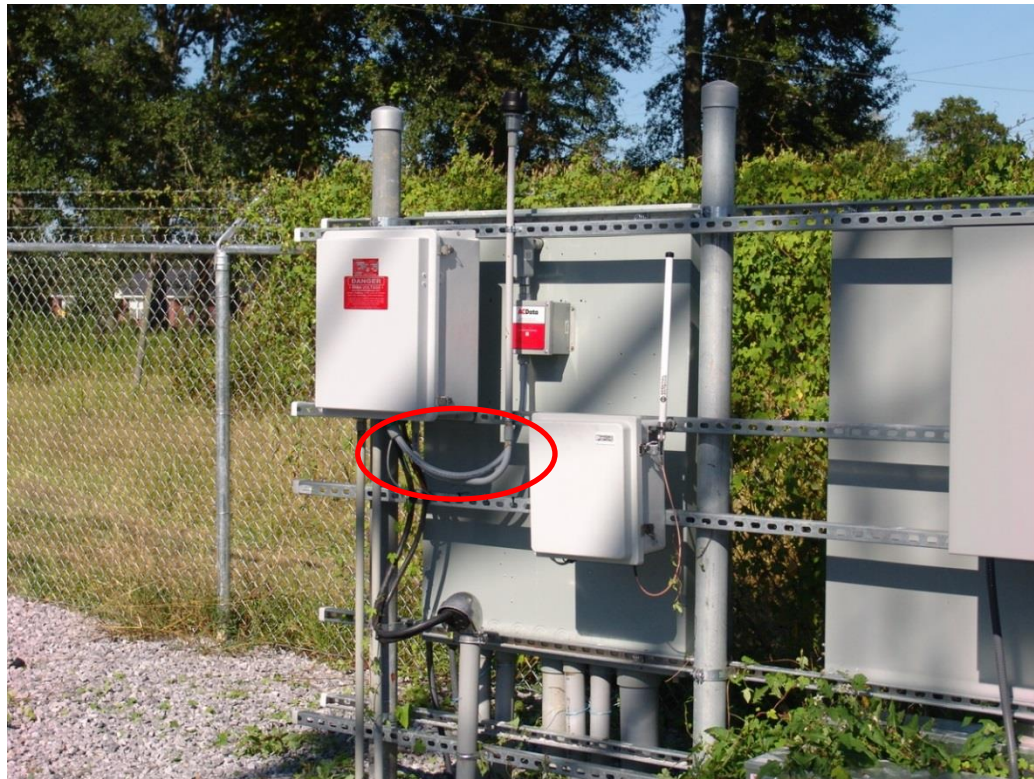
Note:

- Pipe sizing is based on 0.5" H₂O pressure drop. Sizing includes a nominal number of elbows and tees.
- Please verify adequate service and meter sizing.

What are the Challenges - Contractor Concerns

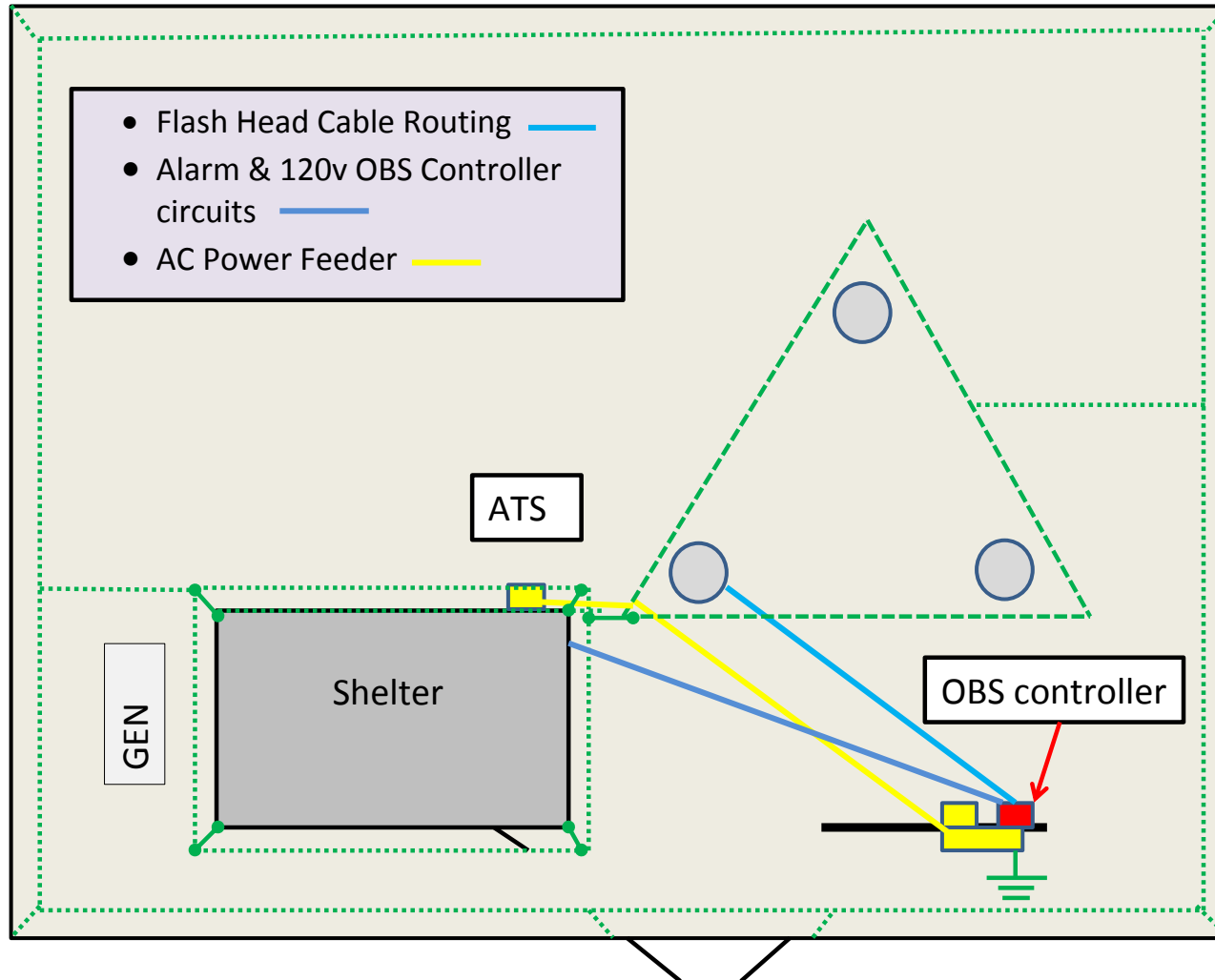
Challenges: Repeated Lightning Damage

- (X) = Site was built.
- At time of our involvement, there were no known records of the installed grounding architecture.
- AC Service and controller installed on H-Frame.
- Alarm from SPD goes to the OBS (Obstruction Lighting) controller, they share same multi-conductor from H-frame to shelter



What are the Challenges - Contractor Concerns

Cell Site Grounding Electrical Layout



What are the Challenges - Contractor Concerns

Challenges: Repeated Lightning Damage

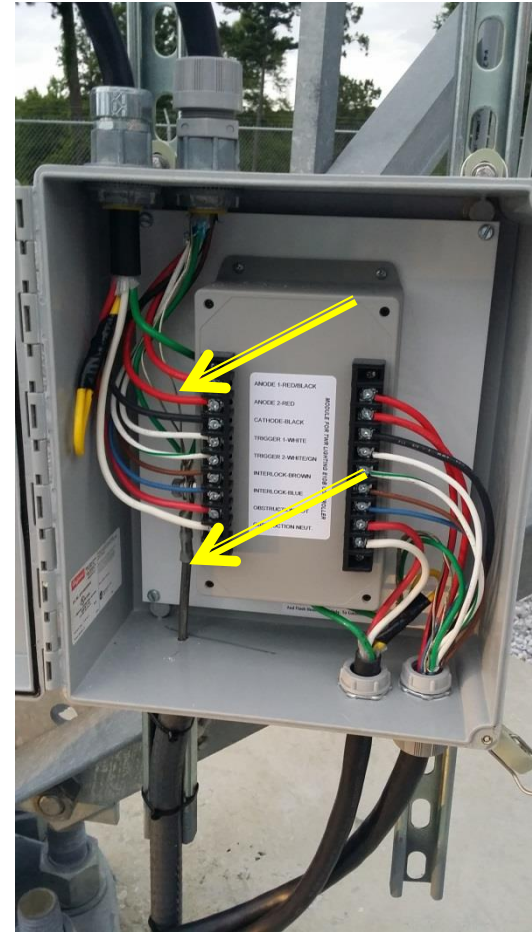
- Cellular equipment, AC SPD and OBS controller suffered lightning damage in first year.
- AC Power SPD Upgrade Solution was chosen.
- Additional grounding, alarm protection, and OBS lighting protection was not chosen.



What are the Challenges - Contractor Concerns

Challenges: Repeated Lightning Damage

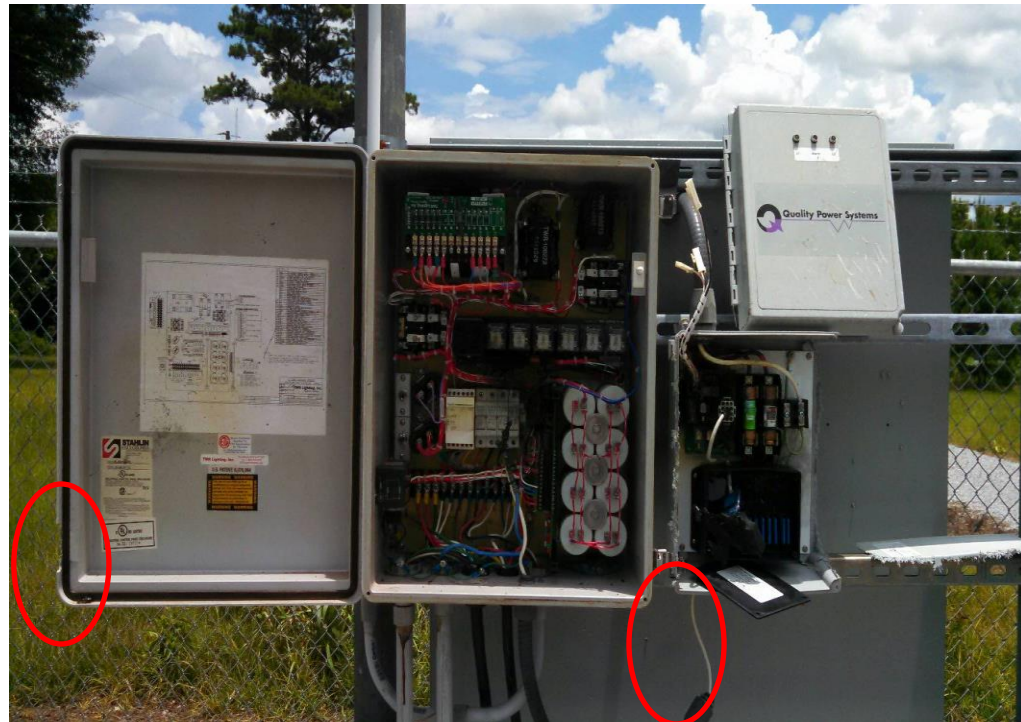
- One year later, lightning damages cellular equipment (alarms) and OBS controller.
- Tower light SPD installed.
- Additional bonding and alarm SPD not chosen.
- Note: Shield of cable bonded to SPD module and 2AWG SBTC going to buried ring



What are the Challenges - Contractor Concerns

Challenges: Repeated Lightning Damage

- Less than one year, Cellular equipment (alarms), AC Power SPD along with OBS controller destroyed during thunderstorm.
- OBS SPD not damaged.
- **How did OBS controller and AC Power SPD get destroyed and yet no damage to OBS SPD mounted on the tower?**

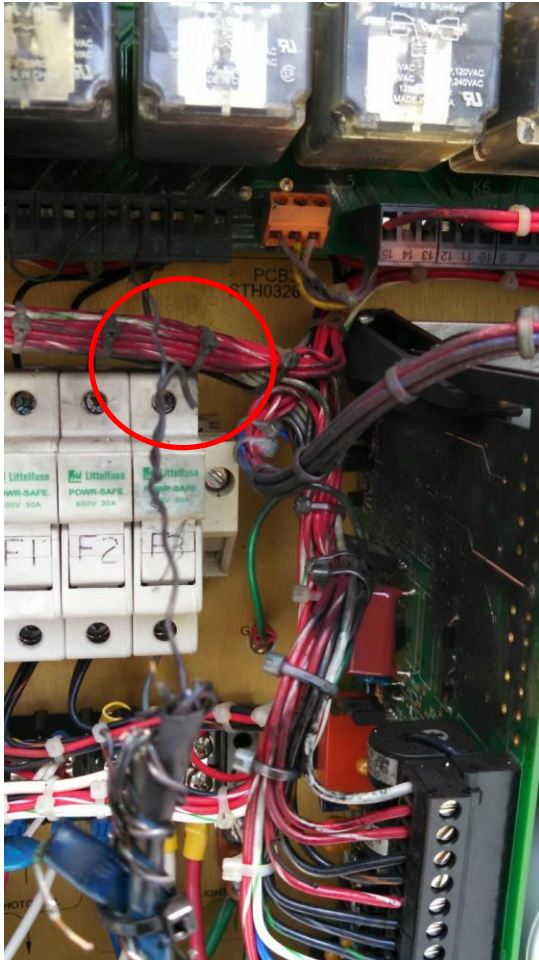


- Note Alarm Cable.

What are the Challenges - Contractor Concerns

Challenges: Repeated Lightning Damage

OBS ALARM VAPORIZED

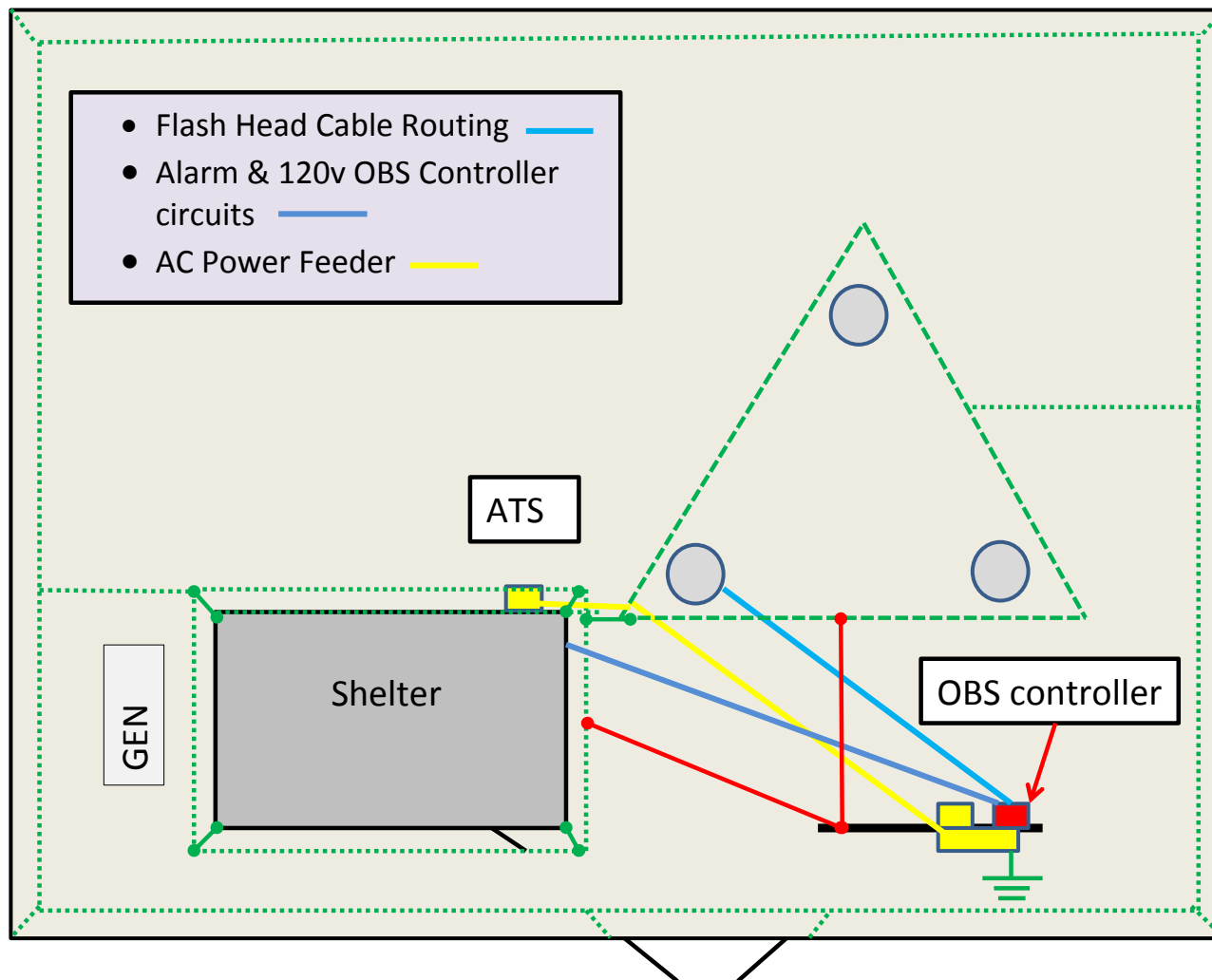


ARC ON GATE POST



What are the Challenges - Contractor Concerns

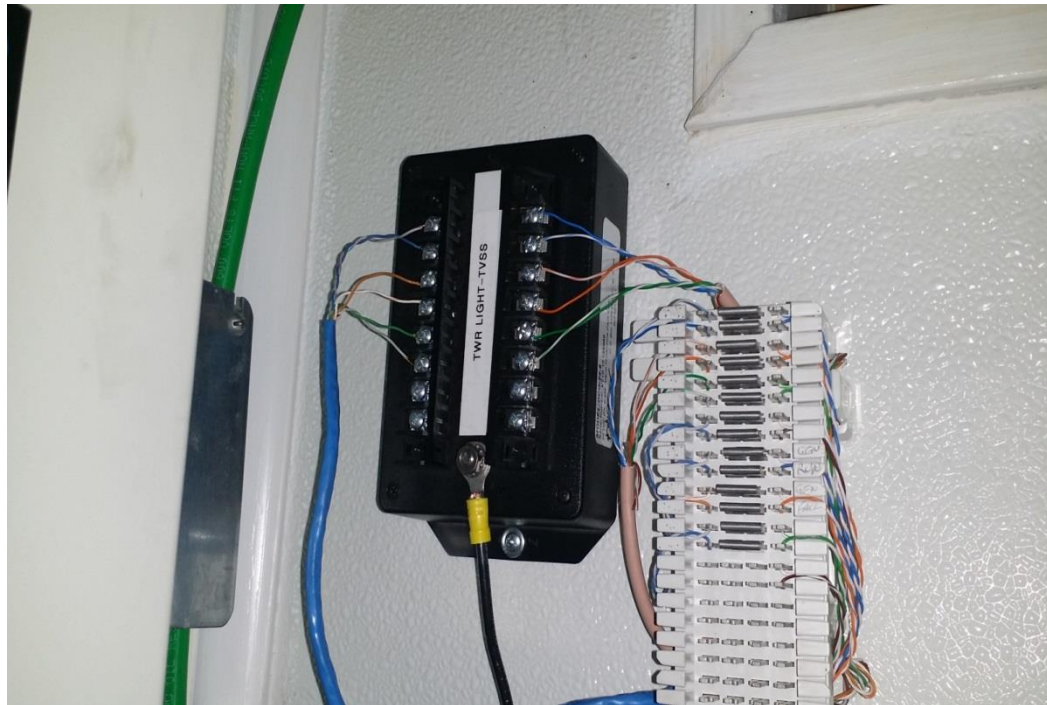
Cell Site Grounding Electrical Layout



What are the Challenges - Contractor Concerns

Challenges: Repeated Lightning Damage

- Additional Bonding added from H-frame to tower ring.
- Additional bonding from H-frame to shelter ring.
- AC power SPD and OBS controller replaced.
- Alarm protection added.
- No more damage.



What are the Challenges - Contractor Concerns

Challenges: Raised Platform Generator Installation

- **Site located on Gulf Coast-Dauphin Island**
- **Very busy site with weekend traffic and special events**
- **Site had 3-4 hrs. battery reserve.**
- **Physical space limitations and multi-tenants made portable generator deployment difficult.**
 - **Could not leave generator parked**
- **Customer wanted to provision standby generator.**
- **Low Bid contractor awarded work.**
- **GC from over 400 miles away, used sub from Oklahoma.**
- **No pre construction site walk**

What are the Challenges - Contractor Concerns

Challenges: Standby Generator Installation

- Carrier reported Loss of Power.
- Carrier Tech dispatched to site.
- After they verified the outage, repair crew arrived at site <2 hours.
- By then the site was off air.
- GC was still working on their project with no attempt to get site back on the air.
- Pulled conductors out of meter socket



What are the Challenges - Contractor Concerns

Challenges: Standby Generator Installation

- Contractor did not have a MOP.
- Contractor did **NOT** follow basic procedures to identify buried utilities.
- Contractor did **NOT** take any ownership to get site back on the air.



What are the Challenges - Contractor Concerns

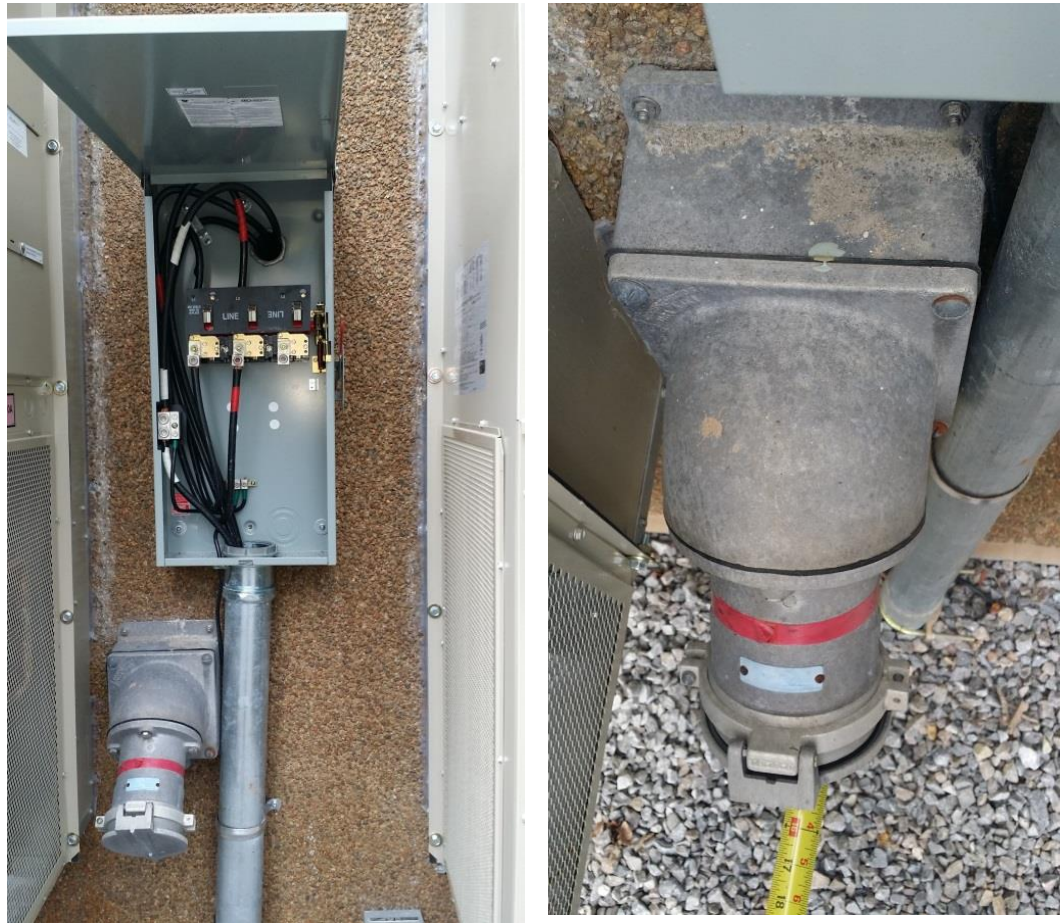
Challenges: Standby Generator Installation



What are the Challenges - Contractor Concerns

Challenges: AHJ Oversight

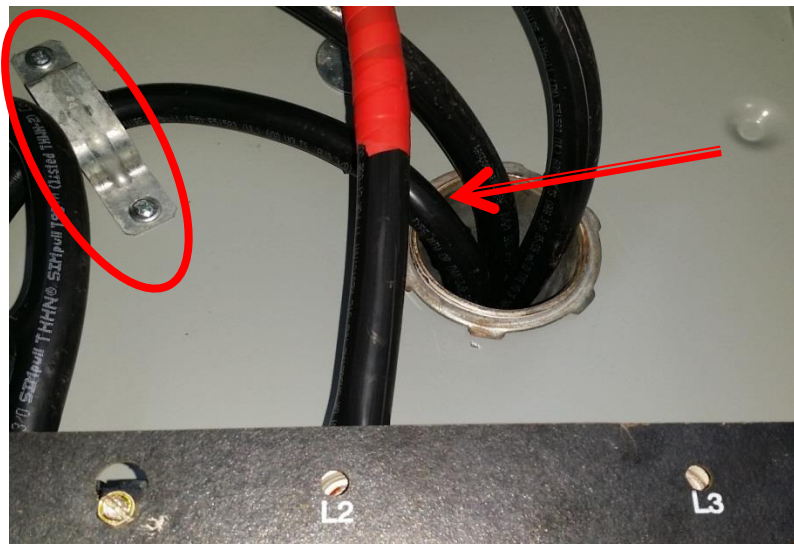
- EC installed electrical system with numerous NEC violations.
- Article 110 Working Clearance
- Unfused service disconnect.
- AHJ accepted work and issued Certificate of Occupancy.



- NEC Article 110 violations

What are the Challenges - Contractor Concerns

Challenges: AHJ Oversight

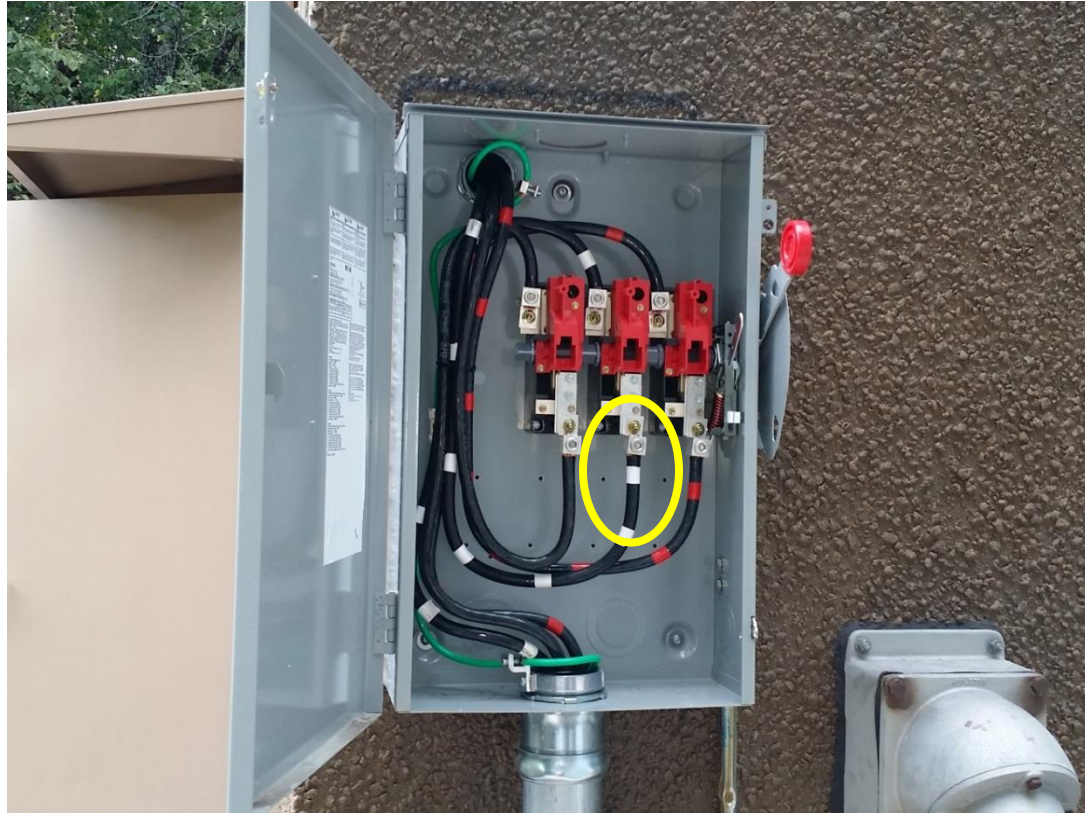


- 2 hole strap for smaller conduit was used as 1 hole strap
- Service entrance (SE) strap was used in disconnect to keep ungrounded conductor secured.
- No bushing on steel nipple with ungrounded conductor digging into nipple wall.
- I don't make this stuff up folks.

What are the Challenges - Contractor Concerns

Challenges: AHJ Oversight

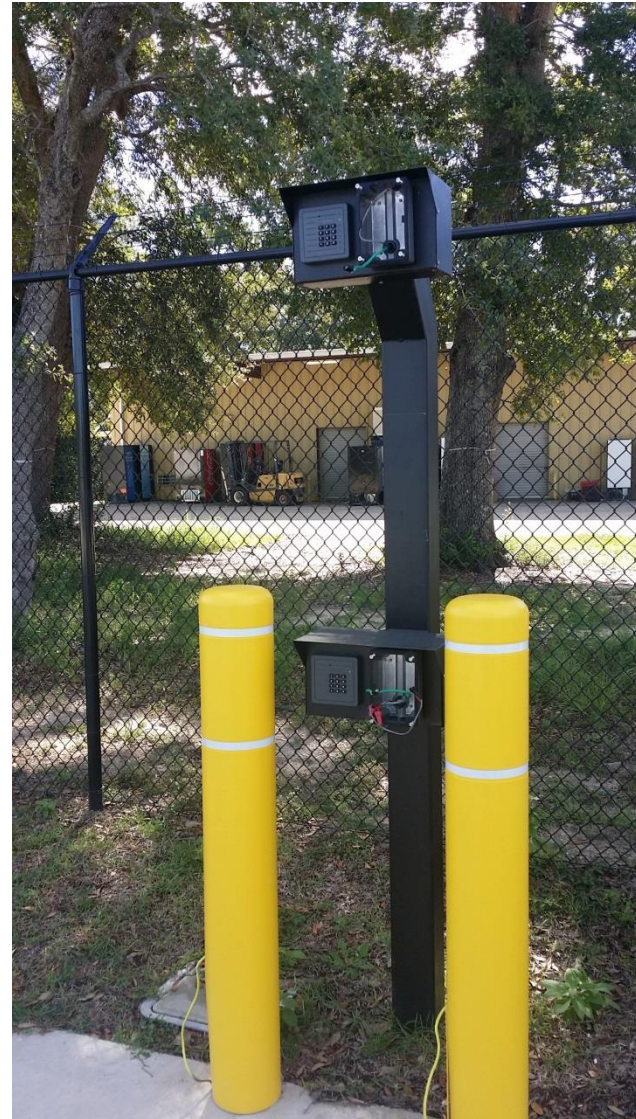
- Shelter disconnect wired with switched neutral.
- GC upset that NEC violation was called out.
- No More work was awarded from the GC after calling them out.



What are the Challenges - Contractor Concerns

Challenges: PoE

- **MSC in FL has two gates, East and West side of the switch**
- **No tower, 2 services**
- **Next to railroad tracks**
- **PoE Intercom and gate controller damaged repetitively.**
- **Stations located inside and outside compound.**
- **Where trucks bring COWS, COLT into lot, upper and lower station required at each pole.**
- **8 stations total**
- **Note bonding on bollards**



What are the Challenges - Contractor Concerns

Challenges: PoE

- Outside access.
- Separate AC Power service drop installed to feed generators, COW's, etc.



What are the Challenges - Contractor Concerns

Challenges: PoE

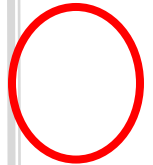
- **MSC electrical service fed by service lateral from pad mounted transformer.**



What are the Challenges - Contractor Concerns

Challenges: PoE

- Cable entry



What are the Challenges - Contractor Concerns

Challenges: PoE

- View of East gate from MSC
 - Note lighting from MSC, gate controller fed from 2nd service



What are the Challenges - Contractor Concerns

Challenges: PoE

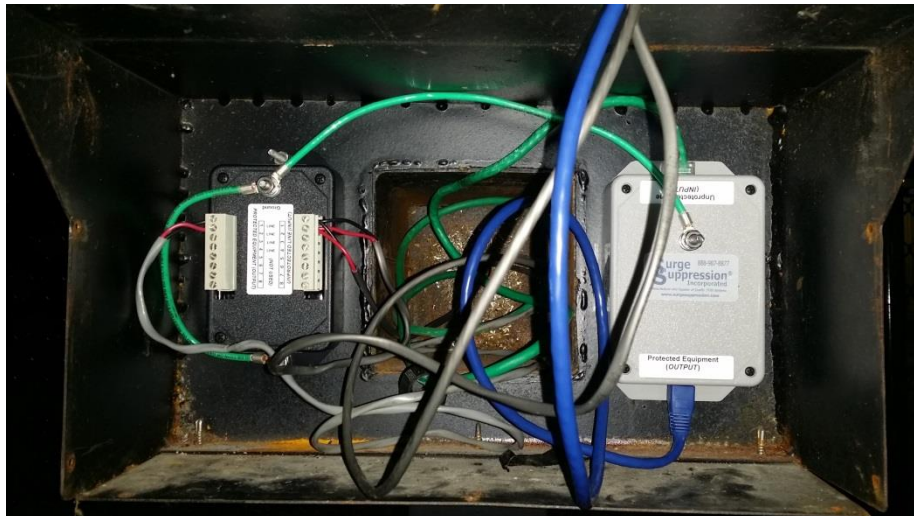
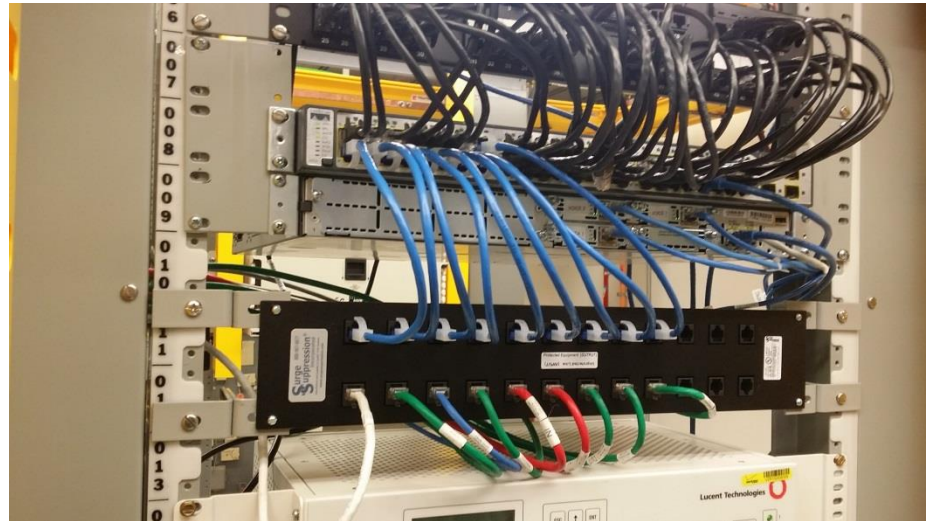
- The problem



What are the Challenges - Contractor Concerns

Challenges: PoE

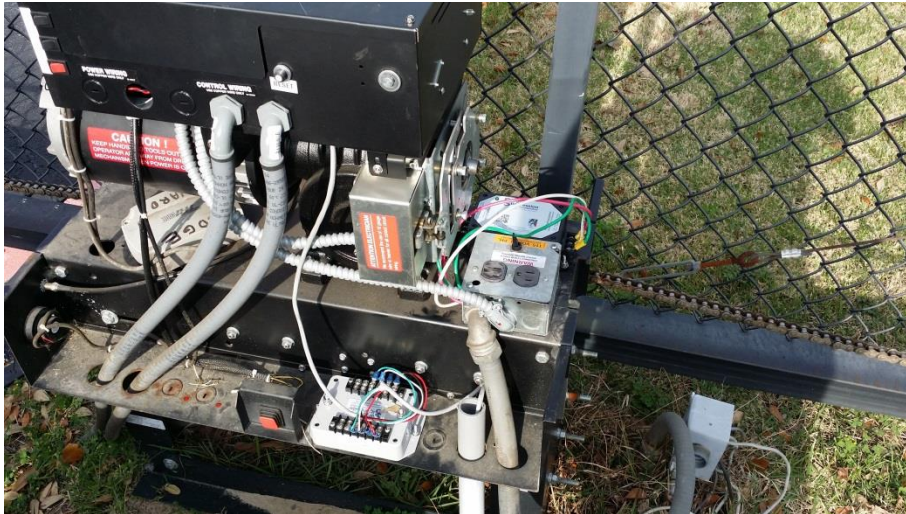
- The solution



What are the Challenges - Contractor Concerns

Challenges: PoE

- The solution



What are the Challenges - Contractor Concerns

Challenges: AHJ Oversight

- AHJ issued CO without getting a final inspection.
- 3 months after installation, the service disconnect burnt up.
- During repairs, AHJ wanted to know why final inspection had not been called in.



What are the Challenges - Contractor Concerns

Challenges: AHJ Oversight

- Hole blown through back of enclosure



What are the Challenges - Contractor Concerns

Challenges: Rectifier & Standby Generator Conflict

- Generator would not carry building load.
- Generator would “hunt” and lights would go on and off.
- Generator technician was unable to solve the problem.
- Determined issue occurred when rectifiers came online.



What are the Challenges - Contractor Concerns

Challenges: Rectifier & Standby Generator Conflict

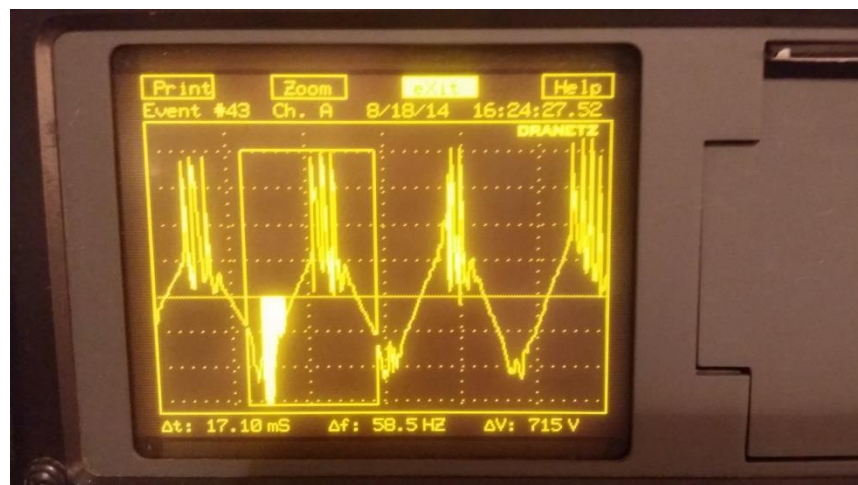
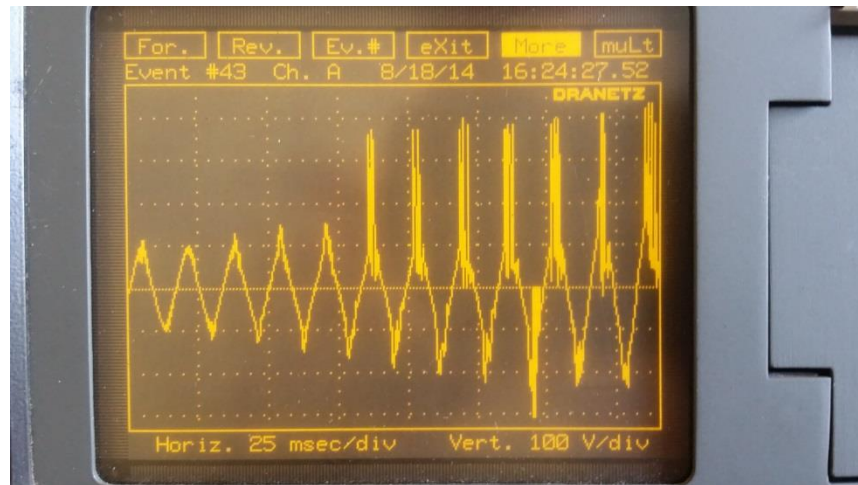
- Elected to use PQ analyzer for AC power monitoring.
- Monitoring setup performed using a Dranetz 658 disturbance analyzer
- Channel setup (1, 2, & 4) for voltage L-L, L-N, and a clamp-on CT on L-1.



What are the Challenges - Contractor Concerns

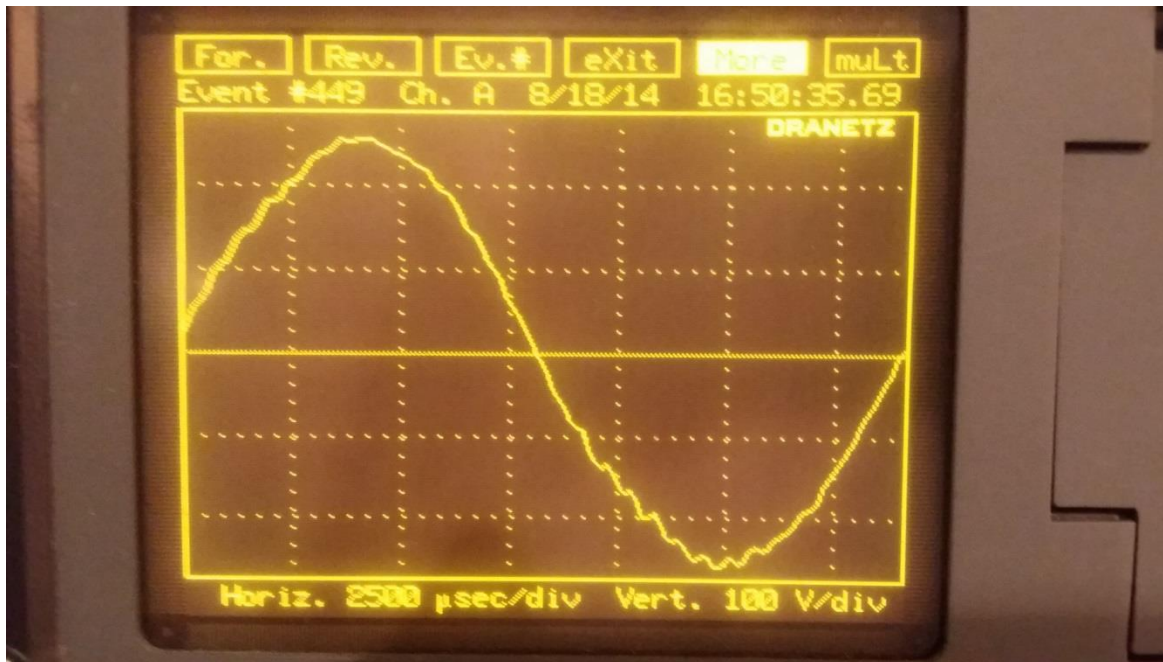
Challenges: Rectifier & Standby Generator Conflict

- Commutation from SCR's could be seen as the voltage came up.
- Transients were occurring in positive and negative polarity.
- Lower picture is a zoom feature of the transients.



What are the Challenges - Contractor Concerns

Challenges: Rectifier & Standby Generator Conflict



- Added surge protection with 100kHz filters and sine wave smoothed out.
- There was still some hunting with the generator controls but site stayed up.

What are the Challenges - Contractor Concerns

Challenges: Rectifier & Standby Generator Conflict



What are the Challenges - Contractor Concerns

Challenges: Rectifier & Standby Generator Conflict



- Installed new solid state speed control and Mag pickup
- Adjusted throttle linkage

What are the Challenges - Contractor Concerns

Challenges: Repeated Trips

- **Two Other Vendors previously called to Repair PIM issues**
- **Discovered poor connector repair.**
 - **Retaining spring on back nut was missing in jumper causing center pin to move on front fitting creating PIM issues.**



What are the Challenges - Contractor Concerns

Thoughts....

- **The value of a good preconstruction walk is to identify work requirements to carry out the job, but also to inspect the site to ensure there are no major issues to prevent safe completion of work.**
- **Site review reveals many related and unrelated issues that are reported back to customer – for customer decision on which items (if any) to address.**
- **Customers may want to make corrective changes but budget allocations (not planned for) constrain them.**

What are the Challenges - Contractor Concerns

Pre-construction Objectives

- **Fully Understand Scope of Work**
- **Provide thorough Pre-walk/Investigation**
- **Provide Report of items that may change the SOW**
- **Provide solutions**
- **Provide training as required**
- **Execute the project**

Post-construction Objectives

- **Provide well documented COP**
- **Provision for site visit**
- **Otherwise there will be no accountability**

What are the Challenges - Contractor Concerns

Sample-Prebid SOW

- Cover Page



100 Parker Drive
Pelham AL 35260
Telephone: (205) 620-3420
E-mail: jpfau@qualitypowerinc.com

DUBLIN GENERATOR UPGRADE SOW

Job Site: GA 1422	Dublin, GA Cell Site	Date of Audit: February 5, 2015
Project Description:	Diesel Generator Upgrade	Co-Locate with VZW MW shelter
Project #: V2152071422	Electric Utility: Little Ocmulgee EMC, Meter 37938	200A service lateral, 200A fuses
Office Type:	Cell Site	Rock Veneer
Address:	613 Firetower Road	Dublin, GA 31021
Site Code:	20-7-1625	Lat: 32.48722222, LONG: -82.93027778
Auditor:	Joe Pfau	205-999-6618
Site Contact:	Jeremy Ormiston	770-713-1053

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Executive Overview and Summary:

Quality Power, Inc. was contracted to perform an inspection of the existing generator installation and AC power infrastructure and write a SOW to be used for the bidding process.

The inspection and site review was conducted at the Dublin Cell Site on February 5, 2015. The audit revealed several items to be considered in order to have a first class installation.

This audit was conducted at the direction of Operations personnel. We wish to thank VZW for their assistance and co-operation. Scope of work can be found on Page 2. Supporting Pictures are found on pages 3-7.

What are the Challenges - Contractor Concerns

Sample-Prebid SOW

- Summary Page

LIST OF ISSUES FOUND AT DUBLIN CELL SITE

The cell site is located in Fiberbond shelter with a generator room, there is a guyed Crown Castle owned tower, with other carriers on the tower. The AC power service lateral is 1 phase, 200 Amp, 120/240 volts. There are no issues traveling to and accessing the site. Because the new generator will be installed inside and the ATS footprint is larger, the ATS will have to be installed outside of the shelter. The SOW is as follows :

AC Power and Generator Preparation

- Write MOP and have approved copy before work begins.
- Obtain permit (if required)
- Schedule outage with VZW local operations. Verify battery reserve capacity.
- Schedule new radiator transition with sheet metal shop. (Possible requires visit to site when new generator is installed).
- Provide VZW provisioned portable generator to be used as backup during work.
- Pump fuel off of existing Onan generator.
- Remove fuel vent and lines/piping from tank and out of wall. (New ATS will mount outside at this location.) Seal holes on shelter exterior before mounting ATS.
- Remove all wiring from Onan generator to ATS.
- Remove radiator transition from Onan radiator.
- Install temporary power from service disconnect to Panel DP-1. Use coax ports and 80' minimum of 200A temporary feeder.
- Remove wiring from ATS feeding panel DP-2 (Transformer circuit)
- Remove existing Onan ATS.
- Install new ATS to the right of the intake air louver. (See Picture 1)
 - Bond RMC conduit, the service disconnect and ATS to the buried ring with 2AWG SBTC conductors.
- Run 2" RMC conduit between the service disconnect and ATS.
 - Pull conductors from meter to service disconnect and from service to ATS. Connect conductors in ATS.
 - Call for inspection. (if required)
- Run Load conduit from ATS to panel DP-1. (See Pictures 3 & 4)
 - Tie into existing 2" conduit that was fed from service disconnect outside.
 - Set 12" x 12" x 6" NEMA 1 junction box over hole where existing ATS fed panel DP-1
 - Pull Power conductors from ATS to Panel DP-1.
 - Remove temporary feeder and wire new feeder and wire new feed from Service disconnect

Generator Installation

- Remove Existing Onan generator. Drain all fluids and dispose of properly.
- Install new Generac diesel generator in generator room.
- Install new radiator transition
- Install new thimble and exhaust system. Includes new silencer with center inlet. Wrap all parts of exhaust system. Note: New Thimble and exhaust system will require a larger hole through the shelter wall.
- Install new fuel fill line and vent pipe stack.
- Run new conduits from generator to ATS. (See Pictures 3 and 5)
- Run all alarm circuits, start stop, 120 volt block heater and battery charger circuits. Use existing conduit and extend as required.
- Wire power, alarms, 120 volt circuits. Bond generator frame using Burndy compression lug and tool.
- Fuel generator and commission.
- Schedule with warehouse for delivery/return of old generator.

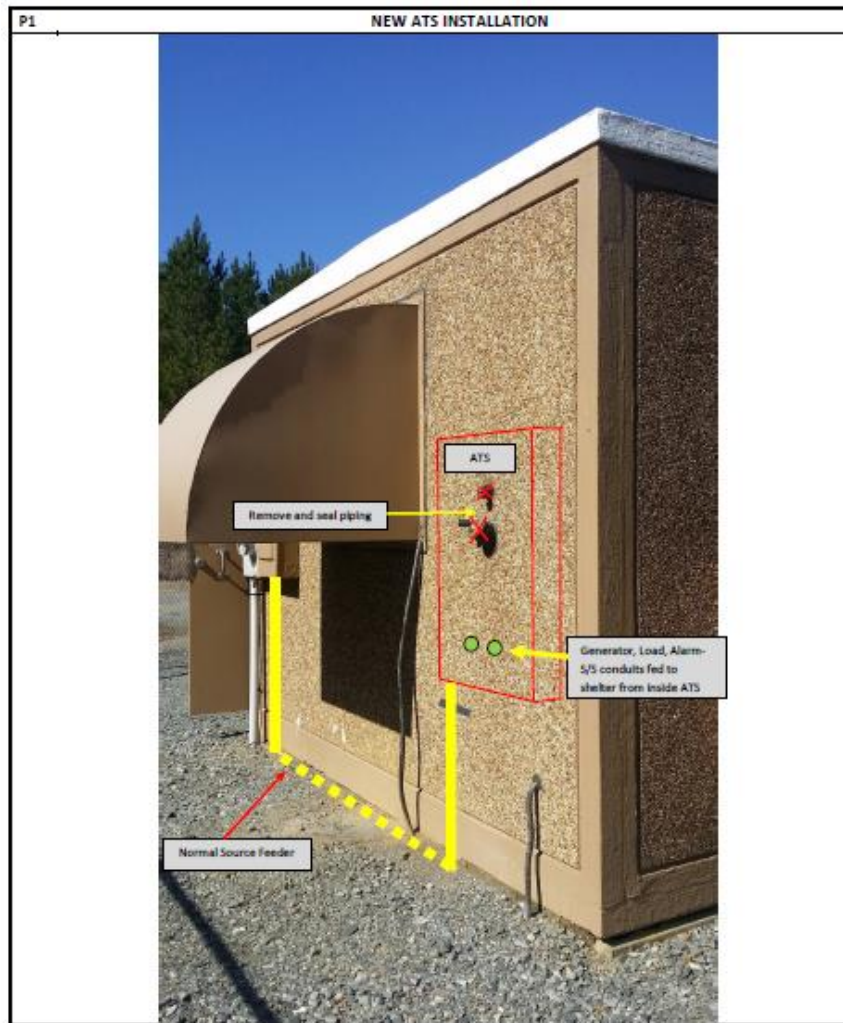
Interior Work

- Remove circuit feeding Panel DP-2.
 - Remove Isolation Transformer
 - Remove panel DP-2, all conduit, wiring, seal all holes with UL listed hole closures
 - Remove Joslyn SPD and seal holes

What are the Challenges - Contractor Concerns

Sample-Prebid SOW

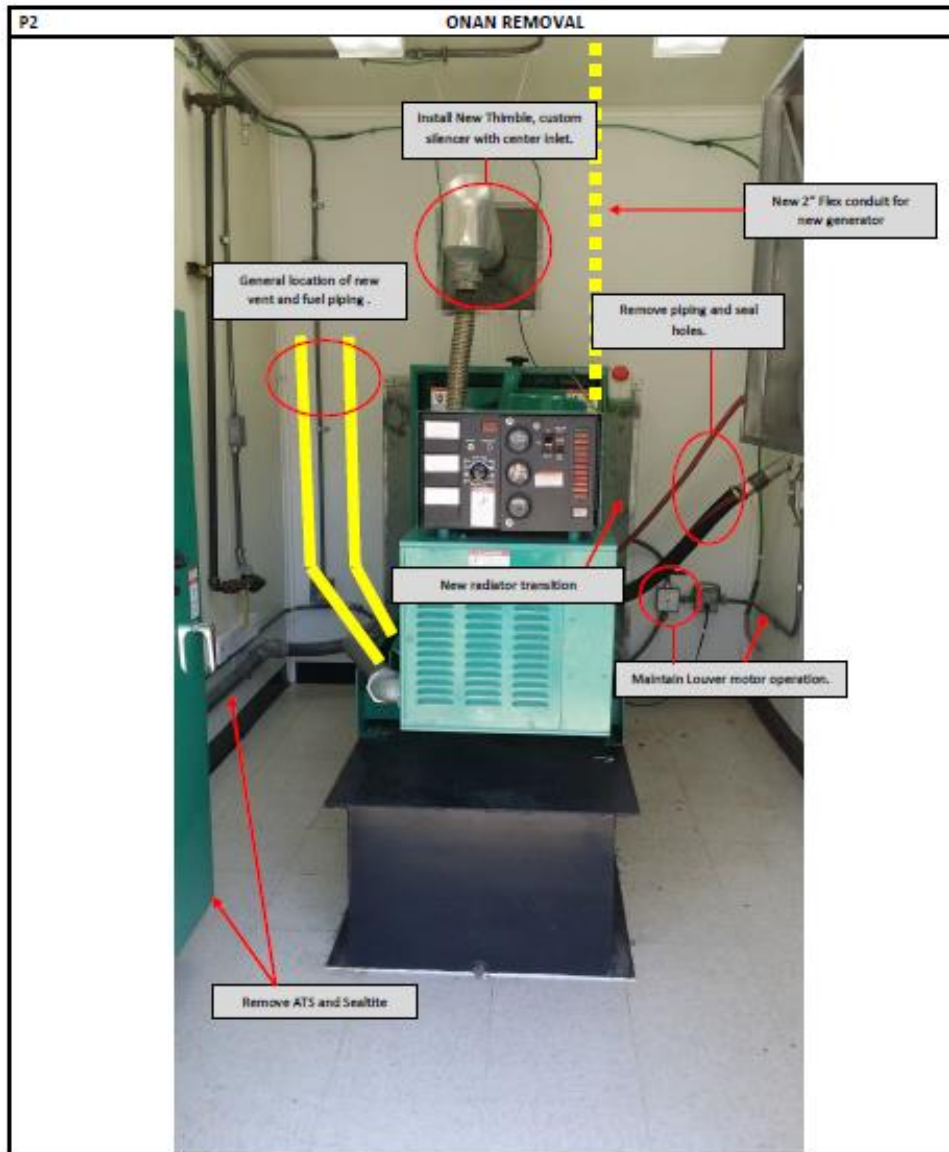
- Supporting Pictures



What are the Challenges - Contractor Concerns

Sample-Prebid SOW

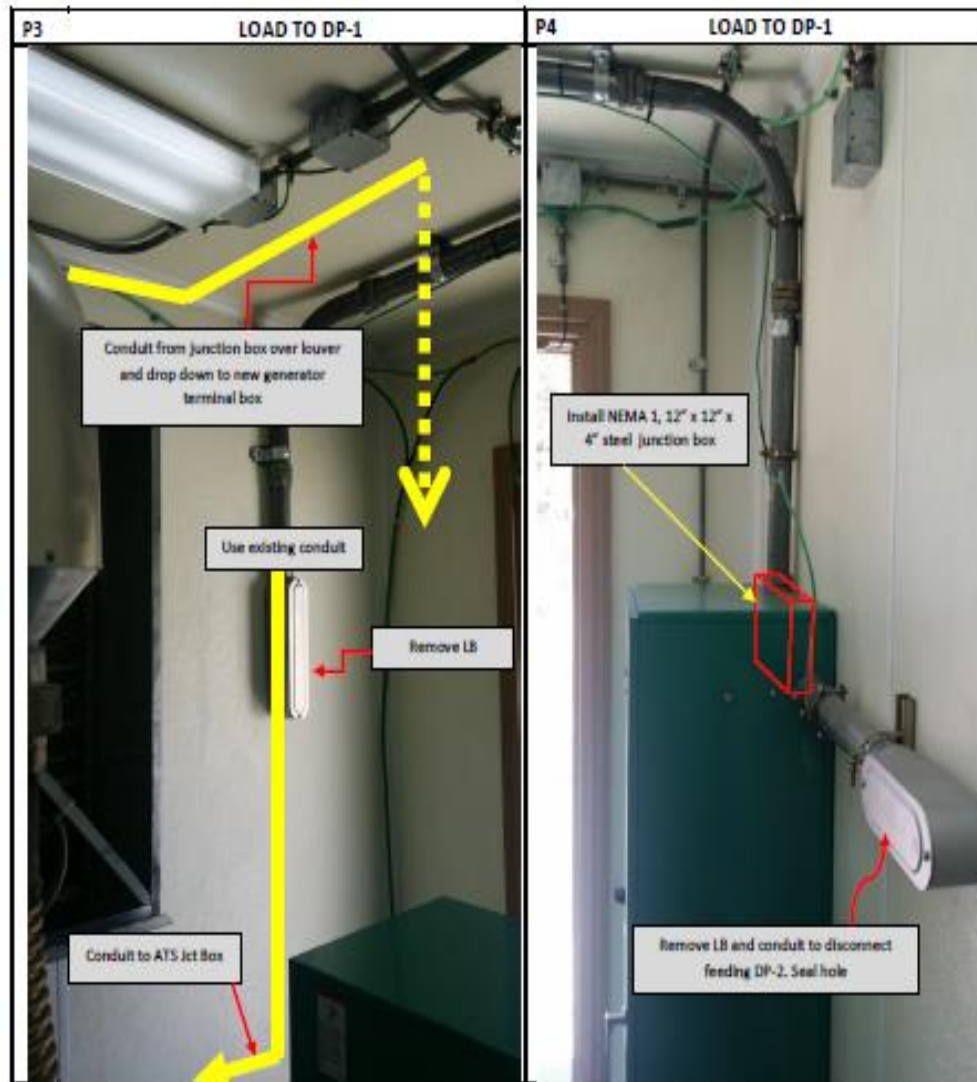
- Supporting Pictures



What are the Challenges - Contractor Concerns

Sample-Prebid SOW

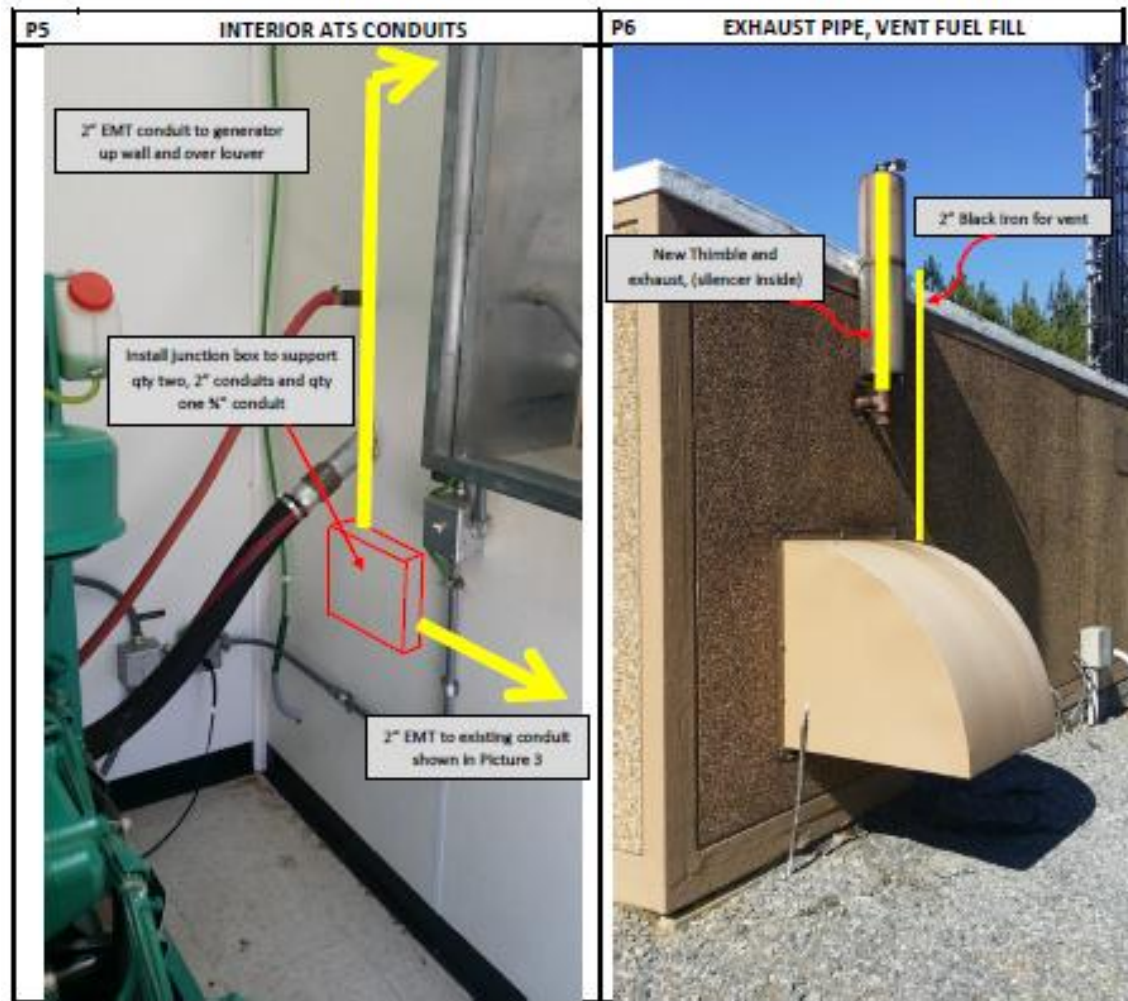
- Supporting Pictures



What are the Challenges - Contractor Concerns

Sample-Prebid SOW

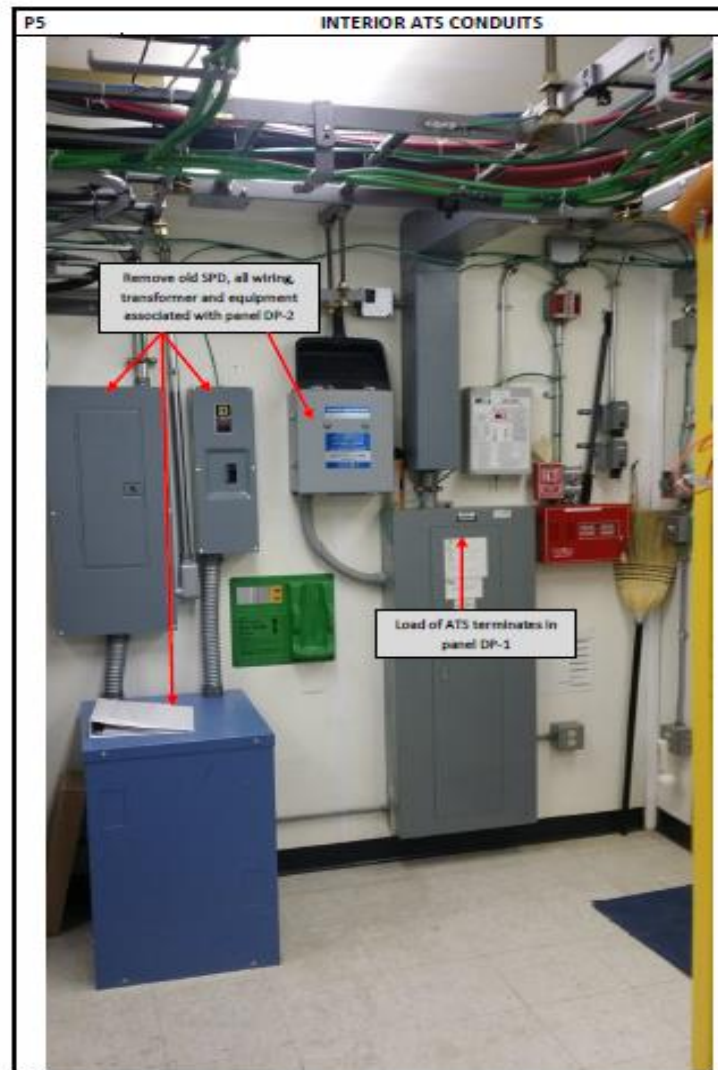
- Supporting Pictures



What are the Challenges - Contractor Concerns

Sample-Prebid SOW

- Supporting Pictures



END OF REPORT

What are the Challenges - Contractor Concerns

SUMMARY

- **Experience still shows that inadequate communication is a major reason for project issues.**
 - **There must be a conscientious effort with all parties involved.**
- **Carrier must invest more resources to manage the project.**
 - **Must develop contractor knowledge to insure mutual success. Standards, Work Practices, Documentation**
- **Contractors must be held accountable and take ownership of their work including training.**

You Do Not Know...

What You Do not Know...

Until You Know...

What You Do not Know

Part 3

QUESTIONS??

THANK YOU!