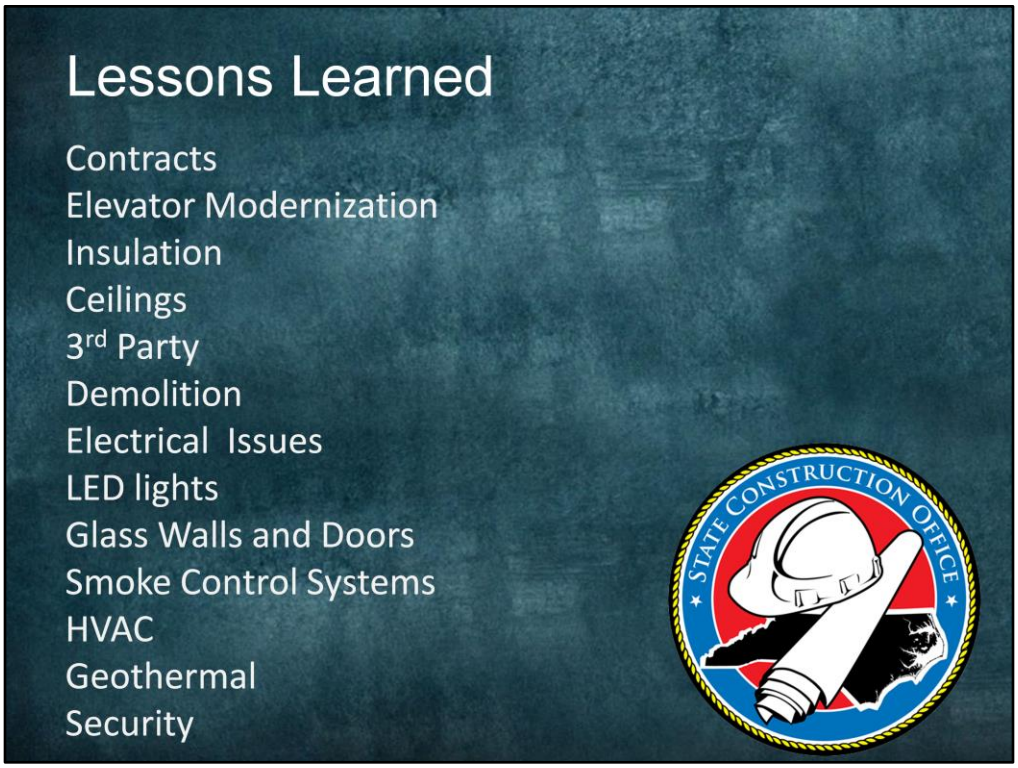
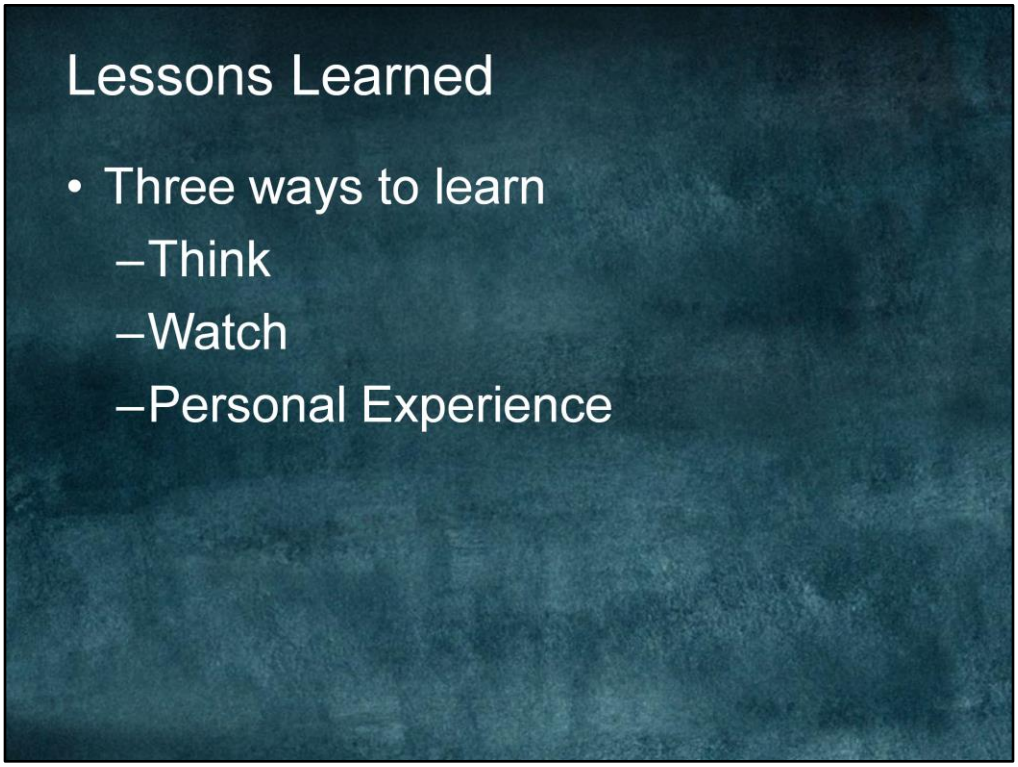
Good afternoon, I am Bob Talley. I am a project manager, electrical engineer and electrical inspector for the State Construction Office.
I want to welcome you to a session on recent Lessons Learned in construction by our office.
(next) If you are interested in “looking behind the scenes” at the kinds of things that can go wrong on a state project then you are in the right place today.
(next – will advance two slides)

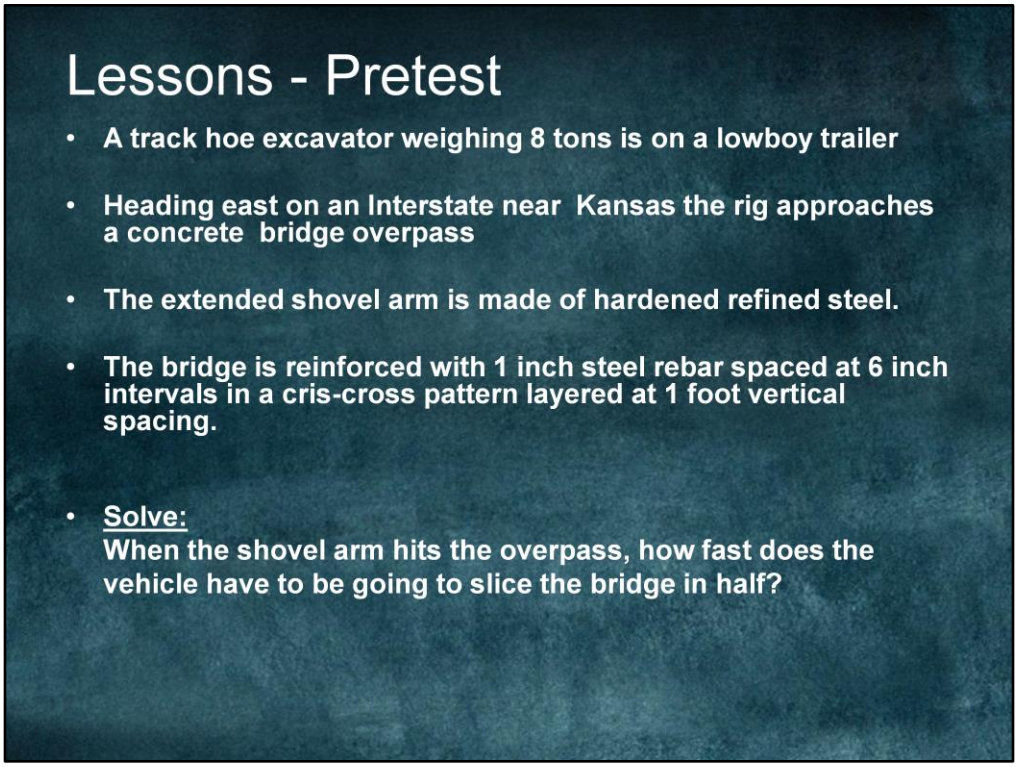
I worked in private practice for a number of years – the subjects we cover today are intended to be a view from the “other side.”



Today we will briefly cover lessons from each of the following areas:
(next)
Contracts (both design and construction)
Elevator Modernization
Insulation
Ceilings
3rd Party Approval
Demolition
Electrical Issues
LED lights
Glass Walls and Doors
Smoke Control Systems
HVAC
Geothermal
Security
System Effect – not listed but is the impact one system has on another
(next)



An old Chinese proverb claims that there are “Three ways to learn”
You can “Think” deeply about a subject- You can spend time in evaluation and modeling – those are valuable educational tools.
(next) You can learn by “Watching” the world. – You can pay attention to what others have done. LOOK and learn
(next) Finally you can learn from “Personal Experience” – This tends to be the most difficult and painful way to learn; but, it is effective.
My mother was a history major and was fond of telling her kids “those that don’t learn history are destined to repeat it.” So in an attempt to limit the number of people who are learning things the hard way we are going to review some of our recent difficult lessons.
The format of this session is designed to get you to think about a set of circumstances and then show you some pictures that illustrate the problem we experienced The intent is to show you a condition that we would prefer to avoid on future projects.
If you have questions you can ask them at the end.
So the next slide is a Pre-test to show you how the format will work. It is not an example of one of our projects so that is why I want to use it.
(next)



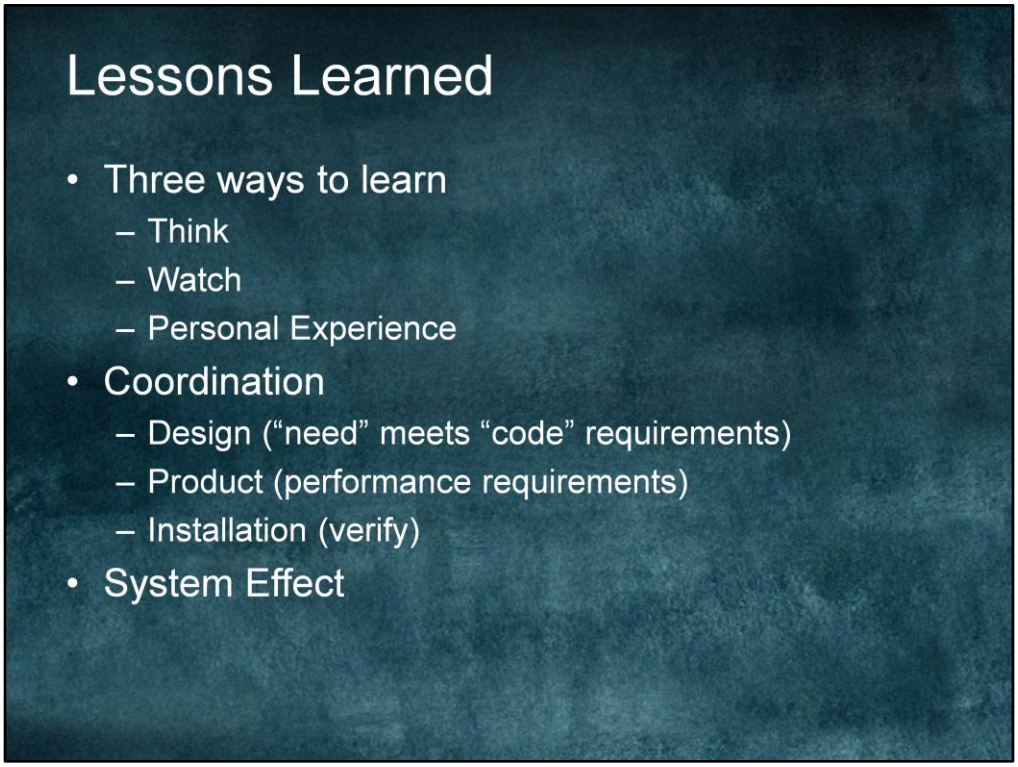
Pre-test
A track hoe excavator weighing 8 tons is on a lowboy trailer towed by a Semi.
And is heading east on an Interstate near Kansas. The rig approaches a concrete bridge overpass.
The extended shovel arm of the excavator is made of hardened refined steel.
The bridge is reinforced with 1 inch steel rebar spaced at 6 inch intervals in a cris-cross pattern layered at 1 foot vertical spacing.
(Next) (Solve): When the shovel arm hits the overpass, how fast does the vehicle have to be going to slice the bridge in half?
(next)

These are pictures of the resulting impact.
We can only speculate on the bridge accident, none of us know what actually happened or why.

The same will be true of all the examples I will show you today. We will be able to see the results of specific decisions and their interaction.

If you think you recognize any of the examples I'm using then please keep that information to yourself.

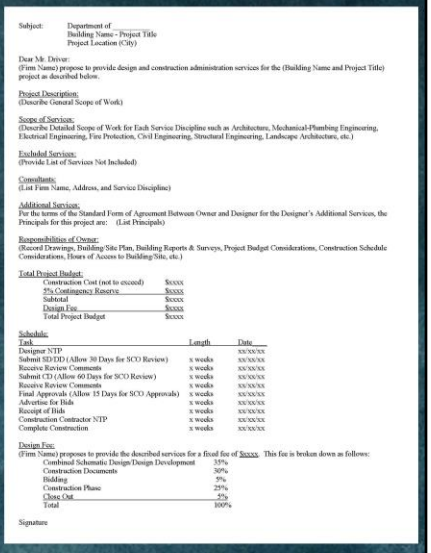
(next)



In almost every case we discuss today we will find multiple failures.
(Next) I believe good **Coordination** is key to avoiding problems
(next) The **design** should be where the owners needs meet the code requirements for construction. Occasionally one or the other of those two gets out of balance. The design/ review/ submittal / construction/ inspection process catches many significant problems, but you cannot expect that process to do the coordination for you.
(next) once the applicable codes are known, we expect the designer to fully understand the performance requirements of the products being specified. On far to many jobs we find that products have been specified that either …. cannot meet the needs of the owner or will not meet the requirements of the code.
(next) By law and by contract with the state we expect our designers to be the ones that verify the construction. You are the ones most knowledgeable as to the design intent and requirements.
(next) then there is System Effect - When something goes wrong at the very end of a project or just after it is accepted it is often a by product of System Effect. This is where the interaction of multiple systems create an undesirable condition
Lets start the lessons by looking at the Design Contract.
(next)

Lesson – Design Contract

- **Proposal to SCO**
- **Scope**
- **Design services**
- **Consultants and services**
- **Principals for the project**
- **Owner responsibilities**
- **Project Budget**
- **Schedule**
- **Fee and breakdown**



Subject: Department of
Building Name – Project Title
Project Location (City)

Dear Mr. Driver:
(Firm Name) propose to provide design and construction administration services for the (Building Name and Project Title) project as described below.

Project Description:
(Describe General Scope of Work)

Scope of Services:
(Describe Detailed Scope of Work for Each Service Discipline such as Architecture, Mechanical-Plumbing Engineering, Electrical Engineering, Fire Protection, Civil Engineering, Structural Engineering, Landscape Architecture, etc.)

Excluded Services:
(Provide List of Services Not Included)

Consultants:
(List Firm Name, Address, and Service Discipline)

Additional Services:
Per the terms of the Standard Form of Agreement Between Owner and Designer for the Designer's Additional Services, the Principals for this project are: (List Principals)

Responsibilities of Owner:
(Record Drawings, Building/Site Plan, Building Reports & Surveys, Project Budget Considerations, Construction Schedule Considerations, Hours of Access to Building/Site, etc.)

Total Project Budget:

Construction Cost (not to exceed)	$xxxx
5% Contingency Reserve	$xxxx
Subtotal	$xxxx
Design Fee	$xxxx
Total Project Budget	$xxxx

Schedule:

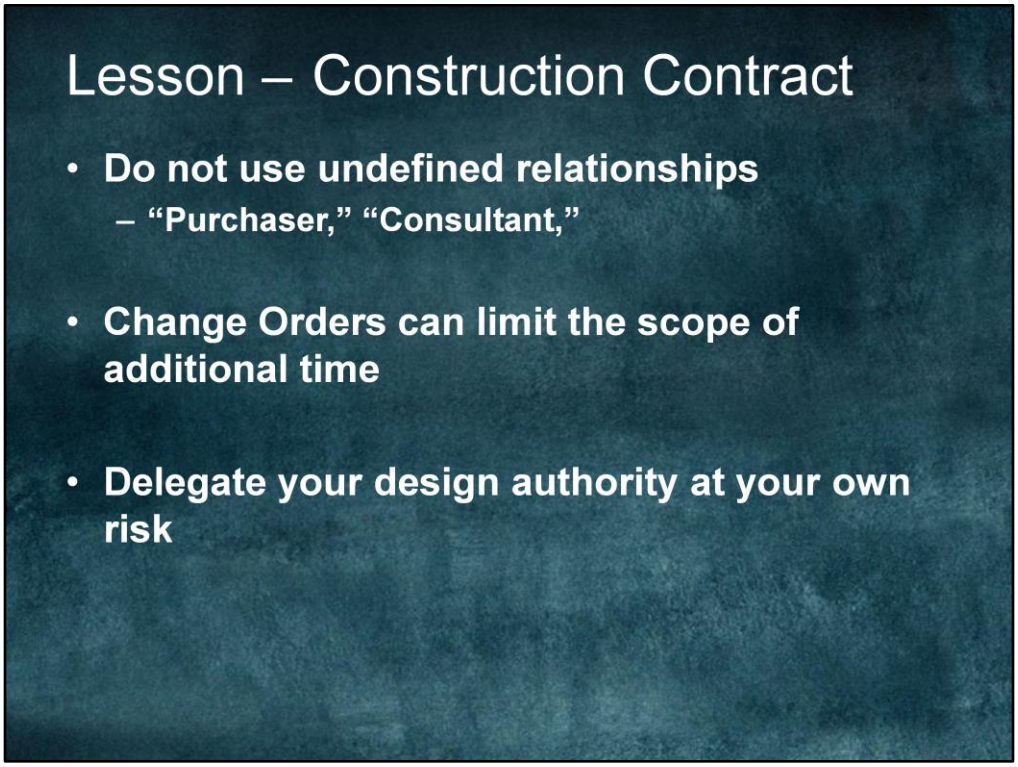
Task	Length	Date
Designer NTP		xx/xx/xx
Submit SD/DD (Allow 30 Days for SCO Review)	x weeks	xx/xx/xx
Receive Review Comments	x weeks	xx/xx/xx
Submit CD (Allow 60 Days for SCO Review)	x weeks	xx/xx/xx
Receive Review Comments	x weeks	xx/xx/xx
Final Approvals (Allow 15 Days for SCO Approvals)	x weeks	xx/xx/xx
Advertise for Bids	x weeks	xx/xx/xx
Receipt of Bids	x weeks	xx/xx/xx
Construction Contractor NTP	x weeks	xx/xx/xx
Complete Construction	x weeks	xx/xx/xx

Design Fee:
(Firm Name) proposes to provide the described services for a fixed fee of $xxxx. This fee is broken down as follows:

Combined Schematic Design/Design Development	35%
Construction Documents	30%
Bidding	5%
Construction Phase	25%
Close Out	5%
Total	100%

Signature

(The Design Contract)
I've talked with Ryan Scruggs and he believes the information on this slide might help us avoid some of the problems we have had getting designers under contract. It all starts with your proposal to SCO.
(next) This is a generic form of the information we are looking for, you can get a copy from Ryan, or better yet attend his session.
I am not saying you have to use this format but if you do … getting you a contract will be easier and less work on all of us.
(next) Scope – be clear what you are going to do.
(next) Design services
(next) Consultants and services - who are you going to use
(next) Principals for the project – name them
(next) Owner responsibilities
(next) Project Budget – what did the owner tell you and what is your estimate of the work. This is your chance to confirm that we can build the project for the allocated budget.
(next) Schedule List the tasks and number of weeks between tasks.
(next) Fee and breakdown - be clear on the Fee, and any additional services you are offering.
(We typically are not interested in your third party inspection fees. If you are the designer your inspections are required.)
(next)



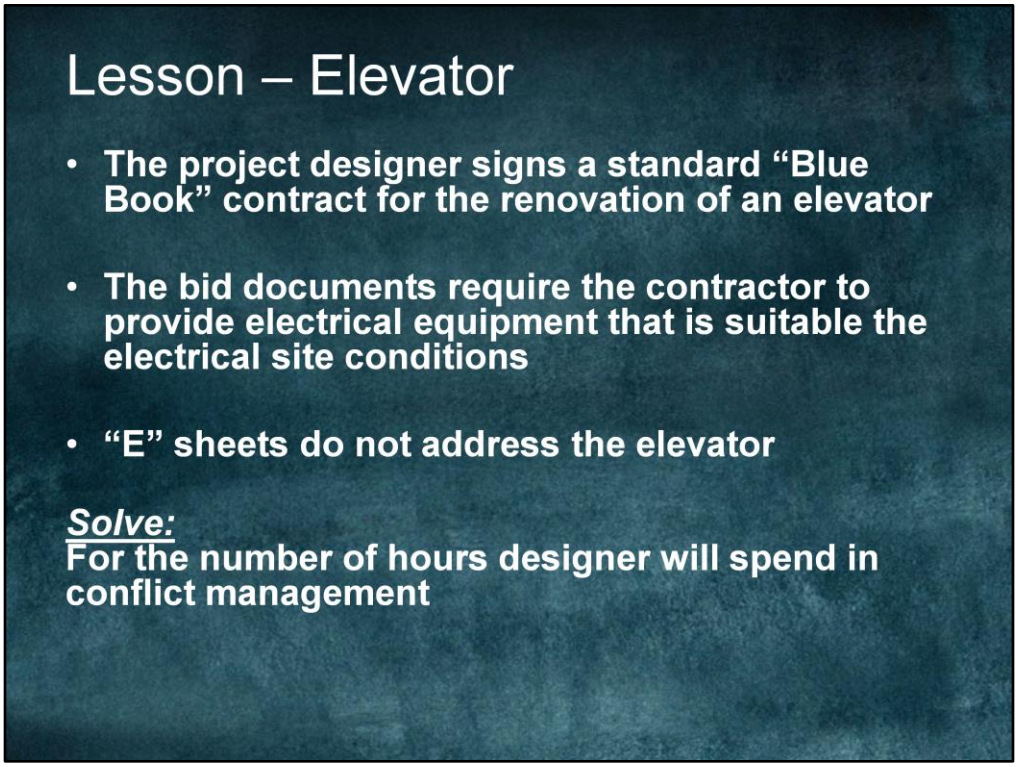
Now – lets consider a few reoccurring problems with construction contracts
(Next) Do not use undefined relationships

A recent project used the terms "Purchaser," "Consultant," in the specifications of construction documents. When problems arose with the construction work of a subcontractor to the General - you can believe they were pointing to the approval of the "Purchaser" – I don't know who that is

(next) Change Orders that request additional time should specifically deal with the scope of the request….let me give an example..

We often have multiphase projects that renovate a portion of a building as well as add an extension to a building. Would you expect a problem with the addition to impact the renovated area that just needed paint. It might if you don't address these separate areas and the project schedule when writing the CO and the time extension.

(next) Delegate your design authority at your own risk; Because SCO will still hold the designer responsible.
Lets take a test on that one.
(next)



Lesson – Elevator (most play)

The Architect signs a standard "Blue Book" contract to provide design services for the renovation of an existing elevator

The bid documents require the contractor to provide electrical equipment that is suitable the electrical site conditions

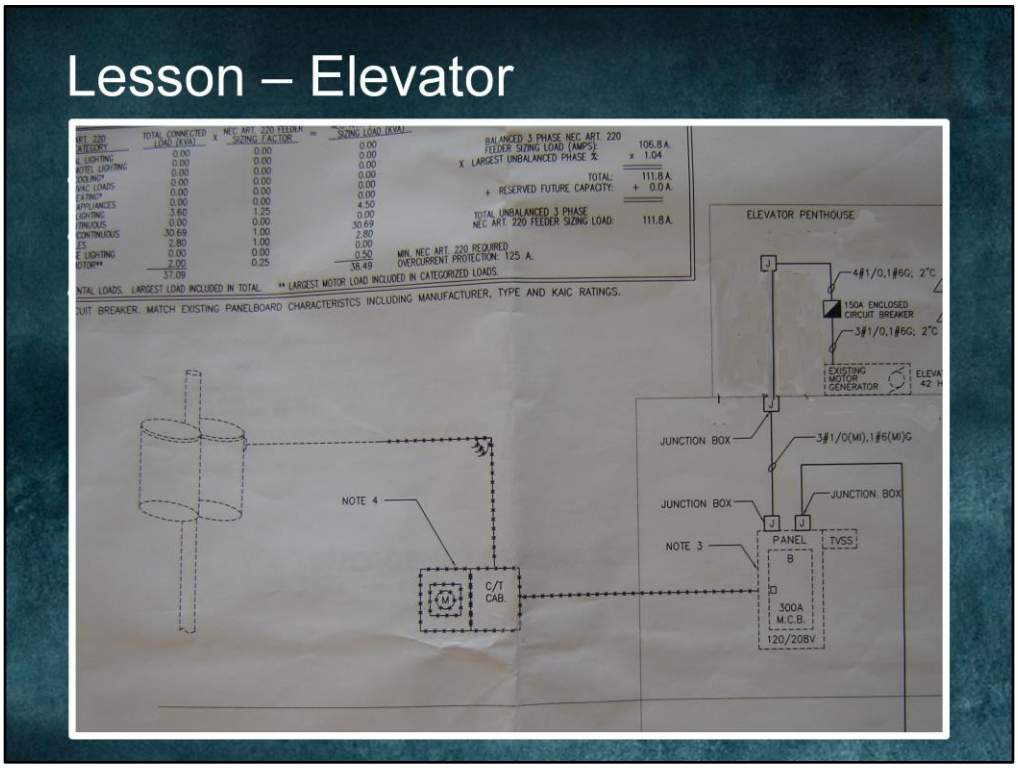
The "Electrical" drawings and specifications do not address the elevator

(next) - Solve: For the number of hours designer will spend in conflict management during and after construction.

Why – because if you delegate your authority to design, know that we still hold you responsible for the final product.
(next)

This is a 42 HP, 1945 era, Otis gearless machine. Originally served by a motor/generator or MG set an elevator modernization project was envisioned that would keep the machine and replace the motor/generator set and controller. The belief was that a change from a continuous running MG set to a VFD should save money.
The MG set creates a DC voltage to drive this machine. The MG set is started every morning and left running until shut down at night. Once the flywheel is moving the MG set acts a little like a rotary UPS. The starting of the 42 hp gearless machine, which could have a significant impact on any electrical system, is minimized by the flywheel in the generator.
A year after the final inspection the elevator was faulting on a regular basis and SCO was called to help evaluate.
List of items to look at:
(next) Voltage
Utility
VFD
Across the line starting
Voltage Drop
Harmonic distortion
Parameters
System Effect
(next)

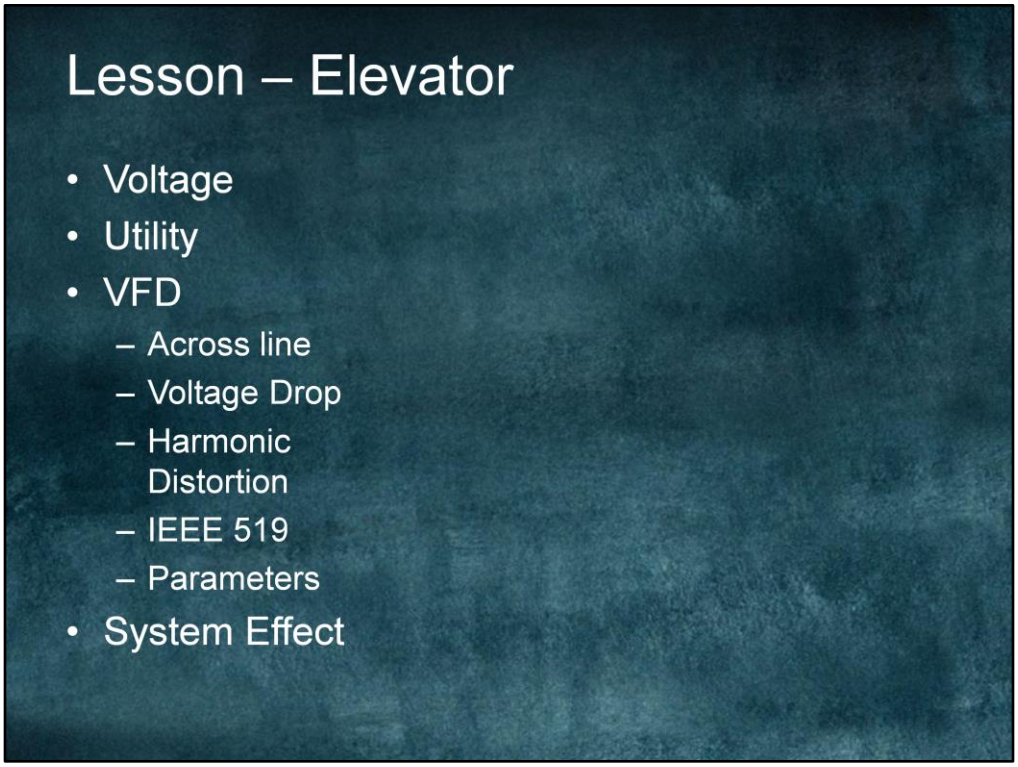
Lesson – Elevator



The elevator was renovated in two phases and that is the start of the problem.
(next) The electrical service for the elevator was replaced prior to the replacement of the elevator controller. This is an edited version of the scheduled work.
This part of the riser shows a two transformer utility pole the feeds a meter and an existing 120/208 volt panel.

> That is not normal. Some of us old guys know that but not everyone would recognize the problem. The existing panel has to be one of those problematic 120/240 volt high leg delta installations. Change the service to 120/208 and the panel needs to come out. The feeder on the right of this drawing is the new service feeder.

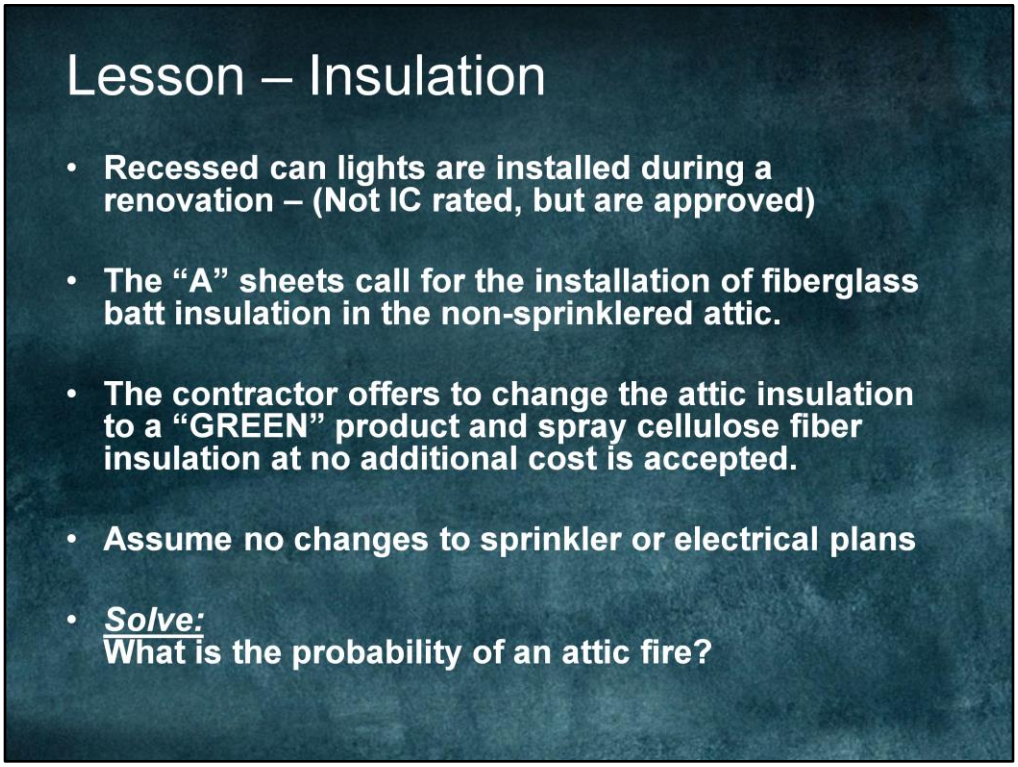
The load schedule on the top of this picture shows the continuous load as 30 kw and 112 Amps. It does not however include the 42 hp elevator in the load. A 240 volt elevator motor can be expected to pull 110 amps when running and significantly more when starting. This implies that the relocation of the service could have significant impact on the power quality at the site.
The designer of the elevator equipment modernization did not consult with the utility about the impact of a VFD on the site and left those decisions up to the contractor.
The contractor replaced the MG set with a 6 pulse VFD which can handle poor utility power quality but is problematic for electrical utilities.
(next)



What did we discover -
Voltage (plans said existing was 120/208 – contractor ordered a 208 volt elevator controller. But the brake and other equipment that is voltage controlled was not changed and needed 240 volts. During operation as the voltage sagged, which applied the brake, causing the motor to pull more current and thereby lower the voltage at the motor even more.
(next) Utility - the utility should have been involved in all discussions about a 40 hp motor on a site.
(next) VFD

(next) The 6 pulse acts like an Across the line starter. - that is a problem
(next) Voltage Drop – Large motors create voltage drop on the line. It must be accounted for in a design.
(next) Manufacturer of the new 6 pulse VFD told me that we could expect that the VFD would create about 30% more distortion than the old MG set it replaced
(next) Specs said to "meet" IEEE 519 – there is nothing to meet. That document is a standard that says how to measure distortion. But a knowledgeable person has to use that document to list where to make measurement and to list the acceptable limits.
(next) Parameters – Every VFD has final parameters and we want the final settings in written form on the site.

(next) System Effect was the problem. Any one of the problems alone might never have been noticed.
We have had multiple elevator problems recently. I can only tell you that the specifications of 10 years ago will not obtain the same equipment we were getting 10 years ago.
Additionally, there should be significant evaluation and discussion of allowing anyone other than the equipment manufacturer modernize a piece of equipment. On this site the original manufacturer did not install the new controller or 6 pulse VFD. They have now given us a price to fix it.
(next)



Lets examine "Insulation"
(next) Recessed can lights are installed in the ceiling of the top floor during a renovation – (They are not the IC rated)

(next) The "A" sheets call for the installation of fiberglass batt insulation in the non-sprinklered attic.

(next) The contractor's offer to change the attic insulation to a "GREEN" product and spray cellulose fiber insulation at no additional cost is accepted.

(next) Assume no changes to sprinkler or electrical plans

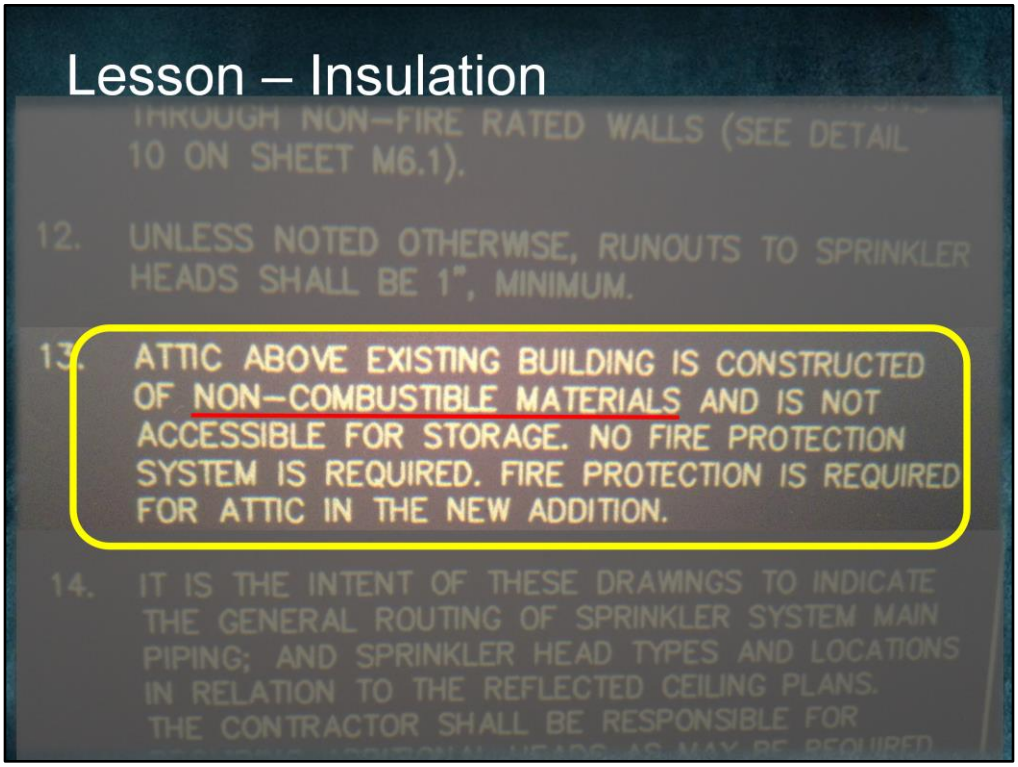
(next) (Solve) What is the probability of an attic fire

In order to answer this question lets review an actual situation.
(next)

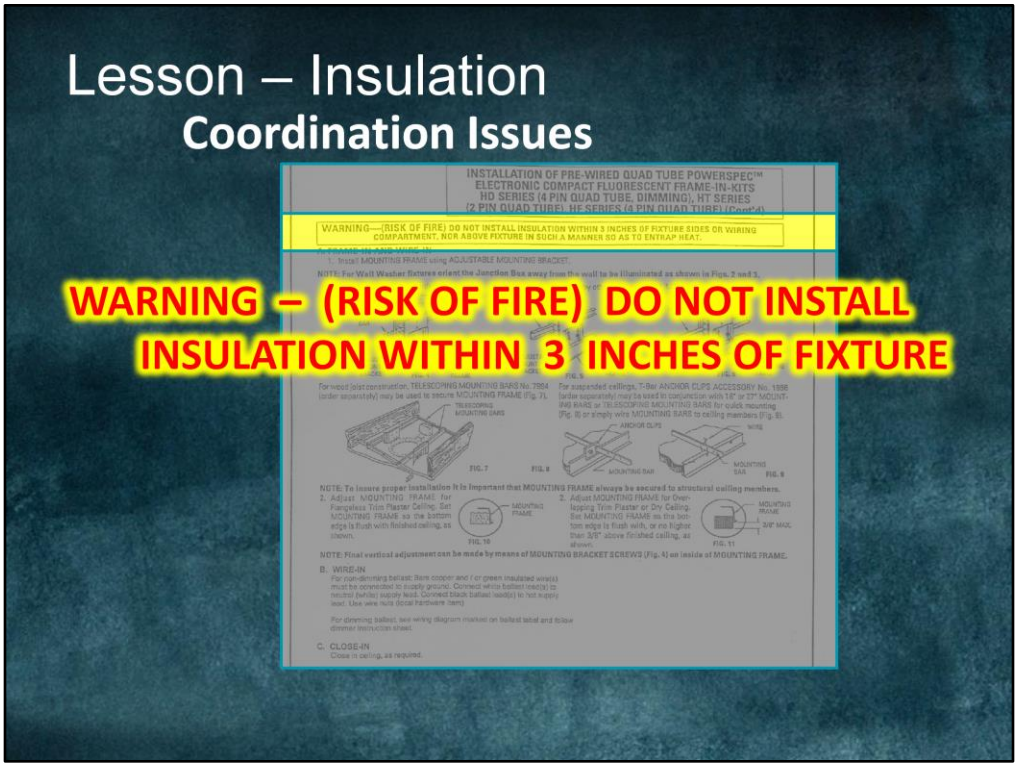
If changes are offered or made during the course of the project a key link in the coordination process may be missed.
Lets start with the design requirements for “this lesson”.

It is a renovation. The funds are limited. The attic has some very tight spaces that will be difficult to get to.

The designer decides that the attic will have not combustible material and will therefore not need to be sprinklered. The sealed drawing says:
(Next)

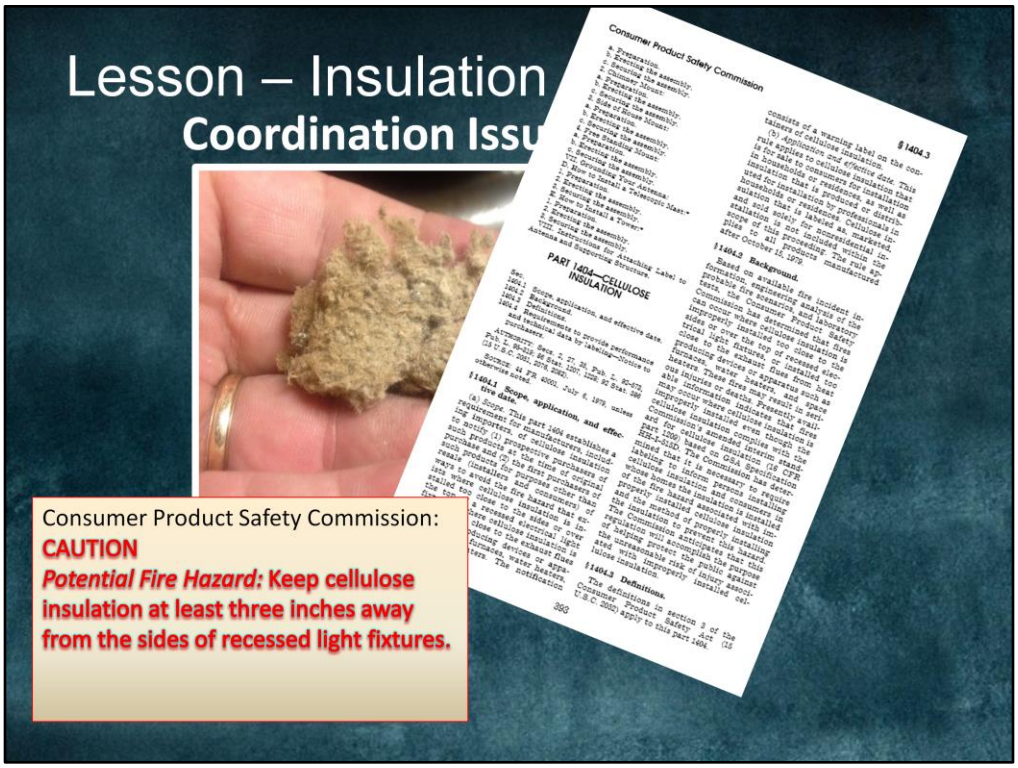


– NO COMBUSTIBLE MATERIAL IN THE ATTIC
- (next - end slide)
- (Next)



What type of Products are used around the attic

- (next) The recessed can lighting for the top floor of the building were submitted and approved.
- (next) These are not Insulation Contact rated and they have a clear warning regarding the installation in the vicinity of any type of insulation. It says "Warning – Risk of fire – do not install insulation within 3 inches of the fixture"
- (next) close
- (next slide)



Sprinkler plans are clear that there shall be NO Combustible material in the attic.
Architect specified fiberglass batt insulation. Admittedly the lighting fixtures are already in conflict with the architectural design.
(next) The contractor proposed swapping blown insulation for fiberglass bats. The blown insulation that was used was blown cellulose. By Green product they mean it is made of recycled material - newspaper
It looks like this…
(next) Consumer Product Safety Commission issued this bulletin with the following warning
(next) **CAUTION: *Potential Fire Hazard:* Keep cellulose insulation at least three inches away from the sides of recessed light fixtures. Do not place insulation over such fixtures so as to entrap heat.**
(next)

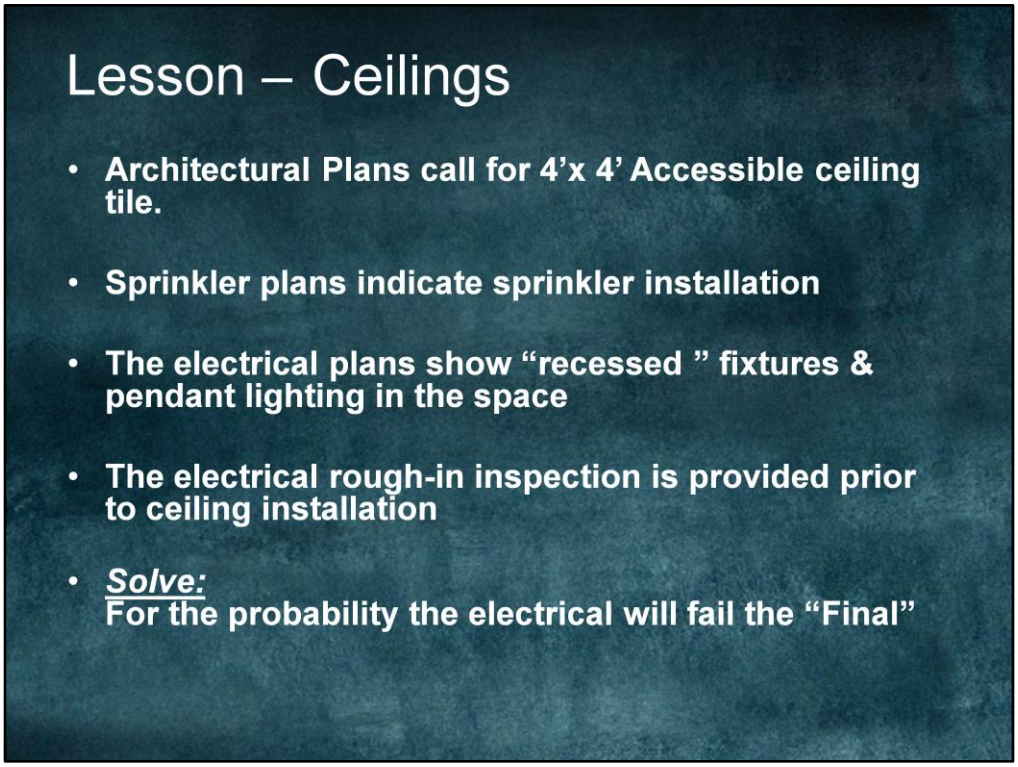
Ok with these two products in mind lets look at the actual **installation**

(next) cellulose fiber falls around a light like this…

It overheats like this..
(next)

The junction box on the top of the can fixture is where the ballast is located. It looks like it got hot.
The results of a fire can look like this..

Now you know the probability of a fire for this site.
The lesson on insulation serves as a good transition to thinking about ceilings in general
Lets take another quiz
(next)



Architectural Plans call for 4'x 4' Accessible ceiling tile.
Sprinkler plans indicate sprinkler installation
The electrical plans show "recessed can" fixtures & 4x4 specialty lighting fixtures in the space
The electrical rough-in inspection is provided prior to ceiling installation
(next Solve:) What is the probability the electrical installation will fail the "Final"
Hint – it is a high number
(next)

For all projects we expect Coordination

During the design everyone needs to be talking about the “needs” above and below the ceiling

Each year it seems we are install more and more Items above and in the ceiling space (HVAC, Elec, Sprinkler)

(next) Products - the past couple of years we have had problems “Accessible” ceilings

– the only definition that will matter is the one driven by code and Accessible is defined in the National Electrical Code

(next) Installation **–** once the products are installed – does it maintain accessibility, is there anything the project did that minimized accessibility. (example, the trunk on my car is accessible – until I lock it)

(next)

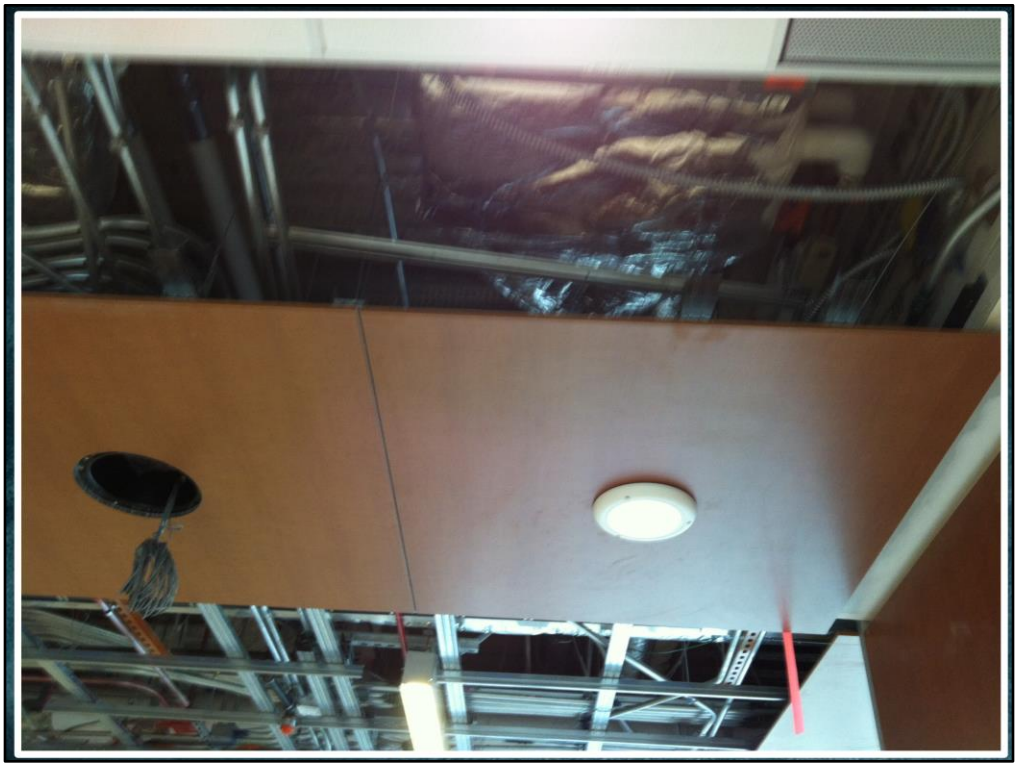
This is one of the Accessible ceilings where we ran into problems
Accessible – Webster -> “Able to be used, entered, reached” - ceiling tile manufacturers may be using this defn
NEC – Defines Accessible
1) Accessible (as applied to equipment) – “Admitting close approach; not guarded by locked doors, elevation, or other effective means.”
2) Accessible (as applied to wiring methods) – Capable of being removed or exposed without damaging the building structure or finish or not permanently closed in by the structure or finish of the building.
(next) this is what it looks like above the ceiling
The ceiling panels tended to be damaged by the removal process. It took two of the installers on a scaffold 20 minutes to remove one panel. The electrical boxes and equipment above the ceiling must remain accessible.

- (clear slide)
- (Start next)

Product Issues - High light the panel sections in this picture. There are 4x4 panels they weigh a lot. It was incredibly difficult to lift the panel out of the grid

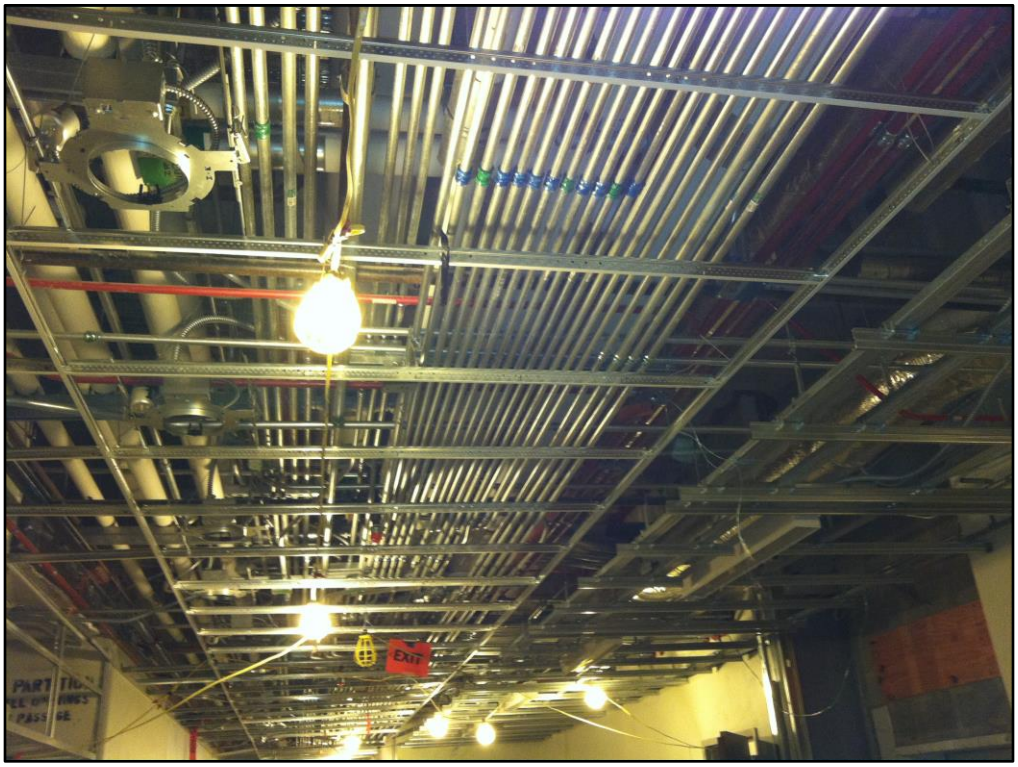
The shaded panels have lighting and other devices installed that prevent the removal of the panels.
(next)

One panel installed
Note the sprinkler head that will be installed in the next panel. So unless so type of huge eschution ring will be used this panel will also be semi permanent.



Note the orange cap and junction box on the far side of this panel. That section will not be easy to remove without significant modification of the ceiling grid.

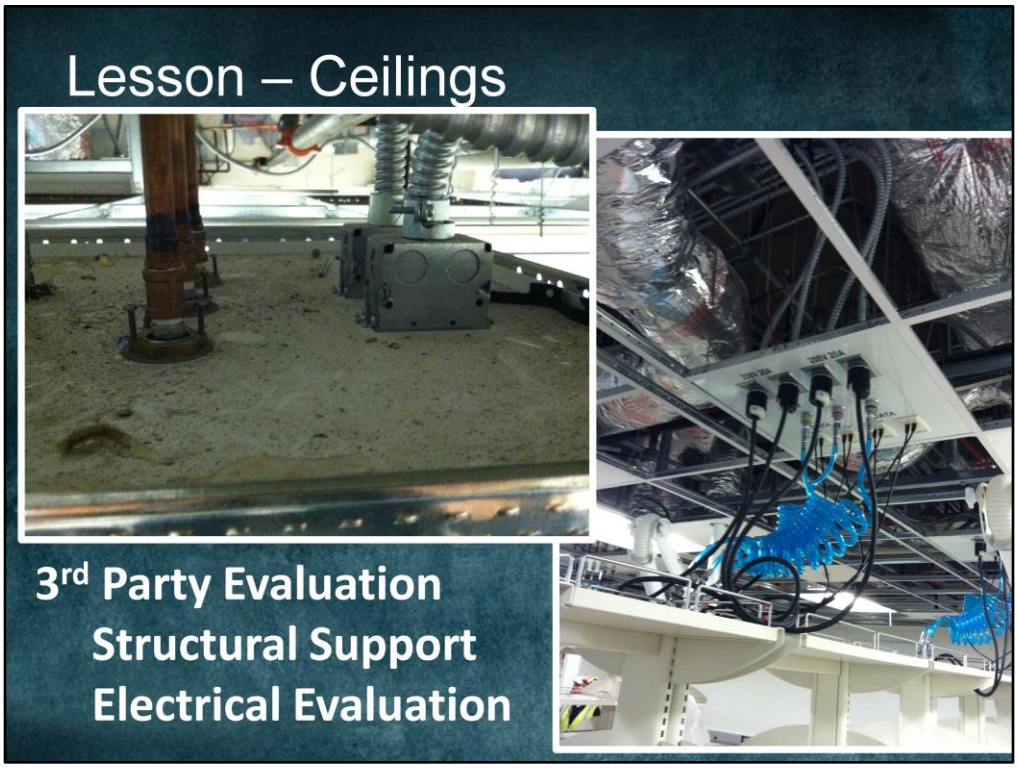
Just so you don think accessible ceiling construction is a new problem … We are constantly doing renovations that remove spline ceilings a replace them with 2x2 or 2x4 acoustic tile ceilings like this one.
(next) The HVAC equipment above this ceiling could not be serviced. The filters on the boxes were never changed because they were not accessible.
(next)



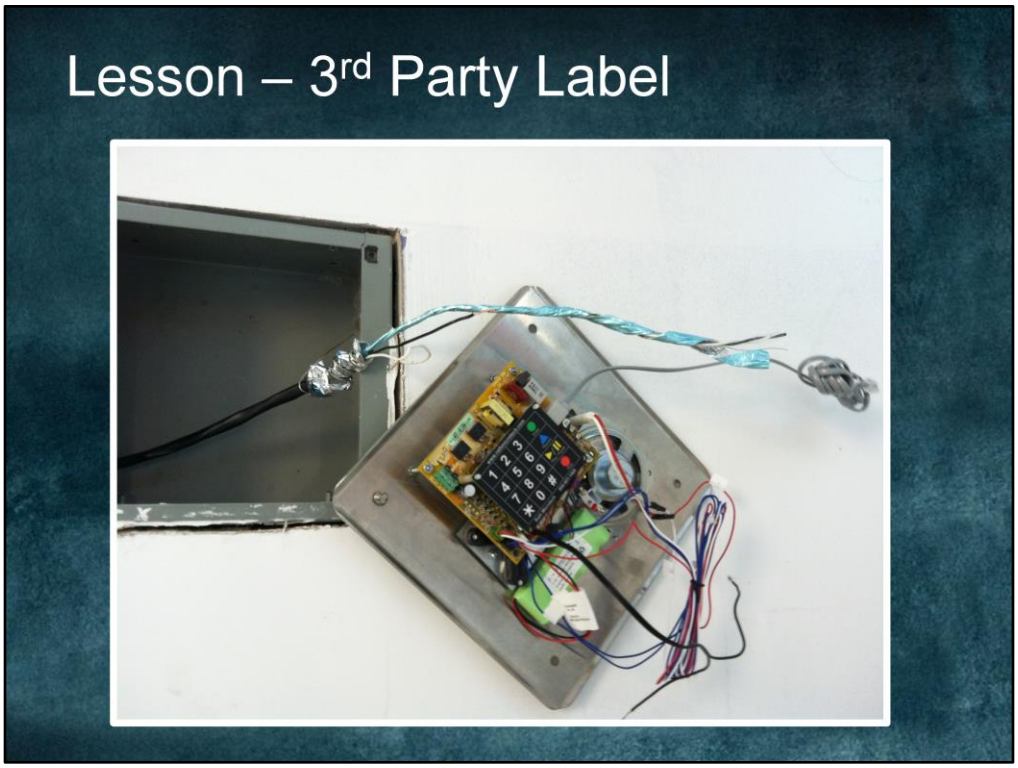
The electrical conduit going above this ceiling may very well be a problem for all future work. This should be coordinated before installation.

In all of our buildings the electrical and HVAC system are becoming increasingly complex.

The solution to this problem will require the design team to dedicate a space for electrical conduit and forcing the stacking of conduit above the corridor ceilings. (next)



This lesson mixes both ceilings and 3rd party listing and labeling
(next) This is an interesting ceiling issue. The metal panel and equipment connections was installed in a grid ceiling system. It raised a significant number of questions about the approval of this metal plate and the electrical equipment attached. Typically we are looking for a 3rd party to inspect and approve this installed system.
3rd Party inspection of all equipment installed on a state project is required per the NC General Statutes
NCGS 66-25 states “All electrical material, devices, appliances, and equipment shall be evaluated for safety and suitability for intended use. This evaluation shall be conducted in accordance with nationally recognized standards and shall be conducted by a qualified testing laboratory.”
The approved Third-Party testing agencies are listed on the NCDOI web site.
(next)
We must know if the panel has been evaluated for proper support and use as part of a ceiling system
(next slide)



Area of Rescue systems are often a problem. A number of the systems that we find have arrived just before the final inspection and they are missing the 3rd party approval. As a part of a life safety system we cannot approve non-listed equipment. (next)

Lesson – Demolition and Dust Control
ON multiple projects DUST created by demolition near occupied spaces became a problem.
(next) Dust Control – It is not good enough to tell the contractor to use appropriate dust control measures
On a project to replace a Spline ceiling that was
60 years old. We specifically limited the demolition work to
Nights & Weekend
(next)
Industrial Hygienist was to be on site and to monitor all the work done. The IH told the contractor the ceiling had to be removed piece by piece. He did not listen.
On Tuesday morning we had 1/8th inch of dust on every desk and every surface in the vicinity of the demolition.
Data wires were left hanging.
We obviously had No Control of work on the site
(next) STOP

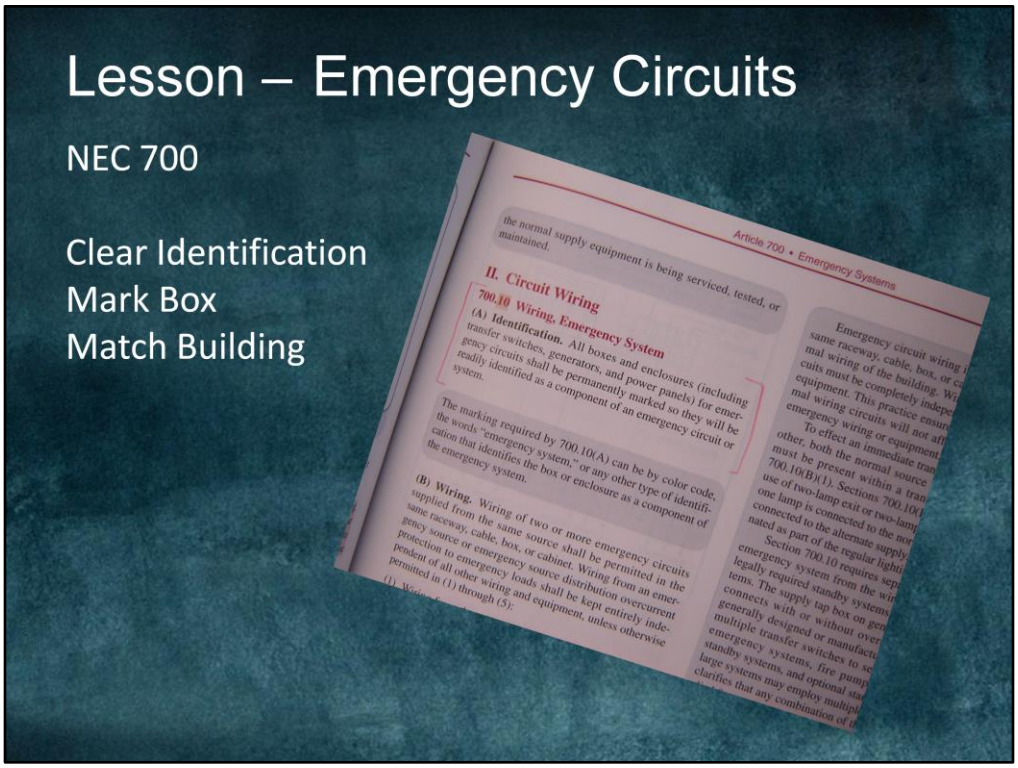
Lesson – Demolition

Demolition (picture up)
When we received permission to start back to work on the site with the following understanding
(next) Dust Control measures must be specific
(next) plastic
(next) filters
(next) Industrial Hygienist
(next) Fri – Sat
(next) Cleaning
(next) Monday Inspect
(next) Data supported
(next)

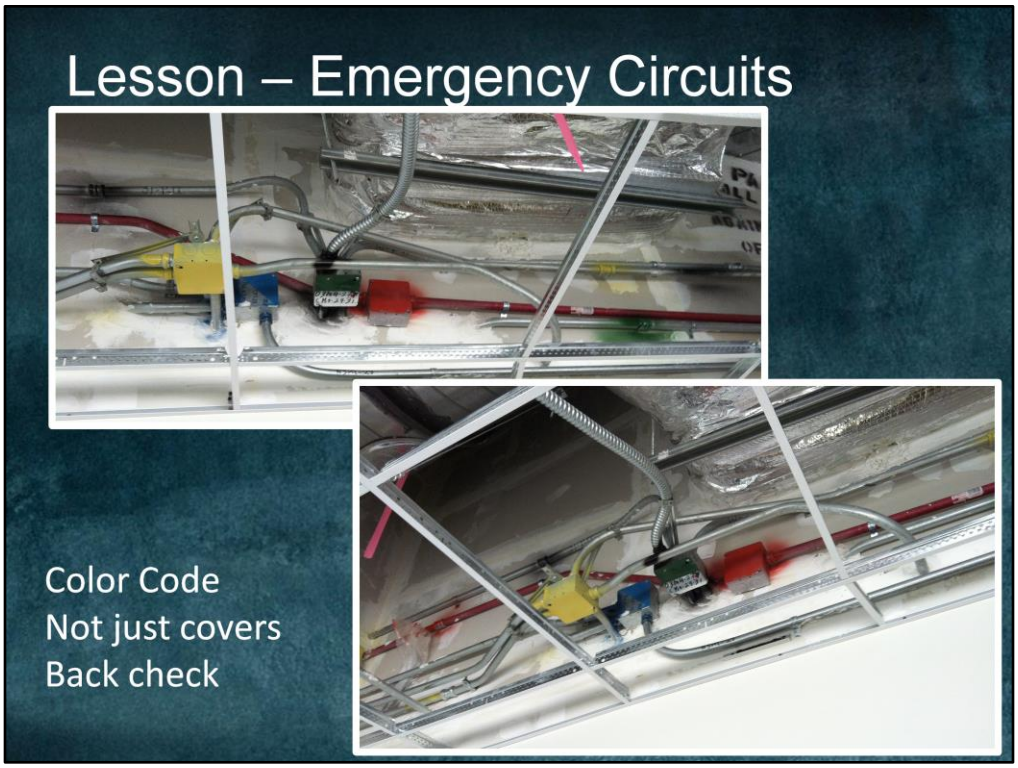
Lesson – Demolition

- Dust Control measures
  - plastic
  - filters
- Industrial Hygienist
- Fri – Sat
- Cleaning
- Monday Inspect
- Data Support

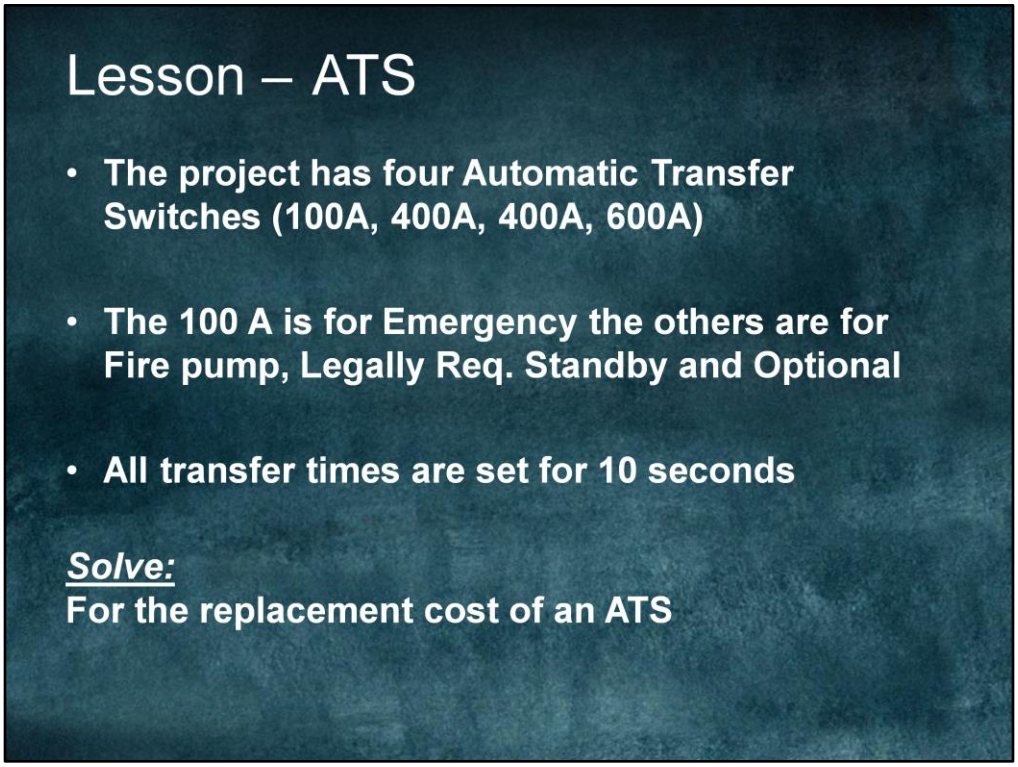
(next) pic – What are your expectations for demolition.
(next)



NEC 700 This is the section of the National Electrical Code on Emergency circuit wiring.
We are going to look at this because multiple designer have confused the requirements of the SCO electrical guidelines with the requirements of the electrical code.
The NEC is the primary document it trumps our guidelines.
(next) the code requires “All boxes and enclosures for emergency circuits shall be permanently marked so they will be readily identified as a component of an emergency circuit or system.”
The SCO guidelines provide some basic color identifications for systems.
On multiple projects the designers have put in the specification that the conduit and boxes for all generator backed circuits shall be green. That is a problem. Because some of the generator circuits are emergency and some are not.
(next) painting a cover is not the same as Marking the Box. We just spent a lot of money fixing a problem caused by someone who swapped the covers of two boxes.
(next) Please Match the existing Building system. If the building is using purple for generator don’t change it to match the guidelines. But that also means we expect you to do a site investigation.
(next)



This is an example of a painted cover project. Fairly easy to swap covers and confuse the maintenance staff for years to come. Since we use separate colors for 120/208 and 277/480 what do you intend to do when we have both voltage levels on the emergency system, or the critical system, or the standby system.
Color Code
Not just covers
Back check – on this project the color of each conduit changed color on the other side of the wall. Just saying….
(Next)



The project has four Automatic Transfer Switches (100A, 400A, 400A, 600A)
The 100 A is for Emergency the others are for Fire pump, Legally Req. Standby and Optional
All transfer times are set for 10 seconds. All transfer and bring on their loads at the same time.
(next) *Solve:* What is the replacement cost of an ATS

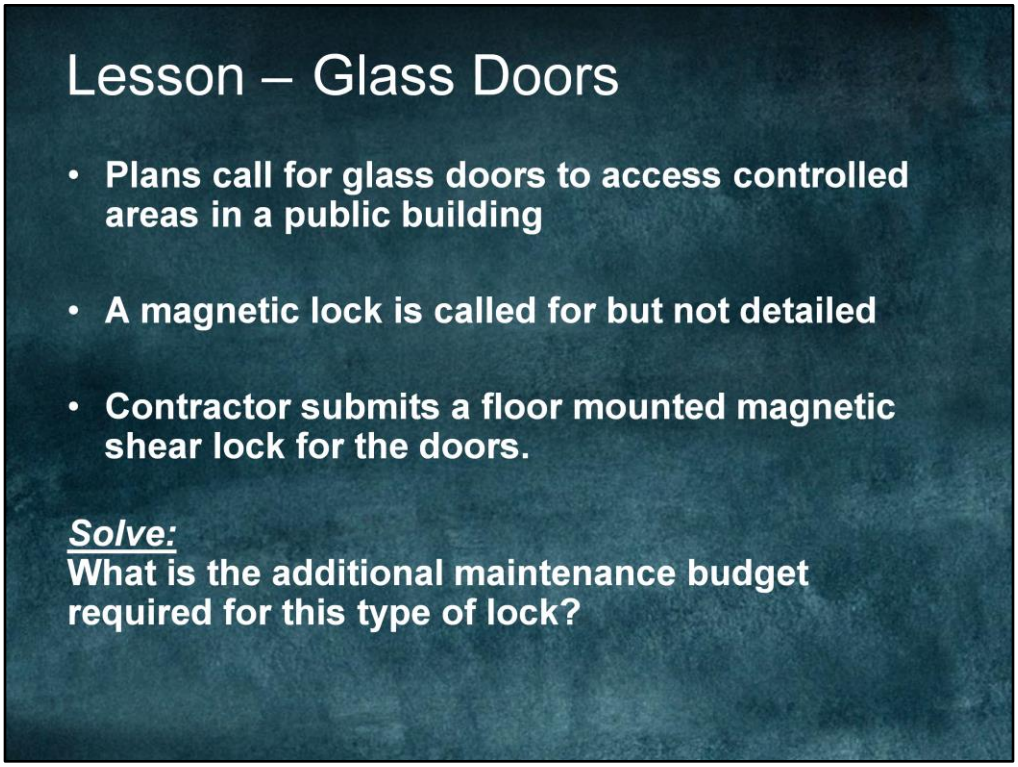
Lesson – ATS
This is a picture of the Automatic Transfer Switch room while it was still under construction.
The 400 amp switch is on the right hand side of this room. It is set for 10 seconds like all the others on site.
We noticed that on occasion while we were testing the generators - this switch would buzz and smell of melting plastic. The manufacturer was called and recertified the equipment several times.
(next) Finally at the acceptance test the solenoid in the ATS failed catastrophically. The electrician used a fire extinguisher on the equipment.
(next) this is the solenoid that failed
We have had several failures of this type and the one thing they had in common: The designer had specified that all the transfer switches would be set for 10 seconds.
We have now changed the settings only those pieces of equipment the serve emergency loads will transfer at 10 seconds. All others will be at different times, somewhere around 60 seconds, when we have given the voltage a chance to stabilize.
(Next)

Structural Support
When large equipment is installed the structural support system cannot be left to the contractor.

The support on the right is wrapped around the duct.
(next)

Lesson – Stair Railings
I would not have expected us to run into a problem with stair railings but we did. This section we will look at two different glass panel installations. The handrail is attached to the glass panels and appears to be proper in every respect.
(next) This system has a continuous top rail that prevents clothing from being caught between the panels.

(next) In the next two pictures the top rail was not installed. One designer included the strip and one did not.
(next) notice how a sleeve tends to catch the edge.
(next) By experience with clothing being caught on the panels we now know the strip has to be there.
(next)



Lets move to a lesson on Glass Doors
(next) Plans call for glass doors to access controlled areas in a public building
(next) A magnetic lock is called for but not detailed
(next) Contractor submits a floor mounted magnetic shear lock for the doors.
(next Solve) What is the additional maintenance budget required for this type of lock?
Maybe you will have the answer after we explore the product.
(next)

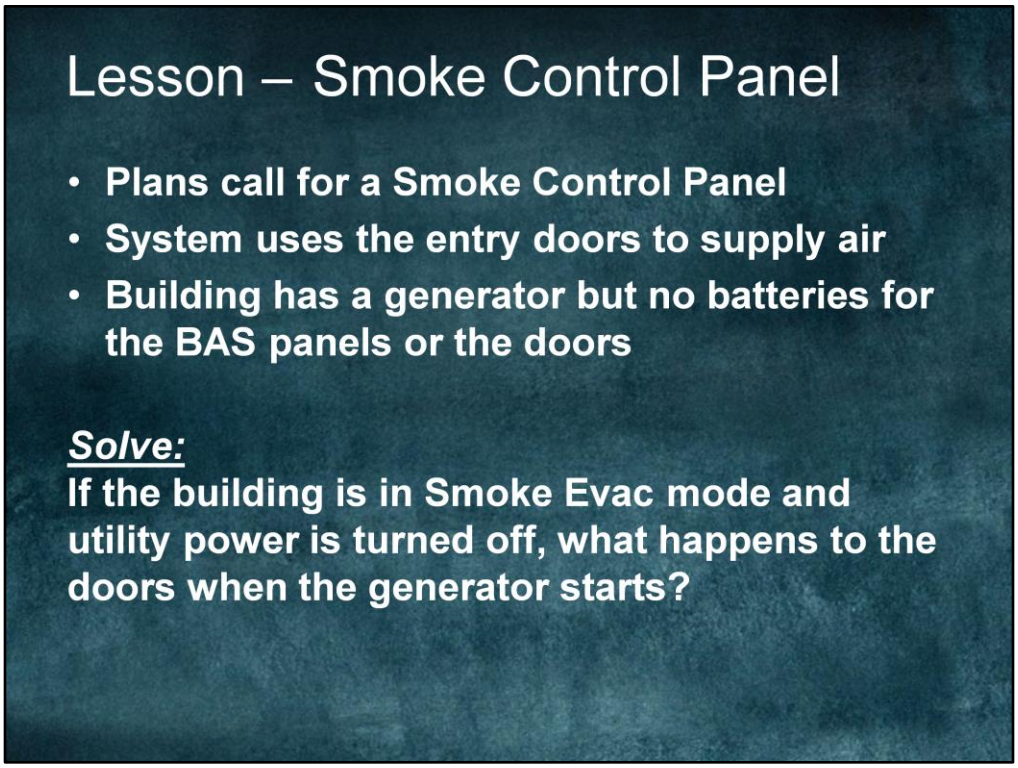
Lets talk about glass doors:
Coordination Issues
look at the Design Requirement
(next) Clean look
(next) Access control
(next) Products
(next) Surface
(next) Shear
I can tell you that the shear locks sell for about $900 each and the ones we have last about two years due to the heavy use in public space
(next) Installation
It has been a huge problem to get the shear lock to work properly. It depends on the door stopping perfectly over the magnet, that way the springs don't get messed up. But in a public building, the doors are used constantly, mud and dirt fall into the sensitive spring systems. Even the manufacturers literature says that shear locks should be used if there are no other options.
(next)

Lesson – Glass Doors

Coordination Issues
- **Design Requirement**
  - **Clean look**
  - **Access control**
- **Products**
  - **Surface**
  - **Shear**
- **Installation**

This is what happens over and over to our glass door that use shear locks
Yes it Clean look but it is not user friendly

This is what the floor portion of the shear lock looks like. It is a trap for dirt and problems.
Must stop centered
Dirt is a problem
Only option
(next)



Plans call for a Smoke Control Panel
(next) System uses the entry doors to supply air
(next) Building has a generator but no batteries for the BAS panels
(next) (Solve) If the building is in Smoke Evacuation mode and utility power is turned off, what happens to the doors when the generator starts?
Before we answer this question lets go over the operation of the panel
(next)

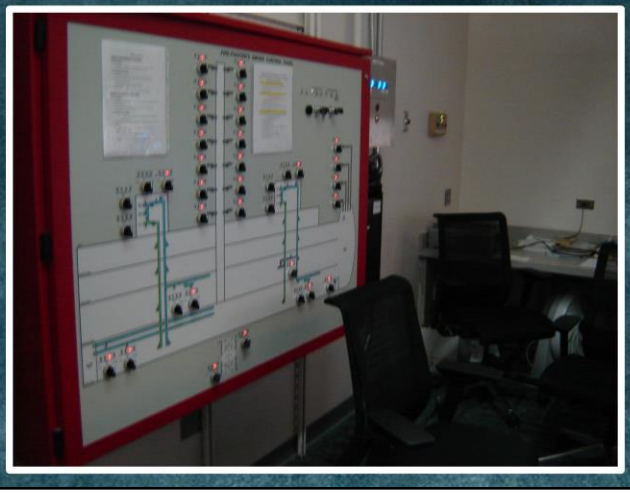
Lesson – Smoke Control Panel

Status – How many points

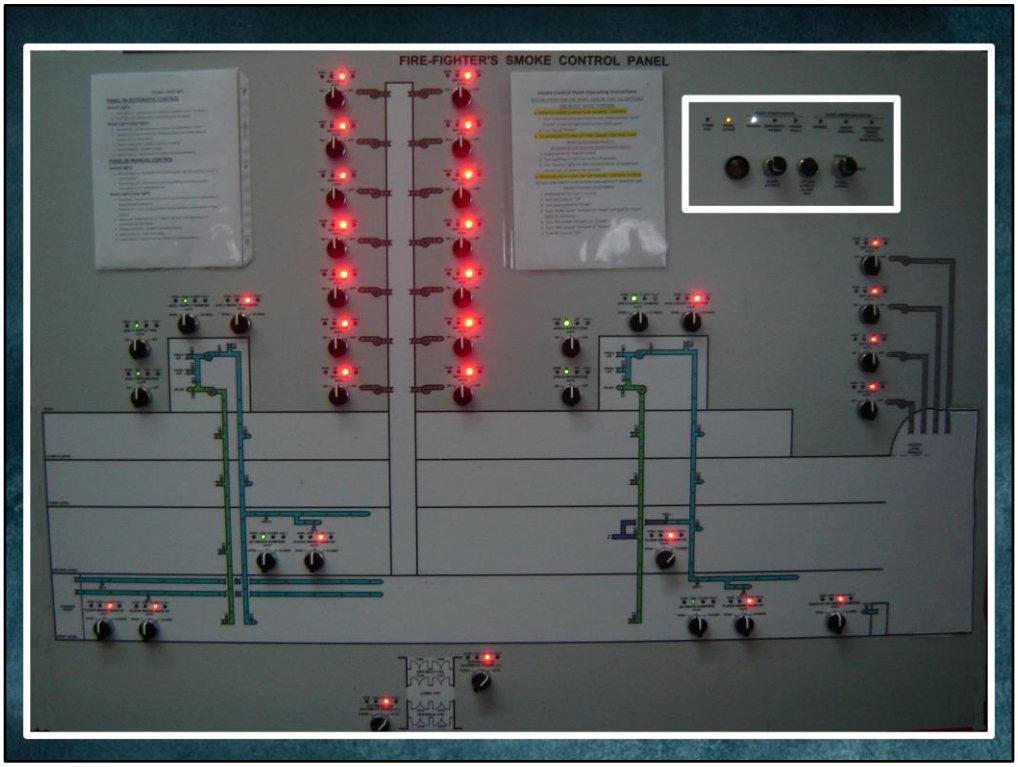
Trades Involved

Failure Mode

Instructions



This is what a Smoke Control panel can look like.
Status – How many points does it monitor. Are they listed somewhere.
How many Trades are Involved
What is the Failure Mode for each system – it is going to be important
Instructions must be posted. This type of panel is not intuitive.
(next)



This is an enlarged view of the Smoke Control Panel and is designed for the fire department to use.
(next) Lets take a closer look at the top right corner of this panel where the primary control switches are located.
(next)

Lesson – Smoke Control Panel

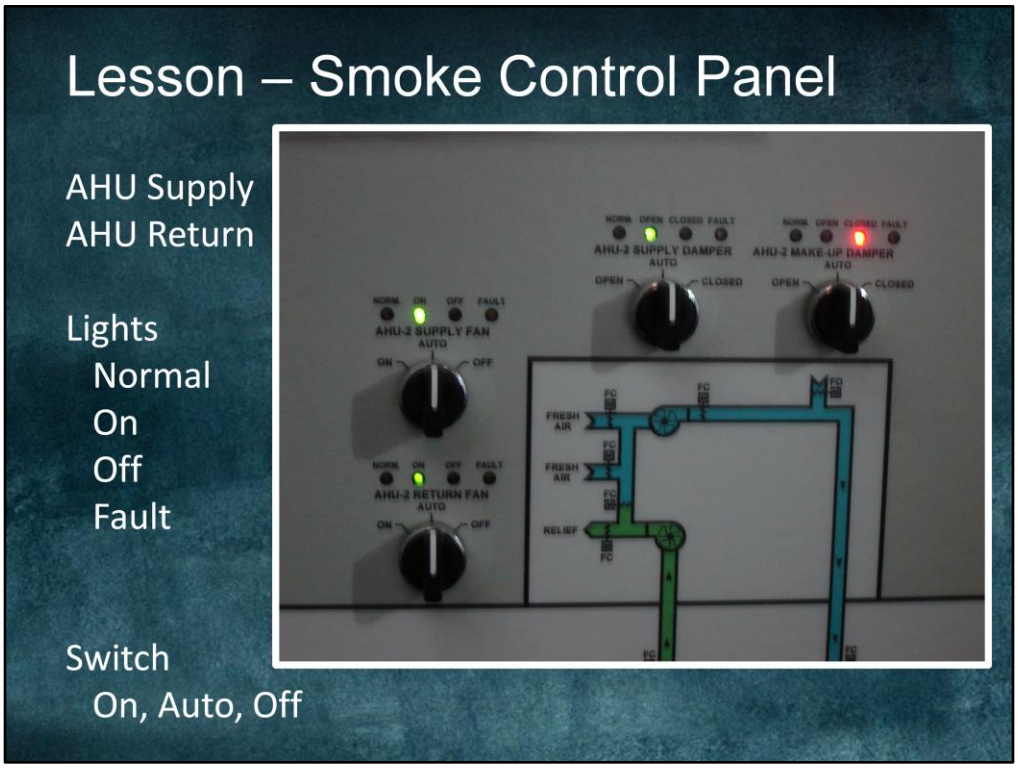
This is an enlarged view of the key switches for the panel.
There are keys in the switches. They can be removed and installed in the Knox box.
They toggle the automatic and manual control.
(next)

This is a close up view of the Damper Controls and the associated graphics

(next) Lights have both text and colors
- Normal
- Open
- Closed
- Fault

(next) Switches have clear descriptions
- Open, Auto, Close

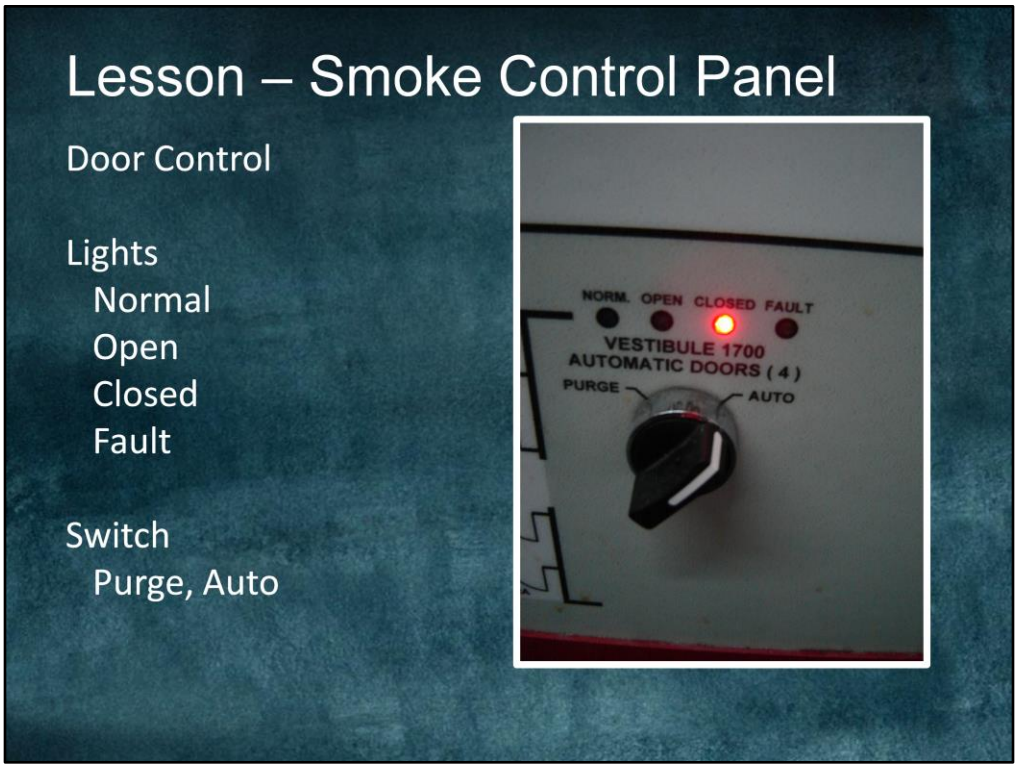
(next)



The AHU Supply Fans and AHU Return Fans have clear controls and associated graphics with names

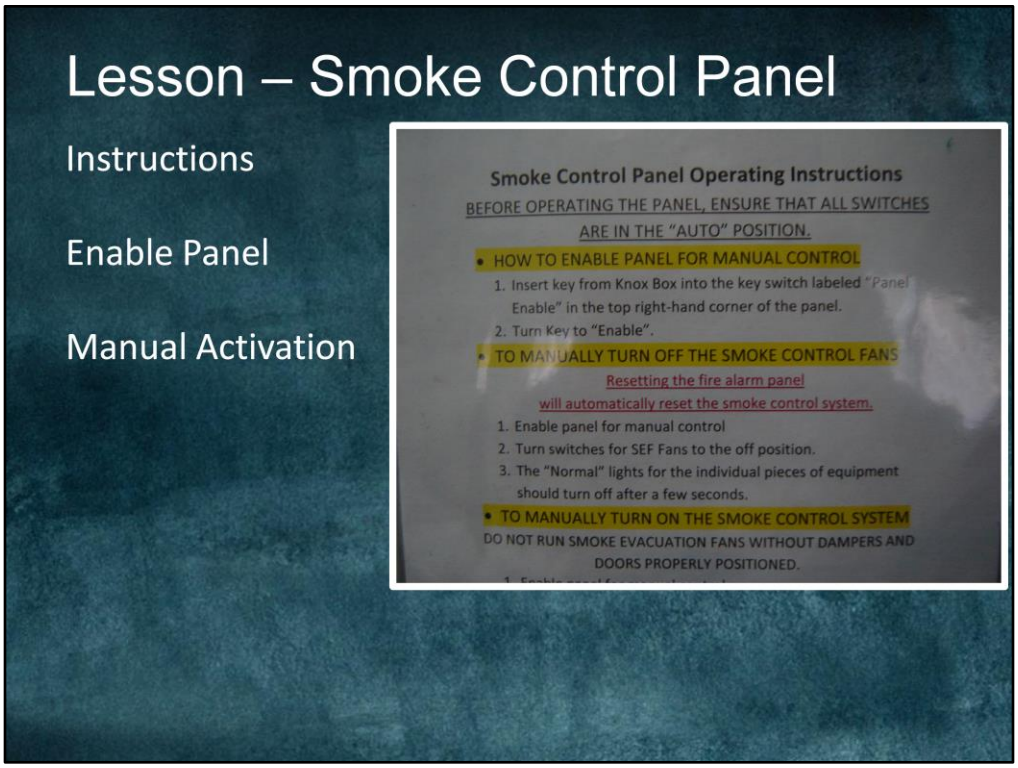
(next) Lights
Normal
On
Off
Fault

(next) Switch
On, Auto, Off
(next) another view of controls
(next)



Door Control – you might want to know it takes about 15 seconds for doors to fully open once commanded to do so.

Lights
Normal
Open
Closed
Fault
Switch
Purge, Auto
(next)

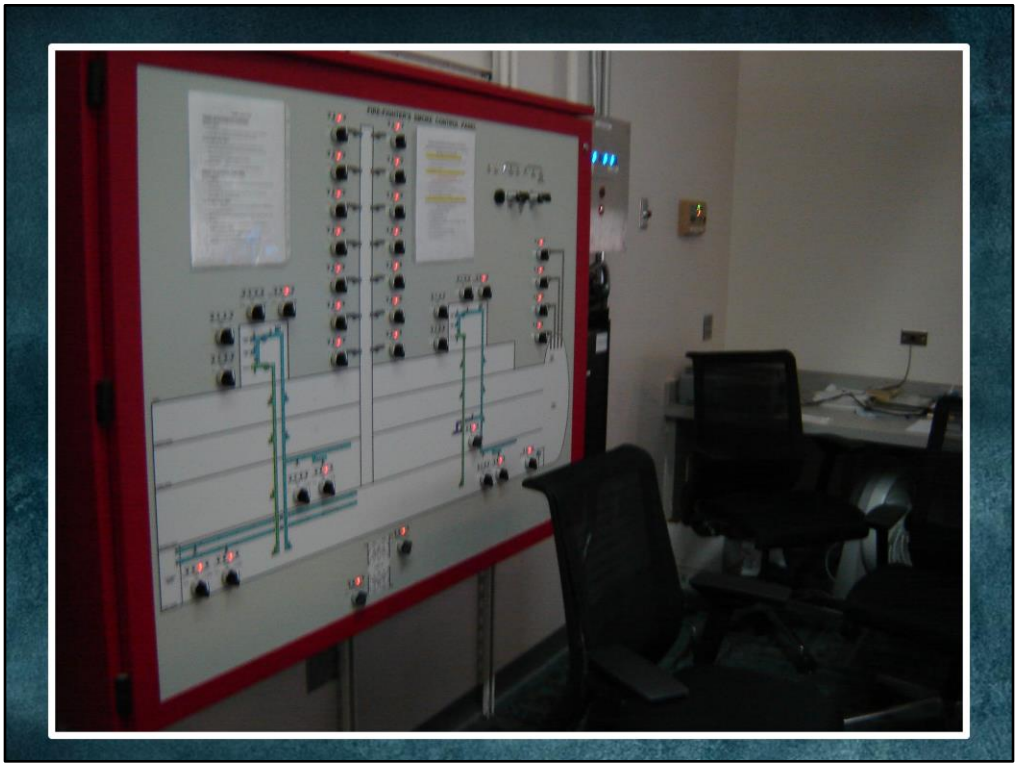


Instructions are posted on the panel. There have been multiple iterations as we have tried to fine tune the instructions to match the testing of the system.

The instructions explain how to Enable the Panel in order to take manual control of the system

Manual Activation – is fully explained. There is even a warning – make sure all the exposed switches are in "AUTO" before enabling the local control of the panel.

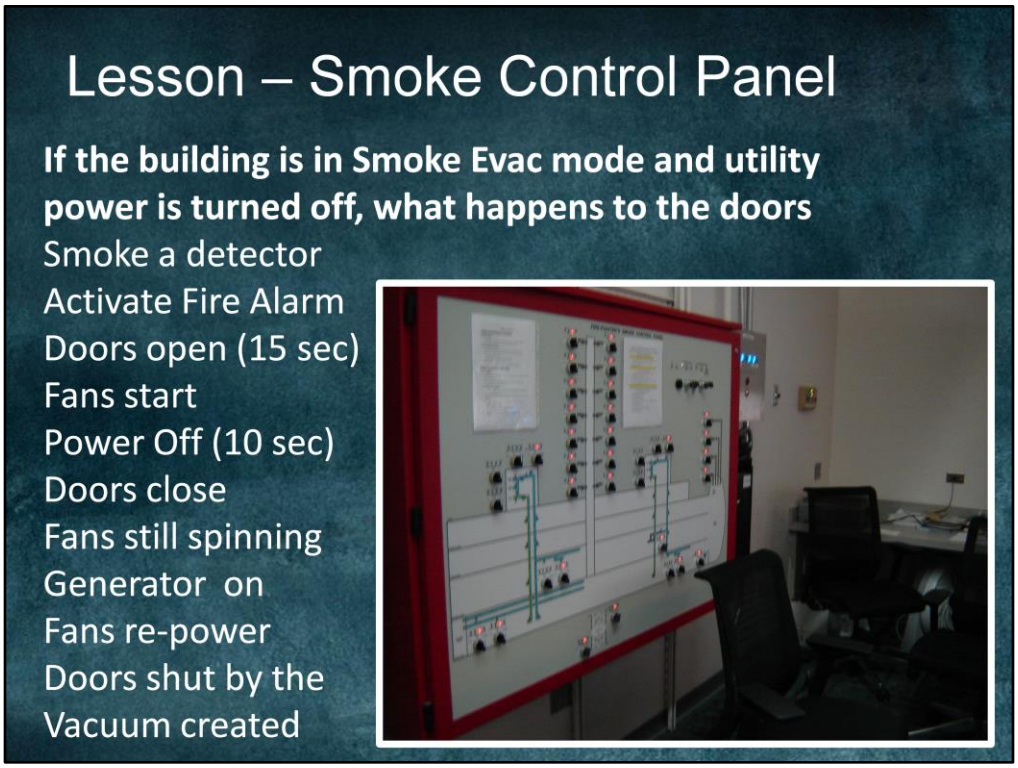
(next)



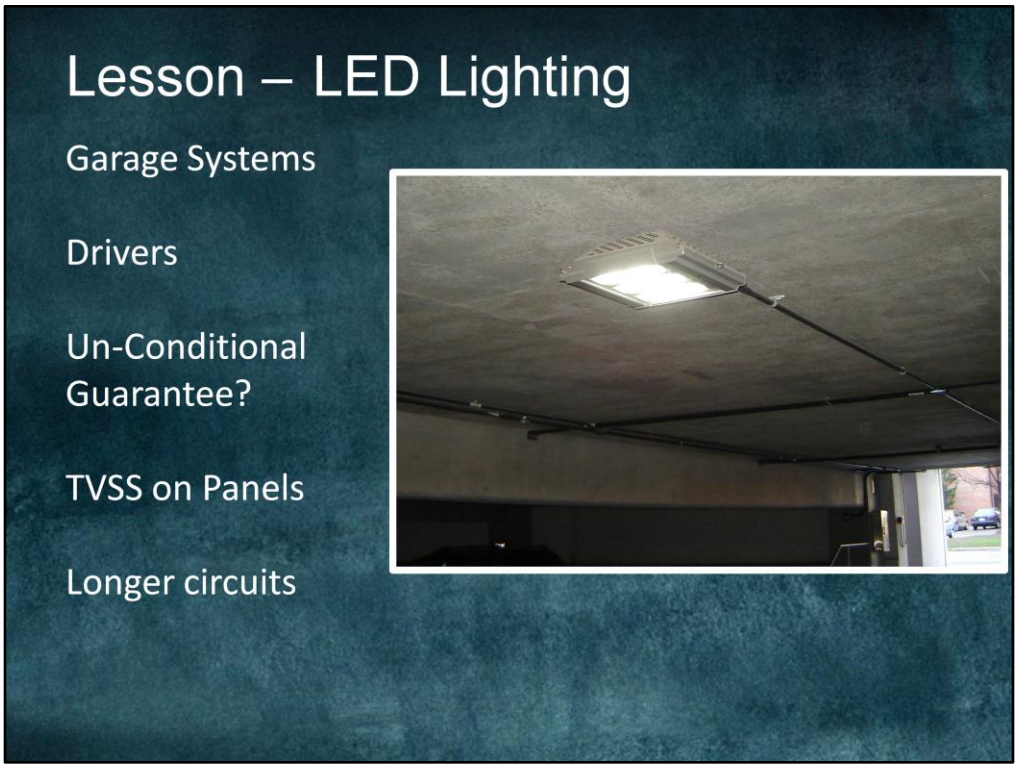
There was a problem with the original installation of this panel. The keys switches were not programmed correctly. The chair in this picture helped us find the problem. It bumped a switch one night and started a shutdown of the building.

The Master key had been left in the enable position. Someone thought the disable position – disabled smoke control.
Not everyone flew model rockets as kids. Put in the key and active the launch switch.

Same here….Until the key is turned the buttons are not active. Once the switch was reprogrammed to disable the local switches this problem has not re-occurred.
(next)



Now … back to the original test question…..
If the building is in Smoke Evac mode and utility power is turned off, what happens to the doors
Smoke a detector
Activate Fire Alarm
Doors open (15 sec)
Fans start
Power Off (10 sec)
Doors close
Fans still spinning
Generator on
Fans re-power
(next) Doors are pulled shut by the vacuum created by the exhaust fans
Why you may ask – because our panel does not monitor the status of the transfer switches and once smoke evac starts it locks in. To keep the doors from closing we move the timing of the Legally required standby ATS to 60 seconds.
Now you know the rest of the story.
(next)



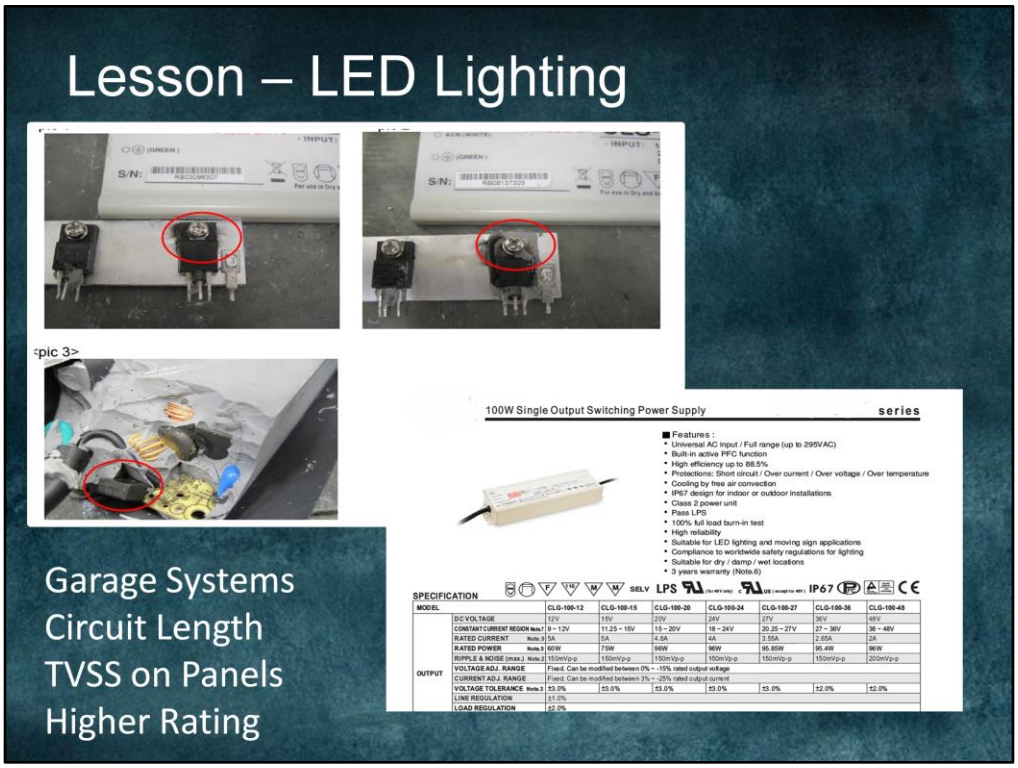
Specifically I want to talk about what has happened on LED Garage lighting Systems
I cannot tell you why we are having problems – but you need to know there have been problems.

(next) Need to know some new terms – A Driver is to an LED fixture what a Ballast is to a fluorescent fixture. That is the part of the fixture we have the most problems with.

(next) We did specify that the LED luminaires would be provided with a 5 year Un-Conditional Guarantee.
We have since been told that the unconditional guarantee does not include surges on the electrical system or other "Acts of God." Our drivers are failing due to surges.

(next) In order to keep any part of the warrantee we were told we had to install TVSS on each electrical panel serving LED lighting. Don't normally have TVSS in our parking decks but we added it.

(next) I do believe that we may eventually connect the Longer circuits runs used in a garage with the high failure rates.
(next)

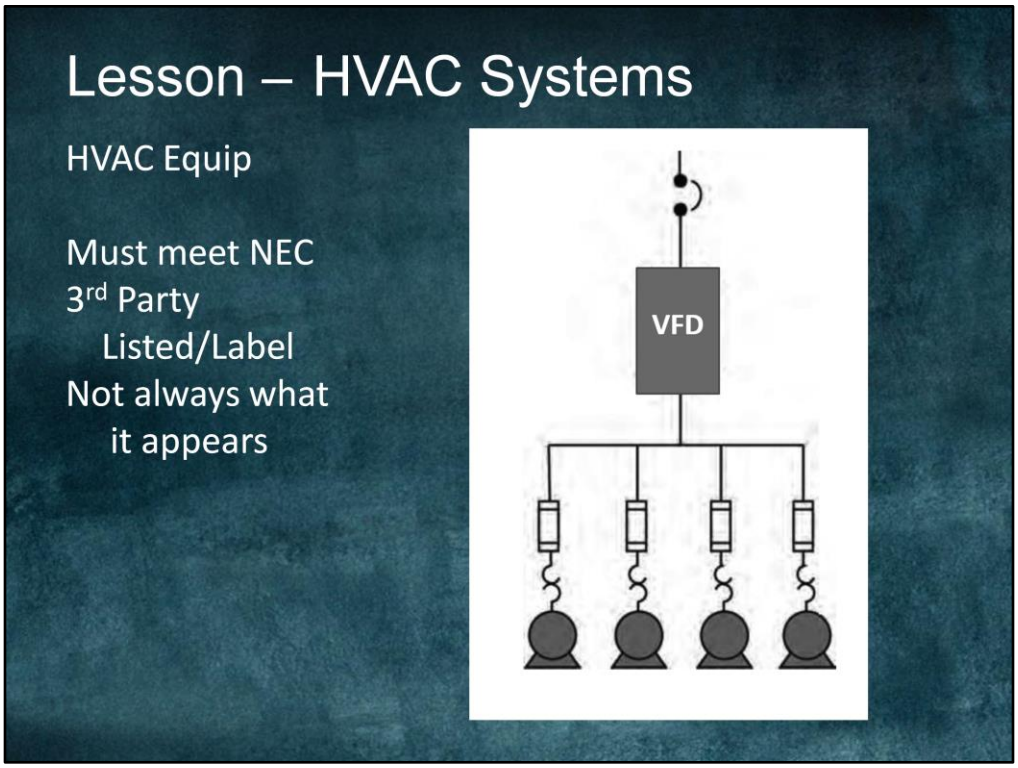


This is a picture of one of the forensic evaluations that was done on one of our failed driver units. (---The failures caused by momentary huge energy into the power supply (surge), when the energy over 4.2KVAC)

So for now I recommend keeping the runs short and specifying Higher ratings on driver surge withstand rating.
And forget about the Unconditional guarantee.

(next)

Equipment Coordination
These pictures speak for themselves.
(next)
(next)
(next)



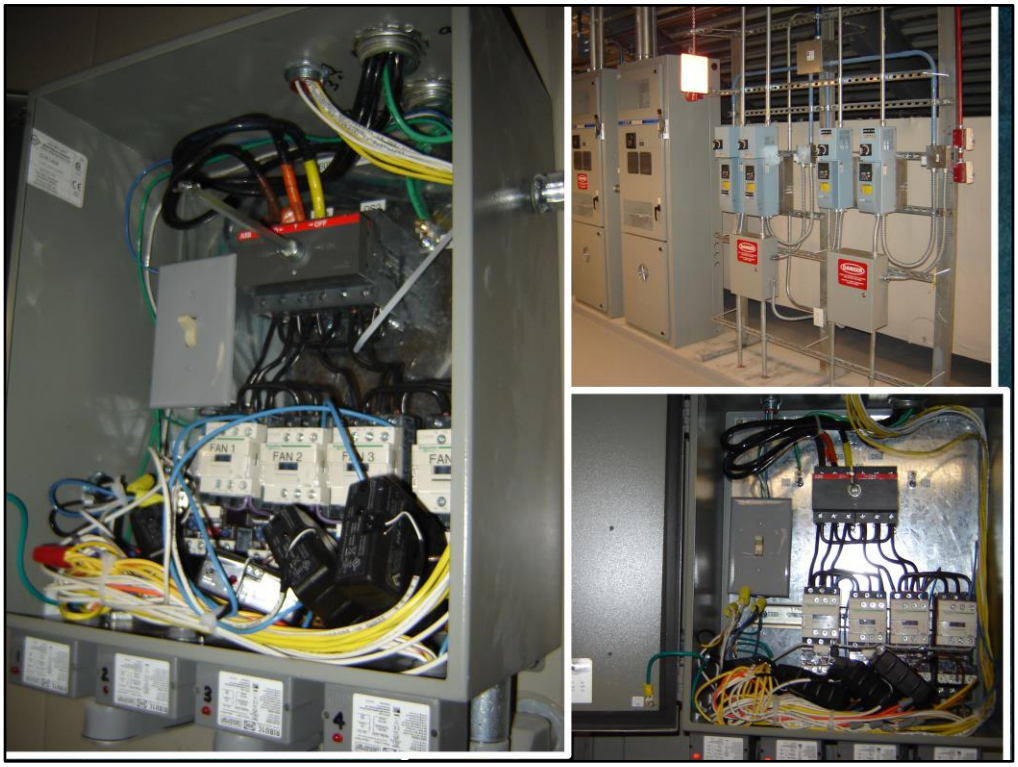
HVAC Systems – lets start with the Equip
The installation must meet the requirements of the National Electrical Code. It is not an acceptable excuse that the Mechanical or Plumbing contractor did not realize they need to call for an inspection of the electrical connection they made.

(next) A 3rd Party inspection is required for all control panels. It should be shipped to the site with the label in place.

(next) On a regular basis contactors are purchasing listed equipment and proceeding to modify the equipment on site. If you modify the equipment it might lose the listing – at that point it is “Not what it appears to be”

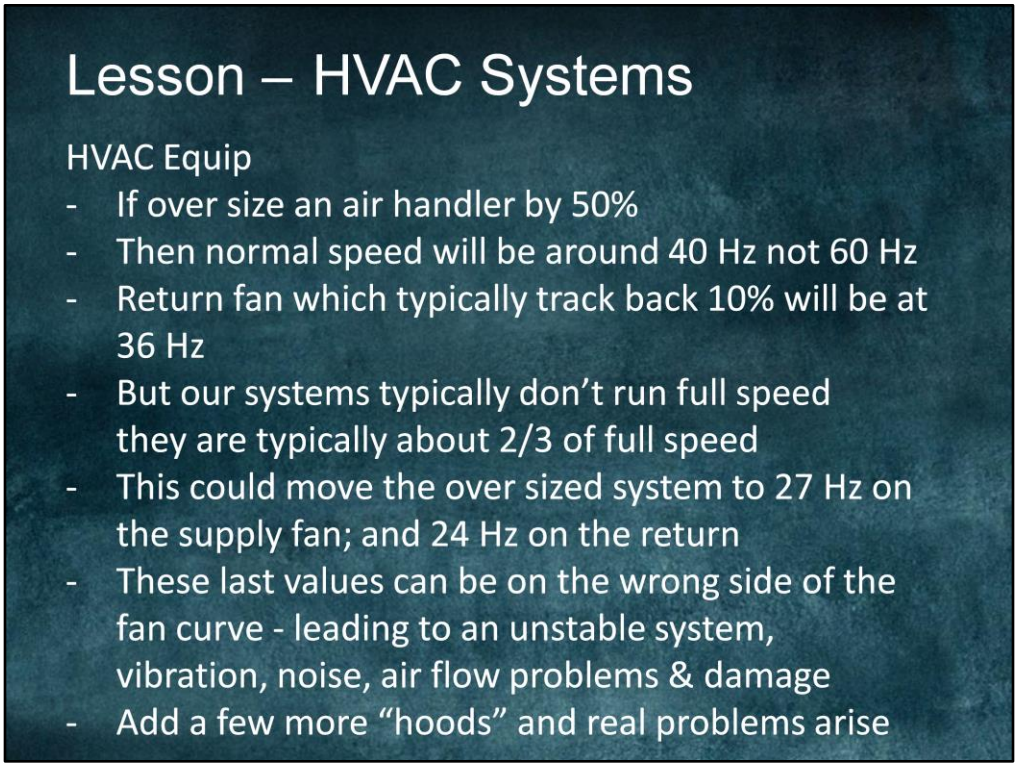
Unlike with a single motor connected to a VFD, each motor must have its own overload and short circuit protection.

We have multiple recent projects that managed to get to the point of inspection before it was realized the equipment submitted was incomplete or had been improperly modified
(next)

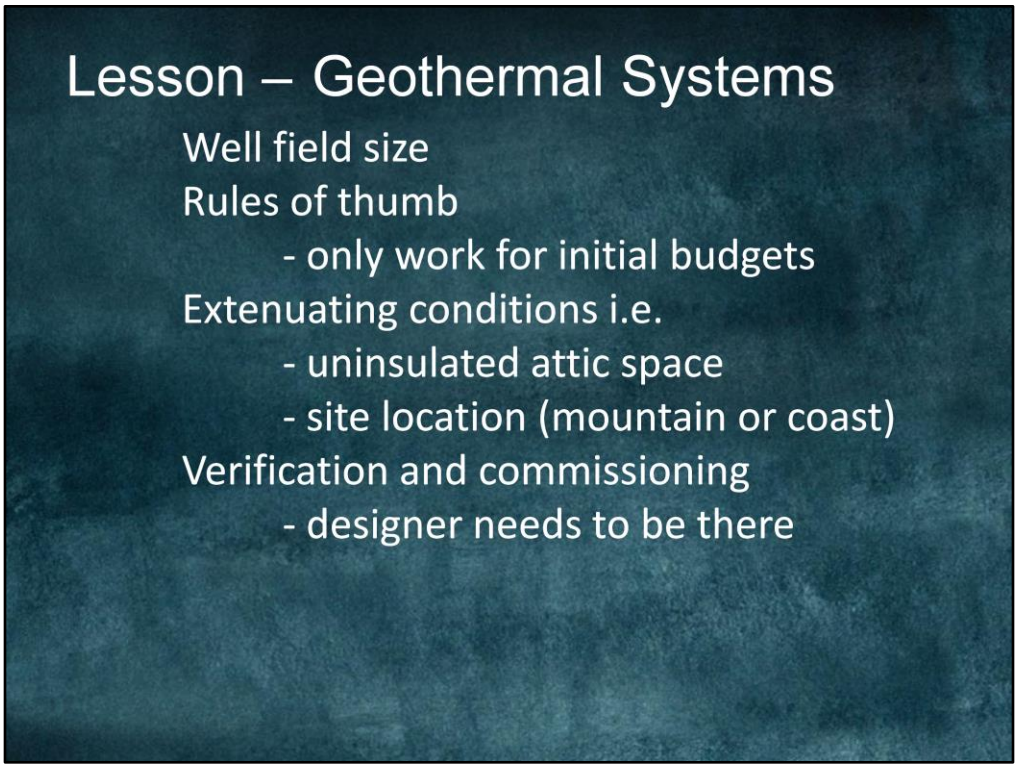


This is a “fan wall” installation with 4 – 10 hp, 480 volt motors that are fed from one 40 hp VFD. The equipment has a label on the panel but some items were added in the field. The field added components are problematic in terms of the Listing and our ability to accept the equipment.

(next)
(next)



HVAC Equip
We have had multiple projects that the HVAC system was making strange noises and was causing the building to shake. Lets take an over simplified look at the impact of oversizing an HVAC system.
(next) If over size an air handler by 50% ….
(next) Then normal speed will be around 40 Hz not 60 Hz
(next) Return fan which typically track back 10% will be at 36 Hz
(next) But our systems typically don't run full speed on any given day - they are typically about 2/3 of full speed
(next) Dial a 40 Hz system back 1/3. This will move the over sized system to 30 Hz on the supply fan and about 27 Hz on the return
(next) These last values are may be on the wrong side of the curve leading to an unstable system
(next) Add a few more lab "hoods" and real problems arise – Do you want to be the person talking about how to fix a brand new system?
(next)



(next)

(next)

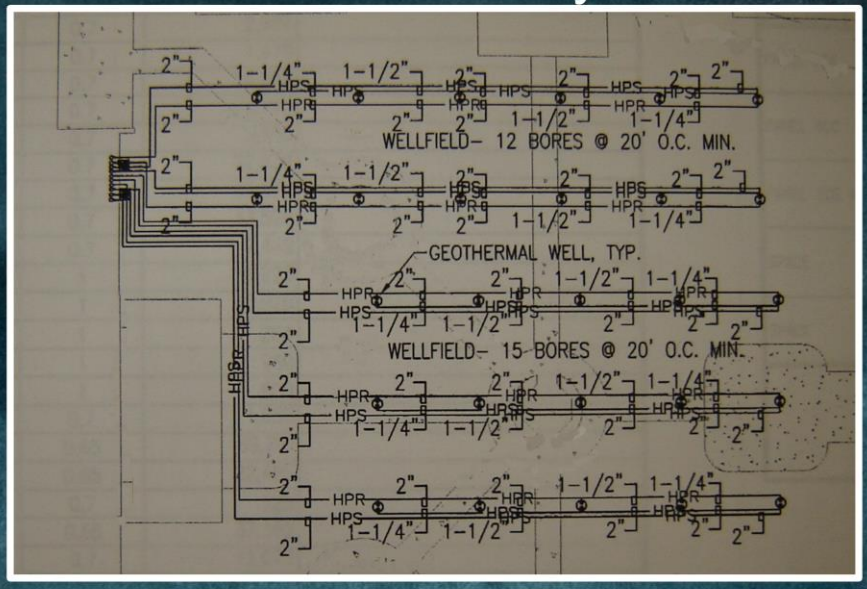
(next)

(next)

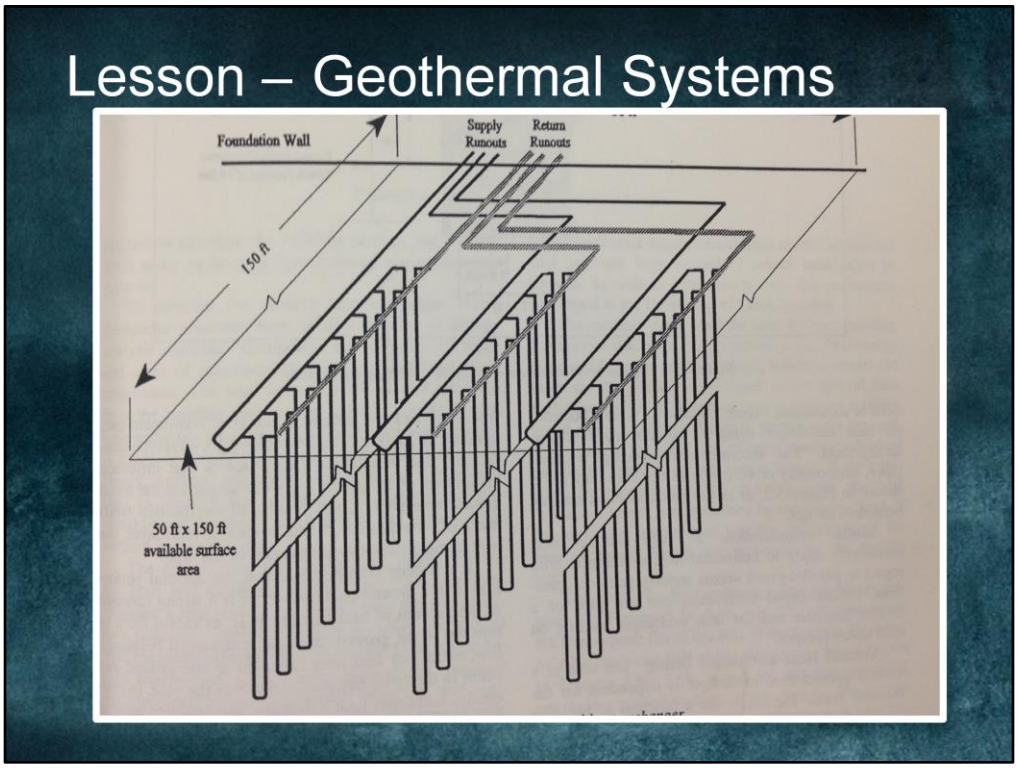
Who verified that the Grout was installed the full depth of the well – it is expensive grout.

(next)

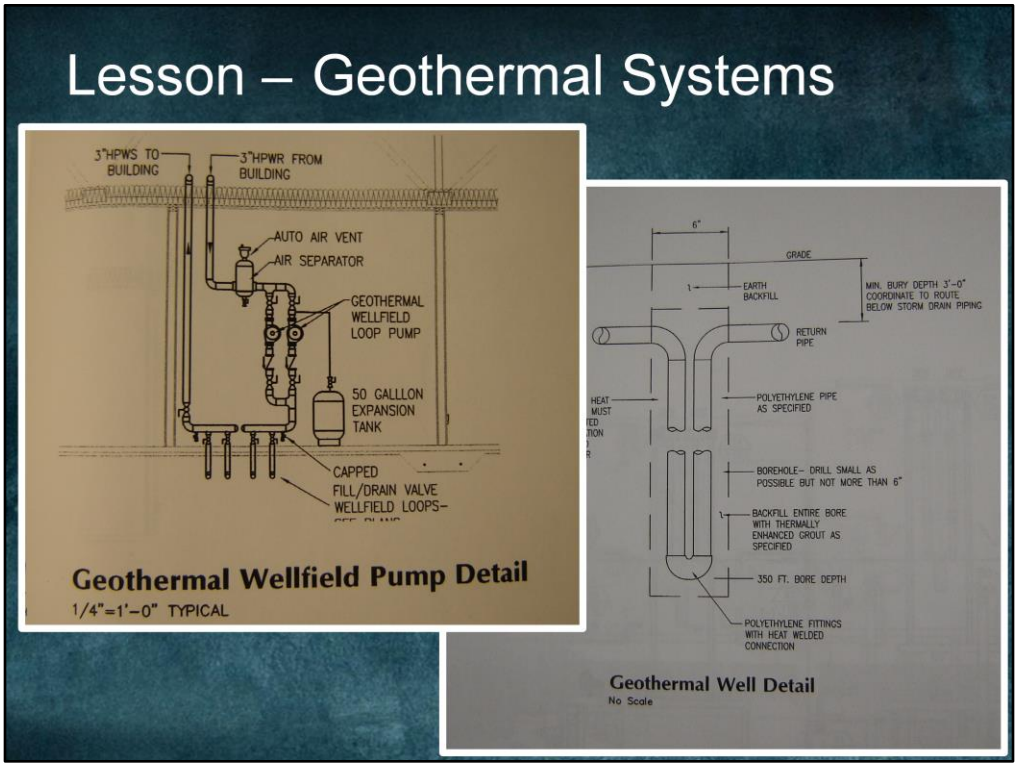
Lesson – Geothermal Systems



(next)



Geothermal
Another way to draw the well fields in 3D. Some people believe it is a much clearer way to show the reverse return concept. The supply and return connections are much clearer. But it does **not** clearly show the distance between wells or the changing pipe sizes.
(next)



Geothermal
This is a Well detail – not completely correct. Though there is only one pipe in and out of the well there is a connection at the top of the well on each side and it may not match the main line size. This would be a good place to detail the reverse return nature of the system.
The statement here to "pressure test" the piping is not enough. Dirt can clog the line and prevent flow to the well, but the system could pass a pressure test. We want to see a flow test and have it witnessed.

(next) Well pump details –
This detail has several problems.
Need to call out the check valves, balancing valve and isolation valve.
The expansion tank is connected to the system in the wrong location. It can be isolated. It needs to stay connected even if one pump is out of service.
Need to show temperature gauges on the supply and return piping to the field. This is where we will need to start trouble shooting if there is a temperature problem.
An interesting point here is that a second pump does not necessarily double the flow. We need clear designer statements as to whether the second pump is a spare or is to increase flow. And we need a statement as to how much it is supposed to increase flow. List it on the pump schedule.
(next)

Geothermal
A view of the attic during construction where the geothermal lines will be routed. I needed a non-specific picture and it was the only one available.

For this particular building and geothermal system a commissioning agent was required for the project and signed off on the building.
However, during the 1st year we started losing compressors and no one could explain why.

When SCO was called in to review the nature of the problems we found that neither the commissioning agent or designer attended the installation of the wells.
Neither witnessed a flow test,
neither of them commissioned the well fields.
Neither of them could tell us what was wrong with the system.
Temperature of the loop is clearly outside of the design parameters and no one knows why.
Please don't let that happen on your project.
(next)

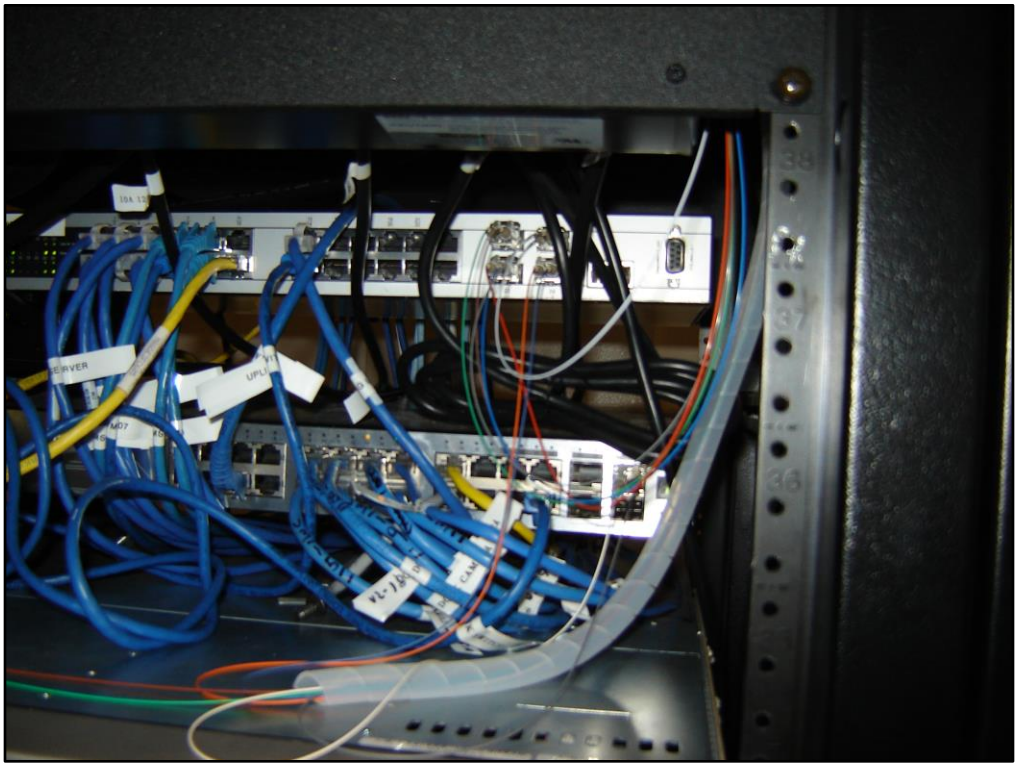
Lets look at a large mechanical/boiler room and the associated equipment.
(next) This is a 40 foot long, 16 foot tall, louver wall for a mechanical room.
Because there are boilers in the room the architect made the whole wall a fixed open louver system.
The designer placed a 5kw heater on the other side of this wall.
Though it is a boiler room, we insulate the boilers pretty well now days.
(next)

These are the pumps located on the other side of the open wall.
(next)

(next)These are the icicles hanging off of one of the pumps this winter.
We were in danger of damaging the sprinkler piping and the other piping system in the room.
These pumps developed significant problems from exposure to the near zero temperatures.
Coordination appears to have been missing.
(next)

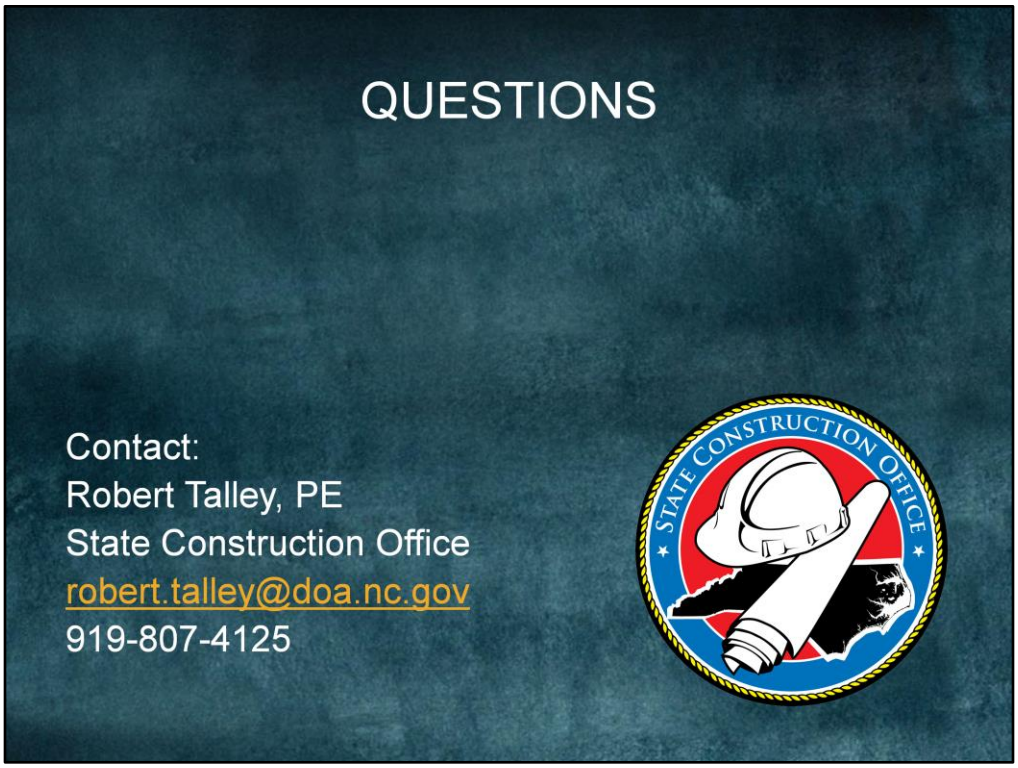
Security is an increasing concern in our society.
It seems everyone wants cameras and recorders, card access and alarms.
This is a typical security monitoring station.
It is typical in two ways
(one it uses flat screen monitors.
Two – the monitors and recorders are for forensic purposes. The systems are for solving problems after the fact.)
(next) The systems are expensive to install and to maintain. Please talk with the user group about their needs, the budget they have, and your ability. If you are looking to them to specify the system you could end up with a mess. Across the state we are finding systems that have been improperly specified, improperly installed, and improperly commissioned. Last week a vendor looked over a system that was recently installed but was malfunctioning. He just shook his head. The previous installer had good equipment but connected and programmed it wrong. Major pieces, were expensive, would not work with each other.

(next) STS 1000 - these system are basically data systems. They use data cabling (cat 5E and 6 and fiber optic, racks, hubs, routers, and IP addresses.)
(next)



But the security installers are not being held to the data cabling standards and that is wrong. Please start including the requirements for patch panels and proper cable management. It is just the right thing to do.
(next)

Same project as the last picture – that is a piece of data equipment that I found in the cable tray system. It does not belong there. The installer thought that the signal was being lost due to distance. When actually it was an overload condition. The system was attempting to pass more data than the switch was capable of handling. This is just one more piece of evidence that the installer was in over his head.
(next)



That concludes the formal portion of this presentation. Are there any questions about what we went over?