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EXISTING FACILITIES EVALUATION REPORT

Project:	Episcopal Church of the Resurrection Greenwood, South Carolina				
Owner:	Episcopal Church of the Resurrection	Date:	8/12/10	By:	Ronnie Banks
Re:	Electrical Systems Evaluation	A/E Project Number:	10-C1070		

ELECTRICAL SYSTEMS EVALUATION:

The Church (Sanctuary):

A. Electrical Service:

The Church and attached Parrish House building are served by a common main panelboard located in the basement mechanical room. The electrical service conductors enter the basement underground from a C.P.W. service pole and meter located along Marion Street on the North side of the building, toward the rear of the site. The main panel is a General Electric Spectra Series that appears to have been manufactured in 1998. General condition of the main panel appears good. There are four circuit breakers in this panel, which supply loads as follows:

350 amp, 3 pole: Feeds the chiller.

100 amp, 3 pole: Feeds a wire gutter adjacent to the main panel, which in turn feeds a small panelboard and starters for the basement mechanical equipment. Fan coil units in the sanctuary are also fed from this panel board.

100 amp, 3 pole: Exits the basement above grade and feeds an outdoor condensing unit adjacent to the patio connector, then continues up to the attic to other unknown loads in the Parrish House.

150 amp, 2 pole: Feeds an old Federal Pacific panelboard located in the stairwell just outside the mechanical room. This panel in turn feeds panelboards in Parrish House as well as the sanctuary panelboard.

Service voltage is 120/240V, three phase high-leg delta. Service conductors appear to be one set of 500 MCM, which would be good for 400 amps maximum. Measured load on the phase conductors were 141, 123, and 132 amps respectively for A, B, and C phase, at the time of our visit, with the chiller running at partial load.

Deficiencies Noted:

1. The main panel does not have a nameplate as required by the National Electrical Code and NEMA standards. Therefore, we could not determine the actual rating of this panel. From general appearance, it should be rated between 400 to 800 amps. We can probably locate an order number somewhere on the equipment and if so, can have GE verify what we have if necessary.

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2. There is no main circuit breaker. In order to disconnect power to these buildings, all four breakers must be switched off. The NEC does allow up to six individual grouped disconnects, but this is not considered a desirable design. Also, the breakers are not marked "Service Disconnect" as required by code, which could be a source of confusion for a fire fighter or someone servicing the building.

3. There is no ground bar or grounding electrode conductor in the panel. The neutral bar is bonded to the metal panelboard can and both neutral and ground conductors are terminated on it. The NEC requires a grounding electrode for every service, which would consist of driven ground rods, water pipe, if present, and building steel or footing rebar, if present. The only system ground is from the utility neutral connection and incidental contact with metal conduits. There should be separate ground and neutral terminal bars with a single connection from ground to neutral.

4. Color coding of the conductors do not meet industry standard practice in some cases. For example, brown tape on the service conductors would normally indicate a 277/480 volt system.

5. There are #12 conductors that originate in the mechanical wireway being pulled through the main panel. The conductors exit in the same conduit as the power circuit to the Parrish House, so it appears this was done for the sake of expediency, being the easiest route. Technically, this violates the NEC, as panelboards are not supposed to be used as pull boxes.

6. General environmental conditions at the service panel location in the basement are poor, due to standing water on the floor, high humidity, mold, etc. Although the main panel condition appears good, these conditions can and will affect safety, service life, and reliable operation of the electrical equipment. Some of the older electrical items in the basement, such as the starters and panelboard on the exterior basement wall, do show some signs of corrosion.

7. The service voltage is considered obsolete and has not been offered by most utilities for a long time. High leg delta services were commonly used in the 1940's and 1950's, a time when single phase loads for lighting and receptacles were fairly small. Most have since been eliminated in favor of 208 / 120 volt three phase systems.

B. Panelboards and Power Distribution:

The Federal Pacific panel located in the stairwell next to the mechanical room serves as a distribution panel for all lighting, receptacle, kitchen, and similar loads in both the Parrish House and the Sanctuary. This panel is fed by a 150 amp breaker at the main panel.

There is only one panelboard present in the main floor level of the sanctuary, that being a small 8 space, main lugs only panel located in the closet near the entry door from the Parrish House side. It is fed by a 70 amp circuit breaker located in the Federal Pacific panel described above. This panelboard feeds lights and receptacles in the sanctuary and adjacent corridor and other rooms. General condition is poor, with the cover having been replaced with a shop fabricated sheet metal cover. It was evident from our inspection of this panel that there are still some of the old fabric insulated conductors remaining in the sanctuary, including the feeder to this panelboard, as well as to lighting and receptacle loads throughout. This was confirmed by spot checks at several receptacles and light switches. Wiring which was obviously added later, i.e. after the original building construction, was the plastic insulated type. (For example, the surface mounted receptacles and switches at the organ.) Except for the wiring to the chiller, which passes through the basement and is in PVC conduit, all wiring appears to be run in metallic conduit as best we could tell. There were no equipment grounding conductors present in any of the original conduits or in the sanctuary panel. There were very few receptacles in the building, with none at all seen in the corridor, entry vestibule, or sanctuary seating area. Some of the receptacles that were present were the old two wire type. Others had since been replaced with three wire grounding type receptacles.

Deficiencies Noted:

1. Except for recent additions, there are no grounding conductors present in branch circuits to receptacles, lighting and other equipment. This was commonly done during the time when this building was constructed, with the metal conduits serving as the grounding means. This is actually still allowed by code, but is not considered good practice. The problem is that over time, the conduit may not be a reliable ground return path because of rust, corrosion, loose joints, and other factors. If a ground fault occurs and a reliable ground is not present, there could be a shock hazard as well as a fire hazard.

2. The old fabric insulated wiring is well past its service life, which as a rule of thumb is about 40-50 years.

3. The sanctuary panelboard is undersized, in poor condition, contaminated with dirt and debris, and in a location that does not allow proper clearances and working space. The NEC requires a 30" wide by 3 foot deep working space in front of this panelboard to allow safe access and working space.

4. There are not enough convenience receptacles present for routine housekeeping and maintenance. Present codes would require receptacles in the corridor, and within 25 ft. of the fan coils for maintenance.

5. The Federal Pacific panel is obsolete and the location at the entry stair area does not meet code requirements for safe clearances and working space.

6. Some of the old two wire receptacles have been replaced with new three wire type with ground prong, but there is no ground conductor present, nor was there a connection to the metallic box. This is a code violation. Use of an appliance or tool with a grounding type cord would not be properly grounded and could produce a shock hazard.

7. Outdoor receptacles were in poor condition and were not the ground fault type as required by the NEC. Ground fault receptacles are required by code in bathrooms, kitchens, wet locations, and outdoors to prevent electrical shock hazards and must be equipped with "weatherproof-in-use" covers when exposed to the weather.

C. Lighting Systems:

The lighting system in the sanctuary consists of pendant mounted lantern style fixtures in rows along either side of the seating area. These fixtures have multiple lamps, arranged for separately switched "up" and "down" control. The lamps in the bottom of the fixtures have been replaced with self ballasted compact fluorescents, while the up lamp is still incandescent. These fixtures are controlled by a wall mounted switch and dimmer next to the organ. Also, in the sanctuary, there were blanked off junction boxes at three locations along the peak of the roof, which may have been used for pendant mounted lighting or fans at some point. In the choir area, there are three wall sconces, as well as two floodlights that serve to accent the altar area. In the altar area, there is ceiling mounted bare bulb incandescent, some of which has been replaced with flood lamps. The remainder of the building has residential style fixtures, surface or pendant type, with the exception of the toilet, which has a fluorescent wall fixture over the mirror. Some of the building mounted outdoor fixtures have been replaced with residential style floodlights with motion sensors, presumably for security lighting.

Deficiencies Noted:

1. Lighting levels in the sanctuary are minimal at best. The existing fixtures do not produce a great deal of light, and are inefficient at distributing the light as well. They are basically a decorative design. The

high overhead structure and wood flooring, both with dark finishes, make it difficult to achieve good foot candle levels. Fortunately, there is considerable natural light contribution from the windows, but the contrast between the dark finishes and the brightness of the windows can make visual tasks difficult, especially for older persons. This can also present safety hazards, such as at the steps to the altar area. Being the same material and finish as the floor, the steps and floor tend to "blend together" and be hard to see, presenting a fall hazard.

2. Lighting levels in the choir area are not adequate, and may make it hard to read hymn books, especially during a night service.

3. Exposed incandescent lamps in the altar area are not recommended. These are a potential fire hazard if broken, and are an inefficient lighting method with little control.

4. There is no logical or convenient method of controlling the lights in the sanctuary, choir, and altar areas. The sanctuary lights are switched from the organist area, but the choir area and altar area lights, along with some of the corridor lights must be switched from a set of switches in the corridor closet.

5. There are no accent lights on the pulpit or lectern areas. This makes it difficult to see the facial features of the speaker under some conditions. Similarly, the baptistery area at the rear of the sanctuary could be hard to see without accent lighting because it is back lit by the windows on the end wall.

6. There were no emergency lights or exit signs present in the sanctuary or in other parts of this building. Present codes require both exit marking and egress path lighting for life safety. The areas immediately outside the exit doors are also required to have emergency lighting.

Bishop's Hall:

A. Electrical Service:

This building is served by a 225 amp General Electric main panelboard, designated panel "A". It is fed underground from the same service pole and meter as the sanctuary service described above. Having a single meter for what is essentially two building services is usually to the advantage of the church because of the way the utility rates are structured; One service being cheaper in cost than two separate ones for the same amout of energy used. Voltage is the same 120/240v high leg delta as the sanctuary, and service conductors are 4 #4/0 and 1#2/0 neutral. One of the #4/0 is a spare. Conductor size is consistent with a 225 amp service. Similar to the sanctuary service, there is no main breaker in this panelboard. There are five branch breakers, one short of the six allowed by code. These feed an adjacent 200 amp single phase panel "B" for lights and receptacles, two condensing units, and two air handlers. General condition of the main panelboard appeared good.

Deficiencies Noted:

1. There is no main circuit breaker. In order to disconnect power to the building, all five breakers must be switched off. The NEC does allow up to six individual grouped disconnects, but this is not considered a desirable design. The breakers are not marked "Service Disconnect" as required by code, which could be a source of confusion for a fire fighter or someone servicing the building.

2. The high leg 120/240V delta service is an obsolete service voltage. See the comments above regarding the sanctuary service. Use of this system restricts the lighting and receptacles panels to single phase, and could be a hazard to someone servicing the system who may be unaware of the system voltage, since the voltage to ground on the "high leg" is approximately 200 volts instead of 120 volts as for

the other two phases.

3. There is not adequate working space in front of the panel due to storage of items and the wall mounted shelving. The door of the main panel barely clears the shelving, while the code requires at least three feet clear working space. Storage of combustible materials, such as paper products, near the electrical panels also presents a fire hazard.

B. Panelboards and Power Distribution:

Panel B is a 200 amp single phase General Electric panelboard and serves all lights and receptacles. General condition appears good. From spot checks above the ceilings, general wiring methods appeared to be stranded conductors run in electrical metallic tubing (EMT) or electrical non-metallic tubing (ENT, blue flexible plastic). There also was considerable metallic flexible conduit, as well as some "MC" cable present. Wall mounted recessed device boxes were metallic type. We did not see any Romex, but were able to see above the ceiling only in limited areas, so there could be some present. We did not enter the attic or inspect wiring to the air handlers as no attic hatch was evident. Ground fault receptacles were present in the toilets and near the sinks in the kitchen, as required by code, and the general number and location of convenience receptacles appeared adequate.

Deficiencies Noted:

1. Code required working space must be maintained in front of panel "B" and storage items should be kept clear of this working space.

2. This building is an assembly occupancy and as such, ENT would not normally be allowed unless the space has non-fire rated construction, which seems to be the case for this building. Even if allowed by code, the use of non-metallic tubing (ENT) is not a desirable wiring method, and is not allowed on many projects. The NEC requires ENT to be secured to the building at least every 3 ft, and within 3 ft. of every termination at a box or device. Also, the longest unsupported length of ENT allowed by the code is 6 ft., as at a lay-in light fixture connection for example. Typically, these code requirement are widely ignored when non-metallic tubing is used, and the result is a sloppy installation and the possibility of the conduit being damaged from later work in the vicinity.

3. In general, workmanship of the electrical installation above the ceiling appears substandard, with unsupported junction boxes, unsupported conduits, and excessive use of flex. Conduit observed.

4. There is a missing cover plate on one of the receptacles near the kitchen. This presents a shock hazard, particularly to young children, and should be repaired immediately.

C. Lighting Systems:

General lighting throughout is by lay-in fluorescent fixtures with four T-12 lamps and magnetic ballasts. Additionally, there are chandeliers in the main area that are controlled by wall box dimmers, and there are decorative wall sconces near the front entry. Two of the exterior doors are marked with exit signs, and there are wall mounted battery pack emergency lights present in the main room. Overall lighting level is good, and light fixtures appear to be in good condition. Realistically, there appears to be more light fixtures than necessary for the room's intended use.

Deficiencies Noted:

1. The T-12 lamps and magnetic ballasts are pending obsolesce. Current standard design is with T8 lamps and electronic ballast for energy savings. These fixtures could likely be retrofitted to T8 / Electronic in the future if desired.

2. Emergency lights are recommended in the gang toilets. There are none present.

3. The exit sign at the front entry area does not work in emergency mode. Also, this is an old incandescent sign, that should be replaced with a new LED type unit for reliability and energy savings. The other exit sign, at the door on the Parrish House side near the kitchen, looks like an LED sign, but won't work in emergency mode.

4. One of the battery emergency lights does not work.

5. There are no hanger wires on the lay-in light fixtures. Current practice is to provide at least two hanger wires directly to the light fixture to meet seismic design standards.

Electrical Summary and Recommendations:

Sanctuary:

While the electrical service panel is fairly new and in good condition, other equipment and wiring throughout the building are old, in deteriorated condition, and need to be upgraded for both safety and functionality. The panelboard in the sanctuary is too small and in poor condition, and there are old fabric insulated conductors remaining in many circuits. The service is not properly grounded, and there are no grounding conductors present in branch circuits to receptacles, lights, and other equipment. Lighting systems in the sanctuary and choir areas are inadequate, and controls and accent lighting that could enhance the worship services are missing. Exit signs and emergency lighting that are required by code are not present, and could create life safety hazards or expose the church to liability.

Recommendations:

1. Label the main panel breakers "Service Disconnect" as required by code. Provide a nameplate designating the panel amps and voltage rating. Provide tag indicating high leg delta service.

2. Provide a service ground electrode as per the NEC. This is a safety issue that must be corrected.

3. Provide a ground bar kit in the main panel and rework to separate the neutral bar.

4. Correct tape color coding of phase conductors where non-standard colors have been used.

5. If a major building project is undertaken, consider reworking the service to standard 208Y120 volts. Both the sanctuary and Bishop's Hall could possibly be re-fed from the service panel in the new building. This is not a difficult conversion, but any motor operated equipment would need to be checked for correct operation, because it would be working at 208 volts after the change. Many times this is not a problem because most HVAC equipment is dual rated at 208-230 volts. (The chiller is rated 208-230)

6. Correct the water and humidity conditions in the basement. They will affect the safety and reliability of the electrical equipment if allowed to remain.

7. Consider completely rewiring the sanctuary building, including a new panelboard, new conductors, and new switches and receptacles. Branch circuit grounding conductors would be provided, and receptacles could be added where needed. Existing metallic conduits and wall boxes could be reused in most cases. The Federal Pacific panel should be relocated and replaced, or eliminated if Parrish house is ever demolished.

8. Replace all of the outside receptacles with GFCI type with weatherproof-in-use covers.

9. Consider a lighting upgrade to improve general lighting levels, particularly in the sanctuary and choir

areas. Provide means for local control of all lighting, and eliminate the closet switches. Add accent lighting for the pulpit and other areas with separate controls to improve visibility and enhance the worship services.

10. Install emergency lighting and exit signs throughout as per code requirements.

11. Check the grounding path for the outside floodlighting. These are accessible from grade, subject to touch, and will be a shock hazard if not properly grounded. Fixtures must be reliably grounded and / or wired to a GFCI protected circuit for safety.

Bishop's Hall:

Being of more recent construction than the sanctuary, the electrical systems in this building are generally in good condition and adequate for the buildings use. The system appears to be properly grounded, and there are grounding conductors run in each branch circuit conduit. There is extensive use of non-metallic tubing throughout, and there are some issues with sloppy workmanship in hidden areas, like the attic. Issues such as improperly supported conduits and boxes are sometimes difficult or impossible to correct once the building is completed. The electrical service does not have a main breaker, which is not a desirable situation, and the breakers that are present are not labeled "Service Disconnect" as they must be. There are also items stored in front of the electrical panels that infringe on the code required working space and add to the possibility of a fire, and there are other items that need attention, such as malfunctioning exit and emergency lights.

Recommendations:

1. Install a new cover plate on the receptacle that is missing one. It is a safety hazard.

2. Repair the emergency light and exit signs that are malfunctioning. The exit sign at the front should be replaced with a new LED type.

3. Remove the wall shelves in front of the main panel, and restrict storage of materials in front of these panels. Three ft. clearance is required for safety and to meet code.

4. Add emergency lights in the toilets.

5. Consider adding support wires to the lay-in fixtures. Because of the insulation batts on the ceiling, this work could best be accomplished as part of other work involving the ceiling.

6. Add "Service Disconnect" labels to the five breakers in main Panel "A". Add signage showing the service voltage and high leg service.

7. In the event of a major project on site, such as a building addition, consider reworking the service to standard 208Y120 volts. See similar comment under the sanctuary recommendations.

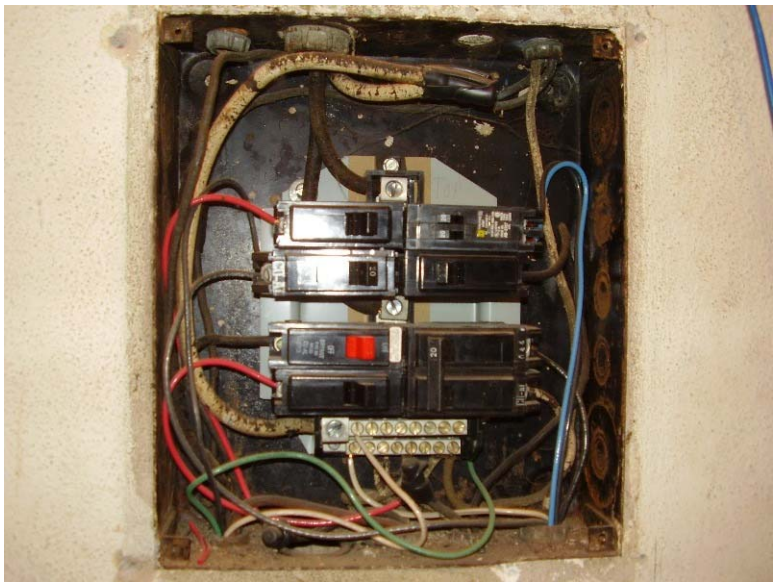
8. It may be desirable to replace or retrofit the fluorescent lay-in lights at some point to T8 lamps and electronic ballasts. This would be predicated more on reliability and continued availability of T12 lamps more so than energy savings, because the minimum hours the fixtures are used would probably not achieve payback.

Electrical Photos:

Sanctuary main panel. Note lack of main circuit breaker and non-standard color coding of conductors. Although the "high leg" is required to be orange, the brown, orange, yellow combination is commonly used for 277 / 480 volt systems.

Main panel neutral bar used as a grounding point. There should have been a separate ground bar provided in the panel, along with a main grounding conductor as required by code.

Sanctuary panelboard with cover removed. Note deteriorated condition and presence of dirt, debris, and old fabric insulated conductors. There are no available spaces or spare breakers left.



Convenience receptacle at the front of the sanctuary near the choir area. Note old fabric insulated conductors and lack of a grounding conductor. This is a 3 wire grounding type receptacle, but is not properly grounded as installed.

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These switches for the choir and altar area lights are located in a closet in the corridor.

Outdoor receptacles at the sanctuary are contaminated and in poor condition. These should be GFCI type to meet code.

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Bishop's Hall main panel "A" (right) and lighting and receptacle panel "B" (left). Note lack of clear working space and storage of combustible materials near the panels. Also, main panel "A" does not have a main circuit breaker, and the five breakers present are not labeled "Service Disconnect".

Above ceiling photo in Bishop's Hall showing improperly supported boxes and conduits and excessive use of flexible conduit. The blue conduit is the non-metallic tubing (ENT) referenced in the report. It appears to have been just laid through the attic framing, and not fastened down as required by the NEC.

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This photo is the top of a lay-in light fixture in Bishop's Hall showing the lack of hanger wires on the lights, as well as improper use and support of ENT conduit. By code, the ENT can run unsupported for a maximum of 6 ft at light fixture connections. Here it is being used in "daisy chain" fashion to wire from fixture to fixture.

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