Construction Management Breadth

Introduction

With such a significant change to the electrical distribution system concerning Alternate 2, I wanted to further investigate the impact these changes would have on the construction end of the project. In doing so, I will address several different areas that might be affected by such a change to the overall system.

Goal

I will determine the cost impact, scheduling impact, and additional considerations that will aid in a smooth delivery and installation for Alternate 2. This should give the client a more accurate view of how the proposed change would impact the entire project.

Assumptions

- Space exists adjacent to the current boiler room (with pad already poured) for the addition of a new 750 KW generator. This boiler room expansion was previously finished on a recent infrastructure project.
- Feeders from the new generator to the main distribution panel in the North Addition are 500 ft.
- Feeders from the existing Substation D to the main distribution panel in the North Addition are 500 ft.
- Existing circuit breakers feeding panels in North Addition will be used in new distribution panel as needed.
- No additional labor costs to install ground wires. This is included in the price for pulling the feeder.

Pricing

With the help of a local electrical distributor, I priced the material and labor costs for both the credits and additional costs associated with the above changes to the current normal distribution system. The following table summarizes the credits associated with the deleted components:

System Component Pricing - Alt. 2 Credits

Equipment Type	Product Number	Quantity	Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
FEEDER (12 #400 MCM)	Electrical Contractor	500	$33,600.00	30	$30.45	$913.50	$34,513.50
FEEDER (3 #1/0)	Electrical Contractor	500	$2,370.00	-	-	-	$2,370.00
EMT (3 3 1/2")	Electrical Contractor	500	$8,449.50	40	$30.45	$1,218.00	$9,667.50
FEEDER (4 #1/0)	Electrical Contractor	500	$3,160.00	30	$30.45	$913.50	$4,073.50
FEEDER (#4)	Electrical Contractor	500	$320.00	-	-	-	$320.00
EMT (2")	Electrical Contractor	500	$1,725.00	40	$30.45	$1,218.00	$2,943.00
FEEDER (4 #4)	Electrical Contractor	500	$1,280.00	30	$30.45	$913.50	$2,193.50
FEEDER (#6)	Electrical Contractor	500	$225.00	-	-	-	$225.00
EMT (1 1/4")	Electrical Contractor	500	$674.50	40	$30.45	$1,218.00	$1,892.50
FEEDER (4 #350 MCM)	Electrical Contractor	500	$9,760.00	30	$30.45	$913.50	$10,673.50
FEEDER (#1)	Electrical Contractor	500	$700.00	-	-	-	$700.00
EMT (3")	Electrical Contractor	500	$1,892.50	40	$30.45	$1,218.00	$3,110.50
FEEDER (3 #2/0)	Electrical Contractor	40	$223.20	2.4	$30.45	$73.08	$296.28
FEEDER (#6)	Electrical Contractor	40	$18.00	-	-	-	$18.00
EMT (2")	Electrical Contractor	40	$138.00	3.2	$30.45	$97.44	$235.44
						Total Credits:	$73,232.22

After I had determined the financial impact of my proposed deleted components, I determined the impact of my proposed additions to the system in the following table:

System Component Pricing - Alt. 2 Additions

Equipment Type	Product Number	Quantity	Material Cost	Labor Quantity	Labor Cost ($/hr)	Total Labor Cost	Total Cost
PANEL EMDP	Eaton Elec. (pg. 27)	1	$18,302.00	8	$30.45	$243.60	$18,545.60
FEEDER (4 #1)	Electrical Contractor	500	$2,800.00	30	$30.45	$913.50	$3,713.50
FEEDER (#6)	Electrical Contractor	500	$225.00	-	-	-	$225.00
EMT (1 1/2")	Electrical Contractor	500	$824.50	40	$30.45	$1,218.00	$2,042.50
FEEDER (4 #2)	Electrical Contractor	500	$2,200.00	30	$30.45	$913.50	$3,113.50
FEEDER (#8)	Electrical Contractor	500	$150.00	-	-	-	$150.00
EMT (1 1/4")	Electrical Contractor	500	$674.50	40	$30.45	$1,218.00	$1,892.50
FEEDER (4 #300 MCM)	Electrical Contractor	500	$8,320.00	30	$30.45	$913.50	$9,233.50
FEEDER (#2)	Electrical Contractor	500	$550.00	-	-	-	$550.00
EMT (2 1/2")	Electrical Contractor	500	$1,507.00	40	$30.45	$1,218.00	$2,725.00
FEEDER (12 #350 MCM)	Electrical Contractor	500	$29,280.00	30	$30.45	$913.50	$30,193.50
FEEDER (3 #2)	Electrical Contractor	500	$1,650.00	-	-	-	$1,650.00
EMT (3 2 1/2")	Electrical Contractor	500	$4,521.00	40	$30.45	$1,218.00	$5,739.00
FEEDER (4 #3)	Electrical Contractor	20	$57.60	1.2	$30.45	$36.54	$94.14
FEEDER (#8)	Electrical Contractor	20	$6.00	-	-	-	$6.00
EMT (1 1/4")	Electrical Contractor	20	$26.98	1.6	$30.45	$48.72	$75.70
FEEDER (4 #3)	Electrical Contractor	35	$100.80	2.1	$30.45	$63.95	$164.75
FEEDER (#8)	Electrical Contractor	35	$10.50	-	-	-	$10.50
EMT (1 1/4")	Electrical Contractor	35	$47.22	2.8	$30.45	$85.26	$132.48
FEEDER (4 #250 MCM)	Electrical Contractor	20	$280.00	1.2	$30.45	$36.54	$316.54
FEEDER (#2)	Electrical Contractor	20	$22.00	-	-	-	$22.00
EMT (2 1/2")	Electrical Contractor	20	$60.28	1.6	$30.45	$48.72	$109.00
FEEDER (12 #300 MCM)	Electrical Contractor	20	$998.40	1.2	$30.45	$36.54	$1,034.94
FEEDER (3 #2)	Electrical Contractor	20	$66.00	-	-	-	$66.00
EMT (3 2 1/2")	Electrical Contractor	20	$180.84	1.6	$30.45	$48.72	$229.56
FEEDER (16 #400 MCM)	Electrical Contractor	500	$44,800.00	30	$30.45	$913.50	$45,713.50
FEEDER (4 #1/0)	Electrical Contractor	500	$3,160.00	-	-	-	$3,160.00
EMT (3 3 1/2")	Electrical Contractor	500	$8,449.50	40	$30.45	$1,218.00	$9,667.50
FEEDER (3 #2/0)	Electrical Contractor	40	$223.20	2.4	$30.45	$73.08	$296.28
FEEDER (#6)	Electrical Contractor	40	$18.00	-	-	-	$18.00
EMT (2")	Electrical Contractor	40	$138.00	3.2	$30.45	$97.44	$235.44
FEEDER (3 #2/0)	Electrical Contractor	40	$223.20	2.4	$30.45	$73.08	$296.28
FEEDER (#6)	Electrical Contractor	40	$18.00	-	-	-	$18.00
EMT (2")	Electrical Contractor	40	$138.00	3.2	$30.45	$97.44	$235.44
ATS-1	Cummins	1	$9,000.00		$30.45	$0.00	$9,000.00
ATS-2	Cummins	1	$9,000.00		$30.45	$0.00	$9,000.00
ATS-3	Cummins	1	$14,000.00		$30.45	$0.00	$14,000.00
ATS-4	Cummins	1	$28,000.00		$30.45	$0.00	$28,000.00
GENERATOR (all inclusive)	Cummins	1	$220,000.00	160	$30.45	$4,872.00	$224,872.00
						Total Costs:	$426,547.64

Notes:

1. Material prices were obtained from Hite Electric (Altoona, PA) and Lowe's of State College
2. Electrician Labor Cost was obtained for the Washington, D.C. area from Leach Wallace Assoc.
3. Labor productivity was quoted by Hite Electric (Altoona, PA) and consists of the following:
   - Lay 100' conduit: 1 person, 8 hrs
   - Pull 100' (3-phase) wire: 2 people, 3 hrs
   - Install small (<45 KVA) transformer: 2 people, 3 days (includes all connections)
   - Install large (>45 KVA) transformer: 2 people, 5 days (includes all connections)
   - 42 pole Panelboard: 1 person, 2 hours (not including connections)
   - Circuit Breaker/Circuit connections: 1 person, 1 hr each
   - No additional labor costs to install ground wires. This is included in the price for pulling the feeder.

4. Generator was priced by Sebastian Theberge (Cummins Power Generation) and includes the following in the price:
   - Outdoor type 750 KW generator
   - 2500 gallon base tank
   - Generator enclosure
   - Fuel tank
   - Exhaust system
   - Outdoor rated circuit breaker

Scheduling

Although I do not have detailed information concerning the entire scheduling of the project, I wanted to know roughly how many man-hours I was adding to the overall project. Comparing the man-hours calculated above for the cost analysis, I determined approximately 260 additional man-hours would be needed for the proposed changes in Alternate 2. Assuming at least a 6 man electrical crew, that would equate to an additional 6 days of work on the project neglecting any lead-time for the generator or any other major equipment. Again, I am also assuming not all of the work is on the critical path. Even if the 6 days are on the critical path, this is in comparison to a 345 day schedule. Although extending the project completion a couple days is not the most favorable situation, 6 days is only a 1.7% increase in total scheduling, and that is the worst case scenario.

Additional Considerations

The following items should be considered and discussed in detail when preparing for the project start date as to not neglect key coordination issues:

- **Lead time for big equipment -** generator, automatic transfer switches, main distribution panel and main circuit breakers.
- **MEP Coordination in boiler plant** – extensive amounts of equipment get packed into boiler plants and sequencing work in this tightly packed area is critical to project efficiency.
- **Crane access** – a crane will be needed to lift and set the new generator and associated equipment. With such a packed site so close to the beltway, extra care must be taken in the placement and timing of the crane operation.
- **Location of generator** – Since the hospital is so close to residential surroundings, placement of the generator is critical as to not create too much noise for surrounding neighbors.
- **Below grade feeder installation –** Since multiple projects will be running so close to each other, coordination of running the feeders by the electrical contractors before the footers and slabs on grade are poured by the concrete subcontractors is crucial to the efficiency of the project.
- **Commissioning of system –** Since there are so many regulations governing the installation and implementation of hospital emergency power supply, proper commissioning of the emergency generator and all associated equipment must be ensured well before any patients visit the new wing.

Conclusions

As stated in the Electrical Depth portion of this report, the comparison of the existing system to the proposed change is not as simple as choosing the cheapest system. The proposed change would increase the budget by $353,000 (15% of the current electrical budget), a pretty sizeable amount. However, the change would also not increase the schedule significantly. Most importantly, the need of the client for isolation of the North Addition must be considered and weighed into the equation. The proposed changes to the alternative power supply can be considered a reasonable alternative for the client to consider. Ultimately, Alternate 2 would be presented as an alternative to the existing emergency system and the final decision would be up to the owner.