Consolidated Edison Central Engineering Design (Electrical) Engineering Process

MG6303
Operation Management

Group #7
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Consolidated Edison, Inc., founded more than 180 years ago, is one of the largest investor-owned, energy-delivery companies in America. Its annual revenue is around $13 billion and total assets are $34 billion approximately. Consolidated Edison Company of New York (Con Edison) is one of its subsidiaries, providing electric service in New York City and most of Westchester County. Con Edison also owns and operates the world’s largest district steam system, providing steam service in most of Manhattan. The company also provides natural gas service in Manhattan, the Bronx, and parts of Queens and Westchester.

With such a large and intricate system, there are many generating stations, substations, and machinery that play a part in generating and distributing electricity, gas, and steam to Con Edison customers. Central Engineering is tasked to providing customers technical and engineering expertise necessary to manage risk and ensure sustained safe system-wide operation. The Chief Design Engineer is in charge of the department with three distinct departments charged by three section managers. The three departments are Electrical Design, Mechanical Concept/3D Design, and Transmission/Civil Design. The mission of Design Engineering is “to ensure safe, reliable design operation and maintenance of the system, within budget and design basis, by providing expertise design requirements of systems, structures and components. Design Engineering provides detail designs of all Company electric, gas and steam generating plants, electrical substation and transmission and commercial facilities within Central Operations.”

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1 Employee Manual
Process Overview

Electrical Design Department specifically deals with maintaining/upgrading existing and new equipment within the stations. To ensure constant and reliable service, top management officers decide that a system-wide upgrade of equipment should be implemented and an allocated budget. For Design Engineering, the engineering department gets the project and assigns engineers to oversee the design and layout of the necessary changes for the upgrade. Each engineer is assigned to a specific station and writes a specification document (Project Scope of Work) pertaining on how to upgrade their assigned station. The approved specification is then given to Electrical Design to be assigned designers to work on the project.

Designers must first read and understand what the project specification states. After that, drawing layouts (schematics) pertaining to the upgrade is pulled from archives. With relevant drawings, a field walk is scheduled to see if field conditions match what is laid out on the drawings. If the drawings match what is out in the station then the designers can proceed with the "Design Engineering Process" (see Figure #1). If drawings do not match field conditions, an "as-built" (changing drawings to match what is actually there) is done and verified before the Design Process can begin. A final package that is ready for review will include marked up schematics, conduit and cable routing, and an Electrical Materials List (all listed equipment that must be purchased for the project). A final package is then given to the engineer for review and comments. If all is well, the final package is approved to go out to the field where construction workers will use the drawings as a guide to upgrade equipment. Once construction is done, another field walk is done to check how the upgrade is working. The finalized drawings
are compared to actual upgrade done in the field. If the drawings do not match, an as-built is done again, this time it may be handed off to a contractor to make the changes. In the end, the station and drawings should be in agreement with one another. The following table shows the amount of time for a project to be completed.

**Stages of Electrical Design:***

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Field Walk</td>
<td>1 Day</td>
</tr>
</tbody>
</table>

*Design Engineering Process*

<table>
<thead>
<tr>
<th>STAGE</th>
<th>DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>As-Built <em>(if necessary)</em></td>
<td>1 week</td>
</tr>
<tr>
<td>Removal</td>
<td>2 weeks</td>
</tr>
<tr>
<td>Engineer’s Comments on Removal</td>
<td>1 week</td>
</tr>
<tr>
<td>Installation</td>
<td>3 - 4 weeks</td>
</tr>
<tr>
<td>Engineer’s Comments on Installation</td>
<td>1 week</td>
</tr>
<tr>
<td>Implementation of Comments</td>
<td>1 week</td>
</tr>
<tr>
<td>Final Review (Engineer’s Review)</td>
<td>&lt; 1 week</td>
</tr>
</tbody>
</table>

**Total Design Process Period:** Approximately 11 weeks

**Field Implementation Period:** Approximately 1 – 2 months

* For an average project.

**Problems with Current Process**

Although the Design Engineering Process is well structured, there are many elements within the process that may cause a project to lag.

**1) Miscommunication**

Of the groups involved (Engineers, Designers and Field personnel), Designers are the drafters, which is more focused on the technical aspect of the project. Their main focus would be that the job design is efficient with less cost and improves function.
Meanwhile, the Engineers have to focus more on the structure and the reality of the project. They produce a schedule in which accounts for the time needed for Electrical Design to do their work but to coordinate it with the schedule of the field to implement the work. While field personnel construct the project with the specifications on the schematics, they’ll tend to focus on more about if it’s doable or not based on the real condition of the construction field. That’s why the communications between each group are important. At Con Edison, things can go wrong because the field personnel will find it’s hard or not practical to build the exactly the same as it is on the schematics due to the different situation or changing conditions of the field, which will be reported back to the engineers. Engineers will take some time to process the requests, confirm with the Design department and get the approval from the Project Engineer/Manager. The whole process will take up to a few days, which will waste a lot of time, and veer off the schedule track.

2) Schematics (Drawings) vs. Real Field Conditions

It’s very obvious that, when designers come to design schematics of the project, they won’t really be drawing on location. So it is essential that they must have the knowledge about how the field condition as soon as the project is initiated. The engineers will inform all the necessary information to designers before they even begin drawing. But the problem is, designers are not construction workers, and most of the designers have no experience on the field. A lot of designing problems will be revealed during the process of the construction, by which time, it will be late to change the schematics but mildly changing according to the real field situation. Construction may
have a lot of experience, but they’re not designers, they may know how to make the project work, but engineers and designers will not only make it work, but with less cost and more efficiency and functional. So we need to deal with the issue of making the “office team” cooperate and work with the “construction team”.

3) Human Resources – Age Gap within the Designers

After Con Edison was de-regulated in the 90’s and coupled with the recession of the economics at that time, the company decided on a “hiring freeze”. It was only after a decade; (in 2000’s) did the company begin to hire new employees. However, it has left a vast age gap between the new employees and seasoned employees. This situation can be seen company-wide, including the Design apartment. As of now, nearly 50% of the designers in the department have been serving the company for five years and less. The problem is further escalated by the fact that, among the latter 50%, 30% of which are of/close to retirement age, whom are referred to as baby boomers, leaving a huge experience gap between the two generations. The main issue for this is how to get the knowledge and experience of the leaving baby boomers to be passed down to the new generation. Transferring 30+ years of knowledge will take some time, yet the company is promoting employees at a fast pace, which gives seasoned titles far quicker than it should really be.

Recommendations

Most of the problems in process strategy can be seen by Cause and Effect diagram.
1) Miscommunication

To minimize miscommunication between Engineers, Designers, and Field personnel during a project, checkpoints should be strategically placed in certain stages of the Design Engineering Process. This will help alleviate any bottlenecking and last-minute problems that would spring up and cause delays. At each checkpoint, a meeting would be set up to resolve any problems/questions engineers, designers, and field personnel may come up with. Collectively, they will come up with a solution that best suits everybody.

2) Schematics (Drawings) vs. Real Field Conditions

When schematics don’t match field conditions, it takes time to note the necessary changes and to make them. A minor disagreement may affect one to two schematics but a major one will affect a minimum of five schematics. As-builts maybe contracted out to be corrected which costs money. For 2010, Electrical Design’s labor cost is budgeted to be $5,057,000 while outside services (vendors and contractors) are budgeted for
$8,889,000. To minimize labor costs and time to correct schematics, each station can have a designer whose sole purpose is to make sure existing schematics in the archives are updated to existing field conditions. Meanwhile, designers who are assigned to current projects would be temporarily relocated to the station to oversee the construction of their project. Any disagreements between the design and reality during construction could be worked out between designers and field personnel.

3) Human Resources – Age Gap within the Designers

There is no solution that can reverse the effects of the decade-long hiring freeze Con Edison had in place in the 90’s but the company can take measures to ensure that the knowledge is not lost for present and future employees.

a. The Learning Center (Con Edison’s “school” to train employees) – hire retirees part-time to give seminars/classes to new and present designers. They can share experiences and explain why they made certain decisions on projects they’ve been on. A training guide could help document their experiences and knowledge for future designers.

b. Pairing the Experienced with the Inexperienced – for each project, a supervisor should assign a senior designer along with a junior designer. By doing so, the junior designer is guided by the senior designer by working together. In a sense, the senior designer mentors the junior designer and answers any questions they may have. The project could continue to make the deadline instead of being delayed because of the inexperience of the junior designer.

2 Central Engineering 2010 EOE Budget Worksheet
The worse case scenario can be seen by Figure #2. By taking these recommendations, not only will the Design Engineering Process run a lot smoother but the duration it takes for each step could be decreased. Departments should have meetings where every employee is involved in the brainstorming of solutions of flaws they see. Working together will not only benefit the company but also the millions of customers Con Edison serve 24/7.
Figure #2

How the project was documented

How the customer explained it

What operations installed

How the Project Leader understood it

How the customer was billed

How the Analyst designed it

How the customer was supported

How the Programmer wrote it

What the customer really needed

How the Business Consultant described it

3 http://www.umsl.edu/~sauterv/analysis/random_analysis_thoughts.html
REFERENCES

1) http://coned.com/history

2) http://en.wikipedia.org/wiki/Consolidated_Edison

The following documents/PDF files from Con Edison Intranet:

- Con Edison Facts 2008
- Central Operations – Central Engineering New Employee Orientation Manual
- CE-0301 – Engineering & Construction Projects
- CE-0501 – Engineering Specifications
- Central Engineering 2010 EOE Budget Worksheet