RELIGHTING DEMONSTRATION PROJECT ROBINS AIR FORCE BASE, GEORGIA

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ABSTRACT
Significant energy savings are available through relighting with modern, energy efficient systems. As a demonstration, a relighting project was recently completed at Robins Air Force Base, Warner-Robins, Georgia. The project was designed to overcome a reluctance to pursue large scale relighting of the entire facility due to prior unfavorable experiences and an unusually large non-office working environment. The project followed contemporary lighting design practices, with the added dimension of involving building occupants in the process. Involving building occupants promoted their acceptance of the project and provided needed critical feedback. Their involvement helped secure their assistance in resolving special design concerns involving radio frequency interference and glare. Although often cited as simple, relighting projects are commonly confronted with problems. This document describes problems, foreseen and unforeseen, encountered by this relighting demonstration, and their solutions.

INTRODUCTION
Significant energy savings are available to Robins Air Force Base through relighting with modern, energy efficient systems. Although relighting projects are often cited as quick and simple, prior unfavorable experiences and a non-office working environment can, and does, generate reluctance to large scale relighting of the entire facility. To overcome this reluctance, a relighting demonstration project was instituted at Robins Air Force Base.

The relighting demonstration project was designed to:

- show Robins Air Force Base staff the benefits of a lighting retrofit,
- improve the overall lighting quality and employee comfort,
- involve site personnel in the design and acceptance of an appropriate lighting retrofit,
- quantify the potential energy savings of a cost-effective lighting retrofit,
- become the “model” for a site-wide lighting retrofit in similar buildings,
- show the serving utility the benefits of a lighting retrofit for future demand side management program designs.

BACKGROUND
Robins Air Force Base, located at Warner-Robins, Georgia, is a large logistics center responsible for rebuilding/refurbishing entire aircraft and aircraft avionics/electronics. The installation is the third largest industrial customer of Georgia Power Company, with an annual electrical consumption of 269,000 MWh (49 MW demand). There are approximately 670 commercial buildings on the site representing over 11 million square feet. Many of the buildings are electronic repair/assembly facilities and warehouses of greater that 100,000 square feet.

Over the past several decades, the repair/assembly facilities have undergone several lighting retrofits. The lighting retrofits appear to have been poorly designed, resulting in employee animosity and unknown savings. Lighting is supplied by a combination of fluorescent drop-in fixtures, high intensity discharge lighting, drop-in ceiling fixtures, and fluorescent work bench and individual task lighting. The lighting retrofits appear to have been poorly designed,
based on observation of the lighting distribution, lighting
quality, lighting levels and complaints from the employees.
Because of the nature of much of the work (electronic
assembly and repair), task lighting is normally needed at
work benches to supplement area lighting.

APPROACH
The simple approach of a quick redesign for efficient
lighting was clearly naive and not the path to a successful
relighting demonstration project at Robins Air Force Base.
A well thought-out approach needed to include:
- selecting the correct building—one that would be a
showcase for the base,
- acquiring complete and unconditional employee
acceptance,
- establishing lighting requirements that include the
'special requirements of the work environment,
- selecting and installing a retrofit design that meets all
work environment criteria,
- accomplishing the installation of the approved retrofit
design based on a competitive bid process in
accordance with federal contracting requirements.

The completed relighting retrofit must be evaluated against
pre-established criteria.

Building Selection/Description
The challenges in building selection included overcoming
employee reticence to ‘yet another relighting project,’ and
providing to them a design that meets the lighting demands
of their work environment.

Overcoming employee reticence involved selecting a
representative building with open access (some buildings
are in secured areas), identifying a demonstration area, and
involving the building occupants in the design acceptance
process. Building 162, the Precision Measurement
Equipment Laboratory, was eventually selected for the
demonstration project. The building was chosen because it
is easily accessible, and is generally representative of
electronic assembly and repair functions in other buildings.
The first floor is about 40,000 square feet. The building’s
interior is divided into three very similar large electronic
service and repair laboratories. By retrofitting one of the
laboratories, the others serve as a comparison, providing a
visual contrast of the pre- and post-relighting retrofit.

From the three laboratories, the north laboratory was
selected for relighting. The north laboratory has
approximately 8,200 square feet of test area. The north
laboratory contained 227 ceiling fixtures, all F40, 4-lamp,
2x4 foot with a single inductive ballast. The fixture
reflectors were white enamel troffers and the lenses were
flat prismatic. There were no incandescent or modern (T-8,
high intensity discharge) ceiling lighting technologies in
use.

An assessment of the physical environment was made prior
to the lighting retrofit to help identify the building’s
lighting needs and requirements. The assessment identified
the following characteristics:
- The walls and floors are cream/beige in color. Walls
and floor have a glossy, smooth finish to minimize the
collection of airborne contaminants such as dust and
oils.
- There is no source of natural light in the building.
- Other than the ceiling lights, the only additional room
lighting comes from individual task lights (6 total) and
a few personal flashlights. The 6 task lights are
circular fluorescent lights with a magnifier in the
center.
- The ceiling lights all appear to be very clean and not
excessively dirty or discolored. The lenses of the
lamps appear crystalline, possessing a symmetrical
square pattern, with each square measuring
approximately one-quarter inch per side.
- The ceiling is standard suspended acoustic tile (tiles
are each 2 feet by 4 feet). The ceiling is 10 feet above
the floor. The ceiling tiles appear clean and
blemished other than normal discoloring from aging.
Except for one area where ceiling tiles had recently
been removed for attic access, the ceiling is intact and
in good condition. The attic space between the ceiling
tile and the upper floor is approximately four feet.
- Since most work performed in the room is with
sensitive electronic equipment, the room has a
controlled environment. The temperature is
maintained at 73 degrees Fahrenheit (± 6 degrees) and
the humidity is maintained between 20 and 50 percent.
Entry and exit to the room are through air locks.
- Work benches are off-white and stand 36 inches high,
with an equipment shelf 24 inches above each work
bench. Old work benches are gradually being replaced
with new benches that have bright white surfaces and
stand approximately 37 inches high.

- The heat loads from computers, lighting, test
equipment, and staff remain constant throughout the
work day. Once equipment is turned on at the
beginning of the work shift, there are no special tests
that would generate large amounts of heat. The room
currently has 4 or 5 desktop computers in addition to
computer-based test equipment. No major changes in
test equipment quantity or type are anticipated for the
next several years.

In addition to the retrofit lighting requirements assessment,
a walk-through and examination of the proposed retrofit
area was conducted. The purpose of the walk-through was to identify potential problems, and how they might be eliminated or at least mitigated. During the walk-through it was noted that the existing lighting fixtures formed their own electrical raceway, something the retrofit lighting would not provide. Including a line item in the contract proposal for the installing contractor to add an electrical conduit resolved this potential problem.

The walk-through provided an opportunity to spot check ballasts for indications of PCBs. No indications of ballasts containing PCBs were found. Similarly, there were no indications of anything that might be asbestos related. Piping and fixtures above the suspended ceiling were limited to the fire suppression system.

An informal reference of baseline lighting energy use was made for comparison to the retrofit lighting energy use. Electrical current measurements were taken at the local lighting panel for each lighting circuit. The approach was simple; use a calibrated clamp-on ammeter to measure the current at each of the circuit breakers. The current readings were taken in the "as-used" condition. No lighting system maintenance was performed prior to taking the readings. See Table 2.

A separate project was monitoring the electrical demand and use profile of Building 162. Information from that project would be available for detailed energy calculations.

Employee Acceptance
Employee acceptance required involving them in the process. Building occupants were surveyed by interviews with project team members, including the lighting designer, and with questionnaires. Interviews were kept short and informal to minimize disruption to on-going activities. The principal function of the interviews was to establish open communication between building employees and project members, and to provide building occupants with a single point of contact in the event of questions or concerns. Interviews provided the lighting designer with detailed information about the requirements of the work environment, and guidance in developing an appropriate questionnaire.

Prior to the relighting, a survey questionnaire was used to determine employee lighting needs and requirements. Employees in the Precision Measurement Equipment Laboratory calibrate various types of precision equipment. Each calibration takes approximately 2 hours and requires the use of 3 or more instruments. Additionally, many employees use either reading glasses, bifocals, or magnifying glasses with integral lights to help perform calibrations. Half of the employees reported that they put on or take off their glasses during the process of calibrating a single instrument, requiring visual adjustment. For all of these criteria, adequate lighting is an important element in job performance and employee comfort. The survey determined that most employees felt the lighting was not adequate to perform their daily tasks. Fifty-six percent of the employees surveyed felt the amount of lighting was either fair or poor. Additionally, the ability to adjust light for work was rated poor by 67 percent of the employees and only fair by 22 percent. For a more complete summary of the survey responses, see Table 1.

Lighting Requirements
Lighting requirements were determined by observing the existing lighting on the site, taking measurements, and from the survey questionnaires distributed to the employees. The original four-tube, "cool white" luminaires with their flat prismatic lenses created a good deal of glare. Visual tasks were particularly difficult; aspects were susceptible to disturbing reflections from both the luminaire above and the luminaires behind and in front of the employee.

The following physical characteristics were considered to have possible effects on lighting operation. These characteristics and their effects on lighting were taken into consideration for the relighting project:
- ceiling height, ceiling material
- exposed ceilings, beams, ducts, pipes, etc.
- density of workstations
- overhead shelves, cabinets, etc.
- windows, skylights, clerestories
- darker finishes on any surface
- glossy or shiny finishes on any surface
- physical relationship of task workspace to windows, ceilings, or walls
- use of partial-height partitions
- cleaner or dirtier environments

The relighting demonstration project, once completed in Building 162, was intended to serve as a model for future relighting projects. Therefore, these characteristics were not only of importance to the Building 162 relighting demonstration project, but are also important for evaluating future site-wide relighting initiatives.
Retrofit Design

Seven options of parabolic and lensed luminaires were evaluated. The luminaire options evaluated would provide in excess of 150 foot-candles, maintained. The remaining light required for “fine inspection task” work would be provided locally, by adjustable task lights. Every design option utilizes three 32-watt lamps, so the overall energy savings is from 5.86 watts per square foot to 2.78 watts per square foot, or a 53% savings. While higher efficiency luminaires are available at higher cost, they provide more light than is necessary. Consequently, the extra cost was considered unwarranted. The basic selection requirement was fluorescent T-8 lamps and electronic ballasts, in keeping with the recommendations in the Federal Relighting Initiative’s Master Lighting Specifications.

Even with the design specification established, two concerns remained crucial to the success and acceptance of the relighting demonstration project—glare and electronic interference.

The first concern was the possibility of unacceptable glare created by the new lighting reflecting off the horizontal and vertical glass surfaces of test equipment. Glare had been a minor problem in the past. Once the retrofit was complete, glare could be no worse than the pre-retrofit condition. The intent was improvement in job comfort by providing a luminaire which is shielded (with parabolic louvers) in order to reduce reflected glare (veiling reflections) on vertical surfaces. The assumption was that improved comfort and visibility would result in improved performance. Due to the use of an open louver which exposes the lamps, concern was express that the proposed lighting might actually make the reflections on horizontal shiny materials more disturbing, while improving the reflected glare on vertical surfaces.

The second concern related to the electronic ballast specification that required an operating frequency of 20kzh or greater. For most applications, 20kzh operation is a distinct advantage over the 60hz operation of inductive ballasts. But for this application, involving avionics repair and testing using extremely sensitive test equipment, the operating frequency of 20kzh or greater could create unacceptable electronic interference.

Pilot Demonstration Area Selection

To resolve the concerns of glare and electronic interference, a decision was made to create a pilot demonstration area to evaluate these two issues. The need for a pilot demonstration area of the proposed retrofit design was both a quantitative and qualitative decision—quantitative because lighting design tools do not suitably evaluate an electronic assembly and repair working environment for electronic interference, and qualitative because of the need to ensure glare was kept acceptably low. Also, installing the proposed retrofit design in a pilot demonstration area provided an invaluable opportunity for employees to be directly involved in the design and acceptance process.

A pilot demonstration area was selected in the northernmost end of the laboratory targeted for retrofit, so that the existing and proposed systems were side by side. This area included three rows of 19 fixtures for a total of 57 fixtures, or about 25 percent of the total room fixtures.

A summary of the specifications for the luminaires installed in the pilot demonstration area are listed below.

Type “FA” - 3” deep, high efficiency, 18-cell parabolic troffer with overlay.
- Mounting: Ceiling recessed. "Lay-in trim G"
- Housing: Total luminaire efficiency of 72 percent or higher. Plenum air return. Nominal 6” depth. 22-gauge cold rolled steel. White painted polyester enamel finish, applied after fabrication.
- Reflector: Precision optically formed specular aluminum reflector
- Baffle: 3” deep semi-specular anodized aluminum parabolic 18-cell louver
- Overlay: KSH 0.040 white acrylic overlay mounted above parabolic louver, held with clips
- Ballast: 277 volt, 3-lamp electronic fluorescent ballast.
- Lamp: (3) F32 T-8 SPX35

Type “FA-1” - 3: deep, high efficiency, 18-cell parabolic troffer (same as Type “FA”, but without the acrylic 0.040 overlay sheet)

Pilot Demonstration Area Results

The first reaction upon entering the room was that the pilot demonstration area was quite pink, slightly less bright, and with slightly greater scallopping on the walls. There was no visible difference from normal viewing angles between the new parabolic fixtures with and without the acrylic overlay. The parabolic luminaires were noticeably lower in brightness than the existing prismatic lensed luminaires, but had little surface brightness, avoiding the “black hole” appearance.

All employees were curious to know the difference in lighting levels for the two areas. Measurements showed the new and existing areas to be essentially the same (ranging between 160 to 180 foot-candles). Once convinced that there was equivalent quantity, the employees offered numerous comments on the quality. As
expected, significant improvement in veiling reflections on vertical tasks (scopes and screens) was found, and the employees concurred. Fortunately, no increase in disturbing reflections on horizontal specular tasks (radio tubes, shiny metal) was found, even with the exposed lamps of the open parabolic, and the employees again concurred. Consequently, the acrylic overlay sheets did not seem to be required for most applications, although there are tasks in other areas of Building 162 which are more visually demanding where the acrylic overlay sheets could be beneficial. Removing the overlays increases the initial lighting levels, as well. Direct glare was reduced, but because of the light colored surfaces and high light levels, this had not initially been perceived as a problem. All employees seemed to find the color in the pilot area favorable once they started working in it, and remarked that in comparison the existing lighting (cool white) now looked greenish blue in comparison. All noticed the healthier skin tones. Some commented that the lighting felt “more restful” and “easier on the eyes”. None of the workers surveyed had any objections to the new lighting, which alleviated concerns of glare.

Employees performed routine testing and directed tests for possible radio frequency interference from the new electronic ballast. The employees were aware of the concern and knew the operating frequency requirements of the electronic ballast, including the possibility of harmonic interference. Their results showed there was no radio frequency interference attributable to the relighting.

Pilot Demonstration Area Recommendations
The results of the pilot demonstration, although favorable, resulted in three recommended changes. First, the room relighting would not require the use of acrylic overlays. Second, the color specification for the lamps was changed from 3500 Kelvin CCT (correlated color temperature) to 4100 Kelvin. The 4100 Kelvin color is perceived whiter, and less pink, but still has all the color rendering advantages of the modified triphosphors. Color discrimination, such as in wire and resistor color coding, will be improved greatly over the original “cool white” lighting. Third, the overwhelming acceptance of the pilot relighting resulted in a request by employees to expand the project area to include the glassed-in administrative office and the two vestibule air-locks. All three changes were implemented.

Unforeseen Problem
The overall depth of the replacement luminaire fixtures was greater than the original fixtures. The deeper fixtures, conflicting with some fire suppression system piping, resulted in adjacent ceiling tiles being slightly askew. In the pilot demonstration area, this was considered a minor cosmetic problem that could be resolved by simple adjustments to the ceiling tile suspension system. What was unanticipated is that the fire suppression piping slopes downward proceeding south, exacerbating the problem. Additionally, one of the lateral pipes interfered with an entire row of fixtures. The interference was no longer cosmetic; it was a problem. In all, 23 of the 227 fixtures were affected.

Alternatives evaluated to resolve the interference included repositioning portions of the fire suppression system, readjusting the suspended ceiling (which would require adding extensions to the fire suppression sprinklers), or changing the luminaires. The costs associated with modifications to the fire suppression system would quickly make the project no longer cost effective. The choice was clearly the third alternative.

Shallower fixtures that would provide the required clearance were not available. The final solution was to use the original fixtures in places of interference, but modifying them with newer more efficient technology components. The original fixtures were stripped of all components, then retrofitted with components from the new fixtures, including the electronic ballast. The conversion from a conventional four-tube to an energy efficient three-tube T-8 configuration resulted in leaving one of the center reflectors empty. The 3-inch deep, 18-cell parabolic baffle would not fit the original fixtures, but the shallower, 420-cell baffle would fit with minor changes.

Most people entering the laboratory for the first time do not notice the two baffle configurations. Once pointed out, they find it aesthetically acceptable. Because the number of modified fixtures are few, differences, if any, at the workbench level are imperceptible.
RESULTS
The key results of this demonstration project are:
- Building 162 has become the model for site-wide retrofits in similar buildings.
- Employees are overwhelmingly satisfied with the results of the relighting demonstration project. To them, this was not "just another relighting project".
- Problems of reflection and glare were significantly reduced while lighting levels were maintained. Employees commented that the lighting felt "more restful" and "easier on the eyes".
- Electrical current measurements of lighting circuits taken before and after the retrofit clearly show the energy savings benefit of a relighting project. The current measurements are included in Table 2.
- The modification of 23 fixtures required to avoid interference with the fire suppression system simply demonstrates that relighting projects are not always as straightforward as generally believed.
- The relighting demonstration project has generated renewed interest in the serving utility in site-wide energy efficient relighting programs.
- The relighting demonstration project has shown that the 8,800 MWh estimated savings opportunity from commercial building relighting at Robins Air Force Base is sound.

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TABLE 1 - WORKER SURVEY RESULTS

Nine workers from Building 162 were issued a survey regarding their work tasks, the physical environment, and the lighting conditions. Some questions from the survey are not recorded below. Only those which are directly related to the lighting and physical environment of the room are listed below.

How long does it take, on average, to calibrate a single instrument?  
Avg. 2 hours

How long do you focus your eyes at close range without looking around?  
Avg. 12 minutes

Please rate your work space on each of the following:

<table>
<thead>
<tr>
<th></th>
<th>Excellent</th>
<th>Good</th>
<th>Adequate</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of space for work</td>
<td>2</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Condition of desks &amp; chairs</td>
<td>0</td>
<td>5</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Amount of lighting</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Location of ceiling lights</td>
<td>1</td>
<td>0</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Color of walls &amp; partitions</td>
<td>0</td>
<td>5</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Color of furniture &amp; objects</td>
<td>0</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Storage space</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Conversational privacy</td>
<td>0</td>
<td>1</td>
<td>4</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Ability to adjust light</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Visual privacy</td>
<td>0</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Comfort/adjustability of chair</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Ventilation &amp; air circulation</td>
<td>0</td>
<td>6</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Heating</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Cooling</td>
<td>0</td>
<td>5</td>
<td>2</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>Air quality</td>
<td>0</td>
<td>3</td>
<td>3</td>
<td>2</td>
<td>1</td>
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<tr>
<td>Condition of floor</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Annoying fumes</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Dust on work surface</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Lighting quality</td>
<td>0</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>1</td>
</tr>
</tbody>
</table>

How would you describe the amount of light available to you now?

- Much too bright: 0
- A bit too bright: 0
- Just about right: 1
- A bit too dim: 7
- Much too dim: 0
- Fine for some tasks, too dark for others: 1

How would you describe the brightness of the lighting fixtures?

- Much too bright: 0
- A bit too bright: 0
- Comfortable: 3
- Never noticed: 2
- Other, explain:
  - "a bit too dim"
  - "most are not fully operational"
  - "several lights are out"
  - "too dim"
Overall, how satisfied are you with the lighting at your workspace?

<table>
<thead>
<tr>
<th>Satisfaction Level</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very satisfied</td>
<td>0</td>
</tr>
<tr>
<td>Fairly satisfied</td>
<td>2</td>
</tr>
<tr>
<td>Neither satisfied or dissatisfied</td>
<td>2</td>
</tr>
<tr>
<td>Not very satisfied</td>
<td>5</td>
</tr>
<tr>
<td>Not at all satisfied</td>
<td>0</td>
</tr>
</tbody>
</table>

Are there any changes that you would make to the lighting at your workstation?

- "Relamp"
- "Increase brightness"
- "Eliminate glare"
- "More steady lighting"
- "Change flickering tubes"

Do you perceive any of the following to be problematic?

<table>
<thead>
<tr>
<th>Perception</th>
<th>Don't Notice</th>
<th>Notice Slightly</th>
<th>Annoying</th>
<th>Very Problematic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Color of light</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Color of materials</td>
<td>5</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Shadows on work surface</td>
<td>1</td>
<td>3</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Direction of light</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>Reflections on work surface</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Flicker from fluorescent lamps</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Flicker from bad lamps or ballasts</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Glare from light fixtures</td>
<td>2</td>
<td>3</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>Glare from windows</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Inability to adjust light</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>0</td>
</tr>
<tr>
<td>Circuit Number</td>
<td>Before Retrofit (amperes)</td>
<td>After Retrofit (amperes)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>----------------</td>
<td>--------------------------</td>
<td>-------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A-phase</td>
<td>48</td>
<td>28</td>
<td></td>
<td></td>
</tr>
<tr>
<td>B-phase</td>
<td>49</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C-phase</td>
<td>50</td>
<td>24</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Emergency lights</td>
<td>--</td>
<td>--</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>10</td>
<td>6.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
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