ENEL 674 – PROJECT INFORMATION SHEET

In this course, students will take on the electrical engineering scope for a building and site in the Canadian province of Alberta. This building is based off an actual installation but has been modified to add additional content and discussion for the ENEL 674 course.

Students will be evaluated based on their consideration of the design requirements, owner's restrictions, and practicality of approach.

Owner Requirements:

The owner has provided the student with the following information to consider in their design.

- The owner has 10 acres of land.
- This is the first building on the land, and approximately 4 other buildings of similar sizes are expected to be developed. Only one utility connection is desired for all the installations.
- The owner wants part of their land to be used for renewable energy sources, such as solar.
- Up-time is essential for this owner as some of their operations are critical and cannot be interrupted.
- The owner requires one room for all of their data services.
- The owner does not want any overhead connections between buildings or to the utility.

For the first building, the owner has stated the following general requirements:

- Use:
  - The building is going to be used as a multi-use community gathering space, educational hub, and local art gallery. The building will feature interpretive trails in the surrounding area and showcase local culture.
  - The owner will allow the space to be rented for events, such as weddings or business socials.
- Power/Data:
  - The owner would like to closely monitor their energy consumption and would like to meter their power usage for different areas of the building.
  - The commons and cultural activity room must have flexibility for power so rentals can lay out their equipment based on their programming.
  - There is a small kitchen (for snacks) and a larger kitchen (for catering) which will have commercial equipment.
  - Wireless data (WiFi) is a requirement.
- Lighting:
  - Expansive use of daylighting is preferred.
  - The architect has waited to choose ceilings until you have selected lights. A strong preference for T-Bar or Suspended ceilings has been indicated.
  - Lighting is to be controlled using a digital master system with low voltage controls.
- Security:
  - The owner would like to have access control using keypads or ID cards for their staff.
  - The owner would like their data, electrical, and mechanical rooms to be secure from the rest of the building using ID cards or keypads.
  - The owner would like security cameras to monitor the public spaces.

The other consultants have provided the following design restrictions to the students:

- Water pressure is not sufficient, a 30 HP fire pump (electrical) is being provided by mechanical.
- The building is sprinklered.
- Room names and sizes are preliminary based on initial discussions. Additional rooms and mechanical items include:
    - Data room has been placed. Cooling for data room has not been considered. The architect has asked you for sizing required for all your equipment.
    - The electrical room has been placed. Cooling for the electrical room has not been considered. The architect has indicated that the sizing should be adequate but would like your input.
- Incoming main service has not been placed.
    - The Civil Engineer indicated that there are significant sewer and gas lines on the north side of the building and immediately on the East side. The West side of the building is undeveloped, but will be used for a parking lot.
    - The utility has an overhead line North West of the building.
    - A major road runs on the North side, 50' from the North tip of the building.
    - An exterior transformer is required.
- An exterior demarcation for communication services is required.
    - There exists a communication pedestal on the North West side of the property.

The following are general project restrictions and notes.

- The utility power in this area experiences outages for about 6 hours every month.
- The project location is in southern Alberta, near Lethbridge.
- The local utility voltage is 25 kV, delta ungrounded.
- The utility will supply a single 112.5 kVA transformer for secondary (cold sequence) metering, or it will permit the site to be primary metered using medium voltage switchgear.

Project:

The project includes the design of all electrical systems related to a new community facility, considering the owner's future plans. The provided documents show the building base plans but the full site has not been provided, nor have all buildings or equipment locations that may be required as part of the student's end design.

The student is responsible for considering all requirements and information provided herein to provide the complete design. The deliverables are loosely laid out as follows:

1. **Milestone 1**: **Layout** – Student will develop general layout of equipment based on preliminary sizing calculations performed. At this stage, the student will be expected to know approximately what is required, space requirements for equipment, any additional space/rooms/buildings required, and be able to provide a 'client' with recommendations/restrictions on their requirements. This stage will include:
    a. A draft single line diagram, including approximate quantity and location of panels. This should include any considerations that might be required for communication with the electrical utility. A service calculation is required and preliminary conductor, breaker, and conduit sizing.
    b. An understanding of what is required, where equipment would be placed, and the identification of any problems with the building layout that require architectural modifications. Students should document their procedure and reasons for optimal equipment placement.
    c. Preliminary:
        i. Lighting layouts, lighting selections, and lighting calculations. A luminaire schedule is required.
        ii. Mechanical coordination including layouts. A mechanical schedule draft is required.
        iii. Life Safety systems – all required life safety systems (lighting, egress signage, and alarm devices) are required to be in place.
    d. Code Considerations – at this stage, students should consider the various codes applicable to this building in their calculations. Design must follow the following:
        i. National Building Code 2019 – Alberta Edition
        ii. Canadian Electrical Code 2021
        iii. Emergency Power for Buildings – C282:19
        iv. All related and referenced standards from NBC 2019 (such as S524:14)
2. **Milestone 2: Option Analysis** – Student will develop a more refined layout. At this stage, the student is expected to provide a cost benefit analysis between major design considerations for the project from a high-level perspective (ex: Class D). The impact to the facility with various options will be included in a summary report. This stage will include:
    a. Design progression for all items under Stage 1. This includes for example refinement of layout locations, improved lighting selections, calculations, mechanical schedule completion, SLD to 90% including panel schedules and sizes, completion of all conductor sizing.
    b. A summary report including review of options for the owner to consider. The claims in the report should be backed by reputable scientific references. Some of these options include:
        i. Inclusion of UPS equipment
        ii. Generator type, location, sizing
        iii. Distribution options for the site
        iv. Renewable Energy or alternative sources

v. Incorporation of zero carbon initiatives, such as electric vehicle chargers
vi. Consideration of future technologies that may impact design over 10-20 years

c. Student will be graded based on their ability to include as many of the owner's desires into the project, yet also maintain a feasible installation.

3. **Milestone 3: 90% Design – Final Review Set** – Student will develop the drawings and proceed on the recommendations made as part of Stage 2. The student's drawings at this time will be considered final review and the majority of the design will be complete. This stage will include:
    a. Design progression to final design stage for everything under Stage 1. This includes for example final lighting selections and calculations, final single line diagram, detailed layout drawings showing device locations, circuits, data numbers, and any details required to inform a contractor on how to install particular considerations.
    b. Inclusion of any recommendations made as part of Milestone 2.
4. **Milestone 4: Studies –** Student will perform all studies required for this project using the appropriate software or hand calculations. For this stage, students must select a manufacturer for the equipment to be used in this building and provide all data sheets for equipment used. These studies include:
    a. Short Circuit analysis and statement of equipment bracing/interrupting requirements
    b. Coordination study for all devices to 0.1s, following recommendations of IEEE 242 and commenting on where issues exist and what changes can be made.
    c. Arc Flash Hazard Analysis for all panels and points of disconnection, including line side calculations at all utility interfaces.
    d. Voltage drop calculations for all conductors on SLD using expected loads
5. **Milestone 5: 100% Design and Report** – Student will incorporate any changes discovered as part of Stage 4 into the Stage 3 design package. Students will develop and include a final summary report indicating any conclusions, the limiting restrictions of the design, equipment specifications and lists, and results of the studies. The student will compile a list of lessons learned in design from start to finish including a summary of any major issues that were discovered from Stage 1 to Stage 4, describing how the issues could be mitigated in future projects.

Important: For each milestone, student should submit **a single comprehensive PDF** file encompassing all drawings and calculations, alongside the relevant documents such as .dwg files

General Notes:

- Utilize the room design requirements provided in a separate document.
- Remember to use referral notes and other annotations on your drawings to describe your design.
- For lighting:
    - Consider luminaire quantities and spacing.
    - Use a light loss factor (LLF) of 0.9 in your calculations. For RCR (Room Cavity Ratio) greater than 10, use the values for RCR = 10 on luminaire cut sheets
    - Submit calculations as part of the project deliverables.
    - Tag all luminaires with required luminaire tags
    - Indicate switching zones (as required)
    - Develop a Luminaire Schedule. Luminaire schedule should, at minimum, have the following features:
        - Luminaire Type (the 'Tag')
        - Description (Describe the luminaire)
        - Mounting (How the luminaire is to be mounted, such as surface, suspended etc)
        - Wattage (How much power the selected luminaire draws)
        - Lumens (How much total lumens the selected luminaire outputs)
        - Manufacturer & Part Number
        - Remarks (Comments to help the installer)
        - Driver (Describe the driver used. Consider control requirements)
        - CCT (Temperature of the light)
        - CRI
        - Controls (consider the controls specified and the driver)
        - Voltage
        - Efficacy (lm/W)
    - As an option for Milestones 2 or 3, recommend alternative luminaire options for the fluorescent fixtures. An alternative luminaire must be greater than or equal to the proposed light in terms of:
        - Efficacy (higher efficacy is considered better)
        - CCT (must be equal)
        - Wattage (lower wattage is considered better)
        - Lumens (higher lumens is not always better, consider the required lighting requirements)
            - If your proposed luminaire has a higher lumen output, indicate the changes required in the calculations and describe the changes in luminaire layout in terms of uniformity and quantity of luminaires.
    - As an option for Milestones 2 or 3, develop a NECB Compliance Schedule. For demonstration of NECB Compliance:
        - Determine the NECB Application Area for each room.
        - Calculate the total number of luminaires in each application area.
        - Calculate the total Wattage of luminaires in each application area.
        - Determine the allowable lighting power density for combined areas.
        - Determine if your solution is compliant.

- For power:
    - Place the motors on the drawings in the locations listed in the motor control schedule.
        - A motor must include a motor tag and a circuit number.
    - Fill in the blanks in the motor schedule with the missing information where applicable.
    - All motors require disconnects.
    - All magnetic starters require Hand-off-Auto, pilot lights, 2 N/O, 2 N/C contacts.
    - The minimum conductor sizes to be used are #12 Awg. Cu. Assume 60°C terminations as per 4-006(2).
    - The minimum conduit size to be used is 21mm.
    - Conduit is not to be used for bonding.
    - All fractional horsepower motors are to have manual starters.
    - It is common practice to install a T-slot (NEMA 5-20R) receptacle for all 20A receptacles.
    - Consider the wattage rating of each receptacle and each piece of equipment while circuiting.
    - All receptacles within 1.5m of a sink to be GFCI Class A receptacles, unless receptacle is behind a stationary device that renders the receptacle inaccessible to portable equipment.
    - Housekeeping receptacles to be 20A.
    - Use wall mounted junction boxes for hardwired equipment.
    - Provide the appropriate breaker for each receptacle.
    - All breakers are rated for continuous operation at 80% of rating.
    - When a load is not provided, assume the circuit is fully loaded to maximum permissible continuous rating of breaker.
    - Panels in this project use a simple naming scheme. Typically, all panels within a building follow a convention to easily identify important features of the distribution without going to the panel. An example will be X#Z
        - X – Indicates the floor, ex. 1=Main, M=Mezzanine
        - # – Indicates the voltage '2' = 208 V, or '4' or '6' for 480 V or 600 V respectively.
        - Z – A unique identifier. Ex. 'A' is the first panel, 'B' would be the second.
    - Branch circuit breakers have loading limitations.
    - Consider your panel balancing.
        - Designers should do their best to circuit a "balanced" panel, where the load is equally shared (ideally within 15%) between phases A, B, & C.

Room Data Sheets

The following are explanations of general requirements/uses for each room. Use this in your design. Where comments are provided, design has been discussed with the owner. In all other locations, use your judgement and design to plan the layouts and equipment. Remember the design must still comply with the CEC, regardless of owner requirements.

Room	**Relevant information**
.Room 100 Foyer	Requires barrier free access. Fire fighter access point. Main entrance for all.
Room 101 Classroom	A projector will be used in this space.
Room 102 Closet	
Room 103 Women's Washroom	Requires barrier free access. Low voltage lighting control not required. All water fixtures will need low voltage power for operation. One hand dryer.
Room 104 Men's Washroom	Requires barrier free access. Low voltage lighting control not required. All water fixtures will need low voltage power for operation. One hand dryer.
Room 105 Washroom Corridor	
Room 106 Janitor	Will have a mop sink and cleaning equipment.
Room 107 Water Meter Entrance	
Room 108 Catering Kitchenette	Will be used for catering, as well as for cooking classes. Lighting is required to showcase the counter (for classes) and be general for safety. Equipment includes: fridge, dishwasher, espresso machines, sinks, digital display board, flat top grill, water purifier, and oven. Grill requires overhead exhaust fan.
Room 109 Commons	Requires barrier free access. Multiple projectors will be used in this room (2) Door is for egress only
Room 110 Cultural Activity Room	Room is to be wired for sound and presentations from either direction (microphones). Two projectors will be used in this room. Door is for egress only.
Room 111 Storage	
Room 112 Snack Preparation Room	Room will have a microwave, coffee machine, fridge, and warming ovens.
Room 113 Information/Gift Shop	Sales and money storage will occur here. Data and security are important.
Room 114	
Room 115 Yukata (Robe) Storage	Climate controlled.

Room	Relevant information
Room 116 Education Office	Office for two people.
Room 117 Mechanical Room	Access required for staff through this door.
Room 118 Staff Lockers	
Room 119 Administration Office	Office for two people
Room 120 Vestibule	Access required for staff through this door.
Room 121 Classroom	A projector will be used in this room.
Room 122 Exhibit Gallery	Exhibits are not set, and may rotate frequently. General area lighting and focus lighting on exhibits required. A projector may be used, provide a rough-in.
Room 123 Tea Ceremony	Lighting is to be minimal.
Room 200 Stairwell	Access required for staff through this door.
Room 202 Electrical	
Room 203 Mechanical	
Room 204 Telecom	