DESIGN OF A HIGHLY RELIABLE MICROGRID FOR KFUPM CAMPUS

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Introduction

In this project, it is required to design a microgrid power system for the power system of KFUPM campus. The microgrid power system will improve the reliability of the current KFUPM power system. The microgrid power system will be working in parallel with SEC to reduce the power taken from SEC. Moreover, during failures in delivering the power from SEC the microgrid will deliver the power to prevent the cutout in system. Furthermore, the generated power can be stored to be used as a backup in case of cutout. However, in this project we are going to consider only the first two benefits.

Objectives

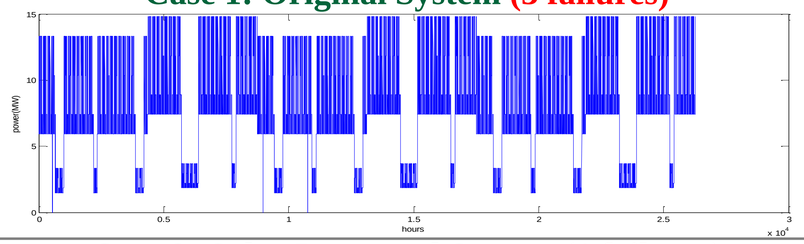
- Evaluate the reliability indices of the current KFUPM power system.
- Improve the reliability of the system by introducing the microgrid concepts.

Comparison between All Cases

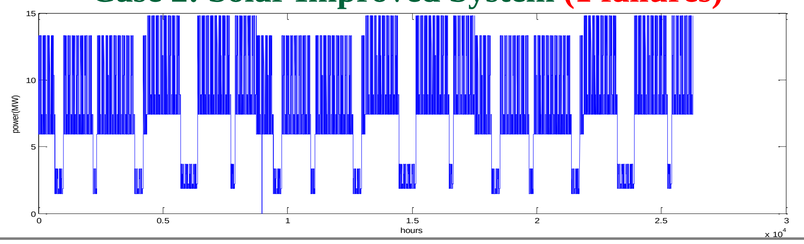
Case	SAIFI (interruptions per customer)	SAIDI (interruption hour)	SAIFI and SAIDI Improvement (Decreased)	Availability
Original System	0.19196	1.0784	0%	99.988 %
Solar Improvement	0.11931	0.6749	37.5%	99.992 %
Wind Improvement	0.18835	1.0586	2%	99.988 %
Solar and Wind Improvement	0.11895	0.67293	38%	99.992 %

Simulation Results for One Load

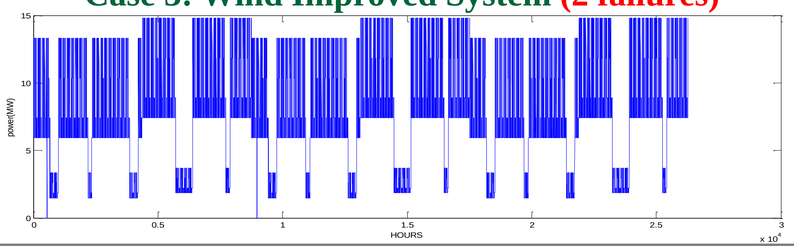
Case 1: Original System (3 failures)



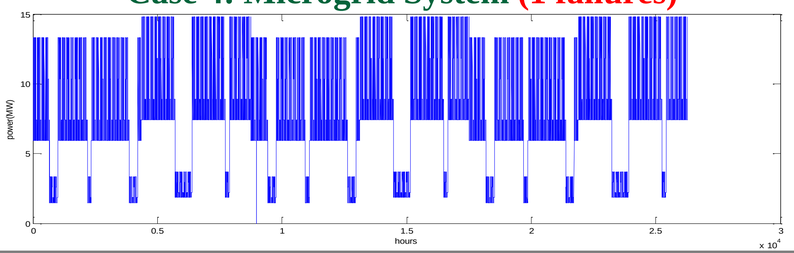
Case 2: Solar Improved System (1 failures)



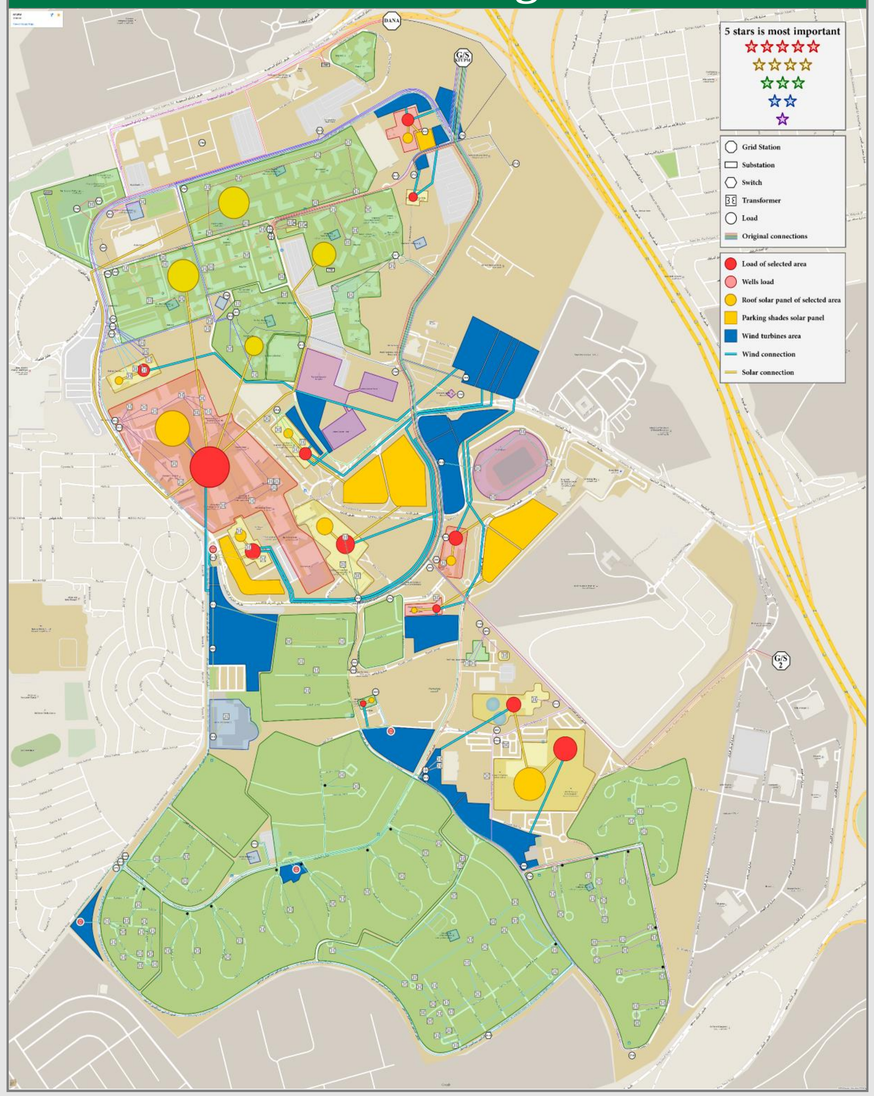
Case 3: Wind Improved System (2 failures)



Case 4: Microgrid System (1 failures)



Final Design



Future Work

1. Using batteries to store the renewable energy.
2. Adding diesel generators to critical loads.
3. Using the uninterruptible power supply (UPS) for critical loads.
4. Taking the failure rates of breakers and switches into account.
5. Controlling switches, breakers and normally open switches between loops and feeders to avoid outage of power to the load point.

Conclusion

In this project, we have presented three improvement designs for KFUPM power system, which are solar, wind and microgrid improvements. The improved areas in the system were chosen based on their outage cost evaluation and importance. KFUPM current power system was compared with the other three improvement designs in term of average interruption frequency (SAIFI), average interruption duration (SAIDI) and availability. The optimum design is the microgrid, which decreased SAIFI and SAIDI by 38%. In this design, we did not consider the cost of implementing the system.