Hypothesis Testing - Load Shedding Capacity*

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Abstract— **This experiment is to check the hypothesis that with the machines that Locbit controls at any point of time, without considering the efficiency of the site, we can shed load at will while ensuring that we could operate the facility at bare minimum without causing any irreversible damage to the facility. If yes, we could also measure the load shedding ability at any point of time in terms of kW. This document also tackles the problem of differential temperature and target cooling.**

I. Introduction

Load shedding capability at any point of time is important to change the landscape of the power graph for a given day and thereby minimizing the cost graph for the given day. At Zion, we identify the non-critical components, quantify the effects of switching it off ('playing dead') and determine the length of experiment. To verify the hypothesis, we should observe a sharp decline in power. We identify the potential parameters to observe to see the effect on the state of the facility and also to determine when to call off the experiment. We also have to observe the elasticity of the power graph once we revert back to the original state (that is, the additional power required to restore the normality).

II. Systems

These are the list of systems at Zion that could make a difference for power consumption.

1) Thermostat - OBIX Integration
2) Zion Wall Switch - refrigeration control
3) 7/30 C/O 1 NP Fridge
4) 7/30 C/O 2 NP Fridge
5) 7/30 C/O 3 NP Fridge
6) 7/30 C/O 4 NP Fridge
7) 7/30 C/O 5 NP Fridge
8) 7/30 C/S Hub Fail Over
9) 7/30 Checkout Stand #10 NP Fridge
10) 7/30 Checkout Stand #9 NP Fridge
11) 7/30 Checkout Stand #8 NP Fridge
12) 7/30 Checkout Stand #7 NP Fridge
13) 7/30 Checkout Stand #6 NP Fridge
14) 7/30 Checkout Stand Express PERISHABLE Fridge - Do not operate
15) Fish FS#2 - Aeon Labs Switch
16) Fish FS#1 - Aeon Labs Switch
17) Fish PW#1
18) kitchen FS#2
19) Kitchen FS#4 - Aeon Labs Switch
20) Kitchen PW#1 - Aeon Labs Switch
21) kitchen PW#2
22) seafood PW#2

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III. Observations

1) checkout ms 1
2) checkout ms 2
3) checkout ms 3
4) checkout ms 4
5) checkout ms 5
6) checkout ms 6
7) checkout ms 7 - Not available
8) checkout ms 8
9) fish ms 16
10) fish ms 17
11) fish ms 18
12) fish ms 19
13) Food Court N2
14) Food Court N3
15) Food Court N4
16) Food Court N5
17) Food Court N6
18) Food Court NM2
19) Food Court NM4
20) Food Court NM6
21) Food Court NW1
22) Food Court S2
23) Food Court S3
24) Food Court S4
25) Food Court S5
26) Food Court SM1
27) Food Court SM3
28) Food Court SM5
29) Food Court SM7
30) Food Court SW1
31) Food Court W1
32) Food Court W2
33) kitchen ms 10
34) kitchen ms 11
35) kitchen ms 12
36) kitchen ms 13
37) kitchen ms 14
38) middle ms 1
39) middle ms 2
40) middle ms 3
41) middle ms 4
42) middle ms 5
43) middle ms 6
44) middle ms 7
45) middle ms 8
46) middle ms 9

IV. What is?

1) Meat SM#1
2) Meat SM#2

V. Temperature Profile on a given day

From the figure, it is clear that the temperature through out the facility is not uniform. Assuming that the building is in equilibrium,

- The unusually hot food court temperatures are because the the heat gets trapped in the ceiling and so we are measuring the trapped heat rather than the actual temperature in the Food Court.
- Some places which are at closer proximity to the local refrigerators tends to be colder and so the will create local cold spots.

VI. Experiment Outcomes

Some questions that need to be answered are,

- why have not the customer used de-stratification fans to disperse off the heat? [2]

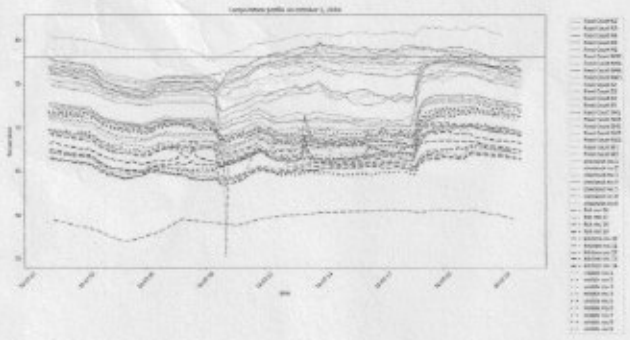

Fig. 1: General Flow.

- Is it advantageous to use flap on the ducts to do target cooling?
- Confirm the temperature gradient across different zones are due to their proximity to heat/cold source.
- There is a sharp increase in temperature of some zones at around 6.30 pm which requires explanation. (Figure 2).
- We could not set temperatures at 'will' at different zones and so the duct delivering cold air will not target the specific zones. Hence if there is a complaint that a zone is hot, the HVAC will tend to bring the temperature of the entire building down. (Figure 3 for Floor plan)
- Now, lets say that there is lower temperature in the place near the cold open refrigerator, if we increase the temperature near the region, it wont affect the performance of the cold open refrigerator.
  All of these can be done without starting the master experiment. The actual experiment could,
  - Provide us the load shedding capacity of our system.
  - Will allow us to ration the available power targeting the different region and hence could quantify the savings.

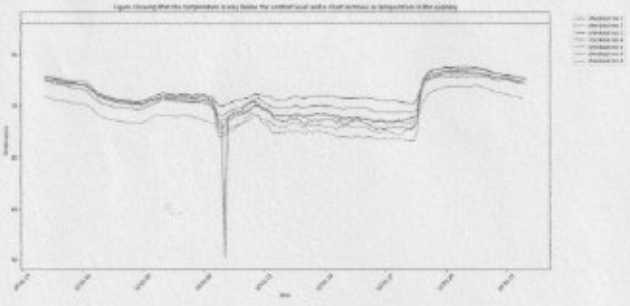

Fig. 2: Temperature at Check stand

VII. Ill effects

It appears, when we look at the equipment that we need to turn off, that the bulk of savings could be achieved by the space heating. The possible ill-effects of such experiment is,

- Possible increase in temperature beyond comfort levels. The recommended thermostat temperature from SDGE is 78 degree F during summer and 68 degree F during winter [1].
- Hazardous room temperature in the areas where food court is located.
- Bad customer experience and possible complaint on the room temperature.

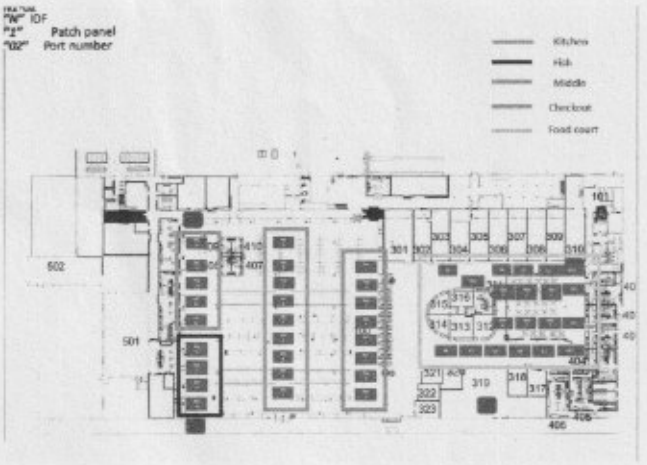

Fig. 3: Floor Plan

References

[1] SDGE "Let Your A/C Setting Help You Save More on Your New TOU Plan" https://www.sdge.com/thermostattips
[2] De-stratification fans "Every building with high ceilings suffers from stratification." https://airiusfans.com/