# ENERGY MANAGEMENT SYSTEM


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ARCACONTINENTAL
Coca-Cola SOUTHWEST BEVERAGES

A Culture of GROWTH

# TABLE OF CONTENTS

# BACKGROUND

- Coca-Cola Southwest Beverages, a company of Arca Continental, is one of the largest Coca-Cola bottlers in the United States and Latin America.
- Coca-Cola is aiming to reduce their carbon footprint, increment recycling and incorporate sustainability in every action they take.
- Coca-Cola will take care to know the consumption of energy and water to manage the consumption levels of productions.

# PROBLEM STATEMENT

- Coca-Cola needs to understand where water and energy is being use and where they could improve consumption levels.
- Control limits need to be established to standardize a consumption optimization process.


Syrup room

Filler

# PRODUCTION PROCESS

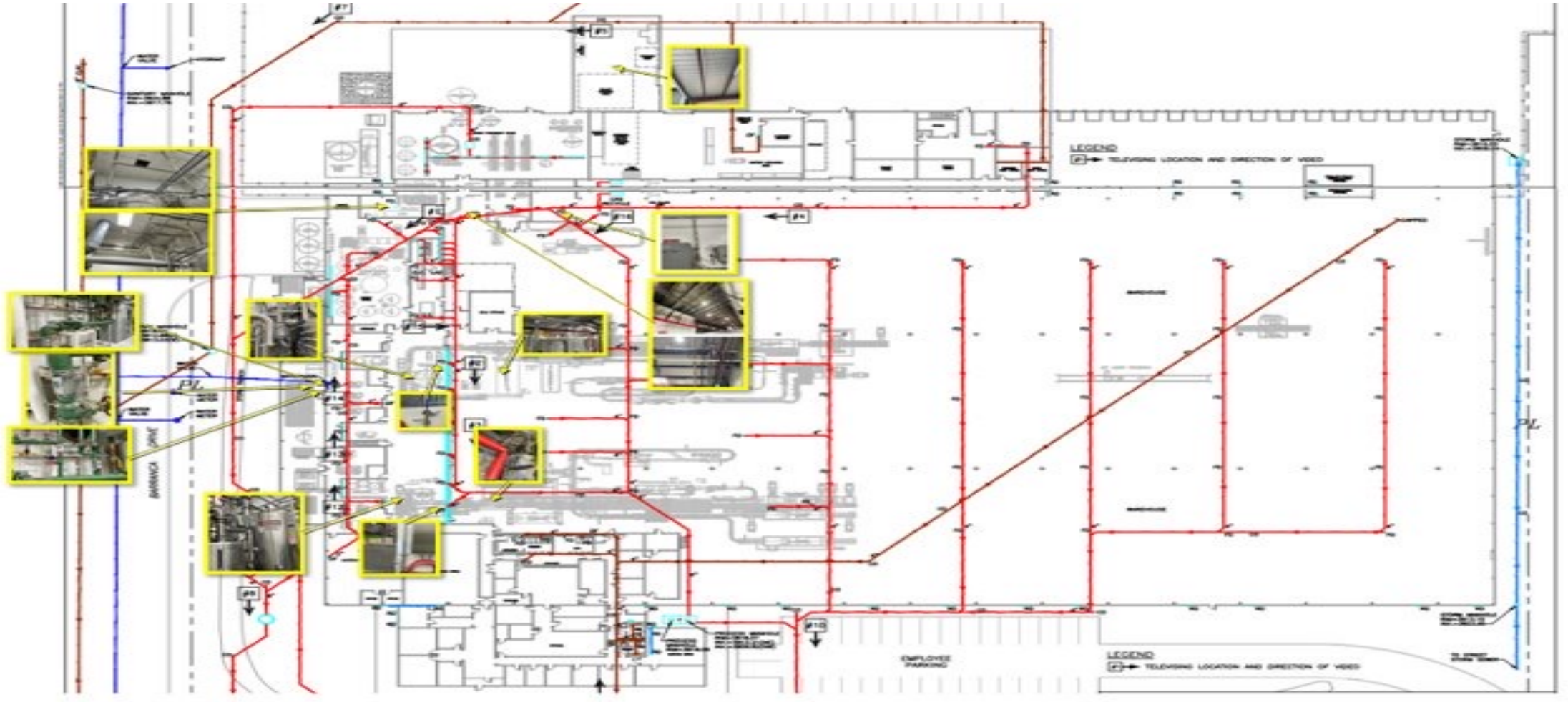
Warmer


CIP room

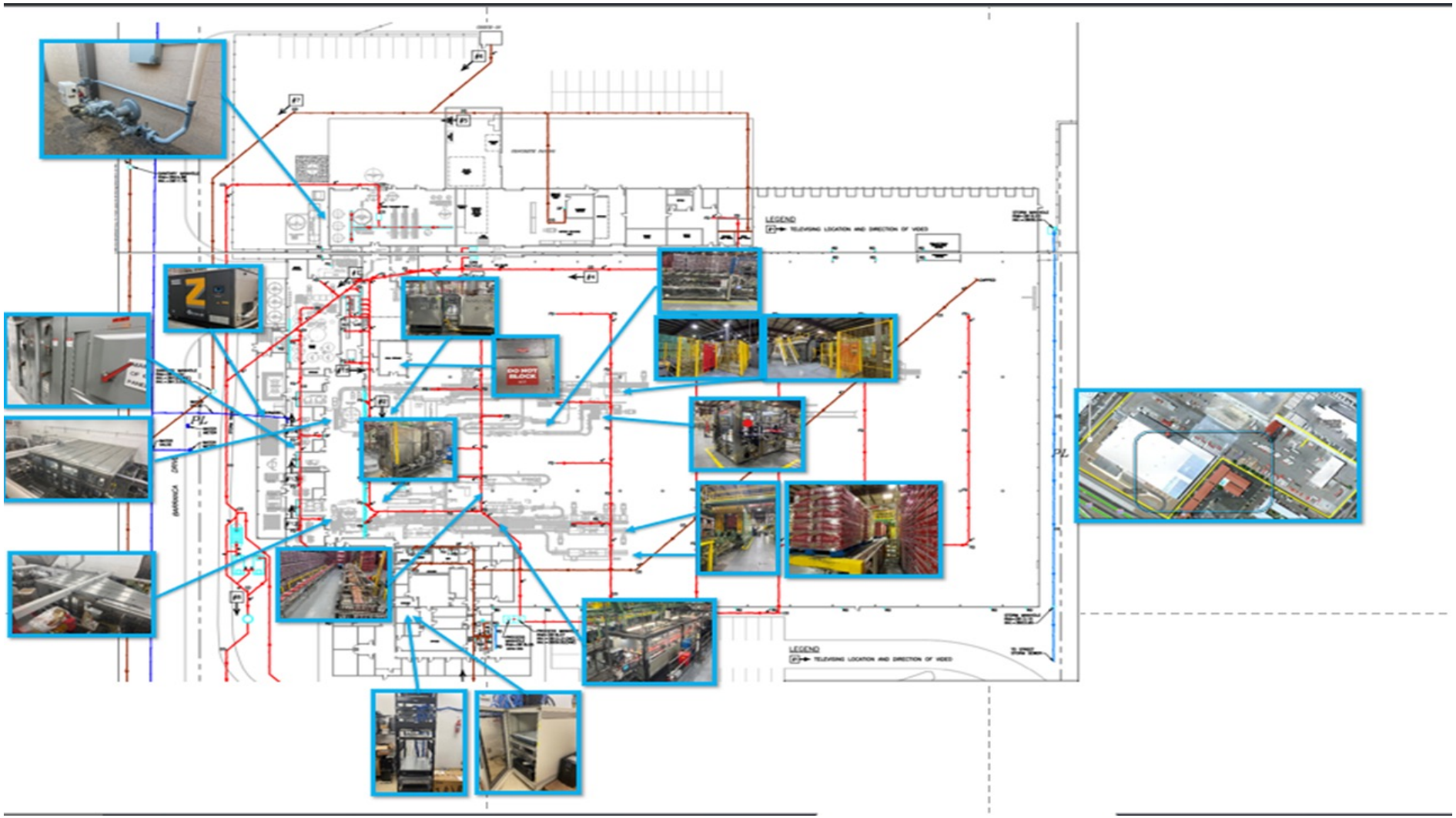

Sanitation

# PRODUCTION PROCESS CONT.

# WATER SENSOR LOCATIONS



# ENERGY SENSOR LOCATIONS



# ENERGY USE RATIO (EUR)

## Environmental Metric – EUR

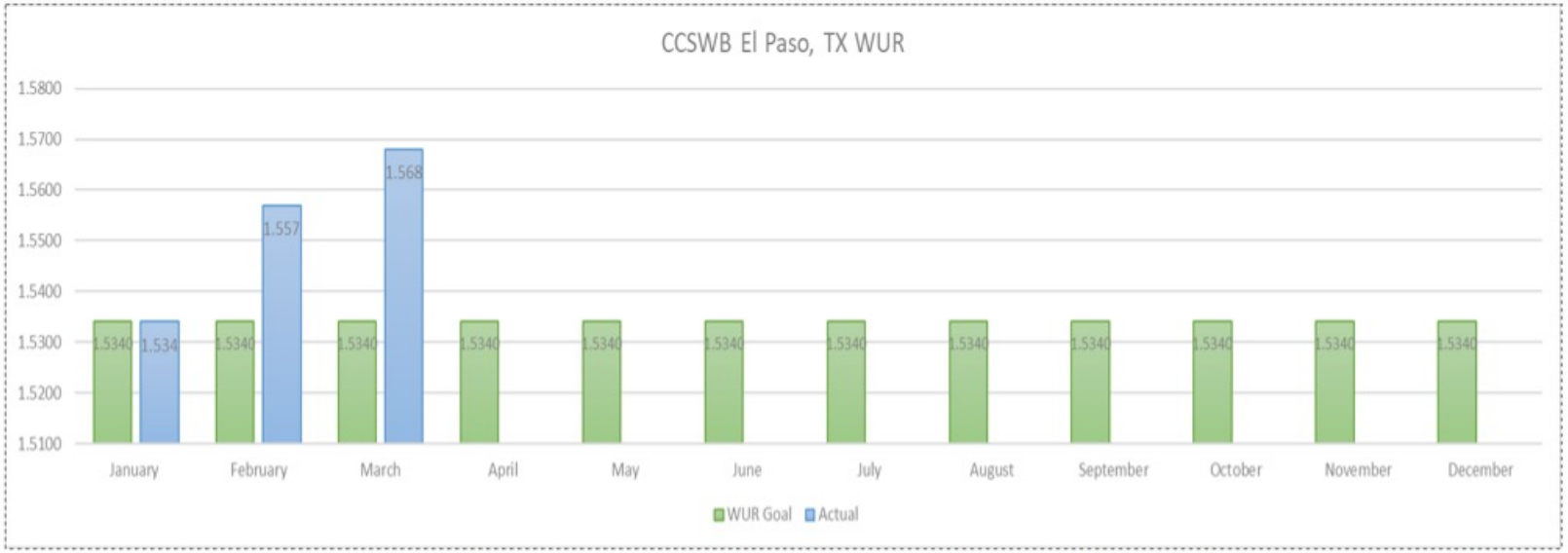

| Metric | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EUR Goal | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 | 0.2810 |
| Actual | 0.241 | 0.252 | 0.275 | | | | | | | | | |
| YTD | 0.241 | 0.246 | 0.256 | | | | | | | | | |

EUR 2023 Goal 0.281 vs YTD = .256

# WATER USE RATIO (WUR)

## Environmental Metric – WUR

**Water Use Ratio**




| Metric | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| WUR Goal | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 | 1.5340 |
| Actual | 1.534 | 1.557 | 1.568 | | | | | | | | | |
| YTD | 1.534 | 1.545 | 1.553 | | | | | | | | | |

WUR 2023 Goal = 1.53 vs YTD = 1.553

# OBJECTIVES

| | |
|---|---|
| Identify | • Identify out of control areas within the production lines |
| Implement | • Implement Energy Management System to track daily water consumption |
| Standardize | • Standardize water use in production lines and minimize water consumption to approximate the WUR |

# METHODOLOGY

To reduce the energy and water consumption of the facility through the application of Six Sigma principles by generating the Control Limits per shift in accordance with the fast-paced changing demand.

It is desired to Implement an Energy Management System that will help Arca Continental to monitor the energy consumption and demand.

# WORK PROCESS

## Energy Management System

**Sponsor:** Emmanuel Juarez
**Mentor:** Fabian Vazquez
**Team:** Abraham Ambriz / Juan M. Barraza

**Date:** 01/01/2023
**Rev #:** 1

***Future Condition*** (What would we like things to look like in the future?)

Achieve 2023 WUR and EUR goals and stablish routines to monitor and improve water and energy by using the Energy Management Ststem

***Implementation Plan*** (List of major steps required to complete the project)

Revised:

| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | WK---> | ### | ### | ### | 3/6 | ### | ### | ### | 4/3 | ### | ### | ### | 5/1 | 5/8 | ### | |
| ID | Activities | Resp. (RACI) | Schedule | | | | | | | | | | | | | | Comments |
| 1 | **Data Accuracy** | | | | | | | | | | | | | | | | |
| 2 | Meeting with UTEP Students | Juan B. | C | | | | | | | | | | | | | | |
| 3 | Managers and Students Training | Juan B. | | | C | | | | | | | | | | | | |
| 4 | Plant tour with UTEP Students and Include new CI Lead (ELP) | Juan B. | | | C | | | | | | | | | | | | |
| 5 | Start weekly routine to analyse data and reports (every Tuesday before Staff | Juan B. | | | | C | | | | | | | | | | | |
| 6 | Remove and send Gas Meeters to calibrate (Warmers) | Buildtech | | | C | | | | | | | | | | | | |
| 7 | Abraham Ambriz to provide costs | Abraham A. | | | | | C | | | | | | | | | | |
| 8 | Gas Meeters Re-Install | Buildtech | | | | | | | | Y | | | | | | | Sensor instaletion pending |
| 9 | Filler Meter data validation | Buildtech & | | | | | | | C | | | | | | | | |
| 10 | Rename Sensors and add description | Buildtech & | | | | | | | | | | | | | | | |
| 11 | New Breaker for Eleectric sensors | ELP | | | | | | | | | | | | | | | |
| 12 | Electric meeters not providing data (investigate why) | Buildtech & | | | | | | | | C | | | | | | | |
| 13 | Meeting with Buildtech (Ecoreport analysis) | Buildtech & | | | | | | | C | | | | | | | | |
| 14 | Set up Alarms | Buildtech & | | | | | | | | | C | | | | | | |
| 15 | Create Control Limits | Buildtech & | | | | | | | | | | C | | | | | |
| 16 | Set up Alarms with results of the Control Limits | Buildtech & | | | | | | | | | | | P | | | | |
| 17 | Meeting with Coca-Cola Corpotative | Juan B. | | | | | | | | | | | | P | | | |
| 18 | **Tools/Reports** | | | | | | | | | | | | | | | | |
| 19 | Provide email adress to set up alerts | Juan B. | | | | | | | | | C | | | | | | |
| 20 | Use Ecoreports and dashboards during weekly meeting | Buildtech & | | | | C | | | | | | | | | | | |
| 21 | Create heating maps in Ecoreports | Buildtech & | | | | | C | | | | | | | | | | |
| 22 | MiniTab results | UTEP | | | | | | | | | | | C | | | | |
| 23 | | | | | | | | | | | | | | | | | |
| 24 | | | | | | | | | | | | | | | | | |
| 25 | **Equipment Acceptance** | | | | | | | | | | | | | | | | |
| 26 | | | | | | | | | | | | | | | | | |
| 27 | | | | | | | | | | | | | | | | | |
| 28 | | | | | | | | | | | | | | | | | |

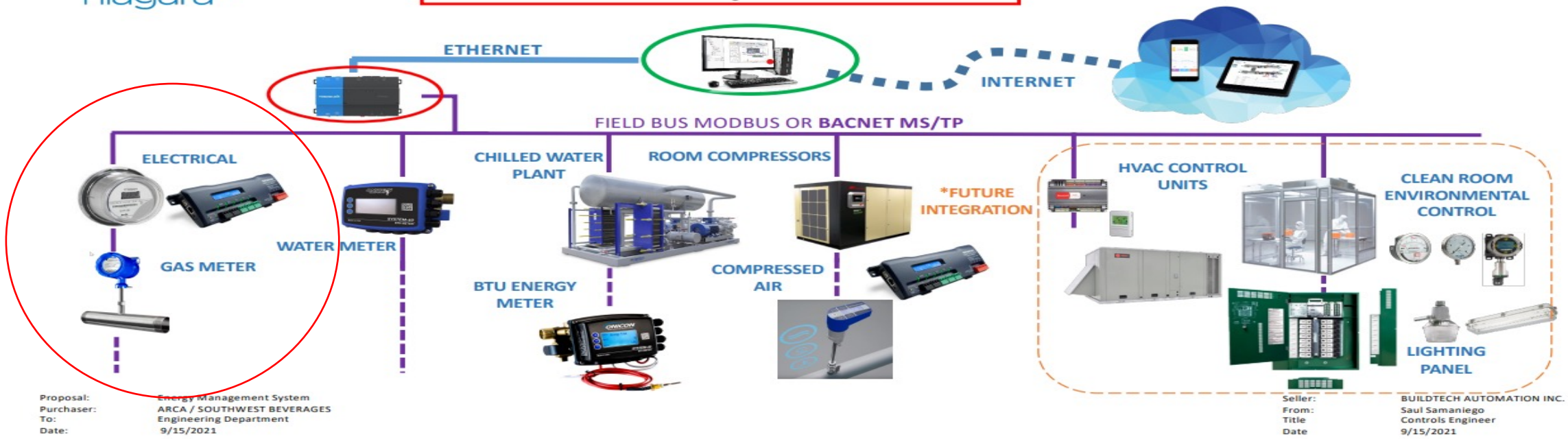
# ENERGY MANAGEMENT SYSTEM

1 ENERGY MANAGEMENT SYSTEM

1.1 CENTRAL MONITORING SYSTEM EQUIPMENT

PROPOSAL

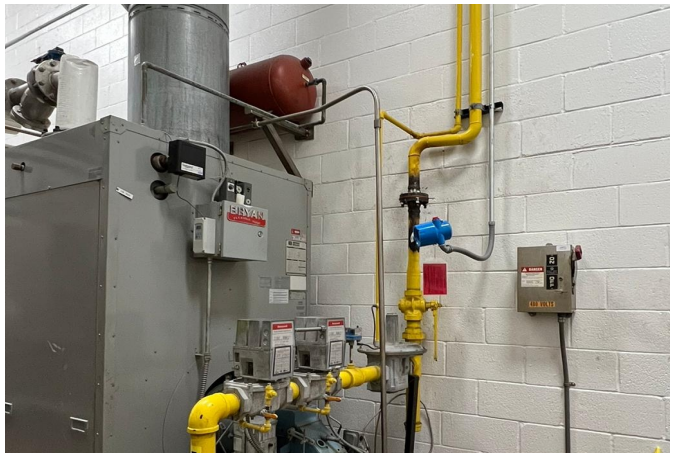
| | | | Central Monitoring System Equipment |
|---|---|---|---|
| 1.1 | 1 | | |
| | | 1 | N4 Supervisor Software |
| | | 1 | Five Year Software Maintenance Agreement |
| | | 1 | License for 250 analytic points for a N4 Supervisor |
| | | 2 | WEB-8000 base controller plus 8100 100 Device / 5,000 Point Core for N4. |
| | | 2 | Five Year Software Maintenance Agreement for 8100 Core |




Proposal: Energy Management System
Purchaser: ARCA / SOUTHWEST BEVERAGES
To: Engineering Department
Date: 9/15/2021

Seller: BUILDTECH AUTOMATION INC.
From: Saul Samaniego
Title Controls Engineer
Date 9/15/2021

# GAS, ELECTRICITY, AND WATER SENSORS

# DATA COLLECTION

Water Sensors

EcoReports

# WATER SENSORS

Electromagnetic sensors

Ultrasonic sensor

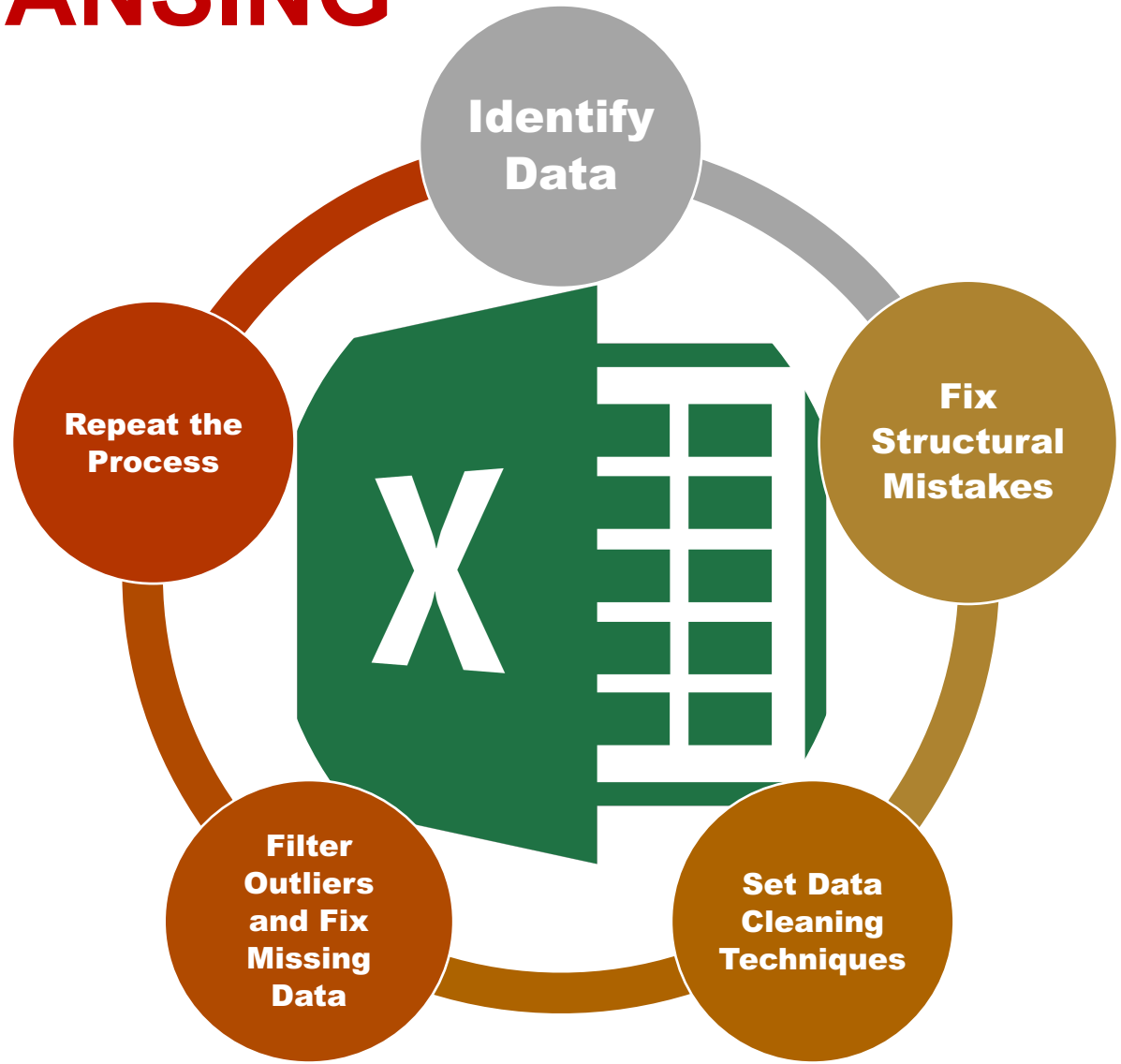
# EcoReports™


EcoReports dashboards retrieve information from the i-Vu Pro building automation system and provide intelligent and informative views for facility managers.

Export the trend source data on a periodic basis from meters.

Create graphs, charts, reports and dashboards to visualize building data easily.

# DATA CLEANSING



# DATA VALIDATION AND ANALYSIS

## Shift 1

5:00 AM – 1:00 PM

- Main Water Meter
- Condenser
- Water Treatment
- Facility
- Filler Line 1 & 2
- Warmer Line 1 & 2
- Sanitation Line 1 & 2

## Shift 2

1:00 PM – 9:00 PM

- Main Water
- Condenser
- Water Treatment
- Facility
- Filler Line 1 & 2
- Warmer Line 1 & 2
- Sanitation Line 1 & 2

## Shift 3

9:00 PM – 5:00 AM

- Main Water
- Condenser
- Water Treatment
- Facility
- Filler Line 1 & 2
- Warmer Line 1 & 2
- Sanitation Line 1 & 2

# MINITAB WORK PROCESS

**1**

- Control limits for Main Water Meter

Condenser
Water Treatment Facility

**2**

- Control limits for Production Line 1 Meter

Filler Can
Warmer Can
Sanitation Can

**3**

- Control limits for Production Line 2 Meter

Filler Can
Warmer Can
Sanitation Can

CONTROL LIMITS MAIN WATER METER

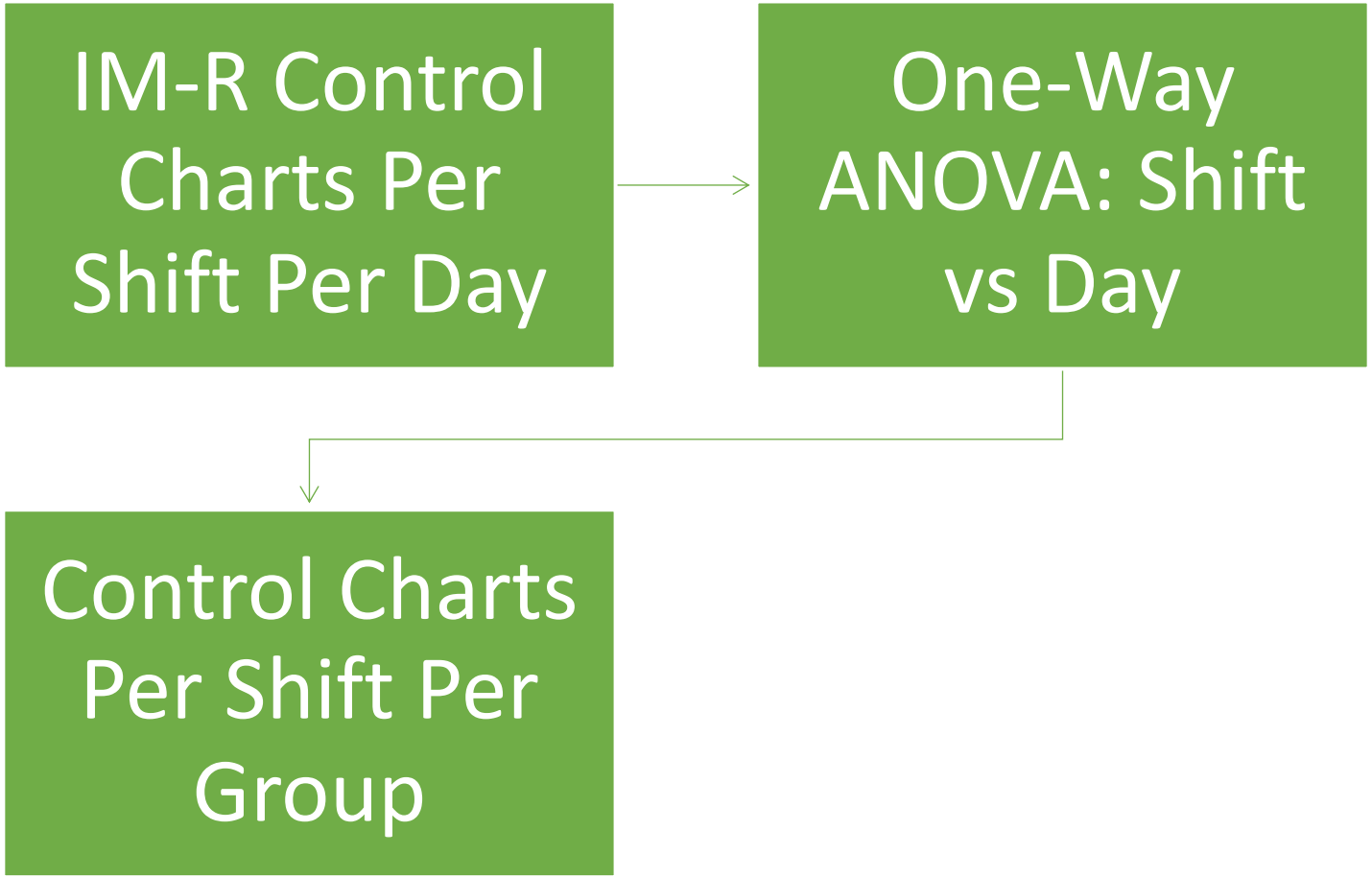
90%

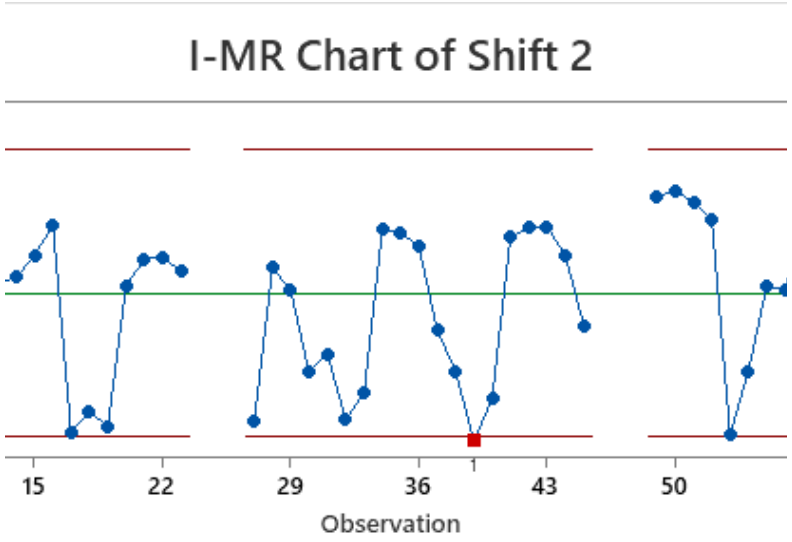
Condenser

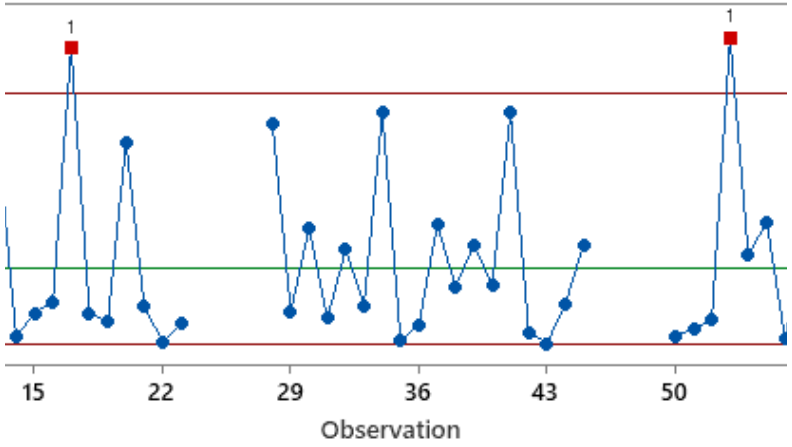
Water Treatment

Facility

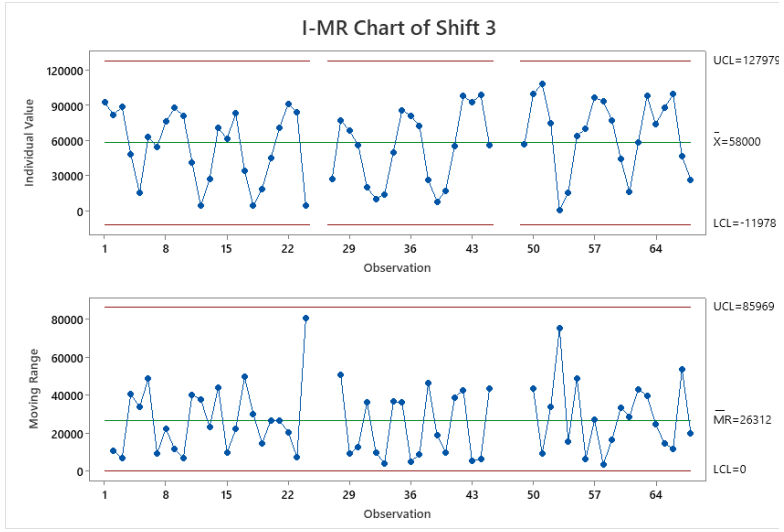
# CONTROL LIMITS

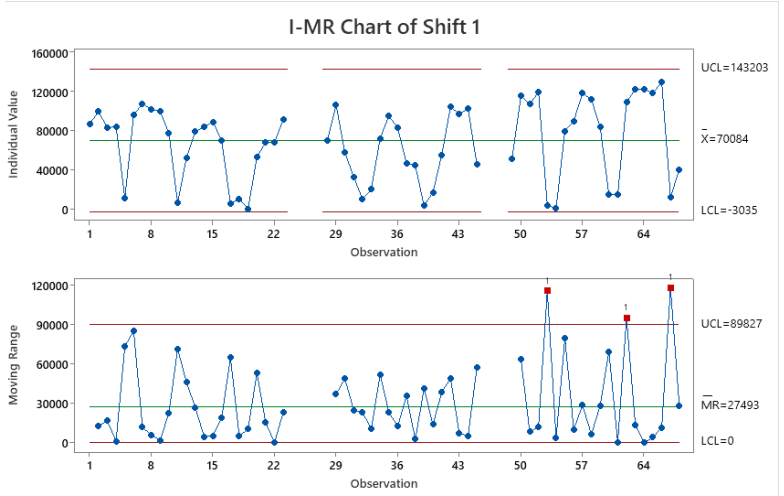





*e calculations: 17, 53, 67*

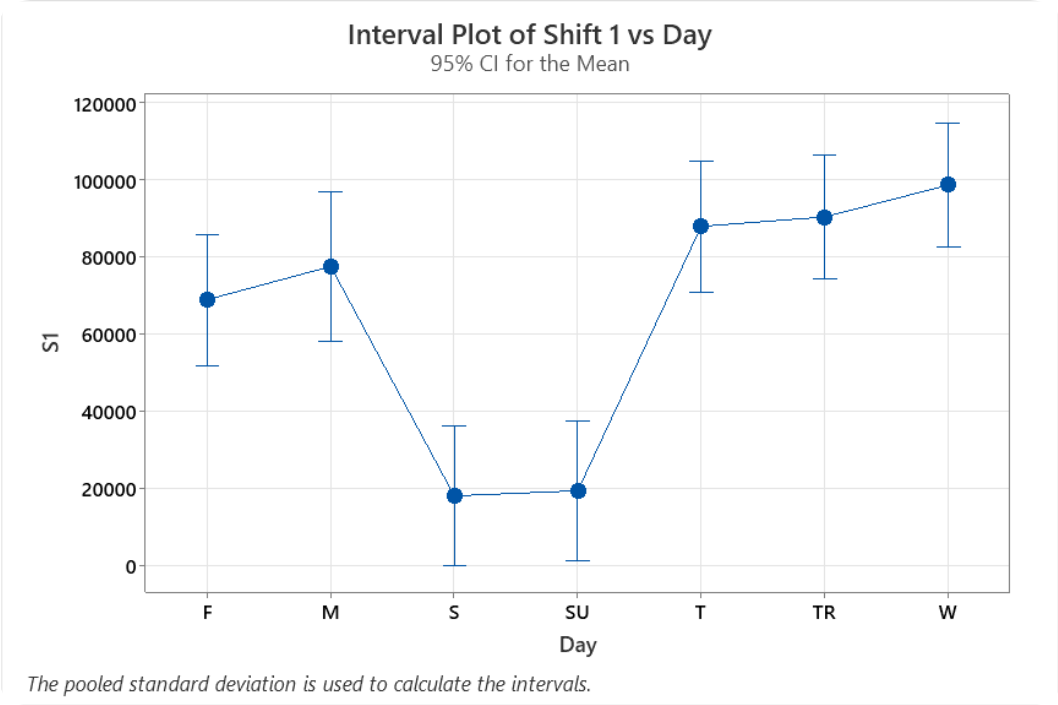



*Data points omitted from the calculations: 53, 67*

# IM-R CONTROL CHARTS PER SHIFT PER DAY

# ONE-WAY ANOVA: SHIFT VS DAY



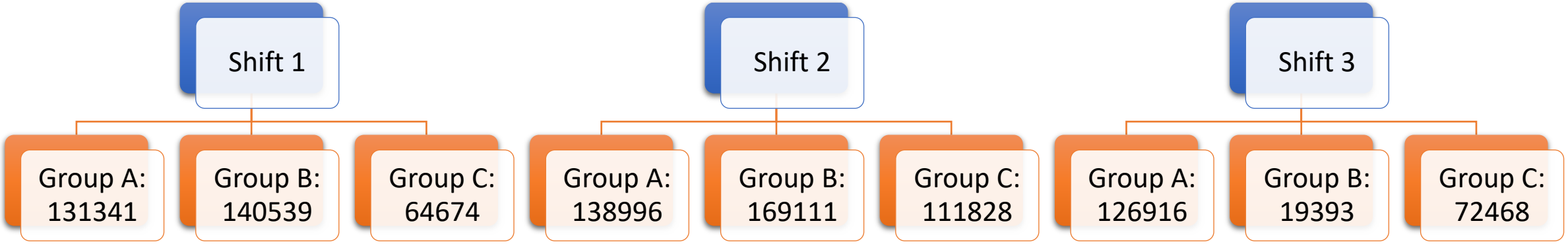

| Analysis of Variance | | | | | |
|---|---|---|---|---|---|
| **Source** | **DF** | **Adj SS** | **Adj MS** | **F-Value** | **P-Value** |
| **Day** | 6 | 5756266977 | 9593778297 | 14.8 | 0 |
| **Error** | 54 | 34997866555 | 648108640 | | |
| **Total** | 60 | 92560536334 | | | |

| Grouping Information Using the Fisher LSD Method and 95% Confidence | | | | | |
|---|---|---|---|---|---|
| **Day** | **N** | **Mean** | **Grouping** | | |
| **W** | 10 | 98786 | A | | |
| **TR** | 10 | 90496 | A | B | |
| **T** | 9 | 88064 | A | B | |
| **M** | 7 | 77653 | A | B | |
| **F** | 9 | 69033 | | B | |
| **SU** | 8 | 19469 | | | C |
| **S** | 8 | 18128 | | | C |

Means that do not share a letter are significantly different.

| Group A | Group B | Group C |
|---|---|---|
| Tuesday | Monday | Saturday |
| Wednesday | Friday | Sunday |
| Thursday | | |

# MAIN WATER METER



# CONTROL LIMITS PRODUCTION LINE 1

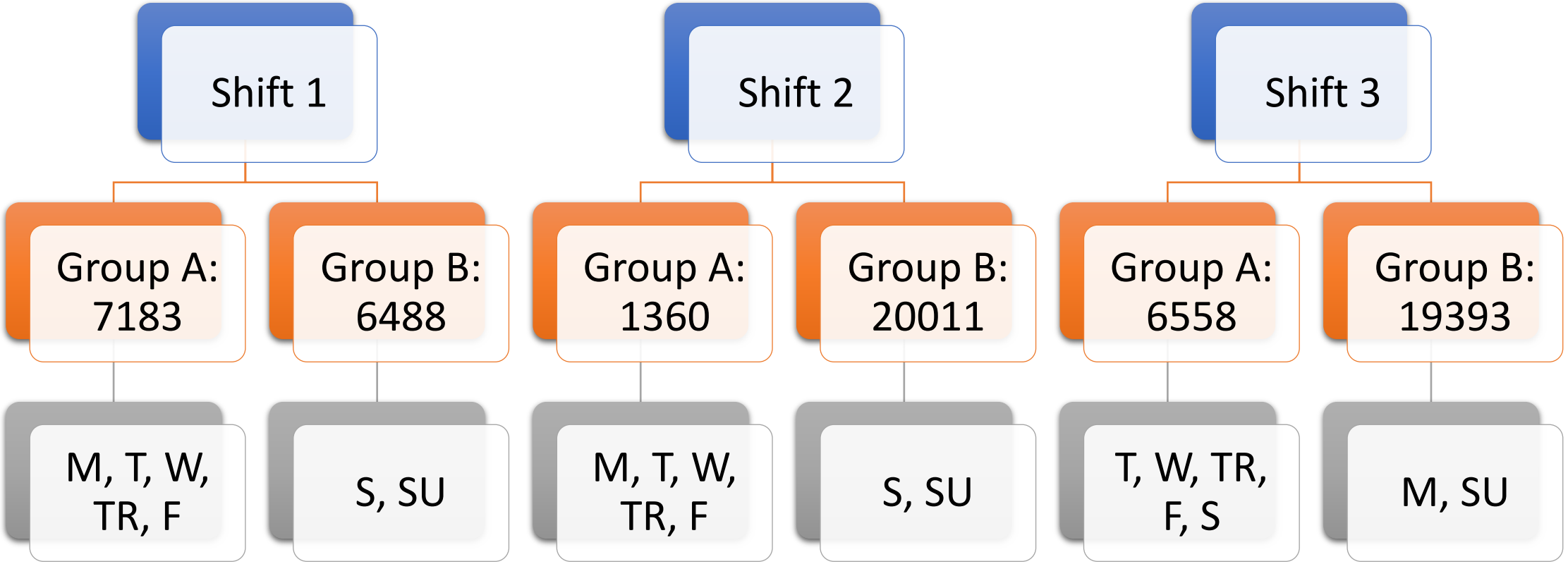
Filler Can

Warmer Can

Sanitation Can

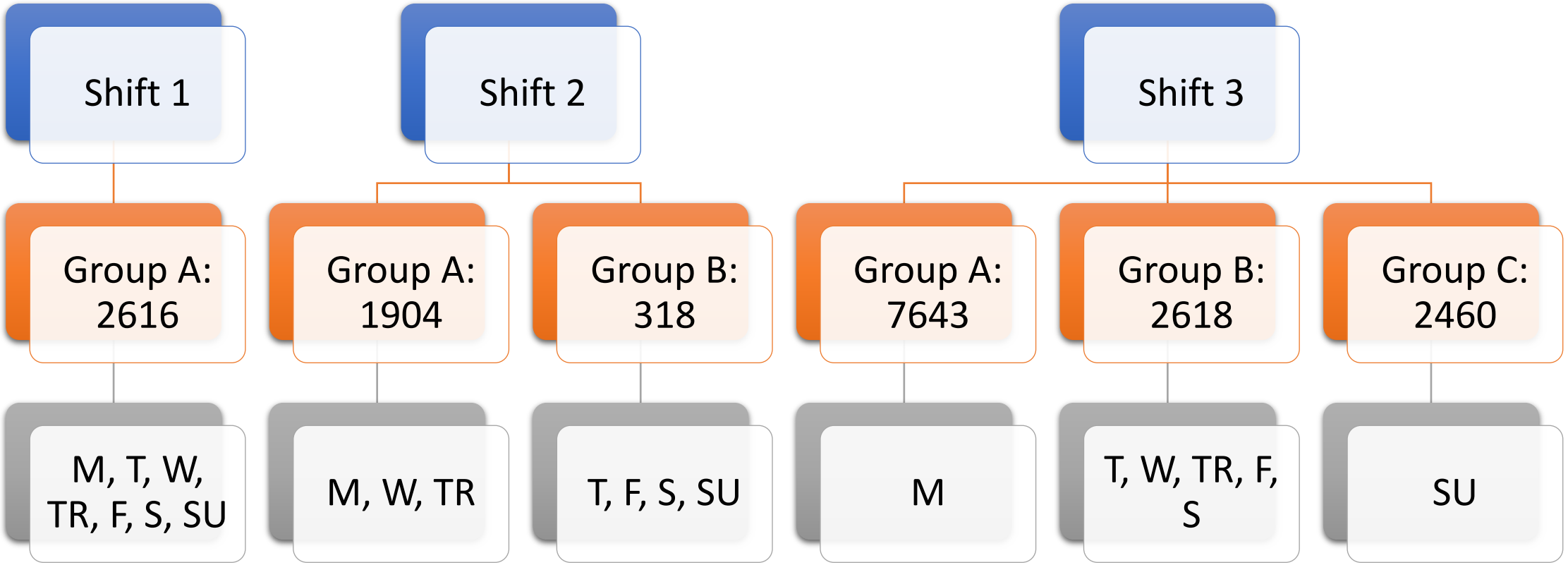
# FILLER CAN

Units: Gallons of water per shift



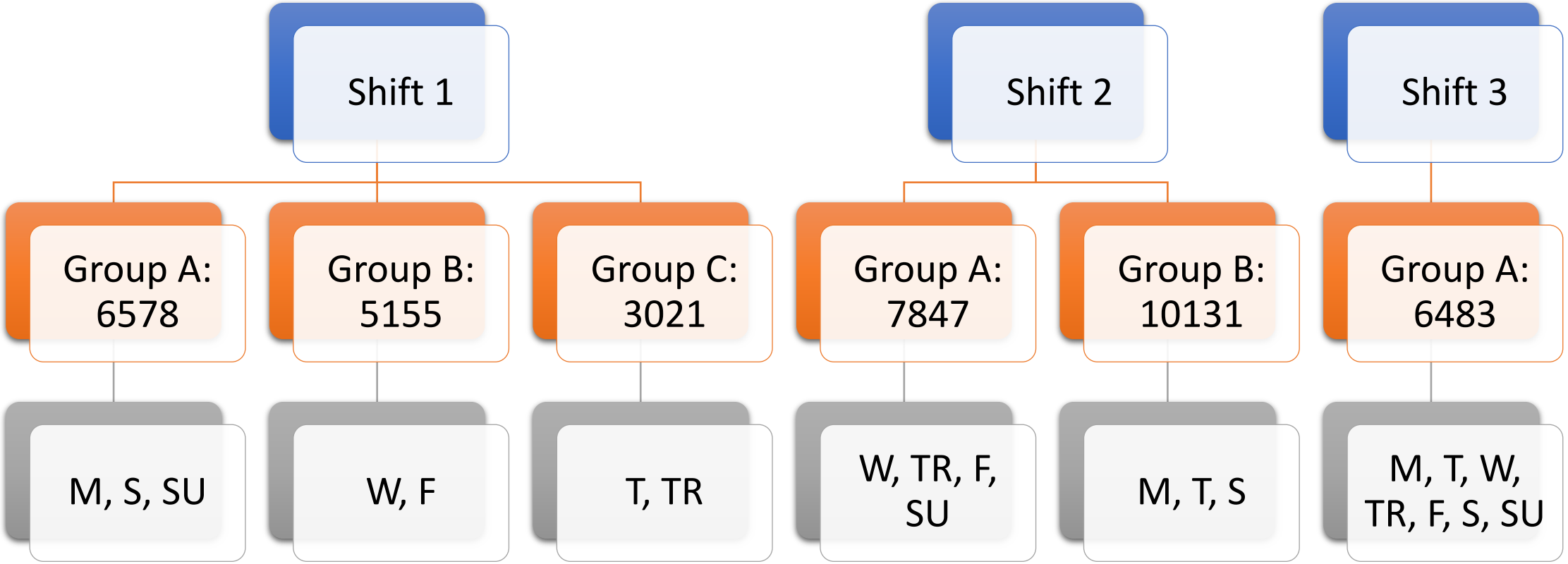
# WARMER CAN

Units: Gallons of water per shift



# SANITATION CAN

Units: Gallons of water per shift



# CONTROL LIMITS PRODUCTION LINE 2

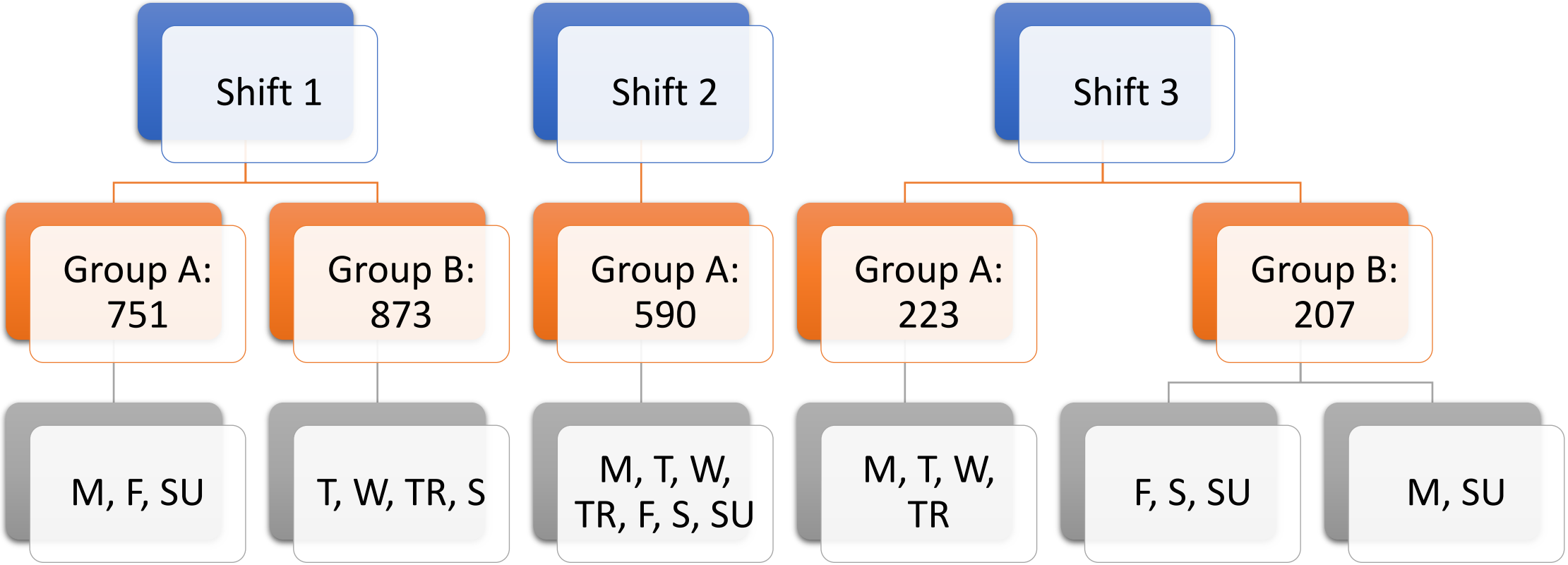
Filler Bottle

Warmer Bottle

Sanitation Bottle

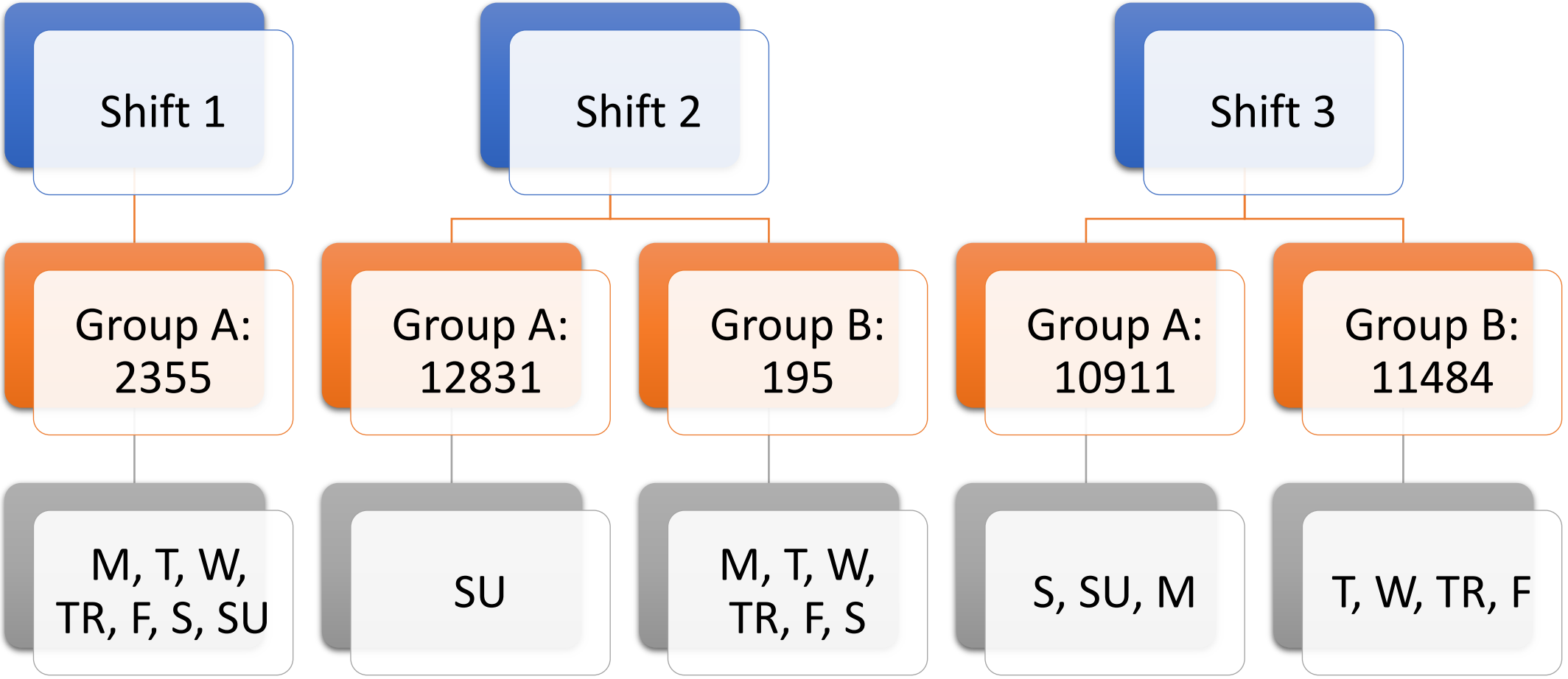
# FILLER BOTTLE

Units: Gallons of water per shift



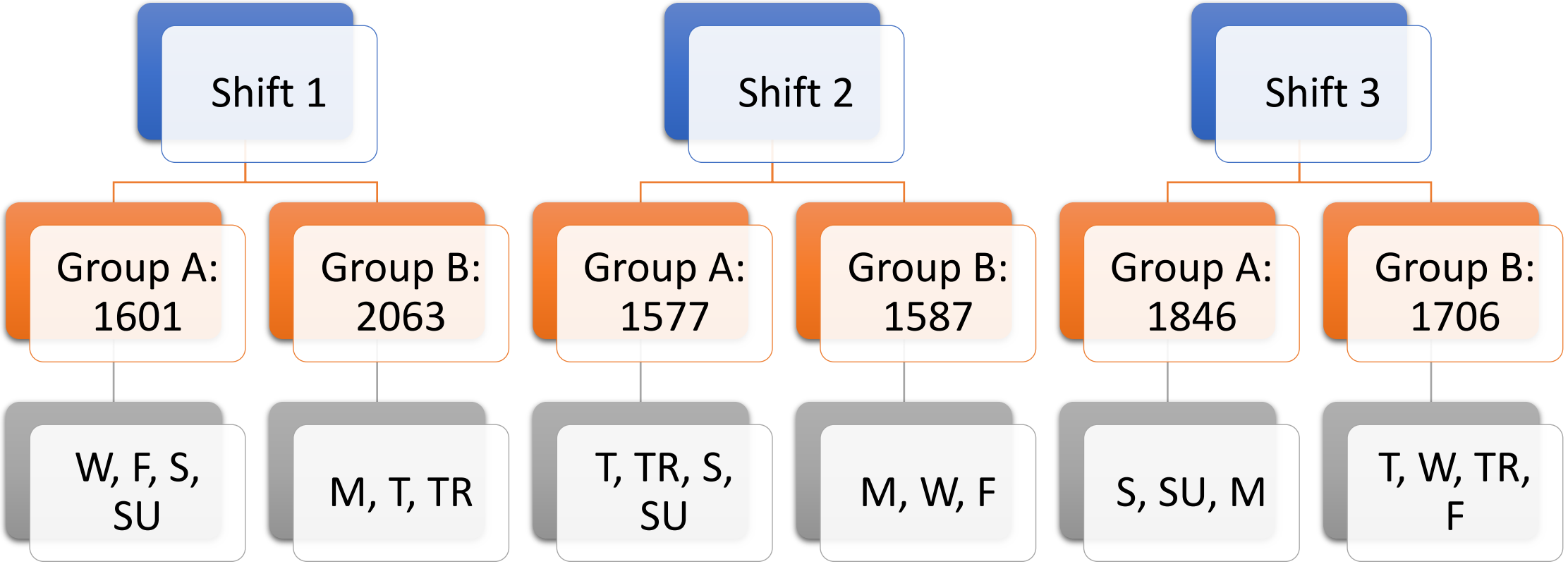
# WARMER BOTTLE

Units: Gallons of water per shift



# SANITATION BOTTLE

Units: Gallons of water per shift

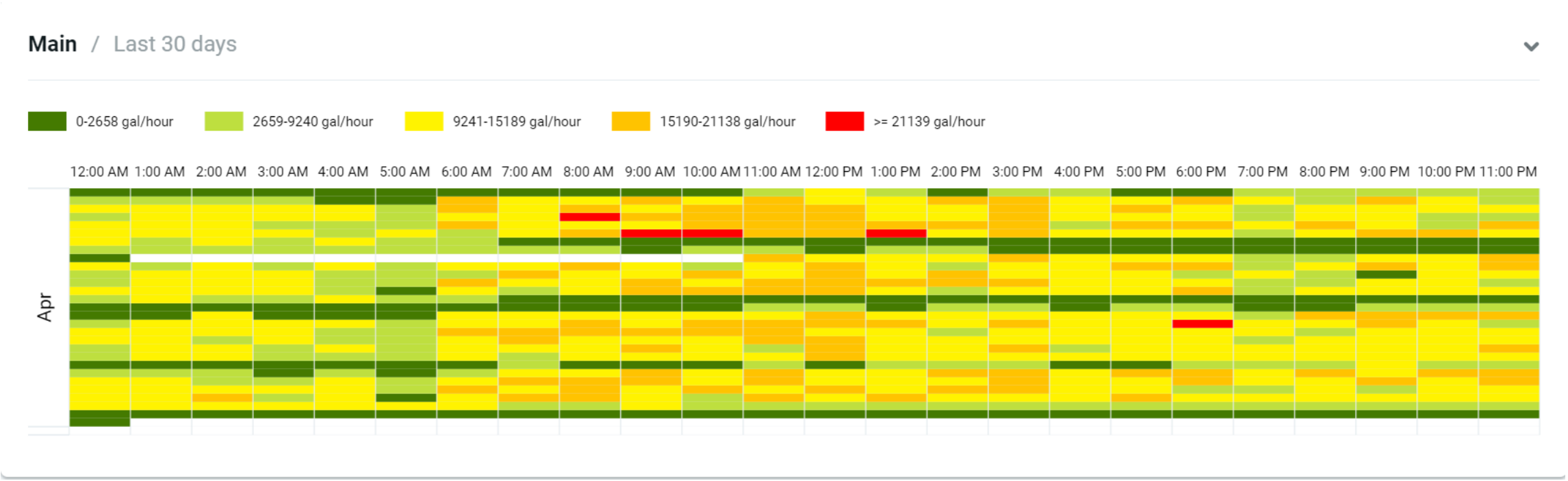



# RESULTS

ARCACONTINENTAL
Coca-Cola SOUTHWEST BEVERAGES

A Culture of GROWTH

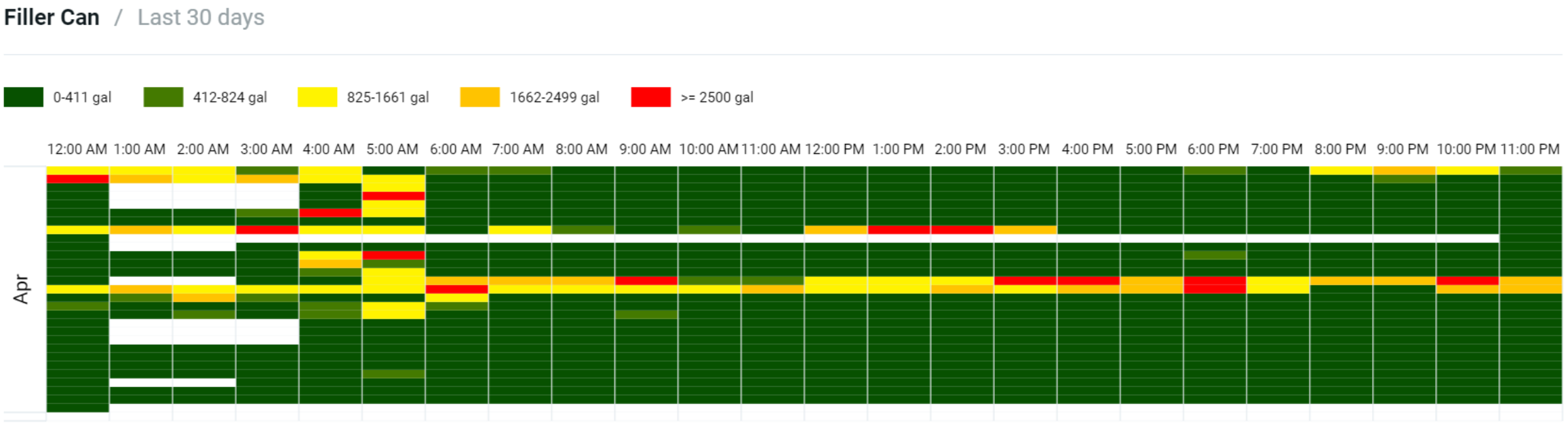
# MAIN WATER METER




Results showed a trend for excess water consumption during the weekends

If there is much water consumption during the weekends, the facility needs to compensate and increase the production during the week to achieve the water use ratio target

# FILLER CAN LINE 1

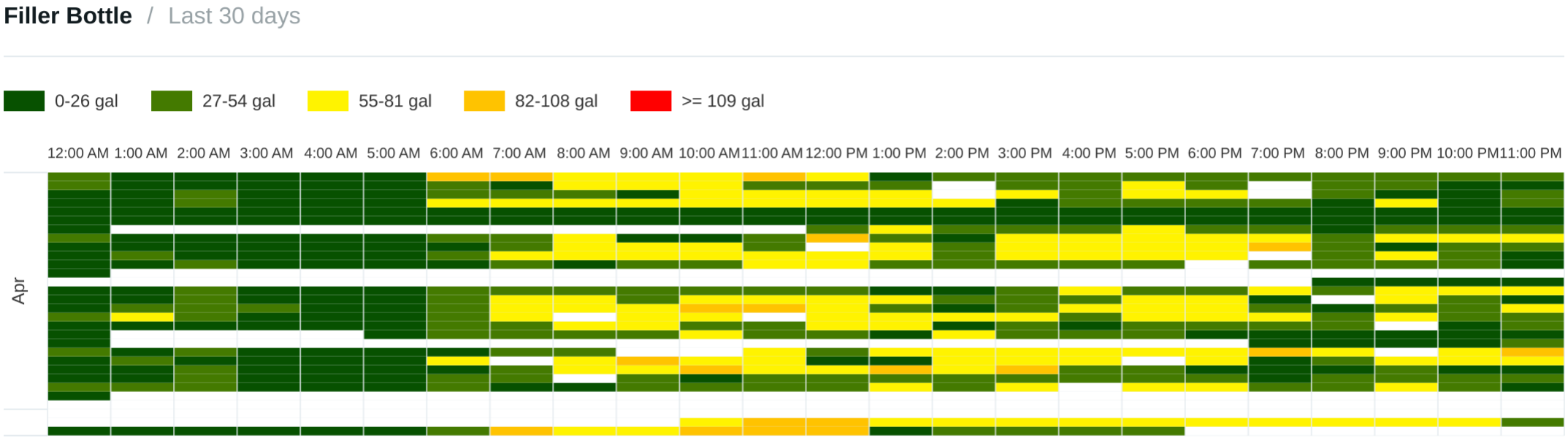



Filler 1: it is working three shifts

Filler 2: it is working only two shifts

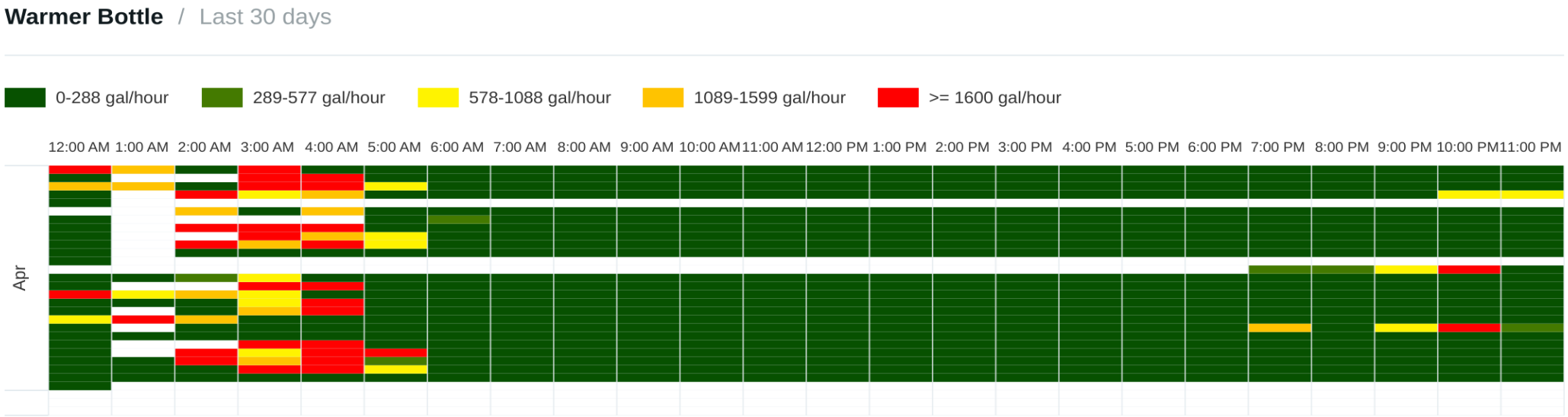
Therefore, water control limits are higher for filler 1

# FILLER BOTTLE LINE 2

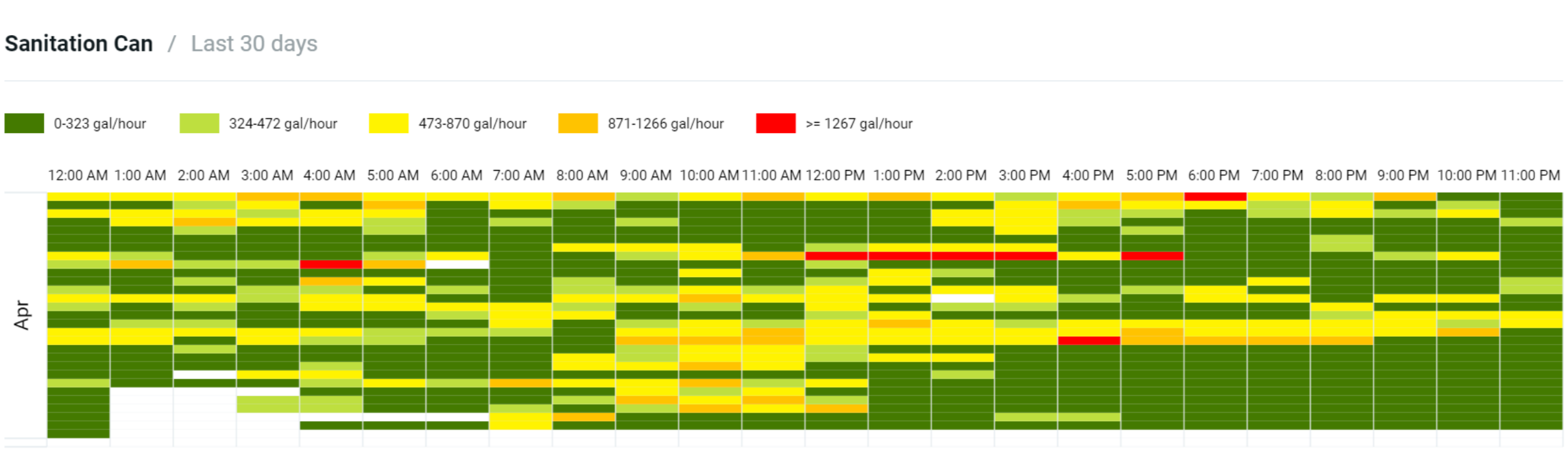


# WARMER CAN LINE 1

# WARMER BOTTLE LINE 2

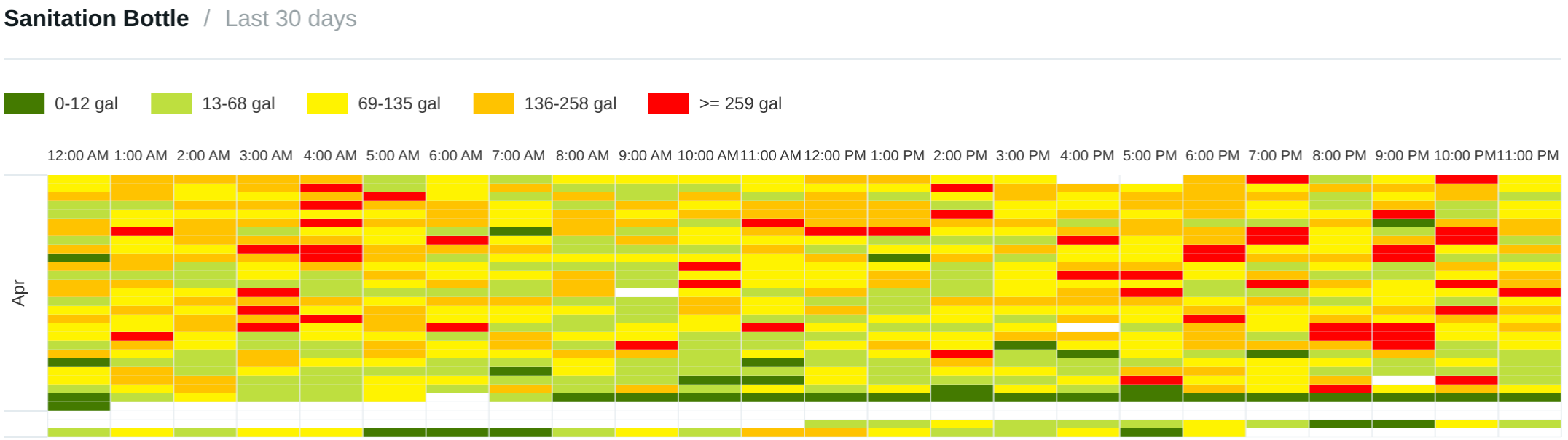


# SANITATION CAN LINE 1




Sanitation process is the same for both production lines; however, results showed a significant increase in production line 1.

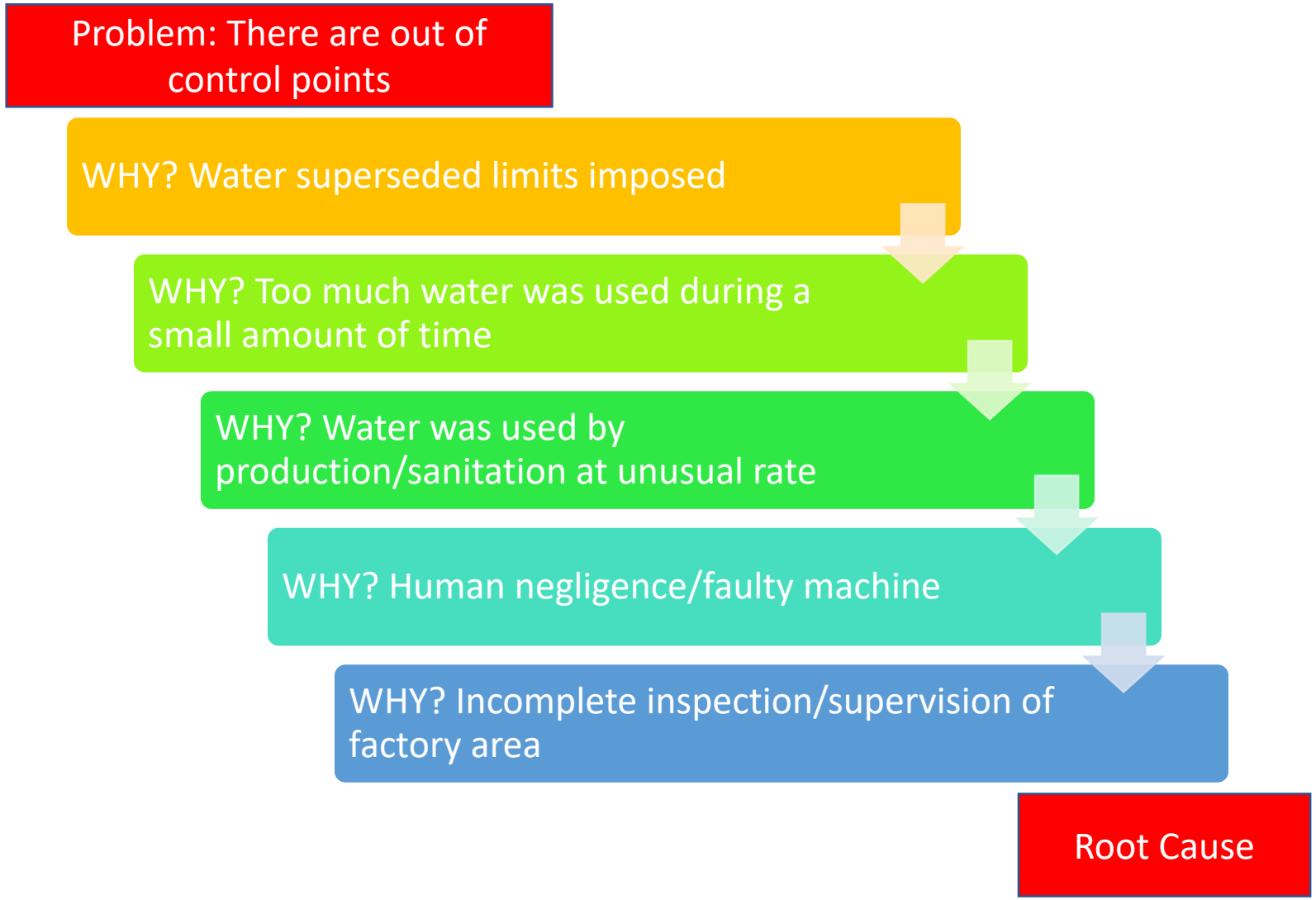
# SANITATION BOTTLE LINE 2



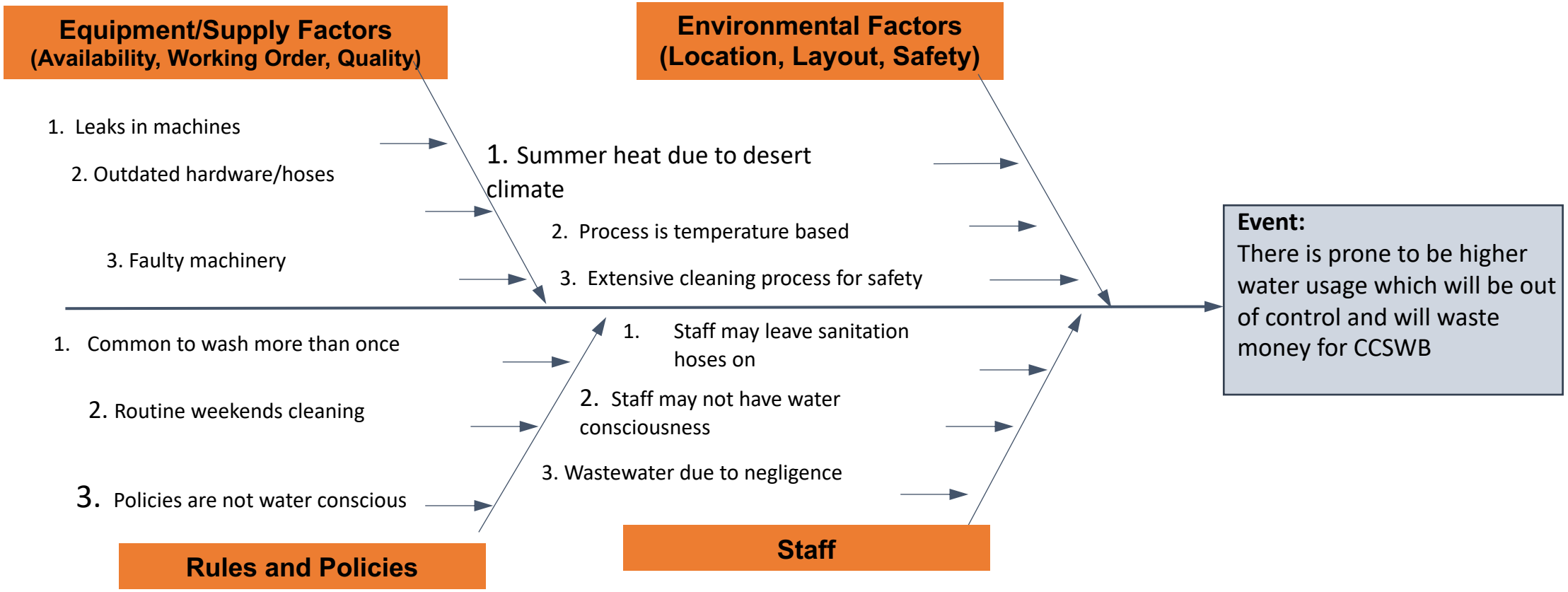
# NEXT STEPS / RECOMMENDATIONS

- Monitoring control limits at the end of each shift needs to continue in order to gather more data, since this project was done during spring there is no knowledge of how temperature might affect water consumption
- With enough data it is easier to identify causes for out-of-control points, such as weekends and look for justifiable causes
- This project lays the groundwork for other sustainability efforts for electricity, gas, waste, etc.
- Investigate sanitation process to understand difference between production lines
- Look for ways to monitor week-end production cleaning
- Implement the alarm system to monitor the water and energy consumption of the facility
- Check for any gaps in data or inaccuracies that may depict damaged sensors or wrong data

# 5 WHY'S DIAGRAM



# FISHBONE DIAGRAM



# CONCLUSION

- Control limits were implemented in the energy management system.
- It will be possible to have greater control of water consumption in the facility.
- The control limits will be used to set an alarm system.
- The alarms will help to have better management in production lines.
- Managers will be able to monitor employee's activities.
- Managers will be able to reach their desired water use ratio at the end of the year.

# ABET LEARNING OUTCOMES

**ABET 2:** Engineering design was applied to the Senior Design Project by the use A3, 5 Why's, and Fishbone diagrams to meet the Coca-Cola requirements of implementing an Energy Management System which poses an environmental matter to El Paso Community.
generation of Control Chart and the identification of patterns that showed controlled and randomized data.

**ABET 3:** The team communicated effectively complex Industrial and System engineering concepts to a large audience of students and processors at the EPCC Valle Verde location.

**ABET 5:** The students were able to create a team with each other as well as present ideas and have meetings with business professionals from both Coca-Cola as well as Buildtech, students presented leadership and proper communication qualities

**ABET 7:** The senior design project included both previous knowledge and new knowledge for students. All students were completely unfamiliar with the processes Coca-Cola