

**S C A M P S      2 0 1 8**



**GEORGETOWN, SC, LOAD-SIDE  
GENERATION FACILITY**

**PRESENTED BY:**

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UTILITY TECHNOLOGY ENGINEERS-CONSULTANTS**

**AND**

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GEORGETOWN, SC**

**June 7, 2018**

# INTRODUCTION

## GEORGETOWN OPERATES TWO 12.47 KV SUBSTATIONS:

- ❖ GEORGETOWN SUBSTATION: 6 – CKTS, 26.4 MW PK
- ❖ MARYVILLE SUBSTATION: 2 – CKTS, 6.1 MW PK
- ❖ TOTAL SYSTEM: 32.5 MW PK

**GEORGETOWN 2013  
POWER SUPPLY RFP**

## KEY CONTRACT REQUESTS:

- ❖ DEMAND CHARGES TO BE BASED ON GEORGETOWN COINCIDENT PEAK WITH POWER SUPPLIER PEAK LOAD
- ❖ CONTINUOUS ACCESS TO POWER SUPPLIERS INSTANTANEOUS LOAD
- ❖ ALLOWANCE FOR GEORGETOWN TO INSTALL LOAD-SIDE GENERATION THAT CAN OPERATE IN PARALLEL WITH THE SYSTEM
- ❖ 10-YEAR CONTRACT RENEWABLE AT END OF TERM

## **ECONOMIC ANALYSIS OF COSTS AND SAVINGS:**

- ❖ **SIGNIFICANT SAVINGS WOULD RESULT FROM INSTALLATION OF PERMANENT LOAD-SIDE PARALLEL OPERATING GENERATION PLANT**
- ❖ **SUFFICIENT SAVINGS WOULD ALSO RESULT FROM INSTALLATION OF TEMPORARY MOBILE GENERATORS NOW
  - ❖ **INSTALLED CATERPILLAR 1800 KW MOBILE ENGINE GENERATOR AT THE WWTP JANUARY 29, 2015**
  - ❖ **INSTALLED CATERPILLAR 1800 KW MOBILE ENGINE GENERATOR AT THE WTP FEBRUARY 26, 2015****

## **ECONOMIC RESULTS:**

- ❖ PERMANENT PLANT COST OPINION - \$4,789,244
- ❖ FOR COMBINATION TEMPORARY GENERATORS AND PERMANENT PLANT:

- ❖ 20-YR POWER COST SAVINGS - \$20,700,197

- ❖ 20-YR NET POWER COST SAVINGS AFTER EXPENSES  
- \$6,546,134

- ❖ NET PRESENT WORTH OF 20-YR NET SAVINGS -  
\$5,274,093

## **ANALYSIS: NATURAL GAS VERSUS DIESEL FUEL:**

- ❖ **ANALYSIS ADDRESSED:**
  - ❖ **INSTALLATION COST**
  - ❖ **MAINTENANCE / OVERHAUL COST**
  - ❖ **OPERATING COST**
  - ❖ **FUEL AVAILABILITY AND COST FORECAST**

# INSTALLATION COST DIESEL ENGINE GENERATORS:

Two Diesel Engine Generators - Equipment and Installation Cost			
Item	Unit Cost	Quantity	Total Cost
<p>Diesel Engine/Generator</p> <p>1825 kW Prime, 2000 kW Standby, 4.16 kV, 350 gal day tank pump/controls, Exhaust Insulation, Exhaust After-treatment. Check-out / startup</p>	\$776,000	2	\$1,552,000
<p>Diesel Fuel Storage Tank System, Piping Insulation, Leak Detection, Level Gauge, Steel, double walled tank</p>	\$152,200	1	\$152,200
<p>Installation – Engine / Generator Set, exhaust piping with insulation, Exhaust After-treatment System, day tank fuel system</p>	\$39,750	2	\$79,500
Total			\$1,783,700



# INSTALLATION COST NATURAL GAS ENGINE GENERATORS:

Two Natural Gas Engine Generators - Equipment and Installation Cost				
Item	Unit Cost	Quantity	Total Cost	
Natural Gas Engine/Generator 1964 kW Prime, 1964 kW Standby, 4.16 kV, Check-out / startup services.	\$928,000	2	\$1,856,000	
Natural Gas Leak Detection System	\$5,500	2	\$11,000	
Install exhaust, insulation, silencer	\$30,000	2	\$60,000	
Installation – Engine / Generator Set, Install separately shipped radiator cooling fan	\$39,750	2	\$79,500	
Natural Gas Line (2000 ft) / Meter Installation by SCE&G	\$23,600	1	\$23,600	
Additional building / site preparation	\$68,875	1	\$68,875	
Total			\$2,098,975	

# MAINTENANCE/OVERHAUL COST:

Caterpillar Engines (Blanchard)		
Task	Diesel Engine Interval / Cost per Engine	Natural Gas Engine Interval and Cost per Engine
Routine Maintenance Replace Engine Oil, Oil Filter, Air Filter, Fuel Water Filter	2000 hours / \$2,900	2000 hours / \$2,700 (no fuel water filter)
1 <sup>st</sup> Overhaul	7500 hour / \$116,000	20,000 hours / \$83,000
2 <sup>nd</sup> Overhaul	22,000 hours / \$217,000	80,000 hours / \$202,000

# OPERATING COST:

Operating Cost Analysis: Savings per year using Natural Gas Units Operating 167 hrs/yr - 1800kW Load/Generator - 2 Generators Operating			
Fuel Cost	Diesel Engine \$ Cost / yr	Natural Gas Engine \$ Cost / yr	Natural Gas \$ Saved / yr
<u>Current Fuel Cost</u> Diesel = \$1.41/ gal DEF = \$2.80 / gal Nat Gas = \$.81883/therm	\$70,089	\$52,812	\$17,277
<u>2016 Projected Fuel Cost</u> Diesel = \$2.22/ gal DEF = \$2.80 / gal Nat Gas = \$.81883/therm	\$104,718	\$52,812	\$51,906
<u>2017 Projected Fuel Cost</u> Diesel = \$2.58/ gal DEF = \$3.25 / gal Nat Gas = \$.8881/therm	\$121,445	\$64,581	\$56,864
<u>Previous Diesel Prices</u> Diesel = \$3.75/ gal DEF = \$4.10 / gal Nat Gas = \$.8881/therm	\$173,992	\$56,865	\$117,127

## FUEL AVAILABILITY AND COST FORECAST:

- ❖ Diesel fuel is stored on site and ready anytime operation is required.
- ❖ Natural Gas will be delivered by a gas service line and meter. Though extremely reliable, natural gas supply could be subject to outages resulting from vehicle accidents, storms, or natural disasters. However, SCE&G has reported that it has never lost service, even during hurricane conditions.
- ❖ The price of natural gas can be compared to the price of diesel fuel by converting the cost of natural gas to diesel gallon equivalent units. Figure 3 illustrates the historical cost of natural gas, converted to diesel gallon equivalent units, compared to other diesel fuel and other alternative fuels.
- ❖ The price of natural gas tends to be more stable.

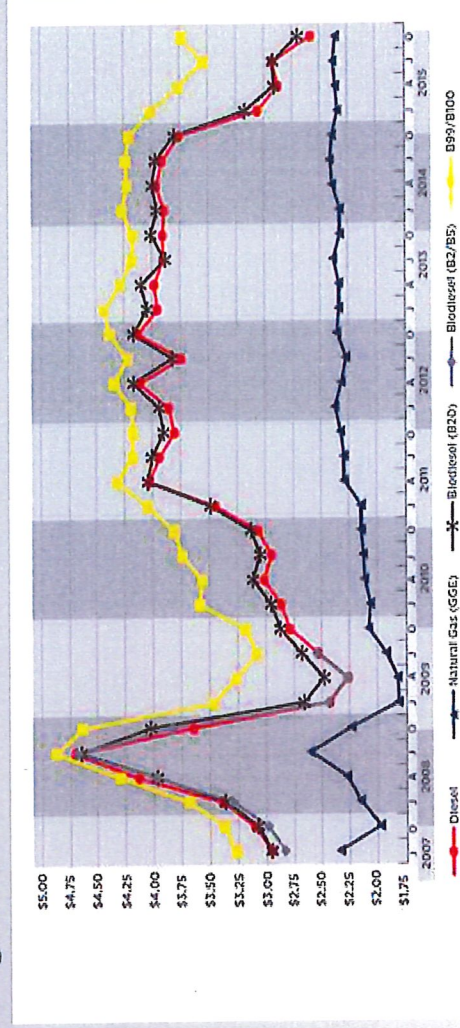


Figure 3: Historical Fuel Cost (Natural Gas Cost at diesel gallon equivalent unit) (Oct 2015 US Dept. of Energy)

## **SUMMARY AND RECOMMENDATION:**

- ❖ Natural gas engine / generator sets will cost \$315,275 more than diesel engine units.
- ❖ The maintenance costs for the diesel engine / generator set and the natural gas engine / set are similar and not a factor in the operating cost analysis.
- ❖ At current fuel prices (diesel - \$1.41/gal; natural gas - \$.81883/therm), the annual cost savings operating a natural gas unit is \$17,277. This represents an 18.25 year payback period.
- ❖ Diesel fuel is currently at a low cost. The US Dept. of Energy forecasts the cost of diesel fuel will increase at a greater percentage than the cost of natural gas. At estimated 2017 and beyond pricing (diesel - \$2.58/gal; natural gas - \$.8881/therm), the annual cost savings operating a natural gas unit is \$56,864. This represents a 5.5 year payback period.
- ❖ At future estimated fuel prices, natural gas becomes a more viable option. However, without a significant increase in diesel fuel cost, the diesel engine generator plant remains the best option.

## **CP DEMAND CONTRACTS:**

- ❖ **POWER SUPPLY PROPOSALS INCLUDED SEVERAL DIFFERENT METHODS TO DETERMINE THE CP BILLING DEMANDS**
  - ❖ **ANNUAL HOURLY CP**
  - ❖ **AVERAGE OF 10 HIGHEST HOURLY LOADS/YR.**
  - ❖ **MONTHLY HIGHEST HOURLY CP LOADS**
- ❖ **COST TO GENERATE POWER CURRENTLY AROUND \$0.200/KWH**
- ❖ **COST TO PURCHASE WHOLESALERE POWER FROM WHOLESALERE CONTRACTS CURRENTLY AROUND \$0.03/KWH TO \$0.05/KWH**
- ❖ **CLEARLY, GENERATE AS LITTLE ENERGY AS POSSIBLE AND INSTEAD PURCHASE MOST ENERGY UNDER THE WHOLESALERE CONTRACT**

## DAILY LOAD PROFILE CURVES:

- ❖ GENERALLY, IT IS THE CUSTOMER'S RESPONSIBILITY TO DETERMINE WHEN TO RUN GENERATORS
- ❖ THEREFORE, WE MUST HAVE ACCESS TO THE POWER SUPPLIERS INSTANTANEOUS LOAD
- ❖ GEORGETOWN HAS 24/7/365 ACCESS TO ITS POWER SUPPLIER'S TOTAL LOAD
- ❖ TYPICAL DAILY PROFILE
  - ❖ SPREADSHEET USES SEASONAL HISTORICAL DATA:
    - ❖ LOADS
    - ❖ TEMPERATURES
    - ❖ HUMIDITY
  - ❖ USING THIS HISTORICAL DATA AND THE FORECASTED WEATHER, THE SPREADSHEET CALCULATES THE INSTANTANEOUS LOAD AT 7 - KEY TIMES:
    - ❖ 12 AM
    - ❖ 4 AM
    - ❖ 7 AM (8:00 AM ON WEEKENDS/HOLIDAYS)
    - ❖ 12 PM
    - ❖ 4 PM
    - ❖ 8 PM
    - ❖ 12 AM NEXT DAY

## **DAILY LOAD PROFILE CURVES CONTINUED:**

- ❖ PROGRAM CALCULATES THE LOADS IN BETWEEN THE KEY TIMES TO PRODUCE THE GREEN CURVE
  - ❖ RED CURVE – PK LOAD PROFILE TO DATE
  - ❖ RED VERTICAL VALUES ARE PEAK HOURLY LOADS TO DATE
  - ❖ BLACK CURVE – ACTUAL PEAK LOADS CURRENT DAY
  - ❖ GRAY CURVE – UPDATE FORECAST LOAD PROFILE CURRENT DAY
  - ❖ BLACK VERTICAL VALUES ARE HOURLY PEAK ENERGY VALUES AND THE BLACK VALUES UNDER THE GRAY CURVE ARE UPDATED HOURLY PROJECTIONS
  - ❖ PURPLE CURVE – FORECASTED PEAK DAY CURVE FOR THE MONTH
- ❖ WEATHER FORECASTS CHANGE AND RESULTING LOAD PROJECTIONS CHANGE. WE MUST MONITOR CHANGING CONDITIONS AND ACTUAL LOADS TO BE READY TO RUN GENERATORS WHEN CALLED FOR**
- ❖ TYPICAL SUMMER PEAK DAY CHART
  - ❖ TYPICAL WINTER PEAK DAY CHART
  - ❖ TYPICAL SPRING PEAK DAY CHART
  - ❖ TYPICAL FALL PEAK DAY CHART



Figure 4-2  
Typical Winter Load Profile

- PK LD TO DATE - 5147 - 01/02/18 HE 8:00 AM
- PK LD LAST YEAR - 5012 - 1/09/17 HE 8 AM
- PREVIOUS PEAK - 4807 - 1/19/16 HE 8 AM
- PREVIOUS PEAK - 4827 - 1/19/16 HE 8 AM
- PREVIOUS PEAK - 4827 - 1/29/15 HE 8 AM
- Projected Monthly Peak: 01/02/18
- Original Daily Forecast
- Today's Actuals
- Today's Updated Projected Load Profile
- Key Hr 5-min Load
- Trigger Ld 4993

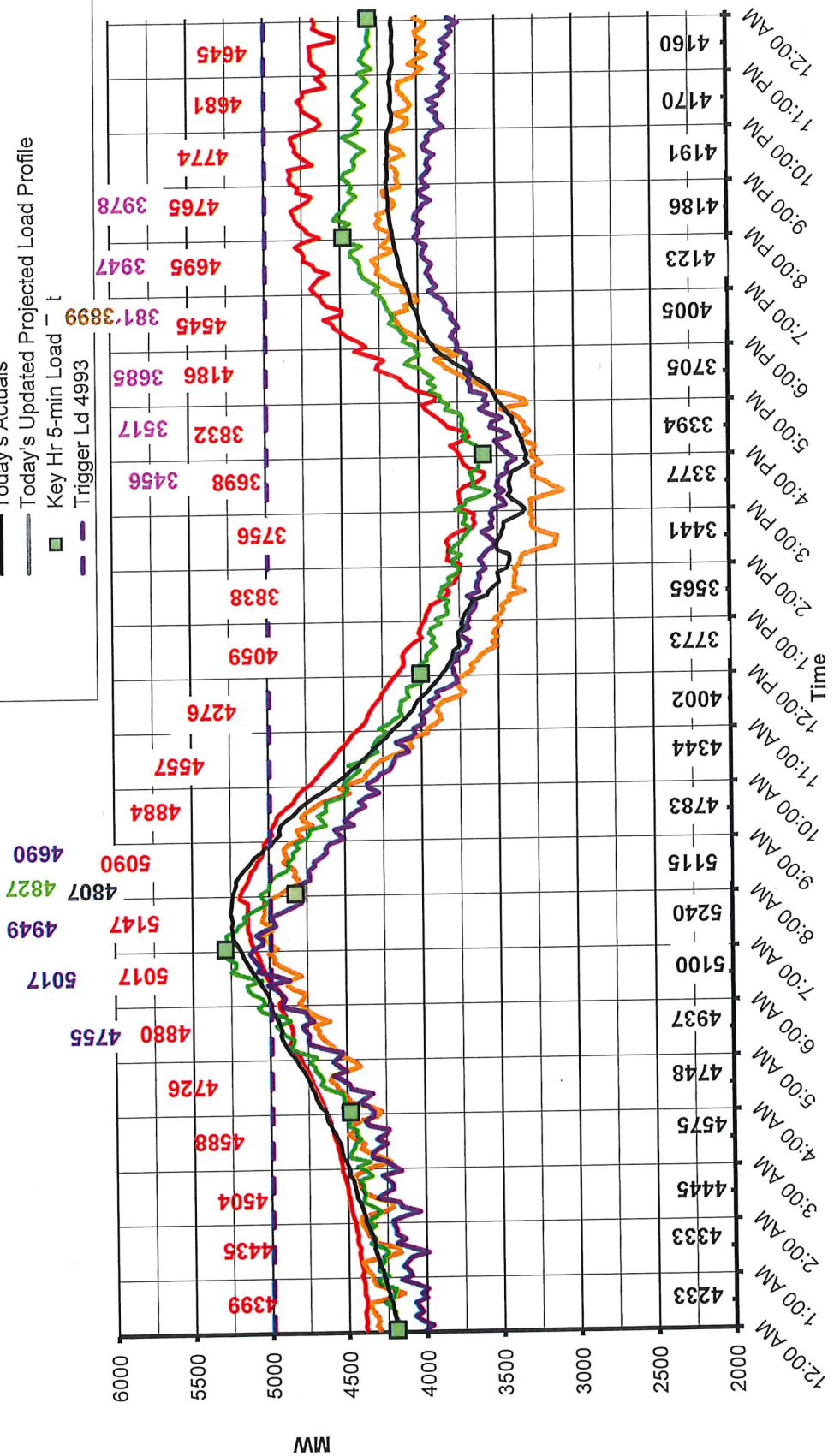




Figure 4-4  
Typical Spring Load Profile

- PK LD TO DATE - 3051 - 04/11/18 HE 8:00 AM
- PK LD LAST YEAR - 3555 - 04/28/17 HE 5 PM
- PREVIOUS PEAK - 3441 - 04/29/16 HE 5 PM
- PREVIOUS PEAK - 3530 - 04/09/15 HE 6 PM
- Projected Monthly Peak: 04/06/18
- Original Daily Forecast
- Today's Actuals
- Today's Updated Projected Load Profile
- Key Hr 5-min Load Est
- Trigger Ld 3020

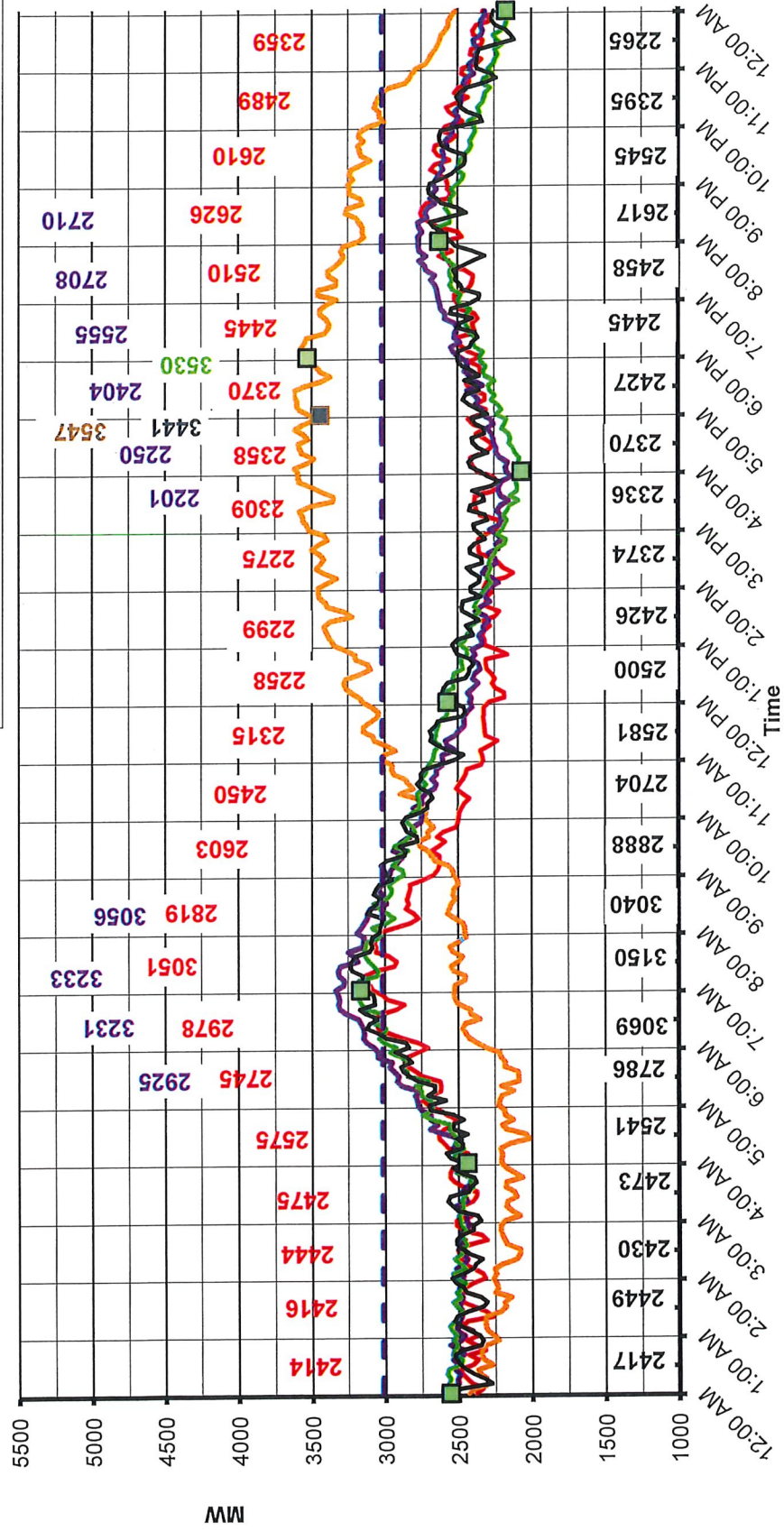
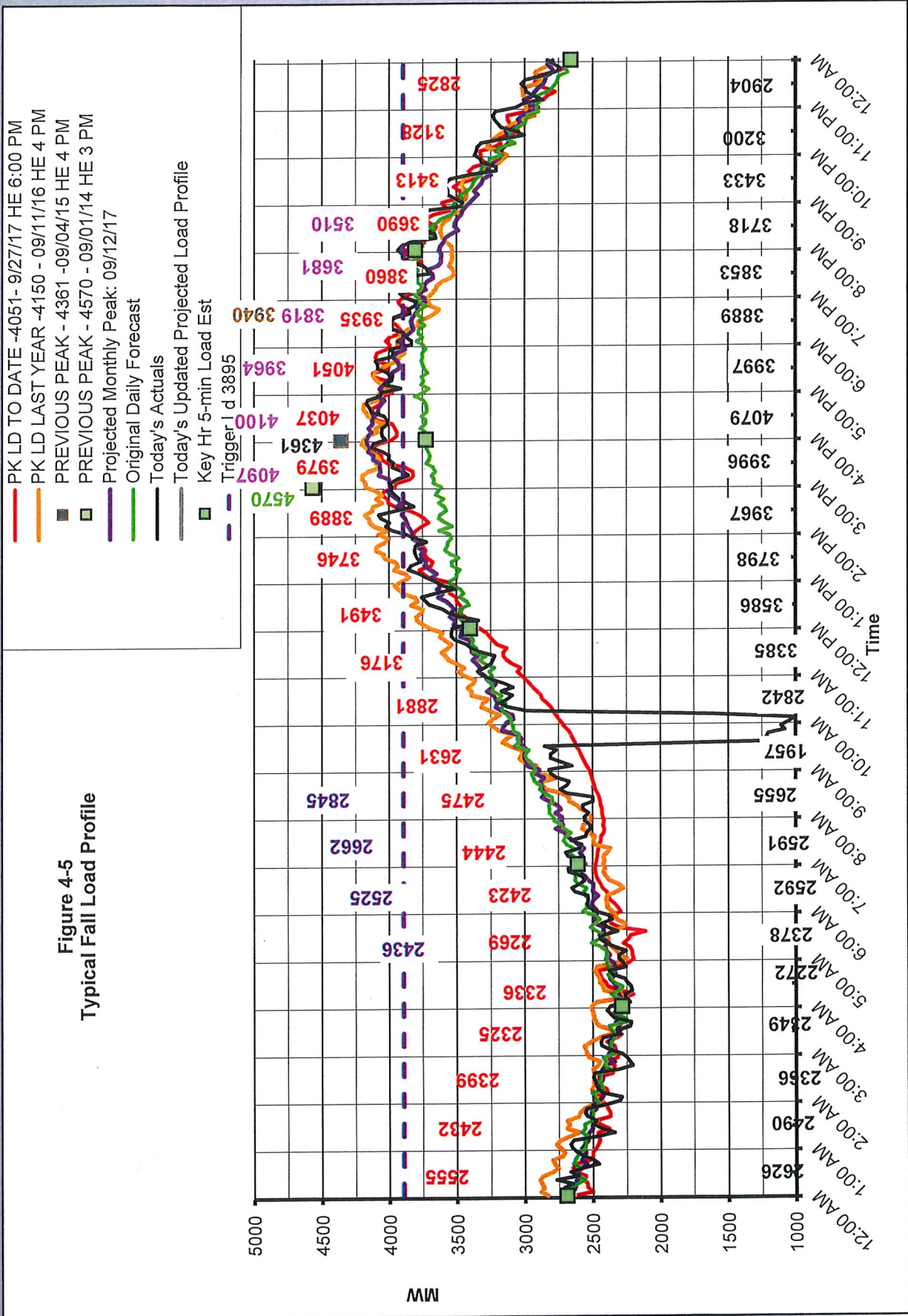


Figure 4-5  
Typical Fall Load Profile



## **TYPICAL OPERATING HOURS:**

❖ YEAR 2016 – 203 HOURS

❖ YEAR 2017 – 208 HOURS

❖ YEAR 2018 THROUGH MAY 31 – 47 HOURS

## **THREE SITE LOCATION OPTIONS:**

### **1. GEORGETOWN SUBSTATION**

- ❖ **BEST LOCATION FROM A LOAD FLOW STANDPOINT**
- ❖ **CONCERNS ABOUT POTENTIAL NOISE COMPLAINTS**
- ❖ **THIS SITE WOULD NOT PROVIDE BACKUP POWER FOR THE WWTP**

### **2. WATER TREATMENT PLANT**

- ❖ **AVAILABLE PROPERTY FOR FUTURE EXPANSION LIMITED**

### **3. WASTE WATER TREATMENT PLANT**

- ❖ **OFFERED SUFFICIENT PROPERTY FOR EXPANSION**
- ❖ **PLANT ON THIS SITE COULD BE DESIGNED TO PROVIDE AUTOMATIC STANDBY FOR THE WWTP DURING PRIMARY SYSTEM OUTAGES**
- ❖ **PLANT COULD BE DESIGNED TO PROVIDE LONG-TERM EMERGENCY SERVICE FOR SOME GEORGETOWN LOADS REMOTE FROM THE SITE**

**THE WASTE WATER SITE WAS SELECTED**

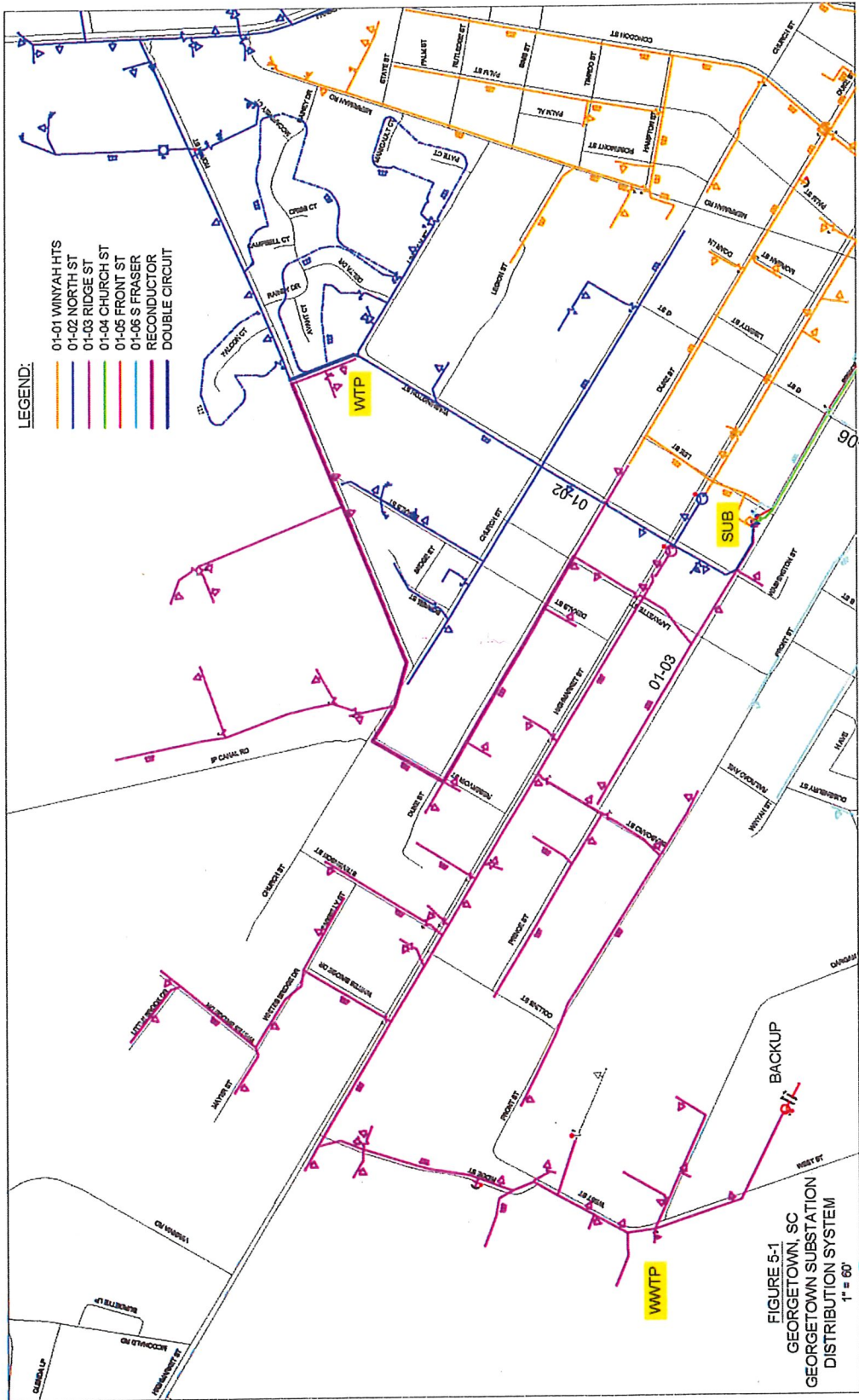


FIGURE 5-1  
 GEORGETOWN, SC  
 GEORGETOWN SUBSTATION  
 DISTRIBUTION SYSTEM  
 1" = 60'





## **FUNCTIONAL ONE-LINE AND SITE PLAN:**

- ❖ **FIGURE 6-1 IS THE ONE-LINE**
- ❖ **DESIGN INCLUDES TWO KIRK KEY INTERLOCKED GANG OPERATED SWITCHES**
  - ❖ **NORMALLY, POWER FLOW IS FROM THE RIDGE STREET CIRCUIT, THROUGH CIRCUIT BREAKER 52 L, TO THE PLANT SUBSTATION, THEN ALONG THE UNDERBUILD-CIRCUIT TO THE PLANT LOADS**
  - ❖ **CIRCUIT BREAKER 52 P IS NORMALLY CLOSED, ENERGYZING THE GSU CONTINUOUSLY**
  - ❖ **THE GSU IS SOLIDLY GROUNDED ON THE WYE SIDE, AND DELTA ON THE 4.16 KV SIDE, THEREFORE THE GSU IS A GROUND SOURCE**



## **SEQUENCE OF OPERATIONS:**

- ❖ **KIRK KEY SWITCHES IN THE POSITION SHOWN IN FIGURE 6-1**
- ❖ **CIRCUIT BREAKER 52 L AND 52 P CLOSED**
- ❖ **LOAD MANAGEMENT MODE**
  - ❖ GENERATORS REMOTELY STARTED THROUGH SCADA OR CELL PHONES
  - ❖ GENERATORS SYNCHRONIZE ACROSS THE 4.16 KV GENERATOR BREAKERS
  - ❖ SHOULD A 12.47 KV FAULT OCCUR WHILE OPERATING IN PARALLE:
    - ❖ GEORGETOWN SUBSTATION RECLOSER WILL OPEN
    - ❖ CIRCUIT BREAKER 52 L WILL OPEN, DISCONNECTING THE GENERATORS FROM THE UTILITY SYSTEM, AND GENERATORS WILL PICKUP THE WWTP LOADS
  - ❖ WHEN NORMAL SERVICE IS RESTORED:
    - ❖ PLANT WILL SYNCHRONIZE ACROSS 52 L
    - ❖ PLANT WILL OPERATE IN THE PARALLEL MODE UNTIL SHUT-DOWN
- ❖ **AUTOMATIC STANDBY MODE**
  - ❖ LOSS OF NORMAL UTILITY POWER
    - ❖ AFTER TIME DELAY, BREAKER 52 L OPENS
    - ❖ GENERATORS START
    - ❖ THE FIRST GENERATOR BREAKER CLOSES TO THE 4.16 KV BUS
    - ❖ THE SECOND GENERATOR BREAKER SYNCHRONIZES AND CLOSES TO THE 4.16 KV BUS, PICKING UP AND SHARING THE LOAD

## **SEQUENCE OF OPERATIONS CONTINUED:**

- ❖ WHEN NORMAL POWER IS RESTORED, PLANT WILL SYNCHRONIZE ACROSS CIRCUIT BREAKER 52 L
- ❖ GENERATORS WILL GO THROUGH NORMAL SHUT DOWN
- ❖ **ISOLATED STANDBY MODE**
  - ❖ GEORGETOWN DECIDES TO OPERATE IN ISOLATED STANDBY MODE
  - ❖ GEORGETOWN WILL INITIALTE REMOTELY VIA SCADA OR LOCALLY
  - ❖ GENERATORS WILL START
  - ❖ GENERATORS WILL SYNCHRONIZE ACROSS THE GENERATOR BREAKERS
  - ❖ GENERATORS WILL INCREASE LOAD TO EQUAL THE PLANT LOAD
  - ❖ CIRCUIT BREAKER 52 L WILL OPEN
  - ❖ PLANT WILL REMAIN IN THIS MODE UNTIL CHANGED BY GEORGETOWN

## **❖ EMERGENCY MODE**

- ❖ EMERGENCY MODE IS FOR THE UNUSUAL CONDITION OF MAJOR GEORGETOWN OUTAGES, SUCH AS A HURRICANE
  - ❖ THE RIDGE STREET FEEDER, AND OTHER LOADS TO BE SERVED, WILL BE ISOLATED FROM THE GEORGETOWN SUBSTATION BY USING A KIRK KEY
  - ❖ THE KIRK KEY WILL BE RETRIEVED AND INSERTED INTO THE EMERGENCY SWITCH OF THE PLANT SWITCHGEAR
  - ❖ THE GENERATORS WILL BE MANUALLY STARTED
  - ❖ CIRCUIT BREAKERS WILL BE MANUALLY CLOSED TO ENERGY THE 12.47 KV FEEDER AND SELECTED GEORGETOWN LOADS
- ❖ WHEN UTILITY POWER IS RESTORED FROM THE GEORGETOWN SUBSTATION:
  - ❖ Plant EMERGENCY OPERATIONS WILL BE MANUALLY STOPPED
  - ❖ THE KIRK KEY WILL BE REMOVED FROM THE SWITCHGEAR AND USED TO CLOSE THE SWITCH IN THE DISTRIBUTION SYSTEM
  - ❖ NORMAL SERVICE WILL BE RESTORED



CONSTRUCTION PROGRESS  
PHOTOGRAPHS



Prior to 8/2017

Aerial view shortly before construction started



10/08/2017

**Bank extension, rip rap, and sub-grade are complete**



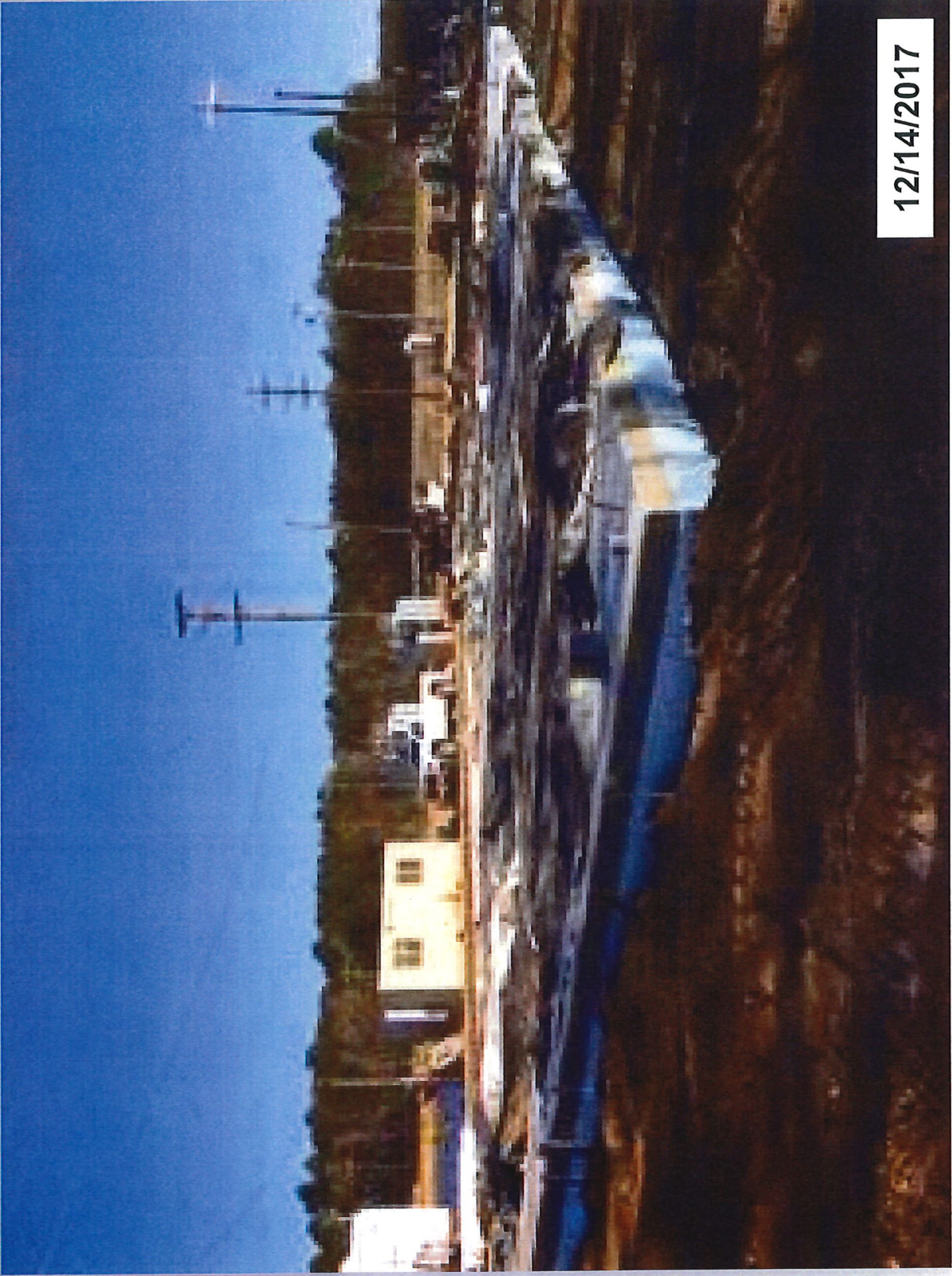
Formation of pad with the conduit system being installed





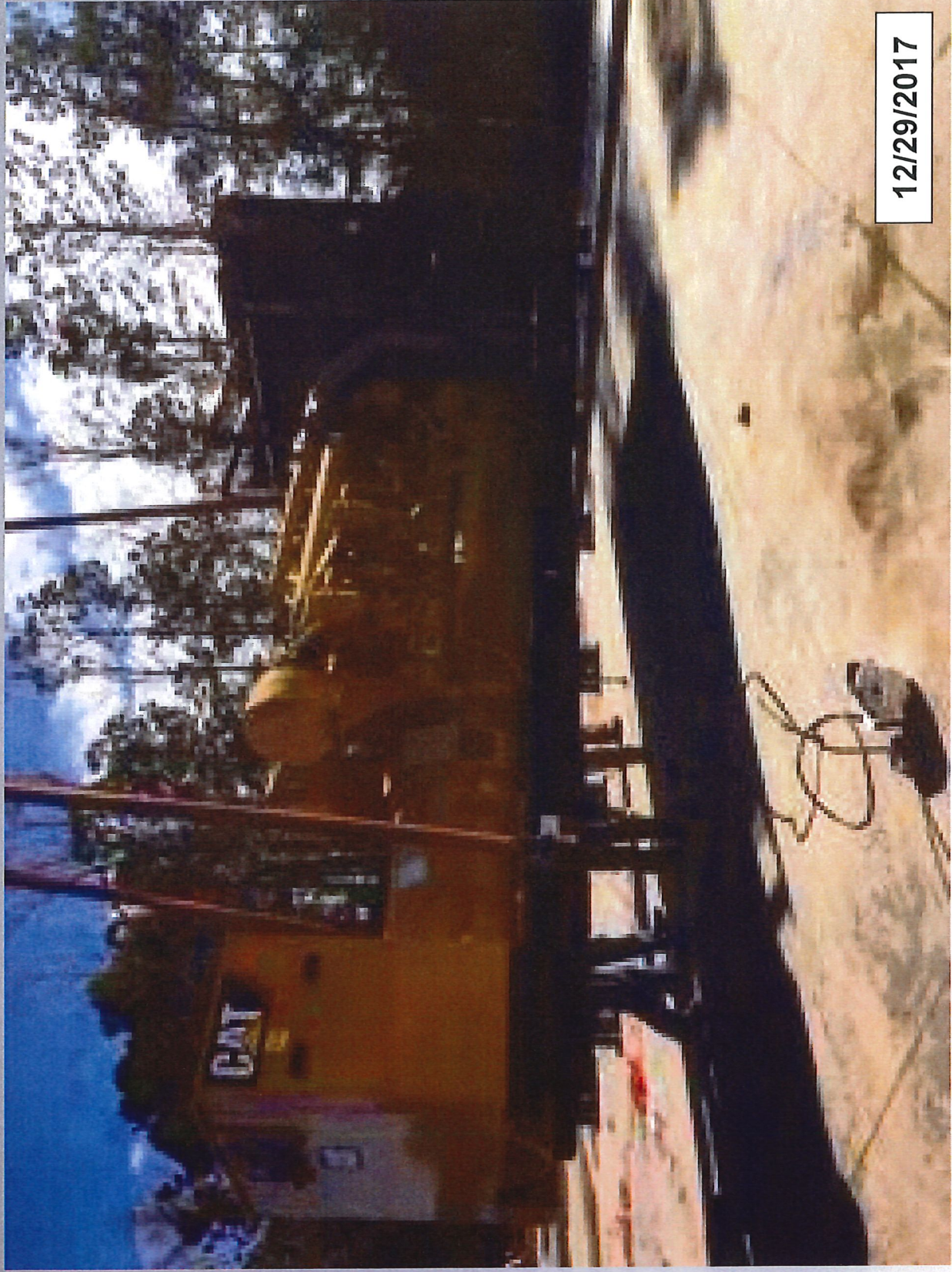
11/08/2017

Formation of pad with the conduit system being installed

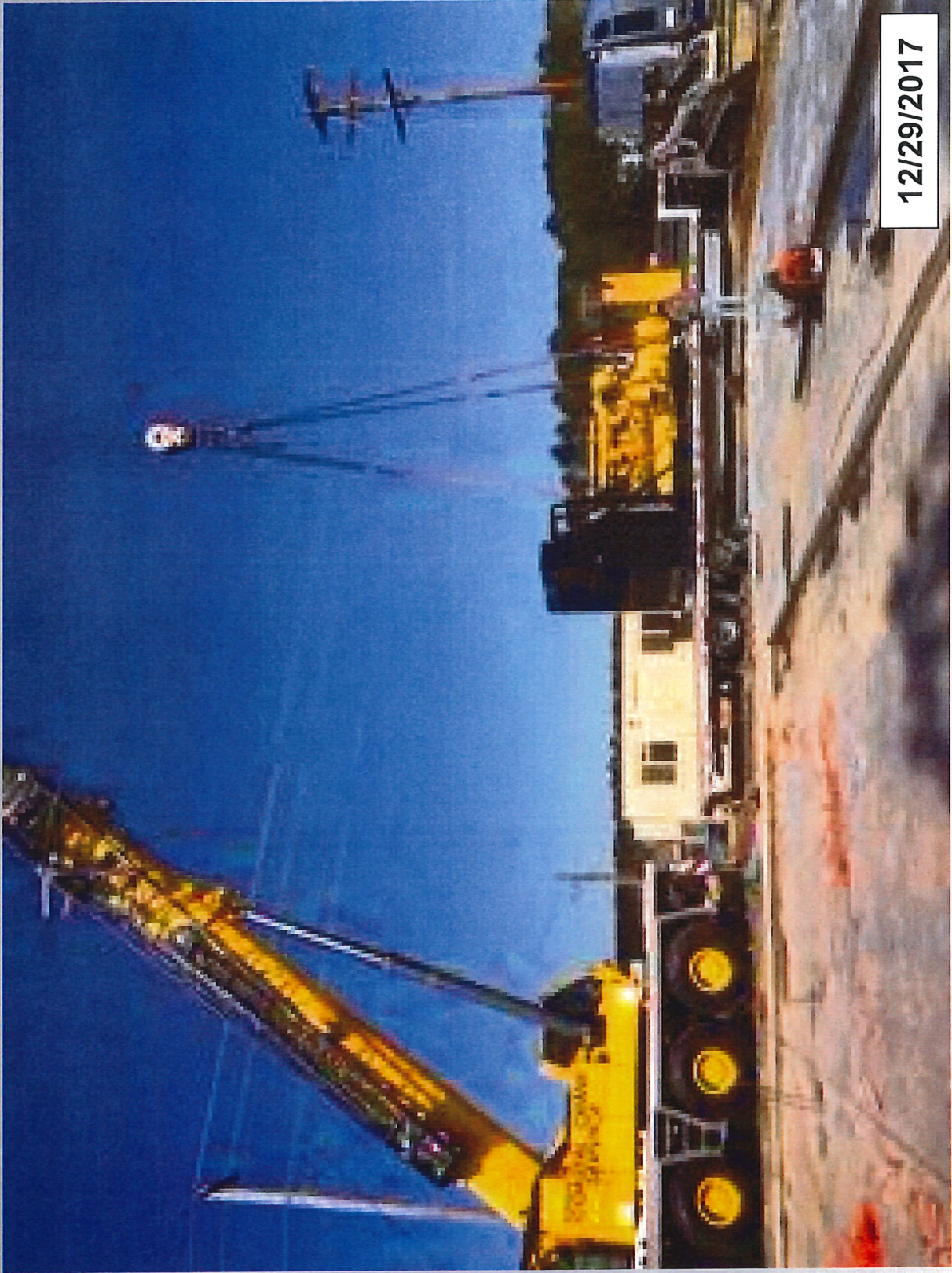


12/14/2017

Approximately 1 week after pad was poured

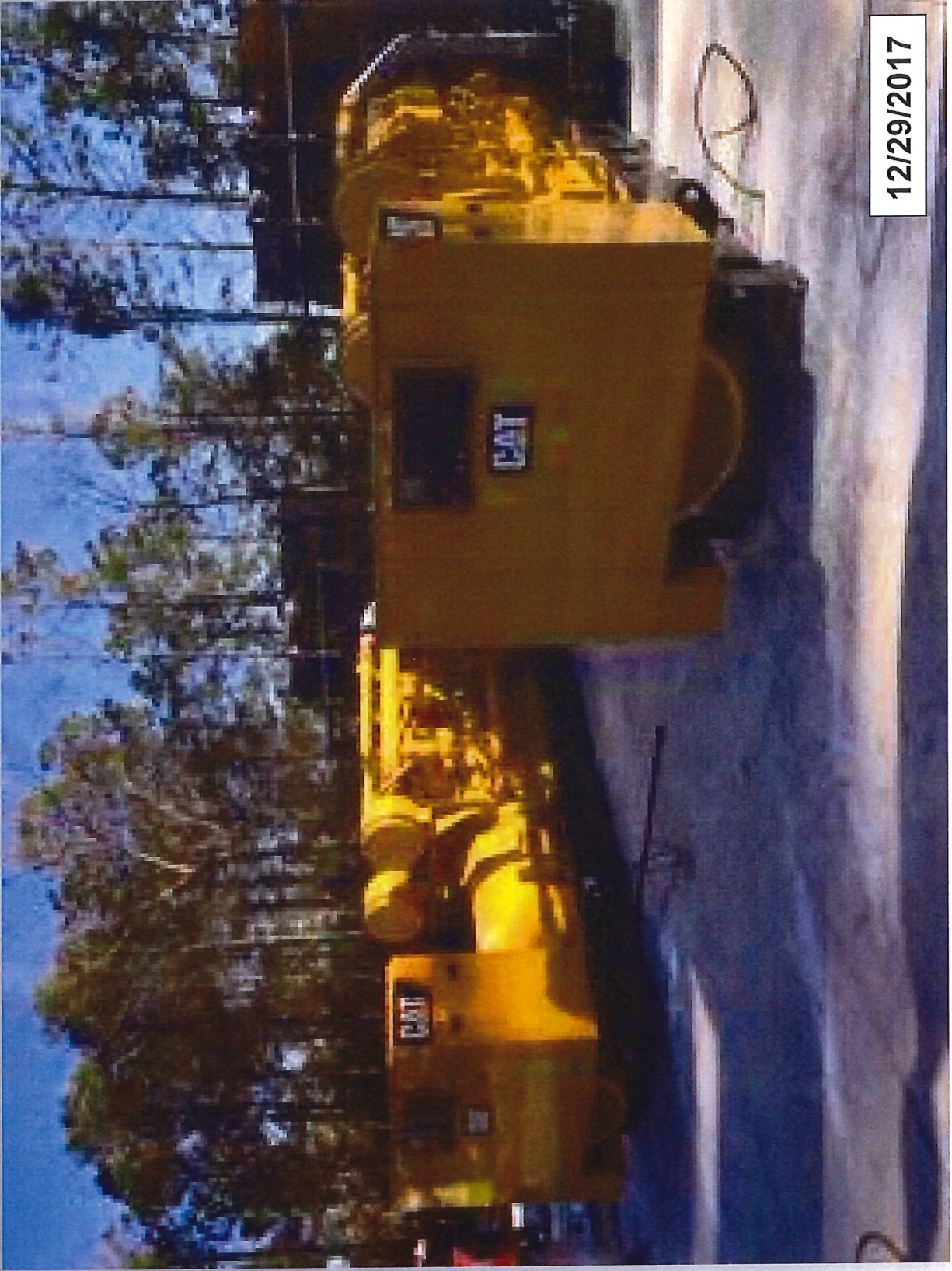


Delivery of Gensets



Delivery of Gussets

12/29/2017



12/29/2017

Delivery of Gensets, placement complete



01/02/2018

Gensets covered with tarps, erection of building begins, 12,000 gallon fuel tank is placed in right portion of photo



Placement of clean emissions module just prior to putting roof on building



First CEM in place





01/23/2018

Placement of GSU transformer and spare



02/22/2018

Under roof, framed and sheet-rocked

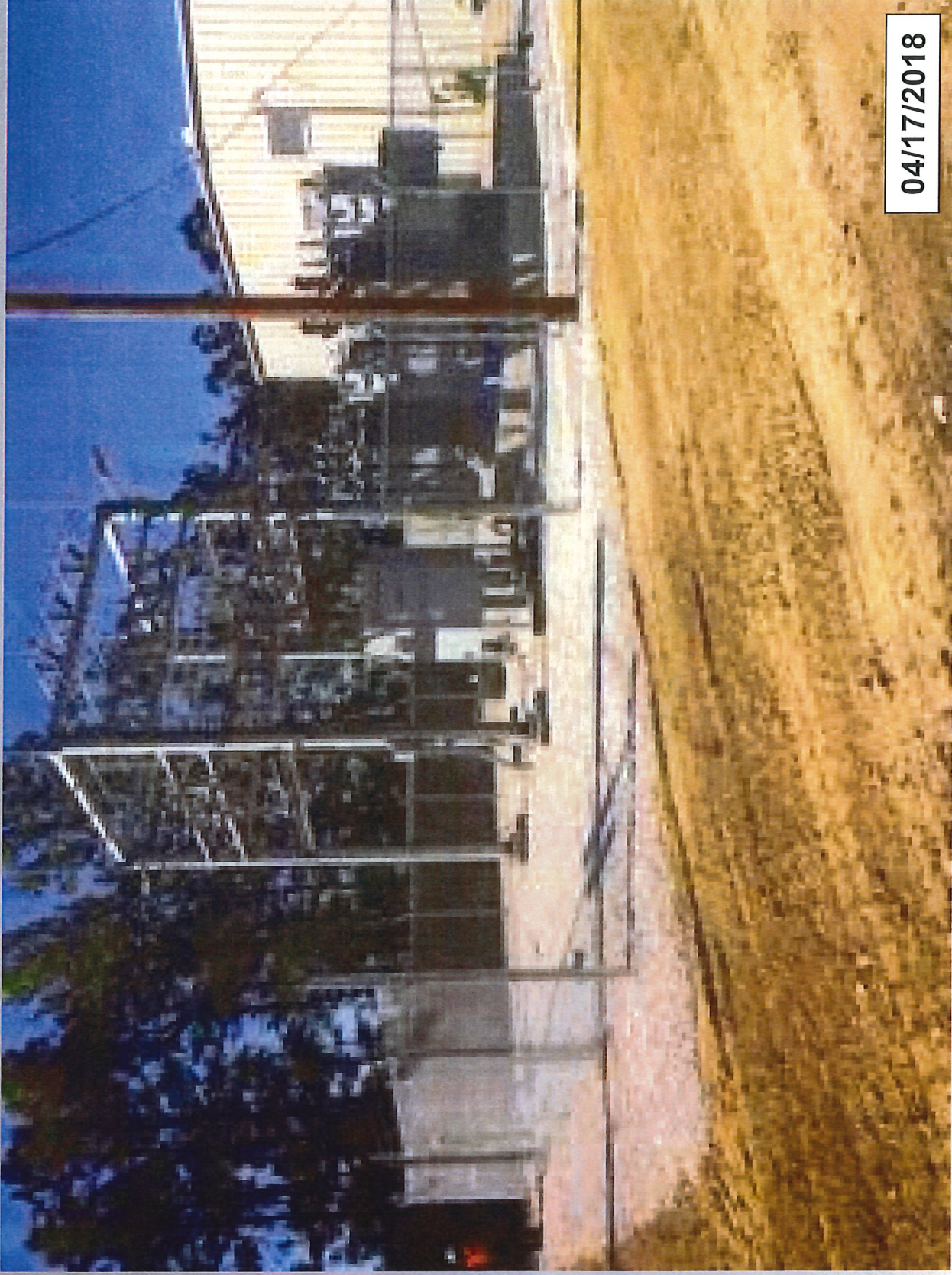


Control and switchgear as it sat in Thompson Electric Shop in Vancouver during factory acceptance testing witnessed by Georgetown, UTEC and Blanchard Staff



03/13/2018

Delivery and placement of control and switchgear

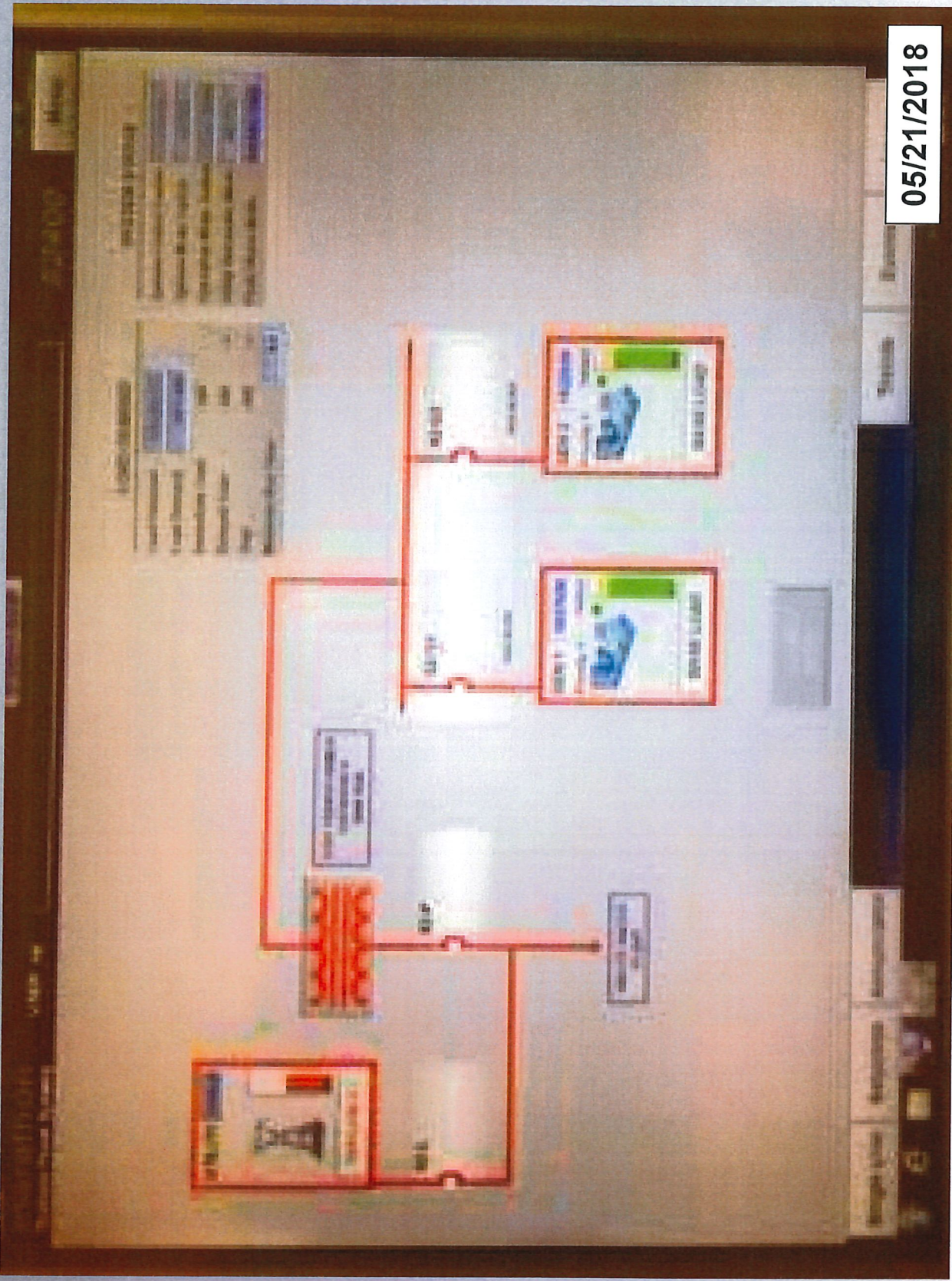


**Substation finished and fenced. Breakers required for switching to provide automatic emergency backup for waste water treatment plant**



05/31/2018

Inside View



05/21/2018

HMI display – One-Line shows both units running at full load for first time



06/04/2018

Insulation placed around muffler/exhaust





05/31/2018

Aerial View from East



# QUESTIONS/ANSWERS