# ATHENA POWER Detroit Edison Sensor Pilot Data Analysis 2023 (First Half)

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# Data Analysis 2023

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# Sensor Daily Count / Collection







Day of Collection Time January 1, 2023 to June .

1)

2)

# **Data Analysis**

- All UFD Sensors provided rich data counts with minimal gaps in data generation and acquisition
- DTE 1 maintained a flat trendline with reasonable variations in Frequency
- DTE 4, 5, and 6 had trending up & down Frequency









The plots of count of DTE 1.csv and average of Frequency(Hz) for Collection Time Day. The data is filtered on Collection Time, which ranges from 1/6/2023 12:00:00 AM to 6/29/2023 11:53:12 PM. The view is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023.

### Data Analysis

DTE 1 maintained a flat trend-1) line with reasonable variations in Frequency







The plots of count of DTE 4.csv and average of Frequency(Hz) for Collection Time Day. The data is filtered on Collection Time (DTE 1) Day, which ranges from January 1, 2023 to June 29, 2023.

### DTE4 Hourly



## **Data Analysis**

- DTE 4 is displaying a downward trend in Frequency
- ) Further assessment is suggested for this issue



### DTE5 Hourly



The plots of count of DTE 5.csv and average of Frequency(Hz) for Collection Time Day. The data is filtered on Collection Time (DTE 1) Day, which ranges from January 1, 2023 to June 29, 2023.

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# **Data Analysis**

- DTE 5 is displaying a 1) downward trend in Frequency
- Further assessment is 2) suggested for this issue







The plots of count of DTE 6.csv and average of Frequency(Hz) for Collection Time Day. The data is filtered on Collection Time (DTE 1) Day, which ranges from January 1, 2023 to June 29, 2023.







### DTE4 Current

DTE6 Current



Day of Collection Time January 1, 2023 to June .



# Feb 1 May 1 Jul 1 Mar 1 Jun 1 Apr 1 Hour of Collection Time [2023]

# **Data Analysis**

- 1) DTE 1 showed large drop in Current on Feb 10<sup>th</sup> (possible tap change) and several times in January
- 2) DTE 1 showed Large spike in Current on March 12<sup>th</sup>
- 3) DTE 4 showed large spike on Jan 21st









DTE1 Current



The trends of average of A, average of B and average of C for Collection Time Hour. The data is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023.

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# **Data Analysis**

- DTE 1 showed large 1) drop in Current on Feb 10<sup>th</sup> (possible tap change) and several times in January
  - DTE 1 showed Large spike in Current on March 12<sup>th</sup>

2)









The trends of average of A (DTE 4), average of B (DTE 4) and average of C (DTE 4) for Collection Time Hour. The data is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023.

### 600 8 WAY WWW WWW 500 400 Avg. A 300 200 100 0 600 8 WAMMAN MAN 500 400 **Avg. B** 300 200 100 0 600 500 400 Avg. C 200 100 0 Jan 11 Jan 21 Jan 31 Feb 10 Feb 20 Mar 2 Mar 12 Mar 22 Apr 1 Jan 1

The trends of average of A (DTE 5), average of B (DTE 5) and average of C (DTE 5) for Collection Time Hour. The data is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023.

### DTE5 Current





The trends of average of A (DTE 6), average of B (DTE 6) and average of C (DTE 6) for Collection Time Hour. The data is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023.

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# Deita Current (Phase Imbalance)

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### DTE1 Delta

### DTE5 Delta



### DTE4 Delta





January 1, 2023 to June . الموديات الترجيات تثار 1) Jul 1 Feb 1 Apr 1 May 1 Jun 1 Mar 1 2) Hour of Collection Time [2023] 3) h h<sup>ul</sup>f ei <sub>bana</sub> Feb 1 Mar 1 Apr 1 May 1 Jun 1 Jul 1 Hour of Collection Time [2023]

# **Data Analysis**

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Day of Collection Time

- DTE 1 showing significant Phase Imbalance in February and large Imbalance on March 13<sup>th</sup>
- DTE 4 and 5 show constant Phase Imbalances throughout the year
- Absolute Value of additional load shown on top chart. Bottom chart allows for cancellations

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### DTE1 Delta



The plots of average of abs(A-B-C) and average of A-B -C for Collection Time Hour. The data is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023. The view is filtered on Collection Time Hour, which includes everything.

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# Data Analysis

DTE 1 showing significant Phase Imbalance in February and large Imbalance on March 13<sup>th</sup>



### DTE4 Delta



The plots of average of abs(A-B-C) (DTE 4) and average of A-B-C (DTE 4) for Collection Time Hour. The data is filtered on Collection Time Day, which ranges from January 1, 2023 to June 29, 2023.



## <u>Data Analysis</u>

DTE 4 shows constant Phase Imbalances throughout the year

### DTE5 Delta



The plots of average of abs(A-B-C) and average of A-B-C for Collection Time Hour. The data is filtered on Collection Time (DTE 1) Day, which ranges from January 1, 2023 to June 29, 2023.



## **Data Analysis**

DTE 5 shows constant 1) Phase Imbalances throughout the year

### DTE6 Delta



The plots of average of abs(A-B-C) (DTE 6) and average of A-B-C (DTE 6) for Collection Time Hour. The data is filtered on Collection Time (DTE 1) Day, which ranges from January 1, 2023 to June 29, 2023.

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# Preliminary Findings

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# Major Findings from Sensor Readings - 2023

All UFD Sensors provided rich data counts with minimal gaps in data generation and acquisition throughout 2023

**Importance Hierarchy:** 

- **Frequency Changes** 1)
  - Very abnormal changes trending up and down (DTE 4 & 5)
  - This is likely a grid-side issue and not from the customer-side

# 2) Large Imbalances of Current

- DTE 5 & 6 constantly had large Phase Imbalances

Additional Suggestions: Being able to read Power Factor would be helpful in further analysis. Voltage monitoring/sensors would be required to do this.

Large black-outs have been associated with such drifts in Frequency

Several days of large Imbalances with Current on DTE 1 with large spikes in Current



# Accitional Information

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Detroit Edison (DTE) and Athena Power deployed UFD sensors throughout downtown Detroit. The sensors were primarily deployed on Netbanks and Switchgear to monitor and detect faults.

The sensors were custom developed for DTE and were primarily oriented for fault detection. The sensors are three-phase oriented with power harvesting technology and direct DNP3 output. Cellular connectivity (utilizing the Sierra Wireless RV 50) were equipped on each Athena UFD Sensor. Custom Antennas and cables were developed for the netbank asset class to demonstrate strong connectivity and uptime

The majority of the sensors were deployed in 2021 and 2022. The sensor management system from Athena, known as Aegis, was used to manage the sensor. Aegis was also used to manage the data and analyze trends and report the data findings



Charges supercapacito Runs system if super Submersible w/water tid High Temp Polyca Magnet or Anchor Mou Supports CT's, Rogow Coils, and other standard ensors (Senso



Fault Detection Algorithm

- Fourier Engine High Accuracy Metrology (.5%) Ultra Low-Power Operation (.36 Watts
- DNP3 Direct Output Designed for Reliability (Low Chi
- Allows for Single-Phase and Th
- Phase designs Supports customized inputs wi
- Voltage & Current Multiple orientation and form
- Supports Rogowski's and othe
- Industry Standard Sensor





Detroit Edison (DTE) and Athena Power deployed (7) UFD sensors throughout downtown Detroit. Below are photos of the installations that took place in 2021 and Q1 2022



Three-phase Current + Neutral was installed on netbanks throughout downtown Detroit. Secondary Power was used to power the unit



Switchgear Installation Athena sensors were also installed on switchgear at the Detroit Institute of Art. The sensors were utilizing power harvesting technology

# **DTE Deployment Photos**



Netbank Installation at John R and Broadway

# **DTE Pilot Settings**

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Analytics Management Map	/iew Reporti	Configure Device DT	E1–NB755–Shelby-John-R	×		X				×	<b>−</b> J	¢ (	
Search Q +	Details	Phase A Threshold:	1000										
DTE1–NB755–Shelby-John-R	Device In	Phase B Threshold:	1000										
DTE2	Nome	Phase C Threshold:	1000				Soft						
DTE3							2.7.1	ware ve	rsion				
DTE4–NB822–Broadway-John-R	DNP3 ID	Cycles:	2				Coll	ection l	nterval				
DTE5–NB741–Woodward-Grand-River	256	Fault Timeout(ms):	40000				600						
DTE6-NB757-Griswold-Grand-River	Data Rea		Enable Low Threshold		Last	Read:Thu	Jan 26 202	3 11:46:	42 GMT-	0500 (Ea	stern Sta	indard Tim	ie)
DTE7–NB748–Shelby-Grand-River		Current A Low:	50										
	A P	Current B Low:		Flo	od Status	Status Communication Status							
	Readings			n Cor	figuration		A	Phase	в	Phase	CF	hase	
	RMS CURF	Current C Low:	50	s)			10	00	10	00	100	0	
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	Phase Ang						40	000					
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	Reactive P		Canture Waveform on Faults	ue Siz	ze		5						
	Active Pow			Amps	s) 		50		50		50		
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	Device Opt	<b>3 9</b>		ys			3						
	Current Ele	Auto Range Percent:	200	rcent			20	0					

Average Device Uptime: 13,686 Hours / 228 Days



# **Monitoring Highlights**

### Resolution

- Resolution capture of 1200Hz and 20 samples • per cycle
- Scanning/Intervals at every 15min
- Three Phase Current-Only Monitoring

### **Fault Detection Settings**

- High Current threshold set at 1000amps
- 2 Cycles
- Low Current threshold at 50 amps

### Communications

- 4G Verizon Cellular
- Sierra Wireless RV 50/55 low power radio

### **Additional Information**

- Netbanks powered through secondary power
- Switchgear powered through power-harvesting

