

Transformer Loading

Driving Enterprise Decisions with ArcGIS Online

Agenda



- ∅ Introductions
- ∅ Business Drivers
- ∅ Business Challenges
- ∅ Solution Overview
 - ∅ *Establish Relationships*
 - ∅ *Data Aggregation*
 - ∅ *Reporting & Visualization*
- ∅ Demo
- ∅ Business Benefits



Introductions



Nathaniel Everett | Middle Tennessee EMC

- GIS Technical Lead
- Covers ArcGIS / ArcFM / Designer
- Information Services Department

Skye Perry | SSP Innovations

- Principal Consultant
- Esri & Schneider Electric Technical Architect
- Utility-Focused ArcGIS Online Specialty Partner
- Began work with MTEMC in 2013



Business Drivers



Transformer Failures Occur Regularly

- Ø Troubleshooter assesses transformer in the field
- Ø Transformers are replaced
- Ø Often up-sized to handle an overloaded scenario
(25 kVA to 37.5 kVA)
- Ø Data is not available to see consumption / loading information



Ø *Result à*

- § Inefficiencies in Network
- § Cost Impact



Business Drivers



Engineering Asked For Help

- Ø Desire to utilize consumption data to determine transformer sizing
- Ø Provided an Example Report that would help
- Ø Provided all Engineering Calculations

Summer/Winter Transformer Loading Report Example (Winter: kW = kWh/360) (Summer: kW = kWh/380)								
Company #	Transformer Size	Device Location #	Total Usage (kwh)	Total Usage (kW)	Total Usage (kVA)	Power Factor (Kw ÷ kVA)	% Loaded (kW ÷ Size)	
98779	75		6075	16.9			22.5	
		6000215021	2820	7.3	na	na		
		6000216632	1660	4.6	na	na		
		6000208062	895	1.9	na	na		
		6000200754	1100	3.1	na	na		
97625	225		17564	55.8			24.8	
		6000197963	4648	14.8	na	na		
		6000205718	4151	16.5	na	na		
		6000200822	6314	17.5	na	na		
		6000202821	377	1.0	na	na		
		6000196358	2874	6.0	na	na		
VUG17 Transformer Loading Report Example - Winter Months (kW = kWh/360)								
Company #	Transformer Size	Device Location #	Total Usage (kwh)	Total Usage (kW)	Total Usage (kVA)	Power Factor (Kw ÷ kVA)	Customer Name	% Loaded (kW ÷ Size)
98779	75		6075	16.9				22.5
		6000215021	2820	7.3	na	na	Customer 1	
		6000216632	1660	4.6	na	na	Customer 2	
		6000208062	895	1.9	na	na	Customer 3	
		6000200754	1100	3.1	na	na	Customer 4	

Business Challenges



- ∅ No DB relationship between Service Location & Transformer
 - ∅ Network Traceable Relationship in GIS
- ∅ SAP CIS Consumption Data Not Available in GIS
 - ∅ Current Monthly Reads, Use with AMI in the Future
- ∅ How Best to Expose Reports & Map to users



The Solution

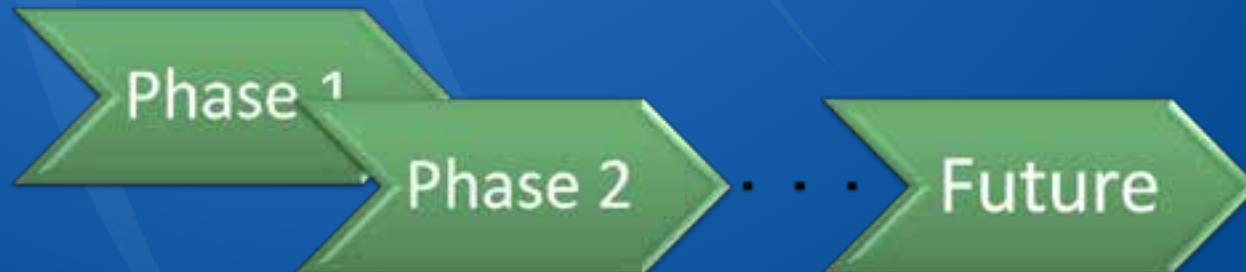


Engaged with SSP Innovations to Design and Develop

Ø *SSP is the in house Esri / Schneider Electric support vendor*

SSP & MTEMC Broke the Effort into Three Phases:

1. Establish Maintainable Relationships from Xfr to Service
2. CIS Consumption Load & Aggregation
3. Reporting & Visualization



Phase 1 – Xfr to Service



- ∅ Schema changes on Service Point
 - ∅ Track Xfr Company Number *By Phase*
- ∅ Initial script to establish relationships
 - ∅ Trace via Electric Network
 - ∅ SQL Script to Not Impact Versioning Performance
- ∅ AutoUpdaters to maintain relationship



ArcFM Attribute Editor		
Selection	Design	QA/QC
Service Point		
128198		
OBJECTID	128198	
Work Function	Null	
JOB_NUMBER	Null	
Subtype	Service Point	
ACTIVE	Null	
Key Account	Null	
CT_PT_INDICATOR	None	
Guarantee Of Supply	Null	
COMMENTS	Null	
Phase Designation	A	
Energized Status	Energized	
Feeder ID	SMY234	
Feeder ID 2	Null	
Feeder Information	1	
Electric Trace Weight	1610614032	
Shape	Shape	
Symbol Rotation	Null	
Last User	bdud4169	
Date Modified	10/16/2009	
Creation User	Null	
Date Created	Null	
Date Installed	Null	
Work Request ID	Null	
Design ID	Null	
Work Location ID	Null	
Work Flow Status	Null	
Work Order ID	Null	
LAT	35.96931	
LONG	-86.55425	
Location ID	Null	
Company Number A	77595	
Company Number B	Null	
Company Number C	Null	

Phase 1 – *Byproduct*



Data QAQC of Energized Phases & Connectivity

- ∅ **NoXfrFnd** – Indicates that no energized power is being fed from a valid transformer bank
- ∅ **MultSrcXfr** – Indicates that multiple transformer banks were found upstream of the service point

Location ID	<Null>
Company Number A	NoXfrFnd
Company Number B	<Null>
Company Number C	<Null>
GlobalID	{04F4A2CC-AA7D

Company Number A	MultSrcXfr
Company Number B	<Null>
Company Number C	<Null>
GlobalID	{0D5F0A6D-29D8

Phase 2 – CIS Data Usage



Chose *SSP Nightly Batch Suite* for Fast Batch Apps

```
<!-- network file shares to read and write -->
<add key="networkConfig" value="C:\Temp\Ba
<add key="networkLog" value="C:\Temp\Batch

<!-- license types to be used by the batch -->
<add key="esriLicense" value="ArcInfo"/>
<!-- ArcInfo, ArcEditor, ArcView -->

<!-- automated email information -->
<add key="mailList-Error" value="skye.perr

foreach (object o in =_batchApps)
{
    ApplicationDefinition def = (Applic
    if (RunThisApp(def))
    {
        if (def.Assembly.Length > 0 &&
        {
            IBatchApplication batchApp
```

∅ Series of three integration applications

1. Load the raw CIS consumption data into GIS

§ *Applied Engineering Calculations*

2. Aggregate max consumption to Transformer Unit (by phase)

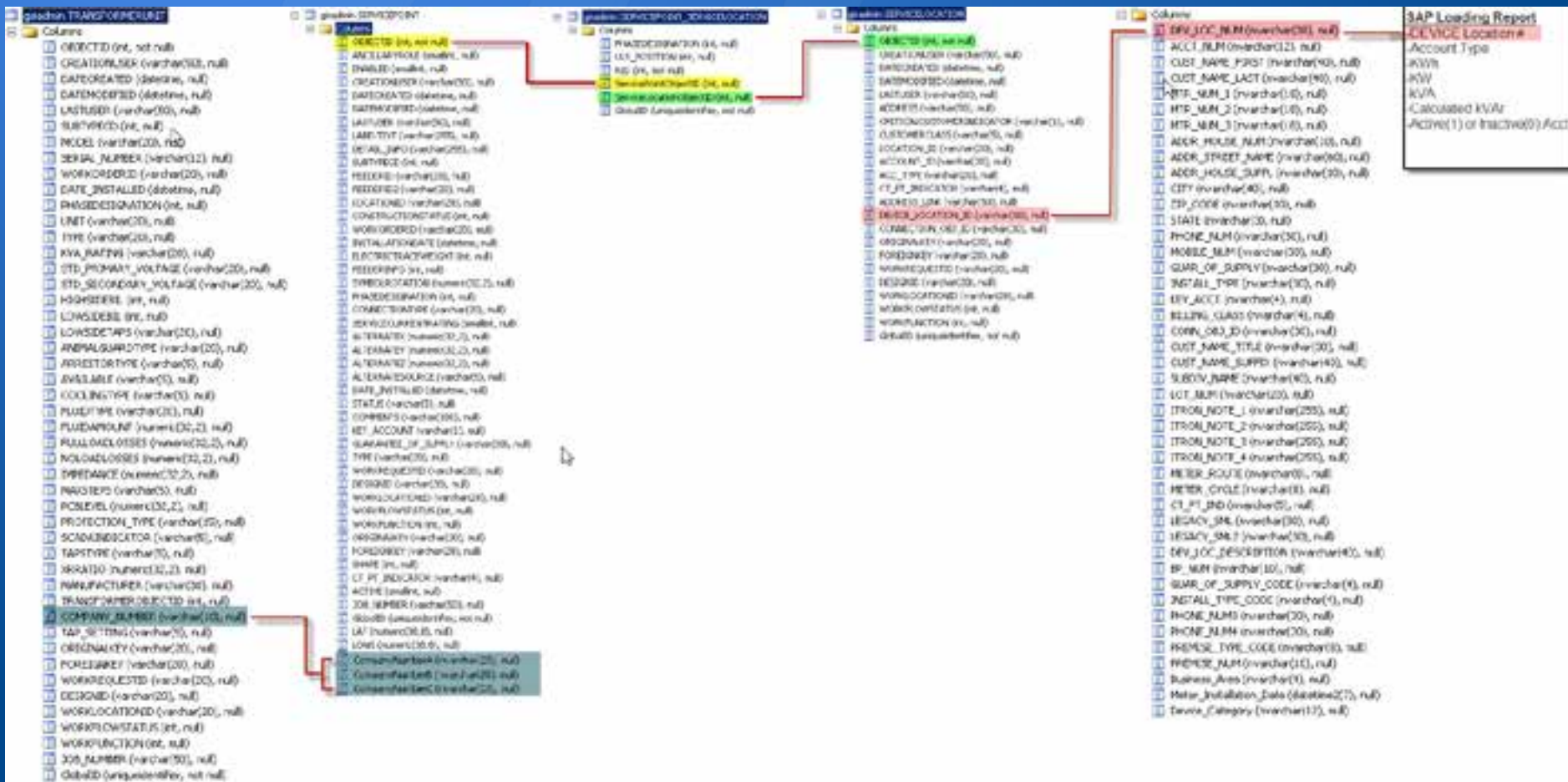
§ *By Month & Season*

3. Create Summary Feature Points for Each Xfr Asset

Phase 2 – CIS Aggregation



Run on weekends to exclude production impact



Phase 2 – CIS Aggregation



Single Phase Aggregation

6000159792: LoadDivider=1, AdjustedKw=4.36
Raw Meter Load Data
6000159792
SAP_TransformerLoadData
75863 - 2013 Summer: 47.36%
6000159824: LoadDivider=1, AdjustedKw=4.5
6000159950: LoadDivider=1, AdjustedKw=4.62
6000159958: LoadDivider=1, AdjustedKw=4.28
TransformerUnit
37.5 KVA/OH

OBJECTID	145579
DeviceLocation	6000159792
AccountType	RS
MeterReadDate	7/1/2013
Kwh	1659
Kw	4.36
KVA	(Null)
CalculatedKVAR	(Null)
Active	1
PowerFactor	(Null)
GISLoadDate	4/9/2014 7:56:56 PM

Transformer Unit
37.5 KVA/OH
SAP Load Data
75863 - 2013 Summer: 47.36%
Adjusted Meter Loads
6000159792: LoadDivider=1, AdjustedKw=4.36
6000159824: LoadDivider=1, AdjustedKw=4.5
6000159950: LoadDivider=1, AdjustedKw=4.62
6000159958: LoadDivider=1, AdjustedKw=4.28

ArcFM Attribute Editor
Selection Design QA/QC
Transformer
OH Single Phase
Assembly
Light Billing Info
MTEMC_GIS.GISADMIN.Transformer_CoNumberKvaText
OHStructure
Substation
Transformer Unit
37.5 KVA/OH
SAP Load Data
75863 - 2013 Summer: 47.36%
Adjusted Meter Loads
6000159792: LoadDivider=1, AdjustedKw=4.36
6000159824: LoadDivider=1, AdjustedKw=4.5
6000159950: LoadDivider=1, AdjustedKw=4.62
6000159958: LoadDivider=1, AdjustedKw=4.28

OBJECTID	79163
LabelText	75863 - 2013 Summer: 47.36%
ComponentNumber	75863
PercentLoaded	47.36
KW	17.76
KVA_Rating	37.5 = 17.76 / 37.5 = 47.36% Loaded
Kwh	6755
KVA	0
PowerFactor	(Null)
Season	Summer
Year	2013
GISLoadDate	4/18/2014 2:47:07 PM
MUS17	No

Phase 2 – CIS Aggregation



Three Phase Aggregation

6000105979 LoadDivider=3, AdjustedKW=28.8

- Raw Meter Load Data
 - 6000105979
 - SAP_TransformerLoadData

OBJECTID	96845
DeviceLocation	6000105979
AccountType	LP
MeterReadDate	7/1/2013
KWh	10200
KW	86.4
KVA	Null
CalculatedKVAR	Null
Active	1
PowerFactor	Null
GISLoadDate	4/9/2014 7:43:20 PM

86.4 / 3 (Loaded Divider) = 28.8

Transformer

- OH Three Phase
 - Assembly
 - Light Billing Info
 - MTEMC_GIS.GISADMIN.Transformer_CoNumberKvaText
 - OHStructure
 - Substation
 - Transformer Unit
 - 50 kVA/OH
 - SAP Load Data
 - 57017 - 2013 Summer: 57.6%
 - Adjusted Meter Loads
 - 6000105979 LoadDivider=3, AdjustedKW=28.8
 - TransformerUnit
 - XNLoadPoint
 - 57017 - 2013 Winter: 52.53%

OBJECTID	46192
LabelText	57017 - 2013 Summer: 57.6%
ComponentNumber	57017
PercentLoaded	57.6
KW	28.8
KVA_Rating	50
KWh	3400
KVA	0
PowerFactor	Null
Season	Summer
Year	2013
GISLoadDate	4/18/2014 12:46:00 PM
VU617	No

28.8 / 50 = 57.6% Loaded

Transformer Unit

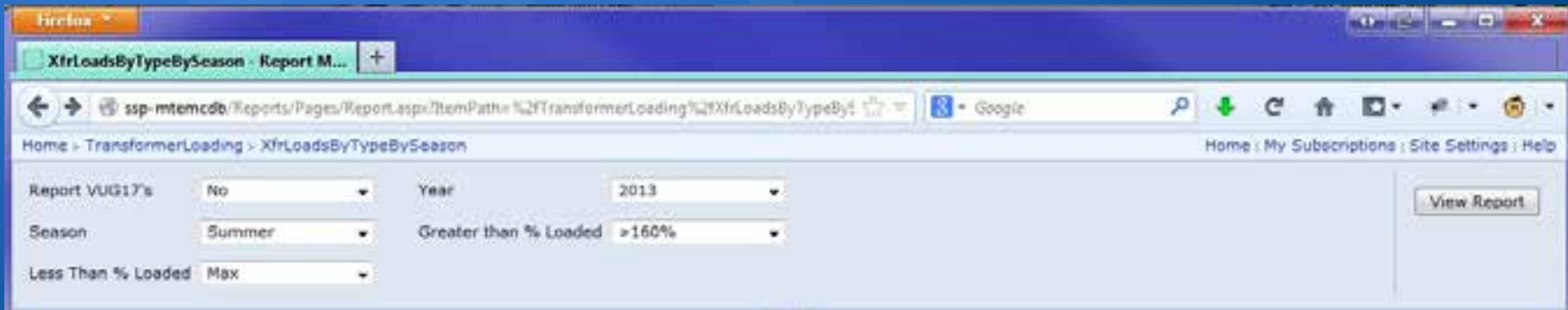
- 50 kVA/OH
 - SAP Load Data
 - 57017 - 2013 Summer: 57.6%
 - Adjusted Meter Loads
 - 6000105979 LoadDivider=3, AdjustedKW=28.8
 - TransformerUnit
 - XNLoadPoint
 - 57017 - 2013 Winter: 52.53%
 - Transformer
 - 50 kVA/OH
 - SAP Load Data
 - 57016 - 2013 Summer: 57.6%
 - Adjusted Meter Loads
 - 6000105979 LoadDivider=3, AdjustedKW=28.8
 - TransformerUnit
 - XNLoadPoint
 - 57016 - 2013 Winter: 52.53%

Phase 3 – Reporting



Utilized SQL Server Reporting Services

- ∅ Out of the Box Web Reports
- ∅ Provided Query Screen to Engineers:



Phase 3 – Reporting



Three Level Report – *Level 1 Shows Transformer Unit*

Transformer Loading Report

Company #	Transformer Size	Total Usage (kwh)	Total Usage (kW)	Total Usage (KVA)	Power Factor	% Loaded
75290	25.00	15,210.00	40.01	NA	NA	160.04%
92912	50.00	7,840.00	80.13	NA	NA	160.27%
92873	50.00	7,840.00	80.13	NA	NA	160.27%
92914	50.00	7,840.00	80.13	NA	NA	160.27%
F4746	10.00	3,788.00	16.08	NA	NA	160.77%
F4743	10.00	3,788.00	16.08	NA	NA	160.77%
F4757	10.00	3,788.00	16.08	NA	NA	160.77%
53417	15.00	9,200.00	24.21	NA	NA	161.40%
36959	10.00	4,351.33	16.27	NA	NA	162.67%
36949	10.00	4,351.33	16.27	NA	NA	162.67%
104726	37.50	23,219.00	61.05	NA	NA	162.80%
F4799	15.00	9,428.00	24.77	NA	NA	165.13%
109104	15.00	9,435.00	24.82	NA	NA	165.47%
94951	25.00	15,744.00	41.41	NA	NA	165.64%

Phase 3 – Reporting



Three Level Report –
Level 2 Shows Adjusted Meter Consumption

The screenshot shows a web browser window with the following content:

- Browser: Firefox
- Page Title: XfrDetail - Report Manager
- Address Bar: ssp-mtemcdb/Rzports/Pages/Report.aspx?ItemPath=%2FTransformerLoading%2FXfrDetail&ExecId=stlglc
- Page Content: Standard Transformer Loading Detail, Company #:75290
- Summary Table:

Season	Company #	Xfr Size	Total Usage (kwh)	Total Usage (kW)	Total Usage (kVA)	Power Factor	% Loaded
2013 - Summer	75290	25.00	15,210.00	40.01	NA	NA	160.04%

Device Location	Load Divider	Adjusted (kwh)	Adjusted (kW)	Adjusted (kVA)	Power Factor	Customer Name
6000012524	1	3,021.00	7.95	NA	NA	SPRINT PCS
6000012610	1	7,907.00	20.80	NA	NA	VERIZON WIRELESS
6000012651	1	4,082.00	10.74	NA	NA	CINGULAR WIRELESS
6000185378	1	200.00	0.52	NA	NA	GLOBAL SIGNAL

Phase 3 – Reporting



Three Level Report –

Level 3 Shows Raw Meter Data from SAP

The screenshot shows a web browser window with the following content:

Browser: Firefox
Tab: MeterLoadDetail - Report Manager
Address Bar: ssp-mtemcdb/Reports/Pages/Report.aspx?ItemPath=%2FTransformerLoading%2FMeterLoadDetail%5BEx...
Page Title: Home > TransformerLoading > MeterLoadDetail
Page Content: **Raw SAP Data for 6000218674**

Adjusted Read:

Device Location	Load Divider	Adjusted (kwh)	Adjusted (kW)	Adjusted (kVA)	Power Factor	Customer Name
6000218674	3	4,687.00	12.33	NA	NA	CONSUMER TRACTOR

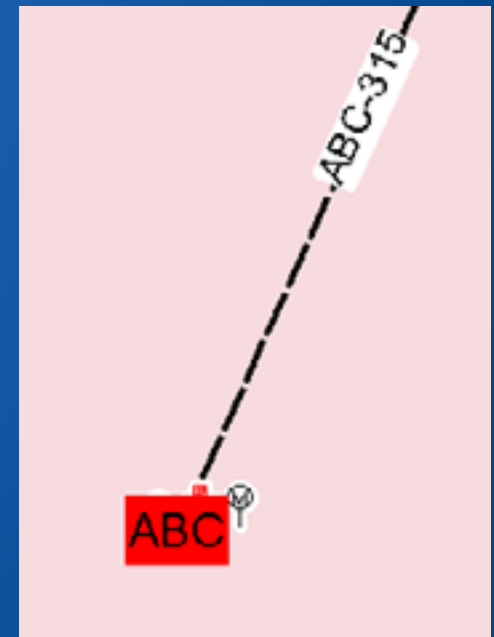
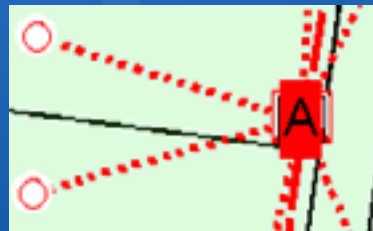
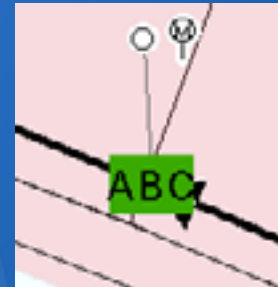
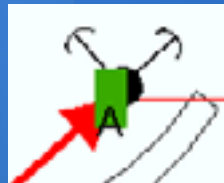
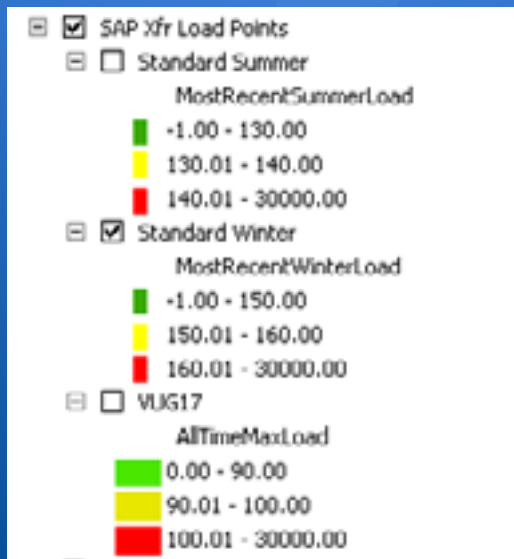
Raw SAP Data:

Device Location	Account Typ	kwh	kW	kVA	Power Factor	Calculated KVAR	Read Date
6000218674	LP	14,061.00	37.00	NA	NA	NA	7/1/2013

Phase 3 – Visualization



Utilized ArcGIS Online –
Created Thematic Map Showing Xfr Load vs. Capacity



Phase 3 – Visualization



- ∅ Exposed via **ArcGIS Online** as a WebMap
- ∅ Troubleshooter uses their phone or tablet when they arrive on scene
- ∅ Zoom via GPS in the device
- ∅ View transformer loading data by color
- ∅ Click any transformer to view details

Live Demo...



Phase 3 – Visualization



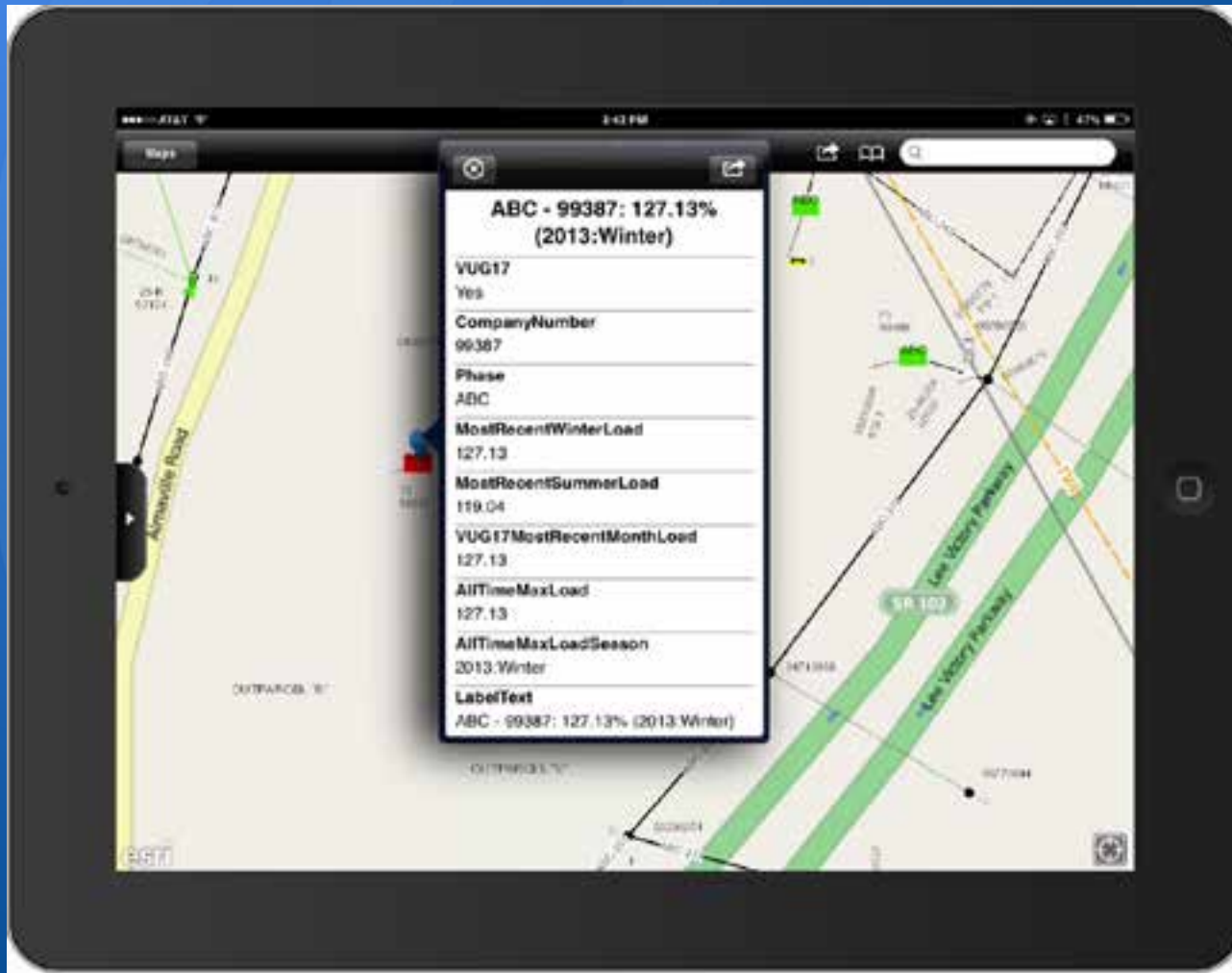
Transformer showing under-loaded scenario:



Phase 3 – Visualization



Transformer showing overloaded scenario:



Business Benefits



Operations

- ∅ Empowered Engineers & Troubleshooters with New Data
- ∅ Provided Real Time Data Access in field from **ANY Device**
 - ∅ Allows for educated decision making
- ∅ Engineering Can Review Existing Xfr Installs Against Usage
 - ∅ May reallocate network
- ∅ **Net Result is Cost Savings, Better Efficiency, & System Awareness**

Business Benefits



IT / GIS

- ∅ Demonstrated capabilities of ArcGIS Online
 - ∅ Have fully functioning DMZ / internal ArcGIS Server architecture
 - ∅ Ready for additional data publishing, editing, and collection via ArcGIS Online
 - ∅ Includes Active Directory Authentication and SSL (https)
- ∅ ***Will Allow for Other Patterns to be Implemented***
 - ∅ ***Quickly & Easily***

Nathaniel Everett

GIS Technical Lead

Middle Tennessee EMC

nathaniel.everett@mtemc.com

Skye Perry

Principal Consultant

SSP Innovations

skye.perry@sspinnovations.com

Questions?

Transformer Loading

Driving Enterprise Decisions with ArcGIS Online