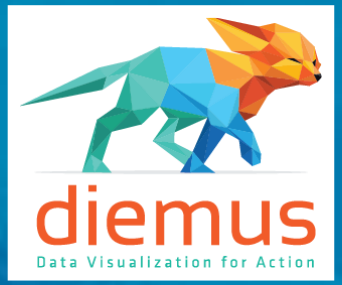
Providing Enterprise Level Visibility for Snowflakes Using PI and AF

David Rodriguez and Lonnie A. Bowling



David Rodriguez
Analytics & Intelligence Engineer
EDF Renewables

Lonnie A. Bowling
Data Interaction Expert
Diemus, Inc

EDF Renewables - North America

Provides Grid-Scale Power, Distributed Solutions, and Asset Optimization

16 GW of renewable energy installed

24 GW planned or in construction

Problem

- Substations status was only visible from SCADA level system
- No backup to this system
- Required higher-level of access and to physically be on-prem
- No remote access to overall substation status
- Missing substation information prevented getting an overall picture of the health of a wind project at any given time.

So, what's a substation anyway?

- Equipment that collects all wind turbine electricity, and connects it to the grid
- Steps up and regulates voltage
- Protects turbines from surges

Requirements

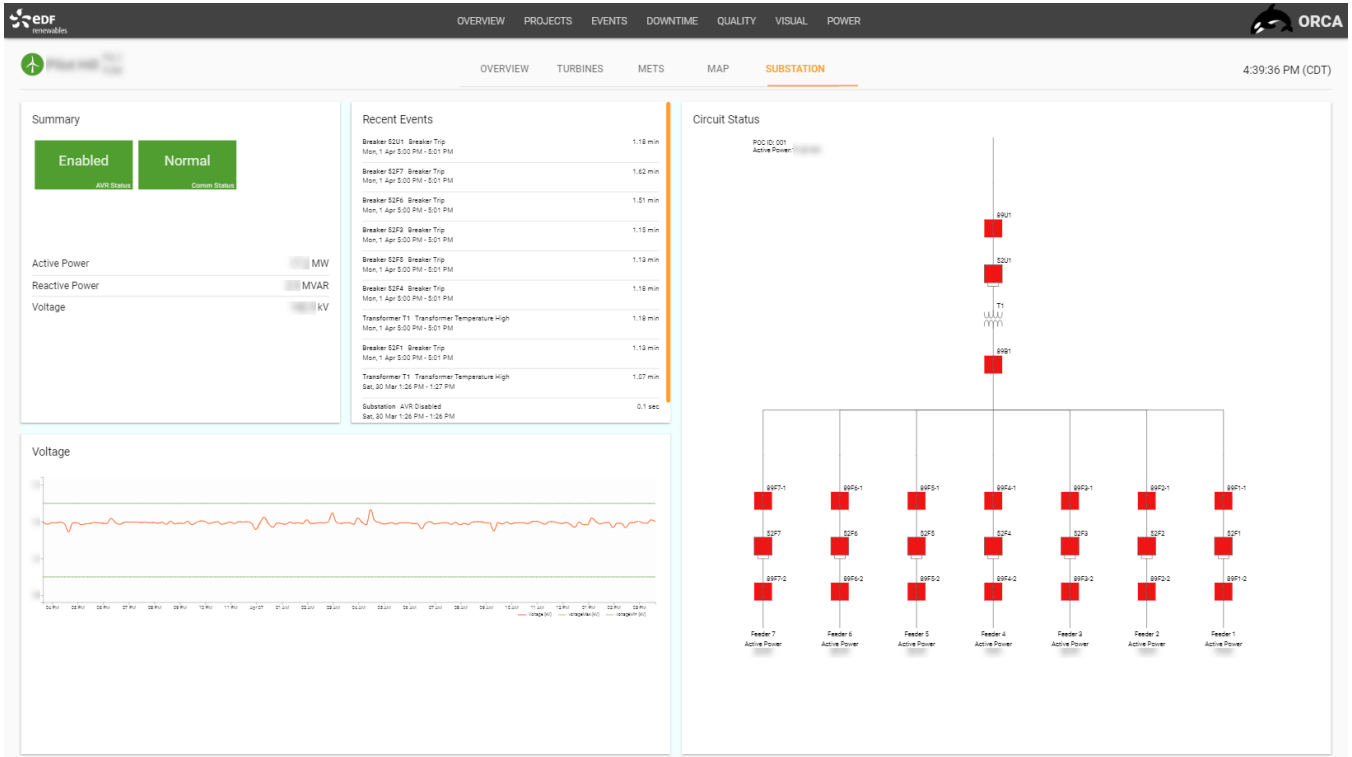
POI Voltage

AVR Status

Breaker Trips

Data Quality

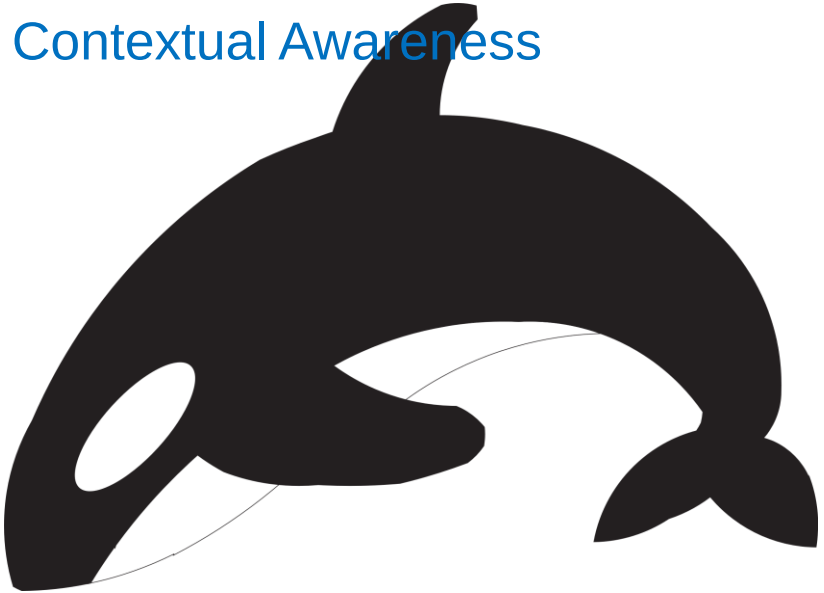
Circuit Visualization



ORCA Platform

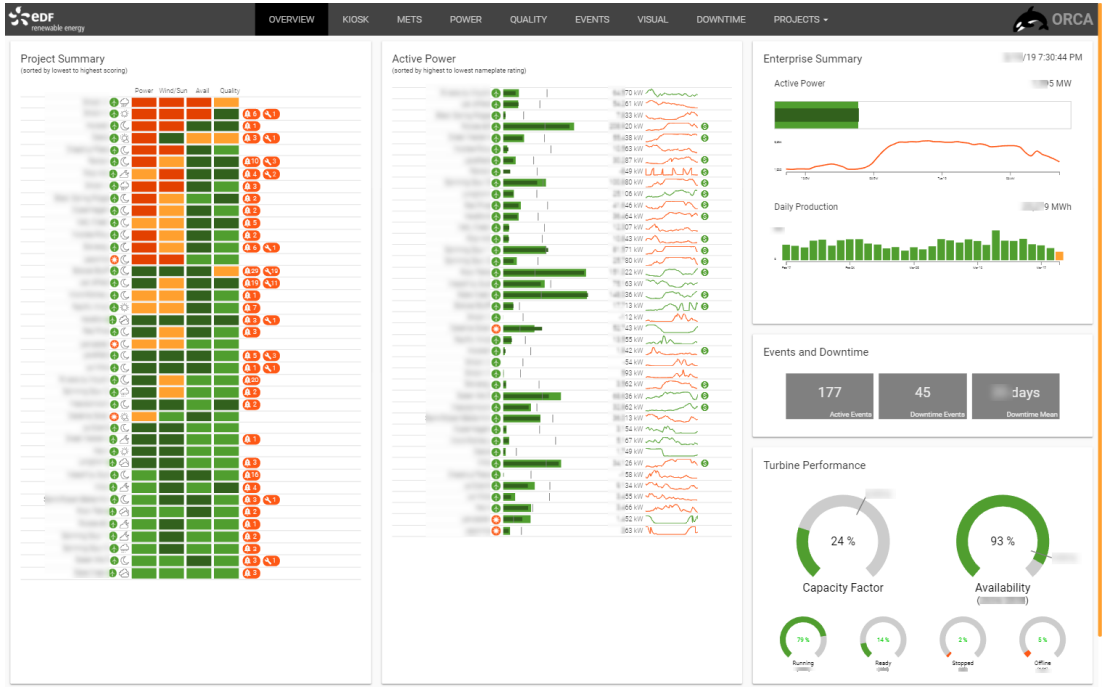
Operational Readiness and Contextual Awareness

Real-time
Normalized AF structure
Visualization rich
Details at all levels
Access for everyone

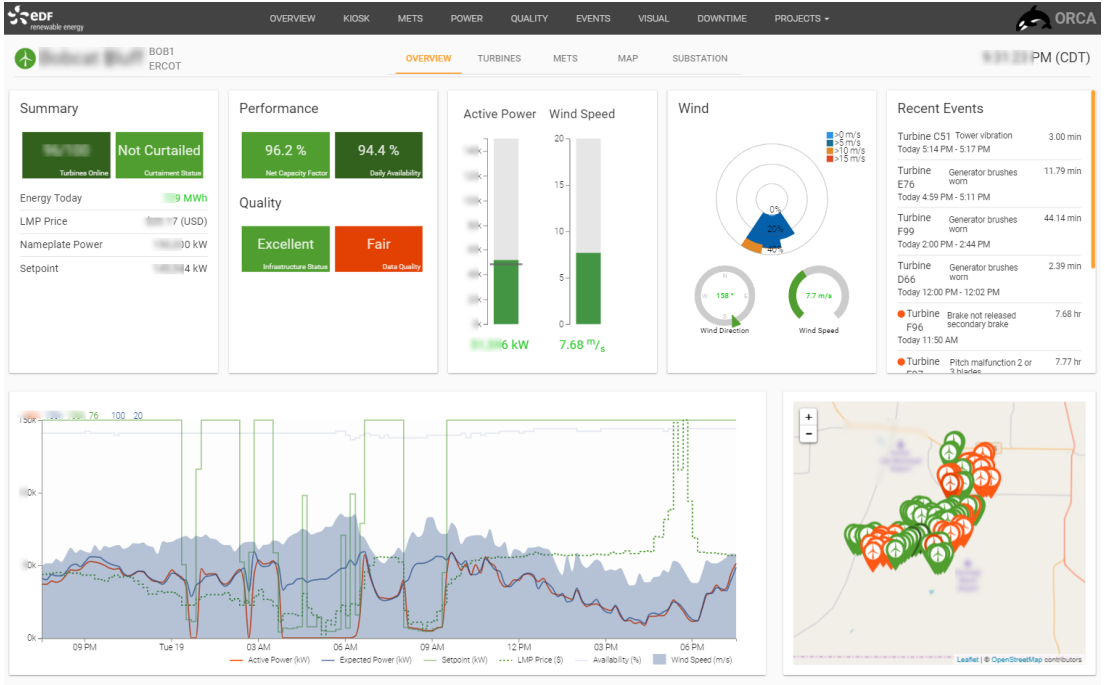


deliver a complete, current and historical, operational picture of all EDF's major assets

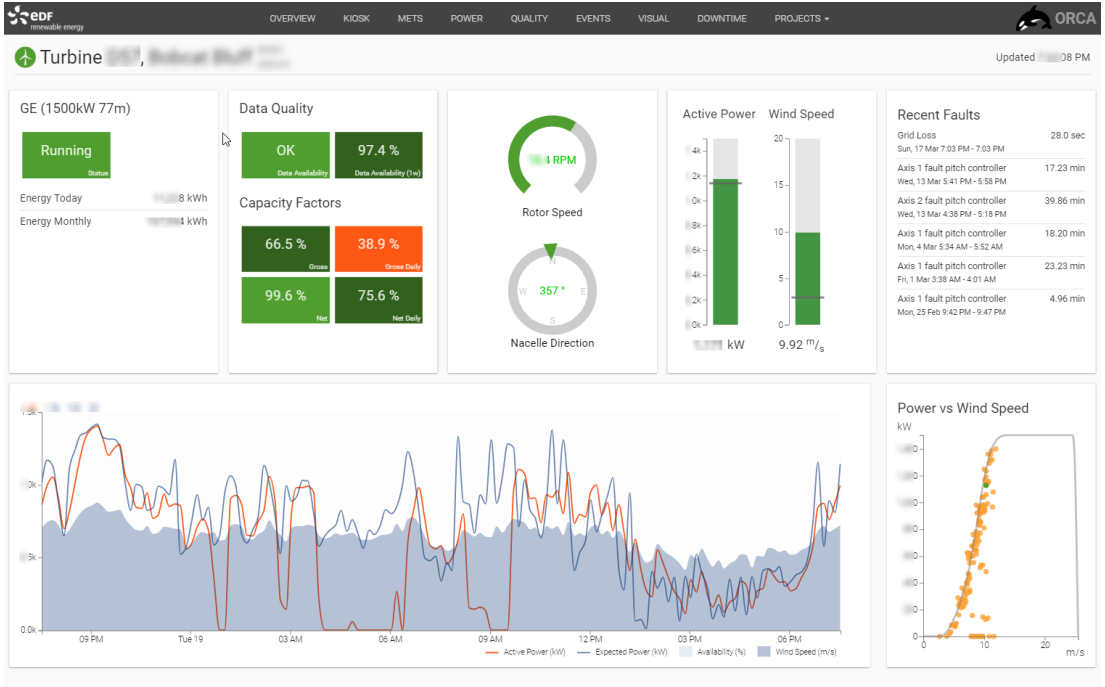
ORCA – Enterprise Level



ORCA – Project Level



ORCA – Turbine Level



ORCA – Visualization Example

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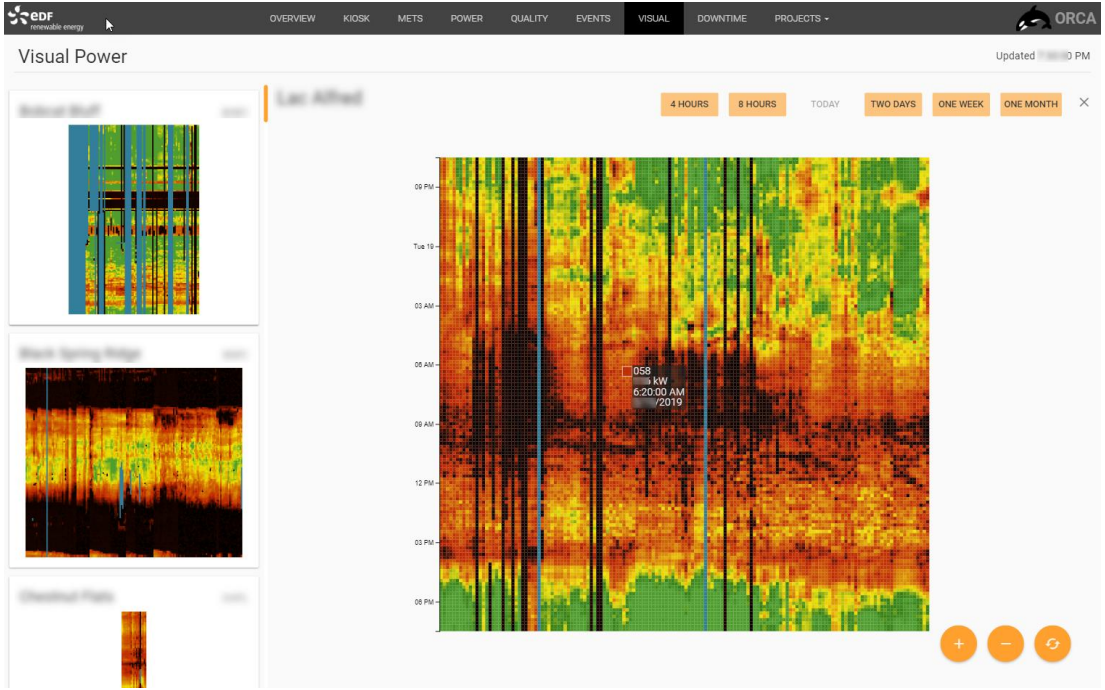
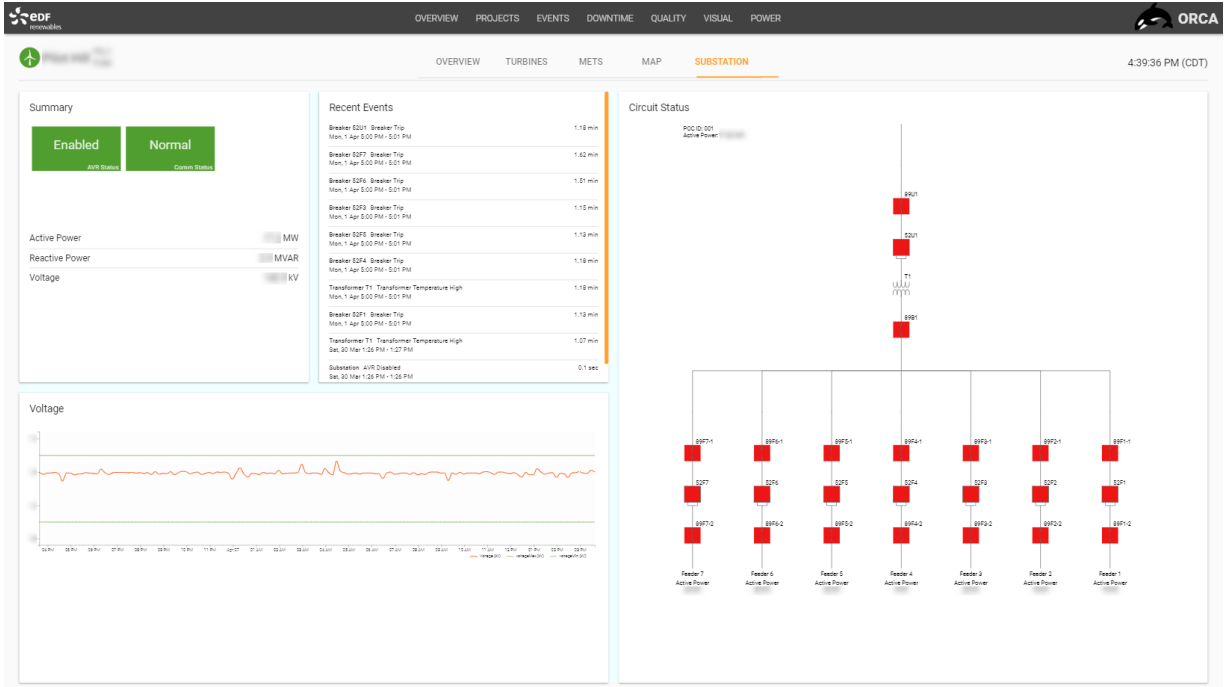


Substation Dashboard



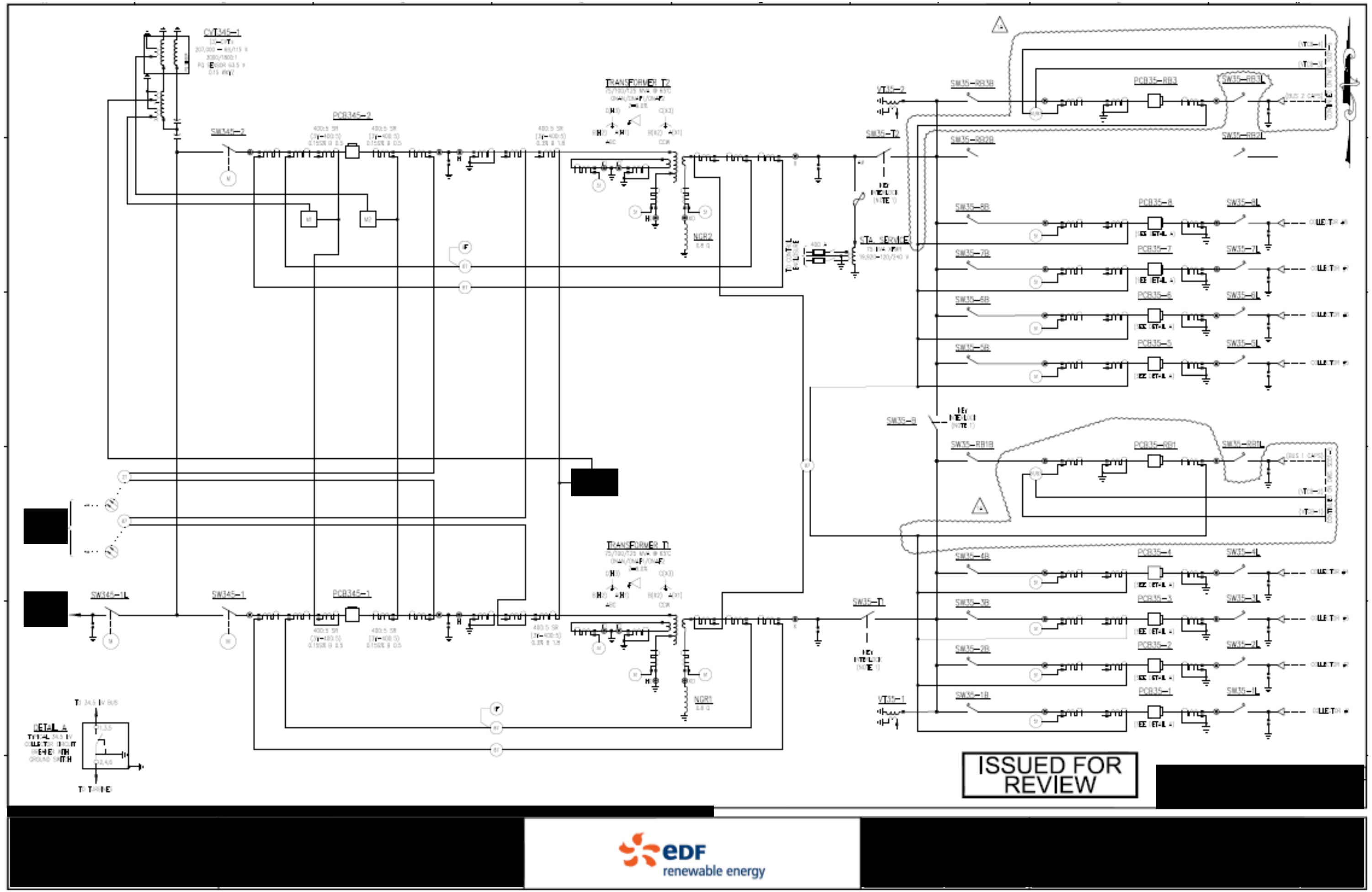
Challenges

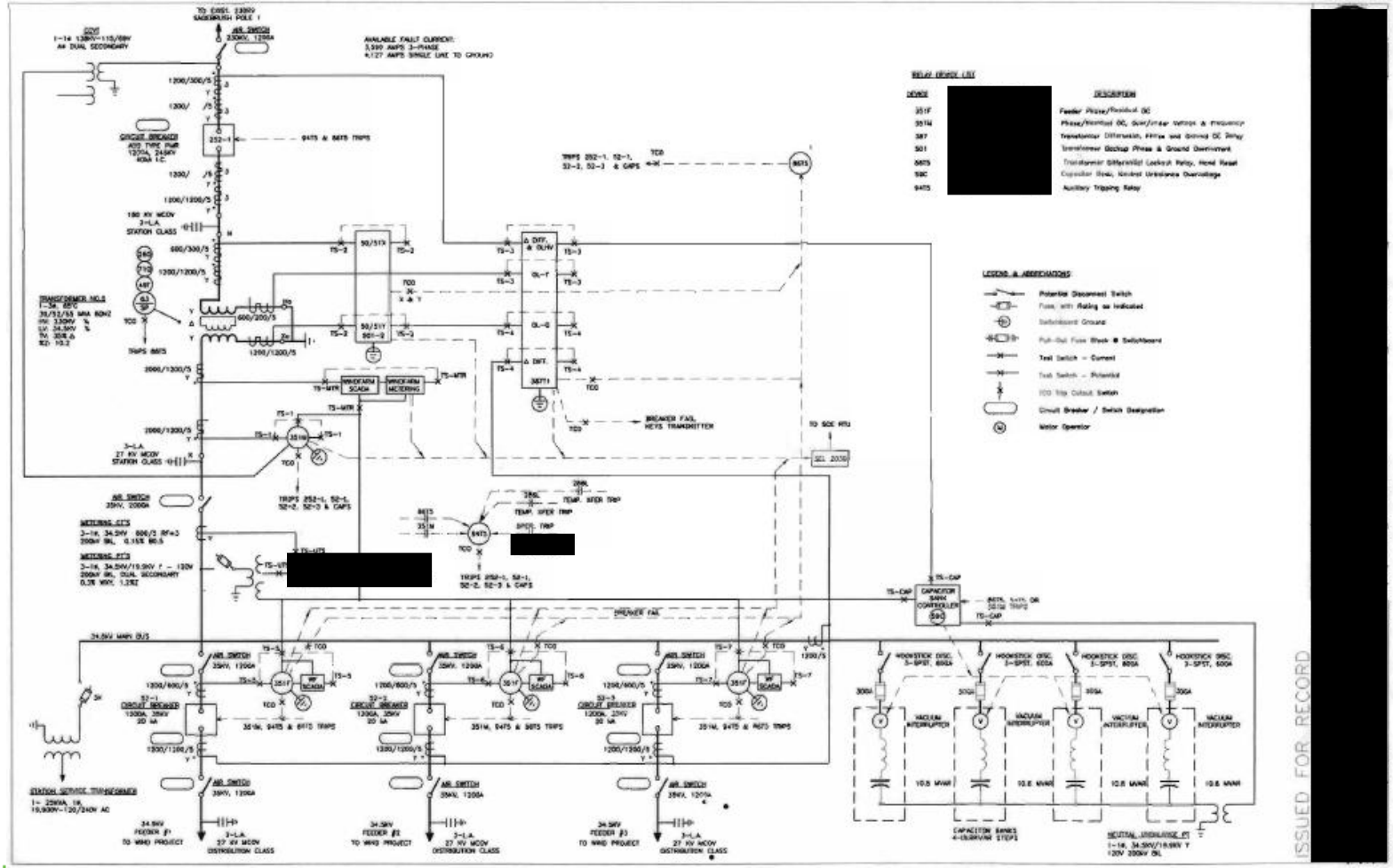
- Physical structure
- Scattered, inconsistent line diagrams
- Tag naming conventions
- Data availability
- Voltage schedule methods
- Large amount of substations

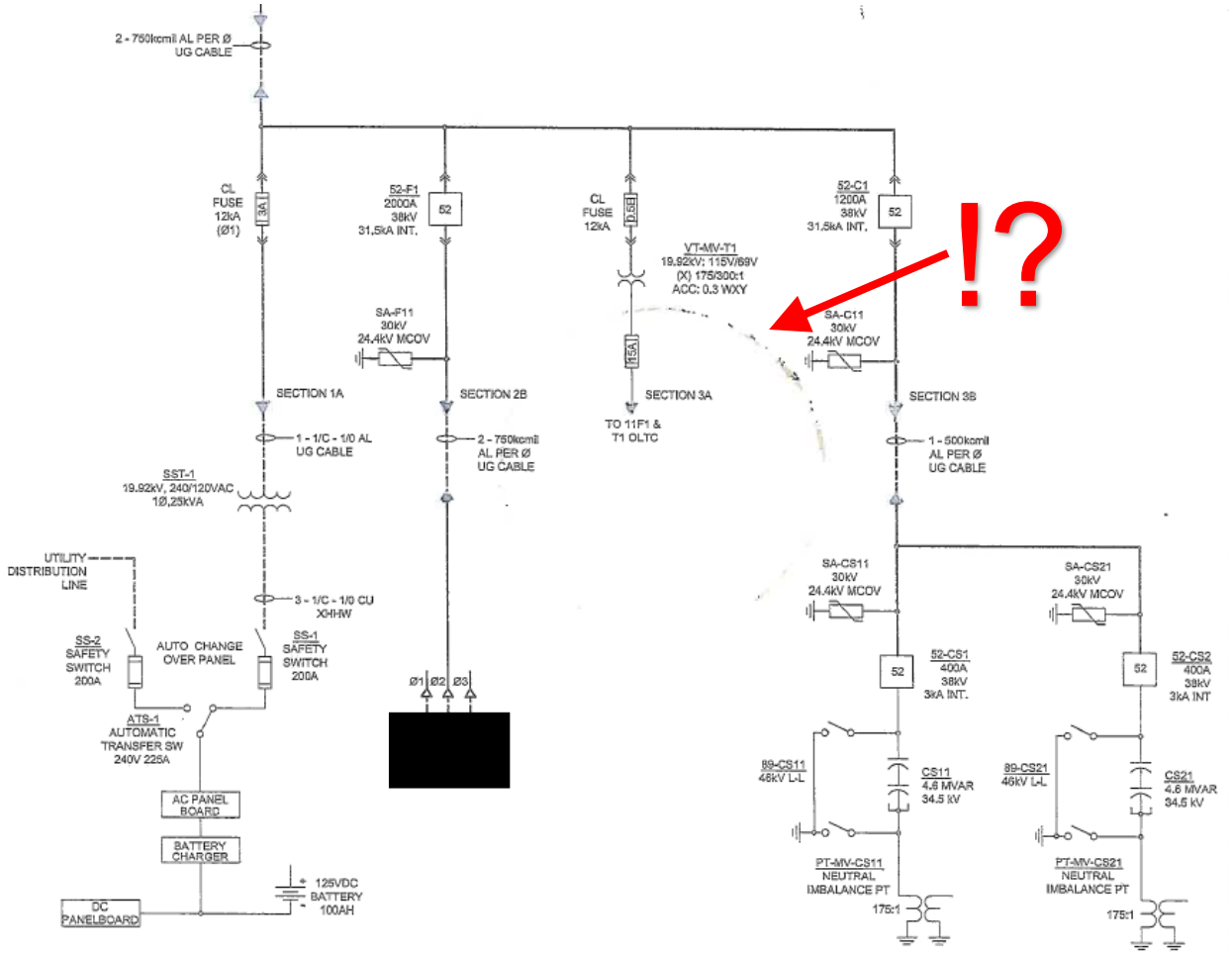
Challenge - Snowflakes!

AVR Status Tag Examples

WSUB001_AO_0015_AVR
WSUB001_MPPC_MPPC_Mode
WSUB1QSE_STVautoAVR
WIND_VEST_AVR_STATUS
WSUB001MV_MPPC_Bad_Data_Input_Alarm
WSUB001_MV_STATCOM_ENABLE
WSUB001_AVRStatus
N_N_UNIT1_Calc_AVR_St
WSUB001_MV_STATCOM.ENABLE
WSUB001_StV_AVR_OEM
WSUB001_VIZ.ENABLE
WSUB001_AVRStatus
SUB001_STV_AGC_Status_WCS1_2
WSUB001_S&C.ENABLE

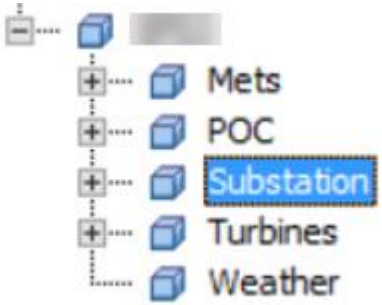






Solution

- AF Implementation – “Structure Convention”
  - Element template family
  - Element naming convention
  - Structural metadata
  - Table lookups
- Display Creation
  - Substation display automatically rendered in ORCA



Category: <None>		
Active Power	57.78 MW	3/19/2019 9:44:07.914 PM
AVR Status	Disabled	3/1/2017 1:59:06.021 PM
Inverted	False	1/1/1970 12:00:00 AM
PITag	WSUB001_StV_AVR_WRG1_Vestas	1/1/1970 12:00:00 AM
Raw	Disabled	3/1/2017 1:59:06.021 PM
Breaker Quality	100 %	3/15/2019 11:28:00 AM
Comm Status	Fault	1/16/2019 9:55:00 AM
Reactive Power	0.637 MVAR	3/19/2019 9:37:15.916 PM
Tolerance Alignment	98 %	3/19/2019 9:44:08.524 PM
Voltage	355.67 kV	3/19/2019 9:44:08.524 PM
Enforced	True	1/1/1970 12:00:00 AM
Maximum	362.61 kV	1/1/1970 12:00:00 AM
Minimum	348.39 kV	1/1/1970 12:00:00 AM
Target	355.5 kV	1/1/1970 12:00:00 AM
Voltage Limit Alarm	Normal	3/19/2019 9:44:08.524 PM
Voltage Target Deviation	0.047 %	3/19/2019 9:44:08.524 PM
Category: Display		
Asset Name	Substation	1/1/1970 12:00:00 AM
Asset Type	Substation	1/1/1970 12:00:00 AM
Display Status	Enabled	1/1/1970 12:00:00 AM

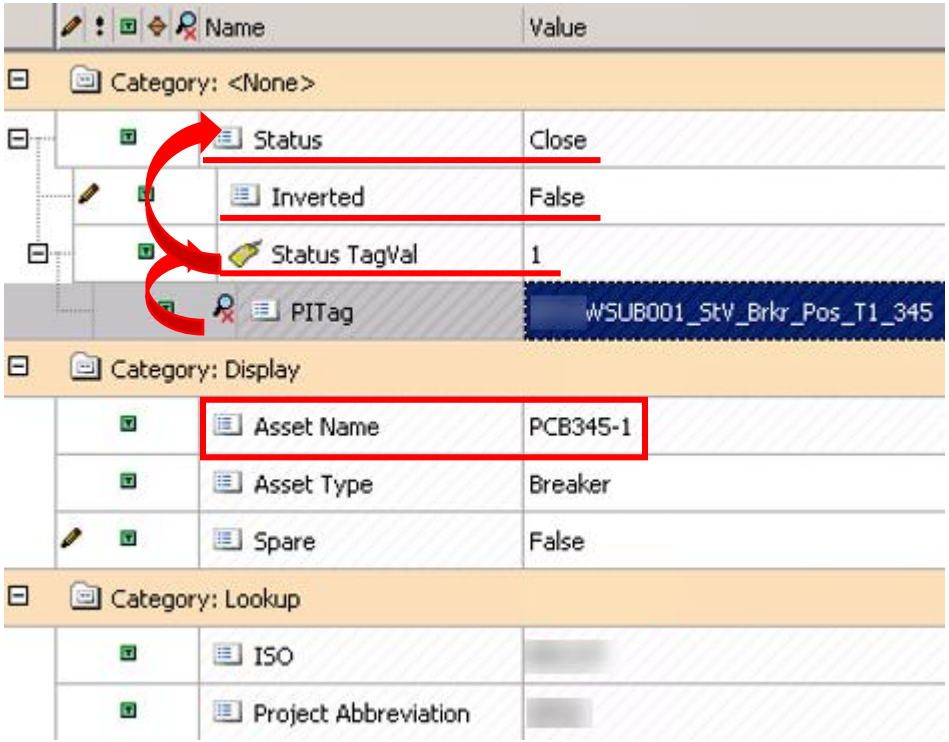
02BR – PCB345-1

Arrangement Order Asset Type Asset Name

Name:	Asset Name
Description:	
Properties:	<None>
Categories:	Display
Default UOM:	<None>
Value Type:	String
Value:	PCB345-1
Data Reference:	String Builder
Display Digits:	-5

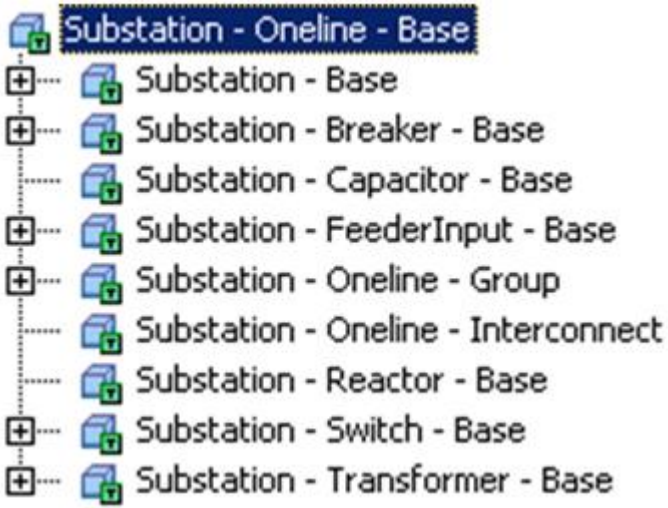
Settings...

Mid(%Element%,8);

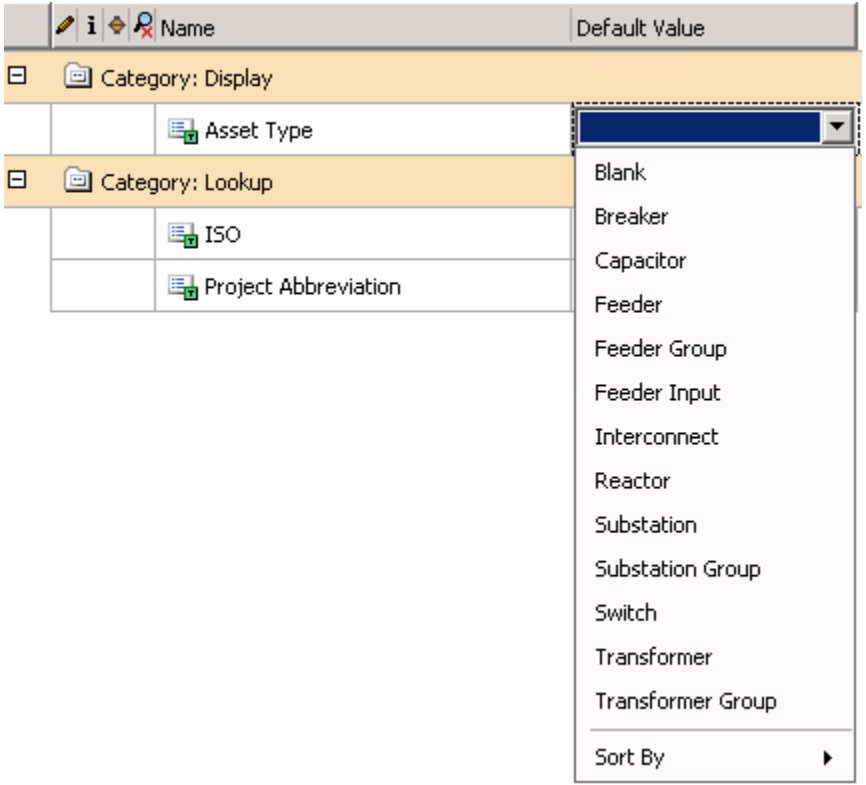


Site	Breaker Name	Status Tag Name
	PCB35-5	WSUB001_StV_Brkr_Pos_F4
	PCB35-6	WSUB001_StV_Brkr_Pos_F5
	PCB35-7	WSUB001_StV_Brkr_Pos_F6
	PCB35-8	WSUB001_StV_Brkr_Pos_F7
	PCB35-9	WSUB001_StV_Brkr_Pos_F8
	PCB35-1	WSUB001_StV_Brkr_Pos_PCB_35_1
	PCB35-10	WSUB001_StV_Brkr_Pos_PCB_35_10
	PCB345-1	WSUB001_StV_Brkr_Pos_T1_345
	PCB345-2	WSUB001_StV_Brkr_Pos_T2_345
	161-1	WSUB001_IO3.DISJ.161-1.52a
	34-11	WSUB001_F11_STVBreaker_Closed
	34-12	WSUB001_F12_STVBreaker_Closed
	34-13	WSUB001_F13_STVBreaker_Closed
	34-14	WSUB001_F14_STVBreaker_Closed
	52-M1	WSUB001_STVMB_52M1_Status

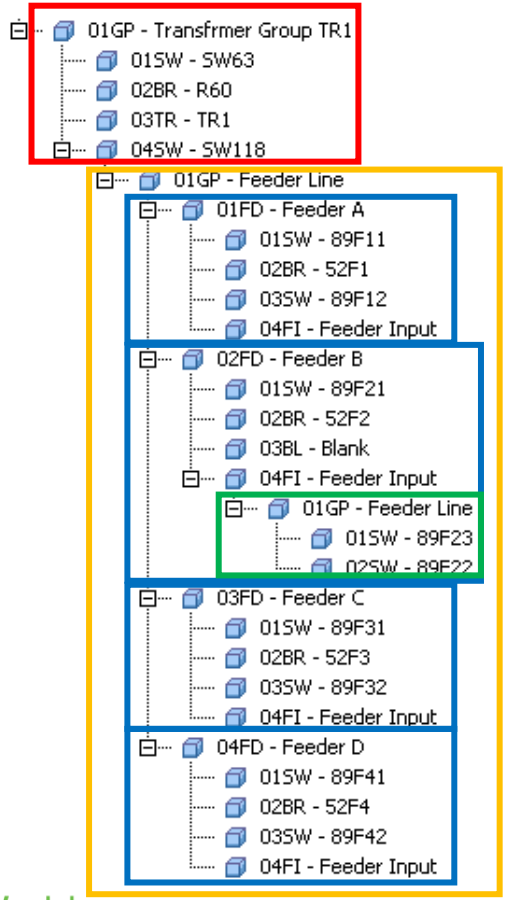
Element Template Family



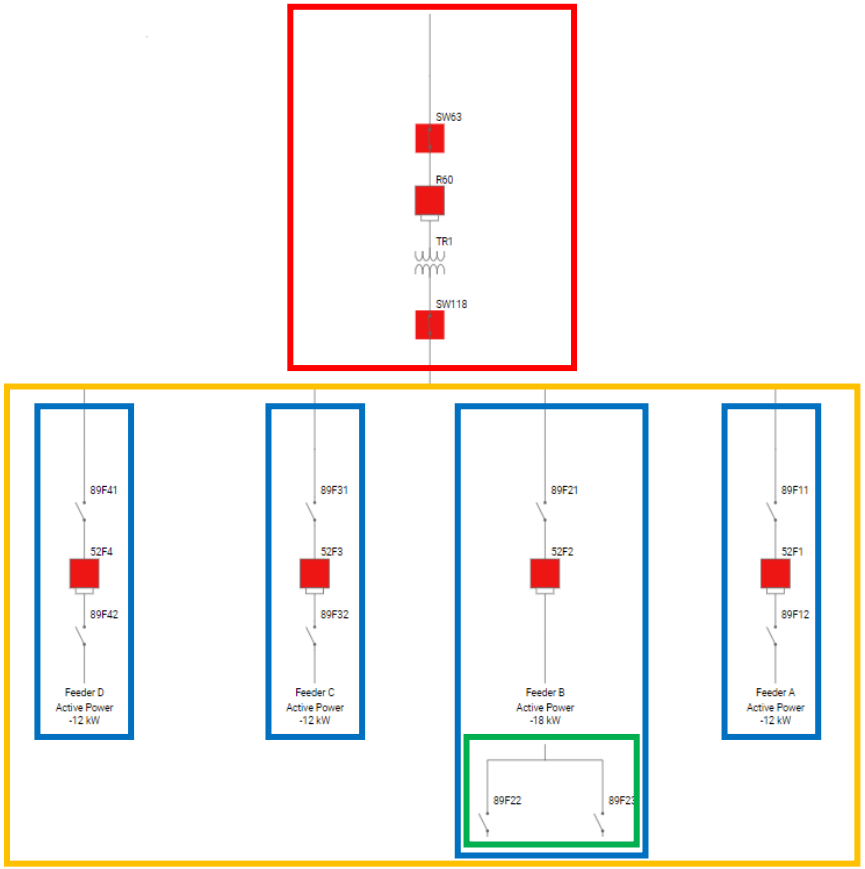
Attributes



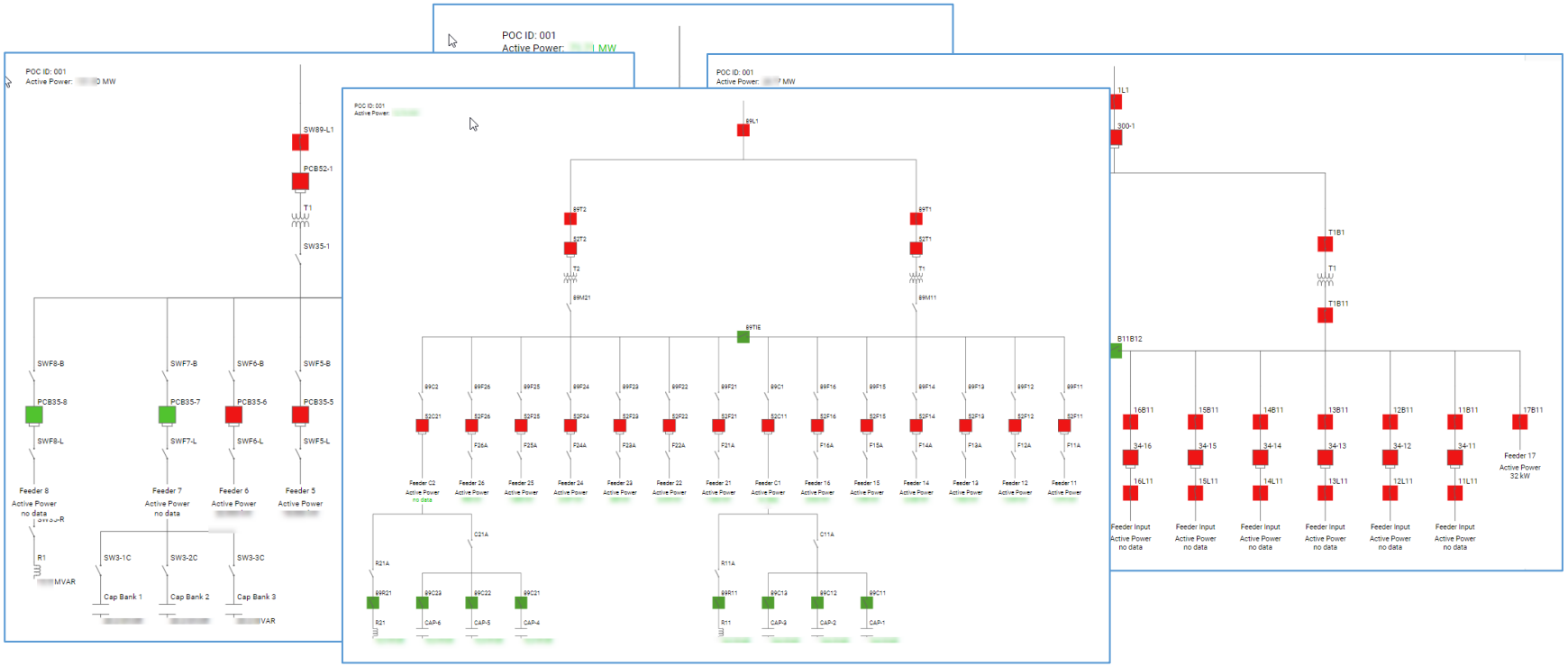
AF Structure



Line Diagram



Visualization – more snowflakes

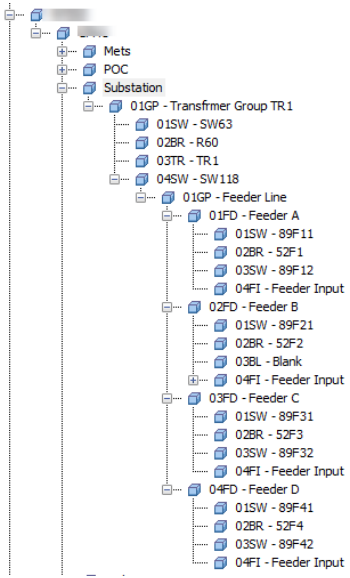


Visualization - Requirements

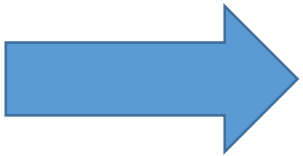
- Leverage AF templates and hierarchy
- Build SVG graphics on demand
- Design elements to behave in real-time
- Use minimal external JavaScript libraries
- Keep with the standard ORCA theme

Step 1 – Server Side API

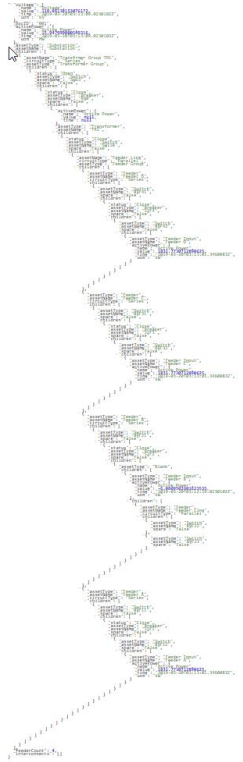
AF



AF SDK



JSON



Step 2 – Layout using D3.js Tree Layout

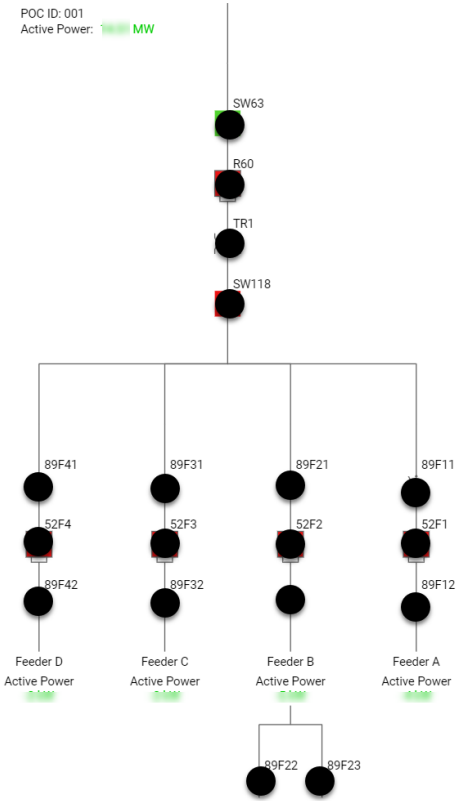
Source: https://d3indepth.com/layouts/

Step 2 Continued

D3 Code

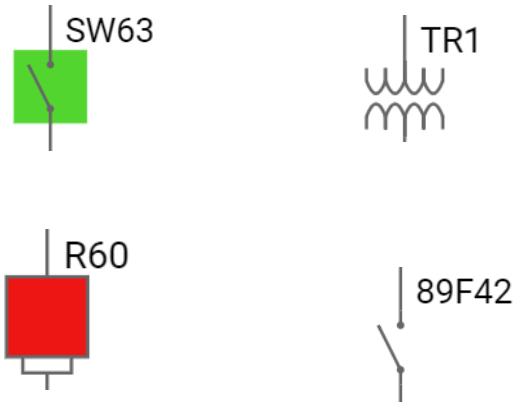
```
var root = d3.hierarchy(data.data)
var treeLayout = d3.tree()
treeLayout.size([width, height])
treeLayout(root)

var rlinks = root.links()
var rdesc = root.descendants()
```

Calculate Values

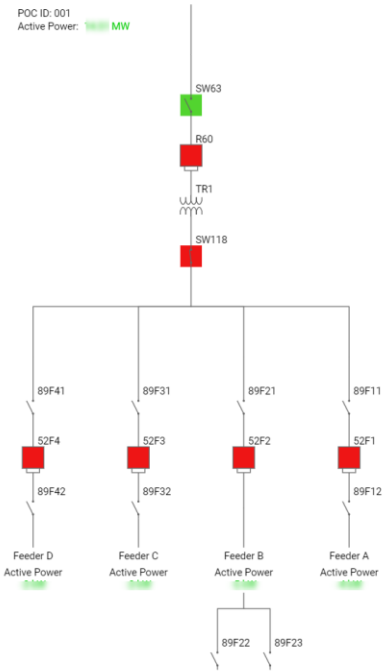


Step 3 – Elements and Lines

SVG Elements Using D3



Final Graphic



Results

“This solution gives the EDFR team greater mobility for awareness of our substation equipment to provide a better picture of plant status”

- Bob Sullivan, OCC

- Substation insights now available to entire company
- Substations added quickly and easily, no front end action required
- Room for improvement: Streamline backend construction

Other Use-Cases

- Other practical use-cases this could be applied
  - Any place where there are assets that are interconnected and data is in a PI System
  - Networking equipment associated with a PI system, interface nodes, edge devices, servers, routers, etc…
  - Process, like water/water systems, utilities such as gas, and electrical

Links

Visual Power Presentation

https://www.osisoft.com/Presentations/Transforming-the-Data-Culture-by-Optimizing-the-PI-System-at-EDF-Renewable-Energy/

Data Quality Presentation

https://www.osisoft.com/Presentations/Monitoring-Data-Quality-with-Asset-Analytics/

D3 Library

https://d3js.org/

Thanks for Listening!

David Rodriguez

Analytics & Intelligence Engineer

EDF Renewables

David.Rodriguez@edf-re.com

Lonnie A. Bowling

Data Interaction Expert

Diemus, Inc.

lonnie@diemus.com

Questions?

Please wait for the **microphone**

State your **name & company**

Please remember