

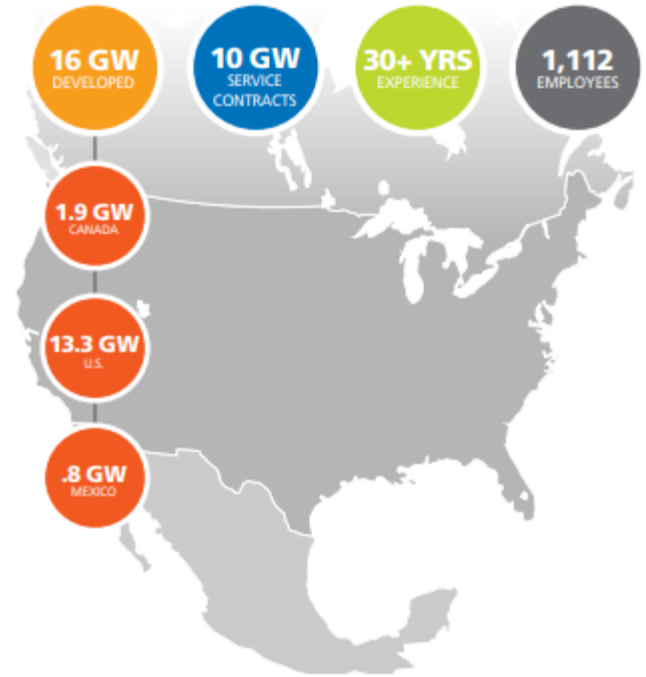
The Epic of Turbine Downtime: Tracking, Automating, and Reporting

Kelsey Bobeck



EDF Renewables North America

- Wind, solar, and storage
- 24GW in pipeline
- Grid-Scale, Distributed Solutions, and Asset Optimization



Our System

- Since 2009
- 40+ sites in PI
- 3-Server Collective
- Separate Interface, Analysis, AF, Notifications, IIS servers
- QA System

Challenge

- No centralized place for tracking down turbines
 - Miscommunication → delays
 - No awareness of opportunities for improvement

2845 Owned Turbines

487 3rd Party Turbines

Objective

- Develop a tool for the business to **track**, **provide updates**, and **measure KPIs** for the Return to Service of Long-Term Down Turbines (LTDT)

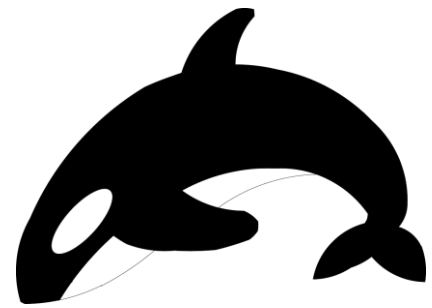
Requirements

1. Make accessible to all
2. Utilize fault codes
3. Minimize additional work
4. Track updates and changes
5. Provide awareness to stakeholders
6. Report RTS metrics

Solutions

1. Make accessible to all: **ORCA**
2. Utilize fault codes: **Event Frames (Analysis)**
3. Minimize additional work: **Auto-Open/Close Service**
4. Track updates and changes: **Event Frames (UI)**
5. Provide awareness to stakeholders: **Notifications**
6. Report RTS metrics: **KPI Engine**

1. ORCA



- **O**perational **R**eadiness and **C**ontextual **A**wareness
- Accessible using AD credentials
- Web-based and mobile responsive
- Utilizes a custom Web API based on the AF SDK

1. ORCA



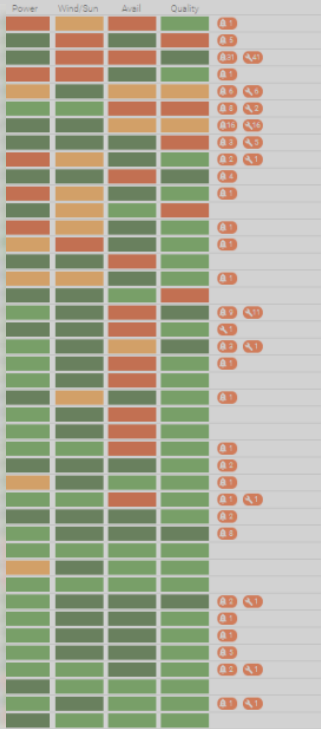
“ORCA is an intuitive interface that allows me to quickly view key KPI's for our fleet using real-time data to make strategic operating decisions.”

-Charles Kasmer

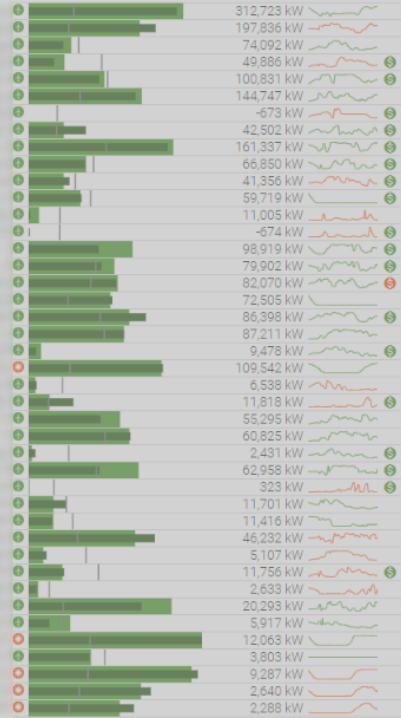
Project Manager

Performance & Reliability Engineering

Project Summary
(sorted by lowest to highest scoring)



Active Power
(sorted by highest to lowest nameplate rating)

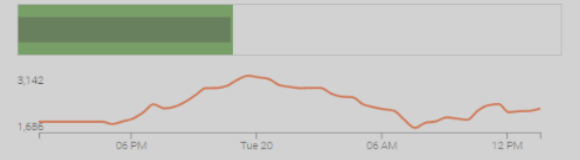


Enterprise Summary

8/20/19 1:36:50 PM

Active Power

2,228 MW



Daily Production

34,580 MWh



Events and Downtime

125

Active Events

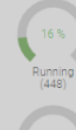
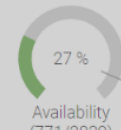
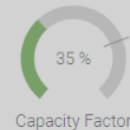
88

Downtime Events

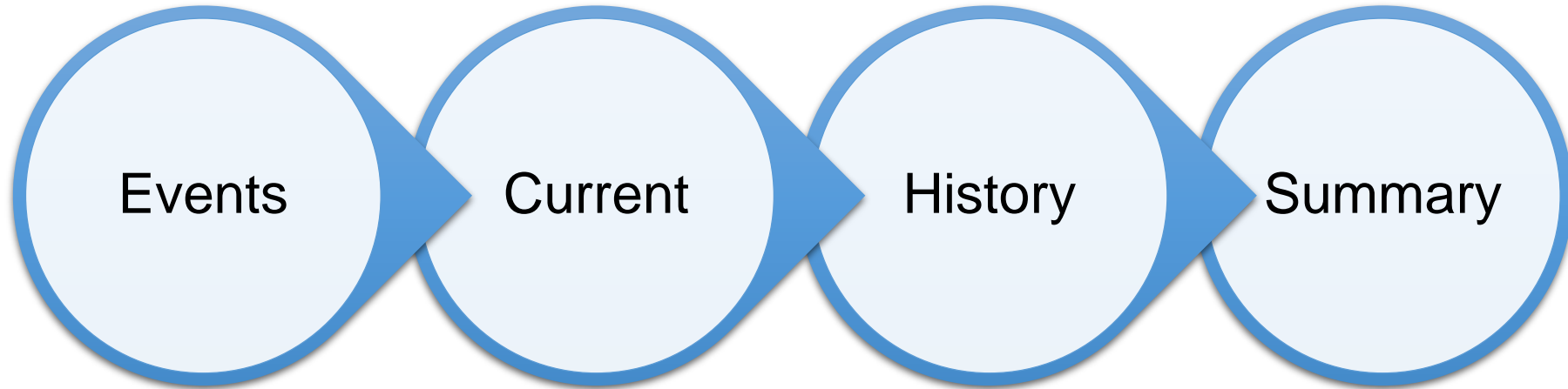
17 days

Downtime Mean

Turbine Performance



Components



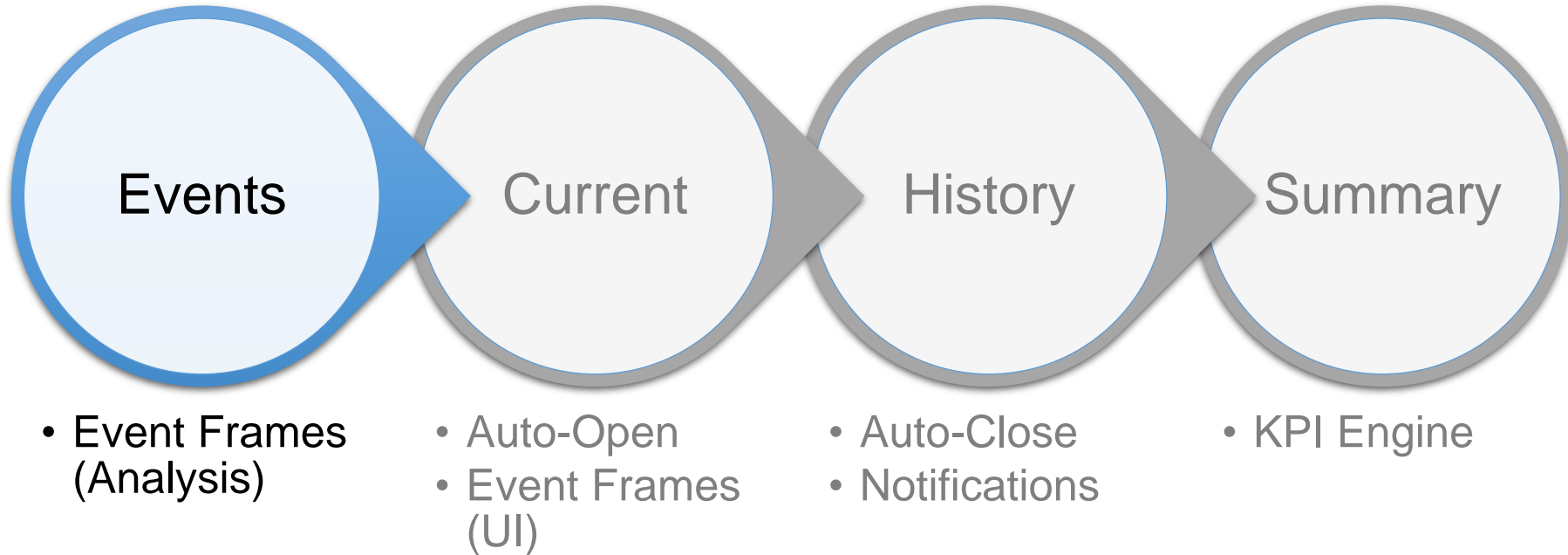
- Event Frames (Analysis)

- Auto-Open
- Event Frames (UI)

- Auto-Close
- Notifications

- KPI Engine

Components



Turbine Downtime

EVENTS CURRENT HISTORY SUMMARY

8/19/2019 12:16 PM

Min Downtime (da...)

2

MANUALLY ADD EVENT

Include Tracked

Project	Asset	Significant Event	Duration ▼	Lost Energy (MWh)		
	E19	693 - SignalAlarm-PAUSE _____	3.0 days	77.9	TRACK	▼
	B08	72 - Outdoor temperature high	2.9 days	0.1	TRACK	▼
	T90	4417 - Grid Inv Breaker Open	2.8 days	87.2	TRACK	▼
	D09	4516 - HubSafty HydrPres Low BldA	2.8 days	64.0	TRACK	▼
	027	13 - Blade Pitch Control Fault	2.7 days	32.6	TRACK	▼
	A03	3551 - GearOilInletPressLow ___ bar	2.1 days	46.1	TRACK	▼

Turbine Downtime

EVENTS CURRENT HISTORY SUMMARY

8/19/2019 12:16 PM

Min Downtime (da...

2



MANUALLY ADD EVENT

Include Tracked

Project	Asset	Significant Ev
---------	-------	----------------

E19	693 - SignalAlar
808	72 - Outdoor tem
T90	4417 - Grid Inv B
D09	4516 - HubSafty
027	13 - Blade Pitch
A03	3551 - GearOilln

Downtime Tracking



Project* Asset*

Start 8/27/2019 4:09 PM

Event*

Code

TRACK DOWNTIME

CLOSE

Turbine Downtime

EVENTS CURRENT HISTORY SUMMARY

8/19/2019 12:16 PM

Min Downtime (da...
2

MANUALLY ADD EVENT

Include Tracked

Project	Asset	Significant Event	Duration	Lost Energy (MWh)	
	E19	693 - SignalAlarm-PAUSE _____	3.0 days	77.9	TRACK
	B08	72 - Outdoor temperature high	2.9 days	0.1	TRACK
	T90	4417 - Grid Inv Breaker Open	2.8 days	87.2	TRACK
	D09	4516 - HubSafty HydrPres Low BldA	2.8 days	64.0	TRACK
	027	18 - Blade Pitch Control Fault	2.7 days	32.6	TRACK

T90 4417 - Grid Inv Breaker Open 2.8 days 87.2 TRACK

Fault	Timestamp	Duration
Grid Inv Breaker Open	Fri, 16 Aug 4:26 PM	2.8 days
Yaw To Cable Twist Reset	Wed, 14 Aug 8:23 AM - 8:43 AM	20.23 min
Slip:___ above limits _	Tue, 13 Aug 9:25 PM - 9:26 PM	1.27 min
Comm Fail	Sat, 10 Aug 12:28 PM - Tue, 13 Aug 2:44 PM	3.1 days
Slip: above limits _	Fri, 9 Aug 7:34 PM - 7:36 PM	1.18 min
GearOilInletPressLow ___ bar	Thu, 8 Aug 1:15 PM - 1:16 PM	30.0 sec

ASSET STATUS

Turbine T90,

Updated 7:47:36 AM

Vestas (2000kW 100m) Mk 7H

Faulted

Status

Energy Today 0 kWh

Energy Monthly 222,198 kWh

Data Quality

OK

Data Availability

99.7 %

Data Availability (1w)

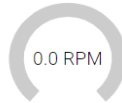
Capacity Factors

-0.4 %

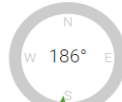
Gross

-0.4 %

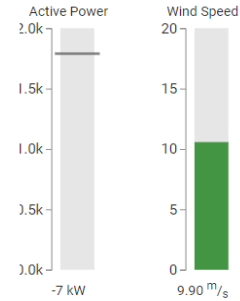
Gross Daily



Rotor Speed

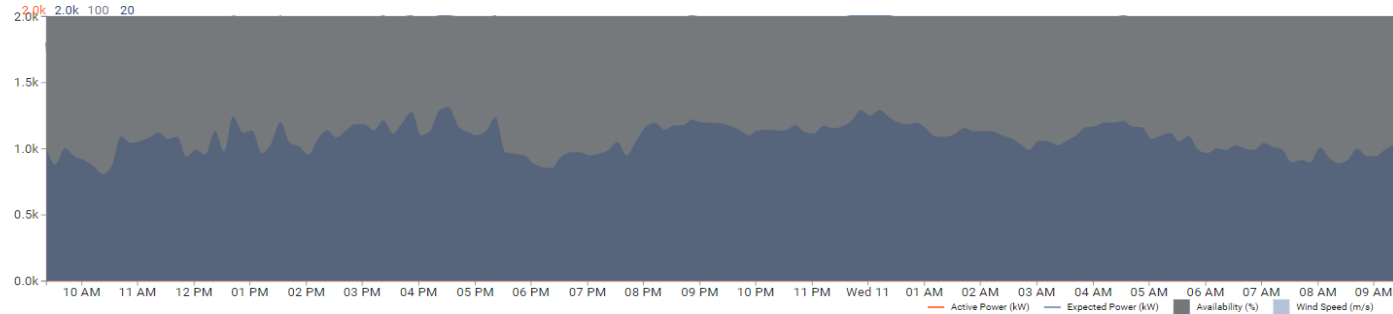


Nacelle Direction

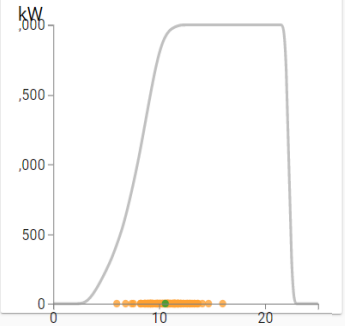


Recent Faults

Slip: above limits _	1.18 min
Yesterday 10:22 PM - 10:24 PM	
Yaw To Nacelle Position Reset	16.58 min
Sat, 24 Aug 11:06 PM - 11:22 PM	
Oil leakage in Hub	13.22 hr
Sat, 24 Aug 12:38 AM - 1:51 PM	
Oil leakage in Hub	3.10 hr
Fri, 23 Aug 9:12 PM - Sat, 24 Aug 12:18 AM	
Oil leakage in Hub	2.95 min
Fri, 23 Aug 9:08 PM - 9:11 PM	
Oil leakage in Hub	1.02 min
Fri, 23 Aug 9:07 PM - 9:08 PM	



Power vs Wind Speed



Event Frames (Analysis)

Generation Mode: Event Frame Template:

Name	Expression	True for	Severity	Value at Evaluation	Value at Last Trigger
Variables					
Trigger	'Active Power 10min Avg' // Forces periodic trigger every 10 minutes			-5.8319 kW	-5.8319 kW
Start triggers					
StartTrigger1	'Fault Level'="Fault"	Not Set	None	True	True
End trigger					
EndTrigger	BadVal('State and Fault')=False And 'Fault Level'="OK"			False	False

Evaluation Time: 08/22/19 14:07:09 Last Trigger Time: 08/22/19 14:03:46 Elapsed Evaluation Time: 0ms

Scheduling: Event-Triggered Periodic

Trigger on:

Fault from Braking List

Communication Fault

Generation Mode: Event Frame Template:

Name	Expression	True for	Severity	Value at Evaluation	Value at Last Trigger
Variables					
Ping	'\EDF Enterprise\ [redacted] Ping Fault'			0	0
State	'EDF State Value'			3	3
Start triggers					
StartTrigger1	// The turbine is in Comm Error state, but the entire site isn't offline State = 4 AND Ping = 0	1 days	None	False	False

Evaluation Time: 08/22/19 14:11:48 Last Trigger Time: 08/22/19 14:10:00 Elapsed Evaluation Time: 0ms

Scheduling: Event-Triggered Periodic

Trigger on:

Event Frames (Analysis)

- T90 - Wind - Turbine Fault - Vestas - 2019-08-16 16:26:26

General Child Event Frames Referenced Elements Attributes

Excluded attributes are hidden.

Filter

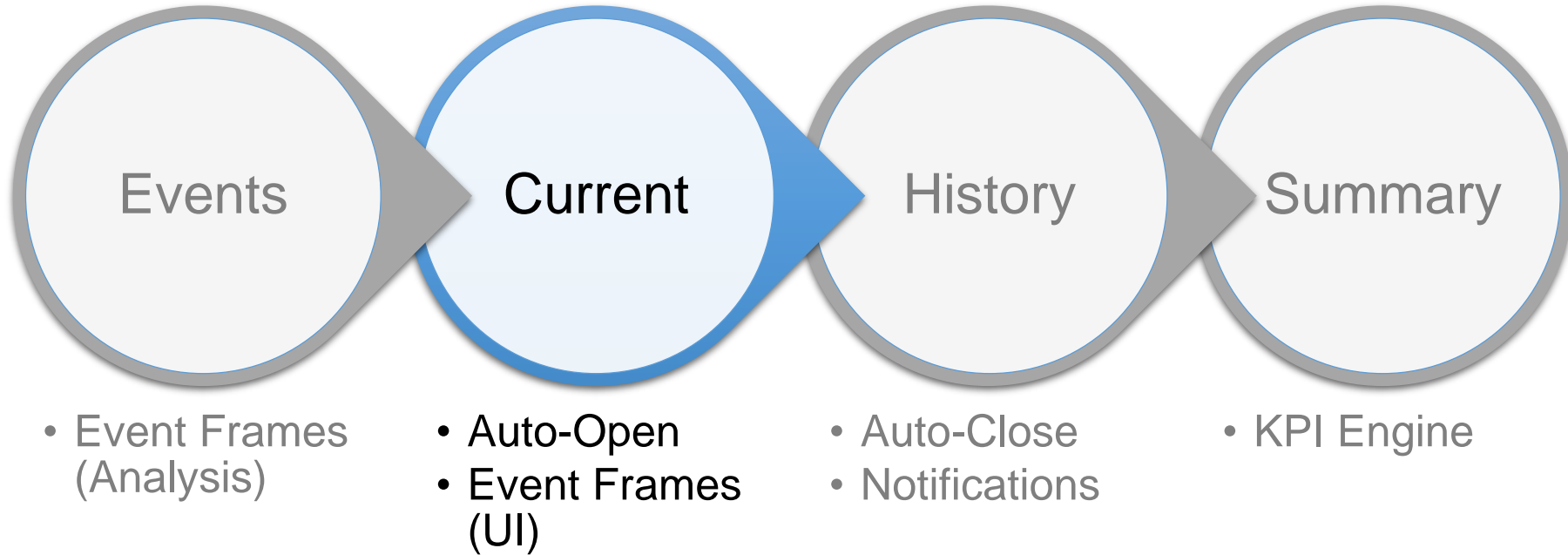
Name	Value	Time Stamp
Category: <None>		
Annotation		08/16/19 16:26:26.349
Duration	141.639043967459 h	08/16/19 16:26:26.349
End Time	08/22/19 14:04:46.907	01/01/70 00:00:00
Fault Action	STATUS ONLY	08/16/19 16:26:26.349
Fault Code	4417	08/16/19 16:26:26.349
Fault Description	Grid Inv Breaker Open	08/16/19 16:26:26.349
ISO	SPP	01/01/70 00:00:00
Lost Production	162.4 MWh	08/22/19 14:04:46.912
Lost Production Alternate	182.3	08/22/19 14:04:46.912
Lost Production Primary	162.4	08/22/19 14:04:46.909
Lost Revenue	2923 \$	08/22/19 14:04:46.916
Project		01/01/70 00:00:00
Start Time	08/16/19 16:26:26.349	01/01/70 00:00:00
User		08/16/19 16:26:26.349
Category: Measured		
State and Fault	4417	08/16/19 16:26:26.349

Auto-Open/Close Service

Auto-open a downtime event if:

1. the turbine's state is not ready or running,
2. its 10m avg. active power is less than or equal to 0,
3. the fault event's duration is greater than 3 days (72 hours), and
4. there is not already an open downtime event for that turbine

Components



Turbine Downtime

EVENTS **CURRENT** HISTORY SUMMARY

8/20/2019 3:53 PM

Provider Filter: RS (15), OEM (92) | Region Filter: Canada (32), Central (11), North (58), West (6) | Status Filter: Awaiting Approval (1), BOP Outage (4), Contractor Sourcing (2), Economic Delay (0), Engineering Disposition (0), Netcom (20), Parts Sourcing (1), Repair (1), Troubleshooting (10), ...

Project	Offline	Median Days	Avg Days	Max Days	Lost Energy (MWh)
	52	3.3	6.1	62.4	783.1
	16	12.7	10.8	13.0	264.9
	11	39.6	44.9	83.1	5,555.1
	6	17.4	30.0	75.2	2,213.1
	5	48.1	36.8	66.2	3,122.3
	3	8.3	10.0	15.4	239.9
	3	29.5	29.9	55.9	0.0
	2	17.3	17.3	18.1	0.0
	1	83.2	83.2	83.2	1,728.7
	1	42.8	42.8	42.8	0.0
	1	41.5	41.5	41.5	595.0
	1	22.4	22.4	22.4	321.3
	1	13.4	13.4	13.4	140.3
	1	11.3	11.3	11.3	35.1
	1	10.6	10.6	10.6	208.9
	1	5.7	5.7	5.7	0.0
	1	4.0	4.0	4.0	119.5
Total	107	6.3	16.2	83.2	15,327.2

Project	Asset	Status	Significant Event	PR/PO	O&M Provider	Duration	Lost Energy (MWh)
T90		Warranty/OEM	4417 - Grid Inv Breaker Open		OEM	4.0 days	119.5
T88		Netcom	32767 - Vestas is installing new transformer on 8/20/2019. Had issues with ITE kit tie rack.		OEM	10.6 days	208.9
T015		Warranty/OEM	null - Broken Blade,		OEM	83.2 days	1,728.7
G48		Troubleshooting	-14 - Manual Idle Stop		RS	4.4 days	
G40		Contractor Sourcing	- Blade Tip Damage		RS	55.9 days	
G19		Contractor Sourcing	- Blade Tip Damage		RS	29.5 days	
E20		Warranty/OEM	900 - Blade Damage CAT5		OEM	8.2 days	161.3
E19		Warranty/OEM	693 - SignalAlarm-PAUSE		OEM	4.1 days	78.0
D08		Troubleshooting	106 - Rotor CCU fault current		RS	11.3 days	35.1
C28		Warranty/OEM	106 - Rotor CCU fault current		RS	13.4 days	140.3
B13		Warranty/OEM	900 - IMS repair is complete as of 7/16/19. Turbine will remain down due to CAT 5 blade damage.		OEM	66.2 days	1,121.1
B12		Warranty/OEM	900 - Pause pressed on keyboard. CAT 5 Blade Damage		OEM	57.4 days	960.2
A13		Warranty/OEM	900 - Blade Damage CAT5		OEM	48.1 days	801.7
162A		Netcom	32767 - Comm Fail		OEM	5.1 days	66.6
161A		Netcom	32767 - Comm Fail		OEM	5.1 days	66.6
160A		Netcom	32767 - Comm Fail		OEM	5.1 days	66.6
159A		Netcom	32767 - Comm Fail		OEM	12.7 days	
158A		Netcom	32767 - Comm Fail		OEM	12.7 days	
157A		Netcom	32767 - Comm Fail		OEM	12.7 days	
156A		Netcom	32767 - Comm Fail		OEM	12.7 days	
155A		Netcom	32767 - Comm Fail		OEM	12.7 days	

Turbine Downtime

EVENTS **CURRENT** HISTORY SUMMARY

8/20/2019 3:53 PM

Provider Filter: RS (15), OEM (92) | Region Filter: Canada (32), Central (11), North (58), West (6) | Status Filter: Awaiting Approval (1), BOP Outage (4), Contractor Sourcing (2), Economic Delay (0), Engineering Disposition (0), Netcom (20), Parts Sourcing (1), Repair (1), Troubleshooting (10), ...

Project	Offline	Median Days	Avg Days	Max Days	Lost Energy (MWh)
	52	3.3	6.1	62.4	783.1
	16	12.7	10.8	13.0	264.9
	11	39.6	44.9	83.1	5,555.1
Status Details					
Warranty/OEM	28.2		Average Days		
	23.8		Median Days		
BOP Outage	42.1				
	42.1				
	2	17.3	17.3	18.1	0.0
	1	83.2	83.2	83.2	1,728.7
	1	42.8	42.8	42.8	0.0
	1	41.5	41.5	41.5	595.0
	1	22.4	22.4	22.4	321.3
	1	13.4	13.4	13.4	140.3
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161A		Netcom	32767 - Comm Fail		OEM	5.1 days	66.6
160A		Netcom	32767 - Comm Fail		OEM	5.1 days	66.6
159A		Netcom	32767 - Comm Fail		OEM	12.7 days	
158A		Netcom	32767 - Comm Fail		OEM	12.7 days	
157A		Netcom	32767 - Comm Fail		OEM	12.7 days	
156A		Netcom	32767 - Comm Fail		OEM	12.7 days	
155A		Netcom	32767 - Comm Fail		OEM	12.7 days	

Turbine Downtime

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8/20/2019 3:53 PM

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Project	Asset	Status	Significant Event	PR/PO	O&M Provider	Duration	Lost Energy (MWh)
	T90	Warranty/OEM	4417 - Grid Inv Breaker Open		OEM	4.0 days	119.5 Start: Fri, 16 Aug 4:26 PM

Annotations

Annotation	Entered By	Timestamp
Initiated tracking - Warranty/OEM	system	Fri, 16 Aug 4:26 PM

New Annotation **SAVE ANNOTATION**

Recent Faults

Fault	Timestamp	Duration
Grid Inv Breaker Open	Fri, 16 Aug 4:26 PM	4.0 days
Yaw To Cable Twist Reset	Wed, 14 Aug 8:23 AM - 8:43 AM	20.23 min
Slip: ___ above limits _	Tue, 13 Aug 9:25 PM - 9:26 PM	1.27 min
Comm Fail	Sat, 10 Aug 12:29 PM - Tue, 13 Aug 2:45 PM	3.1 days
Slip: ___ above limits _	Fri, 9 Aug 7:34 PM - 7:36 PM	1.18 min
GearOilInletPressLow ___ bar	Thu, 8 Aug 1:15 PM - 1:16 PM	30.0 sec
Pause pressed on keyboard	Thu, 8 Aug 1:14 PM - 1:14 PM	5.0 sec
EMF Acc _ Press Low, ___ bar	Thu, 8 Aug 1:14 PM - 1:14 PM	10.0 sec
EMF Acc _ Press Low, ___ bar	Thu, 8 Aug 1:13 PM - 1:14 PM	41.0 sec
EMF Acc _ Press Low, ___ bar	Thu, 8 Aug 1:12 PM - 1:13 PM	1.08 min

ASSET STATUS

Event Frames (UI)

Update Status



Add Annotation



T90 Warranty/OEM 4417 - Grid Inv Breaker Open OEM 4.0 days 119.5 Start: Fri, 16 Aug 4:26 PM

Annotations

Annotation	Entered By	Timestamp
Initiated tracking - Warranty/OEM	system	Fri, 16 Aug 4:26 PM

New Annotation SAVE ANNOTATION

Recent Faults

Fault	Timestamp	Duration
Grid Inv Breaker Open	Fri, 16 Aug 4:26 PM	4.0 days
Yaw To Cable Twist Reset	Wed, 14 Aug 8:23 AM - 8:43 AM	20.23 min
Slip:___ above limits _	Tue, 13 Aug 9:25 PM - 9:26 PM	1.27 min
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GearOilInletPressLow ___ bar	Thu, 8 Aug 1:15 PM - 1:16 PM	30.0 sec
Pause pressed on keyboard	Thu, 8 Aug 1:14 PM - 1:14 PM	5.0 sec
EMF Acc _ Press Low, ___ bar	Thu, 8 Aug 1:14 PM - 1:14 PM	10.0 sec
EMF Acc _ Press Low, ___ bar	Thu, 8 Aug 1:13 PM - 1:14 PM	41.0 sec
EMF Acc _ Press Low, ___ bar	Thu, 8 Aug 1:12 PM - 1:13 PM	1.08 min

ASSET STATUS

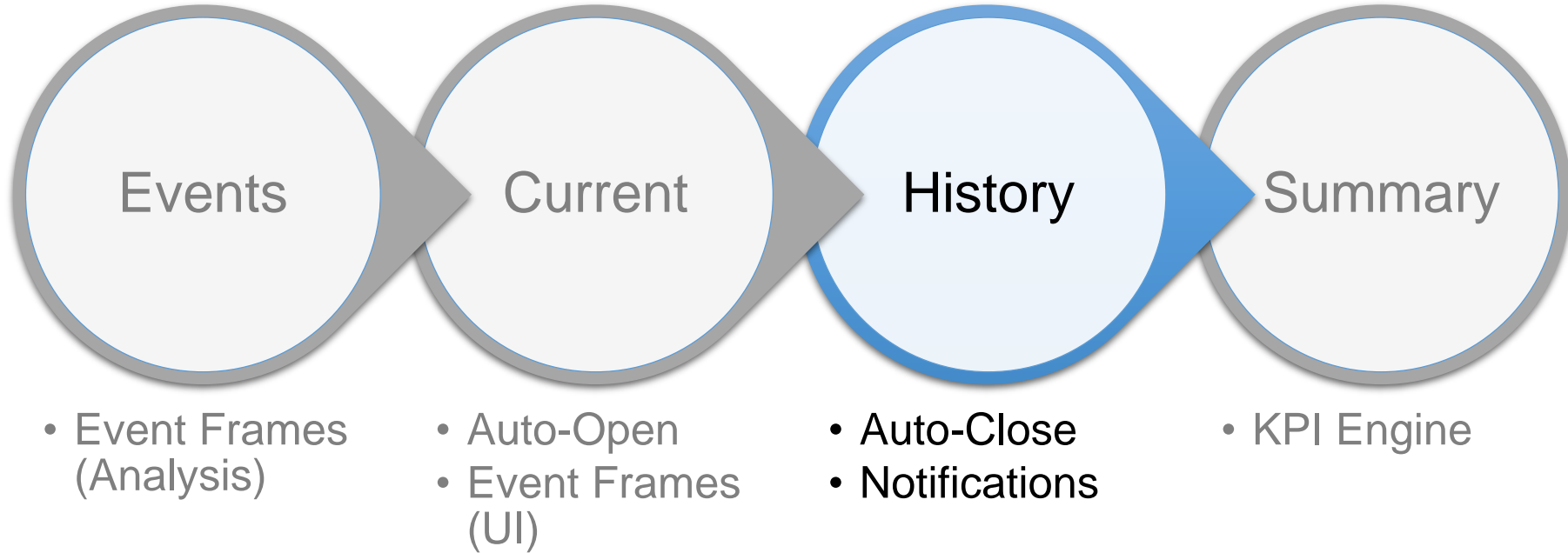
Event Frames (UI)

The screenshot displays the Event Frames (UI) interface. On the left, a tree view shows a hierarchy of events. The selected event is '- T90 - Downtime - Detail - 2019-08-23 06:34:00'. Below the tree view, there is a section for 'Transfer Searches' with a single entry 'Transfer Search 1'.

The main area on the right shows a detailed view of the selected event. It features a table with columns for Name, Value, and Time Stamp. The table is titled 'Category: <None>'. The data rows are as follows:

Name	Value	Time Stamp
Annotation		8/23/2019 6:34:00.79 AM
Duration	0 h	8/23/2019 6:34:00.79 AM
End Time	8/23/2019 6:34:00.79 AM	1/1/1970 12:00:00 AM
Is Deleted	False	8/23/2019 6:34:00.79 AM
Last Updated	8/23/2019 6:34:00.79 AM	8/23/2019 6:34:00.79 AM
Project		1/1/1970 12:00:00 AM
Start Time	8/23/2019 6:34:00.79 AM	1/1/1970 12:00:00 AM
Status	Warranty/OEM	8/23/2019 6:34:00.79 AM
Status Change	False	8/23/2019 6:34:00.79 AM
User		8/23/2019 6:34:00.79 AM

Components



Auto-Open/Close Service

Auto-close a downtime event if:

1. the turbine's state is running,
2. its 10m avg. active power is greater than 0, and
3. its most recent fault event has been closed for at least 30 minutes

Notifications

```
2019-08-24 14:20:06.0245 Orca.Analytics.Service.Program -----
2019-08-24 14:30:01.2680 Orca.Analytics.Service.Program Connecting to [REDACTED], database EDF-RE Assets
2019-08-24 14:30:02.8618 Orca.Analytics.Service.Program Connected.
2019-08-24 14:30:02.8618 Orca.Analytics.Service.Program Searching for open downtime events.
2019-08-24 14:30:05.6431 Orca.Analytics.Service.Program 54 open events found.
2019-08-24 14:30:05.6431 Orca.Analytics.Service.Program Retrieving states and active power for associated turbines.
2019-08-24 14:30:05.7369 Orca.Analytics.Service.Program Filtering for turbines that are "Running" and have 10m average active power > 0.
2019-08-24 14:30:05.7369 Orca.Analytics.Service.Program 1 matching turbines found.
2019-08-24 14:30:05.7369 Orca.Analytics.Service.Program Checking for most recent fault event of matching turbines.
2019-08-24 14:30:06.1119 Orca.Analytics.Service.Program [REDACTED]-T90: Oil leakage in Hub. Event end: 8/24/2019 1:51:15 PM.
2019-08-24 14:30:06.1119 Orca.Analytics.Service.Program Closing event(s) that have passed all checks.
2019-08-24 14:30:06.1119 Orca.Analytics.Service.Program [REDACTED] - T90 - Downtime - Master - 2019-08-16 16:26:26
2019-08-24 14:30:06.5182 Orca.Analytics.Service.Notifications.EmailGenerator Sending email to Contact Group: [REDACTED] Downtime, Contacts: 3
2019-08-24 14:30:09.1119 Orca.Analytics.Service.Notifications.EmailGenerator Notification sent successfully
2019-08-24 14:30:09.1119 Orca.Analytics.Service.Program 1 event(s) auto-closed.
2019-08-24 14:30:09.1119 Orca.Analytics.Service.Program -----
```

Kelsey Bobeck | Kelsey Bobeck 13:21

A downtime event has been auto-closed for [REDACTED]

Phish Alert + Get more add-ins

The following downtime event at [REDACTED] has been auto-closed:

Turbine: T90

Event: [REDACTED] - T90 - Downtime - Master - 2019-08-16 16:26:26

Fault Description: Grid Inv Breaker Open

Please go to [ORCA](#) to view more information.

If you believe this event should not have been closed, please reply to this email.

Turbine Downtime

EVENTS CURRENT **HISTORY** SUMMARY

8/27/2019 9:43 AM

THIS MONTH

LAST MONTH

THIS YEAR

Start Year 2019 Start Month Aug End Year 2019 End Month Aug

Provider Filter RS (61), OEM (246)

Region Filter Canada (169), Central (32), North (90), West (16)

Project	Offline	Median Days	Avg Days	Max Days	Lost Energy (MWh)
	146	7.9	8.4	17.1	456.5
	63	4.4	6.6	23.9	651.5
	16	9.2	21.6	115.4	4,632.3
	13	12.5	12.7	27.3	1,574.1
	8	6.9	7.7	12.4	137.0
	6	6.7	19.4	82.9	690.8
	6	7.5	6.6	8.3	444.2
	5	4.1	5.5	10.3	0.0
	5	9.9	17.7	53.2	2,671.1
	3	9.2	17.2	38.6	0.0
	3	77.7	53.4	78.3	1,413.9
	3	8.1	8.3	11.3	365.2
	3	3.3	6.8	14.0	277.0
	3	9.9	9.2	13.4	453.8
	3	6.3	20.1	47.8	0.0
	2	8.3	8.3	10.4	242.4
	2	13.7	13.7	24.4	247.1
	2	2.5	2.5	3.8	0.0
	2	4.1	4.1	4.8	122.0
	2	6.1	6.1	9.1	24.9

Project	Asset	Status	Significant Event	O&M Provider	Duration	Lost Energy (MWh)
	T90	Turbine RTS	4417 - Grid Inv Breaker Open	OEM	7.9 days	186.1
	T90	Turbine RTS	32767 - Comm Fail	OEM	3.1 days	71.4
	T88	Turbine RTS	32767 - Vestas is installing new transformer on 8/20/2019. Had issues with ITE kit tie rack.	OEM	11.3 days	231.9
	T84	Turbine RTS	3728 - Conv Panel Supply Volt	OEM	14.2 days	366.4
	T55	Turbine RTS	171 - Max no of pitchconnect cmd	OEM	5.4 days	0.0
	T48	Turbine RTS	32767 - Bad transformer, eta for arrival thursday 15th	OEM	8.1 days	133.3
	T43	Turbine RTS	32767 - Comm Fail	OEM	9.9 days	356.0
	T22	Turbine RTS	9902 - Blade Damage to blade tip,	OEM	53.2 days	1,691.2
	T036	Turbine RTS	7111 - Hyd. for crane/cover activated	OEM	3.2 days	11.3
	T004	Turbine RTS	1014 - Stopped for SW update	OEM	9.1 days	13.6
	T003	Turbine RTS	7100 - Bad hydraulic pump	OEM	33.2 days	370.4
	K321	Turbine RTS	13902 - Converter tripped, Auto Start	RS	47.8 days	0.0
	K248	Turbine RTS	13902 - Converter tripped, Auto Start	RS	6.3 days	0.0
	K245	Turbine RTS	13902 - Converter tripped, Auto Start	RS	6.3 days	0.0
	H03	Turbine RTS	null - arc light sensor error	RS	8.3 days	161.1
	G84	Turbine RTS	178 - Fault Battery Charge Switching Shut Down	RS	10.3 days	0.0
	G72	Turbine RTS	308 - Idling Command at WTG	RS	4.1 days	0.0
	G48	Turbine RTS	-14 - Manual Idle Stop	RS	4.8 days	0.0
	G35	Turbine RTS	107 - Gen Side CCU Fault Temperature	RS	4.0 days	0.0
	G33	Turbine RTS	-5 - Repair	RS	4.1 days	0.0
	G02	Turbine RTS	null - bad generator	RS	18.2 days	430.8
	F92	Turbine RTS	-5 - Repair	OEM	4.2 days	23.6
	E84	Turbine RTS	-5 - Repair	OEM	77.7 days	826.1

Turbine Downtime

EVENTS CURRENT **HISTORY** SUMMARY

8/27/2019 9:43 AM

THIS MONTH

LAST MONTH

THIS YEAR

Start Year 2019 Start Month Aug End Year 2019 End Month Aug

Provider Filter RS (61), OEM (246)

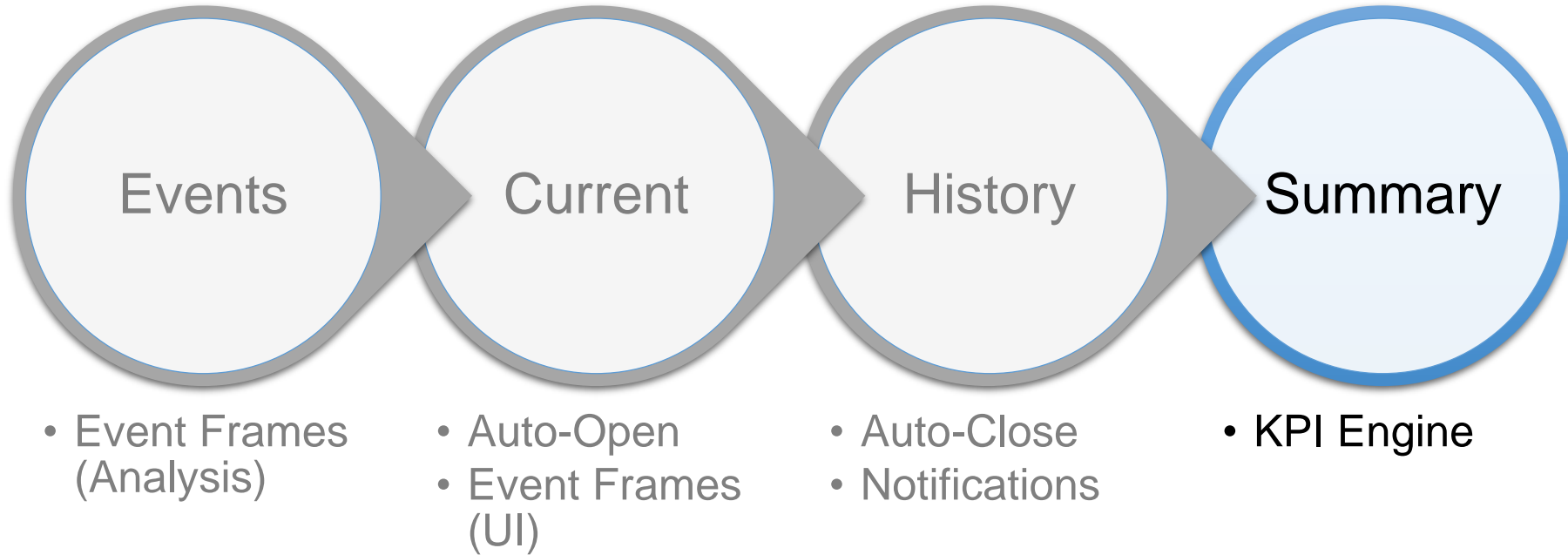
Region Filter Canada (169), Central (32), North (90), West (16)

Project

Offline	Median Days	Avg Days	Max Days	Lost Energy (MWh)
146	7.9	8.4	17.1	456.5
63	4.4	6.6	23.9	651.5
16	9.2	21.6	115.4	4,632.3
13	12.5	12.7	27.3	1,574.1
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6	6.7	19.4	82.9	690.8
6	7.5	6.6	8.3	444.2
5	4.1	5.5	10.3	0.0
5	9.9	17.7	53.2	2,671.1
3	9.2	17.2	38.6	0.0
3	77.7	53.4	78.3	1,413.9
3	8.1	8.3	11.3	365.2
3	3.3	6.8	14.0	277.0
3	9.9	9.2	13.4	453.8
3	6.3	20.1	47.8	0.0
2	8.3	8.3	10.4	242.4
2	13.7	13.7	24.4	247.1
2	2.5	2.5	3.8	0.0
2	4.1	4.1	4.8	122.0
2	6.1	6.1	9.1	24.9

Project	Asset	Status	Significant Event	O&M Provider	Duration	Lost Energy (MWh)
	T90	Turbine RTS	4417 - Grid Inv Breaker Open	OEM	7.9 days	186.1
				Timestamp: Fri, 16 Aug 4:26 PM - Sat, 24 Aug 2:30 PM		
Annotations		Entered By		Timestamp		
Initiated tracking - Warranty/OEM		system		Fri, 16 Aug 4:26 PM		
Annotation		User		Fri, 23 Aug 6:34 AM		
Auto changed status to Turbine RTS		system		Sat, 24 Aug 2:30 PM		
T90	Turbine RTS		32767 - Comm Fail	OEM	3.1 days	71.4
T88	Turbine RTS		32767 - Vestas is installing new transformer on 8/20/2019. Had issues with ITE kit tie rack.	OEM	11.3 days	231.9
T84	Turbine RTS		3728 - Conv Panel Supply Volt	OEM	14.2 days	366.4
T55	Turbine RTS		171 - Max no of pitchconnect cmd	OEM	5.4 days	0.0
T48	Turbine RTS		32767 - Bad transformer, eta for arrival thursday 15th	OEM	8.1 days	133.3
T43	Turbine RTS		32767 - Comm Fail	OEM	9.9 days	356.0
T22	Turbine RTS		9902 - Blade Damage to blade tip,	OEM	53.2 days	1,691.2
T036	Turbine RTS		7111 - Hyd. for crane/cover activated	OEM	3.2 days	11.3
T004	Turbine RTS		1014 - Stopped for SW update	OEM	9.1 days	13.6
T003	Turbine RTS		7100 - Bad hydraulic pump	OEM	33.2 days	370.4
K321	Turbine RTS		13902 - Converter tripped, Auto Start	RS	47.8 days	0.0
K248	Turbine RTS		13902 - Converter tripped, Auto Start	RS	6.3 days	0.0
K245	Turbine RTS		13902 - Converter tripped, Auto Start	RS	6.3 days	0.0
H03	Turbine RTS		null - arc light sensor error	RS	8.3 days	161.1
G84	Turbine RTS		178 - Fault Battery Charge Switching Shut Down	RS	10.3 days	0.0
G72	Turbine RTS		308 - Idling Command at WTG	RS	4.1 days	0.0

Components



Turbine Downtime

EVENTS CURRENT HISTORY **SUMMARY**

8/16/2019 12:05 PM

YEAR TO DATE

LAST FOUR QUARTERS

Start Year: 2019
Start Month: Jan
End Year: 2019
End Month: Sep



Provider Filter

Region Filter

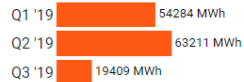
Status Filter

RS (557), O... Canada (261), Central (350), North (4... Awaiting Approval (11), BOP Outage (19), Contractor Sourcing (22), E...

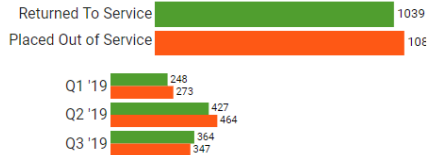


Estimated Lost Energy Production

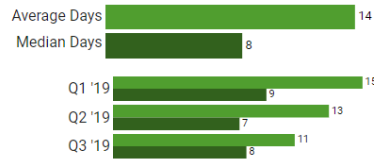
136,904 MWh



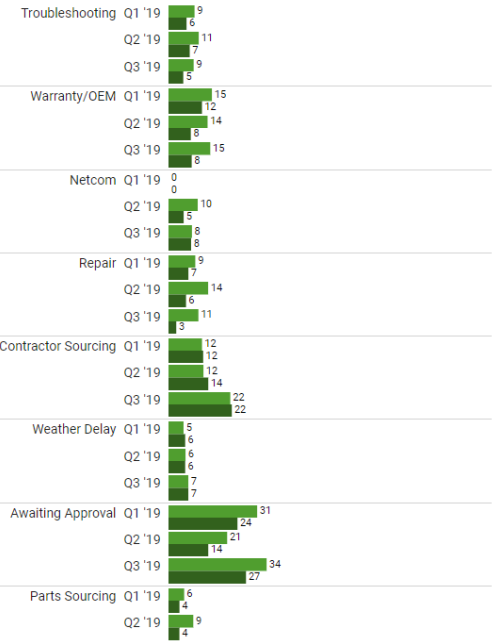
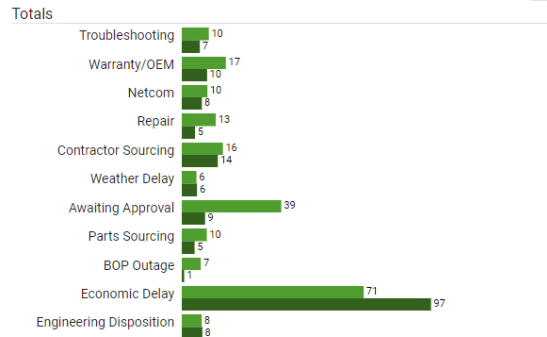
Turbine RTS vs. Placed Out of Service



Average and Median Downtime Totals



Average and Median Time by Status



Turbine Downtime

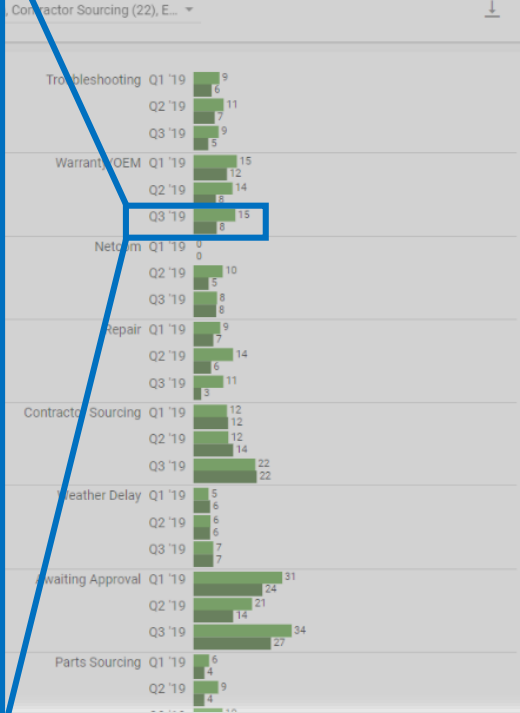
8/16/2019 12:05 PM

Downtime Details

Warranty/OEM Q3 '19 Average 12
Median 7

Project	Asset	Duration	
	065	8.4 days	▼
	C28	8.2 days	▼
	E07	8.1 days	▼
	064	8.0 days	▼
	T90	7.9 days	▼
	B27	7.2 days	▼
	052	7.2 days	▼
	124	7.2 days	▼
	E76	7.1 days	▼
	T038	7.1 days	▼
	C16	6.9 days	▼
	022	6.7 days	▼
	041	6.6 days	▼
	E21	5.9 days	▼
	047	5.8 days	▼
	005	5.8 days	▼
	003	5.8 days	▼
	---	---	

CLOSE



KPI Engine

Downtime Details

Warranty/OEM Q3 '19 Average 12
Median 7

Project	Asset	Duration	
	065	8.4 days	▼
	C28	8.2 days	▼
	E07	8.1 days	▼
	064	8.0 days	▼
	T90	7.9 days	▲

Status: Turbine RTS
Significant Event: 4417 - Grid Inv Breaker Open

Timestamp: Fri, 16 Aug 4:26 PM - Sat, 24 Aug 2:30 PM
Duration: 7.9 days

Annotations

Annotation	Entered By	Timestamp
Auto changed status to Turbine RTS	system	Sat, 24 Aug 2:30 PM
Annotation	User	Fri, 23 Aug 6:34 AM
Initiated tracking - Warranty/OEM	system	Fri, 16 Aug 4:26 PM

	E21	5.9 days	▼
	047	5.8 days	▼
	005	5.8 days	▼
	003	5.8 days	▼
	---	---	

CLOSE

What's Next

- Solar downtime tracking
- Rollout to EDF Renouvelables
- Fine-tuning Comm Fail tracking
- Estimated Revenue Loss

Find Out More

- Providing Enterprise Level Visibility for Snowflakes Using PI and AF
 - David Rodriguez (EDF RE) and Lonnie Bowling (Diemus) at PI World 2019
- Monitoring Data Quality with Asset Analytics
 - David Rodriguez (EDF RE) at PI World EMEA 2018

CHALLENGES

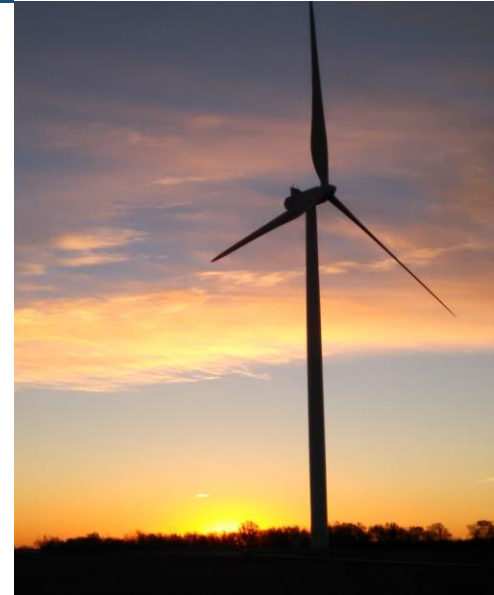
- No central place to track down turbines
- Miscommunications and delays
- No understanding of opportunities for improvement

SOLUTION

- Existing, web-based tool (ORCA)
- Tracking and documentation through EFs
- KPIs accessible by any and all stakeholders

BENEFITS

- 1700+ LTDT events tracked
- Reduced number of LTDTs
- Transparency and “paper trail” for stakeholders



“[In] regions where [EDF] is the O&M provider we have significantly reduced [the] number [of LTDTs]... We used to measure down turbines by days, now we measure down turbines by dollars.”

-John Durels, Director, Field Operations





Kelsey Bobeck
Analytics & Intelligence Engineer
EDF Renewables
Kelsey.Bobeck@edf-re.com

Questions?

Please wait for
the **microphone**

State your
name & company



Please remember to...

Complete Survey!

Navigate to this session in
mobile agenda for survey

An advertisement for the OSISOFT PIWorld app. The background is a dark blue gradient with a subtle pattern. On the left, the text "TO DOWNLOAD APP, SEARCH OSISOFT" is written in white, bold, sans-serif font. Below this text are two black buttons: "Download on the App Store" with the Apple logo and "GET IT ON Google Play" with the Google Play logo. On the right, a smartphone is shown vertically, displaying the OSISOFT PIWorld logo on its screen. The logo consists of a white stylized atom symbol above the text "OSISOFT PIWorld" in white.

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 TAPADH LEIBH 고맙습니다
 БАЯРЛАЛАА MISAOTRA ANAO
 DZIĘKUJĘ CI NGIYABONGA TEŞEKKÜR EDERIM GRACIES OBRIGADO شكرا SALAMAT
 DANKON TANK TAPADH LEAT
 KÖSZÖNÖM DANKIE TERIMA KASIH GRACIES
 СПАСИБО МУЛТUMESC
 PAKMET CIZGE HVALA FAAFETAI
 GO RAIBH MAITH AGAT ESKERRIK ASKO
 БЛАГОДАРЯ GRACIAS MAHADSANID HVALA ХВАЛА ВАМ
 TI БЛАГОДАРАМ TEŞEKKÜR EDERIM
 TAK DANKE DANK JE EΥΧΑΡΙΣΤΩ GRATIAS TIBI GRAZIE
 АČIŪ SALAMAT MAHALO IĀ 'ŌE TAKK SKALDU HA DI OU MÈSI
 RAHMAT MERCI HATUR NUHUN GRAZZI ПAKKA PĒR ありがとうございました ĎAKUJEM
 PAXMAT САГА СИPAS JI WERE TERIMA KASIH MATUR NUWUN
 CẢM ƠN BẠN UA TSAUG RAU KOJ
 WAZVIITA TI БЛАГОДАРАМ
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