Low Tech is the new High Tech

Centralizing Wind Farm Monitoring amidst Development Challenges in India

Nileena Suresh & Prajakta Gurav

October 2018

Forward-Looking Statements

During the course of this presentation, we may make forward-looking statements regarding future events or the expected performance of the company. We caution you that such statements reflect our current expectations and estimates based on factors currently known to us and that actual events or results could differ materially. For important factors that may cause actual results to differ from those contained in our forward-looking statements, please review our filings with the SEC.

The forward-looking statements made in this presentation are being made as of the time and date of its live presentation. If reviewed after its live presentation, this presentation may not contain current or accurate information. We do not assume any obligation to update any forward-looking statements we may make. In addition, any information about our roadmap outlines our general product direction and is subject to change at any time without notice. It is for informational purposes only and shall not be incorporated into any contract or other commitment. Splunk undertakes no obligation either to develop the features or functionality described or to include any such feature or functionality in a future release.

splunk> .conf18

Our Speakers

NIL

Nileena Suresh

Splunk Certified Consultant II

PRAJ

Prajakta Gurav

Splunk Certified Consultant I

SMARTCIRQLS INFOTECH, INDIA

Wind Energy in India

4th Largest Installed Capacity in the World

Wind Power in India

The Stats

1.3

Bn

Total Population of India

240

Mn

Living Without Electricity

FY 2017

5.4

GW

Record High Wind Capacity Addition

FY 2017

¢3.6

per kWh

Record low levelized tariff

26

GW

Additional Capacity Required by 2022

The Need for Transformation

A Wind Turbine Company bags > 35% of the annual capacity addition: 2000+ MW in 1 year.

Priorities

Problem Set

- Local monitoring, manual service requests.
- Alarms generated only post-failure
- Response time to remote areas > 1 day
- Multiple part repairs / replacements

Requirements

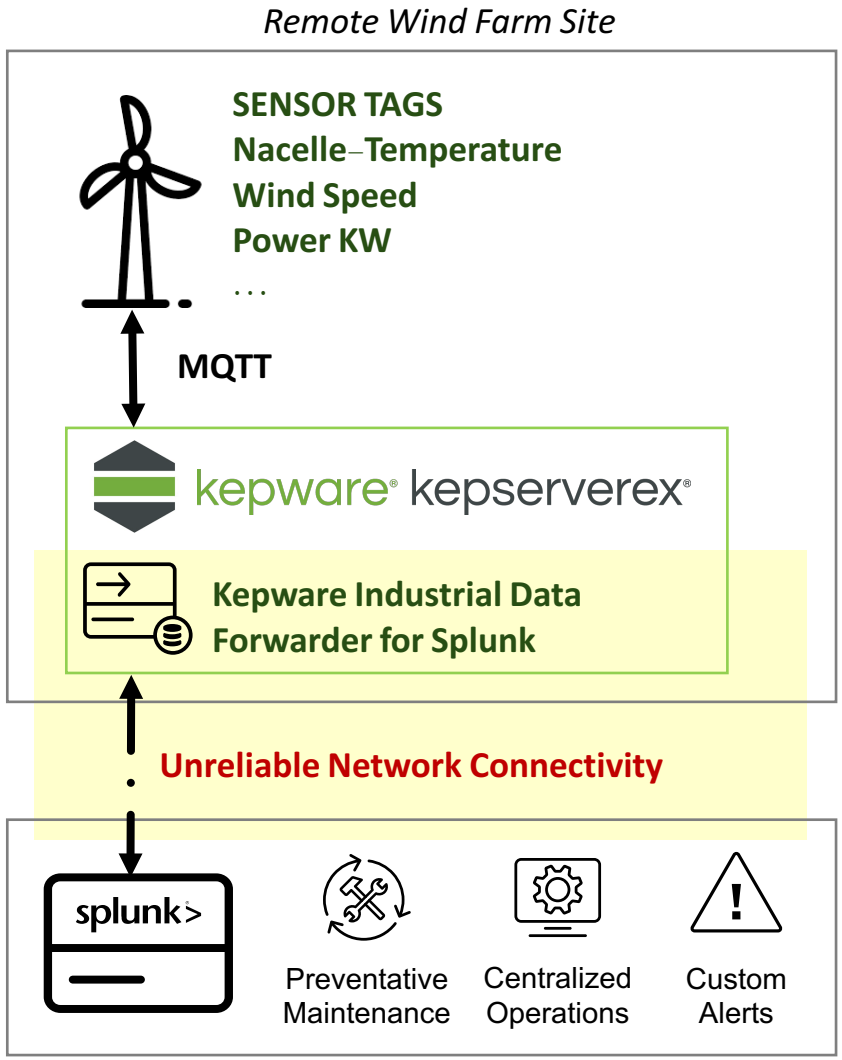
- Centralize Wind Farm Monitoring
- Customize rules for alarms based on sensor parameters
- Predict failure before turbine downtime

Solution

Best Practice #1 – What's "best" for your customer?

A Standard Splunk Solution

And its Challenges

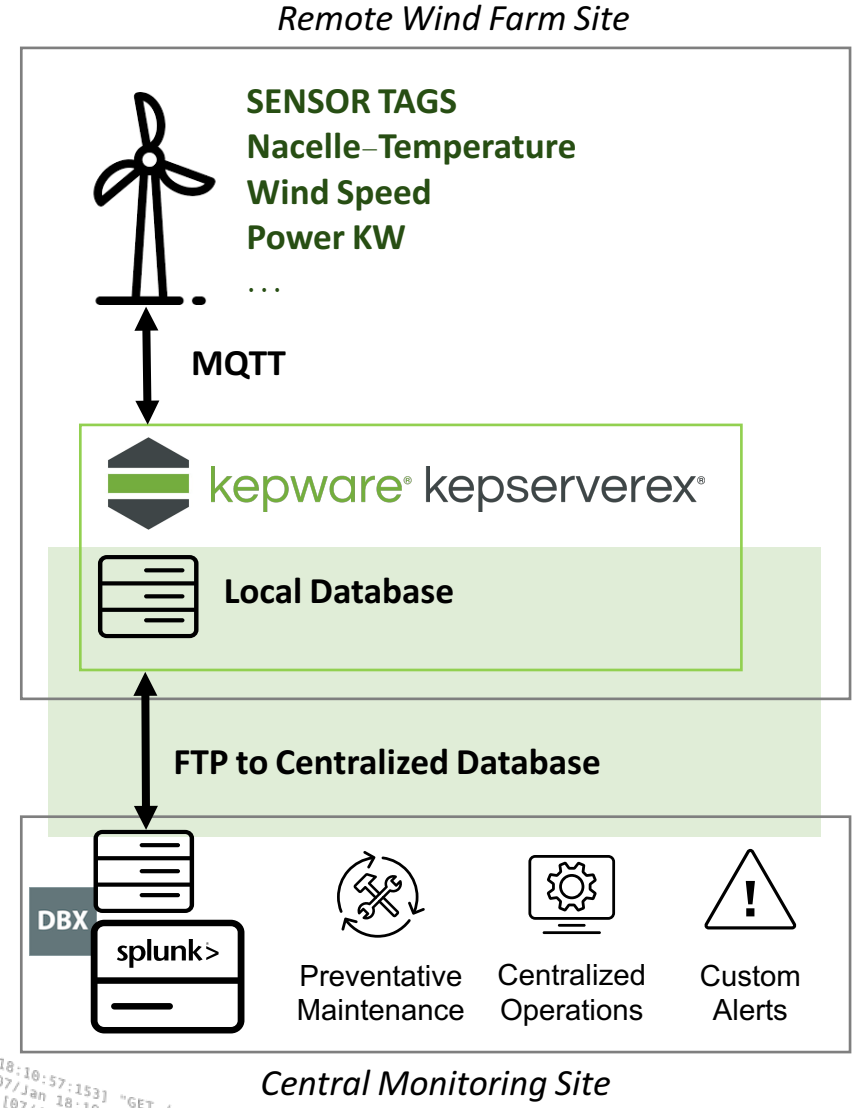


Recommended solutions did not account for the limitations of India's on-ground realities

- **Connectivity** to farm sites may be down for days
- **Accessibility** issues of remote villages for skilled IT professionals
- **Onsite Tech** had dated DB systems. Upgrading required extensive effort.

Implemented Splunk Solution

The India operations team took the initiative to find a creative and viable solution



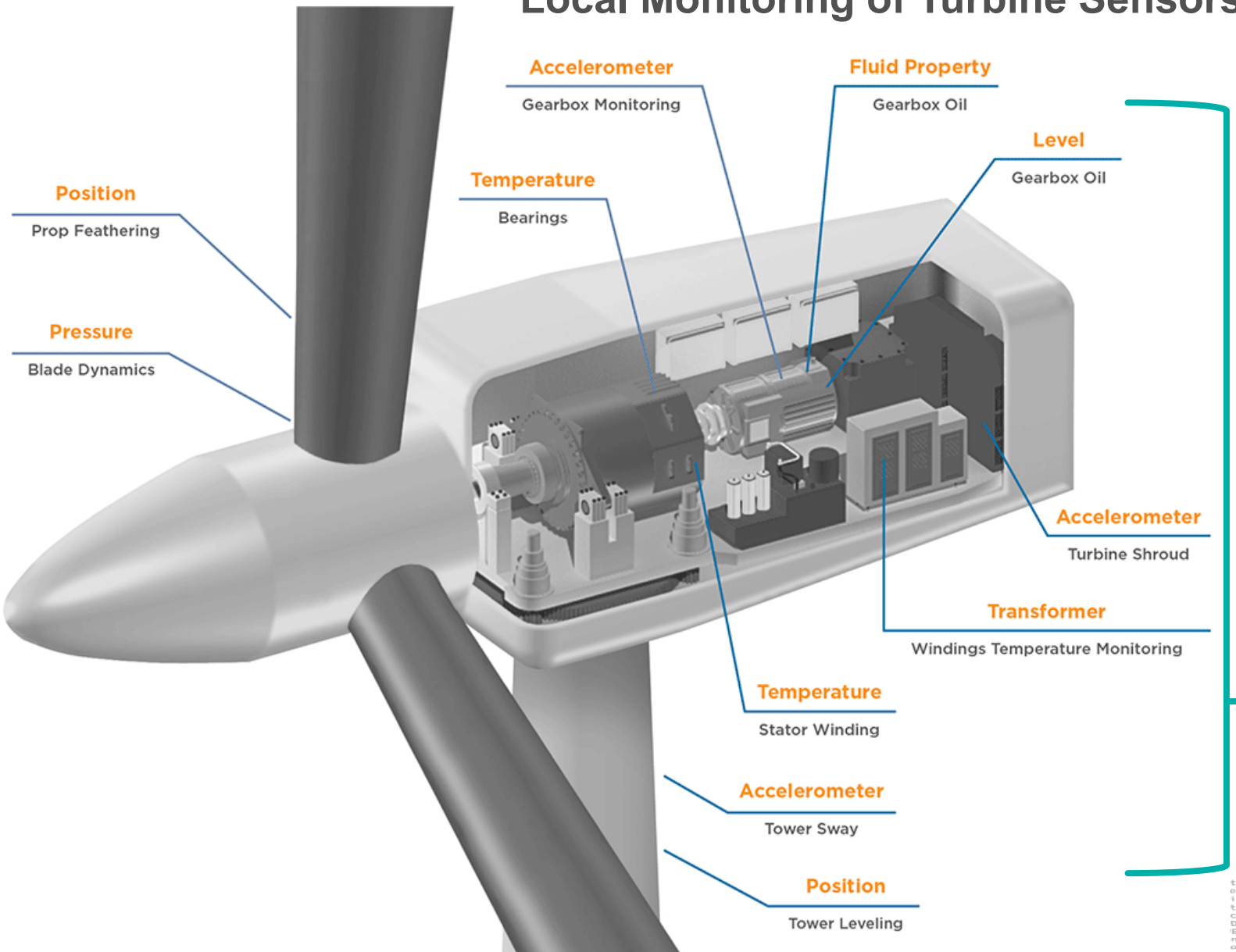
Priorities for the Customer

- **Local Team** familiar with the limitations of the development landscape.
- **Minimal / no disruption** to the existing onsite architecture at wind farms.
- **Splunk skills** not needed at wind farm sites. Only at central site.
- **POC in Production Architecture** for 1 live wind farm - 20 Turbines x 18 tags x10 min intervals, using DB Connect.

splunk> .conf18

Data Collection

Local Monitoring of Turbine Sensors via SCADA



Each Turbine Sends

- 80 Parameter Tags
- 3 Status Tags

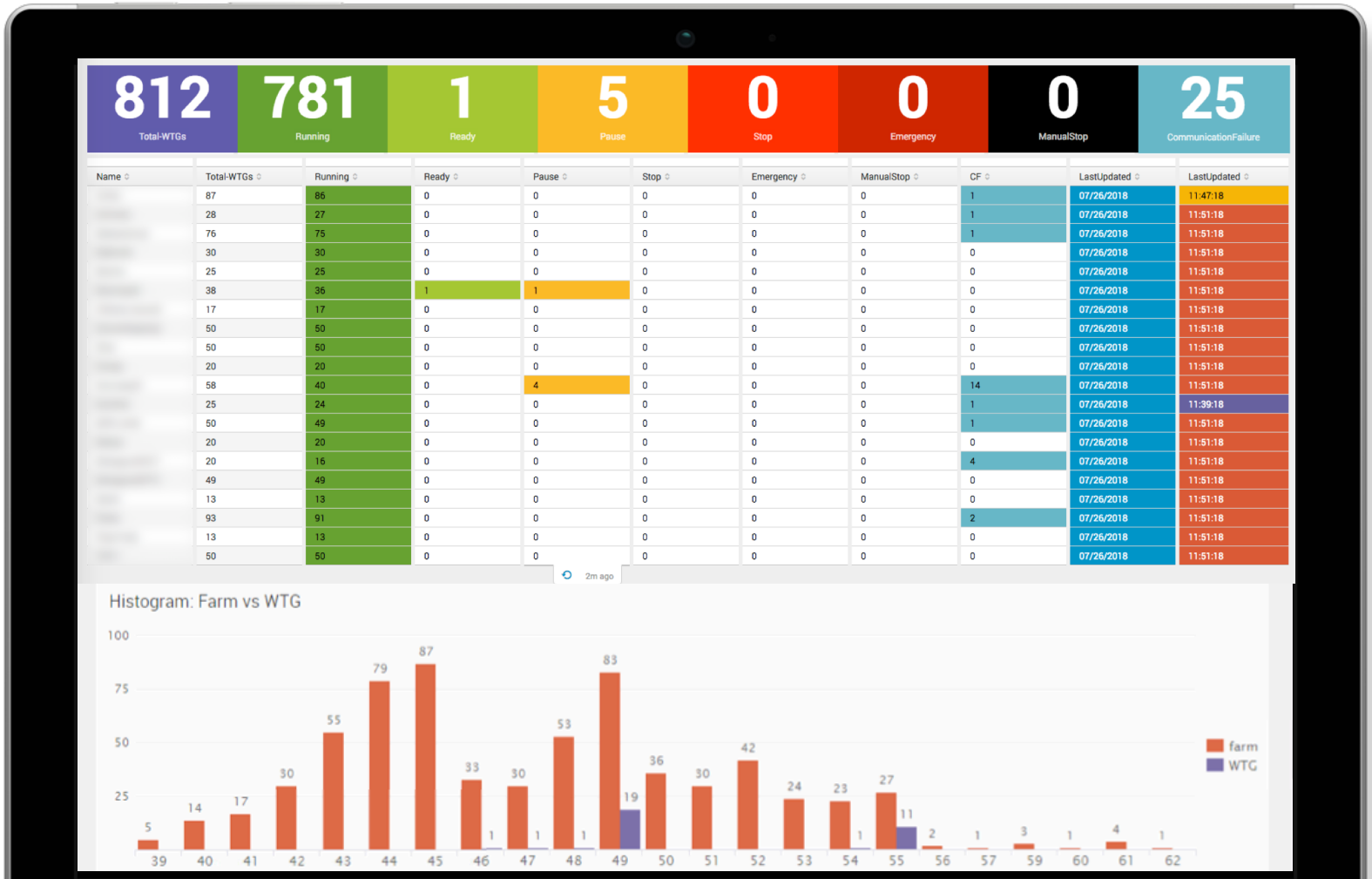
(x 10 min intervals)

SCADA – WIND TURBINE CONTROL SYSTEM

splunk> .conf18

Wind Farm Monitoring

Main Dashboard for Centralized Operations Centre

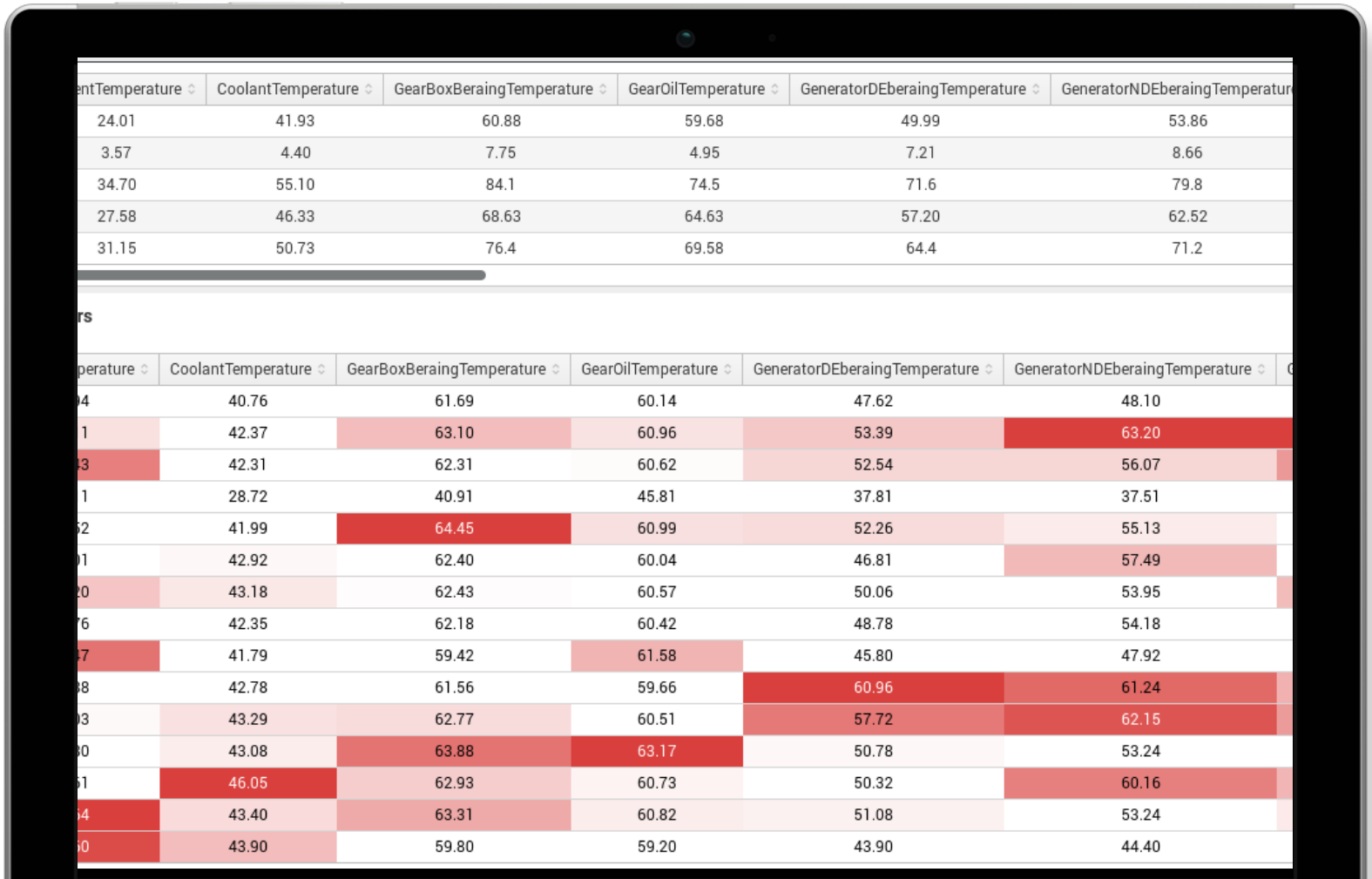


- List of Wind Farms that have turbine problems
- Drill Down to Turbines with problematic parameters
- Histogram of deviation per parameter from its 7day Farm-avg.

splunk> .conf18

Wind Farm Monitoring

Alerting & Prediction



entTemperature	CoolantTemperature	GearBoxBeraingTemperature	GearOilTemperature	GeneratorDEberaingTemperature	GeneratorNDEberaingTemperatur
24.01	41.93	60.88	59.68	49.99	53.86
3.57	4.40	7.75	4.95	7.21	8.66
34.70	55.10	84.1	74.5	71.6	79.8
27.58	46.33	68.63	64.63	57.20	62.52
31.15	50.73	76.4	69.58	64.4	71.2

rs

perature	CoolantTemperature	GearBoxBeraingTemperature	GearOilTemperature	GeneratorDEberaingTemperature	GeneratorNDEberaingTemperature
94	40.76	61.69	60.14	47.62	48.10
1	42.37	63.10	60.96	53.39	63.20
43	42.31	62.31	60.62	52.54	56.07
1	28.72	40.91	45.81	37.81	37.51
52	41.99	64.45	60.99	52.26	55.13
91	42.92	62.40	60.04	46.81	57.49
20	43.18	62.43	60.57	50.06	53.95
76	42.35	62.18	60.42	48.78	54.18
47	41.79	59.42	61.58	45.80	47.92
38	42.78	61.56	59.66	60.96	61.24
03	43.29	62.77	60.51	57.72	62.15
30	43.08	63.88	63.17	50.78	53.24
51	46.05	62.93	60.73	50.32	60.16
04	43.40	63.31	60.82	51.08	53.24
50	43.90	59.80	59.20	43.90	44.40

- Alerts for 3rd deviation of any parameter or combination of parameters predict turbine failure before it occurs.
- Solution scaled to
  - **100 farms**
  - **25-50 turbines per farm**
  - **80 parameters per turbine**

splunk> .conf18

Impact

Pan – India Centralized Monitoring in 3 weeks

Path to Success

- First failure prediction in the POC demo itself.
- Savings from this incident justified entire Phase 1 cost.

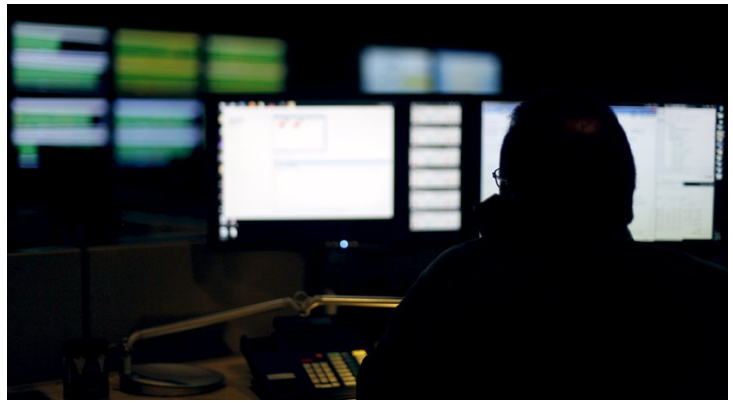
Return on Investment even before the project started.

- Cyclone Vardah rips up the country's undersea cables in Dec 2016.
- Splunk restoration within hours of connectivity.

Viability proved in the aftermath of Cyclone Vardah.

- No upgrading of tech at local farm sites.
- Quick setup and easy maintenance at central site.

Time to market: 3 weeks



#WIN

1. 2 Year ROI achieved during POC.
2. Low Tech, Low Cost Architecture proved to be stable and viable.
3. Centralized Wind Farm Monitoring in 3 weeks.
4. Expansion for substation-wise power loss monitoring

#WIN

April 2018

100% Electrification of inhabited villages

Target: March 2019

100% household electrification

Thank You

Don't forget to rate this session in the .conf18 mobile app