

***Proposal for
“BOLA: An IoT based Distribution Transformer Monitoring
System”***

Contents:

1. Company Introduction	- Pg. 2
2. Brief of IoT solution	
a. Introduction	- Pg. 2
b. Key benefits & Comparison with other practices	- Pg. 3
c. Features, Specifications & Benefits	- Pg. 4-5
d. Architecture & sample pictures	- Pg. 5-7
3. Commercials	- Pg. 7
4. Details required for Installation	- Pg. 8
5. FAQs	-Pg 8-9

BOLA-Better operations & life by Analytics: An IoT based transformer remote monitoring solution

Subject: PoC Proposal for IoT based real time transformer monitoring solution on 11 KV/433 kV Transformers

About KRYFS: KRYFS is India's leading Transformer Core manufacturing company with a annual capacity to process 50,000 MT of CRGO Electrical Steel into transformer laminations and cores.

Today, KRYFS services the entire value chain of energy supply from generation (of Solar Power), Transmission (through its EPC business) to distribution (through manufacture of transformers, cores, and fabrication) and employs over 750 people, all over India.

KRYFS have 9 manufacturing facilities for manufacturing of distribution and medium power transformers up to 10 MVA, 33 KV class, laminations, transformer cores, transformer tanks and lifting slings. Three units are located at Kherdi, in the Union Territory of Dadra and Nagar Haveli, one unit at Palghar, Maharashtra, three units in Baroda and one in Bhopal.

KRYFS has expanded its product range to include transformers from 10 KVA (33 KV class), CRGO laminations up to 765 KV class (India's first POWRGRID certified manufacturer) and transformer tanks up to 765 KV class (at its facility in Bhopal).

From a humble beginning of 120 MT per annum in December 1992 to 50,000 MT per annum in 2017 and expanding the value chain from generation to distribution has been an exciting journey full of learning and many achievements.

With quarter on quarter growth for over the years, in the year 2012, **Toyota Tsusho Corporation** (TTC), Japan, a \$80 Billion subsidiary of Toyota Motors, acquired a strategic stake in KRYFS, which was subsequently increased to 20% in 2013. Since then Toyota Tsusho has been our strategic business partner & together, we have been creating immense value solutions to meet the client requirements.

Solution Brief:

BOLA is an IoT based low-cost distribution transformer remote monitoring solution that will monitor the vital parameters of a transformer (Electrical & Physical) in real-time. The solution diagnoses & sends alerts/notifications on SMS & email whenever there is any abnormality sensed. It enables transformer monitoring remotely from anywhere on the mobile or desktop. This allows maintenance to be scheduled and corrective action to be taken before the failure actually happens.

“Condition based maintenance over present practice of Time-Based Maintenance enables to respond to the criticalities as & when the alerts are provided.”

Some contrasting benefits of IoT based monitoring compared to present practices listed hereunder for your reference:

Description	Type 1	Type 2	Type 3	Type 4
	Traditional Monitoring	Smart meter based monitoring	SCADA monitoring	IoT Monitoring
Approach	Time based (half yearly, annual etc.)	Time based. Electrical parameters monitored in addition to case 1	Real time. SCADA is hardware oriented with complex architecture & vendor specific protocols	Real time. IoT is software oriented with simple architecture.
Mode	Manual (user inspects & collects data)	Same as type 1. Scope for real time monitoring in future	Automatic monitoring from a dedicated remote location & access to limited users	Automatic monitoring with access to multiple users & from any location
Data Storage	Written & documented	Written & documented	Digital	Digital
Asset Condition Transparency	Nil	Low (only load & electrical parameters)	Good (But monitoring by limited users only)	Better than all types. No limit on no. of users to monitor
Cost Vs Failure	Nil - Very High	Low - High	High - Moderate	Low - Low
Upgrade /Scalability	NA	NA	Difficult & Costly	Easy & Cheap

SCADA ecosystem consists of numerous vendor specific protocols, which are mutually incompatible. Also, the cost & process of scaling for IoT is better than SCADA. These factors form a significant challenge for organizations, that need system wide view of operations such as electric utilities working towards a smart grid

What makes IoT monitoring more versatile is its ability of data aggregation which further provides

- a. **Predictive Analysis (Forecasting)**
- b. **Prescriptive Analysis (when, why, what to do)**

BOLA will monitor the following parameters:

Physical Parameters:

- Oil Temperature, Oil Level, Ambient Temperature, Humidity, Winding Temperature, additionally we can also measure Lug Temperature/Panel box temperature(optional), Tap Position Indicator (Optional), Noise Level

Electrical parameters:

- Phase wise Voltage, Current, PF, KW, KVA, KVAR, System V, I, PF, KVAh, KVARh.
- Harmonics: 1st to 31th odd harmonic, THD for Current & Voltage
- Demand: Peak Demand every 15minute, daily, monthly & yearly
- Geo location with Alert Pop Ups & Communication status, Asset Register
- Real time transformer status & graphical trends of Physical & Electrical parameters

Customized alerts for:

- Overload, Unbalance, Voltage drop, High Oil Temperature, High Winding Temperature, Oil Level Low/High, Buchholz Relay, MOG, Winding Temperature etc.
- Asset Availability, Units consumed, Downtime, Units Lost
- Cloud Platform & Analytics, Customized Reports
- SMS, EMAIL alerts as per settings

Specifications:

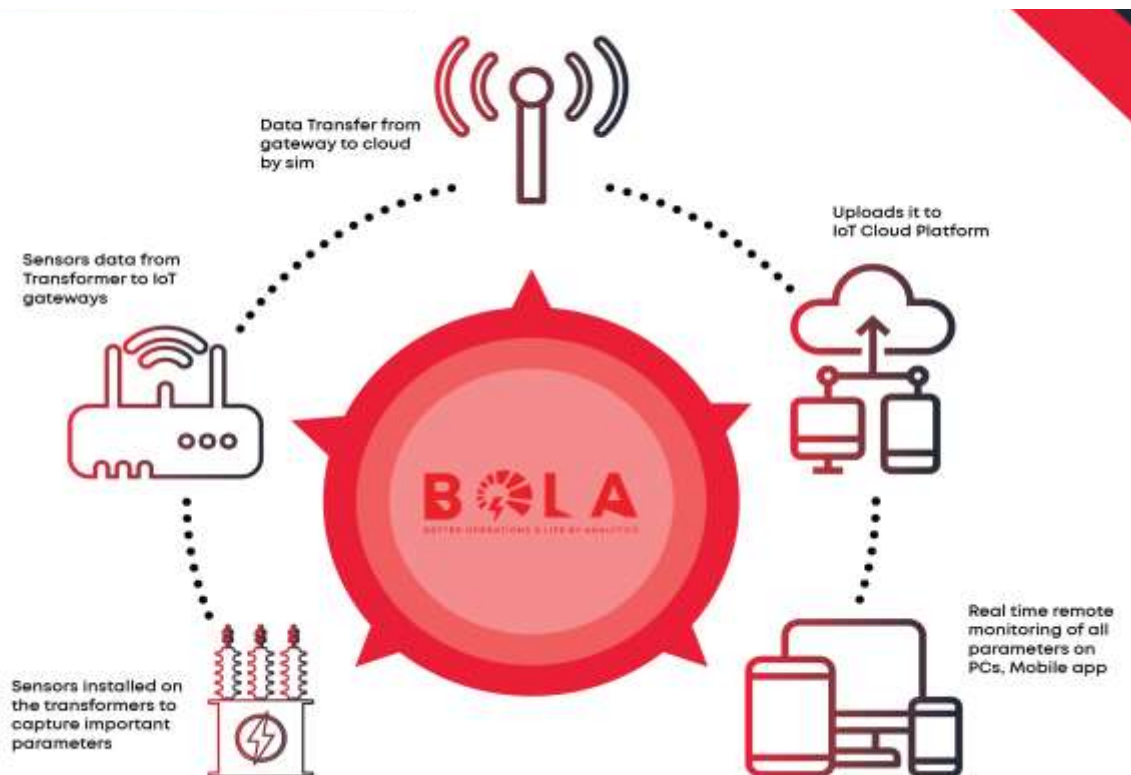
- Communication: 2G/3G/4G GSM + Wi-Fi enabled modem
- Metering circuit/system compliant with IEC 62053-22 (Class- 0.5s)
- Microcontroller (STM) with 72 MHz speed, 128Kb RAM & Inbuilt RTC
- Real time clock
- I/O's: Analogue & digital Inputs/Outputs
- Electrical parameters: Phase Voltage, Current, PF, Frequency, KVA, KVA_r, Kw, Harmonics (THD% V & I), Instantaneous Demand, Peak Demand
- Three Resin Cast CT's of desired rating & 0.5s Class to be mounted on cable/bus bar
- Flexible mounting Oil temperature measurement sensor with IP65 termination Head, SS316 covering, Resolution -0.1DegC, Accuracy- 0.5Deg C, Temperature Range: 0 to 150 Deg. C
- Oil Level Alert Sensor: Switching Type SPST, Termination: IP65 Head, Flexible mounting Cap with Guide tube 8mmx490mm SS316, Variable Sensor length suitable for 250mm to 500mm Conservator tank, Alerts: Normal, Low & High
- Ambient temperature & Humidity sensors: Resolution-0.1DegC, Accuracy- 0.5Deg C, Temperature Range -50 to 100 Deg. C
- IP65 box having size 250mmx300mmx110mm (L x W x H) with shielded wiring/cables, flexible SS conduits cover, connectors/adaptors and box mounting flange (Suitable length cable/conduit length, Max - 5m). We can further provide a metal panel housing.

BOLA- Benefits:

- Reduction in preventive maintenance cost by approx. 30% by condition-based maintenance
- Increased average uptime thereby increasing customer satisfaction
- Optimum asset utilization (over/underload utilized asset)
- Increased revenue by reduction in failure rates (*** a 5 % reduction will save roughly over 50 crores of revenue**)
- Reduction in average outage duration (**a 24-hour reduction in downtime will reduce the revenue loss by 30%**)
- Monitoring of power quality parameters like THD, pf, voltage variations etc.
- Increased revenue by reduction in theft by real time remote monitoring of energy meters (**AT&C losses can be brought down to 7-8%**) by proper identification of theft which is possible through IoT based monitoring of meters
- Real time alerts on phone in case any critical parameter breaches threshold
- Predictive transformer health parameters higher uptime of transformer
- Downtime analysis and calculation of revenue lost
- Structured and authentic data with no human error
- Asset register along with repository of data in cloud, geo- tagged assets on a single dashboard
- Better management of field service & maintenance

*Note: Above estimation is based on the total failures & related revenue loss across the country. However, these may vary from utility to utility depending on the average rating, failure rate, type of failures & time required to replace the faulty transformers.

BOLA Solution Architecture & Platform Pictures:



date	Oil temperature	Oil Level	Winding Temperature	Ambient Temperature	Humidity	VA_MH
Wed Feb 19 2020 10:39	22.950	Normal	0.000	34.000	11.000	232.080
Wed Feb 19 2020 10:24	23.450	Normal	0.000	32.000	12.000	233.850
Wed Feb 19 2020 10:09	23.220	Normal	0.000	36.000	10.000	233.990
Wed Feb 19 2020 09:54	22.780	Normal	0.000	33.000	11.000	235.850
Wed Feb 19 2020 09:39	22.110	Normal	0.000	27.000	14.000	236.510
Wed Feb 19 2020 09:24	21.700	Normal	0.000	24.000	16.000	236.280
Wed Feb 19 2020 09:09	21.300	Normal	0.000	22.000	18.000	237.250
Wed Feb 19 2020 08:04	20.700	Normal	0.000	21.000	28.000	238.000

BOLA: Snapshots of installations in Silvasa



Commercials: Our solution is offered in 3 different packages as given hereunder

Parameter Description	BOLA Basic	BOLA Basic+	BOLA Advance
Oil Temperature	✓	✓	✓
Oil Level	✓	✓	✓
Ambient Temperature	✓	✓	✓
Ambient Humidity	✓	✓	✓
GPS location	✓	✓	✓
Electrical-Parameters (Energy meter)	X	✓	✓
Oil temp Alarm	X	✓	✓
Moisture	X	✓	✓
Analytics	X	✓	✓
Lug temperature	X	X	✓
Winding Temperature	X	X	✓
OLTC	X	X	✓
Others	X	X	✓*

*Other parameters in advanced package shall be as per customer requirement & upon our confirmation of the feasibility

A detailed commercial proposal shall be submitted upon reviewing the parameters to be monitoring, asset design & location, number of devices etc. However, our price range starts from INR 15,000 onwards considering no complexities in the transformer design & located in a well accessible area

Details required for installation:

- Asset details: (Transformer Make, manufacturing year, Vector group, Transformer indoor/outdoor)
- Technical details: - (KVA rating, Max rated load current, Voltage ratio [HV/LV], WTI CT rating, Energy meter protocol RS485/RS432/DLMS).
- Mechanical details: - (Thermal pocket opening size and depth size [i.e. OT cavity], Conservator inner/outer diameter, Conservator opening pipe height, Inner/outer diameter of pipe. LV side Bus bar dimensions.)
- Images: - Transformer name plate image, conservator image, bus bar image, transformer image.
- Coverage: - network connectivity (Idea/Vodafone/Airtel etc.)

FAQs**i. Why do we install BOLA when we have a new transformer and 3/5 years warranty?**

BOLA isn't just for protecting your transformer from failures. It also monitors parameters such as PF, Harmonics, Load unbalances, Overvoltage etc which showcase the quality of power and the losses associated with the usage of various equipment. By monitoring these and taking corrective action, one can save energy, plan their loading of different equipment and protect their equipment from failure. Further it helps in planning the maintenance of the transformer based on the condition of the transformer and helps outage. Hence, whether the transformer is new or old, it will benefit from BOLA.

ii. What is the cost of different versions?

The basic version starts at 15k. Cost varies depending on number of devices needed, parameters monitored and features required

iii. Where to install the BOLA device?

Typically, on the support base of the transformer or within 1-2 meter of the transformer

iv. Will it monitor moisture in oil?

No, we don't monitor the oil moisture as the cost of the sensor itself is very high and hence the cost of the solution will increase to a very high value which would not make sense to deploy on a distribution transformer.

v. Is SCADA integration possible?

Yes. Details of SCADA software and database will be needed

vi. Can we keep the data on client's server?

Yes. This will require additional effort and cost

vii. What additional parameter we can monitor?

Parameters like tap changer position of OLTC, Lug temperature, noise level, physical hooter etc

viii. If there is no network, will BOLA still capture data?

It will store the data and once network is restored; data will be sent back so no loss of data

ix. How is the device powered?

From the secondary output voltage of transformer (needs 230 V ac)

x. What is the effect of rain, heat etc on the device?

BOLA comes with IP 65 protection box

xi. Can it be retrofitted on old transformer? How much downtime is required?

Yes. Takes about 1 hour to install the device

xii. Can it be installed on power transformer? What's the rating up to which we can do it?

No. We do it for distribution transformer with secondary output of 430v

xiii. Will BOLA trip the transformer in case of abnormality of vital parameters?

The basic version isn't equipped with that feature. We can however selectively customize few parameters at which we can trip the transformer

xiv. What is the frequency of collecting data?

Every 15 minutes the data is collected and recorded in the dashboard with timestamp

xv. Can I monitor all my transformers on a single dashboard?

Yes, all transformers are geo-tagged and shown on a single dashboard

xvi. What are the recurring charges of BOLA?

The annual subscription charges are minimal and just around 4k for connectivity and server