

Line voltage regulator Transformer - "Alternative to costly Grid expansion"

Line voltage regulator Transformer

Low voltage Issues: Low voltage causes serious problems for motors and reduces the efficiency of all types of electrical appliances including LED lamp heater, AC & refrigerator etc.

TPCODL Network: So many 11 KV lines in TPCODL service area are extended over long distances to feed loads scattered over large rural areas. Poor Voltage regulation / Low voltages has been a common problem for years. Consumers those are connected at remote locations are continuously facing low voltage problems. **Actually measured 1 phase voltage is found below 150 volt** in many remote areas.

Challenges: Most of the remote areas are smaller load pockets, generally 200KVA, 500KVA or 1000 KVA at the most. Constructing a new 33KV substation is very expensive & therefore cannot be justified for the area where total load is very small i.e. < 1000KVA.

Ultimate Solution: Installation of **Line Voltage Regulator Transformer** at mid line location which will boost the voltages upto 35% on downstream network. LVRT is a specially designed Auto transformer with inbuilt On load Tap Changer & a voltage control relay. **LVRT is the most economical solution & it is an "alternative to costly grid expansion"**.

Pilot Project: TPCODL has developed & installed a 500KVA LVRT which can boost the line voltage from 7KV to 11KV automatically as required. LVRT is running successfully for last 4 months. The LVRT was designed & developed with the help of a local transformer manufacturer in Bhubaneswar. This **pilot project is "First of its kind in India"**.



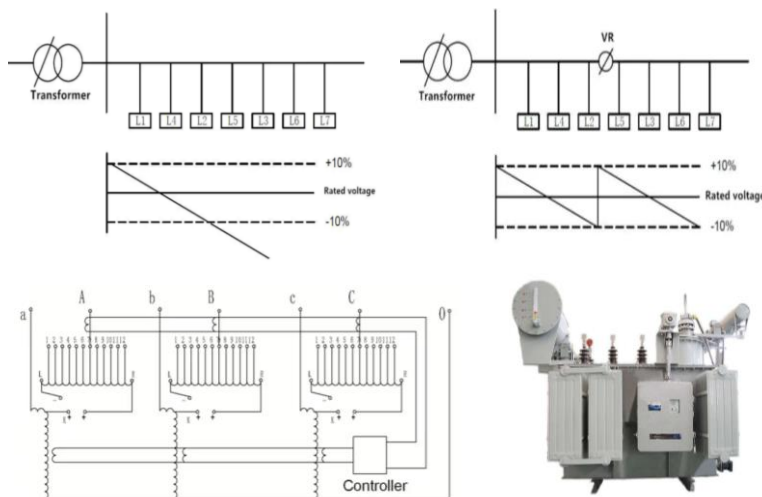
Line voltage regulator Transformer - an Alternative to costly Grid expansion

Line Voltage Regulator Transformer is a specially designed Auto transformer provides constant output voltage under varying input voltage conditions and load currents. It has very low impedance which helps in transferring the downstream load side fault currents to the source side so that the protection relay at the substation can still pick up the remote end fault with sane level of sensitivity. A 500KVA LVRT will have approx. 0.5% impedance. Following are the main components.

Autotransformer – Main Transformer in which part of one winding is common to both the primary and secondary windings. There are multiple taps coming out of the winding. By changing taps the voltage can be boost by 35%.

On Load Tap Changer – Seventeen position Switch designed to work under load to change the configuration of the transformer coil. OLTC is designed to work automatically & manually. In-tank OLTC has been used in the 500KVA LVRT under pilot.

Voltage Control Relay – Control IED that continuously monitors the system voltage and automatically commands the tap changer when voltage dips by certain percentage.



Cyclone Resilient Power Network - TPCODL Study & Design

Cyclone Prone Odisha : Coastal areas of Odisha have been Cyclone prone for decades. In recent years, this area has faced cyclones more frequently & those have resulted in huge damages to Power Lines & other Infrastructure.

TPCODL Service Area : Most of the TPCODL service area comes under Cyclonic wind zones of Odisha. Fani Cyclone in 2019 resulted in Network wide outages & huge damage including more than 100,000 poles & more than 30,000 Distribution Transformers.

Challenges: Distribution Lines are built mostly on PSC poles & Joist Poles. These poles are susceptible to high intensity winds. Winds over 150Kmps are common & resulting in damaging the lines & poles almost every year. Highest wind speed of 260Kmph was recorded by IMD in the coastal areas.

Study of Winds & effects : A comprehensive study of the high intensity winds & effects on existing Poles & Lines has been carried out. STAAD Pro analysis of strength of existing poles done. Most poles are failing at 140KMPH wind speed. Study report has suggested wind zoning and appropriate solutions.

Various Solutions: UG caballing is suggested wherever possible but it is a costly solution & application is limited to city areas. OH line is still a preferred choice for suburban & rural areas .

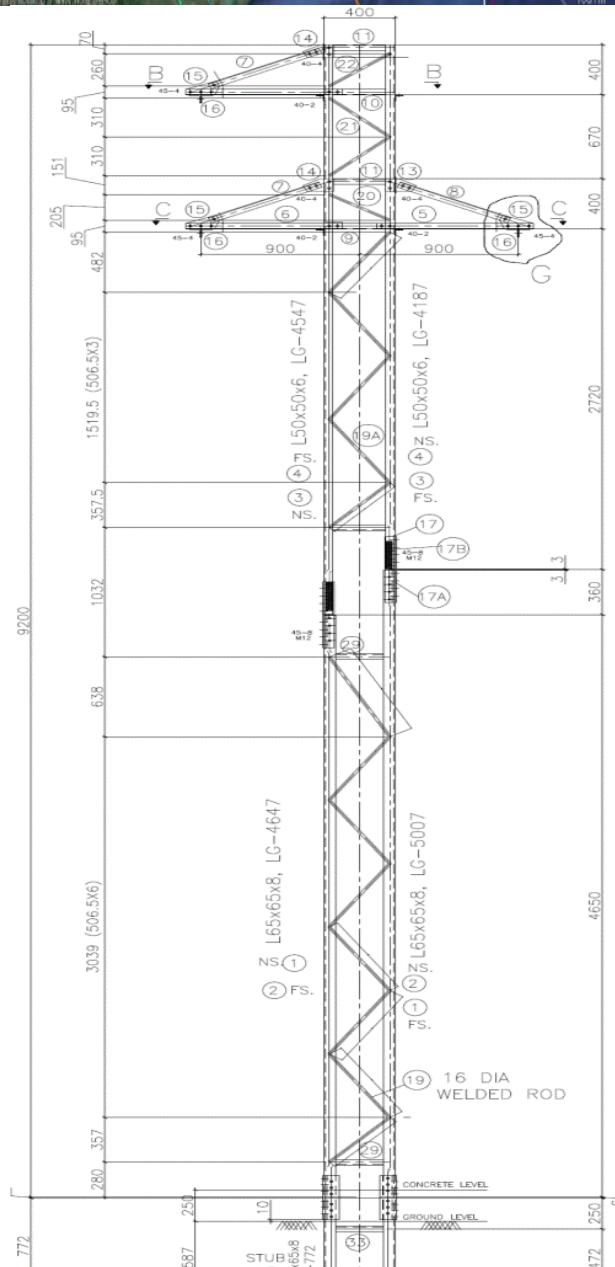
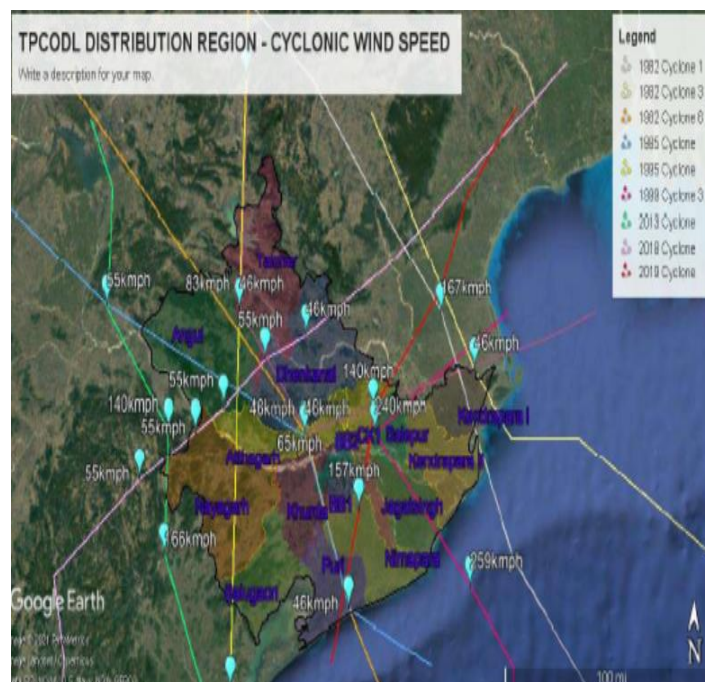
Rebar Lacing Pole for 11 & 33 KV lines: TPCODL has developed a **Low Cost** pole which can **withstand winds up to 300Kmph**. Depending upon the various applications & situations the span length can be 60 to 80 meter.

RLP is Type tested at CPRI lab: Pole was designed jointly with TCE, Fabricated locally in Odisha & Type tested in CPRI Bangalore.

RLP Design: RLP design is very simple. It uses a box frame made of ISAs supported by MS rod welded connections from inside. It can be fabricated in one piece or two pieces. Uses suspension insulators.

RLP Foundation: Foundation design can be selected based on soil condition. A prefab STUB will be buried / embedded in foundation & The RLP has detachable bolted connection with the STUB.

Pilot project near Konark Beach : 15 RLP being installed under the pilot project to test the real field performance in cyclonic conditions.



RLP at project Site



STAD PRO Analysis of Existing Poles

Sl no	Section	Height,m	conductor			Zone (0 to 60 km)		Zone (60 km to 100 km)		
			Area, mm2	Dia mm	Span, m	Design wind pressure, N/m2	utilisation ratio	Design wind pressure	utilisation ratio	Economic section
1	ISMC 200 (H POLE)	9.2	100	12.78	40	3880.09	1.356	2933.91	0.891	-
2	ISMC 200 (H POLE)	9.2	232	19.7	50	3880.09	2.22	2933.91	1.2	-
4	160 X 152	9.2	100	12.78	40	3880.09	5.235	2933.91	3.964	ISMC 200 (H POLE)
5	160 X 152	9.2	232	19.7	40	3880.09	6.316	2933.91	4.247	ISMC 200 (H POLE)
6	160X150	9.2	80	11.43	35	3880.09	3.8	2933.91	2.97	ISMC 200 (H POLE)
7	150X150	13	80	11.43	35	3880.09	8.09	2933.91	6.596	ISMC 200 (H POLE)

	Existing H pole 2XISMC 200	Proposed Lattice structure with rebar lacing
Foundation requirement	No Special requirement	No Special requirement
Total Quantity per one pole, kg	545kg	450kg
Transportability and material handling	No Special requirement	No Special requirement
Ease of procurement	ISMC 200 readily available	MS angle and 16mm MS/HYSD bar readily available
Ease of fabrication	Plate cutting + bolting + hot dip galvanization	Bar bending + welding + hot dip galvanization
Ease of erection	No Special requirement	No Special requirement
Durability	HDG	HDG+ corrosion allowance on bar
Cyclone resiliency	>300kmph	>300kmph
Maximum span without fail	45m	80m
Structural performance	Transverse Stiffness Good	Transverse Stiffness Good
	Longitudinal stiffness weak	Longitudinal stiffness Good
	Axial + bending inferior performance	Axial force better performance
	Can not withstand broken wire scenario	Withstand broken wire scenario.
	Lower strength in longitudinal cascade	Higher strength in longitudinal cascade

Low Cost “Composite Insulated Cross Arm” – CICA for 11KV & 33KV

Low Cost “Composite Insulated Cross Arm” - CICA

Distribution Line Faults: Most common faults on distribution lines are **Insulator failure and Bird Faults**. In TPCODL service area these faults are contributing to more than 50% of system faults & causing 11KV feeder outages very frequently. On long feeders It takes really long time to pinpoint the fault & restore the supply.

Bird faults: Conventionally pin insulators are used in distribution line poles to support the live conductor. This provides very small phase to ground clearances which results in ground faults / flashover, whenever a bird / small animal is sitting there and bridging the gap.

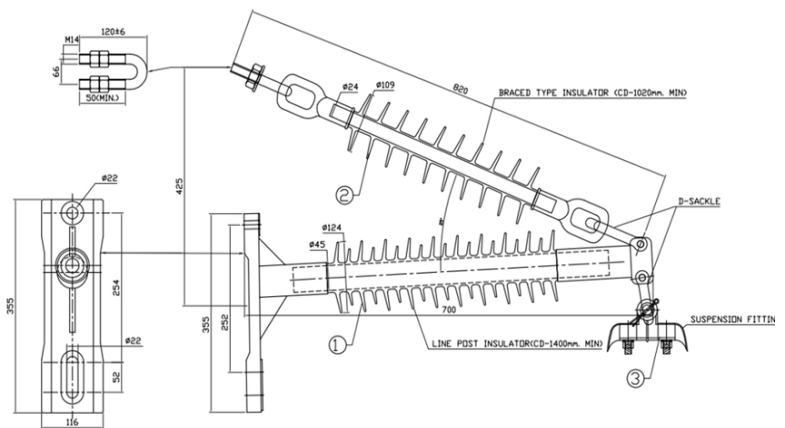
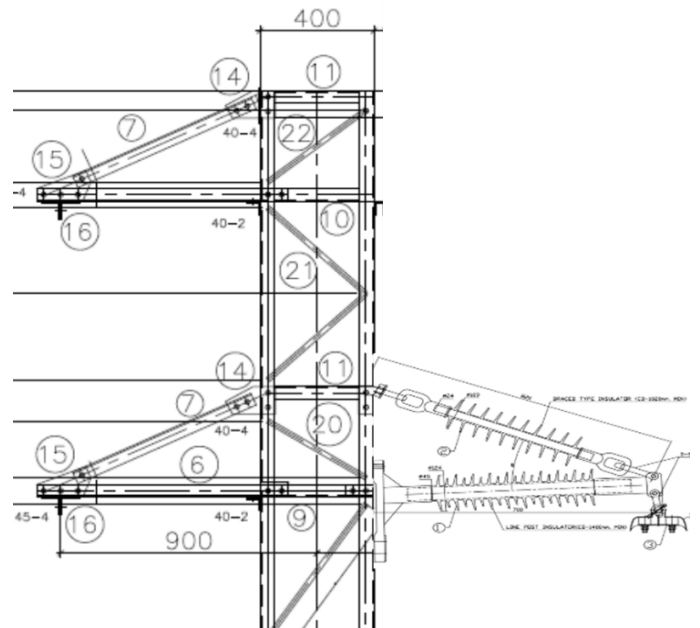
Insulator failure: Pin insulators have smaller creepage which is not sufficient for high saline / polluted environment. Insulator failure numbers are significantly high in TPCODL service area specially in coastal areas. Heavy lightening is also a factor behind insulator failure.

Mechanical failure: Most of the TPCODL area comes within high intensity wind zone & mechanical failure of Insulator due to heavy conductor swing is also very common.

Ultimate Solution: Composite Insulated Cross Arm – **CICA** is the answer to above problems. New design combines the cross arm & insulator into one equipment & has many advantages. CICA is basically a cross arm designed to have properties of an insulator & no additional insulator is required.

Big Advantages : CICA provides high phase to earth clearances at pole which means there will be no more bird faults. It also provides much higher creepage distance & higher mechanical strength which means No more insulator failure. It also provides higher ground clearances because there will be no suspension insulator & conductor will be directly hooked up with CICA. CICA has higher shock absorption capability so it provided better resiliency against the conductor vibrations/swings due to cyclonic wind conditions. Overall this design will improve the reliability of our lines to very high level.

Pilot Project : TPCODL has **developed a low cost CICA** jointly with local manufacturer. 10 CICA are being installed on newly developed cyclone resilient RLP poles under a pilot project in Konark area, Nimapada division. CICA will be used on 11KV & 33KV line poles.



RLP With CICA

RLP with CICA : TPCODL has developed low cost Composite Insulated Cross Arm which will be used on RLP & will help in improving the overall reliability to very high level.

Meter reading and spot billing carry out in TPCODL by Business associates through performance-based contract since June 2020.

During the initial period of takeover, there were lot of challenges with respect of reading and Billing activities and high amount of losses. In order to Improve the Billing Efficiency of the organization and reduce the No of complaints of wrong reading carried out by the Business Associates, TPCODL was the first Utility to come with Innovative idea to do Meter reading along with spot Bill generation on site with OCR technology.

Typically, TPCODL makes an appointment with the customer to read their meter. A worker arrives at the home or workplace, collects data from the meter and brings it back to the supplier. If the meter is located inside the property, the worker will have to gain entry from the customer to collect reading. This is a long, slow and inconvenient process often takes several weeks to complete.

During Intial period TPCODL providers allow customers to submit handwritten readings or read the numbers down the phone, these processes also rely on manual reading, which again leads to errors. The result is that utility distributors who rely on manual meter reading waste considerable time and labor. TPCODL relying on manual data entry simply cannot be confident in the quality of their data. These easily avoidable errors contribute to significant losses for energy distribution companies

How Mobile Meter Reading work

Mobile meter reading brings digitization to meter reading, cutting down on the time it takes to complete the process and eliminating errors. This saves both utilities and their customer's time and money. Using a mobile app or a web page, energy distributors can bypass the lengthy process of traditional meter reading and replace it with a quick, easy and highly accurate digitized solution.

Mobile meter reading relies on optical character recognition (OCR) technology as a foundation.

There are two ways this can work in practice. Firstly, utility workers can scan energy meters using any smartphone to collect energy consumption data during routine visits.

Alternatively, this step can be bypassed and customers can be prompted to scan their meter themselves. When it's time for the utility company to collect meter readings, they will reach out to the customer, either through email, text or some other digital communication. The customer is asked to log into the supplier's app or website with their smartphone to ensure that the correct meter is being read.

The customer then points their smartphone camera at the utility meter. The value displayed on the meter is recognized instantly, turned into digital text and transcribed into the system. After the data is collected, the customer can then check the results and submit it to the utility provider with on simple click. The data is then transmitted to the energy company to automatically bill consumers the correct amount. Typically, it takes less than a minute for customers to collect and submit their meter Readings. The process is highly secure, as well: on-device processing means all data captured stays safe in the utility provider's closed system, and allows the user to scan their meter even if they do not have an active internet connection.

The Limitations of Traditional Meter Reading

Poor Customer Experience

Let's face it: meter reading is a chore. It's not only inconvenient and time-consuming but also error-prone, causing problems for energy providers as well as their customers. At best, it is an unwanted

interruption during a busy day. In some cases, it is a confrontational and unpleasant reminder that money is owed. It seldom puts anyone in a good mood.

The meter reading process is also the most common touchpoint between utilities and their customers, so it is where customer relationships can be made or broken. Traditional meter reading can lead to a fraught relationship, with customers immediately on the defensive against their provider, uncertain they're being billed fairly and distrusting of the entire process.

Revenue Loss Due to Traditional Meter Reading Errors

When a meter is read incorrectly, customers can be overcharged and face utility “bill shock,” an unpleasant surprise when a bill is higher than expected. Bill shock severely damages customer trust, and will lead many customers to switch providers.

What's more, disputes over bills lead to delayed payments, meaning that providers do not receive their expected revenue for the quarter or year. Finally, the process of resolving data quality issues creates its own cost center, with more staff needed to call, visit and record the correct entries before a second bill can be sent.

For these reasons, customers will welcome a faster and more accurate way to collect data from their meters. Mobile self-meter reading adds fairness and transparency to the meter reading process, while removing a major cause of customer dissatisfaction.

Why Mobile Scanning is the Future of Meter Reading

Mobile meter reading saves time and money for energy providers while providing an enhanced customer experience. In this chapter, we focus on the key benefits mobile Self-scanning delivers. Mobile-First Finally, the whole process can be managed from their own device, giving them full control and transparency over their energy usage.

Hassle Free the entire process -from their notification, to scan and submission can be completed in under a minute. Accurate when customers scan their own meter with their mobile device, they can immediately confirm the reading is correct before submitting it, removing the stress of an incorrect reading and a bill dispute later on.

Time Savings

In a similar manner to cost savings, the process of home meter reading eliminates Un necessary time spent on collecting the data on both sides – the customer side and the utility side – while improving the accuracy of the data. Data collection becomes fast and easy, freeing up utility technicians to focus on work that is more productive during their shifts. Utilities employing mobile meter reading are free to build their work schedules in new and more efficient ways, engaging in better workforce management. At the same time, customers do not need to change their schedules or take time off from work to accommodate meter readers.

Improving the Customer Experience

Customers today want accurate, hassle-free and mobile-first energy management – and mobile self-meter reading delivers on all three points.



By saving customers time and aggravation, utility companies can improve the customer experience, improve customer engagement, and create a more loyal customer base. When billing errors eliminated, utility providers can focus on a more positive relationship with customers.

SCANNING OF ANALOG METERS




OCR Technology provides multiple features to ensure that scan results are highly accurate and trusted by employees and customers alike. All meter values are captured, processed and stored completely offline, enabling your workforce to stay mobile and scan in the toughest conditions. The parallel scanning feature allows users to read meter values alongside barcodes and serial numbers all on one screen. Sophisticated machine learning models with real-world conditioning give the advantage when it comes to scanning dirty or partially obscured meter displays. Anyline meter reading solution is available for integration into native mobile apps and web apps to suit the needs of all types of users.

Highlighted Features

1. Instantly detect meter type, background color and number of digits
2. Scan dirty or partially obscured meter displays in low light
3. Scan meter displays together with barcodes and serial numbers
4. Scan changing meters values according to OBIS IEC 62056-61 standard

5. Read meters without any network or internet connectivity
6. Combine multiple scanning solutions from Anyline on one device



Mobile data capture eliminates the need for many manual processes. Using a smartphone or tablet, workers can directly collect data at the source of its origin, which cuts down the amount of work – and room for error.

Mobile data capture eliminates wasteful paper trails and boosts the efficiency of personnel in the field by automating some of their work.

Mobile data capture solutions are built on Optical Character Recognition (OCR) technology. This innovation recognizes typed or handwritten characters and transforms them into a digital format.. It may involve scanning documents, labels, images or even subtext on a photograph.

Implementation plan in TPCODL

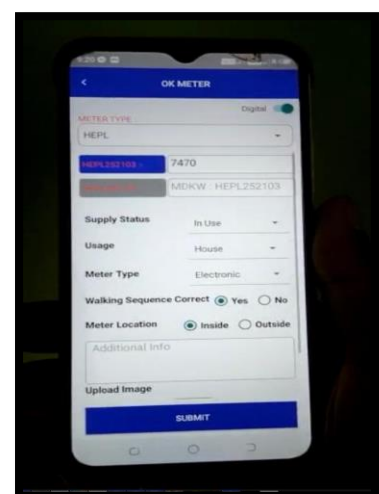
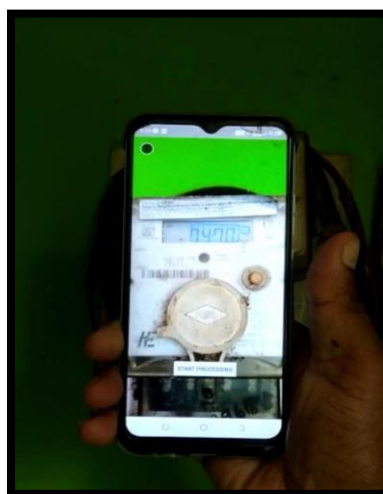
After the implementation of the AI-based OCR meter reading, readings are automatically recognized, punched and saved in the device with no manual intervention and error.

Pilot Implementation on 1st Apr'2022

- ✓ 1st Apr 2022 – 95 readers in 15 sections - 20K reading in April'22.
- ✓ 100 % OCR started in Jagatsinghpur division from May'22
- ✓ Success rate was 92 % per OCR Scan in Jagatsinghpur division 1.27 Lacs customers.

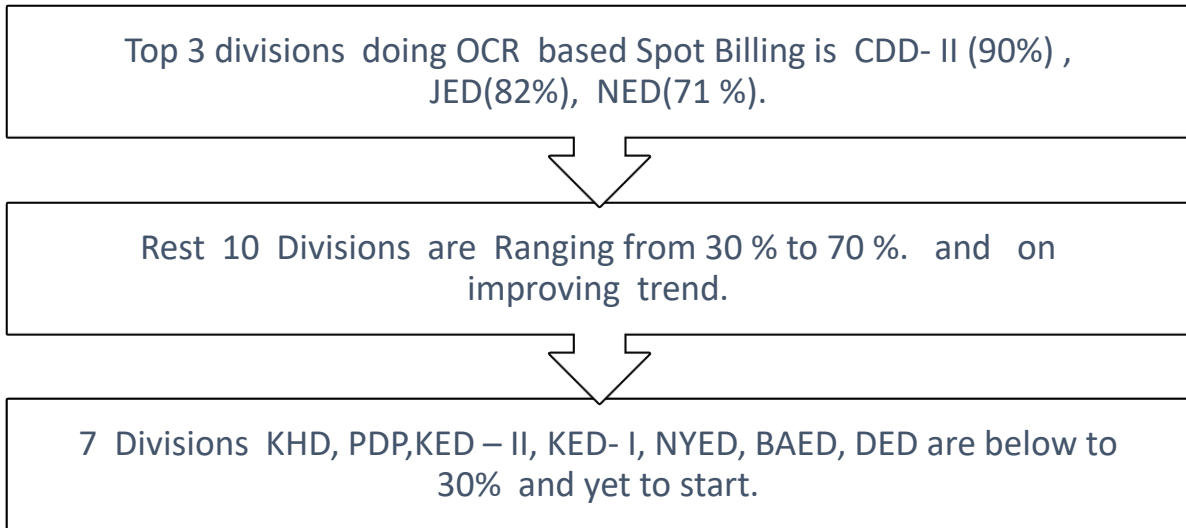
Division wise Go Live Plan

- 100% in one division (JED) from May'22 & 50 sections of other division in May'22.
- 100 % in 5 divisions & 100 sections of other division in Jun'22.
- Plan to Implement 100% OCR in BCDD-1, BCDD-2, BED and CDD-1 & SED from Aug-22 Onwards.
- Remaining 10 divisions will get start OCR from Sep'22.
- Integration with TPCODL Mitra Application for Self Meter reading



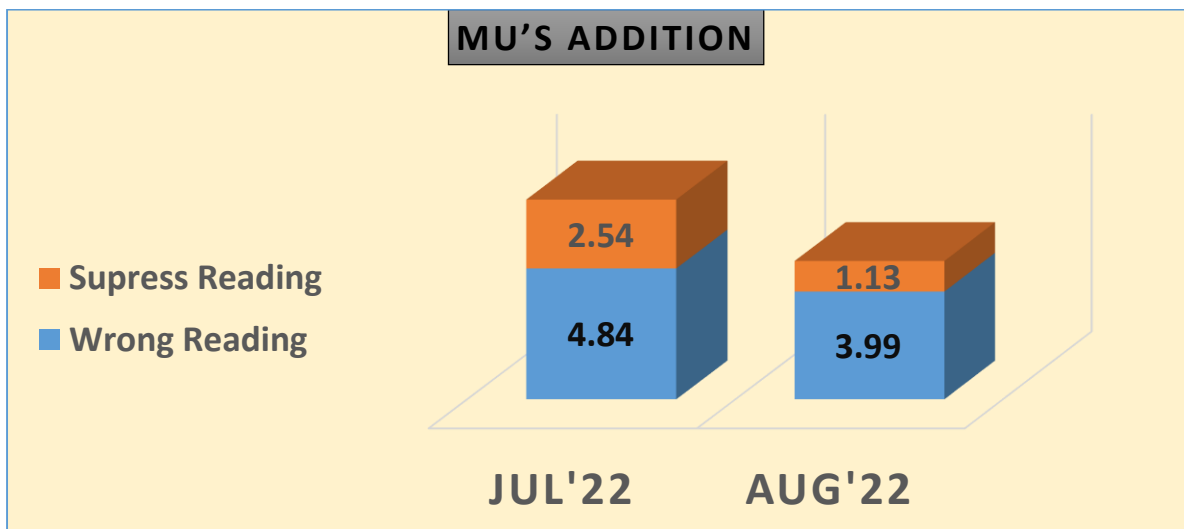
OCR Progress so far in TPCODL Jul'22 Vs Aug'22

Results so far:



Benefits:

With the help of OCR technology, we have increased billing efficiency by adding billed unit of 7.38 MU in July'22 and 5.12 MU in Aug'22. This means additional sales of 6.12 Cr in two months.



Apart from MU addition following benefits, we get from OCR:

Reading Complaints have reduced in 5 divisions.

Reading Quality Check (RQC) and Bill Quality Check (BQC) count has reduced.

Efforts for Sending People On Site to Avoid rework has reduced

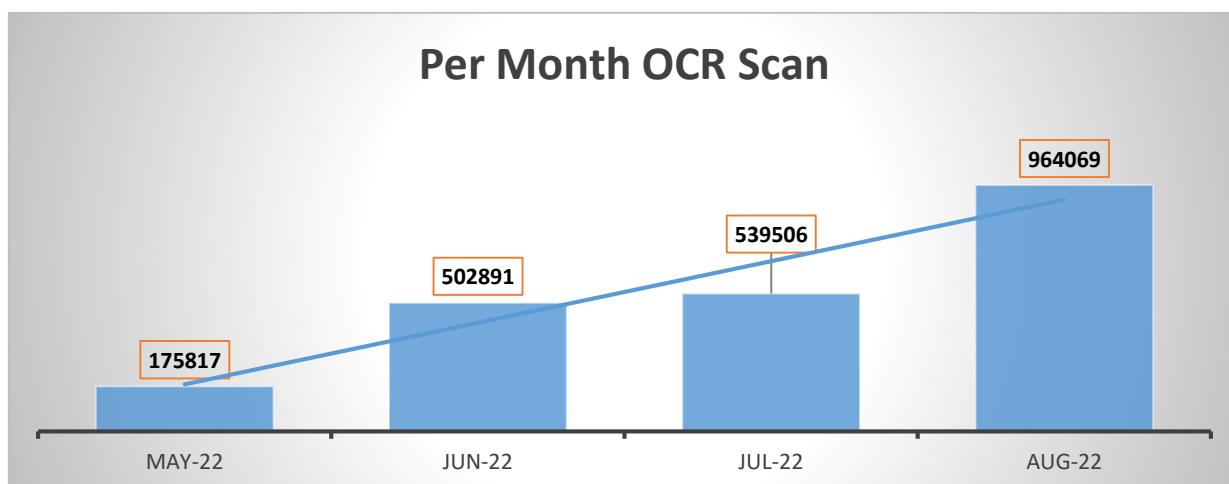
Large amount of Suppress Reading identified and easier for release from BQC.

Reduction in OA Cases

People trained to take Photograph of the meter, which was not happening earlier.

Fear in mind of Meter reader that being monitor at Back end so chances of Mistakes are less.

OCR Journey So Far in TPCODL



Key challenge faced:

Training & implementation of OCR technology to meter readers (Business associates). Initially, the correct scanning percentage was low and readers were doing manual scanning due to lack of training. we closely monitored meter reader-wise performance on the basis of scanning percentage (data fetched from system), photo quality & on-site meter reader QC thus gradually increasing correct scan %age from 75% to 92%. Also, maintaining meter photo quality was the main challenge in the implementation of OCR. The logic was developed in the app for the prevention of over-exposed, blurred photos and values fully not covered in the scanning area thus improving photo quality.



Training to Meter Readers



Motivational Reward



Image Capture, upload from OCR

TPCODL-Anyline for accurate spot billing

Bhubaneswar: Tata Power Central Odisha Distribution Limited (TPCODL), a joint venture between Tata Power and the Government of Odisha, Tuesday announced partnership with Anyline, a global leader in mobile data capture and artificial intelligence, to reduce non-technical losses and support spot billing processes for field workers and customers. This industry-first innovation marks the first use of optical character recognition (OCR) for meter reading by TPCODL and is the result of collaboration between the companies. Commenting on the partnership, M. Shenbagam, CEO, TP Central Odisha Distribution Limited said, “We firmly believe in adoption and integration of cutting-edge technologies to provide reliable power supply and the best customer experience.”