

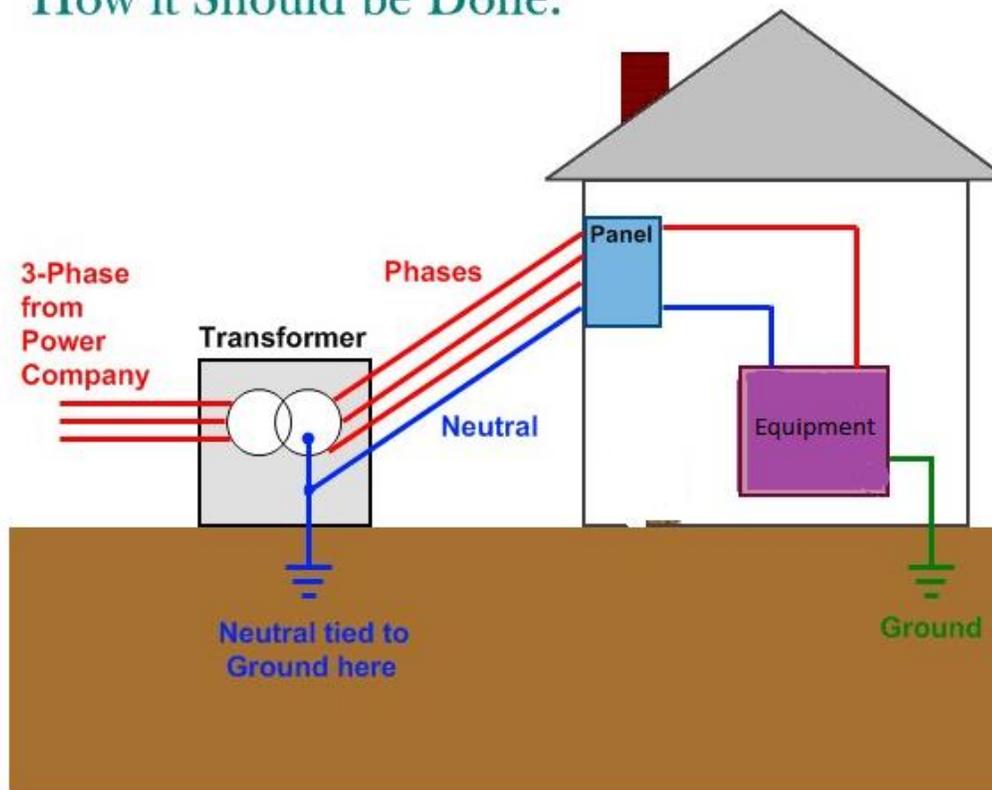


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# Health Monitoring of Earth/Grounding in Oil and Gas Industry.

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How it Should be Done:



## Contents

1	Introduction.....	3
2	Importance of good solid earthing .....	3
3.	What is earth resistance (ER)?.....	4
4.	Methods of earth measurement.....	5
5.	Benefits of MachineSense Power Analyzer.....	6
6	New analytics based method of ground condition measurement.....	6
7.	Simple installation of MachineSense Power Analyzer.....	7
8.	Earthing in Oil and Gas refineries plant.....	8-9
9.	Typical web view of MachineSense Power Analyzer.....	10--11

## Introduction

Low resistance earth grounding is essential for safety and protection of sensitive electronic equipment. Effective earth grounding is essential for grounded AC and DC electrical equipment and distribution systems. Effective grounding provides the level of safety required to protect personnel and equipment from shock and fire hazard. The understanding and evaluation of a facility ground system should be part of any power quality assurance program. A good ground must meet NEC (National Electrical Code) Article 250 requirements. The NEC [2] defines "grounded" as "**Connected to earth or to some connecting body that serves in place of the earth**" and "effectively grounded" **as "intentionally connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current carrying capacity to prevent the buildup of voltages that may result in undue hazard to connected equipment or to persons.**

## Importance of good solid Earthing:

- Limits voltage in an electrical distribution system to definite fixed values.
- Limits voltage within insulation ratings and provides more stability with minimum of transient over-voltage and electrical noise.
- Provides a path to ground in fault conditions for quick isolation of equipment with operation of ground fault protection.
- Provides grounding of all conductive enclosures that may be touched by personnel, thereby eliminating shock hazards.
- Reduces static electricity that may be generated within facilities.
- Provides protection from large electrical disturbances (such as lightning) by creating a low resistive path to earth.

### What is Earth Resistance (ER)?

The resistance offered by the earth electrode to the flow of current into the ground is known as the earth resistance or resistance to earth. The earth resistance mainly implies the resistance between the electrode and the point of zero potential. Numerically, it is equal to the ratio of the potential of the earth electrode to the current dissipated by it. The resistance between the earthing plate and the ground is measured by the potential fall method.

The resistance of the earthing electrode is not concentrated at one point, but it is distributed over the soil around the electrode.

Mathematically, the earth resistance is given as the ratio of the voltage and the current shown below.

$$\text{Earth Resistance} = \frac{\text{Potential to earth electrode}}{\text{Current}}$$
$$\text{Earth Resistance} = \frac{V}{I}$$

Where V is a measured voltage between the voltage spike and I is the injected current during the earth resistance measurement through the electrode.

There is not one standard ground resistance threshold that is recognized by all agencies. However, the NFPA and IEEE have recommended a ground resistance value of **5.0 ohms** or less. The NEC has stated to "Make sure that system impedance to ground is less than 25 ohms" specified in NEC 250.56.

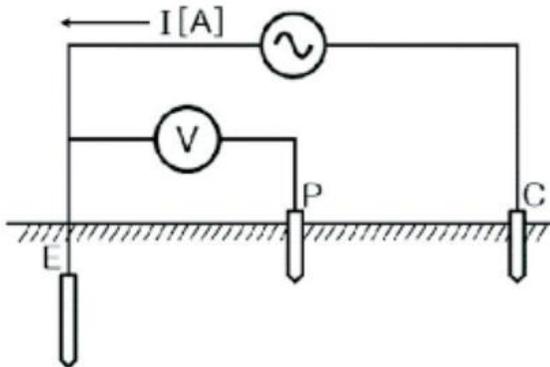
## 5 | Health monitoring of earth/grounding in oil and Gas industry.

### Methods of earth measurement.

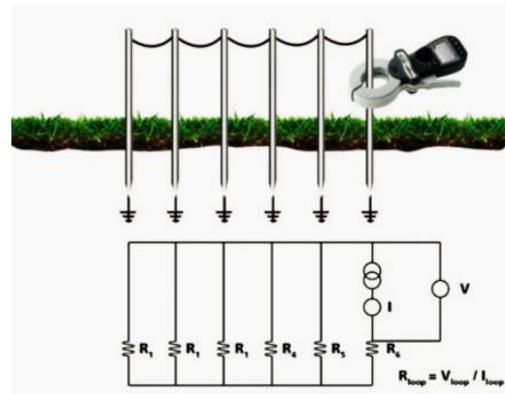
From the past if we go by processes followed by common people to measure earth resistivity, first "Fall of Potential method" will come which is direct measurement, then comes earth leakage resistance measurement, which is indirect measurement. Main disadvantage of Fall of Potential Method is that the user has to turn off live machine before connecting measuring device. It consumes some time and involves some loss of productivity. Then with the advancement of semiconductors, people are able to measure earth conditions indirectly by just measuring earth leakage current using current clamp meter.

These two are presently available in market but both are very expensive. So, the user has to be very selective between the amount they are paying against the benefits they are getting while choosing such device.

MachineSense brings new technology-based Power Analyzers which can predict the grounding conditions and do it without even turning off your live machines.



Fall of Potential method



Earth leakage current measurement using clamp meter

### **Benefits of MachineSense Power Analyzer.**

- a) Its 24x7 online monitoring system. User can see data anytime from any part of the world.
- b) Easy to install.
- c) It saves time and productivity as it can be installed against live machine.
- d) It gives information about the health condition of the running pump/motor/fan/blower in green-yellow-red color meaning healthy-warning-alarming respectively along with other quality parameters and grounding condition.
- e) Provides user friendly data viewer which is easy to understand.
- f) Available at very low cost ( almost 75% less than currently available standard product).

### **New method of ground condition measurement.**

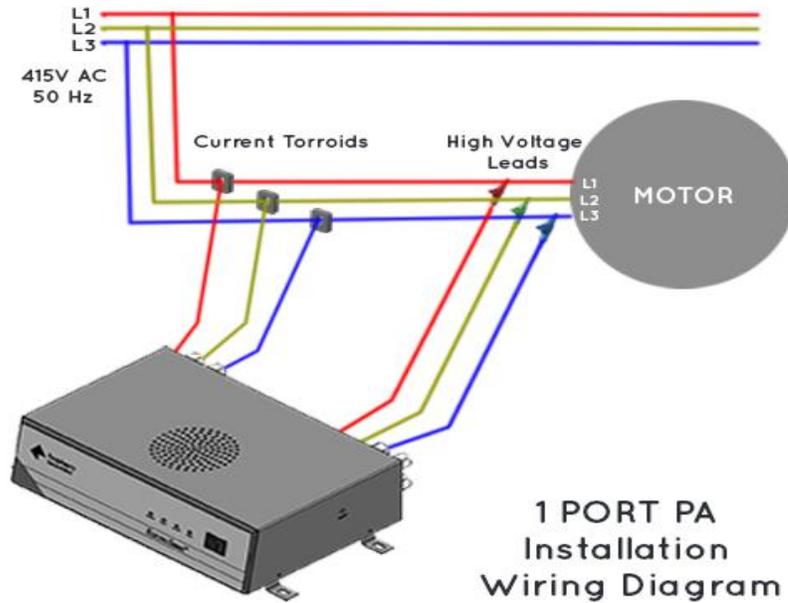
MachineSense used new analytics-based technique to identify ground health condition. The user don't use additional voltage/current clamp for that. It uses both, very high sampling FFT data of the voltage and current signature.

After extracting several analytical features out of those FFT data, MachineSense PA does cloud computation and predicts health of ground condition.

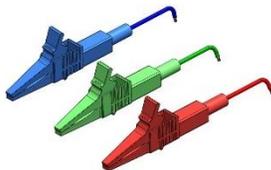
Basic idea behind this technology is that whenever earth condition gets bad, neutral point of supply will no longer be at absolute equilibrium reference point where it normally is, in case of well balanced and solidly grounded system. So, definitely will impact on voltage signature and as current is nothing but the voltage divided by resistance, current also gets affected. So, very very high sampling based FFT will help you to find anomaly between good and bad grounding if proper analysis is done.

7 | Health monitoring of earth/grounding in oil and Gas industry.

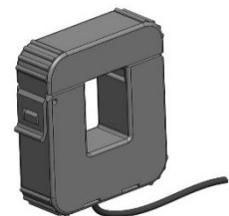
**Simple installation of MachineSense Power Analyzer**



Power cable



Voltage Probes



Current sensor

### Earthing in Oil and Gas refineries plant:

Hydrocarbon processing plant needs uninterrupted high quality power supply for every part of the process. Production starts with Cracking. In addition to the heating up with steam, several general pumps (GP) are used. If a pump fails, the flow of substances in the process could be disturbed. The quencher pump (QP) is important to refill the water reservoir of the quencher. It prevents the system from polymerization during short term interruptions. Long interruptions will lead to process downtime and damage the system. The second General Pumps (GP) are necessary to sprinkle the gas with oil to cool and clean in the scrubbing towers. If failure of a pump occurs, the separation process is influenced and the product quality changes. Inside the acid gas scrubber, a compressor (CM) is necessary to sprinkle the gas with sodium hydroxide solution under high pressure. If the compressor fails to clean the chamber, the cracking of gas is not possible any longer. Efficiency and product quality will decrease immediately; system damage can occur for longer states. The cooling pump (CP) is used to avoid polymerization during compaction and for the increase of purity in the cooling processes. Finally, it ends with the sub-process of super heating steam for rectification. Thus, in all the stages of the process in a refinery plant, pumps play a critical role, failure of which will damage the downstream production. Failure of most of these pumps are caused by higher harmonics and imbalanced power line fed to those pumps. MotorSense can monitor health of the Pumps ( GP,CP, CM, QP) 24x7 and any potential risk of the pump's failure will raise an alarm. MotorSense can monitor harmonics and line imbalances which usually cause great damage to mission critical pumps.

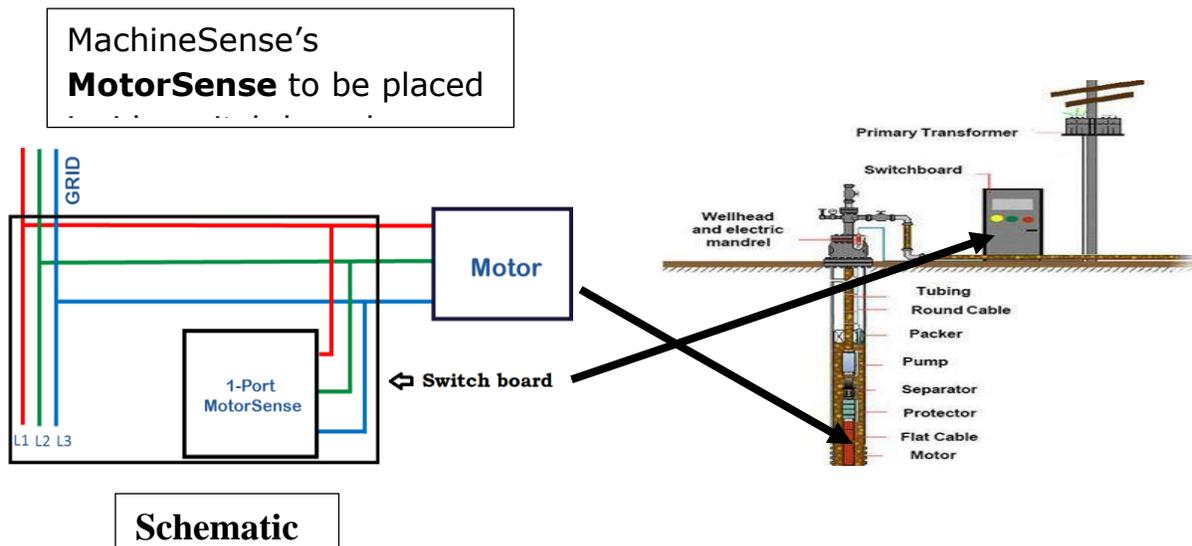
Electric Submersible Pumps (ESP) are used in a wide-range of applications from onshore to complex offshore, deep water, or subsea applications. Premature failures during well drilling can lead to high financial losses. It is also well known that additional harmonics currents are generated when the ESPs near failure threshold. MachineSense MotorSense can detect ESP failures ahead of time. It is also reported, due to overworking of these Pumps during drilling, 10% of the pumps die much before finishing their assigned task in the field. MotorSense can

## 9 | Health monitoring of earth/grounding in oil and Gas industry.

send SMS/email much before ESP pumps develop its fatigue and thus prevents unplanned failure in field which may disrupt production.

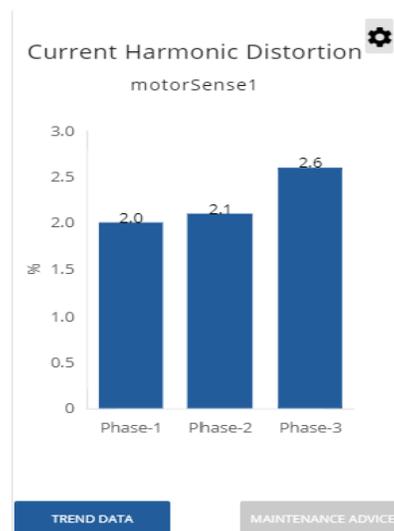
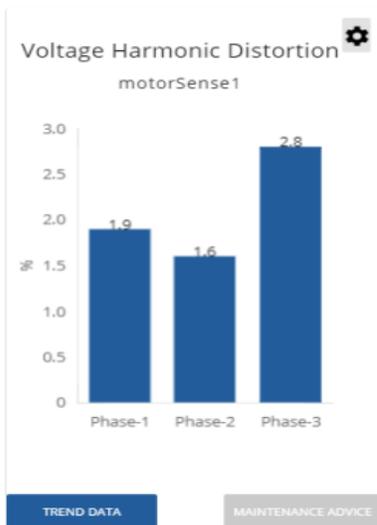
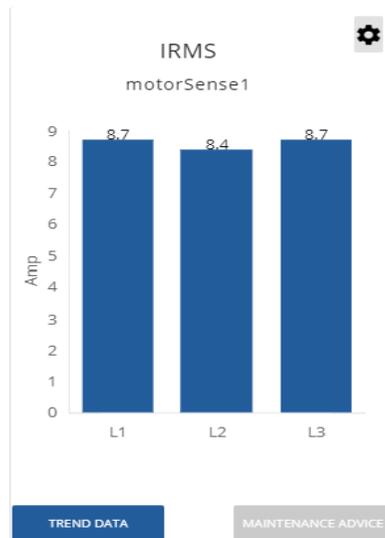
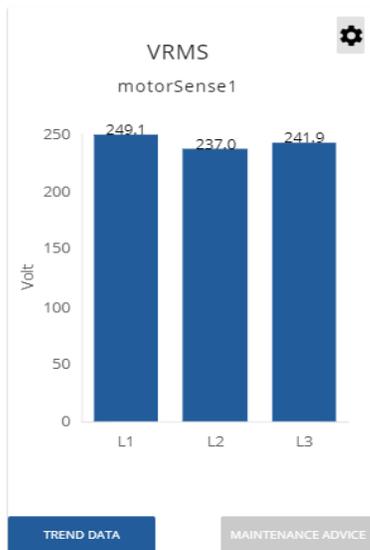
- Most large plants do have multiple Earth pits to have very low resistive path to earth. But the common problem of such plants is that, it has only schedule-based maintenance and quality checking method and that too is hardly done appropriately by maintenance team until and unless any damage is done.
- Here is the importance of 24x7 monitoring which automatically sends alarms/sms to the concerned person to have a look immediately before actual damage is done. This way it overcomes the lack of intense work often made by maintenance team.

MachineSense's MotorSense is best suited in such cases to get alerts before any actual lightning damages costly equipment, especially in the monsoon season, when failure of multiple earth pits occur in the plant.



### Typical Web view of MachineSense Power Analyzer.

MachineSense Power Analyzer provides easy visualization platform to get data. It also allows users to set their custom setting for different alarm thresholds if they want to change. Depending upon analytic packages, it gives users the knowledge about the status of running machines, productivity, predictive and preventative maintenance guidance. Green-Yellow-Red indicates Healthy-Warning-Alarming state of the machine.



11 | Health monitoring of earth/grounding in oil and Gas industry.

Motor Winding (Stator) 

motorSense1

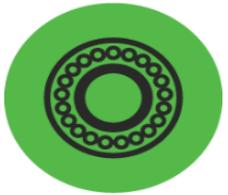


Reliability Quotient : 100%

TREND DATA MAINTENANCE ADVICE

Motor Bearing Status 

motorSense1



Reliability Quotient : 100%

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Ground Condition 

motorSense1



Reliability Quotient : 100%

TREND DATA MAINTENANCE ADVICE