## purvSHAKTI

Issue:1, November, 2016



Eastern Regional Power Committee (ERPC) introduces the पूर्व शक्ति (purvSHAKTI) mobile App

Shri P.K.Pujari, Secretary, Power, Government of India formally launched " पूर्व शकि" on 11th July, 2016 at Scope Complex, New Delhi. Senior dignitaries from the power sector including Smt. Shalini Prasad, Addl. Secretary, MoP; Shri R.Sharma, CMD, REC; Shri M.K.Goel, CMD, PFC; Shri A.K.Verma, Jt. Secretary, MoP; Shri Pratyaya Amrit, Chairperson, ERPC & CMD, BSPHCL; Shri Hemant Sharma, CMD, OPTCL&GRIDCO, Shri Rajesh Pandey, CMD, WBSEDCL, Shri R.Lakshmanan, MD, BSPTCL and Shri A.K.Bandyopadhyaya, Member Secretary, ERPC were present.

पूर्व शक्ति provides information on power sector of Eastern Region such as Power map, Line diagram, Generator details, important Transmission system elements, Power supply position of the region, etc. पूर्व शक्ति also provides an indicative snapshot of various Commercial accounts issued by Eastern Regional Power Committee. Latest shutdowns, Important schemes, and other essential operational data are made available. It is our endeavour to make पूर्व शक्ति user friendly and provide further information in future.

Power Utilities, Academic institutions and public in general would be benefitted from the use of information provided in the App.



This is an abridged version containing the compilation of Spark...Ignited to share-- pages 75-143

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SPARK......Ignited to share

### SPARK.....Ignited to share----A power engineer' WAPP group----Frequently asked questions among practicing engineers.

**Group Administrator:** P. K. Pattanaik, Asst General Manager (Elect.), Odisha Power Transmission Corporation Ltd. (Bhubaneswar)

Compiled by: A. K. Bandyopadhyaya, Member Secretary, ERPC

#### 1. Now a day's vegetable oil is also used as transformer oil. Up to what kV it is used. ? Any utility of any state have started usingit?

The use of veg oil in transformer has been started by few private users. This is being divided into two types containing natural ester and synthetic ester. Veg oil contains natural ester. Other one being chemically processed also used. This has all advantages except the compromise in oxidation property and cost in comparison. The companies in India is Cargill oil Ltd as far as my knowledge. This can be used for 400 kV class also. EMCO transformer was displaying a transformer of 220/132 in recent ELECRAMA, international exhibition at Bangalore.

### 2. +91 94389 07357: 100VA. Or 50VA/0.2 burden for 245 & 245 kv CVT, which is technically more acceptable for today's microprocessor system?

+91 94389 07492: Burden of higher value is always preferable to accommodate more relays/instruments. But when to use microprocessor relays/instruments, the burden becomes very less.

In practice when CVT is to be used in circuit and if burden remains within 5 to 10% of its rating, then ratio error becomes more. So before choosing its burden of rating either 50 or 100VA, the working VA (load) of instruments should be close to 70 to 80% of rating.

+91 94373 06970: Regarding selection of burden of instrument transformers, cable length also plays an important role as burden will increase with the increase of cable length. Hence in case of automated s/s, where bay kiosk is used and the cable requirement is significantly less, the burden should be judiciously selected.

3. +91 94389 07492: In the event of Zone1 fault, for any reason if the concerned breaker did not actuate till to the setting provided on LBB relay, then will this (LBB feature) actuate? Could the Z4 manage to avoid such critical tripping or any other logic to help such?

+91 99014 90941: When a protection operates say for example a line protection it issues a trip signal to the circuit breaker and breaker is expected to trip. In case breaker fails to open or break the current for any reason the fault continues. In such a situation if an LBB relay is provided it trips all the other breakers that are feeding the fault. This is normally done by initiating BB protection.

In case LBB relay is not provided the fault will have to be cleared by various back up protections and fault clearance will take a long time, which is not good. Zone 4 is for different purpose.

Zone 4 is to serve as back up to BB protection. If a bus fault takes place and BB protection fails to operate the fault will have to be cleared by remote back up protection (ex: Zone2), It means tripping of many remote end breakers for a bus fault. Z4 which is a reverse zone if provided trips again after some time delay but trips local end breaker.

If delayed tripping is not acceptable then BB protection is to be duplicated. This is done for all 400kV and 765kV stations. Z4 serves as a back up to BB protection.

## 4. +91 99372 97758: What will be the impact of frequent switching ON & OFF of power transformers?

+91 94389 07490: My view on frequent switching ON& OFF of TR is that:

1) If the Neutrals are not properly grounded then failure may occurred;

2) If System voltage during switching is very high then overfluxing occur & Core may get saturated, if unprotected;

3) Frequent ON & OFF may damage insulation;

+91 94389 07687: I would like to add that that frequent On/Off may result in high magnetizing in rush current in the primary due to which high voltage side coils will be under severe stress. Such situation will be further aggravated if a power transformer is switched on from a far end through a feeder because it causes a transient over voltage in the network. For example the power transformer at Phulnakhara/ Cuttack Grid is switched on from Chandaka / Bidanasi (BPPL) during Change Over or tripping of power supply from source.

+91 98108 01555: Practically it has been seen that with the excessive switching on and off the power transformers dove tailed insulated spacers provided in the various windings get loose and disturbed. This results in short-circuit of the winding (s). Besides that mechanical structure

of the transformer get loose including loosening of nuts and bolts of the core if it is of bolted type. This disturbs the magnetic flux distribution of the transformer.

+91 99370 00046: When a transformer is switched into or out of a system, the transient voltage produced at the terminals of the transformer may contain a high frequency oscillatory component. When this oscillatory terminal voltage has a frequency component near one of the natural frequencies of the transformer and is of sufficient magnitude and duration, permanent damage to the transformer internal insulation structure. Systems of concern are those having a breakerswitching device and transformer in close proximity with the transformer unloaded or very lightly loaded. These system conditions have shown the capability of producing transient voltages at the transformers terminals containing high frequency oscillatory wave forms. When these oscillatory transient terminal voltages are near the transformers natural frequencies, large internal overvoltages may result. Systems that are ungrounded or grounded through high impedance may also produce voltages of concern.

Systems that are solidly grounded or effectively grounded with high power factor loads tend not to producehigh frequency oscillatory waveforms of sustained duration. Additionally, systems with very largecapacitive components between the breaker switching device and transformer tend to produce oscillatoryterminal voltages with frequencies below the transformers resonant frequencies and as such tend not toproduce high internal voltages.

Before the transformer is constructed an estimate of the impedance versus frequency and its internalamplification factors can be obtained by building an analytic model (lumped parameter model) of the transformer. Using this model one can compute its transient response (both terminals and internal) along with its impedance versus frequency characteristic.

Once the transformer is constructed it is possible to make low voltage transient voltage measurements. Additionally, the impedance versus frequency of a winding can be determined. It is often difficult todetermine amplification factors by measurements because the physical location of interest is in general not available for inspection or measurement.

The switching duty may also be a concern. A frequently switched transformer (e.g. daily switched) hasmore risks to encounter a problem. It should be recognized that even with some or all of the aboveconditions present the occurrence of an event that will produce the excessive voltages causing destructive results cannot be predicted with certainty. In each instance detailed analysis is necessary to predict withcertainty that a switching event can produce an oscillatory voltage wave form containing a frequency nearthe resonance and that this will lead to destructively high internal overvoltage.

Systems that are normally not of concern are those that are having their neutral solidly grounded oreffectively grounded and connected to high power factor loads. These systems may produce

transientvoltages at the terminal of the transformer, of a large magnitude and appropriate frequency, but the loadprovides substantial damping and the transient decays rapidly.

Additionally, systems with very relatively large capacitive components between the breakerswitchingdevice and transformer will not generally exhibit the breaker re-ignition and are generally not of concern.

In this situation the capacitance will tend to lower the frequency of the transformer terminal transientvoltage and produce the same effect as a snubbed capacitor.

+91 94389 07492: First of all switching of any electromagnetic circuit has the tendency of developing sudden voltage across the coil, depending upon the development of flux in the core. Now this generation of flux depends upon the wave form of the injected voltage and as per the flux wave form and rate of its change linkage causes the induction voltage. So accordingly certain current passes during initial charge that contains the frequency of fundamental and it's multiple. The current component that contains 2nd harmonic is treated as INRUSH current, the magnitude becomes very high, depending upon the type of magnetic material used and as per the geometry of the magnetic path.

Moreover for the situation of 3 phase supply, the switching of all phase may not be simultaneous, that also results the development of asymmetric voltage in comparison.

So every switching has the impact of possible result of transient effect, which may cause the problem on the insulation.

Again repeated switching before stabilization of the magnetic path if attempted then superimpose of switching surge may result severity of the insulation.

Solution: 1.So each time it is wise to charge the TR with some load on secondary. So the effect of inrush could be minimised.

2. Before loading in the event of idle charge you have to wait at least 3to 4 minutes for stabilisation of the magnetic path.

Note: This is not wise at all to switch on repeatedly.

#### 5. +91 94371 13454: In the model setting guideline for DP relays RFPP & RFPE value adopted are different for Z1, Z2 & Z3. It is observed in case of high resistive fault Z1 faults are cleared in Z2 time. On adopting same RFPP & RFPE value for all zones, correct zone operation has been observed. Explain.

+91 99014 90941: The resistive reach setting should not be more than 4-5 times X setting. Otherwise the relay might over each due to remote end indeed effect. Thus for short lines resistive reach setting for Z1 gets limited due to this. In such case Resistive reach setting is set higher for Z2.

If such considerations are not there the resistive reach settings for Z1 and Z2 can be same.

# 6. +91 94389 07492: Can zone 3 selection be omitted from the DP relay and to be used with revised zone1 and zone2 with rev. Zone. Because in protection history it has been found with rare actuation of Z3 and on every actuation cascaded tripping had been resulted with massive system disturbance.

+91 94371 13454: Load encroachment in case of long lines had caused many disturbances in our system in recent past. Modifications in setting has been made to avoid uncoordinated tripping of Z3.With 2 numbers numerical protection, we may think of over current and earth fault coordination instead of Z3, particularly for long lines.

+91 94370 58624: Instead of blocking of zone 3 if more other end information can be retrieved using dedicated channel then load encroachment may not create issue like that happened in 2012.

+91 94389 07492: The incident that resulted during 2012 is one of the consequences of zone3 tripping. But in actual while considering the zone coverage, this z3 could be called back to back up zone and actuation of this during fault occurrence shall cause massive system disturbance.

In my view:

1. Zone3 should be omitted, zone1 and its back up zone2 to be considered with revised coverage as per the protection requirement;

2. E/f relay in directional feature with proper co-ordination can be introduced;

3. Selection of back up zone 2 and reverse zone should be considered on logic base as per the situational requirement;

+91 94370 58624: We can think of another way also if more fiber optics or dedicated links are provided then why to omit zone 3. Whatever modifications even if we provide reach accuracy never be obtained. And maybe this is what the cause of introduction of third zone concept.

+91 94371 13454: With 120% of protected line + adjacent long line for Z3 setting, we had observed tripping of 220 kV line in one of the southern grid of Odisha few months back. It was analyzed to be load encroachment case. However, the current in the feeder was above 150% of rated. We have adopted o/c setting 125% IDMT in order to avoid permanent damage and unfavorable sag in old lines.

- 7. +919438907492: Each protection scheme should have Main and it's BACK UP. So for line protection, considering of forward zone and reverse zone, we should consider the selection as follows.
- Forward: Z1 as main and Z2 as back up with its selection for extra coverage to next network. Moreover selection of Z2 is case specific, to be decided as per situation requirement and load flow study.
- Back up {EF relay} could be tagged also under this selection for the same line.
- Other special protection or logical tripping, like LADR/SPS could also be brought to manage after fault stability situation at any power hub.
- Reverse zone could be judiciously taken by considering BB as its Main protection.

## So selection of Z3 as extra zone and allowing the Tripping of healthy system and causing cascade outage method has to be relook soon. Experts please comment upon it.

+91 99014 90941: There appears to be lot of reservations about Z3. I wish to know how often it happens that a line fault is not cleared by primary protection in 100 ms.if it does not, then sometimes what are the options?

+91 94389 07492: Fault clearance by main protection confirms the successful clearance of the fault. But now everybody's concern about the wrong tripping or overload encroachment tripping or after fault stability issues for which disturbance results. If to be reviewed on the fault occurrence and its effect, then Z3 actuation could be one of the reason. So setting of this or omission of it, in lieu of adjustment with other logics could be the solution. So time has come to relook upon it.

+91 94371 13454: The incidence of Z3 tripping I mentioned occurred after trip out of some transmission elements. Generally observed with numerical relays fault is cleared instantaneously, if carrier protection is healthy. Otherwise fault is cleared in Z2 time if the fault is within 80-100%. Z1& z2 with carrier inter trip arrangements give primary protection to the line. Z3 setting for long line some time creates problem. I think for long lines IDMT o/c and e/f can give backup protection.

+91 99014 90941: The main reason for Z3 operation is voltage collapse due to overloading of lines.

A tripping of one line results in overloading of adjacent line. If this exceeds surge impedance loading voltagecollapses. Voltage collapse results in over current and impedance entering distance relay zones. This causes tripping and then cascade tripping.

The means to arrest voltage collapse is to install SVCs.

It is said that even if Z3 are blocked tripping will still take place due to rise in current and fall in voltage.

In my opinion both relay engineers and Power system engineers should work together to understand the problem and address it.

+91 99014 90941: If old distance relays with Mho characteristic are still in service, they should be replaced by relays with shaped characteristic.

Voltage instability is one of many causes of zone 3 over each. From simulation results also it can be obtained and checked the performance of distance relay.

+91 99014 90941: If it is possible to validate Z3 setting of a line by simulation using PSCAD or similar tools? Then it may be possible to see if there are coordination issues during normal conditions.

8. +91 99372 97806: Today we have encountered a tripping of a 220/132kv auto Transformer with differential protection. In relay, it is showing current flowing in HV R phase CT only.No current in LV side CT.Transformer IR Value,turn ratio test,primary injection test and CT terminal tightness checked.But there is no abnormality found.

Still the reason is unknown. Please suggest, what other test to be carried out?

+91 94389 07818: What is the make of the relay...

+91 94389 07818: Is it SEL?

+91 99372 97806: ABB RET 650

+91 94389 07492: First confirm the tripping of TR was only with differential relay or any other mechanical protection had been supported. If only due to differential only, then don't get panic. Problem is due to CT or on its circuit or wrong setting of the relay. So you have to provide the DR(Disturbance Record data) and stability report for the study. As mentioned that differential had been operated so it is of CT circuitry PROBLEM. Hope we can help to solve the issue if you extend proper information.

+91 99372 97806: No mechanical relay operated and it was in running condition.

+91 94389 07492: Good, nothing to worry. Check current balance test, i.e. short circuiting 132 KV side inject 3 phase voltage and measure all currents on the terminals of the differential relay. If found ok, then provide the setting of relay. Sometimes LA as used inside the CT region in the system. Due to problem on LA also differential may come. So provide detail data. But nothing has resulted to TRF, temporary current unbalance might have occurred for which diff has tripped.

+91 99370 00046: How old/healthiness of CB

+91 99372 97806: New switchyard charged on last May, 2016.

+91 99370 00046: If CB of all the three phase has closed properly then Transformer stability test and Relay settings particularly selection of vector group in relay shall be checked.

+91 99372 97806: We have observed there is abnormally high current flowing in the range of 67KA in R phase high voltage side, as per relay trend which is not possible.We are expecting some harmonics or CT saturation related issue.

+91 94389 07492: Current of 67 KA assumed to be very very high, but cannot be overruled of its flow. So simply you check the R phase LA monitoring counter and compare with other phase LA of this TRF. If it's counting number becomes abnormally more than others, then problem on R PH LA. But without getting the stability test result nothing can be confirmed. So please do the stability test and check the setting of relay.

Then how the relay was working during service condition. During running condition, if the current drawal becomes small, then abnormal value being within limit may not cause tripping of relay. However the stability check after this incident can confirm problem in CT or in its circuit.

+91 99372 97758: It seems to be a very temporary current unbalance. The normal tests like IR; ratio test etc can only ensure the healthiness of winding etc. But passing of 67KA is really a serious concern. I believe LA test is required to be done for all three phases & a study on previous transformer healthiness report if available & go for SFRA & trend analysis. 67KA as per relay data seems to be little abnormal.

+91 94385 68673: For differential protection operated LA may be the hidden problem.

9. +91 94389 07492: Which Electrical parameter (Voltage, frequency, power factor) is the most important factor for the selection of good supply and why?

+91 94389 07492: Power system stability is the game of matching of generation and demand. In consumer perspective, how the quality energy billing to be done and should we expect to bill on the basis of power quality linked with frequency base, pf base or voltage base or integration of these. We need to know regarding the mechanism to be adopted to extend justice to the society and the quality conscious consumers.

+91 88952 75644: Regarding quality of supply frequency& voltage are the main indicators of power system operation. Frequency variation indicates load generation imbalance & voltage variation is indicator of reactive imbalance.So in a normal system we look to load -gen balance, constant system frequency, bus voltage within the limit&no over loading.A consumer also looks to harmonics in the system & required to maintain power factor close to unity.In a dynamic situation we aim for normal condition which is hard to achieve.All r interlinked.

+919438907315: If asked to single out one parameter, I as a consumer, 'lwill say - it is \_Voltage\_, as.....

Frequency: In the National Grid regime, abnormal frequency is a short lived phenomenon, as the Load Despatchers are quite alert to maintain this parameter within statutory limits, with curtailment of load and generation.

Power Factor: The combined p.f. in the targeted area decides the quantum of bulk current flow which is factored in derivation of the receiving end voltage, the end product.

Quality Billing in terms of.....

P.F. based: it appears genuine. The conscious consumers will opt to use healthier electrical loads and avoid low p.f penalty, overdrawal penalty per kVA, i.e. the components of p.f based billing.

Voltage based: Consumers may be interested, but suppliers & regulators never, as no individual entity may be blamed for abnormality of this parameter.

Frequency based: Applicability for Generators, Traders, State Utilities and Bulk Customers.

+91 78739 96999: Voltage is the main issue along with current is the main cause of worries.

+91 78739 96999: Power Quality and its related issues could be segregated in two parts:

- 1. Residential use
- 2. Commercial like industries...

Frequency purely depends on generation and all equipment and accessories are designed for frequency variation beyond which generators will also trip.

So...Fundamental Frequency is not related to quality.

Powerfactor is connected to industries ...Which is also the cause of disturbance... which give stress to entire grid also...

All other problems of power quality is derivative of those above factors

+91 98732 87623: For quality of power it's the harmonics which play a vital role. Harmonics are nothing but very high frequency components which is mixed with power and reduces the quality of power.

+91 94389 07492: The point is to be addressed properly, particularly the control of frequency on the network system. As we know, the game change over on frequency is due to mismatch of demand and generation. Within tolerance we should come back to the system stability condition or else the total network could be affected due to outage of generation.

But we are now concern about the quality supply and its commercial transaction. Moreover the users are very particular about the supply with correct voltage and frequency to be fed for their load. The supplier face problem to attend the same due to unforeseen system condition.

But all the way we should attend the situation as required by the electrical society.

Time has come to extend justice and to provide the best possible energy billing on the basis of quality power supply as like demand says to go for KVARH billing, ABT billing or two part tariff billing.

+91 94372 92476: I would like to add a few lines on voltage and frequency.

Ns=120f/p

i.e. synchronous speed of generator =120\*frequency/no of poles of generator. As number of poles of a generator is constant, synch speed is directly proportional to frequency.

When load on generator increases, its speed decreases. This leads to supply of more input to turbine (in shape of steam for thermal generator or water for hydro generator) by the governor.

When guidevanes of generators are fully opened, further more input to turbine cannot be given. This results to decrease in speed of generator with further increase of load. By this frequency of system decreases. With reduction of speed, required EMF cannot be generated which results to decrease in voltage.

Hence when system frequency decreases, reduction of load is required which is monitored by RLDC/SLDC.

+91 88952 75644: Got all inputs for supply side management.Now from consumer end address the issues. The issue of reliability was raised.Reliability indices are specified by IEEE standard 1366 of 1998.OERC adopted:

- 1. System Average Interruption Frequency Index
- 2. System Average Interruption Duration Index

3. Momentary Average Interruption Frequency Index.

These can be truly measured only we have smart meters in place. To achieve this and guaranteed particulars like voltage unbalance we need to have well planned distribution network with appropriate CBs in place. Ring main for at least n-1 condition.

Voltage though a condition by Gen/Load/Configuration of Transmission/Distribution system still local phenomenon to be handled by strictly following Voltage Regulation Criteria by Discoms. It will ensure appropriate line design and transformer capacity etc. Interested persons can see OERC PLANNING & OPERATION CODE 1998.

Power factor has a critical role but apparent power does not do any real work but loads the system to take care of it KVA and KVAh comes to play. In a 15 min block when demand metering is done PF may fluctuate in tiny time blocks say from  $t_{1,...,t_n}$ . To take of that variation concept average PF is introduced which we all know is ratio of Kwh/Kvah which in case will be lower than the Kvah from squaring of recorder Kwh and Kvarh.KVA .is a derivative of recoded Kvah. So commercially a Demand Charge and PF penalty forces the consumer for reactive compensation that helps the system and consumer.

Further charging KVAh in place of KWh will amount to double penalty.But such is not the case with single part metering.FOIR engaged a consultant who recommended billing onKVAh basis for all consumers on single part tariff as it reflects utilisation of both active & reactive components as the system also carries the reactive current. I have explained that KVAh figure will be higher than KWh unless UPF load.But it will not benefit DISCOs as the KVAh will be priced lower.My suggestion was continue billing on KWh basis as the consumer may not be able to differentiate between two after change over.But at the same time utilise the KVA figure for billing also like two part to help DSM as the consumer exceeds the declared KVA.This will make them aware about their drawal.This is also necessary as today lot of domestic/other consumers use reactive load compared to good old days.It is fair to consumer and supplier.

+91 94389 07492: Sir you have opined this concept and explained its impact on both supplier and consumers. But in respect of quality of supply, the supplier should be warned and accordingly tariff to be decided. But as per the type of load (resistive, inductive or capacitive), the consumer becomes responsible to control DSM (Demand Side Management) and type of supply.

We should think both. If so then present tariff to be addressed on the basis of four quadrants.

+91 88952 75644: The supplier is responsible for planning,connection standards at Interface,operation.Take for instance OPTCL it has to ensure quantity quality operational efficiency like availability in short at load centre or be penalised.Generation is very rigidly monitored through frequency linked price mechanism.Intariff for long we have introduced plant availability or be penalised.PLF and availability is compelling generation and hence quality.Unfortunately intrastate ABT though in place is not financially enforced which can force Discoms to limit overdrawal avoid system collapse. There are Grid collapse due to unlimited drawal. At distribution level it is right that suppliers are going scot free after subjecting to interruption low voltage high harmonics by not adhering to guaranteed standards. For each item a time frame and penalty is already in place. Consumers are to claim and in certain cases compensation is automatic. People are not aware. Our biggest problem is metering and communication for scientific information is not coming for which the supplier gets the benefit of doubt. Large no of consumers are not law abiding example large AC load without intimation, unbalanced loading etc. and of course theft.Answer metering & data communication to enforce financial penalties to the supplier and regulate consumer.

+91 94395 41934: If we can go through the literal meaning of quality it conveys "an essential and distinguishing attribute of something".....so in this context determining which parameter has more impact is more like deciding which Pakistani terrorist group is more dangerous for India....however there are 3 fundamental parameters to the structure of electrical science i.e VOLTAGE, CURRENT & FREQUENCY and all other parameters are derivatives of the profiles of fundamental parameters. Moreover these 3 parameters are also correlated to each other.Hence all of them unequivocally important for the system.

+91 94370 00261: I don't think frequency is a problem at present grid scenario, as most of the times the frequency is remaining in the IEGC operating band.

## 10. +91 99014 90941: I was given to understand that many grid disturbances take place in Orissa grid particularly in rainy season. This affects many of the industries which are dependent on grid power.

Can someone explain what are the reasons for this and what corrective actions can be taken?

+91 94373 06970:In Odisha, major system disturbances take place during summer and not in rainy season. The primary cause for the same is increase in load & ambient temperature, whirl wind and thunder storms. The system stabilizes after regular rain fall.

+91 94373 06970: All the major industries of Odisha are having their own CGP and are connected to grid through double circuit with suitable islanding scheme for emergency supply only. So they remain unaffected. However interruptions to other industries are attended on emergency basis.

+91 94372 92476: I would like to supplement a few lines on system disturbance during rainy days.

1- Mini/micro cracks and pores develop on insulators due to ageing, bad manufacturing, system surges, lightning etc.

During dry weathers these insulators do not behave abnormal.But after some spell of rains, impure rain water enter inside these insulators causing loss of insulating properties and reduction of effective creepage distance. By this ground leakage current flows along with bursting of insulators (at times.)This causes breakdown of transmission lines.

2-Along the row corridor of line, many dry/live tree branches are there (mostly in 33,11kv and LT lines).With slight wind and rain these dry branches get wet, conductive and touch live conductors.This causes interruption.

3-During heavy lightning breakdown of EHV lines occur mostly where earth resistance of towers are very high due to poor maintenance.

These are three reasons.

After rectification of faults for sl. 1 and 2, lines become stable and during continuous rain also power failure does not occur much.

+91 98108 01555: Seeing the 3 broad reasons for these trippings it can be safely concluded that these breakdowns can be avoided safely with the planned preventive maintenance. The concerned engineers have to take timely action to take timely corrective action.

+91 94389 07492: Regarding the situation that used to develop in the private industries during disturbance:

On the basis of CLMS (Composite Load Management Scheme) or SPS(Special Protection Scheme) or LADR (Load Accessed Directional Relay), the industries with their CGP, IPP extends these schemes for island of the system. So if the scheme actuates correctly, then industries don't have any problem.

Sometimes the network instability occurs due to outage of the generators of these industries and mismatch between LOADS and GENERATORS causes cascade outage massive disturbance.

But in Odisha this issue does not become that prominent, but sometimes due to deficit in the system network terminates with problems. These nooks are to be addressed soon.

+91 78529 45980: Regarding failure of insulators, snapping of conductors some of my observations—

1. The tower footing resistance might have been increased either due to theft of earthing device or getting damaged both in coastal areas & high resistivity areas (theft or damage of counterpoise earthing).

2. Loosening of earth wire stringing, the phase to earth wire distance at mid span is getting less than at the towers which reduces the shielding angles.

3. Periodic checking of earth grid mostly in coastal SS & making new earthing grid.

4. Interconnection of transmission system (N-1).

Now OPTCL is strengthening its transmission system, still then there is some places in the 220 kv 400 kv systems are radial like Paradeep, Bolangir, Dhenkanal, Joda areas.

5. In our distribution sector the earthing system both in HT& LT lines & sub stations is very poor. This should be addressed (now OPTCL has taken some actions ODSSP as well as in DDUGJY) but still then in old line & substations the earthing modification will be required with new CB, relay etc.

+91 94389 07561: Regarding failure of supply the line plays major role.Huge percentage is due to growth of trees, bushesetc inside the corridor.People demand compensation even for charged lines, which OPTCL doesn't have definite provision.So in my opinion, utilities should purchase the corridor land or make statutory provisions for compensation.Once the line is clear90% of faults will vanish automatically.

11. +91 94395 41934: In present logics it is found that two transformers are in parallel and we have put one in master mode and another in follower mode. During the tap change process if emergency push button of any of the RTCC is operated the other one is still completing the tap change process.

The question is difference of one tap is around 1.25 kv& the total bus and winding resistance may come around max to max 50 ohms don't we think such a logic will invite serious circulating current in the circuit which may aid andabet in spurious tripping?

+91 94389 07492: Sometimes unequal tap position in parallel running of TFRs are intentionally used to cater extra MVA load to the network. This practice had also been considered with us at one of the 220/132 kV grid. This concept is called impedance cutting principle. So the situation as raised by you if it results then considerable dangerous circulating current may not flow in the circuit. The practicability of such situation we have already experienced.

12. +91 98260 09149: What are the probable causes for failure of LAs? Any monitoring is there to pre- determine its healthiness to prevent the effect of its failure on system? I've faced the problem of simultaneous failure of 02 phases LA (9.6 kV, Metal oxide, station type) in same supply network of 11kV.

+91 94370 16319: We normally have leakage current detectors for LA in 220 KV class. That's to be checked daily to know the health of LA.

+91 99370 00046: This is a real challenge as generally there won't be any counter provided at 11 kv level due to cost constraints. The major cause may be keeping higher voltage (up to 12 kv) due to which higher leakage current flows.

+91 94389 07492: Probable reasons of LA failure:

1. Entry of moisture into ZNO2 chamber.

2. Improper earthing causing delay of surge current dissipation to ground.

3. Improper installation

4. Manufacturing defects etc.

Symptoms just before failure:

- 1. Flow of leakage current above the green zone in the monitor
- 2. Abnormal increase of count comparison to other LAs.
- 3. On idle charge condition, the leakage current becomes more accompared to other phase.

Solutions: 1. Use polycrete insulated LA.2. There should be discharge vent (nose shaped). 3. Earthing flat (preferable 75x8mm) with minimum bend and running length less than 8 ft. 4. Tripod earthing pit interelectrode distance approx. =3mtr and again connected to main mat. 5. Cable from LA to Counter should be straight run without much curled to avoid inductive path and delay in discharge current.

## 13. +91 73810 07007: We have lost one 40 MVA 220/11Kv Transformer. Y phase bushing punctured within operation of 1 year. All protection operated but transformer could not be saved. What are the probable reasons?

+91 94370 16319: All the protection schemes operated and yet could not save the transformer; it indicates that the protection perhaps did not operate in time to isolate the transformer.

+91 94385 68673: Think which is first? Protection operation or bushing failure. Failure of bushing first and then protection operated. Transformer protection is designed to restrict damage.

+91 95607 63305: Voltage conversion of 220/11kv is bit unusual. Protections for transformer may be shared along with its location in grid.

+91 73810 07007: Just 5 minutes before we have noted all transformer parameters like bolt, current, wind Temp, oil temp. All were ok. We have just heard a punctured sound. When we see smoke observed from bushing and transformer breaker was also in trip condition. During the year almost 70 times we have tripped over voltage from grid side. Transformer was commissioned just before 1 year. Loading was also not crossed 50%.

+91 94389 07492: The symptoms as indicated is the case of problem on the TAN DELTA point cap issue. This might have been in open or in loose condition. The symptom is of developing hissing sound of crackling nature. This situation as described for 220 kV bushing and becomes prominent for HV condition. But the damage of bushing shall cause the actuation of differential relay only. As mentioned that protection provided to reduce the severity of damage, cannot prevent fault in the system. So keep faith upon protection. Moreover as of important device different Protections are provided in the system.

+91 78739 96999: Testing and protection has come through many stages i.e. from periodic maintenance to condition based monitoring...Unfortunately till date we are yet to learn trend analysis properly to remove failure much before it occurs...Today ON-LINE monitoring is gaining importance.

+91 78739 96999: Failure of insulators can be prevented by testing in charged condition ...MSETCL and POWERGRID are doing such things to prevent failure of insulators...MSETCL has found 25/30 % insulators prone to failure and replaced them...

+91 78739 96999: On line Tan Delta monitoring becoming a new trend ...bit expensive but surely can remove certain issues for critical application.

+91 94370 16319: Yes, a protective scheme can't prevent a fault. It could only sense it and initiate a preventive process to restrict damages.

In this case what could possibly be the differential setting so as to sense the hotspot developed at the loose joint?

In hydro-generators we have experienced hotspots on the joints of stator bars that's sensed by a relay to instantaneously trip the Generator. That relay is also based on the logic of differential protection.

## 14. +91 94389 07806: At control panel a man shorted D71 and E71. What will be the effect of that at normal and fault condition?

+91 94389 07492: Theoretically no effect shall come. But shorting point is most important. If combined short and then earth, then for the case of uneven PT load or fault occurrence, the development of voltage on its common point will affect both CT and PT circuitry. So wise to have separate wire extension and connect to earth.

# 15. +91 94389 07966: I have one small doubt in connection with traction drawal and its impact on the generating stations connected to the same bus. Since traction is drawing in two phases, isit at all possible that the CPPs connected to the same bus would experience a jerk during peak drawal of railways? It is happening.

+91 94389 07492: In practice traction loads are fed from 2 phases from the HT system preferably 132 kV bus. During traction loading the current drawal on these two becomes heavy and sometimes results with lowering of voltage on the respective phase. So on the basis of available fluctuation, the generation plant trip on under voltage.

So it can be said this will cause jerk/ fluctuation on the system voltage and in practice unwanted.

Solution: those plants should have to use zero sequence voltage relay Integration with limit of lower voltage.

+91 98108 01555: Practically are we experiencing tripping of generating plants quite frequently on lowering of voltage on phases in the traction system and have we not provided such under voltage relays to protect the system so far

+91 94389 07492: The tripping of generation plant is rare. But where it is resulting frequently, it is due to problem in the setting of the UV relay. Particularly setting of DROP OFF and PICK UP value. An example:

Say UV setting is 85%. But drop off setting is such that after UV pick up of the contact needs certain voltage to drop off the contact to release the tripping of system. But due to wrong setting this may cause unwanted tripping. So setting needs to be reviewed for such case to avoid such tripping.

#### 16. +91 94371 16780: Why Scott connection is not considered for traction loading?

+91 94389 07492: Methods used:

- 1. Single phase transformer.
- 2. Two 1phase transformer.
- 3. Star-Delta transformer.
- 4. Star-Star transformer.
- 5. Scott transformer.
- 6. Leblanc transformer.

Where maximum voltage unbalance is of 1. 12-13%; 2. 6-7%; 3. 8-9%; 4. 11-12%; 5. 10-12%; 6. 6-7%.

Solutions: Each system has its own limitation and Voltage unbalance depends upon the type of connection, which is technical concept. But commercial and situational issue like availability of HV station at suitable area, cost of the transformers etc. are also to be considered.

BUT BETTER SOLUTION FOR REDUCTION OF THE UNBALANCE IS TO PROVIDE EQUAL LOADING ON THE TFRs in sequence (RY, YB, and BR) for equal zones.

In India we generally adopt the no1 method by use of EQUAL loading concept. But due to situational and suitability condition, practically, this did not get attended.

#### 17. +91 94389 07817: What is the reason of showing distance -ve Km in zone-1 DP relay?

+91 94389 07492: Please confirm about the relay make. As our experience says sometimes data bounces and value comes -ve. So advice to consider the 2nd fault occurrence and its data as the confirmation.

+91 94389 07817: The relay is SEL 311C and this is the 2nd time the -ve value for the same relay.

#### 18. +91 94389 07492: ONCE AGAIN please RELOOK the use of Z3 for DP relay.

As we are using IEDs of logic base so flexible logic could be taken in the relay to look at the integrated protection. Moreover communication link could also be tagged for its design. Judicious use of Z3 or replacement of it with logic as per situational requirement need to be deliberated more.

+91 99014 90941: The problem to my mind is voltage collapse which results in tripping of distance zones. Can the following be checked from DR records?

During disturbances

Is it always Z3 tripping or it can also be other zones tripping?

Does the current go up and voltage fall when these tripping takes place?

+91 99014 90941: Is the reach reduced to prevent Z3 reach in to lower voltages? There again in-feeds may prevent it overreaching. If some studies can be done that should give clear idea.

My question was Z3 operation during disturbances. Can someone check on voltage collapse and its impact on currents and voltages?

Here is an extract from CIGRE WG report 34.08 "Protection against Voltage Collapse' 1998-pp21--

......During voltage collapse conditions very low voltages and very high load currents, the distance relays may pick up according to the settings and will trip within some seconds which can lead to a cascading outages of lines. It is therefore important that line distance relay application and setting studies include considerations of the apparent impedance measured during high stress low voltage conditions.

......Therefore my submission is our discussion on Zone3 should be more quantitative than qualitative to understand the problem better. This is the situation I see everywhere in India including organisations like Power Grid and NTPC.

+91 94389 07492: Can zone 3 selection be omitted from the DP relay and to be used with revised zone1 and zone2 with rev. Zone.

Because in protection history it has been found with rare actuation of Z3 and on every actuation cascaded tripping had been resulted with massive system disturbance. Deliberate

+91 94371 13454: Load encroachment in case of long lines had caused many disturbances in our system in recent past. Modifications in setting has been made to avoid uncoordinated tripping of Z3.With 2 numbers numerical protection, we may think of over current and earth fault coordination instead of Z3, particularly for long lines.

+91 94370 58624: Instead of blocking of zone 3 if more other end information can be retrieved using dedicated channel then load encroachment may not create issue like that happened in 2012.

+91 94389 07492: The incident that resulted during 2012 is one of the consequences of zone3 tripping. But in actual while considering the zone coverage, this z3 could be called back to back up zone and actuation of this during fault occurrence shall cause massive system disturbance.

In my view:

1. Zone3 should be omitted, zone1 and it's back up zone2 to be considered with revised coverage as per the protection requirement.

2. E/f relay in directional feature with proper co-ordination can be introduced.

3. Selection of back up zone 2 and reverse zone should be considered on logic base as per the situational requirement.

+91 94370 58624: We can think of another way also if more fiber optics or dedicated links are provided then why to omit zone 3. Whatever modifications even if we provide reach accuracy never be obtained. And maybe this is what the cause of introduction of third zone concept.

+91 94371 13454: With 120% of protected line + adjacent long line for Z3 setting, we had observed tripping of 220 kV line in one of the southern grid of Odisha few months back. It was analyzed to be load encroachment case. However, the current in the feeder was above 150% of rated. We have adopted o/c setting 125% IDMT in order to avoid permanent damage and unfavorable sag in old lines.

+919438907492: Each protection scheme should have Main and it's BACK UP. So for line protection, considering of forward zone and reverse zone, we should consider the selection as follows.

1. Forward: Z1 as main and Z2 as back up with its selection for extra coverage to next network. Moreover selection of Z2 is case specific, to be decided as per situation requirement and load flow study.

2. Back up {EF relay} could be tagged also under this selection for the same line.

3. Other special protection or logical tripping, like LADR/SPS could also be brought to manage after fault stability situation at any power hub.

4. Reverse zone could be judiciously taken by considering BB as its Main protection.

So selection of Z3 as extra zone and allowing the Tripping of healthy system and causing cascade outage method has to be relook soon.

+919437113454: The zone setting philosophy adopted for eastern region by ERPC protectionsubcommittee broadly compliments to the provisions enumerated in the Ramakrishna task force report.As I observed it is operating excellently except the z3 for long lines. In these case we deviate as per practical consideration. As regards zone 3 operation, it is rarely observed.

+91 94395 41934: if the purpose is to prevent unnecessary tripping like load encroachment then we need to revisit its very logic. It's a phenomena where unlike fault condition R/X ratio is quite high.....secondly when load encroachment happens we also need to take in to account the thermal loading capability of the line as it will not be a transient phenomenon like power swing detection. So it could be opined that:

1) We should keep zone 3 intact as we can avoid unnecessary tripping of a larger electrical radius during a temporary fault with high impedance value instead of tripping the line with zone 2 timing if we don't keep zone 3.....

2)It's better to consider load encroachment as a different feature like power swing detection where more delay can be allowed say 2 minutes( by blocking zone 3 activation) for initiating load shedding in the s/s through inter relay goosing and then unblock zone 3.

3) As load encroachment is a phenomena observed in long and heavily loaded line an elliptical characteristic may be considered as its characteristic depending on the line parameters.

Hence ...for me protection philosophy has facets.....sensitivity or selectivity....i have advocated for selectivity although alone it is never absolute.....

Note: Some of thing that I quoted may not be an available feature in existing relays but as utilities we recommend it as an input for manufacturers to mull over this idea....

+91 94389 07490: Z3 may be submitted to manufacturer view.

+91 99014 90941: Z3 is going to stay. That is the only one which can give back up protection. Z2, Z4 are for other purposes and cannot replace Z3.Even when line differentialProtection is used additional Z3 is provided for back up.

What should be done is to make studies and validate its setting both under normal conditions and under disturbance conditions.

Power Grid is providing lot of Static Var Compensators which will prevent voltage collapse and distance relay Mal operations.

Therefore my suggestion is OPTCL take up sample study on few of the 400kV lines and validate Z3 settings. Also see if SVCs are required in some locations.

+91 94389 07492: Adoption or rejection of Z3 is not exactly our concern. We have to conclude such that time has come to relook and revisit upon the setting philosophy of Z3.

1. On basic we can say, this zone is a backup zone to Z2.

2. Its action is due to the consequences of after fault situation and covers to the area where fault current has least effect.

3. So if this zone actuates then disturbance coverage becomes more and situation of instability results due to mismatch of load and supply.

4. So on very specific we say that this zone selection has to be selected with integrated logic on the condition of after fault effects on load and supply study to avoid unwanted tripping.

5. By the use of SPS, LADR, Islanding scheme or remote relay GOOSING of information, this unwanted tripping could be controlled. In case Z2 does not then this should

+91 94395 41934: We should throw the tantrum to load encroachment which is the prime culprit ...my only request to the distinguished intellectuals is to find out ways and means to discriminate between a zone 3 fault and a load encroachment.....

One probable solution is....

During load encroachment the tripping in z3 hopefully actuates with the activation of all 3 phases like a seemingly symmetrical fault wherein the current value not exceeding than 1.2 to 1.8 times the rated capacity (but the voltage dip creates the problem). While in case of a 3 ph fault the current in all 3 phases will definitely increase more than 2 times .so if we may take this logic in to account, then under such condition we can block z3 for say 2 minutes and initiate load shedding and still if it persists then it will be unblocked and initiate tripping to safeguard the line thermal loading capacity.

## 19. +91 94389 07490: Why earlier distance Relay setting were adopted ie.z1-80%/0sec,z2 - 120%/0.5sec,z3-150%/1.5sec in conventional characteristic by expert & statutory body .Did not they think of load encroachment? Now Quad. Characteristic has more space.

+91 98454 58903: We should understand that z1 and z2 protections are only for primary line. Depending on the infeed at the next level and parallel line effect z2 reach beyond primary line is a bonus. Hence we cannot do away with Z3. , Z3 setting should be arrived using analytical methods.

+91 94389 07492: Z3 has to be reviewed and clearly discrimination to be drawn for its actuation not on the basis of its action due to fault, rather due to the post fault condition to manage the system stability by the special protection schemes available.. We request all the protection experts to save the situation by choosing the special logics during this era of the use of numerical relay.

+91 94389 07492: Initial days and even in present situation we also adopt the selection as described.

1. Upon the Selection Z1 all experts have the same view regardingits under reaching selection.

2. Z2 is the back up to the Z1 and selection is more than 100% depending upon the need of the protection scheme and no such specific norm.

3. Z3 is back to back up and it has also no specific choice, it depends upon the user to select as per requirement.

On specific answer upon the earlier days selection

4. During those days, the network system was of regional with less traffic on power system as compared to the present interconnected network with involvement of large power system.

5. As all of us we know actuation of Z3 if proper selection not considered then larger area could be affected. Moreover during those days also load encroach issues were there and system was getting affected.

6. But we urge to speak now that at present we have numerical relays with advance communication link and integrated logical selection. So we have to be selective and very rightly to relook upon the choice on Z3 to extend justice to the system very soon.

+91 94389 07492: Our concern is very specific that in the present Z3 selection, utilities face problem on discrimination of load encroachment during post fault situation and problem during non-operation of prime zone (z1, z2).

## 20. +91 94389 07971: If a battery charger (in float mode) trips frequently in over current without rise of the DC output current (beyond 30A), what may be the probable reasons?

+91 94389 07492: This might be the problem on the Automatic Control Card. So for confirmation of the problem use the card from Boost mode and check its performance.

+91 94389 07971: Sir, the card has been replaced by a new one, but the problem still persists.

+91 94389 07492: This is the problem of the loose connection of the battery bank. Any one the cell might be in loose connection. So during floating mode, fluctuation of the charging current results tripping of the charger.

To confirm loose connection:

1. Switch off the charger.

- 2. Put the station load on battery bank.
- 3. Operate any of the breaker.

- 4. Check the fluctuation of DC voltmeter and load current Ammeter.
- 5. If fluctuation results then any of the cell might be in loose connection.

### 21. +91 94389 07883: Which one are better-Porcelain insulator vs Silicon composite Insulators for all voltage?

- +91 94389 07492: Obvious silicone Composite insulator is better. It has following advantages
- 1. Light weight and flexible to adjust to situation.
- 2. Hydrophobic in nature, water droplet does not stick to it
- 3. Ease for handling and installation.
- 4. Unbreakable.
- 5. High mechanical strength.
- 6. Confirms to US 2486, IEC 61109.

ONLY COST is the factor and in case of failure total to be replaced.

Moreover it is gaining popularity on the use of insulator stacks of Electrical field EQUIPMENT like CB, CT, CVT, PT and bushing of TRF also. Only problem in Indian market regarding its acceptability.

+91 78529 45980: There is some other disadvantages in silicon composite insulators.

1. This insulators does not take vertical loading while used in Tension points, for which the workmen moving over it for removal of come along clamps, some other methods are being adapted.

2. The prevention of damage by rodents during preservation.

3. Sometimes the birds are also damaging it.

+91 98108 01555: Let me add that there are four levels of pollution...light, medium, heavy and very heavy

The porcelain insulators are generally suitable for light pollution levels and medium levels with increased creepage distance

The porcelain insulators are not at all suitable for heavy and very heavy pollution levels. In these cases we are using only polymer insulators with silicon impregnated...

In the foggy weather there used to be lot of trippings on 400 kV lines around Delhi prior to 2007. Due to heavy pollution suchtrippings have been checked since then with the replacement of porcelain insulators with polymer insulators

Many other utilities in northern region are changing porcelain insulators because of limitation of the same to withstand heavy and very heavy pollution levels

+91 98108 01555: I would like to add that there is wide acceptability of polymer insulators in the world for the last few decades including China and India.Power Grid is also using these insulators for the last about 10 years

Other utilities have also started using the same in the country in view of its best performance under heavy and very heavy pollution areas

Its cost is also near the cost of porcelain insulators and in cases may be lesser now.

The other inhibitions like storage problems etc should also be over.

We should practically start using it wherever required without any practical difficulties.

In addition the porcelain housings of equipment like C.T.s., P.Ts., C.V.T.s etc. are getting replaced world over with polymer housings in view of its technical and safety merits over porcelain

+91 94389 07492: Thank you sir for extending one of the major points of handling such insulator for TL system. Sir could you help us to know the methods as adopted at the point of tension as it does not manage the required vertical loading. Members from manufacturing industry are requested to provide the solution if any.

+91 78529 45980: For solution of fixing Tension silicon insulators, we were using a ladder fixing in the X-arm for bypassing the insulated portions for movement of workmen during stringing operation. This was our then idea only accordingly we are doing.

22. +91 94389 07490: Please find a case occurred .The 132kv BPPL feeder which was supplying load to Phulnakhra & Cuttack through reserve bus of CDKA &Mancheswargrid ssTripped on DP Z3 at BPPL, Y-E, distance nearly 34km and at Phulnakhra end also DP operated in Z1, Yph-E, distance nearly 5km.The actual Y phase Insulator was broken and fall on bottom cross arm.There was no other source/feeder charged at Phulnakhra g/s.Is it ok?

I think relay operation at Phulnakhra is wrong.

+91 98454 58903: What is the transformer vector group at phulnakhra? Depending on the vector group or transformer construction there can be earth fault current feed, even though no source exists.

+91 94389 07687: Sir, it is YNyn0 for both the power transformers, one 40MVA & another being 20MVA.

+91 94389 07490: The vector group of 2\*20 MVA ,132/33KV Power Transformers , V gr.-YyNno,%z9.73 & 11.8757 of ALSTOM & EMCO make respectively.

+91 94389 07490: Both Transformers are 20MVA &3rd 40 MVA is not yet installed

+91 94389 07492: Sir if the fault occurrence had been beyond phulnakhara and towards Cuttack, then there could be the operation of relay at phulnakhara end due to dip of voltage and rise of corresponding current for TRF winding being involved. Because there was load (transformer and its 33 kV system) at Cuttack end.

In this condition two abnormalities have occurred.

1. Tripping of 3rd zone at BPPL, when relay at PHULNAKHARA operated to clear the fault. (This indicates Phulnakhara is T- connected from system).

2. Non-initiation of Cuttack relay (not tripping but pick up).

The analysis has only been on considering the fault in Phulnakhara- Cuttack zone. Please confirm.

+91 94389 07490: The fault was in between Phulnakhra&Mancheswar near village Orilo.

+91 94389 07490: Phulnakhra is not T connected but it is radial from BPPI-Chandaka - Manchswar-Phulnakhara -Cuttack.The 33kv load at Phulnakhra& Cuttack g/s end. Also the 132kv ckt New Dubri-Paradeep-Jagatsinghpur-Cuttack was in Off Condition at Cuttack g/s end.

+91 94371 13454: The DR of both the relays at BPPL as well as Phulnakhra and system configuration of Phulnakhra& Cuttack Grid is required for proper analysis.

+91 94389 07490: Ok.

+91 94389 07492: The description indicates that at Phunakhara grid the line is LILO because the DP at this end has operated.

Now abnormalities as found.

1. Tripping of Z3 at BPPL end if considered BPPL to phulnakhara line as its protected line (setting CRITERIA at BPPL andPhulnakhara to be confirmed)

2. Why Cuttack relay did not pick up.

+91 88952 75644: I am watching sometime with interest the discussions on protection matters as i was involved for long.In the past it was a practice to do the calculation of relay settings of all

lines and transformers of all grid s/s almost manually in the jurisdiction of every MRT subdivision by the concerned MRT SDO.That brings clarity.Hope OPTCL is following it and major interruptions are being analysed at GCC. Now with number of interconnection and with the advantage of computerization one can analyze quickly. If it is really followed Phulnakhara fault issue quite common in nature must be explained by checking the calculation and relays. I just wanted to know with number of LILO after tapping for industries/area load any difficulty is being faced for line protection though we have very advanced relays. Next protection of very short lines how has been the result.

# 23. +91 94375 67560: One transformer manufacturer is mentioning flux density 1.65 tesla at rated voltage and frequency. What will be the effect on core and other technical parameters if the above flux density is considered? Normally the flux density should be within 1.5 Tesla at rated voltage and frequency.

+91 94389 07492: This topic is one of the important for the best design of TRF.

Choosing of LOWER FLUX DENSITY is always better for the TRF, due to following

1. To attend lower density either cross sectional area to raise or quality of core material to be chosen. So selection goes for quality material.

2. Iron loss shall be less and loadabilty of Transformer shall be increased, so choice for better quality copper winding.

3. Choice with low density with better limit of knee point voltage allows the Transformer to be used at higher voltage. Hence better insulation to be provided to withstand such voltage and transformer could be designed better.

4. To meet above points, designer has to strengthen the all other accessories.

But these are engineering we mentioned, then comes techno-commercial factor comes into action. So you are the decider to draw its breakeven point.

+91 94385 18261: Maintaining higher flux density means cross sectional area will be lower. So cost becomes less also higher flux density will give more hysteresis loss leading to unnecessary heating of the core.

+91 94370 12395: Regarding flux density. The cost aspect will increase and safety is ensured to some extent....earlier we were purchasing transformers of 1.90 or 1.95 Tesla...burning occurred frequently at Chainpal.....it was apprehended that transformers nearer to generating stations are subject to sudden in rush.... Some lowering of flux density say if I'm correct to 1.45 was taken...during 1995 around...

+91 94375 67560: Sir, kindly refer the clause 7.9.1 of IS: 1180 (outdoor type oil immersed dist. Transformers up-to and including 2500kva, 33kv.

+91 94375 67560: The transformer manufacturer is back calculating the flux density as per the above clause and showing that 1.65 Tesla is under 1180 limit. Core grade used 23HP90.

+91 94370 12395: What is the practice followed now in OPTCL

Must have taken all angles into consideration. I have indicated very safe figure...that is definitely costlier and can be used in vulnerable places. Now there is lot of improvement in protection against such eventuality...if this are placed them...willdefinitely benefit all.

+91 94389 07492: The technical theory as provided is better for the transformer and on the basis of power transformer above 132 kV class. So you have to judge and accept the flux density factor like its cost in comparison to its voltage class.

But if it is of 33 kV class and satisfying all criteria, then 1.65 value is ok as far my knowledge is concerned. But while to refer any standard the max limit always mentioned to meet both ways(manufacturer and purchaser) so on mutual agreement thing should be taken as practice.

+91 94375 67560: Flux density is inversely proportional to net core area. Hence for lower flux density the net core area will be more. Which corresponds to increase in core material and cost of transformer.

+91 94370 12395: Yes cost is more. Transformer will be heavy. Safety will be there.

+91 94389 07492: During earlier days the transformer was of huge structure for even 5Mva rating. But the technology has been advanced and we are now considering the choice of quality core in place of cross sectional area.

+91 94389 07492: Any electric m/c is designed on two parameters -specific electric loading and specific magnetic loading. More is elect loading, more will be cu loss, more is magnetic loading, and poorer will be pf.

91 94389 07652: Choosing lower flux density is always for better sustainability of transformer of the following reasons-

1. Lower flux density minimise the inrush current.

- 2. Noload current is minimum.
- 3. Loading capacity will be increased.
- 4. Avoid over fluxing during high voltage condition.
- 5. Temp rise is less.
- 6. Harmonic effect is less.

- 7. Avoid over heating of insulation.
- 8. Knee point attends at max % of ratedvoltage.
- 9. Avoid wastage of energy results total annual loss of power amounts to a substantial fig.
  - 24. +91 94389 07492:.Discussion is kindly invited on selection of optimum value of loadings based on techno economic parameters. 1.9 T is maximum for CRGO core .REC has specified 1.5 T for distribution Transformer.Many utilities have specified 1.6 T for power Transformer.

+91 88952 75644: When we talk of a transformer connected to a system its area of cross section, no of turns are fixed. Supply frequency and nominal voltage is fixed within limits. Hence nominal flux density comes into play to decide how the transformer operates. Output is linked to total flux frequency and ampere turn and from there we derive that voltage per turn or E/N = 4.44BmxAxfx10(-6). Here Bm stands for Maximum Flux density in Tesla in the core and A stands for cross sectional area of the core in mm.

The designer would like that the transformer operates as high as possible closure to saturation at normal frequency and voltage within limits ensuring margin that under light load condition it operates below saturation.British practice voltage rise allowed upto 10% so also we.A supplier looks to efficient and economic operation including less core loss.Hence the search for a core material that provides low core loss and high permeability that allows higher level of flux density compared to conventional.So electrical steel that allows upto 1.9T helps reduction of size and lower operating losses. Typical American government guide line says decision depends how a utility value losses. We are equally concerned & allow our transformers to operate by use of CRGO steel.It has a bearing on cost.Cost of core 100MVA & higher account for 22 to 24% and copper 18to27% two years back in USA.Obviously we may be around that.

### 25. +91 94375 67560: Whether chemical earthing is advisable to be adopted instead of conventional pipe and rod earthingfor the grid sub stations.

+91 94389 07492: Chemical earthing is effective but costly.IE rules 1956 doesn't specify any particular value of earth resistance. Chemicalearthing can provide resistance below 1 ohm but its maintenance is also costly as after a fixed time chemical is required to be changed.Not very much recommended taking cost into consideration.

+91 94389 07492: First of all let me to speak upon the use of electrodes for conventional and chemical earthing.

1. The similar electrode generally used for both case except like marbonite and others.

2. The use of backfill material plays the role of difference, like use of bentonite and other chemicals in proportionate with soil.

Then regarding its adoption in practice, chemical earthing is definitely advisable, though costly but reliable.

Only factor of its replacement after few years 10 to 15 years, depending upon the type of chemical used.

+91 78529 45980: Regarding Chemical earthing we have got some bitter experience as once during 2009 the supplier has done a test earthing near our newly constructed OPTCL building, after 20 days when we measured the resistance it gave more than 20 ohms against less than 1 ohm as committed. What I feel that dependson the surrounding soil & moisture content. At BBSR the soil is laterite having very less moisture content during summer. What I feel in such areas the earth pits has to be filled with powered loam soil mixed with Bentonite powder, salt by excavating 1x1x 3 mts.in each pit with water hydrant .I had seen the water hydrant system is being effectively utilized at Machkund hydro power house. For this reason I had introduced this system in CAPEX, also in ODSSP OPTCL has been adopted the water hydrant system. My view it should be adopted in dry areas with laterite soil.

+91 94389 07492: We agreed. But for rocky or special earthing we can try MARBONITE material which has special concept on earthing on critical area.

+91 94373 06970: Chemical earthing has not been successful, when it was carried out on experimental basis in 132/33kv Mancheswar and Kalarangi grid s/s. So it has a long way to go before it becomes operational in large grid s/s. Moreover there are no specific standards for chemical earthing.

+91 78529 45980: I also agreed. During 2007/8 we have tested it near the new building of OPTCL, where the soil is hard laterite .The result of electrode resistance was much more. For that reason we didn't adopted in OPTCL system.Now if modified it may be adopted.

+91 78739 96999: Chemical earthing does not require daily watering to retain its value...life is better than conventional earthing

#### 26. +91 90406 24335: Life span of a chemical earthing is how many years?

+91 94389 07492: As far my knowledge and collected from different manufacturer's manual, the life span is minimum of 10-15 years, after to which chemical is to be replaced.

+91 78529 45980: The earth mat design depends upon the earth resistivity of the substation area, maximum fault current keeping the touch & step voltage within the limit.

### 27. +91 90406 24335: Chemical earthing needs regular water hydrant and resistance value increases gradually. Is there any process to keep the earth resistance less?

+91 94389 07492: We are not sure on the happening that chemical earthing needs regular water hydrant. Please go through the chemical characteristics of the material used for such. As far my

knowledge this has no relationship upon water hydrant, that this chemical itself maintains the property such resistivity remains less days long.

+91 78529 45980: Water hydrant is required to maintain moisture level of peripheral soil around the earth electrode.

+91 78529 45980: If the Water bearing capacity of the peripheral soil around the earth pipe is very poor ( in case of our BBSR, Choudwar, Khurda, Dhenkaletc laterite soil) in that case the water hydrant will be required to maintain the moisture label of earth pit during dry period.

## 28. +91 97780 31301: If water hydrant is required for chemical earthing then in which way it is beneficial from normal conventional Earth pits?

+91 78739 96999: Chemical earthing is beneficial as it does not wash away with water over a period of time...but chemical earthing itself cannot be left without monitoring....

+91 78739 96999: More over its characteristics of conductivity is better than charcoal and salt

+91 78739 96999: Charcoal should be discouraged as it encourages people to burn tree ...in turn environment issues.

+91 97780 31301: As per my knowledge, now days instead of charcoal and salt we are using bentonite powder mixed with loose soil as bentonite can retain moisture.

+91 97780 31301: So can we suggest that these chemical earthing pits need to be only hydrated in dry season and there is no need of putting water in other season.

+91 78739 96999: Bentonite is not considered as chemical earthing. It is used mainly with charcoal and salt to keep moisture and in turn better conductivity. It requires periodic watering mainly in summer

## 29. +91 90406 24335: This has been revealed that on-load, off-load tap changers are great trouble creators. Can we replace it by a link? This link could be made taking different No of turns at a closed box on outer surface of transformer?

+91 88952 75644: A Bolted link position with the transformer totally isolated is available but as an off circuit mode.Used for Unit Transformer and other large power station auxiliaries, Capacity high as 650MVA at 20.9/345 KV.Instances are there when Auto Transformer do not have tap changer because of providing at line end. Hence OLTC is provided after that at 132 kV. Hence OLTC in spite of unreliability is unavoidable .Even when we accept CRGO steel with Bm of 1.9T because of Tap changing at the lowest tap point at the highest system voltage saturation has to be avoided. To accommodate 10% over voltage design flux density at normal voltage will be 1.9/1.1 or 1.72.To accommodate transformer tap upto -13% it has to be further reduced to 1.72/1.13 or 1.52T a value around this is used for 132kv.To get the desired capacity size has to be bigger and costlier. Yet OLTC has many advantages in spite of other disadvantages.

## 30. +91 90406 24335: In switchyard which equipment to be connected directly to earth mat and which equipment to be connected through earth pit?

+91 78529 45980: Normally we are connecting LA,PT,CVT,NCT, Columns having spikes or earth wire, connected with earth mat through earth pit (earth electrode)

+91 73810 07007: LA to be connected directly to earth pit. Rest I think all equipment can be connected to earth mat connected to pits as per design.

+91 94389 07492: Related to Earthing of S/y equipment.

1. All non-current carrying metal part( structure, body, enclosure etc..) to be connected to earth mat by running two different directed earth flat, to be preferred with earth pit again to mat.

2. System earthing (star point of TRF, PT, CVT, LA generators etc), must be used with earth pits at minimum distance flat run to it again these pits to be connected to Earth Mat.

Note: So under all situation related to earthing to be decided to have maximum GRID structure (interconnection of earth pit and mat ) that can reduce earth resistance and helps to discharge/dissipate the fault current quicker to universal sink( earth mat).

## 31. +91 94375 67560: In some areas where Hard Rock is found, it is very difficult for achieving the required depth of 3 meters for earthing. What are the recommendations for earth pit?

+91 78529 45980: No, as per IS, you can find the equipment and structures as mentioned above will be connected to earth mat at two different directions through earth pit.In IS you may find that where 3 mts depth cannot be achieved the slanting earth electrode can be fixed. Regarding hard rock area the earth pit has to be filled up with powered black cotton soil mixed with Bentonite power and common salt.Also some of the earth flats may be connected to remote good earth. At upper kolab power house we had done this type of method.Two flats to remote earth & two flats to tail race .In laterite soil the bentonite without water hydrant shouldn't be used, as the water bearing capacity of this type of soil is very less, the soil with Bentonite mix will be separated from earth electrode during very dry weather.

+91 78739 96999: The value of earth electrode depends of surrounding earth...i.e soil resistivity ...not chemical of the electrode

+91 94389 07492: Selection of soil with better earth resistivity may attain the designed earth resistance. But selection of treated earth pit has the following advantages.

1. The pit could be hydrated during summer.

2. At present chemicals are used in place of old salt and charcoal, hence the replacement could be attended.

3. Moreover the earth constituent is not homogeneous, hence needed to be treated as per requirement. So always to choose treated earth pit.

+91 78529 45980:Previously in all our grid construction we were adopting all treated earth pit by using charcoal salt & loam soils in alternate layers. Now due to constraint in availability of charcoal we are using Bentonite powder and loam soil (1:10) proportion.

+91 78529 45980: The earth mat design depends upon the earth resistivity of the substation area, maximum fault current keeping the touch & step voltage within the limit.

32. +91 94398 79229: One 15yrs old 132/33kv, 40MVApower transformer feeder was tripping indicating differential and Buchholz fault. Oil DGA test conducted and observed presence of acetylene gas. OEM was called to diagnosis the exact reason. After draining the oil, OEM checked inside the transformer and notice that only flashover has occurred in the tap changer .and other tests such as ratio, IR,PI,windingresistance, vectorgroup, magnetic balance and all test results at Ok. OEM advised to repair/replaced the tap changer. After replacement of the tap changer this transformer will work or not?

+91 94389 07492: Sir OLTC is the weak link for the failure of the transformer.But you have sought the views regarding the working of the TRF after repair, YES nothing doubt upon it if repair has-been attended you can successfully charge and run the transformer.

+91 94389 07492:

1. Abolish of this tap changer could be also the choice.

2. Special box with link plates to be another choice.

3. In some utilities like PGCIL, NTPC as far my knowledge, the practice of non-use of tap changer has already been started. The voltage control has been done with matching of load with supply.

+91 88952 75644: OLTC onGenerator and inter bus transformer to assist in the control of system VAR is a practice. It also compensates for regulation within transformer and maintains constant voltage output Pertinent to mention that while we finalised the Grid Code the issue was discussed. According to IEGC ICT tap at drawn point shall be varied to control VAR apart from switching of 400kv bus and line reactor as per RLDC. Similar in OGC. This in place today with pricing of VAR to regulate it. On generator side LV side voltage is controlled up to -+ 5% by AVR. For unreliability of OLTC some control through off ckt tap -2% to 5% rest by AVR. It is not common practice as it requires a big AVR. Hence OLTC is required there. Just see how many

OLTC problems being faced in about 200 transformer of OPTCL and why. I remember it was only one in 40 transformers some time back. The problem is not in OLTC principle but in driving mechanism which has to be further improved and of course put outside the tank. It has served well.

+91 94389 07492: Sir with due logic, can we include such that the point like generation zone, where voltage control on VAR adjustment could be done, we should avoid using of OLTC. Where on downstream VAR adjustment not possible we should go for OLTC?

Note: We should avoid the use of such mechanical item as possible.

# 33. +91 94398 79229: We have planned to make SCADA system of our substations installed at ParadipPort.Can anybody share its experience to install and implement the SCADA system and also requested to give the details of the firms who are mainly in this line to execute this type of work.

+91 94389 07492: Sir SCADA had already been adopted in many utilities. This can be used also with present running system. Company like Alstom, Siemens, ABB, GE, ER are the leading group in this regard.

### 34. +91 94389 07357: What are the possible reasons for short circuit in the hospitals or any important places where protection must be available?

+91 94389 07490: May be due to Poor maintenance & substandard protection device or wrong wiring.

## 35. +91 99014 90941: On Voltage collapse and means to arrest it, my question is should relays get blamed for the problems in power system design and operation.

On the relay side I can say that best of the protection people in the country were Involved in preparing setting guidelines in the CEA task force in 2012- 14 and have referred the best of the documents from CIGRE in preparing them.

#### 36. +91 78733 38123: R phase conduct of a 132/33kv 40 MVA transformer in LT side broken but did not touch the ground but a high magnitude of current passed through the lv neutral without tripping of E/F really. What is the circulating path of neutral current and why current pass through neutral without E/f?

+91 94385 18261: Since the situation like broken conductor and as because there is no zero sequence current the relay will not trip in Earth fault.

+91 78733 38123: But what is the circulating path of neutral current
+91 94385 18261: There is no circulating current but I think when current suddenly becomes zero in a inductive circuit there is rise in voltage due to Ldi/dt which forces current to flow through neutral

+91 94389 07495: It may be the case that the relay is directional and looking towards the transformer.

+91 94389 07492:

1. The relay used may be of directional E/F type. So no polarizing effect (no change in voltage) only negative sequence current has been flown so relay did not trip.

2. Differential relay as used has also no effect due to such condition current on either side have same replica with no current on operating coil.

3. REF relay has also no effect due to equal of residual current and neutral current.

4. Only the use of NEG SEQ. relay or non-directional E/F relay could have helped for tripping.

5. As this transformer is y-y connected, so circulating current of unbalanced condition (Y+B) shall cause the flow on the neutral (|R| phase current equal phasor magnitude). So on both side neutral (HT+LT) its effect shall be there.

6. But due to larger current flow on LT side and non-tripping of the transformer, there might have been observed (though not mentioned) heating of the neutral earth pit along with surrounding mat.

7. Some cases it is found with melting of neutral electrode after continuous heating.

8. HT neutral shall have the same effect, but due to less current heating may not be that much as compared to LT.

Note: This becomes prominent for the case of independent earth pit and not connected to mat. \*SO IT IS ADVISIBLE TO CONNECT NEUTRAL TO EARTH PIT AND AGAIN TO EARTH MAT.\*

## 37. +91 90406 24335: Jharkhand discom.Transmission Company of Jharkhand uses three winding transformer at 132/33/11KV substationunder starstar delta or delta star delta mode.Whycannot we go for star delta mode at 132/33 Kv two winding transformer?

+91 94385 18261: If we use 132/33KV transformer in star -delta mode then no. of conductors per phase in delta mode will increase leading to more insulation and hence cost of transformer will increase.

## 38. +91 94398 79229: Should we connect transformer neutral to its dedicated earth pit or the dedicated earth pit shall be connected to earth mat. Should we connect LA to his dedicated earth pit or to earth mat?

+91 94389 07492: As far as earth connection we should have always the pit/mat to obtain the least earth resistance with maximum coverage of dissipation of fault current to this universal sink(Earth system).

So it is absolutely necessary to have treated earth pit.

#### 39. +91 78733 38123: Frequency everywhere should be same as all grids are interconnected. But it is observed remarkable frequency variations in the local end where there is sudden disturbance rather than in whole grid. Under frequency protection is desirable or not?

+91 94389 07492: Any disturbance will cause short duration fluctuations or ripples in frequency plot. Oscillations may or may not die out soon depending on whether it is a fault or a swing. However, if the frequency continues to be abnormal for longer, say 1 second or more it may again lead to loss of synchronism and corresponding affects. So, any frequency protection must be time delayed. Industry and utilities world over have been using time delayed 81U function successfully.

#### 40. +91 94389 07655: How much individual earth electrode resistance desirable as per IS?

+91 94389 07492: As far my knowledge no such IS available. But on the point of desirable value this should be less than 50hm

## 41. +91 94371 06703: We are maintaining the 220V DC system as +110 - 0v - (-) 110v. But in some other utilities they are maintaining DC System as 220 v -- 0v. From the operation point of view what are the advantages of latter system over our system?

+91 94389 07490: No such advantage for operation. It is a standard opted.Only cable insulation cost decrease.

+91 94385 18261: 110-0-(-110) is midpoint earthing system and other is -ve earth system which is old one. First one is better than other.

#### +91 94389 07492:

1. In both case we get 220 v as the voltage across our equipment for control. So pattern of availability of supply has same advantages.

2. The physical placement of control/protection schemes are usually connected with copper cable running to different means to switchyard/other panels etc. So there could be the possibility of DC leakage in the system (touching of earth to any terminal say +ve or -ve.)

3. For the  $1^{st}$  case no harm shall result and system shall run with of same potential if 220 v with shifting of voltage availability as zero and 220v on other.

4. But for 2nd case with -ve being in earth connection and for the eventuality if +ve terminal results with leakage, then voltage across would be zero due to short circuit and fuses to blow out of the Dc supply source.

So this system has nothing advantageous.

Some utility may use earth as the reference and if this method shall be used then use of -ve cable may not be required.

#### +91 99370 00046:

In case of point 3 i.e if negative is earthed any leakage on -ve there will not be any effect in fault currents. In case of positive side leakage there will be huge fault current and copper requirement is to be taken into account accordinglywhile designing.

For point no.4 i.e. midpointearthing both side leakages will yield to fault current, but the copper requirement during fault conditions will be lesser.

+91 99370 00046: I think I have changed the point numbers, the first point shall be read as point no.4 and second point as point no.3. Sorry for the mistake and inconvenience.

+91 94389 07241: This is regarding use of DC control supply. Generally centre earth,+ve earth,-ve earth systems are used. In case of +ve and -ve earth system a second earth on the other side paralyses the control system. But in case of center earth system, with an earth fault on any side, the system works perfectly and we can simultaneously get an alarm during a fault. So center earth system is always reliable and advisable.

### 42. +91 90406 24335: In an ideal 33kv s/s with one 33kv incoming, 2 Power Transformer and 8 outgoing 11kv feeders. What should be no. of earth pit in standard design.?

+91 99370 35551: We should consider center earthing w.r.t safety aspect of the Operator handling less Voltage.

### 43. +91 90406 24335: Can online monitoring of load/current of each major electrical equipment over Web via mobile app avoid fire hazard in hospital.?

+91 94389 07492: Yes on line remote monitoring of load current could be done.

2. But the application part related action on fire hazard needs automated system with use of sensor for outage of supply and auto action of extinguisher system etc needs special gadgets.

3. But your idea could be taken on the basis of situational requirement in line with the cost factor.

Note: My comments in place of preferring on remote control it is preferable to have most reliable local automated control with use of sensor and extinguishers

# 44. +91 94371 06703: If the CT secondaries are not open, IR values are very good (in G ohms) and it is a very new CT of around three years old and it bursts then what may be the probable reason? Then what other tests to be conducted at site for CTs (both new and old) except IP and ratio?

+ 919437064178: Please carry out tan delta testing, Thermo visioning at outside clamps and connections will also greatly help.

+91 94389 07492: To comment upon the failure following data required.

1. Voltage class of the CT, whether tan Delta point was there or not, if there then itstan delta cap was properly fixed or not.

2. Installation of the CT with connection of primary conductor on its stud, if conductor giving tension on the stud, then the porcelain on the base of the stud may be damaged and water/moisture entry may cause, the failure of the dielectric and failure if CT.

3. Type of design and withstanding of fault current. For the case of fault both tangential and axial force results on the primary conductor. So for live tank and dead tank CT, the use of primary turns and its action during fault is also the factor for failure.

4. The use of secondary TB (terminal block), TBs should be of stud type to void looseness. If this is of pin type, then on regular fault occurrence, this may be loosen, resulting development of higher voltage on secondary and damage of the insulation.

5. On your data you have simply mentioned on data of IR value, but tan delta value is required for comments, if this becomes objectionable, then new CT may fail.

6. If this CT has failed on the date of installation, idle charged (without flow of current), then this is due to insulation failure. This IR value may be better, but PI may be less than 1. So on energisation, failure has occurred.

7. Manufacturing defect could be the reason also.

So new CT s with obtaining all allowable value may be damaged due to one or few points as described above.

Testing:-

- 1. Condition monitoring to be done by tandelta measurement.
- 2. Study of secondary current during load condition.
- 3. Other preliminary site tests are also to be done.

Note: care to be taken on its installation and handling in the circuit.

+91 94389 07492: Looseness of tan delta point, pd may be occurring due to manufacture defects. DGA of oil may be tested after 15 days of charging and another sample with in warranty period, if it is oil filled CT.

+91 75418 29051: Fault level analysis also appears to be necessary. If the fault level of the system is more than designed value of CT and protection relay takes considerable time to pick up,temp rise could be high enough to burn the CT.

## 45. +91 94389 07219: Many fire hazards are due to electrical short circuits as per the reports. What electrical protections can be adopted by LT & domestic consumers for these short circuits? RCCB is one such device. What are the other protective devices?

+91 94389 07492: There are automated residual current monitoring relays as mentioned RCCB, LCMR and E/f relay to supervise the current flow.

During short circuit the relay device may act for disconnection of supply, but due to sparking, the fire just initiated may aggravate if not extinguished immediately. So automated actuation of fire extinguisher on the target is one of important factor for this process. So outage of supply and automated actuation of fire extinguisher both are important.

## 46. +91 99014 90941: Very often it is read in newspapers about live conductor that has fallen on the ground and someone accidentally steps on it and dies. How this can be addressed?

+91 78733 38123: If no trip in e/f then the death may be due to step potential

- +91 78529 45980:
- 1. There is very very less in individual pole earthing.
- 2. Many 33kv &11kv feeders having group control CB.
- 3. GI wires are being used in some theft prone areas.
- 4. Many 33/11 kV substation having old electromechanical relays.
- 5. Earthing system in many substation are very poor.
- 6. In some areas it could be found that CBs without CT.

The following could be supplemented-

1. Sometimes for LT system, during fault condition, the fault loop contains impedance earth path.

2. An example say one conductor snapped and touched ground and due to improper earth return, the current may rise but the drawal from the source could be like a system of drawing heavy load and due to use of electromechanical relay, the setting may not be enough for tripping of the line.

3. So on eventually if anyone or any livestock comes under the contour of this GPR (ground potential Rise), then fatal situation may result.

4. So to avoid such we at present situation now using numerical relay for LT system of 1.3seconds (Extreme Inverse characteristics).

5. Moreover for the case of delta winding, this is required to use zero/neg. sequence voltage relay to take care voltage unbalance during fault condition.

+91 98454 58903: In the earlier distribution system design, there used to be a metallic cross arm at the pole which was grounded. Whenever conductor snaps, it invariably has to fall on this metallic body ensuring the earth fault and tripping.

+91 94373 06970: The aforesaid technical analysis on the fault of distribution system is ok, but the physical observations made are is absolutely correct. The ground reality is that, the DISCOMS are so engrossed with revenue collection with an intention to reduce the AT & C loss that, they give least priority to the technical issues. Moreover the DISCOMS are very much fund constraint to provide numerical relays and modern switch gears for the improvement of the system. Now Government is implementing so many schemes for system improvement.

#### 47. +91 90406 24335: We are facing one of the frequent problems due to lightning. Being in MCL Basundhara one of the hurdles is break down of weigh bridges due to lightning. This effects badly on production of coal. Any specific solution regarding this may kindly be intimated.

+91 78529 45980: Generally we are providing earthing spikes to protect equipment inside the substations, theprotective angle 30-30 (60 deg),

+91 99372 85292: What type of problem. What Equipment is Installed?

+91 94389 07492: Problem on the case lightning could be solved by adopting following methods.

1. Reconsider the rating of the LA (lightning Arrestor), preferably the rating to be revised to lower value i.e its MCOV (Minimum Continuous Operating Voltage) to be reduced.

2. Use earth mesh upon your weight bridge with proper of protection.

3. Avoid using cable for connection to ground from LA.

4. The flat that used should be straight as possible and direct minimum run to earth pit and again connected to earth mat.

5. If frequent problem resulting then use tripod earth connection (Three separate earth pit separated by 3mtrs among them and interconnected) again this interconnection to be connected to earth mat.

Sir, the data you have extended is in adequate to suggest, but in anticipation we suggested the common recommendation.

On receipt of the correct information we can have better discussion.

+91 97774 51621: Separate electronic earthing of the weigh bridge electronic components may be a possible solution

#### 48. +91 90406 24335: Whether treated earth pit is a necessity or a misnomer?

+91 78529 45980: My view is in critical areas where soil resistivity is more all pits should be treated.

### 49. +91 90406 24335: Why surge counters will be connected in series some times and sometimes parallel....?

+91 94389 07492:

1. Surge counter is generally connected in series to the earth path from the base of LA to the connection to earth mat.

But as far my knowledge, parallel connection is not technically possible because this is used to count the number of surge that passes through it.

2. Use of common counter possible for R,Y,B LA as proposed for capacitor bank connection, but not wise. Because during lightning, the current tracking to ground should be independent with shortest possible path to ground. In combination path shall be long.

### 50. +91 94389 07911: What current rating to be considered for 132kv clamps & connectors suitable for ACSR Moose in a substation?

+91 78529 45980: As per IS 398, part-2, 1996, the current carrying capacity of ACSR, Moose at 75 deg. is 836 amp.

51. +91 90406 24335: I would like to raise a tech issue for discussion...

#### As government is a promoting LED light for energy saving, and LED lamps are nonlinear loads, and generating harmonics, which will make derated to distribution transformers installed by DISCOM, because as government has not taken any step.

+91 97774 51621: Harmonics can be suppressed by using suitable L-C filters

+91 97774 51621: In industries, other than LED lights, we have many nonlinear loads like Rectifiers, VFDs etc. By using L-C filters the total harmonic distortion is maintained below the allowable limit for specified voltage level.

+91 90406 24335: Installation of LC filters in industries are easy to install and maintain , but problem with the major installation single phase distribution transformers in street of city , installation of LC filters on each transformers and maintenance is not possible...due to harmonics, frequent failure of transformers will occur ultimately and saving by reduced energy consumption will not effective....

+91 94389 07492: The concern as asked regarding use of LED lamp, inverter and other harmonic generated items for domestic purpose in large scale has to be addressed. Similarly the solution as raised by maximum of our members is also correct.

But has this solution been used for our domestic consumers?

Presently use of CFL and LED is gaining its popularity. But the energy consumption and billing out of it with harmonics has to be addressed soon.

+91 94373 45385: Suppression of some odd harmonics generated by domestic use of CFL, LED bulbs, inverteretc. I think suppression of odd harmonics is looked after by grounded neutral of LT winding of transformer.

## 52. +91 90406 24335: kindly give reason of L.A. failure in one of our 400 kV line. L.A. rating is 336 kV. No lightening. LCM is 45 mA in last test. Two times auto reclose successful occurred.

+91 90406 24335: LA end cover may have gap for rain water entry.... Which makes short circuit to earth and failed

+91 90406 24335: See the top point if sealing gasket has any leakage... After erection it allows moisture in to LA chamber and makes earth fault

+91 94389 07492: Followings are few reasons of LA failure.

1. Moisture entry destroys quickly the non-linearity kinked property of ZNO2, so for the case of even better previous result value, this may fail.

2. Delay in disposal of lightning surge to ground due to improper earth flat connection to pit and again to mat.

3. The case as described this has attended successful Auto Reclose for twice.

4. So during lightning if zone1 trip has occurred at both ends, then simultaneously the concerned pole has to reclose after the de-energisation of the voltage on the line. So selection of dead time in relation to die down of lightning surge through earth path is to be decided properly.

Suggestion:

1. Test LCM, THRC value.

2. Use Tripod Earthing pit with inter electrode distance of 3mtrs being interconnected and finally connected to mat.

3. Review the dead time selection and other feature of AR scheme.

This is Ch Mohan Rao from PGCIL. You have rightly mentioned the causes for LA failure. Here I would like to add few points.

1. Most of the LA failures are due to degradation caused by moisture ingress through sealing/direction ports for pressure relief.

2. Along with THRC measurements if we can see the temperature profile from thermo vision camera which can help to identify the local heating between ZnO disc and between discs to enclosure caused by moisture ingress.

+91 94389 07490: Already adopted at 400kv Mendhasal G/S of OPTCLas preventive measure and replaced 9 nos. of 220kv & 400, kV LA having high THRC to avoid failure last yr& no failure till date.

+91 90406 24335: A Lightning Arrester is a device used on electrical power systems and telecommunications systems to protect the insulation and conductors of the system from the damaging effects of lightning. The typical Lightning Arrester has a high-voltage terminal and a ground terminal. When a lightning surge (or switching surge) travels along the power line to the Arrester, the current from the surge is diverted through the Arrestor, in most cases to the earth.

If protection fails or is absent, lightning that strikes the electrical system introduces thousands of kilo Volts that may damage the transmission lines, and can also cause severe damage to transformers and other electrical or electronic devices.

Lightning-produced extreme voltage spikes in incoming power lines can also damage electrical home appliances that's why it is damn crucial to the integrity of Lightning Arrester.

Presently the monitoring of total leakage current (capacitive and resistive currents) is being used by many utilities. The Leakage Current Monitors are used to measure the Leakage Current of Surge Arrestors, and in case of high leakage current Surge Arrestors are replaced. However, it is felt that this method is not the fool proof method as the total leakage current, which is purely capacitive, does not signify precisely the health of the Surge Arrestors. There have been the cases when the Surge Arrestors have blasted even though total leakage current value was below the limit prescribed by the manufacturers.

Resistive current is 15-30% of total current and since capacitive and resistive currents are at 90 degree face shift even considerable change of resistive current results in very small increase in the total current. Hence monitoring total leakage current may not truly indicate the degradation of ZnO disc. Degradation of long linear ZnO disc generally leads to harmonics in the leakage current when system voltage of fundamental frequency is applied. Third harmonic resistive current measurement is based on filtering of third harmonic component from the total leakage current. Leakage current of the order of about 500 micro amps is generally considered to be safe.

The resistive part of the leakage current or the power loss can be determined by several methods given below:

Using a voltage signal as reference compensating the capacitive component by using a voltage signal. Capacitive compensation by combining the leakage current of the three phases .Third order harmonic analysis. Direct determination of the power losses. Third order harmonic analysis with compensation for harmonics in the voltage.Advance Monitoring System with "resistive current" component calculations.

The use of advance diagnostic methods greatly reduces the chances of failure & hence avoids loses of man and money. It is therefore desirable to check the condition of Surge Arresters at regular time intervals, by measuring the resistive component of the continuous leakage current in service without de-energizing the Arrester. Reliable measurements are achieved by the instruments based on the principle of "Voltage Signal" as a reference.

Regular monitoring of LA has prevented many failures in 66 kV to 765 kV substations.

New advanced equipment carryout the testing while the Surge Arrester is in service, analyzing by means of a special current clip-on transformer the leakage current in the Surge Arrester ground connection. The values of this current normally ranges from fractions of milli ampere to a few milli ampere, and are characterized by a resistive current variations whose value is an indicator of the deterioration of the Surge Arrester.

The resistive component of this leakage current may increase due to different stresses causing ageing and finally causing Arrester failures.

### 53. +91 94395 41934: In which cases single phase fault mva is higher than 3 phase fault as it has been in some of our substation data.?

+91 98454 58903: At the fault location, if the zero sequence driving point impedance is less than positive sequence driving point impedance, then slg fault mva is higher than 3 phase fault mva.

For example in case of high voltage terminal of the power plant bus, zero sequence impedance looking from the generator is less compared to Positive sequence driving point impedance, as the GT winding configuration is delta on generator side star grounded on HV side.

Similarly in case of 3 winding transformer, as tertiary is delta connected, at times Slg fault mva will be higher.

3 phase fault current = 1/z1

Slg fault current = 3/(z1+z2+z0)

Generally z1=z2

Hence Slg fault current= 3/(2z1+z0)

If z0 is less than z1 at the fault location, slg fault current will be higher.

z: driving point impedance

### 54. +91 94395 41934: I have seen in internet that if z0 is less than (2z1 - z2) then such a situation an exception will come.Can we justify this equation?

+91 94385 18261: The equation (z1-z2) signifies the subtraction of positive sequence and negative sequence voltage waveform.

## 55. +91 94395 41934: Why does the magnetizing reactance decreases as a CT goes in to saturation.....and to be very specific what physical attribute(say grain orientation) inside a magnetic material impacts the variation in magnetizing reactance.?

+91 94385 18261: As CT goes into saturation since there is no bucking effect due to secondary the primary current becomes excitation current for CT which is normally 200 times its original exciting current value also as core saturates the inductance decreases hence inductive reactance decreases but the flux alternates due to alternating current in primary but alternates it constant saturation value in both positive and negative half cycle it means orientation of magnetic grains change alternatively.

#### 56. +91 99372 85292: What will happen if transformer runs in leading power factor?

+91 97038 45823: As far as Transformers are concerned, all these are operated with lagging power factor. However, in case if they were made to operate at leading power factor, it can lead to increases in terminal voltage which consequently damages the insulation of connected devices

+91 97038 45823: Further, real power carrying capability may also reduce. Perhaps, reactive power capability increases.

+91 94389 07492:

Transformer running on capacitive load is not advisable due to following.

1. Members have already pointed out regarding the development of higher terminal voltage than induced causing damage to equipment.

2. So voltage regulation could be also a problem area for TRF.

3. During this if fault results then severe damage may be resulting for the system.

4. Case of numbers of TRF running in parallel and transformer with of lower impendence may have more sharing of this capacitive load causing more heating.

5. In case of unequal tap circulating current could be prominent.

+91 94389 07652: Generally the transformers are operated lagging pf. when it will attain unit pf. full KVA can be utilized. When it will attains more than one it attains over load condition for which gradient will be more as a result temp rise be more.

#### 57. +91 99372 85292: If voltage is within the limit then?

+91 94385 18261: If transformer run at leading power factor then receiving end voltage will be more than sending end voltage hence voltage at load end increases hence current and if induction motor are connected then its magnetic saturation occurs leading to harmonics

## 58. +91 94389 07315: Please suggest on 40mm MS Rod or 75x10 GI Flat for use in Earth Mat, taking into consideration the chemical reaction of different soil ingredients with the Mat material.

+91 78529 45980: As per IS 3043/1987, cl.9.3- the average loss factor of copper, ms rod, GI ms flats are 0.2%,2.2%,& 0.5% per year respectively.We are designing the earth grid for 25 years. Considering above corrosion factor the size of MS rod will be more than GI flats for the same year.The 2nd factor is during execution proper care has to be taken during welding of rods as the point of contacts between rods are very less where as in flats the point or contacts is very large.

+91 90406 24335: Below ground it is MS above ground it should be GI

We can use GI Flat in ground for main mat purpose.... It is suggested for more long life and corrosion proofing system. Its use in main mat grounding installation only effect more cost instead of MS rod or flat. The earthing system requires only making least resistance path... Generally it should be less then" One Ohm"... Size of material to be used for obtaining required earthing value is depending on the soil condition where you need to be grounded or earthed.....

GI flat is better as its surface area is more. Basically fault current is AC. If we need to reduce resistance, the spacing of flats to be reduced.

In external earthing connection the size conductor is depended on maximum fault current occurs such applicants (ex. Electrical Equipment. Supporting structures, all other metal parts connected to electrical systems.

Selection between GI flat and round MS bar, it is preferred that above the ground level GI flat and for underground mate MS round Bar. In GI flat due to more surface area corrosion rate is fast .On other hand MS bar have less surface area so corrosion rate is less. For current carrying capacity total area is effective, MS rod have more total area then GI flat.

+91 94389 07492:

As far engineering on the query few of our members have already posted their views.

To supplement I want add.

1. GI flat of size 75×10 is always better, because of its contact area and anti-corrosion factor.

2. This also helps to prepare the proper bed for treated bentonite with loamy soil.

3. Moreover continuity upon the use of joint is better (inter joint and with electrode of earth pit.)

### 59. +91 94389 07492: Most of the time it was observed that LA fails due to high resistive current in the order of mA) followed by thermal run away.

Now Question arises...LA act as insulator (having insulation resistance of more than 10GOhm min.) to the operating voltage. Any one stack will fail first. Then why Ph - Gnd fault occur at that time when other stack remain healthy.

+91 94389 07492: The flow of leakage current through monitor in LA is due to the condition of ZNO2 used. So technically certain MCOV (Min. Continuous Operating Voltage), the voltage above which the oxide starts conductive and results the flow of surge current. So this is designed by use of number of stacks in series between conductor and earth.

In case one stack (one unit) fails, then the other available unit may not withstand to the voltage appearance on it and results conductive with the normal applied voltage causing phase to earth fault and in case of delay tripping may cause damage of LA

+91 94389 07492: Suggest arresting the oil leakage in 11kv lv bushing of 60mva Generator Transformer of Burla Power House. Whether we apply devcon?

+91 94389 07492: Oil leakage could be arrested by

1. Change of gasket as suggested, but needs shut down and overhauling work.

2. As of this is resulting from bushing so check the base and looseness or hair crack of the support.

3. But the application of DEVCON compound could be also the solution. Refer the DEVCON application consultant.

+91 78529 45980: Sometimes the oil leaks due to damage of 0 ring in 33kv &11kv bushings.

+91 94389 07492: Application of DEVCON helps a lot as per our experience with minimum time of shutdown.

+91 94389 07492: You can refer this use of DEVCON putty or STAVCON putty.

Use steel putty available with stanvac and Devon but do not use araldite and m-seal. But at the time of application, oil static pressure will be there. So take short shutdown period isolate conservator, observe then apply

+91 94373 45385: Transformer Top cover leakage is due to damage of gasket. Tightening might not have been done evenly. Retightening may be done if still leakage not stopped Devcon compound is very good alternative.

+91 94373 45385: Putting a GT for long period of shut down may not be allowed for generation constraint. Transformer be taken under shut down for short period n application of Devcon compound is an excellent remedial measure to arrest oil leakage. Application of this compound has been found quite effective for a long period of ten to twelve years& more

## 60. +91 94389 07152.Oil leaks from top cover of 12.5MVA Transformer. After tightening the top cover oil leakage not arrested. Top Gaskets seems not be damaged. Leakage from one corner of the Transformer top cover. How oil leakage can be checked?

+91 99372 97758: It's is difficult to predict & confirm that there is no damage of gasket. Need to down the oil level; identify the leakage point & apply steel Putty & keep it for half an hour minimum. Replace the bolts if not tightening properly If not successful then it's better to consult the OEM. Go for a complete over hauling by replacement of gasket & bolts.

### 61. +91 94389 07492: Should the ground terminal of LA be directly earthed? Or should it be connected to Surge counter and then earthed. Which method is to be followed?

+91 94389 07492: This should connected to surge counter and then to its pit which finally to be connected to earth mat.

### 62. +91 99372 85292: La counter should be fixed directly to structure or with insulator. If with insulator what should be earthing. Please clarify

+91 94389 07492:

1. The counter is also to be insulated by the insulator gutka (small insulator), as provided by the manufacturer.

2. If counter directly fixed to structure, then surge current may not flow on its designated flat and make delay discharge and probable damage.

### 63. +91 94389 07496: Why it is chosen 45 degree as Maximum Torque Angle in all back up relay used in OPTCL?

+91 94385 18261: Any line to ground fault makes the power factor lagging by 90 degree and any arcing fault makes the power factor unity so angle is zero degree hence a optimum angle in between them that means middle angle of 0 degree and 90 degree which is 45 degree & is chosen to take care of both faults

### 64. +91 97113 09639: Sometimes OPTCL requires to set -15degree as MTA for earth fault, why is that?

+91 94389 07492:

1. The choice depends upon the type of connection of the relay (current coil and voltage coil).

2. The selection of compensation angle (Nature of operating flux proposed from its reference).

3. Both of these factors decide the MTA (maximum torque angle).

Note: 1.The most popular connection is 90deg (Ia, Vbc) for OC (to obtain availability of active voltage during fault).

2. Max compensating angle 45deg.

So by choosing such, MTA comes 45 deg lag. Hence choice is taken 45 deg for best coverage and proper discrimination between operate and restraint. Others please comment.

But difference is that for the case of Earth fault, the appearance of fault is due to development of 3V0 & 3I0, hence the polarised torque among the fluxes due to these two factors is considered.

1. To cover our desired direction of tripping the MTA is chosen upon the connection and compensation angle.

2. Preferably with 12.5 deg, 45 deg choice is considered.

3. So on case specific 15 deg might have been chosen. But better choice is 45deg.

+91 97113 09639: This explanation is more in line with electro mechanical relays. In numerical relays, polarizing quantity can be selected as negative sequence voltage for phase faults and zero sequence voltage for ground faults. Fault inception angle is same as line angle when directional is applied to lines in general. So line angle can be selected as the MTA. : Forward area of operation can cover the resistive reach of distance providing accurate backup. Selectivity and sensitivity for close in faults improves this way.

# 65. +91 94389 07492: Explain the reason for tripping of any voltage level line during lightening, even though putting L.A. and all line locations are having C.P./Pipe Earthing. This type of cases happens not always but sometimes. There is advance in L.A. counter but unable to prevent tripping and trip in 1-ph to grnd.

+91 94389 07492: The case of lightning and operation of 1ph-gr fault is due to the particular case of delay discharge of surge current to ground might be for the following reason.

1. The earth system may not be connected to earth mat.

2. The relay as used may be set with HIGH SET of 2-3 times nominal current and time with instant value.

Note: 1.But such rare tripping is allowed to some extent instead causing damage to system.

2. Proper coordination with strengthening of earth system could be chosen.

3. The concept of use of lower rating LA with Lower MCOV to sensitize the system for quicker action is also an option.

But personally I don't recommend such.

#### 66. +91 94389 07818: MCOV stands for?

+91 94389 07492: MCOV= Min. Continuous Operating Voltage, deciding factor for LA to be selected upon the voltage rating application.

#### 67. +91 94385 18261: What is the physical interpretation of a negative Tan-delta value.

+91 78733 38123: Negative ten delta signifies presence induction

+91 94395 41934: Negative tan delta for insulation practically is observed where UST MODE is used i.e. TFR bushing, CT.FOLLOWING ARE SOME TYPICAL CASES...

1. If there is an arcing path from tan delta point to ground then an inductance comes in series with the insulation capacitance and the total current may become inductive depending on the quantum and nature of arc.

2. Surface leakage current also at times may create an inductive path in parallel to the original bushing capacitance....hence the value may become negative...

### 68. +91 94386 78222: Can we filling oil from top valve of transformer after core and winding deep with oil? It's a 200mva transformer.

+91 94389 07492: Yes for this case of core winding in deep oil, you can fill from top valve. But it is always wise to fill from bottom valve.

1. To avoid bubble in oil

2. For the case of moisture content in oil, due to sprinkling, the insulation may contain the same.

3. The air, gas etc shall get the passage upward during filling.

4. Easy to use vacuum filling of oil.

## 69. +91 94389 07491: We are adopting RCA for O/C=+45deg .E/F=-45deg in Areva P14D P141.GE Multilin F650.but for SEL 751A .it is +45deg and -15deg respectively. Pease create and send Math variable for SEL751A E/F to check in actual condition.

10/29/16, 5:27 AM - +91 94389 07491: Math variable for -45deg RCA for SEL751A .E/F

+91 94389 07492: The basic principle and applicable to both EM and numerical relay.

Difference for EM it is case specific but for numerical as per your coverage of the forward operate and reverse blocking you can choose the angle of RCA/MTA.

So this relay can be used as the back up to DP relay and on the basis of selectivity/ sensitivity.

+91 97113 09639: Sir, set MV02=-45degree which is RCA for e/f

70. I'm discussing the concept of plotting the directional feature onto the impedance planes.. It can be done from the sequence impedance networks
+91 94389 07492: In the distribution system we are not using distance impedance relay like grids. Kindly suggest is there any equipment available to use in the distribution network like 11kv and 33kv feeders to identify the fault locations. Presently we are using line isolators /ABswitch arrangements for long feeders both in 11kv and 33kv and spending lots of time for fault finding by using our line staffs

+91 94389 07492:

1. At present OFF LINE fault locators are available for tracing the fault distance. But it will take the same time as like we now use of meggering of the line. But off line FL is one of the useful kit.

2. At present we are using DP relay also for 33 kv line, but due to multi connection, the fault distance is not becoming accurate.

3. Another easy method has been thought like use of CT secondary injection and study of reflected primary current to locate the fault. But not yet tried.

4. We can think and soon to apply it if become success, then shall be a revolution.

+91 97113 09639: For 33kV distribution feeders you may use Fault Passage Indicators

+91 94389 07492: What is Off Line Fault Locator and How it works.- mean accuracy.

+91 94389 07492: Off line fault locator is a testing instrument to check the open ckt/ dead short ckt of each phase of long transmission line. Also we know the fault distance from the testing point. During commission of new line we can also get the status of tree infringements /any foreign object along the transmission line by the help of fault analyser. It is a very good tool for testing long line. It is operating in the basic principle of velocity =Length/Time, ie. Length= velocity×time. One pulse generates and transmitted through the line in a particular velocity. Its accuracy is +-3%. TAURUS, Bangalore is manufacturing in India.

+91 94373 06970: I'd like to add one more feature of the Off Line Fault Locator. It can accurately determine the length of a transmission line, as it takes care of the conductor sag and jumpers. Accurate line length is very much essential for calculation of the line impedance and relay settings for distance protection. Hence it should be used prior to charging of new transmission lines.

## 71. +91 94389 07492: Is there any solution for safe design of earth mat in 33/11kv substation having 70000hm-m soil resistivity. Area is small say, 1000sq.m and fault level is 16/17 KA. Can anybody explain @ E-tap software?

+91 94389 07492:In Etap there are 2 method 2 carry the ground grid analysis. One is IEEE 80 Method another one finite element analysis method.

IEEE 80 Method is for substation and FFE is for analysis of plant which divides plant surface area into small and bit pieces to carry the study

For IEEE 80 method the above case can be carried out.however certain value are required in that case as mentioned below

- 1. Surface material resistivity.
- 2. Top layer and lower layer resistivity
- 3. Depth of each layer
- 4. Fault duration tf.
- 5. Shock duration ts
- 6. Duration of current for sizing conductor
- 7. Ground fault current

X/r value can be obtained in sccal

Rest all parameter like corrective projection factor and current division factor can be assumed to worst condition to carry the ground grid calculation in Etap

+91 94395 41934: ETAP is a power system simulation software like pscad, mat lab n many others available in market....the previous versions below 12.6 were not compatible with windows 7 and above operating system....but the current 14.2 version is compatible with even windows 10...just register in ETAP website and they send the demo cd....but don't forget to ask the demo code.....it's a very powerful n user friendly tool as per power system simulation is concerned.....videos are available in YouTube for reference....or else training classes are there in Hyderabad.....in Canada recently there have been a lot of job opportunities with this skill set.

+91 94370 58624: ETAP is although good but not for transient analysis. PSCAD is more suitable for the fault analysis.

## 72. +91 94370 58624: In different relays till now what is the phasor estimation technique use. DFT or any other technique like Least Error Square is also implemented in modern numerical relays like SEL or GE or SIEMENS. Please explain.

+91 97113 09639: Different OEMs have different techniques. : Majorly DFT, since LSE has multiple sub techniques for nose filtering.

+91 97113 09639: Phasor estimation is required crucial for calculation in the frequency domain. However, the future protection will be on the time domain, breaking free from phasor limitations. Ultra-high speed relays yet extremely secure.

+91 94370 58624: So in practical domain LES has already been implemented or yet to.

+91 94370 58624: Time domain has many limitations and one of that is the noise generated due to electronics equipment such as communication devices

+91 97113 09639: Time domain is unaffected with the effects of noise, with the use of antialiasing filter, differentiator smoother and when synchronized with high accuracy GPS Signal, and capability of Mhz order sampling frequency, protection can be fast and accurate

+91 94370 58624: MHz sampling frequency can applicable because this will require more memory space and consume more time for simulations.

+91 94370 58624: 1000 Hz sampling frequency is generally applied to relaying devices.

+91 97113 09639: 1 kHz or 20samples/cycle is still in use but on the verge of obsolescence.

+91 97113 09639: Numerical relays for even distribution and industrial protection like feeder/motor protection sample at anywhere between 32 to 128samples/cycle

+91 97113 09639: relays in EHV have up to 8 kHz or 160s/cy

+91 97113 09639: Processor and on board storage are surely not a hurdle these days

+91 97113 09639: In general relays sampling at above frequency are also storing multiple records of settable length.

+91 94395 41934: Accuracy and speed of digital relays are essentially decided by the type of signal processing algorithm employed for a given word length and hardware......

Protection algorithms are broadly classified in to two groups...1.based on waveform description 2.based on line model representation.....

In case of the former we use cross correlation techniques using orthogonal functions i.e. Fourier, WASH, HAAR.....

In case of later we use trapezoidal rule of integration where simultaneous integrations of parameters are carried out in consecutive intervals.....

In any case we may have to deal with higher order equations and analysis of nonlinear parameters. Hence in time domain it makes the computation of complex algorithms cumbersome.....which is not the case with FREQ. DOMAIN ANALYSIS....although antialiasing filters, Kalman filtering is there to reduce unwanted signal noise but when it comes to pre-amplification and post-amplification of the signal before sampling , it is better realised by freq. domain.....plz comment if u have different views.

+91 94370 58624: Please provide one example of any relaying logic based on time domain information which is practically used. Whether for device or system protection.

+91 94395 41934: Mostly For calculating current transients-decaying dc offsets time domain analysis is preferred.....transients parameters may be better realised in time domain but may be this is as end user's bookish knowledge.

## 73. +91 94395 41934: Please explain why do we extend the zone characteristics in to 2nd quadrant as we never experience a fault where resistance is negative and reactance is positive?

+91 99014 90941: The characteristic is extended in to 2nd and 4th quadrant to get good dynamic performance. The operating time increases as the fault point moves to the boundary lines. So in short this is to get good operating times. We can't extend it too much also. Then we may get selectivity problems. Therefore it is a balance between the two.

+91 94370 58624: These quadrants are because of the active and reactive power flow. The combination is either ++, +-, -+, and - - so according to this the impedance trajectory enters the zone setting.

+91 94395 41934: Can an insight of a physical condition of a line where a relay identifies a fault in 2nd quadrant be given? Can such a phenomena be observed ever in reality?

+91 99014 90941: This can happen as for example if fault takes place in R phase , Y or B phase elements may operate.

## 74. +91 94389 07492: Which Electrical protection is better for any electromagnetic equipment? And Why? 1. Current 2. Voltage 3. Both voltage and current. 4. Integration of these parameters.

+91 94389 07408: It is current. This is the application of KCL.

+91.....It's both current and voltage. We know the importance of current differential protection but we cannot ignore the importance of df/dt or under impedance protection for any electromagnetic equipment like generators/ motors.

+91 98732 87623: It is both voltage and current. Also integration of these when heating value is considered like negative sequence, thermal overload.

+91 94330 68533: It is only voltage I think.

+91 99370 47045: I think it's' integration of voltage & current for giving complete protection.

+91 04389 07490: The driving force of any electromagnetic equipment is voltage obliviously voltage protection is better. But when the response current is used then both current & voltage may be integrated for protection.

+91......For electromagnetic instruments protection the integration of the voltage and current parameters is better than only using current or voltage individually.

+91 94389 07492: As protection to be provided either for fault or abnormal condition. As fault condition is highly important for which voltage dips and current rises, so it is essential to save the equipment from sudden rise of current. So current protection is better to protect the winding part of the item. During abnormal like rise of voltage, change of frequency and other parameters may affect the insulation of the system that in long run affects the equipment. So this protection is also required. For the condition of integrated power dynamic and defined protection zone we also use integrated protection. But care should be taken for the protection to current factor.

### 75. +91 99372 97806: Can switchyard be prepared with concrete in place of gravel? Can it be recommendable?

+91 94330 68533: Earlier gravel was recommended. CEA inspection never allows concrete. Nowadays not sure.

+91...... The switchyard design to be standardised. Otherwise it will be very difficult to execute a project as there is no space available at site. So during tendering, first choose the site with space and prepare the design. Then please offer the tender. Please take needful step before tendering

+91 98108 01555: Yes Power Grid has attempted a few switch yards with concrete blocks instead of gravel. More details can be had from their engineers who have worked on the subject. I will also try to collect more information and get back

+91 99370 00046: Gravel reduces step potential, However Grass and weeds growth is a problem only with Gravel filling. OPTCL earlier used Sand filling and Gravel filling.

+91 94389 07492: Yes can be prepared and presently few organizations including our OPTCL have started using RCC with gravels over to it. The technical concept of step and touch potential to be considered during design of the earthing, concreting of Switchyard.

## 76. +91 94389 07561: Some member said standardisation of switchyard. Let me tell you here substation are constructed without planning. Most of 132kv substations are LILO-ed and less than30 km apart. Is it technically justified? Pl answer or comment.

+91...... As per our technical specifications it's 30 Kms but in OPTCL we have LILO GSS at less than 30Kms also. Technically as per specifications it shouldn't be but as per practical we have. Basically requirements depend on voltage profile. At some places even though there is GSS but the voltage received by a village or subdivisions 15 to 20 Kms away is too low. So in these conditions either one has to upgrade the distribution system or place a 132 KV LILO GSS to overcome it. The losses in distribution are too high as compared to LILO GSS loss. So I think this might be the reason behind setting up of LILO GSS at less than 30 Kms range.

+91...... It is not justified. Further OPTCL is avoiding LILO and close s/s.

## 77. +91 04389 07490: Is it advisable to keep LA in differential & REF protection zone of ICT. Auto Tr. Because during LA failure the said protection operate. Which is not desirable as per the aim of the scheme? Pl. deliberate the view of member.

+91 94389 07492: Yes sir it is advisable to keep LA inside protection zone. Because the use of this LA is meant to protect the TFR from the lightning effect and it should as close possible.

+91 04389 07490: .But I want to know is it advisable for operation of differential/Ref. protection on L A failure as they are in protection zone. Will it necessary to use bushing CT both side for this protection & B/U protection will take care of LA failure.

+91 94389 07492: I think it is required for the operation of transformer for the failure of LA instantly. Because during this failure, the current drawal could be very high and may affect the winding of TFR due to close in fault. So operation of main relay is desirable. Sir for the case of bushing CT it is advisable to use High set instant trip on BU relay with non-directional feature.

#### 78. +91...... What should be the cross-section of primary in sq.mm of 245kv 1200-600-300/1-1-1-1A CT.? 1. 600sqmm 2. 576sqmm 3. 720sqmm 4. Not specific. Please justify your answers.

+91 04389 07490: Please specify current density & take decision.

+91 94389 07492: The cross Section of any conductor depends upon the current density. Hence type of conductor and it's density to be considered for this choice.

- +91..... Copper conductor.
- +91.....For density, I will intimate
- +91.....Rated continuous current 120% of primary rated current.

+91 94389 07492: We are sorry for not getting the actual data to decide the cross sectional area.

+91..... Regarding cross sectional area it is rated continuous current by current density. And the answer is 720sqmm.

### 79. +91.....: Cross shielding of switchyard- overhead shield cable for lightning protection. Is it mandatory? If not benefits/draw back.

+91 94389 07492: In protection any thing over and above is always advisable. But not mandatory in present practice, because of the use of Zno2 LA in the network and mandatory for all feeders. More deliberation required.

+91...... What is the significance of excitation current of CT having both metering & protection core? How to choose the rating?

+91 94389 07492: The role of excitation current and its importance is required for protection core that signifies the quality of magnetic material used in Ct and on its availability we can decide the linearity of saturation excitation curve with its knee point voltage. The choice to be considered as small as possible and on normal practice preferred for less or equal to 30mA at Vk/4.

### 80. +91...... Is it acceptable 52.35V instead of 48V & 247.55V instead of 220V in case of battery charger?

+91 94389 07492: Yes, it is the battery charger that has to be designed/rated for higher voltage than that of the battery set/battery bank. So during boost charge/over voltage condition this can be able to provide the required current. More over on normal condition also the voltage could be more than its rating. Hence it is acceptable.

### 81. +91 94389 07492: Should the intermittent voltage system of 132kv to be abolished and direct 220kv to be stepped down to 33kv system? Pros and cons.

+91 94389 07408: It was decided by OERC to go for 220kv/33 kV Grid SS in future for better voltage regulation if nearby 220 kV source is available. Cost will be more for construction of long distance 220 kV line.

+91..... For long distances high voltage transmission is economical comparing line cost and line losses.

+91...... For medium distances, intermittent voltages are economical...always the selection of voltage depends on line cost versus line losses.

+91 99372 97758: In Odisha; 33KV system is used mostly & it's continuing in distribution companies. Where as in many metros in India mostly 66Kv system are available. However; in Odisha now- -a-days most of the new generators installed are getting connected to Grid at 220KV instead of 132KV & gradually this 132KV system is getting absolute. Commercially; the cost of equipment increases with increase in voltage. But; when the system reliability; power evacuation transmission loss etc. comes into picture it is definitely better to have 220KV rather than 132KV system.

+91...... We can think of gradually replacing 132 KV lines and erecting 220 KV lines in the same path.

+91 78529 45980: The abolition of 132 system is a good idea. If we can convert the existing 132 kV tower for 220 kV purpose by using insulated x-arms & interposing extra towers for taking the

extra load of Zebra conductors in a phased manners, I feel it may be possible. Another thing I am thinking to remove 11kv system by using 33/.4 kV system the losses & cost of Distribution system can also be reduced with better regulation.

+91 94389 07152: In rural area 33 kV system will cause more accidents due to poor distribution system specially in Odisha

+91 94389 07315: 220/33kV or 220/132/33kV? Probably 3years back, there was a congregation of electrical experts of Odisha at OERC and this was one of the topics of discussion.

The consensus was like this -

Unless there is a requirement of 132kV Industrial / Traction feeders, let us go for 220/33kV scheme in place of 220/132/33kV.

One level of transformation will be skipped that way, which will result in less project cost, reduction in transformation loss and saving in space which is so costly now-a-days.

220/33kV Substations may be strategically placed to ensure - the lengths of 33kV outgoing feeders are maintained within the allowable Kms.

In case of strengthening of power supply system within a city, there is no 2nd thought to 220/33kV and all 33/11kV Substations in a 33kV ring system connected with the 220kV Substations.

If the command area under the Substation in question extends beyond the allowable length of 33kV feeders, we have to construct 220kV or 132kV Lines for the receiving end Substations. These Capital Projects, if to be executed against Loan, are to be cleared through cost benefit analysis for which realistic estimation of demand in the targeted area plays a major role, as the quantum of revenue to be generated out of the same decides the no. of years over which the loan component is to be repaid, which is a tool normally used by the project approvers.

+91 94389 07492: As discussion going on and consensus was drawn for power network, the phase wise abolition of 132kv could be an option for system stability and power regulation.

+91 99370 00046: Instead of investing heavily in Higher voltage networks roof top Solar and open areas lease for Solar based panels shall be promoted with Subsidy. Evening to morning requirements when total demand goes down shall be adequate with existing network. However detailed study of LDC load patterns and also network planning will help ib huge cost savings on the additional network.

+91 78529 45980: OK for present and future requirement, but though the load centre is the coastal area, which is also a cyclone prone and also in wind pressure zone 5. This may be considered for installation at roof top.

#### 82. +91...... Why the voltage levels are in multiples of 11?

+91 98732 87623: I think it is not multiple of 11, it is multiple of 1.1(form factor in AC circuit)

+91 94389 07408: There is no specific reason for this. This was a convenience but not now.

+91 94389 07492: Initial days it was being considered on the basis of form factor approximation I.e 1.11. But presently it is on the basis highest that becomes realisable in practice i.e. the standard for testing the same as far its BIL, IMPULSE etc. has to be taken into the consideration.

+91.....Like 400kv and 765kv not multiple of 1.1 or 11. So initially people started 11kv, 33kv n we follow that.

+91..... As per old Westinghouse manual 1930, it is mentioned to give the voltage drop allowance of 10%... I think there is no role of form factor or Reymon series as assumed by some earlier. However due to technology improvement in the present days, the same is not being followed for the new series like 400kV and 760kV.

+91 99372 97758: Form factor is one consideration for 11kv. But voltages like 400kv; 750kv; 500kv; 1050kv are not multiples of 11. I believe,; this is an old perception when people thought there is 10% loss in line & the system voltage should be designed with 10% higher to get a round off at receiving end.

+91 94389 07408: In the year 1980 I had attended the summer course at IIT, Kanpur while I was a lecturer at UCE. Some top professors had concluded that while DC was converted to AC it was not possible to eliminate all DC machines and rather gradually. To facilitate the ac dc conversion 11 multiple was considered and subsequently this became applicable for generation, transmission and distribution. The papers are available with me and when I will get time shall circulate in the group

### 83. 91 94389 07492: Could power system stability be enhanced by use of compensators and updated technology like FACTS, HVDC system with use of HTLS conductor etc.

+91 99372 97758: Yes. It's possible. HTLS technology through high temp by allowing high amperage can allow the system to sustain; increasing transient stability.

+91 99372 97758: Flexible AC transmission system controllers will improve voltage stability steady state stability & transient stability if PS.

+91 99372 97758: VAR compensators can improve the voltage profile by controlling the bus voltage. Whereas UPFC can improve steady dynamic & transient stability. SS RATH Vedanta.

#### 84. +91...... Is Ip-52 for enclosure protection acceptable instead of IP-55? Please interact.

+91 94389 07492: No IP 52 is meant for to check dust with water droplet. IP 55 for dust with water jet. So both protection is different and as far as acceptance concerned, it depends upon the user related to requirements

+91 78529 45980: Normally we are using IP 55 or 56  $\,$  in the outer panels , Kiosks etc for better protection against dust and Water.

### 85. +91 99372 97758: Can lightening arrestor protect fully any installation? If so; how & what should be the basic design base. If not fully; how to ensure 100% safety.

+91 94389 07408: Shielding of Direct lightning Stroke depends on the Parabolistic nature of lightning phenomena. It is not possible to provide 100% shielding against lightning. However proper grounding design is an integral part of the solution.LA s are to be put in strategic locations to provide coordinate protection for major equipment in SS.

+91 98108 01555: Yes. It is correct that 100 percent protection of any installation cannot be provided through L.A.s alone. Besides strategic location of L.As the type of L.A its effective earthing and proper ground mat commensurate to the fault level are required to be taken care of. The effective earthing of other equipment & other aspect to be carefully provided. The shielding of equipment through earth wires at the top is also the additional factor which will help in this regard. Providing of L.A.s near transformers and its effective earthing is further going to save this costly equipment.

+91 94389 07492: Use of LA is for specific kind of protection. So this cannot provide full protection as expected. Moreover the associated earthing path and distance wise location to dissipate surge current plays the role.

#### 86. +91...... Pl comment on fault tripping of one Pr. Transformer which is charged with only station Transformer load. Fault currents are HV R-170A, Y-170A, B-500A,N-250A and LV R-1A,Y-1A,B-2696A,N-2696A. Both Differential and LV Backup Relay operated. Pl share fault analysis.

+91 99372 97758: I believe information is not enough. Some imp data are required like transformer rating. PRI & sec voltage rating. Rated PRI & sec current. Connected load of. Transformer etc.

+91..... Regarding fault analysis of transformer following data may help transformer rating is12.5 MVA &volt is 132/33 kV. Other than station transformer load there is no other load.

+91 94389 07492: It indicates the problem on B pH LA of station transformer. This might have punctured with continuation of arc on the gap/Zno2 space. So the current on Lt Side becomes confirmed of Bph and N. But continuation of fault current and delay of BU trip might have resulted the tripping of differential current or could be loosening of any HT terminal may result abnormal fault current flow in the system.

To check: 1. Looseness of any HT terminals at isolators, breaker or any junction. Status of Bph LA on station transformer.

87. +91 94389 07496: Is it correct to connect neutral earthing of power transformer to grid earth mat? Again is it correct to connect individual LA earthing to grid earth mat. Please suggest concisely.

+91 94389 07219: All noncurrent carrying equipment/ materials of a substation are generally connected to earth mat.

+91 94389 07408: As per rule transformer neutral to be connected to two no separate earth pit and it should not be connected to main mat. Further the two connecting flats to be insulated and separated from each other. Similarly for LA also. If it is connected to main mat the surge shall affect the other healthy equipment through main mat although the mat is interconnected to so many earth pit. The surge voltage is to the tune thousand MV may be for a fraction of second.

+91 78529 45980:: I do not think the LAs & Tr. Neutral will not to be connected with main earth grid as the effective resistance of earth grid is very much less than the individual earth pit. Another thing we are generally adopting to reduce one insulator less in each insulator string in 3 nos towers near the grid to maintain the BIL .Proper earthing of each towers is very much essential. The effect of moisture contained in the substations earth grid is also have a vital role, for this purpose the water hydrant in the substation should be adopted. In our substations having laterite soil the water hydrant system has to be adopted.

+91 94389 07492: Earthing has the role for quick dissipation of fault current. So interconnection of earth mat with installation with its earth pit is the best choice and practice. Moreover if all the earth points get interconnected THEN all being at same potential shall reduce the flow of unwanted current and there shall not be any GPR( ground potential rise). So advisable for connection of Neutral point or LA earth to mat along with its pit.

+91 78529 45980: Connect LAs Transformer Neutral with earth grid that we are adopting. At Upper Kolab we had provided two no earthing pipe for each LAs and interconnect it with main earth grid as per CEA's approved drawing in 220 kV system but in other areas in our other grid we are providing single earth pipe per each LAs and connecting with station earth grid at two different direction of earth mat.

+91 99372 97758: Should we conclude it that it should be connected to Mat? But as per prior comments it is not OK. But I agree & it should be done.

+91 04389 07490: Regarding Earthing of LA, I may inform that during renovation of total earth mat of 220/132/33kv Chandaka GSS. OPTCL during 1997 when I was in s/s maintenance and one of senior officer supposed to be expert told that LAS & Neutral earthing of Transformer should not be connected to mat and they must be earthed to individual earth pits. Which must at a distance of 3.3 mts from electrode to electrode to avoid field superimposed during fault.

+91..... As per POWERGRID practice we are connecting Transformer or any other equipment neutral pit with main earth mat to reduce neutral impedance.

+91 94389 07408: Regarding LA connection to earth mat I agree. This the observation of CEI. However in OPTCL the transformer neutral is further connected to main mat but not the LAs.

+91 04389 07490: LA Earthing. This is to underline that the wave form of Lightning surges are non-symmetrical wave forms having nos. of peaks both positive & negative. All type of harmonics & instantaneous in nature, whose mean value can't calculate easily to find amount of heat it can generate. Thus wave surge will heat the s/s earth mat and damage them

+91 94389 07492: The point described regarding the uneven nature of surge and enormous quantity of current needs to be dissipated at the quickest possible time to avoid the heating effect and others. So it highly essential to use least resistive path on its circuit for discharge.

Hence it bears the simple rule that if the mat so connected, then either the fault current in case of TFR or surge current in case of LA will dissipate quickly, without affecting the system. So, all the utilities and even PGCIL have the practice of connecting to earth mat.

+91.....: Your views on earthing is as recommended by IEEE.

+91 99372 97758: Earthing is a low resistance path in an electrical system for discharge of fault current in least time; whether it's an FC or a surge to be dissipated. The lower the resistance; maximum FC transmission to ground. It is always better to connect to mat if available; irrespective of in which utility/industry is it.

# 88. +91...... In one of our control panel, we observed some sparking during heavy lightning. We checked the voltage with the earthing system and found that some of the cable armour have more than 35 VAC across them against earthing Conductor. Please provide analysis for the case.

+91 94389 07492: It seems to have problem with Earthing of the grid and connection of cable to earth structure. As this is prominent during lighting, indicates the GPR and dissipation of current towards control room.

Solution.

- a. Connect all earthing to common mat to maintain equipotential point including your Control room earthing.
- b. Develop earth mess around your Control room with earth pit of inter distance being 3mtr and connect the mess to grid mat.
- c. All cable if distance more than 1km, use one side sheath earth and other with SVL( surge voltage limiter)
- d. NOTE: this type of incident is dangerous to both person and equipment. Take corrective action.

89. +91...... I have a small doubt, hopefully this is the best platform for me to clear my doubts among such wise person.

•While testing (MICOM P444, Distance Relay) through Omicron 356(Advance distance not available) at 220KV Substation, Bidanasi.

•Total length of our line is 9KM, in zone1 setting is 80% of protected line, ie. If i give a fault in zone1 boundary in Rio, it must show nearly 7.2 KM in relay DR

• My doubt is if I give a fault in zone1 boundary with remove feedback cable in my kit, it showed exact km around 7.1 But after connected feedback cable the KM showed around 6.3

•This problem happened only phase to ground fault

•Is there any specific reason, or I can continue testing without feedback for getting exact KM.

+91 94389 07492: Problem of getting distance value without feedback is not understood. Pl confirm the value within zone instead of exact boundary. Sometimes at boundary the distance may shift to next zone. In the case of blocking of next zone i.e here it is zone2, the distance may come erratic. So confirm please.

+91...... Can over current relay coordination can be done based on online calculation using optimization technique.

+91 94389 07492: Absolutely YES. Simple to say that OC feature is never used for fault condition. This feature is purely chosen to restrict over and above current during over load scenario. So optimisation technique could be the actual method for online situation.

+91..... Example in distribution system from the mother downstream to upstream side we need to coordinate the relay then all the calculations like TMS PSM are offline. So if network configuration change then can we adapt

+91..... Adaptive feature to coordinate the o/c relay.

+91 94389 07492: OC relay coordination depends on the choice of the user for restriction of Overload to the area needed for which the upstream shall not trip. So for the interconnected system, as per the load flow in network due to its impedance, the relay gradation has to be done. So the coordination may change as per the configuration and load flow.

#### 90. +91 94330 68533: Please give some idea on Z4 reverse protection

+91 94389 07492::Reverse zone Z4 to be selected as the backup for the critical protection like BB protection. So this setting should be coordinated with BB protection. Preferable to be provided with the setting of 15 to 20% of the protected impedance. Tripping should be integrated with BB protection if available. If any fault results then BB should take action to trip the

connected line. If not then it should trip with Z4. For the system with no BB, its time setting should be very minimum like 150 to 250 msec.

+91 99014 90941: There was a question on Zone4 setting. I am giving below extract from the new draft manual of CBIP on protection.

Zone-4 substation local back up protection

Zone-3 distance protection is usually targeted to provide only remote back-up protection. In such a case, the distance relay may be provided with an additional zone of reverse-looking protection (e.g. Zone-4) to offer substation-local back-up protection. The criterion for setting Zone-4 reverse reach would be as under.

The Zone-4 reverse reach must adequately cover expected levels of apparent bus bar fault resistance, when allowing for multiple in feeds from other circuits. For this reason, its resistive reach setting is to be kept identical to Zone-3 resistive reach setting.

With a reverse reach setting of less than the Zone-1 reach of distance protection for the shortest line connected to the local bus bar, the Zone-4 time delay would only need to co-ordinate with bus bar main protection fault clearance and with Zone-1 fault clearance for lines out of the same substation. For this reason this can be set according to the Zone-2 time setting guidelines.

+91 94389 07492: I think if we could integrate its setting on logic selection to BB relay, we can get back up protection to BB. Please comment. We need help to formulate protection philosophy for this line DP relay.

### 91. +91 9433068533: Zone 1 initiated but CB did not because of say some reason. LBB will operate then? Z4 will prevent this LBB operation?

+91 94389 07492:: Sir, BB Tripping acts on the logic of signal from lock out relay with fault current on the system and utility does not want this to trip. So we are searching for other alternative. I think we can integrate this with other zone or LADR concept for segregation of bus.

But sir if the case of non-tripping of breaker due to mechanical problem then LBB or BB has to operate. We appreciate the question asked. We definitely come forward to solve these issues with better thought by the members of this group.

### 92. +91...... In general almost all HT motors are star connected. Want to know why the star point is not connected to earth?

+91 94389 07408: Earthing of motor star points creates a path for earth leakage current which flows through the motor star point. If there are number of motors in an industry and their star points are earthed, similar number of additional path will be there for flow of earth leakage

current and protection relays used shall be very much complicated. Further motor is balanced 3 phase load and we need not have the grounded neutral.

+91 94389 07492: Neutral of any HT EQUIPMENT is always preferred to be connected to EARTH for quick dissipation of fault current. However for the case HT MOTORS of higher rating say 10MW and above with 6.6 kV or less, the normal load current becomes high to the tune of 900-1000amp and during fault, this current could be much high and difficult to manage to flow thru Earth mat by the normal use of EARTH flat. Hence it is preferable to use RESISTANCE on Neutral path to limit fault current. But with such limited fault current and with use of sensitive earth fault relay the tripping of supply could be attended.

NOTE: The LT MOTORS of lower rating is always preferred to be solidly grounded.

+91 99370 00046: Grounding of neutral point is not being decided based on the presence of unbalance loads. It is decided for safety reason and for earth fault protection requirement. Unbalance 3-phase load will result in some current flowing through the neutral conductor but it doesn't result in a (residual) current flowing through the neutral-ground connection.

Motor is a balanced 3-phase load. However when the system supply voltage is unbalanced caused by unbalanced loads somewhere else or due to network conductors problem, the motor operating under unbalance voltage will result in unbalance current in the 3 windings. The same is true for the generator windings under that condition. The design engineer may then decide that individual machines should be fixed with negative phase sequence current protection.

Even if there is a neutral voltage shift in the induction motor, we should not ground the motor's neutral point. If you ground it, it may create nuisance trip of earth fault protection relays (the motor's EF relay, upstream EF relays, or the EF relay connected to transformer's neutral-ground CT).

If we ground the star point, we still will not get rid of the unbalance current/voltage from the motor windings. There the negative sequence current is still present in the motor winding. If we think an unbalance voltage supply is causing problem to the motors, we should solve the unbalance voltage problem elsewhere, not by grounding the motor's star point.

+91...... If LT or HT motors neutral connected to earth, during fault of any one of motor will causes to trip of all other healthy motors which are connected to same source as fault current returns to source through the other motors.

+91 94389 07492: Any HT equipment with star connection has to be connected with either solid or RESISTANCE earthing because of the reason as described. The flow of circulating current or tripping other motors as mentioned is not understood. Because flow of unbalance current on any circuit depends upon its driving source. During unbalance current on any particular motor, current shall flow only on its neutral instead of other motor Neutral path.

Then discussion comes regarding the magnitude of current flow on this Neutral.

Abnormal current due to unbalance load or opening of any phase, the residual current shall flow.

For the case of fault in the system, the fault driving voltage divided by fault impedance becomes the Current to flow in the Neutral and on the affected phase.

Now magnitude depends upon the use of impedance on Neutral path.

If RESISTANCE gets use in the Neutral, current value gets limit and within the range of control. Note: But by use of RESISTANCE, certain voltage shall be made available on Neutral, for which voltage rise may occur on the healthy phase. So choice of the RESISTANCE use should be calculated properly.

#### 93. +91 97113 09639: As per standard the PI value of a transformer should be within 1.5 to 2.5. If the value is below range than it can be increased by vacuumisation, filtration heat run etc. but if the PI value is found more than 6 then what to do? Whether the transformer will be commissioned or not please share view.

+91 94389 07492: *T*ransformer PI of value 1.5 to 2.5 is within range as taken the practice by maximum utilities. PI indicates the behaviour of insulation on DC supply. Any value beyond 4-6, indicates regarding the dried paper insulation. So utilities fear to charge the unit.

Action: the paper used need to be impregnated with oil. So the temperature of oil to be controlled. Reduced temperature oil to be kept for few hours with oil for soaking with paper. Then circulation to be done on the usual temperature during filtration process.

Note: One such experience at 220/33 kV Barkote grid, where this situation had happened and value was coming at around 4.5 and final value came of 3.1-3.5 and the TFR was charged Ok. But after successful running for 1/2 years the PI value was found with the allowed limit

### 94. +91.....Under which fault condition will the TRFs only trip with E/F relay indication whereas the incomer feeder has no relay indication at all?

+91 94389 07492:

- a. The situation as mentioned indicates either the problem in relay setting or relay coordination.
- b. On setting of relay
- c. Check EF whether used with directional or non-direction. This might have been with non-direction.
- d. EF might be used with HIGH set value.
- e. Check regarding the connection of isolators that might have been resulting spark during fault condition and because of unbalance current, EF may trip.

Solution: 1.check setting of EF relay and its coordination with outgoing feeders. Check isolators and its contacts.

+91 90406 24335: Please check the alignment of isolators, also check the relay coordination. If possible please furnish complete data for detail analysis.

### 95. +91 94395 41934: How absorption index is helpful in drawing an inference about insulation health of transformer.

+91 94389 07492: Absorption Index and PI is related to the study of the insulation on DC supply. The AI relates to the initial part of the study= IR value 60 sec/ value at we 15 sec, also called PI 1, and PI is the ratio of value at 600 to 60 sec.

So AI could be considered as to know the preliminary behaviour of insulation. The quicker it goes relates to quick polarisation of molecules and better insulation.

Note: This index may not be helpful to draw any inference, as Absorption or polarisation current remains on the way to attain its final reduced value.

DD: Degree of Discharge is another factor also used for insulation study.

# 96. +91 94389 07806: FRA test are conducted before transformer transporting & after transporting to check any mechanical change within transformer. After any fault on transformer. It is wise to conduct FRA test to check any change in electrical & mechanical parameters.

+91 94389 07492: For the case of fault, including the mechanical displacement of the winding the other changes result like short circuit, burning of the winding or any kind of confirmation change of the winding in case of the winding fault.

So the FRA testing can be conducted for comparison of the signature of previous result. But as other diagnosis test used to provide the condition of the winding, hence we do not do this FRA test.

#### 97. +91...... Our STGs trip on respective fault protection during lightening /thundering. Kindly suggest feeder protection relay for 11kV overhead lines to avoid Tgs tripping

+91 94389 07492: For the condition as described it is required to provide relay coordination. As this is of particular case specific, so detail data required, like SLD, type of relay used with its setting and other electrical parameters {Earthing system etc..}.

### 98. +91 99370 47045: What is the periodicity to be maintained for conducting SFRA test of power transformers?

+91 94389 07492: In practice, there is no such kind particular recommendation for Power Transformer. But it could be better if you take SFRA test in every 5 years on the basis of continuous use of the transformer on loading condition. Every time you have to compare the signature to the previous curve.

## 99. +91 94389 07492: The interest of the engineers is really fantastic. Today we can have the discussion on tap changer on transformer. Is it required? What could be any other alternative to this? Please interact.

+91...... Yes OLTC (On Load Tap Change) for Power Transformer is essential to change the voltage level of secondary side according to the load change to fulfil requirement and to maintain constant voltage within the limit.

#Alternate method is STATCOM (Static Synchronous Compensator) is a flexible AC transmission system device, which provide reactive compensation to control power flow for Power system. Since for improve voltage control OLTC as well as STATCOM is required.

#finally I have a doubt that why OLTC connected on HV side of power Transformer always?

+91 99370 00046: HV sides has lesser current compared to LV Side. Moreover transformation also in Multiples.

+91 95607 63305: Tap changing is much cheaper than other methods of V control. But it is not used often may be due to problems in 0 & m

+91 99372 97758: But frequent tap changing is not advisable; without knowing the reason of under/over voltage & studying of voltage profile over a period of time.

+91 98108 01555: There is lot of investment on tap changer but still not practically used at many places... Let us start thinking of eliminating it, where system also permits so. Power Grid has already started working on the subject. Let us study more

+91 98108 01555: Yes in power houses where step up transformers are there...the organisations have already eliminated the tap changers...like N.H.P.C.

+91 99370 00046: For Generating stations Voltage can be directly controlled from generating units if it us a generator transformer.

## 100. +91 94389 07357: Is it acceptable 72808 pf as secondary capacitance, 7281pf as primary Capacitance & 6600pf as HF capacitance in a 145 kv CVT where burden is 100VA/.2?

+91 94389 07492: Rating of the capacitance of the stacks plays the role for voltage division. So more capacitance value shall add more charge and current on the capacitor stacks. So it is not preferable. But if the size of the stacks in accordance to the number to be changed then this design can withstand the current and could be considered.

#### 101. +91......Suppose there is a situation of CT saturation then first question in digital relay what are the available methods that has already been implemented to detect it. Second question then how relay will take care of it. Whether go for only voltage or provide time delay to let the transients die down or simply go for another solution.

+91 94389 07492: Saturation in CT shall cause rise of the CTR. In digital relay in present practice the monitoring of CT supervision facility available, where in the opening of CT core, developing of zero sequence current in the system could be obtained. But under measurement

mode by studying the value of magnitude and phase angle one can confirm regarding the saturation. We appreciate this and can ask to relay developer to add this logic in future.

## 102. 91 97780 31301: Here at OPTCL for all GIS substations we are implementing TWO BUS system where if one feeder goes out of order then the same feeder cannot be fed from bus coupler bay.

### 103. So like in AIS SYSTEM for GIS system doesn't we have a reserve bus system or Transfer bus system?

+91 94389 07492: Considering reliability and expecting rare fault in the system the use of coupler has not been considered. Because addition of any extra common system shall add to the cost and design of extra bus. This had not been taken at info city site Odisha. But this arrangement could be done as per requirement of the user. Pl deliberate.

+91 94389 07315: I feel, economy of space & cost is the consideration.

Dear you have seen at our GIS, Bus-I and Bus-II are kept on one side vertically spaced and bay take-off for Feeder / Transformer at the other end with Bus Duct or Cable interface. It may be one economical option. However the manufacturers may have other options as per users' specifications those may influence the dimensions of the GIS building also.

In our adopted configuration at Info city-II or Chandaka-B, Bus Coupler is not meant for any individual bay, rather it is for flexibility in maintenance of Bus Bars or the connected VTs.

Whenever the charged Bus-I is to be put under shut down for maintenance of the Bus Bar or the connected VT(s), we may energise Bus-II through Bus Coupler Bay, then transfer the Source as well as the Load to 2nd Bus closing Bus-II disconnectors (Isolators) & opening Bus-I disconnectors without any arc across the equipotential points and finally open the Bus Coupler. The same procedure is to be followed for reverting back to the original system.

+91 97780 31301: But is that system has been done for GIS Kenjhor project of OPTCL which is being executed by Toshiba Ltd.?

So what is the development and what are other options are available at any other place for the GIS systems?

+91 94389 07492: At present in my knowledge the GIS scheme is simply of 2 bus system without of any transfer bus in OPTCL. As we stated that any system can be done considering the requirement of the user, on the basis of cost and other technical viability.




Target for renewable power capacity by 2022

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