

$$E_{rms} = \frac{2\pi fNaB_{peak}}{\sqrt{2}}$$

$$X'_s = a^2 X_s$$

$$V_s = N_s \frac{d\Phi}{dt}$$

# Forensic Services

## Transformers

Dibenzyl  
Disulfide tracking

insulation  
failure

lightning thermal  
stressing

oil loss

thermal  
fault

overloading

water  
ingress

arcing

over  
excitation

corona  
discharge



Forensic Services  
Consulting Scientists and Engineers



# TRANSFORMERS

## INVESTIGATION AND MITIGATION

The sudden failure of a transformer causes great financial loss. FSM provides both root cause analysis and loss mitigation in respect of transformer breakdown.

### ROOT CAUSE ANALYSIS

FSM has skilled electrical engineers to carry out investigations into transformer accidents. They are engaged full time on transformer breakdowns throughout Asia, ranging from 400MVA, step-up, auto-regulating, oil-filled transformers such as would be found at hydroelectric or thermal

power stations, to dry-type transformers in major buildings or universities. We are also experienced with transformers designed for specific industries, such as electric arc steel/carbide making and induction melting.

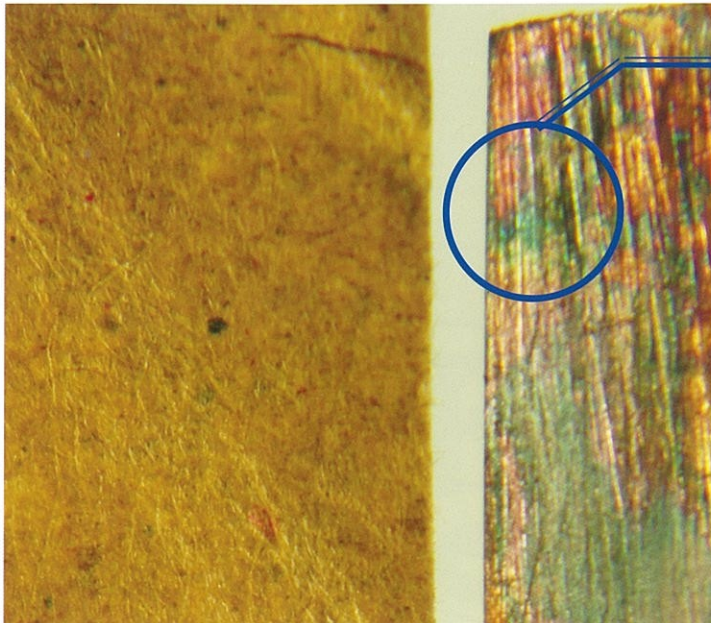


FSM engineers examining arc flash damage on a 6.6kV starter

### TYPICAL ASSIGNMENTS

- Determining that oil leakage from a 'sealed' transformer over four years was the cause of an internal arc flash.
- Identifying failures of 'Dry Type' transformers due to thermal stressing and/or cyclic loading.
- Establishing that corrosive oil was the cause of the breakdown of a 292MVA transformer in Indonesia.
- Technical adviser for in-situ recovery of 300MVA, 3 phase, 18.5kV to 500kV power station transformer following arc flash and water ingress.





## CORROSIVE TRANSFORMER OIL

A proportion of transformers suffer premature failure because of the presence of corrosive substances in the transformer oil.

The FSM laboratory can analyse transformer oils to detect whether corrosive substances are present. We carry out two tests, one a corrosivity test and the other specific for a particular sulphur compound. Both tests are performed to international standards.

## MITIGATION

Transformer accidents can be particularly costly because of business interruption.

We can advise on extent of damage and whether repair is possible locally or the transformer has to be returned to the manufacturer.

Through our international contacts, we can source temporary replacements. We can also advise whether replacements suggested by others are technically capable of providing the electrical output needed, or introduce risks of their own.



Fire damage to a transformer in a major network distribution switchyard

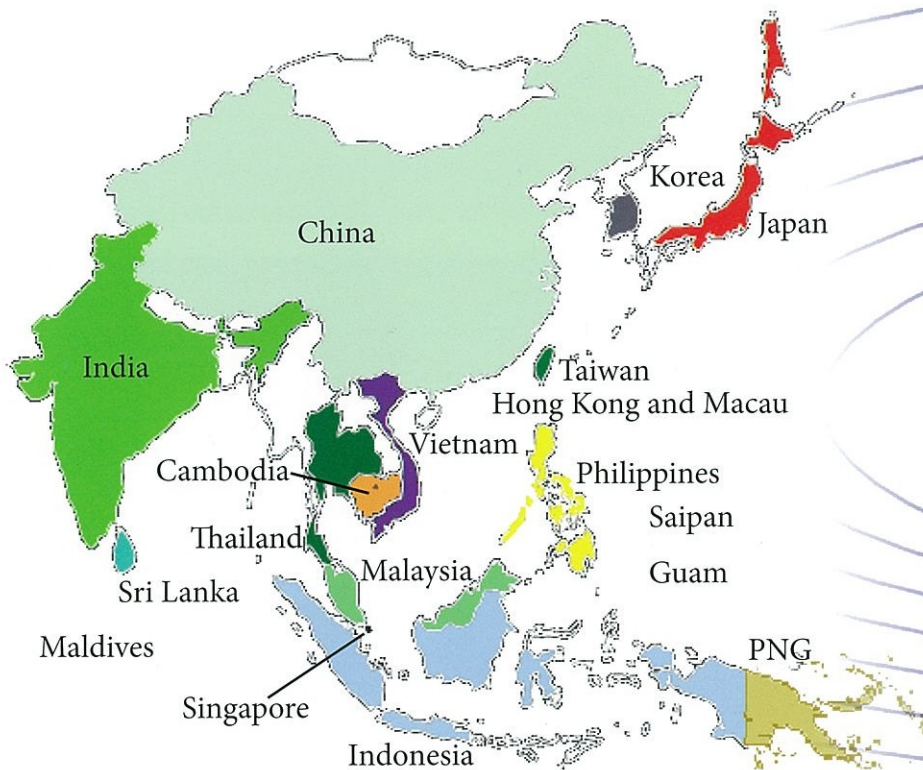






# Forensic Services

Covering Asia



Forensic Services is based in Kuala Lumpur, Malaysia.  
Forensic investigations have been carried out in each of  
the countries named in the map above.

## Contact us

### Forensic Services

#### Asia Pte Ltd

51 Goldhill Plaza #07-10/11

Singapore 308900

Singapore

Tel : (+65) 6240 6899

Fax: (+65) 6354 3261

### Forensic Services

#### (M) Sdn Bhd

12A Jalan Mesra

55000 Kuala Lumpur

Malaysia

Tel : (+603) 2145 2022

Fax: (+603) 2145 1022