Isolated Phase Bus Condition Assessment with EMI Diagnostics

Doble Global Power Services

Products + Services + Knowledge = The Doble Solution

EMI Testing

- EMI stands for electromagnetic interference.
- It is a tool to improve a condition based maintenance program of high voltage mission critical assets
- Both electrical and mechanical problems are identified on the first test.
- Over 85 unique defects and conditions can be identified.

EMI Testing

EMI Signatures & patterns differ with the type of defect and the source location.

Visual identification of each pattern is determined in real time by the test engineer while on site. A location is determined.

All analysis and reports are peer reviewed for accuracy.

EMI Testing

Data is collected from one split core RFCT (Radio Frequency Current Transformer).

The RFCT used has a 5 in diameter window.

EMI Testing

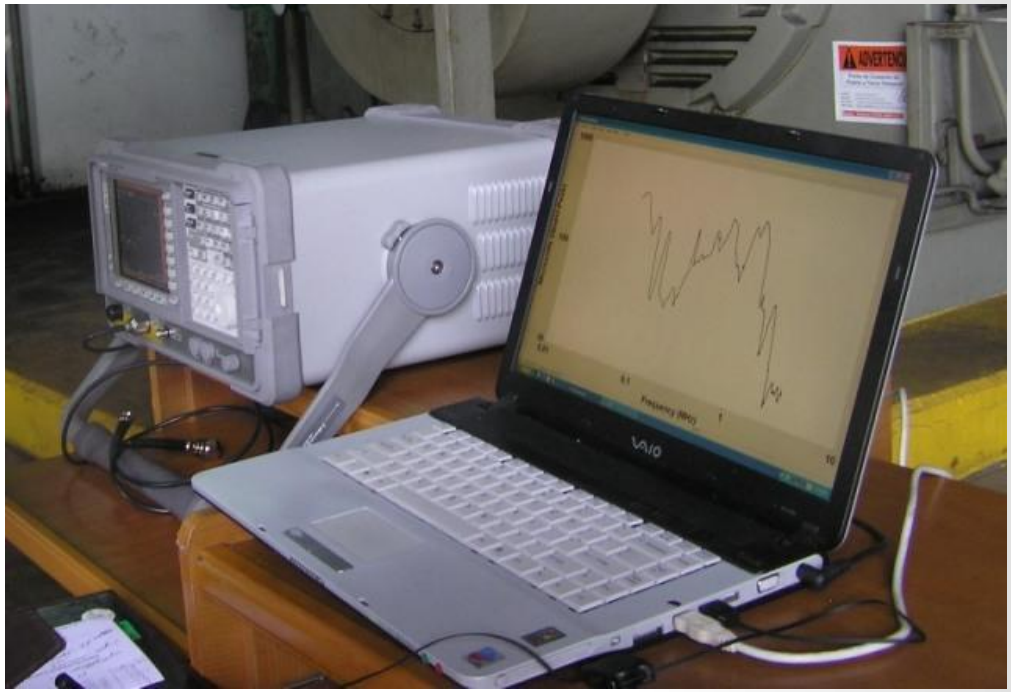
EMI data is collected by instruments that comply with CISPR 16 standards.

This is a very

sensitive receiver.

No signal is injected

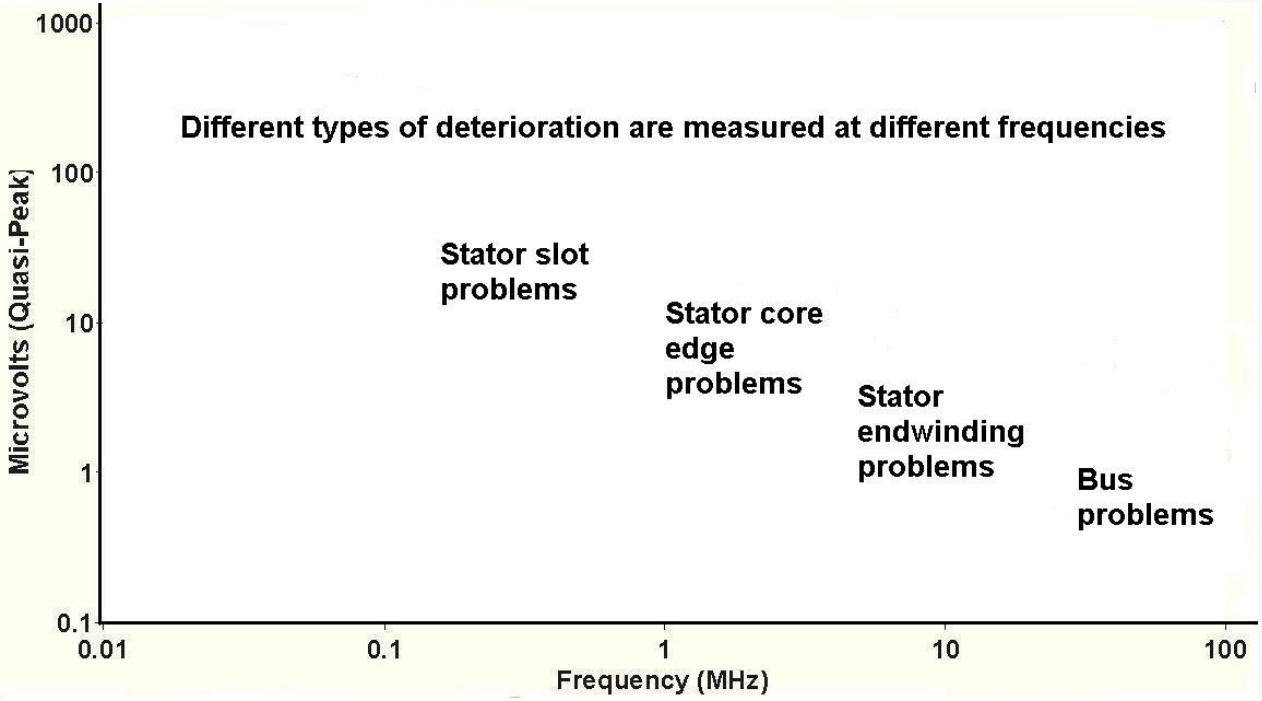
into the system.



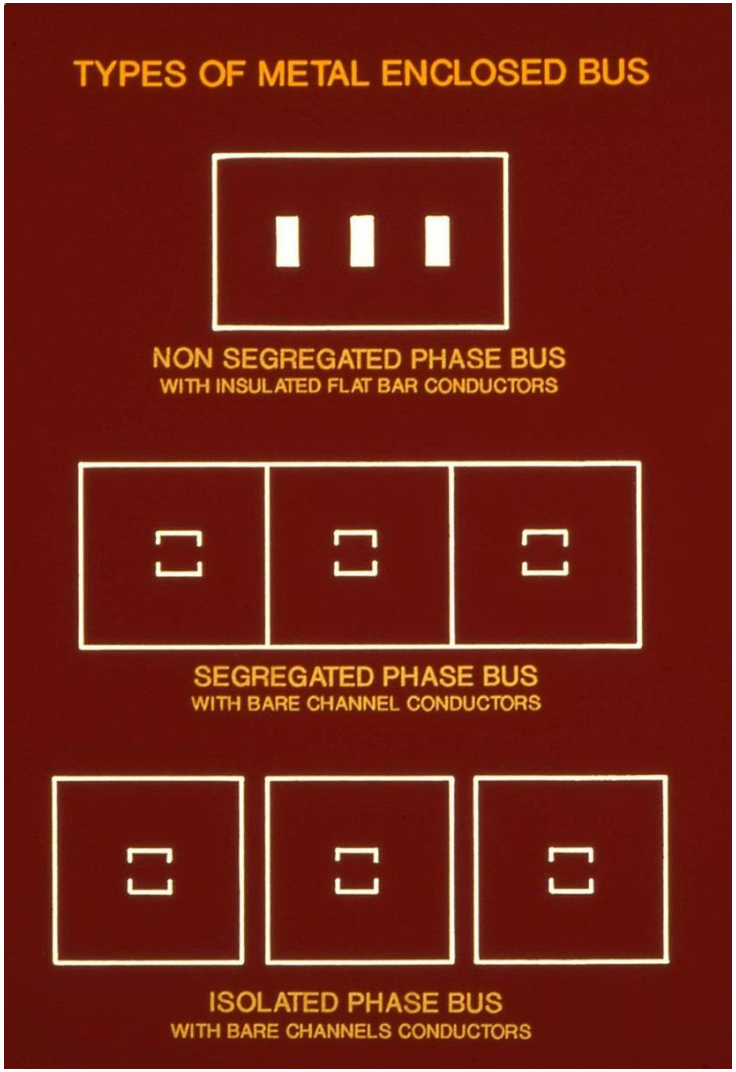
EMI Testing

- Where the RFCT is placed depends on the electrical apparatus under investigation.
- A safe low voltage or grounded location is selected for data collection.
- There is never a connection to a “HOT” circuit.
- Never an arc flash concern.
- No interference with normal operations to collect data.
- No signal of any kind is injected into the system.

Different frequencies in the EMI Signature describe different system problems



Isolated Phase Bus Condition Assessment with **EMI Diagnostics**



Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

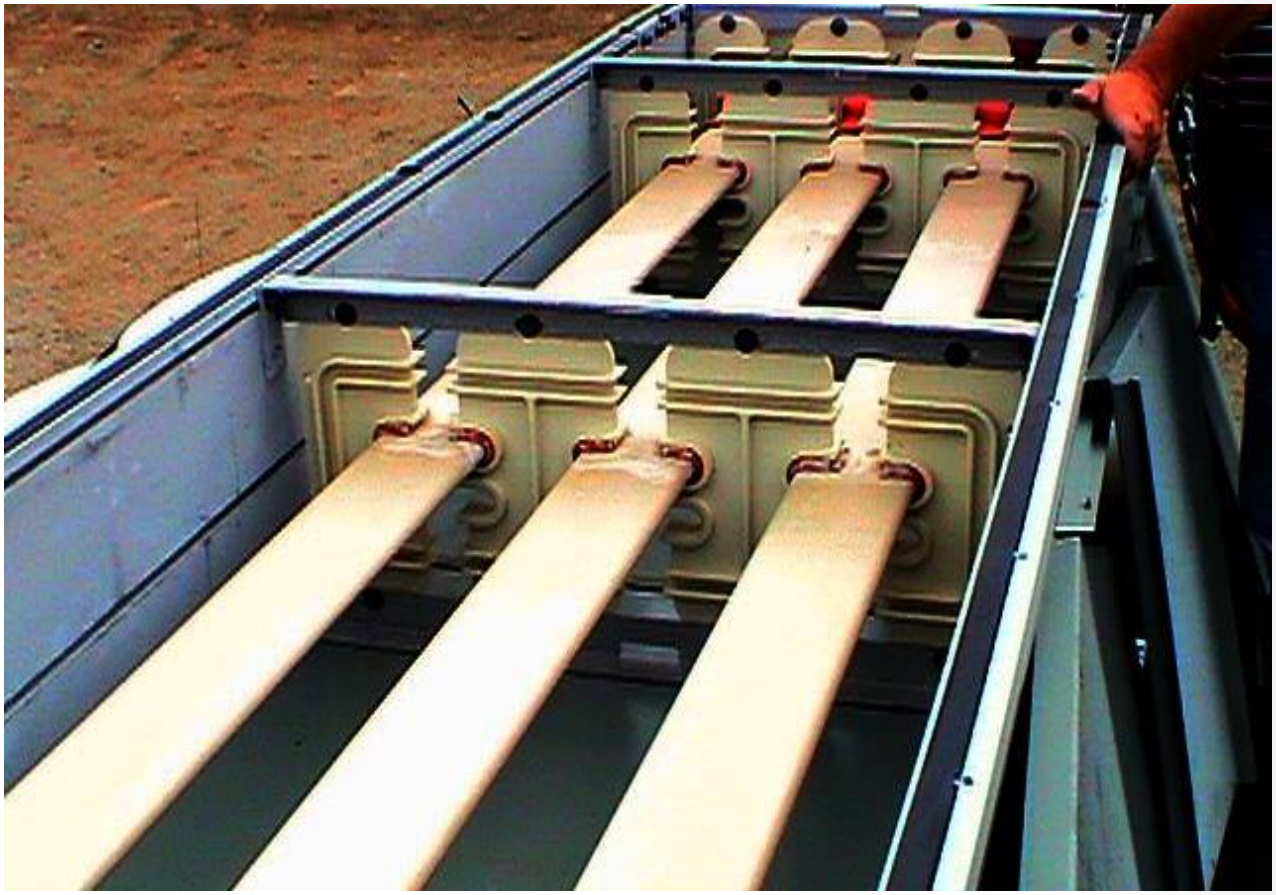
An isolated phase bus is that part of the electrical system that carries power from a generator to the main and aux transformer.

Two types of isolated phase bus:

– Continuous enclosure
– Non-continuous enclosure

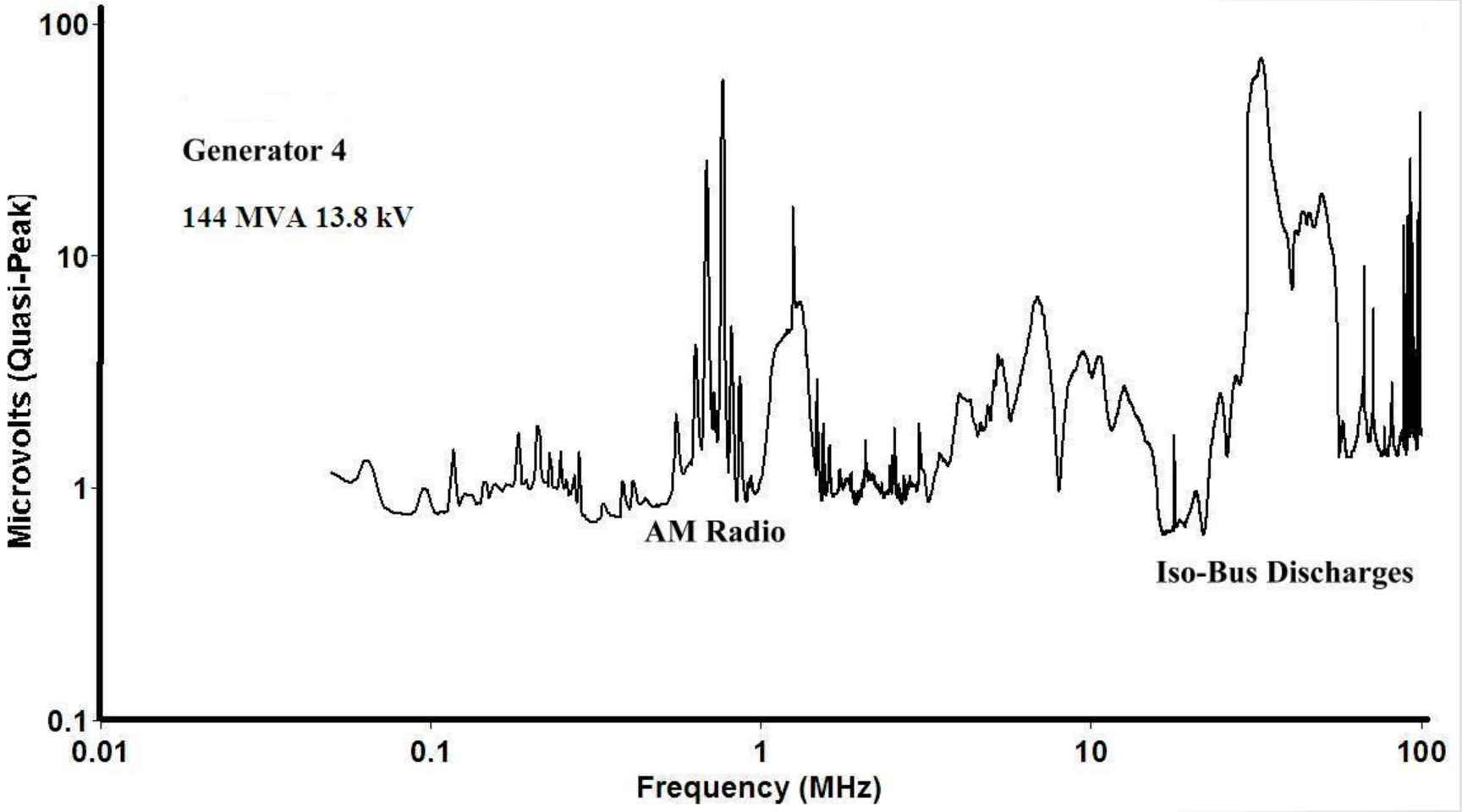
Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

This design is used on smaller generators and from the AUX transformer to the switchgear.



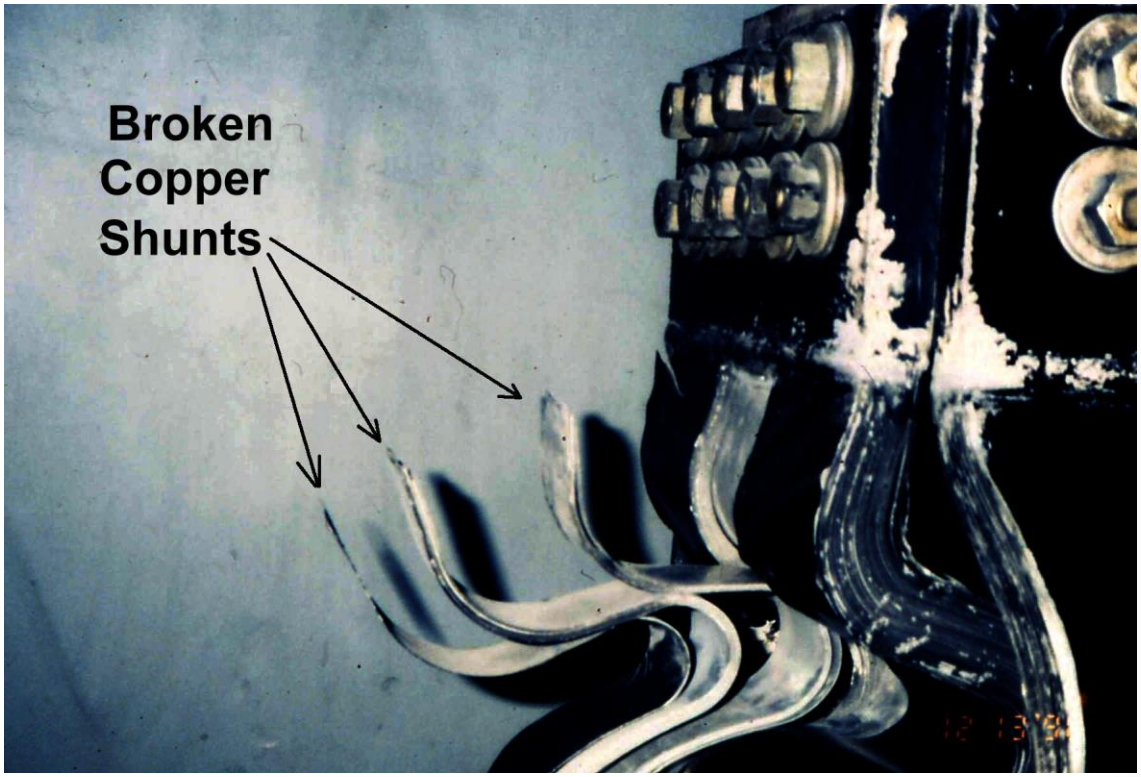
Non-Continuous Bus Enclosure
EMI Diagnostics

Insulation failures can be expected.



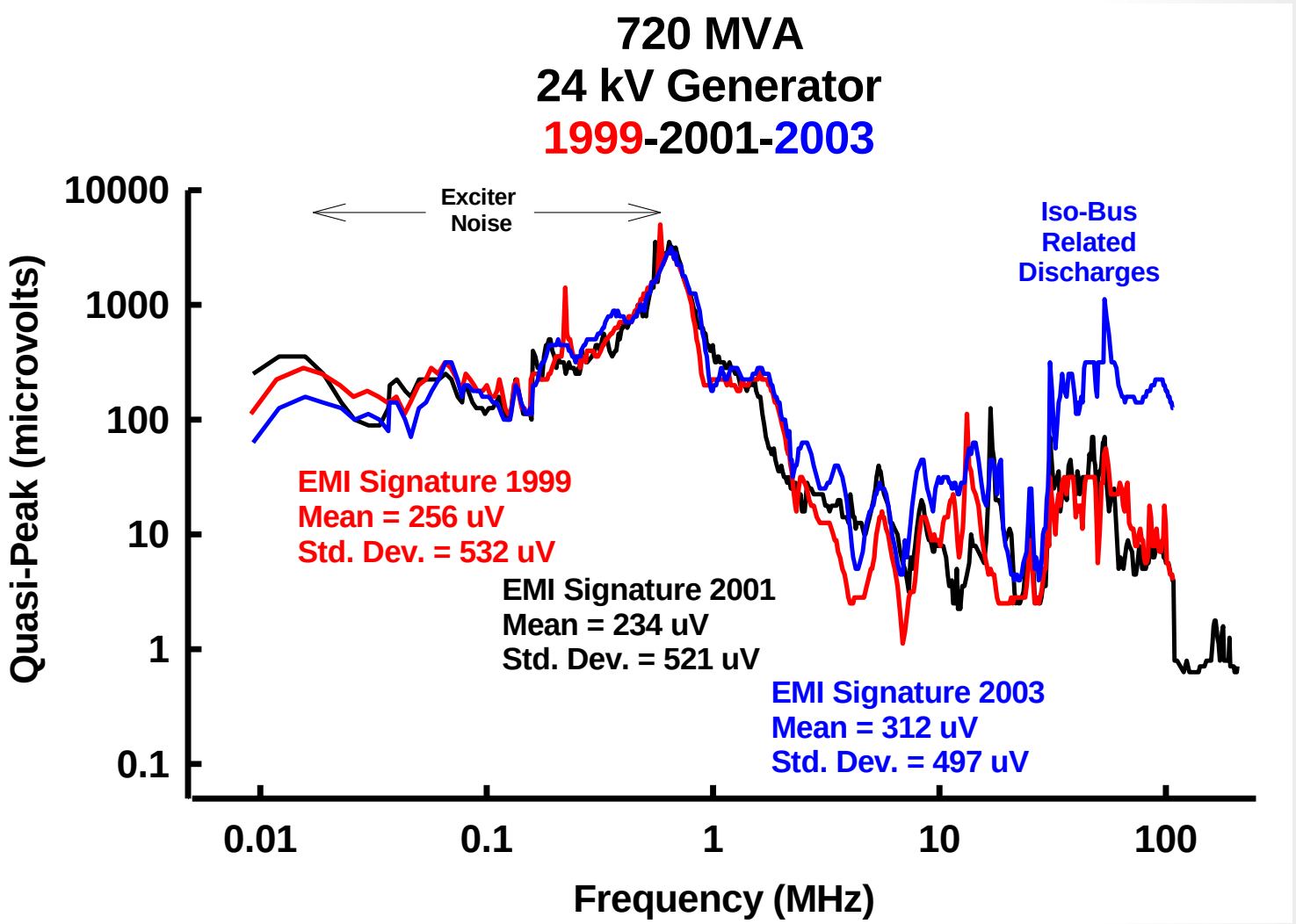
Continuous Bus Enclosure
EMI Diagnostics

Broken conductor shunts will develop. An inspection or **EMI Diagnostics** will locate.



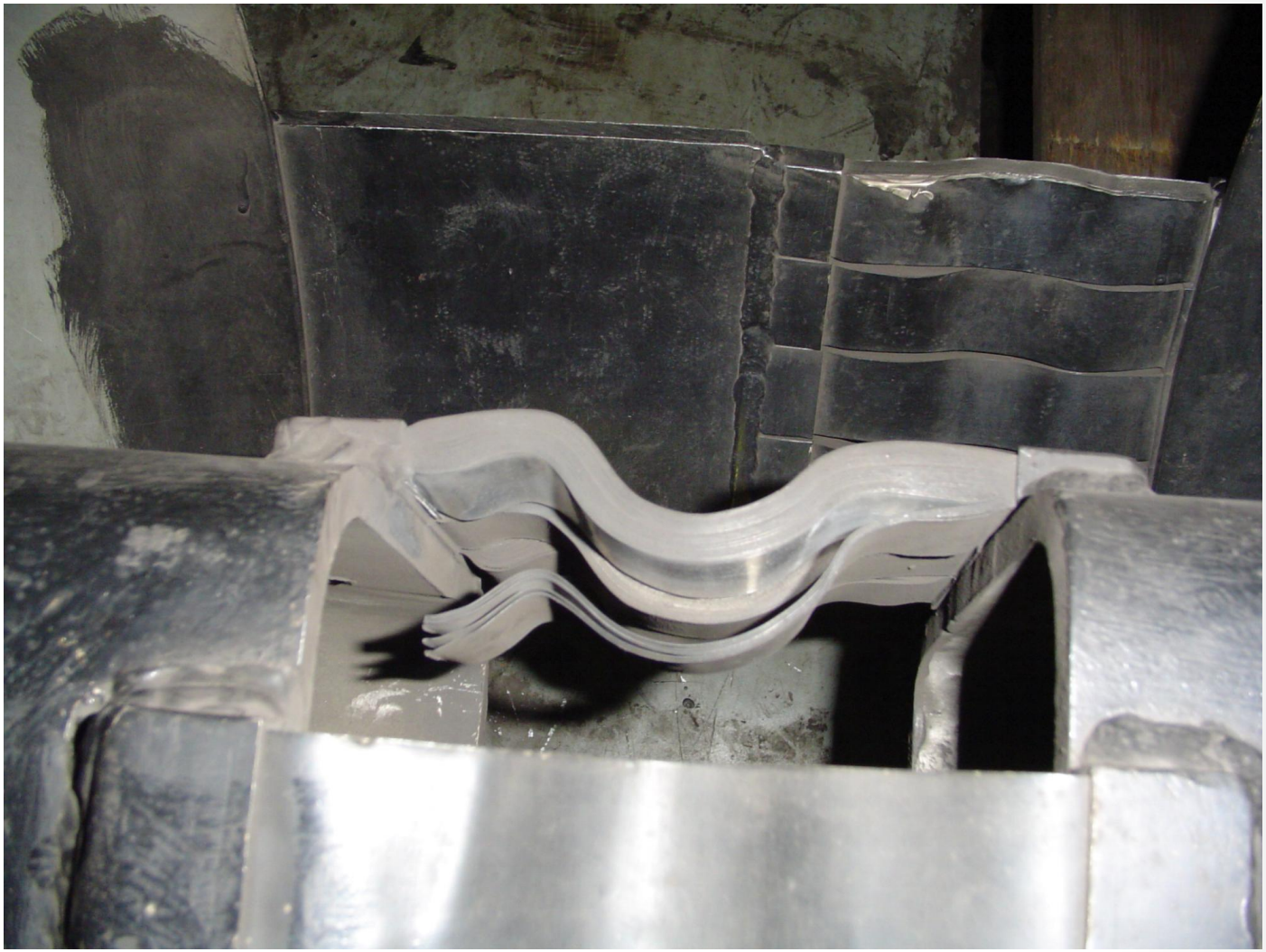
Continuous Bus Enclosure
EMI Diagnostics

EMI Diagnostics will detect numerous types of internal **bus** problems.



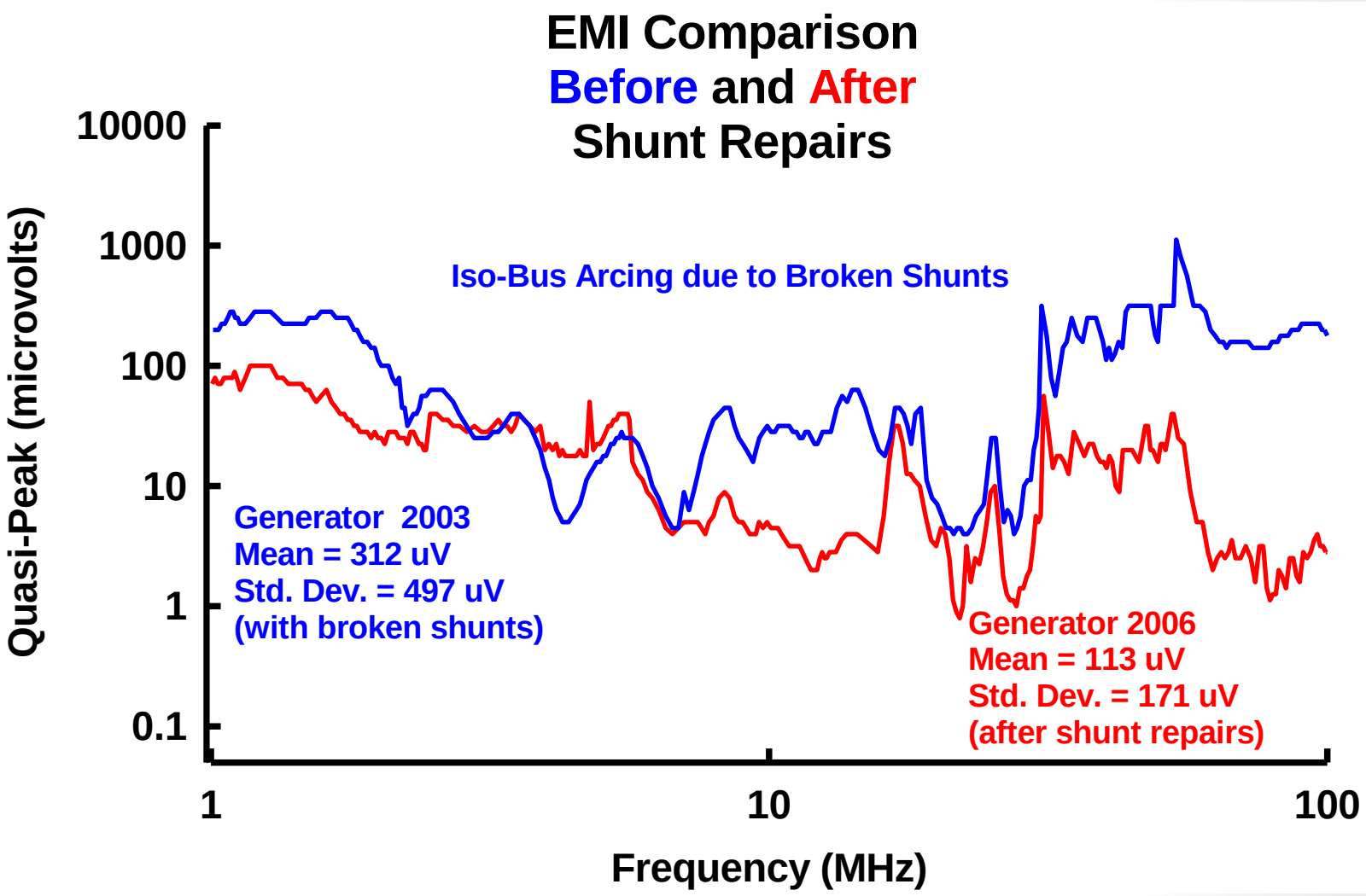
Continuous Bus Enclosure
EMI Diagnostics

When the bus was inspected, these **broken shunts** were found.

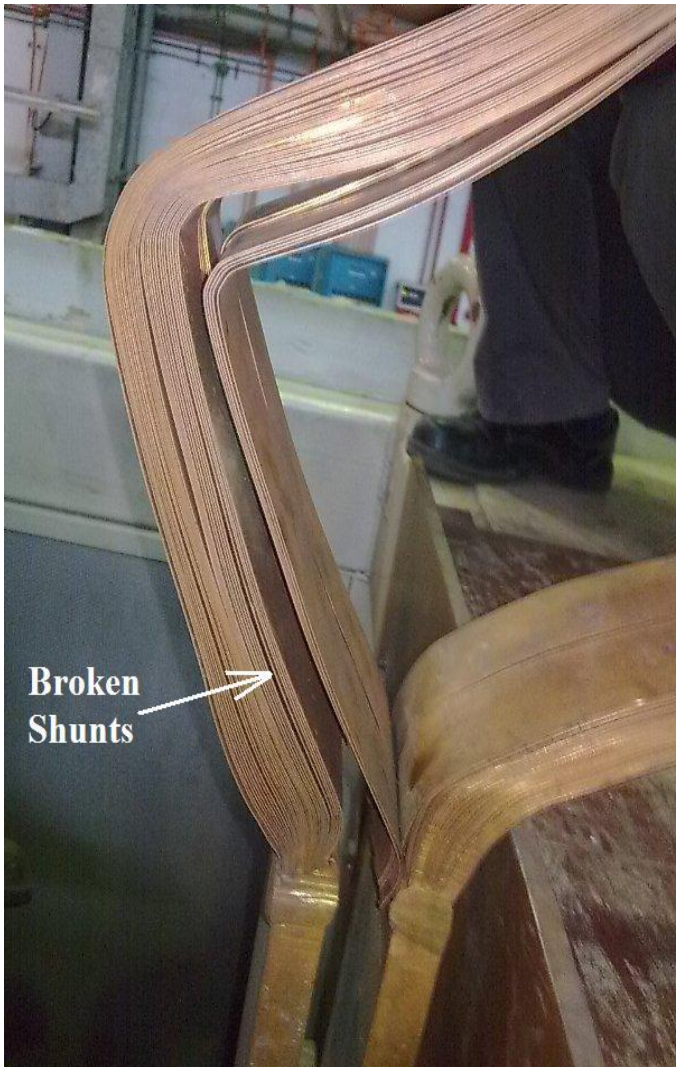


Continuous Bus Enclosure
EMI Diagnostics

A drop in bus-related EMI confirmed **repairs were successful**.



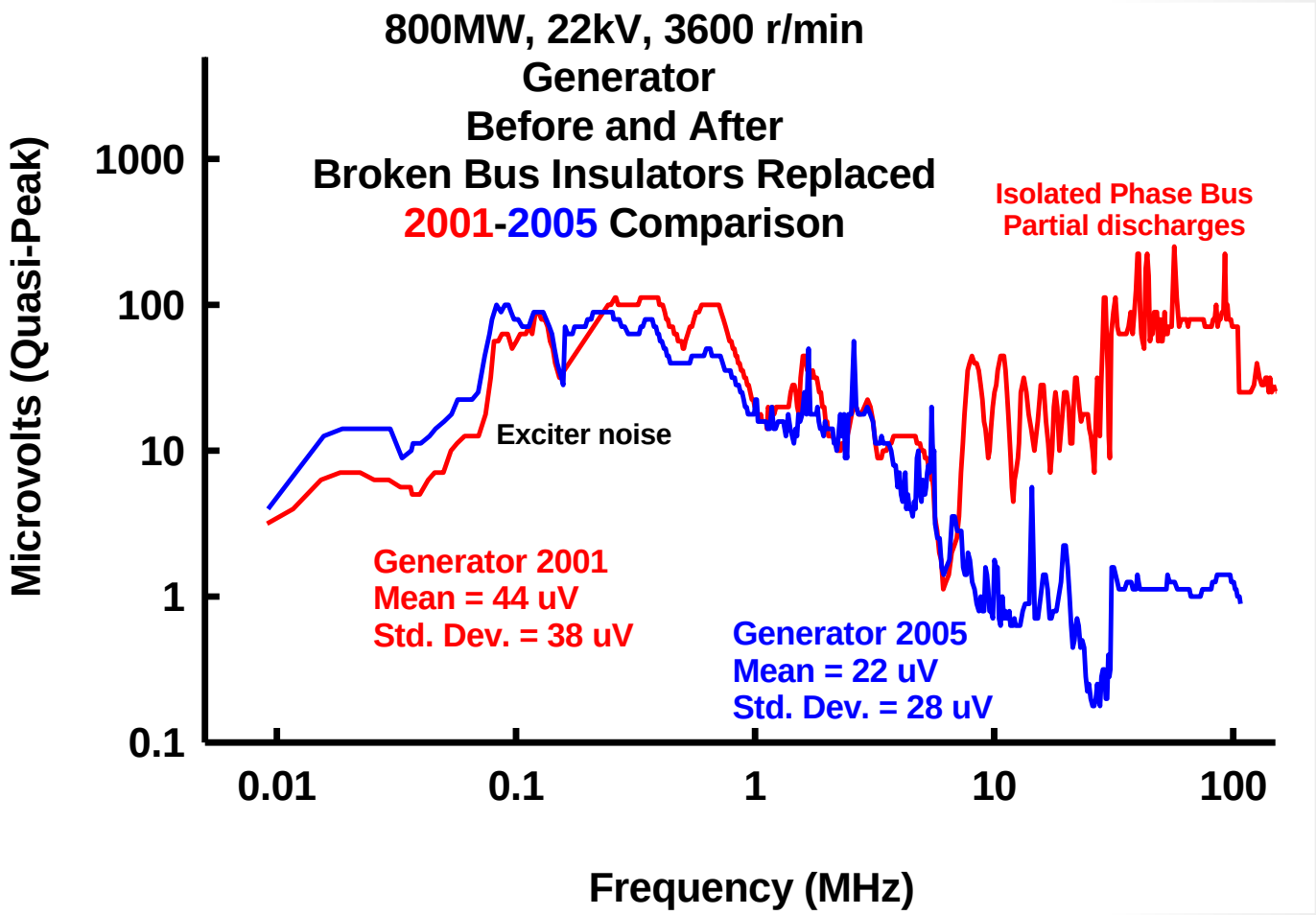
Continuous Bus Enclosure
EMI Diagnostics



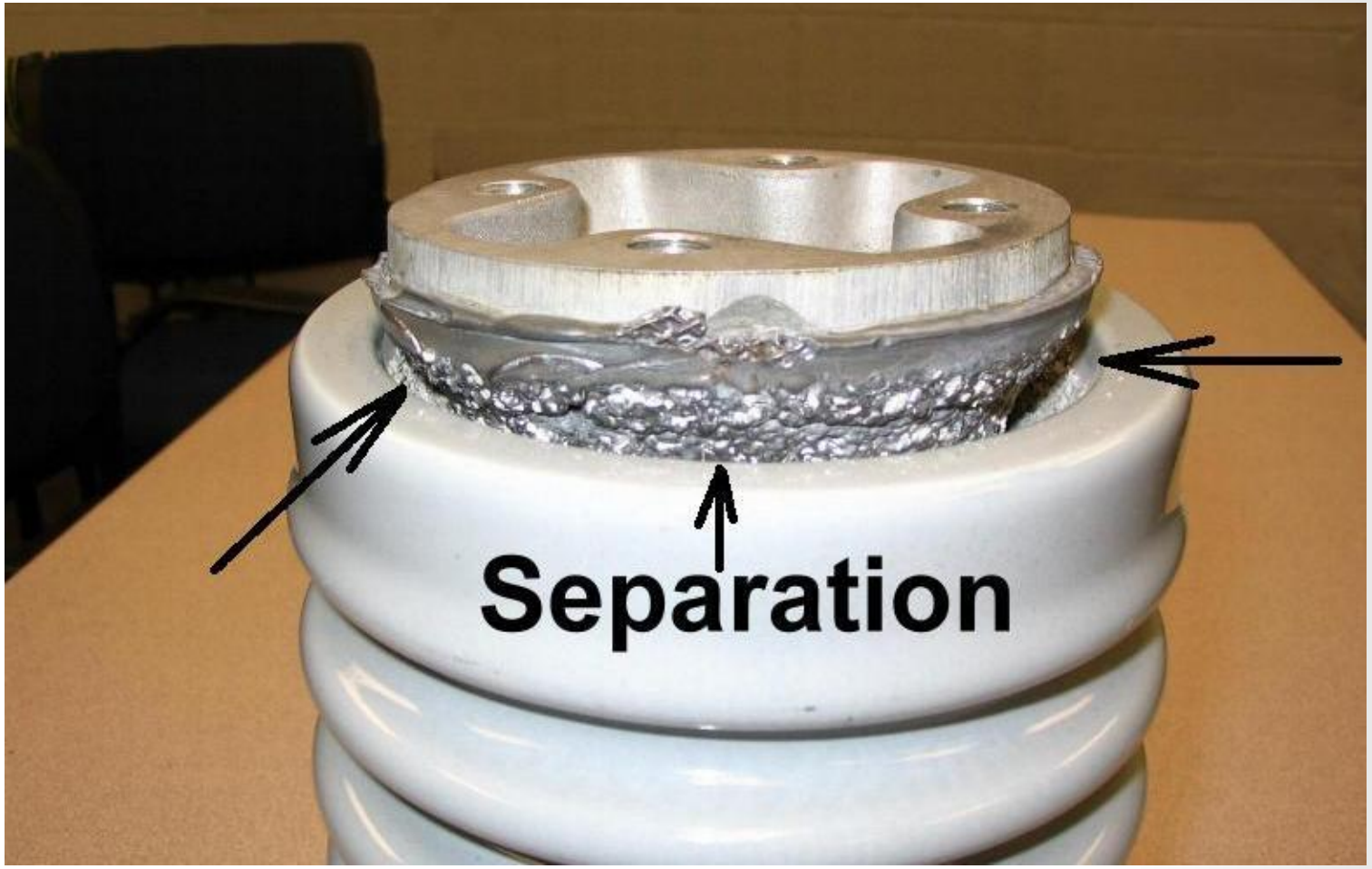
Another example of **broken shunts**.

Continuous Bus Enclosure
EMI Diagnostics

This STG had high floor **vibration**.



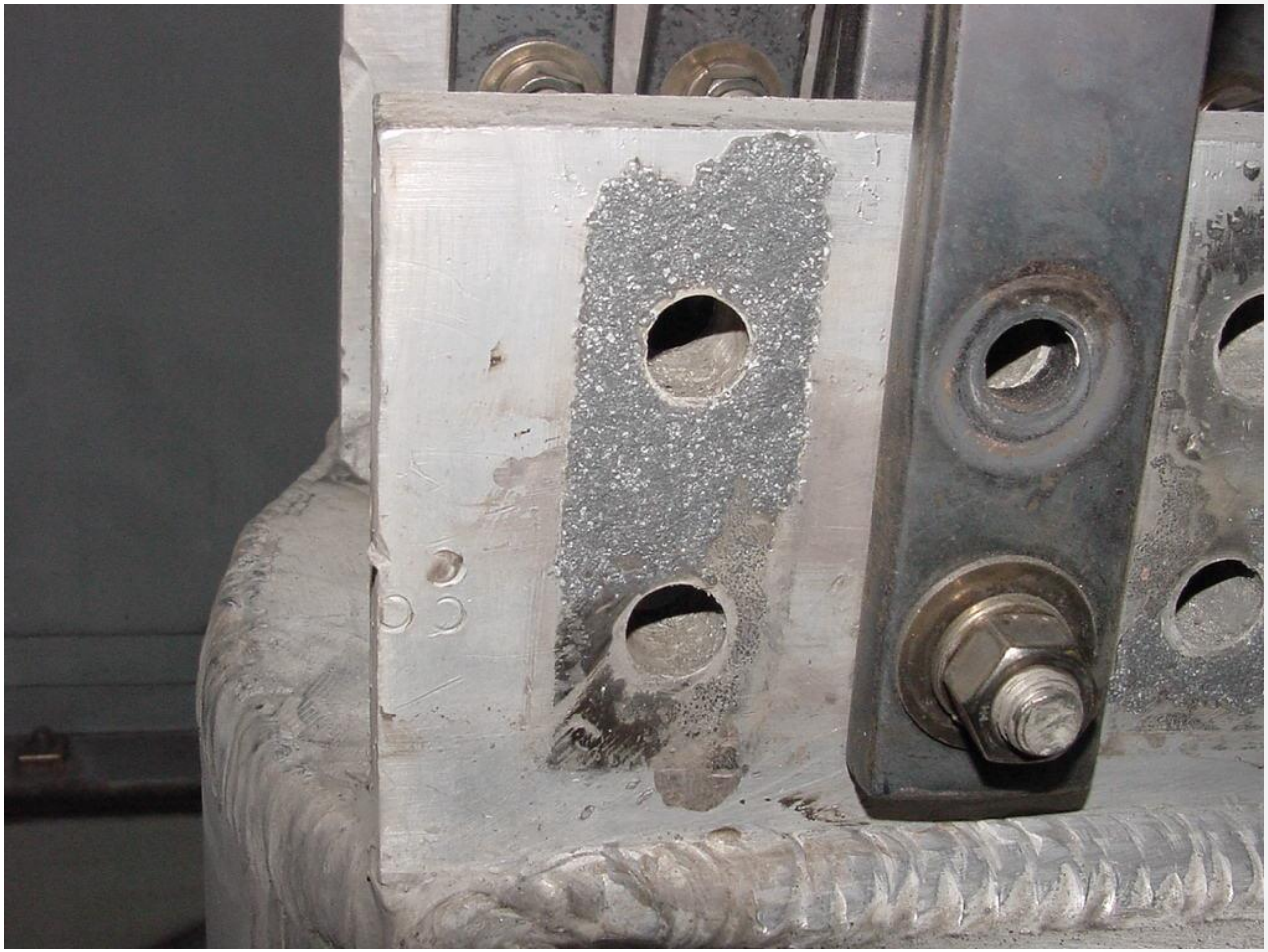
Vibration will loosen insulator caps.



Continuous Bus Enclosure
EMI Diagnostics

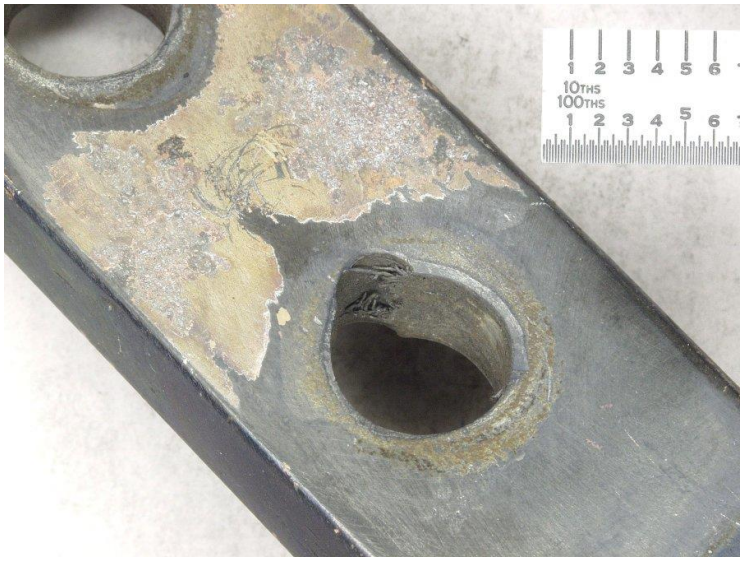
Iron caps pulled free of the porcelain.

Bolted connections can deteriorate.



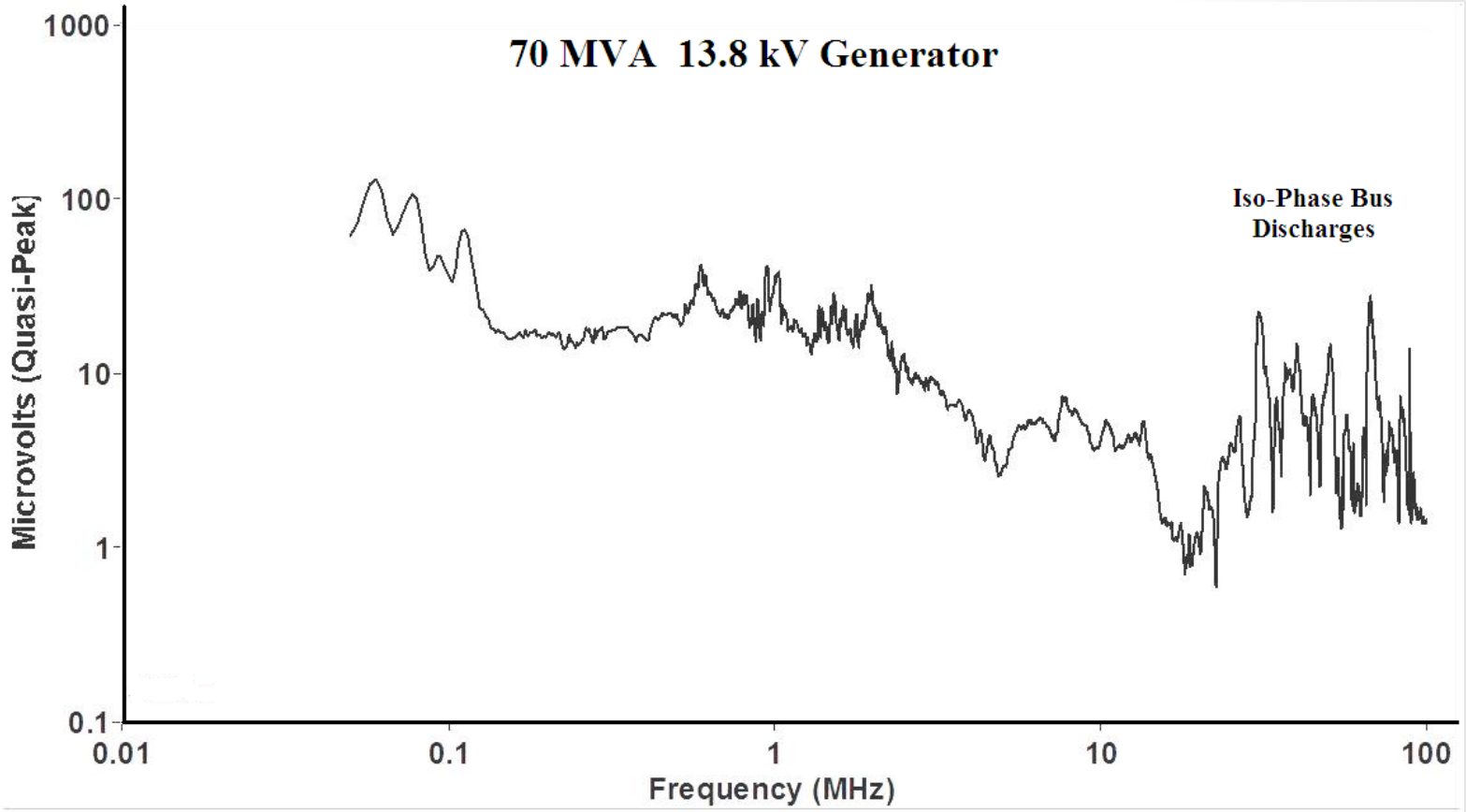
Continuous Bus Enclosure
EMI Diagnostics

Loss of silver will result in sparking and overheated connections.



Continuous Bus Enclosure
EMI Diagnostics

IPB problems were indicated.



Continuous Bus Enclosure
EMI Diagnostics

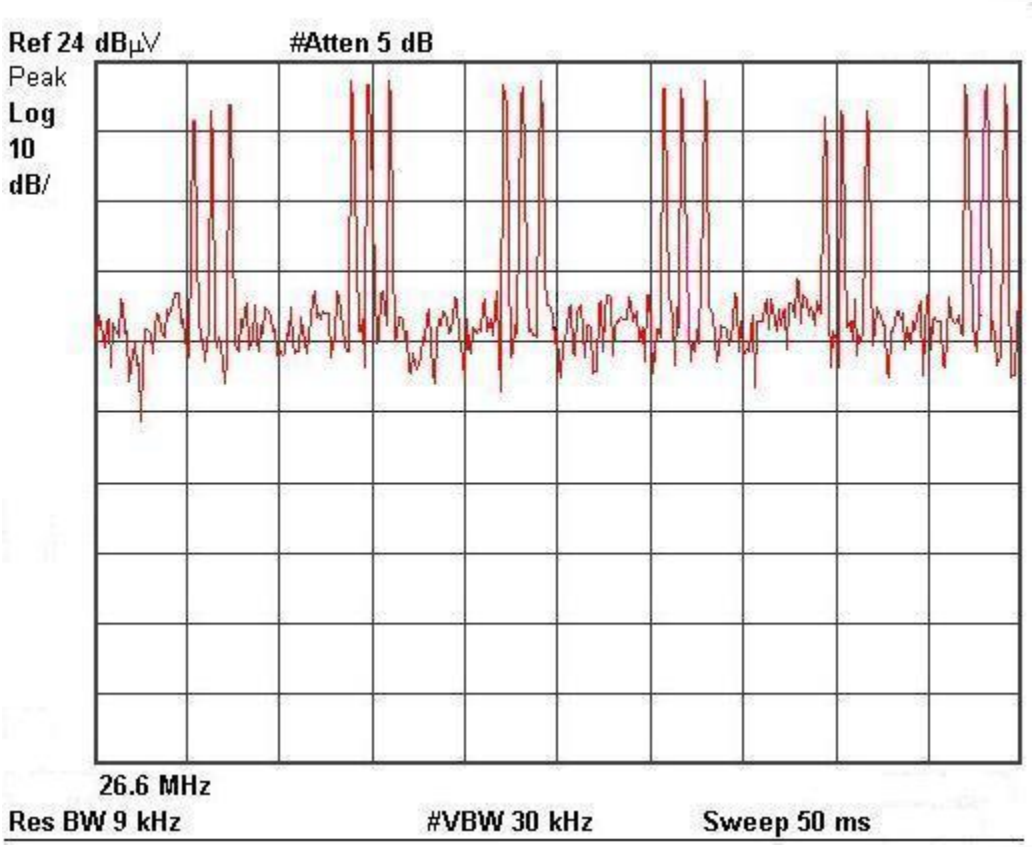
These connections were arcing for years.

Continuous Bus Enclosure
EMI Diagnostics

Loose connections are easy to detect.

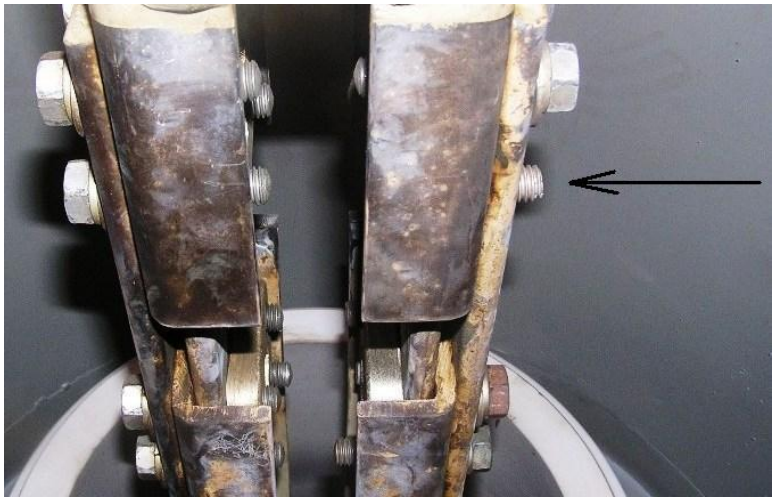
Continuous Bus Enclosure
EMI Diagnostics

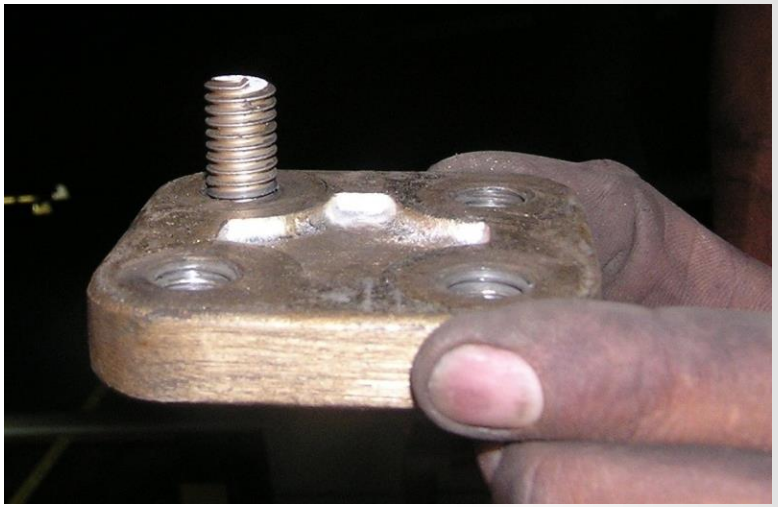
This is the **EMI** pattern noted.



Continuous Bus Enclosure
EMI Diagnostics

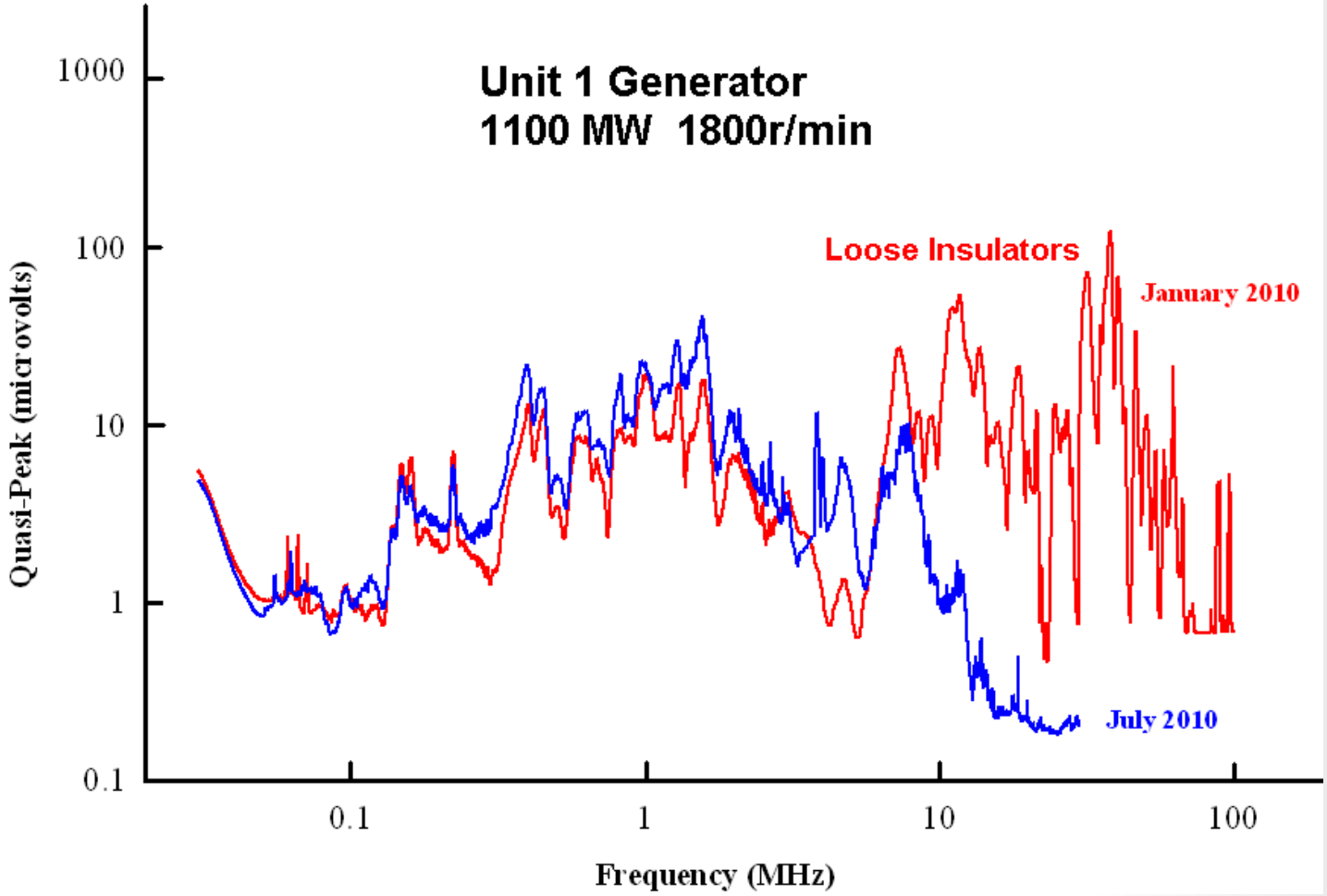
One bolt was broken and another bolt was missing.





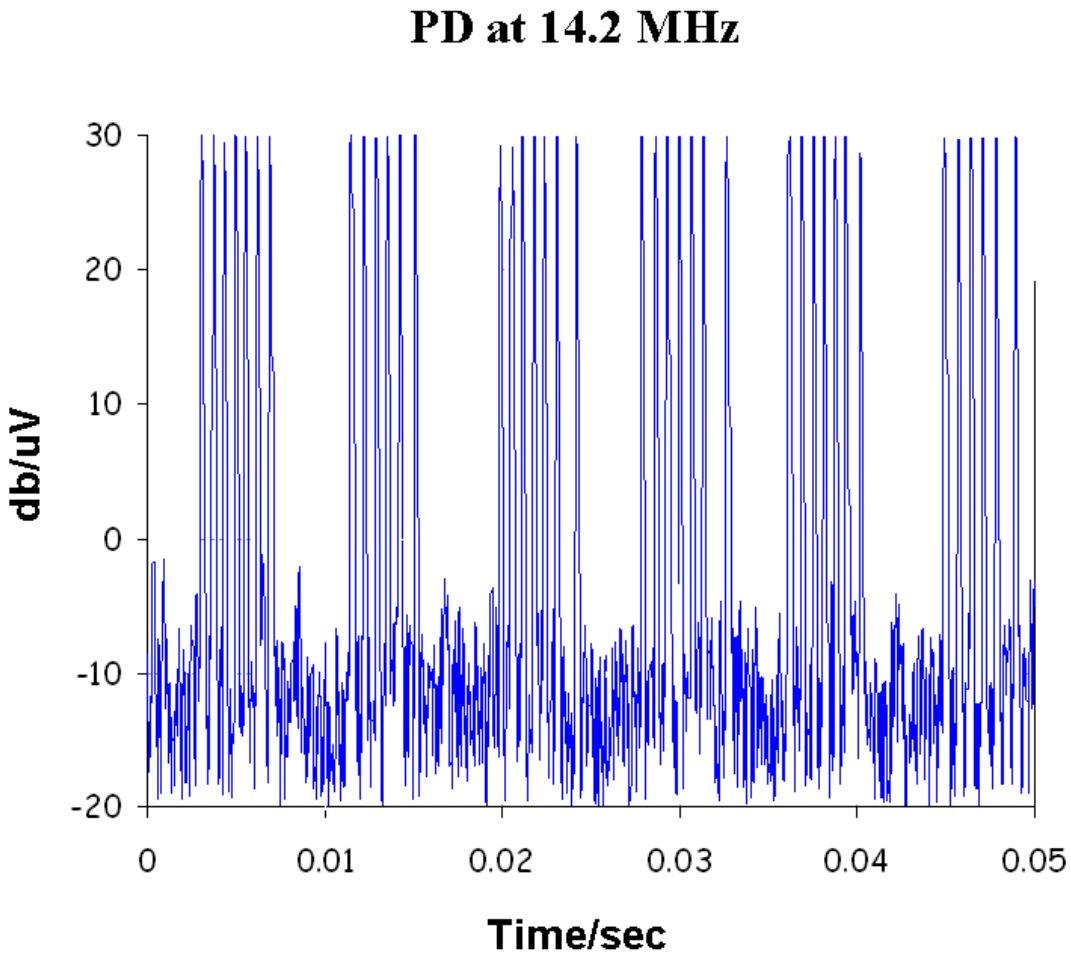
Continuous Bus Enclosure
EMI Diagnostics

An IPB problem was indicated, then corrected.



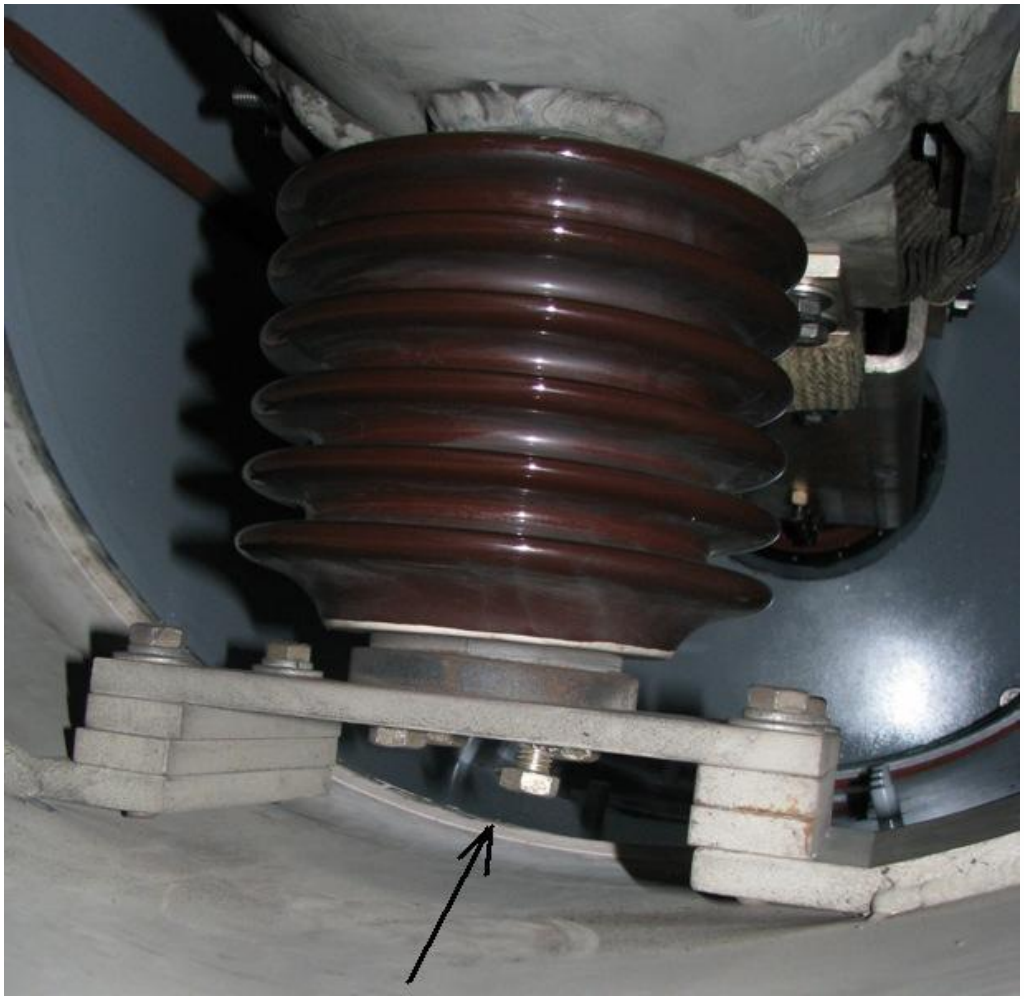
Continuous Bus Enclosure
EMI Diagnostics

A PD pattern of high-voltage over a gap.



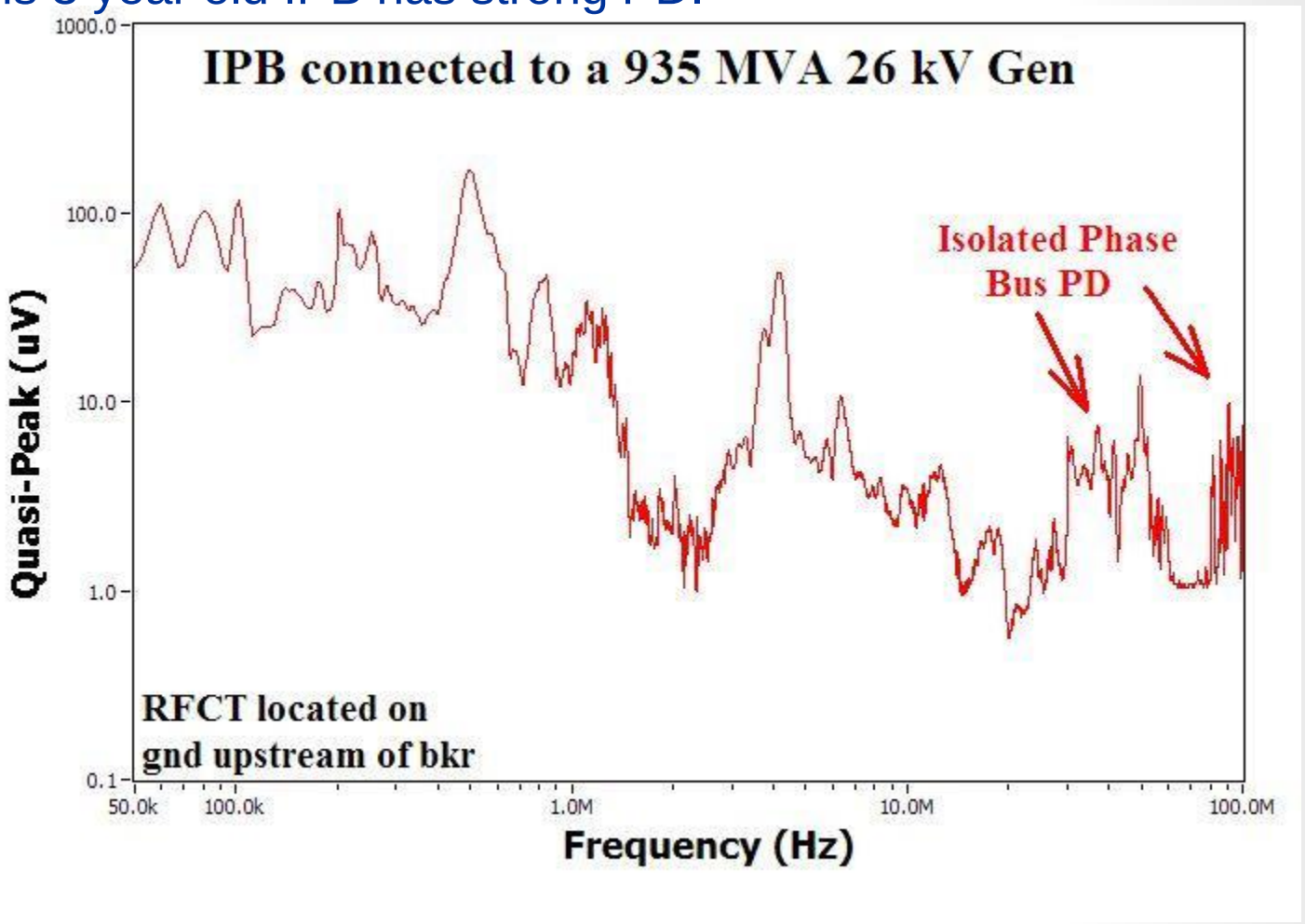
Continuous Bus Enclosure
EMI Diagnostics

Two insulators were loose in a vertical run.



Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

This 3 year old IPB has strong PD.

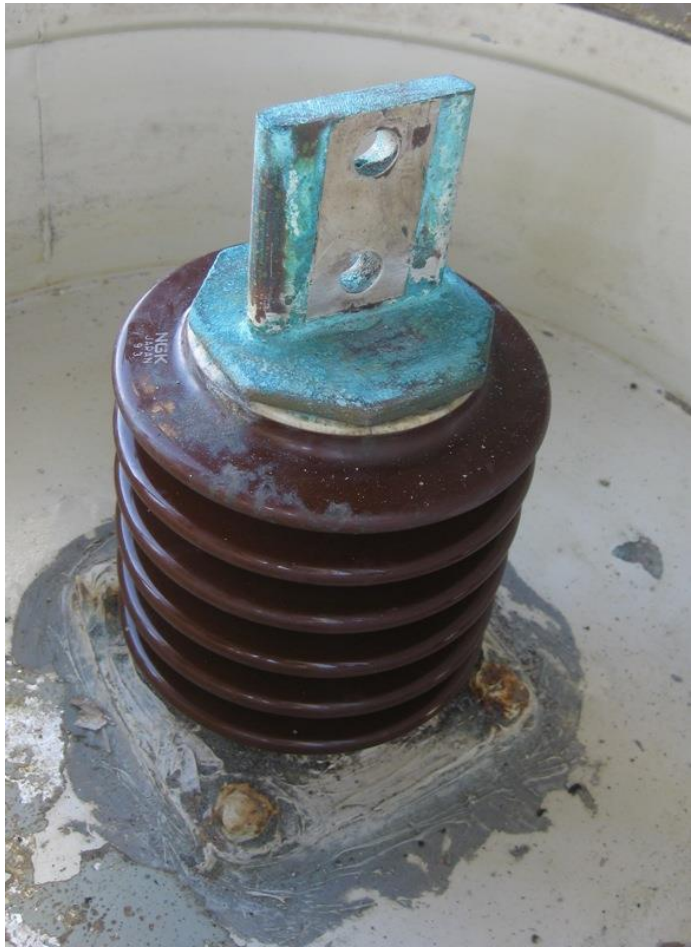


Bus must remain dry.
Moisture and ozone combine to form nitric acid that will corrode metal surfaces.

This contamination results in a corona EMI pattern.

Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

Transformer connection.



Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

Center conductor.

Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

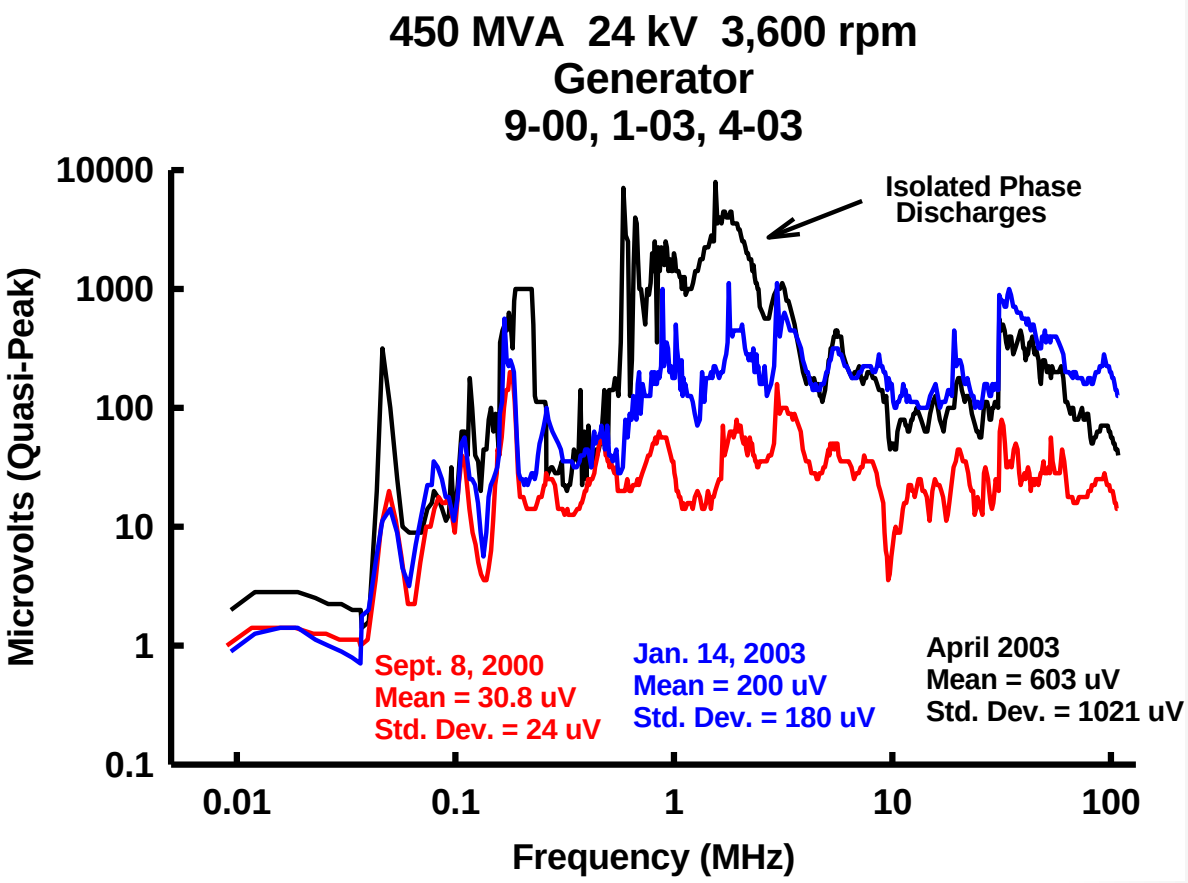
Insulator mounting deterioration.

Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

A hand-held **EMI "sniffer"** can be used to identify an internal defect location.

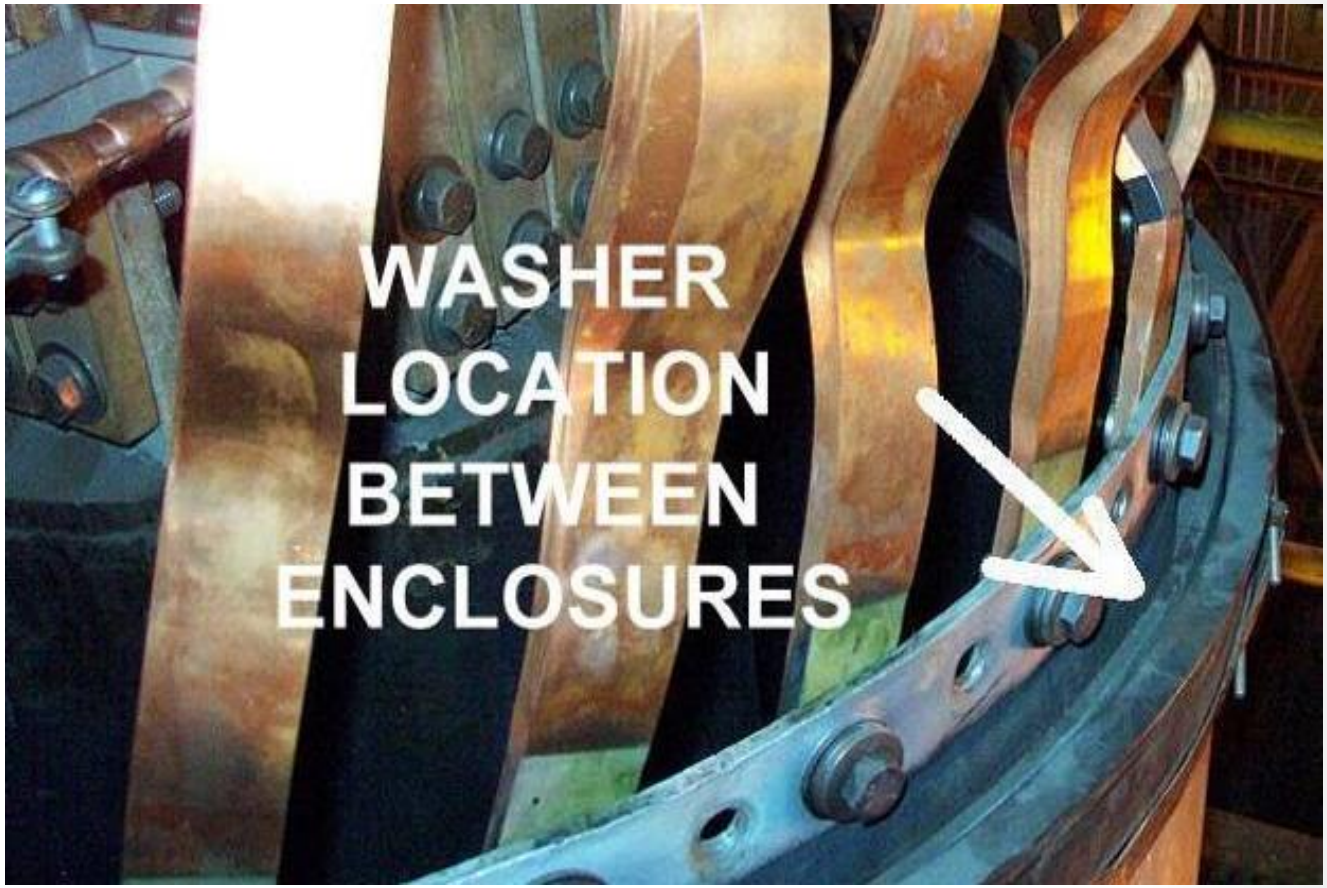
Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

The “sniffer” located the EMI source as in the isolated phase bus under the generator.



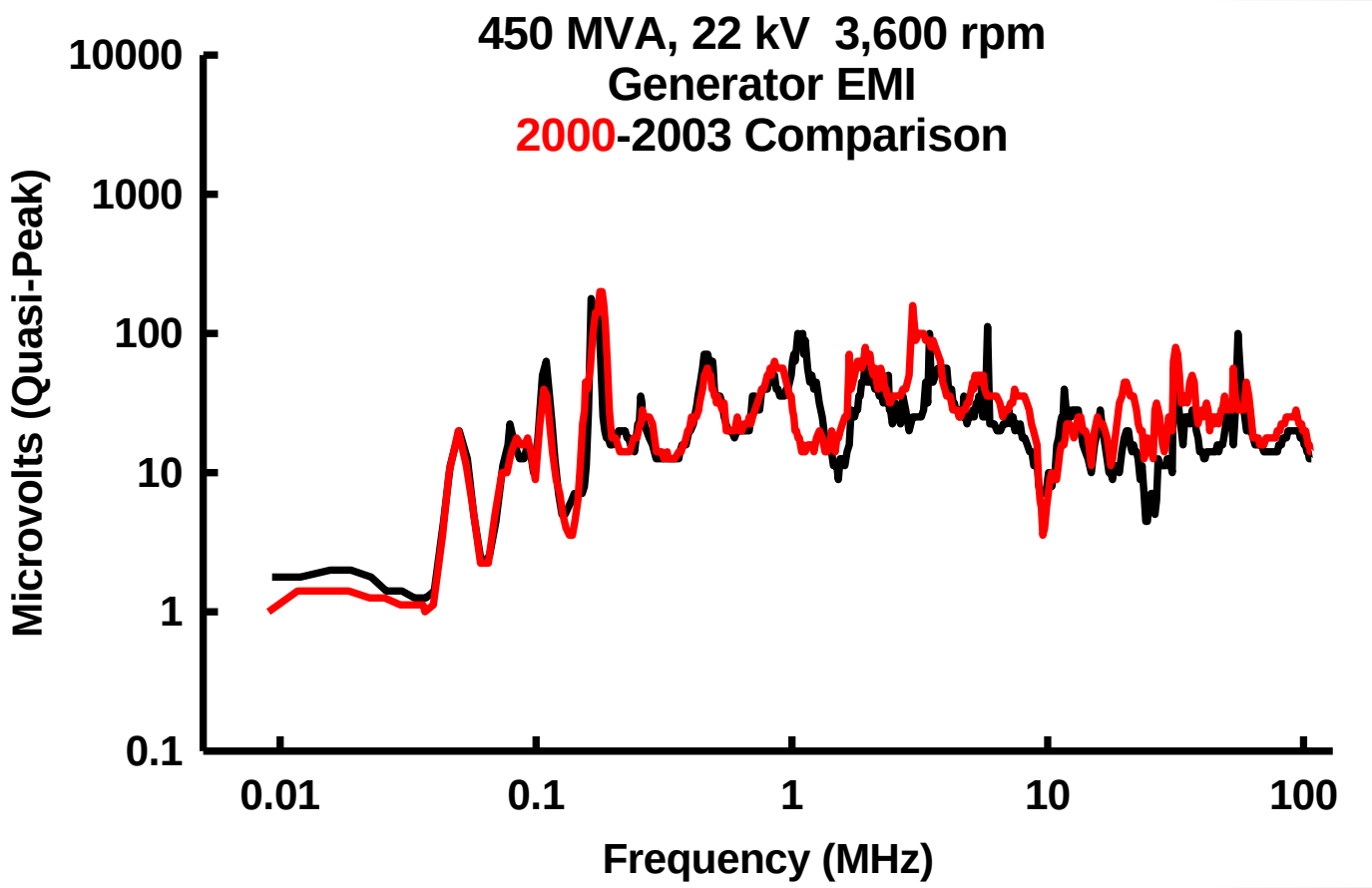
Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

A loose washer was found between the removable cover and the enclosure. This was removed.



Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

With these IPB defects corrected, the generator signature was the same as in 2000. No deterioration and no maintenance needed.



Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

A common problem today is loose PT hardware.

Isolated Phase Bus Condition Assessment with **EMI Diagnostics**

Summary:

– **EMI Diagnostics** has the ability to detect and classify a variety of patterns generated by electrical and mechanical IPB system defects.

– On-line technique is of benefit in the identification of contamination and deterioration of IPB and associated electrical equipment.

– Scheduled condition based maintenance can then be focused on only the system components where deterioration is indicated.

– Number of in-service failures can be greatly reduced.

– Success of repairs can be determined as soon as equipment is returned to service.

Isolated Phase Bus & AUX Bus Conditions Detected with **EMI Diagnostics**

1. Loose & broken support insulators
2. Contaminated insulators (dirt, cement dust, water)
3. Loose and corroded bus hardware
4. Stray circulating currents outside bus enclosures
5. Defective isolated phase bus enclosure insulation
6. Foreign metal objects inside bus enclosure
7. Defective bus potential transformer connections
8. Open PT high voltage fuses
9. Loose AUX transformer connections
10. Loose GSU transformer connections
11. Defective surge capacitor connections
12. Loose disconnect switch components
13. Loose breaker connections
14. Verify correct maintenance was / was not performed
15. Verify no bus maintenance was necessary.

Isolated Phase Bus Condition Assessment with EMI Diagnostics

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