



# Integrated Maintenance Approach

“Assessment, Optimization, and Reliability Improvement”

# PROVIDING SOLUTIONS FOR THE COMPLETE ASSET LIFE CYCLE

## LARGEST RE-ENGINEERING SERVICES FACILITY



Transformers  
200 MVA

Motors  
27000 HP

Generators  
1200 MW

## IN-HOUSE MANUFACTURING



Preformed  
Coils

Magnet  
Wires

## FACILITY HAVING REGION'S BIGGEST



VPD  
Oven

Impulse  
Generator

VPI  
Oven

## TESTING & COMMISSIONING SERVICES



300+  
Projects

700+  
Strong Team

\$30 mn  
Equipment  
Investment

## O&M AND CALIBRATION SERVICES

- 24/7 Operation & Maintenance for all voltage levels
- Preventive, Corrective, Predictive Maintenance
- Specialised Calibration Labs & Repair Workshop

## ADVANCED TECHNICAL TRAINING

- 124392 Training Hours
- 848 Trainees
- Simulation & Onsite



## WHO WE ARE?

Managed by a team of professional training experts, **alfanar training institute (ATI)** provides several technical training programs with **Basic, Intermediate & Expert levels** as well as customized training.

ATI is a specialized Institute under alfanar Engineering Services which is part of the alfanar group of companies.

### Empowering the Next Generation:

Located in Riyadh, ATI intends to technically train and qualify young Saudis/expatriates in order to meet the market & industry needs, contribute to community growth

### Teaching Process:

Quality standards of teaching process starting with Analyzing, Preparing, Teaching and Qualifying a trainee

### Industry Certified:

Trainers are certified from international companies:



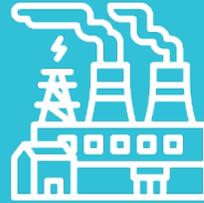
# TRAINING



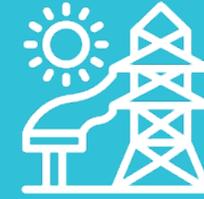
**Technical Training**

**Engineering Back Office**

# TRAINING PORTFOLIO



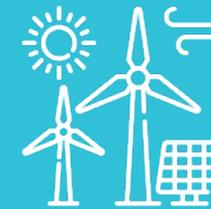
GENERATION



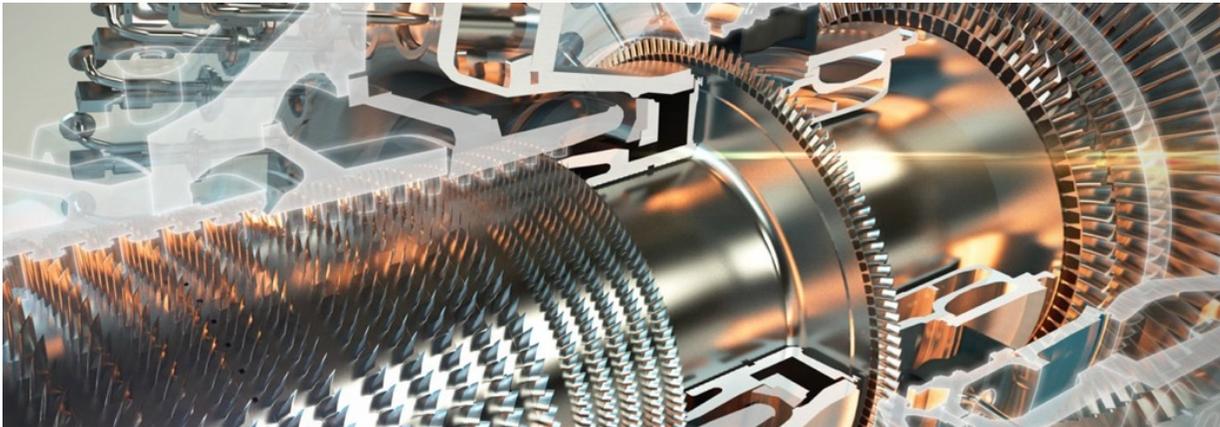
TRANSMISSION



DISTRIBUTION



RENEWABLE



## TRAINING COURSES

- Low, Medium, High and Extra High Voltage Switchgear (380V, 13.8kV up to 380kV)
- Protection and Control Relays for all Power System Equipment
- Power & Auxiliary Transformer.
- Distribution Equipment as Smart Ring Main Unit "RMU" and Smart Auto Recloser
- AC and DC Auxiliary Systems
- Renewable Energy (KACARE Accredited - Solar PV System Design)



# **Integrated Asset Maintenance Approach**

**“Assessment, Optimization, and Reliability Improvement”**

# Assets

- ❑ is an item, thing or entity that has potential or actual value to an organization.
- ❑ In business terms, an asset is a resource of value that you own or lease that helps you run your business.



**Assets are crucial in helping you generate revenue, increase your business' value and facilitate the running of your business.**



# Sustainable Asset Management

# Sustainable Asset Management

- Sustainable asset management is crucial for mitigating risks associated with changes, ensuring long-term profitability, and meeting regulatory and stakeholder expectations.



maximizing resources



enhancing  
operational efficiency



ensuring sustainable  
growth.

# Challenges in Asset Management

- ✓ Many organizations struggle with data silos and lack real-time visibility into asset performance.
- ✓ Outdated systems and infrastructure can hinder effective asset management.
- ✓ Limited budgets and personnel can impede the implementation of advanced asset management practices



**Data  
Management**



**Aging  
Infrastructure**



**Resource  
Constraints**



# Asset Lifecycle Management

# Stages of Asset Lifecycle Management



**Planning:** Strategic identification of asset needs based on business goals and operational requirements.



**Acquisition:** Procurement or development of assets through purchasing, leasing, or construction.



**Operation:** Utilization of assets in daily business activities to generate value and achieve objectives.

# Strategies for Maintaining Asset Lifespan and Performance

- ✓ **Routine Maintenance:** Regular inspections and preventive maintenance to detect issues early and prevent breakdowns.
- ✓ **Predictive Maintenance:** Using data and analytics to predict potential failures and schedule maintenance proactively.
- ✓ **Asset Optimization:** Adjusting asset operations to maximize efficiency and productivity while minimizing costs.



**Routine  
Maintenance**



**Predictive  
Maintenance**



**Asset  
Optimization**



# Sustainable Asset Management Strategies

# Strategies for Enhancing Asset Management

## A. Technology Integration

- 1. Asset Management Software:** Adopting advanced asset management software allows for real-time tracking, predictive maintenance, and better decision-making.
- 2. Internet of Things (IoT):** IoT sensors provide real-time data on asset conditions, enabling more accurate forecasting and maintenance planning.

## B. Data Analytics

Leveraging data analytics helps organizations make decisions by analyzing asset performance, predicting failures, and optimizing maintenance schedules. Predictive analytics can significantly reduce unplanned downtime and extend asset lifecycles.

# Strategies for Enhancing Asset Management

## C. Best Practices

- 1. ISO 55000 Framework:** Adopting standards such as ISO 55000 can provide a structured approach to asset management, ensuring consistency and continuous improvement.
- 2. Regular Audits:** Conducting regular audits of asset management practices helps in identifying gaps and implementing necessary improvements.
- 3. Training and Development** Investing in training programs for staff ensures that they are equipped with the skills needed to manage assets effectively. Continuous professional development helps in keeping pace with evolving technologies and practices.



# Equipment Management

Critical Equipment Calibration and Monitoring

# Process Overview

## 2. Equipment Receiving

Upon arrival, the lab verifies and inspects the equipment against the job sheet, then logs it into PQMiS with status updates.

## 1. Job Creation

Initiate a job request by adding new equipment or choosing from the existing list. An email notification is automatically sent to the lab. Print the job sheet to accompany the equipment.

## 3. Equipment Calibration

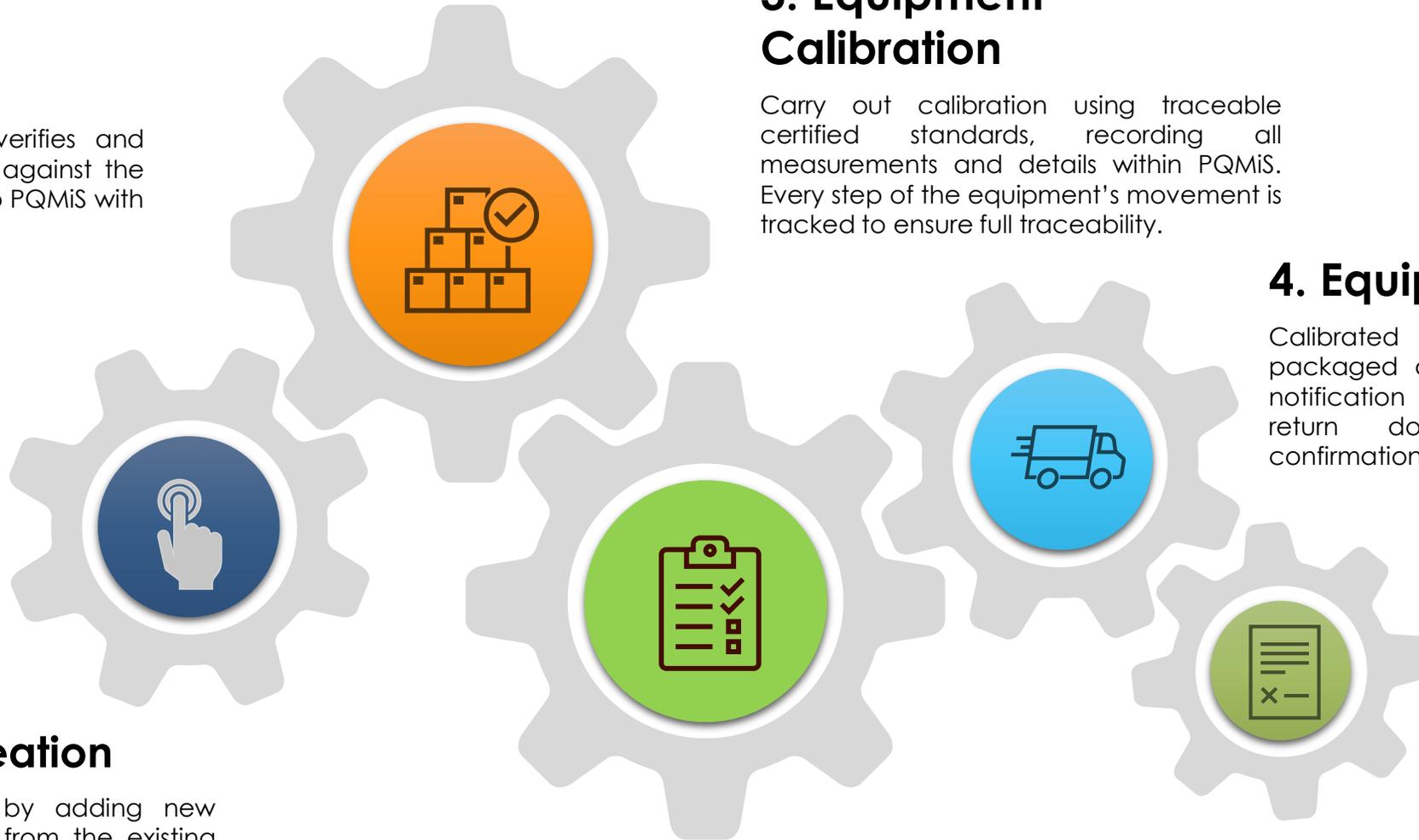
Carry out calibration using traceable certified standards, recording all measurements and details within PQMiS. Every step of the equipment's movement is tracked to ensure full traceability.

## 4. Equipment Return

Calibrated equipment is carefully packaged and returned, with an email notification sent to the requester and a return document issued. Delivery confirmation is recorded in the system.

## 5. Online Archiving

Calibration certificates are uploaded to PQMiS and associated with equipment records, available anytime through the mobile app or by scanning the QR code.



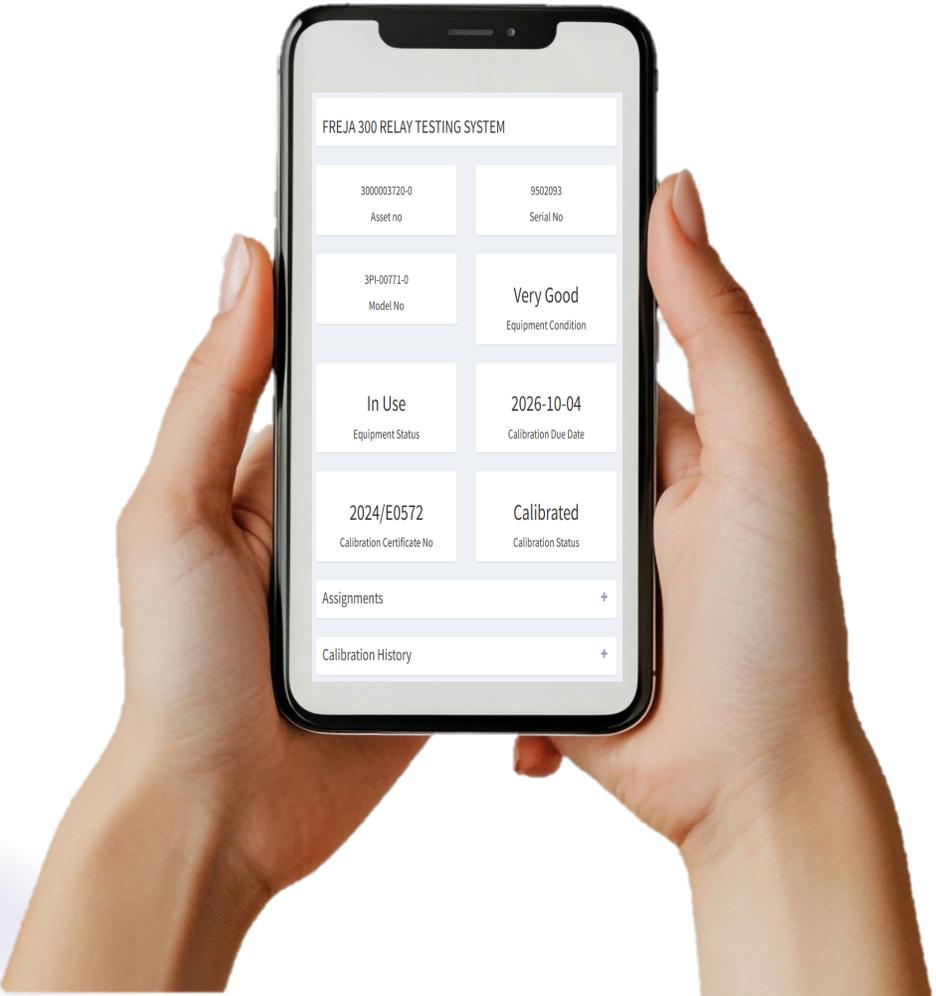
Jobs Management

Copy CSV Excel PDF Show 10 rows Hide Columns Search: calibration

Reference No	Title	Status	Submission Date	Initiated By	Last Action	Action
CLAB/DIM-LAB/3822	Calibration Services	Completed	2025-07-07	Engr. Waqar Ahmad Malik Manager QA	<b>Job Completed</b> Equipment calibrated, certificate issued.	Details
CLAB/zad/2770	Calibration Services	Completed	2025-06-12	Engr. Waqar Ahmad Malik Manager QA	<b>Job Completed</b> werwer	Details
CLAB/ELE-LAB/591	Electrical Lab - Calibration Services	Initiated	2025-04-21	Engr. Waqar Ahmad Malik Manager QA	<b>In progress</b> We are currently in the process of addressing this matter. Thank you for your patience.	Details
0	Calibration Service - test	In progress	2025-01-16	Engr. Waqar Ahmad Malik Manager QA	<b>In progress</b> please expedie.	Details
CLAB/ELE-LAB/559	Electrical Lab - Calibration Services	In progress	2025-04-15	Engr. Waqar Ahmad Malik Manager QA	<b>In progress</b> only 3 equipment delivered.	Details
CLAB/ACL/583	Electrical Lab - Calibration Services	Completed	2025-04-20	Engr. Waqar Ahmad Malik Manager QA	<b>Reviewed</b> Equipment Dispatched	Details
CLAB/ELE-LAB/557	Electrical Lab - Calibration Services	Completed	2025-04-15	Engr. Waqar Ahmad Malik Manager QA	<b>Reviewed</b> Everything is fine.	Details
0	Calibration Service - test	Initiated	2025-01-16	Engr. Waqar Ahmad Malik Manager QA	<b>Initiated</b> asa	Details
CLAB/DIM-LAB/1025	Electrical Lab - Calibration Services	Initiated	2025-05-07	Engr. Waqar Ahmad Malik Manager QA		Details
Reference No	Title	Status	Submission Date	Initiated By	Last Action	Action

Showing 1 to 10 of 96 entries

# Accessible from all Devices



# Equipment Surveillance

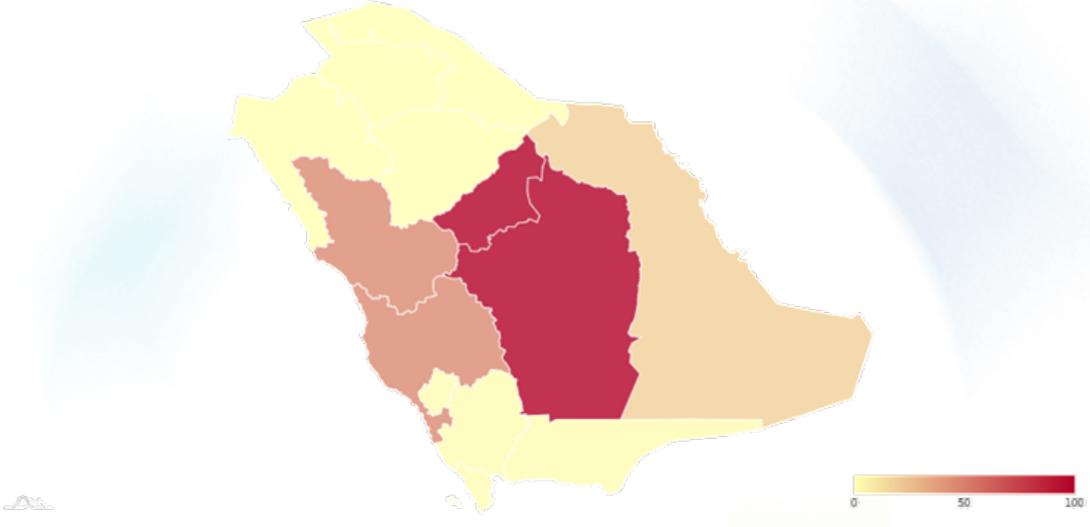
**9,546**  
Total Assets  
135,491,314 SAR

**9,293**  
Accepted  
131,330,873 SAR

**226**  
Pending Acknowledgment  
Daily Transfer  
3,731,303 SAR

**26**  
Last Transfer - Receiver Denied  
429,137 SAR

**531**  
Require Calibration  
13,952,786 SAR



**1,656**  
Chargeable  
223,320 SAR/day

**9,054**  
Moveable  
131,117,929 SAR/day

**2,579**  
Auditable  
117,070,094 SAR/day

**6,662**  
Physically Verified  
89,164,642 SAR

**2,696**  
Calibrated  
87,776,479 SAR

**8,394**  
Good Condition  
124,232,573 SAR

**1,152**  
Needs Attention  
11,258,741 SAR

Region

**4,787**  
Central Region  
62,212,297 SAR

**2,373**  
Western Region  
28,561,941 SAR

**1,114**  
Eastern Region  
21,903,607 SAR

**353**  
Southern Region  
3,398,397 SAR

**291**  
Northern Region  
4,926,221 SAR

**13**  
All Over Kingdom  
137,128 SAR

**1**  
Other  
120,000 SAR

# Reliability Intelligence for Power Networks

From Incident History to Faster Decisions and  
Improved System Efficiency

 Site Incident Report ↑

Employee File Number * <input type="text" value="Select"/>	Employee Name <input type="text"/>	Employee Mobile Number <input type="text"/>	Employee Email <input type="text"/>
Employee Nationality <input type="text" value="Select"/>	Years of Experience * <input type="text"/>		
Process Type * <input type="text" value="Select"/> 	Date * <input type="text" value=""/>		
Case Study <input type="text" value="Incident"/>	Substation * <input type="text"/>	Field * <input type="text" value="Select"/>	

Title \*

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Executive Summary \*

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Solution Provided \*

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Recommendations Type * <input type="text" value="Select"/>	Recommendations Subtype * <input type="text" value="Select"/>
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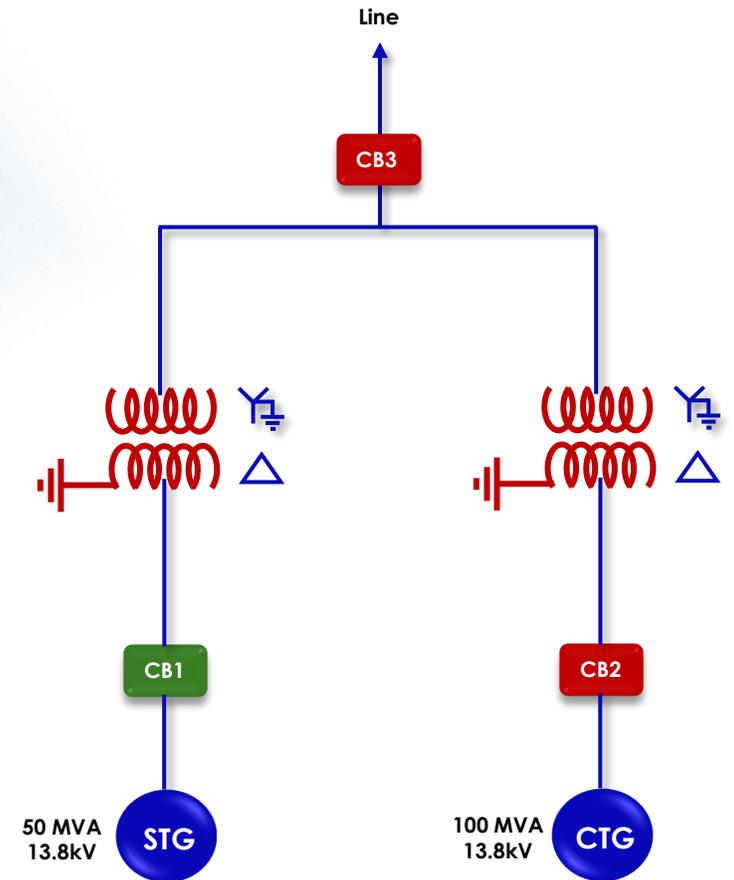
Attachment  
 

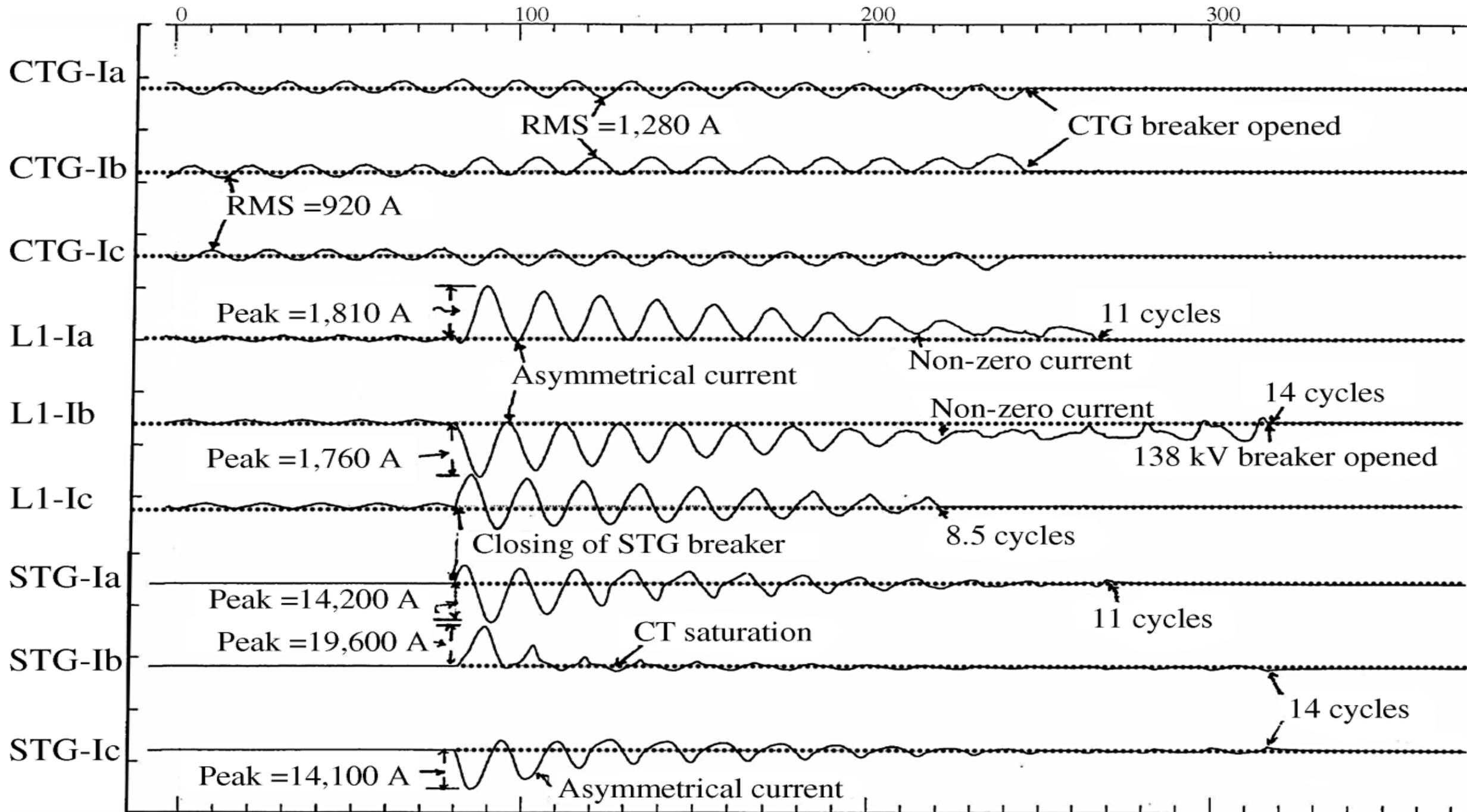
Managerial approver comments

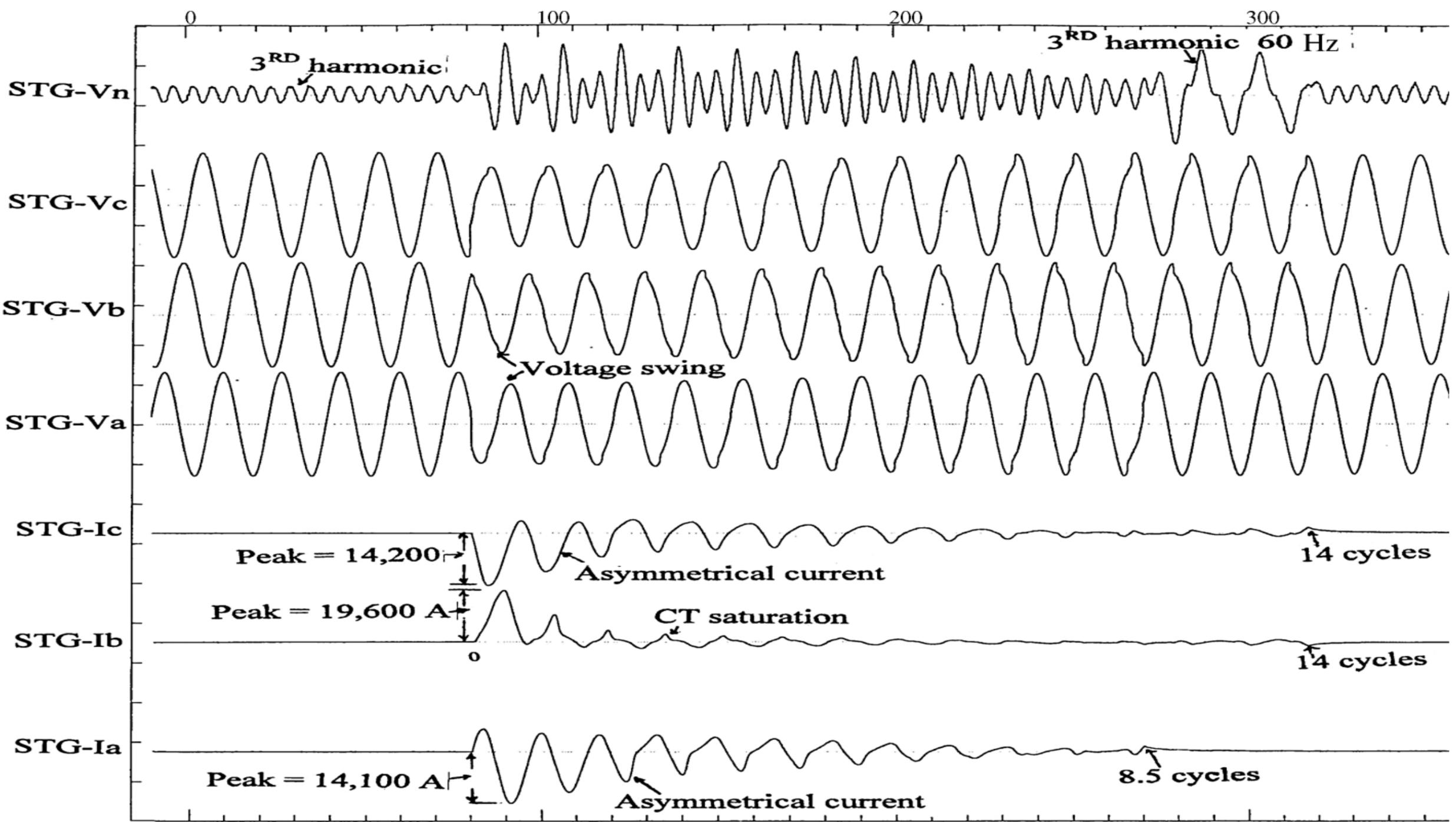
# Generator Fault Case Study\_01

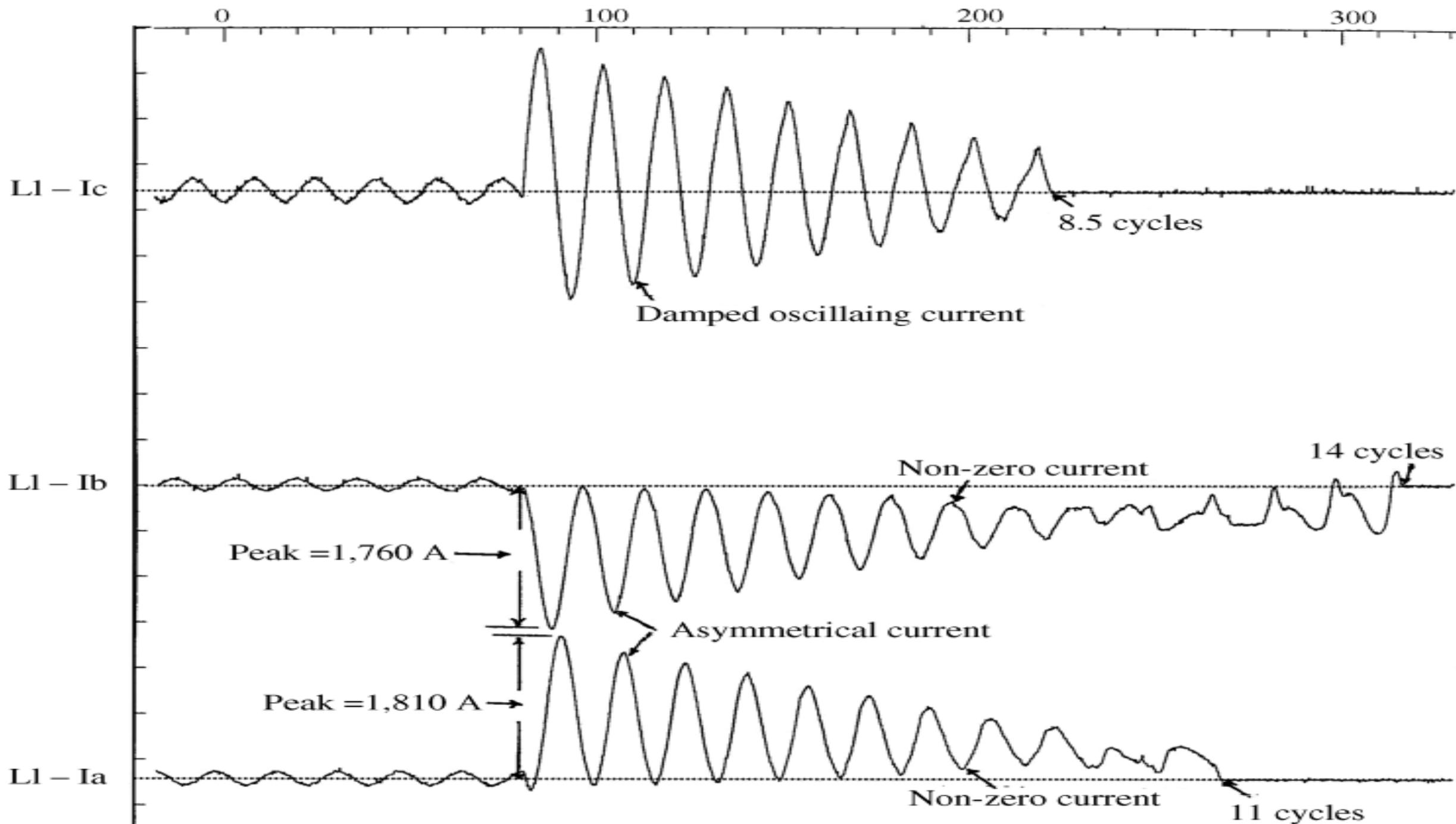
The combined-cycle plant consists of

- 100-MW combustion turbine generator (CTG) and
- 50-MW steam generator (STG).
- ❑ Synchronization of the generators is done using 13.8kV generator breakers.
- ❑ Due to poor governor speed control, the synchronizer could not achieve the proper slip frequency, and hence the STG remained unsynchronized to the system with an idle speed near the synchronous speed of 3600 RPM. The STG oscillated slowly between speeds of **3590 and 3610 RPM**.
- ❑ During the mode change, the automatic synchronizer produced a false output that closed the unit breaker accidentally, thus energizing the generator at a wider angle with the system  $109^\circ$ .









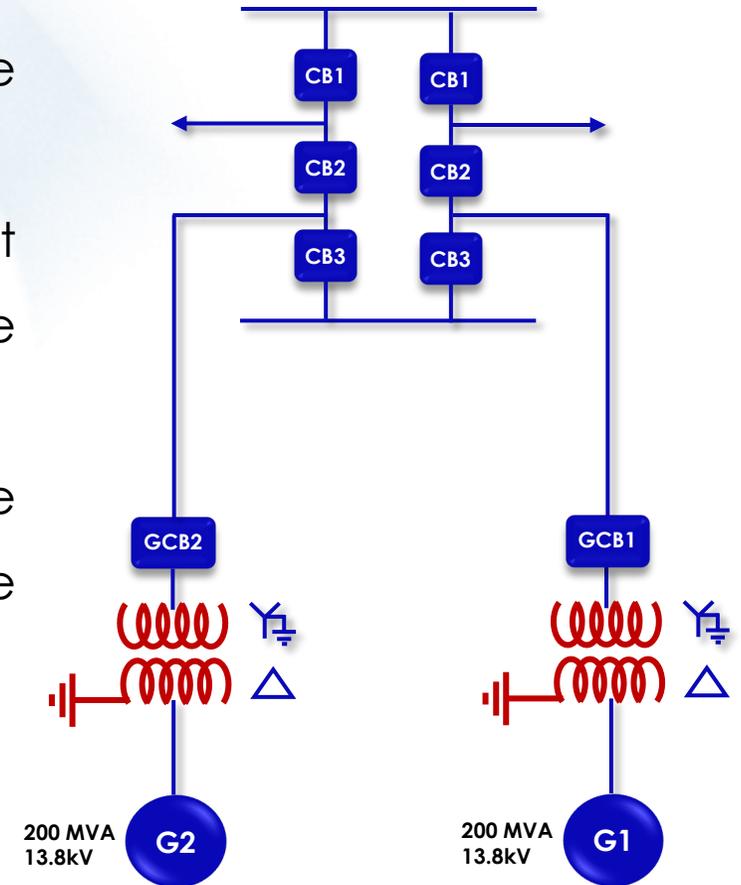
# Generator Fault Case Study\_02

As shown in the Single Line Diagram

**Incident Overview:** A 200 MW generating unit tripped out of service due to operator error.

**Cause of Error:** The operator was shutting down unit G2 but got interrupted by a phone call; upon return, he mistakenly went to the G1 control board.

**Incorrect Action:** The operator unintentionally turned off the excitation system of unit G1, thinking he was completing the shutdown of G2.

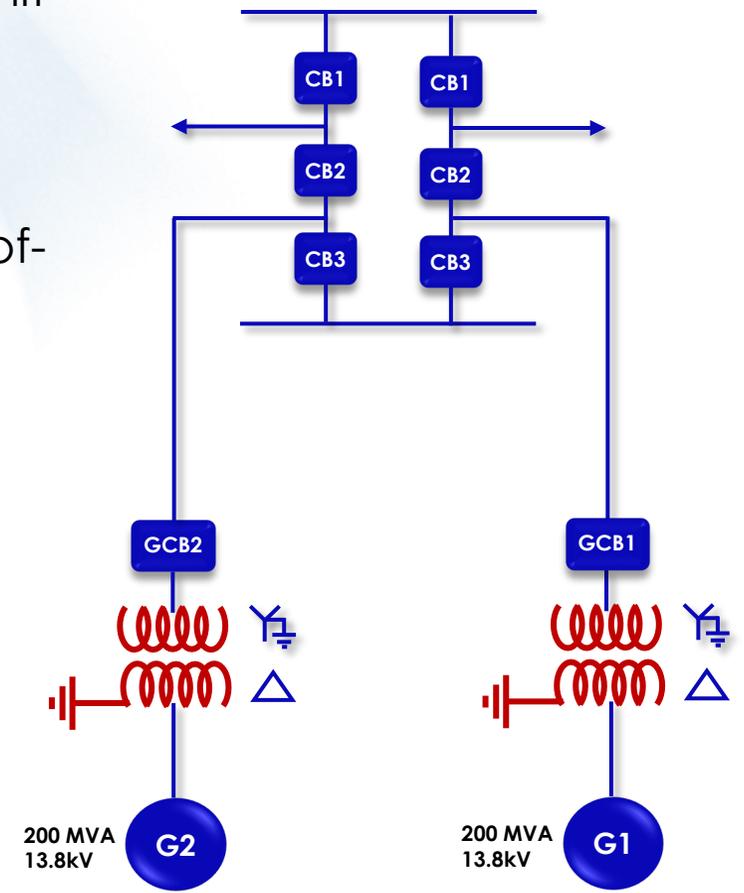


# Generator Fault Case Study

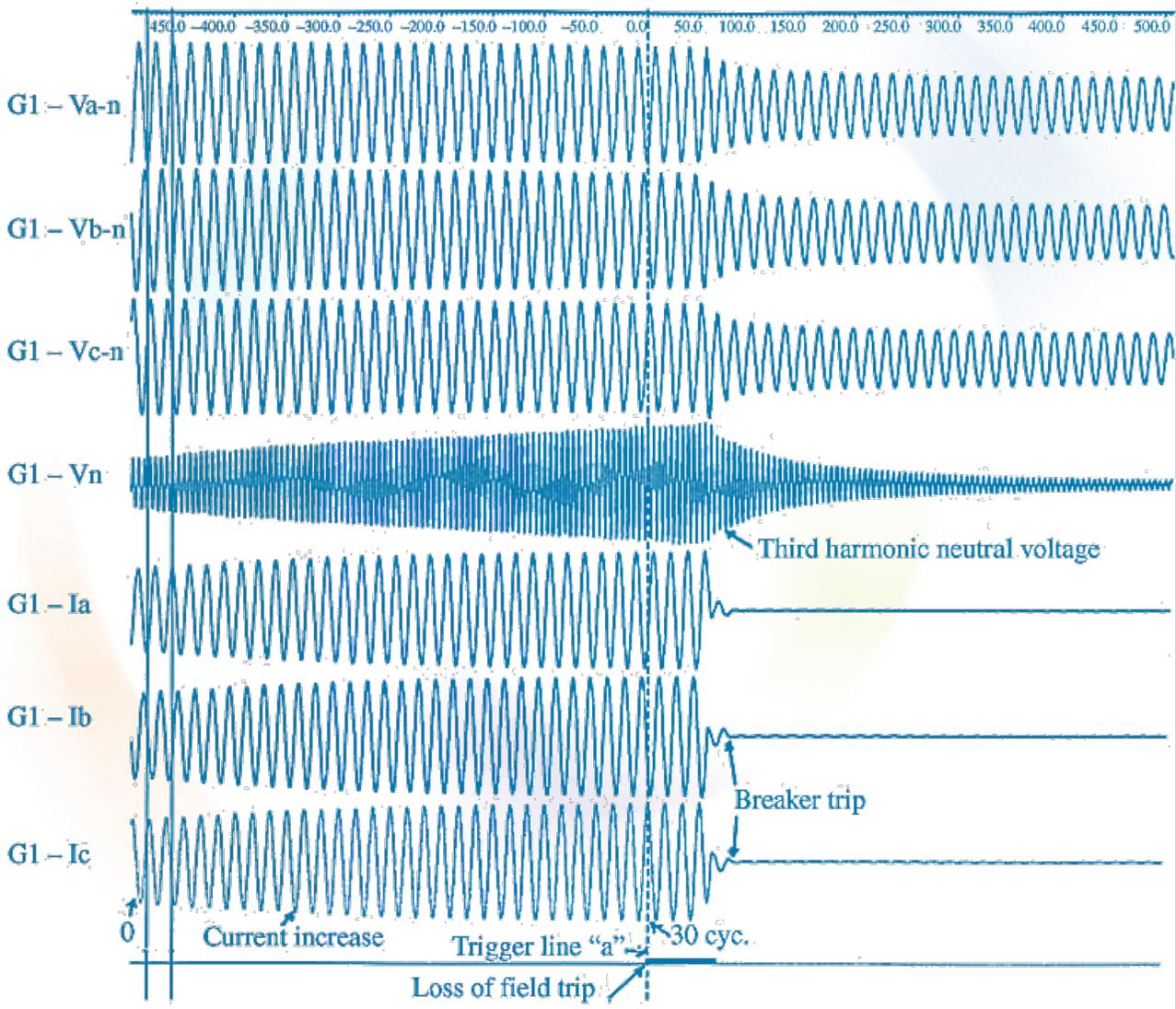
**Resulting Condition:** Loss-of-field occurred on unit G1, causing the unit to trip.

## Relay Performance:

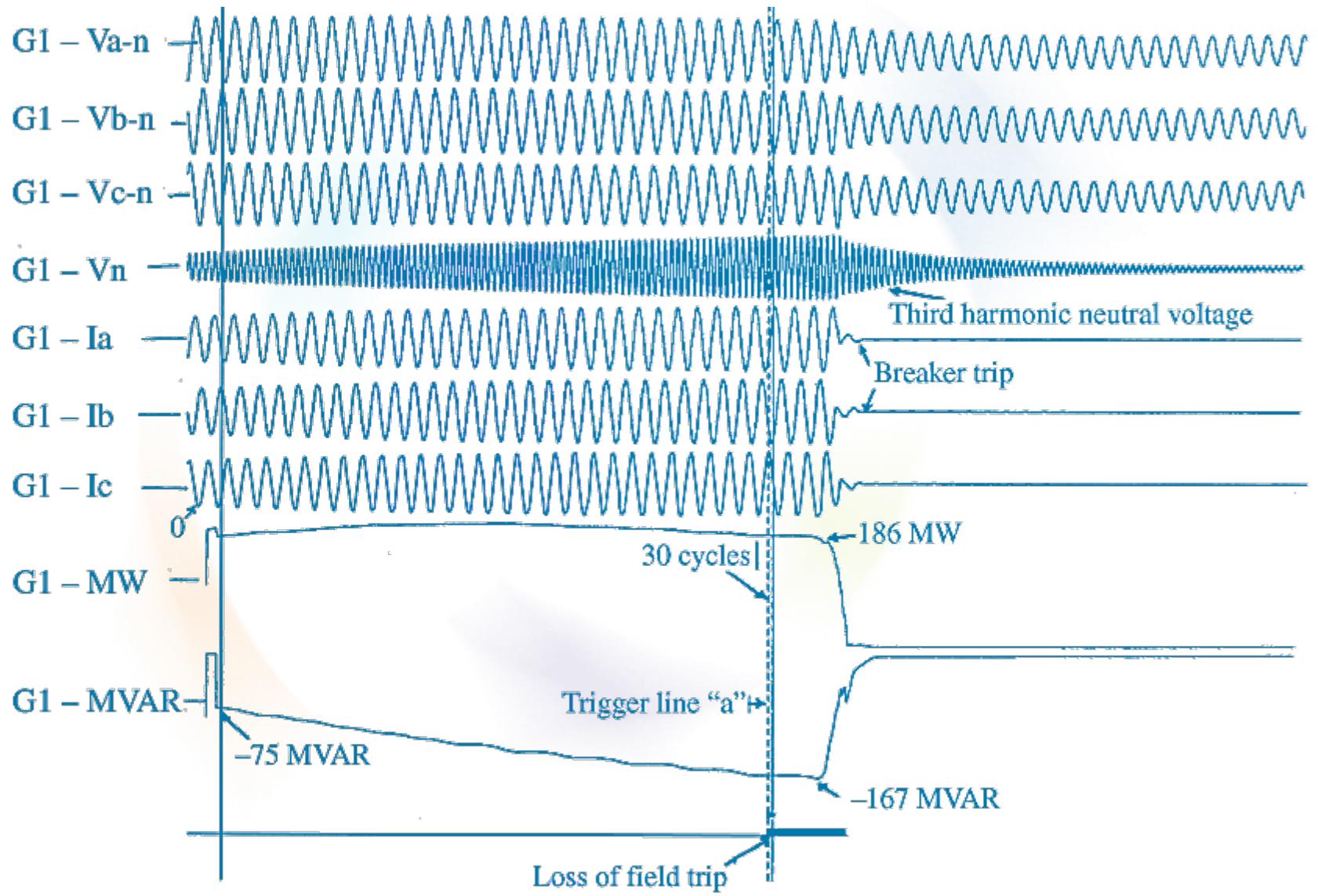
- One numerical multifunction relay successfully detected the loss-of-field condition and tripped the unit.
- *The other relay failed to detect the condition.*



# Generator Fault Case Study



# Generator Fault Case Study





# **Training and Development**

**“Competent People Are the Backbone of Asset Reliability”**

# Learning and Development Matrix

← LDM - Learning and Development Matrix / LDM - Learning and Development ...

Search AI Mohamed Rashad Mohamed

Form Approvals Attachments Comments Clarifications Request Flow

gsama.salema@alfanar.com 23 Dec 2025 02:18PM Pending With Collapse Sections

**Employee Details**

Employee File Number \* 91137 Employee Name \* ABC Area \* Southern-Testing

Email Mobile Number Years of Experience \* 10 Nationality \* Egypt

Last Training Name 13.8 kV Medium Voltage Switchgear Drawing and Control Systems (Testing, Maintenance and Troubleshoot) Date - Last Training 01/01/2026 Position Testing, Engineer

Employee Joining Date 18/12/2025 Class Engineer

Area Manager Email Area Manager Name Project Manager Email Project Manager Name

**Basic Level**

**Basic Level +**

**Intermediate Level**

**Intermediate Level +**

380kV SWGR Scheme	Date - 380kV SWGR Scheme	Attitude Evaluation-IL+380kV SWGR Scheme	Technical Evaluation-IL+380kV SWGR Scheme
<input type="checkbox"/>			
Transformer Stability	Date - Transformer Stability	Attitude Evaluation-IL+Transformer Stability	Technical Evaluation-IL+Transformer Stability
<input type="checkbox"/>			

**Advanced Level**

**Advanced Level +**

**Training Report** Column Search Freeze Column Export Import

**Customized Couses** Column Search Freeze Column Import

# Library for Training Material

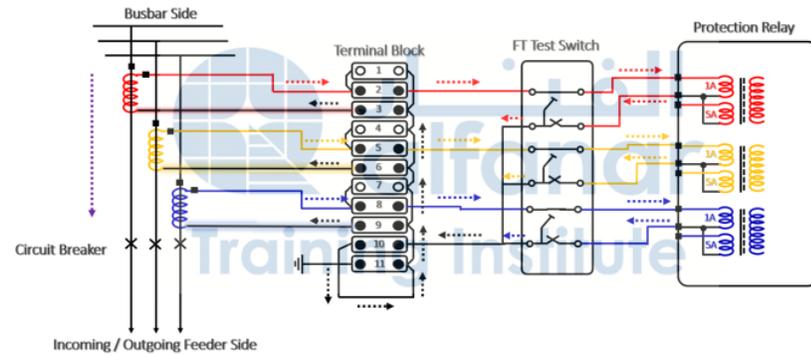
CT shorting and isolating facility is very important to allow maintenance of protection relays even if the feeder is energized. Shorting and isolating shall be executed from the terminal block [Disconnected type TB] or through the test switch [if applicable based on the test switch type].

### CT Circuit Normalization

The 3 phase CT requires 3 terminal blocks for each phase if the CT was a single ratio, but if the CT is a multi-ratio it would require:

$$\text{Terminal blocks number} = \text{number of CT tabs} + 1$$

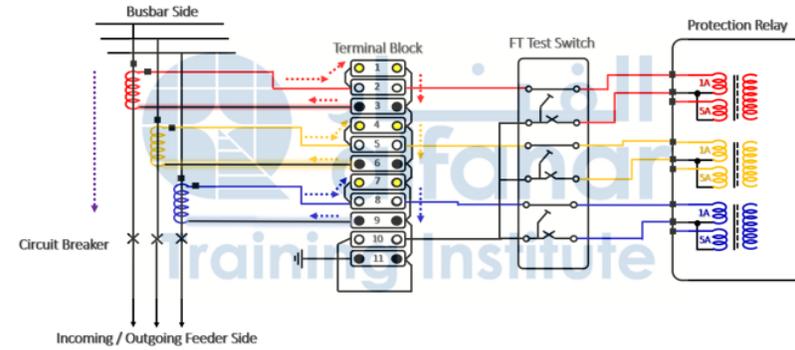
To normalize that CT circuit, close terminal blocks number 2,3,5,6,8,9,10 and 11



### CT Shorting and Isolating through Terminal Block

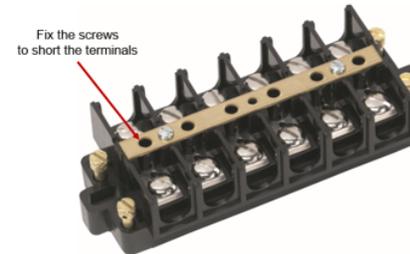
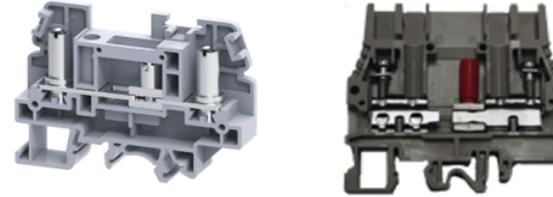
Shorting is for the CT secondary winding and Isolating is for the protection relay under maintenance. To make shorting and isolating,

1<sup>st</sup> close terminal blocks number 1,4 and 7 then open 2,5,8 and 10



### Shorting Through Terminal Block

The below Terminal Blocks are used in the CT circuit. The disconnected type is used for shoring and isolating as illustrated is the previous point but the other fixed type terminal block is providing the shorting facility by fixing a metal bar as shown below and fix screws that will contact the terminals together through the metal bar.



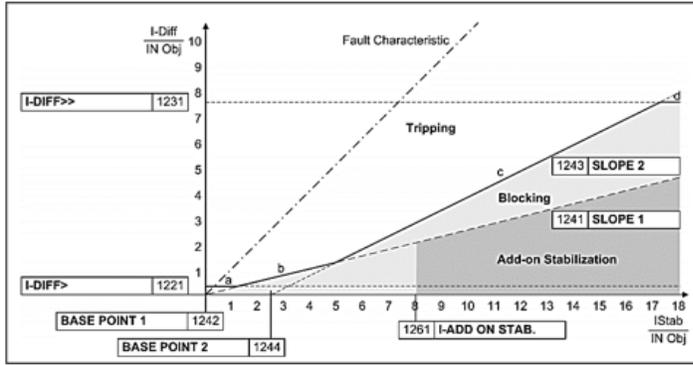
### 3.5.5 Transformer Differential Protection Test

#### The tripping Characteristics of Differential protection

It is relation between (Idiff & Istab) where:

Idiff =  $|I_1 + I_2|$  (as Vector Summation)

Istab =  $|I_1| + |I_2|$  and this relation represented by Idiff>, Slope1, Slope2 and Idiff>>



#### Assume the following settings:

Transformer Voltage	: 13.8/132KV
Transformer Capacity	: 60MVA
Side_01 CT Ratio	: 3000/1A
Side_02 CT Ratio	: 300/1A
Star Point for Side 1 is	: Isolated
Star Point for Side 2 is	: Earthed
Transformer Side 1 Connection	: (D) Delta
Transformer Side 2 Connection	: (Y) WYE
Vector Group For Side -2	: 11
Idiff>	: 0.4 I/In
Idiff> Time Delay	: 0.00 sec
Idiff>>	: 7.5 I/In
Idiff>> Time Delay	: 0.00 sec
Slope1 of Tripping Characteristics	: 0.25
Base Point for Slope 1 of Characteristics	: 0
Slope2 of Tripping Characteristics	: 0.5
Base Point for Slope 2 of Characteristics	: 2.5

### 3.5.5.1 Min Differential Current Test Idiff>

#### Min Differential current test Idiff>

$$P/U \text{ Value} = (I_{NTR} / I_{CT Primary}) * I_{Set Diff} > * KVG * 0.85$$

$$\text{Trip Value} = (I_{NTR} / I_{CT Primary}) * I_{Set Diff} > * KVG$$

Drop off Values = 70 % Trip Value

#### Calculations for Side\_1 (Delta Side)

$$\text{Transformer nominal sec. current (In)} = \frac{\text{Tran. MVA}}{\sqrt{3} \times V_{\text{side 1}} \times CTR_{\text{side 1}}} = \frac{60000}{\sqrt{3} \times 13.8 \times 3000} = 0.83674$$

$$\text{For Phase-Phase } I_1 = \frac{I_{inj}}{I_n \times KVG} = 1.195 I_{inj}$$

$$\text{For 3 Phase Fault } I_1 = \frac{I_{inj}}{I_n \times KVG} = 1.195 I_{inj}$$

$$I_{\text{differential}} = |I_1 - I_2| = I_1 \quad \text{in case of } I_2 = 0$$

$$I_{\text{bias}} = |I_1 + I_2| = I_1 \quad \text{in case of } I_2 = 0$$

Hence:

- For Phase-Phase or 3 Phase Fault  $I_{inj} = 0.335$  Amp to issue differential trip signal

Where: KVG (FACTOR) is according to transformer vector group as per following table

Type of fault	Reference Winding (Upper Voltage)	Even VG-numeral 0,2,4,6,8,10	Odd VG-numeral 1,3,5,7,9,11
Three-phase	1	1	1
Two-phase	1	1	0.866
Single-phase with $I_0$ elimination	1.5	1.5	1.73
Single-phase without $I_0$ elimination	1	1	1.73

- Inject 2 Phases (AB, BC, CA) to simulate Phase to Phase Faults

$I_A$	$I_B$	$I_C$
.....	.....	0
$\Phi_A$	$\Phi_B$	$\Phi_C$
$0^\circ$	$180^\circ$	$120^\circ$

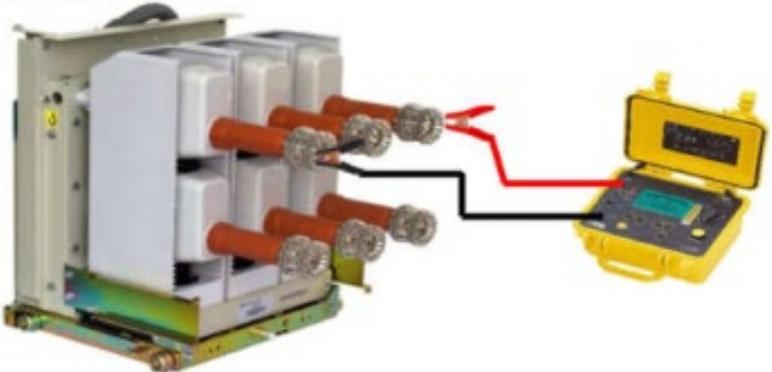
- Repeat the test again while injecting the 3 Phases ABC for simulating the 3 Phases Fault.

$I_A$	$I_B$	$I_C$
.....	.....	.....
$\Phi_A$	$\Phi_B$	$\Phi_C$
$0^\circ$	$240^\circ$	$120^\circ$

**Note: For Delta Side, we shall not simulate Single Phase Fault.**

# Online Practices

According to the following Photo, the insulation resistance test shall be done by injecting ..... on 13.8KV CB



- A. 5000 VAC
- B. 1000 VAC
- C. 5000 VDC
- D. 1000 VDC



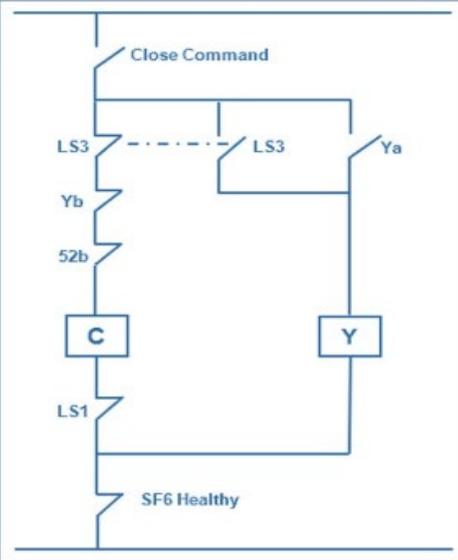
Question Type: Multiple Choice  
Randomize Answers: Yes  
Date Added: Sun 28th Jun 2020  
Last Modified: Sat 18th Jan 2025  
QID#: 22,089,898

Answers Edit Duplicate Used In Recorder

### Question 7

alfanar Online Courses / 3. MV SWGR (Principles) 4 pts

As per the shown figure, "52b" is considered .....



- A. Anti pumping contact
- B. Anti-slam Contact
- C. Spring Charging contact



Question Type: Multiple Choice  
Randomize Answers: Yes  
Date Added: Thu 28th Dec 2024  
Last Modified: N/A  
QID#: 37,603,372

Answers Edit Duplicate Used In Recorder Remove From Test

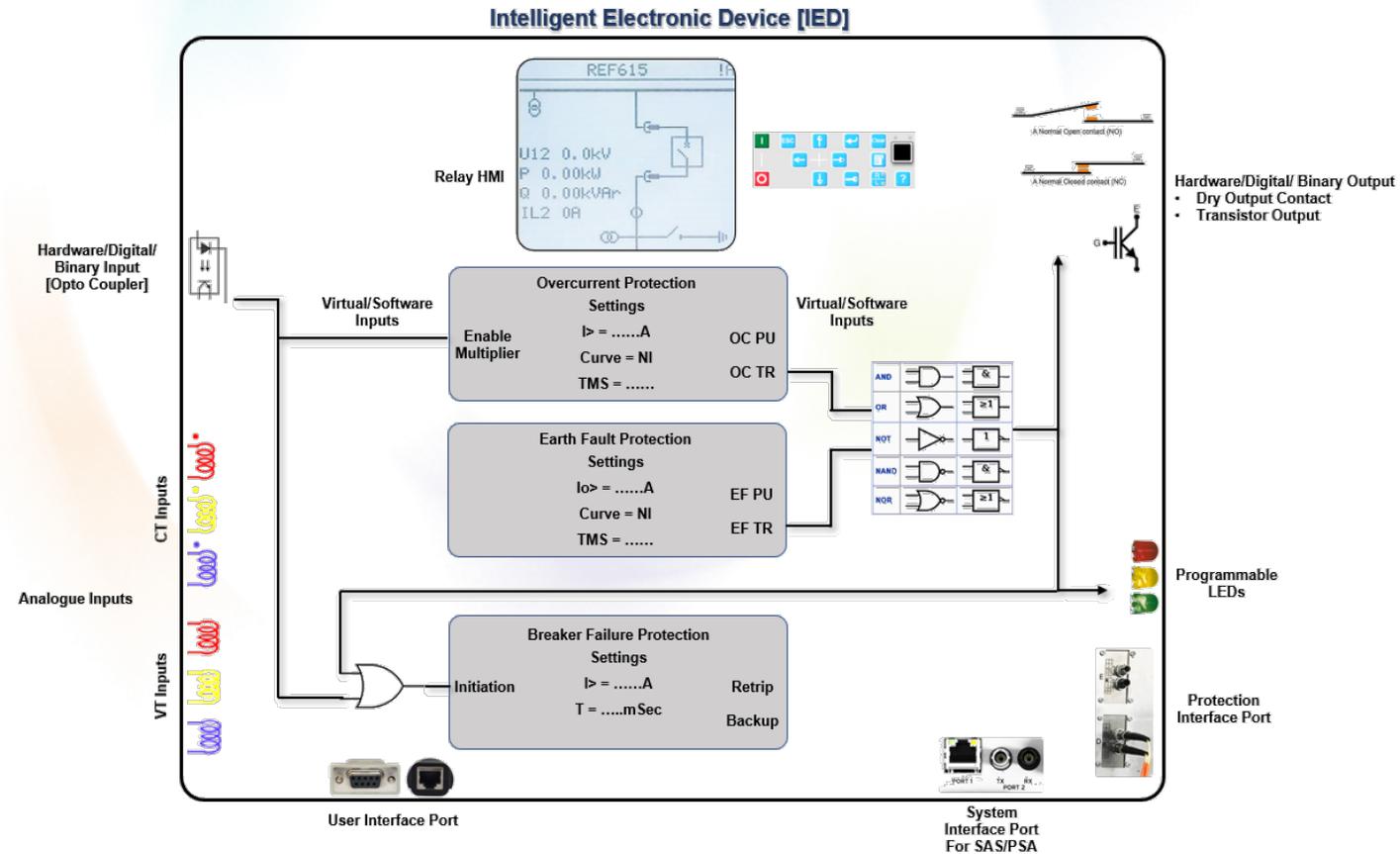
# Power System

“Prot. Systems Testing under  
Transient Conditions”



# IEDs [Protection Relays Testing]

Protection relays are vital to the safety and reliability of power systems, ensuring faults are detected and isolated quickly to prevent equipment damage, outages, or hazards. Regular relay testing is therefore critical for verifying correct performance under real operating conditions.



# Automatic Testing

The new **Freja 546 Automatic Testing Facility** enhances this process by offering advanced, efficient, and user-friendly testing capabilities, ensuring compliance and reducing human error.



## Reliability

Confirms relays will operate correctly to protect equipment and personnel during faults.



## Regulatory Compliance

Supports utilities and industries in meeting international standards and audit requirements.



## Time Efficiency

Automates complex test sequences, reducing testing duration and operator effort.



## Accuracy & Consistency

Minimizes manual intervention, ensuring repeatable and precise results.



## Flexibility

Capable of testing a wide range of relay types and protection schemes in substations and industrial applications.



## Data Management

Provides detailed reporting, logging, and storage of test results for easier documentation and traceability.

# Freja 546 Template

ALSTOM P546 v2

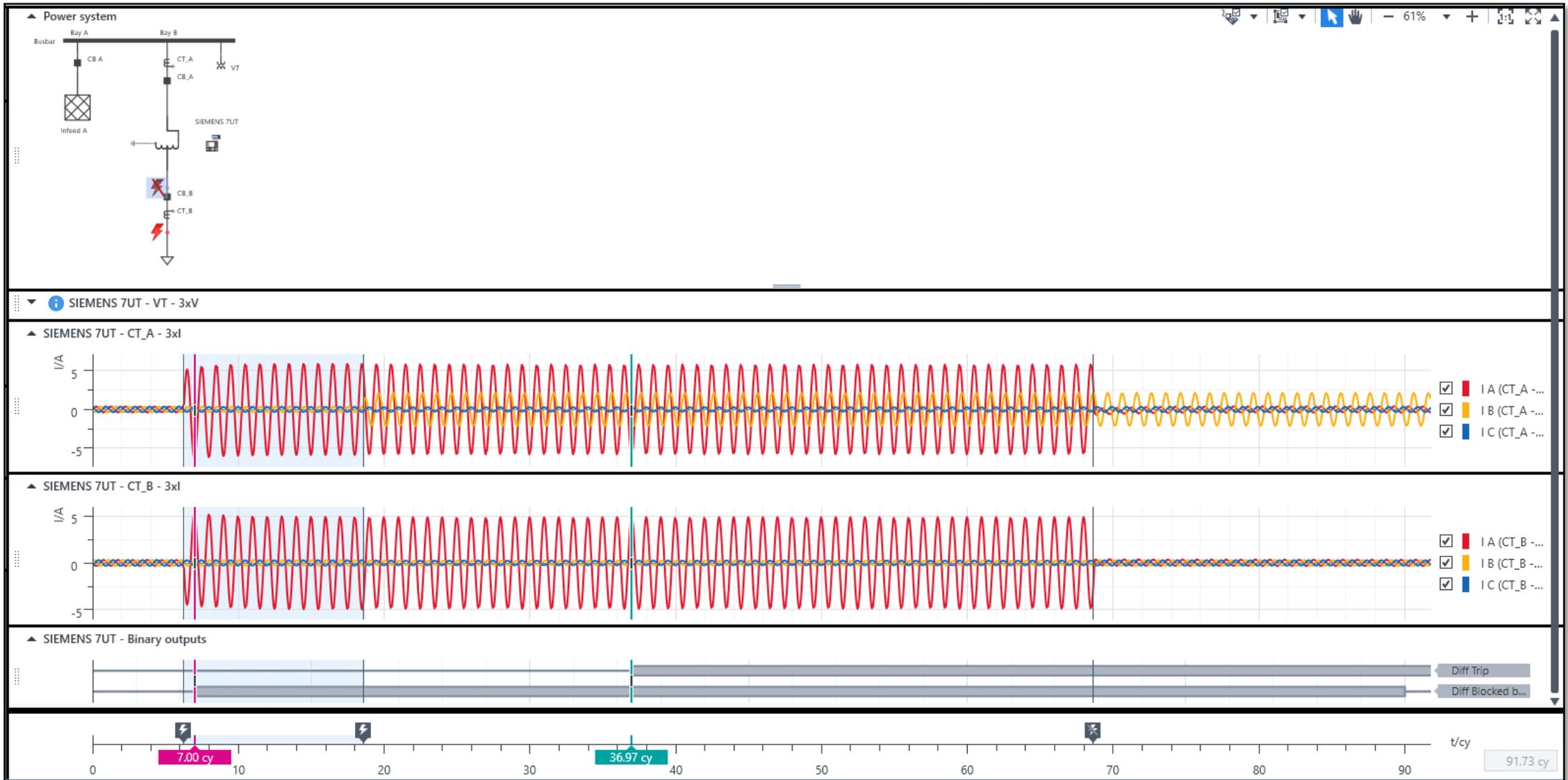
Test Groups: Tests: +

Test Groups	Tests
Preliminary Check	1. Mechanical check and Visual Inspection
Line Differential Test Mode	2. Operating DC Supply Current
Distance Reach and Timing	3. Electrical Tests
Switch Onto Fault	4. Binary Inputs
Distance Aided Scheme [POR]	5. Binary Outputs
Current Reversal	6. Current measures
Weak Infeed	7. Voltage measures
Directional Earth Fault [DEF]	8. Power Measures
DEF Aided Scheme [POR]	
VT Fuse Failure	
Synchrocheck and Manual Closing	
Auto Recloser [Single Breaker]	
Power Swing	
Overcurrent Prot [Phase_Ground]	

Sel >

Green: Pass; Red: Fail; Black: Not Tested; Blue: Incomplete

# Advanced Testing for Transient Faults [Evolving Faults]



# Advanced Testing for Transient Faults [CT Saturation]



# Looking Forward to Train You