

Preventing Loss of Engine Generators on A320 Family, A330 and A340 Aircraft



Some cases of emergency electrical configurations on A320 aircraft were reported to Airbus where both Integrated Drive Generators (IDGs) failed in sequence due to worn components inside their Constant Speed Drive (CSD).

This article describes one of these events and explains why worn IDGs may have frequency regulation issues in certain circumstances that may lead to emergency electrical configuration. It also presents the preventive maintenance tasks that have been introduced to detect worn IDGs in advance. Recommendations are provided to flight crews to prevent a potential emergency electrical configuration in the case of one generator failure.

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CASE STUDY

Event Description

An A319 aircraft was initiating its descent from FL360 toward its destination airport. Autothrust and autopilot were engaged in **THR IDLE | OP DES | NAV** modes. The selected target altitude was 26 000 ft.

① Crossing 31 500 ft, (fig.1) the **ELEC GEN 2 FAULT** ECAM alert triggered (**To**).

② 5 s later (**To+5s**), the aircraft switched to the emergency electrical configuration, and the Ram Air Turbine (RAT) deployed and activated accordingly. The autothrust and autopilot disconnected and the flight controls reverted to ALTERNATE law. Only the Captain's PFD and ND, and the upper ECAM displays remained ON. The **AUTO FLT AP OFF** and **ELEC EMER CONFIG** triggered.

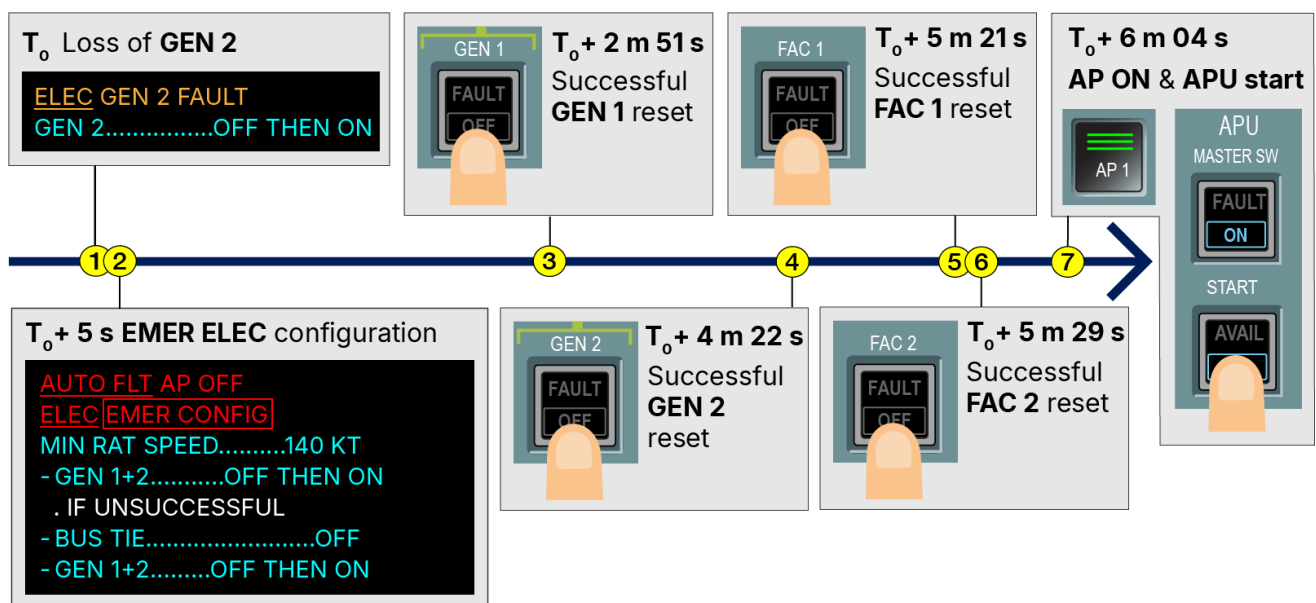
During the next 2 minutes and 46 seconds, the flight crew attempted to reset both generators. ③ At **To+2m51s**, GEN 1 was successfully reset and electrical power restored to the network. The **ELEC GEN 2 FAULT** and **ELEC IDG 2 OIL LO PR** ECAM alerts were displayed on the ECAM.

④ 1 m 31 s later (**To+4m22s**), GEN 2 was also successfully reset.

⑤ 59 s later (**To+5m21s**), the flight crew successfully reset FAC 1, enabling the recovery of the normal flight control law. ⑥ 8 s later (**To+5m29s**), FAC 2 was also successfully reset.

⑦ 43 s later (**To+6m04s**), the flight crew re-engaged the autopilot and started the APU as a safety precaution. The aircraft continued its descent and safely landed at its destination airport (**To+19m38s**).

(fig.1) Sequence of actions during the event



Event Analysis

Worn generator components

Both generators were removed from the aircraft and sent to the manufacturer for examination. It was confirmed that they both failed due to frequency regulation issues, which originated from worn hydraulic blocks inside their Constant Speed Drive (CSD) module.

Correct electrical reconfiguration

During the event, the **successful electrical network reconfigurations** enabled the aircraft to maintain safe flight conditions and recover a full electrical supply after the successful reset of GEN 1. The subsequent successful reset of GEN 2 enabled the flight crew to restore a dual generation configuration. ■

TECHNICAL BACKGROUND

Constant Frequency Generation vs Variable Frequency Generation

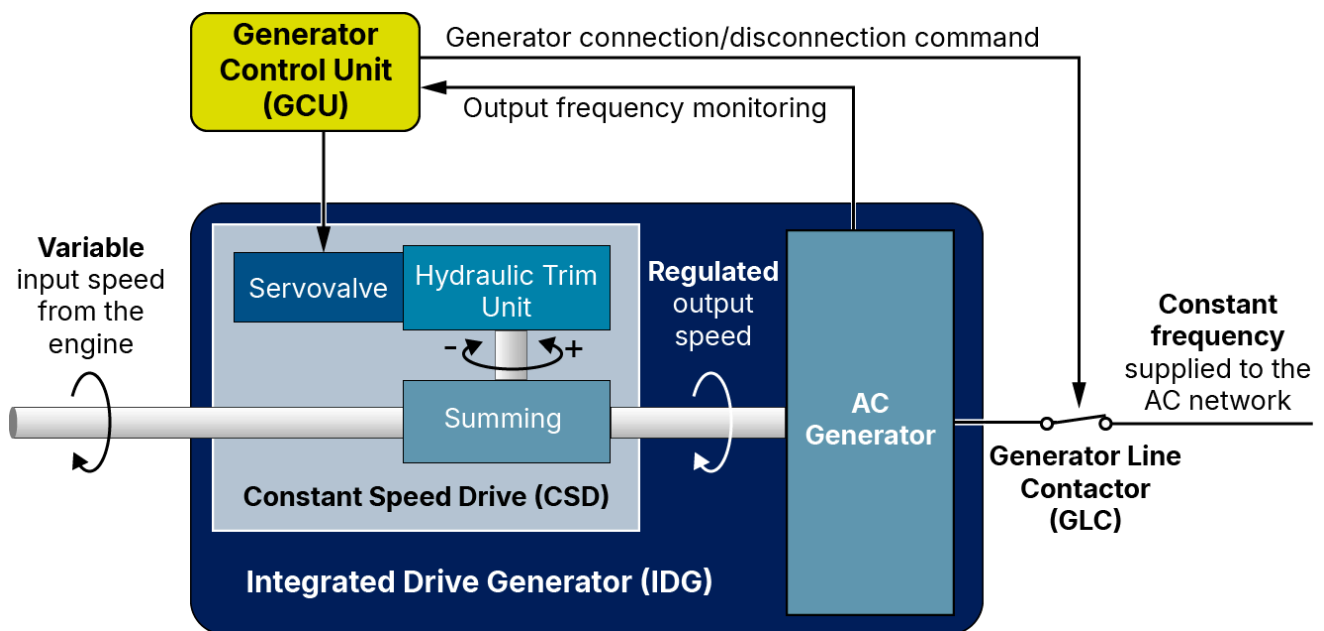
Two types of engine generators are used on Airbus aircraft: the Integrated Drive Generators (IDG) and the Variable Frequency Generators (VFG).

Integrated Drive Generators (Constant frequency generator)

IDGs are mounted on engines of A300, A310, A320 family, A330 and A340 aircraft.

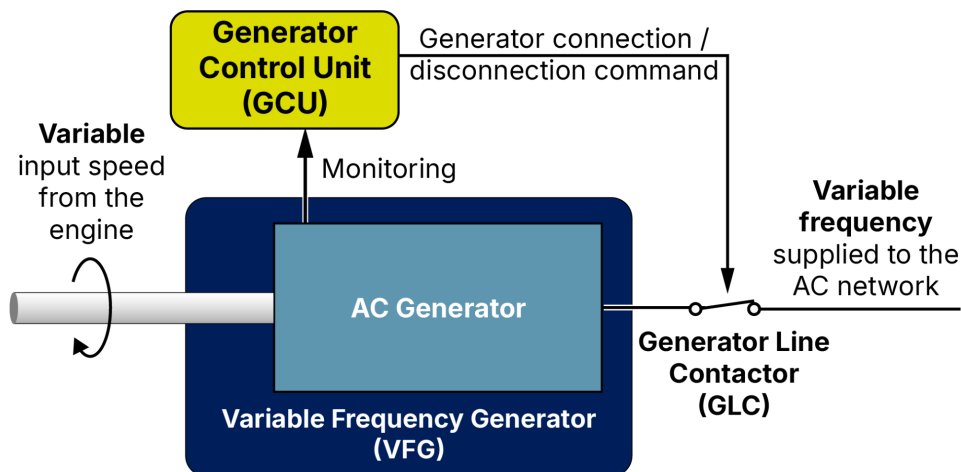
This type of generator provides AC power at a constant frequency. To do so, a **Constant Speed Drive (CSD)** is integrated into the IDG to convert the variable input rotation speed from the engine into a constant output rotation speed to the AC generator unit (**fig.2**). The **Generator Control Unit (GCU)** monitors the output frequency of the generator and sends regulation commands to the servovalve of the hydraulic trim unit to add or subtract rotation speed to the input speed coming from the engine in order to obtain a constant output speed.

(fig.2) IDG concept



Variable Frequency Generators (VFGs)

This type of generator does not have a CSD (fig.3). They provide **AC power voltage with a variable frequency to the aircraft electrical network**. These generators are installed on engines of A220, A350 and A380 aircraft. When necessary, frequency regulation is performed using power converter components within the aircraft's systems



(fig.3) VFG concept

Focus on the IDGs of A320 family, A330 and A340 aircraft

Several reported events on A320 family aircraft

In recent years, Airbus received reports of emergency electrical configuration events on A320 family aircraft due to the loss of both engine generators, as in the event described previously. In all cases, the Ram Air Turbine (RAT) deployed and powered the emergency electrical network. In most cases, the full power supply was restored to the aircraft's electrical network by a successful reset of at least one generator or by starting the APU, which connected its generator to the network.

These events mainly occurred during descent, shortly after a loss of one generator. Some cases of total loss of electrical power have also been reported on ground during Single Engine Taxi Without APU (SETWA) operations.

A330 and A340 aircraft may also be affected by similar generator failures

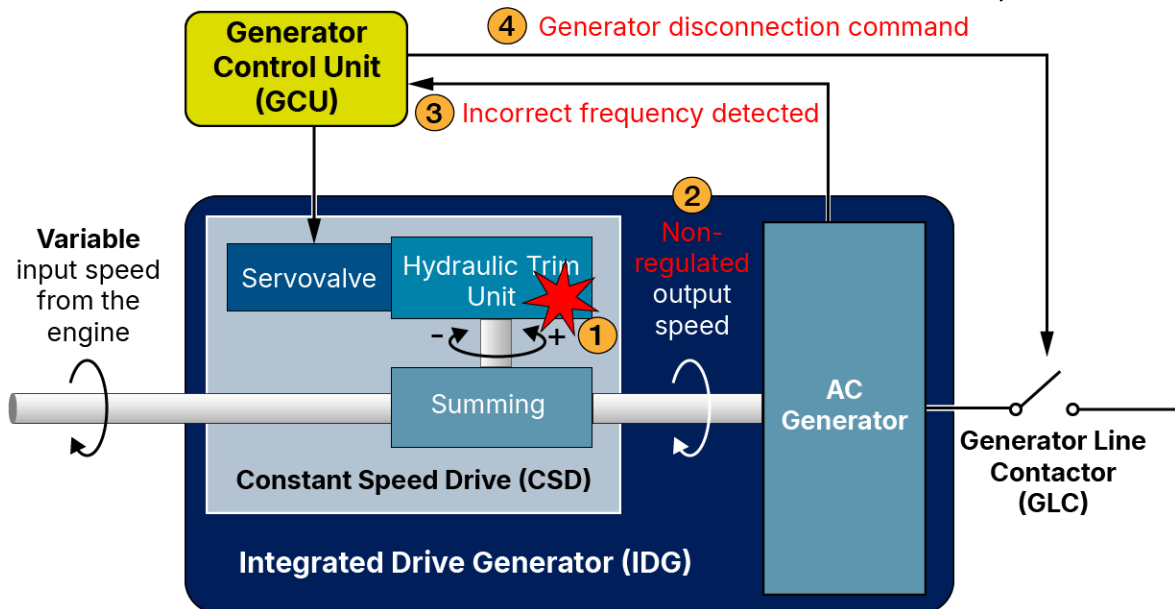
No similar events were reported on A330 and A340 aircraft, however, the design of the IDG is similar and so these aircraft can also be affected.



Worn hydraulic components leading to frequency regulation issues

Analysis showed (fig.4) that the generators suffered from ① worn hydraulic blocks inside its CSD causing ② an incorrect regulation of the CSD output speed. ③ This resulted in electrical frequency fluctuations that were detected by the GCU, which ④ disconnected the generator from the electrical network to protect the aircraft's systems.

(fig.4) Frequency regulation issue due to worn IDG



Low engine rotation speed also as a contributor

A low engine rotation speed can also contribute to frequency regulation issues on worn generators. Most of the in-service events occurred during descent while the engines were at a close to idle thrust setting, providing an IDG input speed close to the so-called **"straight through" rotation speed**. At the straight-through speed, IDG input rotation speed does not need to be corrected by the CSD for the generator to produce a 400Hz current. When close to this speed, the regulation function of the CSD will toggle on and off. Worn hydraulic components may cause delays in the application of the speed correction by the CSD and this can cause frequency variation.

Sudden increased electrical load on the remaining generator as a contributor

After a failure of one generator, the other generator will have a sudden electrical load increase that may contribute to a frequency regulation issue, and could result in disconnection from the electrical network by its GCU if hydraulic components in its CSD are worn. ■

MAINTENANCE CONSIDERATIONS

Prevention of this kind of event relies on detecting worn IDG components prior to their failure in service. Modifications to the Airbus maintenance documentation provides additional guidance to prevent this kind of in-service occurrence.

Introduction of a MPD task for early detection of worn generators

The Maintenance Planning Document (MPD) of A320 family, A330 and A340 aircraft has been updated to request repetitive applications of the **A320 AMM task 24-20-00-710-801-A** or of the **A330/A340 AMM task 24-21-00-710-819 "Operational check of network reconfiguration in case of single generator failure"** every **3 000 FH or 36 Mo** for A320 family and A330/A340 aircraft.



INFORMATION

- **A320 MPD 242000-25-1** "Operational check of network reconfiguration in case of single generator failure"
- **A320 AMM 24-20-00-710-801-A** "Operational check of network reconfiguration in case of single generator failure"
- **A330/A340 MPD 242200-02-1** "Operational check of network reconfiguration in case of single generator failure"
- **A330/A340 AMM task 24-21-00-710-819** "Operational check of network reconfiguration in case of single generator failure"



BEST PRACTICE

Operators should perform the MPD task **at the earliest maintenance opportunity** for each aircraft so that worn generators are detected without being further exposed.

Update of the AMM test procedure

Both the **A320 AMM task 24-20-00-710-801-A** and **A330/A340 AMM task 24-21-00-710-819 "Operational Check of Network Reconfiguration in Case of Single Generator Failure"** are updated to add additional loads on the network as well as an APU start in single generator configuration to check that the remaining generator can sustain this kind of sudden load increase. The AMM task update is already available for A320 family aircraft. The updated task for A330 and A340 aircraft is planned for publication by July 2025.

Introduction of a TSM Task "Loss of 115 V power"

In the case of a loss of AC power occurring on ground during Single Engine Taxi Without APU (SETWA) operation, all the cockpit displays lose power and go black and the related ECAM alerts will therefore not display. An **A320 TSM task 24-20-00-810-977** and an **A330/A340 TSM task 24-20-00-810-A01 "Loss of Normal 115V AC"** are now included to provide maintenance teams with an appropriate entry point for troubleshooting.

Specific Attention to Worn Hydraulic Blocks During IDG Shop Maintenance

In shop maintenance, maintenance organizations should replace CSD hydraulic blocks if wear is found out of allowable limit or, as a preventive measure, if the wear is considered as close to the limit or excessive. ■

OPERATIONAL CONSIDERATIONS

Prevention of a potential emergency electrical configuration in the case of one generator failure

Follow the **ELEC GEN 1(2) FAULT** ECAM procedure

The **ELEC GEN 1(2) FAULT** ECAM procedure requests to reset the faulty generator. In most cases, if the loss of the generator is due to an incorrect frequency regulation due to worn hydraulic blocks, the reset of the faulty generator is often successful. Flight crews should however be aware that this procedure does not prevent a subsequent failure should the conditions that caused the frequency regulation issue occur again.

Start APU to recover a dual generator configuration

In the case of a single generator failure, starting the APU enables recovery of the electrical network power supply redundancy by adding the APU generator to the network. This will prevent reversion to emergency electrical configuration should the second engine generator also fail. ■

PRODUCT ENHANCEMENTS

Enhanced CSD hydraulic blocks are under development to improve their service life. However, this improvement will not eliminate the need to perform the repetitive MPD task "Operational Check of Network Reconfiguration in Case of Single Generator Failure".

The enhanced hydraulic blocks should be available through a Service Bulletin that is expected to be published by the end of 2025 for A320 family, A330 and A340 aircraft. ■

Contributors:**Olivier AUSSEIL**

Customer Engineering
Support Specialist
Customer Support

Stéphane COTE

Incident/Accident
Investigator
Aviation Safety

Maxime LANSONNEUR

Director Safety - Training
and Flight Operations
Customer Support

Fabien VERGNE

Electrical & Electronic
Development Engineer
Design Office

**Gonzalo
ZUBIETA-GARCIA**

A320 family, A330 &
A340 Electrical System
ISeR
Design Office

Airbus received few reports of A320 aircraft reverting to emergency electrical configuration after a failure of both IDGs one after the other.

Analysis showed that IDGs mounted on A320 family, A330 and A340 aircraft may face output frequency regulation issues when the hydraulic blocks from their Constant Speed Drive (CSD) are worn.

After a first IDG failure, if the CSD of the remaining IDG is worn, it may fail to regulate its output frequency, causing the generator to be disconnected from the network, leading to an emergency electrical configuration.

Additional contributing factors to the frequency regulation issues have been identified. The first one being a sudden increase of the electrical load on the generator that could happen after the first generator failure. The second factor being a low input rotation speed when the engines are close to idle speed. Close to this speed, the frequency regulation components are particularly solicited due to the frequent toggling of the regulation.

The MPD of A320 family, A330 and A340 aircraft have been updated to request a repetitive application of an AMM task to test each IDG capability to handle the electrical load in mono-generator configuration, and therefore detect worn generators in advance.

A TSM task has also been added to provide maintenance teams with an appropriate entry point for troubleshooting in the case of a loss of the IDG during Single Engine Taxi Without APU operation.

During flight, in the case of a generator failure, the flight crew should apply the ECAM procedure and attempt to reset the faulty generator. If unsuccessful, they should start the APU to recover a dual generator configuration. Flight crews should be aware that if a generator with worn components is successfully reset following the ECAM procedure, it could fail again in flight if the same conditions that caused the initial issue recur.

When generators are removed for shop maintenance, particular attention should be given to inspecting the CSD hydraulic blocks for close-to-limit or excessive wear.

Enhanced CSD hydraulic blocks are being developed. They should have an increased resistance to wear, but will not prevent from performing the repetitive MPD task to check the generators' health.

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Editor: Yannick Malinge, SVP
AViation Safety.

Editorial team: Guillaume Estragnat,
Vanessa Sadi, Gwyneth Duggan,
Javier Martinez Marina, Tim Roach.

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Airbus - Aviation Safety department (W)
1, rond point Maurice Bellonte
31707 Blagnac Cedex - France
safetycommunication@airbus.com

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