GOBIERNO DE ESPAÑA
MINISTERIO DE FOMENTO
SUBSECRETARÍA DE FOMENTO
COMISIÓN PERMANENTE DE INVESTIGACIÓN DE ACCIDENTES E INCIDENTES MARÍTIMOS

CIAIM REPORT 21/2018

Collision between the ships FANTASTIC and VIKING STAR at the Port of Barcelona on 12 January 2018

NOTICE

This report was written by the Maritime Accident and Incident Investigation Permanent Commission (CIAIAM), which is regulated by Article 265 of the Revised Text of the Law on State Ports and the Merchant Marine, approved by Royal Legislative Decree 2/2011 of 5 September, and by Royal Decree 800/2011 of 10 June.

The purpose of the CIAIM when investigating maritime accidents and incidents is to obtain conclusions and lessons learned that can reduce the risk of maritime accidents, and thus contribute to improving maritime safety and to preventing contamination from ships. To this end, the CIAIM conducts a technical investigation into each case that aims to determine the causes and circumstances that may have, directly or indirectly, influenced the accident or incident and to make the relevant safety recommendations.

This technical report does not, under any circumstance, prejudge any decision that may stem from legal proceedings, nor does it seek to evaluate responsibilities or assign blame.

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Figure 1. FANTASTIC

Figure 2. VIKING STAR

Figure 3. Area of the accident

1. SUMMARY

On 12 January 2018 at 12:15 UTC, the ro-pax vessel FANTASTIC experienced a blackout as it was exiting the port of Barcelona, which resulted in the loss of the main engines and caused the bridge crew to lose control of the vessel. In this condition, the ro-pax FANTASTIC collided with the passenger vessel (P/V) VIKING STAR, which was moored. The collision did not cause any significant injuries to persons or material damage to the ships. The ro-pax FANTASTIC tied up again with aid from tugboats.

The loss of the electric plant was likely caused by the failure of the speed governor in one of the auxiliary generators. Once it was replaced, the auxiliary generator worked normally once more.

1.1. Investigation

The CIAIM was notified of the accident on 12 January 2016. That same day, the event was classified as a "minor accident" and the Commission agreed to open an investigation. The CIAIM board approved the event's classification and the opening of a safety investigation. This report was reviewed by the CIAIM at its meeting of 21 May 2019 and, after its subsequent approval, was published on November 2019.

* * *

2. OBJECTIVE INFORMATION

Table 1. Information on the ship.

Name	FANTASTIC	VIKING STAR
Flag/Registry:	Italy	Norway
Identification	IMO #: 9100267 Call sign: IBDF MMSI: 247094000	IMO #: 9650418 Call sign: LAIW6 MMSI: 257903000
Type	Roll-on/roll-off passenger vessel	Passenger vessel
Main characteristics:	• Overall length 188.22 m • Beam 26.80 m • Draft 6.815 m • Gross tonnage 35222 GT • Hull material: Steel • Propulsion: Four 6480-kW diesel generators • Auxiliary generators: 3 x 2430 kW • One 1850-kW bow thruster	• Overall length 228.3 m • Beam 28.89 m • Draft 6.6 m • Gross tonnage 47842 GT • Hull material: Steel • Diesel-electric propulsion. Generators: 2 x 5040 kW + 2 x 6720 kW Two 7250-kW electric propulsion engines. • Emergency generator: 1 x 1390 kW • Two 1400-kW bow thrusters
Ownership and management	Grandi Navi Veloci SpA	Viking River Cruises
Registration company	American Bureau of Shipping	Bureau Veritas
Construction details	Built in 1996 by Nuovi Cantieri Apuania SpA	Built in 2015 by Fincantieri - Cantieri Navali Italiani SpA
Minimum safety crew	For transporting a maximum of 2033 passengers: 69 crew	For transporting 954 passengers: 167 crew.

Table 2. Details of the voyage

Name	FANTASTIC	VIKING STAR
Ports of arrival/destination	Barcelona/Genoa	Barcelona/Marseilles
Type of voyage	Scheduled international passenger and roll-on/roll-off cargo	International passenger
Cargo information	823 passengers and 322 vehicles	897 passengers
Complement	95 crew	486 crew
Documentation	No deficiencies found related to the accident.	No deficiencies found related to the accident.

Table 3. Information on the event

Name	FANTASTIC	VIKING STAR
Type of accident or incident	Collision	
Date and time	12 January 2018 at 12:15 UTC	
Location	Port of Barcelona. 43º 38.98' N; 005º 59.66' W	
Ship operation and segment of voyage	Maneuvering to exit port	Berthed
Shipboard location	Port quarter	Port quarter
Damage to ship	Minor damage to superstructure	Minor damage to superstructure
Injured / missing / fatalities onboard	No	No
Contamination	No	
Other personnel injuries	No	

Table 4. Maritime and meteorological conditions

Wind	2 to 3 on Beaufort scale (4 to 10 knots) and gusts of 11 to 16 knots from N and NW (290º to 360º).
Sea state	Inside the port, rippled, with a significant wave height of 0.1 m.
Visibility	Good, 10 km or more

Table 5. Response by officials on land and reaction by emergency services

Organizations involved	Barcelona Pilots Association
Resources used	• MONTALT port tugboat • RAMON CASAS port tugboat
Response time	Immediate
Measures taken	Mobilization of two port tugboats
Results	Additional damage to both ships avoided.

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3. DETAILED DESCRIPTION

This description of the event is based on the information, statements and reports available. All times are UTC.

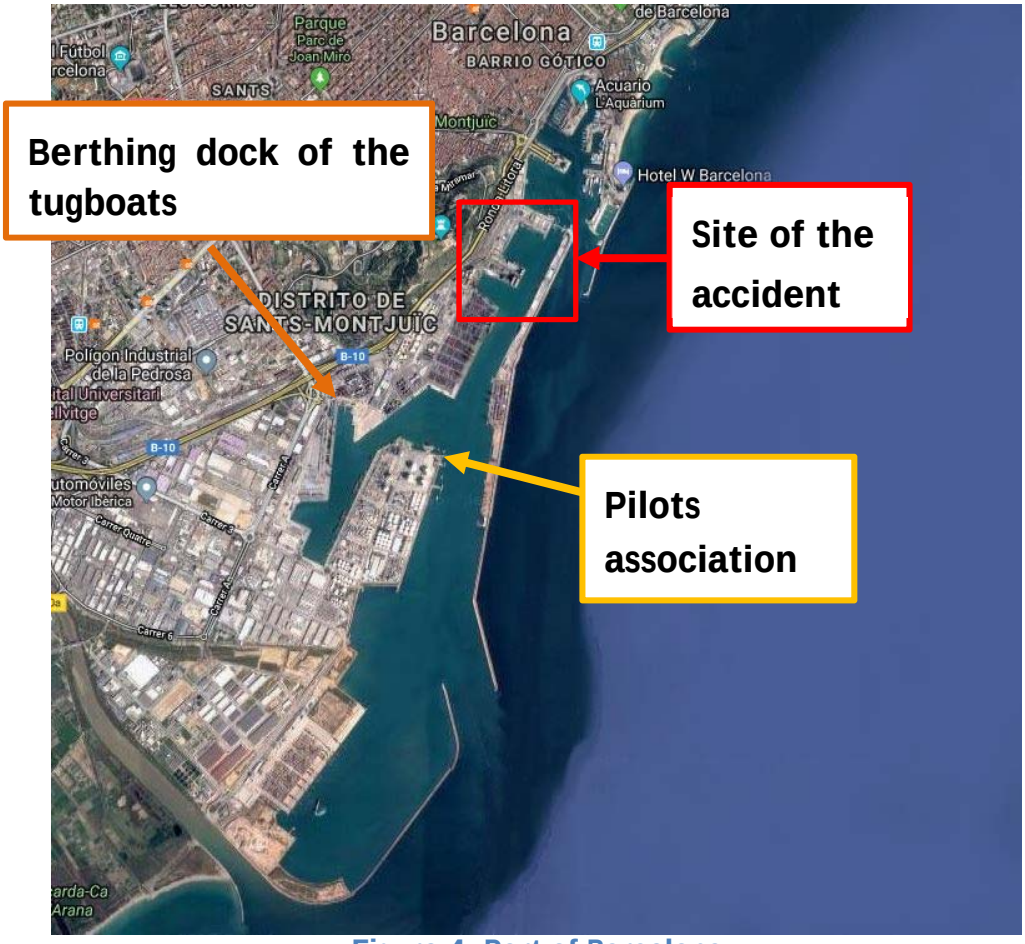

Figure 4. Port of Barcelona

On 12 January 2018 at 11:00, the crew of the FANTASTIC ro-pax vessel completed the safety checks prior to the maneuver to exit the port of Barcelona.

At 11:48, the pilot was on board the vessel to initiate the maneuver to undock from Muelle Costa (Figure 5).

At 11:50, the stern gate was closed and the ship was about to start the maneuver to undock from its berth.

At 11:52, the FANTASTIC cast off the ropes and started the maneuver to exit the berth.

A short time later, clear of the berth and while turning in Morrot Harbor, the captain had the impression that the bow thruster was not providing the usual amount of force. He checked with the chief engineer, who confirmed that only about half its usual power was available.

Figure 5. Maneuver performed by the FANTASTIC ro-pax vessel

At 12:00, the electric plant went offline, which immediately caused the main engines to stop, leaving the ship unable to maneuver. The FANTASTIC was in the channel[1] formed by the Contradique and Adosado harbors. By that point it had completed its turn, but the inertia kept the bow turning to starboard. Its speed was approximately 2 knots.

Faced with the total loss of control of the ship, the pilot immediately requested assistance from two tugboats.

[1] The channel is about 215 meters wide.

The pilot initially requested help from the tugboat[2] located alongside the bridge (see Figure 5), but it was busy with another maneuver and was unable to provide assistance to the FANTASTIC. At that point, the pilot noticed that a car-carrier vessel was in the vicinity of the pilots association (Figure 4), maneuvering into port, and he asked the pilot on board that vessel to release one of the two tugboats that was assisting him to help him handle the emergency with the FANTASTIC.

The second tugboat that was requested responded from its base.

At 12:06, the pilot ordered the port anchor dropped to keep the FANTASTIC from continuing to advance and colliding with the Contradique harbor. But due to the ship's inertia and to having dropped the anchor, the ship started to turn about the anchor, with the bow drifting to port in the direction of the VIKING STAR.

At 12:12, the port quarter of the FANTASTIC impacted the port quarter of the VIKING STAR (Figure 6). The collision removed paint from a 50-cm section of the air draft of the FANTASTIC. A 1-m section of a balcony in the air draft of the VIKING STAR was dented (Figure 7).

Before the collision, the horn on the FANTASTIC was sounded several times to warn the passengers of the imminent collision.

At the time of the collision, the tugboat MONTALT, despite being alongside the starboard quarter of the FANTASTIC, had not managed to fasten any lines (Figure 6).

At 12:16, the tugboat MONTALT managed to tie one rope from the ship's starboard quarter and proceeded to maneuver the FANTASTIC parallel to the dock.

At 12:20, the second tugboat, RAMÓN CASAS, fastened the line from the port quarter while the MONTALT kept the stern tow line fastened. The maneuver to steer the FANTASTIC to the Poniente Sur harbor was initiated.

A short time later, while approaching the Poniente Sut harbor, an auxiliary generator and two main engines (one per line) on the FANTASTIC became operational.

By 12:30, very close to the Poniente Sur harbor, two auxiliary generators, the bow thruster and the four main engines were available.

The berthing maneuver was completed at 12:48.

After the accident, once the vessel was tied up, inspectors from the Port Authority of Barcelona, the P&I[3] and the registration company reported on board to conduct the relevant tests and checks of the auxiliary generators. By 17:45, the malfunction with the generator had been repaired and the FANTASTIC set sail for Genoa.

[2] The pilot was interviewed and he stated that a tugboat is normally tied up alongside the bridge to help with any potential emergencies. At that time, it was busy carrying out another maneuver.
[3] Protection and Indemnity (P&I) Club

Figure 6. Seconds prior to the collision between the ships

Figure 7. Damage to the VIKING STAR (left) and FANTASTIC (right)

4. ANALYSIS

4.1. Bridge crew and pilot

On the bridge of the FANTASTIC were the pilot, captain, a helmsman, one trainee and two officers.

The captain was highly experienced and had been a captain at the company since 2001. He had a pilotage exemption at the Port of Barcelona with other company ships and he was in training to qualify for a piloting exemption on the FANTASTIC. He made two trips to the Port of Barcelona on this route every week.

The pilot had more than 14 years of experience at the Port of Barcelona.

The collision cannot be attributed to an incorrect action by the bridge crew or pilot, but rather to the fact that the vessel was not under control and the tugboats were unable to reach the site of the incident quickly enough to fasten the lines to the FANTASTIC and try to avoid the impact.

After the loss of power, the emergency generator started and connected immediately, supplying emergency loads throughout the incident. The VDR[4] recording shows that the helm controls worked after the blackout. The captain ordered the rudder moved in an effort to steer the ship despite the little headway.

The passengers were not assembled at muster points during the emergency, nor were any emergency procedures carried out.

It should be noted that the blasts of the horn intended to warn the passengers and crew of both ships of their imminent collision resulted in a response that was opposite to that expected, as some passengers went to the area of the collision to see what was happening.

4.2. Actions of the Registration Company and the Port Authority

After the incident, and at the request of the operator, inspectors from the Registration Company reported to the FANTASTIC. According to information in the deck log and that provided by the chief engineer, the ship experienced a blackout while maneuvering out of the Port of Barcelona.

The speed adjusting motor on the governor for the #3 auxiliary generator was replaced with a spare part available on board. Tests were conducted with auxiliary generators #1, #2 and #3, including load, alarm, safety and automation system tests. During these tests, the electric plant operated correctly.

The hull was also inspected to verify the damage sustained by the superstructure. Scratches were found on the plates between decks 5 and 6. No deformations or fractures were found.

Inspectors from the Barcelona Port Authority also reported to the FANTASTIC after the accident. The inspectors corroborated that the malfunction that caused the blackout had been repaired and that the equipment was operational and ready for departure.

[4] Voyage Data Recorder

Before the ship was allowed to leave the Port of Barcelona, the Port Authority required the use of a tugboat and assistance from a pilot. It also required a detailed report from the captain and chief engineer on the departure. A report was also requested from the Registration Company to determine if repairs were needed at the next port or if any other action was required.

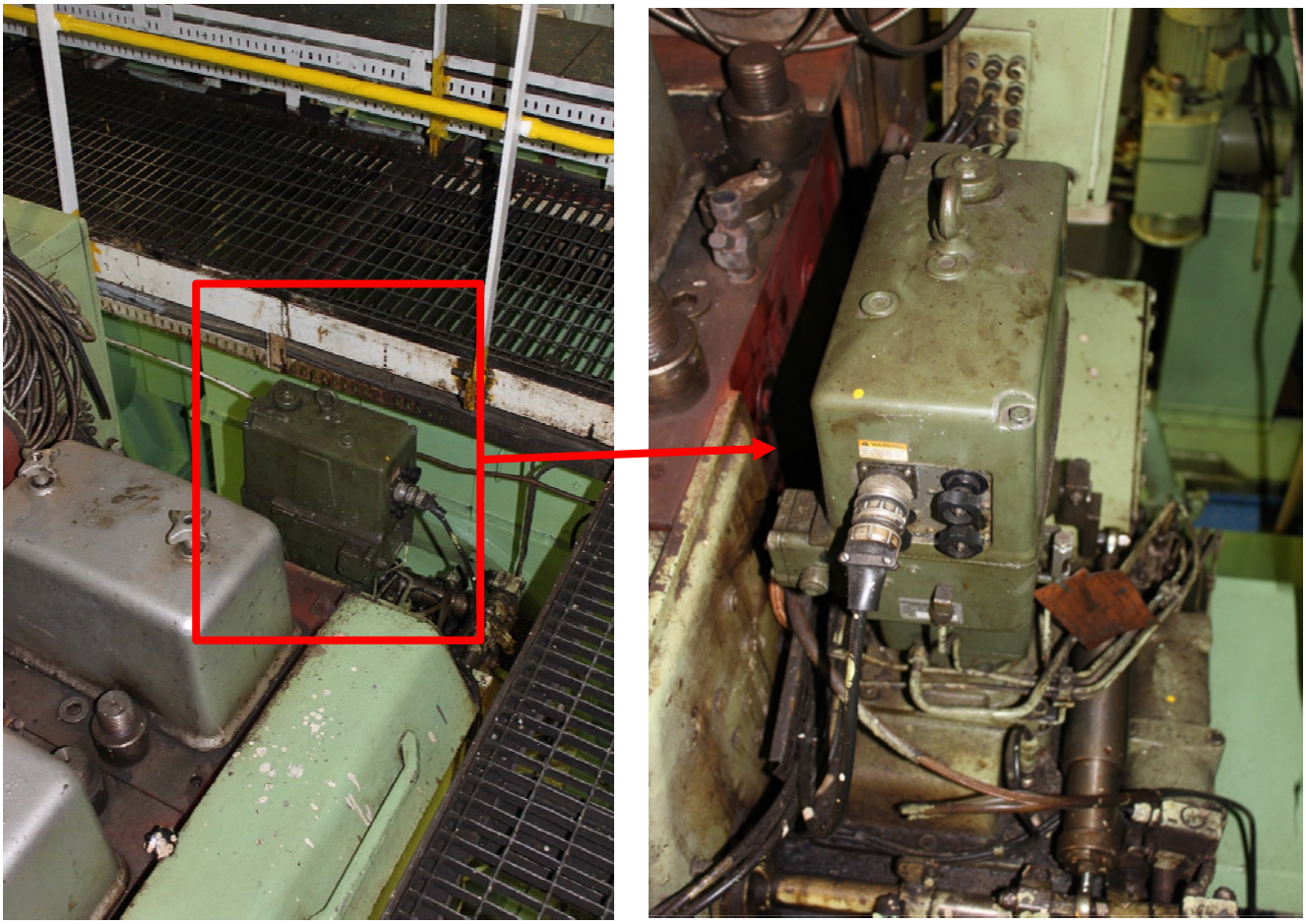

Figure 8. Woodward mechanical governor

4.3. Blackout

According to the chief engineer, the blackout was caused by the failure of the speed adjusting motor on the mechanical governor (see Figure 8) for the #3 auxiliary diesel generator. The failure of the frequency controller caused the Woodward governor to freeze and shifted the load between the three generators. The #3 auxiliary generator had taken up all the load from the two other auxiliary generators. The #1 and #2 auxiliary generators went into reverse power and tripped. The #3 auxiliary generator tripped due to overpower. The electric plant was operating in automatic mode.

The reports from the Registration Company and the Port Authority of Barcelona note that once the speed adjusting motor was replaced on DG3, tests were carried out on the three generators, including load, alarm, safety and automation system tests, all of which were satisfactory. As a result, both the operator and the Registration Company concluded that the blackout had been a direct consequence of a single failure in the speed adjusting motor of the DG3 governor.

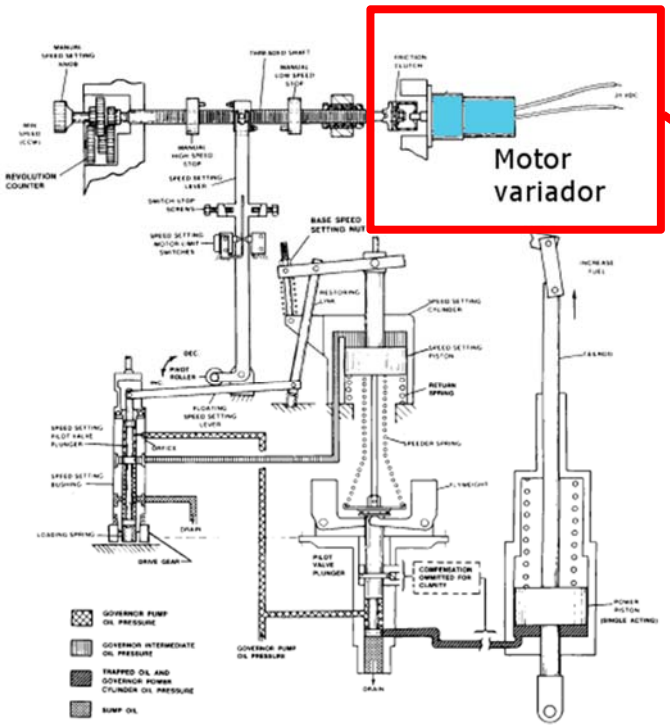

Figure 9. Diagram of the Woodward governor

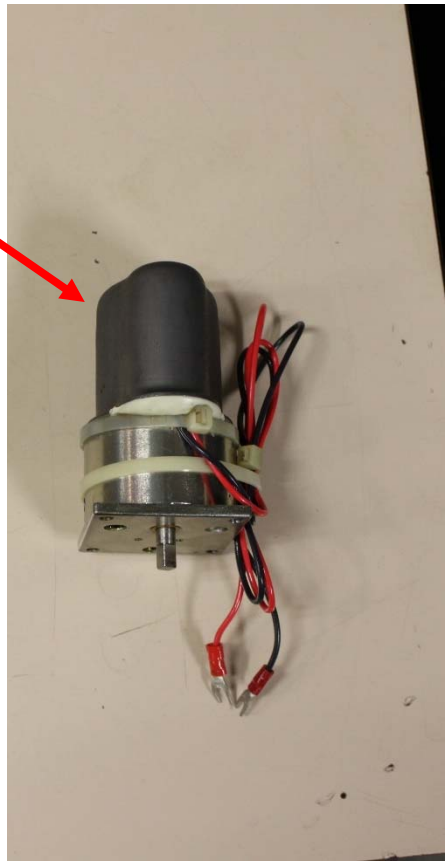

Figure 10. Speed adjusting motor

In light of the rated powers of the three generators and the bow thruster, the CIAIM believes that DG3 connected to the bus bar could not by itself provide all the load demanded by the vessel during the exit maneuver, considering the intermittent operation of the bow thruster. Therefore, to cause a blackout, it would suffice to disconnect DG1 and DG2.

On the FANTASTIC, load is shared between the generators by adjusting the relevant controls on the Woodward speed governors of the generators, see Figure 9. This adjustment can be made locally at the governor itself, or remotely by using the speed adjusting motor. Therefore, when the speed adjusting motor on the DG3 governor froze, this prevented the crew from adjusting the speed control of the governor remotely, but it did not impede load sharing between the various generators. But for DG1 and DG2 to shed electrical load and go into reverse power, the load sharing has to be adjusted. Since the plant was operating automatically and the governors were not adjusted locally but remotely, the load sharing could only be adjusted if the PMS (power management system) operated the governors during the exit maneuver.

The PMS for the electric plant on the FANTASTIC was designed by ABB. The PMS acts on the Woodward governors of the generators through their speed adjusting motors, and one of its main functions is to help those governors keep both the load sharing between the various generators and the frequency output to the grid stable. This is done through commands that the PMS sends automatically to the speed adjusting motors on the governors to raise or lower the speed adjustment on each governor.

Therefore, in a scenario of significant adjustments to the electrical load, as happens when maneuvering in port and intermittently using the bow thruster, the PMS would constantly be providing inputs to the speed regulators on the generators. In this scenario, it is possible that the PMS was unable to properly handle the freezing of the speed adjusting motor on DG3 and sent commands to the three governors, causing uneven load sharing that resulted, first, in DG1 and DG2 tripping due to inverse power, and then DG3 tripping on overload when the load increased upon actuating the bow thruster. This is all that can be said without knowing the full details on the electricity balance on the ship during the maneuver and the safety devices on the generators.

4.3.1. Operation of the bow thruster

Certain statements indicate that the bow thruster was working abnormally during the exit maneuver. It was not possible to determine if said abnormal operation was related to the blackout. It is possible that if the electric plant was operating erratically (due to the failure of the speed adjusting motor on DG3 and/or other simultaneous causes), the chief engineer opted not to supply the full rated power to the bow thruster.

On ships with several generators operating in parallel and with maneuvering thrusters, it is typical to set up the electric plant such that one of the generators is isolated and supplies only the maneuvering thrusters, with the remaining ship's service loads being supplied by the other generators. This way, any irregularities caused by the intermittent (or improper) operation of the maneuvering thruster are confined to the dedicated generator and cannot affect the rest of the electric plant.

5. CONCLUSIONS

The collision between the FANTASTIC and the VIKING STAR was caused by a blackout on board the FANTASTIC.

This blackout was presumably due to a failure of the speed adjusting motor in the mechanical governor for the #3 generator, a situation that the plant's automatic control system was unable to handle. There is no record to date of this mechanical failure having occurred again.

Even if said speed adjusting motor did fail, in light of the condition and operation of the bow thruster, the CIAIM cannot conclude that said failure was the sole cause of the blackout.

6. SAFETY RECOMMENDATIONS

In light of the conclusions reached, no safety recommendations are formulated on this occasion.

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ANNEX.

Load sharing and frequency regulation in synchronous generators operating in parallel

In a generator, the mechanical governor (in this case the Woodward governor) acts on the primary motor during changes in the electrical load in order to keep a constant rotational speed, and thus a constant electrical frequency. This governor reacts to changes in the motor's speed, acting on the fuel rack to raise or lower power and restore the desired frequency. This primary frequency regulation takes only a few seconds.

When several synchronous generators are operating in parallel, load is shared between them by applying droop control to the mechanical governors of the primary motors. Droop control is a characteristic of the governor that allows the frequency of the motor to change slightly when the power demand changes. It is normal for generators to operate with a negative droop control of 3% to 5%, meaning that the motor RPMs at full load would be 3% to 5% lower than the no-load RPMs.

Generators have to work with negative droop control for the power plant to remain stable. Load sharing is a function of the droop of the generators.

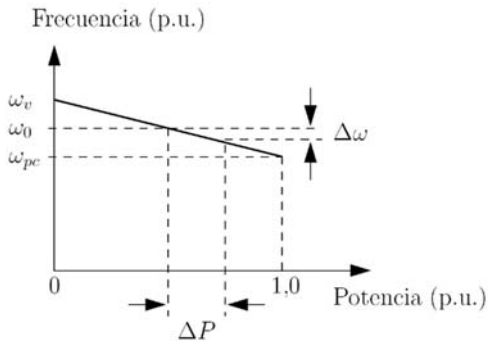

Figure 11. Graph showing droop control in a generator

The load sharing between generators is modified by adjusting their speed. In the following figure, the electrical load P_{load} is shared between two generators, G1 and G2, as determined by their respective droop control (represented with the angled straight lines), to yield a stable system frequency, f_{system}. If the speed of G2 is now increased (equivalent to shifting the line representing its droop vertically), the load sharing is changed, with part of the load being transferred from G1 to G2. The system reaches a new equilibrium frequency, f'_{system}, that is different from the initial one.

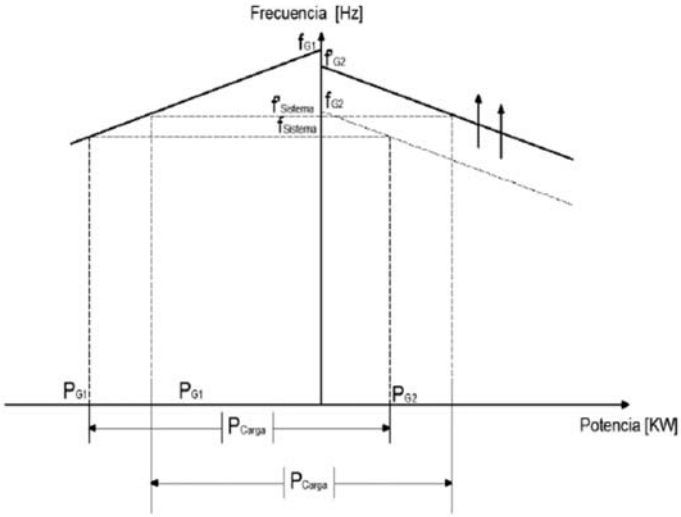

Figure 12. Load sharing between two synchronous generators in parallel

That is, in an electric plant consisting of several synchronous generators operating in parallel, the controlling action of the primary regulation (by way of mechanical governors, the Woodward governor in this case) can be used to regain the balance between the provided and demanded powers, but with a shift in the frequency with respect to the reference frequency.

To avoid this problem and keep the frequency stable regardless of the power demand, secondary frequency regulation is required. This is done by the PMS, which measures the frequency of the electricity generated and issues a command to all the generators to adjust the electricity generated. In this case, the PMS sends a command to the speed adjusting motor on the speed governors to increase or decrease the speed adjustment.

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