

UFR (UNDER FREQUENCY RELAY) RELAY ANALYSIS IN OVERCOMING BLACK OUT NIAS ISLAND

Andi Hernawan¹, Siti Anisah², Hamdani³

Program Study Electrical engineering , Faculty Science and Technology Universitas
Pembangunan panca Budi

Email : andih222@gmail.com, sitianisah@dosen.pancabudi.ac.id

ABSTRACT

Article Info

Received, 01/08/22

Revised, 28/08/22

Accepted, 30/08/22

The power system disturbance that occurred at the Nias power plant due to overcurrent caused a trip to the Nias Gas Engine Power Plant (PLTMG) generator. This causes a decrease in frequency due to the system losing power supply. Frequency interference can be detected automatically with UFR (Under Frequency Relay). The working principle of UFR is to compare the value of the frequency system and the value of the frequency setting which determines the amount of load removed. This study analyzes the performance of UFR on the Nias island power system by simulating a decrease in UFR resulting in a decreased frequency system state.

Keywords: UFR, Frequency, PLTMG Generation

1. INTRODUCTION

An electric power system has a very vital function in everyday life, as technology advances and development develops. The use of electricity is an important factor in people's lives, both in the household sector, lighting, communication, industry and so on. Therefore, good quality of electricity must be achieved so that consumer needs can be met. Dalam penyediaan energi listrik yang kontinyu kepada konsumen, so the use and provision of electrical power must certainly be balanced.

An electric power system is said to be a good system if it meets several requirements, namely reliability, quality, and stability. In a good electric power system, the three conditions must be met, namely the system must be able to provide a continuous supply of electricity with a standard amount for voltage and frequency by the rules this applies and should return to normal immediately when the system is affected by interference.

Some conditions that cause frequency changes include brief circuit interference, disconnection of the generator, sudden load changes. If the demand power of the load is greater than the power generated by the generator, it will cause a decrease in frequency. A sustained decrease in frequency will result in a total outage (Black Out) on the system. Therefore, further action is needed so that the system frequency stabilizes again at the permissible level. One of the actions that must be done is to do the release of the load. Load discharge applied using Under Frequency Relay. By determining the frequency based on the rate of decrease in frequency and removing the load in accordance with predetermined provisions.

The working principle of UFR compares The Present Value (system frequency value) and setting value (frequency set value) which produces an error output that aims to drive the UFR to release the load The nominal frequency of the electric power system in Indonesia is 50 Hz, The permissible frequency range is from 49.5 Hz or higher than 50.5 Hz and during times of emergency and interference, system frequencies are allowed to drop to 47.5 Hz or rise to 52 Hz before the generating unit is allowed out of operation.

Maintaining the balance of the frequency system can also provide sufficient backup power. The electricity condition of Nias Island currently reaches 38 MW, with conditions 2 times the peak load in the morning and night. Nias Island electricity relies on its main plant, namely PLTMG 5X5 MW and assisted by a 15 MW capacity rental plant.

2. LITERATURE REVIEW

2.1 Substation

Substation is a subsystem on the Electric power system, as a transmission system. Substations have an important role in their operation cannot be separated from the distribution system. Overall the

substation is equipped with the necessary facilities and equipment in accordance with its purposes and has operating and maintenance facilities.

2.2 Relay Frequency

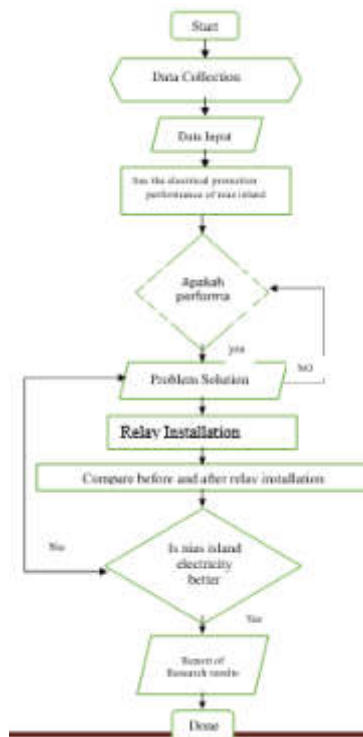
Frequency Relay serves to read large frequencies while giving commands when responding to frequency changes that reach values beyond the limits that have been set. Frequency relays are divided into OFR (Over Frequency Relay) which functions as a safety on the generator and UFR (Under Frequency Relay) which serves to secure if the system frequency decreases to beyond the tamed limit or setting value on the UFR relay. In addition to reading changes in frequency, UFR also acts as a regulator for the load release system partly as a follow-up to the occurrence of frequency reduction.

2.3 PLTMG (Pembangkit Listrik Tenaga Mesin Gas)

A gas engine power plant is a plant that uses two fuels, namely fuel oil (BBM) and Liquid Natural Gas (LNG).

3 METHODS.

This research was conducted on the high voltage side (70kV Transmission) using software, PCM 600 and Power DB with megger SMRT 410 Data used in the form of Load data and single line data of Gunung Sitoli GI diagram. The data used refers to data obtained from PT PLN (Persero). From the data obtained, simulations were carried out on the PCM 600 software to set the desired UFR value to find out the magnitude of the frequency decrease that occurred in the Gunung Sitoli GI system and know the UFR's performance in response to the frequency decrease that occurred in the CIOM Mountain GI. The image below is an image of the research analysis flow. It starts with collecting technical data related to relay setting analysis. Continued by creating a single line diagram in GI Gunung Sitoli and providing an example of a state of disturbance that makes the system frequency decrease by providing the state of the Generating Machine that bears the gi load of Mount Sitoli trip. The simulation was carried out using the UFR drop practice method in Power DB Software.



4. RESULTS AND DISCUSION

4.1 Planning Result

Nias Electricity Condition consists of 2 substations with a load growth of 38.1 MW in 2021. PLTMG Nias operates with Island Mode or Load Share mode and PLTMG load is transmitted through substations the mother of the Gunung Sitoli. PLTMG nias began to support nias electricity in 2019, the electricity of nias island at that time experienced a variety of disturbances both from nature and the equipment itself. The interference data can be seen from the image below.



Figure 2. Comparison of Black Out in 2019 – 2020 Nias Island

At the beginning of PLTMG operation is a challenge for all people who work to support the electrical reliability of Nias Island. In the image above, you can see 53 black out disturbances and in 2020 it has been reduced 21 times while now from the existing data there has not been a single Black out disturbance on nias island.

This proves that the nias island network is as reliable in meeting the needs of electricity supply on nias island. Black out interference can be overcome by improving UFR performance by breaking loads in various kinds of refiners. This solution proved to be able to reduce black out disturbances on nias island.

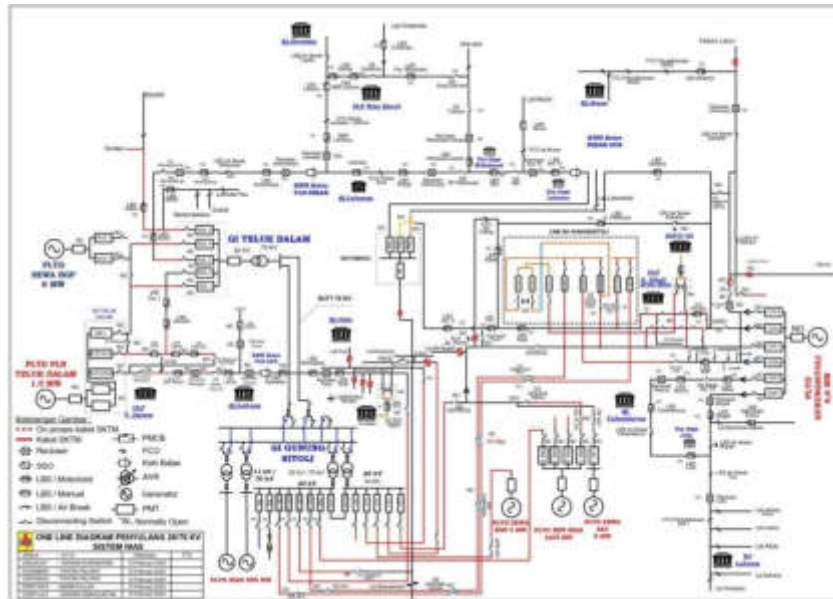


Figure 3. Single Line Diagram Pulau Nias

The image above is a single line diagram of nias island from the transmission of the transmitting voltage up to be transmitted by substations to all regions of nias island.

Tabel 1. Nias Island Equipment Data

Pembangkit	PLTMG	
	Jumlah Unit	5
	Daya / unit	6,9 MW
	PLTG	
	Jumlah Unit	1
	Daya / unit	25 MW
	PLTD	
	Jumlah Unit	15
	Daya / unit	0,8 MW
Trafo GI	Main Trafo	
	Jumlah unit	9
	Tegangan primer	77 KV
	Tegangansekunder	20 KV
Beban	Pulau Nias	50 MW
	GI GunungSitoli	29,1
	GI teluk Dalam	9,1

The electricity of Nias Island is its main source comes from pltmg plants. Synchronous PLTMG on the 11 kv network then the voltage is increased to 70 KV in the gunung Sitoli substation transformer to transmit. Another thing with pltd that helps the electricity system of nias island at the time of the peak load of the pltd will be in sync at 20 kv.

4.2 Simulation and analysis of case Studies

The simulation was conducted using case studies by lowering the frequency on the DB power software that has been installed to the transformer and also the megger tool whose setting value has also been installed using the PCM 600 application. This case study was conducted to find out whether the UFR is correct or does not release PMT if it reaches its setting value in restoring the system to avoid from the black out.

UFR performance must be reliable and fast in its operation. The decrease in load that is trigger by the weight of work of a generating system caused by the trip unit of the plant becomes the main impact of the decline in UFR. If the UFR has reached its setting value, it must quickly signal to the PMT to perform load release so that the frequency can recover. The release of the load on nias island is divided into 3 stages, namely:

Tabel 2. load release stage data

TAHAP	FREK (HERTZ)	PENYULANG
I	48,0	GB 2
II	47,6	NS 2
III	47,4	GB 3

When the frequency touches the above number and lasts a maximum of 5 seconds, there must be a load that must be automatically reduced by coordinating UFR and PMT so that UFR performance can be restored to meet nias electricity needs. If the frequency. Touch the number in stage 3 and last for 5 seconds then the nias island system will be extinguished or Black Out.

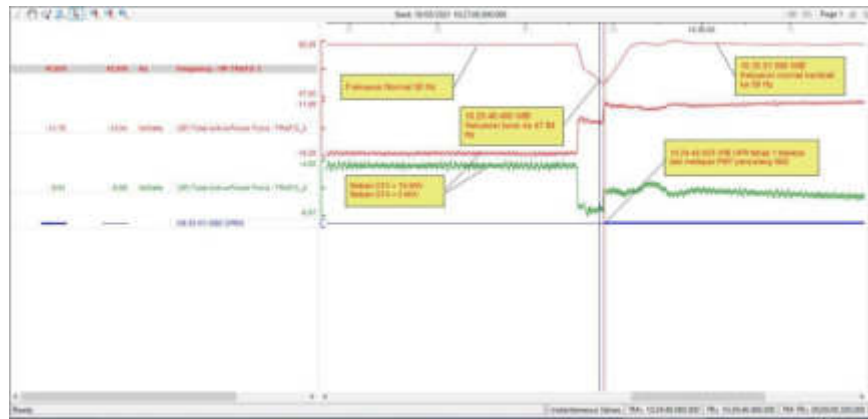


Figure 4. UFR happens due to the generator unit trip

At 10:27 a.m. the normal frequency then there is a decrease in frequency at 10:29 and UFR stage one immediately works. The image above is a simulation of the release of a generator breaker or synchronous breaker at a load of 5 mw which causes UFR stage 1 to work. When one of the generating units resigns by force there must be a spare load that is able to withstand the surge of the load, this method of operation is called Load share Mode. In regulating the spare load of the plant can also reduce the impact of this UFR disruption because the plant is still able to withstand the surge in load that will be carried by other plants in PLTMG.

5 CONCLUSION

Based on UFR Analysis on the unit of the plant and substation of mount sitoli, it can be drawn some conclusions as follows.

1. At the time of simulation of 5 MW load release from the generator synchronous breaker only resulted in UFR stage 1 work did not cause blackout impact on nias island electricity system
2. Simulation can only be done once even with situations and conditions that have been estimated not to cause excessive disruption impacts and spare loads have also been calculated so that they can be carried with other plants.
3. The results of the analysis also show that the electricity of nias island is increasingly reliable with the reduced number of disturbances

REFERENCE

- [1] PT PLN Nias Plant Master Unit. Nias Generation Unit Data. Sumut: PT PLN Nias Generation Unit 2019.
- [2] Marsudi, Jiteng, Operation Of The Electric Power System. Yogyakarta: Graha Ilmu, 2006.
- [3] D. Marsudi, Power Generation. Jakarta: Erlangga, 2011.
- [4] Island Operation Sistem Tenaga Listrik Jawa Tengah bulan Maret tahun 2003.
- [5] Bhrama Sakti, Study of Ufr Analysis On Substations of Pesanggaran. Bali : PT PLN 2019.