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USING THE RATE OF CHANGE OF FREQUENCY AND THRESHOLD FREQUENCIES IN LOAD SHEDDING IN A DG-FED ISLANDED SYSTEM

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ABSTRACT: Whenever a distribution network is about to become unstable, protection relays will start to work, thus creating unintentional islanding. In order to keep balance between generated and consumed power in an islanded system, it is necessary to shed loads. This paper proposes a new method for load shedding based on the rate of change of frequency (RoCoF) at the first step and on threshold frequencies at subsequent steps. For this purpose, three lookup tables were created in order to prioritize loads to be shed according to the willingness of subscribers to pay (WSP) and the RoCoF. The strength of the proposed method was verified by considering four cases. Consumption load was considered as voltage- and frequency-dependent in three of the cases, and as constant-power in the fourth case. The results indicate that the proposed method is flexible and, in comparison with previous research, results in a slighter frequency decline and stabilizes the islanded system in a shorter time.
KEYWORDS: DG resources, islanding, load shedding, rate of change of frequency, threshold frequencies

INTRODUCTION

In the early days of power industry, generators were small in size and low in capacity. Advances in technology brought in AC networks. Pursuit of financial benefits led power utilities to generate more electricity. However, large power networks impose huge maintenance costs. In the last decade, this revived interest in small-size generators, which are often known as distributed generation (DG) resources and play a key role in generating electrical energy in power networks.

An instance of DG use is when an islanded system is in need of power. Islanding happens either intentionally or unintentionally. In the former case, upstream circuit breakers are opened on purpose. The latter case is when a fault occurs in the system, causing the protection relays to command islanding [1-3]. The voltage and frequency of the loads in a DG-fed islanded system should be within desired limits. The only way of achieving this would be through load shedding. Load shedding has been extensively researched over the past few years. In the approach adopted by [4], load shedding for high power was performed according to the qv curve (reactive power margin) outside of a limit defined for the voltage and frequency. Ref. [5] based load shedding on operator experience and studied three different load shedding schemes: invariable maximal load shedding with the amount of load shed per step being fixed, invariable maximal load shedding with the amount of load shed per step being variable, and variable maximal load shedding with the amount of load shed per step being variable. Where the amount of load shed per step was variable, load was shed in accordance with the rate of frequency decline. In [6], where load shedding was based on active power and rate of change of voltage, the Kalman filter was utilized to estimate the rate of change of voltage and frequency. Ref. [7] estimated minimum nominal voltage and threshold voltage using pv(active power margin) and qv curves and defined load shedding according to under-voltage and under-frequency. This means that the under-frequency relay commands load shedding if the voltage of certain buses decreases below the threshold level. In [8], the coefficients of the Slovenian load shedding standards system was modified in accordance with power deficiency (dp). The load shedding scheme used in [9] was based on the Supervisory Control And Data Acquisition (SCADA) system, where the scheme is done for the high power.

The methods and approaches reviewed above involved generators as strong as large power plants. However, to the best of our knowledge, only one study [10] has investigated load shedding in islanded systems fed by low-capacity DG resources. This reference discussed load shedding in terms of the rate of change of frequency (RoCoF) and created a lookup table in order to prioritize loads. The *main problem with this method was that it caused considerable frequency decline and brought about slow-pace stability.*

The method proposed here aims to stabilize an islanded system in as short a time as possible. In this method, the first step is based on the RoCoF, and other steps have basis on threshold frequencies. Using this method, there will be less frequency decline, and stability will be reached at a faster pace.

PROBLEM STATEMENT

Load shedding results in an economically and technically optimized islanded system. Economic optimization is accomplished if fewer loads are shed; technical optimization if the voltage and frequency of the loads are put within desired limits.

Load shedding can be carried out in the following way [10]. A lookup table is created in order to determine in which order loads should be shed. Prioritization is based on the two factors of willingness of subscribers to pay (WSP) and the RoCoF. Table 1 is a lookup table. From left to right, the columns give the shedding priority of each load, the name of each load in the islanded system, the WSP for each load (as the main prioritizing factor), the RoCoF of each load, and the cumulative RoCoF (as the factor that determines the amount of load shedding at the first step).

Table 1. A lookup table

Shedding priority	First Case			
	Load name	WSP	RoCoF	Cumulative RoCoF
1	Load 09			
2	Load 10			

To determine how many loads should be shedded at the first step, the RoCoF of the islanded system calculated after the first half-cycle (10ms) is compared with the cumulative RoCoF in the lookup table for that half-cycle, where the cumulative RoCoF is calculated by $\sum_{i=1}^{NL} RoCoF_i$.

The shedding priority to be chosen will be the one corresponding to the cumulative RoCoF larger than the RoCoF of the islanded system.

Table 2. The method proposed in [10]

	Prerequisite for load shedding in an islanded system	Load(s) to be shed in an islanded system
Step one	A comparison of the RoCoF of the islanded system after the first half-cycle (10 ms) and the cumulative RoCoF in the lookup table	The shedding priority corresponding to the cumulative RoCoF larger than the RoCoF of the islanded system
Step two and the following steps	Decreasing RoCoF of the system for 10 continuous half-cycles with f<49.5 Hz	a single load at each step

At each subsequence step, a single load is shed. To determine where one step ends and the next step starts, two condition are considered: (1) the frequency of the islanded system at every step should be less than 49.5Hz (A normal system has a frequency of 50Hz), and (2) the RoCoF of the system (df/dt) for 10 continuous half-cycles should tail off as we progress from one step to the next. Load shedding stops permanently when the first condition is violated. Indeed, this violation means the system has reached stability. Also, if the first condition still holds, but the RoCoF begins to rise, load shedding is temporarily discontinued waiting to see if this rising trend continues or reverses. Table 2 and Figure 1 demonstrate the load shedding process.

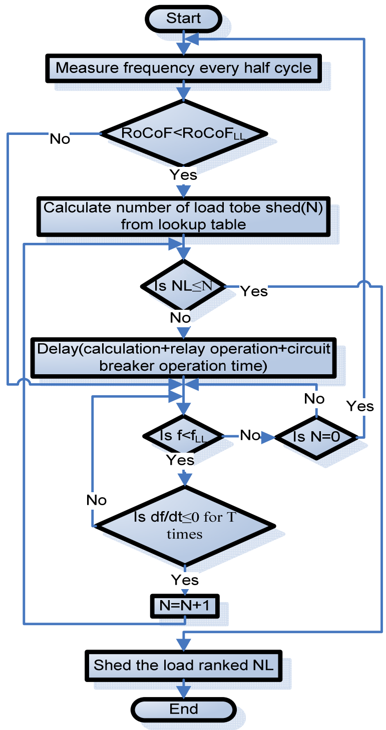

Figure 1. The flowchart presented in[10].

The method described above suffers from a major problem, which is the long time required for a single load to be shed from the second step onward. This “delay” is 100ms long (equal to 10 half-cycles). The problem becomes more serious if load shedding involves a great number of steps. This causes the frequency to decline even further and ultimately slows down the process of system stabilization. The present paper proposes a solution to this problem.

RoCoF: Rate of Change of Frequency of the islanded system
RoCoFLL: cumulative of the consuming load
N: the number of the shedded consuming load
NL: ranking of the consuming load
f: system frequency
fLL: threshold frequency for stability

PROPOSED METHOD

The proposed method is like the one described above: lookup tables were created considering the two factors of WSP and RoCoF, load shedding at the first step was based on the RoCoF of the islanded system, and a single load was shed at each subsequent step.

However, a difference is that threshold frequencies, rather than the RoCoF, were used for load shedding at subsequent steps. For the second step, it was decided that load shedding start if the frequency of the islanded system declines by a certain degree according to [11]. According to [11], whenever the frequency of the system declines to 49Hz, a certain percentage of the system loads should be shed. However, in the proposed method only one load is shed in such cases. Another difference is that the standard demands the last step to start when the frequency of the system reaches 48Hz, but in our method a frequency of 47.5Hz [12, 13] is taken as an indicator of the last step of load shedding. In the method proposed in this paper, from the second step onward, one load is shed from the system in order of priority each time the frequency declines by the predetermined degree. Load shedding stops permanently when the predetermined degree of frequency decline does not take place.

Figure 2 is a flowchart of the present method.

It should be noted at this stage that using threshold frequencies instead of the RoCoF for subsequent steps saved us the problem associated with the method described above. In the proposed method, the greatest level of frequency decline was at the last step: 48Hz at the fifth step for voltage- and frequency-dependent load, and 47.5Hz at the sixth step for constant-power loads.

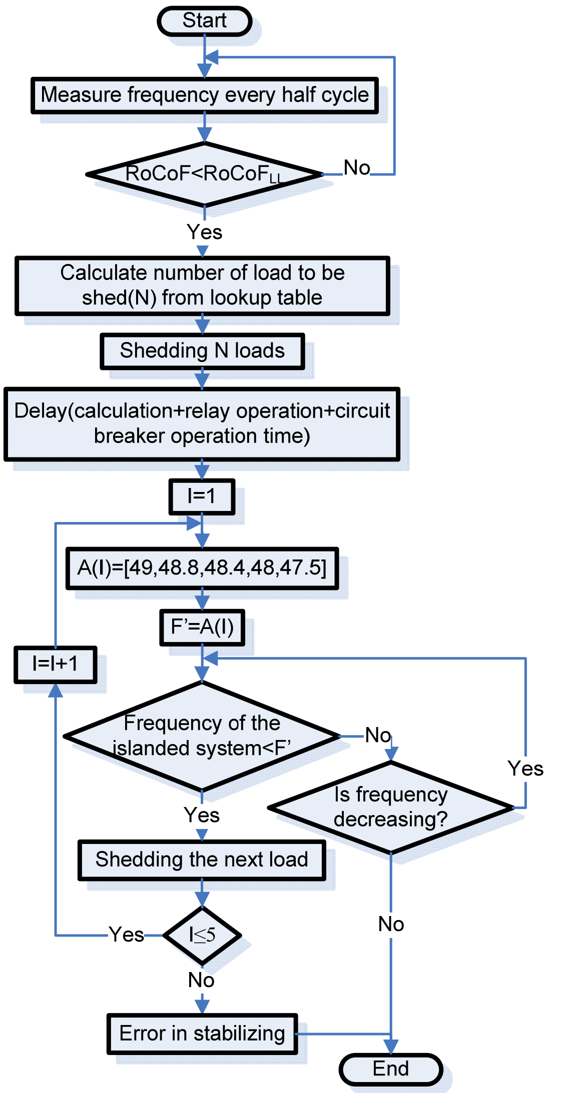

Figure 2. The flowchart of the proposed method

SIMULATION

The proposed method was simulated using DIgSILENT Version 14.0. This software is capable of modeling power networks and simulating different kinds of faults. Figure 3 shows the system in which the proposed method was tested. This system is part of a distribution network in Denmark and consists of 11 loads, three 630-kW fixed-speed stall-regulated wind turbine generators (WTGs), and a combined heat and power (CHP) plant with three 3-MW gas turbine generators (GTGs). WTGs and the CHP plant operate at unity power factor. The distribution system is linked to a transmission network at Bus 05.

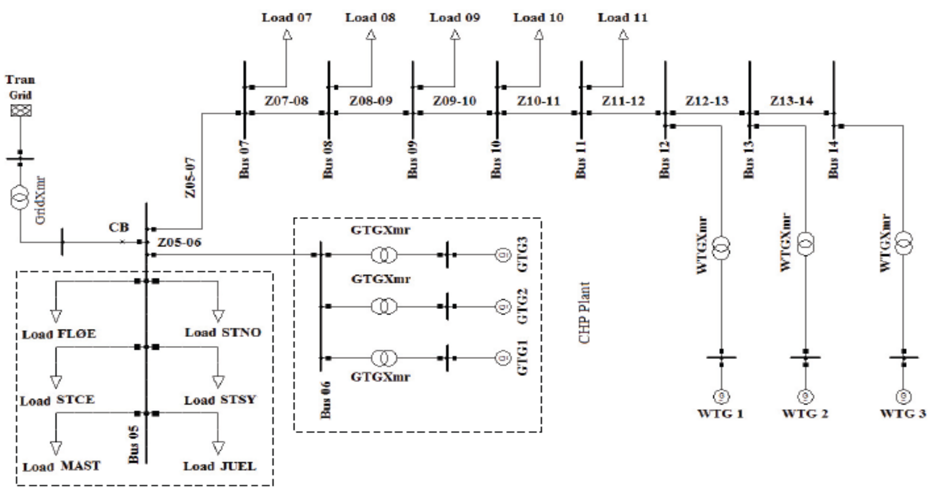

Figure 3. The test system

For the purpose of this study, an IEEE-type ST1 excitation system [14] and GAST model [15], both available in DIgSILENT, were used to model exciter and governor systems in GTGs, respectively. In addition, WTGs were modeled as a two-mass system [16]. Islanding was simulated by opening the circuit breaker (CB). All the relevant data are given in [17].

As the loads in an actual system are always voltage and frequency dependent, the loads in DIgSILENT were se to the 100% dynamic mode so that they could truly represent the reality. (1) is the mathematical representation of this simulation.

$$P = P_0\left(1 + K_{pf}\Delta f + K_{pv}\Delta V\right)$$
$$Q = Q_0\left(1 + K_{qf}\Delta f + K_{qv}\Delta V\right) \quad (1)$$

where:

P : *active power at the new voltage and frequency*

P_0 : *active power at the base voltage and frequency*

Q : *reactive power at the new voltage and frequency*

Q_0 : *reactive power at the base voltage and frequency*

K_{pf} : *coefficient of the dependency of the active power of the load on frequency*

K_{pv} : *coefficient of the dependency of the active power of the load on voltage*

K_{qf} : *coefficient of the dependency of the reactive power of the load on frequency*

K_{qv} : *coefficient of the dependency of the reactive power of the load on voltage*

Δf : *frequency change in per unit*

ΔV : *voltage change in per unit.*

The power of the load will be constant if the coefficients are 0; and highly dependent on frequency and voltage if the coefficients are 1. Thus, the value of each coefficient was considered to be 0.5 so that to have a balanced RoCoF.

In this section, if the value of the coefficient is chosen to be in the interval [0, 1] the rate of change of system frequency does not vary.

Tables 3, 4, and 5 are the three lookup tables created in the present study.

Table 3. Lookup table for Case 1

shedding priority	case 1							
	load name	WSP	RoCoF	Cumulative RoCoF	RoCoFv	Cumulative RoCoFv	dp	Cumulative dp
1	Load 09	0.81	-21.7	-21.7	-1.7027	-1.7027	-83.5099	-83.5099
2	Load 10	0.83	-21.7	-43.4	-1.7027	-3.4054	-83.5099	-167.0199
3	Load 11	0.86	-21.7	-65.1	-1.7027	-5.1081	-83.5099	-250.5299
4	Load 07	0.87	-25.1	-90.2	-1.7908	-6.8989	-88.5935	-339.1235
5	Load 08	0.89	-28.5	-118.7	-1.8736	-8.7726	-93.4586	-432.5821
6	JUEL	0.91	-29.6	-148.3	-1.9011	-10.6737	-94.7444	-527.3266
7	STCE	0.92	-32.5	-180.8	-1.9824	-12.6561	-99.4948	-626.8214
8	FLOE	0.93	-40.9	-221.7	-2.2084	-14.8646	-111.9883	-738.8098
9	STSY	0.95	-41.1	-262.8	-2.2151	-17.0798	-112.2833	-851.0931
10	STNO	0.96	-38.7	-301.5	-2.1469	-19.2266	-108.6315	-959.7246
11	MAST	1	-48.9	-350.4	-2.4404	-21.6671	-125.1918	-1084.9164

Table 4. Lookup table for Case 2

shedding priority	case 2							
	load name	WSP	RoCoF	Cumulative RoCoF	RoCoFv	Cumulative RoCoFv	dp	Cumulative dp
1	STSY	0.79	-41.1	-41.1	-2.2151	-2.2151	-112.2833	-112.2833
2	Load 10	0.84	-21.7	-62.8	-1.7027	-3.9178	-83.5099	-195.7933
3	STNO	0.85	-38.7	-101.5	-2.1469	-6.0647	-108.6315	-304.4248
4	Load 09	0.86	-21.7	-123.2	-1.7027	-7.7674	-83.5099	-387.9348
5	STCE	0.89	-32.5	-155.7	-1.9824	-9.7498	-99.4948	-487.4296
6	Load 07	0.9	-25.1	-180.8	-1.7908	-11.5407	-88.5935	-576.0232
7	Load 08	0.91	-28.5	-209.3	-1.8736	-13.4144	-93.4586	-669.48186
8	FLOE	0.95	-40.9	-250.2	-2.2084	-15.6229	-111.9883	-781.4702
9	Load 11	0.98	-21.7	-271.9	-1.7027	-17.3256	-83.5099	-864.9802
10	JUEL	0.99	-29.6	-301.5	-1.9011	-19.2266	-94.7444	-959.7246
11	MAST	1	-48.9	-350.4	-2.4404	-21.6671	-125.1918	-1084.9164

Table 5. Lookup table for Case 3

shedding priority	case 3							
	load name	WSP	RoCoF	Cumulative RoCoF	RoCoFv	Cumulative RoCoFv	dp	Cumulative dp
1	MAST	0.89	-48.9	-48.9	-2.4404	-2.4404	-125.1918	-125.1918
2	Load 07	0.9	-25.1	-74	-1.7908	-4.2313	-88.5935	-213.7853
3	Load 09	0.91	-21.7	-95.7	-1.7027	-5.9340	-83.5099	-297.2953
4	Load 10	0.92	-21.7	-117.4	-1.7027	-7.6367	-83.5099	-380.8053
5	STCE	0.93	-32.5	-149.9	-1.9824	-9.6191	-99.4948	-480.3001
6	STNO	0.94	-38.7	-188.6	-2.1469	-11.7660	-108.6315	-588.9316
7	Load 11	0.95	-21.7	-210.3	-1.7027	-13.4687	-83.5099	-672.4416
8	JUEL	0.96	-29.6	-239.9	-1.9010	-15.3698	-94.7444	-767.1860
9	FLOE	0.97	-40.9	-280.8	-2.2084	-17.5783	-111.9883	-879.1744
10	Load 08	0.99	-28.5	-309.3	-1.8736	-19.4520	-93.4586	-972.6331
11	STSY	1	-41.1	-350.4	-2.2151	-21.6671	-112.2833	-1084.9164

The RoCoF formula is (2) below:

$$RoCoF = \frac{df}{dt} \tag{2}$$

For each of the loads in the lookup table, dt was conventionally decided to be 10 ms, equal to a half cycle. For df, we needed DIgSILENT. To give us df, the software needed dp, the difference between generated power and consumed power in an islanded system. For different loads, we provided the software with different values of generated power and consumed power. This was because we wanted the difference between the two in the case of each load to be equal to the active power of that load.

Voltage-dependent RoCoF (RoCoFv) and Deficiency of Power (dp) in the tables are the functions which were used as two alternatives to the RoCoF. However, no significant difference was observed between the three functions as they determined the same number of loads to be shed. The formulae for calculating RoCoFv and dp are given in [18].

The cumulative values of RoCoF, RoCoFv, and dp were calculated because we wanted to predict roughly how many loads should be shed for the islanded system to suffer from less deficiency of active power.

$$RoCoF = \frac{df_{Hz}}{dt} = \frac{P_{def} . f_N}{2H_{eq} . S_{eq}} \tag{3}$$

$$RoCoF_v = \frac{f_N}{2H_{eq} . S_{eq}} \sum_{i=1}^{m} P_{L0,i} \cdot \left[\left(\frac{U_i}{U_{0,i}} \right)^{\alpha_i} - 1 \right] \tag{4}$$

$$dp = \frac{2.H_{COI}}{f_N} . \frac{df_{COI}}{dt} .100 + \sum_{i=1}^{m} P_{L0,i} \cdot \left[\left(\frac{U_i}{U_{0,i}} \right)^{\alpha_i} - 1 \right] . \frac{100}{P_{L0}} \tag{5}$$

$P_{L0,i}$ is the value of the active power of the ith consumer's load.
P_{L0} is the value of the active power of the consumer's load.
U_i is the value of the nth load.
$U_{0,i}$ is the value of the nth load before disturbances in the system.
ai is the active power coefficient which depends on the nth load usage that is considered to be 1 according to [8]

H_{COI} , df_{COI} *and* $\frac{f_N}{2H_{eq} . S_{eq}}$ *the lookup tables are omitted from the formula 5 and it is the same for all cases (the cases before disturbances)*

Following [10] and using the lookup tables, four cases were considered in order to verify the robustness and flexibility of the proposed method in shedding loads from an islanded system.

Case 1 (Table 3): It is assumed that customers are least willing to pay for the loads with the least active power. Thus, prioritizing loads according to WSP would mean putting the loads with the least active power before those with the greatest active power.

Case 2 (Table 4): It is assumed that there is no relationship between WSP and active power. Thus, prioritizing loads according to WSP would mean putting loads in random order according to the active power.

Case 3 (Table 5): As in Case 2, loads were randomly arranged. However, the difference is that here the load to be shed first is the one with the greatest active power.

For these three cases, voltage- and frequency-dependent consumption load was taken into account, and the system RoCoF was calculated to be -23.4Hz/s.

However, to capture all the possibilities, a fourth case was included in the simulation. This case is like Case 1, but the difference is that here the consumption load is of a constant-power type. The system RoCoF used for this case was calculated to be -24 Hz/s.

It should be noted at this point that like in [10] the lookup tables were created using the data obtained from the test system in December 2006. These tables were then used to predict what the test system would be like in the following month (i.e., January 2007). The system was islanded at the 0th second. Also, it was assumed that it takes each circuit breaker 80 ms to open.

SIMULATION RESULTS AND DISCUSSION

The four cases noted above will first be studied in detail. Then, a comparison will be drawn between the method proposed in this paper and the method employed in [10] along the following lines:

- *The maximum amount by which the frequency of the islanded system overshoots (i.e., exceeds 1p.u.): the smaller the amount, the faster the system reaches stability.*
- *The maximum amount in Hz by which the frequency of the islanded system declines: the smaller the amount, the faster the system reaches stability.*
- *The sum of squares of frequency required for the frequency of the islanded system to reach 1p.u.: this roughly equates with variance.*
- *The length of time it takes the frequency of the islanded system to reach 1p.u.: the shorter the time, the faster the system reaches stability.*

Case1

The lookup table for Case 1 shows that the RoCoF calculated for the islanded system is larger than the cumulative RoCoF value of Load 09 and smaller than the value for Load 10. This means that these two loads are simultaneously shed at 0.09s. Then, we wait for the frequency of the system to decline to 49Hz. Once this happens (at 0.11s), Load 11 is shed at 0.19s. The next step in frequency decline is 48.8 Hz (at 0.13s), causing Load 07 to be shed at 0.21s. The final loads to be shed are Load 8 and JUEL, at 0.25s and 0.32s, respectively. It is worth noting here that we simply care about protecting the islanded system from collapsing and do not wait for the response of the system. Thus, while we are waiting for a shedding command to be executed, another command may be issued for the next-priority load. The details can be seen in Table 6 and Table 7. In addition, Figure 4 and Figure 5 compare the method proposed here and the one used in [10] in terms of the status of the frequency of the islanded system after load shedding.

Table 6. Load shedding time line (Case 1)

Name of circuit breaker	Operation time of circuit breaker
Load09	0.09s
Load10	0.09s
Load11	0.19s
Load07	0.21s
Load08	0.25s
JUEL	0.32s

Table 7. The relationship between load shedding steps and frequency values (Case 1)

	System RoCoF in the first half-cycle	49 Hz	48.8 Hz	48.4 Hz	48 Hz
Step one	■				
Step two		■			
Step three			■		
Step four				■	
Step five					■

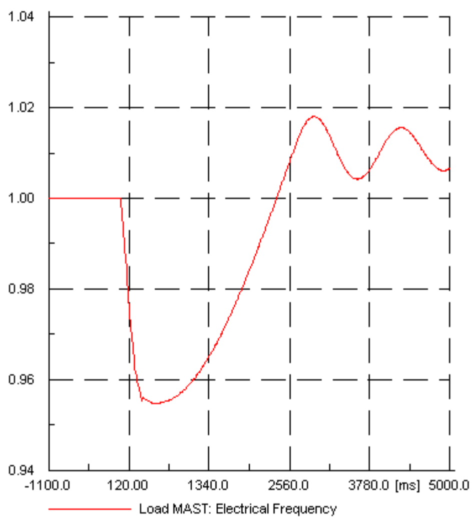

Figure 4. Frequency of the islanded system after load shedding in the proposed method

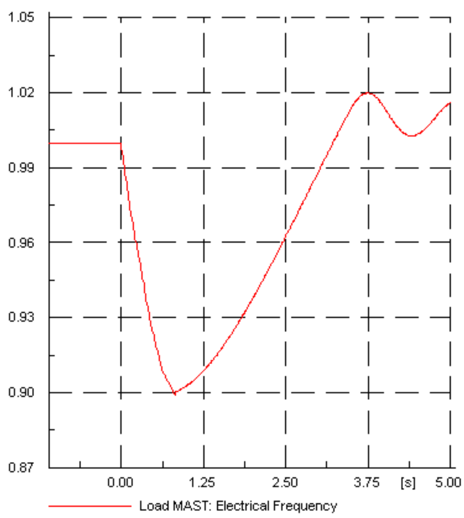

Figure 5. Frequency of the islanded system after load shedding in the method used in [10]

As can be seen, the proposed method has two major advantages over the method used in [10]:

- ☐ *The maximum amount by which the frequency of the islanded system declines is 2.2587Hz in the proposed method and 5.0336 Hz in the method used in [10].*
- ☐ *The frequency reaches 1p.u. at 2370ms in the proposed method and at 3230ms in the method used in [10]. As can be seen, the proposed method has two major advantages over the method used in [10].*

Case 2

The lookup table for Case 2 shows that the RoCoF calculated for the islanded system is smaller than the cumulative RoCoF value for the first-priority load (i.e., STSY). This load will be shed at 0.09s. Then, once the frequency of the system goes down to 49Hz (at 0.13s), Load 10 is shed at 0.21s. And lastly, the system frequency drops to 48.8Hz (at 0.21s), causing STNO to be shed at 0.29s. Table 8 and Table 9 give the details. Also, Figure 6 and Figure 7 depict the post-shedding status of the frequency of the islanded system in the proposed method and the method employed by [10], respectively.

Table 8. Load shedding time line (Case 2)

Name of circuit breaker	operation time of circuit breaker
STSY	0.09s
Load10	0.21s
STNO	0.29s

Table 9. The relationship between load shedding steps and frequency values (Case 2)

	RoCoF of the islanded system in the first half-cycle	49 Hz	48.8 Hz
step one			
step two			
step three			

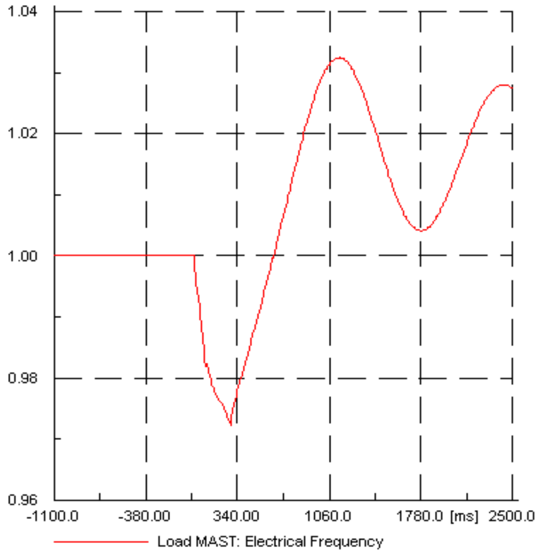

Figure 6.Frequency of the islanded system after load shedding in the proposed method

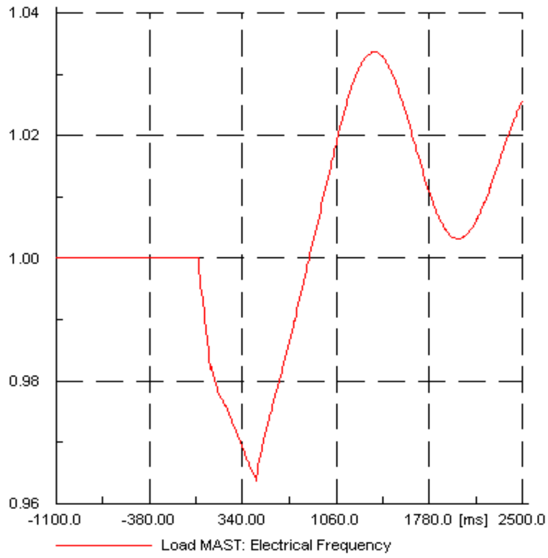

Figure 7. Frequency of the islanded system after load shedding in the method used in [10]

According to the figure, the proposed method is better than the method used in [10] in two main ways:

- ☐ *The maximum amount by which the frequency of the islanded system declines is 1.3848Hz in the proposed method and 1.8146 Hz in the method used in [10].*
- ☐ *The frequency reaches 1p.u. at 630ms in the proposed method and at 860ms in the method used in [10].*

Case 3

The lookup table for Case 3 shows the RoCoF calculated for the islanded system to be smaller than the cumulative RoCoF value for the first-priority load (i.e., MAST). This load will be shed at 0.09s. However, load shedding does not go beyond the first step since the frequency of the system does not drop to 49Hz. No difference was observed in this case between the method proposed here and the one used by [10]. Table 10 and Table 11 present the detailsFigure 8 illustrates the post-shedding status of the frequency of the islanded system which turned out to be the same in the proposed method and the method employed in [10].

Table 10. Load shedding time line (Case 3)

Name of circuit breaker	operation time of circuit breaker
MAST	0.09s

Table 11. The relationship between load shedding steps and frequency values (Case 3)

	RoCoF of the islanded system in the first half-cycle
step one	

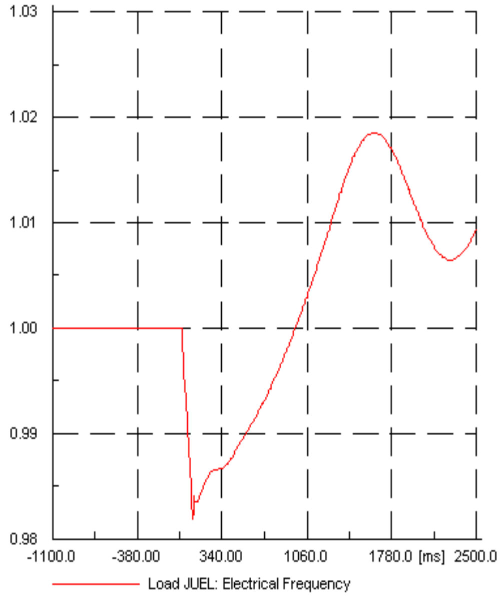

Figure 8. Frequency of the islanded system after load shedding in the proposed method and the method used in [10]

Before we deal with Case 4, it is well worth considering that in terms of the length of time it takes the frequency of the islanded system to reach 1 p.u., the amount by which the system frequency declines, the number of steps involved in load shedding, and a few other factors, Cases 1 and 3 are the worst and the best, respectively. Case 2 falls somewhere in between.

Case 4

The lookup table used here is similar to the one used for Case 1. This worst-case lookup table was used because we believed that if the proposed method could prove robust and flexible in this case, it would certainly prove the same in other cases.

Table 12. Load shedding time line (Case 4)

Name of circuit breaker	operation time of circuit breaker
Load09	0.09s
Load10	0.09s
Load11	0.18s
Load07	0.2s
Load08	0.25s
JUEL	0.31s
STCE	0.78s

The details can be seen in Table 12 and Table 13. Furthermore, Figure 9 and Figure 10 display the post-shedding status of the frequency of the islanded system in the proposed method and the method employed by [10], respectively.

Table 13. The relationship between load shedding steps and frequency values (Case 4)

	RoCoF of the islanded system in the first half-cycle	49 Hz	48.8 Hz	48.4 Hz	48 Hz	47.5 Hz
step one						
step two						
step three						
step four						
step five						
step six						

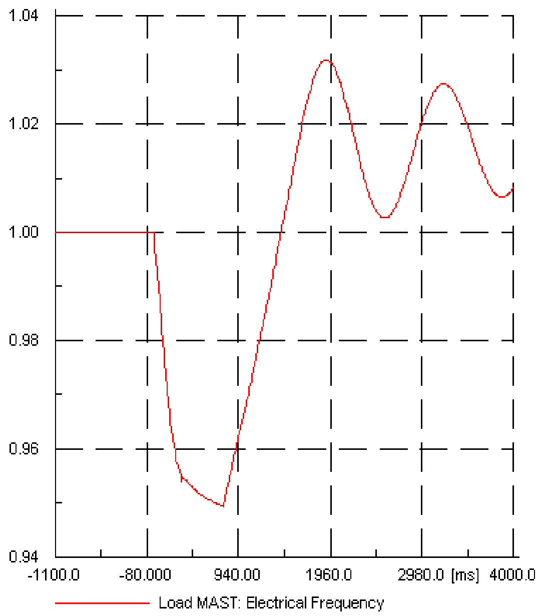

Figure 9. Frequency of the islanded system after load shedding in the proposed method

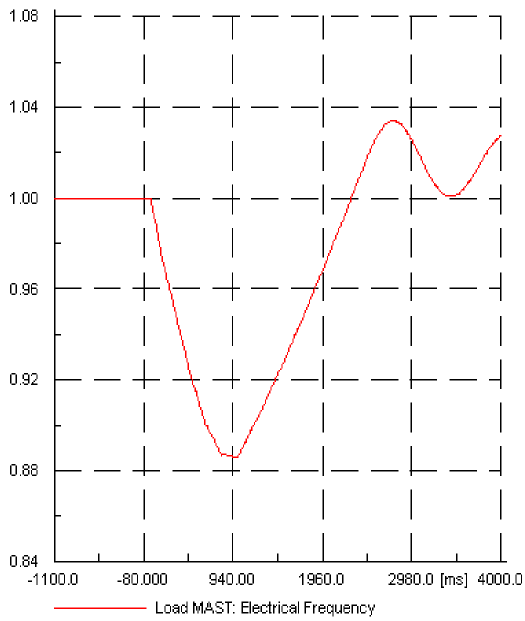

Figure 10. Frequency of the islanded system after load shedding in the method used in [10]

From the figure it can be seen that the proposed method has two important advantages over the method deployed in [10]:

The maximum amount by which the frequency of the islanded system declines is 2.5328Hz in the proposed method and 5.7184 Hz in the method used in [10].

The frequency reaches 1p.u. at 1420ms in the proposed method and at 2300ms in the method used in [10].

On the whole, the proposed method proved to be more desirable than the method used in [10] as Table 14 summarizes. Both methods result in the same number of loads being shed in each case; however, in addition to improving the factors in the table, the proposed method causes the frequency of the islanded system to dampen in a shorter time.

Table 14. Performance comparison between the proposed method and the method employed in [10]

		Frequency overshooting (p.u.)	Frequency decline (Hz)	Variance	Time at which frequency reaches 1 p.u. (sec.)	Simulation time (sec.)
old method	case1	0.0198	5.0336	1.4027	3.23	5
	case2	0.0336	1.8146	0.0449	0.86	2.5
	case3	0.0185	0.9058	0.0107	0.97	2.5
	case4	0.0339	5.7184	1.2814	2.3	4
new method	case1	0.0179	2.2587	0.2600	2.37	5
	case2	0.0324	1.3848	0.0193	0.63	2.5
	case3	0.0185	0.9058	0.0107	0.97	2.5
	case4	0.0319	2.5328	0.1946	1.42	4

CONCLUSIONS

The conventional load shedding strategy that is used in large power systems cannot be implemented as successfully in islanded systems because the two systems are characteristically different. The load shedding strategy introduced in this paper takes account of economic and technical considerations as it result in putting the frequency of the loads within the desired limits. Two main advantages of the proposed method is that it causes less frequency decline and stabilizes the islanded system faster than does the old method. It is observed that, if it is stable at threshold frequencies then the stability is occurred otherwise it becomes unstable. This procedure was tested on a real system and a positive result was obtained.

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