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Injection Analysis of Hera And Betano New Power Plants At the Interconnection System in Edtl of Timor Leste

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ABSTRACT: Electricity system in Timor Leste is supplied from small scale Diesel Power Plants (DPP) which are distributed at each district that not interconnected, as the consequences, electric continuity at some districts are disturbed so caused power outage. To overcome the matters, the steps taken by Timor Leste government by establishing 2 units of centered DPP with total capacity of 250 MW at Dili District of 120 MW and at BetanoDistrict of 130 MW. The new power plant will be injected at the electricity system of Timor Leste through transmission line of 150 kV. The new power plant injection will cause the power flow and system stability of Timor Leste entirely. Steady state analysis done including the power flow analysis before and after injection of DPP of Hera and Betano so can be seen the voltage profile change and the decrease of electric power losses. Beside the steady state analysis, also done the power system stability analysis to know whether the system can operate normally after short circuit disturbance of three phases before and after new DPP injection. The steady state analysis showed that the system voltage condition before injection of DPP of Hera and Betano experience decrease of -13% from the sending voltage, and the active power losses of 6.8%. After DPP of Hera and Betano injection the decrease only -6% and active power losses can be minimized become 5.3%. The results of power system stability showed the rotor angle stability, frequency and voltage stability during disturbance occurrence become more stable after injection with recovery time faster if compared with before injection of new power plant.

Keywords: Steady State, dynamic stability, new powerplant, Hera DPP injection, Betano DPP injection.

I. INTRODUCTION

Timor Leste is a new state with republic form, mostly with mountainous area in 15.410 km^2 with population of 1.143.667 people distributed in 13 district(provinces) and Dili as it capital. Electric energy needs in Timor Leste since 2002 of independence to 2011increases continuously. The availability of power plant unable to fulfill the electricity consumer so needs electric power plant with higher capacity. Electricity system in Timor Leste since 2002to 2011 has Diesel Power Plant (DPP) with middle distribution system 20 kV separated between one district with other districts. The operational cost become high and only able to operate between 6 to 8 hours and 12 hours in a day. DPP capacity in 13 districts since the lowest capacity of 200 kW at Viqueque district to the highest capacity of 36.532 kW at Dili. While the load capacity for each district, since 99 kW (district of Liquica); 125 kW (district of Ainaro); 200 kW (district of Oecusse); 236 kW (district of Viqueque); 300 kW (district of Aileu); 319 kW (district of Manatuto); 420 kW (district of Betano); 668 kW (district of Ermera); 680 kW (district of Lospalos); 681 kW (district of Baucau); 1025 kW (district of Maliana); and 22.314 kW (district of Dili). At several districts experience power supply shortage from each power plant, such as Aileu district of 20%, Betano of 3%, Lospalos of 65%, and Viqueque of 15% (EDTL, 2009).

To fulfill the electric power supply shortage and the electric power distribution to the remote areas, the Timor Leste government in 2009 established high capacity diesel power plant of Hera in Dili district with capacity of 120 MW and Betano DPP at Betano district of 130 MW. The DPP will be injected at the electric system of Timor Leste through the transmission line 150 kV and 9 substations, that is Dili substation, Liquica substation, Maliana substation, Suai substation, Betano substation, Manatutu substation, Baucau substation, Lospalossubstation and Viqueque substation. With the interconnection system of 150 kV, then the power plant with distribution line of 20 kV which is separated one another is replaced with the interconnection system through 150kV transmission line in Timor Leste. The injection of new power plant (DPP of Hera and Betano) at the Timor Leste Electricity system will cause the change of power flow in the current system, and will influence the stability of entire system. Analysis of the new power plant injection toward the electricity need to do to get the best strategy in maintaining the system to operate synchronously during disturbance occurrence. Power flow analysis is needed to do to determine the best injection location and improve the voltage profile, so impact to the power losses decrease. Beside steady state analysis, dynamic analysis in the form of voltage stability, frequency, rotor angle stability before and after injection need to do to know the system performance during disturbance occurred.

II. ANALYSIS OF POWER FLOW

Power flow analysis is done to get information about power flow and system voltage in the steady state. The information is needed to evaluate the power system performance and analyzing the generating or loading condition. The analysis also needs power flow information in the normal or emergency condition (Cekdin, 2007). The power flow problem including the calculation of voltage, active power or reactive power profiles at various bus at the electric power grid at normal condition.

In the power flow analysis, the buses are grouped into three classification, that is:

a. Slack bus or swing bus or reference bus.
   The magnitude known in slack bus is Vand δ (phase angle). During power flow calculation, V and δwill constant. Slack bus serve to fulfill the power shortage (losses or load) entirely, because the line losses can not be known before the calculation is finished.
b. Voltage controlled bus or generator bus
   At the voltage controlled bus or generator bus, the P and V have been known.
c. Load bus

At load bus the P and Q have been known At each bus there are 4 units, that is

- Real or active power (P).
- Reactive power (Q).
- Scalar value of voltage |V|.
- Phase angle of voltage (δ).

At each bus only two quantities that are determined while the both other quantities are the results of calculation. The determined quantities are:

a. Slack bus; scalar value |V|and phase angle δ.
b. Voltage controlled bus; real power P and scalar value of voltage |V|.
c. Load bus; real power P and reactive power Q.

Slack bus served to supply the real power shortage and reactive power at system.

III. POWER SYSTEM STABILITY

Power system stability in general is divided into two categories, steady state stability and transient stability. Steady state stability is the power system ability back to normal operation after small and slow disturbance, such as the gradual power change. While transient stability is the power system ability to normal condition after great disturbance such as the loss of generation, loss of big load or short circuit. (Saadat, 2009).

1. Stability of rotor angle

Rotor angle stability refer to the machine ability from interconnected power system to still in synchronous condition after disturbance. It is depend on ability to maintain the balance between electromagnetic torsion and mechanical torsion at synchronous machine in the system. The instability that can increase the swing angle in several rotor causes synchronization losses with the other generators.

2. Frequency stability

Frequency stability refer to power system ability to maintain stable frequency follow the system upset that produce imbalance between generator and load. It depends on the ability to maintain balance between generator and load, with minimum unintentional load loss. Instability occurred able in the form of frequency swing that is leading that cause tripping of generating unit or load unit.

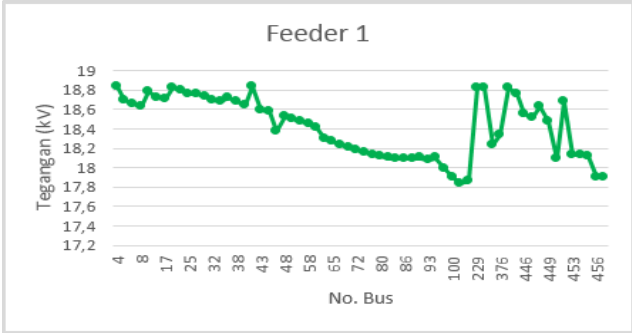
3. Voltage stability

Voltage stability refer to the power system ability to maintain the stable voltage in all buses in the system after disturbance from initial operation. It depends on the system ability to maintain the load need and power system availability. The stability form is influenced by load characteristic, continuous control, and discrete control that is given in short time. The concept is useful in responding the small system change. With appropriate assumption, the system equation can be linearized for analysis so enable the sensitivity calculation that is useful in identifying the influencing factors. However, the linearization unable to explain the non linear effect such as tap changer (deadband, discrete tap steps, and time delays)

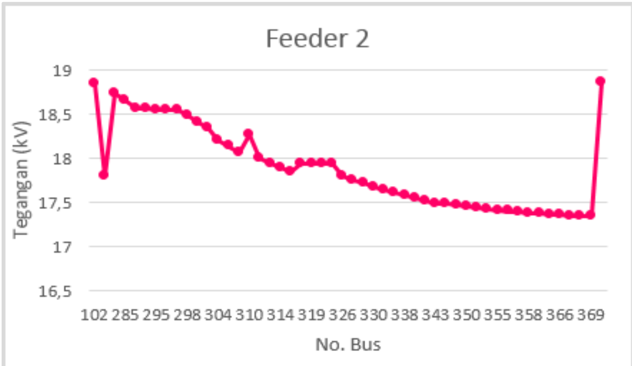
IV. RESULTS AND DISCUSSION

1. Steady State analysis

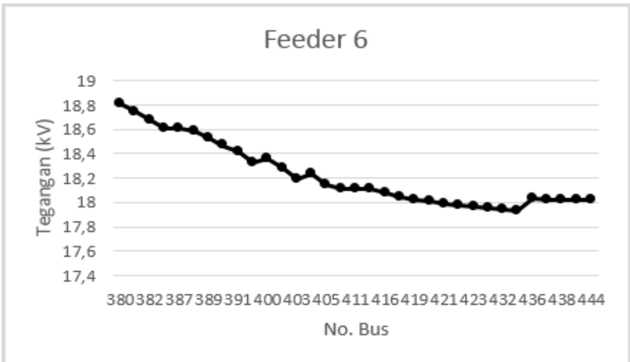
Power flow analysis before injection showed that from six feeders at Dili district, three feeders, that is feeder 1, feeder 2, feeder 6 at several buses experienced voltage decrease with out of standard determined voltage of +5% and -10%. It was caused by feeder 1, feeder 2 and feeder 6 are the longest feeder, the served load is high compared with other three feeders. (feeder 3, feeder 4 and feeder 5).



(a)



(b)



(c)

Figure 1. Graphs of system voltage at (a) feeder 1, (b) feeder 2, (c) feeder 6 befor injection of Hera &Betano DPP

Figure 1. (a) above showed that at feeder 1 there are 6 buses experienced voltage decreased, at bus 98, bus 100, bus 101, bus 103, bus 456 and bus 457. Bus experienced highest decrease at bus 101 of V = 17,836 kV or -11%. Figure 1. (b) showed that at feeder 2 there are 33 buses that experienced voltage decrease, that is at bus 278, bus 313 to bus 315, bus 318, bus 319, bus 322, bus 323, bus 326, bus 328 to bus 332, bus 338, bus 340, bus 342 to bus 345, bus 350, bus 351, bus 354 to bus 358, bus 364 to bus 369. Bus which experienced highest decrease at bus 369 of V = 17,348 kV or -13%. Figure 1. (c) showed that at feeder 6 there are 6 buseswhich experience voltage decrease, that is at bus 421 to bus 424, bus 432 and bus 433. Bus which experienced the highest voltage decrease at bus 433 of V = 17,931 kV or -10 %.

The power flow analysis after injection of DPP of Heraand Betano at the 20 kV system in Dili district given in figure 2, figure 3, and figure 4. From the figure, it can be seen that after injection the total power P =250 MW the voltage value at each bus at the feeder 1, feeder 2 and feeder 6 increased. Feeder 1, Bus 98 which initially decrease -10% increase become -7%, bus 100 from -11% increase -7%, bus 101 from -11% increase become -8%, bus 103 from -11% increase become -7%, bus 456 from -11% increase become 7% and bus 457 from -11% increase become -7% as given in table 1.

Table 1.Calculation of voltage value before and after new dpp injection at the decreasing voltage bus at feeder 1

Feeder 1	Condition Of System Voltage			
	Before injection of new DPP		After injection of new DPP	
	kV	%	kV	%
Bus 98	17,98	-10,07	18,65	-6,73
Bus 100	17,89	-10,52	18,56	-7,19
Bus 101	17,83	-10,82	18,49	-7,50
Bus 103	17,85	-10,70	18,52	-7,38
Bus 456	17,89	-10,52	18,56	-7,19
Bus 457	17,89	-10,52	18,56	-7,19

Source: (Data of Simulation results, 2017)

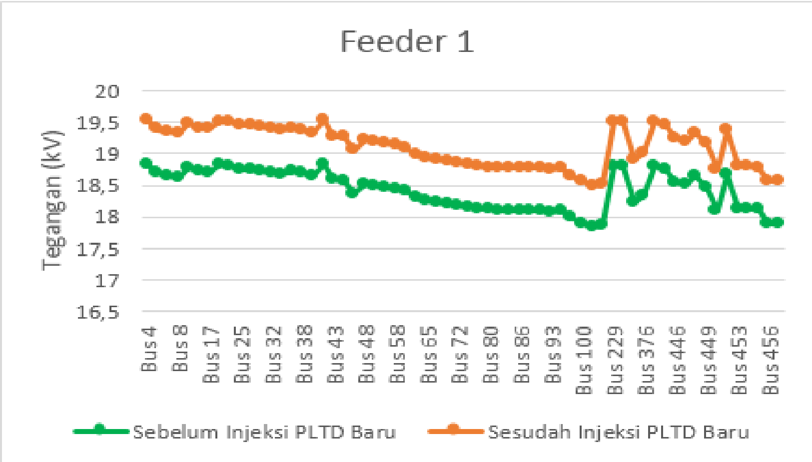


Figure 2. Graph of system voltage at feeder 1 before and after injection of Hera and Betano DPP.

Feeder2, Bus 278 which initially experienced decrease of -11% increase become -8%, bus 313 from -10% increase become -7%, bus 314 from -11% increase become -7%, bus 315 from -11% increase become -7%, bus 318 from -10% increase become -7%, bus 319 from -10% increase become -7%, bus 322 from -10% increase become -7%, bus 323 from -10% increase become -7%, bus 326 from-11% increase become -8%, bus 328 from-11% increase become -8%, bus 329 from -11% increase become -8%, bus 330 from -12% increase become -8%, bus 331 from-12% increase become -8%, bus 332 from-12% increase become -9%, bus 338 from -12% increase become -9%, bus 340 from -12% increase become -9%, bus 342 from-12% increase become -9%, bus 343 from-13% increase become -9%, bus 344 from -13% increase become -9%, 345 from -13% increase become -9%, bus 350 from -13% increase become -9%, bus 351 from -13% increase become -%, bus 354 from -13% increase become -10%, bus 355 from-13% increase become -10%, bus 356 from -13% increase become -10%, bus 357 from -13% increase become -10%, bus 358 from -13% increase become -10%, bus 364 from-13% increase become -10%, bus 365 from-13% increase become -10%, bus 366 from -13% increase become -10%, bus 367 from -13% increase become -10%, bus 368 from -13% increase become -10%, bus 369 from -13% increase become -10%, as seen in table 2.

Table 2.comparison of voltage value before and after new dpp injection at bus which experience decrease at feeder 2.

Feeder 2	Condition Of System Voltage			
	Before injection of new DPP		Before injection of new DPP	
	kV	%	kV	%
Bus 278	17,798	-11	18,468	-8
Bus 313	17,947	-10	18,621	-7
Bus 314	17,895	-11	18,568	-7
Bus 315	17,845	-11	18,516	-7
Bus 318	17,942	-10	18,616	-7
Bus 319	17,939	-10	18,613	-7
Bus 322	17,943	-10	18,617	-7
Bus 323	17,941	-10	18,615	-7
Bus 326	17,799	-11	18,469	-8
Bus 328	17,756	-11	18,425	-8
Bus 329	17,716	-11	18,383	-8

Bus 330	17,677	-12	18,344	-8
Bus 331	17,642	-12	18,307	-8
Bus 332	17,608	-12	18,272	-9
Bus 338	17,608	-12	18,238	-9
Bus 340	17,545	-12	18,208	-9
Bus 342	17,518	-12	18,18	-9
Bus 343	17,493	-13	18,154	-9
Bus 344	17,485	-13	18,146	-9
Bus 345	17,478	-13	18,139	-9
Bus 350	17,46	-13	18,121	-9
Bus 351	17,447	-13	18,107	-9
Bus 354	17,432	-13	18,091	-10
Bus 355	17,417	-13	18,076	-10
Bus 356	17,403	-13	18,061	-10
Bus 357	17,392	-13	18,05	-10
Bus 358	17,382	-13	18,04	-10
Bus 364	17,374	-13	18,031	-10
Bus 365	17,366	-13	18,023	-10
Bus 366	17,359	-13	18,016	-10
Bus 367	17,353	-13	18,01	-10
Bus 368	17,35	-13	18,006	-10
Bus 369	17,348	-13	18,005	-10

Source: (Data of simulation results, 2017)

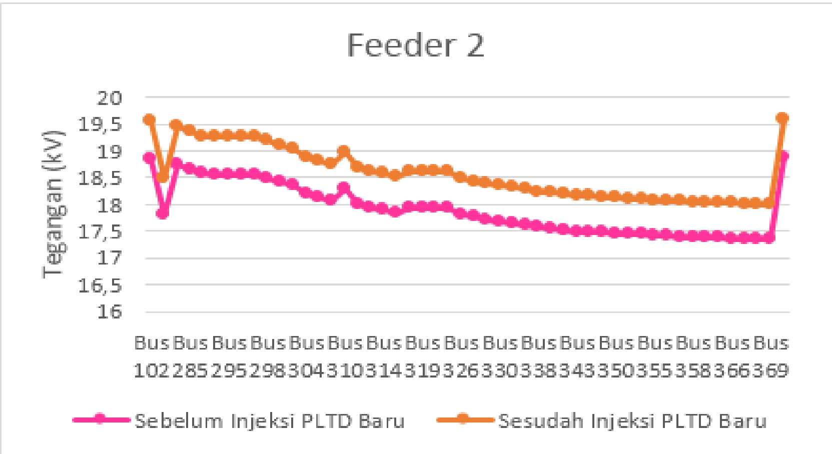


Figure 3. Graph of system voltage at feeder 2 before and after injection of Hera and Betano DPP

Feeder 6, Bus 421 which initially experienced voltage decrease of -10% increase become -7%, bus 422 from -10% increase become -7%, bus 423 from-10% increase become -7%, bus 424 from -10% increase become -7%, bus 432 from -10% increase become -7% and bus 433 from -10% increase become -7% as given in Table 3.

Table 3.comparison of voltage value before and after injection of new dpp at bus which experience voltage decrease at feeder 6.

Feeder 6	Condition Of System Voltage			
	Before injection of new DPP		Before injection of new DPP	
	kV	%	kV	%
Bus 421	17,989	-10	18,658	-7
Bus 422	17,974	-10	18,643	-7
Bus 423	17,962	-10	18,629	-7
Bus 424	17,95	-10	18,617	-7
Bus 432	17,94	-10	18,607	-7
Bus 433	17,931	-10	18,598	-7

Source: (Data of simulation results, 2017)

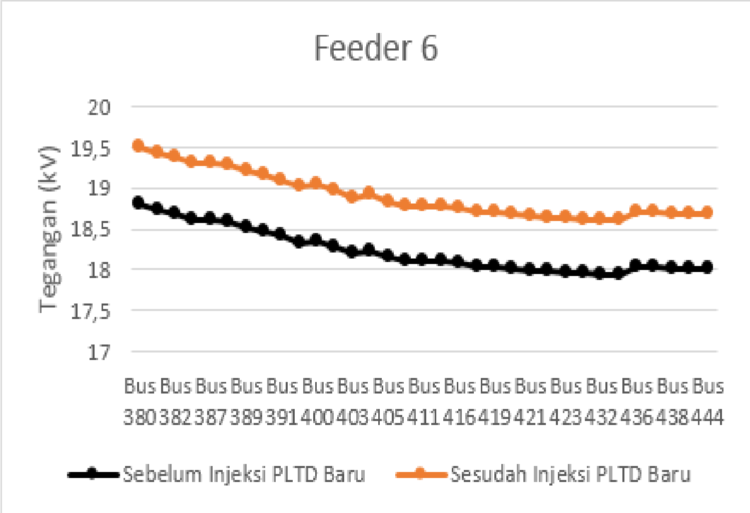


Figure 4. Graph of voltage system at feeder 6 before and after injection of Heraand PLTD DPP

Analysis results of electricity system at Timor Leste of 20 kV before and aster injection of Hera and Betano DPP obtained losses total value that occurred at Dili district of 20 kV, as given in Table 4.

Table 4. Losses total comparison at dili district of 20 kv

Power flow results and losses	Condition Of System Voltage	
	Before injection of new DPP	Before injection of new DPP
Generation total		
Active power (MW)	27,235	28,760
Reactive power (MVAR)	4,303	2,184
Loading total		
Active power (MW)	25,379	27,249
Reactive power (MVAR)	2,076	2,199
Total losses		
Active power (MW)	1,856	1,510
Reactive power (MVAR)	2,226	0,015
Losses percentage		
Active power (%)	6,8 %	5,3 %
Reactive power (%)	52 %	0,69 %

Source: (Data of simulation results, 2017)

Table 4.shows the comparison results of losses total for two testing condition. From the table it can be seen that the power losses mostly during the system is not connected yet with Hera and Betano DPP with P_{losses} = 1,856 MW (6,8%) and Q_{losses} = 2,226 MVAR (52%). After interconnection with Heraand DPP, losses decreased become P_{losses} = 1,510 MW (5,3%) and Q_{losses} = 0,015 MVAR (0,69%).

2. Analysis of Power System Stability

a. Faultat Dili Substation

- Stability of rotor angle

Simulation results of rotor angle before and after Betano DPP injection given in Figure5 and Table 5.

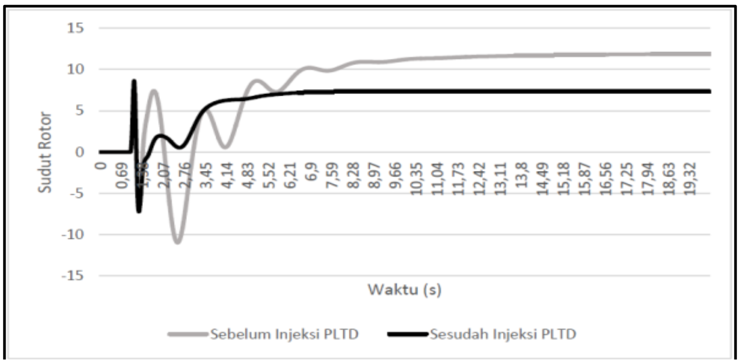


Figure5.Comparison of rotor angle stability before and after Betano DPP injection (fault atDili Substation)

Figure 5.Showed the rotor angle stability experienced faster oscillation after Betano DPP injection if compared with before injection. The time needed of generator rotor angle to synchronous condition faster after Betano DPP injection.

Table 5. Comparision of rotor angle stability before and after Betano DPP injection (fault at Dili Substation)

Condition	$\Delta_{initial}(^0)$	$\Delta_{new}(^0)$	$T_{recovery}$ (s)
Before DPP injection	0	11,76	15,32
After DPP injection	0	7,27	7,12

- Frequency stability

  Simulation results of frequency stability before and after Betano DPP injection shown in Figure6 and Table 6.

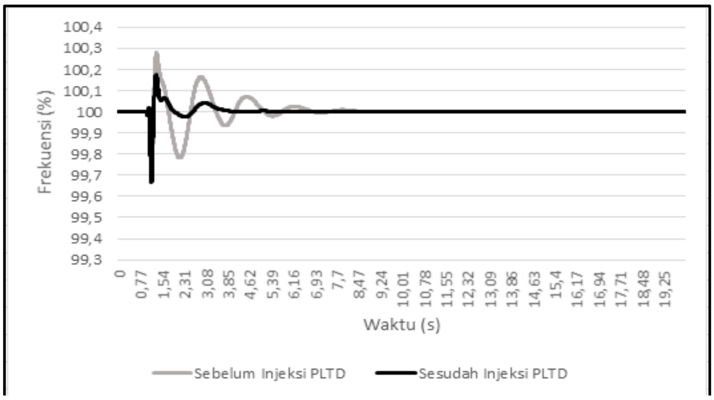


Figure6. Comparision of frequency stability before and after Betano DPP injection (fault at Dili Substation)

Graphs of frequency stability comparison before and after Betano DPP injection showed that before disturbance at t=1 second, generator operated at normal frequency 50 Hz. But after disturbance at t=1, the frequency oscillated. The biggest oscillation before Betano DPP injection if compared with after injection, and the recovery time to normal frequency faster if after injection shown in table 6.

Table 6.Comparison Of Frequency Stability Before And After Betano Dpp Injection (Fault At Dili Substation)

Condition	$F_{initial}$(Hz)	f_{max}(Hz)	$T_{recovery}$ (s)
Before DPP injection	50	50,3	8,47
After DPP injection	50	50,17	5,62

- Voltage stability

  Simulation results of voltage stability before and after Betano DPP injection shown in Figure 7 and Table 7.

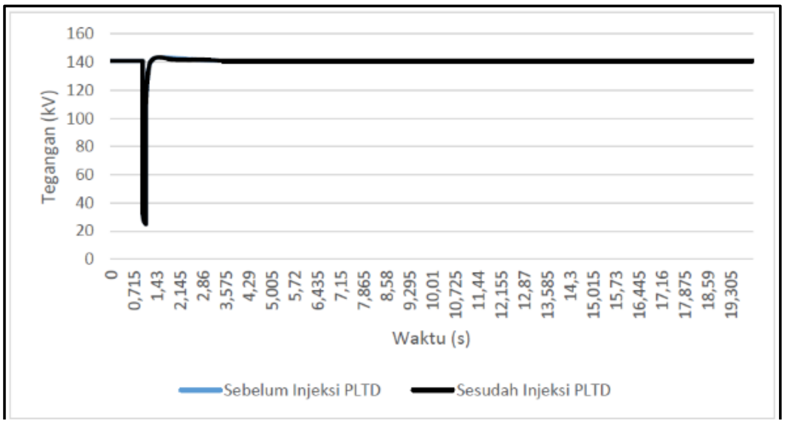


Figure 7. Comparison of voltage stability before and after Betano DPP injection (fault Dili Substation)

Graphs of voltage stability of before and after Betano DPP injection showed the voltage after injection experience no increase compared to before injection. During disturbance, the biggest decrease occurred before power plant injection. The recovery time faster after Betano DPP injection.

table 7. comparison of voltage stability before and after betano dpp injection (fault dili substation)

Condition	$V_{initial}$(kV)	V_{drop} (kV)	$T_{recovery}$ (s)
Before DPP injection	140,8	32,03	3,64
After DPP injection	140,8	32	3,58

b. Faultat Liquica Substation

- Rotor angle stability

Simulation results of rotor angle before and after Betano DPP injection shown in Figure 8 and Table 8.

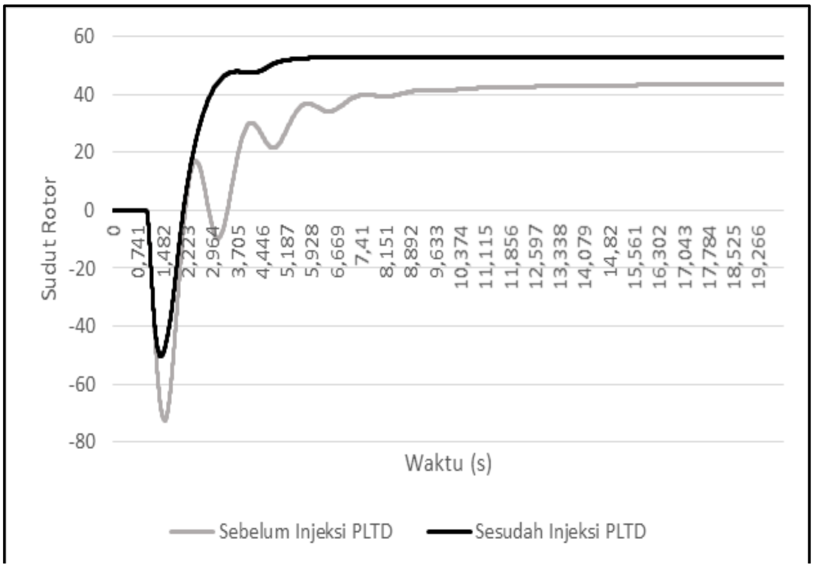


Figure 8. Comparison of rotor angle stability before and after Betano DPP injection(fault Liquica Substation)

Figure8 showed the rotor angle stability experienced oscillation faster after Betano DPP injection if compared before injection. The recovery time needed for rotor angle back to synchronous condition faster after BetanoDPP injection as given in Table 8.

Table 8. Comparison Of Rotor Angle Stability Before And After Betano Dpp Injection (Fault Liquica Substation)

Condition	$\Delta_{initial}(^0)$	$\Delta_{new}(^0)$	$T_{recovery}$ (s)
Before DPP injection	0	42,98	14,07
After DPP injection	0	52,56	6,03

- Frequency stability

Simulation results of frequency stability before and after Betano DPP injection shown in figure9 and Table 9.

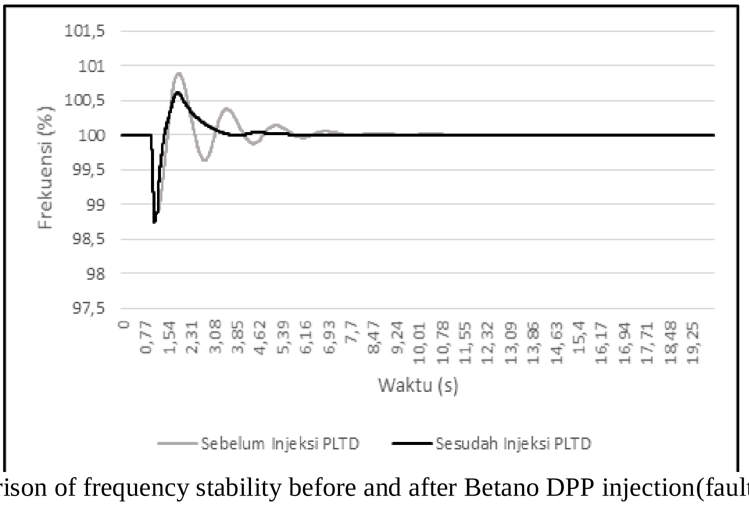


Figure 9. Comparison of frequency stability before and after Betano DPP injection(fault Liquica Substation)

Graph of frequency stability before and after Betano DPP injection showed before disturbance t = 1 second the frequency experienced oscillation. The biggest oscillation occurred before injection if compared with after injection, and the recovery time to normal condition faster after Betano DPP injection, as given in table 9.

Table9.Comparision of frequency stability before and after Betano DPP injection (fault Liquica Substation)

Condition	$F_{initial}$(Hz)	F_{max}(Hz)	$T_{recovery}$ (s)
Before DPP injection	50	50,89	9,05
After DPP injection	50	50,52	5,34

- Voltage stability

Simulation results of voltage stability before and after Betano DPP injection shown in Figure10 and Table 10.

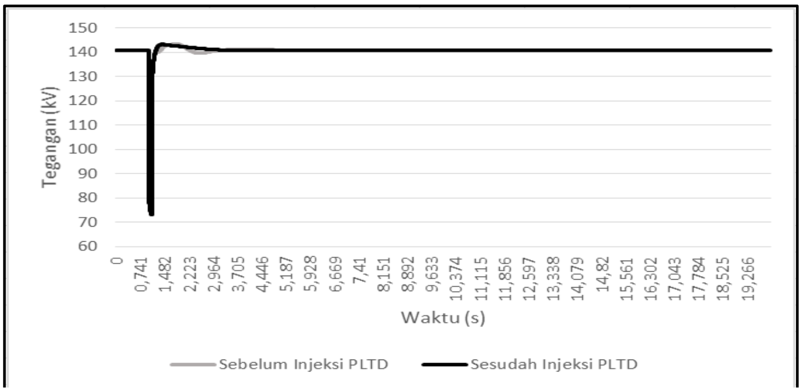


Figure10. Comparison of voltage stability before and after Betano DPP injection (fault Liquica Substation)

Graphs of voltage stability comparison before and after Betano DPP injection showed that after injection no increase compared with before injection. During disturbance, the biggest voltage decrease occurred before injection. The recovery time faster after Betano DPP injection.

Table 10.Comparison of voltage stability before and after betano dpp injection (fault liquica substation)

Condition	$V_{initial}$(kV)	V_{drop} (kV)	$T_{recovery}$(s)
Before DPP injection	140,8	81,97	4,35
After DPP injection	140,8	81,9	3,07

c. Fault Manatuto Substation

- Rotor stability angle

Simulation results of rotor angle stability before and after Betano DPP injection shown in Figure 11 and Table 11.

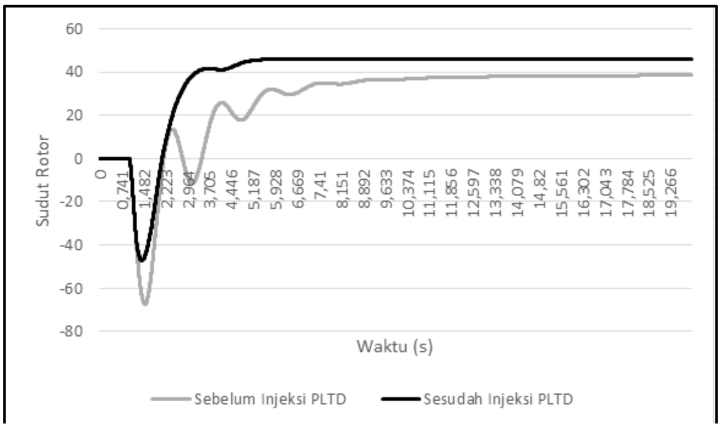


Figure11.Comparison of rotor angle stability before and after Betano DPP injection (fault ManatutoSubstation)

Figure11 showed the rotor angle stability experienced oscillation after DPP injection if compared with before injection. The time needed to back to synchronous condition faster after Betano DPP injection as given in table 11.

Table 11comparison Of Rotor Angle Stability Before And After Betano Dpp Injection(Fault Manatuto Substation)

Condition	$\delta_{initial}(^0)$	$\delta_{new}(^0)$	$T_{recovery}(s)$
Before DPP injection	0	38,29	17,43
After DPP injection	0	45,82	5,64

- Frequency stability

Simulation results of frequency stabilitybefore and after Betano DPP injection shown in Figure 12 and Table 12.

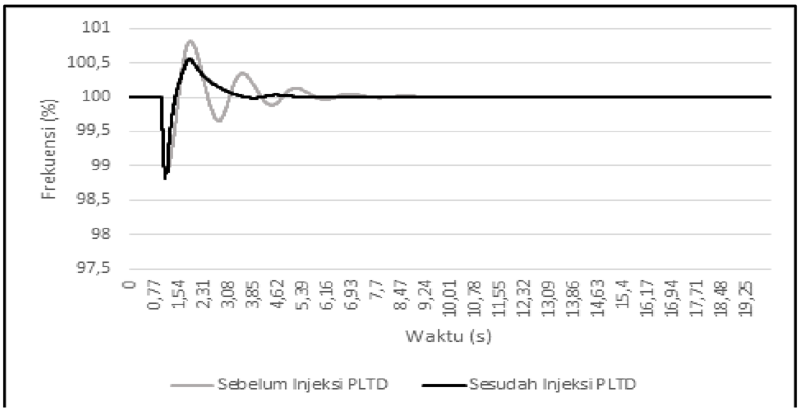


Figure 12 .Comparison of frequency stabilitybefore and after Betano DPP injection(fault Mantuto Substation)

Graph of frequency stabilitybefore and after Betano DPP injection showed before disturbance at t = 1 second, generator operated at normal frequency of 50 Hz, after disturbance at t = 1 second, the frequency oscillated. The biggest oscillation before Betano DPP injection if compared with the after injection, and recovery time needed faster after Betano DPP injection given in table 12.

Table 12. Comparison Of Frequency Stability Before And After Betano Dpp Injection (Fault Manatuto Substation)

Condition	$f_{initial}$(Hz)	f_{max}(Hz)	$T_{recovery}(s)$
Before DPP injection	50	50,8	9,08
After DPP injection	50	50,52	5,19

- Voltage stability

Simulation results of voltage stabilitybefore and after Betano DPP injection shown in Figure 13 and Table 13.

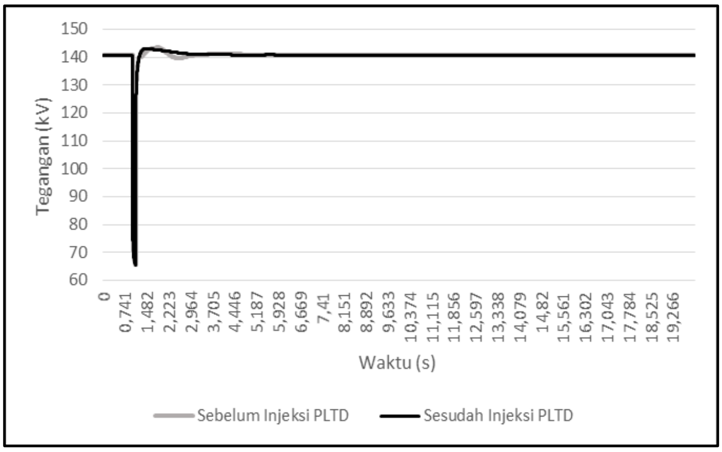


Figure 13. Comparison of voltage stabilitybefore and after Betano DPP injection(fault Manatuto Substation)

Graph of voltage stabilitycomparison before and after Betano DPP injection showed the voltage condition after injection no increase compared with before injection. During disturbance, the biggest voltage decrease faster then after Betano DPP injection as given in table 13.

Table 13.Comparison Of Voltage Stability Before And After Betano Dpp Injection (Fault Manatuto Substation)

Condition	$V_{initial}$(kV)	V_{drop} (kV)	$t_{recovery}$(s)
Before DPP injection	140,8	74,86	7,21
After DPP injection	140,8	74,8	4,17

d. Fault Baucau Substation
- Rotor angle stability

Simulation results of rotor anglestability before and after Betano DPP injection shown in Figure 14 and Table 14.

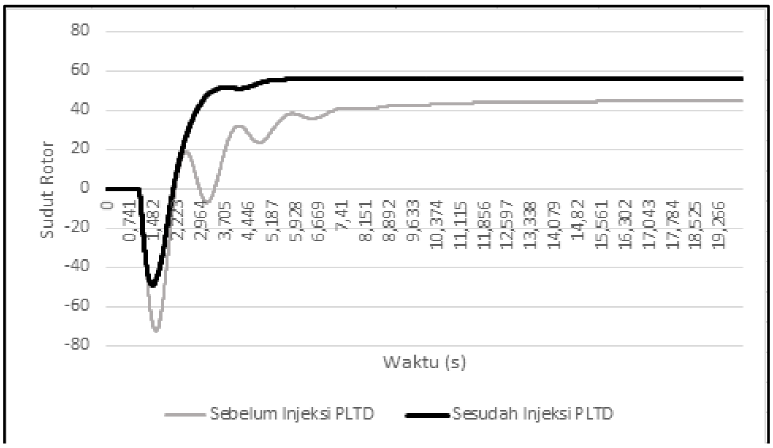


Figure 14. Comparison of rotor anglestability before and after Betano DPP injection(fault Baucau Substation)

Figure 14 showed the rotor angleexperienced oscillation faster after Betano DPP injection compared with before DPP injection. The time needed by generator rotor angle to back to synchronous condition faster after Betano DPP injection as shown in Table 14.

Table 14. Comparison Of Rotor Angle Stability Before And After Betano Dpp Injection (Fault Baucau Substation)

Condition	$\delta_{initial}(^0)$	$\delta_{new}(^0)$	$T_{recovery}$(s)
Before DPP injection	0	44,3	15
After DPP injection	0	55,32	5,41

- Frequency stability

Simulation results of frequency stabilitybefore and after Betano DPP injection shown Figure 15 and Table 15.

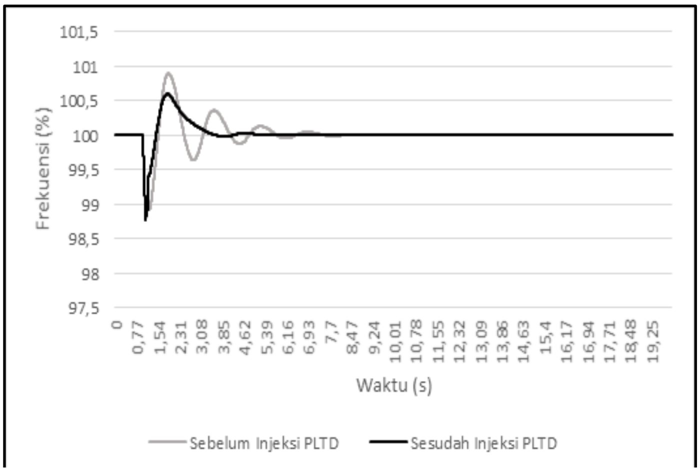


Figure 15. Comparison of frequency stabilitybefore and after Betano DPP injection(fault Baucau Substation)

Graph of frequency stabilitycomparison before and after Betano DPP injection showed that before disturbance at t = 1 the generator operated at normal frequency 50 Hz, after disturbance at t = 1 second the frequency experienced oscilation. The biggest oscillation occurred before Betano DPP injection compared with after injection, and recoverytime needed for frequency to back to normal condition faster after Betano DPP injection as shown in Table 15.

Table 15.Comparison Of Frequency Stability Before And After Betano Dpp Injection (Fault Baucau Substation)

Condition	$f_{initial}$(Hz)	f_{max}(Hz)	$T_{recovery}$(s)
Before DPP injection	50	50,89	9
After DPP injection	50	50,61	5,34

- Voltage stability

Simulation results of voltage stabilitybefore and after Betano DPP injection shown in Figure 16 and Table 16.

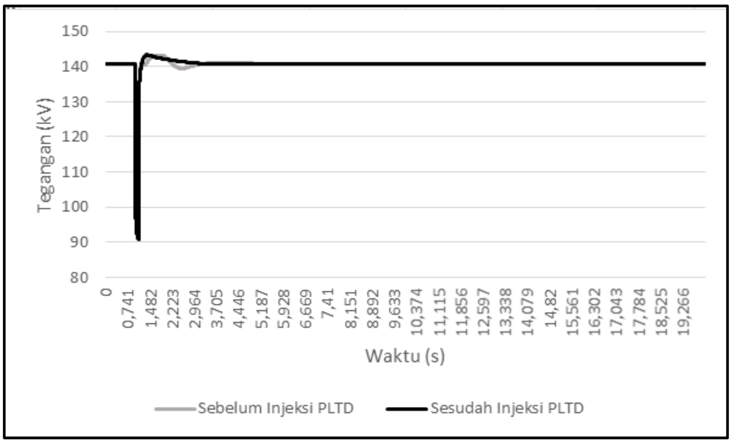


Figure 16. Comparison of voltage stabilitybefore and after Betano DPP injection(fault Baucau Substation)

Graph of ofvoltage stabilitycomparison before and after Betano DPP injection showed voltage condition after injection no increase compared with before injection. During disturbance, the biggest voltage decrease occurred before generator injection. Voltage recovery time faster after Betano DPP injection as shown in Table 16.

Table 16.Comparison of voltage stability before and after betano dpp injection (fault baucau substation)

Condition	$V_{initial}$(kV)	V_{drop}(kV)	$t_{recovery}$(s)
Before DPP injection	140,8	98,45	5
After DPP injection	140,8	98,4	3,12

V. Closing

Based on simulation results and analysis done then it can be concluded as follows:

a. Analysis results before Hera and Betano DPP injection, showed voltage condition at several feeders, that is feeder 1, feeder 2 and feeder 6 (Dili District) under the determined standard operation, in range between -10,82% to -13% fromthe sending voltage. The biggest active power losses of 6,8% and reactive powerlosses of 52%.

b. Analysis results after injection of Hera and Betano DPP injection showed the impact of power injection by Hera and Betano DPP toward system, that is the maximum voltage decrease occurred in range between -6% to -10%. Active powerlosses can be minimized up to 5,3% and Reactive powerlosses can be minimized up to 0,69%.

c. Analysis results of power system stability showed the rotor angle stability, frequency stability, and voltage stabilityat the electricity of Timor Leste become more stable after Betano DPP with recovery time after three phases disturbance faster then before injection.

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