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LAMPIRAN

Lampiran 1. *Wind Turbine System Requirements Simulator Wind Turbine*

1. *Blade Requirements*

Type description	*AL 40*
Blade length	*40 m*
Material	*Carbon/wood/glass/epoxy*
Standard colour	*RAL 7035*
Gloss	*Class 2: (30-70%) to be measured acc. to DS/ISO2813*
Type of rotor air brake	*Full blade*
Blade profiles	*FFA - W3, NACA 63.4*
Twist	*20°*
Largest chord	*3.08*

2. *Brakes Requeremets*

Mechanical	
Type description	*Active Brake*
Brake disc	*Steel, mounted on high speed shaft*
Number of calipers	*2 piece*
Brake Hydraulics	
Voltage	*3 x 480 V*
Working pressure range	*140-150 bar*
Oil capacity	*11 l*

3. *Environment Requirements*

Temperature interval for operation	*-30 to +30°C*
Temperature interval for structure	*-40 to +50°C*

4. *Geartrain Requirements*

Type description	*1. step planet, 2. step helical*
Gear house material	*Cast*
Ratio	*1:84.3*
Mechanical power	*1800 Kw*
Bending strength acc. to ISO 6336	*SF > 1.6*
Surface durability acc. to ISO 6336	*SH > 1.25*
Scuffing safety acc. to DNV 41.	*SS > 1.3*
Shaft seals	*Labyrinth*
Oil sump	*App. 250 l*

5. *Generator Requirements*

Type description	*1 speed generator, water cooled*
Rated power	*1650 kW*
Apparent power	*1808 kVA*
Rated current IN	*1740 A*
Max power at Class F Pfma	*1815 kW*
Max current at Class F IFmax	*1914 A*
No load current I0	*430 A*
Reactive power consumption at rated power (tolerance. acc to IEC 60034-1)	*740 kvar*
Reactive power consumption at no load (tolerance. acc to IEC 60034-1)	*447 kvar*
Number of poles P	*6*
Synchronous rotation speed n0	*1200 rpm*
Rotation speed at rated power nN	*1214 rpm*
Slip at rated power sN	*0.0117*
Voltage UN	*3 x 600 V*

Type description	*1 speed generator, water cooled*
Frequency F	*60 Hz*
Coupling	*Δ*
Enclosure	*IP54*
Insulation class/ Temperature increase	*F/B*

6. *Main Controller Requirements*

Annual average wind speed 8.5 m/s	*8.5 m/s*
Wind shear 0.20	*0.2*
Extreme wind speed	*42.5 m/s (10 min. average)*
Survival wind speed 59.5 m/s (3 sec. average)	*59.5 m/s (3 sec. average)*
Automatic stop limit 20 m/s (10 min. average)	*20 m/s (10 min. average)*
Re-cut in 18 m/s (10 min. average)	*18 m/s (10 min. average)*
Characteristic turbulence intensity	*16% (including wind farm turbulence)*
Maximum in-flow angle	*8°*

7. *Nacella Requirements*

Material EN-GJS-400-18U-LT	*EN-GJS-400-18U-LT*
Standard colour RAL 7035	*RAL 7035*
Corrosion class, outside Acc. to DS EN ISO 12944:C5 I	*Acc. to DS EN ISO 12944:C5 I*
Rotor	
Number of blades 3 pieces	*3 pieces*
Tip speed (synchronous) 61.8 m/s	*61.8 m/s*
Rotor shaft tilt 5°	*5°*
Eccentricity (tower center to hub center)	*3447 mm*

Material EN-GJS-400-18U-LT	*EN-GJS-400-18U-LT*
Solidity (Total blade area/rotor area)	*0.05*
Rotor orientation	*Upwind*

8. *Pitch Actuation Requiremens*

Hydraulic pressure	*2e7 Pa*
Accumulator Capacity	*0.1 L*
Accumulator Preload Pressure	*1.5e7 Pa*
Accumulator Maximum Pressure	*2.5e7 Pa*

9. *Pitch Controller Requirements*

Track angle within	*1 degree*
Rise Time	*3 seconds*
Settling Time	*5 seconds*

10. *Tower Requirements*

Type Description Conical, tubular	*Conical, tubular*
Material Welded steel plate	*Welded steel plate*
Corrosion class, outside Acc. to DS EN ISO 12944: C5 I	*Acc. to DS EN ISO 12944: C5 I*
Colour RAL 7035	*RAL 7035*
Access conditions	*Internal, safety harness, ladder cage*

11. *Yaw Actuation Requirements*

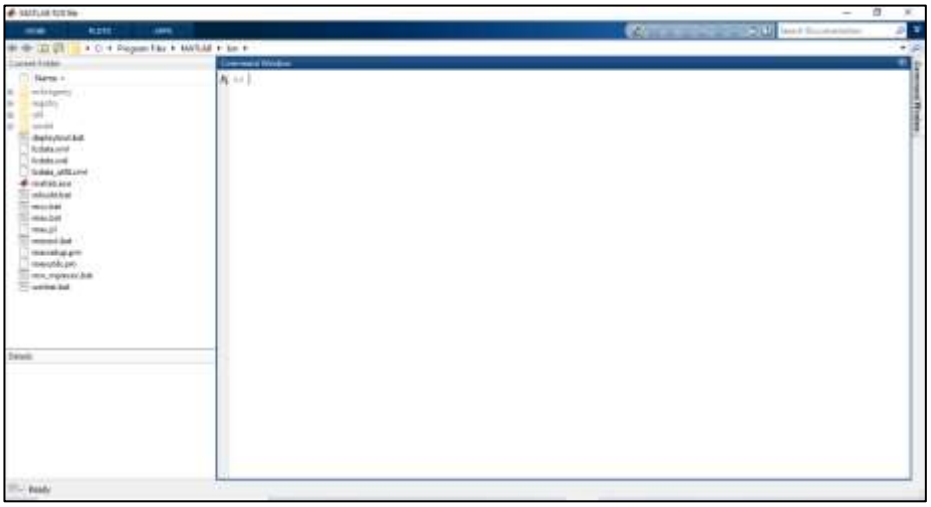
Type description	*Planetary gear motor*
Gear ratio of yaw gear unit	*app. 1:1687*
Voltage	*3 x 480 V*
Rotational speed at full load	*1140 rpm*

Type description	*Planetary gear motor*
Number of yaw gears	*4 pieces*
Yaw Brake	*Hydraulic disc brake*
Number of Yaw Friction Units	*6 pieces*
Voltage	*3 x 480 V*
Working pressure range	*140-150 bar*
Oil capacity	*App. 10 l.*

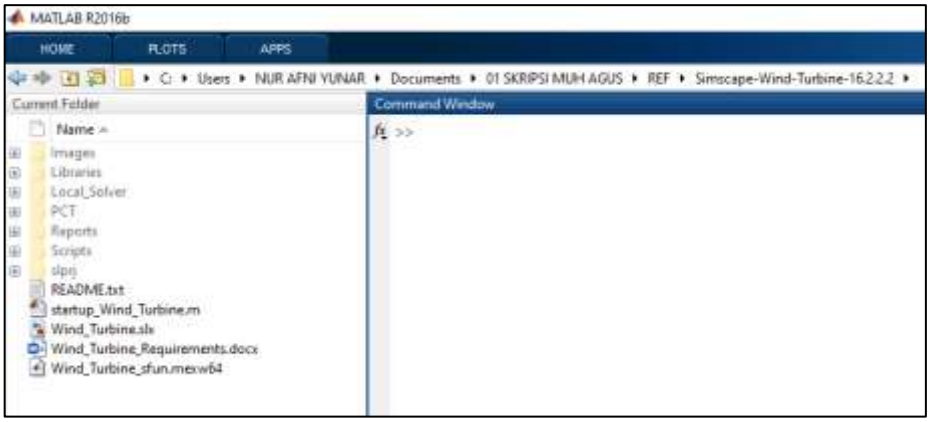
Lampiran 2. *Start Up* Simulasi

Simulasi model turbin angin dilakukan dengan menggunakan Software Matlab *Simulink* versi R2016B yang dikembangkan oleh *MathWork.Inc*. Untuk memulai simulasi model turbin angin pada Matlab *Simulink*, dibutuhkan beberapa tahapan sebagai berikut:

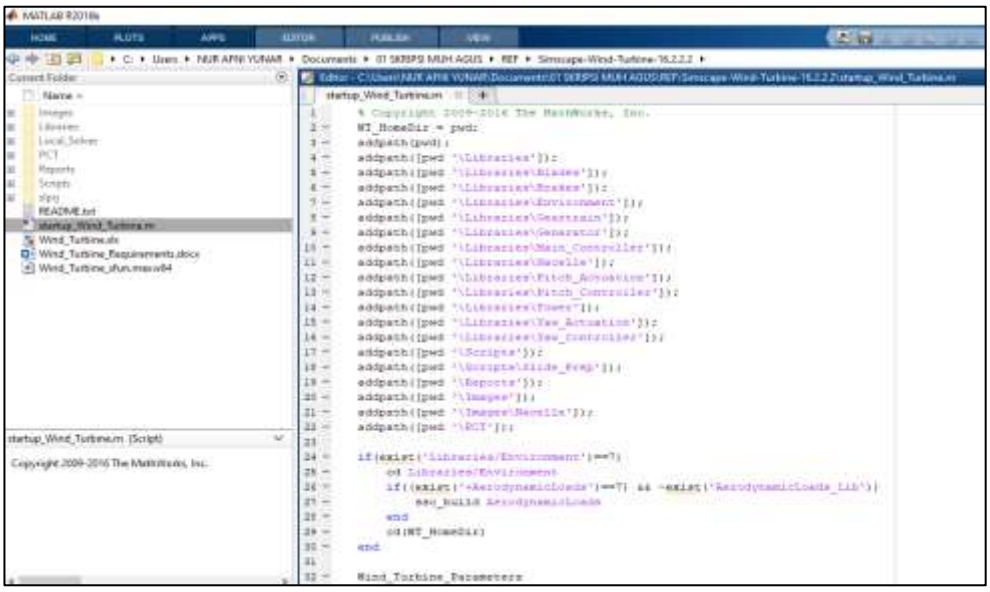
1. Menjalankan program Matlab/*Simulink*, sehingga akan muncul tampilan seperti gambar



2. kemudian memanggil file simulasi yang tersimpan pada komputer.

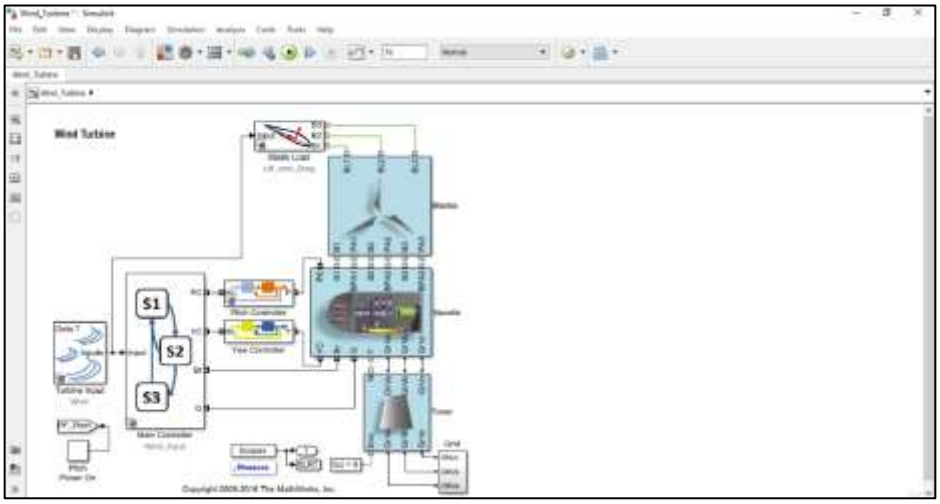


3. klik dua kali *startup_Wind_turbine.m*, sehingga akan muncul tampilan seperti pada gambar berikut .

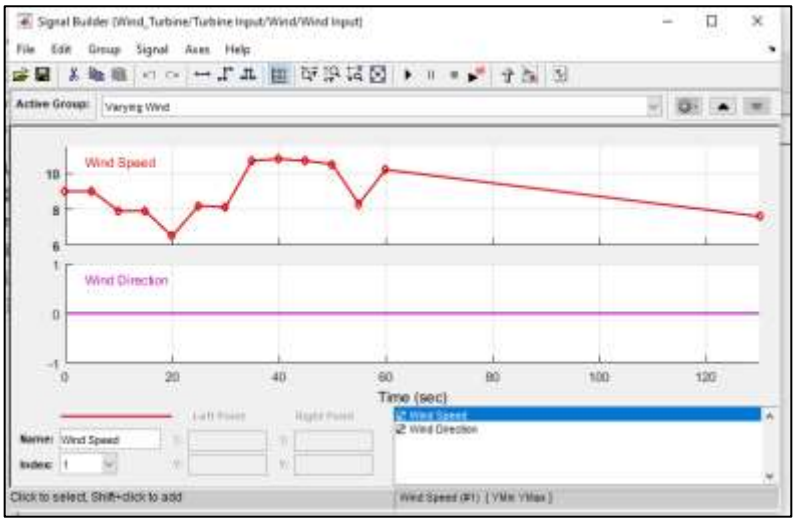


4. klik *EDITOR*, kemudian klik perintah *Run* seperti pada gambar 4.4 berikut.

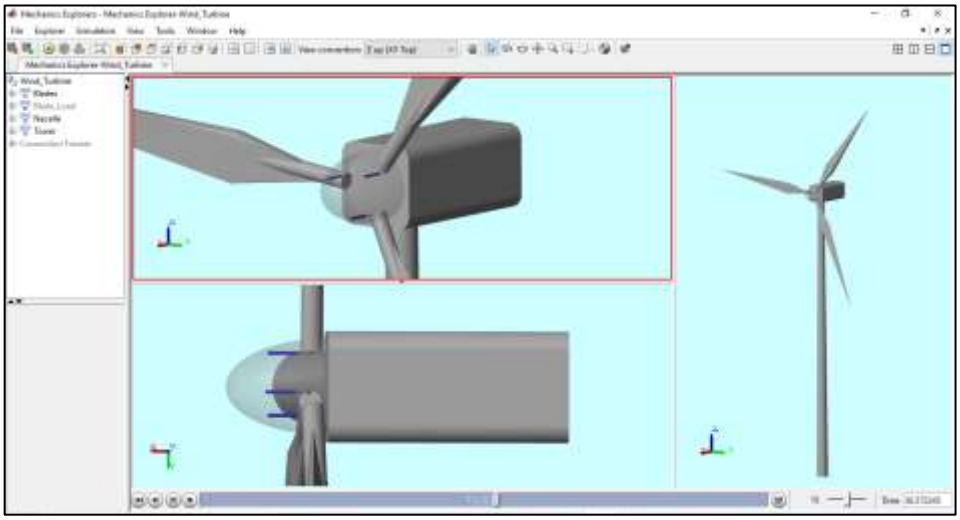
5. Beberapa saat setelah perintah *Run* di klik, makan akan muncul tampilan *Simulink Wind_turbine* beserta komponen-komponen turbin angin (penjelasan setiap komponen dapat dilihat pada BAB 2) dan *Wind Turbine Demo Script* .



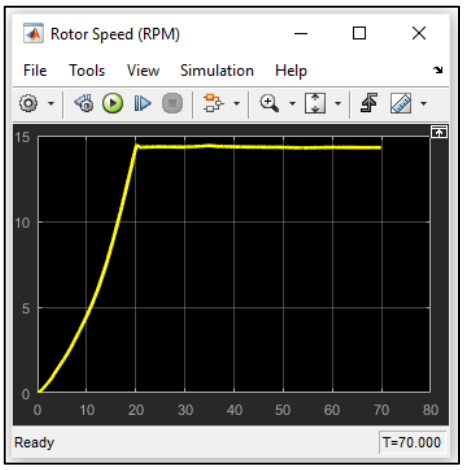
6. Kemudian mengubah nilai kecepatan dan arah angin dengan membuka *library Turbine Input* sesuai kebutuhan.



7. Setelah mengubah nilai dan arah kecepatan angin sesuai kebutuhan, klik perintah *Run* yang ada diatas tampilan *wind turbine model* sehingga akan muncul model fisik dari turbin angin dalam bentuk animasi seperti pada gambar berikut.



8. Untuk mengamati *input* dan *output* dari sistem, maka klik setiap *scope* pada *display Simulink* sehingga akan muncul contoh tampilan seperti gambar berikut.



Lampiran 3. Rekapitulasi Perhitungan Efisiensi

- Perhitungan Efisiensi Sistem

$$ŋ = \frac{Daya\ generator}{Daya\ angin}\ x\ 100\%$$

Untuk arah angin 0 derajat.

- 4 m/s

$$ŋ = \frac{0}{0{,}207}\ x\ 100\%$$

= 0 %

- 5 m/s

$$ŋ = \frac{0{,}219}{0{,}404}\ x\ 100\%$$

= 54,21 %

- 6 m/s

$$ŋ = \frac{0{,}508}{0{,}699}\ x\ 100\%$$

= 72,68 %

- 7 m/s

$$ŋ = \frac{1{,}058}{1{,}11}\ x\ 100\%$$ = 95,32 %

- 8 m/s

$$ŋ = \frac{1{,}156}{1{,}657}\ x\ 100\%$$ = 69,76 %

- 9 m/s

$$ŋ = \frac{1{,}160}{2{,}359}\ x\ 100\%$$ = 49,17%

- 10 m/s

$$ŋ = \frac{1{,}204}{3{,}236}\ x\ 100\%$$ = 37,21%

- 11 m/s

$$ŋ = \frac{1{,}237}{4{,}307}\ x\ 100\%$$ = 28,72%

- 12 m/s

$$ŋ = \frac{1{,}239}{5{,}592}\ x\ 100\%$$

= 22,16%

- 13 m/s

$$ŋ = \frac{1{,}253}{7{,}109}\ x\ 100\%$$ = 17,63%

- 14 m/s

$$ŋ = \frac{1{,}267}{8{,}879}\ x\ 100\%$$ = 14,27%

- 15 m/s

$$ŋ = \frac{1{,}270}{10{,}921}\ x\ 100\%$$ = 11,63%

- 16 m/s

$$ŋ = \frac{1{,}287}{13{,}254}\ x\ 100\%$$ = 9,71%

- 17 m/s

$$ŋ = \frac{1{,}263}{15{,}898}\ x\ 100\%$$

= 7,94%

- 18 m/s

$$ŋ = \frac{1{,}261}{18{,}872}\ x\ 100\%$$ = 6,68%

- 19 m/s

$$ŋ = \frac{1{,}235}{22{,}195}\ x\ 100\%$$ = 5,56%

- 20 m/s

$$ŋ = \frac{0}{25{,}887}\ x\ 100\%$$ = 0%

Lampiran 4. Rekapitulasi Data Hasil Simulasi

Kecepatan Angin (m/s)	Daya Output (MW)										
	0°	1°	2°	3°	4°	5°	6°	7°	8°	9°	10°
4	0	0	0	0	0	0	0	0	0	0	0
5	0,219	0,207	0,198	0,121	0,141	0,154	0,153	0,231	0,235	0,266	0,13
6	0,508	0,484	0,451	0.492	0,603	0,414	0,578	0,598	0,548	0,606	0,539
7	1,058	1,047	1,028	1,051	1,081	0,996	0,984	1,014	0,980	0,972	1,023
8	1,156	1,091	1,072	1,096	1,088	1,084	1,081	1,091	1,081	1,095	1,126
9	1,160	1,119	1,122	1,096	1,108	1,109	1,107	1,145	1,111	1,126	1,160
10	1,204	1,181	1,177	1,173	1,174	1,179	1,173	1,182	1,192	1,168	1,164
11	1,237	1,193	1,190	1,198	1,201	1,202	1,209	1,212	1,215	1,216	1,191
12	1,239	1,202	1,203	1,202	1,206	1,209	1,219	1,229	1,228	1,212	1,190
13	1,253	1,218	1,181	1,219	1,219	1,221	1,187	1,243	1,218	1,208	1,237
14	1,267	1,222	1,232	1,235	1,235	1,239	1,246	1,242	1,219	1,235	1,206
15	1,270	1,238	1,237	1,243	1,240	1,246	1,252	1,253	1,261	1,253	1,243
16	1,287	1,254	1,254	1,258	1,263	1,269	1,270	1,243	1,272	1,247	1,243
17	1,263	1,235	1,238	1,244	1,251	1,257	1,261	1,257	1,256	1,243	1,261
18	1,261	1,228	1,228	1,231	1,232	1,251	1,252	1,250	1,216	1,229	1,252
19	1,235	1,221	1,225	1,229	1,242	1,243	1,246	1,232	1,238	1,231	1,239
20	0	0	0	0	0	0	0	0	0	0	0

Kecepatan Angin (m/s)	Daya Output (MW)									
	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
4	0	0	0	0	0	0	0	0	0	0
5	0,132	0,139	0,128	0,125	0,117	0,104	0,082	0,093	0,264	0,180
6	0,674	0,702	0,528	0,719	0,489	0,500	0,405	0,419	0,513	0,568
7	1,029	0,996	1,019	1,054	1,020	1,034	1,040	1,052	1,044	1,030
8	1,109	1,149	1,097	1,106	1,097	1,110	1,125	1,142	1,121	1,118
9	1,148	1,168	1,169	1,134	1,126	1,130	1,151	1,125	1,136	1,117
10	1,188	1,155	1,167	1,173	1,179	1,167	1,195	1,168	1,178	1,190
11	1,193	1,183	1,209	1,192	1,196	1,188	1,201	1,183	1,219	1,201
12	1,207	1,189	1,216	1,210	1,222	1,213	1,198	1,200	1,210	1,224
13	1,218	1,205	1,210	1,229	1,226	1,201	1,233	1,227	1,236	1,222
14	1,233	1,222	1,223	1,226	1,235	1,218	1,248	1,254	1,238	1,238
15	1,237	1,230	1,238	1,242	1,234	1,228	1,239	1,233	1,248	1,238
16	1,277	1,239	1,258	1,244	1,270	1,265	1,258	1,257	1,259	1,256
17	1,240	1,256	1,252	1,250	1,254	1,248	1,255	1,251	1,241	1,235
18	1,243	1,229	1,224	1,238	1,248	1,233	1,232	1,239	1,245	1,238

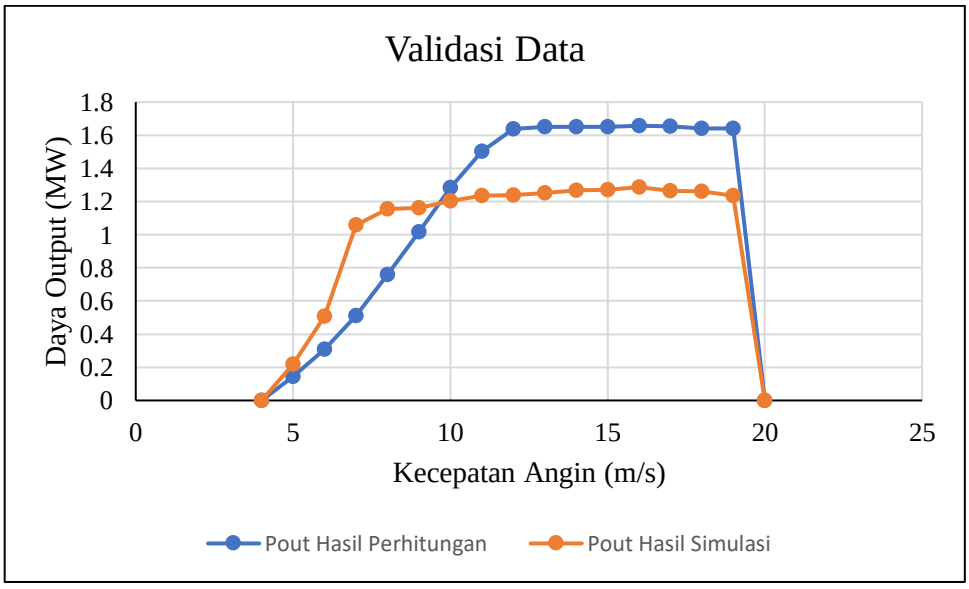
Kecepatan Angin (m/s)	Daya Output (MW)									
	11°	12°	13°	14°	15°	16°	17°	18°	19°	20°
19	1,236	1,228	1,225	1,238	1,241	1,223	1,233	1,232	1,230	1,224
20	0	0	0	0	0	0	0	0	0	0

Kecepatan Angin (m/s)	Daya Output (MW)				
	-5°	-4°	-3°	-2°	-1°
4	0	0	0	0	0
5	0,159	0,142	0,124	0,181	0,201
6	0,418	0,457	0,463	0,415	0,460
7	0,970	0,968	1,042	1,029	0,964
8	1,079	1,082	1,094	1,093	1,131
9	1,105	1,100	1,104	1,111	1,135
10	1,179	1,173	1,172	1,177	1,170
11	1,202	1,200	1,205	1,191	1,204
12	1,214	1,208	1,204	1,202	1,200
13	1,222	1,220	1,216	1,216	1,217
14	1,238	1,231	1,232	1,233	1,237
15	1,251	1,239	1,244	1,239	1,240
16	1,268	1,256	1,253	1,247	1,249
17	1,258	1,252	1,252	1,234	1,236
18	1,248	1,239	1,241	1,230	1,230
19	1,247	1,237	1,225	1,223	1,224
20	0	0	0	0	0

Lampiran 5. Validasi Data Hasil Penelitian

$$P_m = P_w x C_p$$

Kecepatan Angin (m/s)	P_w	C_p	P_m/Pout Hasil Perhitungan (MW)	Pout hasil simulasi (MW)
4	0.207	0	0.000	0
5	0.404	0.356	0.144	0.219
6	0.699	0.442	0.309	0.508
7	1.11	0.461	0.512	1.058
8	1.657	0.458	0.759	1.156
9	2.359	0.431	1.017	1.160
10	3.236	0.397	1.285	1.204
11	4.307	0.349	1.503	1.237
12	5.592	0.293	1.638	1.239
13	7.109	0.232	1.649	1.253
14	8.879	0.186	1.651	1.267
15	10.921	0.151	1.649	1.270
16	13.254	0.125	1.657	1.287
17	15.898	0.104	1.653	1.263
18	18.872	0.087	1.642	1.261
19	22.195	0.074	1.642	1.235
20	25.887	0	0.000	0



Lampiran 6. Data Kecepatan Angin Kab. Jeneponto

Lampiran Surat
Nomor : KL.01.00/007/KBB4/II/2021
Tanggal : 05 Februari 2021

DATA KECEPATAN ANGIN PERMUKAAN
AAWS JENEPONTO, KABUPATEN JENEPONTO

KOORDINAT : 5°40'17.36" LS, 119°44'0.17" BT

DATA KECEPATAN ANGIN RATA-RATA												
Tahun	Jan	Peb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nop	Des
2015	2.8	1.9	1.7	1.5	2.9	1.2	4.1	4.6	5.2	4.9	2.6	2.7
DATA ARAH ANGIN TERBANYAK												
Tahun	Jan	Peb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nop	Des
2015	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
DATA KECEPATAN ANGIN MAKSIMUM												
Tahun	Jan	Peb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nop	Des
2015	17.5	15.4	15.4	12.8	16.1	15.9	20.8	21.0	20.8	20.6	16.3	20.0
DATA ARAH ANGIN SAAT KECEPATAN MAKSIMUM												
Tahun	Jan	Peb	Mar	Apr	Mei	Jun	Jul	Ags	Sep	Okt	Nop	Des
2015	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW

Keterangan:
Kecepatan angin dalam knot
Sumber data : AAWS Jeneponto

Mengetahui,
Plt. Kepala Sub Bidang Manajemen Data

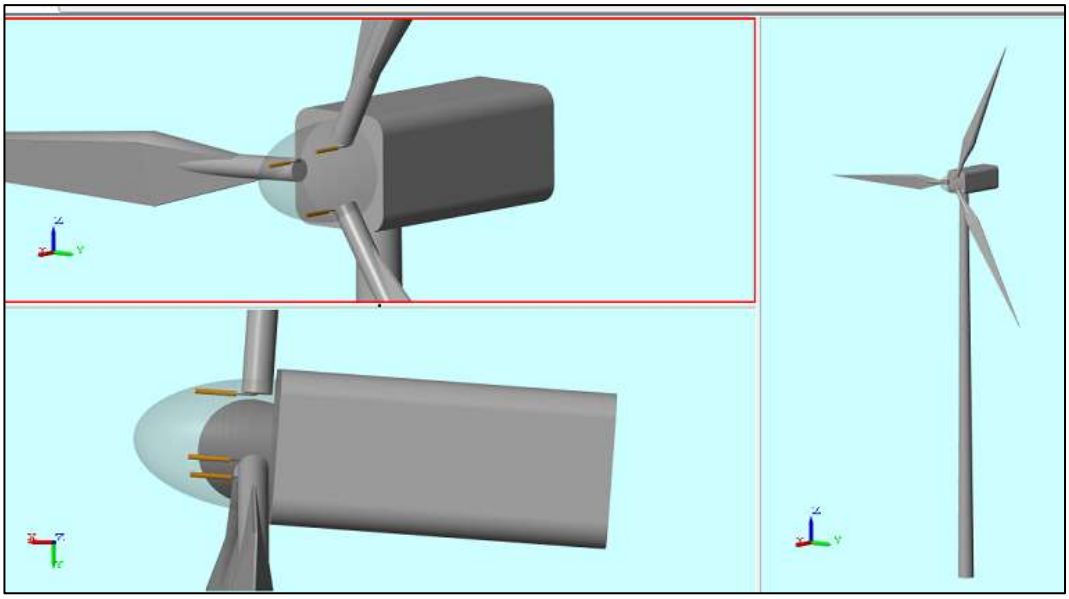
Mufliah

Makassar, 05 Februari 2021

Pemberi Informasi

Mappa Senreng

Lampiran 7. Model Fisik Sistem PLTB pada *Simulink*



Lampiran 8 Surat Permohonan Tarif Nol Rupiah

KEMENTERIAN RISET, TEKNOLOGI DAN PENDIDIKAN
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
Jalan Poros Malino Km.6Bontomarannu (92172) Gowa, Sulawesi Selatan 92172.
Sulawesi Selatan Telp. (o411) 586015. 586262 Fax (0411) 586015
http://eng.unhas.ac.id. Email : teknik@unhas.ac.id

Gowa, 19 Januari 2021

Nomor : -
Lampiran : -
Perihal : Permohonan Tarif Nol Rupiah Untuk Tugas Akhir

Kepada Yth.
Kepala Balai Besar Meteorologi, Klimatologi, dan Geofisika Wilayah IV Makassar
Cq. Kepala Unit PTSP Balai Besar Meteorologi, Klimatologi, dan Geofisika Wilayah IV Makassar
di
Tempat

Dengan Hormat,

Yang bertanda tangan di bawah ini :

Nama	:	Muh. Agus
Nama instansi/badan usaha	:	Universitas Hasanuddin
Jabatan	:	Mahasiswa
Alamat	:	Paccinikang, Desa Simbang, Kec. Simbang, Maros

Telp.: - Ext.: - HP : 085656092799 E-Mail: agusgotta97@gmail.com

Dengan ini mengajukan permohonan mengenai tarif sebesar Rp. 0,00 (nol rupiah) atas PNBP untuk:

Kegiatan	:	Penyelesaian Tugas Akhir/Skripsi
Deskripsi Kegiatan	:	Memodelkan Sistem Pembangkit Listrik Tenaga Bayu, untuk mengetahui karakteristik tegangan dan arus dari PLTB yang sudah dimodelkan berdasarkan kecepatan angin dan arah angin di Kabupaten Jeneponto yang diambil dari data BMKG
Jenis Informasi	:	Data Kecepatan Angin Dan Arah Angin selama Satu Tahun
Periode	:	1 Tahun
Lokasi/Wilayah	:	Kabupaten Jeneponto, Sulawesi Selatan

Demikian permohonan kami. Atas kerjasama yang baik kami ucapkan terima kasih.

Hormat Kami,

Muh. Agus
D41115026

Lampiran 9 Surat Permohonan Data Penelitian

KEMENTERIAN PENDIDIKAN DAN KEBUDAYAAN
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK

Jalan Poros Malino Km.6Bontomaranu (92172) Gowa, Sulawesi Selatan 92172. Sulawesi Selatan
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Nomor : 600/UN4.7.1/PT.01.06/2021 19 Januari 2021
Lamp : -
Hal : Permohonan Data Penelitian Mahasiswa

Yth.
Kepala Balai Besar Meteorologi, Klimatologi, dan Geofisika Wilayah IV Makassar
Cq. Kepala Unit PTSP Balai Besar Meteorologi, Klimatologi, dan Geofisika Wilayah IV Makassar
di
Tempat

Dengan hormat, kami sampaikan bahwa dalam rangka penyelesaian skripsi/tugas akhir pada Departemen Teknik Elektro Fakultas Teknik Universitas Hasanuddin, maka kami mohon atas kebijaksanaan Bapak/Ibu kiranya berkenan memberikan kesempatan melakukan pengambilan data penelitian bagi mahasiswa

Nama/Nim : Muh. Agus/D41115026

Judul TA : Pemodelan Pembangkit Listrik Tenaga Bayu (PLTB) Skala Mini Menggunakan Software MATLAB Simulink

Tujuan : Pengambilan data kecepatan angin dan arah angin dalam satu tahun di Kabupaten Jeneponto Sulawesi Selatan

Atas perhatian dan kerjasama yang baik kami sampaikan terima kasih

a.n. Dekan,
Wakil Dekan Bidang Akademik,Riset dan Inovasi

Prof Baharuddin Hamzah, ST., M.Arch., Ph.D
NIP. 196903081995121001

Tebusan
1. Dekan FT-UH
2. Ketua Departemen Teknik Elektro FT-UH

Lampiran 10 Surat Pernyataan Pengambilan Data

SURAT PERNYATAAN

Yang bertanda tangan di bawah ini

Nama	:	Muh. Agus
Nomor KTP	:	730992705970002
Alamat Sesuai KTP	:	Paccinikang, Desa Simbang, Kec. Simbang
Alamat Domisili	:	Makassar
NIM	:	D41115026

untuk selanjutnya disebut sebagai **"Pembuat Pernyataan"**

dengan ini secara sadar dan tanpa paksaan menerangkan dan menyatakan hal-hal sebagai berikut:

a. Bahwa saya telah mengajukan permohonan tarif nol rupiah untuk informasi :
   - Kecepatan dan Arah Angin Dalam Satu Tahun di Kabupaten Jeneponto.
b. bahwa informasi sebagaimana dimaksud benar saya butuhkan untuk kepentingan penyusunan Tugas Akhir/Skripsi saya.

berdasarkan hal-hal tersebut di atas Pembuat Pernyataan dengan ini menyatakan bahwa:

a. menggunakan informasi yang dimohon dikenakan tarif nol rupiah hanya untuk kepentingan Tugas Akhir saya di Jurusan Teknik Elektro Program Studi Teknik Elektro Universitas Hasanuddin dengan judul Pemodelan Pembangkit Listrik Tenaga Bayu (PLTB) Skala Mini Menggunakan Software MATLAB Simulink dan tidak akan pernah menggunakan informasi tersebut untuk kepentingan lain tanpa persetujuan tertulis dari BMKG.
b. saya akan menyerahkan hasil Tugas Akhir di Jurusan Teknik Elektro Program Studi Teknik Elektro Universitas Hasanuddin dengan judul Pemodelan Pembangkit Listrik Tenaga Bayu (PLTB) Skala Mini Menggunakan Software MATLAB Simulink paling lambat tanggal LIMA BELAS bulan JULI tahun DUA RIBU DUA SATU kepada Badan Meteorologi, Klimatologi, dan Geofisika.
   Dalam hal saya tidak menyerahkan hasil Tugas Akhir saya di Jurusan Teknik Elektro Program Studi Teknik Elektro Universitas Hasanuddin dengan judul Pemodelan Pembangkit Listrik Tenaga Bayu (PLTB) Skala Mini Menggunakan Software MATLAB Simulink tanggal LIMA BELAS bulan JULI tahun DUA RIBU DUA SATU kepada Badan Meteorologi, Klimatologi, dan Geofisika, maka saya harus membayar tarif PNPB yang seharusnya dikenakan sesuai tarif yang berlaku.

Surat Pernyataan ini dibuat dan diberikan dengan ketentuan dan syarat-syarat sebagai berikut:

1. Surat Penyataan ini berlaku sejak ditandatangani;
2. Surat Pernyataan ini tidak dapat ditarik kembali, dicabut dan/atau tidak akan berakhir karena sebab apapun juga tanpa persetujuan tertulis terlebih dahulu dari Badan Meteorologi, Klimatologi, dan Geofisika.

Gowa, 19 Januari 2021

Pembuat Pernyataan

METERAI TEMPEL 6000

Muh. Agus
D41115026

Lampiran 11 Spesifikasi Turbin Angin Vestas NM82/1650

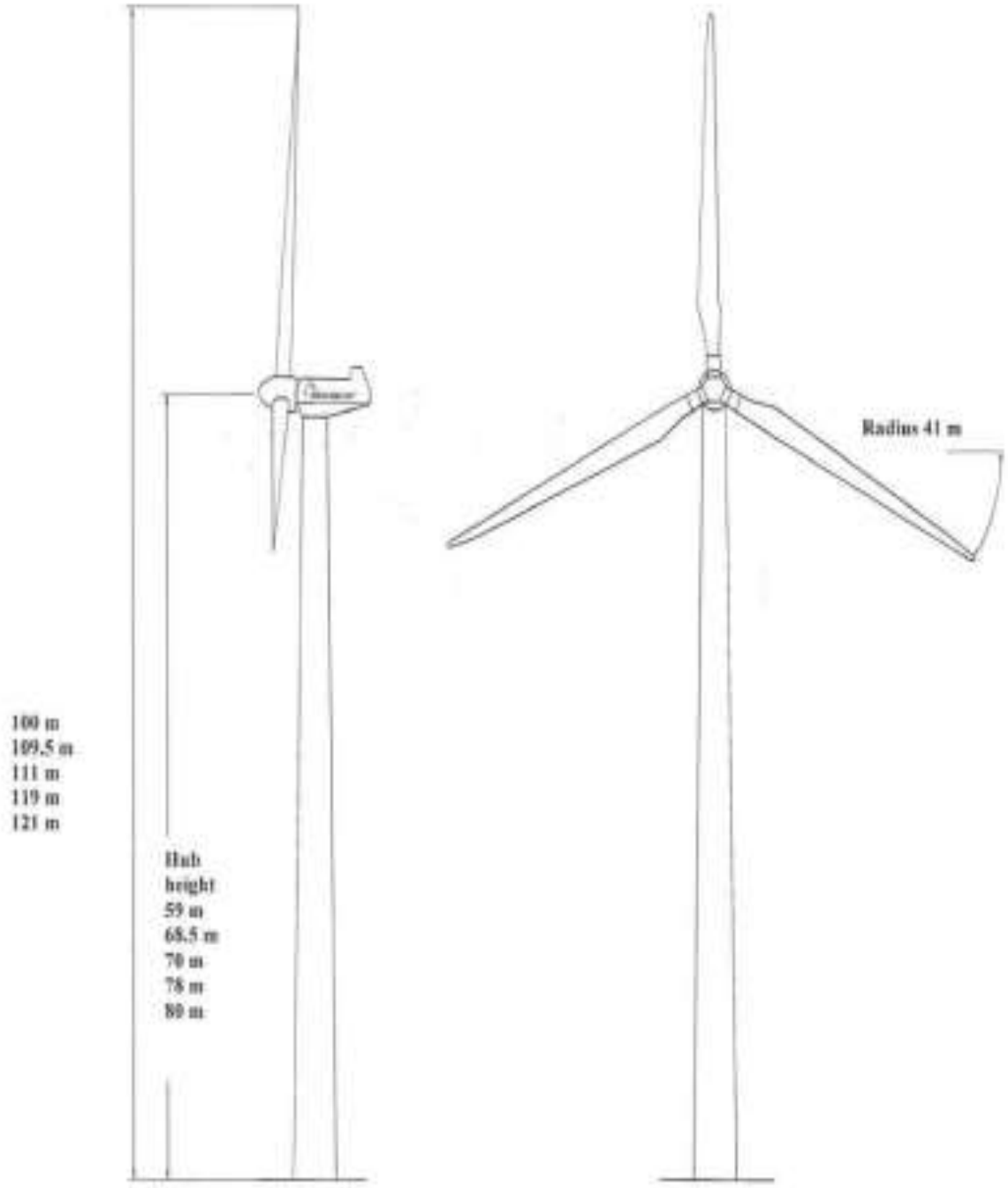
Class I
TSD 4000258-02 EN
2005-02-09

General Specification

V82-1.65 MW MK II
NM82/1650 Vers. 2

0	Illustration

Vestas


Radius 41 m
100 m
109.5 m
111 m
119 m
121 m
Hub height
59 m
65.5 m
70 m
78 m
80 m

1	Main Data			
		50 Hz	**60 Hz**	**60 Hz UL**
	Nominal Power	1650 kW	1650 kW	1650 kW
	Rotor diameter	82 m	82 m	82 m
	Swept area	5281 m^2	5281 m^2	5281 m^2
	Hub height, IEC IIb	59 m, 68.5 m, 70 m, 78 m	70 m, 78 m	59 m, 70 m, 80 m
	Rotational speed	14.4 rpm	14.4 rpm	14.4 rpm

2	Nacelle Base Frame		
		50Hz	**60Hz**
	Material	EN-GJS-400-18U-LT	EN-GJS-400-18U-LT
	Standard colour	RAL 7035	RAL 7035
	Corrosion class, outside	Acc. to DS EN ISO 12944:C5 I	Acc. to DS EN ISO 12944:C5 I

3	Rotor		
		50Hz	**60Hz**
	Number of blades	3 pieces	3 pieces
	Tip speed (synchronous)	61.8 m/s	61.8 m/s
	Rotor shaft tilt	5°	5°
	Eccentricity (tower center to hub center)	3447 mm	3447 mm
	Solidity (Total blade area/rotor area)	5.0 %	5.0 %
	Power regulation	Active Stall®	Active Stall®
	Rotor orientation	Upwind	Upwind

4	Blades		
		50Hz	**60Hz**
	Type description	AL 40	AL 40
	Blade length	40 m	40 m
	Material	Carbon/wood/glass/epoxy	Carbon/wood/glass/epoxy
	Standard colour	RAL 7035	RAL 7035
	Gloss	Class 2: (30-70%) in accordance with (1), to be measured acc. to DS/ISO2813	Class 2: (30-70%) in accordance with (1), to be measured acc. to DS/ISO2813
	Type of rotor air brake	Full blade	Full blade
	Blade profiles	• FFA -W3, NACA 63.4	• FFA - W3, NACA 63.4
	Twist	20°	20°
	Largest chord	3.08 m	3.08 m
	Blade area (projected)	86 m^2	86 m^2
	Note! (1) Technical Criteria for Danish Approval Scheme for Wind Turbines		

5	Blade bearing		
		50 Hz	**60 Hz**
	Type description	Ball bearing	Ball bearing
	Number of bearings	3 pcs.	3 pcs.

6	Hub		
		50Hz	**60Hz**
	Type description	Spherical	Spherical
	Material	EN-GJS-400-18U-LT	EN-GJS-400-18U-LT
	Corrosion class, outside	Acc. to DS EN ISO 12944:C5 I	Acc. to DS EN ISO 12944:C5 I

7	Main shaft		
		50Hz	**60Hz**
	Type description	Forged shaft and flange	Forged shaft and flange
	Material	34CrNiMo6 + QT	34CrNiMo6 + QT
	Corrosion class	Acc. to DS EN ISO 12944:C2	Acc. to DS EN ISO 12944:C2

8	Main Bearing		
		50Hz	**60Hz**
	Type description	Spherical roller bearing	Spherical roller bearing
	Number of	1 piece	1 piece
	Lubrication	Oil pump	Oil pump

9	Main Bearing Housing		
		50Hz	**60Hz**
	Type description	Flange bearing	Flange bearing
	Material	EN-GJS-400-18U-LT	EN-GJS-400-18U-LT

10	Gearbox		
		50 Hz	**60Hz**
	Type description	1. step planet, 2. step helical	1. step planet, 2. step helical
	Gear house material	Cast	Cast
	Ratio	1:70.2	1:84.3
	Mechanical power	1800 kW	1800 kW
	Bending strength acc. to ISO 6336	S_F > 1.6	S_F > 1.6
	Surface durability acc. to ISO 6336	S_H > 1.25	S_H > 1.25
	Scuffing safety acc. to DNV 41.2	S_S > 1.3	S_S > 1.3
	Shaft seals	Labyrinth	Labyrinth
	Oil sump	App. 250 l	App. 250 l

11	Cartridge Gear Heater - for Arctic Version only		
		50 Hz	**60 Hz**
	Rating	800 W/ pcs.	800 W/ pcs.
	Number of	4 pieces	4 pieces

12	Oil pump		
		50 Hz	**60Hz**
	Voltage	3 x 690 V	3 x 480 V

13	Heat Exchange Unit (Water/Oil)		
		50 Hz	**60 Hz**
	Cooling capacity	41.3 kW	41.3 kW

14	Oil Cooler		
		50 Hz	**60 Hz**
	Cooling capacity	37.5 kW	37.5 kW

15	Water Pump		
		50 Hz	**60Hz**
	Voltage	1 x 230 V	3 x 480 V

16	Water Cooler/ Radiator		
		50 Hz	**60 Hz**
	Cooling capacity	46.2 kW	46.2 kW

17	Electrical Nacelle Heater - for Arctic Version only		
		50 Hz	**60Hz**
	Voltage	3 x 690 V	3 x 600 V
	Power	20 kW	20 kW
	Number of heaters	2 pieces	2 pieces

18	Mechanical Shaft Brake		
		50 Hz	**60Hz**
	Type description	Active Brake	Active Brake
	Brake disc	Steel, mounted on high speed shaft	Steel, mounted on high speed shaft
	Number of calipers	2 piece	2 piece

19	Hydraulic Power Unit for Mechanical Shaft Brake		
		50 Hz	**60Hz**
	Voltage	3 x 690 V	3 x 480 V
	Working pressure range	140-150 bar	140-150 bar
	Oil capacity	11 l	11 l

20	Coupling		
		50 Hz	**60Hz**
	Type description	Flexible coupling, constant rpm	Flexible coupling, constant rpm

21	Generator			
			50 Hz	60 Hz
	Type description		1 speed generator, water cooled	1 speed generator, water cooled
	Rated power	P_N	1650 kW	1650 kW
	Apparent power	S_N	1805 kVA	1808 kVA
	Rated current	I_N	1510 A	1740 A
	Max power at Class F	$P_{max\ F}$	1815 kW	1815 kW
	Max current at Class F	I_{max}	1661 A	1914 A
	No load current	I_0	400 A	430 A
	Reactive power consumption at rated power (tolerance: acc to IEC 60034-1)	Q_N	731 kvar	740 kvar
	Reactive power consumption at no load (tolerance: acc to IEC 60034-1)	Q_0	478 kvar	447 kvar
	Number of poles	P	6	6
	Synchronous rotation speed	n_0	1000 rpm	1200 rpm
	Rotation speed at rated power	n_N	1012 rpm	1214 rpm
	Slip at rated power	s_N	1.20 %	1.17 %
	Voltage	U_N	3 x 690 V	3 x 600 V
	Frequency	F	50 Hz	60 Hz
	Coupling		Δ	Δ
	Enclosure		IP54	IP54
	Insulation class/ Temperature increase		F/B	F/B

22	Yaw System – Ball Bearing Slewing Ring		
		50 Hz	60 Hz
	Type description	Ball bearing, internal gearing	Ball bearing, internal gearing

23	Yaw System – Yaw Gear and Motors		
		50 Hz	60 Hz
	Type description	Planetary gear motor	Planetary gear motor
	Gear ratio of yaw gear unit	app. 1:1687	app. 1:1687
	Voltage	3 x 690 V	3 x 480 V
	Rotational speed at full load	620 rpm	1140 rpm
	Number of yaw gears	6 pieces	6 pieces

24	Yaw System – Yaw Brake		
		50 Hz	60 Hz
	Type Description	Hydraulic disc brake	Hydraulic disc brake
	Number of Yaw Friction Units	6 pieces	6 pieces

25	Hydraulic Power Unit for Yaw Brake		
		50 Hz	60 Hz
	Voltage	3 x 400/ 3x 690 V	3 x 480 V
	Working pressure range	140-150 bar	140-150 bar
	Oil capacity	App. 10 l.	App. 10 l.

21	Generator			
			50 Hz	60 Hz
	Type description		1 speed generator, water cooled	1 speed generator, water cooled
	Rated power	P_N	1650 kW	1650 kW
	Apparent power	S_N	1805 kVA	1808 kVA
	Rated current	I_N	1510 A	1740 A
	Max power at Class F	P_{max}	1815 kW	1815 kW
	Max current at Class F	I_{max}	1661 A	1914 A
	No load current	I_0	400 A	430 A
	Reactive power consumption at rated power (tolerance. acc to IEC 60034-1)	Q_N	731 kvar	740 kvar
	Reactive power consumption at no load (tolerance. acc to IEC 60034-1)	Q_0	478 kvar	447 kvar
	Number of poles	P	6	6
	Synchronous rotation speed	n_0	1000 rpm	1200 rpm
	Rotation speed at rated power	n_N	1012 rpm	1214 rpm
	Slip at rated power	s_N	1.20 %	1.17 %
	Voltage	U_N	3 x 690 V	3 x 600 V
	Frequency	F	50 Hz	60 Hz
	Coupling		Δ	Δ
	Enclosure		IP54	IP54
	Insulation class/ Temperature increase		F/B	F/B

22	Yaw System – Ball Bearing Slewing Ring		
		50 Hz	60 Hz
	Type description	Ball bearing, internal gearing	Ball bearing, internal gearing

23	Yaw System – Yaw Gear and Motors		
		50 Hz	60 Hz
	Type description	Planetary gear motor	Planetary gear motor
	Gear ratio of yaw gear unit	app. 1:1687	app. 1:1687
	Voltage	3 x 690 V	3 x 480 V
	Rotational speed at full load	920 rpm	1140 rpm
	Number of yaw gears	6 pieces	6 pieces

24	Yaw System – Yaw Brake		
		50 Hz	60 Hz
	Type Description	Hydraulic disc brake	Hydraulic disc brake
	Number of Yaw Friction Units	6 pieces	6 pieces

25	Hydraulic Power Unit for Yaw Brake		
		50 Hz	60 Hz
	Voltage	3 x 400/ 3x 690 V	3 x 480 V
	Working pressure range	140-150 bar	140-150 bar
	Oil capacity	App. 10 l	App. 10 l

30a	Power Factor – No Load Compensation - Standard											
	Preconditions											
	Rated power	P_N	1650 kW					1650 kW				
	Rated voltage	U_N	3 x 690V					3 x 600V				
	Frequency	f	50 Hz					60 Hz				
	Reactive power consumption. At rated power (tolerance. Acc to IEC 60034-1)	Q_N	731 kvar					740 kvar				
	Reactive power consumption at no load (tolerance. Acc to IEC 60034-1)	Q_0	478 kvar					447 kvar				
	Capacitor banks:											
	Capacitors		550 kvar, split into steps					499.4 kvar, split into steps				
	Capacitor banks resolution		2 x 25 kvar					2 x 22.7 kvar				
	Min. regulation time (operation)		120 sec.					120 sec.				
	Generator G, 6 poles, 1650 kW:											
	Generator load	%	25	50	75	100	110	25	50	75	100	110
	Power factor without phase compensation (tolerances acc to IEC 60034-1)	cos φ	0.71	0.86	0.91	0.91	0.91	0.69	0.85	0.90	0.91	0.91
	Power factor with phase compensation (tolerances acc to IEC 60034-1)	cos φ	0.99	1.00	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.98

30b	Power Factor – Full Load Compensation – Optional											
	Preconditions											
	Rated power	P_N	1650 kW					1650 kW				
	Rated voltage	U_N	3 x 690V					3 x 600V				
	Frequency	f	50 Hz					60 Hz				
	Reactive power consumption. At rated power (tolerance. Acc to IEC 60034-1)	Q_N	731 kvar					740 kvar				
	Reactive power consumption at no load (tolerance. Acc to IEC 60034-1)	Q_0	478 kvar					447 kvar				
	Capacitor banks:											
	Capacitors		850 kvar, split into steps					817 kvar, split into steps				
	Capacitor banks resolution		2 x 25 kvar					2 x 22.7 kvar				
	Min. regulation time (operation)		120 sec.					120 sec.				
	Generator G, 6 poles, 1650 kW:											
	Generator load	%	25	50	75	100	110	25	50	75	100	110
	Power factor without phase compensation (tolerances acc to IEC 60034-1)	cos φ	0.71	0.86	0.91	0.91	0.91	0.69	0.85	0.90	0.91	0.91
	Power factor with phase compensation (tolerances acc to IEC 60034-1)	cos φ	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

31	Climate and Site Conditions regarding structural design		
		50 Hz – IEC IIb	**60 Hz – IEC IIb**
	Design life time	20 years	20 years
	Temperature interval for operation	See specifications below	See specifications below
	Temperature interval for structure	See specifications below	See specifications below
	A-factor	9.59 m/s	9.59 m/s
	Form factor, c	2.0	2.0
	Annual average wind speed	8.5 m/s	8.5 m/s
	Wind shear	0.20	0.20
	Extreme wind speed	42.5 m/s (10 min. average)	42.5 m/s (10 min. average)
	Survival wind speed	59.5 m/s (3 sec. average)	59.5 m/s (3 sec. average)
	Automatic stop limit	20 m/s (10 min. average)	20 m/s (10 min. average)
	Automatic stop limit	24 m/s (1 min. average)	24 m/s (1 min. average)
	Automatic stop limit	32 m/s (1 s. average)	32 m/s (1 s. average)
	Re-cut in	18 m/s (10 min. average)	18 m/s (10 min. average)
	Characteristic turbulence intensity acc. to IEC 61400-1 (15 m/s)	16% (including wind farm turbulence)	16% (including wind farm turbulence)
	Air density	1.225 kg/m3	1.225 kg/m3
	Maximum in-flow angle	8°	8°

32	Specific Climate and Site Conditions			
		Standard (only 50 Hz)	**Tropical -20 to +40°C (50 + 60 Hz)**	**Arctic (50 + 60 Hz)**
	Temperature interval for operation[1,2,3]	-20 to +30°C	-20 to +35°C (+40°C)	-30 to +30°C
	Temperature interval for structure	-20 to +50°C	-20 to +50°C	-40 to +50°C
	[1] Note! For Tropical! Rated power is reduced to 1500 kW for temperature between +35°C and +40°C. [2] Note! No operation if temperature is below -10°C in control panel or gear oil sump. Heating systems are optional. [3] Note! If the windturbine is placed more than 1000m above sea level, a higher temperature rise than usual might occur in the generator, the transformer and other electrical components. In this case a periodic reduction of rated power might occur, even if the ambient temperature is within specified limits. Furthermore increased risk of icing up occur at sites more than 1000m above sea level.			

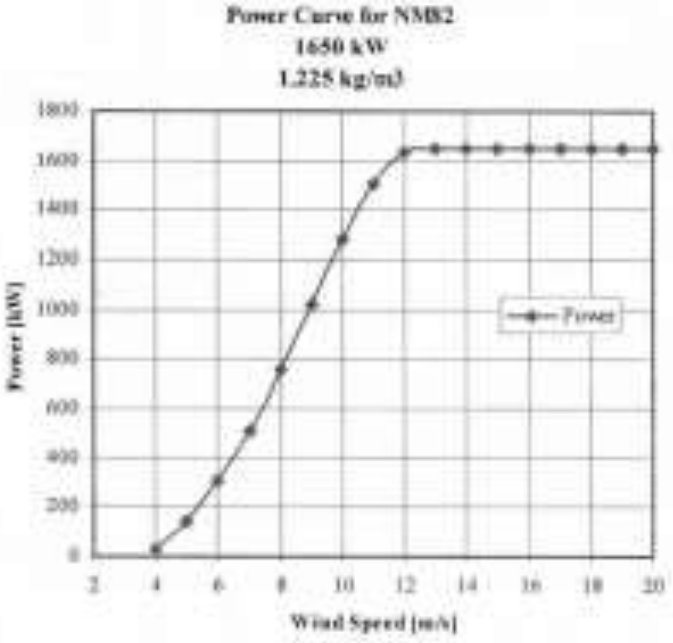
33	**Conditions for Power Curve (at hub height)**		
		50 Hz	**60Hz**
	Air density	1.225 kg/m³	1.225 kg/m³
	Wind shear	0.12-0.16	0.12-0.16
	Turbulence intensity	11-16 %	11-16 %
	Blades	Clean	Clean
	Ice/snow on blades	No	No
	Leading Edge	No damage	No damage
	Rain	No	No
	Terrain	IEC 61400-12	IEC 61400-12
	Inflow angle	0±2 °	0±2 °
	Grid frequency	50 ±0.5	60±0.5 Hz
	Verification acc. to	IEC 61400-12	IEC 61400-12

34 Power Curve for Standard Density

The power curve is calculated at air density 1.225 kg/m³

Cut –in wind speed: 3.5 m/s (10 min. average)

Wind speed (m/s)	Power (kW)
3	0
4	28
5	144
6	309
7	511
8	758
9	1017
10	1285
11	1504
12	1637
13	1650
14	1650
15	1650
16	1650
17	1650
18	1650
19	1650
20	1650
>20	0



35 Power Curve

Air density [kg/m³]	0.97	1.00	1.03	1.06	1.09	1.12	1.15	1.18	1.21	1.225	1.24	1.27
Wind speed [m/s]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]	Power [kW]
3	0	0	0	0	0	0	0	0	0	0	0	0
4	15	16	18	19	21	22	24	25	27	28	29	30
5	107	112	116	120	125	129	133	138	142	144	146	151
6	238	246	255	263	271	280	288	296	305	309	313	321
7	399	412	425	438	452	465	478	491	504	511	517	530
8	589	609	627	645	664	683	702	722	746	758	767	788
9	794	818	843	867	892	916	941	968	999	1017	1028	1058
10	995	1025	1055	1085	1116	1147	1178	1217	1260	1285	1299	1333
11	1191	1226	1266	1303	1341	1379	1417	1453	1489	1504	1518	1546
12	1371	1415	1459	1504	1548	1588	1620	1628	1638	1637	1639	1642
13	1520	1589	1616	1637	1642	1643	1645	1646	1647	1650	1650	1650
14	1624	1635	1643	1650	1650	1650	1650	1650	1650	1650	1650	1650
15	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
16	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
17	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
18	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
19	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650
20	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650	1650

36	Cp												
	Air density [kg/m³]	**0.97**	**1.00**	**1.03**	**1.06**	**1.09**	**1.12**	**1.15**	**1.18**	**1.21**	**1.225**	**1.24**	**1.27**
	Wind speed [m/s]	-	-	-	-	-	-	-	-	-	-	-	-
	3	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	4	0.092	0.095	0.103	0.106	0.114	0.116	0.123	0.125	0.132	0.135	0.138	0.140
	5	0.334	0.339	0.341	0.343	0.347	0.349	0.350	0.354	0.356	0.356	0.357	0.360
	6	0.430	0.431	0.434	0.435	0.436	0.436	0.439	0.440	0.442	0.442	0.443	0.443
	7	0.454	0.456	0.456	0.456	0.456	0.458	0.459	0.459	0.460	0.461	0.460	0.461
	8	0.449	0.450	0.450	0.450	0.451	0.451	0.452	0.453	0.456	0.458	0.458	0.459
	9	0.425	0.425	0.425	0.425	0.425	0.425	0.425	0.426	0.429	0.431	0.431	0.433
	10	0.388	0.388	0.388	0.388	0.388	0.388	0.388	0.391	0.394	0.397	0.397	0.398
	11	0.349	0.349	0.350	0.350	0.350	0.350	0.351	0.350	0.350	0.349	0.348	0.346
	12	0.310	0.310	0.310	0.311	0.311	0.311	0.309	0.302	0.296	0.293	0.290	0.283
	13	0.270	0.270	0.270	0.268	0.260	0.253	0.247	0.240	0.235	0.232	0.229	0.224
	14	0.231	0.226	0.220	0.215	0.209	0.203	0.198	0.193	0.188	0.186	0.184	0.179
	15	0.191	0.185	0.180	0.175	0.170	0.165	0.161	0.157	0.153	0.151	0.149	0.146
	16	0.157	0.153	0.148	0.144	0.140	0.136	0.133	0.129	0.126	0.125	0.123	0.120
	17	0.131	0.127	0.123	0.120	0.117	0.114	0.111	0.109	0.105	0.104	0.103	0.100
	18	0.110	0.107	0.104	0.101	0.098	0.096	0.093	0.091	0.089	0.087	0.086	0.084
	19	0.094	0.091	0.088	0.086	0.084	0.081	0.079	0.077	0.075	0.074	0.073	0.072
	20	0.081	0.078	0.076	0.074	0.072	0.070	0.068	0.066	0.065	0.064	0.063	0.062

37	Ct												
	Air density [kg/m³]	**0.97**	**1.00**	**1.03**	**1.06**	**1.09**	**1.12**	**1.15**	**1.18**	**1.21**	**1.225**	**1.24**	**1.27**
	Wind speed [m/s]	-	-	-	-	-	-	-	-	-	-	-	-
	3	0.979	0.979	0.979	0.979	0.979	0.979	0.979	0.979	0.979	0.979	0.979	0.979
	4	1.105	1.106	1.107	1.108	1.108	1.109	1.110	1.110	1.111	1.111	1.112	1.112
	5	1.007	1.007	1.008	1.008	1.009	1.009	1.010	1.010	1.010	1.014	1.011	1.011
	6	0.922	0.922	0.923	0.923	0.923	0.924	0.924	0.924	0.925	0.925	0.925	0.925
	7	0.841	0.841	0.841	0.841	0.842	0.843	0.843	0.843	0.843	0.843	0.843	0.843
	8	0.765	0.765	0.765	0.766	0.766	0.766	0.767	0.767	0.767	0.768	0.768	0.773
	9	0.691	0.692	0.692	0.692	0.692	0.693	0.693	0.693	0.694	0.701	0.697	0.713
	10	0.619	0.620	0.620	0.620	0.621	0.621	0.621	0.621	0.626	0.642	0.634	0.649
	11	0.554	0.555	0.555	0.555	0.555	0.559	0.559	0.567	0.570	0.578	0.578	0.584
	12	0.494	0.494	0.494	0.495	0.495	0.496	0.501	0.506	0.507	0.509	0.509	0.509
	13	0.438	0.438	0.439	0.439	0.440	0.440	0.440	0.439	0.438	0.438	0.437	0.436
	14	0.386	0.386	0.385	0.384	0.383	0.382	0.381	0.380	0.380	0.379	0.379	0.378
	15	0.340	0.339	0.339	0.338	0.337	0.336	0.336	0.335	0.335	0.334	0.334	0.334
	16	0.302	0.302	0.301	0.301	0.300	0.300	0.300	0.300	0.299	0.299	0.299	0.299
	17	0.270	0.270	0.271	0.271	0.271	0.270	0.271	0.271	0.271	0.272	0.272	0.271
	18	0.248	0.248	0.249	0.248	0.249	0.248	0.249	0.249	0.249	0.249	0.250	0.249
	19	0.229	0.229	0.229	0.230	0.230	0.230	0.231	0.231	0.231	0.232	0.233	0.235
	20	0.213	0.213	0.214	0.214	0.215	0.215	0.216	0.216	0.218	0.218	0.218	0.220

38	Guaranteed Sound Power Level at Hub Height					
	Conditions for Sound Power Level:	Wind shear: 0.13 **Max turbulence at 10 meter height: 16%** Inflow angle (vertical): 0 ± 2° Air density: 1.225 kg/m³				
	Hub Height	HH 59 m	HH 68.5 m	HH 70 m	HH 78 m	HH 80 m
	Verification Report: WT SE03007 B2					
	L_{wA} @ 3 m/s (10 meters above ground) (dB(A))	100.4	100.4	101.1	101.1	101.1
	L_{wA} @ 4 m/s (10 meters above ground) (dB(A))	100.9	100.9	100.9	101.4	101.4
	L_{wA} @ 5 m/s (10 meters above ground) (dB(A))	101.1	101.1	101.1	101.6	101.6
	L_{wA} @ 6 m/s (10 meters above ground) (dB(A))	101.3	101.3	101.3	101.8	101.8
	L_{wA} @ 7 m/s (10 meters above ground) (dB(A))	101.9	101.9	101.9	102.2	102.2
	L_{wA} @ 8 m/s (10 meters above ground) (dB(A))	102.9	102.9	102.9	103.2	103.2
	L_{wA} @ 9 m/s (10 meters above ground) (dB(A))	103.1	N/A	N/A	N/A	N/A
	L_{wA} @ 95% Rated Power (9.1 m/s. 10 meters above ground) (dB(A))	103.3	N/A	N/A	N/A	N/A
	L_{wA} @ 95% Rated Power (8.9 m/s 10 meters above ground) (dB(A))	N/A	103.3	103.3	103.3	N/A
	L_{wA} @ 95% Rated Power (8.8 m/s 10 meters above ground) (dB(A))	N/A	N/A	N/A	N/A	103.3

The Wind Turbine is designed according to Vestas design specifications.
Vestas Wind Systems A/S reserves the right to change specifications without prior notice.

Lampiran 12 Tampilan *Start Up Wind Turbine*

```
WT_HomeDir = pwd;
addpath(pwd);
addpath([pwd '\Libraries']);
addpath([pwd '\Libraries\Blades']);
addpath([pwd '\Libraries\Brakes']);
addpath([pwd '\Libraries\Environment']);
addpath([pwd '\Libraries\Geartrain']);
addpath([pwd '\Libraries\Generator']);
addpath([pwd '\Libraries\Main_Controller']);
addpath([pwd '\Libraries\Nacelle']);
addpath([pwd '\Libraries\Pitch_Actuation']);
addpath([pwd '\Libraries\Pitch_Controller']);
addpath([pwd '\Libraries\Tower']);
addpath([pwd '\Libraries\Yaw_Actuation']);
addpath([pwd '\Libraries\Yaw_Controller']);
addpath([pwd '\Scripts']);
addpath([pwd '\Scripts\Slide_Prep']);
addpath([pwd '\Reports']);
addpath([pwd '\Images']);
addpath([pwd '\Images\Nacelle']);
addpath([pwd '\PCT']);

if(exist('Libraries/Environment')==7)
   cd Libraries/Environment
   if((exist('+AerodynamicLoads')==7) && ~exist('AerodynamicLoads_Lib'))
      ssc_build AerodynamicLoads
   End
   cd(WT_HomeDir)
End

Wind_Turbine_Parameters
load Actuator_Lookup_data
Wind_Turbine
```

Lampiran 12 Daftar Hadir Ujian Sarjana

KEMENTERIAN PENDIDIKAN, KEBUDAYAN, RISET DAN TEKNOLOGI
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
Jl. Poros Malino Km. 6 Gowa, 92171, Sulawesi Selatan
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http://eng.unhas.ac.id/elektro, Email : elektro@unhas.ac.id

DAFTAR HADIR UJIAN SARJANA

Nama/Stambuk : Muh. Agus D41115026

Judul Skipsi/T. A : **" Simulasi Pengaruh Angin Terhadap Daya dan Efisiensi Pembangkit Listrik Tenaga Bayu Menggunakan Matlab Simulink"**

Hari/Tanggal : Rabu, 08 Juni 2022

Jam : 08.30 WITA – Selesai

Tempat : Daring (On-line/Zoom)

No.	Jabatan	Nama Dosen	Tanda Tangan
I.	Pembimbing I	1. Dr. Ir. Yusran.,ST, MT	1.
	Pembimbing II	2. Hasniaty A, ST.,MT, Ph.D	2.
II.	Anggota Penguji	3. Dr. Ir. Hj. Sri Mawar Said., MT	3.
		4. Dr. Indar Chaerah Gunadin, ST.,MT	4.

PANITIA UJIAN SARJANA

Ketua,

Dr. Ir. Yusran.,ST, MT

Sekretaris

Hasniaty A, ST.,MT, Ph.D

Lampiran 13 Berita Acara Ujian Sarjana

KEMENTERIAN PENDIDIKAN, KEBUDAYAN, RISET DAN TEKNOLOGI
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
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☎ (0411) 586015, 586262 Fax (0411) 586015
http://eng.unhas.ac.id/elektro, Email : elektro@unhas.ac.id

BERITA ACARA UJIAN SARJANA

Pada hari ini **Rabu** tanggal **08 Juni 2022** Pukul **08.30 WITA - Selesai** bertempat di Rumah **(Daring On-line Zoom),** telah dilaksanakan Ujian Sarjana bagi Saudara :

Nama : Muh. Agus

No. Stambuk : D41115026

Program Studi : Teknik Elektro

Judul Skripsi/TA : **"Simulasi Pengaruh Angin Terhadap Daya dan Efisiensi Pembangkit Listrik Tenaga Bayu Menggunakan Matlab Simulink"**

Yang dihadiri oleh Tim Penguji Seminar Hasil sebagai berikut :

No.	N a m a	Jabatan	Tanda tangan
1.	Dr. Ir. Yusran.,ST, MT	Pemb. I/Ketua	1.
2.	Hasniaty A, ST.,MT, Ph.D	Pemb.II/Sekretaris	2.
3.	Dr. Ir. Hj. Sri Mawar Said., MT	Anggota	3.
4.	Dr.Indar Chaerah Gunadin, ST.,MT	Anggota	4.

Hasil keputusan panitia penilai Seminar Hasil : **Lulus / Tidak lulus** dengan nilai angka **...**dan huruf **..A** 87,75

Gowa, 08 Juni 2022

Ketua/Sekretaris Panitia Seminar Hasil

Dr. Ir. Yusran.,ST, MT

Lampiran 14 SK Pembimbing Skripsi

KEMENTERIAN PENDIDIKAN, KEBUDAYAAN, RISET DAN TEKNOLOGI
UNIVERSITAS HASANUDDIN
FAKULTAS TEKNIK
Jl. Poros Malino Km. 6 Gowa, 92171, Sulawesi Selatan
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https://eng.unhas.ac.id/elektro E-mail : elektro@unhas.ac.id

Nomor : **10537/UN4.7.7.1/PT.01.06/2022** 03 Juni 2022

Lamp. : -
Hal : Usulan SK Pembimbing Tugas Akhir

Kepada Yth Bapak Wakil Dekan Bidang Akademik
Fakultas Teknik UNHAS
Di-
Gowa

Dengan hormat,

Dalam rangka Pembimbingan tugas akhir, maka bersama ini kami sampaikan nama mahasiswa dan Dosen Pembimbing Tugas Akhir :

Nama	Stambuk
1. Muh. Agus	1. D41115026

Dosen Pembimbing :

1. Dr. Ir. Yusran, S.T, M.T
2. Hasniaty A, ST.,MT, Ph.D

Dapat dibuatkan Usulan SK Pembimbing Tugas Akhir.

Demikian penyampaian kami, atas bantuan dan perhatiannya diucapkan terima kasih.

Gowa, 03 Juni 2022

Sekretaris Departemen Teknik Elektro

...as Kitta.,ST,MT
...197609142008011 0

Lampiran 15 Lembar Perbaikan Skripsi

LEMBAR PERBAIKAN SKRIPSI

SIMULASI PENGARUH ANGIN TERHADAP DAYA DAN EFISIENSI PEMBANGKIT LISTRIK TENAGA BAYU MENGGUNAKAN MATLAB SIMULINK

Oleh:

Muh. Agus **D41115026**

Skripsi ini telah dipertahankan pada Ujian Akhir Sarjana tanggal 08 Juni 2022

Telah dilakukan perbaikan penulisan dan isi skripsi berdasarkan usulan dari penguji dan pembimbing skripsi

Persetujuan perbaikan oleh tim penguji

	Nama	Tanda Tangan
Ketua	Dr. Ir. Yusran, S.T, M.T.	
Sekretaris	Hasniaty A, ST ,MT. Ph.D	
Anggota	Dr. Ir. Hj. Sri Mawar Saad., MT	
	Dr. Indar Chaerah Gunadin, ST ,MT	

Persetujuan perbaikan oleh pembimbing

Pembimbing	Nama	Tanda Tangan
I	Dr. Ir. Yusran, S.T, M.T.	
II	Hasniaty A, ST ,MT. Ph.D	