BAB V
KESIMPULAN DAN SARAN

5.1 Kesimpulan

1. Pada pengujian Multilin SR 469, semakin besar arus yang diberikan maka relay akan trip dengan waktu yang lebih cepat.

Tabel 5.1 Hasil Pengujian

No	Arus Gangguan	Current Inject (A)	Pengujian (Ampere)	Waktu aktual Trip (s)	Expected Trip Time (s)
			Arus Gangguan x FLA		
1	1,01	1,599	38,38	Tidak trip	
2	1,1	1,742	41,8	1125	1666,7
3	1,2	1,900	45,6	388,1	795,44
4	1,3	2,058	49,4	328	507,22
5	1,4	2,217	53,2	184,9	364,55
6	1,5	2,375	57	135,6	279,96
7	1,75	2,771	66,5	81,86	169,66
8	2	3,167	76	55,8	116,63
9	2,25	3,563	85,5	42,48	86,12
10	2,5	3,958	95	31,22	66,64
11	3	4,750	114	19,71	43,73
12	3,5	5,542	133	14,7	31,09
13	4	6,333	152	10,96	23,32
14	4,5	7,125	171	8,766	18,17
15	5	7,917	190	6,794	14,57
16	5,5	8,708	209	5,415	11,96
17	6	9,500	228	4,622	9,99
18	6,5	10,292	247	3,882	4,48
19	7	11,083	266	3,393	7,29
20	7,5	11,875	285	2,829	6,33
21	8	12,667	304	2,764	5,55
22	10	15,833	380	2,559	5,55
23	15	23,750	570	0,039	5,55

2. Perbandingan nilai trip time antara standard overload curve dengan nilai pada pengujian menggunakan Merger Relay Tester dapat dilihat bahwa saat trip time, pengujian lebih singkat dibandingkan dengan trip time yang diharapkan pada standard overload curve.

Tabel 5.2 Standard curve multipiers

PICKUP (×FLA)	STANDARD CURVE MULTIPLIERS														
	×1	×2	×3	×4	×6	×8	×7	×8	×9	×10	×11	×12	×13	×14	×15
1.01	4353.6	8707.2	13061	17414	21768	26122	30475	34829	39183	43536	47890	52243	56597	60951	65304
1.05	853.71	1707.4	2561.1	3414.9	4268.6	5122.3	5976	6829.7	7683.4	8537.1	9390.8	10245	11098	11952	12806
1.1	416.68	833.36	1250	1666.7	2083.4	2500.1	2916.8	3333.5	3750.1	4166.8	4583.5	5000.2	5416.9	5833.6	6250.2
1.2	198.86	397.72	596.58	795.44	994.3	1193.2	1392	1590.9	1789.7	1988.6	2187.5	2386.3	2585.2	2784.1	2982.9
1.3	126.8	253.61	380.41	507.22	634.02	760.82	887.63	1014.4	1141.2	1268	1394.8	1521.6	1648.5	1775.3	1902.1
1.4	91.14	182.27	273.41	364.55	455.68	546.82	637.96	729.09	820.23	911.37	1002.5	1093.6	1184.8	1275.9	1367
1.5	69.99	139.98	209.97	279.96	349.95	419.94	489.93	559.92	629.91	699.9	769.89	839.88	909.87	979.86	1049.9
1.75	42.41	84.83	127.24	169.66	212.07	254.49	296.9	339.32	381.73	424.15	466.56	508.98	551.39	593.81	636.22
2	29.16	58.32	87.47	116.63	145.79	174.95	204.11	233.26	262.42	291.58	320.74	349.9	379.05	408.21	437.37
2.25	21.53	43.06	64.59	86.12	107.65	129.18	150.72	172.25	193.78	215.31	236.84	258.37	279.9	301.43	322.96
2.5	16.66	33.32	49.98	66.64	83.3	99.96	116.62	133.28	149.94	166.6	183.26	199.92	216.58	233.24	249.9
2.75	13.33	26.65	39.98	53.31	66.64	79.96	93.29	106.62	119.95	133.27	146.6	159.93	173.25	186.58	199.91
3	10.93	21.86	32.8	43.73	54.66	65.59	76.52	87.46	98.39	109.32	120.25	131.19	142.12	153.05	163.98
3.25	9.15	18.29	27.44	36.58	45.73	54.87	64.02	73.16	82.31	91.46	100.6	109.75	118.89	128.04	137.18
3.5	7.77	15.55	23.32	31.09	38.87	46.64	54.41	62.19	69.96	77.73	85.51	93.28	101.05	108.83	116.6
3.75	6.69	13.39	20.08	26.78	33.47	40.17	46.86	53.56	60.25	66.95	73.64	80.34	87.03	93.73	100.42
4	5.83	11.66	17.49	23.32	29.15	34.98	40.81	46.64	52.47	58.3	64.13	69.96	75.79	81.62	87.45
4.25	5.12	10.25	15.37	20.5	25.62	30.75	35.87	41	46.12	51.25	56.37	61.5	66.62	71.75	76.87
4.5	4.54	9.08	13.63	18.17	22.71	27.25	31.8	36.34	40.88	45.42	49.97	54.51	59.05	63.59	68.14
4.75	4.06	8.11	12.17	16.22	20.28	24.33	28.39	32.44	36.5	40.55	44.61	48.66	52.72	56.77	60.83
5	3.64	7.29	10.93	14.57	18.22	21.86	25.5	29.15	32.79	36.43	40.08	43.72	47.36	51.01	54.65
5.5	2.99	5.98	8.97	11.96	14.95	17.94	20.93	23.91	26.9	29.89	32.88	35.87	38.86	41.85	44.84
6	2.5	5	7.49	9.99	12.49	14.99	17.49	19.99	22.48	24.98	27.48	29.98	32.48	34.97	37.47
6.5	2.12	4.24	6.36	8.48	10.6	12.72	14.84	16.96	19.08	21.2	23.32	25.44	27.55	29.67	31.79
7	1.82	3.64	5.46	7.29	9.11	10.93	12.75	14.57	16.39	18.21	20.04	21.86	23.68	25.5	27.32
7.5	1.58	3.16	4.75	6.33	7.91	9.49	11.08	12.66	14.24	15.82	17.41	18.99	20.57	22.15	23.74
8	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.1	12.49	13.88	15.27	16.65	18.04	19.43	20.82
10	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.1	12.49	13.88	15.27	16.65	18.04	19.43	20.82
15	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.1	12.49	13.88	15.27	16.65	18.04	19.43	20.82
20	1.39	2.78	4.16	5.55	6.94	8.33	9.71	11.1	12.49	13.88	15.27	16.65	18.04	19.43	20.82

5.2 Saran

1. Perlu dilakukan schedule pengecekan relay secara berkala untuk mengetahui trip time dari relai masih sesuai standar dan didokumentasikan.
2. Diharapkan melakukan kalibrasi pada peralatan yang sedang beroperasi khususnya pada proteksi pada electric motor.
3. Bila terjadi kegagalan pada relay yang sedang beroperasi, sebaiknya sudah disediakan relay yang sudah ready sebagai pengganti agar tidak terjadi lost time produksi.

DAFTAR PUSTAKA

[1] H Sungkowo, A Setiawan, BI Kurniawan, EEP Pradana, RD Lestari, ADT Setyawan "ANALISIS PENGUJIAN RELAY PROTEKSI MENGGUNAKAN RELAY TESTING UNIT TIPE PTE-100-C PLUS" Jurnal Teknik Ilmu Dan Aplikasi, 2022

[2] MR Adzani , "Analisis Evaluasi Setting Relay DOCR (Directional Over Current Relays) sebagai proteksi pada PT Linde Indonesia Situs Gresik JawaTimur", Jurnal ITS, Surabaya, 2016.

[3] I Nengah Sunaya, IGS Widharma "Analisis Koordinasi Over Current Relay Dan Ground Fault Relay Terhadap Keandalan Sistem", Jurnal Ilmiah VASTUWIDYA Vol. 3, No.1, 2020

[4] Said Abubakar, Muhammad Kamal Hamid, "Pengujian Relay Arus Lebih Woodward Tipe XI1-I di Laboratorium Jurusan Teknik Elektro," Journal of Electrical Technology, Vol. 1, No. 2, Juni 2016.

[6] [Zuhal, 1988 Dasar Tenaga Listrik dan elektronika daya Hal. 101].

[7] Prih Sumardjati, dkk., Teknik Pemanfaatan Tenaga Listrik Jilid 3 Hal. 408

[8] Pratama, gusti. (2021). Aplikasi Matlab Sebagai Simulasi Pengaturan Kecepatan Putaran Motor Induksi 3 Fasa Menggunakan VSD (Variable Speed Drive) Acs 800. Electro national conference (ENACO) politeknik negeri sriwijaya, , 42-48

[9] Darmadi, I. P. Y., Wijaya, I. W. A., & Rinas, I. W. (2021). Pengaruh Filter Pasif Untuk Menekan Harmonisa (THD) Terhadap Unjuk Kerja Motor Induksi 3 Phase Menggunakan Matlab. Jurnal SPEKTRUM, 8, 216-221

[10] Aulia, S. L., Toto, T., & Kartono, W. (2021). Simulasi Aplikasi PLC Sebagai Sistem Proteksi Arus Dan Temperatur Lebih Pada Motor Induksi Tiga Fasa. Prosiding The 12th Industrial Research Workshop and National Seminar Bandung, 18-23.

[12] Daryanto. (2016). Media Pembelajaran. Yogyakarta: Gava Media.

[13] GE Multilin, Event record data GE Multilin SR 469, 2013.

[14] Megger, Multi-Phase Relay Test System [Online]. Available: www.megger.com/ Multi-Phase Relay Tester smrt46

[15] Masalah yang sering terjadi pada electric motor https://www.indotara.co.id/masalah-yangsering-terjadi-pada-electric-motor&id=615.html

CGS 3
HPS PUMP E
DEVICE DEFINITION
ORDER CODE: 469-P5-111-A20-T
VERSION: 5.2X
SERIAL NUMBER: B3034880
DESCRIPTION: DATA MULTILIN
INTERFACE: COM6: 19200 N 8 1

STATUS

MOTOR STATUS

Motor Status	Stopped
Motor Load	0.00 FLA
Motor Thermal Capacity Used	0 %
Estimated Time to Trip on Overload	Never
Motor Speed	Low Speed (Speed 1)
Phase A Current	0 A
Phase B Current	0 A
Phase C Current	0 A
Average Phase Current	0 A
Current Unbalance	0 %
Vab	0 V
Vbc	0 V
Vca	0 V
Average Line Voltage	0 V
System Frequency	0.00 Hz
Power Factor	1.00 Lag
Real Power	0 kW
Real Power (HP)	0 hp
Reactive Power	0 kvar
Apparent Power	0 kVA

TRIP STATUS

Cause of Last Trip	Overload Trip
Time of Last Trip	21:47:14
Date Of LastTrip	07/10/2014
Motor Speed During Trip	Low Speed (Speed 1)
Pre-Trip Tachometer RPM	0 R.P.M
Phase A Pre-Trip Current	49 A
Phase B Pre-Trip Current	49 A
Phase C Pre-Trip Current	49 A
Pre-Trip Motor Load	1.58 FLA
Pre-Trip Current Unbalance	0 %
Pre-Trip Ground Current	0.00 A
Phase A Pre-Trip Differential Current	0 A
Phase B Pre-Trip Differential Current	0 A
Phase C Pre-Trip Differential Current	0 A
Hottest Stator RTD During Trip	0
Pre-Trip Temperature of Hottest Stator RTD	-----
Hottest Bearing RTD During Trip	0
Pre-Trip Temperature of Hottest Bearing RTD	-----
Hottest Other RTD During Trip	0
Pre-Trip Temperature of Hottest Other RTD	-----
Hottest Ambient RTD During Trip	0
Pre-Trip Ambient RTD Temperature	-----
Pre-Trip Voltage Vab	4010 V
Pre-Trip Voltage Vbc	4020 V
Pre-Trip Voltage Vca	3990 V
Pre-Trip Voltage Van	0 V
Pre-Trip Voltage Vbn	0 V
Pre-Trip Voltage Vcn	0 V
Pre-Trip System Frequency	60.03 Hz
Pre-Trip Real Power	-299 kW
Pre-Trip Reactive Power	-171 kvar
Pre-Trip Apparent Power	345 kVA
Pre-Trip Power Factor	0.87 Lag
Analog Input #1 Pre-Trip	0
Analog Input #2 Pre-Trip	0
Analog Input #3 Pre-Trip	0
Analog Input #4 Pre-Trip	0
Pre-Trip Temp. of Hottest Stator RTD (°F)	-----
Pre-Trip Temp. of Hottest Bearing RTD (°F)	-----
Pre-Trip Temp. of Hottest Other RTD (°F)	-----
Pre-Trip Temp. of Hottest Ambient RTD (°F)	-----

ALARM STATUS

Remote Alarm Status	Off
Pressure Switch Alarm Status	Off
Vibration Switch Alarm Status	Off
Digital Counter Alarm Status	Off

ANSI/IEEE Standard Device Numbers

In North America protective relays are generally referred to by standard device numbers. Letters are sometimes added to specify the application (IEEE Standard C37.2-2008).

Device Numbers (the more commonly used ones are in bold)

1 - Master Element
2 - Time Delay Starting or Closing Relay
3 - Checking or Interlocking Relay
4 - Master Contactor
5 - Stopping Device
6 - Starting Circuit Breaker
7 – Rate of Change Relay
8 - Control Power Disconnecting Device
9 - Reversing Device
10 - Unit Sequence Switch
11 – Multifunction Device
12 - Overspeed Device
13 - Synchronous-speed Device
14 - Underspeed Device
15 - Speed or Frequency-Matching Device
16 – Data Communications Device
20 - Elect. operated valve (solenoid valve)
21 - Distance Relay
23 - Temperature Control Device
24 – Volts per Hertz Relay
25 - Synchronizing or Synchronism-Check Device
26 - Apparatus Thermal Device
27 - Undervoltage Relay
30 - Annunciator Relay
32 - Directional Power Relay
36 - Polarity or Polarizing Voltage Devices
37 - Undercurrent or Underpower Relay
38 - Bearing Protective Device
39 - Mechanical Condition Monitor
40 –Field (over/under excitation) Relay
41 - Field Circuit Breaker
42 - Running Circuit Breaker
43 - Manual Transfer or Selector Device
46 – Rev. phase or Phase-Bal. Current Relay
47 - Phase-Seq. or Phase-Bal. Voltage Relay
48 - Incomplete-Sequence Relay
49 - Machine or Transformer Thermal Relay
50 - Instantaneous Overcurrent
51 - AC Inverse Time Overcurrent Relay
52 - AC Circuit Breaker
53 – Field Excitation Relay
55 - Power Factor Relay
56 - Field Application Relay
59 - Overvoltage Relay
60 - Voltage or Current Balance Relay
62 - Time-Delay Stopping or Opening Relay
63 - Pressure Switch
64 - Ground Detector Relay
65 - Governor
66 – Notching or jogging device
67 - AC Directional Overcurrent Relay
68 - Blocking or "out of step" Relay
69 - Permissive Control Device
74 - Alarm Relay
75 - Position Changing Mechanism
76 - DC Overcurrent Relay
78 - Phase-Angle Measuring Relay
79 - AC-Reclosing Relay
81 - Frequency Relay
83 - Automatic Selective Control or Transfer Relay
84 - Operating Mechanism
85 – Pilot Communications, Carrier or Pilot-Wire Relay
86 - Lockout Relay
87 - Differential Protective Relay
89 - Line Switch
90 - Regulating Device
91 - Voltage Directional Relay
92 - Voltage and Power Directional Relay
94 - Tripping or Trip-Free Relay

Suffixes indicating zone of protection
B –Bus
G – Ground or generator
L—Line
N –Neutral
T – Transformer
U—Unit