VILLAGE OF PAW PAW

SYSTEM COORDINATION STUDY

FINAL REPORT April 7, 2017



Village of Paw Paw 111 E. Michigan Ave. Paw Paw, MI 49079



GRP Engineering, Inc. 459 Bay Street Petoskey, MI 49770

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VILLAGE OF PAW PAW PROTECTIVE DEVICE COORDINATION PHILOSOPHY

This document will serve as the base for determining settings and operational procedures for the Village of Paw Paw protective devices including reclosers and fuses. Overcurrent device selection shall limit system interruptions created by faults to the fewest number of customers for the shortest amount of time. This plan shall be weighted against the economic factors of device selection.

Objectives

The objectives of installing protective devices on the electrical distribution system is to:

- Safeguard human life, including operation personnel and general public.
- Protect equipment from damage caused by faults on the electrical system.
- Limit extent & duration of service interruption to the Village of Paw Paws' electric customers.

The exception to this rule will be faults on portions of underground circuits. Coordination schemes will be developed so that protective devices remove only the smallest portion of the line necessary to clear the fault. These schemes will compromise between equipment damage and service interruption time. The human safety factor will weigh the highest in the decision making process of overcurrent device selection.

All equipment interrupting ratings shall be above the maximum available fault current at the installed location. Periodic reviews of available fault current shall be completed to ensure equipment is not overdutied at any point in the system. Transmission system and generation changes external to the Village of Paw Paw's distribution system will affect available fault current.

The protective device coordination philosophy for the electrical system, are separated into the categories below.

Substations

The Village of Paw Paw's electrical distribution system does not consists of any major distribution substations.

Primary Distribution Circuits

The Village of Paw Paw does not have any substations. All four of their primary distribution circuits are metered interconnection points to the 12.47kV I&M system. The Village of Paw Paw owns the reclosers and controllers that protect these interconnected circuits.

All distribution circuits will be protected by reclosers with settings customized for the type of circuit and the customers served by it. Overhead circuits will have different settings then the underground circuits. Circuits that are comprised of 80% or more of underground cable will be defined as "underground" circuits and will have reclosing intervals and number of operations to lockout that are different then the overhead circuits.

All of Paw Paw's circuits are composed of less than 80% underground cable. The existing settings have either three or four operations to lock-out and differing reclosing intervals. The number of operations to lockout, number of operations on fast curves, and reclosing intervals are outlined in the table below.

		0 0	
Circuit	Operations to Lockout	Operations on Fast Curve	Reclosing Intervals
North Circuit	3	1	Inst. & 10s
South Circuit	3	1	1s & 10s
Almena Circuit	3	1	Inst. &10s
Walmart Circuit	4	2	2s, 10s, & 30s

Circuit Reclosers Existing Settings Table

The settings should be uniform between all the circuits, as they are all considered to be overhead circuits. The circuit reclosers have fast curves enabled, meaning that the operating philosophy is a "fuse saving" scheme. In this type of protection scheme, the circuit reclosers will operate prior to any fuses being allowed to blow. There is an alternate protection philosophy "fuse sacrificing" where fuses are allowed to blow prior to the circuit recloser operating. A fuse saving philosophy will typically results in less permanent outages, but will temporarily interrupt service to all customers on a circuit. This can cause irritation to customers, especially those with sensitive equipment including point of sale machines. A fuse sacrificing philosophy will limit an outage to the least amount of customers, but increase the frequency of outages. The protection philosophy is ultimately up to the village of Paw Paw and its customers, however, GRP Engineering, Inc. recommends only having one operation on fast curves if a fuse saving philosophy is followed.

Overhead circuits should have four operations to lock-out, the reclosing intervals will be 2, 5, 10 seconds and then the circuit will lock-out. Reclosing intervals of less than 2 seconds have been shown to still be above the threshold of perception for the human eye and can irritation to customers and equipment. The shortest reclosing interval should be 2 seconds.

Underground circuits should have two operations to lock-out, the reclosing interval will be 5 seconds followed by a second operation to lock-out. Underground circuits need a longer reclosing interval than the overhead circuits do to the arc from a fault typically being contained in an enclosure. It can take up to 5 seconds for the air to de-ionize and fault to extinguish when the fault is in an enclosure.

Proposed number of operations to lockout, number of operations on fast curves, and reclosing intervals are outlined in the table below.

		1 0	
Circuit	Operations to Lockout	Operations on Fast Curve	Reclosing Intervals
North Circuit	4	1	2s, 5s, & 10s
South Circuit	4	1	2s, 5s, & 10s
Almena Circuit	4	1	2s, 5s, & 10s
Walmart Circuit	4	1	2s, 5s, & 10s

Circuit Reclosers Proposed Settings Table

All of the circuits with the exception of the Walmart Circuit have the same phase and ground minimum pickup settings. The North, South, and Almena Circuits have a phase pickup of 400A and a ground pickup of 240A. The Walmart Circuit has a phase pickup of 100A and a ground pickup of 75A. The pickup levels on the North and Walmart Circuit need to be increased.

The North Circuit has a 2500kVA transformer that serves the Bronson Lakeview Hospital. The proper protective fuse for this size of a transformer is a 140K, see the "*Village of Paw Paw Distribution Transformer Fusing*". The largest fuse that will coordinate with the current settings in the North Circuit recloser controller is a 100K. The pickup on this circuit should be raised to 600A to allow coordination with a 140K fuse. See attached time-current curves (TCC) attached to the end of this report.

The Walmart Circuit has a 1500kVA transformer that serves the Walmart Super Center. The proper protective fuse for this size of a transformer is a 100K, see the "*Village of Paw Paw Distribution Transformer Fusing*". The largest fuse that will coordinate with the current settings in the Walmart Circuit recloser controller is a 25K. The pickup on this circuit should be raised to 450A to allow coordination with a 100K fuse. See attached time-current curves (TCC) attached to the end of this report.

If the Village of Paw Paw builds an underground circuit in the future, overhead settings should have alternate settings that can be enabled. The alternate settings will match the standard underground settings. These settings will be enabled when an underground circuit is tied to an overhead circuit and the overhead circuit is the source feed.

Changes made to the recloser controller settings, especially pickup levels and operating curves, will need to be coordinated with I&M. I&M may need to adjust their protective device settings in order to maintain coordination with the Village of Paw Paw's circuit reclosers.

Distribution Taps

All distribution circuit taps will be protected by fuses or reclosers sized appropriately for the maximum tap load and coordination for the available fault current range. In-line reclosers on overhead lines will operate similarly to the circuit reclosers following a "fuse saving" philosophy allowing the recloser to operate prior to a downline fuse. In-line reclosers will operate prior to the circuit recloser operating. All distribution tap fuses will clear after circuit or line reclosers first operation. Backup protection will be the circuit recloser or upline mainline fuses or recloser (where installed). Tap reclosers will have four operations to lock-out. Reclosing times will be 2, 5, 10 seconds respectively. Reclosers will not be utilized for underground taps, all underground taps will be fused. The exception will be underground mainline sections, these may use 600A single phase disconnect switches.

Criteria for selecting overcurrent protective devices for taps include tap length, wooded vs. open right-of-way, single-phase or three-phase loads, and taps crossing a highway. Lengthy circuit taps with sensitive three phase customers will be protected by a three-phase recloser where practical.

Mainline and tap fuses on the overhead system will be K speed, tin links. The largest fuse that will coordinate with the circuit reclosers is shown on the TCC curves for each circuit attached to the end of this report. Underground taps in padmount switchgear will be S&C SMU-20, K speed fuses.

All 200A underground cable risers will be protected with fusing sized for the largest transformer served by it and will coordinate with the upline recloser or fuses. This riser pole fusing will be less than the padmount transformer fuse and possibly less than the overhead transformer fuse standard. Considering underground faults are rarely temporary, it is prudent to install the smallest possible fuse. Underground loops will be fused for all transformers in the loop to allow for picking up all load from either overhead source point. One span overhead taps to underground cable riser poles will not be fused at the tap point. Upline recloser operations on underground cable will not be allowed prior to the underground cable fuse clearing. Taps that cross a highway will be individually evaluated by utility staff and may not be fused at the tap, but rather a span or two into the tap, to allow for safe access off of the highway.

Distribution Transformers

All distribution transformers will be protected by fuses, either open cutout style (pole-mount) or bay-o-net (pad-mount). Fusing for both polemount and padmount transformers will allow for short term overloads and cold load pickup. Allowed cold load pickup will be as follows:

Multiple Full Load	<u>Time</u>
25 X	0.01 Sec
12 X	0.1 Sec
6 X	1.0 Sec
3 X	10 Sec
2 X	15 Min

All distribution transformers will have backup protection from upline protective devices including circuit reclosers, mainline fuses, tap reclosers, etc.

Polemount transformers will be protected with K speed, tin link fuses. Polemount transformers will be allowed to operate at a minimum of 200% rating prior to the fuse melting. Padmount transformers will be protected with dual sensing bay-o-net fuses. Padmount transformers will be allowed to operate at a minimum of 140% rating prior to the fuse melting.

The Village of Paw Paw fuse schedule shall be followed when selecting the fuse size for a distribution transformer.

Capacitor Banks

Capacitor bank fuses will protect the distribution circuit from a failed capacitor unit as well as protect the capacitor bank from the potential rupture of a failed individual unit. Several factors will be evaluated in order to select the proper fuse size including maximum available fault current at the capacitor bank location, capacitor manufacturer, capacitor unit type, number of units per phase, connection and back-to-back capacitor switching. Capacitor banks shall be installed with current limiting fuses and oil or vacuum disconnect switches.

Primary Metering Customers

Primary metering customers with connected transformer kVA less than or equal to 2500kVA at 7.2kV will be protected by fusing on the utility side of the primary metering installation. Where practical, customer side disconnects shall also be installed. The Village of Paw Paw shall have access to both utility and customer owned fuses and switches.

Primary metering customers with connected transformer kVA greater than 2500kVA at 7.2kV will be protected by a breaker or recloser on the customer side of the primary metering installation. Switches shall be provided by the customer at the primary metering point with access for both the Village of Paw Paw and customer to operate.

Distributed Generation Customers

Distribution generation installations shall protect the Village of Paw Paw's system through a device meeting the criteria of IEEE 1547. The over-current and frequency relays or inverters will provide a trip signal back to the generator breaker. All distributed generation installations shall be studied on a case-by-case basis and all will coordinate with upstream protection devices. Protection schemes must be in place to insure no out-of-sync closing conditions are allowed. Relays or inverters will operate based on frequency and voltage conditions, the generator breaker(s) will operate within 2 seconds of the loss of the system source voltage and will not be allowed to close into the system until voltage is present for 5 minutes and in sync.

Mis-coordination

Acceptable situation for mis-coordination include protection of high value items including substation transformers and human life. Engineering notes shall be placed on file to document all mis-coordination situations.

Relay Maintenance & Testing

All circuit reclosers will be calibrated and trip checked on a five-year cycle. This includes reclosers at the beginning of the circuit and those installed out on the lines. Distributed generation protective devices will be tested, at the owner's expense, on an annual basis. Distributed generation testing will be completed by removing the system source voltage and

verifying that the isolation device operates at the point of common connection within 2 seconds and is locked out from closing until after the system source voltage has been present for 5 minutes.

Emergency Operations

All temporary system changes during emergency operating procedures shall be reviewed by the Village of Paw Paw engineering & operation staff to insure equipment damage is minimized and life safety is not compromised.

<u>Safety</u>

While personnel are working on energized lines, reclosing devices will be placed into Non-Reclose to prevent multiple operations of protection devices. While working on de-energized equipment, personnel will work between visible open points and protective grounds will be installed on all sides of the work area.

Village of Paw Paw Distribution Transformer Fusing

Transformer kVA		Overhead	Fuse Link ¹	Podmount Euco Link ²			
Single Phase	Three Phase	Prin	nary				
Single Fliase	Thee Fhase	2.4kV	7.2kV	2.4kV	7.2kV		
5	15	6K	ЗK				
10	30	8K	ЗK				
15	45	10K	6K	C05 (8A)	C03 (3A)		
25	75	15K	6K	C08 (15A)	C05 (8A)		
37.5	112.5	25K	8K	C10 (25A)	C08 (15A)		
50	150	30K	10K	C10 (25A)	C08 (15A)		
75	225	40K	15K	C12 (50A)	C10 (25A)		
100	300	65K	20K	C12 (50A)	C10 (25A)		
167	500	100K	30K	C14 (65A)	C12 (50A)		
250	750	140K	50K	C16 (100A)	C14 (65A)		
333	1000		65K	C18 (140A)	C14 (65A)		
	1500		100K		C18 (140A)		
	2000		140K				

NOTES:

- 1. Overhead fuse links are S&C Positrol "K" speed in XS open cutouts. (TCC 165-6 &165-6-2) Size based on minimum recommended fusing values in the S&C Fuse Application Manual.
- 2. Padmount fuse links are Cooper-RTE bayonet type, dual-sensing, catalog number 358C. (TCC 1557B & 1558B)
- 3. Fuses are sized for the following transformer loadings: 6X 1sec; 3x 10sec; 2X 15min.



Almena Recloser and Largest Fuse

7.2 kV



North Recloser and Largest Fuse



North Recloser (Proposed Settings)



South Recloser and Largest Fuse



Walmart Recloser and Largest Fuse



Walmart Recloser (Proposed Setting



6K and 40K Fuse TCC



10K and 50K Fuse TCC



20K and 50K Fuse TCC





25K and 65K Fuse TCC





30K and 80K Fuse TCC



50K and 100K Fuse TCC



Village of Paw Paw Tap & Fuse List

Fuse #TapDir.Fuse LocationNameFuseXfmr kVA1Xfmr kVA2MinMaxDeviceCommentsF0130ES. Gremps St. & E. Paw Paw St.North10K50751,6132,864North RecloserF0230WW. Michigan Ave., & Lord St.NorthNorthNone1,3942,449F35Mainline Fuse, replace with 600A disconneF0310NW. Michigan Ave., & Fairfield Dr.North15K75751,0981,448F106UG Tap 1-Phase Transformer (75kVA)F0430WCommercial Ave. & Industrial Ave.South65K3335081,5432,726South RecloserF0510NE. Berrien St. & S. LaGrave St.Almena15K501131,1962,524Almena RecloserF0630SE. Berrien St. & S. Niles St.Almena10K101,2161,963Almena RecloserF0730NCommercial Ave. & Gremps St.South80K1001051,4992,656South RecloserUpline of fuse F9F0830SCommercial Ave. & Gremps St.South80K1001051,4992,656South RecloserUpline of fuse F133F0930WCherry St., north of Commercial Ave. & Gremps St.South80K1001001,4992,573F07UG Tap 3-Phase Transformer (300kVA)F0930WC	
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F06 3Ø S E. Berrien St. & S. Niles St. Almena 10K 10 1,216 1,963 Almena Recloser Verify transformer size against selected fu F07 3Ø N Commercial Ave. & Gremps St. South 80K 100 105 1,499 2,656 South Recloser Upline of fuse F9 F08 3Ø S Commercial Ave. & Gremps St. South 80K 100 265 1,499 2,656 South Recloser Upline of fuse F9 F08 3Ø S Commercial Ave. & Gremps St. South 80K 100 2655 1,499 2,656 South Recloser Upline of fuse F133 F09 3Ø W Cherry St., north of Commercial Ave. (downline of fuse F07) South 20K 100 1,499 2,573 F07 UG Tap 3-Phase Transformer (300kVA) F04 97 5 07 5 07 107 108 1,499 2,573 F07 UG Tap 3-Phase Transformer (300kVA)	
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F08 3Ø S Commercial Ave. & Gremps St. South 80K 100 265 1,499 2,656 South Recloser Upline of fuse F133 F09 3Ø W Cherry St., north of Commercial Ave. (downline of fuse F07) South 20K 100 100 1,449 2,573 F07 UG Tap 3-Phase Transformer (300kVA) F09 50 50 50 50 50 50 100 100 1,449 2,573 F07 UG Tap 3-Phase Transformer (300kVA)	
F09 3Ø W Cherry St., north of Commercial Ave. (downline of fuse F07) South 20K 100 1,449 2,573 F07 UG Tap 3-Phase Transformer (300kVA)	
L F10 3/2 E County Road 665 & M40 Walmart 100K 500 500 1,407 2,191 Walmart Recloser UG Tap to Walmart	
F11 3Ø N Elm St. & Marcelletti Ave. Almena 100K 971 1,576 Almena Recloser 3-Phase UG Riser	
F12 1Ø E. Davis St. & Merriman Ln. Almena 65K 855 1,502 F11 3-Phase UG Riser	
F13 3Ø S Ampey Rd., east of fuse F14 South 10K 50 50 1,280 2,283 South Recloser UG Tap 3-Phase Transformer (150kVA)	
F14 3Ø N Ampey Rd., east of fuse F17 South 20K 100 1,268 2,261 South Recloser OH transformers in transclosure	
F15 3Ø S Ampey Rd., east of fuse F18 South 20K 100 1,241 2,213 F17 UG Tap 3-Phase Transformer (300kVA)	
F17 1Ø Ampey Rd., east of fuse F18 South 80K 100 1,255 2,237 South Recloser Upline of fuse F15	
F18 3Ø N Ampey Rd., east of Gremps St. South 20K 100 125 1,242 2,213 South Recloser	
F19 3Ø W M40 & Lakeview Ter. Almena 8K 25 50 813 1,429 F12	
F20 1Ø E M40 & North St. NE Almena 20K 50 115 747 903 F12	
F21 3Ø E M40, south of Industrial Ave. South 100K 250 550 1,369 2,438 South Recloser OH tap to east	
F22 3Ø S M40, south of Industrial Ave. (downline of fuse F21) South 50K 250 1,335 2,401 F21 UG Tap 3-Phase Transformer (750kVA)	
F26 3Ø S Ampey Rd., east of fuse F27 South 30K 167 1,087 1,929 South Recloser OH transformers in transclosure	
F27 3Ø N Johnson St. & Ampey St. South None 1,065 1,888 South Recloser Mainline Fuse, replace with 600A disconne	ects
F28 3Ø N Johnson St. & Ampey St. South None 1,058 1,883 South Recloser Mainline Fuse, replace with 600A disconne	ects
F29 1Ø W Johnson St. & Hidden Ln. North 40K 25 75 1,343 1,783 F35 Upline of fuse F49	
F30 3Ø W County Road 665 & Health Pkwy Walmart 100K 667 671 1,273 1,997 F89	
F31 3Ø E M40 Family Fair South 30K 100 175 1,269 2,264 F69	
F34 3Ø N W. Michigan Ave., west of S. Gremps St. North 20K 100 100 1,533 2,728 North Recloser UG Tap 3-Phase Transformer (300kVA)	
F35 3Ø W W. Michigan Ave., west of F34 North None 1,536 2,720 North Recloser Mainline Fuse, replace with jumpers	
F36 3Ø S W. Michigan Ave., west of F35 North 10K 50 50 1,519 2,687 North Recloser UG Tap 3-Phase Transformer (150kVA)	
F37 3Ø S W. Michigan Ave. & Hazen St. North 20K 50 100 1,507 2,664 North Recloser UG Tap 3-Phase Transformer (2-150kVA)	
F39 3Ø N W. Michigan Ave. & Hazen St. North None 1,504 1,665 F35 Mainline Fuse, replace with 600A disconne	ects
F40 3Ø E N. Gremps St., between E. Michigan & Oak St. North 10K 50 50 1,564 2,779 North Recloser UG Tap 3-Phase Transformer (150kVA)	
F41 3Ø S Oak St., between N. Gremps St. & N. Kalamazoo St. North 10K 50 50 1,540 2,737 North Recloser UG Tap 3-Phase Transformer (150kVA)	
F43 3Ø S Oak St., between N. Niles St. & N. LaGrave St. North 20K 100 100 1,455 2,575 North Recloser UG Tap 3-Phase Transformer (300kVA)	
F44 3Ø S Oak St., between N. Niles St. & N. LaGrave St. North 20K 100 100 1,448 2,562 North Recloser UG Tap 3-Phase Transformer (300kVA)	
F45 1Ø E Pine St. & N. Van Buren St. Almena 6K 25 25 897 1,112 Almena Recloser OH Tap 1-Phase Transformer (25kVA)	
F46 3Ø N Cedar St. & N. Brown St. Almena 20K 100 100 880 1,438 Almena Recloser Unknown transformer on tap	
F47 1Ø N Cedar St. & N. Niles St. Almena 10K 50 50 860 1,060 Almena Recloser OH Tap 1-Phase Transformer (50kVA)	
F48 3Ø E M40 & Fadel St. South 15K 75 1,318 2,350 South Reclloser UG Tap 3-Phase Transformer (225kVA)	
F49 1Ø End of Hidden Ln. North 6K 25 25 1,274 1,697 F29 Downline from F29	
F50 3Ø W W. Michigan Ave., & Lord St. North 10K 50 50 1,396 2,454 F51 UG Tap 3-Phase Transformer (150kVA)	
F51 3Ø N W. Michigan Ave., & Lord St. North 50K 50 75 1,415 2,489 F35 Protects OH tap to Fuse 50	

				Circuit	Proposed	Largest	Sum	Fault Cu	irrent (A)	Upline	
Fuse #	Тар	Dir.	Fuse Location	Name	Fuse	Xfmr kVA ¹	Xfmr kVA ²	Min	Max	Device	Comments
F52	1Ø	Ν	W. Michigan Ave, west of N. Harris St.	North	10K	50	88	1,440	1,946	F35	
F53	3Ø	S	W. Michigan Ave., west of Miller Ct.	North	100K	250	543	1,464	2,583	F35	Upline of fuse F54
F54	3Ø	W	Miller Ct.	North	50K	250	417	1,395	2,485	F53	
F55	1Ø	Ν	W. Michigan Ave. & Miller Ct.	North	6K	25	25	1,477	2,607	F35	
F57	3Ø	Е	Miller Ct.	North	6K	25	25	1,455	2,577	F35	UG Tap 3-Phase Transformer (75kVA)
F59	3Ø	Ν	E. Berrien St., east of fuse F60	Almena	10K	50	50	1,255	2,024	Almena Recloser	UG Tap 3-Phase Transformer (150kVA)
F60	3Ø	S	E. Berrien St., east of S. Gremps St.	Almena	20K	100	100	1,263	2,038	Almena Recloser	UG Tap 3-Phase Transformer (300kVA)
F61	3Ø	Е	M40, north of fuse F65	South	15K	75	75	1,367	2,434	South Recloser	UG Tap 3-Phase Transformer (225kVA)
F62	3Ø	W	M40, north of fuse F65	South	100K	333	791	1,352	2,408	South Recloser	OH tap to west (uknown transformer on tap)
F63	3Ø	W	M40, north of fuse F65	South	65K	333	683	1.319	2.354	F62	Downline of fuse F62
F64	3Ø	Е	M40, south of E. Berrien St.	South	30K	167	167	1.301	2.320	South Recloser	UG Tap 3-Phase Transformer (500kVA)
F65	3Ø	Е	M40, north of Commercial Dr.	South	15K	75	75	1.382	2,460	South Recloser	UG Tap 3-Phase Transformer (225kVA)
F66	30	F	M40 between Commenticial Ave & Industrial Ave	South	15K	75	75	1 398	2 488	South Recloser	UG Tap 3-Phase Transformer (225kVA)
F67	30	F	M40, between Commenticial Ave. & Industrial Ave.	South	1010	10	10	1,000	2 488	South Recloser	
F68	300	F	M40, porth of Fadel St	South	10K	50	50	1 351	2,100	South Recloser	UG Tap 3-Phase Transformer (150k\/A)
F60	300	F	M40, Junine of fuse E31	South	80K			1 208	2,407	South Recloser	Unknown transformer on tan
F70	30	L W	M40, south of Fadel St	South	15K	75	75	1 326	2,313	South Recloser	UIG Tan 3-Phase Transformer (225k)/A)
E71	30	WV	M40, porth of Fadel St	South	2014	100	100	1,320	2,303	South Recloser	UC Tap 3 Phase Transformer (200k)/(A)
E74	30	VV \\/	E St. Joseph St. cost of S. Kolomozoo St.	Almono	101/	50	75	1,330	2,301	Almono Boolooor	
F74	10		E. St. Joseph St., edst of S. Kalamazoo St.	Almena	2014	167	75	1,175	1,907	Almena Recloser	
F70	10	E	S. LaGrave St. & River Ru.	Almena	30K	167	242	1,000	1,374	Almena Recloser	Couth of fund F70
F77		5	S. LaGrave St.	Almena	00	25	40	1,021	1,318	Almena Recloser	South of fuse F76
F/8	30	VV	E. Main St. & N. Liberty St.	Almena	10K	50	/5	1,053	1,703	Almena Recloser	
F80	30	N	E. Berrien St. & S. Brown St.	Almena	None	50	150	1,175	1,495	Almena Recloser	Mainline Fuse, replace with 600A disconnects
F81	10	E	S. Liberty St., south of E. Saint Joseph St.	Almena	25K	100	200	1,089	1,638	Almena Recloser	
F82	VØ	E	E. Saint Joseph St. & S. Liberty St.	Almena	65K	100	400	1,085	1,363	Almena Recloser	Upline of fuse F83 F85
F83	1Ø	S	E. Saint Joseph St., east of S. Liberty St.	Almena	25K	100	200	1,059	1,334	F82	
F85	1Ø	S	E. Saint Joseph St., east of fuse F83	Almena	25K	100	200	1,040	1,312	F82	
F86	3Ø	N	E. Main St. & N. Woodman St.	Almena	6K	25	25	1,023	1,658	Almena Recloser	UG Tap 3-Phase Transformer (75kVA)
F87	3Ø	Ν	E. Main St. & S. State St.	Almena	10K	50	50	1,018	1,648	Almena Recloser	UG Tap 3-Phase Transformer (150kVA)
F88	1Ø	S	E. Main St. & Hamilton St.	Almena	10K	50	75	1,020	1,270	Almena Recloser	
F89	3Ø	W	County Road 665 & M40	Walmart	SB	667	816			Walmart Recloser	Upline of fuse F30
F90	1Ø	S	M40 (Behind Tractor Supply)	Walmart	20K	50	250	1,370	1,809	Walmart Recloser	Feed into mobile home park
F91	1Ø	Ν	Elm St. & N. Dyckman St.	Almena	6K	25	25	929	1,154	Almena Recloser	
F92	3Ø	S	Elm St., east of N. Dyckman St.	Almena	10K	50	50	937	1,526	Almena Recloser	UG Tap 3-Phase Transformer (150kVA)
F93	3Ø	Ν	Elm St. & Madison St.	Almena	50K	100	200	949	1,544	Almena Recloser	Upline of fuse F94 and F103
F94	1Ø	Ν	Elm St. & Madison St.	Almena	20K	100	100	925	1,512	F93	
F95	3Ø	Е	Hamilton St., north of E. Michigna Ave.	South	10K	50	50	1,001	1,619	Almena Recloser	UG Tap 3-Phase Transformer (150kVA)
F96	3Ø	S	Oak St., between N. Kalamazoo St. & N. Niles St.	North	20K	100	175	1,496	2,654	North Recloser	
F97	1Ø	Ν	Cedar St.	Almena	6K	25	25	873	1,082	Almena Recloser	OH Tap 1-Phase Transformer (25kVA)
F98	3Ø	Ν	N. Gremps St. & Cedar St.	North	8K	38	48	1,435	2,565	North Recloser	
F99	1Ø	Е	N. Kalamazoo St. & Pine St.	North	10K	50	50	1,360	1,868	North Recloser	
F100	3Ø	Е	Hazen St. & W. Willard St.	North	100K	833	833	1,402	2,511	F39	UG Tap to Hospital
F102	3Ø	w	Power Plant Rd. & M40	Almena	30K	25	315	730	1,277	F12	
F103	3Ø	N	Elm St. & Madison St.	Almena	15K	75	75	925	1,512	F93	
F106	3Ø	w	Charles St., south of W. George Ct.	North	None			1,212	2,178	F39	Mainline Fuse, replace with 600A disconnects
F107	1Ø	Ŵ	Fairfield Dr. & Lakeview St.	North	8K	25	50	1,177	2,150	F106	
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				Circuit	Proposed	Largest	Sum	Fault Cu	urrent (A)	Upline	
Fuse #	Тар	Dir.	Fuse Location	Name	Fuse	Xfmr kVA ¹	Xfmr kVA ²	Min	Max	Device	Comments
F109	1Ø	E	Glenview Dr. & Hillcrest Rd.	North	6K	25	35	1,127	1,480	F106	
F111	3Ø	Ν	W. North St., west of Charles St.	North	65K	333	583	1,223	2,204	F39	UG Tap 3-Phase Transformer (750kVA & 1000kVA)
F112	1Ø	W	Charles St. & W. Geaorge Ct.	North	10K			1,219	1,633	F39	Verify transformer size against selected fuse
F115	1Ø	Ν	Hazen St., north of W. North St.	North	6K	25	25	1,264	1,703	F39	UG Tap 1-Phase Transformer (25kVA)
F116	3Ø	W	Hazen St., north of W. North St.	North	30K	167	167	1,264	1,703	F39	UG Tap 3-Phase Transformer (75kVA)
F117	1Ø	Ν	Lake St.	North	20K	67	67	1,187	1,603	F39	UG Tap 1-Phase Transformer (2-100kVA)
F118	3Ø	S	W. Michigan Ave., east of Glenview Dr.	North	20K	100	100	1,357	2,386	F2	UG Tap 3-Phase Transformer (300kVA)
F119	3Ø	S	W. Michigan Ave., east of Glenview Dr.	North	15K	75	75	1,357	2,386	F2	UG Tap 3-Phase Transformer (225kVA)
F120	3Ø	S	W. Michigan Ave., west of Glenview Dr.	North	6K	25	25	1,337	2,352	F2	OH Tap to 75kVA power bank
F121	3Ø	S	W. Michigan Ave., west of Glenview Dr.	North	6K	25	25	1,337	2,352	F2	UG Tap 3-Phase Transformer (75kVA)
F122	1Ø	E	W. North St. & Hazen St.	North	6K	25	25	1,355	1,830	F39	
F125	1Ø	Е	Hazen St.	North	6K	25	25	1,269	1,713	F39	
F126	3Ø	W	36th St., north of Lake St.	North	50K	167	320	1,181	1,593	F39	
F127	1Ø		Lake St., east of F117	North	10K	50	50	1,150	1,551	F39	
F128	1Ø		36th St., north of fuse F126	North	10K	50	50	1,147	1,547	F39	UG Tap 1-Phase Transformer (50kVA)
F129	3Ø	Ν	Ampey Rd., east of fuse F130	South	30K	167	167	1,173	2,088	South Recloser	UG Tap 3-Phase Transformer (500kVA)
F130	3Ø	Ν	Ampey Rd., east of fuse F131	South	30K	167	167	1,173	2,088	South Recloser	UG Tap 3-Phase Transformer (500kVA)
F131	3Ø	S	Ampey Rd., east of fuse F26	South	20K	100	100	1,159	2,062	South Recloser	UG Tap 3-Phase Transformer (300kVA)
F132	3Ø	S	Ampey Rd., east of fuse F26	South	30K	167	167	1,159	2,062	South Recloser	UG Tap 3-Phase Transformer (500kVA)
F133	3Ø	S	Industrial Ave., downline of fuse F08	South	20K	100	100	1,433	2,547	F08	UG Tap 3-Phase Transformer (300kVA)
F135	3Ø	Ν	E. Red Arrow Hwy., east of Hastings St.	South	10K	50	50	972	1,582	South Recloser	UG Tap 3-Phase Transformer (150kVA)
F136	3Ø	S	E. Red Arrow Hwy., east of fuse F135.	South	10K	50	75	963	1,570	South Recloser	
F137	3Ø	W	Commercial Ave. & Industrial Ave.	South	40K	167	232	1,543	2,726	South Recloser	Feeds transformers down Factory St.

Notes:

1. Xfmr kVA is for a single phase transformer unless noted as 3 phase in the comments

2. Sum Xfmr kVA is the largest sum of kVA on any single phase of the tap.

3. Fuse # is based off Milsoft models' fuse elements name.







