

**TABLE ZS-1
PERFORMANCE CRITERIA LIMITS EXCEEDED AND OTHER CONSTRAINTS – 2009 Summer Peak, 70% High Transfer and 90% East-to-West Bias Cases**

Planning Zone	Criteria Exceeded/Need	2009 Summer Peak Case		2009 High Transfer Case		2009 90% E-W Case		Facility Outage(s)	Project
		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
1	Sigel and Lakehead Vesper 138-kV bus voltages	–	91 – 92%	–	–	–	–	Arpin-Sigel 138-kV line	Publicly announced load curtailments
1	Council Creek and Petenwell 138-kV bus voltage	–	90 – 95%	–	–	–	91%	Base Case Saratoga-Petenwell 138-kV line	Monroe County – Council Creek 161-kV line
1	Necedah, Whistling Wings, Dellwood, and Friendship 69-kV bus voltages	–	90 – 92%	–	–	–	91 – 92%	Petenwell 138/69-kV transformer Petenwell-Big Pond 69-kV line Big Pond-Necedah tap 69-kV line	Mckenna capacitor bank expansion
1	Wien – Stratford 115-kV line	99 – 105%		103.5%	–	–	–	Arpin 345/138-kV transformer Arpin 138/115-kV transformer Arpin-Galvin 115-kV line Galvin-Hume 115-kV line	Use recently validated circuit ratings
2	Delta – Mead 69-kV line	103-163 %	-	95-111%	-	103-161%	-	Base Case Chandler-Lakehead Tap 69-kV line Lakehead Tap-Masonville 69-kV line Masonville-Gladstone 69-kV line Gladstone-North Bluff 69-kV line North Bluff-Bay Tap 69-kV line Bay Tap-Mead 69-kV line	Dispatch local generation
2	Chandler – Delta 69-kV #1 line	109%	-	118%	-	109%	-	Chandler-Delta 69-kV #2 line	Dispatch local generation
2	Chandler – Delta 69-kV #2 line	103%	-	113%	-	103%	-	Chandler-Delta 69-kV #1 line	Dispatch local generation
2	Chandler 138/69-kV transformer	95-104%	-	101-102%	-	98-104%	-	Nordic-Mountain 69-kV line Mountain-Harris Tap 69-kV line Forsyth 138/69-kV transformer	Increased existing summer emergency rating from SELD
2	Chandler – Lakehead Tap 69-kV line Masonville – Lakehead Tap 69-kV line Masonville – Gladstone 69-kV line Gladstone – North Bluff 69-kV line North Bluff – Bay Tap 69-kV line Mead – Bay Tap 69-kV line	124-162%	-	98%-109%	-	121%-158%	-	Delta-Mead 69-kV line	Dispatch local generation
2	Pine River – Straits 69-kV line	104%-108%	-	-	-	103%-106%	-	Hiawatha-Lakehead 138-kV line Lakehead-Brevort 138-kV line Brevort-Straits 138-kV line	Dispatch of hydro and/or diesel generation
2	Straits– Evergreen 69-kV line Evergreen-Pine River 69-kV line	95%-105%	-	-	-	96%-104%	-	Hiawatha-Lakehead 138-kV line Lakehead-Brevort 138-kV line Brevort-Straits 138-kV line	Dispatch of hydro and/or diesel generation
2	Valley, Evergreen, Indian Lake, St. Ignace, Blaney Park, Curtis, Gould City, Straits, Engadine, Hiawatha 69-kV bus voltages	-	105.2%-105.8%	-	105.0%-105.6%	-	105.1% - 105.7%	Base Case	Operating guide
2	Engadine, Newberry Village, Lou Pac, Newberry, Newberry Hospital, Newberry Hospital Tap, Roberts, Hulbert, Eckerman, Raco 69 kV bus voltages	-	80.9%-91.4%	-	-	-	80.3%-91.3%	Hiawatha-Engadine 69-kV line Engadine-Newberry 69-kV line	9 Mile/Roberts 69-kV capacitor banks
2	Atlantic 138-kV bus voltage	-	88.9%	-	-	-	-	Atlantic-M-38 138-kV line outage	Operating guide
2	Iron Grove, Twin Lake 69-kV bus voltages	-	88.0%-88.9%	-	-	-	-	Twin Lake -Lakota Rd 138-kV line Twin Lake-Iron Grove 138-kV line	Operating guide
3	North Stoughton-Stoughton East – Stoughton 69-kV line	136.3% - 96.9%	–	–	–	119.4% - 103.2%	–	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line	Rebuild Stoughton Substation bus

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3	Verona-Sun Valley-Oregon 69-kV line	121.3%	–	–	–	105.9%	–	Stoughton-Aaker 69-kV line	Rebuild the Y-119 Verona to Oregon 69-kV line
3	McCue-Harmony-Lamar 69-kV line	111.6% - 95.2%	–	–	–	99.6% - 97.2%	–	Kegonsa 138/69-kV transformer Kegonsa-North Stoughton 69-kV line North-Stoughton-Stoughton E 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation
3	Fitchburg-Syene 69-kV line	101.1%	–	–	–	–	–	Royster-Pflaum Tap 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Stage Coach-Black Earth 69-kV line	98.3%	–	–	–	97.7%	–	Spring Green 138/69-kV transformer	Install a second 138/69-kV transformer at Spring Green with a 100 MVA summer normal rating
3	Royster-Pflaum Tap 69-kV line	97.8%	–	–	–	–	–	Fitchburg-Syene 69-kV line	Loop 6947 Nine Springs-Pflaum 69-kV line into Femrite Substation
3	Enzyme Bio Systems-RC3 69-kV line	97.7%	–	–	–	98.1% - 95.5%	–	Colley Road – Dickinson 138-kV line	Operating guide
3	McCue-Harmony 69-kV line	95.2%	–	–	–	–	–	Brodhead Switching Station-Brodhead South 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation
3	Concord, Rubicon, Hustisford, Hubbard and Butler Ridge 138-kV buses	–	93.4% - 94.7%	–	–	–	94.1% -94.8%	Base Case	Dispatch local generation
3	Harmony, Lamar, Fulton, Saunders Creek, Dana Corp, Sheepskin and Evansville 69-kV buses	–	83.6% - 91.8%	–	90.5% - 91.5%	–	86.8% - 91.5%	McCue-Harmony 69-kV line Harmony-Lamar 69-kV line Lamar-Fulton 69-kV line	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69-kV capacitor banks at Lamar Substation
3	Lakehead Cambridge Tap, Fort Atkinson, Jefferson, Crawfish, Concord ,Hubbard, Hustisford, Rubicon and Butler Ridge 138-kV buses	–	86.4% - 91.5%	–	–	–	88.3% - 91.8%	Rockdale to Lakehead Cambridge Tap 138-kV line Lakehead Cambridge Tap-Jefferson4 138-kV line Jefferson4-Jefferson 5 Bus outage Jefferson5-Crawfish 138-kV line Crawfish-Concord4 138-kV line Plus other less severe outages	Dispatch local generation

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		% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage	% of Facility Rating	% of Nominal bus voltage		
3	Brodhead Muni 3, Brodhead Muni 2, Brodhead, Brodhead Muni 1, RCEC Orfordville, Orfordville, Bass Creek, Footville, RCEC Center, Evansville 69-kV bus voltages	–	88.2% - 91.7%	–	–	–	90.7% - 92%	Brodhead Switching Station-Brodhead Muni 3 69-kV line Brodhead Muni 2 – Brodhead Muni 3 69-kV line Brodhead Muni 2-Brodhead 69-kV line	Upgrade Sheepskin capacitor bank from 10.8 MVAR to 16.2 MVAR and Install 5.7 MVAR distribution capacitor bank at Union Townline 69-kV Substation
3	Aaker, Oregon and Brooklyn 69-kV buses	–	88.2% - 89.5%	–	–	–	–	Stoughton-Aaker 69-kV line	Rebuild the Y-119 Verona to Oregon 69-kV line
3	Spring Green, Arena, Mazomanie, Mazomanie Industrial, Lone Rock, Muscododa, Avoca, Blue River, Boscobel, Boscobel Muni 69-kV bus voltages	–	88.5% - 91.4%	–	–	–	90.5% - 91.7%	Spring Green 138/69-kV transformer	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation
3	Hubbard and Hustisford 138-kV buses	–	89.1% - 89.7%	–	88.5% -89.3%	–	–	Rubicon-Hustisford 138-kV line Hubbard-Hustisford 138-kV line	Adjust load tap changer at Hubbard
3	Dickinson, Global Renewable Energy, William Bay and Brick Church 138-kV buses	–	90.0% - 91.2%	–	89% - 91.5%	–	89.1% - 91.7%	Colley Road – Dickinson 138-kV line Dickinson-Global Renewable Energy 138-kV line Global Renewable Energy-Brick Church 138-kV line	Install a total of 6.3 MVAR distribution capacitor banks at Dickinson Substation and Install one temporary 12.45 MVAR 69-kV mobile capacitor bank at Brick Church Substation
3	Eden and Lancaster 138-kV buses	–	90.4% - 91.7%	–	–	–	–	Nelson Dewey-Lancaster 138-kV line Lancaster-Eden 138-kV line	Install 2-16.33 MVAR 69-kV capacitor banks at Spring Green Substation
3	N Stoughton, Stoughton E, Stoughton and Aaker 69-kV buses	–	91.2% - 91.5%	–	–	–	–	N Stoughton-Kegonsa 69-kV line	Rebuild the Y-119 Verona to Oregon 69-kV line and Construct new Oak Ridge-Verona 138-kV line and install a 138/69-kV transformer at Verona with a 100 MVA summer normal rating
3	Muscododa and Avoca 69-kV buses	–	91.3% - 91.7%	–	–	–	91.9%	Spring Green-Lone Rock 69-kV line	Install 1-8.16 MVAR capacitor bank at Boscobel 69-kV Substation and upgrade existing 5.4 MVAR bank with an 8.16 MVAR bank
3	Paddock 345/138 kV transformer	–	–	107.7%	–	–	–	Base case	Dispatch local generation
3	Paddock-Townline 138-kV line	–	–	103.1%	–	–	–	Base case	Dispatch local generation
3	Paddock-Townline 138-kV line	–	–	123.3% - 113.8%	–	–	–	Paddock-NW Beloit 138-kV line NW Beloit-Blackhawk 138-kV line Blackhawk-Colley Road 138-kV line	Dispatch local generation
3	Paddock-NW Beloit-Blackhawk-Colley Road 138-kV line	–	–	116.8% - 105.5%	–	–	–	Paddock-Townline 138-kV line	Dispatch local generation

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3	Huiskamp-Mendota-Ruskin 69-kV line	–	–	106.5% - 98.9%	–	–	–	North Madison-Vienna 138-kV line Vienna-Yahara River 138-kV line Yahara River-American Center 138-kV line American Center-Sycamore 138-kV line	Dispatch local generation
3	N Stoughton-Stoughton E-Stoughton 69-kV line	–	–	113.9% - 104.4%	–	–	–	Paddock 345/138 kV transformer Paddock-Wempletown 345-kV lines	Dispatch local generation
3	North Monroe-Darlington 138-kV line	–	–	100.8%	–	–	–	Paddock 345/138 kV transformer Paddock-Wempletown 345-kV lines	Dispatch local generation
3	Brick Church 138-kV bus	–	–	–	94.9%	–	–	Base case	Dispatch local generation
3	Brick Church, Global Renewable Energy, North lake Geneva, William Bay, Elkhorn, Bristol, Sugar Creek and Bluff Creek 138-kV buses	–	–	–	90.8% - 91.8%	–	–	Burlington 138-kV Bus tie outage	Dispatch local generation
3	Potosi, Hillman, Lafayette wind, Darlington, Albany and North Monroe 138-kV buses	–	–	–	87.3% - 91.8%	–	–	Nelson Dewey-Potosi 138-kV line Potosi-Hillman 138-kV line Hillman-Lafayette Wind 138-kV line	Dispatch local generation
3	Entire Rock County and Walworth County 138-kV bus voltages	–	–	–	86.8% - 91%	–	–	Paddock 345/138 kV transformer Byron-Wempletown 345 kV line Paddock-Wempletown 345-kV line	Dispatch local generation
3	McCue-Harmony 69-kV line	96.5%	--	--	--	--	--	Columbia generator unit 1 or 2	Uprate Y-61 McCue-Lamar 69-kV line to achieve 300 deg F line ratings and install 2-12.45 Mvar 69 kV capacitor banks at Lamar Substation
4	West Marinette 138/69-kV transformer #1	96.6-95.1%	–	–	–	–	–	Wells St-Roosevelt 69-kV line Roosevelt 138/69-kV transformer	- Expand the Menominee 69-kV Substation and install 138-kV terminals. Loop the West Marinette-Bay De Noc 138-kV line into the Substation - Install 138/69-kV transformer at the expanded Menominee Substation
4	Sunset Point-Pearl Ave 69-kV line	104.8%	–	–	–	–	–	Ellinwood-Twelfth Ave 69-kV line	- Rebuild 2.37 miles of 69 kV from Sunset Point to Pearl Ave with 477 ACSR
4	Pioneer-Sobieski 69-kV line	99.6%	–	–	–	–	–	Pulliam-Suamico 69-kV line outage followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Sobieski 69-kV bus	–	93.9%	–	–	–	94.8%	Base Case	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV

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4	Suamico 69-kV bus	-	91.6%	-	-	-	-	Pulliam-Suamico 69-kV line outage followed by Sobieski-Pioneer 69-kV line close	Rebuild/Convert Bayport-Suamico-Sobieski-Pioneer 69-kV line to 138 kV
4	Bluestone, Wesmark 69-kV buses	-	89.3-91.5%	-	-	-	-	Finger Rd-Bluestone 69-kV line outage	Construct a new 138-kV substation and loop Highway V-East Krok 138-kV line into the substation
5	Concord 138 kV bus Bark River 138 kV bus Cooney 138 kV bus Cottonwood 138 kV bus Germantown 138 kV bus Hartford 138 kV bus Merrill Hills 138 kV Maple 138 kV bus Summit 138kV bus	-	93.5 % 94.2 % 92.8 % 93.1 % 93.6 % 94.9 % 94.7 % 94.1 % 92.9 %	-	-	-	-	Intact System	Dispatch local generation
5	Concord, Cooney, Cottonwood, Summit, Bark River 138-kV bus voltages	-	90.6 – 91.8% 87.8 – 90.6 % 87.7 – 91.0 % 88.0 – 91.4 % 89.1 - 91.0 %	-	- - - -	-	91.8 -- 91.9% 89.5 -- 91.9% 88.9 – 90.4 % 89.5 – 90.7 % 91.1 – 91.7 %	Jefferson–Lakehead – Rockdale 138-kV line Jefferson-Crawfish River – Concord 138-kV line Bark River – Cottonwood 138-kV line Bark River – Sussex 138-kV line Maple – Saukville 138kV line Plus other less severe outages	Dispatch local generation
5	Germantown and Maple 138-kV bus voltages	-	88.7% 83.8 – 84.1% 89.4 – 90.4%	-	-	-	91.1 % 87.3 – 87.6 % 91.1 – 91.9%	Germantown – Maple 138kV line Maple - Saukville 138kV line Bark River – Sussex 138kV line	Dispatch local generation
5	Hartford 138-kV bus voltage	-	86.8%	-	-	-	88.6 %	Hartford – St. Lawrence 138kV line	Load shifting
5	Bain 345/138-kV transformer	159.0%	-	130.7%	-	159.1%	-	Pleasant Prairie bus split between buses 3 and 4	Dispatch local generation
5	Albers – Bain 138-kV line	97.6%	-	-	-	102.7%	-	Bain – Kenosha 138-kV line	Dispatch local generation
5	Oak Creek 345/230-kV transformer (T884)	97.5%	-	-	-	-	-	Oak Creek 230-kV bus split between buses 6 & 7	Dispatch local generation
5	Arcadian4 – Waukesha1 138-kV line	-	-	-	-	98.2%	-	Arcadian6 – Waukesha3 138-kV line	Dispatch local generation
5	Arcadian6 – Waukesha3 138-kV line	-	-	-	-	97.4%	-	Arcadian4 – Waukesha1 138-kV line	Dispatch local generation
5	Albers – Paris 138-kV line	-	-	100.7%	-	-	-	Paddock 345/138-kV transformer	Dispatch local generation
5	Harbor – Kansas 138-kV line	-	-	92.6% 93.2% 93.6% 94.6%	-	-	-	Montana – Dewey 138-kV line Dewey 138-kV bus tie outage Dewey – Norwich 138-kV line Kansas – Norwich 138-kV line	Dispatch local generation
5	Tichigan and Burlington 138-kV buses	-	-	-	89.3-89.6%	-	91.6%	Burlington 138-kV bus split	Load shift
5	Albers- Kenosha 138-kV line	-	-	111.3%	-	113.3%	-	Albers – Bain 138-kV line	Dispatch local generation
5	Root River – Oak Creek 138-kV line	-	-	-	-	101.2%	-	Albers – Paris 138-kV line	Dispatch local generation
5	Tichigan, Burlington and Air Liquide 138-kV buses	-	-	-	91.3-92.0%	-	-	Paddock 345/138-kV transformer	Load shift

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5	Arcadian 345/138-kV transformer #3	- 106.0%	-	108.0% 94.1%	-	100.2% 106.4%	-	Arcadian 345-kV bus and Arcadian transformer #2 Arcadian transformer #1	Dispatch local generation (temporary) Arcadian transformer (provisional permanent solution)
5	Arcadian 345/138-kV transformer #2	96.0 %	--	--	--	97.5%	-	Arcadian transformer #1	Generation redispatch (temporary) Arcadian transformer (provisional permanent solution)