Power Precision

Electrical Equipment Maintenance Frequencies - Based on CSA Z463-18 Guideline on Maintenance of Electrical Systems

Table M.4.1

Circuit Breakers

Legend:
x = a test or inspection should be performed
y = factory testing should be performed
- = factory testing not required
n/s = not specified; testing frequency is at the discretion of user
n/a = not applicable
a/n = as needed

	Type of equipment — Tests to be performed							Maintenance priority		
Maintenance activities	Panelboard Circuit breakers	Low-voltage insulated case or molded case circuit breakers (MCCBs)	Low-voltage power air circuit breakers (LVCBs)	Medium- and high-voltage power air circuit breakers	Medium- and high-voltage power oil circuit breakers	Medium- and high-voltage power vacuum circuit breakers	Medium- and high-voltage power SF6 circuit breakers	Minimal Frequency	Good electrical practice	Optimized program for critical or severe duty applications
Exercising (open/close operation only)	X	X						60	36	12
Trip the breaker using the test button [ground fault circuit interrupters (GFCI) breakers only]	X							60	36	12
Trip the breaker using the mechanical trip button	X	X						60	36	12
Trip the breaker using a 9 V battery			X					60	36	12
Infrared thermography while the equipment is in service and carrying load	X	X	X	X	X	X	X	36	12	12
Verify that the trip settings match the applicable drawings and studies		X	X					60	36	12
Inspect the case for cracks		X						60	36	12
Verify that the continuous load is not higher than 80% of the breaker rating, that the ambient air is not too hot, and that the plug-in members are well seated (to avoid nuisance tripping)		X						60	36	12
Verify that the breaker/cell anti-condensation heater is working				X	X	X	X	12	12	12
Check the tank oil level, sight glass, gauges, valves, gaskets, breathers, oil lines, oil colour, and tank lifters					X			n/s	36	12
Maintain breaker lifting devices and fifth wheels			X	X	X	X	X	60	36	36
Check that outside SF6 breaker heating blankets are working							X	36	12	12
Requiring specialized training, equipment, and safety precautions										
Trip testing using primary injection		X	X					-	-	36
Trip testing using the shunt trip device		X	X					60	36	12
Trip testing using secondary injection (solid-state trip device)		X	X					60	36	12
Measure insulation resistance (megger) for 1 min (bolt-in)		X	X					-	-	36
Measure insulation resistance (megger) for 1 min (draw-out)			X	X	X	X	X	60	36	12
Measure contact/pole resistance		X		X	X	X	X	60	36	12
Verify connection tightness (line and load side)		X						-	36	12
Remove arc chutes and inspect them		X	X	X				-	36	12
Inspect the stationary and movable contacts		X	X	X				-	36	12
Compare thermal-magnetic trip times (thermal or long-time-delay element)		X						-	-	60
Compare thermal-magnetic trip times (instantaneous element)		X						-	-	60
Manually trip, charge, and close the breaker mechanically			X	X	X	X	X	60	36	12
Clean and dust the equipment to allow heat dissipation and prevent tracking		X	X	X	X	X	X	60	36	12
Verify breaker wiring for tightness and brittleness			X	X	X	X	X	n/s	36	12
Lubricate the breaker (very lightly and only if necessary)			X	X		X	X	60	36	12
Test breaker/cell mechanical interlocks			X	X	X	X	X	-	36	12
Trip, charge, and close the breaker electrically			X	X	X	X	X	60	36	12
Power factor or dissipation factor tests (line and load side)				X	X	X	X	n/s	n/s	n/s
Direct current (dc) hi-pot testing across poles and between phases/ground				X	X	X	X	n/s	36	12
Blowout coil testing using tissue paper				X				n/s	36	12
Time travel analysis				X	X	X	X	n/s	n/s	n/s
Inspect for signs of corona, tracking, or thermal damage				X	X	X	x	n/s	36	12
Verify proper contact wipe, pressure, and contact alignment				X	X			n/s	36	12
Verify proper contact wipe, pressure, and contact wear indicators						X	X	n/s	36	12
Inspect draw-out primary disconnects on the breaker/cell for signs of overheating, proper alignment, and broken or weak springs. The disconnects should be lightly coated with a contact lubricant.				X	X	X	X	n/s	36	12

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Maintenance activities	Type of equipment — Tests to be performed							Maintenance priority		
	Panelboard Circuit breakers	Low-voltage insulated case or molded case circuit breakers (MCCBs)	Low-voltage power air circuit breakers (LVCBs)	Medium- and high-voltage power air circuit breakers	Medium- and high-voltage power oil circuit breakers	Medium- and high-voltage power vacuum circuit breakers	Medium- and high-voltage power SF6 circuit breakers	Minimal Frequency	Good electrical practice	Optimized program for critical or severe duty applications
Auxiliary devices, such as charging motors, anti-pumping relays, auxiliary switches, open/close indicators, spring charge indicators, key and padlock interlocks, cell breaker size rejection features, etc., should be checked for correct operation				X	X	X	X	n/s	36	12
Trip the breaker using one or all of the protective device relays				X	X	X	X	36	36	12
Remove a sample of fluid and have it dielectrically tested					X			n/s	36	12
Check wooden parts for cracks					X			n/s	36	12
Remove the oil, lower the tank, and inspect the contacts					X			n/s	36	12
Test the SF6 gas							X	n/s	n/s	n/s
Opportunities										
On LVCBs, replace dashpot relays with solid-state trip units (SSTs)										
Convert medium- and high-voltage breakers from air or oil to vacuum technology										
Standardize breaker types and sizes										

(1) Prior to testing ensure that all requirements for safe access to the equipment are met [e.g., permits, safety hazard and risk analysis]
(2) The following safety concerns and precautions should be taken into consideration:
(a) Older breakers can contain asbestos, which requires special handling procedures.
(b) Breakers in a closed state contain stored energy, which can harm workers if the breakers open unexpectedly.
(c) X-rays can be omitted when a dc hi-pot test is being performed. Required barricades and distances must be enforced.
(d) Opening, closing, and causing trip-free breaker operations cause loud noises. Hearing protection should be worn.
(e) Large air circuit breaker arc chutes can cause breakers to tip over if more than one chute is lifted at any time.
(f) On double-ended substations without interlocks, the equipment short-circuit ratings can be exceeded during the bumpless transfer process.
(g) It is possible to trip the wrong breaker during maintenance.
(h) If test data differ significantly from recommended values for equipment of similar make, remove the equipment from service.
(i) 600 V dashpot protection breakers should be replaced or retrofitted with solid-state tripping devices to better ensure the breaker's trip time (tripping time can be tested to verify that it is within the specified parameters).
(j) Medium- and high-voltage air or oil breakers should be replaced or retrofitted with vacuum bottles to obtain quicker opening times, which will lower incident energy levels downstream.
(3) The information shown above is based on: CSA Z463-18 Guideline on Maintenance of Electrical System and is not necessarily identical to the source.