

Digital radiography

Verify SF₆ circuit breaker reliability while reducing maintenance costs

Siemens offers a cost-effective, non-invasive service to inspect SF₆ circuit breakers. This innovative service utilizes digital radiography (x-rays) to inspect a circuit breaker's critical internal components. Combined with regular "external" preventative maintenance, digital radiography can improve breaker reliability, ensure that critical components are acceptable for continued use, and allow for tracking interrupter wear over the life-cycle of the breaker.

Radiography allows us to examine and measure critical interrupter components and dimensions such as arcing contact and nozzle wear, contact alignment, loose hardware and other mechanical defects. The accuracy of the digital images reduces the subjective nature of an internal inspection, eliminates the need to handle SF₆ gas, and mitigates infiltration of external contaminants as well as personnel errors during breaker disassembly/reassembly.

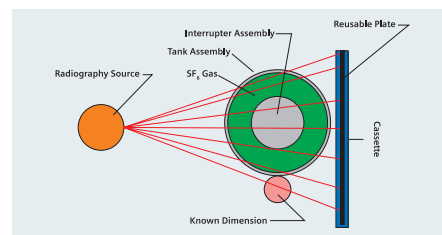
Customer benefits:

- Lower maintenance cost (as much as 50 percent)
- Maintenance expenditures allocated toward breakers requiring entry to correct problems that may lead to equipment failure
- Reduced risk
- Capable of determining dimensional details vs. subjective internal inspection
- No infiltration of external contaminants
- Reduced outage window (hours vs. days)
- Extended maintenance cycles
- Reduced number of unplanned outages

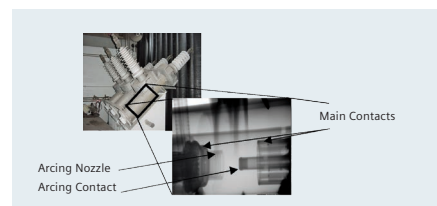
What is digital radiography?

Radiography utilizes x-ray imaging technology to capture detailed digital images of critical internal components. Gamma radiation is passed through the breaker tank assembly onto the opposite side where a phosphorous-laden plate accepts the radiation.

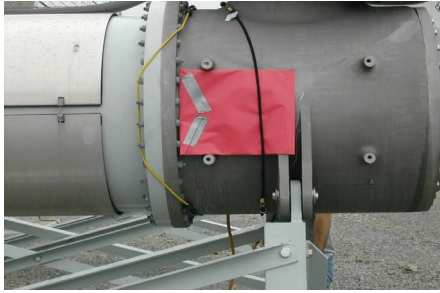
Radiation attenuation by the internal components provides the image contrast due to the different material densities. These digital images are then reviewed by OEM specialists who compare dimensions and tolerances against the original drawings.



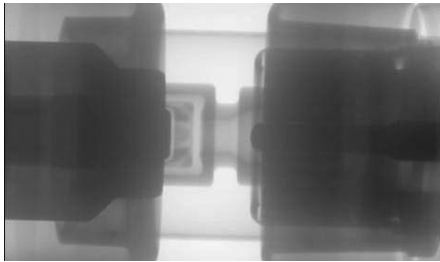
Radiography shows the arcing contact and teflon nozzle, clearly highlighting the internal nozzle structure. Once the image is digitized, the software takes dimensions to verify nozzle tolerance and arcing contact wear. The digital image can be overlaid with earlier interrupter images or with a new interrupter to compare differences.



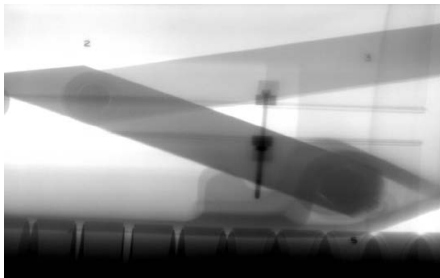
72kV Siemens SP SF₆ Circuit Breaker



Imaging plate placement



Detailed 115kV interrupter inspection



550kV interrupter resistor switch linkage and resistor stock assembly

SF₆ circuit breaker condition assessment comparison

Digital radiography	Traditional internal inspection
Breaker out of service but not grounded (except in case of live-tank breaker)	Breaker out of service and grounded
	Pre-testing (as found)
	SF ₆ gas reclamation
	Disassembly of pole units and interrupters
Complete radiography inspection of critical internal components	Internal inspection of critical components
Onsite assessment of images and components	
Detailed analysis of images	Replacement of components (as required)
	Re-lubrication and reassembly
	Refill breaker with SF ₆
Breaker testing (timing, contact resistance, SF ₆)	Breaker testing (timing, contact resistance SF ₆)
Results comparison, test report	Results comparison, test report

Circuit breaker rating	Digital radiography with external testing	Current internal inspection outage
38 - 145 kV	4 hours	2 days
245kV	6 hours	3 days
345kV and greater	8 - 10 hours	4 - 5 days
245 - 500 kV (live-tank)	2 days	5 - 8 days

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