

Online Surge Arrester Monitoring

White Paper 2026 | From periodic inspection to status warning - substations and transmission lines

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Why arresters need online monitoring

Metal-oxide arresters (MOA) protect primary equipment from overvoltage in substations/converter stations and on transmission-line towers. Under continuous voltage, transient overvoltage and ageing, valve blocks gradually deteriorate - resistive current rises, power loss increases, heating intensifies, and thermal runaway can eventually cause explosion.

Traditional pain points: manual reading of discharge counters cannot capture continuous trends and has low coverage; line arresters 'installed but invisible' - whether and how many times they operated requires tower climbing; mountainous/rainy areas are hard to reach.

Online monitoring collects total current, resistive current and operation counts in real time, warning early at valve-block deterioration and converting emergency repair into advance warning - directly cutting outage and inspection costs.

HUWOR solution overview

HUWOR offers two complementary technical routes: meter-type passive (energy-harvesting) and core-through zero-flux (externally powered), with differentiated selection and power-supply schemes for substation and transmission-line scenarios.

Route 1 - meter-type passive (wireless/wired): series-connected into the grounding loop, self-powered by sensing leakage current (starts at 100 uA, transmits at 200 uA). Wireless version is cable-free and maintenance-free - the break-through choice for outage-free batch retrofits of existing stations.

Route 2 - core-through zero-flux: one-turn core-through on the grounding down-lead, active, back-end powered - for high voltage classes and wide range (35 kV - 1000 kV including UHV).

Important boundary: line arresters are generally of the gapped type (EGLA) with no continuous leakage current - station-side self-powering does not apply; line-side solutions must use solar/battery power with operation-count monitoring.

Route 1: passive remote meter (HMJ1011-WBQ)

Installed below the arrester on its support, series-connected into the grounding loop; self-powered from the arrester leakage current (100 uA start-up, 200 uA for data transmission). Wireless via LoRa or wired via communication cable - no external power in either form.

Total current: 0.1-5 mA (wireless), resolution 1 uA; digital display 100 uA-5 mA.

Resistive current (optional): 0.01-5 mA - main criterion for valve-block degradation.

Self-powering: starts at 100 uA, transmits at 200 uA - no external power, no cabling.

Communication: LoRa 2.4G/470M (<= 400 m) wireless; or wired via cable.

Protection: IP67; operating temperature -45 ~ +85 C.

Design life: 16+ years (self-powered, maintenance-free), meeting the >= 10-year grid requirement (Q/GDW 1535-2015 / DL/T 1498).

Accuracy: < 0.1%, measured by Jiangsu Electric Power Research Institute and Xi'an High Voltage Apparatus Research Institute.

Track record: scaled deployment in 7 x 500 kV substations in Shandong and Jiangsu Taizhou 220 kV substation; 2021 performance and wireless-protocol consistency testing by Jiangsu EPRI, performance testing by Xi'an HV Research Institute.

Route 2: core-through zero-flux sensor (active)

Zero-flux (magnetic compensation) measurement: one-turn core-through on the grounding down-lead without breaking electrical continuity; three-layer shielding enables highly linear measurement of uA-mA small currents in strong EMC environments, up to 1000 kV.

Voltage class: 35 kV - 1000 kV (including UHV).

Total current: 0.1 mA - 1000 mA, +/- 0.5% (nominal).

Resistive current: 0.01 mA - 650 mA.

Structure: one-turn core-through, three-layer shielding - no disturbance to the arrester.

Standard: DL/T 1432.1/3 - power-industry standard for arrester online monitoring devices.

Protection: IP55; supply: active, fed from the back-end acquisition unit.

Clarification: the core-through sensor depends on back-end power feed; the meter-type passive wireless version harvests energy from leakage current. Power and cabling must be planned accordingly - the 'cable-free' assumption of the meter type does not apply.

Selection guide: substation vs line

Substation arresters: gapless, continuously stressed - leakage current exists, self-powering applies; meter-type self-powered or core-through fed by station supply; LoRa <= 400 m + concentrator; key metric = resistive current trend.

Line arresters (towers): generally gapped (EGLA) - no continuous leakage current, self-powering not applicable; must use solar/battery supply and public 4G/NB-IoT backhaul; key metric = lightning operation count with time stamps.

Engineering rule: confirm the arrester structure type (gapped/gapless) before design - line-side gapped arresters can only be monitored for operation counts; confirm this in the bidding/technical stage to avoid rework.

Trust evidence & track record

State Grid (Sichuan): 2026 award, State Grid Sichuan first 2025 grid sporadic materials e-commerce procurement (arrester online monitoring).

State Grid (Jiangxi): 2026 award, State Grid Jiangxi first 2026 framework agreement (e-commerce) - substation online monitoring accessory package, ranked No.1 overall.

CSG: consecutive framework bid awards in 2025 (arrester online monitoring etc.).

Substation cases: digital leakage-current meter retrofit in 7 x 500 kV substations in Shandong (33 units at 500 kV zone + 24 at 220 kV zone); Jiangsu Taizhou 220 kV Gaozhuang substation passive wireless pilot.

Measurement endorsement: meter accuracy < 0.1% measured by Jiangsu EPRI / Xi'an HV Research Institute; design life 16 years.

Standard compliance

DL/T 1432.1/3: online monitoring devices for substation equipment (arrester) - core-through zero-flux and arrester online monitoring devices.

DL/T 1498.1-2016: Technical specification for on-line monitoring devices of transformation equipment, Part 1: General.

About Huawang Technology (HUWOR)

Zhuhai Huawang Technology Co., Ltd. (HUWOR) is a national high-tech enterprise established in 2010, specialising in condition monitoring and assessment of power equipment. The company supplies smart sensors, testing instruments and online monitoring systems for partial discharge detection, with R&D; centres in Zhuhai and Xi'an, 39 granted patents (11 invention), 63 software copyrights and ISO 9001/14001/45001 certified manufacturing. HUWOR supports OEM and ODM projects for distributors and system integrators worldwide.