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Optimize Maintenance Budgets with Efficient Insulator Cleaning
Shorten or eliminate days or weeks of Power outage downtime

Polluted Insulators: A Threat to Network Reliability

CASE STUDY: 1,131.1MW Combined Cycle Power Plant GIS-400 kV Substation
Advanced LIVE LINE Insulator Washing System

Objective: Develop a Comprehensive Preventive Maintenance Program for
Live-Line Insulator Washing
WITHOUT POWER OUTAGE

This case study outlines a comprehensive preventive maintenance program for live-line cleaning energized, polluted insulators on a 1,131.1 MW combined cycle power plant's 400 kV GIS outdoor gantry and substation.



During construction, site photos capture the 1,131.1 MW combined cycle power plant's 400 kV GIS outdoor substation. (Location: Ras Djinet, Algeria)

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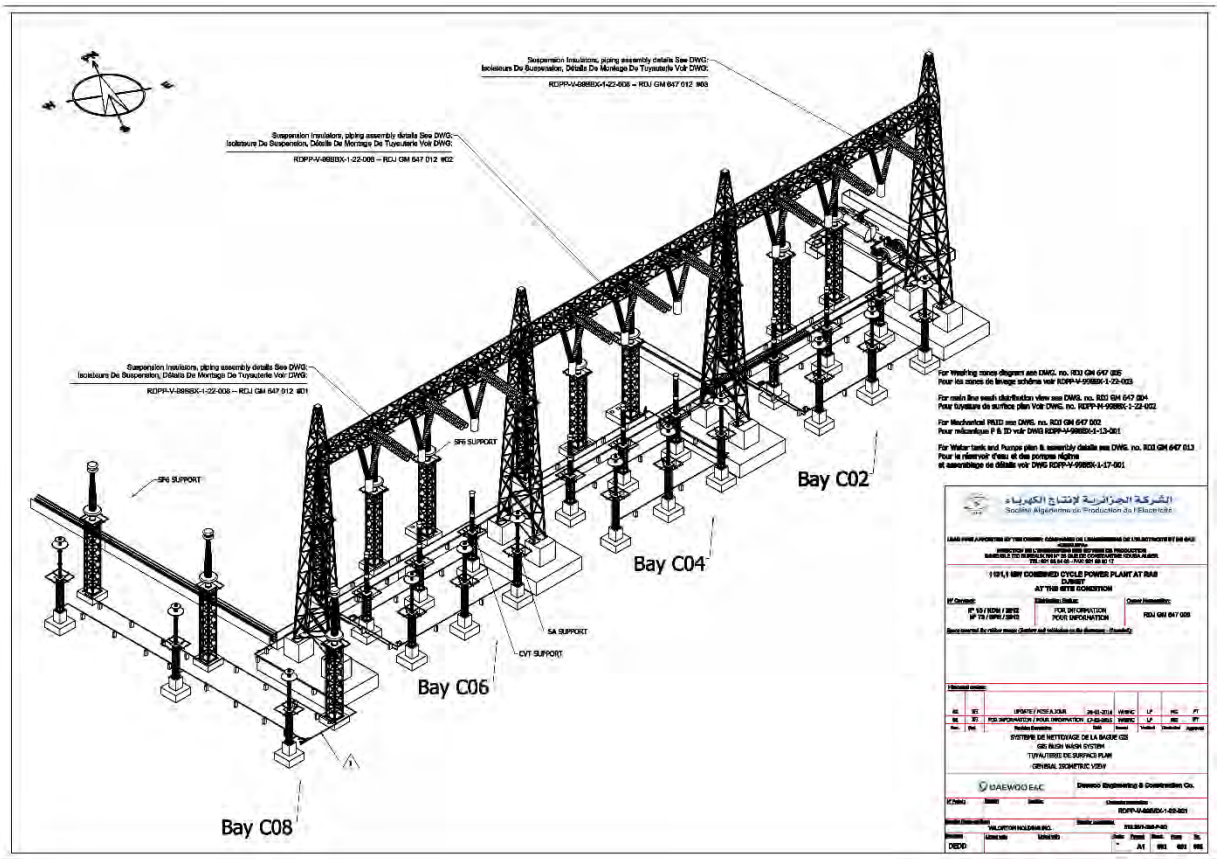
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Advanced Washing Systems for Glass, Ceramic, Polymeric, and RTV-Coated Insulators

CASE STUDY: 1,131.1MW Combined Cycle Power Plant GIS-400 kV Substation - Advanced LIVE LINE Insulator Washing System – Introduction:

GIS-400 kV Substation configuration: Nos. 4 Bays.

	Tot. Qty	Description
–	Nos. 12	SF6 - Air Bushings
–	Nos. 12	LA - Lighting Arresters
–	Nos. 9	CVT - Capacitive Voltage Transformers
–	Nos. 9	TI - Tension Insulators (Gantry)
–	Nos. 9	SI + LT Suspension Insulators (Gantry-side)



Isometric View

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- The power plant's coastal location presents a significant challenge for insulator maintenance. Salinity and land dust drive frequent cleaning requirements.
- Saline Contamination Exhibits Seasonal Increase. Salinity Deposits Increase Rapidly During Hot, Humid Periods.
- Each bay requires one washing cycle every four days.
- The Preventive Cleaning Program design recommends daily cleaning of all insulation within a bay.
- Fog, mist, humidity, or light rain usually creates conditions that produce a conducting film on the dirty insulator surface without washing the impurities from the surface.
- When the polluted insulators become wet, a conductive layer forms on the contaminated insulator surface, initiating a leakage current.
- Outdoor bushings/insulators are subject to surface dirt deposits to some degree and in all the substation operational areas.



SF6 – AIR BUSHING Live Video Automated Washing System: https://youtu.be/noCFxIyRiTk

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AWS Overview:

The entire substation's AWS system is divided into 17 washing zones. Each zone is typically made of three insulators/bushings of the same type, and the washing time is approximately 15-25 seconds.

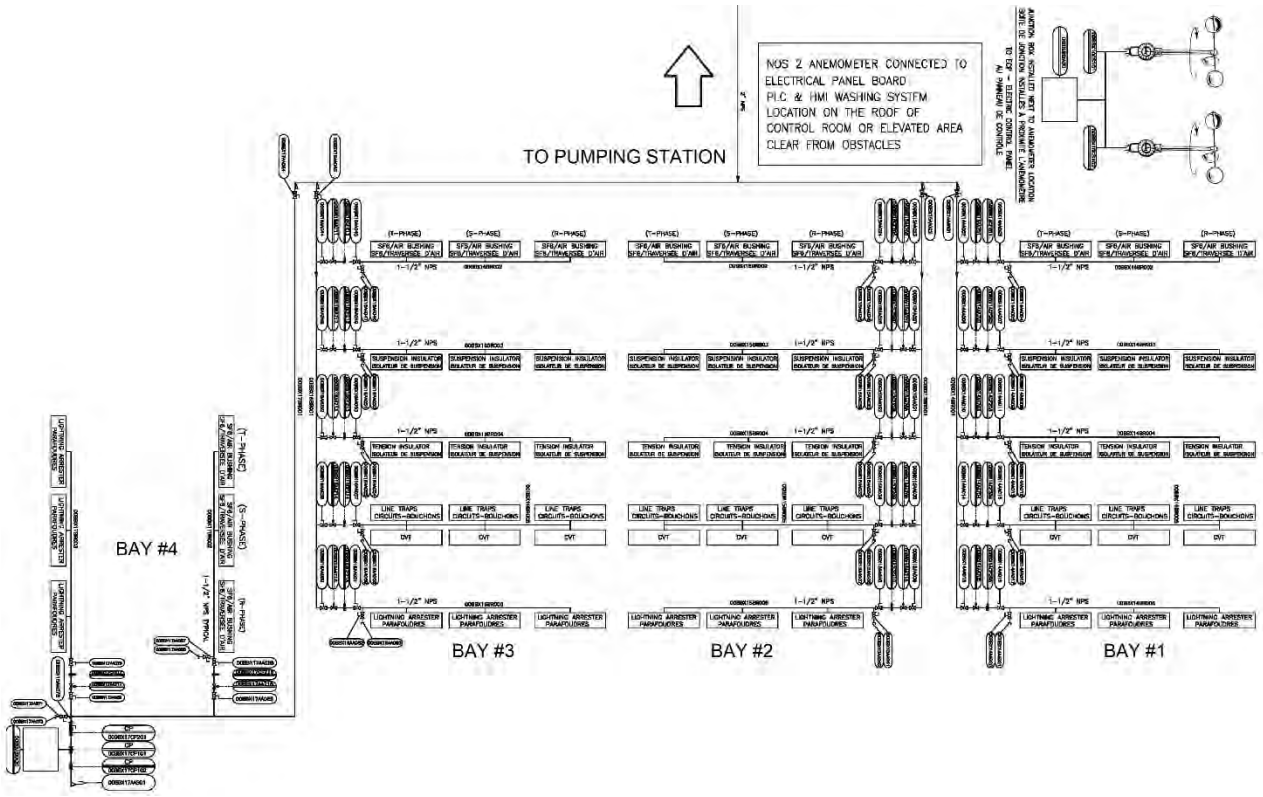
All the insulators of each wash zone are washed at the same time. The kV rating dictates the washing water requirement. Demineralized water required quality for 400 kV rating is ≤ 20 µS/cm.

The wind direction dictates the washing sequence.

Washing zone(s), summary:

GIS 400 kV Power Plant Substation	Number of Insulator				Total
Description	Bay #1	Bay #2	Bay #3	Bay #4	
SF6 - Air Bushings	3	3	3	3	12
LA - Lighting Arresters	3	3	3	3	12
CVT - Capacitive Voltage Transformers	3	3	3	-	9
TI - Tension Insulators (Gantry)	3	3	3	-	9
SI - Suspension Insulators (Gantry-side)	3	3	3	-	9
			Total Insulators		51

GIS-400 kV INSULATOR CLEANING SYSTEM – P&ID

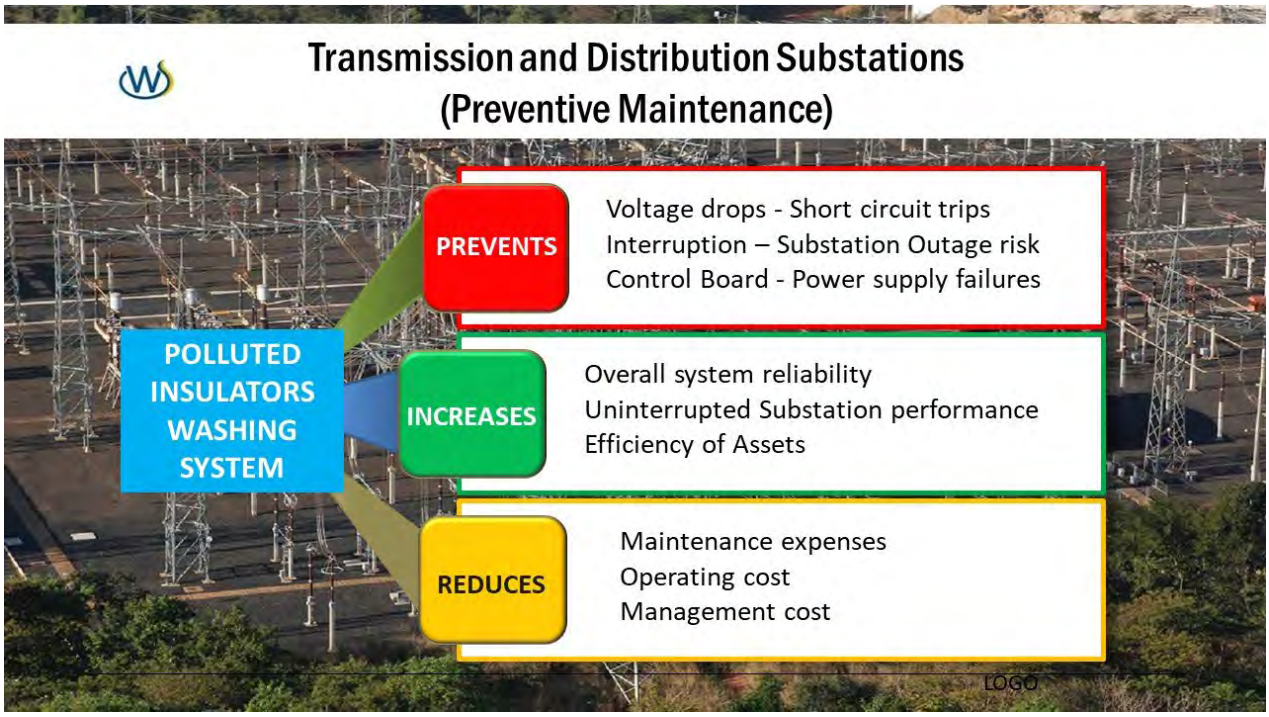


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Demi-Water pressure, washing frequency:

- The water pressure depends on the type of contaminant to be washed and may vary from 350 kPa to 3000 kPa (50 psi to 430 psi) or higher values up to 1000 PSI.
- In the case studied – Power Plant GIS 400 kV Substation - we recommend a max water pressure at spray nozzle tip of ≥1000 <3000 KPa.
- The seasonally programmable washing frequency is dictated by the type of contaminant and its buildup rate on the insulator.
- The User selects a custom washing frequency and decides to wash one specific bay, all bays, or the entire substation (4 bays) daily, weekly, monthly, as needed.
- A customized preventive maintenance program has been designed to adjust to the season/weather changes.
- The management program is user programmable.



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Automated Washing System Design Overview:

Location design conditions:

- Ambient temperature: °C 45
- Elevation above sea level: m 5
- Ambient air pressure: bar 0.9
- Relative humidity: % 76

Main electrical parameters:		
a)	Nominal System Voltage	400 kV
b)	Highest System Voltage	420 kV
c)	Frequency	50Hz
d)	No. of Phases	3
e)	Short circuit current rating	40kA for 1 sec
f)	System Neutral earthing	Effectively Earthed
h)	a) One Min. Power Frequency withstand voltage kV rms	650
	b) Rated 1.2/50 m Sec. Lightning Impulse withstands voltage kVp	1425
	c) Rated 250/2500 mSec. Switching Impulse withstand voltage kVp	1050
i)	Total creepage distance mm (min.)	13020
j)	Water cut. Shed required	Yes
k)	Minimum Air clearance	-
l)	Ph-Ph	4200 mm
m)	Ph-E	4200 mm
n)	Sectional	6500 mm

- Special precautions are applied to protect materials and equipment against deterioration due to humidity, temperature, dust, salt-laden atmosphere, etc.
- Attention must also be paid to selecting and protecting AWS PP electronic components, protection relays, instrumentation, and temperature—and humidity-sensitive equipment.
- The AWS design ensures a minimum requirement of manual intervention in case of an individual plant component or system failure. To achieve this, the AWS must provide the necessary redundancies.
- This redundancy concept is applied to the AWS sensitive washing system.
- All AWS-selected equipment and components have undergone no less than five continuous years of proven successful operation.
- The design, material, equipment, construction, manufacture, inspection, testing, and performance of the AWS GIS-400 kV Insulator Washing System and accessories conform with regulations and safety codes in the locality where the equipment will be installed and the relevant International Standards.

The Automated Washing System (AWS) Control System, before starting washing, preliminarily checks that all the design pre-conditions are met, e.g.:

- Storage tank, water level
- Water conductivity parameters
- Wind speed
- Wind direction
- Electrical system functionality
- Water system pressure

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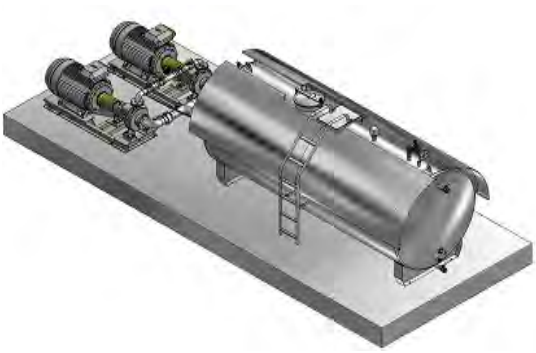
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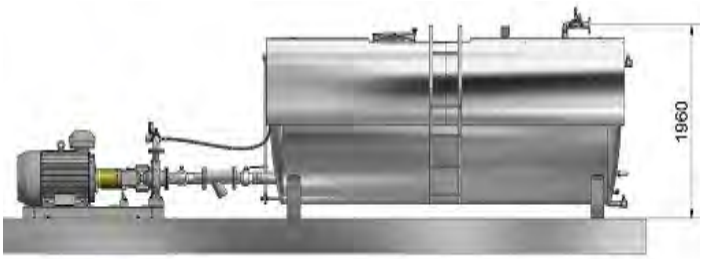
AWS description, general:

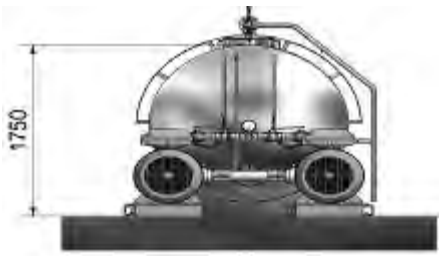
Pumping Station:

- With one stainless steel seven cubic meters capacity demi-water storage water tank complete with filter, stainless steel valves, magnetic water level switch, backflow by-pass, two centrifugal pumps (100% redundancy), two continuous water conductivity monitors (100% redundancy), etc.

Automated Washing System, typical Pumping Station outline







Front View

Water piping system:

- Primary water distribution piping system with fittings. Piping specification: API-5L/ASTM A106 Gr. B, Schedule. 40 HDG. Fittings specification: A 105 HDG. Stainless steel material grade (Optional)
- Washing zones piping branches with fittings, Stainless Steel Flex. pipes
- Stainless Steel spraying nozzles (Nozzles quantity & type vary depending on the insulator type)
- Ball valve, inox lever, SS-304/316 material grade, PN-64, dia. 2"/1-1/2"/1", NPT thread
- Automatic piping system vent valves
- Piping clamps, spacers, etc.
- Automatic drainage station (Optional equipment)

Control System:

- One control panel complete with HMI panel SIMATIC TP2200 (22") touchscreen
- One CPU Siemens S7-1500, or higher CPU, for indoor installation (Inside the substation control room)
- Electrical system, cables, junction boxes, solenoid valves, controlling pressure system, etc.
- A manual washing control system (Useful in case of PLC-HMI malfunction)

Nos. 99 Wash zones Control panel Front View (Sample)

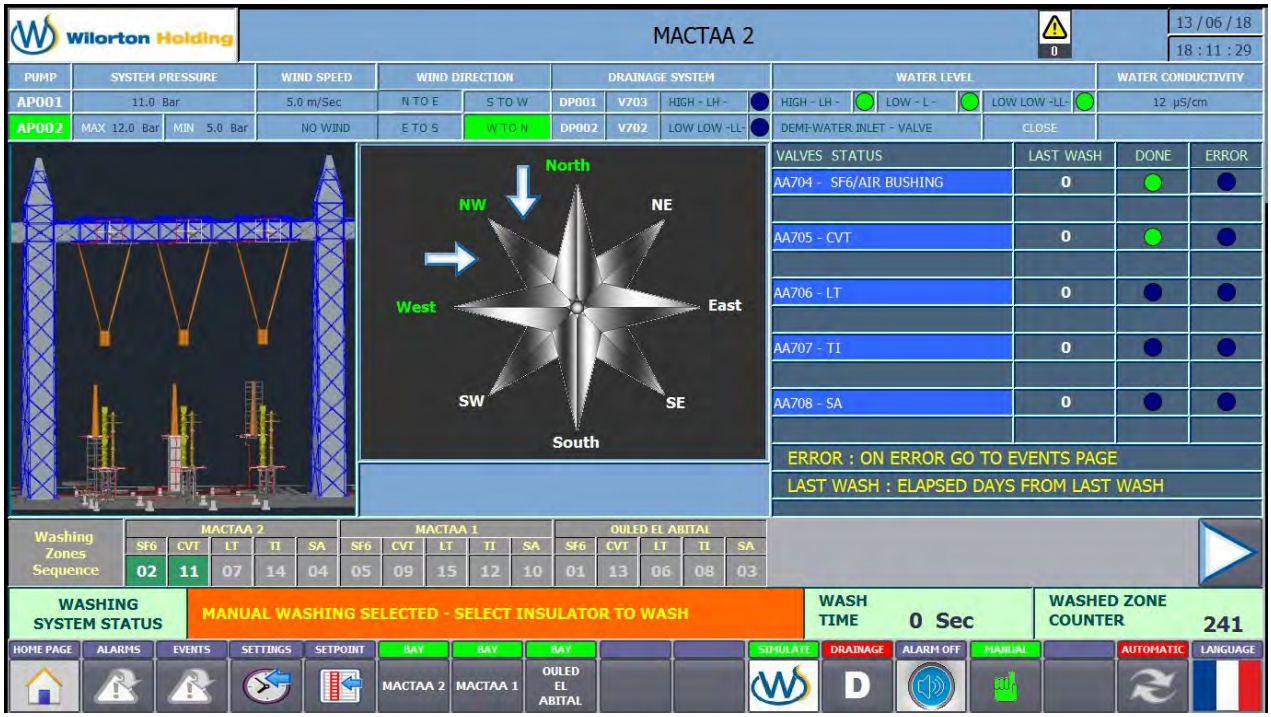


- Weather station – Nos. Two Anemometers (Redundancy: 100%).
- Detects the wind direction and speed.
- The system is designed to prevent the danger of overspraying.
- The washing sequence automatically changes in case the wind direction changes.

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CONTROL PANEL SCREEN EVIDENCING WIND CONTROLS AND PARAMETERS (SAMPLE)



Wind speed:

- The AWS control system continuously checks the wind speed and direction.
- With wind speed exceeding design parameters, the AWS Control System automatically puts on hold the washing cycles.

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Wilorton's supply of Automated Washing Systems includes:

- AWS Engineering.
- Construction and installation drawings.
- Turn-key supply of electro-mechanical equipment/materials (*)
- Supply of Control System equipment management software.
- Site installation supervision
- AWS site test
- AWS site commissioning
- User training

(*) NOTE: Unless otherwise required and conveniently available in the USER local market, supply of commercial materials/equipment (e.g., pipes & fittings, valves, etc.) in compliance with specifications might be procured locally directly by the Client's procurement office. Our office must approve the specifications for local equipment/materials. Wilorton will supply unique components (e.g., stainless steel custom-made spraying nozzles, management software, control panels, etc.).

STANDARD MAINTENANCE PROCEDURES *vs.* WILORTON ADVANCED WASHING SYSTEMS (AWS)

<table>
<tr><th colspan="3">POWER PLANT AND DISTRIBUTION SUBSTATIONS - POWER TRANSFORMERS - GANTRIES</th></tr>
<tr><th>Typical Maintenance Procedures CONS</th><th colspan="2">Wilorton Advanced Washing Systems PROS</th></tr>
<tr><td>DAYS AND WEEKS OF MANDATORY OUTAGES
for RTV Coatings, hand cleaning, greasing, …</td><td rowspan="3">ELIMINATE</td><td>POWER OUTAGES AND REPAIR TIME</td></tr>
<tr><td rowspan="2">COSTLY MAINTENANCE CONTRACTS AWARD
INEVITABLE PRODUCTION LOSSES
INEVITABLE LOSS OF REVENUES</td><td>MATERIAL & MANPOWER COSTS
RTV Coatings, hand cleaning, greasing, …</td></tr>
<tr><td>LOSS OF PRODUCTION
LOSS OF REVENUES</td></tr>
<tr><td></td><td>OPTIMIZE</td><td>UPTIME INFRASTRUCTURE RELIABILITY
NETWORK OPERATIONAL EFFICIENCY</td></tr>
</table>

Contact us for a customized free-of-charge study for your pollution-affected infrastructure.

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SONELGAZ, the Algerian National Company for electricity and gas, opted to install the WILORTON AUTOMATED WASHING SYSTEMS (AWS) for their Power Plant GIS-400 Substation in the following locations:

-KOUDIET EDDRAOUCH ALGERIA, 3x400 MW COMBINED CYCLE POWER PLANT, the year 2010
-KHAIS ALGERIA, 1266,71 MW COMBINED CYCLE POWER PLANT, the year 2014
-RAS DJINET ALGERIA, 1131,1 MW COMBINED CYCLE POWER PLANT, the year 2014
-AIN ARNAT ALGERIA, 1015,121 MW COMBINED CYCLE POWER PLANT, the year 2015
-BOUTLELIS ALGERIA, 445,971 MW COMBINED CYCLE POWER PLANT (GIS-230 kV), the year 2017
-MOSTAGANEM ALGERIA, 1450,356 MW COMBINED CYCLE POWER PLANT, the year 2018

Eradicate Power Outages with Advanced Insulator Maintenance

Preventive maintenance is the cornerstone of a reliable and efficient energy grid. Our advanced solutions address polluted insulators, a leading cause of power outages.

Learn more about our Insulator Washing Systems: follow our dedicated LINKEDIN Showcase page and subscribe to our YOUTUBE channel

Visit **Wilorton's Home page** for additional information on our products & services range.
Thanks for your attention

Unified Customer Support Service - Operating seven days a week: info@wilorton.com

A POWER OUTAGE IS NOT A MAINTENANCE OPTION!