Wilorton Holding

Manufacturing consulting engineering design and services for electric power lines, telecommunications, and industrial applications

PREFACE:

LEAKAGE CURRENTS, SHORT CIRCUITS & CURRENT INTERRUPTIONS

ARE FREQUENTLY CAUSED BY POLLUTED INSULATORS

CASE & COST STUDY

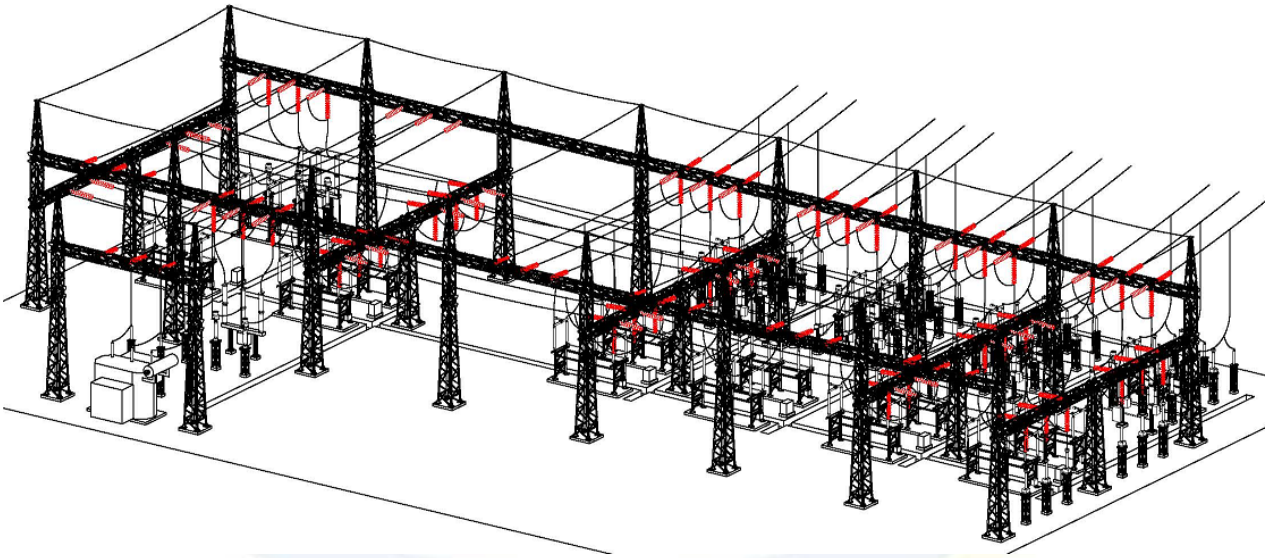
150 kV Distribution Substation

Energized Polluted Insulator Cleaning System

Preventive Maintenance WITHOUT POWER OUTAGE

SCOPE: Identify a preventive maintenance program to resolve the polluted insulators problem, WITHOUT **POWER OUTAGE**.

Herewith enclosed is our consideration with the SCOPE of identifying a preventive maintenance program for cleaning energized polluted Insulator, installed on a 150 kV outdoor gantry and substation, as shown on the sketch drawing.



150 kV Substation Configuration details:

- Nos. 6xCB's insulators installed on the ground
- Nos. 18 - CT's insulators installed on the ground
- Nos. 55 - CVT-SA-PI's insulators installed on the ground
- Nos. 72 insulators installed on incoming gantries
- Nos. 72 insulators installed on busbars gantries

Wilorton Holding Inc.
Mail address: c/o Fiam SA Via Carlo Frasca, 3 - 6901 Lugano Switzerland
Tel. Pbx: +41(0)91 695 1070 - http://www.wilorton.com
email: css@wilorton.info

CASE STUDY: 150 kV Distribution Substation

150 kV Substation Configuration details, cont'd:

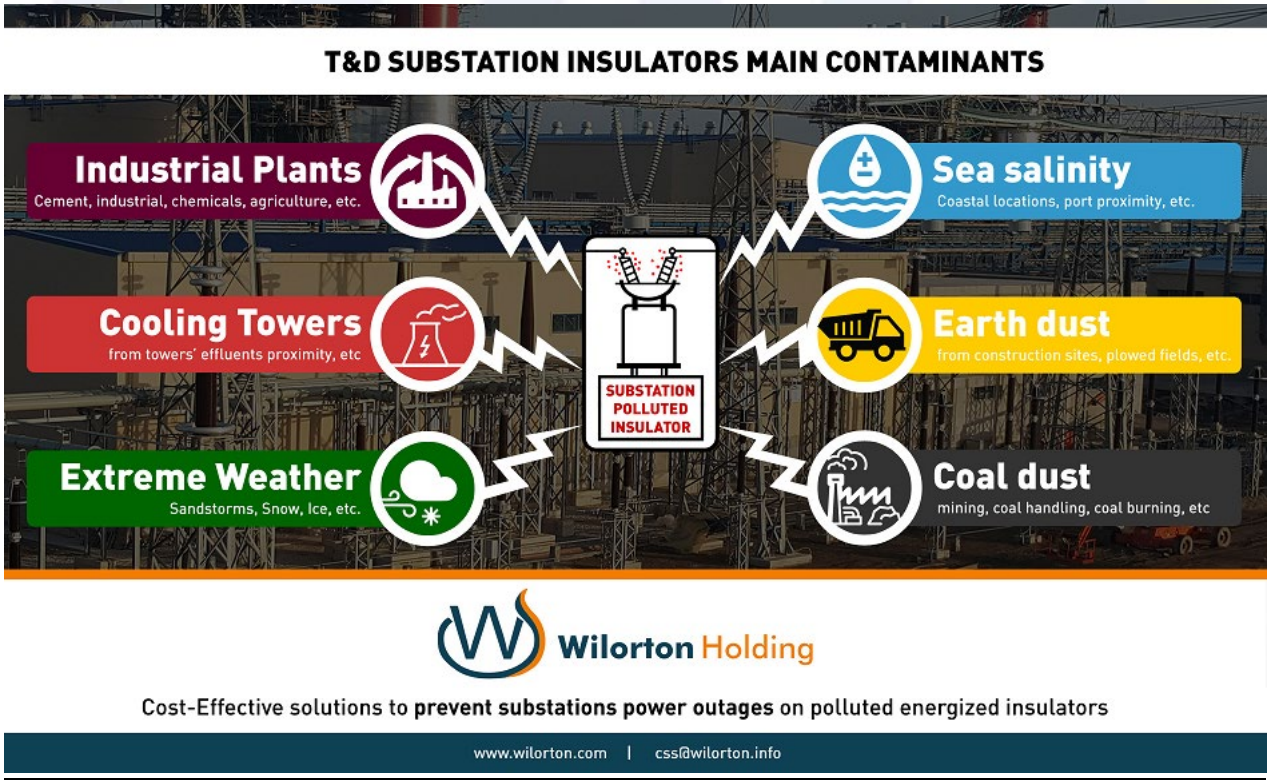
- The insulators are subject to dirt deposits, the pollutants builds-up gradually during dry and hot weather seasons without decreasing the insulation strength. The insulation strength does not decrease when the insulators are dry.

- **In this location, the dry and hot weather period is followed by fog and light rain.**

- Fog, mist, 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 leakage current.

- Outdoor bushings/insulators are subject to surface dirt deposits to some degree and in all operating areas. Most encountered contaminants have little effect on insulator performance as long as the surface is dry.



150 kV Substation Configuration details, cont'd:

The manager of this substation, mainly in conjunction with the beginning of the wet season, experiences current leakages and flashovers and is forced to a power outage to resolve issues adopting **de-energized insulators** cleaning technique (cold wash). The failed insulators are replaced during downtime at a cost.

The **de-energized insulators** cleaning technique (cold wash) consists in handwashing/cleaning, with rags or wiping cloths in mild detergent water, etc., the insulators most critically exposed to coal pollution generated by a nearby coal depot.

To prevent "power outages" when a contaminant-related failure takes out a line, rather than running the risk of having multiple flashovers, repeated relay operations, that are hard on the circuit breakers and substation equipment, to increase the power supply reliability for uninterrupted performance and higher productivity among other factors, the financial efficiency, we have proposed to the User an energized (hotline) insulators MOBILE washing system.

As standard procedure, the MOBILE washing system, wash the energized polluted insulators with a custom maintenance program seasonally adjusted.



View Live Washing of 150 kV SS Polluted Insulators: https://youtu.be/o-iMVBj9WKM

A seasonally adjusted maintenance program focused on washing energized and POLLUTED insulators, prevents leakage currents, flashovers, and power outages.

Preventing T&D power interruption with Automated or Mobile Washing Systems, attain operational excellence reduce downtime risk, ensure personnel safety, achieve financial efficiency optimizing maintenance budget.

CASE & COST STUDY
150 kV Distribution Substation
Energized Polluted Insulator Cleaning System
Preventive Maintenance WITHOUT POWER OUTAGE

General Technical analysis:

The MOBILE washing water requirement depends on the kV rating. Demineralized water required quality for 150 kV rating is ≤ 667µS/cm.

- Demi-Water consumption, water quality, and washing distance from the spray nozzle tip to conductor:

- CB-CT's insulators: total lt/1' 2.820
- CVT-SA-PI's, incoming/busbar gantries: lt/1' 17.412
- Total demi-water required to wash all installed insulators: lt 20.232
- Demi-water quality: ≤ 667µS/cm
- Washing distance from the spray nozzle tip to any energized conductor: 4.2 m



Corona measurement
(Optional equipment)



Washing from ground
(Ground Level)

Proposed MOBILE washing system, overview:

- Washing equipment option "**A**" Estimated wash timing to clean all SS insulators **6 workdays**:

- Mobile washer unit **MK-S-4C** – SKID config., with 4 cubic meters water tank capacity - loaded onto a truck or trailer or any suitable vehicle, positioned near or inside the SS:
  - **4 CM** water, daily demi-water availability, and:
  - No. **1 (one)** spray gun
  - Nos. **1+1** washing operators
  - Daily demi-water consumption: 4 Cubic meters approx. per day
  - Nos. **6 workdays** to clean all the insulators (WITHOUT POWER OUTAGE)

- Washing equipment option "**B**" Estimated timing to clean all SS insulators **3 workdays**:

- Mobile washer unit **MK-S-4C** – SKID config., with 4 cubic meters water tank capacity - loaded onto a truck or trailer or any suitable vehicle, positioned near or inside the SS:
  - **4 CM** water tank capacity
  - No. **2 (two)** spray gun
  - nos. **1+2 washing operators**
  - Daily demi-water consumption: 8 Cubic meters approx. per day
  - Nos. **3 workdays** to clean all the insulators (WITHOUT POWER OUTAGE); to achieve the 3 workdays washing timing, **the water tank should be re-filled** with 4 CM demi-water.



Mobile washer unit **MK-S-C** – SKID configuration

- Washing equipment option "**C**" Estimated timing (*) to clean all SS insulators **3 workdays**:

- Mobile washer unit **MK-S-8C** – SKID config., with 8 cubic meters water tank capacity - loaded onto a truck or trailer or any suitable vehicle, positioned near or inside the SS:
  - **8 CM** water tank capacity
  - No. **2 (two)** spray gun
  - nos. **1+2** washing operators
  - Daily demi-water consumption: 8 Cubic meters approx. per day
  - Nos. **3 workdays** to clean all the insulators (Without power outage); to achieve the 3 workdays washing timing, **the water tank DOES NOT need to be re-filled**.



Mobile washer unit **MK-S-C** – SEMI-TRAILER configuration

Mobile washing general:

Mobile washer unit **MK-S Series** – SKID config., with **4 or 8** CM (cubic meters) water tank capacity

Introduction:

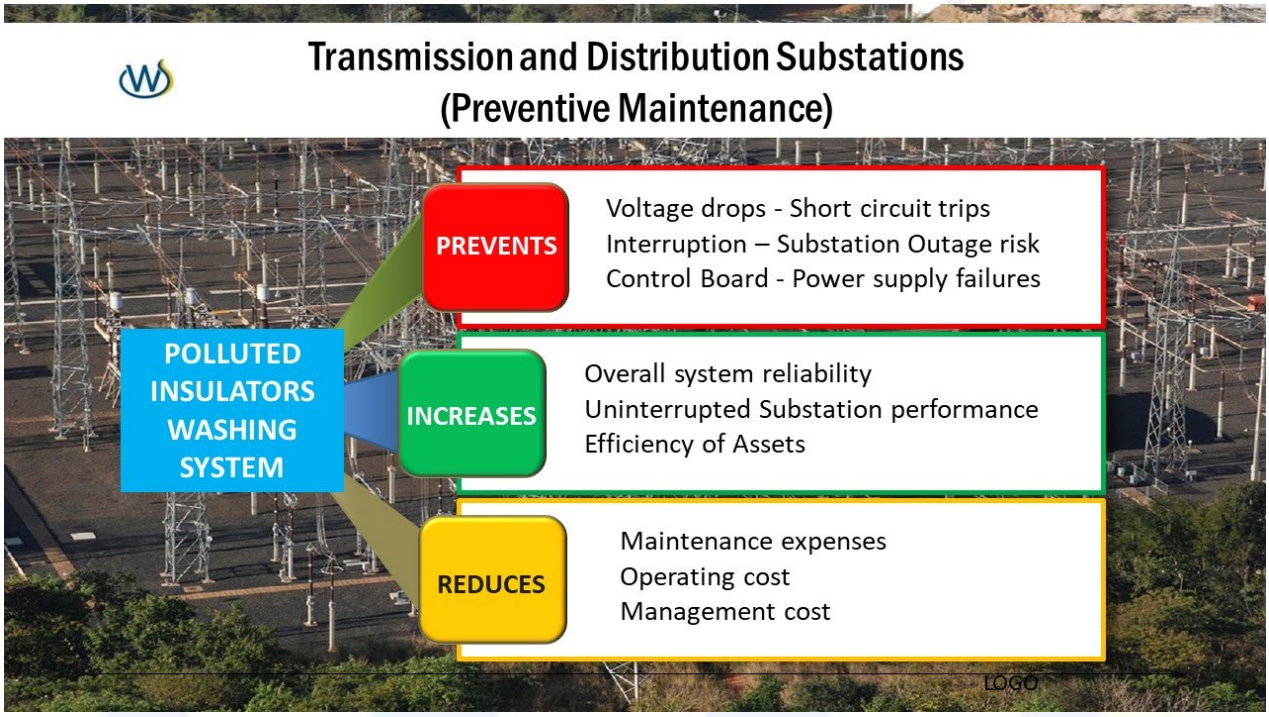
- "Mobile" washing energized insulators installed **up to 10/12 m** from ground level (GL): the operator, positioning himself onto the truck/trailer or on ground level, pulls & holds one water hose with a spray gun at the required distance to wash the energized insulators.
- The minimum safe washing distance from any energized conductor is 4.2 m. (For 150 kV SS)
- Demineralized water quality requirement: ≤ 667µS/cm
- "Mobile" washing of energized insulators installed at **>12 m** from ground Level (GL): the operator climbs the steel structure or, from an aerial basket to the required distance from energized insulator, pulling the flex hose from the hose reel mounted on the skid washer unit, and spray water to wash the energized insulators.
- The spray water jet can reach a distance of approx. 10/12 m from the spray nozzle tip. (In no-wind condition).
- To note that in high wind conditions, the washing jet will be dispersed. Washing in high wind conditions will be ineffective.
- The SKID washer unit shall be fixed onto an available or new vehicle (Trailer/Truck/Chassis/Aerial Platform). If the suitable vehicle is available w/in the User facility, you do not need to procure a new one, minimizing the investment cost. The skid washer unit is liftable and unloadable if not needed for a length of time, freeing the vehicle for other activities.

Wash time:

- Manual wash: approx. 15/30 sec. for each insulator. Washing time may vary depending on the operator's efficiency. The operator must keep himself at the mandatory safe distance of 4.2 m from any energized conductor(s).
- **Note**: Nozzle-to-conductor distance for a given line voltage and nozzle diameter is the most important parameter that influences the leakage current and the washing effectiveness of the water stream.
- The washing sequence is dictated by the wind direction.

Demi-Water pressure, washing frequency:

- The spraying 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 value up to 1000 PSI. In the case study - 150 kV Substation - we recommend a max water pressure at spray nozzle tip of 3000 Kpa.
- The washing frequency is dictated by the type of contaminant, and its rate of buildup on the insulator.



Visit our YouTube channel to visualize operational Substation's Energized Insulators washing system (Mobile washers and Fixed washing systems).

https://www.youtube.com/watch?v=oA6irotje08	Energized Insulators washing from ground level
https://www.youtube.com/watch?v=bdNwm_k6VKQ	Energized Insulators washing from ground level
https://www.youtube.com/watch?v=DaQts6gHe4M	Energized Insulators washing from telescopic boom basket
https://www.youtube.com/watch?v=noCFxIyRiTk	Automated substation washing system
https://www.youtube.com/watch?v=3GYKkKWVZR8	Automated outdoor gantry washing system
https://www.youtube.com/watch?v=pT-Qz9nVbbY	Automated substation washing system

View our WEB www.wilorton.com Download area for Energized Insulators washing systems technical articles.

Follow our Insulator Washing systems showcase page in LinkedIn: https://cutt.ly/treL4LU

BUDGETARY QUOTATION

Wilorton scope: supply one (1) skid mounted and transportable mobile washer unit, for cleaning all the energized Insulators installed on the 150 kV outdoor gantry(s) and substation, in connection with the sketch drawing shown on page 1. **Within our scope, including a customized seasonally adjusted preventive maintenance washing program. (**User interruptions history report is useful**).**

- ***MK-S WASHER SERIES*** *Equipment General Specifications:*

- MK-S-4C or 8C COMPACT unit, SKID MOUNTED with 4 or 8 CM parallelepiped tank shape. This unit shall be fixed onto any available and suitable vehicle (truck/chassis/trailer/aerial platform).

OPTION "A" QTY 1 HIGH PRESSURE CENTRIFUGAL PUMP DRIVEN BY DIESEL ENGINE

PUMP RPM	CAPACITY	WORKING PRESSURE
2900	400 LT/MIN.	30

- At spray nozzle tip.
- Diesel Direct injection, Turbocharger, Water cooled

OPTION "B" & "C" QTY 1 HIGH PRESSURE CENTRIFUGAL PUMP DRIVEN BY DIESEL ENGINE

PUMP RPM	CAPACITY	WORKING PRESSURE
2900	600 LT/MIN.	30

- At spray nozzle tip.
- Diesel Direct injection, Turbocharger, Water cooled

QTY 1 PORTABLE WATER CONDUCTIVITY TESTER

- Accuracy of ±1% of reading ±.2% at Calibration Point
- Automatic Temperature Compensation, auto-ranging, durable, fully encapsulated electronics,
- Waterproof powered by 1 N Type Battery

QTY 1 CONSTANT WATER CONDUCTIVITY MONITOR

- Constant Water Conductivity Monitor provided in Tank, continuously measure the water conductivity and tripping the pump with water quality not suitable for energized insulators washing.

QTY 1 SPRAY GUN (**OPTION "A"**) QTY 2 SPRAY GUN (**OPTION "B" & "C")**

- No fluid passage upon trigger release.
- Covered by shockproof plastic semi-housings
- Sturdy construction of stainless steel & brass with dynamic Teflon seals
- Seat and shutter pin in stainless steel. Gun with the minimum load loss
- Assembly on hoses equipped with G ¾-1" fittings. Entirely built of stainless steel & body in brass
- Spray gun is equipped with 6 mm nozzles.

- ***MK-S WASHER SERIES*** *Equipment General Specifications, cont'd:*

- Gun design for continuous use, at a water temperature of 60°C (140°F). It can resist at the max. the temperature of 100°C (210°F) for short periods only.
- Gun design for continuous use, at a water temperature of 60°C (140°F). It can resist at the max. the temperature of 100°C (210°F) for short periods only.
- Attention: to prevent any risk of INSTABILITY of the gun due to pressure spikes, the use of safety devices (SHOULDER REST) is recommended and included.

QTY 1 HOSE REEL WITH 1" HIGH-PRESSURE HOSE **for MK-S-4C** (**OPTION "A**")

or

QTY 2 HOSE REEL WITH 1" HIGH-PRESSURE HOSE **for MK-S-4C & 8C** (**OPTION "B" & "C")**

- Hose Reel – Electric and mechanical rewind, length 45 m, non-conductive flexible hose with quick coupler.
- Max. working pressure 88 Bar burst pressure 350 Bar.

QTY 1 WATER TANK **4 CUBIC METER CAPACITY for MK-S-4C** (**OPTION "A" & "B")**

or

QTY 1 WATER TANK **8 CUBIC METER CAPACITY for MK-S-8C** (**OPTION "C")**

- Stainless steel AISI-304 material grade, parallelepiped (Compact series) shape, complete with:
- Stainless steel Manhole with automatic breathing vent valve, Stainless steel drain, outlet, by-pass connections, Visual external water level. Ladder with service platform to access the water tank manhole
- Stainless steel AISI316, ball valves, and fittings. Strainer filter, Magnetic Water Level Switch: at 500 mm from bottom Alarm start (Warning level), at 150 mm from bottom Pump Stop, Rotating warning alarm lamp, Lifting eyes.

QTY 1 GROUNDING SYSTEM

- Grounding Reel with 30 m Length of grounding cable with suitable clamp, manual rewind

QTY 1 CONTROL PANEL

- Controls/protection:
- (Diesel engine) - low oil pressure, over-temperature, belt breakage, minimum fuel level, air filter clogging, cooling liquid low level, over speed, under-speed, hour display, oil pressure, oil/water temperature, tachometer, fuel level.
- (Alarm/Signals/Settings) - Minimum water level alarm (Warning level), minimum water level alarm (Shutdown level), water conductivity control, conductivity level, conductivity level settings, battery/oil lights, maintenance warning request, emergency Stop.

- ***MK-S WASHER SERIES*** *Equipment General Specifications, cont'd:*

QTY 1 EXTRA HEAVY-DUTY FRAME

- Fabricated in Tubular Mild Steel, epoxy painted to support the washing equipment, suitable to be fixed onto the trailer/truck-chassis or aerial platform. Including one (1) lockable storage compartment for accessories and tools.

- **MK-S-4C** with PARALLELEPIPED TANK - **Overall Dimensions/Weight** (Approx.):

MK-S WASHER SERIES	Overall Dimension			Weight Kg	
Model	W	L	H	Tank Empty	Tank Full
MK-S-4C with 4 cubic meters water tank	2.0	5.0	2.0	3500	7500
MK-S-8C with 8 cubic meters water tank	2.0	5.8	2.0	4500	12500

Budgetary equipment costing:

NET PRICES MK-S-4C:	Starting from >€55.500	With 1 hose reel. 1 spray gun
NET PRICES MK-S-4C:	Starting from >€62.500	With 2 hose reels. 2 spray guns
NET PRICES MK-S-8C:	Starting from >€66.500	With 2 hose reels. 2 spray guns

Optional(s):

Job-site training (*)	€3.200.00
2 Years spare parts	€2.560.00
Safety clothing for energized works	€750.00
(Glasses - Insulating Gloves/ Boots Helmet, cloths)	

SUPPLY GENERAL TERMS & CONDITIONS

Payment:	By irrevocable and confirmed L/C, payable by negotiation against presentation of standard shipping documents
Estimated Time of Delivery:	Starting from 10/12 weeks from receipt and confirmation of a clarified order and L/C. For a shorter delivery time, pls. apply
(*) Job Site Training:	For 6 people, 5 workdays. Excluding air ticket, inland transportation and lodging, visa charges, if any, for our Trainer(s)
Technical package:	O&M manuals & documentation - in English language
Warranty period:	24 months from FOB date
After-sales guarantee:	Spare parts availability and technical support, 10 years from delivery
Goods Origin:	Italy
Validity,	Until 31-05-2022

Wilorton Holding Inc.