



NAE WOI KOREA

Inverter Dust, Micro Oil Cleaning of Solar Power Plant



Tel/ Fax: +27 11 678 1330

E-mail: admin@sieyaya.co.za

P.O.Box 5309 Cresta, JHB, 2118

www.sieyaya.co.za

1. Work Overview

1) Inverter Dust Cleaning

Names of Power Plants	Power Supply
• Yeongam TechnoSolar Power Plant	3,500kW
• Yeongam Haeoreum Solar Power Plant	2,750kW
Total	6,250kW



2) Purpose

By removing flammable dust, Micro Oil contaminants, etc. stuck to PCB, resistance, condenser, coil etc. in the inverter:

- Enhancing insulating properties and improving heat release; and
- Improving power-generation efficiency and preventing electrical accidents based on stable facilities operation

3) Place and Date

- Place: Area 206, Nabul-ro, Samho-eup, Yeongam-gun, Jeollanam-do, Korea
- Date : July23~25,2019

2. Inverter Management and 『Dust』

1) About the Inverter

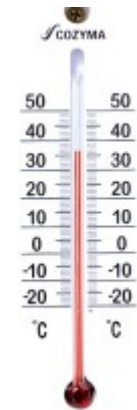
Inverter is an electronic equipment composed mainly of semiconductor devices and, as it is sensitive to the environmental impact such as temperature, humidity, dust, micro oil, vibration etc., should be inspected on a daily basis in order to prevent malfunction.

In particular, when a lot of dust and micro oil are accumulated, the insulation resistance is reduced thereby shortening the life of the equipment.

Therefore, the dust gathered on the cooling fan etc. should be removed by setting the cleaning cycle.

2) Service Environment and Cleaning Cycle

Category	Item/cycle	Details
Service environment	Ambient temperature	-10°C~40°C(Requiring neither ice nor frost)
	Storage temperature	-20°C~65°C
	Ambient humidity	Relative humidity 60%RH or less (Requiring no dew condensation)
	Altitude . vibration	1,000m or less · 5.9m/sec(=0.6G) or less
	Ambient condition	Requiring no corrosive gas, inflammable gas, oil mist, dust etc.
Cleaning cycle	12 months	Eliminating dust in the inverter



※In accordance with the Inverter Management Regulation:

The rated current of the inverter reduces by 2.2% for every 1°C rise when the temperature is above 40°C, which is why the temperature of various control panels should be kept at 40°C or lower.

3. Safety Checks and Dust Cleaning

1) Cleaning Process

Category	Details	Product Supplier	Supervisor
① Pre-check	-Check "ON/OFF" status of main power -Pre-check the distribution board (contamination, damage, etc.) -Photograph the contaminated status	NAE WOI KOREA., LTD	<ul style="list-style-type: none"> • Manager of Hanwha Q CELLS, and • Director of the power plant site
② Dust cleaning	-NWK99OPP/ Carry out the dust and Micro oils cleaning at night when power generation is completed		
③ Final check	-Final check, measure the insulation resistance, and measure the thermal image		
④ Operationcheck	-Set up and check normal operation		

2) Precautions before Work

- Identify the location of fire extinguishers and safety-related facilities in the workplace and share the information with all team members.
- Carry out dust, micro oil cleaning while wearing safety equipment (insulated boots, gloves, face shields, insulated hat, etc.) and ensuring safety distance.
- Remove the contaminants by spraying the cleaning agent to the object to be cleaned from top to bottom with 20~30cm intervals.
(If the contamination is severe, repeatedly spray the cleaning agent with a time interval of 2 to 3 times.)
- As for the blackening contamination of the distribution board case, wipe it off with a separate cleaning agent (NWK747) on a paper or cotton cloth.


- Ensure that the lead wires exposed to the outside from the devices like inverter should not be stretched before working, especially if there are bolt and nut wirechips, and be sure to arrange them before working.
- Also, in order to prevent re-contamination, carry out cleaning after installing the adsorbing cloth or plastic cover as shown below.

Category	Details			
	(Before) Cleaning	Absorbing cloth	Cleaning	(After) Cleaning
Photos				

※ Cleaning work should be carried out by an expert.



3) Product Specifications and Certifications

Division	Detail	Other
ProductName	· NWK99OPP(Type:Spray)	
Mainingredients	* FriendlyEnvironmentalLiquid	
Color	· Transparent	
Weight	· 15.3kg(20ℓ) pail	
Dielectric breakdownvoltage	·Max 55KV	
Humanhazards	·LowToxic	
Causticity	· None	
Spraypower	· 7~8kg/cm ²	
Spray distance	· 20~30cm	
Absorbing cloth (1piece/1Can)	· 1,000mm*750mm	

4. Proposals for Future Management

- Although it is considered that according to the regular maintenance plan, overall control over parts damage, etc., is comparatively excellent, the inverter is a facility that has a long start-up time and is more susceptible to contamination by micro dust and micro oil than general industrial electric panels.

- In particular, in my opinion, It seems that pollution was heavy the number of years used.

The reasons?

First: The site is adjacent to the road where vehicles come and go frequently,

Seconds: I think that as the vicinage is also surrounded by marine manufacturing plants,

the pollution has been aggravated due to mote and dust generated from time to time.

- In addition, it has been confirmed that it is difficult to remove pollutants stuck to PCB, Coil, etc., in the inverter during cleaning, unless removing them repeatedly several times with a special cleaning agent..



Before (cleaning)



Cleaning (1st)



Cleaning (2nd~3rd)

- In particular, failure caused by contamination (short-circuit, malfunction, short, etc.) can be directly connected to serious damage due to inability to operate the facility.

Therefore, for efficient and stable operation of the inverter, it is deemed effective to remove dust and micro oil once every two to three years, which is shorter than the current interval of five years.

- References:

· *Monthly Electrical Journal*: "Fine dust and micro oil in electric and electronic communication equipment are the direct cause of safety accidents."

· Paragraph 5 Comparison of Dust Cleaning (before, after) and "attached" Operation Video

(April.16, 2019) 'Fine dust' in electric and electronic communication equipment is the direct cause of safety accidents.

In November 2017, the government launched the 'National Strategic Project Group on Fine Dust' with the goal of reducing 30% of fine dust generation. The project group is comprised of 500 scientists from 10 research institutes in Korea and plans to invest KRW 49.2 billion by 2020. The damage caused by fine dust is not limited to people only. As all electric and electronic communication equipment operated 24/7/365 in the industrial field, is controlled by semiconductors which are vulnerable to fine dust, static electricity, heat, etc., in order to safely use them without failure, a preventive management system should be established to remove contaminated dust immediately and to minimize recontamination. In particular, most dust is flammable. According to the definition of the Occupational Safety and Health Administration (OSHA) of the USA and the Canadian Centre for Occupational Health and Safety (CCOHS), the flammable dust means materials that can ignite and explode when blended with air, including solid organic

materials (such as sugar, flour, grain, wood, etc.) and non-metallic inorganic materials (such as stone, cement, concrete, glass, ceramics, etc.), organic materials (such as wood, paper, textile, leather, rubber, plastic etc.), and metals (such as aluminum, bronze, magnesium, zinc etc.) and chemical dust (such as coal, sulfur, etc.).

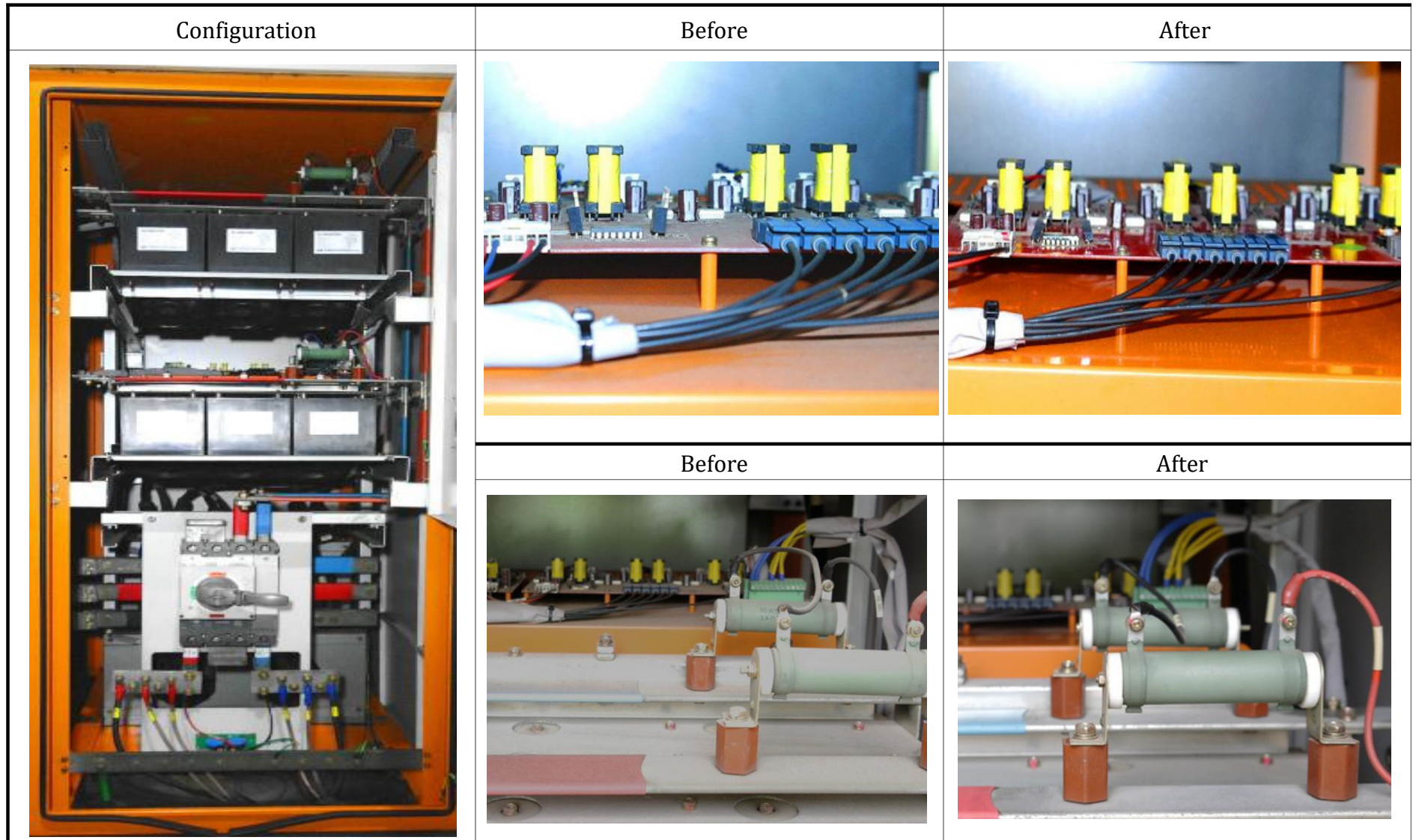
Particularly, there are cases where degraded insulation resulted in stopping the power plant directly connected to the production of electricity. For reference, Inverter, UPS, PLC, SCADA, etc., are typical electrical and electronic communication devices that can be extended to fire accidents due to sparks and arcs, not to mention malfunctions and short faults of equipment, even with a small amount of dust contamination. According to the Korea Electrical Safety Corporation, it turned out that 78% of the total electrical fire accidents in 2015 were caused by sparks and arcs. The cause is that when the circuit is blocked or injected, the contact part is rapidly overheated by the contact resistance, and the occurrence is increased if the inductance load of the motor, etc., is included in the circuit.

The elevator is an essential transportation in modern people's daily life. The 'control panel' of the elevator is also comprised of numerous semiconductors. When fine dust accumulates, internal heat rises to more than 40°C, causing malfunction and, in severe cases, a device may be damaged, which is related to frequent breakdown of elevators during the summer season. According to the Inverter Management Regulations, as the rated current is reduced by 2.2% for each degree rise from 40°C, it is regulated that the inverter dust should be cleaned once a year. In addition, the spark and ark occurring in the electromagnetic contactor and relay ignite the accumulated dust, thereby causing fires in the control panel.

Primarily among government agencies, in order to prevent safety accidents in elevators that are can devastate people's lives, the Ministry of Public Administration and Security has published and enforces 'Elevator Self-check Items and Methods' as follows in order to intensively control 'dust' in preparation for Subparagraphs 1~ 3 of ▲ Poor environment condition (dust, foreign matter), ▲ Items vulnerable to a risk of fire, ▲ Possibility of malfunction due to contamination by dust or foreign materials, and ▲ Poor contact of substrate. The Korea Elevator Safety Agency, which is the management organization, also recommends dust removal using a cleaning agent exclusively for dust removal to prevent the control panel from failing in the summer. However, considering that dust is a direct cause of safety accidents, I think it is high time to carry out a more thorough evaluation focusing on the performance test.

Since it has been confirmed that "Fine dust can be minimized, but cannot be completely prevented," from now on, I look forward to the activities for preventing electric safety accidents by collaborative endeavor linking the management group with the electric facility managers in order to break away from such phenomena as, even nowadays, reduction of electric and electronic communication equipment's life, occurrence of malfunction as well as safety accidents such as fires caused by dust contamination through use of the optimized agents used exclusively for dust cleaning.

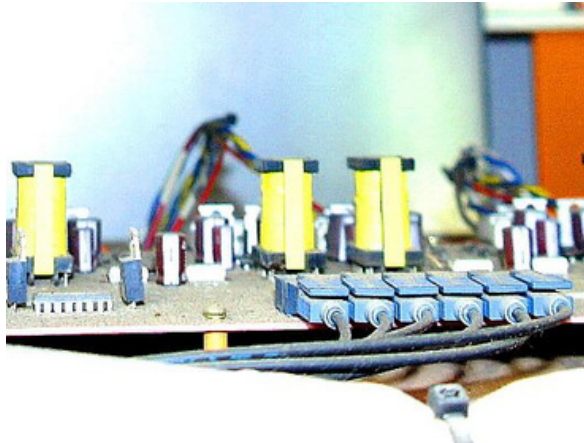
5. Comparison of Dust Cleaning (Before, After)



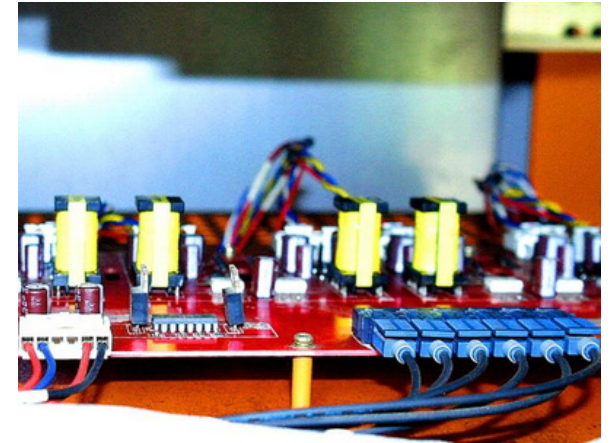
Configuration



Before



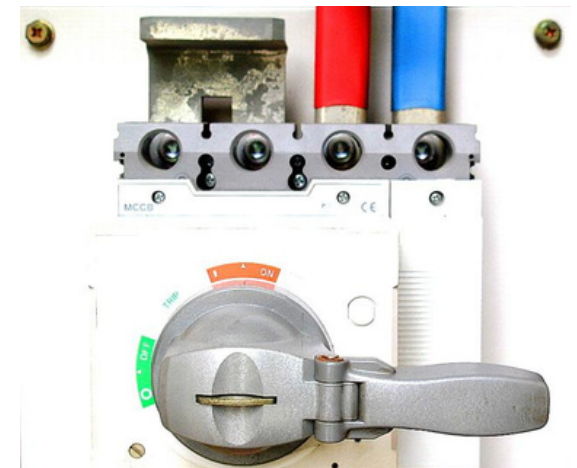
After



Before



After



Configuration



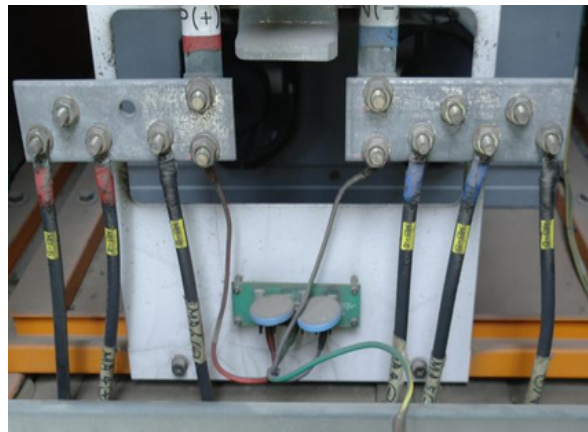
Before



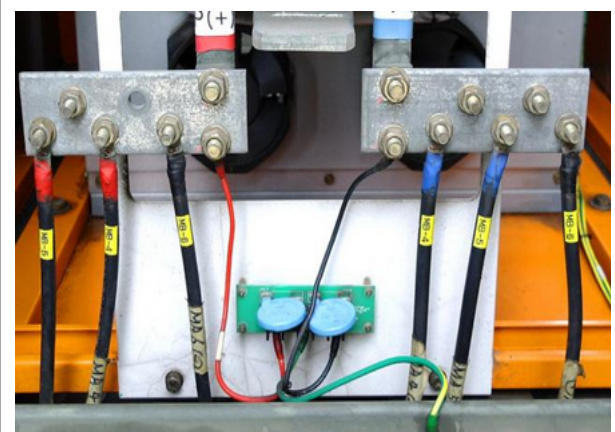
After



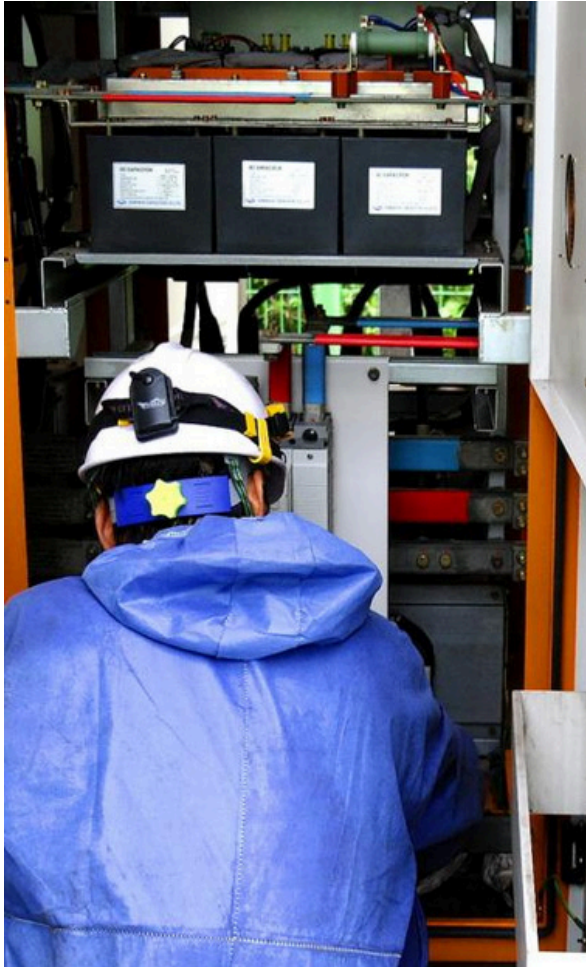
Before



After



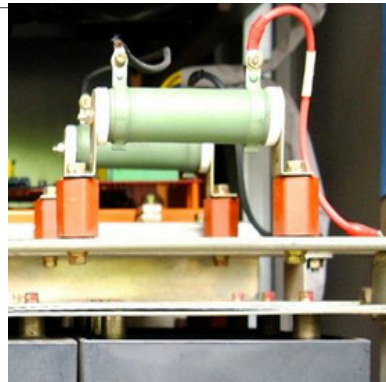
Configuration



Cleaning



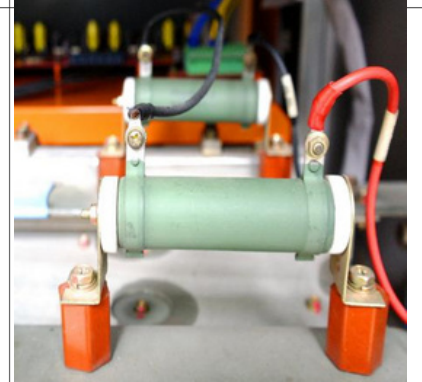
Before



Cleaning



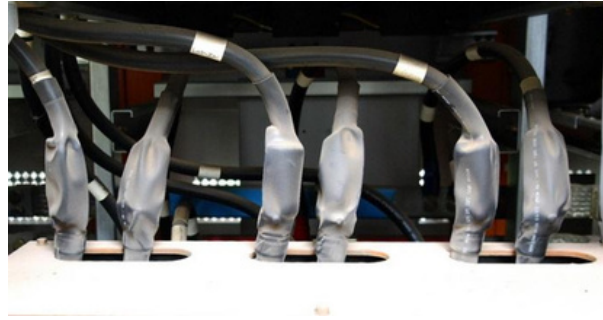
After



Configuration



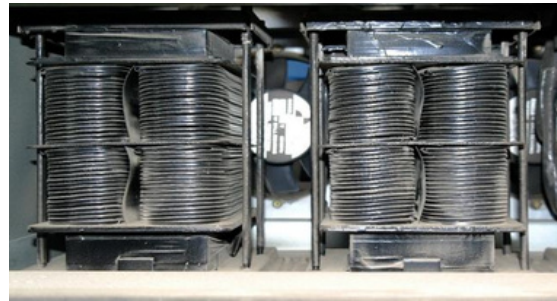
Before



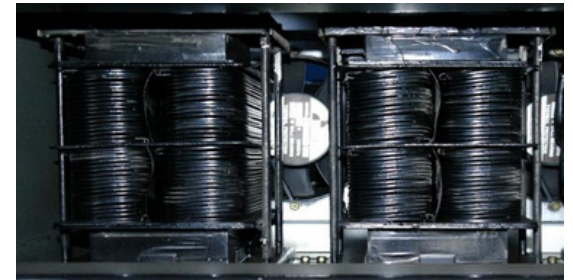
After



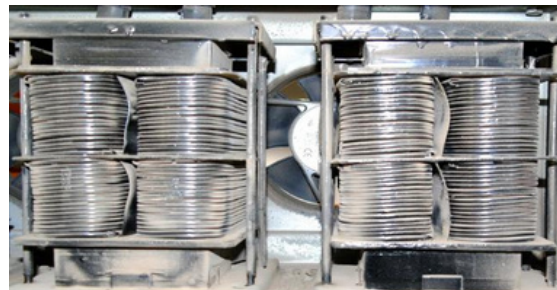
Before



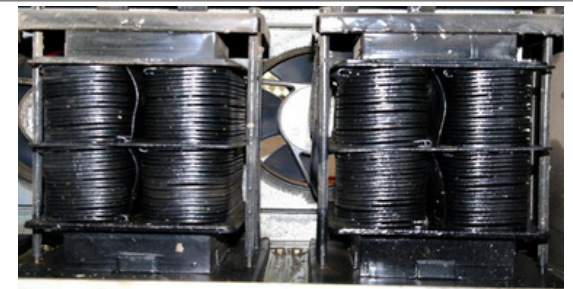
After



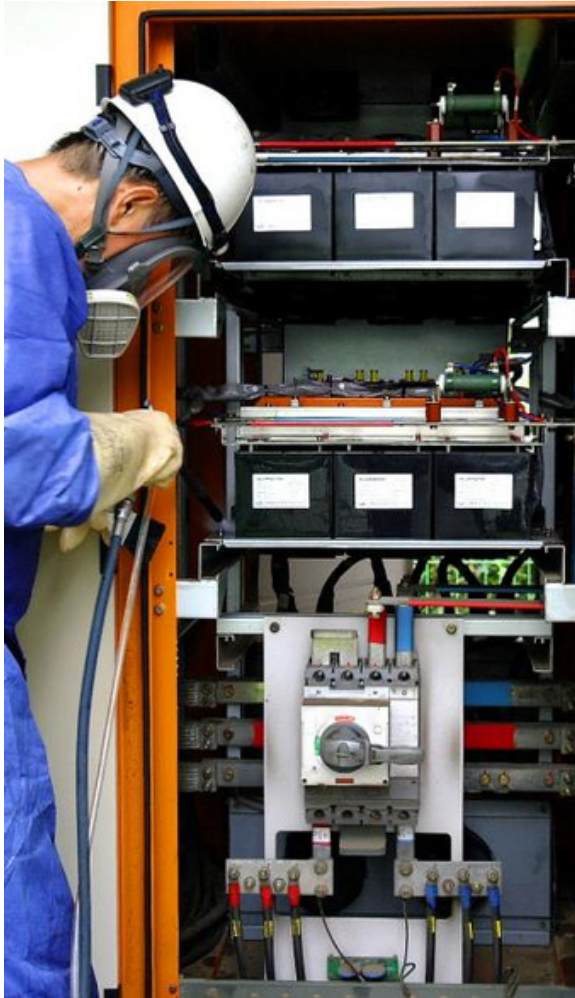
Before



After



Cleaning(Before)



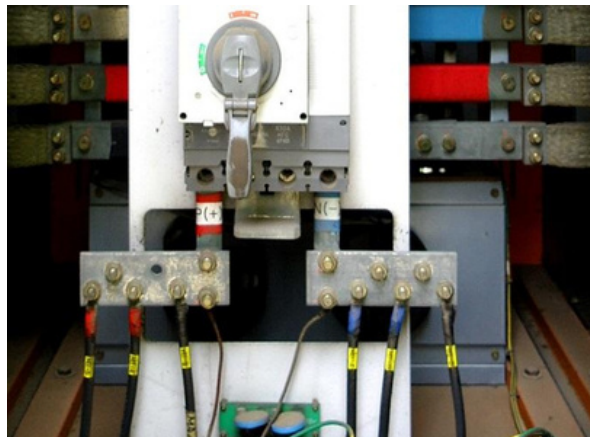
Before



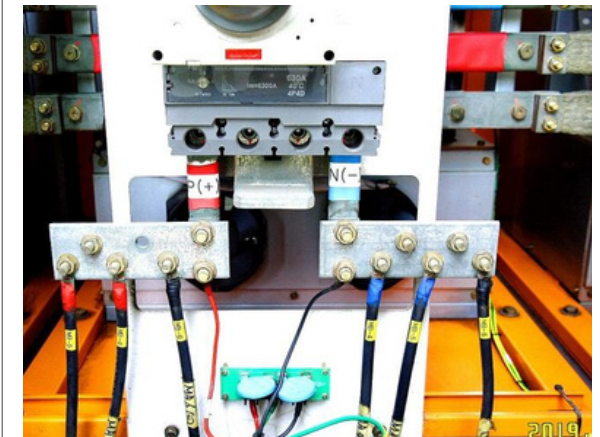
After



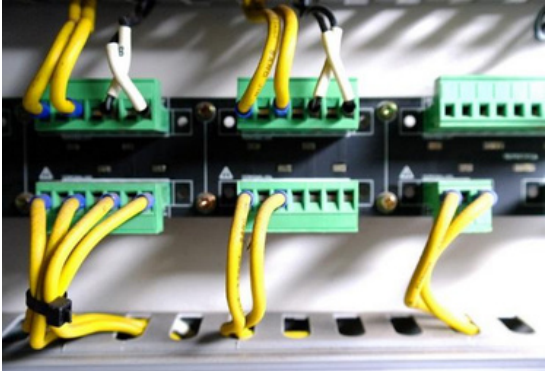




Before



After



Configuration	Before		After	
				
				
	Before	1st cleaning	2nd~3rd cleaning	
	