



Introducing the **World's First and Only**  
**Ferraris ERR(Energy Recycling Reservoir) System**  
for Decentralized Power Generation

August 2019 *(Updated January 3, 2020)*



## Ferraris Challenge



Ever since the commercialization of electricity, there have been an untapped byproduct in form of electromagnetic field generated by flowing currents in power lines. By harnessing the forgotten and unused electromagnetic energy through electromagnetic energy recycling, Ferraris has opened a new pathway for electric power generation and energy recycling technology for the mankind. Ferraris was founded in a strive to harness the power from a magnetic field produced by power lines and transform it into a reliable and countable power source.

Dr. KOO, who is the founder of Ferraris wishes the investors to set their focus and priority environmental social governance with key focus on providing clean energy produced by Ferraris' products through the magnetic energy over the corporate management of Ferraris. The prime directive of Ferraris is to provide clean energy with no environmental pollution around the world to improve and restore environment for the benefit of current and future generations to come.

We have named Ferraris Inc. in memory of Galileo Ferraris.



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## **I. Decentralized Power Generation**

## **1. What is Decentralized Power Generation ?**

Decentralized power generation is an approach that employs multiple small-scale technologies to produce electricity close to the end users of power. Decentralized power generation technologies often consist of modular (and renewable-energy) generators, and they offer a number of potential benefits. In many cases, decentralized power generators can provide lower-cost electricity and higher power reliability and security with fewer environmental consequences than can traditionally power generators.

In contrast to the use of a few large-scale generating stations located far from Load centers – the approach used in the traditional electric power paradigm – Decentralized power generation systems employ numerous, but small plants and can provide power onsite with little reliance on the distribution and transmission grid. Decentralized power generation technologies yield power in capacities that range from a fraction of a kilowatt to about 100 megawatts.

## **2. What are the potential benefits of Decentralized Power Generation Systems ?**

Potential power backup system feature in case of main power failure. Consumer advocates who favor decentralized power generation point out that distributed resources can improve the efficiency of providing electric power. They often highlight that transmission of electricity from a power plant to a typical user wastes of the electricity as a consequence of aging transmission equipment.

Environmentalists and academics suggest that decentralized power generation technologies can provide ancillary benefits to society. Large, centralized power plants emit significant amounts of carbon monoxide, sulfur oxides, particulate matter, hydrocarbons, and nitrogen oxides. The US Environmental Protection Agency has long noted the correlation between high levels of sulfur oxide emissions and the creation of acid rain.

## **II. Ferraris, Experience our Future**

We as human race have reached the pinnacle of modern digital age with constant influx of new and improved electronic goods to improve our everyday life. In order to increase productivity and efficiency, adequate infrastructures such as Smart farms, Smart factories and Smart cities are being constructed. To match its power consumption, intermittent solar, wind, and other renewable energy sources are being developed to meet the ever-growing power demands. Even with the best efforts, the reality is that there are limitations and struggles for the renewable energy sources to meet the demands of increasing power demands.

While developing Ferraris ERR (Energy Recycling Reservoir) System, Ferraris pondered whether decentralized power generation could be delivered to better meet the ever-increasing power demands of humanity. In order to whether such technology could be developed and be applied, Ferraris ran a case study on pumped-storage hydroelectric power stations.

Pumped-storage hydroelectric is one of the best technologies we have for storing intermittent renewable energy, such as solar, wind power, which means these sites could act as giant batteries. Pumped-storage hydroelectric has a typical lifetime of 50 years and is the large-scale energy-storage technology available. However, the pumped-storage hydroelectric require tremendous amount of resources, permits, time, and funds to be constructed.

Ferraris extracted the Energy Recycling Reservoir concept to Pumped-storage. There are difference between Ferraris ERR System and pumped-storage hydroelectric (and Solar, Wind power) in their methodology and operational aspects. The basic flow of Ferraris ERR System is that it harvests magnetic energy from the incoming power lines of the commercial buildings to be sent to distribution panel which sorts the recycled power and transmits it to building's load, which cuts the costs of the building's utility costs.

Furthermore, under assumption that Ferraris ERR System is installed in 100, 200 or 1,000 different buildings, sudden power outages or shortages arising from emergency situations, the Ferraris ERR System can be used to provide steady electrical energy to power the building's load. This could potentially be used to save lives by providing alternative to medical facility's backup generators as the network of buildings (**InterBuilding Power Energy Network**, where Building-to-Building power energy share ) using Ferraris ERR System can support such facilities in the direst circumstances.

This is a simple example of Ferraris ERR System's future use, and Ferraris envisions further application of its Ferraris ERR System beyond interBuilding power energy network to an **InterCity Power Energy Network** where City-to-City power energy share where a stable emergency power can be provided to the most critical electric infrastructures such as hospitals in state of emergency.

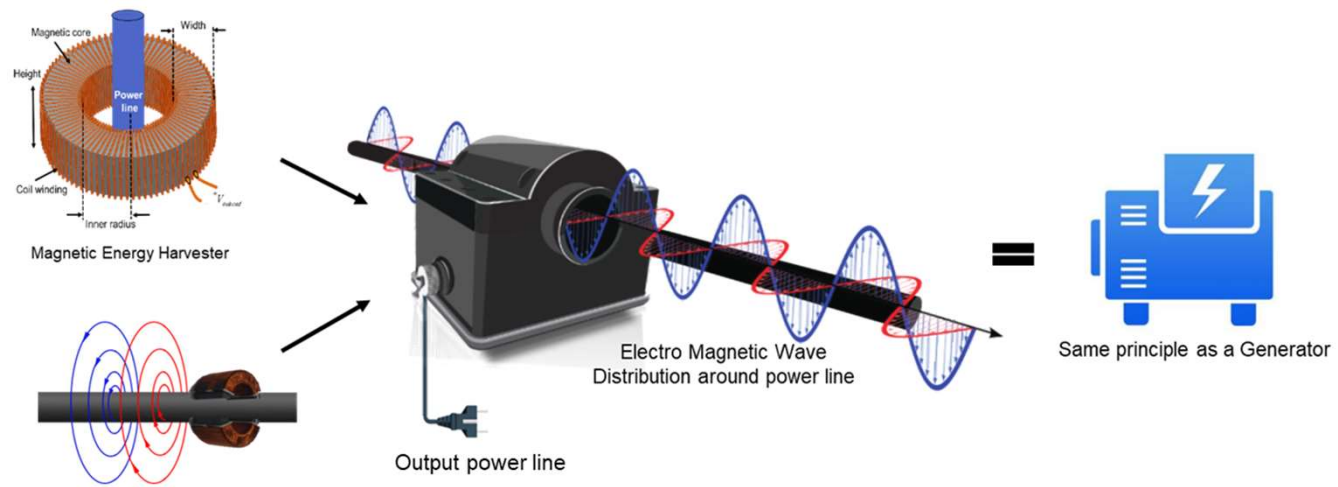
With this in mind, Ferraris have developed Ferraris ERR System with remote monitoring power and control systems that can simultaneously operate on more 1,000 different sites.

The vision of Ferraris is to procure investments in order to mass provide Ferraris ERR System at economical pricing while upgrading electrical energy capacity to make our vision of future come true.

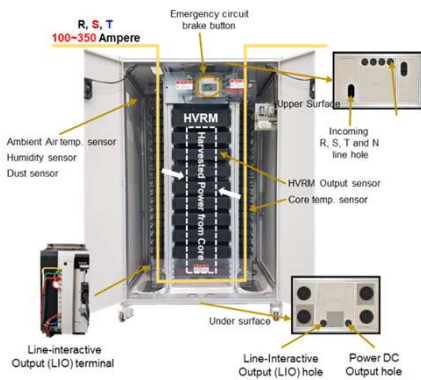


### **III. Introducing Ferraris ERR System**

1. A Ferraris Tolenoide C<sup>®</sup> technology which harnesses induced electrical energy from the magnetic energy variation produced from the power line regardless of the power line voltage. Ferraris Tolenoide C<sup>®</sup> is designed, developed and manufactured mainly for the electrical power generation. For further information of the products, request to “Introducing Ferraris Tolenoide C<sup>®</sup>” report.



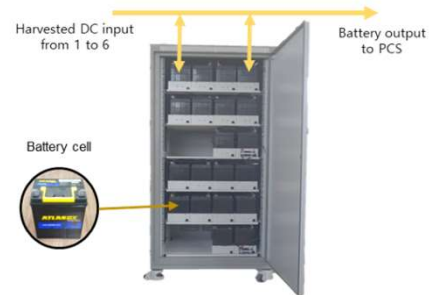
2. We proudly introduce world's first and only Ferraris ERR System created by Ferraris. **The Ferraris ERR System is decentralized power generator.** Ferraris providing a revolutionary paradigm of efficient electric power generation by using magnetic energy harvesting based on existing power lines via the Ferraris ERR System, which composed of multiple Tolenoind C<sup>®</sup> for high power (<https://youtu.be/JUoLj0x8qM>) with state of art Linear power scalability technology.



**Ferraris Core/HVRM  
(High Voltage Regulator Module)  
System and LIO power**



**Power Control Subsystem**

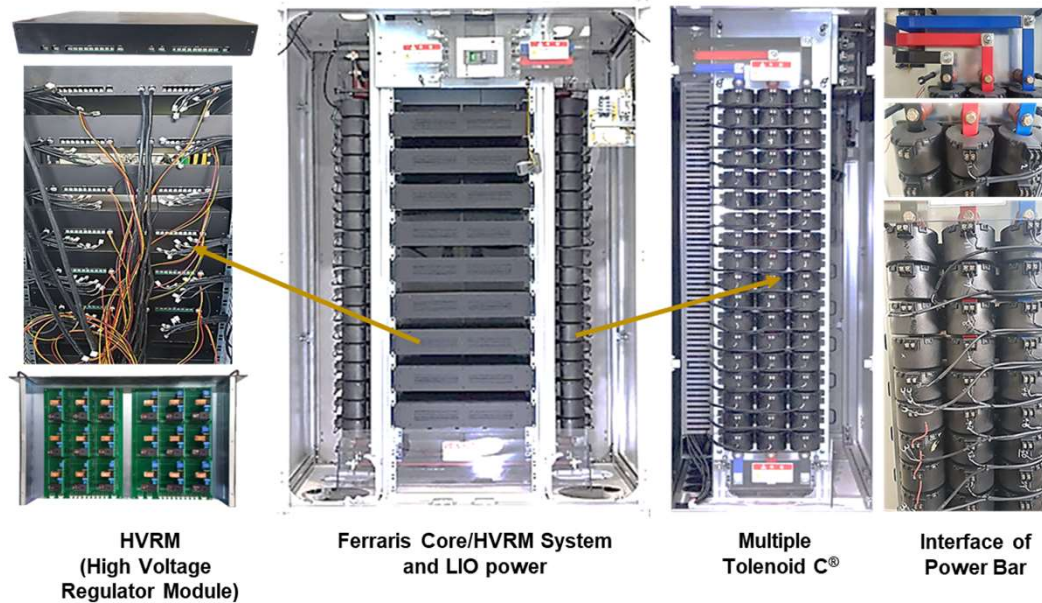


**Battery and BMS Subsystem**



**Remote Monitoring Power and  
Control system for Multi-site**

- Ferraris ERR System is designed to be multiple contactless (Linear power scalability technology) attached to incoming power lines to harness induced electrical energy from magnetic energy variation produced from power lines. The harnessed electrical energy then can be stored in the battery to be used when needed or real-time distributed to the Load, which means magnetic energy harvesting and using power for Load are happened at the same time.



4. The Ferraris ERR System is normally installed using contactless method on three-phase four-wire power lines (R, S, T and N). Ferraris ERR System can be cascade (serially) and/or Parallel connected and is highly scalable with decentralized installation. This scalable feature enables customer decide electric power capacity of Ferraris ERR System depending on the environment and customer requirement easily.
5. Under assumption that Ferraris ERR System is installed in 100, 200 or 1,000 different buildings, sudden power outages or shortages arising from emergency situations, the Ferraris ERR System can be used to provide steady electrical energy to power the building's load. This could potentially be used to save lives by providing alternative to medical facility's backup generators as the network of buildings (**InterBuilding Power Energy Network**) using Ferraris ERR System can support such facilities in the direst circumstances.
6. This is a simple example of Ferraris ERR System's future use, and Ferraris envisions further application of its Ferraris ERR System beyond interBuilding power energy network to an **InterCity Power Energy Network** where City-to-City power energy share where a stable emergency power can be provided to the most critical electric infrastructures such as hospitals in state of emergency.
7. Potential power backup system feature in case of main power outages.
8. Ferraris have developed Ferraris ERR System with remote monitoring power and control systems that can simultaneously operate on more 1,000 different sites.

9. For example, the high power lines, such as commercial building, server operating company, EV charging station (level 3 charging), markets (Whole foods market, Costco, VONS, Ralphs etc.), cold storage, frozen foods storage, factories, solar farm, wind farm and more potential customers can be easily used to harness the magnetic energy constantly from their existing power distribution lines without upgrading power source.
10. Therefore through Ferraris ERR System, customers can vastly improve electric energy usage efficiency, such as reducing reactive power and improving power factor and so on, ultimately reducing costs from power consumptions over the long run.

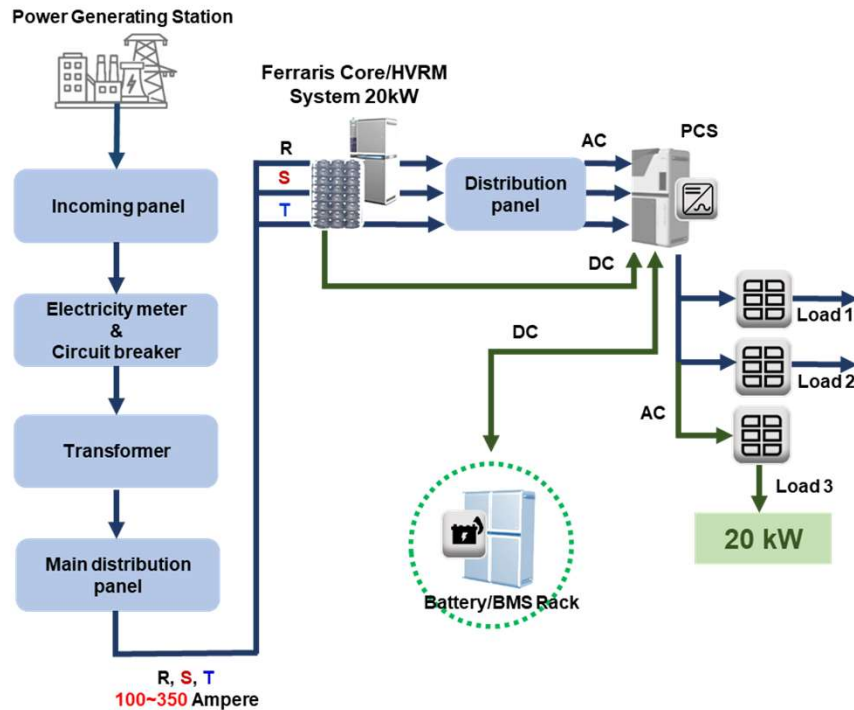
## **IV. Estimated electricity production by Ferraris ERR System**

Case	Configuration of Ferraris ERR System	R, S, T Line Current (Ampere)	Using R, S, T Line	Using Ferraris Core/HVRM system (20kWh)	Supply power to the Load	Supply power (kWh/each the Load)	Total supply power
1	Basic	100~350	1	1	1	20	<b>20 kWh</b>
2	Cascade	100~350	1	3	3	20	<b>60 kWh</b>
3	Cascade	100~350	1	3	1	60	<b>60 kWh</b>
4	Cascade	100~350	4	12	4	60	<b>240 kWh</b>
5	Parallel	200~600	1 (line split)	2	1	40	<b>40 kWh</b>
6	Parallel & Cascade	200~600	1 (line split)	6	1	120	<b>120 kWh</b>
7	Parallel & Cascade	200~600	4 (line split)	24	4	120	<b>480 kWh</b>



## **V. Configuration of Ferraris ERR System**

▪ **Case 1 - Basic Configuration (20 kW x 1 Load) and configuration guide**

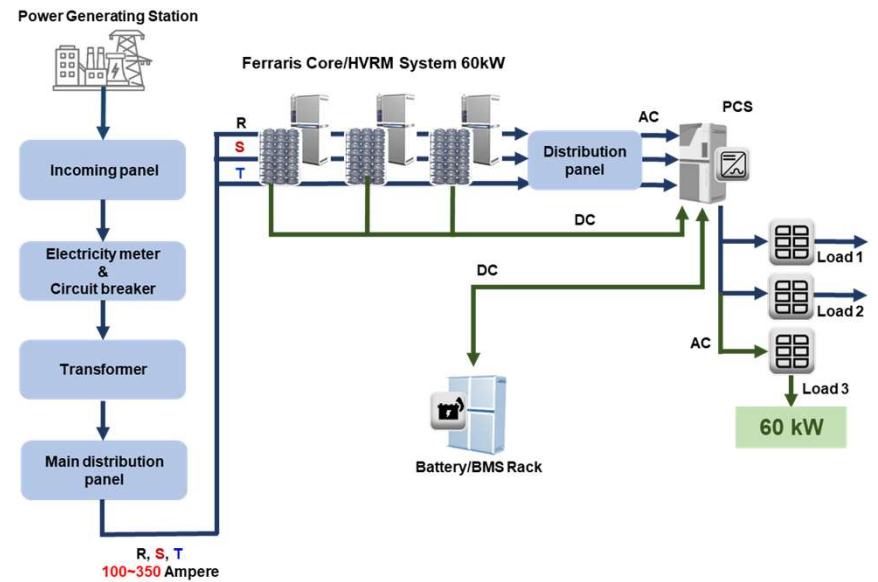
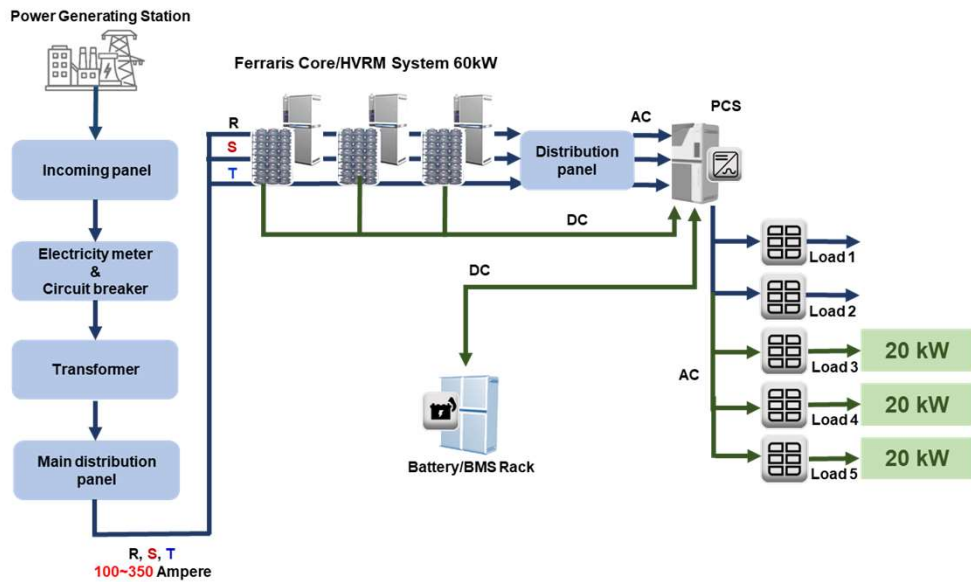


1. Ferraris ERR System is designed to be installed and run on Incoming power line with current range between 100 to 350 Ampere.
2. If the Incoming power line's current range lies between 200 to 600 Ampere (or more Ampere), Ferraris ERR System can split & merge R, S, T, and N lines and can be installed and operated in Parallel & Cascade configuration as shown through Case 5 to 7.
3. The productivity efficiency of Ferraris ERR System will increase in correlation to the higher line current.
4. As default power lines are configured in commercial buildings with four sets of R, S, T and N lines with one extra set as a backup. By employing case 4 and 7 where the configuration uses four sets of R, S, T and N lines, power productivity efficiency will increase by 4 times.

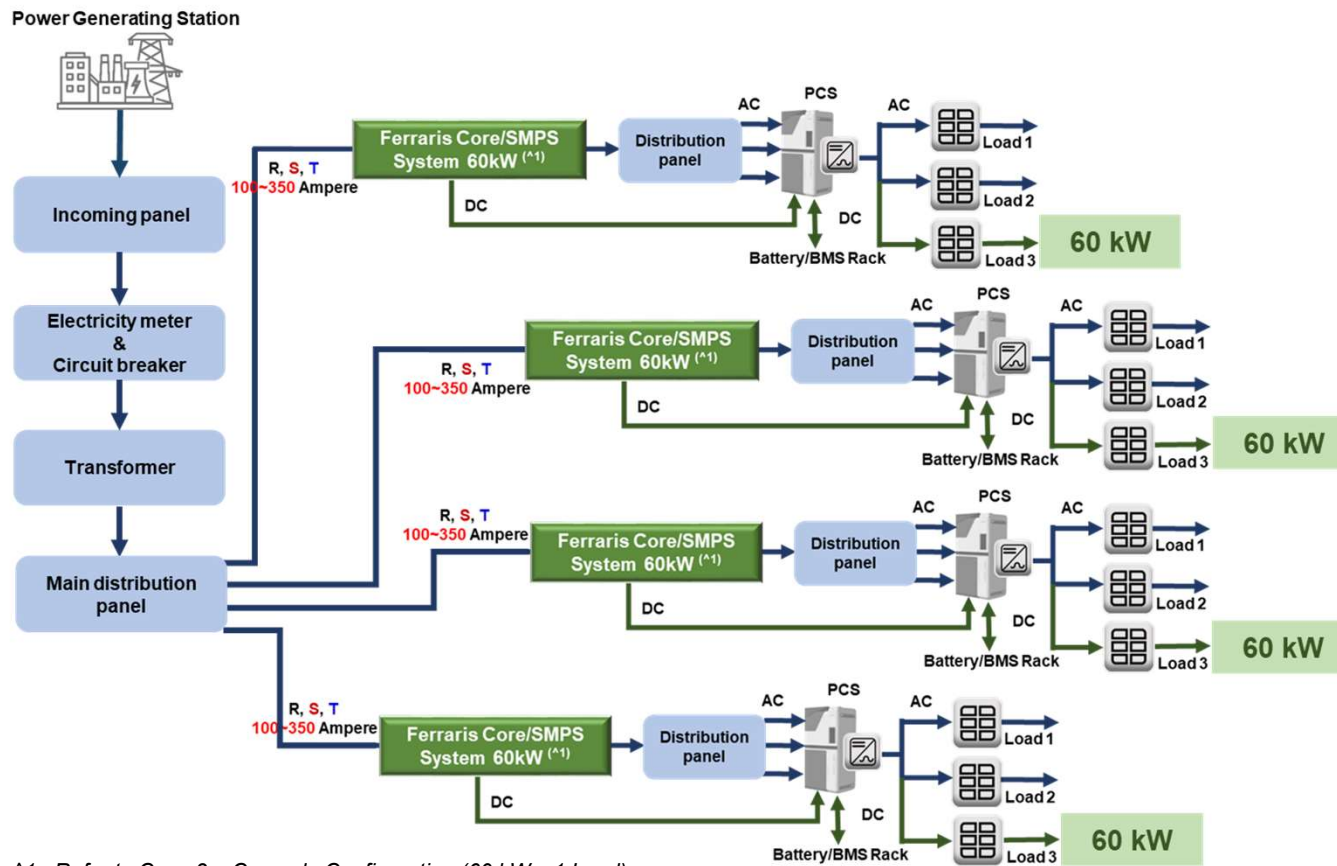
5. Ferraris Core/HVRM system generates electrical energy from the magnetic harvesting modules on R, S, T Lines, and also act as a power supplier Ferraris to the Load through PCS.
6. Battery/BMS is the buffering system for balancing between incoming and outgoing power at PCS point, that is Load requirement.
7. If the power generated through Ferraris Core/HVRM system is required to be used by the Load 24 hours non-stop, the minimum quantity of deep cycle battery may be installed for the Battery/BMS.
8. The Green circle (by referencing case 1 to 3) means that Battery/BMS install (small to large scale option) is possible according to the power usage of the Load.
9. Battery/BMS, Line-interactive power capacity is determined by the power usage of the Load which connects to the Ferraris Core/HVRM system.
10. The Line interactive power module monitors power usage of the Load in real time to redirects the Load's unused (or underused) power generated by Ferraris Core/HVRM system to other Loads connected to the distribution panel, resulting in further increase in power efficiency and reduce cost.
11. Normally PCS line input circuit is going to compensate potential voltage variation compared to normal (in this case 380Vac) due to Ferraris Core/HVRM system at R, S, T and N lines.

▪ Case 2 - Cascade ( 20kW x 3 Load )

▪ Case 3 - Cascade ( 60 kW x 1 Load )

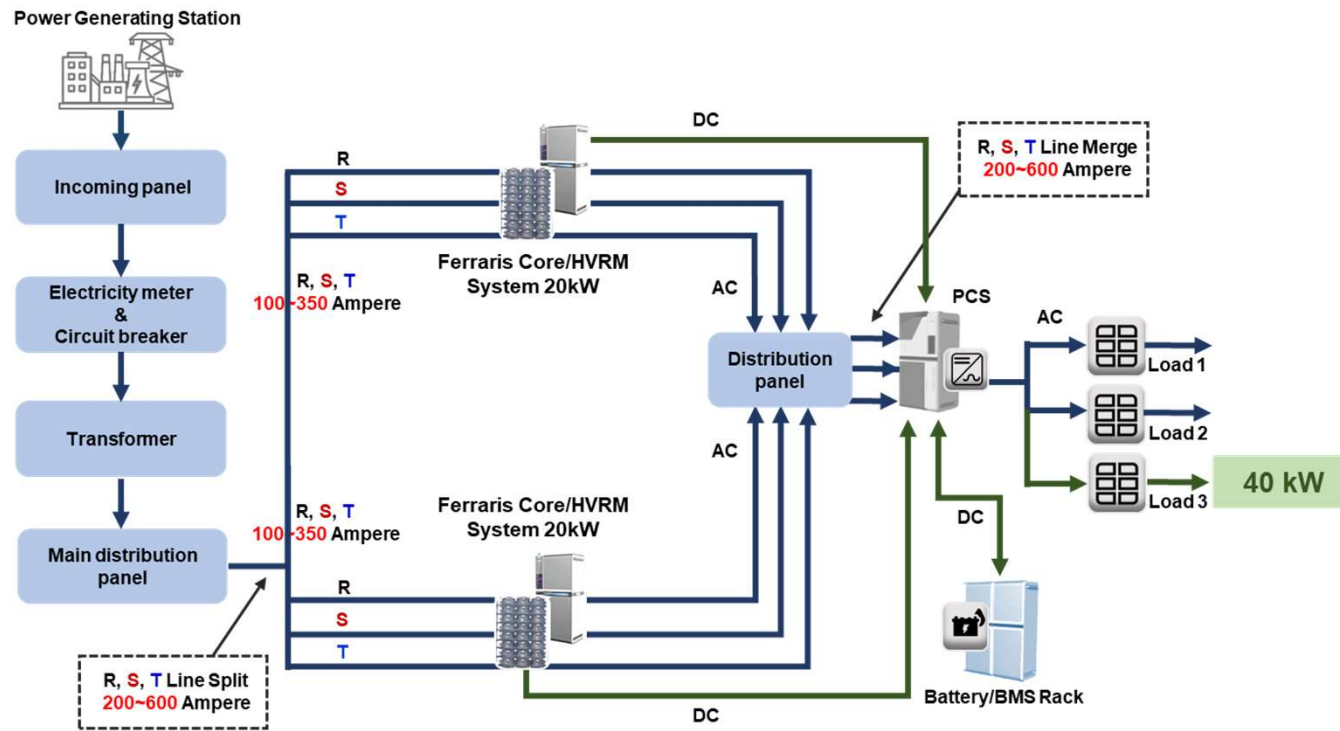


▪ Case 4 - Cascade ( 60 kW x 4 Load )

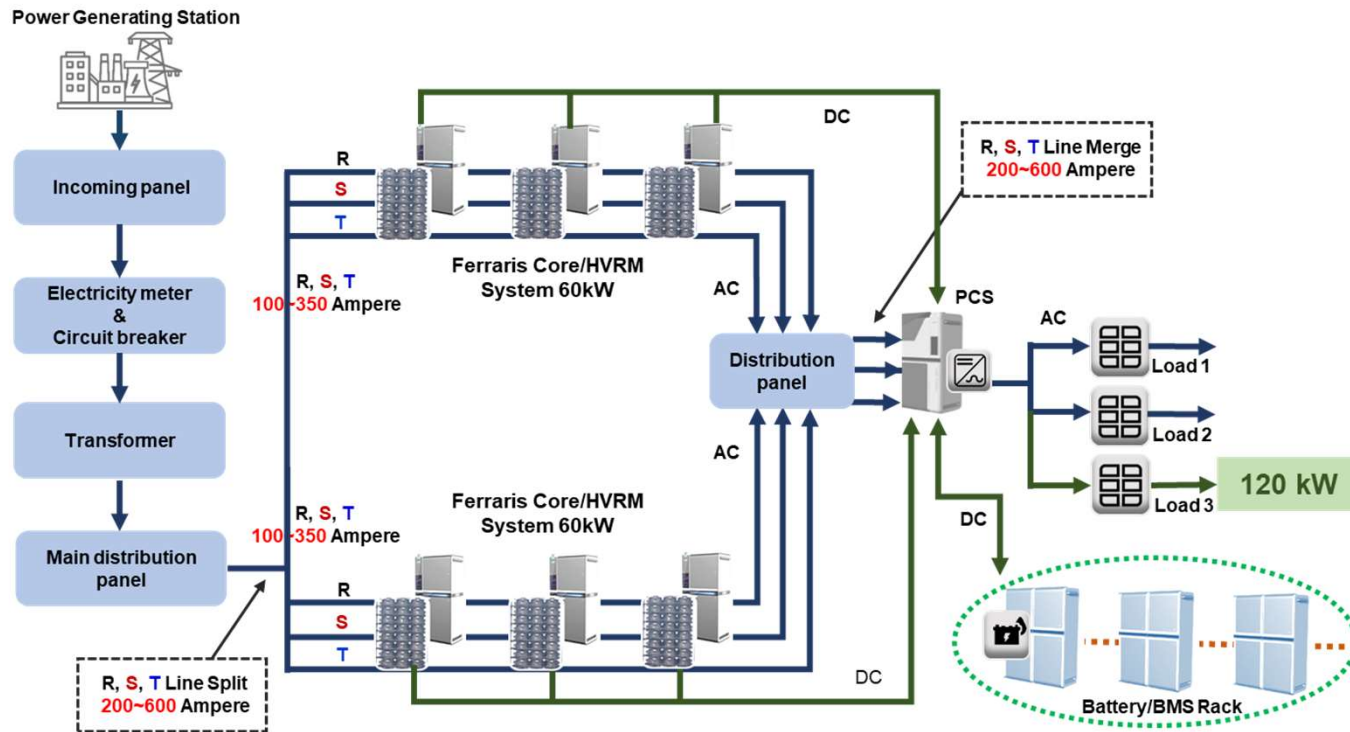


<sup>^1</sup> : Refer to Case 3 – Cascade Configuration (60 kW x 1 Load)

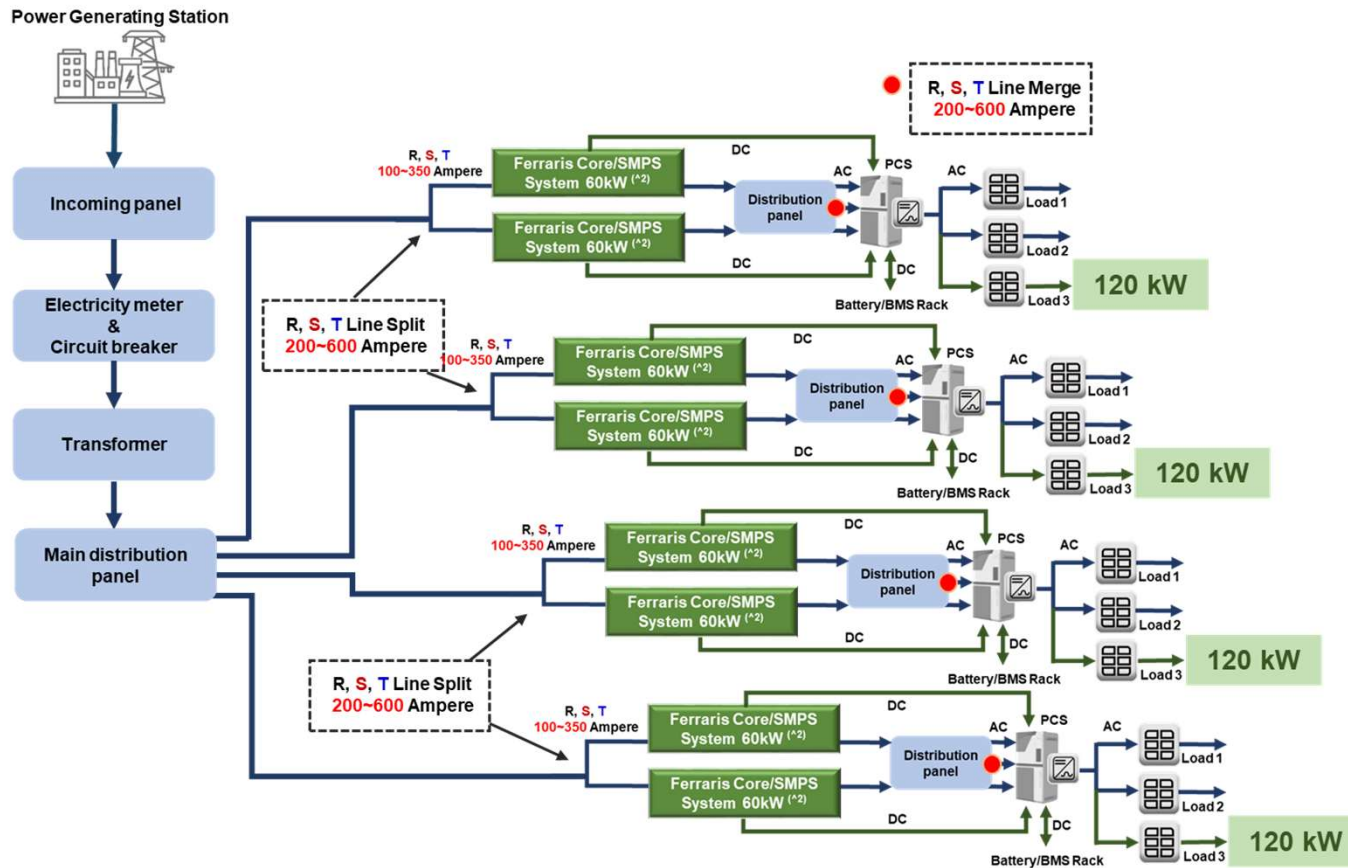
▪ Case 5 - Parallel ( 40 kW x 1 Load )



▪ Case 6 - Parallel & Cascade ( 120 kW x 1 Load )



▪ Case 7 - Parallel & Cascade ( 120 kW x 4 Load )

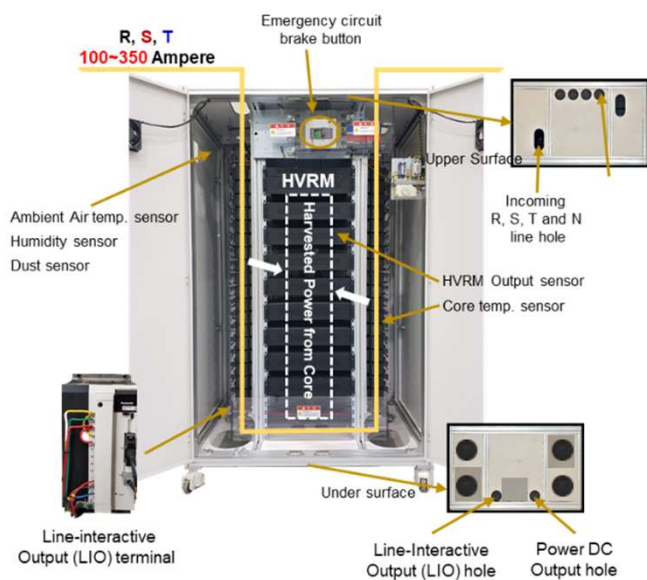


<sup>^2</sup> : Refer to Case 6 – Parallel & Cascade Configuration (120 kW x 1 Load)



## **VI. Spec Sheets of Ferraris ERR System**

## ▪ Ferraris Core/HVRM (High Voltage Regulator Module) system



Ferraris Core/HVRM system rack – Front side

### Basic Operation

- Ferraris Core/HVRM system is doing Magnetic Energy Harvesting Function from R, S, T and N power lines.
- R, S, T and N power lines are passing thru inside hole of Ferraris Core (normally more than 100 to 200 cores).
- Collected power by Cores is sent to HVRM (High Voltage Regulator Module) and leveled for the Battery/BMS interface.
- HVRM output is sent to Battery/BMS as a DC power format.
- LIO (line-interactive Output) power is the redundant output power in case harvested power is more than that of required output power. This extra power can be connected to other distribution panel to supply extra power.

### Basic Features

- Emergency Shutoff Function. (R, S, T and N power line bypass)
- Core Shutoff Function. In case of Core malfunction, Core output is shutoff to protect other subsystem.
- In case of Malfunction of HVRM, connected Cores are shutoff to prevent harvesting function.
- Real-time checking Ambient condition.(Temperature, Humidity, Dust) inside Rack. In case of abnormal condition Emergency Shutoff Function (bypass) will be acting.
- For each harvested output by HVRM are monitored in real-time and these status data are sent to the host monitoring system via RS-232 or I2C.
- This system can be cascaded by connecting R, S, T and N power line to the next input R,S,T and N power lines.

### Primary R, S, T and N power line electrical specification

Voltage range	380 ~ 420 Vac
Current range	100 ~ 350 A

### Harvested power electrical specification

Voltage range	380 ~ 420 Vdc
Current range	13A ~ 53A
Output power	5kW ~ 22.5kW

### Line-interactive Output electrical specification

Voltage range	380 ~ 420 Vac
Current range	4 ~ 5 A (2kW)

### Ambient operating specification

Temperature range	- 4 ~ 167°F	
Humidity range	30 ~ 80 %	
Cooling function	Type A	Type B
	21 Watt	46 Watt

### Physical Specification

Dimension (W*L*H)	48 * 30 * 75 (inches)
Weight	640 ~ 772 (lb)
Material	AL
Primary line terminal size	0.43 * 1.38 (inches)
Primary line cable thickness	Ø95 ~ Ø450

## ▪ PCS (Power Control System) Subsystem



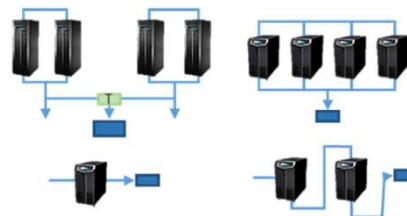
PCS Modules are stackable.



### Basic Operation

- PCS deliver the powers either from the Battery/BMS or Core/HVRM System to the load.
- In case of Emergency, outside normal AC power line can be supported to the Load in real-time.
- **PCS capacity ranges from 20kW and increased up to 120kW by six stacking 20kW module and up to two 120kW module can be connected in parallel (240kW) depending on their configuration.**
- Support Remote monitoring and control feature for easy maintenance.

Several different kind of configuration of PCS



Plug & Play Module Maintenance



### Basic Features

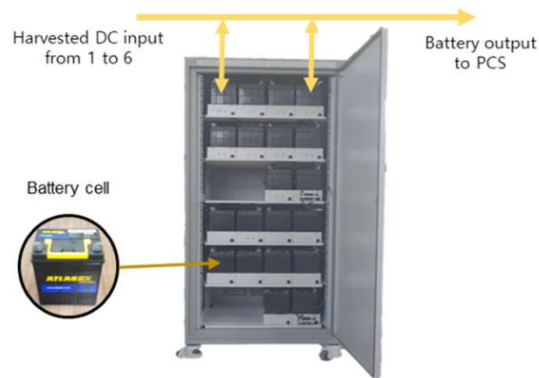
- Support Input bypass breaker for emergency situation.
- **Wide range of input Voltage (208Vac ~ 477Vac) and frequency range (45Hz ~ 65Hz).**
- **N+X Redundancy feature from 20kW module base to unit base, system reliability is increased dramatically.**
- **In multi-module or unit configuration, output power are self synchronizing itself.**
- The PCS monitor consists of buttons with functions such as data settings, menu movements, warning when errors occur, and system settings for different configuration.
- With remote access power based on RS232 and I2C interface protocols, remote monitoring and control are possible.

Input / Output electrical specification	
Typical Input voltage	380 ~ 420 Vdc + N + PE
Input current	Max. 52 A per Module
Backup input power	380/400/415 Vac + N + PE
Output capacity	20kW per Module
Output voltage range	380/400/415 Vac + N + PE
Output frequency	50/60 Hz ± 0.1 %
Output rate of change (Slew Rate)	1 Hz / Sec

Ambient operating specification	
Temperature range	32 ~ 167°F
Humidity range	30 ~ 95 %
Cooling function	Air-cooled (Multi-FAN with adjustable speed depending on load)

Physical specification	
Dimension (W*L*H)	45 * 18 * 74 (inches)
PCS terminal size	0.22 * 0.4 (inches)
Material	AL

## ■ Battery Subsystem with BMS (Battery Management System)



Battery System – Front Side



### Basic Operation

- This system is storing magnetic energy into Battery rack for the buffering and pass them into PCS.
- Battery cell composed of 11 battery has one more extra battery for the redundancy feature (Urgent replacement, Plug in Play).
- It has its own BMS including several types of sensors together and it BMS detects malfunction of certain battery, then automatically that battery will be replaced with redundancy one and send emergency signal to the host monitoring and control system.
- This system can accept up to 6 input from Ferraris Core/HVRM systems depending on the configuration.
- Two battery subsystem Outputs can be connected in parallel (Doubling battery capacity) for future backup.
- Harvested input can pass thru to PCS directly when it is needed. Pseudo battery operation of magnetic Core.
- Excellent local communication features with BMS monitors..

### Basic Features

- Emergency shutoff function support (Bypass input to output without battery).
- Support Urgent swap from battery to cell level for minimum MTTR and easy maintenance.
- With extended capacity of battery, Emergency backup power supply configuration is possible with proper PCS features together.
- With BMS monitoring system, customer can monitor all of internal battery's operation in real-time thru BMS output line.
- Has Internal ambient temp. sensor, humidity sensors.

### Input / Output electrical specification

Input voltage range	380 ~ 420 Vdc
Output voltage range	380 ~ 420 Vdc

### Battery specification

Battery type (Deep cycle)	Lead-Acid Battery
	24Vdc 40AH
Amount of battery per cell	11 EA +1EA (Redundancy)
Capacity of battery per cell	10 kW
Usage by capacity	Depend on power usage 10kW ~ 2kW
Extensibility	Basic 10kW, expandable up to 6 racks (20kW x 6 ea = 120kW)

### Input / Output line specification

Input/output method	Single-phase
Input channel quantity	Max 6 channel
Output channel quantity	1 Channel

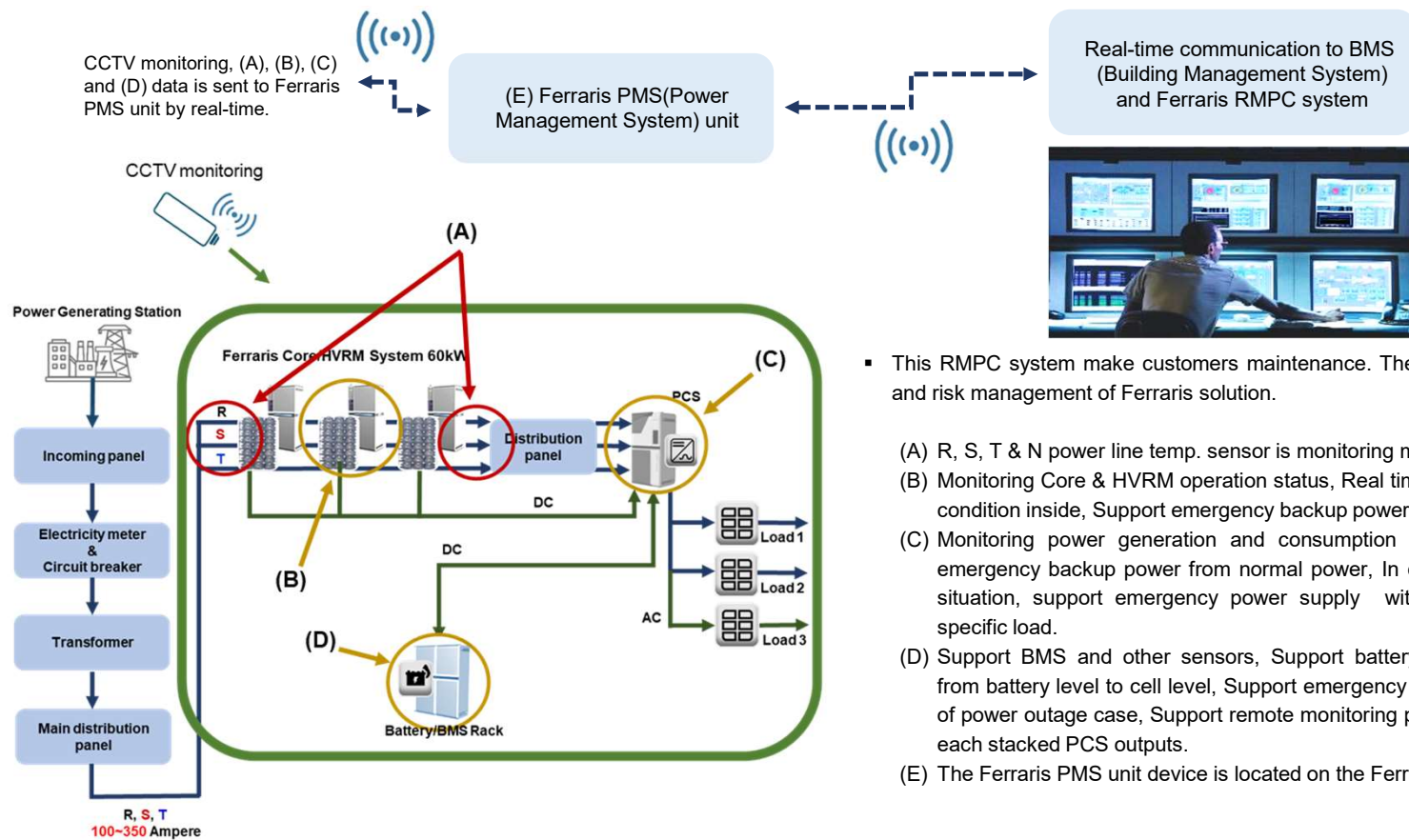
### Ambient operating specification

Temperature range	- 4 ~ 167°F
Humidity range	30 ~ 80 %

### Physical specification

Dimension (W*L*H)	Basic rack : 29*30*73 (inches)
	Customized
Weight	Customized
Material	AL

## ▪ RMPC (Remote Monitoring Power and Control) system for Multi-site



- This RMPC system make customers maintenance. Their multi-site operation and risk management of Ferraris solution.

- (A) R, S, T & N power line temp. sensor is monitoring main power line status.
- (B) Monitoring Core & HVRM operation status, Real time monitoring ambient condition inside, Support emergency backup power system.
- (C) Monitoring power generation and consumption in real-time, Support emergency backup power from normal power, In case of power outage situation, support emergency power supply with battery system for specific load.
- (D) Support BMS and other sensors, Support battery redundancy feature from battery level to cell level, Support emergency power source in case of power outage case, Support remote monitoring power generation from each stacked PCS outputs.
- (E) The Ferraris PMS unit device is located on the Ferraris ERR System site.

## **VII. Operating result of $\beta$ Test and reference site**

**Ferraris ERR System 3kW  $\beta$  Test at KOMIPO (Korea Midland Power Co., Ltd.), Ferraris ERR System installed at small Hydro power plant on August, 2016**

▪ **The purpose of test**

1. Ferraris ERR System would run stable safely with primary power line in any aspect.
2. Any power quality changes on primary power line when Ferraris ERR System is tested.
3. Test possibility of Ferraris ERR System as power generation at 3.3 kV primary power line environment.



Method	Source	Capacity	Total power generation (MW)
Steam Power Plant	Bituminous coal	# 1 ~ 8 500 MW × 8ea	4,000
Combined Cycle Power Plant	LNG	#1 G/T : 150 MW × 2ea S/T : 150 MW × 1ea	1,350
		#2 G/T : 150 MW × 2ea S/T : 150 MW × 1ea	
		#3 G/T : 150 MW × 2ea S/T : 150 MW × 1ea	
Renewable Energy	Small Hydro Power Plant	1.25MW × 6ea * $\beta$ Test field	7.5
	Solar Farm	0.53 MW × 1ea 0.05 MW × 1ea	0.5712
	Fuel Battery	0.3 MW × 1ea	0.3
<b>Total Capacity</b>		<b>5,358.3712MW</b>	

### Test Result Summary from 1st ~ 3rd Report

1. Ferraris ERR System 3kW doesn't effect to primary power line in terms of heat problem by Ferraris ERR System.
2. No impact to Primary power line by power line voltage and current distribution.
3. Power quality is Normal, No distortion on wave of Active power, Inactive power, Power factor and Apparent electric power.
4. No impact to power plant performance.
5. Measured Max. 2.7kW of power from Magnetic Field of primary power line at 24 Months normal power plant environment.
6. The Ferraris Linear power scalability technology has been proved to be perfect.

Check point		Test results	Test method
Primary power line temperature		Max. 60°C / Under cable allowable temperature (90°C)	Temperature sensor
Impact of Ferraris ERR System on power plant performance	Power generation(W)	Max. -1%~5% deviation	DEWETRON data comparison between Small Hydro Power Plant #3 and Small Hydro Power Plant #4
	Voltage (V)	Max. 9V (0.24%) drop	
	Current (A)	Max. -1% ~ 5% deviation	
Impact of Ferraris ERR System on power quality	Power factor 0.8/Normal range		
Power generation from magnetic energy harvesting		Max. 2.7kW(DC 100V, 27A)	



## Test Environment

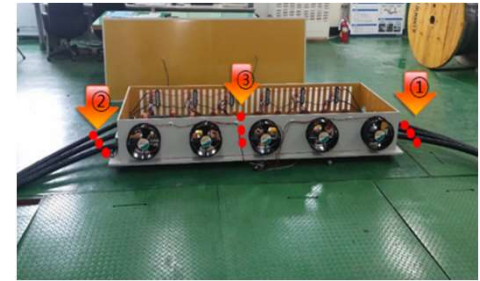
- Transmission line extension and construction



- Core heat check (IR camera)



- Check line temperature by temp. sensors



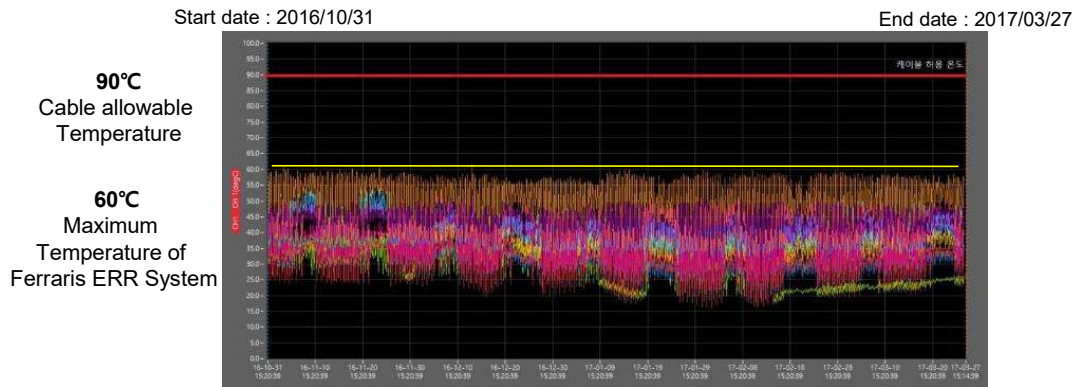
- Confirmation of power generation facilities abnormality
- DEWETRON (check primary power line)



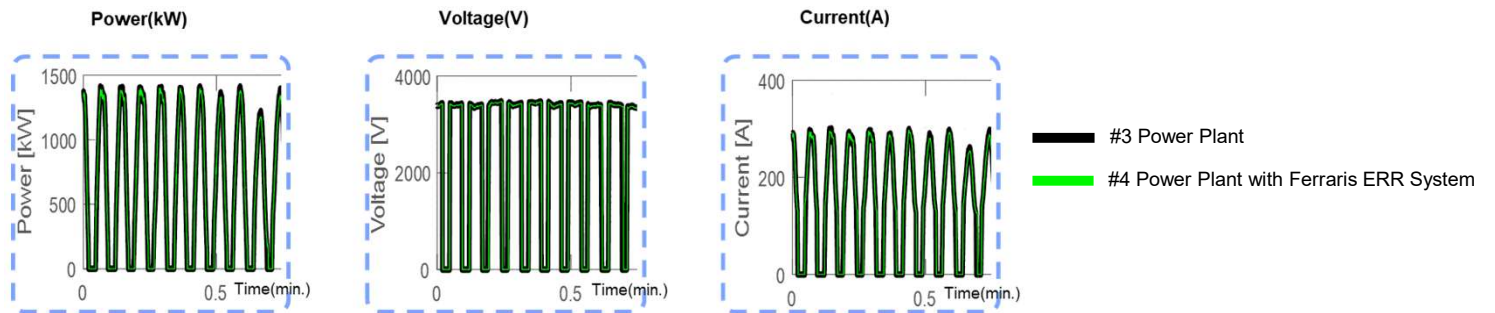
- Power generation from Ferraris ERR System



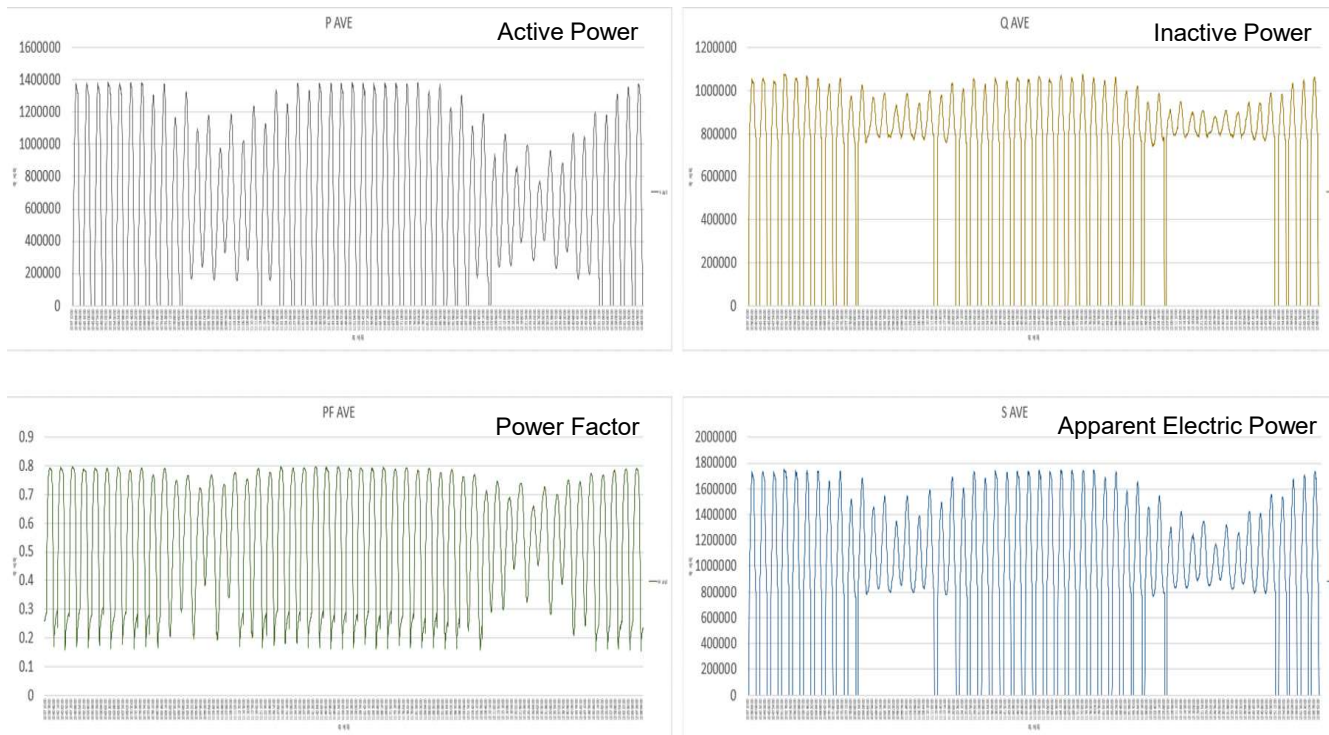
- Primary power line temperature test results : No impact to primary power line by Ferraris ERR System



- Impact of Ferraris ERR System on Power plant performance : No impact to power plant performance



- Impact of Ferraris ERR System on power quality : Power quality is normal, No distortion on wave of active power, Inactive power, Power factor and Apparent electric power



- Power generation from Ferraris ERR System :

**(Primary)**

Power generation from #4 Plant

- Voltage : 3.3 kV
- Current : 130A ~ 270A

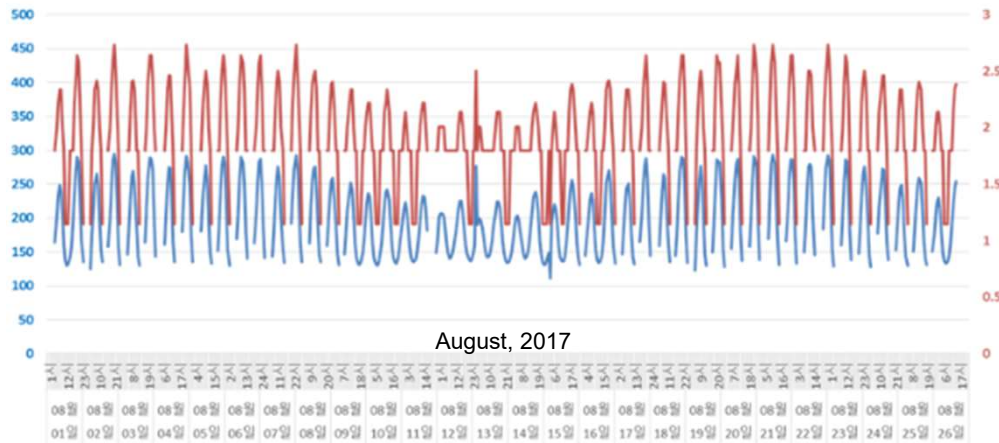
**(Secondary)**

Power generation from Ferraris ERR System

- Voltage : DC 65V ~ 100V
- Current : 17A ~ 26A
- Power generation : 1.1kW ~ 2.7kW

Power generation from #4 Plant (A)

Power generation from ERR System (kW)





***Electric energy is Electromagnetic energy,***

***Our approach to a new paradigm of efficient electric power generation and recycling !***



*If there are any questions, please feel free to contact Ferraris Inc. as below,*

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