HVDC (High Voltage Direct Current)

New Feeding Method for High Efficiency Data Centre
Background

- APEC at Yokohama JAPAN (Nov. 2010)
  One of the Action list supporting the APEC leaders’ strategic growth is,
  - Promote energy conservation activities through the introduction of more energy efficient ICT devices and systems, including data centres and ICT utilization in many sectors and new ICT services such as cloud computing (Green ICT).

- Recently, the situation at the data centre has widely changed.
  - Support for environmental protection
  - Initiatives to Green ICT
  - Correspondence to ICT technology with fast advancement.

- To achieve the Green data centre.
  - Air-conditioning efficiency improvement
  - Server consolidation by virtualization
  - High Voltage Direct Current (HVDC)
It is possible to achieve it by HVDC.

1. Energy-saving design
   Comprehensive efficiency 20~35% improvement!
   Naturally, the electricity bill of operating is reduced and the CO2 emissions significantly reduced!

2. High-reliability design
   UPS is unnecessary. The system down is prevented by the n+1 composition.

3. Safety design
   The electric shock, an earth fault, and the arc problem are cleared.

Power Supply Rack (small-sized! From 1/5 to 1/10 compared to UPS!)

Server Racks

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1. Energy-saving design
   – Efficiency comparison –

UPS system (current)

HVDC

➢ Two conversions are eliminated.
➢ Significant energy saving.
➢ Further improved reliability.

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1. Energy-saving design
   - Efficiency comparison -

**UPS system (current)**
- 98% (Transformer)
- 80~85% (AC)
- 98.5% (S/B)
- 58~70% (AC)

**HVDC 12V systems**
- 98% (Transformer)
- 98% (PS Rack)
- 95% (DC/DC Centralized power)
- 98.5% (S/B)
- 99% (Bus for stabilizing)
- 20~35% (power reduction)
- Approx. 91%

**HVDC 12V systems is 20~35% power reduction.**
※The air conditioning power reduction also added!

※ Efficiency calculation is the reference on 50% load.
※ Value about the efficiency varies depending on the configuration.

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2. High-reliability design

- n + 1 The merit of redundancy

The Spare always backs up with n+1. System does not down even the failure of multiple locations!

Non-stop system

It is possible to be extended without stopping the system!
3. Safety design

We achieved “Safety” by our new technology, HVDC!

① ARC Restraint Technology
• By setting the arc control circuit, suppress the generation of the arc.

② Middle point ground Anti-electric shock • earth measure
• An electric shock, an earth fault with high voltage are limited on a secure current value by the high resistivity of 47kΩ.

Arc outbreak at the time of the direct current interception had been a problem.

Danger associated with the high voltage had been pointed out.
Electric shock and earth fault protection  

- Middle point ground -

When getting an electric shock, the current that flows to a human is \(2\text{ (kΩ) of resistance}\).

\[ I_3 = \frac{E \times R_2}{R_1 \times (R_2 + R_3) + R_2 \times R_3} \]

\[ I_3 = \frac{380\text{ V} \times 47\text{ kΩ}}{47\text{ kΩ} \times (47\text{ kΩ} + 2\text{ kΩ}) + 47\text{ kΩ} \times 2\text{ kΩ}} = 7.5 \text{ mA} \]

When the leakage (electric shock) detected, turn off the switch and interrupting the route of leakage, the electric shock is instantaneously stopped.

There is no influence on the system feeding power by the leakage (electric shock) and the earth fault.

We developed high-resistance grounding method aimed at high-voltage electric shock accident prevention.

※ In an actual device, short time peak current flows by the load. However, we solved in discharge circuit.
HVDC – Basic system configuration

- **Basic System Configuration**

  - **AC** input
  - **ΔY** transformers
  - **PS RACK**
    - **DC340V**
    - **Battery voltage** DC288V
  - **Server Rack**
    - **DC/DC** 340V→12V
    - **DC/DC** 340V→48V

  - **During a power outage**: DC/DC 340V→48V

- **Phase Shift**: 30°
- **Three-phase Delta Connection**
- **Three-phase Star Connection**

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HVDC – Floor Configuration –

Conventional AC • UPS systems

HVDC systems

Floor layout 1

Floor layout 2
Result of JAPAN

- **Major data center company A**
  - This company constructs the data center of 4000 racks scale in the autumn of this year.

- **Major data center company B**
  - This company is examining the introduction at the beginning of next year.

- **Major carrier C**
  - The evaluation machine was introduced.
Suggestions

The photovoltaic generationInstallation.

General method of Japan
- photovoltaic panel
- Power controller
- UPS
- DC/AC
- AC/DC
- DC/AC
- Battery
- Server, Router, etc.
- Converter
- AC/DC
- 340V → 12V

HVDC can be used without converting the power of the photovoltaic generation.

HVDC Supply
- AC incoming
- DC200~400V
- MTTP with control operation
- DC/DC Converter
- DC340V
- Priority
- Non-priority

The output of the photovoltaic panel is a high voltage, so the HVDC data centre is a good combination!
- No power controller
  - Highly effective, high reliability, and low price!
- As running out of the photovoltaic generation power, the electric power is automatically supplied from the AC system side.
- HVDC does not flow back to the AC system in waveform troubled!
If you have any interest in our products, please feel free to contact the following address.

Thank you for your attention.

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