Recommendation

ITU-T L.1306 (02/2023)

SERIES L: Environment and ICTs, climate change, e-waste, energy efficiency; construction, installation and protection of cables and other elements of outside plant

Energy efficiency, smart energy and green data centres

Specification of an edge data centre infrastructure

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ENVIRONMENT AND ICTS, CLIMATE CHANGE, E-WASTE, ENERGY EFFICIENCY; CONSTRUCTION, INSTALLATION AND PROTECTION OF CABLES AND OTHER ELEMENTS OF OUTSIDE PLANT

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Recommendation ITU-T L.1306

Specification of an edge data centre infrastructure

Summary

Recommendation ITU-T L.1306 defines systematic requirements for infrastructure equipment utilized in the edge data centre including information and communications technology (ICT) equipment, power feeding system, cooling system, monitoring system, etc. to get green, safe, reliable, smart energy saving.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
1.0	ITU-T L.1306	2023-02-22	5	11.1002/1000/15175

Keywords

Cooling, edge data centre, management, power.

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FOREWORD

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1 Scope

This Recommendation focuses on the specification of edge data centre infrastructure, such as principles, basic components, technical specification of power feeding systems, cooling systems (design, maintenance, operation and energy consumption), monitoring systems and others.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T L.1205] Recommendation ITU-T L.1205 (2016), *Interfacing of renewable energy or distributed power sources to up to 400 VDC power feeding systems*.

[ITU-T L.1221] Recommendation ITU-T L.1221 (2018), *Innovative energy storage technology for stationary use – Part 2: Battery*.

[ITU-T L.1305] Recommendation ITU-T L.1305 (2019), *Data centre infrastructure management system based on big data and artificial intelligence technology*.

[ITU-T L.1381] Recommendation ITU-T L.1381 (2020), *Smart energy solutions for data centres*.

[IEC 62040-3] IEC 62040-3:2021, *Uninterruptible power systems(UPS) - Part 3: Method of specifying the performance and test requirements.*

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 air-handling unit (AHU) [b-ASHRAE Terminology]: Assembly consisting of sections containing a fan or fans and other necessary equipment to perform one or more of the following functions: circulating, filtration, heating, cooling, heat recovery, humidifying, dehumidifying, and mixing of air. It is usually connected to an air-distribution system.

3.1.2 cooling system [b-IEC 60050-841]: Set of devices and circuits ensuring the flow of the cooling medium, e.g., air or water, through elements and parts of the induction heating installation.

3.1.3 data centre [b-ITU-T L.1301]: A physical location dedicated to computing, as well as a telecom operator location, with equipment dedicated to telecommunication functions (e.g., switching functionality, billing).

3.1.4 infrastructure [b-ITU-T L.1325]: Equipment that supports the ICT equipment, e.g., power delivery components and cooling system components.

3.1.5 ICT equipment [b-ITU-T L.1200]: Information and communication equipment (e.g., switch, transmitter, router, server, and peripheral devices) used in telecommunication centres, data centres and customer premises.

3.1.6 power feeding system [b-ITU-T L.1325]: Power sources to which ICT equipment and facilities are intended to be connected, such as uninterruptible power supply (UPS), backup generator, etc.

3.2 Terms defined in this Recommendation

This Recommendation defines the following term:

3.2.1 edge data centre: A data centre located near the final user in which it is necessary to finish relevant data processing in a short time and with low latency.

NOTE – Edge data centre can make timely and safe data processing for one or not too many serviced bodies. Meanwhile, it can make a supplement for calculating the capability of cloud computing. Furthermore, it provides services for users on information processing, storage, communication, etc. Additionally, daily monitoring and maintenance of the edge data centre can be accomplished by it.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AHU Air-Handling Unit

AI Artificial Intelligence

BMS Battery Management System

CLF Cooling Load Factor

ECO Ecology, Conservation, Optimization

GHG Greenhouse Gas

ICT Information and Communications Technology

IEC Indirect Evaporative Cooling

PUE Power Usage Efficiency

PV Photovoltaic

SDGs Sustainable Development Goals

UPS Uninterruptible Power Supply

5 Conventions

None.

6 Characteristic of an edge data centre

Edge data centres are located near the physical body of users such as commercial buildings, factories, autonomous driving vehicle stations, etc. In general, it can only process local and nearby business data to reduce the latency of data transmission and calculation, so that the total volume of data would not be much as in a cloud data centre. Additionally, due to make adaptations in different application scenarios, the condition of environmental circumstances in which the edge data centre is constructed must be variable, sometimes with much higher relative humidity, sometimes with many thunderstorms, and sometimes with extremely hot or cold days. Therefore, the safety, reliability and high efficiency of infrastructure in the edge data centre are much more important compared with the traditional data centre.

The edge data centre infrastructure should be in accordance with the following principles:

- It is located between users and the cloud data centre in that there is no need of uploading a large volume of business data to the cloud platform to make data processing. It is definite that the time delay of the communicating network can be optimized while the outcome feedback can be made faster. This way, the user experience is more ideal.
- The scale of edge data centres in different scenarios can be different. Generally, the power of a single edge data centre does not exceed 250 kW. Given that the average power per servers cabinet is not less than 5 kW, the number of servers cabinet in an edge data centre does not exceed 50 kW.
- Due to different application scenarios and locations, scattered overall arrangement is a key property for edge data centres.
- Due to scattered arrangement, there is nobody on daily maintenance when the edge data centre is installed outdoors. It is actually motivated by some initiative functions like safety function (e.g. monitoring, anchoring, warning), maintenance function (e.g. auxiliary scensoring), operation function (e.g. more automatic), and resilience function.

7 Structure of an edge data centre

For specific composition, the edge data centre is composed of a servers cabinet system, monitoring system, power feeding system, cooling system, cabling system and other components of the aisle. In some special scenarios, the edge data centre can be a cabinet that can be put into commercial buildings or near municipal infrastructures for information processing and analysing. The general and classic structure of the edge data centre is shown in Figure 1.

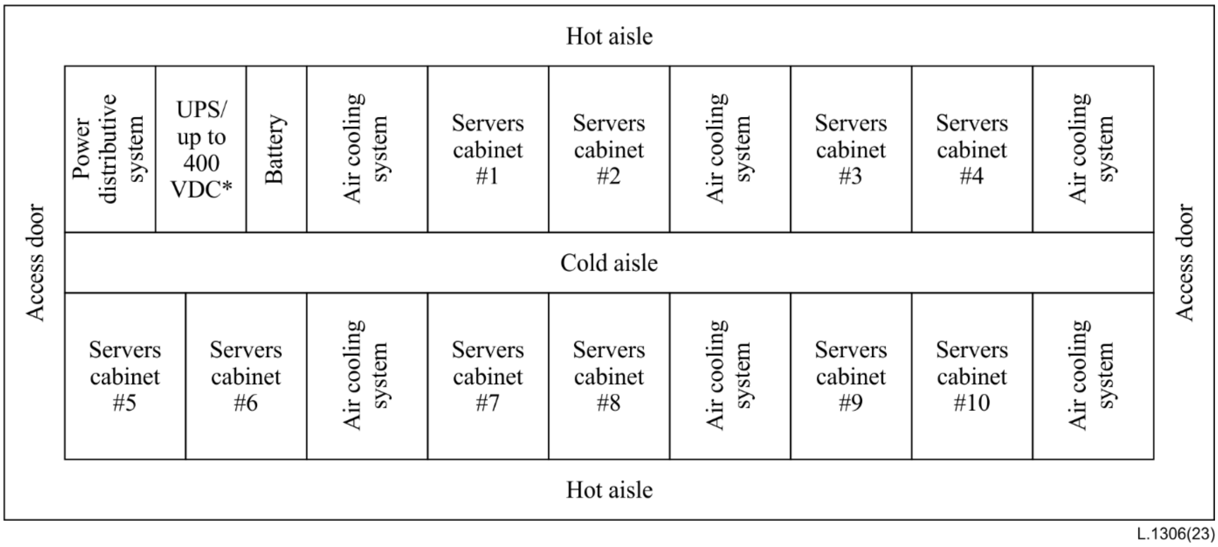

Figure 1 – Example of structure and component of an edge data centre
(* both AC and DC power feeding systems are in the modular)

8 Power feeding system

8.1 Modular uninterruptible power supply (UPS) power feeding system

8.1.1 Background

With the booming development of Information and Communication Technology (ICT) applications such as edge computing, much more power would be supplied for servers and computers. When an edge data centre is widely applied, the number of data centres would sharply increase while the power demand would be variable based on different data working modes.

Nevertheless, we can realize that the settlement of the power feeding system is not coupling well with the digital business. Therefore, it is necessary to make the power flexibly allocated in the edge data centre. As it is known in common, the construction cost would be relatively huge, and the operation cost would be relatively higher with a lower power rate if we cannot allocate power flexibly with the actual workload.

8.1.2 Characteristics of modular UPS

For the edge data centre, the modular UPS is one of the best choices for a power feeding system, which is shown in Figure 2. We can initially regulate the power feeding system to finish workload coupling by flexibly adding / reducing power modules without the power off. Finally, the power feeding efficiency will be increased while the cost of investment will be optimized.

Figure 2 – Modular AC UPS product [b-CPW]

Creatively, there is an ecology, conservation, optimization (ECO) mode in which the energy feeding is directly from the grid in priority after filtering in the modular UPS in which the total power efficiency can reach up to 99% and the influence feedbacking to the grid can be reduced to some extent. In addition, it can make smart tests and compensation to current harmonics and reactive power of the load. It can also effectively promote the power factor of bypass input to make the quality of the grid be consistent with [IEC 62040-3]. With smart control, the modular UPS can make power modules be in hibernation one by one when the load is less that the maximum power of the UPS.

8.1.3 The characteristic of the application of a modular UPS power feeding system in a edge data centre

Compared with traditional data centres and cloud data centres, the specification of power feeding systems is much more strict on safety and stability in the edge data centre. It is inevitable that we also consider making much higher power efficiency while taking more renewable energy in the power feeding system. In the edge data centres, it is obvious that there is no much room for a redundant power feeding system as the stand-by. Therefore, a modular UPS power feeding system is a better choice.

For the application scenario, each power module can be the stand-by power feeding system with others. It means that if any power module were to fail, the other module which is in stand-by or in sleep mode can be in normal mode in time. Additionally, due to the power per module becoming

200 kVA, if the power of the edge data centre is not more than 250 kW as mentioned before, a single power feeding system is sufficient.

Moreover, in the edge data centre, ECO mode is much more popularized in the UPS. With small-sized data centres, the power usage efficiency (PUE) is respectively higher. Thus, with the higher qualified development of grid power, ECO mode uses grid power as the first choice. When obvious voltage fluctuation of grids are detected, it can automatically be changed to inverting power mode. With this ECO mode, the PUE of an edge data centre can be improved.

8.1.4 UPS green power feeding system

Since edge data centre installations will increase, a number of good choices to reduce the greenhouse gas (GHG) emission of them is to move to solar energy use.

Figure 3 which is derived from [ITU-T L.1381] consists of a solution in which the AC power feeding system can be a hybrid structure where the UPS system is supplied from both AC mains and a photovoltaic (PV) energy inverter.

In this case, UPS and other AC loads can be supplied by the solar solution and by the main if the solar energy is insufficient. In this way, the edge data centre will be supplied in a more sustainable way reducing the GHG emissions of the edge data centre solution.

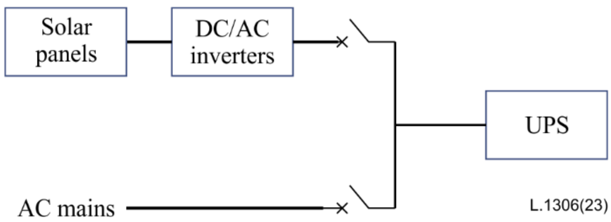

Figure 3 – Structure UPS green power feeding system using the solar solution with inverter

Other possible solutions include not using a traditional solar installation but directly connecting the solar energy to the DC bus of the UPS, as shown in Figure 4.

In this case, the UPS can also store the energy produced by solar panels in the battery to create a backup of energy and use the solar energy as an alternative or in combination with the AC main energy.

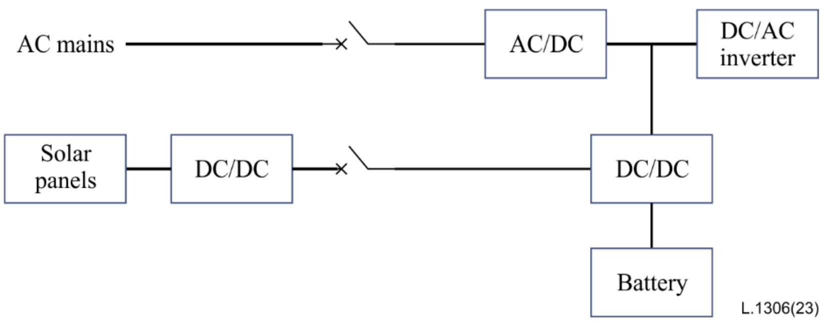

Figure 4 – Structure of UPS green power feeding system using the solar solution connected to UPS DC bus

8.2 Up to 400 VDC power feeding system

8.2.1 Background

With the rapid development of IT devices and big data application, the safety requirement of power feeding in an edge data centre is stricter than others. In addition, it cannot be ignored that for AC power feeding systems, reliability should be promoted. Meanwhile, since there are so many power conversion equipment in power feeding systems therefore, electric loss and higher costs of maintenance have been focused on. Hence, it is a good way of powering in the edge data centre with a DC power feeding.

8.2.2 Characteristics of up to 400 VDC power feeding system

The structure of up to 400 VDC power feeding system is shown in Figure.5.

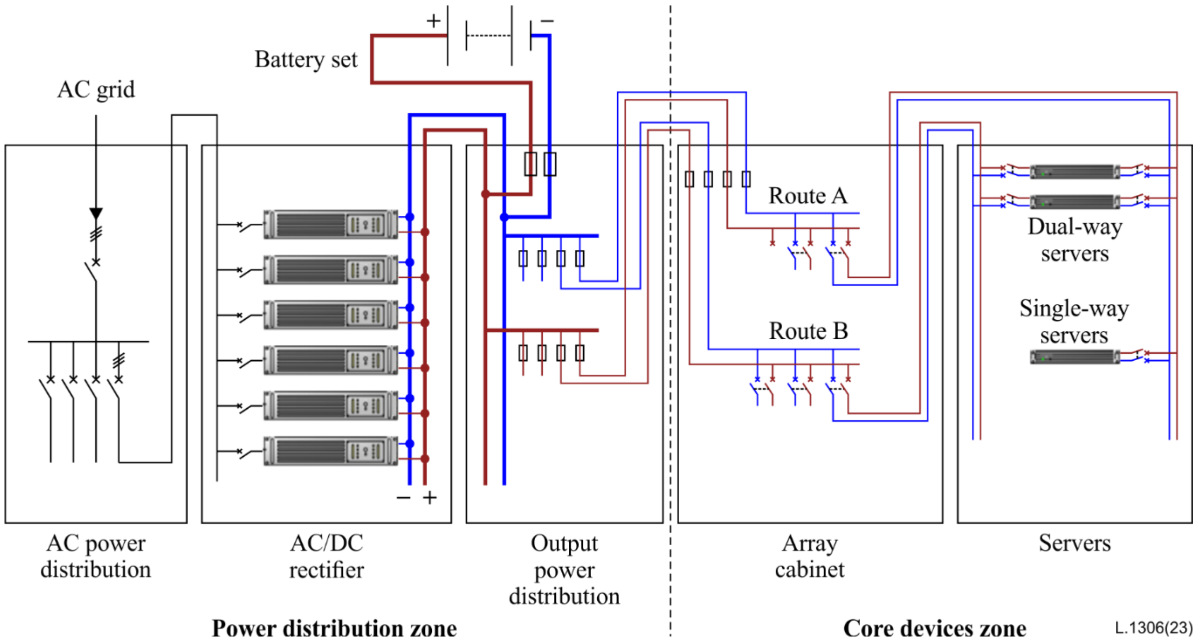

Figure 5 – Structure of up to 400 VDC power feeding system

Compared with modular UPS, the up to 400 VDC power feeding system is without a 2-step power transformation (the inverting part from UPS and the rectifying part from power feeding of servers). In most application scenarios, a single power feeding system with a dual power route and the "grid+single-routed up to 400 VDC power feeding system" can be good choices because the total power efficiency is higher than UPS without the ECO mode. In addition, the battery can be directly connected to servers without inverters, so the reliability can be increased.
As with only a single rectifying part, the total structure of up to 400 VDC power feeding system is much simpler and more reliable than the UPS. The output power is floated so that it is much safer under touching conditions. Furthermore, the level of the output voltage is not constant, each user can choose a different voltage such as 336 V or 240 V.

For power efficiency, the up to 400 VDC power products with different brands can reach up to 98%, so it is much more friendly with the environment and can take as fewer devices as possible with the same power needed in the edge data centre.

8.2.3 Up to 400 VDC green power feeding system

From Figure 6 which is the reference of [ITU-T L.1381], the DC power feeding system can be a hybrid structure in which the up to 400 VDC power is to be supplied both from the AC/DC rectifier and a photovoltaic (PV) energy controller. They are combined into an integrated power feeding system that can maintain maximum output power by adjusting the output voltage in a smart way, by which the output voltage of the rectifiers that are connected to the PV system is higher than that of the rectifiers connected to the AC mains. When the output current of the PV system is lower than the load current, i.e., if the PV system output power is not sufficient for the load power, the PV output voltage decreases automatically to a value equal to the voltage of the rectifier connected to the AC mains, so that the whole ICT equipment is powered by the PV and the mains together. The most important is the output voltage of the rectifiers that are connected to the PV system and the AC mains, should be dynamically adjusted according to the load power, so that the whole system is controlled by a smart power solution. This should also be complied with [ITU-T L.1205].

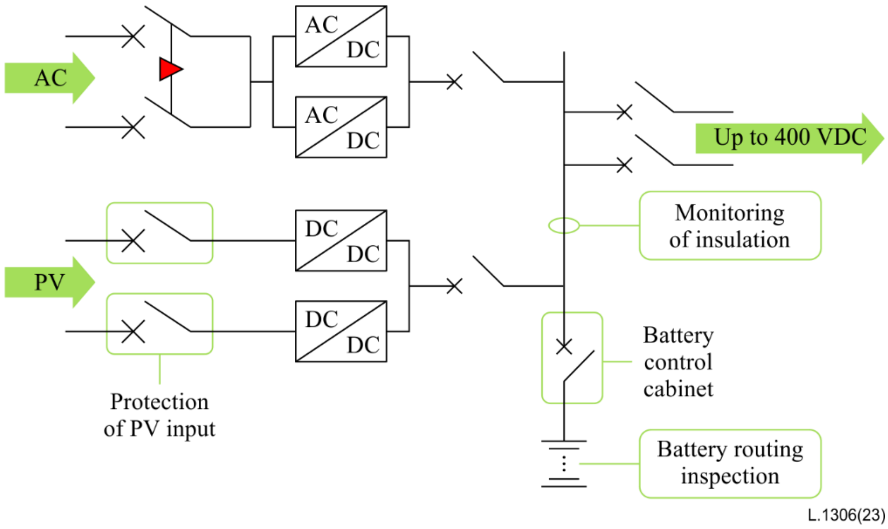

Figure 6 – Structure of up to 400 VDC green power feeding system

8.2.4 Application characteristic of up to 400 VDC green power feeding system in the edge data centre

With the booming development of the edge data centre, up to 400 VDC green power feeding systems can be a good choice to get more stable and high-power-efficiency power feeding and make GHG emissions reduction which can meet the need of the sustainable development goals (SDGs).

It is an innovative way of up to 400 VDC green power feeding that if the served user by the edge data centre has a relatively large physical building or factory, it is possible to construct a PV power feeding system laid outside the building or put it on a wide ground. It means that the up to 400 VDC green power feeding system in the edge data centre should get a PV power feeding from the served user's building, which is not a totally independent power feeding system in the edge data centre.

Figure 7 – Example of a roof-top PV near the edge data centre [b-GBWindows]

If the surrounding area for the PV system is not sufficient to get green energy coupling with traditional up to 400 VDC power feeding system, making collaboration with a nearby electric power generating company would be a choice. For the cost saving part, some edge data centres in the same geographic area (e.g., in the same city) can get PV from the same electric power generating company. In relatively high possibility, the quality and volume of the PV system can be much improved compared with self-constructed PV systems aside from buildings.

Figure 7 shows an example of a PV installation in an edge data centre that is valid for up to 400 VDC solutions and UPS solutions.

9 Cooling system

9.1 Physical installation of cooling system in the edge data centre

The adaptable cooling system in the edge data centre is generally based on the settling condition and power capacity. If the edge data centre and other functional rooms are in the same building, there should have an independent cooling system. When the power of per servers cabinet is less, the cooling solution can choose a moveable ground floor to make an upward air supply and downward returned air. For another choice, it can also apply the in-row cooling solution to make a forward air supply and a backward return of air.

The cold aisle and hot aisle would be separate in the edge data centre. Additionally, the control of the relative humidity can be independently accomplished by a terminal air conditioner and also from an independent humidity controlling device.

9.2 Double cycle system with refrigerant pump and vapour compression cooling solution

9.2.1 Background

In the future, as servers can work with higher temperatures, more free cooling solutions will be used in the edge data centre. The free cooling solution will be the first choice for the data centre. The power efficiency increasing room by hardware improvement is relatively limited. Therefore, intelligent software algorithms are used to achieve energy saving optimization in terms of collaboration between devices, optimization between running modes, and coordination between internal components.

9.2.2 Basic principle

A double cycle system with a refrigerant pump and vapour compression is a new refrigeration strategy that makes full use of natural cooling sources to dissipate heat for the data centres, which consists of two different refrigeration cycle processes by seasons.

– In summer, when the outdoor temperature is high, it is automatically switched to a compressor circulation mode through temperature perception and data analysis. As shown in Figure 8 (a), check valve 1 is opened, and check valve 2 is closed. The refrigerant circulates in the way of a green arrowed line, and the refrigerant is compressed and cycled by the compressor to discharge the heat generated by the equipment in the data centre;
– In winter or when outdoor temperature decreases to the rated value, the data centre switches to the refrigerant pump circulation mode, as shown in Figure 8 (b). Check valve 1 is closed, check valve 2 is opened, the compressor stops working, and the refrigerant pump work starts. After heat exchange with the indoor air in the evaporator, the refrigerant directly enters the air-cooled condenser to make a heat exchange with the outdoor cooling source. The process of refrigerant liquefaction can overcome the tube resistance and return to the evaporator for heat exchange under the action of the refrigerant pump.

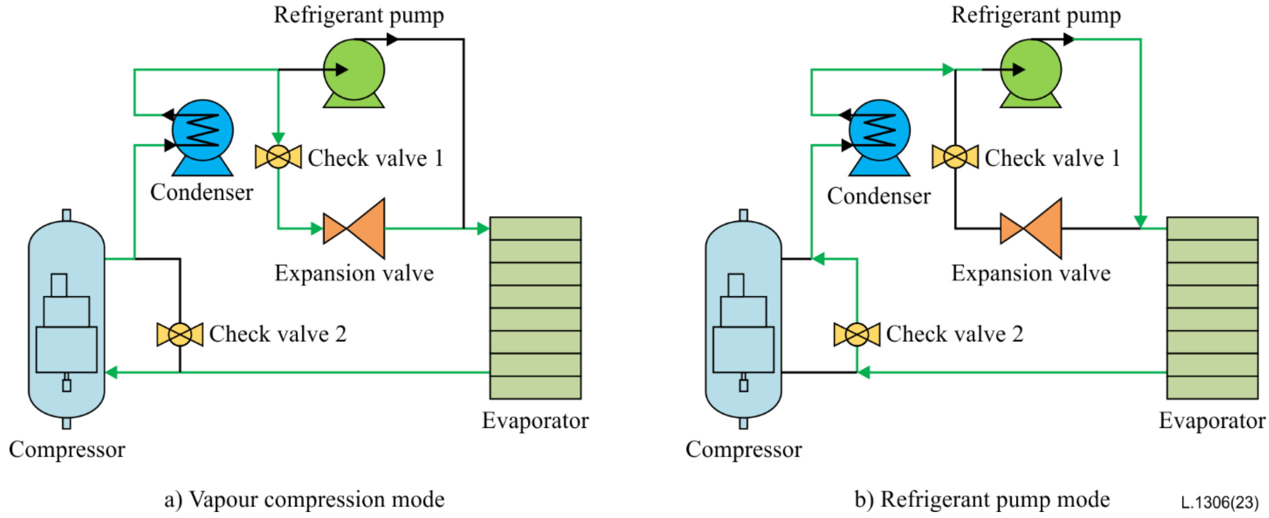

Figure 8 – Double cycled refrigeration mode

This double cycle refrigeration system can be modified without changing the original hardware facilities and only occupies a small space, which will have a great application potential under the trend of global carbon neutrality in the future.

9.2.3 Application of this double cycle cooling system in the edge data centre

It is a good application with a small power capacity, thus if the edge data centre were settled independently near the users' building or factory, this can be an independent cooling system. For edge data centres especially settled in the area with lower ambient temperature for the whole year, a double cycle system with a refrigerant pump and vapour compression cooling solution is a better choice.

9.3 Cold water cooling solution in edge data centres

The cold accumulating devices should be settled in an edge data centre using a cold water cooling system. The time of operation getting resources from cold accumulating devices should be in accordance with the safety requirement of the edge data centre. The key part of the cold water cooling system should have the same stand-by one.

For the heating volume per cabinet which is much more than 6 kW, the heat exchange device in-row cooling system can make its function and afterwards put a cold source into the in-row cooling system through a relatively safe refrigerant. In this process, it should be made sure that there is no water pipe routed from the indoor edge data centre.

10 Battery system

In the edge data centre, since there is limited room there is a smaller space settling the battery. A solution with higher energy density with a much more safe management platform is necessary for the small-sized data centre.

Smart solution with lithium-ion battery, as illustrated in Figure 9, is becoming a more popular application scenario in edge data centres. The battery cell with higher stability under smart control is to make sure that it cannot be inflamed when heat-out-of-control occurs. Meanwhile, multi-level battery management system (BMS) is settled with a battery set so that the safety and reliability can be promoted. The lithium battery should comply with [ITU-T L.1221]. Compared with lead acid batteries, the settled room can be largely saved using a lithium-ion battery.

As for utility, the lifetime of this kind of smart energy storage system is twice of a lead acid battery so that under the condition that the edge data centre is not maintained for a long period under extreme weather, the power feeding can be guaranteed.

Figure 9 – Smart energy storage system in an edge data centre [b-Huawei]

Under conditions with green power feeding systems, the smart energy storage solution can make some peak cut work to get more electricity with less cost. Certainly, for only one edge data centre, the cost saving is not much. We cannot ignore that the rapid development of edge data centres will make the economic benefit be more clear in the future.

11 Monitoring and control system

For edge data centres without periodic maintenance, especially in extreme weather areas, the automatic, smart, and comprehensive monitoring and control system is pretty significant. In other words, it is an important support for the stable and safe operation of edge data centres.

The smart monitoring and control system should be a comprehensive platform that can unify all the infrastructure. The remote management of operation and maintenance can be finished through this system with the same interactive interface as a nearby platform.

The real-time monitoring and control can be accomplished through data collection, data operation, information process and smart management. All the operating information of devices and components can be fast acquired fast and relevant management strategies finished in a short time. The given data information can be transformed into the foundation of all smart strategies by big data and AI technology which are in accordance with [ITU-T L.1305], so the feasibility, openness, and expandability can become true. It is apparent that safety can be totally guaranteed.

The environmental condition is more complicated for edge data centres compared with others. Thus it has more strict requirement monitoring for indoor temperature, relative humidity, air pressure difference and water leakage. Taking this kind of sensored data in circumstances, devices monitoring system is necessary to make precise adjustments.

For smart monitoring and control of the cooling systems, we usually consider the settling situation of the central air conditioner and primary air system. Then, the operation status and pressure difference of the filter should be real-timely monitored. For special air conditioners, the remote control of switch mode, cooling, heating, humidifying, dehumidifying, etc. can be made. Meanwhile, for remote communication of warnings, a sensor failure can be detected and pressure, water level, and volume of the wind should be remotely tested.

For smart monitoring and control of the power feeding system, the edge data centre should monitor the quality of the overall system such as the switch state, current, voltage, power, power factor, harmonic distortion, etc.

Appendix I

Smart indirect evaporative cooling solution

(This appendix does not form an integral part of this Recommendation.)

I.1 Background

In the future, as servers can work with higher temperatures, more free cooling solutions will be used in the edge data centres. The free cooling solution should be the first choice for the data centre. The power efficiency increasing room by hardware improvement is relatively limited. Therefore, intelligent software algorithms are used to achieve energy saving optimization in terms of collaboration between devices, optimization between running modes, and coordination between internal components.

An indirect evaporative cooling (IEC) system, as described in [ITU-T L.1381] is one of the major free cooling approaches, which is usually supplemented with mechanical cooling for compensation in the season with higher temperatures (e.g. summer, autumn, etc.). Intelligent control dynamically adjusts the operating status of the evaporative cooling system and works with loads in real time, minimizing the total power consumption of the data centre and achieving optimal power usage efficiency (PUE).

I.2 Linkage control between indirect evaporative cooling system and server

The optimal efficiency point of the indirect evaporative cooling system is in real-time and dynamic and is closely related to the configuration and environmental disturbance. The evaporative cooling system automatically optimizes the running status based on information such as the server chip temperature and fan speed, and improving the overall energy-saving operation of the data centre.

Due to a large amount of information such as server chips, fans, indoor and outdoor temperature and humidity, and evaporative cooling system quantity and distribution, the limited test data or models cannot be used in all application scenarios. The artificial intelligence (AI) tool collects a large amount of data and implements automatic optimization control in all scenarios through machine learning [ITU-T L.1305].

The indirect evaporative cooling system and upper-layer servers are controlled in a way that breaks the traditional supply air temperature control mode. The cooling capacity is adjusted based on the server inlet temperature and directly controls the final cooling object.

The IEC introduces information such as server chip temperature, fans, indoor and outdoor ambient temperature and humidity, number and distribution of evaporative cooling systems, and auto-learns through the AI big data.

The AI training platform optimizes the power consumption model of "in-module servers + evaporative cooling system" in real time, outputs the inference model of the lowest total power consumption of data centres, and achieves the optimal PUE.

As shown in Figure I.1, the left side indicates the traditional supply air temperature control mode. Each unit has fixed the supply air temperature and automatically adjusted the air based on the return air. There is no coordination or cooperation between the units. As a result, some units run very largely while some units run very small, which is a non-energy state. The example on the right indicates the linkage control mode. This mode combines IT loads with indirect evaporative cooling units to implement intelligent IT partitioning. In each area, the IT loads and indirect evaporative cooling units are linked and controlled. The air outlet temperature in each area can be set to different values to ensure optimal and energy-saving operation of the entire data centre.

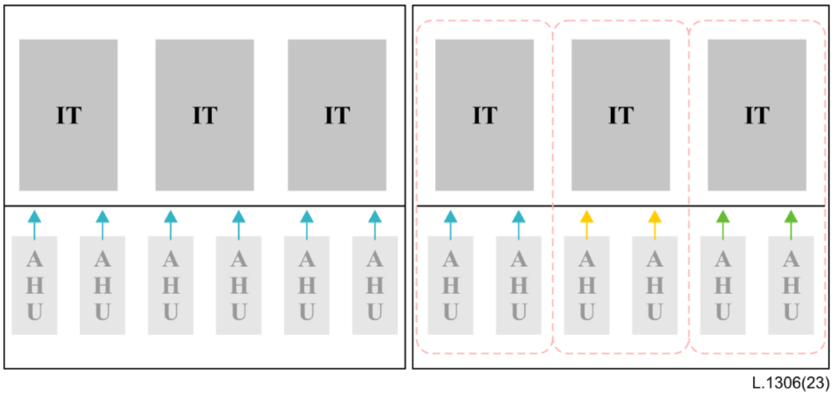

Figure I.1 – Comparison of different supply air temperature control mode

I.3 Intelligent coordination control between multiple indirect evaporative cooling units

Coordination control function definition: In a group, one unit functions as the master unit and the other units function as slave units. The master unit calculates the coordination control system requirements and delivers the control commands.

1) Traditional coordination control

The traditional coordination function consists of a number of units. Multiple units work together to optimize heat load distribution and reduce power consumption.

2) Intelligent coordination control

Traditional coordination control improves the data centre equipment room reliability and has a limited energy-saving effect on the linkage between multiple evaporative cooling systems. During actual operation, the outdoor ambient temperature, humidity, and the IT load change in real time. How to schedule all the evaporative cooling systems in the group to run in the most energy-saving state poses a new challenge.

Intelligent coordination control dynamically adjusts the number of running evaporative cooling systems and the cooling capacity output based on changes in the outdoor ambient temperature and humidity and IT load, and optimizes the overall power consumption and PUE while ensuring that the temperature and humidity in the data centre are within the pre-set range.

Take an edge data centre as an example, as shown in Figure I.2. There are eight evaporative cooling units in the N+1 configuration. When the IT load rate is 50%, six evaporative cooling units are running (each unit provides 40% cooling output), and the overall cooling load factor (CLF) is optimal.

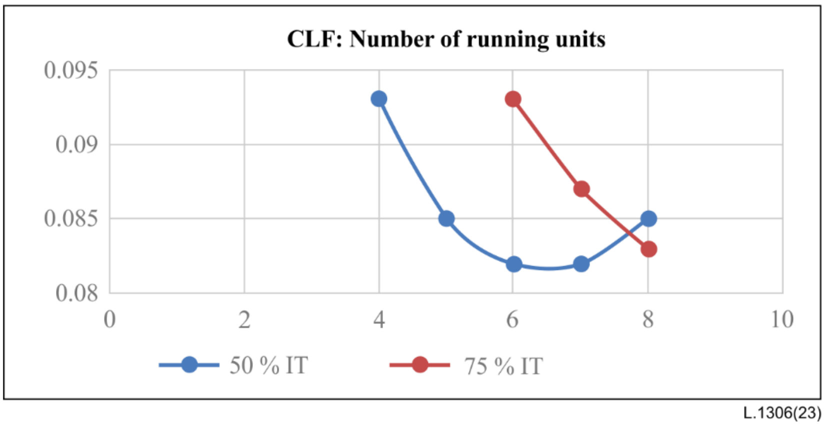

Figure I.2 – PUE reduction with different units and different load rates

I.4 Optimal control of different operating modes for a single indirect evaporative cooling unit

When a single indirect evaporative cooling unit has a different outdoor ambient temperature, humidity, and cooling capacity output, the optimal operating mode switching point is available to minimize the energy consumption. In practice, the system automatically optimizes and controls the operating modes based on the IT load rate and outdoor ambient temperature and humidity changes, achieving the lowest power consumption and optimal energy efficiency.

Figure I.3 shows an example of an indirect evaporative cooling unit working in different modes: wet mode, dry mode and hybrid mode depending on the outdoor temperature. When the outdoor temperature is 10°C and the IT load rate is 50%, the unit works in wet mode with minimum power consumption and optimal energy efficiency.

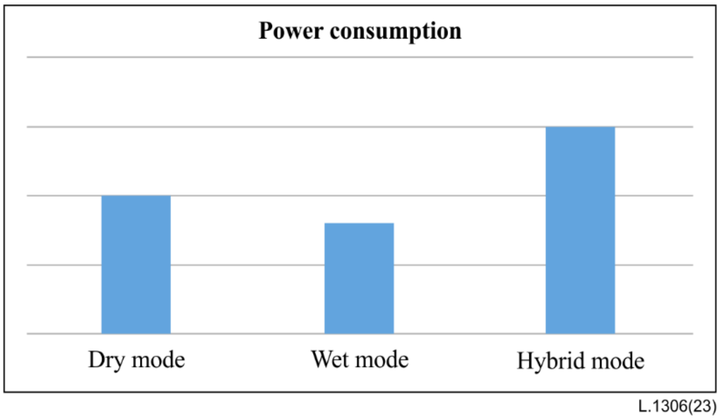

Figure I.3 – Example of an IEC cooling unit

I.5 High electric power utilization rate and continuous cooling

For the indirect evaporative cooling unit of the data centre, the peak power consumption often occurs in a short period of extreme weather conditions throughout the year such as a few days, or even a few hours in a day. In order to meet the peak power consumption of the IEC in this short period of operation, we should distribute more electric capacity for the IEC unit, but usually the power consumption of the IEC is less than the electric capacity, so it is not economical.

Under this background, a new type of indirect evaporative cooling unit which integrates lithium battery is considered. In extreme conditions the electric supply and the lithium batteries supply power to the IEC unit at the same time and in normal conditions. The electric supply power to the IEC unit only can fix the total energy supplied to the DC, reduce the electric capacity need of the IEC unit, and increase the electric capacity of the IT, this way the electric power utilization rate will also increase.

Meanwhile, the indirect evaporative cooling unit which integrates a lithium battery can provide continuous cooling without UPS. This greatly reduces the cost of the data centre and saves the space of the UPS for the IT.

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