TEMPERATURE RISE DURING OUTAGE

INTERSTITIAL
SYSTEMS

DATA CENTER TEMPERATURE RISES WHEN THE AIR CONDITIONING FAILS

ABSTRACT

No one wants a power failure, or any kind of failure for that matter. The job of every IT professional and those designing data centers is to plan for the WHAT IFs in life. Interstitial Systems can help you with that.

Cooling systems are dependent on the power grid to keep them running, but in the event of a power failure the cooling system will shut down. The systems then depend on the generators to kick- in, but there's a time lag for the generators to achieve full power (up to 45 seconds). Depending on the type of cooling system there can be a time lag of from 22 seconds up to and beyond 5 minutes to achieve full cooling capacity.

Cabinet layouts are denser than ever before --- 10,15, 20 kW and more. Depending on the W/sf of the space, and the ceiling height, the temperature can skyrocket after a power failure. The Table below shows the temperature rise per minute in degrees Fahrenheit at various W/sf and ceiling heights.

DATA CENTER TEMPERATURE RISE PER MINUTE

WATTS	7' CEILING	8' CEILING	9' CEILING	10' CEILING	11' CEILING	12' CEILING	13' CEILING	14' CEILING	15' CEILING	16' CEILING	17' CEILING	18' CEILING	19' CEILING	20' CEILING
PER SF	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F	°F
50	22.7°	19.8°	17.6°	15.87°	14.42°	13.22°	12.2°	11.3°	10.6°	9.9°	9.3	8.8	8.4	7.9
75	34°	29.7°	26.4°	23.8°	21.64°	19.8°	18.3°	17°	15.8°	14.9°	14.0	13.2	12.5	11.9
100	45.3°	39.7°	35.3°	31.7°	28.8°	26.4°	24.4°	22.7°	21.2°	19.8°	18.7	17.6	16.7	15.9
125	56.7°	49.6°	44°	39.7°	36°	33°	30.5°	28.3°	26.4°	24.8°	23.3	22.0	20.9	19.8
150	68°	50.5°	52.9°	47.6°	43.3°	39.7°	36.6°	34°	31.7°	29.7°	28.0	26.4	25.1	23.8
175	79.3°	69.4°	61.7°	55.5°	50.5°	46.3°	42.7°	39.7°	37°	34.7°	32.7	30.9	29.2	27.8
200	90.6°	79.3°	70.5°	63.5°	57.8°	52.9°	48.8°	45.3°	42.3°	39.7°	37.3	35.3	33.4	31.7
250	113.3°	99.1°	88.2°	79.3°	72.1°	66°	61°	56.7°	52.9°	49.6°	46.7	44.1	41.8	39.7
300	136°	119°	105.8°	95.2°	86.5°	79.3°	73.2°	68°	63.4°	59.5°	56.0	52.9	50.1	47.6
350	158.6°	138.8°	123.4°	111°	100.9°	92.5°	85.4°	79.3°	74°	69.4°	65.3	61.7	58.5	55.5
400	181.3°	158.6°	141°	126.9°	115.4°	105.8°	97.6°	90.6°	84.6°	79.3°	74.7	70.5	66.8	63.5
450	204°	178.5°	158.6°	142.8°	129.8°	119°	109.8°	102°	95.2°	89.3°	84.0	79.3	75.2	71.4
500	226°	198.3°	176.3°	158.6°	144.2°	132.3°	122°	113°	105.8°	99.2°	93.3	88.2	83.5	79.3

This Table assumes an ambient room temperature of 70°F. It does not factor in the flywheel effect resulting from cold sinks such as cabinets, walls, ceilings, and the concrete slab.

USING THE FOLLOWING EXAMPLE, LET'S CONSIDER WHAT WOULD HAPPEN IN THE EVENT OF A POWER FAILURE:

EXAMPLE

A 12,857 sf data center with 588 cabinets @ 9 kW each, wich is 411 W / sf, and having a 20' ceiling height.

BASED ON THE TABLE ABOVE THE TEMPERATURE WOULD RISE, 63.5˚F IN ONE MINUTE.

WHAT IF:

In a system failure the IT Equipement would have to be shut down almost immediately to avoid serious equipement damage. It would take several minutes for the cooling system to come back to normal operating mode, and the temperature in the room would skyrocket - about 63.5˚F per minute.

WHAT IF:

THERE'S A DROP CEILING USED FOR A RETURN AIR PLENUM?

The presence of a return air plenum would compound the temperature rise problem. A 5' plenum ceiling would mean an effective ceiling height of 15'. As the table shows, the temperature rise is a 33% increase, or 84.6°F per minute.

WHAT IF:

A SINGLE A/C UNIT FAILS OR IS DOWN FOR SERVICE?

Perhaps the problem isn't a power failure, but a single CRAC/CRAH unit failure. Because this design depends on CRAC units, which are spot coolers as normally used, acceptable redundancy best practice is not N +1. It's more in line with one redundant unit for 3-4 units. Even if you have multiple redundant units they have little or no value unless they cover the distribution area of the failed unit1. This can mean a significant temperature rise within the distribution area of the downed CRAC/CRAH.

ON THE OTHER HAND,

(FOR THE SAME 12,857SF DATA CENTER)

WHAT IF:

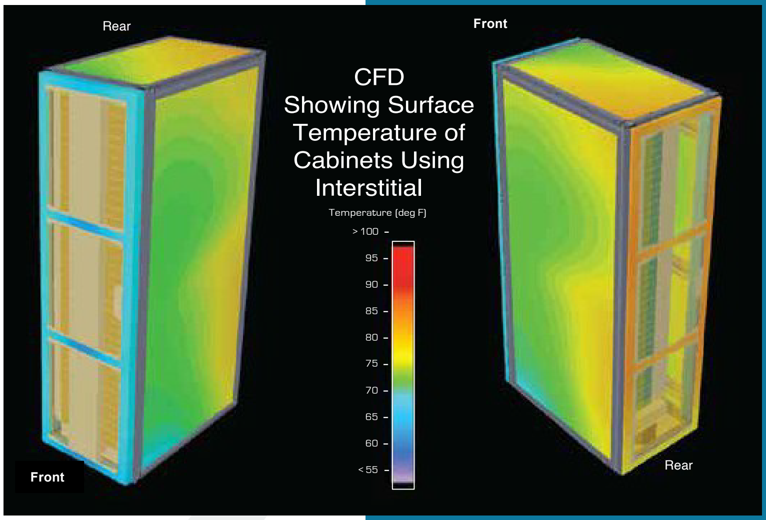
THE ROOM IS DESIGNED DIFFERENTLY USING Interstitial?

Interstitial has a dedicated, pressurized air plenum so that in the example given the time for air to cabinets is only 4.12 seconds.

Liebert DSE 250 cooling equipment has a 22 second full system restart time,

fans ramp up to 100% within 6 sec.

Evolve, Evolution Series Generator has an 8 sec. to full load block start-up time.



During the 18.12 second start-up time (6 sec. fans, 8 sec. generator, 4.12 sec. air distribution) the temperature rise is only 19.18°F. Because the time is so short the circulation of air through the plenum will benefit from the flywheel effect from the concrete slab until the cooling system is fully operational.

Servers, regardless of their distance from the cooling equipment, will begin to be cooled within that 18.12 second window. A full cooling system reboot occurs 12 seconds later. The CFD image demonstrates Interstitial's inherent ventilation effectiveness. The system's dedicated air distribution plenum assures the delivery of air precisely where it's needed in the volumes required, all the way to the top of the cabinet when the air conditioning, or at minimum fans, are up and running. Air will get to and rescue the servers faster with Interstitial because of the right-sized pressurized supply air plenum, in contrast to a much higher, leaky, single level floor.

WHAT IF:

THERE'S A DROP CEILING USED FOR A RETURN AIR PLENUM?

With Interstitial there's no need for a drop ceiling. An open room return with a 20' ceiling works well. The higher ceiling increases the volume of air in the space, which means a lower temperature rise.

WHAT IF:

A SINGLE A/C UNIT FAILS OR IS DOWN FOR SERVICE?

Interstitial used with a dedicated mechanical equipment room, and a properly designed mixing box, provides effective N +1 redundancy so that only one redundant unit is needed to maintain good ventilation throughout the room regardless of which unit may fail. This is because pressurized air distribution does not depend on an air handler limited area of distribution.1

INTERSTITIAL SYSTEMS

The Foundation of Your Data Center

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