



Eni ICT Green Data Center

... we re-discussed what we knew ...

A few words about eni

Eni operates in the oil and gas, electricity generation and sale, petrochemicals, oilfield services construction and engineering industries. In these businesses it has a strong edge and leading international market position.

Every action will be more and more based on making the most of people, contributing to the development and well-being of the communities with which it works protecting the environment, investing in the technological innovation and energy efficiency, as well as mitigating the risks of climate change.



Sustainability



Innovation

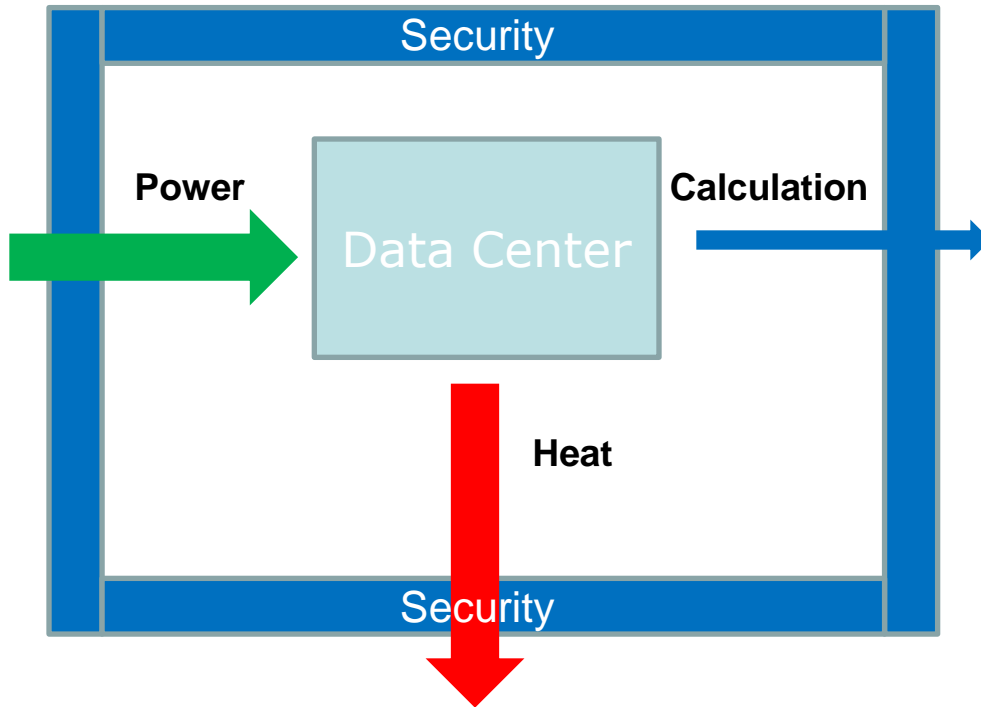


The community benefit of a project
is increased if you share the ideas
and solutions developed

... eni's business is not DC projects



What is a Data Center ?



- It's a specific **industrial plant**
- Which transforms **power** in **calculation** and **heat**
- With a very high avg density of **electrical / thermal power**
- Key parameters are **total available power** and **heat to be wasted**
- **Space** so is a consequence, a limit, a cost

Since the last two years we developed (and started to build) the new Eni Green Data Center:

- ✓ **Multipurpose IT DC (legacy and HPC)**
- ✓ **PUE_{L3,YC} < 1,2 (avg, at any load)**
- ✓ **30MW max IT power**
- ✓ **5.200m² in 6 IT rack rooms**
- ✓ **45.000m² total facility area**
- ✓ **5kW/m² avg load (50 kw/m² max)**
- ✓ **TIER IV**



The rendering

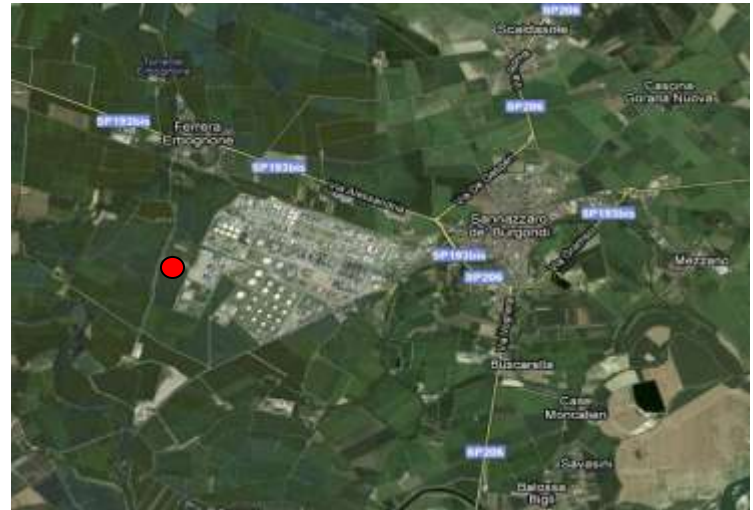


The rendering

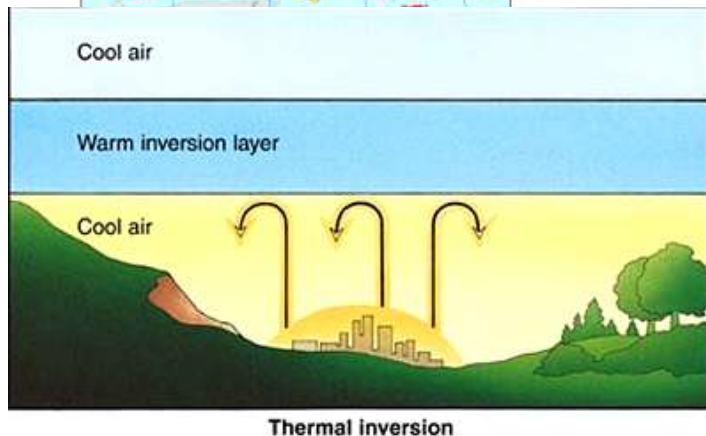
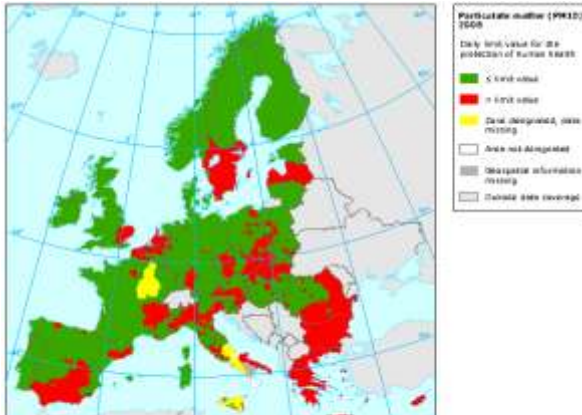


- ✓ Which are the characteristics of a server, today ?
 - *meeting with main HW manufacturers and study of their data sheets (Dell, IBM, Sun, HP, Intel ...)*
 - ✓ Which are the newest technologies for DCs ?
 - *web, visits and meetings with Labs and best practice DCs (Microsoft, HP, Google, I.NET ...)*
 - ✓ Which rules must be respected ?
 - *analysys of all applying standards & guidelines (ASHRAE, ISO, ANSI, ESDA, White Papers, ...)*
- ... but keeping your brain turned on !!!*





Environmental conditions



Mesurement and study by
"Department of Environmental Sciences
(Environmental Chemistry, Particulate Matter
Research Group)
University of Milano-Bicocca"



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American Society of Heating, Refrigerating, and Air-Conditioning Engineers

ASHRAE TC 9.9 guidelines sets:

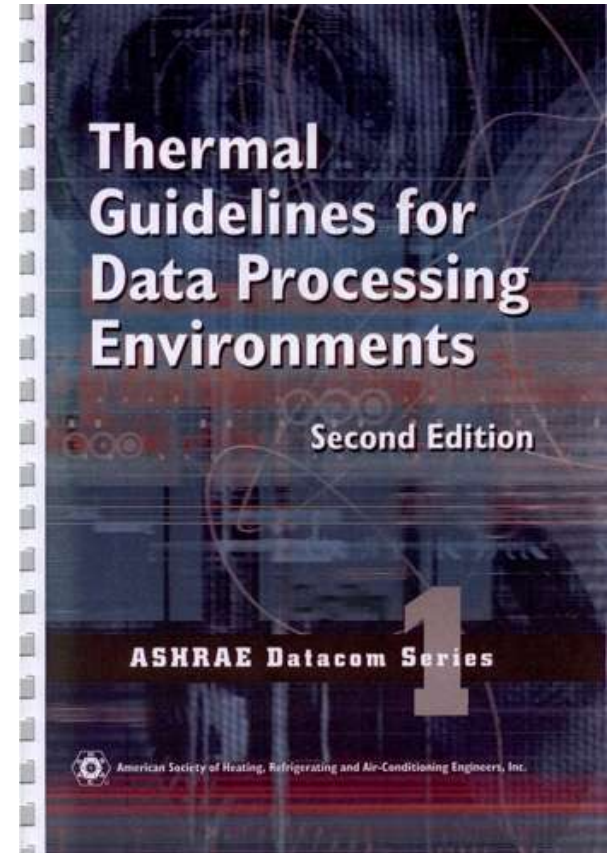
- Temperature/humidity conditions
- Particulate contaminations
- Gas & Corrosion limits



Electrostatic Discharge Association

ANSI/ESD S20.20-2007

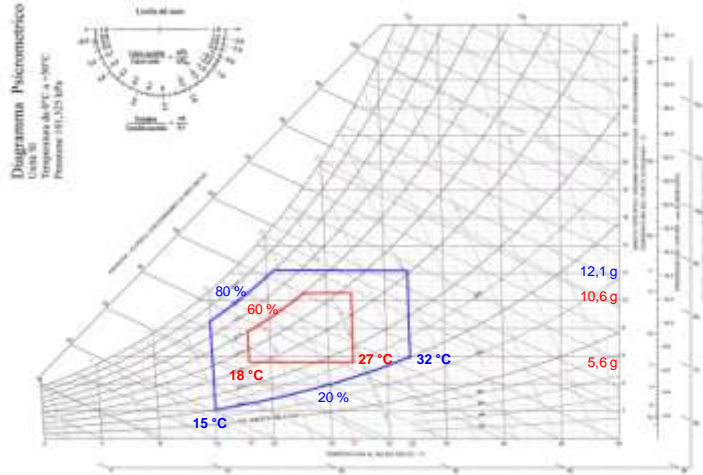
Revision of ANSI/ESD S20.20-1999



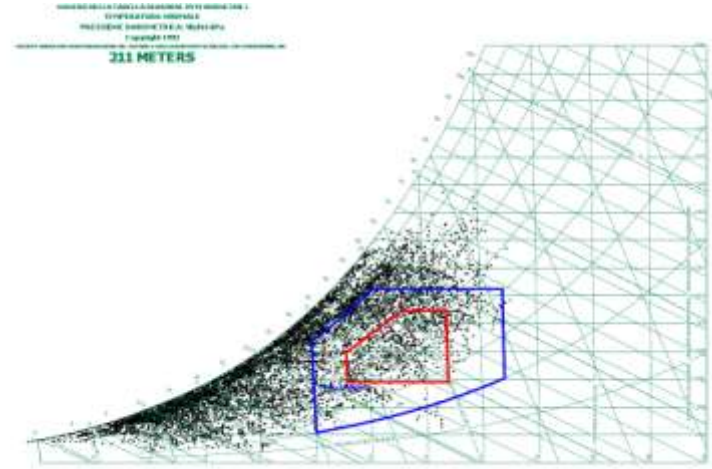
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Temperature/humidity conditions

Climatic Limits **recommended**/**allowable**



Milano Malpensa (average/typical climatic data for one year)



www.handsdownsoftware.com

Particulate Contamination Limits

ISO 14644-1

ISO Class	D> 0,1 µm	D> 0,2 µm	D> 0,3 µm	D> 0,5 µm	D> 1 µm	D> 5 µm
1	10	2				
2	100	24	10	4		
3	1 000	237	102	35	8	
4	10 000	2 370	1 020	352	83	
5	100 000	23 700	10 200	3 520	832	29
6	1 000 000	237 000	102 000	35 200	8 320	293
7				352 000	83 200	2 930
8				3 520 000	832 000	29 300
9				35 200 000	8 320 000	293 000

Gas Contamination Limits

ANSI/ISAS71.04-1985

Severity Level	G1	G2	G3	Gx
Reactivity Level	< 300 angstroms	< 1000 angstroms	< 2000 angstroms	≥ 2000 angstroms
Gas	Gas Concentration			
H ₂ S Acido Solfidrico	< 3 ppb	< 10 ppb	< 50 ppb	≥ 50 ppb
SO ₂ Dossido di Zolfo	< 10 ppb	< 100 ppb	< 300 ppb	≥ 300 ppb
Cl ₂ Cloro	< 1 ppb	< 2 ppb	< 10 ppb	≥ 10 ppb
NO _x Ossidi di Azoto	< 50 ppb	< 125 ppb	< 1250 ppb	≥ 1250 ppb
O ₃ Ozono	< 2 ppb	< 25 ppb	< 100 ppb	≥ 100 ppb
NH ₃ Ammoniac	< 500 ppb	< 10 000 ppb	< 25 000 ppb	≥ 25 000 ppb

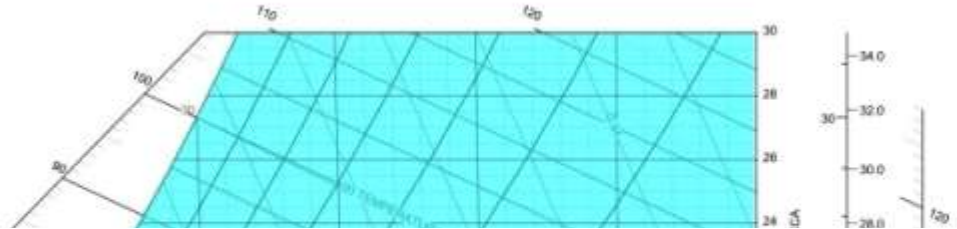
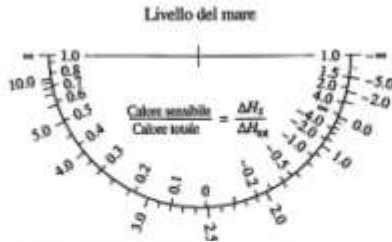


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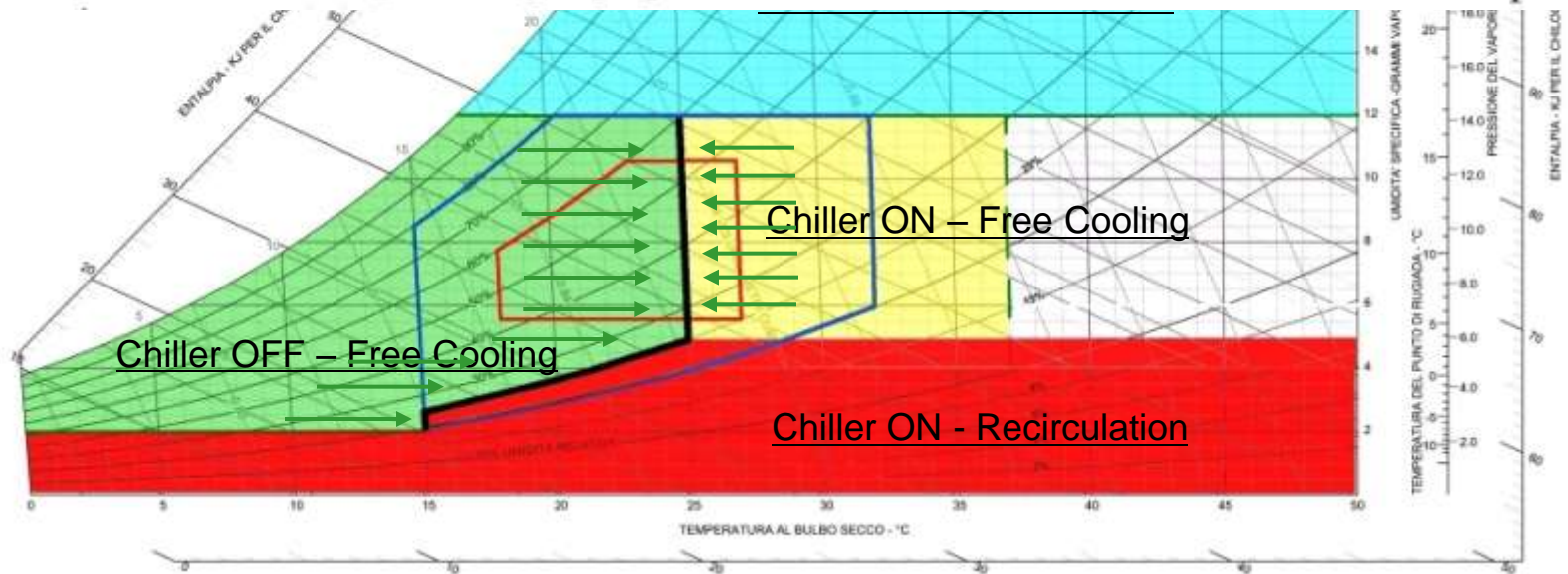
Temperature/humidity settings

a Psicrometrico

0°C a +50°C
25 kPa



Practical Application: Prolonged exposure of operating equipment to conditions outside its recommended range, especially approaching the extremes of the allowable operating environment, can result in decreased equipment reliability and longevity. Exposure of operating equipment to conditions outside its allowable oper-



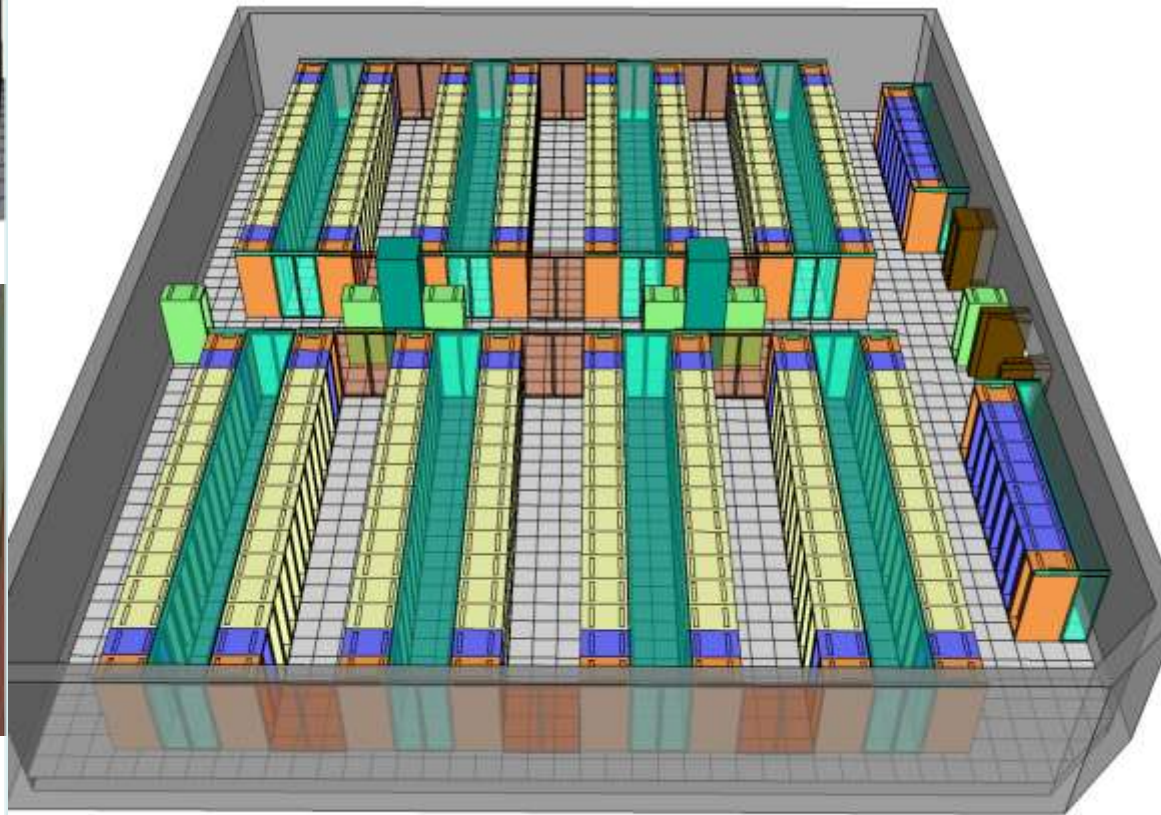
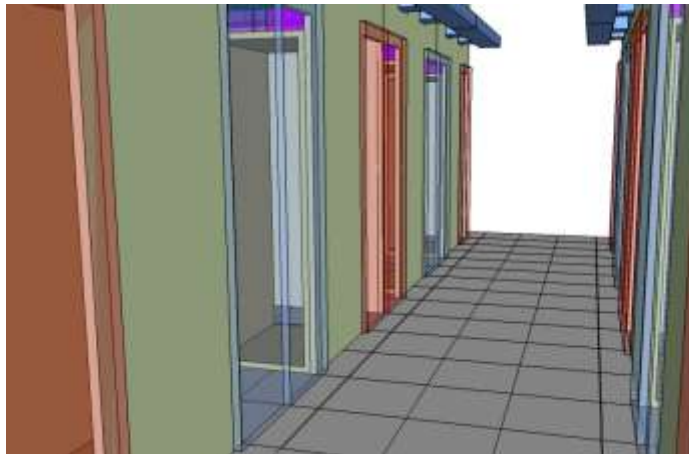
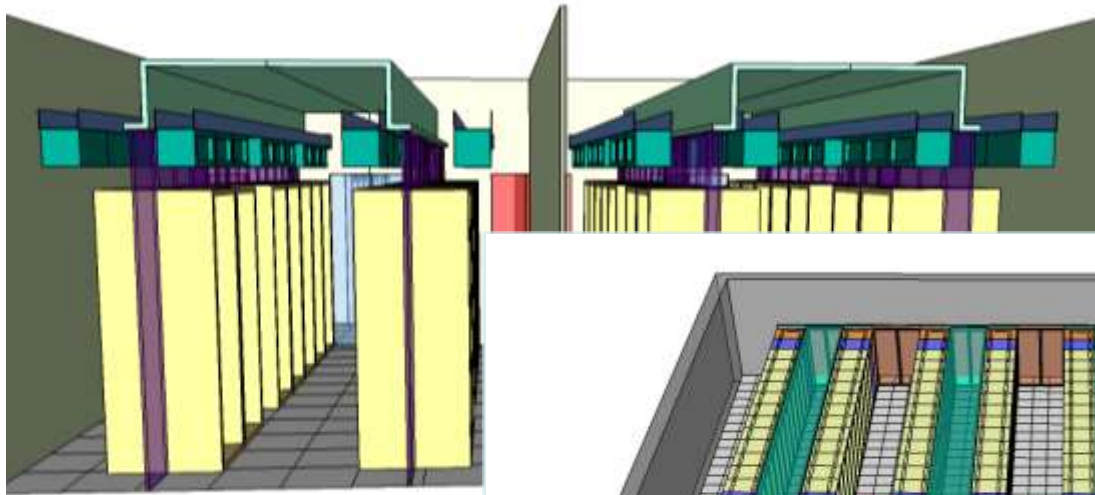
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For efficiency, **Humidity** is more important than **Temperature**

	T Min	T Max	RH Min	RH Max	HA Min	HA Max	Free Cooling
Recommended	18°	27°	--	60%	5.5°	15°	40%
Allowable	15°	32°	20%	80%	--	17°	76%
Cold	--	27°	--	60%	5.5°	15°	40%
Hot	18°	--	--	60%	5.5°	15°	40%
Wet	18°	27°	--	--	5.5°	15°	40%
Dry	18°	27°	--	60%	--	15°	76%
	18°	27°	--	60%	5.5°	--	66%
BEST	18°	27°	--	60%	--	--	90%
Prudent	15°	25°	20%	60%	--	15°	76%

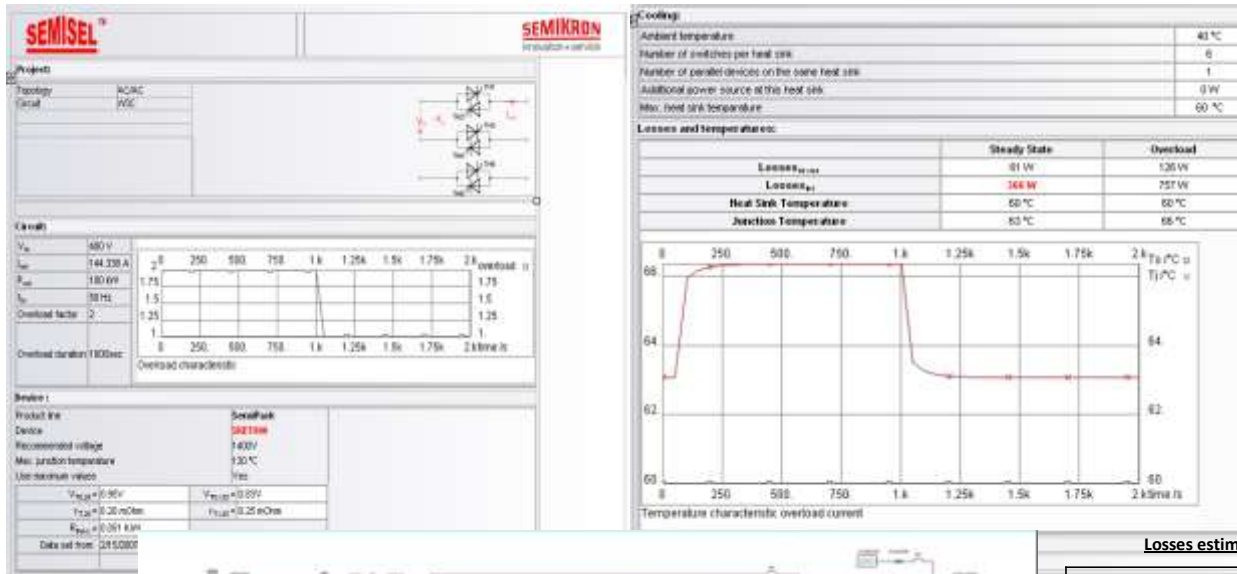


Hot / cold aisle containment



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New products: UPS off-line, 200 kVA, eff.= 99,40%



Losses estimation at load supplied by reserve and inverter in stand by

@Tamb = 25 C	@200kW	@100kW
SCR (1)	757W	366W
Power cable (2)	185W	41W
Firing SCR	25W	25W
Fan	45W	45W
Control	80W	80W
Other (3)	10W	10W
Total	1102W $\eta_{AC/AC} = 99.45\%$	567W $\eta_{AC/AC} = 99.44\%$

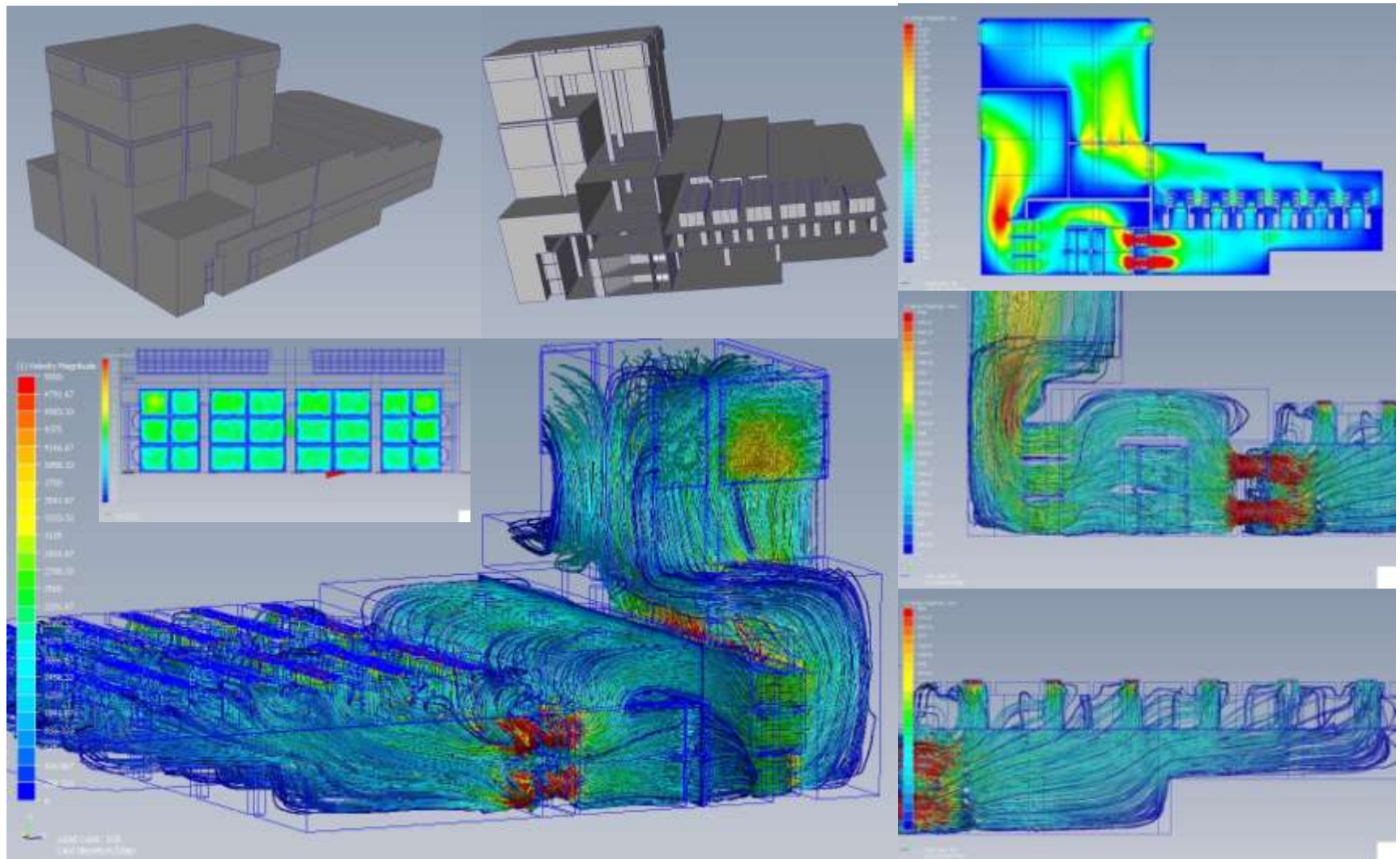
(1) 6x SKET800, worse case, see annex

(2) Total power cable length = 9m, AWG 3/0, (@200kW, R eq. = 2.18mΩ, @100kW, R eq. = 1.94mΩ)

(3) Network analyzer, CT,....



Design approach: CFD Analysis



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CO2 emission reduction

	MW	P.U.E.	gCO2 /KWh	Year Kton CO2 emission	Year Kton CO2 saving
Traditional	30	3,3	550	477	--
Eni Green Data Center	30	1,2	449	141,6	335,4

**1% of Italy target
vs Kyoto
20-20-20**

CO2 Conversion factor 0.550 Kg * kW/h standard power

CO2 Conversion factor 0.449 Kg * kW/h methane gas power



And so many others new solutions, ideas, studies ...

.....

CAGE (hot/cold aisle containment),
Direct FreeCooling, with no outlet fans,
fire protection (sprinkler, no gas),
chiller (temp. vs dehumidif. systems),
UPS off-line, standby,
humidity control,
architectural solutions,
energy SW simulator,
filtering SW system simulator,
integrated monitoring SW system,
environmental OPC database,
lightning overvoltage modeling,

.....



GreenNet 2010: Google shares its green DC secrets



Bill Weihl, Google green energy manager

(GreenNet convention, apr2010, San Francisco)

By embracing some fairly basic practices, the average data center operator can reduce his or her facility's **PUE to 1.5** : the most significant gains, can be achieved on the side of **cooling, power infrastructure, and lighting**.

1. backup power: for each server we use a 12-volt battery, no UPS
- ✓ 2. create hot and cold aisles, to prevent cool air from mixing with hot
- ✓ 3. adjust the thermostat accordingly : DC admins at Google wear shorts instead of warm clothing typically worn by IT staff in the average overchilled data center
- ✓ 4. whenever possible, embrace free cooling - such as cooling towers and outside air - to supplement costly CRAC operations
- ✓ 5. monitoring performance of both infrastructure and IT gear can help an organization track and address inefficiencies



The team



The final results

- Flexibile: DC for IT multipurpose, air/liquid refreshment
- Scalable: steps of progressive expansions (power / space / density): up to 5.200mq and 30MW IT load
- Efficient: power density to more than 20 kW/mq
- Integrated: olistic approach : the DC as a whole system
- Innovative



✓ Location: in Italy (PV) - 45°



✓ Project: made in Italy

✓ Construction: made in Italy





Thanks !