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Investigation report

On the fire in the OVH data storage center

located in Strasbourg (67) on March 10, 2021.

Documentary slip

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Warning

The technical survey that is the subject of this report is carried out within the framework of Articles L. 501-1 to L. 501-19 of the Environmental Code.

This investigation is for the sole purpose of preventing future accidents. Without prejudice, where applicable, to the judicial inquiry that may be opened, it consists of collecting and analyzing useful information, determining the circumstances and the certain or possible causes of the event, accident or incident and, if necessary, to establish security recommendations. It is not intended to determine responsibilities.

Consequently, the use of this report for purposes other than prevention could lead to erroneous interpretations.

For the purposes of this report, the following terms mean:

- Cause of the accident: any action or event of a technical or organizational nature, voluntary or involuntary, active or passive, having led to the occurrence of the accident. It can be established by the elements collected during the investigation, or assumed indirectly. In this case, the investigation report specifies this explicitly.

- Contributing factor: element which, without being decisive, may have played a role in the occurrence or aggravation of the accident.

- Safety lesson: element of experience feedback drawn from the analysis of the event. These may be practices to be developed because they are likely to avoid or limit the consequences of an accident, or to be avoided because they could favor the occurrence of the accident or aggravate its consequences.

- Safety recommendation: safety improvement proposal formulated by the BEA-RI, on the basis of the information gathered within the framework of the safety investigation, with a view to preventing accidents or incidents. This recommendation is sent, when the final report is published, to a natural or legal person who has two months from receipt to inform the BEA-RI of the follow-up they intend to take. The response is published on the BEA-RI website.

Synthesis

On the night of March 9 to 10, 2021, a fire broke out in the data storage center (or datacenter) OVH located on the port of Strasbourg (67). The disaster started on the ground floor of the SBG2 building and quickly spread to the whole building, also impacting the neighboring buildings SBG1 (partially destroying 4 out of 12 rooms) and SBG3 (impacting the inter-building between SBG2 and SBG3). The fire was brought under control around 10 a.m. after the electricity network was cut and a pump boat intervened.

The BEA-RI technical investigators went to the site on Thursday March 11, 2021. They discussed with representatives of the OVH company, the Bas Rhin fire and rescue service and the inspection of classified installations as well as of the manager of the electricity network of the city of Strasbourg.

The fire caused no casualties and no injuries. On the other hand, it caused significant material and financial damage. The service provided by OHV was interrupted for a significant number of customers, including institutional customers.

The fire started in the premises which house the batteries and the UPS (uninterruptible power supply) necessary for the operation of the servers. These rooms, also called F energy rooms G, were equipped with fire detection but had no automatic extinguishing system. The outbreaks of fire occurred almost simultaneously on the batteries and on an inverter. The precise causes of departures within these facilities, which are the subject of an expert court, are not known at the date of the report. The BEA-RI therefore does not take a position on this point which could, if necessary, be the subject of an additional report.

Despite the rapid arrival of emergency services, the design of the building, the absence of an automatic extinguishing system, the delay in making the site electrically safe and the water resources in the area did not prevent the widespread conflagration of SBG2 and the spread of the fire to neighboring buildings.

The BEA-RI has issued safety lessons relating to the detection and prevention of fire by automatic extinguishing systems, battery maintenance, building design, and the development of fire protection plans. emergency in liaison with the fire and rescue services including disconnection of the power supply.

In addition, the BEA-RI issues the following recommendations:

- **For the attention of the DGPR:**

  OVH's experience feedback from the fire shows that protecting only the battery storage room would not have prevented the fire. It is therefore appropriate to apply the requirements relating to the fire behavior of buildings to premises which house the electrical equipment which is used to charge the batteries and which is directly connected to them. This amounts to defining a charging workshop as the room that houses the batteries and also the equipment used for charging.

- **For the attention of OVH:**

  - **As part of the reconstruction of its facilities or the construction of its next data centers, take into account the feedback from the building fire SBG2 in Strasbourg in terms of design of buildings and rooms F energy G, in terms of means of detection and fire fighting, and in terms of procedure**

emergency. On the Strasbourg site, establish and implement, through exercises, emergency response procedures and the securing of electrical installations in order to facilitate the intervention of the public emergency services

- **Carry out an audit of all of its facilities, to study the vulnerability of its sites to the risk of fire.**

Summary

I. Reminder on the security investigation 7
II. Immediate observations and start of the investigation 7

II.1 Circumstances of the accident 7
II.2 The results of the accident 8
II.3 Measures taken after the accident 9
II.4 Initiation and organization of the survey 9

III. Context 10

III.1 The company 10
III.2 The Strasbourg site 10
III.3 Design of buildings 12
III.4 Electricity management 14
III.5 Fire safety in data centers 16

IV. Report of the investigations carried out 18

IV.1 Field reconnaissance 18
IV.2 Relationship with the expertise mandated by the Court of Strasbourg 19

V. Course of the event 20

V.1 Triggering of the event 20
V.2 The intervention of the SIS 67 20
V.3 The intervention of Strasbourg Electricity Networks 21

VI. Conclusions on the scenario of the event 22

VI.1 Scenario 22
VI.2 Contributing factors 25

VI.2.1 Contributed to the spread of the fire 25
VI.2.2 Contributed to limiting the consequences of the accident and the spread of the fire 30

VII. Safety lessons 32

VII.1 In terms of detection 33
VII.2 In terms of fire protection 33
VII.3 With regard to the intervention of the emergency services 33
VII.4 In terms of building design 34
VII.5 In terms of preventive maintenance of batteries 35
VII.6 Regarding the sizing of water resources 35
VII.7 Data center security 35

VIII. Safety recommendation for the operator 36

VIII.1 For the DGPR 36
VIII.2 For the operator 36

IX. Appendices 38

Annex 1 Photographic board of the site 39
Annex 2 Map of the OVH Strasbourg site 41
Annex 3 Plan of the ground floor of the SBG2 building 42

Investigation report
On the fire in the data center
OVH located in Strasbourg on March 10, 2021

I. Reminder on the security investigation

The technical survey that is the subject of this report is carried out within the framework of Articles L. 501-1 to L. 501-19 of the Environmental Code.

This investigation is for the sole purpose of preventing future accidents. Without prejudice, where applicable, to the judicial inquiry that may be opened, it consists of collecting and analyzing useful information, determining the circumstances and the certain or possible causes of the event, accident or incident and, if necessary, to establish safety recommendations.

It is not intended to determine responsibilities. Consequently, the use of this report for purposes other than prevention could lead to erroneous interpretations.

II. Immediate findings and start of the investigation

II.1 Circumstances of the accident

On the night of March 9 to 10, 2021, the OVH data storage center is operating as usual.

In accordance with the internal organization, a guard and two technicians take part in the permanence which is ensured during the night.

At 12:35 a.m., the guard received a fire alarm at the guard post in one of the power rooms in the SBG2 building. Technicians also receive unusual information regarding the operating parameters of certain equipment. The agents went to the SGB2 building and noted the significant presence of smoke in the inverter room. In accordance with the procedures, the site guardian contacts the fire and rescue service. The call is given at 00:42. They will arrive on the scene at 00:59.

The fire will be extinguished at 10:02 a.m. and the intervention considered finished at 6:13 p.m. Almost 4000 liters foam concentrates will be used.

Photograph 1: site during the fire (source SIS 67)

II.2 The results of the accident

The fire caused no casualties and no injuries. On the other hand, it caused significant material and financial damage. It caused the total destruction of the SBG2 building and the partial destruction of the SBG1 building (4 rooms).

The service provided by OVH from its Strasbourg site has been interrupted for a significant proportion of its customers. According to public sources, approximately 3.6 million websites corresponding to 464,000 domain names were unavailable at the height of the crisis, i.e. nearly 18% of active IP addresses assigned to OVH over the previous two weeks. A panel of experts appointed by the Court of Justice of Strasbourg is responsible for assessing the total amount of damage caused by this fire and the conclusions of the panel are not known at this date.
From experience, however, we can estimate that the direct loss for OVH amounts to millions of euros for the real estate component alone, without taking into account the technical or commercial damage suffered by the company's customers.

Photograph 2: site the day after the fire (source SIS 67)

II.3 Measures taken after the accident

Following the fire, all utilities were shut down in order to carry out safety diagnostics before considering restarting the sectors that were not affected by the fire.

The company OVH had diagnostics carried out on the pollution of the extinguishing water and the buildings on the site in order to prepare the operations for dismantling the destroyed buildings and restarting the installations in a state of restarting. Additional analyzes were prescribed by the prefect of the Bas-Rhin to assess the environmental impact of the fire. OVH informed us that these analyzes had been submitted to the administration.

The dismantling of the steel structure of the SBG2 building was also the subject of particular attention given the damage to the structure and the upcoming expertise on the areas suspected of being the cause of the departure of the fire.

II.4 Engagement and organization of the survey

Given the circumstances and the context of the accident, the director of the industrial risk investigation and analysis office (BEA-RI) decided to open an investigation.

BEA-RI technical investigators went to the site on Thursday, March 11, 2021. They met with representatives of OVH, the Bas-Rhin fire and rescue service and the inspection of classified installations.

They collected the testimonies or written declarations of the actors involved in the event and in its management. They had, following these interviews and the technical meetings organized thereafter, communication of the exhibits and documents necessary for their investigation.

An expert assessment was also undertaken in the context of civil proceedings conducted by a panel of experts appointed by the Court of Justice of Strasbourg. The BEA-RI did not have access to the elements ar conclusions of this expert report, not having at the date of the accident the prerogatives currently set by law (see point IV.2 below).

III. context

III.1 The company

OVHcloud, formerly OVH, is a French company, founded in 1999, specializing in the provision of IT services including hosting and server administration. The company also offers public and private cloud computing services, an activity consisting in processing a customer's computer data, which is used via the Internet, in the form of services provided by a service provider.

The company says it serves more than 1.5 million customers, relying on a network of data centers spread across Europe, North America and Asia-Pacific.

In France, OVHCloud has two major locations: its Roubaix site (created in 2007) and its Strasbourg site, the first phase of which (SBG1) was commissioned in 2012. The OVH group operates 32 datacenters located on 4 continents.

III.2 The Strasbourg site

The OVH Strasbourg data storage center is located in the Port du Rhin industrial zone at 9 rue du bassin de l'industrie in Strasbourg.

Map 1: The OVH site is located in the Port du Rhin industrial zone in the suburbs of Strasbourg, near the German border.

Photograph 3: aerial view of the site

The site consists of 5 independent buildings built over the evolution of the company. The last building called SBG5 was not yet in operation at the time of the fire.

Data storage facilities (servers) are not strictly speaking classified facilities. But the generating sets which make it possible to compensate for a loss of electrical power from the network and the battery charging installations (the batteries supply the inverters intervening as a backup before the full function of the generating sets) are classified under the regulations relating to Installations classified for environmental protection.

A declaration dated August 5, 2016 is archived at the DREAL under these two headings:

- **2910 A2 (generators): 12.5 MW,**
- **2925-1 (battery charging systems): 153 kW.**

However, the site has evolved since that date, the construction of new buildings having increased the total thermal power of generating sets and battery charging capacity.

Following the fire, the Inspectorate of Classified Installations asked OVH for an administrative update of its site taking into account all the extensions made.

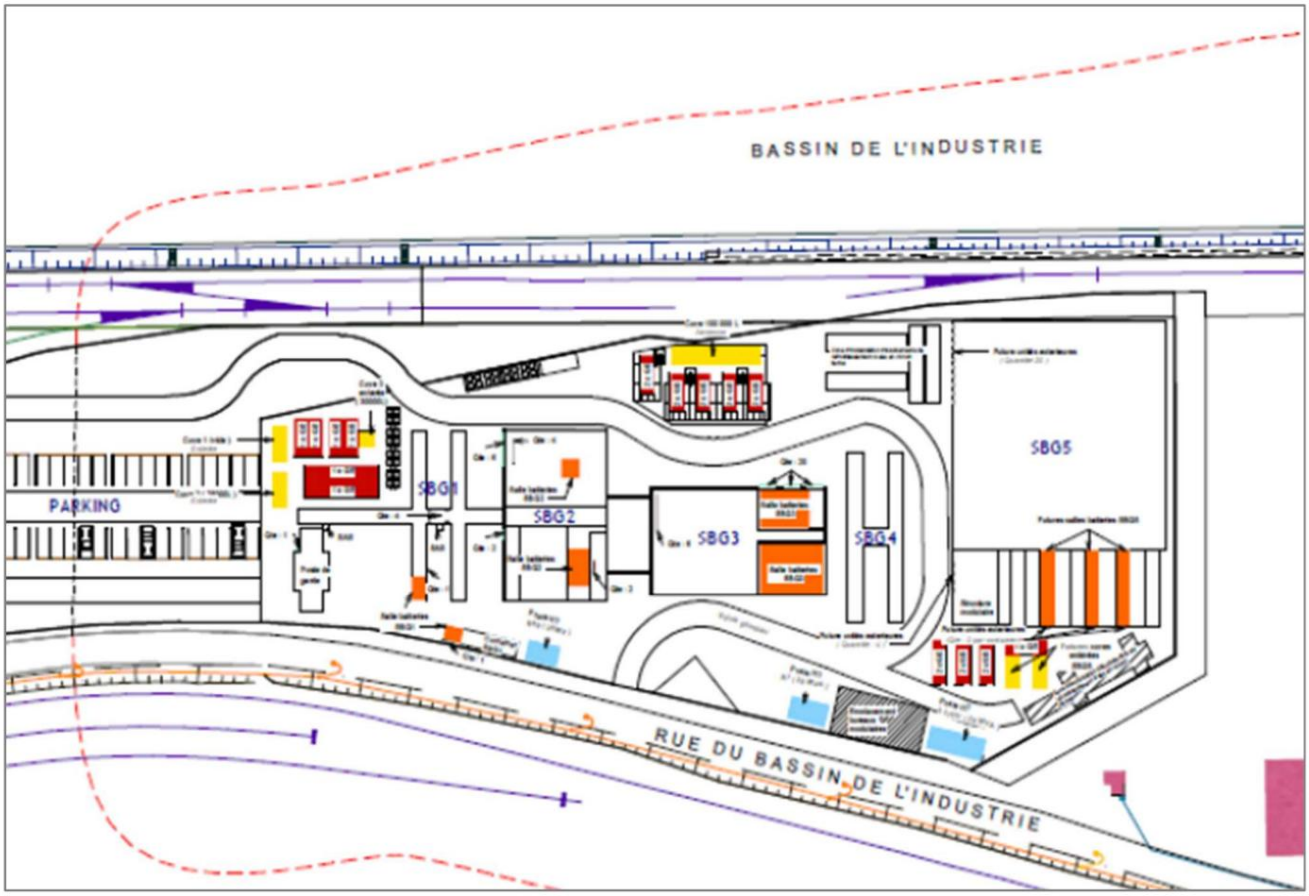


Figure 1: Site plan (source OVH) (The same plan on a larger scale is shown in appendix 2)

In terms of fire prevention, the site is equipped with a detection system combined with the permanent presence of personnel trained in the handling of fire extinguishers. However, it is not equipped with an automatic extinguishing system. The sector's fire protection is provided by the public network consisting of a single power supply line and a fire hydrant.

III.3 Building design

The OVH Strasbourg site has undergone several expansion phases, each of which resulted in the construction of new buildings (named SBG1 to SBG5) intended to house the company's electrical and IT equipment. These buildings adopt very different structural and architectural options.

In this context of continuous growth, the various technical choices made in terms of construction take into account criteria of modularity, speed of execution, costs but also energy efficiency.

To characterize the consumption of a data center, operators have an energy performance indicator (Power Usage Effectiveness, PUE) or DCEM (Data Center Energy Management). Insofar as electricity consumption is the main center of expenditure (apart from the initial investment in the design of the site), the hosts must seek an optimized indicator which, beyond the economic and environmental considerations in this case convergent, offers a commercial argument with their customers.

	SBG1		SBG3		SBG5
	SBG2		SBG4		

Figure 2: location of the various buildings on the site

The first building named SBG1 is built by stacking three levels of containers, each container housing electrical and computer equipment.

For the SBG2 building, OVH kept the idea of a modular building, but here on 6 levels, backed by a steel structure. In this configuration, the caissons consist of prefabricated concrete walls backed by a steel frame which ensures stability, particularly in the event of seismic or meteorological hazards.
The floors are made of raw wood that has undergone an intumescent treatment and the outer walls of single skin cladding or aluminum strip cladding. The objective of this construction is to promote heat exchange with the outside and to reduce the consumption of energy devoted to cooling computer or electrical equipment.

In terms of fire protection, the documents communicated by OVH show that the internal structure has benefited from a treatment ensuring fire stability for 1 hour and the floors from a fireproof treatment for 1 hour by application of intumescent paint or of flocking.

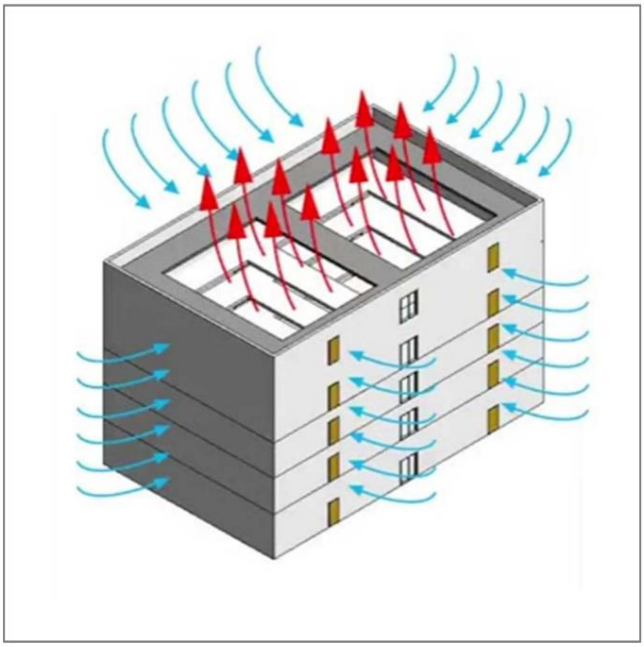


Figure 3: SBG2 is a building designed to promote server cooling by circulating outside air.
(OVH illustrations)

The SBG3 building is of a more classic design with a concrete structure in R+5.

For SBG4, in operation since 2013, OVH opted for construction choices comparable to SBG1 by constructing a building on a single level.

More recently for SBG5, a building still under construction at the time of the fire, OVH adopted a concrete structure on one level, breaking with previous constructions. This structure provides other guarantees in terms of stability and fire resistance.

III.4 Electricity management

Data centers are designed to guarantee storage and accessibility of data to its owner at any time of the day and night, 7 days a week. Faced with this availability requirement, the interruption of the power supply constitutes the main major risk. faced by a data center operator.

The TIER standard defined by the UPTIME Institute ranks data centers from 1 to 4 according to their availability rate.

Better availability requires better security of power supply to the site. This depends on three factors:

- **The electrical network,**
- **Redundancy and distribution of electrical power sources,**
- **On-site emergency equipment and its operation.**

In the case of the OVH site, the supply of electricity is ensured by:

- **Two redundant 20 kV MV links,**

- **Fuel-powered generators that meet the site's electrical needs in the event of interruption of MV links,**
- **Energy storage rooms containing a large quantity of lead acid batteries.**

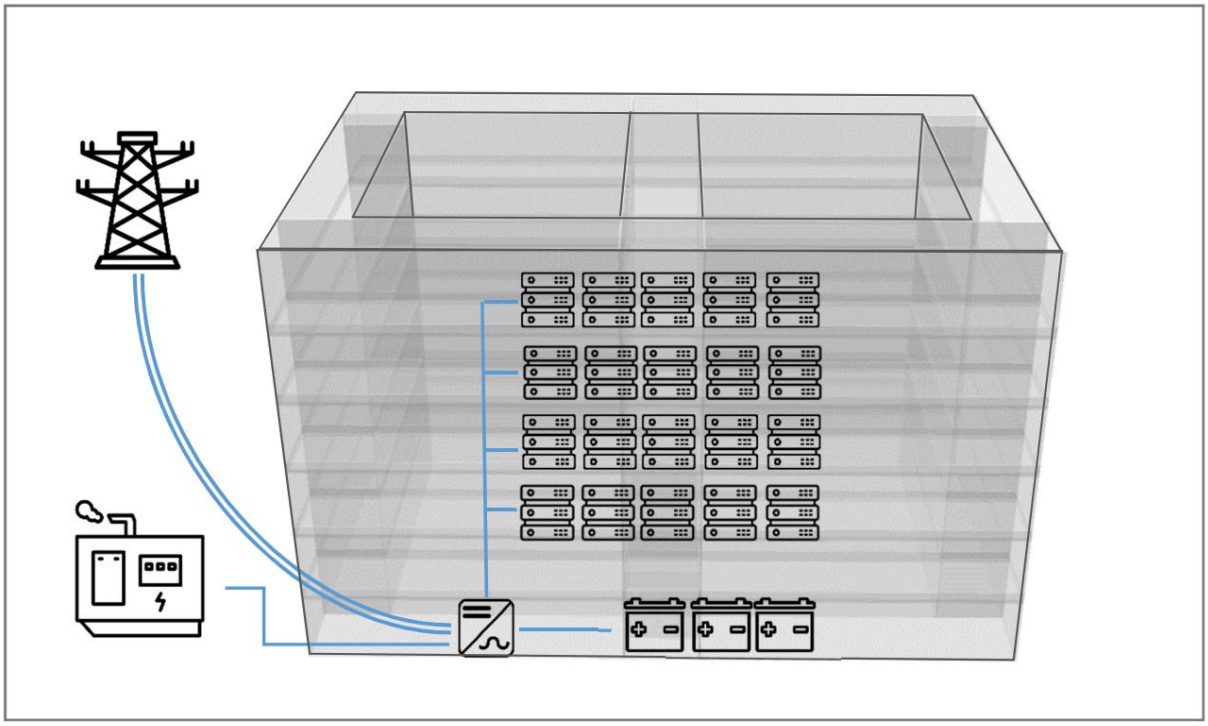


Figure 4: Block diagram of the SBG2 power supply. The main power supply is provided by the electrical network. Batteries and generators are back-up power supplies which, depending on the technical solutions used, correct, back-up or replace the electrical network.

The continuity of supply is ensured, from these three sources of energy, by the uninterruptible power supply system (UPS) which is equipment comprising, in a fairly synthetic way, an inverter and rectifiers.

There are several UPS operating modes:

- **The UPS inverter supplies the servers continuously. The rectifier receives alternating current from the grid and transforms it into direct current for the inverter and the battery charger keeps the batteries charged. The inverter transforms direct current into regulated, clean alternating current to power the servers.**
- **If priority has been given to the network, the UPS continuously checks the conditions of the input power supply, and decides to supply the servers through the direct line or the conditioned line depending on the quality of the power.**

The result of this design is that a data center is autonomous in terms of energy and that an electrical lockout of the site which may be necessary in the event of intervention by the emergency services requires the shutdown of the general power supply, the neutralization of the generators and the discharge of the emergency batteries.

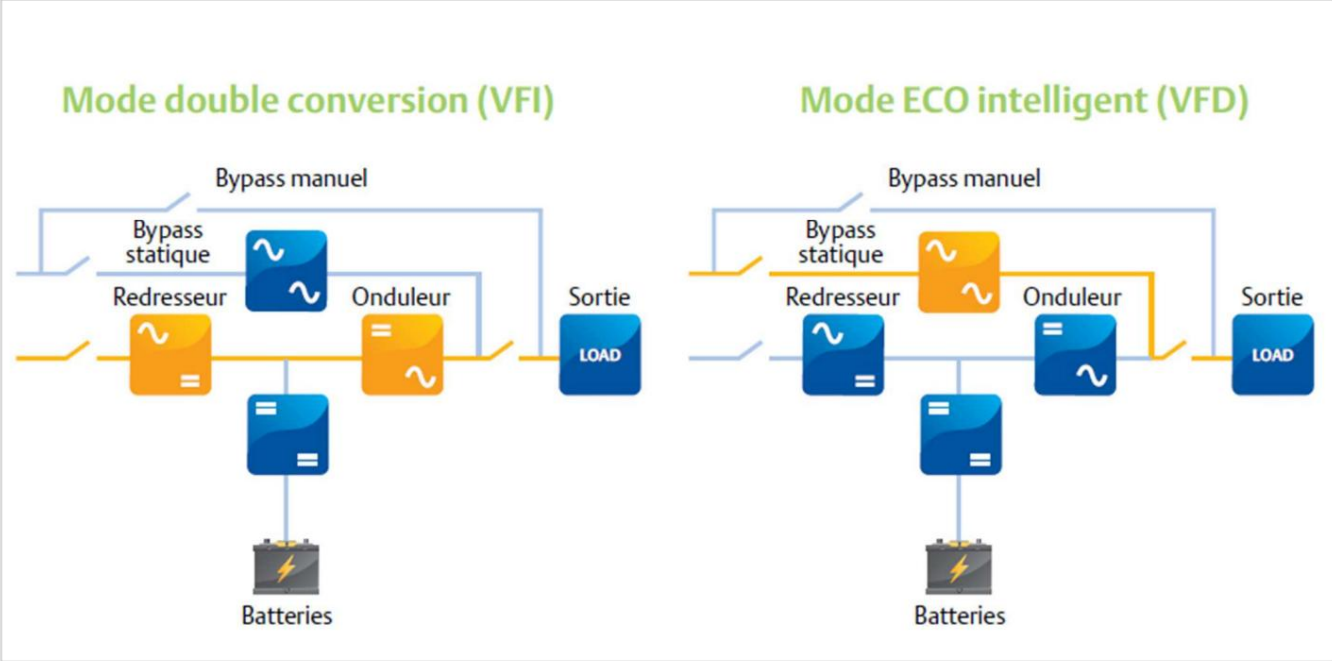


Figure 5: Power supply mode via the UPS (source: equipment manufacturer's sales brochure)

III.5 Fire safety in data centers

Within a data storage center, the main function of storing and providing data provided by the servers is not subject to the regulations for classified installations.
for the protection of the environment. On the other hand, the equipment necessary for the production of energy or the cooling of computer equipment is classified. The following are thus covered by the regulations:

- **The emergency groups made up most of the time of thermal engine generators and the fuel tanks necessary for their operation;**
- **Cold production equipment which may consist of cold units or, more rarely because they consume more energy, air-cooling towers;**
- **Electricity storage rooms which house sometimes large quantities of batteries electric lead or, more recently, lithium.**

It emerges from this inventory that a large volume of building is not subject to ICPE1 regulations and is therefore not subject, under these regulations, to any specific prescription in terms of fire protection.

1 From the moment an establishment has several ICPE classified installations, one of which is subject to authorization, the principle of connectedness (L.181-12 of the Environmental Code) leads to the consideration that all of them are subject to authorization. ICPE. This principle of connectedness is applied in a restrictive manner when installations are only subject to registration or declaration and represent only a small part of a larger project.

As soon as the building does not fall under either the ERP2 categories or the IGH3 categories, most of the building comes under the common law regulations applicable to an industrial building with a height of less than 28 m. This is essentially covered by the Labor Code, which does not provide for specific requirements on the possible implementation of automatic extinguishing means.

On the other hand, fire detection is made mandatory to allow the evacuation of employees working in the building (other obligations exist in terms of personnel evacuation, they will not be developed here). In the specific case of buildings with several levels, the Code du Travail also contains provisions applicable to buildings whose bottom floor of the last level is located more than eight meters from the ground (Articles R4216-24 to R4216-29). These articles are supplemented by a ministerial order[4], the provisions thus fixed impose a fire resistance of the structure, a degree of firebreak for the floors and vertical walls as well as the level of fire behavior of the materials used for the floors, the walls and the ceilings).

In January 2020, France Datacenter, which for a dozen years has brought together companies involved in the design, construction, equipment or operation of data centers, published a white paper dedicated to F fire safety in data centers G[5]. This document is intended to support data center operators in improving their installation's fire safety.

The document draws up an inventory of the applicable regulations, detection and automatic extinguishing devices currently available on the market and whose implementation, even if it is not imposed by the regulations, can be recommended. by insurance companies. It constitutes, in the current state of knowledge, a frame of reference for the profession in terms of fire safety. We can however regret that it does not recall the provisions of the Labor Code which can apply to data centers built on several levels and whose floor of the last level is more than eight meters from the ground.

2 Establishment open to the public
3 High-rise building
[4] Order of August 5, 1992 for the application of Articles R. 235-4-8 and R. 235-4-15 of the Labor Code and laying down provisions for the prevention of fires and smoke extraction from certain workplaces
[5] https://www.francedatacenter.com/wp-content/uploads/ressources/uj296tn4ye/livre_blanc_securite_feu.pdf

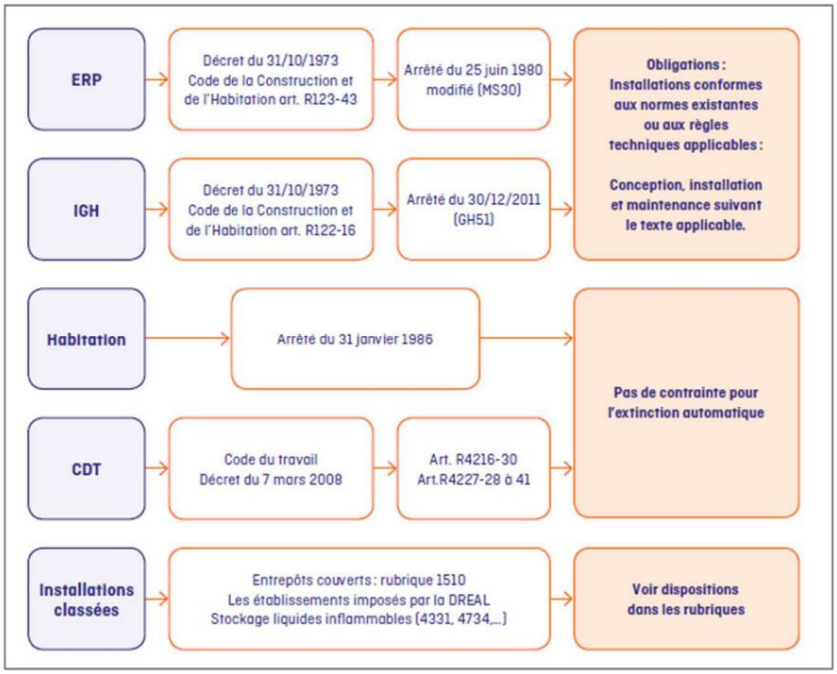


Figure 6: illustration of the regulations applicable to data storage centers (excerpt from the white paper = fire safety in datacenters – France Datacenters)

IV. Report of the investigations carried out

IV.1 Field reconnaissance

A site visit took place on March 11, 2021. Representatives of the site operator, the Classified Installations Inspectorate, SIS 67 and the two BEA-RI investigators were present on site.

The purpose of this visit was to understand the organization and operation of the site before the fire, and to review its progress. It was not possible to gain access to the SBG2 building, whose metal structure was badly affected by the fire and no longer offered sufficient guarantees in terms of stability. The plan below represents the ground floor of the building from which the fire started.

However, it was possible to gain access to the SBG3 building.

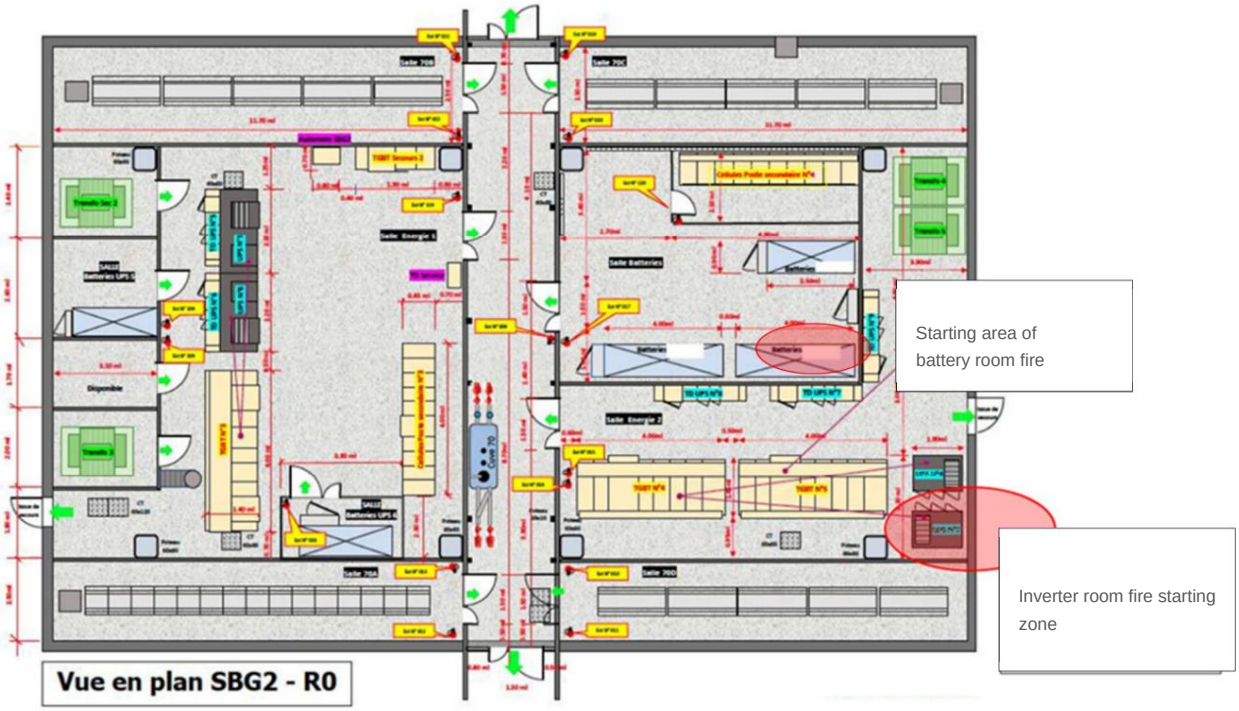


Figure 7: R0 plan of the SBG2 building (OVH source plan). The fire starting zone was added by the BEA-RI in order to improve the readability of the plan and the understanding of the text. (The same plan on a larger scale is shown in appendix 3)

As part of the investigation, in addition to the interviews that took place on the day of the trip, the BEA-RI spoke with staff from OVH, the equipment manufacturer that supplied the UPS, one of the legal experts and representatives of Strasbourg Electricité Réseaux, which is the distributor of electricity in Strasbourg.

IV.2 Relationship with the expertise mandated by the Court of Strasbourg

The fire gave rise to the opening of several civil proceedings to deal with claims for compensation for damages suffered during the fire by OVH customers but also by OVH itself. As part of these procedures, a panel of legal experts has been appointed by the Court of Strasbourg in order to characterize the disputes and order the necessary expert opinions which will make it possible to establish responsibilities and fix compensation.

The provisions created in Articles L. 501-1 to L. 501-19 of the Environmental Code in August 2021 give BEA-RI investigators the possibility of taking material for the purpose of conducting expert appraisals. Since these provisions had not yet been taken at the time of the launch of this investigation and the carried out by the college of legal experts, it was therefore not possible for the BEA-RI to oppose a right of inspection on the expert reports or to launch its own investigations.

As a reminder, the BEA-RI investigation aims exclusively to draw lessons with a view to improving safety, in addition to the other investigations, which aim to find fault or responsibility, to assess the extent of the damage to property, people or the environment, and to make recommendations, if necessary, on the methods of repair, depollution or compensation for damage.

On the date of publication of this report, the conclusions of the college of experts on the precise causes of the outbreak of fire were not yet known. This is the reason why the BEA-RI will not comment on the reasons which caused the observed outbreaks of fire. The fact remains that the place origin of the fire, the equipment involved in the first moments of the fire and the conditions which allowed its development are sufficiently determined to allow the publication of this report.

This is the reason why, without waiting for the conclusions of the civil proceedings, the BEA-RI wished to submit its own conclusions and issue its recommendations. The BEA-RI reserves the right to issue an additional report if the conclusions of the civil expertise provide additional elements to improve safety.

V. Course of the event

V.1 Triggering of the event

On March 10, 2021, at 12:35 a.m., an alarm went off in the security PC of the OVH Strasbourg site. At 12:37 a.m., the guard reached energy room 2 on the ground floor of the SBG2 building and noticed the presence of thick black smoke. The building was evacuated at 12:39 a.m., and the SIS was called at 12:42 a.m.

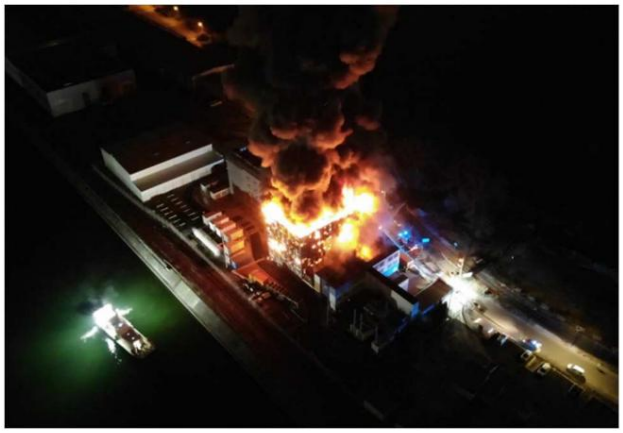
First responders arrived at the scene at 12:59 a.m. There are then significant releases of smoke on the ground floor. OVH cut off the emergency energies of the SBG2 building at 1:13 a.m. and those of the SBG3, SBG1 and SBG4 buildings at 1:28 a.m.

V.2 The intervention of the SIS 67

The Bas-Rhin fire and rescue service was called by OVH at 00:42. They arrived on the scene at 12:59 a.m. and requested that the power be cut off at Strasbourg Électricité Réseaux. There was then significant release of smoke on the ground floor and the emergency services noted the presence of electric arcs in the energy room. A water lance is deployed awaiting the site's power cut. The emergency services soon noticed that the design of the building would not allow the fire to be contained. The risk of propagation to upper floors is assessed as significant.

The emergency energies of the buildings are cut off at 1:13 a.m. (for SBG2) and 1:28 a.m. (for SBG3, SBG1 and SBG4) by the OVH teams. At 01:28, water resources were deployed in front of SBG2. At 1:42 a.m., the fire had spread to the entire 1st floor and the spread to the upper floors could no longer be stopped. There are then two lances in operation, one on the same level and one on an automatic pivoting ladder (EPA). At 1:49 a.m., support from the EUROPA pump boat was requested because the water resources become insufficient.

At 1:50 a.m., the site's power supply is cut off at the upstream source substation by RES (see point V.3). But at 02:14, there is still current in building 2, now totally ablaze, and a significant spread towards building 1 is observed.



Photograph 4: Arrival of the Europa boat in the area (source SIS 67)

Photograph 5: Lance on automatic pivoting ladder (EPA) (source SIS 67)

EUROPA arrives on site at 02:57. Due to the deformations observed on the facade, a collapse of building 2 on itself is feared. The fire spread to building 1 and building 3. Two attack sectors were set up. A third sector is supplied by EUROPA. From 03:28, there is no more current on the site. At 6.45 a.m., the fire was brought under control, but extinguishing the residual fires was made difficult by the impossibility

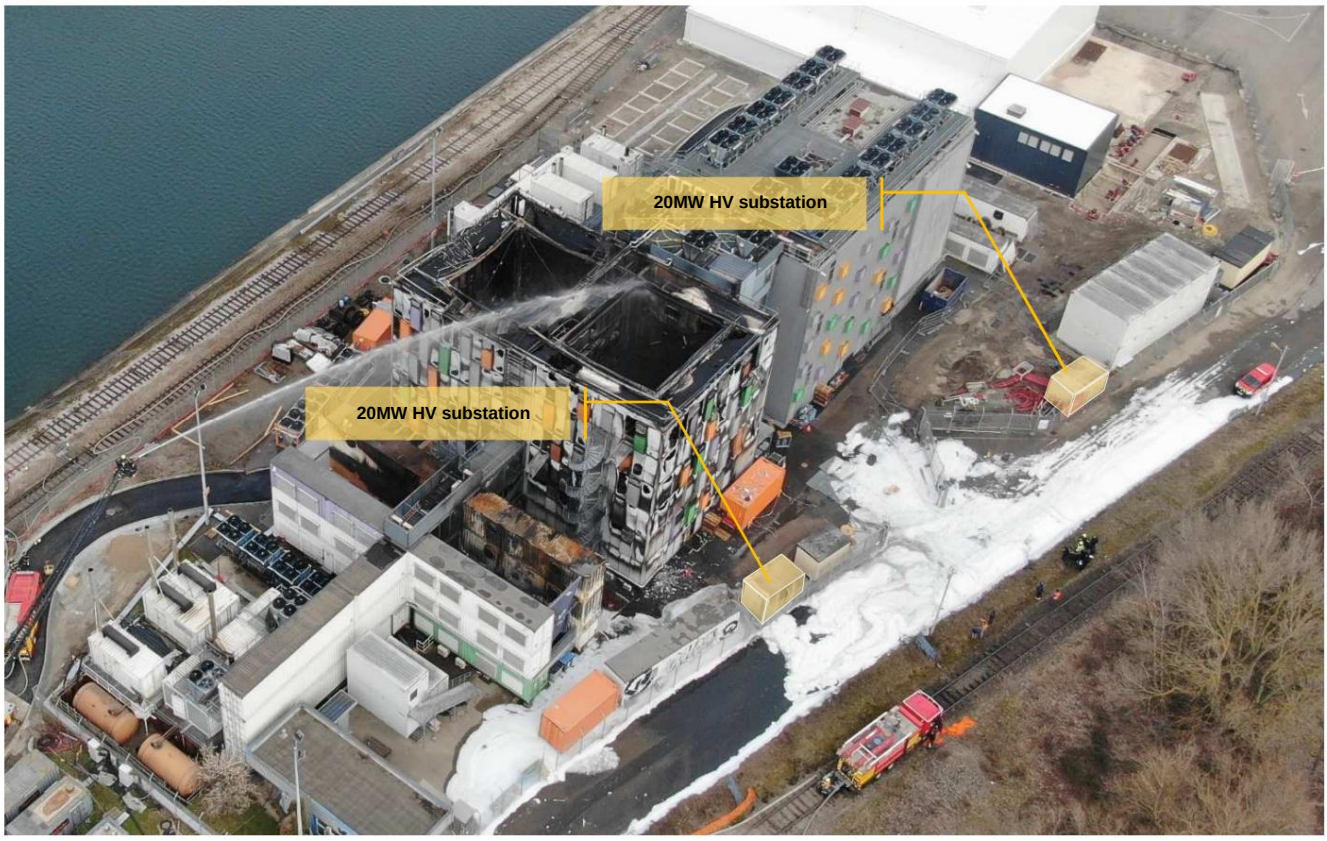
to penetrate inside metal structures.

The fire was extinguished at 10:02 a.m. and the intervention was considered finished at 6:13 p.m. Almost 4000 liters foam concentrates have been used.

V.3 The intervention of Strasbourg Electricity Networks

Strasbourg Électricité Réseaux (SER) was notified by SIS 67 at 00:52. Their on-call team was mobilized and arrived on the scene at 01:27. Prior to their arrival, SER was questioned to find out if it was possible for their agents to intervene at the level of the secondary substation which supplies SBG2. SER indicated that since this position belongs to the client, such an intervention was not possible. When they arrived at the scene, the fire had already developed. Intervention on the secondary substation is excluded and SER does not obtain authorization to cut off the electrical power supply to the site at the customer substation because of the risks associated with fire. The decision is therefore made to cut off the current at the upstream source substation. The cut will be carried out remotely and will be effective at 01:50.

Finally, SER did not notify us of any abnormal event on the sector's power supply network during the night.



Photograph: Location of 20 MW HV substations near buildings SBG2 and SBG3

VI. Conclusions on the scenario of the event

VI.1 Scenario

The incident occurred, almost simultaneously around 12:35 a.m., in two F energy G rooms of SBG2 while the datacenter was in an operating mode that we would qualify as normal.

The equipment in question was regularly maintained. During the days leading up to the event, one of the inverters in energy room no. 2, referred to in this report as ASI2, had undergone maintenance operations due to recurring problems switching to by mode. -unexplained passes. These interventions gave rise to reports of interventions and recommissioning checks which do not mention any singular element.

The batteries6 are not equipped with a scanning or supervision system, but OVH told us that they respect the lifespans recommended by the battery manufacturer.

[6] As a reminder, these are lead batteries.

It is difficult to say what the operating mode of the energy rooms was when the failure occurred. The BEA-RI asked OVH to obtain the operating parameters of the inverters (voltages and intensities delivered, mode of operation, etc.) at the time of the equipment failure. OVH told us not to have it.

The video surveillance system and the monitoring of the site's fire control panel show that an electrical fault has occurred at the level of the UPS2 and at the level of the batteries connected to it. The UPS and associated batteries were not in the same room.

Photograph 6: 12:35 a.m., fire starting in the battery room (source: image taken from OVH video surveillance)

Photograph 7: 12:35 a.m., outbreak of fire in UPS2 (source: image taken from OVH video surveillance)

The analysis of the ambient parameters reported in Figure 8 (temperature and humidity measured on sensors located on the rear face of the inverters) leads to the observation of a singular humidity measurement around 11:15 p.m. and a further increase in it shortly after 12:30 a.m. The BEA was unable to establish whether it was a measurement error or a humidity peak linked, for example, to the presence of liquid. Nevertheless, we find that from the 11:15 p.m. measurement:

- **At the level of the recording of the ambient temperature, the minimum temperature increases slightly (24°C) compared to the previous phase of temperature variation cycles which evolves between Max 25.5°C Min 23.5 °C;**
- **At the level of hygrometric measurements, the humidity rate is experiencing a new significant clearly more marked increase from 12:30 a.m.;**
- **The failure of the inverter is reflected in the temperature curve by a continuous increase and by a new hygrometric peak.**

The presence of a liquid or moisture in an electrical device can cause the formation of an internal short circuit likely to cause the damage observed. However, these elements alone do not allow however, not to determine the cause of the failure.

Figure 8: Temperature and humidity readings on the site at the UPS2 level (source OVH)

We will also note that the battery technology used by OVH (lead battery) is a more robust and stable technology than the lithium solution. Internal short circuits on this type of technology remain rare.

It is not possible, at this stage, to establish the cause of the failure at the level of the UPS which could be explained by various hypotheses (presence of liquid or humidity linked to the presence of the cooling system located nearby, malfunction linked to the maintenance operation carried out the same morning, operation of the inverter outside the normal operating ranges, etc.).

The ongoing legal expertise (see point IV.2) which includes examinations of equipment similar to that in question should provide information on the origin of the fire outbreak. The BEA-RI does not rule out at this stage the possibility of supplementing this report according to the conclusions of the ongoing expertise.

VI.2 Contributing factors

Beyond the primary technical causes of the fire, we looked at the elements that had an impact on the spread of the fire in this data center.

VI.2.1 Contributed to the spread of the fire

i. The design of buildings and their proximity

Examination of the circumstances of the accident and the sequence of events show that the constructive provisions adopted during the construction of the building played a role in the spread of the fire.

To do this, the BEA-RI used the data from the fire safety center and in particular the chronology of the triggering of the fire detectors. Care should be taken in the use that can be made of this data because the detectors give an indication of the propagation of smoke and not of flames. In addition, the difference in sensitivities of the technologies used in terms of detection can induce trigger shifts. But since the smoke constitutes a preferential vector for the propagation of the fire, its presence nevertheless sheds light on its diffusion kinetics.

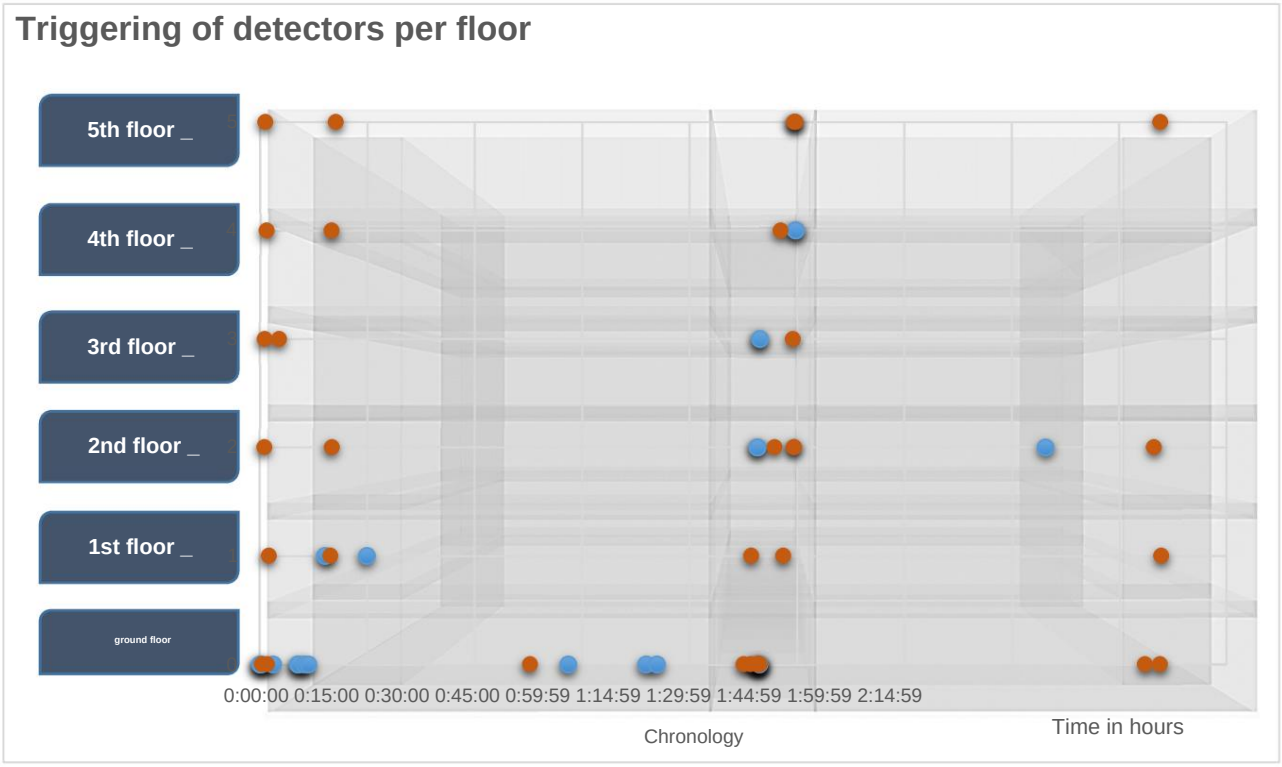


Table 1: Chronology of triggering of fire detectors within SBG2. At t+15 minutes, smoke was detected on all floors by the aspirating smoke detection sensors (orange dots). At t+1 hour, the SIS signals the flashover of the first level, a new series of detectors are triggered in the upper levels and the first optical detectors (in blue) of the second floor are triggered.

Examination of the fire detection triggering sequence is particularly interesting in this sense. It can be seen that during the 15 minutes following the start of the fire, several fire detectors were triggered on the ground floor but also on all the upper floors of the SBG2 building. Some detectors located on the upper floors even trigger a few minutes after the start of the fire. This initial finding demonstrates the building's great permeability to the outside air and therefore to fire smoke which can spread quickly and without
difficulty.

In addition to the choice to promote the circulation of air within its facilities by means of openings in the facade (see part III.3), the materials chosen to build SBG2 and the absence of floor overhangs in the facade do not did not make it possible to sufficiently slow the progression of the fire in view of the time required to massively engage the water resources necessary to control and then extinguish the fire.

Other factors can also promote the spread of the fire (protection of cable passages at floor or wall level, presence of combustible materials, keeping sectioning doors open). However, the presence of these factors could not be observed during the visit to the scene of the accident.

At 1:28 a.m., less than an hour after the first alarm went off, the firefighters reported the spread of the fire to the entire first floor. At 1:40 a.m., the temperature sensors saturate on the second floor, i.e.

two levels above the level of
start of the fire.

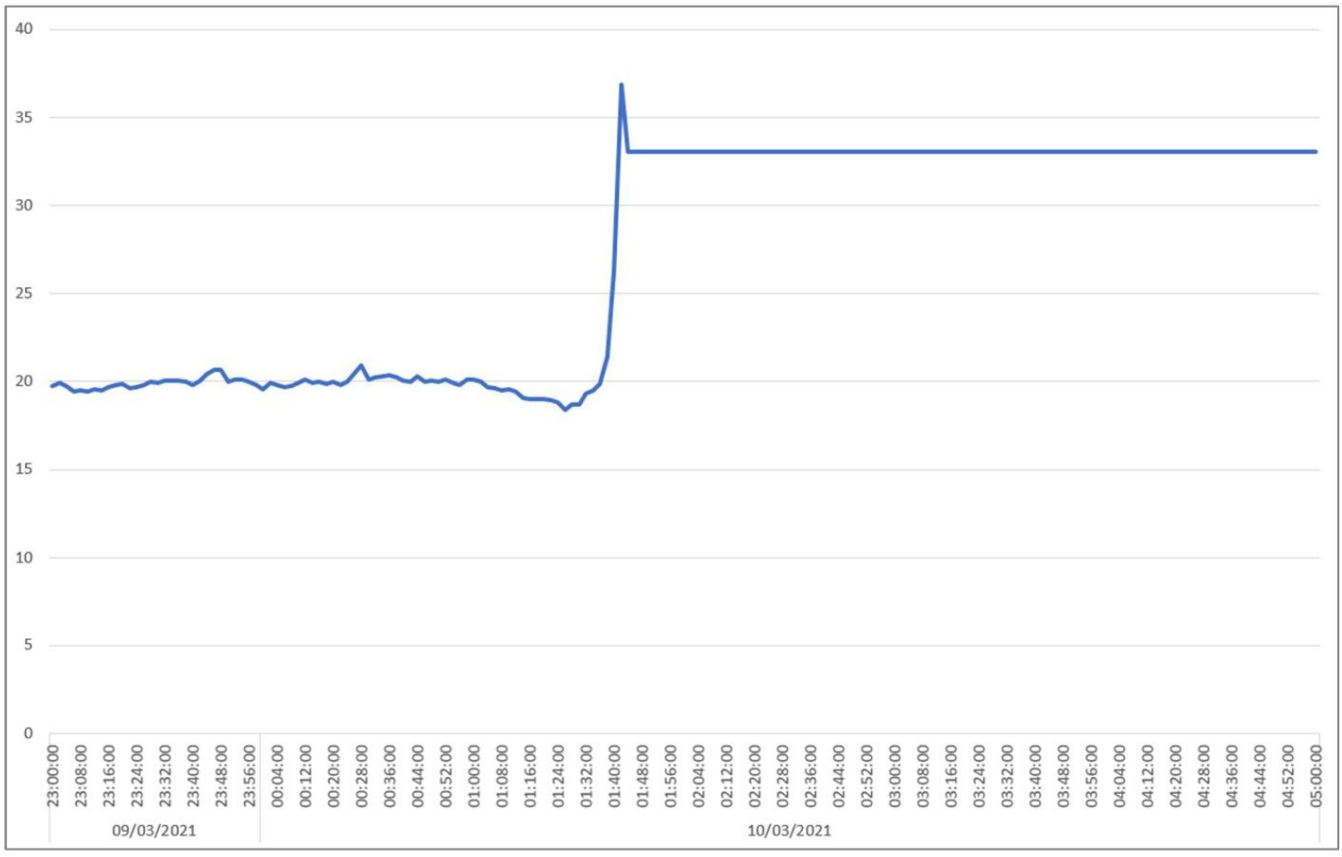
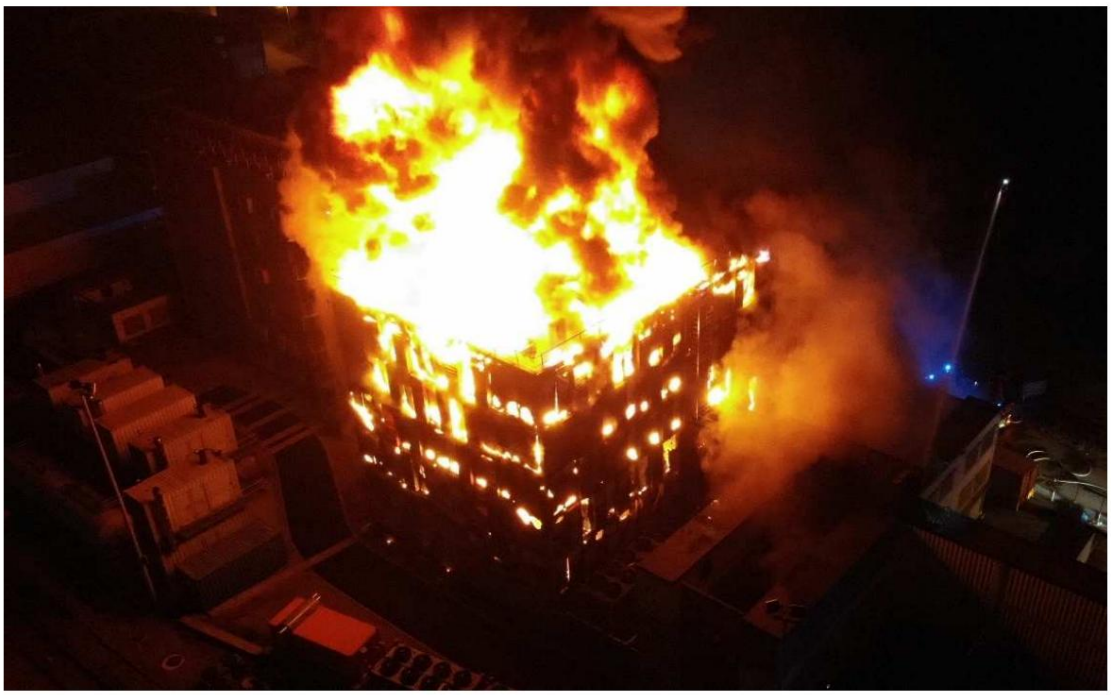


Figure 9: temperature curve measured by an SBG2 wing B second floor ambient sensor which shows an abnormal rise in temperature around 1:40 a.m.

At 2:00 a.m., nearly an hour and a half after the first alarm was triggered, the firefighters reported the generalized conflagration of SBG2. The photo below gives an overview of the situation at 2:50 a.m., 2 hours and 20 minutes after the start of the fire.



Photograph 8: Photograph of SBG2 at t0 + 140 min (Source: SIS 67)

Examination of the timing of the triggering of the detectors of the neighboring buildings shows that it takes between an hour and an hour and a quarter for the optical detectors and the aspirating detectors to trigger significantly in the buildings SBG1 (1st floor) and SBG3 .

Smaller in size, less well protected from thermal flows (maritime container type design), SBG1 will moreover be more strongly impacted than SBG3, which has benefited from the presence of a firebreak device (firewall 2 hours and fire door) and water resources mobilized by the Bas-Rhin fire brigade.

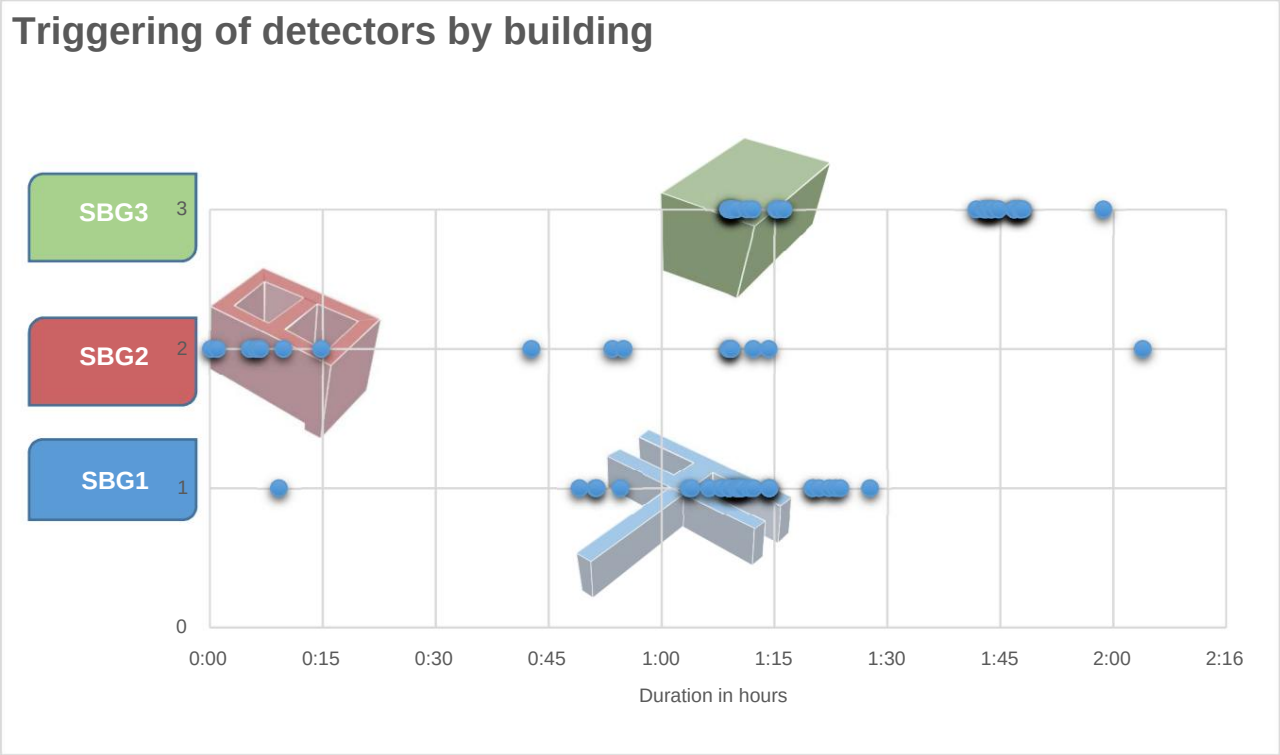


Table 2: Chronology of triggering of optical detectors within the buildings of the OVH site. We see a first series of triggers during the first 15 minutes on SBG2, followed by triggers on SBG1 (t0+50 min) then on SBG3 (t0+70 min). The triggering on SBG1 during the first fifteen minutes is due to the triggering of a sensor in traffic.

Finally, we recall that if the datacenter is not subject as a whole to ICPE regulations, some of these parts may be subject to it beyond a certain threshold: generators, hydrocarbon storage, cold production, load rooms

of batteries.

In the case of SBG2, the battery charging rooms, given the quantities of batteries present7 , should have complied with the objectives of resistance and fire resistance8 .

However, it is difficult to say what impact battery charging rooms that comply with regulations would have had in the Strasbourg fire, given the almost simultaneous outbreak of the fire in the inverter room, a room that is not explicitly targeted. by the ICPE regulations.

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[7] SBG2 housed 800 batteries of 30kg with a unit power of 13kW.

8 The Order of 29/05/00 relating to the general requirements applicable to classified installations subject to declaration under heading No. 2925 as loading workshops provides in point 2.4.1. : *The premises housing the installation must have the following minimum fire reaction and resistance characteristics: - walls and high floors with a 2-hour fire rating - incombustible roofing, - interior doors with a 1/2-hour rating and fitted with a door closer or a device ensuring their automatic closing, - door opening outwards, 1/2 hour flame arrester, - for other materials: class M0 (incombustible).*

And in point 2.4.2. : *The premises must be equipped in the upper part with devices allowing the evacuation of smoke and combustion gases released in the event of fire (skylights on the roof, openings on the facade or any other equivalent device). The manual opening controls are placed near the accesses. The smoke extraction system must be adapted to the particular risks of the installation.*

ii. The absence of an automatic extinguishing system

OVH has chosen not to equip any of the five buildings in its Strasbourg data center with an automatic fire protection system. As a reminder, a fire protection system can have several functions:

- **Extinguishing the fire,**
- **The control or temporization of the fire, which makes it possible to contain its progression and to give time to the organization and the intervention of the emergency services.**

Moreover, in the case of an installation such as a data center, it makes it possible to implement water resources very early in the accident sequence, without even waiting for the interruption of the electricity supply, and without exposing personnel at risk of electrocution.

iii. Insufficient water resources

The public emergency services only had a fire hydrant available for this intervention, which delivered an insufficient flow rate (less than 60m3 /h)9 . The operator also did not have its own extinguishing water reserve or means of pumping in the Rhine canal. Given the rapid and unfavorable evolution of the incident, they quickly requested the support of the EUROPA fireboat, which is arrived in the area at 3:00 a.m.

The arrival of this means made it possible to contain the development of the fire, and to prevent its spread to the rest of the installations and in particular to the SBG1 and SBG3 buildings which were nevertheless partially damaged.

iv. The time needed to make the installations electrically safe

During the first surveys, the firefighters quickly identified the presence of an electrical risk which prevented the implementation of significant water resources. Although the order to cut off the site's power supply was given quickly (0h58), electrical security only intervened much later.

Several factors that could explain this observation were brought to the attention of the investigators:

- **On the site :**
  - **The absence of a general site cut-off device easily accessible in the event of a fire, which required the intervention of the electricity network manager to cut off the power supply from the source substation;**
  - **The location of electrical substations near the intervention area emergency services, not allowing intervention at these posts;**

9 Order of 29/05/00 relating to the general requirements applicable to facilities classified for the protection of the environment subject to declaration under heading no. 2925 requires in its point 4.2 the presence of at least one pole in in force. The order of 08/12/11 relating to the general requirements applicable to classified installations subject to declaration under heading No. 2910-C of the nomenclature of classified installations for the protection of the environment (for generating sets) imposes 4.2 the presence of a fire hydrant capable of supplying a minimum flow of 60 m3 /h for a period of at least two hours.

- o **Generators subject to the sole requirement of electricity supply, which start up automatically despite the fire in progress (OVH teams must neutralize the emergency generators so that they do not start when the power is cut);**

- o **Charged batteries will be the last to supply power. Estimating the operating time of the batteries was a final difficulty in the absence**

  precise information on the subject. This duration is estimated at around twenty minutes after the main power supply and the generators have been cut off (this delay estimated by SER is also confirmed by the SIS timeline (point of 2h14)).

- **Off-site, the shutdown of the power supply from the source substation of the MV lines (2x20kV) requires additional intervention and reconnaissance time compared to what would have been an on-site shutdown by the operator.**

In the end, we estimate that the site is electrically secure from 2:30 a.m., which corresponds to the time when the water resources are put into action. At this time, SBG2 is fully ablaze and the fire is spreading to adjacent buildings.

These elements show the need to be able to electrically isolate the datacenter from the general network without requiring the intervention of an external operator whose intervention times will inevitably increase the site's electrical lockout times.

Moreover, in the absence of a pre-established emergency procedure and of technical devices which make it possible to simply neutralize energy production equipment, power supply redundancies and electrical backup groups, which in normal times are essential continuity of service, may hinder the intervention of the public emergency services.

VI.2.2 Contributed to limiting the consequences of the accident and the spread of the fire

i. Fire detection

The OVH site is equipped with fire detection using automatic optical detectors and aspirating detectors (to which manual call points should be added). The latter played their role of detection perfectly and allowed a rapid alert of the personnel present on site and the on-call personnel. The employees present had time to evacuate the building and seek shelter.

ii. The presence of personnel on site and the mobilization of on-call personnel

The personnel present on site, the team consisting of two technicians and a guard, were able to quickly clear up any doubts and transmit the alert to the public emergency services. They were able to confirm with the first responders that all the personnel present were sheltered.

The OVH on-call teams were able to quickly mobilize internal or external technical skills, particularly on the electrical component, to assist the public emergency services during the intervention. This technical collaboration proved to be all the more necessary as the manufacturer did not have simple means of securing the site electrically and, as far as the SIS was concerned, the site did not benefit from a listed establishment plan.

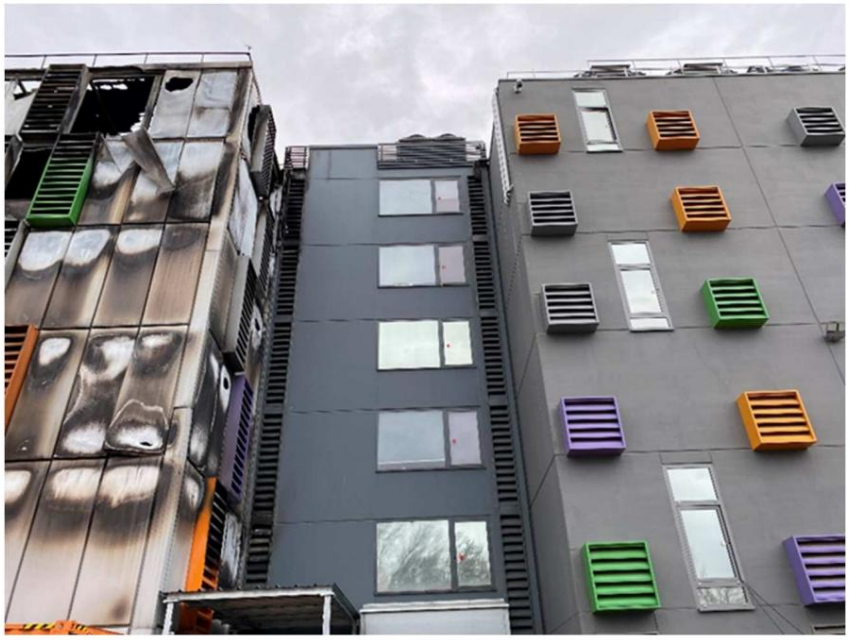
iii. The intervention of additional water resources

The fire and rescue services used EUROPA, the Franco-German pump boat based in Strasbourg. This boat, which has been in service since January 1 , 2008, is entrusted to a Local Cross-Border Cooperation Group (GLCT), specially dedicated to the operation of this boat and financed by 6 partners (Land Baden-Württemberg, the French State, the Department of Bas-Rhin, SIS 67, the Alsace Region and the Autonomous Port of Strasbourg). This group ensures ownership and co-management on both sides of the border. Equipped with a significant pumping capacity (3 extinguisher water pumps with a capacity of 15,000 l/min and 2 fire hoses (foam and water) of 4,500 l/min each), this boat played a determining role in the management of the fire given the lack of the operator's own extinguishing means and the limited capacity of the fire network (DECI) in the area. In the absence of such means, the consequences of the fire would probably have been greater on the adjacent buildings.

iv. The presence of a firewall between SBG2 and SBG3

Although the SBG1 and SBG3 buildings have different technical and dimensional characteristics, we note however that SBG3, protected from SBG2 by 2-hour fire walls and by a separation (inter-building zone made up of circulations), was less impacted than SBG1 which did not have the same level of protection (4 rooms destroyed out of 12). However, the emergency services reported to us that fire doors had been kept open during the evacuation, which had the effect of degrading the effectiveness of this system.

Photograph 9: aerial view of SBG3 (in brown), SBG2 (in blue) and SBG1 (in green). SBG1, smaller in size than SBG2, was directly exposed to heat flows from the SBG2 fire. SBG3 separated by a construction (in yellow) comprising stairs and technical spaces and of comparable size was further protected from the fire. In dark color appears the area of SBG1 affected by the fire.



Photograph 10: area between SBG2 and SBG3

VII. Safety lessons

In general, the experience feedback from this fire highlights the need to have a coherent approach to fire risk on the four themes of detection, fire protection, construction measures and fire safety strategy. intervention of public or private emergency services.

In the absence of specific regulations in terms of fire protection (excluding Labor Code, IGH or ERP regulations), it is up to the manufacturer to set the level of performance he wishes achieve on each of these themes. Depending on technical, economic or environmental considerations, he can opt for more or less efficient solutions in terms of the fire resistance of buildings, detection or extinguishing systems, while ensuring that a sufficient level of performance is achieved to provide customers the level of data protection and retention they expect.

It follows, under these conditions:

- **That effective fire detection is an essential prerequisite for guaranteeing the the shelter of personnel present on site,**
- **That the safest and most resilient installations will be those which combine both constructive provisions which offer good fire resistance and which delay its spread, an automatic fire protection system and, finally, those for which a fire safety and response has been developed.**

The safety lessons formulated below are therefore not to be taken individually from each other but in a global and coherent approach.

VII.1 In terms of detection

In the case of the OVH accident, the suction detection system and the optical detection system played a decisive role in alerting personnel and bringing them to safety. The systems put in place (vacuum and point technology) worked perfectly.

We recall on this subject that the white paper relating to the fire safety of data centers established by the profession lists in a complete way the various detection systems existing on the market as well as the premises having to be supervised in priority. In accordance with the recommendations of this guide, the inverter and battery rooms were monitored on the OVH site.

VII.2 In terms of fire protection

An automatic and detection-dependent protection system is designed according to the desired objective: fire extinction, fire reduction or fire control.

The aforementioned white paper lists a set of devices commonly deployed in data centers (gas inerting, water mist or sprinkler) and specifies the most appropriate technology for each desired function.

As part of the MTE-BEARI-2021-004 investigation, the BEA-RI made recommendations for an automatic extinguishing system in the event of a fire in a lithium battery container10 .

As this battery technology is likely to find applications in the field of data centers, it seems appropriate to recall the safety lessons learned from the examination of this accident. Powder or inert gas systems may be of interest for fires external to the batteries because, in the event of triggering, damage to electrical equipment not caught in the fire is more limited. However, when the fire is caused by the thermal runaway of a lithium battery, the sprinkling of water in quantity has the advantage of ensuring both the extinction and the cooling of the batteries. Other safety lessons have also been learned in terms of signage and accessibility for the emergency services, configuration of the extinguishing system (automatic or not) as close as possible to the batteries, or installation of containers when such a solution is adopted.

VII.3 Regarding the intervention of the emergency services

The speed of intervention of the internal or external emergency services will depend on the responsiveness with which the installations will be made electrically safe. This point is developed in VII.6.

The speed of intervention will also depend on the collaboration that will be set up between the commander of the relief operations and the industrialist. It is therefore important for the manufacturer to be able to inform and advise the COS during the intervention on the basis of pre-established internal procedures or even an internal operation plan. On the side of the fire services, data centers given their particularities should benefit from a plan as a listed establishment. These procedures, or these plans, must also be regularly tested. The regular association of the SIS with these exercises is good practice, especially when the site is subject to regular extensions or modifications.

In order to ensure the safety of the firefighters in intervention, the implementation of water resources can only begin when the electrical risk has been eliminated. At a site such as a data center that has

[10] http://www.cgedd.developpement-durable.gouv.fr/IMG/pdf/rapportperlesvdif_cle286783.pdf

multiple sources of energy, this safety involves the shutdown of the general power supply, the neutralization of the generators and the discharge of the electric batteries.

In addition, cutting off the power supply to a data center is synonymous with stopping the IT service rendered to several thousand users, some of whom are of vital importance.

If they are not anticipated in terms of the design of the installations and the IT architecture and if they are not thought out and formalized in emergency procedures, these operations may require a significant period of implementation which will hamper the chances of rapid intervention by the emergency services.

VII.4 In terms of building design

In the field of building design, we will retain two safety lessons.

First of all, the requirements applicable to battery charging rooms, when they are located inside a building, require a sufficient degree of fire resistance to prevent it from spreading to the rest of the building. The existing regulations already seem to us to be complete11, and the OHV accident does not call their technical relevance into question.

However, two configurations, in the current state of the regulations, deserve particular attention:

- **When the batteries used are not likely to generate hydrogen during charging (if lead batteries are now mainly used in energy storage in data centers, lithium technology offers one more alternative more competitive which tends to develop);**

- **Or when these charging rooms are located outside.**

On the first point, the BEA-RI considers that the prescription relating to the constructive provisions should also concern the other battery technologies for which electrical failure and thermal runaway cannot be physically ruled out. This type of failure can lead to major fires and justify specific construction measures.

On the second point (outdoor charging rooms), the BEA-RI recalls the recommendations issued in its report MTE-BEARI-2021-004 on the battery container fire in Perles and Castelet (09)12 .

Then, the experience feedback shows that the concept of workshop must be understood in a rather broad way and encompass, by connection, all the electrical equipment which contributes to the charging of the batteries. In the case of Strasbourg, the fire broke out almost simultaneously at the level of the battery and at the level of the inverter which was connected to it in a separate room. Reinforcement of the battery room alone would, in this case, have contained only one of the two fire outbreaks

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[11] The decree of 05/29/2000 specifies:
= 2.4.1. The premises housing the installation must have the following minimum fire reaction and resistance characteristics:

- *walls and high floors with a 2 hour fire rating*
- *incombustible cover,*
- *1/2 hour degree fire resistant interior doors fitted with a door closer or a device ensuring their automatic closing, door opening outwards 1/2 hour degree flame arrester,*
- *for other materials: class M0 (incombustible) .*

2.4.2. The premises must be equipped in the upper part with devices allowing the evacuation of smoke and combustion gases released in the event of fire (skylights on the roof, openings on the facade or any other equivalent device). The manual opening controls are placed near the accesses. The smoke extraction system must be adapted to the particular risks of the installation K

[12] http://www.cgedd.developpement-durable.gouv.fr/IMG/pdf/rapportperlesvdif_cle286783.pdf

Finally, it emerges from the elements drawn from the OVH fire :

- **That the intervention of the emergency services will be facilitated if the energy rooms are located in a separate building or on the ground floor of buildings which guarantee sufficient fire resistance to allow the intervention,**
- **That the server rooms must be intersected by fireproof walls and floors above all whether they perform redundant or back-up functions between them.**

VII.5 In terms of preventive maintenance of batteries

The lifespan of a battery depends on its conditions of use (temperature range, input/output electrical parameters, number of charge and discharge cycles, charging speed and discharge). Beyond this time, the performance and safety level of the equipment may deteriorate. It is therefore up to the data center operator to ensure strict compliance with the recommendations issued by the battery manufacturer and to set up monitoring of the operating conditions and the state of the batteries, to define maintenance rules preventive or replacement in order to prevent the risk of failure. When the number of batteries is large, monitoring by means of a polling or data management system from the BMS of the batteries when they are provided with them is all the more justified.

VII.6 Regarding the sizing of water resources

Since a datacenter such as that of OVH is neither an ERP nor an IGH, the regulatory requirements in terms of extinguishing water resources are mainly covered by ICPE regulations for battery charging and the operation of generators. The investigation revealed that these initial requirements were not met.

But beyond this question of conformity, the BEA-RI considers that these means, even present, would probably not have made it possible to avoid the fire of SBG2, for lack of rapid implementation in relation to the kinetics of fire. This accident therefore shows that, in the absence of a sufficiently sized overlap, a widespread fire is a plausible scenario which a data center operator and, in the event of a fault, the local public emergency service must be able to cope with. It is therefore important to anticipate this situation in terms of intervention strategy and sizing of water resources.

VII.7 Data center security

The BEA-RI is responsible for carrying out technical investigations following industrial accidents with the aim of learning lessons and advancing safety in the field of installations classified for the protection of the environment, which are installations presenting risks for the environment and the population.

The expertise carried out within the framework of this investigation shows that the fire, although significant, ultimately had no consequences on the human level and, at this stage, limited on the environmental level. The major consequence of such a fire is above all economic and strategic in terms of loss of sensitive data and unavailability of the service.

This finding is consistent with the fact that data centers are not installations classified as such, even if, as indicated above, certain utilities necessary for their operation (generators, battery charging installations, possibly air-cooling towers) may be classified facilities.

Consequently, the BEA-RI does not consider that the level of risk presented by the data centers justifies their being classified to be subject to safety regulations under the Environment Code13 .

Insofar as data centers are not classified installations and where the town planning code makes it difficult to set specific requirements relating to fire prevention, the BEA-RI welcomes the initiative of the profession and insurers in the development of professional guides (cf. III.5). It is important that this approach be continued and integrate experience feedback such as that resulting from the present event.

Like other datacenter operators, OVH has the security visa of ANSII, the National Agency for Information Systems Security (ANSSI), which allows it to host data on behalf of public entities, operators of vital importance (OIV) and operators of essential services (OSE). These organizations can thus outsource the hosting of their data, applications and information systems to partners such as OVH.

However, the fire in Strasbourg highlighted the vulnerability of facilities to technological hazards and the need to demand from these operators a minimum level of safety and resilience in the industrial sense of the term.

Consequently, the BEA-RI considers that the security recommendations resulting from this professional guide should be taken into account within the framework of this certification by the ANSSI.

VIII. Safety recommendation for the operator

VIII.1 To the DGPR

The BEA-RI issues the following recommendation to the attention of the DGPR:

OVH's experience feedback from the fire shows that protecting only the battery storage room would not have prevented the fire. It is therefore appropriate to apply the requirements relating to the fire behavior of buildings to premises which house the electrical equipment which is used to charge the batteries and which is directly connected to them. This amounts to defining a charging workshop as the room that houses the batteries and also the equipment used for charging.

VIII.2 For the operator

The BEA-RI issues the following recommendations to OVH:

- As part of the reconstruction of its facilities or the construction of its next data centers, take into account the feedback from the fire in the SBG2 building in Strasbourg in terms of the design of buildings and rooms F energy G, in terms of means of detecting and fighting fires, and in terms of emergency procedures. On the site of

[13] The ICPE classification of data centers could nevertheless be justified by the important issues related to the limitation of the energy consumption of this equipment insofar as the rational use of energy has been part of the protected interests listed in article L 511 since 2010. -1 of the environmental code. The classification of data centers would then lead to registering them within the framework of a special policy under the responsibility of the prefect, whereas their location today is solely a matter of planning decisions. It is not for the BEA-RI to take a position on this subject.

Strasbourg, establish and implement, through exercises, emergency procedures for securing electrical installations in order to facilitate the intervention of the public emergency services.

- **Carry out an audit of all of its facilities, to study the vulnerability of its sites to the risk of fire.**

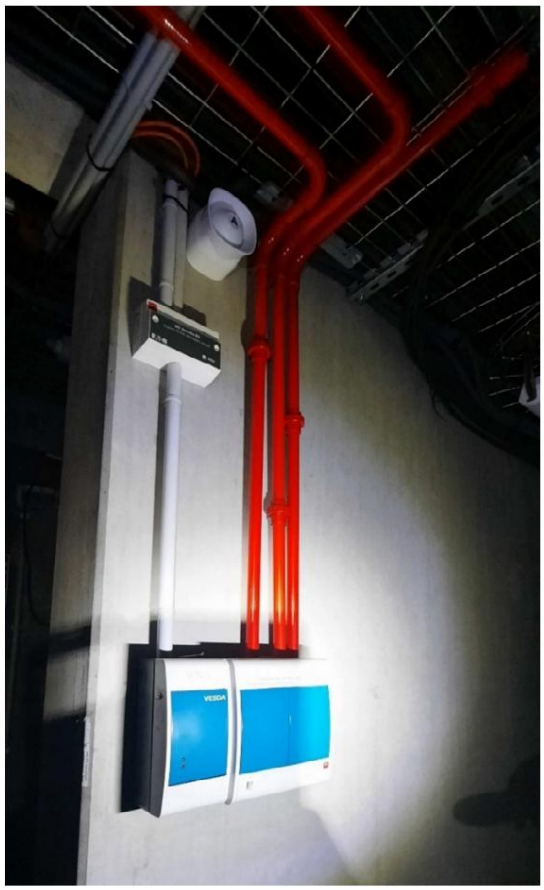
IX. Appendices

Annex 1	Photographic board of the site	39
Annex 2	Map of the OVH Strasbourg site	41
Annex 3	Plan of the ground floor of the SBG2 building	42

Annex 1 Photographic board of the site

Photograph 11: Battery room of the type involved in the fire

Photograph 12: uninterruptible power supply system (UPS) similar to that involved in the fire



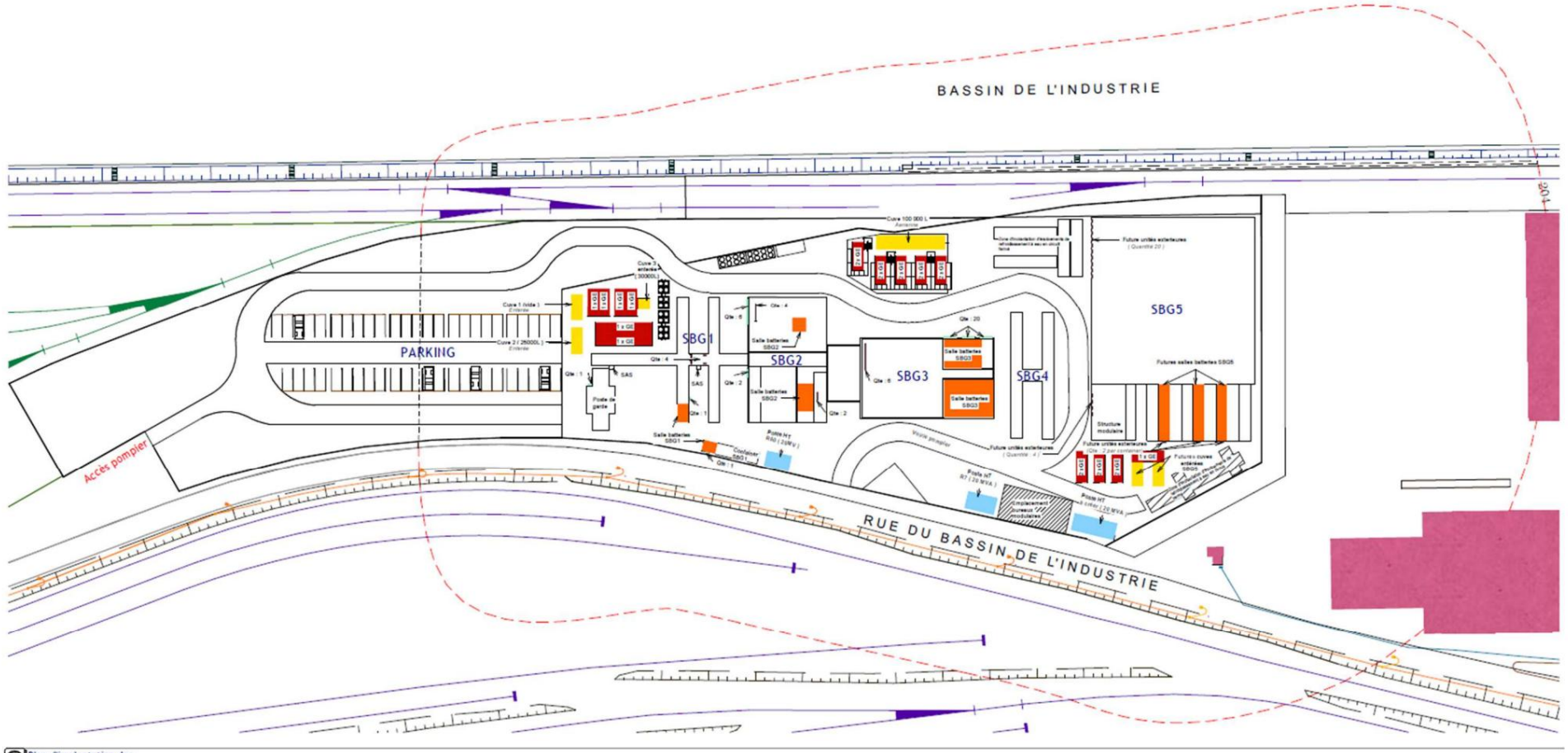
Photograph 13: fire detection unit

Photograph 14: SBG1 building

Photograph 15: view of the OVH site at 6:47 a.m. on March 10, 2021 (source SIS 67)

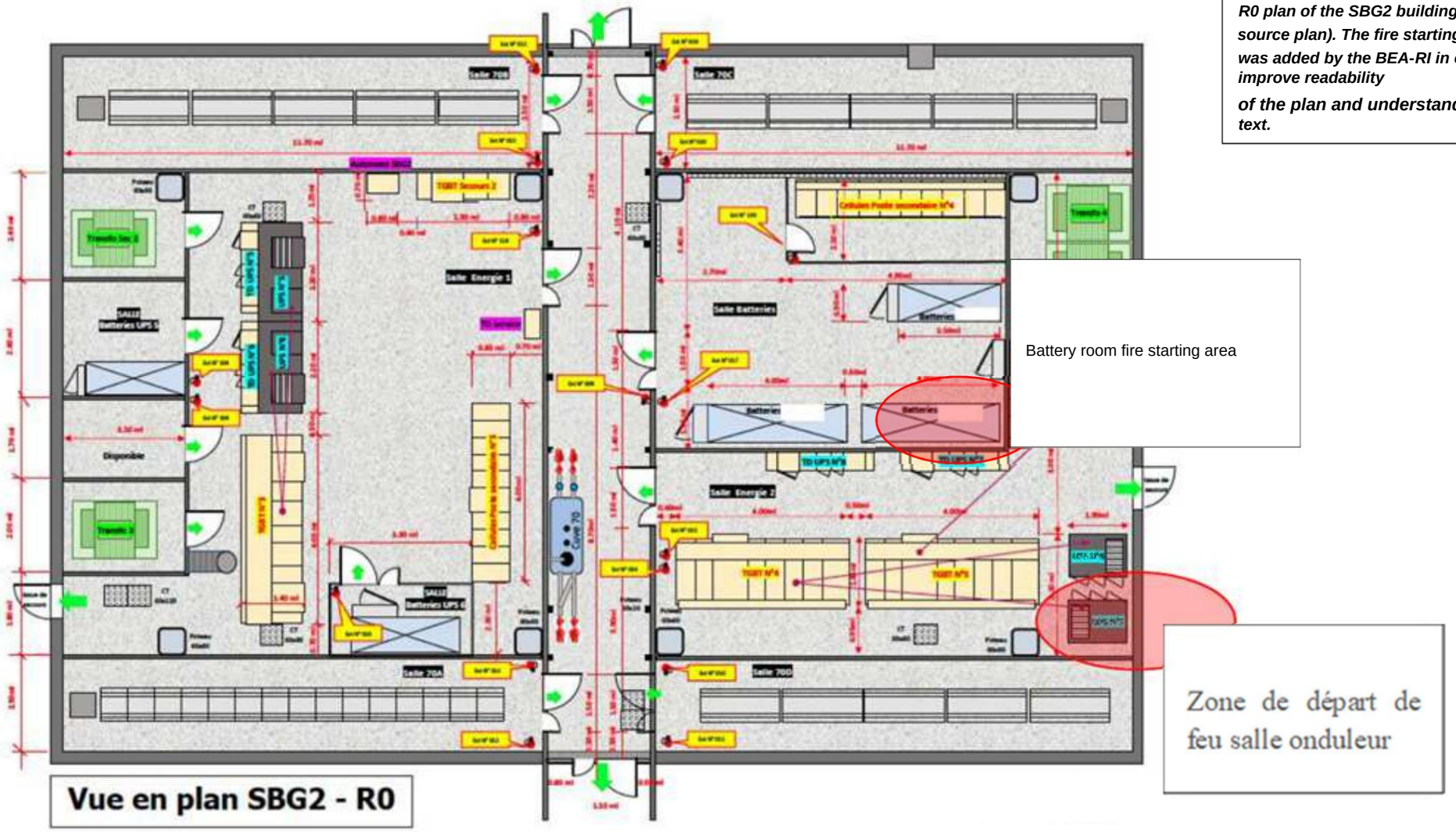
Photograph 16: view of the OVH site at 9:30 a.m. on March 10, 2021 (source SIS 67)

Appendix 2 Map of the OVH Strasbourg site



Plan d'implantation des equipements niveaux rez-de-chaussée

Annex 3 Plan of the ground floor of the SBG2 building



R0 plan of the SBG2 building (OVH source plan). The fire starting zone was added by the BEA-RI in order to improve readability of the plan and understanding of the text.

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Risques industriels

Bureau of Investigation and Analysis of Industrial Risks

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