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TECHNOLOGY FOR
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Test report: ACCU Stabilizers for Positive Cold Room

Tests conducted at the CERP Rouen Site Mareuil Les
Meaux - CF2N Installed in November 2022

Date: 07/01/2022

Preamble

We develop solutions to improve the storage and distribution of temperature-controlled pharmaceuticals. As such, we have identified a sensitive point in the storage of heat-sensitive products in cold rooms, and in particular in the autonomy of cold rooms in the event of failure of cold production systems.

To overcome this, we have developed a type of energy accumulator to store and restore energy at any time, depending on the drifts of exploitation. This system consists of solid plates, filled with PCM (Phase Change Material), an element with positive phase change.

These plates are deployed in the cold room in a homogeneous way in order to guarantee an optimal restitution of the stored energy in case of necessity.

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1. Objective of the test

The main objective of the test is to demonstrate the interest and effectiveness of the solution under reset conditions, in the cold room of the client.

For this, the ACSEs are positioned in a representative manner in the cold room. Following this, deliberate breakdowns are then simulated.

2. Test Framework

The test takes place on the cold room 8 glass doors at the agency of CERP Mareuil les Meaux, newly installed. The cold room has been calibrated and qualified at the pre-able. We supplied 280 PCM5 batteries of 4 kg to equip the cold room. We performed a complete mapping of 30 sensors of the working volume of the cold room. Cold room tested: Installed refrigeration capacity 2 x 7kW

Length = 9,60m

Width = 3,60m

Height = 2.46m

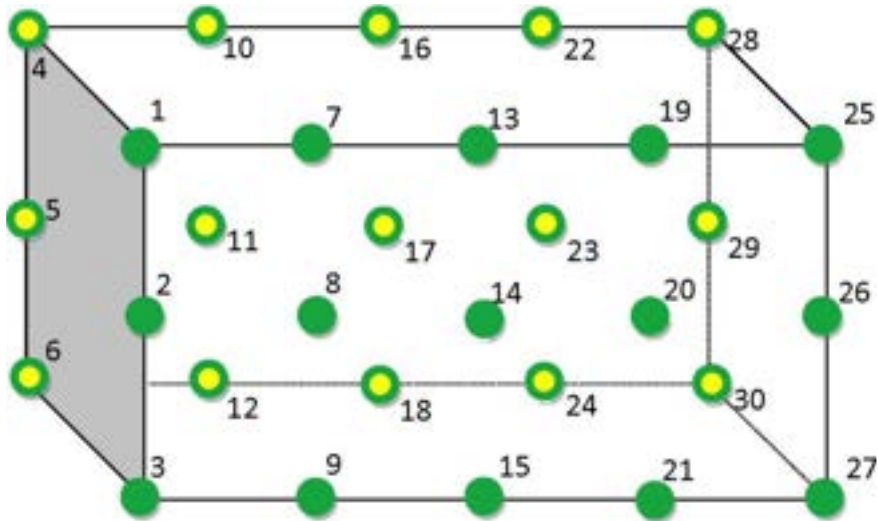
Useful volume = 80,5m³



3. Mapping of test

Mapping sensors to calibrated probe numbers:

Sensor name	Positioning	Serial number reference calibration
Sensor 1	See diagram	9283
Sensor 2	See diagram	7417
Sensor 3	See diagram	9789
Sensor 4	See diagram	2139
Sensor 5	See diagram	9758
Sensor 6	See diagram	0684
Sensor 7	See diagram	1630
Sensor 8	See diagram	1764
Sensor 9	See diagram	8282
Sensor 10	See diagram	9568
Sensor 11	See diagram	9694
Sensor 12	See diagram	9575
Sensor 13	See diagram	7851
Sensor 14	See diagram	9051
Sensor 15	See diagram	1583
Sensor 16	See diagram	1271
Sensor 17	See diagram	3095
Sensor 18	See diagram	9914
Sensor 19	See diagram	5670
Sensor 20	See diagram	1182
Sensor 21	See diagram	9937
Sensor 22	See diagram	0691
Sensor 23	See diagram	9374
Sensor 24	See diagram	9821
Sensor 25	See diagram	9613
Sensor 26	See diagram	1384
Sensor 27	See diagram	9728
Sensor 28	See diagram	1714
Sensor 29	See diagram	7832
Sensor 30	See diagram	0532



4. Implementation of THE ACCUS

The 280 energy batteries are deployed on the shelves of the cold room. Given that we are in a provisional test condition, the BATTERIES are simply placed on the shelves. In case of definitive implementation, the batteries would be supported below the shelves so as not to encroach on the volume of exploitation of the client. Illustrations of the deployment:



5. The Protocol

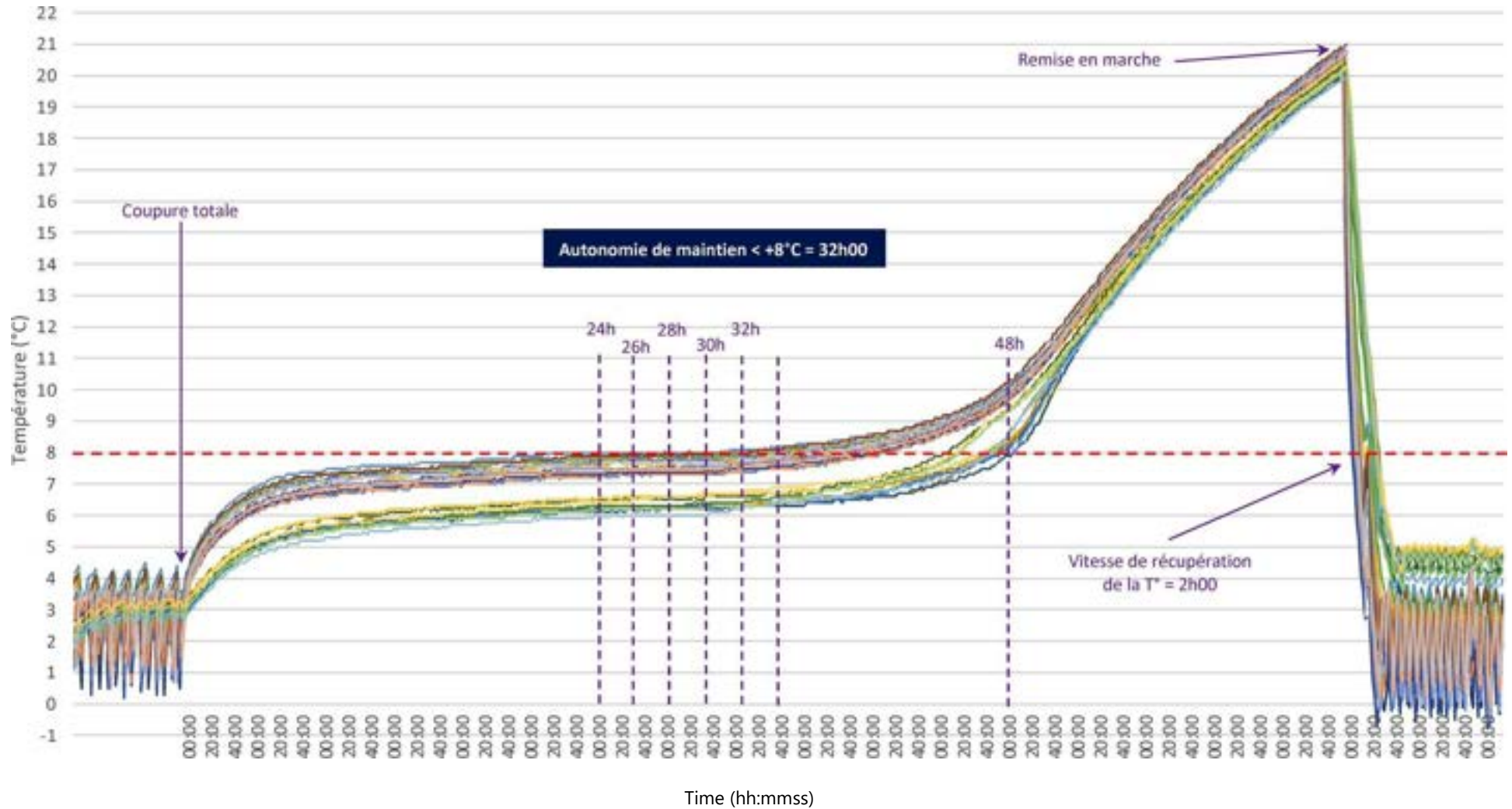
The operational conduct of the test was as follows:

Steps	Description	Day
i	On-site reception of ACCUS	0
2	Installation of CF monitoring sensors - CF setpoint at +4.5°C	1
3	Installation of the power consumption logger	1
4	Check-in starts for 24:00 continuous	1
5	Data recovery - re-installation of sensors	2
6	Installation of CF BATTERIES - setting set to 0°C	2
7	Stabilization of THE ACCUS for 48h00	3
8	CF set setting to +4.5°C.	5
9	Check-in for 24h00 of consumption	5
10	Partial shutdown of GR1 installation at shutdown - not done	6
11	Partial shutdown of GR2 installation at shutdown - not done	6
12	Total shutdown of gr1 and GR2 installation at a standstill	7
13	End of test - dismantling ACCUS - return of F equipment	8

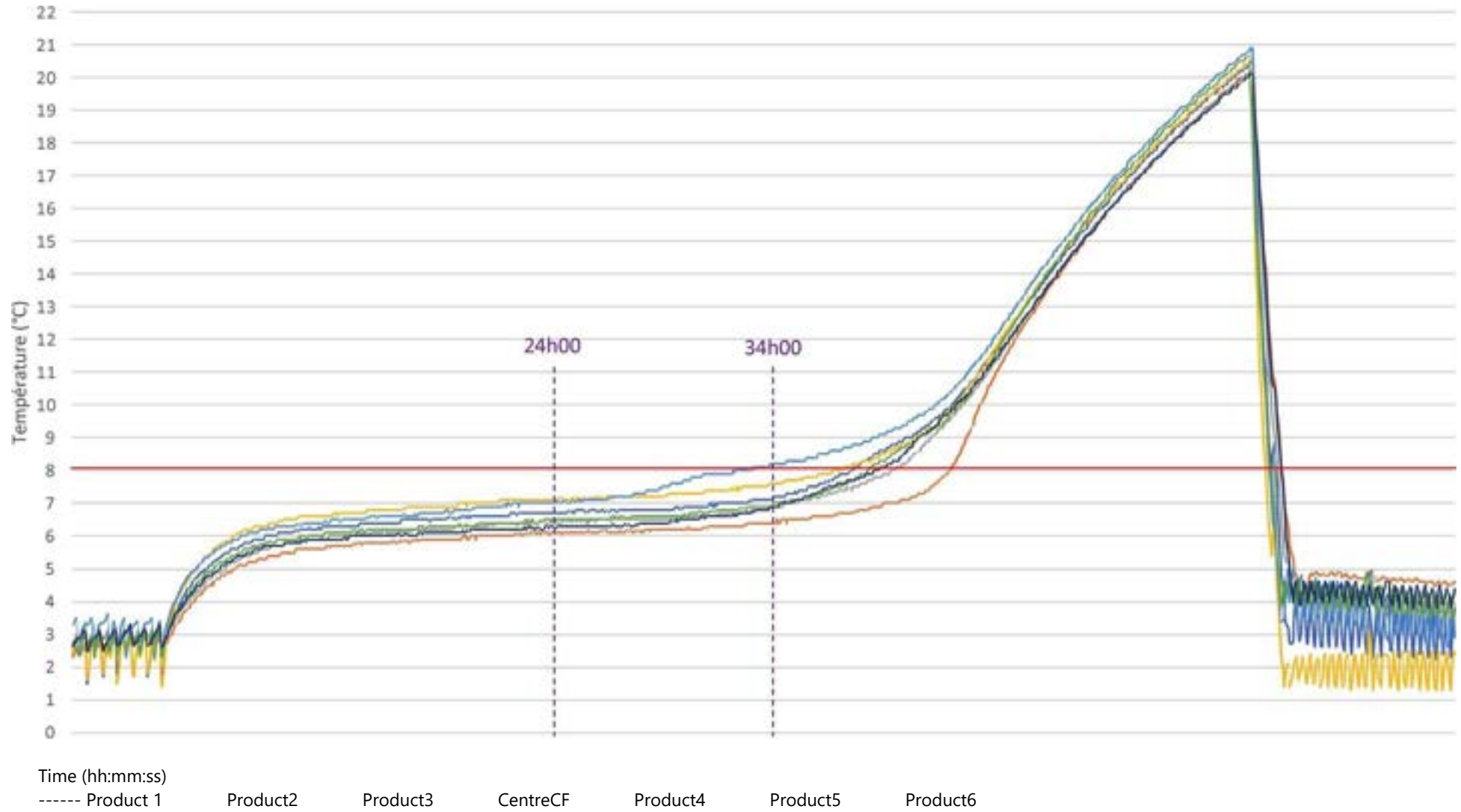
6. The Resultd

The most relevant data are those obtained during the total cut-off test of the cold room; we will dwell on the analysis of this step. Below is the graph illustrating the temperature rise of the 30 sensors of the mapping.2

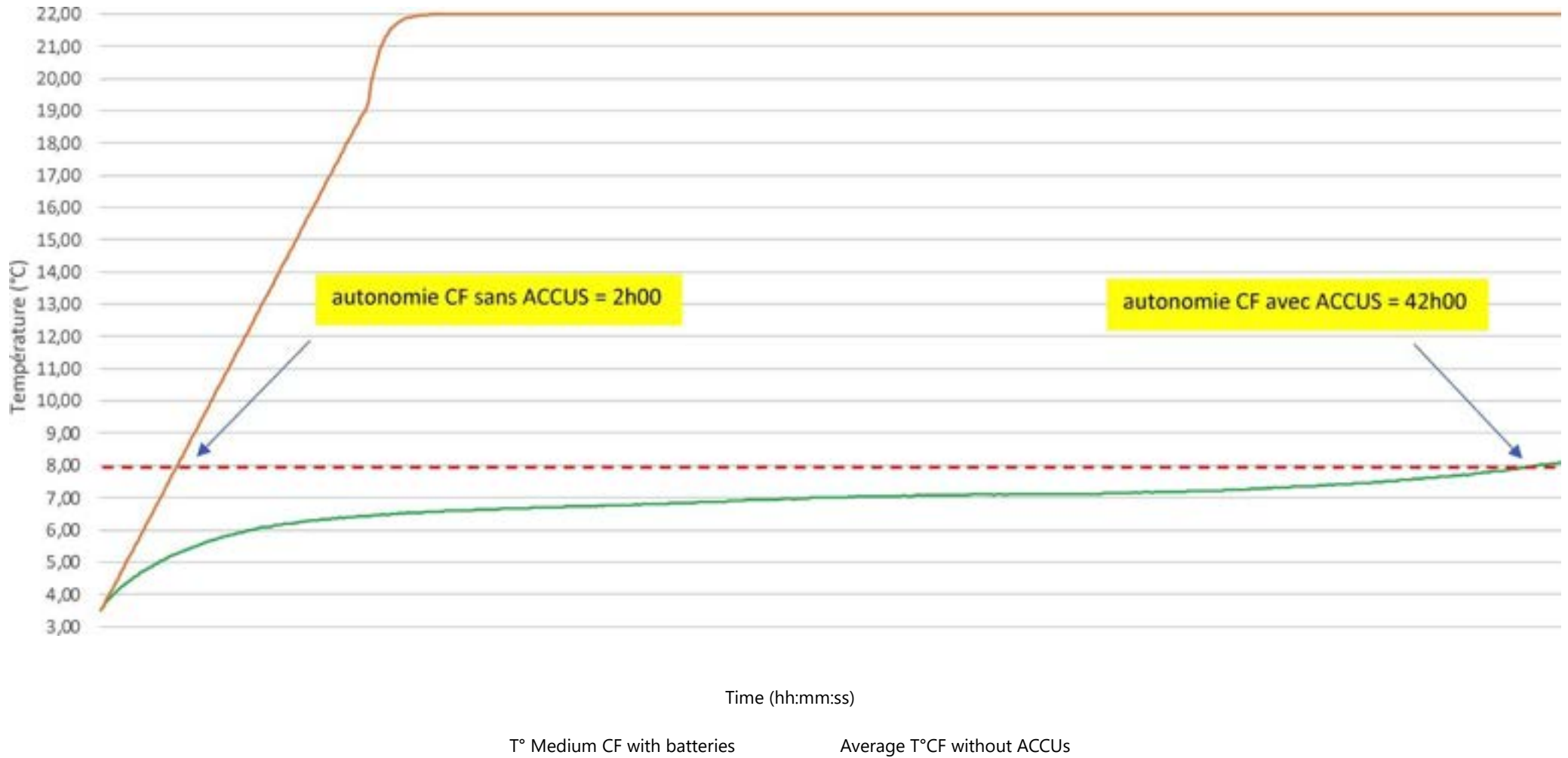
Measure of autonomy of Batteries Cold in cold room Positive - CERP Mareuil - le 22/12/2021



Cold Batteries Test - T° at the level some produce in CF - Cerp Mareuil - on 22/12/2021



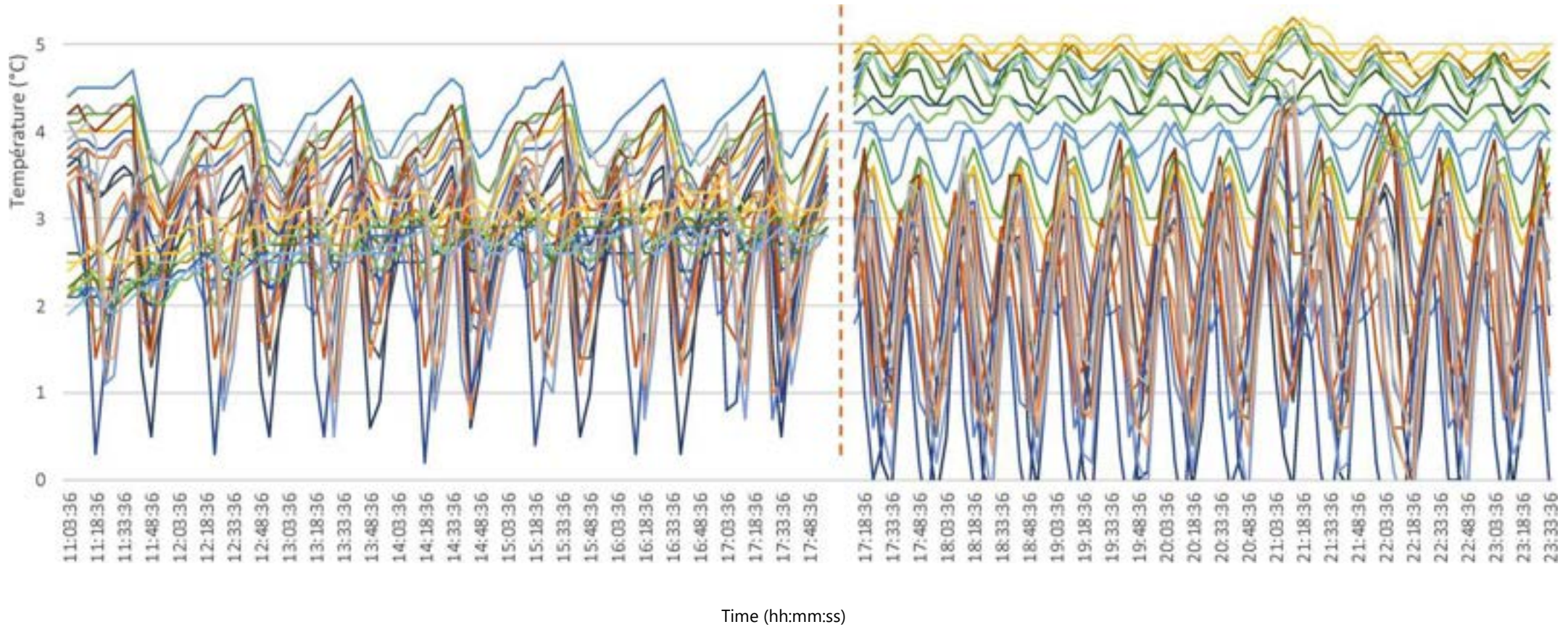
Autonomies averages compared - CF with ACCUS / CF without ACCUS - le 12/01/2022



Comparison of Operation Cold groups - With ACCUS / without ACCUS - on 20/12/202

With ACCUS

Without BATTERIES



7. Conclusion

Cold battery effect:

The measurement in more than 30 points made it possible to demonstrate the effectiveness of THE PCM ACCUS in positive cold room . The autonomy for a cold room of 80 m3 mass loaded with 1120 kg of PCM batteries has increased the autonomy of the cold room initially known from 2h00 to now more than 32h00. The "average autonomy of the 30 sensors" a vacuum even reached 42h00.This test was carried out empty; it is certain that the autonomy in charge would certainly be increased by a few hours.

Energy saving effect - "approached":

Elsewhere, the number of cold unit starts is reduced by 30%; we go from 19 starts on 6h00 continuous against 13 with the ACCUS set up. This would make it possible to achieve energy savings that may resemble

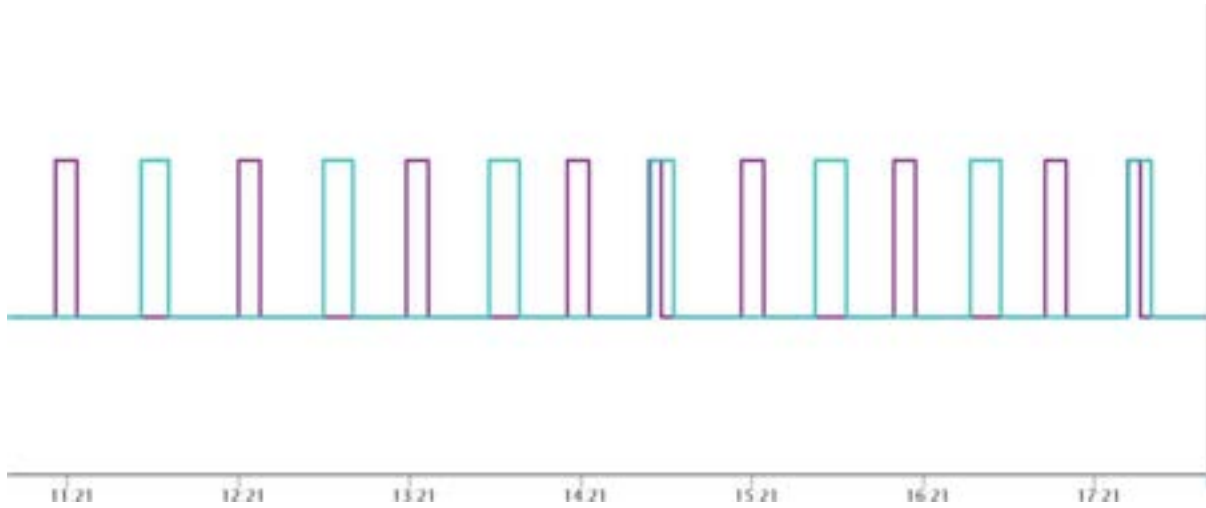
- Each refrigeration unit is 4.5 kwh
- 2 refrigeration units per CF either = 9 kwh or 108 kwh per day
- Or 3240 kwh per month for normal operation
- The annual total consumed is 38,880 kwh or 5832 € / year (kWh valued at 150€/MWh)

The annual savings generated by the addition of the ACCUS is potentially 1944 € / year per cold room.

ANNEXES

Compressor Starts:

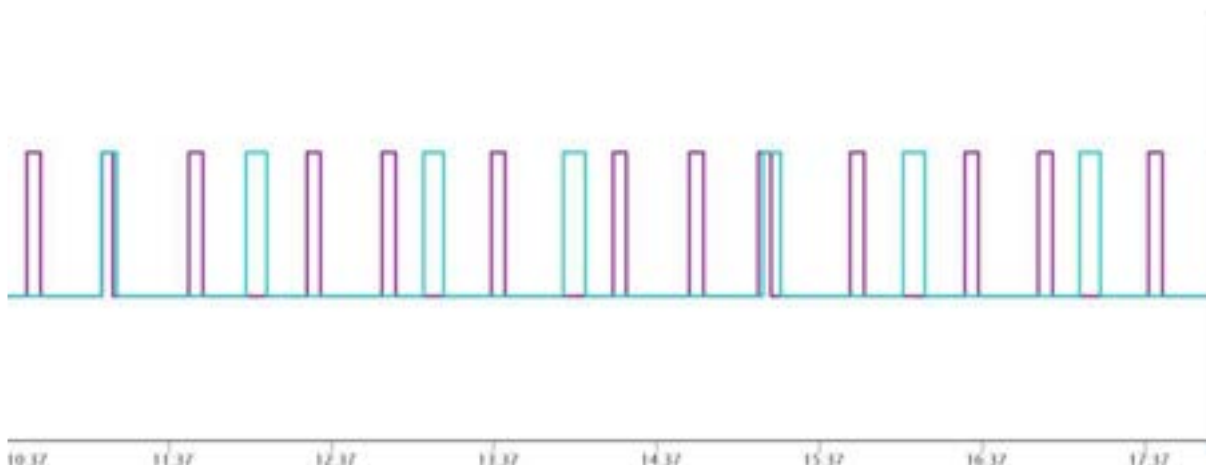
WITH Batteries



— S077-2 CERP Mareuil CF2 - CF2 Compressor 1—S077-2CERPMareuilCF2-CF2Compressor2

Zoom from 12/17/2021 10:21:00 to 1 7/12/2021 18:00:59

WITHOUT Batteries



— S077-2 CERP Mareuil CF2 - CF2 Compressor 1—S077-2CERPMareuilCF2-CF2Compressor2

Zoom from 2021-12-23 10:37:00 to 12/23/2021 18:00:59