

Passive HVAC cooling system

Prolonged passive room cooling via phase change materials

Framatome's passive room cooling solution enables you to achieve a prolonged operation of critical components during insufficiencies or failure of HVAC systems. By providing an extended cooling time through application of phase change materials you gain critical time in accident situations and cushion for regulator time constraint requirements

Challenge

Modernization of I&C cabinets almost always lead to an increase of I&C room thermal heat load which can in turn endanger the stable operability of a power plant. With every increase in heat load, the thermal inertia of the affected room decreases. To keep electrical equipment within its qualified temperature limits an adequate cooling capacity is paramount.

In case the HVAC system fails or runs with insufficient capacity and critical I&C equipment is no longer cooled, its qualification temperature can be exceeded in a matter of minutes. Overheated I&C cabinets will stop to function due to their thermal protection or may get damaged in this process.

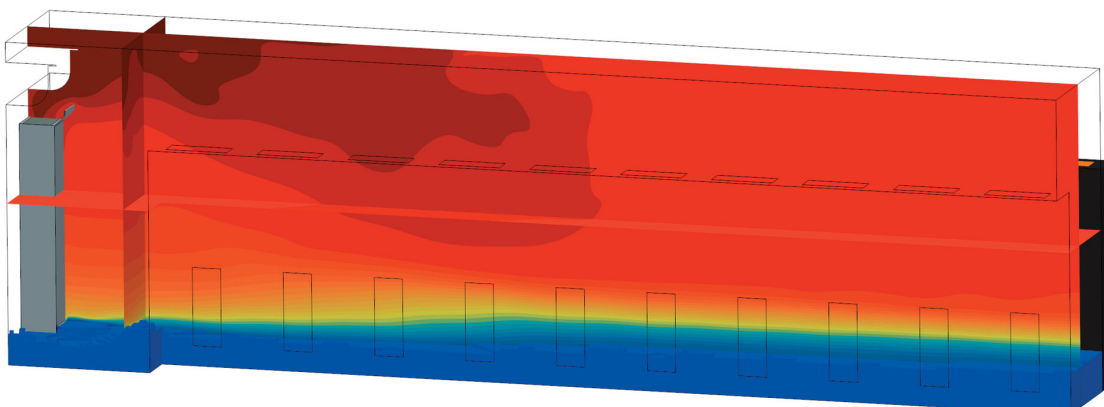
Solution

Framatome's semi-passive HVAC cooling solution is based on phase change materials (PCMs) that absorb excess heat in the enthalpy of the melting process. This enables the increase of thermal inertia of any room. Especially for critical or safety I&C our solution helps to extend the permitted grace period before equipment limiting qualification temperatures are reached.

The semi-passive HVAC system is not only suited for new build projects but can also be fitted to existing structures. Depending on the space available and the size of the room, the grace period before equipment reaches the maximum operating temperature can be extended from only minutes without PCM to several hours. The extended grace period allows enough time to react to malfunctioning or any incident leading to a temporary loss of the HVAC system and decreases the importance of active ventilation.

Customer benefits

- Ensure inherently safe room cooling for critical time periods ("grace period").
- Gain valuable time to analyze and fix malfunctioning or insufficient HVAC system while I&C cabinets remain within temperature limits.
- Decrease impact of active HVAC systems on safety assessments.
- Avoid loss of I&C functions and keep plant operational for longer.
- Tailor-made to customer needs:
 - Fast and cost-efficient construction of HVAC room models according to customer layout requirements due to extensive in-house experience.
 - Large variety of customer requirements can be met with our existing scalable CFD base models.



CFD room model with air temperature color profile – 10 I&C racks and 1 PCM rack

Technical information – function principle

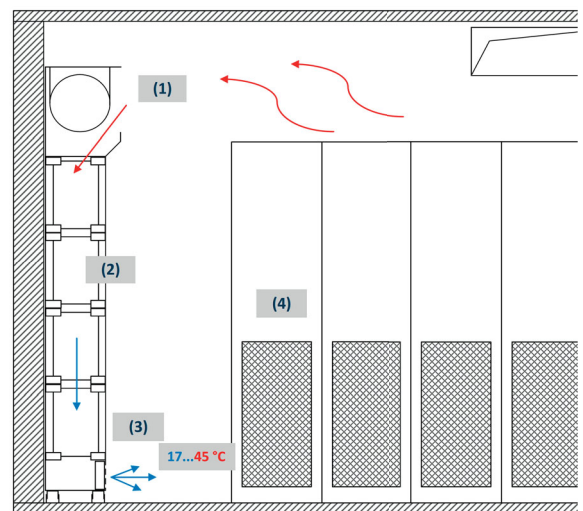
With operational HVAC in normal operation, cool air coming from the HVAC system enters the PCM rack from the top, flows downwards alongside the PCM plates and keeps them “frozen”.

In case of HVAC insufficiency or total loss of HVAC, rooms with high heat emissions an critical equipment can be equipped with Framatome PCM racks which then acts as a “thermal battery” via phase change material melting.

The hot air gathers at the room ceiling and moves towards the PCM rack inlet. It then flows downwards passing the cold PCM plates inside the housing and is cooled down while melding the PCM.

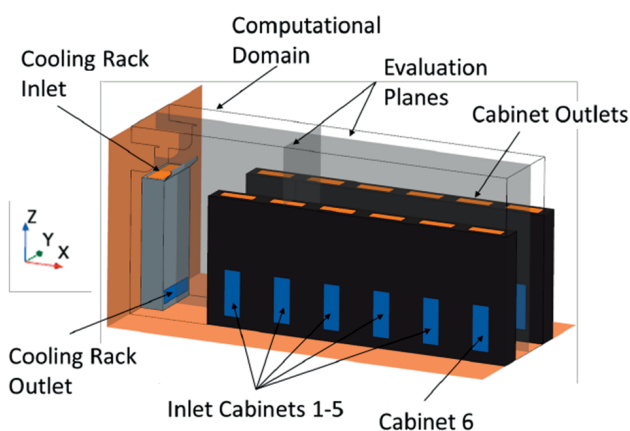
This passive room air circulation can also be enhanced decisively by a low power fan-module (e.g. 20W, battery backed), installed in the bottom area of the PCM rack.

The PCM plates are arranged in 1 m rack modules with a special integrated supply air duct. Wall mounting in a line as well as an installation in the room, e.g. between heat sources, is possible.



- (1) Hot room air inlet
- (2) Air flow cooled by PCM plates
- (3) Cooled air outlet
- (4) Heat source: e.g. Battery powered I&C cabinets

Example 3D room model



Grace period [h]	Waste heat per I&C cabinet [W]					
	100	200	300	400	500	600
1	10	10	10	10	10	10
2	10	10	10	10	10	10
3	10	10	10	10	10	10
4	10	10	10	10	9	7
5	10	10	10	9	7	6
6	10	10	10	7	6	5
7	10	10	9	6	5	4
8	10	10	7	5	4	3
9	10	10	7	5	4	3
10	10	9	6	4	3	3

Key parameters

- Increase safety I&C cabinets temperature grace period from minutes to hours
- Small footprint
- Simple design
- Passive or semi passive with minimal power requirements (~20W)

Your performance
is **our** everyday **commitment**

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