GenCell®

COLD START MECHANISM - ENSURING RAPID FUEL CELL KICK - IN EVEN IN SUB - FREEZING TEMPERATURES

The GenCell BOX™ and GenCell REX™ long-duration backup power solutions for mission-critical applications and for utility substations have been designed to deliver zero-emission, climate-resilient power to ensure uninterrupted operations in locations where the grid is at high risk of power outages. Fueled by hydrogen, GenCell's alkaline fuel cell technology is extremely rugged and robust, capable of withstanding inclement weather and severe climate conditions and a broad temperature range. With little maintenance or servicing, the units are positioned in remote locations on stand-by, ready to kick in and deliver power immediately on-demand and to continue to operate continuously until the outage is repaired, for as long as fuel is available.

A notable and exceptional advantage of alkaline fuel cell technology is its ability to withstand sub-freezing temperatures. To best leverage this capacity, GenCell developed an automated cold start mechanism and incorporated it as a standard feature of GenCell's backup solutions. Tested in the lab and in the field, the mechanism has been proven effective and has since been commercially deployed at customer sites.

GENCELL's AUTOMATED COLD START MECHANISM: A TECHNICAL DESCRIPTION

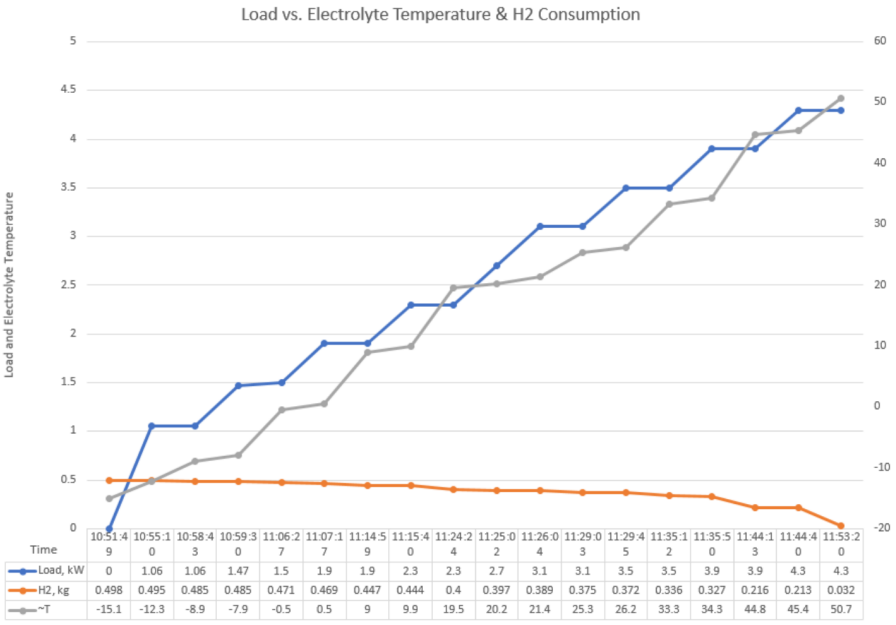
A standard feature of the GenCell BOX and REX backup units, the cold start mechanism ensures that the unit is operationally ready to kick in at any time, without thermal conditioning, regardless of low temperatures. Operating at a temperature range of between -20° through to + 45°C, in operating temperatures under -20° C and as low as -30°C, the system automatically activates a preheating unit (PHU) to prevent the temperature of the unit from falling under -15°C. The PHU consumes no more than ~200–350W of external power, which it obtains from either the grid connection or the battery.

If an outage occurs when the temperature of the electrolyte inside the ECG is -15°C, the system will immediately initiate operations, first heating the electrolyte to a temperature of +20°C, a process that will take some 30 minutes, at which point the fuel cell will begin to generate power to the load.

In contrast, Proton Exchange Membrane (PEM) fuel cells need to maintain the moisture of the membrane with water that will have to be kept at a temperature of above 4°C to protect the membrane from damage.

At a GenCell BOX deployment at a mobile telecom tower site in Germany, the unit was installed with a PHU featuring a manual start process which was configured to maintain the electrolyte at a constant temperature of +30°C degrees. In the event of an outage, the fuel cell would kick in and support the electrical load within one minute.

At another GenCell BOX customer deployment at a mobile telecom tower site in Hungary, GenCell carried out a two-hour test of the cold start mechanism when the outside temperature averaged 6°C. In this case the unit did not include a PHU, yet within ten minutes from the test start, the system had successfully heated up the electrolyte to 50% of the target temperature and after 70 minutes the unit achieved full capacity to support the site load.



Time	10:51:49	10:55:10	10:58:43	10:59:30	11:06:27	11:07:17	11:14:59	11:15:40	11:24:22	11:25:02	11:26:04	11:29:03	11:29:45	11:35:12	11:35:50	11:44:13	11:44:40	11:53:20
Load, kW	0	1.06	1.06	1.47	1.5	1.9	1.9	2.3	2.3	2.7	3.1	3.1	3.5	3.5	3.9	3.9	4.3	4.3
H2, kg	0.498	0.495	0.485	0.485	0.471	0.469	0.447	0.444	0.4	0.397	0.389	0.375	0.372	0.336	0.327	0.216	0.213	0.032
~T	-15.1	-12.3	-8.9	-7.9	-0.5	0.5	9	9.9	19.5	20.2	21.4	25.3	26.2	33.3	34.3	44.8	45.4	50.7

This test supported the findings of an internal test of the cold start mechanism conducted by the GenCell R&D Lab in 2022 evaluating the ability of the system to kick in at severely cold temperatures in a range from -15°C to -20°C. The goal of the test was to warm up the electrolyte to a target temperature of +50°C so as to generate a nominal power output of 5 kW without an external power supply, using only the system's internal heating sources. The test involved a duration of some 70-75 minutes for the electrolyte to heat up to the target temperature without external preheating of the system. The fuel cell unit displayed stable performance throughout the testing procedure. Visual inspection conducted after the test revealed neither defects nor damage to the system. The test demonstrated that the fuel cell reached a power output of 3kW after 34 minutes and an output of over 4kW in under an hour.