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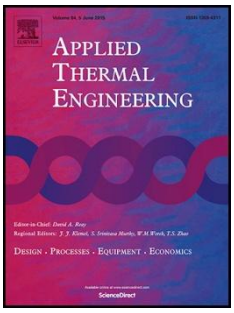

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Protection of electronic devices on nuclear rescue robot: passive thermal control

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Highlights

- A passive thermal control strategy for electronics on nuclear robot was proposed.
- The PCM based adiabatic system prolonged 12-fold safety working time.
- The system kept drivers safely working for more than 98 min at 100 ^{o}C test.

Abstract

Thermal control is one of the most crucial problems for electronic devices on nuclear emergency rescue robot due to the harsh operating conditions. Phase change material (PCM) based heat sink and heat insulation layers, serving as a passive thermal control system, were applied for motor driver as a case for electronics protection on nuclear rescue robot. Two types of PCM based thermal control systems for both room temperature and elevated temperature environments were proposed considering the nuclear accident condition. The anti-irradiation property of an organic commercial PCM OP44E was studied. Experiments were conducted to investigate effects of system structure and heat source power on the temperature control. Results showed that the system can greatly prolong the motor driver's safe running time for more than 1 hour without any power consumption. The best working time was almost linearly decreased with the increase of the input power. High temperature test at 100 ^{o}C indicated that the motor driver could safely operate for more than 98 min. The PCM based support frame increased 54% of the best working time.

Keywords: Nuclear rescue robot; Phase change materials; Passive thermal control; Motor driver

1 Introduction

Since the nuclear disaster occurred at Fukushima in 2011, various types of irradiation, high temperature and humidity make human body impossible to approach the nuclear station. Emergency rescue robots are therefore in urgent need to access to critical area for data collection, undertaking primary tasks, including detection, drill, twisting valves, underwater probing and welding [1-2]. However, because

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