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Redox Flow Batteries for Grid-scale Energy Storage

SUMMARY

Though considered a promising large-scale energy storage device, the real-world deployment of redox flow batteries has been limited by their inability to work well in a wide range of temperatures and their relatively high cost. Historically, the state-of-the-art has been an all-vanadium redox flow battery using a sulfate-based electrolyte.

Researchers at PNNL have developed two novel approaches to redox flow batteries that overcome these barriers and offer superior performance and cost advantages unlike any existing system.

The first approach is a new mixed-acid electrolyte with 70% higher energy density and a broader operating temperature range than current all-vanadium redox flow batteries. The second approach is a low-cost iron-vanadium redox flow battery, with higher energy density and greater temperature stability without the hydrogen gas evolution issues (flammability) that currently plague the Fe-Cr flow battery. The two new chemistries allow design optimization between battery performance, operating conditions and cost.

Detailed life cycle cost analyses further show that these new redox flow batteries are less expensive than most other storage alternatives and incorporation could enable addition of more wind turbines and solar panels to the grid without compromising grid reliability.

ADVANTAGES

* Independently scalable in two dimensions (capacity [kW-h] and in power [kW])

* Very cost effective for grid-scale applications

* Safe, stable and tolerant of temperature extremes

* Enables renewable technology integration

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