

Leading Deployment and Applications of Safe, Reliable and Flexible New Generation VFB

Remote island grid



C& I, With PV



ReFlex™



- 👍 Highly modularized
- 👍 Safe
- 👍 Reliable
- 👍 Flexible
- 👍 Sustainable
- 👍 Value-competitive

Microgrid, with PV



T&D application



ZERO CAPACITY DEGRADATION
NON-FLAMMABLE ELECTROLYTE
UNLIMITED CYCLES
NO THERMAL RUNAWAY
20+ YEAR LIFETIME
HIGHLY RECYCLABLE
SHIPS WET, 50% CHARGED
SELF-POWERED AUX BACKUP
SECONDARY CONTAINMENT
REDUNDANCY OPTION
AIR COOLED

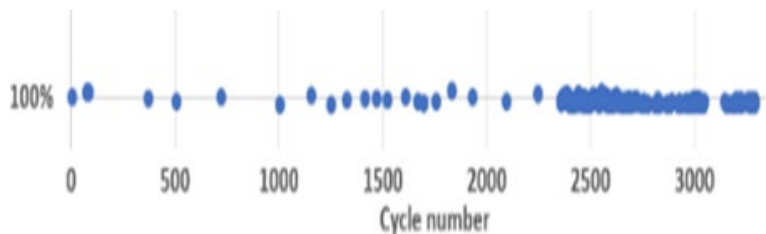
DISCHARGE PERFORMANCE

Duration	Power	Energy	Efficiency
2 Hour	14 kW	28 kWh	75%
4 Hour	9.5 kW	38 kWh	80%
6 Hour	7 kW	42 kWh	82%
8 Hour	5.5 kW	44 kWh	84%



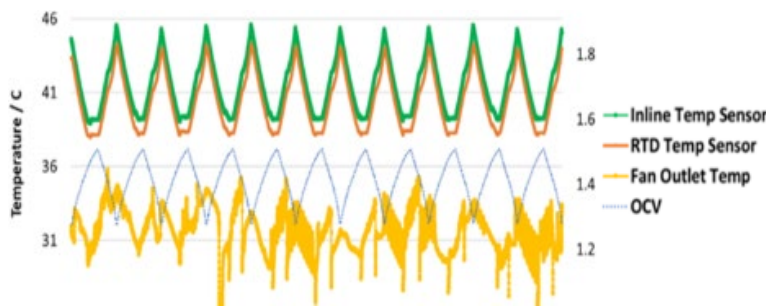
Up to multi-MWs

Rigorously tested, being UL/CE certified



Cyclability and Stability:

no capacity fade over
>3400 cycles at 100%
DOD



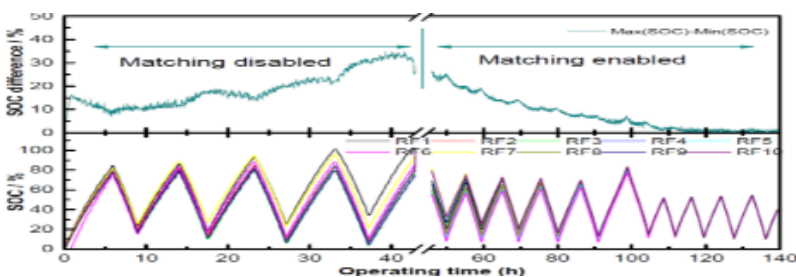
Heat Management,

validated with only fan
cooling adequate



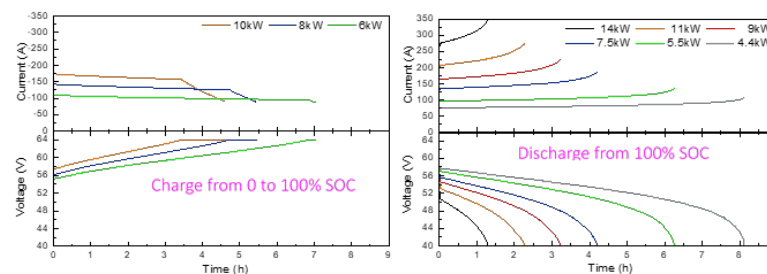
Scalability, stacked up:

Seamless bypass,
150X in availability
over Uni.System™



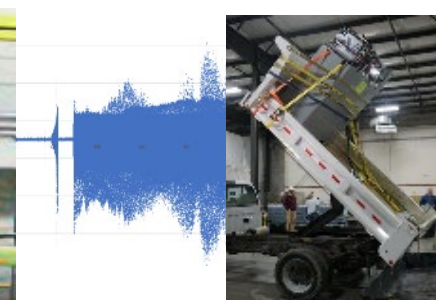
Balancing management:

Proprietary control, 98%
capacity alignment,
achieved long term
stability



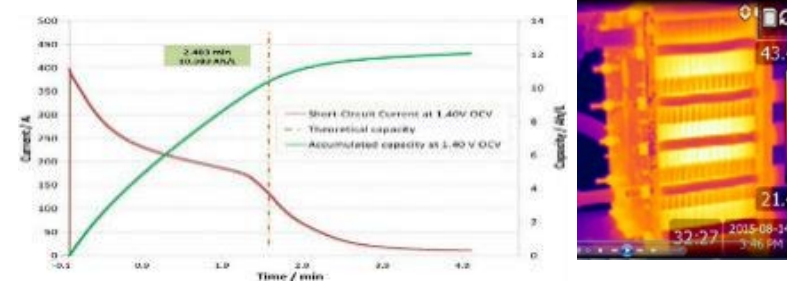
Flexibility in Performance,

meeting customer
demands in kW and kWh



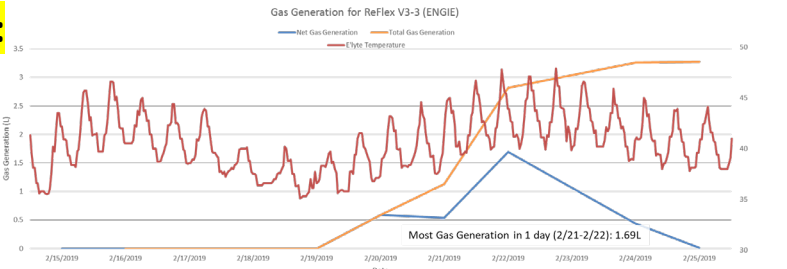
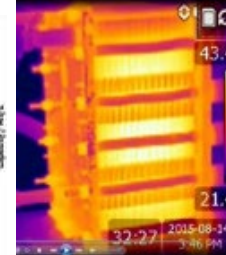
Mechanical Integrity -

Transportation/Shipping
Validation



Safety Validation:

Short circuited, Increasing
by only 9°C; No thermal
runaway



Gas management:

Negligible gas evolution
under normal operation,
fully managed under
extreme conditions

Accumulated over 500K hrs operation, achieved 98% availability

From C&I, Microgrid to T&D, plus renewable integration



PNNL



UET



SNL



MEPPI



Laborelec, Engie



Shangluo



RKPI



BNM



NR Project



Heron Island

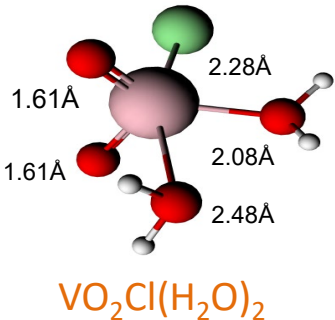
A long journey from lab to a safe, reliable and flexible product



2008~2011

Discovery at PNNL

- Developed new generation VRFB chemistry



2012~14

Early Productization

- Engineering, prototyping, rolling out container products



20'X20' container system

2015-17

Field Demos & Validation

- Manufacturing, field-deployment and operation
- Understanding customers



Uni.System™

2018~present

Product Maturation

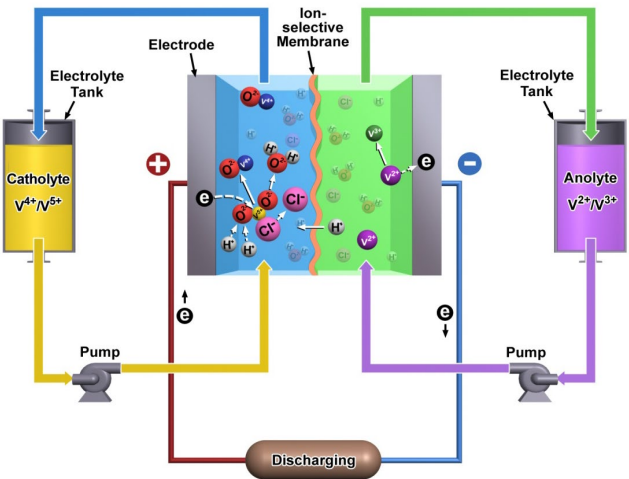
- Customer driven-design
- Flexible, Modular, Resilient



ReFlex™

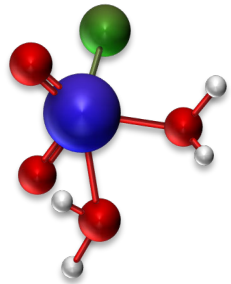


17 February 2020



*Leading Development, Deployment and Applications of **Safe, Reliable and Flexible** New Generation VFB*

Technologies:



Working with SNL, PNNL to
advance safety, reliability

INNOVATION + QUALITY + PARTNERSHIPS



Channel partners on
deployment



Membrane development and
production, advancing stacks

EcoPartners:



10 years stack field experience, ramping
up GW production capacity



Electrolyte production: 1.5 GWh/yr
capacity