

Welcome to National Renewable Energy Laboratory (NREL)



Advanced Grid Technologies Laboratory Workshop Series

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Manager, Distributed Power System Section

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Laboratory Snapshot

NREL is the only federal laboratory dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency technologies

- Physical Assets Owned by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy
- Operated by the Alliance for Sustainable Energy under Contract to DOE
- 2300 staff and world-class facilities
- More than 600 active partnerships annually
- Campus is a living model of sustainable energy
- FY14 Funding 360 million



Sustainable Transportation

Vehicle Technologies
Hydrogen
Biofuels

Energy Productivity

Residential Buildings
Commercial Buildings

Renewable Electricity

Solar
Wind
Water: Marine
Hydrokinetics
Geothermal

Systems Integration

Grid Integration of Clean Energy
Distributed Energy Systems
Batteries and Thermal Storage
Energy Analysis

Partners

Private Industry
Federal Agencies
State/Local Government
International



305 acres — National Wind Technology Center



Distributed Energy
Research and Test
Facility (DERTF)

Field Test Laboratory
Building (FTLB)



Thermal Test
Facility (TTF)



Main Campus

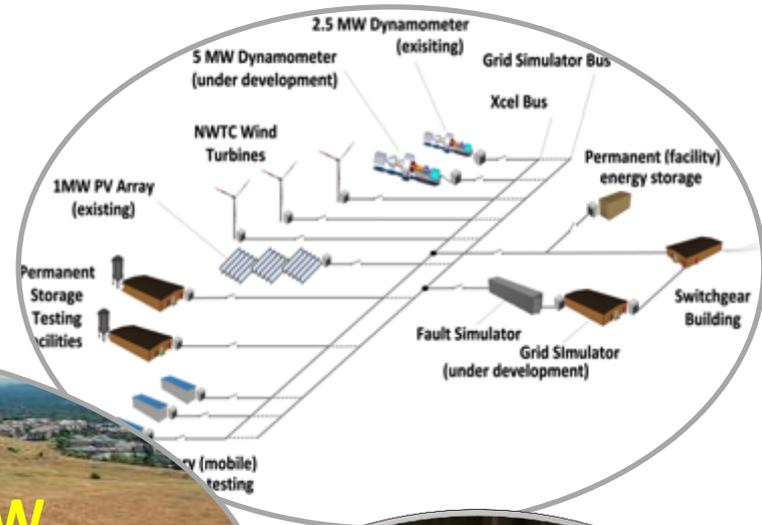


327 acres — Golden campus

NREL's Energy Systems Integration Facilities

A unique national asset for energy systems integration R&D, testing, and analysis at various scales

NWTC – 2MW+



SRRL



DERTF

1kW-200kW



ESIF

1kW-2MW

Laboratories

HPC



EV Chargers
NG and H2
Filling Stations

TTF



VTIF



RSF and NREL Campus



<http://www.nrel.gov/esif>



**Shortening the time
between innovation
and practice**



NREL | ENERGY SYSTEMS
NATIONAL RENEWABLE ENERGY LABORATORY | INTEGRATION FACILITY

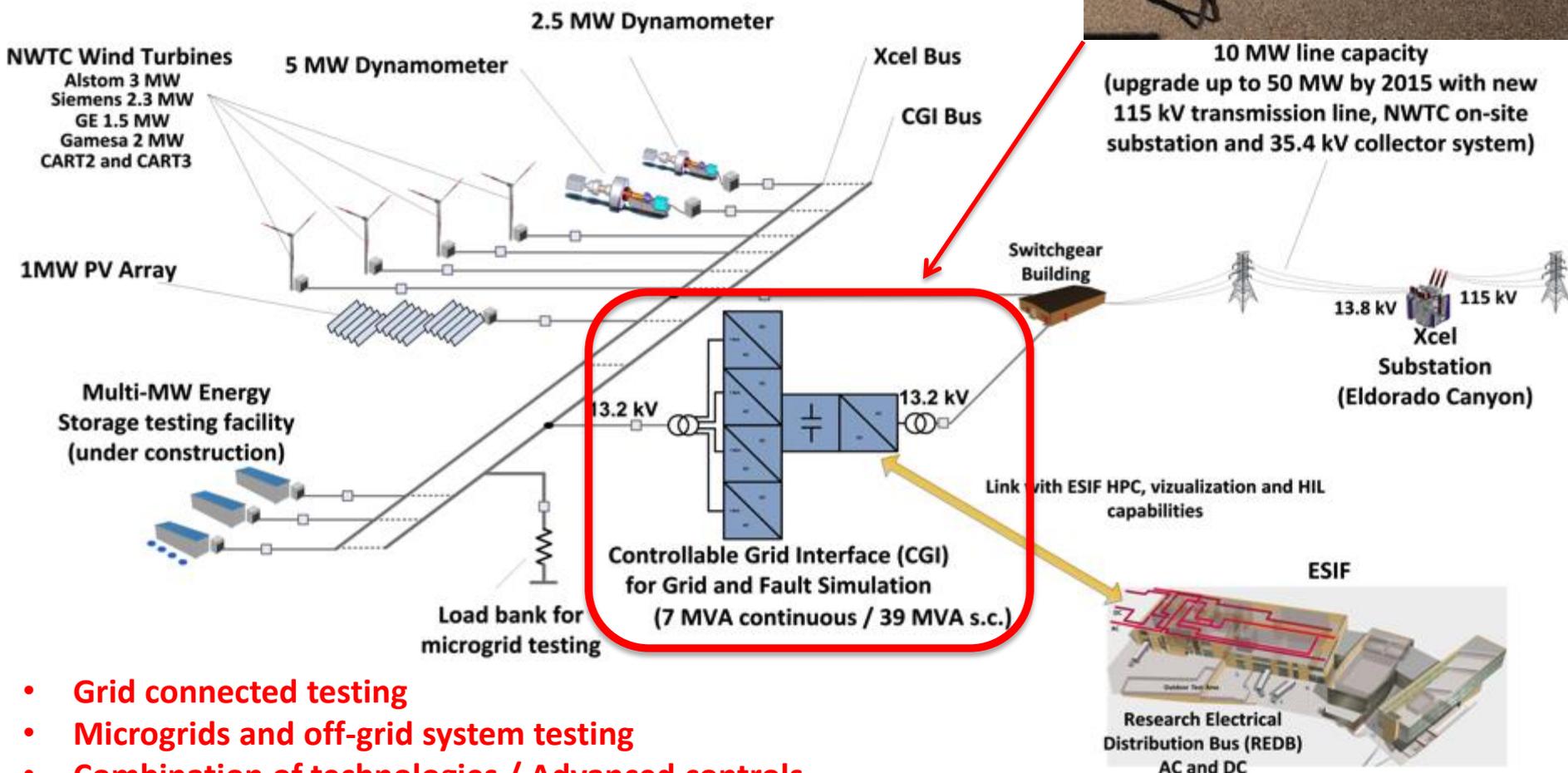
U.S. DEPARTMENT OF ENERGY

Unique Capabilities

- Multiple parallel AC and DC experimental busses (MW power level) with grid simulation and loads
- Flexible interconnection points for electricity, thermal, and fuels
- Medium voltage (15kV) microgrid test bed
- Virtual utility operations center and visualization rooms
- Smart grid testing lab for advanced communications and control
- Interconnectivity to external field sites for data feeds and model validation
- Petascale HPC and data mgmt system in showcase energy efficient data center
- MW-scale Power hardware-in-the-loop (PHIL) simulation capability to test grid scenarios with high penetrations of clean energy technologies



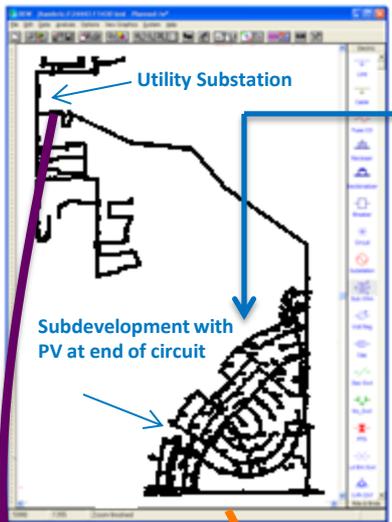
10 MW line capacity
(upgrade up to 50 MW by 2015 with new 115 kV transmission line, NWTC on-site substation and 35.4 kV collector system)



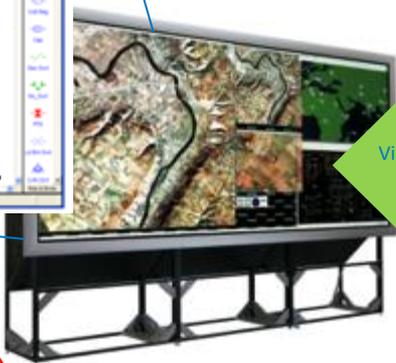
- **Grid connected testing**
- **Microgrids and off-grid system testing**
- **Combination of technologies / Advanced controls**

Power Hardware-in-the-Loop: Connecting Experiments to Simulations

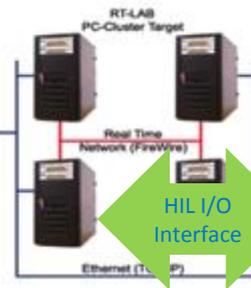
Simulation validated
with real field data



Simulation and Visualization at ESIF



Visualization
Interface



Actual hardware at ESIF



1.5MW

Solar Simulator



Device Under Test
(e.g. inverter, energy
storage, EV, load, etc.)



1 MW

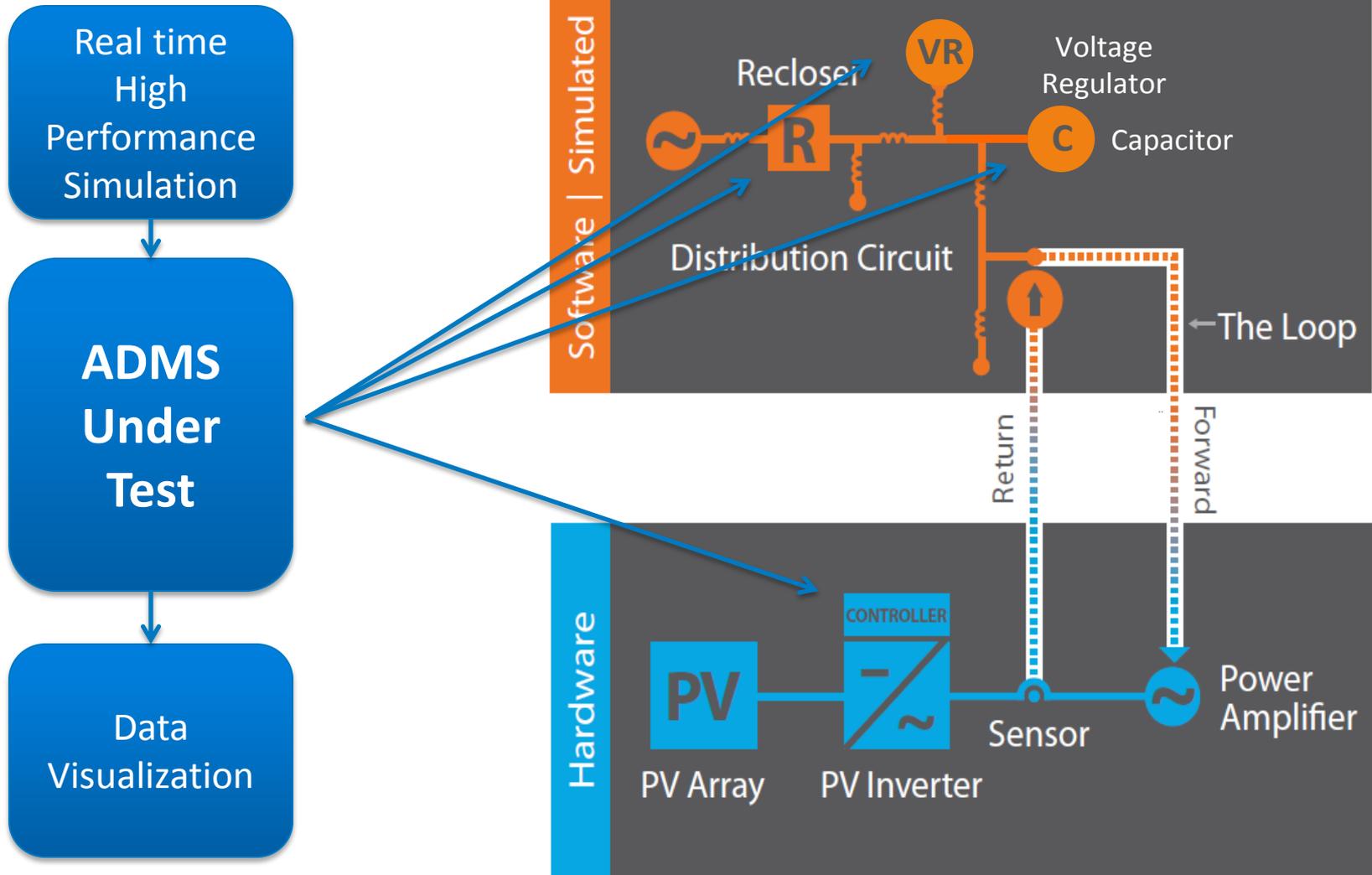


1 MW

Replicated into
Larger Simulation

Simulation loop
closed with actual
hardware

Example: ADMS Test Bed Integration at ESIF



What's in you folder?

On the Left:

[Energy System Integration Facility 2014 annual report](#)
[Energy System Integration Partnering Information](#)



On the Right:

[Energy System Integration Facility User Guide](#)
[Advanced Grid Technologies Workshop Series Agendas](#)
[Partnerships fact sheets: Raytheon, Abengoa, Wyle, Solectria, Advanced Energy, SolarCity and The Hawaiian Electric Companies, Google, Asetek](#)



- 8:00 a.m.** Registration and Breakfast
- 8:30 a.m.** Welcome and NREL Overview *Dr. Murali Baggu, Manager, Distributed Power Systems, NREL*
- 9:00 a.m.** Opening Keynote *Eric Lightner, Director, Federal Smart Grid Task Force, Office of Electricity Delivery and Energy Reliability, U.S. Department of Energy*
- 9:30 a.m.** Keynote: “Next-Generation Distribution Management Systems and Distributed Resource Energy Management Systems” *Dr. S.S. (Mani) Venkata, Principal Scientist and Director of Distributed Energy Resources Research and Development, Alstom*
- 10:00 a.m.** Break
- 10:15 a.m.** Implementing Advanced Functionalities of Distribution Management Systems—Utility Experience and Perspectives
Moderator: David Narang, Manager, Applied Distributed Power, NREL
Panelists: Tom Bialek, San Diego Gas & Electric, Leslie Ponder, Duke Energy, John Gibson, Avista
- 11:45 p.m.** Lunch and Networking Break
- 1:00 p.m.** Using Advanced Functionalities for Automated Grid Control
Moderator: Dr. Bryan Palmintier, Senior Engineer, NREL
Panelists: John McDonald, General Electric, Scott Koehler, Schneider Electric, Ethan Boardman, Alstom
- 2:30 p.m.** Break
- 2:45 p.m.** Breakout Sessions: Research and Testing Needs for Evaluating Technical Solutions
- 4:45 p.m.** Closing Statements: *Dr. Murali Baggu*

- 8:00 a.m.** Registration and Continental Breakfast
- 8:30 a.m.** Welcome and Energy Systems Integration Overview *Dr. Bryan Hannegan, Associate Laboratory Director, Energy Systems Integration, NREL*
- 9:00 a.m.** Opening Keynote: *Kevin Lynn, Lead, Energy Systems Integration, U.S. Department of Energy*
- 9:30 a.m.** Energy Systems Integration Facility (ESIF) *Dr. James Cale, Manager, Distributed Energy Systems Integration Group, NREL*
- 10:00 a.m.** Break
- 10:15 a.m.** Super Session: Testing and Evaluation at the ESIF, *Moderator: Mariko Shirazi, Electrical Engineer, NREL*
Featured studies: Advanced Distribution Management Systems, Microgrids, Advanced Inverters, Energy Storage, Electric Vehicle Charging and Power Hardware-in-the-Loop/Remote Power Hardware-in-the-Loop
- 11:45 p.m.** Lunch and Networking Break
- 1:00 p.m.** Tour of the Energy Systems Integration Facility
- 2:00 p.m.** National Wind Technology Center and Controllable Grid Interface
Shuttle will leave from the ESIF at 2:15 p.m. and return to the NREL campus at approximately 4:45 p.m.



- 8:00 a.m.** Registration and Breakfast
- 8:30 a.m.** Welcome and NREL Overview, *Dr. Bryan Hannegan*
- 9:00 a.m.** Opening Keynote, *Dan Ton, Program Manager, Smart Grid R&D, Office of Electricity Delivery & Energy Reliability, U.S. Department of Energy*
- 9:30 a.m.** Cyber Security and Resilience, *Dr. Erfan Ibrahim, Director of Cyber Physical Systems Security and Resilience, Energy Systems Integration, NREL*
- 10:00 a.m.** Break
- 10:15 a.m.** Microgrid Controls and Management Systems—Functional Requirements, Standards, and Testing
Moderator: Dr. Sudipta Chakraborty, Senior Electrical Engineer, NREL
Panelists: James Reilly, Reilly Associates, Arindam Miatra, Electric Power Research Institute, Gregory Martin and Dr. Mariko Shirazi, NREL
- 11:45 p.m.** Lunch and Networking Break
- 12:30 p.m.** Microgrid Controls and Management Systems Implementation—Owner Perspective
Moderator: Robert Butt, Senior Engineer, NREL
Panelists: Dr. Robert Lasseter, University of Wisconsin, Madison, Dr. Tom Bialek, San Diego Gas & Electric Mick Wasco, Miramar, Vince Guthrie, Fort Carson (SPIDERS)
- 2:30 p.m.** Break
- 2:45 p.m.** Microgrid Controls and Management Systems Design and Development—Vendor Perspective
Moderator: Dr. Murali Baggu
Panelists: Ryan Faries, Raytheon, Holger Kley, Spiraе, Jayant Kumar, Alstom, Santosh Veda, GE
- 4:45 p.m.** Closing Statements: *Dr. Murali Baggu*

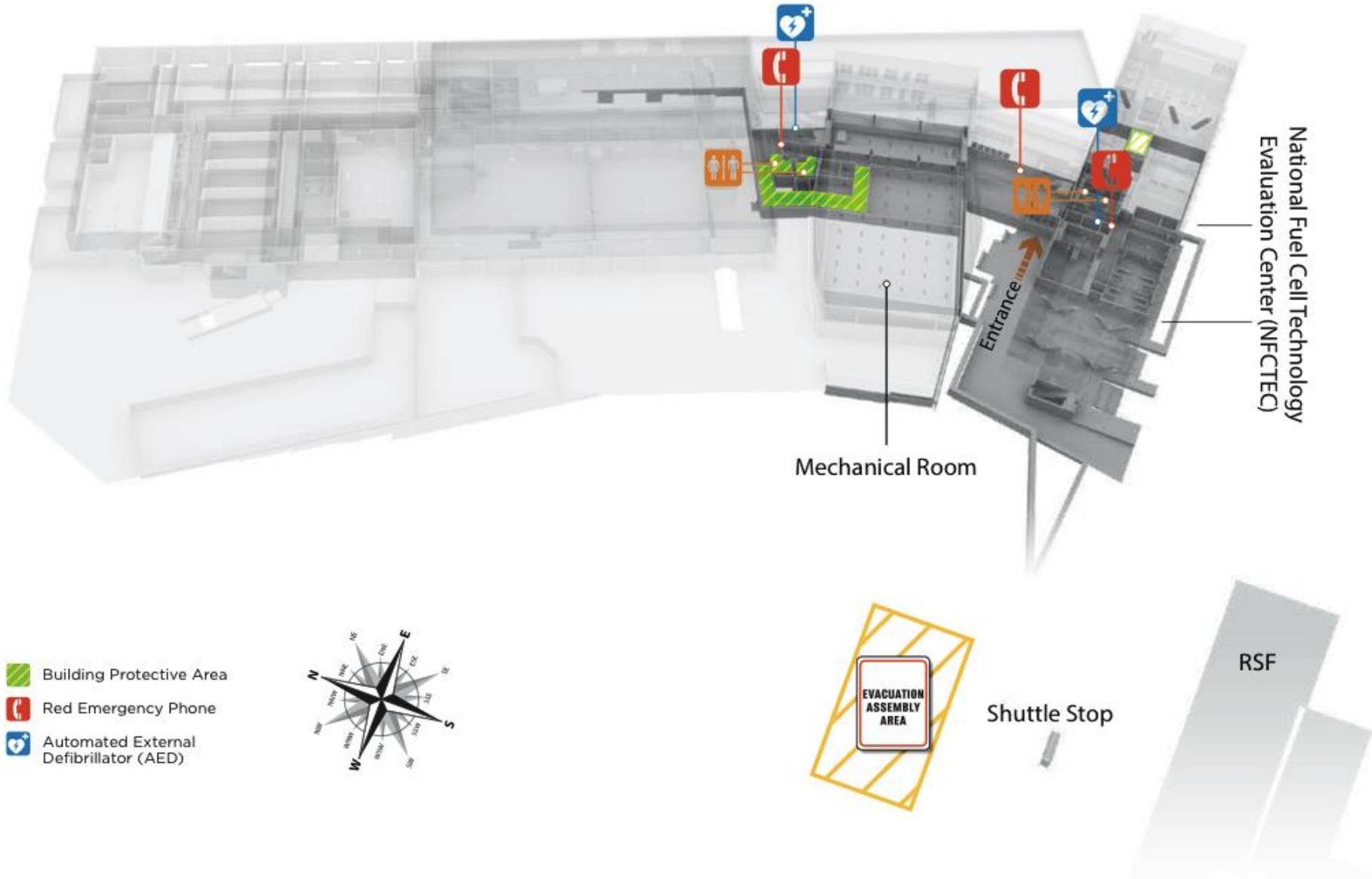
Office of Security and Emergency Preparedness 303-384-6811
security@nrel.gov

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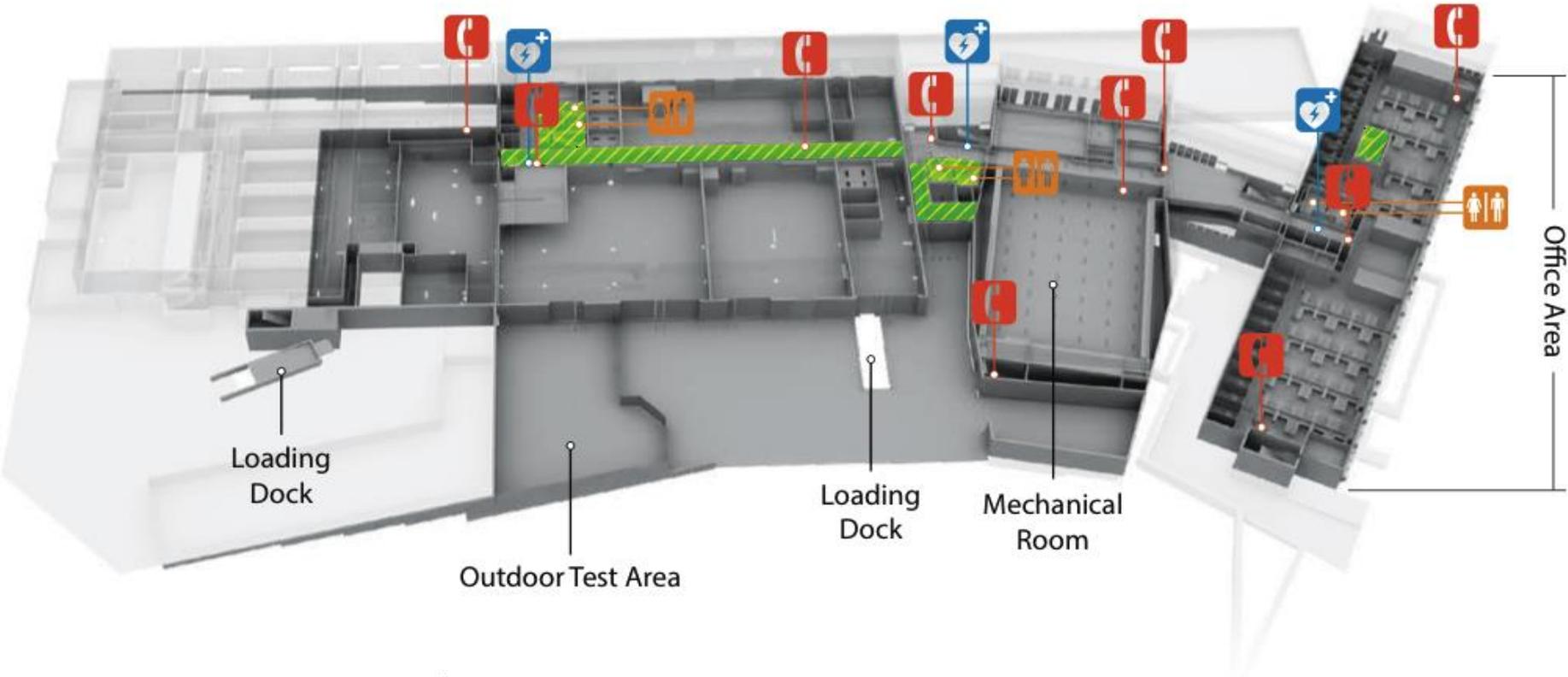
The following articles are prohibited on NREL sites:

- **Alcoholic beverages**
- **Drugs or controlled substances**
- **Firearms or explosives**
- **Dangerous weapons or materials**
- **Cameras, unless permission has been given by the research program**

Safety – ESIF First Floor

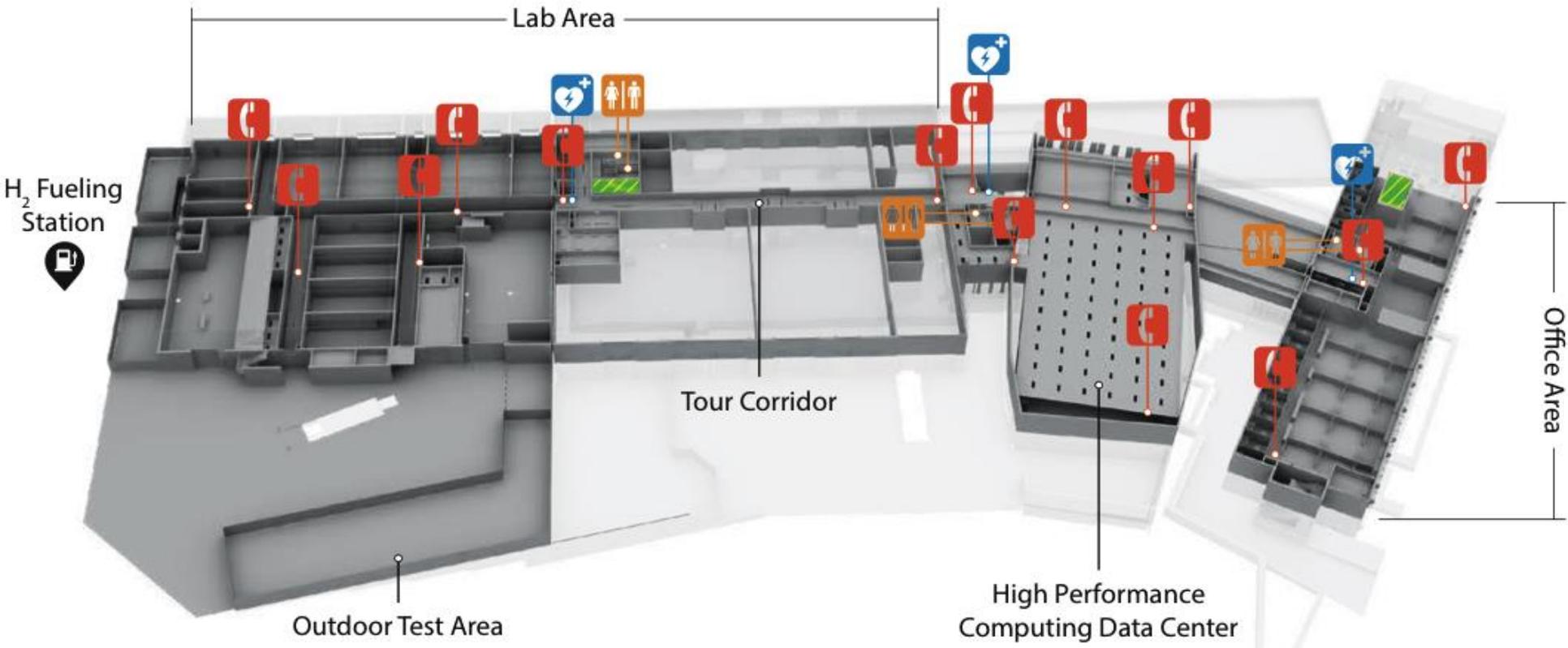


Safety – ESIF Second Floor



-  Building Protective Area
-  Red Emergency Phone
-  Automated External Defibrillator (AED)





-  Building Protective Area
-  Red Emergency Phone
-  Automated External Defibrillator (AED)



Identify your nearest exits!

No matter where you exit the ESIF, everyone will assemble on the sidewalk adjacent to the bus stop on the southwest corner of the ESIF.

ESIF





Thank You

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