Narada®

Battery Energy Storage System (BESS)

NESP NWI (Outside Accessible) Series

Reliable Energy Storage Solution for Smart Grid

Global

Innovative

Narada®

Green

Responsible

Being global, innovative, green and responsible is our core strategy. We are dedicated to achieve harmonious co-existence and sustainable development between enterprise and environment.

As a leader in ESS industry, Narada is devoted to build a smart energy network based on micro-grid and distributed energy storage solution.

- President of Narada

Introduction

Narada Power Source Co., Ltd. was established in 1994 and has been public listed in Shenzhen Stock Exchange Market since 2010. Narada is specialized in providing energy system integration products, solutions and operation services to Information and Communication Technology (ICT), Renewable Energy Storage, Electric Vehicle (EV) and other energy saving and environmental protection applications. With the development in decades, Narada has become the leader in global industrial batteries section, and “Narada” brand has been the famous and well-known brand in all over the world.

Corporate Culture

Vision

SMART ENERGY
WONDERFUL GREEN LIFE

Value

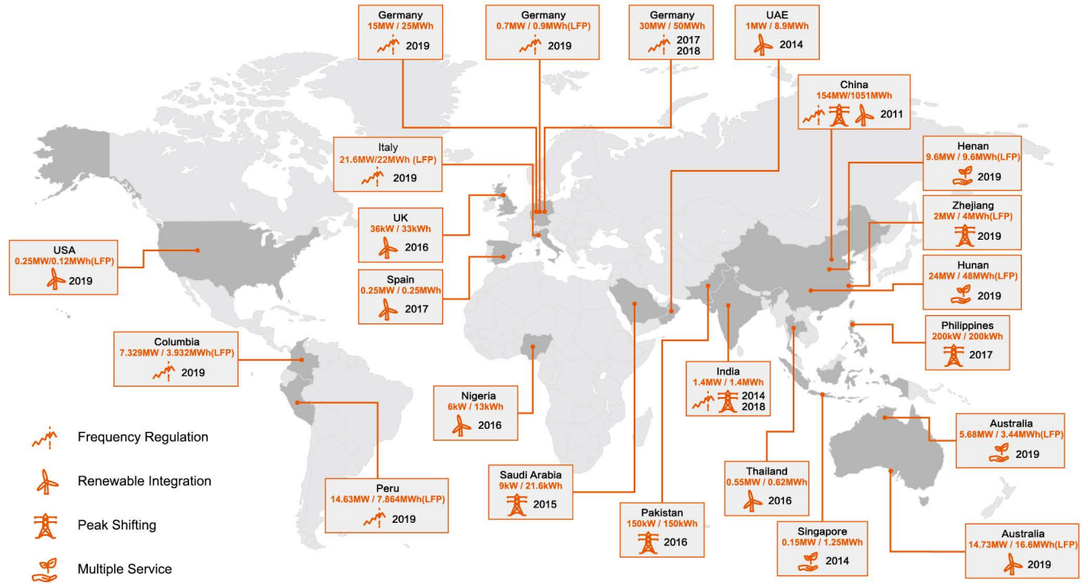
Credibility | **Responsibility** | **Creativity** | **Devotion**

Global Presence

Distribution in Over 158 Countries

Narada Branches

Global Installations



Milestones

First Island Project
Zhejiang , China
200kW/560KWh
Lead Carbon

2010

2011

First BESS jointly with Solar in China
Narada First BESS Trial Project in 2011
Narada factory
500kW/2MWh
Lead Carbon & Lithium Battery

First Ramping Rate Control Project with Wind
Jiangsu, China
2.5MW/1.87MWh
Lead Carbon

2013

2014

First Oversea Project
Singapore
30kW/250kWh
Lead Carbon

India First Frequency Regulation Project
India PGCIL
1MW/1MWh
Lead Carbon & Lithium Battery

Largest Solar BESS project for Telecom Operator
Abu Dhabi, United Arab Emirates
1MW/8.86MWh
REX

Largest Energy Quality, Demanding Response & Arbitrage Solution
Tiangong Group – Jiangsu, China
12.5MW/100MWh
Lead Carbon

First Containerized Lithium Solution for Solar Out of China
Chiengmai, Thailand
500kW/500kWh
Lithium Battery

First Energy Shifting & Arbitrage Project
GCL– Zhejiang, China
1.5MW/12MWh
Lead Carbon

2016

2017

First Large BESS Project in Africa
Nigeria & Tanzanian
3MW/14MWh
Lead Carbon

Largest Project for Distribution Upgrade Deferral & Voltage Support
WuXi Industry Zoon
20MW/160MWh
Lead Carbon

First Lithium Project for Distribution Upgrade Deferral
Henan China
9.6MW/9.6MWh
Lithium Battery

First & Largest Frequency Regulation Project
Germany
30MW/50MWh
Lead Carbon

NARADA AWARDED TECH DRIVER GLOBAL LENDING BET PACIFICT CORE AS OF 2019 DCTI

2018

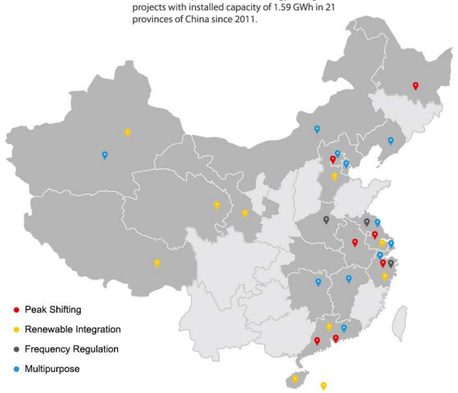
2019

UL 9540, UL 1973, IEC 62619 Certified
NESP LFP SS-40AS MW Scale Containerized BESS

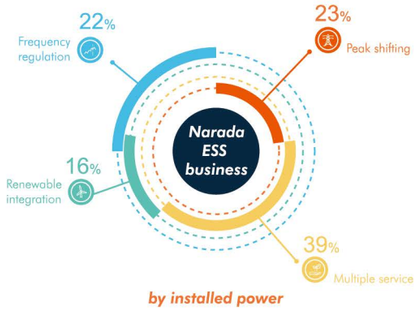
First VPP project for C&I Application
Germany
360kW/240kWh per Site, 12 Sites in total
Lithium Battery

First BESS Project with the Largest Energy Capacity per Single Container in China
Henan China
24MW/48MWh
Lithium Battery

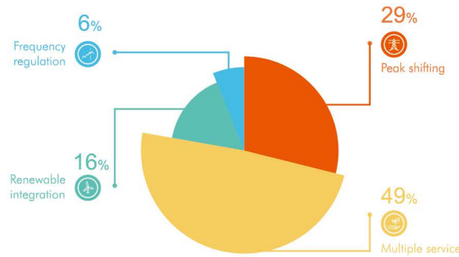
Narada has implemented 110 + energy storage projects with installed capacity of 1.59 GWh in 21 provinces of China since 2011.



- Jiangsu (18 sites) 62.7MW/494.4MWh
- Jiangsu (10 sites) 39.9MW/313.6MWh
- Jiangsu (3 sites) 0.3MW/2.1MWh
- Jiangsu (2 sites) 0.5MW/0.7MWh
- Hunan 24MW/48MWh（LFP）
- Qinghai (3 Sites) 15.5MW/122MWh
- Guangdong (4 sites) 5MW/20.5MWh
- Guangdong (2 sites) 0.95MW/3.8MWh
- Guangdong 0.5MW/1.5MWh
- Zhejiang (5 sites) 3.1MW/6.4MWh
- Zhejiang (6 sites) 3MW/18.1MWh
- Zhejiang 0.2MW/0.4MWh
- Zhejiang 2MW/4MWh（LFP）
- Henan 9.6 MW/9.6MWh（LFP）
- Beijing (5 sites) 1MW/5.3MWh
- Beijing (2 sites) 0.5MW/3MWh
- Hebei (3 Sites) 2.1MW/12.5MWh
- Hubei 1.5MW/9MWh
- Xinjiang (2 sites) 2MW/4MWh
- Xinjiang 0.1MW/1MWh
- Liaoning (5 Sites) 0.5MW/3.8MWh
- Shenzhen 0.5MW/2.9MWh
- Xizang 0.35MW/2.8MWh
- Inner Mongolia (2 Sites) 1.1MW/2.6MWh
- Heilongjiang (2 Sites) 0.33MW/2.6MWh
- Gansu 0.32MW/1.8MWh
- Shanghai (3 Sites) 0.1MW/1.1MWh



by installed power



by installed capacity

Cell Technology

1.Lithium Iron Phosphate

Best Lithium Option for BESS;
The safest Lithium technology for BESS

2.Stacking plates

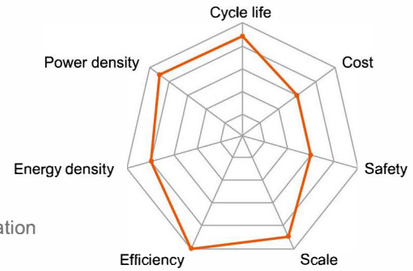
Stacking plates is good for high power operation and thermal dissipation

3.Prismatic Cell

Multi-layered Protection at cell level

4.Aluminum Case

Excellent Thermal Conductivity and Cooling Performance;
Safe and efficient heat release from inside to outside



Module

Rack

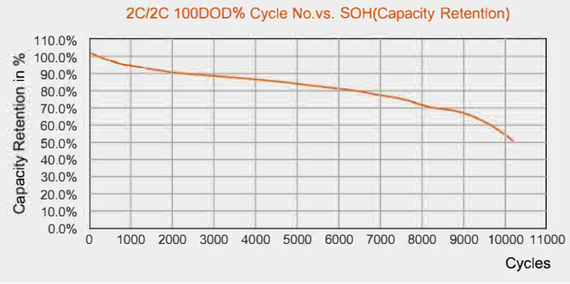
Sustainable Design

Continuously innovating to increase the energy density while maintaining the same form factor and cell dimensions, thus facilitating future upgrades to higher capacity, higher energy density, ESS with no change to pack design.

Cell Model		FE80B	FE105A	FE125A	Unit
Weight		2.20	2.30	2.35	kg
Dimensions	Length	130			mm
	Width	36			mm
	Height	240			mm
Nominal Capacity		86	105	130	Ah
Nominal Voltage		3.2			V
Allowed C-Rate		2	2	1	C
Recommended C-Rate		2	1	0.5	C

Long Life and Wide Application & Experience

Wide application & experience on Telecom, BESS and Automotive, collecting knowhow and innovating superior and adaptive technology.



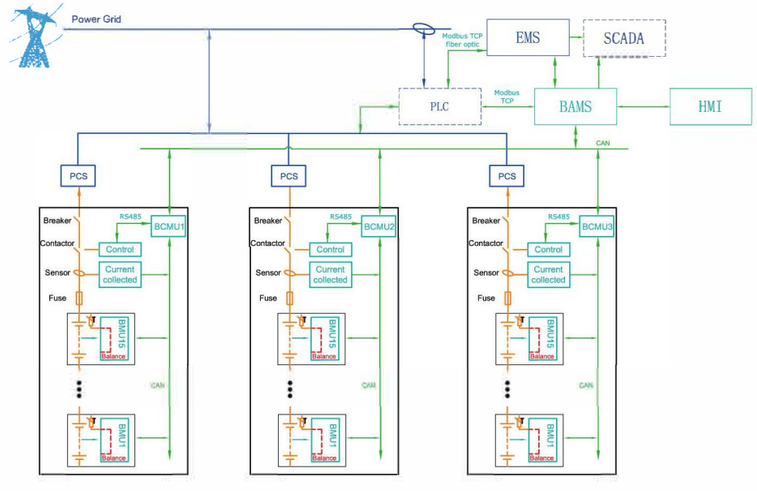
Features of Module & Rack Design

1. Platform Design for Energy, Medium and Power Solutions
2. 0.5C to 2C options available for Frequency regulation, Peak Shaving, Energy Reserve, etc
3. The Highest Energy density for LFP Energy Solution to optimize footprint and BOP cost
4. Passive & Active Thermal Ventilation System, Designed in both Module & Rack
5. Particular Considering for Containerized solution with proper aisle space
6. The Highest Lifetime Performance for Energy Storage System
7. Tested and Listed to UL and IEC Standard for Safety

BMS

BMS Function

1. Battery working condition Monitoring
2. State of Charge (SOC) estimation
3. State of Health (SOH) estimation
4. Discharge Control
5. Thermal Management
6. Fault Diagnosis Alarm
7. Information Monitor
8. Balance
9. Protection



NESP Containerized Solution

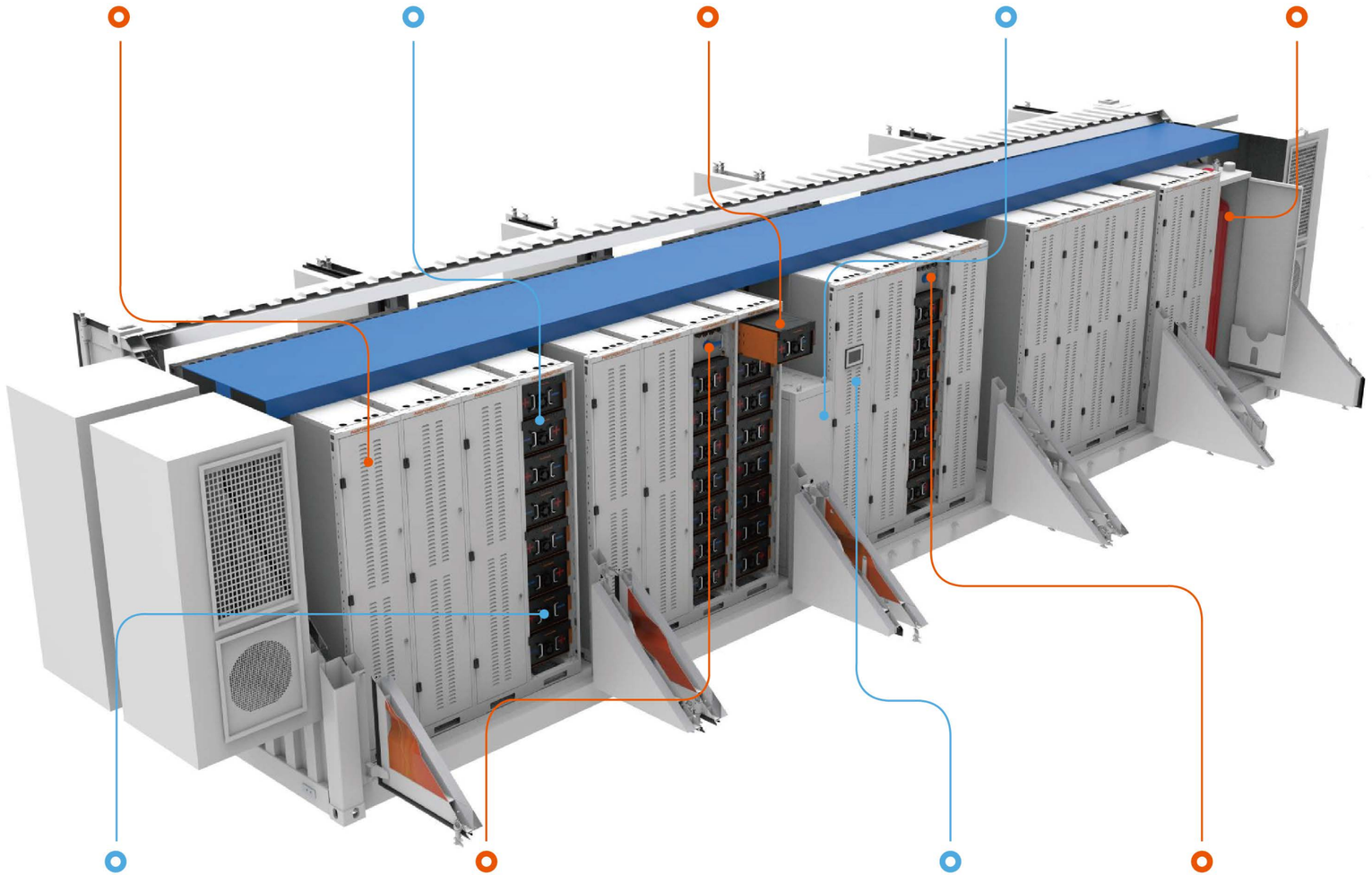
Rack

LFP Cell

Module

DC Panel

Fire Suppression System



Module BMS (BMU)

Rack BMS (BCMU)

System BMS (BAMS)

Battery Protection Unit (BPU)

COMPLETED NESP BESS

D.C.System

- Cell
- Module
- Rack
- BMS (Module, Rack, System)
- Battery Protection Unit
- Container
- DC Panel
- HVAC System
- Fire Suppression System

A.C.System

PCS Partner List: Siemens, SMA, Sungrow, etc.

KPI for choosen: Country Certificate, Product Type, System Cost, Client Requirement, etc

NESP Module & Rack Specification

Item		Module	Rack Type 1	Rack Type 2	Rack Type 3
Type No.		76.8NESP160	76880135	76880160	76880184
Cell Capacity	Ah	160	160	160	160
Energy	kWh	12.3	135	160	184
Nominal Volt	V	76.8	844.8	998.4	1152.0
Minimum Volt	V	67.2	739.2	873.6	1008.0
Maximum Volt	V	86.4	950.4	1123.2	1296.0
Dimension (W x D x H)	mm	400*884*265	500*938*1860 (2 pcs)	500*938*2130 (2 pcs)	500*938*2400 (2 pcs)
Weight	kg	110.7	1597.7	1859.1	2120.5

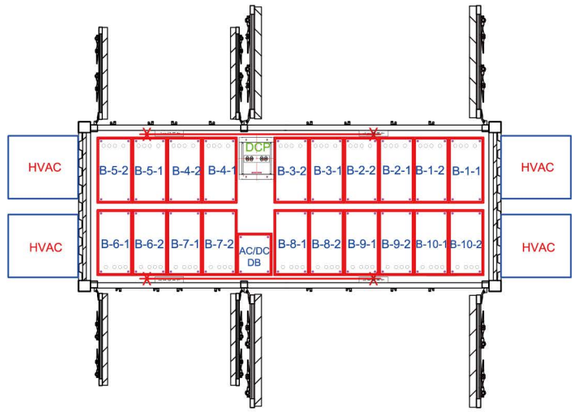
Item		Module	Rack Type 1	Rack Type 2	Rack Type 3
Type No.		76.8NESP200	768100169	768100200	768100230
Cell Capacity	Ah	200	200	200	200
Energy	kWh	15.4	169	200	230
Nominal Volt	V	76.8	844.8	998.4	1152.0
Minimum Volt	V	67.2	739.2	873.6	1008.0
Maximum Volt	V	86.4	950.4	1123.2	1296.0
Dimension (W x D x H)	mm	400*884*265	500*938*1860 (2 pcs)	500*938*2130 (2 pcs)	500*938*2400 (2 pcs)
Weight	kg	133.5	1848.5	2155.5	2462.5

Item		Module	Rack Type 1	Rack Type 2	Rack Type 3
Type No.		76.8NESP250	768125211	768125250	768125288
Cell Capacity	Ah	250	250	250	250
Energy	kWh	19.2	211	250	288
Nominal Volt	V	76.8	844.8	998.4	1152.0
Minimum Volt	V	67.2	739.2	873.6	1008.0
Maximum Volt	V	86.4	950.4	1123.2	1296.0
Dimension (W x D x H)	mm	400*884*265	500*938*1860 (2 pcs)	500*938*2130 (2 pcs)	500*938*2400 (2 pcs)
Weight	kg	141	1931	2253	2575

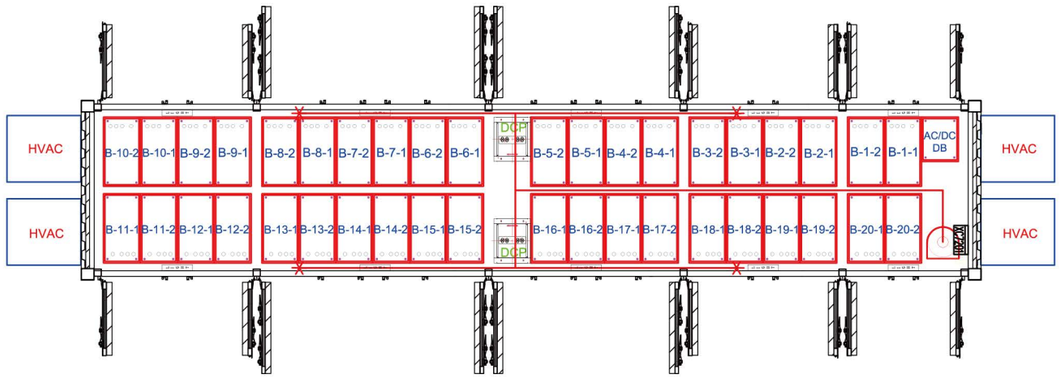
System Specification

System Characteristics									
Battery Type	Lithium-Ion		LFP						
Energy Rating	DC Nominal Energy	MWh	2.88	2.30	1.84	5.76	4.61	3.69	Energy @ C/2 Rate
	Discharge C-Rate	C	0.5	1.0	2.0	0.5	1.0	2.0	Up to 2C
Power Rating	Rated Power	MW	1.44	2.30	3.69	2.88	4.61	7.37	
Battery Voltage	Nominal Voltage	Vdc	1152						at Rack
	Voltage Range	Vdc	1008 ~ 1296						at Rack
SOC Range	Recommended Range		5%~95%						
Physical Characteristics									
Container Building	Quantity	pcs	1						
	Dimensions (L x W x H)	ft	20'			40'			ISO HC
	Weight	ton	31.88	30.64	26.88	62.16	59.74	52.41	
System Performance Characteristics									
Efficiency	D.C. Round Trip Efficiency	%	95%	94%	93%	95%	94%	93%	C/2 P - 25℃
Aux Power	Max Aux Power	kW	14.4	27.6	51.6	28.8	55.3	103.2	Depends on HVAC
Interconnection Parameters									
Point of Interconnect	PCS A.C. Voltage	Vac	Customized						
	POI Voltage	kV	Customized						
	A.C. Frequency	Hz	50Hz/60Hz						
Environmental Characteristics									
Environment conditions	Operating Temperature	℃	-40 ℃ to 60 ℃						Maximium
	Storage Temperature	℃	10 ℃ to 30 ℃						Optimium
Relative Humidity	Maximum Humidity	%	up to 95%						
Altitude	Above Sea Level	m	2000m / 600ft						
Applications									
Ancillary Service, Peak shaving, Demanding Response, Ramping Rate Control, Energy Shifting, etc									

General Layout of Containerized Solution



0.5C	1.0C	2.0C
20ft ISO HC Container External Mounted HVAC Max Rack Enery 288kWh Max Container Energy 2.88MWh Rated Power 1.44MW	20ft ISO HC Container External Mounted HVAC Max Rack Enery 230kWh Max Container Energy 2.30MWh Rated Power 2.30MW	20ft ISO HC Container External Mounted HVAC Max Rack Enery 184kWh Max Container Energy 1.84MWh Rated Power 3.69MW



0.5C	1.0C	2.0C
40ft ISO HC Container External Mounted HVAC Max Rack Enery 288kWh Max Container Energy 5.76MWh Rated Power 2.88MW	40ft ISO HC Container External Mounted HVAC Max Rack Enery 230kWh Max Container Energy 4.61MWh Rated Power 4.61MW	40ft ISO HC Container External Mounted HVAC Max Rack Enery 184kWh Max Container Energy 3.69MWh Rated Power 7.37MW

Codes & Standards

Safety	
UL 9540	Safety for Energy Storage Systems and Equipment
UL 9540A	Test Methods for Evaluating Thermal Runaway Fire Propagation - BESS
UL 1973	Batteries for Use in Stationary Applications
UL 1642	Standards for Lithium Batteries
IEC 62619	Safety for Secondary Lithium Cells and Batteries
IEC 61508, UL 991, UL 1998, UL60730-1	Functional Safety for Electrical Systems
NFPA 70E	Standard for Electrical Safety in the Workplace
NFPA 70	(NEC) National Electrical Code
ANSI/IEEE C-2	National Electric Safety Code
UL 60950	Electrical Insulation
NFPA 551 / NFPA 550	Fire Detection and Suppression
IEC 60812	Safety Analysis and Control System (FMEA, FTA)
IEC 61025	
MIL-STD-1629A	
UL1778	UPS for Ancillary
UL1598	Luminaire
UL8750	
UL1012	Rectifier for D.C. power supply
UL1995	Air conditioner for cooling
UN 38.3 / IEC 62281	Transportation Safety of Lithium metal and lithium ion batteries
Performance Standards & Grid Interconnect	
IEC61427-2 2015	Secondary cells and batteries for renewable energy storage – General requirements and methods of test – Part 2: On-grid applications
IEC 62620	Secondary Lithium Cells and Batteries for Industrial Application
PNNL-22010	Protocal for Measuring Performance of Energy Storage System
UL 1741 (SA)	Standards for Inverters, Converters, Controllers and Interconnection System Equipment
IEEE 1547	Standard for Interconnecting DR WITH EP
ANSI/IEC 60529	Degrees of Protection Provided by Enclosures
NEMA 250	Enclosures for Electrical Equipment
NEMA 250 / UL 50E	Environmental Considerations for Electrical Equipment Enclosures
IEEE 693-2005	Recommended Practice for Seismic Design of Electrical Equipment

Global Track Record

Since 2011, Narada's BESS products have been successfully operating in over 17 countries, ranking Top 3 worldwide in terms of installed capacity according to Bloomberg's statistics and ranking the 1st in China in terms of installed capacity and power according to CNESA..

SINCE
2011

TOTAL
420MW/1.8GWh

COUNTRIES
17

Europe

Germany

45MW / 75MWh

0.7MW / 0.9MWh (LFP)

Italy

21.6MW/22MWh (LFP)

UK

36 kW / 33 kWh

Spain

0.25 MW / 0.25 MWh

Asia pacific

India

1.4 MW / 1.4 MWh

Australia (2 sites)

20.4MW/20MWh (LFP)

Pakistan

150 kW / 150 kWh

Philippines

200 kW / 200 kWh

Thailand

0.55 MW / 0.62 MWh

Singapore

0.15 MW / 1.250 MWh

Saudi Arabia

9 kW / 21.6 kWh

Nigeria

6 kW / 13 kWh

Saudi Arabia

9 kW / 21.6 kWh

UAE

1MW / 8.9MWh (multiple sites)

USA

0.25MW/0.12MWh 2019 (LFP)

China

Jiangsu (35 Sites)

104 MW / 812 MWh

Qinghai (3 Sites)

15.5 MW / 122 MWh

Guangdong (7 Sites)

6.2 MW / 26 MWh

Zhejiang

6.3 MW / 25 MWh

Zhejiang

2 MW / 4 MWh (LFP)

Beijing (7 Sites)

1.5 MW / 18.3 MWh

Henan

9.6 MW / 9.6 MWh (LFP)

Hebei (3 Sites)

2.1 MW / 12.5 MWh

Hubei

1.5 MW / 9 MWh

Xinjiang (3 Sites)

2.1 MW / 5 MWh

Inner Mongolia (2 Sites)

1.1 MW / 2.6 MWh

Hunan

24 MW / 48 MWh (LFP)