
# Narada®

An Expert of Energy Storage Solutions.

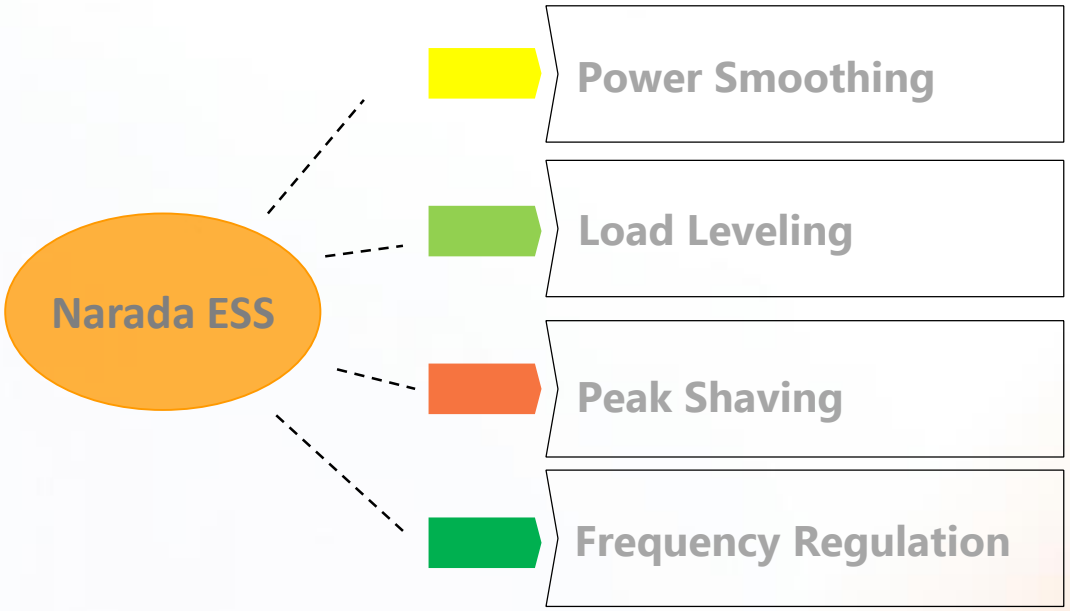
Narada®

# Narada Energy Storage System (ESS) Solution

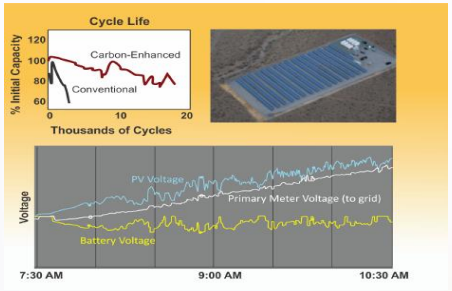

- ✓ Internationally advanced energy storage technology
- ✓ Innovative TMS
- ✓ Smart BMS
- ✓ Reliable PCS with high efficiency
- ✓ Smart EMS
- ✓ Module design
- ✓ Movable storage

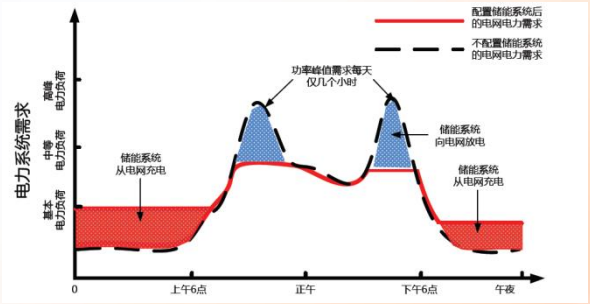
Narada®

# Narada ESS Services




- Smart Grid
- Micro-grid
- Distributed power generation
- Off-grid power generation
- Island isolated power supply

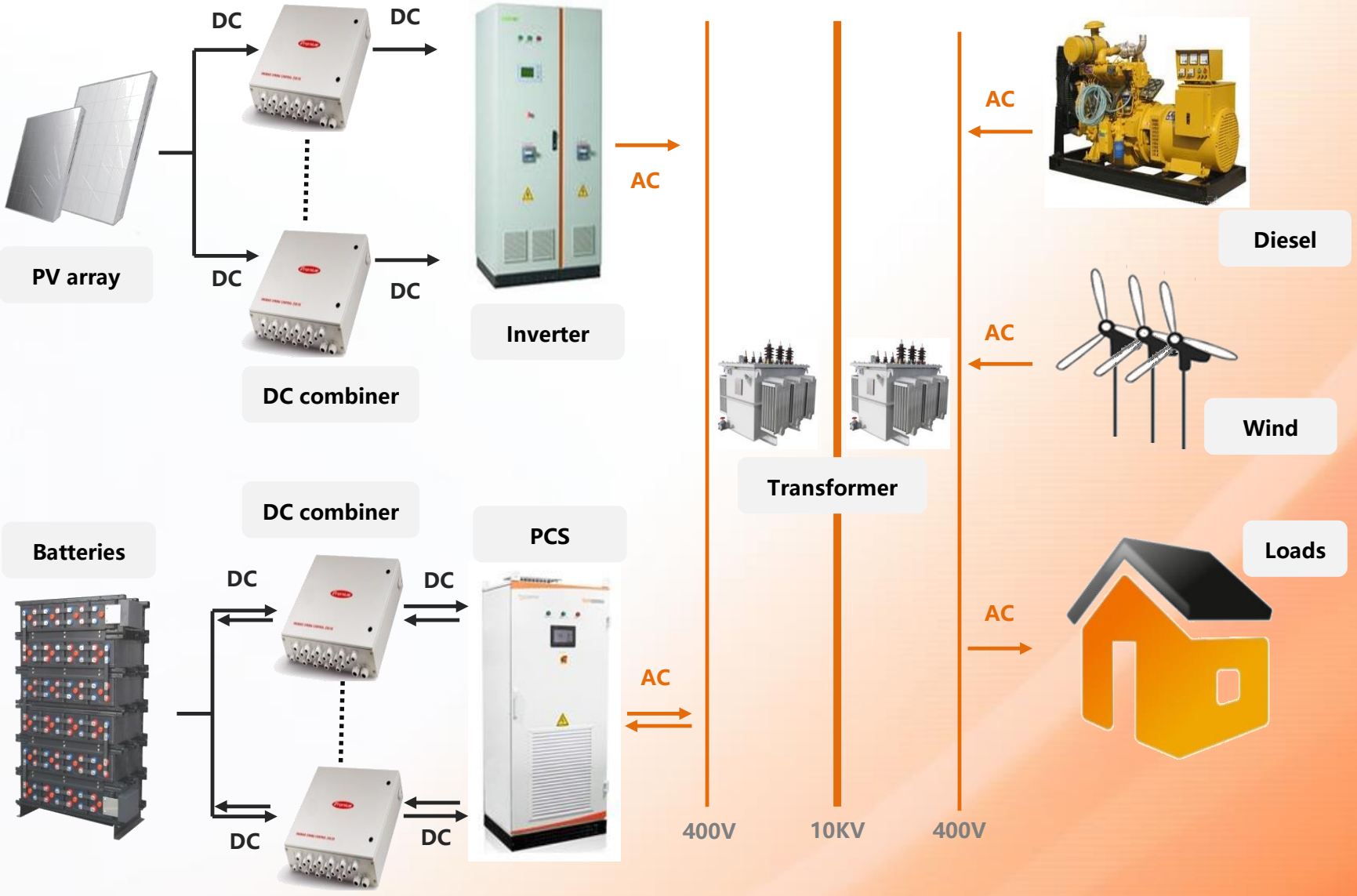




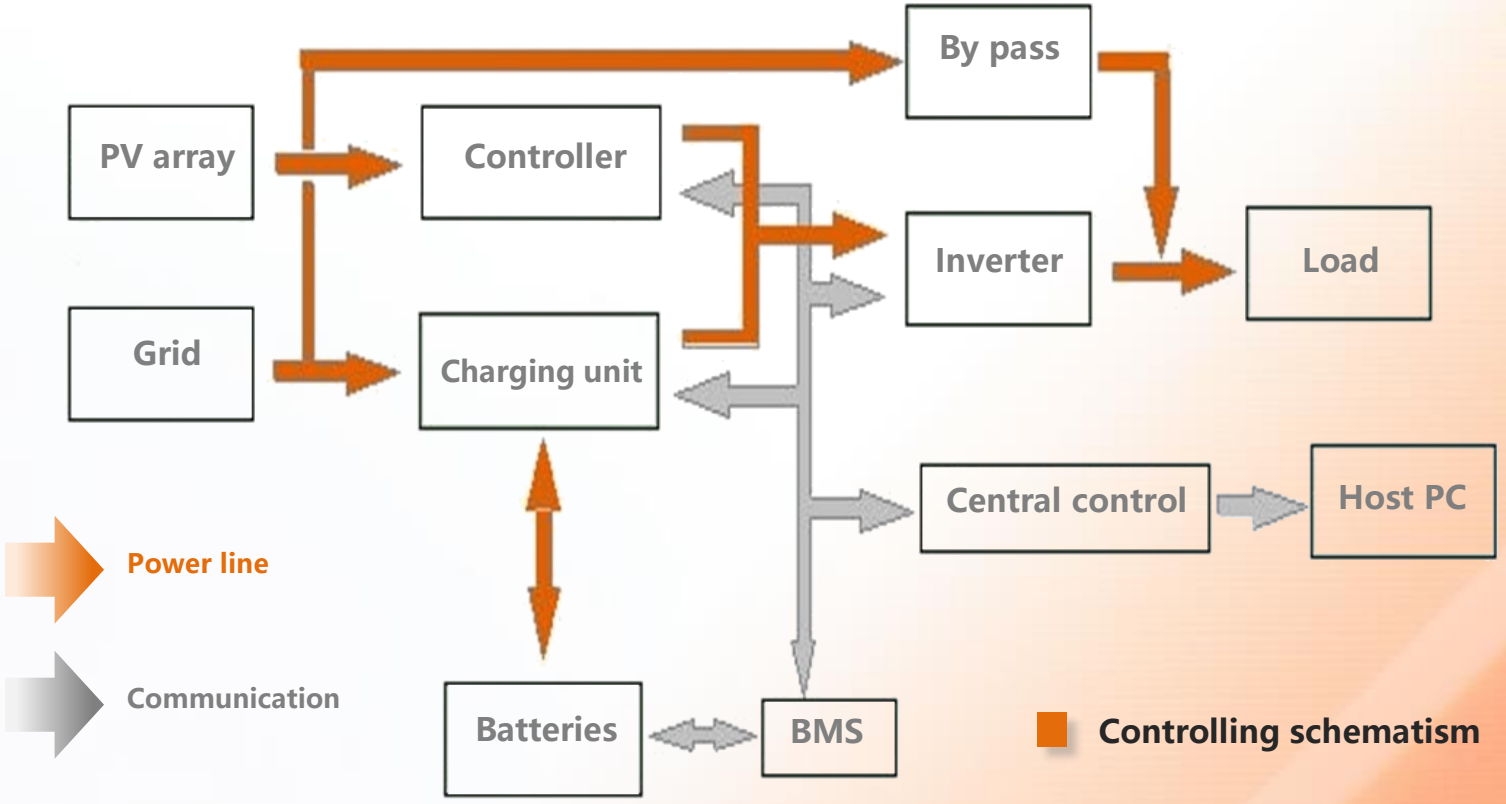
Narada®

# General PV & Energy Storage System Structure




Narada®

# Highlights of Narada Hybrid ESS




Build up a mathematic model for storage system by software, then analyze and calculate to optimize structural parameter, save response time, prevent influence from harmonics, and to improve power quality

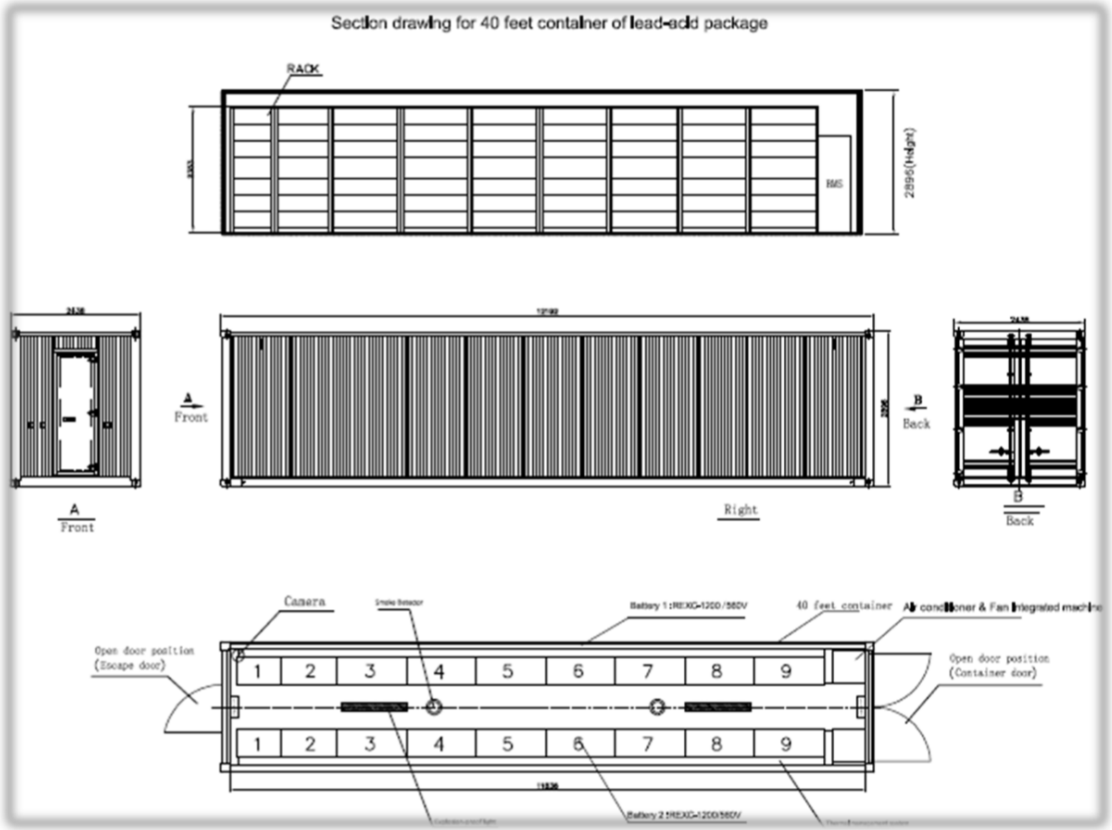
# Technical Proposal

Narada®

# Technical Proposal

## Technical Proposal – *Layout of 40FT Battery Container*

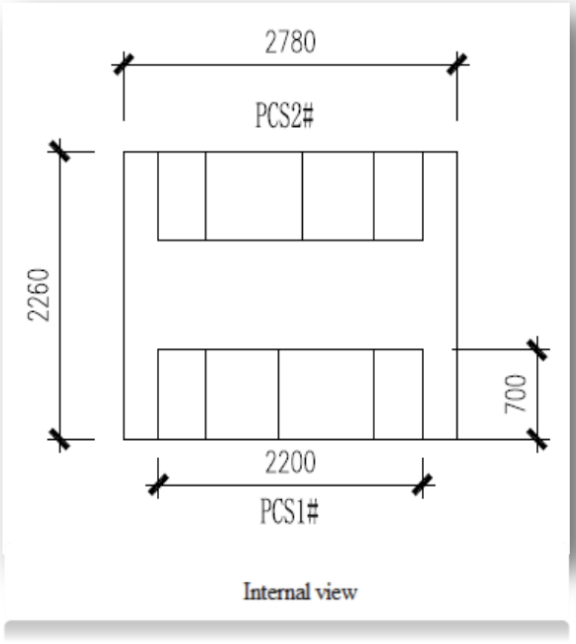
Narada®
stored energy solution for a demanding world



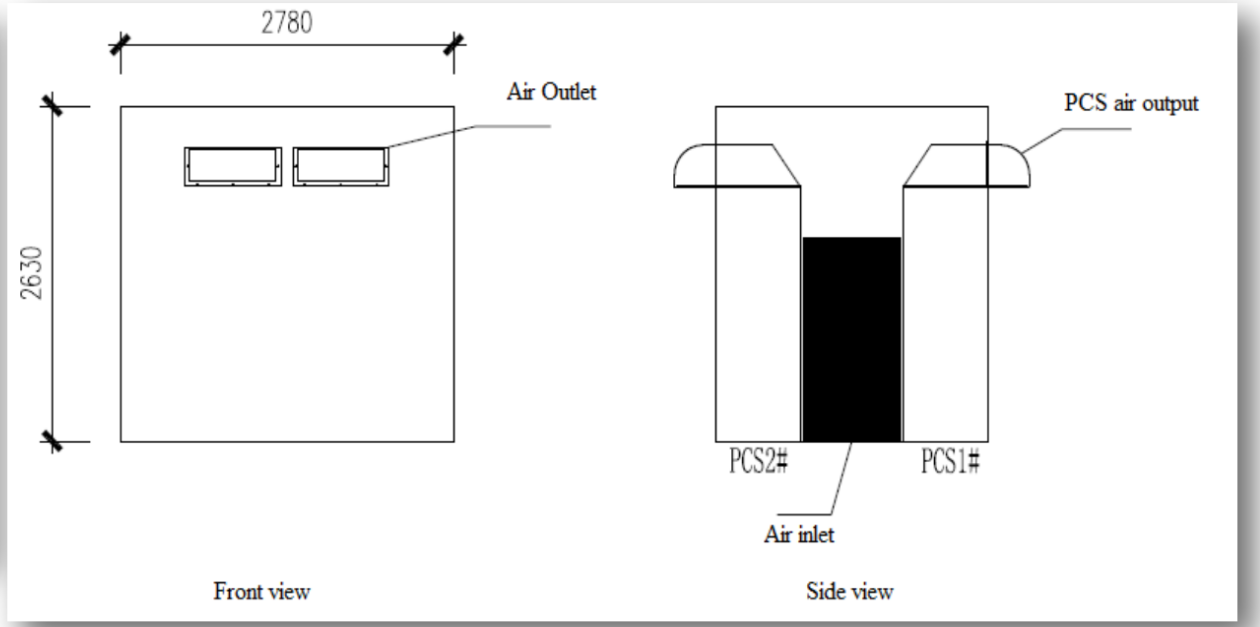
# Technical Proposal

## Technical Proposal – *Layout of PCS + Transformer 20FT Container*

Narada®
stored energy solution for a demanding world




Internal view




Front view

Side view

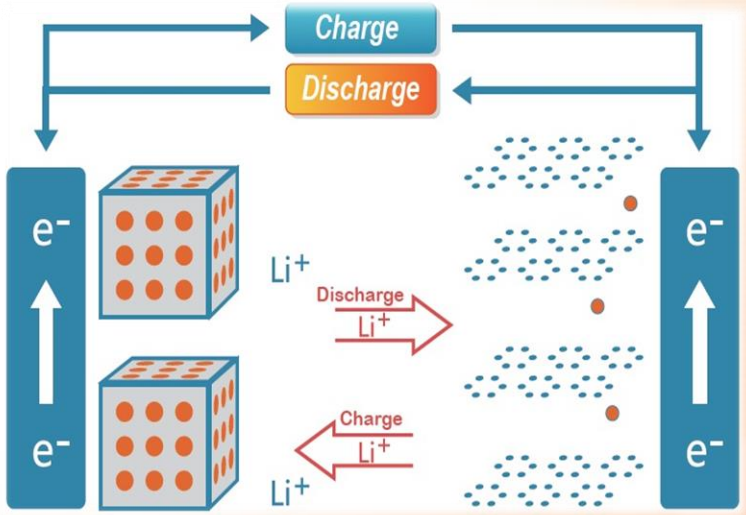
# Technical Proposal - BESS

| | |
|---|---|
| Battery Type | LiFePO4, 51.2V/200Ah |
| Battery Rack | 8 Racks ( 153.6kWh / Rack)<br>15 modules connect in series to form 768V/200Ah. Total 8 strings of module |
| BMS (Battery Management System) | 1 set of BMS is provided for each string. Total 8 strings |
| TMS (Thermal Management System) | 1 set of TMS is provided for each container |
| PCS (Battery Inverter) | 1 set of 1.7MW SMA SCS1900 battery inverter (a part of SMA MVPS2200 power station) |
| Transformer | 1 set of 0.33kV/13.8kV Transformer (a part of SMA MVPS2200 power station) |

# Technicall Proposal Option : Lithium Ion ( LiFEP04) Battery

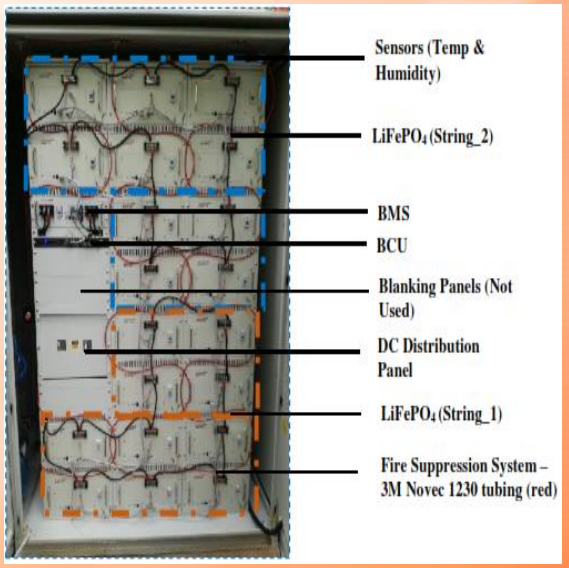
## *Advanced Battery Technology (Li-ion)*

- ✓ Long service life
- ✓ High energy density
- ✓ High power density
- ✓ High energy conversion efficiency
- ✓ High reliability
- ✓ High environment adaptability
- ✓ Modular design
- ✓ Capacity SCADA





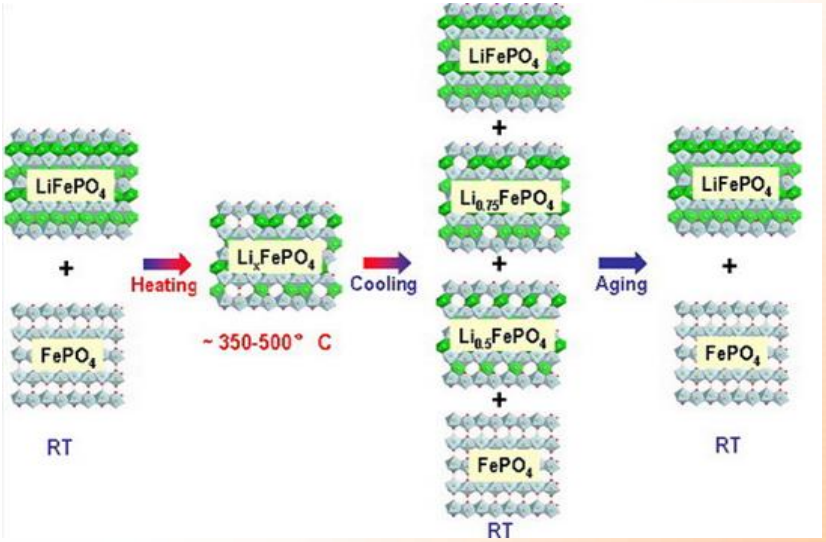
- 3.84kwh
- >6000 cycles
- 15 years working life
- Smart control
- High reliability
- Affordable price




Narada®

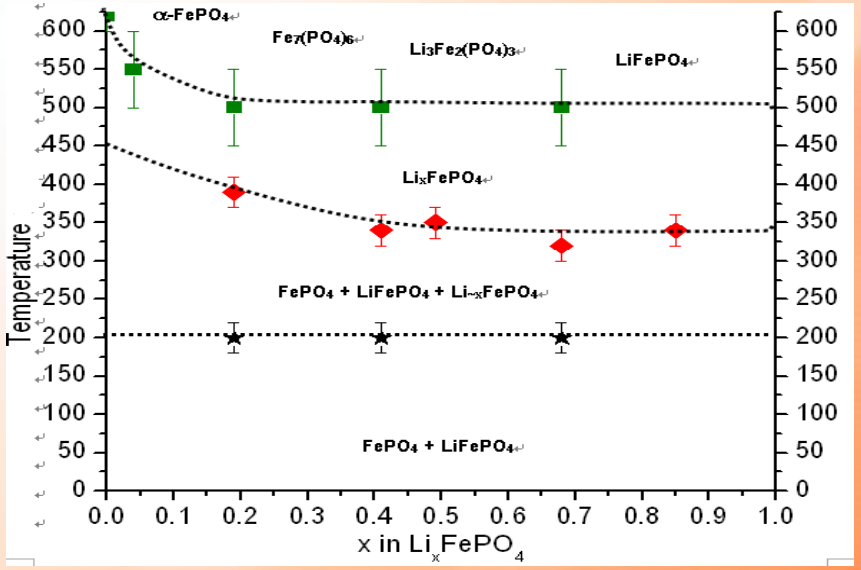
# Technical Proposal - Lithium battery

**Safe since positive material**




**Stable structure at high temperature**

**difficult to thermal runaway**




Narada®

# Technical Proposal - BESS

Module Case

32 Lithium Battery Cells

NESP Module for High Voltage Energy Storage / UPS

BMS

Man-machine Interface

- Cabinet
- Protection Devices

String level:
15 Modules + BMS Cabinet
in two cabinets

## BMS

### BMS Function

- Battery working condition Monitoring
- State of Charge (SOC) estimation
- State of Health (SOH) estimation
- Discharge Control
- Thermal Management
- Fault Diagnosis Alarm
- Information Monitor
- Balance
- Protection

Narada

# Technical Proposal – Option Lithium Ion Battery

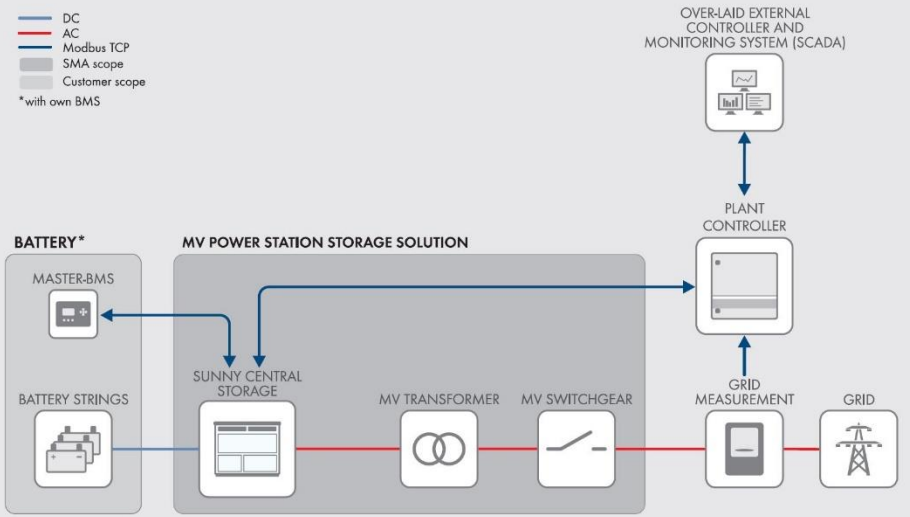
# Technical Proposal- PCS (SMA)


## Compatible with energy management system functionalities

- External static grid supporting functions
- Ramp-rate control of PV power
- Peak shaving
- Energy shifting
- Genset optimization control
- Reducing necessary spinning reserve of gensets
- Battery start-up and stop sequence
- Operates the battery within optimal operation window
- Grid Forming
- Black Start

## Grid-connected functions

- Setpoints for active and reactive power
- Static grid support Q(U), P(f)
- Dynamic grid support (FRT)
- Active islanding detection (AID)
- High compatibility with different battery types




By combining several of these schemes, higher power systems can be realized

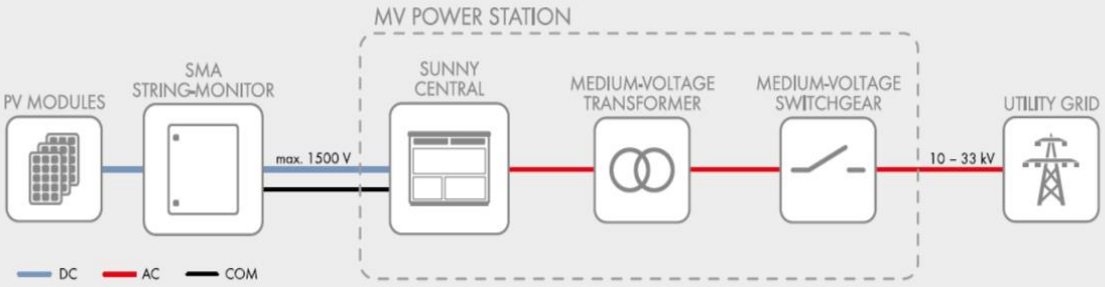
# Technical Proposal- PCS

## MV POWER STATION 2200SC / 2500SC-EV

Turnkey system solution with the new Sunny Central inverter

With the compact power of the new, robust Sunny Central inverter and with matching medium-voltage components, the MV Power Station is a turnkey solution that is available worldwide. It represents the ultimate utility scale solution in compactness with 1,000 $V_{DC}$ (2,200 kW) or 1,500 $V_{DC}$ (2,500 kW). Being the ideal choice for large-scale PV power plants, the integrated 20 foot container station is quick to assemble and commission as well as easy and cost-effective to transport. The compact station itself (IEC 62271-202) and all its components are type-tested. The MV Power Station combines rigorous plant safety with maximum energy yield and minimized operating risk. The MV Power Station's components are delivered completely pre-installed and pre-commissioned to speed up station commissioning as much as possible.


**SYSTEM DIAGRAM**




Narada®

# Technical Proposal –Option Lead Carbon Battery



## *Lead Carbon Battery*


| | | | |
|---|---|---|---|
| **FEATURE** | Advanced Lead Carbon Technology, a combination of deep cycle VRLA battery and Supercapacitor | | |
| | High rate fast charge/discharge capability | | |
| | Ideal solution for HR PSoC cyclic application | | |
| | Extremely long cyclic life | | |
| **TECHNICAL PARAMETER** | Battery Model | REXC-1200 | |
| | Rated Voltage and Energy ($C_{10}$) | 2V, 2.4kWh | |
| | Dimension (mm) and Weight (Kg) | 264 X 232 X 514 (mm), 90Kgs | |
| | Energy Density (Wh/Kg) | 30Wh/Kg | |
| | Max. Charging Current | 360A | |
| | Working Temperature Range (recommended) | 15 Degree C – 25 Degree C | |
| | Cyclic Life (@80% DOD) | 3200 Cycles | |
| | Design Life (@25 Degree C) | 20 Years | |

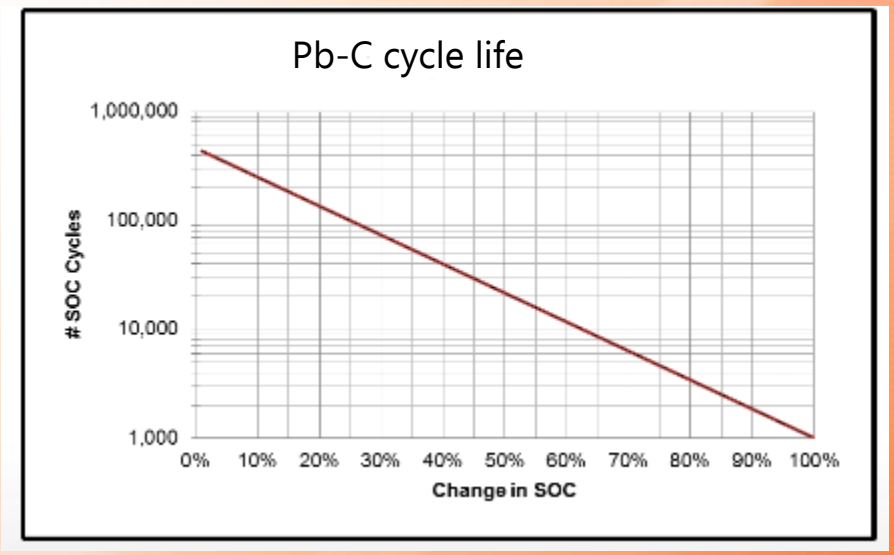
# Battery Module ( Option 2) : Lead Carbon battery

Lead carbon battery

- Combine the advantage of lead acid battery and supercapacitor;
- Ideal for PSOC cycle application;
- High power, repid charge/discharge;
- Reduce sulfation of negative plate, excellent recharge acceptance performance;
- Waterproof, anti-salt treatment, shockproof module installation design;
- Comply with IEC60896,IEC61427 etc. standard
- Deep cycle battery, 3500 cycles @70％DOD

# Features of Narada's Lead Carbon Batteries


- Combined strengths of lead-acid batteries and supercapacitors
- Perfect for HRPSOC cycling scenarios
- High specific power, rapid charge and discharge
- Eliminated negative sulfation, long cycle life
- Internationally advanced, 40% superior in charge acceptance and 5 times in battery cycle life to ordinary ESS products



# Advantage of Lead-Carbon

**3. Improved PSOC performance - Long cycle life**

## Energy type application

- PSoC cycle @SoC=80%-40% up to 5,000cycles
- PSoC cycle @SoC=60%-20% up to 5,000 cycles
- PSoC cycle @SoC=30%-80% (tested by Chinese electricity institute) up to 5,000 cycles
- 50%DoD cyclic life >5,000 cycles

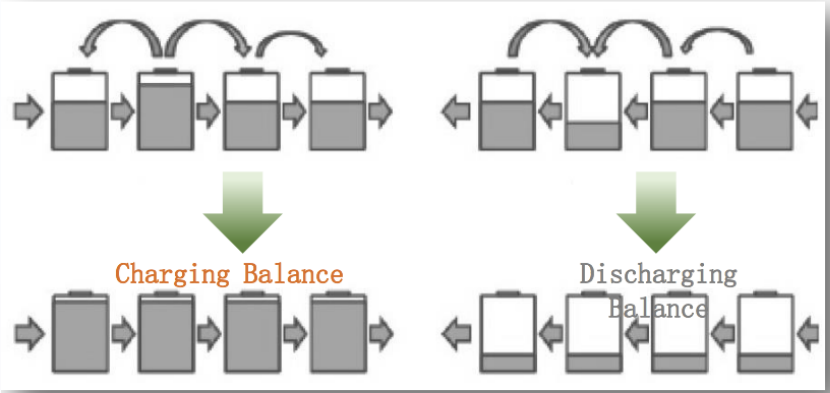
## Power type application

- IEC61427-2 Peaking shaving and frequency regulation 180,000 cycles
- IEC61427-2 load tracing, 60,000 times

# Technical Proposal -Battery Management System (BMS)

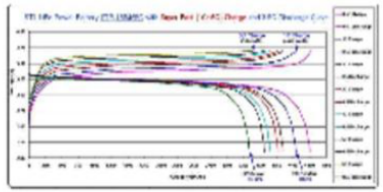
Unique Balancing Technologies:

- Non-destructive active balancing
- High balancing current, almost no heat dissipation
- Balancing regardless of circumstances




Smart Management System:

- High Accuracy Voltage Detection
- High Accuracy Current Detection
- High Current Non-destructive Active Balance
- High Efficiency Balancing Strategy
- Multi-Protection
- Applicable SoC Estimation
- High Reliability
- Intellectual BMS Interface
- Historical Events Log

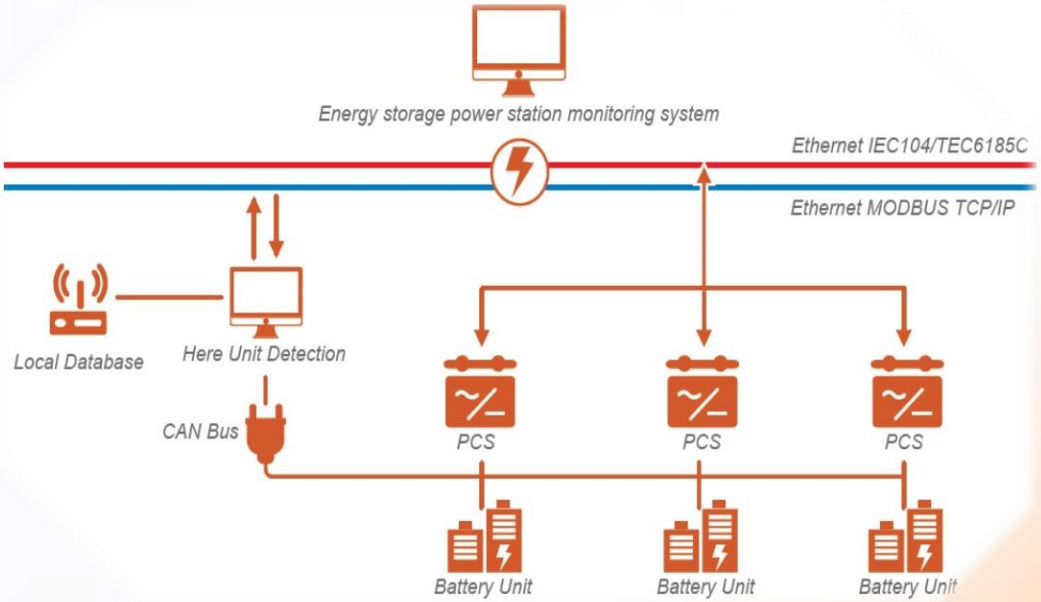


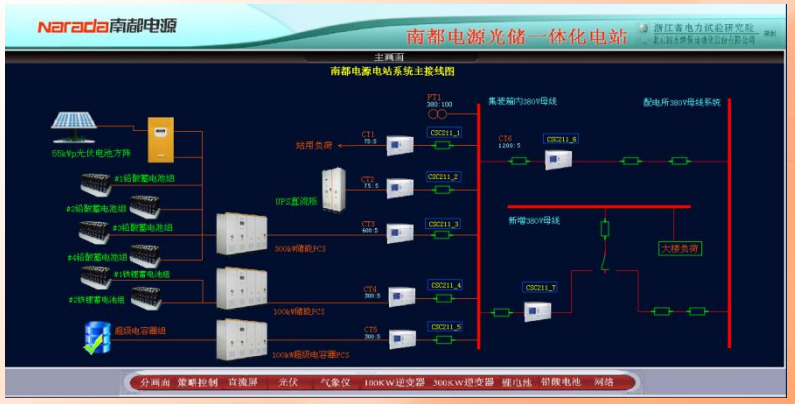
Narada®

# Technical Proposal – BMS

## Monitoring System\Remote Monitoring Platform

* Flexible setup
* Friendly interface
* Distributed datalog
* Multiple protocol



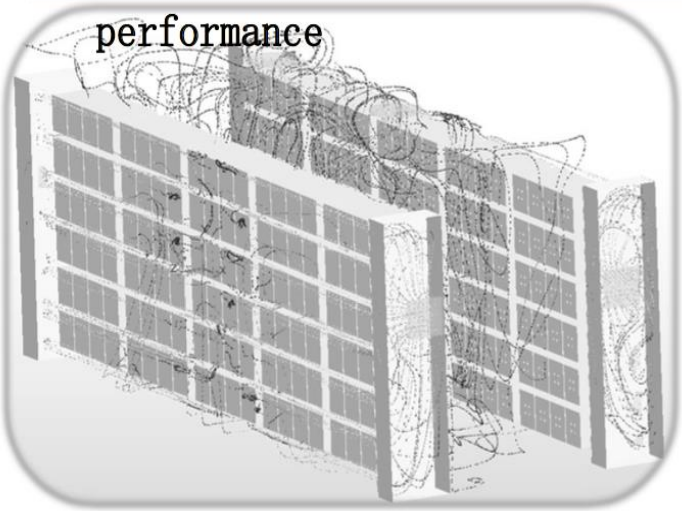



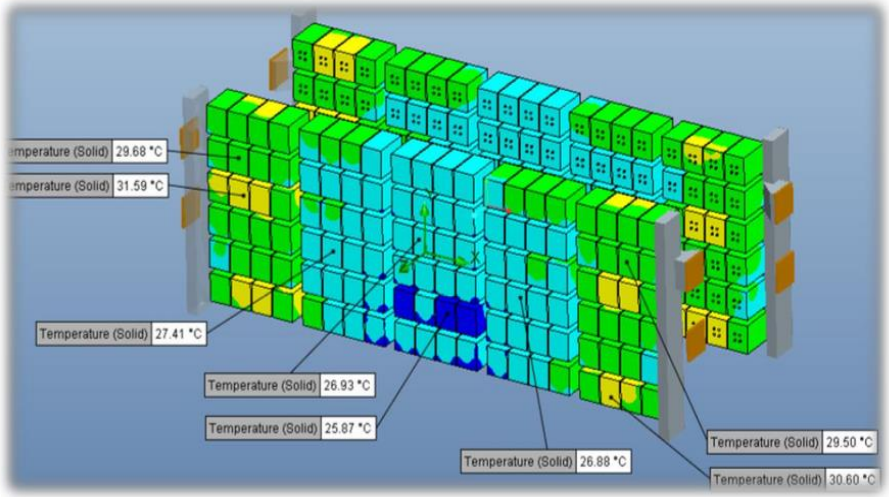

Narada®

# Technical Proposal - Thermal Management (TMS)



- Designed based on theories of air dynamics and hydrodynamics
- Simulated Tests have been conducted by large scale computer system
- Unique temperature-regulated air supply system was designed and widely employed in the construction of BEES power stations
- Ensure optimized temperature for battery cells to be operated in even performance





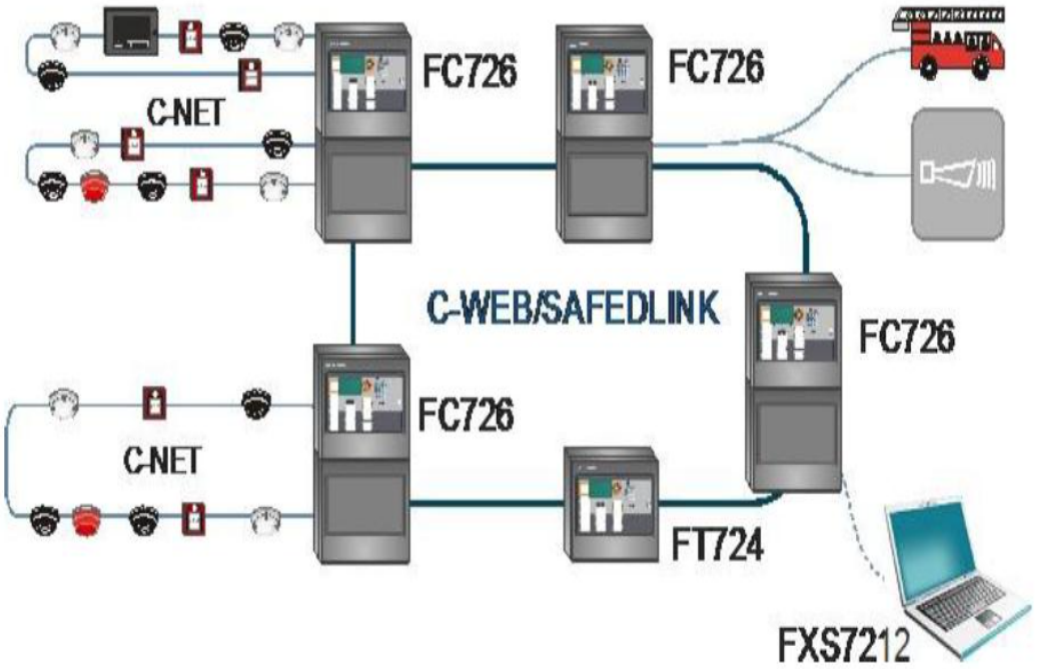
# Technical Proposal – battery Layout

The view of container Internal

Include:

1. Battery
2. Racks and cables
3. Battery management system (BMS)
4. Fire alarm system
5. lighting system
6. Cooling system
7. Insulation parts

# Technical Proposal- Fire Protection




**Control of fire alarm**

1. "Smoke detector" & "Temperature detector" are installed and connected to "Light & Sound Alarm" via "signal Input Output Module".
2. Whenever the Sensitivity of smoke is over 2.5%/m, or temperature increasing is higher than 10 degC per min, system may consider there is risk of fire and will trigger local alarm system with "Light & Sound Alarm". And report to DMS system for remote notice.
3. Or if any anyone find the risk of fire, can press "Manual Call Point" to trigger fire alarm;
4. "Fire extinguisher" is available both in & out of container;
5. Whenever got a fire alarm, a visually check is required and fire alarm can be recovered manually after confirm fire risk is terminated.

# Technical Proposal - Fire Protection

Local Alarms

Audible and visual alarm(Indoor)

Audible and visual alarm(Outdoor)

Safety Door Locker

Safety Locker Design

# Solar Panels – Chint / Astronergy / Jinko

## KEY FEATURES

**High Voltage**
UL and IEC 1500V certified; lowers BOS costs and yields better LCOE

**PID Free**
World's 1st PID-Free module

**Innovative Solar Cells**
Five busbar polycrystalline cell technology improves module efficiency

**Low-Light Performance**
Advanced glass technology improves light absorption and retention

**Strength and Durability**
Certified for high snow (5400Pa) and wind (2400Pa) loads

**Weather Resistance**
Certified for salt mist and ammonia resistance

Narada®

# PV Inverter - ABB

**High total performance**
- High power density with small footprint
- Low auxiliary power consumption
- Efficient maximum power point tracking
- Long and reliable service life of at least 20 years

**Modular industrial design**
- Compact and easy-to-maintain product design
- Fast and easy installation
- Integrated and flexible DC input cabinet

**Full grid support functionality**
- Reactive power compensation also during the night time
- Active power limitation
- Low voltage ride through with current feed in

**Extensive protections**
- DC and AC side protection with built-in fuses, surge protection and filters
- Increased reliability and safety with DC and AC side contactors
- Heavy-duty surge protection

**Grid code compatibility**
- Wide country-specific grid code compliance
- Adjustability to various local utility requirements

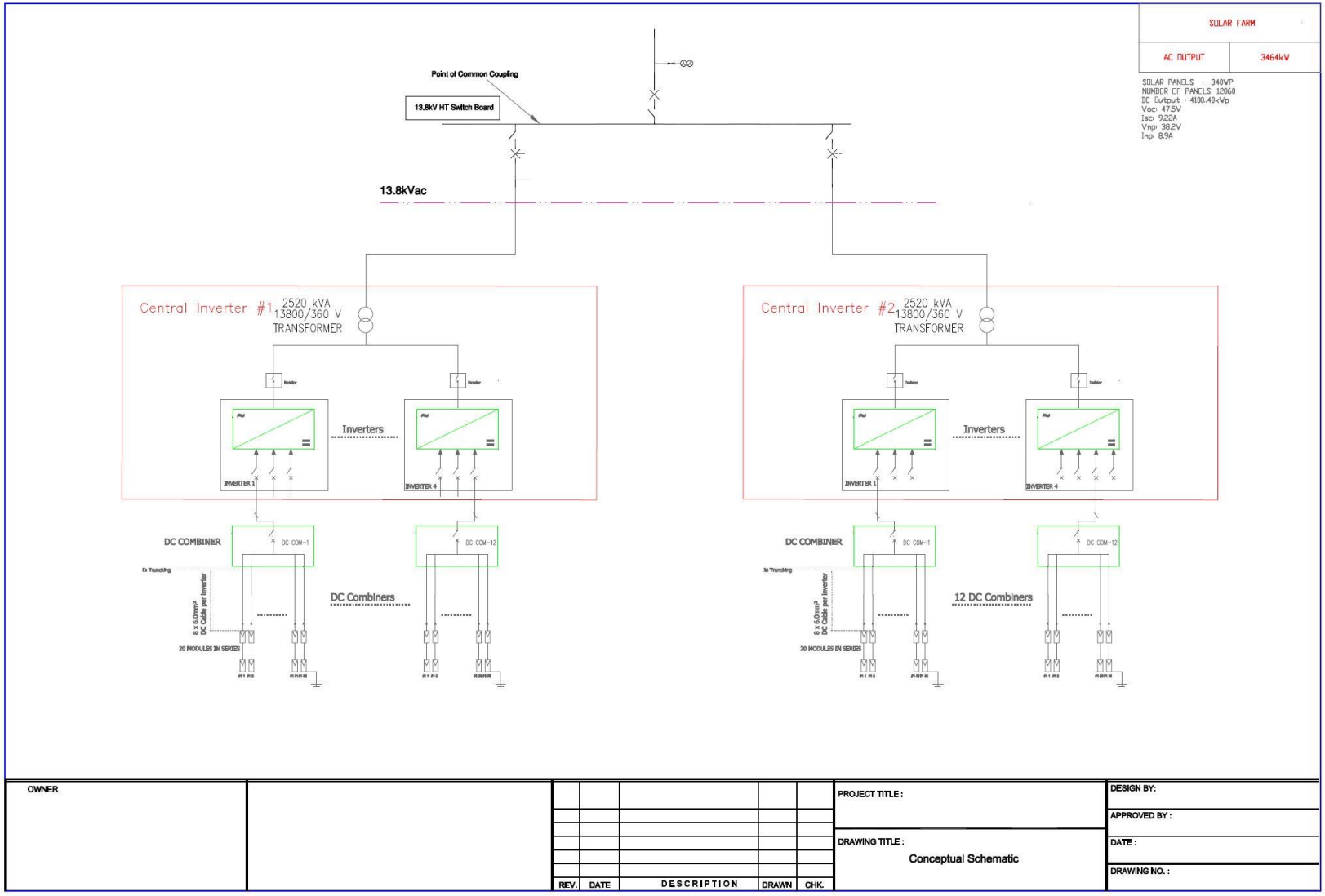
**Proven technology**
- Based on ABB's market-leading technology platform used in frequency converters

**Life cycle service and support**
- ABB's extensive global service network
- Extended warranties
- Service contracts
- Technical support throughout the service life

**Wide communication options**
- Complete range of industrial data communication options
- Ethernet/Internet Protocol
- Remote monitoring

Narada®

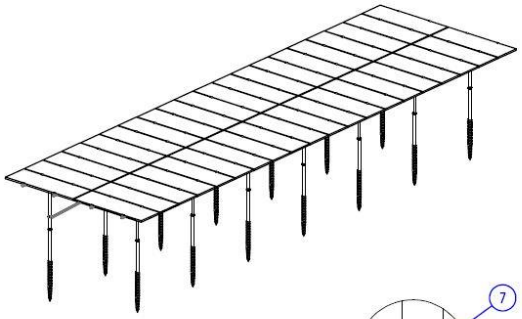
# SLD - Sample

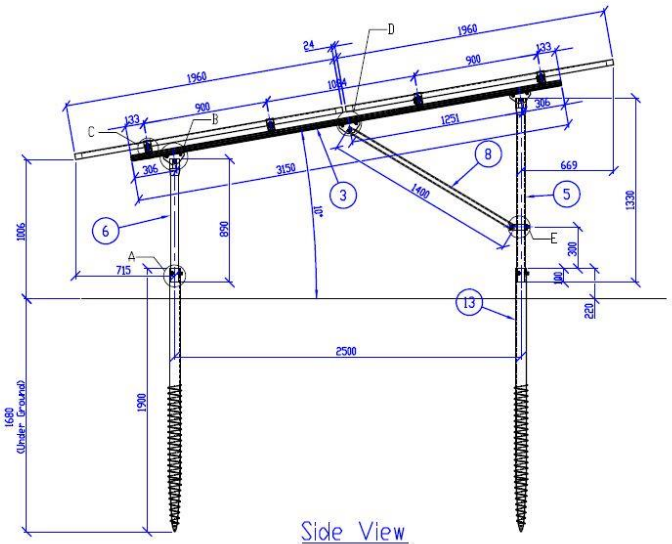


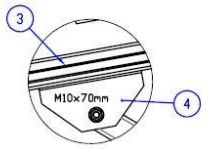

Narada®

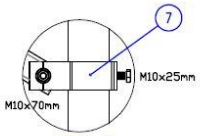
# Mounting Frame - Sample

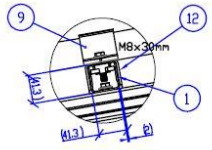
| ITEM NO. | PART NUMBER | DESCRIPTION | MATERIAL |
|---|---|---|---|
| 1 | 308-0007 | GALVANISED RAIL PIECE(41.3x41.3x2.0), CUSTOM LENGTH #1 | Q235B STEEL |
| 2 | 308-0012 | GALVANISED RAIL PIECE(41.3x41.3x2.0), CUSTOM LENGTH #2 | Q235B STEEL |
| 3 | 308-0016 | GALVANISED TRUSS PIECE(41.3x41.3 x2.0), CUSTOM LENGTH | Q235B STEEL |
| 4 | 309-0002 | GALVANISED PIVOT BRACKET ASSEMBLY | Q235 STEEL+SUS 304 |
| 5 | 307-0009 | REAR LEG PIECE, OVAL END TUBE , CUSTOM LENGTH | Q235 STEEL |
| 6 | 307-0010 | FRONT LEG PIECE, OVAL END TUBE ,CUSTOM LENGTH | Q235 STEEL |
| 7 | 312-0001 | DAIGONAL BRACE SLEEVE ASSEMBLY | AL 6005-T5+SUS 304 |
| 8 | 313-0002 | BRACE ARM PIECE, CUSTOM LENGTH | Q235 STEEL |
| 9 | 302-0006 | FIXED 40 MM HIGH END CLAMP ASSEMBLY FOR GALVANISED RAIL, 50 MM | AL 6005-T5+SUS 304 |
| 10 | 301-0003 | MID CLAMP ASSEMBLY, FOR GALVANISED RAIL, 50 MM | 6005-T5 |
| 11 | 319-0002 | BATTEN-TRUSS CONNECTOR ASSEMBLY | Q235 STEEL+SUS 304 |
| 12 | 303-0002 | GALVANISED RAIL JOINER ASSEMBLY | Q235 STEEL+SUS 304 |
| 13 | 110-0002-19 | GROUND SCREW,STANDARD THREAD, OPEN HOLE TYPE, LENGTH= 1900 MM | Q235 STEEL |
| 14 | 100-0028 | HEX SCREW, M12 x 25 MM, C-1022, DACROMET | C-1022 STEEL |
| 15 | CS6U-320P | PV SOLAR MODULE , 1960X992X40 | |

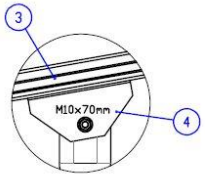


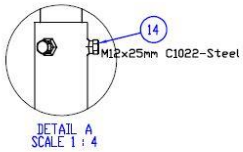


# Solar PV Farm

Narada®

# Schedule of Main Components

| Item | Make / Model | Qty | BUDGETARY ESTIMATE (USD) |
|---|---|---|---|
| **Solar Farm (“X” MW PEAK SOLAR FARM)** | | | |
| PV Modules | Brand to be advised | 1 Lot | TBA |
| Mounting Frame | Brand to be advised | 1 Lot | |
| Solar Inverters | Brand to be advised | 1 Lot | |
| Basic Control System | Brand to be advised | 1 Lot | |
| **Narada Energy Storage System (”X” MWH ESS)** | | | |
| Advance Monitoring & Control System | Brand to be advised | 1 Lot | TBA |
| Bi-Directional Inverter | Brand to be advised | 1 Lot | |
| Battery ( Lead Carbon) / Litihium | Narada Lead Carbon Battery/ Lithium | 1 Lot | |
| **Diesel Generators (Optional)** | | | |
| Diesel Generator (option) | NA | NA | NA |
| **Consultant and Engineering Services (Optional)** | | | |
| EPC | Local partner - Engineering Procurement & Construction | 1 Lot | tba |
| Local Installation | tba | 1 Lot | tba |
| Project Audit & Consultancy | tba | 1 Lot | tba |
| Project Management | Narada | 1 Lot | tba |

Narada®

Narada®

An Expert of Energy Storage Solutions.

2016

# Some of our Project Reference List