

Battery Energy Storage in India

Nov 13th , 2019





DELIVERING SAFE,
RELIABLE & SUSTAINABLE
**ENERGY TO
MILLIONS OF
PEOPLE**

About AES

Our Mission: Improving lives by accelerating a safer and greener energy future.

- Fortune 500 Company, headquartered in Arlington, Virginia , USA
- AES is Fortune 200 Global Power Company
- AES provides affordable, sustainable energy to 15 countries through our diverse portfolio of distribution businesses as well as thermal and renewable generation facilities
- Having continued presence in India since 1992

\$33B

TOTAL ASSETS
OWNED & MANAGED

\$11B

TOTAL 2018
REVENUES

32,000 MW

GENERATION CAPACITY

4,500 MW

UNDER CONSTRUCTION



6

**UTILITY
COMPANIES**



9,000
**GLOBAL
WORKFORCE**

Why Battery Storage?

TRANSFORMING NETWORK

Transmission & Distribution Enhancement

TRANSFORMING GENERATION

Frequency Regulation

Capacity Peak Power

Generation Enhancement

TRANSFORMING ENERGY USE

Black Start

Energy Arbitrage and DSM

Renewable (Solar and/or Wind with BESS) Integration

Micro-grids & Islands

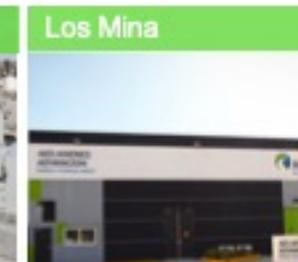
8 primary energy storage applications available full spectrum of use cases

AES' Battery Energy Storage Fleet

570 MW

In operation, construction or late stage development

Teck



Experience in India



Delhi BESS

10 MW/10 MWh


TATA POWER-DDL


AES
we are the energy


Mitsubishi
Corporation

FLUENCE
A Siemens and AES Company

TATA
TATA POWER



Delhi BESS Project

- India's first grid scale battery based energy storage project and largest in South Asia
- AES, Mitsubishi Corporation (MC) and Tata Power Delhi Distribution Limited (TDPPL) have deployed a 10 MW / 10 MWh Battery Energy Storage System at Rohini substation
- Technology supplied by Fluence, a joint venture of AES and Siemens
- Built in an area of 603 m² (6500 sq ft)

Project Timeline

Project NTP

Completion of Building

Installation of Batteries

Commissioning of the Project



Final Completion of the Project



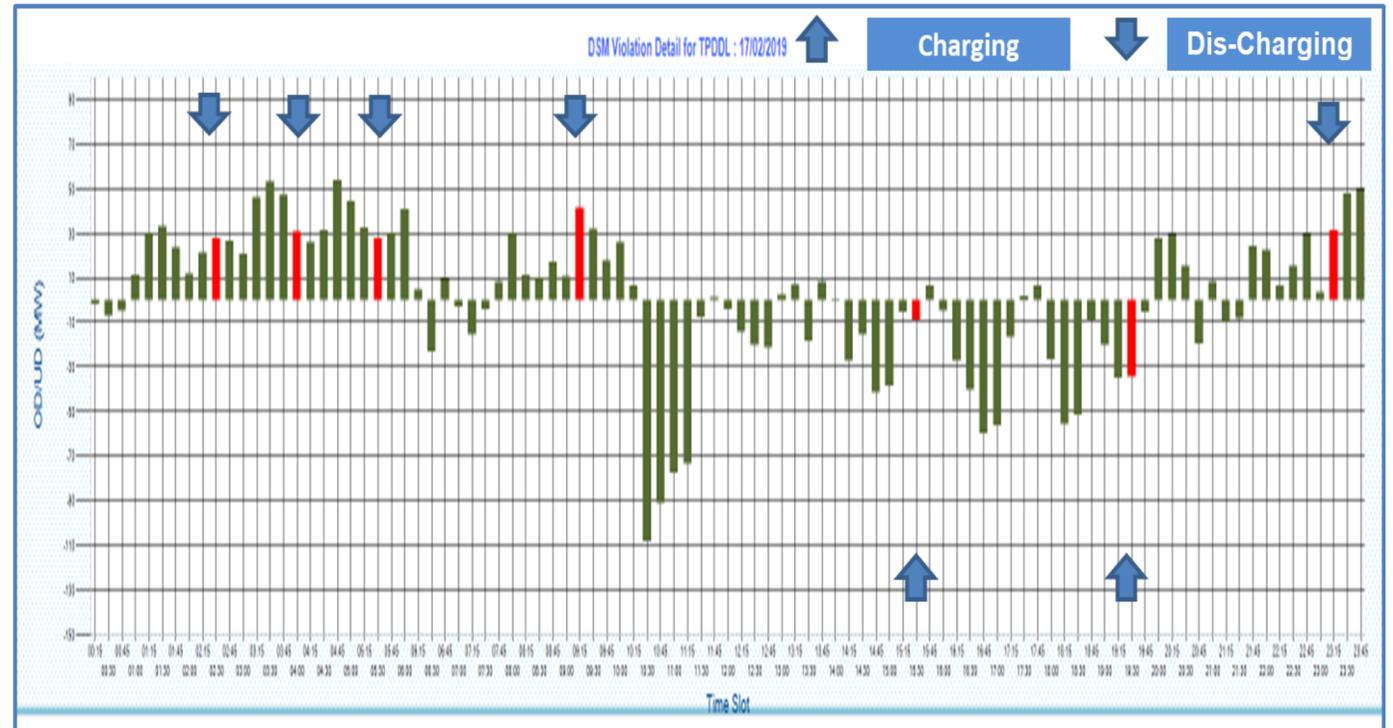
Key Challenges faced by Tata Power - DDL

- Managing Sustained Deviation penalty
- Disposal of surplus power during off-peak hours
- Power Quality Management
- Peak Load Management and Capex deferral
- Frequency Management

Key Challenges faced by Tata Power - DDL

Managing sustained deviation penalty

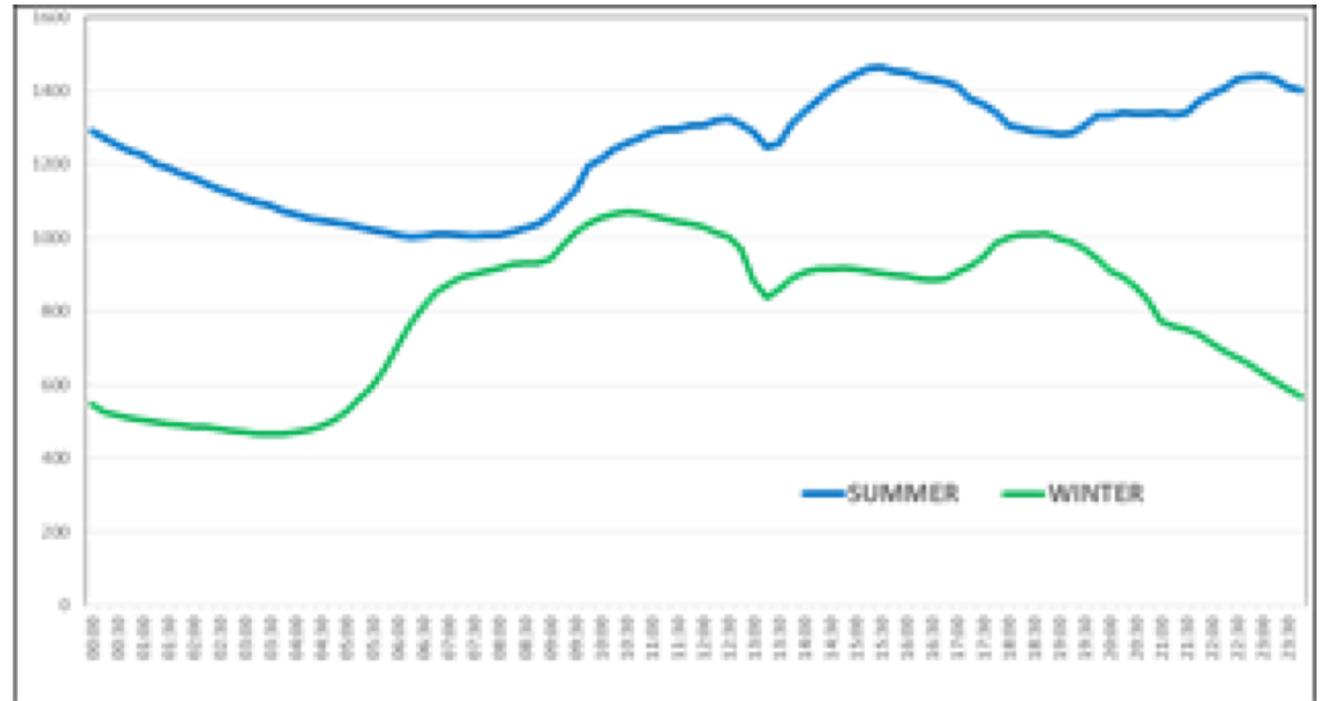
- DSM sustained violation of TP-DDL for 17th Feb 2019 were seven which are highlighted in Red Bar which is 140% additional charges on DSM net charges for the day.
- Battery storage can give dynamic command of charge and discharge during sustained violation.



Key Challenges faced by Tata Power - DDL

Disposal of surplus power during off-peak hours

- Long term power purchase agreement are on RTC basis and this results in huge surplus during off-peak hours.
- The disposal of surplus power during off-peak hours is major bottleneck issue for DISCOMs. Power exchange rates are also low during off-peak hours so selling the power through exchange won't give benefit.

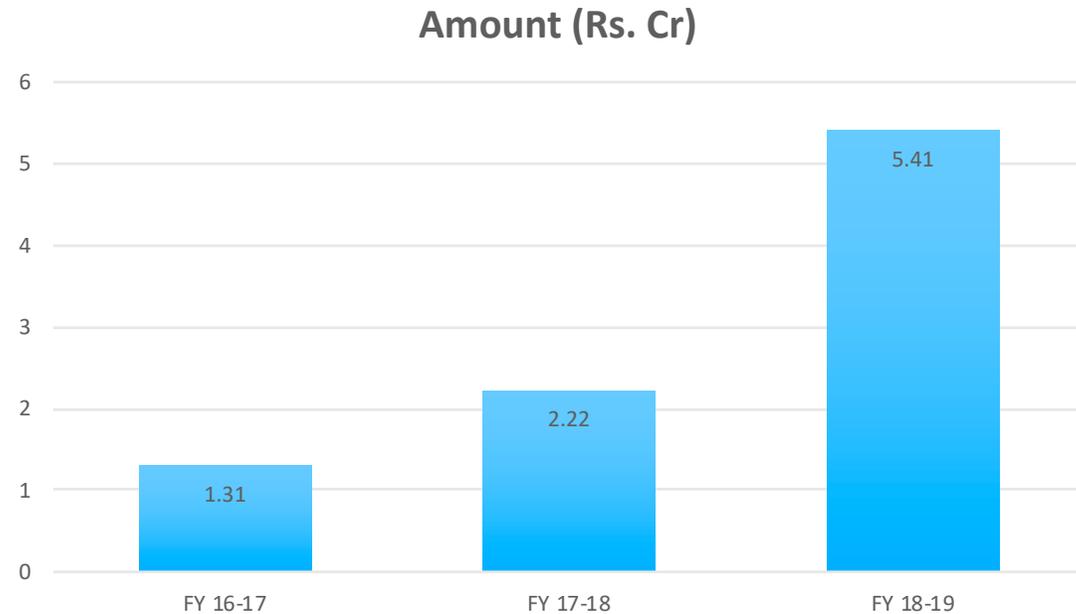


1500MW Gap in Demand between Summer and Winter

Key Challenges faced by Tata Power - DDL

Power Quality Management

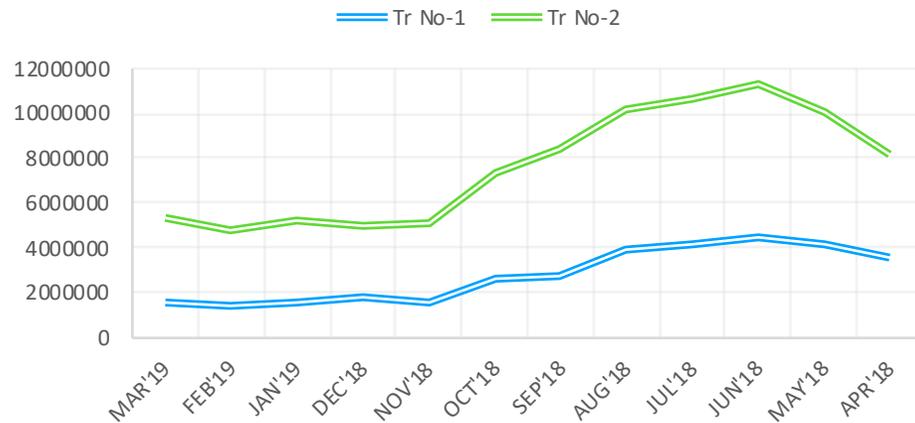
- Every year reactive power injection goes on increasing in TPDDL system due to which penalty also increase
- Battery storage can give dynamic command to absorb or inject reactive power as per need



Key Challenges faced by Tata Power - DDL

Peak Load Management and Capex Deferral

TRANSFORMER LOAD CURVE

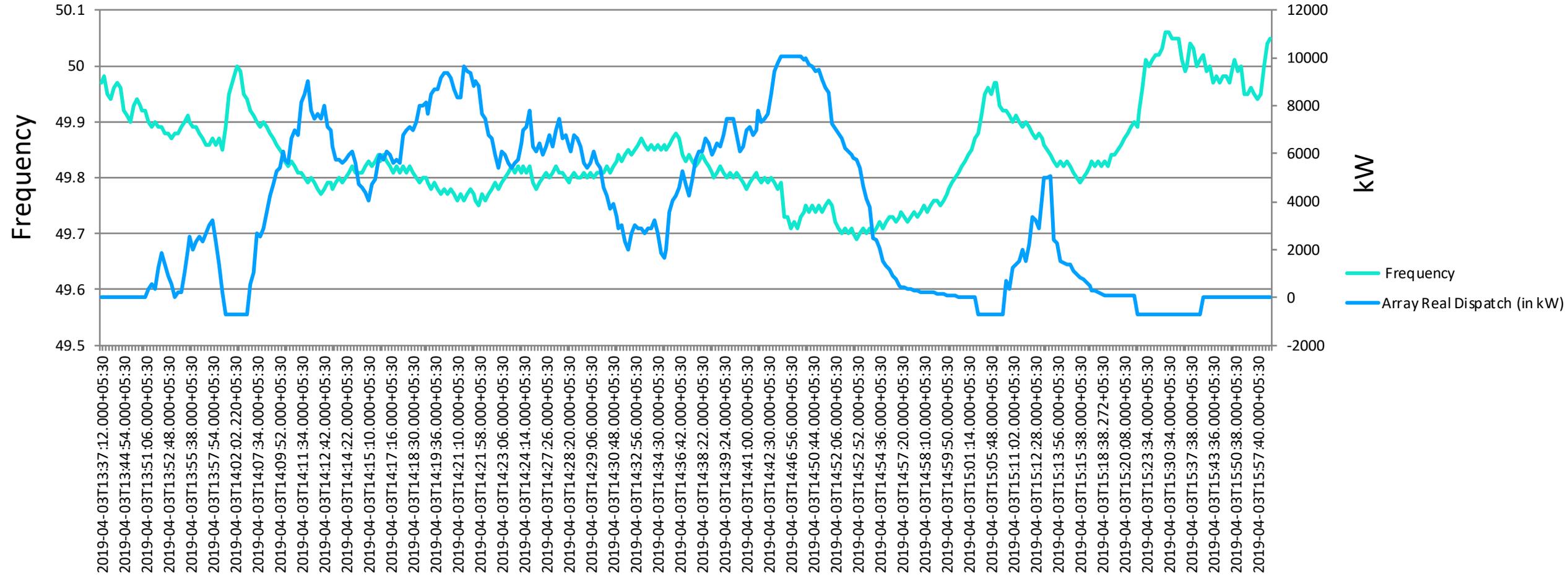


RG-24 Grid Substation

Date	Time	11 KV I/C NO-1	11 KV I/C NO-2	Total
		20 MVA(1040A)		
		Avg Current		
10.07.2018	04:00:00	571.474	730.934	1302.408
10.07.2018	04:15:00	568.823	731.729	1300.552
10.07.2018	04:30:00	563.244	741.368	1304.612

- Managing the peak demand is a key challenges for any power distribution utility BESS can support short duration overload management at power transformer level and reduce transmission line congestion

April 03, 2019 Northern Grid





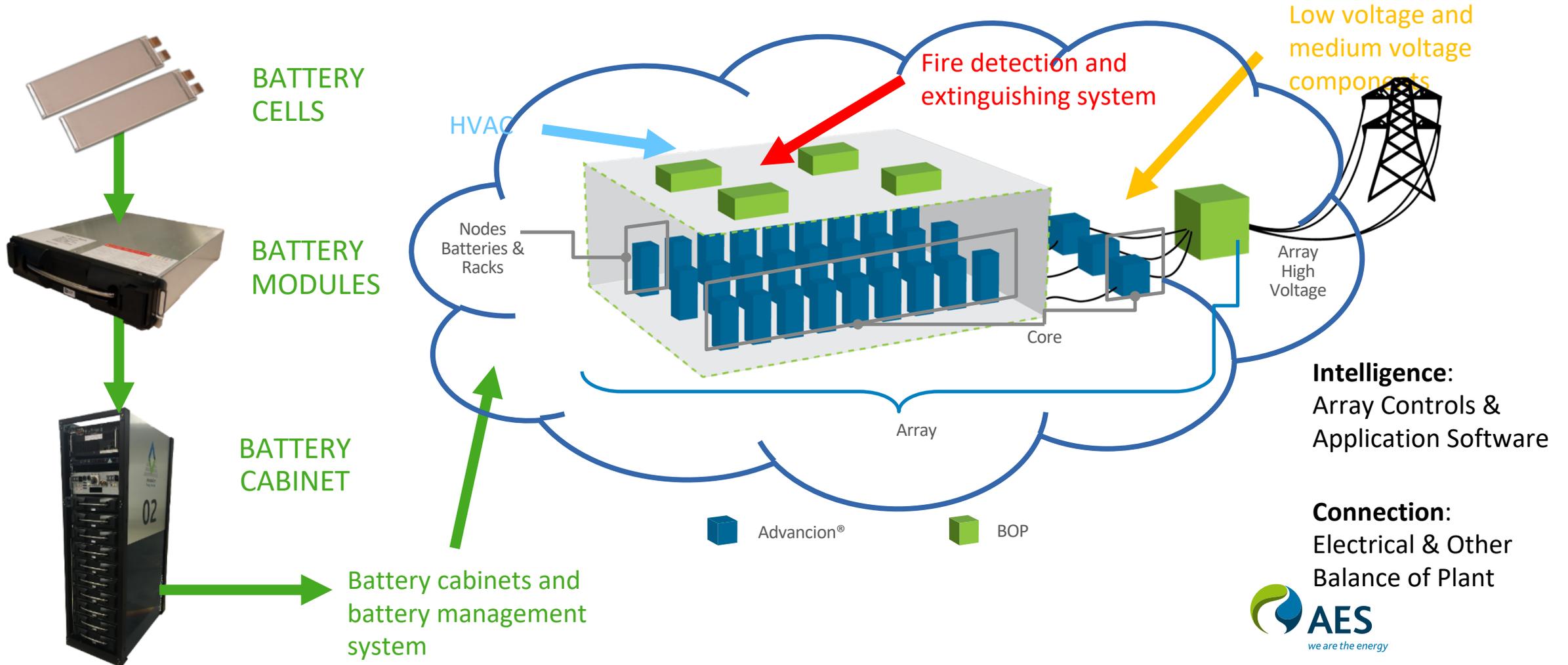
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Appendix



What is Battery Energy Storage?

Modular, scalable arrays of proven technologies integrated at utility and industrial scale





Screen shot of HMI (human machine interface)

Advancion® HMI - Tata Delhi Tue Jun 04 2019 10:37:45 Sign Out >

+ MDU Primary Frequency Control (POSOCO) Status

+	Array	-705.8 kW	-4.7 kvar	-10020.6 kW	10020.6 kW	47.9 %	ARC (Collective)	Status
+	Core 01	-175.54 kW	-1.68 kvar	-2495.0 kW	2495.0 kW	47.4 %	ARC (Collective)	Status
+	Core 02	-174.23 kW	-8.69 kvar	-2454.0 kW	2454.0 kW	34.4 %	ARC (Collective)	Status
+	Core 03	-175.52 kW	0.81 kvar	-2535.8 kW	2535.8 kW	54.8 %	ARC (Collective)	Status
+	Core 04	-177.08 kW	2.84 kvar	-2535.8 kW	2535.8 kW	54.8 %	ARC (Collective)	Status

+ Events Log

Advancion® HMI - Tata Delhi Tue Jun 04 2019 10:39:37 Sign Out >

+ MDU Primary Frequency Control (POSOCO) Status

+	Array	-702.8 kW	19.3 kvar	-10020.8 kW	10020.8 kW	48.1 %	ARC (Collective)	Status
+	Core 01	-172.81 kW	5.17 kvar <td>-2495.0 kW</td> <td>2495.0 kW</td> <td>47.8 % <td>ARC (Collective)</td> <td>Status</td> </td>	-2495.0 kW	2495.0 kW	47.8 % <td>ARC (Collective)</td> <td>Status</td>	ARC (Collective)	Status
+	Core 02	-178.8 kW	-3.9 kvar <td>-2454.0 kW</td> <td>2454.0 kW</td> <td>34.8 % <td>ARC (Collective)</td> <td>Status</td> </td>	-2454.0 kW	2454.0 kW	34.8 % <td>ARC (Collective)</td> <td>Status</td>	ARC (Collective)	Status
+	Core 03	-172.45 kW	8.09 kvar <td>-2535.8 kW</td> <td>2535.8 kW</td> <td>55.0 % <td>ARC (Collective)</td> <td>Status</td> </td>	-2535.8 kW	2535.8 kW	55.0 % <td>ARC (Collective)</td> <td>Status</td>	ARC (Collective)	Status
+	Core 04	-174.59 kW	5.13 kvar <td>-2535.8 kW</td> <td>2535.8 kW</td> <td>55.0 % <td>ARC (Collective)</td> <td>Status</td> </td>	-2535.8 kW	2535.8 kW	55.0 % <td>ARC (Collective)</td> <td>Status</td>	ARC (Collective)	Status

Service Mode: **ARC** Manual Idle Disconnect

Current Status: ARC (Collective)

Show Details

Set Node Status: **Connect** Disconnect Reset

Advancion® HMI - Tata Delhi Tue Jun 04 2019 10:38:33 Sign Out >

- MDU Primary Frequency Control (POSOCO) Status

Application: Primary Frequency Control (POSOCO) Scheduler: Off

Nominal System Frequency (Hz): 50.0

Service Charge Limit (kW): -10148.0

Service Discharge Limit (kW): 10148.0

Real Ramp Rate (kW/min): 0.0

Show Details

Overall

Overall

- Breaker Status
- Overall Status

Controls

- Capacity Diminished
- Contact Fluence Service Team
- E-Stop Status
- Ground Fault Detected Status
- Heat/Deaf Status
- Heat/Deaf Status
- Hi SOC Status
- Lo SOC Status
- Trim Loop Status
- Warning Present

Core 04 Nodes

Events Log