EVNHANOI

REPORT

PROGRESS OF PILOT PROJECT

BATTERY ENERGY STORGAGE INSTALLATION

Hanoi, November 2025

CONTENT

OVERALL OBJECTIVE

OVERVIEW OF HANOI' S GRID

05

TBA 500kV

8,100 MVA

Total capacity

500kV Hiệp Hòa

500kV Đông Anh

500kV Phố Nối

500kV Thường Tín

500kV Western Hanoi

EVNHANOI

OVERALL OBJECTIVE

As of 10/2025

05 (8,100 MVA)
500kV substation

13 (7,500 MVA)
220kV substation

220kV
110kV
35kV
22kV

8,34 km
220 kV transmission line

01 TBA/02 MBA/ 500 MVA
TBA 220kV

1,125 km
220 kV transmission line

65 TBA/ 152 MBA/9.003 MVA
TBA 110kV

2,905,751 CUSTOMERS

2,610,593	295,158
RESIDENTIAL USE	NON-RESIDENTIAL USE

HANOI

23,495	17,774.41	11,949.19
MBA	Capacity (MVA)	Underground cable + overhead transmission line (km)

EVNHANOI

14,738	8,782.40	10,396.5
MBA	Capacity (MVA)	Underground cables + overhead transmission line (km)

CUSTOMERS

8,757	8,992.01	1,552.69
MBA	Capacity (MVA)	Underground cables + overhead transmission line (km)

GOAL

Meeting the power capacity demand of Hanoi during:

- Hot season peak periods, when the power supply in the Northern region is deficient.
- Peak periods, when the distribution grid's load surges unexpectedly.

1 Meet Hanoi's power demand

Supporting the power grid system in Hanoi to operate safely, stably, enhancing power supply reliability, especially during scheduled outages or power reductions for construction/repair work and natural disaster recovery.

2 Support grid system

3 Deployment – evaluation

Deploy, evaluate some specific auxiliary services when applying ESS and flexible distribution utilization (e.g.: electricity pricing mechanisms, load shifting)

4 Optimize capacity

Optimize power transmission and distribution on the grid by integrating flexible energy storage at load center nodes.

TAILORED ENERGY STORAGE SYSTEM

FUNCTIONS AND OPERATING MODES

- Required functions: frequency regulation, voltage regulation, backup power, energy time-shifting, power capacity optimization, and power quality improvement
- Typically, an energy storage system can combine multiple functions; appropriate operational solutions are required for each function to ensure power system stability.

BATTERY STORAGE TYPES BASED ON ACTUAL DEMAND

- Currently, battery storage technology is developing rapidly, and costs are becoming increasingly competitive. The most common types for battery storage systems include Li-ion, Vanadium Redox Battery (VRB), and Sodium-Sulfur (NAS) batteries.
- Factors for comparing these technologies include technical characteristics, cost, commercialization status, and environmental friendliness.
- The choice of battery storage technology has a significant impact on the other auxiliary components of the energy storage system.

TAILORED ENERGY STORAGE SYSTEM *(continued)*

CONFIGURATION, VOLTAGE, POWER, CAPACITY

- Energy storage specifications are determined based on power system calculations to ensure suitability.
- Focus on storage capacity, power conversion capabilities, and system characteristics matching the intended use to select the appropriate system.

ECONOMIC ANALYSIS OF BESS

- Optimal energy storage system sizing requires economic calculations tailored to the grid structure and intended use.

OTHER KEY MATTERS

- Issues: safety, reliable, environment friendly, recycling capability, maintenance

Note: At present, numerous developed countries have deployed energy storage systems (ESS) with power ratings scaling from a few MW up to hundreds of MW.

1. EVALUATION OF DEPLOYMENT SOLUTIONS

1 — INSTALLATION AT 110KV SUBSTATION – LOAD CENTERS

Shifting peak loads and mitigating local overload risks for 110kV substations, relieving overloads on certain 110kV lines, improving transmission grid voltage quality, and reducing distribution network losses...

Most feasible solution.

Requirement: Deploying large-scale capacity storage systems requires the availability of suitable sites with high feasibility..

2 — INSTALLATION ON 22KV GRID LOCATED AT LOAD CENTERS

Shifting peak load and reduce local overload risks, improving transmission grid voltage quality...

This is the most unfeasible option.

Issue: Unavailability of deployment site.

3 — INSTALLATION AT RE POWER PLANTS

Generation peak shifting and supporting increased system ramp rates... (periods when renewable energy peak generation does not coincide with peak load).

This is the most optimal option.

However: Natural and socioeconomic conditions of Hanoi are not enablers for building utility-scale RE power plants.

2. SELECTION CRITERIA

EVNHANOI selects option 1 owning to its advantages for pilot deployment and based on the following criteria:

Prioritize locations with feasible site conditions for installation that are under EVNHANOI management.

Prioritize hotspots that frequently experience overloading during peak hours or have high loading levels. Focus on major, concentrated distribution nodes such as 110kV substations or switching stations.

Prioritize critical load areas requiring continuous power supply, such as: Public administrative and political centers, hospitals, broadcasting stations, etc.

Prioritize industrial cluster areas with large concentrated loads, such as: Bac Thang Long Industrial Park, Quang Minh Industrial Park, etc.

VI – OPTIONS FOR BESS INSTALLATION

LOCATION

Suitable locations for installing battery energy storage systems (BESS) must have sufficient installation area, be situated at load centers, and facilitate convenient management and operation within the Hanoi City power grid at 110kV substations, based on the following expected criteria:

- ❑ **Average vacant area: ≥ 250m2**
- ❑ **No encroachment on overhead power grid safety corridors or underground infrastructure.**
- ❑ **Power/Capacity: 10MW/20MWh.**
- ❑ **110KV substations/grid operating under high load conditions.**
- ❑ **Substations located near or within industrial zones, etc.**

BESS

Selection of BESS needs to:

- ❑ **Analyze and evaluate existing battery storage technologies.**
- ❑ **Calculate power system demand of Hanoi.**
- ❑ **Evaluate control systems and ancillary services**

Remark: At present, Lithium-ion battery technology remains the preferred choice for battery energy storage projects globally.

	Energy density (kW/kg)	Efficiency(%)	Lifespan (year)	Environment friendliness	Capacity range	Energy storage range
Li-ion	150÷250	95	10÷15	Yes	~ 100MW	< 200MWh
NaS	125÷150	75÷85	10÷15	No	~ MW	≥ 100 kWh
Flow	60÷80	70÷75	5÷10	No	~ 30MW	100kWh
Ni-Cd	40÷60	60÷80	10÷15	No	NA	NA
Lead Acid	30÷50	60÷70	3÷6	No	~ MW	<10 MWh

- Battery storage:

Battery type:	Lithium-ion battery (850 ÷ 1500 VDC)
Capacity:	Depending on the manufacturer, the latest technology and suitable capacity should be selected; it is proposed to choose a capacity range of 2.5 MWh/container ÷ 4.8 MWh/container
Lifespan:	At least 10 years or 6000 discharge/charge cycles (under standard operational condition)
Discharge time:	≥1 hour
Installation:	Container 20ft (ISO)

- Power Conversion System (PCS):

Architecture:	Single-stage power converter
Capacity:	Depending on the manufacturer, the latest technology and suitable capacity should be selected; it is proposed to choose a capacity range of 2.5–5 MW for the pilot implementation
Voltage:	Depending on the manufacturer (<1000VAC)
Type:	3 phase, unearthed
Installation:	Container 20ft (ISO)
Operation:	Depending on system requirement

- Ste-up transformer and RMU system:

- Connected to the 22kV distribution switchgear system in the distribution room of the 110kV substation. Each step-up transformer will be connected to a 22kV RMU (Ring Main Unit) installed adjacent to the transformer (packaged substation); the transformer capacity must be compatible with the PCS capacity.(2÷5 MVA).

- Control monitoring system:

- The telecommunications and SCADA infrastructure serving the operation of the energy storage system will share/utilize the existing infrastructure of the 110kV substation;
- Communication channels;
- Telecommunication terminal equipment: Routers, Firewalls, Ethernet Switches, etc.

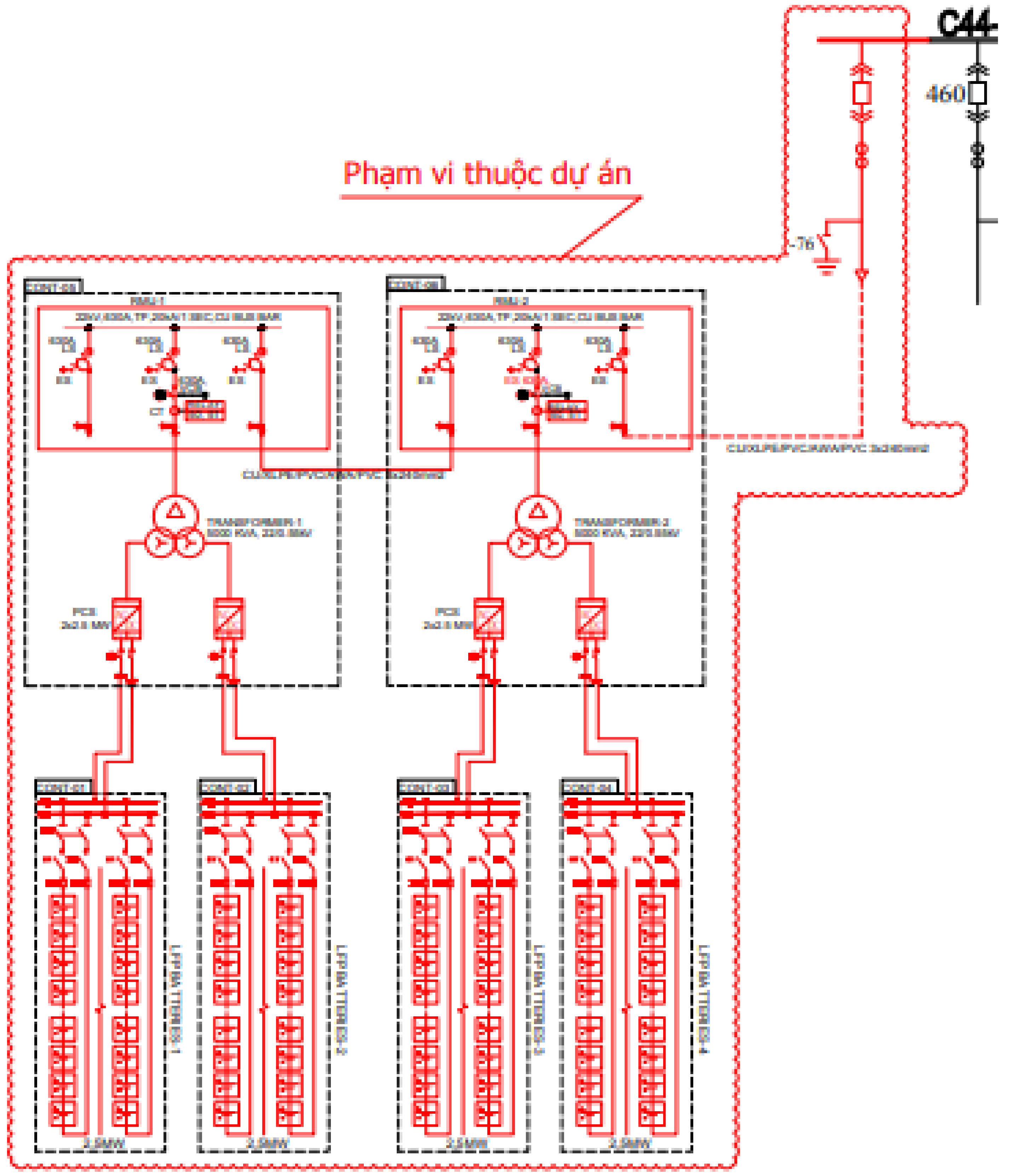
- Ancillary services:

- Integrated and compatible with the battery energy storage system and the power conversion system;
- Fully equipped with Battery Management Systems (BMS), HVAC, and Fire Protection Systems to ensure regulatory compliance and operational safety.

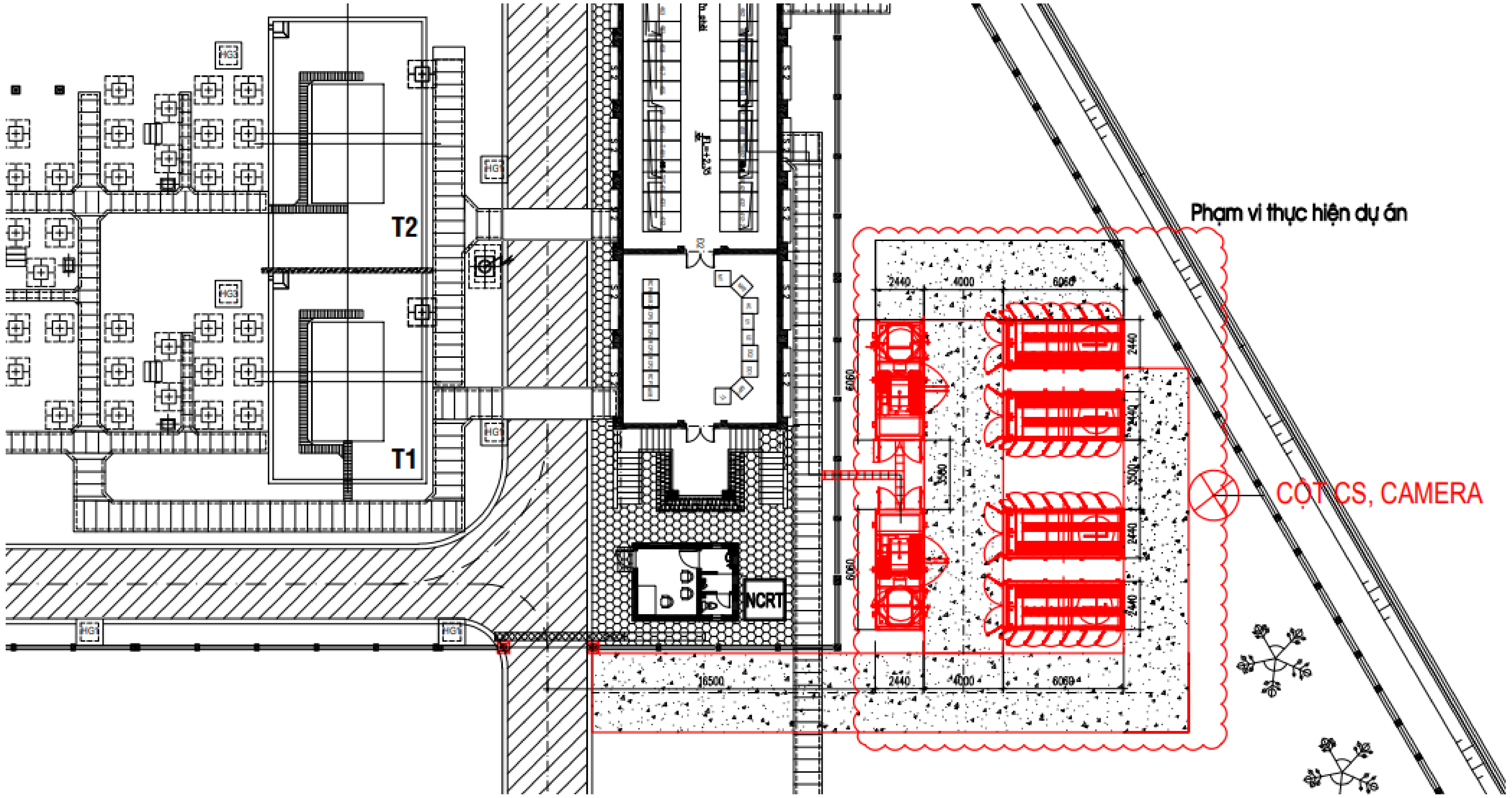
VI - OPTIONS FOR BESS INSTALLATION

❑ **Proposed Interconnection Scheme for deployment at 110kV substations:**

E1.17 -



❑ **Proposed Site Layout for 110kV substations connection:**



A EVALUATION

1. EFFICENCY IN POWER GRID OPERATION:

- Peak load shifting on the distribution grid (storing energy during off-peak hours and discharging during peak hours).
- Flexibility in dispatching and allocating power capacity within the distribution grid..
- Load leveling and mitigation of local overloading at 110kV substations equipped with BESS.
- Load reduction for certain 110kV lines supplying multiple 110kV substations, thereby improving voltage quality on the 110kV grid.

2. EFFICIENCY IN ELECTRICITY BUSINESS:

- Price arbitrage efficiency (storing energy during off-peak hours at low electricity prices and discharging during peak hours at high electricity prices).

Specifically:

- Summer time: Pmax: 5263 MW; Pmin: 2081 MW; Difference: 2.5 times
- Winter time: Pmax: 4554 MW; Pmin: 1445 MW; Difference: 3.2 times
- Peak hour price: 3,176 dong/kWh ; Off-peak price: 1,009 dong/kWh; Difference: 3.14 times *(equivalent to 2.167 VND)*

B OPTION

SELECTING ESS AT SOME 110 KV SUBSTATIONS

No.	Location (110kV substations)	Substation capacity (MVA)	2024 Load (%)	Battery (*)		Installation area/vacant area (m2)
				Power (MVA)	Capacity (MVAh)	
1	Northern Thăng Long	4 x 50	62	10	20	300/1200
2	Quang Minh	2 x 63	76	10	20	300/600
3	Sài Đồng 2	2 x 63	65	10	20	300/800
4	Phùng Xá	2 x 63	80	10	20	300/600
5	Thanh Oai	2 x 63	74	10	20	300/550

PROPOSED SITE LAYOUTS AND DEPLOYMENT LOCATIONS AT 110KV SUBSTATIONS

Proposed installation location at vacant area within 110kV substation (ensuring no encroachment on overhead power grid safety corridors and underground utilities).

Preliminary estimate:

+ Each installation location 10MW/20MWh:

+ Total planned installed capacity50MW/100MWh:

Currently, the prevalent discharge power rating is equal to ½ of the storage capacity. EVNHANOI is deploying battery storage systems with a power/capacity of 50MW/100MWh, distributed across five 110kV substations. In 2026, deployment will continue with an additional 150MW, expected to be distributed across twelve 110kV substations.

A CHALLENGES

1. **STANDARDS**

- National standards for BESS are under development, and perfection. (issued recently on Oct 15, 2025)
- Lack of synchronized standards and guidelines for fire safety and environmental compliance for BESS installed at 110kV substations.

2. **PLANNING**

- Site planning for BESS projects deployed on the distribution grid remains unspecific.

3. **TECHNOLOGY SELECTION, OPERATION**

- Battery storage technologies are diverse and evolve rapidly over short periods.
- Integrating the BESS operation monitoring and management system synchronously with the existing SCADA system at 110kV substations to ensure safety, security, and confidentiality in accordance with regulations.
- Needs to study and clarify issues regarding the impact/influence of BESS when directly connected to the distribution grid at source nodes (22kV busbars of 110kV substations)

B PROPOSAL

1. **STANDARDS**

- Continue to complete/finalize the national standards framework for BESS and related standards such as Fire Protection, environmental protection, etc.

2. **PLANNING**

- Provide guidelines and supplement planning for BESS installation locations (which exist in planning but currently lack specific siting)

3. **STUDY, TECHNICAL REVIEW**

- Strengthen collaborative research to assess the impact of BESS on the distribution grid and share experiences in system operation management.