Study Committee B3

Substations and Electrical Installations

Paper ID_11002

EGAT's experience on integration between conventional substation and IEC 61850 control and protection system applied for grid scale energy storage

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Background and Overview

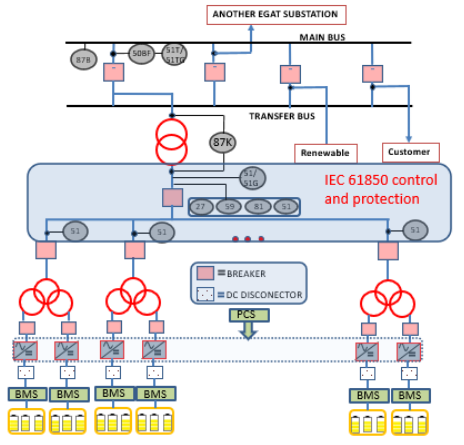
- The grid-scale Battery Energy Storage System (BESS) of EGAT is the pilot project for reducing fluctuation, managing congestion of electricity demand and utilizing the excess energy supply from renewable feeders and other EGAT substations.
- The control and protection system of 22 kV switchgears of which for BESS is designed based on IEC 61850 and it is integrated with the control and protection of the existing conventional substation.

EGAT 16 MW grid-scale Battery Energy Storage System

Motivation of this project :

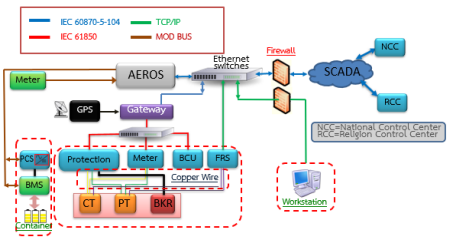
- Practical experience and prototype to integrate the conventional substation with the semi-fully digital substation to support smart grid including energy storage which is widely widespread in the future.
- Time saving of designing, construction and installation of the control and protection system.
- Cost saving from reducing equipment, copper cables, installation area.
- Merging multi digital platforms : TCP/IP from FRS IEC61850 from protection system and the MOD BUS from battery controller.

Structure of Control and Protection System for Energy Storage System



- Transformer high side protection composes of 87B, 87K, 51T&51 and 50BF.
- Protection of incoming energy storage feeders compose of multifunction IED (27,59,51,81) and protection of outgoing to energy storage feeders are assigned as 51. Both are designed on the basic of IEC 61850.

BESS connection diagram and implementation of 22 kV switchgear for IEC 61850



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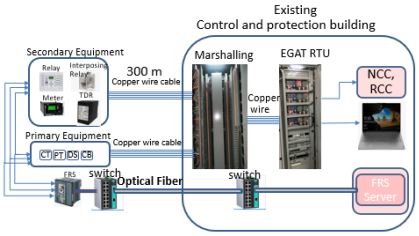
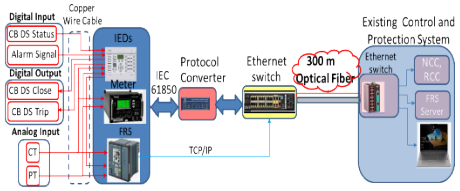
Compare structure of common design and IEC 61850 based control and protection system



Structure of control and protection system and connection to the existing building of conventional substation.



Structure of control and protection system and connection to the existing building of semi-fully digital substation designed for BESS.

Advantage of adapting to semi-fully digital substation

➢ **Decrease of Copper cables**

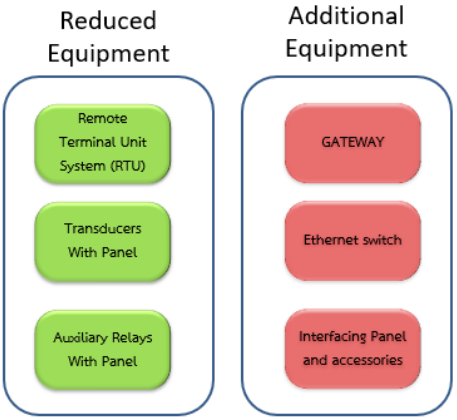
Numerous of copper cables of connection between the control and protection system of 22 kV switchgear and the existing building and connection between IEDs are replaced with few optical fibres.

	Equipment Description	Conventional Sub.	Semi-fully digital Sub.	
	Copper Cable	$63,000	$2,000	
	Optical Fiber		$1,500	
Estimate Price (USD)		$63,000	$3,500	
Price Diffrence (USD)				$59,500

Estimated price of copper cables for conventional substation and optical fibers for semi-fully digital substation.

➢ The total price of the copper cables for the one (1) incoming feeder and the seven (7) outgoing feeders can be reduced up to 94.4 %

➢ **Equipment cost reduction**

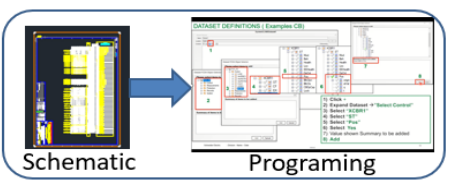


	Equipment Description		
	Conventional Substation	Semi-fully digital Substation	
	1XMarshalling Panel for RTU	1XGateway	
	1XRTU System with Panel -64 Analog Input -128 Digital Output -384 Digital Input	2XOptical Interfacing Panel and Accessories	
	Transducers with Panel		
	Auxilary Relays for control CB,DS,ES with Panel		
Estimated Price (USD)	$37,000	$12,500	
Price Diffrence (USD)			$24,500

Price comparison of control and protection equipment for conventional substation and IEC 61850 based energy storge feeders.

➢ **Saving Time and cost for Engineering design**

- Schematics of connection and the wiring diagrams of TDRs, interposing relays, marshaling RTU and RTU system are vanished and are replaced by programing
- approximately 70 man-hours are reduced.



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- **Reduce cost of Installation & Maintenance, and decrease area of installation**

RTU system , Transducers with panel , Auxiliary relays with panel are vanished which effect on installation & maintenance cost and the area of installation .

Conclusion.

- This project shows the advantages in term of cost reduction and time saving of integration between conventional substation and IEC 61850 control and protection system applied for grid scale energy storage.
- The topology and practical experience of combination of conventional substation with IEC 61850 22 kV switchgear feeders which link with energy storage system are presented in this paper.
- The idea of adapting our conventional substation to the semi-fully digital substation to support smart grid by increasing new digital feeders is indicated in this project.

Future approach

- Development the project of addition new feeders for floating solar with BESS by merging the concept of fully digital control and protection with the conventional substation.

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