

Study Committee B3

Substations and Electrical Installations

Design and Consideration for Relocatable Containerized STATCOM Installation to Provide Grid Flexibility and Stability

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Motivation

- Electricity Generating Authority of Thailand (EGAT) foresees that the future grid must be flexible and economically efficient because the increasing of Third-Party Access (TPA) and Renewable Energy (RE) can introduce many challenges to the power system. Based on EGAT's experience, **the locations where the reactive power is required may change** depending on the incoming connection of TPA or RE to the grid in the future. Therefore, EGAT sees the opportunity to introduce Relocatable Containerized STATCOM (RC STATCOM) to mitigate these challenges and smoothly enable RE and TPA to the grid.
- RC STATCOM is introduced because it provides the capability to relocate the previously-installed STATCOM to other substations where STATCOM is needed – providing "plug and play" functions.

- The PCC voltage level of these substations must be identical so that the design of a single RC STATCOM will be compatible with all pre-selected substations.

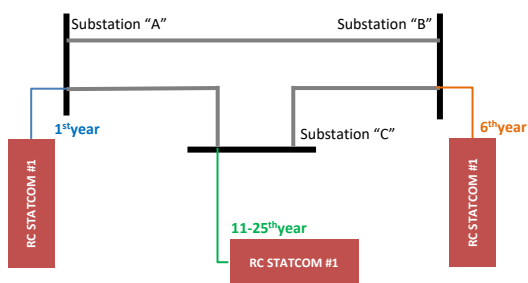


Figure III. One design of RC STATCOM is suitable for all three pre-selected substations. In the 1st year the RC STATCOM#1 will be installed at substation "A". In the next 5 years, the RC STATCOM#1 will be installed at substation "B". In the 11th year, the RC STATCOM#1 will be relocated to substation "C".



Figure I. Non-relocatable building (SVC in Thailand)



Figure II. Relocatable building (BESS in Thailand)

One Design for ALL

- One RC STATCOM can be designed by using **standardised design** concept that will be promptly installed at the various substations.
- The crucial characteristics of substations includes the minimum and maximum short circuit current, Point of Common Coupling (PCC) voltage, background harmonic and environmental data of the substations. All these data are significant for RC STATCOM design process.

RC STATCOM as Plug & Play

To achieve the relocatable concept, EGAT has considered various criteria for the robust design of RC STATCOM such as reactive power output capacity, execution time, footprint, comfortable transportation, effortless installation and relocation, maintenance access, housing design, proper design of control system and price

- There are three possible solution of RC STATCOM with two categories of housing, which are container and knockdown building, to facilitate relocation and transportation as plug and play.
- The first design concept, as presented in Figure IV all three of the VSC valve, control and protection panels, initial charging resistors, electrical panels and and cooling's pump system will be initially installed from the manufacturers factory in the same container, whereas the transformer of RC STATCOM, air core reactors and exhaust fan must be segregated separately as they are all installed outdoor.
- In the second design concept, as presented in Figure V, one container consists of a single phase of VSC valve, cooling's pump system, and initial charging resistor. Thus, three containers are required for three phases VSC valve, and another container is for the control & protection panels. Cooling's pump system and electrical panels for each phase of VSC valve must be installed in the same container.
- The knockdown building solution, as shown in Figure VI, is different from the first two pre-fabricated containerized solutions. Specifically, the indoor component, such as converter valves, cooling's pump system and initial charging resistor, cannot be pre-fabricated and installed inside the knockdown building from the factory before delivering to the substation.

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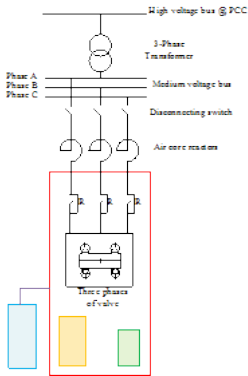


Figure IV. RC STATCOM: Pre-fabricated three phase containerized solution

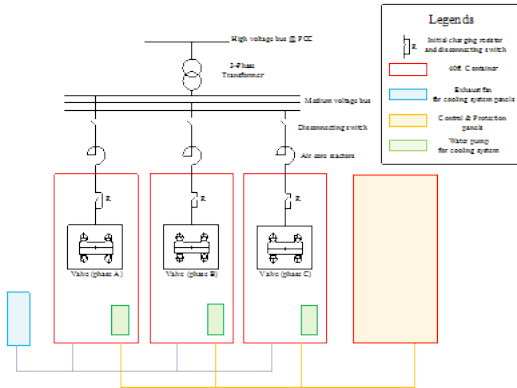


Figure V. RC STATCOM: Pre-fabricated one phase containerized solution

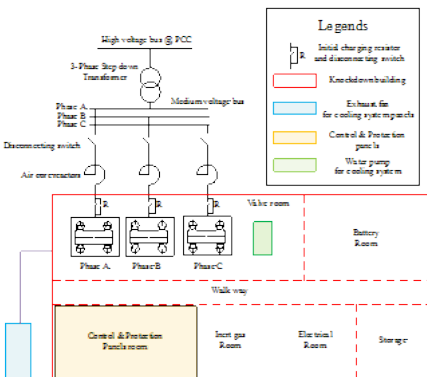


Figure VI. RC STATCOM: Knockdown Building Solution

Relocation period

- In case of purchasing a new RC STATCOM, the entire process from the submission of Letter of Offer and Acceptance (LOA) to complete energizing RC STATCOM of all solutions still reduces from 24 months to 18 months, compared with the non-relocatable STATCOM.
- The relocatable function could reduce the time to complete the entire process from 24 months to only 5 months, compared with purchasing a new non-relocatable STATCOM (Only for containerized solution)

Location	Working process (month)			
	Prior substation	2 months	1 month	1 month
Relocated substation	Foundation work		Transportation & Installation	Test

De-energized RC STATCOM (at Prior substation)
Energized RC STATCOM (at Relocated substation)

Figure VII. Relocation timeline for RC STATCOM with pre-fabricated containerized solution to another substation.

Conclusion

- EGAT has reviewed three potential solutions of RC STATCOM to be installed in EGAT transmission system. Based on the review, the Pre-fabricated three-phase containerized solution and Pre-fabricated one-phase containerized solutions are the two solution which provides a high degree of relocation flexibility and fast installation. The knockdown building solution is, on the other hand, only selected when there is no additional function from the non-relocatable STATCOM with concrete building, but the fast installation is required. Regarding the control system design, the selection of control system depends on required functions, including relocatable capability, parallel connection or faster installation.
- EGAT must thoroughly study the system requirement to match with application of each RC STATCOM solution. This will bring the most efficient RC STATCOM in term of investment and technical.