Black Start-Up Study of the Interconnected Sri Lankan Power System

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Introduction

In present situation the Jaffna Medium Voltage (MV) network is being operated in islanded mode. But according to the recent development plan, it is now being connected to the national grid and will be in operation by 2013 [1]. This interconnection requires long transmission line, which will introduce higher line losses, voltage flickering, transient stability issues such as power oscillation and some problems in black start-up [2]. This study investigates the black start-up operation of the interconnected power system with Static VAr Compensator (SVC). Simulation results presented in this paper have confirmed that SVC makes the interconnected system more controllable for any transient effect.

Literature Review

Flexible AC Transmission System (FACTS) technology can improve transient stability, voltage control capability and power transfer capability [3 & 4]. Cost and long term usage basis SVC is better than the other reactive power compensators such as STATCOM and UPFC.

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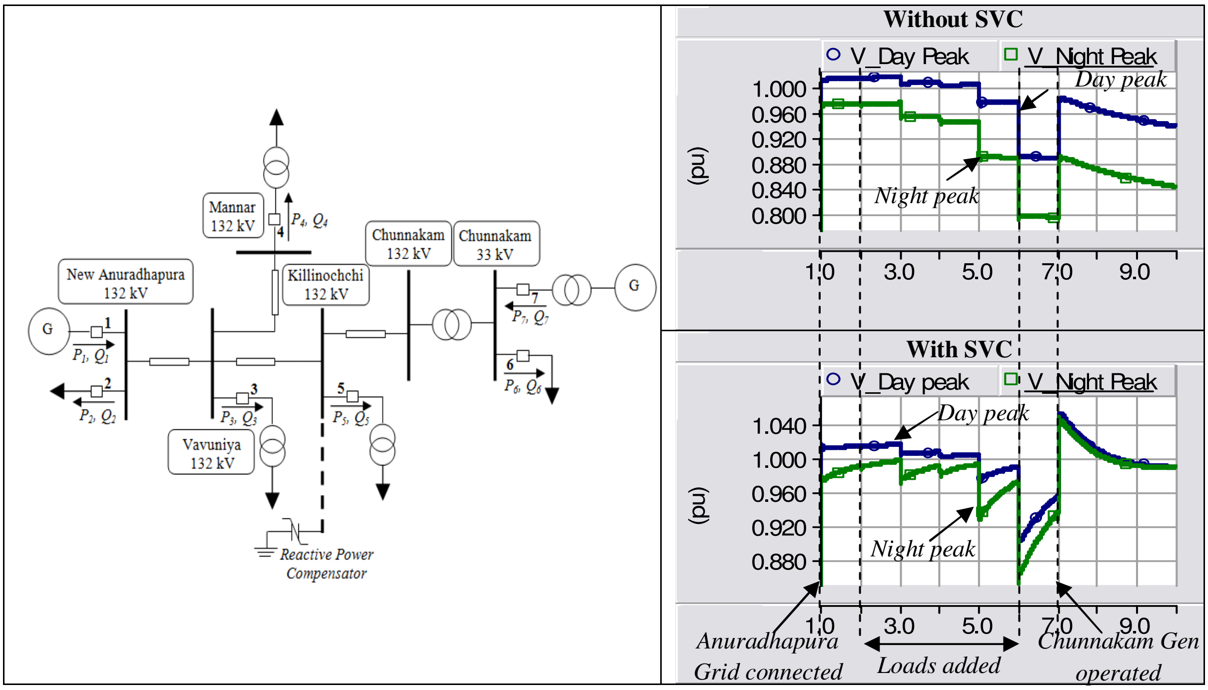

Figure 1: (a) block diagram of simplified system and (b) Kilinochchi grid voltage profile

To study the black start-up transients a simplified equivalent circuit of the interconnected transmission network as in 2016 was modelled using EMTDC/PSCAD with breakers placed at loads and plants for introducing transients. An SVC was connected to the Kilinochchi grid. The breakers were closed one after the other (with 1 sec interval) according to the number order mentioned in fig. 1 (a). Voltage profile of the Kilinochchi grid is shown in fig. 1 (b).

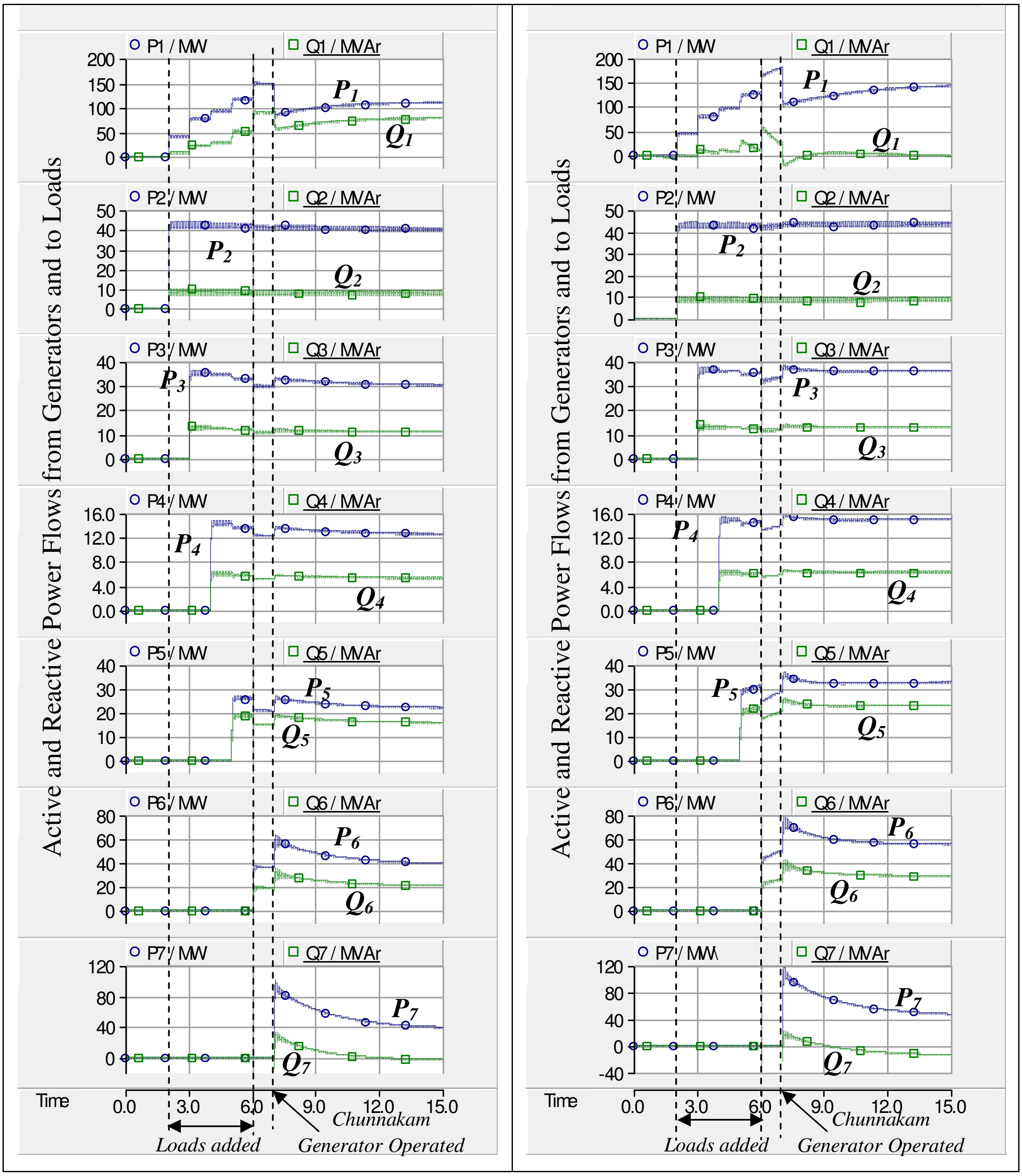

Figure 2: Power flow (a) without and (b) with reactive power compensator

As shown in fig. 1(b) the New Anuradhapura generator was powered on at 1 sec and then Anuradhapura, Vavuniya, Mannar, Kilinochchi and Chunnakam loads were connected one by one with 1 sec time interval. Finally at 7 sec the Chunnakam generator was switched on. When there is no reactive power support every load addition decreases the voltage in steps. But with reactive power compensation the voltage was controlled to 1 p.u. Sri Lanka has a much higher night peak demand compared to the day peak demand. Therefore without SVC case, the voltage profile of the night peak is much lower than the day peak scenario. But after installing the SVC, voltage profile of both scenarios are maintained closely at 1p.u. in steady state.

Fig.2 shows the active and reactive power flow measured at the sources loads in the night peak. Every load switching affects the power flow to every other load. It can be observed that the SVC supplies the reactive power and it improves the active power supplied by generators when system started from a blackout.

Conclusions

This paper motivates the integration of FACTS devices to the Sri Lankan power system for solving transient stability issues. The simulation results obtained with the placement of SVC showed improved voltage profile and it helps to maintain the voltage within the limits. In this study the SVC supplies reactive power to improve the active power flow from the generation plant. The amount of the reactive power supplied by the compensator depends on whether it is night peak or day peak (Load demand). Based on the results obtained with the simulation study done using EMTDC/PSCAD simulation package it can be concluded that easy black start-up is possible after installing the SVC to the system.

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