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FACTS Devices in Indian Power System

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Abstract: ***This paper aggressively tells about FACTS (Devices in Indian Power System) study whose full form is Flexible Alternative current Transmission System. FACTS is used as it is the best technology which is growing around to improve power transfer capabilities around us to improve the power transfer. FACT devices has its many benefits which are like if for a given transmission system we use it then it will improve the power transfer capability also enhances reliability, and not only provide security for system but also helps in maintaining the stability with better controlling abilities in power transmission networks with all these benefits it is economical which add an advantage for using this in existing network. After seeing such a growth and advantages of FACTS Devices has been system of attention due to which many developing countries like China, Australia, Brazil, etc. has adopted this technology. India is also one of the developing country whose demand of power is increasing rapidly so to provide that demand more efficiently Indian Power system is installing FACTS devices which is helping with great economy and also improving the transmission system. By this paper we have gone through the different surveys which shows that how India's state electricity boards has installed and used FACTS devices in detailed manner.***

Keyword: ***FACTS System, Indian Power System Devices, various project running in India on Facts Devices, Difference in cost between SVC and FACTS***

I. INTRODUCTION

In today's rapid growing world with new technologies are all depended directly or indirectly on the electricity. Due to such heavy demand of electricity we need to get some strong base to fulfill the requirement. As per the old technologies it is not possible to get such high demand so we need to strengthen our power transmission network. Possibilities will increase when use of FACTS devices is more. By using such devices it helps us to make our resources properly as it not possible to get new transmission network and it is also time consuming with lots of capital investment which is very difficult for the developing country like India. Investment funds are raised and invested by government in FACTS devices which helps in increasing both quality and capacity of transmission networks. If electricity board need to overcome the difficulties which is occurring partially or completely then that need to increase flexibility of existing network. So by the fact it can be said that by installing FACTS device it becomes an alternative way which helps in strengthening the power transmission network and capability. FACTS installations is generally used to get control in ac transmission network and systems. There are many ways by which can connect transmission line to FACTS devices. For the connectivity we can use different combination and that can series, shunt or combination of both. As for series combination we use is thyristor controlled series capacitor (TCSC); for the shunt connection the static synchronous compensator (STATCOM) and VAR compensator (SVC) are used and now for series and shunt connection unified power flow controller (UPFC) [1]. For stability increase series connection is built and for reactive power compensation shunt connection of FACTS devices is built.

II. SCENARIO OF WORLD

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III. SCENARIO OF INDIA

In India FACTS has received much attention in the last 2 decades. The first FACTS device installed in India is Thyristor Controlled Series Capacitor (TCSC) with Fixed Series Compensation (FSC) at 400 kV transmission line between Kanpur (U.P) and Ballabgarh (Haryana) in the Northern Grid [2]. Some more existing FACTS project which work successfully in India are, Ranchi-Sipat 400 kV D/C , 376 Km transmission line with 40% FSC at Ranchi end, Raipur-Rourkela 400 kV, D/C ,412 Km transmission line with FSC-TCSC installed at Raipur end [3]. FSC-TCSC installed at Kalpak am-Khammam 400 kV, D/C, and 364 Km transmission line in Andra Pradesh [4].

IV. DETAILED SURVEY

A. Case-1

A 3 phase 400 kV, 364 km long transmission system between kalpak am and Khammam in Andhra Pradesh. This transmission line takes 50% Series Compensation [4]. Out of which 30% is provided for fixed compensation and remaining 20 % is for TCSC device. Data are collected from APTRANSCO [4]. As when we talk about this system its shows improvement and gives controlling operation when FC-TCSC is install with various conditions of loads.

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The system is design for (i) line without compensation (ii) line with fixed series compensation and (iii) line with Fixed Capacitance and TCSC [4]. By installation of FC-TCSC improvement in result is better than before and output which we are getting is very controlled although it has included some cost but installation devices of it has justified.

B. CASE-II

Another FC-TCSC are installed at 3 phase 400 kV, 412 km double circuit transmission system between Raipur and Raurkela to transfer surplus power from eastern grid to western grid and also provide back up support for eastern region to southern region in case of contingency of one pole outage of Talcher- Kolar HVDC Bipole[3]. Raipur- Rourkela becomes strategic location to use for implementing devices as for connecting eastern to southern area this is important area to link through HVDC Badravati station. After that when government if implement FC-TCSC then it can be easily observe that some of faults can be seen in the result which is inrush power as that can cause an increase oscillation which is taken care by TSC as it damped that out and gives the best way of controlling and also provides more stability.

V. PROPOSED FACTS-PROJECT

From north to south India there are some STATCOM projects plans are made whose cost is estimated near Rs. 704 crore. When compare with SVC with related to its rating as well as cost is less. Although both are used for shunt devices which are used for increase in transfer capacity and reactive power compensation.

Table- I: Proposed STATCOM project in India are as follow [5]:-

STATE	LOCATION S/s	v/g level	MVAR Rating	Estimated Cost (Cr.)
Maharashtra	Vita/Pandharpur S/s	220kV	(+)50 /(-) 100	57.75
J&K	Budgam S/s Udhampur	220kV	(+)125 /(-)25	57.75*2
Tamil Nadu	Theni S/s Kodikuruchi Udaythu	220kV	(+)100 /(-)50	57.75*3
Andhra Pradesh	Urvakonda	220kV	(+)100 /(-)100	57.75
Karnataka	Chitradurga	220kV	(+)50 /(-)100	57.75
Rajasthan	Tinwari S/s	220kV	(+)50 /(-)100	57.75
Gujarat	Radhanpur	220kV	(+)50 /(-)100	57.75

Table- II: Proposed Bus reactors (Switchable/ Controlled reactor) project in India are as follow:-

STATE	LOCATION S/s	v/g level	MVAR Rating	Total No.
Tamil Nadu	Tappagndu & Rasipalayam Salen & Hosur	420kV 420kV	1x150 1x125	2 2
Andhra Pradesh	Kondapur Hindupur	420kV 420kV	1x150 1x125	1 1
Maharashtra	Dondaicha/Dhule – STU Alkud (MSETCL) Kolhapur S/s	220kV 420kV 7650kV	l1x50/25 l1x150 l1x240	1 1 1
Gujrat	Motipaneli,Bhatia, Bachau, Deodhar & Nakhtarna Solar Park-II	220kV 420kV	1x25/1x5 l1x150	5 1
Karnataka	Davangiri & Hiriyur Narendra S/s	420kV 765kV	l1x150 1x240	2 1
Rajasthan	Jaipur, Merta, Ramgarh Bhadla, Akal, Bikaner, Jaisalmer	420kV 420kV	1x125 1x125	3 4

When other devices such as SVC and FACTS devices are compared with each other what was observed was that FACTS devices are cheaper .SVC is costliest device so due to that they are installed in only two area in India. And also when we compare kilovolt ampere reactive (kVAR) or also known as MVAR Rating then also SVC has high rating then other devices.

Table- III: Proposed SVC project in India are as follow [5]:-

STATE	LOCATION S/s	v/g level	MVAR Rating	Estimated Cost(Cr.)
Maharashtra	Kolhapur S/s	400kV	(+)400/(-)300	211.75
Tamil Nadu	Udumalpet S/s:	400kV	(+)400/(-)300	211.75

VI. CONCLUSION

Nation like India which are on path of development, where demand for power is increasing rapidly and due to this high power demand the capacity and quality should be taken care. The old transmission network which are there should be updated with the help of new devices. The transmission network should be strengthened by installing FACTS so that it can improve the all over performance under various operation. Mainly under the Indian Circumstances one should utilize all the facilities which existing for proper efficiency which can improve the quality and capacity of transmission networks at least for limited period of time and that can be by adopting various method with less capital investment.

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