MULTI TERMINAL DC SYSTEM

→ HVDC transmission systems designed and operated so far are Point to point systems with two terminals (converter stations)

* A MTDC systems has more than 2 converter stations, some of operating as rectifiers & others are inverters.

→ By tapping, we build a MTDC system in an existing two terminal system.

→ Uel operation of converters and bipoles are also Multi terminal operation.

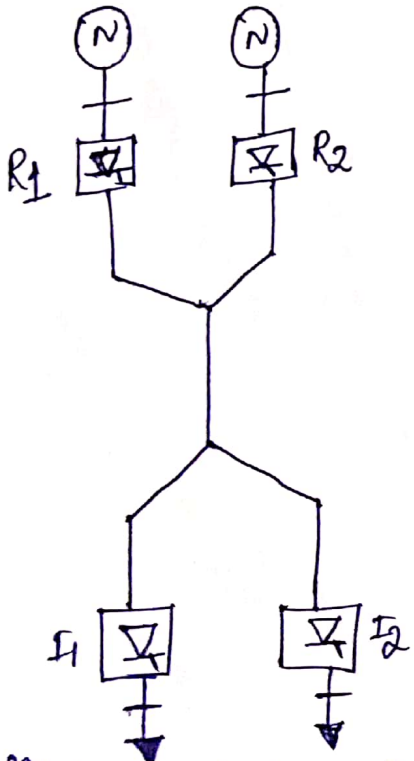
→ In MTDC systems, the HVDC breakers are required.

→ The MTDC system is more attractive in VSC - HVDC transmission (VSC - voltage source converter)

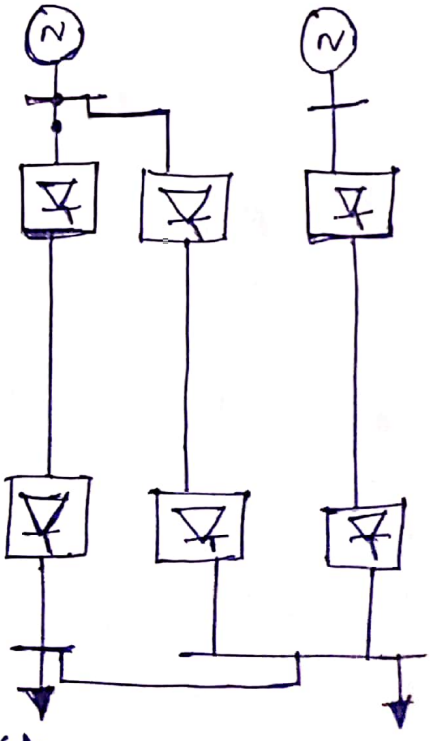
Potential applications of MTDC systems :-

→ Apart from tapping of powers from existing 2 terminal systems, 3 specific areas of applications for MTDC systems. They are listed below.

1. Bulk power transmission from several remote generating stations to several load centres.
(Each generating plant is directly connected to rectifier station. so dispensing with the AC collector system. similarly a converter station at each load centre eliminates the additional AC (or DC) lines for flexible energy exchange.)



(Fig. 1 MTDC System configuration for bulk power transmission)



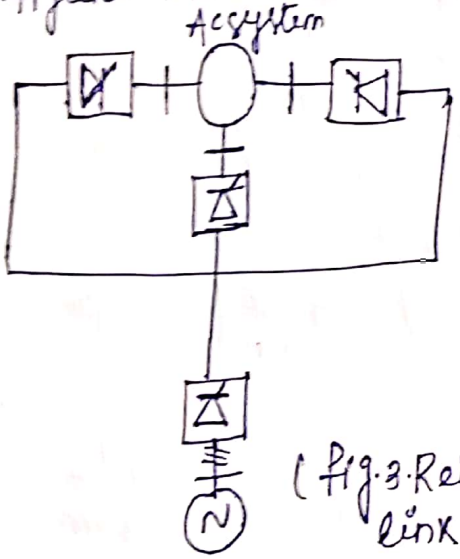
(Fig 2. Bulk power transmission using 2 terminal links)

→ Fig.1. shows the system of two generating stations and 2 loads.
→ It is radial system of two rectifiers and 2 inverters.
→ For energy exchange, three two terminal DC links will be required in addition to a link connecting the two receiving systems. which could be AC or DC.
→ It may cause extra cost for converter stations, lines & additional power loss.

2. Asynchronous interconnection between adjacent power systems.
(for more flexible for MTDC system to interconnect & employing several two terminal DC links.)

3. Reinforcing of an AC n/w which is heavily loaded.
(Ex:- urban power system)

→ MTDC system with one rectifier station and several inverter stations.
→ The below figure shows the Reinforcing of AC n/w using MTDC link.



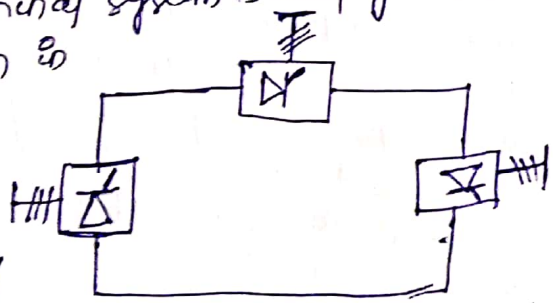
(Fig.3. Reinforcing of AC n/w using MTDC link)

Types of MTDC systems :-

→ There are two possible types of MTDC systems
1. series
2. parallel
   - Radial
   - Mesh

1. Series MTDC system :-

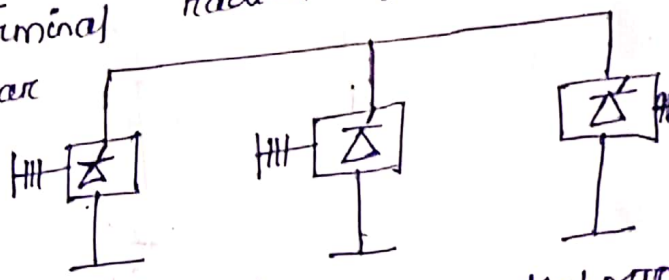
→ The natural extension of two terminal system is used by this.
→ A 3 terminal MTDC system is shown in below fig. & it is a Monopolar arrangement but homopolar arrangement also possible.
→ one point is grounded, that may chosen conveniently.



(Fig.4. A series connected MTDC system)

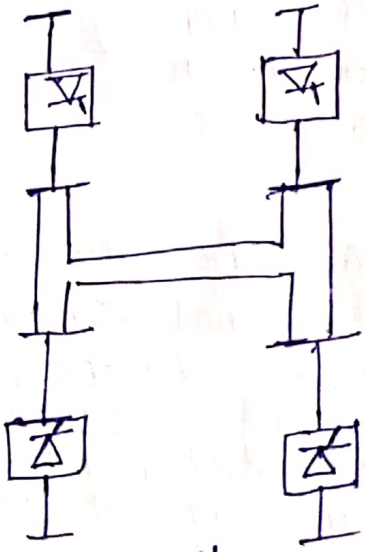
→ Ground point is shifted when there is a line insulation is adequate. And the ground point is shifting based on operating cond's.
→ In this system, the current is set by one converter station and is common for all the stations.
→ Remaining stations operate at constant angle (or) voltage control.
→ The sum of the voltage across the rectifier stations must be larger than the sum of the voltage across the converter station.
→ The power control in a two terminal system is accomplished by adjusting the current.
→ In a MTDC series system, central control would be required to adjust the current in response to changing loading cond^ns.

2. Parallel MTDC system :-
→ The currents in all the converter stations except one are adjusted according to the power requirement.
→ If one terminal operates as a voltage setting terminal.
→ The below figure shows the 3 terminal radial system.
→ It is a monopolar system but bipolar arrangement would be normally used.



(fig.5. A 3 terminal connected radial MTDC system)

→ In radial system, disconnection of one segment of transmiss-ion would result in interruption of power from one or more converter stations.
→ The below ~~diagram~~ fig. shows the 4 terminal Mesh system.
→ In a Mesh system, the removal of one link would not result in a disrup-tion. provided the remaining links are capable of carrying the required power.
→ Mesh is more reliable than radial type system.
→ Reversal of power involve Mechanical switching.



(fig.6. A 4 terminal connected Mesh type MTDC system)

Comparison of series and parallel MTDC systems

Series MTDC system

1. High speed reversal of power is possible in series systems with out mechanical switching.
2. The valve voltage rating in the series system is related to the power rating.
3. Increased losses in the thyristor valves in series systems.
4. Insulation coordination is a problem in series systems as the voltage along the line varies.
5. The permanent fault in a line section would lead to complete shut down in a series connected system.
6. The control and protection in a series MTDC system is a natural extension of that in a two terminal system.

Parallel MTDC system

1. It is not possible in the parallel systems.
2. Current rating in the parallel system is related to the power.
3. Losses in parallel systems are that much compare to series systems.
4. No loss in the parallel system.
5. It would lead to only the shut down of a converter station connected to the line section in a radial MTDC system.
6. Extension to parallel systems is not straight forward.

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* Questions Related to this Chapter

1. What are the potential applications of MTDC system? (L-2) (6)
2. Write the types of MTDC systems. (L-2)
3. Comparision b/w series MTDC and the parallel MTDC systems (L-2) (6)
4. What do you mean by MTDC system?