# *Korea Corner*

## Road Map of HVDC Deployment in Korea

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### 1. Introduction

HVDC transmission systems, when installed, often provide high reliability with a long useful life. Furthermore HVDC link avoids some of the disadvantages and limitations of AC transmission by offering no technical limit to the length of a submarine cable connection and improving the AC system's stability as shown in Figure 1. In 1954, the first HVDC (10MW) transmission system was commissioned in Gotland. Since then HVDC Current Source Converter of 800kV/6.4GW and Voltage Source Converter of 320kV/800MW are the mature technologies and have played a vital part in both long distance transmission and in the interconnection of renewable energy.

### 2. Korean Experiences on HVDC T/L

Since 1998, although the system's catastrophic submarine cable failure in 2006, Jeju#1 HVDC T/L has been operated successfully. Until 2007, the total return on investment beyond the initial capital cost ($300M) reached more than $ 500 M. Due to the urgent need for the enhanced system reliability, the construction of the extra HVDC T/L has been initiated. In 2012, Jeju #2 HVDC T/L Project (Construction Cost $600 M) was finally completed and now ready for commercial operation. Table 1 shows the technical brief on Jeju #1 and Jeju #2.

Table1. HVDC Converter Jeju #1 and Jeju #2

| Factor | Jeju #1 | Jeju #2 |
|---|---|---|
| Commercial Operation | Since 1998 | Since 2012 |
| $U_0$(kV) | 180 | 250 |
| MW | 300 | 400 |
| Converter | Alstom | Alstom |
| Cable | Alcatel | LS Cable |
| Thyristor | 5.2kV<br>1,128 units/pole | 8.5kV<br>864 units/pole |

### 3. Roadmap on HVDC T/L

Recently KEPCO (Korea Electric Power COmpany) has announced the long term deployment planning of HVDC T/L as shown in Figure 2. Under smart grid environment, large scale off-shore wind power generation plants will be connected via HVDC T/L in West Sea by 2018 as illustrated in Figure 3. The project is divided into three steps – Prototype, Demonstration and Large Scale Project.

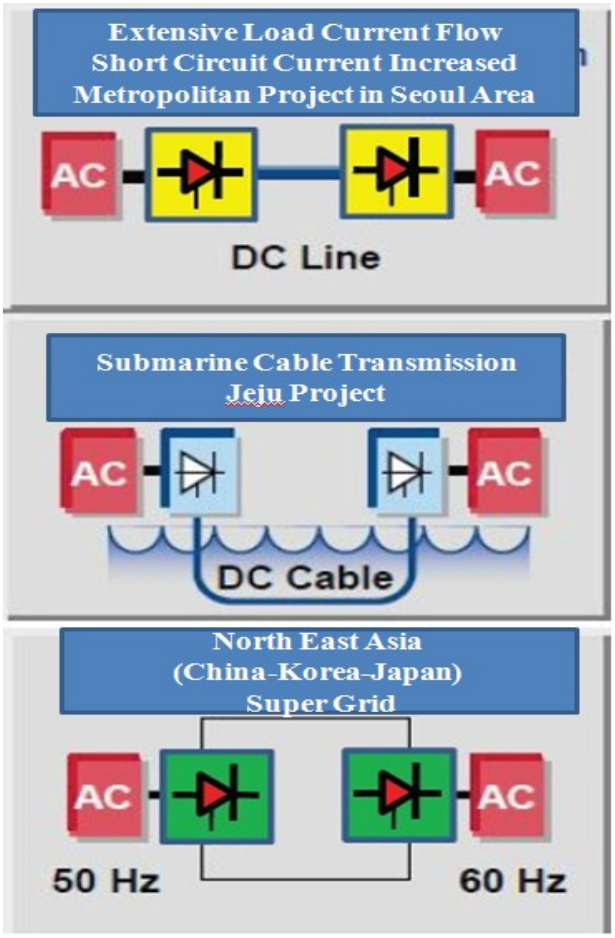


Figure 1. Concept of HVDC T/L

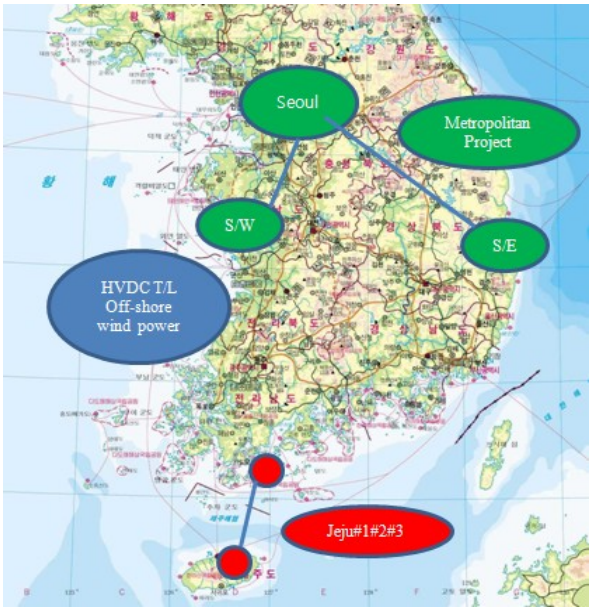


Figure 2. HVDC T/L Project in Off-Shore, Metropolitan and Jeju

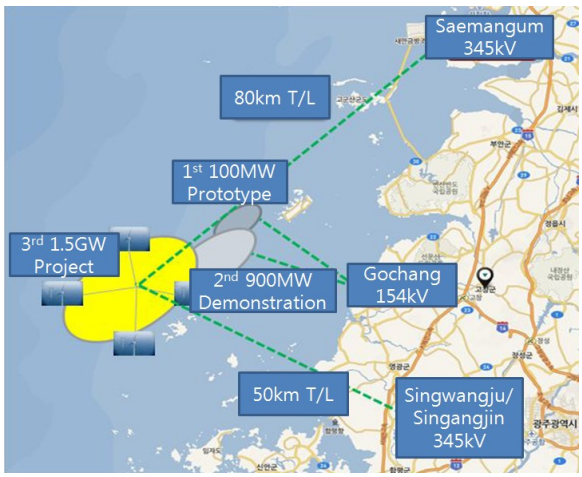


Figure 3. HVDC T/L Project in Off-Shore

The second project is focused on the reliability enhancement in Metropolitan area due to the long T/L distance from the power plants located both in South-East region and South-West region. The HVDC T/L project rated 1 GW is scheduled to complete its construction by 2015. The third project will be the extra HVDC T/L Project (200MW, by 2018) in Jeju Island. The future international project under consideration is China-Korea-Japan Super Grid via HVDC T/L.

## 4. Demonstration Project for Proposed Road Map of HVDC T/L

KEPCO, LS Industry and Hyosung Heavy Industry have been involved in the prototype development. In 2012, KEPCO and LS Industry completed the demonstration project of HVDC T/L ($35 M, 80 kV, HVDC Current Source Converter, HVDC Transformer) in Jeju Island. Based on the experience from the demonstration project, they are now planning to accommodate their technologies into the above mentioned large scale commercial projects such as Off-Shore, Metropolitan and Jeju projects. The commercial production up to 500 kV HVDC T/L is scheduled by 2019.

In addition, Hyosung Heavy Industry and KEPCO are now planning to develop Voltage Source Type HVDC Converter. And a feasibility study on 20 MW/

Figure 4. 80kV HVDC Transformer (LS Industry)

±10kV (Target Model by 2020: 250kV, 100MW, Modular Multilevel Converter) is now under consideration

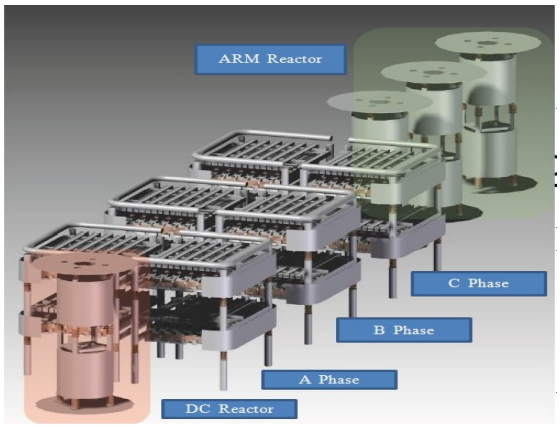


Figure 5. HVDC Voltage Source Converter (Hyosung Heavy Industry)

## 5. Further Studies on R&D Activities for New Installation of HVDC T/L

In HVDC T/L project, HVDC Converter and Transformer are the major power components. Due to the availability of higher voltage IGBT and the relatively lower DC polarity reversal effect in HVDC transformer, nowadays MMLC (Modular Multi Level Converter) Type HVDC Voltage Source Converter rapidly expands its market share in relatively short distance application such as Off-Shore Wind Power Connection. In this context, the major studies will be focused on the development of HVDC converter topology and its higher voltage application up to 250 kV.

### Reference

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