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OVERVIEW

TESHMONT specializes in providing engineering services for HVDC and EHVAC power transmission systems. Our highly skilled staff of engineers and technicians provide a wide range of services, from assistance with specialized system studies, to complete project design and implementation support. We are recognized worldwide for our HVDC expertise and have designed and managed the installation of transmission systems from the permafrost of northern Canada to the deserts of the Middle East.

While our technical emphasis is on power transmission, our service emphasis is on client satisfaction. We strive to provide each of our clients with the expertise they require to meet their particular needs. While there is tremendous diversity in the type and amount of expertise provided on every project, our focus remains singular on providing the best and highest value solutions for our clients.

Teshmont's partners are Manitoba Hydro, Amec Foster Wheeler, and Stantec. The professional engineers of these organizations provide an in-depth resource of technical expertise in numerous disciplines, and are readily available to assist Teshmont when additional specialized support is required.

DESCRIPTION OF SERVICES

TESHMONT specializes in system studies, specification and design of HVDC converter stations, HVDC electrodes, SVC and FACTS devices, EHV AC terminal stations, electrical and structural design of associated transmission lines, and construction review and commissioning of transmission systems. Teshmont has provided engineering services for projects representing over 65,000 MW of the world's installed capacity of HVDC.

SELECT PROJECT DESCRIPTIONS ARE PROVIDED BELOW:

Nelson River Transmission Facilities, Manitoba, Canada

Teshmont has worked continuously on the Manitoba Hydro Nelson River HVDC Transmission System since 1966. Teshmont initially worked as Owner's Engineer on Bipole I for Atomic Energy of Canada, and has subsequently worked on the various upgrades to Bipole I and on Bipole II for Manitoba Hydro. Currently, Teshmont is Owner's Engineer for Bipole III.

The Bipole III HVDC Converter Stations Project includes the northern Keewatinohk converter station, ac switchyard, and electrode, and the southern Riel converter station, synchronous compensator facility and electrode.

Teshmont has provided the following engineering services for this project to date:

- Performing system studies including harmonic impedance studies of northern and southern systems and dc side interference studies
- Preparing conceptual single-line diagrams and layout drawings for LCC and VSC options
- Developing requirements for the converter buildings and the ancillary buildings
- Establishing performance and design criteria
- Performing a technical review of VSC technology in comparison to LCC technology
- Providing environmental licensing support
- Providing project management support, including cost estimating, scheduling, quality assurance, and risk management
- Synchronous compensator facility, including performing a technology review of available technologies
- Determining machine parameters, ratings, and performance requirements
- Overseeing development of technical specifications for both LCC and VSC options
- Performing technical bid evaluations of the tenders that have been received from the potential EPC Contractors and technical contract negotiation assistance

Teshmont recently commenced performing design review for this project, and will witness factory tests, and provide commissioning assistance as the project progresses.

Substations

Teshmont has provided design of new substations and modification of existing substations up to 230 kV services for Manitoba Hydro. The work included major equipment, control, protection, annunciation, auxiliary power supplies, buswork, cabling, grounding and liaison with other departments e.g., civil, telecommunications, construction and commissioning. The scope of work also covered the evaluation and design of gas insulated substations (GIS), complete with construction supervision and commissioning.

Montana Alberta Tie Line RAS

The Montana Alberta Tie Line (MATL) is a new 230 kV, 300 MW electrical transmission line that provides a direct link between the Alberta Interconnected Electrical System (AIES) in Canada and the NorthWestern Energy (NWE) system in the United States. Since it is a new transmission path in the Western Electricity Coordinating Council (WECC) network, a remedial action scheme (RAS) was necessary to maintain system reliability and stability.

Teshmont carried out transient stability studies to determine the functional requirements of the RAS for MATL. The study results were used to prepare the conceptual design of the RAS scheme, including the determination of protection algorithms and settings. Teshmont developed the RAS model and verified with further transient stability studies that the RAS performance satisfied the stability and reliability requirements for MATL. Teshmont also provided support to the client for third party stakeholder engagement throughout the study and design process. Teshmont presented the study results and the RAS design to the WECC Remedial Action Scheme Subcommittee on behalf of the client in order to obtain approval for the RAS.

Alberta Electric Systems Operator (AESO) ±500 kV HVDC Systems

Teshmont has been providing technical support to the Alberta Electric System Operator (AESO) on the development of two ±500 kV HVDC systems in Alberta. Teshmont's scope of work has included the following:

- Carrying out system planning studies, including load flow and stability studies
- Preparing a Functional Specification to define the system requirements of the HVDC systems, which is the basis for the technical bidding
- specifications prepared by the two utilities who have been assigned to build and own the HVDC systems
- Providing training to the AESO on HVDC
- Reviewing, on behalf of the AESO, technical reports from the two utilities
- Preparing technical reports on various aspects of the HVDC systems, including: Provision

for Possible DC System Future Upgrading; AC and DC Single Line Diagrams; Reliability and Availability; AC Harmonic Filters; and DC Filters

- Providing ongoing HVDC technical support to AESO as required
- Teshmont has also performed multi infeed dc studies associated with four terminal interaction for the AESO

NEMO HVDC Project

Teshmont was retained by Elia (Belgium) and National Grid (UK) to provide Owner's Engineer services for the Nemo HVDC Interconnector Project.

Teshmont's initial involvement focused on developing two technical specifications for the 1000 MW, ± 350 kV or ± 400 kV project, namely one document for associated with the HVDC converter stations and one associated with the submarine and underground cables between Zeebrugge, Belgium and Richborough, UK.

The Nemo HVDC Link will utilize Voltage Source Converter (VSC) technology, in a symmetrical bipole arrangement, using two HVDC cables. The specification was developed to allow for the use of either XLPE or mass impregnated cables.

Teshmont developed two specifications for the Nemo HVDC Project, namely:

- HVDC converter station specification package, which included a description of functional requirements for design, supply, and installation of two VSC HVDC converter stations including the dc equipment, ac equipment associated with the VSC interface transformers, and buildings associated with the converter stations.
- HVDC land and submarine cable specification package, which included a description of functional requirements for design, supply, and installation of submarine and underground HVDC cables, terminations, splices and auxiliary equipment.

Teshmont's team also provided technical bid evaluation services for this project which involved reviewing the various bids, asking clarification questions to the bidders, assessing the clarification responses, and providing recommendations

Atlantic Wind Connection Project

Teshmont has been retained as Owner's Engineer for the Atlantic Wind Connection (AWC) Project. The AWC project involves the development of an offshore high voltage direct current (HVDC) undersea cable transmission backbone that will facilitate the connection of up to 6,000 MW of offshore wind generation along the eastern seaboard of the United States. The backbone will consist of over 190 circuit miles of submarine HVDC cables. The AWC Project will utilize state of the art HVDC technologies including voltage source converters (VSC), multi-terminal HVDC, and land and submarine HVDC cables.

Teshmont is providing engineering services to the Atlantic Grid Development, who is developing the project. Teshmont has carried out system integration studies and equipment studies, developed conceptual designs and high level cost estimates, supported environmental and regulatory processes, and has been involved in the development process with the Engineering, Procurement, and Construction (EPC) Contractor and the dc equipment technical partner.

As the project progresses, Teshmont will prepare technical specifications for the HVDC equipment and the land and submarine cables (HVDC and AC), review the detailed design for the converter equipment and cables, monitor manufacturing and installation, and participate in system testing and commissioning.

TYPICAL CLIENTS

Typical clients of Teshmont are electrical utilities and independent power producers in North America and throughout the world who are planning to expand, rehabilitate or interconnect their high voltage transmission systems.