

**4.0 PROJECT DESCRIPTION**

Physically, the VITR Project consists of overhead lines, underground cables, submarine cables, one new cable terminal adjacent to the Tsawwassen substation and modifications to two existing substations and four existing cable terminals. Detailed descriptions of the overhead and submarine aspects of the proposed Project facilities are provided below. Appendix A in the VITR CPCN Application contains environmental alignment sheets that show the proposed layout of terrestrial portions of the Project, including all but the two submarine crossings (Segments 3 and 5) overlaid on aerial orthophotos of the existing corridor.

**4.1 Overhead Lines**

**4.1.1 Existing 138 kV Overhead System**

The existing 138 kV transmission infrastructure between the Lower Mainland of British Columbia and Vancouver Island, including the overhead transmission lines, cable terminal stations and submarine cables, was constructed in the mid-1950s. The overhead portion of the existing 138 kV transmission system is comprised of two single-circuit lines (1L17 and 1L18). The original design transmission capacity was 120 MW for each circuit, but both have been derated to 100 MW due to armour wire corrosion on the submarine cables.

There are currently 254 138 kV structures along the overhead sections of this corridor, including 156 wood H-frame structures and 98 lattice steel structures. The wood H-frame structures are located on the 12.4 km segment in South Delta and Tsawwassen (Segments 1 and 2) and a 4.5 km portion of the segment in North Cowichan near VIT (Segment 8). The segments on Galiano and Parker Islands (Segment 4) and Salt Spring Island (Segment 6) and the balance of the Vancouver Island segment (Segment 8) use lattice steel structures.

The existing structure types and heights along the corridor are summarized in Table 4.1-1.

**Table 4.1-1 Existing Overhead Structure Types and Heights**

Location	Structure Type	Range in Height	Average Height
South Delta (Segment 1)	Wood H-frame	16 to 27 m	17.5 m
Tsawwassen (Segment 2)	Wood H-frame	16 to 20 m	17.5 m
TBY to Montague Harbour on Galiano Island (portion of Segment 4)	Steel Lattice	19 to 26 m	22 m
Across Montague Harbour to MTG on Parker Island (remainder of Segment 4)	Steel Lattice	41 m	41 m
Salt Spring Island (Segment 6)	Steel Lattice	19 to 32 m	22 m
North Cowichan (first portion of Segment 8)	Steel Lattice	20 to 33 m	22 m
North Cowichan (remainder of Segment 8)	Wood H-frame	16 to 21 m	17.5 m

No animal-caused outages have occurred on the existing 138 kV circuits 1L17/1L18 in the last ten years. As animal-caused outages are not an issue on these circuits no mitigation is in place. BCTC does not anticipate any changes as a result of the Project.

---

1 4.1.2 Proposed Overhead Transmission Lines (Segments 1, 4, 6, 7 and 8)

2 The two existing 138 kV overhead lines will be replaced with a single new 230 kV double-  
3 circuit line on galvanized steel poles in the existing ROW, except for the portion through  
4 Tsawwassen (Segment 2), where new facilities are proposed to be constructed underground  
5 (see Section 3.3.3). With the exception of four existing special long-span structures near  
6 Montague Harbour, all conductors, insulators, hardware and supporting structures will be of  
7 conventional design and new manufacture. The design life of the new overhead line should  
8 exceed 60 years.

9 While the ultimate configuration of the new infrastructure will allow for two 230 kV circuits,  
10 each with a nominal rating of 600 MW, initially only one circuit will be energized at 230 kV.  
11 The second overhead 230 kV circuit will be connected to the remaining portions of the existing  
12 138 kV facilities (see Section 3.5) and operated at 138 kV to continue supply to the southern  
13 Gulf Islands through existing substations on Galiano Island and Salt Spring Island.

14 Several technical studies have been performed to investigate alternatives, validate a  
15 conceptual design for the proposed overhead facilities and support cost estimating activities.  
16 Descriptions of proposed work and locations of substations, cable terminals and the  
17 conductors are provided in Figures 1.3-1 through 1.3-3

---

18 4.1.2.1 Structure Design Alternatives

19 Selection of new transmission support structures and conductor configurations has been  
20 based on engineering design requirements (Appendix B in VITR CPCN Application), plus the  
21 following objectives:

- 22 • minimize disruption to the current land uses along the ROW;
- 23 • minimize construction of new roads and vegetation removal;
- 24 • reduce EMF, radio frequency interference (RFI), and audible noise as much as practical; and
- 25 • improve aesthetic appearance of the ROW.

26 As indicated above, BCTC proposes to use galvanized steel poles. With the exception of a  
27 few special long-span structures, all new structures will be capable of supporting two 230 kV  
28 circuits (double-circuit). Narrow configuration single-circuit steel poles may be considered in a  
29 few locations as a means of reducing structure heights, where desirable.

30 In total, approximately 126 new structures will be installed and four modified to replace the  
31 existing 263 wood H-frame and lattice steel structures (excluding Segment 2 in Tsawwassen).  
32 The majority of the new structures will be placed adjacent to existing structure sites in  
33 positions that will minimize ROW preparation requirements and site disturbance. In  
34 Tsawwassen, 18 of 36 existing wood H-frame structures will be removed and replaced with  
35 underground construction.

---

36 4.1.2.2 Location within Right-of-Way

37 Minimum separation from ROW edge and existing electrical circuits has been determined on  
38 the basis of CAN/CSA Standard C22.3-No.1-01 and past practice. Increments for minimum

1 clearances from existing electrical utilities will be included to facilitate construction and  
 2 maintenance and to conform to safety standards on “limits of approach” for line workers.

3 **4.1.2.3 Preliminary Structure Spotting**

4 To support engineering feasibility studies, public consultation, environmental studies and cost  
 5 estimating, preliminary structure spotting has been completed for the entire length of the route  
 6 (see Appendix C of the VITR CPCN Application 2005). This layout was completed using a  
 7 digital elevation model of the existing corridor complete with existing structure geometry and  
 8 location. The preliminary structure spotting allows evaluation of different structure types and  
 9 configurations and examination of individual structure loading using the proposed conductors,  
 10 limiting design conditions, minimum clearances and expected severe weather loading.

11 Although final results will depend on detailed line design, the conceptual layout shown will  
 12 result in the structure placements and approximate heights detailed in Table 4.1-2 below.

13 **Table 4.1-2 Proposed Structure Type, Placement and Height**

Segment	Existing 138 kV Structure Type and Placement	Proposed 230 kV Structure Placement	Typical 230 kV Height
1 - South Delta	Wood H-frame structures, 230 m span, not matched to adjacent HVDC lattice steel structures	Match step with HVDC towers plus additional mid-span structures	30 m
2 - Tsawwassen	Wood H-frame structures, 230 m span, match stepped for each circuit	None – remove one of two existing 138 kV circuits	None
4 - Galiano Island	Lattice steel structures, 350 m span, match stepped for each circuit	For the majority of sites, proposed structures will generally be match stepped with existing structure locations. Terrain and increased sag of the new conductor will require at least two additional structure locations. The cross under of HVDC transmission lines at the summit of Galiano Island will require lower, flat single-circuit construction	30 m
5 - Montague Harbour, Parker Island	Lattice steel structures, match stepped for each circuit	New single-phase steel pole structures will be located at the same sites as existing structures. Bases of the four taller lattice steel structures adjacent to Montague Harbour will be modified to support new heads and height extensions necessary to maintain safe navigation clearances	Increase height of four existing lattice steel structures by 8 m

Segment	Existing 138 kV Structure Type and Placement	Proposed 230 kV Structure Placement	Typical 230 kV Height
6 - Salt Spring Island	Lattice steel structures, 350 m span, match stepped for each circuit	On the Athol Peninsula (Nose Pt.) and the western half of the Island, proposed structures have been placed where terrain and clearances dictate. This will result in a few additional mid span structures. Within the central portion of the island, where terrain is more favourable, the proposed 230 kV structures will generally be match stepped with the existing 138 kV lattice steel structures	30 m
7 - Sansum Narrows	Single-phase lattice steel structures	New single-phase steel pole structures will be located at the same sites as existing towers	25 m
8 - Vancouver Island, Lattice Steel Section	Lattice steel structures, 350 m span, match stepped for each circuit	Due to the rugged terrain and shorter allowable spans for new structures, structures have been placed where terrain and clearances dictate. A few additional mid-span structures are required.	30 m
8 - Vancouver Island, Wood H-frame Section	Wood poles, 230 m span, match stepped for each circuit	Match step with existing 138 kV wood pole structure locations	30 m

1 **Weather Loading**

2 Structural loading criteria have been established to meet established design standards and  
 3 expected weather loading due to ice and wind.

4 **External Hazard Assessment**

5 BCTC's evaluation of the existing 138 kV corridor did not identify any significant natural terrain  
 6 hazards or non-natural hazards that could affect security of the proposed overhead facilities.  
 7 While the entire Project area is in a seismically active zone, overhead structures and systems,  
 8 as proposed, are not especially vulnerable to seismic events.

9 **4.1.2.4 Foundations**

10 Sub-surface soil investigation has been done as part of the preliminary technical studies. To  
 11 assist in preliminary layout and cost estimating, conceptual foundation designs have been  
 12 prepared for representative structure types under the differing site conditions encountered.  
 13 The foundation types include:

- 14 • steel caisson foundations in the Fraser River delta (South Delta – Segment 1);
- 15 • concrete foundations in locations with shallow soft soils overlaying rock or more competent  
 16 soils such as in North Cowichan (Segment 8), west of Maple Bay;
- 17 • direct burial of pole ends in some areas with good granular soils; and

- 1 • rock anchor foundations in certain areas on Galiano and Salt Spring Islands and the  
2 eastern half of the North Cowichan portion (Segments 4, 6, 7 and 8).

---

3 4.1.2.5 Conductor Design

4 It is proposed that each of the new overhead circuits, except for the long spans at Montague  
5 Harbour and Sansum Narrows, use single 1590 MCM ACSR conductor for each of the three  
6 phase wires. For standard summer conditions, conductors will be rated for 1,626 amps for a  
7 conductor temperature of 100°C.

8 BC Hydro Transmission Engineering Technical Standards, Procedures and Guidelines for Vertical  
9 and Operating Clearance Criteria will be applied to the conductor sag and swings. These criteria  
10 meet or exceed CAN/CSA Standard C22.3 - No. 1-01. All other clearances not covered by  
11 BC Hydro Transmission Standards will conform to CAN/CSA Standard C22.3 - No. 1-01.

12 Over Montague Harbour and Sansum Narrows, it is proposed that a double-bundled  
13 conductor be installed for each phase wire, using the same type of high-strength conductor  
14 (238.3 mm<sup>2</sup> 54/37 ACSR “Special”) as the existing lines. Due to the existing conductor’s age,  
15 and the need to match sag profiles, the existing conductor will not be re-used at these  
16 locations.

---

17 4.1.2.6 Insulation

18 Insulation for all 230 kV facilities will provide a minimum basic insulation level equivalent to 12  
19 standard suspension insulator units. This includes the second circuit, which will be operated  
20 at 138 kV. The proposed design will use a composite polymer braced post assembly on  
21 typical tangent structures. Insulators for special long spans, heavy angles and dead-end  
22 structures will be a glass suspension type. The use of composite insulators for 230 kV  
23 construction, other than braced post type or for horizontal posts for jumpers on dead-ends,  
24 has not been accepted as a standard by BCTC or BC Hydro.

25 All temporary 138 kV connections to substation structures at ARN, Galiano, Salt Spring and  
26 VIT will conform to 138 kV transmission line standards.

---

27 4.1.2.7 Grounding and Lightning Protection

28 Standard design practice for 230 kV transmission lines in BC includes an overhead  
29 groundwire for 500 m or three line structures, whichever is greater, beyond the terminal  
30 substation (ARN and VIT in this case). There will be similar requirements for the underground  
31 or submarine cable terminal stations. Structures connected to the overhead groundwire are  
32 required to be fully grounded with a ground resistance less than 10 ohms. Structures outside  
33 of the overhead groundwire section shall have a ground resistance not in excess of 250 ohms.

34 To aid in conceptual design and cost estimating, ground resistivity measurements were taken  
35 at several locations. Generally these measurements indicated relatively high ground  
36 resistivities; therefore, additional buried grounding conductors will be required at some of the  
37 structures closest to ARN and VIT.

---

1 4.1.2.8 Corridor Access Assessment

2 An access assessment was conducted for the entire terrestrial corridor except for the  
3 Tsawwassen section between TSW and EBT. The assessment reviewed the condition and  
4 suitability of access to and along the corridor for ROW preparation and structure installation.  
5 The assessment covered the terrain, identified access to and along the ROW where new  
6 accesses are required and observed restrictions, requirements and ground and vegetation  
7 conditions at existing and proposed structure sites. An access assessment was not required  
8 for the Tsawwassen section. This is a fully developed urban area with a well developed road  
9 system and access points are well known.

---

10 4.1.2.9 Vegetation Analysis

11 A vegetation analysis of the potential effect the proposed 230 kV double-circuit line will have  
12 on vegetation, both on and adjacent to the existing corridor between ARN and VIT, has been  
13 prepared. The analysis was based on Digital Elevation Model (DEM) ground data, a fall 2004  
14 and spring 2005 Light Detection and Ranging (LiDAR) survey of the Tsawwassen, Galiano,  
15 Salt Spring and Vancouver Island areas, a conceptual conductor profile for the proposed  
16 230 kV double-circuit construction and a field assessment of the identified locations.

---

17 4.1.3 Overhead Construction Methods and Procedures

18 Construction activities associated with the VITR Project include:

- 19 • site preparation along the ROW; required vegetation clearing and access improvements  
20 will be limited since it is an existing transmission corridor;
- 21 • removal of the existing 138 kV conductors and structures (removal of only one set of  
22 structures in Tsawwassen);
- 23 • installation of foundations and anchors;
- 24 • installation of new steel support structures;
- 25 • installation of conductors, overhead ground wires and counterpoise (buried ground wires); and  
26 • site restoration along the ROW, including decommissioning of any temporary construction  
27 access roads.

28 The following is a brief summary of construction activities and potential temporary effects  
29 during overhead line construction. All construction activities are routine in nature.

30 For Segments 1 and 8 (South Delta and the western portion of the North Cowichan segment),  
31 both existing wood H-frame 138 kV lines will be removed, beginning in Delta. The southern  
32 Gulf Island load will be served from Vancouver Island until the new 230 kV overhead line is  
33 complete on the Mainland and one circuit reconnected to the 1L17 submarine cables.

34 For Segments 4, 6, 7 and 8 (Galiano, Salt Spring, Sansum Narrows and the eastern portion of  
35 North Cowichan), both existing lattice steel 138 kV lines will be removed. The southern Gulf  
36 Island load will be served from the Lower Mainland during overhead line construction between  
37 Salt Spring Substation and VIT.

1 The existing conductor will be spooled on reels for recycling. Wood poles and cross-arms,  
2 steel structures, insulators and other hardware and materials will be removed and properly  
3 recycled or disposed of. Concrete foundations and anchors will be removed. Holes remaining  
4 after removing the wood poles and lattice steel foundations will be filled with suitable local or  
5 offsite material.

6 Construction in the soft soils in Delta will require excavating for caisson foundations in a  
7 manner similar to that used previously for the HVDC line. In better soils, directly embedded  
8 poles and concrete spread footings may be used. In some areas on the Gulf Islands, rock  
9 anchor foundations will require drilling and grouting.

10 Transmission structures will be simple, galvanized steel poles. Structures will be located to  
11 reduce impacts on agricultural operations. Lower sections will likely be installed using  
12 construction cranes. Upper sections may be lifted and mounted using helicopters. See Figure  
13 4.1-1 through 4.1-4 for typical before and after simulations on the existing ROW.

14 The new conductor will be installed using reels and tensioning equipment at a limited number  
15 of locations for each segment.

16 Access to the ROW will be timed to avoid conflicts with agricultural and recreational activities;  
17 and to minimize impacts to surface soils, vegetation and site drainage due to vehicles and  
18 construction operations. Work at road and rail crossings will be carefully scheduled to ensure  
19 public and worker safety and to minimize any traffic disruption.

20 Disturbed lands will be restored on a site-specific basis taking into account the pre-  
21 construction habitat/landscape values in consultation with the appropriate regulatory  
22 authorities and/or landowner.

23 An Environmental Management Plan (EMP) will be prepared, detailing measures to be taken  
24 during removal and reconstruction to avoid, where possible, and mitigate, where practical, any  
25 environmental effects. The EMP will include restoration plans. This EMP is outlined in  
26 Chapter 13 of this Application and will be reviewed as part of the environmental assessment  
27 and approval process. A final EMP will be issued prior to construction.

---

## 28 4.2 Underground Cables – Segment 2

29 During alternatives analysis and public consultation for the VITR Project, it became apparent  
30 that the existing corridor through the densely developed residential area in Tsawwassen would  
31 pose considerable challenges for community acceptance and future operation of any new  
32 overhead line. Consequently, on March 17, 2005, BCTC made a public commitment to not  
33 recommend construction of a new overhead 230 kV line on the existing ROW in Tsawwassen.  
34 A detailed discussion of the alternatives considered is provided in Section 3.1.

35 After considerable evaluation of available alternatives, BCTC has determined that it is the best  
36 balance of all stakeholder interests to retain the existing corridor through Tsawwassen. BCTC  
37 proposes underground construction on the existing overhead 53.3 m (175 ft) ROW for  
38 Segment 2 in Tsawwassen. One of the two existing 138 kV wood H-frame single-circuit lines  
39 will be removed and replaced with a 230 kV cable circuit in underground conduits. In selected  
40 areas of Segment 2, a second set of underground conduits will be installed to facilitate the

1 potential installation of a second 230 kV cable circuit in the future and to limit repeated  
2 disturbance to private properties. The second existing 138 kV overhead circuit will remain in  
3 place to continue to provide service to the southern Gulf Islands.

4 BCTC anticipates receiving an order from the BCUC granting a Certificate of Public  
5 Convenience and Necessity in July 2006. There is a possibility that BCTC may be ordered to  
6 undertake overhead construction on the existing corridor or that BCTC may have to resort to  
7 overhead construction if it is unable to secure underground rights. Should BCTC construct  
8 overhead for the Tsawwassen segment, steel structures, wire configurations and construction  
9 methods very similar to the balance of the terrestrial corridor would be used. BCTC does not  
10 believe that there will be a material effect on the environment that is different from  
11 underground construction. The 3.7 km section in Tsawwassen is a well developed, densely  
12 populated urban area. Should BCTC be required to proceed with overhead construction, an  
13 addendum to the EAC Application will be filed with the BCEAO.

14 BCTC has also committed that, if alternative sources of funding or financing can be put in  
15 place to cover the additional costs associated with some of the other alternative means of  
16 undertaking the Project in Tsawwassen, such as underground construction in public streets or  
17 advancing the underground replacement of the second 138 kV line, then BCTC would be  
18 prepared to undertake the Project in this manner.

---

#### 19 4.2.1 Underground Cable Facilities

20 BCTC will employ conventional underground cable design and construction for the VITR  
21 Project. The underground portion will begin adjacent to TSW, continue for a distance of  
22 approximately 3.7 km, and terminate at EBT. There will be three separate cables installed in a  
23 single concrete encased ductbank. Four to five underground chambers, located near cross-  
24 streets, will be required for construction and maintenance activities. These will be accessed  
25 by manholes. Smaller supplementary manholes may be required between the larger  
26 manholes to facilitate duct cleaning and cable pulling (see Figure 4.2-1). Once the cables are  
27 installed, subsequent access will be infrequent.

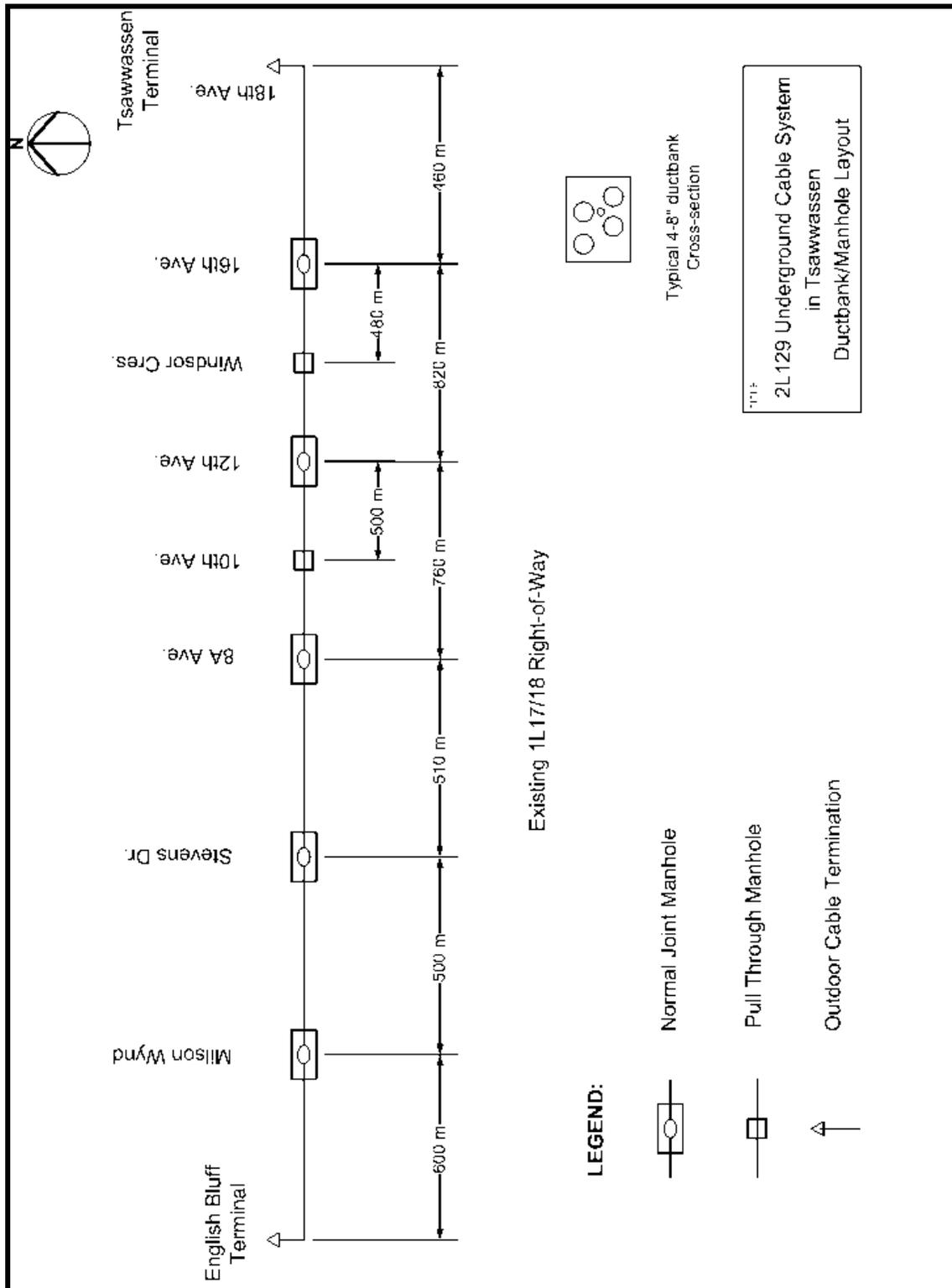
28 The ductbank location will be 5 m from the existing ROW centreline. A portion of a second  
29 ductbank and manholes will also be installed during the initial construction to avoid future  
30 disruption to private property if a second 230 kV circuit is installed in the future. The second  
31 ductbank will be located 5 m on the opposite side of the ROW centreline, providing a total  
32 10 m circuit separation distance. This distance is needed to minimize mutual heating effects  
33 between the two circuits, which would otherwise result in a loss of transmission capacity. It  
34 will also help to minimize induced currents and voltages in the parallel buried cable system's  
35 conductor and sheaths, which can be a hazard to workers doing maintenance on de-  
36 energized circuits. In openly accessible areas or properties not requiring excavation for the  
37 first ductbank, future ductbanks and access manholes for the potential second circuit will not  
38 be installed at this time.

39 Configuration of the buried cable system will be approximately as shown in Figure 4.2-2.  
40 Cables used for the underground sections will be self contained fluid-filled, similar to those  
41 used for the submarine cable sections (see Section 4.3.1), except that they will not be

1 armoured, and the conductor size will be larger to compensate for their closer proximity and  
2 warmer soil ambient temperatures. A typical cable cross-section is shown in Figure 4.2-3.

3 The transition from the underground cable system to the submarine cable system will be made  
4 at EBT. This can be done via back-to-back cable terminations, which will facilitate complete  
5 electrical and hydraulic separation between the two systems, if needed for operations.  
6 Alternatively, transition joints can be provided eliminating the need for above ground cable  
7 terminals at EBT. This cannot be determined until the public tendering process has been  
8 completed and cable supplier's costs and proven capabilities have been evaluated.

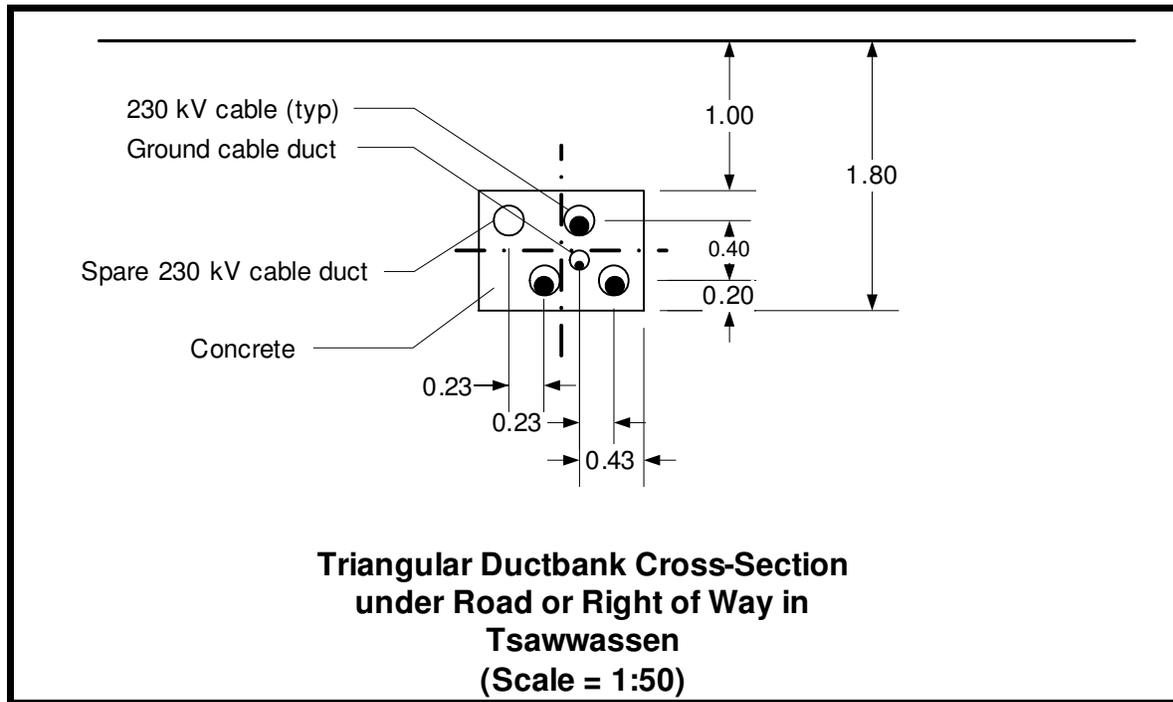
1 **Figure 4.2-1 Manhole/Ductbank Layout in Tsawwassen**



2

3 Source: VITR BCUC CPCN Application, Figure 3.23

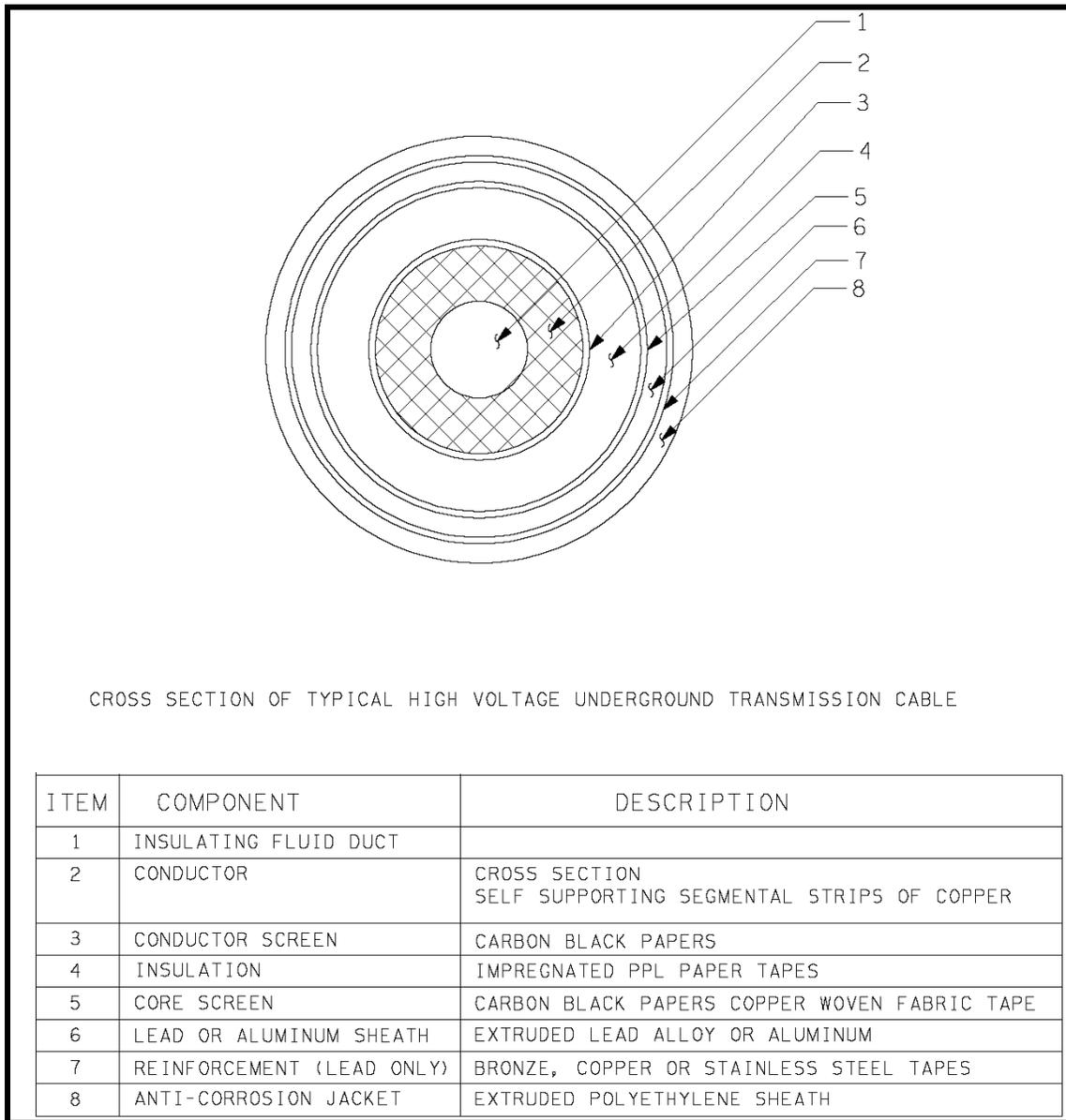
1 **Figure 4.2-2 Configuration of the Buried Cable System in Tsawwassen**



2

3 Source: VITR BCUC CPCN Application, Figure 3.23

1 **Figure 4.2-3 Underground Transmission Cable Cross Section**



2  
 3 Source: VITR BCUC CPCN Application, Figure 3.24

4 **4.2.2 Underground Cable Construction**

5 Construction on this segment will require the select removal of fences, vegetation and other  
 6 barriers for varying widths of 20 m, 18 m and 15 m through properties within the ROW. This  
 7 space will be required for excavating equipment and construction vehicles. Linear access for  
 8 the entire corridor will be required but can be completed in stages. Work will be planned to  
 9 minimize, to the extent practical, the disruption and time span for overhead line removal, new  
 10 underground construction and site restoration on individual properties.

1 As indicated above, one of the existing 138 kV wood pole lines will be removed prior to  
2 installation of the underground facilities. The second existing overhead line will remain in  
3 place to provide service to the southern Gulf Islands.

4 The ductbank location will be 5 m from the existing ROW centreline. A portion of a second  
5 ductbank and manholes will also be installed during the initial construction to avoid future  
6 disruption to private property if a second 230 kV circuit is installed in the future. The second  
7 ductbank will be located 5 m on the opposite side of the ROW centreline, providing a total  
8 10 m circuit separation distance. This distance is needed to minimize mutual heating effects  
9 between the two circuits, which would otherwise result in a loss of transmission capacity. It  
10 will also help minimize induced currents and voltages in the parallel buried cable system's  
11 conductor and sheaths, which can be a hazard to workers doing maintenance on de-  
12 energized circuits. In openly accessible areas or properties not requiring excavation for the  
13 first ductbank, future ductbanks and access manholes for the potential second circuit will not  
14 be installed at this time.

15 Excavation for each ductbank will be approximately 1.5 m wide and 2 to 3 m deep. Most  
16 excavated material will be removed from the site, unless high re-compaction densities of  
17 native material can be proven. Otherwise, select imported backfill materials will be used.  
18 Topsoil will be retained and vegetation restored. Minimum cover over the concrete encased  
19 ductbank will be 1 m. Surface improvements will also be restored, except for non-conforming  
20 structures or deep-rooted trees located within 5 m of the ductbank centreline.

21 The three to five underground chambers required for cable splicing and worker access are  
22 approximately 3 m wide by 10 m long by 3 m deep, and will be located near street crossings to  
23 facilitate maintenance. These chambers are normally precast in two segments to reduce  
24 installation time and disruption. After the ductbank is complete, cable installation can proceed  
25 from the access manholes in or near streets without further disruption at other locations.  
26 Cables will be installed from reels using specialized equipment. Cable splicing will be done in  
27 the underground chambers beneath the access manhole covers.

28 A new cable terminal, adjacent to TSW, will be constructed entirely on the existing property.  
29 Overhead dead-end structures will be installed for both new 230 kV overhead circuits from  
30 ARN. One new circuit will be connected through to the one existing 138 kV overhead circuit  
31 remaining in Segment 2. The other 230 kV circuit will connect to the new 230 kV underground  
32 cable terminals above ground.

---

### 33 4.3 Submarine Cables – Segments 3 and 5

34 As indicated above, as part of the VITR Project, three of the existing 138 kV submarine cables  
35 will be removed and replaced with three new 230 kV cables within the Strait of Georgia and  
36 Trincomali Channel. The expected life of the new 230 kV submarine cables is a minimum of  
37 50 years. The remaining 138 kV submarine cable circuit, comprised of three operating cables  
38 and one spare, will remain in place to supply Salt Spring and Galiano substations from either  
39 ARN or VIT.

40 Submarine cables designs that are currently in use in other situations similar to the VITR  
41 Project include:

- 1 • Self contained fluid filled cables: Includes both PPLP and Kraft paper insulation. These  
 2 cables are suitable for voltages up to 500 kV AC or DC and water depths to 1000 m.  
 3 These cables can be manufactured in a single length limited only by insulation processing  
 4 capacity (treating tank) and transportation capability (cable ship). Field joints are well  
 5 developed. These cables have significant operating experience under a variety of  
 6 conditions. Their insulation is pressurized with insulating fluid via pumping plants at the  
 7 cable ends, feeding into a hollow conductor core.
- 8 • Self contained gas filled (SCGF) cables: These cables are similar to SCFF cables except  
 9 the insulation is pressurized with dry nitrogen gas. The existing 138 kV submarine cables  
 10 are of this type. Because of limitations to voltage level (138 kV AC) and maximum  
 11 operating temperature, manufacturing of this cable type has been discontinued.
- 12 • Mass impregnated (MI) cables: These cables contain a fluid impregnated paper insulation  
 13 that is not pressurized. They are suitable for voltages up to 69 kV AC or 500 kV DC and  
 14 water depths to 1000m. These cables can be manufactured in a single length limited only  
 15 by insulation processing capacity (treating tank) and transportation capability (cable ship).  
 16 Field joints are well developed. These cables have significant operating experience under  
 17 a variety of conditions. They are commonly bundled into a 3 phase configuration for  
 18 smaller cable applications.
- 19 • Cross linked polyethelene (XLPE) cables: XLPE insulation is a solid dielectric material.  
 20 These cables have operating experience that is fairly extensive at voltages up to 130 kV  
 21 AC and no operating experience at 230 kV and higher. They have been designed for  
 22 deep water applications but have limited operating experience. The maximum single  
 23 cable length is limited by the manufacturing processes. Factory joints are required on  
 24 longer lengths. These cable are commonly bundled into a 3 phase configuration for  
 25 smaller ac cable applications.

26 A summary of some similar submarine cable projects currently under consideration or under  
 27 construction include:

Project	Description	Contract Status	In-Service Date
Hong Kong Submarine, Lamma Island	275/550 kV AC , two circuits, 2.7km (SCFF PPLP)	J-Power	2005/6
Gibraltar 2 <sup>nd</sup> link (Spain – Morocco)	400kV AC, 30 km (SCFF Kraft Paper)	Pirelli / Nexans	Dec 2005
Norwalk Ct. (USA) Replacing circuit 1385	3x138 kV circuits, 3x17.6 km (XLPE)	Tender in progress	2007
Hainan Crossing (China)	500kV AC, 31 km (SCFF Kraft Paper)	Tender in progress	2007
Norway, Gossen Island	415 kV AC, 2.7km (XLPE)	Nexans	2006
EstLink, Gulf of Finland	150 kV HVDC, 80 km (XLPE)	ABB	2006
Saudi Arabia - Bahrain	420 kV AC , 42km (SCFF Kraft Paper)	Nexans, Prysmian	2007
Thailand, Khanom (mainland) - Ko Samui Island	115 kV AC , 24 km (XLPE)	Nexans	2007
VITR	242 kV AC, 30km (SCFF PPLP or Kraft Paper)	Tender in Progress	2008

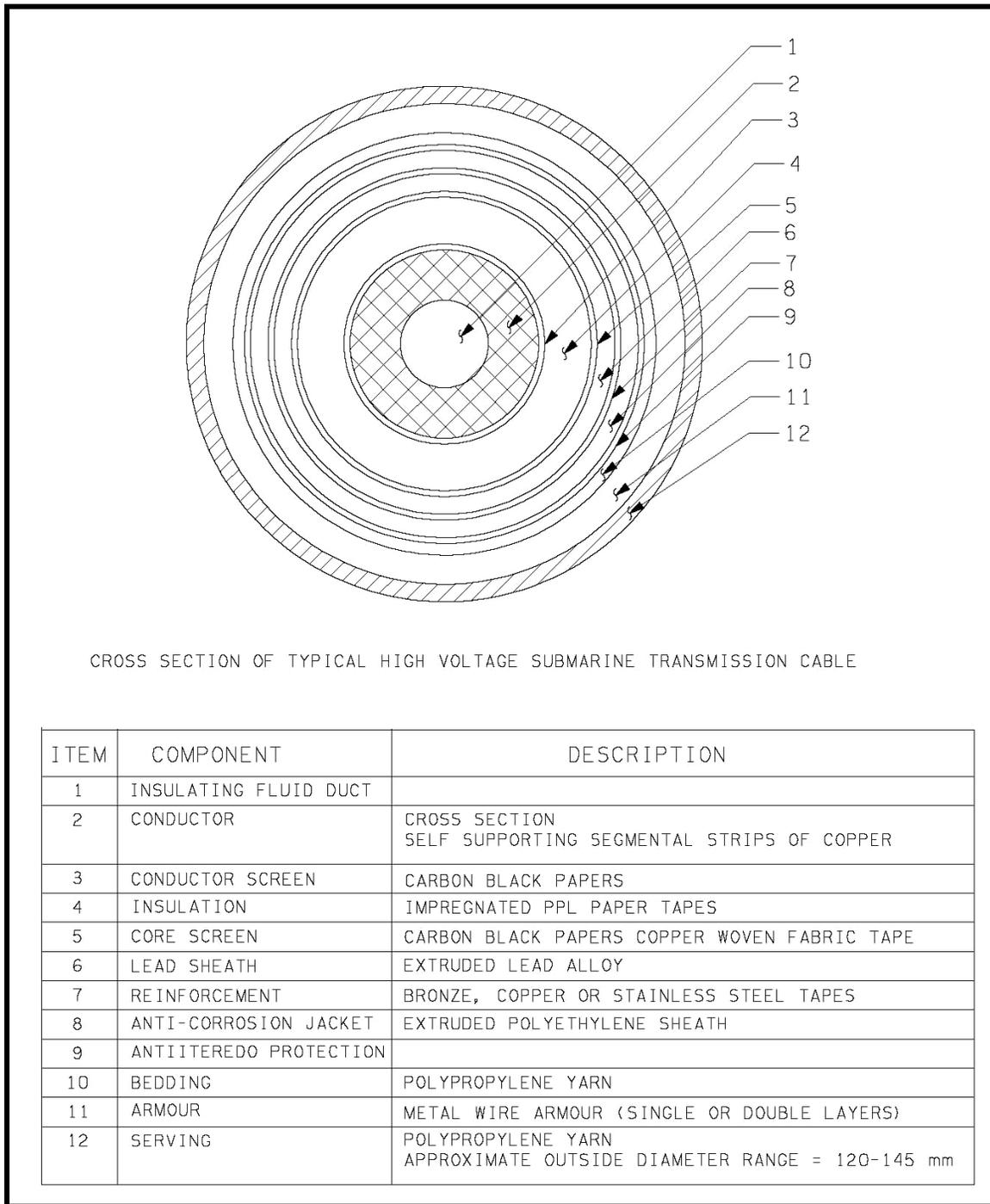
1 4.3.1 Cable Design

2 The new submarine cables will be a self-contained, fluid-filled (SCFF) design, in which the  
3 cable insulation is pressurized with insulating fluid supplied from the cable terminals. The  
4 outside cable diameter will be approximately 125 mm (5 inches). This is currently the only  
5 cable type with proven reliability suitable for the long distance, deep water and high-voltage  
6 AC installation; however, BCTC is continuously monitoring technological developments and  
7 will consider new proven technologies during final design and contract tendering.

8 A cross section of a typical SCFF submarine cable is shown in Figure 4.3-1. The central  
9 stranded-copper conductor is the current-carrying component. Its hollow core provides a  
10 passageway for insulating fluid under static pressure provided by equipment at the cable  
11 terminals. The insulating fluid saturates the cable insulation, maintaining the electrical  
12 integrity of the cable, and prevents damaging ingress of water in the unlikely event of an  
13 underwater leak.

14 The proposed insulating fluid is LAB, which provides optimal electrical, thermal, hydraulic and  
15 biodegradability characteristics. The fluid functions to control the high electric stresses in the  
16 insulation, which is important in this higher voltage (230 kV) application. The fluid's low  
17 viscosity aids in maintaining internal cable pressure requirements when the electrical load  
18 changes rapidly. It also evaporates relatively quickly from the water surface in the unlikely  
19 event of a leak. LAB is widely used in similar applications and is superior to refined mineral  
20 oil, from a biodegradability perspective. Further details regarding the cable design are  
21 provided in Appendix E of the VITR CPCN Application.

1 **Figure 4.3-1 Submarine Transmission Cable**



2

3 Source: VITR BCUC CPCN Application, Figure 3.25

1 4.3.2 Cable Removal

2 The three most southerly 138 kV cables in the Strait of Georgia and the three most northerly  
3 cables in Trincomali Channel will be decommissioned before installation of the new 230 kV  
4 cables commences. It is currently expected that this will be done via a separate removal and  
5 disposal contract beginning in 2007. It may be necessary to use air-lifting and water-jetting  
6 equipment to uncover the cables where they are currently buried from shore to below the lowest  
7 tide line. Metal components of the recovered cable will be recycled. The area of disturbance  
8 within 30 m of the high high water mark at the cable terminals is associated with construction of  
9 new cable chaseways, burial of the 230 kV cables and establishing work spaces. The exact  
10 area requirements will be established by the cable terminal and cable laying contractors; at this  
11 time it is estimated to be approximately 450 m<sup>2</sup> (15 m work area by 30 m).

12 As part of this environmental assessment, the benefits and constraints of removing the  
13 existing 138 kV submarine cables, versus abandoning them in place, have been evaluated on  
14 the basis of environmental and technical considerations. The results of this evaluation are  
15 provided in Section 3.2.3 of this EAC Application. An evaluation of the potential adverse  
16 effects of the cable removal on fish, invertebrates and aquatic plants (including eelgrass) is  
17 incorporated in the analyses presented Sections 7.2, 7.3 and 7.6.

18 The procedure for removal of cables is expected to be done generally as follows:

- 19 • On Shore: Cut and cap the cables within the bottom of EBT tunnel, uncover them where  
20 buried within the EBT fence, pull cables into EBT station, dispose of at recycling facilities.  
21 Repeat the process for the TBY, MBO and MTG terminal vicinity, as per the EBT with  
22 variations since there is no tunnel there. Removal of the concrete cap on the cable chase  
23 will be necessary, between the fence and the lower end of the chase near mean low  
24 water. Use diver operated air-lifting equipment to uncover cables, if necessary.
- 25 • Upper Intertidal: Excavate cables in the upper intertidal zone using machinery such as  
26 light duty tracked excavators, cut and cap the cables at the lowest point, remove the  
27 existing split pipe cable protectors, pull cables uphill into the EBT station, and dispose of at  
28 recycling facilities.
- 29 • Mid-Intertidal: Hand excavate cables in the mid intertidal zone to the seaward end of the  
30 split pipe cable protectors. Excavation points will only be necessary at about 5 m spacing,  
31 pull the cable/protectors to the surface, cut and cap into manageable lengths and attach  
32 floats to each cable length, remove cable lengths by barge at high tide and dispose of at  
33 recycling facilities.
- 34 • Shallow Subtidal: Using a barge on a moveable four point mooring system, slowly winch  
35 the cables on board, cutting them into manageable lengths for disposal in a polyethylene  
36 sheet lined shipping container to be recycled. Cut and cap the seaward cable ends, ready  
37 for deepwater removal.
- 38 • Deep Water: Using a specially equipped cable laying/recovery barge with tugboat  
39 guidance, recover each cut/capped cable end and winch on board using a powered reel or  
40 caterpillar drive linear cable engine. Wash mud and sea life from cable using sea water  
41 pumps before cable is brought on board. Monitor cable tension during recovery to ensure

1 maximum tension limits are not exceeded. Coil cable on board using a gantry system or  
2 cut into shipping container lengths, as with the near shore sections. Continue across  
3 Strait of Georgia to the other cable cut/cap end at about -3m near the opposite landing.  
4 Offload barge at a port for cable disposal and recycling.

---

#### 5 4.3.3 Cable Installation

6 Installation of submarine cables will require a cable-laying vessel with dynamic positioning  
7 capabilities and touchdown monitoring using an underwater remotely operated vehicle  
8 (ROV). It is proposed that each cable will be installed in one continuous length between  
9 cable terminal landings.

10 Figure 4.3-2, Figure 4.3-3 and Figure 4.3-4, provide views of typical cable installation practices  
11 proposed for the VITR Project.

12 The new 230 kV cables will be installed in the existing ROW. Their final position will be  
13 controlled and final locations known with precision, using modern navigation and cable-laying  
14 equipment. The sequence of activities for cable removal and new cable installation will be  
15 determined during detailed design and construction tendering. Cable manufacturers,  
16 submitting competitive tenders, often propose innovative solutions to help expedite installation  
17 or reduce costs based on their specific designs and installation equipment or their experience  
18 on recent projects.

19 The new submarine cables will be installed to ensure that the new circuit meets seismic  
20 performance requirements. Marine-based geotechnical and geophysical investigations have  
21 been conducted to evaluate seismic risks of various alternatives. These studies provided  
22 recommendations for optimum routing of the proposed 230 kV submarine cables, and  
23 identified possible risk mitigation measures. The area of greatest potential challenge for  
24 installation of the new cables is within the intertidal and steep-sloped subtidal areas west of  
25 EBT and Point Roberts. This area is at the southern edge of the Fraser River delta.  
26 Geotechnical investigations have characterized the marine geology and geophysics in this  
27 area, particularly with respect to stability during a seismic event (see Appendix F of the VITR  
28 CPCN Application).

29 Across the Strait of Georgia it is proposed that the new submarine cables be located south of  
30 the existing cable locations for approximately the first 8 km west of EBT. As the cables enter  
31 deeper waters, they will be spread out along the southern portion of the ROW. Based on  
32 geophysical analysis, this routing will minimize potential risk of damage to the cables during  
33 seismically induced underwater slides along the edge of the Fraser River delta. Through  
34 Trincomali Channel, the new cables will be laid on the north side of the ROW.

35 A Non-Natural Marine Hazards Assessment has been completed that examines potential  
36 hazards from anchors, fishing gear or tug tow-lines (Robert Allan Limited 2006). Results  
37 indicate no excessive risks to the cables from marine activities in the area.

1 **Figure 4.3-2 Pirelli Cable Laying Ship C/S Giulio Verne During Installation of new DC5 Cable**



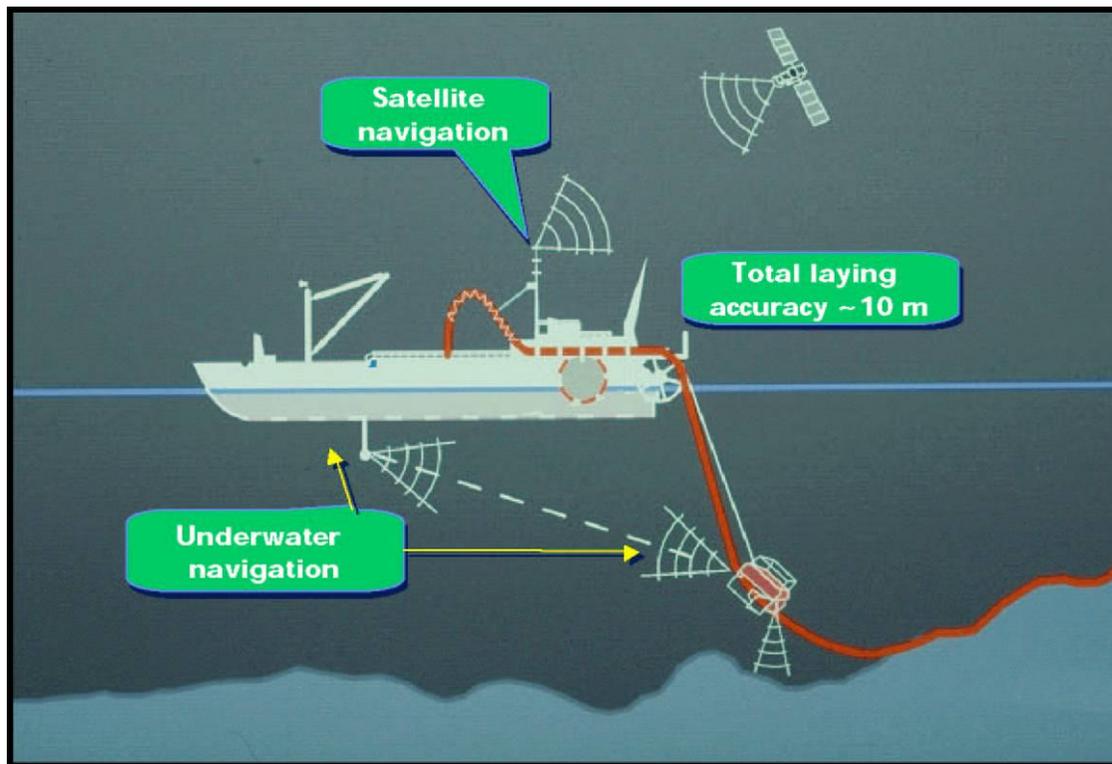
2  
3 Source: VITR BCUC CPCN Application, Figure 3.26

4 **Figure 4.3-3 Typical Cable Laying Turntable and Gantry**



5  
6 Source: VITR BCUC CPCN Application, Figure 3.27; Pirelli Cables & Systems

1 **Figure 4.3-4 Cable Laying with ROV for Touchdown Monitoring**



2  
3 Source: VITR BCUC CPCN Application, Figure 3.28; Nexans Norway

4 The three new 230 kV cables will run from new termination positions at EBT, located at  
5 approximately the same location as the three existing 138 kV terminations. From there they  
6 will use the existing exposed concrete chaseways to the east side of English Bluff Road. They  
7 will then pass under the road in the existing ventilated culvert system and into a section of  
8 ventilated concrete chaseway that was covered as part of the creation of Fred Gingell Park.  
9 The cables will then make a transition to the upper end of the ventilated tunnel and travel  
10 downhill on vertical racks to the bottom tunnel exit at the high water level. Some structural  
11 modifications may be necessary to the bottom end of the tunnel. From there the cables will  
12 pass into a buried zone where cable spacing will be increased to about 10m with about 1.0m  
13 cover. Protective split pipe covers will be placed around the cables in the upper intertidal zone  
14 to provide additional protection against high wave energy and seasonal sediment transport.

15 It is proposed that cable burial in the upper intertidal zone be done with mechanical  
16 excavators, such as small tracked backhoes. In the mudflat zone it is proposed to bury the  
17 cables using a jet plow or water jetting machine. Both systems are designed to specifically  
18 minimize seabed and eelgrass disturbance, as well as water turbidity, and have recently been  
19 used successfully in the San Juan Islands for submarine cable burial. The cables will be  
20 buried across the Roberts Bank mudflats and into US waters, where they will continue to be  
21 buried until a water depth of -3 m LLW.

22 Bringing the cable end ashore to EBT will be challenging due to the approximate 2.0 km long,  
23 shallow, intertidal mud flats, and the relatively deep draft of cable-laying vessels. Typically  
24 they are restricted to water depths greater than 15-20 m. At all terminals, each of the three

1 cable ends would be floated ashore guided by shallow draft workboats, during favourable  
2 weather conditions. Workboats would typically be zodiacs and herring skiffs with outboard  
3 motors, as well as larger V-hull boats with inboard motors, more suitable for rough weather  
4 work. They would be suitable for operations in water depths no less than 1.2 m.

5 Positioning the cables on alignments across the mudflats is also challenging because:

- 6 • floating the cables ashore must be done during high tides;
- 7 • during the summer months, wind direction is mainly toward the shore at EBT; and
- 8 • water depths along the possible alignments through eelgrass zones are no greater than  
9 about 1.2 m during high tide periods.

10 Once over the Roberts Bank mudflats, the cables will be laid directly on the sea bottom  
11 without burial, until the approach to TBY on the other side of Strait of Georgia. Special care  
12 will be taken to lay the cables in optimal locations across the Galiano Ridge area, which is  
13 about 4.0 km east of Galiano Island.

14 At the TBY side, the procedure will be similar, with the exception that there is no road to cross,  
15 nor tunnel to transit. The existing open shaded cable chaseway will be used from the  
16 terminations to the seaward fence and the existing covered chaseway will be used between  
17 the fence and its lower extremity at about mean low water. It may require widening by about  
18 1.0 m on the south side. Between the lower end of the covered chaseway and -3 m LLW the  
19 cables will be buried 1.0 m in the sediment. Protective split pipe covers will be placed around the  
20 cables in the upper intertidal zone, as at EBT. It is proposed that cable burial in the upper  
21 intertidal zone be done with mechanical excavators, such as small tracked backhoes. In the  
22 mudflat zone it is proposed to bury the cables using a water-jetting or jet-plow machine, as at  
23 EBT. If large cobbles are present in the seabed materials approaching the cable chaseway, it  
24 may not be possible to use water-jetting or plow equipment to bury the cables. If this occurs,  
25 manual air-lifting excavation may be necessary, using divers. In addition if shallow bedrock is  
26 present between the cable chase and -3 m rock splitting at select locations may be necessary  
27 to obtain the required 1.0 m burial depth.

28 Cable installation across Trincomali Channel would be similar to for Strait of Georgia, but  
29 without the complications due to the long mudflats at Roberts Bank, the Galiano Ridge  
30 crossing. The existing cable chaseways may also need to be widened by about 1.0 m on the  
31 north side at MTG and MBO

32 The cable laying procedures near EBT are expected occur generally as follows:

- 33 • The cable laying vessel would be moored in about 10 m water depth adjacent to EBT. It  
34 would be kept in position either using a dynamic positioning system or with a five point  
35 anchor system and tugboat management.
- 36 • The cable end would be floated to shore, perpendicular to it, on a rising tide, and directed  
37 up the tunnel to EBT. Cable anchors would be fitted at EBT.
- 38 • The floats would be left on the cable, while it remained oriented perpendicular to the  
39 shore.

- 1 • On the next rising tide a small cable burial barge equipped with the jet-plow and water  
2 pumps would move toward the mouth of the tunnel, ready for burial as the cable is floated  
3 toward its final alignment. The small barge would be guided by a shallow draft tugboat  
4 and moored as necessary.
- 5 • The main barge would slowly move south, parallel to the shore, paying out cable while  
6 smaller workboats guide the cable into the proposed alignment. Divers would remove the  
7 floats as the cable is moved into the correct location while the smaller cable burial barge  
8 moves over it. Water-jetting burial would be done directly behind where the floats are  
9 removed.
- 10 • A team of three divers will be used to guide, operate and monitor the cable burial  
11 equipment.
- 12 • Depending on laying and burial progress rate, two tidal cycles may be necessary to  
13 complete the cable laying/burial operation along the proposed route to -3 m LLW.
- 14 • The procedure would be repeated for the remaining two cables, separated by three to  
15 seven days. Careful temporary marking of the previously buried cable locations would be  
16 required to assure proper cable separation during laying of later cables. This is because it  
17 is expected that several tidal cycles will remove any evidence of the laying/burial activity.
- 18 For the other three landings at TBY, MTG and MBO, cable laying procedures would be similar,  
19 except that the cable laying vessel would be able to approach much closer to shore due to the  
20 absence of mudflats. Patchy eelgrass is present near TBY, so there would be similar care  
21 observed as for the EBT landing.
- 22 At TBY, MTG and MBO, the existing chaseways will be modified and reused from the high  
23 water level to the new 230 kV cable termination footings in each terminal station. Figure 4.3-5  
24 through Figure 4.3-8 shows the existing cable chaseways at EBT, TBY, MTG and MBO. New  
25 sunshades may be installed over the existing exposed chaseways to reduce solar heating  
26 effects.
- 27 All areas on land will be restored to pre- construction conditions. The effects of disturbance of  
28 the seabed and the subsequent restoration if described in greater detail in Section 7.6.

1 **Figure 4.3-5 Cable Chaseway at English Bluff Terminal (EBT)**



2

3 Source of Figures 4.3-5 through 4.3-8: VITR BCUC CPCN Application, Figure 3.29-3.32

1 **Figure 4.3-6 Cable Chaseway at Taylor Bay Terminal (TBY)**



2

1 **Figure 4.3-7 Cable Chaseway at Montague Terminal (MTG)**



2

3 **Figure 4.3-8 Cable Chaseway at Maracaibo Terminal (MBO)**



4

---

#### 1 4.3.4 Cathodic Protection Systems

2 To avoid the potential for corrosion of cable armour, cathodic protection systems may be  
3 installed for the intertidal and subtidal areas near EBT or areas of potential cable abrasion  
4 from underwater features such as the Galiano Ridge.

5 The VITR submarine cables will have one or two layers of metallic armour wires wound on the  
6 outside of the cable. The armour is required to sustain part of the mechanical stresses during  
7 the laying and recovery of the cable, since the conductor alone is not sufficient for this  
8 purpose. As for other metallic structures in submerged environments (e.g. steel piles in piers,  
9 gas and oil pipelines), the armour wires in submarine cable are subject to corrosion.

10 It is proposed that impressed current cathodic protection (ICCP) systems be installed at TBY,  
11 MTG and MBO. The protection against corrosion in the metallic armour wire is achieved by  
12 injecting a DC current from a rectifier in the terminal to anodes submerged in the sea. The  
13 current leaves the anodes and enters the cable armour (cathode), rendering the armour  
14 negatively charged. By regulating the current to the correct polarization of the armour,  
15 corrosion is prevented.

16 The cathodic protection system will consist of the following equipment at each terminal:

- 17 • a rectifier with adjustable voltage and current, located in the control building;
- 18 • anodes to be located offshore in water depths of approximately 20 to 50 m, sufficient in  
19 number, material and surface area to keep voltage levels in the seawater to within  
20 acceptable limits;
- 21 • insulated wire connections from the rectifier to the anodes (insulated wire); and
- 22 • insulated wire connections from the rectifier to the armour wire.

23 Particulars on the final design, size and locations will be established in the detailed design  
24 stage of the Project. Once this is complete, drawings showing the locations (including latitude  
25 and longitude) of cathodic protection works in navigable waterways will be provided to  
26 Transport Canada to review in accordance with the *Navigable Waters Protection Act*.

---

#### 27 4.4 Substations and Cable Terminals

28 The VITR Project will require modifications at ARN and VIT substations, a new underground  
29 cable terminal adjacent to TSW and modifications to each of the four existing submarine cable  
30 terminals (EBT, TBY, MTG and MBO). An overview of work at substations and cable  
31 terminals is provided in Figures 1.3-1 through 1.3-3.

---

##### 32 4.4.1 Methods of Removal and Installation of Substation and Terminal Equipment

33 The nitrogen storage tanks not required for the remaining circuit will be dismantled and  
34 removed from site by truck or barge and returned for recycling. The nitrogen system buildings  
35 will remain on site for the remaining 138 kV cable system. The transmission steel towers or  
36 wood poles, support structure steel and fibreglass enclosures will be dismantled and removed

1 from site by truck or barge and disposed of appropriately. This work will take place  
2 immediately prior to the installation of the VITR works.

3 Removal of existing civil works including transmission tower footings, cable termination footing  
4 and parts of the chaseway will be completed with conventional machinery such as backhoes,  
5 hoe rams and excavating machines. The materials will be removed from site via dump trucks  
6 or barges as appropriate. Standard practices for dust and noise control will be followed.

7 The chaseway sun shades will be removed by hand and transported to an appropriate refuse  
8 depot on Vancouver Island via barge or truck. Where replacement fencing is required the  
9 existing fencing will be removed and recycled.

10 Conventional substation construction techniques will be employed. Rock excavation on site  
11 will be by mechanical means (excavators, jackhammers, *etc.*), drilling and hydraulic wedging.  
12 Excess material will either be redistributed within the terminal station fence or removed from  
13 site. New materials (crushed rock, concrete and fills as required) will be brought to site by  
14 truck or barge. Within the terminal station a ground grid consisting of bare copper conductor  
15 will installed at a spacing of approximately 3 m. The grid will be excavated by backhoe to the  
16 predetermined depth depending on site conditions. The grid will be installed and backfilled  
17 with material of the appropriate electric properties. A top coating of crushed rock will be  
18 applied for safety purposes and vegetation control. New footings will either be excavated to a  
19 required depth or rock bolt type foundations installed where bedrock is encountered at shallow  
20 soil depths. The terminations and cable fluid pressurizing system will have a fluid containment  
21 system consisting of concrete containment structures (filled with crushed rock for fire  
22 mitigation), connected via a piped fluid collection system with a fluid / water separator.  
23 Concrete placement will utilize conventional forming and placement methods or placement of  
24 pre-cast components.

25 The overhead line, cable termination and surge arrester steel structures will be installed using  
26 cranes brought to site by truck or barge.

27 The new fluid pressurizing pumping plant will be housed in a new building that will include fluid  
28 containment. The pressurizing system is brought to site in two main components, the  
29 pumping system and the fluid storage tank. These components together with interconnecting  
30 piping, controls, alarms and telemetry will be assembled and commissioned on site by  
31 qualified personnel.

32 The spare cable storage facility at MBO will require assembly of a steel turntable (if required)  
33 and a gantry system for guiding the cable onto the turntable or platform.

---

#### 34 4.4.2 Modifications at ARN and VIT

35 The ARN and VIT substations will be modified to accommodate the additional 230 kV line  
36 positions. This is routine work and will take place entirely within the existing property. At ARN,  
37 improvements will include installation of a new slack span 230 kV terminal tower and  
38 foundation. Two new breakers will be installed on existing foundations, and new foundations  
39 and equipment will be installed for a three-phase surge arrester.

40 The works at VIT will be similar to those at ARN. In addition to the line position modifications,  
41 a phase-shifting transformer (PST) will also be installed at VIT. A PST is a relatively large, oil-

1 filled device similar to a conventional high-voltage transformer. It will be installed within a  
2 secondary fluid containment basin of sufficient capacity to minimize the risk of contamination.  
3 Installation of the PST may require expansion of the fenced enclosure at VIT but would take  
4 place within the existing property. Site preparation and miscellaneous station improvements  
5 would be required. Details on PST configuration and specifications will be determined during  
6 the detailed engineering phase. In addition, noise abatement measures will be incorporated  
7 as required into the modifications at VIT to reduce disturbances to surrounding landowners  
8 associated with operation of the PST.

---

#### 9 4.4.3 Shunt Compensation Equipment

10 System studies show that it is necessary to install shunt compensation equipment at TBY and  
11 Sahtlam Substation. The purpose of the shunt compensation equipment is to reduce over-  
12 voltages on the 230 kV system during light loading conditions and to compensate for the cable  
13 insulation charging current, which reduces real power transmission capacity. Plans are to  
14 install a new 75 Mvar device (with concrete footings, disconnect switches, fluid containment  
15 systems and auxiliary equipment) at each location. This will require expanding the fenced  
16 enclosure at TBY and relocation westward of the existing access road to the GLS, all within  
17 the existing property. Some tree clearing and site grading will be required. Installation at  
18 Sahtlam can be done within the existing site. In addition, noise abatement measures will be  
19 incorporated as required in the Shunt Compensation Equipment to reduce disturbances to  
20 surrounding landowners.

---

#### 21 4.4.4 Cable Terminals

22 Modifications and improvements to the four existing cable terminal sites (EBT, TBY, MTG and  
23 MBO) will include removal of existing steel supports for one set of 138 kV cable terminations  
24 and overhead line dead-end steel structures. Except for EBT, which will serve as a transition  
25 point between the submarine and underground sections, new installations will include:

- 26 • new cable termination footings and support structures;
- 27 • new overhead line dead-end footings and structures, lightning arrestors and footings, and  
28 insulating fluid pressurizing and containment systems;
- 29 • cable chase modifications;
- 30 • termination protection barriers;
- 31 • grounding systems;
- 32 • site enlargement and resurfacing and other miscellaneous improvements, such as  
33 relocating the access road at TBY and MBO; and
- 34 • construction a cable storage turntable at MBO.

35 Some tree trimming and clearing will be required at TBY, MTG and MBO. Rock excavation in  
36 small localized areas will be completed by drilling and wedging using hydraulic equipment.  
37 Larger areas of rock excavation will include controlled blasting. A new cable terminal station,

1 Tsawwassen Cable Terminal (TST), similar to EBT, TBY, MTG and MBO, will be constructed  
2 adjacent to TSW within the existing property.

3 The cable insulation fluid will be pressurized by systems located at each of the four cable  
4 terminal sites. For the Strait of Georgia crossing, pumping plant systems will be used to  
5 maintain predetermined pressures within the cables. For the shorter and shallower Trincomali  
6 Channel crossing, cable insulation fluid will be pressurized either through a conventional  
7 pumping plant at MBO and a crossover at MTG, or alternatively, via a passive pressure tank  
8 system at each terminal. Either of these options will be effective at maintaining required  
9 pressure of the insulating fluid for the Trincomali Channel crossing during normal operations  
10 and at automatically reducing pressure under abnormal conditions.

11 If required, a cable fluid containment system will be provided at each of the Cable Terminals to  
12 minimize the risk of cable fluid contamination. Containment of cable fluids will consist of a  
13 catchment pit filled with drain gravel connected to a fluid/water separator. Small leaks and  
14 drips from equipment will be caught in the gravel-filled catchment pit. Some of this cable fluid  
15 will be carried into the fluid/water separator where the fluid will float to the surface and remain  
16 there for safe removal. Rain water will settle at the bottom of the separator and be discharged  
17 downhill into splash pads where the water will drain by natural seepage. Large cable fluid  
18 spills resulting from equipment failure will be captured in the catchment pit and fluid/water  
19 separator. A gravity valve inside the fluid/water separator will close and stop all discharges  
20 from the separator.

21 A new storage facility for spare cable will be constructed within the existing MBO property.  
22 The storage facility will consist of a revolving steel turntable mounted on a concrete footing.  
23 An insulating fluid containment and monitoring system will also be provided.

---

#### 24 4.5 Service to the Southern Gulf Islands

25 The two existing 138 kV circuits (1L17 and 1L18) are currently used to supply the southern  
26 Gulf Island loads from ARN, with lines normally open at VIT due to supply limitations on  
27 Vancouver Island. Two 138 kV distribution substations, located on Salt Spring Island (SAL)  
28 and Galiano Island (GLS), are fed from the two circuits.

29 The installation of one 230 kV circuit will provide sufficient capacity to supply the forecasted  
30 Vancouver Island shortfall for approximately ten years. Since the southern Gulf Islands are  
31 currently served through existing 138 kV substations, upgrading both existing 138 kV circuits  
32 would involve costly, and unnecessary, modifications to these substations for conversion to  
33 230 kV. Accordingly, notwithstanding that the VITR Project will provide increased capacity to  
34 Vancouver Island, it is necessary to continue to be in a position to supply the southern Gulf  
35 Islands at 138 kV.

36 To accomplish this under VITR, one of the new 230 kV overhead circuits connected to the  
37 230 kV submarine cables will supply Vancouver Island directly. The other new 230 kV  
38 overhead circuit will be connected to the remaining set of 138 kV submarine cables and  
39 operated at 138 kV to supply SAL and GLS from either ARN or VIT until it is necessary to  
40 complete the installation of the second 230 kV circuit. At that time, both 230 kV overhead  
41 circuits will operate at 230 kV and be configured to supply Vancouver Island and the southern

1 Gulf Islands. SAL will be converted to 230 kV and connected to the 230 kV circuits. GLS may  
2 be fed from the converted 230 kV SAL at distribution voltage or directly supplied from a  
3 converted 230 kV GLS. It is proposed that the second 138 kV submarine cable circuit be  
4 decommissioned and removed prior to installation of the second set of submarine cables.

5 As previously noted, BCTC is not applying for a CPCN or EAC Application for any of this  
6 future work to complete the second 230 kV circuit or to convert SAL at this time. The project  
7 will be the subject of a separate CPCN Application and EAC Application when those facilities  
8 are needed.

---

#### 9 4.6 Schedule and Implementation

10 Figure 4.6-1 shows a proposed schedule for the Definition Phase of the VITR Project,  
11 concluding with the receipt of a CPCN from the BCUC, an EAC from the BCEAO, successful  
12 completion of the required US environmental assessment process, and receipt of required  
13 Canadian and US regulatory permits, approvals and authorizations. The proposed schedule  
14 includes a conceptual schedule for the BCUC review of the CPCN Application, although the  
15 actual schedule of activities in the review process will be determined by the Commission.

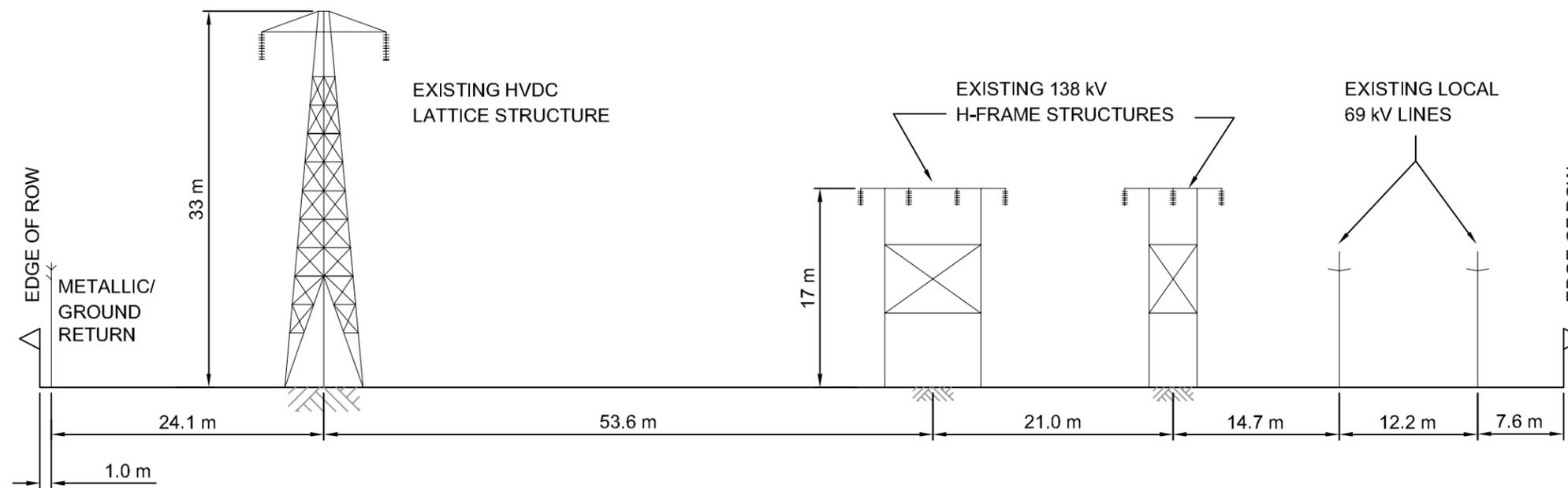
16 Figure 4.6-2 shows the proposed schedule for the Implementation (tender and construction)  
17 Phase, and indicates significant overlap will the Definition Phase. The tender process for  
18 submarine cable manufacture and installation has begun. Tenders are due in April 2006. No  
19 irreversible contractual commitments will be made prior to receipt of a CPCN and an EAC.  
20 BCTC currently proposes to award a cable contract and perhaps a contract for the phase  
21 shifting transformer prior to receipt of the environmental approvals and other permits in 2006.  
22 This is necessary to maintain the Project schedule because of the long lead time required to  
23 design, manufacture and install submarine cable. BCTC considers there to be little risk that  
24 the EA process will not be completed successfully or will result in changes to the design of the  
25 Project or conditions on the Project that would affect these decisions.

26 Timing constraints or restrictions with respect to activities such as instream works, tree  
27 clearing and audible noise are discussed in the relevant effects analysis sections (6.2.5, 6.3.5,  
28 6.14.5, 7.2.5, 7.3.5, 7.4.5).

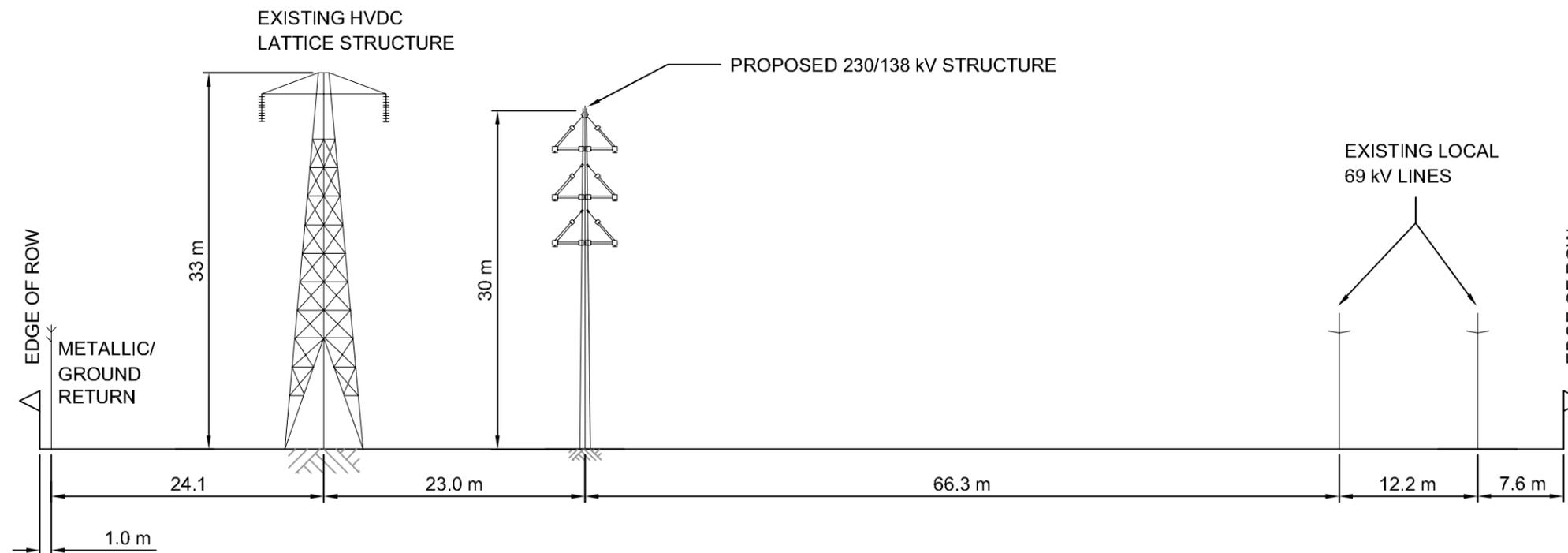
---

#### 29 4.7 Labour Force

30 It is estimated that the project will require approximately 68 person-years of direct employment  
31 to construct, roughly 61 person-years for the land portion (overhead and underground) and  
32 seven person-years for the marine portion. The workforce is likely to originate from locations  
33 around the Lower Mainland, the southern Gulf Islands and Vancouver Island, with the  
34 exception of cable laying ships, which will be brought in from outside of Canada. No new  
35 permanent jobs will be created for the operational phase of the project.



**ORIGINAL CONFIGURATION - LADNER**



**PROPOSED CONFIGURATION - LADNER**



PROJECT: **VANCOUVER ISLAND TRANSMISSION REINFORCEMENT**  
 LOCATION: **DELTA, BRITISH COLUMBIA**  
 PROJECT No. **BCV50466.09**



**British Columbia Transmission**  
 CORPORATION™

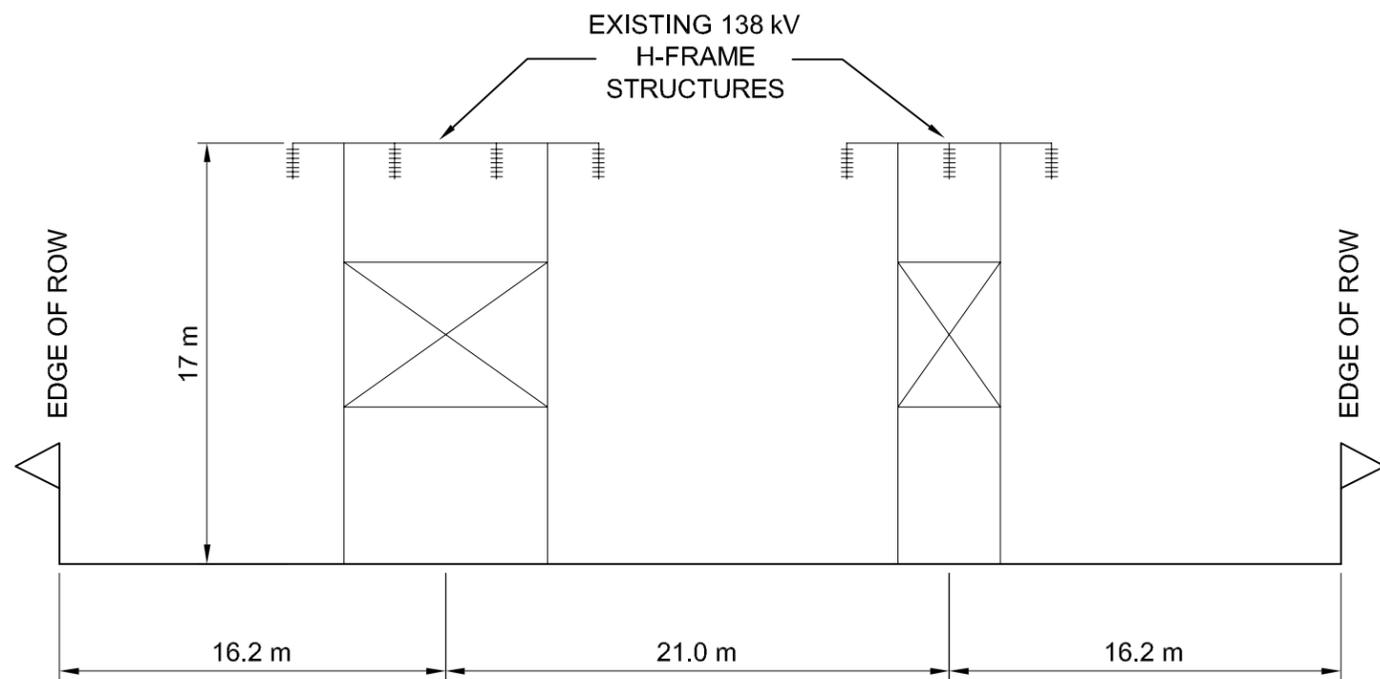
**Typical Overhead Transmission  
 Structure Configuration**

DATE: **May 12, 2006**  
 AUTHOR: **NP**

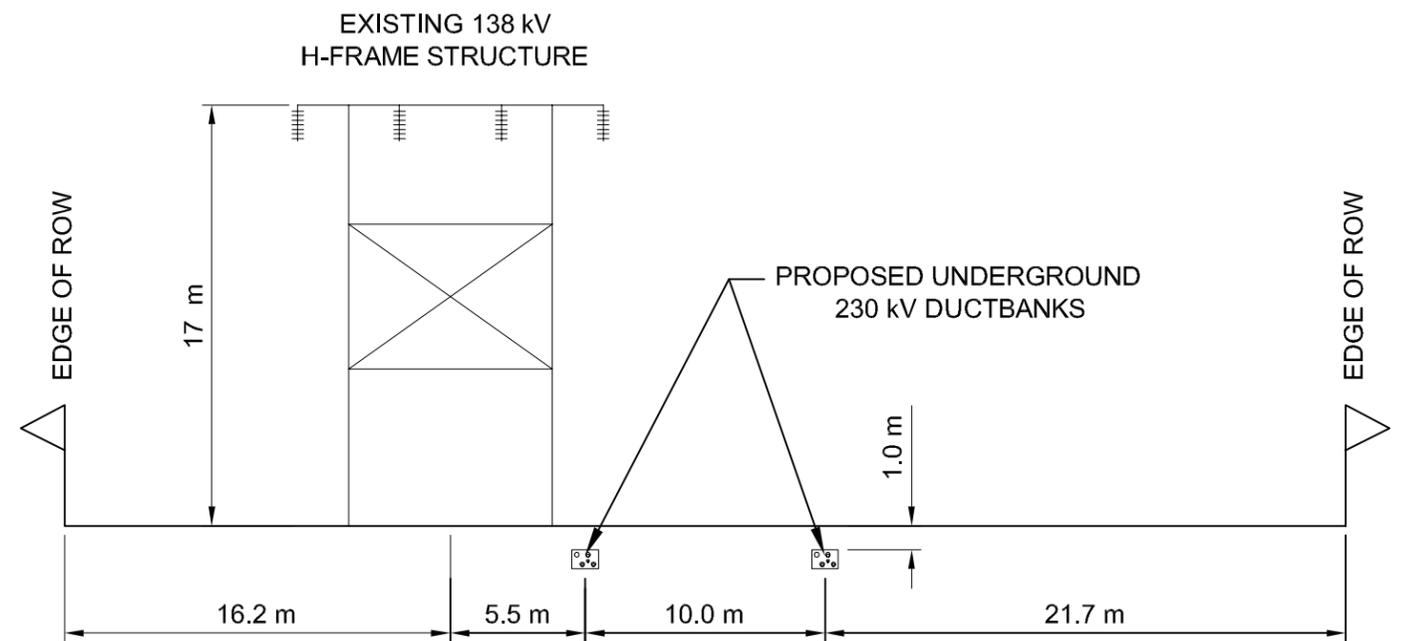
APPROVED: **WP**

PROJECTION: **UTM**  
 DATUM: **NAD 83 - ZONE 10**

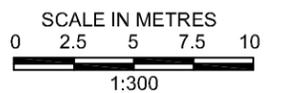
FIGURE No. **4.1-1**  
 4 - 31



ORIGINAL CONFIGURATION - TSAWWASSEN



PROPOSED CONFIGURATION - TSAWWASSEN



PROJECT: **VANCOUVER ISLAND TRANSMISSION REINFORCEMENT**

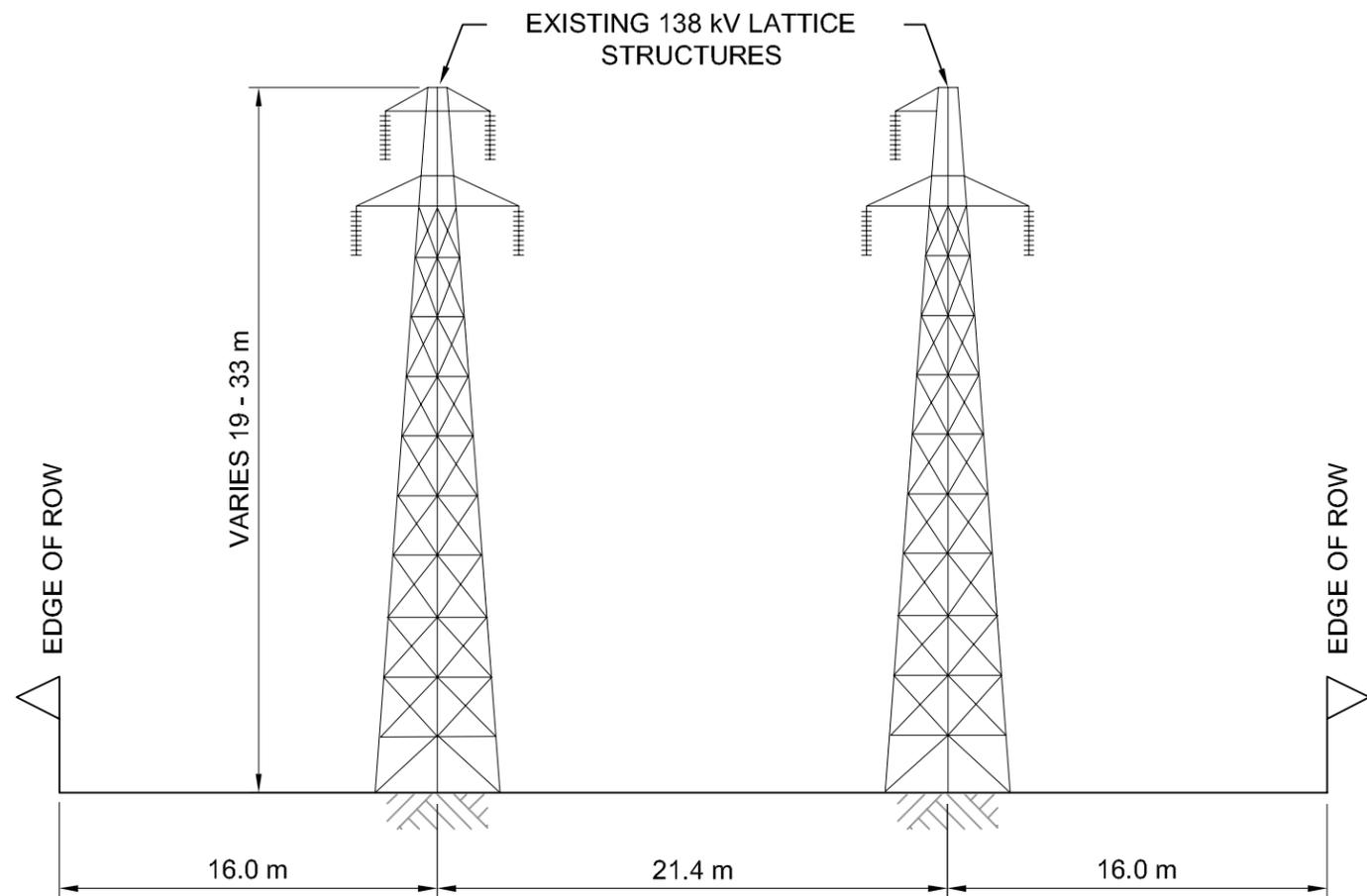
LOCATION: **DELTA, BRITISH COLUMBIA**

PROJECT No. **BCV50466.09**

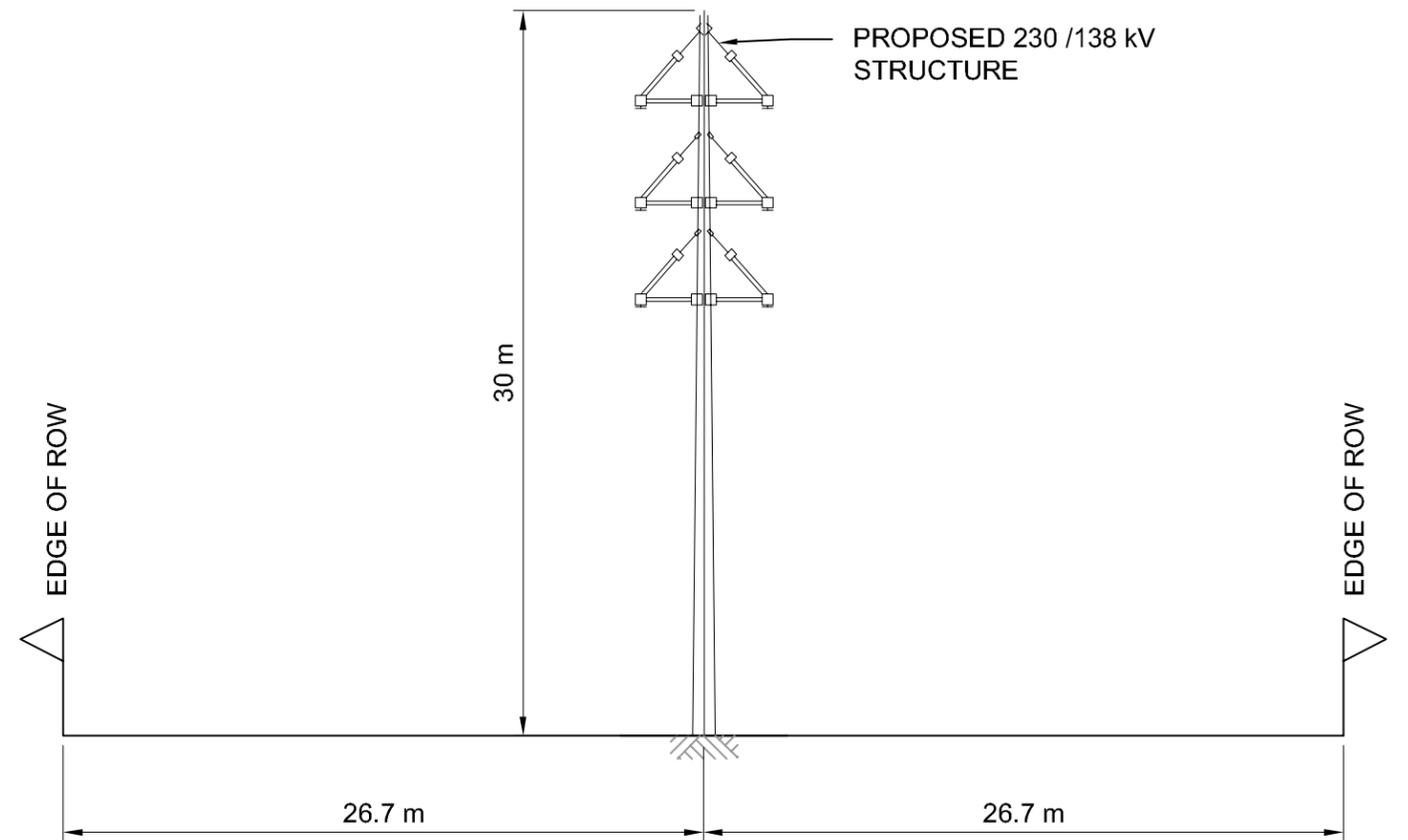


**Typical Overhead/Underground  
Transmission  
Structure Configuration**

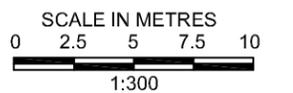
DATE: <b>May 12, 2006</b>		PROJECTION: <b>UTM</b>	FIGURE No. <b>4.1-2</b>  4 - 32
AUTHOR: <b>NP</b>	APPROVED: <b>WP</b>	DATUM: <b>NAD 83 - ZONE 10</b>	



**ORIGINAL CONFIGURATION - PORTIONS OF GULF ISLANDS & VANCOUVER ISLAND**



**PROPOSED CONFIGURATION - PORTIONS OF GULF ISLANDS & VANCOUVER ISLAND**



PROJECT: **VANCOUVER ISLAND TRANSMISSION REINFORCEMENT**

LOCATION: **GULF Is. AND VANCOUVER Is., BRITISH COLUMBIA**

PROJECT No. **BCV50466.09**



**British Columbia Transmission**  
CORPORATION™

**Typical Overhead Transmission  
Structure Configuration**

DATE:  
**May 12, 2006**

AUTHOR:  
**NP**

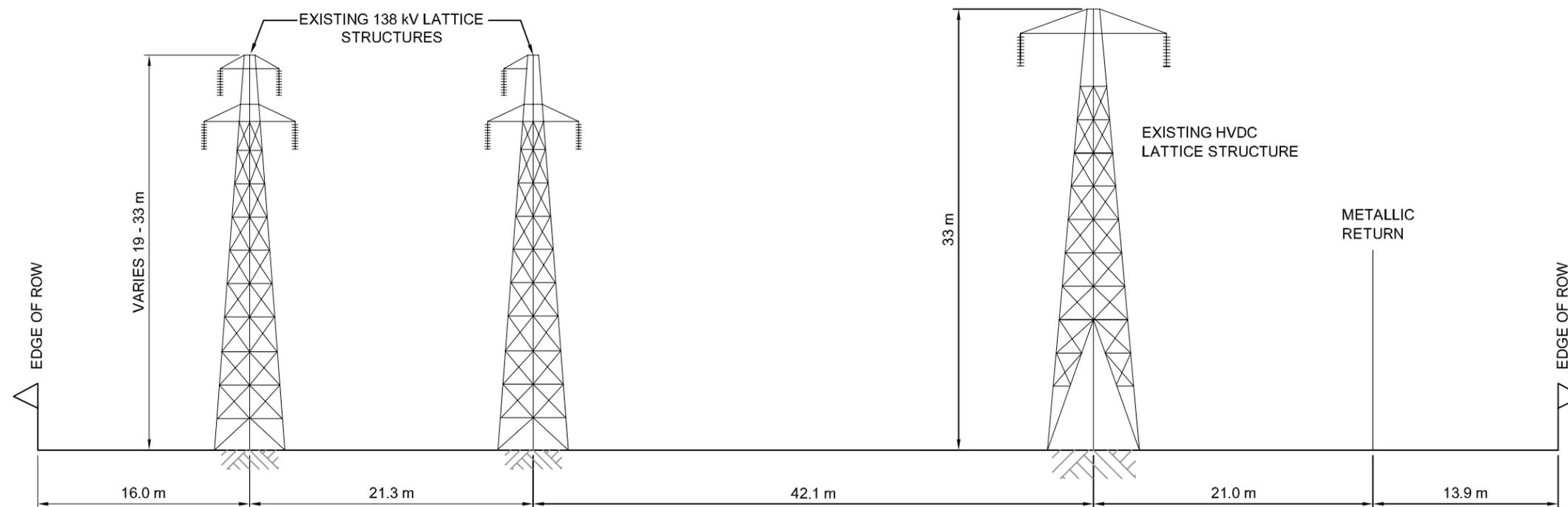
APPROVED:  
**WP**

PROJECTION:  
**UTM**

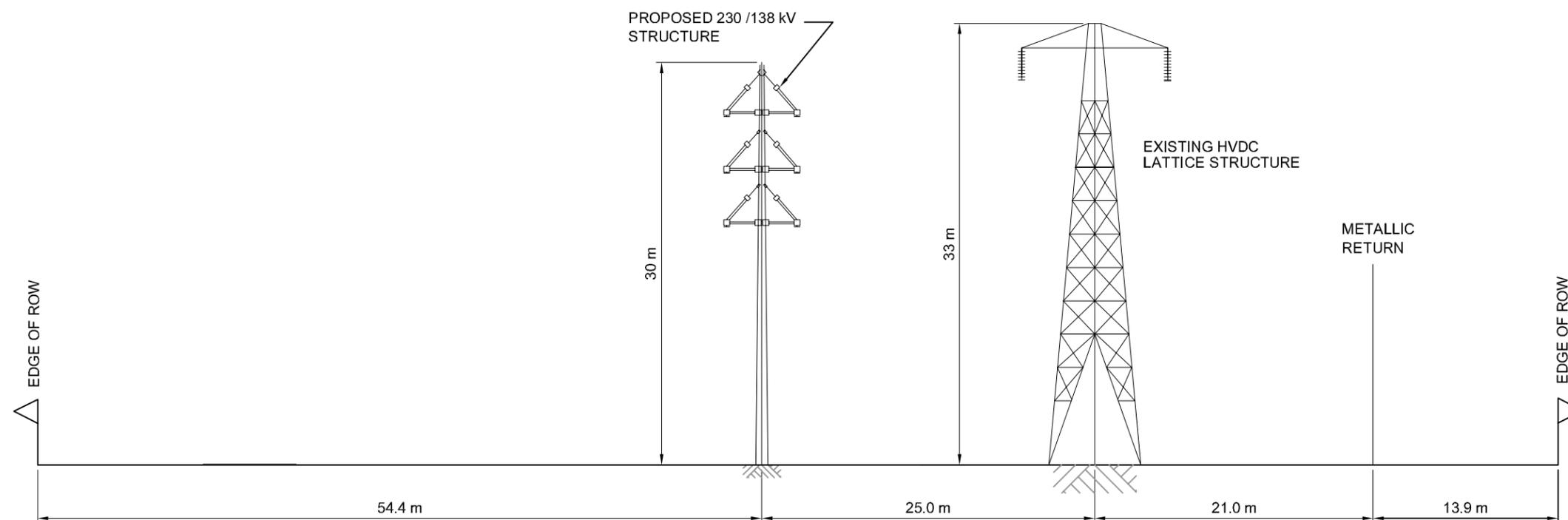
DATUM:  
**NAD 83 - ZONE 10**

FIGURE No.  
**4.1-3**

4 - 33



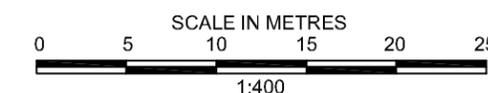
**ORIGINAL CONFIGURATION - PORTIONS OF SALT SPRING ISLAND & VANCOUVER ISLAND**



**PROPOSED CONFIGURATION - PORTIONS OF SALT SPRING ISLAND & VANCOUVER ISLAND**

**NOTE:**

PROPOSED 230 /138 kV STRUCTURE LOCATION SHOWN REPRESENTS CONFIGURATION ON SALT SPRING ISLAND. VANCOUVER ISLAND CONFIGURATION IS SIMILAR, HOWEVER SEPERATION BETWEEN 230 /138 kV STRUCTURE AND EXISTING HVDC LATTICE STRUCTURE VARIES BETWEEN 50 AND 100 m.



PROJECT: **VANCOUVER ISLAND TRANSMISSION REINFORCEMENT**  
 LOCATION: **NORTH COWICHAN, BRITISH COLUMBIA**  
 PROJECT No. **BCV50466.09**

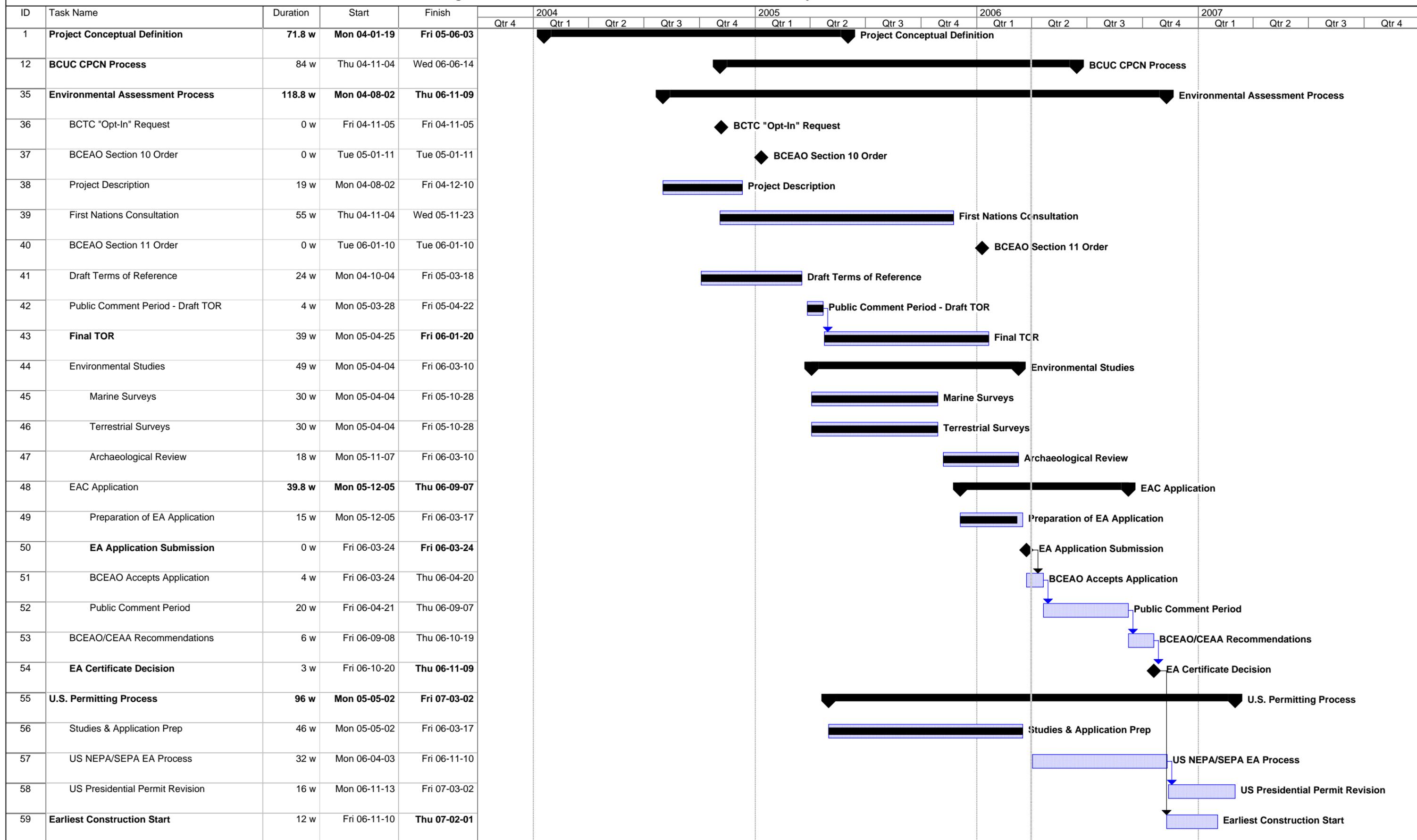


**British Columbia Transmission**  
CORPORATION™

**Typical Overhead Transmission  
Structure Configuration**

DATE: <b>May 12, 2006</b>		PROJECTION: <b>UTM</b>	FIGURE No. <b>4.1-4</b>  4 - 34
AUTHOR: <b>NP</b>	APPROVED: <b>WP</b>	DATUM: <b>NAD 83 - ZONE 10</b>	

Figure 4.6-1 Vancouver Island Transmission Reinforcement Project Definition Phase Schedule

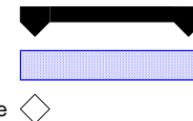


VITR Project Definition Phase

Task  
Progress  
Milestone



Summary  
Rolled Up Task  
Rolled Up Milestone



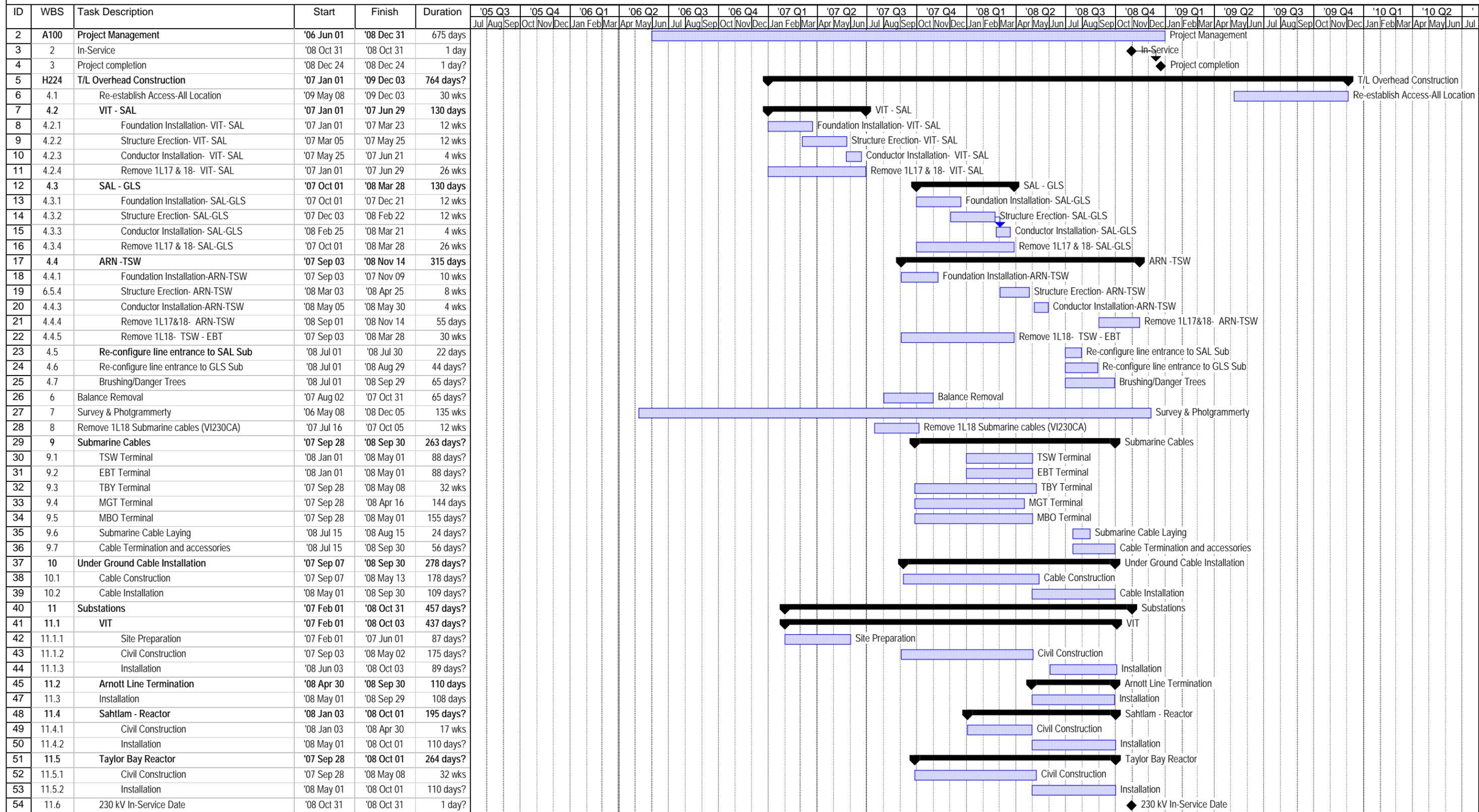
Rolled Up Progress  
Split  
External Tasks



Project Summary  
Group By Summary



Figure 4.6-2 Vancouver Island Transmission Reinforcement Project Construction Phase Schedule



VITR Project Construction Phase

