Engineering and safety

1.76 Company standards, specifications, manuals, and recommended practices

Reference:

A3S0Z5, Application Volume 4A, Project Design and Execution – Engineering, Appendix D – Tables:

i) Table 5.1.2 – KMC Standards, Specifications, Manuals and Recommended Practices, PDF page 4 of 93
ii) PDF page 1 of 93
iii) A3S1A5, Application Volume 4A, Project Design and Execution – Engineering, Appendix F – KMC/TMEP Specifications to be Developed during Detailed Engineering and Design, PDF page 1 of 1

Preamble:

Reference i) is a list of Kinder Morgan Canada's standards, specifications, manuals, and recommended practices.

Reference ii) states that the documents listed in Reference i) will, where applicable, be adopted by Trans Mountain and used in the design, construction, operation, and maintenance of the proposed Project. Trans Mountain states that additional Kinder Morgan Canada standards, specifications, manuals, and recommended practices may be developed and adopted during the detailed engineering and design phase, and that Trans Mountain-specific standards, specifications, and manuals may also be developed.

Reference iii) is a list of Kinder Morgan Canada and Trans Mountain specifications to be developed during detailed engineering and design

Request:

Please provide copies of:

a) the documents listed in Reference i); and

b) any additional Kinder Morgan Canada – and Trans Mountain–specific standards, specifications, and manuals that will be developed for the Project, upon their completion.

Response:

a) The engineering specifications and standards listed in Table 5.1.2 in Reference i) are being updated during the detailed engineering phase of the work and are expected to be complete in Q4 2014. The construction specifications will be updated and developed during the detailed engineering phase and will be complete 60 days prior to start of construction. These specifications and standards are proprietary and would only be made available to the NEB upon request and Trans Mountain would seek to have it be filed on a confidential basis.

The Safety Standards Manual (referred to as the Health and Safety Standards Manual in Table 5.1.2 in Reference i) was submitted to the NEB in 2013 by Kinder Morgan Canada Inc. (KMC), the operator of the existing Trans Mountain Pipeline system.

Trans Mountain considers the KMC Integrity Management Procedures as proprietary information and these would only be made available to the NEB upon request and Trans Mountain would seek to have it be filed on a confidential basis.

A table of contents of both the Mechanical Maintenance Procedures (NEB IR 1.76a - Attachment 1) and the Pipeline Maintenance Procedures (NEB IR 1.76a - Attachment 2) are also provided. Again, as these procedures are proprietary, they will only be made available to the NEB upon request and Trans Mountain would seek to have it be filed on a confidential basis.

b) Upon their completion, Trans Mountain will provide the NEB with copies of the documents that are identified as draft in reference i) and those described in Reference iii), or new ones that are developed during the detailed engineering and design phase of the Project. The engineering related documents will be provided by Q1 2015 while the construction related documents will be provided 60 days prior to start of construction.

Summary of New Commitments:

- Trans Mountain will provide Project-related standards, specifications, and manuals that are developed during detailed engineering and design phase of the Project, upon their completion. The engineering-related documents will be provided by end of Q1 2015 while the construction-related documents will be provided 60 days prior to start of construction.

1.77 Detailed engineering designs

Reference:

A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering, PDF page 39 of 110

Preamble:

The reference lists anticipated physical conditions or construction circumstances not specifically or adequately addressed in Canadian Standards Association (CSA) Z662 or the OPR.

Trans Mountain states that appropriate, qualified engineering specialists will evaluate and prepare detailed engineered designs, such that the design, construction, and operation of the pipeline will implicitly meet the safety and integrity requirements of CSA Z662 and the OPR. These include:

- blasting of rock adjacent to existing pipelines, roads, railways, and utilities;
- mitigating potential slope instability;
- dealing with the potential for seismic activity;
- watercourse scour and erosion;
- controlling pipe buoyancy; and
- high voltage alternating and direct current interference.

Request:

a) Please indicate whether Trans Mountain has identified, or anticipates, any other conditions or circumstances not specially or adequately addressed in CSA Z662 or the OPR;

b) an indication of when the detailed engineering designs for any conditions or circumstances not specially or adequately addressed in CSA Z662 or the OPR will be completed; and

c) Please provide copies of the detailed engineering designs for any conditions or circumstances not specially or adequately addressed in CSA Z662 or the OPR, upon completion.

Response:

a) Trans Mountain has not identified or anticipated any other such conditions or circumstances to date not specifically or adequately addressed in CSA Z662 or the OPR.

b) Trans Mountain expects to complete detailed engineering designs for the conditions and circumstances mentioned in the preamble during the detailed engineering and design phase of the Project. Where circumstances exist such that the detailed engineering designs cannot be completed during this phase, all outstanding detailed engineering designs will be completed and submitted to the NEB 60 days prior to the commencement of construction of the mainline pipeline in a particular spread.

Final determination of the locations for the implementation of buoyancy control will be determined by the main Pipeline Contractor and Trans Mountain during the construction of the pipeline.

c) Upon their completion, Trans Mountain will provide to the NEB copies of any detailed engineering designs that are developed during the detailed engineering and design phase of the Project for conditions and circumstances not specially or adequately addressed in CSA Z662 or the *Onshore Pipeline Regulations* (OPR).

Summary of New Commitments:

- Where circumstances exist such that the detailed engineering designs cannot be completed during detailed engineering, all outstanding detailed engineering designs will be completed and submitted to the NEB 60 days prior to the commencement of construction of the mainline pipeline in a particular spread.
- Trans Mountain will provide to the NEB copies of detailed engineering designs for conditions and circumstances not specially or adequately addressed in CSA Z662 or the OPR as described in the NEB Application Volume 4A, Section 2.9, 60 days prior to the commencement of construction of the mainline pipeline in a particular spread.

1.78 Acid rock drainage

Reference:

i) A3S0Z5, Application Volume 4A, Project Design and Execution – Engineering, Appendix D – Tables, Table 5.1.4 – Primary Terrain Stability Considerations and Standard Mitigation Measures, PDF page 7 of 93
ii) A3S1D6, Application Volume 4A, Project Design and Execution – Engineering, Appendix H – Terrain Mapping and Geohazard Inventory Report, Appendix B – Natural Hazards Summary Table, PDF page 14 of 20
iii) A3S1T3, Application Volume 5C, Environmental and Socio-Economic Assessment – Biophysical Technical Reports, Acid Rock Drainage and Metal Leaching Potential, Table 5-1 – Potential Mitigation Options, PDF page 26 of 87

Preamble:

Reference i) states that, with respect to acid rock drainage, Trans Mountain will conduct visual assessment followed by sampling and analysis, when required, during construction. It states further that acid rock drainage mitigation protocols will comply with the Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia.

Reference ii) identifies one location along the pipeline route where acid rock is identified as a natural hazard (from reference kilometre (RK) 696 to 696.1) and refers to the Trans Mountain Expansion Project Acid Generating Potential report (i.e., Reference iii).

Reference iii) identifies four locations with potential acid rock drainage mitigation concerns, none of which coincide with the location identified in Reference ii).

Request:

Please provide:

a) the required qualifications of the persons who will be conducting the visual assessment, whether and when they would be present during excavation, and how they will determine when sampling would be required;

b) a copy of the Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia; and

c) a reconciliation between the information on acid rock locations provided in References ii) and iii).

Response:

a) For potential acid generating (PAG) sites identified prior to construction, a professional geologist (P.Geo.) registered in the appropriate province and with experience in geochemistry will be on site to visually inspect materials and be responsible for delineating the PAG zone and PAG segregation. For previously unidentified PAG sites encountered during construction, Spread Foremen will be educated in recognizing oxidized/rusty staining

in excavation material or significant mineralization in rock. Upon recognition of such features, the professional geologist will be brought on site to visually inspect materials, undertake sampling if necessary, and be responsible for delineating the PAG zone and PAG segregation. Sampling would be undertaken in accordance with recommended practice in the "Guidelines for Metal Leaching and Acid Rock Drainage at Mine Sites in British Columbia", which is provided as Attachment 1 to the response to NEB IR No. 1.78b (NEB IR No. 1.78b – Attachment 1).

Reference:

Price, William A. and Errington, John C., Ministry of Energy and Mines. 1998. Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia.

b) The reference is provided in NEB IR No. 1.78b - Attachment 1.

c) Trans Mountain has determined that the reference kilometre (RK) values it provided in Acid Rock Drainage and Metal Leaching Potential, Table 5-1, Reference iii), are incorrectly labelled and refer to the existing Trans Mountain Pipeline (TMPL) kilometre post (KP) values. Please see attached a revised report with the correct RK values (NEB IR No. 1.78c – Attachment 1).

Reference ii) provides a preliminary list of geohazards along the proposed pipeline corridor.

When the lists of potential acid generating (PAG) locations were generated, one such (PAG) location was indicated based on office studies (principally, in this case, of geologic maps and mineral claim filings). Reference iii) provides results of more detailed field identification, sampling and laboratory testing of PAG sites along the corridor.

The site identified in Reference ii), RK 696, was also identified as a PAG location in Reference iii) as Site 019A.

The field program also indicated another three PAG sites in addition to RK 696, originally identified. The preliminary geohazard list in Reference ii) will be superceded by the Geohazard Assessment referred to in NEB IR No. 1.79 and the Geohazard Assessment will include the four PAG sites identified in Reference iii).

Reference:

Revision 1 of the of the Acid Rock Drainage and Metal Leaching Potential report dated 23 April, 2014 is attached to replace reference iii) A3S1T3.

1.79 Geohazard assessment

Reference:

i) A3S4V5, Application Volume 7, Risk Assessment and Management of Pipeline Facility Spills, PDF page 41 of 84
ii) A3S4V7, Application Volume 7, Risk Assessment and Management of Pipeline Facility Spills, Appendix A – Threat Assessment Report, PDF page 31 of 60

Preamble:

Reference i) states that, for the Project's geohazard assessment, factors related to frequency and vulnerability will be evaluated using expert judgement and applied in a probabilistic framework.

Reference ii) states that geotechnical/hydrological forces are typically associated with site-specific threats, such as subsidence, earth movement, seismic activity, floods, stream erosion, and rock fall. In order to assess the degree of threat that a pipeline will be exposed to, a thorough evaluation of all information along the length of the pipeline must be completed. It further states that the gathering of this information is ongoing and further information will be made available in time for the quantitative risk assessment. Mitigation plans will be incorporated into the detailed design.

Request:

Please provide:

a) an indication of when the geohazard assessment will be complete; and

b) a copy of the geohazard assessment upon completion.

Response:

a) Geohazard assessment will be iterative and ongoing throughout detailed design as additional site specific information on individual geohazard sites are investigated. A preliminary geohazard assessment is currently being completed and will be provided in Q3 2014 as part of the risk assessment on Line 2 referred to in NEB IR No. 1.81a.

b) Preliminary geohazard assessment to be provided as part of the risk assessment on Line 2 cited in response to NEB IR No. 1.81a.

Summary of New Commitments:

- A preliminary geohazard assessment is currently being completed and will be provided in Q3 2014.
- Preliminary geohazard assessment to be provided as part of the risk assessment on Line 2 cited in response to NEB IR No. 1.81a.

1.80 Watercourse crossing methods – horizontal directional drilling

Reference:

A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering:

i) PDF page 43 of 110
ii) PDF page 46 of 110
iii) CSA Z662-11, Clause 6.2.11

Preamble:

Reference i) states that:

- extensive geotechnical investigations are required to determine the feasibility of using horizontal directional drilling at selected water course crossings;
- bored crossings may be used in some instances and are typically limited to 100 m in length;
- a contingency isolated or open cut crossing method would be developed for use if the horizontal directional drilling method is determined to be not feasible, or if it is unsuccessful;
- micro-tunnelling will be considered for watercourse crossings where a horizontal directional drilling crossing is not feasible, and where fisheries and other considerations preclude a trenched crossing; and
- tunnelling and aerial crossings are also discussed briefly in the Project application, although no locations have been identified for their use. Trans Mountain stated that the need for tunnels would be determined during the detailed engineering and design phase.

Reference ii) states that 84 watercourse crossings were evaluated for the technical feasibility of using horizontal directional drilling. It also states that one or two boreholes were drilled where permits were received, and that geophysical surveys were completed for about half of the crossings evaluated. Horizontal directional drilling feasibility assessments will be submitted in the second quarter of 2014 and additional geotechnical and geophysical investigations will be carried out during the detailed engineering and design phase. Trans Mountain submits that early assessments indicate that the horizontal directional drilling crossing technique may be feasible for 21 major watercourses.

Reference iii) establishes the requirements for installing piping with horizontal directional drilling.

Request:

Please provide:

a) an indication of whether tunnelling and aerial crossings are currently being considered and, if so, at what locations;

b) a preliminary feasibility report for each proposed horizontal directional drilling crossing detailing the assessment that was completed to determine that horizontal directional drilling could be successfully completed;

c) a description of the contingency plan to be followed at each crossing if the horizontal directional drilling is not successful;

d) a horizontal directional drilling execution plan according to Reference iii); and

e) an indication of when final horizontal directional drilling technical feasibility studies will be available for all crossings where horizontal directional drilling would be attempted.

Response:

a) Tunnelling and aerial crossings for watercourse crossings are currently not being considered.

b) Trans Mountain will provide to the NEB feasibility reports for the horizontal directional drill (HDD) of five watercourse crossings by June 16, 2014.

c) Trans Mountain will provide to the NEB a contingency plan for each watercourse crossing where an HDD will be attempted, along with the feasibility reports referenced in NEB IR No. 1.80b, by June 16, 2014.

d) During the detailed engineering and design phase, Trans Mountain will develop a horizontal direction drill specification and provide it to the NEB by September 30, 2014. An HDD execution plan is generally crossing specific and will not be available until just prior to construction of the crossing.

e) Trans Mountain plans to undertake field geotechnical investigations in summer/fall 2014 for the remaining 16 of 21 watercourse crossings where horizontal direction drills (HDDs) are currently being contemplated. The feasibility reports for watercourse crossings determined to be feasible using HDD will be provided to the NEB as they are completed, with the final one to be submitted prior to the end of Q1 2015.

Trans Mountain may identify additional watercourse crossings during the detailed engineering and design phase of the Project that will be installed using trenchless methods. In those cases, the feasibility reports will be completed and provided to the NEB 60 days prior to the commencement of construction of each crossing.

Summary of New Commitments:

- Trans Mountain will provide to the NEB feasibility reports for the horizontal directional drill of five watercourse crossings, by June 16, 2014.
- Trans Mountain will provide to the NEB a contingency plan for each watercourse crossing where a horizontal directional drill will be attempted, along with the feasibility reports referenced in NEB IR No. 1.80b, by June 16, 2014.
- During the detailed engineering and design phase, Trans Mountain will develop a horizontal direction drill specification and provide it to the NEB by September 30, 2014.
- Trans Mountain will provide to the NEB feasibility reports for the remaining 16 of 21 watercourse crossings where horizontal directional drills are currently being

contemplated as they are completed, with final one to be submitted prior to the end of Q1 2015.

- Trans Mountain may identify additional watercourse crossings during the detailed engineering and design phase of the Project that will be installed using trenchless methods. In those cases, the feasibility reports will be completed and provided to the NEB 60 days prior to the commencement of construction of each crossing.

1.81 Pipe wall thickness

Reference:

i) A3S0Y8, Application Volume 4A, Project Design and Execution, PDF page 51 of 110
ii) A3S0Z5, Application Volume 4A, Project Design and Execution, Appendix D – Tables, Table 5.1.8 – Preliminary Pipe Wall Thicknesses, PDF page 16 of 93

Preamble:

Reference i) states that a risk assessment will be undertaken and it is expected that heavier wall pipe will be specified at specific locations, such as at highway and road crossings and larger watercourse crossings, and for some areas designated as high consequence areas. The wall thickness at proposed horizontal directional drilling crossings will be determined through stress analysis to comply with maximum stresses allowed for in CSA Z662.

Reference ii) outlines preliminary pipe wall thicknesses for three applications of the two proposed pipe outside diameters (914 mm from Edmonton to Burnaby, and 762 mm from Burnaby to Westridge). The three applications are: 1) mainline pipeline, 2) road crossings and watercourse crossings, and 3) horizontal directional drilling crossings and uncased railway crossings.

Request:

Please provide:

a) an indication of when the risk assessment referred to in Reference i) will be completed; and

b) a risk ranking for the various pipe wall thicknesses for the new pipeline segments upon completion of the risk ranking.

Response:

a) The risk assessment cited in Reference i) will be submitted to the NEB in Q3 2014.

b) The risk ranking for the various wall thicknesses for the new pipeline segments will be provided upon completion of the risk assessment in Q3 2014.

Summary of New Commitments:

- Trans Mountain will submit to the NEB the completed risk assessment for Line 2 in Q3 2014.
- Trans Mountain will provide a risk ranking for the various wall thicknesses for the new pipeline segments in Q3 2014.

1.82 Seismic design (pipelines and facilities)

Reference:

A3S1F6, Application Volume 4A, Project Design and Execution – Engineering, Appendix J – Seismic Assessment Desktop Study Report:

i) PDF page 19 of 112
ii) Executive Summary, PDF page 4 of 112

Preamble:

Reference i) states that the desktop study is a preliminary seismic hazard assessment for the proposed pipeline corridor and does not specifically address hazards or foundation conditions for pump stations, valves, storage facilities, terminals, or other related facilities. The study involved no sub-surface investigations or detailed analyses using site-specific data. The purpose of the study is to identify potential seismic hazards and prioritize detailed seismic assessment studies.

Reference ii) states that the liquefaction and landslide hazard maps are based on conservative assumptions, and are intended to guide detailed site investigation efforts. The actual risk of liquefaction or landsliding at any given site depends on ground conditions and other site-specific criteria.

Request:

Please provide:

a) an indication of when the detailed seismic assessment studies will be completed for the pipeline corridor and facilities, including pump stations, valves, storage facilities, terminals, and other related facilities; and

b) copies of all detailed seismic assessment studies, upon completion.

Response:

a) Trans Mountain will initiate detailed seismic assessment studies for the pipeline corridor inclusive of pipeline block valve sites in summer 2014, as part of engineering and detailed design, and the studies will continue as pipeline centreline and detailed design is advanced, in 2015. Trans Mountain will also conduct geotechnical field programs at the pump stations and terminals in Q2 and Q3, 2014. The geotechnical reports, which will include a variety of design recommendations, including those related to seismic considerations, will inform the detailed design work that will take place in 2015.

   Trans Mountain estimates that these studies will be completed in Q1 2015.

b) Trans Mountain will provide the detailed seismic assessment studies of pipeline corridor and geotechnical assessments of terminals and pump station once they are completed.

Summary of New Commitments:

- Trans Mountain will submit to the NEB the detailed seismic report for pipeline corridor and geotechnical reports for the terminals and pump stations by March 31, 2015.
- Trans Mountain will provide the detailed seismic assessment studies of pipeline corridor and geotechnical assessments of terminals and pump station once they are completed and prior to March 31, 2015 as per response to NEB IR No. 1.82a.

1.83 Foreign crossings

Reference:

i) A3S0Y8 Application Volume 4A, Project Design and Execution – Engineering, PDF page 36 of 110

ii) A3S0Z5 Application Volume 4A, Project Design and Execution – Engineering, Appendix D – Tables, Tables 5.1.14 to 5.1.17, PDF pages 39 to 92 of 93

Preamble:

In Reference i), Trans Mountain states that the primary element assessed by the routing specialists was constructability, and that other factors were considered as well.

Reference ii) provides lists of highway, road and rail crossings, foreign pipeline crossings, overhead power lines, and buried cables and utilities. The Board notes that a total of more than 2,700 linear crossings are listed (approximately 2.5 per kilometre).

Request:

Please provide:

a) how these crossings were considered in the route selection, scheduling, and feasibility of the Project; and

b) what special measures, if any, are being planned to address any issues related to the density and number of crossings, including:
   b.1) safety;
   b.2) traffic congestion; and
   b.3) interruption of communication and utility services.

Response:

a) As outlined in Volume 4A, Section 2.8.1, the primary routing criteria was to locate the proposed pipeline corridor on or adjacent to the existing Trans Mountain Pipeline (TMPL) easement or, failing that, adjacent to other linear infrastructure. The second criterion was to locate the proposed pipeline adjacent to existing easements or right-of-way of other linear facilities. For all routing criteria, constructability is essential.

   The route selection process used by Trans Mountain was designed to minimize the number of utility and linear infrastructure crossings. Since the TMPL was originally constructed, other linear infrastructure has been constructed adjacent to the TMPL in many locations within the Hargreaves to Bridal Veil Falls transportation corridor; this infrastructure includes highways, foreign pipelines, high voltage overhead powerlines, buried utilities and, to a lesser extent, roads. This infrastructure development, coupled with the very steep terrain and watercourses through the corridor, have increased the density of crossings and resulted in unavoidable crossings by the TMEP. In urban areas on the Lower Mainland, there is ongoing optimization of the proposed pipeline corridor to minimize crossing impacts.

Additional design and constructability issues associated with crossing linear features can be technically challenging, time consuming and costly. These factors have been taken into account in Project feasibility assessments.

Additional complexity associated with such crossings are also accounted for in the scheduling of construction activities, which may include the use of more complex crossing methodologies such as boring or horizontal directional drilling, activities which generally take longer to complete.

b.1) Trans Mountain will carefully assess each crossing during the detailed engineering and design phase of the Project to determine the existence of potential hazards, and incorporate designs to mitigate the hazards to the extent possible. In accordance with the Trans Mountain Expansion Project Safety Management Plan, the Construction Contractor will complete Risk Assessments (RAs) and Project-Specific Safety Plans (PSSPs), which will include safety measures to mitigate the potential hazards.

b.2) For most cases, crossings of highways, roads and railways will involve boring under these features, with no effect on traffic. At crossings within or immediately adjacent to traffic of any kind, traffic control measures will be implemented in compliance with the requirements of local and provincial authorities having jurisdiction.

b.3) Trans Mountain currently anticipates there will be no interruption to communication or utility services during construction. In the unexpected event that such services require interruption, the interruption will be coordinated with the owner of the infrastructure to minimize the duration and, if required, a temporary replacement service will be provided during the construction period.

1.84 Corridor and route selection

Reference:

i) A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering, PDF page 38 of 110
ii) A3S1L4, Application Volume 5A, Environmental and Socio-Economic Assessment – Biophysical, PDF page 24 of 39

Preamble:

Reference i) states that additional landowner, stakeholder, environmental, socio-economic, geotechnical, and other information will come forward that will lead to improvements in the location of the pipeline corridor. It also states that the pipeline routing experts are continuing to refine the proposed 150 metre-wide corridor and narrow it down to a pipeline construction right-of-way.

Reference ii) states that, where corridor modifications occur, additional studies will be completed to confirm predictions and implement appropriate mitigation from the Environmental Protection Plans.

Request:

Please provide:

a) an updated listing and set of maps of all deviations from the route (as filed) that are currently being considered, including locations and status; and

b) an updated listing and set of maps identifying all facility locations, including facilities currently being considered that were not included in Trans Mountain's 16 December 2013 Project application.

Response:

a) Please refer to Table 1.40A-1 provided in the response to NEB IR No. 1.40a for a list of all deviations from the proposed pipeline corridor that are currently being considered by Trans Mountain.

   Please refer to the attached 1:50,000 scale corridor maps (NEB IR No. 1.84a – Attachment 1) that illustrate the deviations from the proposed pipeline corridor that are currently being considered by Trans Mountain.

b) The locations of all pump stations that will be on Line 1 and Line 2 after the completion of the proposed Project, referenced to pipeline kilometres, were identified in Table 3.3.4, Section 3.3.1, Volume 4A of the Application.

   An expanded version of Table 3.3.4 (Table 3.3.4R1) has been provided in NEB IR No. 1.84b – Attachment 1 to identify Global Positioning System (GPS) coordinates of the pump stations and references to the Route Maps provided in Appendix E, Volume 4A of the

Application. In addition, Figure 1.84B-1 has been provided in NEB IR No. 1.84b – Attachment 2 to show the location of Jasper Pump Station, which will have minor modifications made.

All Line 2 pump stations (except for Black Pines) will be co-located with existing pump stations. Black Pines Pump Station will be at a new site and will serve both Line 1 and Line 2. The exact GPS coordinates of the new Line 2 pump stations will not be known until the detailed engineering and design phase is partially complete in Q1 2015. The coordinates given in Table 3.3.4R1 for the Line 2 pump stations are approximate. No coordinates for Black Pines Pump Station have been provided as several sites in the general area are being considered. The Route Map which includes the general area under consideration for Black Pines Pump Station shows an approximate location.

1.85 Route physiography and hydrology

Reference:

i) A56000, Application Volume 4A, Project Design and Execution – Engineering, Appendix I – Route Physiography and Hydrology Report (in its entirety)
ii) A3S1D8, Application Volume 4A, Project Design and Execution – Engineering, Appendix I – Route Physiography and Hydrology Report, PDF page 15 of 97

Preamble:

Reference i) is an office study by BGC Engineering Inc. that describes the physiography, topography, bedrock lithology, relevant geological history, surficial geology, and climate for each region or sub-region along the pipeline route. The Board notes that no site-specific field investigations were completed as part of this work and, as such, flood frequency estimations are limited to catchments with sufficient published data.

Reference ii) states that additional investigation and assessment would need to be carried out as part of detailed design.

Request:

Please provide:

a) an indication of when the field investigations will be completed and when flood frequency estimations will be available for the entire pipeline route; and

b) a copy of the information referred to in a) upon completion.

Response:

a) Field investigations and bathymetric surveys are scheduled to take place in summer and fall 2014. Flood frequency estimations on specific crossings along the entire pipeline route will be available in Q4 2014.

b) A copy of the information referred to in a) will be provided upon completion, which is anticipated to occur in Q4 2014.

Summary of New Commitments:

- Trans Mountain will submit to the NEB revised flood frequency estimations to Reference i) in Q4 2014.

1.86 Reactivation of pipeline segments

Reference:

A3S0Y9, Application Volume 4A, Project Design and Execution – Engineering:

i) PDF pages 23 and 24 of 35
ii) PDF page 24 of 35
iii) PDF page 32 of 35
iv) A3S1K5, Application Volume 4B, Project Design and Execution – Construction, PDF page 35 of 55
v) CSA Z662-11, Clause 3.3

Preamble:

Reference i) states that:

- a preliminary engineering assessment has been completed as a first step in satisfying the requirements of the OPR for reactivating the NPS 24 pipeline segment from Hinton, Alberta, to Hargreaves, British Columbia, and the NPS 24 pipeline segment from Darfield to Black Pines, British Columbia.
- the purpose of the preliminary engineering assessment is to document the integrity management status of the segments to be reactivated and the measures that Trans Mountain will employ to verify their integrity prior to reactivation.
- the preliminary engineering assessment will be updated to a final engineering assessment during the detailed engineering and design phase.

Reference ii) contains elements of the preliminary engineering assessment, including a description of the pipe and a history of hydrostatic tests and in-line inspections.

Reference iii) states that Trans Mountain is currently undertaking a risk assessment for the reactivation segments, which is expected to be complete in the second quarter of 2014. The updated engineering assessment report will include the results of the risk assessment.

Reference iv) provides a Preliminary Reactivation Schedule. Accordingly, in-line inspection tool runs, which will be used to assess the current condition of the proposed reactivated segments, are scheduled for September 2016.

Reference v) establishes the requirements to conduct an engineering assessment.

Request:

Please provide:

a) an approximate completion date for the final engineering assessment stated to be completed during the engineering and design phase;

b) a copy of the final engineering assessment, in accordance with Reference iv) to the Board upon completion;

c) a copy of the risk assessment for the proposed reactivated segments to the Board upon completion; and

d) a description of the potential contingency plan, should the engineering assessment demonstrate that the proposed reactivation of one or both pipeline segments cannot be implemented due to the magnitude and extent of the corrective measures necessary to make the pipe suitable for service, considering that the condition of the two pipeline segments is currently unknown and Trans Mountain's proposed timing for Project commissioning is late 2017.

Response:

a) The final engineering assessment is expected to be completed by the end of Q3 2014. Trans Mountain also commits to provide an updated engineering assessment that incorporates the results of the hydrostatic testing and the in-line inspection and repair program prior to reactivation of the pipeline segments.

b) Trans Mountain will provide a copy of the final engineering assessment to the NEB upon completion, by the end of Q3 2014.

c) As indicated in Annex B of CSA Z662-11, pipeline condition is a fundamental input to a risk analysis of an existing pipeline. The most effective means of obtaining a characterization of the condition of an existing pipeline is through integrity assessments, such as in-line inspections and hydrostatic testing. As outlined in the Application Volume 4A, Project Design and Execution – Engineering, Trans Mountain will complete in-line inspections of these segments using a high resolution metal loss tool, a high resolution axial flaw detection tool, and a high resolution geometry tool prior to reactivation of the Hinton to Hargreaves and the Darfield to Black Pines segments. The in-line inspections will be used to inform the inspection and repair program, and will be followed by a hydrostatic test.

   Recognizing that the above assessment information is essential to a quantitative estimation of failure likelihood, and in the absence of such current information at this time, Trans Mountain decided not to undertake a quantitative estimate of failure likelihood, but to complete a threat-based assessment. This will be further informed through outflow, overland and stream flow modeling (see response to NEB IR No. 1.97b) to provide an understanding of risk that evaluates both failure likelihood and consequences in the reactivation segments.

   In a threat-based assessment, the attributes for all potential threats to a pipeline system are reviewed in consideration of the status of the materials, design, construction, and operational variables that are associated with the pipeline system. Through this review, the relevance and severity of each threat can be assessed in the context of the operating environment for the pipeline being reviewed.

   The threat-based assessment is currently underway, and it is anticipated that it will be filed in Q3 2014. The timing of the outflow, overland and stream flow modeling analysis on the reactivation segments is addressed in the response to NEB IR No. 1.97b.

d) The pipeline segments were deactivated in anticipation of being reactivated for future service. The pipeline segments were purged of oil and a nitrogen blanket was maintained to prevent internal corrosion. In addition, pipeline protection systems including cathodic protection, natural hazards monitoring, and mechanical damage prevention programs were monitored and maintained.

Trans Mountain understands the threats to the reactivation segments and has experience in managing these threats on the currently active pipeline segments. Trans Mountain is confident that the proposed plan to complete integrity assessments and repair programs prior to the reactivation of the pipeline segments represents a reasonable and likely level of effort to correct deficiencies that may be found. Please see the response to NEB IR No. 1.86c for additional information on threats and risk associated with the reactivation sections.

Trans Mountain also has past experience with the reactivation of deactivated segments with the reactivation of the Edson to Hinton NPS 30 loop in the mid 1990's, and reactivation of the Darfield to Kamloops loop in 2003. The reactivations were successfully undertaken under a similar program of in-line inspection, repair, and hydrostatic testing and are currently operating today, which provides further confidence of the planned program's success.

Summary of New Commitments:

- Trans Mountain will submit to the NEB final engineering assessment by the end of Q3 2014.
- Trans Mountain will submit an updated engineering assessment incorporating the results of the hydrostatic testing and the in-line inspection and repair program prior to the reactivation of the pipeline segments.
- Trans Mountain will submit the final engineering assessment for the reactivation sections by the end of Q3 2014.
- Trans Mountain will file a Threat-Based Assessment for the reactivation segments in Q3 2014.

1.87 Change of operating conditions

Reference:

i) A3S0Q7, Application Volume 1, Summary, PDF page 67 of 113
ii) CSA Z662-11, Clause 3.3

Preamble:

Reference i) states that the new pipe segments and two existing active pipeline segments on Trans Mountain's system will be combined to create Line 2. The two existing active pipeline segments are:

- 151 kilometres long, 914 mm outside diameter (NPS 36), from Hinton, Alberta, to Hargreaves, British Columbia, built in 2008; and
- 43 kilometres long, 762 mm outside diameter (NPS 30), from Darfield to Black Pines, British Columbia, built in 1957.

Reference ii) establishes the requirements to conduct an engineering assessment.

The Board notes that little information has been provided in the Project application regarding this proposal, particularly information on how the two pipeline segments are fit for the intended service under the operating conditions of Line 2.

Request:

Please provide:

a) a list of other existing facilities that will be used on Line 2;

b) an engineering assessment, according to Reference ii), to demonstrate that both of the referenced pipeline segments identified on Reference i) will meet the same design conditions as Line 2, as well as the measures that Trans Mountain will employ to verify their integrity prior to the proposed change in operating conditions;

c) a risk assessment for both of the referenced pipeline segments, the results of which will also be included in updated engineering assessment referred to in b); and

d) A discussion of Trans Mountain's contingency plan, should the engineering assessment or the risk assessment demonstrate that the proposed change in operation of one or both pipeline segments is not feasible, considering Trans Mountain's proposed timing for Project construction and a late 2017 operation start-up date.

Response:

a) Table 1.87a-1 indicates existing facility equipment or systems that will be used on Line 2 after completion of the proposed Project. In some cases existing facility equipment or systems will be shared between Line 1 and Line 2. Where practical, Remote Main Line Block Valves (RMLBVs) for Line 2 will be co-located and share power, control, and communications infrastructure with the existing RMLBVs that will be used on Line 1.

TABLE 1.87A-1

EXISTING FACILITY EQUIPMENT OR SYSTEMS TO BE USED ON LINE 2

Station/Terminal	Moved to Line 2	Shared with Line 2
Edmonton		Backup power
Stony Plain		Main Line Block Valve (MLBV) power and control
Gainford		Substation, backup power
Chip		MLBV power and control
Wolf	Substation, electrical and control infrastructure	MLBV power and control
Edson		Backup power
Hinton		Substation
Jasper		MLBV power and control
Reargaurd		Substation, transformer (upgrade required), backup power
Albreda		MLBV power and control
Chappel		MLBV power and control
Blue River	Substation, electrical and control infrastructure	MLBV power and control
Finn		MLBV power and control
McMurphy		MLBV power and control
Blackpool		Substation, backup power
Darfield	Sending trap infrastructure	Electrical and control infrastructure to support sending trap infrastructure, MLBV power and control
Kamloops		Backup power, relief tank
Stump		MLBV power and control
Kingsvale		Backup power
Hope		Relief tank, MLBV power and control
Wahleach		MLBV power and control
Sumas		MLBV power and control
Sumas (Line 2 Take-off)		Relief tank, power and control
Burnaby		Control infrastructure

b) CSA Z662-11, Clause 3.3 identifies the requirements for completing an engineering assessment. The clause does not define under what conditions an engineering assessment is required for in-service pipeline segments. CSA Z662-11, Clauses 10.3.7 and 10.3.8 define the requirements to complete an engineering assessment for in-service pipelines

when there is a change in the service fluid or when upgrading to a higher maximum operating pressure.

Trans Mountain is not proposing to increase the licensed operating pressures on the referenced pipeline segments. The pipeline segments are currently licensed and currently transport heavy crude oil similar to the type that will be transported in Line 2 service. The pipeline segments are in active service and the integrity of the pipeline segments are managed and maintained in a fit for service condition. As a result Trans Mountain does not believe this meets the requirements for a change in service and has not completed an engineering assessment.

Trans Mountain understands that the NEB requires additional information to understand the current condition and risks associated with these pipeline segments. In that respect, please refer to the response to NEB IR No. 1.87c.

References:

CSA Z662-11, Clause 10.3.7

CSA Z662-11, Clause 10.3.8

c) The two existing active pipe segments that will be incorporated into Line 2 are currently being managed under Kinder Morgan Canada Inc.'s (KMC's) Integrity Management Program, and as such, they are subject to regular risk assessment under KMC's Risk Management Program for operating pipelines. This regular re-evaluation of risk is currently in progress on these segments, and the results will be made available in a supplemental filing in Q3 2014. There will be no pressure upgrade involved in the incorporation of the two existing active pipe segments into Line 2. Nevertheless, as with any operating pipeline, any change in operating condition (such as a change in throughput, which may influence potential outflow volume) will be reflected in the regular re-evaluation of risk.

d) The pipeline segments are currently active and the integrity of the pipeline segments are managed to maintain the fitness for service of the pipeline (refer to the response to NEB IR No. 1.87b. The changes proposed by Trans Mountain will not result in a change to the licensed operating pressures of the pipeline segments. The pipeline is currently shipping similar products to those proposed for Line 2 service.

   Changes that may occur that would impact the risks to the pipeline or the integrity and maintenance programs for these sections of line will continue to be assessed in accordance with existing operations risk assessment and integrity management processes and corrective actions will be taken as necessary to manage these risks.

Trans Mountain believes that the proposed change to Line 2 service will result in nominal impact. With the appropriate mitigations as described above, Trans Mountain believes these efforts represent a reasonable and likely level of effort to correct any deficiencies that may occur as a result of the reconfiguration of pipe segments to Line 2 service.

Summary of New Commitments:

- Submit the risk results for the two existing active pipe segments that will be incorporated into Line 2 using KMC's risk model for operating pipelines to the NEB in a supplemental filing in Q3 2014.

1.88 Reactivation of the Niton Pump Station

Reference:

i) A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering, PDF page 73 of 110

CSA Z662-11:

ii) Clause 2.2
iii) Clause 3.3
iv) Clause 10.15.2

Preamble:

Reference i) states that the Niton Pump Station, which has been deactivated since 2006, will be reactivated (on Line 1). Inspection and testing procedures will be developed to ensure that the station can be safely returned to service.

Reference ii) defines piping as a portion of a pipeline system, consisting of pipe or pipe and components.

Reference iii) establishes the requirements to conduct an engineering assessment.

Reference iv) states the requirements for the reactivation of piping.

Reference i) does not include an engineering assessment that demonstrates whether the Niton Pump Station would be suitable for its intended service as per Reference iv).

Request:

Please provide:

a) a list of other facilities that may be reactivated as a result of the proposed expansion, and engineering assessments for each facility demonstrating that the facility would be suitable for the intended service;

b) a Piping and Instrumentation Diagram showing how the Niton Pump Station was disconnected from Line 1 during its deactivation. The diagram must also show the proposed piping and equipment that will be reactivated;

c) a current copy of the engineering assessment, according to Reference iii), that fulfills the requirements of Reference iv); and

d) a document summarizing the last three integrity inspections carried out on below and above ground piping in the station. The summary must include, but not be limited to, inspection dates, components inspected, percentage of station piping inspected, coating type, findings, and mitigation measures (both planned and completed).

Response:

a) The only other facility components that Trans Mountain intends to reactivate, as part of the proposed Project, are two station isolation valves on the 609.6 mm (NPS 24) outside diameter existing line at Jasper Pump Station. Trans Mountain will complete an engineering assessment for reactivation of these isolation valves by June 2016, in sufficient time to replace the valves in the unlikely event that they are deemed unfit for service on Line 1.

b) Attachment 1.88b-1 (NEB IR No. 1.88b-Attachment1) includes a Piping & Instrumentation Diagram (NT00-GS1001) for Niton Pump Station, which shows how the pump station is isolated from the existing pipeline with blinds at the station suction valve (MOV 1060) and the station discharge check valve (adjacent to MOV 1063). The proposed piping and equipment to be reactivated is located on the pump station side of a) the station suction valve (MOV 1060) and b) the station discharge check valve (adjacent to MOV 1063). Re-activation of the Niton Pump Station will generally include (but not be limited to) the following activities:

- Inspection of the pumps, motors, and large diameter valves. Completion of any maintenance requirements identified during the inspections.
- Hydrostatic testing of the station piping.
- Connection of the sump tank pump out line to the pipeline.
- Flipping of the spectacle blinds at the pump station emergency shutdown valves (i.e. opening the station suction and discharge piping to the pipeline).
- Re-activation of the Uninterruptable Power Supply (UPS).
- Re-activation of the backup power generator.
- Re-activation of the Supervisory Control and Data Acquisition (SCADA) communications system.
- Re-commissioning of all existing mechanical, electrical, instrumentation, and control systems, as applicable, and in accordance with the equipment manufacturer's written recommendations and Trans Mountain and Kinder Morgan Canada (KMC) procedures.

c) Pursuant to NEB Draft Condition 16, Trans Mountain will complete an engineering assessment of Niton Pump Station in accordance with the requirements of Clauses 3.3 and 10.15.2 of CSA Z662-11. Any issues identified during this assessment will be addressed, prior to reactivation, to ensure that the station is suitable for its intended operation on Line 1.

d) Above ground facility piping inspections are performed routinely by Kinder Morgan Canada (KMC) personnel as part of KMC's Facility Integrity Management Program (FIMP). The frequency and scope of these inspections varies from weekly to annually depending on the inspection procedure requirements. The most recent three inspections at Niton Pump Station occurred on March 24, 2014, March 27, 2014, and March 31, 2014. The scope of these inspections included a visual check of above ground facility piping and equipment. These inspections identified no findings requiring mitigation.

Annual facility piping visual inspections are more detailed and include the following:

- condition of coating;

- evidence of pipe corrosion or damage;
- condition of pipe insulation;
- checks for sags in pipe spans;
- checks for signs of piping vibration or movement;
- spot checks of pipe in insulated segments;
- checks of all flanged connections including fasteners;
- checks of all branch connections (welded or threaded); and
- checks of all elements associated with pipe support structures and systems.

Annual facility piping inspections were completed at Niton Pump Station in 2012 and 2013 and no mitigation work resulted from these inspections.

Below ground piping at Niton Pump Station has not been inspected; however, all the Niton Pump Station piping is isolated and drained of process fluids. A comprehensive assessment of all the above and below ground piping at Niton Pump Station will be completed to support the engineering assessment referenced in the response to NEB IR 1.88c.

Summary of New Commitments:

- Trans Mountain will complete an engineering assessment for the reactivation of two isolation valves at Jasper Pump Station by June 2016, in sufficient time to replace the valves in the unlikely event that they are deemed unfit for service on Line 1.
- Pursuant to NEB Draft Condition 16, Trans Mountain will complete an engineering assessment of Niton Pump Station in accordance with the requirements of Clauses 3.3 and 10.15.2 of CSA Z662-11. Any issues identified during this assessment will be addressed, prior to reactivation, to ensure that the station is suitable for its intended operation on Line 1.

1.89 Reactivation of the segment from Hinton to Hargreaves

Reference:

A3S0Y9, Application Volume 4A, Project Design and Execution – Engineering:

i) PDF page 25 of 35
ii) PDF page 26 of 35

Preamble:

Reference i) states that the initial post-construction hydrostatic test for the Hinton to Hargreaves segment took place in 1953. This segment was initially tested in three sections. The test pressures ranged from 83 to 91.5 per cent of the specified minimum yield strength (SMYS) at the low points. No failures occurred as a result of these initial tests. Additional hydrostatic testing of the pipeline occurred in eight sections between 1964 through 1998, with a test pressure ranging between 88 and 101.8 per cent of the SMYS. Three failures occurred in the 1965 hydrostatic test to 100 per cent of the SMYS. No failures occurred in the other seven tests.

Reference ii) states that the Hinton to Hargreaves segment has been inspected with the following high resolution in-line inspection tools:

- 1998 – Pipetronix WM Ultrasonic Metal Loss;
- 2001 – BJ GEOPIG (High Resolution Geometry);
- 2007 – BJ Vectra (High Resolution Metal Loss); and
- 2007 – GE UltraScan Crack Detection (High Resolution Crack Detection).

Request:

Please provide:

a) the hydrostatic test pressure at the lowest point on each test held between 1964 through 1998;

b) the cause of the three hydrostatic test failures that occurred in 1965;

c) the mitigation measures taken after the three hydrostatic test failures occurred in 1965; and

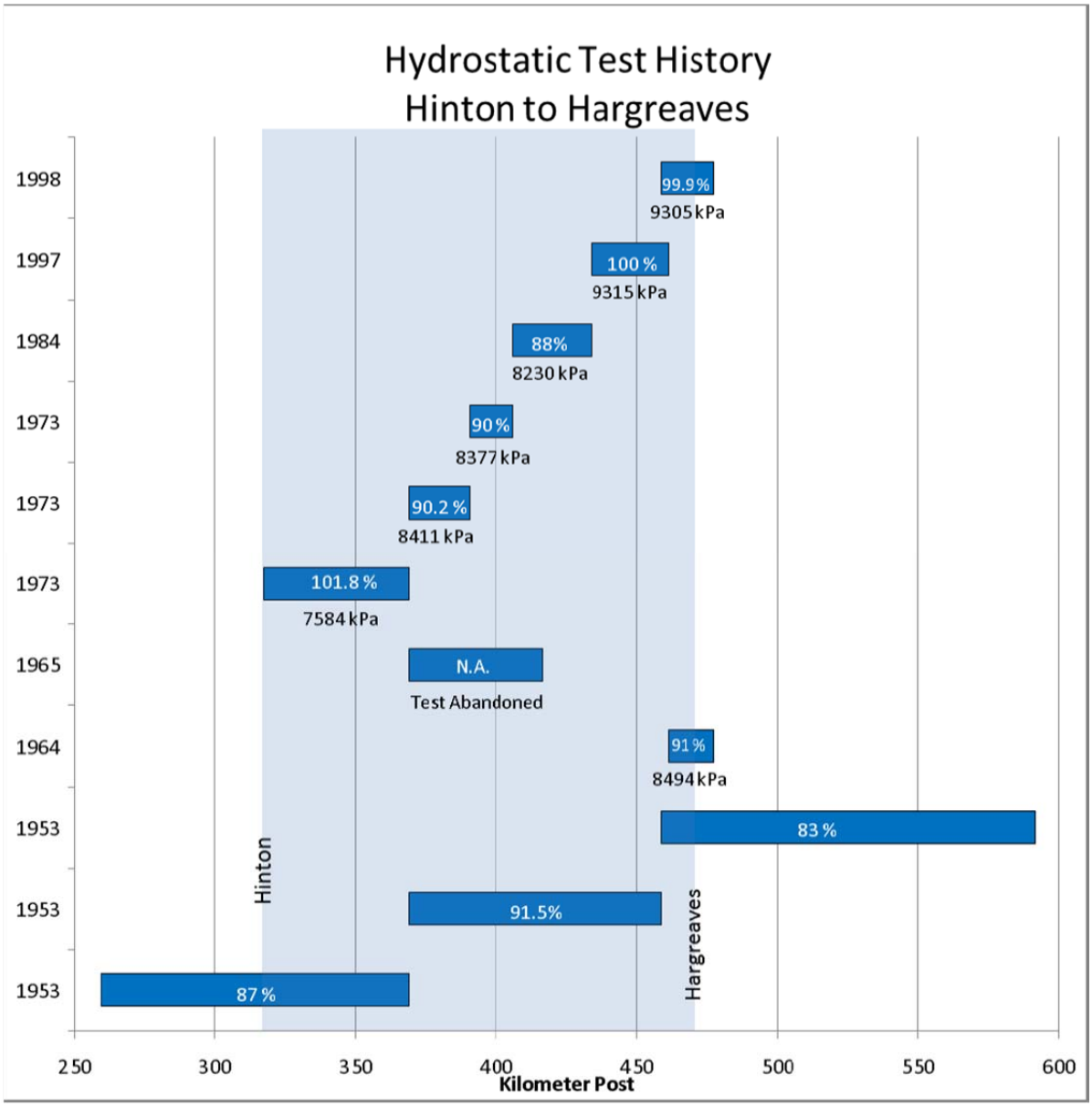
d) conclusions made from data integration of the two (i.e., 1998 and 2007) metal loss in-line inspection results, or the rationale for not integrating the metal loss in-line inspection results.

Response:

a) The Application (Volume 4A, Section 3.6.3.5) incorrectly identified that the 1964 and 1965 hydrostatic tests were completed to 100% SMYS. The 1964 hydrostatic test was completed to 91% SMYS. The 1965 test was abandoned following the third failure.

   Figure 3.6.1 has been modified to correct the errors in the Application (Figure 1.89A-1). The figure has also been modified to include the pressure achieved at the highest stress location in the test section between 1964 and 1998, indicated in kPa below each test segment.

Figure 1.89A-1 Hydrostatic Testing History – Hinton to Hargreaves



b) All three failures were attributed to damage to the pipe wall during initial construction.

c) In 1973 Trans Mountain successfully completed hydrostatic tests in the section of line that failed during the 1965 hydrostatic test. Please see the response to NEB IR No. 1.89a for information on the hydrostatic tests.

In the early 1970s low resolution metal loss inspection technology became available for use on pipeline systems. Trans Mountain began inspections using this technology in the pipeline system starting in 1974. In 1975 the pipeline segments that had experienced the hydrostatic test failures were inspected using this technology. Inspections with high resolution tools began in 1998 as described in Volume 4A, Section 3.6.3.6 of the Application.

d) The report for the 2007 metal loss inspection was received in March of 2008. The nitrogen purge of the Hinton to Hargreaves pipeline segment was scheduled to begin in April of 2008. With the line segment being deactivated, the risk associated with this pipe segment was considered low and the data integration that would normally be done in preparation of a dig program was not completed.

During the proposed inspection and repair program to support the Engineering Assessment of the reactivation of this segment, Trans Mountain will integrate the new inspection data with the 1998 and 2007 inspection data to estimate the corrosion growth rates and to assess potentially interacting features.

Further integration will be completed during the time dependent cracking assessment that will be completed within the first two years of operation.

Summary of New Commitments:

- Trans Mountain will commit to complete integration of all inspection data sets with the final integration to be complete within the first two years of operation or following completion of the dig program for the crack inspection.

1.90 Reactivation of the segment from Hinton to Hargreaves

Reference:

A3S0Y9, Application Volume 4A, Project Design and Execution – Engineering, PDF page 27 of 35

Preamble:

The reference states that:

- off-potentials along the Hinton to Hargreaves segment are generally good with test station readings showing that the minimum target of -850 mV is being maintained with the exception of a few locations.
- test station readings in 2012 showed that low readings occurred between kilometre post (KP) 370 and KP 380, KP 407 and KP 408, and KP 455 and KP 465. As part of Trans Mountain's cathodic protection maintenance program, Trans Mountain is reviewing the protection at these locations to determine whether adjustments or modifications to the cathodic protection system are required.

Request:

Please provide:

a) the reasons for not reaching required cathodic protection levels in a few locations, as identified in the reference; and

b) a mitigation plan for the KPs with a reading less than -850 mV, as identified in the reference.

Response:

a) In 2013, Kinder Morgan Canada Inc. (KMC) completed a depolarized survey in the area of the low cathodic protection readings to determine if the test leads met the minimum 100 mV shift criteria as per CGA OCC-1, 2013 Control of External Corrosion on Buried or Submerged Metallic Piping Systems, Appendix B. KMC was able to verify appropriate cathodic protection using the CGA OCC-1 criteria at KP 370 to KP 380 and KP 407 to KP 408. KMC was unable to verify polarization at KP 464.857 and KP 464.882. A previous attempt to increase the potentials at this location in 2010 by installing a remote groundbed 4km upstream was not successful. The reasons for not reaching the target cathodic protection level remains under investigation and is included in the 2014 maintenance program (see NEB IR No. 1.90b).

Reference:

CGA OCC-1, 2013 Control of External Corrosion on Buried or Submerged Metallic Piping Systems, Appendix B

b) The mitigation plan for the KPs with a reading less than -850mV is as follows:

1. In the spring of 2014 further testing will be completed by increasing the current output of nearby rectifiers. Polarization at the area of the low readings will be measured.
2. If 100mV of polarization is still not met at the area of the low readings then further diagnostic testing will commence and a groundbed will be designed to increase the potentials to an acceptable level.

1.91 Valve locations

Reference:

i) A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering, PDF page 52 of 110
ii) A3S0Y9, Application Volume 4A, Project Design and Execution – Engineering, PDF pages 17 and 18 of 35
iii) CSA Z662-11, Clause 4.4.3

Preamble:

Reference i) states that:

- the proposed locations of remote mainline block valves (RMLBVs) – i.e., those mainline block valves (MLBVs) not located at pump stations – will initially be determined in accordance with CSA Z662-11, Clause 4.4 – Valve Location and Spacing.
- to limit the consequences associated with a pipeline leak or rupture, the following additional factors will also be considered in selecting the proposed RMLBV locations: topography, the location of environmentally sensitive features and terrain, population density, accessibility of electrical power, maintenance flexibility, release volume analyses, release volume dispersion modelling, and the risks to high consequence areas.

Reference ii) states that:

- Line 1 will have 24 MLBVs located at the existing and new pump stations and at the existing terminals. Some of these sites will also have check valves, and some MLBVs (i.e., where there are traps) may be combinations of multiple valves.
- Line 2 will have 12 MLBVs (11 with associated check valves) located at the new Line 2 pump stations and at the existing terminals. Some of these MLBVs (i.e., where there are traps) may be combinations of multiple valves. There will also be one MLBV at Burnaby Terminal (with an associated check valve) and one MLBV at the Westridge Marine Terminal on each of the Burnaby to Westridge Marine Terminal pipelines.

Reference iii) states that a company shall perform an engineering assessment to determine the number and spacing of sectionalizing valves to be installed.

Request:

Please provide the engineering assessments undertaken by Trans Mountain to determine the valve spacing for Line 1, Line 2, the existing delivery line and the two proposed delivery lines from Burnaby Terminal to the Westridge Marine Terminal.

Response:

CSA Z662 clause 4.4.3 advocates an engineering assessment for isolation valve spacing, or alternatively references clause 4.4.4, which provides valve spacing recommendations in accordance with table 4.7. Table 4.7 indicates that minimum valve spacing for a Low Vapour Pressure (LVP) pipeline is not required (NR).

The preliminary valve locations for Line 2 and the two proposed delivery lines from Burnaby to Westridge terminal were based on practical considerations such as co-location of pre-existing valve sites on adjacent pipelines, accessibility, and site suitability for construction and operations. As a form of Engineering Assessment, Trans Mountain is committed to and undertaking a risk based design for Line 2 segments, as the risk level is sensitive to valve location and spacing, and it is through the iterative risk based design process that final valve site locations will be established.

For the reactivated segments of Hinton to Hargreaves and Darfield to Black Pines, as well as the existing operating pipelines between these stations, a separate valve optimization analysis will be performed based on outflow analysis, and overland and stream flow modeling. The outflow analysis, and overland and stream flow modeling will be completed by Q3 2014. See also response to NEB IR No. 1.86c and 1.97b.

Summary of New Commitments:

- Trans Mountain will submit overland and stream flow models for the Hinton to Hargreaves and Darfield to Black Pines (both the reactivated sections as well as the pre-existing operating pipelines) in Q3 2014.

1.92 Pipeline system map

Reference:

i) A3S0Z2, Application Volume 4A, Project Design and Execution – Engineering, Appendix A – Configuration Map and Schematics, Map 5.1.1 – Project Configuration Map and System Schematics, PDF page 3 of 11
ii) A3S4V5, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills, PDF page 42 of 84

Preamble:

Reference i) shows the Project configuration map and system schematics, including two inactive segments from Edson to Hinton, Alberta, and from Black Pines to Kamloops, British Columbia.

Reference ii) states that:

- as part of Kinder Morgan Canada's ongoing operations risk management program, high consequence areas (HCAs) along the existing pipeline corridor have been previously identified and mapped. The reference to HCAs is an adaption of the United States Department of Transportation Pipeline and Hazardous Material Safety Administration (PHMSA) safety regulations, which use the concept of HCAs to identify specific locales and areas where a release could have the most significant adverse consequences.
- Portions of the new pipeline will be located in areas which, if a release were to occur, would have elevated consequences due to land use or location with respect to water bodies, such as rivers, streams, and lakes. These are defined as HCAs, which include the following:
  - national, provincial, or regional parks;
  - watercourses, and, in particular, those deemed to be sensitive due to the presence of fish habitat or fish populations;
  - high population areas that contain 50,000 or more people and have a population density of at least 1,000 people per square mile;
  - other populated areas that contain a concentrated population, such as an incorporated or unincorporated city, town, village, or other designated residential or commercial area;
  - First Nation lands;
  - an area which contains drinking water sources or an aquifer that could be impacted by a release; and
  - other environmentally sensitive areas, such as ecological reserves.

Request:

Please provide:

a) the definition of the term "Existing Pipeline – Inactive" as shown in Reference i);

b) two maps of the Project (showing Line 1, Line 2, the proposed and existing delivery lines, proposed and existing facilities, valves, power lines, and proposed right-of-way) with kilometre posts, at a scale of 1:250,000, with the following information:
   b.1) Map 1: to show HCAs provided in Reference ii) or updated HCAs; and

b.2) Map 2: to show areas of geotechnical and seismic hazards, and water crossings;

c) the rationale for defining high population areas for the proposed Project as areas with 50,000 or more people and a population density of at least 1,000 people per square mile; and

d) clarification on Trans Mountain's definition of HCA, as stated in Reference ii), and whether *other areas*, such as shorelines, the Pacific Ocean, lakes, recreational areas, campgrounds, among others, form part of that definition.
   d.1) If *other areas* were included in the definition of HCA, provide the rationale for doing so, as well as a revised definition of HCA including these *other areas*.
   d.2) If *other areas* were not included in the definition of HCA, provide a rationale.

Response:

a) "Existing Pipeline – Inactive" identified in Trans Mountain Expansion Project Configuration Map 5.1.1 in Reference i) are two segments of 24" pipeline that had previously been deactivated and will remain deactivated following the Project.

b) The two new map sets requested involve 11 maps per set. The datasets for the map sets are currently being updated to reflect updated information (i.e. geohazards, HCAs, etc.) for the proposed pipeline corridor, which has been changed in a few areas since the Application was filed in December 2013. Updated route maps have been submitted to the NEB in response to NEB IR No. 1.84. Trans Mountain will submit to the NEB the requested two new map sets by June 16, 2014 reflecting up to date information for the proposed pipeline corridor and any revisions to the proposed pipeline corridor since the Application was filed.

c) The definition of a high population area comes from the U.S. Pipeline and Hazardous Materials Safety Administration (PHMSA), Hazardous Liquid Integrity Management Enforcement Guidance CFR Sections 195.450 and 195.452.

   A high population area is an urbanized area as defined and delineated by the Census Bureau, that contains 50,000 or more people and has a population density of at least 1,000 people per square mile (386 people per square km).

   Trans Mountain adopted the above population density definition for use in Canada.

d) For the purpose of the risk assessment, High Consequence Areas (HCAs) include shorelines (as part of watercourses), lakes and the shorelines of lakes with fish habitat (as part of watercourses and ecological reserves HCAs), recreational areas and campgrounds if they are of regional significance (i.e., national, provincial, and regional parks).

Summary of New Commitments:

- Trans Mountain to submit to the NEB by June 16, 2014, Map 1 Set: to show HCAs provided in Reference ii) or updated HCAs
- Trans Mountain to submit to the NEB by June 16, 2014, Map 2 Set: to show areas of geotechnical and seismic hazards, and water crossings

1.93 Capacity

Reference:

A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering:

i) PDF page 31 of 110
ii) PDF pages 47 and 48 of 110
iii) A3S0Z0, Application Volume 4A, Project Design and Execution – Engineering, PDF page 5 of 7
iv) A3S0Q7, Application Volume 1, Summary, PDF pages 27 to 29 of 113

Preamble:

Reference i) states that the expanded Line 1 pipeline will be capable of transporting an annual average of 55,640 cubic metres per day (m^3/d) [350,000 bbl/d] and will provide a batched transportation service for refined products and light crude oils. Line 1 will also be capable of transporting heavy crude oil at a reduced rate.

Reference ii) states that:

- Line 2 has been designed so that it will have a sustainable annual average pipeline capacity of approximately 85,850 m^3/d (540,000 bbl/d), based on an assumed slate of heavy crude oils. Line 2 will also be capable of transporting light crude oils, if necessary.
- the availability factor for the Project has been selected as 0.95 for preliminary design purposes, but may be revised during the detailed engineering and design phase after considering a number of reliability and operating parameters. In the final design, the availability factors are not expected to be less than 0.90 for either pipeline.
- Based on the 0.95 availability factor, the design flow rates (i.e., maximum design throughput) for Line 1 and Line 2 are 58,570 m^3/d (368,400 bbl/d) and 90,370 m^3/d (568,400 bbl/d), respectively.

Reference iii) states that batches of oil destined for the Westridge Marine Terminal will be collected in the storage tanks at Burnaby Terminal and delivered via two new 762.0 mm (NPS 30) outside diameter pipelines and the existing 609.6 mm (NPS 24) outside diameter pipeline. Each pipeline will have a capacity of 4,635 m^3/hour (700,000 bbl/d), except that the existing line will only be capable of this flow rate when delivering light oil.

Reference iv) states that, since its completion in 1953, various modifications have been made to Trans Mountain's system to add throughput capacity and facilities in order to respond to growing demand and changing shipper needs. As a result, between 1957 and 2013, the capacity of the system gradually increased from 150,000 bbl/d to 300,000 bbl/d.

Reference iv) also provides the Project scope.

Request:

Please provide:

a) the properties of crude oils that Trans Mountain plans to transport in Line 1 and in the existing delivery line after completing the Project;

b) the annual average capacities of Line 1 and the existing delivery line, after completing the Project, if the lines transport:
   b.1) heavy crude oil; and
   b.2) batched heavy crude oil with lighter products;

c) the following information on the existing 609.6 mm (NPS 24) outside diameter delivery line:
   c.1) construction year;
   c.2) design flow rate (i.e., design capacity); and
   c.3) current annual average capacity;

d) the following information on the two proposed 762.0 mm (NPS 30) outside diameter delivery lines:
   d.1) design flow rate (i.e., design capacity); and
   d.2) annual average capacity;

e) the following information on Line 1:
   e.1) design flow rate at the time when the line was built (i.e., original design flow rate);
   e.2) copies of any engineering report(s) or a study(ies) to support the response to e.1); and
   e.3) if the original design flow rate is less than the proposed 58,570 m^3/d (368,400 bbl/d) design flow rate provided in Reference ii), explain why only the sections to be reactivated are in the Project scope instead of the entire Line 1;

f) a list of Project-specific reliability and operation parameters that will be considered for revising the availability factor;

g) a description on how the parameters provided in f) would affect the availability factor for each pipeline (i.e., Line 1 and Line 2);

h) an explanation of the impact on the Project should the availability factor be changed to 0.9 for each pipeline (i.e., Line 1 and Line 2) during the detailed engineering phase;

i) a discussion on:
   i.1) the likelihood of future capacity expansion on Line 1, Line 2, the existing delivery line, and two proposed delivery lines; and
   i.2) a detailed description of any potential expansion scenarios for these lines.

Response:

a) Trans Mountain plans to transport light conventional crude oil, light synthetic crude oil, and refined products in Line 1, although Line 1 will also have the ability to transport heavy crude oil. The reason that Line 1 is intended for light crude oil service is that the transportation of material amounts of heavy crude oil will significantly reduce its capacity. Although Trans

Mountain plans to transport light crude oil in Line 1, it will be able to transport any of the crude oils that the existing Trans Mountain pipeline currently transports, as well as varieties of crude oil (subject to Trans Mountain approval) that shippers may wish to have transported in the future. The list of crude oils currently approved for transport in the Trans Mountain system is included in Table 1.93A-1.

TABLE 1.93A-1

TRANS MOUNTAIN APPROVED CRUDE OILS

Name	Identifier	Name	Identifier
LIGHT SWEET CRUDES		**HEAVY SYNTHETIC CRUDES**	
BC Light Crude	BCL	Suncor Synthetic P	OSP
Bonny Glen Crude	BOG	Suncor Synthetic S	OSS
Peace River Crude	PCR		
Pembina Crude	PEM	**SUPER HEAVY CRUDES**	
Pembina North	PNC	Albian Heavy Synthetic	AHS
Rainbow Crude	RBW	Albian Residual Blend	ARB
		Cold Lake Blend	CL
LIGHT SOUR CRUDES		Statoil Cheecham Syn-Bit	SCS
Bonny Glen Sour Crude	BGS	Statoil Cheecham Mixed	SCM
Boundary Lake Crude	BLK	Wabasca Crude	WH
Light Sour Oil	LSO		
Koch Alberta	KOC	**HIGH TAN SUPER HEAVY CRUDES**	
Peace River Sour	PCSR	Albian Muskeg Heavy	AMH
		Albian Vacuum Gas Oil	AVB
LIGHT SYNTHETIC CRUDES		Access Western Blend	AWB
Horizon Synthetic	CNS	Borealis Heavy Blend	BHB
Premium Albian Synthetic	PAS	Kearl	KRL
Premium Synthetic	PSC	Long Lake Heavy Blend	PSH
Shell Synthetic Light	SSX	McKay Heavy	MKH
Suncor Synthetic A	OSA	Oil Sands Q	OSQ
Suncor Synthetic C	OSC	Peace River Bitumen	PH
Syncrude	SYN	Seal Heavy	SH
		Statoil Cheecham Blend	SCB
MEDIUM SEMI-REFINED		Suncor Synthetic H	OSH
Strathcona Special Stream	SSS	Surmont Heavy Blend	SHB

The representative properties of these crude oils are included in Table 5.1.7, Appendix D, Volume 4A of the Application. The highest crude oil density approved by Trans Mountain is 0.940 kg/m^3.

Trans Mountain plans to transport any crude oils that are approved for transport in Line 1 or Line 2, and that shippers have the desire to export, in the existing Westridge delivery line. It is expected that the existing Westridge delivery line will be in light crude service more often than heavy crude service (see the response to NEB IR 1.93b.2).

b.1) As it is not Trans Mountain's intent to transport material amounts of heavy crude oil in Line 1, the average annual (sustainable) capacity of Line 1 with all heavy crude oil has not been determined. The current sustainable capacity of the existing Trans Mountain pipeline system with 20% heavy crude oil and 80% light crude oil and refined products, in batches, is approximately 47,700 m^3/d (300,000 bbl/d). Compared to the existing Trans Mountain

pipeline system, Line 1 will have fewer pipeline segments greater than 609.6 mm diameter (NPS 24) and fewer active pump stations (19 versus 23). Therefore, the capacity of Line 1, transporting all heavy crude oil, will be significantly less than 47,700 m^3/d (300,000 bbl/d).

The instantaneous capacity of the existing Westridge delivery line is approximately 72,000 m^3/d (453,000 bbl/d) transporting heavy crude oil and this will not change materially after completion of the proposed Project. The capacity is somewhat dependent on the density and viscosity of the heavy crude oil and which tanks at Burnaby Terminal crude oil is being delivered from. Since the line is currently operated intermittently and will operate intermittently in the future, the concept of average annual (sustainable) capacity is not applicable. In order to achieve the 111,290 m^3/d (700,000 bbl/d) target capacity on the existing Westridge delivery line it will need to be in light crude oil service (see Section 3.4.4.1.4, Volume 4A of the Application). However, there will be times (i.e. for the loading of smaller vessels) that a lower capacity will be acceptable. There may also be rare cases when three heavy crude oil vessels are loading simultaneously. Under these circumstances and under other circumstances, where logistical considerations dictate, the existing Westridge delivery line may operate in heavy crude oil service.

b.2) Experience with the existing Trans Mountain pipeline system has shown that impacts to capacity occur with the introduction of less than 10% heavy crude oil in batches and that the transportation of approximately 30% heavy crude oil in batches has the same impact on capacity as if the system were transporting 100% heavy crude oil. There is some variability in the effects depending on the size of the heavy crude batches and their locations in the pipeline. As the total percentage of heavy crude oil rises and the batch sizes and frequencies increase accordingly, heavy crude oil fills individual pipeline segments (between pump stations) and the reduced capacity in those segments controls the rate of the entire pipeline. Since it is not Trans Mountain's intent to transport material amounts of heavy crude oil in Line 1, the average annual (sustainable) capacity of Line 1 with batches of heavy crude oil has not been determined. However, for the reasons stated in the response to NEB IR 1.93b.1, it can be concluded that the introduction of small amounts of batched heavy crude oil will reduce the sustainable capacity below 55,650 m^3/d (350,000 bbl/d) and that if the amount of heavy crude oil were to reach 30%, the capacity would be significantly less than 47,700 m^3/d (300,000 bbl/d).

The only time that the existing Westridge delivery line will operate in a batch mode is when the line is changing service from light crude oil to heavy crude oil or vice versa. This may occur at the end of the vessel loading cycle in preparation for the next vessel loading. When the line is full of heavy crude, its capacity will be approximately 72,000 m^3/d (453,000 bbl/d). As the heavy crude is replaced with light crude, the capacity will rise to approximately 111,290 m^3/d (700,000 bbl/d). The effect will be reversed during a light crude to heavy crude transition.

c.1) The existing Westridge delivery line was constructed in 1953.

c.2) The design flow rate at the time of construction was 76,310 m^3/d (480,000 bbl/d) by gravity feed in conventional light crude oil service.

c.3) See the response to NEB IR 1.93b.1, Paragraph 2.

d.1) The design flow rate (design capacity) of each of the two proposed 762.0 mm (NPS 30) delivery lines is 111,290 m^3/d (700,000 bbl/d) (see Section 3.4.4.1.4, Volume 4A of the Application).

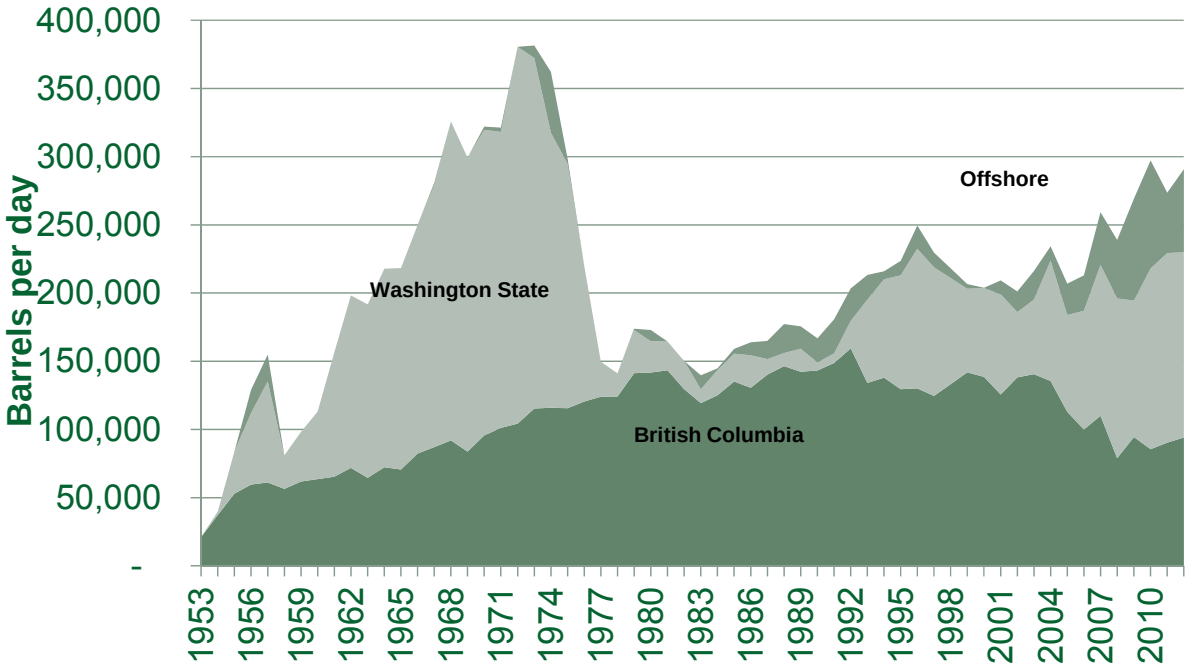
d.2) As each line will operate intermittently, the concept of average annual (sustainable) capacity is not applicable. It is not possible to determine how much of the Westridge Terminal design average annual throughput of 100,160 m^3/d (630,000 bbl/d) will be transported in each of the Westridge delivery lines, including the existing 609.6 mm (NPS 24) Westridge delivery line. If the throughput were to be carried equally between the three lines, the average annual throughput in each line would be 33,390 m^3/d (210,000 bbl/d). The purpose of having three lines is to be able to serve three vessel loading berths simultaneously, when required, and to have some redundancy for loading two vessels simultaneously during times when one of the three lines is out of service. The design flow rate has been selected to be able to load an Aframax class vessel within 24 hours.

e.1) The design flow rate, at the time when the existing 609.6 mm (NPS 24) segments (that will form part of Line 1 after the completion of the Project) were built, was 23,850 m^3/d (150,000 bbl/d) with four pump stations, although the pipeline wall thicknesses were selected to be able to achieve 47,700 m^3/d (300,000 bbl/d) with 13 or 14 pump stations.

e.2) To support the response to NEB IR 1.93e.1, relevant excerpts from Canadian Bechtel 1954 (Page 22, Page 23, Page 25, Exhibit 1, and Exhibit 3) are included in Attachment 1.93e.2-1 (NEB IR No. 1.93e.2-Attachment1).

e.3) Trans Mountain does not consider the original design flow rate when the line was built to be relevant to the proposed Project. The sections of the existing Trans Mountain pipeline that are currently in service, and that will form parts of Line 1, have maximum operating pressures (MOPs) which are accepted and permitted by the National Energy Board (NEB). The location and configuration (the number and size of pump units) of the pump stations for the proposed Project have been selected to make use of the available MOPs, where applicable, but not to exceed them. Many different locations and configurations of pump stations, although not necessarily practical, could be used to achieve higher or lower design flow rates without exceeding the permitted MOPs of the existing active pipeline segments. As indicated in Figure 1.93E.3-1, historical throughputs on the Trans Mountain system reached approximately 60,000 m3/d (380,000 bbl/d) in 1972 and 1973. This was achieved primarily by adding pump stations to the original system. Subsequently, as transportation demand fell, pump stations were removed from the system and the capacity was reduced. Pump stations and pump units were added again to increase the capacity to the current level. The purpose of the configuration proposed for the Project is to achieve the 58,570 m^3/d (368,400 bbl/d) deemed necessary to support the planned annual shipments of light crude oil and refined product contract and spot volumes in Line 1.

Figure 1.93e.3-1 Historical Throughputs on Trans Mountain 1953-2012



f) Trans Mountain has a long operational history and the configurations (numbers of pump stations, pump units, and installed spares) of the proposed Line 1 and Line 2 are not materially different that those on the existing pipeline system. Empirical evidence based on operating experience suggests that the availability factor of 0.95 currently selected for both Line 1 and Line 2 is appropriate. During the detailed engineering and design phase, Trans Mountain will do a reliability, availability, and maintainability (RAM) analysis to confirm or adjust the availability factor and the sparing philosophy for each pipeline. Parameters that may be considered in the RAM analysis include (but are not limited to):

- the failure frequencies and durations (times to repair or replace) of equipment such as variable frequency drives (VFDs), motors, pumps, etc.;
- the failure frequencies and durations (times to restore) of utility power supplies;
- the frequencies and durations of planned outages for inspections or maintenance of pipeline segments or facility components;
- the availability in Edmonton of crude oils and refined products to be transported;
- the capacity of Edmonton, Kamloops, Sumas, and Burnaby Terminals to receive the crude oils and refined products to be transported;
- the availability of vessels at Westridge Terminal to receive crude oils;
- the impact of the failures, outages, availabilities, and capacities, on pipeline sustainable capacity.

g) It is not possible to describe the effects of each parameter provided in the response to NEB IR 1.93f in isolation. In general, more frequent failures of equipment and utility power supplies, longer times to repair, replace, or restore, lower availabilities of crude oils and vessels, and lower capacities at the terminals will reduce the availability factors. The typical

approach to ensure that the availability factors are above 0.9 and, ideally, 0.95 or higher, is to include installed spares for critical equipment (equipment that if not available, due to failure, has the greatest impact on capacity).

h) If the availability factors for Line 1 and Line 2 were to change from 0.95 to 0.9, the design capacities would need to be increased to 61,830 m^3/d (388,900 bbl/d) and 95,390 m^3/d (600.000 bbl/d), respectively. However, it may not be practical or cost effective to increase the capacities of the pipelines to these levels. As discussed in the response to NEB IR No. 1.93f and NEB IR No. 1.93g, it is more likely that Trans Mountain will review the currently proposed equipment sparing philosophy and add installed spares where appropriate, practical, and cost effective, in order to achieve availability factors close to 0.95.

i.1) Trans Mountain cannot speculate on the likelihood of future capacity expansions on Line 1, Line 2, the existing Westridge delivery line, or the two proposed Westridge delivery lines. Market conditions, economic feasibility, and technical feasibility will all influence future expansion considerations. Trans Mountain will be required to file subsequent applications with the National Energy Board (NEB) for any future capacity expansions.

i.2) Trans Mountain has considered a theoretical future expansion scenario of 124,010 m^3/d (780,000 bbl/d) average annual (sustainable) capacity on Line 2. The 914.4 mm (NPS 36) pipeline (from Hinton to Hargreaves) that was constructed as part of the Anchor Loop Project and the new segments of 914.4 mm (NPS 36) pipeline proposed for Line 2 have (or will have) maximum operating pressures (MOPs) that will support the increased capacity. This expansion scenario would require the installation of new 914.4 mm (NPS 36) pipeline from Darfield to Black Pines, the addition of two, three, or four unit pump stations at Stony Plain, Chip, Obed, Jasper, Chappel, McMurphy, Stump, and Sumas, and the addition of pump units at Wolf, Rearguard, Blackpool, Black Pines, and Kingsvale. This particular expansion scenario was selected, in part, because it will have a stable (not rising) temperature profile assuming a pipeline inlet temperature (at Edmonton) of 38°C, which is both the current maximum crude oil receipt temperature accepted by tariff and the proposed pump station design temperature. It also maintains reasonable pump station spacing and numbers of pump units at each pump station. The purpose of considering a future expansion case is to ensure that the pump station piping sizes, pump configurations, and other design elements, selected for the currently proposed expansion, are appropriate for the higher capacity, and that physical space is available, at the pump stations proposed for the Project, for the required additional pump units. As Trans Mountain is contractually obligated to maintain capacity, the pipeline will not be able to be idled, or to operate at significantly reduced capacity, for the lengthy periods of time that would otherwise be required to rebuild the pump stations if the expansion considerations were not integrated into the designs. This approach is commonly accepted as prudent engineering. However, there are many obstacles to the viability of this expansion scenario, including (but not limited to) the availability of power supply, particularly in the North Thompson Valley, the space available for tanks and terminal infrastructure at Edmonton, Sumas, and Burnaby, the capacity of the Puget Sound pipeline, and the capacity of the Second Narrows in Burrard Inlet (for increased vessel traffic).

Trans Mountain has not considered any theoretical future expansion scenarios on Line 1 as the 609.6 mm (NPS 24) pipeline segments have limited capacity to support cost effective expansion.

Trans Mountain has not considered any theoretical future expansion scenarios for the Westridge delivery lines. As discussed in the response to NEB IR 1.93d, the capacity of each Westridge delivery line will be adequate to load an Aframax class vessel within 24 hours and the three lines will capable of loading three vessels simultaneously. The capacity of Westridge Terminal will be constrained by elements other than the delivery line capacities.

Summary of New Commitments:

- Trans Mountain will conduct a RAM analysis for Line 1 and Line 2 during the detailed engineering and design phase to confirm or adjust the availability factors and sparing philosophy. It is expected that the RAM analysis will be complete by the end of Q1 2015.

1.94 Pipeline specifications and maximum operating pressure

Reference:

A3S0Y8, Application Volume 4A, Project Design and Execution – Engineering:

i) PDF page 50 of 110
ii) PDF page 62 of 110
iii) PDF page 65 of 110
iv) A3S0Z5, Application Volume 4A, Project Design and Execution – Engineering, Appendix D – Tables, Table 5.1.8 – Preliminary Pipe Wall Thicknesses and Table 5.1.9 – Estimated Pipe Lengths, PDF page 16 of 93
v) A3S0Q7, Application Volume 1, Summary, PDF pages 27 to 29 of 113

Preamble:

Reference i) states that new pipeline segments will be hydrostatically tested in accordance with CSA Z662 to provide a point-to-point maximum operating pressure (MOP) that is expected to vary between 6,000 and 10,000 kilopascals. The higher MOP values will generally occur at the low points and the lower MOP values will occur at the high points.

Reference ii) states that the MOP at Line 1 pump stations will be as prescribed in the existing Operating Limits and Protective Device Settings document. The MOP at all Line 2 pump stations, including inlet and outlet piping, will be 9,930 kilopascals. The diameter of pump station piping will be 610 mm.

Reference iii) specifies the features that will be included in the pump station piping design.

Reference iv) specifies the preliminary pipe wall thickness and pipe lengths for Line 2.

Reference v) states that, since its completion in 1953, various modifications have been made to Trans Mountain's system to add throughput capacity and facilities in order to respond to growing demand and changing shipper needs. As a result, between 1957 and 2013, the capacity of the system gradually increased from 150,000 bbl/d to 300,000 bbl/d.

Request:

Please provide:

a) a table with the following information for each segment with a different MOP for Line 1 (including segments to be reactivated), Line 2, the existing delivery line, and the two proposed delivery lines upon Project completion:
   a.1) MOP and design pressure;
   a.2) estimated length corresponding to the MOP;
   a.3) diameter;
   a.4) wall thickness;
   a.5) diameter/wall thickness ratios;
   a.6) material grade;
   a.7) CSA notch toughness category;

a.8) yield strength and tensile strength
a.9) design factor;
a.10) location factor;
a.11) joint factor;
a.12) coating;
a.13) seam weld type; and
a.14) its intended use (e.g., crossings, horizontal directional drilling);

b) a table with the following information for each segment with a different MOP for Line 1 and the existing delivery line following the previous expansion of Trans Mountain's system in 2008:
   b.1) MOP and design pressure; and
   b.2) estimated length corresponding to the MOP;

c) the following information for all pumps stations on Line 1 (including the segments to be reactivated) and Line 2, upon Project completion:
   c.1) the design pressures; and
   c.2) maximum inlet pressures and outlet (discharge) pressures;

d) the following information for all pumps stations on Line 1 following the previous expansion of Trans Mountain's system in 2008:
   d.1) the design pressures; and
   d.2) maximum inlet pressures and outlet (discharge) pressures;

e) the temperature profile of each line between each pump station for the applied-for facilities; and

f) copies of all engineering reports and studies prepared for, or by, Trans Mountain supporting the conceptual and preliminary design of the pipelines and associated facilities which have not been previously provided.

Response:

a) The only Line 1 segments that will have a different licensed MOP is the reactivated 610 mm (NPS 24) pipeline segments. Trans Mountain intends to test the reactivation segments up to 100% SMYS at points of maximum stress to qualify these sections to operate at a higher MOP than currently licensed. The final MOP will be determined as part of engineering and detailed design and in accordance with CSA Z662-11. The information requested for a.1) through a.14) is included in the attached table IR No. 1.94a – Attachment 1.

   The existing pipeline segments that are to be part of Line 2 have existing MOPs that are licenced through the NEB with no plans to increase the MOP. The new pipeline segments will have a design pressure of 9930 kPa and the MOP will be determined as part of engineering and detailed design in accordance with CSA Z662-11. The information requested for a.1) through a.14) for Line 2, both the new and existing segments, is included in the attached table IR No. 1.94a – Attachment 2.

The new pipeline delivery segments will have a design pressure of 4964 kPa and the MOP will be confirmed after completion of hydrostatic testing as per CSA Z662-11. The information requested for a.1) through a.14) for the 2 new proposed delivery lines is included in table IR No. 1.94a – Attachment 2.

b) There have been no changes in the licensed MOP for Line 1 and the existing delivery line subsequent to the expansion completed in 2008.

c) Table 1.94C-1 provides the design maximum operating pressures (MOPs) and the maximum discharge pressures for the Line 1 and Line 2 pump stations. It also provides the maximum inlet (suction) pressures for the Line 1 pump stations. The maximum inlet pressures for the Line 2 pump stations will be provided following completion of the transient hydraulic analysis, expected by Q2 2015.

TABLE 1.94C-1

PUMP STATION DESIGN, INLET, AND DISCHARGE PRESSURES

Location	Line 1 Pump Stations			Line 2 Pump Stations	
	Design MOP (kPa)[1]	Maximum Inlet Pressure (kPa)[2]	Maximum Discharge Pressure (kPa)[2]	Design MOP (kPa)[1]	Maximum Discharge Pressure (kPa)[2]
Edmonton	9000	1150	7840	9930	9930
Stony Plain	9930	5030	7040	N/A	N/A
Gainford	9600	5130	6670	9930	9930
Chip	9930	3565	5810	N/A	N/A
Niton	5890	3000	9600	N/A	N/A
Wolf	N/A	N/A	N/A	9930	9930
Edson	8300	2900	5022	9930	9930
Hinton	9930	3424	5670	9930	9930
Jasper	9600	6000	6200	N/A	N/A
Rearguard	9930	4765	7000	9930	9930
Chappel	9907	4000	6510	N/A	N/A
Blue River	N/A	N/A	N/A	9930	9930
Finn	9930	4375	6200	N/A	N/A
McMurphy	9600	4445	6600	N/A	N/A
Blackpool	9930	4800	7100	9930	9930
Darfield	9500	5315	6100	N/A	N/A
Black Pines	9930	4840	5478	9930	9930
Kamloops (Parallel)	9900	1200	9700	N/A	N/A
Kamloops (Series)	9900	N/A	9700	9930	9930
Kingsvale	8689	4200	6770	9930	9930
Hope (Relief)	9930	5800	N/A	N/A	N/A
Sumas	9600	4500	5034	N/A	N/A
Port Kells	9930	2718	4052	N/A	N/A

Notes: 1. Refers to Question 1.94c.1
2. Refers to Question 1.94c.2

d) Table 1.94D-1 provides the pump station design maximum operating pressures (MOPs) and the maximum inlet (suction) and outlet (discharge) pressures subsequent to the 2008 expansion of the Trans Mountain system.

TABLE 1.94D-1

PUMP STATION DESIGN, INLET, AND DISCHARGE PRESSURES AFTER 2008

Location	Line 1 Pump Stations		
	Design MOP (kPa)[1]	Maximum Inlet Pressure (kPa)[2]	Maximum Discharge Pressure (kPa)[2]
Edmonton	9000	1150	7840
Stony Plain	9930	5030	7040
Gainford	9600	5130	6670
Chip	9930	3565	5810
Wolf	9927	3610	5600
Edson	8300	2900	6700
Hinton	9930	3424	5670
Jasper	9600	6000	6200
Rearguard	9930	4765	7000
Albreda	9600	4000	6200
Chappel	9907	4430	6510
Blue River	9930	4375	6375
Finn	9930	4445	6200
McMurphy	9600	4800	6600
Blackpool	9930	5315	7100
Darfield	9500	4840	6100
Kamloops (Parallel)	9900	1200	9700
Kamloops (Series)	9900	N/A	9700
Stump	9930	6240	7570
Kingsvale	8689	4200	6770
Hope	9930	4500	7040
Wahleach	9930	4585	6640
Sumas	9600	4500	6200
Port Kells	9930	3230	5120

Notes: 1. Refers to Question 1.94d.1
2. Refers to Question 1.94d.2

e) Figure 1.94E-1 in Attachment 1 (NEB IR No. 1.94e – Attachment 1) provides the expected Line 1 temperature profile at the design flow rate of 58,570 m^3/d (368,400 bbl/d) with an 18 $^{\circ}C$ pipeline inlet temperature at Edmonton.

Figure 1.94E-2 in Attachment 2 (NEB IR No. 1.94e – Attachment 2) provides the expected Line 1 temperature profile at the design flow rate of 58,570 m^3/d (368,400 bbl/d) with a 5 $^{\circ}C$ pipeline inlet temperature at Edmonton.

Figure 1.94E-3 in Attachment 3 (NEB IR No. 1.94e – Attachment 3) provides the expected Line 2 temperature profile at the design flow rate of 90,370 m^3/d (568,400 bbl/d) with an 18 $^{\circ}C$ pipeline inlet temperature at Edmonton.

Figure 1.94E-4 in Attachment 4 (NEB IR No. 1.94e – Attachment 4) provides the expected Line 2 temperature profile at the design flow rate of 90,370 m^3/d (568,400 bbl/d) with a 5 $^{\circ}C$ pipeline inlet temperature at Edmonton.

18 °C is the historical average mid-summer pipeline inlet temperature at Edmonton. 5 °C is the historical average mid-winter pipeline inlet temperature at Edmonton. Under the current tariff, the maximum receipt temperature at Edmonton is 38 °C. It is not possible to determine to what extent average pipeline inlet temperatures will vary (up to the tariff maximum of 38 °C) once the Project is complete and the expanded Trans Mountain system is operational. This will depend largely on factors outside of Trans Mountain's control, including the origins, lengths, and flow rates of new or expanded feeder pipelines and the utilization of tanks at Edmonton. For completeness, theoretical temperature profiles for a pipeline inlet temperature of 38 °C are being developed. However, the 18 °C mid-summer and 5 °C mid-winter pipeline inlet temperatures are expected to be more representative of future operating conditions.

References:

Attachment 1 (NEB IR No. 1.94e – Attachment 1). Figure 1.94e-1 – Line 1 Temperature Profile at 58,570 m3/d (368,400 bbl/d) Design Flow Rate, 18 °C Inlet Temperature at Edmonton.

Attachment 2 (NEB IR No. 1.94e – Attachment 2). Figure 1.94e-2 – Line 1 Temperature Profile at 58,570 m3/d (368,400 bbl/d) Design Flow Rate, 5 °C Inlet Temperature at Edmonton.

Attachment 3 (NEB IR No. 1.94e – Attachment 3). Figure 1.94e-3 – Line 2 Temperature Profile at 90,370 m3/d (568,400 bbl/d) Design Flow Rate, 18 °C Inlet Temperature at Edmonton.

Attachment 4 (NEB IR No. 1.94e – Attachment 4). Figure 1.94e-4 – Line 2 Temperature Profile at 90,370 m3/d (568,400 bbl/d) Design Flow Rate, 5 °C Inlet Temperature at Edmonton.

f) Trans Mountain interprets this question as being related to the design of pipeline segments. Trans Mountain has undertaken iterative and evolving conceptual design work largely through direct and ongoing interaction with internal experts and consultants. This approach has generated very few documents which can be considered discrete deliverables (i.e., engineering reports and studies). Analyses that were produced, particularly early in the conceptual design process, do not necessarily reflect the decisions and commitments that have been included in the Facilities Application. As such, providing these reports outside the context of the continuing design evolution will not inform the review of the Facilities Application and, in Trans Mountain's view, will lead to confusion. If requested by the NEB, Trans Mountain will provide engineering reports and studies, to be completed during the detailed engineering and design phase, that reflect the final detailed design basis or are deliverables of the detailed engineering and design process.

To support the answers to NEB IR No. 1.94a through 1.94f, Trans Mountain has included the hydraulic (head) profiles at the design flow rates of 58,570 m^3/d (368,400 bbl/d) for Line 1 in NEB IR No. 1.94f – Attachment 1 and 90,370 m^3/d (568,400 bbl/d) for Line 2 in NEB IR No. 1.94f – Attachment 2. In addition to other useful information, these show that at each pump station the discharge head does not exceed the existing or planned maximum operating head (MOH), satisfying the fundamental criterion of pipeline design. The preliminary selection of pipe grades, wall thicknesses, and other design aspects are based

on the requirements of CSA Z662-11 and the other considerations described in Section 3.2, Volume 4A of the Facilities Application.

Summary of New Commitments:

- Trans Mountain will provide to the NEB the maximum inlet (suction) pressures for the Line 2 pump stations following completion of the transient hydraulic analysis, expected by Q2 2015.
- If requested by the National Energy Board (NEB), Trans Mountain will provide engineering reports and studies, to be completed during the detailed engineering and design phase, that reflect the final detailed design basis or are deliverables of the detailed design process.

1.95 Spill outflow model assumptions

Reference:

i) A3S4V7, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills, Appendix B – Oil Spill Outflow Model Results, PDF pages 47 to 60 of 60
ii) A3S4V5, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills, PDF page 43 of 84

Preamble:

Reference i) provides oil flow model results, including results between Burnaby and Westridge. The Board notes that these results could be for the two proposed delivery lines from Burnaby Terminal to the Westridge Marine Terminal; however, the maximum design throughput considered in calculating oil outflow volumes for the two delivery lines from Burnaby Terminal to Westridge Marine Terminal is not clear.

Reference ii) states that the volume outflow calculation is based on the release prior to pump shutdown and valve closure, plus the volume of the product remaining in the pipeline that would drain out due to gravity. A time interval of 10 minutes was used for the release prior to pump shutdown. After the pumps are shutdown, the mainline block valves located upstream and downstream of the leak site are closed, which will take 5 minutes from the time of activation to full valve closure.

Reference ii) also provides the following assumptions used in the model:

- Maximum design throughput of 90,370 m^3/d (568,400 bbl/d).
- Product released through an opening in the bottom of the pipeline equivalent to the internal diameter.
- Preliminary valve locations that will be finalized during detailed engineering.
- Conservative assumptions of times to system shutdown and valve closure, based on assumptions for recognition, shutdown, and isolation of pipeline segments.

Request:

Please provide:

a) clarification on the throughput value and the pipelines that were considered in calculating the oil flow model results from Burnaby to Westridge provided in Reference i); and

b) the rationale for selecting each assumption provided in Reference ii), taking into account the suitability of the following assumptions:
   b.1) design throughput of Line 2 versus the combined design throughput of Line 1 and Line 2, should both Line 1 and Line 2 be affected at the same time;
   b.2) an opening located in the bottom of the pipe as opposed to the top or sides of the pipe; and
   b.3) 10 minutes for pump shutdown and 5 minutes for valve closure, shutdown, and isolation of pipeline segments; and

c) the assumptions and their rationale used in calculating the outflow volumes from Burnaby to Westridge.

Response:

a) The throughput value for the pipeline from Burnaby Terminal to Westridge Terminal considered in calculating the outflow model results reported in Volume 7, Appendix B (A3S4V7) was 90,370 m^3/day (568,400 bbl/d). Trans Mountain has noted that this throughput value is incorrect for this segment, as a value of 111,290 m^3/day (700,000 bbl/d) should have been used (see also the response to NEB IR No. 1.96a). Revised outflow results based on this corrected throughput value are shown in the attached Figure (NEB IR No. 1.95a - Attachment 1).

This Figure replaces Page 14 in Volume 7, Appendix B (A3S4V7) in the Application.

b) Trans Mountain determined the most credible worst-case scenario for modelling volume outflow, is a full-bore opening of one pipeline. The potential for concomitant failure, i.e., a failure of one pipeline precipitating the failure of an adjacent pipeline, is considered to be more applicable to high-pressure natural gas pipelines. While Trans Mountain acknowledges that there are some scenarios in which simultaneous failures of parallel low-vapour pressure liquids pipelines could occur, it maintains that for the purposes of a risk assessment, the most credible worst-case scenario entails a full-bore opening of one pipeline. Trans Mountain chose to be conservative in selecting an assumption of having the opening located in the bottom of the pipe in determining the volume of product that could evacuate the pipeline in the immediate proximity of the failure location.

As indicated in the Application, Volume 7, Risk Assessment & Management of Pipeline & Facility Spills, a time interval of ten minutes was assumed for the release prior to pump shutdown. During this interval, operations personnel would be verifying the validity of the low pressure SCADA and Leak Detection alarms and all pump stations would continue to operate. For a full bore rupture, the loss of pressure would be dramatic and the pump stations downstream of the rupture site would quickly alarm on low suction pressure, followed by automatic shutdown of the station. The ten-minute period until pump shutdown time includes a five-minute recognition period for personnel to confirm that a full-bore failure has occurred. A five-minute valve closure time has been assumed for the closure of the main line block valves located upstream and downstream of the leak.

At some locations, such as at river crossings, check valves will be employed, which will provide an immediate shut off and prevention of backwards flow from the downstream sections of the pipeline.

c) As noted in the response to NEB IR No. 1.95a, the throughput value used in generating the outflow results for the Burnaby to Westridge segment as reported in Volume 7, Appendix B (A3S4V7) was incorrect; updated outflow results have been provided, based on the correct throughput, as part of the response to NEB IR No. 1.95a. Apart from throughput, the assumptions used in calculating the outflow volumes from Burnaby to Westridge are the

same assumptions used in calculating the outflow volumes for Line 2 between Edmonton and Burnaby, as documented in Reference ii).

1.96 Spill outflow model results

Reference:

i) A3S4V7, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills, Appendix B – Oil Spill Outflow Model Results, PDF pages 47 to 60 of 60

A3S4V5, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills:

ii) PDF page 43 of 84
iii) PDF page 42 of 84

Preamble:

Reference i) provides the oil flow model results including:

- shutdown volumes, drain down volumes, elevation, remote valve locations, and check valve locations.
- results between Burnaby and Westridge. The Board notes that these results could be for the two proposed delivery lines from Burnaby Terminal to the Westridge Marine Terminal; however, the maximum design throughput considered in calculating oil outflow volumes for the two delivery lines from Burnaby Terminal to Westridge Marine Terminal is not clear.

Reference ii) states that:

- the volume outflow calculation is based on the release prior to pump shutdown and valve closure plus volume of the product remaining in the pipeline that would drain out due to gravity. A time interval of ten minutes has been used for the release prior to pump shut-down. After the pumps are shutdown, the Main Block Valves located upstream and downstream of the leak site are closed which will take five minutes from the time of activation to full valve closure.
- the following assumptions were used in the model:
  - Maximum design throughput of 90,370 m^3/d (568,400 bbl/d).
  - Product released through an opening in the bottom of the pipeline equivalent to the internal diameter.
  - Preliminary valve locations that will be finalized during detailed engineering.
  - Conservative assumptions of times to system shutdown and valve closure, based on assumptions for recognition, shutdown, and isolation of pipeline segments.

Reference iii) provides the high consequence areas considered for the Project.

Request:

Please provide:

a) the maximum design throughputs and their related drain down volumes, based on the assumptions provided in Reference ii) for:
   a.1) Line 2;

a.2) the two proposed delivery lines from Burnaby Terminal to the Westridge Marine Terminal (individual and combined drain down volumes for two lines are required);
a.3) the two segments proposed for reactivation (i.e., the Hinton, Alberta, to Hargreaves, British Columbia, segment; and the Darfield to Black Pines, British Columbia, segment); and
a.4) the two segments proposed to become Line 2 (i.e., the active Hinton, Alberta, to Hargreaves, British Columbia, segment; and the active Darfield to Black Pines, British Columbia, segment);

b) the oil outflow maps for the following segments:
b.1) the two segments proposed for reactivation (i.e., the Hinton, Alberta, to Hargreaves, British Columbia, segment; and the Darfield to Black Pines, British Columbia, segment); and
b.2) the two segments proposed to become Line 2 (i.e., the active Hinton, Alberta, to Hargreaves, British Columbia, segment; and the active Darfield to Black Pines, British Columbia, segment); and

c) updated oil flow graphs for all the pipeline segments in the Project scope, containing the following information:
c.1) primary Y axis: total outflow volume in cubic metres (i.e., shutdown volume plus drain down volume); and
c.2) high consequence areas: mark and label these on the graphs (e.g., mark as the linear extent of high consequence areas along the X axis, shading on the graph, other suitable method).

Response:

a) The following Table has been created in order to clarify the assumptions used in outflow modelling of the various segments:

Question	Segment	Design Throughput and Reference Document	Outflow Analysis Reference Document	Status
a.1)	Line 2	90,370 m^3/day (see Volume 7, A3S4V5 pdf 43)	Volume 7, Appendix B (A3S4V7)	These results are currently being revised to reflect updated routing, and the revised results will be provided in Q3 2014.
a.2)	Burnaby – Westridge Delivery Lines	111,290 m^3/day (see Volume 4A, A3S0Y8 pdf 31)	Volume 7, Appendix B (A3S4V7)	These results were revised and provided as an attachment to response to NEB IR No. 1.95a. These results will be further updated to reflect revised routing, as well as to provide results for individual and combined drain down volumes, and will be provided in Q3 2014
a.3)	Hinton-Hargreaves & Darfield – Black Pines Reactivation Segments	58,570 m^3/day (see Volume 4A, A3S0Y8 pdf 48)	Not provided in application.	These results are currently being developed, and will be filed in Q3 2014
a.4)	Hinton-Hargreaves & Darfield – Black Pines Currently Active Segments	90,370 m^3/day (see Volume 7, A3S4V5 pdf 43)	Not provided in application.	These results are currently being developed, and will be filed in Q3 2014

b) The oil outflow maps for the pipelines segments listed in b.1) and b.2) are currently being developed and will be submitted to NEB in Q3 2014.

c) Trans Mountain assumes that the phrase 'oil flow graphs' used in this context refers to spill outflow model results included in Appendix B of Volume 7. These results will be developed for all segments in the project scope to reflect High Consequence Areas, and will be submitted to NEB in Q3 2014.

Summary of New Commitments:

- Trans Mountain will submit to the NEB revised outflow volumes for Line 2 in Q3 2014.
- Trans Mountain will submit revised outflow volumes for Burnaby – Westridge delivery lines, reflecting revised routing, as well as to provide results for individual and combined draindown volumes in Q3 2014.
- Trans Mountain will submit the outflow volume results for Hinton – Hargreaves and Darfield to Black Pines reactivated segments in Q3 2014
- Trans Mountain will submit the outflow volume results for Hinton – Hargreaves and Darfield to Black Pines currently active segments in Q3 2014
- Trans Mountain will provide to the NEB revised oil outflow maps for the pipelines listed in b.1) and b.2) in Q3 2014.
- Trans Mountain will provide to the NEB revised spill outflow graphs reflecting High Consequence Areas for all the pipeline segments in the Project scope in Q3 2014.

1.97 Overland and stream flow model

Reference:

i) A3S4V5, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills, PDF page 43 of 84
ii) A3S4V8, A3S4V9, A3S4W0, A3S4W1, A3S4W2, A3S4W3, A3S4W4, A3S4W5, A3S4W6, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills – Appendix C – Overland and Stream Flow Modeling of Potential Full-Bore Rupture

Preamble:

Reference i) states that hypothetical spills were simulated along the Project route using the OilMAP model to determine the overland and downstream pathways, using the input volumes from the outflow model.

Reference ii) provides overland and stream flow modelling of a potential full-bore rupture.

Request:

a) Please confirm the volumes used in the overland and stream flow modelling in Reference ii) for Line 2 and for the two proposed delivery lines.

b) Please provide overland and stream flow models for:
   b.1) the two segments proposed for reactivation (i.e., the Hinton, Alberta, to Hargreaves, British Columbia, segment; and the Darfield to Black Pines, British Columbia, segment); and
   b.2) the two segments proposed to become Line 2 (i.e., the active Hinton, Alberta, to Hargreaves, British Columbia, segment; and the active Darfield to Black Pines, British Columbia, segment).

Response:

a) The outflow volumes used are those that are reported within Volume 7, Appendix B, Oil Spill Outflow Model Results.

   The outflow results used in the overland and stream flow modelling are summarized in the response to NEB IR No. 1.96a. As noted in responses to NEB IR No. 1.95a and 1.95c, Line 2 throughput was incorrectly used in the calculation of outflow results for the Burnaby to Westridge delivery lines; a corrected set of outflow results has been provided in the response to NEB IR No. 1.95a. The revised overland and stream flow modelling results based on revised throughput values and revised routing, are currently being developed, and will be provided to NEB in Q3 2014.

b) The overland and stream flow models for the pipelines listed in b.1) and b.2) are currently being developed, and will be submitted to the NEB in Q3 2014.

Summary of New Commitments:

- Trans Mountain will provide to the NEB revised overland and stream flow modelling results, based on revised throughput values and revised routing for Burnaby to Westridge delivery pipelines in Q3 2014.
- Trans Mountain will provide to the NEB overland and stream flow models for the pipelines listed in b.1) and b.2) in Q3 2014.

1.98 Facility risk assessment

Reference:

A3S4V5, Application Volume 7, Risk Assessment and Management of Pipeline and Facility Spills, PDF page 45 of 84

Preamble:

Reference i) states that facilities proposed as part of the Project include remote block valve sites, pump stations, and terminals. The results of risk assessments will be completed as part of detailed design.

Request:

Please provide:

a) a current copy of the risk assessments for all proposed facilities;

b) an indication of when the final risk assessments for the facilities will be completed; and

c) a copy of the final risk assessments for the facilities to the Board upon completion.

Response:

a) The current risk assessments for the proposed new and expanded facilities are included in Attachments 1 through 10 (NEB IR No. 1.98a – Attachment 1 to NEB IR No. 1.98a – Attachment 10).

   The formal reports by Doug McCutcheon and Associates Consulting, in Attachments 1 through 5 (NEB IR No. 1.98a – Attachment 1 to NEB IR No. 1.98a – Attachment 5), describe assessments completed using the criteria in the Major Industrial Accidents Council of Canada (MIACC) "Risk Based Land Use Planning" guideline, the Canadian best practice for development proposals. These assessments present worst case fire scenarios for the expanded Edmonton, Sumas, Burnaby, and Westridge terminals, **without** consideration of the activation of mitigation measures, such as foam deployment and other fire-fighting or emergency actions. The assessments show the risks to be within the MIACC acceptability criteria, even without mitigation measures, provided that appropriate design features and maintenance practices are employed to keep the probability and magnitude of releases low. Trans Mountain will use the recommendations in the reports to inform the detailed designs and maintenance practices and will also include fire control and suppression systems and measures at the terminals. The worst case scenarios will also be used to inform the development of emergency response plans and in human health risk assessments.

   The tables in Attachments 6 through 10 (NEB IR No. 1.98a – Attachment 6 to NEB IR No. 1.98a – Attachment 10) summarize preliminary assessments of the risks of a broader variety of hazards and the effect of various control and mitigation measures, using Trans Mountain's quantitative risk assessment protocol. These assessments will also be used to inform detailed design.

In general, minimization of risk (probability and consequence reduction) is achieved through robust facility design, including temperature, pressure, flow, release, and fire detection systems, emergency shut-down systems, secondary containment, fire suppression systems, procedural operations management, inspection, and maintenance, and emergency response planning and training.

Volume 4A of the Application provides information on the release and fire prevention and control measures that will be incorporated into the designs, subject to further definition and refinement in the detailed engineering and design phase. Volume 4C provides information on planned operations, inspection, testing, and maintenance procedures. Additional information on these topics is also included in Sections 3.2.1 and 3.2.2 in Volume 7. Additional information on hazards and consequence reduction measures is also provided in Appendix E in Volume 7.

References:

Attachment 1.98-1 (NEB_IR_No._1.98a-Attachment1). Doug McCutcheon and Associates Consulting. 2013. Trans Mountain Expansion Project, Edmonton Terminal Portion, Risk Assessment. Prepared for Trans Mountain Pipeline ULC. Canal Flats, BC.

Attachment 1.98-2 (NEB_IR_No._1.98a-Attachment2). Doug McCutcheon and Associates Consulting. 2013. Trans Mountain Expansion Project, Sumas Tank Farm Portion, Risk Assessment. Prepared for Trans Mountain Pipeline ULC. Canal Flats, BC.

Attachment 1.98-3 (NEB_IR_No._1.98a-Attachment3). Doug McCutcheon and Associates Consulting. 2013. Trans Mountain Expansion Project, Burnaby Terminal Portion, Risk Assessment. Prepared for Trans Mountain Pipeline ULC. Canal Flats, BC.

Attachment 1.98-4 (NEB_IR_No._1.98a-Attachment4). Doug McCutcheon and Associates Consulting. 2013. Trans Mountain Expansion Project, Westridge Marine Terminal Portion, Risk Assessment. Prepared for Trans Mountain Pipeline ULC. Canal Flats, BC.

Attachment 1.98-5 (NEB_IR_No._1.98a-Attachment5). Doug McCutcheon and Associates Consulting. 2013. Trans Mountain Expansion Project, Westridge Marine Terminal Ship Loading Portion, Risk Assessment. Prepared for Trans Mountain Pipeline ULC. Canal Flats, BC.

Attachments 1.98-6, 1.98-7, 1.98-8, 1.98-9, and 1.98-10. (NEB_IR_No._1.98a-Attachment6 to NEB_IR_No._1.98a-Attachment10 inclusive). Trans Mountain Pipeline ULC. 2013. Preliminary Facility Qualitative Risk Assessments for proposed terminal facilities (Edmonton Terminal, Sumas Terminal, Burnaby Terminal, Westridge Marine Terminal) and proposed pump stations.

b) Trans Mountain will undertake final risk assessments for the proposed facilities after detailed engineering and design is near completion, expected by mid 2016. The final risk assessments will be completed with sufficient lead time for input to the development of emergency response plans and the updating of human health risk assessments.

c) Trans Mountain will submit the final risk assessments for the proposed facilities to the NEB upon completion.

Summary of New Commitments:

- Trans Mountain will undertake final risk assessments for the proposed facilities after detailed engineering and design is near completion, expected by mid 2016.
- Trans Mountain will submit the final risk assessments for the proposed facilities to the NEB upon completion.