Third Party Connections (IGT & UIP)

Stress Analysis for Exposed Pipeline Crossings Briefing Note

Scope

The purpose of this briefing is to provide guidance on the process for determining the necessary stress calculations when designing exposed pipeline crossings operating ≤2Barg pressure on Cadents distribution network. The information within this document is applicable to all personnel involved in the design of exposed pipeline crossings and is reflected internally within Cadent in approved Engineering Bulletin EB/774.

The need for guidance has been identified to aid design teams when considering the type of stress calculation that shall be undertaken when designing exposed pipeline crossings.

Note: *The information contained within this document and guidance should be considered when laying MP/LP small diameter ≤2" ST services when installed above ground.*

1. Introduction

The guidance within IGEM/TD/3 and IGEM/TD/13 classifies overhead crossings as an above ground installation (AGI) and therefore must conform to the current standards for Cadent to have confidence in the structural integrity of its network. The pipework associated with AGIs should be subject to stress analysis as per IGEM/TD/12. However, it is recognised by Cadent that a full pipework stress analysis conforming to TD/12 may not be required in certain circumstances as detailed below.

Where a UIP or Third party is seeking to lay exposed pipework, a complex project co-ordinator will be assigned to ensure that this briefing is adhered to. They will also provide the intermediary between the third party and the relevant engineering functions within Cadent where approval of these designs will reside.

Note: *Where design authorisation does not identify a crossing it shall be the third party's responsibility to highlight this to Cadent and seek the appropriate support.*

2. Requirement for Stress Analysis

As a default position a pipework stress analysis to TD/12 should be required for all crossings unless technical justification is provided, that states why a stress analysis to TD/12 is not required. The below are acceptable reason for avoidance of TD/12 Stress analysis.

1. Stress Analysis has been previously undertaken for a pipeline of the same/similar design,
2. Comparable stress analysis has been undertaken to a recognised design code e.g., ASME B31.3,

3. Simplified calculation has been undertaken to confirm that the stresses in the pipeline crossing are acceptable, including thermal expansion and pipe support load cases.

Note: *Where access deterrent measures (ADM's) are to be fitted, the effect of the additional weight and wind loading shall also form part of the calculations. Any ADM design shall be in accordance with G/19/D/101.*

2.1 Stress Analysis has been previously undertaken for a pipeline of the same/similar design.

It may be possible to make small amendments to a design if it is proven that the changes have a negligible effect on the stress calculations and performance of the crossing. A statement must be provided to outline why the designs are similar.

Acceptable minor changes listed below:

- Minor change of the pipeline wall thickness
- Change in pipeline diameter provided a comparable diameter/wall thickness ratio is maintained.
- Minor change in relative position of the crossing supports. In this case a minor change would be the distance is ≤ the diameter of the pipeline. If the change in support placement is greater than this distance supplementary calculations could be used to show the new support arrangement is acceptable.

When considering any change to a previously approved design the margin of safety on the original stress analysis should be noted. For example, if the maximum stress was <50% of the allowable this would be considered 'low stress' and therefore allows greater flexibility when considering change. However, if the maximum reported stress was >70% of the allowable this would be classed as 'high stress' and only minimal change to the original design should be allowed.

2.2 Comparable stress analysis has been undertaken to a recognised design code.

A comparable stress analysis can be used which conforms to a recognised international stress piping code however any alternative stress analysis shall include all load cases of that in TD/12. If a comparable stress analysis is used this must include, but no limited to:

- Self-weight,
- Pressure,
- Temperature,
- Wind loading as appropriate.

The designer should also provide documentation to show that any alternative stress analysis can be considered to include an equivalent factor of safety as that stipulated in TD/12.

2.3 Simplified calculation has been undertaken to confirm that the stresses in the pipeline crossing are acceptable.

Some installations will be classed as 'simple' and will lend themselves to allowing simplified calculations without the need for full TD/12 analysis. Simple calculations should be able to demonstrate the following:

- The crossing support configuration is acceptable for the weight of the pipe,
- Any bending stresses from thermal expansion / contraction is acceptable,

- Wind loading is not a credible threat,
- An equivalent stress check should be included to confirm that the combined bending and pressure stresses are acceptable.

However, justification shall be clearly outlined within the brief and accompany the calculations and design upon submission.

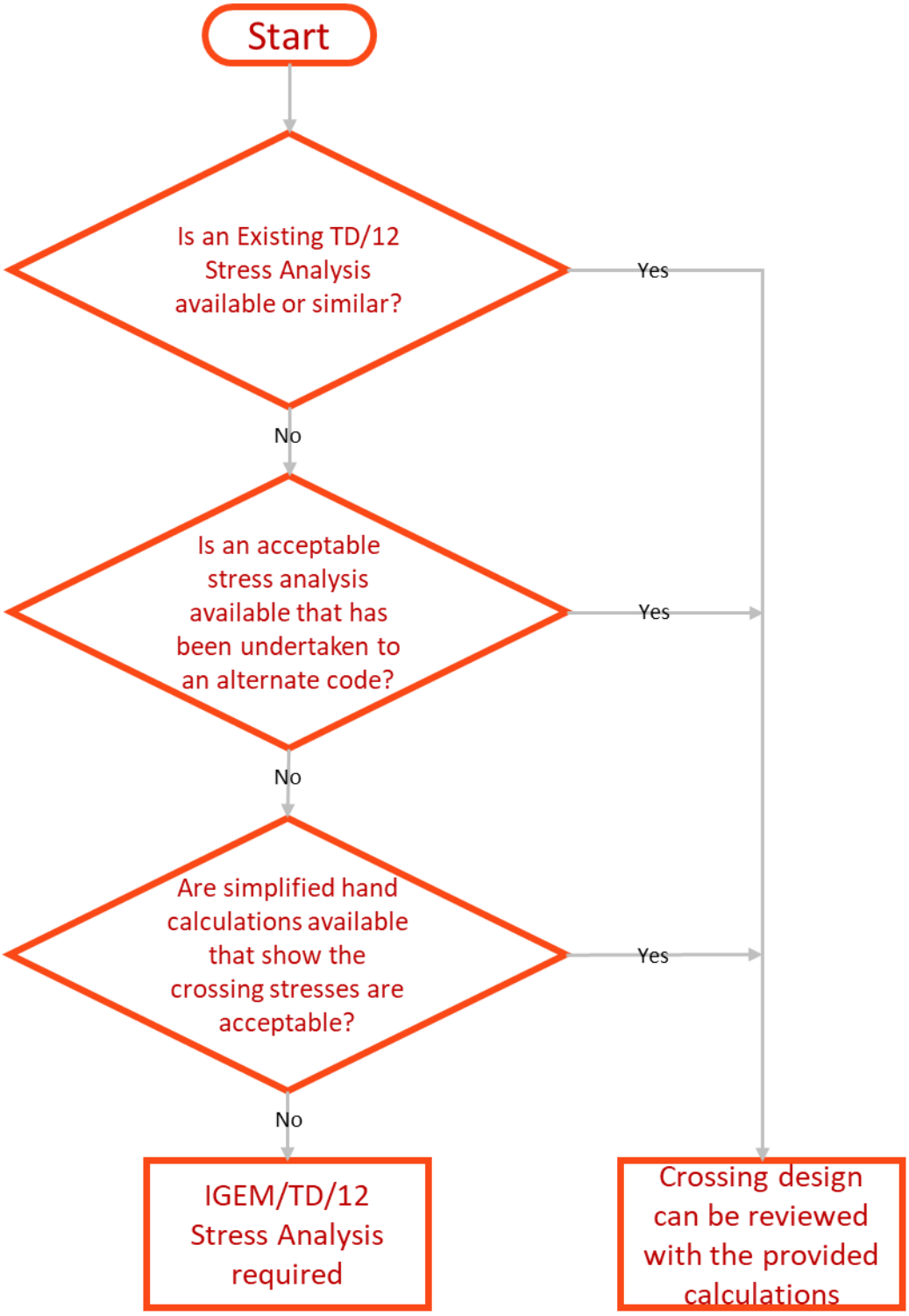
Note: *Given that any simplified calculations will always approximate the actual stresses, it is recommended that reduced stress limits are used to conform acceptance. If the predicted stress levels are found to exceed 50% of the pipe yield stress, then a full TD/12 stress analysis will be required.*

Simplified calculations will not be appropriate for all types of crossings and shall only be used for straight forward designs, such as short lengths (where the maximum unsupported lengths are not exceeded), horizontal crossings with no change in direction and some goal post arrangements.

When assessing the applicability of a crossing for simplified hand calculations, the following are example of types of crossings that are likely to be acceptable:

- A horizontal crossing with no changes in direction that is not subjected to any significant external loads (e.g., wind loading)
- A goal post type crossing with vertical or inclined sections at either end. However, sufficient margin should be included within the stress calculations to account for stress concentration at the bends.
    - Note – a goal post type crossing with any bends in the horizontal direction is likely to require full TD/12 stress analysis or similar.
    - If the coal post type crossing, is at risk of wind loading, then it is likely to require dull TD/12 stress analysis or similar.
- It could be possible to justify more complex crossing geometry under the following circumstances:
    - The crossing has a short length and can be assessed using conservative loading assumptions,
    - The crossing is supported in such a way that thermal expansion of different sections is resisted by fixed support. This is likely to be achieved using clamp type supports that prevent the transverse movement of the pipe. In this instance, it may be possible to break down the crossing into separate boom sections models.

3. Decision Tree



3. Design and Construction

Although 2Bar and below assets are outside the formal scope of IGEM/GL/5 due to their pressure regime, there is a requirement for Stress Analysis to be undertaken in accordance with the standard and for the appropriate sections of the design process to be followed, where formal design approval shall be sought from the User.

For new pipeline construction buried crossings are the preferred installation method, this is to maximise the integrity of the network and minimise risks and future maintenance requirements.

- Thrust boring and horizontal direction drilling can be employed for such crossings, with depth of cover being agreed with the relevant authorities / owners whilst not exceeding limitations of use.
- Alternatively, shallow lay across a structure may be permissible under deviation.

If the criteria for installing below ground crossing cannot be met and the option to install an above ground crossing is deemed as the only viable route, then this document shall be adhered to.

When submitting an FM138a/FM138 application, the exposed pipeline crossing checklist should also be included, the checklist has been designed to ensure all the minimum requirements from IGEM/TD/3, CAD/PM/MSL/1 and IGEM/TD/101 for the correct design of the crossing.

The connection design for flow calculations and routing will be reviewed and approved by the network design function, this will be caveated that a further approval will be required for the detailed design of crossing, at this point a project co-ordinator will also be appointed.

The checklist and any other information provided will be reviewed by Cadent Engineering Services to ensure that the design is acceptable to be adopted onto the network. The design will be subjected to a medium level risk assessment.

Upon construction Cadent Energy Operations shall attend site to undertake the first inspection referred to in CAD/PM/MS/5. This is mandatory and shall be undertaken between construction and commissioning. Early engagement through the project co-ordinator is essential to minimise delays to commissioning.

Exposed pipeline crossing can be deemed as ‘critical’ and therefore the correct welding and test procedures shall be adhered to as outline in CAD/SP/P/1. The welding procedures will need to be qualified by Cadent’s Welding Engineer, which will include the intended inspection and testing regime to ensure compliance to current and relevant standards.

Note: *Critical locations are typically crossings associate with bridges, railways, major roads and motorway, navigable waterways and welded joints not included in the hydrostatic pressure test.*

During the design stage of the exposed pipeline crossing, any easements or permissions required to install the crossing and/or cadent to carry out any future maintenance shall be identified and sought. Similarly, if the above ground crossing is to be attached to a supporting structure, authorisation from the asset owner shall be sought. The structure will be required to be deemed appropriate and structurally safe for use.

Once the pipe has been commissioned, the crossing signed off and project completed, a copy of the checklist shall be held within the completion file returned to Cadent.

4. IGEM References

IGEM Standard	Section
IGEM/GL/5	Section 4 Table 1 – States that pipework stress analysis is in scope
IGEM/TD/3	Section 5.12 - Classes and overhead pipe crossing as an AGI subject to stress analysis
IGEM/TD/12	Section 2 - Classes overhead crossings as in scope of the document
IGEM/TD/101	Section 7.3 – The GT shall undertake all checks necessary to ensure the submitted design is suitable for adoption Section 7.3.1 – Lists the minimum information require to be submitted which includes any design calculations used Section 5.2.2 – An outline checklist is to be completed at the proposal stage Section 5.3.1, 5.4.2 and 5.5.2 – State the design along with any other detail requested by the GT is to be provided at design proposal stage

5. Key Contact Information

Stress analysis queries should be directed to the assigned project co-ordinator and box.complexexitconnections@cadentgas.com

Appendix A

Exposed Pipeline Crossings – Buried crossings are preferred to exposed pipeline crossings in order to maximise the integrity of the system and minimise future maintenance and risks.

FORM TO BE COMPLETED BY THE ORGANISATION REQUESTING THE DESIGN APPROVAL. Failure to fully complete all sections or attach the relevant information may result in the review of the above ground crossing request being delayed pending presentation of all the required information. For assistance please see key contacts.	
Date form submitted.	
Name of person requesting the design approval. Including full company name and address.	
Contact telephone No.	
Contact email address.	
Full address or location of works including post code and grid reference.	
Customer reference	
Cadent reference No.	
Please provide here all supporting documentation e.g. specifications, photos, map extracts, PDF's.	*(Supplementary sheet to be added if required)*
Please detail here the full reason for the design of the special engineering crossing above ground pipeline as opposed to buried underground pipeline	

Engineering Quality Assurance Review

Name:	Name:	Name:
Signature:	Signature:	Signature:
Date:	Date:	Date:

Factors to be considered and evidenced when designing above ground crossings below 2 Barg:

Factors	**Checked**	**Comments**					
Feature to be crossed. e.g. navigable water course, farmland susceptible to dredging, electrified rail way etc. Provide ownership details of feature to be crossed (For ongoing access)		Railway	Road	Building	Open ground	Track/ Path	Water
If new special engineering crossing to be attached to 3rd party structure what agreements have been made							
Are any easements or agreements required for installation of and future maintenance of the above ground crossing?							
Provide potential risk for Environmental stability. e.g. slope stability, erosion of banks and beds, flood risks							
Provide provisions for ongoing accessibility for maintenance and repair to the entire structure							
Provide details of sufficiently designed and constructed barrier systems to deter unauthorised access in accordance with **G/19/D/101**							
Pipework Stress and stability analysis to the requirements of IGEM/TD/12 unless technical justification can be provided for the use of alternative design or pipe stress analysis standards or methods (see EB774 information)		- Anchorage requirements (if necessary) - Sustained load case to determine maximum unsupported length and necessary support requirements - Design of support/restraints - Abnormal or accidental loading / vandalism - Environmental loading (e.g. ice, wind, flooding)					
Provide details of appropriately designed support system ensuring no interference with CP system							
Confirm SMYS and grade of pipe? Confirm wall thickness is above minimum as specified in IGEM/TD/3 ensuring a safety factor of 0.3 SMYS							
Method of jointing to be employed (**welding procedure to be approved by Cadent**)							
Provide provision for isolation valves							

How shall the effectiveness of cathodic protection either side of the crossing be safeguarded. (Including isolation joints)		
Evidence wind / water line protected as per CAD/SP/CW/5		
Evidence above ground coatings applied shall be in accordance with CAD/SP/PA/10		
Detail impact protection for pipework and associated supports e.g. dredging and dumping, vehicular, river traffic etc. Carry out vehicle impact assessment as necessary		
Detail provision of accessible marker posts		
Provide detail of cathodic protection on any buried steel designed and installed in accordance with CAD/SP/ECP/7 and CAD/PM/ECP/4		- Inclusion of buried coupons to facilitate an indicative off reading - Inclusion of reed switches in test posts to facilitate an instant off reading - Post commissioning survey - Natural potential survey