IPLOCA TIE-INS GUIDELINES

Recommendations from

IPLOCA HSE & CSR Committee

15/04/2025

CONTENT

1 Purpose and Scope of this Document

The purpose of this document is to provide a comprehensive guide to tie-in operations through definition, fundamentals, rules and guidelines with the objective to set requirements in order to guarantee a safe operation.

Broadly speaking, this document applies to tie-in activities, as defined below, to be carried out during the construction of onshore pipelines. This document therefore applies to any operations involving the connection of a new line to an existing line whenever the latter is buried and/or restrained by mechanical or civil means with regards to the definition given on §4.1.

This document does not apply to standard welding – lowering-in operation. This document does not apply to offshore operation.

The content defined in this procedure can be implemented only after verification of the specific legal requirements of the country of operations. Whenever project specific or country legal requirements are different, these will prevail over the requirements of the present procedure. If those are less restrictive, the requirements herewith contained are to be followed and to be implemented as best practices.

If a project specific document is implemented outlining the present measures and protection described herein, the present procedure may not be applied. The project specific document must follow and cite this document as a standard reference.

2 References

2.1 Legislative and International References

Doc. No.	Principal Documents
ISO 45001: 2018	Occupational Health and Safety management systems – Requirements with guidance for use

2.2 Corporate References

Doc. No.	Principal Documents
	HSE Policy
	OHS MS Manual
	Operations Safety Manual
	Risk Assessment

3 Definition of Tie-in

For the purpose of the herein recommended procedure, it's important to define properly the notion of tie-in and to identify the difference with the notion of connecting a piece of pipe. In fact, it is a common misuse of language to define as a tie-in any operation that consists of connection a piece of pipe to another.

In general terms tie-in refers to the operation which causes an external piece to fit or harmonize with an existing system. This definition brings in the concept that the tie-in can be defined as a final operation which aims to complete a system or as an operation which aims to accommodate modifications of an existing system. This consequently excludes standard fitting operation such as welding a piece of pipe to another as in automatic welding operations for example.

Another key element of understanding tie-in operation is to define what is understood by 'existing system". The notion "existing" means that, whether complete or not, the system is fixed to something / not free to move.

This last concept finally allows us to exclude any operation wherever both sections are free to move such as connecting a joint to previously lowered section in a ditch, in the measure that the ditch section is not blocked by any civil (backfill, sand/dirt wall) or mechanical (come-along) means and can be moved.

Some construction methodologies used for steep slope involves that one of the sections, usually the lower one, can't be moved and therefore could be assimilated to a tie-in as per the previous herein described. As this is a very specific activity which also presents additional risks, reference shall be made to the specific project procedure or method statement developed for steep slope operations.

Therefore, tie-in is any operation, in which at least one of the pieces to be welded is blocked or cannot be accessed and/or moved, which aims to fit or complete a system.

4 Method statement

4.1 Resources

Material	Equipment	Personnel
• Pipes – Pups • Ditch wall collapse mitigations measures (sheet pile, trench box,…) • Material used for signage and delimitation (fences, barriers…) • Material used for equipment support (bog mats, wooden blocks…) • Material used for work illuminations or in site dewatering (light towers, generators) • Etc.	• Lifting equipment • Internal / External Clamps • Pipe heating solutions (propane) • Inspection gauges and tools used to check pipe geometry and set-up • Lifting hardware (slings, hoist chains …) • Rigging / Hoisting hardware used for fitting purposes (come-along …) • Etc.	• Surveyor / Geologist • Welding technicians & inspectors • Operators • Pipefitter • Grinders • Site supervision • Etc.

4.2 Methodology of Works

One of the main hazardsduring tie-in operation is the tension present on the constrained pipe section during the laying and joining of the new section. For fitting purposes or for specific operations such as welding the hydrotest head, pipes need sometimes to be forced in position by mechanical or civil means.

This situation is particularly dangerous as, if the means used to hold the pipe in position had to fail or is removed for fitting purposes, the section will tend naturally to return to its original position. This phenomenon is called piping stress release and is generated whenever a force acts on a piping system and tries to deform it. Due to the inertia effect, the piping system will try to resist that force with an internal resistance creating stress that would be released eventually uncontrolled if the force is removed.

The stress build-up can be released at any time, upon equipment / material failure or by a simple lack of knowledge / failure to identify the hazard. This movement can be violent and according to the pipe length, diameter and weight can lead to severe consequences if personnel is caught in the line of fire.

The following methodology will detail the main steps that need to be taken in order to lower the probability of this event to happen, to mitigate the consequences in order to reduce the personnel exposure to this hazard.

4.2.1 Assess & Identify

The first step in any risk-prevention methodology is to analyze the situation to prevent or reduce as low as reasonably possible the exposure to the hazard. Therefore prior to starting any fitting operation the supervisor should ensure there is no tension build-up in the section to be welded on by checking the following points:

- Is the section properly aligned with the ditch line? This can be easily checked by ensuring the section is properly placed nor misaligned and does not present an anormal deviation (delta) on its end as shown in Figure 1 below

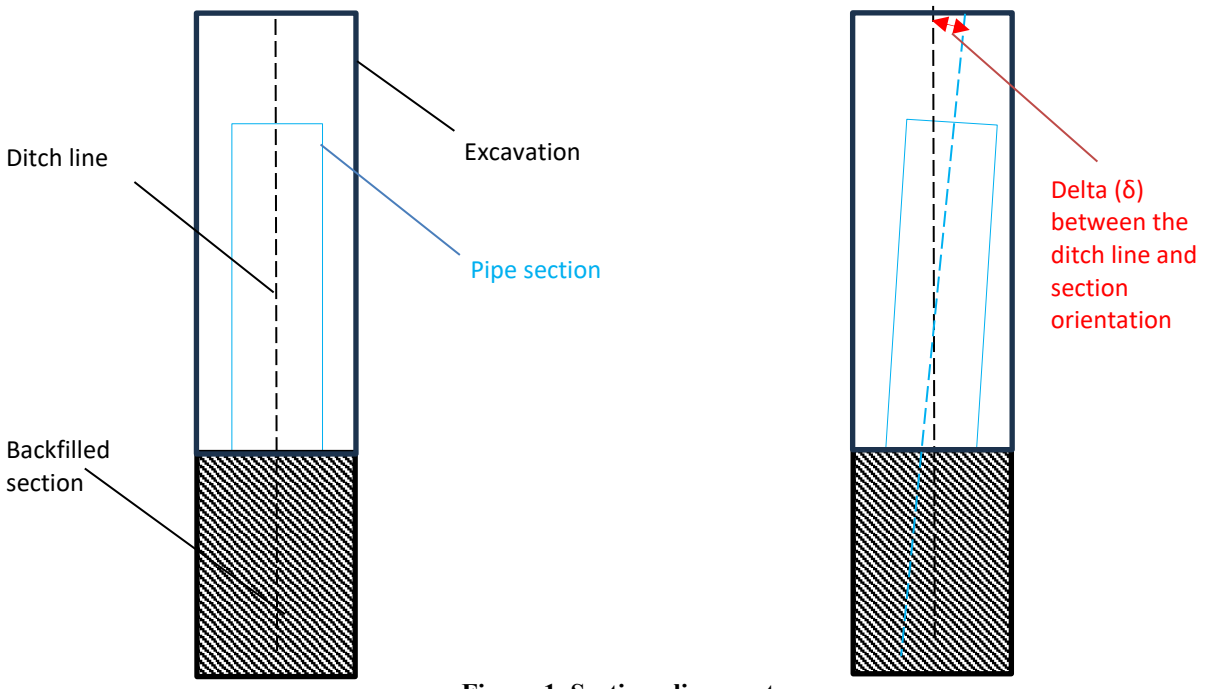


Figure 1. Section alignment

It has to be noted that this does apply to whatever kind of civil or mechanical means which block the pipe section; here it is illustrated with a part of the section being backfilled but the concept remains the same whatever the means restraining the pipe in position.

- Is there any means present holding the section? Tie-in supervisor should verify if there is any means, previously installed, holding the pipe in its actual position as shown on Figure 2 below. Particular attention should be paid, especially if the activity will require to move the section position to allow the fitting process.

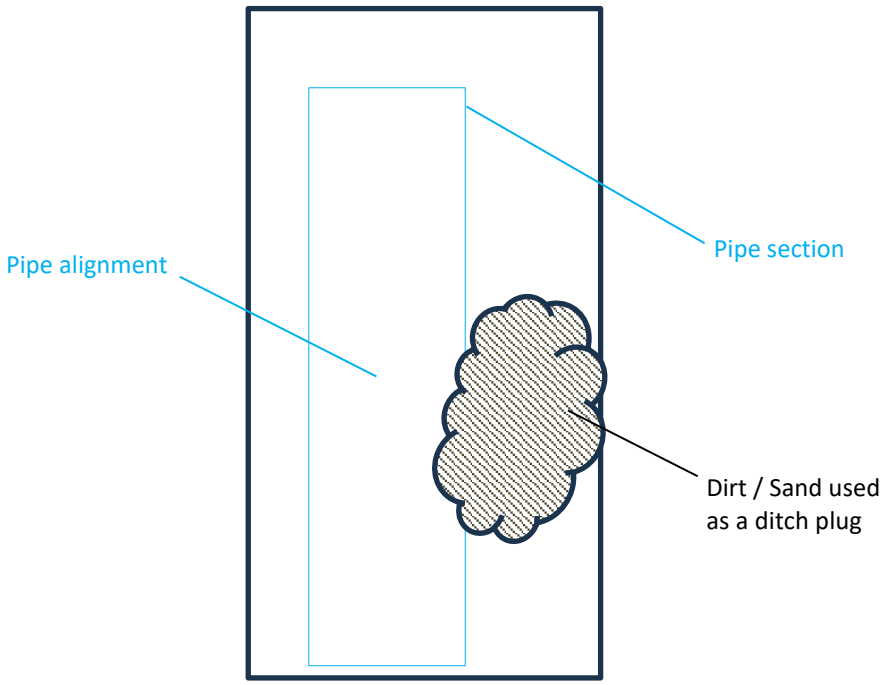


Figure 2. Tension build-up in pipe section

It has to be noted that this does apply to whatever the pipe section is aligned with, the ditch line or not. Supervisor should ensure that, if there is any means of previously installed methods to hold the pipe in a certain position, these means are in proper working condition and to assess if the activity can be safely performed.

These checks should be performed prior to starting the tie-in operation as part of the Job Hazard Analysis. If any tension build-up is noted supervisor should assess if the tension can be removed prior to starting the activity and inform all workers involved in the fitting activity of the hazard and related preventions measures.

4.2.2 Limit the Exposure

As previously mentioned in §A, the first step of risk-prevention methodology is to try to eliminate or prevent the exposure to the hazard. Therefore, since for fitting or laying operations some practices can lead to stress the pipe and create tension build-up, the first step is to limit as reasonably as possible to fall back on these practices.

- Forcing pipe into position – Longitudinal stress: An incorrect pipe position or a wrong engineering / layout of the pipe – excavation can lead to the technical difficulty to align both sections and to perform the fit-up operation. A common practice is to apply a longitudinal force, usually applied by

an external mechanical means such as an additional lifting equipment or a come-along as shown in Figure 3 below.

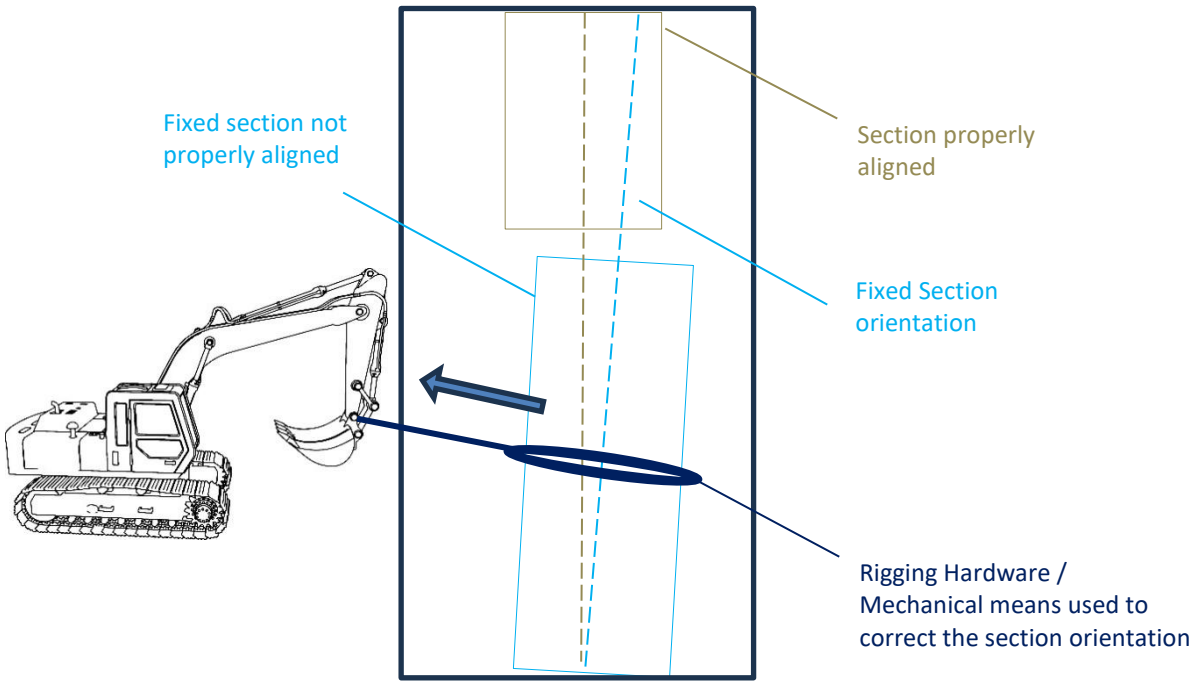
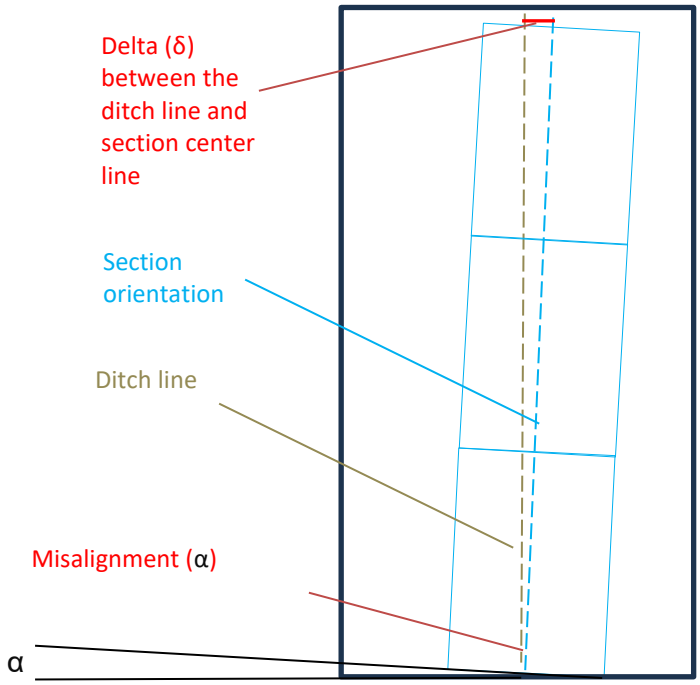


Figure 3. Longitudinal stress applied for fitting operation

Applying external longitudinal force to a fixed pipe section should be limited as reasonably as possible, however sometimes this operation can be necessary to fit-up a pipe. Therefore, to prevent this issue, pipe position should be always controlled by the pipe-fitter and corrected as soon as reasonably possible, as the later the orientation is corrected the more it would require to be displaced and the more it would generate tension.



Delta has been voluntarily exaggerated in Figure 4. To illustrate the phenomenon.

However, it is important to remember that a single degree of misalignment (α=1°) will lead, on a base of 18m joint, to the following significant delt built-up:

Distance (meters)	Delta δ (meters)
18 (1 pipe)	0.31
36 (2 pipes)	0.63
54 (3 pipes)	0.94

Figure 4. Misaligment and illustration of delta

However, in some specific operations the pipe alignment is voluntarily not properly oriented to allow an operation such as fitting hydrotest or pigging heads and/or can't be corrected. In those cases, the risk to be exposed to tension hazards is present, therefore supervisor must ensure to apply the best practices control measures.

4.2.3 Control Measures

4.2.3.1 Pipe Fitting

As sometimes the exposure tension cannot be removed a number of best practices / control measures shall be implemented to ensure the safe execution of the activity. Supervisor should enforce an exclusion zone during the pipe lifting, fitting and welding operations. Excavation shall be designed as an exclusion zone during pipe movements, access shall be granted, only to competent, limited and trained personnel for fitting purposes. The personnel involved in the fitting operation should be aware of the line of fire and tension, if any, present in the pipe to be able to properly place themselves out of the danger zone, as shown in Figure 5.

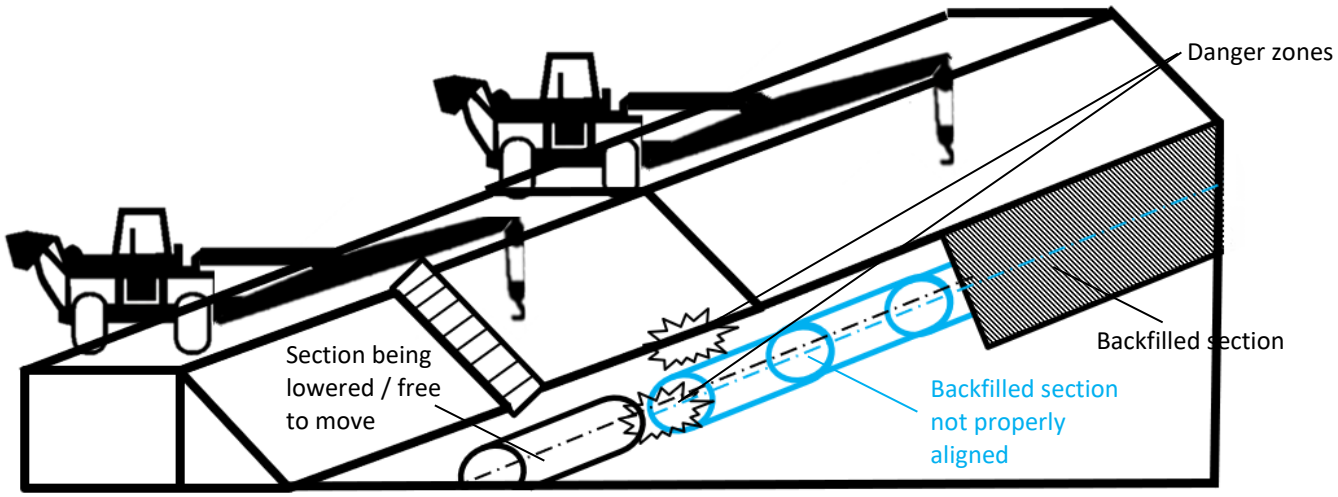


Figure 5. Line of fire Illustration during tie-in operations

In addition to standard line of fire with heavy equipment and suspended loads, workers involved in the tie-in activity should be aware of the 4 following danger zones:

- Crush point between pipes, this is valid in any welding operation between the section heads.
- Crush point between overlapping pipes in case of an overlapping section.
- Crush point between pipes and ditch walls while the pipe is a suspended load until the pipe is in its final position to be clamped,
- Crush point between pipes and ditch walls during all tie-in operations with the pipe identified with tension.

As tension cannot always be detected and as we can all fail in the assessment of this hazard, it's crucial to ensure nobody, under any circumstances, is located between an overlapping section and another pipe / hard surface and/or during tensioning of a "fixed" section between the "fixed" section and the ditch wall. This latter statement is valid whatever the axis of the force is applied as the pipe section could have been held by

a ditch plug, previously removed for the fitting operation, and could return to its original axis upon being lifted.

It is important to mention that during tie-in operation and especially unless pipe is clamped, the access to the excavation shall be limited only to the pipe fitting personnel. Pipe fitting personnel shall, on their hand, await the final approach of the pipe to enter the excavation to start the fitting operation placing themselves according the above-mentioned danger zones.

4.2.3.2 Use of External Line-up Clamps

Personnel involved in the fitting and welding operations shall be aware when using external centering equipment (Line-up clamps) for connections (tie-ins), that there is a possibility for the external clamp to fail. This could lead to the immediate release of the pipe sections due to unforeseeable and latent tensions.

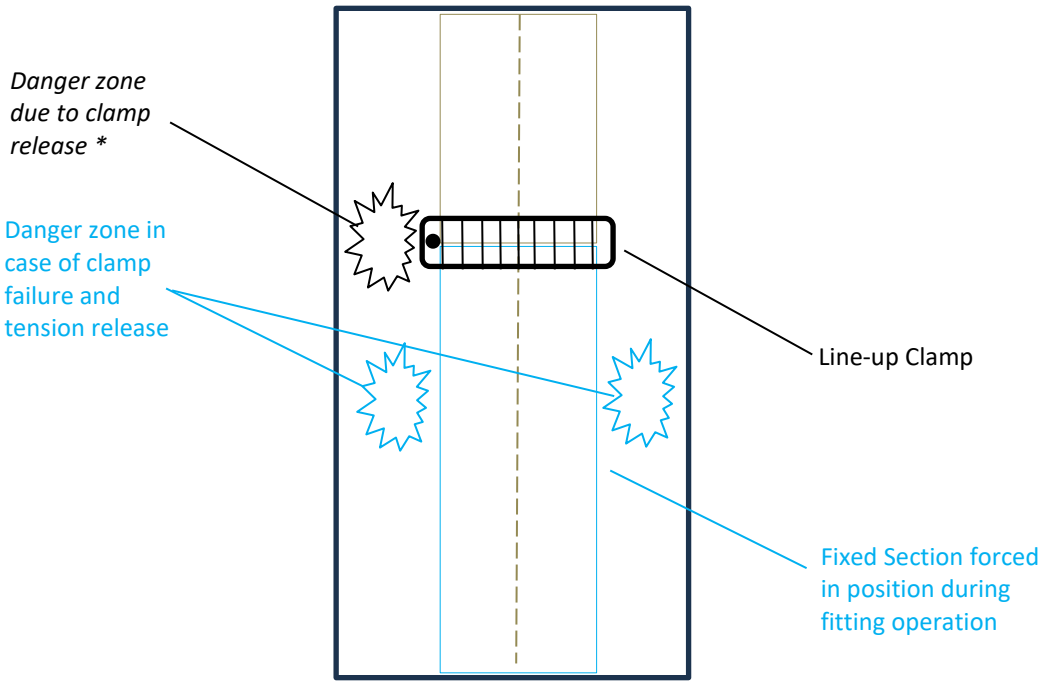


Figure 6. Line of fire external clamp

** It has to be noted that while manipulating the line-up clamp the main danger zone is located on the clamp's fitting side, area in which the clamp is likely to break free in case of failure, therefore this danger zone can be located on either side of the pipe according to the clamp position.*

To limit the exposure of the workers the supervisor shall ensure to secure the section against jerky movements. This can be achieved by ensuring each side of the welds / each section is supported by a lifting equipment or other means of constraint. On the other hand, Supervisor shall ensure, once pipe is fitted, that all lifting equipment is secured in position (hydraulic lever engage, brakes secured) to prevent any undesired movement of the pipe during the welding operation.

Supervisor and pipe fitter shall especially pay attention during the fitting operation to limit the tension build-up and to ensure the proper installation of the clamp without exaggeration of force. According to the configuration supervisor could decide to use a hydraulic line-up clamp for 'heavy duty' situations when tension build-up has been identified.

Personnel involved in the fitting activity shall be adequately trained with regards to the line of fire / danger zones and to the safe handling of the line-up clamp. It is crucial to understand the pinch and crush points generated and where not to be standing during the fitting activity.

Personnel involved in the fitting activity shall be aware of the best practices mentioned in the paragraphs above, moving themselves outside of the danger zones whenever the pipe position needs to be adjusted for fitting purposes. Under no circumstances, the pipe position shall be moved, once clamped, without first requesting all personnel inside the ditch to move out.

4.2.3.3 Cutting Operation

Personnel involved in cutting operations shall be aware of the existing potential for the pipe to be under tension and thus move jerkily due to unforeseeable and latent tensions. Supervisor and pipe-fitter should assess the overall situation prior to starting the cutting operation referring to §A.

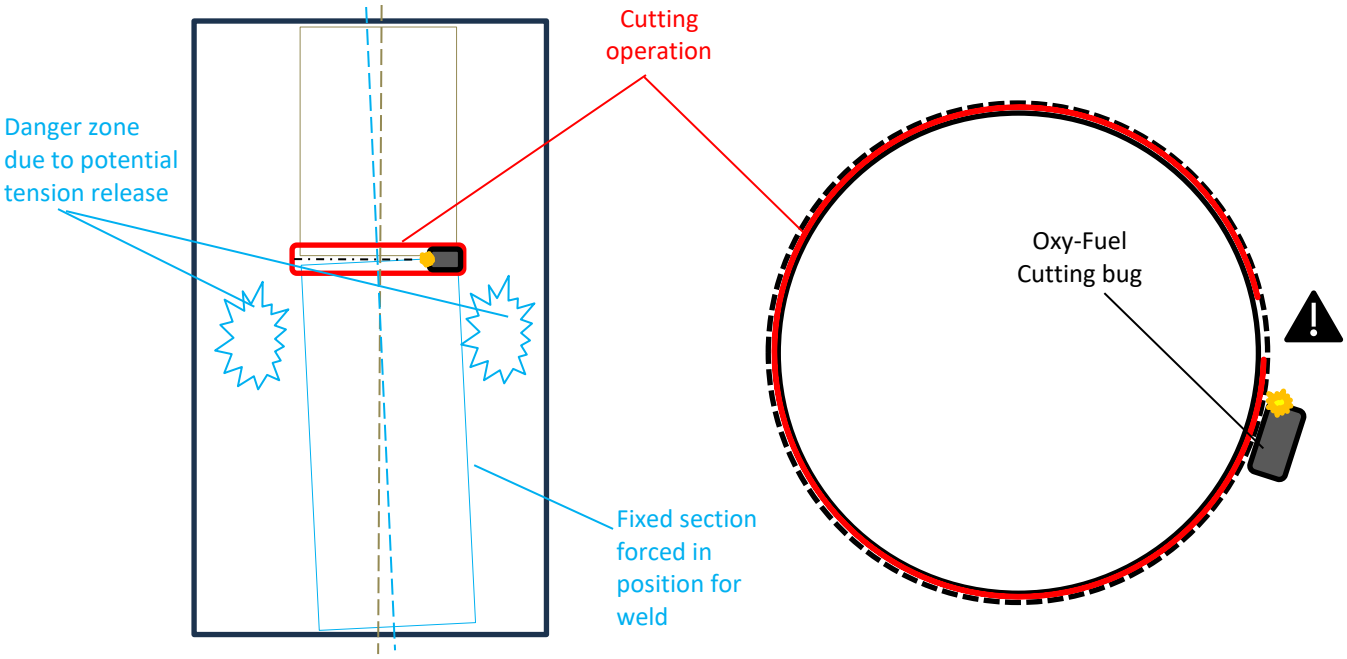


Figure 7. Tension release during cutting operation

During cutting operation personnel shall be particularly cautious in the final approach of the Oxy-Fuel Cutting bug as the pipe, if submitted to inner tension, could suddenly break and be released causing an abrupt movement.

To limit the exposure of the workers the supervisor shall ensure to secure the section against jerky movements prior to starting the cutting operation. This can be achieved by ensuring each side of the cut is supported by a lifting equipment or other constraint means. Personnel in the vicinity of the cutting operation shall be restricted to the strict minimum trained workforce.

If one side of the section to be cut has ground coverage it is the supervisor's responsibility to ensure it can be considered as an adequate retention method considering the length of pipe covered and free pipe. In case of doubts personnel shall follow the standard methodology involving the use of 1 lifting equipment on each side of the cutting operation.

As the cutting operation proceeds the personnel involved shall pay particular attention to any cutting edge movements (lateral, vertical, torsional) as they can be an indicator of pipe tension. It is crucial to stop the operation if any movements are identified and to contact the supervisor in charge. To resume the operation the pipe shall be secured against any movements by lifting or others means of constraint.

As the bug approaches its final position, the personnel shall properly place themselves according to the danger zone identified as per Figure 7. Personnel shall as reasonably as possible avoid to stage themselves in front of the cutting operation during the final approach due to the potential of pipe release.

4.2.4 Exemption and Particular Cases

In certain conditions, the above-mentioned methodology needs to be applied with specificities, this can be due to a situation as welding on a steep slope for example or due to a particular process as cutting an overlapping section. The current paragraph will focus on such conditions and the particularities they entail.

4.2.4.1 D.1 Overlapping Section Tie-in / Cutting Operation

In some specific occasion such as after hydrotest completion, the golden weld must be carried by cutting out an overlapping section as shown on Figure 8 below.

Figure 8. Overlapping sections

This operation can be hazardous due to the potential inner tension present in the pipe and the worker exposure with the overlapping section.

In the current Figure the presence of tension can be deducted thanks to the backfilling plug and by looking at the section's axis (voluntarily offset to previously allow the fitting of the hydrotest head)

For cutting purpose, the measurement is sometimes done by overlaying one section above another. In this specific case, in addition to the previously mentioned hazards, the personnel shall be aware of the potential for the tension in pipe to be released upon being lifted. As such movements are difficult to predict the supervisor shall enforce the following points, whatever the presence of tension is suspected or not:

- As mentioned under paragraph B Figure 3, it's crucial to ensure nobody, under any circumstances, is located between an overlapping section and another pipe. This needs to be considered as a critical

danger zone. Access shall be granted only by accessing the ditch in a way that no one has to be exposed to this danger zone as for example providing access up and downstream of the operation.

- Supervisor shall enforce a clear exclusion zone and keep a clear visual on the danger zone, to ensure nobody is exposed, prior to giving the permission to the operators to proceed. Under no circumstances, the operators shall start the lifting operation prior to receive the confirmation that the danger zone is cleared and that the permission has been granted.

- Supervisor shall pay particular attention to the hoisting equipment set-up and especially location, avoiding as reasonably as possible to have a sling present between the overlapping sections. If the hoisting hardware require to be moved, personnel shall refer to the first point mentioned before. Supervisor shall provide safe means to reach the rigging hardware without exposing the personnel such as a pike pole or using another hoisting equipment to "run" the sling without additional human intervention.

- As pipe sections are usually set offset of the ditch central line using civil or mechanical means, the supervisor shall be particularly cautious if such means were previously removed or had to be removed to allow the cutting – fitting operation. As mentioned in the point above nobody shall be standing by the danger zone during such operation, as the pipe could be released together with the means used to keep it offset. If such means are removed before any tie-in / cutting activity, it shall be clearly reminded to the personnel during the Toolbox Talk and documented under the JSA (Job Safety Analysis) prior to performing the tie-in / cutting activity.

4.2.4.2 D.2 Steep Slope Section Tie-in & Alignment Operation

The Figure 9 below illustrates the typical challenges involved with steep slope sections:

- Technical difficulty to move one section, even if not restrained by any means except its own weight.

- Technical difficulty to correct pipe position and to prevent its release by the use of lifting means.

Figure 9. Tie-in operation on steep slope

According to these conditions, a specific methodology must be developed for tie-in operations on steep slope. This paragraph will list the key control measures to be taken into account into project specific steep slope documentation.

The first step is to make the difference between the various methodologies that can be used:

- D1 Classic operation using lifting equipment to lower the section in the ditch and perform welding, cutting etc operations. Supervisor shall refer to project engineered lifting reduced chart and equipment traction capacities. This methodology presents the advantage to allow the use of 2 or more lifting means as in standard operation. Therefore, personnel shall refer to §4.2.1 to 4.2.4.1. In D1 configuration standard construction methodology detailed in specific project procedures which take into account slope hazards and requirements shall be followed. This usually applies to smoother slopes where heavy equipment can be used safely or using winching support.

- D2 Winch operation using a Line up sled connected to a winch to lower the section from the top of the slope toward the welding point. Specific steep slope documentation shall refer to project engineered winching drawings. This methodology, if not combined with a lifting means, does not allow the option to move the lower section for the fitting operation thus making any welding operation a tie-in activity as per definition given in §4.1.

- D3 Cable crane operation using a cableway to lower the section onto the ditch location. Supervisor shall refer to project specific cable crane documentation. This methodology, if not combined with a lifting mean, does not allow the option to move the lower section for the fitting operation thus making any welding operation a tie-in activity as per definition given in §4.1.

As described in paragraph B Figure 3 a longitudinal stress can be applied to the lower section in order to rectify its position, this can be applied in D2 or D3, by means of a come along pulley system. As this system will generate stress in the section the control measures defined in the present document shall be taken into account when developing Project specific steep slope documentation. Thus, as previously mentioned pipe position shall be corrected as soon as possible to limit the force required to move the section and thus the stress generated in the pipe.

The Figure 10 below illustrates the typical challenges involved to correct a wrong pipe alignment on steeper sections where the use of lifting means is limited and restricted

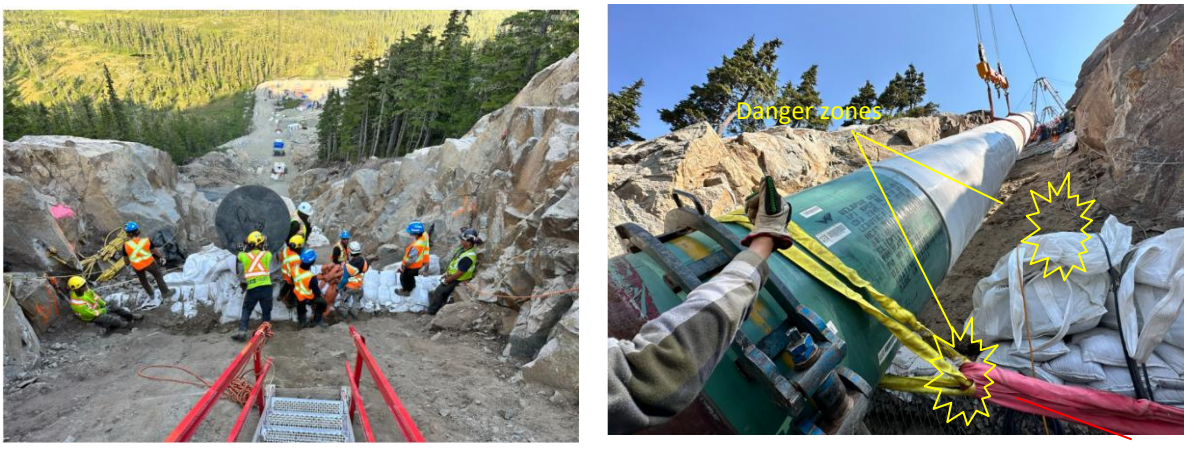


Figure 10. Rectify pipe alignement on steep slope for fitting

During such activity, the following control measures shall be applied:

- Anchor points, if used, shall be approved as per engineering design, and tested to ensure their viability. The rigging hardware used in the come-along pulley system operation shall be properly rated for the operation.

- Prior to starting the operation, the access to the location shall be restricted to a small quantity of trained personnel (pipe-fitter – come-along pulley system technician). Other personnel shall be staged uphill of the operation on the free-section side.

- Pipe shall be secured with the clamp and the lifting equipment (here illustrated with the cable crane) shall be in position prior to letting anyone walk by the fitting area due to the danger zone. Under no circumstances the come-along pulley system shall be manipulated as long as someone is in the danger zone. Under no circumstances will the come-along pulley system be manipulated without the supervisor approval.

- As reasonably as possible personnel shall avoid walking under / by the come-along system as long as the latter is in tension in case of undesired failure. It is important to note that nobody shall be crawling under the suspended load at any time as well.

- Under no circumstances, as the suspended load is in its final approach, someone shall be standing between the pipe ends or exposing its hands, legs or any body part. This hazard mentioned previously does particularly apply to steep slope due to the pipe inertia and gravity effect (D2 allow a better control than D1 and D3 on this point).

For other specific situations, not mentioned above, for which the standard methodology described in §A, B and C could not be applied, supervisor shall refer to specific steep slope method statements and construction management for the methodology to be applied..

Any change of methodology or new approach shall be developed with regards to the herein guideline and applicable legal requirements. Personnel shall always keep in mind the hazard associated with tie-in operation such as tension build-up, crush and pinch points as major hazards to be controlled during such activities