ENSURING SAFETY IN PIPELINE CROSSINGS FOR MARINE INSTALLATIONS

Phil Footman-Williams, Lee Hashem (TE SubCom)
Email: pfootman@subcom.com
TE SubCom, 250 Industrial Way West, Eatontown, NJ, 07724, USA

Abstract: The operational and commercial risk of installing a telecommunication cable in a region with a large number of oil and gas pipeline crossings poses unique requirements on the project. Managing this risk requires a focus on safety with in-region resources and intricate liaison with pipeline owners, cable system owners, and permitting authorities in multiple countries. The requirements of the cable ship, crew training, hazard identification, safety and installation procedures are especially heightened. The successful program requires in-region experience and close co-operation between client and supply contractor.

1. INTRODUCTION

Telecommunications cables installed in regions with significant oil and gas activity can face unique challenges with multiple pipelines, owners and countries.
The operational management of the processes and liaison requires a significant focus and significant in-region resources to manage this activity in order to ensure safety of personnel and plant, prevent delays and cost overruns.
In this paper, we discuss the operational aspects of successfully completing over one hundred pipeline crossings with twenty pipeline owners in ten different countries.
The requirements of the cable ship, crew training, hazard identification, safety and installation procedures are discussed, together with the intricate liaison between all operational and permitting parties. The need for pre and post installation surveys, use of spacers, coverings, mattresses, and other protection methods, burial, and the importance of documentation is also discussed.

2. CHALLENGES OF MULTIPLE CROSSINGS

The challenges that arise with multiple crossings can be grouped into three primary categories:

- Multiple Owners
- Multiple Countries
- Pipeline and oilfield congestion

Multiple pipelines occur frequently in many regions such as The Gulf (shown in the chart below), the west coast of India, and in the Red Sea near Suez.

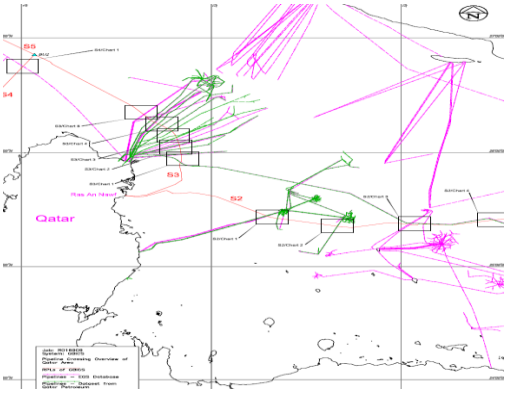

Figure 1: Pipeline Congestion in The Gulf

Multiple Pipeline Owners: Pipeline Crossing Agreements between the cable and pipeline owners require extensive negotiation as they set long-term (life-time) and short-term (installation) commitments and liabilities for the parties and represent significant commercial impact. Crossing Agreements include legal, commercial, technical and operational documents. Since each document and elements within require reviews within each company by their experts, the process tends to be a lengthy one. Each Crossing Agreement must be

signed with each pipeline owner and, as a single pipeline may itself have multiple owners, this further adds to the complexity and time required. The process is best initiated at the earliest phase of the project for these reasons.
Each pipeline owner will have its own unique requirements which must be vetted with all parties. These include:

- Specific legal/commercial terms
- Specific technical and operational requirements
- Different legal/signature processes

Liaison with multiple pipeline owners is time consuming, especially in instances where Crossing Agreement negotiations become protracted due to the liabilities and financial exposure being assumed by each party.

Different / Multiple Countries: Where a cable route crosses multiple jurisdictions, those countries will likely have different, national requirements for vessels operating inside their territorial waters. In addition, there are requirements for operating inside lease blocks and active oil fields, as well the requirements of the pipeline owners. The negotiations required obtaining these multiple permits and the liaison effort to manage these requirements is considerable.

Pipeline and oilfield congestion: Oil and gas fields can be congested and in restricted areas where pipelines are less than 1000 metres apart. For example, based on information from a database of pipelines, one congested oil field has 20 pipeline, cable and umbilical crossings inside a route distance of 30 kilometres. Each such crossing must be planned individually and, as crossings usually occur with multiple owners, the planning and liaison challenge is considerable. In our specific experience of the multiple-crossing scenario, oil companies will often require provisions for future pipeline installations.
Dedicated, crossing-management teams and experienced personnel is the only feasible way for these challenges to be met.

3. PROJECT PLANNING PHASE

Ensuring the safe crossing of pipelines and protecting project timelines and budgets begins early in the project planning phase. Critical, long-lead tasks must be initiated at the start of the project; namely:

- Identification of pipelines and owners
- Pipeline separation specifications
- Safety protocols and procedures
- Approvals to work
- Logistics

Each of these tasks requires a specific knowledge base that can only be acquired through experience.

Identification of Seabed Assets: All oilfield assets, including pipelines, subsea manifolds, platforms and rigs are identified during the desk-top study phase. However, the different data bases in use may well result in ambiguous data, especially with multiple crossings. Often, purchased databases show conceptual connections between facilities, not the actual route position. It is essential to resolve these conflicts at an early stage in the project planning process. An accurate database is indispensable, as is direct communication with the pipeline owners. At this stage, it is also important to discuss oilfield development plans and future builds which may affect the cable route and installation.

Ambiguities which cannot be resolved in the early planning phase should be highlighted for investigation during the route survey phase.

Pipeline separation specifications: The specifications of the separation between pipeline and cable will vary from pipeline owner to pipeline owner as pipelines differ in construction and owners have different internal requirements. These may include:-

- High density polyurethane half shell protectors which enable approximately 30mm separation between cable and pipeline
- Some pipeline owners require 350mm separation and this is also enabled by the application of thicker polyurethane protectors
- Concrete mattresses, bridges, sleepers, rock dumping may also be specified
- Some materials and pipeline owners may require Touch Down Monitoring (TDM) to ensure accurate positioning and alignment. The figure below shows the TE SubCom vessel Teneo undertaking TDM

Figure 2: TE SubCom Vessel Teneo - TDM

Separation requirements and associated operations vary in cost, time and availability. Typical separation materials are shown in the following figures:

Figure 3: Polyurethane covering for 350mm separation between cable and pipeline.

Figure 4: Polyurethane covering for 30mm separation between cable and pipeline.

Safety Protocols and Procedures:

Pipeline owners often each have their own safety protocols and technical requirements, as outlined below, such as:

- Vessel-specific Safety Interface Agreements before any vessel can operate
- Vessel and machinery maintenance as part of the Safety Audit
- Pre installation ROV surveys of the pipeline
- Pipeline owners with piggy-back pipelines requiring TDM

Dialogue is essential to develop trust and rapport with the pipeline owners and to better establish clear lines of communication and to develop safety/technical procedures.

Approvals to Work: In addition to national permitting requirements, pipeline owners often require that all vessels operating inside their oilfields meet their own specific safety and operating standards, which include survey, installation and support vessels.

Figure 5: TE SubCom Vessel used for pipeline crossing installations.

Vessels will be expected to meet high standards of construction, maintenance and operation, which will apply to all aspects of the vessel operation. This will include Dynamic Positioning, ROV systems, cable handling systems, and environmental protection systems. Modern, competently manned vessels are essential, such as the vessel shown in figure 5.

Requirements vary from owner to owner but typically include the following prior to receiving approvals to work:

- Vessels and crews will be subject to a detailed audit, inspection and survey
- Vessel owner and/or charterer safety procedures and policies will be inspected, safety and accident records will be checked
- Project-specific safety plans must be prepared and inspected. Emergency plans will be required
- Project/pipeline risk assessments (HAZIDS) must be prepared, discussed and approved including an analysis of all risks and risk mitigation actions
- Methods of Procedures are required for each pipeline crossing and include detailed charts and route position lists

Logistics: In situations of multiple pipeline crossings, procurement and delivery of the separation materials and storage onboard the installation vessel becomes critical. Few of these materials are generic, readily available and simple to apply over all pipelines. Most such materials, however, have to be planned and manufactured on a pipeline-by-pipeline basis, have a long lead time and may require additional training to apply. This conclusion is based on SubCom's experience in applying various types of separation material available for use with pipelines. Separation materials can also be large and storage onboard has to be planned at an early stage in the project.

Documentation: Multiple pipeline crossings will involve a large number of documents from pre operational planning, through formal crossing agreements, safety requirements, operational procedures to final reporting and charting. Documentation control and management is a critical factor in the safety and success of a project.

4. OPERATIONAL PLANNING

The oil and gas industry operational and safety regulations vary from country to country and from pipeline owner to pipeline owner. In two recent projects, the one hundred pipeline crossings involving twenty pipeline owners in ten countries, it was essential that each planned and installed as an individual crossing. Long-lead project planning criteria were discussed in preceding sections, and operational criteria are discussed here.

Risk management: All personnel and operational risks, including survey, installation, ROV/plough operations,

weather and medical etc. must be identified and evaluated so that mitigation methods can be developed. Formal planning techniques such as HAZIDS enable these risks to be qualified and quantified and is a process that the majority of pipeline owners require as part of the approval to work permit. Given the risks and liability associated with this work, the need for experienced staff to perform this analysis should not be underestimated.

Crossing Methodologies: Detailed crossing methodologies (Methods of Procedure or MOPs) are prepared and agreed with pipeline owners and cover each pipeline crossing. MOPs must comply with the recommendations of the HAZIDS and will include:

- Crossing charts and position lists
- Vessel installation operations
- ROV survey operations
- Vessel and equipment specifications
- Separation material specifications
- Communication plans

It is crucial that the MOPs are prepared and agreed by all team members, and that they are adhered to completely. An experienced supplier requires a team and necessary equipment dedicated to the efficient and accurate production of these documents. There are also stringent timing and notification requirements that a supplier must diligently observe in order to avoid conflicts with the pipeline owner and preserve the installation schedule.

5. OPERATIONAL PHASE

Operations inside oil fields and across pipelines can only be undertaken once all the planning, permits, safety protocols and methods of procedures are agreed and in place. All operations, including surveys and installation, must be undertaken in full compliance with agreed documentation and requirements.

Location / Survey of pipelines: The first operation inside the oilfields is the marine route survey, during which pipeline positions are verified and ambiguities and conflicts in database positions are resolved. Due to the protracted efforts required to obtain permits to work inside oilfields, it is critical to resolve all position conflicts at this stage and to ensure that all the pipelines have been positively located and identified.
It may be advisable to conduct ROV surveys of the pipelines prior to cable installation, especially in areas where significant fishing takes place and where pipeline damage occurs. This could protect the cable owners against possible claims.
In The Gulf, some pipeline owners require pre ROV surveys as a condition of the permit to work.

Permit Compliance: Permits and crossing agreements will have been obtained during the project planning phase and these contain deliverables and compliances. In cases of multiple pipeline crossings and multiple countries, these compliances can be significant. Compliance with safety requirements and deliverables is paramount, as is the necessity of adhering to the Notification protocols.

Cableship audits / Crew training: Prior to commencing operations inside oilfields it is necessary to conduct vessel audits, and to ensure that the vessel and crews are fully qualified and trained to carry out the work as per the agreed MOPs. Methodologies associated with pipeline crossing operations (installation, survey, TDM) vary from pipeline to pipeline and everyone must be fully competent with the different operations.

Command and Control: In all pipeline crossings, decisive command and control is paramount, but in the case of multiple crossings, it is essential to have clear and

unambiguous lines of communication between pipeline owner, onshore project management and offshore cable installation teams. These lines of communication must be established at the early planning stages of the project and must continue until the end of the project - trust and integrity between all parties is critical in the success of the installation.

Liaison with Third Parties: Oilfields can be congested sites with a number of different operations being carried out by different contractors at the same time. The permits, safety protocols and MOPs will specify liaison, reporting and notification requirements and these must be complied with. With multiple national permit authorities as well as multiple pipeline owners to liaise with, each with different requirements, this can be a significant task. It is important for a supplier to have existing relationships and/or know the process for forming these relationships quickly and effectively.

Pipeline Owner Representatives: Pipeline owners may well require a representative onboard the installation vessel. In cases where the vessel enters and exits different national boundaries and crosses different owners´ pipelines, the logistics may be complicated and personnel transfers may be required. Careful planning and close liaison is required.

Shipboard Operations: The paramount issue during all operations is personnel safety and safety protocols, HAZIDS and MOPs will have been focussed on conducting operations with this in mind. All operations and onboard activities must be undertaken in full accordance with the instructions contained in these documents and it is important that these are fully understood by the entire team. Of particular importance during installation operations are:

- Oil platform exclusion zones
- Plough exclusion zones
- Vessel navigation and positioning
- Application of separation materials
- Notifications and third party liaison
- Pre and Post Lay Inspections
- Reporting, charting and documentation

6. CONCLUSIONS

Given the critical nature of crossing a pipeline safely, it is imperative for the supplier to have the ability to accurately plan and implement pipeline crossing solutions. The primary conclusions following SubCom´s recent projects involving multiple pipeline crossings and pipeline owners are:

- Focus early on identification of pipelines, owners, and pipeline positions; and resolve ambiguities in multiple datasets and charts. This minimizes the risk and extraordinary hazard of plowing through unknown pipelines, which could permanently derail a project.
- Effectively negotiate crossing agreements with pipeline owners at an early stage to establish lines of communication, set safety protocols and identify crossing specifications.
- Liaison with pipeline owners and national authorities in a continuous process throughout the project through a dedicated in-country team. The supplier should be skilled in establishing trust and respect between cable owner, pipeline owner and installer.
- Safety protocols and operating procedures are clearly understood and followed by the entire team.
- Pipeline crossing operations and support operations must be undertaken using only quality vessels,

with experienced, fully trained and professional crews backed up by solid project management.

7. REFERENCES

[1] C: Green, Trelleborg, Technical presentation 2011
[2] TE SubCom Pipeline Crossing procedures 2011