Umbilical Termination Assembly (UTA) Selection and Sizing Recommendations

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Introduction

General

This document was compiled by the UMSIRE Joint Industry Project (JIP) group with the aim of addressing the increasing difficulties in installation of high-functionality subsea umbilical terminations (SUTs). The document focuses on highlighting the implications of increasing size and weight on installation. The JIP committee was composed of a representative cross section of experienced industry personnel from umbilical and umbilical termination assembly (UTA) manufacturers, installation contractors, and operators. UTA is a subassembly of SUT.

While there are widely accepted codes and standards for the design of UTA and its subsystems, such as materials, core connector type, tubing specification, corrosion protection, and lifting arrangements, none of these standards specifically address the substantially increased risks incurred during packing, handling, and installing umbilicals with large UTAs.

The JIP deliverables are two API documents, API Technical Report 17TR9, *Umbilical Termination Assembly (UTA) Selection and Sizing Recommendations*, and API Technical Report 17TR10, *Subsea Umbilical Termination (SUT) Design Recommendations*.

NOTE API 17TR10 deals in more depth with umbilical and UTA installation and the differing style and restrictions of installation lay spread types.

Use of the Document

This document is intended to be used as a reference guide by end users and operators, UTA and umbilical manufacturers, installers, and front-end engineering design (FEED) companies. The intention is that the document will enable the currently inherent installation difficulties to be addressed up front by the UTA designers, prior to commencing SUT design and functionality definition. It is also intended to be used as a reference document to enable reviews to be undertaken to ensure that installation risk has been properly considered as part of SUT design and operations reviews on a case-by-case basis.

This document assumes that the reader has a good level of understanding of the design, engineering, and installation of UTAs and other related components. API 17TR10 may be referred to for educational purposes and for additional technical information on UTAs. API 17TR10 can also be referred to for understanding and highlighting installation vessel and lay-spread restrictions that are compounded if unnecessary dimension and weight increases are made without a full awareness of these areas.

Applicability

In recent years, the size and complexity of umbilical terminations have grown considerably, driven by increasing umbilical functionality and additional flexibility and redundancy capability, as well as the need to integrate with functions found on subsea SUTs, manifolds, wellheads, subsea trees, booster pumps, etc. Due to some of the existing lay spreads and their long service life, the equipment has been unable to keep pace with these UTA changes. It also appears that the difficulties and increased risk implications incurred during installation of excessively large UTAs are not given due consideration during early planning stages. Historically, in some cases, the design has been such that the UTA cannot be easily deployed when connected to the umbilical by conventional installation methods.

This emerging trend poses severe challenges to installers and appears to be compounded by the increased functionality and higher expectations of parties in the supply chain (FEED contractors, termination designers, operators, and manufacturers). This trend has led to occurrences where the SUT cannot be installed through conventional lay equipment, which results in the necessity for higher specification lay spreads and vessels and proportionately increased risk to personnel, equipment, schedule, and overall impact on the project cost.

Without full consideration of these collective impacts, this trend of higher functionality and proportionately larger UTAs is expected to continue.

It is acknowledged that having a separate subsea distribution unit (SDU) may have an impact on the overall cost. However, the costs of the UTA/SDU alone is not the deciding factor in increasing the UTA proportions and weight to achieve an all-encompassing single UTA. Further analysis is undertaken for the whole life cycle of the UTA, which may include the following:

— packing, transporting, and increased installation costs of the larger unit in conjunction with a risk analysis;

— assessment of the aforementioned factors with detailed examination of the increased risks in offshore handling, deployment, and lay-down on the seabed.

This final UTA design approval may be made following close scrutiny of these analyses and assessments.

API 17TR9 applies during all stages of UTA concept selection, design, and installation.

Be aware that integration of distribution leads typically leads to increase in size of the UTA; however, it is required in some cases (e.g. integrated umbilical termination and distribution units) and can be a valid technical solution for smaller developments. Wherever it is required, the size of the UTA should the kept within the category sizes detailed within this document. For the purpose of this document, it is assumed that the termination does not provide distribution.

Umbilical Termination Assembly (UTA)
Selection and Sizing Recommendations

1 Scope

This technical report identifies and describes:

— technical, commercial, and installation risks associated with high-functionality umbilicals and umbilical terminations [resulting in large and heavy umbilical termination assemblies (UTAs)], especially with respect to installation;

— implications of decisions made early in the umbilical and subsea umbilical termination (SUT) planning, selection, and design phases, to ease the manufacturing, handling, and final umbilical/UTA installation;

— guidance on specification and sizing of umbilical terminations, including overall size, weight, and handling requirements.

This document is intended to aid with informed decision making and selection of optimal choices during the early design phase of field development.

The primary purpose of this document is to be a reference guide during the early field development planning stage to ensure that due consideration is given to the implications of the size of UTAs and possible consequences during installation.

Guidelines for the design of UTAs are included in API 17TR10.

2 Normative References

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

API Specification 17E, *Specification for Subsea Umbilicals*, Fourth Edition, October 2010

API Technical Report 17TR10, *Subsea Umbilical Termination (SUT) Design Recommendations*

ASME/ANSI B16.5, *Pipe Flanges and Flanged Fittings: NPS ½ through NPS 24 Metric/Inch Standard*

3 Terms, Definitions, Acronyms, Abbreviations, and Symbols

3.1 Terms and Definitions

For the purposes of this document, the following definitions apply.

3.1.1
bend restrictor
(Definition as per API 17E.)

Device for limiting the bend radius of the umbilical by mechanical means (*from API 17E*).

NOTE 1 The definition of bend restrictor and bend stiffener are very similar; the two terms are commonly used in the industry and hence have been defined separately.

NOTE 2 A bend restrictor is typically composed of a series of interlocking metallic or molded rings, applied over the umbilical. It is sometimes referred to as a bend strain reliever (BSR) or bend limiter.

3.1.2
bend stiffener
bend strain reliever
Device for controlling bending strain in the umbilical by providing a localized increase in stiffness; usually a molded device, sometimes reinforced depending on the required duty, applied over the umbilical.

NOTE 1 The stiffener is usually a molded device, sometimes reinforced, depending on the required duty, applied over the umbilical.

NOTE 2 This is sometimes referred to as a "*bend strain reliever*."

3.1.3
rigid length
Sum of the combined lengths of the UTA and subsea termination interface (STI) and any other component that increases the axial rigid length and cannot easily be removed or reinstalled offshore.

NOTE Further details are provided in 6.2.6 and Figure 5, Figure 6, and Figure 7.

3.1.4
subsea distribution unit
SDU
Separately installed structure that receives hydraulic and/or electric and/or optical functions from the UTA and distributes those functions to multiple locations such as manifolds or trees.

3.1.5
subsea termination interface
STI
Mechanism that forms the transition between the umbilical and the subsea termination (*from API 17E*).

NOTE The interface is composed typically of an umbilical armor termination and/or a mechanical anchoring device for the tubes, bend stiffener/limiter, and tube or hose-end fittings. If the umbilical contains electric cables/fiber optics, then penetrator(s) and/or connectors may also be incorporated.

3.1.6
subsea umbilical termination
SUT
Mechanism for mechanically, electrically, optically and/or hydraulically connecting an umbilical or jumper bundle to a subsea system (*from API 17E*).

NOTE Functional components within the umbilical may include hoses, tubes, and electrical or fiber-optic cables, as stated in API 17E.

3.1.7
umbilical
Group of functional components, such as electric cables, optical fiber cables, hoses, and tubes, laid up or bundled together or in combination with each other, that generally provides hydraulics, fluid injection, power, and/or communication services (*from API 17E*).

NOTE Other elements or armoring may be included for strength, protection, or weight considerations.

3.1.8
umbilical termination assembly
UTA
Mechanism for connecting an umbilical or jumper bundle to a subsea system, mechanically, electrically, optically, and hydraulically, as required.

3.1.9
UTA yoke

A frame attached to a UTA, typically at its sides, by hinged or swiveling joints and provided with a central attachment point for lifting rigging.

3.2 Acronyms, Abbreviations, and Symbols

ABR	allowable bend radius
BSR	bend strain reliever (bend stiffener)
CoG	center of gravity
FAT	factory acceptance test
FBC	free board clearance
FEED	front-end engineering design
FMEA	failure mode effects analysis
FTA	fault tree analysis
Hs	higher limiting sea state
HSE	health, safety, and environment
ID	inner diameter
JIP	Joint Industry Project
MBR	minimum bend radius
MQC	multiple quick connects
OD	outer diameter
NPS	nominal pipe size
RHD	reel hub drive
ROV	remotely operated vehicle
SDU	subsea distribution unit
SIT	systems integration test
STI	subsea termination interface
SUT	subsea umbilical termination
UMSIRE	umbilical termination size reduction
UTA	umbilical termination assembly
VLS	vertical lay system

4 Functionality and Distribution of Umbilicals

4.1 Umbilical Functionality

Functionality is generally limited by the actual umbilical specification rather than the UTA size.

The functionality versus umbilical limitations is evident very early in the umbilical design process. Once the final umbilical design specification is reached, then the design of the UTA must be fully optimized to minimize external dimensions and the overall weight of the UTA (including the STI and BSR/bend restrictor weights).

An important consideration to fulfill the requirements of this document (also see API 17TR10) is enabling precise routing of functions within the UTA by having well-designed cable and fluid core distribution routes.

4.2 Subsea Distribution Unit (SDU)

SDUs can substantially reduce the overall UTA dimensions by encompassing the distribution paths and outlet ports. It is acknowledged a separate SDU may have an impact on the overall manufacturing cost in order to connect the units together, but the additional design and manufacture costs of separate UTA and SDU arrangements should not be the sole reason for opting for an all-encompassing UTA. Factors such as complicated handling, packing, transporting, increased installation costs, elevated risk of installation damage, and possible replacement of an umbilical with subsequent schedule impact must be thoroughly analyzed and assessed to make an informed decision about the split or combined arrangement of UTA and SDU. These risks should be evaluated against the consequences associated with using a separate SDU arrangement, such as additional equipment lead time, additional installation time, and the risk of additional subsea leak paths.

The application of this document should be from the inception of the umbilical manufacturer’s initial design. Subsequently, the UTA designers should interface closely with highly experienced installation engineers who know installation possibilities, lay spread, and vessel specifications. Figure 1 shows the optimum interfacing of relevant parties who will play a part in achieving a successful umbilical/UTA installation project.

The intent with describing these project stages is to clarify when within the umbilical project timeline each umbilical termination size reduction (UMSIRE) document should be referenced and the interested parties that should be involved in discussions during each stage.

5 Drivers for UTA Size

5.1 General

The trend of increasing functionality of topside, subsea, and downhole equipment over the past decade has created increasing requirements for additional fluid, electrical, and optical lines to be routed from the platform to the subsea equipment. This has resulted in a greater number of functionalities required through control umbilicals and consequently the UTAs.

There is competition for space between umbilicals and production risers. If it is assumed that one large umbilical is more space efficient than multiple smaller umbilicals, then larger umbilicals are generally the best option.