RDS-O&G

Reference Designation System for Oil and Gas

MANUAL

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2020-06-19

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Preface

RDS-Oil and gas MANUAL

Reference **D**esignation **S**ystem for **O**il and **G**as

As a part of the on-going digitalization of the Oil and gas sector, there is a need for clear designation of assets. This will come in handy as the basis for requirements management, asset management, data collection and more.

This manual describes the first edition of a reference designation system for Oil and gas (RDS-O&G). The system is based on a tailored application of the international ISO/IEC 81346 standard series (“RDS”).

RDS-O&G is developed by Systems Engineering A/S in collaboration the READI JIP project – which is covering governance of digital requirements in the Oil and gas industry.

This version is the 1st revision of the manual to be released as part of the READI JIP project

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Part 1
Introduction to RDS-O&G

1 Introduction

This document describes the Reference Designation System for Oil and gas in the Oil and gas sector (RDS-O&G). RDS-O&G provides semantic views and terminology for designation of systems.

RDS-O&G

Reference **D**esignation **S**ystem for **O**il and **G**as

In general, RDS can be seen as an international “naming convention” designed for use on systems and their elements, and as a practical technique to establish a common understanding among different technical domains.

The RDS-O&G is created in accordance with the ISO/IEC 81346 standard series.

The output of RDS-O&G are system breakdown structures with accompanying reference designations i.e. TAG-numbers.

The reference designations act as labels for the systems and system elements, see Figure 1, and are used for instant and unambiguous recognition across different kinds of models or documentation. Thereby the RDS-O&G can act as a point of synchronization across different technical domains and data sources throughout the system life cycle.

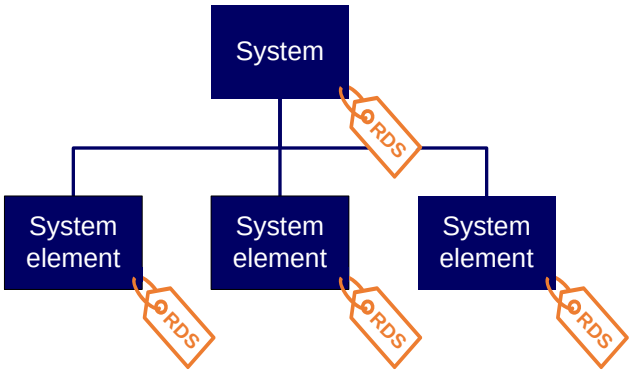


Figure 1 – Illustration of breakdown of systems and system elements therein with RDS tagging

2 Scope of 1st edition RDS-O&G

The potential application of RDS within the Oil and gas sector is quite wide-ranging when considering the multiple systems involved in the production of Oil and gas.

This first edition of RDS-O&G is limited to Oil and gas and covers the following:

- **Oil and gas production (O&G)** i.e. systems and locations that are directly involved in the process of producing oil.

- **Construction works (CW)** i.e. systems and locations for civil construction works that support the Oil and gas production such as platform support structures, roads, buildings, etc.

All other systems related to exploration of new oil fields, refining, distribution on-shore and decommissioning are not part of the scope of RDS-O&G 1st edition.

The application scope of RDS-O&G is first and foremost within the context of requirements management, but readers of this manual may freely investigate and apply the methodology within their domain as long as it abides by the rules set out in this manual.

NOTE: The examples provided in text and figures in this manual are made to illustrate and support the meaning and possible usage of RDS-O&G. They serve to illustrate the principles and do not attempt to standardize any system design, facility layout, component use, etc.

3 Applied standard

The RDS-O&G is based on the ISO/IEC 81346 standard series and is tailored for Oil and gas production. The 81346-standard series consists of multiple parts (1, 2, 10 & 12), of which parts 1, 2, and 12 are used in RDS-O&G and shown in Table 1.

Table 1 – Overview of the relevant parts of the 81346 standard series

Title	Relevant content
IEC 81346-1 (2009) *Industrial systems, Installations and Equipment and Industrial Products – Structuring Principles and Reference Designations – Part 1: Basic rules.*	The fundamental rules for: - Objects - Systems - Structuring - Aspects - Designations (TAG's)
IEC 81346-2 (2019) *Industrial systems, Installations and Equipment and Industrial Products – Structuring Principles and Reference Designations – Part 2: Classification of Objects and Codes for Classes.*	Classification for: - Component systems - Spaces
ISO 81346-12 (2018) *Industrial systems, Installations and Equipment and Industrial Products – Structuring Principles and Reference Designations – Part 12: Construction works and building services.*	Classification for construction works and building services related to power production.

Part 1 of the standard is applied without changes. (NOTE: This part is currently under revision, however no radical changes compared with the 2009 edition will apply.)

Part 2 of the standard is applied without any changes to the rules laid out therein, but with terms added which are specific for Oil and gas.

Part 12 is applied without changes for systems related to construction works and building services supporting the Oil and gas production. The Type aspect which is scheduled for introduction in the forthcoming revision of IEC 81346-1 is also applied from this standard.

Part 2
RDS-O&G – Semantics

4 Introduction

RDS-O&G is based on the ISO/IEC 81346 standard series and applies semantics from the series within the scope of RDS-O&G. Existing semantics within the Oil and gas sector and evolving semantics in new initiatives are not required to align with the semantics of RDS-O&G. The semantics of RDS-O&G is based on systems thinking and an object-oriented perception of systems. The following chapters further describe the key semantic concepts used in RDS-O&G, including:

- Systems thinking
- System element / object
- RDS-structure
- Aspects
- Classification

5 Systems thinking

It is a fundamental presumption for RDS-O&G that any element in Oil and gas production is regarded as a **system made up of system elements**, see Figure 2. System elements are related to each other by different kinds of relations, and the system is separated from its environment by an imaginary boundary across which interaction with elements outside the system may occur.

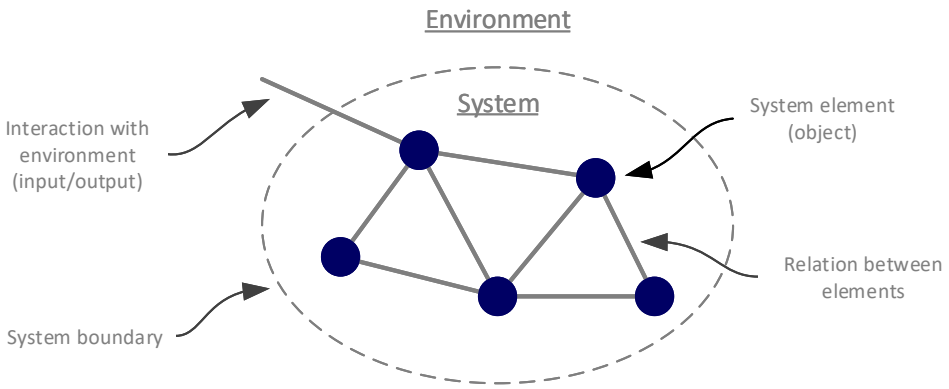
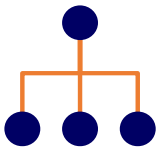


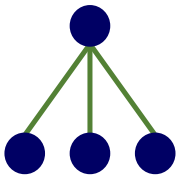
Figure 2 - Generic model of a system

Within RDS-O&G two kinds of relations are used: Part-of relation and Type-of relation.



The **part-of relation** in RDS-O&G is a hierarchical partitive relation [1 sec. 3.2.22].

The part-of relation is used to describe the composition of systems i.e. how any system is sub-divided into its constituent objects, known as system elements.



The **type-of relation** in RDS-O&G is a hierarchical generic relation [1 sec. 3.2.21].

The type-of relation in RDS-O&G is used to describe what kind of systems and system elements are found in system structures. The relation is used to define classes of systems and system elements based on their common characteristics.

6 System elements / objects

6.1 Introduction to objects

System elements are the objects of which a system is composed. The definition of the term "object" is very general and covers all items that are subject to activities in the whole life cycle of a system.

Compared to its strictly literal definition, the term "object" has a broader meaning within the frame of RDS in that it does not necessarily need to exist physically. The term, as used within the scope of this document, is defined in ISO/IEC 81346-1.

Objects can have different data associated to them, see Figure 3.

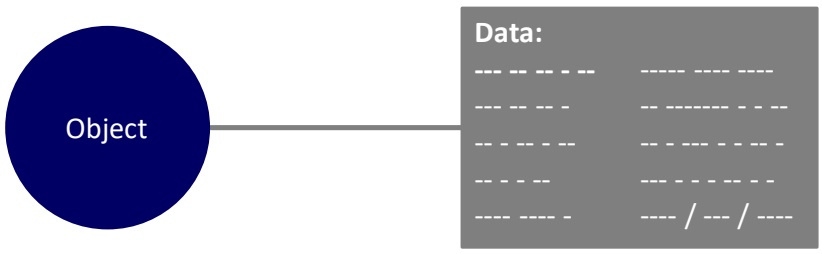


Figure 3 – An object (i.e. system or system element) (left) with associated metadata (right)

It is the designer/engineer who decides that an object exists within their model and establishes the need to identify the object. When an object is established, information may be associated with it. This information may change throughout the life cycle of that object.

6.2 Occurrences and individuals

To understand how objects are treated by RDS-O&G, it is important to know that RDS-O&G differentiates between the occurrence of an object within an RDS-based model, and objects existing in the real world i.e. something tangible in the real world. This is defined in two key concepts:

Object Occurrence
The existence of an object within an aspect.

Product Individual
One specimen of a product type irrespective of where it is being used.

NOTE RDS-O&G designates object occurrences only.

NOTE A product individual is a single specific specimen of a real-world object, that can exist independently of the system and has an independent life cycle. This is for example a specific product that is produced, purchased, shipped, installed, operated, serviced and decommissioned.

Object individuals are not identified using RDS-O&G but are instead given other identifiers such as serial numbers, inventory numbers and similar.

The object occurrence is 100% stable during the lifecycle of an object, whereas the product individual may or will change by nature, for example when a motor is replaced with another during maintenance.

The object occurrence can be said to represent the role that a product individual will fulfil at some point in time of the system life cycle.

To better understand this important mechanism in RDS, an analogy to specific roles played by humans on a football team is made: Goalkeeper (object occurrence) is a well-defined role which can be fulfilled by different humans (product individuals) with the appropriate skills. The point is, that roles remain whereas individuals can be changed without affecting the role.

RDS-O&G is used to designate object occurrences only and not product individuals, see Figure 4:

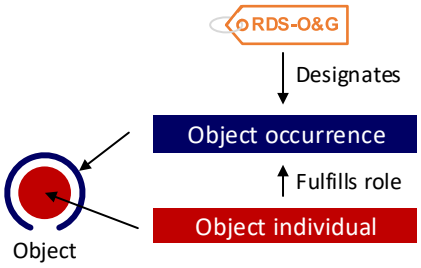


Figure 4 - Object occurrence and individual

Some object occurrences may be physically manifested by an object individual at a certain stage of the system lifecycle (e.g. a transformer, a sensor, a valve). Other objects will never have a physical manifestation but exist for different purposes, for example:

- For structuring purposes
- For description of functionality
- For software generated objects only used inside computers.

As RDS-O&G only designates object occurrences, see Figure 4, it does not distinguish between those objects which are physically manifested and those that are not. Both kinds of objects can be relevant for being identified and handled in the life cycle of an Oil and gas system.

The purpose of designating the object occurrences, as distinct from the product individuals, is to create a 100% stable identifier in the life cycle of any system or system element, i.e. the reference designation will not change in the life cycle.

An example of an object occurrence's relation to different product individuals throughout the system life cycle can be seen in Figure 5; In this example the role of a motor in a system is fulfilled by three different physical motors at various stages of the system life cycle, as one motor replaces the other as part of regular servicing.

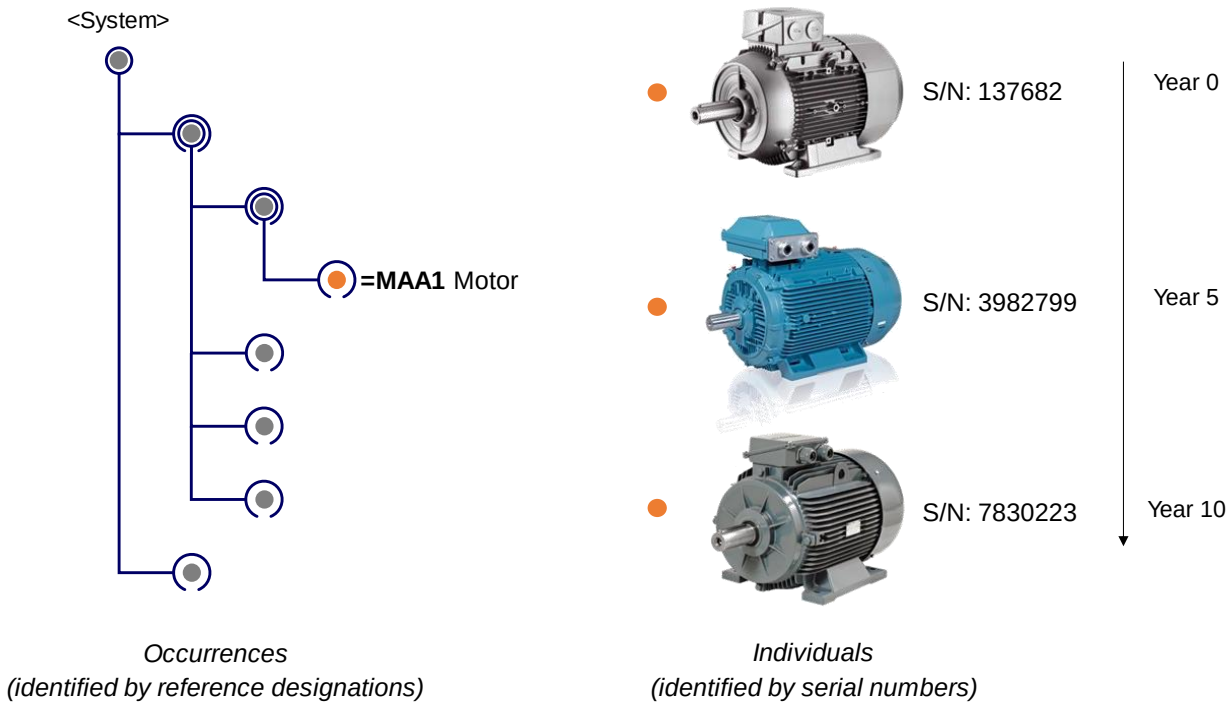


Figure 5 - Occurrences and individuals throughout a system life cycle

7 RDS-structure

The term *RDS-structure* in the context of RDS-O&G is used for system breakdown structure of an Oil and gas production system and related systems like support systems and construction works.

An RDS-structure is a hierarchical tree-structure that describes the composition of systems. Because the system concept is recursive, this means that systems are composed of system elements, which can in turn themselves be systems, see Figure 6.

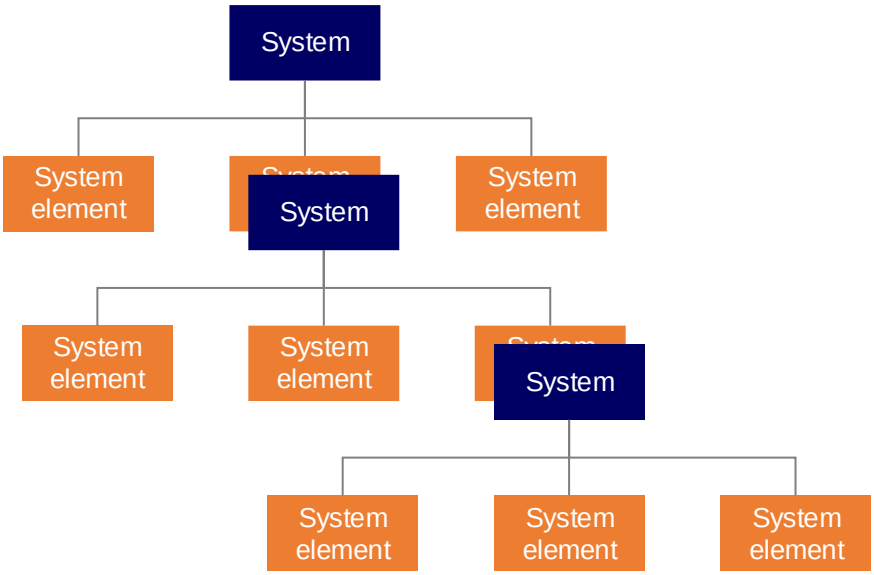


Figure 6 - A system breakdown structure showing the recursive phenomenon of system elements also being systems

In regards to the system concept it should be noted that a system is characterized by two basic properties [2]:

1) The system's behaviour
2) The system's compositional structure.

RDS-structures describe the system's compositional structure based on part-of relations, and not its behaviour.

The resolution level at which the system is modelled is dependent on the availability of and need for detailed design information regarding the design. As a rule of thumb, a system is divided into system elements, if a system comprises of between 5 and 25 system elements. If a system is made of more than 25 system elements, further division is needed.

8 Aspects

Aspects determine the view of the system that is used when forming RDS-structures and define the kind of system elements that are considered and the basis for how the compositional relations are defined. This means that the aspect will determine what kind of elements make up the RDS-structure. For example, a functional aspect will consider elements and relations relating to functionality. Structures based on a functional aspect could therefore contain elements that represent functions or functional design solutions.

The RDS standard series defines four basic aspect kinds that can be used to create RDS-structures, and each aspect kind is represented by a prefix character used in the RDS syntax, see Table 2.

Table 2 - RDS aspect kinds and their associated prefix used in reference designations.

Prefix	Aspect kind
= (equals sign)	Function
- (minus sign)	Product
% (percent sign)	Type
+ (plus sign)	Location

By applying an aspect when structuring, one can only see the information that is relevant for this aspect, and any other information must be obtained in another manner, e.g. in another aspect, or by defining relations between objects designated by RDS-O&G. The overall purpose is to create a clear view on the system of interest in each aspect, and the aspects in RDS-O&G therefore represent very different views of the Oil and gas production.

Furthermore, the rule of having multiple views based on the same aspect kind is applied in RDS-O&G [3, Rule 16], specifically two aspects of the Location kind are used in RDS-O&G. The aspects used in RDS-O&G are listed in Table 3.

Table 3 - Aspects used in RDS-O&G.

Prefix	Aspect	Aspect kind
= (equals sign)	Function	Function
- (minus sign)	Product	Product
% (percent sign)	Type	Type
+ (plus sign)	Point of installation	Location
++ (double plus sign)	Site of installation	Location

9 Classification

Classification in RDS-O&G is the categorization of objects based on their common characteristics.

The classification is used to recognize and distinguish between different kinds of system elements and different kind of spaces in RDS-structures. Additionally, classification in RDS-O&G may have other uses such as searching and filtering in data sets, quantity calculations, pre-coding of modelling elements and definition of attribute sets.

The classification scheme in RDS-O&G consists of separate classification tables for classification of different kinds of objects. Each classification table has its own classification theme which governs the definition of classes within the table.

The classification in RDS-O&G is dependent on the system domain, so that systems for Oil and Gas production follow one classification scheme and systems in construction works follow another classification scheme.

Part 3
RDS fundamentals

10 Introduction

RDS-O&G is used to create a Reference Designation System (RDS) for any system-of-interest, being either all systems related to Oil and gas production or a part thereof.

The reference designation system consists of system breakdown structures (RDS-structures) that provide the reference designations (i.e. identifiers) for the elements of the system-of-interest. As shown in Figure 7, a reference designation is an identifier, or an "address" associated with an object's position in the breakdown structures.

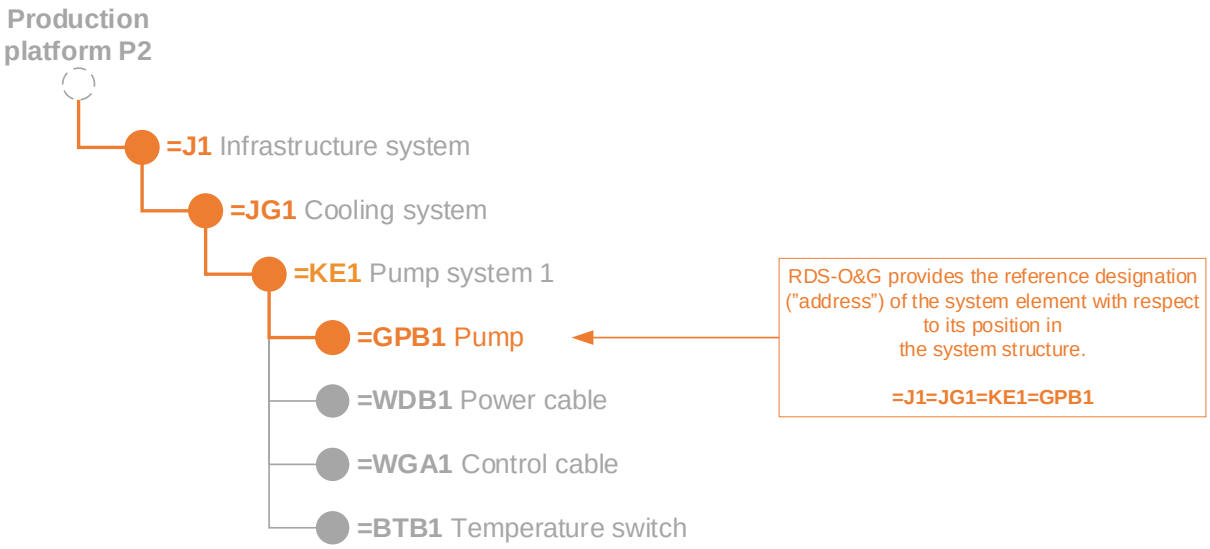


Figure 7 - A system breakdown structure for a system-of-interest

Reference designations are created in compliance with the rules of ISO/IEC 81346-1 [3] and come in two forms:

Single-level reference designations are the reference designations that are formed with respect to an object's parent object. In Figure 7 the code **=GPB1** is a single-level reference designation of the highlighted pump with respect to its parent object *"Pump system 1"*.

Multi-level reference designations are the reference designations that are formed by concatenating single-level reference designations with respect to the top-node of the RDS-structure. The multi-level reference designation represents the full reference designation of the system element. In Figure 7 the code **=J1=JG1=KE1=GPB1** is the full multi-level reference designation of the highlighted pump.

11 Single-level reference designations

Single-level reference designations are composed of three syntax elements: **Aspect prefix**, **Classification letter code** and **Numbering** as follows:

Aspect prefix

Aspect prefixes are characters that represent the RDS-O&G aspect applied when forming the RDS-structure. All RDS-structures are created based on an aspect of the system design.

RDS-O&G provides five aspects that can be used to create RDS-structures, see Part 4.

For computer implementations, the prefix sign shall be chosen from the G0-set of ISO/IEC 646 or similar international standards.

Figure 9 shows aspect prefixes applied in **orange** in an RDS-structure.

Classification letter code

The classification letter code is a letter code that represents the class of the object (i.e. “what kind of object you are identifying”) in the RDS-structure. The letter code varies in length from one to three letters, representing objects such as for example Oil and gas systems (one), Oil and gas technical systems (two letters) and Component systems (three letters).

Elements of RDS-structures are classified using the RDS-O&G classification scheme, see Part 5.

Figure 9 shows classification applied in **blue** in an RDS-structure.

Numbering

All elements of RDS-structures are numbered relative to their position in the structure and classification.

A number shall not be assigned with a specific meaning, for example that certain numbers should always be interpreted in a particular way. Such meanings are difficult to maintain over time and across projects, and therefore not to be used. This also includes the use of number series and leading zeroes (e.g. “01” or “001”).

Figure 9 shows numbering applied in **green** in an RDS-structure.

The three syntax elements are combined in the order shown in Figure 8.

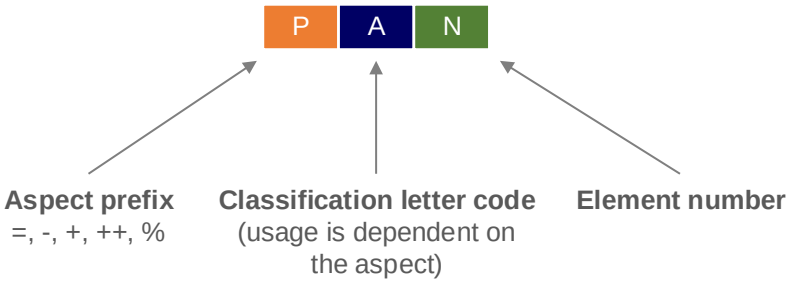


Figure 8 - Order of syntax elements in single-level reference designations.

Figure 9 shows an example of an RDS-structure with single-level reference designations applied to all the elements of a structure representing an Oil and gas plant. The applied aspect is a functional aspect, and the structure is a functional systems structure represented by an equal sign (=); the letter codes represent the class of the elements designated, and the numbering distinguishes between elements of the same class within a system.

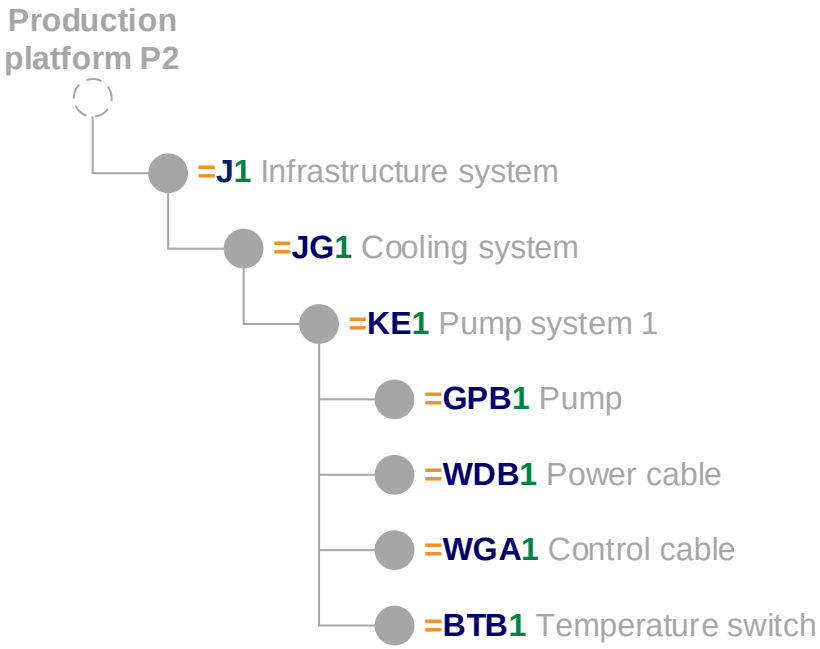


Figure 9 – An RDS-structure showing single-level reference designations for all system elements

12 Multi-level reference designations

A complete reference designation for any element in each RDS-structure is concatenated from the single-level reference designations from each level of the RDS-structure down to the level of the element of interest. Figure 10 shows the syntax of a multi-level reference designation.

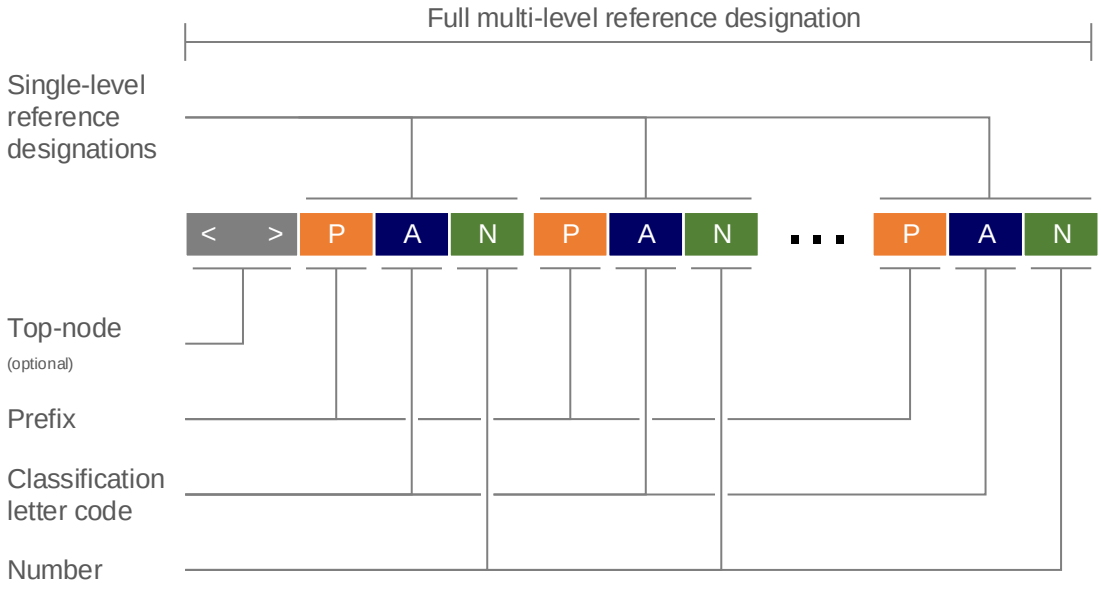


Figure 10 - The RDS-O&G reference designation syntax [ISO 81346-12, figure 2 modified]

The designation of any system and its elements depends on the complexity of the system, which is reflected within the reference designation. Therefore, the length of the reference designation for an element will depend on the depth of the RDS-structure i.e. a non-fixed format.

The reference designations of RDS-O&G are therefore 100% flexible in two directions: 1) vertically, as no fixed breakdown in system elements is required, 2) horizontally, as unlimited numbers of RDS-structure representing system and system elements are possible.

Part 4
RDS-structures for O&G systems

13 Describing system architecture using RDS-structures

Specifying, modelling, designing, building, operating and maintaining a system requires a clear description of the architecture of the system. The fundamental purpose of the RDS-structures created using RDS-O&G is to describe the key elements in the architecture of systems within the Oil and gas sector, and to use the resulting reference designations to manage, exchange, and capture system information.

Because there are multiple system concerns that must be addressed in the life cycle of an Oil and gas production system, different aspects of the system architecture must be described. RDS-O&G provides this multi-facetted description of the system architecture using the four fundamental aspects kinds of RDS.

These aspects are the basis upon which different views of the system architecture can be created, i.e. the basis of RDS-structures. Each RDS-structure provides a unique view of the system architecture, that allows for identification of different kinds of elements, that can be referenced in documentation and IT systems.

The first revision of RDS-O&G allows for creation of five kinds of RDS-structures based on the fundamental aspects.

Table 4 shows that each RDS-structure has an associated prefix, which is used in the reference designations associated with that structure:

Table 4 - RDS-O&G structures and their associated prefixes

Prefix		RDS-structure
=	(equals sign)	Functional structure
-	(minus sign)	Product structure
%	(percent sign)	Type structure
+	(plus sign)	Point of installation structure
++	(double plus sign)	Site of installation structure

NOTE 1: Any new kind of RDS-structure which may be added to RDS-O&G in future revisions will be based on the same four fundamental aspect kinds.

NOTE 2: To align with other industry parts of RDS in the ISO/IEC 81346 standard series, the “+” is used for designation of the Point of Installation (a relative location), whereas the “++” is used for designation of Site of installation (an absolute location).

All RDS-structures follow a decomposition hierarchy with three levels of abstraction, with top-level systems which are composed of intermediate sub-systems, which are again composed of lowest level systems.

The kinds of top-level, intermediate and lowest level systems appearing in the RDS-structures will depend on what kind of RDS-structure it is and what technical sector the system belongs to.

IMPORTANT!

RDS-O&G does not dictate a fixed structure of any reference designation, i.e. no specific meaning or reservations of positions in a character string are made in the TAG number based on RDS-O&G.

Instead, systems and their elements can be arranged in any way which reflect the model or hierarchy the designer wish to represent. E.g. top-level systems can be composed of other top-level systems, intermediate level systems can be composed of other intermediate level systems and the lowest level systems can be composed of other lowest level systems etc. This also complies with the rule of recursive replication of systems and their system elements.

The depth of the RDS-structure is therefore flexible, so that users can specify the breakdown of any system-of-interest to fit their needs.

Recognition of individual single level reference designations are made by the use of one-two-three letter codes as described in chapter 22 - The classification scheme – Three libraries.

14 Functional structure (=)

14.1 Description

The function aspect offers a view of a system based on the intended functionality of the system i.e. what functionality the system elements fulfil, disregarding how it is constructed. The kind of system elements that are viewed when applying the function aspect are typically functions, functional systems or design solutions fulfilling functionality.

The functional structure in RDS-O&G therefore provides a breakdown of the system into technical solutions that are the carriers of desired or achieved functionality i.e. functional systems. The structure allows for designation of systems based on the functional purpose of the systems without taking the physical construction or location of the systems into consideration. The kinds of system elements appearing in this RDS-structure are hardware and software systems that are defined based on their functionality.

The functional structure is represented in reference designations using the prefix sign "**=**" (equals sign).

A process diagram for a given process is a good place to start when defining the functional structure. In a process diagram the physical placement of the process elements and their realization in a product concept are not considered.

14.2 Example

Please see Figure 11.

15 Product structure (-)

The product aspect is also sometimes called the "construction aspect", "physical aspect" or "build aspect".

The product aspect offers a view of a system based on how the system is constructed, i.e. the aspect focuses on how system elements are arranged in order to construct the system. The kind of system elements that are viewed when applying the product aspect are typically delivered products or constructions that may implement one or more desired functions.

Users of RDS can often recognize that a product aspect is applied for structuring when system elements are described using terms such as these: unit, plant, assembly, construction, product, module, part, component, equipment, etc. The product aspect structure usually looks like the structure of a BoM – Bill of Material but is not the same as the product structure shall follow the rules of RDS-O&G to form a reference designation.

This view may or may not directly match the functional view of the system, so that one element viewed in the product aspect directly implements the functionality of one element viewed in the function aspect. This will depend on the system and the designers view of the functional and construction design.

If a company chooses to describe a system-of-interest using both the functional structure and product structure, then it may be the case that some system elements are found in both structures. In such cases, the object shall have a reference designation from both structures as part of a “reference designation set” for the object.

For example, the same valve could be found in both the functional structure and the product structure. In this case both the reference designation from the functional structure and the reference designation from the product structure could be used to designate the valve, and therefore the valve is assigned a reference designation set containing both the reference designations.

Figure 11 shows an example of how a control valve (class QNA) can be classified with both a functional and a product aspect:

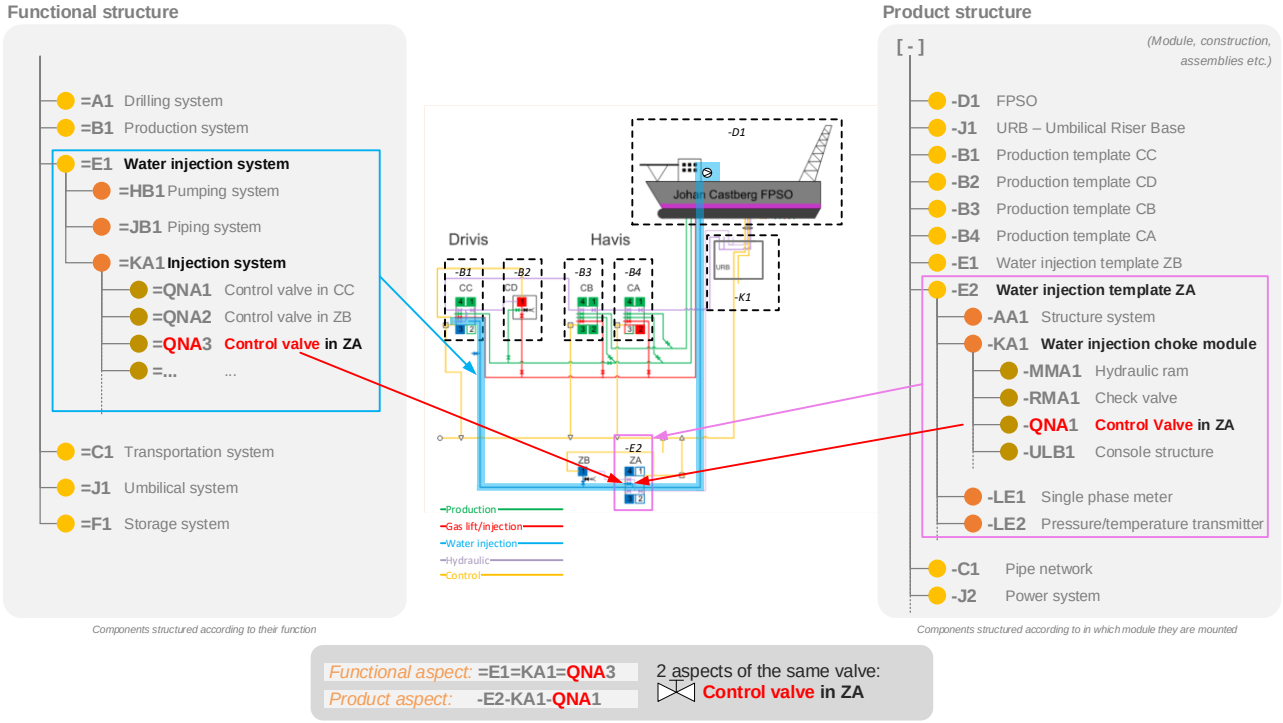


Figure 11: Functional and product aspect of the same control valve (class QNA)

16 Location aspects

16.1 General

RDS-O&G offers two views on locations with Oil & Gas facilities:

- Point of installation structure
- Site of installation structure

NOTE The names of these structure are congruent with the naming in IEC 81346-10 (RDS-PS) and IEC 81346-12 (RDS-CW), but may be changed in the future depending on the response within the Oil & Gas Industry.

The two structures allow for both a grid based designation relative to any system of interest, and a designation of defined spaces relative to the facilities on a site. They are both described further in the following sections.

16.2 Point of installation structure (+)

16.2.1 Description

The point of installation structure provides a breakdown of a system as a collection of locations defined by a local grid system. A point of installation structure is therefore always defined relative to a system e.g. for a facility, module, equipment, etc., and must be described in the documentation accompanying the system.

The grid system may be multi-dimensional (e.g. 3D) and does not need to be uniform in its sub-division.

Some common applications for the point of installation reference includes:

- Designation of grid zones on facilities
- Designation of mounting planes on assemblies

16.2.2 Structure syntax

No classification library is applied in the point of installation structure. Instead the grid cells are referenced using numbers or letter codes. The designer of the point of installation structure is free to define the grid system of the system of interest, and no industry wide rules are defined at present.

The syntax of a point of installation structure is therefore composed of as many single level reference designations as needed, see Figure 12.

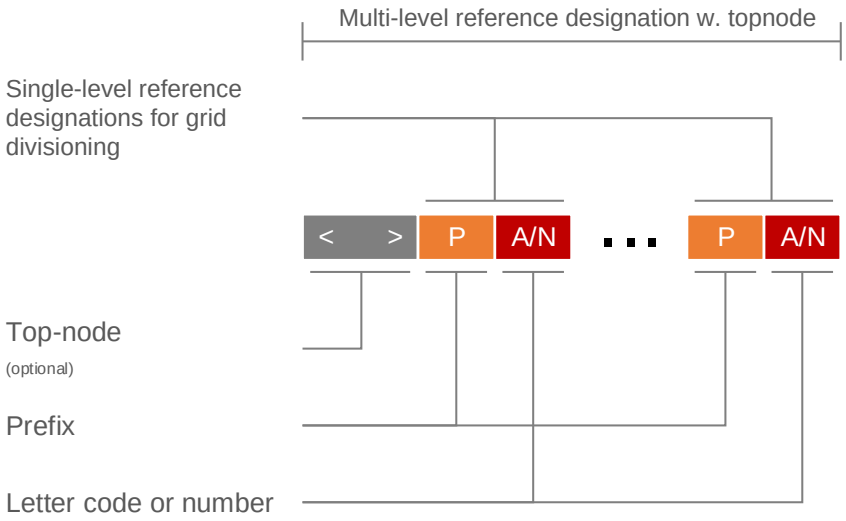
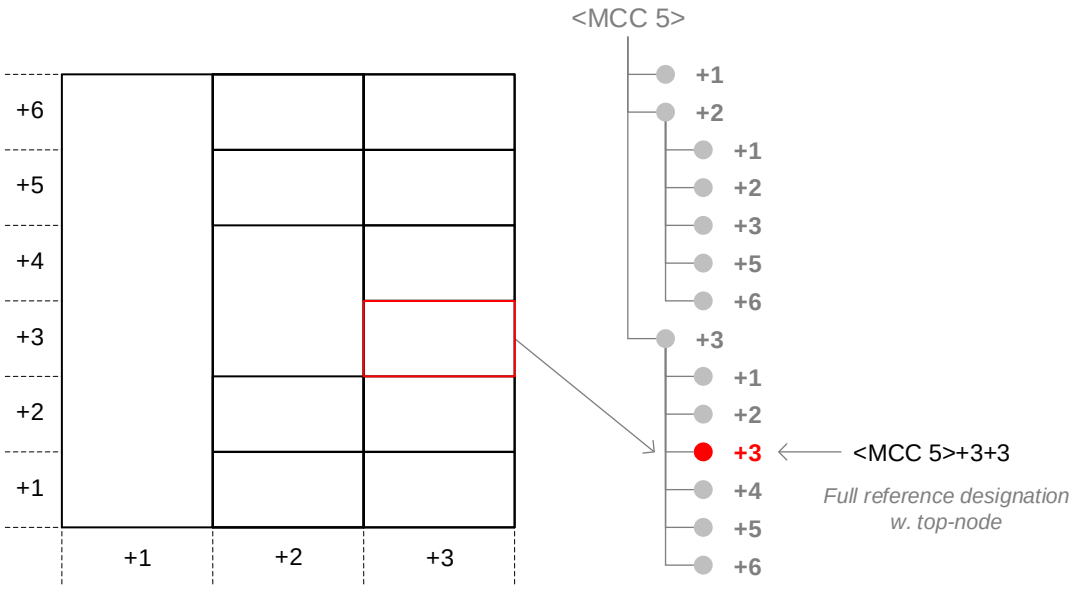


Figure 12 - Syntax of the point of installation structure

16.2.3 Examples

Figure 13 and Figure 14 show two examples of designation of locations relative to two systems of interest (a motor control centre and a control cabinet). A grid system is defined for each system, which is specific to that system.

The grid definition for the motor control centre is based on coordinate axis, where a horizontal and vertical coordinate provides the reference of grid cells. The coordinate system is uniform across the motor control centre.



a) Layout of a Motor control centre (MCC)

[Grid cell designation] = [Horizontal coordinate] + [Vertical coordinate]

Figure 13 - Point of installation structure for a motor control centre.

Unlike for the motor control centre, the grid system applied for the control cabinet is not uniform, a horizontal divisioning (+X…+Z) is followed by a vertical divisioning that is different for each column, which provides references for the main grid. A further dub-divisioning is applied within some of the main grid cells using numbered grid cells. This results in a point of installation structure for the control cabinet that is up to three levels deep in some places.

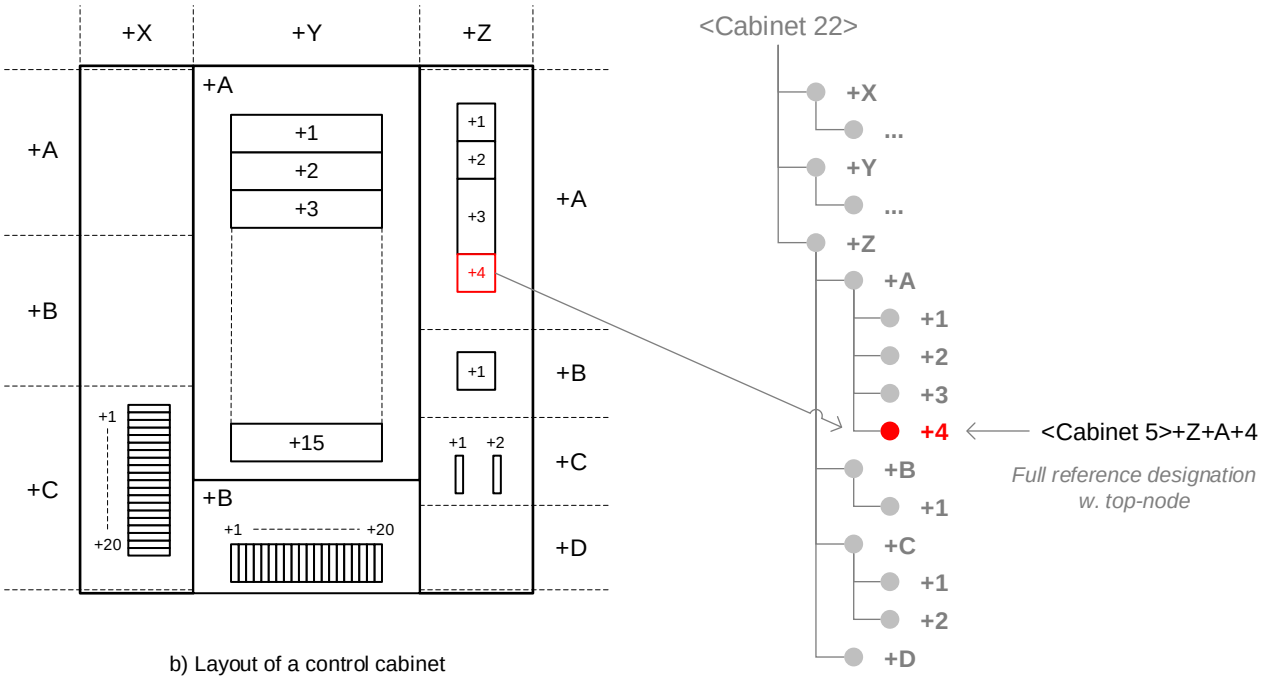


Figure 14 - Point of installation structure for a control cabinet.

16.3 Site of installation structure (++)

16.3.1 Description

The site of installation structure provides a breakdown of the system-of-interest as a collection of spaces in which systems and system elements are located e.g. where components are located.

The structure is based on the site-of-installation designation from ISO 81346-12:2018 and includes three levels of abstraction in the breakdown as shown below.

Figure 15 shows the breakdown of a site of installation structure:

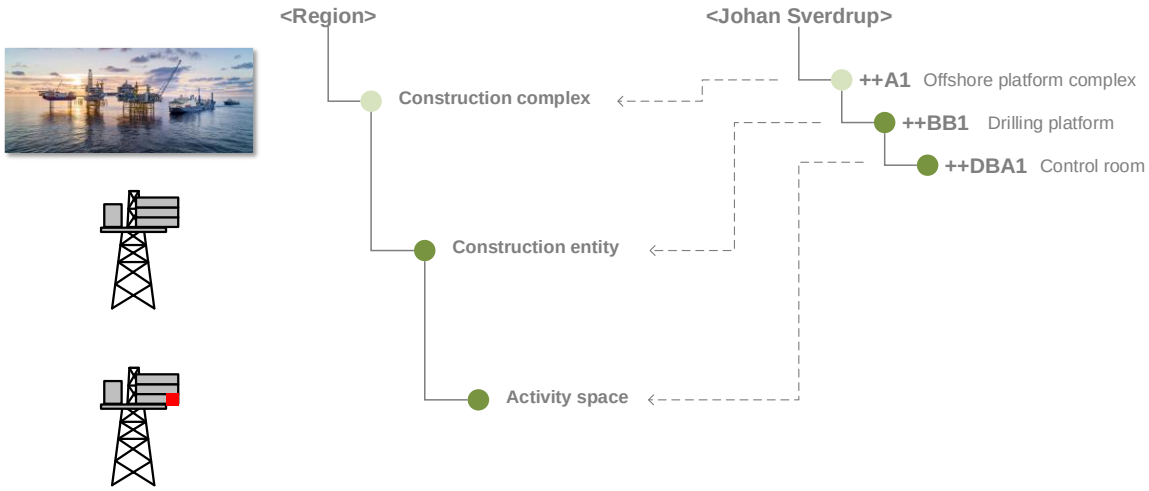


Figure 15 - The three levels of abstraction used in the site of installation structure

The higher levels of the structure are defined as construction complexes (i.e. sites), in which there are construction entities (e.g. facilities). Construction entities in turn contain activity spaces which are numbered according to the requirements in ISO 4157-2:1998, section 4.4.

It is important to note that

- It is possible to skip “construction entity” in the structure.
- There is no fixed number of levels, so a construction complex can be sub-divided into sub-complexes, a construction entity can be subdivided into sub-construction entities, and activity spaces can be subdivided into other sub-activity spaces.

In addition to the breakdown using construction complexes, construction entities and activity spaces, it is possible to interject a numbered breakdown level representing a needed sub-division to represent a level or zone. An example is shown in Figure 16, where the topside levels of a platform have been added as a breakdown level in the site of installation structure previously shown in Figure 15.

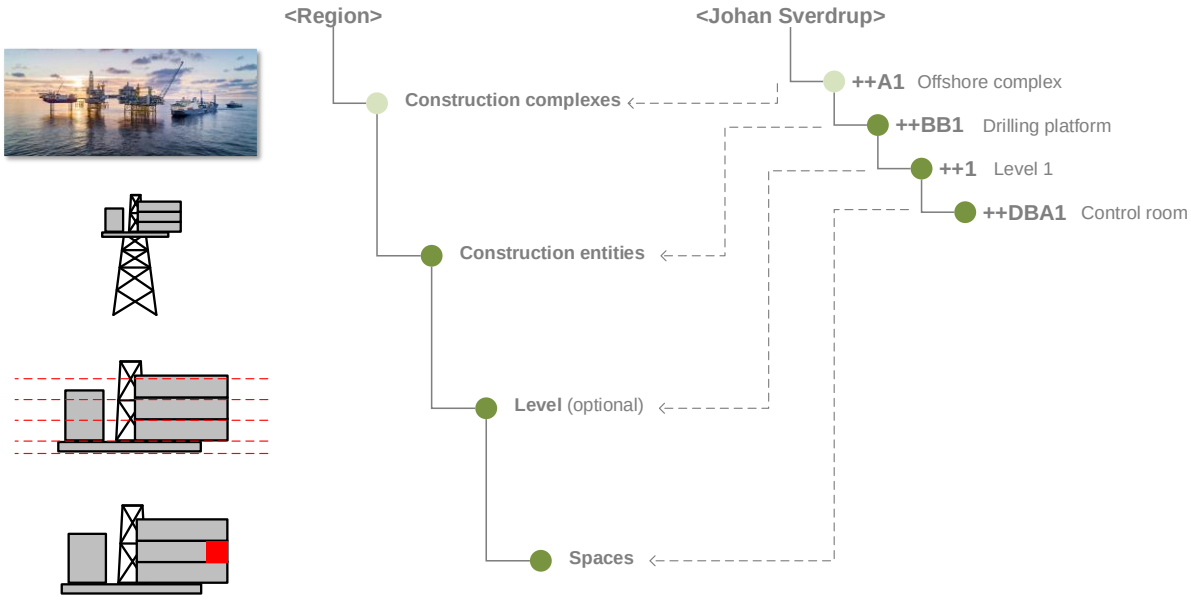


Figure 16 - Example of site of installation structure including an interjected numbered level.

16.3.2 Structure syntax

The site of installation structure uses classification libraries for location objects that define three levels of abstraction: Construction complex, Construction entity and Activity space, see Part 6. This is similar to the abstraction mechanism applied for systems but applied to locations. The structure syntax of the site of installation structure is shown in Figure 17.

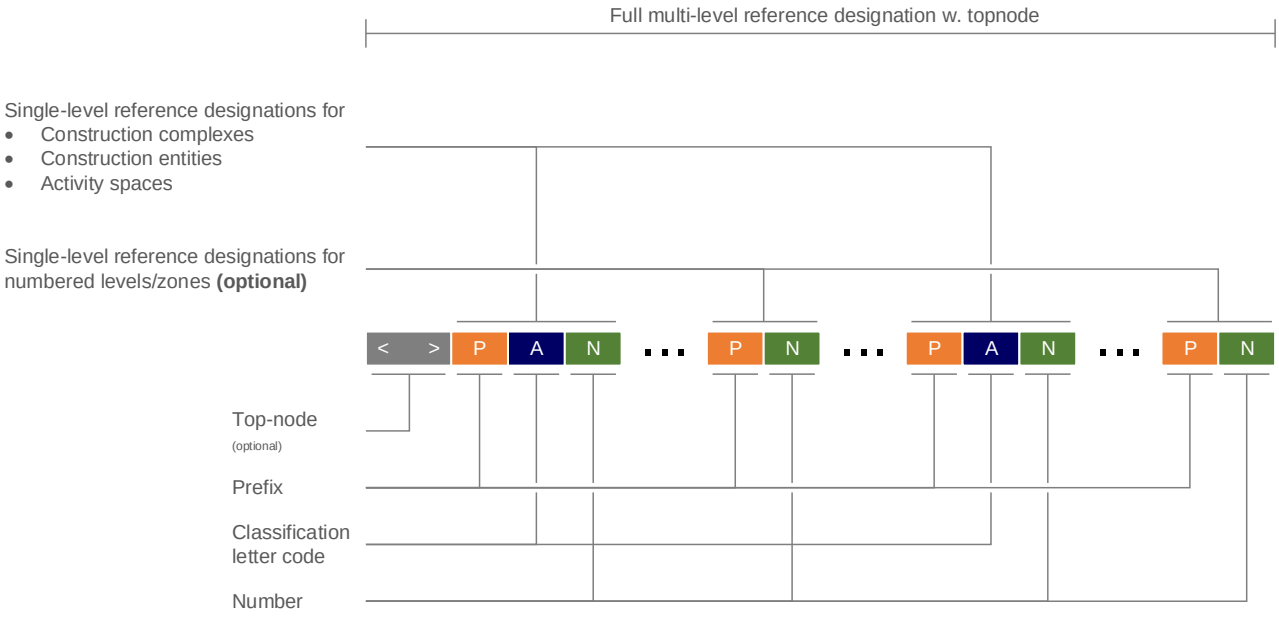
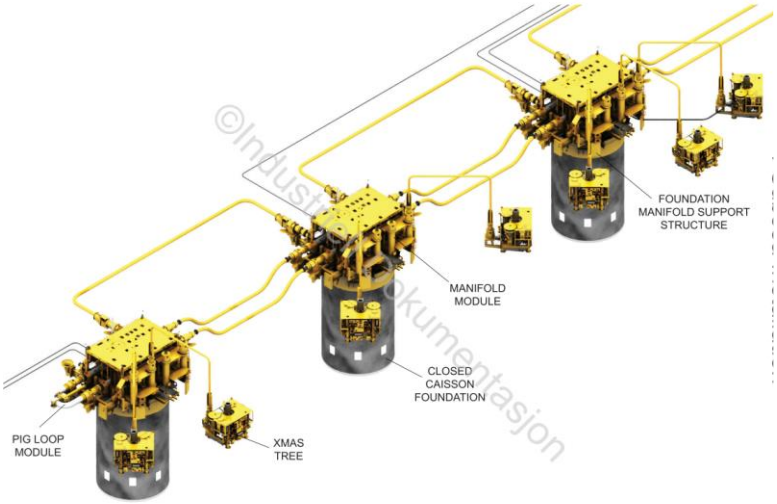


Figure 17 - Syntax of site of installation structure.

16.3.3 Example

An example of designation of sites within a complete Oil and gas production system can be seen in Figure 18. This example shows two alternative ways to structure a subsea production complex to the level of construction entity.



Structure alternative 1

<Project>
- **++A1 Subsea complex**
  - **++A1** Well complex 1
    - **++BE1** Manifold installation
    - **++BC1** Satellite X-mas tree installation
    - **++BC2** Satellite X-mas tree installation
    - **++BC3** Satellite X-mas tree installation
  - **++A2** Well complex 2
    - **++BE1** Manifold installation
    - **++BC1** Satellite X-mas tree installation
    - **++BC2** Satellite X-mas tree installation
  - **++A3** Well complex 3
    - **++BE1** Manifold installation
    - **++BC1** Satellite X-mas tree installation
    - **++BC2** Satellite X-mas tree installation

Structure alternative 2

<Project>
- **++A1 Subsea complex**
  - **++BE1** Manifold installation
  - **++BE2** Manifold installation
  - **++BE3** Manifold installation
  - **++BC1** Satellite X-mas tree installation
  - **++BC2** Satellite X-mas tree installation
  - **++BC3** Satellite X-mas tree installation
  - **++BC4** Satellite X-mas tree installation
  - **++BC5** Satellite X-mas tree installation
  - **++BC6** Satellite X-mas tree installation
  - **++BC7** Satellite X-mas tree installation

Figure 18 – Alternative examples of site of installation structure (++) within a subsea production complex.

17 Type structure (%)

17.1 Type aspect (%)

The type aspect offers a view of a system that designates objects with common characteristics, i.e. types. Users of RDS can often recognize that a designated object represents a type when the elements are described using terms such as these: type, variant, kind, design type, master, platform, group, family, archetype, etc.

The type aspect can thus be used to both identify such groups (i.e. types) and to describe to which group a system element belongs (i.e. what type a system element is).

The type aspect is typically used to describe the variety within a system and the existence of multiple system elements that have the same attributes or designs, for example what kind of valves are used or what kind of system designs are used.

An example is shown in Figure 19, where different types of liquid matter transport systems are defined.

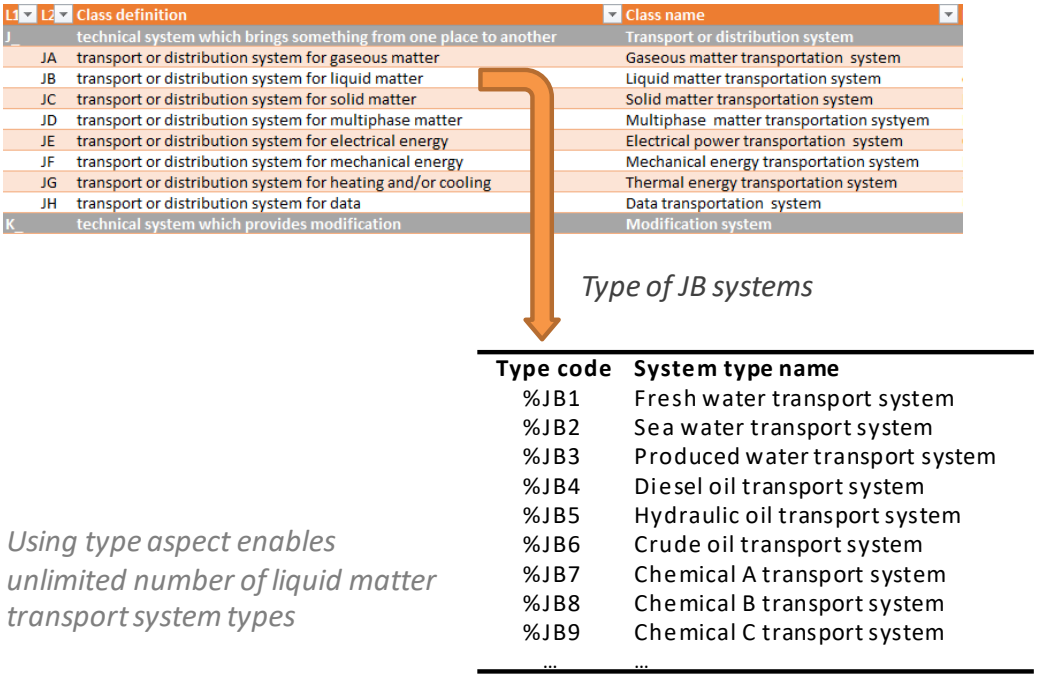


Figure 19: Example of how the type aspect [%] can support variants of a technical system

No common types of systems have been defined across the Oil and gas sector, as this will require a combined effort by multiple companies within the sector to define.

Companies applying RDS-O&G are therefore free to define their own company specific types of systems and components using the type aspect (%). When applied, the meaning of each type shall be explained in the supporting documentation.

Part 5
RDS-structures for Construction works systems

18 Describing system architecture using several RDS-structures

For some parts of an offshore platform it makes more sense to designate structures and components according to RDS for Construction Works (ISO 81346-12 i.e. RDS-CW) rather than RDS-O&G. This is especially relevant when designating living quarters, infrastructures on shore, buildings and constructions which are not directly related to an oil and gas process. The reason for using RDS-CW for these parts are that RDS-CW is specifically developed to designate construction works and building services and covers the needs for classical construction complexes including fresh water supply, drainage, ventilation, wall, decks roofs, electrical installation, etc. However, working with two industry specific extensions of the RDS standard series (RDD-O&G and RDS-CW) may be tricky but by following the following rules the designation is straight forward.

19 Top node identifier

When working with RDS-structures, it is not allowed to mix RDS-extensions (CW and O&G) in the same structure.The way of working with both RDS-O&G and RDS-CW on the same platform or complex is by creating separate RDS-structures and using the top node identifier of the structure to show which RDS-extensions the structures are based on.

Table 5: Various top node identifiers

Top node	**Library**
<RDS-CW>	Reference Designation System - Construction Works
<RDS-O&G>	Reference Designation System - Oil and Gas

Three different scenarios for how a flare tower can be designated are described in the following chapters. Each of them is correct, which one to use is up to the designer to choose.

19.1 Scenario A – a beam designated by RDS-O&G

In this scenario only the RDS-O&G library has been used. This includes both simple constructions and oil and gas process equipment (Flare nozzle and flare piping)

<RDS-O&G>
-**JA1** Flare tower system
  -**AA1** Tower systems
    -**ULE1** Beam 1
    -**ULE2** Beam 2
    -**ULB1** Console
  -**JA1** Flare nozzle system
    -**WPA1** Flare Pipe lower
    -**WPA2** Flare pipe upper
    -**RND1** Flare Nozzle

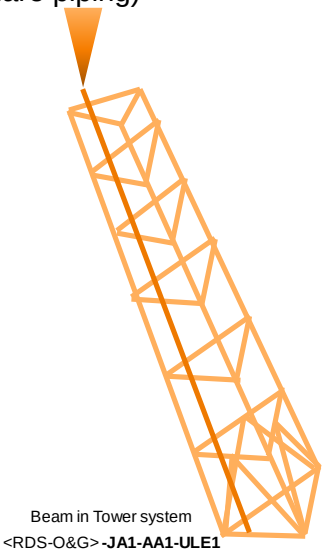


Figure 20 - A beam designated by RDS-O&G

As an example the “Beam 1” gets the designation **<RDS-O&G>-JA1-AA1-ULE1**

19.2 Scenario 2 – a beam designated by RDS-CW

In this scenario the construction works and therby the beam is designiated by the RDS-CW while all equipment related to the oil and gas process is designated according to RDS-O&G

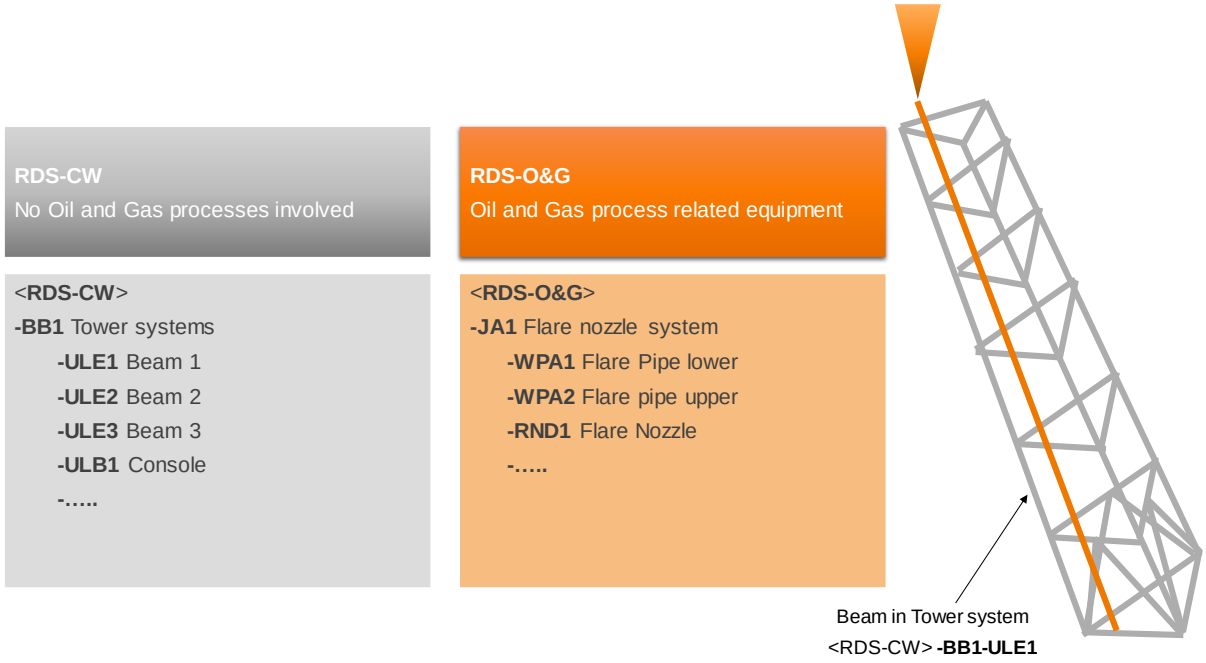


Figure 21 - A beam designated by RDS-CW

In this example the “Beam 1” gets the designation **<RDS-CW>-BB-ULE1**

19.3 Scenario 3 – a beam designated by RDS-O&G and RDS-CW

In the last scenario the beam is designated both by the RDS-O&G and by the RDS-CW. This case could be the case if the flare tower structure came from a subcontractor without the flare nozzle system installed. In this case each element of the flare tower will have a reference designation set associated to them, which contains reference designations from RDS-O&G and RDS-CW.

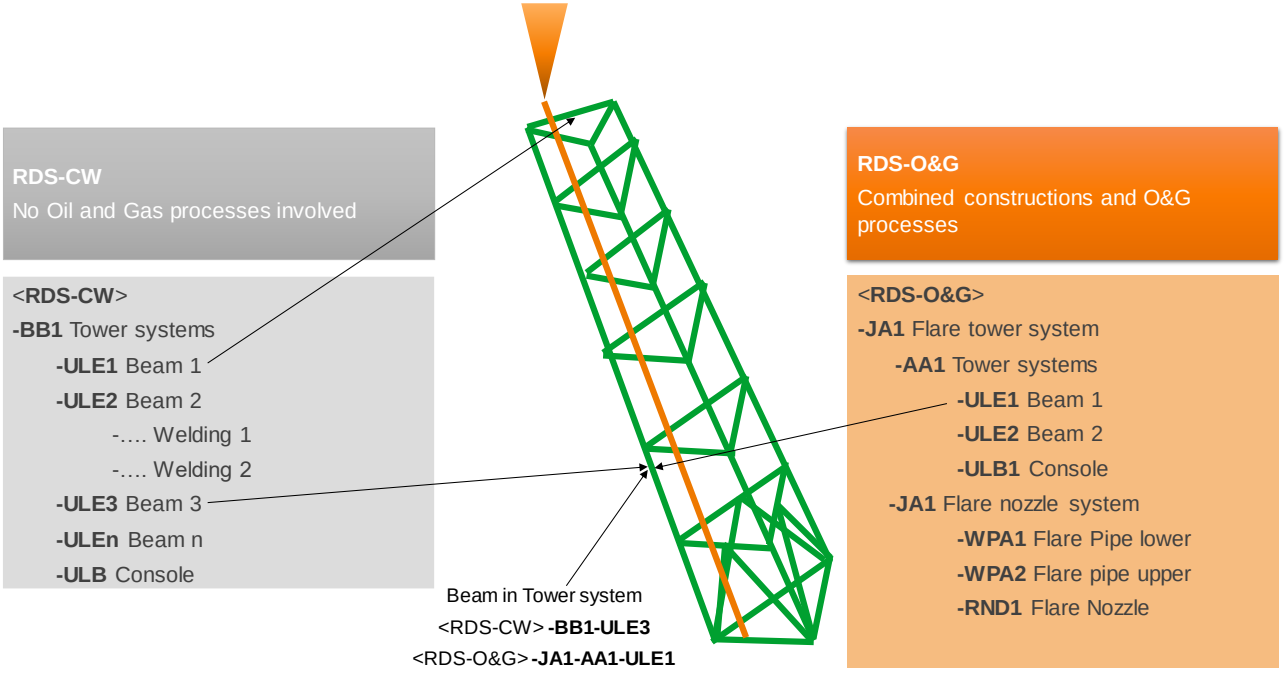


Figure 22 - A beam designated by RDS-O&G and RDS-CW

In this example the designer of the flare tower has another way of numbering the beams than the designer of the complete flare tower system, so now the same beam is beam 1 in the RDS-O&G world while it is seen as beam number 3 in the construction works world. RDS is fully capable of handling this scenario where the same beam now has two different designations as seen below. The reference designation set for the same beam is shown below.

<RDS-CW>**-BB1-ULE3**

<RDS-O&G>**-JA1-AA1-ULE1**

Both designations are correct according to, on the one hand RDS-O&G and on the other hand RDS-CW. That is the flexibility of RDS in a nutshell. Both designations are correct as long as the top node identifier is included <RDS-CW> or <RDS-O&G>, then the reader knows which library to look into.

20 RDS-CW functional and product aspects

As for the RDS-O&G (See section 14 and 15) the RDS-CW can also be used to describe/designate both the functional aspects and the product aspect of the same system.

- The functional aspect is useful when describing which functions the systems contains from a construction point of view.
- The product aspect is useful when describing how the system is physical is built of modules and assemblies with a construction mindset

This is especially relevant for the living quarter on a platform, but it could also be relevant to a flare tower as described above.

- When systems/parts of the plant contain mainly civil work, construction and infrastructure RDS-CW is straight forward to designate from.
- If the systems are covering Oil and gas related process and functions RDS-O&G should be used. By the end of the day the designer is free to decide which of the above tree scenarios to follow.

21 Type aspect

As described in section 17.1 types can handle various kinds of liquid transports systems. The same applies for structural parts of a platform designated by RDS-CW. The two tables below show examples of how beam types can be defined and used to define the beam type for specific beams in a project.

Table 6 shows an example of a list of beam types used in a project with properties of the types.

Table 7 shows an example of a list of the specific beams within the project and their associated data. This data includes a reference to the beam type.

Table 6 – List of beam types

Element ID	**Name**	**Profile**	**Suitable for corrosive environment**
%ULE1	I-beam, Corrosive	I	yes
%ULE2	I-beam, Non-Corrosive	I	no
%ULE3	U-beam, Corrosive	U	yes
%ULE4	U-beam, Non-Corrosive	U	no
%ULE5	L-beam, Corrosive	L	yes
%ULE6	L-beam, Non-Corrosive	L	no
%ULE7	Pipe, Corrosive	O	yes
%ULE8	Pipe, Non-Corrosive	O	no

Table 7 – List of beams with properties, including the beam type.

Element ID	**Name**	**Material**	**Weight [kg]**	**Type**
-BB1-ULE1	Beam	Steel	120	%ULE7
-BB1-ULE2	Beam	Steel	125	%ULE7
-BB1-ULE3	Beam	Steel	90	%ULE7

NB: Purpose of the tables are only to illustrate the method. Lists of types have not been developed as part of this 1st revision.

Part 6
Classification scheme

22 The classification scheme – Three libraries

The RDS-O&G classification scheme acts as an interdisciplinary classification scheme, from which system or location classification is applied.

The complete RDS-O&G classification scheme consists of multiple classification tables that are used to classify different objects in RDS-structures. The tables are divided into three libraries that provide classification for Oil and gas systems, construction works systems, and locations.

The tables in the three libraries are listed in Table 8:

Table 8 - List of tables in the RDS-O&G classification scheme.

Used for	Table	Description
[-] Product [=] Function [%] Type	O&G 1 **– Oil and gas systems**	Sector specific table based on classification principles defined in ISO 81346-12:2018
	O&G 2 **– Oil and gas technical system**	Sector specific table based on classification principles defined in ISO 81346-12:2018
	RDS 3 **– Component systems**	Table 3 from IEC 81346-2:2019
	RDS A.1 **– Construction works functional systems**	Table A.1 from ISO 81346-12:2018
	RDS A.2 **– Construction works technical systems**	Table A.2 from ISO 81346-12:2018
[++] Site of Installation	O&G 3 **– Construction complexes**	Sector specific table based on classification principles of ISO 81346-12:2018
	O&G 4 **– Construction entities**	Sector specific table based on classification principles of ISO 81346-12:2018
	RDS 4 **– Spaces**	Table 4 from IEC 81346-2:2019

Figure 23 illustrates the three libraries each of which contain three classification tables. The pyramid shape symbolizes the hierarchy level of the RDS-structures at which the classification is applied. For example, in the case of the Oil and gas system library:

1. Higher level elements are classified using ONE letter code from table “O&G 1 – Oil and gas systems”

2. Intermediate level elements are classified using TWO letter code from table “O&G 2 – Oil and gas technical systems”

3. Lower level elements are classified using THREE letter code from table “RDS 3 – Component systems”.

Figure 23 shows the overview of the RDS-O&G classification tables. Table IDs are listed next to the pyramids, and the tables’ subjects are listed within the pyramid.

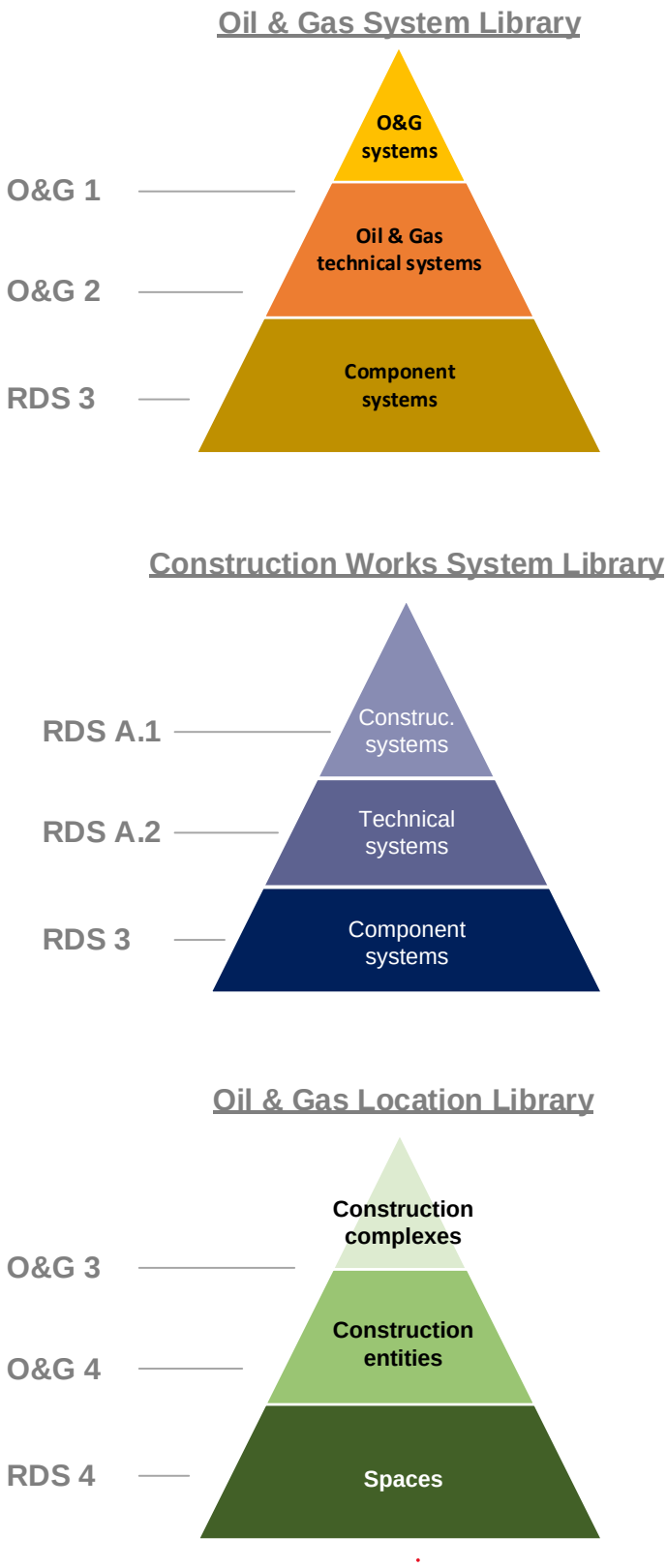


Figure 23 – The three libraries of classification tables.

The libraries are applied within the two technical sectors “Oil and gas production” and “Construction works” as shown in Table 9 and Table 10. The tables show which of the three libraries and their tables that are used within RDS-structures for each sector: O&G or CW:

Table 9 - The use of the classification libraries for RDS-structures for Oil and gas production.

Aspect	Tables
Function	O&G 1 **– Oil and gas systems** O&G 2 **– Oil and gas technical system** RDS 3 **– Component systems**
Product	O&G 1 **– Oil and gas systems** O&G 2 **– Oil and gas technical system** RDS 3 **– Component systems**
Type	O&G 1 **– Oil and gas systems** O&G 2 **– Oil and gas technical system** RDS 3 **– Component systems**
Point of installation	N/A
Site of installation	O&G 3 **– Construction complexes** O&G 4 **– Construction entities** RDS 4 **– Spaces**

Table 10 - The use of the classification libraries for RDS-structures for Construction works.

Aspect	Tables
Function	RDS A.1 **– Construction works functional systems** RDS A.2 **– Construction works technical systems** RDS 3 **– Component systems**
Product	RDS A.1 **– Construction works functional systems** RDS A.2 **– Construction works technical systems** RDS 3 **– Component systems**

23 Classification library – Oil and gas functional systems

The classification of systems involved in Oil and gas production is based on a pragmatic approach following the principles of creating sector specific application of the ISO/IEC 81346-standard series. The classification defines three levels of abstraction when defining the systems and system elements.

These three levels allow for classification of systems at varying levels of abstraction and scope. In practical terms, this means that the classification of systems on the highest, intermediate and lowest levels of decomposition follow three separate classification tables respectively:

O&G 1: Classes of Oil and gas systems

O&G 2: Classes of Oil and gas technical systems

RDS 3: Classes of Component systems (shared library)

NOTE 1 Components are in fact often “small systems”, they are therefore recognized to be component systems. Components may include items currently referred to as parts, components, equipment and more.

NOTE 2 RDS 3 is defined in IEC 81346-2 and shared with other industries.

Figure 24 shows the principle of the classification applied in an RDS-structure. The highest-level elements are classified using the O&G 1 table, the intermediate level elements are classified using the O&G 2 table, and the lowest level elements are classified using the RDS 3 table.

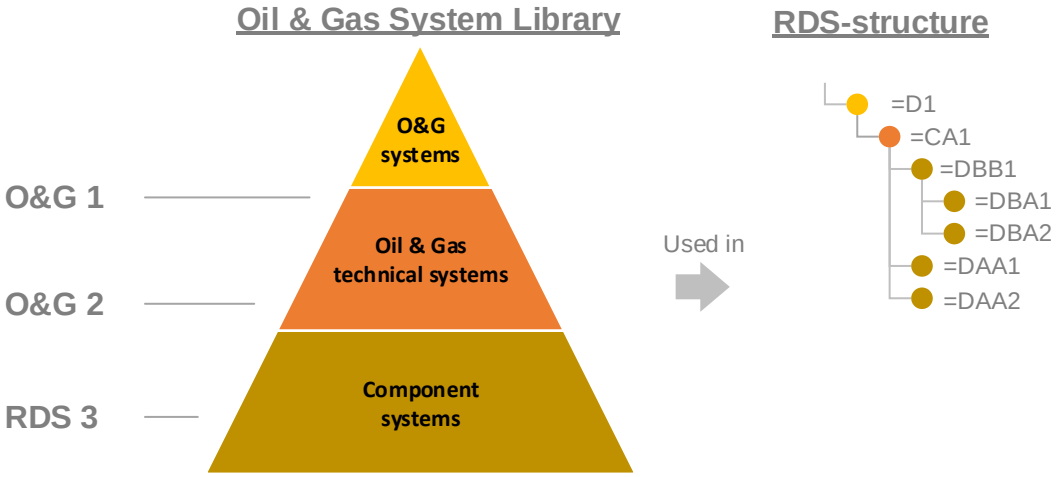


Figure 24 – Application of classification tables on elements in RDS-structure at three levels of abstraction.

When applying the Oil and gas systems library to classification in RDS-structures the following can be observed:

- Class codes for Oil and gas are recognized by **ONE** letter code
- Class codes for Oil and gas technical systems are recognized by **TWO** letter codes
- Class codes for component systems are recognized by **THREE** letter codes

Letter codes from the three classification tables do not share any meaning, e.g. a single letter code "X", two letters code "XX", and three letters code "XXX" from the three tables are not related.

Classes of Oil and gas systems and Oil and gas technical systems are defined for usage in power production systems only. Classes for Component systems are shared with other industries and are covered by tables in IEC 81346-2 [4], however specific Oil and gas terms are mapped to the appropriate classes of component systems to be able to search among recognized terms used in Oil and gas.

24 Classification library - Construction works

The classification of systems involved in civil construction works is based on ISO 81346-12:2018.

Like in RDS-O&G, the classification defines three levels of abstraction when defining the systems and system elements. These three levels allow for classification of systems at varying levels of abstraction and scope. In practical terms, this means that the classification of systems on the highest, intermediate and lowest levels of decomposition follow three separate classification tables respectively.

The three tables are as follows:

RDS A.1:	Classes of Construction works functional systems
RDS A.2:	Classes of Construction works technical systems
RDS 3:	Classes of Component systems (shared library)

NOTE: Components are in fact often "small systems", they are therefore recognized to be component systems. Components may include items currently referred to as parts, components, equipment and more.

Application examples of RDS-CW are given in ISO/IEC 81346-12:2008.

When applying the library to classification in RDS-structures the following can be observed:

- Class codes for Construction works systems are recognized by **ONE** letter code
- Class codes for Construction works technical systems are recognized by **TWO** letter codes
- Class codes for Component systems are recognized by **THREE** letter codes

Letter codes from the three classification tables do not share any meaning, e.g. a single letter code "X", two letters code "XX", and three letters code "XXX" from the three tables are not related.

25 Location library

25.1 Description

The classification of location sites is based on the principles of designation for site-of-installation (++) defined in ISO 81346-12:2018 and tailored to the Oil and gas Sector.

The RDS-O&G classification defines three levels of abstraction when defining the location objects. These three levels allow for classification of locations at varying levels of abstraction and scope. In practical terms, this means that the classification of locations on the highest, intermediate and lowest levels of decomposition follow three separate classification tables respectively.

O&G 3:	Classes of Construction complexes
O&G 4:	Classes of Construction entities
RDS 4:	Classes of Spaces (shared library)

NOTE: RDS 4 is defined in IEC 81346-2 and shared with other industries.

When applying the library to classification in RDS-structures the following can be observed:

- Class codes for Construction complexes are recognized by **ONE** letter code
- Class codes for Construction entities are recognized by **TWO** letter codes
- Class codes for Spaces are recognized by **THREE** letter codes

Letter codes from the three classification tables do not share any meaning, e.g. a single letter code “X”, two letters code “XX”, and three letters code “XXX” from the three tables are <u>not</u> related.

The classification theme for spaces is based on what activity the space is designed for. The classification of spaces is shared with other industries and are covered by tables in ISO/IEC 81346-2:2019 [4].

Abbreviations, Definitions and Bibliography,

26 Abbreviations

IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
ISO	International Organization for Standardization
RDS	Reference Designation System
RDS-O&G	Reference Designation System for Oil and gas
RDS-CW	Reference Designation Systems for Construction Works (ISO/IEC 81346-12)

27 Definitions

The following definitions applies in this manual:

activity space
space defined by the spatial extension of an activity
[5 sec. 3.1.9]

Oil and gas system
object with characteristics which predominantly represents an overall inherent function in production of energy by Oil and gas

architecture
fundamental concepts or properties of a system in its environment embodied in its elements, relationships and the principles of its design and evolution
[6 sec. 3.2]

aspect
specified way of *viewing* an object
[3 sec. 3.3]

Note: In the context of this manual, an object is a system or system element

class
a set of objects that share one or more characteristics

component system
object with characteristics which predominantly represents a specialized industrial product solution

function
intended or accomplished purpose or task
[3 sec. 3.5]

identifier
attribute associated with an *object* to unambiguously distinguish it from other *objects* within a specified domain
[3 sec. 3.9]

location
intended or accomplished *space*
[3 sec. 3.8]

point of installation
relative coordinate or zone in which components are installed

site of installation
space in which systems or components are physically located
[7 sec. 3.17]

EXAMPLE Cabinet located in a technical room

multi-level reference designation
reference designation consisting of concatenated *single-level reference designations*
[3 sec. 3.13]

RDS
reference designation system
a system for reference designations

RDS-O&G
industry application of *reference designation system* for Oil and gas (O&G) for the Oil and Gas sector

reference designation
identifier of a specific object formed with respect to the system of which the object is a constituent, based on one or more *aspects* of that system
[3 sec. 3.11]

reference designation set
collection of two or more *reference designations* assigned to an *object* of which at least one unambiguously identifies this object
[3 sec. 3.14]

semantic view
a specific way of understanding the meaning of words, phrases or system
[8]

semantics
the meaning of words, phrases or systems
[8]

single-level reference designation
reference designation assigned with respect to the *object* of which the specific *object* is a direct constituent in one *aspect*
[3 sec. 3.12]

structure
RDS-structure
organization of relations among *objects* of a *system* describing constituency relations (part-of)
[3 sec. 3.9 (modified)]

Note: The term “RDS-structure” is used to qualify the daily used term “structure”, which might otherwise be confused with physical structures in a construction

space
limited three-dimensional extent defined physically notionally
[5 sec. 3.1.8]

syntax
the way reference designation(s) are put together using aspect prefixes, classification letter codes and numbers

system
combination of interacting elements organized to achieve one or more stated purposes
[9 sec. 4.1.46]

Note: ISO/IEC 81346-1, 3.2 has a different definition of “system”, which is not in conflict with this definition. Thus, this definition from the systems engineering standard is applied in this manual.

system element
member of a set of elements that constitute a *system*
[9 sec. 4.1.47]

technical system
object with characteristics which predominantly represents a coherent technical solution with an inherent function
[7 sec. 3.21]

top-node
the topmost level in a RDS-structure which has no reference designation but another identifier

view
a way of understanding or thinking
[8]

28 Bibliography

[1] ISO. *ISO 1087:2005 Terminology work - Vocabulary - Part 1: Theory and application*. 2000.

[2] KLIR, Jiri and Miroslav VALACH. *Cybernetic modelling*. London: Iliffe Books Ltd., 1967.

[3] IEC and ISO. *IEC/ISO 81346-1:2009(E) Industrial systems, installations and equipment and industrial products : structuring principles and reference designations : part 1 : basic rules*. Geneva: ISO. 2009.

[4] IEC and ISO. *IEC/CDV2 81346-2:2017 Industrial systems, installations and equipment and industrial products - structuring principles and reference designations : Part 2 : Classification of objects and codes for classes*. Geneva: IEC. no date.

[5] ISO. *ISO 12006-2:2015 Building construction - Organisation of information about construction works - Part 2: Framework for classification*. Geneva: ISO. 2015.

[6] ISO, IEC and IEEE. *ISO/IEC/IEEE 42010:2011 Systems and software engineering : Architecture description*. Geneva: ISO. 2011.

[7] ISO. *ISO 81346-12:2018 Industrial systems, installations and equipment and industrial products - Structuring principles and reference designations : Part 12 : Construction works and building services*. Geneva: ISO. 2018.

[8] HORNBY, A S. *Oxford Advanced Learner's Dictionary* [online]. 8th ed. 2010. ISSN 09510893. Available at: doi:10.1093/elt/ccr085

[9] ISO, IEC and IEEE. *ISO/IEC/IEEE 15288:2015 Systems and software engineering : System life cycle processes*. Geneva: ISO. 2015.