RPS Energy

PLL Calculation for Welland Decommissioning Options Summary Report

PERENCO

REV	ISSUE DATE	STATUS	AMENDMENT DETAILS	PREPARED BY	APPROVED BY
00	30/03/10	Draft	Internal Review	Siva Mohan Senior Consultant	John Crawford Principal Consultant
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1.0 Introduction

As duty holder of the Welland installation and associated infrastructure, Perenco UK Ltd (Perenco), has certain obligations with regard to decommissioning of offshore installations and pipelines as stipulated in Petroleum Act 1998. Perenco is currently undertaking a comparative assessment of the available decommissioning options. As a part of the comparative assessment process, Perenco wish to undertake a high level QRA primarily quantifying the Potential Loss of Life (PLL) for each available decommissioning option under consideration. RPS Energy has been requested by Perenco to quantify the PLL for the available decommissioning options. Note that the scope of the PLL calculation relates only to the workforce directly involved in the decommissioning work. The risks to other users of the sea have not been considered. However, the risks to those involved in onshore decommissioning work (required for some of the available options) have been considered.

2.0 Approach

The Welland decommissioning options and the associated data provided by Perenco (*Reference 1*) have been used as a basis for the PLL calculation. In addition, a FAR value has been taken from the join industry project report prepared by Safetec (*Reference 2*).

Notes;

1. FAR is the Fatal Accident Rate for an activity and is normally expressed as the number of fatalities that occur during a period of 100 million exposed working hours
2. Decommissioning operations typically have a wide range of specific work tasks, such as; Rope Access, Scaffolding, Marine Operations, Diving and Lifting. These tasks have widely varying FARs (from <10 to >100)
3. The Safetec Report (*Reference 2*) concludes that the average experienced FAR value for decommissioning projects in the North Sea is 26
4. The Safetec Report (*Reference 2*) indicates that available FAR values may underestimate the risks involved for a variety of reasons.
5. For the purpose of the PLL calculation for the Welland decommissioning options, it has been assumed that each option involves a range of work tasks as per the Safetec Report (*Reference 2*). This justifies the use of an average FAR of 26 for all the listed decommissioning options provided by Perenco UK ltd (*Reference 1*).

RPS Energy calculated the PLL for each available decommissioning option by summing up the exposure manhours and multiplying by the appropriate FAR. The results are provided in Section 4.

4.0 Results

Table 4.1: PLL for Jacket and Topsides

PLL for Jacket and Topsides		
Option 1	**Option 2**	**Option 3**
Heavy Lift Vessel	Piece Small	Minimal Disposal
9.26E-03	**5.16E-02**	**1.51E-03**

Table 4.2: PLL for Subsea Protection Frames

PLL for Subsea Protection Frames			
Option 1	**Option 2**	**Option 3**	**Option 4**
Heavy Lift Vessel	Drill Rig	Crane Vessel	Leave in Situ
7.92E-03	**1.04E-02**	**6.52E-03**	**0.00E+00**

Table 4.3: PLL for 16" Export Pipeline

PLL for 16" Export Pipeline								
Option 1	**Option 1a**	**Option 1b**	**Option 2**	**Option 2a**	**Option 2b**	**Option 3**	**Option 3a**	**Option 3b**
Clean (pigs), Flush (2cuM/min) & De-pressure			Flush (2cuM/m) & De-pressure			De-pressure only		
Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried	Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried	Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried
3.22E-02	**2.29E-02**	**7.28E-03**	**3.15E-02**	**2.21E-02**	**6.51E-03**	**2.81E-02**	**1.87E-02**	**3.17E-03**

Table 4.4: PLL for 3" MEG Pipeline

PLL for 3" MEG Pipeline					
Option 1	**Option 1a**	**Option 1b**	**Option 2**	**Option 2a**	**Option 2b**
Flush (2cuM/m) & De-pressure			De-pressure only		
Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried	Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried
2.53E-03	**2.53E-03**	**1.47E-03**	**2.46E-03**	**2.46E-03**	**1.05E-03**

Table 4.5: PLL for Subsea Flowlines

PLL for 3 x 8" Subsea Flowlines								
Option 1	**Option 1a**	**Option 1b**	**Option 2**	**Option 2a**	**Option 2b**	**Option 3**	**Option 3a**	**Option 3b**
Clean (pigs), Flush (2cuM/min) & De-pressure			Flush (2cuM/m) & De-pressure			De-pressure only		
Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried	Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried	Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried
3.72E-02	**2.60E-02**	**1.02E-02**	**3.62E-02**	**2.50E-02**	**9.16E-03**	**3.40E-02**	**2.28E-02**	**6.97E-03**

Table 4.6: PLL for Subsea Umbilicals

PLL for 3 x Subsea Umbilicals Options					
Option 1	**Option 1a**	**Option 1b**	**Option 2**	**Option 2a**	**Option 2b**
Flush (2cuM/m) & De-pressure			De-pressure Only		
Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried	Cut on Seabed & Remove in sections	Remove, cut into sections on surface	Leave in situ, ends buried
1.82E-02	**1.25E-02**	**7.41E-03**	**1.49E-02**	**9.33E-03**	**4.32E-03**

Table 4.7: PLL for Pipeline Crossing Points

PLL for 3 x Pipeline Crossing Points	
Option 1	**Option 2**
Remove	Leave in Situ
1.37E-02	**0.00E+00**

Table 4.8: PLL for 126 Mattresses

PLL for 128 Subsea Mattresses		
Option 1	**Option 2**	**Option 3**
Remove	Bury in Situ	Minimal Disposal
1.33E-02	**2.58E-03**	**1.75E-04**

5.0 Discussion

The Welland infrastructure included in the planned decommissioning operations includes the following components:

- Welland Installation Jacket and Topsides
- Three Subsea Wellhead Protection Frames
- Welland-Thames 8" Export Pipeline
- Piggyback 3" MEG Pipeline
- Three 8" Subsea Flowlines
- Three Subsea Control Umbilicals
- Three Pipeline Crossing Points
- 128 Concrete Mattresses

The PLL for the decommissioning the above components has been calculated and presented in Section 4.0. The following provides a brief discussion of the findings.

Jacket and Topsides

For Jacket and Topsides the following three options have been considered:

- Heavy Lift Vessel
- Piece Small
- Minimal Disposal

From the Table 4.1, it is evident that HLV and Minimal Disposal option carry the lowest risk. The piece small option contributes 83% of the risk. This is largely due to the fact that the piece small option would require a Jack-up rig/barge to present which contributes to significant additional manhours in comparison to HLV and Minimal disposal options.

Subsea Wellhead Protection Frames

Four decommissioning options have been considered for subsea protection frames. These are:

- Heavy Lift Vessel
- Drilling Rig
- Crane Vessel
- Leave in-situ

Drilling rig contributes the highest risk (42%) followed by HLV (32%) and Crane Vessel (26%). The drilling rig requires a high level of POB which leads to significant exposed manhours in comparison to HLV. The leave-situ option contributes negligible risk. This may well be due to no effort is required to make the subsea protection frames save for other users of the sea.

Export Pipeline

For export pipeline, three main options have been considered. These are:

- Clean, Flush and De-pressure
- Flush and De-pressure
- De-pressure Only

Note that for each option there is further three sub-options have been considered. Table 4.3 illustrate the PLL figures for all the options. The leave-situ option with ends buried effectively contributes to the lowest risk.

3" MEG Pipeline

The options considered for MEG Pipeline is similar to export pipeline with an exception that no cleaning is undertaken. Table 4.4 clearly demonstrates that there are no differences in terms of option 1 & 1a and option 2 & 2a. Option 1 & 1a contributes 39% of the risk and Option 2 and 2a contributes 41% of the risk. The in-situ option effectively carries the lowest risk.

Subsea Flowlines

The decommissioning of subsea flowlines options is identical to export pipeline options. The 'cut on seabed and remove in section option' is considered to be the highest risk, followed by 'remove and cut on surface option'. The leave in-situ with ends buried option contributes the lowest risk primarily due to the fact that least manhours required undertaking the decommissioning work task.

Subsea Umbilicals
Table 4.6 demonstrates that the cut in seabed and remove in section options contributes to a significant risk. Option 1 contributes 48% of the risk and the Option 2 contributes 52%. This is primarily driven by significant manhours required to cut and lift from seabed using pipelay barge. Leaving the subsea umbilicals in-situ option effectively carries the lowest risk.

Pipeline Crossing Points
It can be seen from Table 4.7 that in-situ option is effectively carries negligible risk. This may well be that no effort is required to leave the pipeline crossing points on the seabed.

Mattresses
Three decommissioning options have been considered for subsea mattress. These are

- Complete Removal
- Bury In-situ
- Minimal Disposal

The complete removal option contributes significant risk (i.e. 83%) followed by bury in-situ option (16%) and the minimal disposal option almost negligible (1%).

References

1. Excel spreadsheet of Subsea Umbilicals CA Table, Export Pipeline CA Table, Jacket and Topsides CA Table, 3" MEG Pipeline CA Table, Pipeline Crossing Points CA Table, Subsea Flowlines CA Table, Subsea Protection Frames CA Table, Subsea Mattress CA Table; received from Perenco on 24 March 2010.

2. Safetec, Joint Industry Project; Risk Analysis of Decommissioning Activities; 3rd March 2005 (Rev 03)