

SPE Thailand Exploration and Production Annual Award Program 2015

In Situ Mercury Decontamination for Pipeline Decommissioning in the Gulf of Thailand

PTT Exploration and Production Public Company Limited

Team Leader : Mr. Peerapong Chailapo

Team members

1. Ms. Suchada Punpruk
2. Mr. Chatawut Chanvanichskul
3. Mr. Passaworn Silakorn
4. Mr. Chanya Thammawong
5. Mr. Patara Limpanachaipornkul
6. Mr. Apichart Whungkhunnatham

Involving Disciplines

Internal : Operations, SSHE, Engineering, Construction, Legal, Logistics

Copyright and Confidential

Requests for permission to disclose any information written in this paper shall be in writing to PTT Exploration and Production Public Company Limited.

Innovation Features

The decommissioning of platform structures and other installations used in E&P business must be undertaken by the concessionaire upon the termination of petroleum production and expiry of concession.

For offshore decommissioning in the Gulf of Thailand, Mercury (Hg) has been recognized as a serious contaminant in hydrocarbon streams. Consequently, for PTTEP, as the E&P operator in the Gulf of Thailand, one of the significant environmental issues to tackle during decommissioning is the decontamination of Hg in the equipment/instruments and pipeline.

PTTEP's decommissioning plan focuses on leaving in situ of subsea pipelines which can be arranged only if Hg contaminated item is almost fully cleaned and Hg content is below the acceptable level of Department of Mineral Fuel (DMF). Techniques to decontaminate Hg from pipeline and post-monitoring methods are required in the Final Decommissioning Program that has to be submitted to DMF. Therefore, the research to identify the techniques to measure and remove Hg contents from metal is required.

The innovation scope is the overall in situ Hg decontamination from pipeline which comprise of 3 main processes including:-

1. Identifying depth of mercury penetration through the pipe surface

To select the most appropriate technique for mercury decontamination, it is necessary to identify depth of mercury penetrated through the internal pipe surface. Metal sample preparations with the appropriate laboratory testing methodology have been initiated.

2. Methodology for in-situ mercury decontamination from the pipeline

Based on part 1 results and worldwide experiences of chemical cleaning and pigging operation, chemical and mechanical pig train concept has been proposed. But new chemicals and new two types of mechanical pigs is developed. Design concepts of the two mechanical pigs are as follows.

- The 1st mechanical pig is designed to remove Hg and scale in combination of chemicals to accelerate the removal process which is considered as primary removal. Conventional brush pig concept has been adapted by adding the function to ensure that the brush part will be in contact with unsmooth/corroded internal pipe surface at all times. In addition, it shall be robust enough to remove hard scale until the end of the pipeline.
- The 2nd mechanical pig is designed as a secondary removal to ensure that all residual Hg are removed. The pig will be installed with a special planetary system and diamond wire brushes having a pendula motion around the central axis of the pig. The planetary systems are positioned in the two heads allowing to turn as clockwise and counterclockwise motion. The concept to use one clockwise motion and one counterclockwise motion is to increasing the probability of removal quantity of the hard deposited / rough surface scale in corroded area in the pipe wall and also covering all circumference of the pipe. The purpose of the planetary system is to:
 - ✓ Permit a pendula motion around the central axis of the pigging, adjustable from 0 to 180 degree, the top surface of the pipe which contain maximum amount of mercury will be cleaned.
 - ✓ Allow an easy and fast regulation of the diameter on function of the pipe schedule.
 - ✓ Extend the life of the brushes, if compared with a single grinding wheel, and consequently improve the efficiency of the equipment.

3. Methodology for measuring contaminated Hg content in pipeline before leaving it in situ

In order to ensure that the remaining Hg content after decontamination process does not exceed the allowable limit, the inline Hg measurement is highly essential. The first idea is to embed XRF (X-ray fluorescence) sensor in pig running in pipeline.

However, it is found that XRF portable analyzer which is commonly used to measure elements in material surface, including Hg, is not qualified as XRF analysis requires proper calibration to gain the reliable result and surface to be measured must be smooth. The second concept of “**New In line pig equipped metal sampling tool**” has been initiated as per below concept:

The 1st step : Specialized pig that can go into sealine to collect internal pipe surface metal sample in designated area and depth.
The 2nd step : Collected sample will be sent for laboratory analysis, to measure Hg content using standard method which are acceptable by DMF and industry i.e. Inductively Coupled Plasma Mass Spectrometer (ICP-MS) or Atomic Absorption (AA) methods.

Thailand E&P industry impact and values

As mercury is unique and exceptionally high for oil and gas reservoir in the Gulf of Thailand and decommissioning activities here is not yet occurred, technology for in-situ mercury decontamination from metal surface i.e. pipeline is not proven for E&P industry, although several mercury removal technique are commercialized for produced fluid stream.

Therefore, outcomes of this project have several impacts and values both direct and indirect to Thailand E&P Industry as follows :-

- New pig tools and methodology for in-situ mercury decontaminations in pipeline will be available for Thailand E&P decommissioning in the near future.
- By leaving pipeline in-situ, cost of pipeline removal is eliminated. Significant decommissioning cost saving will be gained (approximately in the range of 0.5-1.5 MMUSD/kilometer). By including total of subsea pipelines from all E&P operators in the Gulf of Thailand, the cost saving for Thailand E&P industry will be enormous.
- It is potentially create new business opportunity for pipeline decommissioning in Thailand and South East Asia including others E&P worldwide where Hg contaminated is a major issue by using this new pig tools and methodology for in-situ mercury decontaminations in pipeline.
- It will serve green practices as green decommissioning concept has been applied by eliminating Hg contaminated waste that will be generated to onshore. All Hg contaminated waste from in-situ pipeline Hg decontamination activities will be re-injected to the depleted wells. In case that in-situ Hg decontamination technique is not available and pipeline removal shall be performed, significant amount of Hg contaminated pipeline will be generated to onshore (not only PTTEP's pipelines, but also others Thailand E&P operators).
- Cross functional working team and national recognition as this project involves many parties representing a variety of disciplines, both internal (i.e. Operations, SSHE, Engineering, Legal, Logistics) and external stakeholders (NSTDA, MTEC, KMUTNB, etc).
- It serves Thailand E&P decommissioning plan. All E&P operators in the Gulf of Thailand have the responsibility to submit the final decommissioning program before the end of its concession in the near future.

Abbreviations :

NSTDA = National Science and Technology Development Agency,

MTEC = National Metal and Materials Technology Center, Thailand,

KMUTNB= King Mongkote University of North Bangkok

Why this project should win the award?

An increasing number of depleted E&P reservoirs and ageing facilities in the Gulf of Thailand leads to highly important of decommissioning technology in the near future. Innovation is a must to breakthrough of the existing problem.

The World First Methodology and Tools

Although facilities decommissioning has already been occurred in others E&P operators worldwide, there is no specific problem on significant mercury contamination in the oil and gas reservoir as found in the Gulf of Thailand. Several attempts have been made to breakthrough of the existing problem by exploring potential technology, testing in laboratory and small scale pilot for concept proving. Several technical discussions with expert worldwide were arranged to finalize the best solution. The proposed methodology and tools will be served as a first innovated technique for mercury decontamination from the in situ pipeline.

Green Decommissioning and Responsibility for Society

The proposed decommissioning plan focus on the eco-friendly option, leaving pipeline in situ with best environmental treatment is considered as the most suitable option. This proposed technique will serve **GREEN** practices by eliminating significant amount of Hg contaminated pipeline that will be generated to onshore, not including Hg releasing to sea environment during pipeline cutting under water prior to removing onshore. Responsibility to the society has demonstrated by innovating of the technique that will protect the environment both under water and onshore to save the world lives.

Thailand E&P Cost Effective Decommissioning and New Business Opportunity

It is not only protecting the environment. It also serves as cost effective decommissioning. Significant cost saving will be gained to Thailand E&P Industry, in addition to creating of new business opportunity for pipeline decommissioning in Thailand and South East Asia including others E&P worldwide where Hg contaminated is a major issue.

Knowledge contribution from E&P Industry to National Research Unit and University

Without team work, we will never success. Collaboration across multiple disciplines with various knowledges and experiences both inside and outside the company is the key to succeed. National research unit and university including NSDTA, MTEC and KMUTNB are our key partners. The study has contributed the knowledges, increased capability and served collaboration, not only inside PTTEP but for also National research unit, university, other related partners and stakeholders.

New Standard / Guideline Development

As a final step, guideline to decontaminate Hg from in-situ pipeline including the post-monitoring method shall be developed and submitted for the approval by DMF as a part of decommissioning program. Once it is approved, it will potentially become corporate standard to serve other E&P operators in the Gulf of Thailand for future Thailand E&P decommissioning activities.

In conclusion, with our concept of eco-friendly and cost effective decommissioning, we currently have potential Hg decontamination technology that can be served as a part of near future Thailand E&P decommissioning. Most importantly, we have demonstrated the responsibility for the society in order to maintain sustainability for Thailand E&P Industry.