Failures of piping systems in the oil, gas and petrochemical industries can lead to damage of assets, personal injury and loss of life. Piping failure can be caused by excessive vibration, in the form of high levels of acoustic energy (AIV), or by flow turbulence (FIV) created by shear forces within the piping system.

A desire for increased flow rates, the use of ‘thin’ wall piping, the growing demand to reduce mass, the requirement for fast activating valves and use of longer piping has led to a rise in the number of potential piping failures. Although the phenomenon of induced vibration has been understood since the 1950s (in the aerospace industry), it is only more recently that process and piping engineers have had to consider these impacts in the preliminary and detailed design phases of their projects.

As a leading provider of AIV and FIV assessment for the oil and gas industry WKC offer bespoke training in the assessment and evaluation of AIV and FIV training.
Course Overview

- Acoustically-induced vibration - including description of relevant AIV methodologies and codes (EI, CONCAWE, Exxon, Eisinger)
- Flow-induced vibration - using EI Guidelines
- Application of the assessment methodologies and mitigation measures used during the design phase of a project to minimize the risk of induced vibration

Course Objectives

The course objectives are to:

- Enable participants to be able to undertake an AIV and FIV assessment following good industry practice.
- Allow participants to gain an understanding of the prediction, screening and assessment procedures.
- Provide participants with an oversight of design measures that can be implemented in order to minimise the risk of induced vibration.
- Provide worked examples of the application of the assessment methodologies during the design phase of a project.

Specially Designed For

The course is aimed at professionals who have involvement in the design of oil and gas assets, who want to gain a comprehensive understanding of how AIV and FIV assessments are carried out and gain some practical experience in undertaking such studies.

The course is primarily aimed at Project Managers, Process Engineers, and Mechanical Engineers.

Program Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
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</thead>
<tbody>
<tr>
<td>08:00 – 09:00</td>
<td>Registration (Day1)</td>
</tr>
<tr>
<td>09:00 – 11:00</td>
<td>Session I</td>
</tr>
<tr>
<td>11:00 – 11:15</td>
<td>Refreshment &amp; Networking Session I</td>
</tr>
<tr>
<td>11:15 – 13:00</td>
<td>Session II</td>
</tr>
<tr>
<td>13:00 – 14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00 – 15:30</td>
<td>Session III</td>
</tr>
<tr>
<td>15:30 – 15:45</td>
<td>Refreshment &amp; Networking Session II</td>
</tr>
<tr>
<td>15:45 – 17:00</td>
<td>Session IV</td>
</tr>
<tr>
<td>17:00</td>
<td>End of Day</td>
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</tbody>
</table>

Supported by

[Logos of various organizations]
Course Agenda

**DAY 1**

**Introduction**

This will provide a brief summary of the course, and definitions and brief explanations of AIV, FIV. With further explanation into what the risks are and the research that has been carried out to date.

**AIV Assessment and Mitigation**

Covering the principles and theory of AIV, and outline the relevant screening guidance documents such as CONCAWE 85/52, Eisinger, Exxon and the EI Guidelines. The session will then go on to explain how to conduct a screening and detailed assessment followed by an overview of the possible design solutions that could be incorporated into the design to minimize the risk from AIV.

**DAY 2**

**AIV ‘Real Word’ Case Study Examples**

Based on the principles learnt on day 1 and following the EI Guidelines Methodology, participants will undertake a step by step assessment of a real world case study example. The Likelihood of Failure (LOF) will be calculated at each discontinuity downstream of a pressure reducing device to the flare header and where required recommendations discussed on how the risk of fatigue/failure could be minimised.

**FIV Assessment and Mitigation**

An overview of the principles and theory of Flow-induced Vibration in gaseous and liquid systems. Followed by a breakdown of the assessment process as detailed within the EI Guidelines and an examination of the possible design changes that could be incorporated into the design in order to alleviate the potential risk from FIV.

**DAY 3**

**FIV Case Study Examples**

Using the EI Guidelines worked examples will be followed to provide process and piping engineers with the basic understanding of how to carry out an FIV study during the design stages of a project and to provide a recap of the assessment procedures.

**Small Bore Connection (SBC) Assessment**

SBCs are branch lines with a diameter of equal to or less than 2 inches. This will focus on the SBC assessment for different branch types and configurations in order to provide a modified assessment of the risk from FIV along these lines. The practical application of control measures for SBCs shall also be discussed.
Richard Palmer, based in WKC’s Abu Dhabi office, has over 12 years’ experience of working in the oil and gas and petrochemical industries, specialising in acoustic and vibration assessments. He is an acoustic specialist by background and has the responsibility of overseeing and providing noise services in the form of environmental and occupational noise assessments, acoustically and flow induced vibration studies, permit applications, modelling, and training for major international oil & gas developments, particularly in the Middle East, Caspian Region, East Asia and South Africa.

Richard has managed and undertaken numerous acoustically induced and flow induced vibration studies for major oil and gas projects within the Middle East region - He is familiar with the major international guidelines, including; the Energy Institute, CONCAWE, Exxon, Shell, Eisinger, and Carucci and Mueller.

As a member of the Energy Institute he has access to the most recent research into the phenomenon of induced vibration fatigue and has open dialogue with a number of its senior members, specifically in the ongoing research projects into AIV and FIV.

### Project Experience

- **Ruwais Refinery Expansion Project Package 2 - Acoustically Induced Vibration Study, TAKREER, Abu Dhabi, UAE**
- **Lube Base Oil Project Acoustically Induced Vibration Study, TAKREER, Abu Dhabi, UAE**
- **Yanbu Export Refinery Project (3 & 4) – Acoustically and Flow Induced Vibration Study, Saudi Aramco, Kingdom of Saudi Arabia**
- **Jubail Export Refinery – Acoustically Induced Vibration Study, SATORP, Kingdom of Saudi Arabia.**
- **Kuwait Oil Company Pipelines Project – Acoustically and Flow Induced Vibration Study.**

### Fields of Competence

- **Acoustic Engineering**
- **Environmental and Occupational Noise Measurement**
- **Acoustic Induced Vibration Studies**
- **Transportation and Industrial Noise Modelling**
- **Environmental Impact Assessment**
- **Environmental Policy and Compliance**

### Partial Client List

- Exxon
- Shell
- Fluor
- Kuwait Oil Company
- Worley Parsons
- Saudi Aramco
- Technip
- Arenesco
- TAKREER
- Bureau Veritas
- CIC Energy
- SK (E & C)
- Daelim
- Tecnicas Reunidas
- Gulf Marine Service
- CONCAWE
- UAE (GS & C)
- Eisinger
- Carucci
- Mueller
- HYUNDAI
COURSE DETAILS

Title: Acoustic and Flow Induced Vibration
Date: 20th-22nd Apr 2015 | 07th-09th Sep 2015 | 26th-28th Oct 2015
Location: Kuala Lumpur, Malaysia | Bangkok, Thailand | Bandung, Indonesia

INVESTMENT PACKAGES

Please checklist the package that you are attending!

<table>
<thead>
<tr>
<th>Acoustic and Flow Induced Vibration</th>
<th>Early Bird Offer</th>
<th>Standard Price</th>
<th>Group Discount (3 or more)</th>
</tr>
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<tbody>
<tr>
<td>20th - 22nd April 2015</td>
<td>SGD 2,795</td>
<td>SGD 2,995</td>
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<tr>
<td>07th - 09th September 2015</td>
<td>SGD 2,795</td>
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<td></td>
</tr>
<tr>
<td>26th - 28th October 2015</td>
<td>SGD 2,795</td>
<td>SGD 2,995</td>
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</tbody>
</table>

* Group discount is based on standard price
* Early Bird Offer is one month before the event schedule
* To enjoy the promotion & discount offer, payment must be made before deadline
* For 5 or more delegates, please inquire for more attractive package
* Prices include lunches, refreshments and materials. Promotion & discount cannot be combined with other promotional offers.
* Important: Please note that registration without payment will incur a SGD 200 administration fee.

DELEGATES DETAIL

1st Delegate Name: Mr [ ] Mrs [ ] Ms [ ] Dr [ ] Others [ ]
Direct Line Number: ______________________________ Email: ______________________________
Job Title: ______________________________ Department: ______________________________
Head of Department: ______________________________

2nd Delegate Name: Mr [ ] Mrs [ ] Ms [ ] Dr [ ] Others [ ]
Direct Line Number: ______________________________ Email: ______________________________
Job Title: ______________________________ Department: ______________________________
Head of Department: ______________________________

3rd Delegate Name: Mr [ ] Mrs [ ] Ms [ ] Dr [ ] Others [ ]
Direct Line Number: ______________________________ Email: ______________________________
Job Title: ______________________________ Department: ______________________________
Head of Department: ______________________________

INVOICE DETAILS

Attention Invoice to: ______________________________________________________________________________
Direct Line Number: ______________________________ Fax:  _____________________________________________
Company: _______________________________________________________ Postcode: _________________________
Address: _______________________________________________________ Phone: +65 6415 4500
Country: ______________________________ Email: __________________________________________________________
Please note:
- Indicate if you have already registered by Phone [ ] Fax [ ] Email [ ] Web [ ]
- If you have not received an acknowledgement before the training, please call us to confirm your booking.

PAYMENT METHODS

- By Credit Card: Please debit my credit card: [ ] Visa [ ] MasterCard [ ] AMEX [ ] Security Code: __________
Card Number: __________ Expiry Date: __________
Name printed on card: ______________________________

- By Direct Transfer: Please quote invoice number(s) on remittance advice

PAYMENT TERMS: Payment is due in full at the time of registration. Full payment is mandatory for event attendance.

AUTHORIZED SIGNATURE : ______________________________

CONFIRMATION

I agree to PetroSync’s terms & conditions, payment terms and cancellation policy.

TERMS AND CONDITIONS

DISCLAIMER
Please note that trainers and topics were confirmed at the time of publishing; however, PetroSync may necessitate substitutions, alterations or cancellations of the trainers or topics. As such, PetroSync reserves the right to change or cancel any part of its published programme due to unforeseen circumstances. Any substitutions or alterations will be updated on our webpage as soon as possible.

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You may substitute delegates at any time as long as reasonable advance notice is given to PetroSync. For any cancellation received in writing not less than fourteen (14) working days prior to the training course, you will receive a credit voucher worth total transaction with less a SGD 200 administration fee and any related bank or credit card charges.

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In the event that PetroSync cancels or postpones an event for any reason and that the delegate is unable or unwilling to attend in on the rescheduled date, you will receive a credit voucher for 100% of the contract fee paid. You may use this credit voucher for another PetroSync to be mutually agreed with PetroSync, which must occur within a year from the date of postponement.

PetroSync is not responsible for any loss or damage as a result of the cancellation policy. PetroSync will assume no liability whatsoever in the event this event is cancelled, rescheduled or postponed due to any Act of God, fire, act of government or state, war, civil commotion, insurrection, embargo, industrial action, or any other reason beyond management control.

CERTIFICATE OF ATTENDANCE
70% attendance is required for PetroSync’s Certificate of Attendance.

DETAILS

Please accept our apologies for mail or email that is incorrectly addressed. Please email us at registration@petrosync.com and inform us of any incorrect details. We will amend them accordingly.

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- For Payment by Direct Telegraphic Transfer, client has to bear both local and overseas bank charges.
- For credit card payment, there is an additional 4% credit card processing fee.

Authorized Signature: ______________________________

PAYMENT TERMS: Payment is due in full at the time of registration. Full payment is mandatory for event attendance.

I agree to PetroSync’s terms & conditions, payment terms and cancellation policy.

Authorized Signature: ______________________________