Produced water contains a complex mixture of inorganic (dissolved salts, trace metals, suspended particles) and organic (dispersed and dissolved hydrocarbons, organic acids) compounds, and in many cases, residual chemical additives (such as scale and corrosion inhibitors) that are added into the hydrocarbon production process. These substances may have varying degrees of impact to the receiving environment and need to be treated prior to discharge into surface water or marine environment. Alternatively, treated produced water may be injected into disposal wells or into evaporation pits.

Treatment of produced water is driven by local legal requirement, technology availability and cost. As the industry looks at recovering output from mature fields and develop new fields in challenging environments, produced water management is becoming more challenging due to high water cut, presence of emulsion and significant volume of contaminants such as mercury, fine sand, and H₂S.

These challenges are driving the needs for the industry to explore new or enhanced feasible alternatives for a more cost-effective and sustainable management and disposal of produced water. This may include reduction at subsurface source by using methods such as mechanical blocking devices, water shut-off chemicals and downhole separation. Another alternative is to reuse produced water through reinjection into the reservoir, to enhance oil recovery or reuse for industrial, agricultural and recreational purposes. Digitalisation may also be optimised in allowing automation of produced water treatment, real-time or online sampling, and monitoring of produced water treatment system performance and discharge quality.

This workshop will serve as a platform for industry practitioners and subject matter experts to share and exchange knowledge on:
• Regulatory trends
• Overall produced water treatment challenges
• Aging facilities, new fields, and deepwater operation challenges
• Emerging Technologies solutions and Digitalisation
• Best practices and lessons learnt

Operators need to determine on whether the “cradle-to-cradle or cradle-to-grave” option is most suitable for each of their fields.

**Session Highlights**

<table>
<thead>
<tr>
<th>Regulation on Produced Water Treatment and Environmental Impact</th>
<th>Application of Produced Water Re-injection</th>
<th>Field Development Plan with Produced Water Management in Mind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Produced Water Treatment from Aging Assets and Mature Fields</td>
<td>Managing Challenging Applications in High Contaminants and Deepwater Operations</td>
<td>Emerging Technologies - Solutions and Digitalisation</td>
</tr>
</tbody>
</table>

**Who Should Attend**

Professionals involved in:
- Asset Operations and Management
- Data Science and Analytics
- Drilling and Completions
- Field Development Planning
- Water Treatment Research and Technology
- Reservoir Engineering
- Wells Engineering
- Produced Water Reinjection
- HSE

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Principal (Environment)
PETRONAS

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Mubadala Petroleum

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- Demonstrate thought leadership in your area of expertise and interest at both local and international levels

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This workshop provides opportunities for sharing and discussing views, experience, success stories, technology, advancements, and challenges from operators, service providers, regulators, and decision makers. The programme discusses lessons learnt and value improvements generated through strategic collaborations, and innovative strategies to design for disassembly instead of decommissioning, improve development commercial viability, and execution efficiency to sustain and prolong the field life.

Workshop Objectives

hours of peer-to-peer networking opportunities

hours of knowledge sharing and technical discussion

expert-led technical discussion topics
**Monday, 26 April 2021**

<table>
<thead>
<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>1300 - 1430</td>
<td>Welcome Remarks and Session 1: Regulation on Produced Water Treatment and Environmental Impact</td>
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<tr>
<td>1430 - 1500</td>
<td>Networking Break</td>
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<tr>
<td>1500 - 1630</td>
<td>Session 2: Application of Produced Water Re-injection</td>
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<tr>
<td>1630 - 1700</td>
<td>Networking Break</td>
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**Tuesday, 27 April 2021**

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<th>Time</th>
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<tr>
<td>1300 - 1430</td>
<td>Session 3: Field Development Plan with Produced Water Management in Mind</td>
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<td>1430 - 1500</td>
<td>Networking Break</td>
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<tr>
<td>1500 - 1630</td>
<td>Session 4: Produced Water Treatment from Aging Assets and Mature Fields</td>
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<td>1630 - 1700</td>
<td>Networking Break</td>
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**Wednesday, 28 April 2021**

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<tr>
<th>Time</th>
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<tr>
<td>1300 - 1430</td>
<td>Session 5: Managing Challenging Applications in High Contaminants and Deepwater Operations</td>
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<td>1430 - 1500</td>
<td>Networking Break</td>
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<tr>
<td>1500 - 1630</td>
<td>Session 6: Emerging Technologies - Solutions and Digitalisation</td>
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<tr>
<td>1630 - 1700</td>
<td>Networking Break</td>
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Register and join the sessions at your local time:

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<th>Time</th>
<th>City/Time Zone</th>
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<tr>
<td>0800 hours</td>
<td>Doha / Kuwait City / Manama / Riyadh</td>
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<tr>
<td>0900 hours</td>
<td>Abu Dhabi / Dubai / Muscat</td>
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<td>1030 hours</td>
<td>New Delhi</td>
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<td>1130 hours</td>
<td>Yangon</td>
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<td>1200 hours</td>
<td>Bangkok / Hanoi / Jakarta</td>
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<td>1300 hours</td>
<td>Bandar Seri Begawan / Beijing / Kuala Lumpur / Perth / Singapore</td>
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<td>1430 hours</td>
<td>Adelaide</td>
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<td>1500 hours</td>
<td>Brisbane</td>
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<td>1630 hours</td>
<td>Wellington</td>
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<td>1700 hours</td>
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**Technical Programme Preview**

**MONDAY, 26 APRIL 2021**

<table>
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<tr>
<th>Time</th>
<th>Session</th>
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<tbody>
<tr>
<td>1300 - 1310</td>
<td>Welcome Remarks Co-Chair: Rohaiad Bin Mohd Nopiah, PETRONAS</td>
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<tr>
<td>1310 - 1430</td>
<td>Session 1: Regulation on Produced Water Treatment and Environmental Impact</td>
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</table>

**Session Chairpersons:**
- Rohaiad Bin Mohd Nopiah, PETRONAS
- Azlina Binti Khairi, PETRONAS
- Zunita Binti Mahar Afandi, Malaysia Petroleum Management

The potential harm caused by the ocean disposal of produced water to the ecology has become a major concern. Produced water is a complex mixture of dissolved and particulate organic and inorganic chemicals. The concern of the chemicals in produced water is due to their concentrations, that may be high enough to cause bioaccumulation and their toxicity. Marine organisms and animals near a produced water discharge may bioaccumulate metals, phenols, and hydrocarbons from the ambient water, their food, or bottom sediments. Hence, the principal purpose of produced water related regulations is to protect the environment. While some produced water management activities are subject to regulatory standards, others are subject to operational standards set by operators or end users. In this session, we will discuss the various regulatory requirements / standards on produced water management, including discharges, that relate to the environmental impacts posed by produced water.
Produced water is an inextricable part of any oil/gas production. Produced water forecast in Field Development Plan (FDP) exercises is crucial. The actual produced water volume that is away from FDP requires strategy restoration. Enforcement of more stringent environmental regulations can create an additional factor where this deviation can adversely affect the project economics.

Low oil price scenario is a challenging situation, and a detail strategy must be envisaged in FDP to address all challenges throughout the whole field life. The production forecast that includes produced water and associated contaminants is important in produced water system design and strategy. Generic unspecific content for the produced water management in the FDP is a thing of the past. A well-planned and strategic development concept in produced water management at the early stages of FDP is crucial.

Produced water is the largest waste stream in the oil and gas industry and its volume varies as fields mature along with its aging assets. The characteristics of produced water is dependent rock formations e.g. in Middle East and Upper Midwest of America, produced water is up to 10 times more saline than sea water while produced water in Malaysia is less saline compared to sea water. Produced water is also a carrier for organic compounds, produced sand, sludge, naturally occurring radioactive materials (NORM) and production chemicals. Produced water characteristics and quantity also varies significantly over the lifetime of a field, and these changes are complex and site specific. This leads to a need to have customized strategies with periodic review for each field to prevent and mitigate issues related to produced water management and optimize operation and maintenance cost. This combination, along with increasingly stringent environmental regulations creates a challenge to operate safely and sustainably. Determining an optimal produced water management strategy requires a holistic techno-economic approach e.g. treating and disposing water at an abandoned well can minimize expenditure required for well abandonment.

Presence of contaminants in reservoir production fluid including solids, acid gases, injected chemicals and organic acids can lead to produced water treatment inefficiencies and can adversely impact facilities integrity. In deepwater operations, produced water breakthrough often worsens the existing flow assurance issues for the field e.g. hydrates formation and slugging operation due to bulk increase in water/liquid presence in the system. Managing these issues including liquid handling and assuring discharge compliance may require extensive resources, strategic long-term planning, prudent asset maintenance program and enhanced technology solutions. This session shall outline the operational experience in these challenging applications and what effective produced water management strategies are available to mitigate their impact.

Digital tools are increasingly used for oil and gas production to improve operations efficiency and to reduce costs. Real time measurement technology plays an important part in these tools. For produced water management and handling, produced water quality must be measured in terms of its oil and / or solids content regardless if the produced water is to be discharged, re-injected or re-used. Online oil-in-water measurement technology has been available for the oil and gas industry for many years. It has been predominantly used for process trending and optimisation to date. However, it is now increasingly considered for oil-in-produced water discharge reporting and for produced water treatment automation in particular for remote unmanned installations. In this session, we shall discuss the latest in using online oil-in-water measurement technologies for produced water treatment, management and their roles in a production digitalisation era.
Sponsorship support of the event helps offset the cost of producing workshops and allows SPE to keep the attendance price within reach of operation-level individuals, those who benefit most from these technical workshops. Supporters benefit both directly and indirectly by having their names associated with a specific workshop. While SPE prohibits any type of commercialism within the virtual event platform itself, SPE recognises that supporting companies offer valuable information to attendees outside the technical sessions.

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<th>Entitlements</th>
<th>Principal Sponsor</th>
<th>Gold Sponsor</th>
<th>Silver Sponsor</th>
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<td>Complimentary Full Access Virtual Workshop Registration (worth USD 500 per person)</td>
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<td>5</td>
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<td>Company logo in the Virtual Workshop Technical Programme booklet</td>
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<td>Company logo in lobby video placed in virtual event’s live console</td>
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<td>Company logo in holding slides displayed during live event</td>
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<tr>
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Workshop Guidelines

1. Documentation
   a. Presentation slides / Proceedings will not be published; therefore, formal papers and handouts are not expected from Discussion Leaders.
   b. Work in progress, new ideas, and interesting projects are sought.
   c. Resource documents may be provided as pre-reads and during the live event.

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3. Commercialism
   In keeping with the Workshop objectives and the SPE mission, excessive commercialism in presentations are not permitted. Company logos must be limited to the title slide and used only to indicate the affiliation of the presenter.

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