PERF Overview

The Petroleum Environmental Research Forum (PERF) is a research and development joint venture, formed to provide a stimulus to and forum for the collection, exchange, and analysis of research information relating to the development of technology for health, environment & safety, waste reduction and system security in the petroleum industry. PERF is a non-profit organization of Members which are corporations engaged in the petroleum industry that recognize the importance of a clean, healthy environment and are committed to support cooperative research and development. PERF does not itself participate in research projects but provides a forum for Members to collect, exchange, and research information relating to practical and theoretical science and technology concerning the petroleum industry and a mechanism to establish joint research projects in the field.

December 2014

Announcing the 91st PERF Meeting

Save the dates! On March 31st and April 1st 2015, the Centre of Documentation, Research and Experimentation on Accidental Water Pollution (Cedre) and Total will host the next biannual PERF Meeting in Brest, France. The general theme of the meeting will be “Marine Environmental Issues” including oil spills, ecosystems, marine mammals and oil & gas activities.

Upcoming Events

91st PERF Meeting
Host: Cedre / Total
Date: March 31st & April 1st 2014
Location: Brest, France

PERF Remote Sensing Workshop
Host: BP
Date: TBD (2Q 2015)
Location: Chicago

PERF LCA Workshop
Host: Total
Date: TBD (2Q 2015)
Location: Montreal

Announcing the PERF Remote Sensing Workshop

The next Remote Sensing workshop will be hosted by BP in Chicago in the second quarter of 2015. With a focus on downstream operations, the objective is to share experiences and expectations on technologies for fence-line monitoring, gas cloud imaging...

Announcing the PERF Life Cycle Analysis (LCA) Workshop

In the second quarter of 2015, Total will host a Life Cycle Analysis workshop in Montreal. The objective is to understand the potential environmental benefits of this global approach applied to the Oil & Gas industry. The agenda of the meeting is under development.
**Member Companies**
- BP
- Chevron
- ConocoPhillips
- ExxonMobil
- Hess Corporation
- Petrobras
- Phillips 66
- Qatar Petroleum
- Repsol
- Saudi Aramco Oil Company
- Shell
- Statoil
- Suncor
- Syncrude Canada Ltd
- Total
- Tullow

**Associate Members**
- CH2MHill
- Nalco Champion
- Poseidon
- Test America
- Trihydro
- Veolia Water

**External Group Liaisons**
- American Petroleum Institute
- Argonne National Laboratory
- Battelle
- Centre of Documentation, Research and Experimentation
- Electric Power Research Institute
- U.S. Department of Energy
- Energy & Environmental Research Center
- Lawrence Berkeley National Laboratory
- International Association of Oil and Gas Producers
- Oak Ridge National Laboratory
- Pacific Northwest National Laboratory
- RTI International
- Flemish Institute of Science and Technology
- Water Environmental Research Foundation
- World Ocean Council

---

**Highlights from the 90th PERF Meeting:**

"Water quality and wastewater treatment"

On November 4th and 5th, Shell hosted the 90th biannual PERF meeting at Shell Technology Center in Houston (STCH). The meeting focused on water quality and wastewater treatment and covered upstream and downstream activities. Over 60 engineers and scientists from various sectors related to the oil & gas industry discussed collaborative research opportunities. During these two days of technical presentations, attendees learned about novel research and technology advances in the field of water treatment, identified knowledge gaps, and discussed common areas of interest and possible approaches to partnering on research.

A brainstorming session with all attendees was conducted on November 5th to identify new environmental research opportunities for upstream and downstream operations. During that session, various ideas of collaborative research projects were proposed, some of which were selected for further development by PERF member companies. Four new potential projects were scoped focusing on 1) wastewater treatment modeling (Downstream), 2) effluent guidelines data gathering (Downstream), 3) removal of selective constituents in brine and produced water (Upstream) and 4) removal of organics from unconventional flowback and produced water (Upstream).

Representatives from oil companies (BP, Chevron, ConocoPhillips, ExxonMobil, Hess, Petrobras, Phillips 66, Saudi Aramco, Shell, Suncor, Total), industry associations (API, IPIECA), service providers and universities (Battelle, Bauer, Cedre, CGLI, CH2MHill, Environ, Hach Company, Poseidon, Siemens, University of Michigan, US Peroxide, WERF) participated to this event.

At this meeting, a new slate of officers and a new Board member were selected. Bruce Randolph of Phillips 66 will be Chair of the Board of Directors, Veronica Blackwell of Chevron will be Vice Chair. These changes are effective January 1, 2015. Bill Hafker of ExxonMobil was formally voted to the PERF Board of Directors, effective immediately.

[Meeting agenda](http://www.perf.org/membersarea.html) and presentations are posted to the PERF website at accessible to PERF member company staff.

---

**Update on the Upstream Water Discussion Group**

The Upstream Water Discussion Group held its first face to face meeting after the 90th biannual PERF meeting hosted by Shell. This meeting was the culmination of monthly conference calls to gather project ideas for an upstream program on projects around water topics. Though the opportunity is not new, the intent of the program is to consolidate current and future work and planning.

The face to face meeting agenda included presentations from Total and BP on project proposals, as well as Hess on leveraging proposed projects with other industry groups, such as the American Petroleum Institute and the unconventional and onshore focused Energy Water Initiative. The meeting participants also discussed potential funding models for the upstream water program.

The second half of the meeting was spent developing a draft shaping plan for a Produced Water Program, possible through the active participation of discussion group. The goal developed by the group is to lower cost of produced water management while managing risks to the environment of reuse and of disposal. The group identified four project themes around understanding produced water, risk / impact assessment, treatment technology and communication. The next steps will be to identify and advance the projects under these themes.

Oil companies represented included BP, Chevron, ConocoPhillips, ExxonMobil, Hess, Petrobras, Shell, and Total. For more information on the Upstream Water Discussion Group, please contact Lily Baldwin at [liliesbaldwin@chevron.com](mailto:liliesbaldwin@chevron.com).
PERF Board of Directors & Legal Counsel

**PERF Officers**
- **Chair:** Veronica Blackwell, Chevron
- **Vice Chair:** Bruce Randolph, Phillips66
- **Treasurer:** Karen Haynes, Shell
- **Secretary / Webmaster:** Frederic Perie / Yannick Mervant, Total
- **Past Chair:** Todd Ririe, BP

**At-Large Members**
- Yasser Kattan, Saudi Aramco
- Dave Fashimpaur, BP
- Bill Hafker, ExxonMobil
- Samer Adham, ConocoPhillips
- Paulo Negrais, Petrobras

**Legal Counsel**
- F. Joseph Gormley, Baldwin, Kagan & Gormley LLC

---

**Highlights from the PERF Remediation Workshop**

On September 9th and 10th, 2014, ExxonMobil hosted a PERF workshop in Houston focusing on the Remediation of Heavy Hydrocarbon-Impacted Soil and LNAPL-Impacted Aquifers. The workshop was attended by over 40 participants representing industry, consulting and academia. A total of 21 presentations were given over the 2 day meeting.

Day One focused exclusively on heavy hydrocarbon remediation. Opening presentations by experts Sara McMullen (Chevron) Roger Prince (ExxonMobil), Renae Magaw (Chevron) and Gérald Zagury, (Polytechnique Montreal / Total) set the stage for the day’s discussion by defining the problem and providing insights into heavy hydrocarbon risks, the limits of bioremediation and the significance of oral bioavailability. Several excellent presentations followed on remedial approaches that may be specifically suitable for heavy hydrocarbons, including enhanced biological, chemical and thermal-based.

Day Two focused on 2 aspects of subsurface LNAPL remediation: the emerging field of Natural Source Zone Depletion (NSZD) and potentially sustainable LNAPL remediation approaches. Many of the leading researchers and practitioners in these fields were in attendance. Dr. Uli Mayer (University of British Columbia) reviewed the basics of NSZD and highlighted existing data gaps. Subsequent presentations covered lab and field studies on NSZD rates collected by a variety of methods. The workshop concluded with well received framing presentation by Dave Woodward (AECOM) on sustainable remediation, followed by reports on pilot studies using Sustainable Thermally Enhanced LNAPL Attenuation (STELA) and Bioparging technologies.

The 3 sessions were concluded with discussions facilitated by Thomas Hoelen (Chevron), Jim Higinbotham (ExxonMobil) and Chuck Newell (GSI Environmental, Inc.), respectively, to summarize data gaps and identify topics for potential future collaboration. As a result of the workshop several potential new PERF proposals were identified for further follow up. Of these proposal ideas, four are already ready to progress: Sheens Management (contact Mark Lyverse at Chevron at mlyv@chevron.com), Heavy Hydrocarbon Aesthetics (contact Andrew Kirkman at BP at Andrew.kirkman@bp.com), Critical Evaluation of NSZD Variability (contact Harlay Hopkins at ExxonMobil at harley.hopkins@exxonmobil.com), and Benzene NSZD (contact Andrew Kirkman at BP at Andrew.kirkman@bp.com). Kick-off teleconference calls will be arranged soon so if your company is interested in joining the scoping discussion, please reach out to the contact listed.

Todd Ririe is acknowledged for presenting highlights of PERF’s mission and ongoing projects and activities. Harley Hopkins (ExxonMobil) and Roopa Kamath (Chevron) are acknowledged for their efforts in organizing and facilitating the workshop.

Meeting agenda and presentations are available to PERF member company staff at PERF website.

---

**Active Projects**

<table>
<thead>
<tr>
<th>Ref.</th>
<th>Project type</th>
<th>Company leading</th>
<th>Company participating</th>
<th>Starting date</th>
<th>Duration</th>
<th>Final report expected in</th>
<th>For more information, please contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-02</td>
<td>Refinery Wastewater Online Monitoring</td>
<td>Sharing + funded</td>
<td>ExxonMobil</td>
<td>January 2014</td>
<td>12 months</td>
<td>December 2014</td>
<td>Bhavana Karnik <a href="mailto:BhavanaKarnik@chevron.com">BhavanaKarnik@chevron.com</a></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Phillips 66, Saud Aramco</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Brief Description:** The overall goal of this project is to increase effluent treatment plant reliability and operability by understanding the state-of-the-art of online monitoring of refinery wastewater by: 1) Sharing company experience on various monitoring systems; 2) Engaging vendors to understand state-of-the-art; 3) Providing guideline/criteria for selecting online monitoring equipment based on technology and performance.

**Focus:** Downstream.
Comparison of Dispersion Models for Offshore Exploration and Production Activities  

<table>
<thead>
<tr>
<th>Project type</th>
<th>Sharing + funded</th>
<th>Starting date</th>
<th>March 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>Chevron</td>
<td>Duration</td>
<td>21 months</td>
</tr>
<tr>
<td>Company participating</td>
<td>BP, ExxonMobil, Total</td>
<td>Final report expected in</td>
<td>December 2014</td>
</tr>
<tr>
<td>For more information, please contact</td>
<td>Lily Baldwin, <a href="mailto:LilySBaldwin@chevron.com">LilySBaldwin@chevron.com</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Brief Description:** The objective of this project is to conduct a comparison among the dispersion models currently used by E&P companies by examining modeling results that arise from a common set of input data applied to different models and by comparing those to the validation test studies derived from the literature. The project originated due to the complexity of numerical modeling of produced water and drilling muds and cuttings discharges, and a shared interest amongst E&P companies to better understand the results of marine dispersion models. As regulations become more stringent globally and the demand for risk management for marine discharges grows, reliable model results and an understanding of the variability in modeled results are needed.

**Focus:** Upstream.

Understand and Improve Cooling Tower PM Emission Measurement and Estimation Methods  

<table>
<thead>
<tr>
<th>Project type</th>
<th>Funded</th>
<th>Starting date</th>
<th>January 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>BP</td>
<td>Duration</td>
<td>12 to 18 months</td>
</tr>
<tr>
<td>Company participating</td>
<td>Chevron, ExxonMobil, Phillips 66, Shell, Total</td>
<td>Final report expected in</td>
<td>June 2015</td>
</tr>
<tr>
<td>For more information, please contact</td>
<td>Dave Fashimpaur, <a href="mailto:dave.fashimpaur@bp.com">dave.fashimpaur@bp.com</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Brief Description:** The objective of this project is to develop emission factor guidance for cooling tower PM and PM2.5 emissions. An industry-led approach to improve emission factors will be useful in regulatory discussions and reporting by member companies. An improved knowledge base for cooling tower emissions and analytical methods will improve the accuracy and consistency of emissions reporting. The Phase 1 was completed in July 2014 to assess new technology capable of CT PM2.5 measurement. A proposal has been received from the contractor for method development work. Currently looking for more participants in phase 2 including API and EPRI.

**Focus:** Downstream.

Flare Destruction Efficiency Estimation and Operating Practices  

<table>
<thead>
<tr>
<th>Project type</th>
<th>Sharing + funded</th>
<th>Starting date</th>
<th>February 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>ExxonMobil</td>
<td>Duration</td>
<td>12 months</td>
</tr>
<tr>
<td>Company participating</td>
<td>BP, Chevron, Suncor Energy, Total</td>
<td>Final report expected in</td>
<td>August 2014 for Phase 1, February 2015 for phase 2</td>
</tr>
<tr>
<td>For more information, please contact</td>
<td>Duane R. McGregor, <a href="mailto:Duane.R.McGregor@ExxonMobil.com">Duane.R.McGregor@ExxonMobil.com</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Brief Description:** The objective of this project is to evaluate existing flare configuration, operating, and efficiency data, and from that data, develop options for estimating flare combustion/ destruction efficiency (CDE) from known operating parameters. The project has two Phases. Phase 1 will survey industry on flare types, flare operations, and flare efficiency data to develop a database that can be used to assess possible gaps in flare efficiency data. The second phase will analyze existing data to understand if flare efficiency varies with flare type/operation and develop tools for estimating flare efficiency.

**Focus:** Upstream + Downstream.
Stranded Wastes and Recyclables in Developing Countries  Ref. 2012-02

<table>
<thead>
<tr>
<th>Project type</th>
<th>Sharing + funded</th>
<th>Starting date</th>
<th>May 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>Chevron</td>
<td>Duration</td>
<td>20 months</td>
</tr>
<tr>
<td>Company participating</td>
<td>BP</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Hess</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Repsol</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shell</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saudi Aramco</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ExxonMobil</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final report expected in</td>
<td>January 2015</td>
<td>For more information, please contact</td>
<td>Lucy Webb</td>
</tr>
</tbody>
</table>

Brief Description: The purpose of the PERF Stranded Wastes project is to share and develop ideas and methods for waste minimization, treatment, reuse, and recycling for international locations where issues, such as the lack of infrastructure or technology, are barriers to many traditional methods. Other issues included in the scope of the Stranded Wastes proposal include: remote location, limitations from government or regulations, lack of customers/suppliers/end users for materials, no or poor quality third-party waste management or recycling facilities, or lack of advanced technical/operational skills. Together we are working to develop strategies and methods to help overcome stranded waste challenges. The phase 1 “sharing” is completed. The phase 2 “joint funded” for a consultant began in March 2014.

Focus: Upstream.

Cost Effective Reverse Osmosis Concentrate/Brine Management  Ref. 2012-04

<table>
<thead>
<tr>
<th>Project type</th>
<th>Sharing + funded</th>
<th>Starting date</th>
<th>February 2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>ConocoPhillips</td>
<td>Duration</td>
<td>10 months</td>
</tr>
<tr>
<td>Company participating</td>
<td>BP</td>
<td></td>
<td>December 2014</td>
</tr>
<tr>
<td></td>
<td>Chevron</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saudi Aramco</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final report expected in</td>
<td></td>
<td>For more information, please contact</td>
<td>Zaid Chowdhury &amp; Arnold Janson</td>
</tr>
</tbody>
</table>

Brief Description: The overall goal of this project is to identify technically, economically and environmentally viable methods for managing the concentrated brine produced by reverse osmosis units used in oil & gas operations. Technologies will be ranked based on technical suitability, cost-effectiveness and their environmental impact in various applications. For those technologies deemed most promising, life cycle cost analyses will be developed.

Focus: Upstream + downstream.

Refinery Stream Speciation Update  Ref. 2013-07

<table>
<thead>
<tr>
<th>Project type</th>
<th>Sharing + funded</th>
<th>Starting Date</th>
<th>December 2014 for Phase 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>ExxonMobil</td>
<td>Duration</td>
<td>12 months +</td>
</tr>
<tr>
<td>Company participating</td>
<td>BP</td>
<td></td>
<td>Early 2015 for Phase 1</td>
</tr>
<tr>
<td></td>
<td>Chevron</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Saudi Aramco</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Shell</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final report expected in</td>
<td></td>
<td>For more information, please contact</td>
<td>Steve Codoluto</td>
</tr>
</tbody>
</table>

Brief Description: The PERF Stream Speciation database, developed over 15 years ago, is believed to be used by many companies to estimate air toxics emissions from tanks, fugitives, loading, and other emission sources. The purpose of the program is to verify whether changes in refinery feeds, operating conditions and product slates since the database was developed warrant updating the existing PERF report, and revise the speciation data, if necessary, using a combination of currently available company data and jointly-funded collection of new data.

Focus: Downstream
Project Proposals

**DNA Based Technologies for Environmental Monitoring**  
Ref. 2013-01

<table>
<thead>
<tr>
<th>Project type</th>
<th>Funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>ExxonMobil</td>
</tr>
</tbody>
</table>

**Brief Description:** The objectives are 1) to understand the applications and costs related to the use of DNA-based technologies compared to the traditional approaches in environmental assessment and monitoring; 2) to develop a user-friendly software package for data analysis and visualization of environmental sequencing and related data. Because of the significant advances in sequencing technologies, namely high-throughput next-generation DNA sequencing, DNA-based approaches such as barcoding hold great promise for the rapid and economical monitoring of conditions and changes in monitored ecosystems. The development of user-friendly software could allow more effective data processing and interpretation of next-generation sequencing data, and therefore could facilitate timely decision-making and early response to environmental changes.

**Focus:** Upstream + downstream.

---

**Pressure Relief Valve (PRV) Stability Research Program**  
Ref. 2013-10

<table>
<thead>
<tr>
<th>Project type</th>
<th>Sharing + funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>ExxonMobil</td>
</tr>
</tbody>
</table>

**Starting Date:** November 2014  
**Duration:** 12 months  
**Final report expected in:** November 2015

**For more information, please contact:** Clark Shepard  
clark.d.shepard@exxonmobil.com

**Brief Description:** The objective of this project is to determine the engineering factors that lead to stable Pressure Relief Device Operation to provide more solid engineering and scientific basis for the guidance in API STD 520 Part II, and to provide guidance to the refining and petrochemical industry on the installation of pressure relief devices to prevent chatter leading to a loss of containment. This study is a continuation of a previous PERF Study (99-05) which was extended several times with additional funding for more scope and completed in 2011.

**Focus:** Downstream.

---

**Improvement in Pressure Equipment Integrity / Corrosion Under Insulation**  
Ref. 2013-09

<table>
<thead>
<tr>
<th>Project type</th>
<th>Funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company leading</td>
<td>ExxonMobil</td>
</tr>
</tbody>
</table>

**For more information, please contact:** Joe Krynicki  
joseph.w.krynicki@exxonmobil.com

**Brief Description:** On-stream, reliable, and cost effective inspection technologies are valuable for a variety of reasons. The Pressure Equipment Integrity project is focused on continuously improving and optimizing safety, reliability and integrity of pressure equipment in refinery and petrochemical facilities.

- **Objective:** to identify new methods of equipment inspection that improve the ability to identify possible integrity concerns and thereby enable more timely and effective mitigation steps.
- **Primary and initial focus:** would be on CUI (Corrosion Under Insulation) inspection with the intent to include other focus areas at a later time.

**Focus:** Downstream.
### Analytical Method Development for Characterization of Produced Water Organics  
**Ref. 2014-03**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>Total</th>
<th>For more information, please contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConocoPhillips</td>
<td></td>
<td>Zaid Chowdhury</td>
</tr>
<tr>
<td>Project type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing + funded</td>
<td></td>
<td><a href="mailto:Zaid.Chowdhury@conocophillips.com">Zaid.Chowdhury@conocophillips.com</a></td>
</tr>
</tbody>
</table>

**Brief Description:** Comprehensive characterization of organics in produced and processed waters will enhance proper evaluation for discharges, reuse, and recycling of these waters. Objectives are to 1) perform a survey of currently available analytical methods and development of a systematic and comprehensive methods for PW characterization that can be tailored to the type of produced water source, 2) collect and analyze produced water samples from up to 10 different sources (1 or 2 per project participant). The outcome of this project will become a ready reference for analytical laboratories within the Oil and Gas industry which will guide the analyst through a systematic approach for analyzing organics in produced water, processed wastewater, with or without the presence of commonly utilized field chemicals.

**Focus:** Upstream + Downstream.

### Ceramic Membrane Applied to Treatment of Produced and Process Wastewaters  
**Ref. 2014-04**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>Total</th>
<th>For more information, please contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>ConocoPhillips</td>
<td></td>
<td>Zaid Chowdhury</td>
</tr>
<tr>
<td>Project type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharing</td>
<td></td>
<td><a href="mailto:Zaid.Chowdhury@conocophillips.com">Zaid.Chowdhury@conocophillips.com</a></td>
</tr>
</tbody>
</table>

**Brief Description:** Many operators are using and/or considering ceramic membrane for treatment of produced water and process wastewater. Deliverable from this project will house collective knowledge on this technology application, which the end-users can utilize while making decision regarding this technology. Participants will share basic information about the use of ceramic membrane in their applications using a common template and will discuss during a 2-day workshop, possibly in Houston. The deliverable from this project could easily save the hassles and efforts to compile previous experiences prior to any decision regarding the consideration of ceramic membrane in a given application which could amount saving hundreds of man hours per incidence.

**Focus:** Upstream + Downstream.

### Satellite / Aerial / UAS Synergies  
**Ref. 2014-05**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>Total</th>
<th>For more information, please contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tullow Oil</td>
<td></td>
<td>Colleen Abell</td>
</tr>
<tr>
<td>Project type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funded</td>
<td></td>
<td><a href="mailto:Colleen.Abell@tullowoil.com">Colleen.Abell@tullowoil.com</a></td>
</tr>
</tbody>
</table>

**Brief Description:** Recent and rapid developments in earth observation capability for Oil & Gas applications have seen an increasing number of agile satellite sensors, aerial systems and unmanned aerial vehicles. An understanding of the datasets available, their specifications and applications is required particularly around synergy between the various technologies and potential gaps that may exist. The objectives of this project are to understand available technology and use across the industry, to discuss the interaction and synergies between satellite, aerial and UAS systems, to identify where systems are complimentary, to bridge gaps between in-situ data acquisition and satellite imagery and to understand global requirements and capabilities.

**Focus:** Upstream.
Assessment of Commercial Airborne Methane Remote Sensing Capabilities

Ref. 2014-06

| Company leading     | Chevron                  | For more information, please contact | Christian Haselwimmer
|---------------------|--------------------------|---------------------------------------|-------------------------
| Project type        | Funded                   |                                       | cehaselwimmer@chevron.com

Brief Description: Strategic Fit: The objective of this project is to perform a consistent and fair assessment of the capabilities of currently available commercial airborne remote sensing systems for fugitive methane emissions mapping with a focus on leak detection. There are HES (exposure, environmental regulatory and safety/explosion) and cost implications (loss of product) of fugitive methane emissions from O&G activities. Estimates of fugitive methane emissions from fracking have ranged from 2-9% of produced volume. At the upper range of release estimates, natural gas produced by fracking loses its greenhouse gas benefit. There is a significant gap in knowledge concerning capabilities of currently available commercial airborne instruments designed specifically for leak detection.

Focus: Upstream

The use of Remote Sensing for Ecosystem Services Assessment

Ref. 2014-07

| Company leading     | BP                        | For more information, please contact | Peter Collinson
|---------------------|---------------------------|---------------------------------------|----------------------
| Project type        | Sharing + funded          |                                       | peter.collinson@uk.bp.com

Brief Description: The objective is to develop a standardized approach for the O&G sector to use remote sensing technology to assess ecosystem services in a consistent and repeatable manner; and share common practice among the PERF members to increase awareness and understanding.

There is an increasing use of space borne remote sensing adopted within the O&G sector, and is now applicable to the ‘environmental’ and ‘social’ realm. ‘New access’ regions are often difficult to access (e.g., Arctic and DR Congo) and remote sensing could provide a rapid solution to environmental assessments at the early stages of major projects (or operations). Emerging regulations may focus on ‘ecosystem services’ which will most likely impact the O&G sector. However, the O&G sector is not fully aligned on what ‘ecosystem services’ is, or how to assess it.

Focus: Upstream

Experimental Characterization of Flares Emissions by Optical Methods

Ref. 2014-08

| Company leading     | Total                     | For more information, please contact | Catherine Juery
|---------------------|---------------------------|---------------------------------------|----------------------
| Project type        | Funded                    |                                       | catherine.juery@total.com

Brief Description: Emissions of flares, and specifically individual VOC (such as CMR ones) and particles, are quite unknown and could have a large impact on air quality or odor when petrochemical sites are near cities and houses. New optical technologies could be of interest to improve knowledge on VOC behavior in flare emissions: implementation of combustion efficiency seems to overestimate some compounds emissions and is not adequate to estimate secondary compounds.

The objective of this project is to assess optical methods to identify and quantify individual VOC and their by-products in case of incomplete combustion and particles composition in flare emissions under several operational conditions.

Focus: Downstream

Explore and Evaluate Potential Produced Water Reuse for Irrigation

Ref. 2014-09

| Company leading     | Total                     | For more information, please contact | Patrick Baldoni- Andrey
|---------------------|---------------------------|---------------------------------------|-------------------------
| Project type        | Sharing + funded          |                                       | patrick.baldoni-andrey@total.com

Brief Description: Produced water, if managed as a resource rather than a waste for disposal, has the potential to be used beneficially. Reuse for irrigation is a suitable alternative especially in water-scarce regions, with limited freshwater resources. The objective of this project is to understand the barriers for beneficial reuse (social, regulatory, water quality treatment objectives), to draw lessons from past experiences and to identify what solutions can be implemented.

Values of this project are to 1) propose alternative water resources at a minimal cost, 2) grow plants or trees as a new resource for the region, 3) minimize the cost of reinjection.

- Phase 1: Sharing company experiences on what has been done in the field of produced water reuse for irrigation.
- Phase 2: If opportunities are identified, collaborative research or joint funding for a consultant or research organization.

Focus: Upstream
### Direct Monitoring of Flare Combustion Efficiency  
**Ref. 2014-10**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>ExxonMobil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project type</td>
<td>Funded</td>
</tr>
</tbody>
</table>
| For more information, please contact | Bill Hafker  
william.r.hafker@exxonmobil.com |

**Brief Description:** The objective of this project is to evaluate technologies that can directly and remotely measure flare combustion efficiency. The program would conduct field tests to compare capabilities of potential remote monitoring technology. The intent is to improve monitoring of flare emissions at lower cost than existing approaches. Impact of this program will be global as requirements for flare monitoring are considered outside the U.S.

**Focus:** Downstream

### Leak Detection and Repair Emissions and Best Practices  
**Ref. 2014-11**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>BP</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project type</td>
<td>Sharing + funded</td>
</tr>
</tbody>
</table>
| For more information, please contact | Dave Fashimpaur  
dave.fashimpaur@bp.com |

**Brief Description:** The objective of this project is to leverage participating companies' existing data to determine effectiveness of LDAR best practices for reducing emissions. The value is to improve the representativeness of data used in emissions estimating by leveraging across companies to create statistically meaningful databases.

- **Phase 1:** Collect, blind and evaluate existing data from member companies. Have statistician analyze these databases to determine the effectiveness of new EPA requirements. Deliverable will be a PERF report outlining updated methodology for estimating emissions.
- **Phase 2:** If needed, contractor conducts testing and/or gathers additional data to fill gaps.

**Focus:** Downstream

### Fracturing Fluid Impacts on WWTP Operations  
**Ref. 2014-12**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>ExxonMobil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project type</td>
<td>Funded</td>
</tr>
</tbody>
</table>
| For more information, please contact | Ronald Vaughan  
ronald.l.vaughan@exxonmobil.com |

**Brief Description:** With opportunities to bring in fractured products as refinery feedstock, there is a need to better understand the impacts of the residual fracturing fluids on WWTP operations. Potential issues could arise in both primary treatment (emulsion formation) and secondary treatment (damaging for biomass, increased conventional pollutant loading). The objective of this project is to study the impacts of common residual fracturing fluids, brought in with fractured products for refinery feedstock, on WWTP operations. Minimizing upsets and disruptions to the WWTP will lead to improved WWTP operations and compliance.

**Focus:** Upstream + downstream

### Critical Evaluation of NSZD Rate Variability  
**Ref. 2014-13**

<table>
<thead>
<tr>
<th>Company leading</th>
<th>ExxonMobil</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project type</td>
<td>Sharing + funded</td>
</tr>
</tbody>
</table>
| For more information, please contact | Harley Hopkins  
harley.hopkins@exxonmobil.com |

**Brief Description:** Natural Source Zone Depletion (NSZD) describes the contaminant mass loss and transformation from subsurface LNAPL source areas, under ambient conditions. Quantification of NSZD provides a basis to: 1) understand the current contribution towards site cleanup by unassisted biological and physical losses, 2) estimate long term natural attenuation cleanup times and 3) assess the incremental value of any engineered remedial options under consideration at a site. The objectives of this project are to identify the sources of variability within and between the available NSZD datasets that may account for the differences provided by different NSZD measurement techniques (e.g., CO2 traps, flux chambers, gradient based, thermal flux) and to leverage the findings to improve NSZD measurement technologies, SOPs and field data collection strategies.

**Focus:** Upstream + downstream