



International  
Association  
of Oil & Gas  
Producers

The new IOGP 456 3rd Ed.  
“Process Safety - Recommended  
Practice on Key  
Performance Indicators”

Margarita Malaspina – Woodside  
Process Safety Subcommittee  
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# IOGP Report 456 Background

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IOGP Report 456 - Process Safety - Recommended Practice on Key Performance Indicators provides guidance for upstream companies on **Key Performance Indicators (KPI) used in managing process safety** for the prevention of unplanned and uncontrolled loss of containment events

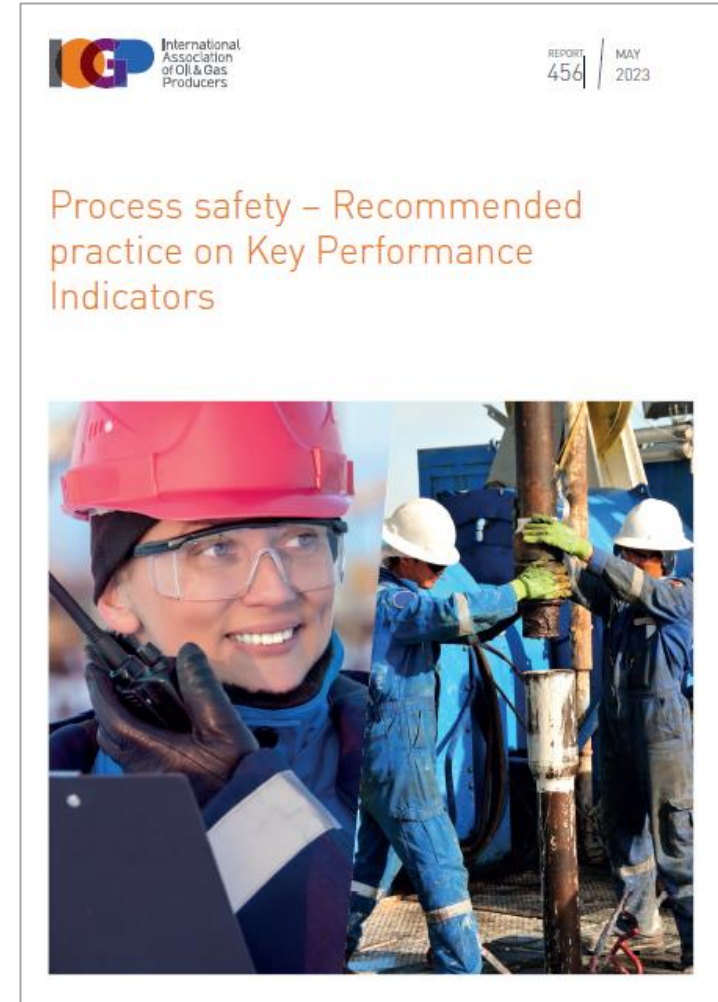
It builds on the framework and definitions included in the API Recommended Practice (RP) 754, Process Safety Indicators for the Refining and Petrochemical Industries, on process safety indicators, with specific **emphasis on their application to upstream oil and gas activities**

Due to the new API RP 754 3<sup>rd</sup> Ed. issued in August of 2021, IOGP Report 456 2<sup>nd</sup> Ed. of Nov 2018 was required to be updated for maintaining proper alignment

Publication – May 2023

# IOGP 456 Update at a glance

- IOGP 456 Update Task Force created late end of 2021 (+**15 SMEs** involved)
- Regular TF meetings
- 456 update **maintains alignment** with current API RP 754
- **Updates and increase** of Process Safety Events (PSEs) examples (from 74 to 112)
- **Greater clarity** on definitions and classification of PSEs well operations related and well control incidents (WCIs)
- Recent thinking and use of **leading indicators** considered
- For IOGP data reporting purposes, the IOGP 456 3<sup>rd</sup> edition will apply to **PSEs recorded from 2023 onwards**




# Key Drivers

- **New API RP 754, 3<sup>rd</sup> Edition, issued August 2021**
- **IOGP PSSC 2021 PS Leading Indicators Survey**
- **WEC proposals on well operations definitions and examples**

**Process Safety Performance Indicators for the Refining and Petrochemical Industries**

ANSI/API RECOMMENDED PRACTICE 754  
THIRD EDITION, AUGUST 2021



15<sup>th</sup> June 2022 - Rev.00 Final

**Process Safety Leading Key Performance Indicators (KPI) Survey Results**

This report is the result of the conducted 2021 survey on Process Safety (PS) metrics.

The survey was conducted to understand the maturity and status of PS KPIs in oil and gas IOGP Members and provide a consolidated report.

The survey was also used to investigate the progress and developments in PS KPIs by IOGP Members since the last survey carried in 2014.

The IOGP Companies replied to the 2021 PS Leading Indicators (KPI) survey, thus, even if the outcomes are considered preliminary, it is suggested to maintain this report as IOGP Process Safety Survey Results rather than a formal IOGP publication.

The survey results may be considered for updating current IOGP Report 456 Process Safety - Recommended Practice on Key Performance Indicators issued in November 2016, with new metrics/examples, if any.

Hereunder the key outcomes of the 2021 Survey are listed:

- Challenges to Safety Systems (T3) are the most in use PS KPIs (note: other LOPC events (T3) is in use within all Responders)
- Timely completion of inspections (T4) remains one of the most important PS KPI
- Actions Items follow-up (T4) increased in use in respect to 2014 Survey
- Number of Safety Systems/Devices override and inhibition (T3), Alarm Rate (T4) and Backlog of SECC Work Orders (T4) are emerging KPIs considered by the Responders
- The following items resulted with limited leading indicators (T4) in use: PS workforce training/competency/capability, Fatigue risk management and Operating and Maintenance procedures
- In respect to the 2014 Survey, today most Companies have in place reliable PS leading indicators monitoring process thanks to training on general PS items and process safety metrics, QA/QC programs, continuous improvement initiatives and assurance processes
- Digitalization Projects are ongoing in almost all the Companies to facilitate collection and sharing of PS leading indicators, offering the base for a future step change in KPIs management and trending analysis

1. IOGP Process Safety Leading Key Performance Indicators (KPI) 2021 Survey Results

drilling rig first spuds a well until drilling and completion production tree (or well cap) is installed. Actual drilling and completion to be taking place. This does not include rig up and rig down.

Well operations people is a common term and means: "operations people/well"

Well operations worked includes all activities whether the operation is direct or indirect, on, or not clear if it includes moving, rig ups, supply etc.

- (pag. 21) For drilling operations, Tier 1 and 2 PSEs are excluded for:
  - drilling/workover/wireline operations when not "in-hole" -> misleading (out of provided glossary definition): most of LOPC could happen at surface, literally "out of hole" e.g. connection to equipment used for well operations
  - loss of circulation, loss of drilling mud, well kick, or underground blowout where there has not been an associated LOPC of material (e.g., gas, oil, other fluids, or mud) released above ground or above sea-bed or onto the rig floor -> such events should be reported because in most cases are significantly impacting the safety; the difference should be between controlled and uncontrolled hydrocarbon influx in respect to standard well control practices (to be further discussed for explorative wells if necessary or not an exclusion)
- (example 73 of annex part F ). An LOPC while connected to a platform when "in-hole" is reported as a process safety event. -> this is a correct example for current definition inside the report but not clear enough for a first reader expert in well operations
- Possible solution: eliminate the term "in-hole".  
Well operations to be considered are those performed into a pressurized reservoir/geological structure as well as workover and interventions (e.g. wireline, acid job) into a cased well/borehole/open hole, having equipment directly (e.g. BOP, tubing) or indirectly (e.g. manifold) connected to the same

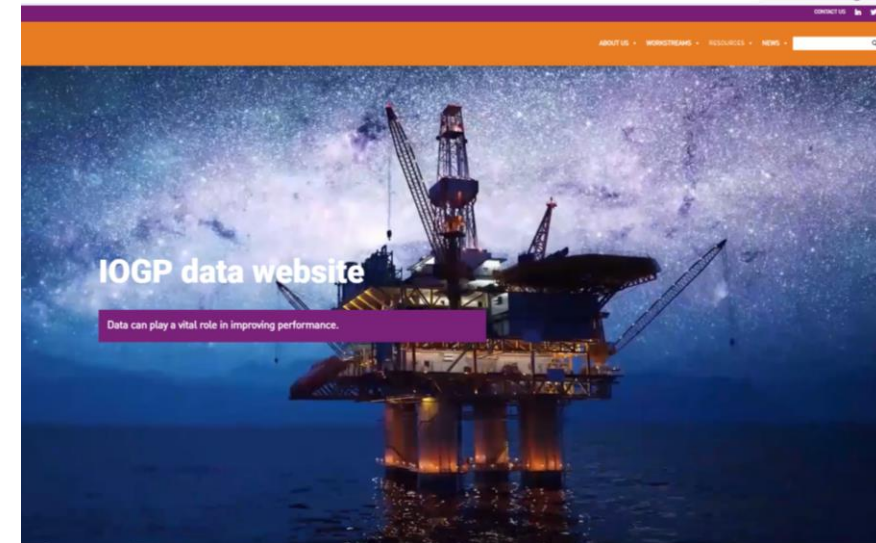
# Continuous improvement, not fundamental changes

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- Reduction of the material hazard classification for **corrosive agents** to better align with the other hazard classes
- Updates and expands the list of process safety event Tier classification **examples**
- Updated definitions of **primary and secondary containment, direct cost, indoor release, and unsafe location**
- Provides **greater clarity** on the classification and definitions of process safety events that are **well operations** related, as well as the classification system for Well Control Incidents (WCIs), helping IOGP members to more consistently report these events and better engage the Wells Community
- Includes insights from the 2021 process safety **leading indicators** survey conducted among the IOGP Members Companies
- **Tier 1 Severity Weighting** by API RP 754 3<sup>rd</sup> Ed. referred to but not mandatory
- **Global Harmonisation System** (GHS) option by API RP 754 3<sup>rd</sup> Ed. referred to but not mandatory

# Examples of process safety event (PSE) tier classification

- Part F of IOGP Report 456 3<sup>rd</sup> edition contains examples of upstream events and their classification as PSEs (or otherwise) using the guidance of this Report
- PSEs examples are **adapted for upstream operations** from API RP 754 and from reporting experience of IOGP member companies
- The examples of process safety event tier classification set out in the Part F are available **via the IOGP website**, accessible by IOGP members, for easy reference
- This feature will allow **inclusion of additional examples** which, subject to the approval of the IOGP process safety subcommittee, may be proposed by IOGP members
- Additional examples **will be incorporated in future updates** of the Report 456



# Key updates

## Updates and expands the list of process safety event Tier classification **examples**

- IOGP 456 3<sup>rd</sup> Ed. - Part F “Examples of process safety event tier classification” contains now **112 examples** (in previous revision were 74) of upstream events and their classification as PSEs (or otherwise)
- They are **adapted for upstream operations** from API RP 754 3<sup>rd</sup> Ed. and from reporting by IOGP member companies
- General review/update for **improving clarity of all examples**
- Added new examples concerning **two-phase release, diesel generator leak, oily water leak and heat exchanger tube leakages**
- Added new section of examples concerning **PSE Reporting Responsible Party** (8 examples)
- Deeply refreshed and updated the Well Operations section examples (from 10 to 18 examples), including **PSE Tiers** and Well Control Incident – **WCI – classification**

Process safety – Recommended practice on Key Performance Indicators

### Part F – Examples of process safety event tier classification

#### Scope

Part F contains 74 examples of upstream events and their classification as PSEs (or otherwise) using the guidance of this Report.

They are adapted for upstream operations from API RP 754 and from reporting from IOGP member companies.

#### Injury or fatality

Example	Reporting
1 An operator walks through a process unit and slips and falls to the ground and suffers in an occupational injury, which is a lost work day case (LWDC). The slip/fall is due to weather conditions, 'chronic' oily floors, and slippery shoes. This is not a Tier 1 or Tier 2 PSE. Personal safety 'slipping/fall' incidents that are not directly associated with evacuating from or responding to a LOPC are specifically excluded. Same as above, except that the operator slips and falls while responding to a small spill of liquid with a flash point <23 °C (73 °F) quantity less than 7 barrels in 1 hour, resulting in a recordable LWDC incident. This would also be recorded as a Tier 1 PSE since the operator is responding to an LOPC, even though the LOPC is below the Tier 1 threshold quantity in Table E.4.	LWDC but not a PSE (Part D)  Tier 1 PSE and a LWDC
Same as above, except that the operator slips and falls several hours after the incident has concluded. This is a recordable LWDC incident but would not be reported as a PSE. Occupational safety events that are not directly associated with onsite response to a LOPC are excluded. A slip or fall after the LOPC has concluded (such as 'after-the-fact' clean-up and remediation) is not directly associated with onsite response.	LWDC but not a PSE (Part D)
2 A scaffolding contractor is injured after falling from a scaffold ladder while evacuating from a LOPC on nearby equipment. The contractor is absent from work for 5 days and the injury is recorded as a recordable LWDC incident and the LOPC is then classified as a Tier 1 PSE, whether or not the release exceeded the Table E.1 Threshold quantities.	Tier 1 PSE and a LWDC
3 An operator walks past a steam trap that discharges to an unsafe location. The steam trap releases and the operator's ankle is burned by the steam, resulting in an occupational injury which needed medical treatment and his work is restricted for 3 days. This incident is a Tier 2 PSE, because even though the LOPC event was steam (vs. hydrocarbon or chemical), the physical state of the material was such that the unintended release caused a recordable injury. Non-toxic and non-flammable materials are within the PSE scope when a recordable injury results from LOPC.	Tier 2 PSE and recordable injury (restricted work day case)
If this incident had not resulted in an occupational injury it would not be a PSE because the physical state of the material does not mandate a Tier 1 or Tier 2 classification without the associated recordable injury.	Not a PSE
4 A separator chamber or other vessel has been intentionally purged with nitrogen. A contractor bypasses safety controls, enters the enclosure and dies. This is not a PSE because there is no unplanned or uncontrolled LOPC, but it would be a recordable occupational injury and classified as a contractor employee fatality.	Fatality but not a PSE
If nitrogen had inadvertently leaked into the enclosure, this would be a Tier 1 PSE because there was a fatality associated with an unplanned or uncontrolled LOPC.	Tier 1 PSE
5 A maintenance technician is turning a bolt on a flange on a gas pipe with a wrench. Due to improper body positioning, the wrench slips and hits the employee in the mouth, requiring dental surgery. This incident is a recordable occupational injury (medical treatment case) but not a PSE, because there is no unplanned or uncontrolled LOPC involved with the injury.	Recordable injury but not a PSE

# Key updates

Updated definitions of **primary and secondary containment, direct cost, indoor release, and unsafe location** in alignment with API RP 754 3<sup>rd</sup> Ed.

IOGP 456 2 <sup>nd</sup> ed.	IOGP 456 3 <sup>rd</sup> ed.
<p><b>Primary containment</b> A tank, vessel, pipe, truck, rail car, or other equipment designed to keep a material within it, typically for purposes of storage, separation, processing or transfer of material. The terms vessel and pipe are taken to include containment of reservoir fluids within the casing and wellhead valving to the surface. Note that primary containment for a specified material may comprise a vessel or pipe that is inside another vessel that is also designed as primary containment for a different material; for example, a heating tube is primary containment for fuel gas or fuel oil, even though the tubes may be inside a firebox which is in turn within an oil-water separator.</p>	<p><b>Primary containment</b> A tank, vessel, pipe, truck, rail car, or other equipment designed to keep a material within it, typically for purposes of storage, separation, processing or transfer of material. The terms vessel and pipe are taken to include containment of reservoir fluids within the casing and wellhead valving to the surface. <b>Primary containment also includes closed systems that have a pressure boundary such that there is no exposure of process material to the atmosphere. Where there is a pressure boundary, liquids and vapors are recovered or controlled, and at no time is material directly in contact with the atmosphere. Examples include closed drainage or collection systems, rapid de-inventory systems, double-walled tanks, etc.</b></p>
<p><b>Secondary containment</b> An impermeable physical barrier specifically designed to mitigate the impact of materials that have breached primary containment (i.e. an LOPC). Secondary containment systems include, but are not limited to: tank dykes, curbing around process equipment, drainage collection systems, the outer wall of open top double walled tanks, etc.</p>	<p><b>Secondary containment</b> An impermeable physical barrier specifically designed to mitigate the impact of materials that have breached primary containment (i.e. an LOPC). Secondary containment systems include, but are not limited to tank dikes, curbing around process equipment, <b>open drainage collection systems, trenches, pits, open sumps</b>, the outer wall of open top double-walled tanks, etc.</p>



# Key updates

Updated definitions of **primary and secondary containment, direct cost, indoor release, and unsafe location** in alignment with API RP 754 3<sup>rd</sup> Ed.

IOGP 456 2 <sup>nd</sup> ed.	IOGP 456 3 <sup>rd</sup> ed.
<p><b>Direct cost</b> Cost of repairs or replacement, cleanup, material disposal, and acute environmental cost associated with a fire or explosion. Direct cost does not include indirect costs, such as business opportunity, business interruption and feedstock/product losses, loss of profits due to equipment outages, costs of obtaining or operating temporary facilities, or costs of obtaining replacement products to meet customer demand. Direct cost does not include the cost of repairing or replacing the failed component leading to LOPC if the component is not further damaged by the fire or explosion. Direct cost does include the cost of repairing or replacing the failed component leading to LOPC if the component failed due to internal or external explosion or overpressure.</p>	<p><b>Direct cost</b> Fire or explosion direct cost includes the material and labor cost of (1) in-kind repairs, replacement, or restoration of process and non-process equipment and tangible public or private property to prevent condition whether completed or not, (2) aftermath cleanup, (3) material disposal, and (4) short-term cleanup and material disposal associated with fire/explosion emergency response efforts that result in off-site environmental impact (e.g. fire-fighting foam/water runoff). Direct cost does not include the cost of (1) emergency response personnel, equipment, materials, and supplies utilized to manage the event or incidental damage caused by the emergency response, (2) engineering or inspection assessments to determine the extent of damage or necessary repairs, (3) opportunity upgrades to materials or technology, (4) superficial or cosmetic only damage that does not affect function or performance to company-owned process and non-process equipment, (5) indirect costs, such as business opportunity, business interruption, fines, and feedstock/product losses, (6) loss of profits due to equipment outages, costs of obtaining or operating temporary facilities, or (7) costs of obtaining replacement products to meet customer demand. Direct cost does not include the cost of repairing or replacing the failed component leading to LOPC if the component is not further damaged by the fire or explosion. Direct cost does include the cost of repairing or replacing the failed component leading to LOPC if the component failed due to internal or external fire or explosion.</p>

# Key updates

Updated definitions of **primary and secondary containment, direct cost, indoor release, and unsafe location** in alignment with API RP 754 3<sup>rd</sup> Ed.

IOGP 456 2 <sup>nd</sup> ed.	IOGP 456 3 <sup>rd</sup> ed.
<p><b>Indoor Release</b> Not present</p>	<p><b>Indoor Release</b> A release within a structure composed of four walls, floor, and roof. Note: The potential consequences of indoor releases are magnified due to hazards associated with congestion, confinement, personnel proximity, and limitations on egress. Open doors or windows and powered or natural ventilation systems do not change the definition of indoor.</p>
<p><b>Unsafe location</b> An atmospheric pressure relief device discharge point or downstream destructive device (e.g. flare, scrubber) discharge point that results in a potential hazard to personnel due to their proximity, such as the formation of flammable mixtures at ground level or on elevated work structures, presence of toxic or corrosive materials at ground or on elevated work structures, or thermal radiation effects from ignition of relief streams at the point of emission.</p>	<p><b>Unsafe location</b> An atmospheric PRD or upset emission discharge or a downstream destructive device (e.g. flare, scrubber) discharge that results in a potential hazard to personnel, <b>whether present or not, due to</b> the formation of flammable mixtures at ground level or on elevated work structures, presence of toxic or corrosive materials at ground level or on elevated work structures, or thermal radiation effects <b>at ground level or on elevated work structures</b> from ignition of relief streams at the point of emission <b>as specified in API 521, Section 5.8.4.4.</b> <b>Excluded from the definition of an unsafe location are those ground level and elevated work structure locations that have a known potential for exposure of personnel to flammable mixtures, toxic substances, corrosive materials, or thermal radiation effects if access to those locations is controlled by virtue of authorized access or hard barriers with appropriate warning signs.</b> Note: The term “unsafe location” is used in the description of one of the four potential Tier 1 or Tier 2 consequences associated with an engineered pressure relief or an upset emission from a permitted or regulated source. The assumption is the discharge from the engineered pressure relief whether directly to atmosphere or via a downstream destructive device or the emission from a permitted or regulated source are engineered for safe dispersion of the release.</p>

# Key updates

Provides **greater clarity** on the classification and definitions of process safety events that are **well operations** related

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The term **well operations is used instead of drilling** because, although the definition of drilling is wider, the use of this term may create confusion and potential missed reporting of non-drilling process safety events, such as during wireline interventions, etc.

## GLOSSARY

### **Drilling**

~~All exploration, appraisal and production drilling, and workover as well as their administrative, engineering, construction, materials supply and transportation aspects. It includes site preparation, rigging up and down and restoration of the drilling site upon work completion. Drilling includes all exploration, appraisal and production drilling.~~

### **Well Operations**

All well activities related to well construction (e.g. exploration, appraisal and development drilling and completions), well testing, surveillance, interventions and workovers (e.g. wireline, stimulation, coiled tubing), and abandonment (including downhole plugging and temporary abandonment).

### **Production**

Petroleum and natural gas producing operations, including their administrative and engineering aspects, minor construction, repairs, maintenance and servicing, materials supply, and transportation of personnel and equipment. It covers all mainstream production operations ~~including wireline~~.



# Key updates

Provides **greater clarity** on the classification and definitions of process safety events that are **well operations** related

The previous edition “**in-hole**” or “**not in-hole**” concept was removed since misleading and proposed a clearer definition for well operations PSEs applicability associated to **well operations activities connected to the well**

## PART C

### Applicability to upstream operations

Any LOPCs from a well that occur during Well Operation PSEs and meet Tier 1 and 2 thresholds are reportable to IOGP. Well Operations PSEs may occur when connected to a well with a work unit (e.g., drilling rig, workover rig, rigless unit, etc.) including during riserless operations. It includes any LOPC from the well.

For well operations, Tier 1 and 2 PSEs are excluded for:

- equipment staging
- ~~drilling/workover/wireline operations when not ‘in-hole’~~
- loss of circulation, loss of drilling mud, well kick, or underground blowout where there has not been an associated LOPC of material (e.g., gas, oil, other fluids, or mud) released above ground or above seabed or onto the rig floor

## GLOSSARY

### Process

Facilities used in well and production operations in the oil and gas industry. This includes rigs and process equipment (e.g. vessels, piping, valves, boilers, generators, pumps, compressors, exchangers, refrigeration systems) and includes storage tanks, ancillary support areas (e.g. boiler houses and waste water treatment plants), on-site remediation facilities, and distribution piping, wells and other well operations equipment – see note below - (e.g. rig equipment, well control equipment, fluid storage pits/tanks, degassers, temporary pipework, frac pumps, flow-back & well test equipment, coil tubing, etc.) under control of the Company.

Note: Well operations equipment is only considered part of the process while connected to the well

# Conclusions

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- IOGP Report 456 provides **guidance for upstream companies** on KPIs used in managing process safety for the prevention of unplanned and uncontrolled loss of containment events
- IOGP Report 456 3<sup>rd</sup> Ed maintains alignment with API RP 754 3<sup>rd</sup> Ed.
- Provides **greater clarity** on the classification and definitions of process safety events that are **well operations** related, helping IOGP members to more consistently report these events and better engage the Wells Community
- Includes insights from the 2021 process safety **leading indicators** survey conducted among the IOGP Members Companies
- Aligned PSE reporting with standardized metrics and taxonomies enables benchmarking and learning
- Actively use data to identify opportunities to reduce PSEs and eliminate fatalities – *moving from data to action*

# Process Safety Data 2022 Video

[IOGP PSE 2022 data video on Vimeo](#)

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For more information please contact:

Margarita Malaspina – [margarita.malaspina@woodside.com](mailto:margarita.malaspina@woodside.com)

Felipe Carvalho – [carvalho.felipe@petrobras.com.br](mailto:carvalho.felipe@petrobras.com.br)

Ismaeel Hussain – [iah@iogp.org](mailto:iah@iogp.org)

#### **IOGP Headquarters**

City Tower, 40 Basinghall St, London EC2V 5DE, United Kingdom

T: +44 (0)20 3763 9700

E: [reception@iogp.org](mailto:reception@iogp.org)

#### **IOGP Americas**

T: +1 713 261 0411

E: [reception-americas@iogp.org](mailto:reception-americas@iogp.org)

#### **IOGP Asia Pacific**

T: +60 3-3099 2286

E: [reception-asiapacific@iogp.org](mailto:reception-asiapacific@iogp.org)

#### **IOGP Europe**

T: +32 (0)2 790 7762

E: [reception-europe@iogp.org](mailto:reception-europe@iogp.org)

#### **IOGP Middle East & Africa**

T: +1 713 261 0411

E: [reception-mea@iogp.org](mailto:reception-mea@iogp.org)

[www.iogp.org](http://www.iogp.org)