Minutes of Meeting
76th Meeting of the Technical Study Group
London (UK) - November 28th - 29th, 2024

PRESENT

P.E. Decroës	ENGIE – TSG Chairman	
H. Malvos	ENGIE / CRIGEN – TSG Secretary	
R. Ellis	BP	
V. Chaudhary	Centrica Energy / British Gas	
P. Bansal	Dhamra LNG Terminal	
S. Planteline	Dunkerque LNG	
G. Caudron de Coquereaumont	Elengy	
R. Jimenez	Enagas	
K. Stevens	Fluxys LNG	
R. Vara	Freeport LNG	(partial attendance on 28th pm remotely)
A. El Bouazzaoui	Gate Terminal	
L. David	GIIGNL	
M. Renard	GIIGNL	
A. A. Mulji	MOL LNG Transport (Europe)	
P. Cervera	Naturgy	
M. Hirabayasi	Osaka gas	
R. Alikhanbagi	Shell Global Solutions International B.V.	
S. Shimizu	Tokyo Gas	
O. Pasteau	TotalEnergies	

INVITED

A. Hubert	Engie (partial attendance on 28th pm remotely)
J. Kanda	MOL LNG Transport
S. Shibata	MOL LNG Transport
S. Wang	MOL Europe&Africa
J. Hooker	National Grid (Grain LNG)

APOLOGIES RECEIVED

J. Lauck	Distrigas/Constellation
J. Yang	Equinor ASA
S. Lovett	Glencore
A. Scaraggi	Sempra Infrastructure

P.P. Ang	Singapore LNG Corporation
T. Gröning	Uniper

Agenda Item 1: INTRODUCTION

TSG Chairman opened the session, thanking Mitsui O.S.K. Lines for kindly hosting the meeting and making the excellent arrangements for this 76th meeting.

He noted the attendance of 20 participants from 18 companies at the TSG meeting, as well as the participation of 3 invited guests from MOL. He mentioned also 3 interventions to be held at distance on November 28th in the afternoon (from Engie, Freeport LNG and Shell).

Distrigas/Constellation, Equinor, Glencore, Sempra Infrastructure, Singapore LNG and Uniper sent apologies for absence. Unfortunately the dates that had to be chosen for this meeting made attending difficult for north American members since it was overlapping with Thanksgiving.

Mr. Jun Kanda (MOL, Managing Director) welcomed all participants in MOL London office, where 70 employees work. He introduced a safety moment in form of a brilliant poetic videos casting MOL employees.

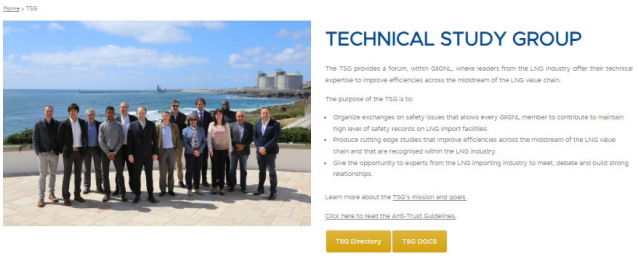
This meeting covered the TSG ongoing and planned new works as specified in the Meeting Agenda.

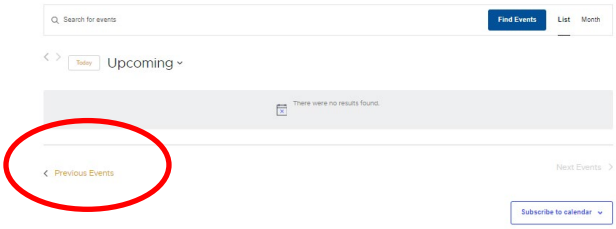
TSG Chairman welcomed new TSG representatives from existing members (Mr. Ghislain Caudron de Coquereaumont, who replaced last May Mr. Philippe Bouchy from Elengy, and Mr. Ali El Bouazzaoui, new Alternate Member from Gate Terminal), as well as new TSG representatives from new members (Mr Pradeep Bansal from Dhamra LNG Terminal).

TSG Chairman initiated a round table presentation in order to introduce each participant to new members. Mr. Bansal specified that he was second handed from TotalEnergies to Dhamra LNG terminal.

TSG Secretary reminded the main rules attached to anti-trust / competition law. He presented as well the principles of the Chatham House Rule for the verbal reports. He also circulated an attendance sheet. Both Anti-Trust Guidelines and Chatham House Rule are posted, as reminder, on the private area of GIIGNL website, with the present minutes and the signed attendance sheet.

It was also reminded that the minutes of TSG meetings and the related presentations are posted on the following page of GIIGNL website: https://giignl.org/tsg/





By clicking on "Previous Events", one can access the documents specific to each TSG meeting.

Agenda Item 2: GIIGNL INFORMATION

GIIGNL General Delegate (Mr. Laurent DAVID) and GIIGNL LNG Analyst & Communications Officer (Mrs. Marianne Renard) attended this TSG meeting.

TSG Chairman reminded that GIIGNL has currently 94 company members and that TSG keeps count of 50 members (about 50% from Europe, 35% from Asia and 15% from Americas).

75th TSG meeting (held in Groningen in May 29-30, 2024)

The minutes of the 75th TSG meeting had been issued to all members in advance and were posted on GIIGNL website. Only one remark was received prior to this 76th TSG meeting: from Enagas for correcting a figure related to a detection limit. The draft minutes were corrected accordingly and, since no other remarks were made by the participants, TSG Chairman therefore declared approved the minutes of the 75th TSG meeting.

Agenda Item 3: SAFETY ON LNG FACILITIES

A3.1. Incident Identification database (Leader Elengy)

Reminder:

There is a real necessity to maintain a regular update of the database; Lessons learnt from the past are helpful for all members (designers, operators, maintenance staff, ...) to improve the daily operation and when discussing with the authorities, the local communities...
Confidentiality attached to the data collection is ensured through a specific process involving regional coordinators and secure web access (https address).
Each GIIGNL member shall make sure to bring all available data into the database. All users were regularly reminded by the regional coordinators to use the database.

General information about the database

The administration of the database is carried out by Mr. Caudron de Coquereaumont (Elengy) with the support of Central Office.

The database is accessible by PC, laptop, touch pad or smartphone with the following link: https://incidents-giignl.org

The recommended navigators are Chrome and Firefox. Login and password generation is carried out by the administrators.

As soon as the user enters the web platform a message pops up informing him of the last event registered. Also, TSG members receive an automatic email when a new incident is registered in the database.

The scope of the Data Base covers all LNG facilities, including FSRUs and small-scale facilities. Large public incidents but also near misses are considered (HiPo events). Although ships at sea are excluded from the database, they are considered when at berth at a terminal.

It was reminded that the information in SIGTTO database related to accidents on ships at berth, should be available as well in GIIGNL database. Consistency of both databases on this part was checked in the past and such a comparison could be made again.

GIIGNL database is NOT an exhaustive list of all the incidents, since it doesn't represent all terminals in the world, but it is representative of what could happen in a typical LNG Terminal. The database provides a description of the accident, its consequences and the measures taken to prevent such

accident to happen again. For recent incidents, sketches/pictures are attached. The information is recorded anonymously and is validated by a regional coordinator.

The regional coordinators are:

- Mr. Olagoke Phillips (National Grid) for Europe (36 originators authorized so far),
- Mr. Masayuki Hirabayashi (Osaka Gas) for Asia (34 originators authorized so far),
- Mr. Anthony Scaraggi (Sempra Infrastructure) for Americas (16 originators authorized so far).

Mr. Scaraggi succeeded to Mr. Mierez who entered a number of incidents in the database. As suggested by Mr. Caudron, it is advisable to keep Mr. Mierez contribution to the database and to set his profile as originator.

The role of the coordinators is to liaise with the originators to ensure the completeness of the incident description, and to track the incidents published in the LNG news in their respective region.

A video, accessible through the website menu, explains how to create and search an incident and presents as well guidelines / flowchart.

Status of the Database:

Mr. Caudron presented the current status of the GIIGNL Incident Identification Data Base web platform (see PwPt presentation). He also reminded some general background information.

- So far, 484 incidents are registered in the data base.

Three new incidents were registered in the data base since last TSG meeting and were presented by Mr. Caudron:

- Incident N° 1932, an untimely shutdown of the seawater pumps led to the automatic closing of the ORV inlet LNG valves. One of these valves did not close, causing excessive flow in the ORV because by design the HP pumps were not stopped in this case.
- Incident N° 1933, during maintenance of a valve, the valve actuator shaft was incorrectly reassembled, it was repositioned 90° from its normal position. One month later, this led to an accident where very large quantities of LNG were sent into the BOG network.
- Incident N° 1934, after the maintenance of an in-tank LNG pump, the pump well was opened to re-install the pump when the tank was almost full, generating a cloud of gas and a small overflow of Liquid LNG, with two operators suffering burns of cold (Pump well were not equipped with foot valves)

Mr. Caudron pointed out a too limited flow of new incidents / near misses / HiPo events in 2022/23/24. He alerted also on the fact that some facilities under-represented in the data base, such as FSRU or truck loading facilities.

TSG Secretary insisted on the need to keep an active participation of the GIIGNL members and the HSE managers, pointing out the role of TSG members for contacting HSE & Operation & Maintenance managers and inciting them to record the incidents of interest. Answering a question, he insisted on the fact that on field operators are more than welcome to become an originator and that such request should be addressed directly to Mr Caudron, with copy to Central Office.

As a follow-up of a decision taken at last TSG meeting for reviewing the list of originators to make sure that it is still up to date, Mr. Caudron proposed a list of profiles to be deleted by Central Office.

End of 2023, the developer of the database (Kernix) proceeded with the following modifications requested in former TSG meetings:

- Implementation of automatic launching of bi-annual campaigns for collecting the incidents. The receivers should be the TSG members and the originators of the data base (with a link to the tutorial video and guidelines).
- In case of update of an incident by the administrators, recording and display of the date of the update in addition to the date of the incident creation,
- Automatic notification by email to the "sleeping" originators, after 3 years without entering any incidents with copy to the TSG company representative.

Mr.Caudron suggested the following additional improvements :

- Simplification of the fields to be completed
- Export files could be simplified
- Information email of a new accident only when it has been moderated/validated, so that it can be consulted

Decisions were as follows:

- Mr. Caudron will set Mr. Mierez's profile as originator and will inform him by email, reminding that his valuable contribution is still expected to feed the database.
- The new features suggested by Mr. Caudron are accepted (simplification of the fields, simplification of the export files, Information email of a new accident only when it has been moderated/validated).
- Mr. Caudron will liaise with Central Office for ensuring that these new features are implemented in the database by the developer.
- Efforts are required from the data base originators to include also incidents related to FSRUs, small scale terminals and truck loading.
- GIIGNL Central Office will delete the originators profiles mentioned in the list provided by Mr. Caudron.

A3.2. Lessons from incidents

To extend safety information sharing and as a mean to promote the use of the database, information on representative incidents which occurred in the last period is included in the Agenda (Lessons from incidents). Such discussions enrich members knowledge on the type of incident which are recorded in the data base.

-Mr. Chaudhary (Centrica) mentioned two incidents which occurrent in a recent period:

- Issues with booster pump seizure in FSRU causing outages. It is believed this was due to heavies in cargo. Similar challenges are heard off in EU facilities assisted by FSRU.
- 'Minor' rollover that occurred on a LNGC converted into FSRU : stratification after bottom loading of heavier LNG (only a few kg/m3 density difference), interrupting supply and leading to new operating guidelines on heel management. This would affect load on top operation to pre-determined levels lower than normal.

Shipping operators have to separate the technical heel requirements (to prevent from roll-over) and the commercial heel requirements. Before loading, the first criteria is the density difference. In case of bottom loading of heavier LNG, the technical heel requirement is an important criteria (GTT recommends 8000 m3 max heel). If not possible commercially, GTT proposes to load heavy LNG in an empty tank (e.g. Tk2), stop loading at 50%, pump the lighter LNG from the adjacent tank TK3 and bottom fill the TK2 with lighter LNG but it could lead to LNGC demurrages.

Mr. Chaudary (Centrica) mentioned their use of Engie model (LNG Master software) which helps them in managing rollover risk issues.

Mr. Ellis mentioned that SIGTTO is considering an update of their roll-over study in order to clarify the shipping recommendations on roll-over as the preventive actions on board are more limited (Ageing models not accurate, no top filling on converted vessel, no chromatograph on board). They might launch a study with GTT on rollover on FSRU. As GIIGNL is also considering to update his Roll-over publication to insist on roll-over preventive measures on FSU/FSRU, Mr. Ellis proposed to put both parties in contact to stream line the messages.

-Mr. Jimenez (Enagas) reported an incident which occurred recently at Barcelona Terminal during the disconnection of an LNG hose in a truck loading operation (see annexed document). A driver suffered splashes and minor burns on arms and legs due to errors in the disconnection procedure. The driver was wearing personal protective equipment (PPE) but lacked a cryogenic apron.

The following situation led to the incident:

- After a Control System issue at the beginning of the operation, the vehicle's loading position was changed;
- It appeared that the loading had not started, giving a false impression that the lines were empty;
- Only one purge towards the plant was performed instead of the usual three purge towards the tanker and three purges towards the terminal;
- The absence of pressure in the LNG hose was not verified by opening the manifold purge valve.

Improvement proposals were issued at the terminal after this incident, on both procedures and PPE:

1. Procedures
- Ensure proper alignment of loader valves before disconnecting hoses;
- Confirm hoses are empty and depressurized by opening the purge valve.
2. PPE
- Use a face shield, cryogenic gloves, an apron, and keep sleeves rolled down during connection and disconnection as per risk assessment.

After this incident, Enagas reminded the following key messages: Do not become complacent during routine operations, even with 10,000 annual loadings. Always confirm there is no liquid and no pressure inside before disconnecting hoses.

-Several truck loading incidents have been reported such as

- quantity to be loaded communicated by radio. In case of wrong figure, a truck overflow is possible
- Incorrect trailer recorded, leading to a wrong loaded volume and truck overflow in the BOG line (which is difficult to drain).

-Truck loading arms : some terminal equipped with arms moved to flexibles and vice-versa.

-Enagas is not convinced about the dry coupling connection for truck loadings. They did extensive tests in Cartagena and the results are not satisfactory. It works if there is enough time between two loadings to allow a proper nitrogen flushing of the connection in the parking position. In case of high loading frequency, the connection is blocked by humidity after 5 or 6 loadings. When the flexible remains iced, the problem happens quickly : problem with O ring, no correct seal, internal flapper not closing..etc. The only solution in this case is the warming + flushing of the flexible.

MOL uses a 8" dry coupler, with dry N2 flushing (DWP pf -40°C) with success. CryoSC is a new type of coupler which gives good results.

-Based on the number of incidents reported in LNG truck loading stations (normally located inside a private area, with trained personnel and proven procedures), the industry is concerned with the potential incidents in open access LNG refueling stations, where all these good practices are not always applied. However, the LNG industry is recognizing the gaps and some actions are already taken : the open access refueling stations are more and more regulated (refer to Dutch regulation on LNG refueling stations in attachment), some European countries require proper driver training (refer to Marcogaz survey on European driver training requirements in attachment) and some energy companies are involved in the design/construction/operation of these stations (like BP in a JV for refueling stations in UK).

Decisions were as follows:

- Mr. Caudron (Elengy) will report at next TSG meeting if GIIGNL Truck Loading Safety Guidelines should be updated at the light of the recent incidents linked to LNG trucks.
- Mr. Jimenez (Enagas) will register in the database the truck loading incident which he presented.
- Mr. Chaudhary (Centrica) will register in the database some incidents on FSRUs.
- Mr. Bouazzaoui (Gate Terminal) will register in the database some truck loading incidents.
- Mr. Ellis will liaise with SIGTTO for having TSG Task Force on FSU/FSRU Rollover joining the SIGTTO / GTT study. Central Office will organize a meeting between SIGTTO and GIIGNL (Mr. David, Mr. Decroes, Mr. Malvos, Mrs. Alikhanbagi, Mr. Ellis).
- Mrs. Alikhanbagi (Shell) will report at next TSG meeting on the new scope of work of her Task Force after discussing it with SIGTTO.
- TSG Chairman and Secretary will check consistency of GIIGNL and SIGTTO data bases on incident which occurred on ships at berth.

Agenda Item 4: OPERATION & MAINTENANCE

A4.1. Recent O&M Surveys

TSG Chairman reminded the possibility given to members to raise a question to Central Office. If the interest is confirmed, Central Office may circulate it, as a survey, to all members. After gathering the answers, Central Office analyses the results and produces an anonymous synthesis.

1) <u>O&M survey on Flare pilots</u>

After previous TSG meeting in Groningen a survey was launched about the flare pilot (Is the pilot always on/off ? what kind of fuel is used (CH_4/propane/H_2) ? How to ignite the pilot ?...etc.). After that meeting, Central Office circulated the questionnaire and gathered the answers :

-Usually terminals having a flare use a pilot which is constantly on.

-Dunkerque LNG mentioned that they are performing a study on two options for reducing the carbon footprint of their flare pilots. Flare Pilots represented indeed 52% of terminal scope 1 emissions in 2023. The 2 following solutions are being further assessed:

- Pilot replacement by low consumption pilot (potential reduction up to 40-50 %, new proven technology: ZEECO High Stability Low Flow (HSLF) flare pilot),
- Pilot ignition on demand (reduction up to 100%, based on 2 fast-opening fuel gas valves).

-Enagas, who is studying the concept of flare on demand, questioned this option, pointing out the impact of methane emissions versus CO_2 emissions. A discussion followed with National Grid on venting and on demand ignition.

-In gate, the flare pilot is normally off. All PSV's (except tank and ORV) are released into the BOG system. Therefore, no CO_2 emissions in normal operation. In case of PSV releasing into the BOG system, the tank pressure will increase and the operator has to ignite the flare before automatic opening of the control valve to vent/flare by high high tank pressure.

-All TotaEnergies' facilities have now to come with closed flares (full recovery system), with fast opening valves and rupture disks in case valves don't work. Flare ignition by ballistic pellet system. This is a standard design for new facilities (expensive and gun shot is noisy but it works). They have instruction to deploy it everywhere for new facilities and they try to retrofit old facilities, but this is difficult.

Decisions were as follows:

- Central Office will post the results of the survey about the flare pilot on TSG web pages and share it with all contributors to the survey.
- TotalEnergies will give a presentation at next TSG meeting on their closed flare system.

A4.2. NORMs (Naturally Occurring Radiative Materials)

TSG Chairman raised this topic again since a discussion occurred on the subject at last European Terminal Manager Meeting.

National Grid (who gave a presentation on this topic at a former TSG meeting), as well as Elengy, Enagas and Fluxys mentioned that they experienced such NORM powder and have implemented Norm safety procedures (measure required at each equipment opening, PPE's). MOL mentioned that they found black or grey powder in pre-cooler filters and that they have NORM safety procedures as well in Qatar where they dry dock. Naturgy founded powder in compressors & ship tanks.

It was mentioned as well that Gate LNG had to get a nuclear permit after they discovered a NORM problem when operating a temporary flare a couple of years ago; This information is available publicly.

It could be noted that neither National Grid, Fluxys or Enagas can correlate NORMs to an LNG origin.

BP mentioned an IOGP paper covering this NORM topic for the Oil and Gas industry (not specific to LNG, but covering all what is need for LNG): see attached documents (2016 NORM IOGP report 412 and 2016 NORM IOGP Fact Sheet). For ships, there is also an intertanko publication on the subject.

As a reminder, National Grid, South Hook LNG and TotalEnergies gave respectively a presentation on this NORM topic at 73rd TSG Meeting in Barcelona. These 3 presentation are posted on TSG pages of the private area of GIIGNL website:

https://giignl.org/wp-content/uploads/_pda/2023/04/Item-4-NORMs-National-Grid.pdf

https://giignl.org/wp-content/uploads/_pda/2023/04/Item-5-NORM-South-Hook-LNG.pdf

https://giignl.org/wp-content/uploads/_pda/2024/06/Item-5-NORM-TotalEnergies.pdf

Norms exposure limits are well regulated in each country. The only action that GIIGNL can take is to share this experience regularly to be sure that all LNG operators are aware and take the appropriate actions during maintenance works. No need for specific GIIGNL publication as enough information are publicly available.

Decision was as follows:

- Share this NORM issue regularly, in order to be sure that all TSG members are aware of it for taking safety measures.

A4.3. CH_4 fugitive emission from Marine Loading Arm (MLA)

A Technical Learning was share for maintaining leak free MLAs, following a CH_4 fugitive/leak emission which occurred around LNG loading arm swivels (one drone observation lasting 19 minutes detected ~21kg/hr).
Seal failures are a known issue in the industry with various know root causes:

- E.g. Basic seal design & material selection of seal and spring
- (Execution of) cool down procedure

The following information was pointed out (see attached document) :

MLA design – swivel leak detection

▪ **Industry standards** for MLA's recommend a s**wivel leak detection port** connected to the cavity between primary and secondary seal, to be able to verify seal integrity
▪ Good **industry practice** is to **regularly test (~every 6 months)** for seal leakage and replace any leaking primary seal – this requires people access (e.g. by EWP, rope) to all swivels
▪ Replacing seals (in particular top seal) requires significant effort (scaffolding etc.)

MLA design – swivel nitrogen purging system

▪ **Industry standards** for MLA's recommend a s**wivel nitrogen purge system,** to keep swivel bearings dry
▪ The swivel nitrogen purge system is connected to the cavity between secondary and weather seal
▪ It runs from MLA base from swivel to swivel to a flow meter at the style 80 and tube to atmosphere
▪ Good **industry practice** is to check nitrogen flow at every offload to verify integrity of nitrogen purging system
▪ Check during every offload if any of the nitrogen lines coming out of the swivels is icing up
▪ Hand-held gas detector can be used to detect leak by measuring at flow meter outlet during offload

In USA, a full pressure test of the swivel joints is required once per year at 6-9 barg.

Enagas, is doing regularly bottom up and top down surveys. The purpose of these top down surveys is precisely to detect leaks in places difficult to access (arms, tank PSV's..etc). Drones are not allowed to fly above pipes/equipment.
The frequency of these surveys depends on the results. Usually, we start with a high frequency and the frequency is then reduced when the number of leaks detected decreases.
A discussion took place about the detection limit of camera's (<500 ppm) and drones (0,25 kg/h).

A4.5. Recent issues with LNG composition (N2, C6+..)

- **Heavy Hydrocarbons (C6+)**

Reminder : A survey was circulated in Feb 2023 about potential issues with C6+ in LNG and has been regularly discussed at TSG meetings since then.

A lot of issues were reported on :

- *US LNG liquefaction terminals ;*
- *LNG ships in ballast condition or equipped with subcoolers/reliquefaction when they are transporting US LNG cargoes ;*
- *LNG regas terminals (Issues with the BOG reliquefaction, suction filters of BOG compressors and HP pump), with potential HSE and safety concerns (as Benzene is carcinogenic)*

TSG Chairman mentioned that when breaking in details the C6+ line in the LNG chromatography, the problem lies with Benzene, Toluene and Xylene components (BETEX), particularly with Toluene and Xylene since their solubility is very low and fluctuates with temperature and composition (so, in case of LNG ageing with temperature increases, betex becomes solid and clog filters/sprayers..)

According to Mr. Vara (Freeport LNG), this C6+ issues is more linked to ConocoPhillips cascade technology as the process is less sensitive to these components. The following rule of the thumb is currently applied in Freeport (Air liquid process) with success : not more than 1 ppm of Benzene in the feed gas (prealarm is at 0,73 ppm). If this limit is respected for Benzene indeed, then Toluene and Xylene will follow, staying below acceptable limits. With more than 1 ppm in the feed gas after pretreatment, the cold box is rapidly plugged. When needed, Freeport LNG uses a chromatograph for monitoring the feed gas every 10 minutes at the inlet of each train and when needed the feed gas is washed with Butene in the pretreatment.

Centrica mentioned C6+ issues as well, pointing out that they never had issues with cargoes coming from Freeport. In order to help in solving C6+ issues on their ships, they had to increase the size of the heel (doubling it), reduce the ship speed, warm the tanks with sprayer clogged or flush the filters to GCU, with operational/maintenance/environmental consequences. Sampling on some cargoes showed values as high as 700 ppm for C6 to C10.

Fluxys mentioned a shipment coming from Sabine Pass which analysis showed the following values: Benzene: 9 ppm, Toluene: 7 ppm, Xylene: 3 ppm. Other regas terminals are concerned with damages on HP pumps, the impact on safety devices like LTD's and additional HSE measures taken for their personnel.

Chairman reported that an LNG fueled vessel had to switch to MDO during a voyage, because the LNG fueling pump was blocked by C6+ content of the cargo and the only solution was to empty and warm the LNG fuel tank.

Current advise for ships/regas plants : pay attention to the C6+ content of US LNG. If fraction is not zero, ask for a detailed breakdown of the C6+, monitor the equipment and take additional HSE measures.

- **High N2 content in LNG**

Reminder : Several regas terminals reported that some US liquefaction operators asked to increase the N2 content at LNG loading above 1%. Contractually, in most of the cases it is OK as the usual limits are for all inerts (CO2+N2), but the question was raised on the potential operational consequences.

Mr. Vara (Freeport LNG) pointed out that such increase becomes an issue as the content of N2 in some permian gas fields is increasing. One new pipeline was mentioned showing 3% N2 content: the limit is 3% for inerts (N2+CO2), but since there are incentives for producers to remove CO2 (CO2 credits), the content of N2 only can reach 3%.
The level of N2 in feed gas raised over 1%, with observed values reaching 1.2%, 1.3%, … Although it is not clear, it could stabilize around 1.5%, which is the maximum which could be acceptable for liquefaction.
A long term solution would be to source the gas from different locations.
Mr. Vara mentioned that anything above 1% N2 in the feed gas has an impact on their LNG production. So, there are two solutions : (1) N2 removal unit as pretreatment or (2) pass N2 in the LNG. To keep a high N2 in the LNG, there are two solutions : either to raise the LNG pressure (and the vessel tanks have limits) or to decrease the temperature and make the LNG super cold (-165°C which require additional refrigeration capacity).

TSG Chairman mentioned that high N2 content has important issues downstream:

-difficulties to manage BOG with very high N2 content (not being able to send out such gas in zero sendout mode),
-difficulties for LNG ships running on LNG (due to low heating value) getting ship to run on MDO instead of LNG. For ship engines, normal N2 limit in LNG is 0,6/0,65%, corresponding to 25%/28% N2 in BOG, with a switch to MDO at 0,7% N2 in LNG. However, modern ships are less sensitive.
-Elengy pointed out the problem of very low temperature (-165°C), leading to condensation in tanks. Moreover, we are approaching the ship and onshore tank design temperatures (-163°C to -167°C).
-Finally, there is a potential increased risk of N2 induced roll-over.

- **High O2 content in LNG**

Fluxys mentioned that they had problems with high O2 content in the BOG. They had an issue when cooling-down or reloading because of the high O2 content (100 to 1000 ppm) of the vapour return (Limit is 100 ppm in BOG and 10 ppm in grid). Now, they ask a O2 certification in advance and measure O2 in BOG. In case of high O2, Zeebrugge refuses the vapour return.

Gate has also to refuse a cargo (O2 limit of 5 ppm)

Zeebrugge had also the same issue when loading LNG road tankers, which occurred after the LNG road tanker had formerly loaded liquefied bio-methane (O2 measured between 100 & 1000 ppm in the vapour return). In case of normal sendout, the consequences are less severe as the vapor return quantities from a single truck loading are small.

It was reminded that there is a O2 limit of 10 ppm for the gas grid in BE/NL/GE because of corrosion issues in underground storages.

Decisions were as follows:

- The C6+ issue will be relayed to the US LNG suppliers by GIIGNL central office, with the assistance of both TSG and CSG because of the potential HSE, safety, operational, reliability and environmental consequences
- Pending : As a follow-up of last TSG meetings, TSG Chairman and Secretary will ask SIGTTO if they have information to share about the NORMs issue.

Agenda Item 5: GHG EMISSIONS

A5.1. Ways to reduce the CO_2 footprint of the LNG terminals (Leader Dunkerque LNG)

Remind : A first study linked to this topic was led by Mr. Witteman (Gate LNG) on Methane Emissions. Other GIIGNL publications are also available, listing more or less directly CO_2 reduction examples, but none with a direct focus on CO2 reductions. To avoid repeats, the study focuses on new recent solutions and on the CO_2 impact of each main equipment of a terminal.

The Task Force members are: Dunkerque LNG (Task Force Leader), Enagas, Engie, Sempra Infrastructure, Shell and TotalEnergies.

Mr. Planteline (Dunkerque LNG) gave an update of the work carried out by his Task Force.

To feed the reflections of the Task Force on CO2 emissions reduction, a questionnaire was circulated on May 13th, 2024 and 12 replies were received. Following the 75th TSG meeting and the extension of the questionnaire response time, two additional replies were received, bringing the total number of replies to 14.Some responses were partial only. The questionnaire results will be shared with TSG members in an anonymized format via Central office.

It appears that there is not enough material concerning any "new" and "unusual" initiatives at this stage to justify a report. Some well-known classical solutions deployed from start on recent terminals are envisaged for oldest terminals (Pipeline compressor to reduce flaring at zero sendout, NI sweeping of flare header, replace SCV's by ORV's..)

Mr. Planteline proposed to deploy a Case Study Presentation template to start collecting and sharing the few initiatives that were reported into the questionnaire, starting with the warm water production in Mejillones with solar panels. A report could be envisaged in a second step when the number of case study will be significant to justify to reassemble them into a single document to present a global overview useful for members.

Decisions were as follows:

- The information gathered in reply to the survey will be posted by Central Office on the TSG page of the private area of GIIGNL website.
- With support of TSG chairman, Mr. Planteline will issue a template for deploying a Case Study Presentation. Mr. Planteline will collect, through this template, the few initiatives that were reported into the questionnaire.
- An overview report could be envisaged in a second step if the number of case study is significant enough.

A5.2. GIIGNL MRV and CHG Neutral Framework

Remind : A Task Force was launched for creating a structure to report primary data to be used with GIIGNL MRV and CHG Neutral Framework. There is a need indeed for the LNG industry to continue to collect primary data as it allows to have a better picture of the real carbon footprint of the industry.

The Task Force members are Shell (Task Force Leader), Hazira, Gate terminal and Engie (with Mejillones Terminal.

Mrs. Raha Alikhanbagi (Shell) sent (November 25th), to all TSG members, a frame for gathering primary data: see attached document. Mrs. Raha will analyze the replies which are expected by end 2024 and will report on the results.

Decisions was as follows:

- Task Force Leader will report at next TSG meeting on the result gathered through the frame sent end of November 2024.

A5.3. LCO2 terminalling

Remind : The LCO2 Terminalling Task Force focuses on CO2 liquefaction, storage and export from LNG terminals. It's objectives are :

- *To evaluate the challenges and synergies brought by combining onshore LNG receiving and CO2 liquefaction terminals,*
- *To define design principles considering the overall CO2 chain from capture to re-injection,*
- *To treat onshore LNG Terminals (FSRU specificities will only be studied in a second phase, if interest is confirmed).*

Task Force Leader is Elengy, with support of Engie Lab Crigen. Mrs. Audrey Hubert (Engie Lab Crigen) took over Mrs. Clémence Detournay (Engie Lab Crigen) in September 2024, after Mrs. Detournay changed position within Engie.

Task Force Members are now : BP (Mr. Richard Ellis), Dunkerque LNG (Mr. Sylvain Planteline), Elengy (Mr. Ghislain Caudron de Coquereaumont, Mr. Benjamin Poirson, Mr. Yann Le Goc), Engie (Mrs. Audrey Hubert: Task Force Leader, Mr. Paul-Emmanuel Decroes, Mr. Hugues Malvos, Mrs. Florencia Cappuro), Equinor (Ms. Jingshhi Yang), Fluxys LNG (Mr. Kim Stevens, Mr. Siegfried Spanhove), National Grid (Mr. Olagoke Phillips), Osaka Gas (Mr. Masayuki Hirabayash, Sempra Infrastructure (Mr. Yovannis Mierez), Shell (Ms. Raha Alikhanbagi, Mr. Pablo Vega Perez), Singapore LNG (Ms. Pei Pei Ang), Tokyo Gas (Mr. Shogo Shimizu), TotalEnergies (Mr. Ginès Petit , Mr. Olivier Pasteau / Mr. Stéphane Dubois du Bellay)

Mrs. Hubert gave an update of the work carried out by the Task Force (see PwPt presentation).

A kick-off meeting of the Task Force was held on June 3rd, 2024 and 2 work meetings were held since then, in July and in October. Participants agreed on the table of content and the report writing and review is ongoing. First draft of some parts have been written (§ in green in the table of content below). Next meeting in planed for January, 2025.

Table of content of LCO2 Terminalling report:

1. Introduction: What is LCO2 as a product and its characteristics?
2. Interfaces between a receiving LNG terminal and a LCO2 terminal
   - 2.1. Cold synergy LNG / LCO2
     - 2.3.1 Cold integration concept
     - 2.3.2 Operational needs
     - 2.3.3 Terminal schematic
     - 2.3.4 Design recommendations, codes & standards
   - 2.2. Safety specificities
   - 2.3. Impact on LNG operations
     - 2.3.5 Risk of CO2 freezing
     - 2.3.6 Low and medium pressure management

2.3.7Jetties & loading facilities

3. Opportunities
   2.3. Advocacy
   2.4. Projects mapping
4. Conclusions and recommendations

The proposed deliverables are a survey about CCUS chain and LCO2 terminal sent to GIIGNL members, on one hand, and a report including LCO2 terminal export case studies, on the other hand.

Decisions were as follows:

- Next work session will be organized in June 2025.
- The work carried out will be presented at next TSG meeting.

A5.4. European regulation on methane emissions

Context : Methane is considered as the second most important GHG contributor to climate change after CO2. IEA considers that a lot of gas was wasted worldwide due to venting/flaring and 50% of these wastes can be mitigated by proper measures. Therefore, EU issued in 2020 a European methane strategy, with the purpose to reduce the CH4 emissions from energy, agriculture and waste sectors. This strategy was then followed in 2024 with a regulation on CH4 emission reductions with the purpose to stop all available release of CH4 in EU and in the EU supply chain. The regulation insists on the improved MRV, on stopping venting/flaring, on detections with LDAR.

A discussion followed on the subject as the principles are there but each EU member must define how to apply it. Number of LDAR/y and the time to repair is for instance not realistic. Dunkerke decided to perform 2 LDAR campaigns per year.

A debate took place on the Howard report, comparing the US LNG import chain in EU with coal from China. GIIGNL is preparing an answer to be proposed to Excom members in Santiago as the approach is not scientific (taking the worst gas field, the worst ship, the worst burner efficiency)..

Agenda Item 6: GIIGNL PUBLICATIONS

A6.1. Update of the Custody Transfer Handbook (Leader Fluxys LNG)

As a reminder, the purpose of the custody handbook is to serve as a reference manual to assist readers in understanding the procedures and equipment available to be used by GIIGNL members. It helps to determine the energy quantity of LNG transferred between LNG ships and LNG terminals (ship to shore or shore to ship).

It is neither a standard nor a specification, but it sets out the practical issues and requirements to work out a suitable procedure for a specific LNG custody transfer application.

Last Update of GIIGNL Custody Transfer Handbook was finalized at the end of 2021 (6th edition). The link for downloading the 6th edition of GIIGNL Custody Transfer Handbook is:

https://giignl.org/document/custody-transfer-handbook-6th-edition-2021/

Mr. Stevens (Fluxys LNG) presented the new topics to be potentially included in next update of GIIGNL Custody Transfer Handbook :

- Integration of small-scale LNG transfer operations (load bunker vessel, STS transfer, fueling of ships and trucks, filling of LNG trucks or containers (Enagas) ?
- Addressing partial loading/unloading by adding paragraph dealing with temperature issues (Equinor) ?
- Rephrasing paragraph on periodic recalibrations with a recommendation interval (SLNG) ?
- Transshipment and the issue with composition changes due to flash gas and gas quality determination (Fluxys) ? ➔ reference in appendix CTH
- Use of flow meter for custody transfer measurements (Enagas) ?
  - Update or new experience
  - For small vessels Coriolis ➔ section 17,2 alternative method for measuring transfer
- Use of portable vaporizer/chromatograph (which could be useful for counter expertise) (SLNG) ?
- Rules for ship level meter filtering (modification of the filtering could make 200-300m³ difference ?
- Complete unloading (tank stripping) ?
- SLNG observation: during loading of MOSS type tanks, tanks show erratic level readings at start of loading until level reaches 4-5 meter. This phenomenon due to cavitation or push over of liquid to tanks sides due to loading?
- Estuary ship operations (ADN regulation)

Mr. Stevens reviewed as well the existing topics which should be amended:

- Use of Raman for custody transfer (*sole a mention of the technology is made in the current edition*)
  - Is there an update on testing of this technology by Zeebrugge, Enegas or other terminals? No MIB certificate for the moment, only one vendor, limited accuracy → Not mature ?)
  - GERG report available with findings and recommendations (Raman method for determination and measurement of LNG composition): Reference can be made to this study in the CTH
- Mistake in current CTH handbook on density calculation
- Volume correction factor K1
  - Clarification needed which table to use with pressurized vessels and conventional ships
  - No need to mention in more detail

Mr. Stevens also proposed to investigate on the standards to be used for dealing with C6+ and BTEX:

- Currently GPA2261 in CTHB as standard for breakdown C6+
  - Intertanko study (impact of long chain hydrocarbons in LNG) recommends using GPA2286 to take more precise into account C6+
  - There's also ISO6974 used by some loading and discharge terminals (Enagas, Fluxys,…)
- Something to add on BTEX (Benzene, Toluene, ethyl-benzene and xylene)?
  - Acceptable limits to avoid operational & human risks ..?
- In general C6+ could lead to more operational issues, commercial impacts

Decisions were as follows:

- All the presented subjects will be analysed and if relevant included in the next revision of CHTB.
- Mr. Stevens (Task Force Leader) will liaise with Enagas, Equinor and Singapore LNG, for drafting the corresponding paragraphs.
- Mr. Stevens will report at next TSG meeting on the work carried out for updating the CTHB.

A6.2. Rollover in LNG Storage Tanks

Reminder : A roll-over on ships/FSU's/FSRU's is credible (some 'light' cases were reported in Klaipeda, Mejillones, Moss ship after partial unloading/reloading), in particular due to inevitable partial tank filling on ships not equipped with top filling. It was decided at last TSG meeting in Groningen to envisage to complete the rollover report issued in 2015 for on-land LNG tanks with LNGC/FSU/FSRU cases (See: https://giignl.org/wp-content/uploads/2021/08/rollover_in_lng_storage_tanks_public_document_low-res.pdf).

The members of the Task Force at this stage are: Shell (Task Force Leader), Engie and N.V. Nederlandse Gasunie.

After a detailed reading of both GIIGNL and SIGTTO roll-over publications, it was concluded that the credibility of roll-over on vessels is clear. It was therefore suggested to update slightly the GIIGNL publication to insist more precisely on the elements to consider during design/operation of a FSRU (vessel never empty during loading, converted vessel not equipped with LTD's and top filling devices). Task Force Leader will propose some adjustment of the current publication.

As mentioned at Agenda Item A3.2. (Lessons from incidents) SIGTTO is considering an update of their roll-over study in order to clarify the shipping recommendations on roll-over. They might launch a study with GTT on rollover on FSRU. Central Office will organize a meeting between SIGTTO and GIIGNL (Mr. David, Mr. Decroes, Mr. Malvos, Mrs. Alikhanbagi, Mr. Ellis) to be sure that we pass the same message.

Decisions were as follows:

- GIIGNL/TSG will investigate with SIGTTO/GTT their intention on rollover on ships.
- Task Force Leader will adapt accordingly the proposal of work to be carried out and will present it at next TSG meeting.

A6.3. LNG quality & compatibility

Remind : Last update of the composition table which used to be published in GIIGNL annual report on the LNG industry was issued more than 10 years ago (2012 with cargo information from 2008-2010): https://giignl.org/wp-content/uploads/2021/07/giignl_the_lng_industry_2012.pdf

The composition table appeared in later reports but without being updated. Finally it was deleted from the annual report as it was not representative anymore of the LNG international market (for instance, US and Australian LNG were not in).

At last TSG meeting in Groningen, it was decided to investigate with GIIGNL Commercial Study group, how to overcome the confidentiality issue which prevented the update of this composition table, as there are external interest for this table.

Decision was as follows:

- TSG Chairman will coordinate with CSG Chairman and Equinor for launching a Task Force on LNG quality and compatibility. He will report on the progress at next TSG meeting.

Agenda Item 7: OTHER MATTERS

A7.1. New study subjects

As a reminder, this creative part of the meeting is of highest importance, since it allows to bring added value to the TSG in order to help the LNG industry in today's activities and preparing for the future.

All TSG members are asked to think about new study ideas to be discussed at next TSG meeting. To date, several ideas have been proposed, such as:

- Standardizing the design of LNG trucks (connections, overfill detection systems..), in order to develop unmanned truck loading stations. Standardization for truck loading facilities (including connections) is a subject of interest for several TSG members (such as Dunkerque LNG, Fluxys LNG or Gate LNG).
- Developing a technical paper on green gases (Bio-LNG, Liquefied Synthetic Methane and LH2)
- Infrastructure synergies for LNG and LH2, LNG and ammonia.
- New O&M philosophy in an environment where more flexibility is required (zero send-out to peak send-out, additional services such as truck loading, transshipment, ship reloading..).
- Benchmarking of maintenance of the main LNG equipment.
- Providing design, operational or safety recommendations for the operation of floating or small-scale facilities.

Also, some existing studies could be slightly updated such as:

- Cold recovery: the Rankine cycle in Barcelona has been upgraded.
- Rollover: Appendix A is to be deleted from the text as the public document is referring to it but the appendix, on purpose, is not attached.
- Technical manual on emissions: GWP of CH_4 is now 30 instead of 20 in the documents. Some new technologies to be added, such as flexibles.
- Updating previous publications (earthquake guidelines, environment impacts of LNG facilities, cold recovery, update the 2005 TSG report on LNG Maintenance Strategy Benchmarking).

Decision was as follows :

- Each member is encouraged to propose new subjects to be developed by the Technical Study Group.

A7.2. Coordination with other LNG bodies (IGU, ISO, SIGTTO, GLE, GERG, Marcogaz, …)

Marcogaz launched a study on LNG quality. Mr. Lana (Enagas), who used to work on this subject within GIIGNL/TSG, as former representative of Enagas, is involved in the work carried out by Marcogaz. The results should be available soon.

Agenda Item 8. DATE AND VENUE OF NEXT TSG MEETING

Next TSG meeting (76th) will be held in Izmir (Türkiye) on May 14-16, 2025, at the kind invitation of EgeGaz. The 44th CSG meeting will be held at the same time and location. A 'Save the Date' will be sent by Central Office.

Agenda Item 9. VERBAL REPORTS BY MEMBERS ON TOPICAL LNG MATTERS

Before opening the verbal reports section of the Agenda, MOL gave a presentation on its Wind Challenger Program (see PwPt presentation). MOL presented as well its Wind hunter concept (see https://www.mol-service.com/en/services/low-carbon-decarbonized-business/wind-hunter).