COMAH Control of Major Accident Hazards

COMAH Competent Authority Agenda

SITE DETAILS		
Name of Company: ExxonMobil Chemical Ltd		**Address of Company:** Beverkae House Cowdenbeath Fife KY4 8EP
Inspection Title: Process Safety Inspection		
Service order No: SVC 4321536	**Site ID:** 1036032	
Inspection Date: 13 - 14 June 2016	**Case No:** 4171550	
Visiting Inspector(s):	**Discipline:**	**Unit & Team:**
[redacted]	Regulatory Inspector	CEMHD 1B
[redacted]	Process Safety	CEMHD 6A

Site: Mossmorran and Braefoot Bay

Date: 13th – 14th June – 09.30 start
Purpose of visit: Process Safety Inspection

Agenda

Day 1: Mossmorran

1. **Introductions/Domestics**

2. **Overview**
   - *Please provide a brief overview of the processes on site, materials handled and major accident hazards for both Mossmorran and Braefoot Bay*
   - *Utilities used on site*
   - *COMAH safety report revision cycle*

3. **Process Risk Assessment**
   - *Overview discussion on company arrangements for assessing process risks*
   - *Identification of Major Accident Hazards*
   - *Process safety assessments – HAZOPs? HAZIDs? QRA? LOPA?*

4. **DSEAR**
   - *Overview of the company's approach to DSEAR compliance*
   - *Hazardous area classification*
   - *Identification of sources of ignition*
   - *Portable and fixed equipment for use in Hazardous areas*

5. **Lunch**

6. **Site Inspection**
    - *General site inspection to cover control room and plant areas.*

7. **Company's approach to Management of change**
    - *Overview discussion on the company's arrangements for Management of change*

8. **Occupied Buildings**
    - *Occupied Buildings risk assessment*
    - *Company's approach to temporary buildings*

Day 2: Braefoot Bay

9. **Overview of facility**
    - *Short recap of facility*

10. **Site inspection**
    - *Site inspection to include, control room, storage tanks, tanker unloading facility, jetty operation.*

11. **Ethylene pipeline Management of transfer operations via pipeline**
    - *Discussion on control measures in place*

12. **Road tanker operations**
    - *Discussion on control measures in place*

13. **Lunch**

14. **Level protection on storage**
    - *Company's approach to overfill protection/ 2011 study*
    - *Overfill protection in general*

15. **Loading operations to shore to ship**
    - *Discussion on control measures in place*

16. **CA time out**

17. **Conclusion**
    - *Early feedback from inspection*

Order of inspection is flexible to suit availabilities etc.

[redacted]
SSHE Manager
ExxonMobil Chemical Ltd,
Fife Ethylene Plant,
Beverkae House,
Mossmorran,
Cowdenbeath,
Fife. KY4 8EP

Health and Safety Executive
Hazardous Installation Directorate

[redacted]

CEMHD 1B
Belford House,
59 Belford Road,
Edinburgh. EH4 3UE
Tel: 0203 028 [redacted]
[redacted]@hse.gov.uk

www.hse.gov.uk/comah/

Date 15th February 2017

Reference **SVC4321536 Line 5-2016/17**

Cc: [redacted] SEPA

For the attention of [redacted] SSHE Manager

Dear [redacted],

Health & Safety at Work etc. Act 1974

The Control of Major Accident Hazards Regulations 2015

I am writing following my visit to your establishments at Mossmorran and Braefoot Bay on the 13th and 14th of June 2016 where I was accompanied by my colleague [redacted] (HM Specialist Inspector of Health & Safety – Process Safety). The purpose of our visit was to carry out a planned Inspection of some high level Process Safety management systems following the assessment of the Safety Reports submitted in respect of these sites in 2012. I would like to thank all of the personnel who assisted us during the Inspection.

This letter and the accompanying Specialist Report cover the matters found at the time of the Inspection. The three Actions (Legal) below summarise the conclusions of the Specialist Report which contains the observations, analysis and reasoning behind these Actions.

Actions (Legal)

Action number / Description: ER/EM/PS/130616/1 You should review the tanker drivers building to confirm if this is an occupied building and to determine if there are any risks to personnel within the building from the nearby tanker loading operation by virtue of being in the building.
You should report the findings of this review to the CA.
End date: ***1st June 2017***
Details: There was some evidence that personnel would spend time in the building adjacent to the tanker bay at the Fife Ethylene Plant. Paragraphs 80 and 81 of the attached Report discuss.
Legal Basis: COMAH Regulation 5(1) & 5(2)

Action number / Description: ER/CP/PS/140916/2 You should review the design of the control room at Braefoot Bay to determine if it will provide protection to staff within against the predicted thermal radiation contours in the event of a pool fire at the C5+ bund.
You should confirm whether the philosophy in the event of fire at the C5+ tank is to shelter in place within the control room or to evacuate.
You should report the findings of this review to the CA.
End date: ***1st June 2017***
Details: Paragraphs 82 to 87 of the attached Report discuss.
Legal Basis: COMAH Regulation 5(1) & 5(2)

Action number / Description: ER/CP/PS/140916/3 You should review whether surge overpressure is an issue on the ethylene and C5+ transfer lines. This should include consideration of whether credible surge over pressure events can exceed the design pressure of the pipework and loading arms.
This should include: ethylene Mossmorran to Braefoot; ethylene Braefoot storage to ship; ethylene recycle line jetty to tank; and C5+ transfer from Braefoot storage tank to ship.
You should report the outcome of this review to the CA.
End date: ***1st June 2017***
Details: Paragraphs 88 to 94 of the attached Report discuss.
Legal Basis: COMAH Regulation 5(1) & 5(2)

Health and Safety at Work etc. Act 1974, Section 28(8): Information for employees

I am required to give specific health and safety related information to your employees. I would be grateful if you would discuss the contents of this letter within your Safety Committees and with Safety Representatives.

Should you require clarification on anything contained within this letter please do not hesitate to contact me.

Yours faithfully,

[redacted]

HM Inspector of Health and Safety

COMAH Competent Authority

COMAH Competent Authority Inspection Report

ESTABLISHMENT DETAILS			
Name of Operator:	ExxonMobil Chemical Company		
Establishment Address:	Fife Ethylene Plant Beverkae House Cowdenbeath Fife KY4 8EP Braefoot Bay Fife KY3 0XR	**COIN Site Ref:**	1036032 1036087
		Case No:	
		Service order No:	SVC4321536 SVC4321535

INSPECTION DETAILS			
Inspection Title:	Process Safety Inspection Mossmorran and Braefoot Bay		
Report Discipline(s):	Process Safety		
Intervention Plan ref:	n/a	**Inspection Date:***	13 – 14 June 2016

NOTE TO OPERATOR:** ***If you have been given access to the public information system **please ensure that you have updated the "date of the last site visit" field on the system following this planned inspection. The date above is the date of the last planned COMAH regulatory visit in line with the intervention plan for your establishment. You can select the relevant date from the system.**

[Delete this box if this is not a planned inspection from the Intervention Plan]

Visiting CA Staff:	Discipline:	CA Organisation, Unit & Team:
[redacted]	HM Inspector of Health and Safety	CEMHD 1B
[redacted]	HM Specialist Inspector (Process Safety)	CEMHD 6A

Persons seen:	Position:
[redacted]	SSHE Manager
[redacted]	Instrument Engineer
[redacted]	Process Safety Engineer
[redacted]	Engineering Specialist Group Head
[redacted]	Process Engineer
[redacted]	Shift Manager (Mossmorran)
[redacted]	Control Room Operator (Braefoot Bay)
[redacted]	Outside Operator (Braefoot Bay)
[redacted]	Lead Instrument Engineer
[redacted]	Site Operations Manager

Dan Moore	Plant Manager

Relevant documentation seen

[List all documentation seen - include revisions and dates where possible. If appropriate, clarify the level of review within this section e.g. only parts of the document were reviewed]

Prior to Inspection

- Safety Report for Mossmorran and Braefoot Bay (October 2012).
- PFD: "Mossmorran Facilities". EG-F2-228. Rev 2. Sept 2000.

During Inspection

- Drawing: "Mossmorran Potential Blast Study". EG-A0-177. Rev 2. 08.02.12.
- Drawing: "Braefoot Bay Potential Blast Study". EB-A0-178. Rev 2. 25.03.11.
- Procedure: "Ship Loading – Ethylene". OP/R/BB/Ship Loading – Ethylene. Rev 36. 21.01.16.
- HAC drawing: Braefoot Bay

Inspection Summary:

[Provide high level summary - include the following: a brief summary of the purpose of the visit; brief overview of anything outstanding from previous interventions; a short summary of the key findings; a summary of actions to be addressed and timescales]

This was a 2 day inspection covering a range of topics at linked top tier sites at Mossmorran and Braefoot bay. Topics covered included, process risk assessment, management of change, compliance with DSEAR, Occupied Buildings, high level protection and a site inspection of both sites.

Three Actions Legal have been raised following the inspection covering:

1) Occupied Buildings – Mossmorran.
2) Occupied Buildings – Braefoot Bay.
3) Surge overpressure on transfer lines linking Mossmorran and Braefoot Bay, and the jetty facility at Braefoot Bay.

Report author: [redacted]

CA Organisation, Unit & Team: HSE, CEMHD 6A

Date of report: 23 January 2017

Location: Edinburgh

Purpose of visit:
[Describe the purpose of the visit and how that purpose was met, and the approach taken e.g. site based inspection, presentations by site personnel, review of documentation etc. Any additional items addressed during the inspection should be noted and included in the Discussion and Conclusions section.]

The purpose of this visit was to assess the company's arrangements both in terms of management systems and arrangements on plant in a number of areas including: process risk assessment; compliance with DSEAR; occupied buildings; transfer operations; and tanker operations.

Factual observations and findings:
[This section should describe what was inspected, what was found, benchmarks used by the company e.g. built to a standard. Include references to standards, guidance etc. listed in the glossary at the end of the report.]

Background

1. This report covers a two day inspection visit to two upper-tier COMAH sites located at Mossmorran and Braefoot Bay in Fife. The sites are operated by ExxonMobil Chemicals Ltd. The Mossmorran site receives ethane from the adjacent Shell FNGL plant. This material is passed through one of 7 cracking furnaces to produce ethylene. Ethylene is exported via pipeline to either Braefoot bay for refrigerated ship loading, or to Ineos Chemicals Grangemouth for further transition via a pipeline network.

2. A C5+ fraction (containing 70 – 80% benzene) generated by the process, is transferred to Braefoot Bay via road tanker and stored in a large internal floating roof tank prior to export via ship.

3. The inspection visit included office based discussion plus site visits to the control rooms and plants on both sites.

MAH / COMAH Safety Report

4. The company's safety report had identified 38 representative Major Accident Hazards (MAH) at Mossmorran and 14 at Braefoot bay. In general terms the accident scenarios involve the release of high flammable gases or liquids followed by ignition.

5. The company described a corporate risk matrix approach which allows risks to be ranked, therefore allowing comparison of units and sites. This assessment of risk drives the company's approach to risk management. The company reference the ISO 31000 guidelines in this approach.

6. The company are due to submit a 5 year revision of its COMAH safety reports in

2017 for both sites. Topics where extra detail will be included in the revised report include: greater detail on the LOPA process; ALARP demonstrations; and MATTE potential.

Process Risk Assessment

7. The company's approach to the assessment of process (and other risks) was discussed in overview. The company described an "Operations integrity management system" which formed the basis of the sites safety management system. This was intended to provide a common, corporate approach regardless of where the site was in the world, but with scope for local interpretation based on relevant national standards etc.

8. The company described an approach to hazard assessment that would be applied for new project and periodically for existing plant. The company described both HAZID and HAZOP with the decision on which tool to use based on the perceived hazard. This was based on a gated process in the company's procedure. Following this Hazard identification process, the company described a process of brain storming potential improvements and preparation of an ALARP demonstration.

9. The company's approach to HAZOP was discussed. The Mossmorran plant had been split into 11 sections with HAZOP's being carried out on a periodic, rolling basis. This would initially be carried out on a 5 year frequency. After a few cycles the company would look to extend the period to 7 years. The company described carrying out several HAZOP studies per year each one taking approximately one week.

10. HAZOP's are normally internally chaired with a minimum 4 people present. This includes operation personnel and appropriate disciplines. The preparation for the study was reported as including: a review of the previous study; check on the closure of an actions; a review of any modifications made within the area over the cycle (i.e. for cumulative change effects); and a review of any relevant incidents or accidents that had occurred during the review cycle. HAZOP actions are only signed off when the action is fully complete – i.e. any changes have been made.

11. Major accident hazards (MAH) had been identified with a top down approach based on inventories of hazardous materials and a screening exercise. The company stated that this assessment was on a 5 year revision cycle.

12. The company described a Safety Relief Review (SRR) project. This was related to relief venting and the flare system. It included sizing rechecks of the major relief devices on site. The company had previously produced a simulation model of the flare system, but the software this had been produced on was nearing the end of its life. The company described a proposal to prepare an alternative model.

13. The Mossmorran flare system consists of two flare headers "cold/ dry" and "warm/ wet". The company described the "vast majority" of relief streams feeding into this system. Two knock out drums were present, one for each system. The cold header is passed through a heater before the two headers tie together and feed to

flare. Normally this is a ground flare. However, the site also has an elevated flare, in the event of high flowrates; a diversion system based on level within a seal pot will send the flow to the elevated flare. The preference is to use the ground flare for environmental (visible flaring) reasons. The company described the flare pipework as being of stainless or carbon steel appropriate for the potential low temperatures during relief events.

14. The Braefoot Bay site does not have a flare system with hydrocarbon relief directed to atmosphere. Carbon dioxide and hydrogen sulphide is routed to either the boilers or an incinerator. Process venting from C5+ ship loading is also routed to the incinerator.

15. The company described a fire protection survey (FPS) which is carried out on a 5 yearly cycle by an ExxonMobil specialist independent of the site. The company also described a Marine terminal survey on a 6 year cycle, again carried out by an ExxonMobil specialist independent of the site. The company described a security review that had been carried out for both sites.

16. For safety instrumented functions, the company described using a risk graph approach, with the potential to use LOPA.

17. Occupied buildings risk assessment is discussed in a later section of this report.

18. The company described how its safety management system is subjected to a corporate audit annually (internal to the site) and every 3 years (external ExxonMobil personnel not associated with the site).

Management of Change

19. A Process Engineer on site has a role to manage/ administer the company's management of change procedure (MOC 7.1).Each change is assigned a management sponsor who follows the change. The management of change process would also be used for "personnel" type changes.

20. Changes have to be approved by the appropriate discipline. The company describe how the authorisation list is generated by the initial categorisation of the change. This process will also identify the appropriate safety studies, although this can be challenged.

21. Post installation, the company described a pre-commissioning "walk round" of any plant changes.

22. A list of all "live" modifications can be seen in SAP, and a review/ audit system was described where the number and type of changes are reviewed on a quarterly basis to identify any underlying issues.

23. Temporary changes are given a sell by date. In order to extend a temporary change, the change must be reviewed and the extension approved.

DSEAR

24. The company described a range of documents within the corporate EMCAPS system which they felt covered the requirement of DSEAR Regulation 5. A 5 year compliance assessment was also discussed.

25. On Hazardous Area Classification drawings (HAC), the company described how classification would have been carried out at the time of the plants original construction in the 1980s. A full update of the drawings was carried out in 2003; this was based on API 505 and an internal Exxon Mobile standard. The company use 4 drawings covering the Mossmorran site, the tanker loading area, the top area at Braefoot Bay and the jetty area at Braefoot Bay.

26. The company stated that updates of the drawings would be driven by changes to the site, controlled via the management of change procedure. The last update to the Mossmorran drawing had been 2014.

27. The drawing for the Jetty at Braefoot Bay was used as an example. The Jetty head had been classified as a Zone 2 area. The company explained that the zone 2 classification was based on the ships collecting ethylene having a local compressor which would collect vapour generated from the loading, reinjecting it into the ships tanks. For the ships loading the C5+ gasoline fraction, a vapour recovery hose connected the vapour outlet from the ship to a shore based vapour incinerator. Effectively the ship itself did not have a process vent, hence the Zone 2 specification. A single drawing had been produced by the company based on the amalgamated zones for both ethylene and the C5+ fraction.

28. For the specification of equipment, a number of different standards were applicable to different sections of the site – e.g. Zone 1 T4, Zone 1 T1. This meant that a total of 9 subsets of zone classification were present on the site. The company's aim was to standardise as much as possible and that therefore a higher standard than necessary would be installed for consistency purposes. The company's intention was to install Zone 2 rated equipment in "safe" areas where possible for this reason.

29. The company stated that for fixed electrical or mechanical equipment, new equipment would be specified to the appropriate level. A register of equipment was maintained in the maintenance management system (MTS) which included details of the specifications.

30. For portable equipment, the company described a hot work permit system which would control equipment brought to site (e.g. vehicles, diesel generators etc.). The company also described a procedure for the control of portable tools.

31. The company described how the technicians involved in inspecting and maintaining electrical equipment for use in hazardous areas have received "COMPEX" training.

Occupied Buildings

32. Details of occupied buildings are held within a Blast Technology Manual (BTM). The last full revision of the risk assessment was carried out in 2011. The company described how QRA work had been carried out internally with the results for blast overpressure plotted on two site plan drawings, covering Mossmorran and Braefoot Bay. This was based on ignition of gas cloud within identified congested areas.

33. For permanent buildings on site, the main office building, control room and workshop structure had been designed with overpressure in mind. The building was built into the hillside on one side with a protective concrete barrier to the front. The control room part of the building was designed to withstand 10 psi over pressure on the walls and 4 psi on the roof for a 20 mil sec duration. Other parts of the building had different ratings based on their distance from the potential blast source.

34. The company stated that there are no temporary occupied buildings currently on the Mossmorran site. Any temporary staff would be located outside a 0.9 psi(g) (62 mbar(g)) contour. A contour of "API 753 essential occupancy" is shown on the two relevant drawings. API 753 is an American standard on temporary occupied buildings. This area within the contour covers essentially the whole site at Mossmorran and the site excluding the jetties at Mossmorran.

35. For the Braefoot bay site, the control room was designed to withstand 10 psi for 20 milliseconds. Due to the large inventory of C5+ product stored in a tank within a bund there is the possibility of a pool fire and subsequent thermal radiation effects.

36. The company had carried out "Phast" modelling and identified a potential thermal radiation hazard of between 10 and 37.5 kW/m^2 based on a pool fire in the C5+ bund impacting the control room. The company were asked if the control room building was designed to withstand this level of thermal radiation, and whether the intention in an emergency situation was to shelter in place or to evacuate. See further comments in discussion section.

High Level Protection

37. There are a number of large storage tanks across the two sites including refrigerated storage of ethane at Mossmorran and two refrigerated ethylene storage tanks at Braefoot Bay. Additionally there is a large internal floating roof tank at Braefoot Bay for the storage of the C5+ fraction.

38. The refrigerated storage tanks are each fitted with three level probes – 2 "ENRAF" and 1scientific instrument probe which is also capable of measuring temperature and density. The company described a trip function controlled via a hardwired safety PLC with activation of high level closing a valve on the inlet of the tank.

39. The company were able to describe SIL assessment using risk graph methodology which had identified a SIL 1 rating for the trip.

40. The possibility of stratification and subsequent roll over within one of the refrigerated tanks had been considered during the early days of the plants operation. The company described carrying out computer modelling which including factors such as turnover of product had concluded this was an unlikely scenario.

41. See comments on C5+ tank under Braefoot Bay site inspection section.

Site Inspection Mossmorran – Control Room

42. The control room area at Mossmorran is within the main office building. The facilities include DCS control consoles in a large open plan control room with side offices and equipment rooms. There are facilities for the shift team which includes: Shift Manager; Line Supervisor; 3 inside operators; and 4 outside operators.

43. The export of ethylene from site was reviewed at a DCS console with operating staff. Ethylene is exported in the liquid (dense phase) to either Braefoot bay or Grangemouth from a final product drum. On the day of the inspection, liquid export to Grangemouth was set at 26 tonnes/hr with the remainder of production being exported to Braefoot Bay based on level control of the export drum. A vapour return line is recovered from Braefoot Bay.

44. Alarms on the DCS were categorised into three categories: Red (Urgent), Yellow (Medium), White (Low). Standing alarms are displayed on an alarm list. In addition to the DCS control system, "Safety critical" alarms were located on a separate annunciator panel.

45. There was a separate hardwired ESD panel which would allow sections of the plant to be vented to flare. Double boundary isolation valves were described on all transfer lines into and out of the plant for the pipelines; these were motorised valves which would need to be energised to operate.

46. Gas detectors are located on site for leak detection. Priority alarms are configured to come up on the DCS screen in the event of activation.

47. There is CCTV available for sections of the plant displayed in the control room. This includes the flare tip.

48. For pipeline transfers, the company described a leak detection system. This consisted of flowmeters at either end of the line with comparison between the two readings (including temperature and pressure compensation). The company stated that the pipelines are provided with thermal relief in the event of a lock in situation. Pipework, between Mossmorran and Braefoot Bay is managed for the company by Shell.

Site inspection Mossmorran – C5+ tanker loading

49. C5's+ (benzene rich stream) are loaded at a tanker bay located to the West of the plant, distant from the main process areas. Material is transferred from a storage

drum at the end of the process and loaded onto road tankers which are then transferred to Braefoot bay. Transfers are made 2 – 3 times per day.

50. The road tanker is parked in a tanker bay for the loading operation. This includes a weigh bridge on which the tanker sits during charging with the intent of tripping the fill operation on high weight/ level. Flows into the tanker are also metered. The tanker bay is drive in/ drive out with no requirement for reversing. The bay is covered by a fixed deluge system which can be used to put foam onto any release. The deluge system can be activated from a number of buttons in the area. Gas detectors were located at the tanker bay. These were calibrated 10% (High) and 20% (High High) LEL.

51. There was a system to dose an inhibitor agent into the material to prevent/ minimise peroxide formation/ polymerisation prior to the material being shipped from site.

52. On inspection there were two earth connections at the bay – a "Scully" type unit and also a more traditional earthling clamp. The company were asked why two systems were provided, and if both needed to be in place to safely load a tanker. There company described a series of "earth chattering" problems with the Scully system which had caused spurious trips. Until this issue was resolved, the additional earth clamps (in fact there were two units) were in place. A management of change document was shown which covered this change.

53. On the day of inspection, the weigh bridge was not working. On the second day of the inspection, the company were able to show a management of change document covering continued operation of the system without the weigh bridge being operational. This involved using the level in the product drum (feed to the loading point) as an alternative safeguard.

54. Facilities for the tanker drivers are provided in a brick building set a short distance from the tanker bay. The intent is for the driver to connect and disconnect the tanker at the bay, but to initiate the transfer and spend the duration of the loading in the building. A window is provided facing the tanker bay as well as a desk and seat. The intention of this arrangement is to ensure the driver monitors the loading operation throughout, but is physically removed from the hazards associated with any leak or overfill – the material being both highly flammable and toxic.

55. To achieve this aim, the driver is provided with a "dead man's handle" switch which needs to be pressed for the loading operation to be permitted. The switch consisted of a small foot peddle on a long extension lead. This was discussed with the company as it appeared to be a system which could be easily defeated – e.g. by putting the handle on the floor and placing a weight (e.g. the chair) on it. The company report that the type of button may have changed at some point, from a "hand button" to the foot peddle seen during this inspection.

56. The driver's building contained, fridge, kettle, sink, toilet and locker facilities. The status of this building as an "occupied building" was discussed. The company currently did not consider this to be an occupied building.

Site Inspection Braefoot Bay

57. Braefoot Bay is a shared facility with Shell, within a common security fence and with shared access control. In general terms, process equipment, storage and the control room are at the top of a hill, with pipework leading to a jetty area at the bottom. Exxon Mobile and Shell operate across separate jetties. Ethylene is stored in two large refrigerated storage tanks (B-TK-01 & B-TK-02) prior to loading to ship. The C5+ material is stored in a large, internal floating roof tank (B-TK-15), again prior to loading to ship.

58. The process is operated from a control room within a blast resistant building at the top of the site. The control room included: DCS control over 2 consoles; an alarm screen; a hardwired alarm panel; hardwired trips; and CCTV covering the top site and the jetty area.

59. Refrigerated Ethylene is pumped to Braefoot Bay as a supercritical fluid and passed through a three stage let down process. This system included 3 let down drums. A system to reduce the flow of the transfer in the event of high pressure in the let-down system was discussed. Refrigerated liquid at approximately - 100°C is fed into two large refrigerated storage tanks. Flashed ethylene vapour is returned to Mossmorran via pipeline. Typically 1 tank is filled at a time over a period of 2 – 3 days, with the contents then exported across the jetty to a refrigerated tanker.

60. The ethylene tanks were provided with a monitor deluge system which would provide cooling in the event of an external fire, or potentially to knock down any vapour. This system could be activated manually from buttons local to the tanks and also from the control room.

61. The ship loading arrangements for ethylene were discussed. Ethylene is pumped from the storage tank, via a single pump, through a flow control valve, down the hill to the jetty. Loading arms at the jetty date to the construction of the terminal in the 1980's. The ethylene loading line from the storage tanks to the jetty is provided with a recycle (normally at 3 tonnes/ hr) to ensure the line to the remains cold while not loading a ship to ensure the line does not suffer adverse effects due to temperature cycling.

62. The company were able to describe the use of ship to shore checklists to assist communications. Emergency stop buttons are provided local to the jetty and a pendant emergency stop unit is on the ship during the unloading operation. Activation of the ESD system will stop the transfer pump and close the relevant valves.

63. The loading arm connection is subjected to a nitrogen pressure test to 8 bar(g) prior to commencing loading. This test includes both a time delay to check the pressure holds and a "soapy bubbles" check on the loading arm/ ship connection. The operator follows a sequence to open the relevant valves with communication between the outside operator and control room operator for the opening of various actuated valves.

64. The company described how loading is initially started at a low rate of 5 tonnes/ hr for the first 15 minutes of the transfer. A maximum transfer rate is agreed with the ship as part of the pre-transfer checks with the rate being ramped up after the initial low rate. The ship typically has a number of tanks and may swap between them during the loading operation. The ship should communicate to the shore any changes which may affect the flow conditions and vice versa.

65. At the completion of the transfer, the contents of the line are drained into an ethylene drum located below the main jetty head for recovery to the process and the loading arm purged with nitrogen to a vent stack prior to disconnection.

66. The jetty area had line of site gas detector across the front of the jetty head and was covered by deluge cannons, which could be directed from a control panel located at a distance back from the jetty.

67. The loading arm is provided with emergency release arrangements which would separate the arm from the ship in the event of an emergency. Position switches are located on the arm which would detect the ship moving away from the jetty. The arm was described as having sufficient flexibility to cope with normal tidal variation during loading.

68. The transfer is monitored by Briggs Marine personnel during the transfer, but ExxonMobil operators are present at the beginning and end of the transfer.

69. The company described how typically the export is via the same 3 – 4 ships sailing between Braefoot Bay and Antwerp.

70. The possibility of surge over pressure was discussed with the company and is covered in the discussion section of this report.

71. The C5+ stream is delivered to Braefoot Bay via road tankers and stored in a large internal floating roof storage tank. Export from the C5+ tank to ship takes place comparatively infrequently: 2 – 3 times per year. The tank is located in a large concrete bund.

72. The bund is provided with a foam system which can be activated both locally and from the control room. This would deploy foam onto both the surface of the bund and into the internal roof space of the tank.

73. The tanker unloading facilities were viewed. A small GRP enclosure (not fully sealed on all sides) is available for the tanker driver analogous with the Driver's office seen in Mossmorran. Again, a "dead man's handle" device was provided and this was the same type as seen at Mossmorran. Similar comments apply on how easy this would be to defeat.

74. The C5+ tank had high level alarms associated with 2 independent level probes – radar and "Enraf". There is no high level trip on the tank, however, the company described how the volume between high level alarm and overfill is significantly greater than the volume of one road tanker. The company therefore consider overfill unlikely.

75. During tanker unloading, vapour is recovered from the top of the bulk tank and routed to the road tanker. The unloading connections are a "Todo" dry break couplings.

76. The possibility of water collecting in the base of the C5+ tank was discussed – in relation to the potential hazards of hydrocarbon breakthrough when draining water from the base of the tank. In the past water accumulation was an issue and an enclosed drain point had been provided to allow draining from the base of the tank.

77. The company described how the transfer drum at Mossmorran had been modified to include a boot section for separating water, and this meant that little water now reached Braefoot Bay. The company described enclosed sampling in a "Dopak" sample unit which is used to confirm the absence of water.

78. Loading arrangements for the C5+ fraction to ship were similar, albeit, this operation is for a non-refrigerated liquid, and the loading operations are significantly less frequent.

Discussion and Conclusions:
[This section should focus on conclusions and compliance and risk gaps. Where appropriate make reference to the relevant Action reference number. Include other observations that may assist the operator's continuing compliance.]

General

79. This inspection, by its nature, covered a range of process safety "topics" at comparatively high level. The company clearly had a number of overarching safety management systems in place, driven in part by corporate philosophy and procedures, but also taking into consideration local factors.

Occupied Buildings – Mossmorran Tanker Drivers Building

80. The company had previously viewed the Drivers Office as an unoccupied building. Having visited the building, and seen messing, locker and toilet facilities this is questionable. Based on 2 – 3 transfers per day, this would also likely exceed the criteria of 2 hours in a 24 hour period from paragraph 2.7. of the CIA Occupied Buildings guidance.

81. Based on the company's drawings showing blast overpressure contours, the building appears to be outside the main hazard contours, which originate from the main process areas. However, there may be the possibility of pool fire or VCE originating from the tanker bay itself affecting the building and occupants. The company should review and confirm if the Drivers Office is an occupied building, and check if there is any risk associated to occupants of the building from the tanker bay by virtue of being present in the building. An Action Legal has been raised to cover this review.

Action 1: ER/EM/PS/130616/1

Occupied Buildings – Braefoot Bay Control Room

82. The company had identified a potential thermal effect on the Braefoot Bay control room as between 10 and 37.5 kW/m^2, in the event of a pool fire in the C5+ bund. The CIA guidance on Occupied Buildings identifies 10.0 kW/m^2 as causing "pain after 3 seconds of exposure" and 20.0 kW/m^2 as the point at which "wood ignites spontaneously after exposure". The guidance further defines 6.3 kW/m^2 as a "safe escape" level.

83. During the inspection, the company were asked if the control room had been designed to withstand the predicted thermal effects and if the philosophy were to "shelter in place" or to evacuate in such circumstances. This information wasn't immediately at hand at the time of the inspection.

84. The company should provide justification of the design intent of the Braefoot Bay control room on thermal events, and the philosophy in terms of either "shelter in place" or evacuation. An Action Legal has been raised to cover this.

Action 2: ER/EM/PS/130616/2

Mossmorran and Braefoot Bay – Tanker Operations

85. The company had determined that a dead man's handle was required for the tanker loading and unloading operations at Mossmorran and Braefoot Bay. Both units appear to be easy to defeat and the proximity to amenities at Mossmorran (i.e. kettle, toilet etc.), mean there is the potential for abuse.

86. In general terms, the CA would not expect a duty holder to take much credit for a system of this type. It would be expected that majority/ bulk of risk reduction measures would be engineered or robust procedural control, with the level of protection provided being proportional to the risk.

87. If the company feel that such controls are appropriate and worthwhile, it should consider replacing the current "foot peddle" type units with a unit less easy to defeat (i.e. a button on a shorter lead).

Surge protection – transfer operations

88. At Braefoot Bay, the company's neighbour has had issues with overpressure due to surge events. This has been on both Liquefied Natural Gases (LNG –C3's and C4's) and on a "gasoline" stream. This has resulted in the activation of a bursting disc system on the LNG lines and a release from the seals on swivel joints on a loading arm during gasoline unloading. The loading arms on the Exxon site appear to be of the same make and design, and of similar vintage to those on the neighbouring site.

89. There are clearly differences in the process design between the two sites including the provision of bulk storage for ethylene and C5+ at Braefoot Bay. This

would provide intermediate storage between the Mossmorran site and the ship loading operation, intermediate storage is not present on the neighbouring site. Differences also include the use of refrigerated storage and transport by Exxon.

90. Set against this, there is the design and age of the loading arm (which appears the same as those on the neighbouring site) and the "gasoline" stream being analogous to the C5+ stream.

91. Factors which could cause surge over pressure include: sudden closure of valves on the transfer line – the motorised valves on the pipeline are noted; sudden closure of valves on the ship – ship to shore transfer communications and specified closure time on ship board valves noted; and an activation of the ESD system.

92. The company had clearly considered this area to some extent. It was however not clear if all possible transfer operations had been considered by the company in terms of surge.

93. The company should therefore review the possibility of surge overpressure and confirm the risk of a release following an over pressure has been reduced to as low as reasonably practicable. Such a review should include points such as in the event of a valve being suddenly shut, the pressure will not exceed the design pressure of the process pipework, loading arm, and any ship born pipework. An Action Legal has been raised to cover this review.

Action 3: ER/EM/PS/130616/3

94. Transfer lines which should be considered include: ethylene Mossmorran to Braefoot; ethylene Braefoot storage to ship; ethylene recycle line jetty to tank; and C5+ transfer from Braefoot storage tank to ship.

Actions Legal

[Where appropriate Actions should be grouped e.g. by lifecycle phase etc. Each action must be numbered and state clearly what the operator must do to close the risk or compliance gap. The relevant regulations should be referenced, including any useful guidance that may assist the operator to comply with the law.]

Action 1: ER/EM/PS/130616/1

Occupied Building – Mossmorran Tanker Drivers Building

The company should review the tanker drivers building to confirm if this is an occupied building and to determine if there are any risks to personnel within the building from the nearby tanker loading operation by virtue of being in the building.

The company should report the findings of this review to the CA.

COMAH Regulation 5(1)
COMAH Regulation 5(2)
Target date: 01/06/17

Action 2: ER/CP/PS/140916/2

Occupied Buildings – Braefoot Bay Control Room

The company should review the design of the control room at Braefoot bay, to determine if it will provide protection to staff within against the predicted thermal radiation contours in the event of a pool fire at the C5+ bund.

The company should confirm if the philosophy in the event of fire at the C5+ tank is to shelter in place within the control room or to evacuate.

The company should report the findings of this review to the CA.

COMAH Regulation 5(1)
COMAH Regulation 5(2)
Target date: 01/06/17

Action 3: ER/CP/PS/140916/3

Surge Protection

The company should review whether surge overpressure is an issue on the ethylene and C5+ transfer lines. This should include consideration if credible surge over pressure events cannot exceed the design pressure of the pipework and loading arms.

This should include: ethylene Mossmorran to Braefoot; ethylene Braefoot storage to ship; ethylene recycle line jetty to tank; and C5+ transfer from Braefoot storage tank to ship.

The company should report the outcome of this review to the CA.

COMAH Regulation 5(1)
COMAH Regulation 5(2)
Target date: 01/06/17

References

1. L111 "The Control of Major Accident Hazards Regulations 2015. Guidance on Regulation". (3rd Edition, 2015).

2. L138: "Dangerous Substances and Explosive Atmospheres Regulations 2002. Approved Code of Practice and guidance". (2nd Edition 2013).

3. IEC 61511: "Functional safety —Safety instrumented systems for the process industry sector". (2nd Edition 2015).

4. CIA Guidance: "Guidance for the location and design of occupied buildings on chemical manufacturing sites". 3rd Edition. 2010.