COMAH Land Use Planning Assessment for Tynagh OCGT North

***Prepared for*:**

Gravis Planning

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Contents

1 INTRODUCTION

EP Energy Developments Ltd. is progressing the development of a new open cycle gas turbine (OCGT) at Tynagh. This proposed development involves a modification to an establishment – Tynagh Power Station – that falls within the scope of the *Chemicals Act (Control of Major Accident Hazards Involving Dangerous Substances) Regulations*, 2015 (the COMAH Regulations). A previously consented OCGT (refer to Section 6.5.2) was assessed in a separate report (document ref. 578-22X0044).

To support the project, Gravis Planning (agent for the application) requested Byrne Ó Cléirigh to conduct a COMAH land use planning assessment of the development. The purpose of the assessment is to examine the development in the context of the Health and Safety Authority's COMAH land use planning guidance. This report describes our assessment of the development and our conclusions on the levels of individual risk and societal risk presented by the development, and on the risks to the development from the existing COMAH establishments in the vicinity.

2 TYNAGH OCGT NORTH FACILITY

The proposed development relates to installation of:

- OCGT plant, including above- and below-ground high pressure gas pipelines
- above ground installation (AGI)
- acoustic barriers
- secondary fuel storage (24 m diameter, 15.6 m high bulk storage tank) and unloading facility
- distillate fuel gantry
- water storage tanks
- surface water drainage system
- all associated ancillary development, site works and services

The major accident scenarios associated with flammable substances (i.e. distillate fuel oil and natural gas) are discussed in Section 6.

The project will require a connection to the existing subsurface high pressure gas pipeline located to the west of the development, upgrades to the existing electricity substation and associated connections. Given the major accident hazard potential associated with these installations, we also consider these within our assessment.

The proposed plant will be required under the Eirgrid *Grid Code* to maintain a secondary fuel supply of approximately 6,600 m^3 (5,400 tonne) of back up fuel (distillate or hydrotreated vegetable oil) which will be contained in a tank within a bunded area. Based on the proposed natural gas pipeline dimensions, lengths and pressures, the pipelines are capable of storing up to 0.4 tonnes of gas.

The proposed site layout drawing is included in Appendix 1.

3 Planning Context

3.1 Galway County Council Development Plan

In accordance with the Planning and Development Act, 2000, as amended, Galway County Council (GCC) has prepared the latest version of its development plan: *Galway County Development Plan 2022-2028*. Section 7.9.5 of the plan provides a summary of the COMAH legislative regime and the role of the Health and Safety Authority (HSA) in providing advice to planning authorities:

GCC sets out its policy regarding developments of establishments that fall within the scope of the COMAH Regulations, and developments near such establishments:

> *All development proposals involving existing or proposed facilities classified under the* [COMAH] *Directive will be referred to the Health and Safety Authority whose technical advice shall be taken into account in addition to any normal planning considerations*

3.2 Planning & Development Regulations

Part 11 of the Planning and Development Regulations, as amended, sets out the requirements for planning applications relating to developments subject to the COMAH legislation. Section 137(1) requires that a planning authority notifies the HSA where:

> *(a) a planning authority receives a planning application relating to the provision of, or modifications to, an establishment, and, in the authority's opinion, the development would be relevant to the risk or consequences of a major accident,*
>
> *(c) a planning authority receives a planning application relating to development which would, in its opinion, be –*
>
> > *(i) in the vicinity of an* [COMAH] *establishment, and*
> >
> > *(ii) relevant to the risk or consequences of a major accident,*
>
> *and the Health and Safety Authority has not previously provided, either in relation to the development to which the application relates or on a generic basis, relevant technical advice on the risk or consequences of a major accident.*

As the site is proposing to store 5,400 tonnes of distillate fuel oil, and is part of the proposed expansion of the Tynagh Energy Ltd. establishment – a power generating station which utilises a close cycle gas turbine (CCGT) – along with the consented southern open cycle gas turbine (OCGT) development, in our opinion the development may fall within the scope of the criteria set out in 137(1)(a) and/or 137(1)(c) of the Planning and Development Regulations.

3.3 COMAH Regulations

The COMAH Regulations place an obligation on operators of establishments that store, handle, or process dangerous substances above certain thresholds to take all necessary measures to prevent major accidents and to limit the consequences for human health and the environment. Under the Regulations, an establishment may qualify as upper tier or lower tier, depending on the inventory of dangerous substances; sites that store, handle, or process dangerous substances below a certain threshold do not qualify as establishments.

The types of dangerous substance that contribute to an establishment's inventory include flammable substances (such as liquefied petroleum gas, gasoline / petrol, kerosene, gas oil and certain solvents), toxic substances, and substances that are hazardous to the aquatic environment.

The types of establishment that may fall within the scope of the Regulations (depending on their inventories) include oil storage & distribution sites, LNG storage, LPG storage & distribution sites, pharmaceutical plants, and sites that manufacture and / or store certain types of fertiliser.

Under Part 7 of the Regulations, the HSA, as the Central Competent Authority, can provide technical advice to a planning authority on developments of COMAH establishments, as follows:

> *24(2) The Central Competent Authority shall provide technical advice in response to a notice sent by a planning authority under Part 11 of the Planning and Development Regulations 2001 (SI No. 600 of 2001), requesting technical advice on the effects of a proposed development on the risk or consequences of a major accident in relation to the following types of developments…*
>
> > *(a) the siting and development of new establishments*
> >
> > *(b) modifications to establishments of the type described in Regulation 12(1)*
> >
> > *(c) new developments including transport routes, locations of public use and residential areas in the vicinity of establishments, where the siting, modifications or developments may be the source of, or increase the risk or consequences of, a major accident.*

Therefore, in our opinion the proposed development at Tynagh may fall within the scope of the criteria set out in 24(2)(b) of the COMAH Regulations.

3.4 Summary

Based on our examination of the proposed development, the *Galway County Development* Plan, and the requirements of both the *Planning and Development Regulations* and the *COMAH Regulations*, we understand that An Bord Pleanála (ABP) will request advice from the HSA in its consideration of the planning application. To assist ABP and the HSA in their consideration of the proposed development, BÓC has carried out this COMAH land use planning assessment of the development in accordance with the HSA's *Guidance on technical land-use planning advice*.

4 Assessment Methodology

4.1 Guidance on Land Use Planning

The HSA has set out its policy and approach to conducting technical land use planning assessments in its guidance[1], and this assessment has been carried out in accordance with the guidance. The HSA's guidance sets out how it develops technical land-use planning advice, and for each type of sector it describes the nature of the (potential) major accidents to be considered, the approach to estimating the likelihood of those accidents, and the criteria for determining whether the corresponding risk satisfies the HSA's individual risk and societal risk criteria.

4.2 Assessment Criteria

4.2.1 Individual Risk

The level of individual risk is assessed using a three-zone traffic light system shown in Table 1.

Table 1: Risk Based Contour Zones for Individual Risk

Zone	Risk of fatality per year		
Inner	1×10^{-5}	1 in 100,000	0.001%
Middle	1×10^{-6}	1 in 1 million	0.0001%
Outer	1×10^{-7}	1 in 10 million	0.00001%

The HSA provides its advice to planning authorities in the form that it 'advises against' or 'does not advise against' a development depending on which zone (from Table 1) the development lies within, as shown in Table 2 (a tick indicating 'do not advise against' and a cross indicating 'advise against').

Table 2: HSA Matrix for Land Use Planning Advice

Sensitivity Level	Individual Risk Zone (refer to Table 1)		
	Inner Zone	Middle Zone	Outer Zone
Level 1	✓	✓	✓
Level 2	×	✓	✓
Level 3	×	×	✓
Level 4	×	×	×

[1] *Guidance on technical land-use planning advice – For planning authorities and COMAH establishment operators* (2023)

4.2.2 Societal Risk

4.2.2.1 Overview

Societal risk is a measure of the risk of large numbers of people being affected in a single accident. The HSA's guidance notes that:

> *…The advice matrix* [Table 2] *takes account, to a degree, of group risk and the varied receptor sensitivities. It is applicable for the specified developments … that are located near a single COMAH establishment, and where the existing societal risk is well within the tolerable limit. However, there are times when the risk of multiple fatalities from an accident – societal risk – should be taken into account more explicitly. For example, this may include where an application relates to a proposed significant off-site population density, or where there is already a significant population residing/working within the risk zone, or where the risk is emanating from more than one establishment.*

There are several metrics that can be applied to estimate and assess societal risk; the two approaches described in the HSA's guidance are:

- The Expectation Value (see Section 4.2.2.2)
- the FN curve (see Section 4.2.2.3)

4.2.2.2 Expectation Value

The Expectation Value (EV) is the product of the frequency of an accident (expressed in 'chances per million') and the number of people exposed to lethal effects as a result of that accident. The HSA's guidance sets out several criteria for assessing the EV:

- between 100 and 10,000: it should be demonstrated that all practicable efforts have been made to reduce the risk to a level that is as low as reasonably practicable
- greater than 10,000: should not be exceeded; if the EV exceeds 10,000, the TLUP advice to the planning authority will always be 'advise against'
- developmental EV value is greater than 450: an FN curve will be required as part of the demonstration that all practicable efforts have been made to reduce the risk to a level that is as low as reasonably practicable.
- greater than 2,000: for new developments near an establishment further assessment of societal risk will be required and the creation of an FN curve and calculation of the total EV will be necessary.

4.2.2.3 FN-Curve

An FN curve shows the relationship between the frequency of an outcome and the cumulative severity of the outcome, typically plotted on a log-log scale to account for the range of values for both the frequency of occurrence and the severity of the outcome. It can take one of two forms[2]:

1. Non-cumulative frequency basis: for these graphs, called f-N curves (lower case 'f'), the value plotted on the y-axis is the discrete frequency of experiencing exactly N fatalities.

[2] *Guidelines for Developing Quantitative Safety Risk Criteria*, Centre for Chemical Process Safety, 2009

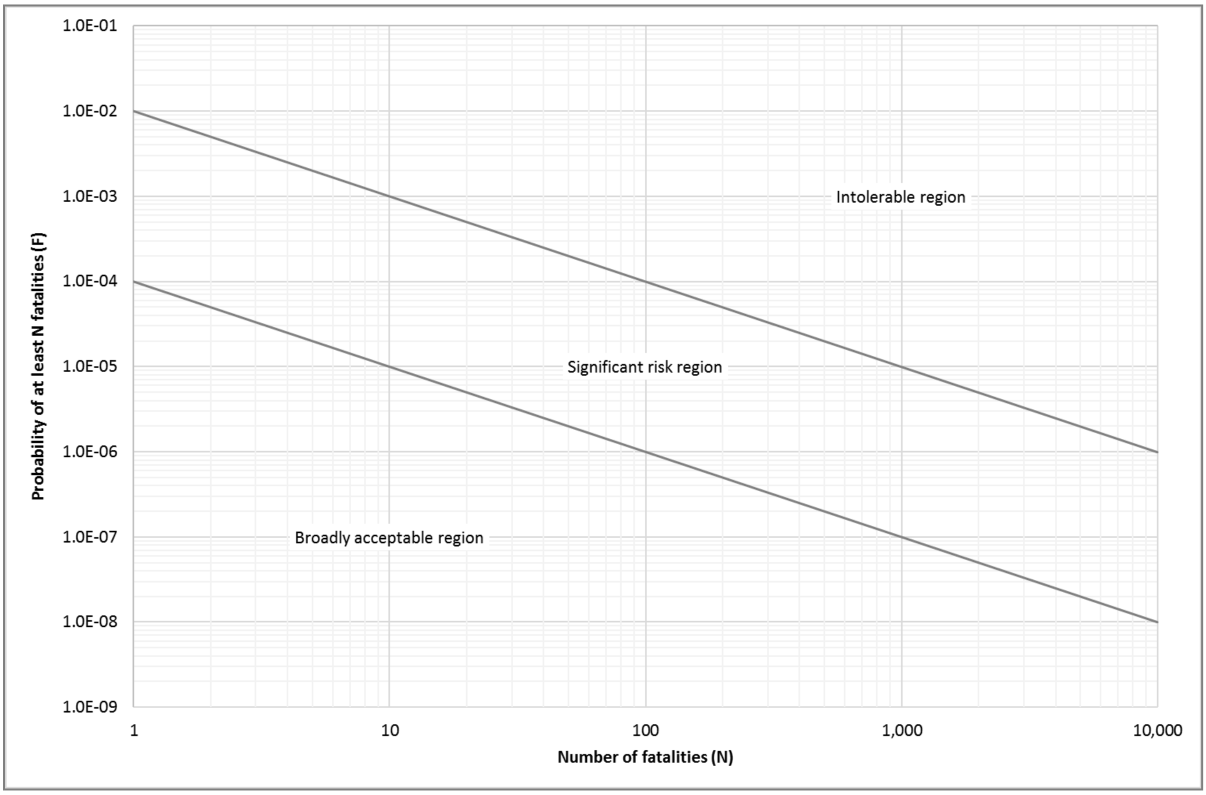
2. Cumulative frequency basis: for these graphs, called F-N curves (upper case 'F'), the value plotted on the y-axis is the cumulative frequency of experiencing N or more fatalities.

When assessing whether the level of societal risk may be regarded as tolerable, it is necessary to select appropriate criteria. In its guidance, the HSA identifies two criterion lines for FN (cumulative frequency) curves:

- an upper criterion of 1 in 5,000 for 50 fatalities
- a lower criterion line of 1 in 100,000 for 10 fatalities

Figure 1 shows the general format of an FN curve, with the number of (potential) fatalities, *N*, on the x-axis and the probability of at least *N* fatalities on the y-axis, *F*, together with the two criterion lines.

Figure 1: Criterion Lines for FN Curves



The area above the upper criterion is considered to be the intolerable region and the area below the lower criterion line is considered to be the broadly acceptable region. The area between the two lines is generally considered to be the ALARP region, where the risk may be considered to be 'tolerable' provided that it is As Low As Reasonably Practicable (ALARP)[3].

[3] The UK HSE comments on the use of the terms so far as is reasonably practicable (SFAIRP) and as low as reasonably practicable (ALARP). It notes that SFAIRP is most often used in the context of workplace health and safety legislation and that ALARP is used by risk specialists. The HSE uses the term ALARP in its COMAH guidance and, in its view, considers that the two terms are (generally) interchangeable.

4.3 Development Sensitivity Levels

The HSA provides advice to the planning authorities under the COMAH Regulations using a similar system to that applied by the UK HSE, as described in the UK HSE's *Land Use Planning Methodology*. Different types of development are broadly categorised under one of four sensitivity levels:

- Level 1: people at work, parking (workplaces and parking areas)
- Level 2: developments for use by the general public (housing, hotel / hostel / holiday accommodation, transport links, indoor use by the public, outdoor use by the public)
- Level 3: developments for use by vulnerable people (institutional accommodation and education, prisons)
- Level 4: very large and sensitive developments (institutional accommodation, very large outdoor use by the public)

Table 3 provides a summary of the sensitivity levels and examples of the types of development for each.

Table 3: Summary of development types for Land Use Planning Zones

Zone	Type	Description / Examples
Inner	Workplaces	Workplaces (non-retail) for less than 100 occupants in any building **and** fewer than three occupied storeys
	Parking area	Parking facilities (car park, truck park) with no other associated facilities (other than toilets)
	Estate & access roads	Single carriageway roads
	Members of the public not normally present, or present in small numbers & for a short time	Developments for **indoor** use by the public where total floor space is **less than 250 m^2** (e.g. restaurants and cafés, shops, petrol filling stations, coach / bus stations, ferry terminals)
Middle	Large workplaces	Workplaces (predominantly non-retail) providing for more than 100 occupants in any building, **or** three or more occupied storeys in height
	Transport links	Major transport links (e.g. motorway, dual carriageway)
	Indoor & outdoor areas for use by the general public	Developments for **indoor** use by the general public where total floor space is from 250 m^2 up to 5,000 m^2)
		Principally an **outdoor** development for use by the general public, i.e. developments where people will predominantly be outdoors and not more than 100 people will gather at the facility at any one time
Outer	Large developments for use by the general public	Developments for indoor use by the public where total floor space is greater than 5,000 m^2
		Predominantly open-air developments likely to attract the general public in numbers greater than 100 people, but up to 1,000 people at any one time
	Developments for use by vulnerable people	Institutional, educational and special accommodation for vulnerable people, or that provides a protective environment
Outside all zones	Very large outdoor use by the general public	Predominantly open-air developments where there could be more than 1,000 people present

5 Ambient Conditions

5.1 Meteorological Data

The impacts from major accidents scenarios depend on the meteorological conditions. For fire events, the consequences have been assessed under two wind speeds:

- a 'low' wind speed of 5 m/s
- a 'high' wind speed of 10 m/s

The impacts from other scenarios, such as flash fires and vapour cloud explosions, depend on both wind speed and atmospheric stability. These events have been assessed under two meteorological conditions:

- Typical conditions (D5): a wind speed of 5 m/s and a Pasquill stability class of D, assumed to occur 80% of the time
- Calm conditions (F2): a wind speed of 2 m/s and a Pasquill stability class of F, assumed to occur 20% of the time

The closest meteorological station to the Tynagh Facility, with detailed data relevant to assessing the consequences of major accident scenarios (temperature, wind direction & speed, humidity) is at Athenry. The meteorological data used in this assessment, based on the most recent five-year average (2018-2022), is summarised in Table 4 and Table 5, and shown in Figure 2.

Table 4: Meteorological data for Athenry meteorological station

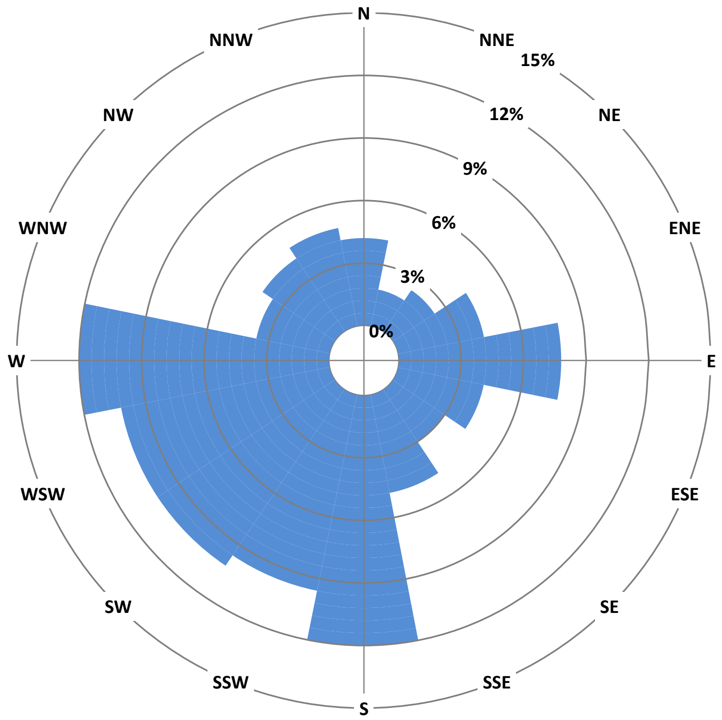
Year	Temperature (°C)	Humidity (%)
2018 – 2022	10.2	83.0

Table 5: Frequency of wind speeds

Wind speed	Frequency (%)
0 – 2.5 m/s	28.4
2–5 - 5 m/s	46.7
–5 - 10 m/s	24.2
> 10 m/s	0.6

The data in Table 5 shows that the wind speed is less than 5 m/s approximately 75.2% of the time, and is greater than 5 m/s approximately 24.8% of the time; these frequencies have been applied to the 'low' and 'high' wind speeds for assessing the impacts from fire events.

Figure 2: Wind Rose for Athenry meteorological station (2018 – 2022)



5.2 Surface Roughness

The dispersion of a flammable cloud is determined, in part, by the roughness of the surrounding land. Table 6 shows the range of surface roughness lengths values that can generally be applied in consequence modelling. The roughness length is an artificial length-scale describing the wind speed over a surface, which characterises the roughness of the surface.

Table 6: Surface roughness

Number	Roughness length	Description
1	0.0002 m	Open water, at least 5 km
2	0.005 m	Mud flats, snow, no vegetation
3	0.03 m	Open flat terrain, grass, few isolated objects
4	0.1 m	Low crops, occasional large obstacles, x/h > 20
5	0.25 m	High crops, scattered large objects, 15 < x/h < 20
6	0.5 m	Parkland, bushes, numerous obstacles, x/h < 15
7	1.0 m	Regular large obstacles coverage (suburb, forest)
8	3.0 m	City centre with high- and low rising buildings

For this assessment, the land surrounding the Tynagh facility is considered to be equivalent to *low crops, occasional large obstacles*, with a corresponding roughness length of 0.1 m.

6 Major Accident Scenarios

6.1 Overview

The HSA's guidance advises that it is the policy of the Authority for a simplified application of a risk-based approach as the most appropriate for land use planning. The difficulties associated with the complexity of analysing many scenarios can be avoided by considering a small number of carefully chosen representative events, whose frequency has been estimated conservatively.

The HSA's guidance sets out the types of major accident scenario to be considered as part of a COMAH land use planning assessment for the different types of establishment. For a site that stores flammable liquids (including petroleum products), the HSA's guidance identifies the corresponding loss of containment (LOC) scenarios and the relevant end events to be considered. In addition, the guidance sets out the approach to be taken for establishments where there is a significant major accident risk associated with releases from on-site natural gas pipelines.

- Natural gas

  For establishments with underground or overground natural gas pipelines, pipeline rupture and pipeline leak scenarios need to be considered, according to the HSA's guidance. Although there is no storage of gas associated with the development, the gas supply presents a major accident hazard and is included in the scope of the assessment. The consequences associated with these loss of containment events are jet fires, flash fires, and vapour cloud explosions (VCEs).

  Further to a request from the HSA to An Bord Pleanála (ref: PAR 4169, 2nd October 2023), we have included a VCE event in a gas turbine enclosure at the OCGT.

  The major accident scenarios associated with natural gas installations are discussed in detail in 6.3.

- Flammable liquids (including petroleum products)

  There are several loss of containment scenarios identified in the HSA's guidance for establishments which store petroleum products in bulk tanks. The consequences associated with these loss of containment events are pool fires. The likelihood of this end event occurring is dependent on the ignition category which the substance falls under, which is a function of its flash and boiling point. The major accident scenarios associated with distillate oil storage is discussed in detail in Section 6.4.

Because of the proximity of the proposed development to the existing CCGT power station and the consented Tynagh South OCGT, we have also included consideration of the potential for escalation effects between the sites as part of this assessment (discussed in detail in Section 6.5).

6.2 Consequence Modelling Software

The consequences from each of the hazardous events –thermal radiation and overpressures – have been determined using the GEXCON EFFECTS modelling software (version 12.0.01).

6.3 Natural Gas Supply

6.3.1 Loss of Containment Events

6.3.1.1 Pipelines

The proposed development includes 257 m of below ground natural gas pipelines between the AGI and the OCGT (at 30 bar pressure). In addition, we also consider potential additional high pressure pipework (up to 75 bar) connection between the existing subsurface high pressure gas pipeline to the west of the site and the proposed AGI (refer to Section 2), and at the AGI. The diameter of the proposed natural gas pipelines is 250 mm.

For establishments with underground or overground natural gas pipelines, the guidance identifies two broad loss of containment events:

1. a pipeline rupture, and
2. a leak from a pipeline where the diameter of the opening is 10% of the line diameter, e.g., a 25 mm diameter opening in the 250 mm diameter line.

The consequences associated with these loss of containment events are jet fires, flash fires, and vapour cloud explosions (VCEs). The loss of containment events, consequences and probabilities set out in the HSA's guidance are set out in Table 7 for natural gas.

Table 7: Major accident scenarios for natural gas pipelines within an establishment

Scenario	Frequency (per metre per annum)			HSA reference
	Ø < 75 mm	75 mm ≤ Ø ≥ 150 mm	Ø > 150 mm	
Pipeline rupture	1×10^{-6}	3×10^{-7}	1×10^{-7}	87
Pipeline leak of 0.1 Ø (max. 50 mm)	5×10^{-6}	2×10^{-6}	5×10^{-7}	88
Note 1: An order of magnitude reduction is applied for underground pipe sections. Note 2: The conditional probabilities for a flammable gas release from a pipeline are as follows: • Fireball / jet fire = 0.1 • Flash fire = 0.36 • Vapour cloud explosion = 0.54				

The modelling results for these events are set out in Section 6.3.3.

6.3.1.2 Gas Turbine Enclosure

The proposed development includes a gas turbine enclosure with the following dimensions: 17.4 m length, 10.17 m width and 6.85 m height. For the purposes of modelling, we have assumed that the entire volume of the turbine closure is available for natural gas accumulation.

Based on the dimensions of the enclosure, this equates to a volume of 1,212 m^3. This volume of air comprises 255 m^3 of oxygen. Applying stoichiometry, this volume of oxygen can react with 90.86 kg of natural gas. This is a conservative assessment as it does not reduce available air in the room to account for the volume displaced by the turbine equipment. The impacts of an explosion of this quantity of gas is modelled using the Multi-Energy Model, as described in Section 6.3.3.

For the purposes of this assessment, we have assumed that a release from a turbine is comparable to a release from a process vessel. The loss of containment events and associated probabilities set out in the HSA's guidance are set out in Table 8 for process vessels.

Table 8: Major accident scenarios for process vessels

Installation type	Scenario	Loss of containment frequency (per annum)	HSA reference
Process vessel (HSA §3.9.1.2)	Instantaneous failure	5×10^{-6}	181
	Failure over 10 minutes	1×10^{-5}	182
	10 mm pipeline leak over 30 minutes	5×10^{-4}	183

We have conservatively assumed that full accumulation of natural gas in the turbine hall can occur following an instantaneous failure or a failure over 10 minutes. Therefore, the probability of this event occurring is 1.5×10^{-5} per year.

We have also conservatively assumed an ignition probability of 100% for the VCE event.

6.3.2 General model inputs

We have modelled the consequences for a variety of jet fire, flash fire and VCE scenarios as methane in the EFFECTS model. Meteorological conditions are set out in Section 5.1. Full ruptures are modelled using the diameter of the pipeline (250 mm); leaks are modelled using 10% of the pipeline diameter (25 mm).

A pipeline roughness of 0.045 mm (commercial steel, wrought iron) was used, and we have conservatively modelled 'rounded edges' for hole rounding.

Depending on the section of pipeline being modelled, an initial (absolute) pressure of 30 bar or 75 bar was used.

6.3.3 Consequence Modelling Results

6.3.3.1 Jet Fire

Under the HSA's guidance, jet fires are modelled as vertical releases, with the receptor assumed to be downwind of the release. Further to a request from the HSA to An Bord Pleanála (ref: PAR 4169, 2nd October 2023), we have also modelled jet fires as horizontal releases. A 50% likelihood has been assigned to either event (horizontal jet fire or vertical jet fire) occurring.

The consequence modelling results are summarised in Table 9 for vertical releases and Table 10 for horizontal releases. The model results show the impacts for a guillotine failure and for a leak.

Table 9: Consequence modelling for jet fire scenarios (vertical release)

Endpoint (kW/m²)	Distance to Endpoint (m)							
	Guillotine failure (30 bar)		Leak (30 bar)		Guillotine failure (75 bar)		Leak (75 bar)	
	D5	F2	D5	F2	D5	F2	D5	F2
25.6	-	28.8	2.6	0.5	-	58.8	2.8	-
12.7	61.7	69.6	6.0	0.5	86.6	111.0	8.6	4.3
6.3	98.7	104.2	9.3	7.4	142.2	162.3	13.6	11.4
4	126.7	130.6	11.8	10.4	183.5	200.5	17.2	15.7

Table 10: Consequence modelling for jet fire scenarios (horizontal release)

Endpoint (kW/m²)	Distance to Endpoint (m)							
	Guillotine failure (30 bar)		Leak (30 bar)		Guillotine failure (75 bar)		Leak (75 bar)	
	D5	F2	D5	F2	D5	F2	D5	F2
25.6	188.9	229.0	16.7	20.7	288.2	348.8	24.5	30.1
12.7	207.2	247.1	18.3	22.2	316.7	376.6	26.8	32.4
6.3	231.8	270.6	20.4	24.3	355.3	413.5	29.8	35.3
4	252.6	290.3	22.1	26.0	387.6	444.1	32.3	37.8

6.3.3.2 Flash Fire

In the event of a release of gas, where the release is not ignited directly, this can result in the formation of a flammable gas-air mixture. Subsequent ignition of this release can give rise to a flash fire or to a VCE.

The size of the resulting cloud is dependent on the characteristics of the release (release rate, gas properties) and on the surrounding conditions, such weather conditions at the time of release. We have modelled the impacts of these scenarios using the two weather conditions set out in Section 5.1.

The consequences of a flash fire are treated as follows:

- For people outdoors, fatality levels of 100% are assumed inside the Lower Flammable Limit (LFL) envelope, with 0% fatalities outside that envelope.
- Indoor fatality levels are conservatively assumed to be 10% within the flash fire envelope.

For each scenario we calculated the size of the flammable cloud and how this cloud varies with distance from the release point. The modelled maximum distance to flammable concentration was used to determine the hazard distances. The maximum area and length of the flammable cloud for the pipeline guillotine and leak flash fire scenarios are set out in Table 12.

Table 11: Consequence modelling for flash fire scenarios

Parameter	Guillotine failure (30 bar)		Leak (30 bar)		Guillotine failure (75 bar)		Leak (75 bar)	
	D5	F2	D5	F2	D5	F2	D5	F2
Maximum area of flammable cloud (m^2)	707	643	9	6	1,201	1,093	23	13
Max length of flammable cloud (m)	45	32	6	3	71	54	10	4

The results show the impacts for the guillotine and leak failure events in D5 and in F2 weather conditions. The flash fire hazard distances are much less significant for the leak events.

6.3.3.3 Vapour Cloud Explosion (VCE)

Pipelines

In the case of delayed ignition giving rise to a VCE, the consequences are associated with the generation of overpressures, which can result in damage to the surrounding area. As with the flash fire scenario, the release is modelled in D5 and in F2 conditions. The mass of gas within the flammable mixture is calculated in each case. The impacts of an explosion are calculated using the TNO multi-energy method to determine overpressure levels in a VCE: 20% of the stoichiometric cloud volume is assumed to be in the congested area (where the ignition is assumed to occur) and the scenario is assigned strength 7, in accordance with the HSA's guidance.

The consequence modelling results for the pipeline guillotine and leak VCE scenarios are set out in Table 12.

Table 12: Consequence modelling for VCE scenarios

Endpoint (mbar)	Distance to Endpoint (m)							
	Guillotine failure (30 bar)		Leak (30 bar)		Guillotine failure (75 bar)		Leak (75 bar)	
	D5	F2	D5	F2	D5	F2	D5	F2
600	29.5	34.2	2.6	2.9	42.9	48.5	4.0	4.0
140	79.0	91.8	7.0	7.7	115.0	130.0	10.8	10.8
70	137.2	159.4	12.2	13.4	199.9	225.9	18.8	18.8
30	291.1	338.3	25.8	28.4	424.1	479.3	39.8	39.8

The results show the impacts for the guillotine and leak failure events in D5 and in F2 weather conditions. The maximum hazard distances are much less significant for the leak events.

Gas turbine enclosure

The TNO multi-energy method was used to determine overpressure levels in the VCE. We conservatively assumed that 100% of the stoichiometric cloud volume is in the congested area (where the ignition is assumed to occur) and the scenario is assigned strength 10, to account for the degree of confinement and congestion within the enclosure.

The consequence modelling results for the VCE scenario at the gas turbine hall are set out in Table 13.

Table 13: Consequence modelling for VCE scenario at gas turbine hall

Endpoint (mbar)	Distance to Endpoint (m)
600	32.4
140	80.5
70	139.8
30	296.6

The results show that the consequences of this event are less significant than some of the pipeline release scenarios, e.g. a full rupture of the 75 bar natural gas pipeline.

6.4 Distillate Fuel Storage

6.4.1 Loss of Containment Events

The HSA guidance notes that the fire hazard associated with distillate fuel storage is low. Distillate fuel is a Class III petroleum product with a high flash point (>55°C) and so is equivalent to an ignition category 3 substance, i.e., it presents a very low fire hazard.

HSA guidance advises that the risk of a fire associated with distillate fuel storage can effectively be eliminated, provided that there are appropriate controls to protect against a release escaping off site. This means that, if the site is designed with appropriate secondary containment (bunding), together with tertiary containment to retain any material that could overtop the bund wall in the event of catastrophic tank failure, then the risk of a fire following a release of distillate fuel is negligible. As such it is important for the proposed development that there are appropriate controls to protect against this scenario.

The ignition probabilities for ignition category 3 substances are therefore zero, and fire and explosion events are not considered credible unless:

- they are located in the same bund as lower category (category 0, 1 or 2) substances, or
- there are no other flammable substances on the site, or in the vicinity, close enough to initiate a major accident, or
- an ignition category 3 substance overtops a bund and is released *outside* the establishment, in which case it is conservatively assumed that it could ignite (as a pool fire) in the absence of the control measures (the controls on ignition sources) within the establishment boundary.

In the case of the proposed development, based on the proximity of the tank farm to the AGI to the south-west, scenarios involving a bund fire or an overtopping fire are considered credible, albeit extremely remote. To ensure that a conservative approach was adopted, the contents of the tanks have been treated as if they were ignition category 2.

The loss of containment events set out in the HSA's guidance for ignition category 2 flammable liquids are set out in Table 14.

Table 14: Major accident scenarios for ignition category 2 flammable liquids

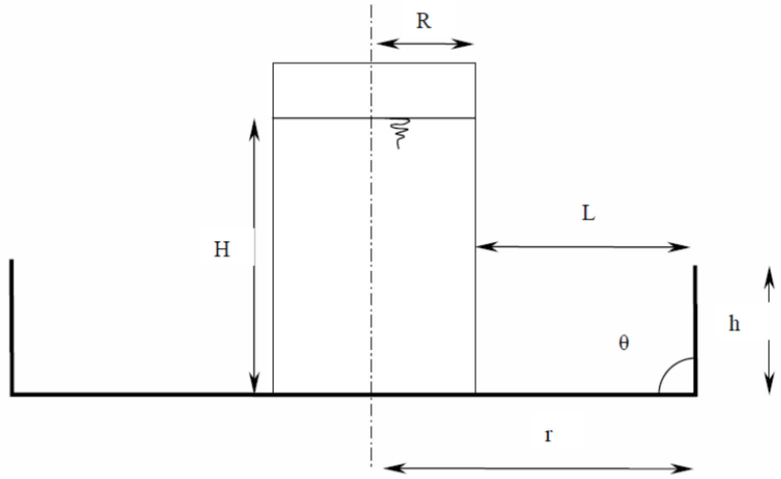
Installation type	Scenario	Loss of containment frequency (per annum)	Consequence	Ignition frequency (per annum)	HSA reference
Ignition category 2 substances and mixtures (Class II & III) (HSA §3.6.3)	Instantaneous failure	5×10^{-6}	Pool fire	5×10^{-8}	123
	Failure over 10 minutes	5×10^{-6}		5×10^{-8}	125
	10 mm pipeline leak over 30 minutes	1×10^{-4}		1×10^{-6}	127

The probability of an overtopping pool fire is 5×10^{-8} per year.

6.4.2 Bund Overtopping

In the event of catastrophic tank failure, the quantity that could escape the bund as a result of bund overtopping is dependent on the tank and bund dimensions. The key dimensions are illustrated in Figure 3.

Figure 3: Key Tank and Bund dimensions for calculation of bund overtopping



The OVERTOP routine is summarised using the following correlation, which has been derived by Liverpool John Moores University (LJMU) on behalf of the UK HSE as a best-fit to a range of laboratory scale tests.

$$\text{Overtopping Fraction} = 1.0255 - 0.1886\,(r/H) - 2.9951\,(h/H) + 0.3842\,(R/H) + 0.0140\,(r/H)^2 + 2.7535\,(h/H)^2 - 0.0637\,(R/H)^2 - 0.0005\,(r/H)^3 - 0.8595\,(h/H)^3$$

The equation calculates the amount of material that could overtop the bund wall based on worst case conditions, i.e., that the tank is full at the time, failure is instantaneous, and the direction of failure is such that the released material impacts the closest bund wall at right angles.

The overtopping fraction is therefore dependent on a variety of ratios relating to the tank and to the bund dimensions, the most significant of which is the ratio of the bund height to the liquid level in the tank (h/H).

The tank farm configuration and layout will be finalised at the detailed design phase. We have conducted our overtopping assessment based on the proposed site arrangement of a single tank, each with a diameter of 24 m and a maximum fill height of 14.6 m, located in a single bund (45 m x 45 m) with a vertical bund wall 4.5 m in height. The distillate fuel bund has been sized to retain in excess of 110% of the tank contents, in accordance with good practice. We have calculated the overtopping fraction as a result of catastrophic failure of one of the storage tanks in Table 15.

Table 15: Bund overtopping calculation following catastrophic distillate fuel tank failure

Parameter	Value
Liquid level in tank (H)	14.6 m
Tank Radius (R)	12 m
Bund Height (h)	4.5 m
Distance from tank wall to bund wall	10.5 m
Overtopping Fraction	35.2%
Overtopping Volume	2,327 m^3

The results indicate that ~35% of the tank contents, or 2,327 m^3, could overtop the bund wall in the event of catastrophic tank failure. As noted above, the HSA's guidance advises that tertiary containment can be used to protect against an overtopping release from escaping offsite. The site will be designed so that the area surrounding the distillate fuel bund will act as a tertiary containment area and will be sized appropriately to retain a value of 110% of the maximum overtopping fraction at a minimum. A major unbunded release would be collected in the site drainage system.

With this arrangement in place, the risk of a major release escaping off site as a result of catastrophic failure of a distillate fuel tank will be mitigated and the risk of a major fire as a result of a release of distillate fuel off site is negligible.

6.4.3 Model inputs

We have modelled the consequences for a variety of pool fire scenarios as gasoline in the EFFECTS model. Meteorological conditions are set out in Section 5.1; the dimensions of the bund are detailed in Section 2.

6.4.4 Consequence Modelling Results

The modelling results for these fire events are shown in Table 16.

Table 16: Consequence modelling for pool fires at distillate fuel tank farm

Endpoint (kW/m^2)	Distance to Endpoint (m) Note 1					
	Instantaneous Failure (Overtopping Pool Fire) Note 2		Failure Over 10 Minutes (Bunded Pool Fire)		10 mm Pipeline Leak Over 30 minutes (Bunded Pool Fire)	
25.6	71.6	70.8	43.9	46.4	6.3	6.9
12.7	94.1	103.3	57.5	61.8	8.6	9.5
6.3	129.2	142.6	78.4	81.7	11.3	11.8
4	157.3	170.5	94.2	96.0	13.1	13.3

Note 1: The distances are expressed as distances from the centre of the pool in each case.

Note 2: Notwithstanding the overtopping calculations shown in Table 15, the HSA's land use planning guidance advises that the overtop pool size is based on site conditions and modelling parameters, but the pool diameter modelled is never greater than 100 m.

6.5 Escalation Effects

6.5.1 Tynagh Energy Ltd. CCGT Power Station

The proposed development would represent an expansion of the Tynagh Energy Limited CCGT power station, which generates electricity for export to the national grid. This site qualifies as a lower tier site under the COMAH Regulations. As a lower tier COMAH site, a Hazard Identification (HAZID) exercise was undertaken to identify the major accident scenarios for the site, with consequence modelling and risk assessment carried out for the worst case representative major accident scenarios [4]. The potential impact of the consequences of these major accident scenarios on the proposed development are discussed in Section 8.1.1.

6.5.2 Tynagh South OCGT Power Station

In February 2023, EP Energy Development Ltd. received planning permission for the installation of a 299 MW OCGT power plant to the west of the Tynagh Energy Ltd. CCGT Power Station (ABP-313538-22). The permitted development includes for secondary fuel storage (four bunded distillate fuel storage tanks) and an expanded above ground installation (AGI) to facilitate connection to the existing gas pipeline.

Major accident scenarios, and the consequences associated with these scenarios, were identified and assessed in a land use planning report carried out by Byrne Ó Cléirigh as part of the planning application (ref: 578-22X0044). The potential impact of major accident scenarios associated with this development on the proposed new development are discussed in Section 8.1.2.

[4] *Consequence Modelling and Risk Assessment Report, Tynagh Energy Ltd., EHS Support, IE0311324-23-RP-002, Issue A, PM Group*

7 CONSEQUENCE ASSESSMENT

7.1 Risk of Fatality

The risk of fatality arising from a major accident hazard can be related to the consequences of the event (e.g. exposure to thermal radiation, a blast overpressure, or a toxic substance) by means of probit functions and other derived relations.

As described in the UK HSE's *Methods of approximation and determination of human vulnerability for offshore major accident hazard assessment*, probits account for the variation in tolerance to harm for an exposed population, with the fatality rate of personnel exposed to harmful agents over a given period of time calculated using a probit function of the general form:

$$Y = k_1 + k_2 \ln(V)$$

where:

- *Y* is the probit, a measure of the percentage of the vulnerable resource that might sustain damage (the probability of fatality).
- *k1* & *k2* are constants depending upon the type of harm that the population is exposed to (thermal, pressure, toxic effects).
- *V* is the product of intensity (*I*) or concentration (*C*) of the received hazardous agent to an exponent n and the duration of exposure in seconds or minutes (*t*). In other words, $V = C^n \cdot t$.

The probit function can be used to calculate the risk to people exposed to the hazardous agent (thermal radiation, overpressure, or concentration of toxic substance), expressed as a probability of lethal impacts:

$$Probability = \frac{1}{\sqrt{2\pi}} \int_{u=-\infty}^{u=Y-5} exp\left(-\frac{u^2}{2}\right) du$$

For example, a probit value of 5 corresponds to a probability of fatality of 50%, while probit values of 3.72 and 6.28 correspond to probabilities of fatality of 10% and 90%, respectively.

7.2 Thermal Effects

The probit function for thermal effects is:

$$Y = -14.9 + 2.56 \cdot \ln\left(I^{4/3} \cdot t\right)$$

In this equation, *I* is the thermal flux expressed in kilowatts per square metre (kW/m^2) and the time *t* is expressed in seconds. For short duration fire events, such as a fireball from a BLEVE at an LPG facility, the time during which people may be exposed to the thermal radiation is set at the duration of the event. For longer duration events, such as bund, pool, or building / warehouse fires, the duration is set at 60 seconds to take account of the time required for people to escape from the area.

7.3 Overpressure Effects

The probit function for overpressure effects is:

$$Y = 1.47 + 1.35 \cdot \ln(P)$$

Unlike the probit for thermal effects, the probit for overpressure effects is only related to the overpressure (*P*) expressed in pounds per square inch (psi).

7.4 Indoor Effects

The probit functions shown in Sections 7.2 and 7.3 apply to people located outdoors. For people located indoors, the probability of fatality changes to account for both the protective effects of buildings / shelter in the case of thermal radiation, and the increased risk from a projectiles / a collapsed or damaged building in the case of overpressures. As per the HSA's guidance, we have assumed that people are indoors 90% of the time and outdoors 10% of the time.

In the case of thermal effects, for people located indoors, the HSA advises that the building may provide some protection from the fire and that this should be taken into account.

- For exposure to fluxes in excess of 25.6 kW/m^2 the building is conservatively assumed to catch fire quickly and a 100% fatality risk is applied.
- For exposure to fluxes less than 12.7 kW/m^2 the people inside the building are assumed to be protected and a 0% fatality risk is applied.
- For exposure to fluxes in between these two values, people are assumed to escape outdoors and, therefore, have a risk of fatality corresponding to that outdoors.

In the case of overpressures, the relationship between outdoor effects and indoor effects has been examined by the Chemical Industries Association (CIA) for various types of building, and the CIA has developed correlations relating overpressures to indoor vulnerabilities[5]. For this assessment, we have conservatively applied the correlation for typical office block-type buildings (category 2).

7.5 Occupancy Levels

For this assessment, the population at and in the vicinity of the site can be divided into three broad groups[6]:

- Day time occupants: people who are in the vicinity of the site during normal working hours (the representative timeframe is taken as 8 hours per day, Monday to Friday).
- Night-time occupants: people who are in the vicinity of the site outside of normal working hours (the representative timeframe is taken as 8 hours per night, Monday to Friday).
- Residents: people who are or who may be in the vicinity of the site at all times (8,760 hours per year).

[5] *Guidance for the location and design of occupied buildings on chemical manufacturing sites*, 2nd Edition.

[6] Weekend workers are accounted for under the 'residents' category, with the duration of their exposure to the risks from the site adjusted accordingly.

We have estimated the proportion of people that may be indoors and outdoors; for residential areas, we have assumed that, on average, people are indoors for 90% of the time and outdoors for 10% of the time.

8 Risk Assessment

8.1 Escalation Risk

8.1.1 Impact of Tynagh Energy Ltd. CCGT on proposed Tynagh OCGT North

We have reviewed the consequence modelling and the probabilities for the worst case representative major accident scenarios to identify any potential scenarios which could result in an escalation event at the new site. The results from our review are summarised in Table 17.

Table 17: Review of potential escalation events (accident scenarios at existing CCGT)

Scenario	Probability	Consequences
Diesel		
Jet fire following release from pipeline during tanker unloading	5.1×10^{-12}	No impact at Tynagh OCGT North.
Bunded pool fire	1.4×10^{-7}	No impact at Tynagh OCGT North.
Overtopping pool fire	1.2×10^{-8}	Radiation contours extend onto the footprint of the OCGT South site; however, there is no escalation hazard to the major accident scenarios examined in the LUP report (ref: 578 - 22X0044), nor is there any impact at Tynagh OCGT North.
Natural Gas – Flash Fire or VCE		
Outdoor release of natural gas	3.0×10^{-6}	No impact at Tynagh OCGT North.
A release of natural gas in the turbine hall	2.0×10^{-6}	Reference overpressure levels due to the VCE are provided: 168 mbar at 26.2 m; 20 mbar at 47.1 m. At its closest point, the turbine hall is approximately 200 m from the proposed AGI and 315 m from the proposed bund wall. This means that the peak overpressure at these assets are calculated to be considerably less than 20 mbar. This overpressure would not give rise to a damage to the diesel tank, or loss of containment from the tank, or be expected to cause any damage to the AGI, bund or tank.
Release of hydrogen when unloading or connecting hydrogen MCP	4×10^{-6}	No impact at Tynagh OCGT North.
Natural Gas – Jet Fire		
Outdoor release of natural gas	3×10^{-6}	No impact at Tynagh OCGT North.

Scenario	Probability	Consequences
A release of natural gas in the turbine hall	2×10^{-6}	Reference thermal radiation levels due to the jet fire are provided: 13.4 kW/m^2 at 22.7 m; 9.3 kW/m^2 at 24.7 m; 6.3 kW/m^2 at 26.7 m. At its closest point, the turbine hall is approximately 200 m from the proposed AGI and 315 m from the proposed bund wall. This means that the peak thermal radiation at these assets is calculated to be considerably less than 6.3 kW/m^2. This level of thermal radiation would not give rise to a loss of containment from the tank or be expected to cause any damage to the AGI, bund or tank.
Release of hydrogen when unloading or connecting hydrogen MCP	4×10^{-6}	No impact at Tynagh OCGT North.
BLEVE		
Release of hydrogen when unloading or connecting hydrogen MCP	4×10^{-6}	Reference overpressure levels due to the BLEVE are provided: 200 mbar at 20 m; 168 mbar at 22.5 m; 20 mbar at 101 m. At its closest point, the hydrogen MCP is approximately 115 m from the proposed AGI and 225 m from the proposed bund wall. This means that the peak overpressure at these assets is calculated to be less than 20 mbar. This overpressure would not give rise to a loss of containment from the tank or be expected to cause any damage to the AGI, bund or tank.

In addition, we note that the existing AGI is located immediately south of the proposed OCGT North AGI. A VCE following a release from a natural gas pipeline at the existing AGI could expose the proposed AGI to overpressures of ~650 mbar, which would result in significant risk of damage to pipelines in this area. Because of this escalation risk, we have increased the probability of a jet fire occurring following a release from a natural gas pipeline at the proposed AGI by 5.4×10^{-8} per annum.

8.1.2 Impact of Tynagh OCGT South on Tynagh OCGT North

We reviewed the consequences associated with the major accident scenarios that were identified and assessed in a land use planning report carried out for the Tynagh OCGT South development (ref: 578-22X0044). The major accident scenarios are similar to those for the current development, namely impacts from fires or explosions following the release of distillate fuel from bulk storage tanks and releases from natural gas pipelines.

Worst case consequences – thermal radiation

The worst-case event is an unbunded pool fire resulting from a catastrophic failure of one of the distillate oil storage tanks. A spill to the north of the bund is the closest event to the proposed development. The centre of this spill is located approximately at the south-east corner of the proposed AGI, 130 m from the proposed switchyard and 165 m from the proposed gas turbine. The thermal radiation that the switchyard and turbine would be exposed to from such an event is

6.8 kW/m^2 And 3.2 kW/m^2. This level of thermal radiation would not be expected to cause any damage to the gas turbine or switchyard building.

However, an overtopping pool fire to the north of the bund would result in flame engulfment or impingement at the proposed AGI. The probability of this event is 2.27 ×10^{-7} per annum. This would result in immediate escalation of a fire with significant risk of damage to pipelines at the AGI. As a result of this, we have increased the probability of a jet fire occurring following a release from a natural gas pipeline at the AGI by 2.27 ×10^{-7} per annum.

Worst case consequences – overpressure

The worst-case event is a guillotine failure of a section of the 40 bar pipeline under F2 weather conditions at the AGI (the closest point of the gas installation to the proposed development). This major accident source is located approximately 75 m from the proposed AGI, 190 m from the proposed firewater pumphouse and 210 m from the proposed switchyard and distillate bund. The overpressure exposure to these assets from such an event is 257 mbar, 73 mbar and 64 mbar, respectively. These levels of overpressure could result in roof damage to oil storage tanks or minor damage to steel frames of buildings (in the case of the two lower overpressures). At exposure levels of ~260 mbar, slight deformation of a pipe bridge could occur; however, overpressures in excess of 350 mbar are typically required to cause displacement or breakage of a pipe bridge.

The probability of this event is 9.6 ×10^{-7} per annum.

Individual risk contours

The risks from each scenario were aggregated to determine the overall risk profile for the development. The contour plot of the three risk contours – the inner, middle and outer zones – shows that the middle and outer zone contours extend over part of the proposed AGI. The AGI is sensitivity level 1 under the HSA's criteria and so the presence of this building inside the middle and outer zone is in accordance with the HSA's criteria.

8.1.3 Impact of Tynagh OCGT North on Tynagh Energy Ltd. CCGT

Worst case consequences – thermal radiation

The worst-case fire event is a jet fire following a horizontal guillotine failure of a section of the 75 bar pipeline under D5 weather conditions to the west of the proposed AGI. The distance between this major accident source and different parts of the existing site are set out in Table 18. The corresponding thermal radiation levels from this scenario to the existing site are also provided.

Table 18: Thermal radiation exposure from Tynagh OCGT North worst case event to existing site

End point	Distance between major accident source and end point (m)	Thermal radiation (kW/m^2)
Major accident source		
Existing AGI	40	136.7
Hydrogen MCP	150	136.7
Above ground natural gas pipelines near Power House Building	225	136.7
Gasoil storage tank	325	16.9

The results in Table 18 shows that large parts of the existing site would be exposed to thermal radiation levels of 135-140 kW/m^2, which is sufficient to cause a rapid escalation risk.

The probability of this event is low (2.1 ×10^{-7} per annum for the 50 m of 75 bar pipeline). Furthermore, the likelihood of this event is further reduced because the release would also require a failure of the pipeline to give rise to a release in the direction of the existing site. If the orientation of the release is towards a receptor then it can present an escalation hazard. The calculated probability of this occurring, based on the dimensions of the flare in the worst case event, and the proximity of the plant items, is 16.5% (for the hydrogen MCP) and 12.8% (for the AGI near the Power House Building).

Therefore, the likelihood of the hydrogen MCP being exposed to this event is 3.5 ×10^{-8} per annum and reducing to 2.7 ×10^{-8} per annum for the aboveground pipelines at the Power House Building.

The exposure to this end event is also expected to be short, as the flare/jet fire will only persist so long as there is a supply of gas to feed it. The natural gas pipelines will be equipped with various protection features, including fire detection and automatic shutoff valves. The exposure duration for this event is expected to be less than 60 seconds.

Worst case consequences – overpressure

The worst-case explosion event is a guillotine failure of a section of the 75 bar pipeline under F2 weather conditions to the west of the proposed AGI. The distance between this major accident source and different parts of the existing site are set out in Table 19. The corresponding overpressures from this scenario to the existing site are also provided.

Table 19: Overpressure exposure from Tynagh OCGT North worst case event to existing site

End point	Distance between major accident source and end point (m)	Overpressure (mbar)
Major accident source		
Existing AGI	40	659
Hydrogen MCP	150	101
Above ground natural gas pipelines near Power House Building	225	60
Gasoil storage tank	325	40

This end event would likely lead to complete destruction of the existing AGI due to its close proximity and could give rise to loss of containment at the AGI with potential for secondary jet fires. The exposure levels referenced in Table 19 are unlikely to be sufficient to cause any significant damage to pipelines at the Power House building or to the gasoil storage tank. Similarly for the hydrogen MCP, exposure levels in excess of 200 mbar are typically required to cause slight deformations of a pipe bridge and over 500 mbar for failure of connecting pipes.

The probability of this event is 4.7×10^{-7} per annum for the 50 m of 75 bar pipeline.

Individual risk contours

The risks from each scenario were aggregated to determine the overall risk profile for the development. The contour plot of the three risk contours – the inner, middle and outer zones – shows that the middle zone extends over part of the existing AGI and the administration, control and security building are within the green zone. These buildings are all considered sensitivity level 1 under the HSA's criteria and so their presence inside these zones is in accordance with the HSA's criteria.

Societal risk

A broader discussion on societal risk is included in Section 8.2.3.

8.2 Individual Risk

8.2.1 Overview

The risk presented by each loss of containment event identified in this report is a combination of its probability of occurrence (as described in Sections 6.3.1 and 6.4.1) and the severity of its impact (based on the consequence modelling results in Sections 6.3.3 and 6.4.4). We have aggregated the risks from each scenario to determine the overall risk profile for the proposed development. We have also accounted for the escalation risk from other major accident hazards in close proximity to the proposed development (refer to Sections 8.1.1 and 8.1.2). The individual risk contour plot for this proposed development is shown in Figure 4. As per Section 7.4,we have assumed that people are indoors 90% of the time and outdoors 10% of the time.

The HSA's approach to assessing developments within these contours for individual risk is detailed in Section 4.2.1.

8.2.2 Offsite Risk

The risk contour map shows that an inner zone is formed over the turbine hall enclosure. The middle zone – the orange contour – extends over the proposed AGI, the turbine hall, the distillate tank bund and part of the existing AGI. In addition, it extends outside the site boundary to the west, in the vicinity of the existing subsurface high pressure gas pipeline. The outer zone – the green contour – extends further than the middle zone, covering the administration, control and security buildings to the south.

The plot also shows that there is an area to the west of the site which is located inside the outer zone. This area is industrial in nature, occupied by Sperrin Galvanisers. This neighbouring development is sensitivity level 1 under the HSA's criteria and so the presence of this building inside the zone is in accordance with the HSA's criteria. In addition, the outer zone extends outside the boundary of the development to the east, covering part of the old Tynagh Mine site.

There are no developments within any of the contours which would not satisfy the HSA's criteria for individual risk. Neither zone includes any residential development or developments with vulnerable populations, based on the HSA criteria. Personnel on site are considered to be sensitivity level 1, based on the HSA criteria set out in Section 4.2.1. These can be accommodated within the inner, middle or outer zones.

The only other development in the vicinity of the site is the access road, a section of which lies within the risk zones that have been plotted. Based on the HSA guidance, access roads and estate roads are classed as sensitivity level 1 and thereby satisfy the HSA's criteria, i.e., sensitivity level 1 developments are permitted within each of the three risk zones. These are characterised by having minimal numbers of people, with exposure to risk for a short period (predominantly).

The contour plot also shows that the level of risk to the existing Tynagh Energy Limited CCGT site is low. The outer zone contour extends onto the existing site footprint. The consequence modelling results show that there are some accident scenarios at the proposed new development which could give rise to impacts at the existing site, although the risk curves reflect the fact that this risk is low.

Based on the above, all developments that are located within the LUP contours for the site would satisfy the HSA's LUP criteria for individual risk.

Figure 4: Individual risk contours

8.2.3 Onsite Risk

Under Regulation 12 of the COMAH Regulations, operators of establishments are required to review and, where necessary, update the notification, MAPP and safety management system, and/or safety report prior to any modification of an installation, establishment, storage facility, or process or of the nature or physical form or quantity of dangerous substances which could have significant consequences for major accident hazards. In that context, an assessment of proposed modifications to an existing COMAH establishment is typically carried out in accordance with the HSA's *Guidance on 'Significant Modifications' Under the COMAH Regulations* (2019).

In assessing individual risk associated with a modification, the HSA's guidance includes criteria related to onsite risk:

- If the on-site fatality risk following the modification is less than 1×10^{-6} per year, then no action is necessary and the HSA will allow the modification to proceed without any further requirements.
- If, following the modification, the fatality risk to employees in an affected location is greater than 1×10^{-6} per year and less than 1×10^{-4} per year (including where the existing risk falls within this range), then the operator will be required to demonstrate that it is not reasonably practicable to reduce the risk through the further use of additional technical measures (ATMs).
- If the predicted major accident fatality risk in an affected location is greater than 1×10^{-4} per year after a modification, then the HSA will not permit the modification. The HSA notes that on-site fatality risk of 1×10^{-3} per year is considered just tolerable within the ALARP framework for existing risks, but it is the HSA's policy to require continuous improvement in the control of major accident hazards, hence the lower threshold of 1×10^{-4} for significant modifications.

Given that this proposed development could potentially be developed in conjunction with the Tynagh South OCGT, we have assessed the change in onsite risk using the combination of the risk contours for these two developments.

The highest location-based risk inside the site boundary arising from the two proposed developments is 2.85×10^{-5} per year at the Tynagh South OCGT AGI. However, this area of the site will not be permanently occupied. We have conservatively assumed that an operator could be located there for up to 5 hours per week. For an operator present with this level of frequency, the level of individual risk from the new developments would be approximately 8.48×10^{-7} per year.

The location-based risk at the security building from the two proposed developments is 1.7×10^{-5} per year. An employee based there 40 hours per week would be exposed to a risk of 4.05×10^{-6} per year. This level of exposure is within the range that the HSA requires consideration of additional technical measures. Subject to achieving planning permission for this development, EP Energy Developments Ltd. will carry out a detailed significant modifications assessment and submit to the HSA for approval before carrying out any construction works.

8.3 Societal Risk

The contour plot shows the extents of the risk zones for the site, based on the major accident scenarios identified using the HSA's guidance.

Site personnel for the proposed development site, the consented OCGT South development and the existing Tynagh Energy Limited CCGT site will share administration and workshop space. In addition, the three stations will have a single security gatehouse which will be staffed 24/7. The on-site population is shown in Table 20 and Table 21.

Table 20: On-Site Population – normal working hours

Building	Total
Security Gatehouse	1
Administration Building	16
Workshops	8
Control Room	6

Table 21: On-Site Population – outside of normal working hours

Building	Total
Security Gatehouse	1
Administration Building	3
Workshops	0
Control Room	6

The security gatehouse will be located close to the site entrance, to the west of the site. The other personnel may be present at various locations throughout the site, e.g. carrying out visual inspections. For risk assessment purposes, they have been taken to be based in in the administration building and workshops (located to the south of the site boundary of the proposed development) and control room (adjacent to the substation on the existing Tynagh Energy CCGT site).

When assessing the societal risk associated with a COMAH establishment, the HSA guidance uses the expectation value (EV) as its measure of societal risk.

$$EV = \Delta R_{cpm} \times N$$

where N is the number of fatalities

Between expectation values of 100 and 10,000, the guidance states that it should be demonstrated that all practicable efforts have been made to reduce the risk to a level that is as low as reasonably practicable (above a developmental EV level of 450, an FN curve will be required as part of the demonstration).

The societal risk calculation is set out in Table 22. This includes the on-site population as well as the population in the nearby Sperrin Galvanisers site.

Table 22: Societal Risk Calculation

Population	Risk	Occupancy	IR (cpm)	N	EV
Security	3.25×10^{-7}	1	0.3	1	0.3
Administration (9am-5pm)	4.92×10^{-7}	0.33	0.2	16	2.6
Administration (5pm-9am)	4.92×10^{-7}	0.67	0.3	3	1.0
Workshops (9am-5pm)	8.54×10^{-8}	0.33	0.0	8	0.2
Control Room	4.46×10^{-7}	1	0.4	6	2.7
Sperrin Galvanisers	1.91×10^{-7}	1[7]	0.2	30	5.7
Total					**12.6**

The values for risk are the location-based risks at the occupied buildings. The values for IR are the individual risks to each population, expressed in chances per million (cpm), based on the location-based risk and patterns of occupancy. It should also be noted that, although the security building is shown as having an occupancy of 1, this does not mean that there will be an individual present at all times, rather that there will be a rotation of security personnel so that there is always someone present. The level of risk to an individual security guard is calculated to be 0.4 cpm. This risk is mitigated by the fact that alarms will be in place to detect a major accident at the site, enabling personnel to evacuate to a safe distance. The emergency response and evacuation procedures will be developed to ensure that all personnel are aware of the hazards associated with the activities at the site and know the appropriate measures to take in the event of an alarm.

The results show that the calculated values for RI and for EV are significantly lower than the thresholds used by the HSA. The EV of 12.6 represents a level of societal risk that is broadly acceptable.

8.4 Environmental Risk

The design of the site will include provision for a hardstanding area outside of the main bund area to collect the maximum overtopping volume. For any unbunded distillate fuel release, this would be captured in the site drainage system. This would be collected in a large outdoor collection chamber. This contains an inlet screen, oil adsorbent booms and some 'biobags' to digest any residual oil present. After some time settling in the large collection chamber it is then pumped to an oil/water separator unit which then separates out any remaining oil present. The storm water is then sent to a final discharge chamber. An oil water detector here checks if there is any remaining oil present. Finally, it is discharged to surface water.

The drainage must therefore be pumped to be discharged off site. This means that there is no pathway for a release of oil to escape off-site. As such the risk of a major release to the environment will be mitigated by the design and construction of the site.

[7] Conservatively assume 24 hours occupancy.

9 Conclusions

The results of the risk assessment show how the proposed development of the Tynagh Energy station compares with the HSA's criteria for risk.

- Individual risk (offsite): The inner and middle zone risk contours are largely confined within the site footprint, while the outer zone contour extends to the west of the site into an industrial area occupied by Sperrin Galvanisers. The only populations located within the risk contours will be workers associated with the power stations or Sperrin Galvanisers. These are seen as low sensitivity (level 1) and can be accommodated within any of the risk zones. They are located in the outer zone, with an individual risk less than 1 cpm.
- Individual risk (onsite): When the proposed development is assessed in conjunction with the Tynagh South OCGT, the individual risk at the security building is approximately 4 cpm. Subject to achieving planning permission for this development, EP Energy Developments Ltd. will carry out a detailed significant modifications assessment and submit to the HSA for approval before carrying out any construction works.
- Societal risk: The total societal risk is found to be much lower than the HSA's thresholds for EV. This level of risk is broadly acceptable.
- Environmental risk: The distillate fuel storage area will be bunded in accordance with good practice, with tertiary containment at the site to collect overtopping material in the worst-case event of catastrophic tank failure and to prevent a pathway for a major environmental release to escape offsite.

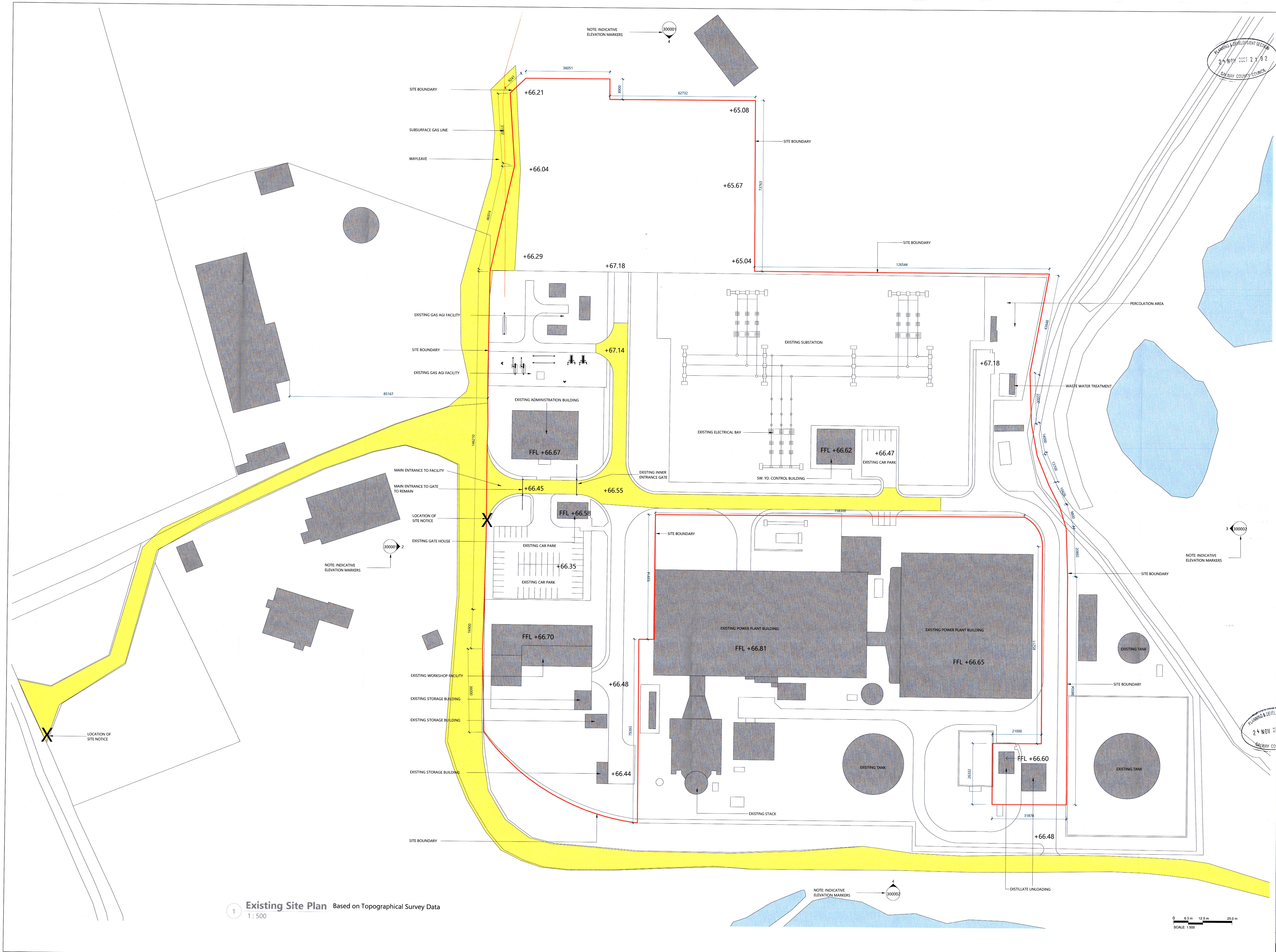
Based on these findings, the proposed development satisfies the risk-based criteria that are set out in the HSA's land use planning guidance.

APPENDIX 1: SITE LAYOUTS

Map 1 = Existing site layout

Map 2 = Proposed site layout for Tynagh OCGT South

Map 3 = Proposed site layout for Tynagh OCGT North



Existing Site Plan Based on Topographical Survey Data
1 : 500

SCALE: 1:500

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Use figured dimensions only.

NORTH SYMBOL

LEGEND:
- SITE BOUNDARY
- EXISTING BUILDING
- LOCATION OF SITE NOTICE
- RIGHT OF WAY / WAYLEAVE
- GNI SUBSURFACE GAS PIPE LINE
- ELEVATION MARKER SYMBOL

Rev:	Date:	Description:	Drwn by:	Chkd by:

Client: EP ENERGY DEVELOPMENTS Ltd.

Project Name: PROPOSED OCGT DEVELOPMENT

Drawing Title: Existing Site Plan

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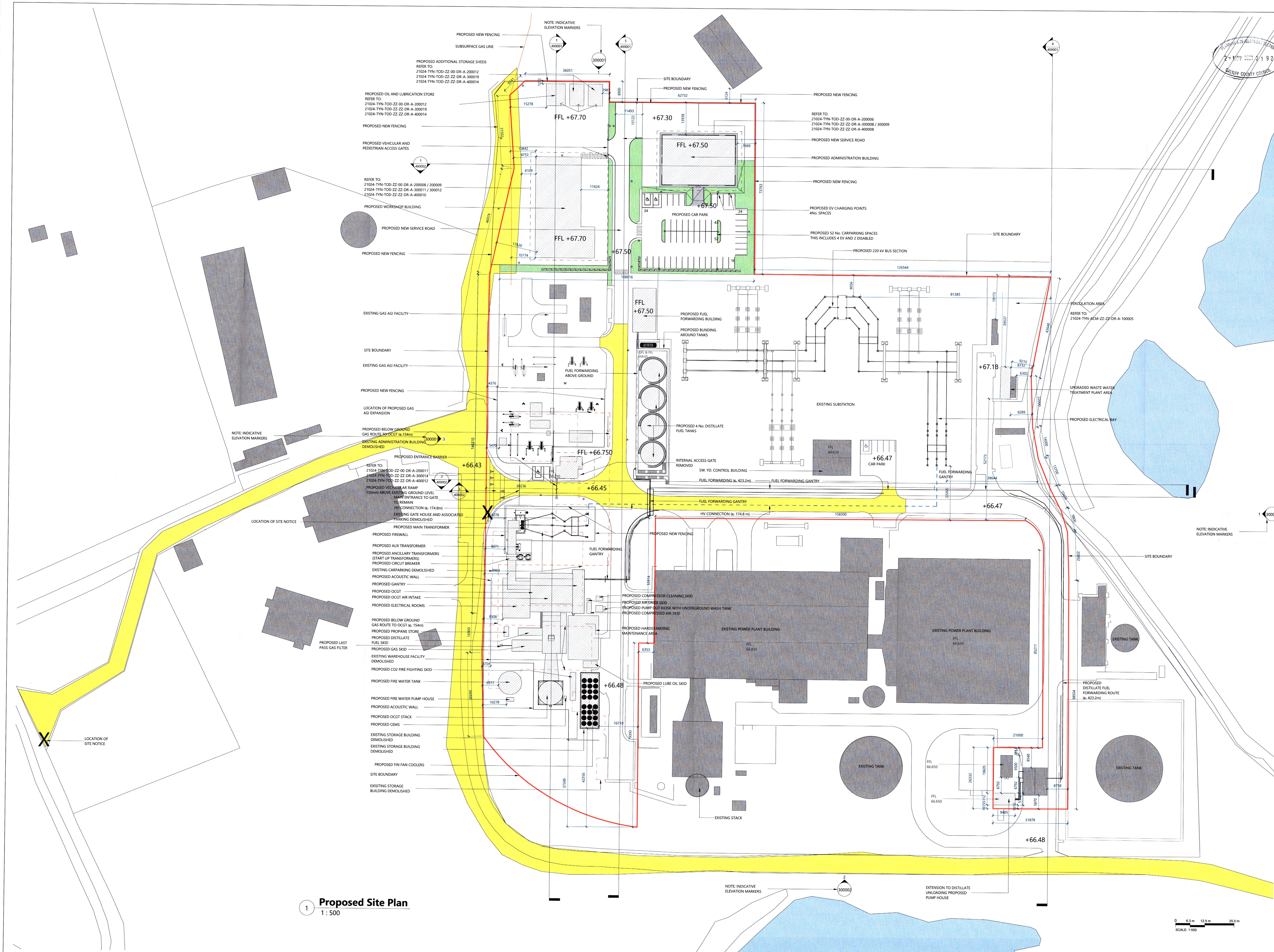
TODD

Date:	Dwn by:	Ckd by:	Scale:	Page:
12/11/21	AS	PL	As indicated	A0

Project No:	Status:	Revision:
21024	PLANNING	

Drawing Number: TYN-TOD-ZZ-ZZ-DR-A-100003



1 Proposed Site Plan
1 : 500

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Use figured dimensions only.

NORTH SYMBOL

LEGEND:

- SITE BOUNDARY
- X LOCATION OF SITE NOTICE
- EXISTING BUILDINGS + STRUCTURES
- PROPOSED BUILDING + STRUCTURES
- PROPOSED ELECTRICAL CABLE HV ROUTE (c.175M)
- PROPOSED FUEL FORWARDING ROUTE (c. 423.2M)
- PROPOSED AGI EXTENSION GAS ROUTE (c. 154M)
- OUTLINE OF EXISTING BUILDINGS TO BE DEMOLISHED
- EXISTING GAS CONNECTION ROUTE (SUBSURFACE)
- LANDSCAPING
- RIGHT OF WAY / WAYLEAVE
- ELEVATION MARKER SYMBOL

OS MAP

ORDER NO:
50183161_1

MAP SHEETS:
3635

PLANNING & DEVELOPMENT SECTION
24 NOV 2021 2192
GALWAY COUNTY COUNCIL

PLANNING

Rev:	Date:	Description:	Drwn by:	Chkd by:

Client: EP ENERGY DEVELOPMENTS Ltd.

Project Name: PROPOSED OCGT DEVELOPMENT

Drawing Title: Proposed Site Plan

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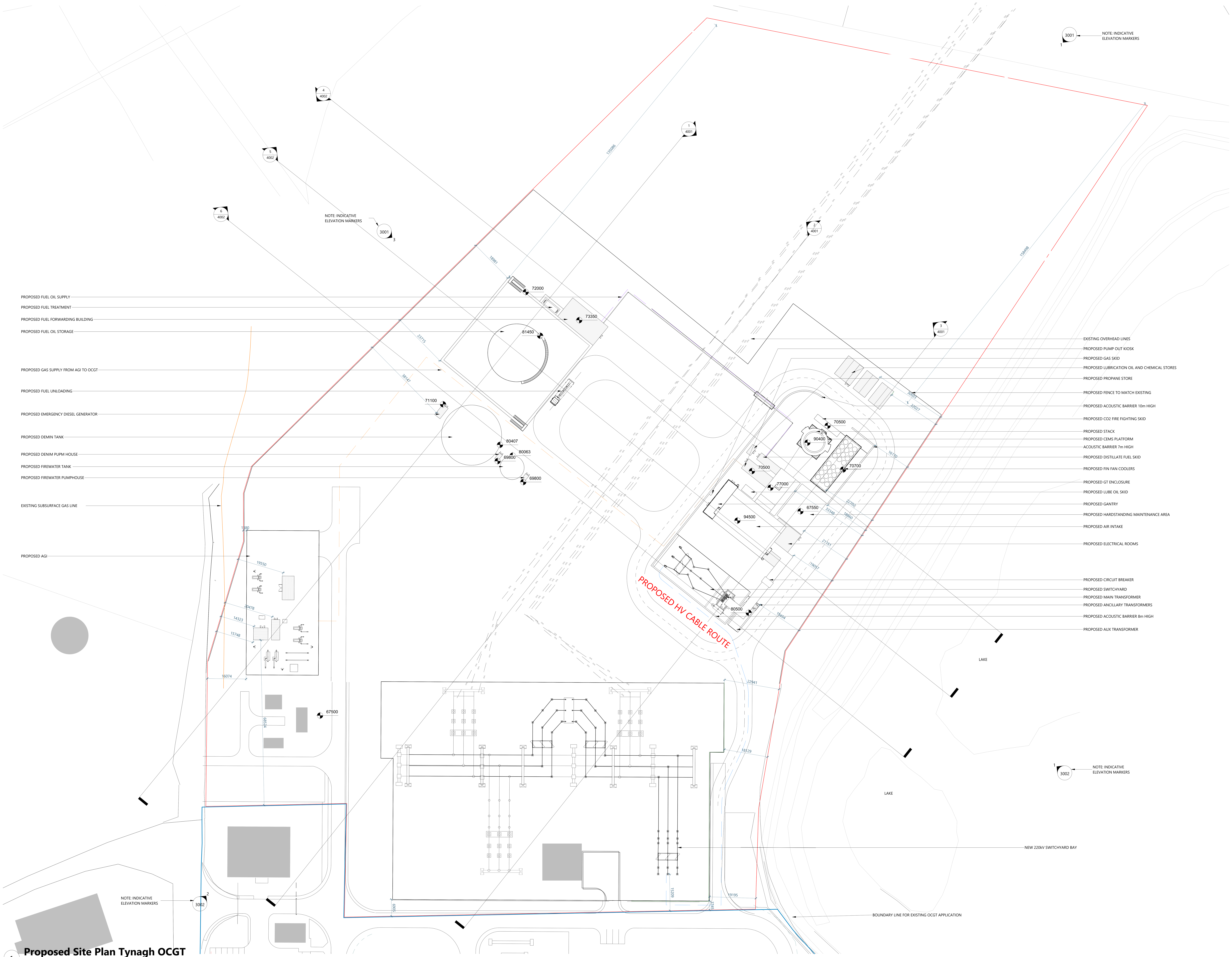
TODD

Date:	Dwn by:	Ckd by:	Scale:	Page:
12/11/21	AS	PL	As indicated	A0

Project No:	Status:	Revision:
21024	PLANNING	

Drawing Number: **TYN-TOD-ZZ-ZZ-DR-A-100004**



1 **Proposed Site Plan Tynagh OCGT**
1 : 500

LEGEND:

- SITE BOUNDARY TOTAL AREA 13.630Acre (55162.092sqm)
- OHL — OVERHEAD LINES
- EXISTING GAS LINE
- PROPOSED FENCING TO MATCH EXISTING
- LOCATION OF PROPOSED ACCESS GATE
- ADJOINING LAND IN THE OWNERSHIP/CONTROL OF TYNAGH ENERGY LIMITED

NORTH SYMBOL

Rev:	Date:	Description:	Drwn by:	Chkd by:
	10.08.23	Issued for Rev		TODD
	08.08.23	Issued For Comments		TODD

Client: EP ENERGY DEVELOPMENTS Ltd.

Project Name: TYNAGH NORTH

Drawing Title: PROPOSED SITE PLAN

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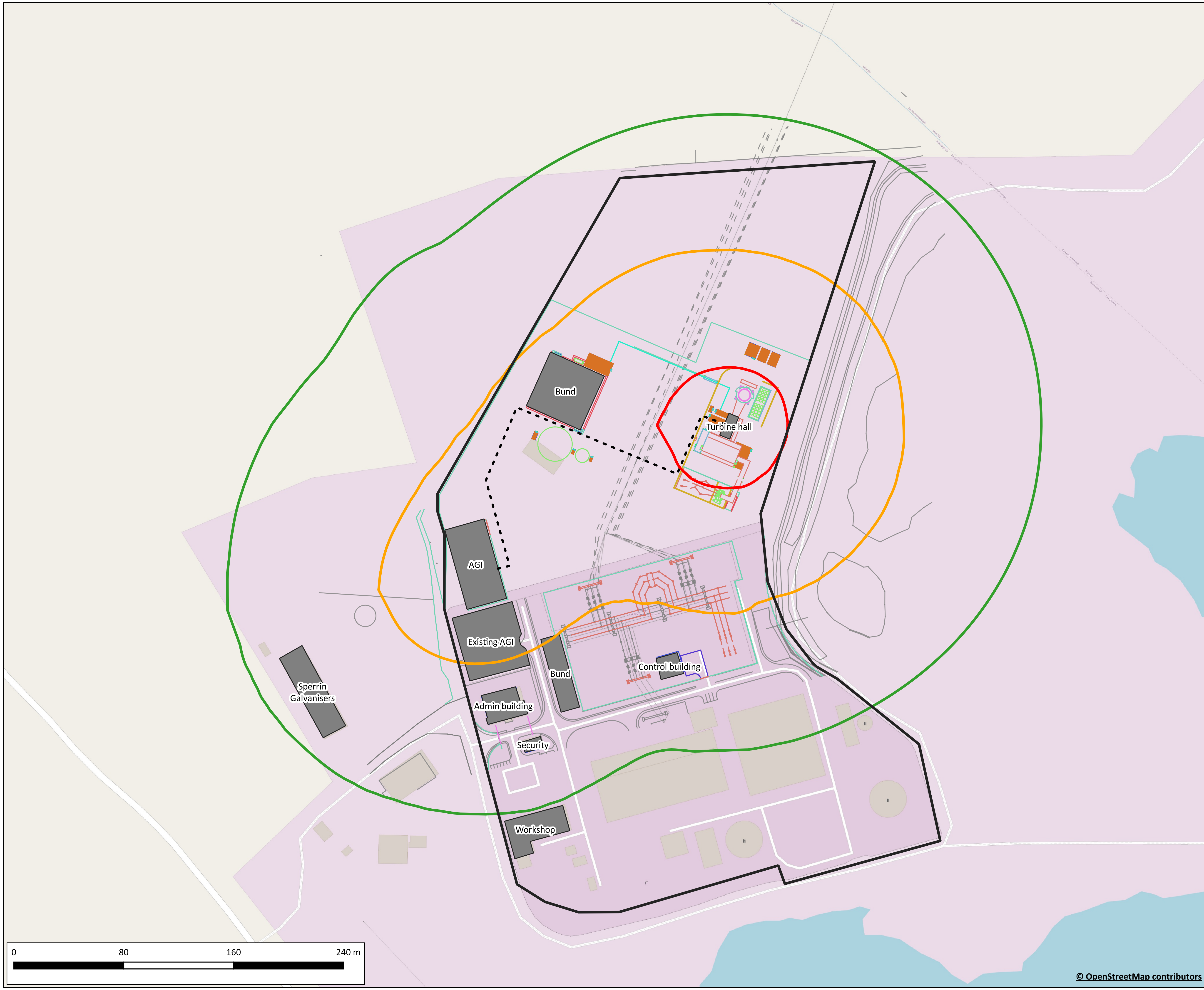
Date:	Dwn by:	Ckd by:	Scale:	Page:
08/06/23	BS	PL	As indicated	A0

Project No:	Status:	Revision:
21024	Planning Application	

Drawing Number: **TYN-TOD-ZZ-ZZ-DR-A-1004**

APPENDIX 2: INDIVIDUAL RISK CONTOURS



N

Legend

Assets

COMAH establishment boundary

Below ground pipeline

Risks

Risk contours

1 x 10-7 per year

1 x 10-6 per year

1 x 10-5 per year

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Client	**Gravis Planning**
Project	**EP Energy Developments** **Proposed OCGT North**
Title	**COMAH Land Use Planning** **Individual Risk Contours**
Scale	1:2500
FBS	07.02.03
	578-23X0041
	R7