

Project Dragon

Sustainable Aviation Fuel (SAF) Production Facility
Lighting Assessment

LanzaTech UK Limited

11 August 2023

Quality information

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Revision History

Revision	Revision date	Details	Authorized	Name	Position
00	11 August 2023	Draft for review			

Distribution List

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1. Introduction

- 1.1 This Lighting Assessment has been prepared by AECOM Ltd on behalf of LanzaTech UK Limited and supports an application for planning permission for the construction, operation and maintenance of a new industrial development at the Land at Crown Wharf, Port Talbot Docks. The associated development includes the construction and operation of an ethanol to sustainable aviation fuel (SAF) production facility, including enclosed ground flare, storage tanks, installation of pipework and electrical, processing and utility equipment, administration, warehouse and laboratory buildings, new access, car parking and transport infrastructure including a truck loading area and associated works, hard and soft landscaping, areas for temporary construction laydown, and associated development. A light pollution statement is required to accompany the planning application.
- 1.2 A detailed lighting proposal has been developed for the plant site to accommodate staff welfare facilities, movement of goods and storage uses developed within the Site. The introduction of lighting, such as road lighting and floodlighting, is to provide visual amenity, safety and operational performance, which may have the potential to result in obtrusive light at receptor locations.
- 1.3 The extent of the study area for this lighting assessment includes the Site and the adjacent surrounding areas, focussing on those receptors in near proximity and/or with a direct line of sight to the proposed development (up to approximately 2 km). Analysis includes key sensitive receptors that are most likely to experience a noticeable change given a new lighting installation or view of the night time scene. The study area for the lighting assessment is set out in Figure 1-1 in red, with the Site redline boundary also indicated.

Figure 1-1 Study Area for the Lighting Assessment



Source: Google Maps overlay

- 1.4 The purpose of this lighting assessment is to consider and define potential constraints on the external lighting strategy for lighting and a review of strategy provided. The report is comprised of the following:
 - a review of relevant standards and good practice guidance;
 - identification of the type and location of the light sensitive receptors;

- classification of the surrounding area with regard to the Environmental Zones as set out in the Institute of Lighting Professionals Guidance Notes for the Reduction of Obtrusive Light;
 - confirmation of environmental obtrusive light limits and technical requirements for the exterior lighting installation;
 - overview of the provided lighting strategy for operational conditions including control;
 - providing a general strategy for mitigation measures to adequately control obtrusive light.
- 1.5 Documents referenced for the compilation of this lighting assessment are in Appendix A. Drawings referenced for calculations are in Appendix B. Lighting calculation reports are provided for reference in Appendix C.

2. Legislation, Policy, Standards and Guidance

- 2.1 The following documents identify the current policy, standards and guidance that are relevant to the design and implementation of a new lighting design associated with the project.

Legislation

Clean Neighbourhoods and Environment Act 2005

- 2.2 The Clean Neighbourhoods and Environment Act 2005 [1] provides consideration of artificial lighting. Clause 102 defines statutory nuisance from artificial lighting as *“artificial lighting emitted from premises so as to be prejudicial to health or nuisance”*. The clause also includes guidance for local authorities to control exterior lighting, depending on the specific context.

Policy

Future Wales: The National Plan 2040

- 2.3 Future Wales: The National Plan 2040 [2] details the Government’s planning policies for Wales and how these are expected to be applied. In Section 4 on Future Wales’ spatial strategy, in relation to lighting and visual impact Policy 18 sets out:

“Proposals for renewable and low carbon energy projects (including repowering) qualifying as Developments of National Significance will be permitted subject to the following criteria:

2) there are no unacceptable adverse visual impacts on nearby communities and individual dwellings; and

7) there are no unacceptable adverse impacts by way of shadow flicker, noise, reflected light, air quality or electromagnetic disturbance.”

Planning Policy Wales (PPW) 2021

- 2.4 The Distinctive and Natural Places chapter of the Planning Policy Wales Edition 11 [3], which was last updated in February 2021, provides practical guidance on light pollution and advice for local authorities on when and how to consider light within the planning system. It also outlines which factors are relevant when considering possible ecological impacts of a new or changed lighting system. The PPW states:

“There is a need to balance the provision of lighting to enhance safety and security ... with the need to:

- protect the national and historic environment including wildlife and features of the natural environment such as tranquillity;*
- retain dark skies where appropriate;*
- prevent glare and respect the amenity of neighbouring land uses; and*
- reduce the carbon emissions associated with lighting.”*

Neath Port Talbot Local Development Plan

- 2.5 The Neath Port Talbot Local Development Plan 2011 to 2026 [4] was adopted in 2016 and is used to make planning decisions. Strategic objectives from the plan that are relevant to this development in relation to lighting is captured in policy EN 8 on Pollution and Land Stability, which states:

“Light pollution can be an issue where it has potential adverse effects on the natural or historic environment, on people’s health and amenity or on wildlife and habitats. These concerns will need to be balanced against the need to enhance safety and security and to enable sport, recreation and other activities to take place.

Where lighting proposals have the potential to cause adverse effects, mitigation measures will be required to ensure that their impact is minimised.”

British Standards

- 2.6 British Standards (BS) are standards produced by the British Standards Institute (BSI) which provide a standard set of tools describing consistent requirements for design, installations, and use of different aspects of design. The following standards are considered when developing and evaluating a new lighting installation:
- BS 5489-1:2020 Code of Practice for the Design of Road Lighting Part 1: Lighting of Roads and Public Amenity Areas (BSI, 2020) [5]
 - BS EN 13201-2:2015 – Code of Practice for the Design of Road Lighting – Part 2: Performance Requirements [6]; and
 - BS 12464-2: 2014 Lighting of Work Places – Outdoor Work Places (BSI, 2014) [7].

Good Practice Guidance

The Chartered Institution of Building Services Engineers (CIBSE) Society of Light and Lighting (SLL) lighting guidance

- 2.7 The SLL has produced a series of lighting guides that address various approaches and requirements for lighting. The following guidance is considered when developing new exterior lighting installations
- Lighting Guide 6 (LG6) – The Exterior Environment [8]; and
 - Lighting Guide 21 (LG21) – Protecting the Night-Time Environment [9].

Institution of Lighting Professionals (ILP) guidance

- 2.8 The ILP is the current body of the former Institute of Lighting Engineers (ILE). They have produced the following guidance documents which are considered when developing new lighting installations:
- Guidance Note 1 (GN01) - The Reduction of Obtrusive Light [10]; and
 - Guidance Note 8 (GN08) - Bats and Artificial Lighting in the UK [11].

3. Scope of Assessment

- 3.1 New lighting is required for the Project to provide safe access and site use when adequate daylight is not available during both the construction and operational phases.
- 3.2 This requirement for new lighting needs to be balanced against the character of the wider site and surrounds to ensure that sensitive receptors in the form of residential development and terrestrial / marine habitat are considered. There is potential for wildlife to be present given the watercourse and land routes from the river to other undeveloped or agricultural parcels of land.
- 3.3 The assessment addresses potential effects stemming from the following:
- column mounted lighting;
 - building mounted lighting;
 - handrail-fixed bracket mounted lighting;
 - mobile tower lighting (during construction activities).
- 3.4 The assessment will consider the effect created by the Project on key obtrusive light metrics:
- Light spill: light reaching beyond the area that is being lit, to adjacent land, habitat or windows;
 - Sky glow: light shining into the night sky from direct light (expressed as an upward light ratio, ULR) and from direct/indirect light (expressed as an upward flux ratio, UFR); and
 - Glare: noticeably bright light against a dark surround or direct views of light sources.

Assumption and Limitations

- 3.5 While the effects of a lighting installation may be commented on in terms of technical performance, aesthetic visual impact does not form part of the analysis.
- 3.6 The lighting assessment is undertaken as a desktop exercise. Detailed design information and mapping were obtained via the design team with lighting information provided by Turley and Technip (listed in Appendix A and Appendix B).
- 3.7 A worst-case condition is used for the assessment that assumes lighting will be needed to cover all areas of the site rather than be zoned to accommodate site use patterns throughout the year.
- 3.8 Due to the 24/365 operation highlighted, it is unlikely that lighting will be turned off under normal conditions. It is, however, expected that during the post-curfew period (11pm – 6am) lighting will be dimmed or turned off where it is not required for safe site use or security purposes.
- 3.9 The report gives recommendations about maximum permissible values of obtrusive effects based on good practice guidance for exterior lighting installations. These values are regarded as limiting values, and the lighting schemes for each aspect of the development should strive to meet the lowest criteria for the design.

4. Assessment Methodology

- 4.1 The lighting assessment described in this chapter has been undertaken in accordance with the Institute of Lighting Professionals (ILP) GN01 Guidance Notes for the Reduction of Obtrusive Light [10]. Accordingly, this assessment:
 - identifies the contextual lighting condition which is experienced by local residents and ecological receptors with the current state of lighting use on the Site and in the surrounding areas;
 - identifies and assesses the sensitivity of receptors to existing lighting conditions and potential impacts and provides a rating or benchmark. Impact sensitivity ratings are made in the context of wider district lighting conditions, site specific building and environmental factors, legislation, planning policy, current relevant standards and good guidance practice; and
 - provides a baseline for assessment against which the potential effects of a lighting condition attached to a grant of planning permission can be benchmarked against good practice guidance.

Assessment Criteria

- 4.2 GN01 [10] advises that lighting which has the same characteristics as the overall area lighting is less likely to cause disturbance, as well as minimise instances of light pollution; to that end it provides recommended limiting criteria. Table 4-1 is an extract from the guidance document which gives an overview of how brightness characteristics are considered and informs on which targets are recommended.

Table 4-1 Lighting Environmental Zones

Zone	Surrounding	Lighting environment	Examples
E0	Protected	Dark (SQM 20.5+)	Astronomical Observable dark skies, UNESCO starlight reserves, IDA dark sky places
E1	Natural	Dark (SQM 20 to 20.5)	Relatively uninhabited rural areas, National Parks, Areas of Outstanding Natural Beauty, IDA buffer zones etc.
E2	Rural	Low district brightness (SQM ~15 to 20)	Sparsely inhabited rural areas, village or relatively dark outer suburban locations
E3	Suburban	Medium district brightness	Well inhabited rural and urban settlements, small town centres of suburban locations
E4	Urban	High district brightness	Town / City centres with high levels of night-time activity

Source: extract ILP GN01 2021, Table 2 [10].

- 4.3 The local area lighting characteristics have been established as similar to those associated with an industrial type of development which is typically environmental zone E3. Although with reference to, it is expected that the existing Port and industrial development will present an increased brightness resulting in brighter overall characteristics which has a rapid drop to E2 levels or below away from Port Talbot Dock and the Afan River coast. The current lighting character with respect to existing industrial development creates a brighter context condition and a lower target criterion should be aimed for where possible.
- 4.4 Accordingly, the obtrusive lighting criteria associated with Environmental Zone E3 have been adopted for this assessment.
- 4.5 Obtrusive light limits for exterior lighting installations are shown below in Table 4-2 for Zone E3 and are intended to support decision makers in establishing whether artificial lighting is detrimental to local amenity or a potential statutory nuisance.

Table 4-2. ILP Environmental Zone E3 Criteria

Environmental Zone	Sky Glow		Light Spill (into windows)		Glare	
	Upward Light Ratio (ULR ^a)	Upward Flux Ratio (UFR ^b)	Vertical Illuminance ^c		Luminous Intensity ^d	
			Road / Amenity	Pre-curfew	Post-curfew	Pre-curfew
E3	5 %	8% / 12 %	10 lux	2 lux	10,000 cd	1,000 cd

- (a) Upward light ratio (ULR) of the installation is the maximum permitted percentage of luminaire flux for the total installation that goes directly into the sky
- (b) Upward flux ratio (UFR) provides the effect of both direct and reflected upward components of the whole installation, including ground and building surface reflections
- (c) Vertical illuminance measured flat at the glazing at the centre of a residence window
- (d) Luminous intensity of bright luminaires in the field of view between an observer (at a residence location) and a light source

- 4.6 Curfew hours for exterior lighting installations are enforced by the local council where 23:00 is typically applied. This means that between hours of 23:00 and 06:00 a more stringent criteria should be adhered to (per Table 4-2). The permitted light spill limit at a residential receptor for Zone E3 before curfew is 10 lux, and post-curfew it is 2 lux. The permitted source luminous intensity limit when viewed from a residential receptor before curfew is 10,000 candela (cd) and post-curfew is 1,000 cd.
- 4.7 The lighting proposals are consistent with road lighting and amenity area lighting therefore the permitted sky glow limits for ULR of lighting installations is 5 % and the permitted UFR for amenity is a maximum of 12 % and these apply across pre- and post-curfew hours.
- 4.8 As the lighting requirements for the Site will not definitively change during the hours of darkness, only the ILP post-curfew obtrusive lighting criteria have been applied for comparison with the model results.

- 4.9 There are no definitive criteria to quantify the potential effects on ecological and landscape receptors, however many creatures such as owls and bats are active at night and sleep during the day, while others such as birds or moths may be attracted to light. Impacts will potentially limit feeding opportunities, or cause creatures to become confused or collide with floodlit structures. It is generally recommended that for some bats, a maximum limit of 3 lux (or less) be applied (Ref GN08), this is what is adopted for this lighting assessment.
- 4.10 Light colour and spectral composition also have the potential to alter an individual's perception of their environment with respect to colour and clarity, as the human eye responds best to whiter light with higher quantities of ultraviolet wavelengths. Various wildlife species respond differently to a ultra violet (UV) rich spectral composition depending on how reliant they are on darkness and a warmer light colour would be preferred; many nocturnal animals may continue their social habits and feeding behaviours with increased activity in the area while others may decrease their activity and possibly desert their habitat.

5. Proposed Development Overview

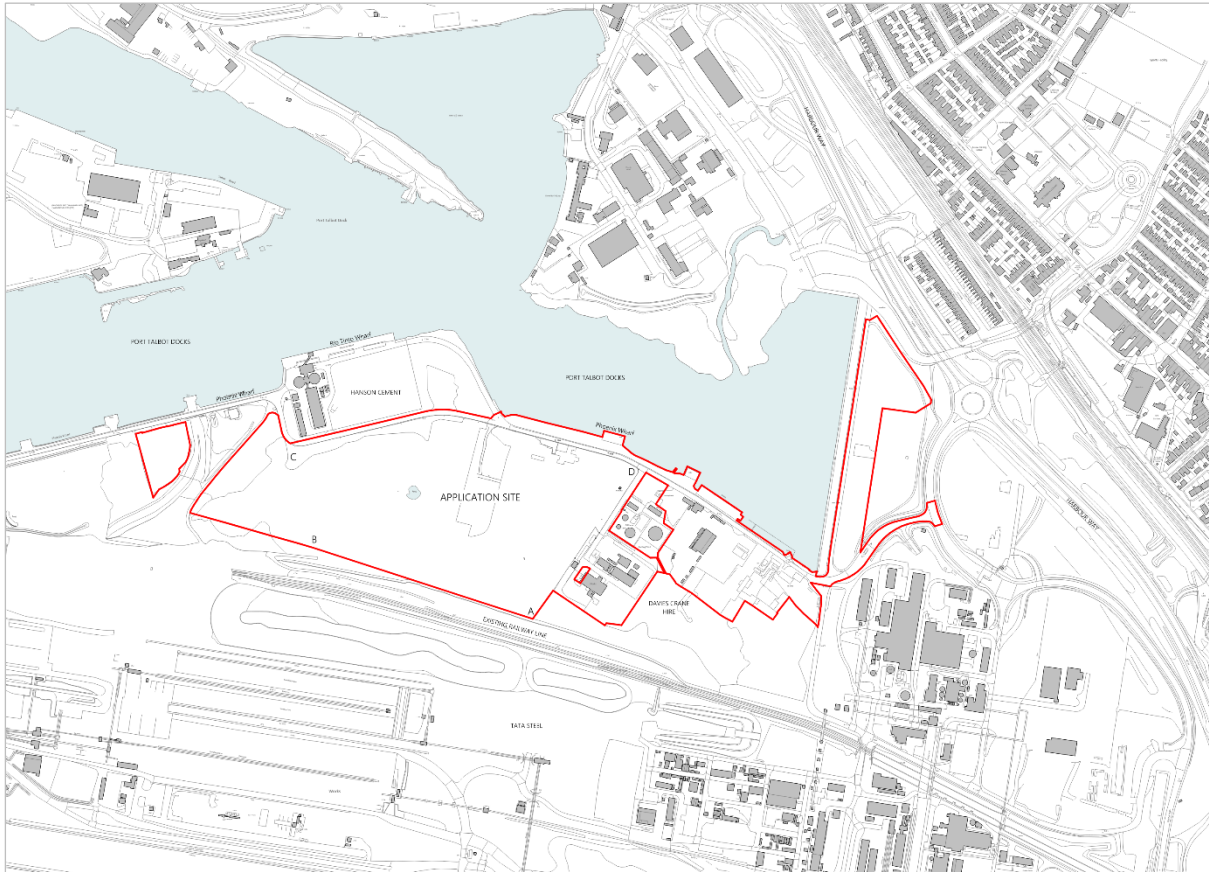
- 5.1 Details of the proposed development are provided in the Project Dragon ES Chapter 4 and in both the Planning Statement and Design and Access Statement and are summarised below.
- 5.2 The facilities that will be provided are contained within the land development and have a requirement for exterior lighting to support safe use and access for contractors and staff.

Project Location

- 5.3 The Land at Crown Wharf, Port Talbot Docks, hereafter named as the 'Site', is located in the county borough of Neath Port Talbot, Wales on the south bank of Port Talbot Dock, situated on the east side of Swansea Bay. The overall site has minimal development and has a general classification as urban, within a location that is predominantly industrial, with the unused docks directly to the north, the cement works to the north-west and other industrial development including the steelworks to the south.
- 5.4 The nearest settlement to the Site is the suburban district Taibach of Port Talbot which is located approximately 490m north-east of the Site (at its closest point). The closest residential properties to the site include twenty-six residential properties located on the west side of West End Road and on the eastern side of Harbour Way (A4241).
- 5.5 The main body of the residential town of Port Talbot is located at less than 1 km to the west, north, east and south-east of the site, where the bulk of residential development is located.
- 5.6 There is a limited degree of wildlife associated with the site; these classified into marine ecology linked to the Port and terrestrial ecology.

Project Site Description

- 5.7 The site comprises brownfield industrial land, which has re-greened over a prolonged period. Land contained within the defined planning red line includes:
- Primary parcel of land for the location of the proposed production facility (approximately 9.12 ha), comprising bare land adjacent to Crown Wharf (Port Talbot) (referred to as the 'Production Development Zone [PDZ]');
 - Temporary Construction Areas located within the wider Port Talbot Docks, approximately 7.44 ha in total) (referred to as 'Temporary Construction Areas'); and
 - An extent of the Unnamed Port Road, running adjacent to the northern boundary of the PDZ (referred to as 'Unnamed Port Road Supporting Infrastructure').
- 5.8 The total overall site size for all land within the planning red line boundary is 17.98 hectares.
- 5.9 Figure 5-1 provides an overview of the Project location with the site extents indicated by a red boundary.

Figure 5-1 Project Dragon Site Location Plan

Source: Inspire Architects drawing 2143.01-IA-ZZ-ST-DR-A-0100 - Site Location Plan, Revision P12.

Proposed Project Layout

- 5.10 Construction of the new Sustainable Aviation Fuel (SAF) production facility at the Site will include an enclosed ground flare, storage tanks, installation of pipework and electrical, processing and utility equipment, administration, warehouse and laboratory buildings, new access, car parking and transport infrastructure including a truck loading area and associated works, hard and soft landscaping, areas for temporary construction laydown, and associated development.
- 5.11 Figure 5-2 shows the proposed site arrangements for Project Dragon development in plan.

Ecology

Terrestrial Ecology

- 6.5 An ecological impact assessment produced by RPS in August 2023 has identified that the main terrestrial species associated with the site include bats, birds and invertebrates [12].
- 6.6 At present, low levels of bat and bird activity has been recorded with respect to foraging habitat within the trees and shrubs present within and surrounding the Site, though the site is not considered to have a high value for the noted species overall. So that a minimal impact to bat populations is made, new development will need to be appropriately controlled to reduce site level effects. Otherwise, the proposed development is not anticipated to create an impact on the conservation status of bats.

Marine Ecology

- 6.7 The Port Talbot Dock is well known to anglers as a fishery area, and according to the UK Fishery Guide the dock is host to a range of course fish species, some of which enter the venue through the dock gates [13]. Known fish include pike, mullet, bass, skimmers, roach, perch, rudd, bream, eels and tench.
- 6.8 Though there is potential for minor changes to result from new lighting such as a new risk of predation but given the area where new lighting is planned for use, it is not expected to disrupt or block migratory routes for the noted marine life.
- 6.9 Note that a comprehensive review of the marine ecology within the Port Talbot waters will be fully developed for the Marine License for the temporary construction and permanent operational wharf facilities. The Marine Licence will complement the planning permission for the terrestrial elements of Project Dragon. It is recommended that the assessment be updated when this new information has been obtained.

Receptor Map

- 6.10 Figure 6-1 provides an overview of residential receptor areas in relation to the site called out in aqua-blue, ecological receptors in Proposed Site area indicated with a red hatch. Key residential locations have been selected

Figure 6-1 Residential and Ecological Receptors



Reference	Type	Address/ Location	Comments
R1	Residential	Mariners Point	Sandfields East residences 850 m west-northwest of the Site on the northern side of Port Talbot with direct views of the Site across the River Afan
R2	Residential	Darwin Road	Sandfields East residences 980 m northwest of the Site on the northern side of Port Talbot with direct views of the Site beyond the Little Warren Playing Fields and over the Port Talbot Dock.
R3	Residential	Harvey Crescent	Sandfields East residences 1.0 km northwest of the Site on the northern side of Port Talbot Dock with direct views of the Site
R4	Residential	Glenavon Street	Aberavon residences 1.1 km north-northwest of the Site on the northern side of Port Talbot Dock with some direct Site views.
R5	Residential	Green Park Street	Aberavon residences 1.1 km north of the Site across Port Talbot. Direct views at lower levels will be partially obstructed by the AWD Group recycling centre in between the residences and the Site.
R6	Residential	79-103 Talbot Road	Residences south of central Port Talbot, located 680 m north-northeast of the Site across Port Talbot Dock. Direct views toward Site partially obscured by tall established trees near Llewelyn's Quay.
R7	Residential	St Albans Terrace	Taibach residences 530 m east of the Site with direct views of the Site across open grassland and the Port Talbot Dock.
R8	Residential	35-56 Tal-Y-Wern	Margham residences 1.3 km southeast of the Site. Direct site views partially obstructed by the Tata Steel works.
E1	Terrestrial Ecology	Treeline on a bund of land	Located 60 m south of the Site across the rail line. Thick, dense treeline of tall trees, identified as potential habitat for bats, birds.

Reference	Type	Address/ Location	Comments
E2	Terrestrial Ecology	Tall shrub woodland on southern Site boundary	Identified as potential habitat for foraging bats and birds identified in these areas.
E3	Terrestrial Ecology	Tall shrub woodland on eastern Site boundary	Identified as potential habitat for foraging bats and birds identified in these areas.
E4	Terrestrial Ecology	Tall shrub woodland on western Site boundary	Identified as potential habitat for foraging bats and birds identified in these areas.
E5	Marine Ecology	Port Talbot Dock	Host to marine fish of various sizes.

Existing Lighting Context

- 6.11 The Site is unlit but is subject to effects from lighting conditions associated with local developed areas particularly the Tata Steel works.
- 6.12 There is a mix of lighting typologies installed in the local area around the Site; on Harbour Way (A4241), and on access roads and carparks supporting to the various neighbouring industrial sites there are streetlight style luminaires mounted on 10-12 m height columns (post top and bracket-arm style); larger industrial sites will also employ building-mounted bulkheads or floodlights, and some column mounted floodlights.
- 6.13 Lamp types observed are predominantly Light Emitting Diode (LED), but also include Metal Halide and High-Pressure Sodium types.

Associated Brightness Conditions

- 6.14 Light mapping from the Campaign for the Protection of Rural England (CPRE) [14] shows that the area around the Site has a moderate to high characteristic brightness which follows along the industrial coast of southern Port Talbot. These developments tend to require increased light for safely undertaking exterior tasks and supporting appropriate security measures. These types of areas tend to be at the higher end of environmental zones as defined by the ILP.
- 6.15 The intensity of light reduces toward the greater Swansea Bay to the west and the agricultural/green reserve land on the hilly rise to the west beyond the suburbs of Taigham and Margam and the M4 motorway.
- 6.16 Figure 6-2 provides an overview of the intensity of light local to the Site where the blocks shown depict the level of radiance that shines up into the night sky. This is a combined result of light shining directly upward and light reflecting upward from the ground or other surfaces.

Figure 6-2 Great Britain Light Pollution and Dark Skies Map



Source: <https://nightblight.cpre.org.uk/maps/> [14]

7. Development Lighting Strategy

Design Overview

- 7.1 The exterior lighting strategy developed reflects the different spatial requirements across the full site.
- 7.2 This lighting assessment reviews proposals to address these requirements and provides an overview of their likely performance in relation to obtrusive light, in particular light spill, sky glow and glare, based on identified constraints, where present, and the local area lighting character.

Lighting Design Parameters

- 7.3 The following lighting targets summarise the minimum criteria that have been used to develop a lighting strategy to support the operation of the Dragon facility. Table 7-1 sets out the design performance criteria established by British Standards (BS EN 5489-1 [5], BS EN 13201-2 [6] & BS EN 12464-2 [7]) requirements and CIBSE good practice guidance.

Table 7-1 Lighting design criteria

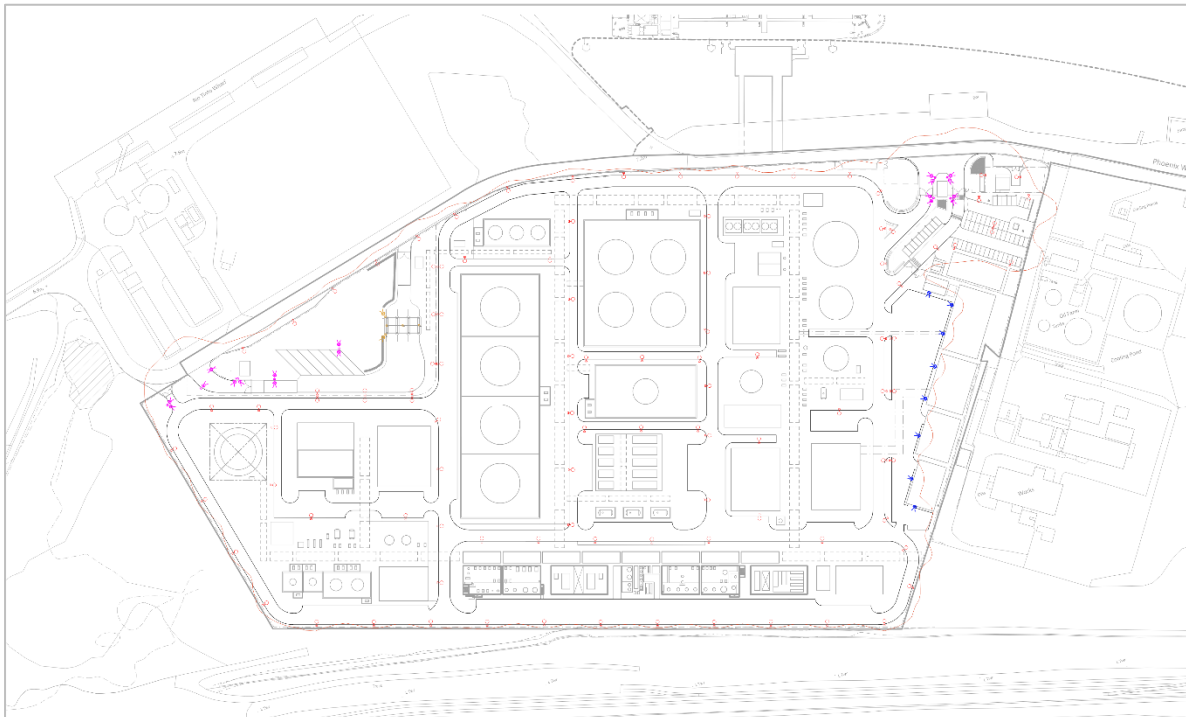
Site area	Light level (lux)	Uniformity	Colour rendering (min)	Glare ratio	Comments
General Circulation (vehicular)	20	0.4	20	50	
High risk operational areas	50	0.4	20	50	
Loading area for hazardous products	100	0.4	20	45	
Car Park / Parking Areas	10	0.25	20	50	
Maintenance Track	10	0.25	20	50	
Entrance Gate	150	0.4	50	50	
Tanker filling (general area)	50	0.4	20	45	

Site area	Light level (lux)	Uniformity	Colour rendering (min)	Glare ratio	Comments
Stairways and Ladders	50 (typical) 100 (high activity)	0.4 (typical) 0.5 (high activity)	40	45	
Outdoor operating platforms	50	0.4	20	50	
Outdoor pump & valve areas	100	0.4	20	50	
Electrical sub-stations outdoor switchyard	50	0.4	20	50	
Electrical sub-stations outdoor transformer area	50	0.4	20	50	
Electrical sub-stations Street lighting	5	0.4	20	50	
Electrical sub-stations Generator fuelling area	50	0.4	20	45	
Outdoor Walkway	50	0.25	20	50	
Pedestrian Walkway	5	0.25	20	50	

Lighting Arrangements

7.4 A lighting strategy has been developed by Technip Energies. Figure 7-1 and Figure 7-2 present extracts of the proposed arrangements in plan and Table 7-2 provides an overview of the proposed lighting equipment selection. Full details of the proposal can be found in Appendix B.

Figure 7-1 Proposed Lighting Layout – Ground Areas



Source: Technip Energies drawing 202947C-050-DW-1632-00001 – External Lighting Layout Drawing (Planning), Revision 1.







Figure 7-2 Proposed Lighting Layout – External Module Areas (outlined red)



Source: Technip Energies drawing 202947C-050-DW-1632-00001 – External Lighting Layout Drawing (Planning), Revision 1.

Table 7-2 Luminaire Typologies

Symbol	Image	Product	Description	Lamp Details	Installation
		Thorn R2L2M 60L50 730 WS CL2 GY	Streetlight Pole mounted Mounting height – 8 m	89 W 12695 lm 139 lm/W 4000 K	Tilt angle 15° above the horizontal (via outreach arm)
		Thorn LEDFIT M 90W A/S CL1 L840	Floodlight Bracket mounted Mounting height – 6 m	90 W 9000 lm 100 lm/W 4000 K	Tilt angle 15° above the horizontal
		Thorn AFP M 72L70 740 WR BS 3550 CL1 GY	Floodlight Pole mounted Mounting height – 10 m	150 W 23249 lm 155 lm/W 4000 K	Tilt angle 15° above the horizontal
		Stahl Floodlight LED Series 6125/2	Floodlight Pole mounted Mounting height – 10 m	160 W 16631 lm 107 lm/W 5700 K	Tilt angle 15° above the horizontal

Symbol	Image	Product	Description	Lamp Details	Installation
		Stahl Universal Spotlight LED Series 6050/6	Highbay Lighting Pendant mounted Mounting height – 8.5 m	80 W 8100 lm 104 lm/W 5000 K	Tilt angle 0°
		Stahl Universal Spotlight LED Series 6050/6	Highbay Lighting Pendant mounted Mounting height – 5.5 m	80 W 8100 lm 104 lm/W 5000 K	Tilt angle 0°
		Stahl EXLUX Linear LED Series 6002/4	Linear Lighting Handrail pole mounted Mounting height – 8.5 m	50 W 6960 lm 139 lm/W 5000 K	Tilt angle 45° around length axis

Lighting Controls

- 7.5 There will be three main service categories: Normal, Essential and Emergency.
- Normal lighting will support day to day site activities and applies to main production facility. This state is considered to utilise 100% of illuminance capacity, although it should be noted this may need to be revisited once the final design and equipment selection has been made to prevent over-lighting in exterior areas.
 - Essential lighting service is required to carry out critical activities in the event of a systems failure, using a back-up generation system or other power source as specified. It is anticipated this would normally apply to interior areas but could also be required where hazardous conditions exist to ensure a consistent lighting condition for safe working.
 - Emergency lighting conditions are considered for internal areas only and are outside the scope of this assessment.
- 7.6 Photocells are to be used as a primary control on all exterior lighting so that no luminaires will remain switched on during daylight hours.
- 7.7 A manual override switch integral to the distribution board shall also be incorporated to control the exterior lighting in the event of an emergency.
- 7.8 In the event a distribution board is regulated by a photocell, the photocell is to be located outside the building housing the board.
- 7.9 High-level platform / module / tank lighting will have the capability of being dimmed and manually switched off when not required.
- 7.10 Site training on lighting control and monitoring to be provided to all staff during site inductions.

8. Technical Assessment

- 8.1 Lighting performance has been determined from arrangements and calculations provided by Technip Energies and a high-level assessment of the outline strategy developed for the SAF production facility.
- 8.2 This assessment considers the effects of the proposed development based on a worst-case scenario, i.e. site area, build height and spatial setup during operation, with all lighting which may be utilised during phased requirements switched on. Screening and obstruction by buildings or other structures outside of the Site boundary was not included in the lighting assessment calculation. Additionally, variable screening that might be provided by mature trees or shrubbery is not included for the assessment, although it is recognised that there will be landscape elements like trees along certain areas of the site boundary. These will create some degree of variable screening throughout the year and further reduce reported effects (where effects are noted from off-site locations).
- 8.3 The DIALux lighting calculation report is provided in Appendix C.

Modelling Parameters

- 8.4 A maintenance factor of 0.9 was used in the Technip calculations to represent a projected long life for fittings, an assumed less than 3-year cleaning cycle and commitment to regular inspection and upkeep of exterior lighting, to include replacement where necessary in case of lamp failure, so that the lighting condition will be consistent for the time it is used.
- 8.5 The simulation images reflect this performance. Day 1 conditions are usually brighter, but this initial brightness can be controlled by using a constant current system that adjusts to provide a consistent light output over time.
- 8.6 Surface reflectance of the ground was set to 20 % and building reflectance set to 30 %.

Light Performance

- 8.7 Areas identified were generally found to meet or exceed the design criteria assumed for light levels and uniformity. It should be noted that the 'Truck Loading' area is illuminated to more than double the required levels for these activities at full output and luminaires will need to be dimmed along this route to avoid over-lighting as part of the normal operational condition. Also note the 'Truck loading entry' area may require 1-2 additional lights to ensure minimum average lux levels are maintained through the lifetime of the luminaires.
- 8.8 The provision of the additional light would allow for some flexibility in raising levels to accommodate any high-risk operational requirements, where necessary.
- 8.9 Table 8-1 provides a summary of the provided simulation results.

Table 8-1 Lighting design results

Site area	Light level (lux) target	Uniformity target	Avg. Light level (lux) result	Min/Avg, Uniformity result	Comments
Car parking area	20	0.25	35	0.32	Meets design criteria
Truck loading area	20	0.40	33	0.41	Meets design criteria
Truck loading	50	0.40	88	0.64	Sufficient light provided; dimming may be required for normal operation.
Roads	10	0.40	13	0.63	Meets design criteria
Truck loading entry	100	0.40	96	0.82	Illumination level close to but not meeting design criteria - may be considered sufficient.
Main entry	100	0.40	118	0.70	Meets design criteria
Building area	20	0.25	26	0.28	Meets design criteria
Weigh bridge	50	0.40	68	0.68	Meets design criteria

Light Spill

- 8.10 The level of light spill from the wellsite at receptor locations has been calculated and simulation results are given in Table 8-2.

Table 8-2 Predicted Light Spill at Receptor Locations

Receptor	Address / Location	Light Spill Criterion (pre/post curfew) (lux)	Predicted Light Spill (max) (lux)
R1	Mariners Point	10 lux pre-curfew / 2 lux post-curfew	0.01
R2	Darwin Road	10 / 2 lux	0.01
R3	Harvey Crescent	10 / 2 lux	0.01

Receptor	Address / Location	Light Spill Criterion (pre/post curfew) (lux)	Predicted Light Spill (max) (lux)
R4	Glenavon Street	10 / 2 lux	0.01
R5	Green Park Street	10 / 2 lux	0.02
R6	79-103 Talbot Road	10 / 2 lux	0.04
R7	St Albans Terrace	10 / 2 lux	0.04
R8	35-56 Tal-Y-Wern	10 / 2 lux	0.01
E1	Treeline on a bund of land	3 lux pre- and post-curfew	(vertical lux) 1.63
E2	Tall shrub woodland on southern Site boundary	3 lux pre- and post-curfew	(vertical lux) 1.95
E3	Tall shrub woodland on eastern Site boundary	3 lux pre- and post-curfew	(vertical lux) 0.16
E4	Tall shrub woodland on western Site boundary	3 lux pre- and post-curfew	(vertical lux) 0.49
E5	Crown Wharf, Port Talbot Dock	3 lux pre- and post-curfew	(horizontal lux) 0.0

R1-R8

8.11 Results show that light spill beyond the boundary of the Site is minimal in most directions with respect to the guidance criteria for pre- and post-curfew lux levels, therefore residential receptors are unlikely to experience a perceived change of their lighting condition in relation to this metric.

E1-E4

8.12 The wood and shrub planting immediately surrounding the Site are identified as a potential habitat for bats, birds and invertebrates [12] offering some foraging habitat for bats but is generally of limited quality and connectivity. Vertical illuminance was measured to a height of 6 m at the treelines, of note, a maximum illuminance reading of 1.95 lux at E2 on the western end of the north-facing boundary closest to the active parts of the Site. Similarly, maximum lux levels on the trees at E1 were detected at around 1.63 lux. Lux levels at other tree/shrub receptor locations were all significantly lower, and values for all the terrestrial ecology receptors are within the acceptable limits for light spill.

E5

8.13 On the waters of Crown Wharf, at 0 m elevation, it was calculated there would be no spill light originating from the Site therefore this is within requirements for light spill.

Glare

8.14 The level of light intensity associated with light sources for the Site when viewed from the eight residential receptor locations has been calculated. Receptors were modelled at a typical height of 1.7 m above the ground (representative of ground floor window). Existing screening effects afforded by mature, dense landscape are not included within the simulation due to the variable amount of leaf / canopy density available throughout the year.

8.15 A summary of results is provided in Table 8-3 and the lighting performance is rated against the most sensitive post-curfew condition. Full details of the glare results are given in Appendix B.

Table 8-3 Predicted Glare at Residential Receptor Locations

Receptor	Address / Location	Light Intensity Criterion (pre/post curfew) (cd)	Modelled Light Intensity (cd) (max value)	Potential Interference Sources
R1	Mariners Point	10,000 cd pre-curfew / 1,000 cd post-curfew	1,349 cd	50 W linear luminaires mounted at 45° angle on Module rooftops

Receptor	Address / Location	Light Intensity Criterion (pre/post curfew) (cd)	Modelled Light Intensity (cd) (max value)	Potential Interference Sources
R2	Darwin Road	10,000 / 1,000 cd	1,297 cd	50 W linear luminaires mounted at 45° angle on Module rooftops
R3	Harvey Crescent	10,000 / 1,000 cd	1,196 cd	50 W linear luminaires mounted at 45° angle on Module rooftops
R4	Glenavon Street	10,000 / 1,000 cd	927 cd	-
R5	Green Park Street	10,000 / 1,000 cd	1,143 cd	50 W linear luminaires mounted at 45° angle on Module rooftops
R6	79-103 Talbot Road	10,000 / 1,000 cd	1,290 cd	50 W linear luminaires mounted at 45° angle on Module rooftops
R7	St Albans Terrace	10,000 / 1,000 cd	1,204 cd	50 W linear luminaires mounted at 45° angle on Module rooftops
R8	35-56 Tal-Y-Wern	10,000 / 1,000 cd	1,346 cd	50 W linear luminaires mounted at 45° angle on Module rooftops

8.16 For all eight residential receptor locations, potential glare during pre-curfew hours was calculated to be within the recommended criteria maximum of 10,000 lux. Some of the predicted values are within the pre-curfew range however there are minor exceedances within the post-curfew period at seven of the eight residential receptors, based on 24 hour working.

8.17 The light fixtures which were found to be potential interference sources for glare were the linear batten style luminaires required for illuminating the open-air rooftop areas on the Modules. These are proposed to be mounted on approximately 3 m height poles supported by the handrails, with luminaires tilted at 45° from the horizontal. Please refer to Section 9 for mitigation strategies to minimise the obtrusive lighting impact from these fixtures.

Sky Glow

8.18 Sky glow associated with the production facility, in the form of both upward lighting ratio (ULR) and upward flux ratio (UFR), has been evaluated. As can be seen from Table 8-4, predicted ULR from the wellsite is within the guidance benchmark but the UFR is in exceedance.

Table 8-4 Predicted Sky Glow

Receptor	Upward Light Ratio (ULR)		Upward Flux Ratio (UFR)	
	Criterion	Development	Criterion	Development
Wider surrounding area	5 %	3.5 %	12 %	24.1 %

8.19 Results show that the direct upward light criteria (ULR) is met. Sky glow is likely to exceed recommended levels for environmental zone E3 from reflected light as the UFR contribution above the recommended criteria. Specific light sources that are identified as most likely high contributors are the fittings which are over-lighting particular task areas.

8.20 The moderately high UFR can be brought back within recommended good practice guidance levels using the approaches listed in Section 9 on Proposed Mitigation.

Results Overview

8.21 Light spill outside of task areas and onto the surrounding land and water is most likely to occur as a result of the new development at Crown Wharf due to the scale of the Project and design requirements to

support safe operation and access around the production facility. This does not extend beyond the site boundary.

- 8.22 Glare and sky glow are expected to be moderately well contained by the proposals, however there is a greater potential for an increase of sky glow from indirect light should there be large areas of over-lighting and so dimming should be considered alongside the proposals to ensure that only the light required is provided.
- 8.23 While not developed to a detailed design level, exterior lighting of the building, modules and tanks is expected to follow a similar performance to general circulation calculated as part of this report, and the same recommendations apply.

9. Proposed Mitigation

- 9.1 To mitigate glare and sky glow effects upon residential receptors some adjustments are recommended, based on the guidance and modelling results provided in this report. A remodelling of certain aspects of the detailed lighting scheme would control obtrusive light to suitable limits and could include the following mitigation measures as part of good lighting design practice:
- introduce a shield or baffle to the linear Module lighting mounting bracket to minimize / obscure source intensity in affected viewing directions and contribution to sky glow from upward lighting;
 - give careful consideration to luminaire positioning and orientation;
 - confine lighting to the task area (use horizontal cut-off optics and zero floodlight tilt angles);
 - reduce light levels to ensure spaces are not over-lit or far beyond recommended levels;
 - observation of a curfew period, where lighting can be shut off and/or dimmed, when practicable; and
 - as the Site is near potential habitat for sensitive ecological receptors (i.e. bats, birds, marine life), lighting should limit output in the blue / ultraviolet range to avoid a change to insect and other animal behaviours. Lower colour temperature lamps (CCT \leq 4000K) should be used where possible.

10. Summary

- 10.1 As stated, exterior lighting is required in the locations shown on the drawings included in Appendix B to allow for safe access and use of the area by employees and visitors. The drawings include the proposed external lighting to illuminate roads, paths, car parks and truck loading areas and task lighting for external areas associated with the modules and compressor houses.
- 10.2 Light modelling of the new lighting arrangement has been undertaken using DIALux software to calculate exterior lighting scenes and evaluate the design against standard good practice guidance for the minimisation of obtrusive light. The model includes all exterior and roof lighting units indicated on the drawings included at Appendix B.
- 10.3 The indicative lighting design strategy largely contains light within the confines of the Land at Crown Wharf, Port Talbot. Pole lighting provides illumination to the designated areas predominantly without over-lighting, and equipment will create a distribution that drops below 1 lux within 45 m from pole locations. It should be noted that the lower aiming angle in the assessment area, and their distance from wooded areas, aids in minimising light reaching adjacent trees.
- 10.4 In summary, the assessment found that no effects relating to light spill upon residential receptors are anticipated. Indirect sky glow and low-level glare effects are anticipated, but these can be sufficiently mitigated using standard, easily applied mitigation measures, such as luminaire shielding, and careful consideration of luminaire positioning and orientation (aiming the fixtures downwards with a concerted intention to only illuminate areas that require light) and by avoiding overlighting areas where possible. No effects upon ecological receptors are anticipated, therefore no specific mitigation is required.

11. References

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- [18] "ILP PLG04 Planning Guidance 4 Guidance on undertaking Environmental Lighting Impact Assessments," Institution of Lighting Professionals (ILP), 2013.
- [19] "SLL Code for Lighting," Chartered Institute of Building Services Engineers, Society of Light and Lighting (SLL), 2022.
- [20] "SLL Lighting Handbook," Chartered Institute of Building Services Engineers, Society of Light and Lighting (SLL), 2018.

Appendix A Drawings

- 2143.01-IA-ZZ-ST-DR-A-0100, Rev P12 (09/08/2023) - Site Location Plan (Inspire Architects)
- 2143.01-IA-ZZ-ST-DR-A-0215, Rev P7 (09/08/2023) – Proposed PDZ Layout (Inspire Architects)
- 2143.01-IA-ZZ-ZZ-DR-A-0401, Rev P6 (09/08/2023) – Proposed Site Sections – Sheet 1 of 2 (Inspire Architects)
- 2143.01-IA-ZZ-ST-DR-A-0402, Rev P5 (09/08/2023) – Proposed Site Sections – Sheet 2 of 2 (Inspire Architects)
- 2143.01-IA-ZZ-ST-DR-A-0610, Rev P1 (27/04/2023) – Proposed Site 3D Views – 01 (Inspire Architects)

Appendix B Calculations

- 202947C-050-DW-1632-00001, Rev 1 (10/08/2023) – External Lighting Layout Drawing (Technip Energies, LanzaTech)
- 202947C-050-STC-1693-00001, Rev 0 (24/03/2023) – Lighting Installation Standard Drawings (34 drawings) (Technip Energies, LanzaTech)
- 202947C-050-DW-XXXX-00001, Rev 0 (28/07/2023) – Lighting Layout Drawing (Planning) (Technip Energies, LanzaTech)

Appendix C Reports

- DIALux Lighting Calculation Report (07/08/2023) (AECOM Specialist Lighting) – attached.

