

Special Applications



Glen Lyon FPSO 2020

Project Type	Initial Blast Event Escape Tunnel
Location	Offshore, North Sea
Owner	BP
Classification Society	Lloyd's Register



Glen Lyon FPSO. The design specification required that the escape tunnel should withstand an explosion over-pressure of 2 bar and a subsequent jet or hydrocarbon fire. The tunnel is required to provide both a safe refuge and a protected means of escape in the event of an emergency. It also has positive internal air pressure to prevent the ingress of smoke and dangerous gases, with airlocks spaced at intervals along the length to allow safe and easy access.

Details

The tunnel is divided into four sections, each of which is suspended from one of the four topside modules. Between each section is an airlock giving access to the processing modules and main deck area. The combined length of the SPS escape tunnel and airlocks is approximately 152m, extending from the aft accommodation area to the forward end of the process deck.

To meet the specification of this demanding project a unique "double protection" system using two concentric SPS tunnels separated by an air gap was designed. The specification of the SPS panels is 4.5-25-4.5, meaning two 4.5mm face plates separated by an elastomer core of 25mm. In the areas of high risk from jet fire, the outer skin of the SPS panels is fabricated from stainless steel, giving additional protection due to the higher melting point compared to carbon steel.

Summary

The SPS Escape Tunnel delivers:

- Protection from explosions and subsequent fire events
- Safe refuge and protected means of escape
- Confirmed performance verified by full-scale tests for fire and blast resistance

Background

The offshore working environment has many hazards and the risk of life-threatening events involving explosions and fire is ever present. The concept of an escape tunnel extending over the length of the vessel was originated by BP to meet their stringent safety requirements for the





Features

The outer tunnel of the double protection system consists of SPS panels forming a primary barrier to resist the initial blast event. The air gap allows the outer tunnel to absorb the blast energy and the SPS inner tunnel provides additional blast and fire protection.

The section profile of the escape tunnel is a rectangular shaped tube, with rounded corners to reduce the drag loads imposed by high velocity gases passing over the structure during a blast event.

The composite SPS panels have no secondary stiffeners, thus avoiding stress concentrations that could potentially lead to structural failure in high energy blast events.

Conventional steel structures require a separate insulation layer such as rockwool blanket to meet the required fire protection standards. But this can become damaged or dislodged in the initial blast, compromising resistance to a subsequent fire event. However SPS panels have built-in fire protection which cannot be dislodged; so the fire protection remains fully effective after the initial explosion.

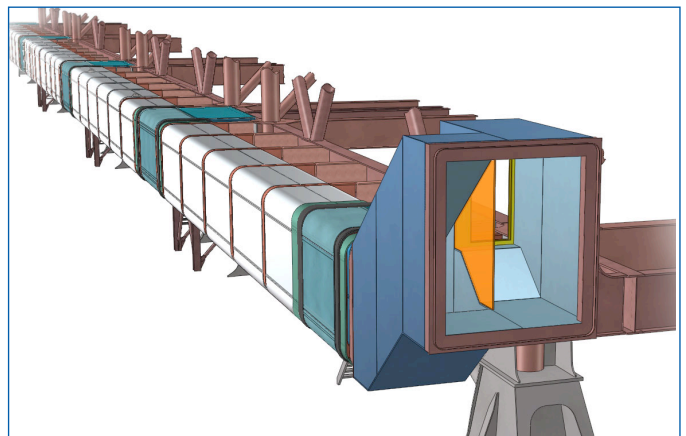
SPS is a structural composite material comprising two metal plates bonded with a core to form a light, stiff sandwich material with excellent strength and energy absorption characteristics. In using SPS, structures can be tailored to take advantage of the enhanced impact protection, greater resistance to blast and ballistics, built-in fire protection and improved performance against fatigue and corrosion compared to traditional steel structures.

Verification and testing

Every aspect of the SPS escape tunnel design was subjected to extensive verification. All of the technical work was subjected to independent assessment by Lloyds Register. To verify the blast resistance, full scale tests were conducted at a specialist facility operated by GL-Noble Denton.

Tests for hydrocarbon and jet fires are among the most onerous used in the industry. To demonstrate compliance IE built a number of full-scale samples which were subjected to the specified tests at GL-Noble Denton and at the UK Building Research Establishment, witnessed by Lloyds Register.

In addition to blast and fire performance, a programme of extensive engineering design and analysis was conducted to demonstrate compliance with the specified strength requirements. This included blast loads, live loads, stresses induced by hull bending, green water impact, wind loads and vessel motions. The analytical verification was completed for the specified survivability requirements and included pre- and post-emergency event scenarios.



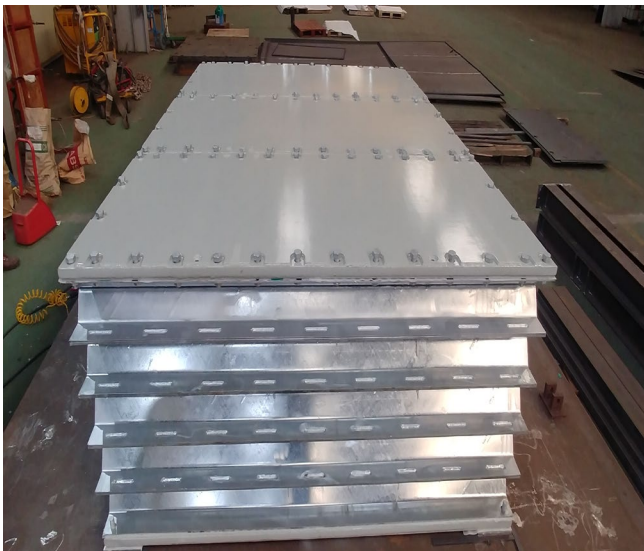
Project Dennison
2019

Project type	SPS Impact Resistant Deck
Location	UK
Team	Subject to NDA



SPS Technology was asked to design an impact-resistant deck to protect an existing floor from damage due to falling objects. The protection deck is intended to resist penetration and to absorb and distribute the impact load of a 1.6 tonne object dropped from a height of 50m at an impact velocity of 31.3 m/s with 810 kJ of kinetic energy.

Three design variations were developed and presented for consideration through a process of 3D modelling, finite element analysis and physical testing.



All versions of the SPS protection deck consisted of an SPS panel to resist penetration of the impact object; collapsible elements to convert kinetic energy to plastic strain energy; and a base to distribute the remaining force to the floor. The three arrangements were assessed and optimised - a two-layer system using wide flange shapes, a three-layer system using channels and wide flange shapes and a uniform honeycomb system.

Of the proposed options, the honeycomb protection deck system, was the most effective in reducing the load on the floor and therefore became the preferred alternative.

Clean Rooms
2013, 2018-19 (4 projects)

Project Type SPS Floor Panels
Location North America and Ireland
Team Subject to NDA



Used as an alternative to reinforced and cast-in-place concrete, heavy steel or stiffened aluminium panels, which are prone to deformation, SPS structural composite panels offer a superior high-performance, lightweight floor system with inbuilt impact resistance, noise and vibration damping and thermal insulation. **They are capable of withstanding a 7-tonne point load on a 50cm² panel, in other words, they become immediate load-carrying platforms for forklifts to drive on but are still light enough for one person to lift.**

SPS Technology is building a strong global track record of using SPS structural composite panels to solve the unique challenges of clean rooms, including installations in leading semiconductor manufacturers' facilities. SPS 'pop-out' panels are fully removable offering access to below floor spaces. The panels were designed and installed as cover plates for access ports located on an extremely low vibration waffle floor system. SPS floor panels offer a lightweight alternative to conventional solutions. Our largest panel weighs approximately 13kg/28lbs, against nearly 43kgs/95lbs for a traditional material and are simple to install or remove as required using, for example, standard suction cups with handles.

These unique panels are maintenance-free and fully recyclable. SPS 'pop-out' panels can be manufactured to any required size or geometry, with load carrying capacities designed to meet your requirements.

Cape Canaveral Crew Access Tower 2015

Project type SPS Structural Floor Panels
Location Florida, US
Team United Launch Alliance



United Launch Alliance (ULA), America's Ride to Space, chose SPS for the structural flooring panels on the top three levels of a Crew Access Tower at Space Launch Complex 41 at Cape Canaveral Air Force Station. The SPS product offers an ultra slim deck at 1 ¼" (3.18cm) thick that is structurally composite with the steel framing of the tower; the panels also offer sound damping and assist in vibration reduction.

SPS is a lightweight alternative to other typical structural decking options weighing just 20 psf, with an expected 75 year service life.

The SPS panels offer a level of durability and protection not achievable with traditional materials and have been tested against cellulosic, hydrocarbon and jet fires. They have an A60, H120 and J60 fire rating and offer protection against extreme oil and gas fires. SPS absorbs blast energy and preserves structural integrity.

ULA brings together two of the launch industry's most experienced and successful teams, Atlas and Delta, to provide reliable, cost-effective space launch services for the US Government.

"As these projects don't come around very often, it is gratifying that SPS was selected. This structural material has been tested for thousands of hours and we know that it will provide the acoustic and vibration damping and strength required by the structure."

David Glover
CEO, SPS Technology

Modular Police Holding Cells
2011 - 2019 (6 sites)

Project type	Prefabricated Modular Units
Location	London, UK
Team	Wates Construction



SPS Technology has a proven track record in the design, manufacture and installation of modular holding cells. A total of 6 sites have successfully been upgraded for the Metropolitan Police, London.

The use of SPS brings many benefits including better ballistics and ballast protection, improved detainee and correctional staff safety, more cells in a smaller footprint (SPS is only 28mm thick whereas typical construction is 200mm), scalable facilities (additional wings can be added when required) and good acoustic performance (airbourne sound insulation 35db for bare SPS).

The holding cells can be supplied either as a flat pack with on-site bolted assembly or pre-assembled off-site with welded connections with panels for corridors and ceilings delivered flat packed, ready for installation. All cells are independent units with no shared walls and can be installed after the building is enclosed (roof already in place).

Each cell, typically 2.4m (W), 3.5m (L) and 3.2m (H), is manufactured with service runs and windows and arrives on site with connections, penetrations and coatings incorporated at the manufacturing plant, which leads to a dramatic reduction in deliveries and construction time, which in turn improves site safety. The cells, lifted directly from the truck, require smaller cranes and two four-person crews with a foreman. Up to 10 units can be installed per day.

Pressure Test Enclosure
2010

Project type Prefabricated modular unit
Location Bradford, UK
Team Hoerbiger UK Ltd



The SPS pressure test enclosure delivered a safer environment to pressure test compressor components, providing enhanced protection against projectiles and shrapnel. The energy absorbing characteristics of the light, slim SPS panels made it ideal for this application. The 3.6m x 3.6m x 3.15m enclosure was designed and constructed in accordance with HSE Pressure Test Safety Guidelines (Report 168/1998). It can withstand a nitrogen blast pressure of 0.1 MPa and prevent the passage of projectiles and shrapnel in a blast event. This equates to a maximum test pressure of 400 bar at the internal volumes being tested.

The composite structure of SPS provides triple-barrier protection and a safer working environment than conventional all-steel enclosures. Ballistic tests have demonstrated that SPS is more effective at absorbing energy from projectiles. It also reduces the risk of fragmentation (scab) from the outside surface of the SPS panel, which is a common cause of injury to personnel and damage to property. The enclosure was pre-fabricated at our SPS production facility and transported to Bradford for on-site assembly. The bolted design incorporated an inward opening door that is secured against the metal frame when closed.

“Hoerbiger’s aim is to offer the best possible quality and solution to our customers. The ability to test components to their full working pressure in a safe manner allows us to meet this objective. Using SPS panels gives our test engineers additional protection that steel alone would not provide.”

Matt Jackson
Manager, UK Engineering & Technical Services Hoerbiger UK Ltd

SPS Citadel Access Protection

Enhanced protection against hostile attacks

Summary

SPS Citadel Access Protection provides:

- A new final barrier to delay and deter hostile attacks
- Protection within 90 seconds
- Enhanced protection from impact loads, blasts and projectiles
- Ballistic and blast compliant designs available

Background

Citadel protection is a proven concept that has a successful track record for protecting ships and crew from piracy. The internationally recognised Best Management Practice to Deter Piracy in the Gulf of Aden and off the coast of Somalia recommends that due consideration should be given to establishing a secure citadel that “is designed and constructed to resist a determined pirate trying to gain entry for a fixed period of time”. SPS is an ideal product for citadel hardening.

Details

SPS Citadel Access Protection delays and deters entry to the safe refuge. The SPS protection panels create a formidable final barrier that is specifically designed to prevent unauthorised access. The SPS panels are typically located 125mm inside the existing doorway and can be installed on new construction vessels or retrofitted on existing vessels.



View from inside Citadel

The SPS system comprises a solid steel frame, SPS panels and clamps. The solid steel frame is straight forward to install and is constructed from standard steel profiles. The frame is fully welded around the existing doorway and the SPS panels are then secured against the frame using specially designed clamps. The SPS barrier can either be constructed from a single hinged SPS door or interlocking SPS panels that are manhandled into position.

Location	Accesses leading to safe area or “Citadel”
Design	SPS protection panels
Installation	By ship’s crew/steel contractors



View from outside Citadel

Once installed, the SPS barrier creates a detail free surface that can be rapidly deployed within 90 seconds. The panels slot into position and are secured by tightening tommy screws in the clamps. When closed, the SPS panels create an extremely strong barrier that can withstand far higher impact loads than equivalent steel structures with superb protection against ballistics and shrapnel damage. Panels can be designed to survive/protect against any defined ballistics or fragmentation threat.

¹ Local removal/relocation of insulation and services may be required to fit the frame

SPS for Citadel Protection

Crew safety is the upmost importance to all seafarers, operators and owners, never more so than when under attack by pirates. Installing SPS Citadel Access Protection at entrances to the designated citadel will better protect the crew. SPS will delay the advance of pirates while the crew retains command and control of the vessel and waits for outside assistance.

The composite structure of SPS creates an extremely strong barrier that is highly resistant to impact loads typically inflicted by mechanical tools. The installed doorway was tested by repeatedly hammering/stabbing the panels with 5kg sledge hammers, picks and pikes (see pictures below). The panels proved extremely resilient, resisted indentation, remained flat and secure after multiple attacks.

The composite structure of SPS provides triple-barrier protection that is far superior to standard steel water-tight doors. Ballistic tests conducted at leading military facilities

in the US, UK and Japan demonstrated that SPS structures outperform steel structures. Ballistic tests by QinetiQ (UK) indicate that the risk of penetration from projectiles is reduced by 75% and that these projectiles are stopped at higher angles of attack. The test series also demonstrated that SPS panels reduce the risk of fragmentation (scab from the outside surface of the panel, which is a common cause of injury to personnel and damage to property).

Sandwich Plate System - SPS

SPS is a structural composite material made up of two metal plates bonded with an elastomer core. SPS delivers high strength, superb impact resistance and enhanced stiffness making it a more robust alternative to conventional stiffened steel structures.

SPS is now used in a wide variety of products including structural flooring, stadia and arena terraces, blast enclosures, ships, offshore structures and bridges.



Test Equipment
Hammers, picks and pikes



SPS Panel Test
SPS panel repeatedly attacked



QinetiQ Ballistics Test
Protection from bullets and fragments