Certified Sustainable Cable Maintenance

Fire protection of electrical cables on

NAVAL VESSELS

FS has protected more than 300 vessels, including naval vessels, LNG carriers, passenger ferries and cruise ships at the rate of nearly one a month for a quarter of a century.

MANAGEMENT SYSTEM CERTIFICATION
DNV
ISO 9001 · ISO 14001
ISO 45001

Fire Security / US Navy Testing Background

In 2012 the USS Miami - a USN Los Angeles Attack Class Submarine - was in the Portsmouth Naval Shipyard for a scheduled twenty-month engine overhaul and systems upgrade

- A twelve-hour fire raged after being intentionally set by a disgruntled contractor
- Unprotected cable routings propagated the spread of the fire
- Repairs were estimated at USD 700 Million resulting in the USS Miami being decommissioned and replaced at an estimated cost of USD 1.3 Billion.

End Result - A vital national asset decommissioned at mid-life… leaving a gap in the force and a hole in a nation´s warfighting capabilities.

After the USS Miami fire the Navy set out to find solutions to mitigate these problems.

Coating the electrical cables was found as one of the solutions. The civilian market was scoured and a range of candidates for trials were found. Based on extensive US Navy testing the FS1 cable coating was down-selected.
Fire Security was then requested by the Navy to support further testing to ensure the suitability of FS1 in a naval vessel environment.

FS1 is SSRAC approved for inclusion in NAVSEA Std Item 009-32.

Non-fire tests

- FS1 found to have a "PERMITTED" usage category

"…it is recommended that the FS1 coating be considered for transition into the fleet."

…testing conducted suggests that the installation of the coating on shipboard cableways would provide significant benefit to shipboard fire protection…

FS1 coated cables would significantly reduce the propagation and gas release potential of cables in the vicinity of the fire.

The FS1 is a persistent, passive fire risk mitigation technology designed to protect vessels and lives in the maritime environment.

- **FS1 has been in commercial use on cruise ships and oil platforms for over twenty years**
- **FS1 has been down-selected and successfully tested by the US Navy**
- **FS1 has been deemed acceptable for use in submarine reactor compartments.**

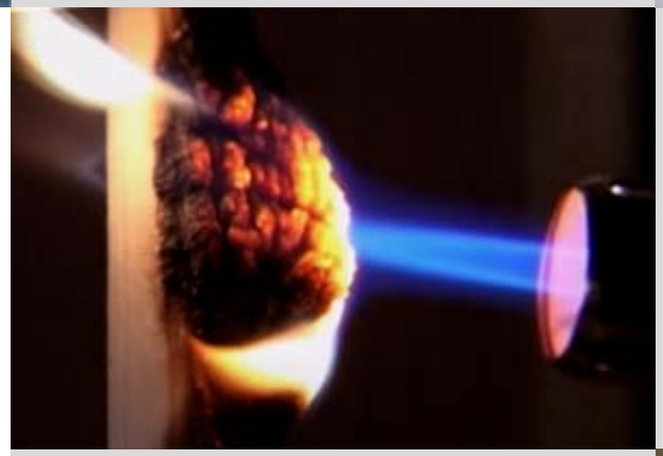
Fire Security is a Norwegian company specializing in class-approved repair and fire protection of electrical cables. We are the only producer offering a turn-key operation with specially trained personnel for application worldwide. We have more than 30 years of experience in cable fire protection worldwide.

FS coated cables will function during a fire, and if the fire is extinguished within a reasonable time, there is no need for cable replacement.

Fire Security Technical Director
Leif Harald Tveitnes

FS1 CABLE COATING

Passive Fire Protection



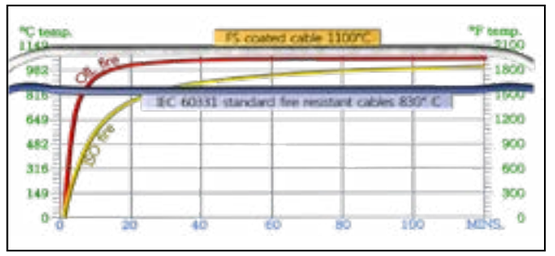
FS1 is an intumescent coating that will expand 100 times its thickness during a fire - thus protecting the cables from fire damage and making sure the cables function when needed the most.

SAVING COST, SAVING ASSETS, SAVING LIVES

In a fire situation our systems will prevent:

- *Ignition of the cable insulation*
- *Release of toxic fumes from the cable insulation*
- *Release of poisonous gas (HCL) from the cable insulation*
- *The cable tray from melting and collapsing*

Will your cables survive a hydrocarbon fire?



The yellow curve shows the temperature of an ISO fire - 830° Celsius, which is a normal cellulose fire. The red curve represents the temperature of an oil fire - up to 1100° Celsius - the temperature to which Fire Security has tested their coatings. This is the temperature you would be facing if you had such a fire.

How the protection works
During a fire, the coating will expand up to 100 times its thickness, thus protecting the cable from fire damage. Coated cables will function during a fire and be usable afterwards. If the fire is extinguished within a reasonable time, there is no need for cable replacement.

A PROVEN SOLUTION TO CABLE FIRE PROTECTION

Problem

- MIL- DTL-24643 and MIL-DTL-24640 compliant cables are excellent cables comparable to the best in the commercial market. Nevertheless, these cables have over a long time been known to contribute to fuel fires and propagate fires.
- Cable outer sheath and ships paint and general protective coatings burn off in the first minutes of a high temp space fire.
- Shipboard cables provide a significant fuel source for fires.
- Fires propagate in minutes on uncoated cables.
- Electrical cables and cableways provide conduit for fire-spread.
- Legacy Polyvinyl Chloride (PVC) cabling is still present on older ships and releases hydrogen chloride acid gas when exposed to fire presenting threat to life and critical electrical systems.

Solution

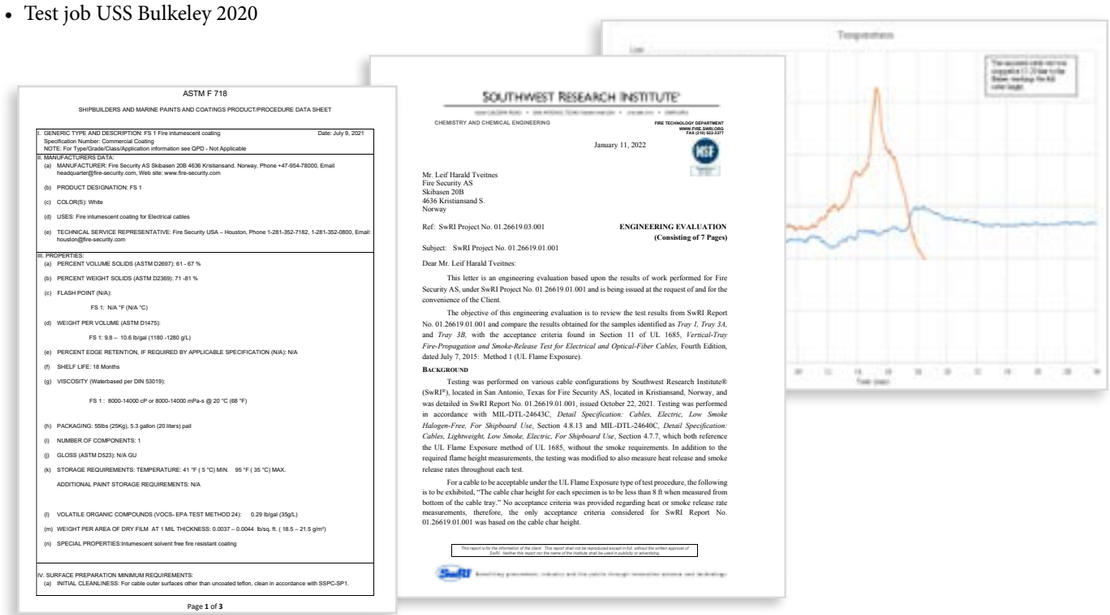
- Among others, the Cruise industry uses the commercial marketplace´s most sophisticated and safest cables. Nevertheless, the Cruise industry has experienced on numerous occasions that these cables fail prematurely and contribute fuel to the fire. Subsequently, the Cruise industry has implemented FS1 as a voluntary standard.
- FS1 is a Mature/High TRL passive fire protection - Ready TODAY.
- More than twenty years´experience in Offshore, Cruise ships, and Commercial shipping - Proven high ROI
- FS1 is an intumescent coating system available to mitigate fire risks used on cruise ships and oil platforms for more than 20 years.
- Significantly reduces the fire-spread and the release of toxic gasses from PVC cabling.
- Improves fire survivability and inhibits fire spread involving MIL- DTL-24643 compliant cables and cableways.

FIRE PROTECTION AND EXTENDED OPERATIONAL LIFE

Fire Security's coating systems have the ability to upgrade the cables fire technically and at the same time extend the lifetime of the cables without any shutdown. This gives you a huge flexibility when maintaining or upgrading an existing ship.

US NAVY TESTING COMPLETED 2015-2017

- NSWCCD: Fire Performance Evaluation Of Coated and PVC Electric Cable
- NMCPHC: Submarine Materials Review for the use of FS1 onboard LOS ANGELES, OHIO, and SEAWOLF class submarines.
- BUMED: Health Hazard Assessment (HHA) surface ships.
- MIL-DTL-24643 Large-scale fire testing on coated and uncoated cables.
- UL 910 and UL 1666 Worst-case fire threats in both the horizontal and vertical orientations.
- NSWCCD down selected FS1 coating during testing and provided recommendation for Fleet use in 2017
- New test in 2021
- Navsea standard Item 009-32 Approved
- Test job USS Bulkeley 2020



ASTM F 718

SHIPBUILDERS AND MARINE PAINTS AND COATINGS PRODUCT/PROCEDURE DATA SHEET

I. GENERIC TYPE AND DESCRIPTION: FS 1 Fire intumescent coating — Date: July 9, 2021
Specification Number: Commercial Coating
NOTE: For Type/Grade/Class/Application information see QPD - Not Applicable

II. MANUFACTURERS DATA:
(a) MANUFACTURER: Fire Security AS Skibasen 20B 4636 Kristiansand. Norway, Phone +47-954-78000, Email headquarter@fire-security.com, Web site: www.fire-security.com
(b) PRODUCT DESIGNATION: FS 1
(c) COLOR(S): White
(d) USES: Fire intumescent coating for Electrical cables
(e) TECHNICAL SERVICE REPRESENTATIVE: Fire Security USA – Houston, Phone 1-281-352-7182, 1-281-352-0800, Email: houston@fire-security.com

III. PROPERTIES:
(a) PERCENT VOLUME SOLIDS (ASTM D2697): 61 - 67 %
(b) PERCENT WEIGHT SOLIDS (ASTM D2369): 71 -81 %
(c) FLASH POINT (N/A):
FS 1: N/A °F (N/A °C)
(d) WEIGHT PER VOLUME (ASTM D1475):
FS 1: 9.8 – 10.6 lb/gal (1180 -1280 g/L)
(e) PERCENT EDGE RETENTION, IF REQURIED BY APPLICABLE SPECIFICATION (N/A): N/A
(f) SHELF LIFE: 18 Months
(g) VISCOSITY (Waterbased per DIN 53019):
FS 1 : 8000-14000 cP or 8000-14000 mPa-s @ 20 °C (68 °F)
(h) PACKAGING: 55lbs (25Kg), 5.3 gallon (20 liters) pail
(i) NUMBER OF COMPONENTS: 1
(j) GLOSS (ASTM D523): N/A GU
(k) STORAGE REQUIREMENTS: TEMPERATURE: 41 °F (5 °C) MIN. 95 °F (35 °C) MAX.
ADDITIONAL PAINT STORAGE REQUIREMENTS: N/A
(l) VOLATILE ORGANIC COMPOUNDS (VOCS- EPA TEST METHOD 24): 0.29 lb/gal (35g/L)
(m) WEIGHT PER AREA OF DRY FILM AT 1 MIL THICKNESS: 0.0037 – 0.0044 lb/sq ft. (18.5 – 21.5 g/m²)
(n) SPECIAL PROPERTIES:Intumescent solvent free fire resistant coating

IV. SURFACE PREPARATION MINIMUM REQUIREMENTS:
(a) INITIAL CLEANLINESS: For cable outer surfaces other than uncoated teflon, clean in accordance with SSPC-SP1.

Page 1 of 3

SOUTHWEST RESEARCH INSTITUTE®

CHEMISTRY AND CHEMICAL ENGINEERING — FIRE TECHNOLOGY DEPARTMENT

January 11, 2022

Mr. Leif Harald Tveitnes
Fire Security AS
Skibasen 20B
4636 Kristiansand S.
Norway

Ref: SwRI Project No. 01.26619.03.001 — **ENGINEERING EVALUATION (Consisting of 7 Pages)**

Subject: SwRI Project No. 01.26619.01.001

Dear Mr. Leif Harald Tveitnes:

This letter is an engineering evaluation based upon the results of work performed for Fire Security AS, under SwRI Project No. 01.26619.01.001 and is being issued at the request of and for the convenience of the Client.

The objective of this engineering evaluation is to review the test results from SwRI Report No. 01.26619.01.001 and compare the results obtained for the samples identified as *Tray 1, Tray 3A,* and *Tray 3B,* with the acceptance criteria found in Section 11 of UL 1685, *Vertical-Tray Fire-Propagation and Smoke-Release Test for Electrical and Optical-Fiber Cables,* Fourth Edition, dated July 7, 2015 . Method 1 (UL Flame Exposure).

BACKGROUND

Testing was performed on various cable configurations by Southwest Research Institute® (SwRI®), located in San Antonio, Texas for Fire Security AS, located in Kristiansand, Norway, and was detailed in SwRI Report No. 01.26619.01.001, issued October 22, 2021. Testing was performed in accordance with MIL-DTL-24643C, *Detail Specification: Cables, Electric, Low Smoke Halogen-Free, For Shipboard Use,* Section 4.8.13 and MIL-DTL-24640C, *Detail Specification: Cables, Lightweight, Low Smoke, Electric, For Shipboard Use*, Section 4.7.7, which both reference the UL Flame Exposure method of UL 1685, without the smoke requirements. In addition to the required flame height measurements, the testing was modified to also measure heat release and smoke release rates throughout each test.

For a cable to be acceptable under the UL Flame Exposure type of test procedure, the following is to be exhibited, "The cable char height for each specimen is to be less than 8 ft when measured from bottom of the cable tray." No acceptance criteria was provided regarding heat or smoke release rate measurements, therefore, the only acceptance criteria considered for SwRI Report No. 01.26619.01.001 was based on the cable char height.

This report is for the information of the client. This report shall not be reproduced except in full, without the written approval of SwRI. Neither this report nor the name of the Institute shall be used in publicity or advertising.

Temperature

Flame spread

"Uncoated cables spread flame more than 2.4 m (8 ft) further than the coated cable array. This additional flame spread produced significantly more heat, and the fire growth associated with the uncoated cable was so untenable that the test was terminated early due to flames breaching the test enclosure. …the benefit of FS1 becomes more apparent as the severity of the exposure fire increases."
Extract: NAVSEA Test Report 2017

Enhanced Circuit Integrity in a fire situation

- More time to stay on mission
- More systems online to suppourt the mission
- More time to fight the fire.
- More systems online to fight the fire
- The larger the scale of the test or severity of the exposure, the greater the benefit that is provided by the FS1 coating."

Extract: NAVSEA Test Report 2017

Smoke and toxicity

The FS1 cable coating material met and exceeded test criteria for US Navy tests conducted in both small- and full-scale scenarios.
"All cases had reductions in gas release concentrations, and in some cases the complete prevention of a certain species of gas from being released was observed."

KEY FEATURES OF FS1 INTUMESCENT COATING

Our products have been approved by the world's leading classification societies and authorities.
In a fire situation our FS1 coating will prevent:

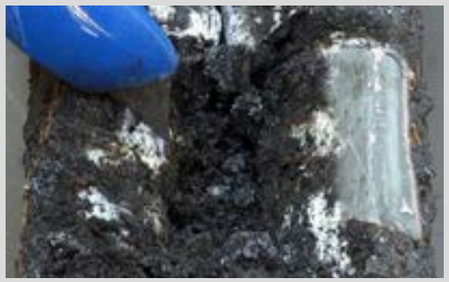
- Ignition of the cable insulation.
- Release of toxic fumes from the cable insulation
- Release of poisonous gas (HCL) from the cable insulation
- The cable tray from melting and collapsing

FS1 Intumescent coating product will expand up to 100-times its original thickness. As the coating expands, it becomes considerably more voluminous creating a lightweight char insulator that keeps high temperature away from cable cores and structural members, such as cable supports and cable trays.

FS1 Intumescent coating is made of a series of chemicals suspended in a binder. When the binder is exposed to heat it begins to soften, which allows the suspended chemicals to heat. The chemicals begin to react. A carbonization occurs and this solidifies into an off-black insulating material that is often referred to as char.

Protects uncoated areas up to 4cm

The picture above shows how the intumescent coating expands to provide protection from heat and flames. It is also important to note that the FS1 Product is not burning. Instead, a chemical reaction is taking place that builds up an insulating material that protects even unprotected exposed areas up to 4cm for the whole length of the cable tray vertical and horizontal from heat and direct flame contact.



AN INTERNATIONAL STANDARD FOR THE CRUISE INDUSTRY

Millions of people travel the ocean every year for business or pleasure. Fire Security is one of the most important partners in making this travel as safe as possible. It is our objective to enhance the safety of the vessel, its passengers and crew and consequently Fire Security's products have become an international standard for the cruise industry.

Fire Security - what we offer and how we work.
Fire Security is a company specializing in class-approved repair and fire protection of electrical cables. We are the only producer offering a turnkey operation with specially trained personnel for application worldwide.

Fire Security offers to conduct surveys of cables in high-risk areas of your vessels, after which a detailed report is handed over to you with suggestions to what we can do to improve the fire technical properties of your cables, what you will gain and a price quote. This is done totally free of charge with no commitment from your side.

Our **Vice President Terje Waage** is in charge of the cruise sector at Fire Security. As a co-founder of the company, he has more than 30 years of experience and has overseen more than 270 cruise ships being protected by our team of applicators at the rate of one a month for the last twenty-three years.


Carnival

January 11, 2008

To Whom It May Concern

Carnival Cruise Lines is the world's largest cruise operator and over the past six years the company has protected cabling in high fire risk areas throughout its fleet using Fire Security 's highly effective coating systems.

The company plans to continue use Fire Security's products on its future newbuilding projects.

Fire Security products are used in a variety of engine room spaces, specifically the separator rooms, incinerator flat, emergency generator and Azipod rooms.

The safety and security of Carnival's guests and crew is of the utmost importance so it is vital to use a company that possesses a solid reputation in the industry and offers products that can perform at high levels in extreme temperatures. In addition, we require a product that would allow us to continue normal service, regardless of the surrounding environment and temperature.

Since Fire Security met all our expectations and demands with regards to organization and products, Carnival contracted with them to complete the remaining vessels in our fleet.

Carnival is very pleased how Fire Security assisted our company in these various projects and can offer Fire Security and their coatings our highest recommendation.

Best Regards

B.W. Swensen
Vice President, Technical Operations
Carnival Cruise Lines


Color Line
MARINE

Sandefjord, 16.09.2005

To: **Whom it may concern**

Fire Security Coating

Color Line is one of the leading cruise- and ferry operators in Scandinavia.
On all our vessels we have protected the cables in high risk areas, such as engine rooms, purifier rooms etc. by using the products of Fire Security.

In August 2005 we experienced a fire in the main engine room on board one of our vessels. Lighting fixtures and smoke detectors melted completely, nevertheless the consequences were insignificant.

Over a short period temperatures were extreme until the local fire protection system - Hifog - extinguished the fire. The cables were found to be in normal working order and there was no need for any cable replacements as a result of this incident.

We assign this fortunate outcome to the products of Fire Security, which allowed the ship to continue it's normal service.
We are pleased to give Fire Security and their coatings our best recommendation.

Best regards
for COLOR LINE MARINE AS

Johann Martinussen
Superintendent, Electric & Automation

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THE WORLD · SEABOURN · SILJA LINE · SILVERSEA · STAR CRUISES · SUPERFAST FERRIES · TUI Cruises

Last updated March 2023

Certified Sustainable Cable Maintenance

FS offer certified sustainable solutions to extend cable life
and avoid electrical fire, using non-toxic materials.

Save Lives / Save Costs / Save The Environment

Our products have been approved by leading classification societies
and authorities including U.S. COAST GUARD, IMO MED D & IMO MED B,
Lloyd's Register, Achilles, Bureau Veritas, DNV, RINA, NMA, ABS, FM and UL

Sjøfartsdirektoratet
Norwegian Maritime Authority

DNV

FM Approvals

Notified Body
0575

BUREAU VERITAS

RINA

IMO

ABS

Lloyd's Register

UL Underwriters Laboratories

Global headquarters

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