

# The power for a cleaner energy future and a safer environment is in our hands

Cable Solutions for the Nuclear power industry



# CONNECTING THE WORLD. TODAY AND IN THE FUTURE

**Prysmian Group is world leader  
in the energy and telecom cables  
and systems industry.**

**With 140 years' experience,  
the Group is strongly positioned  
in high-tech markets and offers  
the widest possible range  
of products, services, technologies  
and know-how.**

**140**  
YEARS OF  
EXPERIENCE

**25**  
R&D CENTRES  
AROUND  
THE WORLD



**We specialise in underground and submarine cables and systems** for power transmission and distribution, special cables for applications in many different industries, and medium and low voltage cables for the construction and infrastructure sectors.



**For the telecommunications industry, the Group is the world's largest provider** of cutting-edge cables and accessories for voice, video and data transmission, offering a comprehensive range of optical fibres, optical and copper cables and connectivity systems.



**We are committed to environmental responsibility** in our production processes, the protection of the global environment, and the responsible management of relations with the local communities in which we work.



**For us, innovation means meeting the needs of our customers and communities** by understanding their business drivers as quickly as they do. To do that, our team of over 900 Research & Development professionals is constantly looking to the future, predicting and identifying emerging trends in each of our industries and sectors. Acting on this intelligence from 25 R&D centres around the world, we're constantly close to our customers in their own local markets.





# Nuclear Cables

The Paris Climate Change Conference Agreement resulted into the declaration in favour of the consolidation of efforts of the signatory countries to create a green energy future. When referring to eco-friendly power, solar, wind and hydroelectric are the most widely acknowledged sources and nuclear is usually left out. Nuclear power, instead, is an undeniable component of a green energy mix and can make a significant contribution to achieving sustainable energy goals and enhancing energy security. It is a reliable and predictable source of electricity and supports economic development by providing “clear conditions” that may be forecast up to 60 years in advance. It also offers “low volatility” because the “commodity component” in the cost of energy generated by nuclear power plants is very low, below 3%.

Three main principles drive the development of nuclear power: security of energy supplies, environmental safety and cost efficiency. These have always been Prysmian Group’s main focus in the development of cables for nuclear power stations. Nuclear power plants consist of various areas that differ by ambient temperature, radiation-related risks and relevance for the overall system security: the Nuclear Island, where reactor and safety systems are located; the Conventional Island, where the turbines that generate electricity are installed; and the Building Block (Balance of Plant or BOP) that comprises of all power plant’s supporting components and auxiliary systems needed to deliver the energy, other than the generating unit. The environmental conditions in the first two operating areas are severe and persistent over time and many of the components that are critical for the safe and efficient operation of a nuclear power plant, including cables, are permanently exposed to such harsh conditions.

Metals are not affected by such exposure, but organic polymeric compounds undergo oxidization, due to the combined action of oxygen, high temperature and gamma radiation. In cables, the deterioration of polymeric layers does not guarantee the consistently high levels of safety and reliability that are required throughout a cable’s operation life cycle, usually 60 years.

In order to tackle this technical challenge, Prysmian Group offers the highest standards of reliability and safety, developed over more than 50 years of expertise in designing and manufacturing nuclear cables both in the USA and in Europe and R&D centres specifically dedicated to nuclear cables development.



## **INTERNATIONAL STANDARDS, CERTIFICATIONS AND PROTOCOLS**

Prysmian Group offers three different nuclear cable families, certified by

renowned third party laboratories and suitable, respectively, for CST4C068 Nuclear Protocol (EPR Reactor type), for IEEE 323/383 Nuclear Protocol (Westinghouse, GE-Hitachi, Mitsubishi, KEPCO and CANDU Reactor type) and for NP 001-15 (OPB 88/15) Nuclear Protocol (VVER Reactor type).

## **FULL PRODUCT PORTFOLIO**

Our large portfolio of cable products for typical and bespoke applications inside a nuclear power plant includes:

Low Voltage, Instrumentation & Control, Medium Voltage up to 20 kV, Coaxial, Ethernet, Composite and Fibre Optic Cables.

## **EXTENDED PROJECT TRACK RECORD**

Prysmian Group relies on the participation in the construction of the most recent nuclear power

stations worldwide and on a long-standing proven experience in successfully delivering projects in partnership with major EPC contractors.

## **GLOBAL EXCELLENCE, LOCAL REACH**

Our goal is to provide our international customers with the best added-value offer,

meeting local production requirements, guaranteeing the support of a competent and multi-role team in proximity and delivering reliable cables with a proven lifetime of at least 60 years in operation for the utmost security of their nuclear power plants, anywhere in the world.

## **MATERIALS INNOVATION, EXPERIENCE AND EXPERTISE**

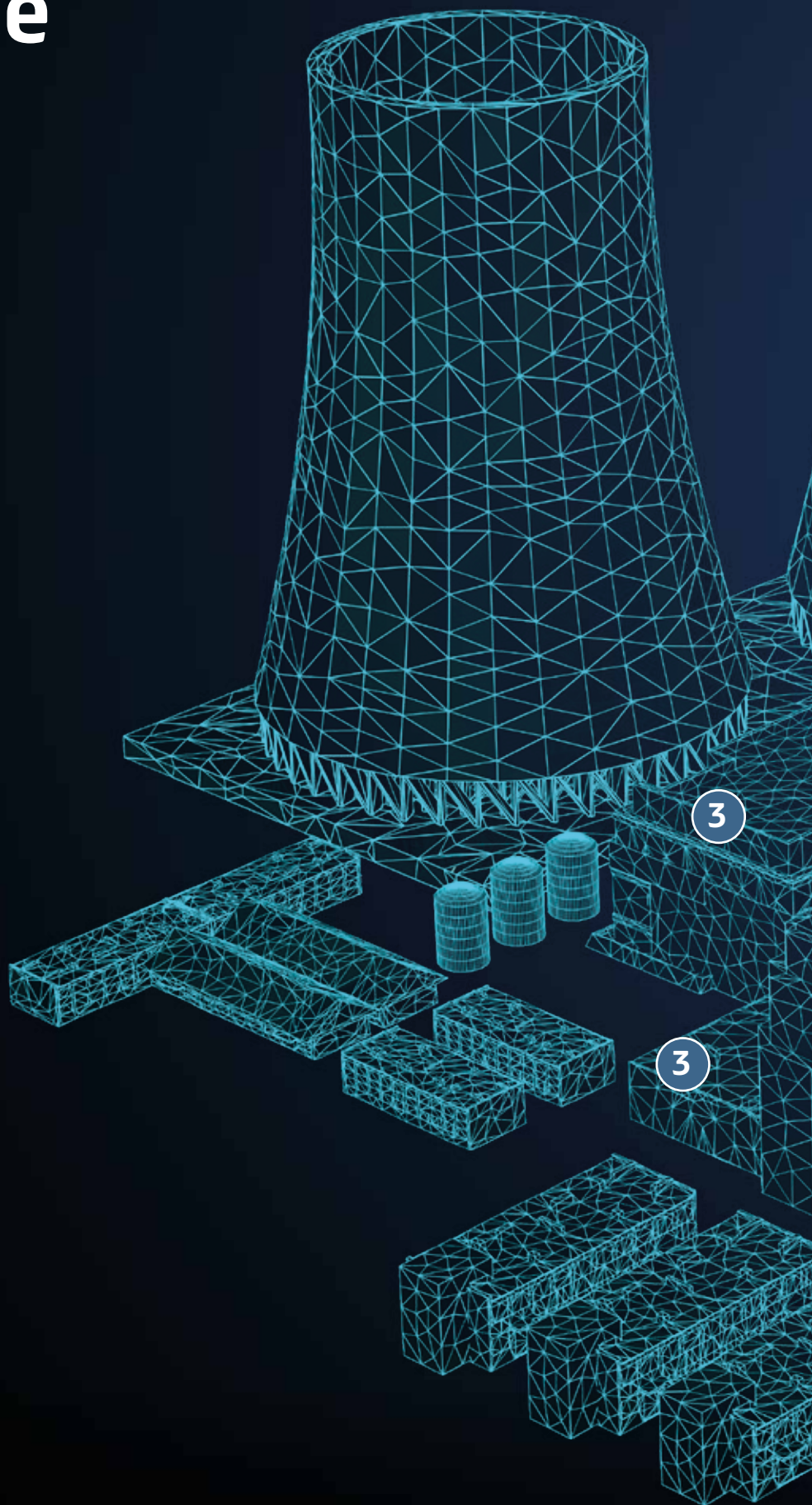
Prysmian Group's experience and expertise in the

development and fine-tuning of proprietary innovative organic polymeric compounds for harsh and safety-related environment is just one of the many areas in which we excel at. Extensive experience about effects of gamma irradiation, irradiation flow rate, combined temperatures and pressures in thermodynamic shocks, extensive researches on degradation of polymers and compounds impacting nuclear cables (thermal and radiation aging) are also among the many.

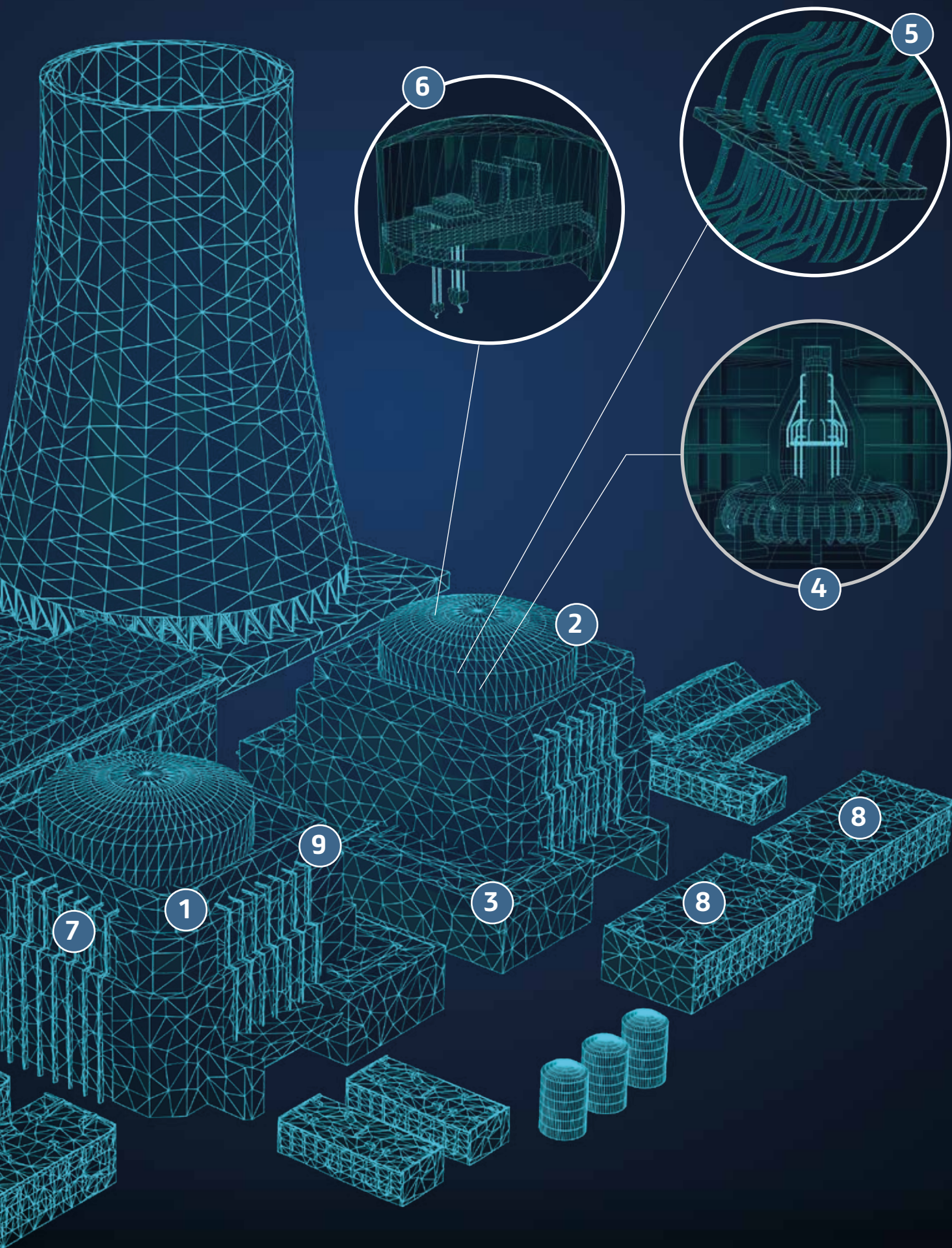


# Product Families at a glance

- 1 1E Safety Class (IEEE) or K1/K2 (CST) or HF-FRHF NP 001-15 cables inside Reactor containment
- 2 1E Safety Class cables for Nuclear Containment Sealing
- 3 1E Non Safety Class (IEEE) or K3 (CST) or LS-FRLS NP 001-15 cables for Turbine Island and auxiliary Safety Systems
- 4 K2 (CST) Coaxial Cables for measuring neutronic chain, reaction & core temperature
- 5 K1/K2 (CST) Composite Cables for Control Rod Systems
- 6 K1/K2 (CST) or HF-FRHF NP 001-15 cables for polar cranes inside reactor containment
- 7 K1/K2/K3 (CST) or HF-FRHF-LS-FRLS NP 001-15 Thermocouple cables
- 8 1E Non Safety Class (IEEE) or K3 (CST) or LS-FRLS NP 001-15 LV, I&C, Coaxial Ethernet, Optical Fiber cables for Control Room, Electrical Cabinets
- 9 1E Safety/Non Safety Class (IEEE) or K1/K2/K3 (CST) or FRHF FRLS NP 001-15 Fire Resistant Cables







# Product Mapping

PRYSMIAN BRAND	CABLE FAMILY	CABLE BRAND	DESIGNED FOR REACTOR TYPE	NUCLEAR SAFETY CLASS	APPLICATION	NUCLEAR STANDARD	
GENERAL CABLE		ULTROL 60+	AP1000- ABWR - APWR -CANDU-APR1400	CLASS 1E TC-ER	LV Power	IEEE323/ IEEE383 (1974/2003)	
GENERAL CABLE		ULTROL 60+	AP1000- ABWR - APWR -CANDU-APR1400z	CLASS 1E / SAFETY-RELATED	Thermocouple Extension	IEEE323/ IEEE383 (1974/2003)	
GENERAL CABLE		ULTROL 60+	AP1000- ABWR - APWR -CANDU-APR1400	CLASS 1E SAFETY-RELATED	Instrumentation	IEEE323/ IEEE383 (1974/2003)	
GENERAL CABLE		ULTROL 60+	AP1000- ABWR - APWR -CANDU-APR1400	CLASS 1E / SAFETY-RELATED	Control Cable	IEEE323/ IEEE383 (1974/2003)	
GENERAL CABLE		ULTROL 60+	AP1000- ABWR - APWR -CANDU-APR1400	CLASS 1E / SAFETY-RELATED	Medium Voltage	IEEE323/ IEEE383 (1974/2003)	
PRYSMIAN		AFUMEX TECNUC	EPR - ATMEA	K1 LSOH (PK1BB) K2 LSOH (PK2BB) K3 LSOH (PK3BB)	LV Power	RCCE/ CST74C068	
PRYSMIAN		AFUMEX TECNUC	EPR - ATMEA	K1 LSOH (PK1KC) K3 LSOH (PK2KC)	Thermocouple	RCCE/ CST74C068	
PRYSMIAN		AFUMEX TECNUC	EPR - ATMEA	K1 LSOH (PK1HC) K2 LSOH (PK2HC) K3 LSOH (PK3HC)	MV Radial Field Single core & Three cores	RCCE/ CST74C068	
PRYSMIAN		AFUMEX TECNUC	EPR - ATMEA	K1 LSOH (PK1CG) K2 LSOH (PK2CG) K3 LSOH (PK3CG)	Control	RCCE/ CST74C069	
PRYSMIAN		AFUMEX TECNUC	EPR - ATMEA	K1 LSOH (PK1PS) K2 LSOH (PK2PS) K3 LSOH (PK3PS)	Instrumentation paired cores with Individual and General Screen	RCCE/ CST74C068	
PRYSMIAN		AFUMEX TECNUC	EPR - ATMEA	K2 LSOH	Coaxial	RCCE/ CST74C068	
PRYSMIAN		SIENOPYR (HF-FRHF) - TECNUC (HF) - SAFENUC(HF-FRHF)	VVER	FRHF-HF (Class. 2-3-4) & FRLS-LS (Class. 2-3-4)	LV Power Fire Resistant LV Power	P 001-15 NP 001-15	
PRYSMIAN		SIENOPYR (HF-FRHF) - TECNUC (HF) - SAFENUC(HF-FRHF)	VVER	FRHF-HF (Class. 2-3-4) & FRLS-LS (Class. 2-3-4)	LV Power Fire Resistant LV Power	P 001-15 NP 001-15	
PRYSMIAN		SIENOPYR (HF-FRHF) - TECNUC (HF) - SAFENUC(HF-FRHF)	VVER	FRHF-HF (Class. 2-3-4) & FRLS-LS (Class. 2-3-4)	MV Power (HF)	P 001-15 NP 001-15	
PRYSMIAN		SIENOPYR (HF-FRHF) - TECNUC (HF) - SAFENUC(HF-FRHF)	VVER	FRHF-HF (Class. 2-3-4) & FRLS-LS (Class. 2-3-4)	Control (HF)	P 001-15 NP 001-15	
PRYSMIAN		SIENOPYR (HF-FRHF) - TECNUC (HF) - SAFENUC(HF-FRHF)	VVER	FRHF-HF (Class. 2-3-4) & FRLS-LS (Class. 2-3-4)	Instrumentation (HF) & Instrumentation Fire Resistant (FRHF)	P 001-15 NP 001-15	
PRYSMIAN		SIENOPYR (HF-FRHF) - TECNUC (HF) - SAFENUC(HF-FRHF)	VVER	FRHF-HF (Class. 2-3-4) & FRLS-LS (Class. 2-3-4)	Compensation (HF) Compensation Fire Resistant (FRHF)	P 001-15 NP 001-15	



	DESCRIPTION	CROSS-SECTION	CONDUCTOR	CONDUCTOR MATERIAL	VOLTAGE	INSULATION	SCREEN	OUTER JACKET	CABLE COLOR SHEATH
	3x 4x Conductor + V/G Dual Sheath	8 AWG (8,36 mm <sup>2</sup> )-750 kcmil (38 mm <sup>2</sup> )	ASTM B8 Class B	CU	600V	FR-XLPE		XLPO	Black
	1-12 Pairs Individually Shielded Overall Shield	18 AWG (0,82 mm <sup>2</sup> ) and 16 AWG (1,31 mm <sup>2</sup> ) solid alloy	ASTM B8 Class B	CU	600V	FR-XLPE		XLPO	Black
	2-19 Pairs/Triads individually Shielded Overall Shielded	18 AWG (0,82 mm <sup>2</sup> ) and 16 AWG (1,31 mm <sup>2</sup> ) solid alloy	ASTM B8 Class B	CU	600V	FR-XLPE		XLPO	Black
	2-37 Multi-Conductor/ Overal Shield	14 AWG (2,08 mm <sup>2</sup> ) and 10 AWG (5,26 mm <sup>2</sup> )	ASTM B8 Class B	CU	600V	FR-XLPE		XLPO	Black
	Single Conductor Shielded	6 AWG (13,3 mm <sup>2</sup> ) and 1000 kcmil (507 mm <sup>2</sup> )	ASTM B8 Class B	CU	5kV -8kV-15kV	EPR		XLPO	Black
	1x-5x Conductor Dual Sheath	1,5 mm <sup>2</sup> -800 mm <sup>2</sup>	IEC 60228 Class 1-2-5	CU	0,6/1 (1,2) kV	XLPE		Cross-Linked Polyolefin	Blue
	1P--24P Dual Sheath	1 mm <sup>2</sup>	NFC 42-324	+Nichel Chrome / - Nichel Alloy	600 V	XLPE	Copper Braid Individual Screen & General Screen	Cross-Linked Polyolefin	Green
	1x & 3x Conductor Dual Sheath	16 mm <sup>2</sup> -800 mm <sup>2</sup>	IEC 60228 Class 2	CU - AL (only K3)	6/10 kV 8,7/15 kV	XLPE	Copper Tape	Cross-Linked Polyolefin	Black
	2x & 48x Conductor Dual Sheath	0,34 mm <sup>2</sup> -10 mm <sup>2</sup>	IEC 60228 Class 2	CU	0,3/0,5 kV 0,6/1 kV	XLPE	Copepr Braid	Cross-Linked Polyolefin	Gray
	1P--24P Dual Sheath	0,35 mm <sup>2</sup> -1,5mm <sup>2</sup>	IEC 60228 Class 5	CU	0,15/ 0,25k V 0,3/0,5 kV	XLPE	Copper Braid Individual Screen & General Screen	Cross-Linked Polyolefin	White
	1x Conductor Dual Sheath	ø 0,90 mm - ø 2,25 mm		Silver CU -Tinned CU	50 Ω 75 Ω 112 Ω	XLPE	Tinned Copper Braid Screen	Cross-Linked Polyolefin	White
	1x-5x Conductor Dual Sheath	1,5 mm <sup>2</sup> -240 mm <sup>2</sup>	IEC 60228 Class 1-2-5	CU	0,6/1 kV	EPR		Cross-Linked Polyolefin	Black
	1x-5x Conductor Dual Sheath	1,5 mm <sup>2</sup> -240 mm <sup>2</sup>	IEC 60228 Class 1-2-5	CU	0,6/1 kV	EPR	Copper Tape Screen	XL-LSOH/ LSOH	Black
	1x-3x Conductor Dual Sheath	95 mm <sup>2</sup> -500 mm <sup>2</sup>	IEC 60228 Class 2	CU	6/10 kV	XLPE	Copper Tape Screen	XL-LSOH/ LSOH	Black
	2x-37x Conductor Dual Sheath	1 mm <sup>2</sup> -6 mm <sup>2</sup>	IEC 60228 Class 1-2-5	CU	0,6/1 kV	XLPE	Copper Tape/ Copper Braid/ Al/PET tape + drain wire	XL-LSOH/ LSOH	Black
	1P--40P Conductor Dual Sheath	0,5mm <sup>2</sup> -1,0mm <sup>2</sup>	IEC 60228 Class 1-2-5	CU	250 V & 500 V	EPR	Copper Braid/ Al/PET tape + drain wire	XL-LSOH/ LSOH	Black
	1P--14P Conductor Dual Sheath	0,5 mm <sup>2</sup> -1,0 mm <sup>2</sup>	IEC 60228 Class 1-2	+Nichel Chrome / - Nichel Alloy	0,6/1 kV	EPR	Individual metallized polymeric Tape, General Copper Braid	XL-LSOH/ LSOH	Black

# Product & Brands

## AFUMEX TECNUC

The historical brand of Prysmian Group developed in the Group's excellence centre for nuclear cables in France and identifying the whole family of cables for nuclear power plants. Originally designed for RCC-E Nuclear Protocol and addressed to Nuclear power plants by AREVA/Framatome/EDF, AFUMEX TECNUC has extended its reach to VVER Reactors and the relevant P 001-15 NP 001-15 Nuclear Protocol according to safety class HF Class 3. Thermodynamic performances of AFUMEX TECNUC have been verified and approved respectively by EDF SEPTEN labs for the RCC-E Nuclear Protocol and by the AREVA/Framatome laboratory for P 001-15 NP 001-15 Nuclear Protocol safety Class HF class 3 (60 years life-time big leaks 150 °C) .

## ULTROL 60+

The well-known General Cable US legacy brand name and the latest evolution of the ULTROL cable family, serving the US nuclear market for more than 40 years. ULTROL 60+ cables have been designed in compliance with Nuclear Protocol IEEE 323/383 ver. 1974/2003, pursuant to all US Nuclear Regulatory Commission recommendations and to the environmental protocol of reactors installation designed by Westinghouse, GE-Hitachi, Mitsubishi and KEPCO. Cables are approved and certified both for 1E Class and 1E Non-Class Safety Level, by independent IEEE-related certification bodies.







## SIENOPYR KO / SIENOPYR XA

The brand name identifies products developed by Prysmian Group's excellence centre located in Germany. The cables have been originally developed in cooperation with AREVA/ Framatome to serve Germany's domestic nuclear market. Subsequently, the application of the cable family has been extended to the VVER Nuclear Protocol P 001-15 NP 001-15 for safety category FRHF- HF Class 2 & 3, following extensive test sessions at the Chemistry and Radio Chemistry AREVA/ Framatome labs of Erlangen. SIENOPYR KO identifies Fire Resistant cables 60 years life-time big leaks 215 °C. SIENOPYR XA is the KO equivalent version without fire resistance performances.



## SAFENUC

The latest Prysmian Group's cable family released, offering a viable, reliable and proven technical solution for nuclear environment safety classified as type 1E Non-Class, K3 Class and, above all, HF- FRHF class 4 and LS FRLS class 2-3-4 in compliance with Nuclear Protocol P 001-15 NP 001-15 (VVER Reactors). SAFENUC cables use special compounds developed internally by Prysmian Group and offer local production sourcing opportunities while complying with the strict requisites of reliability and performance imposed by the safety requirements of the relevant zone of installation.



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