

核电站用1E级电缆

1E Class Cable for Nuclear Power Station

该类电缆适用于核电站核反应堆(压水堆或沸水堆)安全壳外用1E级K3类电缆回路。

生产执行标准

企业标准 (参照法国《RCC-E压水堆核电站核岛电气设备设计和建造规则》及核工业第二研究设计院编写的《0.6/1kV控制电缆技术规格书》的规定要求)

产品主要特点

- 1.该产品是用于核反应堆安全壳外, 在正常情况及地震荷载下能执行其功能的电缆。质量鉴定程序为“K3”类。
- 2.产品具有无卤低烟阻燃特性, 当火灾发生时蔓延速度慢, 烟浓度低, 有害气体释放量小, 故对仪器设备的腐蚀性伤害小, 能够适应核电站特殊环境要求。
- 3.该类产品共开发了以下几个品种: 额定电压6/10kV及以下电力电缆、控制电缆、仪器仪表电缆、补偿电缆、通信用光缆等五个系列, 以适应不同场合的使用要求。

产品型号规格

- 1、额定电压6/10kV及以下电力电缆
型号名称

It is used for return circuit of class 1E category K3 outside security housing of nuclear reactor in nuclear power station.

Executive Standard:

as the enterprise's enterprise (with reference to "Design & Manufacturing Regulations on Electric Devices of Nuclear Island of RCC-E Reactor in Nuclear Power Station" of France & "Technical Specifications of 0.6/1kV Control Cable" by No.2 Research & Design Institute of Nuclear Industry)

Main Features:

- 1.The cable, which is located outside security housing of nuclear reactor, keeps itself in normal operation under normal circumstance and earthquake loading. It belongs to category K3 by quality appraisal procedure .
- 2.It has flame-retardant performance free from halogen with low smoke and low spreading speed, smoke density and poisonous gas emission in fire disaster, which results in low corrosion on instruments and devices. It could meet special environmental demands of nuclear power station.
- 3.Cables for nuclear power station include 5 categories: powercable of rated voltage 6/10kV or lower, control cable, instrument cable, compensational cable, & optic fiber cable.

- Power Cable of Rated Voltage 6/10kV or Lower
Type & Description

核电站电力电缆 型号及名称
Type & Description of Power Cable for Nuclear Power Station

型 号Type		名 称Description
铜Cu	铝Al	
HDYJE-6	HDYJLE-6	额定电压6/10kV交联聚乙烯绝缘热塑性(热固性)护套无卤低烟阻燃核电站用电力电缆 Flame-retardant power cable for nuclear power station of rated voltage 6/10kV with XLPE insulation, low smoke and halogen-free thermoplasticity (thermosetting) sheath
HDYJE23-6	HDYJLE23-6	额定电压6/10kV交联聚乙烯绝缘钢带铠装热塑性(热固性)护套无卤低烟阻燃核电站用电力电缆 Flame-retardant power cable for nuclear power station of rated voltage 6/10kV with XLPE insulation, steel tape armor, low smoke and halogen-free thermoplasticity (thermosetting) sheath
HDYJE-1	HDYJLE-1	额定电压0.6/1kV交联聚乙烯绝缘热塑性(热固性)护套无卤低烟阻燃核电站用电力电缆 Flame-retardant power cable for nuclear power station of rated voltage 0.6/1kV with XLPE insulation, low smoke and halogen-free thermoplasticity (thermosetting) sheath
HDYJE23-1	HDYJLE23-1	额定电压0.6/1kV交联聚乙烯绝缘钢带铠装热塑性(热固性)护套无卤低烟阻燃核电站用电力电缆 Flame-retardant power cable for nuclear power station of rated voltage 0.6/1kV with XLPE insulation, steel tape armor, low smoke and halogen-free thermoplasticity (thermosetting) sheath

规格

Specification

核电站用电力电缆规格
Power Cable Specification for Nuclear Power Station

型 号 Type	芯数 Core Number	额定电压 Rated Voltage kV	
		0.6/1	6/10
		标称截面mm ²	Nominal Cross-section Area mm ²
HDYJE-6	1	1.5~400	50~400
HDYJLE-6	2	1.5~150	--
HDYJE23-6	3	1.5~300	25~400
HDYJLE23-6	4	1.5~300	--
HDYJE-1	4	1.5~300	--
HDYJLE-1	3+2, 4+1	1.5~300	--
HDYJE23-1	5	1.5~35	--
HDYJLE23-1			

注：钢带铠装结构电缆，导体截面应选择2.5mm²以上规格。

Remarks: The cross-section area of conductor for the cable with steel tape armor should be more than 2.5mm².

2、控制电缆

Control Cable

型号名称

Type & Description

核电站用控制电缆型号及名称
Type & Description of Control Cable for Nuclear Power Station

型 号Type	名 称Description
HKYJE	铜芯交联聚乙烯绝缘热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用控制电缆 Control cable for nuclear power station with Cu core, XLPE insulation, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) polyolefin sheath
HKYJEP	铜芯交联聚乙烯绝缘镀锡铜线编织屏蔽热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用控制电缆 Control cable for nuclear power station with Cu core, XLPE insulation, shield of braided tinned Cu wire, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) polyolefin sheath
HKYJE23	铜芯交联聚乙烯绝缘钢带铠装热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用控制电缆 Control cable for nuclear power station with Cu core, XLPE insulation, steel tape armor, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) sheath

注：电缆屏蔽形式可以是编织屏蔽型，也可以是铜塑复合带(P2)或铝塑复合带(PL)绕包屏蔽型。

Remarks: The shieldings include braiding shield, Cu-plastics compound tape (P2) or Al-plastics compound tape (PL) wrapping shield.

规格

Specification

核电站用控制电缆规格
Specifications of Control Cable for Nuclear Power Station

型 号 Type	额定电压 Rated Voltage(kV)	标称截面 Nominal Cross-section Area (mm ²)		
		1.0	1.5	2.5
		芯 数 Core Number		
HKYJE	0.6/1	2~61		
HKYJEP				
HKYJE23		4~61		

3、仪器、仪表电缆

Instrument Cable

型号及名称

Type & Description

核电站用仪器仪表电缆型号及名称
Type & Description of Instrument Cable for Nuclear Power Station

型 号Type	名 称Description
HYYJEP	铜芯交联聚乙烯绝缘镀锡铜丝编织总屏蔽热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用仪器仪表电缆 Instrument cable for nuclear power station with Cu core, XLPE insulation, general shielding of braided tinned Cu wire, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) polyolefin sheath
HYYJP ₂ EP ₂	铜芯交联聚乙烯绝缘铜塑复合带绕包分屏蔽及总屏蔽热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用仪器仪表电缆 Instrument cable for nuclear power station with Cu core, XLPE insulation, individual and general shields of wrapping Cu-plastics compound tape, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) polyolefin sheath
HYYJP _L EP	铜芯交联聚乙烯绝缘铝塑复合带绕包分屏蔽镀锡铜丝编织总屏蔽热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用仪器仪表电缆 Instrument cable for nuclear power station with Cu core, XLPE insulation, individual shield of wrapping Al-plastics compound tape and general shield of braiding tinned Cu wire, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) polyolefin sheath
HYYJEP ₂	铜芯交联聚乙烯绝缘铜带绕包总屏蔽热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用仪器仪表电缆 Instrument cable for nuclear power station with Cu core, XLPE insulation, general shielding of wrapped Cu tape, low smoke, halogen-free & flame-retardant thermoplasticity (thermosetting) polyolefin sheath
HYYJEP _L	铜芯交联聚乙烯绝缘铝带绕包总屏蔽热塑性(热固性)无卤低烟阻燃聚烯烃护套核电站用仪器仪表电缆 Instrument cable for nuclear power station with Cu core, XLPE insulation, general shielding of wrapped Al-plastics compound tape, low smoke & halogen-free thermoplasticity (thermosetting) polyolefin sheath

规格

Specification

核电站用仪器仪表电缆规格
Specifications of Instrument Cable for Nuclear Power Station

型 号 Type	额定电压V Rated Voltage V	导体直径 mm Conductor Diameter mm	线芯对数 (二线组或三线组) Core Pair(s) (2 wire or 3 wire group)
HYYJEP HYYJEP ₂ HYYJEP _L HYYJP ₂ EP ₂ HYYJP _L EP	300/500	1.0或(or) 0.8	1~37

4、补偿电缆
型号及名称

Compensational Cablee
Type & Description

核电站用补偿电缆型号及名称
Type & Description of Compensational Cable for Nuclear Power Station

型 号Type	名 称Description
HB-(KCB)YJEP	铜-铜镍40型合金丝导体交联聚乙烯绝缘镀锡铜丝编织屏蔽热塑性(热固性)护套无卤低烟阻燃聚烯烃护套核电站用补偿电缆 Compensational cable for nuclear power station with Cu-CuNi 40 type alloy conductor, XLPE insulation, shield of braided tinned Cu wire, thermoplasticity (thermosetting) polyolefin sheath, low smoke, halogen-free & flame-retardant sheath

注: ①补偿电缆的屏蔽型式有总屏蔽、分屏蔽、分屏蔽加总屏蔽三种可供选择, 屏蔽材料有: 镀锡铜丝(P)、铜带(P2)、铝带(PL);
②其它型号补偿电缆EX、TX、NC、JX等只需改写型号中括号内的部分, 如: HB-EXYJEP₂、HB-KXYJEP。

Remarks: ①The cable shieldings include 3 forms, i.e. general shield, individual shield, individual & general shields, and shielding materials include inned Cu wire (P), Cu tape (P2) & Al tape (PL).
②The indication of compensational cables of other types such as EX, TX, NC, JX could be made with the change of those in the brackets, for example, HB-EXYJEP₂, HB-KXYJEP.

型 号 Type	额定电压V Rated Voltage V	线芯对数 Core Pair(s)	标称截面 Nominal Cross-section Area (mm ²)
HB-(KCB)YJEP	300/500	1~19	1.0、1.5、2.5

主要技术参数

Main Technical Parameters:

1、导体直流电阻 (20℃)

1. D.C. Conductor Resistance (20℃)

1.1额定电压6/10kV及以下核电站用电力电缆, 其导体直流电阻值可参照普通塑力缆。

1.1PLS make reference to that of common power cable with plastic insulation for D.C. conductor resistance of power cable of rated voltage 6/10kV or lower for nuclear power station.

1.2控制电缆导体直流电阻

1.2D.C. Conductor Resistance of Control Cable

标称截面 Nominal Cross Section Area (mm ²)	根数/单丝直径 mm Pieces/ Diameter of Single Piece		20℃时导体直流电阻 D.C. Conductor Resistance (20℃) ≤W/km	
	1类 Category 1	2类 Category 2	不镀金属 Non-plated	镀金属 Plated
1.0	1/1.13	7/0.43	18.1	18.2
1.5	1/1.38	7/0.52	12.1	12.2
2.5	1/1.78	7/0.68	7.41	7.56

1.3仪表电缆导体直流电阻

1.3D.C. Conductor Resistance of Instrument Cable

导体直径 Conductor Diameter (mm)	20℃时导体直流电阻 D.C. Conductor Resistance (20℃) ≤W/km	
	不镀金属 Non-plated	镀金属 Plated
0.8	36.0	36.7
1.0	23.5	23.8

1.4补偿电缆导体结构

1.4Conductor Structure of Compensational Cable

标称截面 Nominal Cross Section Area (mm ²)	20℃时导体直流电阻 D.C. Conductor Resistance (20℃) ≤Ω/km	
	单股 Single Strand	多股 Multi Strand
1.0	1/1.13	7/0.43
1.5	1/1.37	7/0.52
2.5	1/1.76	19/0.41

2、绝缘电阻常数 (Ki)

2.Insulation Resistance Constant (Ki)

90℃时 3.67M W•km

3.Voltage Test of Finished Cable under Working Frequency:

90℃/min 3.67M W•km

3、成品工频耐压试验

(1).Power Cable, Control Cable:3.5kV/5min

(1).电力电缆、控制电缆: 3.5kV/5min

(2).Instrument Cable, Compensational Cable:between insulated cores: 2.5kV/5minbetween insulated core and shielding:1.5kV/5min

(2).仪表电缆、补偿电缆: 绝缘线芯间: 2.5kV/5min; 绝缘线芯与屏蔽间: 1.5kV/5min

4.Long-term Thermal Cycle Test:

4、长期热循环试验

(1).Test Time 5000h

(1).试验时间5000h

(2).Test Voltage 2kV

(2).试验电压2kV

5.Flame-retardant Performance:

5、阻燃性能

5.1 Vertical Firing Test of Single Insulated Core
Flame Supply Time: 15 S Flame-free Time: 15 S
The damaged area should be less than 25% after 5 times of

5.1单根绝缘线芯垂直燃烧试验供火时间: 供火15S, 停

火15S, 反复5次指示旗烧伤面积应小于25%

5.2成束电缆燃烧试验 (B类) 电缆损烧长度 $\leq 2.5\text{m}$

5.3 电缆烟浓度试验 (透光率) $\geq 60\%$

5.4 被覆材料燃烧气体的腐蚀性PH值 ≥ 4.3 ; 电导率 $\leq 10\text{ms/mm}$

使用条件

1. 电缆导体的最高额定温度为 90°C , 短路时(持续时间不超过5S)导体最高温度不超过 250°C ;

2. 电缆敷设时环境温度不低于 0°C ;

3. 敷设时电缆的允许弯曲半径: 非铠装电缆不小于电缆外径的8倍; 铠装电缆不小于电缆外径的16倍, 电力电缆还需加大一些;

4. 反应堆厂房正常工况 γ 射线辐照累积剂量为 250KGY ; LOCA工况 γ 射线辐照累积剂量为 600KGY ;

交货长度

1. 交货长度不低于200m;

2. 根据协议可以任何长度交货;

3. 长度计量误差不超过 $\pm 0.5\%$ 。

repetition.

5.2 Cable Firing Test in Bundle (Category B): damaged Cable Length $\leq 2.5\text{m}$

5.3 Smoke Density Test (Light Penetration Rate):

5.4 The emitted gas corrosion in firing of sheath material: PH value ≥ 4.3 ; Electric Conductivity $\leq 10\text{ms/mm}$

Working Conditions:

1. The highest rated temperature of cable conductor is 90°C . It should be no higher than 250°C in time of short circuit. (It lasts no longer than 5 minutes.)

2. Ambient temperature in installation should be no lower than 0°C .

3. Allowed bending radius in installation should be no less than 8 times that of cable outer diameter for cable without armor, and 16 times for armored cable. And it should be bigger for power cable.

4. γ ray radiation volume accumulated under normal operation status of reactor is 250KGY ; γ ray radiation volume accumulated under LOCA status is 600KGY .

Cable Length:

1. It should be no less than 200 meters.

2. It depends on final both agreements.

3. The length error allowance should be no more than $\pm 0.5\%$.