



# **NOVARIS**

Application Note  
(0015-D113V1)

## **SURGE PROTECTION FOR GAS PIPELINES**

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# 1 | INTRODUCTION

Gas pipelines are dependent on electronic systems for monitoring, telemetry, metering, valve control and cathodic protection. These systems are vulnerable to transient overvoltages caused by lightning and power system disturbances.

Unlike conventional industrial facilities, gas pipelines may extend many kilometers either above or underground through exposed terrain. Their physical construction and electrical isolation from earth make them particularly susceptible to induced lightning effects.

Lightning striking the ground in the vicinity of a buried pipeline can induce significant transient voltages into the pipe. Because the pipeline is electrically insulated from earth, these voltages can travel many kilometres before finding a discharge path. The result can be flashover of insulating joints, damage to cathodic protection systems and failure of instrumentation connected to the pipeline.

This application note describes the mechanisms responsible for surge damage on gas pipelines and outlines a coordinated protection approach using Novaris surge protection devices.

## 2 | PIPELINE CONSTRUCTION

Gas pipelines present a unique surge protection challenge. Modern pipelines are typically coated with a high integrity polyethylene coating and electrically isolated from the surrounding soil. While this is essential for corrosion prevention, it also creates an efficient collector of lightning-induced energy.

The most common coating system is a polyethylene coating often referred to as 'Yellow Jacket'. Individual pipe sections are welded together in the field. Following welding, the joint area is coated with a field-applied corrosion protection system such as "Denso tape" or equivalent coating materials. The resulting pipeline forms a continuous steel conductor that is electrically isolated from earth over its length.



**Figure 1.** Typical coated gas pipeline showing Yellow Jacket coating and field joint insulation

## 3 | CATHODIC PROTECTION SYSTEMS – INSULATED JOINTS

Because no coating system is perfect, cathodic protection (CP) is applied to prevent corrosion.

Insulating joints (IJs) are installed throughout pipeline systems to separate cathodic protection zones, electrically isolate metering stations and prevent unwanted current flow.

These joints are essential for proper cathodic protection operation but also represent one of the most vulnerable points during a surge event.

When a lightning-induced transient reaches an insulating joint, the surge voltage appears across the joint. If the transient exceeds the dielectric strength of the joint, flashover may occur.

A surge protection device installed across the insulating joint provides a controlled discharge path for transient energy while remaining non-conductive during normal cathodic protection operation.

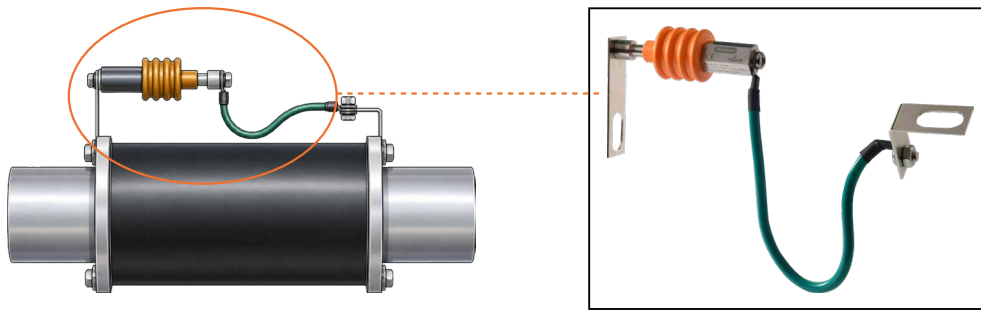


Figure 2. Insulated joint gas filled protective device

# 4 CATHODIC PROTECTION SYSTEMS

A typical impressed current cathodic protection system consists of a cathodic protection DC power supply, an anode bed, a reference electrode and monitoring equipment.

The power supply applies a negative DC voltage to the pipeline while the positive output is connected to the anode bed. Current flows through the soil to maintain the pipeline at a protective potential.

The reference electrode continuously monitors the pipe-to-soil potential, allowing adjustment of the cathodic protection current to suit changing soil conditions.

Cathodic protection systems create several paths through which surge currents can enter sensitive electronics.

The power supply is simultaneously connected to AC mains supply, pipeline, anode bed, reference electrode and station earth. During a lightning event, substantial voltage differences can develop between these points even though they all appear as earth.

Protection is required on the AC supply conductors, power supply DC outputs, anode bed, reference electrode circuits and communications interfaces.

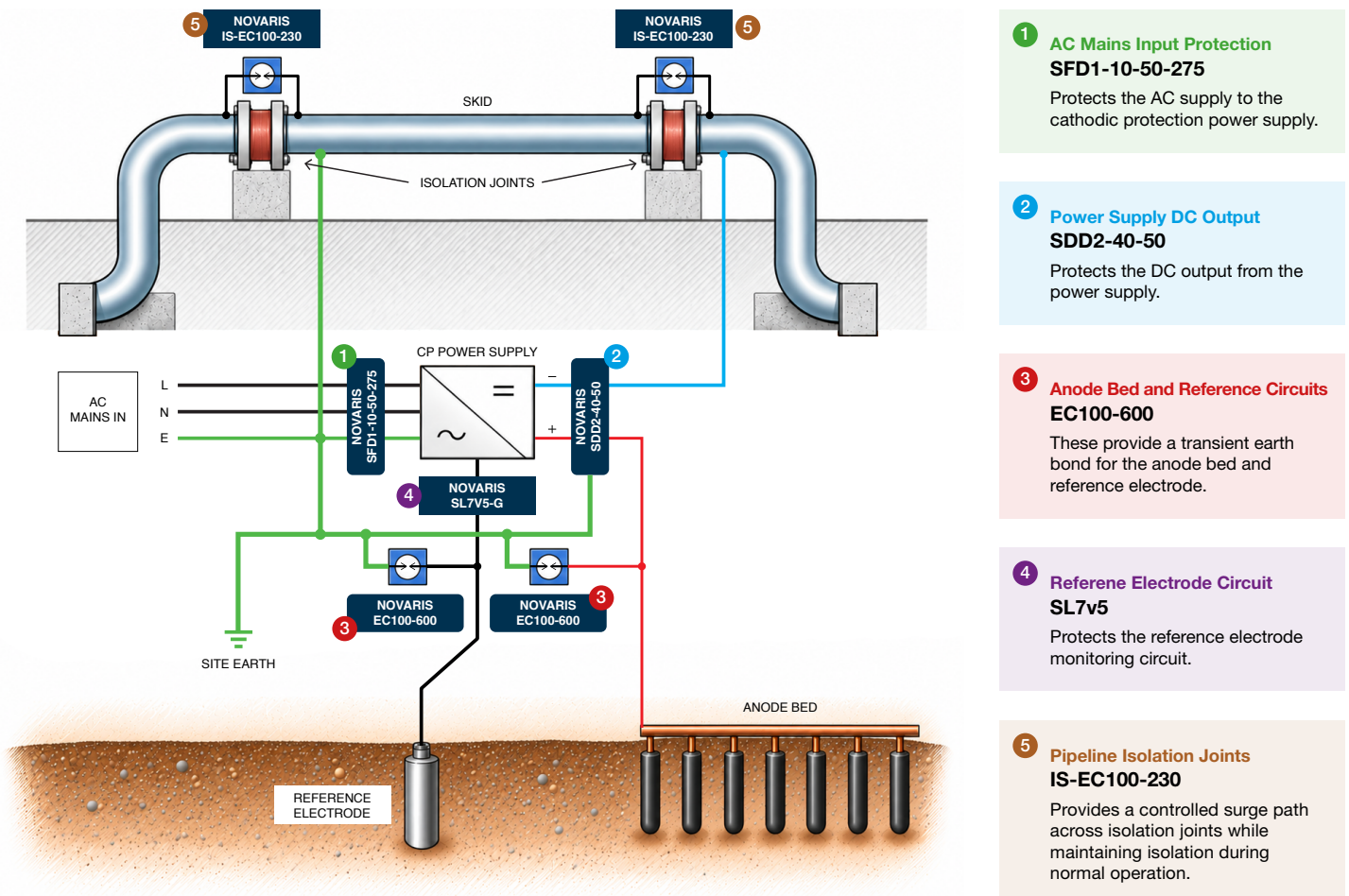


Figure 3. Typical surge protection for a cathodic protection system

# 5 INSTRUMENTATION AND TELEMETRY PROTECTION

Pipeline systems commonly include pressure transmitters, temperature transmitters, flow measurement systems, remote telemetry units and valve control systems.

When the pipeline experiences a surge event, significant voltage differences may develop between the field device and remote equipment, resulting in damage to instrumentation and control systems.

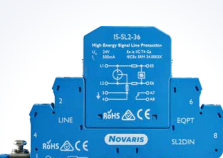
Signal line protection should be installed at both ends of instrument circuits. The application of this protection is detailed in the Novaris Application note 0009-V5V6 "Surge Protection for Hazardous Areas"

# 6 RECOMMENDED NOVARIS PROTECTION SOLUTIONS

## 6.1 Insulated Joint / Cathodic Protection

|                                                                                                                                                                            |                                                                                                                                                                                  |                                                                                                                                                                                |                                                                                                                                                     |                                                                                                                                                                                      |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IS-EC100-230</b><br><br><b>EXD rated 100kA Earth Clamp</b><br>Across isolating joints | <b>EC100-600</b><br><br><b>Earth Clamp 100kA</b><br>To bond anode bed and reference electrode | <b>SDD2-40-50</b><br><br><b>Isolated Surge Diverter</b><br>For DC side of cathodic rectifier | <b>SFD1-10-50-275</b><br><br><b>Surge Filter</b><br>For AC mains | <b>SL7v5-G</b><br><br><b>Signal Surge Protector</b><br>For input signal from reference electrode |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

## 6.2 Instrumentation / Control Protection

|                                                                                                                                                             |                                                                                                                                                        |                                                                                                                                                                     |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IS-SLT</b><br><br><b>IS Instrument Protector</b><br>Field instruments | <b>IS-SL</b><br><br><b>IS Signal Line SPD</b><br>Input / output DCS | <b>IS-SL2</b><br><br><b>High Energy IS Signal Line SPD</b><br>Input / output DCS |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|

# 7 | CONCLUSION

Gas pipelines are particularly susceptible to lightning-induced surges due to their length, electrical isolation and distributed capacitance to earth.

The most common points of damage are insulating joints, cathodic protection systems and pipeline instrumentation.

A coordinated protection scheme incorporating insulating joint protection, cathodic protection, instrumentation protection and power surge protection can significantly improve system reliability while maintaining the integrity of the cathodic protection system.

