

Foreign Debris Remover

Particle Separator for BWR and PWR Applications

Vortex particle separation system for efficient debris removal in nuclear power plant (NPP) systems

Challenge

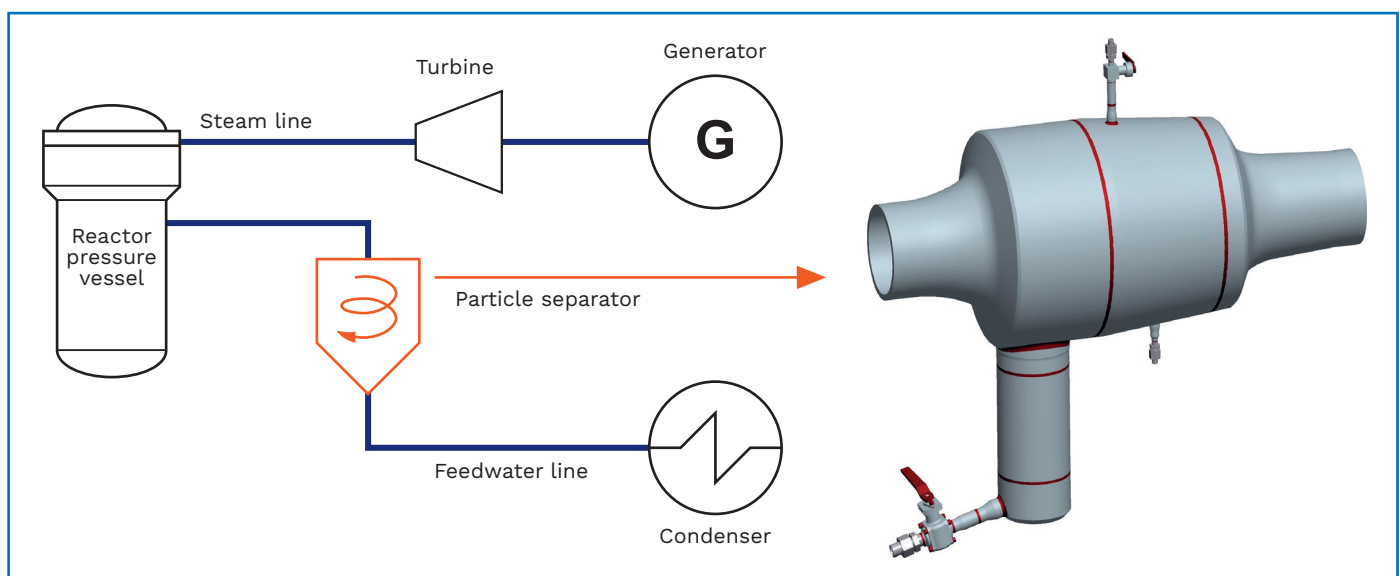
Eliminating debris in NPP systems is critical for plant safety and reliable operations. In boiling water reactors (BWRs), fuel failures can be caused by clad fretting because debris enters the reactor as well as the fuel assembly areas from the main and auxiliary feedwater systems. Additionally, debris in the feedwater and condensate systems can cause increased dose rates to plant personnel. In pressurized water reactors (PWRs), debris in the system can cause severe damage in steam generator tubes.

Solution

The Foreign Debris Remover (FDR) is installed in existing plant systems to remove debris before it enters the reactor vessel or steam generators. Unlike filter systems, which cause high pressure drops, the FDR uses centrifugal forces to separate particles with minimal drops in system pressure. The risk of small parts breaking off the cyclone separator and increasing total debris is low because it does not have any moving or rotating parts.

Customer benefits

- Robust design with no moving or rotating parts
- Compact design to simplify installation
- Effective operation with high separation rates for particle sizes ranging from small to large
- Passive component – requires no additional electrical or instrumentation and control support systems



Particle separator and its position in the feedwater system

Your performance
is **our** everyday **commitment**

Technical information

The FDR works on the principle of centrifugal separation. Internal vanes impart a swirling motion which separates the particles via centrifugal force. The force drives particles to the outer wall where they are collected in a chamber. System flow instrumentation downstream of the FDR is unaffected by its operation. The particle collector can be emptied easily during an outage.

The FDR is intended to be installed as close as possible to the component which should be protected (reactor vessel, steam generator, etc.). Proximity is necessary in order to catch particles from both main feedwater flow and other system inputs. Installation is achieved by removing a section of piping and replacing it with the FDR. It is installed centrally to the system piping via welded or flanged connections and has attachments for any supports that might be required. The FDR is constructed of stainless steel which enables it to be applied to any system without causing water chemistry or corrosion issues.

Further technical specifications:

- Stable and undisturbed flow at two-pipe diameters downstream of the separator
- Low pressure drop (approximately 0.6 bar)
- Can be installed in pipe sizes ranging from 100 to 650 millimeters in diameter
- Machined from homogeneous forgings



Debris removed from coolant circuit

Key figures

Pressure drops less than **1** bar

20 units installed and commissioned

References

Framatome is currently the only company, worldwide, which deals with all stages involved in the implementation of particle separators from feasibility studies to installation.

The first FDR was installed in a Swedish NPP in 1994. Since then five more Swedish plants had this system installed, where the units have demonstrated successful performance.

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