framatome

Filtered Containment Venting System

Efficient Containment Pressure Limitation

Robust Design and Extensive Qualification assure Reliable Filtration and High Decontamination Factors

Challenge

In the wake of a core melt accident the pressure inside the reactor containment can raise excessively. In such cases the containment, forming the last barrier for large amounts of enclosed radioactivity, has to be protected from overpressure.
Thus the challenge is to maintain containment integrity and preventing significant off-site long-term land contamination.

In order to assure this it is necessary to

- Limit the excessive pressure build-up and protect the structural integrity of the containment
- Reduce the radiological impact to the environment to an absolute minimum
- Control of captured fission product decay heat
- Safely store the accumulated fission products or return it to the containment
- Limit the environmental consequences and prevent uninhabitability of the neighbourhood

Solution

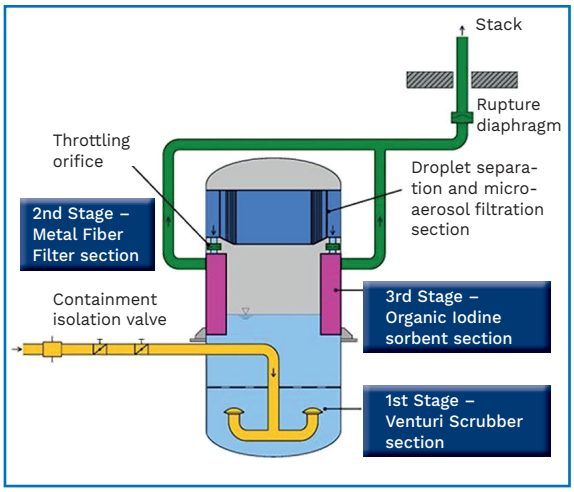
Framatome's Filtered Containment Venting System reliably depressurizes the containment while efficiently retaining the radioactive aerosols and elemental as well as organic iodine.

It combines the advantages of a

- High speed venturi scrubber technology together with
- Highly efficient metal fiber filters and
- Sorbent retention stage.

The robustly designed system

- Does not need external power source for activation and operation
- Encapsulates the filtering stages inside a pressure vessel and ensures a safely depressurization of the containment
- Copes with large quantities of energy from the containment while ensuring highest retention rates for fission products.



Example of Framatome FCVS (Integral Vessel)

Customer benefits

- Fulfills mandatory regulatory requirements
- Is a cost effective measure to prevent excessive containment pressure
- Prevents long term contamination from aerosol depositions
- Reliably retains activity in short & long term conditions
- Is (international/national) qualified and fulfills seismic requirements
- Has compact design and is tailored to specific plant parameters and regional codes and standards

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

Technical information

1. Performance and product

Stage 1: Venturi scrubber unit (wet section)

When the system is activated the venturi scrubber unit is operated at a pressure close to the containment pressure. In the Venturi nozzles the vent gas is accelerated to high velocity. The reduced static pressure is causing self-feeding of scrubbing liquid into slots at the throat area. An extremely enlarged phase boundary is created which is favorable for gaseous iodine reaction and adsorption of aerosols. Clogging – a potential threat to most filter systems – is prevented due to the special design of the nozzles. In the 1st stage already **99%** of **aerosols** and **iodine** are retained due to the unique process design. The decay heat is safely removed by evaporation of the scrubbing liquid not requiring any active measures.

Stage 2: Metal Fiber Filter section (dry section)

The second stage - the dry section - provides **high efficient retention of aerosols** (including **microaerosols**) remaining in the venting gas flow from the 1st stage and is effectively limiting potential aerosol resuspension. Crucial for effectiveness of this stage is the removal of droplets and condensate, which is assured by the optimized filter design.

Thus, the unique combination of the wet and dry filtration stages result in very high filter efficiency and loading capacity effectively avoiding filter clogging.

Stage 3: Organic Iodine Sorbent section

The third retention stage following the wet and dry retention stages, consists of a zeolite which is doped with silver. The remaining gaseous iodine, especially the hard to retain organic iodine, reacts with the silver into stable silver iodide and is fixed to the porous structure of the zeolite.

The organic iodine sorbent section can be part of the initial system design or upgraded to already existing Filtered Containment Venting Systems further minimizing the biological impact due to iodine releases.

System design

The system is designed entirely as pressure equipment and provides an essential hydrogen safety feature in case of postulated deflagration. (Framatome's system design is fully in line with NEI-guidance).

Thanks to the modular, compact design, Framatome's FCVS is easy to backfit into existing buildings at low cost. The system can be easily adapted to any reactor type, unit size, type of containment or other design parameters without impacting the systems efficiency or qualification. Potential layout restrictions can be met by the system design dividing the process / filtration sections into different vessels.

Framatome's **patented** approach ensures high decontamination factors for iodine, large and fine aerosols in a very compact FCVS design. The process design further provides passively superheating of the venting flow for very efficient organic iodine retention in the third sorbent stage.

Key figures

More than **100** applications world wide

References

FCVS applications in PWR, BWR, CANDU, ABWR, PHWR and VVER reactors worldwide (e.g. P. R. China, Canada, Korea, Romania, Japan, Spain, Switzerland, Belgium, Finland, Ukraine, Taiwan, Korea, Netherlands, Brazil, Argentina, Germany) **Patent rights reserved**

Licensing

- Framatome has broad experience on licensing and supports utilities by an extensive qualification and large scale verification data base in the discussion with regulators

Extensive process qualification and performance verification

- Full scale process section tests (JAVA Plus Test Facility Karlstein)
- Third party and international testing
- Tests performed with representative accident aerosols at high pressure and temperatures
- Retention tests with gaseous iodine (elemental and organic iodine)
- Seismic Qualification (up to 8 g (peak) respectively 5 g (rigid body)

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