

CRAFT

Air Filtration System for the Retention of Noble Gases

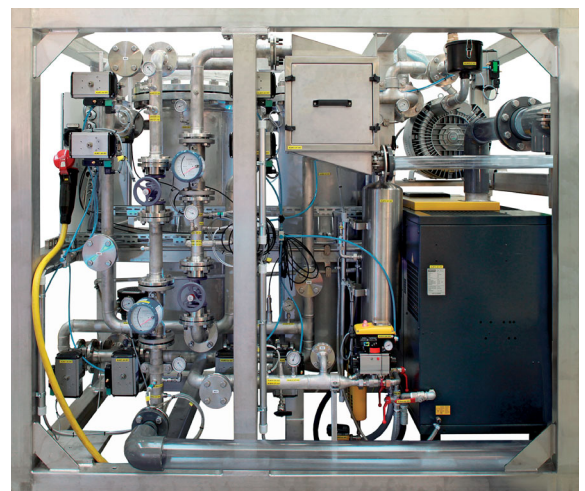
Effective filtration of radioactive noble gases to ensure the habitability inside control rooms and emergency response centers during accidents

Challenge

During severe accident situations in nuclear power plants (NPPs) significant amounts of radioactive isotopes might be released from the containment, either through containment leakages or by intentional containment venting. Most of them, like iodine or cesium, can be filtered by proven technology. Only radioactive noble gases, mainly Xenon and Krypton (especially Xe-133 and Kr-85) are difficult to retain because of their low chemical activity. For the staff working inside main control rooms, emergency control rooms or emergency response centers in the plant, fresh air supply without radioactive noble gases is required. Common heating, ventilation and air-conditioning (HVAC) systems would flush Xenon and Krypton into these locations and expose the staff to the radiation of these isotopes.

Solution

The Control Room Accident Filtration (CRAFT) system is a dedicated filtration system to protect the environment in the control rooms and emergency response centers from airborne radioactivity releases during accidents. CRAFT features both filtration capabilities for airborne substances and noble gas retention (based on dynamic adsorption of noble gases). Its innovative design, with the use of special activated carbon beds, ensures the availability of safe and breathable air for control room staff and emergency personnel. The filtration system automatically regenerates its carbon beds when saturated and enables the system to be used for the entire duration of the emergency.



CRAFT industrial scale demonstration unit

Customer benefits

- Operable without time limitations during the complete accident progression
- Suitable for severe accident scenarios with multiple venting actuations or beyond design basis
- Operator can focus on accident management, knowing that they breathe fresh and harmless air
- Low levels of installation and maintenance required
- Easy to retrofit to existing HVAC systems
- Flexible design – mobile and permanently installed units are available
- Cost-effective, as size of the system can be fitted to individual needs
- Possibility of customized adoptions to fulfill all country- and site-specific requirements by customer and authority

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Technical information

The main components of a CRAFT unit are a compressor, a vacuum pump and columns filled with special activated carbon.

When the system is active, the compressor sucks in outside air which is high in oxygen, low in carbon dioxide, but in the case of a severe accident can contain radioactive Xe and Kr. The air is compressed and injected into the control room by passing through one of the system columns filled with activated carbon. While oxygen, nitrogen and some carbon dioxide pass through the carbon bed unhindered, noble gases will be delayed at the large inner surface of the activated carbon by Van der Waals forces.

As the system is supplying clean air to the room, a vacuum pump simultaneously draws used air from it. This air flushes the noble gases in counter flow out of the second column for regeneration. Once a delay bed is saturated with noble gases, the process switches, so that column one will be regenerated, as column two loads. This pressure swing adsorption mode can be performed during the complete accident scenario without interruption.

The CRAFT standard sizes are:

CRAFT Size S

- Supplies 5 to 20 operators
- Foot print of 4 to 10 m²
- Power consumption of 20 to 30 kW
- Weighs 3 to 5 t

CRAFT Size M

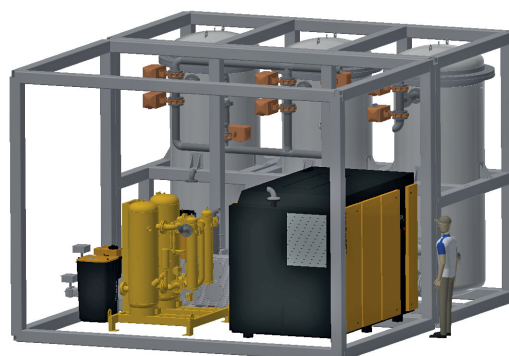
- Supplies 50 to 150 operators
- Foot print of 20 to 40 m²
- Power consumption of 80 to 140 kW
- Weighs 15 to 20 t

CRAFT Size L

- Supplies 250 to 500 operators
- Foot print of 80 to 120 m²
- Power consumption of 400 to 550 kW
- Weighs 450 to 550 t



Small CRAFT unit



Medium-sized CRAFT unit



Special activated carbon

References

- Industrial scale demonstration unit is available at Framatome site Karlstein
- Japan: Basic engineering for 4 NPPs (BWR and PWR)

BWR: boiling water reactor

PWR: pressurized water reactor

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