

RIC 2012

The 24th Annual Regulatory Information Conference

Regulatory actions regarding containment venting and filtration
Filtered containment venting systems in Swiss nuclear power plants focus on
Mühleberg BWR-4 Mark 1 (KKM)

Patrick Miazza, BKW Energy Ltd, Switzerland

Thursday, March 15th, 10:30 AM – 12:00 PM

Nuclear Power Plants in Switzerland



NPP Beznau I & II (KKB I / II)
PWR, 2 x 365 MW_e
Westinghouse 2 Loop
Sept. 1969 / Dec. 1971



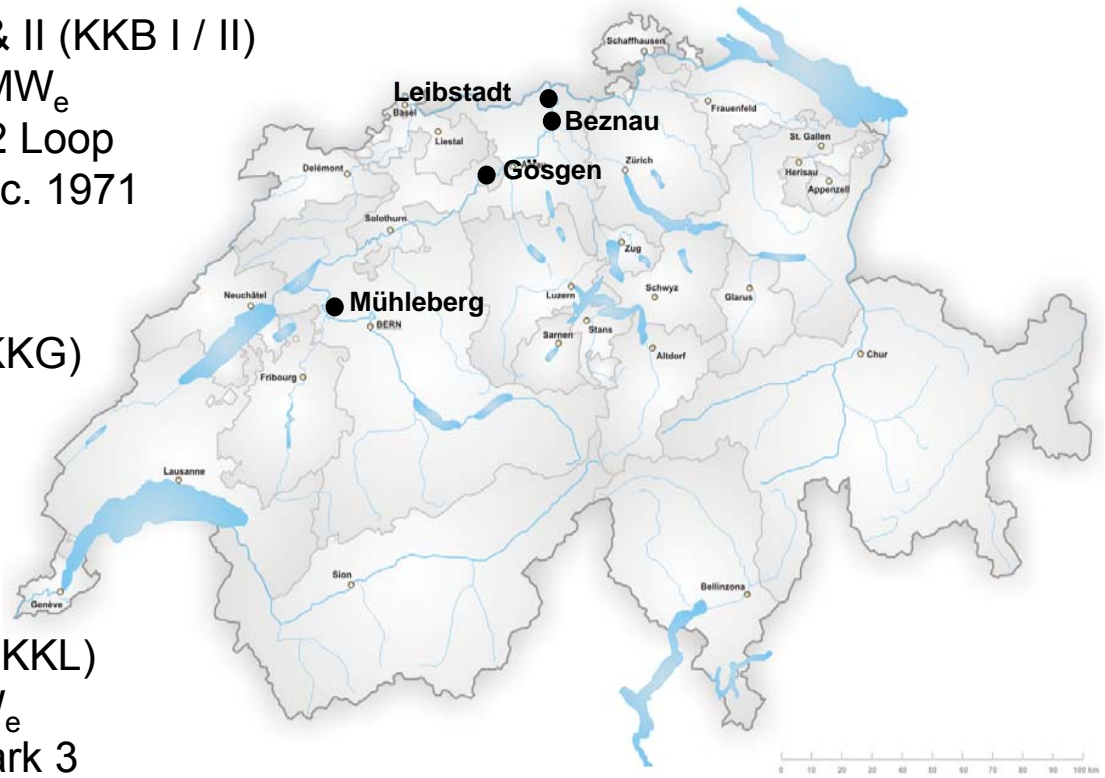
NPP Gösgen (KKG)
PWR, 985 MW_e
Siemens-KWU
Nov. 1979



NPP Leibstadt (KKL)
BWR, 1165 MW_e
GE BWR 6 / Mark 3
Dec. 1984



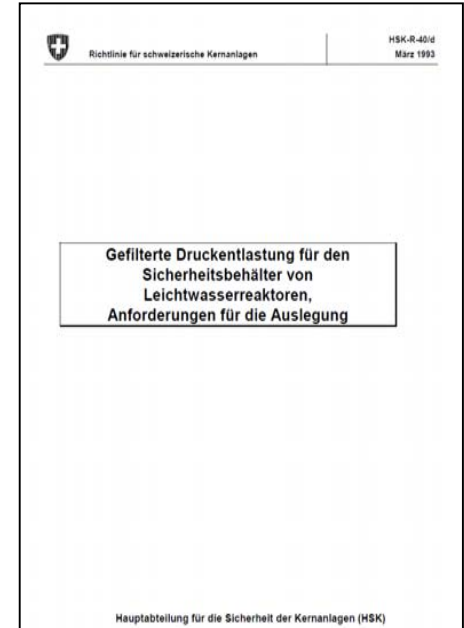
NPP Mühleberg (KKM)
BWR, 373 MW_e
GE BWR 4 / Mark 1
Nov. 1972



Population 7.8 Mio; Area 15 940 sq mi
Electrical consumption: 60 TWh
40% nuclear power

Swiss Safety Authority Requirements for Containment Venting Systems

- First draft document issued 1988 HSK-AN-2026
- Final guideline (1993) HSK-R-40



- Goal: prevention of uncontrolled radioactive release due to loss of integrity of the containment during a severe accident
- Solution: filtered containment venting

Design Requirements for the Containment Venting Systems

- Nominal relief capacity: steam production corresponds to 0.8% of the thermal power
- Max. relief capacity: steam production corresponds to 1% of the thermal power
- Retention factor for aerosols: ≥ 1000 (99.9%)
Prevention of long-term contamination by Cs
- Retention factor for iodine: ≥ 100 (99%)

Design Pressure for Containment Venting Systems

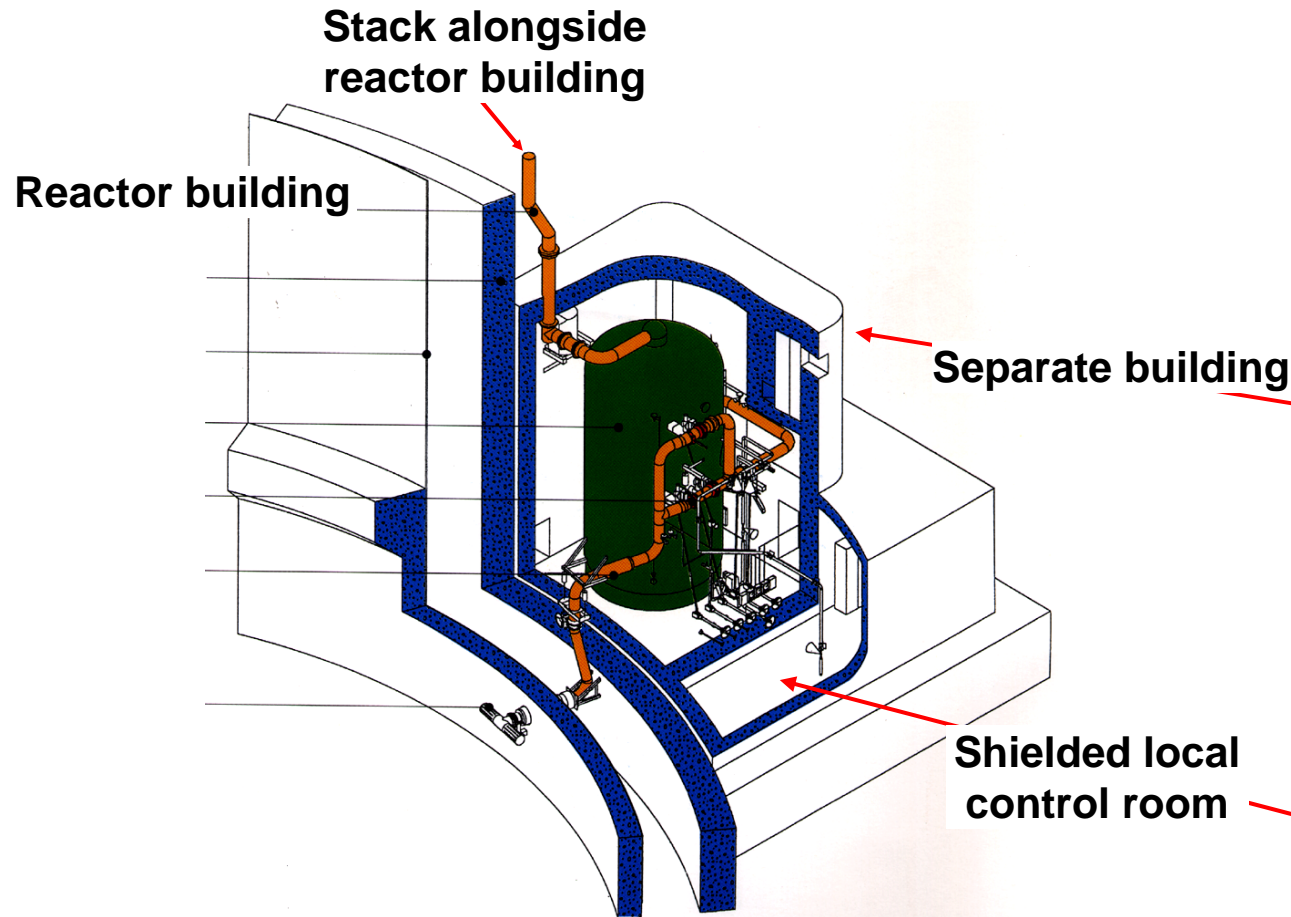
- PWR, non-inerted containment:
max. 1.0 x design pressure or 0.5 x failure pressure
- BWR, inerted containment:
max. 1.5 x design pressure or 2/3 x failure pressure
- BWR, non-inerted containment:
max. 1.0 x design pressure or 0.5 x failure pressure

Failure pressure > 2 x design pressure of Swiss NPPs

Additional Requirements

- Seismic class 1 (highest requirement)
- Efficient at varying pressures and flow rates
- Max. dose for personnel 0.1 Sv
- System availability during station blackout
- 100 hours independent operation of instrumentation
- Passive depressurization (rupture disc)

NPP Beznau Containment Filtered Venting



Designer: Sulzer

Actuation pressure of rupture disc [bar_a]: 5.2

Operating pressure [bar_a]: 3.6

Commissioning date: 1992/1993

Max. flow [kg/s]: 7.2

Nominal flow [kg/s]: 4.8

NPP Leibstadt Containment Filtered Venting

Filtered gas
to stack

Shielded local
control room



Gas from
containment

Filter tanks



Designer: Sulzer / EWI

Actuation pressure of rupture disc [bar_a]: 3.1

Operating pressure [bar_a]: 2.55

Commissioning date : 1993

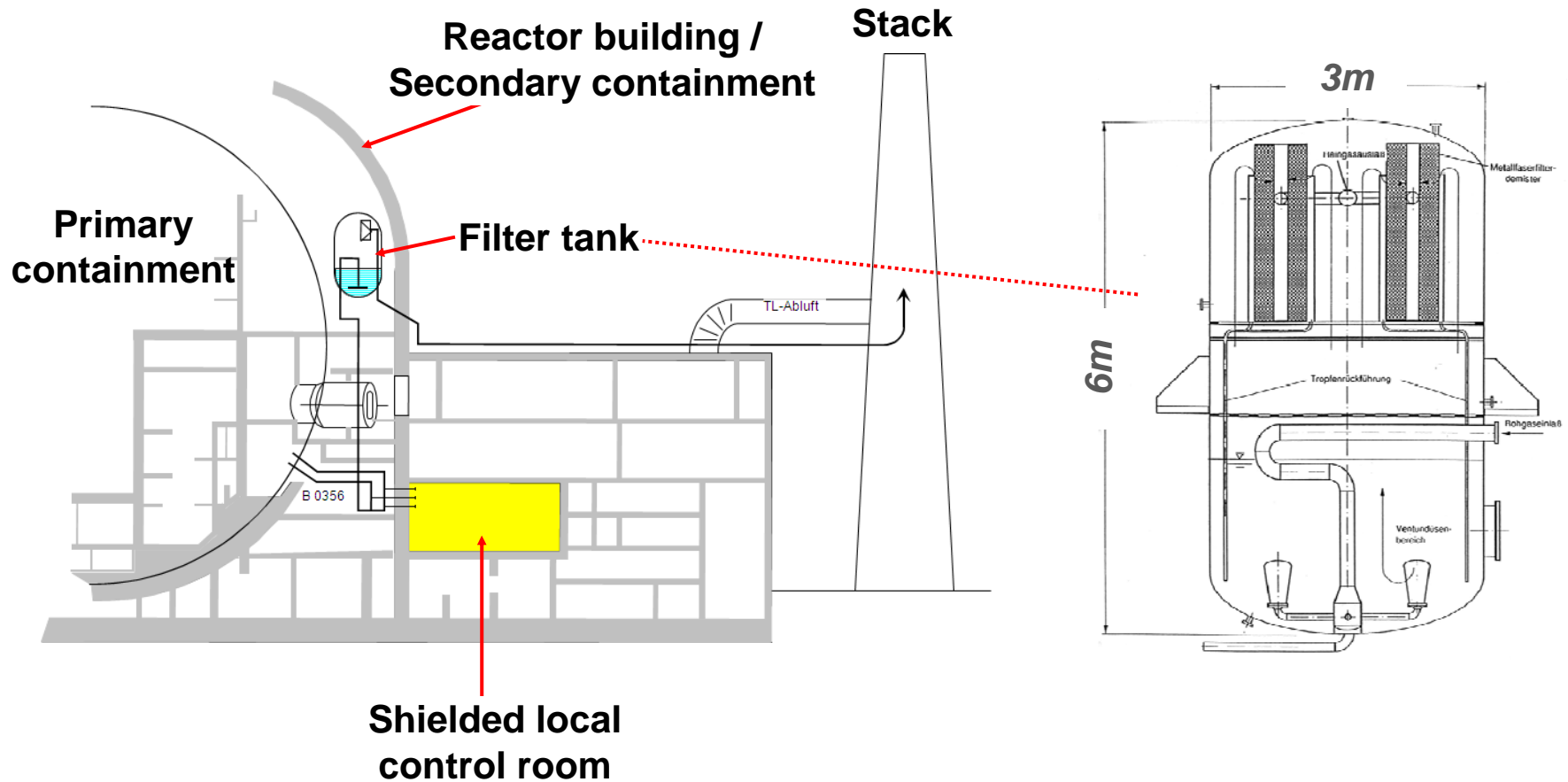
Max. flow [kg/s]: 20.66

Nominal flow [kg/s]: 13.77



SWISSnuclear
Nuclear Energy Section of swisselectric

NPP Gösgen Containment Filtered Venting



Designer: Siemens KWU

Actuation pressure of rupture disc [bar_a]: 6.2

Operating pressure [bar_a]: 4.9 - 6.2

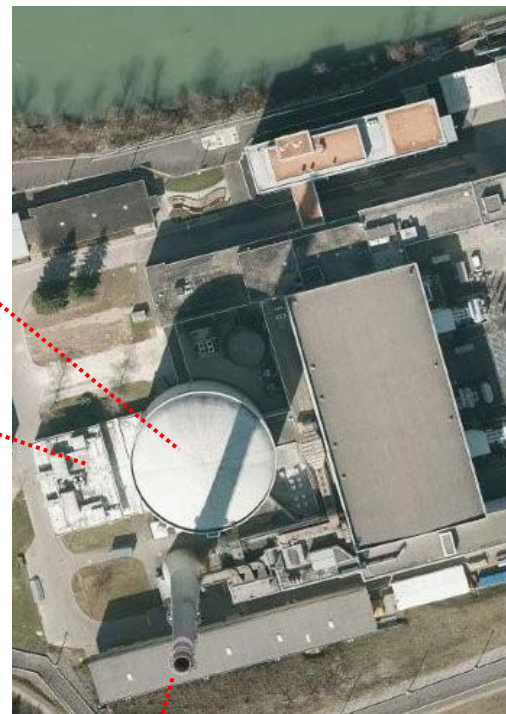
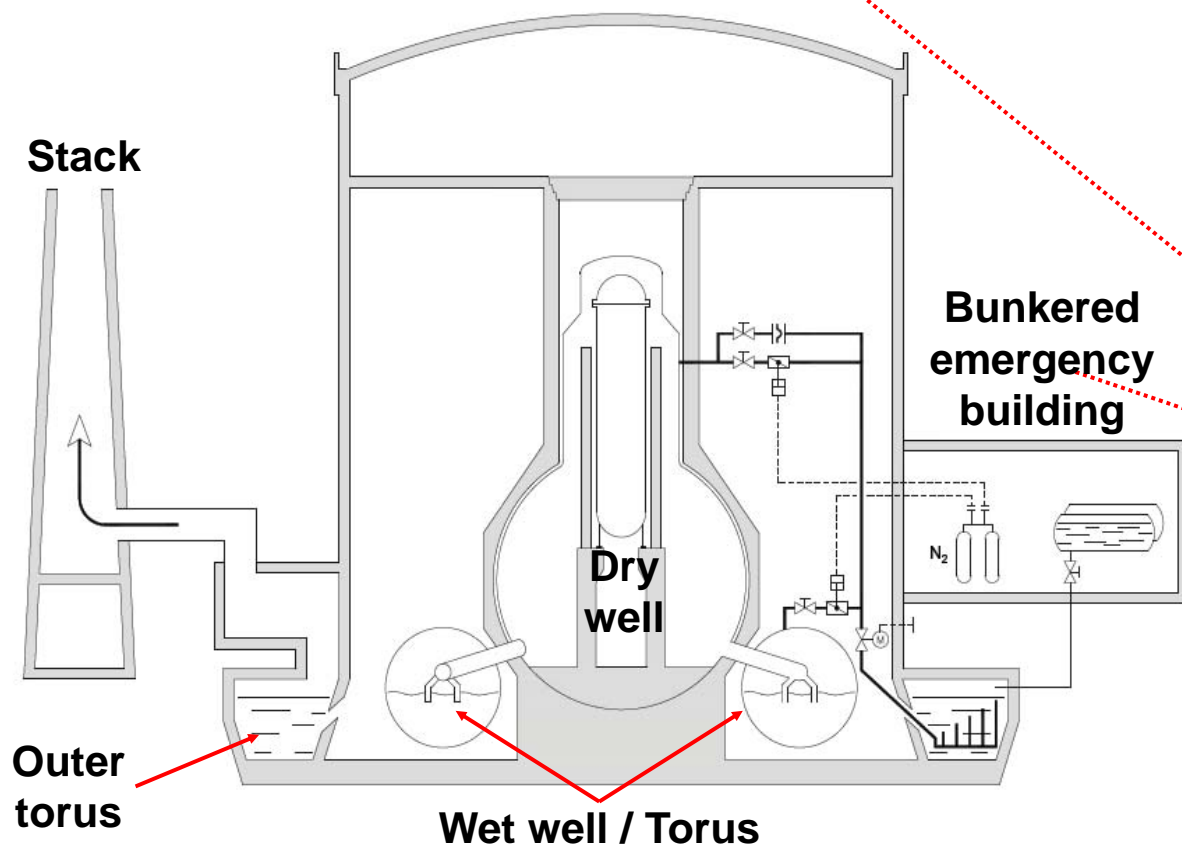
Commissioning date : 1993

Max. flow [kg/s]: 8.6

Nominal flow [kg/s]: 6.8

NPP Mühleberg (KKM) Containment Filtered Venting

Reactor building / Secondary containment



Stack

Designer: ABB Atom

Actuation pressure of rupture disc [bar_a]: 7

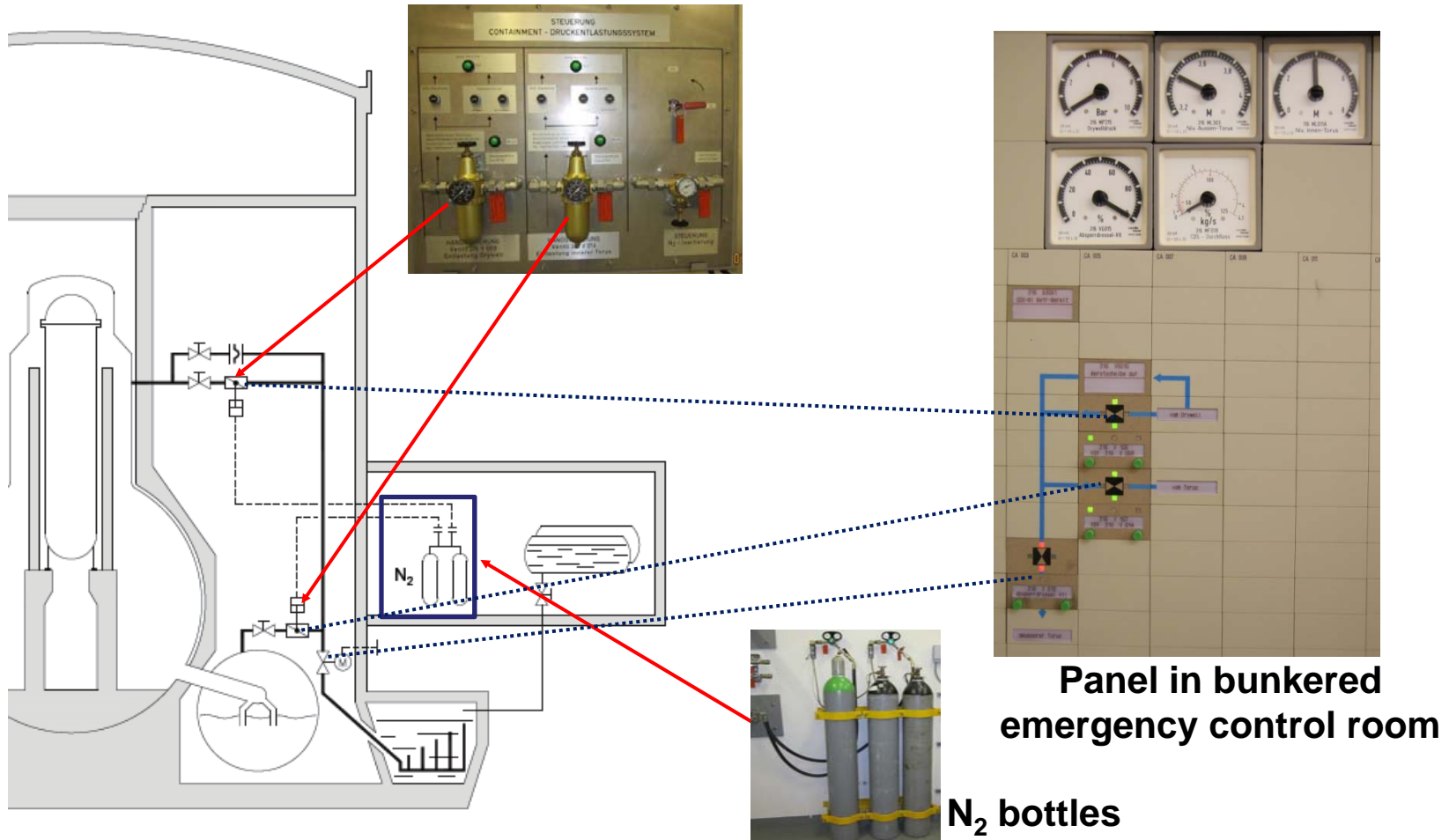
Operating pressure [bar_a]: 5

Commissioning date : 1992

Max. flow [kg/s]: 4.1

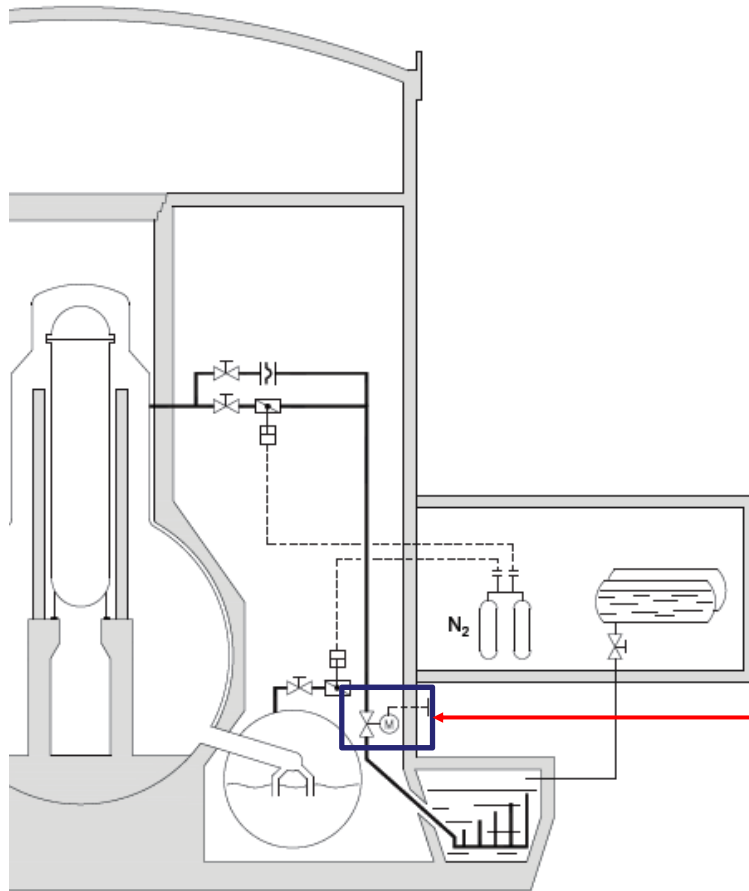
Nominal flow [kg/s]: 3.3

KKM Control Panel (Pneumatic and Electric)



Normally closed spring loaded valves can be actuated either through the control panel or by directly accessing the nitrogen driven pneumatic system (two different locations).

KKM Flow Control Valve



Motor operated valve

**Motor or manual
operation of MOV
inside reactor
building**



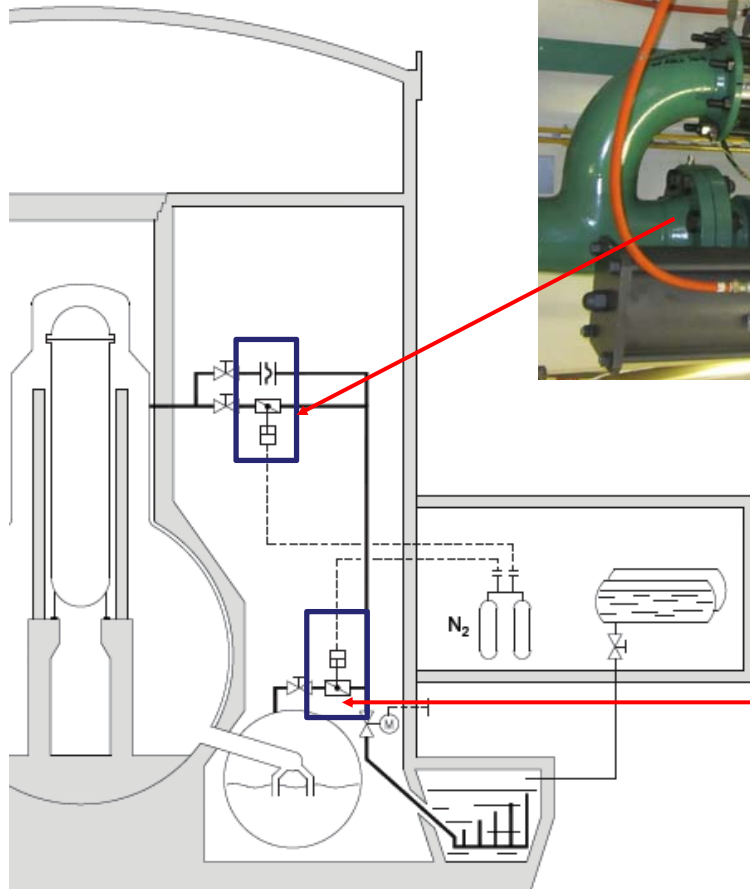
**Handwheel outside
reactor building**



MOV unlocking lever

The flow control valve can be actuated either through the control panel or manually.

KKM Containment Connections



Drywell connection

rupture disc [7 bar_a]

pneumatic valve

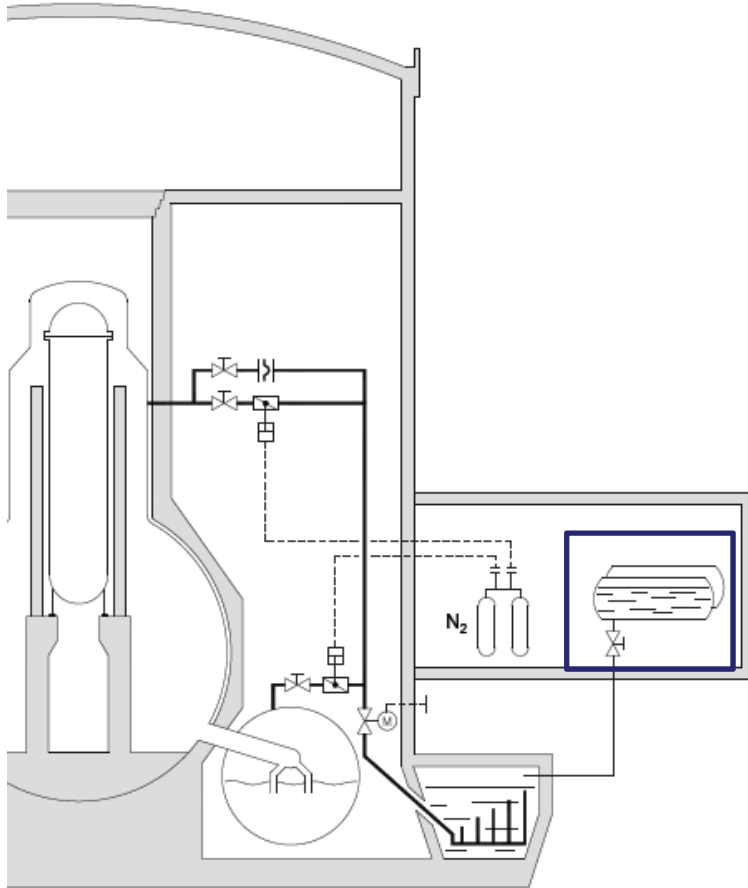
Wet well connection

Pneumatic valve



The pneumatic valves and the rupture disc are located in the reactor building (secondary containment).

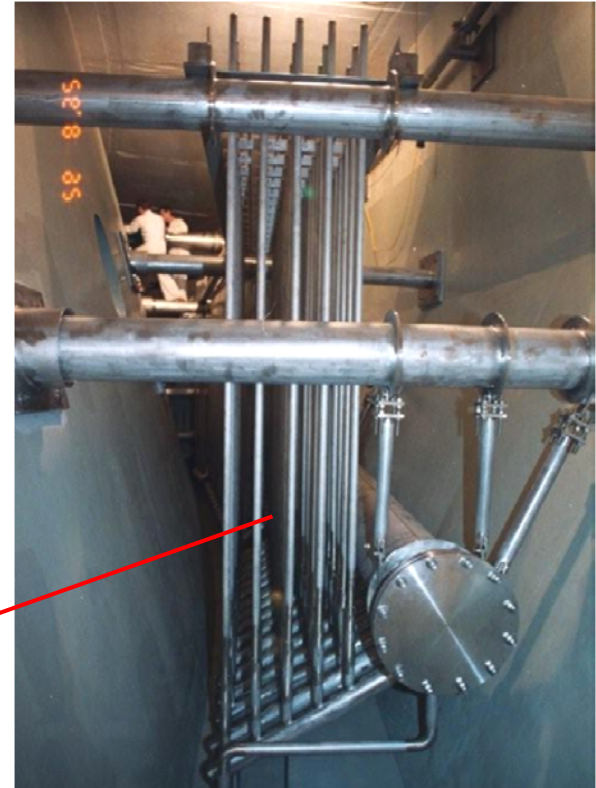
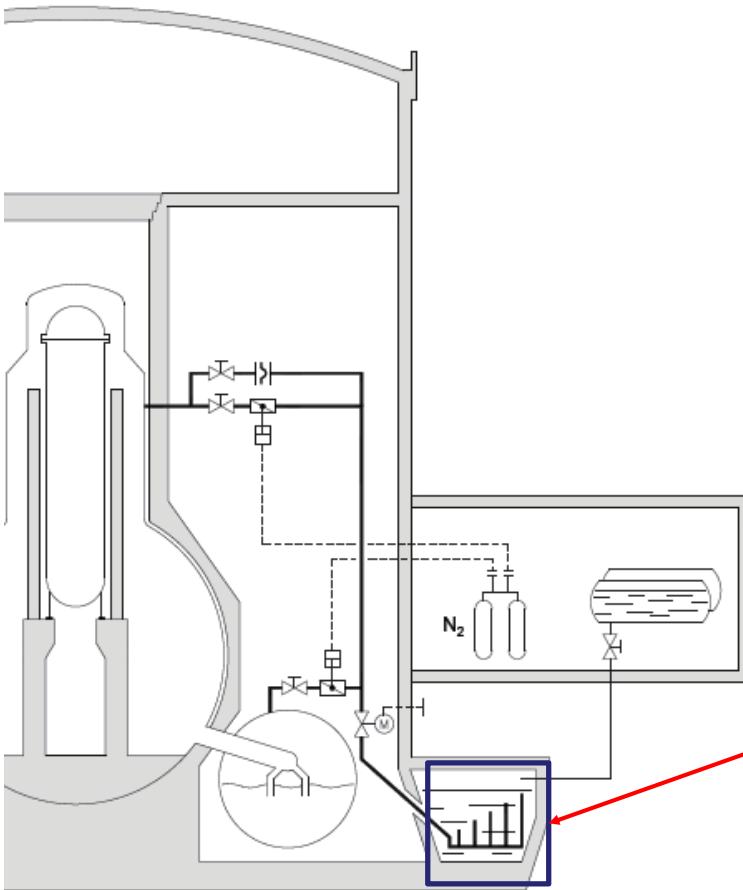
KKM Chemical Injection System



**Sodium carbonate / Bicarbonate
and
sodium thiosulfate mixture**

The chemical mixture flows through gravity to the outer torus.

KKM Multi-Venturi Scrubber System



Drywell volume [m³]: 3100

Wet well water volume [m³]: 2100

Wet well free volume [m³]: 1900

Secondary containment volume: [m³]: 40'000

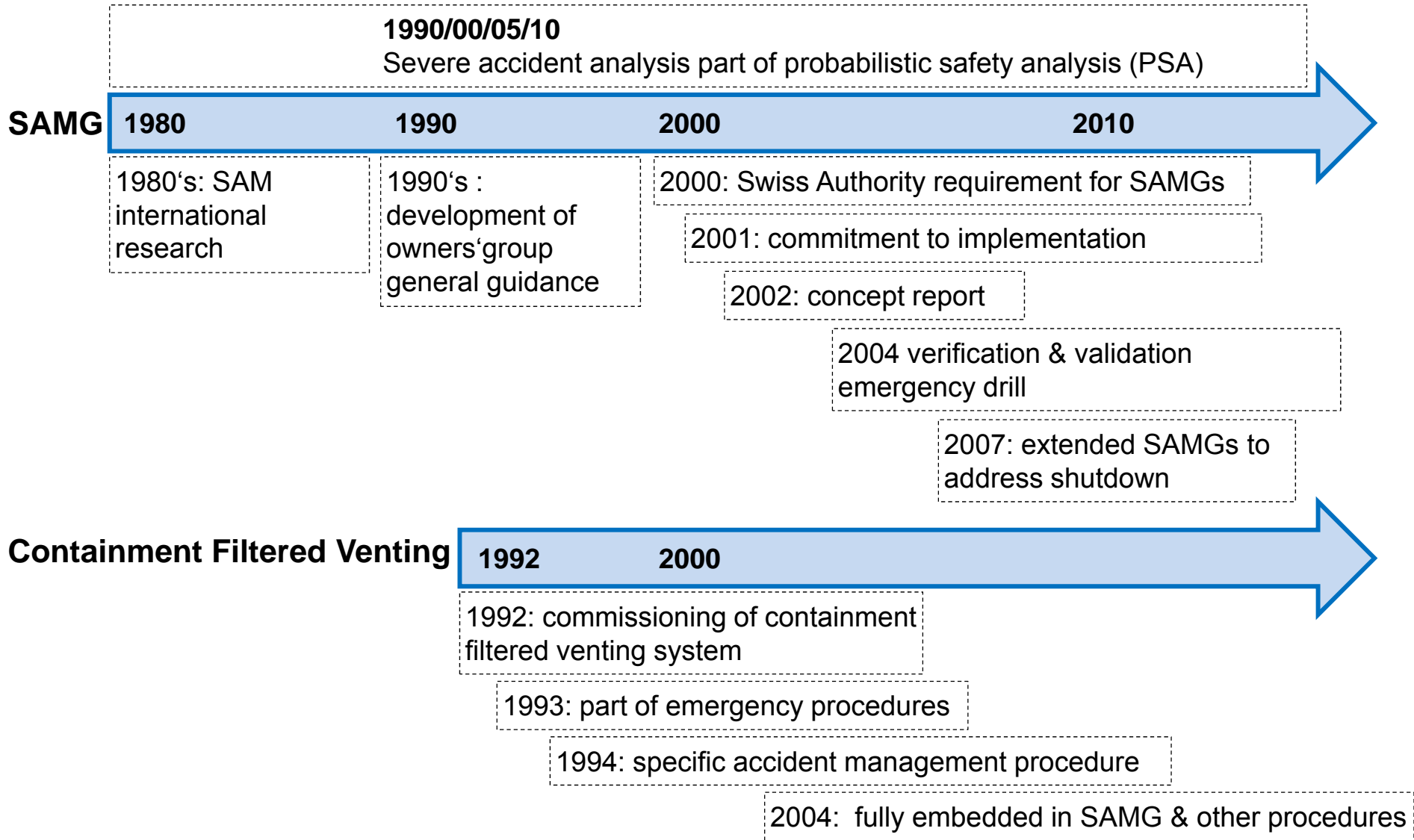
Secondary containment pressure: [bar_a]: 1.3

Outer torus water volume [m³]: 1'000

KKM Staff Training on Containment Filtered Venting

- Basic operator training (field and licensed operators)
- Advanced technical courses for licensed operators
- Advanced training for shift leaders and safety engineers with focus on functional and procedural aspects
- Periodic training of shift personnel
- Training of emergency staff

Accident Management & Containment Filtered Venting Timeline (example Mühleberg)



Containment Filtered Venting Inspections since March 2011

Containment filtered systems had to be re-evaluated for all Swiss NPP's after Fukushima.

In every plant, an in depth inspection was performed by the Safety Authority (ENSI).

The detailed results of the inspections are expected to be published soon.

Thank you for your attention!