Inside and outside – A review of the RCA boundary

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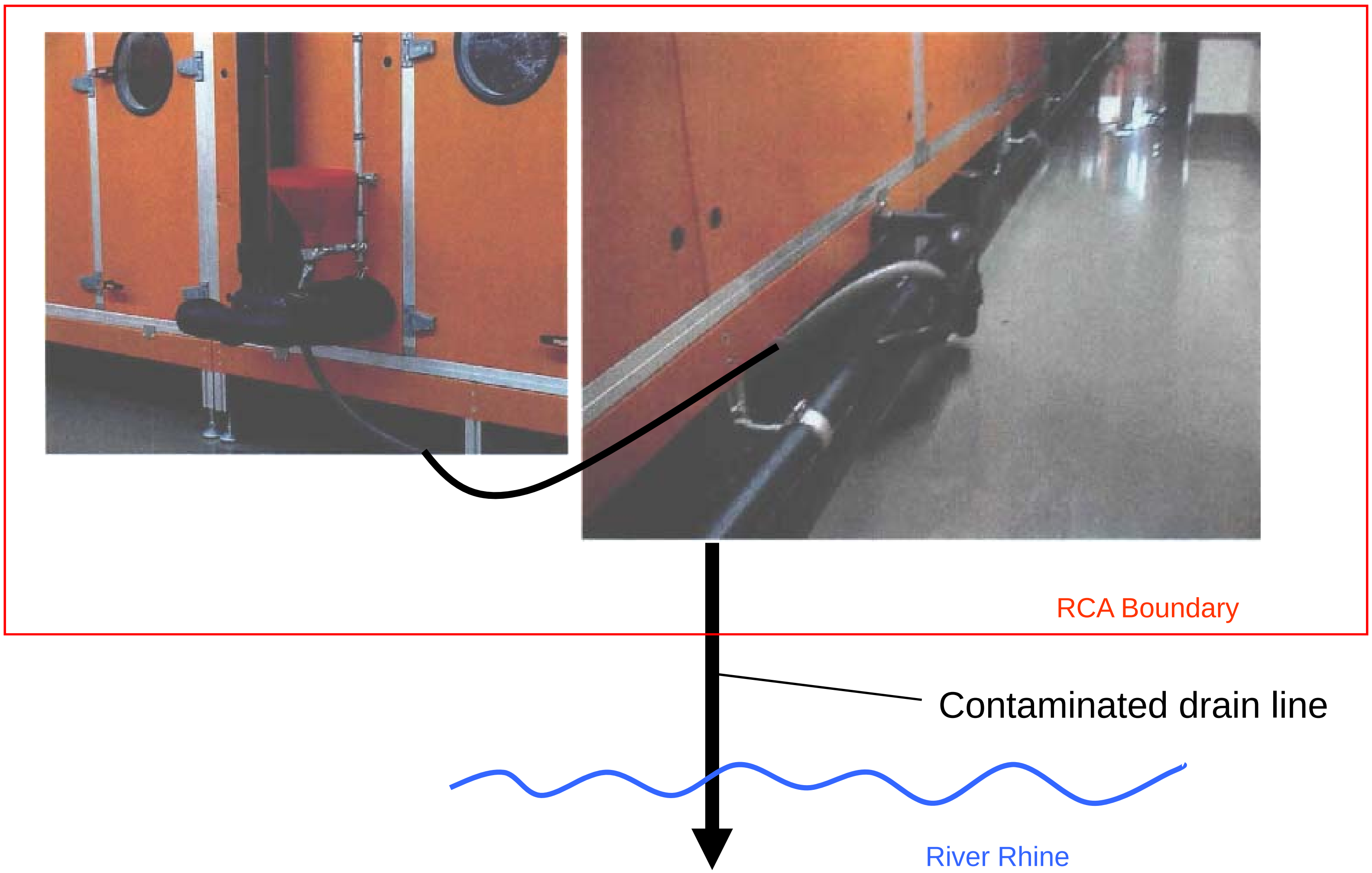
Overview

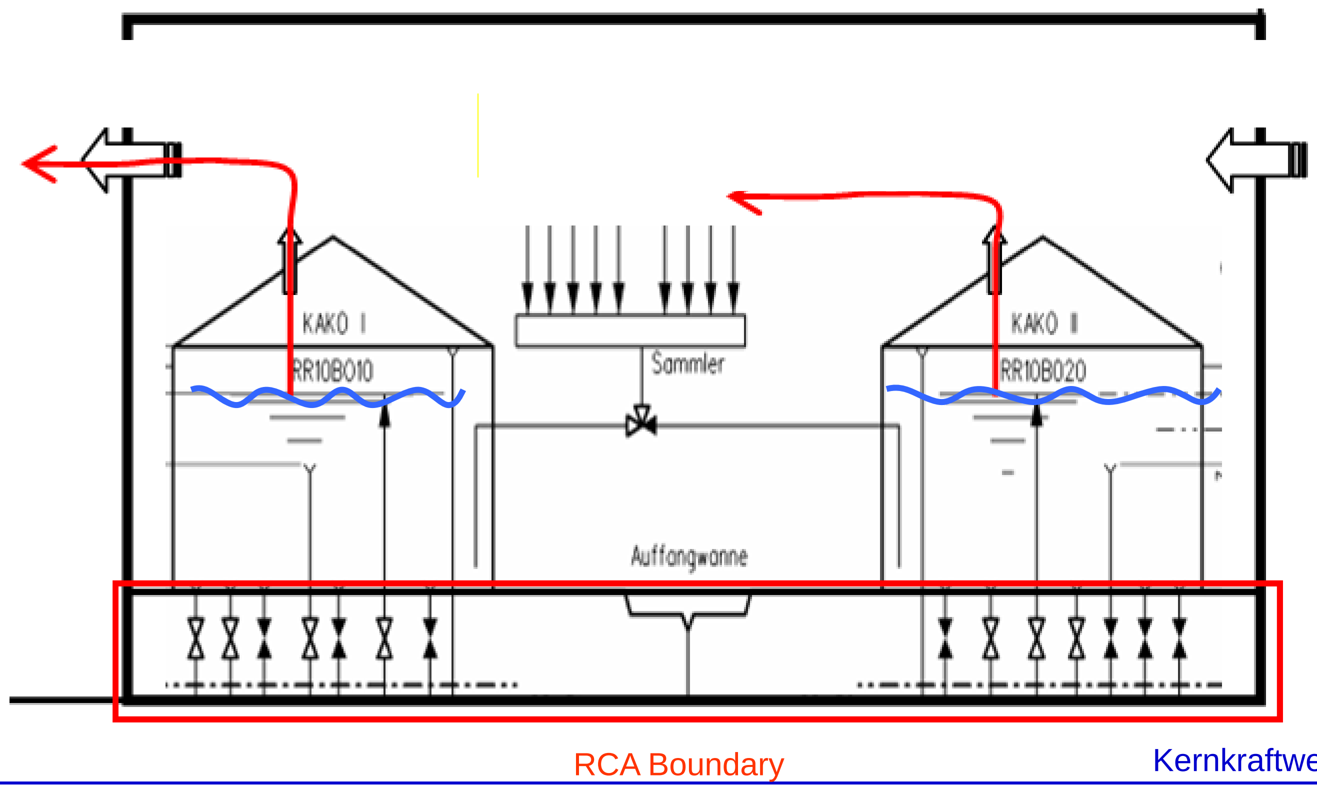
- Initiating events
- Requirements
- Procedure
- Results
- Outlook
- Conclusions

Initial event 1: Hot workshop intake air chiller drain



Initial event 2: Cold condensate storage tank vent

- Cold condensate containing I-131 after fuel failures
- Changes in water level push Iodine-air out of tank vents
- Contamination found outside RCA



A review of the RCA boundary ?

- **HSK = Hauptabteilung für Sicherheit der Kernanlagen = Swiss regulator**
- **HSK-requirement: „A comprehensive review of the entire RCA boundary has to be performed“**
- **Guideline requirement: „Radioactive effluents may cross the RCA-boundary only on licensed pathways, controlled and compared to release limits“**
  - **Licensed pathways: Ventilation to stack, Radwaste discharge**
  - **Controlled: Any instrument reading [cps]**
  - **Compared to release limits: qualified sampling and counting reading [Bq]**

Gentlemans Agreement with HSK

- **Identified unlicensed pathways with existing release: reportable event**
  - Existing release = contaminated pathway
  - Amount of release doesn‘t matter. Everything above background.
- **Identified unlicensed pathways without release: general amnesty**
  - Aim: No penalty for serious review

Consequences

- Review of the Hot Workshop took 2 years, about 0.3 man-year
- Involved: Radiation protection, ventilation engineer, radwaste engineer, civil engineer
- A radiation protection engineer was hired to manage the further project
- Review building by building
- Reporting to HSK every 6 months

Interfaces between radioactive and non-radioactive systems

- **WANO-Peer-Review 2005: „Some interface do not have isolation provisions to prevent contamination of the non-radioactive system“**
- **What is an „isolation provision“ to provide a „safe“ interface?**
- **A safe interface consists of two barriers (two-barrier-concept):**
  - A Check-valve
  - A reliable pressure difference
  - Integrity of component (like a tight heat exchanger tube)
  - Radiation monitor in non-radioactive system (Only under certain circumstances)

Additional tasks:

original

additional

HSK-Requirement: RCA-boundary review

Review of RCA-penetrations

Are there penetrations through the RCA-boundary carrying radioactive material?

Corrective actions

Review of system interfaces

Are there „unsafe“ interfaces between radioactive and non radioactive systems?

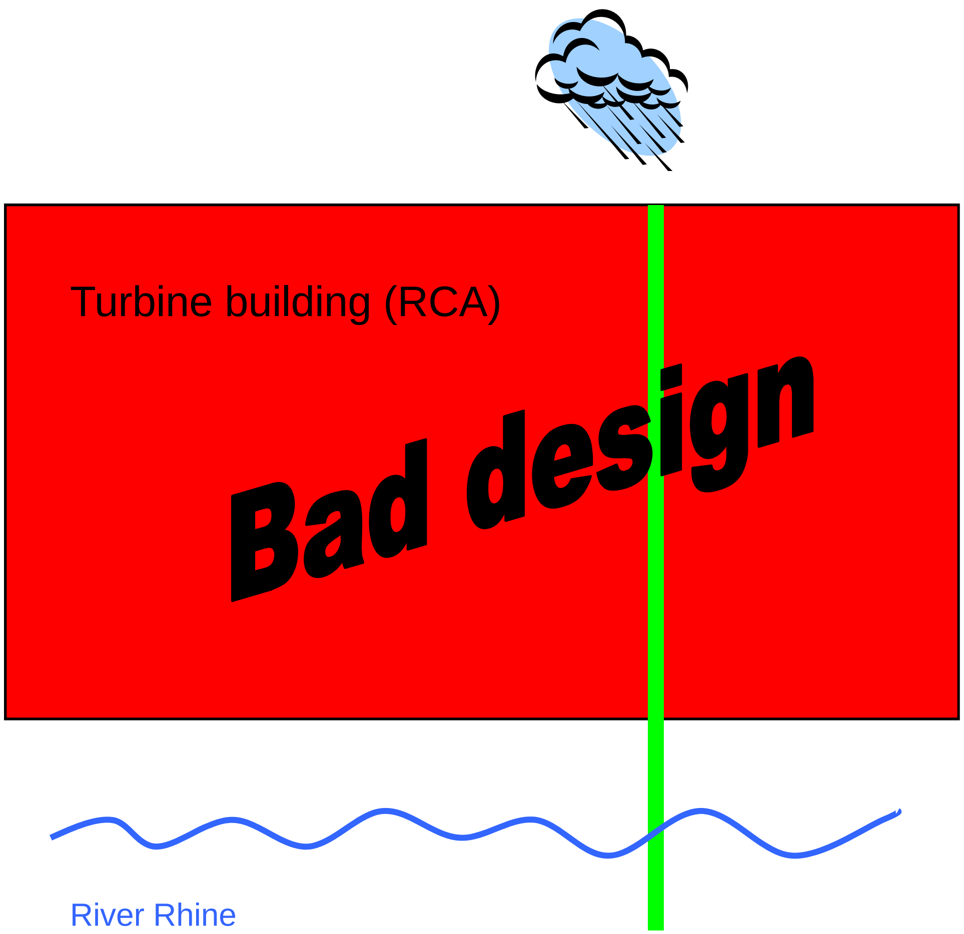
Corrective actions

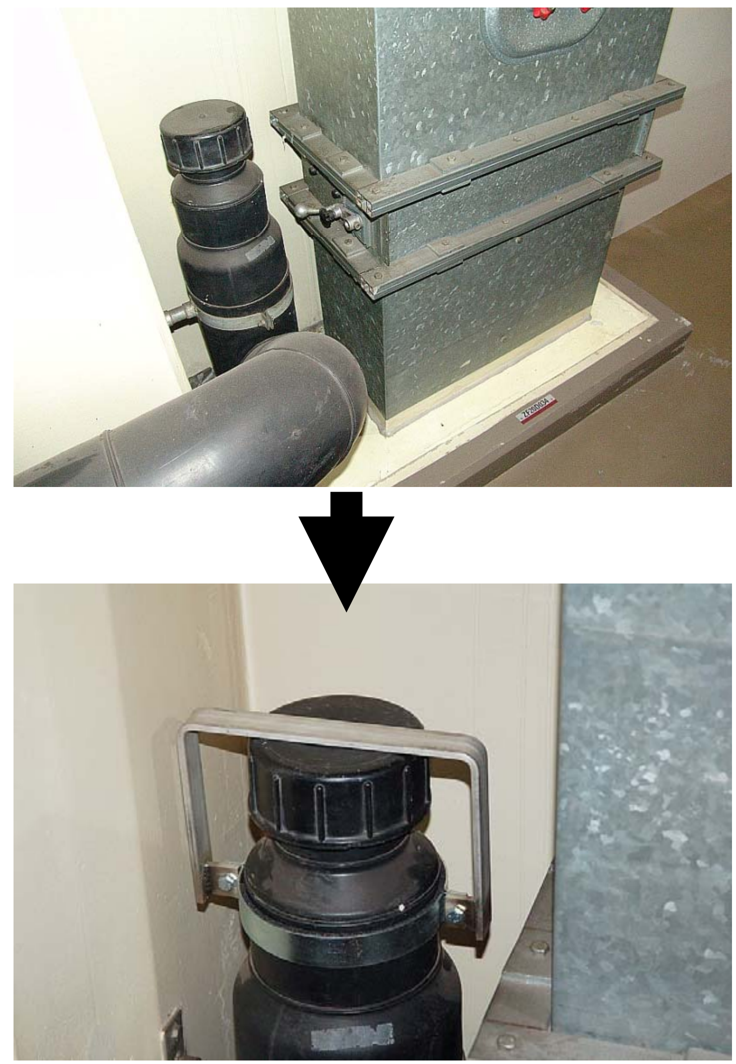
Review of RCA - Penetrations: Procedure

1. **Search and identification of penetrations through RCA - boundary**
    1) Walk - Downs in the field
    2) Discussions with RP/Engineering-staff to gather operational experience
2. **Verify the the identified penetrations in the as-built documentation**
3. **Assessment of the findings**
4. **Suggest technical solutions to improve unacceptable situations**
5. **Report to Plant Safety Committee and HSK**
6. **Follow – up of plant modifications**

Penetrations: Turbine building findings

- A total of 205 penetrations were evaluated
- Rainwater drain lines crossing the RCA



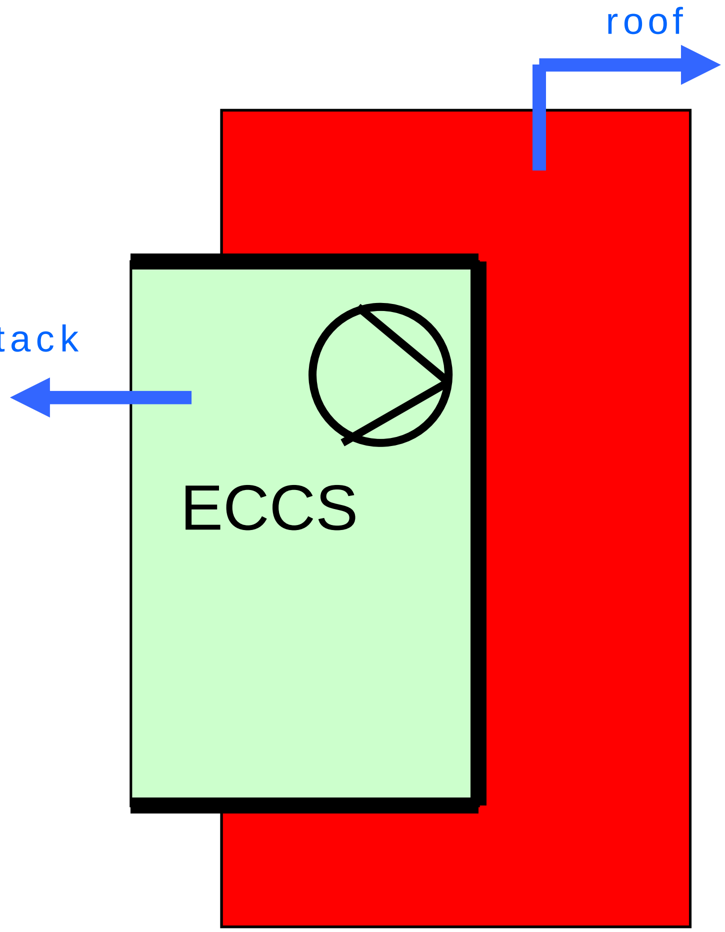


- **Vertical penetration through turbine building foundation**

- **Emergency ventilation exhaust**

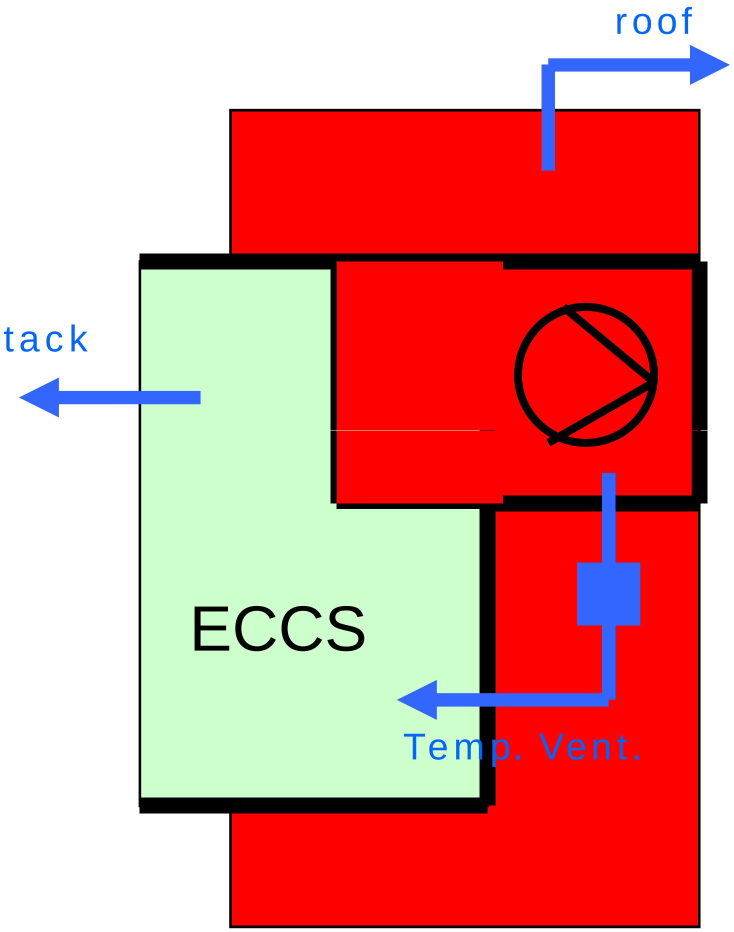
Penetrations: Reactor Auxiliary Building findings

- Reactor Aux Building = RCA
- **2 ventilation concepts:**
  - o **ECCS-rooms:** Ventilation to stack, qualified radiation monitors
  - o **Other rooms (hallways, diesels etc.):** Ventilation to roof, no qualified radiation monitors)
- **Ventilation to the environment without qualified radiation monitoring is a violation of RCA-requirements *per se***

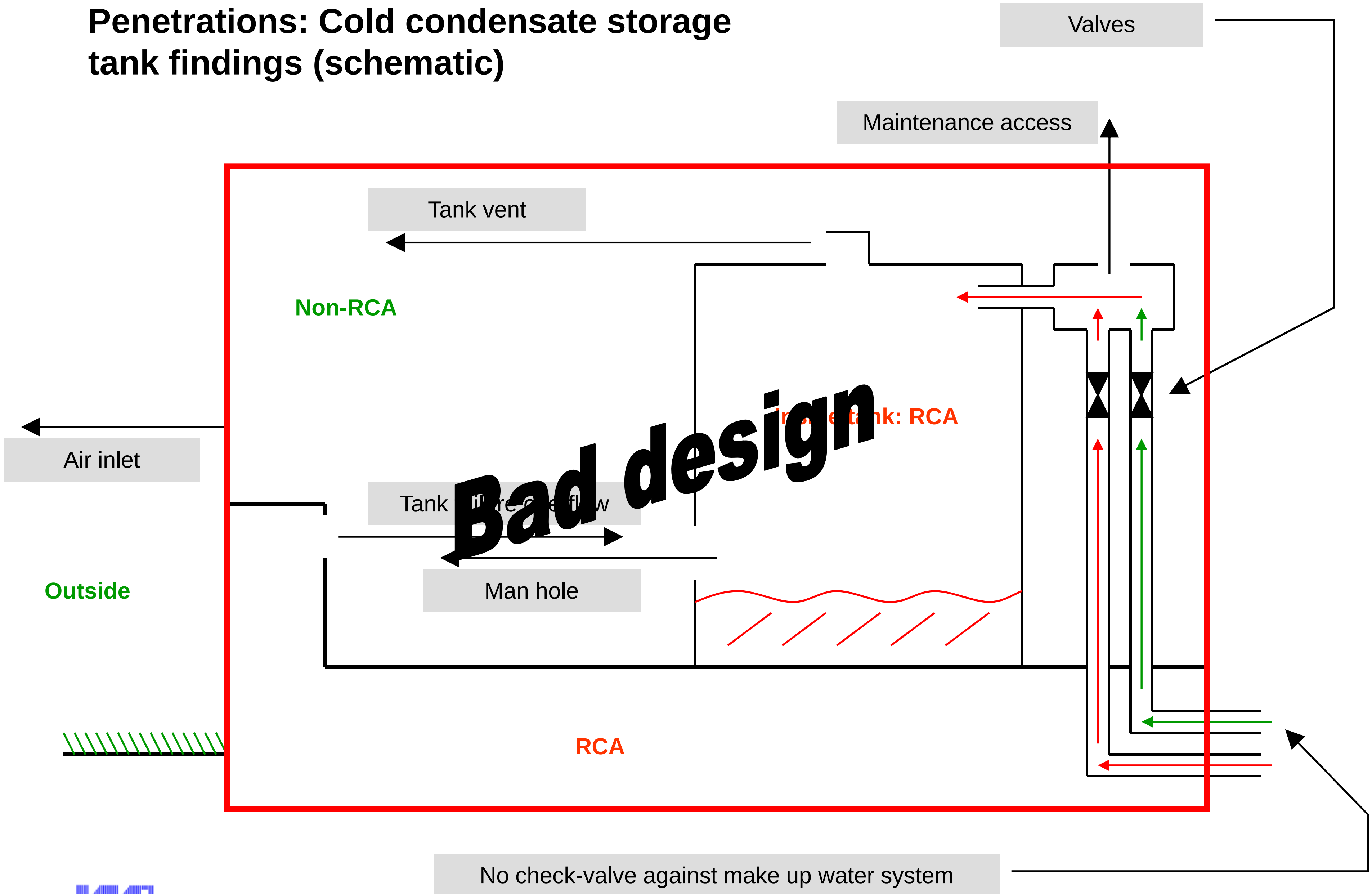


Penetrations: ECCS maintenance

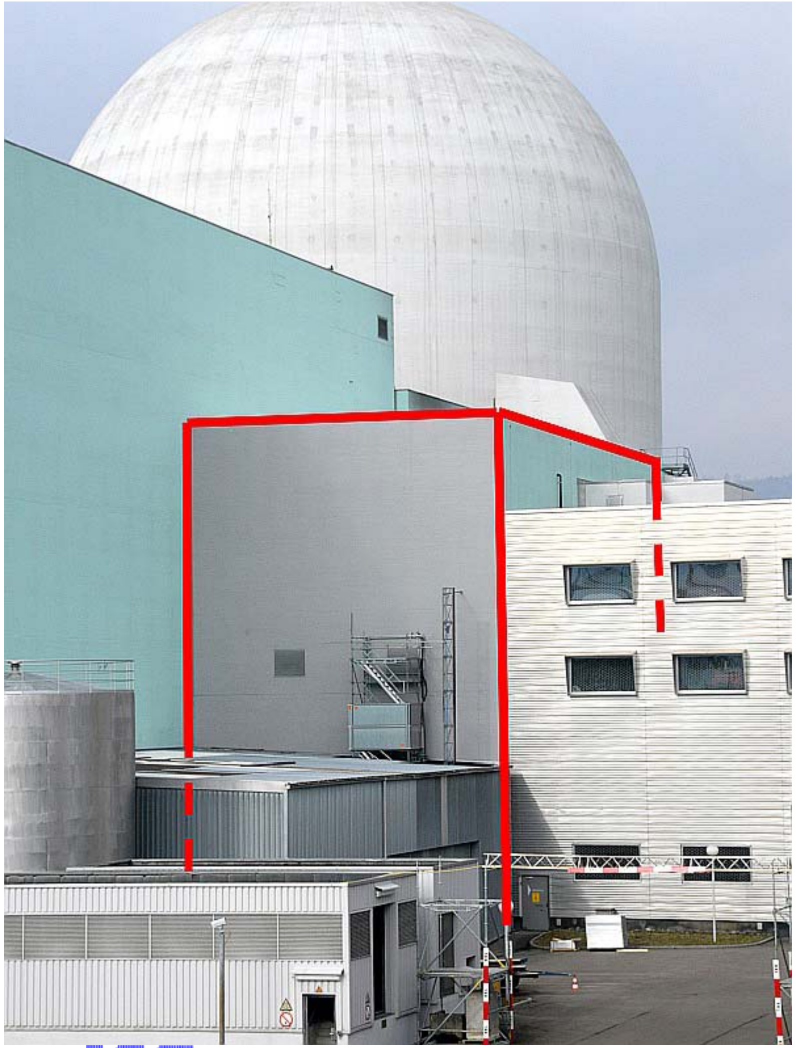
- **Maintenance of ECCS-pumps in Aux-building hallway**
  - o Maintenance of a heavily contaminated component without proper ventilation flow has the risk of a real release via unlicensed pathway
- **Temporary solution 2008 and 2009:**
  - o Tent around maintenance location
  - o mobile HEPA-filters
  - o Redirect ventilation flow from tent to ECCS-rooms
- **Final solution to be discussed**



Penetrations: Cold condensate storage tank findings (schematic)



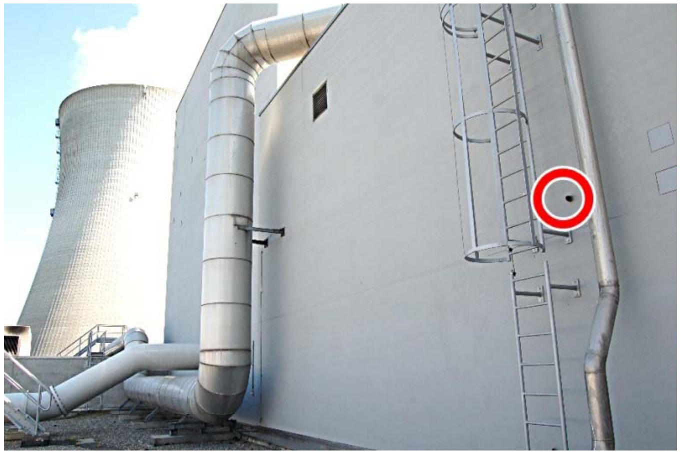
Penetrations: cold condensate storage building



- New roof
- New ventilation
- New coating inside
- 2.5 million $
- New part of the RCA

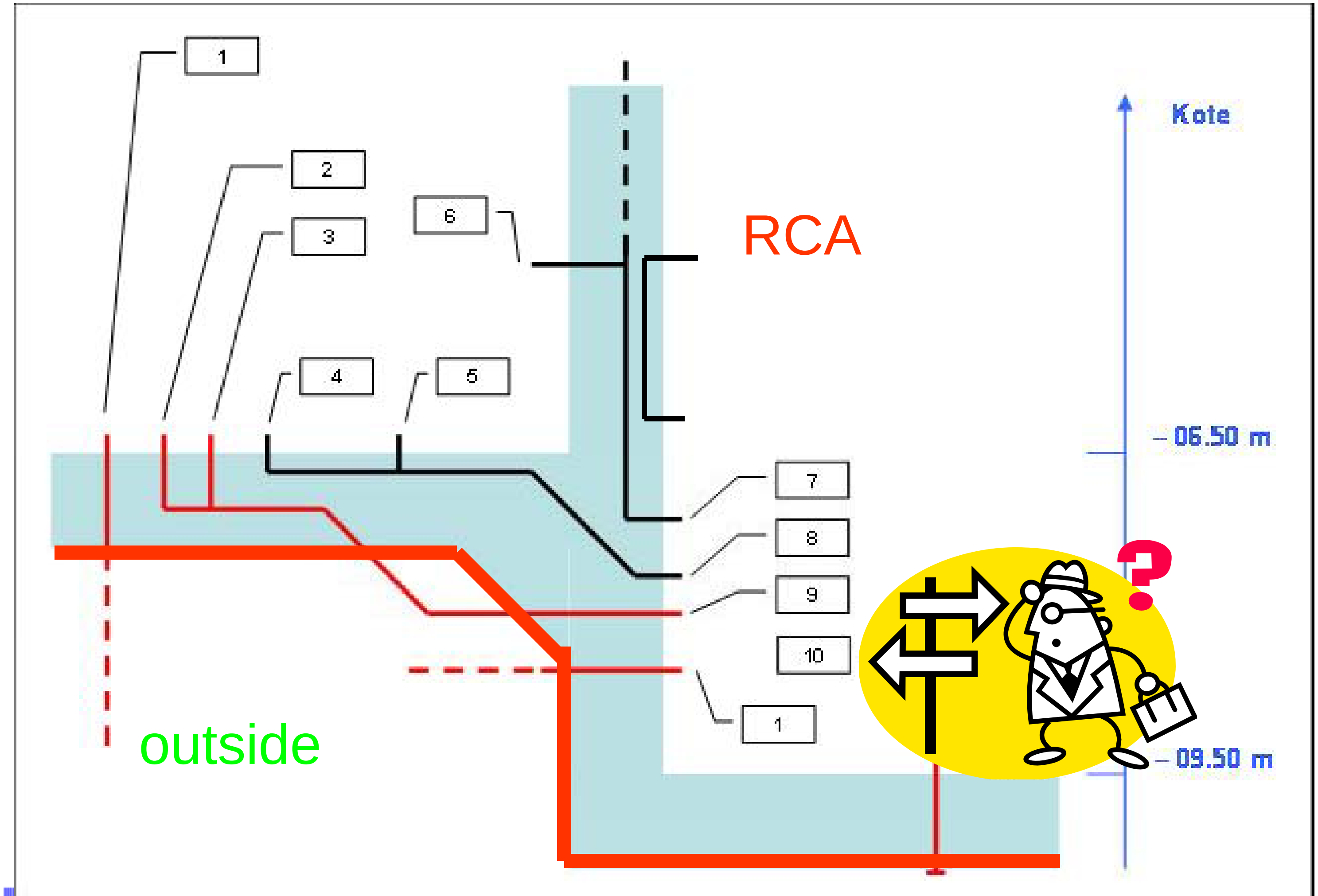
Penetrations: miscellaneous findings

- **Abandoned tube for electric cables in Radwaste building wall**

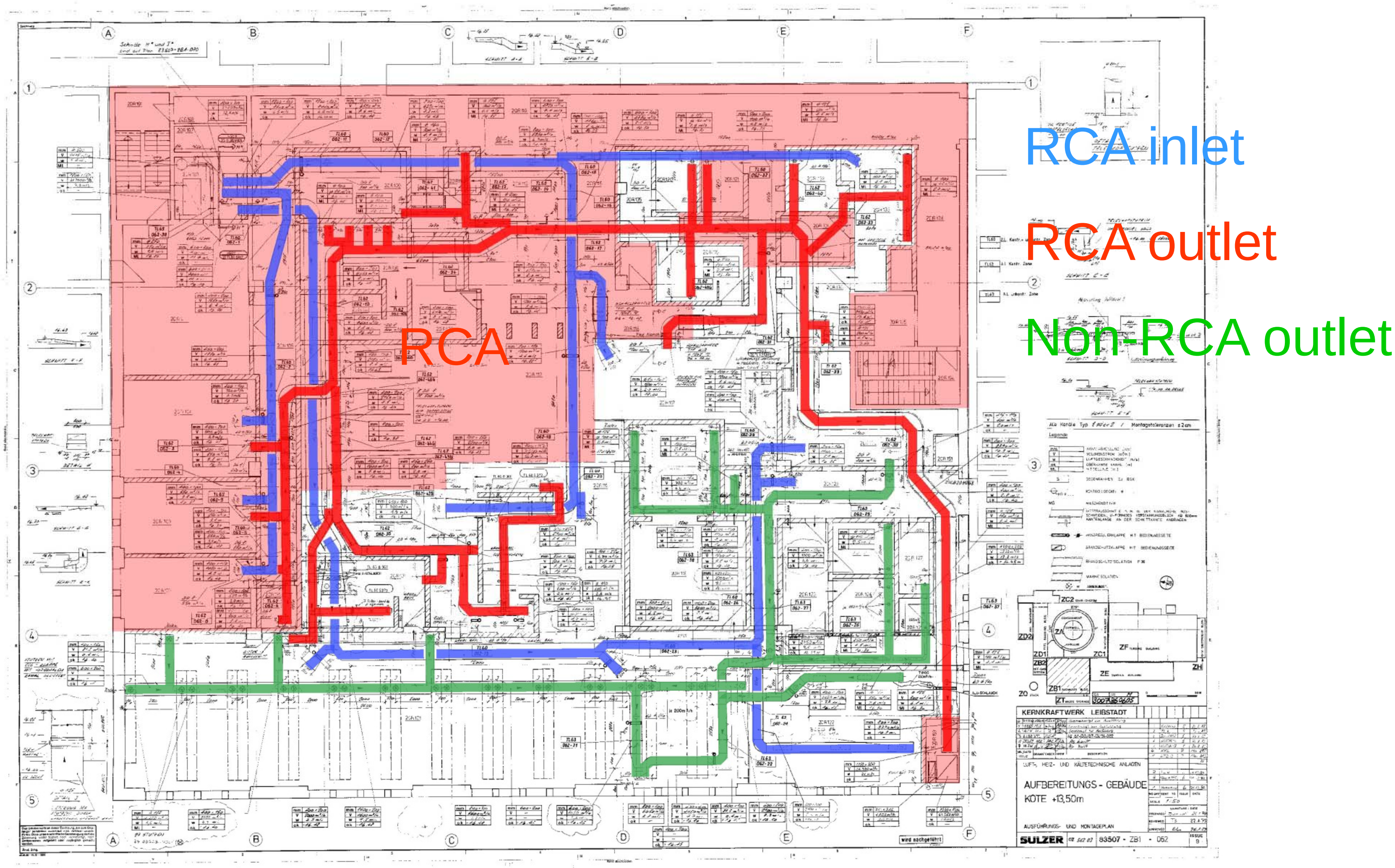


- **Open penetration through RCA-boundary**

Different types of penetrations

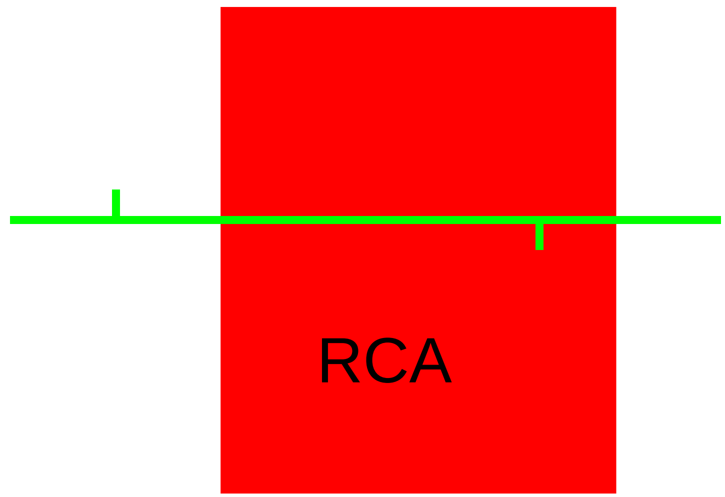


Confusing? Radwaste ventilation!



Interfaces: Findings in the turbine building

- **Make up water outlets:**
  - Coupling fits to various types of hoses
  - 1. Barrier = pressure difference
  - 2. Barrier = non existant
  - Possibility to inject contaminated water into the make up water system
  - Solution: Additional check valve for each outlet

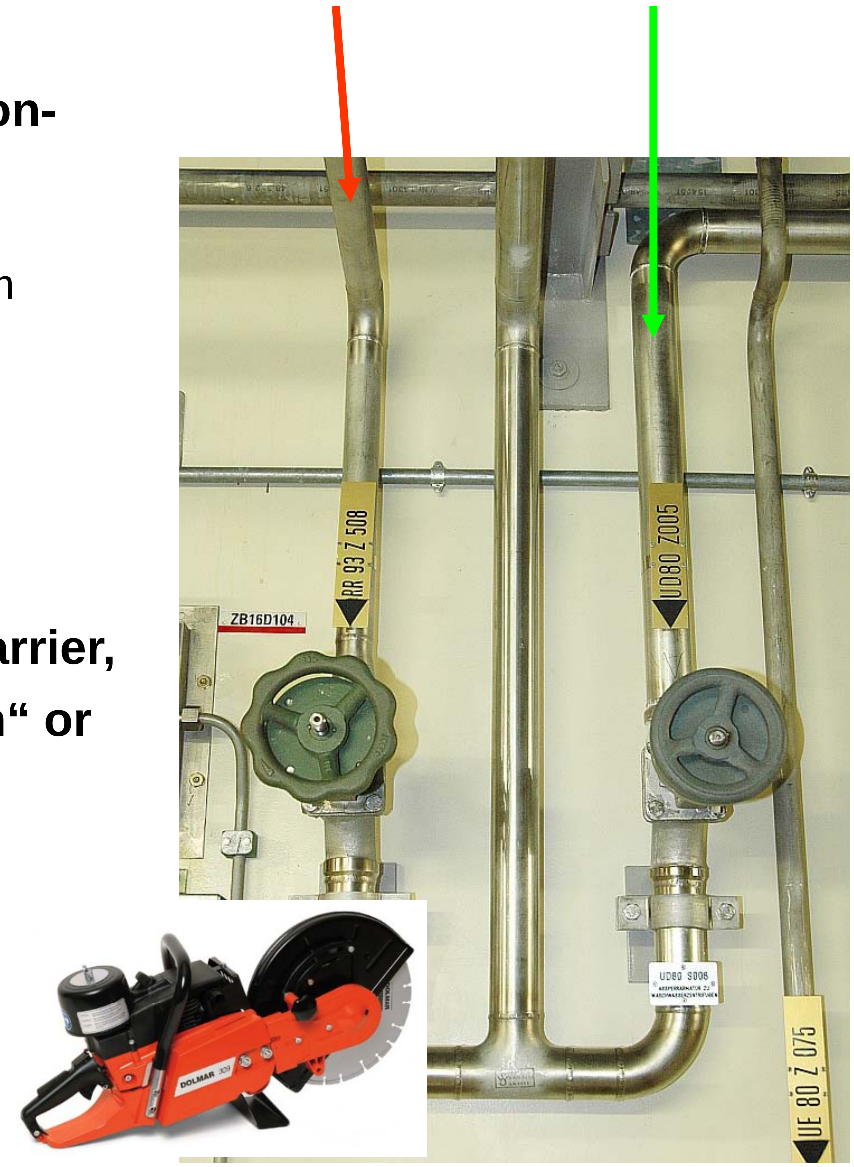


- **Underlying problem:**
  - Non radioactive systems, whose content is used inside and outside of RCA
  - Examples: fire water, make up water, aux steam, compressed air, service air

Interfaces: Findings in the Radwaste

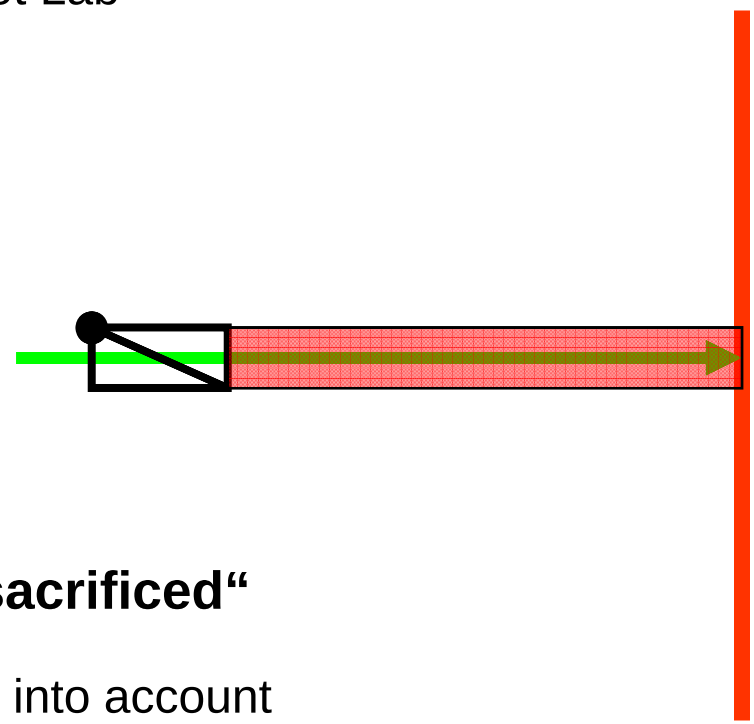
- **Interface between cold condensate (radioactive) and make up water (non-radioactive):**
  - o 1. barrier = non existant (similar system pressure)
  - o 2. barrier = non existant

- **Valves are not considered to be a barrier, because their position can be „open“ or „closed“**



Interfaces: Special situations

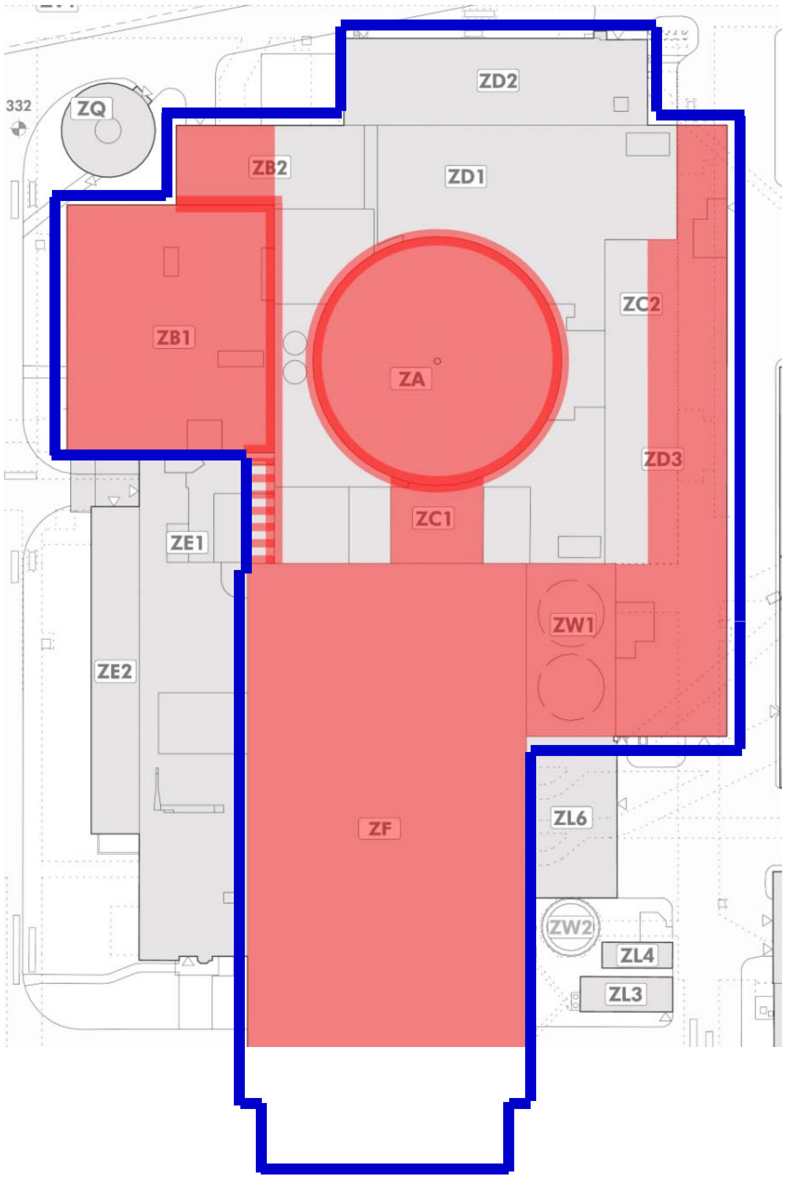
- **Some parts of systems can‘t be protected with reasonable effort**
  - Drinking water system inside Hot Lab
  - Water supply of Hot Laundry
  - Parts of Auxiliary steam system



- **Those parts of systems are „sacrificed“**
  - Possible contamination is taken into account
  - Documentation for future modifications and decommissioning

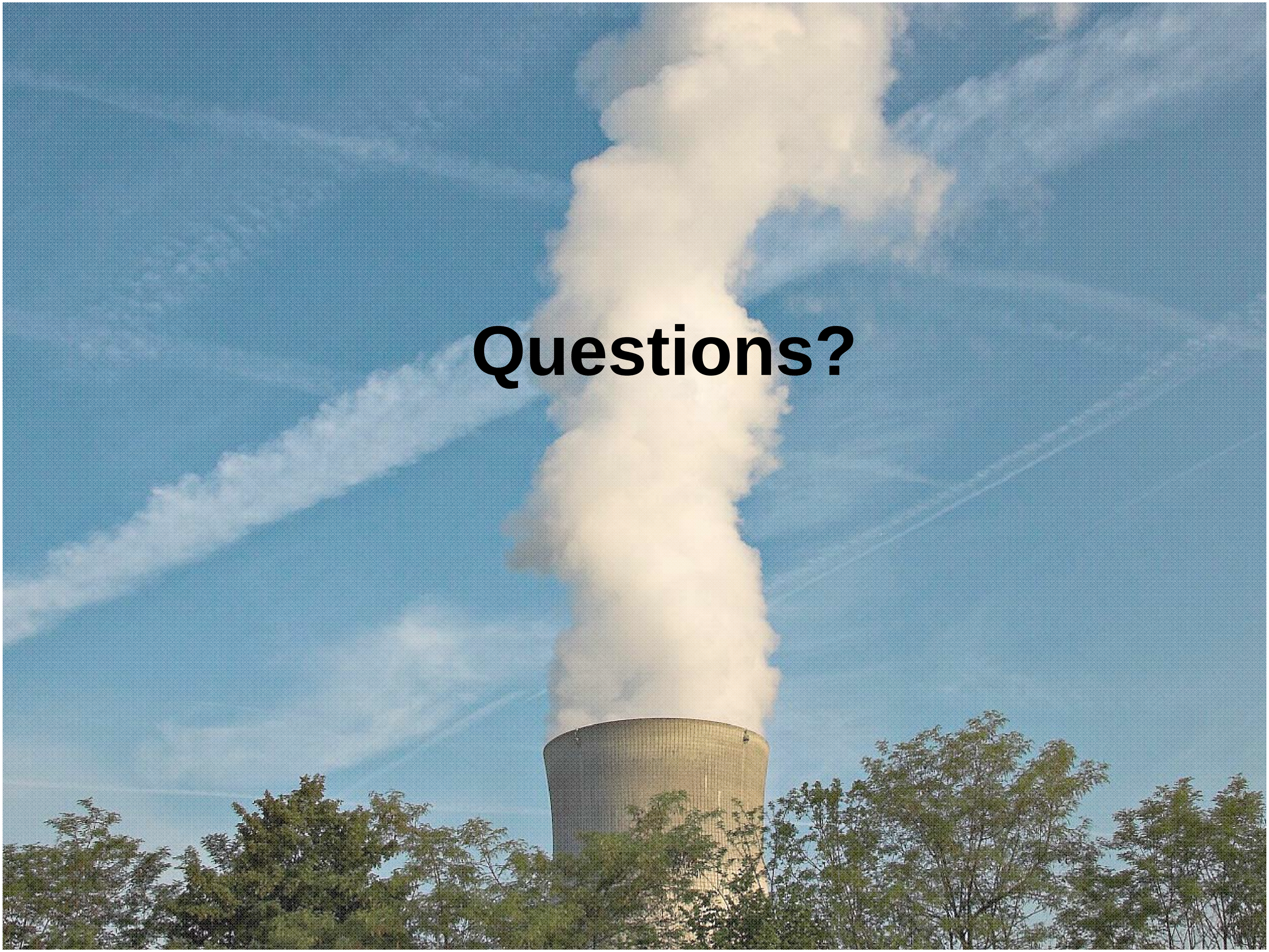
Work progress

- **Review completed**
  - Hot workshop
  - 10 kV-Switchyard
  - Cold condensate storage
  - Turbine building
  - Seismic gap between buildings
  - Steam tunnel
  - Off-gas building
  - Radwaste building
  - Containment
- **Review in progress**
  - Auxiliary building
  - Fuel handling building
  - Waste storage building
  - Stack



Conclusions

- Until now a workload of 3 man-years was generated
- Approx. 2/3 of the project is completed
- A dozen of plant modifications has been triggered
- The understanding in plant and systems design has improved among engineers and Radiation Protection
- A review like this will be part of the new plants licensing process
- KKL has become safer with regard to inadvertent release of radioactive material


Questions?