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Maintenance Tent for TK Detector

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1. **Purpose of maintenance tent**
2. **Concept**
3. **Composition of mobile AC unit**
4. **Thermodynamic process**
5. **Preliminary specifications of AC unit**

Purpose of Maintenance tent

During maintenance TK volume will be kept at low temperatures (0 °C) in order to:

- **survive high radiation environment of the LHC**
- **avoid degradation of silicon wafers**

→ meeting of *"10 years of lifetime"* requirement

Tent provides thermodynamic protection against humidity and heat during maintenance periods

Access time scales for CMS

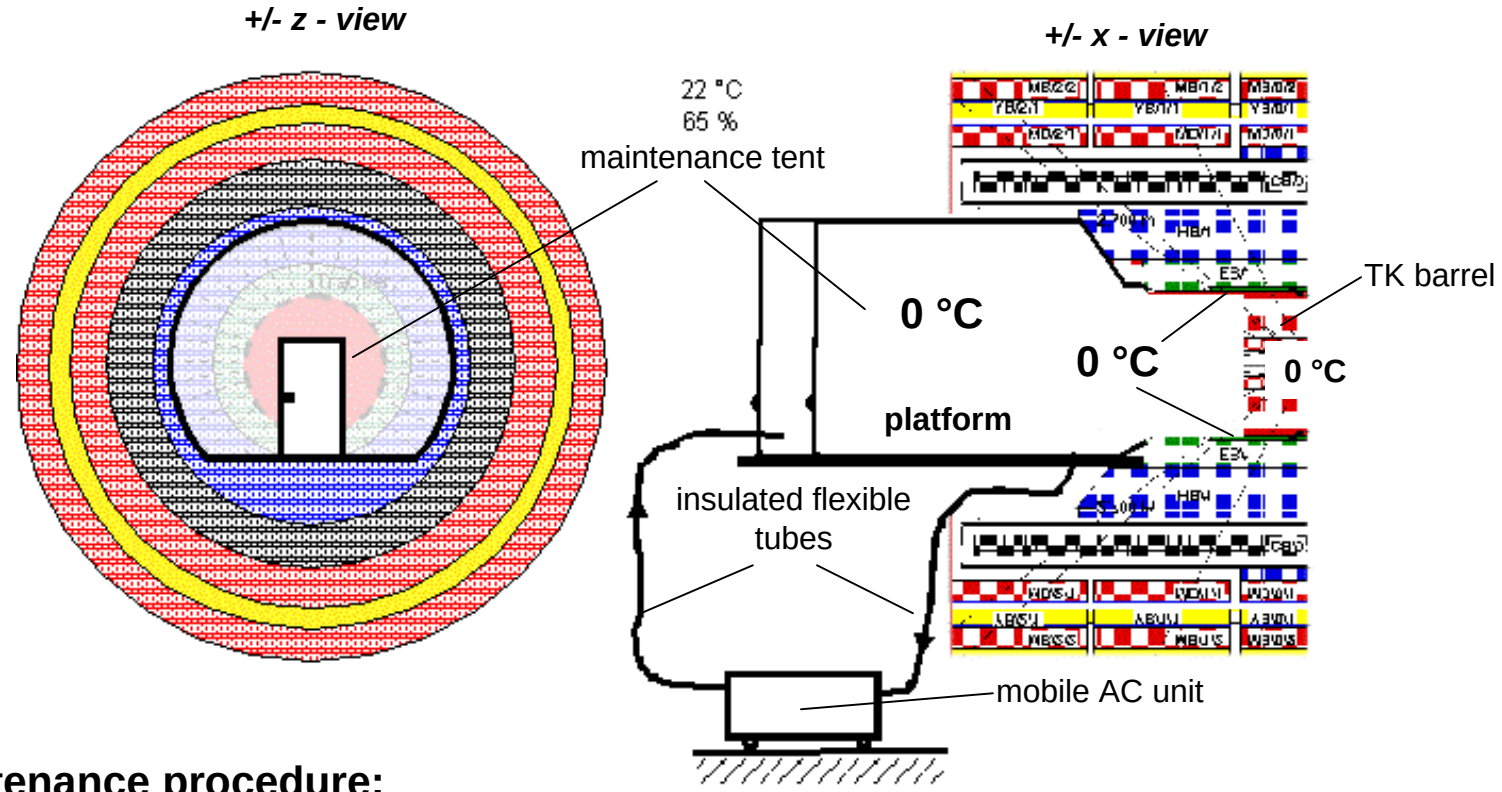
For TK Maintenance works the following access time-scales need to be taken into consideration (TDR CERN/LHCC 98-6):

SHORT TIME ACCESS (1h…3 days):
- No significance for TK

INTERMEDIATE TIME ACCESS (2…3 weeks):
- Opening of CMS endcaps
- Access to TK patch panels and endflanges

END OF YEAR SHUT- DOWN ACCESS (Nov. … April):
- Removal of one TK endcap
- Maintenance and repair works
  - of TK endcap on surface in cold store
  - of TK barrel in situ by means of **maintenance tent**

Concept for TK Maintenance Tent



Maintenance procedure:

Removal of CMS endcap → introduction of platform → setup of tent → connection of AC unit → operation until desired air condition in tent → extraction of TK endcap and storage in foreseen cold area on surface → access to and maintenance of TK barrel

During maintenance:

Tent, TS and TK barrel volume are kept at 0 °C

⇒ thermodynamically neutral atmosphere / environment for TK

Requirements and preliminary assumptions

1. No heat loads for TK barrel and endcap
   $\rightarrow t_{TS}, t_{tent} = t_{TK;surface}$ *(thermodynamically neutral environment !)*

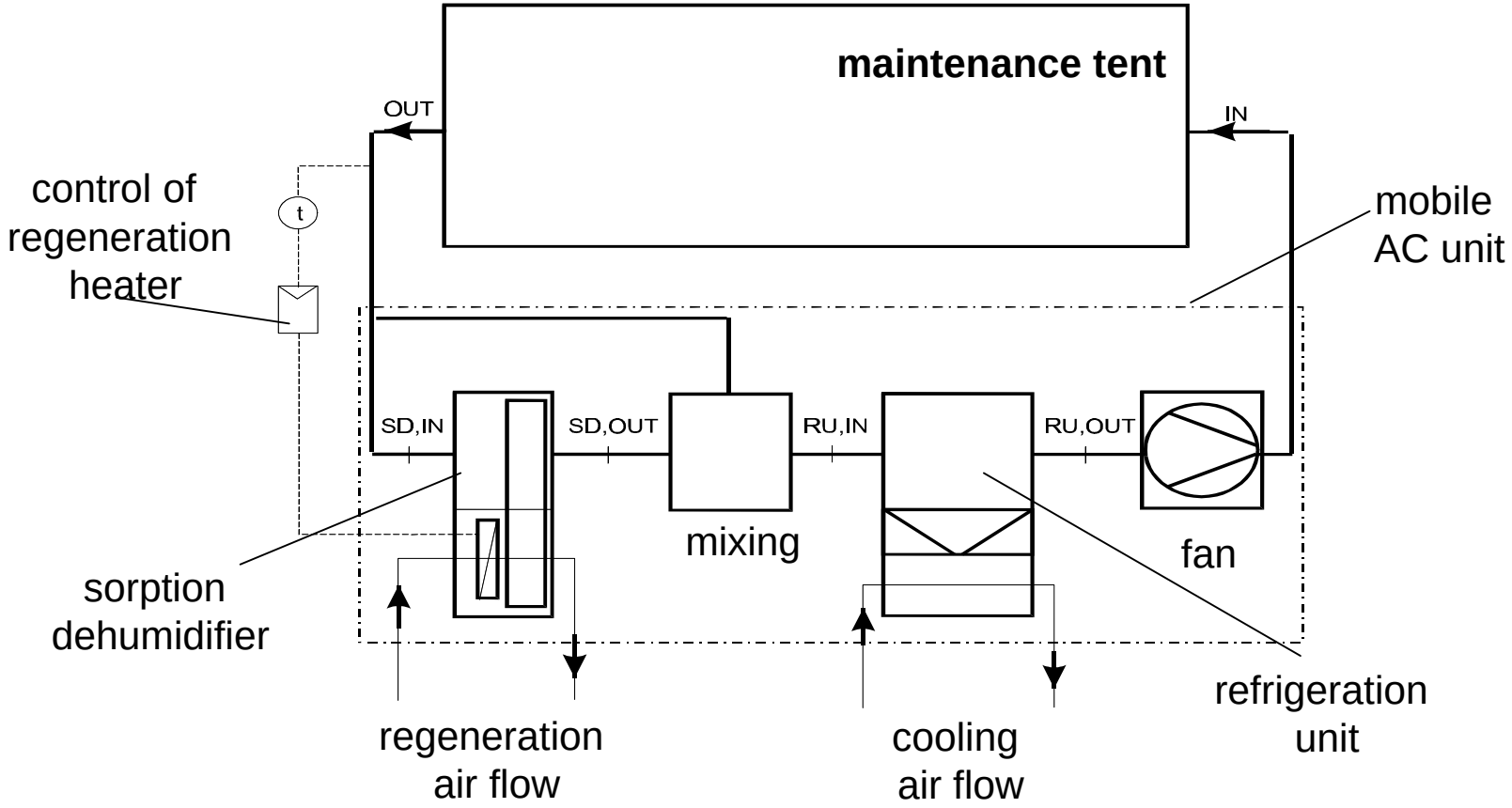
2. No condensation/frosting on TK surface
   $\rightarrow t_{dew,tent} < t_{TK,surface} = 0\ °C$

3. No condensation on outer surface of tent and flexible tubes
   $\rightarrow t_{tent,\ outer\ surface}, t_{tubes,\ outer\ surface} > t_{dew,\ ambient\ air}$

Air conditions
cavern: 22 °C, 65 % $\Rightarrow$ t dew = 15 °C
tent: 0 °C, 40 % $\Rightarrow$ t dew = - 11 °C

Tent Dimensions
height/length: 4,5 m / 5,5 m

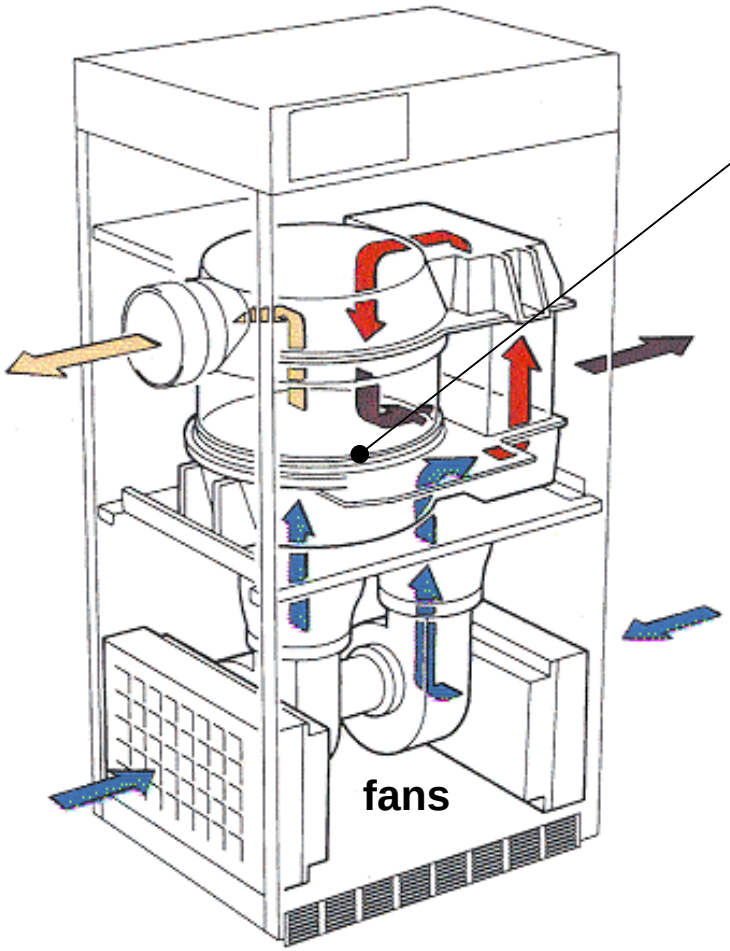
Composition of Mobile AC Unit



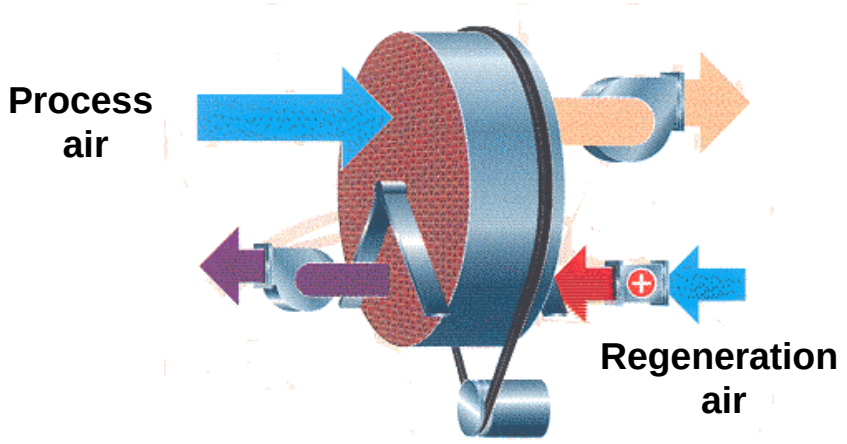
Mobile AC unit:

- closed housing containing all relevant components (dehumidifier, refrig. unit, filter, fan, rotor drive,etc.)
- main switch (MAN/AUTO), basic controls and displays (NET/OPERATION/FAILURE) allow easy external operation

Example of Standard Sorption Dehumidifier

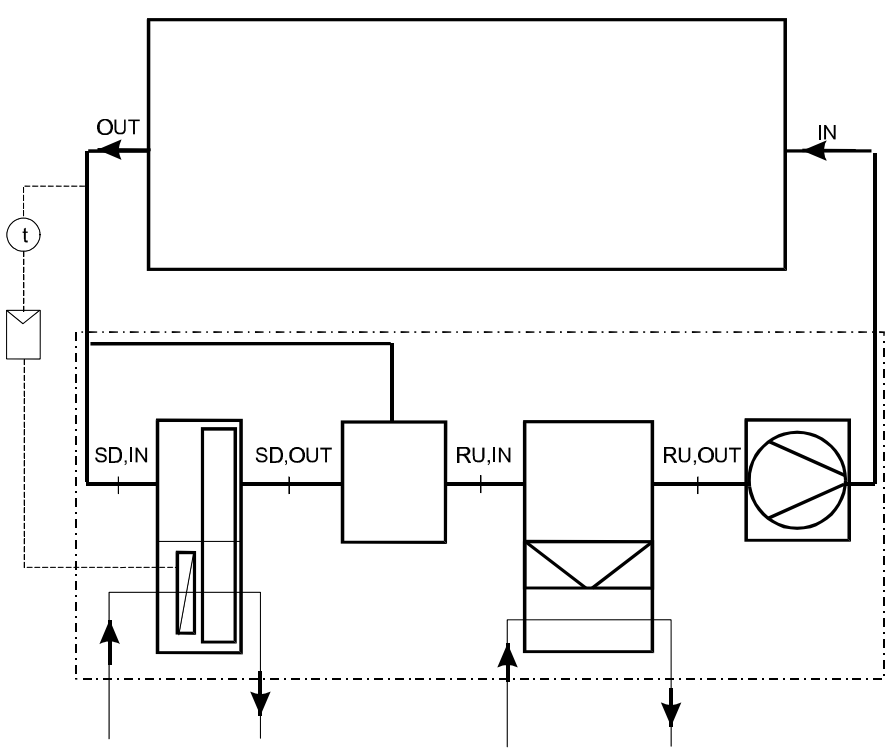


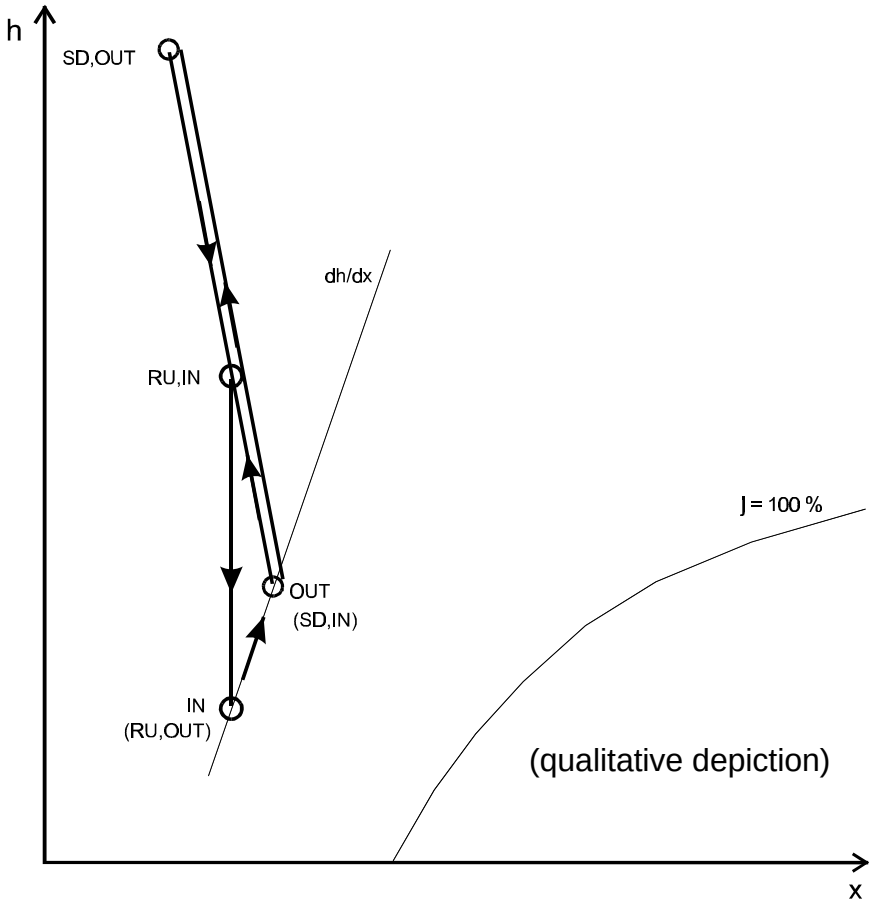
Sorption rotor:
composed of large number of small channels impregnated with sorptive agent



Functional principle:
2 airflows passing through the rotor continuously:
Process air
→ charging of rotor with water molecules
→ dehumidification
Regeneration air
→ drying of rotor
→ humidification

Thermodynamic process in Mollier h,x-diagram





State changes of process air:

IN	→	OUT	state change of air inside the tent (humidification, heat up)
SD, IN	→	SD, OUT	dehumidification of air (exothermic process → heat up of airflow)
OUT + SD, OUT	→	RU,IN	mixing of dehumidified and bypassed air to desired desiccation level (x_{IN})
RU,IN	→	RU,OUT	cooling of air down to desired supply temperature (t_{IN})

Preliminary specifications and cost of AC unit

Housing: zinc coated steel plates with supply/return plugs

Dimensions: ~ 1000 x 500 x 500 mm

Weight: ~ 60 kg

Approx. cost: ~ 50 000 CHF

<u>Option/suggestion:</u>

Usage of mobile AC unit as maintenance device for other purposes
(e.g. desiccation of humid components, thermodynamic protection of components)