

Accelerator Division's requirements for the oxygen deficiency detection system to be installed in HCB, dog shed, CXB and CTL Gallery

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Supporting documentation:

- ✓ ESS guideline for Oxygen Deficiency Hazard (ODH) – ESS-0038692
- ✓ ODH assessment of the accelerator buildings – ESS-0063324

I. Context

The accelerator areas/buildings will soon house several cryogenic systems and therefore might be subject to ODH due to the significant quantity of helium and nitrogen used during operation. A preliminary and simplified ODH assessment was performed in 2016 (see ESS-0063324) and the results of the ODH classification showed that no oxygen deficiency detectors would be needed in those areas. However the Review Committee of the ODH safety review of the accelerator buildings held in September 2016 (see <https://indico.esss.lu.se/event/625/>) recommended implementing oxygen deficiency detectors in those areas due to the high number of instruments (e.g. check valves, hand valves, vent valves, etc.) that could potentially leak. Input data (e.g. leak rate, location of emergency exits, worse case scenarios, etc.) necessary to define the location of the oxygen deficiency monitors has been compiled and provided by the Accelerator Division to the Personnel Safety System (PSS) team in 2016.

The preliminary ODH assessment of the accelerator buildings will soon be updated with the following information: additional failure scenarios and associated failure rate for each area/building.

II. Main purpose and scope

In the frame of the design of the Personnel Safety System (PSS), the main purpose of this document is to provide a list of high-level requirements regarding the design and operation of the oxygen deficiency detection system to be installed in the following areas:

- ✓ Helium Compressor Building (HCB) including the TMCP Hall (TCH), ACCP Hall (ACH), HP Gas Storage (HPGS).
- ✓ Dog shed.
- ✓ Cryogenic Transfer Lines Gallery (CTLG).
- ✓ Coldbox Hall (CXH).

Note that the portable oxygen deficiency monitors are out of the scope of this document.

Remark: the buildings names used in that document are consistent with ESS Accelerator Buildings names defined in ESS-0052867

III. General System Requirements

ACC-ODH-01: The areas/buildings listed above shall be equipped with oxygen deficiency detectors according to the decision of the Review Committee made during the ODH safety review of the accelerator buildings (see <https://indico.esss.lu.se/event/625/>).

ACC-ODH-02: The oxygen deficiency detection system shall be designed in such a way to alert the personnel in order to facilitate their safe and fast evacuation in case of oxygen depletion.

ACC-ODH-03: The location of the oxygen deficiency detectors in the areas/buildings listed above shall be consistent with the layout defined and agreed at the ODH safety review of the accelerator buildings (see <https://indico.esss.lu.se/event/625/>) between the Review Committee and the PSS team.

ACC-ODH-04: The technology used for the oxygen deficiency detection to be placed in the area/buildings mentioned above shall be consistent with has been agreed and approved at the ODH safety review of the accelerator buildings (see <https://indico.esss.lu.se/event/625/>) between the Review Committee and the PSS team:

- Single port fast sampling oxygen deficiency detection in the dog shed and CTLG.
- Multiport sampling (up to four ports) oxygen deficiency detection in HCB and CXB.

Remark: No access interlock to those areas/buildings is required in case of oxygen depletion.

IV. Alarm requirements

ACC-ODH-05: The location of the flashing lights and evacuation alarms in the areas/buildings listed above shall be consistent with the layout defined and agreed at the ODH safety review of the accelerator buildings (see <https://indico.esss.lu.se/event/625/>) between the Review Committee and the PSS team.

ACC-ODH-06: The ODH flashing lights and evacuation alarms in the above-mentioned areas/buildings shall be activated upon detection of low level of oxygen ($\leq 18\%$) from at least one oxygen deficiency detector as follows:

- In case of low level of oxygen in ACH, TCH or HPGS the flashing lights and evacuation alarms of the entire HCB shall be triggered except the dog shed.
- In case of low level of oxygen in the dog shed, only the flashing lights and evacuation alarms of the dog shed shall be triggered.
- In case of low level of oxygen in the CTLG, only the flashing lights and evacuation alarms of the CTLG shall be triggered.
- In case of low level of oxygen in the CXH, the flashing lights and evacuation alarms of the entire Coldbox Building (CXB) shall be triggered.

ACC-ODH-07: If the O₂ concentration drops below 18%: the oxygen deficiency detection system shall send a signal to the main control room and cryogenic control room. The lights and alarms shall remain active as long as the digital signal from the oxygen deficiency detection system's relay module is active.

ACC-ODH-08: If the O₂ concentration drops below 19.5%, the oxygen deficiency detection system shall send a signal to the main control room and cryogenic control room.

ACC-ODH-09: Flashing lights evacuation alarms shall be placed at each entrance leading to the areas/buildings mentioned above in order to alert the personnel prior to entering in case of oxygen depletion.

ACC-ODH-10: In case of failure of one of the oxygen deficiency detectors (e.g. pipe obstruction, power cut, etc.) a signal should be sent to the main control room and cryogenic control room and a local visual indicator should be displayed on the faulty detector.

ACC-ODH-11: The emergency back-up power system shall be designed to supply back-up power for the ODH detection system for at least 4 hours.

ACC-ODH-12: The oxygen deficiency detection system should be designed in such a way to allow the possibility to be connected to a real-time analogue O₂ readout.

Remark: requirements related to alarm acknowledgment by the main control room and/or cryogenic control room as well as data acquisition (e.g. frequency, data storage, etc.) are out of the scope of the present document. Those requirements should be specified by a central Division.