







# Technical Galleries Consolidation-Safety studies

TG-CONS Project board meeting #2
Adrianos Filinis, on behalf of the TG-CONS core team

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General Safety content

ODH and CO2

Ventilation

Alert and triggering alarms in the galleries

Telecommunication in the galleries

Fire safety

Preparing the galleries for worksite activities





## **Safety content - Technical Specifications**



N. Working on the CERN Site

Intro

To be adapted as appropriate

#### N.1 Location of the Activities

France/Switzerland/both

#### N.2 Safety Requirements related to Activities on the CERN Site

In accordance with the provisions of § 3.1 of the document Working on the CERN site, the activities performed by the Contractor on the CERN site will be classified as "Category 2" operation.

CERN will prepare, with the collaboration of the contractor, a Prevention Plan or equivalent, summarizing the safety issues to be followed before and during activities.

The contractor (and subcontractor if any) shall:

- Collaborate with CERN, providing activities description, the workers involved, an assessment of the risks inherent and the risks generated, the preventive and protection measures to be taken;
- Take part in all joint inspections if necessary;
- Inform his personnel and his potential sub-contractors about the provisions, and also take the necessary measures so that his sub-contractors also inform their personnel;
- Inform CERN of changes in the potential risks as and when they arise and vice versa.

Activities are subject to a notice of start of works to be issued by CERN (Impact system)





### **Safety content - Technical Specifications**



#### N.2 Safety Requirements related to Activities on the CERN Site

To be adapted as appropriate

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The Contractor shall comply with the following specific safety requirements, in particular concerning access in galleries:

- Manage the issue of lone worker (according to GSI-SH-2)
- Wear Personal Protective Equipment (PPEs), at least: work clothes, safety shoes, helmet and headlamp.
- Comply with any specific instructions displayed from time to time (for example: wearing an oxygen deficiency detector).
- If the work involves the opening of false floors, secure (barriers/marking/presence of 1 person as appropriate) the areas and close them immediately

after the intervention.

- The obligation to close the fire doors when leaving the work area (midday, evening, weekend).
- Take into account the lack of telephone network coverage in certain areas (will be seen during preparatory visits or joint inspection).

In accordance with § 7 of the Safety regulation CERN SR – SO "Responsibilities and Organisational Structure in Matters of Safety at CERN", the Contractor shall appoint a Safety Correspondent who shall act as its representative at CERN in matters of Safety.





#### **ODH and CO2**



The different gaseous species present in the technical galleries are:

- Nitrogen\*
- Argon
- Helium
- Krypton
- Carbon dioxide

The first 4 gases are linked to ODH risks (displacement of oxygen), whilst large concentrations of carbon dioxide are toxic for humans.

HSE has specified the following limits to guarantee a safe work environment:

- 1. ODH: O2 levels to stay above 18%vol
- 2. CO2 toxicity: max. 10000ppm (short-term [15 min] exposure limit)

<sup>\*</sup>Nitrogen is heavier than air in liquid form

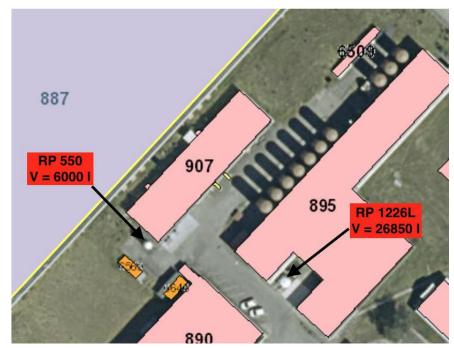




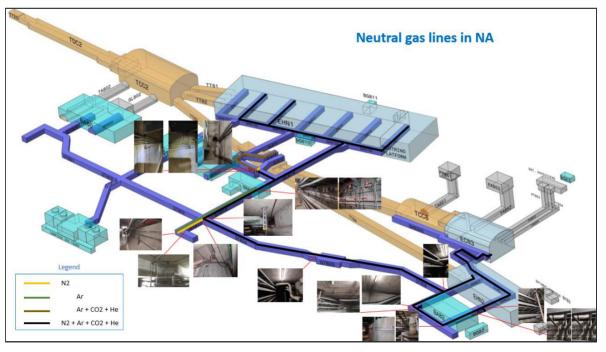
#### **ODH & CO2 risk - location**



ODH risk can also be caused by big leaks of gas lines in technical galleries but could also come from surface buildings in case of big leaks from Dewars at the surface and <u>most importantly</u> when the Dewars are being filled



Location of the LN2 and Lar Dewars in front of buildings 895.



Courtesy of NA-CONS





## **ODH & CO2 risk - Typologies**



Typology		Example	Safety response *
1	Dewars at the surface and/or Ar/N2 gas lines inside the galleries	GHN1, 804,805,806	Forced ventilation + fixed ODH detection system + alarm + portable CO2 meter + Access control
2	Helium lines inside the galleries	835, 818	Portable ODH/CO2 meter + Access control
3	No gas lines inside the galleries	832, 831	Access control

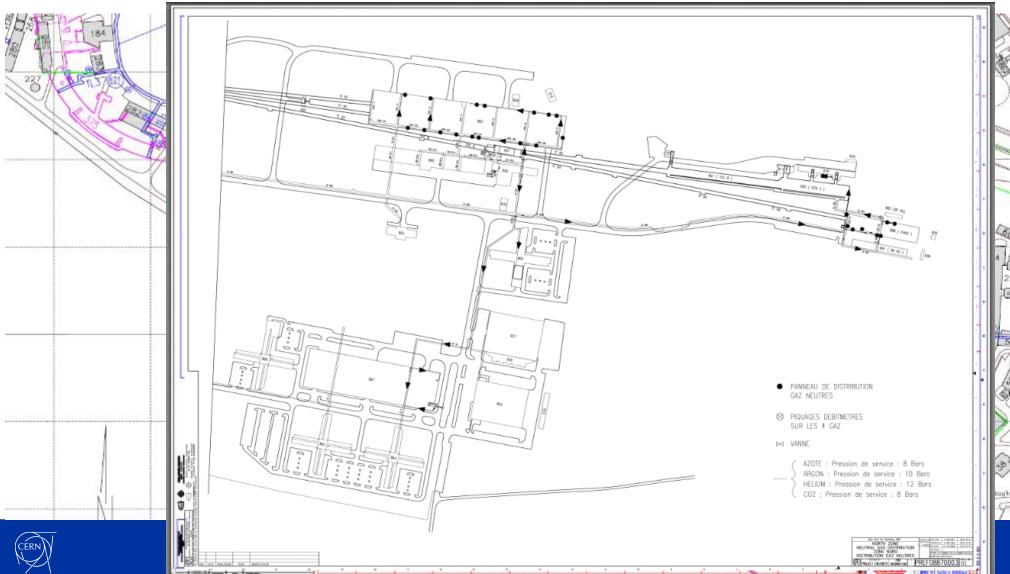
- \* Preliminary assessment, not final, on-going discussions
- Waiting for HSE prescriptions on methodology to use to assess ODH & CO2 risk (currently a Fermilab approach is followed)
- Risk analysis should be performed for SPS-CSAP, action Nr 7 in SPS-CSAP, see EDMS 2438382
- WORKSITE: Respect any specific instructions posted punctually (for example: wearing a detector lack of oxygen / presence of CO2. For this purpose, it may be relevant to anticipate the type of risk and to be permanently equipped).





## **ODH & CO2 lines inventory**









### **ODH & CO2 Dewars inventory**



- Various meetings have been held with BE-EA, TE-CRG, Simon Marsh and Didier Goddard to identify the best approach to cover the danger of leaks from Dewars and buildings located above and close to galleries
- A list of 110 Dewars have been identified up to this point
- The next steps to further reduce the list by taking into consideration are:
  - The volume of gas/liquid inside the Dewar
  - If there is an existing ODH risk analysis and/or existing mechanical ventilation in the building that covers the galleries as well
  - If the above exist but doesn't cover the galleries, try to expand their coverage for the galleries as well
  - Visit each building and discuss with users to identify their usage and find a strategy to address the problem
  - Reduce the list further by removing portable Dewars and depending on their location
  - If the risk can't be mitigated, perform and ODH risk analysis and depending on the results follow the appropriate procedure as was defined with Typologies 1, 2, 3 at the previous slides





### **Dewars list**



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CRRP data N - Ar - Kr											
2 3/21/2022											
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5 CRRP-01623 DEWAR AZOTE LIQUIDE	10		38	TEISSANDIER BENOIT 78822	OUI	GONNARD DIDIER PH X	Azote liquide Inox	15 1	5 .21	20.8	Pi
6 CRRP-03360 DEWAR MOBILE	15		SS	ROCHET JACKY 78374 1 2009	OUI	GONNARD DIDIER PH X	Azote liquide lnox	3	· · · · · · · · · · · · · · · · · · ·	6.4	- FI
7 CRRP-03697 DEWAR LIQUID NITROGEN	24		3S	MENAA NABIL 65242 16-2016	OUI	GONNARD DIDIER PH X	Azote liquide lnox	1.5		14.3	
8 CRRP-03650 DEWAR AZOTE LIQUIDE	24		3S	DZIEWA ANDRE 74040 1 2016	OUI	GONNARD DIDIER PH X	Azote liquide	49 .5	1	77	
9 CRRP-04167 Dewar LN2 PI	112		38	CROUVIZIER MICKAEL DI 2018	OUI	GONNARD DIDIER PH X	Azote liquide Inox		38 .525	6	CE
10 CRRP-03731 Cryostat LN2	113		3S	HENRIST BERNARD 7323 2017	OUI	GONNARD DIDIER PH X	Azote liquide Inox	.5 .5	.074	1.15	Autres
11 CRRP-02980 DEWAR MOBILE	113		3S	JENNINGER BERTHOLD 7 1995	OUI	GONNARD DIDIER PH X	Azote liquide Inox	2.8 3	.16	6	CE
12 CRRP-02861 DEWAR TRANSPORTABLE	113/R-004	I P	3S	JENNINGER BERTHOLD 7 1999	OUI	GONNARD DIDIER PH X	Azote liquide Inox	.7 6	.2	9	Pi
13 CRRP-01768 DEWAR MOBILE	150		3S	WENANDER FREDRIK JOI 1995	OUI	GONNARD DIDIER PH X	Azote liquide Inox	3 3		5.8	Autres
14 CRRP-00389 CRYOSTAT	153		3S	GRANCHELLI JEAN-PIERRE 74939 160251	OUI	GONNARD DIDIER PH X	Argon	3	3.754	4.5	
15 CRRP-01614 DEWAR LIQUID NITROGEN	153		3S	MONGELLUZZO ANTONIO 75997 165116	OUI	GONNARD DIDIER PH X	Azote liquide Inox	.5	.2		Autres
16 CRRP-04036 Cryostat ARIADNE AR T7	157		3S	MAVROKORIDIS KONST/2017	OUI	GONNARD DIDIER PH X	Argon liquide Inox 304 L		1.61	6.15	CE
17 CRRP-02621 RESERVOIR CRYOGENIQUE LN2	157/R-A16	I X		JAILLET DAVID 75535 16 1974	OUI	GONNARD DIDIER PH X	Azote liquide Inox		2.5 12	34	Tête de cheval
18 CRRP-04603 Dewar transportable	163		3S	JACQUOT PIERRE-FRANI 2019	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1.5	.211	6	Pi
19 CRRP-03089 DEWAR MOBILE	163		3S	JACQUOT PIERRE-FRAN(1998	OUI	GONNARD DIDIER PH X	Azote liquide Inox		5.5 .176	24.8	Pi
20 CRRP-03793 DEWAR AZOTE	165		SS	DUFAY-CHANAT LAETIT 1985	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1:	.000		Autres
21 CRRP-03295 DEWAR LN2	165		38	DUFAY-CHANAT LAETIT 1996	OUI	GONNARD DIDIER PH X	Azote liquide Inox	3 3	.12	6	Autres
22 CRRP-03238 Dewar azote	165		38	DUFAY-CHANAT LAETIT 2012	OUI	GONNARD DIDIER PH X	Azote liquide Acier	1.7 6	7.5	6	Pi -
23 CRRP-03237 Dewar azote	165		GS	DUFAY-CHANAT LAETIT 2012	OUI	GONNARD DIDIER PH X	Azote liquide Acier	1.5 6	.16	6	Pi
24 CRRP-02745 DEWAR MOBILE LHe	165 165		38	DUFAY-CHANAT LAETIT 2004 DUFAY-CHANAT LAETIT 1995	OUI	GONNARD DIDIER PH X	Azote liquide Inox	5	.16	5.5	Autres Pi
25 CRRP-01450 Dewar transportable 26 CRRP-01323 RESERVOIR CRYOGENIQUE	165 Q-CRY		GS GS	DUPONT THIERRY 75972 2000	OUI	GONNARD DIDIER PH X GONNARD DIDIER PH X	Azote liquide Inox	2 1		28.6	CE
27 CRRP-03618 DEWAR AD-BASE EXPERIMENT	165 Q-CRY		3S	ULMER STEFAN 71757 1 2014	OUI	GONNARD DIDIER PH X	Azote liquide Azote liquide Inox	1 6	43520	20.0	CE
28 CRRP-03696 DEWAR AZOTE LIQUIDE	165/R-007		3S	DZIEWA ANDRE 74040 1 2016	OUI	GONNARD DIDIER PH X	Azote liquide mox Azote liquide	1.5 0	.3	7	CE
29 CRRP-00002 Réservoir VISL-VAR	170		3S	COLLOMB PATTON CLAI 1955	OUI	GONNARD DIDIER PH X	Argon Acier	2 1	7 72	18	Autres
30 CRRP-05407 Dewar MOBILE	170		3S	LICA RAZVAN 73154 2021	OUI	GONNARD DIDIER PH X	Azote liquide Inox	5	.366	10	CE
31 CRRP-05406 Dewar transportable PI	170		3S	LICA RAZVAN 73154 2021	OUI	GONNARD DIDLER PH X	Azote liquide lnox	5	.157		Pi
32 CRRP-04044 DEWAR MOBILE	170		3S	GAFFNEY LIAM PAUL 73 2018	OUI	GONNARD DIDIER PH X	Azote liquide lnox	5 5	.35		CE
33 CRRP-03676 DEWAR TRANSPORTABLE AZOTE	170		3S	JOHNSTON KARL 73809 2016	OUI	GONNARD DIDIER PH X	Azote liquide lnox	15 6	.24	6	Pi
34 CRRP-03585 DEWAR AZOTE	170		GS .	LICA RAZVAN 73154 2015	OUI	GONNARD DIDIER PH X	Azote liquide Inox	2 2	.35	2.86	CE
35 CRRP-02561 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2009	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1.5 4		6.9	CE
36 CRRP-02555 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2006	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1.5 4	.16	5.5	CE
37 CRRP-02554 DEWAR MOBILE	170	I Po	3S	JOHNSTON KARL 73809 2001	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1.5 2	86 .12	3.58	CE
38 CRRP-02553 DEWAR MOBILE	170		38	JOHNSTON KARL 73809 2006	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1.5 4	.16	5.5	CE
39 CRRP-02552 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2006	OUI	GONNARD DIDIER PH X	Azote liquide Inox	2 2	.3	2.86	CE
40 CRRP-02453 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2007	OUI	GONNARD DIDIER PH X	Azote liquide Inox	4		6.9	CE
41 CRRP-02452 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2007	OUI	GONNARD DIDIER PH X	Azote liquide Inox	4		6.9	CE
42 CRRP-02451 DEWAR MOBILE	170		SS	JOHNSTON KARL 73809 2007	OUI	GONNARD DIDIER PH X	Azote liquide Inox	4		6.9	CE
43 CRRP-01772 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 1995	OUI	GONNARD DIDIER PH X	Azote liquide Inox	3 3	.12	6	Autres
44 CRRP-01771 DEWAR MOBILE	170		38	JOHNSTON KARL 73809 2000	OUI	GONNARD DIDIER PH X	Azote liquide Inox	3 3	5 24	6	CE
45 CRRP-01770 DEWAR MOBILE	170		GS	JOHNSTON KARL 73809 2003 JOHNSTON KARL 73809 1999	OUI	GONNARD DIDIER PH X	Azote liquide Inox	1.5 4		6.9	
46 CRRP-01769 DEWAR MOBILE	170 170		3S 3S	JOHNSTON KARL 73809 1999 JOHNSTON KARL 73809 2000	OUI	GONNARD DIDIER PH X	Azote liquide Inox	3 3 5 5	.16	<u>6</u>	CE CE
47 CRRP-01767 DEWAR MOBILE 48 CRRP-01765 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2000 JOHNSTON KARL 73809 2002	OUI	GONNARD DIDIER PH X	Azote liquide Inox Azote liquide Inox	3 4		6.9	CE CE
49 CRRP-01765 DEWAR MOBILE	170		3S	JOHNSTON KARL 73809 2002 JOHNSTON KARL 73809 2002	OUI	GONNARD DIDIER PH X GONNARD DIDIER PH X	Azote liquide Inox Azote liquide Inox	3 4		6.9	CE
50 CRRP-04135 Dewar NOBILE	180		3S	BENOIT PHILIPPE 76298 12018	OUI	GONNARD DIDIER PH X	Azote liquide lnox Azote liquide lnox		5 .3 35 .211	6.9	CE
51 CRRP-04135 DEWAR 50 M3 LN2	180 Q-NLH		3S	MINGUILLON ACHA JOSE 2018	OUI	GONNARD DIDIER PH X	Azote liquide Inox	8.26	.211 50	15	CE
52 CRRP-01325 capacite tampon	190 Q-NEH		3S	PALESTINI SANDRO 65567 160812	OUI	GONNARD DIDIER PH X	Argon Inox 304 L	5 h	72	4.5	- CL
53 CRRP-04672 Reservoir transportable PI	193		3S	ULMER STEFAN 71757 1/2019	OUI	GONNARD DIDLER PH X	Azote liquide Inox	1.5	419	6	CE
CODD 04074 December 1991	402		20	ULMED CTEEAN 747E7 4 040	001	OONNA DD DIDER DU V		4.5	200	ĸ	CE ▼
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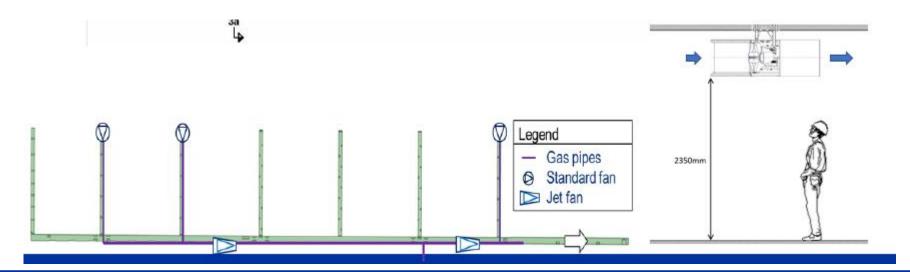




#### **Ventilation**



- An example of ODH risk analysis that has already been carried out can be found in the <u>EDMS</u>: 1728885 and <u>EDMS</u>: 2423229
- A ventilation system have been designed by Alejandro Mejica and is approved for installation to address the issues under EHN1 galleries, the ECR can be found here in <u>EDMS: 2479636</u>
- A similar procedure will be followed where it has been identified the need to install new mechanical ventilation







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## Alert and triggering alarms in the galleries



#### LONG TERM SOLUTION

#### Many reference documents:

- Memorandum HSE/OHS GL EDMS 2588546
- SFR moyens d'alerte dans les galeries de la Zone Nord du SPS EDMS 2350216
- Emergency assistance across CERN underground premises SRF EDMS 2219660
- Meetings with IT/CS on GSM and tetra network coverage
- Meeting with EN/AA for emergency and alarms
- Equipment to be deployed based on safety analysis on a case-by-case study
- Current proposal is to use emergency buttons which fulfill 4/5 HSE requirements\* (except two-way communication)
- Waiting for EN/AA study on new technologies to be used in such cases: «Explore new technology to alert and trigger and alarm in CERN's underground and experimental premises (see EDMS2588546\_v1)"

<sup>\*</sup> GSM network is not a level 3 safety system





## Alert and triggering alarms in the galleries



#### SHORT TERM SOLUTION

#### Needs identified during VIC 835 and 818:

- The gallery workers are in liaison with the surface colleague via walkie-talkie. The surface responder must be equipped with a cell phone that can reach the CERN FRS in the event of an emergency
- Meetings with IT/CS for analyzing a few possible technical solutions
  - Temporary Wired Telephone: no longer installed by IT/CS (dismantling in progress)
  - IP telephone: working only at max 90 m from a Starpoint → not OK for most of the galleries
  - TETRA Back pack
    - using the CERN surface TETRA network coverage and relaying the signal and communication capacity up to 300 m
    - used in the past by EN-EL
    - technical assessment in progress





### ICS equipment, Courtesy of Jean Ramos



- Several equipment were detected as being installed in the technical galleries:
  - Cables estimation: 4000 cables
  - Alarm Dispatchers (SAREP): 36
  - Fire Detectors estimation: 134
  - Fire Detection Air Sampling networks: 80
  - ODH Detectors: 9

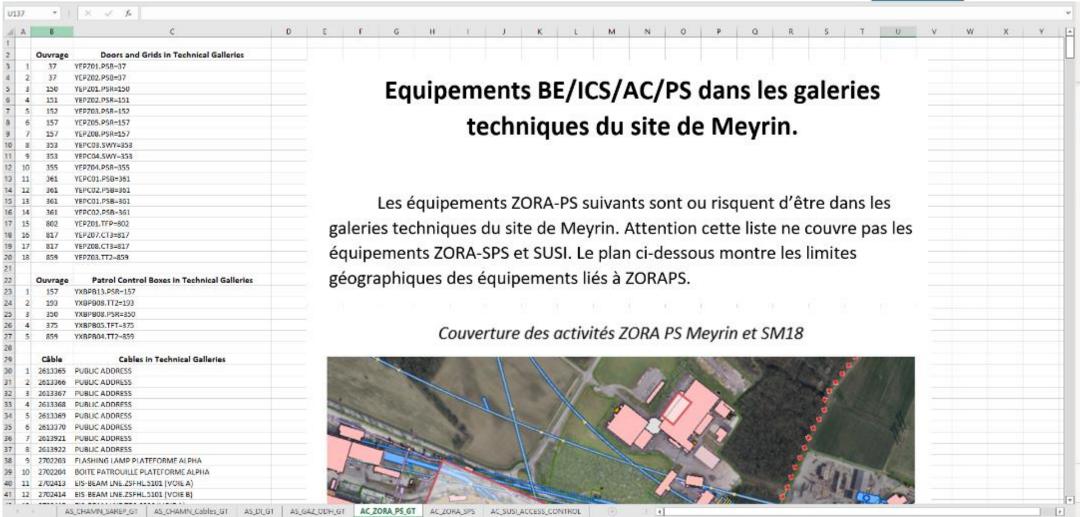
- Warning Flashes or Sirens Gaz Detection : 9
- End of Zone Doors and Grids: 18
- Patrol Control Boxes: 5
- 230V Patch Panels: 10
- Electrical Racks: 10
- The values presented are a first estimate that need to be refined after technical galleries survey.
- These data are mostly the amount of equipment that exists in the Technical Galleries, apart CHAMN and ZORA PS, where it can be found already cable numbers and equipment installed
- New and more detailed information regarding alarm and access control will be presented by Jean Ramos on the 15<sup>th</sup> Project team meeting on the 30<sup>th</sup> of May. Waiting HSE new guidelines regarding Alarms
- A detailed list has been provided to TG-CONS from BE-ICS-AS showing the existence of many alert, fire detection,
   ODH, etc. systems in the galleries. Very promising news as that can help us potentially reduce the cost but more importantly help to reduce the workload and add to the existing systems new ones where required





### Example of the list provided by BE-ICS-AC







### Fire safety



The fire safety in the galleries is related to the ODH analysis, the alarm systems, the access control and telecommunication. For that reason, a meeting was held with the Fire brigade:

- Secure Hatches and Fire doors with master key from the outside. Easy escape from inside
- FB will use material openings for access and evacuation. SCE-SAM-CE will look for a solution to provide easier access and personnel transport. Hatches not convenient as FB needs more than 80 cm opening to enter with equipment
- Proposed smoke detection system is of big interest as it will be connected with the FB. Important for FB to know the exact location
  of the installations. Fire doors to be maintained and kept open with magnets
- Level 3 alarm required in the galleries, proposed smoke detection system includes
- Possibility to communicate with the FB is important (at least during worksite), current proposed solution doesn't include. TG-CONS is investigating possibilities (TETRA Backpack)
- The fire brigade discusses the requirements for the galleries in the HSE meetings, Oriol Ross will inform and invite us on specific meeting regarding the TG-CONS project
- Eventually a reference document will be released.
- Very good feedback received from FB for the reason that they are included in the conversations
- Proposal (or requirement): During worksite, fire extinguishers should exist on site in case of a fire

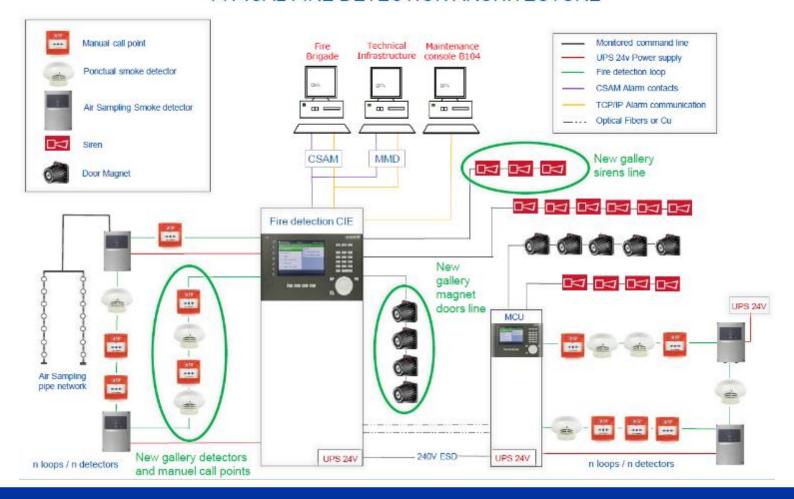




### Proposed smoke detection system



#### TYPICAL FIRE DETECTION ARCHITECTURE





### Preparing the galleries for worksite activities



# As we have started works in the galleries, we are taking the necessary emergency safety measures to ensure a safe working environment:

- Replace missing lights and install new ones where it has been identified that existing light is not adequate
- Perform a pre-cleaning campaign to remove any debris and obstacles from the interior and exterior
- Install electrical cubicles to provide the necessary electrical outputs for the work
- Respond to emergency requests such access consolidation, fences installation to prevent animals entering the galleries, installation of panels and fences to keep people away from working areas, etc.
- Addressing other requests from users, like flooding and condensation problems





