Risks in detonator loading operations

Most relevant safety aspects

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INTRODUCTION

Loading detonators involves handling of primary explosives and, therefore, poses a substantial risk of explosion.

Manual loading implies relying on the operator and requires a great amount of continuous training, whilst automatic loading demands the existence of a qualified maintenance service, not to mention the adequate design of the machine.

In both cases, the isolation of the operator from the hazardous area is of paramount importance, pressing operations being the most likely to engender an explosion, triggered by any malfunction of moving parts of the machinery.

For that reason, any operation involving repairing or cleaning inside the machine has the characteristic of exposing the operator to an accidental explosion. Although being unlikely, the occurrence of such an event would have very severe consequences upon the affected operator, due to the combined effects of both the confined blast and the projections from a short range.

BASIC POINTS TO DEFINE THE PROCESS REGARDING SAFETY

Safety parameters (sensitivity to: friction, impact, heat, static charges)

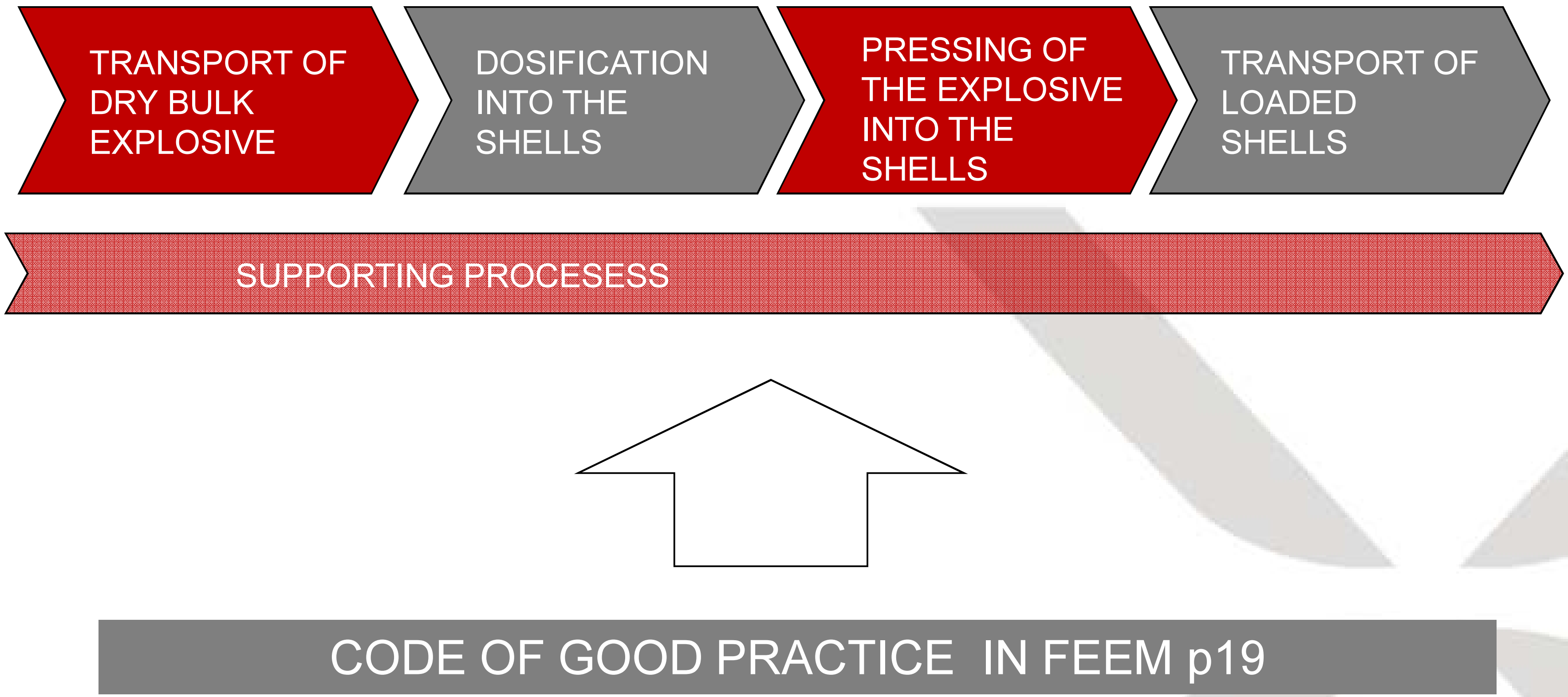
Maximum quantities allowed on each step of the process

Acceptable exposure (likelihood and severity) remote operations… when?

Foreseeable operations (included in standard procedure)

Unforeseeable operations due to incidences (management of the new hazards)

STAGES OF A LOADING PROCESS



Focus on three practical aspects of the loading practice

Cleaning

Incident solving

Importance of detail when designing

THREE DIFFERENT SITUATIONS

Ordinary cleaning of the facility

Cleanings requiring dissembling of tools

Cleanings requiring dismounting of structures

Ordinary cleaning of the facility (1)

First recomendation

Solvents must not be applied by means of compressed-air gun. This would have two undesirable effects: the buildup of static electricity and the dispersion of dust. Furthermore, there could be toxic compounds (lead or other derivatives), so toxic dust clouds could be created.

LEARNING POINT:

⇓

CLEANING is not to change the location of the dust but to dispose of it.

Ordinary cleaning of the facility (2)

<u>A simple and traditional method (Manual cleaning)</u>:

The cleaning liquids must be applied gently and to make sure they don`t spill. Once the dust is desensitized by the application of the liquids it can be picked up in rags.

The typical hazards are:

• The rags get dry before they have been safely disposed of.

• Dust particles are dragged by the liquid itself and can be concealed between surfaces, remaining inaccessible and getting dry after a while. Any subsequent attempt to repair, remove, unscrew, etc. will pose a risk of initiation.

Ordinary cleaning of the facility (3)

Cleaning with volatile products.

Breathing protection required.

Ordinary cleaning of the facility (4)

Vacuum cleaning… an advantage or a newly engendered risk?

If correctly designed, vacuum cleaning systems can assure an in depth cleaning but it must be regarded that:

- The particles of primary explosive must be treated gently.
- Particle speed inside the aspiration pipes and geometry of the pipes themselves must be taken into account.
- Conductive hoses
- Water injection may be advisable.
- The recovered explosive must be kept in a vessel with water. (wet collection system)
- Disposal procedures are also affected by this design.

Cleanings requiring dissembling of tools (1)

Recommendation: During the extraction of the tools, the worker must be protected from the explosive.

Eg. PRIMARY EXPLOSIVE <u>Lead Azide Hoppers</u>

Dosing plates with presence of explosive. The extraction (once the hopper is empty) should not be performed by hand.

The likelihood of initiation in case of excessive friction is not acceptable.

Remote extraction devices should be implemented.

Cleanings requiring dissembling of tools (2)

When the extraction of the hopper itself can be considered a risk operation (closed space, size and weight) a guided system can be developed, offering the following advantages:

- No need to hold the weight and, consequently, easier performance of the task. This allows focusing on other aspects of the operation and being more accurate.

- The risk of accidentally dropping the hopper disappears.

- Reduces the likelihood of hitting the inner walls of the machine with the edges of the hopper and the consequent friction.

- Finally, if an ignition took place after all, the shield would protect the operator both from overpressure and shrapnel.

Cleanings requiring dissembling of tools (3)

Cleanings requiring dissembling of tools (4)

Cleanings requiring dismounting of structures (1)

Ordinary cleaning or in-depth cleaning?

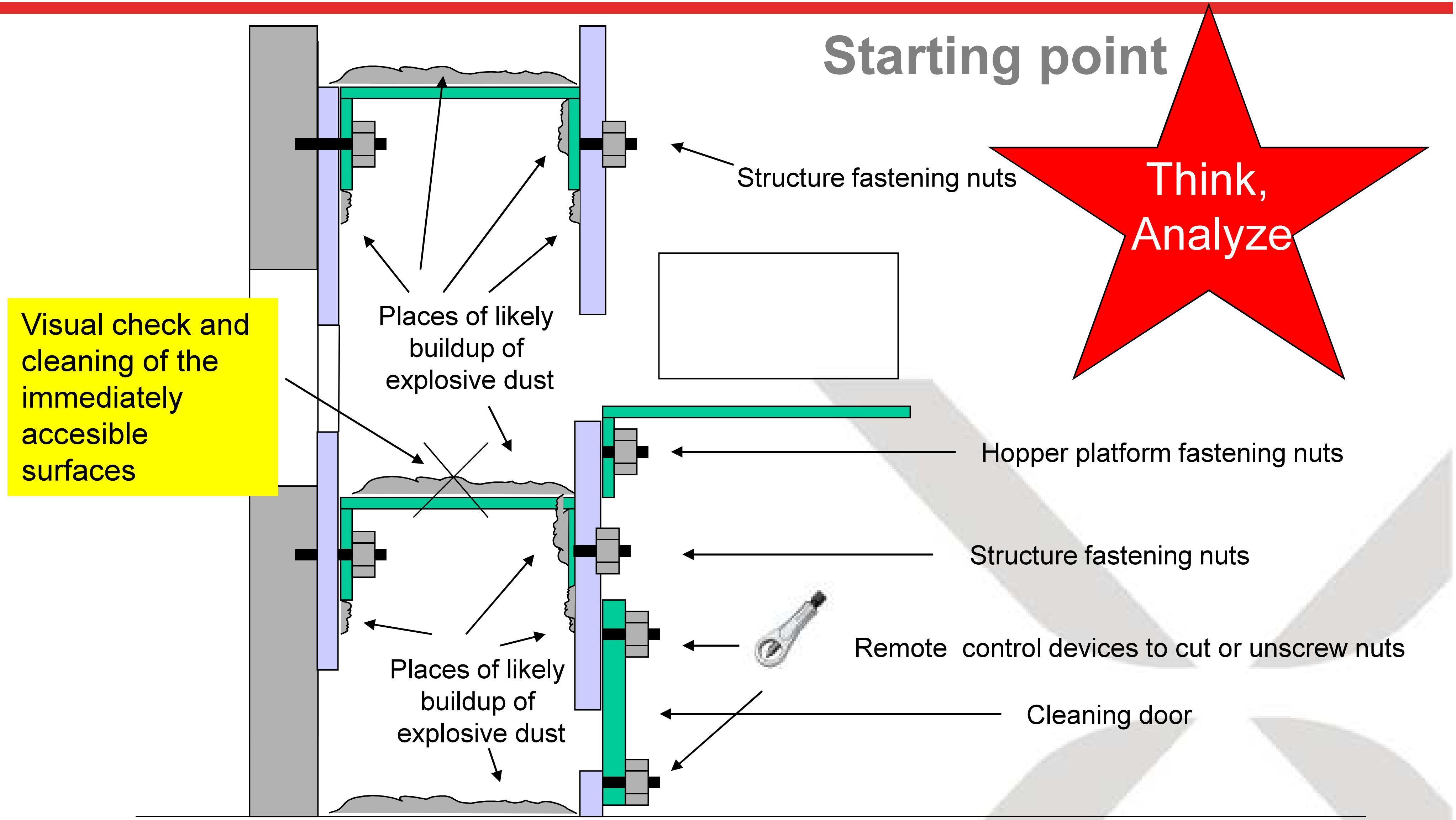
Frequency of cleaning accessible surfaces must be complemented with the cleaning of those that need previous removal of attached parts. It must be understood that this second cleaning engenders a hazard by itself.

Hence, the need to establish a rational balance in the frequency of cleaning: a trade-off between the expected quantity of concealed product and the cost and risk taken during the operation.

It is vital to identify beforehand those tasks that will pose a higher risk, in order to issue a procedure regarding the safest way to carry them out.

Examples of these measures include remote devices to cut or unwind nuts or jacks placed between surfaces to be removed.

Cleanings requiring dismounting of structures (2)



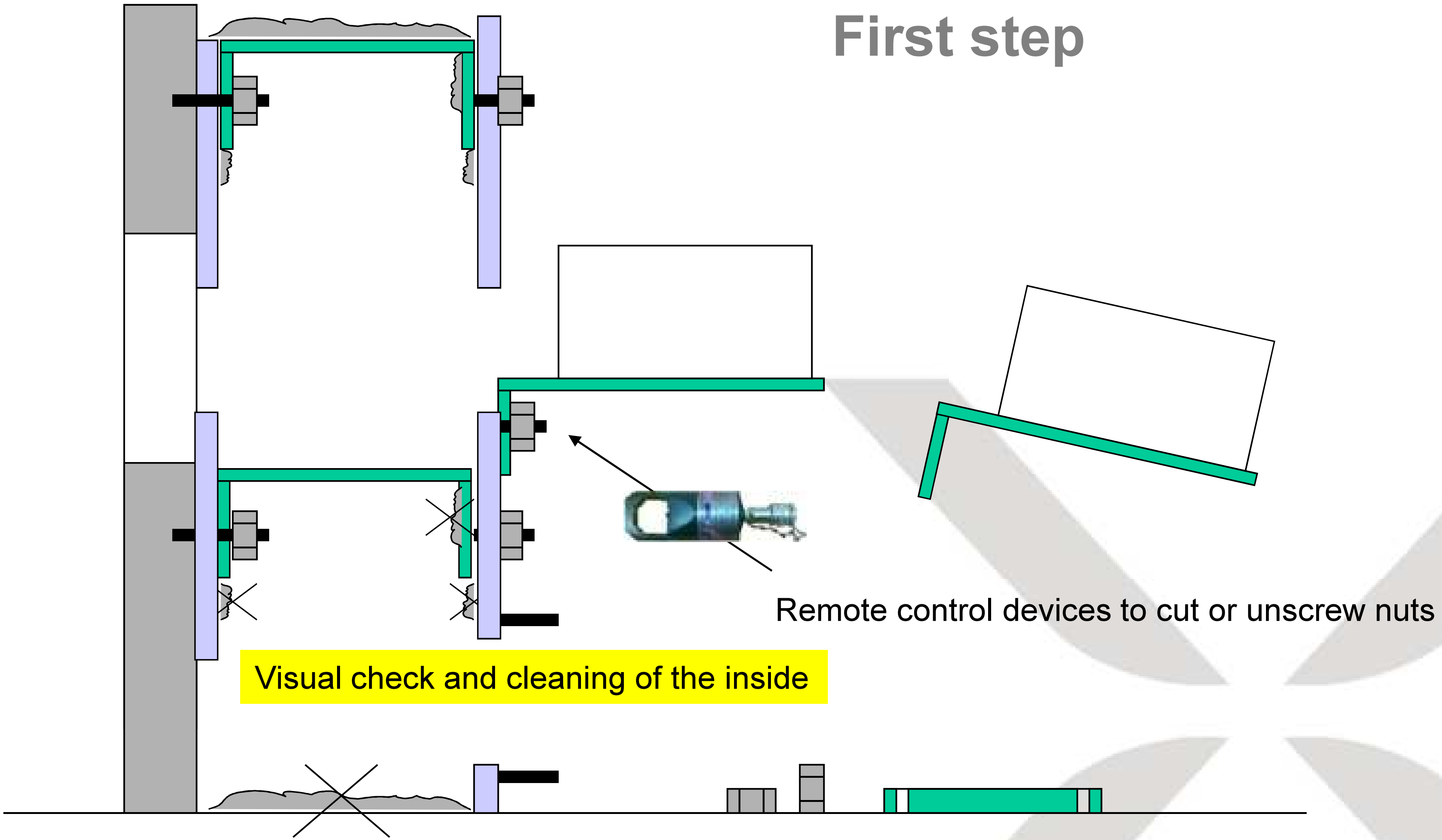
Cleanings requiring dismounting of structures (3)

Sometimes, when designing a cleaning-dismantling operation, it is necessary to determine beforehand which parts of the structure will be cut remotely and which ones will be removed and unscrewed in presence of the operator.

In these cases it is vital to regard aspects such us the degree of the personnel protective equipment (related to the expected severity in case of initiation) and the use of products to reduce sensitivity or destroy chemically the present traces of explosive(related to the likelihood of the initiation)

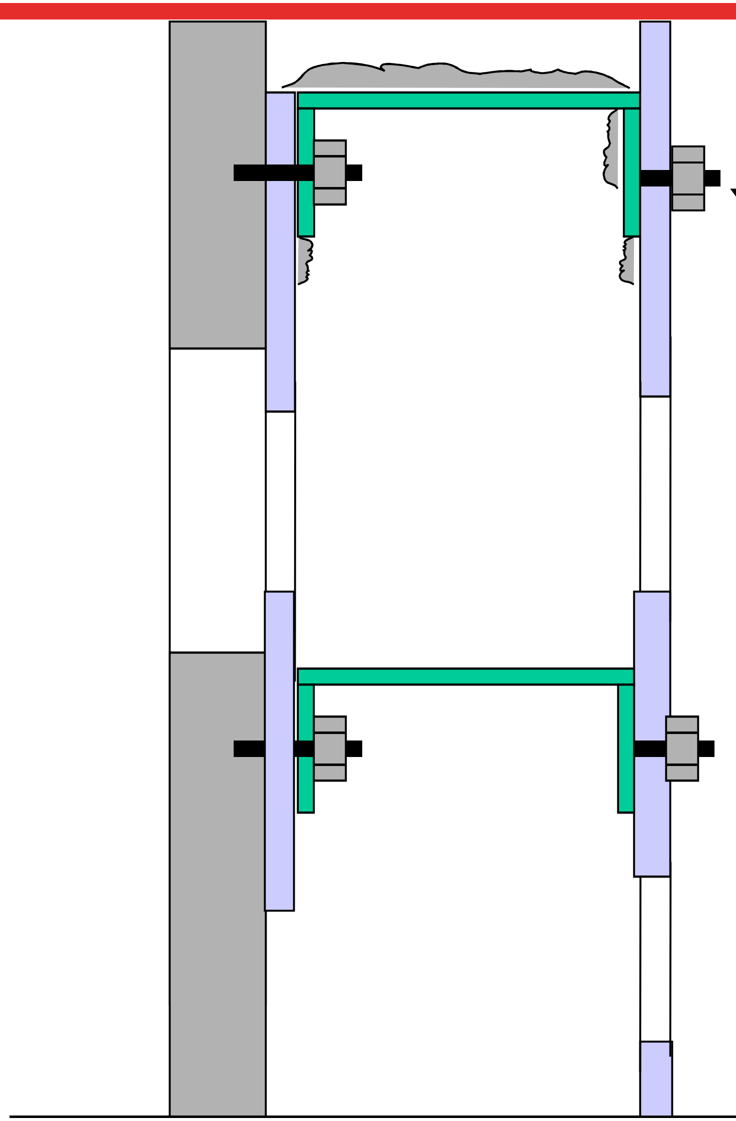
Cleanings requiring dismounting of structures (4)

First step



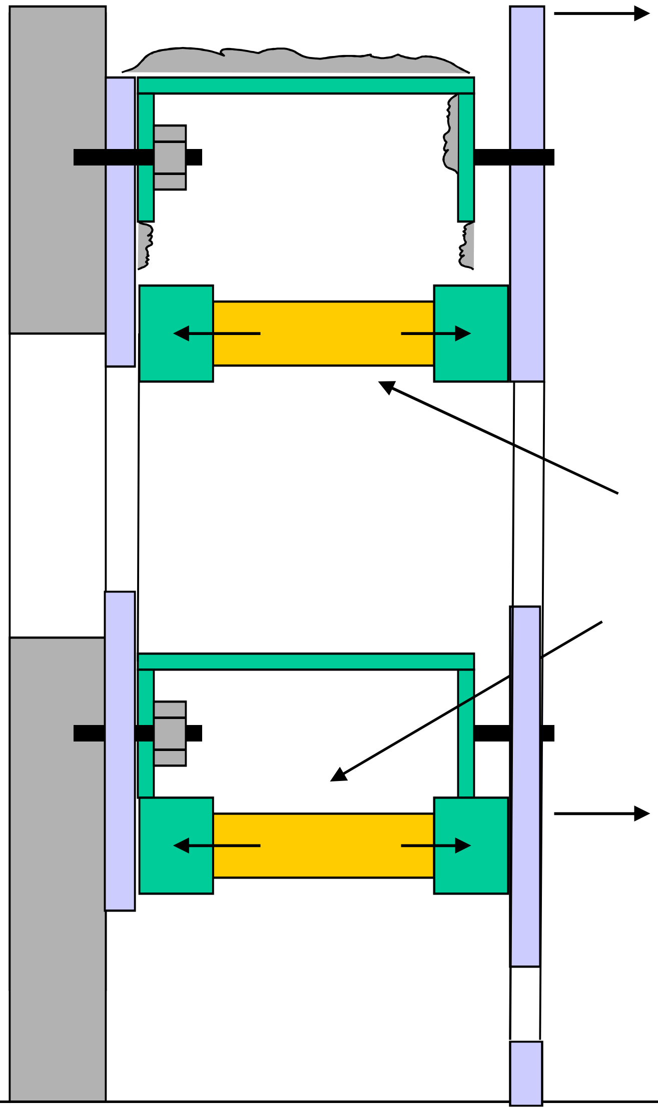
Cleanings requiring dismounting of structures (5)

Second step



Remote control devices to cut or unscrew nuts

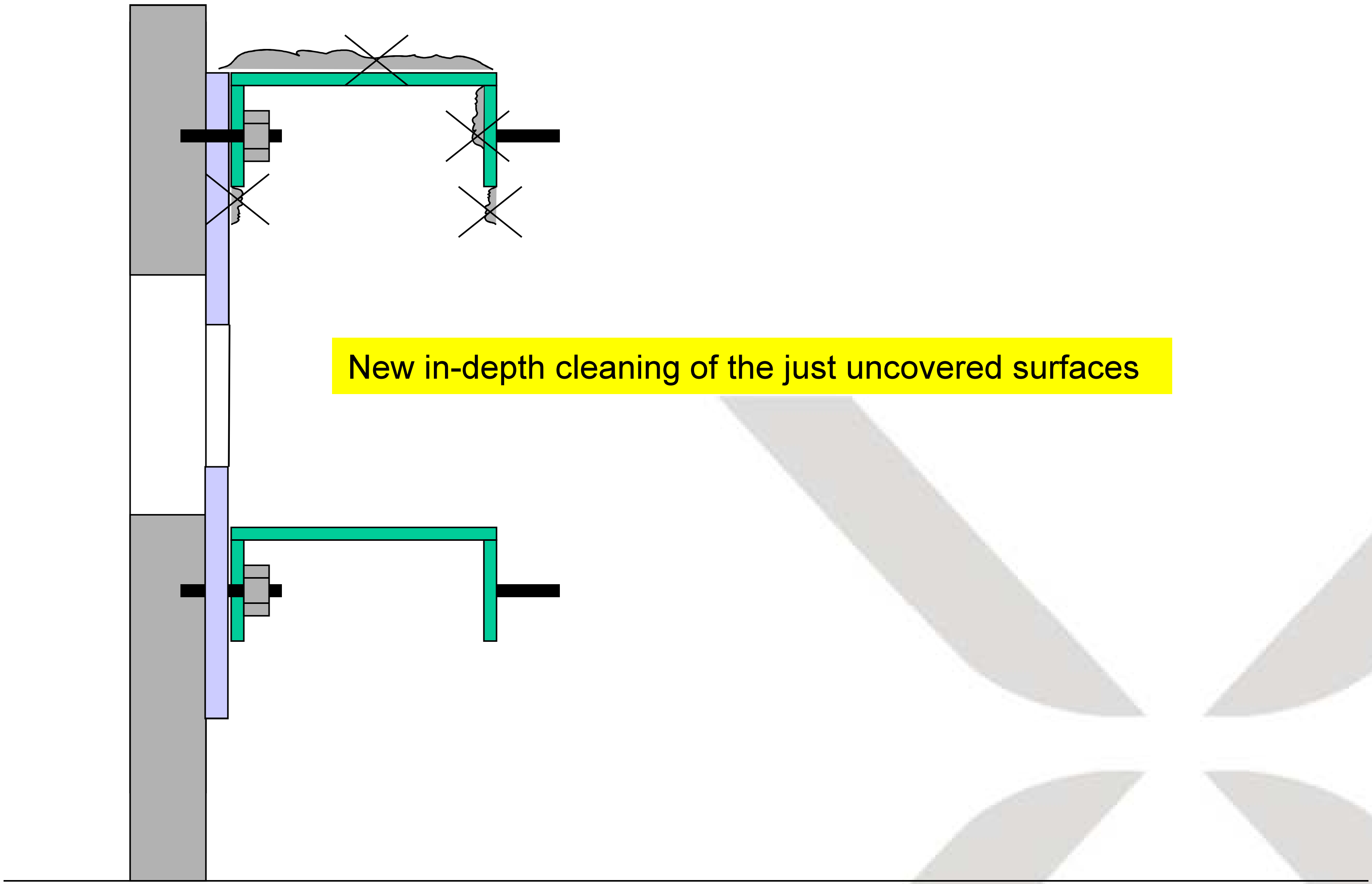
Cleanings requiring dismounting of structures (6)



Third step…

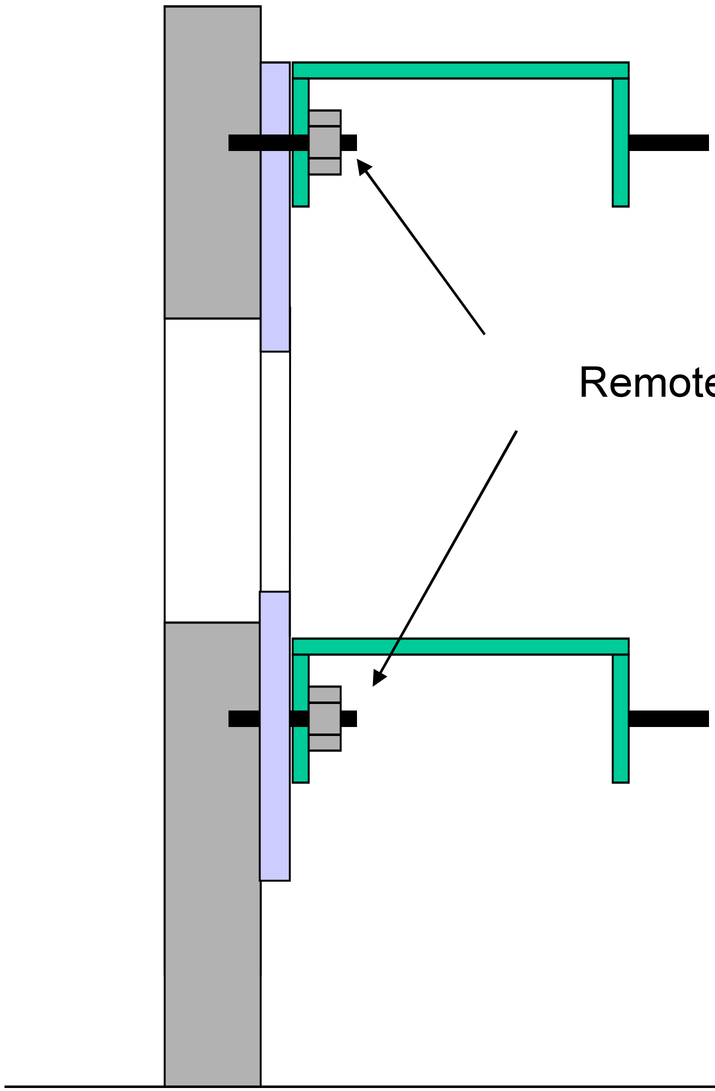
Remotely powered jerks

Cleanings requiring dismounting of structures (7)



New in-depth cleaning of the just uncovered surfaces

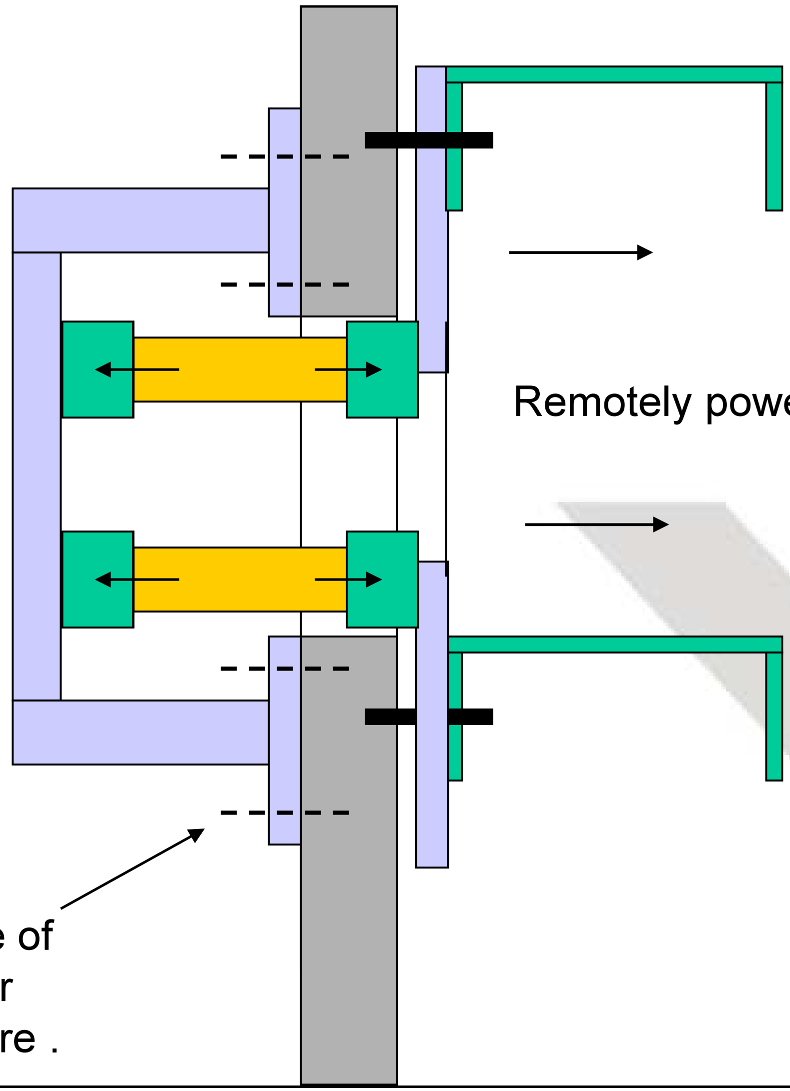
Cleanings requiring dismounting of structures (8)



Remote devices to cut or unscrew nuts

Cleanings requiring dismounting of structures (9)

Final extraction with auxiliary structure to hold up the jerk.



Drills on the outside of the concrete wall for the auxiliary structure .

Incident solving (1)

Extraction of blocked punch out of the matrix

A good example of incident solving that poses a hazard of initiation is the case in which a punch gets stuck inside the shell during the pressing process.

The range of variability of the possible situations makes it really difficult to foresee an accurate procedure. Therefore, only general recommendations can be given and the adaptation to the specific requirements of each case rests on the experience of the supervisor. Sometimes, before attempting to solve the incident, word is sent to the OH&S department and a written procedure is issued for that specific case.

Incident solving (2)

Foreign bodies

Small undetected objects can end up inside the shells which are subsequently loaded with explosive and pressed by a punch.

Several methods (optical or mechanical) can be implemented to avoid this situation. In automatic loading, the same system can be used to assure several necessary conditions, such as:

- Presence of shell
- Correct position (not upside down)
- Absence of foreign body

Some design tips (1)

The stage of workstation design is the first step to a high safety standard in detonator loading.

Some tips to be considered, prior to the construction of the machine or equipment, are:

• Avoid sharp, rough surfaces against which friction can take place when removing parts of the equipments such as loaded hoppers.

• Dissembling procedures (for cleaning at the end of the shift, for instance) must be conceived to minimise handling of vessels containing primary explosives.

Some design tips (2)

• Avoid places where dust can get inaccessible. The process of hopper loading and shell pressing will inherently engender the presence of explosive dust. The design must be thought to allow this dust to be landed on clean, obstacle-free surfaces, in order to help its consequent cleaning afterwards.

• Air pipes, pneumatic pistons, screws and nuts of any kind must be as far from the dust-generation places as possible.

Some design tips (3)

Blast endurance.

One vital aspect when designing a workstation is to make sure that an accidental explosion will not extend its effects beyond the perimeter of the machine.

Physical barriers, even those supplied by the manufacturer, may not have the required endurance. In some cases, real tests may be required.

Some design tips (4)

Blast endurance.