BOS

Basis Of Safety

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Rev.1

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1. THE INEXORABILITY OF ERRORS

Almost 3.000 years ago it was written *"What has been, will be again; what has been done, will be done again; there is nothing new under the sun" (Ecclesiastes 1:9).*

History shows that many accidents that occur are repetitions of accidents that have already occurred in the past, in the same company or in other locations. But why do companies let such accidents happen again and again?

Take for example the terrible accident occurred in the port of Beirut in 2020, when more than 2,700 tons of Ammonium Nitrate ended up detonating due to a series of failures on its management. A simple survey on the internet will show dozens of similar accidents with the same material. Haven´t we learned anything from the past?

It seems that as time goes by, companies are continuously losing their memories regarding the safety aspects of their operations; this can be aggravated if the old, experienced employees do not share/register their knowledge before being replaced by new employees.

Therefore, it is fundamental that the corporate memory – sometimes gathered from painful learnings from past events – be preserved and disseminated throughout the organisation, specially to the new generation of employees.

Port of Beirut, before and after the explosion

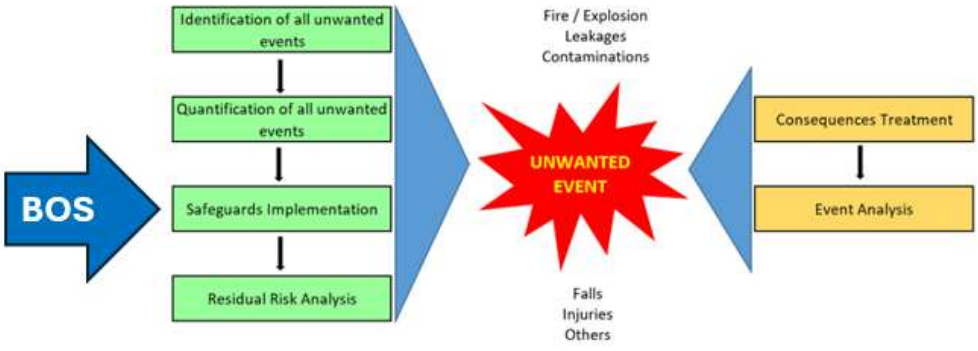
2. THE BOS

BOS is the acronym for **Basis Of Safety**. This is a core corporate tool that brings the company memory of safety, aimed at preventing significant accidents (fire, loss of containment, explosion, environmental disasters, etc.).

The BOS is applied separately to each process in the company and encompass scientific & engineering principles and learnings from past accidents, being the prime vehicle for ensuring the corporate memory and serving as a basis for many other documents. It brings the set of controls that must be in place to eliminate or minimise the risks associated with a hazard, in a specific operation or activity, involving a person, piece of equipment or process.

A good BOS looks at effect, cause and controls and can be prepared for a specific product, equipment or process. Section 2.3 of this document brings an example of a BOS prepared for a raw material.

BOS is part of the Risk Management Program, being one of the “Safeguards Implemented”, as shown below. For more details about the Risk Management Program, please check the document TEC.531, recently published.

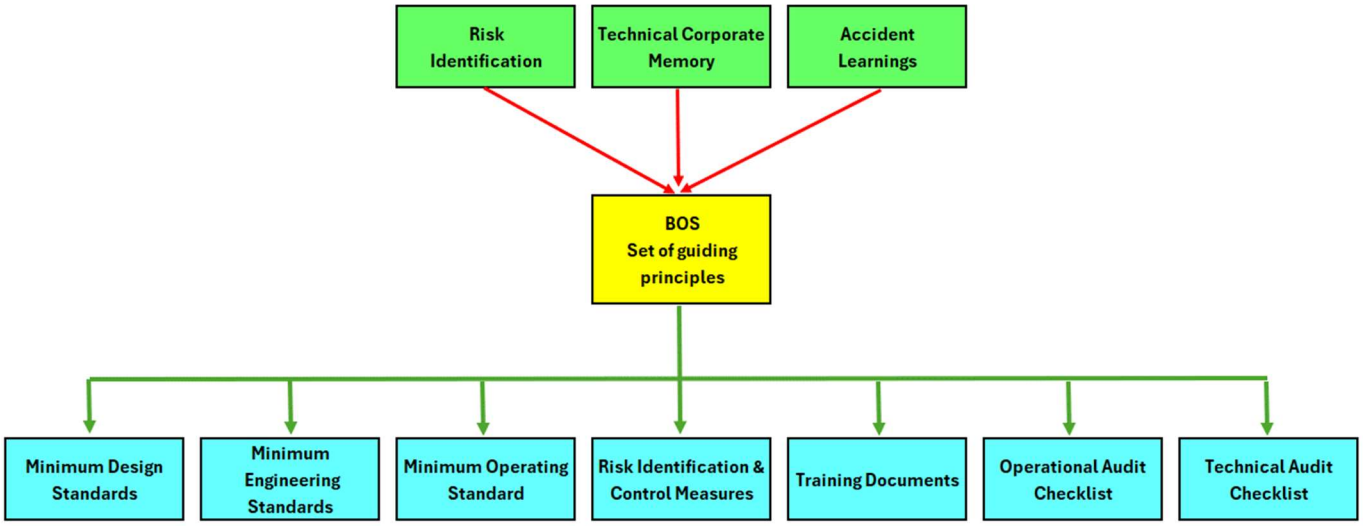


Where the BOS fits in the Risk management Program

2.1 – Preparing a BOS

The preparation of a BOS starts with the identification of the main risks associated with a process and/or equipment. The information on the risks come from literature, corporative memory and lessons learned from past accidents (inside or outside the company). During the identification of the risks, it is important to consider:

- Raw materials, materials in-process, finished products, wastes and effluents.
- Transport, storage, handling and disposal of all products.
- All unit operations (pumping, loading, unloading, reactions, storage, mixing, heating, cooling, drying, recycling, etc.), both desired and undesired.



Once the risks have been identified, the second step is to define the causes that can trigger the accident. Examples of causes include heat, fire, sparks, impacts, frictions, static electricity, etc. With this information, the BOS can be prepared, containing the following information:

- Minimum design, engineering & operational standards to be followed, to eliminate or minimise the presence of the conditions to initiate an accident event.
- Control measures to eliminate or minimise the possibility of having an accident event.
- General Safety recommendations and other relevant information.

2.2 – Importance of Checking & Audits

No matter how well a BOS is prepared, its implementation and use still depends on the human factor. Therefore, it is very important that a periodic check is carried out to ensure this fundamental tool is running according to the intended proposal.

If you are a leader of any installation/plant/site, you must:

- Lead by example, i.e., understand the importance of the BOS and make sure everybody in your organisation knows and follows its recommendations.
- Ensure your staff are trained in the hazards and controls specified in the BOS of your operation.
- Make sure to your staff that not following the BOS recommendations is a severe breach in the safety of the operations.
- Ensure that no new employee or re-positioned employee is exposed to any activity before being educated in the BOS principles.
- Define a minimum audit frequency to ensure all BOS are updated, implemented and being followed.
- Ensure the presence and use of a daily checklist for the equipment/processes that are more prone to have an undesired event.

2.3 – Example of a BOS

The following text brings an example of a BOS prepared for the substance Sodium Nitrite, taken from a company that produces dyestuffs.

Basis of Safety - SODIUM NITRITE

1. Common Use

The principal use of Sodium Nitrite in our company is for the elimination of any residual dangerous diazo compounds that might be present at the end of some dyestuff manufacturing processes. Under controlled conditions of pH and temperature, the Sodium Nitrite reacts with diazo compounds to produce nitrogen, thus eliminating any hazardous diazo residues.

2. Statutory Considerations

Sodium Nitrite has a dangerous goods classification as follows:

Class-primary: 5.1 Oxidising Agent

Sub-risk 1: 6.1 Toxic

Most jurisdictions will require a dangerous goods storage licence. Local regulations pertaining to dangerous goods must be adhered to, always.

As Sodium Nitrite is also a dangerous good of Class 6.1 Toxic (i.e. a poison), local statutory regulations may require purchasing approvals and specific storage and handling protocols.

3. Major Hazards

Sodium Nitrite is highly likely to react violently with any oxidising and combustible agent in uncontrolled situations. *This reaction might be highly exothermic and therefore can lead to a runaway thermal reaction or decomposition*. There are many oxidising and combustible substances used throughout the plant, some of them packaged in a similar way as Sodium Nitrite. Therefore, inexperienced operators can confuse Sodium Nitrite with some other product and may inadvertently mix it with an incompatible material, posing a serious risk to produce a violent reaction and possible explosion.

The inadvertent mixing of spillages (for example, floor sweepings in a store) can lead to the mixing of substances incompatible with Sodium Nitrite. In some circumstances there may be a delayed violent reaction.

In general, Sodium Nitrite is incompatible with combustible materials, powdered metals, acids, amines, oxidising agents, and reducing agents.

In addition to the above hazards Sodium Nitrite is a strong poison. It is extremely harmful (potentially fatal) if swallowed. It is also very toxic to aquatic organisms if it escapes into waterways.

4. Controls

The specific objectives are:

- To prevent violent reactions with incompatible materials due to the uncontrolled mixing of Sodium Nitrite with such materials.
- To avoid illness or injury through poisoning.
- To prevent the escape of Sodium Nitrite into the environment.

The basic approaches to achieve these aims are:

- Ensure the storage and handling of Sodium Nitrite *(including drains and spillage paths)* is separate from incompatible materials. Many jurisdictions mandate storage distances from other materials. Always check state/national laws to ensure full compliance. The recommended minimum standard is 3 metres.
- Avoid the storage of Sodium Nitrite solutions at great hights above the consumption point, since any potential leakage in the storage tank might be directed by gravity to a dangerous place.
- Ensure that the storage and handling of Sodium Nitrite and oxidising agents are such that the possibility of a mix up is minimised.
- Ensure that drains from areas containing Sodium Nitrite do not go directly into the surrounding environment.

In setting up storage and handling areas it is highly desirable to have several layers of protection – any one of which can prevent an incident from occurring.

The required controls for each location arise from detailed risk assessment processes (e.g. Hazard Studies, Risk Quantification). They may be conveniently grouped under three broad headings:

- Generic – widely applicable (e.g. training, written procedures, safety management systems).
- Preventative – stop an event from happening.
- Mitigating – reduce the consequences of an event.

Note: The same control may have elements of each of the above depending on the part particular hazard scenario.).

In the next section examples of each type of control relating to the process risks outlined above are described. (The examples are not comprehensive as the Hazard Studies will identify many potential scenarios - many are similar in nature).

5. Example of Controls

5.1 – Generic

- Wear appropriate PPE at all times. Good personal hygiene is essential. After handling Sodium Nitrite, operators must thoroughly wash their hands. Hands must be washed before eating and going to the toilet.
- Only operators who are fully trained in the safe handling of Sodium Nitrite, including full BOS training, can handle Sodium Nitrite.
- Manage changes to the sourcing of Sodium Nitrite through the proper Management of Change Program.
- As a poison, store Sodium Nitrite away from animal and human foodstuffs.

5.2 – Preventative

- Store Sodium Nitrite in a segregated area. This segregated area must be either completely contained or at an acceptable distance (3m) from other chemicals. Note that some regions mandate larger separation distances. Storage must be locked with key access only to specified individuals (supervision and trained operator(s)). Sodium Nitrite must not be stored with any incompatible material.
- Never store bags of Sodium Nitrite on wood pallets, since Sodium Nitrite can inadvertently get in contact with the wood and start an exothermic decomposition reaction.
- Ensure that Sodium Nitrite is not mixed with incompatible materials in waste collection systems or allowed to escape into the environment.
- Train operators to easily identify Sodium Nitrite. Typically, Sodium Nitrite is a fine off-white to cream coloured hygroscopic powder.
- Carefully check and identify all bags of Sodium Nitrite on receipt. Sodium Nitrite is often confused with Sodium Nitrate. The possibility of confusion is greater where English is not the native language of the operators (*or the supplier).* Sodium Nitrite should be ordered in bags that are obviously different from all other raw materials.
- Do not store Sodium Nitrite near water courses or near human and animal drinking water.

5.3 – Mitigating

Contain plant drains that may catch Sodium Nitrite so that it does not flow directly to the outside environment.

6. Further Information

Further information is available on the Material Safety Data Sheet for Sodium Nitrite.

2.4 – Example of a Daily Checklist

Depending on the complexity of a piece of equipment or a process, a daily BOS checklist is recommended to be performed. This checklist must bring the items that should be verified to comply the recommendations of the appropriate BOS and must be performed at the beginning of each shift, every day. Any point considered not correct/adequate, found during the check-list verification, must be registered and immediately communicated to the plant supervisor (or equivalent), so that the appropriate actions can be taken before commencing the production activities.

As an example, there follows a daily BOS checklist for a pouch packaging machine, taken from a food manufacturer:

BOS Check-list for PAUCH PACKAGING MACHINE **SHIFT:**

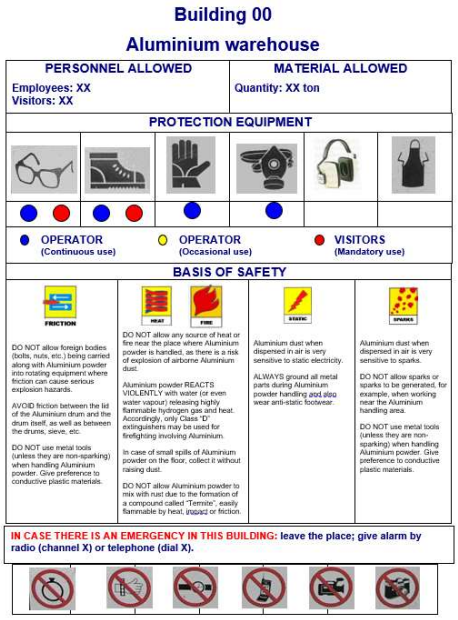
Checkings	MONTH:																												
SAFE Operation (●) blue - UNSAFE Operation (X) red	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Is the general key on?																															
Is the emergency key working properly?																															
Is opening the access door causing the machine to become inoperative?																															
Is the temperature of the extruder correct?																															
Is the installed mandrel appropriate and in working condition?																															
Is the sealer table correctly installed ?																															
Is the up and down connecting rod in the correct position?																															
Has the machine been pressurized?																															
Are hydraulic and lubricating oil reservoirs filled?																															
Is the polyethylene reservoir stocked?																															
Is the removing belt operating properly?																															
Is the cartridge weighing scale working?																															
Is the pressure / temperature pump dosing system working?																															
Is the workplace clean and clear?																															
Is the compressed air pipework free of leaks?																															
Are panel indicator lamps working?																															
Is the film handle clean and in good condition?																															
Are the protective devices in good conditions?																															

OBSERVATIONS

2.5 – Example of an illustrated BOS

As a good practice to help the employees remember the main points of a specific BOS, some companies provide a signpost at the entrance of buildings where everybody can easily identify the main risks associated to the BOS of the materials and/or equipment handled in that specific building.

The example shown below is related to a storage house of aluminium powder. This specific company added some complementary information to the BOS sign, e.g. the PPE to be used in the area, the number of people allowed in the building, safety phones, etc.



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- *TEC.531 – Risk Management Program – MATEC Soluções Corporativas – 2024*
- *Private notes from the author.*

The Autor

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