



## SEMS II: BSEE should focus on eliminating human error

### **How US companies can prevent accidents on start-ups and shut-downs by using valve interlocks**

The proposed changes to BSEE's SEMS (Safety and Environmental Management System) summed up in the new SEMS II rule have been a major topic in the US offshore industry. The SEMS II additions are a response to the oil spills and accidents that occurred recently and show a determination of the American Bureau of Safety and Environmental Enforcement (BSEE) to change the culture of the offshore oil and gas industry. For some dangerous processes however, changing culture is not enough to effectively eliminate human error. Therefore, BSEE should consider the use of valve interlocks as a requirement for processes where accidents should be avoided at all costs.

[www.netherlocks.com](http://www.netherlocks.com)





**What is SEMS and why was it created?**

The ‘Workplace Safety Rule’ on Safety and Environmental Management Systems (SEMS) is a mandatory system of rules which covers all offshore oil and gas operations in US federal waters. SEMS has come into existence in light of accidents such as the Deepwater Horizon explosion. Amongst others, SEMS focuses on the effects that human error and poor organization have on accidents and strives to improve the offshore industry’s safety and environmental records. RP 75 stresses to make safety and environmental information available at every facility.

**RP 75: voluntary ‘Recommended Practice’ made mandatory**

SEMS makes mandatory the essential components of Recommended Practice (RP) 75 of the American Petroleum Institute (API). RP 75 is a comprehensive safety and environmental management standard and can be regarded as a tool for integrating safety management into a variety of offshore operations. It is broad in scope and addresses the identification and management of safety hazards and environmental impacts in design, construction, start-up, operation, inspection and maintenance of installations. It was also created to be a permanent part of a company’s culture, objectives and operations.

**Which are the main principles of RP75?**

RP 75 requires that management of offshore oil and gas companies puts forward a safety program based on the following principles:

- > A written program is required.
- > Leadership, accountability and resources must be

provided.

- > Representatives must be appointed to establish, implement and maintain the program.
- > There are also representatives who report to management on the performance of the program.
- > A written description of the organization and lines of responsibility is required.
- > The expertise of personnel should be utilized in areas such as the identification of hazards, the development of safe work practices, the development of training programs and the investigation of incidents.
- > The owner, operator and contractor management have their own responsibility for assuring safe operations
- > Industry codes should be used in the design, construction, maintenance, and operation of the facility
- > The management of safety is an integral part of the design and operation of the facility.
- > All persons involved in the program must be properly trained.
- > The program should be regularly audited.

**RP 75 as a general safety compass**

RP 75 recommendations address the effects of human error and encourage offshore businesses to concentrate on minimizing these effects. RP 75 also promotes a culture of safety and stimulates companies to set up safe operating procedures. What’s good about RP 75 in particular, is that it stresses to make safety and environmental information available at every facility. BSEE recognizes that local availability of information such as design data, flow charts of facility processes, and diagrams of mechanical components and instruments highly contributes to process safety as a whole.





**What RP 75 lacks**

What RP 75 generally lacks however is the recognition of the fact that human error cannot always be prevented by formal procedures alone. Some processes can have catastrophic results if not carried out the right way and within these processes operators should be physically ‘led by the hand’. One way to establish this is by using mechanical interlocks. Interlocks eliminate human error by physically enforcing operators to follow a strict sequence of opening and closing the right valves in a designated order. Linked to information systems or mimic panels, they not only eliminate human error, but also highlight a Permit Procedure applicable to a specific process. This allows the operator to request and receive all data needed in order to safely proceed to the next stage of a process. Flow charts, sequence diagrams and any other important information can be offered in an organized manner and make important process information locally available.

**RP 75 does not offer clear guidelines and preventive actions**

Albeit a sound safety concept, RP 75 also creates some confusion as to which equipment it applies to (3). RP 75 simply states that it applies to ‘critical’ equipment’, which it defines as “equipment and other systems determined to be essential in preventing the occurrence of or mitigating the consequences of an uncontrolled release. Such equipment may include vessels, machinery, piping, blowout preventers, wellheads and related valves, flares, alarms, interlocks, fire protection equipment and other monitoring, control and response systems.”

**Mechanical integrity**

Moreover, the regulations in RP 75 sometimes deal with safety in general terms, stating that you must ensure “the mechanical integrity and safe operation of equipment through inspection, testing and quality assurance”. It also mentions that “your mechanical integrity program must encompass all equipment and systems used to prevent or mitigate uncontrolled releases of hydrocarbons, toxic substances, or other materials that may cause environmental or safety consequences.” Ultimately it is up to the operator to decide which equipment must be covered by the mechanical integrity section. One BSEE representative did offer one view of how an operator can decide whether equipment is critical, but it still remains indefinite: “For example, if shutting down a piece of equipment impacts the ability to carry on with the operation, that’s a good indication that it’s a critical piece of equipment.”

**RP 520: eliminating human error**

Process safety should leave no room for confusion and ambiguity. Taking into account the disastrous effects that failing mechanical integrity can cause, BSEE could therefore consider other important Recommended Practices that can maybe replace some of the ambiguous elements in RP 75. One of these practices is RP 520. This API recommendation specifically applies to the sizing and selection of pressure relief devices that provide protection against excessive pressure accumulation and is quite precise as to how to ensure mechanical integrity. In articles 6.3.1 and 6.3.2 of this rule, it is mentioned that ‘consideration should be given to using an interlocking system between the inlet and outlet isolation valves to assist with proper sequencing’. What is says is that dual





relief valves need to guarantee an open path to the relief valve at all times. The safety relief valve is clearly identified as a critical part of equipment, as it is the most important safety measure in a particular process or even an entire plant. Operating pressure relief valves in the right manner is not difficult, but the possibility of both relief valves being accidentally offline, creating less relief capacity, just cannot be accepted. Many leading oil & gas companies have already acknowledged this fact and as a result, they have incorporated the use of mechanical interlocks as a mandatory requirement on pressure safety valves (PSV's).

**In less than 5% of the time, more than 40% of the accidents take place**

RP 520 clearly identifies pressure relief devices as potentially dangerous, where RP75 sometimes leaves room for different interpretation as to what equipment is to be regarded as 'critical'. RP 520 only focuses on safe working practices for pressure relief valves however, so the question arises whether it would be possible to define other potentially dangerous devices or processes that can easily be categorized as such.

**A closer look at similarities of accidents**

A closer look at the similarities of accidents in the oil & gas industry might give some clear clues. As a general rule of thumb, one can say that accidents in the industry are mostly related to procedures that do not occur frequently and at the same time can have catastrophic consequences when performed incorrectly. Start-ups, shut-downs and shift handover processes can be identified as such. Research conducted on this matter also confirms this. For instance, a research from the Mary Kay O'Connor Process Safety Center on 'shift handover

processes' (1) revealed that these processes are the most cited as a contributing cause in most accidents (Piper Alpha, Bhopal). Their importance in operations and safety incidents is also underscored by a statement from a senior oil & gas industry executive, quoted in the same research:

“We have learned that while operating in the startup and shutdown mode less than 5% of the time, more than 40% of the accidents take place during this ‘take off’ and ‘landing’ mode” (1,2)

These revelations are supported by combined data from companies producing interlocking equipment. They identified over 50 different processes that are part of a start-up or shut-down procedure. Pigging operations are important examples of these procedures. They have internationally been recognized as highly dangerous procedures where slight mistakes or lack in concentration can have disastrous consequences.

**Process interlocking should be part of legislative standards**

For all these processes, process interlocking applications have been developed and incorporated by numerous companies in the industry. Unfortunately, none of these applications appear in any of the current legislative standards. A remarkable fact, as the results of human error and mistakes, particular during start-up and shut-





down procedures, take place on a daily basis...

**Netherlocks valve interlocks prevent human error**  
**International standards**

Startup and shutdown procedures are highly dangerous, so much should be clear. Human error during these processes should therefore be avoided at all cost, especially as the effects can be disastrous. International oil & gas companies such as Shell, Total, ADCO and PETRONAS have recognized this. Subsequently, they incorporated strict procedures in their engineering practices, reference documents and project guidelines. They also implemented mechanical interlocks on a wide scale. Their procedures leave no room for different interpretations and process interlocking quite often is a formal and mandatory provision to ensure strict adherence to procedures on critical operations, such as start-up and shut-down procedures, relief valve change over and pigging operations. Following the installment of these procedures, these companies established excellent safety records and were able to substantially minimize accidents and spills.

**Creating business opportunity by avoiding spills and production loss**

Recent accidents have led to increased regulations on process safety. Quite often and just as in RP 75, these regulations are broad in scope and primarily focus on the identification and management of safety hazards. What's good about new regulations such as in SEMS II is the attention which is given to changing company culture with regard to safety, accepting human error as an important aspect to take into account.

**Accepting human error as a fact of life**

This acceptance is of huge importance and creates a challenge for all parties involved, but one with great rewards at the end of the road. US oil & gas companies are expected to follow the path that has already been set out by BSEE and changing company culture regarding safety (as advised by BSEE) will probably be the next challenge. Importantly, as a result of this change in culture, human error will be accepted as an important factor in process safety. This will on its turn open the 'mindset' for products that contribute to safety, explicitly by eliminating human error. These products will not limit operation as sometimes is argued, but effectively guide operators through a designated procedure and create better overall safety awareness.

**Implementing the new codes**

On a national level, implementing some of the new codes and practices on process safety will directly lead to results; economically, environmentally and with regard to process safety. The advantages for individual operator companies are obvious; they will experience improved safety track records, large cost reductions and less production loss.

1. *Playing it Safe – an AVEVA Business Paper – How Information Management technology is essential to meet more stringent Process Safety and Regulatory Compliance.*
2. *Sherman J. Glass, Jr., President, ExxonMobil Refining & Supply Company, National Petrochemical & Refiners 2009 Conference, Keynote Address, May 12, 2009.*
3. *PEC – SEMS Plans – Keeping the Equipment Running Safely.*

